BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	R 23-18(A)
AMENDMENTS TO 35 ILL. ADM. CODE	)	
201, 202, AND 212	)	(Rulemaking – Air)
	)	
	)	

NOTICE OF FILING

To: Attached Service List

PLEASE TAKE NOTICE that on this day, the 5th day of September, 2023, I caused to be filed with the Clerk of the Illinois Pollution Control Board **Pre-filed Testimony of Bryan Higgins** and a **Certificate of Service**, a true and correct copy of which is attached hereto and hereby served upon you.

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PRE-FILED TESTIMONY OF BRYAN HIGGINS

I. Introduction

My name is Bryan Higgins of Trinity Consultants ("Trinity"), and I am presenting testimony in this matter on behalf of Rain CII Carbon LLC ("Rain Carbon") in support of the Technical Support Document ("TSD") prepared with my colleague, Jeremias Szust. I am a Senior Consultant at Trinity and expert in providing environmental compliance and permitting support to a variety of industries, including the coke calcining industry. My career has primarily been focused on assisting clients with air quality-related projects. In Illinois, I have served as project manager for dozens of projects, ranging from annual emissions reporting and compliance reporting to state-level construction permitting, Prevention of Significant Deterioration ("PSD") and Nonattainment New Source Review ("NNSR") permitting, and Clean Air Act Permitting Program ("CAAPP") permitting. I have a thorough understanding of Title 35 of the Illinois Administrative Code and associated sections of the Illinois Compiled Statutes and have worked extensively with Rain Carbon's coke calcining facility located at 12817 East 950th Avenue in Robinson, Illinois (the "Facility") to modify its current CAAPP permit, prepare its CAAPP renewal application, and develop the technical support for the Proposed Rulemaking.

My colleague and co-author of the TSD, Mr. Jeremias Szust, is a Managing Consultant and the Office Manager for Trinity's St. Louis office with more than 10 years of experience in air quality consulting. Mr. Szust's main areas of expertise are air dispersion modeling and air toxics related matters. He has conducted and managed both short- and long-range transport analyses in support of both state-level and PSD permit applications. He also has a continued focus on air toxics related matters that include the preparation of state and federal Health Risk Assessments using various protocols and software, including the U.S. Environmental Protection Agency's ("U.S. EPA") Human Health Risk Assessment Protocol and U.S. EPA's Human Exposure Model.

My testimony is being submitted in support of Rain Carbon's proposed amendments to the Illinois Administrative Code to provide alternative emission limits and standards ("AELs") applicable to the Facility's coke calcining kilns during periods of start-up, malfunction, and breakdown ("SMB") (the "Proposed Rulemaking"). The proposed AELs are narrowly tailored and provide AELs for particulate matter ("PM") during SMB and AELs for opacity and volatile organic materials ("VOM") during periods of start-up. As demonstrated in the TSD, Rain Carbon's proposed AELs will ***not*** result in a degradation in air quality and will ***not*** otherwise impact Illinois EPA's Section 110(l) demonstration under the Clean Air Act (the "CAA").

The TSD submitted in conjunction with this testimony as **Exhibit 1** provides a detailed discussion of the air quality modeling and analysis used to demonstrate that Rain Carbon's proposed AELs will have an insignificant impact on air quality. The purpose of this testimony is to support the TSD findings and explain how those findings substantiate the proposed rule language.

II. <u>Rain Carbon Developed the Model to Demonstrate that the Proposed Rulemaking Does Not Interfere with Illinois' attainment or maintenance of the PM and Ozone NAAQS.</u>

a. Section 110(l) Demonstration

As discussed in the Proposed Rulemaking, Section 110(l), 42 U.S.C. § 7410(l), of the CAA requires that a proposed rule does not interfere with the attainment and maintenance of the applicable National Ambient Air Quality Standard ("NAAQS") in effect at the time of the revision. Trinity worked with Rain Carbon to prepare the TSD to provide a "noninterference demonstration" that shows that the proposed amendments to 35 Ill. Adm. Code sections 212.322 (PM), 212.124 (opacity), and 215.302 (VOM) will not interfere with Illinois' ability to attain or maintain compliance with the PM and ozone NAAQS. While there is no NAAQS for opacity, the TSD also demonstrates that the environmental impact of the proposed amendments is insignificant.

A Section 110(l) noninterference demonstration is not actually necessary. Rain Carbon's proposed rule amendments are *more stringent* than the relief afforded to the Facility prior to the SMB Rulemaking. That is, the proposed AELs restrict operations and emissions during SMB more than what was authorized under the Facility's existing CAAPP permit and the 2017 settlement between Illinois EPA and Rain Carbon. For example, the proposed AELs do not provide alternative emission limits during malfunction and breakdown for opacity or VOM, which is presently authorized under the Facility's CAAPP permit.[1] Therefore, Rain Carbon's

[1] Illinois EPA previously granted Rain Carbon permission in its CAAPP permit to exceed the opacity, PM, and VOM limits applicable to Kiln 1 and Kiln 2 during SMB conditions. Illinois EPA further authorized such relief in a separate, independently enforceable settlement agreement with Rain Carbon in 2017 (the "2017 IEPA Settlement").

proposed amendments will result in an *improvement* in air quality as compared to the pre-SMB Rulemaking. By definition, improvements in air quality cannot interfere with NAAQS attainment/maintenance. Nonetheless, in an abundance of caution, air quality modeling was conservatively conducted to compare the proposed AELs to emissions from the Facility that would occur if relief during SMB was never authorized. The modeling, as discussed herein, demonstrates that the proposed AELs will not interfere with the NAAQS when compared to operations that do not include SMB (*i.e.*, during normal operations).

b. The TSD Adopts Different Approaches to Demonstrate Non-Interference for VOM and PM.

In order to evaluate the impact on the Ozone NAAQS, Modeled Emission Rates for Precursors ("MERPs") were used to analyze the impacts of VOM on the secondary formation of ozone. *See* Ex. 1, TSD at Section 3.2. The VOM MERPs represent a level of increased precursor emissions that are not expected to contribute significantly to (*i.e.*, will not interfere with) ozone formation. U.S. EPA's MERPs guidance document[2] was used to estimate the level of emissions that would have a significant impact on ozone concentrations. *See* TSD at Section 3.3. These emissions levels were compared to annualized emission rates during start-up from the Facility's kilns to demonstrate that the proposed AEL for VOM will not interfere with the attainment or maintenance of the ozone NAAQS. *See* TSD at Section 3.4.

In order to evaluate the impact on the PM NAAQS, the Facility's pyroscrubber stacks were modeled based on allowable PM emissions and stack characteristics representative of

[2] U.S. EPA, "Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program" (Apr. 30, 2019).

normal (non-SMB or baseline) operations.[3] The emission rates and stack gas characteristics from a July 20, 2023, engineering study conducted at the Facility (the "Engineering Test") during start-up conditions (when the pyroscrubber inlet temperature is less than 1,800°F) were then modeled to calculate pollutant concentrations for every hour at modeled receptor locations surrounding the Facility (*i.e.*, the SMB model conditions). The difference in those modeled values provides the net impact concentrations, which were then compared against U.S. EPA-developed Significant Impact Level ("SILs") concentrations for PM (specifically, $PM_{2.5}$ 24-hr, $PM_{2.5}$ annual, and PM_{10} 24-hr) to demonstrate that the proposed AEL for PM will not interfere with the attainment or maintenance of the PM NAAQS. *See* TSD at Section 4.2.2.

III. <u>The Model Uses EPA-Approved Methodologies.</u>

a. Modeling Impacts on Ambient Air Quality During Transient Start-up, Malfunction and Breakdown Conditions

Assessing whether the impact of the proposed PM and VOM AELs will interfere with the applicable NAAQS requires a two-step analysis. First, representative emissions of PM and VOM during SMB must be determined using a combination of measured emissions and modeling to project conservative levels of PM and VOM from the Facility's two kilns. Second, the SMB emissions must then be modeled over the corresponding NAAQS averaging period to determine the extent of the modeled impacts on ambient air quality.

Contrary to normal, steady-state operations, emissions conditions during SMB events are irregular. Given the irregular and dynamic conditions associated with SMB events, there are no known prescribed methodologies for assessing emissions and environmental impacts from SMB

[3] Secondary formation of $PM_{2.5}$ can be generated from precursor pollutants NO_X and SO_2. Emission rates of NO_X and SO_2 are expected to be lower during SMB events than during normal operation. Therefore, a secondary formation analysis was not completed for $PM_{2.5}$ as part of this analysis.

events.[4] However, there are prescribed methods for normal, steady-state operations, that utilize measured emission rates using in-stack sampling to predict environmental impacts through ambient air quality modeling. These methods have been developed by U.S. EPA and are commonly used in regulatory permit applications and compliance demonstrations. Consequently, Trinity used emissions data generated from in-stack sampling collected in accordance with U.S. EPA's methods[5] as inputs to air dispersion modeling in accordance with U.S. EPA's methodology.[6] Trinity also used MERPS, based on U.S. EPA guidance,[7] to evaluate potential environmental impacts. Both of these concepts are discussed further below.

Similarly, there are no known thresholds established for determining whether an SMB event would have a significant impact to the ambient air. However, there are thresholds that have been defined by the U.S. EPA for determining whether an emissions increase from a project would have a significant impact on the surrounding ambient air quality. These thresholds are known as SILs[8] and are used in PSD permitting projects to evaluate whether emission increases projected from a project may interfere with (*i.e.*, have a significant impact on) the applicable NAAQS. Consequently, due to the lack of thresholds defined specifically for evaluating the significance of environmental impact from SMB events, Trinity used the appropriate SILs for

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[4] This is further supported by the fact that U.S. EPA requires emissions compliance stack testing under "representative testing conditions," which the Agency defines as "*normal* process operating conditions producing the highest emissions or loading to a control device." In other words, sources are not required to test under SMB conditions because they do not represent "normal" conditions to determine compliance. *See* U.S. EPA, Issuance of the Clean Air Act National Stack Test Guidance (Apr. 27, 2009).

[5] 40 C.F.R. Pt. 60, App. A.

[6] 40 C.F.R. Pt. 51, App. W.

[7] U.S. EPA, "Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program" (Apr. 30, 2019).

[8] 40 C.F.R. Pt. 52, App. S.

assessing the environmental impact significance associated with Rain Carbon's proposed AELs. *See* Ex. 1, TSD at Section 4.2.2.

b. Adapting Modeling Intended for Steady-State Operations to Conservatively Account for Periodic and Transient Operations of SMB

Malfunctions and breakdowns, and often start-ups, are random and unpredictable and can vary from year to year. Unlike steady-state operations, it is not possible for SMB events to last every hour in a given year and, in fact, SMB events at the Facility represent only a small percentage of total operating time in a given year.

Air dispersion modeling, based on 40 C.F.R. Part 51 Appendix W, will generate impact results at thousands of discrete locations near the facility for *every hour* over a consecutive five-year period. In the case of the $PM_{2.5}$ 24-hour SIL (the most restrictive SIL), the modeled result from the calendar day with the highest impact from each of five calendar years is averaged and compared to the SIL. As compared with normal, steady-state operations, it is highly unlikely – if not impossible – for an SMB event to occur for the entire 24 hours of each of those specific days in five consecutive years. As a result, it would be inappropriate to use results directly from air dispersion modeling to represent the potential significance of environmental impact from operating under SMB conditions that occur at random and with relative infrequency. *See* Ex. 1, TSD at Section 4.2.10.3.

To give appropriately weight to the periodic and random nature of SMB events – and, thereby, create a more representative model impact of the proposed AELs – Trinity employed a "Monte Carlo" statistical analysis on the modeling output. *See* TSD at Section 4.3. The Monte Carlo statistical analysis is a mechanism that can effectively simulate a large number of random selections of air dispersion modeling results, based on user-defined input (*e.g.*, 30 SMB events per year). The resulting large number of results selected at random are formed into a distribution that can be evaluated to determine the probability that the specified conditions (*e.g.*, 30 SMB events per year) can exceed the respective SIL.[9] *See* TSD at Section 4.3.

As an example, assume that an SMB event will not occur more than 30 times per year and that the goal is to assess the significance of $PM_{2.5}$ 24-hour impacts. The Monte Carlo simulation can randomly select 30 days in each of five years of results generated by an air dispersion model and average the highest selected results from each year. Then, this simulation can be repeated. If the simulation is repeated 1,000 times, then there are 1,000 results, which are directly comparable to the SIL and can be formed into a statistical distribution. This distribution can be used to quantify the probability that a random selection of 30 SMB events per year for five consecutive years might have an impact that is considered to be significant (i.e., higher than the SIL).

IV. An Engineering Test Was Conducted to Evaluate Emission Profiles for PM and VOM (and Opacity) During Start-up.

a. Background on the Engineering Test

As noted above, SMB conditions are not "representative" test conditions used to demonstrate compliance with emission limits and standards. In order to develop a model representative of ambient air quality impacts from periodic SMB conditions, Rain Carbon

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[9] The Monte Carlo approach has been utilized by U.S. EPA and other regulatory agencies as a means for evaluating impacts from random, sporadic, and infrequent operation scenarios which have potential to emit regulated pollutants. For example, U.S. EPA recently relied upon the Monte Carlo statistical analysis to estimate emissions from facility equipment leaks and evaluate limits on pressure relief devices. *See* U.S. EPA, Proposed amendments to the NESHAP for Hard and Decorative Chromium Electroplating, Chromium Anodizing Tanks, Steel Pickling-HCl Process Facilities, and Hydrochloric Acid Regeneration Plants, New Source Performance Standards for the Synthetic Organic Chemical Manufacturing Industry and National Emission Standards for Hazardous Air Pollutants for the Synthetic Organic Chemical Manufacturing Industry and Group I & II Polymers and Resins Industry, 88 Fed. Reg. 25080 (Apr. 25, 2023) (proposed rule). In the referenced proposed rulemaking, U.S. EPA determined that using a Monte Carlo approach was appropriate because it had been employed in the development of other rules.

collected emissions data in July of this year during a single start-up event at Kiln 1 of the Facility (i.e., the Engineering Test). *See* Ex. 1, TSD at Sections 2 & 3.1.

The purpose of the Engineering Test was to evaluate the emissions profile of PM, opacity, and VOM during representative start-up conditions, from the period of time that green coke is introduced into the Kiln (at approximately 400-600˚F), until the inlet temperature to the pyroscrubber reaches 1800˚F. The Engineering Test was not conducted during malfunction/breakdown, as that is not feasible. However, as noted in the Statement of Reasons to the Proposed Rulemaking (and further discussed in the Pre-filed Testimony of Ross Gares submitted on August 28, 2023), during many malfunction/breakdown events, the Facility suspends the introduction of coke into the kiln, resulting in a decrease in the pyroscrubber inlet temperature below 1800˚F. This is why both the Facility's CAAPP permit and the 2017 IEPA Settlement provided for relief from compliance with PM, opacity, and VOM emission limits while the pyroscrubber inlet temperature (on a 3-hour average) was below 1800˚F.

Consequently, the emissions profiles measured during the Engineering Test while the pyroscrubber inlet temperature was below 1800˚F was an appropriate – and the only available – surrogate for emissions that may be experienced during malfunction/breakdown events. As a result, the proposed AEL for PM is similarly conditioned upon operations when the pyroscrubber inlet temperature is below 1800˚F on a 3-hour average.

Rain Carbon contracted with AirSource Technologies, Inc. ("AirSource") to perform the Engineering Test. The Engineering Test was designed to capture emissions data over several periods of the start-up representing various pyroscrubber inlet temperatures as they increased from ambient temperature toward the required 1800°F (on a 3-hour rolling average).[10] Since the

[10] The tests were conducted using U.S. EPA Methods 1-4, Method 5 for filterable PM, Method 9 for Opacity, and Method 25A for VOM (as propane). The requirements of the methods were met during the

Proposed Rulemaking is associated with emission limitations for PM, VOM, and opacity, each of these pollutants were tested simultaneously during the July 20, 2023, start-up of Kiln 1.[11]

AirSource provided a test report containing results of the testing.[12] Trinity extracted emissions and stack information from the report for use in MERPs and air dispersion modeling.

b. Use of Engineering Test as Inputs to Modeling Evaluation to Assess Impact of Proposed AELs for VOM and PM.

For pollutants that will be emitted in excess of certain thresholds, dispersion modeling is used to determine if ground-level concentrations will exceed SILs. If the SILs are not exceeded, then it is well-accepted that the project (in this case, the proposed AELs) will not cause a significant impact on air quality. VOM acts as a "precursor" pollutant, meaning it contributes to the "secondary" formation of other regulated pollutants, specifically ozone. Due to the highly complex nature of the reactions involved, dispersion models such as AERMOD are unable to evaluate secondary ozone formation, instead requiring extremely complex photochemical modeling. U.S. EPA performed such modeling across an array of hypothetical sources across the continental U.S. to relate VOM to secondary ozone (8-hour basis) formation. Based on the precursor emission rates and the modeled maximum concentrations, MERPs were calculated to represent the precursor emission rates (in tons per year, "tpy") that would result in concentrations equal to the SILs. *See* Ex. 1, TSD at Sections 3.3 & 3.4.

July 20, 2023, testing with the exception of the sample durations, which were less than 60 minutes. The shorter duration is not believed to impact the results in such a way that would suggest they should not be used in this analysis.

[11] Kiln 2 was not operating at the time of the Engineering Test. However, due to the similar design and operations between Kiln 1 and Kiln 2, similar emissions results during start-up would be expected between both kilns. Accordingly, VOM, PM and opacity data collected from Kiln 1 during the Engineering Test were applied to Kiln 2 for purposes of modeling noninterference and developing the proposed AELs in Rain Carbon's Proposed Rulemaking.

[12] The test report is included as an attachment to the TSD. *See* Ex. 1, TSD at Appendix A.

VOM lb/hr emission rates during start-up from the Engineering Test were used in conducting a MERPs assessment to assess the significance of potential impacts to the ozone from operating in SMB events. *See* TSD at Section 3.1. The MERPs method uses the impacts modeled by the U.S. EPA at a nearby location with similar stack height and annual emissions to scale impacts from Rain Carbon based on its emissions as a proportion of those used by the U.S. EPA. *See* TSD at Section 3.3. Trinity utilized the stack testing results from July 20, 2023, to represent the emissions that *could* be emitted during SMB events. The resulting impacts were compared to the SIL for ozone to determine the significance that SMB events may have on the environment. The MERPs analysis demonstrated that the potential impact on ambient ozone concentrations is orders of magnitude lower than the SIL. *See* TSD at Section 3.4.

To evaluate the impact of the proposed AEL on the PM NAAQS, the PM emission rates from the Engineering Test were utilized as inputs into AERMOD, which is U.S. EPA's air dispersion modeling program that is used to determine the impacts of emissions from an emission source. *See* TSD at Sections 4.2.1 and 4.2.2. The testing produced five mass emission rates for PM, each representative of a different portion of a start-up and associated pyroscrubber inlet temperature range. To best represent an SMB event, all five results, from five test runs, were utilized in the modeling by assuming each result represented a period of each 24-hour day, proportional to its portion of the entire stack testing duration performed on July 20, 2023. The subsequent runs' proportions were evaluated in the same way, and each successive run was assigned to the next representative portion of the 24-hour day. Each emission rate was also paired with the associated stack flow rate and temperature from the Engineering Test report.

V. <u>The Model Is Conservative and Assumes Conditions Far Beyond Actual Historical Frequency and Duration of SMB Events at the Facility.</u>

Ambient air quality modeling of non-normal, periodic events is inherently problematic. While it is theoretically possible for a facility to be in start-up, malfunction, and breakdown for significant portions of an operational year, the likelihood of such an occurrence is so low as to border on impossible. As a result, the modeling was conducted based on finding a maximum number of hours per year that Kiln 1 and Kiln 2 could operate at emission rates realized during the Engineering Test that would demonstrate compliance with the applicable PM NAAQS.

To ensure an appropriate margin of conservativeness with respect to establishing an AEL that ensures noninterference with the PM NAAQS, Trinity included a number of elements in the modeling that biased the results high (*i.e.*, conservative), including, most notably:

- <u>The frequency and duration of SMB events.</u> The model assumes 720 hours of SMB operation for each kiln each year over five consecutive years. Rain Carbon has consistently experienced fewer hours of SMB events on an annual basis.
- <u>The length of SMB events.</u> Some modeling scenarios assumed all 720 hours of SMB operation per kiln consisted of SMB events that lasted 24 hours. When modeling an individual kiln experiencing an SMB event, the model produces results for every hour over a consecutive five-year period as if the kiln is experiencing a continuous SMB event. From this dataset, the specific single day on which the highest impact occurs is identified in each of the five years modeled. These five results are averaged, and the result represents the maximum possible impact that could occur from SMB operation of a single kiln. The probability that Rain Carbon would actually operate a kiln in SMB mode for 24 consecutive hours, on the worst possible day of the year, five years in a row, is extremely low.

Trinity adopted other conservative measures as part of the PM NAAQS SIL modeling. This included assuming that emissions of PM_{10} and $PM_{2.5}$ are equal to PM and that the worst-case PM test runs (runs 1 and 5 from the Engineering Test) will occur at the time of day when dispersion is least favorable.

VI. The Modeling Results Confirm that the Proposed Rulemaking Has Negligible Impact on the NAAQS and Ambient Air Quality.

a. VOM During Start-up Conditions

In accordance with U.S. EPA's July 29, 2022, Guidance for Ozone and Fine Particulate Matter Permit Modeling, the SIL for 8-hr Ozone is 1 parts per billion ("ppb"). The VOM emission rate from the Engineering Test was annualized, showing a 3.24 tons per year VOM impact from SMB operations from Kiln 1 and Kiln 2. That annualized emission rate was then compared to the applicable VOM MERPs to derive the expected secondary impacts from the additional VOM emissions during SMB under the proposed VOM AEL. The results demonstrate that the expected secondary contribution of VOM during start-up from the proposed AEL is *1000 times* below the VOM SIL (0.001 ppb compared to the 1-ppb SIL).

Therefore, no interference with the Ozone NAAQS is expected to occur as a result of the proposed VOM AEL. *See* Ex. 1, TSD at Section 3.4.

b. PM During Start-up Conditions

Modeling was conducted to determine the potential for exceeding the $PM_{2.5}$ 24-hour SIL, the $PM_{2.5}$ Annual SIL, and PM_{10} 24-hour SIL during start-up conditions.[13] Neither the $PM_{2.5}$ Annual SIL nor PM_{10} 24-hour SIL results showed any potential exceedances, even if operating in SMB mode for every hour for five consecutive years. *See* Ex. 1, TSD at Table 4-8. Therefore, no further evaluation is needed for these SILs. The $PM_{2.5}$ 24-hour, however, is the more restrictive SIL for this analysis; therefore, the remainder of this testimony specifically addresses only this SIL.

The Kiln 1 model showed no impacts greater than the $PM_{2.5}$ 24-hour SIL. *See id.* This remained true even when conservatively modeling the 720 hours per year SMB operation spread out over thirty 24-hour events. Every modeled result showed that the impact would be less than the $PM_{2.5}$ 24-hour SIL.

The Kiln 2 model did show some small potential for impacts greater than the $PM_{2.5}$ 24-hour SIL. *See id.* As discussed above, this model is a suitable candidate for applying a Monte Carlo statistical analysis in order to provide a more representative evaluation of whether the proposed PM AEL could actually have the potential to interfere with the NAAQS. In other words, the probability of the Kiln 2 results produced by the model actually occurring are so low that it would not provide a modeled basis to conclude that the proposed AEL for PM could interfere with the PM NAAQS based on SMB emissions from Kiln 2.

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[13] As noted above, it is not possible to collect emissions data during a malfunction/breakdown event. Accordingly, start-up conditions were based on emissions data collected during the Engineering Test and extrapolated over a 24-hour period, a length that is conservatively representative of start-up duration. By contract, malfunction/breakdown conditions (discussed below in VI.c of this testimony) were based on the same emissions data but extrapolated over a less 12-hour period, which is more conservatively representative of the length of some malfunction/breakdown events.

The Monte Carlo statistical analysis was applied to the model results for Kiln 2, which randomly selected 30 days per year for each kiln (24 hours of SMB operation per day) over the course of five consecutive years and determined the maximum impact from those random selections. The analysis repeated this random selection and determination 1,000 times to produce a total of 1,000 random results which were then formed into a statistical distribution. The analysis determined that the chances of Kiln 2 having a potentially significant impact from operating 24 hours per day, 30 days per year is 8.3%, or approximately *once every 60 years*. This does not account for the extremely low probability that Kiln 2 would operate in SMB mode for 24 hours, 30 days per year, five years in a row.[14] *See* TSD at Section 4.3.1.1.

c. PM During Malfunction/Breakdown Conditions

The same models as discussed above were modified to represent malfunction events. *See* Ex. 1, TSD at Section 4.2.10.3. For this modeling effort, the model adjusted the duration of events to 12 hours (to better reflect the length of malfunction/breakdown events as compared to start-up events) and below in order to simulate the randomness with which malfunctions occur (*i.e.*, to better simulate the randomness inherent in malfunction/breakdown events, the model applied half of the SMB emission rate across 24 hours/day).

The models for both kilns operating individually (*i.e.*, both kilns are not operating in SMB mode simultaneously) resulted in impacts that are all under the $PM_{2.5}$ 24-hour SIL. While these model results are suitable candidates for applying a Monte Carlo statistical analysis, it is

[14] Note that a model scenario considering both kilns operating simultaneously in start-up mode for 24 hours was executed, and Monte Carlo statistical analysis was applied to those results. The results indicate that in the unlikely event that both kilns were to operate in SMB mode simultaneously for 24 hours multiple times per year, a significant impact *could* occur. However, as noted in the TSD, because it is rare that both kilns enter start-up simultaneously (in the past several years, and perhaps longer, there has not been an occurrence of both kilns operating in start-up mode simultaneously), these modeled results are not considered to represent a potential interference with the PM NAAQS.

not necessary to do so when there is no possibility of exceeding the SIL (even when considering operation in SMB mode 24 hours per day, every day, for five consecutive years).

The models for both kilns operating concurrently and experiencing a malfunction event simultaneously were evaluated applying the Monte Carlo statistical analysis to the modeled results in order to determine the probability that a significant impact could occur if Rain Carbon were allowed to operate in malfunction mode for up to 720 hours per year (per kiln). *See* TSD at Section 4.3.1.2. This modeling approach was conservative because there is a lower probability that both kilns would experience malfunctions at the same time (*i.e.*, one occasion could be a power failure that affects the entire Facility). For malfunctions, the air dispersion model was designed to produce results which are representative of a malfunction or breakdown occurring for up to 12 hours per day. Applying the Monte Carlo statistical analysis to the modeling results, the analysis found a 4.5% probability of both kilns experiencing a 12-hour SMB event on the same day in five consecutive years in a combination that results in an impact greater than the SIL. In other words, a SIL impact might occur approximately *once in every 112 years*.

Granting Rain Carbon up to 720 hours of SMB operating time per kiln will have an extremely low chance of resulting in a significant impact on the ambient air.

VII. <u>The TSD and Model Support the AELs of the Proposed Rulemaking.</u>

Rain Carbon's Proposed Rulemaking seeks amendments to Sections 212.124, 212.322, and Section 215.302 to establish alternative, specific emission standards applicable to the Facility for opacity, PM, and VOM, respectively, during periods of time when the Facility is in start-up (for opacity and VOM) and SMB (for PM) and is unable to achieve or maintain an inlet temperature of 1800˚F at the inlet to the pyroscrubber servicing either Kiln 1 or Kiln 2. While the TSD and modeling demonstrate that the proposed AELs will not interfere with the respective

NAAQS, the proposed AELs were established to ensure that Kiln 1 and Kiln 2 can demonstrate continuous compliance with the applicable state lb/hr VOM and PM emission limits. Stated differently, the TSD relied upon data collected from a single Engineering Test to set AELs that both avoided interference with the NAAQS and set limits with sufficient latitude to account for differences that will occur during transient and highly variable SMB conditions.

a. Opacity

Air quality modeling was not performed for opacity, since there is no NAAQS for opacity and any non-interference with the PM NAAQS is covered by the PM modeling discussed herein. As discussed in more detail in the TSD, and as further explained in the Statement of Reasons for the Proposed Rulemaking, the Facility has no ability to control opacity during start-up when temperatures of the pyroscrubber are well below 1800˚F. U.S. EPA Method 9 opacity readings were taking during the Engineering Testing. Those readings demonstrated that opacity is generally the highest during the first few hours of start-up.

Accordingly, the Proposed Rulemaking seeks a narrow extension of the averaging period during start-up (defined as the period from when green coke feed is introduced into the kiln until the temperature of the pyroscrubber inlet achieves a minimum temperature of 1800˚F over a 3-hour rolling average) to allow for up to three, 1-hour average periods to demonstrate compliance with the 30% opacity standard. Based on the results of the Engineering Study, opacity levels are sufficiently controlled after an adequate amount of coke is added to the kiln. Rain Carbon did not seek relief from the opacity standards during malfunction/breakdown because sufficient temperature remains in the pyroscrubber during such events to ensure compliance with the opacity standards (and this was demonstrated by looking at the Method 9 readings that occurred during the Engineering Study after the first few hours of start-up).

b. VOM

Similarly, the Proposed Rulemaking seeks relief from the 8 lbs/hr VOM standard through averaging VOM start-up emissions up to 24 hours in duration. While it is true that VOM emissions during start-up conditions of the Engineering Test did not exceed 8 lbs/hr at any of the 5 engineering test runs (*see* Table 3.1 of TSD), as expected, VOM emissions were highest during the first few hours of start-up when temperatures at the inlet to the pyroscrubber are farthest away from the optimal 1800˚F minimum operating temperature. While Trinity and Rain Carbon believe that the Engineering Test was representative of typical start-up conditions, the testing occurred over a single day and simply cannot be used as evidence that emissions of VOM during start-up conditions will always remain below the regulatory limit.[15]

Accordingly, as discussed above, the TSD evaluated the impact on secondary formation of ozone from VOM emissions during start-up by comparing the annualized VOM emissions during the Engineering Test to MERPs established by U.S. EPA. As explained above, while the annualized VOM emissions from the Engineering Study were, arguably, low, as compared to the expected VOM levels during start-up, the annualized VOM levels were so far below the MERPs that the VOM emission rate during start-up would need to be roughly 1000 times greater than what was measured during the Engineering Test to model (using MERPs) any interference with the Ozone NAAQS. Therefore, to the extent that VOM emission rates exceed 8 lb/hr during start-up conditions, the TSD demonstrates unequivocally that the proposed VOM AEL will not

[15] To that end, temperatures at the inlet to the pyroscrubber before green coke was introduced into the kiln were significantly hotter than expected – closer to 600 ˚F – during the Engineering Test. This may be been due to the hot ambient temperature conditions during the test. Regardless of the reason, the hotter pyroscrubber temperatures during the beginning hours of start-up (after green coke is first introduced) may have served to *reduce* the levels of VOM (and, for that matter opacity) typically expected during those periods.

interfere with the NAAQS. At the same time, because conditions during the Engineering Test were not reflective of all start-up conditions that the kilns will experience, the averaging period proposed in the AEL for VOM is appropriate and necessary.

c. PM

The Proposed Rulemaking proposes an AEL from the PM process weight emission limit during any period of time (*i.e.*, during SMB) that the inlet to the pyroscrubber is below 1800˚F (based on a 3-hour rolling average) up to 720 hours each year for each kiln.

The results from modeling and Monte Carlo analyses demonstrate that allowing up to 720 hours of SMB operation per kiln has an insignificant impact on the ambient air quality (*i.e.*, the PM NAAQS). 720 hours per year for each kiln of SMB operation is considered to be conservative insofar as the Facility has not in recent years operated in SMB conditions for close to 720 hours per year per kiln.

However, the relief sought by the Facility remains appropriate. First, the modeling confirms that 720 hours per year per each kiln does not interfere with the NAAQS. Second, Rain Carbon is seeking allowance for up to 720 hours to accommodate the potential to operate to the fullest extent allowed by its current CAAPP permit. Third, given the sporadic and unpredictable nature of malfunction and breakdown events (and start-ups that may result from such malfunction or breakdown events), it is possible that the Facility will experience SMB events lasting in the aggregate up to 720 hours per kiln in a given year during which time relief from the process weight PM limits is needed. To be clear, the proposed AEL for PM is intended to provide limited relief for compliance with a short-term lb/hr process weight emission limit. The TSD and associated modeling merely confirm that in the event that SMB conditions occur frequent enough during a calendar year, such conditions will not have a negative impact on the NAAQS and, therefore, are appropriate for adoption into the Illinois State Implementation Plan.

Dated: September 5, 2023

EXHIBIT 1

TECHNICAL SUPPORT DOCUMENT

RAIN CARBON INC.

Rain CII Carbon LLC – Robinson Plant

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September 5, 2023

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Trinity Consultants

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1. INTRODUCTION

Trinity Consultants, Inc. (Trinity) is providing this Technical Support Document (TSD) to provide detailed data, analyses, and conclusions supporting the proposed rule R23-18A, as it pertains to Rain CII Carbon LLC (Rain Carbon). Rain Carbon's coke calcining process generates exhaust gases from the heating of green coke in a rotary kiln. The exhaust gases contain volatile organic matter (VOM) and particulate matter (PM) and are routed to a pyroscrubber air pollution control device to reduce the amount of VOM and PM in the exhaust gas before being released to the atmosphere via the stack attached to the pyroscrubber. If the temperature at the inlet to the pyroscrubber is at least 1,800°F (3-hour rolling average[1]), then Rain Carbon's kilns are able to comply with the applicable opacity, VOM, and PM limitations. There are instances during which it is not possible to maintain this temperature including start-up, malfunction, and breakdown (SMB). When the temperature falls below 1,800°F, the probability of achieving compliance with the applicable emission limits decreases.

In R23-18A, Rain Carbon is proposing emission standards for opacity, VOM, and PM applicable to the two kilns at Rain Carbon's facility during certain periods of SMB. Rain Carbon engaged Trinity to conduct modeling analyses to demonstrate that the potential impact of the proposed emission standards is insignificant and, therefore, would not interfere with the PM and ozone National Ambient Air Quality Standards (NAAQS)[2] in accordance with Section 110(l) of the Clean Air Act (42 U.S.C. § 7410(l)).

This TSD provides the details about the collection of emissions data from in-stack sampling, air dispersion modeling, and results analysis which demonstrates that the potential impacts on the environment related to each of the proposed rulemakings is insignificant.

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[1] When the pyroscrubber inlet temperature of 1,800°F is referenced throughout this document, it is based on a 3-hour rolling average.

[2] Rain Carbon's Facility is located in Crawford County, Illinois. Crawford County is in attainment with the 2015 8-hour ozone NAAQS. Similarly, Crawford County is in attainment of the 2012 PM NAAQS (including the annual $PM_{2.5}$ standard, the 1997 24-hour $PM_{2.5}$ standard and the 2006 24-hour PM_{10} standard).

2. OPACITY

For opacity, Rain Carbon has proposed a standard alternative to the standards in 35 Ill. Adm. Code 212.123 in the proposed rulemaking R23-18A. The current rule requires opacity to remain below 30% with an exception for short periods of higher opacity with specific restrictions. During normal operations[3], Rain Carbon can maintain compliance with this limitation; however, during a kiln start-up, Rain Carbon is unable to consistently maintain compliance with this standard. Therefore, Rain Carbon is proposing to allow for up to three (3) hours during a kiln start-up for averaging opacity observation results. The analysis below demonstrates that the opacity observed during a kiln start-up may be relatively high during the beginning of a start-up but quickly dissipates.

On July 20, 2023, Rain Carbon contracted AirSource Technologies, Inc. (AirSource) to execute an engineering study during a single start-up of one of its two coke calcining kilns (Kiln 1) in order to obtain emissions data for VOM, opacity, and PM during start-up.

For opacity, AirSource conducted observations in accordance with USEPA Method 9 (40 C.F.R. 60, Appendix A-4). AirSource observed and recorded the opacity during five (5) separate 1-hour periods[4] during a single start-up event. Results from the observations are summarized in Table 2-1 below.

Table 2-1. Opacity Observation Results

Parameter	Run 1	Run 2	Run 3	Run 4	Run 5	Average
Start/Stop Time	9:45-10:45	12:11-13:11	13:44-14:37	16:15-17:15	17:47-18:47	-
Maximum Opacity (%)	50	5	5	0	0	-
Average Opacity (%)	13.90	2.71	0.60	0.00	0.00	3.44

Detailed field data sheets have been provided in Appendix A of this TSD (See Appendix C-3 of the AirSource report). During a typical start-up, once Rain Carbon begins to introduce feed coke into the kiln, opacity tends to be in excess of the current standard under 35 Ill. Adm. Code 212.123. For example, during the start-up performed on July 20, 2023, the maximum opacity reading was recorded at 50% and above 30% for more than 8-minutes in a 60-minute period.

[3] "Normal operations" refers to the kilns and associated equipment operating, but not in an SMB event.

[4] Run 3 had a 53-minute duration. The observed opacity for 40 minutes preceding the end of Run 3 was zero, and the observed opacity following Run 3 was zero for 120 minutes.

3. VOLATILE ORGANIC MATTER

In the proposed rulemaking R23-18A, Rain Carbon has proposed an alternative emission standard which would allow Rain Carbon to demonstrate compliance with the existing 8 lb/hr VOM limit (35 Ill. Adm. Code 215.301) as an average over up to 24 hours during kiln start-ups. The analysis below demonstrates that allowing Rain Carbon to operate under the proposed alternative standard would have an insignificant impact to the ozone NAAQS.

3.1 Engineering Study

In addition to observing opacity during the start-up of Kiln 1 that was performed on July 20, 2023, AirSource collected stack samples to obtain VOM emission rates. AirSource utilized USEPA Method 25A (40 CFR 60, Appendix A-7) to determine the concentration of total hydrocarbons (THC) in the stack gas stream during the Kiln 1 start-up. The mass emission rates during each run were calculated by AirSource and are presented in Table 3-1 below.

Table 3-1. VOM Sampling Results

Parameter	Run 1	Run 2	Run 3	Run 4	Run 5	Average
Gas Time Period	9:34-10:30	12:47-13:32	13:45-14:30	16:46-17:31	17:45-18:30	-
Flow Time Period	9:44-10:49	12:11-13:10	13:44-14:37	16:15-17:17	17:47-18:50	-
Emission Rate (lb/hr)	2.41	0.385	0.349	0.290	0.277	0.74

The allowable VOM emission rate pursuant to 35 Ill. Adm. Code 215.301 is 8 lb/hr. Start-up events are inherently variable. While the start-up performed on July 20, 2023 generated emission rates that are below the regulatory limit, was procedurally representative of a typical start-up, and samples were collected based on USEPA methodology, a different set of sampling data could be collected during subsequent start-ups producing different results.

Note that the table presents a “Gas Time Period” and a “Flow Time Period”. The gas time period represents the start/stop time of the sample gas collection for measuring VOM. This alone cannot be used to determine a mass emission rate of VOM, only a concentration. Stack flow data is needed to calculate emissions on a mass-basis, but stack flow data was not collected in sync with the VOM sampling start/stop time because this was instead being collected as part of the Method 5 testing. Since the sampling for both VOM and PM had similar start/stop times in the context of an entire kiln start-up period, the stack gas flow information collected during the PM sampling was used by AirSource to calculate the mass emission rates presented in Table 3-1.

3.2 Modeled Emission Rates for Precursors

Modeled Emission Rates for Precursors (MERPs) can be used to analyze the impacts of secondary formation of ozone from precursor pollutants, in this case VOM. The USEPA used complex photochemical modeling to model hundreds of hypothetical emission points across the United States. Each hypothetical emission point is characterized by a stack height, annual emission rate, and additional factors unique to each specific geographic area. The results from each of the hypothetical models have been provided by the USEPA as a reference for determining impacts from existing or proposed emission points as a function of annual emission rate(s).

The VOM MERPs represent a level of increased precursor emissions that are not expected to contribute significantly to ozone formation. For this analysis, Trinity utilized the USEPA's MERPs guidance document[5] to estimate the level of emissions that would have a significant impact on ozone concentrations. These emissions levels are compared to emission rates from the start-up emission rates (annualized) for purposes of demonstrating that allowing Rain Carbon to operate during start-up will not have a significant impact on ozone concentrations[6].

3.3 MERPs View Qlik and Hypothetical Source Selection

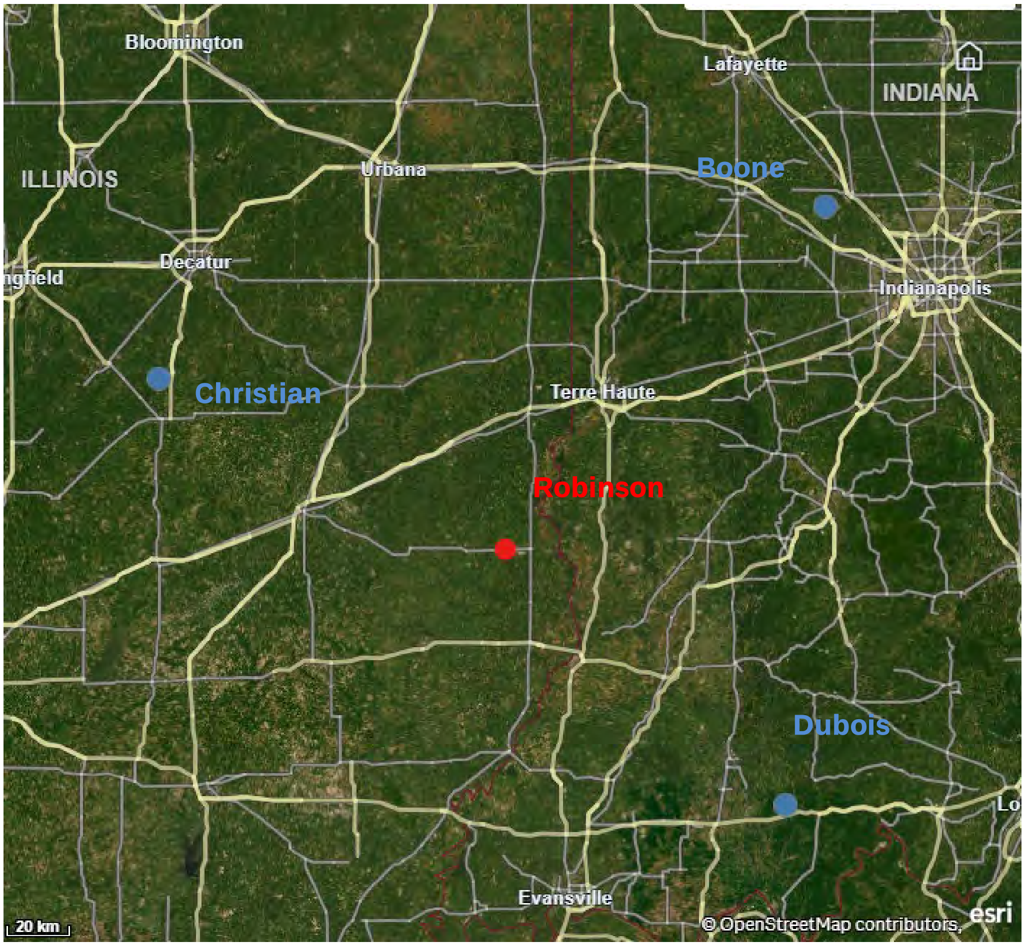
To determine the appropriate MERP values for comparison, a hypothetical source must be selected from USEPA's MERPs View Qlik website[7]. Considering geographical proximity to the Rain Carbon Robinson facility, the three closest hypothetical sources available in the View Qlik website include Christian County, IL, Boone County, IN, and Dubois County, IN, as shown in Figure 3-1 below.

[5] "Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program," USEPA, April 30, 2019.

[6] Note that for this assessment, Trinity considers only VOM to be a potential contributor to increased ozone impacts while recognizing that, in general, nitrogen oxides (NO_X) can have an impact on ozone formation too. During start-up, VOM has potential to have increased emissions, relative to normal operations due to reduced control; however, NO_X are believed to be emitted at a lower rate during start-up, relative to normal operation . Additionally, Rain Carbon is not subject to NO_X emission standards; thus, it is not seeking any alternative standard for NO_x. Refer to *Zhu, B.; Shang, B.; Guo, X.; Wu, C.; Chen, X.; Zhao, L. Study on Combustion Characteristics and NO_X Formation in 600 MW Coal-Fired Boiler Based on Numerical Simulation. Energies 2022* for additional information regarding NO_X emissions from combustion units.

[7] https://www.epa.gov/scram/merps-view-qlik

Figure 3-1. MERPs View Qlik Hypothetical Sources Near Robinson, IL



The MERPs data is shown in tables below for each of the three locations.

Table 3-2. 8-Hour Ozone MERPs Data for Boone County, IN

Precursor	Emissions (tpy)	Stack (m)	MERP (tpy)
VOC	500	10	2,985

Table 3-3. 8-Hour Ozone MERPs Data for Christian County, IL

Precursor	Emissions (tpy)	Stack (m)	MERP (tpy)
VOC	500	10	7,222

Table 3-4. 8-Hour Ozone MERPs Data for Dubois County, IN

Precursor	Emissions (tpy)	Stack (m)	MERP (tpy)
VOC	500	10	5,424

Based on the tables shown above, the MERP value for the Boone County hypothetical source was the lowest; therefore, it has the highest sensitivity to ozone impacts from VOM[8] contribution, so it has been selected as the appropriate source location for this analysis. The EPA MERPs ViewQlik website provides a variety of model combinations with different stack heights and emission rates for each location. The stack heights relevant to this project are 45.72 m, so a stack height of 10 m was chosen as a conservative estimate[9].

3.4 Assessment Approach and Results

Consistent with the USEPA's guidance, the following equation is used to calculate the MERP for VOM.

Equation 1. MERP Calculation

$$MERP = Critical\ Air\ Quality\ Threshold \times \left(\frac{Modeled\ Emission\ Rate\ from\ Hypothetical\ Source}{Modeled\ Air\ Quality\ Impact\ from\ Hypothetical\ Source}\right)$$

Based on USEPA's July 29, 2022, Guidance for Ozone and Fine Particulate Matter Permit Modeling, the significant impact limit (SIL) is 1 ppb for 8-hr Ozone. To calculate the secondary impact of VOM on Ozone, the average hourly VOM emission rate from Table 3-1 was annualized, assuming 8,760 hours of operation per kiln per year. This represents a worst-case annual emissions rate for both kilns, which assumes that both kilns operate at the start-up emission rate for every hour of an entire year. That annualized emission rate is calculated as follows:

Equation 2. Annualized VOM Emissions Rate for MERPs

$$ER_{tpy} = \frac{VOM\ \frac{lb}{hr} * 8{,}760\ \frac{hours}{year} * 2\ Kilns}{2000\ \frac{lb}{ton}}$$

Using the above equation, ER_{tpy} is equal to 3.24 tons per year.

This annualized emissions rate can be compared to the Boone VOM MERPs using the following equation to derive the expected secondary impacts from the additional VOM emissions:

Equation 3. Calculation of Secondary Formation Impacts

$$Ozone\ Secondary\ Impact_{ppb} = \frac{ER_{tpy}}{MERPs_{tpy}} * SIL_{ppb}$$

The secondary contribution is therefore expected to be below the Ozone SIL of 1 ppb based on the values presented in Table 3-5.

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[8] Note that USEPA uses the term volatile organic compounds, or VOC, rather than VOM. For purposes of this demonstration, VOM and VOC are interchangeable.

[9] Throughout this TSD, "conservative" is used as a term to indicate that a variable(s) was defined so that it ultimately contributes to a higher modeled concentration for the respective pollutant. Typical results are expected to be lower.

Table 3-5. Secondary 8-Hour Ozone MERPs Analysis

MERP (tpy)	SIL (ppb)	ER_{tpy}	Secondary Contribution (ppb)
2,985	1	3.24	0.001

As shown in Table 3-5, the potential contribution to ozone from VOM emissions from Rain Carbon's kilns during start-up is orders of magnitude less than what is considered to be a significant contribution.

4. PARTICULATE MATTER

Rain Carbon's kilns are subject to the Process Weight Rate (PWR) rule established in 35 Ill. Adm. Code 212.322. This rule sets limits on PM based on equations that are dependent upon the process rate of an effected unit. When Rain Carbon's pyroscrubbers are not operating at a temperature greater than or equal to 1,800°F (during SMB events), the chances of achieving compliance with the limitation calculated in accordance with the PWR rule decrease. In the R23-18A rulemaking, Rain Carbon has proposed an allowance of 720 hours per year per kiln to operate during periods when the pyroscrubber inlet temperature is below 1,800°F and a SMB event is occurring. The analysis in this Section demonstrates that approving the proposed alternative standard for PM will not result in a significant impact to the environment.

4.1 Engineering Study

During the start-up conducted on July 20, 2023, AirSource collected stack gas samples and utilized USEPA Method 5 (40 CFR 60, Appendix A-3) to capture filterable PM. AirSource collected five samples, each over a 48-minute period[10]. From the sampling, AirSource was able to determine mass emission rates of PM during five periods of the single kiln start-up. Table 4-1 presents the results from the testing performed on July 20, 2023.

Table 4-1. Particulate Matter Sampling Results

Parameter	Run 1	Run 2	Run 3	Run 4	Run 5	Average
Start/Stop Time	9:44-10:49	12:11-13:10	13:44-14:37	16:15-17:17	17:47-18:50	-
Sampling Time (min)	48	48	48	48	48	-
Pyroscrubber Inlet Temperature[a] (°F)	694	1,069	1,125	1,281	1,373	1,086
Filterable PM[b] (lb/hr)	44.7	32.2	33.1	44.1	51.7	41.2

a. Pyroscrubber temperature for individual runs is the average over the duration of the respective run. The average pyroscrubber inlet temperature is calculated as the average of all temperature recordings between the start of Run 1 and the end of Run 5.

b. Rain Carbon's Clean Air Act Program Permit (CAAPP) operating permit 95120092, Condition 4.2.2.b.ii.C.I. specifies that Rain Carbon shall conduct a Method 5 test for PM emissions. This is the testing requirement associated with the PWR PM limit in the permit. Consistent with the CAAPP, this analysis considers only the results from EPA Method 5.

At the maximum process weight rate for Kiln 1 (28 T/hr), the maximum allowable PM emission rate determined in accordance with 35 Ill. Adm. Code 212.322 is:

$$E = C + A(P)^B = 0 + 4.10(28)^{0.67} = \mathbf{38.2\ lb/hr}$$

Three (3) of the sample results presented in Table 4-1 were above 38.2 lb/hr. The average pyroscrubber inlet temperature during each run was below 1,800°F.

[10] The start/stop time on each run indicates a runtime longer than 48 minutes. Sampling occurred for 48 minutes, but the total run time is longer due to the time it takes to move the sampling train to different stack ports to meet the traverse requirements defined in USEPA Method 1.

4.2 Air Dispersion Modeling

In order to assess whether operating in accordance with the proposed rule will have a significant impact on the ambient air, air dispersion models representing these operating scenarios have been developed and executed using the emission rates presented in Table 4-1. The difference between the results from these models and results from modeling baseline operations can be compared to the respective SILs.

4.2.1 Dispersion Modeling Selection

The current USEPA regulatory model, AERMOD (version 22112) was used as incorporated within Trinity's *BREEZE™ AERMOD Pro* software to calculate ground-level concentrations with the regulatory default parameters. Appropriate averaging periods, based on federal and state ambient air quality standards, and model options were considered in the analysis, in conjunction with the following guidance documents:

- USEPA's *Guideline on Air Quality Models* 40 CFR 51, Appendix W (Revised, January 17, 2017)
- USEPA's *AERMOD Implementation Guide* (Revised June 2022);
- USEPA's Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program (April 17, 2018);
- USEPA's Guidance for Ozone and Fine Particulate Matter Permit Modeling (July 29, 2022);

4.2.2 Source Characterization

The kilns are the source of PM emissions; however, they route their exhaust gases to pyroscrubbers which reduce the amount of PM emissions before the exhaust gases are released to atmosphere via two individual stacks. Because the pyroscrubber exhaust stacks represent the point when emissions from the kilns are first released to the atmosphere, the stacks are placed into the air dispersion model as point sources where PM dispersion will begin.

The modeling must consider two operating scenarios – SMB mode and normal operations. Since the kilns cannot operate in SMB mode and normal operating mode simultaneously, and Rain Carbon is currently allowed to operate its kilns up to 8,760 hours pers year, each hour that the kiln operates in SMB mode takes the place of an hour that the kilns could have been operating normally. Since both operating modes have potential to disperse PM emissions to the ambient air, it is the difference in dispersed PM that needs to be quantified. In other words, the assessment needs to consider only the net increase in impacts from operating in SMB mode as opposed to operating normally. To represent the "net" impact from operating in SMB mode for up to 720 hours per year per kiln instead of operating only in normal operating mode during those same hours, the impact representing normal operations must be subtracted from the impact representing SMB operations.

