1860 East River Road, Suite 200
Tucson, AZ 85718
USA

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south32.net

January 29, 2026

Ms. Karla Murrieta
Manager of Air Quality Permits, Air Quality Division
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007

RE: Significant Permit Revision Application – South32 Hermosa Mine, Class I Air Quality Permit #96653

Dear Ms. Murrieta,

South32 Hermosa Inc. (South32) owns and operates the Hermosa project near Patagonia in Santa Cruz County. South32 is currently authorized to construct and operate the Hermosa Mine under Arizona Department of Environmental Quality (ADEQ) Air Quality Class I Permit No. 96653, as amended by Minor Permit Revision No. 106420 on May 23, 2024 and No 109292 submitted on May 6, 2025.

South32 is proposing to reduce the permitted natural gas engines from 58 to 44 total (40 operating and 4 backups) and allow up to 14 of them to run at 50-100% load to align with updated power needs and improve operational flexibility. South32 also proposes to update the diesel engines and tailings source representation in the facility's potential-to-emit calculations.

South32 proposes to expand the operating range for up to 14 engines to 50 to 100% instead of the current 75 to 100% range. The reason for this change is that certain operations, such as hoisting, require considerable power upon start. Under the current permit condition, South32 must use load banks to increase demand to bring generators online and hold them above the 75% limit until demand hits and then rapidly scale the load banks down and then back up to balance the change in load on the system. The net result is that South32 must operate multiple engines on load banks – burning fuel and generating emissions – solely for the purpose of maintaining 75% load. If this change is made, South32 can eliminate substantial time running load banks to balance load swings, likely reducing actual emissions over time and reducing system interruptions with corresponding startups and shutdowns.

In accordance with Arizona Administrative Code (A.A.C.) R18-2-320, South32 is submitting the enclosed significant permit revision (SPR) application and modeling analysis report to incorporate the above changes.

If you have any questions concerning this application or need additional details, please feel free to contact Sarah Richman at Sarah.Richman@south32.net.

Sincerely,

Brent Musslewhite

Digitally signed by Brent Musslewhite
Date: 2026.01.29 16:16:09 -07'00'

Brent Musslewhite
Director, Environment and Permitting
Brent.musslewhite@south32.net

cc: Sarah Richman, South32

ADEQ CLASS I PERMIT 96653 SIGNIFICANT PERMIT REVISION APPLICATION

South32 Hermosa Inc.

South32 Hermosa Inc.
1860 E. River Road
Suite 200
Tucson, AZ 85718
Phone: (520) 485-1300

Prepared By:

TRINITY CONSULTANTS
702 E Osborn Rd., Suite 160
Phoenix, AZ 85014
(602) 274-2900

January 29, 2026

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1. EXECUTIVE SUMMARY

South32 Hermosa Inc. (South32) is a mineral exploration and development company focused on the development of the Hermosa Mine (the Facility) near Patagonia, Arizona in Santa Cruz County. South32 is constructing an underground mine that would lead to the production or beneficiation of mined ores (zinc, silver, manganese, and lead) into crushed ore or concentrates for further beneficiation off-site. These operations are referred to as "the Hermosa Mine" and are located in an area of Santa Cruz County considered to be in attainment or unclassifiable for all national ambient air quality standards (NAAQS).

South32 is currently authorized to construct and operate the Hermosa Mine under Arizona Department of Environmental Quality (ADEQ) Air Quality Class I Permit No. 96653[1]. The operations fall under the SIC codes 1031 (mining – lead and zinc ore), 1044 (mining – silver ore), and 1061 (mining – ferroalloy ores, except vanadium) and North American Industry Classification Systems (NAICS) codes 212230 (Copper, nickel, lead and zinc mining) and 212290 (Other metal ore mining). The primary products from the Hermosa Mine are zinc concentrate, lead concentrate, silver concentrate and crushed manganese ore.

South32 is proposing to authorize the following changes (the Project):

- Reduce the number of permitted 2.6 MW Natural gas engines from 58 to 40, with 4 additional backup engines (44 total, only 40 operating) and authorize up to 14 of the engines to operate in the 50-100% load range rather than the 75-100% range.
- Update emission calculations to reflect the natural gas engine update above, clarify CAT XQ1140 genset (ID: ENGINE 0007-0012) references with engine references (with no change to existing emissions limits), and make similar minor corrections detailed in the emissions calculation section.
- Update the moisture content for the tailings and associated sources to 11.8% to align with latest (Mine Plan of Operations) MPO[2].

Both Project and Sitewide PTE estimates are summarized in Table 1-1. The non-fugitive PTE of regulated air pollutant emissions of the Hermosa Mine, remain below the applicable Prevention of Significant Deterioration (PSD) thresholds. However, the overall increase in particulate matter emissions exceed the thresholds for mNSR under R18-2-334. South32 is electing to demonstrate compliance with R18-2-334 by demonstrating that the Project will comply with the NAAQS through air dispersion modeling.

Accordingly, South32 is therefore submitting this Class I Significant Permit Revision (SPR) application pursuant to Arizona Administrative Code A.A.C R18-2-320.A. As clarified by A.A.C. R18-2-304.E.1, an application for permit revision needs only supply information related to the proposed change and therefore this application includes only that information related to the Project. The enclosed permit application includes ADEQ's Class I permit standard application form and includes an air quality modeling report (under separate cover) demonstrating that the proposed Project will not interfere with the attainment or maintenance of the PM_{10} and $PM_{2.5}$ NAAQS. Furthermore, the revised equipment list is included in Appendix D and the proposed draft permit language is included in Appendix E.

[1] As amended by MPRs 106420 and 109292

[2] Revised MPO dated April 15, 2025

Table 1-1 Project Potential to Emit Summary – Plan I

Emissions	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC	Lead Compounds	Max Single HAP (Acetaldehyde)	Total HAPs	CO_2e
Project Emissions											
Project Non-Fugitive PTE	14.39	14.39	14.39	-50.88	1.05	-49.81	-25.82	0.00E+00	-12.33	-26.95	-344,755
Project Fugitive PTE	-2.83	-0.73	-0.15	0.00	0.00	0.00	0.00	-4.34E-03	0.00	-0.05	0.00
Permitting Threshold Comparison											
Minor New Source Review (mNSR) Thresholds[1]	--	7.50	5.00	20.00	20.00	50.00	20.00	0.30	--	--	--
Does Project Non-Fugitive PTE exceed mNSR Thresholds?	--	Yes	Yes	No	No	No	No	No	--	--	--
Permitted Non-Fugitive PTE[2]	212.39	92.33	54.59	205.61	6.87	220.37	107.94	1.85	39.84	73.53	1,176,929
Permitted Non-Fugitive PTE + Project Non-Fugitive PTE Increases	226.78	106.71	68.97	154.74	7.92	170.56	82.11	1.85	27.50	46.58	832,174
Class I Title V Major Source Thresholds[1]	100	100	100	100	100	100	100	10	10	25	--
Does Non-Fugitive PTE exceed Class I Title V Major Source Thresholds?	Yes	Yes	No	Yes	No	Yes	No	No	Yes	Yes	--
Class I PSD Major Source Thresholds	250	250	250	250	250	250	250	--	--	--	100,000
Does Non-Fugitive PTE exceed Class I PSD Major Source Thresholds?[3]	No	No	No	No	No	No	No	--	--	--	No

1. Per Arizona Administrative Code (A.A.C.)
   R18-2-101.110 - For "Potential to emit" (PTE)
   R18-2-101.75 - For "Major Source"
   R18-2-101.101 - For "Permitting Exemption Thresholds" which is the mNSR Threshold per R18-2-334.A.3
2. Permitted PTE is based on post MPR No. 109292 PTE.
3. Sources exceeding 100,000 tons of CO_2e are only subject to PSD if they also trigger PSD for another regulated NSR pollutant. The Hermosa Project does not trigger PSD for any other NSR pollutant. While CO_2e is not included under the definition of "regulated NSR pollutant" at A.A.C. R18-2-101.124, GHGs are considered a "regulated NSR pollutant" under the federal Prevention of Significant Deterioration (PSD) program at 40 C.F.R. § 52.21(b)(50). South32 is therefore providing estimates of GHG (i.e., CO_2e) emissions for purposes of demonstrating non-applicability of the federal PSD program for GHGs, which ADEQ implements via a delegation agreement with EPA.

Table 1-2 Project Potential to Emit Summary – Plan II

Emissions	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC	Lead Compounds	Max Single HAP (Acetaldehyde)	Total HAPs	CO_2e
Project Emissions											
Project Non-Fugitive PTE	14.39	14.39	14.39	-50.88	1.05	-49.81	-25.82	0.00	-12.33	-26.95	-344,755
Project Fugitive PTE	-8.50	-2.16	-0.43	0.00	0.00	0.00	0.00	-0.01	0.00	-0.14	0.00
Permitting Threshold Comparison											
Minor New Source Review (mNSR) Thresholds[1]	--	7.50	5.00	20.00	20.00	50.00	20.00	0.30	--	--	--
Does Non-Fugitive PTE exceed mNSR Thresholds?	--	Yes	Yes	No	No	No	No	No	--	--	--
Permitted Non-Fugitive PTE[2]	212.39	92.33	54.59	205.61	6.87	220.37	107.94	2.09	39.84	81.58	1,176,929
Permitted Non-Fugitive PTE + Project Non-Fugitive PTE Increases	226.78	106.71	68.97	154.74	7.92	170.56	82.11	2.09	27.51	54.63	832,174
Class I Title V Major Source Thresholds[1]	100	100	100	100	100	100	100	10	10	25	--
Does Non-Fugitive PTE exceed Class I Title V Major Source Thresholds?	Yes	Yes	No	Yes	No	Yes	No	No	Yes	Yes	No
Class I PSD Major Source Thresholds	250	250	250	250	250	250	250	--	--	--	100,000
Does Non-Fugitive PTE exceed Class I PSD Major Source Thresholds?[3]	No	No	No	No	No	No	No	--	--	--	No

1. Per Arizona Administrative Code (A.A.C.)
   R18-2-101.110 - For "Potential to emit" (PTE)
   R18-2-101.75 - For "Major Source"
   R18-2-101.101 - For "Permitting Exemption Thresholds" which is the mNSR Threshold per R18-2-334.A.3

2. Permitted PTE is based on post MPR No. 109292 PTE.

3. Sources exceeding 100,000 tons of CO_2e are only subject to PSD if they also trigger PSD for another regulated NSR pollutant. The Hermosa Project does not trigger PSD for any other NSR pollutant. While CO_2e is not included under the definition of "regulated NSR pollutant" at A.A.C. R18-2-101.124, GHGs are considered a "regulated NSR pollutant" under the federal Prevention of Significant Deterioration (PSD) program at 40 C.F.R. § 52.21(b)(50). South32 is therefore providing estimates of GHG (i.e., CO_2e) emissions for purposes of demonstrating non-applicability of the federal PSD program for GHGs, which ADEQ implements via a delegation agreement with EPA.

2. ADEQ STANDARD PERMIT APPLICATION FORM

According to A.A.C. R18-2-320.D, an application for an SPR must meet all requirements of Article 3 of A.A.C. Title 18, Chapter 2 for applications, public participation, review by affected states, and review by the Administrator that apply to permit issuance and renewal (i.e., complying with all subsections of R18-2-304.B). Pursuant to A.A.C R18-2-304.B, to apply for any permit required by A.A.C. Title 18, Chapter 2, applicants must complete the applicable standard application form provided by the ADEQ and supply all information required by the form's filing instructions. Section 2 and 3 of this application include a completed ADEQ Standard Permit Application Form and an administrative completeness checklist, respectively, identifying the location of the information required by the associated filing instructions in ADEQ's Application Packet for a Class I Permit.

Table 2-1 Application Administrative Completeness Checklist

Item	Requirement	Included in Application			Comments
		Yes	No	N/A	
1	Has the standard application form been completed?	X			Section 2
2	Has the responsible official signed the standard application form?	X			Section 2
3	Has a process description been provided?	X			Section 4
4	Are the facility's emissions documented with all appropriate supporting information?	X			Appendix C and Section 6
5	Is the facility subject to Minor NSR requirements? If the answer is "YES" answer 6a, 6b and 6c as applicable. If the answer is "NO", skip to 7.	X			Section 8
6.a	If the facility chooses to implement RACT, is the RACT determination included for the affected pollutants for all affected emission units?			X	
6.b	If the facility chooses to demonstrate compliance with NAAQS by screen modeling, is the modeling analysis included?	X			A modeling report will be submitted under a separate cover
6.c	If refined modeling has been conducted, is a comprehensive modeling report along with all modeling files included?	X			A modeling report will be submitted under a separate cover
7	Does the application include an equipment list with the type, name, make, model, serial number, maximum rated capacity, and date of manufacture?	X			Appendix D
8	Does the application include an identification and description of Pollution Controls? (if applicable)			X	
9	For any application component claimed as confidential, are the requirements of AR.S. 49-432 and A.A.C. R18-2-305 addressed?			X	
10	For any current non-compliance issue, is a compliance schedule attached?			X	
11	For minor permit revision that will make a modification upon submittal of application, has a suggested draft permit been attached?	X			Suggested draft permit language has been included in Appendix E to expedite review.
12	For major sources, have all applicable requirements been identified?	X			Section 8
13	For major sources, has a CAM applicability analysis been provided? For CAM applicable units, have CAM plans been provided?	X			Section 8.3.3
14	For major sources subject to requirements under Article 4 of the A.A.C., have all necessary New Source Review analyses identified in the application been presented?			X	

SECTION 2.0

CLASS I PERMIT APPLICATION PACKAGE

SECTION 2.1

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Air Quality Division

1110 West Washington • Phoenix, AZ 85007 • Phone: (602) 771-2338

STANDARD CLASS I PERMIT APPLICATION FORM

(As required by A.R.S. § 49-426, and Chapter 2, Article 3, Arizona Administrative Code)

1. Permit to be issued to (Business license name of organization that is to receive permit):
   South32 Hermosa Inc.

2. Mailing Address: 1860 E. River Road, Suite 200
   City: Tucson State: Arizona ZIP: 85718

3. Name (or names) of Owners/ Principals: Brent Musslewhite
   Phone: 520-485-1300 Fax: Email: brent.musslewhite@south32.net

4. Name of Owner's Agent: Brent Musslewhite
   Phone: 520-485-1300 Fax: Email: brent.musslewhite@south32.net

5. Plant/Site Manager/ Contact Person and Title: Brent Musslewhite
   Phone: 520-485-1300 Fax: Email: brent.musslewhite@south32.net

6. Plant Site Name: Hermosa Project

7. Plant Site Location Address: 749 Harshaw Road
   City: Patagonia County: Santa Cruz Zip Code: 85624
   Indian Reservation (if applicable, which one): N/A
   Latitude/ Longitude, Elevation: 31.466232°/-110.724594°, 5,085 ft
   Section/ Township/ Range: Section 26 Township 22 South, Range 16 East

8. General Nature of Business: Mining

9. Type of Organization:
   ☒ Corporation ☐ Individual Owner ☐ Partnership ☐ Government Entity (Government Facility Code----------)
   ☐ Other

8. Permit Application Basis: ☐ New Source ☒ Revision ☐ Renewal of Existing Permit
   (Check all that apply.)
   For renewal or modification, include existing permit number (and exp. date): P96653 August 25, 2029
   Date of Commencement of Construction or Modification: TBD
   Primary Standard Industrial Classification Code: 1031, 1044, 1061

9. I certify that I have knowledge of the facts herein set forth, that the same are true, accurate and complete to the best of my knowledge and belief, and that all information not identified by me as confidential in nature shall be treated by ADEQ as public record. I also attest that I am in compliance with the applicable requirements of the Permit and will continue to comply with such requirements and any future requirements that become effective during the life of the Permit. I will present a certification of compliance to ADEQ no less than annually and more frequently if specified by ADEQ. I further state that I will assume responsibility for the construction, modification,

or operation of the source in accordance with Arizona Administrative Code, Title 18, Chapter 2 and any permit issued thereof.

Signature of Responsible Official: Brent Musslewhite

Official Title of Signer: Director, Environment & Permitting

Typed or Printed Name of Signer: Brent Musslewhite

Date: 1/29/2026 Telephone Number: 520-485-1300

SECTION 2.2 - EMISSION SOURCES

PAGE_____OF _____
DATE _____

Estimated "Potential to Emit" per A.A.C. R18-2-101.
Review of applications and issuance of permits will be expedited by supplying all necessary information on this Table.

REGULATED AIR POLLUTANT DATA					EMISSION POINT DISCHARGE PARAMETERS										
EMISSION POINT [1]		CHEMICAL COMPOSITION OF TOTAL STREAM	AIR POLLUTANT EMISSION RATE		UTM COORDINATES OF EMISSION POINT [5]			STACK SOURCES [6]					NONPOINT	
NUMBER	NAME	REGULATED AIR POLLUTANT NAME [2]	#/ HR. [3]	TONS/ YEAR [4]	ZONE	EAST (Mtrs)	NORTH (Mtrs)	HEIGHT ABOVE GROUND (feet)	HEIGHT ABOVE STRUC. (feet)	EXIT DATA			SOURCES [7]		
										DIA (ft.)	VEL. (fps)	TEMP. (°F)	LENGTH (ft.)	WIDTH (ft.)	
See appendix C and separate modeling report															

GROUND ELEVATION OF FACILITY ABOVE MEAN SEA LEVEL_____feet
ADEQ STANDARD CONDITIONS ARE 293K AND 101.3 KILOPASCALS (A.A.C. R18-2-101)

****Submit emission calculations spreadsheet with your application****

General Instructions:

1. Identify each emission point with a unique number for this plant site, consistent with emission point identification used on plot plan, previous permits, and Emissions Inventory Questionnaire. Include fugitive emissions. Limit emission point number to eight (8) character spaces. For each emission point use as many lines as necessary to list regulated air pollutant data. Typical emission point names are: heater, vent, boiler, tank, reactor, separator, baghouse, fugitive, etc. Abbreviations are O.K.

2. Components to be listed include regulated air pollutants as defined in A.A.C. R18-2-101. Examples of typical component names are: Carbon Monoxide (CO), Nitrogen Oxides (NO_x), Sulfur Dioxide (SO_2), Volatile Organic Compounds (VOC), particulate matter (PM), particulate less than 10 microns (PM_{10}), etc. Abbreviations are O.K.

3. Pounds per hour (#/HR) is maximum potential emission rate expected by applicant.

4. Tons per year is annual maximum potential emission expected by applicant, which takes into account process operating schedule.

5. As a minimum applicant shall furnish a facility plot plan as described in the filing instructions. UTM coordinates are required only if the source is a major source or is required to perform refined modeling for the purposes of demonstrating compliance with ambient air quality guidelines.

6. Supply additional information as follows if appropriate:
   (a) Stack exit configuration other than a round vertical stack. Show length and width for a rectangular stack. Indicate if horizontal discharge with a note.
   (b) Stack's height above supporting or adjacent structures if structure is within 3 "stack height above the ground" of stack.

7. Dimensions of nonpoint sources as defined in A.A.C. R18-2-101.

SECTION 2.3 - EQUIPMENT LIST

The following table should include all equipment utilized at the facility, and should be completed with all the requested information. Be sure to notate the units (tons/hour, horsepower, etc.) when recording the Maximum Rated Capacity information, the Serial Number and/or the Equipment ID Number. The date of manufacture must be included in order to determine if portions of the facility are NSPS applicable. Make additional copies of this form if necessary.

Submit photographs of the faceplates for all engines listed below. If an engine is certified, please also include a copy of the engine certification with the application. For any newly added equipment, include a copy of the specification sheet. These documents will be used to verify equipment information and determine applicable regulations.

Type of Equipment	Maximum Rated Capacity [1]	Make	Model	Serial Number	Date of Manufacture	Equipment ID Number
See appendix D						

[1] For generator sets, enter the maximum rated capacity of the engine rather than the maximum rated capacity of the generator.

3. APPLICATION ADMINISTRATIVE COMPLETENESS

Table 3-1 provides a list of the permit application items required by Section 2.4 of ADEQ's Application Packet for a Class I Permit along with a reference to where the information is located in this application.

Table 3-1 Permit Application Completion Summary

Section 2.4 of Class I Application Packet	Information Required	Application Section
1,2	Process/Product Description including Standard Industrial Classification (SIC) code	1
3,4	Alternate operating process/product description including SIC code	1
5	Process Flow Diagram	5
6	Material Balance Calculations	N/A[a]
7	Emission Calculations	6, Appendix C
8	Applicable Requirements	8
9	Proposed Exemptions from Applicable Requirements	N/A[b]
10(a)-(f), (h)	Annual and Hourly Process Rates, Fuel Usage, Raw Material Information, Operational Limits	6, Appendix C
10(g)	Operating Schedule	4
11	Equipment and Control Device List	Appendix D
12	Stack Information	N/A[C]
13	Site Diagram	5
14	Air Pollution Control Information	Appendix B
15	Acceptable Documentation for Equipment	N/A
16	Compliance Plan	10
17	Compliance Certification	10
18	Acid Rain Program Compliance Plan	N/A[D]
19	Major Source Requirements – Best Available Control Technology (BACT) and Ambient Impact Analysis	N/A

[a] South32 did not base any emission calculations on a material balance.

[b] South32 is not proposing to be exempt from any otherwise applicable requirements.

[C] Stack parameters are included under a separate Air Quality Impact Analysis (AQIA) submittal.

[D] Acid rain information is required only for facilities subject to federal acid rain regulations. South32 is not subject to acid rain regulations.

4. PROJECT DESCRIPTION

South32 has permitted fifty-eight (58) natural-gas fired reciprocating engines to provide the onsite power needed to operate the Facility. South32 is proposing to update the permitted number and representation of the natural gas engines in the air permit.

South32 is proposing to authorize the following changes:

- Reduce the number of permitted 2.6 MW Natural gas engines from 58 to 40, with 4 additional backup engines (44 total, only 40 operating) and authorize up to 14 of the engines to operate in the 50-100% load range rather than the 75-100% range.
- Update emission calculations to reflect the natural gas engine update above, clarify CAT XQ1140 genset (ID: ENGINE 0007-0012) references with engine references (with no change to existing emissions limits), and make similar minor corrections detailed in the emissions calculation section.
- Update the moisture content for the tailings and associated sources to 11.8% to align with latest Mine Plan of Operations (MPO)[3].
- Revise permit conditions to incorporate the above-mentioned changes (explained below and as noted in Appendix E).

4.1 Changes to Natural Gas Engines

South32 is currently authorized to use up to 58 natural gas engines (plus 1 backup) with engines limited to an operating range of 75 to 100% and a requirement to operate the selective catalytic reduction (SCR) and oxidation catalyst units at all times, exclusive of startup and shutdown. Experience has shown that these conditions are too rigid, may create safety risks, and result in unnecessary emissions. South32 is proposing changes to the permit to reduce actual overall emissions while providing needed operational flexibility.

First, South32 proposes to replace the "interlock" requirement with a "program and monitor" requirement that requires South32 to monitor engine performance and take corrective action to restore engines to the operating range within a short period. The interlock requirement could force engines off-line while South32 is hoisting personnel or material from underground operations. Power interruption could result in personnel being trapped below ground or in the hoist. Additionally, abrupt termination of an engine increases the risk of tripping other units or engines risking a cascade failure. In lieu of the interlock, South32 will implement a program and monitor system that tracks engine performance, alarms if an engine falls below the permit load threshold, and requires South32 to determine, within 15 minutes, whether the engine can be brought back up to load or must be shutdown and another unit started. This allows smoother management of power transitions and reduces the number of startups and shutdowns.

Second, South32 proposes to expand the operating range for 14 engines to 50 to 100% instead of the current 75 to 100% range. The reason for this change is that certain operations, such as hoisting, require considerable power upon start. Under the current permit condition, South32 must use load banks to increase demand to bring generators online and hold them above the 75% limit until demand hits and then rapidly scale the load banks down and then back up to balance the change in load on the system. The net result is that South32 must operate multiple engines on load banks – burning fuel and generating emissions – solely for the purpose of maintaining 75% load. Discussion with the vendors has determined that the

[3] Revised MPO date April 15, 2024.

engines are fully controlled within a wider operating range of 50 to 100% albeit with somewhat higher particulate matter emissions on a lb/MWh basis at the 50-75% range. South32's electrical engineers, vendors and consultants have concluded that if 14 engines can operate in the wider 50-100% range, that the total number of engines can be reduced from 58 with 1 backup to 40 with 4 backups. If this change is made, South32 can eliminate substantial time running load banks to balance load swings, likely reducing actual emissions over time and reducing system interruptions with corresponding startups and shutdowns. Trinity Consultants has modeled this revised operating scenario (14 units at 50-100% and 26 units at 75-100%) and determined that the NAAQS are met, as shown in the attached modeling report. South32 has proposed permit language to reduce the number of engines and the need for load bank operation.

Third, South32 and its engine contractor have identified certain required maintenance operations that cannot be conducted either with the engine off or at full operation or to validate proper operation of the SCR units. These maintenance operations are critical to keeping the engines or SCRs unit in good operating order and meeting emissions specifications. South32 has proposed to allow limited operation as needed to allow this manufacturer-required maintenance, consistent with good air pollution control practice.

Fourth, South32 has proposed clear definitions of startup, shutdown and specified maintenance for the engines and control units. This is necessary to allow for proper accounting of emissions during such periods.

Finally, South32 has proposed to test at 50, 75 and maximum achievable load and use these tests to set emission factors in lb/MWh that will be used in conjunction with the monitoring of MWh to calculate emissions more accurately. Startup and shutdown emissions for NOx are substituted for these values, being based on worst case startup/shutdown values and maximum operation at other times. Startup and shutdown values for CO and VOC are added based on a conservative estimate of time during which combustion may occur while the oxidation catalyst is below temperature. South32 also has provided for use of the NSPS Subpart JJJJ limits during periods when the oxidation catalyst or SCR unit is down while repairs are undertaken or if there is an unsuccessful SCR validation. These steps ensure that the annual emissions are not underestimated.

4.2 Diesel Engines

South32 is proposing the option to use the EPA certified emissions in lieu of stack testing. Many of these units operate infrequently or as emergency-equivalent engines and hours consumed by stack testing would substantially increase the overall emissions from the units. The environmental value of stack testing units operating pursuant to an EPA engine certification where the EPA has determined that stack testing is not required is low. *See, e.g.,* 40 C.F.R. 60.4211(c) (allowing compliance to be demonstrated by use of a certified engine installed and configured according to the manufacturer's emission-related specifications).

4.3 Emission Calculation Update

The emissions calculations are being updated to reflect these changes and the newest data from the Mine Plan of Operations on tailings moisture. These steps ensure consistency among South32 permits and filings.

5. SITE & PROCESS FLOW DIAGRAMS

Figure 5-1 through Figure 5-16 include overall site plans during Plan I and Plan II, including property boundaries, as well as zoomed-in maps of the beneficiation areas for Taylor and Clark. Figure 5-17 contains a process flow diagram (PFD) of the emission sources undergoing revisions to existing operations.

Figure 5-1: Hermosa Project - Location Map - Plan I

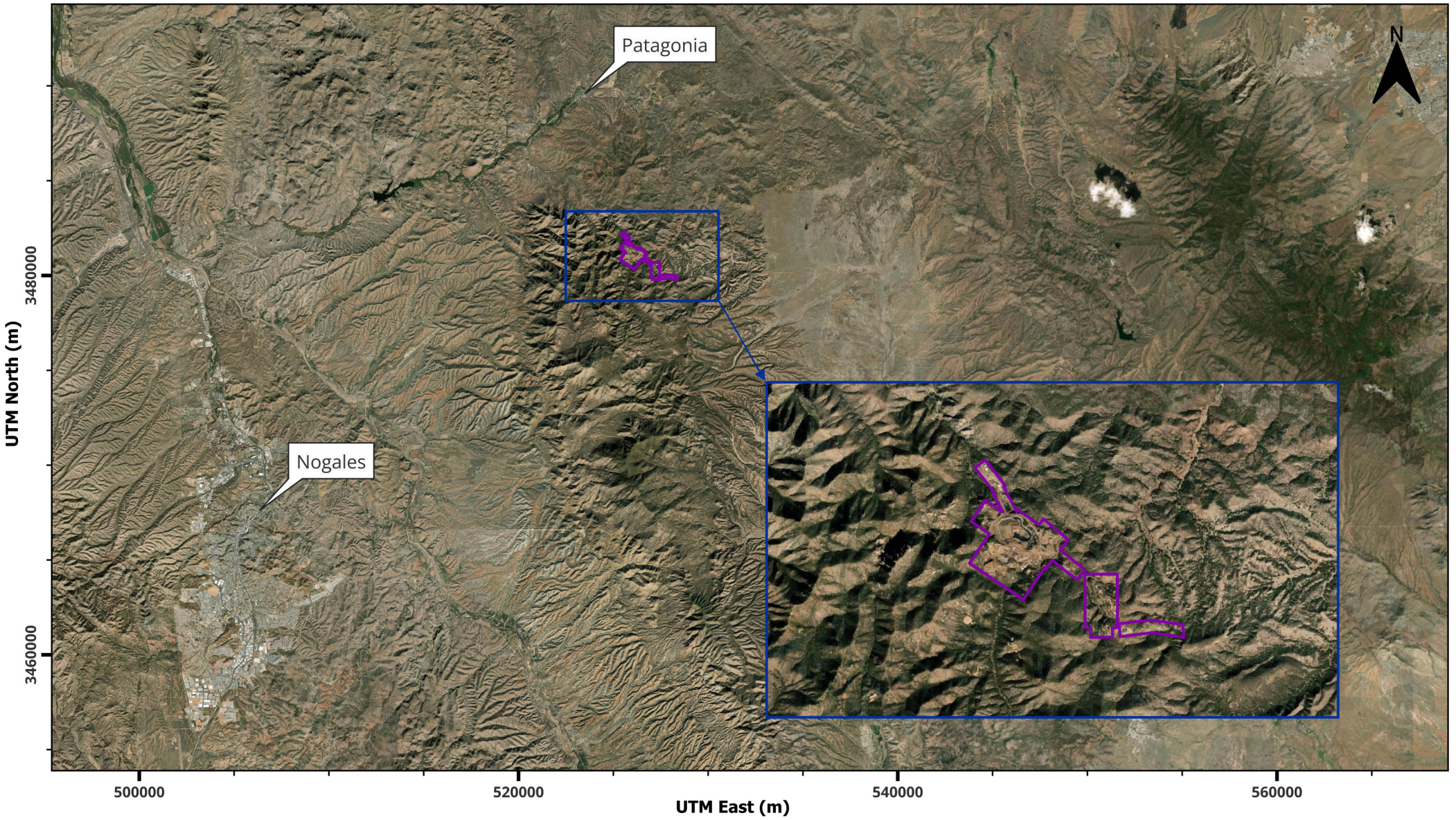


Figure 5-2: Hermosa Project - Location Map - Plan II

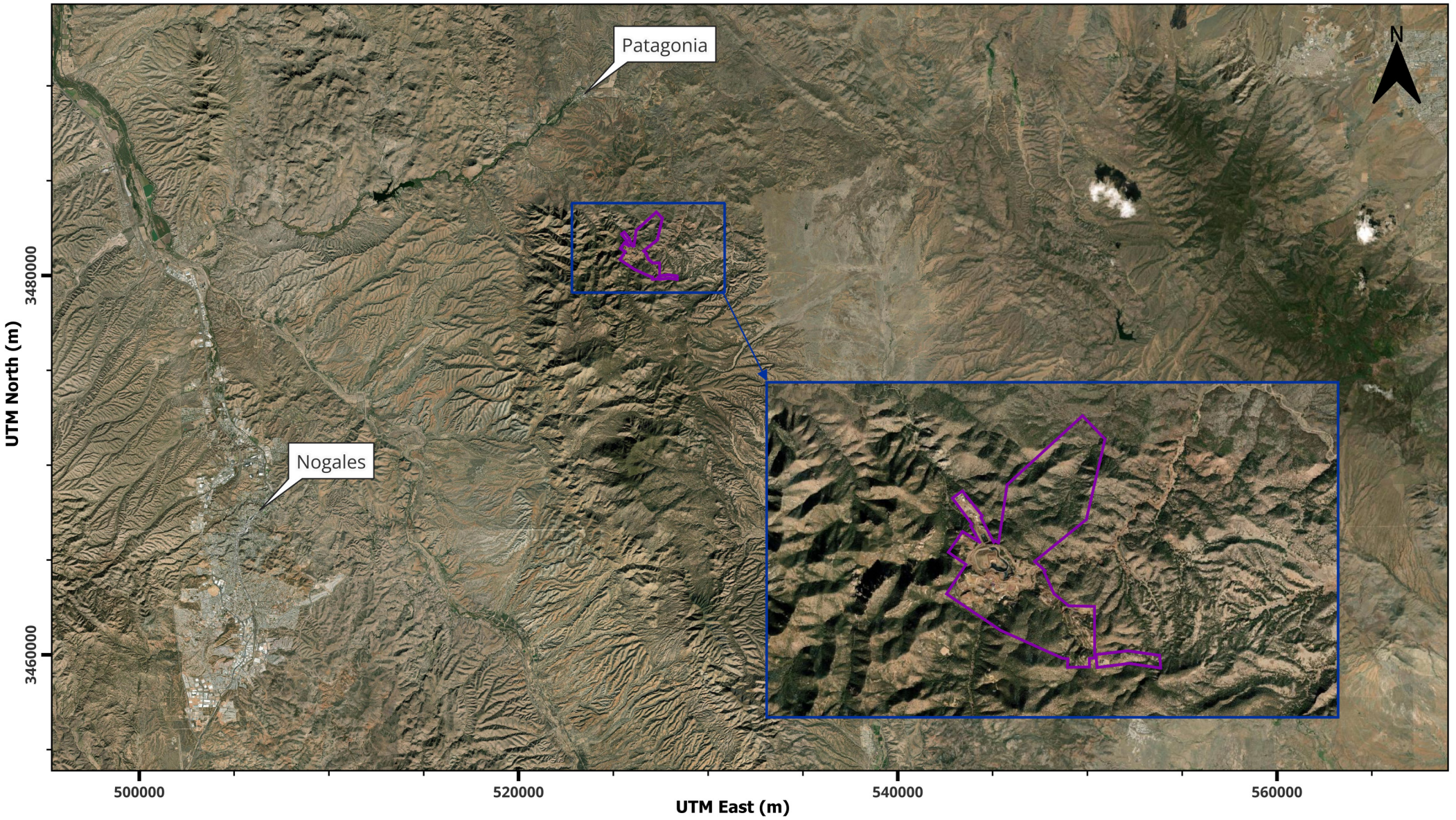


Figure 5-3: Hermosa Project - Zoom In Locations

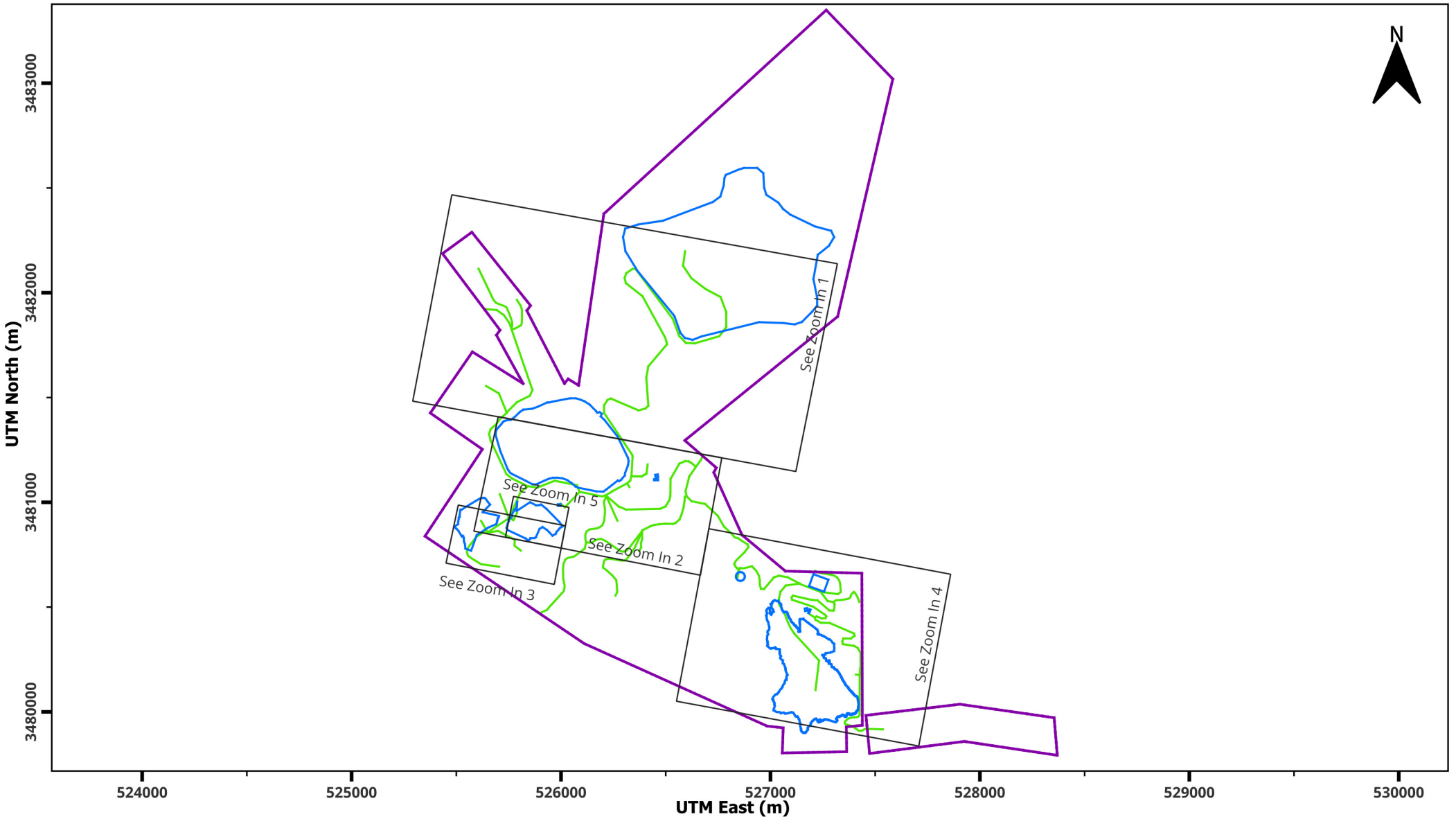


Figure 5-4: Hermosa Project - Piles and Roads - Plan I

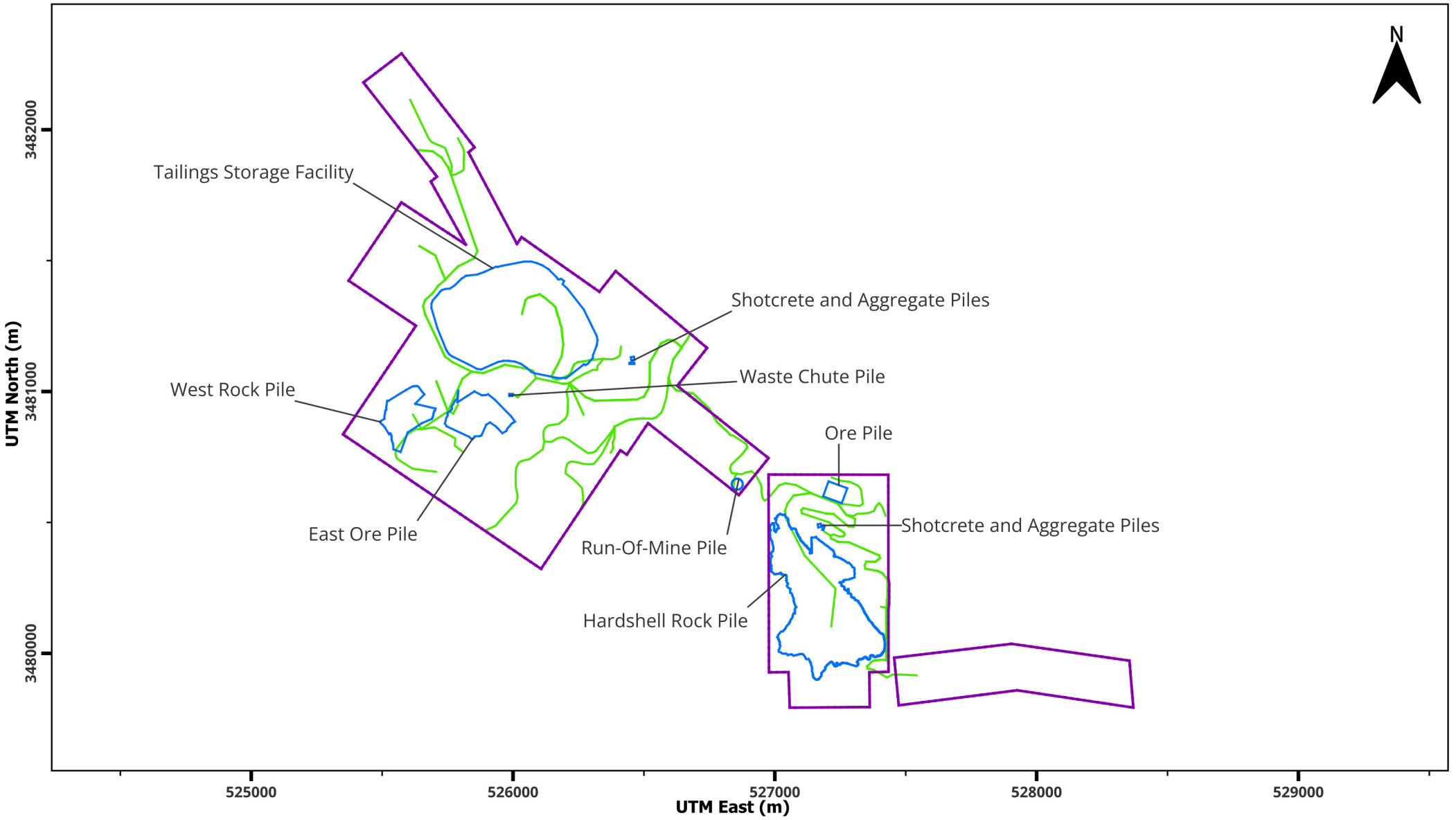


Figure 5-5: Hermosa Project - Piles and Roads - Plan II

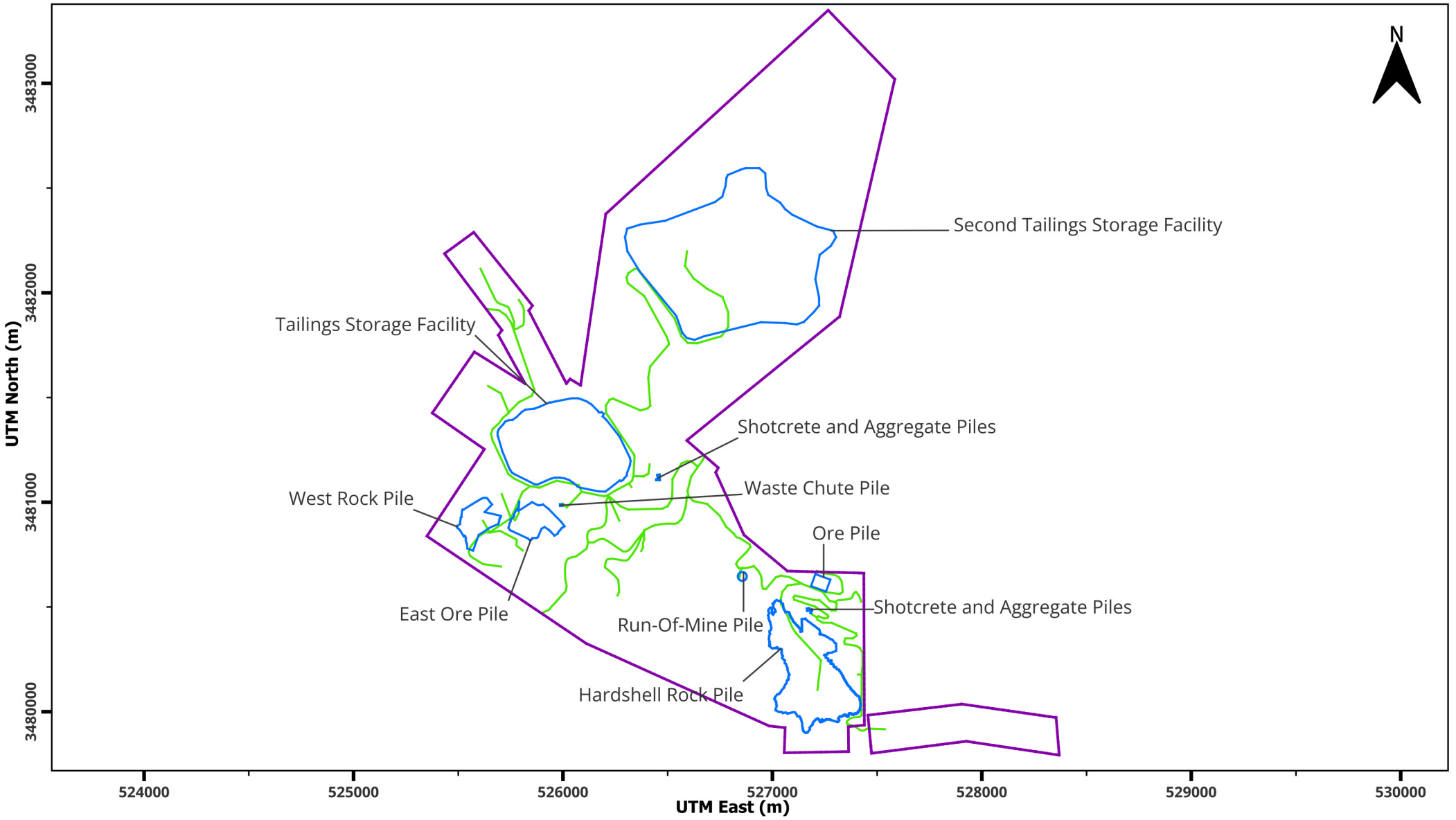
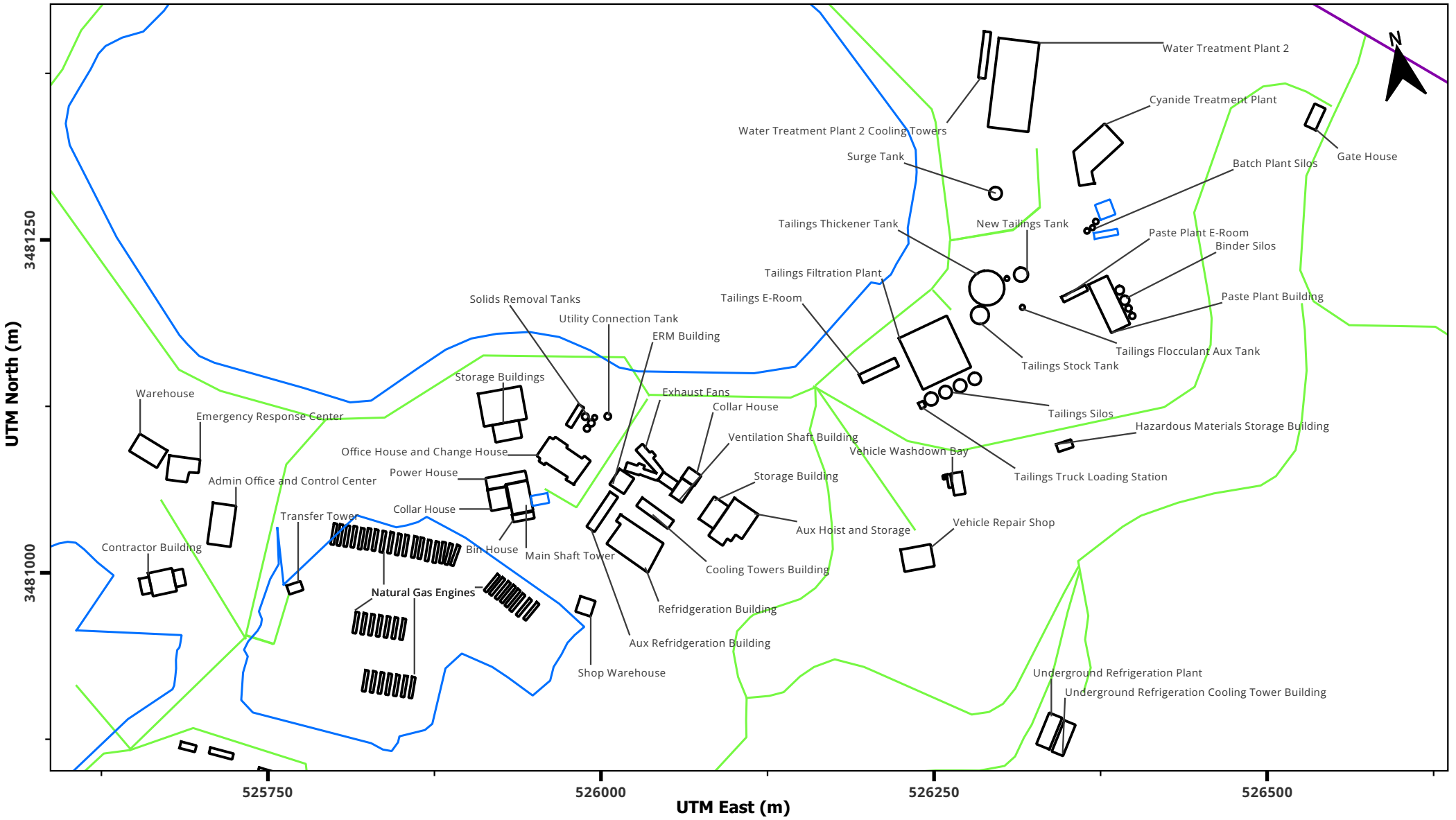


Figure 5-6: Hermosa Project - Building Zoom In 1

Figure 5-7: Hermosa Project - Building Zoom In 2



0 0.04 0.08 0.12 0.16 Miles

All Coordinates shown in UTM Coordinates
Zone 12, NAD 83 Datum

Legend

- Ambient Boundary
- Buildings
- Piles
- Significant Roads

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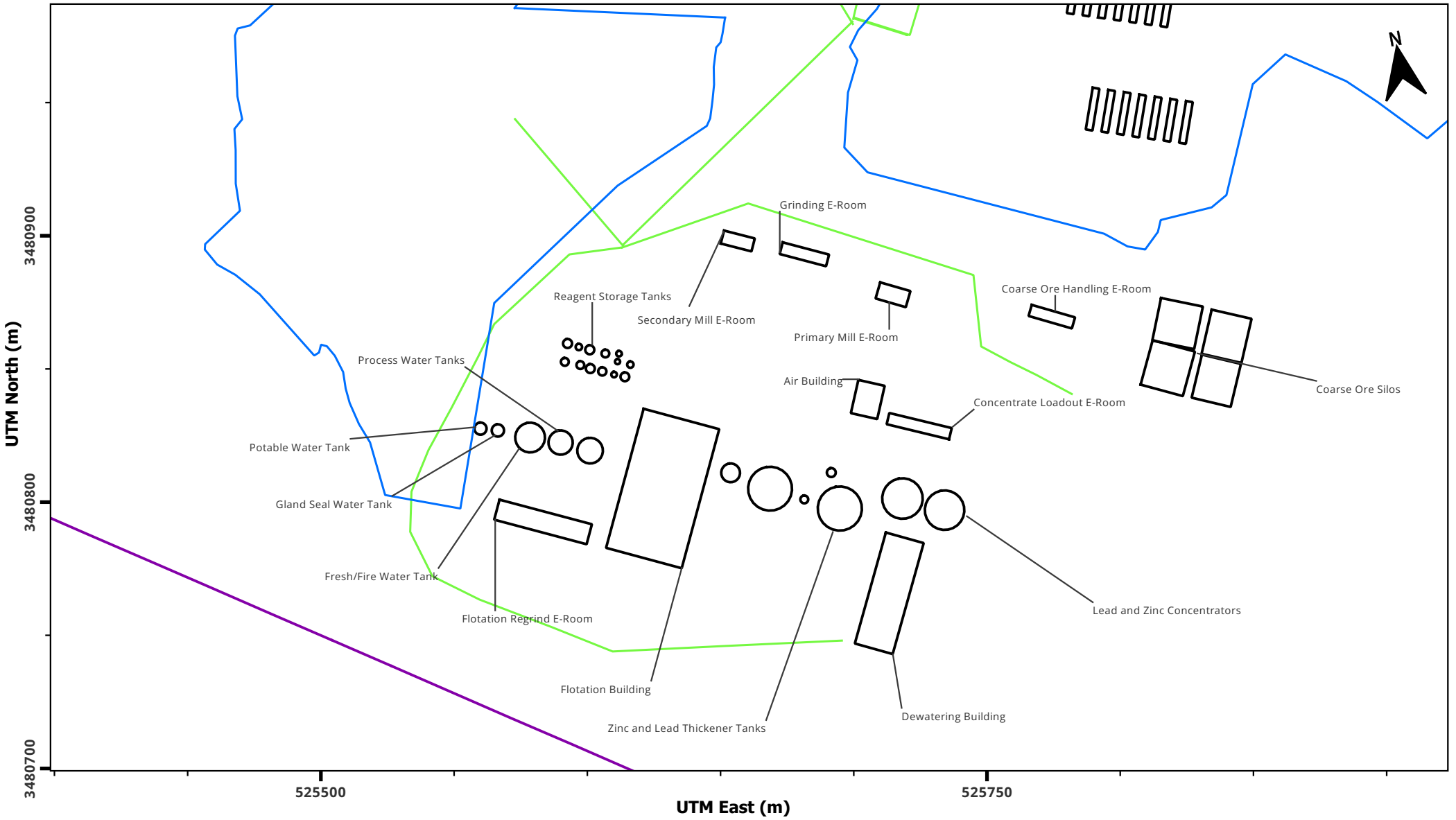
Figure 5-8: Hermosa Project - Building Zoom In 3