To establish the baseline impacts (representing normal operation), the facility's pyroscrubber stacks were modeled based on allowable PM emissions and stack characteristics representative of normal operations.[11] For scenarios during which Rain Carbon is seeking relief from applicable PM emission standards (pyroscrubber inlet temperature less than 1,800°F) the model considers the emission rates and stack gas characteristics from the July 20, 2023 engineering study. Each model calculates pollutant concentrations for every hour and at every location included in the model. Subtracting the baseline model calculated concentrations from the SMB model calculated concentrations provides the net impact concentrations that

[11] Secondary formation of $PM_{2.5}$ can be generated from precursor pollutants NO_X and SO_2. Emission rates of NO_X and SO_2 are expected to be lower during SMB events than during normal operation. Therefore, a secondary formation analysis was not completed for $PM_{2.5}$ as part of this analysis.

can be compared to the respective SILs. These models can be combined into a single model and still generate the desired results if the SMB mode's emission rates are entered in as positive values and the baseline mode's emission rates are entered in as negative values.

SIL modeling is usually conducted by considering net emissions increases of a project in comparison to the USEPA SIL thresholds. Illinois EPA has a published modeling guidance for Prevention of Significant Deterioration (PSD) permitting titled "Prevention of Significant Deterioration, The Art and Science of the PSD Air Quality Analysis, The Modeling Perspective". While Rain Carbon's proposed rulemaking does not represent a PSD permitting action, the Illinois EPA guidance remains instructive as it provides guidance on the modeling of preliminary impacts in comparison to the SIL standards. Section III.A. states "Model for each averaging time of the pollutant emissions concerning the PSD permitting source(s) only. This includes permitted and traditional sources that have increased emissions as a result of emission increases with the PSD permitted source(s)." The subsections below describe the development and execution of air dispersion models used to derive ambient air impact values that are compared to the SILs.

The recommended SIL values for the particulate matter standards are summarized below:

- $PM_{2.5}$ 24-hr – 1.2 µg/m^3
- $PM_{2.5}$ Annual – 0.2 µg/m^3
- PM_{10} 24-hr – 5 µg/m^3

4.2.3 Building Downwash

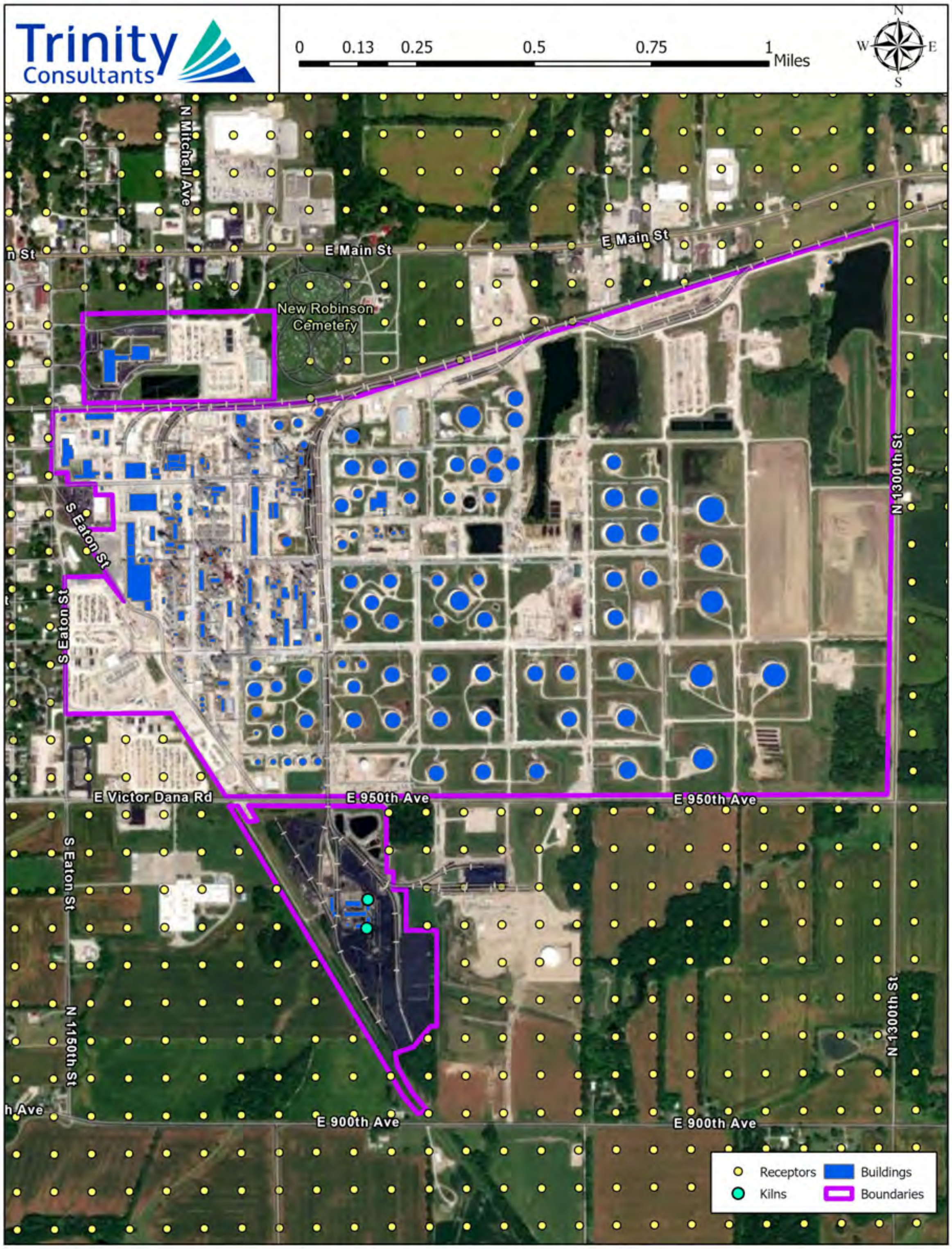
The purpose of a building downwash analysis is to determine if the plume discharged from a stack will become caught in the turbulent wake of a building (or other structure), resulting in downwash of the plume. The downwash of the plume can result in elevated ground-level concentrations.

The Building Profile Input Program (BPIP) with Plume Rise Model Enhancements (PRIME) (version 04274) was used to determine the building downwash characteristics for each stack in 10-degree directional intervals. The PRIME version of BPIP features enhanced plume dispersion coefficients due to turbulent wake and reduced plume rise caused by a combination of the descending streamlines in the lee of the building and the increased entrainment in the wake. For PRIME downwash analyses, the building downwash data include the following parameters for the dominant building:

- Building height,
- Building width,
- Building length,
- X-dimension building adjustment, and
- Y-dimension building adjustment.

Satellite imagery of the facility buildings, as digitized in AERMOD, are included in Figure 4-1 for reference.

Figure 4-1. General Model Overview



4.2.4 Coordinate System

In all modeling input and output files, the locations of emission sources, structures, and receptors were represented in the UTM coordinate system. The UTM grid divides the world into coordinates that are measured in north meters (measured from the equator) and east meters (measured from the central meridian of a particular zone, which is set at 500 km).

4.2.5 Receptor Grid

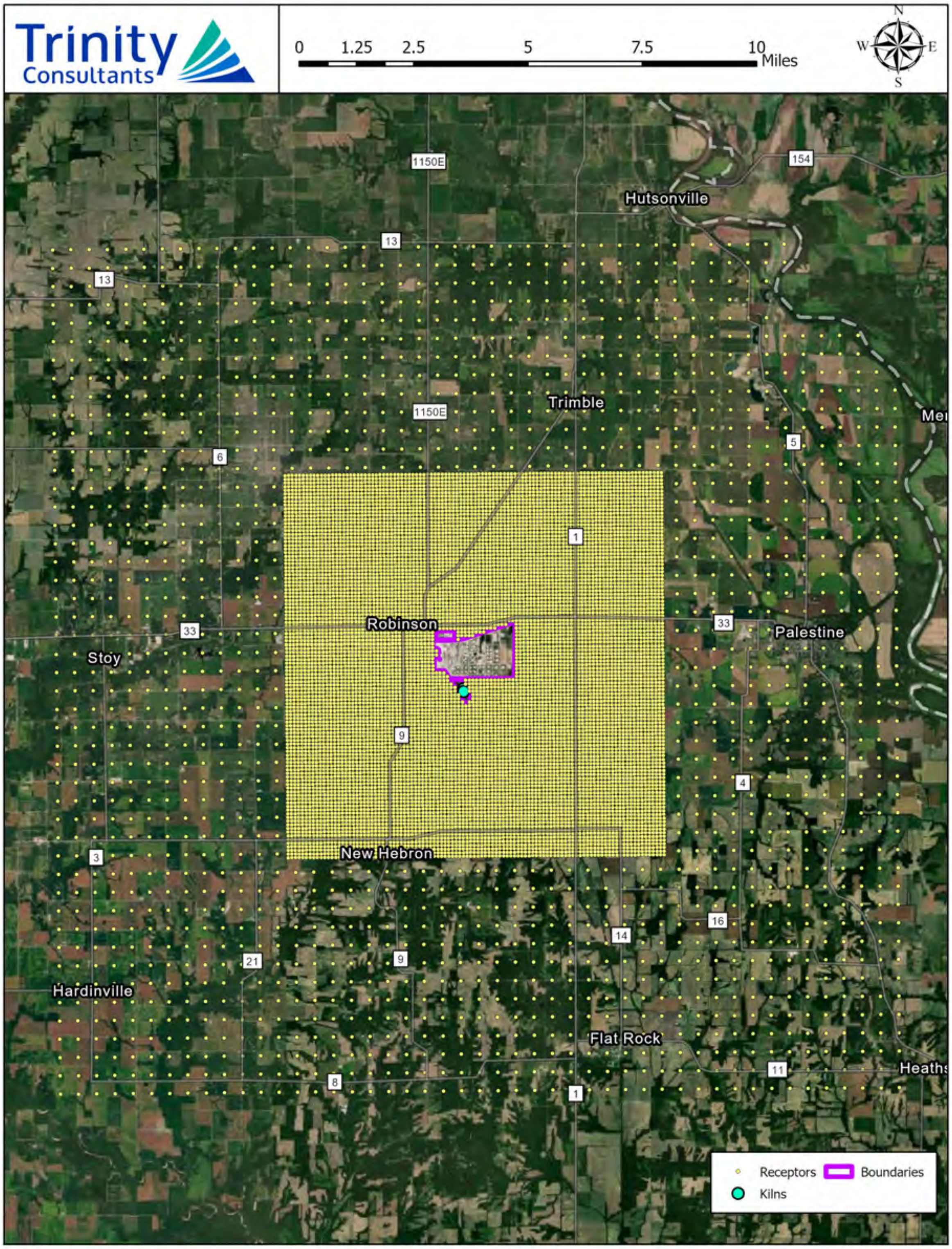
Trinity used a variable-density grid in order to determine the extent of the significant impact area (SIA).

- Property line receptors with spacing of approximately 50 meters
- 100 meter spacing grid extending approximately 5,000 meters from the facility center
- 500 meter spacing, from 5,000 meters to approximately 11,500 meters from the facility center

The Facility is surrounded by fencing and has active security measures, such as guard houses, that restrict access to the facility along the property line. The fences and active security measures cause the property line to serve as a boundary between the facility and its ambient air.[12] Consistent with sulfur dioxide (SO_2) Data Requirements Rule (DRR) modeling submitted and approved by USEPA, most recently in 2019, the Marathon Robinson Refinery, which is located directly adjacent to the Facility, was excluded from the receptor grid as it also has fences and active security measures prohibiting public access to its property. The ambient air boundary for the facility can be seen in Figure 4-1 and Figure 4-2, denoted in purple.

[12] https://www.epa.gov/sites/production/files/2019-12/documents/revised_policy_on_exclusions_from_ambient_air.pdf

Figure 4-2. Receptor Grid and Boundaries



4.2.6 Terrain Elevations

The terrain elevation for each receptor point was determined using Elevated Terrain Mode and National Elevation Dataset (NED) data. The data has terrain elevations at approximately 10-meter intervals. In addition, the AERMOD terrain processor, AERMAP (version 18081), was used to compute the hill height scales for each receptor. AERMAP searches all NED data points for the terrain height and location that has the greatest influence on each receptor to determine the hill height scale for that receptor. AERMOD then uses the hill height scale in order to select the correct critical dividing streamline and concentration algorithm for each receptor. The elevations of the sources and buildings involved in the modeling demonstration were set using AERMAP.

Note that the modeling inputs described in the above subsections were established in a USEPA approved SO_2 DRR model and are being used for this modeling effort.

4.2.7 Meteorological Data

The meteorological data used for this modeling demonstration were obtained from the Evansville Regional Airport (KEVV), located in Evansville, IN. The data is pre-processed for AERMOD using AERMET (version 22112) and NOAA data for the years 2018 through 2022.

KEVV is located approximately 125 km to the south of the Facility. The Facility is located in rural Illinois, and KEVV is the meteorological station consistent with the USEPA approved SO_2 DRR model. One-minute wind data were processed using the AERMINUTE program and provided as inputs to AERMET. Finally, the regulatory default ADJ_U* option was selected in AERMET in the meteorological data used for this analysis.

As shown in Table 4-2, surface data from the KEVV are much greater than 90% complete (i.e., less than 10% missing) each year. The number of calm and missing hours from KEVV are shown for each year in Table 4-2.

Table 4-2. Evansville Regional Airport Meteorological Data Valid Hours

Year	Number of Calm Hours	Number of Missing Hours	Missing Hours (%)
2018	81	149	1.70%
2019	166	32	0.37%
2020	69	9	0.10%
2021	106	20	0.23%
2022	998	173	1.97%

Based on the high data capture rate and previously being used for the USEPA approved SO_2 DRR model, KEVV data was used in this modeling demonstration. The data station is 122.5 meters above sea level, and that was input as the PROFBASE elevation in AERMOD. The upper air data used in the processing is from the Lincoln National Weather Service office in Lincoln, IL.

4.2.8 Representation of Emission Sources

AERMOD allows for emission units to be represented as point, area, volume, or open pit sources, among other less commonly used source types. A source with a stack is most appropriately modeled as a point source. For point sources with unobstructed vertical releases, it is appropriate to use actual stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity) in the modeling analyses. The modeled sources at the Facility include point sources with upward unrestricted releases, which were modeled with the POINT source type. The point source modeled release parameters for the pyroscrubber stacks are presented in Table 4-3 below. The modeled sources and modeling scenarios are described further in Section 4.2.10.

Table 4-3. Release Parameters for Modeled Point Sources

Model ID	UTM East	UTM North	Elevation (m)	Stack Height (m)	Stack Temp (K)	Exit Velocity (m/s)	Stack Diameter (m)
K1_R111	437,642.7	4,315,969.5	165.7	45.72	530.93	9.29	3.05
K2_R111	437,639.4	4,315,893.1	166.6	45.72	530.93	9.29	3.05
K1_R112	437,642.7	4,315,969.5	165.7	45.72	645.37	11.06	3.05
K2_R112	437,639.4	4,315,893.1	166.6	45.72	645.37	11.06	3.05
K1_R113	437,642.7	4,315,969.5	165.7	45.72	677.59	10.84	3.05
K2_R113	437,639.4	4,315,893.1	166.6	45.72	677.59	10.84	3.05
K1_R114	437,642.7	4,315,969.5	165.7	45.72	725.93	11.49	3.05
K2_R114	437,639.4	4,315,893.1	166.6	45.72	725.93	11.49	3.05
K1_R115	437,642.7	4,315,969.5	165.7	45.72	772.59	12.15	3.05
K2_R115	437,639.4	4,315,893.1	166.6	45.72	772.59	12.15	3.05
K1_PWR	437,642.7	4,315,969.5	165.7	45.72	1374.82	16.46	3.05
K2_PWR	437,639.4	4,315,893.1	166.6	45.72	1403.15	19.54	3.05

4.2.9 Emission Rates for Modeling

The emission sources identified in the previous section require emission rates in order for the model to simulate the dispersion. As explained previously, a baseline scenario will be modeled, and its impact will be subtracted from impacts from a SMB scenario. Therefore, emission rates must be determined for both scenarios. The following subsections explain the emission rates used in the models and their derivations.

4.2.9.1 Baseline Kiln Emission Rates

To establish a baseline, allowable emission rates for PM were entered into the model for PM_{10} and $PM_{2.5}$ (Model IDs K1_PWR and K2_PWR). The allowable emission rate is based on the PWR rule defined in 35 Ill. Adm. Code 212.322. Section 4.1 of this report calculated the allowable PM emission rate for a single kiln. The PWR rule applies to "...any process emission unit..." "...which, either alone or in combination with the emission of particulate matter from all other similar process emission units at a source...". Since Kiln 1 and Kiln 2 are "similar process emission units", and each kiln can process up to 28 tons of green coke per hour, they have a combined allowable emission rate calculated according to the rule as:

Equation 4. Process Weight Rate Calculation

$$E = C + A(P)^B = -40.0 + 55.0(28 * 2)^{0.11} = \mathbf{45.6\ lb/hr}$$

This emission limit applies to periods when both kilns are in operation simultaneously. As a conservative measure, the combined allowable emission rate is used for modeling a baseline scenario. Assuming an equal division of the allowable emission rate between the two kilns, each kiln is allowed to emit up to 22.8 lb/hr PM (45.6 ÷ 2). The allowable emission rate for one kiln operating alone is 38.2 lb/hr (see Section 4.1). Keeping stack parameters and meteorological conditions the same, which is true for each individual operating scenario considered in this analysis, increasing emission rates returns a proportional increase in modeled impacts. Since the modeled impact from the baseline scenario will be subtracted from the modeled impact from the kiln SMB scenario, minimizing the baseline emission rate minimizes the modeled impacts which will ultimately be subtracted from the start-up scenario impacts, thus resulting in higher impacts which will be compared to the respective SIL.

4.2.9.2 Start-Up Kiln Emission Rates

Section 4.1 of this report summarizes the results of the engineering study conducted on July 20, 2023 during a start-up of Kiln 1. The emission rates determined from sampling during five different periods of the start-up vary from a minimum of 32.2 lb/hr to a maximum of 51.7 lb/hr and an average of 41.2 lb/hr. Since air dispersion impacts are affected not only by emission rates, but also by stack parameters, and since the stack parameters during a start-up are not steady, the highest emission rate does not necessarily generate the highest modeled impacts. Trinity modeled the impacts from each of the five individual test run results as if the emission rate and stack parameters of the individual run were representative of the entire start-up period. Runs 1 and 5 from the engineering study resulted in the highest impacts. Run 1 did not have the highest emission rate, but it had the least favorable stack parameters for greater air dispersion (i.e., relatively low stack gas temperature and velocity). Run 5 had better dispersion characteristics but had the highest emission rate.

A single run from the engineering study cannot be considered to be representative of the variable emission rate and stack gas parameters that are inherent characteristics of a start-up. Therefore, Trinity utilized emission rates and stack gas parameters from each of the five engineering study runs in the start-up modeling scenario. The modeling scenarios are described in greater detail in the following section.

4.2.10 Modeling Scenarios

In order to thoroughly assess the potential impacts to the ambient air from Rain Carbon operating its kilns in accordance with the proposed rulemaking, multiple operating scenarios were modeled. The following subsections describe each scenario in detail.

4.2.10.1 Baseline Scenario

As established previously in this report, the baseline model varies depending on the scenario being modeled. In the case of single-kiln operation in an SMB event, the single-kiln PWR emission rate is entered into the model as a negative value in the model for the kiln being analyzed. In the case of a dual-kiln SMB event, such as a malfunction of both kilns simultaneously, the combined-kiln PWR emission rate is divided by two and applied as a negative emission rate to each kiln individually.

The reason the kilns are modeled with negative baseline emission rate sources in AERMOD, as opposed to simply subtracting the PWR emission rates from SMB emission rates and entering the resulting emission rates into the model, is that the stack parameters differ between standard operating scenarios and SMB events; thus, effecting dispersion. Modeling the standard operating scenarios as stacks with negative emission rates accounts for this difference in stack parameters and represents a more representative approach in considering the impacts of the proposed rulemaking. The stack gas parameters (temperature, velocity, etc.) applied to the baseline stack configuration match the parameters used for the SO_2 DRR modeling demonstration, which was reviewed and approved by USEPA as recently as 2019. Refer to Table 4-3 for details (modeling IDs ending in “PWR”).

4.2.10.2 Start-Up Scenarios

The test results from the July 20, 2023 engineering study were used to model variable emission rates for SMB events over the course of 24-hour periods. Given that the $PM_{2.5}$ and PM_{10} 24-hr SIL are determined using maximum impacts over any 24-hour period, the test results were applied to all 24-hours of the model to determine the potential daily impact of SMB events. Emission rates and stack data from each of the five runs from the engineering study were used to represent emissions during the 24-hour period for the start-up scenario.

The duration of each run relative to the total amount of time elapsed over the kiln start-up was determined. The proportional amount of time of each run was then scaled to a 24-hour period. Thus, the start-up was modeled to occur over the course of 24 hours. Because AERMOD can only accommodate variable emission rates for whole hours, the number of hours where each run was considered representative was rounded to a whole number. For example:

Equation 5. Example Scaled Run Time Calculation

$$12{:}11\ PM - 9{:}44\ AM = 2.45\ hours$$

$$\frac{2.45\ hours}{Total\ Sampling\ Time} \times 24\frac{hours}{day} = Scaled\ Run\ Duration$$

$$\frac{2.45\ hours}{11.02} \times 24\frac{hours}{day} = 5.34\ hours$$

Table 4-4 presents all five scaled run times. Note that before rounding, all five values would have been rounded down, if rounding convention was followed. In order to scale up the total run hours to 24 hours, the two values closest to rounding up were rounded up (Runs 113 and 115).

Table 4-4. Scaled Run Time Calculations

	Run 111	Run 112	Run 113	Run 114	Run 115
Start	9:44 AM	12:11 PM	1:44 PM	4:15 PM	5:47 PM
Stop	12:11 PM	1:44 PM	4:15 PM	5:47 PM	8:45 PM
Duration (hrs)	2.45	1.55	2.52	1.53	2.97
Scaled	5.34	3.38	5.48	3.34	6.46
Rounded	5	3	6	3	7

The start-ups were modeled as starting at midnight each time. Run 111 data was used to represent the stack starting at midnight and lasting 5 hours, Run 112 conditions start at 5:00 AM and last for 3 hours, and so on and so forth through the 24 hours per the table above. This method ensured that the runs with the highest impacts, Runs 111 and 115, always occurred during the nighttime hours. In general, ground-level turbulence is lowest during nighttime hours and represents the lowest air dispersion characteristics. Because there is less ground-level dispersion at night-time hours, concentrations also tend to be higher during these hours when comparing identical release parameters. Since start-up events would rarely start and stop in alignment with this approach, using Run 111 and 115 emissions during these hours would tend to overestimate concentrations for these modeling analyses. Table 4-5 outlines the variable emissions rates and when they were applied in the model to each kiln.

Table 4-5. AERMOD Variable PM_{10} / $PM_{2.5}$ Emissions Rates for Start-up Events

AERMOD Hour	R111 (lb/hr)	R112 (lb/hr)	R113 (lb/hr)	R114 (lb/hr)	R115 (lb/hr)
1	44.7	0	0	0	0
2	44.7	0	0	0	0
3	44.7	0	0	0	0
4	44.7	0	0	0	0
5	44.7	0	0	0	0
6	0	32.2	0	0	0
7	0	32.2	0	0	0
8	0	32.2	0	0	0
9	0	0	33.1	0	0
10	0	0	33.1	0	0
11	0	0	33.1	0	0
12	0	0	33.1	0	0
13	0	0	33.1	0	0
14	0	0	33.1	0	0
15	0	0	0	44.1	0
16	0	0	0	44.1	0
17	0	0	0	44.1	0
18	0	0	0	0	51.7
19	0	0	0	0	51.7
20	0	0	0	0	51.7
21	0	0	0	0	51.7
22	0	0	0	0	51.7
23	0	0	0	0	51.7
24	0	0	0	0	51.7

Start-up events were modeled as 24-hour events. In reality, start-up events tend to be less than 24 hours in duration. It is possible that 24 hours may be necessary for start-up when the ambient temperature is extremely low, or if a delay occurs during start-up. Assuming 24-hour start-up events places the worst-case engineering study runs (Run 111 and 115) on the worst hours for air dispersion, as described above.

The results from the engineering study were applied to both kilns. Three “scenarios” were modeled for start-up:

1. only Kiln 1 operating in start-up;
2. only Kiln 2 operating in start-up; and
3. Kiln 1 and 2 operating in start-up at the same time.

When each of the Kilns are operating individually, the maximum PWR for a single Kiln is entered into the model as a negative emission rate. When the kilns are operating in combination, the allowable PM emission rate for both kilns combined is divided equally between the two kilns and entered into the model as a negative emission rate.

Table 4-6. AERMOD 24-hr PM_{10}/$PM_{2.5}$ Emissions Rates for Standard Operations

Scenario	Model ID	PM_{10}/$PM_{2.5}$ Emissions (lb/hr)
Kiln 1 Only	K1_PWR_S	-38.228
Kiln 2 Only	K2_PWR_S	-38.228

Based on the scenarios, the model source groups were set up as described in Table 4-7.

Table 4-7. Start-up Scenario Source Groups

Scenario	Source Group Name	Model IDs
Kiln 1 Only	K1_SING	K1_R111 K1_R112 K1_R113 K1_R114 K1_R115 K1_PWR_S
Kiln 2 Only	K2_SING	K2_R111 K2_R112 K2_R113 K2_R114 K2_R115 K2_PWR_S

These scenarios were run in AERMOD assuming operation during every day of the meteorological dataset to determine the preliminary SIL and generate daily results for the Monte Carlo analysis (see Subsection 4.3.1.1 for more information). The term “preliminary SIL” refers to the fact that the base AERMOD run is configured to assume these sources operate in start-up mode every day, which is inconsistent with Rain Carbon’s request for 720 hours of relief per kiln, per year. The model will always determine the meteorological conditions that produce the highest concentrations, and average those across the 5 years of data for $PM_{2.5}$, or select the maximum for PM_{10}. In actuality, a start-up event can occur on any day of the year across the 5-year dataset and can be considered to be a random event. Table 4-8 displays the maximum results for the preliminary SIL and the pollutants and averaging periods requiring further refinement using the Monte Carlo analysis.

Table 4-8. Preliminary SIL Results for Start-up Events

Pollutant & Averaging Period	$PM_{2.5}$ 24-hr	$PM_{2.5}$ Annual	PM_{10} 24-hr
Kiln 1 Only Max Concentration	1.02	0.090	1.56
Kiln 2 Only Max Concentration	1.28	0.128	2.20
SIL	1.2	0.3	5.0
Kiln 1 Only Requires Monte Carlo?	No	No	No
Kiln 2 Only Requires Monte Carlo?	Yes[13]	No	No

A scenario which accounts for both kilns operating in a 24-hour long start-up simultaneously every day for five consecutive years was also evaluated. The results indicate that a significant impact could occur in this scenario. For several years, and perhaps longer, there has not been an instance of both kilns operating in start-up mode simultaneously. Additionally, it is rare for even a single start-up to last for 24 hours. Considering the fact that no simultaneous start-ups have occurred for at least several years, and the already low probability that even a single start-up will last 24-hours, Trinity has excluded this operating scenario from this analysis.

The Monte Carlo analysis for the Kiln 2 Only start-up scenario is described in Subsection 4.3.1.1.

4.2.10.3 Malfunction Scenarios

While it is rare to have a start-up that lasts 24 hours, they do still tend to last longer than malfunctions. Malfunction events typically last 4-5 hours in duration per event but can last longer based on the type of malfunction. As a result, a more conservative 12-hour event was selected as representative of the range of malfunction conditions that can occur at the Facility.

Because malfunction events can be considered truly random, no specific 12-hour window is selected in the dispersion models. Instead, the emission rates utilized in Section 4.2.10.2 were updated to account for only 12 hours of emissions. Therefore, while the model is enabled for 24 hours of runtime consistent with Table 4-5, the emissions are halved to represent a mass emission rate representative of 12 hours of malfunction operation. This configuration assures that no specific 12-hour window is specifically favored in AERMOD while still adequately representing the potential emission rate during a malfunction event.

Table 4-9 shows the variable emissions rates utilized in AERMOD for the malfunction events.

[13] Although both Kiln 1 and Kiln 2 were modeled with the same stack parameters and emission rates, the results vary slightly due to the difference in location of each stack. This results in a difference in how each receptor is impacted.

Table 4-9. AERMOD Variable PM_{10}/$PM_{2.5}$ Emissions Rates for Malfunction Events

AERMOD Hour	R111 (lb/hr)	R112 (lb/hr)	R113 (lb/hr)	R114 (lb/hr)	R115 (lb/hr)
1	22.35	0	0	0	0
2	22.35	0	0	0	0
3	22.35	0	0	0	0
4	22.35	0	0	0	0
5	22.35	0	0	0	0
6	0	16.1	0	0	0
7	0	16.1	0	0	0
8	0	16.1	0	0	0
9	0	0	16.55	0	0
10	0	0	16.55	0	0
11	0	0	16.55	0	0
12	0	0	16.55	0	0
13	0	0	16.55	0	0
14	0	0	16.55	0	0
15	0	0	0	22.05	0
16	0	0	0	22.05	0
17	0	0	0	22.05	0
18	0	0	0	0	25.85
19	0	0	0	0	25.85
20	0	0	0	0	25.85
21	0	0	0	0	25.85
22	0	0	0	0	25.85
23	0	0	0	0	25.85
24	0	0	0	0	25.85

Assuming 12-hour malfunction events occurring over a 24-hour period places the worst-case engineering study runs (Run 111 and 115) on the worst hours for air dispersion, as described previously in Subsection 4.2.10.2.

The results from the engineering study were applied to both kilns. Three "scenarios" were modeled for malfunctions:

1. only Kiln 1 operating in malfunction;
2. only Kiln 2 operating in malfunction; and
3. Kiln 1 and 2 operating in malfunction at the same time.

When each of the kilns are operating individually, the maximum PWR for a single kiln is entered into the model as a negative emission rate and divided by two to account for the 12-hour emissions basis. When the kilns are operating in combination, the allowable PM emission rate for both kilns combined is divided equally between the two kilns, divided by two to account for the 12-hour emissions basis, and entered into the model as a negative emission rate.

Table 4-10. AERMOD 12-hr PM_{10} / $PM_{2.5}$ Emissions Rates for Standard Operations

Scenario	Model ID	PM_{10}/$PM_{2.5}$ Emissions (lb/hr)
Kiln 1 Only	K1_PWR_S	-19.114
Kiln 2 Only	K2_PWR_S	-19.114
Kiln 1 & Kiln 2 in Start-up	K1_PWR_C	-11.4095
Kiln 2 & Kiln 1 in Start-up	K2_PWR_C	-11.4095

Based on the scenarios, the model source groups were set up as described in Table 4-11.

Table 4-11. Malfunction Scenario Source Groups

Scenario	Source Group Name	Model IDs
Kiln 1 Only	K1_SING	K1_R111 K1_R112 K1_R113 K1_R114 K1_R115 K1_PWR_S
Kiln 2 Only	K2_SING	K2_R111 K2_R112 K2_R113 K2_R114 K2_R115 K2_PWR_S
Kiln 1 & 2	K1K2_C	K1_R111 K1_R112 K1_R113 K1_R114 K1_R115 K2_R111 K2_R112 K2_R113 K2_R114 K2_R115 K1_PWR_C K2_PWR_C

These scenarios were run in AERMOD assuming operation during every day of the meteorological dataset to determine the preliminary SIL and generate daily results for the Monte Carlo analysis (see Subsection 4.3.1.2 for more information). The term “preliminary SIL” refers to the fact that the base AERMOD run is configured to assume these sources operate in malfunction mode every day, which is inconsistent with Rain Carbon’s request for 720 hours of relief per kiln, per year. The model will always determine the meteorological conditions that produce the highest concentrations, and average those across the 5 years of data for $PM_{2.5}$, or select the maximum for PM_{10}. In actuality, a malfunction event can occur on any day of the year across the 5-year dataset and can be considered random. Table 4-12 displays the maximum results for the preliminary SIL and the pollutants and averaging periods requiring further analysis using the Monte Carlo approach.

Table 4-12. Preliminary SIL Results for Malfunction Events

Pollutant & Averaging Period	$PM_{2.5}$ 24-hr	$PM_{2.5}$ Annual	PM_{10} 24-hr
Kiln 1 Only Max Concentration	0.51	0.04	0.78
Kiln 2 Only Max Concentration	0.64	0.06	1.10
Kiln 1 & Kiln 2 Max Concentration	1.31	0.15	2.17
SIL	1.2	0.3	5.0
Kiln 1 Only Requires Monte Carlo?	No	No	No
Kiln 2 Only Requires Monte Carlo?	No	No	No
Kiln 1 & Kiln 2 Requires Monte Carlo?	Yes	No	No

The Monte Carlo analysis for the Kiln 1 and Kiln 2 malfunction scenario is described in Subsection 4.3.1.2.

4.3 Monte Carlo Statistical Analysis

The Monte Carlo approach, as defined by IBM, "is a mathematical technique that is used to estimate the possible outcomes of an uncertain event." The Monte Carlo method uses repeated random sampling to provide context on the likelihood of events occurring over many attempts. A Monte Carlo approach does not affect AERMOD modeling directly, does not interfere with USEPA Appendix W, and is appropriate for this analysis because the timing of SMB events are random, rare events that do not occur with any sort of pattern or expected frequency. The randomness of these events paired with the randomness of the dispersion characteristics of meteorological measurements on certain days make the modeling of SMB events a prime candidate for a random sampling approach to determine a probability distribution of impacts exceeding significance levels.

USEPA has utilized Monte Carlo simulations in various rulemakings including the following:

- 88 Fed. Reg. 25080 (Apr. 25, 2023): This action involved USEPA proposing amendments to NESHAP for Hard and Decorative Chromium Electroplating, Chromium Anodizing Tanks, Steel Pickling-HCl Process Facilities, and Hydrochloric Acid Regeneration Plants under section 112(d)(6) and (f)(2) of the Clean Air Act. In the proposed rule, USEPA noted that the AERMOD system "is one of the EPA's preferred models for assessing air pollutant concentrations from industrial facilities." USEPA also made similar statements about AERMOD being the preferred modeling system in the three proposed rules below. EPA described using a Monte Carlo analysis in estimating emissions from facility equipment leaks and in considering limits on pressure release device (PRD) releases. EPA determined that using a Monte Carlo approach was appropriate because it had been employed in other rules.

- 77 Fed. Reg. 6627 (Feb. 8, 2012): This proposed rule involved amendments to NESHAP for Hard and Decorative Chromium Electroplating, Chromium Anodizing Tanks, Steel Pickling-HCl Process Facilities, and Hydrochloric Acid Regeneration Plants under section 112(d)(6) and (f)(2) of the Clean Air Act. USEPA discussed using a Monte Carlo simulation model using "available data on emissions concentrations, exhaust flow rates, and annual operating hours… to simulate allowable emissions for each plant." In particular, USEPA used a Monte Carlo approach to simulate emissions for plants where actual emissions data was not available.

- 84 Fed. Reg. 54278 (Oct. 9, 2019): This proposed rule involved amendments to the NESHAP Generic Maximum Achievable Control Technology Standards for ethylene production. USEPA conducted a Monte Carlo analysis to help assess the impacts of different flare control options in the refinery sector. USEPA determined that a Monte Carlo analysis was appropriate "based on comments the EPA received on the proposed Petroleum Refinery Sector Rule."

- 84 Fed. Reg. 46138 (Sept. 3, 2019): This proposed rule involved amendments to NESHAP for the Site Remediation source category. USEPA conducted a Monte Carlo analysis of random rare events to help determine what limits should be placed on releases from PRDs.

- Framework for Identifying and Evaluating Lead-Based Paint Hazards from Renovation, Repair, and Painting Activities in Public and Commercial Buildings, EPA Office of Pollution Prevention and Toxics (May 2014), https://nepis.epa.gov/Exe/ZyPDF.cgi/P100YEQ5.PDF?Dockey=P100YEQ5.PDF. In this document related to hazards from lead paint, USEPA discusses using a Monte Carlo model consisting "of several modules that perform lookups, sampling, and calculations based on input files specifying the distributions of parameter values, such as the AERMOD air concentration files, indoor dust lead and outdoor soil lead concentration files, and the Leggett response surface tables" to help estimate lead hazards and exposure.

- U.S. Env't Prot. Agency, Office of Air Quality Planning and Standards: Health and Environmental Impacts Division, EPA-452/P-09-003, *Risk and Exposure Assessment to Support the Review of the SO2 Primary National Ambient Air Quality Standards: Second Draft* (2009). This document describes USEPA staff using AERMOD to model SO_2 levels and estimating distributions of indoor SO_2 deposition rates using a Monte Carlo sampling approach.

Practically, a Monte Carlo approach randomly samples a specific number of events from a given dataset and produces a probability distribution. SMB events can be considered random events in the context of the day and time they are occurring. Therefore, as a modeling approach, results can be generated for each day of each year of the five-year meteorological dataset, and a Monte Carlo simulation can be conducted for each year modeled to determine the probability of an impact occurring at each receptor for each year of meteorological data. The Monte Carlo simulation process for the $PM_{2.5}$ SIL is executed as follows:

- 365 days of a meteorological year are modeled for every receptor in AERMOD.
- AERMOD generates a file with 365 days of modeled concentrations at every receptor for each kiln.
- For each year, the Monte Carlo script picks a certain number of events per year, and records the maximum modeled concentration selected for that year. The Monte Carlo analysis does this at each receptor.
- The Monte Carlo script makes this random selection 1,000 times.
- Based on those 1,000 random selections, the script generates a probability distribution of 5th percentile, 25th percentile, population mean, 75th percentile, 95th percentile, and 100th percentile concentrations at each receptor, for each year.
- Given that the $PM_{2.5}$ SIL is based on a 5-year average, the probability distributions for the individually simulated years are averaged across all 5 years at each distribution breakpoint.

Based on this average 5-year distribution, the standard deviation of modeled impacts can be determined for each receptor using the following equation, which is based on the equation for a z-score for a population with a normal distribution:

Equation 6. Standard Deviation Calculation from Monte Carlo Simulation

$$\sigma = \frac{\bar{x} - \mu}{\frac{z}{\sqrt{n}}}$$

Where:

z = standard score[14]

$\bar{x}$ = sample selection, in this case the 95th percentile derived from the Monte Carlo analysis

μ = population mean

σ = population standard deviation

n = sample size

This standard deviation can be utilized to determine the z-score, and probability, of impacts exceeding the SIL at each receptor.

4.3.1 Scenarios

4.3.1.1 Kiln 2 Only Start-up Scenario

To compute the likelihood of the Kiln 2 only start-up scenario exceeding the $PM_{2.5}$ 24-hr SIL, a probability distribution for each model year was generated at each receptor with a random selection of 30 days per year. These selections equate to 720 hours per year. The distributions for each year were then averaged to determine the average 5-year probability distribution at each receptor. A table summarizing the probability distribution at the receptor with the highest probability of exceeding the SIL is included in Table 4-13. The 100th percentile value is included to confirm the Monte Carlo analysis is properly selecting data, as the 100th percentile value should match the maximum impact determined by AERMOD as referenced in Table 4-8, i.e., the meteorological impacts representing maximum impacts are selected for every year in the 5-year met-data set.

Table 4-13. Kiln 2 Only Start-Up 5-year Probability Distribution

Year	5th %ile	25th %ile	Mean	60th %ile	75th %ile	95th %ile	100th %ile
2018	0.418	0.546	0.632	0.703	0.816	1.58	1.58
2019	0.524	0.674	0.76	0.809	0.856	1.18	1.18
2020	0.373	0.593	0.829	0.867	1.12	1.29	1.29
2021	0.434	0.658	0.802	0.832	0.855	1.12	1.12
2022	0.423	0.612	0.745	0.771	0.835	1.25	1.25
Average	0.43	0.62	0.75	0.80	0.90	1.28	1.28

[14] A z-score, or standard score, is a dimensionless quantity used to indicate the fractional number of standard deviations by which an event is above or below the mean value being measured. The z-score representing the 95th percentile of a distribution is 1.645.

Using Equation 6 with the 95th percentile value of 1.28, a sample size of 1,000, and a z-score of 1.645 (representing the 95th percentile), the calculated population standard deviation is 10.196. This standard deviation can then be used to calculate the z-score using Equation 7, where the sample selection is 1.2 µg/m^3 ($PM_{2.5}$ 24-hr SIL), the population mean is 0.75 ug/m3, the standard deviation is 10.196, and the sample size is 1,000.

Equation 7. Calculation of Z-Score from a Monte Carlo Probability Distribution

$$z = \left(\frac{\bar{x} - \mu}{\sigma}\right) * \sqrt{n}$$

Where:

z = standard score
$\bar{x}$ = 1.2 µg/m^3
μ = population mean, in this case 0.75
σ = population standard deviation
n = sample size

The calculated z-score is 1.38448, which using a standard normal table equates to a probability of ~91.69%, implying there is a ~8.31% chance of the SIL being exceeded if Kiln 2 has 30 random start-ups per year, over a 5-year period, each lasting 24 hours. An 8.31% chance occurring over a 5-year period implies that, if Kiln 2 were to start-up 30 times a year, every year, for 24 hours each, an exceedance of the SIL would randomly occur once every 60 years.

Equation 8. Converting Percent Chance to Years-Based Odds

$$8.31\% = \frac{8.31}{100} = \sim\frac{1}{12}\begin{bmatrix} occurs\ approximatley\ once\ every\ 12\ model\ runs, \\ but\ each\ model\ run\ includes\ 5\ years \end{bmatrix}$$

$$12\ model\ runs\ \times 5\ years = 60\ years$$

Given that start-ups rarely occur over a 24-hour period, and Rain Carbon has never started up a kiln 30 times in a year, the actual probability of a SIL exceedance is substantially smaller and unlikely to occur.

4.3.1.2 Kiln 1 & Kiln 2 Malfunction Scenario

To compute the likelihood of the Kiln 1 and Kiln 2 malfunction scenario exceeding the $PM_{2.5}$ 24-hour SIL, a probability distribution for each model year was generated at each receptor with a random selection of 60 days per year for each kiln. These selections equate to 720 hours per year per kiln. The Monte Carlo analysis was set up to make the 60 selections per kiln independently such that most of the selections do not occur on the same day for both kilns. This setup is appropriate because malfunctions are unplanned events and the probability of malfunctions randomly occurring in tandem needed to be considered.

The distributions for each year were then averaged to determine the average 5-year probability distribution at each receptor. A table summarizing the probability distribution at the receptor with the highest probability of exceeding the SIL is included in Table 4-14. The 100th percentile value is included to confirm the Monte Carlo analysis is properly selecting data, as the 100th percentile value should match the maximum impact determined by AERMOD as referenced in Table 4-12, i.e., the meteorological impacts representing maximum impacts are selected for every year in the 5-year met-data set.

Table 4-14. Kiln 1 & Kiln 2 Malfunction 5-year Probability Distribution

Year	5th %ile	25th %ile	Mean	60th %ile	75th %ile	95th %ile	100th %ile
2018	0.435	0.573	0.689	0.768	0.856	1.164	1.387
2019	0.511	0.607	0.745	0.762	0.927	1.047	1.106
2020	0.511	0.647	0.781	0.798	0.857	1.366	1.47
2021	0.489	0.599	0.718	0.767	0.899	1.094	1.095
2022	0.505	0.587	0.693	0.797	0.87	1.251	1.496
Average	0.49	0.60	0.73	0.78	0.88	1.18	1.31

Using Equation 6 with the 95^{th} percentile value of 1.18, a sample size of 1,000, and a z-score of 1.645 (representing the 95^{th} percentile), the calculated population standard deviation is 8.827. This standard deviation can then be used to calculate the z-score for a sample selection of 1.2 $\mu g/m^3$ using Equation 7, where the sample selection is 1.2 $\mu g/m^3$, the population mean is 0.73 ug/m3, the standard deviation is 8.827, and the sample size is 1,000.

The calculated z-score is 1.701, which using a standard normal table equates to a probability of ~95.55%, implying there is a ~4.45% chance of the SIL being exceeded if Kilns 1 and 2 have 60 random cold starts per year, over a 5-year period, each lasting 12 hours. A 4.45% chance occurring over a 5-year period implies that if Kilns 1 and 2 were to malfunction 60 times a year, every year, for 12 hours each, an exceedance of the SIL would randomly occur once every 112 years.

Equation 9. Converting Percent Chance to Years-Based Odds

$$4.45\% = \frac{4.45}{100} = \sim\frac{1}{22.5}\begin{bmatrix} occurs\ approximatley\ once\ every\ 22.5\ model\ runs, \\ but\ each\ model\ run\ includes\ 5\ years \end{bmatrix}$$

$$22.5\ model\ runs\ \times 5\ years = \sim 112\ years$$

Given that malfunctions average fewer than 12 hours per event and 720 hours of malfunctions are unlikely to occur 5 years in a row, the actual probability of a SIL exceedance is substantially smaller and unlikely to occur.

APPENDIX A. AIRSOURCE STACK TESTING REPORT

SOURCE EMISSIONS TEST REPORT

Prepared for

Rain CII Carbon, LLC

Regarding testing of

Kiln 1

Located at the

Robinson Facility
12187 E 950th Ave
Robinson, Illinois 62454

Performed on

July 20th, 2023

by

AIRSOURCE TECHNOLOGIES, INC.
20505 W. 67th St.
Shawnee, Kansas 66218
(913) 422-9001

Project No. 4173

PREFACE

This report was prepared by AirSource Technologies, Inc., and contains the results of engineering testing that was conducted on a kiln at the Rain CII Carbon, LLC facility in Robinson, Illinois on July 20th, 2023. To the best of our knowledge the data contained in this report are accurate and complete. Any questions concerning this report should be directed to Mr. Taylor Pittman, Project Manager, or Mr. Pete Liebl, Principal.

AirSource Technologies, Inc.

Taylor Pittman

Project Manager

Approved by:

Pete Liebl

Principal

August 17, 2023

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SECTION 1 - INTRODUCTION

1.1 FACILITY OVERVIEW

The Rain CII Carbon, LLC (Rain) facility in Robinson produces calcined petroleum coke for the production of aluminum and titanium dioxide.

The facility is owned and operated by Rain Carbon, Inc., headquarters at 10 Signal Road, Stamford, Connecticut 06902, and is located at 12187 E 950th Avenue, Robinson, Illinois 62454.

1.2 SOURCES TESTED AND PURPOSE OF TESTING

The facility's Kiln 1 was the source tested. Engineering testing was conducted to evaluate emission rates that occur during a kiln start-up.

1.3 SUMMARY OF TESTING PERFORMED AND TEST PROJECT PERSONNEL

Testing of the Kiln 1 stack outlet included outlet stack measurements to determine filterable and condensable particulate matter, volatile organic compounds (VOC, as Total Gaseous Organic Compounds - TGOC), as well as visible emissions.

Concentrations of VOC were determined by instrumental analyzer. Volumetric flow rates determined in the course of performing particulate testing were applied to gaseous pollutant concentrations to obtain gaseous mass emission rates where applicable.

Five nominally 48-minute test runs for particulate matter and visible emissions were conducted, and nine 45-minute test runs for VOC emissions were conducted.

Isokinetic and gas sampling was conducted by AirSource Technologies, Inc. (AirSource), 20505 W. 67th St., Shawnee, Kansas, 66218. AirSource personnel who performed sampling were:

Mr. Taylor Pittman: Instrument Operator
Mr. Kevin McKenna: Isokinetic Sampling
Mr. Brian Greenall: Sample Train Operator
Mr. David Hotz: Sample Train Operator Ms.
Lex Hooper: Certified Observer

AirSource personnel who recovered and analyzed particulate samples were Mr. Alex Vansickle and Ms. Lex Hooper, Laboratory Technicians.

Mr. Dan Fearday, Plant Manager, with Rain coordinated the test project scheduling and provided services and coordination on site necessary to conduct testing.

No regulatory agency representative was present during testing.

SECTION 2 - SUMMARY OF RESULTS

Test measurement results are presented in Tables 2-1 and 2-2 below. Complete results can be found in Appendix B, Calculated Results.

2.1 KILN 1 EMISSION RESULTS

The Kiln 1 emissions measurement results are presented in Tables 2-1 and 2-2 below. The VOC concentrations in Table 2-2 are expressed as an equivalent amount of propane.

Table 2-1
Kiln 1 Particulate Emission Results

Parameter	Units	Run 111	Run 112	Run 113	Run 114	Run 115	Average
Date	—	07/20/23	07/20/23	07/20/23	07/20/23	07/20/23	—
Run Time Period	—	09:44-10:49	12:11-13:10	13:44-14:37	16:15-17:17	17:47-18:50	—
Sampling Time	min	48.00	48.00	44.00	48.00	48.00	—
Gas Stream							
Avg. Velocity Head (Δp)	in H_2O	0.156	0.172	0.157	0.167	0.175	0.165
Avg. Temperature	°F	496	702	760	847	931	747
Absolute Pressure	in Hg	29.28	29.27	29.25	29.19	29.20	29.23
Moisture Concentration	%V	5.87	21.22	21.82	18.76	19.62	17.46
O_2 Concentration, Dry	%V	17.72	15.90	16.07	15.33	14.97	16.00
CO_2 Concentration, Dry	%V	1.86	3.04	3.16	3.65	3.85	3.11
Avg. Velocity	ft/min	1,829	2,177	2,133	2,261	2,392	2,158
Flow Rate, Actual	acfm	148,456	176,756	173,133	183,552	194,172	175,214
Flow Rate, Wet	scfm	80,207	78,537	73,204	72,282	71,881	75,222
Flow Rate, Dry	dscfm	75,497	61,875	57,232	58,725	57,778	62,221
PM Concentration							
Filterable PM	gr/dscf	6.91E-02	6.08E-02	6.75E-02	8.77E-02	1.04E-01	7.79E-02
Condensable PM	gr/dscf	1.19E-02	3.04E-02	2.94E-02	4.46E-02	6.83E-02	3.69E-02
Total PM	gr/dscf	8.10E-02	9.11E-02	9.69E-02	1.32E-01	1.73E-01	1.15E-01
PM Emission Rate							
Filterable PM	lb/hr	4.47E+01	3.22E+01	3.31E+01	4.41E+01	5.17E+01	4.12E+01
Condensable PM	lb/hr	7.67E+00	1.61E+01	1.44E+01	2.24E+01	3.38E+01	1.89E+01
Total PM	lb/hr	5.24E+01	4.83E+01	4.75E+01	6.66E+01	8.56E+01	6.01E+01
Sample Volume	dscf	42.169	29.644	26.796	31.003	31.891	—
Avg. Isokinetic Variation	%	93.3	111.5	102.7	108.8	109.2	—

Table 2-2
Kiln 1 Gaseous Pollutant Emission Results – TGOC (as propane)

Parameter	Units	1-1-1	1-1-2	1-1-3	Average
Date	—	07/20/23	07/20/23	07/20/23	—
Instrument Log Time(s)	—	09:45-10:30	10:45-11:30	11:45-12:30	—
Gas Stream					
O_2 Concentration, Dry	%V	17.72	16.66	16.34	16.90
CO_2 Concentration, Dry	%V	1.86	2.62	2.98	2.49
Total Hydrocarbons					
Concentration - Wet	ppmv	4.37	0.89	0.83	2.03
Parameter	**Units**	**1-1-4**	**1-1-5**	**1-1-6**	**Average**
Date	—	07/20/23	07/20/23	07/20/23	—
Instrument Log Time(s)	—	12:47-13:32	13:45-14:30	14:45-15:30	—
Gas Stream					
O_2 Concentration, Dry	%V	15.90	16.07	15.93	15.97
CO_2 Concentration, Dry	%V	3.04	3.16	3.31	3.17
Total Hydrocarbons					
Concentration - Wet	ppmv	0.71	0.69	0.63	0.68
Parameter	**Units**	**1-1-7**	**1-1-8**	**1-1-9**	**Average**
Date	—	07/20/23	07/20/23	07/20/23	—
Instrument Log Time(s)	—	15:45-16:30	16:46-17:31	17:45-18:30	—
Gas Stream					
O_2 Concentration, Dry	%V	15.69	15.33	14.97	15.33
CO_2 Concentration, Dry	%V	3.47	3.65	3.85	3.66
Total Hydrocarbons					
Concentration - Wet	ppmv	0.66	0.58	0.56	0.60

2.2 POTENTIAL FACTORS AFFECTING TESTING

During startup, changing conditions within the kiln stack as the process climbed toward full heat and load over the course of the day made attempts at selecting kiln condition parameters for testing difficult. Isokinetic performance was therefore negatively impacted. Run 112 was determined to be slightly over 110%. All other runs were within the 100±10% isokinetic criteria. This is not expected to have any significant effect on results.

There were no other apparent factors that may have introduced errors in the test results.

SECTION 3 - SAMPLING & ANALYTICAL PROCEDURES

3.1 DESCRIPTION OF SAMPLING LOCATIONS

Outlet emission measurements were conducted in Kiln 1's vertical, circular, steel 122" diameter exhaust stack. Access to the measurement location sampling ports was from a facility landing surrounding the stack and accessible by ladder. Four test ports consisting of steel pipe flanges 90° apart were used for particulate and gaseous concentration sampling.

Test location details such as duct diameter at the test port location, the nearest flow disturbances upstream and downstream of the test ports (with equivalent diameters), and the number of traverse points used for the particulate and associated volumetric flow rate sampling are located in Appendix C, Field Data.

3.2 SAMPLING AND ANALYSIS PROCEDURES

3.2.1 TRAVERSE POINT LAYOUT

The traverse point layout was determined according to procedures in EPA Method 1 in Appendix A-1 of 40 *CFR*, Part 60 to provide a means for obtaining measurements representative of the gas stream. The cross-sectional area of the gas stream at the measurement location was divided into a number of equal areas. The number of equal areas was dependent upon the nearest upstream and downstream flow disturbances. The traverse points were located within each of these equal areas. Actual traverse point location measurement data used to locate the traverse points in the cross-sectional area for sampling when sampling was conducted, and measuring gas stream parameters are in Appendix B, Calculated Results.

3.2.2 VELOCITY AND VOLUMETRIC FLOW RATE

Gas stream velocities and volumetric flow rates were determined according to procedures in EPA Method 2 in Appendix A-1 of 40 *CFR*, Part 60. Type S pitot tube-probe assemblies meeting the dimensional specifications in EPA Method 2 for a baseline pitot tube coefficient and an inclined manometer were used for measuring velocity heads and static pressure. Velocity heads and gas density were used in calculating velocity. Gas density was determined from the molecular weight of the gas, gas stream temperature, and gas stream pressure. Calibrated thermocouples and a temperature meter were used for measuring gas stream temperatures. A digital barometer calibrated against a mercury barometer was used to measure atmospheric pressure at the test location. The atmospheric pressure and the gas stream static pressure were used in calculating gas stream pressure.

3.2.3 GAS MOLECULAR WEIGHT

Oxygen and carbon dioxide concentrations along with an assumed balance of nitrogen were used in the calculation of the dry molecular weight of each gas stream which along with the moisture content of the gas stream was used in all applicable gas stream parameter calculations such as for gas density and velocity.

The procedures in EPA Method 3A in Appendix A-2 of 40 *CFR*, Part 60 were used to continuously extract and analyze gas from the gas stream for oxygen and carbon dioxide as described in Sections 3.3.2, Instrumental Analyzers and Sampling System, and 3.4.2, Analysis for O_2 and CO_2.

3.2.4 MOISTURE CONTENT

Moisture (water vapor) content of the gas stream was determined according to procedures in EPA Method 4 in Appendix A-3 of 40 *CFR*, Part 60 (incorporated as part of the Method 5 sampling procedures). Moisture collected in the back half of each sampling train was determined gravimetrically from the difference between the initial and final weights of all of the impingers. The theoretical moisture content of the gas stream at saturated conditions was determined from the vapor pressure of water at gas stream temperature and the gas stream pressure. The lower of the two results (sampled moisture or saturation moisture) was used in gas stream parameter calculations such as for gas density and conversions of volumetric flow rate and pollutant concentration between wet and dry conditions.

3.2.5 FILTERABLE / CONDENSABLE PARTICULATE MATTER DETERMINATION

The collected particulate samples were recovered and analyzed at AirSource's laboratory. AirSource performed the gravimetric analysis of the EPA Method 5 sampling train nozzle, filterable particulate filter holder front-half acetone rinses, and the dry fraction (filtered particulate matter) samples according to procedures in EPA Method 5. All nozzles and filter holder front halves were brushed and rinsed with reagent grade acetone. Rinse samples were transferred to tared 50-mL beakers and evaporated to dryness at room temperature. Filters along with any loose material were recovered and returned to their original petri dishes.

Gravimetric analysis of the samples and rinses recovered from the EPA Method 202 sampling train for condensable particulate matter were conducted according to procedures in EPA Method 202 in Appendix M of 40 CFR, Part 51 (Dry Impinger Method). All of the components after the filterable particulate filter and up to the condensable particulate filter were rinsed with deionized ultra-filtered water which was added to the sample condensate. Another set of rinses with acetone and hexane was performed and the rinsates stored in a separate sample bottle. Hexane extractions were performed on the recovered aqueous samples to separate the organic and inorganic condensable particulate matter fractions. The hexane and aqueous samples were returned to their respective sample containers after extraction. The condensable particulate filter was extracted three times with water and the extract added to the inorganic sample. This was repeated with hexane and the extract added to the organic sample. The hexane extracts were transferred to tared 50-mL beakers and evaporated to dryness at room temperature. The aqueous samples were transferred to 600-mL beakers and evaporated on a hot plate to about 50-mLs. These aqueous samples were then transferred to tared 50-mL beakers and evaporated on a hotplate to 10-mL. The residual moisture that remained was evaporated at room temperature. This recovery procedure was then immediately repeated on one of the recovered test run sample trains to create a Field Train Recovery Blank (FTRB).

All filterable and condensable rinse sample beakers, and filterable filters in petri dishes were desiccated for 24 hours and weighed to a constant weight (i.e., <0.5 mg change or <1% of total weight less tare weight change, whichever was greater) at intervals of six hours or longer. Each front-half rinse sample volume was determined from the difference between the weights of the empty sample container and the same container with sample divided by the density of acetone for blank correction determination. The total organic and inorganic blank sample weight from the FTRB was subtracted from the total organic and inorganic test run sample up to a maximum allowed subtraction of 2.0 mg. A proof blank train analysis was conducted with the collected sample and field recovery blank trains. The analysis data are located in Appendix D-1, Particulate Gravimetric Analysis.

3.2.6 VOC DETERMINATION

The procedures in EPA Method 25A in Appendix A of 40 *CFR*, Part 60 were used to continuously extract gas stream sample for pollutant analysis and to determine measurement system performance.

Volumetric flow rates measured during the course of testing for particulate emissions were applied to gaseous concentrations determined by instrumental analyzers to report mass emission rates of pollutant emissions where applicable.

3.3 DESCRIPTION OF SAMPLING EQUIPMENT

3.3.1 ISOKINETIC SAMPLING EQUIPMENT

Apex Instruments Inc. or Environmental Supply Company nozzles, probe liners, filter holders, and impingers were used for sample collection. Nutech, Apex, or Environmental Supply sampling probes, filter heater boxes, and impinger boxes, housed all sample glassware. Nutech, Apex, or Environmental Supply sample umbilical adapters and umbilicals and Nutech Model 2010 Stack Samplers with Watlow or Fuji temperature readouts, and Ambient Weather Model WS-108 barometers were used for volume, temperature and pressure measurements.

3.3.2 INSTRUMENTAL ANALYZERS AND SAMPLING SYSTEM

The emission measurement systems consisted of a sample extraction, transport, conditioning, distribution system, analyzers, and a data acquisition system.

The procedures in EPA Methods 3A in Appendix A of 40 CFR, Part 60 were used to continuously extract gas stream sample for analysis and to determine measurement system performance. Sample gas was extracted through a heated 316 stainless steel sampling probe, a Universal Analyzers Model 270S heated, stainless steel out-of-stack filter assembly with a two-micron ceramic filter element for particulate matter removal, and a Technical Heaters 100 foot long heated Teflon® sample transfer line all operated at approximately 250 °F to prevent condensation. Sample gas was extracted with a heated filter assembly which fed sample directly to the instrument sample inlet port. Sample for diluent testing was routed from a tee at the FID inlet port and connected to a thermo-electrically cooled gas sample dryer. Sample flow through the system was approximately 6 liters per minute.

The conditioned dry sample was directed through unheated Teflon® tubing to a flow panel controlling pressure at an instrument manifold delivering sample gas to diluent instrumental analyzers. The flow panel also controlled direct delivery of calibration gas to the instrument manifold and system bias calibration gas delivery to the inlet of the stack probe/filter assembly. Delivery of calibration gas to the filter assembly was adjusted so that excess calibration gas flooded and back fed through the probe.

Calibration gas flow rate to the filter assembly was adjusted so that excess gas flowed in reverse direction through the probe thus preventing dilution of the calibration or zero gas flowing into the filter element, the sample transfer line and to the analyzer.

Calibration gases prepared according to the EPA traceability protocol for assay and certification of gaseous calibration standards were used to calibrate the measurement system.

The data acquisition system included a duTec I/O Plexer for analog-to-digital conversion of instrument voltage or current signals and a personal computer for data logging digitized data. The system software read analyzer signal outputs approximately twice every second and recorded averages every 60 seconds. Data logged during calibrations, quality control checks, and sample gas analysis was transferred into a Microsoft Excel workbook where results for measurement system performance, sample gas concentrations and emission rates were computed. The measurement system performance results are located in Appendix B-2, Instrumental Analyzer Results.

3.4 ANALYTICAL PROCEDURES

3.4.1 ANALYSIS FOR FILTERABLE/CONDENSABLE PARTICULATE MATTER

The collected particulate samples were recovered and analyzed at AirSource's laboratory. AirSource performed the gravimetric analysis of the EPA Method 5 sampling train nozzle, filterable particulate filter holder front-half acetone rinses, and the dry fraction (filtered particulate matter) samples according to procedures in EPA Method 5. All nozzles and filter holder front halves were brushed and rinsed with reagent grade acetone. Rinse samples were transferred to tared 50-mL beakers and evaporated to dryness at room temperature. Filters along with any loose material were recovered and returned to their original petri dishes.

Gravimetric analysis of the samples and rinses recovered from the EPA Method 202 sampling train for condensable particulate matter were conducted according to procedures in EPA Method 202 in Appendix M of 40 *CFR*, Part 51 (Dry Impinger Method). All of the components after the filterable particulate filter and up to the condensable particulate filter were rinsed with deionized ultra-filtered water which was added to the sample condensate. Another set of rinses with acetone and hexane was performed and the rinsates stored in a separate sample bottle. Hexane extractions were performed on the recovered aqueous samples to separate the organic and inorganic condensable particulate matter fractions. The hexane and aqueous samples were returned to their respective sample containers after extraction. The condensable particulate filter was extracted three times with water and the extract added to the inorganic sample. This was repeated with hexane and the extract added to the organic sample. The hexane extracts were transferred to tared 50-mL beakers and evaporated to dryness at room temperature. The aqueous samples were transferred to 600-mL beakers and evaporated on a hot plate to about 50-mLs. These aqueous samples were then transferred to tared 50-mL beakers and evaporated on a hotplate to 10-mL. The residual moisture that remained was evaporated at room temperature. This recovery procedure was then immediately repeated on one of the recovered test run sample trains to create a Field Train Recovery Blank (FTRB).

All filterable and condensable rinse sample beakers, and filterable filters in petri dishes were desiccated for 24 hours and weighed to a constant weight (i.e., <0.5 mg change or <1% of total weight less tare weight change, whichever was greater) at intervals of six hours or longer. Each front-half rinse sample volume was determined from the difference between the weights of the empty sample container and the same container with sample divided by the density of acetone for blank correction determination. The total organic and inorganic blank sample weight from the FTRB was subtracted from the total organic and inorganic test run sample up to a maximum allowed subtraction of 2.0 mg. A proof blank train analysis was conducted with the collected sample and field recovery blank trains. The analysis data are in Appendix D-1, Particulate Gravimetric Analysis.

3.4.2 ANALYSIS FOR O_2 AND CO_2

The procedures in EPA Method 3A in Appendix A-2 of 40 *CFR*, Part 60 were used to continuously extract and analyze gas stream sample for oxygen and carbon dioxide concentrations. The calibration gases were EPA traceability protocol certified concentrations of O_2 and CO_2 in nitrogen.

The analysis results are in Appendix B-2, Instrumental Analyzer Results. Instrument data and copies of the calibration gas certificates are in Appendix C-2, Analyzer Data Lo.

3.4.3 ANALYSIS FOR VOC

The procedures in EPA Method 25A in Appendix A-7 of 40 *CFR*, Part 60 were used to continuously extract and analyze sample gas from the gas stream for VOC expressed as propane. The calibration gases contained EPA traceability protocol certified concentrations of propane in nitrogen.

The analysis results are in Appendix B-2, Instrumental Analyzer Results. Instrument data and copies of the calibration gas certificates are in Appendix C-2, Analyzer Data Lo.

3.5 DEVIATIONS AND MODIFICATIONS TO ANALYTICAL METHODS

There were no deviations or modifications to the published analytical methods.

3.6 DESCRIPTION OF ANALYTICAL EQUIPMENT

3.6.1 ISOKINETIC SAMPLE ANALYTICAL EQUIPMENT

Reagents used were Fisher DIUF water, Fisher Optima grade acetone, and Fisher hexanes. Filterable particulate filters were Whatman 934AH glass microfiber and condensable filters were Tisch PTFE membrane SF16015. Liquid sample was collected in Thermo Scientific I-Chem bottles. Impinger weights were measured with an Ohaus Galaxy Explorer E0D110 and Acculab VIC-1501 balances. Particulate sample weights were measured with a Mettler Toledo XPE 205 analytical balance.

3.6.2 INSTRUMENTAL ANALYZERS

The analyzer used in measuring oxygen and carbon dioxide concentrations according to EPA Method 3A was a California Analytical Model 602P multi-component gas analyzer measuring oxygen using paramagnetic detection and carbon dioxide by nondispersive infrared absorption spectroscopy.

The analyzer used to measure VOC concentration according to procedures in EPA Method 25A was a Thermo Fisher Scientific Model 51i-HT flame ionization detector (FID). The FID was maintained at 392 ºF during testing.

SECTION 4 - QUALITY ASSURANCE/QUALITY CONTROL

The Quality Assurance/Quality Control (QA/QC) procedures and requirements specified in the EPA methods or any other methods used and AirSource standard operating procedures were used. Those procedures include test equipment calibrations and procedural elements of the methods. Examples of those procedural elements are test equipment leak checks, proper traversing and placement of sampling probes in gas streams, and verification of the integrity of measurement systems before and after sampling. The performance and results of all QA/QC procedures were recorded on appropriate forms, data sheets, or in computer workbooks as appropriate.

An assessment of the overall quality of the data generated for this test project was conducted. The data assessment included a review of the sample collection and analytical data, including calibrations. The data generated for this report are traceable and of known and acceptable quality.

4.1 COMPLETENESS

All measurements specified in the test plan were completed. All measurements specified in the test plan were completed and are reported. All samples specified in the test plan were collected and analyzed and the results are reported.

4.2 PARTICULATE MEASUREMENTS AND SAMPLING

The EPA Method 5 sample extraction for the test runs on Kiln 1 was within the 100±10% isokinetic criteria required by the test method, except for Run 112 which was slightly above the 110% criteria. All of the final sampling train leak checks were within method criteria for test runs reported. All of the sampling temperatures were within specified ranges. All of the test equipment requiring calibration met the method criteria for calibrations before and after the testing.

4.3 ANALYSIS FOR PARTICULATE MATTER AND MOISTURE

All of the initial and final analytical balance-check weight values for the filter and beaker weighings were within 0.2 mg of each other. All of the initial and final field balance-check weight values for the impinger weighings were within 0.2 g of each other.

4.4 ANALYSIS FOR O_2, CO_2, AND VOC

The calibration error was less than the ±2% provided by the method. System bias was within the ±5% for the zero and high range calibration gases. Zero drift and calibration drift were less than ±3% of the span over the test run.

APPENDIX A

CALCULATED EQUATIONS

EPA Methods 5 and 202 – Filterable and Condensible Particulate Matter Calculations

Dry Gas Sample Volume

$$V_m = V_f - V_i \qquad V_{m(std)} = \frac{17.64 \times V_m \times Y \times \left(P_{bar} \pm \frac{E_{Mtr}}{1{,}000\ \text{ft}} + \frac{\Delta H}{13.6} \right)}{T_m}$$

E_{Mtr}	Dry gas meter elevation relative to the barometer	ft
P_{bar}	Barometric pressure at the barometer	in Hg
T_m	Average absolute dry gas meter temperature	^oR
V_f	Final dry gas meter volume reading	ft^3
V_i	Initial dry gas meter volume reading	ft^3
V_m	Net dry gas meter volume, actual	ft^3
$V_{m\ (std)}$	Net dry gas meter volume at standard conditions	dscf
Y	Dry gas meter calibration correction factor	dimensionless
ΔH	Average orifice meter pressure-drop	in H_2O
13.6	Specific gravity of mercury relative to water	in H_2O/in Hg
17.64	Standard absolute temperature (527.67 ^oR) divided by standard absolute pressure (760 mm Hg/25.4 mm/in)	^oR/in Hg

Gas Stream Moisture (Water Vapor) Content

$$V_{w(std)} = 0.04715 \times M_{lc} \qquad B_{ws\ (Sample)} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}} \qquad B_{ws(Sat)} = \frac{VP_{H2O}}{P_s}$$

$$P_w = B_{ws} \times 100 \qquad B_d = 1 - B_{ws}$$

B_d	Proportion of the dry gas by volume	dimensionless
B_{ws}	$B_{ws\ (Sample)}$ or $B_{ws\ (Sat)}$, whichever is less	dimensionless
$B_{ws\ (Sample)}$	Proportion of water vapor by volume determined with the sampling train	dimensionless
$B_{ws\ (Sat)}$	Proportion of water vapor by volume for a saturated or supersaturated gas stream	dimensionless
M_{lc}	Total mass of water collected in the sampling train	g
P_s	Absolute gas stream pressure	in Hg
P_w	Percent moisture (water vapor) in the gas stream	%V
$V_{m\ (std)}$	Net dry gas meter volume at standard conditions	dscf
$V_{w\ (std)}$	Equivalent volume of water vapor collected, at standard conditions	ft^3
VP_{H2O}	Vapor pressure of water at gas stream temperature	in Hg
0.04715	Conversion factor for grams of water to cubic feet of water vapor at standard conditions	ft^3/g

Gas Stream Absolute Pressure

$$P_s = P_{bar} \pm \frac{E_{Stk}}{1{,}000\text{ ft}} + \frac{P_g}{13.6}$$

E_{Stk}	Sampling location elevation relative to the barometer	ft
P_{bar}	Barometric pressure at the barometer	in Hg
P_g	Gas stream static pressure	in H_2O
P_s	Absolute gas stream pressure	in Hg
13.6	Specific gravity of mercury relative to water	in H_2O/in Hg

Gas Molecular Weight

For Combustion Sources

$$\%N_2 = 100\% - (\%CO_2 + \%O_2)$$

$$M_d = 0.44 \times \%CO_2 + 0.32 \times \%O_2 + 0.28 \times \%N_2$$

$$M_s = M_d \times B_d + 18 \times B_{ws}$$

B_d	Proportion of the dry gas by volume	dimensionless
B_{ws}	Proportion of water vapor by volume	dimensionless
M_d	Molecular weight of the dry gas	lb/lb-mole
M_s	Molecular weight of the wet gas	lb/lb-mole
$\%CO_2$	Carbon dioxide concentration by volume, dry-basis	%V
$\%O_2$	Oxygen concentration by volume, dry-basis	%V
$\%N_2$	Nitrogen concentration by volume, dry-basis	%V
0.28	Molecular weight of nitrogen divided by 100	lb/lb-mole/100%
0.32	Molecular weight of oxygen divided by 100	lb/lb-mole/100%
0.44	Molecular weight of carbon dioxide divided by 100	lb/lb-mole/100%
18	Molecular weight of water	lb/lb-mole

For Ambient Air Sources

M_d	Molecular weight of dry ambient air	28.965 lb/lb-mole

Gas Stream Velocity

$$\Delta p = \left(\frac{\sum_{i=1}^{n} \sqrt{\Delta p_i}}{n} \right)^2 \qquad v_s = 85.49 \times C_p \times \sqrt{\Delta p} \times \sqrt{\frac{T_s}{P_s \times M_s}} \times \frac{60 \text{ sec}}{1 \text{ min}}$$

C_p	Pitot tube coefficient	dimensionless
M_s	Molecular weight of the wet gas	lb/lb-mole
n	Number of traverse points sampled	
P_s	Absolute gas stream pressure	in Hg
T_s	Average absolute temperature of the gas stream	^{o}R
v_s	Average gas stream velocity	fpm
Δp	Average velocity head of the gas stream	in H_2O
Δp_i	Velocity head at sampling point i	in H_2O
85.49	Pitot tube constant	$\frac{\text{ft}}{\text{sec}}\left[\frac{(\text{lb/lb-mole})(\text{in Hg})}{(^\circ\text{R})(\text{in } H_2O)}\right]^{1/2}$

Gas Stream Volumetric Flow Rate

$$A_s = \frac{D_1 \times D_2 \times \pi}{4} \times \frac{1 \text{ ft}^2}{144 \text{ in}^2} \textit{ Circular Duct} \qquad A_s = W_1 \times W_2 \times \frac{1 \text{ ft}^2}{144 \text{ in}^2} \textit{ Rectangular Duct}$$

$$Q_{s[acfm]} = v_s \times A_s \qquad Q_{s[scfm]} = \frac{17.64 \times Q_{s[acfm]} \times P_s}{T_s} \qquad Q_{s[dscfm]} = Q_{s[scfm]} \times B_d$$

A_s	Cross sectional area of the stack or duct	ft^2
B_d	Proportion of the dry gas by volume	dimensionless
D_1	First internal diameter of the circular stack or duct	in
D_2	Second internal diameter of the circular stack or duct	in
P_s	Absolute gas stream pressure	in Hg
$Q_{s\ [acfm]}$	Gas stream flow rate at actual conditions	acfm
$Q_{s\ [dscfm]}$	Gas stream flow rate at dry standard conditions	dscfm
$Q_{s\ [scfm]}$	Gas stream flow rate at standard conditions	scfm
T_s	Average absolute temperature of the gas stream	^{o}R
v_s	Average gas stream velocity	fpm
W_1	First internal side of the rectangular stack or duct	in
W_2	Second internal side of the rectangular stack or duct	in
4	2 (radiuses per diameter) squared	
17.64	Standard absolute temperature (527.67 ^{o}R) divided by standard absolute pressure (760 mm Hg/25.4 mm/in)	^{o}R/in Hg

Isokinetic Sampling Variation

$$I = \frac{100\% \times P_{std} \times T_s \times V_{m(std)}}{T_{std} \times v_s \times \theta \times P_s \times B_d \times \pi \times \frac{D_n^{\ 2}}{4} \times \frac{1\ \text{ft}^2}{144\ \text{in}^2} \times \frac{60\ \text{sec}}{1\ \text{min}}}$$

B_d	Proportion of the dry gas by volume	dimensionless
D_n	Nozzle diameter	in
I	Percent of isokinetic sampling	%
P_s	Absolute gas stream pressure	in Hg
P_{std}	Standard absolute pressure	29.92 in Hg
t_s	Average absolute temperature of the gas stream	^oR
T_{std}	Standard absolute temperature	528 ^oR
$V_{m\ (std)}$	Net dry gas meter volume at standard conditions	dscf
v_s	Average gas stream velocity	fpm
θ	Total sampling time	min
4	2 (radiuses per diameter) squared	

Filterable Particulate Matter Collected

$$V_{aw} = \frac{WF_{aw} - WI_{aw}}{\rho_{aw}} \qquad V_r = \frac{WF_r - WI_r}{\rho_{aw}} \qquad C_{aw} = \frac{M_{aw}}{V_{aw}}$$

$$M_r = WF_{bkr} - WI_{bkr} - (C_{aw} \times V_r) \qquad M_f = WF_f - WI_f \qquad M_n = M_f + M_r$$

C_{aw}	Particulate matter concentration in the acetone (or water) reagent blank	mg/mL
M_{aw}	Mass of the residue in the reagent blank	mg
M_f	Mass of the particulate matter on the filter	mg
M_n	Total mass of the filterable particulate matter collected	mg
M_r	Mass of the particulate matter in the front-half rinses	mg
V_{aw}	Volume of the acetone (or water) reagent blank	mL
V_r	Volume of the front-half acetone (or water) rinses	mL
WF_{aw}	Weight of the container with the reagent blank sample	g
WF_{bkr}	Final beaker plus residue weight	mg
WF_f	Final filter plus particulate matter weight	mg
WF_r	Weight of the container with the front-half rinses sample	g
WI_{aw}	Tare weight of the container for the reagent blank sample	g
WI_{bkr}	Initial (tare) beaker weight	mg
WI_f	Initial (tare) filter weight	mg
WI_r	Tare weight of the container for the front-half rinses sample	g
ρ_{aw}	Density of the acetone (or water) reagent	g/mL

Condensible Particulate Matter Collected

$$V_w = \frac{WF_w - WI_w}{\rho_w} \qquad V_{ic} = \frac{WF_i - WI_i}{\rho_w} \qquad C_w = \frac{M_w}{V_w} \qquad V_{cond} = \frac{M_{lc} - M_{sg}}{M_{lc}} \times \frac{M_{lc} - M_{sg}}{\rho_w}$$

When ammonium hydroxide (NH_4OH) is not added to the inorganic fraction because the final pH of the impinger solution was greater than 4.5:

$$M_i = WF_{ibkr} - WI_{ibkr} - \left[C_w \times \left(V_{ic} - V_{cond}\right)\right]$$

When an aliquot is removed for analysis for sulfate by ion chromatography, NH_4OH is added to the inorganic fraction, and a correction is made only for the addition of NH_4OH:

$$M_i = (WF_{ibkr} - WI_{ibkr}) \times \frac{V_{ic}}{V_{ic} - V_b} - (0.35457 \times C_{SO4} \times V_{ic}) - \left[C_w \times \left(V_{ic} - V_{cond}\right)\right]$$

When an aliquot is removed for analysis for sulfate by ion chromatography, NH_4OH is added to the inorganic fraction, and a correction is made for the addition of NH_4OH and the combined water removed by the acid-base reaction:

$$M_i = (WF_{ibkr} - WI_{ibkr}) \times \frac{V_{ic}}{V_{ic} - V_b} - (-0.02050 \times C_{SO4} \times V_{ic}) - \left[C_w \times \left(V_{ic} - V_{cond}\right)\right]$$

When the re-dissolved inorganic fraction is titrated with NH_4OH titrant and a correction is made only for the addition of NH_4OH:

$$M_i = (WF_{ibkr} - WI_{ibkr}) - (0.35457 \times 48.0313 \times N \times V_t) - \left[C_w \times \left(V_{ic} - V_{cond}\right)\right]$$

When the re-dissolved inorganic fraction is titrated with NH_4OH titrant and a correction is made for the addition of NH_4OH and the combined water removed by the acid-base reaction:

$$M_i = (WF_{ibkr} - WI_{ibkr}) - (-0.02050 \times 48.0313 \times N \times V_t) - \left[C_w \times \left(V_{ic} - V_{cond}\right)\right]$$

$$V_{Mecl2} = \frac{WF_{Mecl2} - WI_{Mecl2}}{\rho_{Mecl2}} \qquad V_o = \frac{WF_o - WI_o}{\rho_{Mecl2}} \qquad C_{Mecl2} = \frac{M_{Mecl2}}{V_{Mecl2}}$$

$$M_o = WF_{obkr} - WI_{obkr} - \left(C_{Mecl2} \times V_o\right) \qquad M_c = M_i + M_o$$

C_{Mecl2}	Particulate matter concentration in the methylene chloride reagent blank	mg/mL
C_{SO4}	Concentration of the sulfate ion (SO_4^{-2}) in the sample aliquot	mg/mL
C_w	Particulate matter concentration in the water reagent blank	mg/mL
M_c	Total mass of the condensible particulate matter collected	mg
M_i	Mass of the particulate matter in the inorganic fraction sample and rinses	mg
M_{lc}	Total mass of the condensate collected in the impingers	g
M_{Mecl2}	Mass of the residue in the methylene chloride reagent blank	mg
M_o	Mass of the particulate matter in the organic fraction sample and rinses	mg

Continued on the following page →

M_{sg}	Mass of moisture collected in the silica gel impinger	g
M_w	Mass of the residue in the water reagent blank	mg
N	Normality of the ammonium hydroxide titrant	meq/mL
V_b	Volume of aliquot taken for IC analysis for sulfate (SO_4^{-2})	mL
V_{cond}	Volume of the condensate collected in the impingers less an estimated amount of condensate collected in the silica gel impinger (The separate amounts of the condensate from the gas stream and the water reagent collected in the silica gel cannot be determined.)	mL
V_{ic}	Volume of the inorganic fraction sample (same as the final volume recovered from the impingers plus the rinses)	mL
V_{Mecl2}	Volume of the methylene chloride reagent blank	mL
V_o	Volume of the organic fraction sample and rinses	mL
V_t	Volume of ammonium hydroxide titrant used for titration	mL
V_w	Volume of the water reagent blank	mL
WF_i	Weight of the container with the inorganic fraction sample and rinses	g
WF_{ibkr}	Inorganic fraction sample and rinses final beaker plus residue weight	mg
WF_{Mecl2}	Weight of the container with the methylene chloride reagent blank sample	g
WF_o	Weight of the container with the organic fraction sample and rinses	g
WF_{obkr}	Organic fraction sample and rinses final beaker plus residue weight	mg
WF_w	Weight of the container with the water reagent blank sample	g
WI_i	Tare weight of the container for the inorganic fraction sample and rinses	g
WI_{ibkr}	Inorganic fraction sample and rinses initial (tare) beaker weight	mg
WI_{Mecl2}	Tare weight of the container for the methylene chloride reagent blank sample	g
WI_o	Tare weight of the container for the organic fraction sample and rinses	g
WI_{obkr}	Organic fraction sample and rinses initial (tare) beaker weight	mg
WI_w	Tare weight of the container for the water reagent blank sample	g
ρ_{Mecl2}	Density of the methylene chloride reagent	g/mL
ρ_w	Density of water	g/mL
48.0313	Equivalent weight of SO_4^{-2} (ionic weight of SO_4^{-2} divided by 2)	mg/meq
-0.02050	Factor for correcting for the amount of ammonia (NH_3) retained in the sample and the amount of combined water removed by the acid-base reaction (2 x the molecular weight of NH_3 divided by the molecular weight of SO_4^{-2} less 2 x the molecular weight of H_2O divided by the molecular weight of SO_4^{-2})	
0.35457	Factor for correcting only for the amount of ammonia (NH_3) retained in the sample (2 x the molecular weight of NH_3 divided by the molecular weight of SO_4^{-2})	

Total Particulate Matter Concentration in the Stack or Duct

$$C_{s(std)} = \frac{(M_n + M_c)}{V_{m(std)}} \times \frac{1\text{ g}}{1{,}000\text{ mg}} \times \frac{1\text{ lb}}{453.59237\text{ g}} \times \frac{7{,}000\text{ gr}}{1\text{ lb}}$$

$$C_{s(act)} = 17.64 \times C_{s(std)} \times \frac{P_s}{T_s} \times B_d$$

$$C_{s(7\%O2)} = C_{s(std)} \times \frac{20.9 - 7}{20.9 - \%O_2} \qquad C_{s(12\%CO2)} = C_{s(std)} \times \frac{12}{\%CO_2}$$

B_d	Proportion of the dry gas by volume	dimensionless
$C_{s\ (act)}$	Concentration of total particulate matter at actual conditions	gr/ft^3
$C_{s\ (std)}$	Concentration of total particulate matter at dry standard conditions	gr/dscf
$C_{s\ (7\%02)}$	Concentration of total particulate matter at dry standard conditions, corrected to 7% oxygen	gr/dscf
$C_{s\ (12\%C02)}$	Concentration of total particulate matter at dry standard conditions, corrected to 12% carbon dioxide	gr/dscf
M_c	Total mass of the condensible particulate matter collected	mg
M_n	Total mass of the filterable particulate matter collected	mg
P_s	Absolute gas stream pressure	in Hg
T_s	Average absolute temperature of the gas stream	^oR
$V_{m\ (std)}$	Net dry gas meter volume at standard conditions	dscf
$\%CO_2$	Carbon dioxide concentration by volume in the gas stream, dry-basis	%V
$\%O_2$	Oxygen concentration by volume in the gas stream, dry-basis	%V
7	Oxygen concentration standard	%V
12	Carbon dioxide concentration standard	%V
17.64	Standard absolute temperature (527.67 ^oR) divided by standard absolute pressure (760 mm Hg/25.4 mm/in)	^oR/in Hg
20.9	Oxygen concentration in dry air	%V

Filterable and condensible particulate matter concentrations are individually calculated in the same manner as above.

Total Particulate Matter Emission Rate

$$E_p = C_{s(std)} \times Q_{s[dscfm]} \times \frac{60\text{ min}}{1\text{ hr}} \times \frac{1\text{ lb}}{7{,}000\text{ gr}}$$

$$E_{p\ [lb/MMBtu]} = C_{s(std)} \times \frac{1\text{ lb}}{7{,}000\text{ gr}} \times F_c \times \frac{100}{\%CO_2}$$

$C_{s\ (std)}$	Concentration of total particulate matter at dry standard conditions	gr/dscf
E_p	Total particulate matter emission rate	lb/hr
$E_{p\ [lb/MMBtu]}$	Total particulate matter emission rate	lb/MMBtu
F_c	Ratio of the carbon dioxide volume generated by combustion to the high heating value of the fuel combusted	scf/MMBtu
$Q_{s\ [dscfm]}$	Gas stream flow rate at dry standard conditions	dscfm
$\%CO_2$	Carbon dioxide concentration by volume, dry-basis	%V

Filterable and condensible particulate matter emission rates are individually calculated in the same manner as above.

EPA Methods 3A, 6C, 7E, 10, and 25A – Gaseous Diluent (CO_2 and O_2), Gaseous Pollutant (SO_2, NO_X, and CO), and Total Gaseous Organic Concentration (TGOC) Calculations

Calibration Adjusted CO_2, O_2, SO_2, NO_X, or CO Concentration in the Stack or Duct Effluent

$$C_{gas} = \left(\overline{C} - C_0\right) \times \frac{C_{ma}}{\left(C_m - C_0\right)}$$

$\overline{C}$	Average gas analyzer output concentration, dry-basis	ppmv or %V
C_{gas}	Average calibration-adjusted effluent gas concentration, dry-basis	ppmv or %V
C_m	Average of the initial and final gas measurement system bias check responses to the upscale calibration gas	ppmv or %V
C_{ma}	Certified analysis concentration in the upscale calibration gas	ppmv or %V
C_0	Average of the initial and final gas measurement system bias check responses to the zero calibration gas	ppmv or %V

CO_2, O_2, SO_2, NO_X, or CO Analyzer Calibration Error

$$CE = \frac{\left(C_{mai} - C_a\right)}{S} \times 100\%$$

C_a	Analyzer response to the zero, mid-range, or high-range calibration gas	ppmv or %V
CE	Analyzer calibration error for the zero, mid-range, or high-range calibration gas	%
C_{mai}	Certified analysis concentration in the zero, mid-range, or high-range calibration gas	ppmv or %V
S	Effective span of the instrument (span gas concentration)	ppmv or %V

CO_2, O_2, SO_2, NO_X, or CO Measurement System Bias Check

$$CB = \frac{\left(C_s - C_a\right)}{S} \times 100\%$$

C_a	Analyzer response to the zero or upscale calibration gas	ppmv or %V
CB	Gas measurement system bias for the zero or upscale calibration gas	%
C_s	Gas measurement system response to the zero or upscale calibration gas	ppmv or %V
S	Effective span of the instrument (span gas concentration)	ppmv or %V

CO_2, O_2, SO_2, NO_X, or CO Measurement System Zero & Calibration Drift

$$CD = \frac{(C_{sf} - C_{si})}{S} \times 100\%$$

CD	Gas measurement system zero or calibration drift	%
C_{sf}	Final gas measurement system bias check response to the zero or upscale calibration gas	ppmv or %V
C_{si}	Initial gas measurement system bias check response to the zero or upscale calibration gas	ppmv or %V
S	Effective span of the instrument (span gas concentration)	ppmv or %V

Calibration Adjusted TGOC (as Propane) in the Stack or Duct Effluent

$$C_{TGOC} = (\overline{C}_{HC} - C_{zero}) \times \frac{C_{mida}}{(C_{mid} - C_{zero})}$$

$\overline{C}_{HC}$	Average TGOC analyzer output concentration as propane, wet-basis	ppmv
C_{mid}	Average of the initial and final TGOC measurement system responses to the mid-level propane calibration gas	ppmv
C_{mida}	Certified analysis concentration of propane in the mid-level calibration gas	ppmv
C_{TGOC}	Average calibration-adjusted TGOC as propane, wet-basis	ppmv
C_{zero}	Average of the initial and final TGOC measurement system responses to the zero calibration gas as propane	ppmv

TGOC Measurement System Zero & Calibration Drift

$$CD_{TGOC} = \frac{(C_f - C_i)}{S_{TGOC}} \times 100\%$$

CD_{TGOC}	TGOC measurement system zero or calibration drift	%
C_f	Final TGOC measurement system response to the zero or mid-level calibration gas as propane	ppmv
C_i	Initial TGOC measurement system response to the zero or mid-level calibration gas as propane	ppmv
S_{TGOC}	Span is the upper limit of the gas concentration measurement range specified for the affected source category, usually 1.5 to 2.5 times the applicable emission limit; or, if not specified, 1.5 to 2.5 times the expected concentration	ppmv

TGOC Measurement System Calibration Error

$$CE_{TGOC} = \frac{\left(C_p - C_r\right)}{C_{cert}} \times 100\%$$

C_{cert}	Certified analysis concentration of propane in the low-level or mid-level calibration gas	ppmv
CE_{TGOC}	TGOC measurement system calibration error	%
C_p	Predicted response to the low-level or mid-level calibration gas as propane	ppmv
C_r	TGOC measurement system response to the low-level or mid-level calibration gas as propane	ppmv

Dry Gas Sample Volume for Moisture (If Used)

$$V_m = V_f - V_i \qquad V_{m(std)} = \frac{17.64 \times V_m \times Y \times \left(P_{bar} \pm \frac{E_{Mtr}}{1{,}000\ \text{ft}} + \frac{\Delta H}{13.6}\right)}{T_m}$$

E_{Mtr}	Dry gas meter elevation relative to the barometer	ft
P_{bar}	Barometric pressure at the barometer	in Hg
T_m	Average absolute dry gas meter temperature	^oR
V_f	Final dry gas meter volume reading	ft^3
V_i	Initial dry gas meter volume reading	ft^3
V_m	Net dry gas meter volume, actual	ft^3
$V_{m\ (std)}$	Net dry gas meter volume at standard conditions	dscf
Y	Dry gas meter calibration correction factor	dimensionless
ΔH	Average orifice meter pressure-drop	in H_2O
13.6	Specific gravity of mercury relative to water	in H_2O/in Hg
17.64	Standard absolute temperature (527.67 ^oR) divided by standard absolute pressure (760 mm Hg/25.4 mm/in)	^oR/in Hg

Sampled Gas Stream Moisture (Water Vapor) Content (If Used)

$$V_{w(std)} = 0.04715 \times M_{lc} \qquad B_{ws\,(Sample)} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}} \qquad B_{ws(Sat)} = \frac{VP_{H2O}}{P_s}$$

$$P_w = B_{ws} \times 100 \qquad B_d = 1 - B_{ws}$$

B_d	Proportion of the dry gas by volume	dimensionless
B_{ws}	$B_{ws\,(Sample)}$ or $B_{ws\,(Sat)}$, whichever is less	dimensionless
$B_{ws\,(Sample)}$	Proportion of water vapor by volume determined with the sampling train	dimensionless
$B_{ws\,(Sat)}$	Proportion of water vapor by volume for a saturated or supersaturated gas stream	dimensionless
M_{lc}	Total mass of water collected in the sampling train	g
P_s	Absolute gas stream pressure	in Hg
P_w	Percent moisture (water vapor) in the gas stream	%V
$V_{m\,(std)}$	Net dry gas meter volume at standard conditions	dscf
$V_{w\,(std)}$	Equivalent volume of water vapor collected, at standard conditions	ft^3
VP_{H2O}	Vapor pressure of water at gas stream temperature	in Hg
0.04715	Conversion factor for grams of water to cubic feet of water vapor at standard conditions	ft^3/g

Gas Stream Moisture (Water Vapor) Content from Psychrometer Data (If Used)

$$e_a = VP_{Tw} - \frac{(P_a - VP_{Tw}) \times (T_d - T_w)}{2800 - 1.3 \times T_w} \qquad B_{ws} = \frac{e_a}{P_s}$$

$$P_w = B_{ws} \times 100 \qquad B_d = 1 - B_{ws}$$

B_d	Proportion of the dry gas by volume	dimensionless
B_{ws}	Proportion of water vapor by volume	dimensionless
e_a	Vapor pressure of water in the gas stream at the wet and dry bulb measurement location	in Hg
P_a	Absolute gas pressure at the wet and dry bulb location ($P_a = P_s$ if measurements are in-situ)	in Hg
P_s	Absolute gas stream pressure	in Hg
P_w	Percent moisture (water vapor) in the gas stream	%V
T_d	Dry bulb temperature in the gas stream	^oF
T_w	Wet bulb temperature in the gas stream	^oF
VP_{Tw}	Vapor pressure of water at the wet bulb temperature	in Hg

Gas Stream Absolute Pressure

$$P_s = P_{bar} \pm \frac{E_{Stk}}{1{,}000\ \text{ft}} + \frac{P_g}{13.6}$$

E_{Stk}	Sampling location elevation relative to the barometer	ft
P_{bar}	Barometric pressure at the barometer	in Hg
P_g	Gas stream static pressure	in H_2O
P_s	Absolute gas stream pressure	in Hg
13.6	Specific gravity of mercury relative to water	in H_2O/in Hg

Gas Molecular Weight

For Combustion Sources

$$\%N_2 = 100\% - (\%CO_2 + \%O_2)$$

$$M_d = 0.44 \times \%CO_2 + 0.32 \times \%O_2 + 0.28 \times \%N_2$$

$$M_s = M_d \times B_d + 18 \times B_{ws}$$

B_d	Proportion of the dry gas by volume	dimensionless
B_{ws}	Proportion of water vapor by volume	dimensionless
M_d	Molecular weight of the dry gas	lb/lb-mole
M_s	Molecular weight of the wet gas	lb/lb-mole
$\%CO_2$	Carbon dioxide concentration by volume, dry-basis	%V
$\%O_2$	Oxygen concentration by volume, dry-basis	%V
$\%N_2$	Nitrogen concentration by volume, dry-basis	%V
0.28	Molecular weight of nitrogen divided by 100	lb/lb-mole/100%
0.32	Molecular weight of oxygen divided by 100	lb/lb-mole/100%
0.44	Molecular weight of carbon dioxide divided by 100	lb/lb-mole/100%
18	Molecular weight of water	lb/lb-mole

For Ambient Air Sources

M_d	Molecular weight of dry ambient air	28.965 lb/lb-mole

Gas Stream Velocity

$$\Delta p = \left(\frac{\sum_{i=1}^{n} \sqrt{\Delta p_i}}{n} \right)^2 \qquad v_s = 85.49 \times C_p \times \sqrt{\Delta p} \times \sqrt{\frac{T_s}{P_s \times M_s}} \times \frac{60\ \text{sec}}{1\ \text{min}}$$

C_p	Pitot tube coefficient	dimensionless
M_s	Molecular weight of the wet gas	lb/lb-mole
n	Number of traverse points sampled	
P_s	Absolute gas stream pressure	in Hg
T_s	Average absolute temperature of the gas stream	^{o}R
v_s	Average gas stream velocity	fpm
Δp	Average velocity head of the gas stream	in H_2O
Δp_i	Velocity head at sampling point i	in H_2O
85.49	Pitot tube constant	$\frac{\text{ft}}{\text{sec}}\left[\frac{(\text{lb/lb-mole})(\text{in Hg})}{(^\circ\text{R})(\text{in } H_2O)}\right]^{1/2}$

Gas Stream Volumetric Flow Rate

$$A_s = \frac{D_1 \times D_2 \times \pi}{4} \times \frac{1\ \text{ft}^2}{144\ \text{in}^2}\ \textit{Circular Duct} \qquad A_s = W_1 \times W_2 \times \frac{1\ \text{ft}^2}{144\ \text{in}^2}\ \textit{Rectangular Duct}$$

$$Q_{s[acfm]} = v_s \times A_s \qquad Q_{s[scfm]} = \frac{17.64 \times Q_{s[acfm]} \times P_s}{T_s} \qquad Q_{s[dscfm]} = Q_{s[scfm]} \times B_d$$

A_s	Cross sectional area of the stack or duct	ft^2
B_d	Proportion of the dry gas by volume	dimensionless
D_1	First internal diameter of the circular stack or duct	in
D_2	Second internal diameter of the circular stack or duct	in
P_s	Absolute gas stream pressure	in Hg
$Q_{s\ [acfm]}$	Gas stream flow rate at actual conditions	acfm
$Q_{s\ [dscfm]}$	Gas stream flow rate at dry standard conditions	dscfm
$Q_{s\ [scfm]}$	Gas stream flow rate at standard conditions	scfm
T_s	Average absolute temperature of the gas stream	^{o}R
v_s	Average gas stream velocity	fpm
W_1	First internal side of the rectangular stack or duct	in
W_2	Second internal side of the rectangular stack or duct	in
4	2 (radiuses per diameter) squared	
17.64	Standard absolute temperature (527.67 ^{o}R) divided by standard absolute pressure (760 mm Hg/25.4 mm/in)	^{o}R/in Hg

Corrected Gaseous Pollutant (SO_2, NO_X, or CO) Concentration and Corrected TGOC

$$C_{gas(7\%O2)} = C_{gas} \times \frac{20.9-7}{20.9-\%O_2} \qquad C_{gas(12\%CO2)} = C_{gas} \times \frac{12}{\%CO_2}$$

$$C_{TGOC(7\%O2)} = \frac{C_{TGOC}}{B_d} \times \frac{20.9-7}{20.9-\%O_2} \qquad C_{TGOC(12\%CO2)} = \frac{C_{TGOC}}{B_d} \times \frac{12}{\%CO_2}$$

B_d	Proportion of the dry gas by volume	dimensionless
C_{gas}	Average calibration-adjusted effluent gas concentration, dry-basis	ppmv
$C_{gas\ (7\%02)}$	Concentration of the gaseous pollutant on a dry basis, corrected to 7% oxygen	ppmv
$C_{gas\ (12\%C02)}$	Concentration of the gaseous pollutant on a dry basis, corrected to 12% carbon dioxide	ppmv
C_{TGOC}	Average calibration-adjusted TGOC as propane, wet-basis	ppmv
$C_{TGOC\ (7\%02)}$	TGOC as propane on a dry basis, corrected to 7% oxygen	ppmv
$C_{TGOC\ (12\%C02)}$	TGOC as propane on a dry basis, corrected to 12% carbon dioxide	ppmv
$\%CO_2$	Carbon dioxide concentration by volume in the gas stream, dry-basis	%V
$\%O_2$	Oxygen concentration by volume in the gas stream, dry-basis	%V
7	Oxygen concentration standard	%V
12	Carbon dioxide concentration standard	%V
20.9	Oxygen concentration in dry air	%V

Gaseous Pollutant (SO_2, NO_X, or CO) Emission Rate

$$E_a = \frac{C_{gas}\ \text{mL}}{1\text{m}^3} \times \frac{M_w\ \text{g}}{\text{g-mol}} \times \frac{\text{g-mol}}{24.05515\ \text{L}} \times \frac{1\text{lb}}{453.59237\ \text{g}} \times \frac{1\text{L}}{10^3\ \text{mL}} \times Q_{s\ [dscfm]} \times \frac{0.3048^3\ \text{m}^3}{1\ \text{ft}^3} \times \frac{60\ \text{min}}{1\text{hr}}$$

C_{gas}	Average calibration-adjusted effluent gas concentration, dry-basis	ppmv (mL/m^3)
E_a	Emission rate of the gaseous pollutant	lb/hr
M_w	Molecular weight of the gaseous pollutant Sulfur dioxide = 64.0638 Oxides of nitrogen as nitrogen dioxide = 46.0055 Carbon monoxide = 28.0101	g/g-mole
$Q_{s\ [dscfm]}$	Gas stream flow rate at dry standard conditions	dscfm

Total Gaseous Organic Emission Rate (as Propane)

$$E_p = \frac{C_{TGOC}\ \text{mL}}{1\text{m}^3} \times \frac{M_w\ \text{g}}{\text{g - mol}} \times \frac{\text{g - mol}}{24.05515\,\text{L}} \times \frac{1\text{lb}}{453.59237\,\text{g}} \times \frac{1\text{L}}{10^3\ \text{mL}} \times Q_{s\,[scfm]} \times \frac{0.3048^3\ \text{m}^3}{1\,\text{ft}^3} \times \frac{60\,\text{min}}{1\text{hr}}$$

C_{TGOC}	Average calibration-adjusted TGOC as propane, wet-basis	ppmv (mL/m^3)
E_p	Total gaseous organic emission rate as propane	lb/hr
M_w	Molecular weight of propane (44.09562)	g/g-mole
$Q_{s\,[scfm]}$	Gas stream flow rate at standard conditions	scfm

APPENDIX B

CALCULATED RESULTS

Appendix B-1

Particulate Results

AIRSOURCE TECHNOLOGIES, INC.

Run Report - Particulate Matter

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	111

Stack or Duct Dimensions

(●) Circular ( ) Rectangular

Diameter # 1	in.	122.000
Diameter # 2	in.	122.000
Cross-Section Area	ft^2	81.180

Gas Stream Conditions

Avg. Gas Temperature	°F	496
Avg. Velocity Head (Δp)	in. H_2O	0.156
Static Gas Pressure	in. H_2O	0.00
Absolute Gas Pressure	in. Hg	29.28
O_2 Concentration, Dry	%V	17.72
CO_2 Concentration, Dry	%V	1.86
Moisture	%V	5.87
Dry Molecular Weight	lb/lb-mole	29.01
Wet Molecular Weight	lb/lb-mole	28.36

Sampling Conditions

Sampling Time	min	48.00
Avg. Nozzle Diameter	in.	0.431
Avg. Isokinetic Variation	%	93.3
IKV 90-110% Criterion	—	Pass

Dry Gas Meter Conditions

Console Elevation	ft	0
DGM Correction (Y)	—	1.015
Average ΔH	in. H_2O	2.89
Avg. DGM Temperature	°F	84.4
Initial DGM Volume	ft^3	669.700
Final DGM Volume	ft^3	713.000
Leak Check Volume	ft^3	-0.000
Leak Correction Volume	ft^3	
Net DGM Volume	ft^3	43.300
Dry Gas Sample Volume	dscf	42.169

Other Related Data

Barometer Reading	in. Hg	29.40
Test Location Elevation	ft	125
Pitot Tube Coefficient	—	0.840
Average SQRT(Δp)	in. H_2O	0.396

Volumetric Flow Rate Results

Average Gas Velocity	ft/min	1,829
Volumetric Flow, Actual	acfm	148,456
Corrected Flow, Wet	scfm	80,207
Corrected Flow, Dry	dscfm	75,497

Particulate Matter Emission Results

		Filterable	Condensable	Total
Total Particulate Matter Collected	mg	188.9	32.4	221.3
Concentration (Wet)	mg/acf	2.28	0.391	2.67
Concentration (Wet)	gr/acf	0.0352	6.03E-03	0.0412
Concentration (Dry)	mg/dscf	4.48	0.768	5.25
Concentration (Dry)	gr/dscf	0.0691	0.0119	0.0810
Emission Rate	lb/hr	44.7	7.67	52.4

AIRSOURCE TECHNOLOGIES, INC.

Metric Equivalents - Particulate Matter

Project	Rain	Location	K-1 Stack
Project Number	4173	Method	EPA Methods 5 and 202
Test Date	July 20, 2023	Run No.	111

Stack or Duct Dimensions

◉ Circular ○ Rectangular

Diameter # 1	m	3.0988
Diameter # 2	m	3.0988
Cross-Section Area	m^2	7.5418

Dry Gas Meter Conditions

Console Elevation	m	0.0
DGM Correction (Y)	—	1.015
Average ΔH	mm H_2O	73.4
Avg. DGM Temperature	° C	29.1
Initial DGM Volume	m^3	18.96379
Final DGM Volume	m^3	20.18991
Leak Check Volume	m^3	-0.00000
Leak Correction Volume	m^3	
Net DGM Volume	m^3	1.22612
Dry Gas Sample Volume	dscm	1.19411

Gas Stream Conditions

Avg. Gas Temperature	°C	258
Avg. Velocity Head (Δp)	mm H_2O	4.0
Static Gas Pressure	mm H_2O	0.0
Absolute Gas Pressure	mm Hg	743.6
O_2 Concentration, Dry	%V	17.72
CO_2 Concentration, Dry	%V	1.86
Moisture	%V	5.87
Dry Molecular Weight	g/g-mole	29.01
Wet Molecular Weight	g/g-mole	28.36

Other Related Data

Barometer Reading	mm Hg	746.8
Test Location Elevation	m	38.1
Pitot Tube Coefficient	—	0.840
Average SQRT(Δp)	mm H_2O	1.99

Sampling Conditions

Sampling Time	min	48.00
Avg. Nozzle Diameter	mm	10.95
Avg. Isokinetic Variation	%	93.3
IKV 90-110% Criterion	—	Pass

Volumetric Flow Rate Results

Average Gas Velocity	m/min	557.4
Volumetric Flow, Actual	acm/min	4,203.8
Corrected Flow, Wet	scm/min	2,271.21
Corrected Flow, Dry	dscm/min	2,137.83

Particulate Matter Emission Results

		Filterable	Condensable	Total
Total Particulate Matter Collected	mg	188.9	32.4	221.3
Concentration (Wet)	mg/acm	80.4	13.8	94.2
Concentration (Dry)	mg/dscm	158	27.1	185
Emission Rate	kg/hr	20.3	3.48	23.8

AIRSOURCE TECHNOLOGIES, INC.