All Coordinates shown in UTM Coordinates
Zone 12, NAD 83 Datum

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Figure 5-9: Hermosa Project - Building Zoom In 4

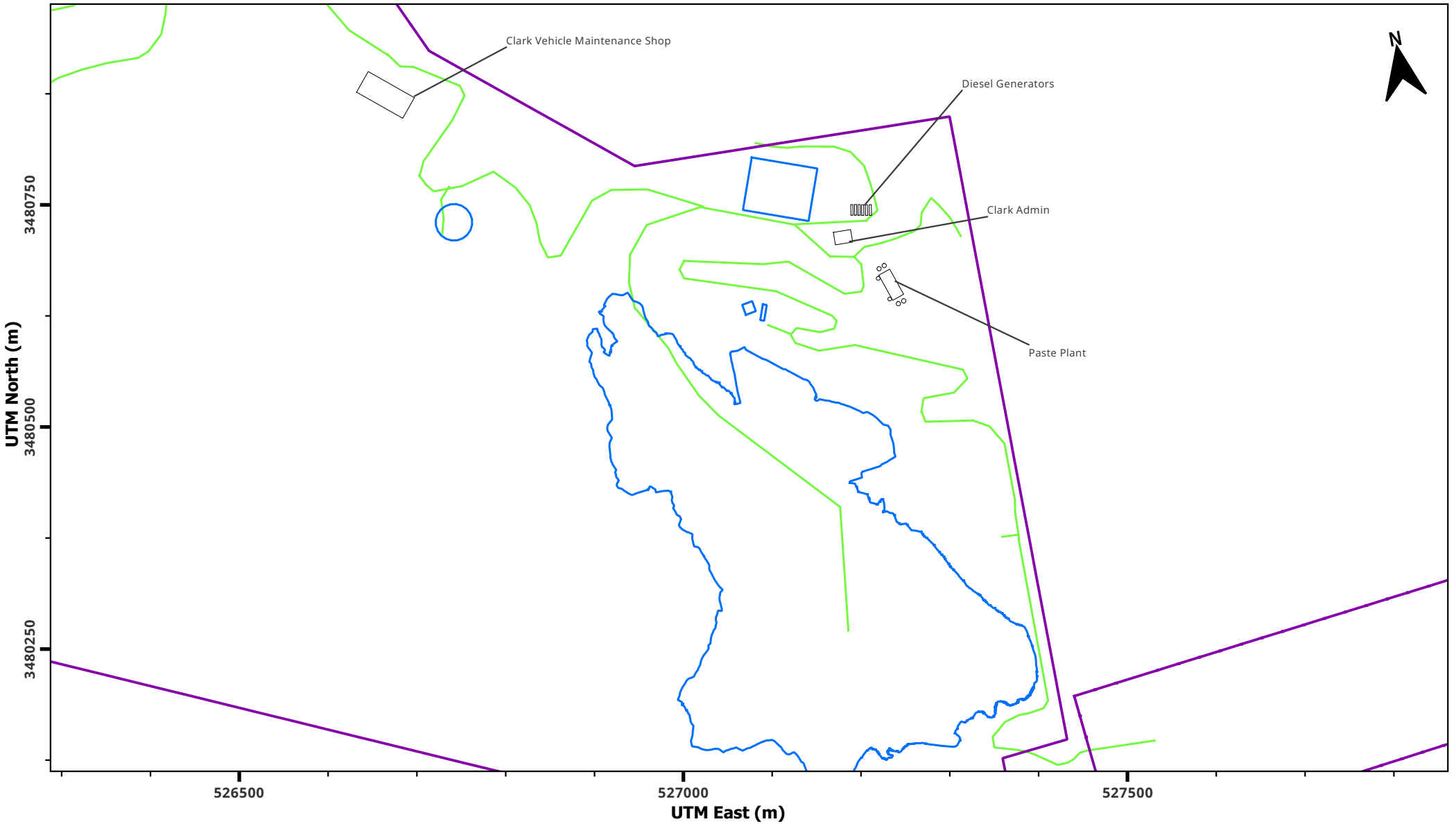


Figure 5-10: Hermosa Project - Building Zoom In 5

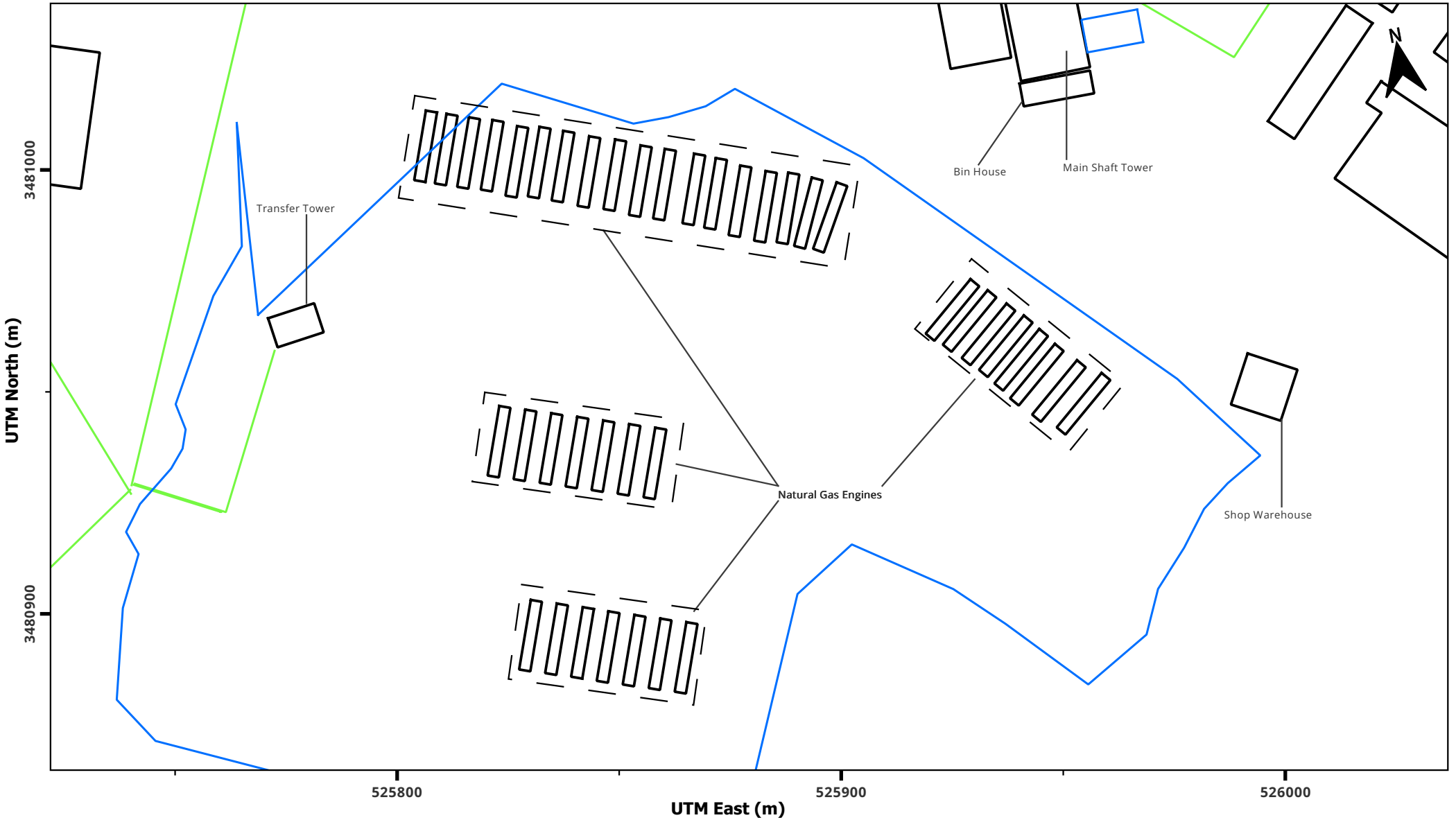
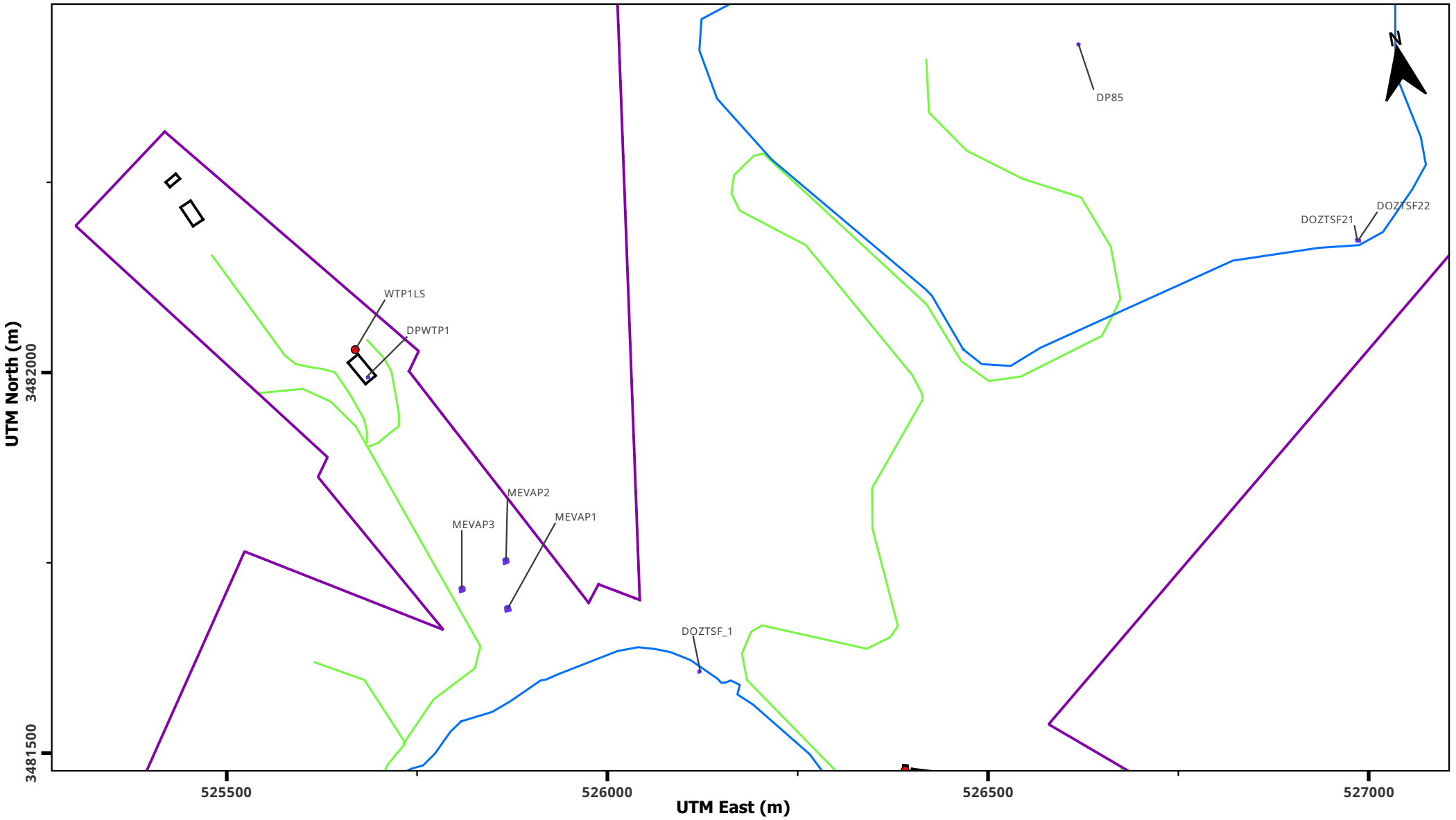


Figure 5-11: Hermosa Project - Emission Sources Zoom In 1



0 0.05 0.1 0.15 0.2 Miles

All Coordinates shown in UTM Coordinates
Zone 12, NAD 83 Datum

Legend

- Ambient Boundary
- Piles
- Significant Roads
- Non-Road Volume Sources
- Buildings
- Point Sources

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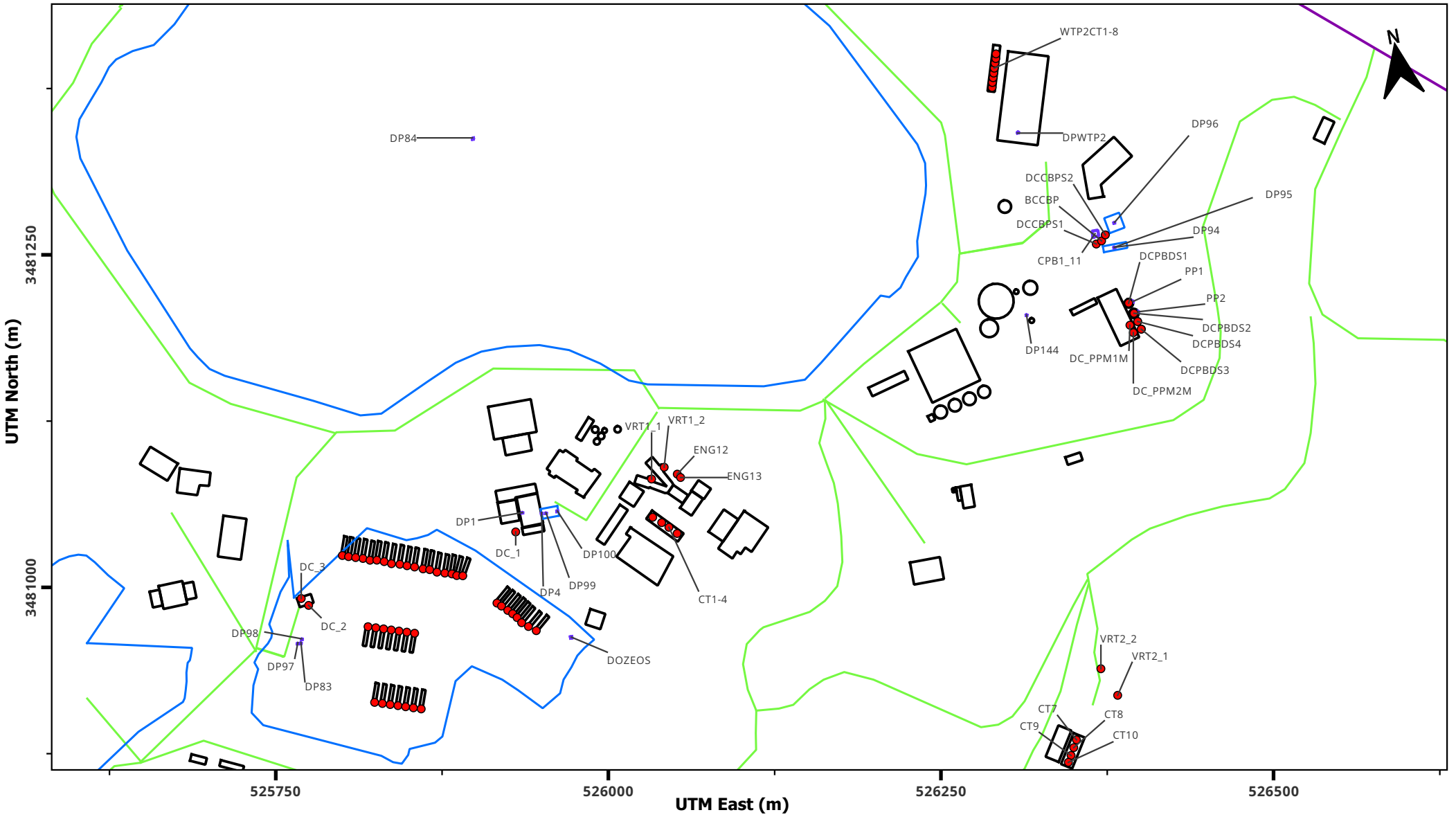
Figure 5-12: Hermosa Project - Emission Sources Zoom In 2



All Coordinates shown in UTM Coordinates
Zone 12, NAD 83 Datum

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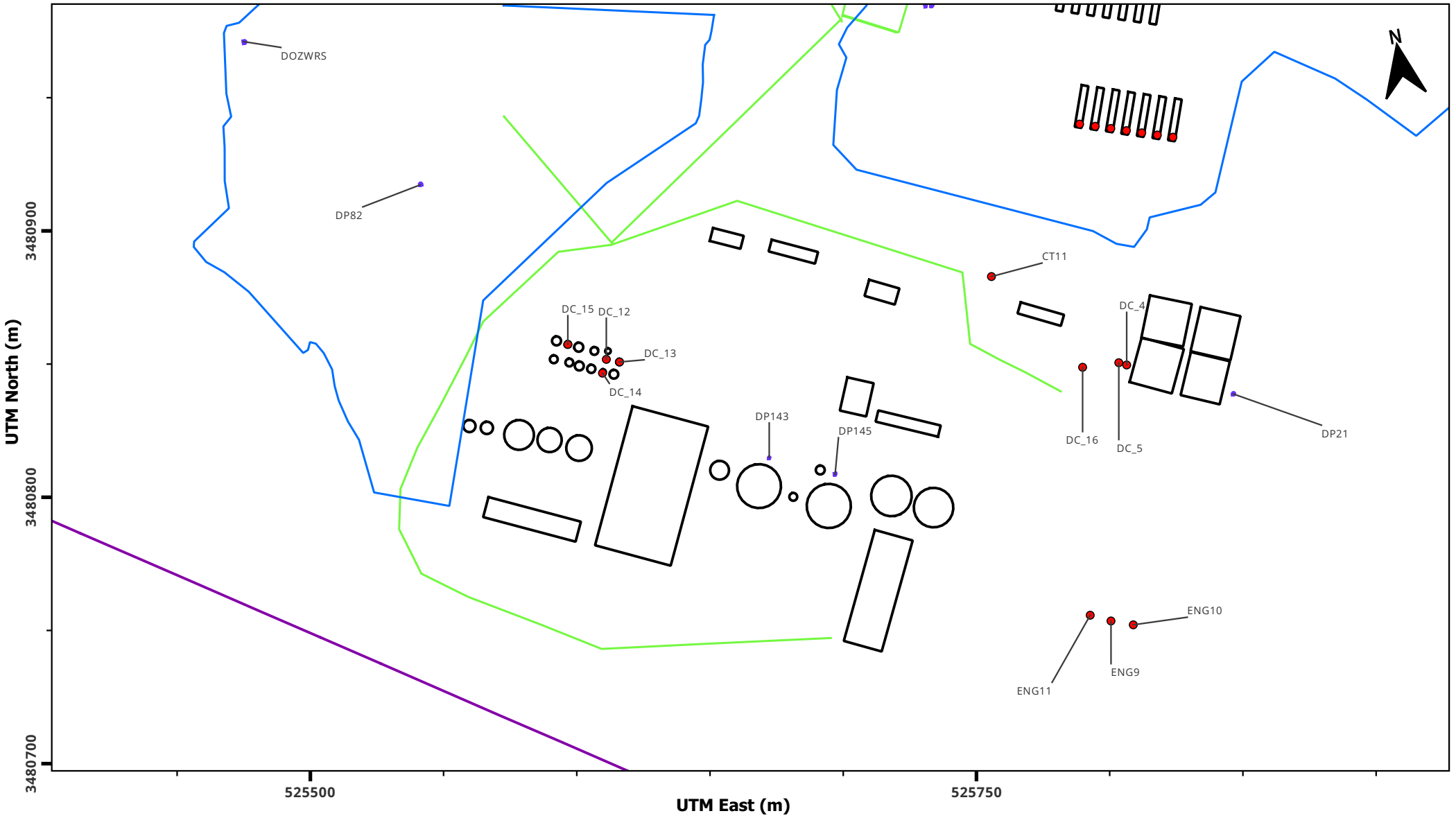
Figure 5-13: Hermosa Project - Emission Sources Zoom In 3



All Coordinates shown in UTM Coordinates
Zone 12, NAD 83 Datum

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Figure 5-14: Hermosa Project - Emission Sources Zoom In 4 (Plan I)

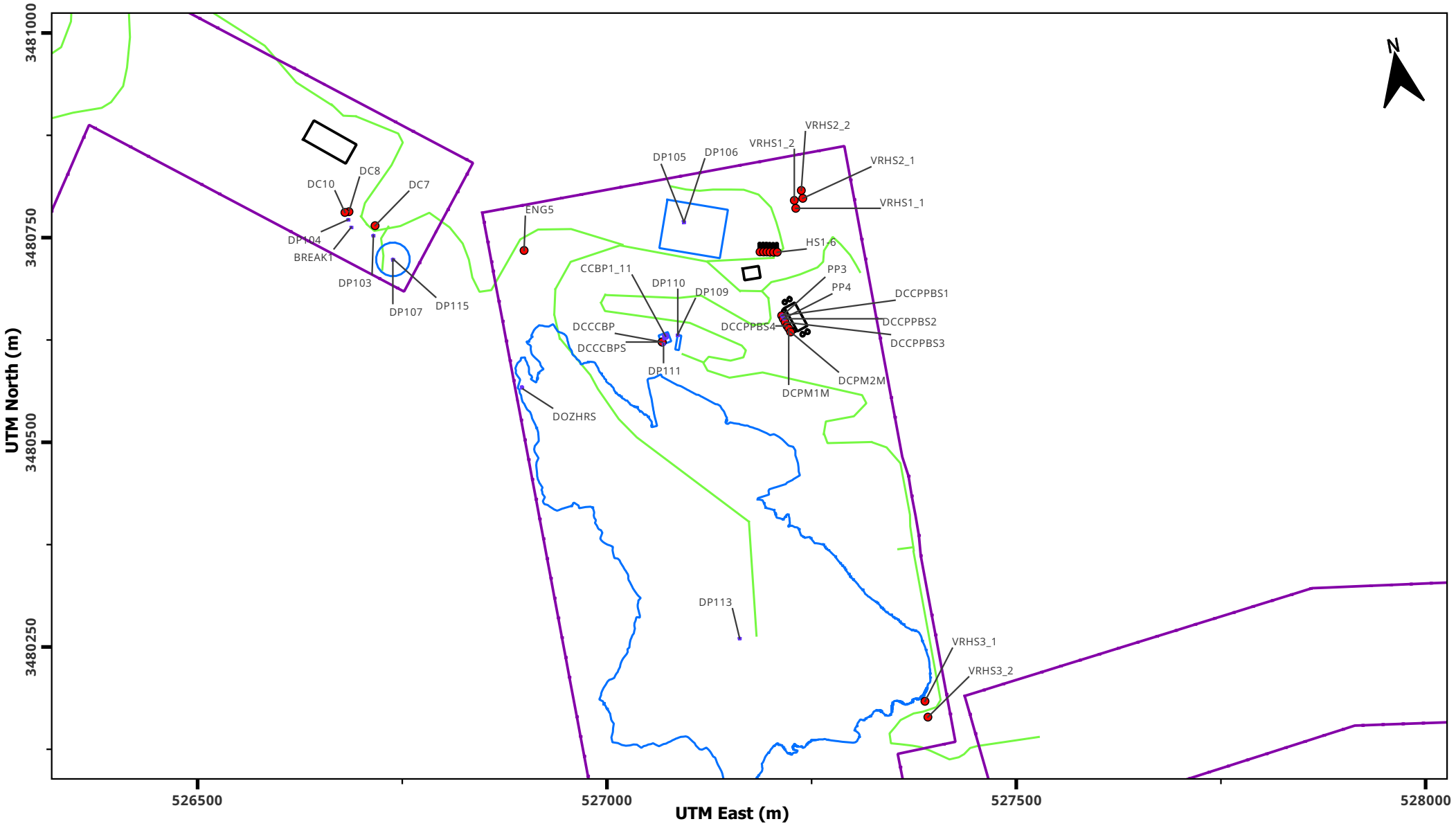


Figure 5-15: Hermosa Project - Emission Sources Zoom In 4 (Plan II)

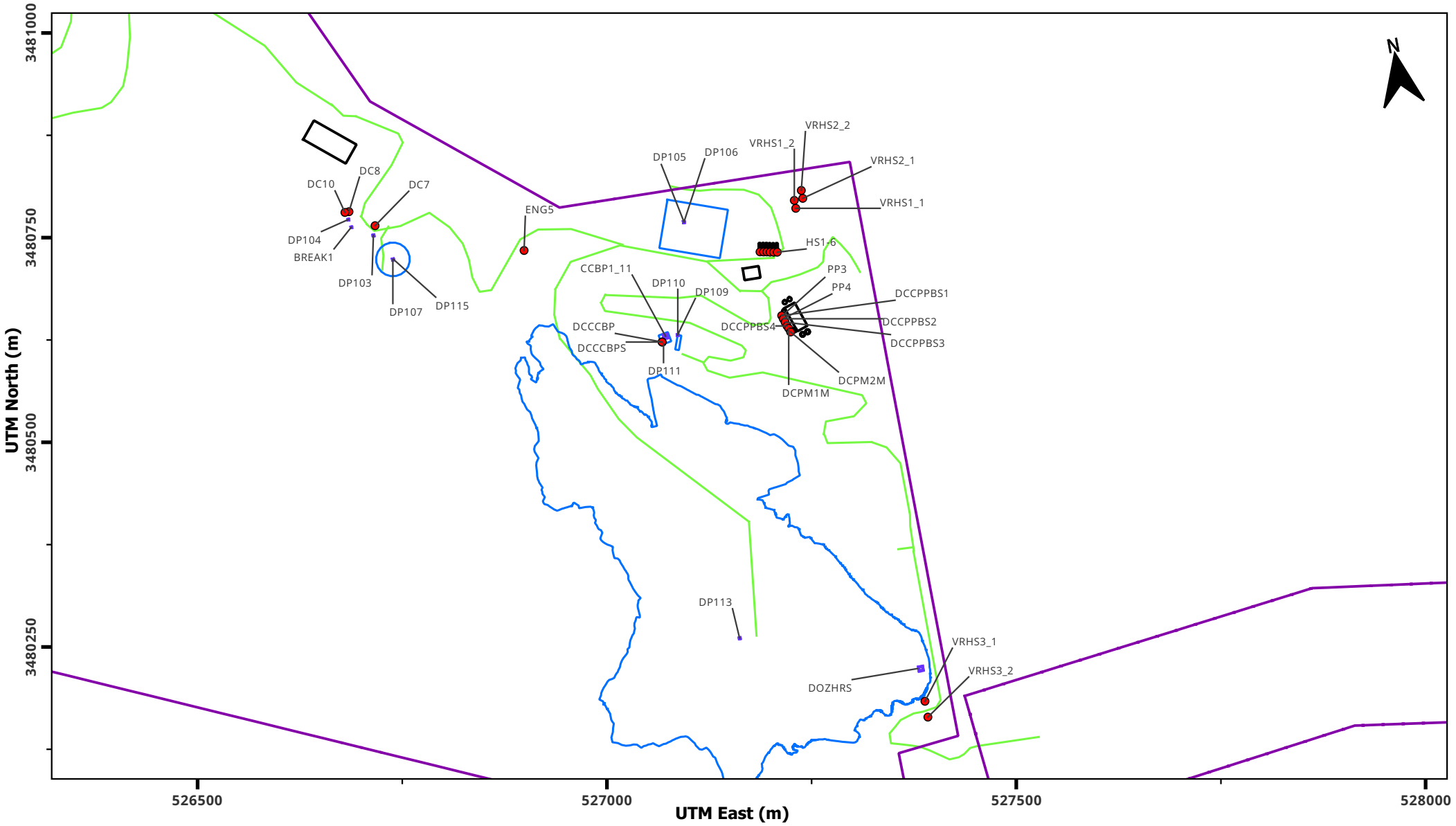
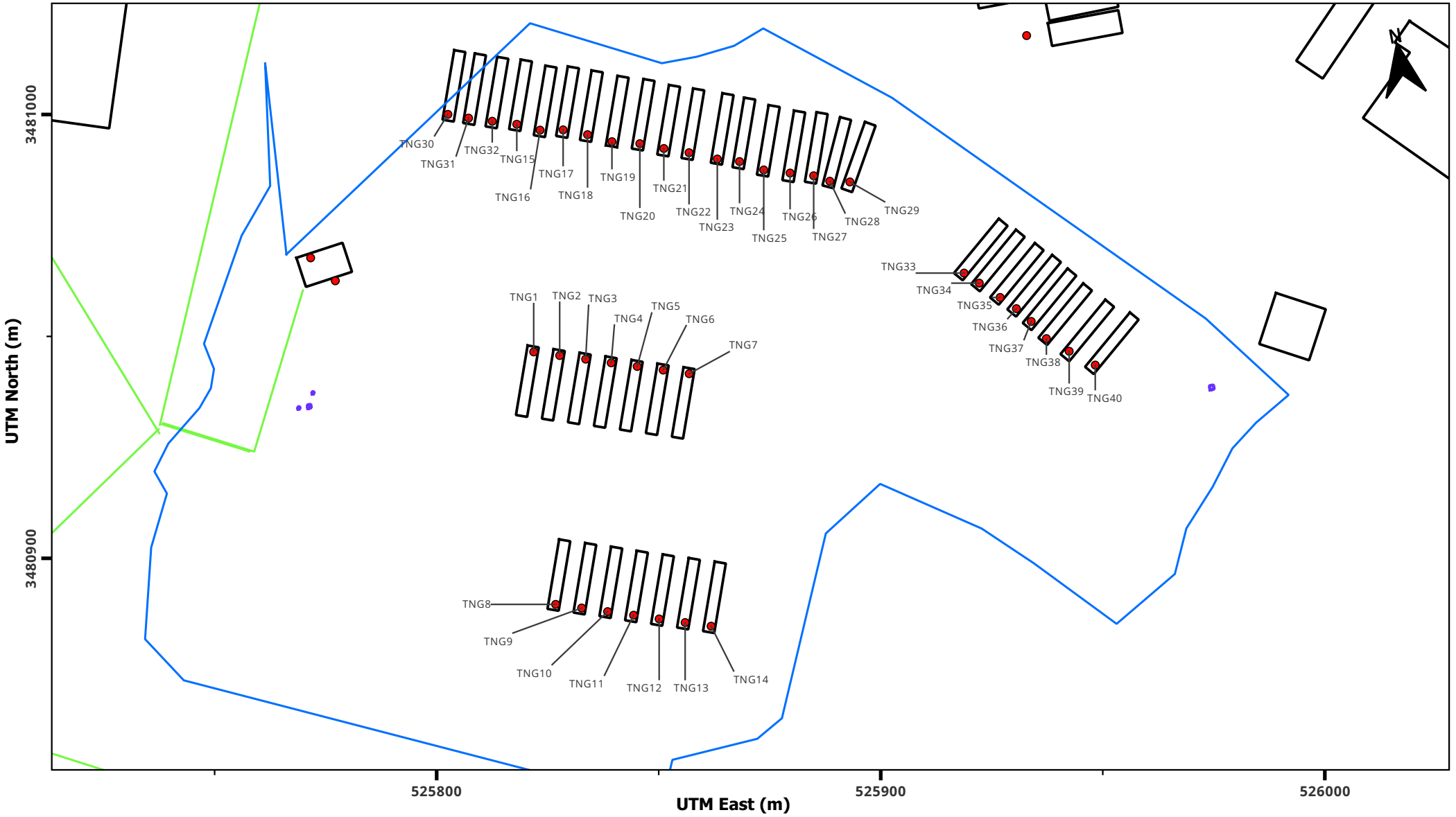


Figure 5-16: Hermosa Project - Emission Sources Zoom In 5

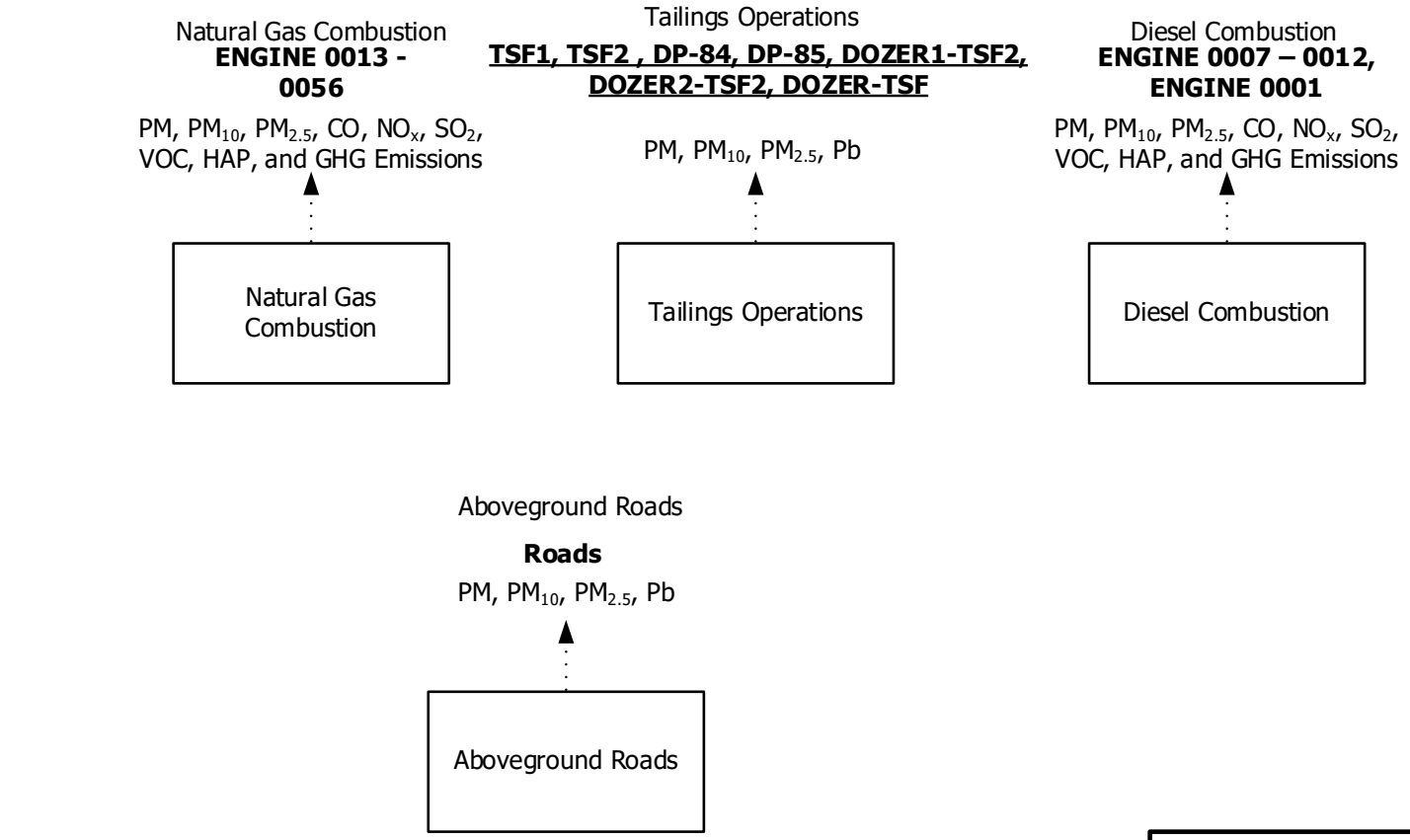


ID	Description
AGG	Clark Agg Stockpile
BCCBP	CBP Cement Silo
BREAK1	Clark Rock Breaker
CBP1_11	CBP Plant
CCBP1_11	Clark CBP Plant
CHUTE	Waste Chute Bin
CT1	Cooling Tower Cell 1
CT2	Cooling Tower Cell 2
CT3	Cooling Tower Cell 3
CT4	Cooling Tower Cell 4
CT7	UG Refridgeration CT Cell 1
CT8	UG Refridgeration CT Cell 2
CT9	UG Refridgeration CT Cell 3
CT10	UG Refridgeration CT Cell 4
CT11	Mill Cooling Tower
DC_PPM1M	Plant Plant Module 1 Mixer
DC_PPM2M	Plant Plant Module 2 Mixer
DC-1	21210-CX-00002 Main Shaft Ore Discharge Dust Collector 7
DC-2	21210-CX-00001 Coarse Ore Overland Dust Collector 7
DC-3	21210-CX-00003 Transfer Tower Silo Dust Collector 4
DC-4	21510-CX-00001 Coarse Ore Silo Dust Collector 4
DC-7	Coarse Ore Dust Collection System,23100-FAN-0001
DC-8	Coarse Ore Dust Collection System,23100-FAN-0002
DC-10	Coarse Ore Dust Collection System,23100-DCD-0005
DC-12	22620-CX-00001 Copper Sulphate Mix Tank Dust Collector
DC-13	22620-CX-00002 10% Zinc Sulphate Mix Tank Dust Collector
DC-14	22620-CX-00005 50% Zinc Sulphate Mix Tank Dust Collector
DC-15	22620-CX-00004 Caustic Mix Tank Dust Collector
DC-16	22210-CX-00001 Pebble Crusher Dust Collector 4
DCCBPS1	CBP Cement Supplement Silo 1
DCCBPS2	CBP Cement Supplement Silo 2
DCCCBP	CBP Cement Silo
DCCCBPS	CBP Cement Supplement Silo
DCCPPBS1	Paste Plant Binder Silo 1
DCCPPBS2	Paste Plant Binder Silo 2
DCCPPBS3	Paste Plant Binder Silo 3
DCCPPBS4	Paste Plant Binder Silo 4
DCPBDS1	Paste Plant Binder Storage Silo 1
DCPBDS2	Paste Plant Binder Storage Silo 2
DCPBDS3	Paste Plant Binder Dosage Silo 1
DCPBDS4	Paste Plant Binder Dosage Silo 2
DCPM1M	Plant Plant Module 1 Mixer
DCPM2M	Plant Plant Module 2 Mixer
DOZAREA	Dozer on Hardrock Storage
DOZEOS	Dozer on East Ore Stockpile
DOZHRS	Dozer on Hardshell Rock Stockpile
DOZTSF_1	Dozer on TSF_1
DOZTSF21	TSF2 dozer 1
DOZTSF22	TSF2 dozer 2
DOZWRS	Dozer on West Rock Stockpile
DP1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin
DP4	Drop from Shaft to Waste Chute
DP21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper
DP82	Drop on West NAG Stockpile
DP83	Drop on East NAG Stockpile
DP84	TSF

ID	Description
DP85	Drops on TSF2
DP94	Transfer from Agg Stockpile to Loader
DP95	Transfer of Agg Material from Loader to Haul Truck
DP96	Transfer of Shotcrete Aggregate from Stockpile to Loader
DP97	Transfer of Ore from East Ore Stockpile to Loader
DP98	Transfer of Ore from Loader to Haul Truck
DP99	Transfer of Rock and Ore from Waste Chute to Loader
DP100	Transfer of Rock and Ore from Loader to Haul Truck
DP103	Haul Truck Dump into Primary Crusher Feed Hopper from ROM Stockpile (23100-HPR-0001)
DP104	Drop from silo to trucks
DP105	Transfer of Development Ore from Ore Stockpile to Loader
DP106	Transfer of Development Ore Mined from Loader to Haul Truck
DP107	Transfer from ROM Stockpile to Loader
DP109	Transfer from Agg Stockpile to Loader
DP110	Transfer of Agg Material from Loader to Haul Truck
DP111	Transfer of Shotcrete Aggregate from Stockpile to Loader
DP113	Hardshell NAG Wasterock Storage Drop
DP114	Ore Stockpile Drop
DP115	ROM Stockpile Drop
DP143	Drop of 50 lb bag of Lead Concentrate Flocculant to 22620-EP-00002 Concentrate Flocculant Preparation Module
DP144	Drop of 1 ton bag of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module
DP145	Drop of 50 lb bag of Zinc Concentrate Flocculant to 22620-EP-00002 Concentrate Flocculant Preparation Module
DPWTP2	WTP2 Reagent Drops inside bldg
ENG5	CUMMINS Power Generation C200D2RE (ENGINE 0001)
ENG9	CAT C175 Substation 1 (ENGINE 0002)
ENG10	CAT C175 Substation 2 (ENGINE 0003)
ENG11	CAT C175 Substation 3 (ENGINE 0004)
ENG12	CAT C175 Shaft 1 (ENGINE 0005)
ENG13	CAT C175 Shaft 2 (ENGINE 0006)
EOS	East Ore Stockpile
HRS	Hardshell Rock Stockpile
HS1	Diesel Hardshell (ENGINE 0007)
HS2	Diesel Hardshell (ENGINE 0008)
HS3	Diesel Hardshell (ENGINE 0009)
HS4	Diesel Hardshell (ENGINE 0010)
HS5	Diesel Hardshell (ENGINE 0011)
HS6	Diesel Hardshell (ENGINE 0012)
MEVAP1	Mechanical Evaporator 1
MEVAP2	Mechanical Evaporator 2
MEVAP3	Mechanical Evaporator 3
ORE	Clark Ore Stockpile
PP1	Truck Pneumatic Loadout to Silo 1
PP2	Truck Pneumatic Loadout to Silo 2
PP3	Truck Pneumatic Loadout to Silo 1
PP4	Truck Pneumatic Loadout to Silo 2
ROM	Clark ROM Stockpile
SHOT	Clark Shotcrete Stockpile
TAGG	Taylor Agg Stockpile
TNG1	Natural Gas Engine 1 (ENGINE 0013)
TNG2	Natural Gas Engine 2 (ENGINE 0014)
TNG3	Natural Gas Engine 3 (ENGINE 0015)
TNG4	Natural Gas Engine 4 (ENGINE 0016)
TNG5	Natural Gas Engine 5 (ENGINE 0017)
TNG6	Natural Gas Engine 6 (ENGINE 0018)
TNG7	Natural Gas Engine 7 (ENGINE 0019)
TNG8	Natural Gas Engine 8 (ENGINE 0020)

ID	Description
TNG9	Natural Gas Engine 9 (ENGINE 0021)
TNG10	Natural Gas Engine 10 (ENGINE 0022)
TNG11	Natural Gas Engine 11 (ENGINE 0023)
TNG12	Natural Gas Engine 12 (ENGINE 0024)
TNG13	Natural Gas Engine 13 (ENGINE 0025)
TNG14	Natural Gas Engine 14 (ENGINE 0026)
TNG15	Natural Gas Engine 15 (ENGINE 0027)
TNG16	Natural Gas Engine 16 (ENGINE 0028)
TNG17	Natural Gas Engine 17 (ENGINE 0029)
TNG18	Natural Gas Engine 18 (ENGINE 0030)
TNG19	Natural Gas Engine 19 (ENGINE 0031)
TNG20	Natural Gas Engine 20 (ENGINE 0032)
TNG21	Natural Gas Engine 21 (ENGINE 0033)
TNG22	Natural Gas Engine 22 (ENGINE 0034)
TNG23	Natural Gas Engine 23 (ENGINE 0035)
TNG24	Natural Gas Engine 24 (ENGINE 0036)
TNG25	Natural Gas Engine 25 (ENGINE 0037)
TNG26	Natural Gas Engine 26 (ENGINE 0038)
TNG27	Natural Gas Engine 27 (ENGINE 0039)
TNG28	Natural Gas Engine 28 (ENGINE 0040)
TNG29	Natural Gas Engine 29 (ENGINE 0041)
TNG30	Natural Gas Engine 30 (ENGINE 0042)
TNG31	Natural Gas Engine 31 (ENGINE 0043)
TNG32	Natural Gas Engine 32 (ENGINE 0044)
TNG33	Natural Gas Engine 33 (ENGINE 0045)
TNG34	Natural Gas Engine 34 (ENGINE 0046)
TNG35	Natural Gas Engine 35 (ENGINE 0047)
TNG36	Natural Gas Engine 36 (ENGINE 0048)
TNG37	Natural Gas Engine 37 (ENGINE 0049)
TNG38	Natural Gas Engine 38 (ENGINE 0050)
TNG39	Natural Gas Engine 39 (ENGINE 0051)
TNG40	Natural Gas Engine 40 (ENGINE 0052)
TSF_1	Tailing Storage Facility
TSF2	USFS Tailings Storage Facility
TSHOT	Taylor Shotcrete Stockpile
VRHS1_1	Ventilation - Exhaust Raises NE Hardshell #1
VRHS1_2	Ventilation - Exhaust Raises NE Hardshell #1
VRHS2_1	Ventilation - Exhaust Raises NE Hardshell #2
VRHS2_2	Ventilation - Exhaust Raises NE Hardshell #2
VRHS3_1	Ventilation - Exhaust Raise SE Hardshell
VRHS3_2	Ventilation - Exhaust Raise SE Hardshell
VRT1_1	Ventilation Shaft - Taylor
VRT1_2	Ventilation Shaft - Taylor
VRT2_1	Vent Raise - Taylor
VRT2_2	Vent Raise - Taylor
WRS	West Rock Stockpile
WTP1LS	Waste Water Treatment Plant #1 Lime Silo
WTP2CT1	WTP2 CT Cell 1
WTP2CT2	WTP2 CT Cell 2
WTP2CT3	WTP2 CT Cell 3
WTP2CT4	WTP2 CT Cell 4
WTP2CT5	WTP2 CT Cell 5
WTP2CT6	WTP2 CT Cell 6
WTP2CT7	WTP2 CT Cell 7
WTP2CT8	WTP2 CT Cell 8

Figure 5-17



South32 Hermosa Inc.	
Process Flow Diagrams	
Trinity Consultants	January 2026

6. PROJECT EMISSION CALCULATIONS

The following section contains a detailed description of the methodology used to calculate emissions for the proposed Project. Detailed emission calculations are included in Appendix C and references to supporting documentation for emissions factors and emissions estimating methodologies are included in Appendix A and B. Details are included in the spreadsheets attached in Appendix A.

6.1 Emissions from Generators

Emissions of Particulate Matter (PM), Particulate Matter ≤10 microns (PM_{10}), Particulate Matter ≤2.5 microns ($PM_{2.5}$), Nitrogen Oxides (NO_X), Carbon Monoxide (CO), Sulfur Dioxide (SO_2), Volatile Organic Compounds (VOC), Hazardous Air Pollutants (HAPs), and Greenhouse Gases (GHGs) will be generated by the generator engines. Emissions from the natural gas generator(s) are represented based on the highest emissions when pairing engine rating to emission factors assuming 8,760 hours of operation per year. No changes are being proposed to the permitted calculation methodology. The following changes are proposed to be made to the generators:

- Update the representation of the six (6) Diesel CAT XQ1140 gensets (ENGINE 0007 – 0012) to account for the two (2) Caterpillar C18 engines in each genset. South32 is not proposing to change the voluntarily accepted limits for Nitrogen Oxides (NO_X), Carbon Monoxide (CO), or Volatile Organic Compounds (VOC) that were accepted for these generator sets.
- Update mechanical engine rating of C200D2RE (ENGINE 0001) to 213 kW from 218 kW.
- Update VOC emissions calculations for the C200D2RE engine (ENGINE 0001) to use the EPA Tier 4 emission factor for VOC instead of the Tier 4 emission factor for particulate matter less than 2.5 microns ($PM_{2.5}$).
- Update the SO_2 emission factor for the CAT G3520 to align with AP-42 Section 3.2, Natural Gas Engines (Maximum Emission Factor Available), dated October 2024.

6.1.1 Emission Factors

The following emission factors were used for natural gas engines:

- NO_x, CO, PM, VOC, Acetaldehyde, Formaldehyde, and GHGs emission factors obtained from stack testing performed in July and September of 2021 on a G3520 Caterpillar engine which is included in Appendix B of this application. A safety factor of 30% was added to the calculations to account for stack test variability.
- SO_2 emission factor was obtained from AP-42 for Natural Gas Engines (maximum emission factor available) dated October 2024.
- HAP emission factors were referenced from AP-42 Chapter 3.2 for 4 Stroke Lean Burn Natural Gas Engines. As these engines are equipped with oxidation catalysts, a calculated control efficiency was applied to select HAPs to account for the emission reductions attributable to this emission control technology.[4] Control efficiencies (CE) were determined by comparing stack tested emission factors for VOC and formaldehyde at 50%, 75%, and 100% loading scenarios. The most conservative among three potential values was chosen and applied to relevant HAP emission factors affected by oxidation catalysts.

[4] Control efficiencies were applied to select HAPs named in AP-42 Chapter 3.2, Table 3.2-2 (4 Stroke Lean Burn Natural Gas Engines) based on guidance provided by Korby Backen, P.E. on December 15th, 2023.

HAPs calculated using average brake specific fuel consumption per AP-42 Chapter 3.3 (Oct. 1996) to convert units for use with natural gas generators.

The following emission factors were used for the Caterpillar C18 diesel engines:

- PM emission factors obtained from the Caterpillar C18 engine emissions certification.
- NO_X, CO, and VOC are based on the voluntarily accepted limit.
- SO_2 emission factor is based on AP-42, Table 3.4-1 (April 2025) for Ultra Low Sulfur Diesel (15 ppm sulfur or 0.0015%) for Large Uncontrolled Stationary Diesel Engines (>600 HP).
- HAP emission factors were referenced from AP-42 Section 3.4, HAP Emission Factors For Large Uncontrolled Stationary Diesel Engines (>600 HP) dated April 2025.

6.1.2 Equations Used for Emission Estimations

The following equations were used to estimate hourly and annual emissions from criteria pollutants, and GHGs:

$$Hourly\ Emissions\ \left(\frac{lb}{hr}\right) = Engine\ Rating\ (kW) x\ Emission\ Factor\ \left(\frac{g}{kW-hr}\right) x\ \left(\frac{1}{453.592}\right)\left(\frac{lb}{g}\right)$$

$$Hourly\ Emissions\ \left(\frac{lb}{hr}\right) = Engine\ Rating\ (kW) x\ Emission\ Factor\ \left(\frac{lb}{kW-hr}\right)$$

$$Annual\ Emissions\ (tpy) = Engine\ Rating\ (kW) x\ Emission\ Factor\ \left(\frac{g}{kW-hr}\right) x\ Operation\ Hours\ \left(\frac{hrs}{yr}\right) x \left(\frac{1}{453.592}\right)\left(\frac{lb}{g}\right) \times \frac{1}{2000}\left(\frac{tons}{lb}\right)$$

The following equations were used to estimate annual emissions from HAPs:

$$Annual\ Emissions\ (tpy) = Engine\ Rating\ (kW) x\ Emission\ Factor\ \left(\frac{lb}{MMBTU}\right) x\ Operation\ Hours\ \left(\frac{hrs}{yr}\right) x\ \left(\frac{1}{2000}\right)\left(\frac{tons}{lb}\right) \times 3.41 * 10^{-3}\left(\frac{MMBTU}{kW-hr}\right) * (1 - CE^{5})$$

6.2 Sources with Updated Moisture

South32 is also proposing to update the moisture content of the tailings to align with the latest MPO[6]. No changes are being proposed to the permitted calculation methodology. This change will affect the following sources:

- Moisture content
  - TSF and TSF2 Dozers (DOZER-TSF, DOZER1-TSF2, and DOZER2-TSF2)
  - Drop on TSF and TSF2 (DP-84 and DP-85)

[5] CE is applied to select HAPs for natural gas engines only, as dicussed in Section 6.1.1

[6] Revised MPO date April 15, 2024

6.3 Emissions from Natural Gas Delivery trips on Roads

PM, PM_{10}, $PM_{2.5}$, and HAP emissions are generated from vehicles traveling on unpaved roads aboveground. Road emissions were calculated based on vehicle miles travelled (VMT), emission factors, and control efficiencies. The VMT from natural gas deliveries was calculated by multiplying number of trips and round-trip distance traveled by the vehicle. The number of trips was estimated based on natural gas usage on-site, truck capacities, and the estimated vehicle miles traveled at the project site.

6.3.1 Emission Factors

Uncontrolled PM, PM_{10}, and $PM_{2.5}$ emission factors for vehicles traveling on unpaved roads aboveground and underground were calculated using the following equations from AP-42, Section 13.2.2 (November 2006):

$$E = (k)\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b}$$

$$E_{ext} = E\left[\frac{(365 - P)}{365}\right]$$

Where:

E = size-specific hourly and daily emission factor (lb/VMT)
Eext = size-specific annual emission factor (lb/VMT)
k = particle size multiplier, per AP-42 Table 13.2.2-2 (November 2006)
s = surface material silt content (%), per South32 engineering judgement
W = mean vehicle weight (tons)
a, b = constants, per AP-42 Table 13.2.2-2 (November 2006)
P = days per year with at least 0.01 inch precipitation, per processed onsite meteorological data collected in 2019, 2020 and 2021. The most conservative year was used.

6.3.1.1 Control Efficiency

Per the EPA document *Control of Open Fugitive Dust Sources*[7], sufficient watering of unpaved roads can result in a control efficiency up to 95%. For emission estimations purposes, a conservative control efficiency of 90% has been used. In this case, sufficient watering is deemed as watering which meets applicable opacity limitations and other requirements such as to comply with A.A.C. R18-2-605 and R18-2-614.

6.3.1.2 Control Efficiency

$$Hourly\ Emissions\ \left(\frac{lbs}{hr}\right) = EF\ \left(\frac{lb}{VMT}\right) x\ Total\ Miles\ Traveled\ \left(\frac{VMT}{hr}\right) x(1 - Control\ Efficiency\ (\%))$$

$$Annual\ Emissions\ (tpy) = EF\ \left(\frac{lb}{VMT}\right) x\ Total\ Miles\ Traveled\ \left(\frac{VMT}{yr}\right) x\ \left(1 - Control\ Efficiency\ (\%)\right) x\ \left(\frac{1}{2000}\right)\left(\frac{ton}{lbs}\right)$$

[7] EPA, Control of Open Fugitive Dust Sources, EPA-450/3-88/008, September 1988.

7. LIST OF INSIGNIFICANT AND TRIVIAL ACTIVITIES

Pursuant to A.A.C. R18-304.F.8, a complete application for a significant permit revision must identify activities which are insignificant pursuant to R18-2-101.68. Insignificant activities shall be listed in a permit application, but the application need not provide emissions data, except as requested by ADEQ following submittal of the application. Therefore, emissions from these equipment and activities are not considered in the PTE calculations in this application. Similarly, the Hermosa Mine has proposed activities which are considered "trivial" pursuant to A.A.C. R18-2-101.146. South32 is not proposing any modifications to the previously listed insignificant and trivial activities.

8. REGULATORY APPLICABILITY

The following sections provide an overview of federal and state regulations potentially applicable to the engines being modified as a part of this significant permit revision. The regulatory applicability analysis does not discuss other permitted emission sources not associated with this significant permit revision.

8.1 Permit Applicability Analysis

8.1.1.1 Major NSR Applicability

The Hermosa Mine will be located in the area of Santa Cruz County classified in attainment with the National Ambient Air Quality Standards (NAAQS) or unclassified for all regulated pollutants. A section of Santa Cruz County is nonattainment for PM_{10} in the Nogales planning area. However, Hermosa Mine operations will be outside the Nogales planning area and were previously determined not to impact the nonattainment area. Accordingly, all regulated NSR pollutants are evaluated for applicability under the PSD program.

Under PSD permitting rules, the major source threshold is 250 tpy unless the facility is listed as a categorical source in A.A.C. R18-2-101.23. The PSD major source threshold for the Hermosa Mine is 250 tpy for any individual regulated NSR pollutant (see A.A.C. R18-2-401.13.b). Note that because the Hermosa Mine is not a categorical source, only non-fugitive emissions are assessed against the 250 tpy major source threshold; fugitive emissions are excluded from the major source applicability determination. Also, the total facility wide post-project PTE has been compared to the major source threshold. As summarized in Table 1-1, all potential post-project site-wide non-fugitive emissions of regulated NSR pollutants will be less than 250 tpy. Therefore, neither this project nor the Hermosa Mine will be subject to PSD review.

8.1.1.2 Minor NSR Applicability

Per A.A.C. R18-2-334.A, minor New Source Review (NSR) requirements shall apply when:

- *The project involves:*
  - *Construction of any new Class I or Class II source, including the construction of any source requiring a Class II permit under R18-2-302.01(C)(4); or*
  - *any minor NSR modification to a Class I or Class II source.*

The Hermosa Mine is an existing Class I source so it does not qualify as a "new Class I or Class II source". The proposed changes at the Hermosa Mine meet the criteria for a "minor NSR modification" as defined in R18-2-301.14 because the PTE increase associated with the Project exceeds the mNSR thresholds as shown in Table 1-1 for PM_{10} and $PM_{2.5}$. As such, air dispersion modeling has been performed as a part of this significant permit revision.

8.2 Permit Revision Provisions

To assess whether the proposed changes could be processed as a minor permit revision, an evaluation was conducted in accordance with A.A.C. R18-2-319.A, which defines the conditions under which the minor permit revision procedures are applicable. One such condition Pursuant to A.A.C. R18-2-319.A.4 is noted below:

> *Do not seek to establish or change a permit term or condition for which there is no corresponding underlying applicable requirement and that the source has assumed to avoid an applicable requirement to which the source would otherwise be subject.*

The proposed modification seeks to establish or change a permit condition for which there is no corresponding underlying applicable requirement and also constitutes a minor NSR change. As such, this change requires a significant permit revision pursuant to A.A.C. R18-2-319.A.4 and 8 and R18-2-320.A.

Accordingly, South32 is requesting that significant permit revision procedures be used in accordance with A.A.C R18-2-320.

8.3 Federal and State Applicability Analysis

This section provides an applicability analysis of federal and state requirements for the Hermosa Mine, including the following:

- New Source Performance Standards (NSPS)
- National Emission Standards for Hazardous Air Pollutants (NESHAP)
- Compliance Assurance Monitoring
- Chemical Accident Prevention
- Arizona Administrative Code

8.3.1 New Source Performance Standards

New Source Performance Standards (NSPS) have been established under 40 CFR Part 60 to regulate emissions of air pollutants from new, modified, or reconstructed stationary sources in specific industrial sectors. The natural gas-fired stationary SI ICEs at the Hermosa Project will continue to be subject to NSPS Subpart A, *General Provisions* and NSPS Subpart JJJJ, *Standards of Performance for Stationary Spark Ignition Internal Combustion Engines.* All associated applicable requirements have already been identified in the existing permit 96653.

8.3.2 National Emission Standards for Hazardous Air Pollutants

National Emission Standards for Hazardous Air Pollutants (NESHAPs) have been established in 40 CFR Part 61 and Part 63 to regulate emissions of HAPs from stationary sources. The Hermosa Mine is currently classified as a major source of HAPs because it has potential HAP emissions greater than the major source thresholds. South32 is not proposing any changes to existing NESHAP applicability and South32 will demonstrate compliance with NESHAP Subpart A, NESHAP Subpart ZZZZ by complying with the applicable requirements in NSPS Subpart JJJJ, and all applicable NESHAP Subpart ZZZZ requirements. All associated applicable requirements have already been identified in the existing permit 96653.

8.3.3 Compliance Assurance Monitoring

The Compliance Assurance Monitoring (CAM) Rule under 40 CFR Part 64 applies to each pollutant-specific emission unit (PSEU) at a Title V source that satisfies all of the following criteria:

- Is subject to an emission limitation or standard for the applicable regulated air pollutant;
- Uses a control device to achieve compliance with any such emission limitation or standard;
- Has potential pre-control emissions of the applicable regulated air pollutant that are equal to or greater than the applicable Title V major source threshold; and
- Is not otherwise exempt.

Note that there are no new sources being authorized as a part of this SPR. As such, there are no new emission sources whose pre-control emissions individually exceed the major source threshold of 100 tpy. As such, the Hermosa Mine is not subject to CAM requirements.

8.3.4 Arizona Administrative Code (A.A.C.)

South32 will continue to comply with all applicable A.A.C. regulations in the current air permit. There are no new applicable requirements as a result of this Project.

9. PERMIT PROCESSING FEE

In accordance with A.A.C R18-2-326, Fees Related to Individual Permits, and the ADEQ Permit Fee Schedule (effective November 1, 2025)[8], no fee is being submitted with this Class I SPR application. However, South32 agrees to pay the $208.00 per hour processing fee required based on the total actual time spent by ADEQ staff on processing this application.

[8] https://static.azdeq.gov/aqd/aqd_class_fees.pdf

10. COMPLIANCE PLAN AND CERTIFICATION

As required by A.A.C. R18-2-304(B)(8)(b) and ADEQ's Instructions in Section 2-4, Item 16 and 17 of ADEQ's Application Packet for a Class I Permit, South32 is committed to maintaining compliance as follows:

- Compliance certification.

The Hermosa Mine is in compliance with all applicable requirements noted as applicable to the Hermosa Mine in Permit No. 96653.

- For applicable requirements with which the source is in compliance at the time of permit issuance.

The Hermosa Mine source will continue to comply with applicable requirements.

- For applicable requirements that will become effective during the permit term.

The Hermosa Mine will meet in a timely manner applicable requirements that become effective during the permit term. South32 is not presently aware of any particular applicable requirements requiring a more specific future schedule. Furthermore, South32 shall submit a compliance certification semi-annually which describes the compliance status of the Hermosa Mine with respect to each permit condition.

- A schedule of compliance for sources that are not in compliance with all applicable requirements at the time of permit issuance. Such a schedule shall include a schedule of remedial measures, including an enforceable sequence of actions with milestones, leading to compliance with any applicable requirements for which the source will be in noncompliance at the time of permit issuance. This compliance schedule shall resemble and be at least as stringent as that contained in any judicial consent decree or administrative order to which the source is subject. Any such schedule of compliance shall be supplemental to, and shall not sanction noncompliance with, the applicable requirements on which it is based.

The Hermosa Mine is not out of compliance with any applicable requirements. Therefore, no compliance schedule is required.

- The Hermosa Mine includes two proposed Alternative Operating Scenarios.

The Hermosa Mine will meet all applicable requirements for each Alternate Operating Scenario upon implementation of the Alternate Operating Scenario. The time of change from one Alternate Operating Scenario to the other will be logged. If a proposed Alternate Operating Scenario would implicate an applicable requirement that will become effective during the permit term, the Hermosa Mine will comply with such requirements on a timely basis. South32 is not presently aware of any applicable requirements would become effective during the permit term.

- A schedule for the submission of certified progress reports no less frequently than every 6 months for sources required to have a schedule of compliance to remedy a violation.

The Hermosa Mine is not subject to a compliance schedule and therefore is not subject to a requirement to schedule certified progress reports.

APPENDIX A. CAT G3520 SPEC SHEET

ELECTRIC POWER - Technical Spec Sheet
ISLAND MODE

G3520

2100 ekW/ 2625 kVA/ 60 Hz/ 1800 rpm/ 440-13800 V/ 0.8 Power Factor

Rating Type: STANDBY

Emissions: U.S. EPA S.I. Stationary

Image shown may not reflect actual configuration

G3520
2100 ekW/ 2625 kVA/ 60 Hz/ 1800 rpm/ 440-13800 V/ 0.8 Power Factor

	Metric	English
Generator Set Specifications		
Maximum Rating @ 0.80 pf	2625 kVA	2100 ekW
Frequency	60 Hz	
Engine Speed (rpm)	1800 RPM	
Fuel	NATURAL GAS	
Emission Standards	U.S. EPA S.I. Stationary	
Performance Number	EM4299-04	
Altitude Capability at 25°C (77°F) ambient, above sea level	2690 m	8825 ft

Engine Specifications		
Engine Model	G3520	
Compression Ratio	11.50	
Aspiration	TA	
Governor Type	ADEM4 W/ IM	
Bore	170 mm	7 in
Displacement	98 L	5956 in³
Stroke	215 mm	9 in
Aftercooler Temperature	54 °C	130 °F
Jacket Water Outlet	99 °C	210 °F

Package Dimensions*		
Length	8511 mm	335 in
Width	3169 mm	125 in
Height	3822 mm	150 in

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Rating Type: STANDBY

Emissions: U.S. EPA S.I. Stationary

Package Fuel Consumption (ISO 3046/1)		
100% Load without Fan	9.16 MJ/ekw-hr	8685 Btu/ekw-hr
75% Load without Fan	9.37 MJ/ekw-hr	8888 Btu/ekw-hr
50% Load without Fan	10.00 MJ/ekw-hr	9481 Btu/ekw-hr

Exhaust System		
Combustion Air Flow (0° C, 101.3 kPa) / (77° F, 14.7 psia)	4.32 Nm3/bkW-hr	6112 ft3/min
Exhaust temperature - engine outlet	472.00 °C	881 °F
Exhaust gas flow (@engine outlet temp, 14.5psia)	4.58 Nm3/bkW-hr	16410 ft3/min

Heat Rejection		
Jacket Water Circuit (JW + OC + 1AC)	1035 kW	58850 Btu/min
Heat rejection to jacket water (JW)	602 kW	34215 Btu/min
Heat rejection to atmosphere (Includes Generator)	270 kW	15368 Btu/min
Heat rejection to exhaust (LHV to 120°C / 248°F)	1392 kW	79168 Btu/min

DEFINITIONS AND CONDITIONS

1. For ambient and altitude capabilities consult your Cat dealer.
2. Engine rating obtained and presented in accordance with ISO 3046/1. (Standard reference conditions of 77°F, 29.60 in Hg barometric pressure.) No overload permitted at rating shown.
3. Ratings are based on a natural gas fuel with a methane number with a LHV of 905 Btu/scf.
4. Gaseous emissions data measurements are consistent with those described in EPA 40 CFR PART 60 SUBPART JJJJ and ISO 8178 for measuring VOC, CO, and NOx.
5. Tolerance: Exhaust stack temperature +/- 8%, Inlet airflow rate +/- 5%, Exhaust flow +/- 6% Fuel rate +/- 5%, Heat rejection +/- 5%, Exhaust heat rejection +/- 10%

APPLICABLE CODES AND STANDARDS:

AS1359, CSA C22.2 No100-04, UL142,UL489, UL869, UL2200,
NFPA37, NFPA70, NFPA99, NFPA110, IEC60034-1, ISO3046, ISO8528,
NEMA MG1-22,NEMA MG1-33, 2006/95/EC, 2006/42/EC, 2004/108/EC.

Note: Codes may not be available in all model configurations. Please consult your local Cat Dealer representative for availability.

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APPENDIX B. 2021 STACK TESTING REPORT

AIR HYGIENE, INC.

Testing Solutions for a Better World

STACK EMISSIONS STUDY
FOR THE
CATERPILLAR, G3520 TALE
PREPARED FOR
CATALYTIC COMBUSTION CORPORATION
AT THE
STEWART & STEVENSON INTEGRATION CENTER
HOUSTON, TEXAS
JULY 29-30 AND SEPTEMBER 1, 2021

Report Date: September 22, 2021

Corporate Headquarters
1600 W Tacoma Street
Broken Arrow, Oklahoma 74012

AIR HYGIENE, INC.

(918) 307-8865 or (888) 461-8778
www.airhygiene.com

Remote Testing Offices
Las Vegas, NV 89156
Ft. Worth, TX 76028
Humble, TX 77338
Shreveport, LA 71115
Miami, FL 33101
Pittsburgh, PA 15205

STACK EMISSIONS STUDY
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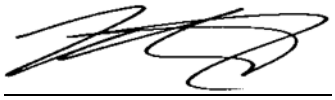
CATALYTIC COMBUSTION CORPORATION
AT THE
STEWART & STEVENSON INTEGRATION CENTER
HOUSTON, TEXAS
JULY 29-30 AND SEPTEMBER 1, 2021

Prepared and Reviewed by:



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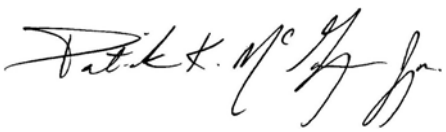

I, _____
Patrick K. McGovern, Jr., QSTI
Sr. Regional Manager-Shreveport, LA
certify that this testing was conducted and this report was created in conformance with the requirements of ASTM D7036

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Stack Emissions Study
Caterpillar, G3520 TALE
Catalytic Combustion Corporation
Stewart & Stevenson Integration Center
Houston, Texas
July 29-30 and September 1, 2021

1.0 INTRODUCTION

Air Hygiene International, Inc. (Air Hygiene) has completed the Stack Emissions Study for nitrogen oxides (NOx), carbon monoxide (CO), total hydrocarbons/volatile organic compounds (THC/VOC), ammonia (NH_3), particulate matter (PM), acetaldehyde (C_2H_4O), formaldehyde (HCHO), methane (CH_4), ethane (C_2H_6), nitrous oxide (N_2O), and carbon dioxide (CO_2) from the exhaust of the Caterpillar, G3520 TALE for Catalytic Combustion Corporation at the Stewart & Stevenson Integration Center in Houston, Texas. This report details the background, results, process description, and the sampling/analysis methodology of the stack sampling survey conducted on July 29-30 and September 1, 2021.

1.1 TEST PURPOSE AND OBJECTIVES

The purpose of the test was to conduct an emission test to document levels of selected pollutants at three test loads (50, 75, and 100 percent). The information will be used to confirm the emissions controls meet certain emission levels. The specific objective was to determine the emission concentration of NOx, CO, THC/VOC, NH_3, PM, C_2H_4O, HCHO, CH_4, C_2H_6, N_2O, and CO_2 from the exhaust of Catalytic Combustion Corporation's Caterpillar, G3520 TALE.

1.2 SUMMARY OF TEST PROGRAM

The following list details pertinent information related to this specific project:

1.2.1 Participating Organizations
- Catalytic Combustion Corporation
- Air Hygiene

1.2.2 Industry
- Catalyst Manufacturing

1.2.3 Plant Location
- Stewart & Stevenson Integration Center in Houston, Texas
  - GPS Coordinates [Latitude 29.93248, Longitude -95.64816]
  - Physical Address: 10750 Telge Road, Houston, Texas

1.2.4 Equipment Tested
- Caterpillar, G3520 TALE

1.2.5 Emission Points
- Exhaust from the Caterpillar, G3520 TALE
- For all gases, three sample points in the exhaust stack from the Caterpillar, G3520 TALE, at 16.7, 50.0, and 83.3 percent of the diameter
- For all PM testing, 24 sampling points in the exhaust stack from the Caterpillar, G3520 TALE

1.2.6 Emission Parameters Measured

- NOx
- CO
- THC/VOC
- NH_3
- PM
- C_2H_4O
- HCHO
- CH_4
- C_2H_6
- N_2O
- Flow
- H_2O
- CO_2
- O_2

1.2.7 Dates of Emission Test

- July 29-30 and September 1, 2021

1.2.8 Federal and State Certifications

- Stack Testing Accreditation Council AETB Certificate No. 3796.02
- International Standard ISO/IEC 17025:2005 Certificate No. 3796.01
- Texas NELAP Accreditation No. T104704523; Mobile Lab No. 1M104704523

1.3 KEY PERSONNEL

Catalytic Combustion Corporation:	Randy Sadler (rsadler@catalyticcombustion.com)	678-691-7214
Catalytic Combustion Corporation:	Kati Sedlacek (ksedlacek@catalyticcombustion.com)	678-691-7214
Air Hygiene:	Pat McGovern, Jr. (pmcgovern@airhygiene.com)	918-307-8865
Air Hygiene:	Matt McBride (mmcbride@airhygiene.com)	918-307-8865
Air Hygiene:	Chandler King	918-307-8865
Air Hygiene:	Pat McGovern, Sr.	918-307-8865
Air Hygiene:	Wade Nesom	918-307-8865
Air Hygiene:	Jeff Wollrab	918-307-8865

2.0 SUMMARY OF TEST RESULTS

Results from the sampling conducted on Catalytic Combustion Corporation's Caterpillar, G3520 TALE located at the Stewart & Stevenson Integration Center on July 29-30 and September 1, 2021 are summarized in the following table and relate only to the items tested.

All testing was performed without any real or apparent errors. All testing was conducted according to the approved testing protocol with the exception of a second mobilization to conduct the 100 percent load testing.

TABLE 2.1
SUMMARY OF CATERPILLAR, G3520 TALE RESULTS

Parameter	50% Load	75% Load	100% Load
Date (mm/dd/yy)	07/29/21	07/30/21	09/01/21
Engine Fuel Flow (SCFH)	14,559	20,455	26,278
Power Output (horsepower)	1,811.2	2,668.6	3,598.0
NOx (as NO_2) (ppmvd)	7.24	6.26	9.81
NOx (as NO_2) (ppm@15%O_2)	3.51	3.09	4.86
NOx (as NO_2) (g/kW*hr)	0.0627	0.0526	0.0787
NO (ppmvd)	7.24	6.23	8.87
NO (ppm@15%O_2)	3.51	3.08	4.19
NO (g/kW*hr)	0.0408	0.0341	0.0465
NO (as NO_2) (g/kW*hr)	0.0626	0.0523	0.0713
NO_2 (ppmvd)	0.00	0.03	0.94
NO_2 (ppm@15%O_2)	0.00	0.02	0.68
NO_2 (g/kW*hr)	0.0000	0.0003	0.0075
CO (ppmvd)	6.14	3.68	2.71
CO (ppm@15%O_2)	2.98	1.81	1.33
CO (g/kW*hr)	0.0323	0.0188	0.0131
THC (as C_3H_8) (ppmvd)	190.48	188.10	110.21
THC (as C_3H_8) (ppm@15%O_2)	79.07	80.06	47.36
THC (as C_3H_8) (g/kW*hr)	1.35	1.30	0.73
VOC (as C_3H_8) (ppmvd)	5.38	4.11	0.00
VOC (as C_3H_8) (ppm@15%O_2)	2.23	1.75	0.00
VOC (as C_3H_8) (g/kW*hr)	0.0381	0.0285	0.0000
CH_4 (as C_3H_8) (ppmvd)	184.80	183.55	167.60
CH_4 (as C_3H_8) (ppm@15%O_2)	89.63	90.62	82.95
CH_4 (as C_3H_8) (g/kW*hr)	1.5320	1.4779	1.2884
C_2H_6 (as C_3H_8) (ppmvd)	0.31	0.43	0.24
C_2H_6 (as C_3H_8) (ppm@15%O_2)	0.15	0.21	0.12
C_2H_6 (as C_3H_8) (g/kW*hr)	0.0025	0.0035	0.0019
Total PM (mg)	14.10	6.27	3.48
Total PM (gr/dscf)	6.18E-03	1.91E-03	9.15E-04
Total PM (lb/hr)	0.22	0.10	0.06
Total PM (g/kW*hr)	0.0730	0.0221	0.0020
N_2O (ppmvd)	1.87	1.75	1.45
N_2O (ppm@15%O_2)	0.91	0.86	0.71
N_2O (g/kW*hr)	0.0155	0.0140	0.0110
C_2H_4O (ppmvd)	1.74	3.16	0.94
C_2H_4O (ppm@15%O_2)	0.85	1.56	0.46
C_2H_4O (g/kW*hr)	0.0145	0.0255	0.0071
HCHO (ppmvd)	0.07	0.00	0.91
HCHO (ppm@15%O_2)	0.04	0.00	0.45
HCHO (g/kW*hr)	0.0004	0.0000	0.0047
NH_3 (ppmvd)	0.47	16.79	5.56
NH_3 (ppm@15%O_2)	0.23	8.29	2.80
NH_3 (g/kW*hr)	0.0015	0.0522	0.0168
CO_2 (%)	6.72	6.59	6.64
CO_2 (g/kW*hr)	556	530	509

3.0 SOURCE OPERATION

3.1 PROCESS DESCRIPTION

Catalytic Combustion Corporation is a provider of catalyst, air correction devices, and exhausts with products used to reduce the output of volatile organic compounds (VOCs). The interest of this test report is one caterpillar natural gas fired internal combustion engine located at the Stewart & Stevenson Integration Center in Houston, Texas.

3.2 SAMPLING LOCATION

The engine exhausts to the atmosphere through an independent stack. A stack extension was fabricated on-site and added prior to the test, the extension and installed test ports met the required EPA Method 1 criteria of at least 0.5 duct diameters (dd) upstream and 2.0 dd downstream from the nearest disturbances. The sampling ports are approximately 27 feet above ground level. A fuel flow meter is located on the unit. Catalytic Combustion Corporation provided an aerial lift to access the stack ports.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 TEST METHODS

The emission test on the Caterpillar, G3520 TALE at the Stewart & Stevenson Integration Center was performed following United States Environmental Protection Agency (EPA) methods described by the Code of Federal Regulations (CFR). Table 4.1 outlines the specific methods performed on July 29-30 and September 1, 2021.

TABLE 4.1
SUMMARY OF SAMPLING METHODS

Pollutant or Parameter	Sampling Method	Analysis Method
Sample Point Location	EPA Method 1	Equal Area Method
Stack Flow Rate	EPA Method 2	S-Type Pitot Tube
Oxygen	EPA Method 3A	Paramagnetic Cell
Stack Moisture Content	EPA Method 4	Gravimetric Analysis
Particulate Matter	EPA Method 5	Front Half Filterables
Stack Flow Rate	EPA Method 19	Dry Oxygen F Factor
Total Hydrocarbons	EPA Method 25A	Flame Ionization Detector
Particulate Matter	EPA Method 202	Back Half Condensables

Pollutant or Parameter	Sampling Method	Analysis Method
Nitrogen Oxides, Carbon Monoxide, Ammonia, Acetaldehyge, Formaldehyde, Methane, Ethane, Nitrous Oxide, Carbon Dioxide, and Moisture	EPA Method 320	Fourier Transform Infrared

4.2 INSTRUMENT CONFIGURATION AND OPERATIONS FOR GAS ANALYSIS

The sampling and analysis procedures used during these tests conform with the methods outlined in the Code of Federal Regulations (CFR), Title 40, Part 60, Appendix A, Methods 1, 2, 3A, 4, 5, 19, 25A; 40 CFR 51, Appendix M, Method 202; and 40 CFR 63, Appendix A, Method 320.

Figure 4.1 depicts the sample system used for the real-time gas analyzer tests. The gas sample was continuously pulled through the probe and transported, via heat-traced Teflon® tubing, to a heated head pump and into the FTIR then to a stainless-steel minimum-contact condenser designed to dry the sample. Transportation of the sample, through Teflon® tubing, continued into the sample manifold within the mobile laboratory via a stainless steel/Teflon® diaphragm pump. From the manifold, the sample was partitioned to the real-time analyzers through rotameters that controlled the flow rate of the sample. Exhaust samples were routed to the wet based analyzer prior to gas conditioning.

Figure 4.1 shows that the sample system was also equipped with a separate path through which a calibration gas could be delivered to the probe and back through the entire sampling system. This allowed for convenient performance of system bias checks as required by the testing methods.

All instruments were housed in a climate controlled, trailer-mounted mobile laboratory. Gaseous calibration standards were provided in aluminum cylinders with the concentrations certified by the vendor. EPA Protocol No. 1 was used to determine the cylinder concentrations where applicable (i.e., C_3H_8 calibration gases).

Table 4.2 provides a description of the analyzers used for the instrument portion of the tests. All data from the continuous monitoring instruments were recorded on a Logic Beach Portable Data Logging System which retrieves calibrated electronic data from each instrument every one second and reports an average of the collected data every 30 seconds. For target compounds measured with the Fourier transform infrared (FTIR) spectrometer, interferograms consisting of 30 co-added scans were recorded continuously during the test periods, and provided approximately 30-second average concentrations. Spectral data was analyzed by the MKS MG2000 software.

Figure 4.2 represents the sample system used for the PM tests. A heated stainless-steel probe with a glass liner and stainless-steel nozzle was inserted into the sample ports of the stack to extract gas measurements from the emission stream through a filter and glass impinger train. Flow rates are monitored with oil filled manometers and total sample volumes are measured with a dry gas meter. Glassware that is used to collect and analyze Method 202 condensable particulate samples is cleaned prior to the test with soap and water, and rinsed using tap water, deionized water, acetone, and finally, hexane. After cleaning, Air Hygiene incorporates a glassware bake at 300°C for six hours rather than the alternative of collecting a field train proof blank.

The stack gas analysis for O_2 concentrations was performed in accordance with procedures set forth in EPA Method 3A. The O_2 analyzer uses a paramagnetic cell detector.

THC emission concentrations were quantified in accordance with procedures set forth in EPA Method 25A. A continuous flame ionization (FID) analyzer was used for this purpose. VOC emission concentrations were quantified in conjunction with procedures outlined in EPA Method 320 for FTIR sampling and analysis of methane and ethane content. These results were then subtracted from the THC concentrations to determine VOC concentrations.

An MKS Instruments - MultiGas™ Fourier Transform Infrared (FTIR) spectrometer was used for NOx, CO, NH_3, C_2H_4O, HCHO, CH_4, C_2H_6, N_2O, CO_2 and H_2O analysis per EPA Method 320. The FTIR spectrometer spectral resolution was 0.5 cm^{-1}. The system employed a silicon carbide infrared source at 1200ºC, a helium neon reference laser, beam splitters, potassium bromide (KBr) cell window, front-surface optical transfer mirrors, and multi-pass absorption cells. MCT detectors were used and cooled with liquid nitrogen in order to maintain a constant temperature of 77 Kelvin. The approximately 5.11-meter multi-pass path cells incorporated aspheric, aberration-correcting mirrors to increase the optical throughput and the detection sensitivity. Transducers and thermocouples were connected directly to the insulated sample cells that provide the pressure and temperatures of the sample streams. During testing, the temperature of the absorption cells was set at 191ºC. Elevated temperature prevented gas condensation within the cell and minimized compound adhesion to the cell walls and mirrors. The volume of the absorption cell was 0.5 liters, so at a sample gas flow rate of 4.0 liters per minute, the sample gas in the cell is refreshed approximately four times each minute. Interferograms consisting of 30 co-added scans were recorded continuously during the test periods, and provided approximately 30-second average concentrations.

TABLE 4.2
ANALYTICAL INSTRUMENTATION

Parameter	Manufacturer and Model	Range	Sensitivity	Detection Principle
NOx, CO, NH_3, C_2H_4O, HCHO, CH_4, C_2H_6, N_2O, CO_2, H_2O	MKS 2030	User may select from multiple ranges	0.1 ppm	Fourier Transform Infrared – FTIR
THC	VIG 210	User may select up to 10,000 ppm	0.1 ppm	Flame Ionization Detector
O_2	SERVOMEX 1440	0-25%	0.1%	Paramagnetic cell, inherently linear.

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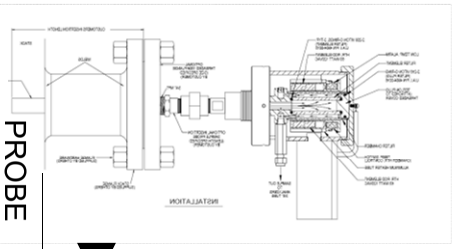
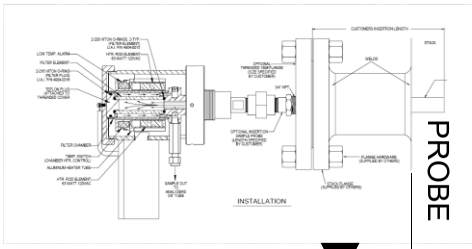


LEGEND
- Heated Teflon Tubing (pre-conditioned sample)
- Unheated Teflon Tubing (conditioned sample)
- Diluted Calibration Gas
- Calibration Gas
- Electronic Input/Output



PROCESS INLET OR 2ND STACK

dual line heated sample umbilical

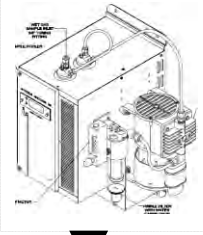
TEST TRAILER EXTERIOR

TEST TRAILER INTERIOR

DATA RECORDER

COMPUTER

GAS CONDITIONER

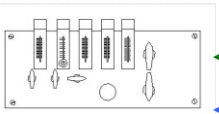


dual line heated sample umbilical

STACK EXHAUST

MOBILE SECONDARY ANALYZERS

MANIFOLD



GAS DILUTER

THC, VOC

HOT/WET ANALYZERS
COLD/DRY ANALYZERS

O_2, CO_2, NOx, CO, SO_2

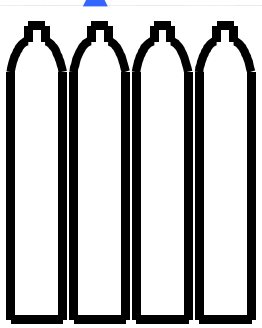
COLD/DRY ANALYZERS HOT/WET

THC, VOC

CONDITIONER

VENT

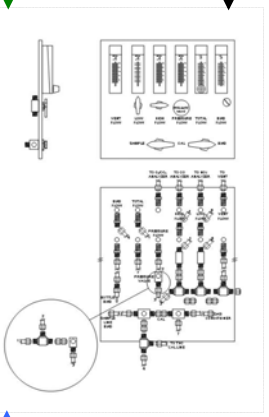
CALIBRATION/ BIAS GAS BOTTLES



VENT

O_2, CO_2, NOx, CO, SO_2

FIXED PRIMARY ANALYZERS



FLOW CONTROL MANIFOLD

FTIR

Page 7 of 250

Shown fully equipped. Some labs may not contain these features and others may contain additional features specific to certain scopes.

AIR HYGIENE

Figure 4.1
EMISSIONS TESTING LAB

1600 W Tacoma Street
Broken Arrow, Oklahoma 74012
www.airhygiene.com
(888) 461-8778

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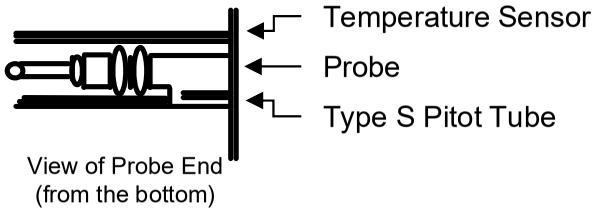

Wet Chemistry Assembly
(photo)

Temperature Sensor (here and multiple locations)

Temperature Sensor

Stack Wall

Liner (glass)

Probe Sheath (heated)

Vertical Condenser With Dropout

CPM Filter Holder

Nozzle

Type S Pitot Tube

Glass Filter Holder

Heated Area

Oil-Filler Manometer

Hot Box

Recirc. pump

Split Cold Box

Impingers

Ice Water Bath

Vacuum Line

Vacuum Gauge

Orifice

By-pass Valve

Main Valve

Dry Gas Meter

Air-Tight Pump

Oil-Filler Manometer

AIR HYGIENE

Figure 4.2
RM5 / 202 ASSEMBLY

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(888) 461-8778

APPENDIX A

TEST RESULTS AND CALCULATIONS

TABLE A.1: EMISSIONS TESTING SCHEDULE

Unit	Load	Component	Run	Date	Start	Stop	Time Sync	Duration
G3520 TALE	50%	Stratification Test	1	07/29/21	11:00	12:10	DAHS	01:10
G3520 TALE	50%	NOx, CO, THC, etc.	1-1	07/29/21	09:34	10:33	DAHS	01:00
G3520 TALE	50%	NOx, CO, THC, etc.	1-2	07/29/21	12:05	13:04	DAHS	01:00
G3520 TALE	50%	NOx, CO, THC, etc.	1-3	07/29/21	14:23	15:22	DAHS	01:00
							DAHS	
G3520 TALE	50%	Cyc. Flow Chk.	R-1 50%-V1	07/28/21	08:46	08:59	DAHS	00:13
G3520 TALE	50%	PM	R-1 50%-1	07/29/21	09:34	11:24	DAHS	01:50
G3520 TALE	50%	PM	R-1 50%-2	07/29/21	12:05	13:59	DAHS	01:54
G3520 TALE	50%	PM	R-1 50%-3	07/29/21	14:23	15:58	DAHS	01:35
							DAHS	
G3520 TALE	75%	NOx, CO, THC, etc.	2-1	07/30/21	13:45	14:44	DAHS	01:00
G3520 TALE	75%	NOx, CO, THC, etc.	2-2	07/30/21	15:00	15:59	DAHS	01:00
G3520 TALE	75%	NOx, CO, THC, etc.	2-3	07/30/21	16:27	17:26	DAHS	01:00
							DAHS	
G3520 TALE	75%	PM	R-1 75%-1	07/30/21	08:08	09:42	DAHS	01:34
G3520 TALE	75%	PM	R-1 75%-2	07/30/21	13:17	14:56	DAHS	01:39
G3520 TALE	75%	PM	R-1 75%-3	07/30/21	15:25	17:01	DAHS	01:36
G3520 TALE	100%	NOx, CO, THC, etc.	3-1	09/01/21	09:23	10:25	DAHS	01:02
G3520 TALE	100%	NOx, CO, THC, etc.	3-2	09/01/21	10:26	12:02	DAHS	01:37
G3520 TALE	100%	NOx, CO, THC, etc.	3-3	09/02/21	12:03	13:06	DAHS	01:03
G3520 TALE	100%	Cyc. Flow Chk.	R-1 100%-V1	08/31/21	07:14	07:38	DAHS	00:24
G3520 TALE	100%	PM	R-1 100%-1	08/31/21	09:36	11:17	DAHS	01:41
G3520 TALE	100%	PM	R-1 100%-2	08/31/21	12:05	13:44	DAHS	01:39
G3520 TALE	100%	PM	R-1 100%-3	08/31/21	14:24	16:05	DAHS	01:41

TEST RESULTS AND CALCULATIONS

50% Load
NOx, CO, THC, N_2O, C_2H_4O, NH_3, HCHO, CH_4, C_2H_6, and H_2O Emissions Data

CATERPILLAR, G3520 TALE 50% LOAD DATA SUMMARY

Parameter	50% Load, Run - 1-1	50% Load, Run - 1-2	50% Load, Run - 1-3	Average
Date (mm/dd/yy)	07/29/21	07/29/21	07/29/21	07/29/21
Start Time (hh:mm:ss)	9:34:23	12:05:23	14:23:23	9:34:23
End Time (hh:mm:ss)	10:33:53	13:04:53	15:22:53	15:22:53
Run Duration (min / run)	60	60	60	60
Bar. Pressure (in. Hg)	29.90	29.90	29.84	29.88
Amb. Temp. (°F)	98	99	96	98
Rel. Humidity (%)	53	49	49	50
Spec. Humidity (lb water / lb air)	0.020978	0.019455	0.018009	0.019481
Engine Fuel Flow (SCFH)	14,625	14,511	14,541	14,559
Stack Flow (RM19) (SCFH)	215,406	215,084	216,383	215,625
Stack Moisture (% Method 320)	14.4	14.4	14.4	14.4
Power Output (horsepower)	1,810.4	1,813.0	1,810.4	1,811.2
Engine Timing (BTDC)	23.0	23.0	23.0	23.00
Actual Power (kW)	1,350.0	1,352.0	1,350.0	1,350.67
Amperes (A)	56.0	57.0	56.0	56.33
Air Manifold Temp. (F)	122.0	122.0	124.0	122.67
Engine Speed (rpm)	1,799.0	1,799.0	1,800.0	1,799.33
NOx (as NO_2) (ppmvd)	8.15	6.92	6.67	7.24
NOx (as NO_2) (ppm@15%O_2)	3.93	3.36	3.25	3.51
NOx (as NO_2) (g/kW*hr)	0.0704	0.0596	0.0579	0.06
NO (ppmvd)	8.15	6.91	6.67	7.24
NO (ppm@15%O_2)	3.93	3.35	3.25	3.51
NO (g/kW*hr)	0.0459	0.0388	0.0378	0.0408
NO_2 (ppmvd)	0.00	0.01	0.00	0.00
NO_2 (ppm@15%O_2)	0.00	0.00	0.00	0.00
NO_2 (g/kW*hr)	0.0000	0.0001	0.0000	0.0000
CO (ppmvd)	6.03	5.97	6.40	6.14
CO (ppm@15%O_2)	2.91	2.90	3.12	2.98
CO (g/kW*hr)	0.03	0.03	0.03	0.03
THC (as C_3H_8) (ppmvd)	183.85	190.60	197.00	190.48
THC (as C_3H_8) (ppm@15%O_2)	75.89	79.16	82.17	79.07
THC (as C_3H_8) (g/kW*hr)	1.30	1.34	1.40	1.35
VOC (as C_3H_8) (ppmvd)	4.67	4.59	6.87	5.38
VOC (as C_3H_8) (ppm@15%O_2)	1.93	1.91	2.86	2.23
VOC (as C_3H_8) (g/kW*hr)	0.03	0.03	0.05	0.04
CH_4 (as C_3H_8) (ppmvd)	178.78	185.57	190.04	184.80
CH_4 (as C_3H_8) (ppm@15%O_2)	86.22	90.07	92.60	89.63
CH_4 (as C_3H_8) (g/kW*hr)	1.4813	1.5330	1.5817	1.5320
C_2H_6 (as C_3H_8) (ppmvd)	0.40	0.44	0.09	0.31
C_2H_6 (as C_3H_8) (ppm@15%O_2)	0.19	0.21	0.04	0.15
C_2H_6 (as C_3H_8) (g/kW*hr)	0.0033	0.0036	0.0007	0.0025
N_2O (ppmvd)	1.59	1.97	2.05	1.87
N_2O (ppm@15%O_2)	0.77	0.95	1.00	0.907
N_2O (g/kW*hr)	0.0132	0.0162	0.0170	0.0155
C_2H_4O (ppmvd)	0.52	0.68	4.04	1.74
C_2H_4O (ppm@15%O_2)	0.25	0.33	1.97	0.848
C_2H_4O (g/kW*hr)	0.0043	0.0056	0.0336	0.0145
HCHO (ppmvd)	0.11	0.07	0.05	7.48E-02
HCHO (ppm@15%O_2)	0.05	0.03	0.02	3.62E-02
HCHO (g/kW*hr)	0.0006	0.0004	0.0003	0.0004
NH_3 (ppmvd)	0.54	0.29	0.57	0.47
NH_3 (ppm@15%O_2)	0.26	0.14	0.28	0.23
NH_3 (g/kW*hr)	0.0017	0.0009	0.0018	0.0015
CO_2 (%)	6.71	6.69	6.75	6.72
CO_2 (lb/hr)	1,651.80	1,643.88	1,669.41	1,655.03
CO_2 (lb/kW*hr)	1,223.58	1,215.91	1,236.62	1,225.37
CO_2 (ton/year) at 8760 hr/year	7,234.89	7,200.20	7,312.00	7,249.03
CO_2 (lb/MMBtu)	115.56	115.56	115.56	115.56
CO_2 (g/kW*hr)	555.01	551.53	560.92	555.82
O_2 (%)	8.67	8.74	8.79	8.73

Calculations, Formulas, and Constants

The following information supports the spreadsheets for this testing project.

Given Data:

Ideal Gas Conversion Factor = 385.23 SCF/lb-mol at 68 deg F & 14.696 psia

Fuel Heating Value is based upon Air Hygiene's fuel gas calculation sheet. All calculations are based upon a correction to 68 deg F & 14.696 psia

High Heating Values (HHV) are used for the Fuel Heating Value, F-Factor, and Fuel Flow Data per EPA requirements.

ASTM D 3588

Molecular Weight of NOx (lb/lb-mole) =	46.01
Molecular Weight of CO (lb/lb-mole) =	28.00
Molecular Weight of N2O (lb/lb-mole) =	64.00
Molecular Weight of THC (propane) (lb/lb-mole) =	44.00
Molecular Weight of VOC (methane) (lb/lb-mole) =	16.00
Molecular Weight of NH_3 (lb/lb-mole) =	17.03
Molecular Weight of HCHO (lb/lb-mole) =	30.03
Molecular Weight of CO_2 (lb/lb-mole) =	44.01

40CFR60, App. A., RM 19, Table 19-1

Conversion Constant for NOx =	0.0000001194351
Conversion Constant for CO =	0.0000000726839
Conversion Constant for N2O =	0.0000001661345
Conversion Constant for THC =	0.0000001142175
Conversion Constant for VOC (methane) =	0.0000000415336
Conversion Constant for NH_3 =	0.0000000442074
Conversion Constant for HCHO =	0.0000000779534
Conversion Constant for CO_2 =	0.0000001142434

NOTE: units are lb/ppm*ft^3

Formulas:

1. Corrected Raw Average (C_{Gas}), 40CFR60, App. A, RM 7E, Eq. 7E-5 (08/15/06)

$$C_{Gas} = (C_{Avg} - C_O) \times \left(\frac{C_{MA}}{C_M - C_O} \right)$$

2. Correction to % O_2, 40CFR60, App. A, RM 20, Eq. 20-5 (11/26/02)

$$C_{adj} = C_{Gas(Target)} \times \left(\frac{20.9\% - AdjFactor}{20.9\% - C_{Gas(O2)}} \right)$$

3. Correction to % O_2 and ISO Conditions

$$C_{ISO} = C_{Adj} \times \sqrt{\frac{P_r}{P_o}} \times e^{(19 \times (H_O - 0.00633))} \times \left(\frac{288}{T_a} \right)^{1.53}$$

4. Method 19 stack exhaust flow (scfh) [ref. EPA EMC FAQ Method 19]

$$Q_S = \left(\frac{FFactor \times Q_f \times HHV}{1{,}000{,}000} \right) \times \left(\frac{20.9\%}{20.9\% - C_{Gas(O2)}} \right)$$

5. Emission Rate in lb/hr

$$E_{lb/hr} = \frac{C_{Gas}}{10^6} \times \frac{Q_S \times MW}{G}$$

6. Emission Rate in tons per year

$$E_{ton/yr} = \frac{E_{lb/hr} \times hr_{year}}{2000}$$

7. Emission Concentration in lb/MMBtu (O_2 based)

$$E_{lb/MMBtu} = \frac{C_{Gas} \times F_d Factor \times Conv_C \times 20.9\%}{20.9\% - C_{Gas(O2)}}$$

8. Emission Concentration in g/hp*hr

$$E_{g/hp\text{-}hr} = \frac{E_{lb/hr} \times 453.6}{mw \times 1341.022} \; or \; \frac{E_{lb/hr} \times 453.6}{hp}$$

RM 7E, (08-15-06), 12.1 Nomenclature. The terms used in the equations are defined as follows:

ACE = Analyzer calibration error, percent of calibration span.
B_{WS} = Moisture content of sample gas as measured by Method 4 or other approved method, percent/100.
C_{Avg} = Average unadjusted gas concentration indicated by data recorder for the test run.
C_D = Pollutant concentration adjusted to dry conditions.
C_{Dir} = Measured concentration of a calibration gas (low, mid, or high) when introduced in direct calibration mode.
C_{Gas} = Average effluent gas concentration adjusted for bias.
C_M = Average of initial and final system calibration bias (or 2-point system calibration error) check responses for the upscale calibration gas.
C_{MA} = Actual concentration of the upscale calibration gas, ppmv.
C_O = Average of the initial and final system calibration bias (or 2-point system calibration error) check responses from the low-level (or zero) calibration gas.
C_S = Measured concentration of a calibration gas (low, mid, or high) when introduced in system calibration mode.
C_{SS} = Concentration of NOx measured in the spiked sample.
C_{Spike} = Concentration of NOx in the undiluted spike gas.
C_{Calc} = Calculated concentration of NOx in the spike gas diluted in the sample.
C_V = Manufacturer certified concentration of a calibration gas (low, mid, or high).
C_W = Pollutant concentration measured under moist sample conditions, wet basis.
CS = Calibration span.
D = Drift assessment, percent of calibration span.
E_p = The predicted response for the low-level and mid-level gases based on a linear response line between the zero and high-level response.
Eff_{NO2} = NO_2 to NO converter efficiency, percent.
H = High calibration gas, designator.
L = Low calibration gas, designator.
M = Mid calibration gas, designator.
NOFinal = The average NO concentration observed with the analyzer in the NO mode during the converter efficiency test in Section 16.2.2.
NOxCorr = The NOx concentration corrected for the converter efficiency.
NOxFinal = The final NOx concentration observed during the converter efficiency test in Section 16.2.2.
NOxPeak = The highest NOx concentration observed during the converter efficiency test in Section 16.2.2.
Q_{Spike} = Flow rate of spike gas introduced in system calibration mode, L/min.
Q_{Total} = Total sample flow rate during the spike test, L/min.
R = Spike recovery, percent.
SB = System bias, percent of calibration span.
SB_i = Pre-run system bias, percent of calibration span.
SB_f = Post-run system bias, percent of calibration span.
SB / D_{Alt} = Alternative absolute difference criteria to pass bias and/or drift checks.
SCE = System calibration error, percent of calibration span.
SCE_i = Pre-run system calibration error, percent of calibration span.
SCE_{final} = Post-run system calibration error, percent of calibration span.
Z = Zero calibration gas, designator.

40CFR60.355(b)(1), (09-20-06), Nomenclature. The terms used in the equations are defined as follows:

P_r = reference combustor inlet absolute pressure at 101.3 kilopascals ambient pressure, mm Hg
P_o = observed combustor inlet absolute pressure at test, mm Hg
H_o = observed humidity of ambient air, g H_2O/g air
e = transcendental constant, 2.718
T_a = ambient temperature, K

Small Engine and FTIR Nomenclature. The terms used in the equations are defined as follows:

bhp = brake horsepower
hp = horsepower
Q_{sys} = system flow (lpm)
Q_m = matrix spike flow (lpm)

RM 19, (07-29-06), 12.1 Nomenclature. The terms used in the equations are defined as follows:

AdjFactor = Percent oxygen or carbon dioxide adjustment applied to a target pollutant
B_{wa} = Moisture fraction of ambient air, percent.
Btu = British thermal unit
$\%_C$ = Concentration of carbon from an ultimate analysis of fuel, weight percent.
$\%_{CO2d}$,$\%_{CO2w}$ = Concentration of carbon dioxide on a dry and wet basis, respectively, percent.
CIP / CDP = Combustor inlet pressure / compressor discharge pressure (mm Hg); note, some manufactures reference as PCD.
E = Pollutant emission rate, ng/J (lb/million Btu).
E_a = Average pollutant rate for the specified performance test period, ng/J (lb/million Btu).
E_{ao}, E_{ai} = Average pollutant rate of the control device, outlet and inlet, respectively, for the performance test period, ng/J (lb/million Btu).
E_{bi} = Pollutant rate from the steam generating unit, ng/J (lb/million Btu).
E_{bo} = Pollutant emission rate from the steam generating unit, ng/J (lb/million Btu).
E_{ci} = Pollutant rate in combined effluent, ng/J (lb/million Btu).
E_{co} = Pollutant emission rate in combined effluent, ng/J (lb/million Btu).
E_d = Average pollutant rate for each sampling period (e.g.,24-hr Method 6B sample or 24-hr fuel sample) or for each fuel lot (e.g., amount of fuel bunkered), ng/J (lb/million E
E_{di} = Average inlet SO_2 rate for each sampling period d, ng/J (lb/million Btu).
E_g = Pollutant rate from gas turbine, ng/J (lb/million Btu).
E_{ga} = Daily geometric average pollutant rate, ng/J (lbs/million Btu) or ppm corrected to 7 percent O_2.
E_{jo},E_{ji} = Matched pair hourly arithmetic average pollutant rate, outlet and inlet, respectively, ng/J (lb/million Btu) or ppm corrected to 7 percent O_2.
E_h = Hourly average pollutant, ng/J (lb/million Btu).
E_{hj} = Hourly arithmetic average pollutant rate for hour "j," ng/J (lb/million Btu) or ppm corrected to 7 percent O_2.
EXP = Natural logarithmic base (2.718) raised to the value enclosed by brackets.
Fc = Ratio of the volume of carbon dioxide produced to the gross calorific value of the fuel from Method 19
F_d, F_w, F_c = Volumes of combustion components per unit of heat content, scm/J (scf/million Btu).
ft^3 = cubic feet
G = ideal gas conversion factor
(385.23 SCF/lb-mol at 68 deg F & 14.696 psia)
GCM = gross Btu per SCF (constant, compound based)
GCV = Gross calorific value of the fuel consistent with the ultimate analysis, kJ/kg (Btu/lb).
GCV_p, GCV_r = Gross calorific value for the product and raw fuel lots, respectively, dry basis, kJ/kg (Btu/lb).
$\%_H$ = Concentration of hydrogen from an ultimate analysis of fuel, weight percent.
H_b = Heat input rate to the steam generating unit from fuels fired in the steam generating unit, J/hr (million Btu/hr).
H_g = Heat input rate to gas turbine from all fuels fired in the gas turbine, J/hr (million Btu/hr).
$\%_{H2O}$ = Concentration of water from an ultimate analysis of fuel, weight percent.
H_r = Total numbers of hours in the performance test period (e.g., 720 hours for 30-day performance test period).
K = volume of combustion component per pound of component (constant)
K = Conversion factor, 10^{-5} (kJ/J)/(%) [10^6 Btu/million Btu].
K_c = (9.57 scm/kg)/% [(1.53 scf/lb)/%].
K_{cc} = (2.0 scm/kg)/% [(0.321 scf/lb)/%].
K_{hd} = (22.7 scm/kg)/% [(3.64 scf/lb)/%].
K_{hw} = (34.74 scm/kg)/% [(5.57 scf/lb)/%].
K_n = (0.86 scm/kg)/% [(0.14 scf/lb)/%].
K_o = (2.85 scm/kg)/% [(0.46 scf/lb)/%].
K_s = (3.54 scm/kg)/% [(0.57 scf/lb)/%].
K_{sulfur} = $2x10^4$ Btu/wt%-MMBtu
K_w = (1.30 scm/kg)/% [(0.21 scf/lb)/%].
lb = pound
ln = Natural log of indicated value.
L_p,L_r = Weight of the product and raw fuel lots, respectively, metric ton (ton).
$\%_N$ = Concentration of nitrogen from an ultimate analysis of fuel, weight percent.
$M_{\%}$ = mole percent
mol = mole
MW = molecular weight (lb/lb-mol)
MW_{AIR} = molecular weight of air (28.9625 lb/lb-mole)[1]
NCM = net Btu per SCF (constant based on compound)
$\%_O$ = Concentration of oxygen from an ultimate analysis of fuel, weight percent.
$\%_{O2d}$, $\%_{O2w}$ = Concentration of oxygen on a dry and wet basis, respectively, percent.
P_B = barometric pressure, in Hg
P_s = Potential SO2 emissions, percent.
$\%_S$ = Sulfur content of as-fired fuel lot, dry basis, weight percent.
S_e = Standard deviation of the hourly average pollutant rates for each performance test period, ng/J (lb/million Btu).
$\%_{Sf}$ = Concentration of sulfur from an ultimate analysis of fuel, weight percent.
S(wt%) = weight percent of sulfur, per lab analysis by appropriate ASTM standard
S_i = Standard deviation of the hourly average inlet pollutant rates for each performance test period, ng/J (lb/million Btu).
S_o = Standard deviation of the hourly average emission rates for each performance test period, ng/J (lb/million Btu).
$\%S_p$, $\%S_r$ = Sulfur content of the product and raw fuel lots respectively, dry basis, weight percent.
SCF = standard cubic feet
SH = specific humidity, pounds of water per pound of air
$t_{0.95}$ = Values shown in Table 19-3 for the indicated number of data points n.
T_{amb} = ambient temperature, ^oF
W/D Factor = 1.0236 = conv. at 14.696 psia and
68 deg F (ref. Civil Eng. Ref. Manual, 7th Ed.)
X_{CO2}=CO_2 Correction factor, percent.
X_k = Fraction of total heat input from each type of fuel k.