Traverse Data - Particulate Matter

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	111

Traverse Point	Gas Temp., °F	Δp in. H_2O	ΔH in. H_2O	DGM Inlet, °F	DGM Outlet, °F
A1	412	0.100	2.00	78	78
2	423	0.150	3.00	80	80
3	437	0.170	3.30	82	82
B1	444	0.100	1.90	83	83
2	481	0.140	2.60	84	84
3	507	0.180	3.20	85	85
C1	501	0.130	2.40	86	86
2	531	0.180	3.20	86	86
3	540	0.200	3.50	87	87
D1	530	0.120	2.10	86	86
2	569	0.210	3.60	88	88
3	575	0.230	3.90	88	88
Average	**496**	**0.156**	**2.89**	**84.4**	**84.4**

Leak Check Volumes

Initial					
Final					
Difference					

AIRSOURCE TECHNOLOGIES, INC.

Filterable Particulate Matter and Moisture Analysis

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	111

Impinger Weights

		Initial	Final	Difference
Condenser & Knockout	g	643.9	672.5	28.6
CPM Impinger	g	465.3	465.3	0.0
H_2O Impinger	g	693.0	695.2	2.2
H_2O Impinger	g			
Silica Gel	g	714.2	739.2	25.0
	Total Collected		g	55.8

Moisture Results

Moisture Volume	scf	2.631
Dry Gas Sample Volume	dscf	42.169
Sampled Moisture	%V	5.87
Saturation Moisture	%V	N/A
Reported Moisture	%V	5.87

Rinse Reagent

◉ Acetone ◯ Water

Sampling Train Front-half Rinses

Container Gross Wt.	g	294.6
Container Empty Wt.	g	165.5
Sample Volume	mLs	163.4
Evap. Beaker No.	C22-8-36	
Beaker Tare Weight	g	30.0453
Beaker Final Weight	g	30.0937
Blank Correction	mg	-0.1
Net Weight	mg	48.3

Acetone Field Reagent Blank

Container Gross Wt.	g	300.5
Container Empty Wt.	g	166.9
Reagent Blank Volume	mLs	169.1
Evap. Beaker No.	C22-8-29	
Beaker Tare Weight	g	28.8716
Beaker Final Weight	g	28.8717
Residue Weight	mg	0.1
Blank Concentration	mg/mL	0.0006

Dry Catch and Filter Weights

Filter No.	F23-7-1	
Filter Tare Weight	g	37.3182
Filter Final Weight	g	37.4588
Filter Blank	g	NA
Net Weight	mg	140.6

Filter Blank

◉ Not Used ◯ Used

Filter No.		
Filter Tare Weight	g	
Filter Final Weight	g	

Total Filterable Particulate Matter

Total Weight	mg	188.9

AIRSOURCE TECHNOLOGIES, INC.

Condensable Particulate Matter Analysis

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	111

Hexane Field Reagent Blank

Container Gross Wt.	g	344.6
Container Empty Wt.	g	165.8
Reagent Blank Volume	mLs	269.7
Evap. Beaker No.	C22-8-30	
Beaker Tare Weight	g	29.9420
Beaker Final Weight	g	29.9428
Residue Weight	mg	0.8

Water Field Reagent Blank

Container Gross Wt.	g	261.0
Container Empty Wt.	g	164.4
Water Blank Volume	mLs	96.8
Evap. Beaker No.	C22-8-31	
Beaker Tare Weight	g	30.5884
Beaker Final Weight	g	30.5885
Residue Weight	mg	0.1

Field Train Recovery (FTR) Blank

Organic Fraction

Container Gross Wt.	g	557.0
Container Empty Wt.	g	297.0
Sample Wt.	g	260.0
Evap. Beaker No.	C22-8-35	
Beaker Tare Weight	g	29.9567
Beaker Final Weight	g	29.9575
Net Weight	mg	0.8

Mass of NH_4^+ Added To Sample

NH_4OH Normality	meq/mL	0.0000
Titrant Volume Used	mLs	0.0
NH_4^+ added to Sample	mg	0.0

Total Condensable Particulate Matter

Total FTR Blank CPM	mg	3.5

Inorganic Fraction

Container Gross Wt.	g	763.5
Container Empty Wt.	g	504.1
Sample Wt.	g	259.4
Evap. Beaker No.	C22-8-34	
Beaker Tare Weight	g	29.5305
Beaker Final Weight	g	29.5332
Less NH_4^+ in Sample	mg	0.0
Net Weight	mg	2.7

Filter Weights

Filter No.	NA	
Filter Tare Weight	g	0.0
Filter Final Weight	g	0.0
Net Weight	mg	0.0

CPM Sampling Train

Organic Fraction

Container Gross Wt.	g	926.0
Container Empty Wt.	g	503.9
Sample Wt.	g	422.1
Evap. Beaker No.	C22-10-21	
Beaker Tare Weight	g	1.5955
Beaker Final Weight	g	1.6258
Net Weight	mg	30.3

Mass of NH_4^+ Added To Sample

NH_4OH Normality	meq/mL	0.0000
Titrant Volume Used	mLs	0.0
NH_4^+ added to Sample	mg	0.0

Total Condensable Particulate Matter

Total CPM Weight	mg	34.4
Blank Correction Used	mg	-2.0
Corrected CPM Weight	mg	32.4

Inorganic Fraction

Container Gross Wt.	g	571.4
Container Empty Wt.	g	294.8
Sample Wt.	g	276.6
Evap. Beaker No.	C22-8-37	
Beaker Tare Weight	g	28.6473
Beaker Final Weight	g	28.6514
Less NH_4^+ in Sample	mg	0.0
Net Weight	mg	4.1

Filter Weights

Filter No.	NA	
Filter Tare Weight	g	0.0
Filter Final Weight	g	0.0
Net Weight	mg	0.0

FTR Blank CPM was >2.0 mg.

AIRSOURCE TECHNOLOGIES, INC.

Run Report - Particulate Matter

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	112

Stack or Duct Dimensions

◉ Circular ○ Rectangular

Diameter # 1	in.	122.000
Diameter # 2	in.	122.000
Cross-Section Area	ft^2	81.180

Gas Stream Conditions

Avg. Gas Temperature	°F	702
Avg. Velocity Head (Δp)	in. H_2O	0.172
Static Gas Pressure	in. H_2O	0.00
Absolute Gas Pressure	in. Hg	29.27
O_2 Concentration, Dry	%V	15.90
CO_2 Concentration, Dry	%V	3.04
Moisture	%V	21.22
Dry Molecular Weight	lb/lb-mole	29.12
Wet Molecular Weight	lb/lb-mole	26.76

Sampling Conditions

Sampling Time	min	48.00
Avg. Nozzle Diameter	in.	0.365
Avg. Isokinetic Variation	%	111.5
IKV 90-110% Criterion	—	Fail

Dry Gas Meter Conditions

Console Elevation	ft	0
DGM Correction (Y)	—	1.015
Average ΔH	in. H_2O	1.39
Avg. DGM Temperature	°F	89.5
Initial DGM Volume	ft^3	728.302
Final DGM Volume	ft^3	759.150
Leak Check Volume	ft^3	-0.000
Leak Correction Volume	ft^3	
Net DGM Volume	ft^3	30.848
Dry Gas Sample Volume	dscf	29.644

Other Related Data

Barometer Reading	in. Hg	29.39
Test Location Elevation	ft	125
Pitot Tube Coefficient	—	0.840
Average SQRT(Δp)	in. H_2O	0.415

Volumetric Flow Rate Results

Average Gas Velocity	ft/min	2,177
Volumetric Flow, Actual	acfm	176,756
Corrected Flow, Wet	scfm	78,537
Corrected Flow, Dry	dscfm	61,875

Particulate Matter Emission Results

		Filterable	Condensable	Total
Total Particulate Matter Collected	mg	116.7	58.3	175.0
Concentration (Wet)	mg/acf	1.38	0.688	2.07
Concentration (Wet)	gr/acf	0.0213	0.0106	0.0319
Concentration (Dry)	mg/dscf	3.94	1.97	5.90
Concentration (Dry)	gr/dscf	0.0608	0.0304	0.0911
Emission Rate	lb/hr	32.2	16.1	48.3

AIRSOURCE TECHNOLOGIES, INC.

Metric Equivalents - Particulate Matter

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	112

Stack or Duct Dimensions

◉ Circular ○ Rectangular

Diameter # 1	m	3.0988
Diameter # 2	m	3.0988
Cross-Section Area	m^2	7.5418

Gas Stream Conditions

Avg. Gas Temperature	°C	372
Avg. Velocity Head (Δp)	mm H_2O	4.4
Static Gas Pressure	mm H_2O	0.0
Absolute Gas Pressure	mm Hg	743.3
O_2 Concentration, Dry	%V	15.90
CO_2 Concentration, Dry	%V	3.04
Moisture	%V	21.22
Dry Molecular Weight	g/g-mole	29.12
Wet Molecular Weight	g/g-mole	26.76

Sampling Conditions

Sampling Time	min	48.00
Avg. Nozzle Diameter	mm	9.27
Avg. Isokinetic Variation	%	111.5
IKV 90-110% Criterion	—	Fail

Dry Gas Meter Conditions

Console Elevation	m	0.0
DGM Correction (Y)	—	1.015
Average ΔH	mm H_2O	35.3
Avg. DGM Temperature	° C	31.9
Initial DGM Volume	m^3	20.62322
Final DGM Volume	m^3	21.49673
Leak Check Volume	m^3	-0.00000
Leak Correction Volume	m^3	
Net DGM Volume	m^3	0.87352
Dry Gas Sample Volume	dscm	0.83942

Other Related Data

Barometer Reading	mm Hg	746.5
Test Location Elevation	m	38.1
Pitot Tube Coefficient	—	0.840
Average SQRT(Δp)	mm H_2O	2.09

Volumetric Flow Rate Results

Average Gas Velocity	m/min	663.7
Volumetric Flow, Actual	acm/min	5,005.2
Corrected Flow, Wet	scm/min	2,223.93
Corrected Flow, Dry	dscm/min	1,752.12

Particulate Matter Emission Results

		Filterable	Condensable	Total
Total Particulate Matter Collected	mg	116.7	58.3	175.0
Concentration (Wet)	mg/acm	48.7	24.3	73.0
Concentration (Dry)	mg/dscm	139	69.5	208
Emission Rate	kg/hr	14.6	7.30	21.9

AIRSOURCE TECHNOLOGIES, INC.

Traverse Data - Particulate Matter

Project	Rain	Location	K-1 Stack
Project Number	4173	Method	EPA Methods 5 and 202
Test Date	July 20, 2023	Run No.	112

Traverse Point	Gas Temp., °F	Δp in. H_2O	ΔH in. H_2O	DGM Inlet, °F	DGM Outlet, °F
A1	676	0.140	1.10	86	86
2	688	0.220	1.80	88	88
3	695	0.240	1.90	89	89
B1	648	0.120	1.00	87	87
2	692	0.180	1.40	89	89
3	702	0.200	1.60	91	91
C1	672	0.130	1.00	89	89
2	703	0.160	1.30	91	91
3	707	0.170	1.40	91	91
D1	789	0.130	1.00	91	91
2	724	0.200	1.60	91	91
3	726	0.200	1.60	91	91
Average	**702**	**0.172**	**1.39**	**89.5**	**89.5**

Leak Check Volumes

Initial					
Final					
Difference					

AIRSOURCE TECHNOLOGIES, INC.

Filterable Particulate Matter and Moisture Analysis

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	112

Impinger Weights

		Initial	Final	Difference
Condenser & Knockout	g	783.0	933.6	150.6
CPM Impinger	g	549.7	549.8	0.1
H_2O Impinger	g	559.9	549.0	-10.9
H_2O Impinger	g			
Silica Gel	g	714.9	744.4	29.5
	Total Collected		g	169.3

Moisture Results

Moisture Volume	scf	7.982
Dry Gas Sample Volume	dscf	29.644
Sampled Moisture	%V	21.22
Saturation Moisture	%V	N/A
Reported Moisture	%V	21.22

Rinse Reagent

◉ Acetone ○ Water

Sampling Train Front-half Rinses

Container Gross Wt.	g	303.1
Container Empty Wt.	g	167.1
Sample Volume	mLs	172.2
Evap. Beaker No.	C22-8-38	
Beaker Tare Weight	g	29.0256
Beaker Final Weight	g	29.0715
Blank Correction	mg	-0.1
Net Weight	mg	45.8

Acetone Field Reagent Blank

Container Gross Wt.	g	300.5
Container Empty Wt.	g	166.9
Reagent Blank Volume	mLs	169.1
Evap. Beaker No.	C22-8-29	
Beaker Tare Weight	g	28.8716
Beaker Final Weight	g	28.8717
Residue Weight	mg	0.1
Blank Concentration	mg/mL	0.0006

Dry Catch and Filter Weights

Filter No.	F22-9-9	
Filter Tare Weight	g	30.3950
Filter Final Weight	g	30.4659
Filter Blank	g	NA
Net Weight	mg	70.9

Filter Blank

◉ Not Used ○ Used

Filter No.		
Filter Tare Weight	g	
Filter Final Weight	g	

Total Filterable Particulate Matter

Total Weight	mg	116.7

AIRSOURCE TECHNOLOGIES, INC.

Condensable Particulate Matter Analysis

Project	Rain	Location	K-1 Stack
Project Number	4173	Method	EPA Methods 5 and 202
Test Date	July 20, 2023	Run No.	112

Hexane Field Reagent Blank

Container Gross Wt.	g	344.6
Container Empty Wt.	g	165.8
Reagent Blank Volume	mLs	269.7
Evap. Beaker No.	C22-8-30	
Beaker Tare Weight	g	29.9420
Beaker Final Weight	g	29.9428
Residue Weight	mg	0.8

Water Field Reagent Blank

Container Gross Wt.	g	261.0
Container Empty Wt.	g	164.4
Water Blank Volume	mLs	96.8
Evap. Beaker No.	C22-8-31	
Beaker Tare Weight	g	30.5884
Beaker Final Weight	g	30.5885
Residue Weight	mg	0.1

Field Train Recovery (FTR) Blank

Organic Fraction

Container Gross Wt.	g	557.0
Container Empty Wt.	g	297.0
Sample Wt.	g	260.0
Evap. Beaker No.	C22-8-35	
Beaker Tare Weight	g	29.9567
Beaker Final Weight	g	29.9575
Net Weight	mg	0.8

Mass of NH_4^+ Added To Sample

NH_4OH Normality	meq/mL	0.0000
Titrant Volume Used	mLs	0.0
NH_4^+ added to Sample	mg	0.0

Total Condensable Particulate Matter

Total FTR Blank CPM	mg	3.5

Inorganic Fraction

Container Gross Wt.	g	763.5
Container Empty Wt.	g	504.1
Sample Wt.	g	259.4
Evap. Beaker No.	C22-8-34	
Beaker Tare Weight	g	29.5305
Beaker Final Weight	g	29.5332
Less NH_4^+ in Sample	mg	0.0
Net Weight	mg	2.7

Filter Weights

Filter No.	NA	
Filter Tare Weight	g	0.0
Filter Final Weight	g	0.0
Net Weight	mg	0.0

CPM Sampling Train

Organic Fraction

Container Gross Wt.	g	932.6
Container Empty Wt.	g	505.7
Sample Wt.	g	426.9
Evap. Beaker No.	C22-10-22	
Beaker Tare Weight	g	1.5904
Beaker Final Weight	g	1.6476
Net Weight	mg	57.2

Mass of NH_4^+ Added To Sample

NH_4OH Normality	meq/mL	0.0000
Titrant Volume Used	mLs	0.0
NH_4^+ added to Sample	mg	0.0

Total Condensable Particulate Matter

Total CPM Weight	mg	60.3
Blank Correction Used	mg	-2.0
Corrected CPM Weight	mg	58.3

Inorganic Fraction

Container Gross Wt.	g	579.4
Container Empty Wt.	g	298.2
Sample Wt.	g	281.2
Evap. Beaker No.	C22-8-39	
Beaker Tare Weight	g	30.8864
Beaker Final Weight	g	30.8895
Less NH_4^+ in Sample	mg	0.0
Net Weight	mg	3.1

Filter Weights

Filter No.	NA	
Filter Tare Weight	g	0.0
Filter Final Weight	g	0.0
Net Weight	mg	0.0

FTR Blank CPM was >2.0 mg.

AIRSOURCE TECHNOLOGIES, INC.

Run Report - Particulate Matter

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	113

Stack or Duct Dimensions

(●) Circular ( ) Rectangular

Diameter # 1	in.	122.000
Diameter # 2	in.	122.000
Cross-Section Area	ft^2	81.180

Gas Stream Conditions

Avg. Gas Temperature	°F	760
Avg. Velocity Head (Δp)	in. H_2O	0.157
Static Gas Pressure	in. H_2O	0.00
Absolute Gas Pressure	in. Hg	29.25
O_2 Concentration, Dry	%V	16.07
CO_2 Concentration, Dry	%V	3.16
Moisture	%V	21.82
Dry Molecular Weight	lb/lb-mole	29.15
Wet Molecular Weight	lb/lb-mole	26.72

Sampling Conditions

Sampling Time	min	48.00
Avg. Nozzle Diameter	in.	0.376
Avg. Isokinetic Variation	%	102.7
IKV 90-110% Criterion	—	Pass

Dry Gas Meter Conditions

Console Elevation	ft	0
DGM Correction (Y)	—	1.015
Average ΔH	in. H_2O	1.35
Avg. DGM Temperature	°F	89.2
Initial DGM Volume	ft^3	759.510
Final DGM Volume	ft^3	787.400
Leak Check Volume	ft^3	-0.000
Leak Correction Volume	ft^3	
Net DGM Volume	ft^3	27.890
Dry Gas Sample Volume	dscf	26.796

Other Related Data

Barometer Reading	in. Hg	29.37
Test Location Elevation	ft	125
Pitot Tube Coefficient	—	0.840
Average SQRT(Δp)	in. H_2O	0.396

Volumetric Flow Rate Results

Average Gas Velocity	ft/min	2,133
Volumetric Flow, Actual	acfm	173,133
Corrected Flow, Wet	scfm	73,204
Corrected Flow, Dry	dscfm	57,232

Particulate Matter Emission Results

		Filterable	Condensable	Total
Total Particulate Matter Collected	mg	117.2	51.1	168.3
Concentration (Wet)	mg/acf	1.45	0.630	2.08
Concentration (Wet)	gr/acf	0.0223	9.73E-03	0.0320
Concentration (Dry)	mg/dscf	4.37	1.91	6.28
Concentration (Dry)	gr/dscf	0.0675	0.0294	0.0969
Emission Rate	lb/hr	33.1	14.4	47.5

AIRSOURCE TECHNOLOGIES INC.

Metric Equivalents - Particulate Matter

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	113

Stack or Duct Dimensions

◉ Circular ○ Rectangular

Diameter # 1	m	3.0988
Diameter # 2	m	3.0988
Cross-Section Area	m^2	7.5418

Gas Stream Conditions

Avg. Gas Temperature	°C	404
Avg. Velocity Head (Δp)	mm H_2O	4.0
Static Gas Pressure	mm H_2O	0.0
Absolute Gas Pressure	mm Hg	742.8
O_2 Concentration, Dry	%V	16.07
CO_2 Concentration, Dry	%V	3.16
Moisture	%V	21.82
Dry Molecular Weight	g/g-mole	29.15
Wet Molecular Weight	g/g-mole	26.72

Sampling Conditions

Sampling Time	min	48.00
Avg. Nozzle Diameter	mm	9.55
Avg. Isokinetic Variation	%	102.7
IKV 90-110% Criterion	—	Pass

Dry Gas Meter Conditions

Console Elevation	m	0.0
DGM Correction (Y)	—	1.015
Average ΔH	mm H_2O	34.4
Avg. DGM Temperature	° C	31.8
Initial DGM Volume	m^3	21.50693
Final DGM Volume	m^3	22.29669
Leak Check Volume	m^3	-0.00000
Leak Correction Volume	m^3	
Net DGM Volume	m^3	0.78976
Dry Gas Sample Volume	dscm	0.75878

Other Related Data

Barometer Reading	mm Hg	746.0
Test Location Elevation	m	38.1
Pitot Tube Coefficient	—	0.840
Average SQRT(Δp)	mm H_2O	2.00

Volumetric Flow Rate Results

Average Gas Velocity	m/min	650.1
Volumetric Flow, Actual	acm/min	4,902.6
Corrected Flow, Wet	scm/min	2,072.92
Corrected Flow, Dry	dscm/min	1,620.64

Particulate Matter Emission Results		Filterable	Condensable	Total
Total Particulate Matter Collected	mg	117.2	51.1	168.3
Concentration (Wet)	mg/acm	51.1	22.3	73.3
Concentration (Dry)	mg/dscm	154	67.3	222
Emission Rate	kg/hr	15.0	6.55	21.6

AIRSOURCE TECHNOLOGIES, INC.

Traverse Data - Particulate Matter

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	113

Traverse Point	Gas Temp., °F	Δp in. H_2O	ΔH in. H_2O	DGM Inlet, °F	DGM Outlet, °F
A1	740	0.120	1.00	87	87
2	756	0.200	1.70	88	88
3	761	0.220	1.90	88	88
B1	746	0.130	1.10	89	89
2	761	0.150	1.30	89	89
3	764	0.170	1.40	90	90
C1	753	0.080	0.70	90	90
2	756	0.140	1.20	90	90
3	778	0.160	1.30	90	90
D1	758	0.150	1.30	89	89
2	788	0.240	2.00	91	91
3					
Average	**760**	**0.157**	**1.35**	**89.2**	**89.2**

Leak Check Volumes

Initial					
Final					
Difference					

AIRSOURCE TECHNOLOGIES, INC.

Filterable Particulate Matter and Moisture Analysis

Project	Rain	Location	K-1 Stack
Project Number	4173	Method	EPA Methods 5 and 202
Test Date	July 20, 2023	Run No.	113

Impinger Weights

		Initial	Final	Difference
Condenser & Knockout	g	647.9	778.5	130.6
CPM Impinger	g	511.8	512.0	0.2
H_2O Impinger	g	637.1	643.2	6.1
H_2O Impinger	g			
Silica Gel	g	834.5	856.2	21.7
	Total Collected		g	158.6

Moisture Results

Moisture Volume	scf	7.478
Dry Gas Sample Volume	dscf	26.796
Sampled Moisture	%V	21.82
Saturation Moisture	%V	N/A
Reported Moisture	%V	21.82

Rinse Reagent

(●) Acetone ( ) Water

Sampling Train Front-half Rinses

Container Gross Wt.	g	296.5
Container Empty Wt.	g	167.5
Sample Volume	mLs	163.3
Evap. Beaker No.	C22-8-40	
Beaker Tare Weight	g	30.2974
Beaker Final Weight	g	30.3450
Blank Correction	mg	-0.1
Net Weight	mg	47.5

Acetone Field Reagent Blank

Container Gross Wt.	g	300.5
Container Empty Wt.	g	166.9
Reagent Blank Volume	mLs	169.1
Evap. Beaker No.	C22-8-29	
Beaker Tare Weight	g	28.8716
Beaker Final Weight	g	28.8717
Residue Weight	mg	0.1
Blank Concentration	mg/mL	0.0006

Dry Catch and Filter Weights

Filter No.	F22-9-10	
Filter Tare Weight	g	34.5761
Filter Final Weight	g	34.6458
Filter Blank	g	NA
Net Weight	mg	69.7

Filter Blank

(●) Not Used ( ) Used

Filter No.		
Filter Tare Weight	g	
Filter Final Weight	g	

Total Filterable Particulate Matter

Total Weight	mg	117.2

AIRSOURCE TECHNOLOGIES, INC.

Condensable Particulate Matter Analysis

Project	Rain	Location	K-1 Stack
Project Number	4173	Method	EPA Methods 5 and 202
Test Date	July 20, 2023	Run No.	113

Hexane Field Reagent Blank

Container Gross Wt.	g	344.6
Container Empty Wt.	g	165.8
Reagent Blank Volume	mLs	269.7
Evap. Beaker No.	C22-8-30	
Beaker Tare Weight	g	29.9420
Beaker Final Weight	g	29.9428
Residue Weight	mg	0.8

Water Field Reagent Blank

Container Gross Wt.	g	261.0
Container Empty Wt.	g	164.4
Water Blank Volume	mLs	96.8
Evap. Beaker No.	C22-8-31	
Beaker Tare Weight	g	30.5884
Beaker Final Weight	g	30.5885
Residue Weight	mg	0.1

Field Train Recovery (FTR) Blank

Organic Fraction

Container Gross Wt.	g	557.0
Container Empty Wt.	g	297.0
Sample Wt.	g	260.0
Evap. Beaker No.	C22-8-35	
Beaker Tare Weight	g	29.9567
Beaker Final Weight	g	29.9575
Net Weight	mg	0.8

Mass of NH_4^+ Added To Sample

NH_4OH Normality	meq/mL	0.0000
Titrant Volume Used	mLs	0.0
NH_4^+ added to Sample	mg	0.0

Total Condensable Particulate Matter

Total FTR Blank CPM	mg	3.5

Inorganic Fraction

Container Gross Wt.	g	763.5
Container Empty Wt.	g	504.1
Sample Wt.	g	259.4
Evap. Beaker No.	C22-8-34	
Beaker Tare Weight	g	29.5305
Beaker Final Weight	g	29.5332
Less NH_4^+ in Sample	mg	0.0
Net Weight	mg	2.7

Filter Weights

Filter No.	NA	
Filter Tare Weight	g	0.0
Filter Final Weight	g	0.0
Net Weight	mg	0.0

CPM Sampling Train

Organic Fraction

Container Gross Wt.	g	916.1
Container Empty Wt.	g	506.0
Sample Wt.	g	410.1
Evap. Beaker No.	C22-10-23	
Beaker Tare Weight	g	1.6017
Beaker Final Weight	g	1.6512
Net Weight	mg	49.5

Mass of NH_4^+ Added To Sample

NH_4OH Normality	meq/mL	0.0000
Titrant Volume Used	mLs	0.0
NH_4^+ added to Sample	mg	0.0

Total Condensable Particulate Matter

Total CPM Weight	mg	53.1
Blank Correction Used	mg	-2.0
Corrected CPM Weight	mg	51.1

Inorganic Fraction

Container Gross Wt.	g	575.7
Container Empty Wt.	g	297.5
Sample Wt.	g	278.2
Evap. Beaker No.	C22-8-73	
Beaker Tare Weight	g	29.4557
Beaker Final Weight	g	29.4593
Less NH_4^+ in Sample	mg	0.0
Net Weight	mg	3.6

Filter Weights

Filter No.	NA	
Filter Tare Weight	g	0.0
Filter Final Weight	g	0.0
Net Weight	mg	0.0

FTR Blank CPM was >2.0 mg.

AIRSOURCE TECHNOLOGIES, INC.

Run Report - Particulate Matter

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	114

Stack or Duct Dimensions

(●) Circular ( ) Rectangular

Diameter # 1	in.	122.000
Diameter # 2	in.	122.000
Cross-Section Area	ft^2	81.180

Gas Stream Conditions

Avg. Gas Temperature	°F	847
Avg. Velocity Head (Δp)	in. H_2O	0.167
Static Gas Pressure	in. H_2O	0.00
Absolute Gas Pressure	in. Hg	29.19
O_2 Concentration, Dry	%V	15.33
CO_2 Concentration, Dry	%V	3.65
Moisture	%V	18.76
Dry Molecular Weight	lb/lb-mole	29.20
Wet Molecular Weight	lb/lb-mole	27.10

Sampling Conditions

Sampling Time	min	48.00
Avg. Nozzle Diameter	in.	0.388
Avg. Isokinetic Variation	%	108.8
IKV 90-110% Criterion	—	Pass

Dry Gas Meter Conditions

Console Elevation	ft	0
DGM Correction (Y)	—	1.015
Average ΔH	in. H_2O	1.53
Avg. DGM Temperature	°F	88.0
Initial DGM Volume	ft^3	787.750
Final DGM Volume	ft^3	820.000
Leak Check Volume	ft^3	-0.000
Leak Correction Volume	ft^3	
Net DGM Volume	ft^3	32.250
Dry Gas Sample Volume	dscf	31.003

Other Related Data

Barometer Reading	in. Hg	29.31
Test Location Elevation	ft	125
Pitot Tube Coefficient	—	0.840
Average SQRT(Δp)	in. H_2O	0.408

Volumetric Flow Rate Results

Average Gas Velocity	ft/min	2,261
Volumetric Flow, Actual	acfm	183,552
Corrected Flow, Wet	scfm	72,282
Corrected Flow, Dry	dscfm	58,725

Particulate Matter Emission Results

		Filterable	Condensable	Total
Total Particulate Matter Collected	mg	176.2	89.5	265.7
Concentration (Wet)	mg/acf	1.82	0.924	2.74
Concentration (Wet)	gr/acf	0.0281	0.0143	0.0423
Concentration (Dry)	mg/dscf	5.68	2.89	8.57
Concentration (Dry)	gr/dscf	0.0877	0.0446	0.132
Emission Rate	lb/hr	44.1	22.4	66.6

AIRSOURCE TECHNOLOGIES, INC.

Metric Equivalents - Particulate Matter

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	114

Stack or Duct Dimensions

(●) Circular ( ) Rectangular

Diameter # 1	m	3.0988
Diameter # 2	m	3.0988
Cross-Section Area	m^2	7.5418

Gas Stream Conditions

Avg. Gas Temperature	°C	453
Avg. Velocity Head (Δp)	mm H_2O	4.2
Static Gas Pressure	mm H_2O	0.0
Absolute Gas Pressure	mm Hg	741.3
O_2 Concentration, Dry	%V	15.33
CO_2 Concentration, Dry	%V	3.65
Moisture	%V	18.76
Dry Molecular Weight	g/g-mole	29.20
Wet Molecular Weight	g/g-mole	27.10

Sampling Conditions

Sampling Time	min	48.00
Avg. Nozzle Diameter	mm	9.86
Avg. Isokinetic Variation	%	108.8
IKV 90-110% Criterion	—	Pass

Dry Gas Meter Conditions

Console Elevation	m	0.0
DGM Correction (Y)	—	1.015
Average ΔH	mm H_2O	38.9
Avg. DGM Temperature	° C	31.1
Initial DGM Volume	m^3	22.30660
Final DGM Volume	m^3	23.21981
Leak Check Volume	m^3	-0.00000
Leak Correction Volume	m^3	
Net DGM Volume	m^3	0.91322
Dry Gas Sample Volume	dscm	0.87789

Other Related Data

Barometer Reading	mm Hg	744.5
Test Location Elevation	m	38.1
Pitot Tube Coefficient	—	0.840
Average SQRT(Δp)	mm H_2O	2.06

Volumetric Flow Rate Results

Average Gas Velocity	m/min	689.2
Volumetric Flow, Actual	acm/min	5,197.6
Corrected Flow, Wet	scm/min	2,046.80
Corrected Flow, Dry	dscm/min	1,662.90

Particulate Matter Emission Results

		Filterable	Condensable	Total
Total Particulate Matter Collected	mg	176.2	89.5	265.7
Concentration (Wet)	mg/acm	64.2	32.6	96.8
Concentration (Dry)	mg/dscm	201	102	303
Emission Rate	kg/hr	20.0	10.2	30.2

AIRSOURCE TECHNOLOGIES, INC.

Traverse Data - Particulate Matter

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	114

Traverse Point	Gas Temp., °F	Δp in. H_2O	ΔH in. H_2O	DGM Inlet, °F	DGM Outlet, °F
A1	814	0.130	1.20	84	84
2	842	0.240	2.10	84	84
3	845	0.250	2.20	87	87
B1	813	0.200	1.80	86	86
2	845	0.050	0.50	88	88
3	853	0.200	1.80	88	88
C1	835	0.100	0.90	89	89
2	850	0.150	1.40	89	89
3	852	0.180	1.60	90	90
D1	861	0.140	1.20	90	90
2	877	0.210	1.80	90	90
3	881	0.220	1.90	91	91
Average	**847**	**0.167**	**1.53**	**88.0**	**88.0**

Leak Check Volumes

Initial					
Final					
Difference					

AIRSOURCE TECHNOLOGIES, INC.

Filterable Particulate Matter and Moisture Analysis

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	114

Impinger Weights

		Initial	Final	Difference
Condenser & Knockout	g	648.5	798.0	149.5
CPM Impinger	g	579.9	579.9	0.0
H_2O Impinger	g	691.8	689.1	-2.7
H_2O Impinger	g			
Silica Gel	g	653.8	658.8	5.0
	Total Collected		g	151.8

Moisture Results

Moisture Volume	scf	7.157
Dry Gas Sample Volume	dscf	31.003
Sampled Moisture	%V	18.76
Saturation Moisture	%V	N/A
Reported Moisture	%V	18.76

Rinse Reagent

◉ Acetone ○ Water

Sampling Train Front-half Rinses

Container Gross Wt.	g	291.5
Container Empty Wt.	g	165.7
Sample Volume	mLs	159.2
Evap. Beaker No.	C22-8-74	
Beaker Tare Weight	g	29.6651
Beaker Final Weight	g	29.7389
Blank Correction	mg	-0.1
Net Weight	mg	73.7

Acetone Field Reagent Blank

Container Gross Wt.	g	300.5
Container Empty Wt.	g	166.9
Reagent Blank Volume	mLs	169.1
Evap. Beaker No.	C22-8-29	
Beaker Tare Weight	g	28.8716
Beaker Final Weight	g	28.8717
Residue Weight	mg	0.1
Blank Concentration	mg/mL	0.0006

Dry Catch and Filter Weights

Filter No.	F23-7-2	
Filter Tare Weight	g	29.3093
Filter Final Weight	g	29.4118
Filter Blank	g	NA
Net Weight	mg	102.5

Filter Blank

◉ Not Used ○ Used

Filter No.		
Filter Tare Weight	g	
Filter Final Weight	g	

Total Filterable Particulate Matter

Total Weight	mg	176.2

AIRSOURCE TECHNOLOGIES, INC.

Condensable Particulate Matter Analysis

Project	Rain	Location	K-1 Stack
Project Number	4173	Method	EPA Methods 5 and 202
Test Date	July 20, 2023	Run No.	114

Hexane Field Reagent Blank

Container Gross Wt.	g	344.6
Container Empty Wt.	g	165.8
Reagent Blank Volume	mLs	269.7
Evap. Beaker No.	C22-8-30	
Beaker Tare Weight	g	29.9420
Beaker Final Weight	g	29.9428
Residue Weight	mg	0.8

Water Field Reagent Blank

Container Gross Wt.	g	261.0
Container Empty Wt.	g	164.4
Water Blank Volume	mLs	96.8
Evap. Beaker No.	C22-8-31	
Beaker Tare Weight	g	30.5884
Beaker Final Weight	g	30.5885
Residue Weight	mg	0.1

Field Train Recovery (FTR) Blank

Organic Fraction

Container Gross Wt.	g	557.0
Container Empty Wt.	g	297.0
Sample Wt.	g	260.0
Evap. Beaker No.	C22-8-35	
Beaker Tare Weight	g	29.9567
Beaker Final Weight	g	29.9575
Net Weight	mg	0.8

Mass of NH_4^+ Added To Sample

NH_4OH Normality	meq/mL	0.0000
Titrant Volume Used	mLs	0.0
NH_4^+ added to Sample	mg	0.0

Total Condensable Particulate Matter

Total FTR Blank CPM	mg	3.5

Inorganic Fraction

Container Gross Wt.	g	763.5
Container Empty Wt.	g	504.1
Sample Wt.	g	259.4
Evap. Beaker No.	C22-8-34	
Beaker Tare Weight	g	29.5305
Beaker Final Weight	g	29.5332
Less NH_4^+ in Sample	mg	0.0
Net Weight	mg	2.7

Filter Weights

Filter No.	NA	
Filter Tare Weight	g	0.0
Filter Final Weight	g	0.0
Net Weight	mg	0.0

CPM Sampling Train

Organic Fraction

Container Gross Wt.	g	857.8
Container Empty Wt.	g	501.5
Sample Wt.	g	356.3
Evap. Beaker No.	C22-10-24	
Beaker Tare Weight	g	1.6011
Beaker Final Weight	g	1.6891
Net Weight	mg	88.0

Mass of NH_4^+ Added To Sample

NH_4OH Normality	meq/mL	0.0000
Titrant Volume Used	mLs	0.0
NH_4^+ added to Sample	mg	0.0

Total Condensable Particulate Matter

Total CPM Weight	mg	91.5
Blank Correction Used	mg	-2.0
Corrected CPM Weight	mg	89.5

Inorganic Fraction

Container Gross Wt.	g	560.9
Container Empty Wt.	g	295.2
Sample Wt.	g	265.7
Evap. Beaker No.	C22-8-75	
Beaker Tare Weight	g	28.5397
Beaker Final Weight	g	28.5432
Less NH_4^+ in Sample	mg	0.0
Net Weight	mg	3.5

Filter Weights

Filter No.	NA	
Filter Tare Weight	g	0.0
Filter Final Weight	g	0.0
Net Weight	mg	0.0

FTR Blank CPM was >2.0 mg.

AIRSOURCE TECHNOLOGIES, INC.

Run Report - Particulate Matter

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	115

Stack or Duct Dimensions

◉ Circular ○ Rectangular

Diameter # 1	in.	122.000
Diameter # 2	in.	122.000
Cross-Section Area	ft^2	81.180

Gas Stream Conditions

Avg. Gas Temperature	°F	931
Avg. Velocity Head (Δp)	in. H_2O	0.175
Static Gas Pressure	in. H_2O	0.00
Absolute Gas Pressure	in. Hg	29.20
O_2 Concentration, Dry	%V	14.97
CO_2 Concentration, Dry	%V	3.85
Moisture	%V	19.62
Dry Molecular Weight	lb/lb-mole	29.21
Wet Molecular Weight	lb/lb-mole	27.01

Sampling Conditions

Sampling Time	min	48.00
Avg. Nozzle Diameter	in.	0.396
Avg. Isokinetic Variation	%	109.2
IKV 90-110% Criterion	—	Pass

Dry Gas Meter Conditions

Console Elevation	ft	0
DGM Correction (Y)	—	1.015
Average ΔH	in. H_2O	1.65
Avg. DGM Temperature	°F	92.1
Initial DGM Volume	ft^3	821.200
Final DGM Volume	ft^3	854.600
Leak Check Volume	ft^3	-0.000
Leak Correction Volume	ft^3	
Net DGM Volume	ft^3	33.400
Dry Gas Sample Volume	dscf	31.891

Other Related Data

Barometer Reading	in. Hg	29.32
Test Location Elevation	ft	125
Pitot Tube Coefficient	—	0.840
Average SQRT(Δp)	in. H_2O	0.418

Volumetric Flow Rate Results

Average Gas Velocity	ft/min	2,392
Volumetric Flow, Actual	acfm	194,172
Corrected Flow, Wet	scfm	71,881
Corrected Flow, Dry	dscfm	57,778

Particulate Matter Emission Results

		Filterable	Condensable	Total
Total Particulate Matter Collected	mg	215.8	141.2	357.0
Concentration (Wet)	mg/acf	2.01	1.32	3.33
Concentration (Wet)	gr/acf	0.0311	0.0203	0.0514
Concentration (Dry)	mg/dscf	6.77	4.43	11.2
Concentration (Dry)	gr/dscf	0.104	0.0683	0.173
Emission Rate	lb/hr	51.7	33.8	85.6

AIRSOURCE TECHNOLOGIES, INC.

Metric Equivalents - Particulate Matter

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	115

Stack or Duct Dimensions

◉ Circular ○ Rectangular

Diameter # 1	m	3.0988
Diameter # 2	m	3.0988
Cross-Section Area	m^2	7.5418

Gas Stream Conditions

Avg. Gas Temperature	°C	500
Avg. Velocity Head (Δp)	mm H_2O	4.4
Static Gas Pressure	mm H_2O	0.0
Absolute Gas Pressure	mm Hg	741.6
O_2 Concentration, Dry	%V	14.97
CO_2 Concentration, Dry	%V	3.85
Moisture	%V	19.62
Dry Molecular Weight	g/g-mole	29.21
Wet Molecular Weight	g/g-mole	27.01

Sampling Conditions

Sampling Time	min	48.00
Avg. Nozzle Diameter	mm	10.06
Avg. Isokinetic Variation	%	109.2
IKV 90-110% Criterion	—	Pass

Dry Gas Meter Conditions

Console Elevation	m	0.0
DGM Correction (Y)	—	1.015
Average ΔH	mm H_2O	41.9
Avg. DGM Temperature	° C	33.4
Initial DGM Volume	m^3	23.25379
Final DGM Volume	m^3	24.19958
Leak Check Volume	m^3	-0.00000
Leak Correction Volume	m^3	
Net DGM Volume	m^3	0.94578
Dry Gas Sample Volume	dscm	0.90304

Other Related Data

Barometer Reading	mm Hg	744.7
Test Location Elevation	m	38.1
Pitot Tube Coefficient	—	0.840
Average SQRT(Δp)	mm H_2O	2.11

Volumetric Flow Rate Results

Average Gas Velocity	m/min	729.0
Volumetric Flow, Actual	acm/min	5,498.3
Corrected Flow, Wet	scm/min	2,035.45
Corrected Flow, Dry	dscm/min	1,636.08

Particulate Matter Emission Results

		Filterable	Condensable	Total
Total Particulate Matter Collected	mg	215.8	141.2	357.0
Concentration (Wet)	mg/acm	71.1	46.5	118
Concentration (Dry)	mg/dscm	239	156	395
Emission Rate	kg/hr	23.5	15.3	38.8

AIRSOURCE TECHNOLOGIES, INC.

Traverse Data - Particulate Matter

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	115

Traverse Point	Gas Temp., °F	Δp in. H_2O	ΔH in. H_2O	DGM Inlet, °F	DGM Outlet, °F
A1	886	0.100	1.00	89	89
2	909	0.190	2.00	90	90
3	930	0.230	2.10	91	91
B1	901	0.120	1.10	91	91
2	924	0.150	1.40	92	92
3	934	0.200	1.80	92	92
C1	925	0.120	1.10	92	92
2	922	0.170	1.60	93	93
3	941	0.200	1.80	93	93
D1	950	0.150	1.40	94	94
2	970	0.250	2.20	94	94
3	982	0.260	2.30	94	94
Average	**931**	**0.175**	**1.65**	**92.1**	**92.1**

Leak Check Volumes

Initial					
Final					
Difference					

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Filterable Particulate Matter and Moisture Analysis

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Methods 5 and 202
Test Date	July 20, 2023	**Run No.**	115

Impinger Weights

		Initial	Final	Difference
Condenser & Knockout	g	770.1	922.2	152.1
CPM Impinger	g	605.9	606.0	0.1
H_2O Impinger	g	615.9	605.4	-10.5
H_2O Impinger	g			
Silica Gel	g	741.4	764.8	23.4
	Total Collected		g	165.1

Moisture Results

Moisture Volume	scf	7.784
Dry Gas Sample Volume	dscf	31.891
Sampled Moisture	%V	19.62
Saturation Moisture	%V	N/A
Reported Moisture	%V	19.62

Rinse Reagent

◉ Acetone ○ Water

Sampling Train Front-half Rinses

Container Gross Wt.	g	306.4
Container Empty Wt.	g	165.7
Sample Volume	mLs	178.1
Evap. Beaker No.	C22-8-76	
Beaker Tare Weight	g	31.3314
Beaker Final Weight	g	31.4437
Blank Correction	mg	-0.1
Net Weight	mg	112.2

Acetone Field Reagent Blank

Container Gross Wt.	g	300.5
Container Empty Wt.	g	166.9
Reagent Blank Volume	mLs	169.1
Evap. Beaker No.	C22-8-29	
Beaker Tare Weight	g	28.8716
Beaker Final Weight	g	28.8717
Residue Weight	mg	0.1
Blank Concentration	mg/mL	0.0006

Dry Catch and Filter Weights

Filter No.	F22-10-24	
Filter Tare Weight	g	37.0460
Filter Final Weight	g	37.1496
Filter Blank	g	NA
Net Weight	mg	103.6

Filter Blank

◉ Not Used ○ Used

Filter No.		
Filter Tare Weight	g	
Filter Final Weight	g	

Total Filterable Particulate Matter

Total Weight	mg	215.8

AIRSOURCE TECHNOLOGIES, INC.

Condensable Particulate Matter Analysis

Project	Rain	Location	K-1 Stack
Project Number	4173	Method	EPA Methods 5 and 202
Test Date	July 20, 2023	Run No.	115

Hexane Field Reagent Blank

Container Gross Wt.	g	344.6
Container Empty Wt.	g	165.8
Reagent Blank Volume	mLs	269.7
Evap. Beaker No.	C22-8-30	
Beaker Tare Weight	g	29.9420
Beaker Final Weight	g	29.9428
Residue Weight	mg	0.8

Water Field Reagent Blank

Container Gross Wt.	g	261.0
Container Empty Wt.	g	164.4
Water Blank Volume	mLs	96.8
Evap. Beaker No.	C22-8-31	
Beaker Tare Weight	g	30.5884
Beaker Final Weight	g	30.5885
Residue Weight	mg	0.1

Field Train Recovery (FTR) Blank

Organic Fraction

Container Gross Wt.	g	557.0
Container Empty Wt.	g	297.0
Sample Wt.	g	260.0
Evap. Beaker No.	C22-8-35	
Beaker Tare Weight	g	29.9567
Beaker Final Weight	g	29.9575
Net Weight	mg	0.8

Mass of NH_4^+ Added To Sample

NH_4OH Normality	meq/mL	0.0000
Titrant Volume Used	mLs	0.0
NH_4^+ added to Sample	mg	0.0

Total Condensable Particulate Matter

Total FTR Blank CPM	mg	3.5

Inorganic Fraction

Container Gross Wt.	g	763.5
Container Empty Wt.	g	504.1
Sample Wt.	g	259.4
Evap. Beaker No.	C22-8-34	
Beaker Tare Weight	g	29.5305
Beaker Final Weight	g	29.5332
Less NH_4^+ in Sample	mg	0.0
Net Weight	mg	2.7

Filter Weights

Filter No.	NA	
Filter Tare Weight	g	0.0
Filter Final Weight	g	0.0
Net Weight	mg	0.0

CPM Sampling Train

Organic Fraction

Container Gross Wt.	g	876.0
Container Empty Wt.	g	502.3
Sample Wt.	g	373.7
Evap. Beaker No.	C22-8-77	
Beaker Tare Weight	g	31.2497
Beaker Final Weight	g	31.3864
Net Weight	mg	136.7

Mass of NH_4^+ Added To Sample

NH_4OH Normality	meq/mL	0.0000
Titrant Volume Used	mLs	0.0
NH_4^+ added to Sample	mg	0.0

Total Condensable Particulate Matter

Total CPM Weight	mg	143.2
Blank Correction Used	mg	-2.0
Corrected CPM Weight	mg	141.2

Inorganic Fraction

Container Gross Wt.	g	557.3
Container Empty Wt.	g	296.5
Sample Wt.	g	260.8
Evap. Beaker No.	C22-8-78	
Beaker Tare Weight	g	28.9085
Beaker Final Weight	g	28.9150
Less NH_4^+ in Sample	mg	0.0
Net Weight	mg	6.5

Filter Weights

Filter No.	NA	
Filter Tare Weight	g	0.0
Filter Final Weight	g	0.0
Net Weight	mg	0.0

FTR Blank CPM was >2.0 mg.

Appendix B-2

Instrumental Analyzer Results

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Initial Instrument Calibrations

Project No.	4173	**Project**	Rain CII Inv. '23
Test Date	7/20/2023	**Location**	Kiln #1

	Standards		**Calibration Error**		**Calibration Bias**	
	Span	EPA Protocol Gas	Instrument Response	Calibration Error	System Response	Calibration Bias
O_2	21	0 12.11 % v/v 21	0.00 12.25 20.98	0.0% 0.7% -0.1%	0.04 12.06	0.2% -0.9%
CO_2	12	0 5.86 % v/v 12.36	-0.01 5.93 12.35	0.0% 0.6% -0.1%	0.16 12.43	1.4% 0.7%

	Standards		**System Response**	
	Span	EPA Protocol Gas	System Response	Calibration Error
THC	25	0.0 ppmv 8.4 ppmv 16.2 ppmv 30.2 ppmv	-0.1 8.5 16.1 30.0	 1.2% -0.5%
	50	51.9 ppmv	52.0	0.2%

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Instrument Run Report

Project No.	4173
Project	Rain CII Inv. '23

Run ID: 1-1-1

Location: Kiln #1

Date: 7/20/2023

Time: 09:45-10:30

Adjusted Data

O2 % v/v	CO2 % v/v	THC ppmv
dry	dry	wet
17.72	**1.86**	**4.4**

Instrument Responses

		O2	CO2	THC
Gas Standards		12.11	12.36	8.4
Initial Calibration	Zero	0.04	0.16	-0.1
	Upscale	12.06	12.43	8.5
Raw Data		17.60	2.02	4.33
Final Calibration	Zero	0.14	0.18	-0.1
	Upscale	12.06	12.49	8.3

Calibration Performance

		O2	CO2	THC
Instrument Span		21	12	25
Initial Bias	Zero	0.2%	1.4%	-0.2%
	Upscale	-0.9%	0.7%	0.4%
Final Bias	Zero	0.6%	1.5%	-0.4%
	Upscale	-0.9%	1.1%	-0.4%
Drift	Zero	0.4%	0.1%	-0.2%
	Upscale	0.0%	0.5%	-0.8%

AIRSOURCE TECHNOLOGIES, INC.

Instrument Run Report

Project No.	4173
Project	Rain CII Inv. '23

Run ID: 1-1-2

Location: Kiln #1

Date: 7/20/2023

Time: 10:45-11:30

Adjusted Data

O2 % v/v dry	CO2 % v/v dry	THC ppmv wet
16.66	**2.62**	**0.9**

Instrument Responses

		O2	CO2	THC
Gas Standards		12.11	12.36	8.4
Initial Calibration	Zero	0.14	0.18	-0.1
	Upscale	12.06	12.49	8.3
Raw Data		16.52	2.81	0.75
Final Calibration	Zero	0.05	0.24	-0.2
	Upscale	12.00	12.45	8.2

Calibration Performance

		O2	CO2	THC
Instrument Span		21	12	25
Initial Bias	Zero	0.6%	1.5%	-0.4%
	Upscale	-0.9%	1.1%	-0.4%
Final Bias	Zero	0.2%	2.0%	-0.7%
	Upscale	-1.2%	0.8%	-0.7%
Drift	Zero	-0.4%	0.5%	-0.3%
	Upscale	-0.3%	-0.3%	-0.3%

AIR SOURCE TECHNOLOGIES, INC.