EXAMPLE CALCULATIONS (FFACTOR)

RM 19, (02-27-14),
2.0 Summary of Method,
2.1 Emission Rates. Oxygen (O_2) or carbon dioxide (CO_2) concentrations and appropriate F factors (ratios of combustion gas volumes to heat inputs) are used to calculate pollutant emission rates from pollutant concentrations.

RM 19, (02-27-14),
12.2 Emission Rates of PM, SO_2, and NOx. Select from the following sections the applicable procedure to compute the PM, SO_2, or NOx emission rate (E) in lb/MMBtu. The pollutant concentration must be in lb/scf and the F factor must be in scf/MMBtu. If the pollutant concentration (C) is not in the appropriate units, use Table 19–1 in Section 17.0 to make the proper conversion. An F factor is the ratio of the gas volume of the products of combustion to the heat content of the fuel. The dry F factor (F_d) includes all components of combustion less water, the wet F factor (F_w) includes all components of combustion, and the carbon F factor (F_c) includes only carbon dioxide.

Mark's Std Hdbk, 10th ed.,pg 4-26
High Heat Value Dry (HHV_{dry}), calc for Methane (single component for the fuel gas)

$$HHV_{dry}(Btu/SCF) = \left[\left(\frac{M_{\%}}{100}\right) \times GCM\right]$$

HHV_{dry} = 98.35 % / 100.00 x 994.85 Btu / SCF = 978.48 Btu / SCF

Mark's Std Hdbk, 10th ed., pg 4-26
Low Heat Value Dry (LHV_{dry}), calc for Methane (single component for the fuel gas)

$$LHV_{dry}(Btu/SCF) = \left[\left(\frac{M_{\%}}{100}\right) \times NCM\right]$$

LHV_{dry} = 98.35 % / 100.00 x 895.75 Btu / SCF = 881.02 Btu / SCF

Civil Eng. Ref. Man.,7th Ed.,pg 14-9/GPA Ref. Bulletin 181-86, App. C
High Heat Value Wet (HHV_{wet}), calc for entire sample (all components of the fuel gas)

$$HHV_{wet}(Btu/SCF) = \frac{HHV_{dry}}{W/D.factor}$$

HHV_{wet} = 998.79 Btu/SCF / 1.0236 = 975.76 Btu/SCF

Civil Eng. Ref. Man.,7th Ed.,pg 14-9/GPA Ref. Bulletin 181-86, App. C
Low Heat Value Wet (LHV_{wet}), calc for entire sample (all components of the fuel gas)

$$LHV_{wet}(Btu/SCF) = \frac{LHV_{dry}}{W/D.factor}$$

LHV_{wet} = 899.60 Btu/SCF / 1.0236 = 878.86 Btu/SCF

Lbs Component per Lb-Mol of Gas (CM), calc for Methane (single component for the fuel gas)

$$CM(lb/lb-mol) = \left[\left(\frac{M_{\%}}{100}\right) \times MW\right]$$

CM = 98.35 % / 100.00 x 16.04 lb / lb-mol = 15.78 lb/lb-mol

ASTM D 3588
Fuel Molecular Weight (MW_{Fuel})

$$MW_{Fuel}(lb/lb \cdot mol) = \left[\sum (CM)\right]$$

MW_{Fuel} = 15.78 lb/lb-mol
+ 0.34 lb/lb-mol
+ etc. = 16.307 lb/lb-mol

Btu per Lb of Gas Gross (**GCV**)

$$GCV(Btu/lb) = \left[\frac{HHV_{dry} \times G}{MW_{Fuel}}\right]$$

GCV = 998.79 Btu/SCF x 385.23 ft^3/lbmol / 16.307 lb/lb-mol = 23,595.43 Btu/lb

ASTM D 3588 (SG)
Specific Gravity

$$SG = \left[\frac{MW_{Fuel}}{MW_{AIR}}\right]$$

SG = 16.31 lb/lb-mol / 28.96 lb/lb-mol = 0.5630

Btu per Lb of Gas Net (**NCV**)

$$NCV(Btu/lb) = \left[\frac{LHV_{dry} \times G}{MW_{Fuel}}\right]$$

NCV = 899.60 Btu/SCF x 385.23 ft^3/lbmol / 16.307 lb/lb-mol = 21,252.13 Btu/lb

Weight Percent of Component ($C_{\%}$), methane

$$C_{\%}(\%) = \left[\left(\frac{CM}{MW_{Fuel}}\right) \times 100\right]$$

$C_{\%}$ = 15.78 lb/lb-mol / 16.31 lb/lb-mol x 100 = 96.76 %

Weight Percent of Volatile Organic Compounds ($VOC_{\%}$)

$$VOC_{\%}(\%) = \left[\sum_{C_3H_8}^{C_8H_{18}} Wt_{\%}\right]$$

$VOC_{\%}$ = 0.05 % + 0.00 % + 0.00 % + etc. = 0.06 %

RM 19, (02-27-14), 12.3.2 Determined **F Factors**. If the fuel burned is not listed in Table 19–2 or if the owner or operator chooses to determine an F factor rather than use the values in Table 19–2, use the procedure below: 12.3.2.1 Equations. Use the eq

RM 19, (02-27-14),
12.1 Nomenclature

K (scf/lb)/%	
H	3.64
C	1.53
S	0.57
N_2	0.14
O_2	0.46

$$F_d = \frac{K\left(K_{hd}\%H + K_c\%C + K_s\%S + K_n\%N - K_o\%O\right)}{GCV} \quad \text{Eq. 19-13}$$

F_d = $\frac{10^6 Btu}{MMBtu}$ x [3.64 SCF / lb · % x 24.75 % + 1.53 SCF / lb · % x 74.35 % + 0.57 SCF / lb · % x 0.00 % + 0.14 SCF / lb · % x 0.38 % - 0.46 SCF / lb · % x 0.51 %] x lb / 23,595.43 Btu = 8,631.70 SCF / MMBtu

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (Methane and Ethane subtraction from THC to determine VOC)

VOC (as propane)

Using a THC analyzer calibrated with propane and an FTIR, GC, or other type of analyzer that reads methane and ethane on a methane and ethane basis, respectively; first convert the wet based methane to a wet based propane equivalent by dividing the number by three, if FTIR is the analysis method, a 1.1 multiplier is applied as the correction factor; then convert the wet based ethane to a wet based propane equivalent by multiplying the number by two and then dividing by three. Once all concentrations are in wet based equivalent units, subtract the methane (as propane) and ethane (as propane) from the THC concentration. If the calculation results in a negative number, which is fairly common when subtracting fairly large numbers, the result will be assumed as zero.

$$VOC(ppm) = C_{THC\,(propane)} - \left(\frac{C_{CH_4\,(methane)}}{3}\right)_{(propane)} \times 1.1 - \left(\frac{C_{C_2H_6\,(ethane)} \times 2}{3}\right)_{(propane)}$$

VOC (ppm) = 157.35 ppm - $\frac{417.32 \text{ ppm}}{3}$ x 1.1 - $\frac{0.52 \text{ ppm x } 2}{3}$ = 3.99 ppm

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (INFORMATION)

Specific Humidity (RH_{sp}) Note: RHsp (gr/lb) calculated using temperature, relative humidity, and barometric pressure with psychrometric chart, psychrometric calculator, or built in psychrometric algorithm.

$$RH_{sp}(lb/lb) = \left[\left(\frac{gr}{lb}\right) \times \frac{lb}{7000\,gr}\right]$$

RH_{sp}= $\frac{146.84 \text{ gr}}{\text{lb}}$ x $\frac{1 \text{ lb}}{7000 \text{ gr}}$ = 0.020978 $\frac{\text{lb } H_2O}{\text{lb Air}}$

EXAMPLE CALCULATIONS (CALIBRATION)

Calibration Error and Estimated Point, RM 25A, THC/VOC Analyzer

RM 25A, (02-27-14), 8.4 Calibration Error Test. Immediately prior to the test series (within 2 hours of the start of the test), introduce zero gas and high-level calibration gas at the calibration valve assembly. Adjust the analyzer output to the appropriate levels, if necessary. Calculate the predicted response for the low-level and mid-level gases based on a linear response line between the zero and high-level response. Then introduce low-level and mid-level calibration gases successively to the measurement system. ... These differences must be less than 5 percent of the respective calibration gas value. (calc for THC/VOC analyzer mid gas, if applicable)

$$E_P = \frac{C_{Dir\,(H)} - C_{Dir\,(Z)}}{C_{V\,(H)} - C_{V\,(Z)}} \times C_{Dir\,(M)} + C_{Dir\,(Z)}$$

Eq. of a line y=mx+b

E_p = $\frac{808.45 \text{ ppm} - 1.42 \text{ ppm}}{802.00 \text{ ppm} - 0.00 \text{ ppm}}$ x 456.00 ppm + 1.42 = 460.28 ppm

$$ACE = \left(\frac{C_{Dir} - C_V}{CS}\right) \times 100$$

Eq. 7E-1

ACE $_{THC\,(}$ = $\frac{461.70 \text{ ppm} - 460.28 \text{ ppm}}{456.00 \text{ ppm}}$ x 100 = 0.31 %

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (RUNS)

Stack Exhaust Flow (Q_S) - RM19

$$Q_S = \left(\frac{FFactor \times Q_f \times HHV}{1{,}000{,}000}\right) \times \left(\frac{20.9\%}{20.9\% - C_{Gas(O2)}}\right)$$

Note: Equation presented in EPA Emission Measurement Center (EMC), Frequently Asked Questions (FAQ) for Method 19

Q_S = 8,631.70 SCF/MMBtu x 14,625.00 SCF/hr x 998.79 Btu/SCF x MMBtu/10^6 Btu x [20.90% / (20.9% - 8.7 %)] = 215,406.45 SCFH

Moisture Correction

RM 7E, (02-27-14), 12.10 Moisture Correction. Use Equation 7E-10 if your measurements need to be corrected to a dry basis. (calc for NOx analyzer, Run 1, if applicable) Note: Calculations may not match as Run 1 results are typically also bias adjusted

$$C_D = \frac{C_W}{1 - B_{WS}} \qquad C_W = C_D \times (1 - B_{WS})$$

Eq. 7E-10 C_D = 6.97 ppmvw / (1 - 0.14) = 8.15 ppmvc or inversely, C_W = 8.15 ppmvd x (1 - 0.14) = 6.97 ppmvw

Diluent-Corrected Pollutant Concentration, O_2 Based

RM 20, (11-26-02), 7.3.1 Correction of Pollutant Concentration Using O_2 Concentration. Calculate the O_2 corrected pollutant concentration, as follows: (calc for NOx gas, Run 1, if applicable) [now contained in applicable Subpart]

$$C_{adj} = C_{Gas(Target)} \times \left(\frac{20.9\% - AdjFactor}{20.9\% - C_{Gas(O2)}}\right)$$

Eq. 20-4 C_{adj} = 8.15 ppm x [(20.9% - 15.00 %) / (20.9% - 8.67 %)] = 3.93 ppm@15%O_2

Emissions Rate (lb/hr)

Calculation for pound per hour emission rate. Calculate, as follows: (calc for NOx gas Run 1, if applicable)

$$E_{lb/hr} = \frac{C_{Gas}}{10^6} \times \frac{Q_S \times MW}{G}$$

$E_{lb/hr}$ = 8.15 ppmvd / 10^6 ppm/part x 215,406 DSCFH x 46.01 lb/lb-mol / 385.23 SCF/lb-mol = 0.21 lb/hr

Emissions Rate (g/kW-hr)

Calculation for grams per horsepower-hour. Calculate, as follows: (calc for NOx gas Run 1, if applicable)

$$E_{g/hp\text{-}hr} = \frac{E_{lb/hr} \times 453.6}{mw \times 1341.022} \text{ or } \frac{E_{lb/hr} \times 453.6}{hp}$$

$E_{g/hp\text{-}hr}$ = 0.21 lb/hr x 453.6 g/lb x 1/1,810 hp x hp/0.7456 kW = 0.0704 g/kW*hr

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

Method 320 Equation 3, Dilution Factor (DF)

(example calculation for Trial #1, where applicable)

$$DF = \frac{SF_{6\,(spk)}}{SF_{6\,(dir)}} = \frac{(SF_{6\,(spk+native)} - SF_{6\,(native)})}{SF_{6\,(dir)}} OR \frac{(CO_{2(native)} - CO_{2(spk+native)})}{CO_{2(native)}}$$

DF (SF_6) = (0.4082 - -0.0034 ppmvw) / 5.61 ppmvw = 0.0734

Test Method 320, Section 9.0 Quality Control

Where,

$SF_{6(dir)}$ = SF_6 (or tracer gas) concentration measured directly in undiluted spike gas

$SF_{6(spk)}$ = Diluted SF_6 (or tracer gas) concentration measured in a spiked sample

$SF_{6(spk)} = SF_{6(spk+native)} - SF_{6(native)}$

$SF_{6(spk+native)}$ = Diluted SF_6 (or tracer gas) concentration measured in a spiked sample in stack gas

$SF_{6(native)}$ = SF_6 (or tracer gas) concentration measured in a native stack gas sample

Dilution Factor Ratio

(example calculation for Trial #1, where applicable)

$$DF\ Ratio = \frac{SF_{6\,(dir)}}{SF_{6\,(spk)}} = \frac{SF_{6\,(dir)}}{(SF_{6\,(spk+native)} - SF_{6\,(native)})} OR \frac{CO_{2(native)}}{CO_{2(native)} - CO_{2(spk+native}} \geq 10$$

DF Ratio = (5.61 ppmvw) / (0.4082 - -0.0034 ppmvw) =

Spike Ratio = 13.6 : 1 ≥ 10

Unspike = Native concentration of analytes in unspiked samples

$Spike_{dir}$ = Concentration of the analyte in the spike standard measured by filling the FTIR cell directly

Method 320 Equation 4 [Method 321 Equation 2], Excepted Concentration of the Spiked Samples

Ideal Spike Yield

(example calculation for Trial #1 (SF_6), where applicable)

$$CS = DF \times Spike_{dir} + Unspike\,(1 - DF)$$

CS = 0.0734 X 5.6103 ppmvw + -0.0034 ppmvw X (1 - 0.0734) = 0.4085 ppmvw

Method 320 Spiked vs Expected

$$Spiked\ vs\ Expected = \frac{Actual\ Spike\ Yield}{Ideal\ Spike\ Yield} \times 100$$

(example calculation for Trial #1 (SF_6), where applicable)

% Recovery = (0.4082 ppmvw / 0.4085 ppmvw) x 100 = 99.940 %

Method 320 Equation 4 [Method 321 Equation 2], Excepted Concentration of the Spiked Samples

Ideal Spike Yield

(example calculation for Trial #1 (C_2H_4O), where applicable)

$$CS = DF \times Spike_{dir} + Unspike\,(1 - DF)$$

CS = 0.0734 X 47.1138 ppmvw + 0.4382 ppmvw X (1 - 0.0734) = 3.8626 ppmvw

Method 320 Spiked vs Expected

$$Spiked\ vs\ Expected = \frac{Actual\ Spike\ Yield}{Ideal\ Spike\ Yield} \times 100$$

(example calculation for Trial #1 (C_2H_4O), where applicable)

% Recovery = (3.6232 ppmvw / 3.8626 ppmvw) x 100 = 93.802 %

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

Method 320 Equation 3, Dilution Factor (DF)

(example calculation for Trial #2, where applicable)

$$DF = \frac{SF_{6\,(spk)}}{SF_{6\,(dir)}} = \frac{(SF_{6\,(spk+native)} - SF_{6\,(native)})}{SF_{6\,(dir)}} OR \frac{(CO_{2(native)} - CO_{2(spk+native)})}{CO_{2(native)}}$$

DF (SF_6) = (0.4291 - -0.0011) ppmvw / 5.61 ppmvw =

0.0767

Test Method 320, Section 9.0 Quality Control

Where,

$SF_{6(dir)}$ = SF_6 (or tracer gas) concentration measured directly in undiluted spike gas

$SF_{6(spk)}$ = Diluted SF_6 (or tracer gas) concentration measured in a spiked sample

$SF_{6(spk)} = SF_{6(spk+native)} - SF_{6(native)}$

$SF_{6(spk+native)}$ = Diluted SF_6 (or tracer gas) concentration measured in a spiked sample in stack gas

$SF_{6(native)}$ = SF_6 (or tracer gas) concentration measured in a native stack gas sample

Dilution Factor Ratio

(example calculation for Trial #2, where applicable)

$$DF\ Ratio = \frac{SF_{6\,(dir)}}{SF_{6\,(spk)}} = \frac{SF_{6\,(dir)}}{(SF_{6\,(spk+native)} - SF_{6\,(native)})} OR \frac{CO_{2(native)}}{CO_{2(native)} - CO_{2(spk+native}} \geq 10$$

DF Ratio = 5.61 ppmvw / (0.4291 - -0.0011 ppmvw) =

Spike Ratio = 13.0 : 1 ≥ 10

Unspike = Native concentration of analytes in unspiked samples

$Spike_{dir}$ = Concentration of the analyte in the spike standard measured by filling the FTIR cell directly

Method 320 Equation 4 [Method 321 Equation 2], Excepted Concentration of the Spiked Samples

Ideal Spike Yield

(example calculation for Trial #2 (SF_6), where applicable)

$$CS = DF \times Spike_{dir} + Unspike\,(1 - DF)$$

CS = 0.0767 X 5.6103 ppmvw + -0.0011 ppmvw X (1 - 0.0767) = 0.4292 ppmvw

Method 320 Spiked vs Expected

$$Spiked\ vs\ Expected = \frac{Actual\ Spike\ Yield}{Ideal\ Spike\ Yield} \times 100$$

(example calculation for Trial #2 (SF_6), where applicable)

% Recovery = 0.4291 ppmvw / 0.4292 ppmvw x 100 = 99.981 %

Method 320 Equation 4 [Method 321 Equation 2], Excepted Concentration of the Spiked Samples

Ideal Spike Yield

(example calculation for Trial #2 (C_2H_4O), where applicable)

$$CS = DF \times Spike_{dir} + Unspike\,(1 - DF)$$

CS = 0.0767 X 47.1138 ppmvw + 0.4477 ppmvw X (1 - 0.0767) = 4.0257 ppmvw

Method 320 Spiked vs Expected

$$Spiked\ vs\ Expected = \frac{Actual\ Spike\ Yield}{Ideal\ Spike\ Yield} \times 100$$

(example calculation for Trial #2 (C_2H_4O), where applicable)

% Recovery = 4.1004 ppmvw / 4.0257 ppmvw x 100 = 101.856 %

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

Method 320 Equation 3, Dilution Factor (DF) — **Test Method 320, Section 9.0 Quality Control**

(example calculation for Trial #3, where applicable)

$$DF = \frac{SF_{6\,(spk)}}{SF_{6\,(dir)}} = \frac{(SF_{6\,(spk+native)} - SF_{6\,(native)})}{SF_{6\,(dir)}} \; OR \; \frac{(CO_{2(native)} - CO_{2(spk+native)})}{CO_{2(native)}}$$

DF (SF_6) = (0.4383 - 0.0018) ppmvw / 5.61 ppmvw = 0.0778

Where,

$SF_{6(dir)}$ = SF_6 (or tracer gas) concentration measured directly in undiluted spike gas

$SF_{6(spk)}$ = Diluted SF_6 (or tracer gas) concentration measured in a spiked sample

$SF_{6(spk)} = SF_{6(spk+native)} - SF_{6(native)}$

$SF_{6(spk+native)}$ = Diluted SF_6 (or tracer gas) concentration measured in a spiked sample in stack gas

$SF_{6(native)}$ = SF_6 (or tracer gas) concentration measured in a native stack gas sample

Dilution Factor Ratio

(example calculation for Trial #3, where applicable)

$$DF\ Ratio = \frac{SF_{6\,(dir)}}{SF_{6\,(spk)}} = \frac{SF_{6\,(dir)}}{(SF_{6\,(spk+native)} - SF_{6\,(native)})} \; OR \; \frac{CO_{2(native)}}{CO_{2(native)} - CO_{2(spk+native}} \geq 10$$

DF Ratio = 5.61 ppmvw / (0.4383 - 0.0018) ppmvw =

Spike Ratio = 12.9 : 1 ≥ 10

Unspike = Native concentration of analytes in unspiked samples

$Spike_{dir}$ = Concentration of the analyte in the spike standard measured by filling the FTIR cell directly

Method 320 Equation 4 [Method 321 Equation 2], Excepted Concentration of the Spiked Samples

Ideal Spike Yield

(example calculation for Trial #3 (SF_6), where applicable)

$$CS = DF \times Spike_{dir} + Unspike\,(1 - DF)$$

CS = 0.0778 X 5.6103 ppmvw + 0.0018 ppmvw X (1 - 0.0778) = 0.4382 ppmvw

Method 320 Spiked vs Expected

$$Spiked\ vs\ Expected = \frac{Actual\ Spike\ Yield}{Ideal\ Spike\ Yield} \times 100$$

(example calculation for Trial #3 (SF_6), where applicable)

% Recovery = 0.4383 ppmvw / 0.4382 ppmvw x 100 = 100.031 %

Method 320 Equation 4 [Method 321 Equation 2], Excepted Concentration of the Spiked Samples

Ideal Spike Yield

(example calculation for Trial #3 (C_2H_4O), where applicable)

$$CS = DF \times Spike_{dir} + Unspike\,(1 - DF)$$

CS = 0.0778 X 47.1138 ppmvw + 0.3622 ppmvw X (1 - 0.0778) = 4.0003 ppmvw

Method 320 Spiked vs Expected

$$Spiked\ vs\ Expected = \frac{Actual\ Spike\ Yield}{Ideal\ Spike\ Yield} \times 100$$

(example calculation for Trial #3 (C_2H_4O), where applicable)

% Recovery = 4.3142 ppmvw / 4.0003 ppmvw x 100 = 107.849 %

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

TEST RESULTS AND CALCULATIONS

75% Load
NOx, CO, THC, N_2O, C_2H_4O, NH_3, HCHO, CH_4, C_2H_6, and H_2O Emissions Data

CATERPILLAR, G3520 TALE 75% LOAD DATA SUMMARY

Parameter	75% Load, Run - 2-1	75% Load, Run - 2-2	75% Load, Run - 2-3	Average
Date (mm/dd/yy)	07/30/21	07/30/21	07/30/21	07/30/21
Start Time (hh:mm:ss)	13:45:23	15:00:23	16:27:23	13:45:23
End Time (hh:mm:ss)	14:44:53	15:59:53	17:26:53	17:26:53
Run Duration (min / run)	60	60	60	60
Bar. Pressure (in. Hg)	29.89	29.87	29.85	29.87
Amb. Temp. (°F)	94	97	97	96
Rel. Humidity (%)	53	47	42	47
Spec. Humidity (lb water / lb air)	0.018296	0.017841	0.015856	0.017331
Engine Fuel Flow (SCFH)	20,603	20,591	20,172	20,455
Stack Flow (RM19) (SCFH)	310,849	310,873	303,928	308,550
Stack Moisture (% Method 320)	13.9	13.9	13.6	13.8
Power Output (horsepower)	2,691.4	2,698.1	2,616.3	2,668.6
Engine Timing (BTDC)	23.0	23.0	23.0	23.00
Actual Power (kW)	2,007.0	2,012.0	1,951.0	1,990.00
Amperes (A)	89.0	90.0	97.0	92.00
Air Manifold Temp. (F)	131.0	131.0	129.0	130.33
Engine Speed (rpm)	1,800.0	1,800.0	1,800.0	1,800.00
NOx (as NO_2) (ppmvd)	6.49	6.25	6.05	6.26
NOx (as NO_2) (ppm@15%O_2)	3.20	3.09	2.98	3.09
NOx (as NO_2) (g/kW*hr)	0.0544	0.0523	0.0511	0.05
NO (ppmvd)	6.49	6.24	5.96	6.23
NO (ppm@15%O_2)	3.20	3.08	2.94	3.08
NO (g/kW*hr)	0.0355	0.0341	0.0328	0.0341
NO_2 (ppmvd)	0.00	0.01	0.09	0.03
NO_2 (ppm@15%O_2)	0.00	0.00	0.04	0.02
NO_2 (g/kW*hr)	0.0000	0.0000	0.0008	0.0003
CO (ppmvd)	3.23	4.20	3.59	3.68
CO (ppm@15%O_2)	1.60	2.08	1.77	1.81
CO (g/kW*hr)	0.02	0.02	0.02	0.02
THC (as C_3H_8) (ppmvd)	176.40	197.01	190.89	188.10
THC (as C_3H_8) (ppm@15%O_2)	74.99	83.86	81.34	80.06
THC (as C_3H_8) (g/kW*hr)	1.22	1.36	1.33	1.30
VOC (as C_3H_8) (ppmvd)	0.83	4.90	6.61	4.11
VOC (as C_3H_8) (ppm@15%O_2)	0.35	2.09	2.82	1.75
VOC (as C_3H_8) (g/kW*hr)	0.01	0.03	0.05	0.03
CH_4 (as C_3H_8) (ppmvd)	174.98	191.69	183.99	183.55
CH_4 (as C_3H_8) (ppm@15%O_2)	86.41	94.72	90.73	90.62
CH_4 (as C_3H_8) (g/kW*hr)	1.4073	1.5380	1.4883	1.4779
C_2H_6 (as C_3H_8) (ppmvd)	0.59	0.42	0.30	0.43
C_2H_6 (as C_3H_8) (ppm@15%O_2)	0.29	0.21	0.15	0.21
C_2H_6 (as C_3H_8) (g/kW*hr)	0.0047	0.0033	0.0024	0.0035
N_2O (ppmvd)	1.68	1.86	1.70	1.75
N_2O (ppm@15%O_2)	0.83	0.92	0.84	0.86
N_2O (g/kW*hr)	0.0135	0.0149	0.0137	0.0140
C_2H_4O (ppmvd)	1.12	3.50	4.87	3.16
C_2H_4O (ppm@15%O_2)	0.55	1.73	2.40	1.56
C_2H_4O (g/kW*hr)	0.0090	0.0280	0.0393	0.0255
HCHO (ppmvd)	0.00	0.00	0.00	0.00
HCHO (ppm@15%O_2)	0.00	0.00	0.00	0.00
HCHO (g/kW*hr)	0.0000	0.0000	0.0000	0.0000
NH_3 (ppmvd)	18.17	16.63	15.56	16.79
NH_3 (ppm@15%O_2)	8.97	8.22	7.67	8.29
NH_3 (g/kW*hr)	0.0564	0.0515	0.0486	0.0522
CO_2 (%)	6.57	6.55	6.66	6.59
CO_2 (lb/hr)	2,333.03	2,325.95	2,312.44	2,323.80
CO_2 (lb/kW*hr)	1,162.47	1,156.06	1,185.28	1,167.93
CO_2 (ton/year) at 8760 hr/year	10,218.67	10,187.65	10,128.47	10,178.26
CO_2 (lb/MMBtu)	115.63	115.63	115.63	115.63
CO_2 (g/kW*hr)	527.29	524.38	537.63	529.77
O_2 (%)	8.95	8.96	8.94	8.95

TEST RESULTS AND CALCULATIONS

100% Load
NOx, CO, THC, N_2O, C_2H_4O, NH_3, HCHO, CH_4, C_2H_6, and H_2O Emissions Data

CATERPILLAR, G3520 TALE 100% LOAD DATA SUMMARY

Parameter	100% Load, Run - 3-1	100% Load, Run - 3-2	100% Load, Run - 3-3	Average
Date (mm/dd/yy)	09/01/21	09/01/21	09/02/21	09/01/21
Start Time (hh:mm:ss)	9:23:57	10:26:27	12:03:27	9:23:57
End Time (hh:mm:ss)	10:25:57	12:02:57	13:06:27	13:06:27
Run Duration (min / run)	62	97	64	74
Bar. Pressure (in. Hg)	29.73	29.73	29.74	29.73
Amb. Temp. (°F)	88	93	95	92
Rel. Humidity (%)	70	57	46	58
Spec. Humidity (lb water / lb air)	0.020202	0.019207	0.016410	0.018606
Engine Fuel Flow (SCFH)	26,278	26,278	26,278	26,278
Stack Flow (RM19) (SCFH)	386,201	399,898	406,400	397,500
Stack Moisture (% Method 320)	13.6	12.9	13.0	13.2
Power Output (horsepower)	3,598.0	3,598.0	3,598.0	3,598.0
Engine Timing (BTDC)	22.0	22.0	22.0	22.00
Actual Power (kW)	2,613.0	2,613.0	2,613.0	2,613.00
Amperes (A)	109.0	109.0	109.0	109.00
Air Manifold Temp. (F)	136.0	136.0	136.0	136.00
Engine Speed (rpm)	1,800.0	1,800.0	1,800.0	1,800.00
NOx (as NO_2) (ppmvd)	10.21	9.38	9.85	9.81
NOx (as NO_2) (ppm@15%O_2)	4.92	4.67	4.99	4.86
NOx (as NO_2) (g/kW*hr)	0.080	0.076	0.081	0.08
NO (ppmvd)	8.60	8.67	9.35	8.87
NO (ppm@15%O_2)	4.14	4.32	4.12	4.19
NO (g/kW*hr)	0.044	0.046	0.050	0.05
NO_2 (ppmvd)	1.61	0.71	0.50	0.94
NO_2 (ppm@15%O_2)	0.78	0.35	0.90	0.68
NO_2 (g/kW*hr)	0.013	0.006	0.004	0.01
CO (ppmvd)	4.36	2.18	1.58	2.71
CO (ppm@15%O_2)	2.10	1.09	0.80	1.33
CO (g/kW*hr)	0.021	0.011	0.008	0.01
THC (as C_3H_8) (ppmvd)	114.77	107.19	108.68	110.21
THC (as C_3H_8) (ppm@15%O_2)	47.70	46.52	47.86	47.36
THC (as C_3H_8) (g/kW*hr)	0.739	0.721	0.742	0.73
VOC (as C_3H_8) (ppmvd)	0.00	0.00	0.00	0.00
VOC (as C_3H_8) (ppm@15%O_2)	0.00	0.00	0.00	0.00
VOC (as C_3H_8) (g/kW*hr)	0.000	0.000	0.000	0.00
CH_4 (as C_3H_8) (ppmvd)	176.10	165.42	161.29	167.60
CH_4 (as C_3H_8) (ppm@15%O_2)	84.74	82.43	81.68	82.95
CH_4 (as C_3H_8) (g/kW*hr)	1.316	1.280	1.269	1.29
C_2H_6 (as C_3H_8) (ppmvd)	0.00	0.28	0.45	0.24
C_2H_6 (as C_3H_8) (ppm@15%O_2)	0.00	0.14	0.23	0.12
C_2H_6 (as C_3H_8) (g/kW*hr)	0.000	0.002	0.004	0.00
N_2O (ppmvd)	2.40	1.16	0.80	1.45
N_2O (ppm@15%O_2)	1.16	0.58	0.40	0.713
N_2O (g/kW*hr)	0.018	0.009	0.006	0.01
C_2H_4O (ppmvd)	0.91	0.96	0.94	0.94
C_2H_4O (ppm@15%O_2)	0.44	0.48	0.48	0.464
C_2H_4O (g/kW*hr)	0.007	0.007	0.007	0.0072
HCHO (ppmvd)	1.29	0.82	0.61	9.07E-01
HCHO (ppm@15%O_2)	0.62	0.41	0.31	4.46E-01
HCHO (g/kW*hr)	0.007	0.004	0.003	0.005
NH_3 (ppmvd)	0.68	2.65	13.33	5.56
NH_3 (ppm@15%O_2)	0.33	1.32	6.75	2.80
NH_3 (g/kW*hr)	0.002	0.008	0.041	0.02
CO_2 (%)	6.81	6.58	6.53	6.64
CO_2 (lb/hr)	3,004.47	3,005.35	3,030.75	3,013.53
CO_2 (lb/kW*hr)	1,119.81	1,120.14	1,129.60	1,123.18
CO_2 (ton/year) at 8760 hr/year	13,159.59	13,163.45	13,274.70	13,199.25
CO_2 (lb/MMBtu)	115.57	115.57	115.57	115.57
CO_2 (g/kW*hr)	507.94	508.08	512.38	509.47
O_2 (%)	8.64	9.06	9.25	8.98

TEST RESULTS AND CALCULATIONS

50% Load
PM Emissions Data

METHOD 5 (FRONT) AND 202 (BACK) - RESULTS

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Historical Data	**R-1 50%-1**	**R-1 50%-2**	**R-1 50%-3**	**Average**	**Units**
Run Start Time	09:34	12:05	14:23		hh:mm
Run Stop Time	11:24	13:59	15:58		hh:mm
Test Date	07/29/21	07/29/21	07/29/21		mm/dd/yy
Load	50%	50%	50%		% or w/DB
Meter Calibration Factor	0.986	0.986	0.986		
Pitot Tube Coefficient	0.8215	0.8230	0.8215		
Average Nozzle Diameter	0.311	0.311	0.311		in
Stack Test Data	**R-1 50%-1**	**R-1 50%-2**	**R-1 50%-3**	**Average**	**Units**
Initial Meter Volume	59.000	96.035	133.977		ft^3
Final Meter Volume	95.989	133.682	171.362		ft^3
Total Meter Volume	36.989	37.647	37.385	37.340	ft^3
Total Sampling Time	90.00	90.00	90.00	90.00	min
Average Meter Temperature	87.00	94.63	93.96	91.86	°F
Average Stack Temperature	906.00	904.83	922.71	911.18	°F
Barometric Pressure	29.87	29.90	29.85	29.87	in Hg
Stack Static Pressure	0.07	0.07	0.07	0.07	in H_2O
Absolute Stack Pressure	29.88	29.91	29.86	29.88	in Hg
Average Orifice Pressure Drop	0.52	0.53	0.53	0.53	in H_2O
Absolute Meter Pressure	30.00	30.03	29.98	30.01	in Hg
Avg Square Root Pitot Pressure	0.41	0.42	0.41	0.41	$\sqrt{}$(in H_2O)
Moisture Content Data	**R-1 50%-1**	**R-1 50%-2**	**R-1 50%-3**	**Average**	**Units**
Impinger Water Weight Gain	117.70	117.80	115.30	116.93	g
Silica Gel Weight Gain	8.40	6.90	7.00	7.43	g
Total Water Volume Collected	126.33	124.92	122.52	124.59	ml
Standard Water Vapor Volume	5.95	5.88	5.77	5.86	scf
Standard Meter Volume	35.2	35.4	35.1	35.2	dscf
Standard Metric Meter Volume	1.0	1.0	1.0	1.0	dscm
Calculated Stack Moisture	14.45	14.26	14.11	14.27	%
Saturated Stack Moisture	100.00	100.00	100.00	100.00	%
Reported Stack Moisture Content	14.45	14.26	14.11	14.27	%
Gas Analysis Data	**R-1 50%-1**	**R-1 50%-2**	**R-1 50%-3**	**Average**	**Units**
Carbon Dioxide Content	6.7	6.7	6.8	6.7	%
Oxygen Content	8.7	8.7	8.8	8.7	%
Carbon Monoxide Content	6.0	6.0	6.4	6.1	ppm
Nitrogen Content	84.6	84.6	84.5	84.5	%
Stack Dry Molecular Weight	29.42	29.42	29.43	29.42	lb/lb-mole
Stack Wet Molecular Weight	27.77	27.79	27.82	27.79	lb/lb-mole
Calculated Fuel Factor	1.822	1.817	1.793	1.811	
Fuel F-Factor	8631.70	8631.70	8631.70	8631.70	dscf/MMBtu
Percent Excess Air	63.4	64.4	65.1	64.3	%

METHOD 5 (FRONT) AND 202 (BACK) - RESULTS

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Volumetric Flow Rate Data	**R-1 50%-1**	**R-1 50%-2**	**R-1 50%-3**	**Average**	**Units**
Average Stack Gas Velocity	37.36	37.43	37.48	37.42	ft/sec
Stack Cross-Sectional Area	5.54	5.54	5.54	5.54	ft²
Actual Stack Flow Rate	12,421	12,445	12,462	12,443	acfm
Wet Standard Stack Flow Rate	288	289	285	287	wkscfh
Dry Standard Stack Flow Rate	246,059	247,565	244,695	246,106	dscfh
Percent of Isokinetic Rate	100.2	99.9	100.3	100.1	%
Gravimetric Analysis	**R-1 50%-1**	**R-1 50%-2**	**R-1 50%-3**	**Average**	**Units**
NH_4OH Correction	0.0000	0.0000	0.0000	0.0000	ml
NH_4OH Correction	0.0000	0.0000	0.0000	0.0000	mg
Emission Rate Data	**R-1 50%-1**	**R-1 50%-2**	**R-1 50%-3**	**Average**	**Units**
Total PM Mass	18.09	14.54	9.68	14.10	mg
Total PM Concentration	5.14E-04	4.11E-04	2.76E-04	4.00E-04	g/dscf
	7.93E-03	6.34E-03	4.26E-03	6.18E-03	gr/dscf
Total PM Emission Rate	0.13	0.10	0.07	0.10	kg/hr
	0.28	0.22	0.15	0.22	lb/hr
	1.22	0.98	0.65	0.95	tpy
	0.0167	0.0134	0.0091	0.0131	lb/MMBtu
Filterable PM Mass	11.69	10.89	7.98	10.19	mg
Filterable PM Concentration	3.32E-04	3.08E-04	2.27E-04	2.89E-04	g/dscf
	5.13E-03	4.75E-03	3.51E-03	4.46E-03	gr/dscf
Filterable PM Emission Rate	0.08	0.08	0.06	0.07	kg/hr
	0.18	0.17	0.12	0.16	lb/hr
	0.79	0.74	0.54	0.69	tpy
	0.0108	0.0101	0.0075	0.0094	lb/MMBtu
Condensable PM Mass	6.40	3.65	1.70	3.92	mg
Condensable PM Concentration	1.82E-04	1.03E-04	4.84E-05	1.11E-04	g/dscf
	2.81E-03	1.59E-03	7.47E-04	1.72E-03	gr/dscf
Condensable PM Emission Rate	0.04	0.03	0.01	0.03	kg/hr
	0.10	0.06	0.03	0.06	lb/hr
	0.43	0.25	0.11	0.26	tpy
	0.0059	0.0034	0.0016	0.0036	lb/MMBtu

Nomenclature

- %CO = carbon monoxide concentration (%)
- $\%CO_2$ = carbon dioxide concentration (%)
- $\%N_2$ = nitrogen concentration (%)
- $\%O_2$ = oxygen concentration (%)
- $\%O_{2,wet}$ = Oxygen content of gas stream, % by volume of wet gas. (Note: The oxygen percentage used in Method 201A, Equation 3 is on a wet gas basis. That means that since oxygen is typically measured on a dry gas basis, the measured percent O2 must be multiplied by the quantity (1 - B_{ws}) to convert to the actual volume fraction. Therefore, $\%O_{2,wet} = (1 - B_{ws}) * \%O_{2,\ dry}$)
- $(\%EA)_{avg}$ = average excess air (%)
- $(F_o)_{avg}$ = average calculated fuel factor
- $[(\Delta p)^{0.5}]_{avg}$ = Average of square roots of the velocity pressures measured during the preliminary traverse, inches W.C.
- μ = Gas viscosity, micropoise
- 12.0 = Constant calculated as 60 percent of 20.5 square inch cross-sectional area of combined cyclone head, square inches
- 17.03 = mg/milliequivalents for ammonium ion
- 22.4 = liters of ideal gas per lb-mol of substance at 0°C and 1 atm (ref. Civil Engineering Reference Manual, 7th ed. - Michael R. Lindeburg)
- 24.04 = liters of ideal gas per lb-mol of substance at 20°C and 1 atm (ref. Civil Engineering Reference Manual, 7th ed. - Michael R. Lindeburg)
- 5.02×10^4 = constant derived from the molecular weight and correcting standard temperature and pressure (ref. Bay Area Air Quality Management District, Source Test Procedure ST-1B, Ammonia Integrated Sampling, Adopted January 20, 1982, Regulation 7-303)
- A = distance upstream (in.)
- A_D = stack diameters upstream (dia.)
- An = Area of nozzle, square feet
- A_s = area of stack (ft^2)
- B = distance downstream (in.)
- B_D = stack diameters downstream (dia.)
- b_f = Average blockage factor calculated in Equation 26, dimensionless
- B_{wm} = meter moisture content (%)
- B_{ws} = stack moisture content (%)
- C = Cunningham correction factor for particle diameter, Dp, and calculated using the actual stack gas temperature, dimensionless
- C_1 = -150.3162 (micropoise)
- C_2 = 18.0614 (micropoise/$K^{0.5}$) = 13.4622 (micropoise/$R^{0.5}$)
- C_3 = 1.19183×10^6 (micropoise/K^2) = 3.86153×10^6 (micropoise/R^2)
- C_4 = 0.591123 (micropoise)
- C_5 = 91.9723 (micropoise)
- C_6 = 4.91705×10^{-5} (micropoise/K^2) = 1.51761×10^{-5} (micropoise/R^2)
- C_a = Acetone blank concentration, mg/mg
- C_b = Concentration of NH3 ion in the back half of train (breakthrough)
- C_f = Concentration of NH3 ion in the front half of train (main catch)
- C_{fPM10} = Conc. of filterable PM_{10}, gr/dscf
- $C_{fPM2.5}$ = Conc. of filterable $PM_{2.5}$, gr/dscf
- C_k = K Factor Constant, 849.8

Nomenclature

- C_n = nozzle diameter constant, 0.03575
- C_p' = Coefficient for the pitot used in the preliminary traverse, dimensionless
- C_p = Pitot coefficient for the combined cyclone pitot, dimensionless
- C_{cpm} = Concentration of the condensable PM in the stack gas, dry basis, corrected to standard conditions, milligrams/dry standard cubic foot.
- C_r = Re-estimated Cunningham correction factor for particle diameter equivalent to the actual cut size diameter and calculated using the actual stack gas temperature, dimensionless
- D_{50} = Particle cut diameter, micrometers
- $D_{50(N+1)}$ = D_{50} value for cyclone IV calculated during the N+1 iterative step, micrometers
- D_{50-1} = Re-calculated particle cut diameters based on re-estimated C_r, micrometers
- D_{50LL} = Cut diameter for cyclone I corresponding to the 2.25 micrometer cut diameter for cyclone IV, micrometer
- D_{50N} = D_{50} value for cyclone IV calculated during the Nth iterative step, micrometers
- D_{50T} = Cyclone I cut diameter corresponding to the middle of the overlap zone shown in Method 201A, Figure 10 of Section 17, micrometers
- D_e = equivalent stack diameter (in.)
- ΔH@ = ΔH @ 0.75 scfm (in. H2O)
- ΔH_{avg} = average orifice pressure (in. H_2O)
- D_n = Inner diameter of sampling nozzle mounted on Cyclone I, inches
- D_{na} = actual nozzle diameter (in.)
- D_p = Physical particle size, micrometers
- Δp = velocity head (in. H_2O)
- Δp_1 = velocity head at first current traverse point (in. H_2O)
- $\Delta p'_1$ = velocity head at first preliminary traverse point (in. H_2O)
- Δp_{avg} = average pitot tube differential pressure (in. H_2O)
- Δp_n = velocity head at subsequent current traverse point (in. H_2O)
- Δp_{RM2} = method 2 velocity head (in. H_2O)
- D_s = diameter of stack (in.)
- F_d = fuel f-factor (dscf/MMBtu)
- f_{O2} = stack gas fraction of O_2, by volume, dry basis
- I = Percent isokinetic sampling, dimensionless
- K_1 = standard volume correction, 17.65^{o}R/in. Hg
- K_4 = isokinetic conversion constant, 0.0945min•in.Hg/sec•^{o}R
- K_5 = water mass to std water vapor, 0.04715 ft^3/g
- K_p = 85.49, ((ft/sec)/(pounds/mole -^{o}R))
- L = length of stack (in.)
- L_{fw} = distance to far wall of stack (in.)
- L_{nw} = distance to near wall of stack (in.) [reference]
- $m_{\#x}$ = weight measurements (g)
- M_1 = Milligrams of PM collected on the filter, less than or equal to 2.5 micrometers
- M_2 = Milligrams of PM recovered from Container #2 (acetone blank corrected), greater than 10 micrometers
- M_3 = Milligrams of PM recovered from Container #3 (acetone blank corrected), less than or equal to 10 and greater than 2.5 micrometers
- M_4 = Milligrams of PM recovered from Container #4 (acetone blank corrected), less than or equal to 2.5 micrometers

Nomenclature

- m_a = Mass of residue of acetone after evaporation, mg
- m_c = Mass of the NH4+ added to sample to form ammonium sulfate, mg
- m_{cpm} = Mass of the total condensable PM, mg
- M_d = Molecular weight of dry gas, pounds/pound mole
- m_{fb} = Mass of total CPM in field train recovery blank, mg
- m_{fx} = final weight, avg of last two measurements (g)
- mg = Milligram
- mg/L = Milligram per liter
- m_i = Mass of inorganic CPM, mg
- m_{ib} = Mass of inorganic CPM in field train recovery blank, mg
- M_n = total particulates (mg)
- m_o = Mass of organic CPM, mg
- m_{ob} = Mass of organic CPM in field train blank, mg
- m_r = Mass of dried sample from inorganic fraction, mg
- m_{tx} = tare weight (g)
- MW = molecular weight (lb/lb-mole)
- M_w = Molecular weight of wet gas, pounds/pound mole
- N = Normality of ammonium hydroxide titrant
- N_a = null angle (deg.)
- N_{re} = Reynolds number, dimensionless
- N_{tp} = Number of iterative steps or total traverse points
- P_b = P_{bar} = barometric pressure (in. Hg)
- P_{bar} = barometric pressure (in. Hg)
- ppmCO = carbon monoxide concentration (ppm)
- ppmv = Parts per million by volume
- ppmw = Parts per million by weight
- P_s = absolute stack pressure (in. Hg)
- P_{static} = static pressure (in. H_2O)
- P_{std} = standard pressure, 29.92 in. Hg
- Θ = total sampling time (min)
- Q_{aw} = average stack wet flow rate (ascf/min)
- Q_I = Sampling rate for cyclone I to achieve specified D_{50}
- Q_m = estimated orifice flow rate, 0.750 acfm, else Vm/Q from previous run
- Q_s = Sampling rate for cyclone I to achieve specified D_{50}
- $Q_{s(std)}$ = total cyclone flow rate at standard conditions (dscf/min)
- Q_{sd} = dry standard stack flow rate (dscfm)
- Q_{sST} = Dry gas sampling rate through the sampling assembly, dscfm
- Q_{sw} = wet standard stack flow rate (ascfm)
- R_{max} = Nozzle/stack velocity ratio parameter, dimensionless
- R_{min} = Nozzle/stack velocity ratio parameter, dimensionless
- t_1 = Sampling time at point 1, min
- t_m = average gas meter temperature (^oF)
- t_m = average meter temperature (^oF)
- T_m = Meter box and orifice gas temperature, ^oR
- t_n = Sampling time at point n, min

Nomenclature

- t_r = Total projected run time, min
- T_s = Absolute stack gas temperature, ^oR
- T_{std} = standard temperature, 68^oF, 528^oR
- T_u = absolute temperature offset, 460^oR
- V_a = Volume of acetone blank, ml
- V_{aw} = Volume of acetone used in sample recovery wash, ml
- V_b = Volume of aliquot taken for IC analysis, ml
- V_c = Quantity of water captured in impingers and silica gel, ml
- V_f = final impinger volume (ml)
- V_i = initial impinger volume (ml)
- V_{ic} = Volume of impinger contents sample, ml
- V_m = Dry gas meter volume sampled, acf
- $V_{m(std)}$ = standard meter volume (dscf)
- v_{max} = Maximum gas velocity calculated from Equations 18 or 19, ft/sec
- v_{max} = maximum nozzle velocity (ft/sec)
- V_{mf} = final dry gas meter reading (dcf)
- V_{mi} = initial dry gas meter reading (dcf)
- v_{min} = Minimum gas velocity calculated from Method 201A, Equations 16 or 17, ft/sec
- V_{ms} = Dry gas meter volume sampled, corrected to standard conditions, dscf
- v_n = Sample gas velocity in the nozzle, ft/sec
- v_{org} = organics wash volume (ml)
- V_p = Volume of water added during train purge
- v_s = average stack gas velocity (ft/sec)
- v_{sl} = local velocity (ft/sec)
- V_t = total impinger volume (ml) = ;(V_f-V_i)
- V_t = Volume of NH4OH titrant, ml
- $V_{w(std)}$ = volume of water vapor in gas sample at standard conditions (scf)
- v_x = blank volume (ml)
- W = width of stack (in.)
- $W_{2,3,4}$ = Weight of PM recovered from Containers #2, #3, and #4, mg
- W_a = Weight of blank residue in acetone used to recover samples, mg
- W_f = final impinger weight (g)
- W_i = initial impinger weight (g)
- W_t = total impinger weight (g) = ;(W_f-W_i)
- w_x = blank weight of solids (g)
- Y = meter calibration factor (a.k.a gamma)
- Z = Ratio between estimated cyclone IV D_{50} values, dimensionless
- γ = Dry gas meter gamma value, dimensionless
- ΔH = Meter box orifice pressure drop, inches W.C.
- ΔH@ = Pressure drop across orifice at flow rate of 0.75 scfm at standard conditions, inches W.C. (Note: Specific to each orifice and meter box.)
- Δp_1 = Velocity pressure measured at point 1, inches W.C.
- Δp_{avg} = Average velocity pressure, inches W.C.
- Δp_m = Observed velocity pressure using S-type pitot tube in preliminary traverse, inches W.C.
- Δp_{max} = Maximum velocity pressure, inches W.C.

Nomenclature

- Δp_{min} = Minimum velocity pressure, inches W.C.
- Δp_n = Velocity pressure measured at point n during the test run, inches W.C.
- Δp_s = Velocity pressure calculated in Method 201a, Equation 25, inches W.C.
- Δp_{s1} = Velocity pressure adjusted for combined cyclone pitot tube, inches W.C.
- Δp_{s2} = Velocity pressure corrected for blockage, inches W.C.
- θ = Total run time, min
- ρ_a = Density of acetone, mg/ml (see label on bottle)
- Σ_n = total number of sampling points

EXAMPLE CALCULATIONS (Reference Method 1 - Circular Stack)

Diameter of Stack (in.)

$$D(in.) = L_{fw} - L_{inv}$$

D (in.) = 32.00 in. - 0.13 in. = 31.88 in.

Stack Diameters Downstream

$$B_D(dia.) = \frac{B}{D}$$

B_D (dia.) = $\frac{64.00 \text{ in.}}{31.88 \text{ in.}}$ = 2.01 diameters

Area of Stack (ft^2)

$$A_s(ft^2) = \pi \times \left(\frac{D}{2 \times 12}\right)^2$$

A_s (ft^2) = 3.14 x ($\frac{31.88 \text{ in.}}{2 \text{ x } 12\text{in./ft}}$)^2 = 5.54 ft^2

Stack Diameters Upstream

$$A_D(dia.) = \frac{A}{D}$$

A_D (dia.) = $\frac{16.00 \text{ in.}}{31.88 \text{ in.}}$ = 0.50 diameters

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (Reference Method 3a) [Values from Run 1 test]

Carbon Monoxide Concentration (%)

$$\%CO = \frac{ppmCO}{10{,}000}$$

$$\%CO\ (\%) = \frac{6.03 \quad ppm}{10{,}000\ ppm/\%} = 0.0006\ \%$$

Nitrogen Concentration (%)

$$\%N_2 = 100 - \%CO_2 - \%O_2 - \%CO$$

$\%N_2$ (%) = 100 - 6.71 % - 8.67 % - 6.03 / 10,000 % = 84.62 %

Stack Dry Molecular Weight (lb/lb-mole)

$$M_d\,(lb/lb-mol) = \sum\left(\frac{MW_{comp}}{100} \times \%component\right)$$

$$M_d\ (lb/lb\text{-}mol) = \left(\frac{44\ lb/lb\text{-}mol}{100} \times 6.71\ \%\right) +$$

$$\left(\frac{32\ lb/lb\text{-}mol}{100} \times 8.67\ \%\right) + \left(\frac{28\ lb/lb\text{-}mol}{100} \times \left[\frac{6.03}{10{,}000} + 84.62\ \right]\right) = \frac{29.42\ lb}{lb\text{-}mol}$$

Stack Wet Molecular Weight (lb/lb-mole)

$$M_S\,(lb/lb-mol) = \left[M_d \times \left(1 - \frac{B_{WS}}{100}\right)\right] + \left[MW_{H_2O} \times \frac{B_{WS}}{100}\right]$$

$$M_S\ (lb/lb\text{-}mol) = \left\{\frac{29.42\ lb}{lb\text{-}mol} \times \left(1 - \frac{14.45\ \%}{100}\right)\right\} + \left\{\frac{18\ lb}{lb\text{-}mol} \times \frac{14.45\ \%}{100}\right\} = \frac{27.77\ lb}{lb\text{-}mol}$$

Average Calculated Fuel Factor (F_o)

$$F_{o(avg)} = \frac{\left[20.9 - (\%O_2)_{avg} - (0.5 \times (\%CO)_{avg})\right]}{(\%CO_2)_{avg} + (\%CO)_{avg}}$$

$$F_{o(avg)} = \frac{20.9\% - 8.67\ \% - (0.5 \times 0.001\ \%)}{6.71\ \% + 0.001\ \%} = 1.822$$

Average Excess Air (%)

$$\%EA_{avg}\,(\%) = \frac{100 \times \left[(\%O_2)_{avg} - (0.5 \times (\%CO)_{avg})\right]}{(0.264 \times (N_2)_{avg}) - \left[(\%O_2)_{avg} - (0.5 \times (\%CO)_{avg})\right]}$$

$$(\%EA)_{AVG} = \frac{100 \times \{\ 8.67\ \% - (0.5 \times 0.001\ \%)\ \}}{(\ 0.264 \times 84.62\ \%) - \{\ 8.67\ \% - (0.5 \times 0.001\ \%)\}} = 63.38\ \%$$

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (Reference Method 2) [Values from Run 1 test]

Absolute Stack Pressure (in. Hg)

$$P_S(in.Hg) = P_b + \frac{P_{static}}{13.6}$$

P_s (in. Hg) = 29.87 in. Hg + $\frac{0.07 \text{ in. } H_2O}{13.6 \text{ in. } H_2O/\text{in. Hg}}$ = 29.88 in. Hg

Average Stack Gas Velocity (ft/sec)

$$v_s(ft/\sec) = K_p \times C_p \times \left(\sqrt{\Delta p}\right)_{avg} \times \sqrt{\frac{(t_s)_{avg} + T_u}{P_s \times M_s}}$$

v_{sl} (ft/sec) =

$\left(\frac{85.49 \text{ ft (lb/lb-mol)(in. Hg)}}{\sec \quad (^oR)(\text{in. } H_2O)}\right)^{1/2}$ x 0.82 x 0.41 in.$H_2O^{1/2}$ x $\sqrt{\frac{906.00 + 460\ ^oR}{29.88 \text{ in. Hg x } 27.77 \text{ lb/lb-mol}}}$ = $\frac{37.3 \text{ ft}}{\sec}$

Average Stack Dry Standard Flow Rate (dscfh)

$$Q_{sd}(dscfh) = \frac{60 \times 60 \times \left(1 - \frac{B_{ws}}{100}\right) \times v_s \times A_s \times T_{std} \times P_s}{(t_s + T_u) \times P_{std}}$$

Q_{sd} (dscf/hr) = $\frac{3600 \text{ sec}}{\text{hr}}$ x (1 - $\frac{14.45\ \%}{100}$) x $\frac{37.36 \text{ ft}}{\sec}$ x 5.54 ft^2 x $\frac{68.00 + 460\ ^oR}{906.00 + 460\ ^oR}$ x $\frac{29.88 \text{ in. Hg}}{29.92 \text{ in. Hg}}$ = $\frac{246{,}058.86 \text{ dscf}}{\text{hr}}$

Average Stack Wet Flow Rate (acfm)

$$Q_{aw}(acfm) = 60 \times v_s \times A_s$$

Q_{aw} (acf/min) = $\frac{60 \text{ sec}}{\text{min}}$ x $\frac{37.36 \text{ ft}}{\sec}$ x 5.54 ft^2 = $\frac{12{,}420.94 \text{ acf}}{\text{min}}$

Average Stack Wet Standard Flow Rate (ascfh)

$$Q_{sw}(ascfh) = \frac{60 \times Q_{aw} \times T_{std} \times P_s}{(t_s + T_u) \times P_{std}}$$

Q_{sw} (ascf/hr) = $\frac{60 \text{ min}}{\text{hr}}$ x $\frac{12{,}420.94 \text{ acf}}{\text{min}}$ x $\frac{68.00 + 460\ ^oR}{906.00 + 460\ ^oR}$ x $\frac{29.88 \text{ in. Hg}}{29.92 \text{ in. Hg}}$ = $\frac{287{,}632.16 \text{ ascf}}{\text{hr}}$

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (Reference Method 4) [Values from Run 1 test]

Water Volume Weighed (scf)

$$V_{wsg\ (std)}(scf) = W_t \times K_5$$

$V_{wsg(std)}$ = 126.10 g x 0.04715 ft^3/g = 5.946 scf

Standard Meter Volume (dscf)

$$V_{m(std)}(dscf) = \frac{K_1 \times Y \times V_m \times \left(P_b + \frac{\Delta H_{avg}}{13.6}\right)}{(t_m)_{avg} + T_u}$$

$$V_{m(std)} = \frac{17.65\ ^\circ R}{\text{in. Hg}} \times 0.99 \times 36.99\ \text{dcf} \times \frac{(29.87\ \text{in. Hg} + \frac{0.52\ \text{in. } H_2O}{13.6\ \text{in. } H_2O / \text{in. Hg}})}{87.00\ ^\circ F + 460\ ^\circ R} = 35.19\ \text{dscf}$$

Calculated Moisture Content (%)

$$B_{ws(calc)}(\%) = 100 \times \frac{V_{wsg(std)}}{V_{wsg(std)} + V_{m(std)}}$$

$$B_{ws(calc)} = 100 \times \frac{5.95\ \text{dscf}}{5.95\ \text{dscf} + 35.19\ \text{dscf}} = 14.45\ \%$$

Saturated Moisture Content (%)

$$B_{ws(svp)}(\%) = 100 \times \frac{10^{6.691 - \frac{3144}{t_{s(avg)} + 390.86}}}{P_b + \frac{P_{static}}{13.6}} \leq 100$$

$$B_{ws(svp)} = 100 \times \frac{10^{(6.691 - \frac{3144}{906.00\ ^\circ F + 390.86})}}{29.87\ \text{in. Hg} + \frac{0.07\ \text{in. } H_2O}{13.6\ \text{in. } H_2O / \text{in. Hg}}} \leq 100 = 100.00\ \%$$

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (Isokinetic Sampling) [Values from Run 1 test]

Desired Orifice (in. H_2O) (first point)

$$\Delta H_d\,(in.H_2O) = K \times \Delta p$$

ΔH_d (in. H_2O) = 3.05 x 0.15 in. H_2O = 0.46 in. H_2O

Absolute Meter Pressure (in. Hg)

$$P_m\,(in.Hg) = P_b + \frac{\Delta H\,@}{13.6}$$

P_m (in. Hg) = 29.87 in. Hg + $\frac{1.83 \text{ in. } H_2O}{13.6 \text{ in. } H_2O/\text{in. Hg}}$ = 30.00 in. Hg

Recommended Nozzle Diameter (in.)

$$D_{nt}\,(in.) = \sqrt{\frac{C_{ti} \times Q_{mi} \times P_{mi}}{(t_{mi} + T_{ti}) \times C_p} \times \left(\frac{1 - \frac{B_{wm}}{100}}{1 - \frac{B_{ws}}{100}}\right)} \times \sqrt{(t_s + T_{ti}) \times \left[\frac{M_d \times \left(1 - \frac{B_{ws}}{100}\right) + \left(18 \times \frac{B_{ws}}{100}\right)}{P_s \times \Delta p_{avg}}\right]}$$

D_{ni} (in.) = $\sqrt{\frac{0.03575 \text{ (lb-mole•°R•in. } H_2O)^{1/2}\text{•min•in.}^2}{\text{acf•in. Hg}^{3/4}\text{•lb}^{1/2}} \text{ x } 0.75 \text{ acf x } 30.00 \text{ in. Hg } \left(1 - \frac{0.00\ \%}{100}\right) \text{ x } \left(\frac{1 - \frac{0.00\ \%}{100}}{1 - \frac{14.45\ \%}{100}}\right) \text{ x } \left[\left(87.00\ ^\circ\text{F} + 460^\circ\text{R}\right) \text{x } 0.82\right]}$

$\sqrt{(906.00\ ^\circ\text{F} + 460^\circ\text{R}) \text{ x } \frac{\frac{29.42 \text{ lb}}{\text{lb-mole}} \text{ x } \left(1 - \frac{14.45\ \%}{100}\right) + \left(\frac{18 \text{ lb}}{\text{lb-mol}} \text{ x } \frac{14.45\ \%}{100}\right)}{29.88 \text{ in. Hg x } 0.41 \text{ in. } H_2O}}$ = 0.315 in.

ΔP to ΔH Isokinetic Factor

$$K = C_k \times C_p^2 \times \Delta H\,@ \times D_{na}^4 \times \left[\frac{M_d \times \left(1 - \frac{B_{wm}}{100}\right) + \left(18 \times \frac{B_{wm}}{100}\right)}{M_d \times \left(1 - \frac{B_{ws}}{100}\right) + \left(18 \times \frac{B_{ws}}{100}\right)}\right] \times \left(\frac{1 - \frac{B_{ws}}{100}}{1 - \frac{B_{wm}}{100}}\right)^2 \times \left(\frac{t_m + T_u}{ts + T_u}\right) \times \frac{P_s}{P_m}$$

K = $\frac{849.8}{\text{in. } H_2O\text{•in.}^4}$ x 0.82 ^{2} x 1.83 in. H_2O x 0.31 ^{4} x $\left(\frac{1 - \frac{14.45\ \%}{100}}{1 - \frac{0.00\ \%}{100}}\right)^2$ x $\frac{87.00\ ^\circ\text{F} + 460^\circ\text{R}}{906.00\ ^\circ\text{F} + 460^\circ\text{R}}$) x

$\left(\frac{\frac{29.42 \text{ lb}}{\text{lb/mole}} \text{ x } \left(1 - \frac{0.00\ \%}{100}\right) + \left(\frac{18 \text{ lb}}{\text{lb-mol}} \text{ x } \frac{0.00\ \%}{100}\right)}{\frac{29.42 \text{ lb}}{\text{lb/mole}} \text{ x } \left(1 - \frac{14.45\ \%}{100}\right) + \left(\frac{18 \text{ lb}}{\text{lb-mol}} \text{ x } \frac{14.45\ \%}{100}\right)}\right)$ x $\frac{29.88 \text{ in. Hg}}{30.00 \text{ in. Hg}}$ = 3.05

Percent Isokinetic (%) (first point)

$$I\,(\%) = \frac{K_4 \times \left(\left(t_s\right)_{avg} + T_u\right) \times V_{m\,(std)}}{\left(\Theta \times \left(v_{s(l)}\right)_{avg} \times P_s \times \pi \times \left(\frac{D_{na}}{2} \times \frac{1}{12}\right)^2\right) \times \left(1 - \frac{B_{ws}}{100}\right)}$$

I (%) = $\frac{0.0945 \text{ min•in. Hg}}{\text{sec•°R}}$ x (900.00 °F + 460 °R) x 1.32 dscf

3.75 min x $\frac{34.83 \text{ ft}}{\text{sec}}$ x 29.88 in. Hg x 3.14 x $\left(\frac{0.31 \text{ in.}}{2} \text{ x } \frac{\text{ft.}}{12 \text{ in.}}\right)^2$ x $\left(1 - \frac{14.45\ \%}{100}\right)$ = 95.97 %

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (Isokinetic Sampling) [Values from Run 1 test]

Cumulative Percent Isokinetic (%) (weighted average of all points)

$$I(\%) = \sum_{1-n} \frac{\left[I(\%) \times V_{m(std)}\right]_{1-n}}{V_{m(std)_{1-n}}}$$

Using Method 5, Eq 5-8 to determine intermediate isokinetics at each point, weighted averaging of the cumulative isokinetics is necessary since all points are not equal, and determined by using the dry standard meter volume collected at each point to weight the cumulative average. Intermediate isokinetics and dry standard meter volumes are found at each point. At each point the cumulative sum is found of each value and the quotient of the two used to determine the cumulative isokinetics for each residual point (n).

Pt	In (%)	x	Vm(std)n	=	I (%)n	∑(I (%)n)	/	∑(Vm(std)n)	=	I (%)
A-1	95.97	x	1.318	=	126.45	126.45	/	1.32	=	96.0
A-2	98.04	x	1.472	=	144.30	270.76	/	2.79	=	97.1
A-3	97.62	x	1.424	=	138.97	409.72	/	4.21	=	97.3
A-4	98.77	x	1.354	=	133.70	543.42	/	5.57	=	97.6
A-5	99.56	x	1.450	=	144.34	687.76	/	7.02	=	98.0
A-6	101.42	x	1.601	=	162.36	850.12	/	8.62	=	98.7
A-7	97.68	x	1.505	=	146.99	997.11	/	10.12	=	98.5
A-8	99.63	x	1.492	=	148.69	1145.80	/	11.61	=	98.7
A-9	99.91	x	1.538	=	153.61	1299.41	/	13.15	=	98.8
A-10	100.38	x	1.544	=	155.01	1454.42	/	14.70	=	99.0
A-11	102.86	x	1.541	=	158.54	1612.95	/	16.24	=	99.3
A-12	95.96	x	1.398	=	134.20	1747.16	/	17.64	=	99.1
B-1	100.45	x	1.384	=	139.00	1886.16	/	19.02	=	99.2
B-2	97.66	x	1.384	=	135.15	2021.30	/	20.40	=	99.1
B-3	99.15	x	1.403	=	139.08	2160.39	/	21.81	=	99.1
B-4	101.47	x	1.479	=	150.04	2310.43	/	23.29	=	99.2
B-5	92.93	x	1.393	=	129.49	2439.92	/	24.68	=	98.9
B-6	109.72	x	1.646	=	180.64	2620.56	/	26.33	=	99.5
B-7	98.33	x	1.473	=	144.88	2765.45	/	27.80	=	99.5
B-8	97.10	x	1.417	=	137.57	2903.01	/	29.22	=	99.4
B-9	97.00	x	1.417	=	137.41	3040.43	/	30.63	=	99.3
B-10	107.27	x	1.565	=	167.87	3208.29	/	32.20	=	99.6
B-11	98.32	x	1.393	=	136.93	3345.22	/	33.59	=	99.6
B-12	112.75	x	1.599	=	180.25	3525.47	/	35.19	=>	100.2
Last Pt										

Percent Isokinetic (%) (intermediate equation, all points)
[equivalent to taking an average of point-by-point isokinetics without weighting the average (e.g. all points equal)]

$$I(\%) = \frac{K_4 \times \left((t_s)_{avg} + T_u\right) \times V_{m(std)}}{\left(\Theta \times (v_{s(l)})_{avg} \times P_s \times \pi \times \left(\frac{D_{na}}{2} \times \frac{1}{12}\right)^2\right) \times \left(1 - \frac{B_{ws}}{100}\right)}$$

$$I(\%) = \frac{\frac{0.0945 \text{ min•in. Hg}}{\text{sec•}^\circ\text{R}} \times (906.00\ ^\circ\text{F} + 460\ ^\circ\text{R}) \times 35.19 \text{ dscf}}{90.00 \text{ min} \times \frac{37.36 \text{ ft}}{\text{sec}} \times 29.88 \text{ in. Hg} \times 3.14 \times \left(\frac{0.31 \text{ in.}}{2} \times \frac{\text{ft.}}{12 \text{ in.}}\right)^2 \times \left(1 - \frac{14.45\ \%}{100}\right)} = 100.00\ \%$$

Raw Data Percent Isokinetic (%)
[utilizes the raw data equation for isokinetics from Method 5]

$$I(\%) = \frac{100\left((t_s)_{avg} + T_u\right)\left[K_4 V_{1c} + \frac{V_m Y}{(t_m)_{avg} + T_u}\left(P_{bar} + \frac{\Delta H}{13.6}\right)\right]}{60\left(\Theta \times (v_{s(l)})_{avg} \times P_s \times \pi \times \left(\frac{D_{na}}{2} \times \frac{1}{12}\right)^2\right)}$$

$$I(\%) = \frac{100 \times (906.00\ ^\circ\text{F} + 460\ ^\circ\text{R}) \times \left[\frac{0.002669 \text{ ft}^3\text{•in. Hg}}{\text{ml•}^\circ\text{R}} \times 126.3 \text{ ml} + \frac{36.99 \text{ dcf} \times 0.986}{87.00\ ^\circ\text{F} + 460\ ^\circ\text{R}} \times \left(29.87 \text{ in Hg} + \frac{0.415}{13.6}\right)\right]}{60 \times 90.00 \text{ min} \times \frac{37.36 \text{ ft}}{\text{sec}} \times 29.88 \text{ in. Hg} \times 3.14 \times \left(\frac{0.31 \text{ in.}}{2} \times \frac{\text{ft.}}{12 \text{ in.}}\right)^2} = 99.93\ \%$$

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (Gravimetric Analysis) [Values from Run 1 test]

Blank Concentration [Acetone Blank Weight of Solids] (mg/ml)

$$C_x(mg/ml) = \frac{1000 \times w_x}{v_x}$$

C_x (mg/ml) = $\frac{1000 \text{ mg}}{\text{g}}$ x $\frac{0.0004 \text{ g}}{137.00 \text{ ml}}$ = $\frac{0.0026 \text{ mg}}{\text{ml}}$ = $\frac{\text{mg}}{\text{ml}}$

Blank Adjustment [Acetone Blank Weight of Solids and Probe Wash] (mg)

$$W_x(mg) = v_x \times C_x$$

W_x (mg) = 200.00 ml x 0.0026 mg/ml = 0.51 mg < Sample Gain

Sample Gain [Probe Wash] (mg)

$$m_x(mg) = (m_{fx} - m_{tx}) \times 1000$$

m_x (mg) = $\frac{1000 \text{ mg}}{\text{g}}$ x (126.00 g - 125.99 g) = 9.50 mg

Adjusted Sample Gain [Probe Wash] (mg)

$$m_{xadj}(mg) = m_x - W_x$$

m_{xadj} (mg) = 9.50 mg - 0.51 mg = 8.99 mg

0.1N NH_4OH Correction (mg)

$$m_c(mg) = 17.03 \times V_t \times N$$

m_c (mg) = 17.03 x 0.00 ml x 0.1 N = 0.00 mg

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

EXAMPLE CALCULATIONS (Analysis) [Values from Run 1 test - Total PM Mass]

Stack Total Concentration (g/dscf)

$$c_s(g/dscf) = 0.001 \times \frac{M_n}{V_{m(std)}}$$

c_s (g/dscf) = $\frac{\text{g}}{\text{1000 mg}}$ x $\frac{\text{18.09 mg}}{\text{35.19 dscf}}$ = $\frac{\text{5.14E-04 g}}{\text{dscf}}$

Stack Total Concentration (gr/dscf)

$$c_s'(gr/dscf) = 0.001 \times \frac{M_n}{V_{m(std)}} \times \frac{7000}{453.592}$$

c'_s (gr/dscf) = $\frac{\text{g}}{\text{1000 mg}}$ x $\frac{\text{18.09 mg}}{\text{35.19 dscf}}$ x $\frac{\text{7000 gr}}{\text{lb}}$ x $\frac{\text{lb}}{\text{453.592 g}}$ = $\frac{\text{7.93E-03 gr}}{\text{dscf}}$

Total Emissions Rate (kg/hr)

$$E(kg/hr) = c_s \times Q_{sd} \times \frac{kg}{1000\ g}$$

E (kg/hr) = $\frac{\text{kg}}{\text{1000 g}}$ x $\frac{\text{5.14E-04 g}}{\text{dscf}}$ x $\frac{\text{246,059 dscf}}{\text{hr}}$ = $\frac{\text{0.13 kg}}{\text{hr}}$

Total Emissions Rate (lb/hr)

$$E'(lb/hr) = \frac{M_n \times Q_{sd}}{V_{m(std)}} \times \frac{lb \times g}{453.592 g \times 1000 mg}$$

E' (lb/hr) = $\frac{\text{g}}{\text{1000 mg}}$ x $\frac{\text{lb}}{\text{453.592 g}}$ x $\frac{\text{18.09 mg}}{\text{35.19 dscf}}$ x $\frac{\text{246,059 dscf}}{\text{hr}}$ = $\frac{\text{0.28 lb}}{\text{hr}}$

Total Emissions Rate (tpy)

$$E''(ton/yr) = E' \times \frac{8760}{2000}$$

E'' (tpy) = $\frac{\text{ton}}{\text{2000 lb}}$ x $\frac{\text{8,760 hr}}{\text{yr}}$ x $\frac{\text{0.28 lb}}{\text{hr}}$ = $\frac{\text{1.22 ton}}{\text{yr}}$

Total Emissions Rate (lb/MMBtu)

Oxygen Based:

$$E'''(lb/MMBtu) = \frac{M_n \times F_d}{V_{m(std)} \times 1000 \times 453.592} \times \left(\frac{20.9}{20.9 - \%O_2}\right)$$

E''' (lb/MMBtu) = $\frac{\text{g}}{\text{1000 mg}}$ x $\frac{\text{lb}}{\text{453.592 g}}$ x $\frac{\text{18.09 mg}}{\text{35.19 dscf}}$ x $\frac{\text{8,631.70 dscf}}{\text{MMBtu}}$ x ($\frac{\text{20.9}}{\text{20.9 - 8.7 \%}}$) = $\frac{\text{0.0167 lb}}{\text{MMBtu}}$

Note: Lack of significant figures may cause rounding errors between actual calculations and example calculations.

TEST RESULTS AND CALCULATIONS

75% Load
PM Emissions Data

METHOD 5 (FRONT) AND 202 (BACK) - RESULTS

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Historical Data	**R-1 75%-1**	**R-1 75%-2**	**R-1 75%-3**	**Average**	**Units**
Run Start Time	08:08	13:17	15:25		hh:mm
Run Stop Time	09:42	14:56	17:01		hh:mm
Test Date	07/30/21	07/30/21	07/30/21		mm/dd/yy
Load	75%	75%	75%		% or w/DB
Meter Calibration Factor	0.986	0.986	0.986		
Pitot Tube Coefficient	0.8230	0.8230	0.8230		
Average Nozzle Diameter	0.311	0.311	0.311		in
Stack Test Data	**R-1 75%-1**	**R-1 75%-2**	**R-1 75%-3**	**Average**	**Units**
Initial Meter Volume	171.591	224.575	278.408		ft^3
Final Meter Volume	224.305	278.151	332.354		ft^3
Total Meter Volume	52.714	53.576	53.946	53.412	ft^3
Total Sampling Time	90.00	90.00	90.00	90.00	min
Average Meter Temperature	82.33	92.13	94.79	89.75	°F
Average Stack Temperature	911.54	908.79	910.17	910.17	°F
Barometric Pressure	29.89	29.90	29.86	29.88	in Hg
Stack Static Pressure	0.21	0.21	0.21	0.21	in H_2O
Absolute Stack Pressure	29.91	29.92	29.88	29.90	in Hg
Average Orifice Pressure Drop	1.14	1.09	1.12	1.11	in H_2O
Absolute Meter Pressure	30.02	30.03	29.99	30.02	in Hg
Avg Square Root Pitot Pressure	0.60	0.59	0.60	0.60	$\sqrt{(in\ H_2O)}$
Moisture Content Data	**R-1 75%-1**	**R-1 75%-2**	**R-1 75%-3**	**Average**	**Units**
Impinger Water Weight Gain	168.90	161.90	157.20	162.67	g
Silica Gel Weight Gain	9.20	9.70	11.10	10.00	g
Total Water Volume Collected	178.42	171.91	168.60	172.98	ml
Standard Water Vapor Volume	8.40	8.09	7.94	8.14	scf
Standard Meter Volume	50.7	50.6	50.7	50.7	dscf
Standard Metric Meter Volume	1.4	1.4	1.4	1.4	dscm
Calculated Stack Moisture	14.21	13.78	13.54	13.85	%
Saturated Stack Moisture	100.00	100.00	100.00	100.00	%
Reported Stack Moisture Content	14.21	13.78	13.54	13.85	%
Gas Analysis Data	**R-1 75%-1**	**R-1 75%-2**	**R-1 75%-3**	**Average**	**Units**
Carbon Dioxide Content	6.6	6.5	6.7	6.6	%
Oxygen Content	9.0	9.0	8.9	8.9	%
Carbon Monoxide Content	3.2	4.2	3.6	3.7	ppm
Nitrogen Content	84.5	84.5	84.4	84.5	%
Stack Dry Molecular Weight	29.41	29.41	29.42	29.41	lb/lb-mole
Stack Wet Molecular Weight	27.79	27.83	27.88	27.83	lb/lb-mole
Calculated Fuel Factor	1.819	1.823	1.796	1.813	
Fuel F-Factor	8632.09	8632.09	8632.09	8632.09	dscf/MMBtu
Percent Excess Air	67.1	67.1	67.0	67.1	%

METHOD 5 (FRONT) AND 202 (BACK) - RESULTS

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Volumetric Flow Rate Data	**R-1 75%-1**	**R-1 75%-2**	**R-1 75%-3**	**Average**	**Units**
Average Stack Gas Velocity	53.86	53.62	53.76	53.75	ft/sec
Stack Cross-Sectional Area	5.54	5.54	5.54	5.54	ft²
Actual Stack Flow Rate	17,907	17,828	17,876	17,870	acfm
Wet Standard Stack Flow Rate	413	413	413	413	wkscfh
Dry Standard Stack Flow Rate	354,670	355,692	356,802	355,721	dscfh
Percent of Isokinetic Rate	100.0	99.5	99.4	99.6	%
Gravimetric Analysis	**R-1 75%-1**	**R-1 75%-2**	**R-1 75%-3**	**Average**	**Units**
NH_4OH Correction	0.0000	0.0000	0.0000	0.0000	ml
NH_4OH Correction	0.0000	0.0000	0.0000	0.0000	mg
Emission Rate Data	**R-1 75%-1**	**R-1 75%-2**	**R-1 75%-3**	**Average**	**Units**
Total PM Mass	6.11	7.36	5.34	6.27	mg
Total PM Concentration	1.20E-04	1.45E-04	1.05E-04	1.24E-04	g/dscf
	1.86E-03	2.24E-03	1.63E-03	1.91E-03	gr/dscf
Total PM Emission Rate	0.04	0.05	0.04	0.04	kg/hr
	0.09	0.11	0.08	0.10	lb/hr
	0.41	0.50	0.36	0.43	tpy
	0.0040	0.0048	0.0035	0.0041	lb/MMBtu
Filterable PM Mass	4.31	5.91	3.89	4.70	mg
Filterable PM Concentration	8.50E-05	1.17E-04	7.68E-05	9.29E-05	g/dscf
	1.31E-03	1.80E-03	1.19E-03	1.43E-03	gr/dscf
Filterable PM Emission Rate	0.03	0.04	0.03	0.03	kg/hr
	0.07	0.09	0.06	0.07	lb/hr
	0.29	0.40	0.26	0.32	tpy
	0.0028	0.0039	0.0026	0.0031	lb/MMBtu
Condensable PM Mass	1.80	1.45	1.45	1.57	mg
Condensable PM Concentration	3.55E-05	2.86E-05	2.86E-05	3.09E-05	g/dscf
	5.48E-04	4.42E-04	4.42E-04	4.77E-04	gr/dscf
Condensable PM Emission Rate	0.01	0.01	0.01	0.01	kg/hr
	0.03	0.02	0.02	0.02	lb/hr
	0.12	0.10	0.10	0.11	tpy
	0.0012	0.0010	0.0010	0.0010	lb/MMBtu

TEST RESULTS AND CALCULATIONS

100% Load
PM Emissions Data

METHOD 5 (FRONT) AND 202 (BACK) - RESULTS

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Historical Data	**R-1 100%-1**	**R-1 100%-2**	**R-1 100%-3**	**Average**	**Units**
Run Start Time	09:36	12:05	14:24		hh:mm
Run Stop Time	11:17	13:44	16:05		hh:mm
Test Date	08/31/21	08/31/21	08/31/21		mm/dd/yy
Load	100%	100%	100%		% or w/DB
Meter Calibration Factor	0.970	0.970	0.970		
Pitot Tube Coefficient	0.8230	0.8230	0.8230		
Average Nozzle Diameter	0.293	0.293	0.293		in
Stack Test Data	**R-1 100%-1**	**R-1 100%-2**	**R-1 100%-3**	**Average**	**Units**
Initial Meter Volume	921.610	984.410	48.125		ft^3
Final Meter Volume	984.105	1046.875	110.390		ft^3
Total Meter Volume	62.495	62.465	62.265	62.408	ft^3
Total Sampling Time	90.00	90.00	90.00	90.00	min
Average Meter Temperature	83.54	91.46	76.50	83.83	°F
Average Stack Temperature	877.75	878.08	876.67	877.50	°F
Barometric Pressure	29.72	29.71	29.66	29.70	in Hg
Stack Static Pressure	-0.36	-0.36	-0.36	-0.36	in H_2O
Absolute Stack Pressure	29.69	29.68	29.63	29.67	in Hg
Average Orifice Pressure Drop	1.41	1.43	1.47	1.43	in H_2O
Absolute Meter Pressure	29.85	29.84	29.79	29.83	in Hg
Avg Square Root Pitot Pressure	0.76	0.76	0.76	0.76	$\sqrt{(in\ H_2O)}$
Moisture Content Data	**R-1 100%-1**	**R-1 100%-2**	**R-1 100%-3**	**Average**	**Units**
Impinger Water Weight Gain	189.10	184.70	233.10	202.30	g
Silica Gel Weight Gain	15.10	15.60	15.30	15.33	g
Total Water Volume Collected	204.57	200.66	248.85	218.03	ml
Standard Water Vapor Volume	9.63	9.44	11.71	10.26	scf
Standard Meter Volume	58.7	57.8	59.1	58.5	dscf
Standard Metric Meter Volume	1.7	1.6	1.7	1.7	dscm
Calculated Stack Moisture	14.09	14.04	16.53	14.89	%
Saturated Stack Moisture	100.00	100.00	100.00	100.00	%
Reported Stack Moisture Content	14.09	14.04	16.53	14.89	%
Gas Analysis Data	**R-1 100%-1**	**R-1 100%-2**	**R-1 100%-3**	**Average**	**Units**
Carbon Dioxide Content	6.8	6.6	6.6	6.7	%
Oxygen Content	8.6	9.1	9.1	8.9	%
Carbon Monoxide Content	4.4	2.2	2.2	2.9	ppm
Nitrogen Content	84.6	84.4	84.4	84.4	%
Stack Dry Molecular Weight	29.44	29.41	29.41	29.42	lb/lb-mole
Stack Wet Molecular Weight	27.82	27.81	27.53	27.72	lb/lb-mole
Calculated Fuel Factor	1.800	1.800	1.800	1.800	
Fuel F-Factor	8631.42	8631.42	8631.42	8631.42	dscf/MMBtu
Percent Excess Air	63.2	68.6	68.6	66.8	%

METHOD 5 (FRONT) AND 202 (BACK) - RESULTS

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Volumetric Flow Rate Data	**R-1 100%-1**	**R-1 100%-2**	**R-1 100%-3**	**Average**	**Units**
Average Stack Gas Velocity	68.00	68.19	68.64	68.28	ft/sec
Stack Cross-Sectional Area	5.54	5.54	5.54	5.54	ft²
Actual Stack Flow Rate	22,611	22,673	22,821	22,702	acfm
Wet Standard Stack Flow Rate	531	533	536	533	wkscfh
Dry Standard Stack Flow Rate	456,526	457,773	447,146	453,815	dscfh
Percent of Isokinetic Rate	102.0	99.9	104.6	102.2	%
Gravimetric Analysis	**R-1 100%-1**	**R-1 100%-2**	**R-1 100%-3**	**Average**	**Units**
NH_4OH Correction	0.0000	0.0000	0.0000	0.0000	ml
NH_4OH Correction	0.0000	0.0000	0.0000	0.0000	mg
Emission Rate Data	**R-1 100%-1**	**R-1 100%-2**	**R-1 100%-3**	**Average**	**Units**
Total PM Mass	6.05	1.64	2.75	3.48	mg
Total PM Concentration	1.03E-04	2.84E-05	4.65E-05	5.93E-05	g/dscf
	1.59E-03	4.38E-04	7.18E-04	9.15E-04	gr/dscf
Total PM Emission Rate	0.05	0.01	0.02	0.03	kg/hr
	0.10	0.03	0.05	0.06	lb/hr
	0.45	0.13	0.20	0.26	tpy
	0.0033	0.0010	0.0016	0.0020	lb/MMBtu
Filterable PM Mass	3.60	1.05	0.00	1.55	mg
Filterable PM Concentration	6.13E-05	1.82E-05	0.00E+00	2.65E-05	g/dscf
	9.46E-04	2.80E-04	0.00E+00	4.09E-04	gr/dscf
Filterable PM Emission Rate	0.03	0.01	0.00	0.01	kg/hr
	0.06	0.02	0.00	0.03	lb/hr
	0.27	0.08	0.00	0.12	tpy
	0.0020	0.0006	0.0000	0.0009	lb/MMBtu
Condensable PM Mass	2.45	0.59	2.75	1.93	mg
Condensable PM Concentration	4.17E-05	1.02E-05	4.65E-05	3.28E-05	g/dscf
	6.44E-04	1.58E-04	7.18E-04	5.06E-04	gr/dscf
Condensable PM Emission Rate	0.02	0.00	0.02	0.01	kg/hr
	0.04	0.01	0.05	0.03	lb/hr
	0.18	0.05	0.20	0.14	tpy
	0.0014	0.0003	0.0016	0.0011	lb/MMBtu

APPENDIX B

EMISSION DATA RECORDS

EMISSION DATA RECORDS

Operating Data
(provided by Catalytic Combustion Corporation)

Catalytic Combustion Corporation

Plant Name or Location:	Stewart & Stevenson Integration Center
Project Number:	catc-21-houston.tx-start#1
Manufacturer & Equipment:	Caterpillar
Model:	G3520 TALE
Test Load:	multiple
Tester(s) / Test Unit(s):	C. King / P. McGovern / J. Wolrab / 217

		RUN								
	UNITS	**1-1**	**1-2**	**1-3**	**2-1**	**2-2**	**2-3**	**3-1**	**3-2**	**3-3**
Start Time	hh:mm:ss	09:34:23	12:05:23	14:23:23	13:45:23	15:00:23	16:27:23	09:23:57	10:26:27	12:03:27
End Time	hh:mm:ss	10:33:53	13:04:53	15:22:53	14:44:53	15:59:53	17:26:53	10:25:57	12:02:57	13:06:27
Bar. Pressure	in. Hg	29.90	29.90	29.84	29.89	29.87	29.85	29.73	29.73	29.74
Amb. Temp.	°F	98	99	96	94	97	97	88	93	95
Rel. Humidity	%	53	49	49	53	47	42	70	57	46
Spec. Humidity	lb water / lb air	0.020978	0.019455	0.018009	0.018296	0.017841	0.015856	0.020202	0.019207	0.016410
Date	mm/dd/yy	07/29/21	07/29/21	07/29/21	07/30/21	07/30/21	07/30/21	09/01/21	09/01/21	09/02/21
Load Designator		50%	50%	50%	75%	75%	75%	100%	100%	100%
Engine Fuel Flow	SCFH	14,625	14,511	14,541	20,603	20,591	20,172	26,278	26,278	26,278
Stack Moisture	% Method 320	14.41	14.43	14.39	13.91	13.86	13.59	13.64	12.89	13.03
Power Output	horsepower	1,810.4	1,813.0	1,810.4	2,691.4	2,698.1	2,616.3	3,598.0	3,598.0	3,598.0
Air Manifold Press.	psia	25.20	25.40	25.30	36.80	36.70	35.60	473.00	473.00	473.00
Air Manifold Temp.	F	122.00	122.00	124.00	131.00	131.00	129.00	136.00	136.00	136.00
Engine Speed	rpm	1,799.00	1,799.00	1,800.00	1,800.00	1,800.00	1,800.00	1,800.00	1,800.00	1,800.00
Actual Power	kW	1,350.00	1,352.00	1,350.00	2,007.00	2,012.00	1,951.00	2,613.00	2,613.00	2,613.00
Amperes	A	56.00	57.00	56.00	89.00	90.00	97.00	109.00	109.00	109.00
Engine Timing	BTDC	23.00	23.00	23.00	23.00	23.00	23.00	22.00	22.00	22.00

-Brake horsepower available from engine panel and/or site personnel.

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EMISSION DATA RECORDS

50% Load
NOx, CO, THC, N_2O, C_2H_4O, NH_3, HCHO, CH_4, C_2H_6, and H_2O
Reference Method Data

Catalytic Combustion Corporation
July 29, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	14,625	SCFH

Weather Data

Barometric Pressure	29.90	in. Hg
Relative Humidity	53	%
Ambient Temperature	98	°F
Specific Humidity	0.020978	lb H_2O / lb air

Unit Data

Unit Load	1,810.4	horsepower
Meas. Stack Moisture	14.4	%
Stack Exhaust Flow (M19)	215,406	SCFH

50% Load, Run - 1-1

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%vd)	NOx (ppmvw)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%vw)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvw)	NO_2 (ppmvw)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (ppmvw)	C_2H_6 (ppmvw)	H_2O (%)
07/29/21 09:34:23	64260	8.64	7.86	5.26	154.78	5.81	1.26	0.25	7.86	0.00	0.62	0.06	412.89	0.43	13.81
07/29/21 09:34:53	64290	8.65	7.74	5.30	155.11	5.79	1.21	0.44	7.74	0.00	0.64	0.10	411.55	0.56	14.08
07/29/21 09:35:23	64320	8.65	7.58	5.22	154.88	5.75	1.29	0.43	7.58	0.00	0.63	0.09	410.71	0.57	14.48
07/29/21 09:35:53	64350	8.64	7.82	5.31	155.59	5.81	1.28	0.48	7.82	0.00	0.60	0.09	411.45	0.58	13.77
07/29/21 09:36:23	64380	8.66	7.59	5.21	156.36	5.80	1.29	0.17	7.59	0.00	0.62	0.02	413.14	0.39	13.89
07/29/21 09:36:53	64410	8.67	7.66	5.22	154.14	5.72	1.23	0.58	7.66	0.00	0.59	0.16	407.82	0.41	14.77
07/29/21 09:37:23	64440	8.67	7.60	5.33	155.38	5.80	1.28	0.69	7.60	0.00	0.59	0.10	413.59	0.41	13.93
07/29/21 09:37:53	64470	8.68	7.65	5.30	158.32	5.85	1.29	0.25	7.65	0.00	0.57	0.03	418.84	0.54	13.40
07/29/21 09:38:23	64500	8.66	8.33	5.33	157.36	5.91	1.29	0.53	8.32	0.01	0.58	0.00	418.45	0.50	12.81
07/29/21 09:38:53	64530	8.67	7.37	5.20	155.95	5.74	1.27	0.66	7.37	0.00	0.60	0.09	413.16	0.60	14.45
07/29/21 09:39:23	64560	8.67	7.57	5.27	157.13	5.84	1.32	0.51	7.57	0.00	0.57	0.03	417.11	0.56	13.50
07/29/21 09:39:53	64590	8.66	7.52	5.27	156.37	5.82	1.32	0.08	7.52	0.00	0.54	0.06	414.39	0.44	13.72
07/29/21 09:40:23	64620	8.66	7.53	5.28	157.35	5.85	1.32	-0.02	7.53	0.00	0.56	0.15	417.90	0.47	13.41
07/29/21 09:40:53	64650	8.65	7.27	5.24	156.81	5.80	1.34	0.28	7.27	0.00	0.57	0.08	415.08	0.60	13.89
07/29/21 09:41:23	64680	8.66	6.98	5.23	153.86	5.64	1.29	0.37	6.98	0.00	0.58	0.13	406.46	0.53	15.59
07/29/21 09:41:53	64710	8.66	6.98	5.24	155.66	5.72	1.29	0.41	6.98	0.00	0.55	0.09	411.26	0.51	14.77
07/29/21 09:42:23	64740	8.66	7.08	5.29	155.72	5.74	1.29	0.39	7.08	0.00	0.58	0.07	412.49	0.52	14.72
07/29/21 09:42:53	64770	8.65	7.42	5.35	154.90	5.79	1.27	0.25	7.42	0.00	0.57	0.09	412.41	0.45	14.19
07/29/21 09:43:23	64800	8.65	7.46	5.21	156.74	5.80	1.30	0.38	7.46	0.00	0.52	0.11	414.00	0.47	13.82
07/29/21 09:43:53	64830	8.65	7.85	5.23	156.47	5.84	1.34	0.58	7.85	0.00	0.55	0.08	415.90	0.48	13.49
07/29/21 09:44:23	64860	8.65	7.19	5.23	155.54	5.69	1.27	0.05	7.19	0.00	0.54	0.03	410.51	0.64	14.97
07/29/21 09:44:53	64890	8.65	7.27	5.29	156.10	5.83	1.33	0.31	7.27	0.00	0.53	0.02	415.84	0.46	13.68
07/29/21 09:45:23	64920	8.65	7.64	5.32	156.06	5.83	1.32	0.72	7.64	0.00	0.52	0.05	414.28	0.69	13.67
07/29/21 09:45:53	64950	8.66	7.76	5.18	151.33	5.56	1.23	0.62	7.76	0.00	0.57	0.31	400.48	0.53	16.76
07/29/21 09:46:23	64980	8.66	7.68	5.36	156.15	5.82	1.33	0.51	7.68	0.00	0.53	0.10	413.91	0.58	13.79
07/29/21 09:46:53	65010	8.66	7.94	5.41	156.70	5.85	1.37	0.73	7.94	0.00	0.53	0.15	415.92	0.52	13.53
07/29/21 09:47:23	65040	8.67	7.41	5.26	156.29	5.75	1.31	0.21	7.41	0.00	0.53	0.06	413.46	0.51	14.44
07/29/21 09:47:53	65070	8.66	7.54	5.38	157.28	5.79	1.32	0.48	7.54	0.00	0.52	0.10	416.22	0.52	13.93
07/29/21 09:48:23	65100	8.65	7.31	5.35	155.73	5.78	1.31	0.51	7.31	0.00	0.52	0.10	413.92	0.53	14.18
07/29/21 09:48:53	65130	8.67	7.54	5.24	152.05	5.65	1.26	0.43	7.54	0.00	0.57	0.16	404.25	0.36	16.05
07/29/21 09:49:23	65160	8.67	6.93	5.25	155.15	5.72	1.29	0.31	6.93	0.00	0.51	0.08	412.31	0.52	14.72
07/29/21 09:49:53	65190	8.67	7.61	5.24	157.01	5.79	1.34	0.26	7.61	0.00	0.51	0.01	414.69	0.55	14.03
07/29/21 09:50:23	65220	8.67	7.36	5.25	158.02	5.80	1.36	0.36	7.36	0.00	0.50	0.07	417.65	0.35	13.99
07/29/21 09:50:53	65250	8.67	7.17	5.11	152.90	5.63	1.29	0.39	7.17	0.00	0.55	0.21	405.00	0.39	16.22
07/29/21 09:51:23	65280	8.67	7.26	5.24	156.56	5.76	1.31	0.53	7.26	0.00	0.49	0.02	414.46	0.46	14.34
07/29/21 09:51:53	65310	8.68	7.53	5.27	157.12	5.80	1.37	0.58	7.53	0.00	0.52	0.03	415.96	0.49	13.91
07/29/21 09:52:23	65340	8.68	7.31	5.25	155.62	5.76	1.39	0.56	7.31	0.00	0.49	0.10	413.86	0.40	14.28
07/29/21 09:52:53	65370	8.69	6.93	5.01	152.16	5.46	1.26	0.51	6.93	0.00	0.55	0.30	400.23	0.53	17.60
07/29/21 09:53:23	65400	8.68	6.93	5.25	157.83	5.74	1.33	0.00	6.93	0.00	0.49	0.00	416.19	0.63	14.47
07/29/21 09:53:53	65430	8.67	6.42	5.22	156.91	5.65	1.30	0.40	6.42	0.00	0.49	0.20	413.78	0.51	15.42
07/29/21 09:54:23	65460	8.67	6.94	5.06	152.99	5.49	1.26	0.48	6.94	0.00	0.56	0.24	402.97	0.43	17.51
07/29/21 09:54:53	65490	8.67	6.91	5.17	157.38	5.74	1.34	0.26	6.91	0.00	0.51	0.07	416.00	0.45	14.44
07/29/21 09:55:23	65520	8.67	6.85	5.16	156.86	5.70	1.32	0.58	6.85	0.00	0.49	0.02	413.18	0.33	14.89
07/29/21 09:55:53	65550	8.67	6.90	5.07	153.00	5.63	1.28	0.31	6.90	0.00	0.51	0.19	406.91	0.42	16.15
07/29/21 09:56:23	65580	8.66	6.69	5.24	155.68	5.68	1.32	0.43	6.69	0.00	0.48	0.08	412.23	0.37	15.24
07/29/21 09:56:53	65610	8.67	6.97	5.09	152.57	5.60	1.28	0.43	6.97	0.00	0.53	0.13	404.35	0.34	16.62
07/29/21 09:57:23	65640	8.66	6.58	5.28	155.53	5.66	1.34	0.44	6.58	0.00	0.49	0.13	412.16	0.52	15.34
07/29/21 09:57:53	65670	8.67	6.36	5.22	156.76	5.66	1.31	0.41	6.36	0.00	0.49	0.11	413.16	0.58	15.30
07/29/21 09:58:23	65700	8.66	6.58	5.21	154.91	5.65	1.26	0.40	6.58	0.00	0.49	0.06	408.84	0.50	15.58
07/29/21 09:58:53	65730	8.67	7.30	5.03	153.53	5.68	1.30	0.57	7.30	0.00	0.52	0.07	407.78	0.38	15.67
07/29/21 09:59:23	65760	8.66	7.43	5.20	153.92	5.68	1.33	0.57	7.43	0.00	0.53	0.03	408.27	0.34	15.67
07/29/21 09:59:53	65790	8.67	6.87	5.30	155.32	5.67	1.33	0.48	6.87	0.00	0.47	0.13	410.96	0.46	15.29
07/29/21 10:00:23	65820	8.67	6.83	5.20	157.56	5.72	1.31	0.27	6.83	0.00	0.48	0.15	414.63	0.64	14.74
07/29/21 10:00:53	65850	8.67	7.35	5.25	157.37	5.81	1.40	0.33	7.35	0.00	0.47	0.07	417.59	0.57	13.78
07/29/21 10:01:23	65880	8.67	7.53	5.26	159.10	5.89	1.43	0.62	7.53	0.00	0.44	0.06	422.35	0.44	12.91
07/29/21 10:01:53	65910	8.67	7.14	5.38	159.41	5.88	1.45	0.12	7.14	0.00	0.44	-0.02	424.89	0.46	12.44
07/29/21 10:02:23	65940	8.69	7.37	5.33	160.28	5.90	1.45	0.38	7.37	0.00	0.41	0.07	425.29	0.58	12.09
07/29/21 10:02:53	65970	8.70	7.13	5.17	157.58	5.85	1.42	0.66	7.13	0.00	0.42	0.02	419.90	0.43	13.24
07/29/21 10:03:23	66000	8.69	7.10	5.14	157.75	5.79	1.41	0.62	7.10	0.00	0.42	0.06	419.81	0.51	13.73
07/29/21 10:03:53	66030	8.69	7.15	5.23	157.78	5.79	1.40	0.52	7.15	0.00	0.42	0.21	418.35	0.33	13.67
07/29/21 10:04:23	66060	8.69	7.44	5.21	157.72	5.80	1.43	0.49	7.44	0.00	0.39	0.08	419.66	0.62	13.52
07/29/21 10:04:53	66090	8.70	6.64	5.17	157.56	5.71	1.42	0.22	6.64	0.00	0.44	0.13	416.02	0.67	14.71
07/29/21 10:05:23	66120	8.70	7.35	5.22	157.35	5.81	1.37	0.57	7.35	0.00	0.44	0.09	418.70	0.48	13.74
07/29/21 10:05:53	66150	8.72	7.22	5.26	158.63	5.86	1.44	0.19	7.22	0.00	0.40	0.09	422.70	0.42	13.11
07/29/21 10:06:23	66180	8.73	7.36	5.15	159.51	5.88	1.41	0.54	7.36	0.00	0.40	0.05	426.25	0.52	12.70
07/29/21 10:06:53	66210	8.72	6.96	5.24	161.63	5.86	1.47	0.32	6.96	0.00	0.39	-0.04	428.99	0.55	12.52
07/29/21 10:07:23	66240	8.71	6.95	5.23	162.42	5.88	1.47	0.47	6.95	0.00	0.39	0.02	430.75	0.51	12.30
07/29/21 10:07:53	66270	8.71	6.84	5.10	156.90	5.72	1.36	0.23	6.84	0.00	0.40	0.09	418.11	0.50	14.51
07/29/21 10:08:23	66300	8.71	6.66	5.08	157.89	5.70	1.40	0.56	6.66	0.00	0.42	0.13	418.07	0.64	14.75
07/29/21 10:08:53	66330	8.72	7.21	5.07	152.75	5.50	1.29	0.39	7.21	0.00	0.47	0.23	405.70	0.61	17.06
07/29/21 10:09:23	66360	8.72	7.06	5.22	159.18	5.78	1.46	0.54	7.06	0.00	0.41	0.14	423.51	0.68	13.88
07/29/21 10:09:53	66390	8.72	6.95	5.16	159.67	5.77	1.45	0.50	6.95	0.00	0.40	0.18	423.30	0.68	13.97
07/29/21 10:10:23	66420	8.72	6.66	5.04	157.74	5.67	1.39	0.15	6.66	0.00	0.41	0.06	418.97	0.49	14.88
07/29/21 10:10:53	66450	8.72	6.82	5.08	158.41	5.71	1.42	0.59	6.82	0.00	0.41	0.11	420.84	0.63	14.59
07/29/21 10:11:23	66480	8.72	6.77	5.11	158.91	5.75	1.42	0.62	6.77	0.00	0.43	0.16	423.31	0.45	14.30
07/29/21 10:11:53	66510	8.71	6.61	5.02	155.78	5.65	1.34	0.69	6.61	0.00	0.45	0.17	414.60	0.44	15.92
07/29/21 10:12:23	66540	8.71	6.62	5.12	158.94	5.75	1.40	0.69	6.62	0.00	0.37	0.10	422.13	0.49	14.35
07/29/21 10:12:53	66570	8.71	6.64	5.07	159.08	5.75	1.40	0.46	6.64	0.00	0.43	0.08	421.03	0.61	14.34
07/29/21 10:13:23	66600	8.70	6.52	5.06	158.62	5.71	1.36	0.30	6.52	0.00	0.38	0.13	420.44	0.60	14.77
07/29/21 10:13:53	66630	8.72	6.42	5.09	157.86	5.67	1.34	0.40	6.42	0.00	0.40	0.09	417.93	0.40	15.09
07/29/21 10:14:23	66660	8.71	6.64	4.99	159.67	5.76	1.42	0.52	6.64	0.00	0.40	0.23	424.81	0.54	13.97
07/29/21 10:14:53	66690	8.70	6.62	5.01	158.59	5.77	1.41	0.56	6.62	0.00	0.39	0.15	422.71	0.50	14.24
07/29/21 10:15:23	66720	8.70	6.43	5.11	158.14	5.76	1.42	0.59	6.43	0.00	0.39	0.03	422.97	0.56	14.18
07/29/21 10:15:53	66750	8.71	6.24	5.05	158.96	5.70	1.36	0.45	6.24	0.00	0.37	0.08	421.67	0.57	14.71
07/29/21 10:16:23	66780	8.71	6.76	5.17	159.48	5.77	1.42	0.44	6.76	0.00	0.40	-0.02	423.51	0.54	14.04
07/29/21 10:16:53	66810	8.70	6.32	5.09	158.58	5.75	1.41	0.13	6.32	0.00	0.40	0.04	422.02	0.58	14.31
07/29/21 10:17:23	66840	8.69	6.56	5.04	157.96	5.74	1.40	0.31	6.56	0.00	0.40	0.01	420.49	0.57	14.55
07/29/21 10:17:53	66870	8.70	6.80	4.99	154.72	5.59	1.33	0.52	6.80	0.00	0.44	0.14	411.17	0.46	16.33
07/29/21 10:18:23	66900	8.71	6.57	5.05	158.74	5.76	1.40	0.37	6.57	0.00	0.39	0.07	421.03	0.54	14.26
07/29/21 10:18:53	66930	8.70	6.03	5.06	157.97	5.63	1.37	0.48	6.03	0.00	0.41	0.03	417.19	0.49	15.46
07/29/21 10:19:23	66960	8.71	6.66	4.95	156.20	5.67	1.37	0.47	6.66	0.00	0.42	0.10	414.46	0.45	15.85
07/29/21 10:19:53	66990	8.70	6.27	5.10	159.48	5.73	1.37	0.27	6.27	0.00	0.38	0.02	422.14	0.58	14.48
07/29/21 10:20:23	67020	8.70	6.71	5.03	159.47	5.77	1.40	0.69	6.71	0.00	0.37	0.06	422.56	0.55	14.09
07/29/21 10:20:53	67050	8.71	6.74	5.10	159.48	5.78	1.42	0.27	6.74	0.00	0.40	0.18	422.83	0.56	13.90
07/29/21 10:21:23	67080	8.71	6.74	5.13	158.99	5.78	1.39	0.74	6.74	0.00	0.37	0.13	422.22	0.65	13.75
07/29/21 10:21:53	67110	8.72	6.60	5.11	159.46	5.77	1.38	0.70	6.60	0.00	0.38	0.09	423.55	0.66	13.89
07/29/21 10:22:23	67140	8.71	6.96	5.13	158.50	5.78	1.43	0.64	6.96	0.00	0.37	0.06	422.56	0.69	13.89
07/29/21 10:22:53	67170	8.71	6.85	5.18	159.38	5.78	1.38	0.59	6.85	0.00	0.40	0.03	423.54	0.67	13.83
07/29/21 10:23:23	67200	8.71	6.95	5.23	159.56	5.84	1.43	0.63	6.95	0.00	0.38	0.08	425.93	0.65	13.40
07/29/21 10:23:53	67230	8.71	7.25	5.21	160.73	5.85	1.39	0.43	7.25	0.00	0.38	0.08	426.85	0.51	13.26