Instrument Run Report

Project No.	4173
Project	Rain CII Inv. '23

Run ID: 1-1-3

Location: Kiln #1

Date: 7/20/2023

Time: 11:45-12:30

Adjusted Data

O2 % v/v dry	CO2 % v/v dry	THC ppmv wet
16.34	**2.98**	**0.8**

Instrument Responses

		O2	CO2	THC
Gas Standards		12.11	12.36	8.4
Initial Calibration	Zero	0.05	0.24	-0.2
	Upscale	12.00	12.45	8.2
Raw Data		16.15	3.17	0.64
Final Calibration	Zero	0.16	0.22	-0.2
	Upscale	11.99	12.42	8.2

Calibration Performance

		O2	CO2	THC
Instrument Span		21	12	25
Initial Bias	Zero	0.2%	2.0%	-0.7%
	Upscale	-1.2%	0.8%	-0.7%
Final Bias	Zero	0.7%	1.8%	-0.8%
	Upscale	-1.2%	0.6%	-0.7%
Drift	Zero	0.5%	-0.1%	-0.1%
	Upscale	-0.1%	-0.2%	0.0%

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Instrument Run Report

Project No.	4173
Project	Rain CII Inv. '23

Run ID: 1-1-4

Location: Kiln #1

Date: 7/20/2023

Time: 12:47-13:32

Adjusted Data

O2 % v/v	CO2 % v/v	THC ppmv
dry	dry	wet
15.90	**3.04**	**0.7**

Instrument Responses

		O2	CO2	THC
Gas Standards		12.11	12.36	8.4
Initial Calibration	Zero	0.16	0.22	-0.2
	Upscale	11.99	12.42	8.2
Raw Data		15.71	3.18	0.51
Final Calibration	Zero	0.10	0.15	-0.2
	Upscale	12.00	12.34	8.2

Calibration Performance

		O2	CO2	THC
Instrument Span		21	12	25
Initial Bias	Zero	0.7%	1.8%	-0.8%
	Upscale	-1.2%	0.6%	-0.7%
Final Bias	Zero	0.5%	1.2%	-0.8%
	Upscale	-1.2%	-0.1%	-0.7%
Drift	Zero	-0.3%	-0.6%	0.0%
	Upscale	0.1%	-0.7%	0.0%

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Instrument Run Report

Project No.	4173
Project	Rain CII Inv. '23

Run ID: 1-1-5

Location: Kiln #1

Date: 7/20/2023

Time: 13:45-14:30

Adjusted Data

O2 % v/v	CO2 % v/v	THC ppmv
dry	dry	wet
16.07	**3.16**	**0.7**

Instrument Responses

		O2	CO2	THC
Gas Standards		12.11	12.36	8.4
Initial Calibration	Zero	0.10	0.15	-0.2
	Upscale	12.00	12.34	8.2
Raw Data		15.92	3.26	0.46
Final Calibration	Zero	0.06	0.15	-0.3
	Upscale	12.03	12.34	8.2

Calibration Performance

		O2	CO2	THC
Instrument Span		21	12	25
Initial Bias	Zero	0.5%	1.2%	-0.8%
	Upscale	-1.2%	-0.1%	-0.7%
Final Bias	Zero	0.3%	1.2%	-1.1%
	Upscale	-1.1%	-0.1%	-0.8%
Drift	Zero	-0.2%	0.0%	-0.2%
	Upscale	0.1%	0.0%	-0.2%

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Instrument Run Report

Project No.	4173
Project	Rain CII Inv. '23

Run ID: 1-1-6

Location: Kiln #1

Date: 7/20/2023

Time: 14:45-15:30

Adjusted Data

O2 % v/v	CO2 % v/v	THC ppmv
dry	dry	wet
15.93	**3.31**	**0.6**

Instrument Responses

		O2	CO2	THC
Gas Standards		12.11	12.36	8.4
Initial Calibration	Zero	0.06	0.15	-0.3
	Upscale	12.03	12.34	8.2
Raw Data		15.79	3.40	0.37
Final Calibration	Zero	0.07	0.14	-0.3
	Upscale	12.01	12.32	8.2

Calibration Performance

		O2	CO2	THC
Instrument Span		21	12	25
Initial Bias	Zero	0.3%	1.2%	-1.1%
	Upscale	-1.1%	-0.1%	-0.8%
Final Bias	Zero	0.3%	1.2%	-1.1%
	Upscale	-1.2%	-0.2%	-0.7%
Drift	Zero	0.0%	-0.1%	-0.1%
	Upscale	-0.1%	-0.2%	0.1%

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Instrument Run Report

Project No.	4173
Project	Rain CII Inv. '23

Run ID: 1-1-7

Location: Kiln #1

Date: 7/20/2023

Time: 15:45-16:30

Adjusted Data

O2 % v/v	CO2 % v/v	THC ppmv
dry	dry	wet
15.69	**3.47**	**0.7**

Instrument Responses

		O2	CO2	THC
Gas Standards		12.11	12.36	8.4
Initial Calibration	Zero	0.07	0.14	-0.3
	Upscale	12.01	12.32	8.2
Raw Data		15.58	3.58	0.45
Final Calibration	Zero	0.02	0.18	-0.2
	Upscale	12.06	12.40	8.3

Calibration Performance

		O2	CO2	THC
Instrument Span		21	12	25
Initial Bias	Zero	0.3%	1.2%	-1.1%
	Upscale	-1.2%	-0.2%	-0.7%
Final Bias	Zero	0.1%	1.5%	-0.6%
	Upscale	-0.9%	0.4%	-0.3%
Drift	Zero	-0.3%	0.3%	0.5%
	Upscale	0.3%	0.7%	0.4%

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Instrument Run Report

Project No.	4173
Project	Rain CII Inv. '23

Run ID: 1-1-8

Location: Kiln #1

Date: 7/20/2023

Time: 16:46-17:31

Adjusted Data

O2 % v/v	CO2 % v/v	THC ppmv
dry	dry	wet
15.33	**3.65**	**0.6**

Instrument Responses

		O2	CO2	THC
Gas Standards		12.11	12.36	8.4
Initial Calibration	Zero	0.02	0.18	-0.2
	Upscale	12.06	12.40	8.3
Raw Data		15.27	3.78	0.50
Final Calibration	Zero	0.03	0.18	0.0
	Upscale	12.08	12.36	8.4

Calibration Performance

		O2	CO2	THC
Instrument Span		21	12	25
Initial Bias	Zero	0.1%	1.5%	-0.6%
	Upscale	-0.9%	0.4%	-0.3%
Final Bias	Zero	0.1%	1.5%	-0.1%
	Upscale	-0.8%	0.1%	-0.2%
Drift	Zero	0.1%	0.0%	0.6%
	Upscale	0.1%	-0.3%	0.1%

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Instrument Run Report

Project No.	4173
Project	Rain CII Inv. '23

Run ID: 1-1-9

Location: Kiln #1

Date: 7/20/2023

Time: 17:45-18:30

Adjusted Data

O2 % v/v	CO2 % v/v	THC ppmv
dry	dry	wet
14.97	**3.85**	**0.6**

Instrument Responses

		O2	CO2	THC
Gas Standards		12.11	12.36	8.4
Initial Calibration	Zero	0.03	0.18	0.0
	Upscale	12.08	12.36	8.4
Raw Data		14.88	3.95	0.51
Final Calibration	Zero	0.02	0.14	-0.1
	Upscale	12.01	12.33	8.3

Calibration Performance

		O2	CO2	THC
Instrument Span		21	12	25
Initial Bias	Zero	0.1%	1.5%	-0.1%
	Upscale	-0.8%	0.1%	-0.2%
Final Bias	Zero	0.1%	1.2%	-0.3%
	Upscale	-1.1%	-0.2%	-0.3%
Drift	Zero	-0.1%	-0.3%	-0.3%
	Upscale	-0.3%	-0.3%	-0.1%

AIRSOURCE TECHNOLOGIES, INC.

Gaseous Emission Rates

Project No. 4173 **Project** Rain CII Inv. '23

Run ID: 1-1-1 Location: Kiln #1

Flow Rate Flow Train ID: 1-1-1

Gas Velocity	ft/min	1,829
Volumetric Flow, Actual	acfm	148,456
Corrected Flow, Wet	scfm	80,207
Corrected Flow, Dry	dscfm	75,497

Date	Gas Time(s)
7/20/2023	09:45-10:30
Flow Time(s)	
09:44-10:49	

Pollutant Emissions TGOC

Molecular Weight		g/g-mol	44.1
Concentration	(dry)	ppmv	4.6
	(wet)	ppmv	4.4
	(dry)	lb/dscf	5.31E-7
	(wet)	lb/scf	5.00E-7
Emission Rate		lb/hr	2.41

Run ID: 1-1-2 Location: Kiln #1

Flow Rate Flow Train ID 1-1-2

Gas Velocity	ft/min	2,177
Volumetric Flow, Actual	acfm	176,756
Corrected Flow, Wet	scfm	78,537
Corrected Flow, Dry	dscfm	61,875

Date	Gas Time(s)
7/20/2023	12:47-13:32
Flow Time(s)	
12:11-13:10	

Pollutant Emissions TGOC

Molecular Weight		g/g-mol	44.1
Concentration	(dry)	ppmv	1.1
	(wet)	ppmv	0.9
	(dry)	lb/dscf	1.30E-7
	(wet)	lb/scf	1.02E-7
Emission Rate		lb/hr	0.482

Run ID: 1-1-3 Location: Kiln #1

Flow Rate Flow Train ID 1-1-3

Gas Velocity	ft/min	2,133
Volumetric Flow, Actual	acfm	173,133
Corrected Flow, Wet	scfm	73,204
Corrected Flow, Dry	dscfm	57,232

Date	Gas Time(s)
7/20/2023	13:45-14:30
Flow Time(s)	
13:44-14:37	

Pollutant Emissions TGOC

Molecular Weight		g/g-mol	44.1
Concentration	(dry)	ppmv	1.1
	(wet)	ppmv	0.8
	(dry)	lb/dscf	1.22E-7
	(wet)	lb/scf	9.54E-8
Emission Rate		lb/hr	0.419

AIRSOURCE TECHNOLOGIES, INC.

Gaseous Emission Rates

Project No.	4173	Project	Rain CII Inv. '23

Run ID: 1-1-1 Location: Kiln #1

Flow Rate Flow Train ID 1-1-1

Gas Velocity	m/min	557
Volumetric Flow, Actual	acm/min	4,204
Corrected Flow, Wet	scm/min	2,271
Corrected Flow, Dry	dscm/min	2,138

Date	Gas Time(s)
7/20/2023	09:45-10:30
Flow Time(s)	
09:44-10:49	

Pollutant Emissions **TGOC**

Molecular Weight		g/g-mol	44.1
Concentration	(dry)	ppmv	4.6
	(wet)	ppmv	4.4
	(dry)	g/dscm	8.51E-3
	(wet)	g/scm	8.01E-3
Emission Rate		g/hr	1,091

Run ID: 1-1-2 Location: Kiln #1

Flow Rate Flow Train ID 1-1-2

Gas Velocity	m/min	664
Volumetric Flow, Actual	acm/min	5,005
Corrected Flow, Wet	scm/min	2,224
Corrected Flow, Dry	dscm/min	1,752

Date	Gas Time(s)
7/20/2023	12:47-13:32
Flow Time(s)	
12:11-13:10	

Pollutant Emissions **TGOC**

Molecular Weight		g/g-mol	44.1
Concentration	(dry)	ppmv	1.1
	(wet)	ppmv	0.9
	(dry)	g/dscm	2.08E-3
	(wet)	g/scm	1.64E-3
Emission Rate		g/hr	218

Run ID: 1-1-3 Location: Kiln #1

Flow Rate Flow Train ID 1-1-3

Gas Velocity	m/min	650
Volumetric Flow, Actual	acm/min	4,903
Corrected Flow, Wet	scm/min	2,073
Corrected Flow, Dry	dscm/min	1,621

Date	Gas Time(s)
7/20/2023	13:45-14:30
Flow Time(s)	
13:44-14:37	

Pollutant Emissions **TGOC**

Molecular Weight		g/g-mol	44.1
Concentration	(dry)	ppmv	1.1
	(wet)	ppmv	0.8
	(dry)	g/dscm	1.96E-3
	(wet)	g/scm	1.53E-3
Emission Rate		g/hr	190

AIRSOURCE TECHNOLOGIES, INC.

Gaseous Emission Rates

Project No.	4173	Project	Rain CII Inv. '23

Run ID: 1-1-4 Location: Kiln #1

Flow Rate Flow Train ID: 1-1-4

Gas Velocity	ft/min	2,261
Volumetric Flow, Actual	acfm	183,552
Corrected Flow, Wet	scfm	72,282
Corrected Flow, Dry	dscfm	58,725

Date	Gas Time(s)
7/20/2023	16:46-17:31
Flow Time(s)	
16:15-17:17	

Pollutant Emissions

			TGOC
Molecular Weight		g/g-mol	44.1
Concentration	(dry)	ppmv	0.9
	(wet)	ppmv	0.7
	(dry)	lb/dscf	1.01E-7
	(wet)	lb/scf	8.17E-8
Emission Rate		lb/hr	0.4

Run ID: 1-1-5 Location: Kiln #1

Flow Rate Flow Train ID 1-1-5

Gas Velocity	ft/min	2,392
Volumetric Flow, Actual	acfm	194,172
Corrected Flow, Wet	scfm	71,881
Corrected Flow, Dry	dscfm	57,778

Date	Gas Time(s)
7/20/2023	17:45-18:30
Flow Time(s)	
17:47-18:50	

Pollutant Emissions

			TGOC
Molecular Weight		g/g-mol	44.1
Concentration	(dry)	ppmv	0.9
	(wet)	ppmv	0.7
	(dry)	lb/dscf	9.89E-8
	(wet)	lb/scf	7.95E-8
Emission Rate		lb/hr	0.3

AIRSOURCE TECHNOLOGIES, INC.

Gaseous Emission Rates

Project No.	4173	Project	Rain CII Inv. '23

Run ID: 1-1-4 Location: Kiln #1

Flow Rate Flow Train ID 1-1-4

Gas Velocity	m/min	689
Volumetric Flow, Actual	acm/min	5,198
Corrected Flow, Wet	scm/min	2,047
Corrected Flow, Dry	dscm/min	1,663

Date	Gas Time(s)
7/20/2023	16:46-17:31
Flow Time(s)	
16:15-17:17	

Pollutant Emissions **TGOC**

Molecular Weight		g/g-mol	44.1
Concentration	(dry)	ppmv	0.9
	(wet)	ppmv	0.7
	(dry)	g/dscm	1.61E-3
	(wet)	g/scm	1.31E-3
Emission Rate		g/hr	161

Run ID: 1-1-5 Location: Kiln #1

Flow Rate Flow Train ID 1-1-5

Gas Velocity	m/min	729
Volumetric Flow, Actual	acm/min	5,498
Corrected Flow, Wet	scm/min	2,035
Corrected Flow, Dry	dscm/min	1,636

Date	Gas Time(s)
7/20/2023	17:45-18:30
Flow Time(s)	
17:47-18:50	

Pollutant Emissions **TGOC**

Molecular Weight		g/g-mol	44.1
Concentration	(dry)	ppmv	0.9
	(wet)	ppmv	0.7
	(dry)	g/dscm	1.58E-3
	(wet)	g/scm	1.27E-3
Emission Rate		g/hr	156

APPENDIX C

FIELD DATA

Appendix C-1
Particulate Data

AIRSOURCE TECHNOLOGIES, INC.

Traverse Point Layout

Project	Rain	**Location**	K-1 Stack
Project Number	4173	**Method**	EPA Method 1
Test Date	July 20, 2023	**Runs**	NA

Stack or Duct Dimensions

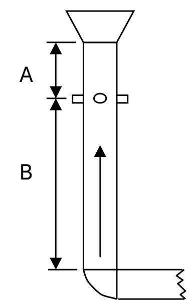
Internal Diameter supplied by facility	10 ft	2	in.
No Applicable Measurements*	ft		in.
Port A Length**	1 ft	6	in.
Internal ID supplied by facility*	10 ft	2	in.
No Applicable Measurements*	ft		in.
Port B Length**	1 ft	6	in.
Internal ID supplied by facility*	10 ft	2	in.
Port C Length**	1 ft	6	in.
Port D Length**	1 ft	6	in.
Equivalent ID supplied by facility	10 ft	2	in.
Cross-Sectional Area	81.180 ft^2		

Port Location From Nearest Flow Disturbance

Distance Upstream (A)	18 ft	in.
Distance Downstream (B)	98 ft	in.
Diameters Upstream	1.77	
Diameters Downstream	9.64	

Number of Traverse Points

Minimum for Particulate Traverses	12
Minimum for Velocity Traverses	12
Number of Traverse Points Used	12
Number of Test Ports Used	4
Traverse Points Per Test Port	3



* Distance as measured. Not determined when internal diameter (ID) supplied by the facility is used.
** Actual port length or distance from outside reference point to inside wall, as measured.

Point No.	Percent of ID from inside wall to traverse point	Distance from inside wall to traverse point, in.	Distance from reference point to traverse point, in.	
Port A			Decimal	Fractional
1	4.4%	5.31	23.31	23 5/16
2	14.6%	17.87	35.87	35 7/8
3	29.6%	36.10	54.10	54 1/8
Port C				
1	4.4%	5.31	23.31	23 5/16
2	14.6%	17.87	35.87	35 7/8
3	29.6%	36.10	54.10	54 1/8

Point No.	Percent of ID from inside wall to traverse point	Distance from inside wall to traverse point, in.	Distance from reference point to traverse point, in.	
Port B			Decimal	Fractional
1	4.4%	5.31	23.31	23 5/16
2	14.6%	17.87	35.87	35 7/8
3	29.6%	36.10	54.10	54 1/8
Port D				
1	4.4%	5.31	23.31	23 5/16
2	14.6%	17.87	35.87	35 7/8
3	29.6%	36.10	54.10	54 1/8

AIRSOURCE TECHNOLOGIES, INC.

Run Data - Filterable and Condensible Particulate Matter

Run Information

Project #	4173
Project	Rain CII LLC
Location	K-1 Stack
Date	7/20/23
Run #	1
Method	EPA Methods 5 and 202

Equipment

Probe ID	5-5
Liner Type	Q
Pitot ID	SS-2
Pitot Coefficient	.84
Thermocouple ID	68.3

Oven Box ID	
Umbilical ID	U-200-1
Barometer ID	B24

Palmtop ID	3
Meter Box ID	1
DGM Correction (Y)	1.015
Orifice Meter ΔH@	1.900

Run Parameters

Train ID	MS202-2
FPM Filter ID/TC ID	F23-17-1 6
CPM Filter TC ID	4
Barometer Reading	29.40
Meter Box Elevation	0
Test Port Elevation	125

Stack Diameter	122"
Static Pressure	
Min/Point	4

Nozzle ID	Q-213
Nozzle Type	Q
Nozzle Diameter	~~.440~~ .430

Assumed Conditions

Percent H_2O	10
Percent O_2	10
Percent CO_2	10
Average Δp	.05
Stack Temp	500

Pitot Leak Checks	Initial (>3" H_2O)	915					
	Final (>3" H_2O)	1020					
	Pass/Fail	P					
Initial Sample Train Leak Check	Time (24 hour)	920					
	Vacuum (in Hg)	>15	>15	>15	>15	>15	>15
	Leak Rate (CFM)	.005					
Final Sample Train Leak Check	Time (24 hour)	1020					
	Vacuum (in. Hg)	18"					
	Leak Rate (CFM)	.004					

Comments

Equipment Problems/Changes/Notes

Performed By: K. McKenna	Reviewed By: JK 8/1/23

Traverse Data - Filterable and Condensible Particulate Matter

Project #: 4173	Project: Rain CII LLC	Location: K-1 Stack	Run #: 111

Traverse Point	Clock Time (24 hr)	Sampling Time (min)	Gas Meter Temp (°F) Inlet	Gas Meter Temp (°F) Outlet	Stack Temp (°F)	Δp (in. H_2O)	ΔH (in. H_2O) Desired	ΔH (in. H_2O) Actual	Gas Meter Reading (ft^3) Desired	Gas Meter Reading (ft^3) Actual	Pump Vac. (in. Hg)	Probe Temp (°F)	FPM Temp (°F)	CPM Temp (°F)	Impinger Temp (°F)
START	944									669.700					
A1		4		78	412	.10	1.96	2.0	672.74	672.700	16	252	251	77	65
2		8		80	423	.15	2.92	3.0	676.45	676.42	14	250	250	73	62
3		12		82	437	.17	3.27	3.3	680.38	680.20	16	252	251	72	62
B1		16		83	444	.10	1.91	1.90	683.40	683.30	10	250	251	73	63
2		20		84	481	.14	2.57	2.60	686.90	686.90	13	250	251	73	63
3		24		85	507	.18	3.23	3.20	690.82	690.75	16	251	252	72	62
C1		28		86	501	.13	2.35	2.40	694.17	694.20	13	250	249	74	63
2		32		86	531	.18	3.15	3.20	698.05	698.00	15	249	253	74	64
3		36		87	540	.20	3.48	3.50	702.12	702.00	15	253	250	76	64
D1		40		86	530	.12	2.10	2.10	705.29	705.25	15	250	251	77	63
2		44		88	569	.21	3.56	3.60	709.41	709.40	16	250	250	78	64
3		48		88	575	.23	3.87	3.90	713.71	713.00	16	251	253	78	64
	1049			84	496	.156		2.89							

JK 8/7/23

AIRSOURCE

Lab Data - Filterable and Condensible Particulate Matter

Project #	4173	**Project**	

Train ID	M5/202-2		
Box ID	33	**Hook-Up ID**	21

Date	7/17/23	7.20.23
Time	17:42	13:04
Analyst	L.HOOPER	T. Pittman
1000 g Cal. Wt.	1000.0	2000.0

Impinger	Type	Charge	Initial Wt.	Final Wt.	Difference
1	Cond/KO Catch	Dry (w/Condenser)	643.9	672.5	
2	MGBS	Dry	465.3	465.3	
-	CPM Filter Holder and Filter				-
3	MGBS	100 mL H_2O	~~707.0~~ LH (693.0)	695.2	
Silica Gel	MGBS	~ 200 g Silica Gel	714.2	739.2	
				Total	

Run ID	111	**FPM Filter ID**	F23-7-1	**Optional CPM Filter ID**	NA

FPM Filter Condition	
Intact?	YES
Color:	Black
Loading:	Heavy
Recovered By:	A. VanSickle

Sample Identification	
FH Rinses:	Proj. No. - Run No. - 010
FPM Filter:	Proj. No. - Run No. - 011
Impinger Catch/Aq Rinses:	Proj. No. - Run No. - 012
Organic Rinses:	Proj. No. - Run No. - 013
Filter CPM:	Proj. No. - Run No. - 014

CPM Filter Condition	
Intact?	YES
Color:	Tan/White
Recovered By:	A. VanSickle

Reagent/Material Information	
Acetone:	Fisher Lot
Reagent Water:	Fisher Lot
Hexane:	Fisher Lot
FPM Filter:	
CPM Filter:	

Silica Gel Condition
95 % Spent

Comments:

Reviewed By:

AIRSOURCE TECHNOLOGIES, INC.

Purge Data - Condensible Particulate Matter

Project Rain CII LLC **Project #** 4173

Train ID M5/202- 2

Run Number 1/1

Date	2/20/23
Analyst	T. Pittman
H_2O added (mL)	122.0
Beginning Pressure (psi)	~ 2150

Purge Time (≥60 min)	Clock Time (24hr)	Flow (≥14 LPM)	Temp (65-85 °F)
0	11:45	14	78.6
10	11:55	14	76.3
20	12:05	14 17	74.4
30	12:15	14 16	73.9
40	12:25	14 16	74.4
50	12:35	14 15	75.1
60	12:45	14 15	75.0

Ending Pressure (psi)	~ 1550

Reagent/Material Information
H_2O Lot No. :
N_2 Cylinder No. :
Regulator ID No. :
Rotometer ID No. :

Comments:

Reviewed By:

AIRSOURCE TECHNOLOGIES, INC.

Run Data - Filterable and Condensible Particulate Matter

Run Information

Project #	4173
Project	Rain CII LLC
Location	K-1 Stack
Date	7/20/23
Run #	112
Method	EPA Methods 5 and 202

Equipment

Probe ID	5-5
Liner Type	Q
Pitot ID	SS 2
Pitot Coefficient	.84
Thermocouple ID	68-3

Oven Box ID	13
Umbilical ID	U200-1
Barometer ID	B-24

Palmtop ID	3
Meter Box ID	1
DGM Correction (Y)	1.015 ✓
Orifice Meter ΔH@	1.900

Run Parameters M5-202-3

Train ID	~~M5-202-2~~
FPM Filter ID/TC ID	~~[illegible]~~ E23-7-15
CPM Filter TC ID	6FF4 9
Barometer Reading	29.39
Meter Box Elevation	0
Test Port Elevation	125

Stack Diameter	122"
Static Pressure	
Min/Point	4

Nozzle ID	Q-242
Nozzle Type	Q
Nozzle Diameter	.365

Assumed Conditions

Percent H_2O	10
Percent O_2	16.75
Percent CO_2	2.65
Average Δp	.160
Stack Temp	520

Pitot Leak Checks	Initial (>3" H_2O)	1125					
	Final (>3" H_2O)	1320					
	Pass/Fail	Pass					
Initial Sample Train Leak Check	Time (24 hour)	1125	1144				
	Vacuum (in Hg)	>15	>15	>15	>15	>15	>15
	Leak Rate (CFM)	—	0.003				
Final Sample Train Leak Check	Time (24 hour)		1320				
	Vacuum (in. Hg)		17"				
	Leak Rate (CFM)		.004				

Comments

Equipment Problems/Changes/Notes

Performed By: K. McKenna	Reviewed By: dK 8/7/23

AIRSOURCE TECHNOLOGIES, INC.

Traverse Data - Filterable and Condensible Particulate Matter

Project #: 4173	Project: Rain CII LLC	Location: K-1 Stack	Run #: 1/2

Traverse Point	Clock Time (24 hr)	Sampling Time (min)	Gas Meter Temp (°F) Inlet	Gas Meter Temp (°F) Outlet	Stack Temp (°F)	Δp (in. H_2O)	ΔH (in. H_2O) Desired	ΔH (in. H_2O) Actual	Gas Meter Reading (ft^3) Desired	Gas Meter Reading (ft^3) Actual	Pump Vac. (in. Hg)	Probe Temp (°F)	FPM Temp (°F)	CPM Temp (°F)	Impinger Temp (°F)
START	1211									728.302					
A1		4		86	676	.14	1.13	1.10	730.64	730.60	5	250	250	82	65
2		8		88	688	.22	1.77	1.80	733.56	733.50	6	250	250	81	64
3		12		89	695	.24	1.92	1.90	736.60	736.60	6	251	251	79	63
B1		16		87	648	.12	1.00	1.00	738.79	738.80	5	250	251	79	64
2		20		89	692	.18	1.44	1.40	741.43	741.40	5	251	250	79	64
3		24		91	702	.20	1.60	1.60	744.22	744.20	6	250	250	78	64
C1		28		89	672	.13	1.06	1.00	746.48	746.50	5	250	248	80	64
2		32		91	703	.16	1.28	1.30	748.97	748.95	6	250	250	77	63
3		36		91	707	.17	1.35	1.40	751.53	751.50	6	249	251	77	63
D1		40		91	789	.13	.97	1.00	753.70	753.65	6	252	248	79	64
2		44		91	724	.20	1.57	1.60	756.46	756.40	6	251	250	80	65
3		48		91	726	.20	1.56	1.60	759.21	759.15	6	250	251	80	65
	1310			90	702	.172		1.392							

LK 8/7/23

AIRSOURCE TECHNOLOGIES, INC.

Lab Data - Filterable and Condensible Particulate Matter

Project #	4173	**Project**	Rain CII Inv. '23

Train ID	M5/202-3
Box ID	34
Hook-Up ID	22

Date	7/17/23	7/21/23
Time	18:00	14:30
Analyst	L. HOOPER	A. VanSickle
1000 g Cal. Wt.	1000.0	1000.1

Impinger	Type	Charge	Initial Wt.	Final Wt.	Difference
1	Cond/KO Catch	Dry (w/Condenser)	783.0	933.6	
2	MGBS	Dry	549.7	549.8	
-	CPM Filter Holder and Filter				-
3	MGBS	100 mL H_2O	559.9	549.0	
Silica Gel	MGBS	~ 200 g Silica Gel	714.9	744.4	
				Total	

Run ID	112	**FPM Filter ID**	F22-9-9	**Optional CPM Filter ID**	NA

FPM Filter Condition	
Intact?	YES
Color:	Black
Loading:	Heavy
Recovered By:	A. VanSickle

Sample Identification	
FH Rinses:	Proj. No. - Run No. - 010
FPM Filter:	Proj. No. - Run No. - 011
Impinger Catch/Aq Rinses:	Proj. No. - Run No. - 012
Organic Rinses:	Proj. No. - Run No. - 013
Filter CPM:	Proj. No. - Run No. - 014

CPM Filter Condition	
Intact?	YES
Color:	White
Recovered By:	A. VanSickle

Reagent/Material Information	
Acetone:	Fisher Lot
Reagent Water:	Fisher Lot
Hexane:	Fisher Lot
FPM Filter:	
CPM Filter:	

Silica Gel Condition	
95	% Spent

Comments:

Reviewed By:

AIRSOURCE TECHNOLOGIES, INC.

Purge Data - Condensible Particulate Matter

Project Rain CII LLC **Project #** 4173

Train ID M5/202-3

Run Number 112

Date	7·20·23
Analyst	T. Sittman
H_2O added (mL)	116.4
Beginning Pressure (psi)	~1550

Purge Time (≥60 min)	Clock Time (24hr)	Flow (≥14 LPM)	Temp (65-85 °F)
0	13:55	14	74.1
10	14:05	14	75.3
20	14:15	14	74.1
30	14:25	14	73.5
40	14:35	14	73.6
50	14:45	14	73.9
60	14:55	14	73.5

Ending Pressure (psi)	~1100

Reagent/Material Information	
H_2O Lot No. :	
N_2 Cylinder No. :	
Regulator ID No. :	
Rotometer ID No. :	

Comments:

Reviewed By:

787.4

AIRSOURCE TECHNOLOGIES, INC.

Run Data - Filterable and Condensible Particulate Matter

Run Information

Project #	4173
Project	Rain CII LLC
Location	K-1 Stack
Date	7/20/23
Run #	1/3
Method	EPA Methods 5 and 202

Equipment

Probe ID	5-5
Liner Type	Q
Pitot ID	SS-2
Pitot Coefficient	.84
Thermocouple ID	68.3

Oven Box ID	13
Umbilical ID	U-200-1
Barometer ID	B-24

Palmtop ID	3
Meter Box ID	1
DGM Correction (Y)	1.015 ✓
Orifice Meter ΔH@	1.900

Run Parameters

Train ID	MS202-1
FPM Filter ID/TC ID	F22-19-10 - 9
CPM Filter TC ID	7
Barometer Reading	29.37 ✓
Meter Box Elevation	0
Test Port Elevation	125

Stack Diameter	122"
Static Pressure	
Min/Point	4

Nozzle ID	Q234
Nozzle Type	Q
Nozzle Diameter	.376

Assumed Conditions

Percent H_2O	10
Percent O_2	15.90
Percent CO_2	3.30
Average Δp	.172
Stack Temp	740

Pitot Leak Checks	Initial (>3" H_2O)	13:37					
	Final (>3" H_2O)	1440					
	Pass/Fail	Pass					

Initial Sample Train Leak Check	Time (24 hour)	13:37					
	Vacuum (in Hg)	>15	>15	>15	>15	>15	>15
	Leak Rate (CFM)	0.004					
Final Sample Train Leak Check	Time (24 hour)	1440					
	Vacuum (in. Hg)	18"					
	Leak Rate (CFM)	.003					

Comments

Equipment Problems/Changes/Notes

Performed By: K. McKenna	**Reviewed By:** LK 8/1/23

AIRSOURCE TECHNOLOGIES, INC.

Traverse Data - Filterable and Condensible Particulate Matter

Project #: 4173	Project: Rain CII LLC	Location: K-1 Stack	Run #: 113

Traverse Point	Clock Time (24 hr)	Sampling Time (min)	Gas Meter Temp (°F) Inlet	Gas Meter Temp (°F) Outlet	Stack Temp (°F)	Δp (in. H_2O)	ΔH (in. H_2O) Desired	ΔH (in. H_2O) Actual	Gas Meter Reading (ft^3) Desired	Gas Meter Reading (ft^3) Actual	Pump Vac. (in. Hg)	Probe Temp (°F)	FPM Temp (°F)	CPM Temp (°F)	Impinger Temp (°F)
START	1344									759.510					
A1		4		87	740	.12	1.03	1.00	761.25	761.70	8	253	250	80	65
2		8		88	756	.20	1.70	1.70	764.61	764.60	8	251	252	80	65
3		12		88	761	.22	1.87	1.90	767.61	767.55	10	250	250	80	64
B1		16		89	746	.13	1.12	1.10	769.94	769.90	10	251	249	78	64
2		20		89	761	.15	1.26	1.30	772.43	772.40	10	250	250	78	63
3		24		90	764	.17	1.44	1.40	775.07	774.98	9	250	253	78	63
C1		28		90	753	.08	.69	.70	776.90	776.80	6	250	250	80	64
2		32		90	756	.14	1.20	1.20	779.31	779.21	7	249	253	80	64
3		36		90	778	.16	1.34	1.30	781.86	781.75	9	250	250	81	65
D1		40		89	758	.15	1.28	1.30	784.35	784.30	9	250	250	81	65
2		44		91	788	.24	2.00	2.00	787.47	787.40 ✓	9	250	249	81	63
3		~~48~~													
			Stopped early for weather.												
	1437		Per Daniel.					1.35							
					760	.157									

JK 8/7/23

AIRSOURCE TECHNOLOGIES

Lab Data - Filterable and Condensible Particulate Matter

Project #	4173	Project	

Train ID	M5/202-1		
Box ID	32	Hook-Up ID	20

Date	7/17/23	7/21/23
Time	17:15	14:45
Analyst	L. HOOPER	A. VanSickle
1000 g Cal. Wt.	1000.0	1000.1

Impinger	Type	Charge	Initial Wt.	Final Wt.	Difference
1	Cond/KO Catch	Dry (w/Condenser)	647.9	778.5	
2	MGBS	Dry	511.8	512.0	
-	CPM Filter Holder and Filter				-
3	MGBS	100 mL H_2O	637.1	643.2	
Silica Gel	MGBS	~ 200 g Silica Gel	834.5	856.2	
				Total	

Run ID	113	FPM Filter ID	F22-9-10	Optional CPM Filter ID	NA

FPM Filter Condition	
Intact?	YES
Color:	Black
Loading:	Heavy
Recovered By:	A. VanSickle

Sample Identification	
FH Rinses:	Proj. No. - Run No. - 010
FPM Filter:	Proj. No. - Run No. - 011
Impinger Catch/Aq Rinses:	Proj. No. - Run No. - 012
Organic Rinses:	Proj. No. - Run No. - 013
Filter CPM:	Proj. No. - Run No. - 014

CPM Filter Condition	
Intact?	YES
Color:	White
Recovered By:	A. VanSickle

Reagent/Material Information	
Acetone:	Fisher Lot
Reagent Water:	Fisher Lot
Hexane:	Fisher Lot
FPM Filter:	
CPM Filter:	

Silica Gel Condition	
90	% Spent

Comments:

Reviewed By:

AIRSOURCE TECHNOLOGIES, INC.

Purge Data - Condensible Particulate Matter

Project	Rain CII LLC
Project #	4173

Train ID	M5/202- 1
Run Number	113

Date	7.20.23
Analyst	T. Pittman
H_2O added (mL)	105.6
Beginning Pressure (psi)	~ 1100

Purge Time (≥60 min)	Clock Time (24hr)	Flow (≥14 LPM)	Temp (65-85 °F)
0	15:05	14	76.8
10	15:15	14	76.2
20	15:25	14	75.7
30	15:35	14	74.7
40	15:45	14	74.9
50	15:55	14	76.0
60	16:05	14	76.0

Ending Pressure (psi)	~600

Reagent/Material Information	
H_2O Lot No. :	
N_2 Cylinder No. :	
Regulator ID No. :	
Rotometer ID No. :	

Comments:

Reviewed By:

AIRSOURCE TECHNOLOGIES, INC.

Run Data - Filterable and Condensible Particulate Matter

Run Information

Project #	4173
Project	Rain CII LLC
Location	K-1 Stack
Date	7/20/23
Run #	1/4
Method	EPA Methods 5 and 202

Equipment

Probe ID	5-5
Liner Type	Q
Pitot ID	55-2
Pitot Coefficient	.84
Thermocouple ID	68.3

Oven Box ID	13
Umbilical ID	U-200-1
Barometer ID	B24

Palmtop ID	3
Meter Box ID	1
DGM Correction (Y)	1.015 ✓
Orifice Meter ΔH@	1.900

Run Parameters

Train ID	M5 202-4
FPM Filter ID/TC ID	F22-7-2 -8
CPM Filter TC ID	3
Barometer Reading	29.31 ✓
Meter Box Elevation	0
Test Port Elevation	125

Stack Diameter	122"
Static Pressure	
Min/Point	4

Nozzle ID	Q 264
Nozzle Type	Q
Nozzle Diameter	.388

Assumed Conditions

Percent H_2O	10
Percent O_2	15.9
Percent CO_2	3.4
Average Δp	.160
Stack Temp	760

Pitot Leak Checks	Initial (>3" H_2O)	1614					
	Final (>3" H_2O)	1720					
	Pass/Fail	Pass					
Initial Sample Train Leak Check	Time (24 hour)	1614					
	Vacuum (in Hg)	>15	>15	>15	>15	>15	>15
	Leak Rate (CFM)	.002					
Final Sample Train Leak Check	Time (24 hour)	1720					
	Vacuum (in. Hg)	18"					
	Leak Rate (CFM)	.004					

Comments

Equipment Problems/Changes/Notes

Performed By: K. McKenna	Reviewed By: dK 8/17/23

Traverse Data - Filterable and Condensible Particulate Matter

Project #: 4173	**Project:** Rain CII LLC	**Location:** K-1 Stack	**Run #:** 114

Traverse Point	Clock Time (24 hr)	Sampling Time (min)	Gas Meter Temp (°F)		Stack Temp (°F)	Δp (in. H_2O)	ΔH (in. H_2O)		Gas Meter Reading (ft^3)		Pump Vac. (in. Hg)	Probe Temp (°F)	FPM Temp (°F)	CPM Temp (°F)	Impinger Temp (°F)
			Inlet	Outlet			Desired	Actual	Desired	Actual					
START	1615									787.750					
A1		4		84	814	.13	1.19	1.20	790.14	790.10	7	250	249	80	65
2		8		84	842	.24	2.15	2.10	793.35	793.30	8	250	250	80	65
3		12		87	845	.25	2.25	2.20	796.64	796.54	8	250	249	80	65
B1		16		86	813	.20	1.84	1.80	799.61	799.60	8	250	249	79	65
2		20		88	845	.05	.45	.50	801.09	801.10	9	250	250	70	63
3		24		88	853	.20	1.79	1.80	804.03	804.00	9	250	250	70	64
C1		28		89	835	.10	.91	.90	806.13	806.10	9	250	250	70	65
2		32		89	850	.15	1.35	1.40	808.69	808.70	9	250	250	70	65
3		36		90	852	.18	1.62	1.60	811.49	811.50	10	249	250	74	65
D1		40		90	861	.14	1.25	1.20	813.95	813.90	10	250	251	75	65
2		44		90	877	.21	1.85	1.80	816.95	816.90	11	249	250	76	65
3		48		91	881	.22	1.94	1.90	820.01	820.01	11	250	250	77	66
	1717			88	847	.167		1.533							

8/7/23

AIRSOURCE

Lab Data - Filterable and Condensible Particulate Matter

Project #	4173	**Project**	

Train ID	M5/202-4		
Box ID	35	**Hook-Up ID**	26

Date	7/17/23	7/21/23
Time	18:45	17:45
Analyst	L. HOOPER	A. VanSickle
1000 g Cal. Wt.	1000.0	1000.1

Impinger	Type	Charge	Initial Wt.	Final Wt.	Difference
1	Cond/KO Catch	Dry (w/Condenser)	648.5	798.0	
2	MGBS	Dry	579.9	579.9	
-	CPM Filter Holder and Filter				-
3	MGBS	100 mL H_2O	691.8	689.1	
Silica Gel	MGBS	~ 200 g Silica Gel	635.8	658.8	
				Total	

Run ID	114	**FPM Filter ID**	F23-7-2	**Optional CPM Filter ID**	NA

FPM Filter Condition	
Intact?	YES
Color:	Black
Loading:	Heavy
Recovered By:	A. VanSickle

Sample Identification	
FH Rinses:	Proj. No. - Run No. - 010
FPM Filter:	Proj. No. - Run No. - 011
Impinger Catch/Aq Rinses:	Proj. No. - Run No. - 012
Organic Rinses:	Proj. No. - Run No. - 013
Filter CPM:	Proj. No. - Run No. - 014

CPM Filter Condition	
Intact?	YES
Color:	white
Recovered By:	A. VanSickle

Reagent/Material Information	
Acetone:	Fisher Lot
Reagent Water:	Fisher Lot
Hexane:	Fisher Lot
FPM Filter:	
CPM Filter:	

Silica Gel Condition	
90	% Spent

Comments:

Reviewed By:

AIRSOURCE TECHNOLOGIES, INC. Purge Data - Condensible Particulate Matter

Project	Rain CII LLC	**Project #**	4173

Train ID	M5/202-4
Run Number	114

Date	7.20.23
Analyst	T. Pittman
H_2O added (mL)	111.7
Beginning Pressure (psi)	~600

Purge Time (≥60 min)	Clock Time (24hr)	Flow (≥14 LPM)	Temp (65-85 °F)
0	17:42	14	79.6
10	17:52	14	79.4
20	18:02	14	79.0
30	18:12	14	78.4
40	18:22	14	78.7
50	18:32	14	78.4
60	18:42	14	78.1

Ending Pressure (psi)	~ 100

Reagent/Material Information	
H_2O Lot No. :	
N_2 Cylinder No. :	
Regulator ID No. :	
Rotometer ID No. :	

Comments:

Reviewed By:

AIRSOURCE TECHNOLOGIES, INC.

Run Data - Filterable and Condensible Particulate Matter

Run Information

Project #	4173
Project	Rain CII LLC
Location	K-1 Stack
Date	7/20/23
Run #	115
Method	EPA Methods 5 and 202

Equipment

Probe ID	5-5
Liner Type	Q
Pitot ID	SS-2
Pitot Coefficient	.84
Thermocouple ID	68.3

Oven Box ID	13
Umbilical ID	U-200-1
Barometer ID	824

Palmtop ID	3
Meter Box ID	1
DGM Correction (Y)	1.015
Orifice Meter ΔH@	1.900

Run Parameters

Train ID	F22-10-24-5-1
FPM Filter ID/TC ID	M5-202-6
CPM Filter TC ID	6
Barometer Reading	29.32
Meter Box Elevation	0
Test Port Elevation	125

Stack Diameter	122"
Static Pressure	
Min/Point	4

Nozzle ID	Q261
Nozzle Type	Quartz
Nozzle Diameter	0.396

Assumed Conditions

Percent H_2O	10
Percent O_2	15.9
Percent CO_2	3.4
Average Δp	.160
Stack Temp	850

Pitot Leak Checks	Initial (>3" H_2O)	1742					
	Final (>3" H_2O)	1854					
	Pass/Fail	PASS					
Initial Sample Train Leak Check	Time (24 hour)	1742					
	Vacuum (in Hg)	>15	>15	>15	>15	>15	>15
	Leak Rate (CFM)	.001					
Final Sample Train Leak Check	Time (24 hour)	1854					
	Vacuum (in. Hg)	19"					
	Leak Rate (CFM)	.002					

Comments

Equipment Problems/Changes/Notes

Performed By: K. McKenna

Reviewed By: LK 8/7/23

[illegible]RSOURCE TECHNOLOGIES, INC.

Traverse Data - Fi[illegible]rable and Condensible Particulate M[illegible]tter

Project #: 4173	**Project:** Rain CII LLC	**Location:** K-1 Stack	**Run #:** 115

Traverse Point	Clock Time (24 hr)	Sampling Time (min)	Gas Meter Temp (°F) Inlet	Gas Meter Temp (°F) Outlet	Stack Temp (°F)	Δp (in. H_2O)	ΔH (in. H_2O) Desired	ΔH (in. H_2O) Actual	Gas Meter Reading (ft^3) Desired	Gas Meter Reading (ft^3) Actual	Pump Vac. (in. Hg)	Probe Temp (°F)	FPM Temp (°F)	CPM Temp (°F)	Impinger Temp (°F)
START	1747									821.200					
A1		4		89	886	.10	.95	1.0	823.35	823.30	7	249	248	80	63
2		8		90	909	.19	1.78	2.0	826.28	826.20	7	250	250	80	63
3		12		91	930	.23	2.12	2.10	829.49	829.35	8	250	249	80	64
B1		16		91	901	.12	1.13	1.10	831.83	831.70	9	251	252	82	64
2		20		92	924	.15	1.39	1.40	834.44	834.35	10	250	251	83	63
3		24		92	934	.20	1.84	1.80	837.43	837.35	10	250	250	83	63
C1		28		92	925	.12	1.11	1.10	839.76	839.70	10	251	249	84	63
2		32		93	922	.17	1.58	1.60	842.54	842.45	10	250	250	82	63
3		36		93	941	.20	1.84	1.80	845.53	845.37	11	249	248	80	62
D1		40		94	950	.15	1.37	1.40	848.12	847.95	12	250	250	80	63
2		44		94	970	.25	2.25	2.20	851.43	851.30	12	249	248	77	61
3		48		94	982	.26	2.32	2.30	854.79	854.60	13	250	250	76	62
	1850			92	931	.175		1.650							

LK 8/7/23

Lab Data - Filterable and Condensible Particulate Matter

Project #	4173	**Project**	

Train ID	M5/202-6		
Box ID	41	**Hook-Up ID**	29

Date	7/17/23	7/21/23
Time	19:20	17:50
Analyst	L. HOOPER	A. VanSickle
1000 g Cal. Wt.	1000.0	1000.1

Impinger	Type	Charge	Initial Wt.	Final Wt.	Difference
1	Cond/KO Catch	Dry (w/Condenser)	770.1	922.2	
2	MGBS	Dry	605.9	606.0	
-	CPM Filter Holder and Filter				-
3	MGBS	100 mL H_2O	615.9	605.4	
Silica Gel	MGBS	~ 200 g Silica Gel	741.4	764.8	
				Total	

Run ID	115	**FPM Filter ID**	F22-10-24	**Optional CPM Filter ID**	NA

FPM Filter Condition	
Intact?	YES
Color:	Black
Loading:	Heavy
Recovered By:	A. VanSickle

Sample Identification	
FH Rinses:	Proj. No. - Run No. - 010
FPM Filter:	Proj. No. - Run No. - 011
Impinger Catch/Aq Rinses:	Proj. No. - Run No. - 012
Organic Rinses:	Proj. No. - Run No. - 013
Filter CPM:	Proj. No. - Run No. - 014

CPM Filter Condition	
Intact?	YES
Color:	white
Recovered By:	A. VanSickle

Reagent/Material Information	
Acetone:	Fisher Lot
Reagent Water:	Fisher Lot
Hexane:	Fisher Lot
FPM Filter:	
CPM Filter:	

Silica Gel Condition	
85	% Spent

13

Comments:

#8 CLIP ON COND/KO

Reviewed By:

AIRSOURCE TECHNOLOGIES, INC. Purge Data - Condensible Particulate Matter

Project Rain CII LLC **Project #** 4173

Train ID M5/202-5

Run Number 115

Date	7-20-23
Analyst	T. Pittman
H_2O added (mL)	120.7
Beginning Pressure (psi)	~2100

Purge Time (≥60 min)	Clock Time (24hr)	Flow (≥14 LPM)	Temp (65-85 °F)
0	19:07	14	79.0
10	19:17	14	79.3
20	19:27	14	79.4
30	19:37	14	79.8
40	19:47	14	79.8
50	19:57	14	80.0
60	20:07	14	81.1

Ending Pressure (psi)	~1500

Reagent/Material Information
H_2O Lot No. :
N_2 Cylinder No. :
Regulator ID No. :
Rotometer ID No. :

Comments:

Reviewed By:

Appendix C-2

Analyzer Data Log

TIER 5 LABS
5353 W. SOUTHERN AVE.
INDIANAPOLIS, IN 46241
317-536-5590

Product:	Nitrogen CEM	Minimum Purity:	99.9995%
Mixture Grade:	5.5	Certification Date:	22 October 2021
		Issuance Date:	22 October 2021
		Expiration Date:	22 October 2029
Cylinder Fill Pressure:	2015 PSIG	Lot Number:	S29513A9

Do not use below 100 psi (0.7 megapascals)

Purity Specification

Analyte	Specification	Concentration	Assay Dates
Total Hydrocarbons	< 0.05 PPM	< 0.05 PPM	10/22/2021
Carbon Monoxide	< 1 PPM	< 1 PPM	10/22/2021
Carbon Dioxide	< 10 PPM	< 10 PPM	10/22/2021
Oxygen	< 2 PPM	= 0.53 PPM	10/22/2021
Total NOx	< 0.02 PPM	< 0.02 PPM	10/22/2021
Nitrous Oxide	< 0.02 PPM	< 0.02 PPM	10/22/2021
Moisture	< 2 PPM	= 0.81 PPM	10/22/2021

Cylinders in Lot

CC458715	CC84077	EB0048027
CC478929	EB0004527	CC81798
EB0053738	CC362797	CC94875
CC517259	CC514172	EB0132154
CC516345	CC480389	CC455093
CC479020	CC462284	CC722220
CC300260	EB0132125	CC479431
EB0053746	CC454521	EB0051888
	CC480390	

40 CFR1065.750 Compliant

The calibration results published in this certificate were obtained using equipment and standards capable of producing results that are traceable to National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI). The expanded uncertainties, if included on this certificate, use a coverage factor of k=2 to approximate the 95% confidence level of the measurement, unless otherwise noted. If uncertainties are not included on this certificate, they are available upon request. This calibration certificate applies only to the item described and shall not be reproduced other than in full, without written approval from the calibration facility. Calibration certificates without signatures are not valid. This calibration meets the requirements of ISO/IEC 17025-2005

Analytical Chemist: Christopher Haas

Production Manager: Eric Frymier

Production Laboratory:
Tier 5 Labs, LLC
5353W. Southern Ave.
Indianapolis, IN 46241
PGVP Vendor ID R12021

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
2722 S. Wentworth Ave.
Chicago, IL 60628
Airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E03NI73E15A1FW8	Reference Number:	54-401323400-1
Cylinder Number:	CC414201	Cylinder Volume:	149.6 CF
Laboratory:	124 - Chicago (SAP) - IL	Cylinder Pressure:	2015 PSIG
PGVP Number:	B12018	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Oct 15, 2018

Expiration Date: Oct 15, 2026

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	6.000 %	5.860 %	G1	+/- 1% NIST Traceable	10/15/2018
OXYGEN	21.00 %	21.00 %	G1	+/- 1% NIST Traceable	10/15/2018
NITROGEN	Balance			-	

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13060414	CC413576	7.489 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Jan 14, 2019
NTRM	15010409	K013750	22.454 % OXYGEN/NITROGEN	+/- 0.2%	Aug 05, 2021

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
CO2-1 HORIBA VIA-510 V1E3H7P5	NDIR	Oct 12, 2018
O2-1 HORIBA MPA-510 3VUYL9NR	Paramagnetic	Sep 17, 2018

Triad Data Available Upon Request

Signature on file
Approved for Release

GASES & WELDING SUPPLIES

Certificate of Analysis – EPA Protocol Gas

Customer:
American Welding & Gas
E Frontage Road
Grandview, MO 64030

PO Number: 438794
Reference#: CGS-10-24195
Date Filled: 7/20/2022
Customer Part #: CSG E840001-A1-1 J20

Serial Number	Size	Concentration Basis	Standard type	Certificate ID
216803160	ALS	Mole	EPA Protocol	05-07282201

Certified Concentration

Carbon Dioxide =	**12.36%**	**+/- 0.06%**
Oxygen =	**12.11%**	**+/- 0.05%**
Nitrogen =	**Balance Gas**	

Analytical Information

Component	Analyzer Make/Model/SN			Analytical Principle	Last Calibration Date
Carbon Dioxide	Thermo	Nicolet 6700	APW100179	FT-IR	7/6/2022
Oxygen	Servomex	5200	12730	Paramagnetic	7/18/2022

Assay Date 7/28/2022

Reference Standard(s)

Component	GMIS #	Cylinder #	Concentration	Uncertainty	Expiration Date
Carbon Dioxide	10-15142-5-2	EB0005338	16.23%	+/- 0.12%	8/31/2026
Oxygen	10-4838-2	CC300673	14.90%	+/- 0.04%	5/5/2028
Nitrogen			Balance Gas		

CO2 GMIS certified by:

Component	SRM #	N.I.S.T. Sample #	Cylinder #	Concentration	Uncertainty	Expiration Date
Carbon Dioxide	2745	9-D-10	FF13635	16.080%	+/- 0.020%	4/8/2021
Nitrogen				Balance Gas		

O2 GMIS certified by:

Component	SRM #	N.I.S.T. Sample #	Cylinder #	Concentration	Uncertainty	Expiration Date
Oxygen	2659a	71-D-35	CAL015756	20.720%	+/- 0.043%	8/23/2021
Nitrogen				Balance Gas		

This calibration standard has been certified per the 2012 EPA Traceability Protocol, Document EPA 600/R-12/531, using the procedure G1.

Do Not Use This Standard Below 100 psig (0.7 Megapascals).