Catalytic Combustion Corporation
July 29, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	14,625	SCFH

Weather Data

Barometric Pressure	29.90	in. Hg
Relative Humidity	53	%
Ambient Temperature	98	°F
Specific Humidity	0.020978	lb H_2O / lb air

Unit Data

Unit Load	1,810.4	horsepower
Meas. Stack Moisture	14.4	%
Stack Exhaust Flow (M19)	215,406	SCFH

50% Load, Run - 1-1

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%vd)	NOx (ppmvw)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%vw)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvw)	NO_2 (ppmvw)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (ppmvw)	C_2H_6 (ppmvw)	H_2O (%)
07/29/21 10:24:23	67260	8.71	7.08	5.07	156.27	5.64	1.39	0.47	7.08	0.00	0.39	0.17	413.62	0.50	15.82
07/29/21 10:24:53	67290	8.72	6.60	5.11	160.35	5.81	1.44	0.56	6.60	0.00	0.37	0.04	426.11	0.47	13.57
07/29/21 10:25:23	67320	8.71	6.65	5.08	159.82	5.78	1.45	0.26	6.65	0.00	0.36	0.02	423.42	0.50	13.83
07/29/21 10:25:53	67350	8.72	6.28	5.07	157.14	5.66	1.42	0.56	6.28	0.00	0.38	0.09	415.31	0.52	15.27
07/29/21 10:26:23	67380	8.74	5.86	5.08	157.56	5.62	1.41	0.57	5.86	0.00	0.37	0.12	416.39	0.48	15.59
07/29/21 10:26:53	67410	8.72	6.63	4.96	156.44	5.65	1.37	0.43	6.63	0.00	0.41	0.10	413.82	0.45	15.79
07/29/21 10:27:23	67440	8.73	5.97	4.86	153.01	5.40	1.33	0.37	5.97	0.00	0.43	0.15	403.75	0.55	18.18
07/29/21 10:27:53	67470	8.75	6.32	5.09	158.31	5.65	1.41	0.08	6.32	0.00	0.39	0.11	417.51	0.64	15.24
07/29/21 10:28:23	67500	8.75	6.48	5.11	160.05	5.72	1.44	0.44	6.48	0.00	0.37	0.13	423.17	0.54	14.46
07/29/21 10:28:53	67530	8.73	6.34	5.05	161.20	5.77	1.47	0.59	6.34	0.00	0.36	0.07	425.53	0.41	13.89
07/29/21 10:29:23	67560	8.75	6.88	5.09	161.83	5.81	1.48	0.66	6.88	0.00	0.33	0.10	427.71	0.60	13.43
07/29/21 10:29:53	67590	8.75	6.79	5.07	160.96	5.83	1.46	0.38	6.79	0.00	0.35	0.12	428.39	0.50	13.22
07/29/21 10:30:23	67620	8.74	6.66	5.05	161.91	5.85	1.50	0.59	6.66	0.00	0.37	-0.02	430.14	0.45	13.16
07/29/21 10:30:53	67650	8.74	6.77	5.01	160.93	5.84	1.50	0.51	6.77	0.00	0.34	0.03	428.55	0.66	13.37
07/29/21 10:31:23	67680	8.74	6.20	5.05	160.09	5.76	1.44	0.66	6.20	0.00	0.35	0.01	426.08	0.56	13.99
07/29/21 10:31:53	67710	8.74	6.02	4.99	158.94	5.70	1.42	0.36	6.02	0.00	0.33	0.09	422.59	0.65	14.59
07/29/21 10:32:23	67740	8.73	6.44	4.96	160.40	5.76	1.43	0.62	6.44	0.00	0.34	0.17	425.67	0.50	13.81
07/29/21 10:32:53	67770	8.73	6.37	5.02	159.65	5.77	1.41	0.60	6.37	0.00	0.31	0.15	425.11	0.50	13.72
07/29/21 10:33:23	67800	8.73	6.12	5.00	160.39	5.71	1.44	0.46	6.12	0.00	0.37	0.09	424.68	0.37	14.53
07/29/21 10:33:53	67830	8.72	6.47	4.94	159.83	5.76	1.43	0.47	6.47	0.00	0.36	0.15	424.18	0.41	13.94
RAW AVERAGE		**8.69**	**6.97**	**5.16**	**157.35**	**5.74**	**1.36**	**0.45**	**6.97**	**0.00**	**0.46**	**0.09**	**417.32**	**0.52**	**14.41**

		O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4	C_2H_6	H_2O
	Serial Number:	INST-O2-0026	INST-IR-0005	INST-IR-0005	INST-VC-0004	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005
		(%)			(ppmvw)										
Bias	**Initial Zero**	0.03			2.53										
	Final Zero	0.07			0.12										
	Avg. Zero	0.05			1.33										
	Initial UpScale	12.03			306.71										
	Final UpScale	11.98			307.25										
	Avg. UpScale	12.01			306.98										
Upscale Cal Gas		11.99			302.00										

EMISSIONS DATA	O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4 (as C_3H_8)	C_2H_6 (as C_3H_8)	VOC (as C_3H_8)
Corrected Raw Average (ppm/% dry basis)	8.67	8.15	6.03	183.85	6.71	1.59	0.52	8.15	0.00	0.54	0.11	178.78	0.40	4.67
Corrected Raw Average (ppm/% wet basis)	7.41	6.97	5.16	157.35	5.74	1.36	0.45	6.97	0.00	0.46	0.09	153.02	0.34	3.99
Concentration (ppm@ 15%O_2)	N/A	3.93	2.91	75.89	3.24	0.77	0.25	3.93	0.00	0.26	0.05	86.22	0.19	1.93
Emission Rate (g/kW*hr)	N/A	0.0704	0.0317	1.3008	555	0.0132	0.0043	0.0459	0.0000	0.0017	0.0006	1.4813	0.0033	0.0330
Non-Bias Adjusted Averages Include:		*	*	*	*	*	*			*	*	*	*	*

Catalytic Combustion Corporation
July 29, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	14,511	SCFH

Weather Data

Barometric Pressure	29.90	in. Hg
Relative Humidity	49	%
Ambient Temperature	99	°F
Specific Humidity	0.019455	lb H_2O / lb air

Unit Data

Unit Load	1,813.0	horsepower
Meas. Stack Moisture	14.4	%
Stack Exhaust Flow (M19)	215,084	SCFH

50% Load, Run - 1-2

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%vd)	NOx (ppmvw)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%vw)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvw)	NO_2 (ppmvw)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (ppmvw)	C_2H_6 (ppmvw)	H_2O (%)
07/29/21 12:05:23	73320	8.74	5.65	4.97	157.72	5.52	1.61	0.36	5.65	0.00	0.33	0.20	417.26	0.55	16.96
07/29/21 12:05:53	73350	8.74	6.03	4.98	157.68	5.64	1.61	0.81	6.03	0.00	0.32	0.06	421.08	0.48	15.97
07/29/21 12:06:23	73380	8.74	6.02	4.99	158.22	5.59	1.59	0.76	6.02	0.00	0.34	0.19	420.26	0.50	16.24
07/29/21 12:06:53	73410	8.75	5.75	5.02	161.33	5.69	1.61	0.28	5.75	0.00	0.23	0.08	428.43	0.69	14.82
07/29/21 12:07:23	73440	8.75	5.85	5.07	162.11	5.72	1.67	0.53	5.85	0.00	0.29	0.06	429.42	0.55	14.38
07/29/21 12:07:53	73470	8.76	5.84	5.07	162.44	5.65	1.63	0.61	5.84	0.00	0.27	0.01	429.28	0.59	14.98
07/29/21 12:08:23	73500	8.76	5.90	5.23	163.11	5.72	1.65	0.71	5.90	0.00	0.27	0.06	432.71	0.51	14.28
07/29/21 12:08:53	73530	8.75	5.97	5.05	163.07	5.73	1.62	0.38	5.97	0.00	0.27	-0.07	431.95	0.50	14.29
07/29/21 12:09:23	73560	8.76	6.16	5.01	159.80	5.58	1.60	0.49	6.16	0.00	0.29	0.19	422.74	0.46	16.30
07/29/21 12:09:53	73590	8.76	5.53	5.17	162.08	5.66	1.63	0.65	5.53	0.00	0.26	0.06	429.14	0.52	14.97
07/29/21 12:10:23	73620	8.76	5.75	5.01	162.41	5.70	1.64	0.70	5.75	0.00	0.28	0.05	430.34	0.59	14.61
07/29/21 12:10:53	73650	8.76	5.95	5.02	160.19	5.60	1.59	0.69	5.95	0.00	0.34	0.05	422.99	0.50	16.17
07/29/21 12:11:23	73680	8.77	5.99	4.93	159.46	5.62	1.59	0.72	5.99	0.00	0.31	0.06	422.94	0.40	16.00
07/29/21 12:11:53	73710	8.75	5.34	5.08	161.91	5.65	1.60	0.81	5.34	0.00	0.26	0.10	428.06	0.54	14.98
07/29/21 12:12:23	73740	8.76	5.42	5.09	163.03	5.67	1.63	0.68	5.42	0.00	0.25	0.09	431.63	0.58	14.81
07/29/21 12:12:53	73770	8.76	6.03	5.09	159.97	5.64	1.62	0.52	6.03	0.00	0.29	-0.04	425.37	0.59	15.70
07/29/21 12:13:23	73800	8.75	5.49	4.99	162.34	5.65	1.61	0.55	5.49	0.00	0.25	0.04	428.83	0.67	15.12
07/29/21 12:13:53	73830	8.75	5.38	5.09	162.23	5.67	1.64	0.66	5.38	0.00	0.28	0.02	430.28	0.50	14.83
07/29/21 12:14:23	73860	8.75	5.76	5.04	162.72	5.71	1.65	0.65	5.76	0.00	0.26	0.05	431.55	0.51	14.57
07/29/21 12:14:53	73890	8.75	6.15	5.02	164.38	5.82	1.67	0.50	6.15	0.00	0.23	0.04	436.74	0.41	13.44
07/29/21 12:15:23	73920	8.75	6.26	5.17	164.12	5.85	1.65	0.65	6.26	0.00	0.25	-0.03	437.36	0.41	13.25
07/29/21 12:15:53	73950	8.74	5.80	5.04	163.03	5.75	1.65	0.45	5.80	0.00	0.26	0.00	433.84	0.51	14.21
07/29/21 12:16:23	73980	8.74	6.14	5.08	163.39	5.81	1.67	0.19	6.14	0.00	0.26	0.01	435.61	0.59	13.54
07/29/21 12:16:53	74010	8.75	6.02	5.04	162.71	5.76	1.66	0.21	6.02	0.00	0.26	0.07	434.03	0.53	14.00
07/29/21 12:17:23	74040	8.75	6.47	5.25	164.94	5.84	1.72	0.58	6.47	0.00	0.25	0.01	438.59	0.53	13.05
07/29/21 12:17:53	74070	8.74	6.12	5.10	163.82	5.80	1.71	0.20	6.12	0.00	0.26	0.06	435.23	0.70	13.60
07/29/21 12:18:23	74100	8.75	6.05	5.15	163.94	5.81	1.68	0.60	6.05	0.00	0.26	0.04	436.18	0.58	13.60
07/29/21 12:18:53	74130	8.75	6.10	5.08	163.23	5.78	1.67	0.55	6.10	0.00	0.25	0.05	434.74	0.56	13.79
07/29/21 12:19:23	74160	8.74	6.47	5.11	165.21	5.88	1.71	0.38	6.37	0.09	0.24	0.12	440.00	0.48	12.74
07/29/21 12:19:53	74190	8.74	6.21	5.07	163.65	5.80	1.69	0.55	6.21	0.00	0.25	0.05	436.94	0.62	13.63
07/29/21 12:20:23	74220	8.74	6.18	5.19	163.88	5.79	1.70	0.81	6.18	0.00	0.23	0.01	436.29	0.59	13.73
07/29/21 12:20:53	74250	8.73	6.15	5.18	163.61	5.85	1.72	0.35	6.15	0.00	0.25	0.05	437.19	0.44	13.17
07/29/21 12:21:23	74280	8.74	6.20	5.06	163.47	5.82	1.69	0.72	6.20	0.00	0.23	0.08	435.26	0.59	13.46
07/29/21 12:21:53	74310	8.73	5.79	5.11	162.29	5.66	1.63	0.52	5.79	0.00	0.25	0.04	427.68	0.61	15.15
07/29/21 12:22:23	74340	8.73	6.17	5.17	163.74	5.80	1.70	0.33	6.17	0.00	0.26	-0.02	434.80	0.60	13.69
07/29/21 12:22:53	74370	8.74	6.33	5.08	164.41	5.83	1.73	0.25	6.33	0.00	0.27	0.03	435.66	0.58	13.35
07/29/21 12:23:23	74400	8.73	5.27	5.06	160.25	5.62	1.65	0.61	5.27	0.00	0.26	0.08	425.18	0.53	15.56
07/29/21 12:23:53	74430	8.73	5.98	5.11	158.20	5.57	1.57	0.49	5.98	0.00	0.32	0.20	418.90	0.49	16.73
07/29/21 12:24:23	74460	8.73	5.57	4.96	157.07	5.48	1.62	0.75	5.57	0.00	0.28	0.16	415.73	0.55	17.73
07/29/21 12:24:53	74490	8.74	5.37	5.07	157.41	5.49	1.61	0.43	5.37	0.00	0.29	0.20	417.50	0.59	17.52
07/29/21 12:25:23	74520	8.74	5.58	5.10	158.52	5.58	1.62	0.69	5.58	0.00	0.32	0.18	421.52	0.53	16.56
07/29/21 12:25:53	74550	8.75	5.53	5.14	162.47	5.68	1.65	0.47	5.53	0.00	0.26	0.06	432.09	0.51	14.99
07/29/21 12:26:23	74580	8.75	5.80	5.21	164.01	5.78	1.67	0.59	5.80	0.00	0.25	0.13	435.94	0.47	13.87
07/29/21 12:26:53	74610	8.74	6.47	5.26	164.86	5.90	1.74	0.85	6.34	0.13	0.26	0.10	438.28	0.58	12.72
07/29/21 12:27:23	74640	8.74	6.22	5.22	166.45	5.88	1.77	0.54	6.22	0.00	0.26	-0.05	442.81	0.69	12.23
07/29/21 12:27:53	74670	8.74	5.91	5.30	165.83	5.86	1.73	0.41	5.91	0.00	0.24	0.03	441.50	0.69	12.59
07/29/21 12:28:23	74700	8.73	6.07	5.32	166.04	5.87	1.78	0.02	6.07	0.00	0.26	0.03	442.40	0.62	12.23
07/29/21 12:28:53	74730	8.73	6.27	5.28	166.98	5.92	1.77	0.43	6.27	0.00	0.20	-0.05	444.80	0.80	11.80
07/29/21 12:29:23	74760	8.74	6.11	5.30	166.98	5.91	1.79	0.30	6.11	0.00	0.23	0.00	444.26	0.77	12.00
07/29/21 12:29:53	74790	8.74	6.58	5.25	162.42	5.88	1.75	0.53	6.50	0.08	0.25	0.03	436.52	0.57	12.95
07/29/21 12:30:23	74820	8.75	5.78	5.29	166.17	5.86	1.76	0.44	5.78	0.00	0.21	0.11	442.71	0.62	12.33
07/29/21 12:30:53	74850	8.75	6.15	5.18	166.93	5.86	1.81	0.50	6.15	0.00	0.21	0.01	442.86	0.73	12.32
07/29/21 12:31:23	74880	8.75	6.48	5.21	163.60	5.86	1.76	0.48	6.44	0.04	0.27	-0.03	436.85	0.64	12.95
07/29/21 12:31:53	74910	8.75	6.59	5.24	164.08	5.90	1.79	0.59	6.47	0.13	0.26	-0.06	440.15	0.54	12.68
07/29/21 12:32:23	74940	8.75	5.79	5.18	162.49	5.67	1.72	1.04	5.79	0.00	0.26	0.13	430.90	0.64	15.02
07/29/21 12:32:53	74970	8.77	6.46	5.17	163.21	5.81	1.77	0.51	6.46	0.00	0.23	0.11	435.69	0.61	13.41
07/29/21 12:33:23	75000	8.77	6.39	5.22	164.40	5.81	1.71	0.83	6.39	0.00	0.24	0.16	437.64	0.62	13.43
07/29/21 12:33:53	75030	8.77	6.04	5.19	163.14	5.73	1.70	0.61	6.04	0.00	0.24	-0.01	434.37	0.64	14.22
07/29/21 12:34:23	75060	8.76	6.39	5.07	159.93	5.62	1.66	0.59	6.14	0.25	0.31	0.16	426.09	0.51	15.71
07/29/21 12:34:53	75090	8.77	6.12	5.05	162.94	5.73	1.70	0.86	6.12	0.00	0.24	0.09	434.06	0.58	14.36
07/29/21 12:35:23	75120	8.77	6.13	5.12	164.71	5.74	1.71	0.76	6.13	0.00	0.25	0.07	437.40	0.63	14.16
07/29/21 12:35:53	75150	8.76	6.16	5.21	164.42	5.78	1.75	0.74	6.16	0.00	0.24	0.03	437.52	0.59	13.73
07/29/21 12:36:23	75180	8.77	6.63	5.24	166.47	5.87	1.71	0.72	6.50	0.13	0.28	-0.01	441.97	0.46	12.81
07/29/21 12:36:53	75210	8.77	5.82	5.06	163.57	5.71	1.68	0.45	5.82	0.00	0.27	0.09	433.06	0.50	14.50
07/29/21 12:37:23	75240	8.77	6.15	5.13	164.88	5.79	1.72	0.58	6.15	0.00	0.24	0.01	437.65	0.63	13.65
07/29/21 12:37:53	75270	8.78	6.28	5.08	165.53	5.81	1.74	0.56	6.28	0.00	0.26	0.01	439.28	0.47	13.26
07/29/21 12:38:23	75300	8.77	5.58	4.97	163.95	5.68	1.69	0.29	5.58	0.00	0.24	-0.02	433.38	0.60	14.80
07/29/21 12:38:53	75330	8.77	6.04	5.16	164.05	5.78	1.70	0.42	6.04	0.00	0.26	0.06	436.84	0.50	13.71
07/29/21 12:39:23	75360	8.76	6.10	5.12	165.45	5.77	1.70	0.39	6.10	0.00	0.24	0.05	438.92	0.65	13.81
07/29/21 12:39:53	75390	8.76	5.42	5.11	163.66	5.63	1.66	0.53	5.42	0.00	0.24	0.10	432.93	0.49	15.34
07/29/21 12:40:23	75420	8.77	5.98	5.11	163.72	5.76	1.70	0.76	5.98	0.00	0.25	0.04	435.37	0.66	14.01
07/29/21 12:40:53	75450	8.76	5.36	5.08	162.30	5.64	1.67	0.67	5.36	0.00	0.26	0.08	431.41	0.50	15.21
07/29/21 12:41:23	75480	8.76	5.93	5.03	163.13	5.73	1.69	0.43	5.93	0.00	0.24	0.06	432.88	0.66	14.33
07/29/21 12:41:53	75510	8.76	6.16	5.20	163.65	5.76	1.69	0.59	6.16	0.00	0.24	0.10	435.09	0.68	13.93
07/29/21 12:42:23	75540	8.76	5.48	5.07	162.03	5.64	1.65	0.66	5.48	0.00	0.23	0.01	430.44	0.53	15.14
07/29/21 12:42:53	75570	8.77	6.03	5.15	164.31	5.77	1.69	0.91	6.03	0.00	0.24	0.10	438.15	0.72	13.89
07/29/21 12:43:23	75600	8.76	5.64	5.11	163.91	5.71	1.67	0.57	5.64	0.00	0.24	0.10	436.43	0.75	14.20
07/29/21 12:43:53	75630	8.76	5.76	5.08	159.52	5.54	1.59	0.50	5.76	0.00	0.25	0.13	422.67	0.52	16.76
07/29/21 12:44:23	75660	8.75	5.27	4.96	158.25	5.48	1.59	0.71	5.27	0.00	0.28	0.16	418.87	0.57	17.54
07/29/21 12:44:53	75690	8.75	5.45	4.94	158.55	5.53	1.62	0.73	5.45	0.00	0.27	0.14	421.18	0.62	17.09
07/29/21 12:45:23	75720	8.75	5.99	5.06	158.98	5.61	1.63	0.79	5.99	0.00	0.28	0.14	423.23	0.59	16.25
07/29/21 12:45:53	75750	8.75	5.56	5.02	158.75	5.56	1.63	0.97	5.56	0.00	0.29	0.21	421.82	0.61	16.70
07/29/21 12:46:23	75780	8.76	5.56	5.00	160.57	5.59	1.63	0.55	5.56	0.00	0.29	0.18	424.76	0.55	16.54
07/29/21 12:46:53	75810	8.75	5.09	4.96	158.23	5.44	1.61	0.75	5.09	0.00	0.28	0.20	417.03	0.44	17.99
07/29/21 12:47:23	75840	8.75	5.79	5.05	159.97	5.59	1.62	0.91	5.79	0.00	0.30	0.08	422.93	0.51	16.37
07/29/21 12:47:53	75870	8.75	5.33	5.05	162.45	5.61	1.63	0.52	5.33	0.00	0.24	0.08	429.46	0.56	15.49
07/29/21 12:48:23	75900	8.75	5.50	5.10	162.70	5.68	1.67	0.48	5.50	0.00	0.24	0.03	432.46	0.66	15.02
07/29/21 12:48:53	75930	8.75	5.96	5.11	163.85	5.74	1.68	0.76	5.96	0.00	0.25	0.02	434.46	0.57	14.27
07/29/21 12:49:23	75960	8.75	5.80	5.05	164.03	5.73	1.71	0.74	5.80	0.00	0.24	-0.01	434.25	0.55	14.24
07/29/21 12:49:53	75990	8.76	5.98	5.08	165.09	5.76	1.69	0.37	5.98	0.00	0.26	0.05	436.73	0.57	14.11
07/29/21 12:50:23	76020	8.76	5.73	5.11	164.95	5.73	1.70	0.65	5.73	0.00	0.22	0.02	435.93	0.58	14.36
07/29/21 12:50:53	76050	8.76	5.67	5.10	163.86	5.72	1.66	0.60	5.67	0.00	0.23	0.01	433.77	0.58	14.47
07/29/21 12:51:23	76080	8.75	6.02	5.21	164.77	5.74	1.72	0.76	6.02	0.00	0.22	0.04	435.93	0.40	14.13
07/29/21 12:51:53	76110	8.75	5.95	5.15	163.95	5.76	1.70	0.35	5.95	0.00	0.22	0.06	434.96	0.63	13.93
07/29/21 12:52:23	76140	8.77	6.17	5.19	164.30	5.79	1.70	0.62	6.17	0.00	0.24	0.01	436.08	0.41	13.68
07/29/21 12:52:53	76170	8.75	6.25	5.16	165.23	5.84	1.73	0.79	6.25	0.00	0.23	0.12	439.02	0.60	13.16
07/29/21 12:53:23	76200	8.75	6.37	5.19	166.19	5.86	1.75	0.95	6.36	0.01	0.23	-0.02	440.99	0.60	12.84
07/29/21 12:53:53	76230	8.75	5.84	5.29	168.38	5.85	1.76	0.32	5.84	0.00	0.21	-0.03	446.24	0.60	12.51
07/29/21 12:54:23	76260	8.76	5.77	5.25	168.62	5.85	1.74	0.46	5.77	0.00	0.20	0.05	447.07	0.50	12.38
07/29/21 12:54:53	76290	8.76	5.90	5.15	168.23	5.86	1.75	0.42	5.90	0.00	0.20	0.00	447.33	0.53	12.26

Catalytic Combustion Corporation
July 29, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	14,511	SCFH

Weather Data

Barometric Pressure	29.90	in. Hg
Relative Humidity	49	%
Ambient Temperature	99	°F
Specific Humidity	0.019455	lb H_2O / lb air

Unit Data

Unit Load	1,813.0	horsepower
Meas. Stack Moisture	14.4	%
Stack Exhaust Flow (M19)	215,084	SCFH

50% Load, Run - 1-2

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%vd)	NOx (ppmvw)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%vw)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvw)	NO_2 (ppmvw)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (ppmvw)	C_2H_6 (ppmvw)	H_2O (%)
07/29/21 12:55:23	76320	8.76	6.06	5.10	167.19	5.86	1.74	0.41	6.06	0.00	0.18	-0.07	445.98	0.62	12.24
07/29/21 12:55:53	76350	8.76	5.92	5.16	167.99	5.86	1.75	0.55	5.92	0.00	0.21	-0.03	445.39	0.45	12.28
07/29/21 12:56:23	76380	8.76	5.93	5.23	167.33	5.84	1.75	0.29	5.93	0.00	0.19	-0.02	444.51	0.60	12.45
07/29/21 12:56:53	76410	8.75	6.08	5.05	163.58	5.73	1.68	0.58	6.08	0.00	0.24	0.12	434.27	0.47	14.32
07/29/21 12:57:23	76440	8.76	5.80	5.20	167.64	5.85	1.73	0.50	5.80	0.00	0.19	-0.09	445.33	0.52	12.41
07/29/21 12:57:53	76470	8.75	6.40	5.17	165.84	5.84	1.74	0.46	6.40	0.00	0.18	0.05	440.59	0.54	13.04
07/29/21 12:58:23	76500	8.76	6.01	5.12	167.99	5.85	1.75	0.51	6.01	0.00	0.19	-0.07	446.51	0.59	12.43
07/29/21 12:58:53	76530	8.77	6.31	5.12	167.32	5.85	1.76	0.69	6.31	0.00	0.21	-0.02	443.84	0.43	12.92
07/29/21 12:59:23	76560	8.75	6.21	5.26	164.10	5.76	1.72	1.11	6.21	0.00	0.21	-0.02	436.99	0.65	13.94
07/29/21 12:59:53	76590	8.75	6.01	5.18	163.97	5.73	1.73	0.53	6.01	0.00	0.20	-0.01	435.04	0.53	14.37
07/29/21 13:00:23	76620	8.75	5.60	5.03	160.43	5.57	1.63	0.75	5.60	0.00	0.26	0.11	423.43	0.33	16.72
07/29/21 13:00:53	76650	8.75	5.60	4.94	159.29	5.56	1.64	0.59	5.60	0.00	0.28	0.19	421.81	0.39	16.76
07/29/21 13:01:23	76680	8.75	5.64	4.93	158.82	5.53	1.65	0.57	5.64	0.00	0.26	0.13	420.39	0.33	17.09
07/29/21 13:01:53	76710	8.75	5.70	5.08	159.50	5.57	1.64	0.81	5.70	0.00	0.26	0.03	422.34	0.49	16.78
07/29/21 13:02:23	76740	8.76	5.64	5.11	159.63	5.58	1.68	0.75	5.64	0.00	0.27	0.05	424.61	0.45	16.71
07/29/21 13:02:53	76770	8.76	5.52	5.04	159.95	5.56	1.66	0.68	5.52	0.00	0.27	0.19	423.86	0.58	16.81
07/29/21 13:03:23	76800	8.77	5.67	5.04	161.08	5.59	1.66	0.63	5.67	0.00	0.27	0.26	427.24	0.49	16.33
07/29/21 13:03:53	76830	8.76	5.26	5.05	163.14	5.62	1.65	0.43	5.26	0.00	0.22	0.04	431.38	0.58	15.40
07/29/21 13:04:23	76860	8.77	5.78	5.15	163.71	5.70	1.71	0.32	5.78	0.00	0.22	0.08	433.27	0.63	14.61
07/29/21 13:04:53	76890	8.78	6.05	5.14	164.89	5.78	1.75	0.54	6.05	0.00	0.23	0.13	439.92	0.49	13.61
RAW AVERAGE		**8.75**	**5.92**	**5.11**	**163.11**	**5.72**	**1.68**	**0.58**	**5.91**	**0.01**	**0.25**	**0.06**	**433.10**	**0.56**	**14.43**

		O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4	C_2H_6	H_2O
	Serial Number:	INST-O2-0026	INST-IR-0005	INST-IR-0005	INST-VC-0004	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005
		(%)			(ppmvw)										
Bias	**Initial Zero**	0.07			0.12										
Bias	**Final Zero**	0.08			0.21										
Bias	**Avg. Zero**	0.08			0.17										
Bias	**Initial UpScale**	11.98			307.25										
Bias	**Final UpScale**	11.97			317.42										
Bias	**Avg. UpScale**	11.98			312.34										
Upscale Cal Gas		11.99			302.00										

EMISSIONS DATA	O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4 (as C_3H_8)	C_2H_6 (as C_3H_8)	VOC (as C_3H_8)
Corrected Raw Average (ppm/% dry basis)	8.74	6.92	5.97	190.60	6.69	1.97	0.68	6.91	0.01	0.29	0.07	185.57	0.44	4.59
Corrected Raw Average (ppm/% wet basis)	7.47	5.92	5.11	163.11	5.72	1.68	0.58	5.91	0.01	0.25	0.06	158.80	0.37	3.93
Concentration (ppm@ 15%O_2)	N/A	3.36	2.90	79.16	3.25	0.95	0.33	3.35	0.004	0.14	0.03	90.07	0.21	1.91
Emission Rate (g/hp*hr)	N/A	0.0596	0.0313	1.3443	552	0.0162	0.0056	0.0388	0.0001	0.0009	0.0004	1.5330	0.0036	0.0324
Non-Bias Adjusted Averages Include:		*	*	*	*	*	*			*	*	*	*	*

Catalytic Combustion Corporation
July 29, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	14,541	SCFH

Weather Data

Barometric Pressure	29.84	in. Hg
Relative Humidity	49	%
Ambient Temperature	96	°F
Specific Humidity	0.018009	lb H_2O / lb air

Unit Data

Unit Load	1,810.4	horsepower
Meas. Stack Moisture	14.4	%
Stack Exhaust Flow (M19)	216,383	SCFH

50% Load, Run - 1-3

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%vd)	NOx (ppmvw)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%vw)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvw)	NO_2 (ppmvw)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (ppmvw)	C_2H_6 (ppmvw)	H_2O (%)
07/29/21 14:23:23	81600	8.78	4.95	5.16	160.80	5.49	1.63	2.32	4.95	0.00	0.53	-0.04	424.48	0.33	17.94
07/29/21 14:23:53	81630	8.80	5.37	5.46	161.71	5.56	1.63	2.68	5.37	0.00	0.53	0.19	427.08	0.20	17.27
07/29/21 14:24:23	81660	8.79	5.31	5.38	165.50	5.71	1.74	1.99	5.31	0.00	0.48	-0.04	437.77	0.18	15.00
07/29/21 14:24:53	81690	8.79	5.86	5.38	167.69	5.82	1.74	2.19	5.86	0.00	0.49	0.14	442.26	0.28	13.92
07/29/21 14:25:23	81720	8.79	6.05	5.45	168.15	5.88	1.81	2.56	6.05	0.00	0.47	0.04	446.56	0.07	13.27
07/29/21 14:25:53	81750	8.80	6.27	5.44	169.12	5.92	1.77	2.07	6.27	0.00	0.49	0.09	449.64	0.14	12.83
07/29/21 14:26:23	81780	8.79	5.52	5.43	170.76	5.88	1.80	2.33	5.52	0.00	0.46	-0.05	452.62	0.34	12.62
07/29/21 14:26:53	81810	8.78	5.61	5.46	171.47	5.91	1.85	2.73	5.61	0.00	0.46	-0.10	452.40	0.08	12.43
07/29/21 14:27:23	81840	8.79	5.77	5.52	169.64	5.93	1.82	3.17	5.77	0.00	0.46	-0.14	452.20	0.28	12.27
07/29/21 14:27:53	81870	8.80	5.66	5.54	170.61	5.91	1.80	2.67	5.66	0.00	0.46	-0.01	452.92	0.41	12.32
07/29/21 14:28:23	81900	8.80	5.91	5.48	172.15	5.93	1.81	2.80	5.91	0.00	0.48	0.09	453.61	0.46	12.23
07/29/21 14:28:53	81930	8.80	6.28	5.45	169.39	5.92	1.78	2.81	6.28	0.00	0.48	0.08	449.09	0.27	12.78
07/29/21 14:29:23	81960	8.79	6.28	5.44	168.54	5.88	1.82	2.37	6.28	0.00	0.50	0.01	445.93	0.21	13.28
07/29/21 14:29:53	81990	8.79	5.36	5.54	166.36	5.64	1.69	2.73	5.36	0.00	0.54	0.07	436.27	0.31	15.67
07/29/21 14:30:23	82020	8.79	5.22	5.39	165.98	5.72	1.71	2.83	5.22	0.00	0.55	0.04	439.28	0.01	15.06
07/29/21 14:30:53	82050	8.79	5.43	5.55	166.77	5.75	1.70	2.43	5.43	0.00	0.51	0.07	441.40	0.14	14.62
07/29/21 14:31:23	82080	8.78	6.19	5.48	169.12	5.91	1.82	3.16	6.19	0.00	0.51	0.02	449.39	-0.01	12.93
07/29/21 14:31:53	82110	8.78	5.34	5.43	168.06	5.72	1.74	2.96	5.34	0.00	0.53	0.09	441.58	0.19	15.00
07/29/21 14:32:23	82140	8.77	5.89	5.57	167.80	5.84	1.69	2.57	5.89	0.00	0.51	0.04	444.75	0.10	13.63
07/29/21 14:32:53	82170	8.78	5.16	5.45	164.86	5.66	1.72	3.25	5.16	0.00	0.50	-0.09	434.52	0.03	15.59
07/29/21 14:33:23	82200	8.79	5.16	5.45	166.79	5.70	1.72	3.17	5.16	0.00	0.53	-0.05	438.21	0.22	15.35
07/29/21 14:33:53	82230	8.78	5.78	5.49	167.12	5.80	1.78	2.88	5.78	0.00	0.53	0.07	442.07	0.03	14.33
07/29/21 14:34:23	82260	8.78	5.58	5.58	167.75	5.77	1.74	3.29	5.58	0.00	0.52	0.10	442.15	0.17	14.54
07/29/21 14:34:53	82290	8.78	6.06	5.47	168.78	5.87	1.82	2.75	6.06	0.00	0.51	0.12	444.97	-0.08	13.60
07/29/21 14:35:23	82320	8.79	5.56	5.45	166.09	5.73	1.72	3.07	5.56	0.00	0.50	-0.13	440.25	0.18	14.83
07/29/21 14:35:53	82350	8.80	5.09	5.58	164.50	5.66	1.74	3.84	5.09	0.00	0.51	0.11	435.81	-0.11	15.61
07/29/21 14:36:23	82380	8.80	5.39	5.38	166.11	5.69	1.76	3.86	5.39	0.00	0.53	0.15	438.50	0.33	15.35
07/29/21 14:36:53	82410	8.80	5.16	5.48	166.36	5.68	1.73	3.63	5.16	0.00	0.49	-0.02	438.78	0.17	15.48
07/29/21 14:37:23	82440	8.80	5.38	5.47	167.09	5.72	1.79	2.63	5.38	0.00	0.50	0.03	440.56	0.23	15.21
07/29/21 14:37:53	82470	8.79	5.73	5.49	167.74	5.77	1.76	2.23	5.73	0.00	0.53	0.05	442.68	0.30	14.51
07/29/21 14:38:23	82500	8.79	5.93	5.57	167.54	5.84	1.81	2.20	5.93	0.00	0.50	0.05	442.88	0.33	13.72
07/29/21 14:38:53	82530	8.80	5.92	5.52	167.15	5.85	1.78	1.34	5.92	0.00	0.46	-0.08	444.54	0.37	13.64
07/29/21 14:39:23	82560	8.80	5.96	5.39	168.48	5.86	1.81	1.79	5.96	0.00	0.43	-0.07	446.71	0.10	13.57
07/29/21 14:39:53	82590	8.80	6.15	5.53	168.85	5.85	1.79	2.09	6.15	0.00	0.49	-0.01	445.04	0.05	13.56
07/29/21 14:40:23	82620	8.80	5.75	5.52	164.93	5.67	1.72	2.59	5.75	0.00	0.55	0.10	434.83	-0.15	15.92
07/29/21 14:40:53	82650	8.80	5.73	5.42	167.39	5.81	1.77	2.46	5.73	0.00	0.50	0.11	444.58	0.13	14.15
07/29/21 14:41:23	82680	8.80	5.98	5.47	168.67	5.81	1.80	2.56	5.98	0.00	0.49	-0.04	444.49	0.10	13.93
07/29/21 14:41:53	82710	8.80	5.91	5.49	168.80	5.81	1.73	2.74	5.91	0.00	0.50	0.01	443.84	0.23	14.01
07/29/21 14:42:23	82740	8.81	6.11	5.59	169.71	5.90	1.79	2.94	6.11	0.00	0.46	0.03	448.08	0.23	13.04
07/29/21 14:42:53	82770	8.81	5.80	5.47	172.69	5.90	1.83	3.45	5.80	0.00	0.48	-0.14	452.83	0.24	12.42
07/29/21 14:43:23	82800	8.80	5.81	5.67	172.59	5.91	1.78	3.07	5.81	0.00	0.42	0.02	453.92	0.20	12.45
07/29/21 14:43:53	82830	8.81	5.09	5.50	167.01	5.66	1.72	3.62	5.09	0.00	0.47	0.08	438.48	0.14	15.58
07/29/21 14:44:23	82860	8.79	5.39	5.49	167.29	5.70	1.72	3.40	5.39	0.00	0.52	0.01	439.63	0.23	15.14
07/29/21 14:44:53	82890	8.81	5.62	5.48	163.22	5.61	1.70	3.82	5.62	0.00	0.55	0.05	429.02	-0.14	16.69
07/29/21 14:45:23	82920	8.81	5.73	5.30	164.65	5.69	1.71	2.95	5.73	0.00	0.52	0.13	434.04	-0.01	15.68
07/29/21 14:45:53	82950	8.81	5.69	5.28	163.51	5.67	1.70	3.23	5.69	0.00	0.54	0.05	432.98	0.05	16.07
07/29/21 14:46:23	82980	8.81	6.03	5.40	170.06	5.83	1.77	3.20	6.03	0.00	0.51	0.06	446.16	0.41	13.87
07/29/21 14:46:53	83010	8.82	6.23	5.39	170.35	5.89	1.76	3.11	6.23	0.00	0.49	0.01	449.65	0.18	13.15
07/29/21 14:47:23	83040	8.81	6.42	5.45	172.15	5.91	1.80	3.33	6.42	0.00	0.49	-0.06	451.03	0.22	12.83
07/29/21 14:47:53	83070	8.81	6.29	5.41	170.90	5.91	1.78	3.93	6.29	0.00	0.47	0.19	450.96	-0.10	13.04
07/29/21 14:48:23	83100	8.81	5.86	5.54	171.81	5.87	1.73	3.40	5.86	0.00	0.47	0.17	450.39	0.44	13.33
07/29/21 14:48:53	83130	8.79	5.77	5.48	168.01	5.79	1.75	3.23	5.77	0.00	0.49	0.08	442.59	0.37	14.26
07/29/21 14:49:23	83160	8.80	6.08	5.36	167.93	5.85	1.82	3.41	6.08	0.00	0.49	0.02	444.75	0.08	13.75
07/29/21 14:49:53	83190	8.80	6.31	5.45	170.99	5.91	1.77	3.96	6.31	0.00	0.48	0.19	449.23	0.05	13.02
07/29/21 14:50:23	83220	8.80	5.93	5.47	171.70	5.91	1.78	3.28	5.87	0.05	0.51	0.04	453.00	0.17	12.99
07/29/21 14:50:53	83250	8.79	6.14	5.57	168.75	5.85	1.79	3.45	6.14	0.00	0.47	-0.04	446.83	0.16	13.73
07/29/21 14:51:23	83280	8.79	5.42	5.64	167.50	5.73	1.75	2.88	5.42	0.00	0.54	0.11	442.06	0.09	14.99
07/29/21 14:51:53	83310	8.79	6.01	5.55	168.48	5.85	1.79	3.30	6.01	0.00	0.50	-0.03	444.62	0.41	13.68
07/29/21 14:52:23	83340	8.79	5.94	5.55	169.27	5.87	1.82	3.90	5.94	0.00	0.49	-0.04	446.93	0.16	13.47
07/29/21 14:52:53	83370	8.80	5.89	5.56	168.39	5.83	1.74	3.97	5.89	0.00	0.48	-0.04	445.78	0.05	13.98
07/29/21 14:53:23	83400	8.79	5.57	5.34	168.40	5.79	1.78	3.78	5.57	0.00	0.48	0.10	441.72	0.12	14.29
07/29/21 14:53:53	83430	8.79	5.23	5.32	166.81	5.67	1.70	3.95	5.23	0.00	0.48	-0.01	438.21	-0.05	15.51
07/29/21 14:54:23	83460	8.79	5.75	5.46	169.85	5.83	1.80	4.03	5.75	0.00	0.49	0.01	445.59	0.49	13.88
07/29/21 14:54:53	83490	8.81	6.50	5.57	170.05	5.91	1.82	3.84	6.50	0.00	0.47	0.15	450.21	-0.16	12.90
07/29/21 14:55:23	83520	8.81	6.34	5.53	171.04	5.92	1.82	4.12	6.31	0.03	0.45	-0.08	451.16	0.11	12.84
07/29/21 14:55:53	83550	8.81	5.69	5.52	173.10	5.88	1.84	3.64	5.65	0.04	0.45	-0.04	454.28	0.42	12.59
07/29/21 14:56:23	83580	8.80	5.85	5.58	173.02	5.93	1.81	3.85	5.85	0.00	0.46	-0.01	456.06	0.10	12.21
07/29/21 14:56:53	83610	8.81	5.93	5.43	170.25	5.79	1.74	4.21	5.93	0.00	0.48	0.10	444.80	0.23	14.05
07/29/21 14:57:23	83640	8.80	5.96	5.61	172.82	5.94	1.85	3.63	5.96	0.00	0.47	0.15	456.92	0.30	12.07
07/29/21 14:57:53	83670	8.79	5.48	5.41	168.27	5.76	1.75	3.36	5.48	0.00	0.45	-0.04	440.87	-0.17	14.76
07/29/21 14:58:23	83700	8.79	6.16	5.55	170.26	5.89	1.80	3.95	6.16	0.00	0.47	-0.03	447.57	-0.08	13.34
07/29/21 14:58:53	83730	8.79	6.30	5.43	169.57	5.90	1.80	2.96	6.30	0.00	0.46	-0.07	446.85	0.00	13.17
07/29/21 14:59:23	83760	8.80	5.48	5.41	168.55	5.69	1.73	3.24	5.48	0.00	0.52	0.06	439.03	0.29	15.22
07/29/21 14:59:53	83790	8.80	5.60	5.43	168.31	5.75	1.76	4.09	5.60	0.00	0.48	0.17	442.60	0.10	14.72
07/29/21 15:00:23	83820	8.81	6.18	5.55	169.79	5.83	1.77	3.53	6.18	0.00	0.47	-0.07	446.44	0.08	13.82
07/29/21 15:00:53	83850	8.81	5.39	5.68	168.20	5.72	1.75	3.67	5.39	0.00	0.48	-0.02	440.72	0.15	15.05
07/29/21 15:01:23	83880	8.82	5.86	5.43	169.35	5.81	1.80	3.03	5.86	0.00	0.52	0.01	444.94	0.03	14.15
07/29/21 15:01:53	83910	8.82	5.97	5.54	170.24	5.81	1.78	3.21	5.97	0.00	0.47	0.01	443.65	0.24	14.05
07/29/21 15:02:23	83940	8.83	5.84	5.68	167.48	5.80	1.78	3.69	5.84	0.00	0.47	-0.03	443.09	0.17	14.20
07/29/21 15:02:53	83970	8.83	5.58	5.40	169.33	5.74	1.76	3.61	5.58	0.00	0.48	0.10	443.91	-0.01	14.65
07/29/21 15:03:23	84000	8.84	5.62	5.52	167.59	5.63	1.65	3.67	5.62	0.00	0.54	0.00	433.48	-0.04	16.41
07/29/21 15:03:53	84030	8.84	5.14	5.51	168.47	5.67	1.73	3.41	5.14	0.00	0.51	0.03	444.23	0.05	15.37
07/29/21 15:04:23	84060	8.84	5.48	5.57	169.24	5.73	1.74	3.83	5.48	0.00	0.49	-0.01	443.99	0.04	14.65
07/29/21 15:04:53	84090	8.83	5.57	5.52	169.56	5.76	1.77	3.80	5.57	0.00	0.47	-0.11	444.55	0.38	14.39
07/29/21 15:05:23	84120	8.82	6.21	5.45	171.41	5.82	1.74	3.69	6.21	0.00	0.47	0.01	449.65	-0.30	13.84
07/29/21 15:05:53	84150	8.83	5.86	5.56	171.77	5.86	1.78	4.10	5.86	0.00	0.44	0.15	450.25	0.06	13.34
07/29/21 15:06:23	84180	8.82	6.37	5.48	171.82	5.92	1.76	3.60	6.37	0.00	0.47	0.03	451.57	-0.10	12.87
07/29/21 15:06:53	84210	8.82	6.18	5.48	172.46	5.92	1.78	4.10	6.17	0.02	0.45	0.14	453.60	-0.09	12.76
07/29/21 15:07:23	84240	8.82	5.98	5.60	173.28	5.91	1.84	3.70	5.91	0.06	0.46	-0.15	455.70	0.22	12.45
07/29/21 15:07:53	84270	8.82	5.54	5.53	173.84	5.89	1.83	4.09	5.54	0.00	0.43	0.00	456.88	0.39	12.57
07/29/21 15:08:23	84300	8.81	5.91	5.46	169.43	5.85	1.82	3.76	5.91	0.00	0.43	-0.04	447.24	0.01	13.58
07/29/21 15:08:53	84330	8.81	6.06	5.54	169.44	5.83	1.79	3.38	6.06	0.00	0.44	0.02	448.37	-0.11	13.61
07/29/21 15:09:23	84360	8.80	5.36	5.60	168.83	5.69	1.70	4.23	5.36	0.00	0.46	0.18	440.51	0.14	15.13
07/29/21 15:09:53	84390	8.80	5.53	5.58	165.71	5.67	1.71	4.25	5.53	0.00	0.55	0.21	434.75	0.06	16.22
07/29/21 15:10:23	84420	8.79	5.59	5.53	165.92	5.69	1.70	4.14	5.59	0.00	0.56	0.01	436.94	-0.06	16.03
07/29/21 15:10:53	84450	8.81	5.64	5.46	165.12	5.62	1.69	4.03	5.64	0.00	0.54	0.07	429.58	-0.03	16.81
07/29/21 15:11:23	84480	8.82	5.29	5.57	164.78	5.60	1.68	4.33	5.29	0.00	0.53	0.13	432.58	0.02	16.76
07/29/21 15:11:53	84510	8.82	5.32	5.62	165.11	5.60	1.67	3.95	5.32	0.00	0.54	0.05	433.01	-0.20	16.87
07/29/21 15:12:23	84540	8.82	5.57	5.52	167.08	5.61	1.68	3.49	5.57	0.00	0.54	0.08	431.95	-0.42	16.78
07/29/21 15:12:53	84570	8.83	5.68	5.54	165.45	5.62	1.66	4.48	5.68	0.00	0.56	0.07	432.92	0.12	16.64

Catalytic Combustion Corporation
July 29, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	14,541	SCFH

Weather Data

Barometric Pressure	29.84	in. Hg
Relative Humidity	49	%
Ambient Temperature	96	°F
Specific Humidity	0.018009	lb H_2O / lb air

Unit Data

Unit Load	1,810.4	horsepower
Meas. Stack Moisture	14.4	%
Stack Exhaust Flow (M19)	216,383	SCFH