Valve Outlet Connection CGA: 590
Mix Pressure(psig)@70F : 2000
Certification Date: 7/28/2022
Shelf Life : 8 years
Expiration date: 7/28/2030

Certified By: Joshua Seh

Reviewed By: Derek Hindman

Produced By:
Coastal Specialty Gas: (409) 981-7700
2150 Interstate 10 East, Beaumont, TX 77703
Coastal Specialty Gas PGVP Vendor ID: O12022

GASES &
WELDING SUPPLIES

Certificate of Analysis – EPA Protocol Gas

Customer:
American Welding & Gas
5353 W Southern Ave
Indianapolis, IN 46241

PO Number: 394546
Reference#: CGS-10-22568
Date Filled: 9/8/2021
Customer Part #: P6MB001-A1-1

Cylinder Number	Size	Concentration Basis	Standard type	Certificate ID
CC463386	ALS	Mole	EPA Protocol	03-04012201

Certified Concentration

Carbon Monoxide =	**6.20 ppm**	**+/- 0.07 ppm**
Nitric Oxide =	**6.77 ppm**	**+/- 0.09 ppm**
NOx =	**6.88 ppm**	
Propane =	**8.40 ppm**	**+/- 0.08 ppm**
Nitrogen =	**Balance Gas**	

Analytical Information

Component	Analyzer Make/Model/SN		Analytical Principle	Last Calibration Date
Carbon Monoxide	Thermo	Nicolet 6700 APW100179	FT-IR	3/23/2022
Nitric Oxide	Thermo	Nicolet 6700 APW100179	FT-IR	3/10/2022
Propane	Thermo	Nicolet 6700 APW100179	FT-IR	3/11/2022

First Assay Date 3/25/2022 **Second Assay Date** 4/1/2022

Reference Standard(s)

Component	GMIS #	Cylinder #	Concentration	Uncertainty	Expiration Date
Carbon Monoxide	10-18973	CC482690	10.37 ppm	+/- 0.06 ppm	10/25/2027
Nitric Oxide	10-09-1402	ND52081	4.97 ppm	+/- 0.04 ppm	11/22/2022
NOx	10-09-1402	ND52081	5.03 ppm		11/22/2022
Propane	PRM	D970450	4.999 ppm	+/- 0.025 ppm	9/14/2026
Nitrogen			Balance Gas		

CO GMIS certified by:

Component	SRM #	N.I.S.T. Sample #	Cylinder #	Concentration	Uncertainty	Expiration Date
Carbon Monoxide	1677c	5-J-16	CAL015280	9.825 ppm	+/- 0.047 ppm	6/24/2024
Nitrogen				Balance Gas		

NO GMIS certified by:

Component	PRM	Cylinder #	Concentration	Uncertainty	Expiration Date
Nitric Oxide		APEX1324309	5.00 ppm	+/- 0.04 ppm	9/12/2021
Nitrogen Oxides (NOx)		APEX1324309	5.00 ppm	+/- 0.04 ppm	9/12/2021
Nitrogen			Balance Gas		

This calibration standard has been certified per the 2012 EPA Traceability Protocol, Document EPA 600/R-12/531, using the procedure G1.

Do Not Use This Standard Below 100 psig (0.7 Megapascals).

Valve Outlet Connection CGA: 660
Mix Pressure(psig)@70F : 1500
Certification Date: 4/1/2022
Shelf Life : 2 years
Expiration date: 4/1/2024

Certified By: Kelly Nagy

Reviewed By: Jennifer Healy

Produced By:
Coastal Specialty Gas; (409) 981-7700
2150 Interstate 10 East, Beaumont, TX 77703
Coastal Specialty Gas PGVP Vendor ID: O12022

GASES & WELDING SUPPLIES

Certificate of Analysis – EPA Protocol Gas

Customer:
American Welding & Gas
5353 W Southern Ave
Indianapolis, IN 46241

PO Number: 471431
Reference#: CGS-10-25339
Date Filled: 3/6/2023
Customer Part #: CSG E6MAB01-A1-2

Cylinder Number	Size	Concentration Basis	Standard type	Certificate ID
RR04942	ALS	Mole	EPA Protocol	03-03212301

Certified Concentration

Carbon Monoxide =	**13.00 ppm**	**+/- 0.13 ppm**
Nitric Oxide =	**12.46 ppm**	**+/- 0.14 ppm**
NOx =	**12.59 ppm**	
Sulfur Dioxide =	**12.95 ppm**	**+/- 0.17 ppm**
Propane =	**16.22 ppm**	**+/- 0.16 ppm**
Nitrogen =	**Balance Gas**	

Analytical Information

Component	Analyzer Make/Model/SN	Analytical Principle	Last Calibration Date
Carbon Monoxide	Thermo Nicolet iS50 AUP2210530	FT-IR	3/3/2023
Nitric Oxide	Thermo Nicolet iS50 AUP2210530	FT-IR	3/10/2023
Sulfur Dioxide	Thermo Nicolet iS50 AUP2210530	FT-IR	3/17/2023
Propane	Thermo Nicolet iS50 AUP2210530	FT-IR	3/9/2023

First Assay Date 3/14/2023 **Second Assay Date** 3/21/2023

Reference Standard(s)

Component	GMIS #	Cylinder #	Concentration	Uncertainty	Expiration Date
Carbon Monoxide	10-18973	CC474269	10.34 ppm	+/- 0.06 ppm	10/25/2027
Nitric Oxide	01-142002	CC493943	9.90 ppm	+/- 0.10 ppm	3/10/2026
NOx	01-142002	CC493943	10.07 ppm		3/10/2026
Sulfur Dioxide	5-08-1303	EB0025323	5.06 ppm	+/- 0.06 ppm	2/3/2026
Propane	05-01-1701	CC493803	10.01 ppm	+/- 0.03 ppm	5/1/2025
Nitrogen			Balance Gas		

CO GMIS certified by:

Component	SRM #	N.I.S.T. Sample #	Cylinder #	Concentration	Uncertainty	Expiration Date
Carbon Monoxide	1677c	5-J-16	CAL015280	9.825 ppm	+/- 0.047 ppm	6/24/2024
Nitrogen				Balance Gas		

NO GMIS certified by:

Component	PRM	Cylinder #	Concentration	Uncertainty	Expiration Date
Nitric Oxide		APEX1324311	10.00 ppm	+/- 0.05 ppm	9/12/2023
Nitrogen Oxides (NOx)		APEX1324311	10.00 ppm	+/- 0.05 ppm	9/12/2023
Nitrogen			Balance Gas		

SO2 GMIS certified by:

Component	PRM	*Cylinder #*	*Concentration*	*Uncertainty*	*Expiration Date*
Sulfur Dioxide		D887573	5.00 ppm	+/- 0.06 ppm	9/20/2022
Nitrogen			Balance Gas		

Propane GMIS certified by:

Component	SRM #	N.I.S.T. Sample #	Cylinder #	Concentration	Uncertainty	Expiration Date
Propane	1666b	84-K-21	FF10563	9.888 ppm	+/- 0.032 ppm	10/5/2019
Nitrogen				Balance Gas		

This calibration standard has been certified per the 2012 EPA Traceability Protocol, Document EPA 600/R-12/531, using the procedure G1.

Do Not Use This Standard Below 100 psig (0.7 Megapascals).

Valve Outlet Connection CGA: 660
Mix Pressure(psig)@70F: 1900
Certification Date: 3/21/2023
Shelf Life: 2 years
Expiration date: 3/21/2025

Certified By: [signature]

Reviewed By: [signature]

Produced By:
Coastal Specialty Gas: (409) 981-7700
2150 Interstate 10 East, Beaumont, TX 77703
Coastal Specialty Gas PGVP Vendor ID: O12023

GASES &
WELDING SUPPLIES

Certificate of Analysis – EPA Protocol Gas

Customer:		**PO Number:**	471203
American Welding & Gas		**Reference#:**	CGS-10-25338
5353 W Southern Ave		**Date Filled:**	3/2/2023
Indianapolis, IN 46241		**Customer Part #:**	CSG E4MAB01-A1-1

Cylinder Number	Size	Concentration Basis	Standard type	Certificate ID
RR04905	ALS	Mole	EPA Protocol	03-03162301

Certified Concentration

Carbon Monoxide =	**25.01 ppm**	**+/- 0.24 ppm**
Nitric Oxide =	**25.86 ppm**	**+/- 0.26 ppm**
NOx =	**26.14 ppm**	
Sulfur Dioxide =	**25.91 ppm**	**+/- 0.29 ppm**
Propane =	**30.22 ppm**	**+/- 0.18 ppm**
Nitrogen =	**Balance Gas**	

Analytical Information

Component	Analyzer Make/Model/SN			Analytical Principle	Last Calibration Date
Carbon Monoxide	Thermo	Nicolet iS50	AUP2210530	FT-IR	3/3/2023
Nitric Oxide	Thermo	Nicolet iS50	AUP2210530	FT-IR	3/10/2023
Sulfur Dioxide	Thermo	Nicolet iS50	AUP2210530	FT-IR	2/17/2023
Propane	Thermo	Nicolet iS50	AUP2210530	FT-IR	3/9/2023

First Assay Date 3/9/2023 **Second Assay Date** 3/16/2023

Reference Standard(s)

Component	GMIS #	Cylinder #	Concentration	Uncertainty	Expiration Date
Carbon Monoxide	12-15-2001	CC713082	25.19 ppm	+/- 0.11 ppm	12/15/2026
Nitric Oxide	10-23677-4	CC740243	25.89 ppm	+/- 0.12 ppm	9/26/2025
NOx	10-23677-4	CC740243	26.35 ppm		9/26/2025
Sulfur Dioxide	2-17-2101	CC409176	50.19 ppm	+/- 0.34 ppm	2/17/2025
Propane	05-10-1710	CC493924	25.13 ppm	+/- 0.06 ppm	5/1/2025
Nitrogen			Balance Gas		

CO GMIS certified by:

Component	SRM #	N.I.S.T. Sample #	Cylinder #	Concentration	Uncertainty	Expiration Date
Carbon Monoxide	1678c	4-K-30	CAL016760	49.07 ppm	+/- 0.19 ppm	2/4/2021
Nitrogen				Balance Gas		

NO GMIS certified by:

Component	PRM	Cylinder #	Concentration	Uncertainty	Expiration Date
Nitric Oxide		APEX1324305	50.02 ppm	+/- 0.20 ppm	9/12/2023
Nitrogen Oxides (NOx)		APEX1324305	50.02 ppm	+/- 0.20 ppm	9/12/2023
Nitrogen			Balance Gas		

SO2 GMIS certified by:

Component	SRM #	N.I.S.T. Sample #	Cylinder #	Concentration	Uncertainty	Expiration Date
Sulfur Dioxide	1693a	96-N-60	FF28076	50.18 ppm	+/- 0.28 ppm	6/27/2023
Nitrogen				Balance Gas		

Propane GMIS certified by:

Component	SRM #	N.I.S.T. Sample #	Cylinder #	Concentration	Uncertainty	Expiration Date
Propane	1667b	83-K-03	FF56567	49.61 ppm	+/- 0.11 ppm	7/1/2024
Nitrogen				Balance Gas		

This calibration standard has been certified per the 2012 EPA Traceability Protocol, Document EPA 600/R-12/531, using the procedure G1.

Do Not Use This Standard Below 100 psig (0.7 Megapascals).

Valve Outlet Connection CGA:	660
Mix Pressure(psig)@70F :	1900
Certification Date:	3/16/2023
Shelf Life :	2 years
Expiration date:	3/16/2025

Certified By: Kelly Nag

Reviewed By: Bean dunbley

Produced By:
Coastal Specialty Gas: (409) 981-7700
2150 Interstate 10 East, Beaumont, TX 77703
Coastal Specialty Gas PGVP Vendor ID: C12023

GASES & WELDING SUPPLIES

Certificate of Analysis – EPA Protocol Gas

Customer:
American Welding & Gas
5353 W Southern Ave
Indianapolis, IN 46241

PO Number: 444080
Reference#: CGS-10-24389
Date Filled: 9/2/2022
Customer Part #: E6MAB01-A1-1

Cylinder Number	Size	Concentration Basis	Standard type	Certificate ID
CC508574	ALS	Mole	EPA Protocol	03-10112201

Certified Concentration

Carbon Monoxide =	**51.45 ppm**	**+/- 0.51 ppm**
Nitric Oxide =	**50.41 ppm**	**+/- 0.55 ppm**
NOx =	**50.52 ppm**	
Sulfur Dioxide =	**51.95 ppm**	**+/- 0.55 ppm**
Propane =	**51.88 ppm**	**+/- 0.21 ppm**
Nitrogen =	**Balance Gas**	

Analytical Information

Component	Analyzer Make/Model/SN	Analytical Principle	Last Calibration Date
Carbon Monoxide	Thermo Nicolet iS50 AUP2010168	FT-IR	9/12/2022
Nitric Oxide	Thermo Nicolet iS50 AUP2010168	FT-IR	10/10/2022
Sulfur Dioxide	Thermo Nicolet iS50 AUP2010168	FT-IR	9/29/2022
Propane	Thermo Nicolet iS50 AUP2010168	FT-IR	9/12/2022

First Assay Date 9/26/2022 **Second Assay Date** 10/11/2022

Reference Standard(s)

Component	GMIS #	Cylinder #	Concentration	Uncertainty	Expiration Date
Carbon Monoxide	01-27-2201	CC16375	50.71 ppm	+/- 0.16 ppm	1/27/2030
Nitric Oxide	10-21521-2	CC438453	51.32 ppm	+/- 0.21 ppm	4/9/2025
NOx	10-21521-2	CC438453	52.83 ppm		4/9/2025
Sulfur Dioxide	2-17-2101	CC409176	50.19 ppm	+/- 0.34 ppm	2/17/2025
Propane	05-10-1706	CC493805	49.86 ppm	+/- 0.13 ppm	5/1/2025
Nitrogen			Balance Gas		

CO GMIS certified by

Component	PRM	Cylinder #	Concentration	Uncertainty	Expiration Date
Carbon Monoxide		D687692	50.05 ppm	+/- 0.15 ppm	9/10/2025
Nitrogen			Balance Gas		

NO GMIS certified by

Component	PRM	Cylinder #	Concentration	Uncertainty	Expiration Date
Nitric Oxide		APEX1324305	50.02 ppm	+/- 0.20 ppm	9/12/2022
Nitrogen Oxides (NOx)		APEX1324305	50.02 ppm	+/- 0.20 ppm	9/12/2022
Nitrogen			Balance Gas		

SO2 GMIS certified by

Component	SRM #	N.I.S.T. Sample #	Cylinder #	Concentration	Uncertainty	Expiration Date
Sulfur Dioxide	1693a	96-N-60	FF28076	50.18 ppm	+/- 0.28 ppm	6/27/2023
Nitrogen				Balance Gas		

Propane GMIS certified by

Component	SRM #	N.I.S.T. Sample #	Cylinder #	Concentration	Uncertainty	Expiration Date
Propane	1667b	83-K-06	FF55567	49.61 ppm	+/- 0.11 ppm	7/1/2024
Nitrogen				Balance Gas		

This calibration standard has been certified per the 2012 EPA Traceability Protocol, Document EPA 600/R-12/531, using the procedure G1.

Do Not Use This Standard Below 100 psig (0.7 Megapascals)

Valve Outlet Connection CGA: 660
Mix Pressure(psig)@70F: 1900
Certification Date: 10/11/2022
Shelf Life: 2 years
Expiration date: 10/11/2024

Certified By: [signature] Reviewed By: [signature]

Produced By:
Coastal Specialty Gas: (409) 981-7700
2150 Interstate 10 East, Beaumont, TX 77703
Coastal Specialty Gas PGVP Vendor ID: O12022

Data Cal

Data File Path:	C:\Users\taylor pittman\Documents\AirSource Log Data Files
Data File Name:	Rain CII Kiln 23 7-20-2023 Cal

Time	Comment	CAI 2-O2	CAI 2-CO2	hermo THC 1-THC
7/20/2023 7:29	zero direct			
7/20/2023 7:30		0.004577637	-0.006103516	30.09338
7/20/2023 7:31	21 o2			
7/20/2023 7:32		20.98134	5.455526	31.38428
7/20/2023 7:33	12.11/12.36			
7/20/2023 7:34		20.98134	5.455526	31.38428
7/20/2023 7:34		12.24874	12.34741	30.62541
7/20/2023 7:34	5.86 co2			
7/20/2023 7:34		20.96522	6.104234	30.48742
7/20/2023 7:39		20.96522	6.104234	30.48742
7/20/2023 7:39		20.96522	6.104234	30.48742
7/20/2023 7:39		20.96522	6.104234	30.48742
7/20/2023 7:39		20.96522	6.104234	30.48742
7/20/2023 7:39		20.96522	6.104234	30.48742
7/20/2023 7:48		20.92712	5.934448	26.86768
7/20/2023 8:30	n2 bias			
7/20/2023 8:36		0.04490444	0.164359	-100
7/20/2023 8:37		0.07019043	0.1642863	-0.05795898
7/20/2023 8:37	12/12/2023			
7/20/2023 8:39		12.06027	12.4312	4.246129
7/20/2023 8:40	51.88 c3h8 span			
7/20/2023 8:41		0.1657104	0.2432251	51.99525
7/20/2023 8:42	30.22			
7/20/2023 8:43		1.607444	0.2125133	30.01185
7/20/2023 8:45	16.22			
7/20/2023 8:46		1.983643	0.201416	16.14484
7/20/2023 8:48	8.4			
7/20/2023 8:49		1.072998	0.1885986	8.504053
7/20/2023 10:32	zero			
7/20/2023 10:32	r1 zero			
7/20/2023 10:33		0.1376065	0.1792214	-0.1106712
7/20/2023 10:34	12/12/2023			
7/20/2023 10:38		12.05885	12.48847	-0.1115343
7/20/2023 10:40	8.4			
7/20/2023 10:43		0.02929688	0.2563477	8.30996
7/20/2023 11:30	r2 n2			
7/20/2023 11:32		0.05249023	0.2380371	-0.1861328
7/20/2023 11:33	12/12/2023			
7/20/2023 11:34		12.00256	12.44812	-0.0640625
7/20/2023 11:34	8.4			
7/20/2023 11:36		0.5132502	0.3712047	8.234498
7/20/2023 12:35	r3 zero			
7/20/2023 12:38		0.15625	0.2197266	-0.2105469
7/20/2023 12:38	12/12/2023			
7/20/2023 12:40		11.9873	12.42065	-0.1128906
7/20/2023 12:43		0.09416853	0.2443586	8.234105
7/20/2023 13:30	r4 zero			
7/20/2023 13:32		0.1009428	0.1464844	-0.2105469
7/20/2023 13:32	12/12/2023			
7/20/2023 13:34		12.00409	12.33521	-0.1373047
7/20/2023 13:35	8.4			
7/20/2023 13:40		0.05187988	0.1413981	8.236718
7/20/2023 14:36	r5 zero			
7/20/2023 14:37		0.06209664	0.1464844	-0.2646825
7/20/2023 14:37	12/12/2023			
7/20/2023 14:39		12.02637	12.33887	-0.1861328
7/20/2023 14:39	8.4			
7/20/2023 14:40		0.181071	0.2543131	8.171615
7/20/2023 14:40		0.09969076	0.2258301	8.187891
7/20/2023 15:30	r6 zero			
7/20/2023 15:32		0.07171631	0.1373291	-0.2837891
7/20/2023 15:32	12/12/2023			
7/20/2023 15:34		11.97876	12.31812	-0.1861328
7/20/2023 15:34		12.00562	12.31842	-0.1861328
7/20/2023 15:35	8.4			
7/20/2023 15:37		0.04621233	0.1534598	8.18789
7/20/2023 15:38		0.002034505	0.1495361	8.224511
7/20/2023 16:33	r7 zero			
7/20/2023 16:35		0.0189209	0.178833	-0.1592773
7/20/2023 16:35	12/12/2023			
7/20/2023 16:38		12.06421	12.40112	-0.08115233
7/20/2023 16:42	8.4			
7/20/2023 16:42		0.000678168	0.1803928	8.331661
7/20/2023 17:31	r8 zero			
7/20/2023 17:33		0.03313337	0.1796177	-0.08847655

Data Cal

Time	Comment	CAI 2-O2	CAI 2-CO2	hermo THC 1-THC
7/20/2023 17:33	12/12/2023			
7/20/2023 17:35		11.97859	12.33521	-0.01523438
7/20/2023 17:35		11.97917	12.34131	-0.01523438
7/20/2023 17:36		12.07581	12.36115	-0.01523437
7/20/2023 17:36	8.4			
7/20/2023 17:37		0.3363715	0.2882216	8.358788
7/20/2023 18:42	r9 zero			
7/20/2023 18:44		0.0221946	0.1376065	-0.08181817
7/20/2023 18:47		12.00867	12.32605	-0.01523438
7/20/2023 18:47		11.9873	12.32571	-0.009809027
7/20/2023 18:48	8.4			
7/20/2023 18:48		0.3869098	0.2685547	8.332253

Data 1-min

Time	Comment	CAI 2-O2	CAI 2-CO2	Thermo THC 1-THC
7/20/2023 6:49		20.2274	-0.1154436	53.30962
7/20/2023 6:50		20.2395	-0.08691406	53.1861
7/20/2023 6:51		20.24446	-0.04279437	52.85882
7/20/2023 6:52		20.25438	-0.04692078	52.59233
7/20/2023 6:53		20.25803	-0.07913279	52.28271
7/20/2023 6:54		20.26224	-0.145949	51.97311
7/20/2023 6:55		20.2636	-0.165366	51.9941
7/20/2023 6:56		20.26085	-0.1626533	50.69159
7/20/2023 6:57		20.2666	-0.1640097	49.64093
7/20/2023 6:58		20.27171	-0.1724782	49.19075
7/20/2023 6:59		20.2646	-0.1597205	48.91769
7/20/2023 7:00		20.26949	-0.1289948	48.05359
7/20/2023 7:01		20.26856	-0.1112553	47.90996
7/20/2023 7:02		20.27038	-0.05279006	48.46577
7/20/2023 7:03		20.26123	-0.01999799	47.8092
7/20/2023 7:04		20.2571	-0.01863178	47.41582
7/20/2023 7:05		20.25553	-0.0422606	46.87114
7/20/2023 7:06		20.25507	-0.08148729	46.33532
7/20/2023 7:07		20.26064	-0.1101131	46.91369
7/20/2023 7:08		20.26025	-0.1061869	41.19994
7/20/2023 7:09		20.2626	-0.0922309	49.16735
7/20/2023 7:10		20.26178	-0.07081506	90.14429
7/20/2023 7:11		20.24936	-0.09030347	47.23207
7/20/2023 7:12		20.25386	-0.09612145	41.88839
7/20/2023 7:13		20.25782	-0.09180259	38.76796
7/20/2023 7:14		20.26014	-0.09119581	37.54198
7/20/2023 7:15		20.2543	-0.09884105	37.15045
7/20/2023 7:16		20.24981	-0.08613138	36.15622
7/20/2023 7:17		20.25511	-0.0856298	34.06773
7/20/2023 7:18		20.26658	-0.1056626	33.28987
7/20/2023 7:19		20.26899	-0.1205983	33.10648
7/20/2023 7:20		20.26468	-0.139189	32.99539
7/20/2023 7:21		20.26665	-0.1557474	32.86851
7/20/2023 7:22		20.27113	-0.1701489	32.71056
7/20/2023 7:23		20.27689	-0.184514	32.99221
7/20/2023 7:24		20.28299	-0.1955997	33.21619
7/20/2023 7:25		20.28621	-0.2296944	32.95696
7/20/2023 7:26		20.284	-0.2230853	32.54626
7/20/2023 7:27		20.28603	-0.1784827	31.9372
7/20/2023 7:28		20.2887	-0.1613841	31.72306
7/20/2023 7:29		20.32521	-0.1887034	30.86645
7/20/2023 7:30		5.780896	-0.27585	30.02265
7/20/2023 7:31		0.1737154	-0.003467086	30.08477
7/20/2023 7:32		16.62916	4.655557	30.95879
7/20/2023 7:33		20.29647	6.100611	30.92129
7/20/2023 7:34		12.32022	11.12364	30.58146
7/20/2023 7:35		16.20703	9.07527	30.5319
7/20/2023 7:36		21.02014	6.103333	30.54111
7/20/2023 7:37		21.03323	6.111775	30.54345
7/20/2023 7:38		21.0378	6.111073	30.13277
7/20/2023 7:39		21.0485	6.096937	28.97291
7/20/2023 7:40		21.04916	6.100592	28.70611
7/20/2023 7:41		20.67261	0.1464844	26.92871
7/20/2023 7:47		20.63599	0.1464844	26.97754
7/20/2023 7:48		20.5621	0.1676382	26.65576
7/20/2023 7:49		20.87202	5.641574	26.70622
7/20/2023 7:50		20.88404	4.278857	26.94099
7/20/2023 7:51		20.81529	2.957939	26.93997
7/20/2023 7:51	setup			
7/20/2023 7:52		20.76135	2.123366	26.27377
7/20/2023 7:53		20.72735	1.642586	26.54844
7/20/2023 7:53		20.71056	1.507568	25.94654
7/20/2023 7:54		20.71659	1.290894	25.58019
7/20/2023 7:55		20.695	0.7321691	25.17379
7/20/2023 7:56		20.59232	0.28022	25.65441
7/20/2023 7:57		20.56242	0.1685288	24.83671
7/20/2023 7:58		20.56585	0.1300518	24.769
7/20/2023 7:59		20.55686	0.1102582	24.39755
7/20/2023 8:00		20.55057	0.1227204	24.7495
7/20/2023 8:01		20.54702	0.1367188	25.83898
7/20/2023 8:02		20.54819	0.1410309	28.27466
7/20/2023 8:03		20.54504	0.1563936	35.10254
7/20/2023 8:04		20.54138	0.1728013	65.26123
7/20/2023 8:05		20.50637	0.1941929	80.26954
7/20/2023 8:06		20.49051	0.2093147	106.6133
7/20/2023 8:07		20.47686	0.2154288	104.5092
7/20/2023 8:08		20.47816	0.2267276	101.8465
7/20/2023 8:09		20.48239	0.2377843	98.85022
7/20/2023 8:10		20.49507	0.2367087	102.7095
7/20/2023 8:11		20.50182	0.2367805	109.7539
7/20/2023 8:12		20.51327	0.2283582	89.73309
7/20/2023 8:13		20.50157	0.2305693	83.5959
7/20/2023 8:14		20.4839	0.237062	84.21537
7/20/2023 8:15		20.47442	0.2380371	72.84467
7/20/2023 8:16		20.47956	0.2355957	65.38129
7/20/2023 8:17		20.49203	0.2323309	60.38869
7/20/2023 8:18		20.50052	0.2205882	58.62778
7/20/2023 8:19		20.51197	0.2229408	68.81789

Data 1-min

Time	Comment	CAI 2-O2	CAI 2-CO2	Thermo THC 1-THC
7/20/2023 8:20		20.51413	0.2211627	56.00098
7/20/2023 8:21		20.51594	0.2220018	53.19564
7/20/2023 8:22		20.50056	0.2229937	46.66303
7/20/2023 8:23		20.48394	0.2396623	44.94542
7/20/2023 8:24		20.46458	0.2601534	46.16269
7/20/2023 8:25		20.47037	0.2628102	46.28016
7/20/2023 8:26		19.57782	0.9909955	61.98141
7/20/2023 8:27		18.63501	1.398825	59.92237
7/20/2023 8:28		18.65073	1.399464	58.62664
7/20/2023 8:29		18.64826	1.4249	53.40222
7/20/2023 8:30		18.64445	1.427469	49.26844
7/20/2023 8:31		18.63468	1.430678	48.23106
7/20/2023 8:32		7.742741	0.4273897	42.25873
7/20/2023 8:33		0.1120534	0.1533059	7.386977
7/20/2023 8:34		0.05109002	0.149967	3.07531
7/20/2023 8:35		0.04060633	0.161061	-2.314166
7/20/2023 8:36		0.03795737	0.1643615	-7.992499
7/20/2023 8:37		0.03331502	0.1617795	-56.85396
7/20/2023 8:38		0.02989626	0.1612132	-0.2301424
7/20/2023 8:39		6.5797	6.590262	7.520947
7/20/2023 8:40		11.99586	12.44584	3.34689
7/20/2023 8:41		5.570838	4.193878	86.4973
7/20/2023 8:42		0.09528063	0.2375254	52.0062
7/20/2023 8:43		9.375365	0.9614682	21.08604
7/20/2023 8:44		1.963951	0.2167838	30.36361
7/20/2023 8:45		11.13102	1.12714	7.005907
7/20/2023 8:46		18.23255	1.399532	4.487918
7/20/2023 8:47		2.03788	0.2102972	16.54307
7/20/2023 8:48		10.24594	1.05653	4.91244
7/20/2023 8:49		13.25724	0.9273689	5.751887
7/20/2023 8:50		1.493534	0.366284	6.91893
7/20/2023 8:51		17.23114	1.452088	1.187781
7/20/2023 8:52		18.53455	1.461627	1.167168
7/20/2023 8:53		18.57472	1.452088	1.1717
7/20/2023 8:54		18.58473	1.457832	1.156642
7/20/2023 8:55		18.58127	1.460652	1.168555
7/20/2023 8:56		18.59182	1.452927	1.10636
7/20/2023 8:57		18.59968	1.460275	1.079452
7/20/2023 8:58		18.5981	1.45805	1.057677
7/20/2023 8:59		18.58436	1.467292	1.042173
7/20/2023 9:00		18.59383	1.463894	1.057816
7/20/2023 9:01		18.6064	1.457973	1.018198
7/20/2023 9:02		18.59058	1.4651	1.032086
7/20/2023 9:03		18.58615	1.465611	1.010449
7/20/2023 9:04		18.58279	1.470984	1.011327
7/20/2023 9:05		18.5916	1.456306	1.011465
7/20/2023 9:06		18.60304	1.455853	1.010303
7/20/2023 9:07		18.60373	1.448858	1.010157
7/20/2023 9:08		18.60483	1.452198	1.010742
7/20/2023 9:09		18.60607	1.450846	1.010157
7/20/2023 9:10		18.59039	1.459325	1.008256
7/20/2023 9:11		18.61324	1.439004	0.9991925
7/20/2023 9:12		18.61064	1.439626	0.9879356
7/20/2023 9:13		18.60249	1.442915	0.9835498
7/20/2023 9:14		18.60181	1.45053	0.945779
7/20/2023 9:15		18.62161	1.437579	0.9546036
7/20/2023 9:16		18.6105	1.445217	0.9608899
7/20/2023 9:17		18.60889	1.443463	0.9835498
7/20/2023 9:18		18.62891	1.435271	0.9675775
7/20/2023 9:19		18.63699	1.432279	0.938961
7/20/2023 9:20		18.64584	1.424444	0.9373503
7/20/2023 9:21		18.61196	1.447264	0.9372067
7/20/2023 9:22		18.63732	1.431914	0.9385225
7/20/2023 9:23		18.63283	1.432682	0.9376453
7/20/2023 9:24		18.65512	1.424751	0.9477326
7/20/2023 9:25		18.63389	1.441672	0.9372067
7/20/2023 9:26		18.64777	1.428477	0.9523185
7/20/2023 9:27		18.63319	1.433449	0.9543113
7/20/2023 9:28		18.62947	1.427894	0.9369143
7/20/2023 9:29		18.63012	1.428003	0.9369143
7/20/2023 9:30		18.61912	1.423142	0.9373529
7/20/2023 9:31		18.63396	1.405589	0.9373503
7/20/2023 9:32		18.63743	1.403589	0.9493407
7/20/2023 9:33		18.63712	1.404208	0.9280496
7/20/2023 9:34		18.63648	1.403187	0.9325285
7/20/2023 9:35		18.63491	1.404832	0.9370605
7/20/2023 9:36		18.63312	1.400483	0.9361833
7/20/2023 9:37		18.62462	1.406061	0.9303748
7/20/2023 9:38		18.62117	1.40761	0.933698
7/20/2023 9:39		18.63685	1.395914	0.9370605
7/20/2023 9:40		18.62409	1.406842	0.9361833
7/20/2023 9:41		18.61733	1.418391	0.9367681
7/20/2023 9:42		18.62099	1.413	0.9255792
7/20/2023 9:43		18.6181	1.414773	0.9125001
7/20/2023 9:44		18.64547	1.402853	0.9125
7/20/2023 9:45		18.62401	1.416343	0.9125001
7/20/2023 9:46		18.63659	1.411228	0.9300431
7/20/2023 9:47		18.63433	1.422229	1.616271

Data 1-min

Time	Comment	CAI 2-O2	CAI 2-CO2	Thermo THC 1-THC
7/20/2023 9:48		18.58802	1.460604	4.577529
7/20/2023 9:49		18.55055	1.482827	8.584315
7/20/2023 9:50		18.48883	1.522407	12.38461
7/20/2023 9:51		18.42436	1.548392	17.92151
7/20/2023 9:52		18.34523	1.579568	21.77896
7/20/2023 9:53		18.28241	1.618053	22.20613
7/20/2023 9:54		18.2288	1.650129	21.74194
7/20/2023 9:55		18.18807	1.686836	17.42929
7/20/2023 9:56		18.08106	1.755985	11.96504
7/20/2023 9:57		17.95961	1.849182	8.316965
7/20/2023 9:58		17.84643	1.913416	5.088168
7/20/2023 9:59		17.76569	1.975858	3.253475
7/20/2023 10:00		17.65813	2.041023	2.455268
7/20/2023 10:01		17.58098	2.101693	1.993886
7/20/2023 10:02		17.54293	2.11485	1.878394
7/20/2023 10:03		17.50971	2.120063	1.765687
7/20/2023 10:04		17.47086	2.131735	1.639369
7/20/2023 10:05		17.41585	2.157977	1.523
7/20/2023 10:06		17.38881	2.172705	1.399906
7/20/2023 10:07		17.37759	2.178078	1.329295
7/20/2023 10:08		17.33428	2.203479	1.279444
7/20/2023 10:09		17.30895	2.216848	1.249648
7/20/2023 10:10		17.35387	2.179869	1.236609
7/20/2023 10:11		17.36081	2.181111	1.205763
7/20/2023 10:12		17.33264	2.183315	1.155044
7/20/2023 10:13		17.31464	2.187743	1.122521
7/20/2023 10:14		17.28984	2.191816	1.128304
7/20/2023 10:15		17.28107	2.187706	1.073104
7/20/2023 10:16		17.26605	2.196757	1.026142
7/20/2023 10:17		17.27396	2.184734	0.9974443
7/20/2023 10:18		17.24134	2.207257	0.982255
7/20/2023 10:19		17.23858	2.207075	0.9438899
7/20/2023 10:20		17.19227	2.234465	0.9085997
7/20/2023 10:21		17.1697	2.243187	0.9530452
7/20/2023 10:22		17.13648	2.261846	0.9127924
7/20/2023 10:23		17.15379	2.238682	0.8969506
7/20/2023 10:24		17.15702	2.229854	0.8888125
7/20/2023 10:25		17.14525	2.236757	0.8812557
7/20/2023 10:26		17.11835	2.263454	0.8667417
7/20/2023 10:27		17.08342	2.276539	0.8545706
7/20/2023 10:28		17.08154	2.277659	0.8394019
7/20/2023 10:29		17.07804	2.268023	0.8309244
7/20/2023 10:30		17.08356	2.26868	0.8203984
7/20/2023 10:31		17.04372	2.285419	0.8146969
7/20/2023 10:32		17.02377	2.30077	0.8053405
7/20/2023 10:33		5.347406	0.5157107	1.385092
7/20/2023 10:34		0.08512028	0.1787928	-0.1044113
7/20/2023 10:35		8.137331	2.849869	0.3268524
7/20/2023 10:36		11.71681	12.32684	-0.009240493
7/20/2023 10:37		12.05068	12.4341	-0.06406245
7/20/2023 10:38		12.05883	12.45848	-0.106458
7/20/2023 10:39		12.05869	12.4927	-0.1114372
7/20/2023 10:40		12.73954	10.0943	0.1626814
7/20/2023 10:41		10.27821	2.842557	4.711149
7/20/2023 10:42		0.1570468	0.3086113	8.303953
7/20/2023 10:43		0.06322803	0.2735252	8.309655
7/20/2023 10:44		0.04535607	0.2602949	8.309947
7/20/2023 10:45		6.203804	1.355273	4.208823
7/20/2023 10:46		16.66775	2.500358	0.9227336
7/20/2023 10:47		16.80967	2.522799	0.8826768
7/20/2023 10:48		16.79175	2.570779	0.8396934
7/20/2023 10:49		16.73997	2.617202	0.8246381
7/20/2023 10:50		16.70803	2.624475	0.8136736
7/20/2023 10:51		16.74786	2.601925	0.8149893
7/20/2023 10:52		16.76881	2.594323	0.817036
7/20/2023 10:53		16.73275	2.633849	0.7942073
7/20/2023 10:54		16.71519	2.661718	0.7771253
7/20/2023 10:55		16.7024	2.682769	0.7639679
7/20/2023 10:56		16.64927	2.728562	0.7588938
7/20/2023 10:57		16.66877	2.712831	0.7660146
7/20/2023 10:58		16.64189	2.73888	0.7751699
7/20/2023 10:59		16.6414	2.742635	0.7809263
7/20/2023 11:00		16.59754	2.76142	0.7532958
7/20/2023 11:01		16.59908	2.769278	0.7452553
7/20/2023 11:02		16.6134	2.751516	0.7462786
7/20/2023 11:03		16.59895	2.763512	0.7479947
7/20/2023 11:04		16.5791	2.785153	0.7612473
7/20/2023 11:05		16.54626	2.795922	0.7573892
7/20/2023 11:06		16.55517	2.79214	0.7586032
7/20/2023 11:07		16.56382	2.793568	0.7566245
7/20/2023 11:08		16.5172	2.820733	0.7414552
7/20/2023 11:09		16.48788	2.842858	0.7411645
7/20/2023 11:10		16.44669	2.879697	0.7414552
7/20/2023 11:11		16.42511	2.894011	0.7414552
7/20/2023 11:12		16.44901	2.881041	0.7416005
7/20/2023 11:13		16.46089	2.864111	0.7312827
7/20/2023 11:14		16.43263	2.89274	0.7027996
7/20/2023 11:15		16.39386	2.914974	0.6929177

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Time	Comment	CAI 2-O2	CAI 2-CO2	Thermo THC 1-THC
7/20/2023 11:16		16.3562	2.947316	0.6934904
7/20/2023 11:17		16.35283	2.946842	0.6966729
7/20/2023 11:18		16.35404	2.92798	0.7000385
7/20/2023 11:19		16.3596	2.934047	0.6968414
7/20/2023 11:20		16.34685	2.949924	0.6950976
7/20/2023 11:21		16.35843	2.92929	0.6959506
7/20/2023 11:22		16.35088	2.949996	0.6901566
7/20/2023 11:23		16.32876	2.964274	0.6968414
7/20/2023 11:24		16.32471	2.956733	0.6940882
7/20/2023 11:25		16.34829	2.951945	0.6907257
7/20/2023 11:26		16.34056	2.96907	0.6913192
7/20/2023 11:27		16.29518	2.99573	0.6930648
7/20/2023 11:28		16.3208	2.97659	0.6943709
7/20/2023 11:29		16.29944	2.990178	0.6887034
7/20/2023 11:30		16.29341	2.994392	0.6937897
7/20/2023 11:31		16.27351	3.008448	0.6758142
7/20/2023 11:32		7.715502	1.198957	1.241143
7/20/2023 11:33		0.09791209	0.2415457	-0.1789692
7/20/2023 11:34		3.062466	4.671419	-0.1481226
7/20/2023 11:35		11.89382	12.43169	-0.06523199
7/20/2023 11:36		7.717023	6.342497	4.504707
7/20/2023 11:37		0.1161861	0.3040062	8.239337
7/20/2023 11:38		8.419307	2.044458	2.999542
7/20/2023 11:39		16.05148	3.071421	0.7411619
7/20/2023 11:40		16.19001	3.046817	0.7019277
7/20/2023 11:41		16.21481	3.05099	0.700813
7/20/2023 11:42		16.22906	3.025809	0.697012
7/20/2023 11:43		16.19511	3.084139	0.6782994
7/20/2023 11:44		16.21002	3.061538	0.6698291
7/20/2023 11:45		16.22614	3.057715	0.6617797
7/20/2023 11:46		16.24029	3.045983	0.6524234
7/20/2023 11:47		16.22059	3.071311	0.6388276
7/20/2023 11:48		16.21397	3.076428	0.6329799
7/20/2023 11:49		16.26471	3.043438	0.6323186
7/20/2023 11:50		16.22643	3.072042	0.631518
7/20/2023 11:51		16.21072	3.094556	0.6351728
7/20/2023 11:52		16.22333	3.088633	0.6247619
7/20/2023 11:53		16.2339	3.074101	0.6183677
7/20/2023 11:54		16.17897	3.130377	0.6263604
7/20/2023 11:55		16.17467	3.139433	0.6145039
7/20/2023 11:57		16.18714	3.131104	0.6283949
7/20/2023 11:58		16.18689	3.132858	0.6321028
7/20/2023 11:59		16.15005	3.157143	0.6143297
7/20/2023 12:00		16.19342	3.124278	0.605662
7/20/2023 12:01		16.17307	3.140058	0.6040339
7/20/2023 12:02		16.1609	3.152886	0.6069577
7/20/2023 12:03		16.16694	3.137243	0.5951163
7/20/2023 12:04		16.18748	3.144083	0.5952633
7/20/2023 12:05		16.15392	3.148756	0.5980401
7/20/2023 12:06		16.17167	3.136045	0.5727367
7/20/2023 12:07		16.17068	3.135572	0.5869783
7/20/2023 12:08		16.14855	3.174413	0.5869295
7/20/2023 12:09		16.13927	3.162608	0.5809357
7/20/2023 12:10		16.13064	3.177615	0.5880567
7/20/2023 12:11		16.12957	3.157215	0.5808145
7/20/2023 12:12		16.13163	3.18768	0.58576
7/20/2023 12:13		16.09057	3.207615	0.5840718
7/20/2023 12:14		16.14095	3.162864	0.5981863
7/20/2023 12:15		16.072	3.229338	0.5916492
7/20/2023 12:16		16.10986	3.20953	0.6033523
7/20/2023 12:17		16.10467	3.194355	0.6093577
7/20/2023 12:18		16.15232	3.188922	0.6022797
7/20/2023 12:19		16.09084	3.226348	0.6079811
7/20/2023 12:20		16.08611	3.237357	0.6189349
7/20/2023 12:21		16.10419	3.207577	0.8877661
7/20/2023 12:22		16.06203	3.26027	0.8574945
7/20/2023 12:23		16.09562	3.240821	0.7789484
7/20/2023 12:24		16.10177	3.217869	0.7717161
7/20/2023 12:25		16.07306	3.25361	0.7045434
7/20/2023 12:26		16.09764	3.229966	0.7148474
7/20/2023 12:27		16.06018	3.269474	0.6895562
7/20/2023 12:28		16.06874	3.235517	0.693935
7/20/2023 12:29		16.07465	3.258656	0.6557859
7/20/2023 12:30		16.03021	3.273641	0.6651421
7/20/2023 12:31		16.07564	3.253137	0.6734751
7/20/2023 12:32		16.08887	3.224337	0.6655807
7/20/2023 12:33		16.09795	3.235819	0.6398263
7/20/2023 12:34		16.04373	3.261945	0.6392662
7/20/2023 12:35		16.08756	3.241148	0.627959
7/20/2023 12:36		16.02916	3.266852	0.6145298
7/20/2023 12:37		8.496313	1.426213	1.046415
7/20/2023 12:38		0.106976	0.2256108	-0.1615723
7/20/2023 12:39		0.05156922	0.2184839	-0.2204879
7/20/2023 12:40		7.727123	9.48203	-0.1387576
7/20/2023 12:41		12.02371	12.35147	-0.07795055
7/20/2023 12:42		13.81098	4.518685	2.267992
7/20/2023 12:43		0.6689746	0.3044448	8.218577
7/20/2023 12:44		0.05835108	0.2375959	8.231999

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Time	Comment	CAI 2-O2	CAI 2-CO2	Thermo THC 1-THC
7/20/2023 12:45		10.48273	2.592861	1.992279
7/20/2023 12:46		15.92725	3.222181	0.7073916
7/20/2023 12:47		16.02323	3.223314	0.6303485
7/20/2023 12:48		16.0589	3.201003	0.6009291
7/20/2023 12:49		16.02107	3.25131	0.5977477
7/20/2023 12:51		15.99634	3.261589	0.5782142
7/20/2023 12:52		16.00225	3.259059	0.5577686
7/20/2023 12:53		16.00451	3.265454	0.5661973
7/20/2023 12:54		15.99267	3.263005	0.553013
7/20/2023 12:55		16.00653	3.242465	0.5226051
7/20/2023 12:56		15.98256	3.259568	0.5221648
7/20/2023 12:57		15.99446	3.238006	0.5253828
7/20/2023 12:58		16.01446	3.215383	0.5078397
7/20/2023 12:59		16.03	3.226701	0.5190798
7/20/2023 13:00		16.04742	3.186912	0.4971677
7/20/2023 13:01		16.03076	3.210669	0.499653
7/20/2023 13:02		15.99381	3.243708	0.4964367
7/20/2023 13:03		16.0291	3.209069	0.4994946
7/20/2023 13:04		16.02144	3.223204	0.5011149
7/20/2023 13:05		16.01383	3.23808	0.4973139
7/20/2023 13:06		16.02926	3.198279	0.4971677
7/20/2023 13:07		16.01069	3.235083	0.4990682
7/20/2023 13:08		15.99647	3.262494	0.492782
7/20/2023 13:09		16.01033	3.225763	0.5002378
7/20/2023 13:10		16.02085	3.221743	0.5170498
7/20/2023 13:11		16.01051	3.227225	0.4940977
7/20/2023 13:12		15.93858	3.279013	0.4954134
7/20/2023 13:13		15.99074	3.246413	0.4986296
7/20/2023 13:14		15.97312	3.231775	0.515916
7/20/2023 13:15		15.99125	3.226087	0.5013605
7/20/2023 13:16		15.94794	3.269534	0.4973156
7/20/2023 13:17		15.95528	3.258699	0.5049721
7/20/2023 13:18		15.96874	3.257303	0.5001887
7/20/2023 13:19		15.97268	3.243619	0.4916473
7/20/2023 13:20		15.93996	3.263395	0.4899481
7/20/2023 13:21		15.94059	3.283801	0.4525793
7/20/2023 13:22		15.94067	3.267793	0.4907353
7/20/2023 13:23		15.91863	3.278246	0.5138336
7/20/2023 13:24		15.98328	3.241259	0.463836
7/20/2023 13:25		15.95039	3.274847	0.4498016
7/20/2023 13:26		15.95207	3.264869	0.4556493
7/20/2023 13:27		15.95737	3.255038	0.4571112
7/20/2023 13:28		15.94629	3.286323	0.4648594
7/20/2023 13:29		15.99362	3.233767	0.4452696
7/20/2023 13:30		15.9994	3.226676	0.4451235
7/20/2023 13:31		15.97211	3.231396	0.5147956
7/20/2023 13:32		3.766783	0.4761839	0.622454
7/20/2023 13:33		0.2594908	0.2079581	-0.2276514
7/20/2023 13:34		9.905677	11.47549	-0.1400821
7/20/2023 13:35		12.04081	12.37029	-0.1375968
7/20/2023 13:36		8.982885	7.893844	3.44328
7/20/2023 13:37		0.1921518	0.2293541	8.217669
7/20/2023 13:38		0.05745345	0.1734568	8.236413
7/20/2023 13:39		0.03974551	0.1536778	8.233944
7/20/2023 13:40		0.03673074	0.1470326	8.233782
7/20/2023 13:41		0.1752842	0.2379275	7.646967
7/20/2023 13:42		13.66219	3.100951	0.8568007
7/20/2023 13:43		15.85348	3.246198	0.548468
7/20/2023 13:44		15.94067	3.211546	0.5325461
7/20/2023 13:45		15.91366	3.249775	0.5084245
7/20/2023 13:46		15.95766	3.207123	0.4919048
7/20/2023 13:47		15.97542	3.213702	0.478309
7/20/2023 13:48		15.93014	3.259972	0.4636898
7/20/2023 13:49		15.95609	3.225361	0.4604736
7/20/2023 13:50		15.98792	3.206612	0.4550645
7/20/2023 13:51		15.92974	3.251612	0.4679599
7/20/2023 13:52		15.89995	3.257962	0.4604736
7/20/2023 13:53		15.96256	3.215931	0.4479011
7/20/2023 13:54		15.93771	3.22474	0.4454158
7/20/2023 13:55		15.935	3.230989	0.4354748
7/20/2023 13:56		15.9458	3.238896	0.4397674
7/20/2023 13:57		15.95225	3.219257	0.4410301
7/20/2023 13:58		15.93917	3.245462	0.4169084
7/20/2023 13:59		15.92561	3.238116	0.4287499
7/20/2023 14:00		15.93474	3.240711	0.4161775
7/20/2023 14:01		15.9127	3.255136	0.4051809
7/20/2023 14:02		15.95126	3.229308	0.4283114
7/20/2023 14:03		15.92667	3.260008	0.4357672
7/20/2023 14:04		15.91187	3.247472	0.4338667
7/20/2023 14:05		15.88226	3.296666	0.4041898
7/20/2023 14:06		15.84771	3.296262	0.4790044
7/20/2023 14:07		15.89728	3.277734	0.4506788
7/20/2023 14:08		15.93482	3.239249	0.4587193
7/20/2023 14:09		15.95933	3.23957	0.4546621
7/20/2023 14:10		15.92612	3.254343	0.4457082
7/20/2023 14:11		15.90993	3.248898	0.4489245
7/20/2023 14:12		15.86048	3.295789	0.4423458
7/20/2023 14:13		15.89991	3.269182	0.4479011

Data 1-min

Time	Comment	CAI 2-O2	CAI 2-CO2	Thermo THC 1-THC
7/20/2023 14:14		15.95782	3.228542	0.4371516
7/20/2023 14:15		15.93452	3.243342	0.4230486
7/20/2023 14:16		15.9384	3.261982	0.4462929
7/20/2023 14:17		15.92703	3.268707	0.5014073
7/20/2023 14:18		15.93983	3.256503	0.5163995
7/20/2023 14:19		15.92888	3.258447	0.5104617
7/20/2023 14:20		15.94345	3.265896	0.5074611
7/20/2023 14:21		15.93555	3.261239	0.4836545
7/20/2023 14:22		15.92016	3.269328	0.5274295
7/20/2023 14:23		15.91256	3.288077	0.5112022
7/20/2023 14:24		15.89853	3.289539	0.4878115
7/20/2023 14:25		15.90097	3.285117	0.4690989
7/20/2023 14:26		15.88738	3.294912	0.4663213
7/20/2023 14:27		15.86095	3.305328	0.447024
7/20/2023 14:28		15.87144	3.325722	0.4666137
7/20/2023 14:29		15.88924	3.320934	0.5588607
7/20/2023 14:30		15.84582	3.330692	0.5028692
7/20/2023 14:31		15.87019	3.322819	0.4723195
7/20/2023 14:32		15.85383	3.344763	0.4446848
7/20/2023 14:33		15.89235	3.293157	0.4297733
7/20/2023 14:34		15.87946	3.323255	0.3980602
7/20/2023 14:35		15.8926	3.317739	0.438484
7/20/2023 14:36		13.17468	2.36334	1.099042
7/20/2023 14:37		0.3473918	0.1597087	-0.2492026
7/20/2023 14:38		0.3191006	0.2424229	-0.2669773
7/20/2023 14:39		9.65715	11.10602	-0.1900797
7/20/2023 14:40		12.04428	12.29219	-0.1261938
7/20/2023 14:41		2.803058	1.472712	7.733865
7/20/2023 14:42		0.8461362	0.5360921	6.941161
7/20/2023 14:43		14.48534	3.29384	0.6032059
7/20/2023 14:44		15.84709	3.32271	0.4457256
7/20/2023 14:45		15.87415	3.344069	0.4002426
7/20/2023 14:46		15.81098	3.374526	0.3880279
7/20/2023 14:47		15.87652	3.328316	0.3746591
7/20/2023 14:48		15.8598	3.347597	0.3691412
7/20/2023 14:49		15.80022	3.413791	0.3752447
7/20/2023 14:50		15.8315	3.373864	0.3784418
7/20/2023 14:51		15.81373	3.403298	0.37539
7/20/2023 14:52		15.80029	3.395081	0.3611485
7/20/2023 14:53		15.84567	3.358968	0.3729195
7/20/2023 14:54		15.81586	3.39668	0.3624476
7/20/2023 14:55		15.86092	3.36936	0.3645718
7/20/2023 14:56		15.84929	3.370347	0.358578
7/20/2023 14:57		15.86128	3.352913	0.347906
7/20/2023 14:58		15.84826	3.362853	0.3405339
7/20/2023 14:59		15.76863	3.42696	0.3427893
7/20/2023 15:00		15.7682	3.4115	0.3427893
7/20/2023 15:01		15.79963	3.389863	0.3524379
7/20/2023 15:02		15.8236	3.399366	0.3324097
7/20/2023 15:03		15.7789	3.428385	0.3268544
7/20/2023 15:04		15.80697	3.420248	0.3131784
7/20/2023 15:05		15.80229	3.398854	0.337234
7/20/2023 15:06		15.80858	3.401266	0.3638409
7/20/2023 15:07		15.75401	3.426923	0.3416198
7/20/2023 15:08		15.79462	3.392422	0.3537536
7/20/2023 15:09		15.77854	3.392787	0.3376726
7/20/2023 15:10		15.84754	3.361063	0.4066751
7/20/2023 15:11		15.80131	3.395309	0.4518482
7/20/2023 15:12		15.77362	3.411718	0.4845177
7/20/2023 15:13		15.82528	3.384454	0.4082831
7/20/2023 15:14		15.75588	3.42674	0.3884011
7/20/2023 15:15		15.76943	3.421351	0.3878912
7/20/2023 15:16		15.72708	3.447317	0.3888396
7/20/2023 15:17		15.74755	3.429225	0.3720276
7/20/2023 15:18		15.78577	3.398014	0.3623789
7/20/2023 15:19		15.78278	3.40949	0.3667647
7/20/2023 15:20		15.76089	3.413327	0.3670571
7/20/2023 15:21		15.75744	3.424219	0.3678893
7/20/2023 15:22		15.7167	3.450277	0.360917
7/20/2023 15:23		15.71849	3.450277	0.3802144
7/20/2023 15:24		15.76748	3.395908	0.352888
7/20/2023 15:25		15.73581	3.428714	0.348637
7/20/2023 15:26		15.77214	3.410659	0.3495141
7/20/2023 15:27		15.75533	3.427873	0.3449822
7/20/2023 15:28		15.76973	3.416032	0.3477598
7/20/2023 15:29		15.65764	3.506013	0.3430817
7/20/2023 15:30		15.67928	3.468214	0.3422567
7/20/2023 15:31		15.71973	3.436686	0.3542312
7/20/2023 15:32		10.37703	1.90862	0.9043645
7/20/2023 15:33		0.1486407	0.1377129	-0.2960695
7/20/2023 15:34		3.772594	4.942715	-0.250019
7/20/2023 15:35		11.92443	12.30443	-0.1906918
7/20/2023 15:36		9.531258	8.1499	3.051639
7/20/2023 15:37		0.2084387	0.2172999	8.17773
7/20/2023 15:38		0.05087481	0.1574853	8.202204
7/20/2023 15:39		0.03358761	0.1473615	8.225595
7/20/2023 15:40		4.533852	1.528145	4.658071
7/20/2023 15:41		15.36927	3.483317	0.4939514

Time	Comment	CAI 2-O2	CAI 2-CO2	Thermo THC 1-THC
7/20/2023 15:42		15.65775	3.447207	0.4138384
7/20/2023 15:43		15.68995	3.457258	0.3882549
7/20/2023 15:44		15.67237	3.48954	0.4175332
7/20/2023 15:45		15.59865	3.547093	0.4031664
7/20/2023 15:46		15.62489	3.539712	0.3938459
7/20/2023 15:47		15.58907	3.556824	0.4166613
7/20/2023 15:48		15.67573	3.495487	0.4125227
7/20/2023 15:49		15.66805	3.514426	0.3973335
7/20/2023 15:50		15.62547	3.534517	0.3862891
7/20/2023 15:51		15.61141	3.563981	0.4061982
7/20/2023 15:52		15.62467	3.530244	0.3938102
7/20/2023 15:53		15.62326	3.541238	0.4125923
7/20/2023 15:54		15.62128	3.53036	0.4077494
7/20/2023 15:55		15.61624	3.549994	0.4057622
7/20/2023 15:56		15.63531	3.536932	0.4132536
7/20/2023 15:57		15.56459	3.58894	0.4044822
7/20/2023 15:58		15.57471	3.562078	0.3957106
7/20/2023 15:59		15.56184	3.599466	0.4003888
7/20/2023 16:00		15.60592	3.539125	0.4550645
7/20/2023 16:01		15.59478	3.565961	0.4517206
7/20/2023 16:02		15.5704	3.595443	0.4226195
7/20/2023 16:03		15.57544	3.586418	0.4063827
7/20/2023 16:04		15.59803	3.58693	0.4421996
7/20/2023 16:05		15.62233	3.544205	0.500384
7/20/2023 16:06		15.62957	3.552977	0.4479011
7/20/2023 16:07		15.59757	3.574117	0.4861251
7/20/2023 16:08		15.60534	3.548518	0.514126
7/20/2023 16:09		15.57508	3.594605	0.4303581
7/20/2023 16:10		15.54693	3.600855	0.4369367
7/20/2023 16:11		15.52789	3.634114	0.4408839
7/20/2023 16:12		15.58239	3.576331	0.4430768
7/20/2023 16:13		15.61897	3.554183	0.4601812
7/20/2023 16:14		15.60048	3.595592	0.5337157
7/20/2023 16:15		15.57741	3.617301	0.5119331
7/20/2023 16:16		15.59181	3.590695	0.4610583
7/20/2023 16:17		15.57727	3.609846	0.4677832
7/20/2023 16:18		15.57354	3.588428	0.4565264
7/20/2023 16:19		15.60807	3.552282	0.4416566
7/20/2023 16:20		15.58242	3.596981	0.480648
7/20/2023 16:21		15.56871	3.593132	0.5320221
7/20/2023 16:22		15.52559	3.622674	0.5173423
7/20/2023 16:23		15.52793	3.633894	0.4689527
7/20/2023 16:24		15.5087	3.648112	0.4566726
7/20/2023 16:25		15.49215	3.646832	0.4288962
7/20/2023 16:26		15.49512	3.656805	0.4346812
7/20/2023 16:27		15.54573	3.598406	0.4461468
7/20/2023 16:28		15.51605	3.633894	0.4581345
7/20/2023 16:29		15.54456	3.587844	0.4900043
7/20/2023 16:30		15.50951	3.632725	0.4671984
7/20/2023 16:31		15.45523	3.662183	0.4809404
7/20/2023 16:32		15.4498	3.656925	0.5426114
7/20/2023 16:33		15.43667	3.664631	0.473777
7/20/2023 16:34		15.30969	3.521147	1.045614
7/20/2023 16:35		1.826559	0.2411802	0.1824159
7/20/2023 16:36		0.04802886	0.1864115	-0.1591027
7/20/2023 16:37		8.554863	10.16265	-0.07692732
7/20/2023 16:38		11.98668	12.37164	-0.08102065
7/20/2023 16:39		12.00759	12.40991	-0.07663491
7/20/2023 16:40		6.821782	5.209976	5.123774
7/20/2023 16:41		0.06873721	0.2463568	8.308058
7/20/2023 16:42		0.02386584	0.2029876	8.330999
7/20/2023 16:43		0.01520397	0.1881491	8.328806
7/20/2023 16:44		2.530864	1.083681	5.930659
7/20/2023 16:45		14.80926	3.69476	0.6836538
7/20/2023 16:46		15.33024	3.689009	0.5362009
7/20/2023 16:47		15.41361	3.655348	0.520997
7/20/2023 16:48		15.3969	3.686925	0.5417563
7/20/2023 16:49		15.43162	3.674024	0.5231898
7/20/2023 16:50		15.35509	3.729577	0.4888348
7/20/2023 16:51		15.34943	3.704071	0.5133002
7/20/2023 16:52		15.35895	3.711228	0.5098124
7/20/2023 16:53		15.33178	3.711851	0.5075473
7/20/2023 16:54		15.34501	3.729395	0.4999603
7/20/2023 16:55		15.3525	3.729431	0.5031616
7/20/2023 16:56		15.35824	3.726324	0.4768471
7/20/2023 16:57		15.32933	3.742113	0.4780166
7/20/2023 16:58		15.37688	3.699863	0.4954134
7/20/2023 16:59		15.34793	3.719234	0.520266
7/20/2023 17:00		15.33982	3.744379	0.5031616
7/20/2023 17:01		15.34827	3.727977	0.47479
7/20/2023 17:02		15.34336	3.734474	0.4815252
7/20/2023 17:03		15.31354	3.760789	0.48518
7/20/2023 17:04		15.3167	3.758421	0.4396221
7/20/2023 17:05		15.32907	3.762909	0.4679294
7/20/2023 17:06		15.32359	3.754905	0.4800633
7/20/2023 17:07		15.25612	3.834433	0.453895
7/20/2023 17:08		15.26997	3.813089	0.4818176
7/20/2023 17:09		15.25232	3.809329	0.4962835

Data 1-min

Time	Comment	CAI 2-O2	CAI 2-CO2	Thermo THC 1-THC
7/20/2023 17:10		15.307	3.777966	0.4895657
7/20/2023 17:11		15.33018	3.765179	0.5066153
7/20/2023 17:12		15.36067	3.718843	0.5170208
7/20/2023 17:13		15.2779	3.795071	0.4740694
7/20/2023 17:14		15.232	3.80143	0.4777242
7/20/2023 17:15		15.22962	3.786775	0.447024
7/20/2023 17:16		15.215	3.799749	0.4689527
7/20/2023 17:17		15.25824	3.748655	0.466175
7/20/2023 17:18		15.24435	3.78915	0.4587193
7/20/2023 17:19		15.22834	3.803952	0.4806481
7/20/2023 17:20		15.20762	3.853584	0.4807943
7/20/2023 17:21		15.20897	3.850031	0.4984896
7/20/2023 17:22		15.16749	3.874897	0.4899034
7/20/2023 17:23		15.17132	3.85073	0.480988
7/20/2023 17:24		15.07957	3.941672	0.5108296
7/20/2023 17:25		15.08697	3.923678	0.5712906
7/20/2023 17:26		15.14191	3.858766	0.5441083
7/20/2023 17:27		15.11447	3.891249	0.5117261
7/20/2023 17:28		15.18357	3.829974	0.5841519
7/20/2023 17:29		15.12817	3.899745	0.5335695
7/20/2023 17:30		15.07652	3.902778	0.5442415
7/20/2023 17:31		15.10178	3.899489	0.5503815
7/20/2023 17:32		14.81027	3.707356	1.222865
7/20/2023 17:33		1.481583	0.2340899	0.165166
7/20/2023 17:34		0.0445048	0.1769656	-0.09051093
7/20/2023 17:35		4.703216	6.06229	-0.05455989
7/20/2023 17:36		11.96267	12.3295	-0.01523438
7/20/2023 17:37		12.01643	12.37457	-0.01348008
7/20/2023 17:38		4.877148	3.430761	6.475828
7/20/2023 17:39		3.247397	1.41914	5.526163
7/20/2023 17:40		14.58534	3.921491	0.6752924
7/20/2023 17:41		14.92942	3.914557	0.5455658
7/20/2023 17:42		14.90694	3.964544	0.4945363
7/20/2023 17:43		14.93628	3.923035	0.4938271
7/20/2023 17:44		15.01294	3.871264	0.5162066
7/20/2023 17:45		14.97991	3.916868	0.4900925
7/20/2023 17:46		15.01134	3.876688	0.493195
7/20/2023 17:47		14.96564	3.92986	0.4604736
7/20/2023 17:48		14.9228	3.944699	0.4474625
7/20/2023 17:49		14.94053	3.946526	0.4844491
7/20/2023 17:50		14.96535	3.912207	0.4939515
7/20/2023 17:51		14.93508	3.927996	0.4756775
7/20/2023 17:52		14.91243	3.931289	0.4802527
7/20/2023 17:53		14.96827	3.887574	0.4895657
7/20/2023 17:54		14.94543	3.921198	0.4990682
7/20/2023 17:55		14.97956	3.877889	0.5052083
7/20/2023 17:56		14.9993	3.871456	0.482841
7/20/2023 17:57		14.94243	3.903472	0.4894196
7/20/2023 17:58		14.95084	3.901389	0.5654393
7/20/2023 17:59		14.94236	3.893495	0.5087169
7/20/2023 18:00		14.96264	3.893129	0.5693865
7/20/2023 18:01		14.94641	3.897479	0.5604687
7/20/2023 18:02		14.91586	3.939143	0.5100326
7/20/2023 18:03		14.8591	4.013628	0.5098864
7/20/2023 18:04		14.89688	3.938974	0.5256981
7/20/2023 18:05		14.91769	3.926388	0.5259675
7/20/2023 18:06		14.87379	3.972841	0.5293299
7/20/2023 18:07		14.90391	3.934406	0.5189677
7/20/2023 18:08		14.86254	3.966225	0.5259675
7/20/2023 18:09		14.86346	3.985118	0.5127556
7/20/2023 18:10		14.89634	3.949048	0.5404406
7/20/2023 18:11		14.85487	3.989701	0.5422192
7/20/2023 18:12		14.8519	3.963484	0.524798
7/20/2023 18:13		14.89367	3.969039	0.5250903
7/20/2023 18:14		14.84693	3.976715	0.5272832
7/20/2023 18:15		14.87009	3.983924	0.5425098
7/20/2023 18:16		14.85033	3.954822	0.5022845
7/20/2023 18:17		14.8905	3.927777	0.4749466
7/20/2023 18:18		14.81466	3.979273	0.5221666
7/20/2023 18:19		14.82361	3.951825	0.547604
7/20/2023 18:20		14.83586	3.974193	0.5338619
7/20/2023 18:21		14.85007	3.965896	0.4813791
7/20/2023 18:22		14.81798	4.016515	0.5158802
7/20/2023 18:23		14.81027	4.000727	0.5066702
7/20/2023 18:24		14.81861	3.998936	0.4825486
7/20/2023 18:25		14.80848	3.983439	0.5204123
7/20/2023 18:26		14.85238	3.961474	0.5157341
7/20/2023 18:27		14.78435	4.016912	0.4931004
7/20/2023 18:28		14.72973	4.034461	0.5092259
7/20/2023 18:29		14.71856	4.026504	0.5220195
7/20/2023 18:30		14.66406	4.060198	0.5224624
7/20/2023 18:31		14.6173	4.105144	0.5218741
7/20/2023 18:32		14.68974	4.019659	0.5163189
7/20/2023 18:33		14.7037	4.027626	0.5131027
7/20/2023 18:34		14.80428	3.965714	0.5471654
7/20/2023 18:35		14.72588	4.053502	0.578158
7/20/2023 18:36		14.73096	4.038883	0.5829824
7/20/2023 18:37		14.63988	4.126379	0.5737723

Data 1-min

Time	Comment	CAI 2-O2	CAI 2-CO2	Thermo THC 1-THC
7/20/2023 18:38		14.59136	4.152752	0.5583498
7/20/2023 18:39		14.69226	4.047215	0.5397096
7/20/2023 18:40		14.67143	4.071447	0.5617845
7/20/2023 18:41		14.67197	4.070241	0.5707022
7/20/2023 18:42		14.73696	4.010083	0.5594454
7/20/2023 18:43		13.36118	3.356093	1.278127
7/20/2023 18:44		0.5572728	0.1557486	-0.05359934
7/20/2023 18:45		0.04765859	0.1342773	-0.08116685
7/20/2023 18:46		1.768082	2.944014	-0.08204393
7/20/2023 18:47		11.72044	12.24663	-0.01302828
7/20/2023 18:48		12.00415	12.32567	-0.01157956
7/20/2023 18:49		5.671619	4.543123	5.814924
7/20/2023 18:50		1.102361	0.7428015	6.873757
7/20/2023 18:51		13.73328	4.021924	0.8075334
7/20/2023 18:52		14.51499	4.153391	0.658842

Appendix C-3
VE Field Data

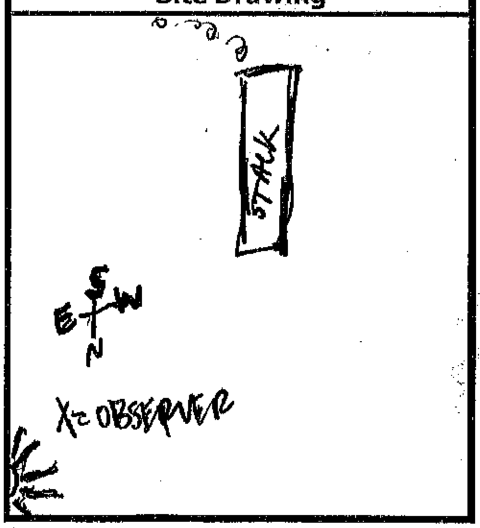
AIR SOURCE TECHNOLOGIES, INC.

Visible Emissons Observation Report

Client/Facility	RAIN CII CARBON	**Project #**	4173
Source Identification	K1 STACK	**Run #**	1

Regulation/Test Method	
M9	
Observation Time	
Test Date:	7/20/23
Start Time:	9:45
End Time:	10:45
Observer Location	
Direction from Source:	NE
Distance from Source:	100'
Height of Observation Point:	30'
Meterological Data	
Wind Direction:	S
Wind Speed (mph):	3
Temperature (°F):	79
Sky Condition:	CLOUDY
Background:	CLOUDY SKY
Production Data	

Site Drawing



	0	15	30	45
0	0	0	0	0
1	5	5	5	5
2	5	10	10	10
3	10	15	15	20
4	20	20	25	25
5	30	30	30	30
Set Average:				
6	35	35	40	40
7	40	40	45	45
8	45	45	40	45
9	40	40	45	45
10	40	45	45	45
11	50	50	50	45
Set Average:				
12	45	50	50	50
13	45	45	45	45
14	45	50	50	45
15	45	40	40	40
16	35	35	35	35
17	30	30	30	25
Set Average:				
18	25	25	20	20
19	20	20	20	15
20	15	15	15	15
21	15	15	10	15
22	15	20	20	15
23	15	20	20	20
Set Average:				
24	15	15	15	20
25	20	20	20	20
26	15	15	15	15
27	10	10	15	10
28	15	10	10	5
29	5	10	5	5
Set Average:				

	0	15	30	45
30	5	5	5	5
31	5	5	5	5
32	5	5	5	5
33	5	5	5	5
34	5	5	5	5
35	0	0	0	0
Set Average:				
36	0	0	0	0
37	0	0	0	0
38	0	0	0	0
39	0	0	0	0
40	0	0	0	0
41	0	0	0	0
Set Average:				
42	0	0	0	0
43	0	0	0	0
44	0	0	0	0
45	5	0	5	0
46	5	0	5	0
47	5	0	5	0
Set Average:				
48	5	0	5	0
49	5	0	5	0
50	5	0	5	0
51	5	0	5	0
52	5	0	5	0
53	5	0	5	0
Set Average:				
54	5	0	5	0
55	5	0	5	0
56	5	0	5	0
57	5	0	5	0
58	5	0	5	0
59	5	0	5	0
Set Average:				

Certified Observer	
Name:	LRY HOOPER
Signature:	LRY HOOPER
Certification Date:	03-16-23

Summary of Results	
Minimum:	0
Maximum:	50
Average:	13.9

Comments

2K 8/1/23

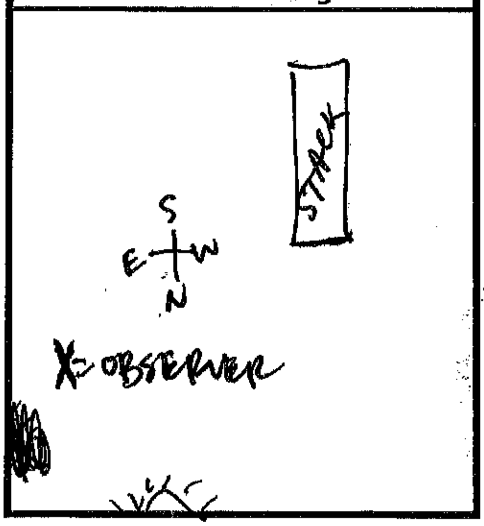
AIR SOURCE TECHNOLOGIES, INC. Visible Emissons Observation Report

Client/Facility	RAIN CARBON	Project #	4173
Source Identification	K1 STACK	Run #	2

Regulation/Test Method	
M9	
Observation Time	
Test Date:	7/20/23
Start Time:	12:11
End Time:	13:11
Observer Location	
Direction from Source:	NE
Distance from Source:	100'
Height of Observation Point:	[redacted] 130'
Meterological Data	
Wind Direction:	[redacted] SW
Wind Speed (mph):	7
Temperature (°F):	82
Sky Condition:	MOSTLY CLOUDY
Background:	CLOUDY SKY
Production Data	

	0	15	30	45		0	15	30	45
0	0	0	0	0	30	0	0	0	0
1	0	0	0	0	31	0	5	0	5
2	0	0	0	0	32	0	5	0	5
3	0	0	0	0	33	0	5	0	5
4	0	0	0	0	34	0	5	0	5
5	0	0	0	0	35	0	5	0	5
Set Average:					Set Average:				
6	0	0	0	0	36	0	5	0	5
7	0	0	0	0	37	0	5	0	5
8	5	5	5	5	38	0	5	0	5
9	5	5	5	5	39	0	5	0	5
10	5	5	5	5	40	0	5	0	5
11	5	5	5	5	41	0	5	0	5
Set Average:					Set Average:				
12	5	5	5	5	42	0	5	0	5
13	5	5	5	5	43	0	5	0	5
14	0	5	0	5	44	0	5	0	5
15	0	5	0	5	45	5	5	5	5
16	5	5	5	5	46	0	5	0	5
17	0	5	0	5	47	5	5	5	5
Set Average:					Set Average:				
18	0	5	0	5	48	0	5	0	5
19	0	5	0	5	49	0	5	0	5
20	0	5	0	5	50	0	5	0	5
21	0	5	0	5	51	0	5	0	5
22	0	5	0	5	52	0	5	0	5
23	0	5	0	5	53	0	5	0	5
Set Average:					Set Average:				
24	5	5	5	5	54	0	5	0	5
25	5	5	5	5	55	0	5	0	5
26	5	5	5	5	56	0	5	0	5
27	5	5	5	5	57	0	5	0	5
28	5	5	5	5	58	0	5	0	5
29	5	5	5	5	59	0	5	0	5
Set Average:					Set Average:				

Site Drawing



Certified Observer	
Name:	LEX HOOPER
Signature:	Lex Hooper
Certification Date:	03-14-23

Summary of Results	
Minimum:	0
Maximum:	5
Average:	2.71

Comments

JK 9/1/23

AIR SOURCE TECHNOLOGIES, INC.

Visible Emissons Observation Report

Client/Facility	RAIN CARBON	Project #	4173
Source Identification	K1 STACK	Run #	3

Regulation/Test Method
M9

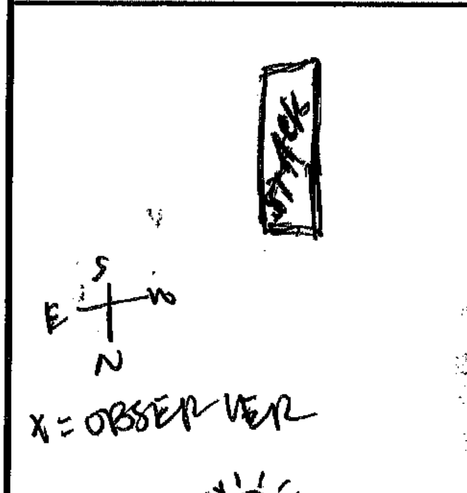
Observation Time	
Test Date:	7/20/23
Start Time:	13:44
End Time:	14:37

Observer Location	
Direction from Source:	NE
Distance from Source:	100'
Height of Observation Point:	30'

Meterological Data	
Wind Direction:	W
Wind Speed (mph):	10
Temperature (ºF):	80
Sky Condition:	PARTLY CLOUDY
Background:	BLUE/CLOUDY SKY

Production Data

Site Drawing



	0	15	30	45
0	0	5	0	5
1	0	5	0	5
2	0	5	0	5
3	0	5	0	5
4	0	5	0	5
5	0	5	0	5
Set Average:				
6	0	5	0	5
7	0	5	0	5
8	0	5	0	5
9	0	5	0	5
10	0	5	0	5
11	0	5	0	5
Set Average:				
12	0	5	0	5
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
Set Average:				
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0
21	0	0	0	0
22	0	0	0	0
23	0	0	0	0
Set Average:				
24	0	0	0	0
25	0	0	0	0
26	0	0	0	0
27	0	0	0	0
28	0	0	0	0
29	0	0	0	0
Set Average:				

	0	15	30	45
30	0	0	0	0
31	0	0	0	0
32	0	0	0	0
33	0	0	0	0
34	0	0	0	0
35	0	0	0	0
Set Average:				
36	0	0	0	0
37	0	0	0	0
38	0	0	0	0
39	0	0	0	0
40	0	0	0	0
41	0	0	0	0
Set Average:				
42	0	0	0	0
43	0	0	0	0
44	0	0	0	0
45	0	0	0	0
46	0	0	0	0
47	0	0	0	0
Set Average:				
48	0	0	0	0
49	0	0	0	0
50	0	0	0	0
51	0	0	0	0
52	0	0	0	0
53	0	0	0	0
Set Average:				
54				
55				
56				
57				
58				
59				
Set Average:				

Certified Observer	
Name:	LEX HOOPER
Signature:	Lex Hooper
Certification Date:	3-14-23

Summary of Results	
Minimum:	0
Maximum:	5
Average:	0.6

Comments

LL 8/7/23

AIR SOURCE TECHNOLOGIES, INC.

Visible Emissons Observation Report

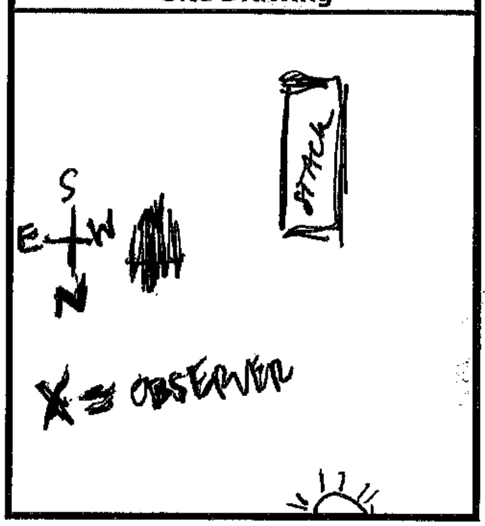
Client/Facility	RAIN CARBON	Project #	4173
Source Identification	K1 STACK	Run #	4

Regulation/Test Method	
M9	
Observation Time	
Test Date:	7/20/23
Start Time:	16:15
End Time:	17:15
Observer Location	
Direction from Source:	NE
Distance from Source:	100'
Height of Observation Point:	130'
Meterological Data	
Wind Direction:	W
Wind Speed (mph):	11
Temperature (°F):	85
Sky Condition:	PART CLOUDY
Background:	BLUE/PART CLOUDY SKY
Production Data	

	0	15	30	45
0	0	0	0	0
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
Set Average:				
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
Set Average:				
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
Set Average:				
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0
21	0	0	0	0
22	0	0	0	0
23	0	0	0	0
Set Average:				
24	0	0	0	0
25	0	0	0	0
26	0	0	0	0
27	0	0	0	0
28	0	0	0	0
29	0	0	0	0
Set Average:				

	0	15	30	45
30	0	0	0	0
31	0	0	0	0
32	0	0	0	0
33	0	0	0	0
34	0	0	0	0
35	0	0	0	0
Set Average:				
36	0	0	0	0
37	0	0	0	0
38	0	0	0	0
39	0	0	0	0
40	0	0	0	0
41	0	0	0	0
Set Average:				
42	0	0	0	0
43	0	0	0	0
44	0	0	0	0
45	0	0	0	0
46	0	0	0	0
47	0	0	0	0
Set Average:				
48	0	0	0	0
49	0	0	0	0
50	0	0	0	0
51	0	0	0	0
52	0	0	0	0
53	0	0	0	0
Set Average:				
54	0	0	0	0
55	0	0	0	0
56	0	0	0	0
57	0	0	0	0
58	0	0	0	0
59	0	0	0	0
Set Average:				

Site Drawing



Certified Observer	
Name:	LEX HOOPER
Signature:	Lex Hoop
Certification Date:	03-14-23

Summary of Results	
Minimum:	0
Maximum:	0
Average:	0

Comments

SKP 8/1/23

AIR SOURCE TECHNOLOGIES, INC. Visible Emissions Observation Report

Client/Facility	RAIN CARBON	Project #	4173
Source Identification	K1 STACK	Run #	5

Regulation/Test Method

Observation Time

Test Date: 7/20/23
Start Time: 17:47
End Time: 18:47

Observer Location

Direction from Source: NE
Distance from Source: 100'
Height of Observation Point: 30'

Meterological Data

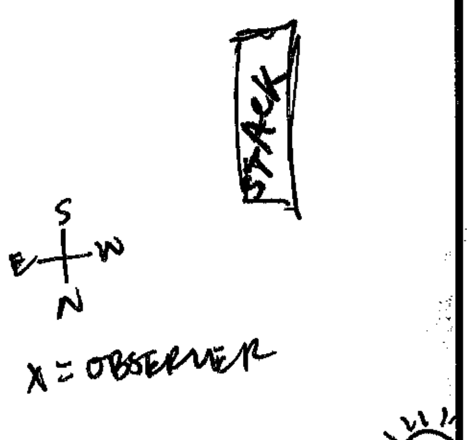
Wind Direction: W
Wind Speed (mph): 11
Temperature (°F): 86
Sky Condition: PART CLOUDY
Background: BLUE/PART CLOUD SKY

Production Data

Min	0	15	30	45
0	0	0	0	0
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
Set Average:				
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
Set Average:				
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
Set Average:				
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0
21	0	0	0	0
22	0	0	0	0
23	0	0	0	0
Set Average:				
24	0	0	0	0
25	0	0	0	0
26	0	0	0	0
27	0	0	0	0
28	0	0	0	0
29	0	0	0	0
Set Average:				

Min	0	15	30	45
30	0	0	0	0
31	0	0	0	0
32	0	0	0	0
33	0	0	0	0
34	0	0	0	0
35	0	0	0	0
Set Average:				
36	0	0	0	0
37	0	0	0	0
38	0	0	0	0
39	0	0	0	0
40	0	0	0	0
41	0	0	0	0
Set Average:				
42	0	0	0	0
43	0	0	0	0
44	0	0	0	0
45	0	0	0	0
46	0	0	0	0
47	0	0	0	0
Set Average:				
48	0	0	0	0
49	0	0	0	0
50	0	0	0	0
51	0	0	0	0
52	0	0	0	0
53	0	0	0	0
Set Average:				
54	0	0	0	0
55	0	0	0	0
56	0	0	0	0
57	0	0	0	0
58	0	0	0	0
59	0	0	0	0
Set Average:				

Site Drawing



Certified Observer

Name: LEX HOOPER
Signature: Lex Hooper
Certification Date: 03-14-23

Summary of Results

Minimum: 0
Maximum: 0
Average: 0

Comments

K 8/7/23

Visible Emission Training

This certifies that

Lex Hooper

has successfully completed the Visible Emission Training held March 14th and 15th, 2023 by the Kansas City, Missouri Health Department, Air Quality Program and is now certified as a visible emission observer.

Expiration: October 2023

KC | Public Health

Naser Jouhari, MIS
Deputy Director
Environmental Health Division

APPENDIX D

LABORATORY ANALYSIS

AIR SOURCE TECHNOLOGIES, INC.

Sample Evaporations

Project Number	4173	Project Name	Rain Carbon M5.202 '23

Reagent Information	
DIUF H2O	LabChem LC267505
Hexane	Fisher 214233
Acetone	Fisher 222473

Analyst	A. VanSickle	L. Hooper
Date	07/24/23	07/31/23
Time	11:20	11:50
Cal. Wt.	1000.1	1000.1

Run No.	Sample No.	Container No.	Leakage	Full Weight	Empty Weight	Comments
000	010	C22-8-29	None	300.5	166.9	
000	012	C22-8-30	None	344.6	165.8	
000	013	C22-8-31	None	261.0	164.4	
PB	012	C22-8-32	None	739.1	505.5	
PB	013	C22-8-33	None	524.5	293.5	
FTRB	012	C22-8-34	None	763.5	504.1	
FTRB	013	C22-8-35	None	557.0	297.0	
111	010	C22-8-36	None	294.6	165.5	
111	012	C22-10-21	None	926.0	503.9	
111	013	C22-8-37	None	571.4	294.8	
112	010	C22-8-38	None	303.1	167.1	
112	012	C22-10-22	None	932.6	505.7	
112	013	C22-8-39	None	579.4	298.2	
113	010	C22-8-40	None	296.5	167.5	
113	012	C22-10-23	None	916.1	506.0	
113	013	C22-8-73	None	575.7	297.5	
114	010	C22-8-74	None	291.5	165.7	
114	012	C22-10-24	None	857.8	501.5	
114	013	C22-8-75	None	560.9	295.2	
115	010	C22-8-76	None	306.4	165.7	
115	012	C22-8-77	None	876.0	502.3	
115	013	C22-8-78	None	557.3	296.5	

Comments:

Completed By:

Date:

AIRSOURCE TECHNOLOGIES, INC.

Container Final Weights

Project Number	4173	Project Name	Rain Carbon M5.202 '23

Container LogIn	Analyst	Date Into Dryer:	08/01/23
	L. Hooper	Time Into Dryer:	10:00

Analyst	L. Hooper	L. Hooper	L. Hooper	L. Hooper
Date	08/02/23	08/02/23	08/03/23	08/04/23
Time (24 hr)	10:00	16:00	13:00	11:30
Room Temp, °F	78	77	77	78
Relative Humidity	51 %	51 %	50 %	51 %
Cal Weight (g)	30	30	30	30
Initial Cal Check	29.9990	29.9991	29.9990	29.9990

Decimals: 4

Run No.	Sample No.	Container No.	Weight (g)	Weight (g)	Weight (g)	Weight (g)	Average (g)	P/F
000	010	C22-8-29	28.8717	28.8716	28.8717	28.8718	28.8718	P
000	012	C22-8-30	29.9428	29.9425	29.9425	29.9426	29.9426	P
000	013	C22-8-31	30.5885	30.5884	30.5884	30.5886	30.5885	P
PB	012	C22-8-32	28.2044	28.2040	28.2041	28.2044	28.2043	P
PB	013	C22-8-33	28.7388	28.7386	28.7386	28.7388	28.7387	P
FTRB	012	C22-8-34	29.5332	29.5328	29.5329	29.5331	29.5330	P
FTRB	013	C22-8-35	29.9575	29.9574	29.9574	29.9575	29.9575	P
111	010	C22-8-36	30.0937	30.0935	30.0938	30.0939	30.0939	P
111	012	C22-10-21	1.6258	1.6260	1.6261	1.6263	1.6262	P
111	013	C22-8-37	28.6514	28.6513	28.6513	28.6513	28.6513	P
112	010	C22-8-38	29.0715	29.0710	29.0721	29.0722	29.0722	P
112	012	C22-10-22	1.6476	1.6476	1.6477	1.6477	1.6477	P
112	013	C22-8-39	30.8895	30.8892	30.8893	30.8894	30.8894	P
113	010	C22-8-40	30.3450	30.3445	30.3456	30.3453	30.3455	P
113	012	C22-10-23	1.6512	1.6511	1.6511	1.6510	1.6511	P
113	013	C22-8-73	29.4593	29.4591	29.4592	29.4593	29.4593	P
114	010	C22-8-74	29.7389	29.7383	29.7378	29.7373	29.7376	P
114	012	C22-10-24	1.6891	1.6891	1.6890	1.6889	1.6890	P
114	013	C22-8-75	28.5432	28.5430	28.5430	28.5432	28.5431	P
115	010	C22-8-76	31.4437	31.4409	31.4404	31.4404	31.4404	P
115	012	C22-8-77	31.3864	31.3770	31.3670	31.3675	31.3673	P
115	013	C22-8-78	28.9150	28.9148	28.9150	28.9149	28.9150	P

Final Cal Check	29.9990	29.9991	29.9990	29.9991

Comments:

Drying Method: ☑ Desiccator ☐ Oven ☐ Other:

Completed By: **Date:**

AIR SOURCE TECHNOLOGIES, INC.

Container Tare Weights

Container LogIn	Date Into Dryer:	08/25/22
	Time Into Dryer:	12:15

Analyst	L. Hooper	L. Hooper		
Date	08/26/22	08/30/22		
Time (24 hr)	12:40	12:10		
Room Temp, °F	77	75		
Relative Humidity	50 %	49 %		
Cal Weight (g)	30	30		
Initial Cal Check	29.9990	29.9990		

Decimals: 4

Container No.	Type	Weight (g)	Weight (g)	Weight (g)	Weight (g)	Average (g)	P/F
C22-8-25	50mL	29.5212	29.5212			29.5212	P
C22-8-26	50mL	29.9222	29.9222			29.9222	P
C22-8-27	50mL	29.0748	29.0749			29.0749	P
C22-8-28	50mL	29.4385	29.4384			29.4385	P
C22-8-29	50mL	28.8716	28.8716			28.8716	P
C22-8-30	50mL	29.9420	29.9420			29.9420	P
C22-8-31	50mL	30.5883	30.5884			30.5884	P
C22-8-32	50mL	28.2023	28.2024			28.2024	P
C22-8-33	50mL	28.7370	28.7371			28.7371	P
C22-8-34	50mL	29.5305	29.5305			29.5305	P
C22-8-35	50mL	29.9567	29.9567			29.9567	P
C22-8-36	50mL	30.0453	30.0452			30.0453	P
C22-8-37	50mL	28.6473	28.6472			28.6473	P
C22-8-38	50mL	29.0257	29.0255			29.0256	P
C22-8-39	50mL	30.8864	30.8863			30.8864	P
C22-8-40	50mL	30.2974	30.2973			30.2974	P
C22-8-41	50mL	28.9688	28.9689			28.9689	P
C22-8-42	50mL	29.3532	29.3535			29.3534	P
C22-8-43	50mL	29.0382	29.0384			29.0383	P
C22-8-44	50mL	28.4812	28.4811			28.4812	P
C22-8-45	50mL	29.4936	29.4935			29.4936	P
C22-8-46	50mL	28.5523	28.5523			28.5523	P
C22-8-47	50mL	28.6655	28.6655			28.6655	P
C22-8-48	50mL	29.8683	29.8683			29.8683	P

Final Cal Check	29.9990	29.9990		

Comments:

Drying Method: ☑ Desiccator ☐ Oven ☐ Other:

Completed By: **Date:**

AIR SOURCE TECHNOLOGIES, INC.

Container Tare Weights

Container LogIn	Date Into Dryer:	08/25/22
	Time Into Dryer:	12:15

Analyst	L. Hooper	L. Hooper		
Date	08/26/22	08/30/22		
Time (24 hr)	13:00	12:20		
Room Temp, °F	77	75		
Relative Humidity	52 %	49 %		
Cal Weight (g)	30	30		
Initial Cal Check	29.9990	29.9990		

Decimals: 4

Container No.	Type	Weight (g)	Weight (g)		Weight (g)	Average (g)	P/F
C22-8-73	50mL	29.4556	29.4557			29.4557	P
C22-8-74	50mL	29.6650	29.6652			29.6651	P
C22-8-75	50mL	28.5396	28.5397			28.5397	P
C22-8-76	50mL	31.3313	31.3314			31.3314	P
C22-8-77	50mL	31.2496	31.2497			31.2497	P
C22-8-78	50mL	28.9085	28.9085			28.9085	P
C22-8-79	50mL	28.7896	28.7896			28.7896	P
C22-8-80	50mL	29.3156	29.3155			29.3156	P
C22-8-81	50mL	30.8033	30.8034			30.8034	P
C22-8-82	50mL	29.4781	29.4779			29.4780	P
C22-8-83	50mL	29.9455	29.9452			29.9454	P
C22-8-84	50mL	28.5254	28.5254			28.5254	P
C22-8-85	50mL	29.1104	29.1102			29.1103	P
C22-8-86	50mL	29.7081	29.7078			29.7080	P
C22-8-87	50mL	29.8353	29.8350			29.8352	P
C22-8-88	50mL	30.2636	30.2634			30.2635	P
C22-8-89	50mL	29.3369	29.3370			29.3370	P
C22-8-90	50mL	28.7700	28.7699			28.7700	P
C22-8-91	50mL	30.5821	30.5821			30.5821	P
C22-8-92	50mL	30.0616	30.0615			30.0616	P
C22-8-93	50mL	28.8915	28.8916			28.8916	P
C22-8-94	50mL	30.3928	30.3925			30.3927	P
C22-8-95	50mL	28.9429	28.9426			28.9428	P
C22-8-96	50mL	30.0988	30.0987			30.0988	P

Final Cal Check	29.9990	29.9990		

Comments:

Drying Method: ☑ Desiccator ☐ Oven ☐ Other:

Completed By: **Date:**

AIRSOURCE TECHNOLOGIES, INC.

Container Tare Weights

Container LogIn	Date Into Dryer:	09/16/22
	Time Into Dryer:	16:00

Analyst	A. VanSickle	L. Hooper		
Date	09/17/22	09/19/22		
Time (24 hr)	16:30	10:00		
Room Temp, °F	78	78		
Relative Humidity	58 %	53 %		
Cal Weight (g)	30	30		
Initial Cal Check	29.9990	29.9990		

Decimals: 4

Container No.	Type	Weight (g)	Weight (g)	Weight (g)	Weight (g)	Average (g)	P/F
C22-10-1	pan	1.5868	1.5869			1.5869	P
C22-10-2	pan	1.5795	1.5797			1.5796	P
C22-10-3	pan	1.5829	1.5830			1.5830	P
C22-10-4	pan	1.5836	1.5836			1.5836	P
C22-10-5	pan	1.5896	1.5897			1.5897	P
C22-10-6	pan	1.5953	1.5956			1.5955	P
C22-10-7	pan	1.5896	1.5897			1.5897	P
C22-10-8	pan	1.5845	1.5845			1.5845	P
C22-10-9	pan	1.5797	1.5798			1.5798	P
C22-10-10	pan	1.5844	1.5844			1.5844	P
C22-10-11	pan	1.5880	1.5880			1.5880	P
C22-10-12	pan	1.5930	1.5931			1.5931	P
C22-10-13	pan	1.5892	1.5893			1.5893	P
C22-10-14	pan	1.5960	1.5960			1.5960	P
C22-10-15	pan	1.5974	1.5976			1.5975	P
C22-10-16	pan	1.5977	1.5980			1.5979	P
C22-10-17	pan	1.5908	1.5910			1.5909	P
C22-10-18	pan	1.6029	1.6030			1.6030	P
C22-10-19	pan	1.5963	1.5965			1.5964	P
C22-10-20	pan	1.6011	1.6013			1.6012	P
C22-10-21	pan	1.5954	1.5956			1.5955	P
C22-10-22	pan	1.5902	1.5905			1.5904	P
C22-10-23	pan	1.6015	1.6018			1.6017	P
C22-10-24	pan	1.6010	1.6012			1.6011	P
Final Cal Check		29.9990	29.9990				

Comments:

Drying Method: ☑ Desiccator ☐ Oven ☐ Other:

Completed By: **Date:**

AIRSOURCE TECHNOLOGIES, INC.

Filter Final Weights

Project Number	4173	Project Name	Rain Carbon M5.202 '23

Filter LogIn	Analyst	Date Into Dryer:	07/22/23
	A. VanSickle	Time Into Dryer:	17:00

Analyst	A. VanSickle	A. VanSickle	L. Hooper	
Date	07/27/23	07/28/23	08/02/23	
Time (24 hr)	12:10	13:25	16:30	
Room Temp, °F	74	76	77	
Relative Humidity	54 %	54 %	51 %	
Cal Weight (g)	30	30	30	
Initial Cal Check	29.9991	29.9991	29.9991	

Decimals: 4

Run No.	Sample No.	Filter No.	Weight (g)	Weight (g)	Weight (g)	Weight (g)	Average (g)	P/F
111	011	F23-7-1	37.4590	37.4585	37.4580		37.4583	P
112	011	F22-9-9	30.4659	30.4659	30.4659		30.4659	P
113	011	F22-9-10	34.6459	34.6456	34.6456		34.6456	P
114	011	F23-7-2	29.4118	29.4117	29.4114		29.4116	P
115	011	F22-10-24	37.1498	37.1493	37.1493		37.1493	P

Final Cal Check	29.9991	29.9991	29.9991	

Comments:

Drying Method: ☑ Desiccator ☐ Oven ☐ Other:

Completed By: **Date:**

AIRSOURCE TECHNOLOGIES, INC.

Filter Tare Weights

Filter LogIn	Date Into Dryer:	09/16/22
	Time Into Dryer:	14:40

Analyst	A. VanSickle	L. Hooper		
Date	09/17/22	09/19/22		
Time (24 hr)	16:20	10:15		
Room Temp, °F	78	78		
Relative Humidity	58 %	53 %		
Cal Weight (g)	30	30		
Initial Cal Check	29.9989	29.9990		

Decimals: 4

Filter No.	Type	Weight (g)	Weight (g)	Weight (g)	Weight (g)	Average (g)	P/F
F22-9-1	82.6mm glass	45.3007	45.3010			45.3009	P
F22-9-2	82.6mm glass	38.8331	38.8334			38.8333	P
F22-9-3	82.6mm glass	37.5652	37.5654			37.5653	P
F22-9-4	82.6mm glass	38.3011	38.3012			38.3012	P
F22-9-5	82.6mm glass	35.3736	35.3736			35.3736	P
F22-9-6	82.6mm glass	33.8569	33.8569			33.8569	P
F22-9-7	82.6mm glass	34.6317	34.6315			34.6316	P
F22-9-8	82.6mm glass	30.5691	30.5693			30.5692	P
F22-9-9	82.6mm glass	30.3948	30.3951			30.3950	P
F22-9-10	82.6mm glass	34.5760	34.5762			34.5761	P

Final Cal Check	29.9990	29.9990		

Comments:

Drying Method: ☑ Desiccator ☐ Oven ☐ Other:

Completed By: **Date:**

AIRSOURCE TECHNOLOGIES, INC.

Filter Tare Weights

Filter LogIn	Date Into Dryer:	10/05/22
	Time Into Dryer:	14:45

Analyst	A. VanSickle	A. VanSickle	A. VanSickle	
Date	10/06/22	10/10/22	10/11/22	
Time (24 hr)	14:55	12:00	12:30	
Room Temp, °F	70	64	70	
Relative Humidity	54 %	54 %	58 %	
Cal Weight (g)	30	30	30	
Initial Cal Check	29.9991	29.9991	29.9990	

Decimals: 4

Filter No.	Type	Weight (g)	Weight (g)	Weight (g)	Weight (g)	Average (g)	P/F
F22-10-1	82.6mm glass	31.8870	31.8868	31.8868		31.8868	P
F22-10-2	82.6mm glass	32.4212	32.4201	32.4202		32.4202	P
F22-10-3	82.6mm glass	43.7019	43.7014	43.7016		43.7015	P
F22-10-4	82.6mm glass	42.3161	42.3161	42.3160		42.3161	P
F22-10-5	82.6mm glass	41.3842	41.3842	41.3837		41.3840	P
F22-10-6	82.6mm glass	36.9454	36.9454	36.9455		36.9455	P
F22-10-7	82.6mm glass	33.8759	33.8758	33.8762		33.8760	P
F22-10-8	82.6mm glass	30.4432	30.4430	30.4434		30.4432	P
F22-10-9	82.6mm glass	31.1834	31.1830	31.1825		31.1828	P
F22-10-10	82.6mm glass	36.2564	36.2565	36.2560		36.2563	P
F22-10-11	82.6mm glass	32.6084	32.6084	32.6084		32.6084	P
F22-10-12	82.6mm glass	32.5784	32.5782	32.5782		32.5782	P
F22-10-13	82.6mm glass	30.1311	30.1307	30.1311		30.1309	P
F22-10-14	82.6mm glass	30.8198	30.8198	30.8198		30.8198	P
F22-10-15	82.6mm glass	33.7245	33.7244	33.7245		33.7245	P
F22-10-16	82.6mm glass	37.0475	37.0466	37.0468		37.0467	P
F22-10-17	82.6mm glass	35.0316	35.0315	35.0315		35.0315	P
F22-10-18	82.6mm glass	31.7286	31.7277	31.7273		31.7275	P
F22-10-19	82.6mm glass	44.8298	44.8291	44.8295		44.8293	P
F22-10-20	82.6mm glass	34.8711	34.8711	34.8711		34.8711	P
F22-10-21	82.6mm glass	32.0230	32.0233	32.0232		32.0233	P
F22-10-22	82.6mm glass	34.7828	34.7827	34.7822		34.7825	P
F22-10-23	82.6mm glass	33.1028	33.1029	33.1026		33.1028	P
F22-10-24	82.6mm glass	37.0462	37.0458	37.0461		37.0460	P

Final Cal Check	29.9991	29.9992	29.9990	

Comments:

Drying Method: ☑ Desiccator ☐ Oven ☐ Other:

Completed By: **Date:**

AIRSOURCE TECHNOLOGIES, INC.

Filter Tare Weights

Filter LogIn	Date Into Dryer:	07/17/23
	Time Into Dryer:	15:00

Analyst	L. Hooper	A. VanSickle		
Date	07/18/23	07/19/23		
Time (24 hr)	15:00	9:45		
Room Temp, °F	75	78		
Relative Humidity	54 %	60 %		
Cal Weight (g)	30	30		
Initial Cal Check	29.9990	29.9990		

Decimals: 4

Filter No.	Type	Weight (g)	Weight (g)	Weight (g)	Weight (g)	Average (g)	P/F
F23-7-1	82.6mm glass	37.3182	37.3181			37.3182	P
F23-7-2	82.6mm glass	29.3093	29.3092			29.3093	P
F23-7-3	82.6mm glass	33.9994	33.9993			33.9994	P
F23-7-4	82.6mm glass	36.1616	36.1616			36.1616	P
F23-7-5	82.6mm glass	27.8962	27.8960			27.8961	P
F23-7-6	82.6mm glass	29.4939	29.4938			29.4939	P
F23-7-7	82.6mm glass	38.8690	38.8690			38.8690	P
F23-7-8	82.6mm glass	46.0553	46.0555			46.0554	P
F23-7-9	82.6mm glass	32.3298	32.3299			32.3299	P
F23-7-10	82.6mm glass	37.1143	37.1142			37.1143	P
F23-7-11	82.6mm glass	41.1322	41.1322			41.1322	P
F23-7-12	82.6mm glass	30.9107	30.9108			30.9108	P

Final Cal Check	29.9990	29.9991		

Comments:

Drying Method: ☑ Desiccator ☐ Oven ☐ Other:

Completed By: **Date:**

APPENDIX E

EQUIPMENT CALIBRATIONS

AIR SOURCE TECHNOLOGIES, INC.

Equipment Calibration Request

Project	Rain LLC	**Project No.**	4173
Test Dates	7/20/2023	**Project Manager**	T. Pittman

Nozzle

ID	Diameter	ID	Diameter
Q213	0.440		
Q242	0.365		
Q234	0.376		
Q264	0.388		
Q261	0.396		

Probe and Pitot Assemblies

Probe ID	Pitot ID	T/C ID
5-5	S-2	68-3

Sample Train Thermocouples

FPF	TRAP/CPF	SG
FPF-6	CPF-4	20
FPF-5	CPF-9	21
FPF-9	CPF-7	22
FPF-8	CPF-3	26
FPF-1	CPF-6	29

Umbilicals

U200-1

Barometers

B24

Method 5 Consoles

Console No.	Avg. ΔH
1	1.763

Method 6/VOST Consoles

Console No.	Flow Rate

Special/Other Equipment

Include
Balance Calibration

Comments

Equipment Problems/Changes/Notes (Copied from all Field Data Sheets)

Report ID:
NA1821-007-041823-CTR

Mettler Toledo, LLC
1900 Polaris Parkway
Columbus, OH 43240
1.800.METTLER

METTLER TOLEDO

Comprehensive Test Report

Customer

Company:	Air Source Technology		
Address:	20505 W 67th St		
City:	Shawnee	**Contact:**	Alexander VanSickle
Zip / Postal:	66218-9620	**Order Number:**	0332632316
State / Province:	Kansas		

Weighing Device

Manufacturer:	Mettler Toledo	**Instrument Type:**	Weighing Instrument
Model:	XPE205	**Asset Number:**	N/A
Serial No.:	B427775532	**Terminal Model:**	PEAT
Building:	Main	**Terminal Serial No.:**	B427775532
Floor:	1	**Terminal Asset No.:**	NA
Room:	N/A	**Alternate Asset No.:**	N/A

Range	Max. Capacity	Readability (d)
1	220 g	0.00001 g

Procedure

Guideline:	EURAMET cg-18 v. 4.0 (11/2015)
METTLER TOLEDO Work Instruction:	30260953 v1.61

This report contains measurements for As Found and As Left testing.