50% Load, Run - 1-3

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%vd)	NOx (ppmvw)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%vw)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvw)	NO_2 (ppmvw)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (ppmvw)	C_2H_6 (ppmvw)	H_2O (%)
07/29/21 15:13:23	84600	8.83	5.44	5.44	166.88	5.62	1.73	4.17	5.44	0.00	0.53	0.11	434.57	-0.12	16.46
07/29/21 15:13:53	84630	8.83	5.45	5.59	165.37	5.65	1.74	4.43	5.45	0.00	0.52	0.05	436.67	0.11	16.28
07/29/21 15:14:23	84660	8.84	5.64	5.58	166.92	5.67	1.71	4.63	5.64	0.00	0.51	0.08	439.81	0.23	15.99
07/29/21 15:14:53	84690	8.82	5.33	5.32	167.29	5.67	1.66	3.85	5.33	0.00	0.47	0.12	438.81	0.29	15.82
07/29/21 15:15:23	84720	8.83	5.72	5.51	167.33	5.70	1.68	4.61	5.72	0.00	0.49	0.19	439.77	0.12	15.62
07/29/21 15:15:53	84750	8.84	5.48	5.48	167.20	5.58	1.70	4.46	5.48	0.00	0.52	0.13	436.46	-0.02	16.86
07/29/21 15:16:23	84780	8.83	4.91	5.28	165.62	5.56	1.67	4.50	4.91	0.00	0.53	0.01	434.79	0.11	17.17
07/29/21 15:16:53	84810	8.82	5.64	5.51	167.92	5.71	1.75	4.60	5.64	0.00	0.51	0.09	438.72	0.29	15.73
07/29/21 15:17:23	84840	8.82	5.13	5.57	171.10	5.70	1.71	4.33	5.13	0.00	0.46	0.13	445.85	-0.17	15.16
07/29/21 15:17:53	84870	8.81	5.32	5.38	170.30	5.72	1.68	4.57	5.32	0.00	0.46	0.25	445.14	-0.16	14.85
07/29/21 15:18:23	84900	8.81	5.08	5.30	171.02	5.75	1.70	3.91	5.08	0.00	0.45	0.12	447.31	-0.31	14.63
07/29/21 15:18:53	84930	8.79	5.48	5.47	171.50	5.77	1.72	3.81	5.48	0.00	0.46	0.09	446.19	0.02	14.61
07/29/21 15:19:23	84960	8.80	5.41	5.48	171.19	5.78	1.69	4.40	5.41	0.00	0.44	-0.08	447.68	-0.01	14.47
07/29/21 15:19:53	84990	8.79	5.67	5.46	169.93	5.81	1.78	4.45	5.67	0.00	0.47	0.03	445.17	0.23	14.41
07/29/21 15:20:23	85020	8.79	5.59	5.39	169.78	5.81	1.79	3.92	5.59	0.00	0.46	0.10	445.79	0.26	14.37
07/29/21 15:20:53	85050	8.79	5.52	5.50	171.61	5.80	1.70	4.43	5.52	0.00	0.49	0.00	445.75	-0.18	14.27
07/29/21 15:21:23	85080	8.78	5.59	5.52	170.83	5.80	1.71	4.20	5.59	0.00	0.49	0.25	446.24	-0.02	14.29
07/29/21 15:21:53	85110	8.78	5.50	5.50	169.00	5.82	1.69	5.14	5.50	0.00	0.45	0.10	446.38	-0.10	14.24
07/29/21 15:22:23	85140	8.79	5.73	5.27	171.34	5.82	1.74	4.55	5.73	0.00	0.45	-0.17	447.28	0.18	14.15
07/29/21 15:22:53	85170	8.79	5.84	5.43	172.11	5.82	1.74	3.65	5.84	0.00	0.44	-0.16	446.95	-0.30	14.16
RAW AVERAGE		**8.80**	**5.71**	**5.48**	**168.64**	**5.78**	**1.75**	**3.45**	**5.71**	**0.00**	**0.49**	**0.04**	**443.69**	**0.11**	**14.39**

		O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4	C_2H_6	H_2O
	Serial Number:	INST-O2-0026	INST-IR-0005	INST-IR-0005	INST-VC-0004	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005
		(%)			(ppmvw)										
Bias	**Initial Zero**	0.08			0.21										
Bias	**Final Zero**	0.09			0.17										
Bias	**Avg. Zero**	0.09			0.19										
Bias	**Initial UpScale**	11.97			317.42										
Bias	**Final UpScale**	11.98			314.03										
Bias	**Avg. UpScale**	11.98			315.73										
Upscale Cal Gas		11.99			302.00										

EMISSIONS DATA	O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4 (as C_3H_8)	C_2H_6 (as C_3H_8)	VOC (as C_3H_8)
Corrected Raw Average (ppm/% dry basis)	8.79	6.67	6.40	197.00	6.75	2.05	4.04	6.67	0.00	0.57	0.05	190.04	0.09	6.87
Corrected Raw Average (ppm/% wet basis)	7.51	5.71	5.48	168.64	5.78	1.75	3.45	5.71	0.00	0.49	0.04	162.69	0.07	5.88
Concentration (ppm@ 15%O_2)	N/A	3.25	3.12	82.17	3.29	1.00	1.97	3.25	0.00	0.28	0.02	92.60	0.04	2.86
Emission Rate (g/hp*hr)	N/A	0.0579	0.0338	1.4004	561	0.0170	0.0336	0.0378	0.0000	0.0018	0.0003	1.5817	0.0007	0.0488
Non-Bias Adjusted Averages Include:		*	*	*	*	*	*			*	*	*	*	*

EMISSION DATA RECORDS

75% Load
NOx, CO, THC, N_2O, C_2H_4O, NH_3, HCHO, CH_4, C_2H_6, and H_2O
Reference Method Data

Catalytic Combustion Corporation
July 30, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	20,603	SCFH

Weather Data

Barometric Pressure	29.89	in. Hg
Relative Humidity	53	%
Ambient Temperature	94	°F
Specific Humidity	0.018296	lb H_2O / lb air

Unit Data

Unit Load	2,691.4	horsepower
Meas. Stack Moisture	13.9	%
Stack Exhaust Flow (M19)	310,849	SCFH

75% Load, Run - 2-1

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%vd)	NOx (ppmvw)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%vw)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvw)	NO_2 (ppmvw)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (ppmvw)	C_2H_6 (ppmvw)	H_2O (%)
07/30/21 13:45:23	165720	8.94	5.59	2.67	149.97	5.60	1.40	0.37	5.59	0.00	15.45	-0.16	407.90	0.76	14.54
07/30/21 13:45:53	165750	8.93	5.69	2.63	149.97	5.62	1.44	0.54	5.69	0.00	15.26	-0.27	407.38	0.93	14.22
07/30/21 13:46:23	165780	8.94	5.80	2.79	150.51	5.65	1.42	0.03	5.80	0.00	14.83	-0.23	408.24	0.74	14.05
07/30/21 13:46:53	165810	8.94	5.78	2.72	150.09	5.61	1.43	0.80	5.78	0.00	14.78	-0.23	406.16	0.96	14.26
07/30/21 13:47:23	165840	8.95	5.79	2.65	150.57	5.61	1.41	0.51	5.79	0.00	15.18	-0.16	407.80	0.82	14.30
07/30/21 13:47:53	165870	8.94	5.73	2.78	152.51	5.64	1.43	0.24	5.73	0.00	15.41	-0.15	407.10	0.84	14.11
07/30/21 13:48:23	165900	8.94	6.01	2.73	150.28	5.62	1.43	0.60	6.01	0.00	15.24	-0.15	406.97	0.89	14.24
07/30/21 13:48:53	165930	8.93	5.79	2.71	148.46	5.57	1.42	0.67	5.79	0.00	15.98	-0.28	403.63	0.96	14.87
07/30/21 13:49:23	165960	8.94	5.69	2.70	152.44	5.59	1.41	0.58	5.69	0.00	16.27	-0.17	407.02	0.84	14.53
07/30/21 13:49:53	165990	8.94	5.69	2.68	150.92	5.59	1.46	0.58	5.69	0.00	16.09	-0.24	405.18	0.80	14.38
07/30/21 13:50:23	166020	8.94	5.87	2.83	149.52	5.63	1.47	0.39	5.87	0.00	15.75	-0.15	406.61	0.86	14.26
07/30/21 13:50:53	166050	8.95	5.87	2.82	151.94	5.63	1.43	0.48	5.87	0.00	15.40	-0.15	408.83	0.91	14.19
07/30/21 13:51:23	166080	8.95	5.96	2.86	149.85	5.63	1.44	0.35	5.96	0.00	15.33	-0.14	407.04	0.80	14.19
07/30/21 13:51:53	166110	8.97	6.04	2.84	150.42	5.63	1.47	0.38	6.04	0.00	15.39	-0.21	407.58	1.03	14.16
07/30/21 13:52:23	166140	8.97	5.99	2.72	149.87	5.61	1.52	0.60	5.99	0.00	15.35	-0.11	407.75	0.79	14.07
07/30/21 13:52:53	166170	9.00	5.92	2.73	150.51	5.60	1.49	0.49	5.92	0.00	15.19	-0.14	409.27	0.96	13.99
07/30/21 13:53:23	166200	8.98	5.58	2.79	150.71	5.62	1.44	0.29	5.58	0.00	15.04	-0.20	408.53	0.93	13.98
07/30/21 13:53:53	166230	8.95	5.73	2.83	150.82	5.66	1.41	0.67	5.73	0.00	14.75	-0.19	410.88	0.85	13.91
07/30/21 13:54:23	166260	8.97	5.46	2.80	151.19	5.65	1.40	0.61	5.46	0.00	14.33	-0.19	411.87	0.92	13.76
07/30/21 13:54:53	166290	8.97	5.68	2.67	153.46	5.67	1.45	0.71	5.68	0.00	13.91	-0.27	411.25	1.04	13.66
07/30/21 13:55:23	166320	8.96	5.52	2.79	151.54	5.66	1.42	0.59	5.52	0.00	13.72	-0.14	411.56	0.70	13.73
07/30/21 13:55:53	166350	8.96	5.38	2.66	151.37	5.64	1.41	0.75	5.38	0.00	13.94	-0.14	411.48	0.84	13.79
07/30/21 13:56:23	166380	8.97	5.82	2.75	152.50	5.64	1.42	0.36	5.82	0.00	14.23	-0.10	410.88	0.66	13.82
07/30/21 13:56:53	166410	8.98	6.10	2.68	150.29	5.65	1.46	0.99	6.10	0.00	14.63	-0.09	409.47	0.76	13.86
07/30/21 13:57:23	166440	8.97	5.96	2.67	150.64	5.64	1.44	0.45	5.96	0.00	14.80	-0.16	408.48	0.72	13.80
07/30/21 13:57:53	166470	8.96	5.37	2.83	150.92	5.66	1.43	0.93	5.37	0.00	14.66	-0.13	410.90	0.71	13.75
07/30/21 13:58:23	166500	8.97	5.53	2.72	151.61	5.67	1.43	0.46	5.53	0.00	14.19	-0.28	410.92	0.72	13.67
07/30/21 13:58:53	166530	8.97	5.37	2.83	153.19	5.63	1.44	0.58	5.37	0.00	14.14	-0.19	409.85	0.84	14.09
07/30/21 13:59:23	166560	8.96	5.36	2.78	150.89	5.65	1.43	0.23	5.36	0.00	13.96	-0.23	411.30	0.61	13.89
07/30/21 13:59:53	166590	8.96	5.35	2.81	151.49	5.64	1.43	0.29	5.35	0.00	13.69	-0.21	411.12	0.75	13.92
07/30/21 14:00:23	166620	8.96	5.36	2.77	152.13	5.67	1.41	0.66	5.36	0.00	13.36	-0.23	412.37	0.85	13.61
07/30/21 14:00:53	166650	8.96	5.53	2.68	152.22	5.70	1.42	0.49	5.53	0.00	13.05	-0.18	414.28	0.77	13.25
07/30/21 14:01:23	166680	8.96	5.73	2.73	152.80	5.72	1.45	0.42	5.73	0.00	12.83	-0.23	414.58	0.88	13.05
07/30/21 14:01:53	166710	8.94	5.63	2.82	152.68	5.75	1.44	0.76	5.63	0.00	12.60	-0.20	415.96	0.91	12.85
07/30/21 14:02:23	166740	8.94	5.75	2.85	152.33	5.76	1.41	0.84	5.75	0.00	12.43	-0.01	415.38	0.90	12.79
07/30/21 14:02:53	166770	8.96	5.79	2.87	152.72	5.75	1.44	0.99	5.79	0.00	12.30	-0.19	416.46	0.86	12.84
07/30/21 14:03:23	166800	8.95	5.83	2.87	152.76	5.75	1.43	0.63	5.83	0.00	12.38	-0.17	416.53	0.97	12.84
07/30/21 14:03:53	166830	8.95	5.78	2.80	152.87	5.75	1.48	0.16	5.78	0.00	12.58	-0.22	416.46	0.95	12.93
07/30/21 14:04:23	166860	8.95	6.02	2.73	153.08	5.77	1.46	0.35	6.02	0.00	12.74	-0.23	417.47	0.72	12.80
07/30/21 14:04:53	166890	8.97	6.26	2.75	152.62	5.76	1.57	0.22	6.26	0.00	12.89	-0.31	416.15	0.76	12.79
07/30/21 14:05:23	166920	8.97	6.13	2.76	154.06	5.75	1.52	0.47	6.13	0.00	13.16	-0.22	415.82	0.82	12.77
07/30/21 14:05:53	166950	8.97	6.03	2.80	151.98	5.75	1.50	0.88	6.03	0.00	13.43	-0.21	414.42	0.76	12.81
07/30/21 14:06:23	166980	8.97	5.72	2.72	153.39	5.61	1.44	0.76	5.72	0.00	14.26	-0.22	411.88	0.77	14.20
07/30/21 14:06:53	167010	8.98	5.59	2.78	151.06	5.62	1.40	0.56	5.59	0.00	14.60	-0.02	408.23	0.63	14.29
07/30/21 14:07:23	167040	8.97	6.05	2.74	153.83	5.71	1.50	0.65	6.05	0.00	14.62	-0.21	413.85	0.78	13.26
07/30/21 14:07:53	167070	8.98	6.02	2.78	151.59	5.74	1.49	0.55	6.02	0.00	14.53	-0.23	412.80	0.83	13.04
07/30/21 14:08:23	167100	8.97	5.59	2.74	151.39	5.59	1.43	0.42	5.59	0.00	15.29	-0.23	407.53	0.75	14.60
07/30/21 14:08:53	167130	8.96	5.84	2.77	150.86	5.68	1.50	0.49	5.84	0.00	15.30	-0.17	408.89	0.67	13.62
07/30/21 14:09:23	167160	8.96	5.88	2.77	150.77	5.69	1.45	0.86	5.88	0.00	15.35	-0.12	410.34	0.81	13.47
07/30/21 14:09:53	167190	8.97	5.86	2.86	150.95	5.67	1.49	0.88	5.86	0.00	15.45	-0.19	411.50	0.74	13.57
07/30/21 14:10:23	167220	8.96	5.37	2.77	150.82	5.58	1.44	0.70	5.37	0.00	16.26	-0.18	408.68	0.91	14.68
07/30/21 14:10:53	167250	8.97	5.46	2.68	150.73	5.58	1.45	0.71	5.46	0.00	16.65	-0.21	408.83	0.89	14.65
07/30/21 14:11:23	167280	8.96	5.68	2.78	150.28	5.65	1.51	0.90	5.68	0.00	16.98	-0.27	409.45	0.71	14.07
07/30/21 14:11:53	167310	8.97	5.41	2.87	151.28	5.65	1.47	1.08	5.41	0.00	16.77	-0.32	411.15	0.79	13.85
07/30/21 14:12:23	167340	8.97	5.82	2.71	151.71	5.67	1.46	0.95	5.82	0.00	16.65	-0.11	410.56	0.66	13.86
07/30/21 14:12:53	167370	8.96	5.64	2.78	151.38	5.68	1.48	0.38	5.64	0.00	16.27	-0.33	411.61	0.76	13.64
07/30/21 14:13:23	167400	8.97	5.57	2.72	151.56	5.66	1.49	0.41	5.57	0.00	16.18	-0.18	411.72	0.85	13.87
07/30/21 14:13:53	167430	8.97	5.44	2.86	150.30	5.65	1.46	0.92	5.44	0.00	16.44	-0.26	409.70	0.91	14.09
07/30/21 14:14:23	167460	8.98	5.32	2.71	150.51	5.61	1.48	0.97	5.32	0.00	16.70	-0.21	408.13	0.78	14.36
07/30/21 14:14:53	167490	8.97	5.29	2.78	151.40	5.60	1.40	1.01	5.29	0.00	16.91	-0.23	409.96	0.69	14.57
07/30/21 14:15:23	167520	8.95	5.33	2.78	151.65	5.60	1.44	0.68	5.33	0.00	16.89	-0.32	406.99	0.71	14.70
07/30/21 14:15:53	167550	8.97	5.23	2.76	150.30	5.58	1.40	0.64	5.23	0.00	17.05	-0.20	406.37	0.76	14.79
07/30/21 14:16:23	167580	8.97	5.29	2.76	151.76	5.57	1.43	0.83	5.29	0.00	17.24	-0.23	405.60	0.86	14.82
07/30/21 14:16:53	167610	8.97	5.32	2.76	152.52	5.58	1.48	0.99	5.32	0.00	17.29	-0.41	407.48	0.82	14.78
07/30/21 14:17:23	167640	8.97	5.20	2.77	148.96	5.56	1.37	1.00	5.20	0.00	17.40	-0.18	405.60	0.90	14.85
07/30/21 14:17:53	167670	8.98	5.15	2.78	149.51	5.55	1.41	1.24	5.15	0.00	17.55	-0.17	405.45	0.77	14.89
07/30/21 14:18:23	167700	8.99	5.13	2.66	150.60	5.56	1.40	1.03	5.13	0.00	17.95	-0.32	408.53	0.54	14.97
07/30/21 14:18:53	167730	8.99	5.10	2.64	147.55	5.30	1.34	0.69	5.10	0.00	21.05	-0.20	392.60	0.58	18.31
07/30/21 14:19:23	167760	8.97	5.45	2.70	146.48	5.43	1.40	1.02	5.45	0.00	21.12	-0.28	398.24	0.66	17.06
07/30/21 14:19:53	167790	8.97	5.32	2.78	151.30	5.55	1.43	0.96	5.32	0.00	19.53	-0.19	404.85	0.77	15.01
07/30/21 14:20:23	167820	8.98	5.39	2.75	153.59	5.59	1.46	1.03	5.39	0.00	19.11	-0.27	409.77	0.86	14.78
07/30/21 14:20:53	167850	8.98	5.40	2.81	153.02	5.60	1.44	1.15	5.40	0.00	18.90	-0.27	410.05	0.80	14.61
07/30/21 14:21:23	167880	8.97	5.38	2.69	150.69	5.62	1.46	1.55	5.38	0.00	18.70	-0.20	407.43	0.69	14.52
07/30/21 14:21:53	167910	8.97	5.32	2.87	151.85	5.61	1.40	1.03	5.32	0.00	18.34	-0.19	408.54	0.78	14.42
07/30/21 14:22:23	167940	8.96	5.37	2.72	150.84	5.63	1.43	1.01	5.37	0.00	18.20	-0.25	409.61	0.75	14.35
07/30/21 14:22:53	167970	8.97	5.42	2.68	152.57	5.62	1.38	1.06	5.42	0.00	17.92	-0.11	409.94	0.82	14.28
07/30/21 14:23:23	168000	8.97	5.53	2.75	150.73	5.65	1.43	1.20	5.53	0.00	17.66	-0.31	408.91	0.54	14.16
07/30/21 14:23:53	168030	8.97	5.35	2.78	151.08	5.65	1.45	1.26	5.35	0.00	16.82	-0.18	410.78	0.65	14.06
07/30/21 14:24:23	168060	8.97	5.47	2.71	151.78	5.65	1.40	1.20	5.47	0.00	16.74	-0.24	410.85	0.60	14.01
07/30/21 14:24:53	168090	8.98	5.50	2.72	152.46	5.65	1.41	1.29	5.50	0.00	16.85	-0.16	411.60	0.74	13.97
07/30/21 14:25:23	168120	8.98	5.50	2.74	154.42	5.66	1.44	1.29	5.50	0.00	16.22	-0.27	411.95	0.73	13.88
07/30/21 14:25:53	168150	8.98	5.74	2.77	151.75	5.68	1.42	1.25	5.74	0.00	15.81	-0.24	408.75	0.66	13.83
07/30/21 14:26:23	168180	8.97	5.76	2.74	151.91	5.68	1.46	0.86	5.76	0.00	15.69	-0.20	410.32	0.62	13.75
07/30/21 14:26:53	168210	8.97	5.55	2.75	152.28	5.69	1.43	1.21	5.55	0.00	15.52	-0.15	409.68	0.75	13.56
07/30/21 14:27:23	168240	8.97	5.61	2.74	151.61	5.64	1.43	1.00	5.61	0.00	15.65	-0.19	410.85	0.90	14.03
07/30/21 14:27:53	168270	8.97	5.15	2.74	149.88	5.60	1.42	1.09	5.15	0.00	16.78	-0.17	408.06	0.66	14.67
07/30/21 14:28:23	168300	8.97	5.58	2.78	152.81	5.66	1.45	1.48	5.58	0.00	16.37	-0.28	412.10	0.73	13.90
07/30/21 14:28:53	168330	8.97	5.53	2.80	151.52	5.70	1.46	1.35	5.53	0.00	16.16	-0.26	412.63	0.77	13.58
07/30/21 14:29:23	168360	8.96	5.75	2.80	151.20	5.69	1.44	1.52	5.75	0.00	15.89	-0.21	409.70	0.70	13.64
07/30/21 14:29:53	168390	8.96	5.53	2.86	152.91	5.68	1.48	1.29	5.53	0.00	16.36	-0.24	414.01	0.60	13.81
07/30/21 14:30:23	168420	8.97	5.69	2.72	151.43	5.68	1.46	1.04	5.69	0.00	16.41	-0.15	412.16	0.71	13.56
07/30/21 14:30:53	168450	8.98	5.69	2.89	153.60	5.71	1.46	1.33	5.69	0.00	16.05	-0.28	411.95	0.82	13.43
07/30/21 14:31:23	168480	8.98	5.91	2.78	154.44	5.72	1.46	1.24	5.91	0.00	15.65	-0.25	413.67	0.81	13.36
07/30/21 14:31:53	168510	8.96	5.75	2.75	151.74	5.73	1.47	1.43	5.75	0.00	15.47	-0.19	412.60	0.51	13.31
07/30/21 14:32:23	168540	8.97	5.67	2.82	151.82	5.70	1.42	1.50	5.67	0.00	15.58	-0.13	411.89	0.75	13.53
07/30/21 14:32:53	168570	8.97	5.92	2.83	151.82	5.74	1.50	1.62	5.92	0.00	15.53	-0.27	412.14	0.61	13.23
07/30/21 14:33:23	168600	8.96	5.74	2.72	154.57	5.72	1.48	1.56	5.74	0.00	15.25	-0.41	412.25	0.61	13.35
07/30/21 14:33:53	168630	8.97	5.58	2.78	152.39	5.67	1.47	1.46	5.58	0.00	15.77	-0.18	410.05	0.54	13.92
07/30/21 14:34:23	168660	8.97	5.48	2.82	153.52	5.66	1.42	1.42	5.48	0.00	16.79	-0.32	410.92	0.62	14.27
07/30/21 14:34:53	168690	8.96	5.32	2.83	151.54	5.63	1.44	1.65	5.32	0.00	17.22	-0.20	407.18	0.57	14.41

Catalytic Combustion Corporation
July 30, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	20,603	SCFH

Weather Data

Barometric Pressure	29.89	in. Hg
Relative Humidity	53	%
Ambient Temperature	94	°F
Specific Humidity	0.018296	lb H_2O / lb air

Unit Data

Unit Load	2,691.4	horsepower
Meas. Stack Moisture	13.9	%
Stack Exhaust Flow (M19)	310,849	SCFH

75% Load, Run - 2-1

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%vd)	NOx (ppmvw)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%vw)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvw)	NO_2 (ppmvw)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (ppmvw)	C_2H_6 (ppmvw)	H_2O (%)
07/30/21 14:35:23	168720	8.97	5.15	2.77	152.90	5.61	1.44	1.70	5.15	0.00	17.43	-0.22	410.71	0.68	14.44
07/30/21 14:35:53	168750	8.98	5.40	2.85	151.24	5.63	1.43	1.41	5.40	0.00	17.47	-0.22	409.78	0.62	14.36
07/30/21 14:36:23	168780	8.98	5.53	2.83	152.34	5.65	1.43	1.65	5.53	0.00	17.28	-0.26	410.71	0.62	14.21
07/30/21 14:36:53	168810	8.99	5.38	2.91	154.17	5.64	1.42	1.54	5.38	0.00	17.27	-0.19	411.62	0.69	14.34
07/30/21 14:37:23	168840	9.00	5.24	2.91	153.21	5.64	1.45	1.13	5.24	0.00	17.28	-0.24	411.68	0.64	14.28
07/30/21 14:37:53	168870	8.97	5.47	2.81	152.42	5.65	1.45	1.78	5.47	0.00	17.10	-0.23	411.69	0.63	14.20
07/30/21 14:38:23	168900	8.98	5.42	2.80	152.65	5.66	1.43	1.48	5.42	0.00	16.90	-0.19	411.89	0.77	14.12
07/30/21 14:38:53	168930	8.99	5.44	2.91	152.73	5.67	1.44	1.58	5.44	0.00	16.52	-0.24	414.89	0.86	13.76
07/30/21 14:39:23	168960	8.98	5.79	2.93	152.87	5.72	1.50	1.54	5.79	0.00	15.56	-0.26	412.79	0.49	13.53
07/30/21 14:39:53	168990	8.99	5.89	2.98	152.32	5.73	1.48	1.86	5.89	0.00	14.95	-0.12	414.92	0.77	13.45
07/30/21 14:40:23	169020	8.98	5.65	2.83	154.63	5.74	1.52	1.71	5.65	0.00	14.64	-0.23	416.08	0.77	13.25
07/30/21 14:40:53	169050	8.98	5.95	2.86	152.01	5.76	1.49	1.69	5.95	0.00	14.33	-0.14	414.33	0.54	13.02
07/30/21 14:41:23	169080	8.99	5.76	2.87	153.24	5.75	1.46	2.06	5.76	0.00	14.00	-0.22	417.51	0.76	12.78
07/30/21 14:41:53	169110	8.98	5.81	2.91	152.70	5.76	1.44	1.49	5.81	0.00	13.88	-0.26	415.53	0.71	12.75
07/30/21 14:42:23	169140	8.98	5.69	2.88	154.77	5.77	1.50	1.65	5.69	0.00	13.94	-0.31	416.26	0.70	12.77
07/30/21 14:42:53	169170	8.99	4.94	2.93	155.75	5.73	1.52	1.27	4.94	0.00	14.04	-0.47	419.17	0.92	12.69
07/30/21 14:43:23	169200	9.00	4.85	2.81	155.30	5.73	1.53	1.90	4.85	0.00	14.03	-0.27	419.67	0.70	12.52
07/30/21 14:43:53	169230	9.01	5.06	3.03	155.34	5.74	1.47	1.67	5.06	0.00	13.98	-0.31	422.97	0.78	12.44
07/30/21 14:44:23	169260	9.02	5.04	2.93	157.03	5.75	1.47	1.92	5.04	0.00	13.99	-0.26	421.95	0.75	12.44
07/30/21 14:44:53	169290	9.01	4.92	2.93	155.37	5.75	1.47	1.73	4.92	0.00	14.09	-0.32	420.53	0.76	12.47
RAW AVERAGE		**8.97**	**5.59**	**2.78**	**151.87**	**5.66**	**1.45**	**0.97**	**5.59**	**0.00**	**15.64**	**0.00**	**410.84**	**0.76**	**13.91**

		O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4	C_2H_6	H_2O
	Serial Number:	INST-O2-0026	INST-IR-0005	INST-IR-0005	INST-VC-0004	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005
		(%)			(ppmvw)										
Bias	**Initial Zero**	0.07			0.13										
	Final Zero	0.06			0.27										
	Avg. Zero	0.07			0.20										
	Initial UpScale	12.01			304.51										
	Final UpScale	11.97			310.21										
	Avg. UpScale	11.99			307.36										
Upscale Cal Gas		11.99			302.00										

EMISSIONS DATA	O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4 (as C_3H_8)	C_2H_6 (as C_3H_8)	VOC (as C_3H_8)
Corrected Raw Average (ppm/% dry basis)	8.95	6.49	3.23	176.40	6.57	1.68	1.12	6.49	0.00	18.17	0.00	174.98	0.59	0.83
Corrected Raw Average (ppm/% wet basis)	7.70	5.59	2.78	151.87	5.66	1.45	0.97	5.59	0.00	15.64	0.00	150.64	0.51	0.72
Concentration (ppm@ 15%O_2)	N/A	3.20	1.60	74.99	3.24	0.83	0.55	3.20	0.00	8.97	0.00	86.41	0.29	0.35
Emission Rate (g/kw*hr)	N/A	0.0544	0.0165	1.2186	527	0.0135	0.0090	0.0355	0.0000	0.0564	0.0000	1.4073	0.0047	0.0058
Non-Bias Adjusted Averages Include:		*	*	*	*	*	*			*	*	*	*	*

Catalytic Combustion Corporation
July 30, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	20,591	SCFH

Weather Data

Barometric Pressure	29.87	in. Hg
Relative Humidity	47	%
Ambient Temperature	97	°F
Specific Humidity	0.017841	lb H_2O / lb air

Unit Data

Unit Load	2,698.1	horsepower
Meas. Stack Moisture	13.9	%
Stack Exhaust Flow (M19)	310,873	SCFH

75% Load, Run - 2-2

Date/Time	Elapsed Time	O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4	C_2H_6	H_2O
(mm/dd/yy hh:mm:ss)	(seconds)	(%vd)	(ppmvw)	(ppmvw)	(ppmvw)	(%vw)	(ppmvw)	(ppmvw)	(ppmvw)	(ppmvw)	(ppmvw)	(ppmvw)	(ppmvw)	(ppmvw)	(%)
07/30/21 15:00:23	170220	9.00	5.28	2.96	154.08	5.69	1.35	2.12	5.28	0.00	17.06	-0.04	414.63	0.44	13.70
07/30/21 15:00:53	170250	8.98	5.34	2.94	154.11	5.70	1.41	2.27	5.34	0.00	16.86	-0.22	412.25	0.31	13.74
07/30/21 15:01:23	170280	9.00	5.30	2.86	154.99	5.68	1.42	2.21	5.30	0.00	16.40	-0.15	415.77	0.50	13.68
07/30/21 15:01:53	170310	9.00	5.33	2.95	154.83	5.69	1.45	2.15	5.33	0.00	16.23	-0.09	412.74	0.82	13.66
07/30/21 15:02:23	170340	9.00	5.33	2.89	154.31	5.68	1.33	2.21	5.33	0.00	16.25	-0.25	410.69	0.72	13.66
07/30/21 15:02:53	170370	9.01	5.33	2.88	156.72	5.68	1.40	2.19	5.33	0.00	16.35	-0.19	416.89	0.74	13.69
07/30/21 15:03:23	170400	9.00	5.42	2.86	156.36	5.70	1.45	2.43	5.42	0.00	16.60	-0.20	415.69	0.58	13.71
07/30/21 15:03:53	170430	9.00	5.46	2.84	155.44	5.68	1.42	2.48	5.46	0.00	16.53	-0.23	415.13	0.41	13.69
07/30/21 15:04:23	170460	9.00	5.36	2.76	152.95	5.70	1.40	2.24	5.36	0.00	16.20	-0.17	413.52	0.61	13.66
07/30/21 15:04:53	170490	8.99	5.44	2.91	154.46	5.68	1.37	1.98	5.44	0.00	15.62	-0.27	410.42	0.79	13.67
07/30/21 15:05:23	170520	8.99	5.49	2.95	154.82	5.69	1.39	2.20	5.49	0.00	15.45	-0.19	410.93	0.67	13.67
07/30/21 15:05:53	170550	8.99	5.65	2.88	156.15	5.71	1.49	1.90	5.65	0.00	15.42	-0.56	413.05	0.45	13.65
07/30/21 15:06:23	170580	8.98	5.55	2.89	154.97	5.75	1.40	2.17	5.55	0.00	15.43	-0.38	411.31	0.41	13.49
07/30/21 15:06:53	170610	8.98	5.88	2.88	155.71	5.71	1.44	2.45	5.88	0.00	15.45	-0.16	413.83	0.54	13.58
07/30/21 15:07:23	170640	8.98	5.41	2.94	155.21	5.69	1.44	2.71	5.41	0.00	16.01	-0.22	410.80	0.40	13.77
07/30/21 15:07:53	170670	8.99	5.21	2.85	153.21	5.69	1.37	2.38	5.21	0.00	16.44	-0.19	412.71	0.48	13.73
07/30/21 15:08:23	170700	8.99	5.28	2.93	156.26	5.69	1.43	2.41	5.28	0.00	16.55	-0.21	413.90	0.79	13.75
07/30/21 15:08:53	170730	8.99	5.09	2.95	153.40	5.61	1.43	2.76	5.09	0.00	17.65	-0.20	408.10	0.53	14.82
07/30/21 15:09:23	170760	8.99	5.37	3.03	153.58	5.65	1.43	2.45	5.37	0.00	18.36	-0.20	409.03	0.45	14.45
07/30/21 15:09:53	170790	8.99	5.37	2.89	155.68	5.67	1.46	2.02	5.37	0.00	17.32	-0.27	411.40	0.40	13.96
07/30/21 15:10:23	170820	8.99	5.55	2.98	154.21	5.72	1.41	2.35	5.55	0.00	16.25	-0.17	412.97	0.45	13.56
07/30/21 15:10:53	170850	8.97	5.59	2.90	154.93	5.78	1.47	2.14	5.59	0.00	15.50	-0.42	411.69	0.66	13.33
07/30/21 15:11:23	170880	8.97	5.60	2.93	153.82	5.77	1.42	2.56	5.60	0.00	15.00	-0.29	413.84	0.61	13.14
07/30/21 15:11:53	170910	8.96	5.77	3.03	152.91	5.79	1.45	2.60	5.77	0.00	14.81	-0.30	411.83	0.28	13.16
07/30/21 15:12:23	170940	8.98	5.71	2.90	154.96	5.79	1.51	2.07	5.71	0.00	14.69	-0.19	413.08	0.68	12.87
07/30/21 15:12:53	170970	8.97	5.25	49.44	972.03	4.16	5.63	1.60	5.25	0.00	14.02	0.35	2,591.39	13.89	11.81
07/30/21 15:13:23	171000	8.96	4.53	35.32	615.49	0.45	16.68	1.57	4.16	0.37	14.81	1.32	1,673.96	0.66	10.89
07/30/21 15:13:53	171030	8.96	5.33	2.88	156.72	5.68	1.40	2.19	5.14	0.19	11.39	1.27	595.22	0.03	5.85
07/30/21 15:14:23	171060	8.96	5.42	2.86	156.36	5.70	1.45	2.43	5.42	0.00	11.41	1.83	554.73	-0.06	6.02
07/30/21 15:14:53	171090	8.97	5.46	2.84	155.44	5.68	1.42	2.48	5.46	0.00	13.64	0.19	231.15	0.08	12.48
07/30/21 15:15:23	171120	8.97	5.36	2.76	152.95	5.70	1.40	2.24	5.36	0.00	11.13	-0.01	289.72	-0.19	12.78
07/30/21 15:15:53	171150	8.97	5.44	2.91	154.46	5.68	1.37	1.98	5.44	0.00	16.35	-0.19	416.89	0.74	13.69
07/30/21 15:16:23	171180	8.97	5.49	2.95	154.82	5.69	1.39	2.20	5.49	0.00	16.60	-0.20	415.69	0.58	13.71
07/30/21 15:16:53	171210	8.98	5.65	2.88	156.15	5.71	1.49	1.90	5.65	0.00	16.53	-0.23	415.13	0.41	13.69
07/30/21 15:17:23	171240	8.97	5.55	2.89	154.97	5.75	1.40	2.17	5.55	0.00	16.20	-0.17	413.52	0.61	13.66
07/30/21 15:17:53	171270	8.95	5.88	2.88	155.71	5.71	1.44	2.45	5.88	0.00	15.62	-0.27	410.42	0.79	13.67
07/30/21 15:18:23	171300	8.95	5.41	2.94	155.21	5.69	1.44	2.71	5.41	0.00	15.45	-0.19	410.93	0.67	13.67
07/30/21 15:18:53	171330	8.95	5.21	2.85	153.21	5.69	1.37	2.38	5.21	0.00	15.42	-0.56	413.05	0.45	13.65
07/30/21 15:19:23	171360	8.95	6.23	2.93	153.34	5.80	1.55	2.28	6.23	0.00	15.43	-0.38	411.31	0.41	13.49
07/30/21 15:19:53	171390	8.93	5.82	2.84	159.23	5.78	1.52	2.45	5.82	0.00	15.45	-0.16	413.83	0.54	13.58
07/30/21 15:20:23	171420	8.93	6.13	2.78	162.43	5.81	1.51	2.58	6.13	0.00	15.42	-0.22	410.80	0.40	13.77
07/30/21 15:20:53	171450	8.93	6.34	2.79	162.71	5.82	1.47	2.94	6.34	0.00	15.43	-0.19	412.71	0.48	13.73
07/30/21 15:21:23	171480	8.94	6.00	2.83	163.18	5.81	1.52	2.14	6.00	0.00	15.45	-0.30	435.66	0.40	12.26
07/30/21 15:21:53	171510	8.93	5.81	2.90	162.58	5.78	1.52	2.30	5.81	0.00	16.01	-0.26	433.01	0.47	12.62
07/30/21 15:22:23	171540	8.92	5.81	2.79	158.77	5.68	1.45	2.65	5.81	0.00	16.44	-0.32	422.40	0.20	14.33
07/30/21 15:22:53	171570	8.94	5.88	2.86	158.19	5.68	1.44	2.56	5.88	0.00	16.55	-0.17	422.76	0.23	14.02
07/30/21 15:23:23	171600	8.94	6.26	2.79	160.29	5.80	1.50	2.40	6.26	0.00	17.65	-0.20	430.19	0.48	12.85
07/30/21 15:23:53	171630	8.94	5.89	2.92	160.26	5.69	1.44	2.52	5.89	0.00	18.36	-0.24	425.61	0.36	14.08
07/30/21 15:24:23	171660	8.94	6.01	2.74	161.11	5.76	1.48	2.67	6.01	0.00	17.32	-0.27	428.17	0.15	13.26
07/30/21 15:24:53	171690	8.94	5.69	2.75	161.33	5.73	1.48	2.37	5.69	0.00	16.25	-0.37	427.32	0.22	13.73
07/30/21 15:25:23	171720	8.94	6.32	2.84	160.38	5.77	1.46	3.06	6.32	0.00	12.05	-0.14	428.12	0.34	13.23
07/30/21 15:25:53	171750	8.94	5.52	2.96	159.66	5.64	1.41	2.81	5.52	0.00	13.02	-0.25	422.83	0.51	14.58
07/30/21 15:26:23	171780	8.94	5.20	2.89	158.70	5.62	1.42	3.04	5.20	0.00	13.55	-0.36	422.13	0.27	14.96
07/30/21 15:26:53	171810	8.94	5.61	2.80	157.68	5.58	1.39	2.98	5.61	0.00	14.30	-0.19	416.17	0.31	15.94
07/30/21 15:27:23	171840	8.94	4.85	2.97	159.58	5.58	1.39	3.26	4.85	0.00	14.48	-0.26	420.91	0.25	15.15
07/30/21 15:27:53	171870	8.92	4.86	2.82	158.95	5.60	1.40	3.06	4.86	0.00	15.07	-0.18	418.97	0.23	15.16
07/30/21 15:28:23	171900	8.94	4.97	2.89	158.70	5.61	1.40	2.78	4.97	0.00	15.27	-0.23	419.98	0.47	15.12
07/30/21 15:28:53	171930	8.94	5.09	3.03	158.28	5.58	1.36	3.15	5.09	0.00	15.48	-0.23	418.18	0.37	15.50
07/30/21 15:29:23	171960	8.94	5.19	2.87	155.45	5.49	1.32	3.61	5.19	0.00	16.64	-0.20	411.78	0.26	17.07
07/30/21 15:29:53	171990	8.94	5.10	3.01	156.35	5.53	1.38	3.48	5.10	0.00	16.92	-0.13	413.70	0.12	16.75
07/30/21 15:30:23	172020	8.94	5.22	2.94	157.11	5.57	1.36	3.84	5.22	0.00	16.76	-0.08	416.05	0.29	16.35
07/30/21 15:30:53	172050	8.94	5.48	2.88	156.36	5.62	1.35	2.95	5.48	0.00	16.16	-0.19	415.17	0.18	15.74
07/30/21 15:31:23	172080	8.93	5.41	2.94	158.75	5.60	1.40	3.13	5.41	0.00	15.28	-0.21	418.93	0.37	15.11
07/30/21 15:31:53	172110	8.93	5.10	2.94	159.54	5.65	1.41	2.79	5.10	0.00	14.66	-0.25	423.49	0.28	14.63
07/30/21 15:32:23	172140	8.94	5.18	2.96	160.89	5.69	1.46	2.90	5.18	0.00	14.22	-0.36	425.47	0.39	14.21
07/30/21 15:32:53	172170	8.93	5.24	3.02	160.73	5.72	1.42	2.83	5.24	0.00	13.77	-0.31	427.59	0.29	13.86
07/30/21 15:33:23	172200	8.93	5.27	3.03	161.50	5.73	1.46	2.96	5.27	0.00	13.51	-0.10	426.89	0.47	13.93
07/30/21 15:33:53	172230	8.94	5.25	3.00	162.31	5.71	1.45	3.03	5.25	0.00	13.40	-0.16	429.08	0.29	13.99
07/30/21 15:34:23	172260	8.94	5.60	2.98	160.39	5.71	1.44	3.23	5.60	0.00	13.31	-0.19	427.02	0.31	13.88
07/30/21 15:34:53	172290	8.94	5.35	3.01	161.73	5.71	1.41	2.73	5.35	0.00	13.24	-0.08	427.52	0.55	13.82
07/30/21 15:35:23	172320	8.94	5.25	3.02	159.98	5.72	1.42	3.32	5.25	0.00	13.17	-0.11	427.35	0.35	13.86
07/30/21 15:35:53	172350	8.94	5.47	2.99	161.41	5.74	1.48	3.68	5.47	0.00	13.06	-0.18	428.00	0.66	13.71
07/30/21 15:36:23	172380	8.95	5.30	2.92	160.96	5.73	1.41	3.13	5.30	0.00	13.14	-0.24	425.51	0.38	13.84
07/30/21 15:36:53	172410	8.94	5.38	2.98	161.64	5.72	1.46	2.97	5.38	0.00	13.06	-0.25	428.15	0.63	13.88
07/30/21 15:37:23	172440	8.94	5.23	2.97	161.13	5.73	1.40	3.51	5.23	0.00	12.97	-0.01	428.27	0.55	13.81
07/30/21 15:37:53	172470	8.93	5.06	3.01	161.90	5.71	1.46	3.43	5.06	0.00	12.88	-0.24	428.42	0.27	13.87
07/30/21 15:38:23	172500	8.94	5.20	3.02	161.55	5.70	1.42	3.68	5.20	0.00	12.84	-0.15	426.92	0.50	14.11
07/30/21 15:38:53	172530	8.94	5.30	3.00	161.75	5.71	1.44	3.32	5.30	0.00	12.69	-0.18	427.17	0.43	14.01
07/30/21 15:39:23	172560	8.94	5.16	3.10	161.35	5.70	1.44	3.01	5.16	0.00	12.82	-0.23	428.15	0.30	14.37
07/30/21 15:39:53	172590	8.94	4.76	3.05	160.77	5.68	1.43	2.91	4.76	0.00	12.96	-0.25	425.10	0.49	14.52
07/30/21 15:40:23	172620	8.94	4.93	2.94	160.16	5.64	1.38	2.48	4.93	0.00	13.28	-0.35	424.52	0.30	14.79
07/30/21 15:40:53	172650	8.93	4.83	3.06	161.08	5.63	1.35	2.98	4.83	0.00	13.57	-0.23	424.31	0.21	14.92
07/30/21 15:41:23	172680	8.93	4.88	3.04	160.45	5.63	1.38	3.01	4.88	0.00	13.86	-0.25	422.99	0.16	14.91
07/30/21 15:41:53	172710	8.94	5.00	3.01	160.16	5.65	1.41	2.75	5.00	0.00	13.80	-0.30	422.58	0.39	14.68
07/30/21 15:42:23	172740	8.94	4.99	3.03	160.76	5.67	1.46	3.48	4.99	0.00	13.47	-0.27	426.36	0.59	14.51
07/30/21 15:42:53	172770	8.94	5.07	3.08	160.43	5.66	1.44	3.70	5.07	0.00	13.24	-0.25	423.59	0.39	14.57
07/30/21 15:43:23	172800	8.94	5.18	3.11	160.86	5.68	1.44	4.23	5.18	0.00	13.30	-0.22	427.25	0.39	14.51
07/30/21 15:43:53	172830	8.94	5.35	3.05	160.98	5.69	1.40	3.77	5.35	0.00	13.41	-0.37	425.83	0.40	14.40
07/30/21 15:44:23	172860	8.95	5.51	3.12	161.01	5.69	1.43	3.91	5.51	0.00	13.39	-0.12	425.82	0.40	14.27
07/30/21 15:44:53	172890	8.95	5.38	3.02	159.22	5.70	1.38	3.96	5.38	0.00	13.31	-0.31	426.40	0.37	14.22
07/30/21 15:45:23	172920	8.94	4.81	2.96	161.41	5.66	1.43	4.19	4.81	0.00	13.48	-0.45	424.81	0.46	14.60
07/30/21 15:45:53	172950	8.94	4.90	3.07	161.82	5.59	1.42	4.06	4.90	0.00	14.13	-0.23	423.42	0.38	15.29
07/30/21 15:46:23	172980	8.95	5.31	2.96	161.20	5.66	1.47	3.87	5.31	0.00	13.71	-0.15	424.07	0.30	14.56
07/30/21 15:46:53	173010	8.94	5.07	3.08	160.88	5.69	1.48	3.86	5.07	0.00	13.51	-0.35	426.34	0.46	14.32
07/30/21 15:47:23	173040	8.94	5.17	2.98	160.06	5.70	1.48	3.56	5.17	0.00	13.35	-0.13	426.55	0.41	14.20
07/30/21 15:47:53	173070	8.95	5.41	3.09	161.01	5.70	1.44	3.67	5.41	0.00	13.15	-0.26	425.67	0.24	14.06
07/30/21 15:48:23	173100	8.95	5.24	3.08	161.73	5.72	1.50	3.77	5.24	0.00	12.93	-0.28	427.57	0.15	13.96
07/30/21 15:48:53	173130	8.95	5.53	3.08	162.80	5.71	1.44	4.09	5.53	0.00	12.74	-0.35	429.29	0.14	13.99
07/30/21 15:49:23	173160	8.96	5.24	3.09	161.82	5.72	1.42	3.29	5.24	0.00	12.79	-0.28	429.10	0.24	14.04
07/30/21 15:49:53	173190	8.95	5.34	3.02	162.42	5.71	1.45	3.28	5.34	0.00	12.83	-0.22	428.60	0.15	14.01

Catalytic Combustion Corporation
July 30, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	20,591	SCFH

Weather Data

Barometric Pressure	29.87	in. Hg
Relative Humidity	47	%
Ambient Temperature	97	°F
Specific Humidity	0.017841	lb H_2O / lb air

Unit Data

Unit Load	2,698.1	horsepower
Meas. Stack Moisture	13.9	%
Stack Exhaust Flow (M19)	310,873	SCFH

75% Load, Run - 2-2

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%vd)	NOx (ppmvw)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%vw)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvw)	NO_2 (ppmvw)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (ppmvw)	C_2H_6 (ppmvw)	H_2O (%)
07/30/21 15:50:23	173220	8.94	5.38	2.92	162.58	5.72	1.49	3.88	5.38	0.00	12.84	-0.17	428.03	0.17	13.94
07/30/21 15:50:53	173250	8.94	5.13	2.98	161.45	5.73	1.46	3.83	5.13	0.00	12.77	-0.24	428.88	0.14	13.93
07/30/21 15:51:23	173280	8.94	5.31	3.12	162.25	5.70	1.42	4.07	5.31	0.00	12.56	-0.27	428.79	0.28	13.84
07/30/21 15:51:53	173310	8.93	5.32	3.01	164.97	5.73	1.44	3.80	5.32	0.00	12.58	-0.12	430.57	0.05	13.87
07/30/21 15:52:23	173340	8.93	5.31	3.01	160.59	5.71	1.55	3.98	5.31	0.00	12.47	-0.20	427.20	0.59	13.79
07/30/21 15:52:53	173370	8.93	5.43	3.18	162.47	5.72	1.50	4.11	5.43	0.00	12.33	-0.21	429.06	0.40	13.77
07/30/21 15:53:23	173400	8.93	5.38	3.08	163.86	5.75	1.52	3.62	5.38	0.00	12.21	-0.34	432.27	0.73	13.78
07/30/21 15:53:53	173430	8.93	5.43	3.21	162.27	5.72	1.52	3.72	5.43	0.00	12.05	-0.28	430.05	0.76	13.78
07/30/21 15:54:23	173460	8.93	5.34	3.07	163.45	5.74	1.52	4.14	5.34	0.00	11.97	-0.42	429.83	0.53	13.79
07/30/21 15:54:53	173490	8.92	5.24	3.00	162.66	5.72	1.55	3.96	5.24	0.00	11.91	-0.21	431.25	0.57	13.77
07/30/21 15:55:23	173520	8.94	5.28	3.19	162.09	5.73	1.41	3.60	5.28	0.00	11.92	-0.28	429.57	0.60	13.80
07/30/21 15:55:53	173550	8.93	5.40	3.09	162.63	5.73	1.47	4.02	5.40	0.00	12.03	-0.43	429.29	0.68	13.80
07/30/21 15:56:23	173580	8.94	5.42	3.11	164.49	5.73	1.47	3.77	5.42	0.00	12.00	-0.30	430.85	0.50	13.79
07/30/21 15:56:53	173610	8.93	5.28	3.09	163.16	5.73	1.54	5.16	5.28	0.00	11.99	-0.37	430.41	0.47	13.79
07/30/21 15:57:23	173640	8.93	5.49	2.99	162.50	5.74	1.50	3.71	5.49	0.00	11.86	-0.29	430.53	0.42	13.78
07/30/21 15:57:53	173670	8.92	5.54	3.12	164.68	5.74	1.59	3.74	5.54	0.00	11.68	-0.38	431.24	0.41	13.78
07/30/21 15:58:23	173700	8.92	5.35	3.07	164.13	5.75	1.47	4.18	5.35	0.00	11.71	-0.34	430.66	0.69	13.79
07/30/21 15:58:53	173730	8.92	5.11	3.16	163.97	5.75	1.49	4.13	5.11	0.00	11.87	-0.47	430.71	0.75	13.79
07/30/21 15:59:23	173760	8.92	5.18	3.04	165.27	5.73	1.53	4.48	5.18	0.00	11.89	-0.39	431.55	0.73	13.79
07/30/21 15:59:53	173790	8.91	5.25	3.10	164.57	5.72	1.41	3.74	5.25	0.00	12.04	-0.22	431.44	0.54	13.80
RAW AVERAGE		**8.95**	**5.38**	**3.62**	**169.71**	**5.64**	**1.60**	**3.01**	**5.38**	**0.00**	**14.33**	**0.00**	**450.35**	**0.54**	**13.86**

		O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4	C_2H_6	H_2O
	Serial Number:	INST-O2-0026	INST-IR-0005	INST-IR-0005	INST-VC-0004	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005
		(%)			(ppmvw)										
Bias	**Initial Zero**	0.06			0.27										
Bias	**Final Zero**	0.04			0.44										
Bias	**Avg. Zero**	0.05			0.36										
Bias	**Initial UpScale**	11.97			310.21										
Bias	**Final UpScale**	11.95			303.21										
Bias	**Avg. UpScale**	11.96			306.71										
Upscale Cal Gas		11.99			302.00										