The sensitivity/span of the weighing instrument was adjusted before As Left testing with a built-in weight.

In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific test conditions.

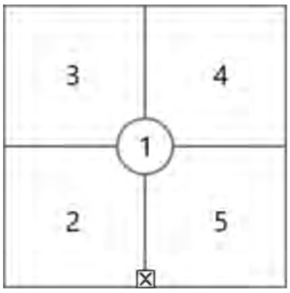
As Found Testing Date:	18-Apr-2023	**Service Technician:**	Alex Rickert
As Left Testing Date:	18-Apr-2023		
Issue Date:	18-Apr-2023		
Next Testing Date:	30-Apr-2024		

Measurement Results

Eccentricity

Eccentricity Test Load: 100 g

Position	As Found	As Left
1	0.00000 g	0.00000 g
2	0.00015 g	0.00017 g
3	0.00000 g	0.00000 g
4	-0.00020 g	-0.00016 g
5	-0.00009 g	-0.00004 g
Maximum Deviation	**0.00020 g**	**0.00017 g**



Error of Indication

			As Found		As Left	
	Tare Load	Reference Value	Indication	Error of Indication	Indication	Error of Indication
1	N/A	0.00000 g	0.00000 g	0.00000 g	0.00000 g	0.00000 g
2	N/A	50.00003 g	49.99997 g	-0.00006 g	50.00005 g	0.00002 g
3	50 g	50.00003 g	49.99995 g	-0.00008 g	50.00004 g	0.00001 g
4	100 g	50.00003 g	49.99996 g	-0.00007 g	50.00005 g	0.00002 g
5	150 g	50.00003 g	49.99993 g	-0.00010 g	50.00002 g	-0.00001 g
6	N/A	100.00001 g	99.99996 g	-0.00005 g	100.00013 g	0.00012 g
7	N/A	150.00004 g	149.99996 g	-0.00008 g	150.00018 g	0.00014 g
8	N/A	199.99995 g	199.99955 g	-0.00040 g	199.99986 g	-0.00009 g

Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

Weight Set 1: OIML E2

Weight Set No.:	480	Date of Issue:	07-Sep-2022
Certificate Number:	220609555	Calibration Due Date:	30-Sep-2023

Remarks

Equipment condition: Good

Next calibration according to customer's procedure

Service adjustments were applied to balance.

This document is issued to record completion of the work performed by METTLER TOLEDO on the subject device in accordance with agreed standards. It does not guarantee the continued performance of the subject device. Any measurements recorded are based on the subject device's performance at a given time as tested by METTLER TOLEDO and, except where explicitly stated otherwise, do not express an opinion as to the sufficiency of any customer designed procedures used to test the device. This document is not a warranty, either implied or express. METTLER TOLEDO expressly disclaims any liability arising from the use of the information in this document for any purpose other than as specified herein.

Manufacturer Tolerance Assessment

Assessment done without considering measurement uncertainty.
The measurements from the attached test report were assessed against METTLER TOLEDO tolerances defined in the SOP 'Test and Measurement Procedures for METTLER TOLEDO balances', Document: 10000018502.

	As Found	As Left
Overall	✓	✓
Repeatability	N/A	N/A
Eccentricity	✓	✓
Linearity	✓	✓
Sensitivity	N/A	✓

Measurement Results

Repeatability

Eccentricity

Test Load: 100 g

Position	As Found	As Left
1	0.00000 g	0.00000 g
2	0.00015 g	0.00017 g
3	0.00000 g	0.00000 g
4	-0.00020 g	-0.00016 g
5	-0.00009 g	-0.00004 g

Maximum Deviation	0.00020 g	0.00017 g
Tolerance	0.000200 g ✓	0.000200 g ✓

The maximum deviation is determined as the absolute value of the largest deviation from the center.

Linearity - Differential Method

As Found

	Preload	Reference Value	Indication	Deviation
2	N/A	50.00003 g	49.99997 g	0.000018 g
3	50 g	50.00003 g	49.99995 g	0.000015 g
4	100 g	50.00003 g	49.99996 g	0.000023 g
5	150 g	50.00003 g	49.99993 g	0.000000 g
8	N/A	199.99995 g	199.99955 g	N/A

Linearity Deviation	0.000023 g
Linearity Tolerance	0.0001 g ✓

Sensitivity Deviation	0.00040 g
Sensitivity Tolerance	N/A

The As Found Sensitivity Tolerance is only valid if the device has been adjusted before the test.

As Left

	Preload	Reference Value	Indication	Deviation
2	N/A	50.00003 g	50.00005 g	0.000010 g
3	50 g	50.00003 g	50.00004 g	0.000010 g
4	100 g	50.00003 g	50.00005 g	0.000020 g
5	150 g	50.00003 g	50.00002 g	0.000000 g
8*	N/A	199.99995 g	199.99986 g	N/A

Linearity Deviation	0.000020 g
Linearity Tolerance	0.0001 g ✓

Sensitivity Deviation	0.00009 g
Sensitivity Tolerance	0.0005 g ✓

The values in column “Deviation” and the “Linearity Deviation” are zero point offset and sensitivity error compensated.

* This point was used to satisfy the sensitivity requirement.

Certification of Calibration

Kansas City Calibration Lab., Inc.
8847 Long Street
Lenexa, Kansas 66215
Telephone: (913) 541-0629 Internet: www.kccl.com Email: service@kccl.com

UNIT UNDER TEST:	Omega CL23A Calibrator-Thermometer K-J-T	TEST RESULT:	PASS
SERIAL NUMBER:	T-263302	PERFORMED ON:	12/30/2022
ASSET NUMBER:	T-263302	DATA TYPE:	FOUND-LEFT
PROCEDURE NAME:	12 Months NIST Certification	TEMPERATURE:	24.4°C
PROCEDURE REV.:	Met Temp	HUMIDITY:	45 %
CALIBRATED BY:	Bart Schwartz		
P.O. NUMBER:		**Recertification Date**	
CUSTOMER:	AirSource Technologies 20505 W. 67th Street Shawnee, KS 66218	**December 30, 2023** Certification Number:	00075443
		Previous Certification Date:	
Cal Seals Intact:	Yes	**December 13, 2021**	

K.C. Calibration Lab., Inc. certifies that the above listed instrument meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). This calibration is traceable to the International System of Units (SI), throught National Metrology Institutes (NIST, PTB NRC NPL, etc), ratiometric techniques, or natural physical constants. This calibration complies with MIL-STD-45662A and ANSI/NCSL Z540-1-1994.

This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the calibration organization issuing this report.

Note: Any Test Uncertainty Ratio (TUR) that is less than four to one will appear under the "TUR" heading on the data record. If the TUR meets or exceeds four to one, the field is left blank.

REMARKS:

Standards Used

Asset #	Description	Cal Date	Due Date
2659119	Hart Scientific 1523 Single Chan Reference Thermometer	1/4/2022	1/4/2023
905040	Burns Engineering 5615 Platinum Resistance Thermometer	2/3/2022	2/3/2023
DW518	Fluke 518 Dry-Block Calibrator	9/5/2022	9/5/2023

Test Results

Nominal Set-point		Actual Value (Reference)	UUT (Test Sensor)	Error	Measurement Uncertainty	Method of Realization
Accuracy ±0.5 >50 F, ±0.04% Rdg >1250 F, ±1.0 F <50 F						
32.00	F	32.33	32.50	0.17		
72.00	F	72.55	72.10	-0.45		
212.00	F	211.98	210.60	-1.38		
600.00	F	600.05	595.70	-4.35		
1200.0	F	1200.1	1193.33	-6.77		

Test Results indicate the following: **Found-Left:** *Unit was left as found*. **As-Left:** *Unit was left after adjustments*.

**********END OF CERTIFICATE**********

K.C. Calibration Labs
Seal

Signed: [signature]

Bart A. Schwartz , Engineer in Charge

AIR SOURCE TECHNOLOGIES, INC.

Nozzle Calibration Data

Project Rain Carbon M5202 '23 **Project No.** 4173

Nozzle Number	Type	D_1	D_2	D_3	D_n	Calibrated by	Date
Q213	Quartz	0.440	0.440	0.440	0.440	FLS	10/03/00
Q242	Quartz	0.364	0.365	0.365	0.365	KRM	12/29/22
Q234	Quartz	0.376	0.376	0.376	0.376	JSS	08/11/06
Q264	Quartz	0.389	0.387	0.387	0.388	KRM	01/03/23
Q261	Quartz	0.396	0.396	0.397	0.396	KRM	01/03/23

Appendix E-1
Pre-Test Calibrations

AIRSOURCE TECHNOLOGIES, INC.

Barometer Calibration

Barometer No.	B24	**Reference**	Mercury No. 1
Performed By	Lex Hooper	**Date**	05/10/23

Mercury Reference Barometer

Mercury Barometer Reading	In. Hg	29.29
Room Temperature	ºF	78
Temperature Correction	In. Hg	-0.131
Latitude	º N or S	39
Gravity Correction	In. Hg	-0.017
Corrected Reading	In. Hg	29.14

Test Barometer

Test Barometer Reading	In. Hg	29.16
Error	In. Hg	0.02
| Error | ≤ 0.2 In.	Pass/Fail	PASS

Comments

Performed by: Lex Hooper

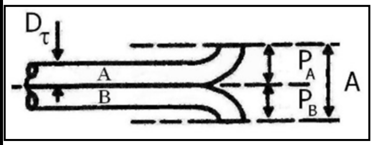
AIRSOURCE TECHNOLOGIES, INC.

Probe Assembly Calibration (Type-S Pitot TC)

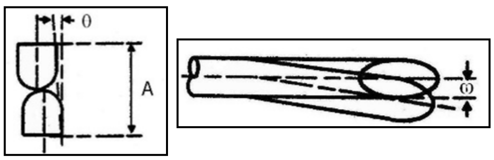
Performed By	L. Hooper	**Probe ID**	5-5
Date	5/26/23	**Pitot ID**	S-2
		Thermocouple ID	68-3

Probe Pitot

Pitot Tube assembly level? (yes/no)	Yes
Pitot Tube openings damaged? (yes/no, if yes - comment below)	No



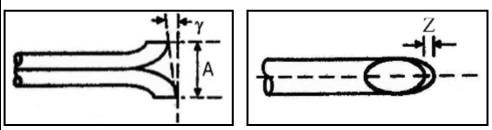
A (no criteria)	in.	0.890	
D_t (0.188" < D_t < 0.375" Recommended)	in.	0.370	
P_A (1.05 D_t < P_A < 1.05 D_t)	in.	0.450	PASS
P_B (1.05 D_t < P_B < 1.05 D_t)	in.	0.420	PASS



θ	deg.	0.5	

$\omega = A \sin(\theta)$

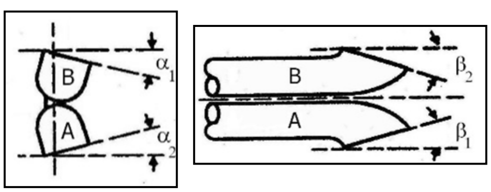
ω (ω < 0.032")	in.	0.008	PASS



γ	deg.	2.5	

Z = A sin (g)

Z (Z < 0.125")	in.	0.039	PASS



α_1 (α_1 < 10^O)	deg.	4.0	PASS
α_2 (α_2 < 10^O)	deg.	4.5	PASS
β_1 (β_1 < 5^O)	deg.	1.5	PASS
β_2 (β_2 < 5^O)	deg.	1.0	PASS

Stack ThermoCouple Calibration

Reference TC ID	FPTC-10/CL23A#2

Heat Source	Stack TC ^{O}F	Ref. TC ^{O}F	|Difference|
Ambient Air	69.5	69.8	0.3
Ice Water Bath	34.7	35.0	0.3
| Stack TC - Reference TC $\|_{max}$ < 2.0 °F			0.3
Stack TC Pass/Fail			PASS

Comments

Performed by *Lex Hooper* ____________________

Electronic Filing: Received, Clerk's Office 09/05/2023

AIR SOURCE TECHNOLOGIES, INC.

Umbilical Hookup Check-Out

Performed By	L. Hooper	Reference TC	FPTC-10/CL23A #2

Hookup No.	20	TC No.	20	Date	06/26/23

Check-Out Procedure

Leak Check	Yes
Flow Check (>4" ΔH)	Yes
Check Valve Operational	Yes

Themocouple Calibration

Hookup T/C Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 2.0 °F
33.7	33.9	0.2	PASS

Hookup No.	21	TC No.	21	Date	06/26/23

Check-Out Procedure

Leak Check	Yes
Flow Check (>4" ΔH)	Yes
Check Valve Operational	Yes

Themocouple Calibration

Hookup T/C Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 2.0 °F
33.7	33.9	0.2	PASS

Hookup No.	22	TC No.	22	Date	06/26/23

Check-Out Procedure

Leak Check	Yes
Flow Check (>4" ΔH)	Yes
Check Valve Operational	Yes

Themocouple Calibration

Hookup T/C Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 2.0 °F
33.8	33.9	0.1	PASS

Hookup No.	26	TC No.	26	Date	06/26/23

Check-Out Procedure

Leak Check	Yes
Flow Check (>4" ΔH)	Yes
Check Valve Operational	Yes

Themocouple Calibration

Hookup T/C Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 2.0 °F
33.8	33.9	0.1	PASS

Hookup No.	29	TC No.	29	Date	05/10/23

Check-Out Procedure

Leak Check	Yes
Flow Check (>4" ΔH)	Yes
Check Valve Operational	Yes

Themocouple Calibration

Hookup T/C Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 2.0 °F
32.3	32.3	0.0	PASS

Comments

Performed by Lex Hooper

AIR SOURCE TECHNOLOGIES, INC.

Filterable Particulate Filter TC

Performed By	L. Hooper	Reference TC	FPTC-10/CL23A #2

Themocouple Calibration

Date: 05/24/23

FPM TC ID: 1

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	69.8	69.3	0.5	PASS
Ice Water Bath	32.4	32.2	0.2	PASS

Themocouple Calibration

Date: 05/24/23

FPM TC ID: 5

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	70.1	69.3	0.8	PASS
Ice Water Bath	32.3	32.2	0.1	PASS

Themocouple Calibration

Date: 05/25/23

FPM TC ID: 6

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	69.8	69.3	0.5	PASS
Ice Water Bath	32.4	32.3	0.1	PASS

Themocouple Calibration

Date: 05/25/23

FPM TC ID: 8

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	70.0	69.3	0.7	PASS
Ice Water Bath	32.5	32.3	0.2	PASS

Themocouple Calibration

Date: 05/02/23

FPM TC ID: 9

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	61.5	61.1	0.4	PASS
Ice Water Bath	32.8	32.7	0.1	PASS

Comments

Performed by Lex Hooper

AIR SOURCE TECHNOLOGIES, INC.

Condensable Particulate Filter TC

Performed By: L. Hooper

Reference TC: FPTC-10/CL23A #2

Themocouple Calibration

Date: 05/02/23

CPF TC ID: CPF 3

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	61.8	61.1	0.7	PASS
Ice Water Bath	27.8	32.7	4.9	PASS

Themocouple Calibration

Date: 05/02/23

CPF TC ID: CPF 4

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	61.6	61.1	0.5	PASS
Ice Water Bath	32.3	32.7	0.4	PASS

Themocouple Calibration

Date: 12/08/22

CPF TC ID: CPF 6

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	63.9	64.1	0.2	PASS
Ice Water Bath	33.9	34.4	0.5	PASS

Themocouple Calibration

Date: 05/10/23

CPF TC ID: CPF 7

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	85.7	85.8	0.1	PASS
Ice Water Bath	32.7	32.3	0.4	PASS

Themocouple Calibration

Date: 10/05/22

CPF TC ID: CPF 9

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	68.6	68.7	0.1	PASS
Ice Water Bath	32.5	33.1	0.6	PASS

Comments

Performed by Lex Hooper

AIRSOURCE TECHNOLOGIES, INC.

Console Calibration

Console #	1	**Performed By**	L. Hooper
Previous Y	1.004	**Date**	5/22/2023

DRY GAS METER VOLUME CALIBRATION

Leak Checks

Inlet thru Pump (Front)	Pass	Pump to Orifice (Back)	Pass

PARAMETER	UNIT	RUN 1	RUN 2	BRACKETING	
Orifice Number		1		15	16
K Factor		0.5229		0.4163	0.5608
Inital DGM Volume	cf	585.100	610.000	573.300	598.000
Final DGM Volume	cf	590.100	615.000	578.300	603.000
Net DGM Volume	cf	5.000	5.000	5.000	5.000
Initial DGM Inlet Temp.	° F	72.0	74.0	69.0	73.0
Initial DGM Outlet Temp.	° F	72.0	74.0	70.0	73.0
Final DGM Inlet Temp.	° F	72.0	75.0	70.0	74.0
Final DGM Outlet Temp.	° F	72.0	75.0	70.0	74.0
Average DGM Temp.	° F	72.0	74.5	69.8	73.5
Initial Room Temp.	° F	68.0	74.0	68.0	73.0
Final Room Temp.	° F	69.0	74.0	68.0	73.0
Average Room Temp.	° F	68.5	74.0	68.0	73.0
Time	m:ss	7:25	7:27	9:13	7:02
	sec	445	447	553	422
Orifice ΔH	in. H_2O	1.50	1.50	0.92	1.70
Barometric Pressure	in. Hg	29.31	29.21	29.31	29.22
Pump Vacuum	in. Hg	22	22	23	22
Vcr (std)	dscf	4.946	4.926	4.896	4.994
Vm (std)	dscf	4.880	4.841	4.894	4.854
Y		1.013	1.017	1.000	1.029
ΔH@		1.873	1.927	1.778	1.942
Error From Average Y	%	0.20	-0.20	1.49	-1.31
+/- 2% Criteria		PASS	PASS	PASS	PASS

Average Y	1.015
Average ΔH@	1.900
Error From Initial Y	1.14%
+/- 5% Criteria	PASS

DRY GAS METER THERMOCOUPLE CALIBRATION

Thermocouple ID	Console	Reference ID	FPTC-10/CL23A #2

DGM TC	Heat Source	DGM TC ^{O}F	Ref. TC ^{O}F	| Difference |
Inlet	Ambient Air	67.0	68.8	1.8
	Hot Water Bath	204.0	204.5	0.5
Outlet	Ambient Air	67.0	68.8	1.8
	Hot Water Bath	204.0	204.5	0.5
$\| DGM TC - Reference TC \|_{max} <$ 5.4 o F				1.8
DGM TC Pass/Fail				PASS

Appendix E-2

Post-Test Calibrations

AIR SOURCE TECHNOLOGIES, INC.

Barometer Calibration

Barometer No.	B24	**Reference**	Mercury No. 1
Performed By	Lex Hooper	**Date**	07/27/23

Mercury Reference Barometer

Mercury Barometer Reading	In. Hg	29.20
Room Temperature	ºF	78
Temperature Correction	In. Hg	-0.130
Latitude	º N or S	39
Gravity Correction	In. Hg	-0.017
Corrected Reading	In. Hg	29.05

Test Barometer

Test Barometer Reading	In. Hg	29.07
Error	In. Hg	0.02
| Error | ≤ 0.2 In.	Pass/Fail	PASS

Comments

Performed by: Lex Hooper

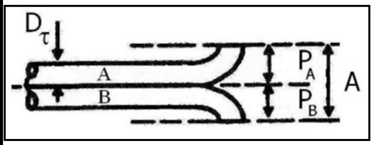
AIRSOURCE TECHNOLOGIES, INC.

Probe Assembly Calibration (Type-S Pitot TC)

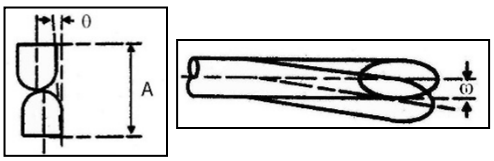
Performed By	L. Hooper	**Probe ID**	5-5
Date	7/27/23	**Pitot ID**	S-2
		Thermocouple ID	68-3

Probe Pitot

Pitot Tube assembly level? (yes/no)	Yes
Pitot Tube openings damaged? (yes/no, if yes - comment below)	No



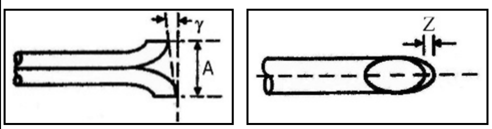
A (no criteria)	in.	0.900	
D_t (0.188" < D_t < 0.375" Recommended)	in.	0.370	
P_A (1.05 D_t < P_A < 1.05 D_t)	in.	0.480	PASS
P_B (1.05 D_t < P_B < 1.05 D_t)	in.	0.430	PASS



θ	deg.	0.5	

$\omega = A \sin(\theta)$

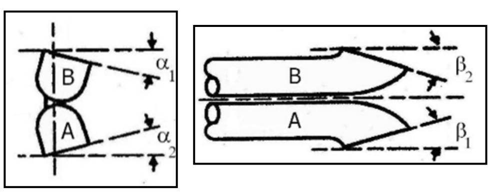
ω (ω < 0.032")	in.	0.008	PASS



γ	deg.	2.0	

Z = A sin (g)

Z (Z < 0.125")	in.	0.031	PASS



α_1 ($\alpha_1 < 10^O$)	deg.	2.5	PASS
α_2 ($\alpha_2 < 10^O$)	deg.	3.0	PASS
β_1 ($\beta_1 < 5^O$)	deg.	1.5	PASS
β_2 ($\beta_2 < 5^O$)	deg.	2.0	PASS

Stack ThermoCouple Calibration

Reference TC ID	FPTC-10/CL23A#2

Heat Source	Stack TC ^{O}F	Ref. TC ^{O}F	|Difference|
Ambient Air	77.7	77.8	0.1
Ice Water Bath	33.1	33.0	0.1
| Stack TC - Reference TC $|_{max}$ < 2.0 °F			0.1
Stack TC Pass/Fail			PASS

Comments

Performed by Lex Hooper

AIR SOURCE TECHNOLOGIES, INC.

Umbilical Hookup Check-Out

Performed By: L. Hooper

Reference TC: FPTC-10/CL23A #2

Hookup No.	20	TC No.	20	Date	07/25/23

Check-Out Procedure

Leak Check	Yes
Flow Check (>4" ΔH)	Yes
Check Valve Operational	Yes

Themocouple Calibration

Hookup T/C Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 2.0 °F
32.5	32.0	0.5	PASS

Hookup No.	21	TC No.	21	Date	07/25/23

Check-Out Procedure

Leak Check	Yes
Flow Check (>4" ΔH)	Yes
Check Valve Operational	Yes

Themocouple Calibration

Hookup T/C Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 2.0 °F
32.4	32.0	0.4	PASS

Hookup No.	22	TC No.	22	Date	07/25/23

Check-Out Procedure

Leak Check	Yes
Flow Check (>4" ΔH)	Yes
Check Valve Operational	Yes

Themocouple Calibration

Hookup T/C Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 2.0 °F
33.0	32.0	1.0	PASS

Hookup No.	26	TC No.	26	Date	07/25/23

Check-Out Procedure

Leak Check	Yes
Flow Check (>4" ΔH)	Yes
Check Valve Operational	Yes

Themocouple Calibration

Hookup T/C Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 2.0 °F
31.8	32.0	0.2	PASS

Hookup No.	29	TC No.	29	Date	07/24/23

Check-Out Procedure

Leak Check	Yes
Flow Check (>4" ΔH)	Yes
Check Valve Operational	Yes

Themocouple Calibration

Hookup T/C Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 2.0 °F
32.7	32.3	0.4	PASS

Comments

Performed by Lex Hooper

Electronic Filing: Received, Clerk's Office 09/05/2023

AIR SOURCE TECHNOLOGIES, INC.

Filterable Particulate Filter TC

Performed By: L. Hooper

Reference TC: FPTC-10/CL23A #2

Themocouple Calibration

Date: 07/24/23

FPM TC ID: 1

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	73.5	73.5	0.0	PASS
Ice Water Bath	32.5	32.3	0.2	PASS

Themocouple Calibration

Date: 07/24/23

FPM TC ID: 5

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	73.7	73.5	0.2	PASS
Ice Water Bath	32.5	32.3	0.2	PASS

Themocouple Calibration

Date: 07/24/23

FPM TC ID: 6

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	73.3	73.5	0.2	PASS
Ice Water Bath	32.4	32.3	0.1	PASS

Themocouple Calibration

Date: 07/24/23

FPM TC ID: 8

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	73.6	73.5	0.1	PASS
Ice Water Bath	32.4	32.3	0.1	PASS

Themocouple Calibration

Date: 07/24/23

FPM TC ID: 9

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	73.3	73.5	0.2	PASS
Ice Water Bath	32.5	32.3	0.2	PASS

Comments

Performed by Lex Hooper

AIRSOURCE TECHNOLOGIES, INC.

Condensable Particulate Filter TC

Performed By	L. Hooper	Reference TC	FPTC-10/CL23A #2

Themocouple Calibration

Date: 07/24/23

CPF TC ID: CPF 3

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	73.3	73.5	0.2	PASS
Ice Water Bath	32.5	32.3	0.2	PASS

Themocouple Calibration

Date: 07/24/23

CPF TC ID: CPF 4

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	73.3	73.5	0.2	PASS
Ice Water Bath	32.6	32.3	0.3	PASS

Themocouple Calibration

Date: 07/24/23

CPF TC ID: CPF 6

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	73.3	73.5	0.2	PASS
Ice Water Bath	32.4	32.3	0.1	PASS

Themocouple Calibration

Date: 07/24/23

CPF TC ID: CPF 7

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	73.2	73.5	0.3	PASS
Ice Water Bath	32.4	32.3	0.1	PASS

Themocouple Calibration

Date: 07/24/23

CPF TC ID: CPF 9

Source	FPM TC Temp. (°F)	Reference Temp. (°F)	Difference (°F)	Difference < 5.4 °F
Ambient Air	73.2	73.5	0.3	PASS
Ice Water Bath	32.2	32.3	0.1	PASS

Comments

Performed by Lex Hooper

Console Calibration

Console #	1	**Performed By**	L. Hooper
Previous Y	1.015	**Date**	7/27/2023

DRY GAS METER VOLUME CALIBRATION

Leak Checks

Inlet thru Pump (Front)	Pass	Pump to Orifice (Back)	Pass

PARAMETER	UNIT	RUN 1	RUN 2	BRACKETING	
Orifice Number		16		7	1
K Factor		0.5608		0.6381	0.5229
Inital DGM Volume	cf	884.000	889.500	897.000	621.500
Final DGM Volume	cf	889.000	894.500	902.000	626.500
Net DGM Volume	cf	5.000	5.000	5.000	5.000
Initial DGM Inlet Temp.	° F	84.0	84.0	86.0	86.0
Initial DGM Outlet Temp.	° F	84.0	84.0	86.0	86.0
Final DGM Inlet Temp.	° F	84.0	85.0	86.0	86.0
Final DGM Outlet Temp.	° F	84.0	85.0	86.0	86.0
Average DGM Temp.	° F	84.0	84.5	86.0	86.0
Initial Room Temp.	° F	79.0	79.0	80.0	80.0
Final Room Temp.	° F	79.0	80.0	80.0	80.0
Average Room Temp.	° F	79.0	79.5	80.0	80.0
Time	m:ss	6:59	6:58	6:00	7:24
	sec	419	418	360	444
Orifice ΔH	in. H_2O	1.70	1.70	2.20	1.50
Barometric Pressure	in. Hg	29.06	29.06	29.06	29.06
Pump Vacuum	in. Hg	21	21	20	22
Vcr (std)	dscf	4.903	4.889	4.789	4.840
Vm (std)	dscf	4.734	4.730	4.723	4.715
Y		1.036	1.034	1.014	1.027
ΔH@		1.931	1.923	1.845	1.913
Error From Average Y	%	-0.10	0.10	2.00	0.78
+/- 2% Criteria		PASS	PASS	PASS	PASS

Average Y	1.035
Average ΔH@	1.927
Error From Initial Y	1.94%
+/- 5% Criteria	PASS

DRY GAS METER THERMOCOUPLE CALIBRATION

Thermocouple ID	Console	Reference ID	FPTC-10/CL23A #2

DGM TC	Heat Source	DGM TC °F	Ref. TC °F	| Difference |
Inlet	Ambient Air	74.0	76.5	2.5
	Hot Water Bath	209.0	208.3	0.7
Outlet	Ambient Air	74.0	76.5	2.5
	Hot Water Bath	209.0	208.3	0.7
$\|DGM\ TC - Reference\ TC\|_{max} <$ 5.4 o F				2.5
DGM TC Pass/Fail				PASS

APPENDIX F

PROCESS DATA

Robinson - Kiln 1 - Start-up Engineering Study Operating Dat			
Date/Time	Feedrate (Tons Per Hour)	Pyroscrubber Inlet Temperature A Thermocouple (Degrees F)	Pyroscrubber Inlet Temperature B Thermocouple (Degrees F)
7/20/23 9:01	0	582	552
7/20/23 9:02	0	581	551
7/20/23 9:03	0	582	552
7/20/23 9:04	0	585	555
7/20/23 9:05	0	588	559
7/20/23 9:06	0	590	561
7/20/23 9:07	0	590	561
7/20/23 9:08	0	590	560
7/20/23 9:09	0	590	560
7/20/23 9:10	0	589	559
7/20/23 9:11	0	588	558
7/20/23 9:12	0	585	555
7/20/23 9:13	0	584	553
7/20/23 9:14	0	582	550
7/20/23 9:15	0	579	548
7/20/23 9:16	0	579	550
7/20/23 9:17	0	582	553
7/20/23 9:18	0	587	558
7/20/23 9:19	0	589	558
7/20/23 9:20	0	587	556
7/20/23 9:21	0	588	558
7/20/23 9:22	0	588	558
7/20/23 9:23	0	588	558
7/20/23 9:24	0	589	558
7/20/23 9:25	0	587	556
7/20/23 9:26	0	586	555
7/20/23 9:27	0	585	554
7/20/23 9:28	0	584	554
7/20/23 9:29	0	586	556
7/20/23 9:30	0	590	561
7/20/23 9:31	0	592	563
7/20/23 9:32	0	593	564
7/20/23 9:33	0	593	562
7/20/23 9:34	0	592	561
7/20/23 9:35	0	590	559
7/20/23 9:36	0	588	556
7/20/23 9:37	0	586	555
7/20/23 9:38	0	585	554
7/20/23 9:39	0	586	556
7/20/23 9:40	0	584	553
7/20/23 9:41	0	583	554
7/20/23 9:42	0	587	559
7/20/23 9:43	0	591	562

7/20/23 9:44	0	591	562
7/20/23 9:45	0	591	561
7/20/23 9:46	6	589	559
7/20/23 9:47	6	586	556
7/20/23 9:48	6	586	557
7/20/23 9:49	6	585	555
7/20/23 9:50	6	585	555
7/20/23 9:51	6	587	557
7/20/23 9:52	6	590	560
7/20/23 9:53	6	594	564
7/20/23 9:54	6	598	570
7/20/23 9:55	6	601	573
7/20/23 9:56	6	609	580
7/20/23 9:57	6	618	590
7/20/23 9:58	6	627	600
7/20/23 9:59	6	637	610
7/20/23 10:00	6	646	619
7/20/23 10:01	6	657	631
7/20/23 10:02	6	668	641
7/20/23 10:03	6	679	652
7/20/23 10:04	6	689	660
7/20/23 10:05	6	699	669
7/20/23 10:06	6	706	677
7/20/23 10:07	6	713	683
7/20/23 10:08	6	720	690
7/20/23 10:09	6	725	696
7/20/23 10:10	6	728	698
7/20/23 10:11	6	731	701
7/20/23 10:12	6	735	704
7/20/23 10:13	6	740	709
7/20/23 10:14	6	744	713
7/20/23 10:15	6	747	716
7/20/23 10:16	6	750	720
7/20/23 10:17	6	754	723
7/20/23 10:18	6	758	728
7/20/23 10:19	6	762	733
7/20/23 10:20	6	767	737
7/20/23 10:21	6	769	740
7/20/23 10:22	6	771	742
7/20/23 10:23	6	775	746
7/20/23 10:24	6	777	750
7/20/23 10:25	6	781	754
7/20/23 10:26	6	785	758
7/20/23 10:27	6	787	758
7/20/23 10:28	6	792	763
7/20/23 10:29	6	794	765
7/20/23 10:30	6	796	766
7/20/23 10:31	6	796	766

7/20/23 10:32	6	798	769
7/20/23 10:33	6	801	772
7/20/23 10:34	6	803	774
7/20/23 10:35	6	804	775
7/20/23 10:36	6	807	778
7/20/23 10:37	6	808	779
7/20/23 10:38	6	811	784
7/20/23 10:39	6	815	787
7/20/23 10:40	6	818	790
7/20/23 10:41	6	825	798
7/20/23 10:42	6	825	798
7/20/23 10:43	6	824	797
7/20/23 10:44	6	826	799
7/20/23 10:45	6	825	798
7/20/23 10:46	6	828	800
7/20/23 10:47	6	831	803
7/20/23 10:48	6	835	806
7/20/23 10:49	6	838	810
7/20/23 10:50	6	840	812
7/20/23 10:51	6	841	814
7/20/23 10:52	6	843	816
7/20/23 10:53	6	847	819
7/20/23 10:54	6	850	822
7/20/23 10:55	6	850	822
7/20/23 10:56	6	850	823
7/20/23 10:57	6	851	824
7/20/23 10:58	6	852	824
7/20/23 10:59	6	855	827
7/20/23 11:00	6	861	835
7/20/23 11:01	6	866	839
7/20/23 11:02	6	865	839
7/20/23 11:03	6	867	840
7/20/23 11:04	6	868	841
7/20/23 11:05	6	867	840
7/20/23 11:06	6	868	842
7/20/23 11:07	6	868	842
7/20/23 11:08	6	871	846
7/20/23 11:09	6	874	848
7/20/23 11:10	6	877	852
7/20/23 11:11	6	881	856
7/20/23 11:12	6	881	856
7/20/23 11:13	6	881	855
7/20/23 11:14	6	883	857
7/20/23 11:15	6	887	861
7/20/23 11:16	6	891	866
7/20/23 11:17	6	897	871
7/20/23 11:18	6	900	873
7/20/23 11:19	6	900	873

7/20/23 11:20	6	901	875
7/20/23 11:21	6	904	878
7/20/23 11:22	6	905	880
7/20/23 11:23	6	906	881
7/20/23 11:24	6	909	882
7/20/23 11:25	6	910	885
7/20/23 11:26	6	912	886
7/20/23 11:27	6	915	888
7/20/23 11:28	6	915	887
7/20/23 11:29	6	917	889
7/20/23 11:30	6	918	890
7/20/23 11:31	6	920	892
7/20/23 11:32	6	922	895
7/20/23 11:33	6	923	895
7/20/23 11:34	6	924	897
7/20/23 11:35	6	927	899
7/20/23 11:36	6	929	902
7/20/23 11:37	6	933	907
7/20/23 11:38	6	936	908
7/20/23 11:39	6	939	910
7/20/23 11:40	6	942	914
7/20/23 11:41	6	946	919
7/20/23 11:42	6	945	919
7/20/23 11:43	6	949	922
7/20/23 11:44	6	952	923
7/20/23 11:45	6	952	924
7/20/23 11:46	6	953	924
7/20/23 11:47	6	955	926
7/20/23 11:48	6	959	931
7/20/23 11:49	6	959	930
7/20/23 11:50	6	962	936
7/20/23 11:51	6	965	938
7/20/23 11:52	6	963	937
7/20/23 11:53	6	964	936
7/20/23 11:54	6	968	941
7/20/23 11:55	6	969	943
7/20/23 11:56	6	970	943
7/20/23 11:57	6	974	947
7/20/23 11:58	6	978	951
7/20/23 11:59	6	978	951
7/20/23 12:00	6	976	950
7/20/23 12:01	6	976	950
7/20/23 12:02	6	979	953
7/20/23 12:03	6	983	955
7/20/23 12:04	6	983	956
7/20/23 12:05	6	985	958
7/20/23 12:06	6	988	961
7/20/23 12:07	6	988	961

7/20/23 12:08	6	989	962
7/20/23 12:09	6	990	963
7/20/23 12:10	6	993	966
7/20/23 12:11	6	995	968
7/20/23 12:12	6	996	970
7/20/23 12:13	6	1000	974
7/20/23 12:14	6	1004	977
7/20/23 12:15	6	1007	980
7/20/23 12:16	6	1006	980
7/20/23 12:17	6	1007	980
7/20/23 12:18	6	1008	982
7/20/23 12:19	6	1010	983
7/20/23 12:20	6	1011	984
7/20/23 12:21	6	1013	986
7/20/23 12:22	6	1017	990
7/20/23 12:23	6	1017	991
7/20/23 12:24	6	1018	993
7/20/23 12:25	6	1017	991
7/20/23 12:26	6	1017	991
7/20/23 12:27	6	1019	993
7/20/23 12:28	6	1020	995
7/20/23 12:29	6	1025	998
7/20/23 12:30	6	1026	999
7/20/23 12:31	6	1029	1004
7/20/23 12:32	6	1032	1006
7/20/23 12:33	6	1030	1005
7/20/23 12:34	6	1030	1004
7/20/23 12:35	6	1031	1006
7/20/23 12:36	6	1035	1010
7/20/23 12:37	6	1039	1013
7/20/23 12:38	6	1037	1012
7/20/23 12:39	6.1	1036	1011
7/20/23 12:40	6	1033	1008
7/20/23 12:41	6	1034	1009
7/20/23 12:42	6	1036	1012
7/20/23 12:43	6	1038	1014
7/20/23 12:44	6	1041	1016
7/20/23 12:45	6	1041	1015
7/20/23 12:46	6	1041	1014
7/20/23 12:47	6	1042	1016
7/20/23 12:48	6	1042	1016
7/20/23 12:49	6	1043	1018
7/20/23 12:50	6	1045	1020
7/20/23 12:51	6	1049	1024
7/20/23 12:52	6	1049	1024
7/20/23 12:53	6	1049	1025
7/20/23 12:54	5.9	1053	1029
7/20/23 12:55	6.1	1055	1031

7/20/23 12:56	6	1057	1032
7/20/23 12:57	6	1058	1033
7/20/23 12:58	6	1060	1036
7/20/23 12:59	6	1061	1037
7/20/23 13:00	6	1061	1036
7/20/23 13:01	6	1058	1033
7/20/23 13:02	6	1059	1035
7/20/23 13:03	6	1059	1033
7/20/23 13:04	6	1057	1033
7/20/23 13:05	6	1059	1035
7/20/23 13:06	6	1061	1036
7/20/23 13:07	6	1066	1041
7/20/23 13:08	6	1067	1043
7/20/23 13:09	6	1067	1043
7/20/23 13:10	6	1067	1044
7/20/23 13:11	6	1068	1044
7/20/23 13:12	6	1068	1044
7/20/23 13:13	6	1073	1049
7/20/23 13:14	6	1075	1050
7/20/23 13:15	6	1077	1051
7/20/23 13:16	6	1075	1051
7/20/23 13:17	6	1078	1054
7/20/23 13:18	6	1082	1059
7/20/23 13:19	6	1082	1059
7/20/23 13:20	6	1082	1058
7/20/23 13:21	6	1085	1061
7/20/23 13:22	6	1087	1064
7/20/23 13:23	6	1088	1066
7/20/23 13:24	6	1086	1062
7/20/23 13:25	6	1086	1061
7/20/23 13:26	6	1088	1064
7/20/23 13:27	6	1089	1064
7/20/23 13:28	6	1091	1067
7/20/23 13:29	6	1090	1066
7/20/23 13:30	6	1092	1069
7/20/23 13:31	6	1094	1071
7/20/23 13:32	6	1095	1071
7/20/23 13:33	6	1096	1071
7/20/23 13:34	6	1096	1071
7/20/23 13:35	6	1099	1074
7/20/23 13:36	6	1101	1076
7/20/23 13:37	6	1104	1080
7/20/23 13:38	6	1105	1081
7/20/23 13:39	6	1103	1080
7/20/23 13:40	6	1102	1079
7/20/23 13:41	6	1105	1081
7/20/23 13:42	6	1106	1083
7/20/23 13:43	6	1106	1083

7/20/23 13:44	6	1108	1086
7/20/23 13:45	6	1109	1086
7/20/23 13:46	6	1111	1087
7/20/23 13:47	6	1110	1086
7/20/23 13:48	6	1108	1083
7/20/23 13:49	6	1107	1083
7/20/23 13:50	6	1108	1084
7/20/23 13:51	6	1110	1087
7/20/23 13:52	6	1114	1091
7/20/23 13:53	6	1113	1090
7/20/23 13:54	6	1115	1092
7/20/23 13:55	6	1117	1093
7/20/23 13:56	6	1118	1096
7/20/23 13:57	6	1117	1092
7/20/23 13:58	6	1117	1093
7/20/23 13:59	6	1121	1097
7/20/23 14:00	6	1122	1097
7/20/23 14:01	6	1120	1095
7/20/23 14:02	6	1122	1098
7/20/23 14:03	6	1126	1102
7/20/23 14:04	6	1127	1102
7/20/23 14:05	6	1127	1101
7/20/23 14:06	6	1124	1100
7/20/23 14:07	6	1126	1101
7/20/23 14:08	6	1127	1101
7/20/23 14:09	6	1127	1101
7/20/23 14:10	6	1128	1104
7/20/23 14:11	6	1130	1106
7/20/23 14:12	6	1131	1107
7/20/23 14:13	6	1132	1106
7/20/23 14:14	6	1129	1104
7/20/23 14:15	6	1131	1106
7/20/23 14:16	6	1132	1107
7/20/23 14:17	6	1132	1107
7/20/23 14:18	6	1132	1107
7/20/23 14:19	6	1129	1104
7/20/23 14:20	6	1129	1104
7/20/23 14:21	6	1131	1106
7/20/23 14:22	6	1132	1108
7/20/23 14:23	6	1130	1107
7/20/23 14:24	6	1131	1107
7/20/23 14:25	6	1131	1107
7/20/23 14:26	6	1134	1112
7/20/23 14:27	6	1137	1115
7/20/23 14:28	6	1139	1116
7/20/23 14:29	6	1142	1119
7/20/23 14:30	6	1144	1120
7/20/23 14:31	6	1145	1121

7/20/23 14:32	6	1146	1121
7/20/23 14:33	6	1141	1116
7/20/23 14:34	6	1142	1118
7/20/23 14:35	6	1141	1117
7/20/23 14:36	6	1142	1116
7/20/23 14:37	6	1142	1117
7/20/23 14:38	6	1142	1117
7/20/23 14:39	6	1144	1119
7/20/23 14:40	6	1142	1118
7/20/23 14:41	6	1140	1116
7/20/23 14:42	6.1	1143	1119
7/20/23 14:43	6	1146	1123
7/20/23 14:44	6	1145	1120
7/20/23 14:45	6	1144	1121
7/20/23 14:46	6	1146	1122
7/20/23 14:47	6	1148	1124
7/20/23 14:48	6	1147	1123
7/20/23 14:49	6	1149	1125
7/20/23 14:50	5.9	1148	1124
7/20/23 14:51	6	1150	1125
7/20/23 14:52	6	1149	1125
7/20/23 14:53	6	1149	1125
7/20/23 14:54	6	1152	1127
7/20/23 14:55	6	1152	1126
7/20/23 14:56	6	1152	1126
7/20/23 14:57	6	1157	1132
7/20/23 14:58	6	1162	1136
7/20/23 14:59	6	1165	1139
7/20/23 15:00	6	1161	1135
7/20/23 15:01	6	1157	1132
7/20/23 15:02	6	1155	1132
7/20/23 15:03	6	1159	1135
7/20/23 15:04	6	1161	1137
7/20/23 15:05	6	1161	1137
7/20/23 15:06	6	1160	1134
7/20/23 15:07	6	1157	1133
7/20/23 15:08	6	1160	1135
7/20/23 15:09	6	1165	1139
7/20/23 15:10	6	1169	1145
7/20/23 15:11	6	1163	1139
7/20/23 15:12	6	1161	1138
7/20/23 15:13	6	1161	1139
7/20/23 15:14	6	1163	1140
7/20/23 15:15	6	1165	1142
7/20/23 15:16	6	1166	1145
7/20/23 15:17	6	1165	1143
7/20/23 15:18	6.1	1168	1145
7/20/23 15:19	6	1165	1141

7/20/23 15:20	6	1166	1142
7/20/23 15:21	6	1165	1141
7/20/23 15:22	6	1167	1142
7/20/23 15:23	6	1170	1144
7/20/23 15:24	6	1172	1147
7/20/23 15:25	6	1171	1145
7/20/23 15:26	6	1168	1143
7/20/23 15:27	6	1170	1146
7/20/23 15:28	6	1178	1153
7/20/23 15:29	6	1180	1154
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7/20/23 22:27	15.5	1772	1759
7/20/23 22:28	15.5	1770	1757
7/20/23 22:29	16.5	1770	1758
7/20/23 22:30	16.5	1775	1763
7/20/23 22:31	16.5	1773	1760

7/20/23 22:32	16.6	1776	1762
7/20/23 22:33	16.5	1781	1769
7/20/23 22:34	16.6	1779	1767
7/20/23 22:35	16.4	1783	1771
7/20/23 22:36	16.5	1789	1776
7/20/23 22:37	16.5	1793	1781
7/20/23 22:38	16.5	1795	1783
7/20/23 22:39	16.6	1797	1784
7/20/23 22:40	16.5	1795	1782
7/20/23 22:41	16.5	1793	1781
7/20/23 22:42	16.5	1793	1781
7/20/23 22:43	16.5	1794	1782
7/20/23 22:44	16.5	1798	1786
7/20/23 22:45	16.5	1804	1792
7/20/23 22:46	16.6	1809	1797
7/20/23 22:47	16.5	1812	1800
7/20/23 22:48	16.5	1811	1800
7/20/23 22:49	16.7	1814	1803
7/20/23 22:50	16.4	1816	1804
7/20/23 22:51	16.5	1820	1809
7/20/23 22:52	16.4	1822	1811
7/20/23 22:53	16.6	1824	1814
7/20/23 22:54	16.4	1828	1817
7/20/23 22:55	16.5	1832	1822
7/20/23 22:56	16.4	1837	1827
7/20/23 22:57	16.4	1837	1828
7/20/23 22:58	16.5	1845	1835
7/20/23 22:59	16.5	1848	1837
7/20/23 23:00	16.6	1848	1837
7/20/23 23:01	16.5	1854	1844
7/20/23 23:02	16.5	1854	1843
7/20/23 23:03	16.7	1857	1847
7/20/23 23:04	16.5	1856	1846
7/20/23 23:05	16.5	1856	1846
7/20/23 23:06	16.4	1859	1850
7/20/23 23:07	16.6	1876	1868
7/20/23 23:08	16.5	1902	1894
7/20/23 23:09	16.4	1916	1908
7/20/23 23:10	16.6	1922	1915
7/20/23 23:11	16.5	1925	1918
7/20/23 23:12	16.5	1922	1914
7/20/23 23:13	16.5	1921	1915
7/20/23 23:14	16.6	1922	1916
7/20/23 23:15	16.5	1923	1916
7/20/23 23:16	16.4	1922	1915
7/20/23 23:17	16.6	1927	1920
7/20/23 23:18	16.5	1931	1924
7/20/23 23:19	16.6	1933	1926

7/20/23 23:20	16.3	1937	1931
7/20/23 23:21	16.5	1937	1930
7/20/23 23:22	16.5	1940	1935
7/20/23 23:23	16.5	1948	1942
7/20/23 23:24	16.5	1952	1945
7/20/23 23:25	16.5	1952	1946
7/20/23 23:26	16.6	1956	1952
7/20/23 23:27	16.5	1958	1953
7/20/23 23:28	16.5	1966	1960
7/20/23 23:29	16.5	1974	1970
7/20/23 23:30	16.5	1978	1974
7/20/23 23:31	16.5	1977	1973
7/20/23 23:32	16.5	1979	1975
7/20/23 23:33	17.5	1972	1967
7/20/23 23:34	17.5	1932	1925
7/20/23 23:35	17.6	1908	1901
7/20/23 23:36	17.4	1906	1899
7/20/23 23:37	17.5	1907	1900
7/20/23 23:38	17.5	1908	1900
7/20/23 23:39	17.5	1910	1903
7/20/23 23:40	17.5	1905	1898
7/20/23 23:41	17.6	1906	1900
7/20/23 23:42	17.5	1909	1902
7/20/23 23:43	17.5	1915	1908
7/20/23 23:44	17.4	1923	1914
7/20/23 23:45	17.5	1912	1903
7/20/23 23:46	17.4	1906	1898
7/20/23 23:47	17.5	1907	1899
7/20/23 23:48	17.5	1906	1898
7/20/23 23:49	17.5	1904	1897
7/20/23 23:50	17.5	1903	1894
7/20/23 23:51	17.5	1904	1896
7/20/23 23:52	17.4	1904	1896
7/20/23 23:53	17.5	1905	1896
7/20/23 23:54	17.5	1907	1900
7/20/23 23:55	17.5	1912	1904
7/20/23 23:56	17.5	1911	1903
7/20/23 23:57	17.6	1912	1903
7/20/23 23:58	17.5	1918	1912
7/20/23 23:59	17.5	1931	1924
7/21/23 0:00	17.5	1923	1916
7/21/23 0:01	17.5	1919	1912
7/21/23 0:02	17.5	1911	1903
7/21/23 0:03	17.6	1913	1905
7/21/23 0:04	17.5	1909	1900
7/21/23 0:05	17.5	1907	1899
7/21/23 0:06	17.4	1903	1895
7/21/23 0:07	17.6	1905	1897

7/21/23 0:08	17.5	1907	1899
7/21/23 0:09	17.6	1902	1894
7/21/23 0:10	17.4	1900	1891
7/21/23 0:11	17.6	1900	1891
7/21/23 0:12	17.5	1899	1891
7/21/23 0:13	17.6	1901	1893
7/21/23 0:14	17.4	1897	1888
7/21/23 0:15	17.6	1896	1887
7/21/23 0:16	17.5	1893	1885
7/21/23 0:17	17.5	1892	1884
7/21/23 0:18	17.4	1893	1885
7/21/23 0:19	17.6	1893	1885
7/21/23 0:20	17.6	1891	1882
7/21/23 0:21	17.6	1890	1880
7/21/23 0:22	17.4	1890	1880
7/21/23 0:23	17.6	1887	1878
7/21/23 0:24	17.5	1885	1876
7/21/23 0:25	17.5	1883	1874
7/21/23 0:26	17.5	1876	1867
7/21/23 0:27	17.6	1870	1861
7/21/23 0:28	17.6	1872	1863
7/21/23 0:29	17.6	1873	1864
7/21/23 0:30	17.3	1869	1860
7/21/23 0:31	17.6	1868	1858
7/21/23 0:32	17.5	1865	1856
7/21/23 0:33	17.6	1864	1854
7/21/23 0:34	17.4	1864	1854
7/21/23 0:35	17.6	1859	1849
7/21/23 0:36	17.5	1860	1851
7/21/23 0:37	17.6	1859	1848
7/21/23 0:38	17.3	1858	1848
7/21/23 0:39	17.6	1856	1846
7/21/23 0:40	17.5	1857	1847
7/21/23 0:41	17.6	1857	1848
7/21/23 0:42	17.5	1855	1846
7/21/23 0:43	17.5	1856	1846
7/21/23 0:44	17.5	1852	1841
7/21/23 0:45	17.5	1851	1842
7/21/23 0:46	17.3	1852	1842
7/21/23 0:47	17.6	1854	1845
7/21/23 0:48	17.6	1854	1844
7/21/23 0:49	17.5	1850	1839
7/21/23 0:50	17.4	1850	1839
7/21/23 0:51	18.5	1856	1846
7/21/23 0:52	18.4	1859	1850
7/21/23 0:53	18.4	1856	1847
7/21/23 0:54	18.5	1853	1843
7/21/23 0:55	18.5	1853	1843

7/21/23 0:56	18.5	1856	1847
7/21/23 0:57	18.5	1856	1847
7/21/23 0:58	18.4	1854	1845
7/21/23 0:59	18.4	1853	1845
7/21/23 1:00	18.4	1851	1842

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	R 23-18(A)
AMENDMENTS TO 35 ILL. ADM. CODE	)	
201, 202, AND 212	)	(Rulemaking – Air)
	)	
	)	

CERTIFICATE OF SERVICE

I, the undersigned, certify that on this 5th day of September, 2023, I have electronically served a true and correct copy of **Pre-Filed Testimony of Bryan Higgins** by electronically filing with the Clerk of the Illinois Pollution Control Board and by e-mail upon the persons identified on the attached Service List.

My e-mail address is Alex.Garel-Frantzen@afslaw.com.

The number of pages in the e-mail transmission is 234.

The e-mail transmission took place before 5:00 p.m.

/s/ Alexander J. Garel-Frantzen

Alexander J. Garel-Frantzen

Dated: September 5, 2023

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