EMISSIONS DATA	O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4 (as C_3H_8)	C_2H_6 (as C_3H_8)	VOC (as C_3H_8)
Corrected Raw Average (ppm/% dry basis)	8.96	6.25	4.20	197.01	6.55	1.86	3.50	6.24	0.01	16.63	0.00	191.69	0.42	4.90
Corrected Raw Average (ppm/% wet basis)	7.71	5.38	3.62	169.71	5.64	1.60	3.01	5.38	0.00	14.33	0.00	165.13	0.36	4.22
Concentration (ppm@ 15%O_2)	N/A	3.09	2.08	83.86	3.24	0.92	1.73	3.08	0.00	8.22	0.00	94.72	0.21	2.09
Emission Rate (g/kw*hr)	N/A	0.0523	0.0214	1.3585	524	0.0149	0.0280	0.0341	0.0000	0.0515	0.0000	1.5380	0.0033	0.0338
Non-Bias Adjusted Averages Include:		*	*	*	*	*	*			*	*	*	*	*

Catalytic Combustion Corporation
July 30, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	20,172	SCFH

Weather Data

Barometric Pressure	29.85	in. Hg
Relative Humidity	42	%
Ambient Temperature	97	°F
Specific Humidity	0.015856	lb H_2O / lb air

Unit Data

Unit Load	2,616.3	horsepower
Meas. Stack Moisture	13.6	%
Stack Exhaust Flow (M19)	303,928	SCFH

75% Load, Run - 2-3

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%vd)	NOx (ppmvw)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%vw)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvw)	NO_2 (ppmvw)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (ppmvw)	C_2H_6 (ppmvw)	H_2O (%)
07/30/21 16:27:23	175440	8.96	5.20	3.09	162.24	5.68	1.52	4.26	5.20	0.00	13.65	-0.14	427.16	0.26	14.22
07/30/21 16:27:53	175470	8.96	5.51	3.11	161.66	5.68	1.55	4.06	5.51	0.00	13.76	-0.10	427.30	0.22	14.07
07/30/21 16:28:23	175500	8.97	5.37	3.07	162.33	5.70	1.57	4.19	5.37	0.00	13.70	-0.33	428.91	0.07	13.95
07/30/21 16:28:53	175530	8.98	5.45	3.14	161.73	5.70	1.52	3.78	5.45	0.00	13.56	-0.16	428.59	0.33	13.81
07/30/21 16:29:23	175560	8.98	5.37	3.16	163.32	5.69	1.46	3.41	5.37	0.00	13.58	-0.22	430.94	0.45	13.79
07/30/21 16:29:53	175590	8.96	5.32	3.18	162.36	5.70	1.51	4.28	5.32	0.00	13.59	-0.02	429.85	0.34	13.80
07/30/21 16:30:23	175620	8.96	5.28	3.15	162.84	5.71	1.49	3.61	5.28	0.00	13.58	-0.04	432.52	0.06	13.81
07/30/21 16:30:53	175650	8.97	5.19	3.02	164.45	5.71	1.51	3.37	5.19	0.00	13.74	-0.25	431.85	0.53	13.90
07/30/21 16:31:23	175680	8.98	5.32	3.01	163.06	5.71	1.56	3.86	5.32	0.00	13.86	-0.26	431.18	0.59	13.89
07/30/21 16:31:53	175710	8.98	5.37	3.06	163.49	5.70	1.54	4.16	5.37	0.00	13.87	-0.22	430.46	0.18	13.88
07/30/21 16:32:23	175740	8.97	5.23	3.12	161.58	5.71	1.50	3.96	5.23	0.00	13.73	-0.14	428.70	0.43	13.80
07/30/21 16:32:53	175770	8.97	5.20	3.09	161.94	5.71	1.48	3.71	5.20	0.00	13.67	-0.11	429.38	0.47	13.75
07/30/21 16:33:23	175800	8.97	5.26	3.09	161.52	5.71	1.48	3.36	5.26	0.00	13.54	-0.08	429.34	0.43	13.74
07/30/21 16:33:53	175830	8.96	5.21	3.09	162.99	5.71	1.53	3.70	5.21	0.00	13.48	-0.35	430.08	0.94	13.72
07/30/21 16:34:23	175860	8.97	5.15	3.05	162.67	5.70	1.46	3.61	5.15	0.00	13.42	-0.22	430.77	0.40	13.72
07/30/21 16:34:53	175890	8.97	5.11	3.09	161.73	5.69	1.52	3.26	5.11	0.00	13.41	-0.26	430.83	0.81	13.71
07/30/21 16:35:23	175920	8.97	5.29	3.02	163.62	5.71	1.48	3.99	5.29	0.00	13.35	-0.27	430.14	0.62	13.72
07/30/21 16:35:53	175950	8.97	5.16	3.16	165.32	5.70	1.51	3.04	5.16	0.00	13.34	-0.26	434.18	0.65	13.73
07/30/21 16:36:23	175980	8.96	5.23	3.00	163.44	5.72	1.51	3.74	5.23	0.00	13.35	-0.52	428.88	0.59	13.74
07/30/21 16:36:53	176010	8.96	5.45	2.93	163.48	5.70	1.52	4.05	5.45	0.00	13.30	-0.11	430.31	0.58	13.67
07/30/21 16:37:23	176040	8.96	5.37	2.92	164.02	5.70	1.49	3.34	5.37	0.00	13.36	-0.39	432.22	0.47	13.65
07/30/21 16:37:53	176070	8.95	5.34	2.94	164.51	5.72	1.52	3.73	5.34	0.00	13.47	-0.32	432.87	0.82	13.69
07/30/21 16:38:23	176100	8.95	5.38	3.20	164.50	5.72	1.53	3.24	5.38	0.00	13.48	-0.26	434.26	0.55	13.71
07/30/21 16:38:53	176130	8.95	5.59	3.11	166.19	5.73	1.57	4.16	5.59	0.00	13.54	-0.31	432.39	0.70	13.72
07/30/21 16:39:23	176160	8.95	5.41	3.16	165.30	5.72	1.49	3.55	5.41	0.00	13.64	-0.18	435.13	0.59	13.73
07/30/21 16:39:53	176190	8.94	5.41	3.17	163.86	5.73	1.53	3.69	5.41	0.00	13.72	-0.11	432.05	0.41	13.73
07/30/21 16:40:23	176220	8.94	5.31	3.04	165.67	5.72	1.53	4.04	5.31	0.00	13.74	0.02	433.43	0.32	13.73
07/30/21 16:40:53	176250	8.94	5.19	3.17	164.72	5.72	1.54	4.07	5.19	0.00	13.69	-0.12	433.49	0.53	13.74
07/30/21 16:41:23	176280	8.94	5.32	3.13	165.07	5.72	1.54	4.17	5.32	0.00	13.63	-0.12	433.90	0.26	13.74
07/30/21 16:41:53	176310	8.95	5.24	3.11	165.63	5.73	1.54	3.91	5.24	0.00	13.66	-0.20	432.97	0.71	13.73
07/30/21 16:42:23	176340	8.96	5.33	3.11	164.83	5.72	1.59	3.64	5.33	0.00	13.70	-0.32	433.01	0.41	13.74
07/30/21 16:42:53	176370	8.98	5.44	3.08	165.03	5.73	1.55	3.59	5.44	0.00	13.76	-0.08	434.03	0.53	13.74
07/30/21 16:43:23	176400	8.97	5.22	3.17	164.73	5.73	1.56	3.89	5.22	0.00	13.97	-0.28	432.25	0.71	13.72
07/30/21 16:43:53	176430	8.97	5.41	3.15	163.83	5.73	1.51	3.91	5.41	0.00	14.18	-0.26	431.82	0.60	13.74
07/30/21 16:44:23	176460	8.98	5.40	3.05	164.98	5.72	1.51	3.81	5.40	0.00	14.19	-0.29	433.20	0.61	13.75
07/30/21 16:44:53	176490	8.98	5.62	3.15	165.96	5.73	1.47	4.23	5.62	0.00	14.34	-0.07	432.68	0.28	13.73
07/30/21 16:45:23	176520	8.97	5.49	3.16	164.48	5.74	1.58	4.56	5.49	0.00	14.46	-0.21	432.58	0.58	13.73
07/30/21 16:45:53	176550	8.97	5.19	3.19	165.52	5.73	1.52	3.75	5.19	0.00	14.36	-0.17	434.05	0.33	13.76
07/30/21 16:46:23	176580	8.96	5.42	3.18	163.83	5.73	1.57	4.26	5.42	0.00	13.97	-0.21	431.62	0.46	13.76
07/30/21 16:46:53	176610	8.96	5.27	3.13	165.74	5.73	1.47	4.41	5.27	0.00	13.55	-0.28	432.33	0.33	13.76
07/30/21 16:47:23	176640	8.96	5.35	3.02	164.14	5.73	1.54	4.01	5.35	0.00	13.34	-0.27	432.18	0.30	13.76
07/30/21 16:47:53	176670	8.97	5.30	3.10	164.58	5.72	1.57	4.25	5.30	0.00	13.30	-0.21	431.82	0.48	13.77
07/30/21 16:48:23	176700	8.97	5.23	3.07	166.09	5.73	1.52	4.47	5.23	0.00	13.30	-0.14	433.25	0.59	13.79
07/30/21 16:48:53	176730	8.95	5.46	3.14	164.59	5.73	1.56	5.08	5.46	0.00	13.07	-0.29	433.13	0.24	13.75
07/30/21 16:49:23	176760	8.96	5.25	3.19	159.22	5.50	1.43	4.02	5.25	0.00	15.24	-0.25	414.50	0.38	16.82
07/30/21 16:49:53	176790	8.95	4.89	3.04	164.21	5.66	1.43	4.06	4.89	0.00	14.06	-0.22	429.74	0.34	14.43
07/30/21 16:50:23	176820	8.95	4.96	3.06	166.83	5.71	1.52	3.66	4.96	0.00	13.79	-0.18	431.24	0.32	13.95
07/30/21 16:50:53	176850	8.94	5.18	3.12	166.23	5.73	1.52	4.20	5.18	0.00	13.66	-0.29	434.25	0.69	13.79
07/30/21 16:51:23	176880	8.95	5.37	3.10	164.52	5.75	1.55	4.35	5.37	0.00	13.70	-0.28	432.03	0.29	13.76
07/30/21 16:51:53	176910	8.96	5.15	3.13	164.16	5.74	1.50	4.77	5.15	0.00	13.74	-0.05	432.73	0.29	13.65
07/30/21 16:52:23	176940	8.98	5.28	3.14	163.56	5.74	1.56	4.53	5.28	0.00	13.63	-0.06	431.91	0.57	13.48
07/30/21 16:52:53	176970	8.97	5.38	3.05	164.15	5.77	1.52	4.71	5.38	0.00	13.35	-0.12	433.33	0.53	13.29
07/30/21 16:53:23	177000	8.97	5.36	3.10	166.71	5.78	1.55	3.63	5.36	0.00	13.11	-0.36	435.10	0.46	13.15
07/30/21 16:53:53	177030	8.98	5.61	3.03	165.77	5.78	1.49	4.58	5.61	0.00	12.89	-0.08	437.33	0.21	13.09
07/30/21 16:54:23	177060	8.98	5.38	3.14	165.90	5.78	1.53	4.35	5.38	0.00	12.84	-0.24	436.28	0.56	13.04
07/30/21 16:54:53	177090	8.97	5.38	3.11	166.61	5.77	1.58	3.78	5.38	0.00	12.83	-0.28	436.12	0.34	12.92
07/30/21 16:55:23	177120	8.97	5.56	3.18	166.49	5.79	1.50	3.87	5.56	0.00	12.84	-0.22	438.02	0.45	12.91
07/30/21 16:55:53	177150	8.96	5.35	2.95	165.62	5.78	1.54	4.40	5.35	0.00	12.93	-0.23	438.22	0.58	12.94
07/30/21 16:56:23	177180	8.96	5.36	3.07	165.60	5.78	1.57	4.13	5.36	0.00	13.12	-0.29	436.74	0.55	12.95
07/30/21 16:56:53	177210	8.96	5.63	3.08	164.50	5.82	1.54	4.54	5.63	0.00	13.20	-0.27	435.95	0.44	12.83
07/30/21 16:57:23	177240	8.97	5.57	3.13	165.64	5.82	1.52	4.36	5.57	0.00	13.03	-0.26	435.31	0.75	12.78
07/30/21 16:57:53	177270	8.97	5.67	3.04	166.42	5.81	1.49	4.43	5.67	0.00	12.84	-0.10	439.44	0.63	12.76
07/30/21 16:58:23	177300	8.95	5.21	3.19	168.72	5.78	1.52	3.29	5.21	0.00	12.64	-0.40	443.47	0.22	12.46
07/30/21 16:58:53	177330	8.96	5.09	3.12	167.57	5.82	1.53	4.17	5.09	0.00	12.20	-0.25	441.46	0.54	12.15
07/30/21 16:59:23	177360	8.95	5.57	3.05	165.08	5.79	1.48	4.59	5.57	0.00	12.35	-0.18	436.65	0.44	13.08
07/30/21 16:59:53	177390	8.95	5.20	3.07	165.43	5.71	1.50	4.37	5.20	0.00	13.21	-0.20	432.50	0.63	13.83
07/30/21 17:00:23	177420	8.95	4.72	3.03	163.98	5.68	1.46	4.51	4.72	0.00	14.56	-0.07	430.28	0.48	14.40
07/30/21 17:00:53	177450	8.95	4.94	3.23	163.57	5.63	1.47	4.72	4.94	0.00	15.63	-0.37	425.06	0.34	14.83
07/30/21 17:01:23	177480	8.95	4.77	3.11	161.57	5.63	1.39	4.16	4.77	0.00	16.43	-0.18	424.39	-0.12	15.08
07/30/21 17:01:53	177510	8.96	5.03	3.18	162.96	5.63	1.47	5.02	5.03	0.00	16.61	-0.19	426.46	0.45	15.18
07/30/21 17:02:23	177540	8.95	4.83	3.13	162.40	5.62	1.41	5.00	4.83	0.00	16.63	-0.22	426.37	-0.05	15.18
07/30/21 17:02:53	177570	8.95	4.76	3.03	163.88	5.61	1.39	4.57	4.76	0.00	16.59	-0.25	427.03	0.07	14.97
07/30/21 17:03:23	177600	8.96	4.96	3.00	163.70	5.63	1.44	4.50	4.96	0.00	16.52	-0.31	427.79	0.12	14.83
07/30/21 17:03:53	177630	8.95	5.05	3.20	163.93	5.67	1.50	4.49	5.05	0.00	16.15	-0.27	430.47	0.51	14.61
07/30/21 17:04:23	177660	8.95	5.13	3.10	162.74	5.65	1.45	4.57	5.13	0.00	15.80	-0.13	428.17	0.40	14.66
07/30/21 17:04:53	177690	8.94	5.37	3.15	163.33	5.69	1.49	4.19	5.37	0.00	15.68	-0.25	427.48	0.01	14.48
07/30/21 17:05:23	177720	8.93	5.16	3.00	164.04	5.68	1.45	4.63	5.16	0.00	15.32	-0.48	428.47	0.17	14.31
07/30/21 17:05:53	177750	8.92	5.26	3.03	162.79	5.70	1.49	3.72	5.26	0.00	15.14	-0.42	429.04	0.15	14.32
07/30/21 17:06:23	177780	8.88	5.38	3.07	165.23	5.69	1.42	4.38	5.38	0.00	15.11	-0.18	428.39	0.25	14.24
07/30/21 17:06:53	177810	8.88	5.28	3.12	165.06	5.74	1.45	4.23	5.28	0.00	14.79	-0.35	431.88	0.28	14.15
07/30/21 17:07:23	177840	8.85	5.02	3.04	165.10	5.74	1.46	4.63	5.02	0.00	14.31	-0.18	435.08	0.28	14.01
07/30/21 17:07:53	177870	8.85	5.06	3.12	165.51	5.77	1.49	3.98	5.06	0.00	13.87	-0.23	432.15	0.20	13.82
07/30/21 17:08:23	177900	8.88	5.32	3.08	157.58	5.64	1.40	4.69	5.32	0.00	15.07	-0.13	421.98	-0.35	15.75
07/30/21 17:08:53	177930	8.88	4.76	3.09	163.85	5.71	1.49	4.85	4.76	0.00	14.61	-0.09	427.85	0.30	14.51
07/30/21 17:09:23	177960	8.89	5.24	3.08	165.21	5.81	1.52	4.24	5.24	0.00	13.39	-0.12	434.44	0.36	13.41
07/30/21 17:09:53	177990	8.87	5.48	3.12	165.49	5.83	1.55	4.18	5.48	0.00	13.01	-0.31	435.19	0.17	13.20
07/30/21 17:10:23	178020	8.88	5.23	3.16	165.44	5.82	1.47	4.72	5.20	0.03	12.95	-0.21	434.24	0.18	13.27
07/30/21 17:10:53	178050	8.88	5.06	3.10	164.78	5.81	1.53	4.08	2.46	2.60	13.06	-0.42	433.53	0.72	13.45
07/30/21 17:11:23	178080	8.88	5.32	3.36	166.12	5.81	0.92	4.53	-1.27	6.59	13.21	-0.12	435.76	0.46	13.34
07/30/21 17:11:53	178110	8.87	4.76	3.90	162.78	5.68	0.07	3.87	4.76	0.00	14.11	0.09	428.08	0.17	14.73
07/30/21 17:12:23	178140	8.85	5.24	4.16	165.06	5.82	0.06	4.44	5.24	0.00	11.99	0.14	434.76	0.26	13.13
07/30/21 17:12:53	178170	8.86	5.48	3.48	168.26	5.83	1.56	4.23	5.48	0.00	10.36	-0.25	441.64	0.63	12.60
07/30/21 17:13:23	178200	8.85	5.23	3.30	167.68	5.86	1.63	4.04	5.23	0.00	11.03	-0.39	442.96	-0.17	12.29
07/30/21 17:13:53	178230	8.85	5.11	3.08	167.84	5.87	1.58	4.51	5.11	0.00	10.62	-0.29	441.86	0.03	12.30
07/30/21 17:14:23	178260	8.85	5.14	3.02	167.62	5.85	1.47	3.79	5.14	0.00	10.61	-0.32	441.64	0.18	12.24
07/30/21 17:14:53	178290	8.85	5.04	3.12	168.82	5.88	1.53	4.15	5.04	0.00	11.60	0.00	444.13	0.25	12.13
07/30/21 17:15:23	178320	8.85	5.24	3.17	167.36	5.90	1.53	4.96	5.24	0.00	12.65	-0.32	442.58	0.82	11.88
07/30/21 17:15:53	178350	8.85	5.21	3.15	171.20	5.91	1.56	4.83	5.21	0.00	11.89	-0.22	444.79	0.37	11.83
07/30/21 17:16:23	178380	8.84	5.28	3.13	168.89	5.91	1.59	4.96	5.28	0.00	12.25	-0.21	445.74	0.25	11.81
07/30/21 17:16:53	178410	8.84	5.00	3.16	164.87	5.65	1.40	4.58	5.00	0.00	11.99	-0.09	429.12	0.11	15.29

Catalytic Combustion Corporation
July 30, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	20,172	SCFH

Weather Data

Barometric Pressure	29.85	in. Hg
Relative Humidity	42	%
Ambient Temperature	97	°F
Specific Humidity	0.015856	lb H_2O / lb air

Unit Data

Unit Load	2,616.3	horsepower
Meas. Stack Moisture	13.6	%
Stack Exhaust Flow (M19)	303,928	SCFH

75% Load, Run - 2-3

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%vd)	NOx (ppmvw)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%vw)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvw)	NO_2 (ppmvw)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (ppmvw)	C_2H_6 (ppmvw)	H_2O (%)
07/30/21 17:17:23	178440	8.84	5.06	3.06	168.22	5.87	1.48	4.52	5.06	0.00	10.62	-0.27	444.05	0.73	12.33
07/30/21 17:17:53	178470	8.84	5.30	3.02	171.17	5.94	1.55	4.36	5.30	0.00	10.61	-0.28	447.17	0.31	11.65
07/30/21 17:18:23	178500	8.81	5.32	3.03	167.25	5.74	1.38	4.98	5.32	0.00	11.60	-0.13	434.22	0.22	14.18
07/30/21 17:18:53	178530	8.81	5.05	3.02	161.55	5.64	1.36	4.12	5.05	0.00	12.65	-0.12	423.40	0.04	16.10
07/30/21 17:19:23	178560	8.80	4.90	2.96	168.67	5.88	1.49	4.74	4.90	0.00	11.89	-0.21	443.32	0.42	12.45
07/30/21 17:19:53	178590	8.80	5.71	2.97	165.63	5.90	1.44	4.58	5.71	0.00	12.25	-0.32	437.62	0.22	12.82
07/30/21 17:20:23	178620	8.81	5.62	3.02	165.57	5.90	1.44	4.78	5.62	0.00	11.99	-0.36	437.27	0.63	12.83
07/30/21 17:20:53	178650	8.82	5.04	3.07	168.18	5.90	1.49	4.09	5.04	0.00	11.94	-0.29	442.26	0.29	12.23
07/30/21 17:21:23	178680	8.80	5.13	2.89	167.87	5.91	1.44	4.67	5.13	0.00	11.81	-0.22	443.18	0.14	12.13
07/30/21 17:21:53	178710	8.80	5.14	2.99	168.77	5.93	1.42	4.56	5.14	0.00	11.75	-0.17	445.98	0.37	11.95
07/30/21 17:22:23	178740	8.81	5.05	2.95	165.21	5.80	1.42	4.54	5.05	0.00	12.50	-0.16	432.28	0.24	13.83
07/30/21 17:22:53	178770	8.82	4.97	2.92	167.78	5.90	1.38	4.53	4.97	0.00	12.18	-0.19	442.61	0.30	12.28
07/30/21 17:23:23	178800	8.81	4.29	3.02	165.00	5.66	1.37	4.95	4.29	0.00	13.55	-0.21	430.24	0.68	15.27
07/30/21 17:23:53	178830	8.80	5.00	3.02	167.91	5.91	1.42	4.24	5.00	0.00	12.66	-0.44	444.46	0.53	12.03
07/30/21 17:24:23	178860	8.77	5.24	2.91	165.43	5.82	1.37	4.11	5.24	0.00	13.45	-0.35	433.08	-0.01	13.55
07/30/21 17:24:53	178890	8.78	5.14	2.98	163.19	5.82	1.43	4.20	5.14	0.00	13.33	-0.31	429.44	0.23	13.65
07/30/21 17:25:23	178920	8.78	5.15	2.94	164.70	5.89	1.45	4.45	5.15	0.00	13.14	-0.30	432.50	0.39	13.06
07/30/21 17:25:53	178950	8.76	5.27	3.04	166.33	5.89	1.39	4.44	5.27	0.00	13.25	-0.31	435.67	0.38	13.20
07/30/21 17:26:23	178980	8.75	4.69	2.97	166.88	5.91	1.41	4.39	4.69	0.00	13.03	-0.23	440.21	0.30	12.47
07/30/21 17:26:53	179010	8.76	4.62	3.00	167.04	5.91	1.42	4.54	4.62	0.00	13.10	-0.30	438.17	0.24	12.40
RAW AVERAGE		**8.91**	**5.23**	**3.10**	**164.95**	**5.75**	**1.47**	**4.21**	**5.15**	**0.08**	**13.44**	**0.00**	**433.59**	**0.38**	**13.59**

		O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4	C_2H_6	H_2O
	Serial Number:	INST-O2-0026	INST-IR-0005	INST-IR-0005	INST-VC-0004	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005
		(%)			(ppmvw)										
Bias	**Initial Zero**	0.04			0.44										
Bias	**Final Zero**	0.06			1.21										
Bias	**Avg. Zero**	0.05			0.83										
Bias	**Initial UpScale**	11.95			303.21										
Bias	**Final UpScale**	11.94			312.59										
Bias	**Avg. UpScale**	11.95			307.90										
Upscale Cal Gas		11.99			302.00										

EMISSIONS DATA	O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4 (as C_3H_8)	C_2H_6 (as C_3H_8)	VOC (as C_3H_8)
Corrected Raw Average (ppm/% dry basis)	8.94	6.05	3.59	190.89	6.66	1.70	4.87	5.96	0.09	15.56	0.00	183.99	0.30	6.61
Corrected Raw Average (ppm/% wet basis)	7.71	5.23	3.10	164.95	5.75	1.47	4.21	5.15	0.08	13.44	0.00	158.98	0.26	5.71
Concentration (ppm@ 15%O_2)	N/A	2.98	1.77	81.34	3.28	0.84	2.40	2.94	0.04	7.67	0.00	90.73	0.15	2.82
Emission Rate (g/kw*hr)	N/A	0.0511	0.0184	1.3313	538	0.0137	0.0393	0.0328	0.0008	0.0486	0.0000	1.4883	0.0024	0.0461
Non-Bias Adjusted Averages Include:		*	*	*	*	*	*	*	*	*	*	*	*	*

EMISSION DATA RECORDS

100% Load
NOx, CO, THC, N_2O, C_2H_4O, NH_3, HCHO, CH_4, C_2H_6, and H_2O
Reference Method Data

Catalytic Combustion Corporation
September 1, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	26,278	SCFH

Weather Data

Barometric Pressure	29.73	in. Hg
Relative Humidity	70	%
Ambient Temperature	88	°F
Specific Humidity	0.020202	lb H_2O / lb air

Unit Data

Unit Load	3,598.0	horsepower
Meas. Stack Moisture	13.6	%
Stack Exhaust Flow (M19)	386,201	SCFH

100% Load, Run - 3-1

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	NOx (ppmvd)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvd)	NO_2 (ppmvd)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (as C_3H_8) (ppmvw)	C_2H_6 (as C_3H_8) (ppmvw)	H_2O (%)
09/01/21 9:23:57	12140	8.62	15.56	4.29	96.72	5.91	1.12	0.80	12.77	2.79	0.60	1.33	412.49	-0.42	13.13
09/01/21 9:24:27	12170	8.61	14.59	4.28	97.14	5.91	1.07	0.84	12.15	2.44	0.66	1.37	411.33	-0.37	13.10
09/01/21 9:24:57	12200	8.61	13.74	4.22	98.52	5.88	1.26	0.76	12.95	0.80	0.60	1.30	410.45	-0.20	13.48
09/01/21 9:25:27	12230	8.62	14.09	4.13	98.75	5.90	1.31	0.83	13.01	1.08	0.58	1.25	412.16	-0.35	13.30
09/01/21 9:25:57	12260	8.61	13.84	3.64	98.21	5.84	1.33	0.94	12.72	1.12	0.62	1.27	409.75	-0.42	14.07
09/01/21 9:26:27	12290	8.61	15.11	3.67	98.45	5.87	1.34	0.88	13.46	1.65	0.61	1.32	411.82	-0.48	13.88
09/01/21 9:26:57	12320	8.61	14.09	4.16	98.85	5.92	1.32	0.77	13.21	0.87	0.66	1.25	412.09	-0.34	13.09
09/01/21 9:27:27	12350	8.62	15.47	3.67	98.04	5.82	1.40	0.85	11.72	3.74	0.67	1.30	406.15	-0.76	14.56
09/01/21 9:27:57	12380	8.61	14.73	3.64	97.91	5.87	1.38	0.85	12.00	2.73	0.65	1.32	413.16	-0.48	13.88
09/01/21 9:28:27	12410	8.60	15.08	3.79	97.37	5.89	1.36	0.78	12.51	2.57	0.63	1.28	413.74	-0.61	13.54
09/01/21 9:28:57	12440	8.61	14.66	3.70	98.69	5.91	1.38	0.86	12.77	1.89	0.64	1.31	409.17	-0.54	13.54
09/01/21 9:29:27	12470	8.60	14.26	3.51	99.77	5.66	1.35	0.86	12.12	2.14	0.63	1.26	396.82	-0.63	16.52
09/01/21 9:29:57	12500	8.62	14.33	3.68	99.41	5.88	1.35	0.86	13.23	1.09	0.60	1.34	411.48	-0.49	13.77
09/01/21 9:30:27	12530	8.60	13.37	4.16	99.32	5.91	1.33	0.74	13.00	0.37	0.65	1.24	412.99	-0.27	13.24
09/01/21 9:30:57	12560	8.61	12.95	4.18	98.88	5.90	1.35	0.75	12.62	0.33	0.58	1.26	412.49	-0.35	13.31
09/01/21 9:31:27	12590	8.61	11.75	4.20	98.87	5.91	1.32	0.83	10.55	1.20	0.63	1.23	415.45	-0.33	13.05
09/01/21 9:31:57	12620	8.58	12.15	4.26	98.90	5.93	1.35	0.80	10.26	1.88	0.62	1.18	418.34	-0.37	12.81
09/01/21 9:32:27	12650	8.60	12.47	4.23	98.83	5.95	1.34	0.83	10.05	2.42	0.62	1.21	414.49	-0.43	12.70
09/01/21 9:32:57	12680	8.61	12.08	4.31	99.55	5.93	1.33	0.81	10.56	1.52	0.61	1.22	414.63	-0.40	12.78
09/01/21 9:33:27	12710	8.61	11.71	4.29	99.63	5.92	1.39	0.74	10.06	1.65	0.58	1.24	414.51	-0.34	12.89
09/01/21 9:33:57	12740	8.61	11.73	3.60	99.19	5.86	1.56	0.85	9.61	2.12	0.53	1.23	410.55	-0.56	13.96
09/01/21 9:34:27	12770	8.61	11.85	4.04	99.10	5.90	1.50	0.72	10.28	1.57	0.58	1.19	417.42	-0.32	13.33
09/01/21 9:34:57	12800	8.60	12.40	4.07	99.20	5.92	1.57	0.75	9.69	2.71	0.62	1.18	414.89	-0.39	13.18
09/01/21 9:35:27	12830	8.60	11.63	3.65	98.54	5.73	1.56	1.07	10.25	1.37	0.62	1.25	407.38	-0.61	15.56
09/01/21 9:35:57	12860	8.60	10.48	4.01	98.58	5.91	1.55	0.73	9.29	1.19	0.61	1.15	416.02	-0.29	13.26
09/01/21 9:36:27	12890	8.59	10.35	3.95	97.36	5.91	1.55	0.76	8.63	1.72	0.60	1.17	413.49	-0.30	13.22
09/01/21 9:36:57	12920	8.60	11.02	3.62	97.01	5.86	1.55	0.80	9.55	1.46	0.59	1.19	413.11	-0.45	13.83
09/01/21 9:37:27	12950	8.59	10.68	3.49	97.85	5.85	1.58	0.76	8.76	1.92	0.63	1.23	410.69	-0.46	14.23
09/01/21 9:37:57	12980	8.60	11.40	3.67	97.87	5.89	1.59	0.81	8.45	2.94	0.66	1.19	414.51	-0.60	13.51
09/01/21 9:38:27	13010	8.59	10.81	3.59	96.68	5.83	1.59	0.91	9.17	1.64	0.56	1.22	412.72	-0.41	14.31
09/01/21 9:38:57	13040	8.59	11.02	3.55	96.65	5.88	1.60	0.87	9.62	1.40	0.58	1.20	412.59	-0.48	13.85
09/01/21 9:39:27	13070	8.60	10.74	3.57	97.43	5.87	1.58	0.81	9.35	1.39	0.58	1.18	415.48	-0.50	13.78
09/01/21 9:39:57	13100	8.59	10.94	3.47	97.90	5.68	1.46	1.08	8.77	2.17	0.51	1.23	405.34	-0.33	15.78
09/01/21 9:40:27	13130	8.61	10.60	3.58	97.97	5.83	1.55	0.84	9.10	1.49	0.57	1.17	412.95	-0.36	14.28
09/01/21 9:40:57	13160	8.61	11.05	3.63	98.84	5.88	1.58	0.79	9.11	1.95	0.63	1.17	417.33	-0.53	13.56
09/01/21 9:41:27	13190	8.58	10.68	3.97	98.42	5.89	1.54	0.80	8.66	2.02	0.70	1.17	413.48	-0.27	13.36
09/01/21 9:41:57	13220	8.59	9.90	4.06	98.57	5.90	1.53	0.69	8.18	1.72	0.57	1.13	416.94	-0.35	13.16
09/01/21 9:42:27	13250	8.59	9.71	4.09	99.03	5.91	1.57	0.61	8.34	1.37	0.57	1.17	416.75	-0.36	13.10
09/01/21 9:42:57	13280	8.59	10.09	3.61	98.64	5.81	1.62	0.78	8.32	1.77	0.60	1.16	410.12	-0.79	14.49
09/01/21 9:43:27	13310	8.60	9.59	3.96	98.71	5.90	1.56	0.74	8.46	1.13	0.57	1.16	414.07	-0.25	13.28
09/01/21 9:43:57	13340	8.58	9.51	4.01	98.46	5.88	1.53	0.71	8.56	0.95	0.62	1.16	412.61	-0.29	13.46
09/01/21 9:44:27	13370	8.60	10.70	4.07	98.15	5.89	1.54	0.76	8.08	2.62	0.64	1.15	414.87	-0.31	13.25
09/01/21 9:44:57	13400	8.59	10.03	4.07	99.17	5.92	1.55	0.72	7.65	2.38	0.56	1.11	419.67	-0.32	13.01
09/01/21 9:45:27	13430	8.60	10.44	4.19	98.32	5.93	1.58	0.71	7.88	2.56	0.60	1.16	416.90	-0.33	12.88
09/01/21 9:45:57	13460	8.60	10.32	4.10	97.91	5.93	1.56	0.77	7.77	2.55	0.59	1.13	417.20	-0.41	12.87
09/01/21 9:46:27	13490	8.58	10.05	4.14	97.87	5.93	1.58	0.72	7.74	2.31	0.58	1.12	417.22	-0.37	12.82
09/01/21 9:46:57	13520	8.60	8.91	3.27	97.69	5.76	1.67	0.87	7.76	1.15	0.58	1.15	408.08	-0.45	15.13
09/01/21 9:47:27	13550	8.58	8.82	4.08	98.83	5.90	1.74	0.69	7.41	1.41	0.55	1.09	416.95	-0.34	13.18
09/01/21 9:47:57	13580	8.59	9.00	3.97	98.81	5.91	1.77	0.67	7.67	1.33	0.57	1.06	417.72	-0.33	13.10
09/01/21 9:48:27	13610	8.60	9.05	3.96	98.90	5.92	1.73	0.70	7.20	1.85	0.64	1.08	414.75	-0.36	13.06
09/01/21 9:48:57	13640	8.59	8.78	3.94	99.05	5.92	1.79	0.75	7.16	1.62	0.58	1.08	414.08	-0.29	13.08
09/01/21 9:49:27	13670	8.59	9.13	3.33	98.52	5.82	1.75	0.78	7.22	1.91	0.58	1.16	412.21	-0.38	14.35
09/01/21 9:49:57	13700	8.58	8.77	3.92	98.09	5.90	1.75	0.77	7.25	1.51	0.59	1.05	419.28	-0.26	13.22
09/01/21 9:50:27	13730	8.58	8.83	3.57	97.72	5.86	1.77	0.83	7.02	1.81	0.61	1.08	418.58	-0.47	13.80
09/01/21 9:50:57	13760	8.59	8.48	4.00	98.23	5.94	1.75	0.81	6.97	1.50	0.60	1.08	416.36	-0.35	13.06
09/01/21 9:51:27	13790	8.56	8.49	3.93	99.06	5.92	1.80	0.72	6.88	1.61	0.56	1.06	418.98	-0.32	13.05
09/01/21 9:51:57	13820	8.58	8.58	3.93	99.00	5.91	1.71	0.79	6.95	1.63	0.63	1.06	417.16	-0.36	13.24
09/01/21 9:52:27	13850	8.57	8.55	3.64	98.96	5.89	1.89	0.93	6.93	1.62	0.56	1.08	415.79	-0.57	13.52
09/01/21 9:52:57	13880	8.58	8.48	3.38	99.12	5.82	1.97	0.89	6.85	1.63	0.61	1.07	411.76	-0.75	14.55
09/01/21 9:53:27	13910	8.58	8.45	3.51	98.30	5.87	1.97	0.82	7.15	1.30	0.61	1.08	414.58	-0.50	13.83
09/01/21 9:53:57	13940	8.59	8.35	3.50	99.04	5.89	1.99	0.80	7.15	1.19	0.55	1.05	411.33	-0.53	13.71
09/01/21 9:54:27	13970	8.60	8.39	3.56	99.26	5.88	1.96	0.77	6.81	1.57	0.57	1.02	417.51	-0.53	13.65
09/01/21 9:54:57	14000	8.58	8.30	3.37	99.28	5.88	1.98	0.83	6.83	1.47	0.58	1.06	414.58	-0.56	13.74
09/01/21 9:55:27	14030	8.60	8.23	3.45	99.35	5.68	1.91	1.05	6.97	1.26	0.57	1.09	400.14	-0.52	16.09
09/01/21 9:55:57	14060	8.60	8.12	3.48	100.20	5.87	1.96	0.90	6.98	1.14	0.59	1.10	408.98	-0.51	13.99
09/01/21 9:56:27	14090	8.60	8.27	3.46	100.16	5.88	1.99	0.77	6.82	1.45	0.57	1.09	414.46	-0.54	13.72
09/01/21 9:59:27	14270	8.59	9.27	3.95	100.53	5.91	2.15	0.61	9.19	0.08	0.60	1.01	416.64	-0.32	13.32
09/01/21 9:59:57	14300	8.60	8.52	3.40	100.14	5.85	2.17	0.88	6.82	1.70	0.60	1.06	412.98	-0.40	14.33
09/01/21 10:00:27	14330	8.60	8.41	3.97	100.85	5.91	2.16	0.74	6.82	1.60	0.62	1.02	414.99	-0.36	13.38
09/01/21 10:00:57	14360	8.58	8.21	3.85	100.80	5.92	2.16	0.72	6.94	1.27	0.65	1.04	416.17	-0.35	13.17
09/01/21 10:01:27	14390	8.60	8.26	3.87	100.37	5.91	2.16	0.69	6.94	1.32	0.59	1.01	416.91	-0.30	13.31
09/01/21 10:01:57	14420	8.59	8.28	3.61	100.45	5.90	2.21	0.85	6.78	1.51	0.60	1.05	415.39	-0.58	13.54
09/01/21 10:02:27	14450	8.59	8.23	3.43	100.23	5.83	2.20	0.80	6.80	1.43	0.56	1.05	412.23	-0.44	14.22
09/01/21 10:02:57	14480	8.59	8.01	3.29	99.98	5.84	2.20	0.84	6.93	1.08	0.58	1.05	411.67	-0.41	14.37
09/01/21 10:03:27	14510	8.60	8.27	3.42	99.44	5.91	2.21	0.82	6.74	1.53	0.58	1.03	415.85	-0.54	13.50
09/01/21 10:03:57	14540	8.60	8.20	3.48	98.91	5.89	2.20	0.83	6.79	1.41	0.54	1.07	414.51	-0.55	13.64
09/01/21 10:04:27	14570	8.59	8.07	3.49	99.41	5.89	2.22	0.89	6.71	1.36	0.57	1.05	414.58	-0.56	13.60
09/01/21 10:04:57	14600	8.58	8.07	3.45	99.49	5.90	2.44	0.82	6.78	1.29	0.55	1.01	412.05	-0.56	13.65
09/01/21 10:05:27	14630	8.58	8.03	3.21	98.64	5.83	2.53	0.87	6.77	1.26	0.53	1.02	413.53	-0.42	14.26
09/01/21 10:05:57	14660	8.58	7.83	3.33	98.56	5.87	2.53	0.82	6.85	0.98	0.56	1.01	415.54	-0.51	13.84
09/01/21 10:06:27	14690	8.59	8.00	3.35	98.75	5.88	2.56	0.86	6.69	1.31	0.55	1.00	416.79	-0.54	13.65
09/01/21 10:06:57	14720	8.58	7.97	3.51	98.94	5.87	2.57	0.86	6.76	1.21	0.52	1.01	419.78	-0.58	13.68
09/01/21 10:07:27	14750	8.57	8.00	3.47	99.34	5.89	2.54	0.82	6.68	1.31	0.57	1.02	418.44	-0.62	13.52
09/01/21 10:07:57	14780	8.58	7.88	3.26	99.41	5.70	2.53	1.00	6.80	1.08	0.53	1.06	403.54	-0.53	15.92
09/01/21 10:08:27	14810	8.58	7.87	3.31	99.49	5.88	2.56	0.79	6.83	1.04	0.55	1.03	416.11	-0.52	13.74
09/01/21 10:08:57	14840	8.58	7.90	3.32	99.29	5.89	2.80	0.81	6.76	1.14	0.59	1.02	415.14	-0.54	13.75
09/01/21 10:09:27	14870	8.58	7.85	3.28	100.08	5.89	2.97	0.74	6.82	1.04	0.54	1.04	415.48	-0.49	13.72
09/01/21 10:09:57	14900	8.57	7.90	3.39	100.32	5.90	2.96	0.74	6.71	1.19	0.56	1.01	419.10	-0.55	13.61
09/01/21 10:10:27	14930	8.57	7.82	3.23	100.04	5.82	2.96	0.71	6.79	1.03	0.59	0.96	411.92	-0.69	14.69
09/01/21 10:10:57	14960	8.58	7.85	3.42	100.60	5.90	3.00	0.82	6.65	1.20	0.54	1.01	415.14	-0.56	13.61
09/01/21 10:11:27	14990	8.57	7.78	3.74	101.49	5.90	2.93	0.66	6.73	1.05	0.55	0.97	418.57	-0.27	13.39
09/01/21 10:11:57	15020	8.58	7.75	3.68	101.37	5.91	2.99	0.68	6.73	1.02	0.55	0.97	416.79	-0.30	13.33
09/01/21 10:12:27	15050	8.59	9.54	3.70	100.61	5.92	2.97	0.70	8.36	1.18	0.57	0.98	412.63	-0.31	13.35
09/01/21 10:12:57	15080	8.60	11.29	3.25	100.40	5.73	2.98	1.00	8.48	2.81	0.60	0.99	404.06	-0.49	15.66
09/01/21 10:13:27	15110	8.61	9.43	3.41	100.42	5.91	3.10	0.70	8.81	0.62	0.63	0.98	416.01	-0.59	13.50
09/01/21 10:13:57	15140	8.61	9.52	3.75	99.57	5.92	3.29	0.64	8.66	0.86	0.58	0.99	416.15	-0.30	13.24
09/01/21 10:14:27	15170	8.59	9.40	3.69	99.05	5.92	3.31	0.65	8.64	0.77	0.61	0.95	417.73	-0.33	13.24
09/01/21 10:14:57	15200	8.61	10.52	3.22	99.12	5.85	3.32	0.77	8.34	2.18	0.55	1.01	415.63	-0.39	14.12
09/01/21 10:15:27	15230	8.60	10.73	3.72	99.85	5.91	3.31	0.69	7.97	2.76	0.53	0.96	419.75	-0.31	13.28
09/01/21 10:15:57	15260	8.61	9.93	3.78	100.53	5.92	3.32	0.73	8.30	1.63	0.61	0.95	419.37	-0.28	13.20

Catalytic Combustion Corporation
September 1, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	26,278	SCFH

Weather Data

Barometric Pressure	29.73	in. Hg
Relative Humidity	70	%
Ambient Temperature	88	°F
Specific Humidity	0.020202	lb H_2O / lb air

Unit Data

Unit Load	3,598.0	horsepower
Meas. Stack Moisture	13.6	%
Stack Exhaust Flow (M19)	386,201	SCFH

100% Load, Run - 3-1

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	NOx (ppmvd)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvd)	NO_2 (ppmvd)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (as C_3H_8) (ppmvw)	C_2H_6 (as C_3H_8) (ppmvw)	H_2O (%)
09/01/21 10:16:27	15290	8.62	10.37	4.21	100.42	5.91	2.01	0.77	8.11	2.26	0.60	1.20	420.56	-0.31	13.11
09/01/21 10:16:57	15320	8.61	9.64	4.55	100.63	5.91	1.82	0.75	8.64	1.01	0.57	1.28	418.11	-0.34	13.07
09/01/21 10:17:27	15350	8.60	9.75	5.27	100.75	5.90	0.25	0.86	8.98	0.77	0.69	1.50	415.16	-0.34	13.01
09/01/21 10:17:57	15380	8.61	10.53	5.44	100.90	5.90	0.17	0.90	8.51	2.02	0.64	1.54	417.24	-0.32	13.00
09/01/21 10:18:27	15410	8.61	11.35	5.43	100.92	5.90	0.16	0.95	8.17	3.18	0.62	1.58	416.38	-0.36	12.99
09/01/21 10:18:57	15440	8.61	10.94	4.39	99.68	5.91	2.50	0.70	8.34	2.60	0.57	1.21	420.61	-0.30	13.04
09/01/21 10:19:27	15470	8.61	10.43	3.76	99.80	5.93	3.33	0.68	8.33	2.10	0.59	0.99	421.58	-0.36	13.05
09/01/21 10:19:57	15500	8.60	9.92	3.75	99.99	5.93	3.39	0.72	8.09	1.82	0.57	0.95	419.50	-0.37	12.93
09/01/21 10:20:27	15530	8.61	9.98	3.85	99.09	5.92	3.37	0.60	8.58	1.40	0.56	0.95	424.30	-0.38	12.90
09/01/21 10:20:57	15560	8.60	10.48	3.13	97.99	5.87	3.32	0.76	8.36	2.12	0.54	1.01	418.67	-0.40	13.80
09/01/21 10:21:27	15590	8.59	10.26	3.34	99.07	5.90	3.34	0.74	8.19	2.07	0.67	1.02	418.01	-0.58	13.64
09/01/21 10:21:57	15620	8.62	9.95	3.80	99.01	5.93	3.34	0.65	8.52	1.43	0.52	0.94	422.67	-0.32	13.06
09/01/21 10:22:27	15650	8.62	10.12	3.22	99.20	5.86	3.37	0.78	8.95	1.17	0.53	1.03	416.90	-0.44	14.05
09/01/21 10:22:57	15680	8.62	10.52	3.73	98.72	5.92	3.47	0.67	8.79	1.74	0.59	0.97	420.37	-0.27	13.29
09/01/21 10:23:27	15710	8.63	9.89	3.68	99.65	5.92	3.48	0.69	8.60	1.29	0.59	0.97	421.08	-0.28	13.22
09/01/21 10:23:57	15740	8.61	10.24	3.64	100.07	5.91	3.48	0.68	9.07	1.17	0.55	0.97	418.20	-0.25	13.39
09/01/21 10:24:27	15770	8.62	11.18	3.73	99.70	5.90	3.46	0.63	9.19	1.99	0.54	0.96	419.60	-0.29	13.48
09/01/21 10:24:57	15800	8.64	10.63	3.66	99.94	5.89	3.40	0.63	9.15	1.48	0.60	0.96	421.90	-0.19	13.48
09/01/21 10:25:27	15830	8.63	10.99	3.28	99.85	5.74	3.46	0.97	9.12	1.88	0.65	1.05	409.91	-0.58	15.43
09/01/21 10:25:57	15860	8.64	12.22	3.34	99.24	5.91	3.75	0.68	8.99	3.23	0.59	0.97	417.11	-0.51	13.56
RAW AVERAGE		**8.60**	**10.21**	**3.76**	**99.12**	**5.88**	**2.08**	**0.79**	**8.60**	**1.61**	**0.59**	**1.12**	**414.75**	**0.00**	**13.64**

		O_2 (%)	NOx	CO	THC (as C_3H_8) (ppmvw)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4 (as C_3H_8)	C_2H_6 (as C_3H_8)	H_2O
	Serial Number:	INST-O2-0026	INST-NX-0025	INST-IR-0005	INST-VC-0004	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-NX-0025	INST-NX-0025	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005
Bias	**Initial Zero**	0.01			0.19										
	Final Zero	0.02			0.20										
	Avg. Zero	0.02			0.20										
	Initial UpScale	11.85			300.98										
	Final UpScale	11.94			300.31										
	Avg. UpScale	11.90			300.65										
Upscale Cal Gas		11.96			299.00										

EMISSIONS DATA	O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4 (as C_3H_8)	C_2H_6 (as C_3H_8)	VOC (as C_3H_8)
Corrected Raw Average (ppm/% dry basis)	8.64	10.21	4.36	114.77	6.81	2.40	0.91	8.60	1.61	0.68	1.29	176.10	0.00	0.00
Corrected Raw Average (ppm/% wet basis)	7.46	8.82	3.76	99.12	5.88	2.08	0.79	7.43	1.39	0.59	1.12	152.08	0.00	0.00
Concentration (ppm@ 15%O_2)	N/A	4.92	2.10	47.70	3.28	1.16	0.44	4.14	0.78	0.33	0.62	84.74	0.00	0.00
Emission Rate (g/kw*hr)	N/A	0.0797	0.0207	0.7392	508	0.0179	0.0068	0.0437	0.0126	0.0020	0.0066	1.3162	0.0000	0.0000
Non-Bias Adjusted Averages Include:		*	*	*	*	*	*	*	*	*	*	*	*	*

Catalytic Combustion Corporation
September 1, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	26,278	SCFH

Weather Data

Barometric Pressure	29.73	in. Hg
Relative Humidity	57	%
Ambient Temperature	93	°F
Specific Humidity	0.019207	lb H_2O / lb air

Unit Data

Unit Load	3,598.0	horsepower
Meas. Stack Moisture	12.9	%
Stack Exhaust Flow (M19)	399,898	SCFH

100% Load, Run - 3-2

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	NOx (ppmvd)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvd)	NO_2 (ppmvd)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (as C_3H_8) (ppmvw)	C_2H_6 (as C_3H_8) (ppmvw)	H_2O (%)
09/01/21 10:26:27	15890	8.63	10.93	3.24	99.31	5.91	3.81	0.76	9.15	1.78	0.63	0.97	417.84	-0.48	13.55
09/01/21 10:26:57	15920	8.62	10.77	3.37	99.38	5.91	3.80	0.70	9.23	1.54	0.64	0.94	417.36	-0.50	13.58
09/01/21 10:27:27	15950	8.62	11.03	3.20	99.52	5.90	3.80	0.75	9.08	1.95	0.58	0.97	418.06	-0.53	13.63
09/01/21 10:27:57	15980	8.64	11.41	3.23	99.55	5.90	3.80	0.72	9.23	2.18	0.54	0.97	418.20	-0.54	13.69
09/01/21 10:28:27	16010	8.63	10.75	3.16	100.19	5.76	3.83	0.75	9.29	1.47	0.60	0.96	411.88	-0.66	15.24
09/01/21 10:28:57	16040	8.62	11.56	3.16	100.40	5.86	3.77	0.67	9.07	2.49	0.65	0.97	419.57	-0.48	14.04
09/01/21 10:29:27	16070	8.64	10.82	3.21	100.54	5.87	3.82	0.74	9.16	1.66	0.60	1.01	417.74	-0.48	13.89
09/01/21 10:29:57	16100	8.63	11.67	3.30	100.76	5.90	3.81	0.72	8.47	3.20	0.68	1.03	417.82	-0.57	13.62
09/01/21 10:30:27	16130	8.63	11.55	3.24	101.14	5.88	3.79	0.65	8.51	3.04	0.61	0.94	416.35	-0.55	13.79
09/01/21 10:30:57	16160	8.62	11.02	3.18	100.86	5.86	3.81	0.76	9.11	1.91	0.73	0.99	417.79	-0.45	14.07
09/01/21 10:31:27	16190	8.64	10.62	3.60	100.74	5.91	3.80	0.72	9.30	1.32	0.78	0.90	417.79	-0.28	13.22
09/01/21 10:31:57	16220	8.63	10.90	3.63	100.52	5.93	3.79	0.54	8.61	2.29	0.69	0.91	418.91	-0.34	13.08
09/01/21 10:32:27	16250	8.62	10.51	3.66	100.73	5.94	3.85	0.59	8.86	1.65	0.72	0.92	423.48	-0.35	12.90
09/01/21 10:32:57	16280	8.63	11.03	3.76	100.97	5.95	3.85	0.59	9.04	2.00	0.73	0.96	422.53	-0.34	12.83
09/01/21 10:33:27	16310	8.63	11.24	3.72	101.35	5.96	3.82	0.64	8.07	3.17	0.72	0.95	423.24	-0.40	12.77
09/01/21 10:33:57	16340	8.62	11.70	3.79	101.21	5.94	2.89	0.66	8.48	3.22	0.76	0.95	421.14	-0.39	12.89
09/01/21 10:34:27	16370	8.63	11.19	4.01	100.92	5.95	2.11	0.75	9.39	1.80	0.72	1.03	419.17	-0.43	12.79
09/01/21 10:36:27	16490	9.10	12.43	3.44	94.25	5.82	2.06	0.76	11.49	0.94	0.76	1.08	418.85	-0.35	14.34
09/01/21 10:36:57	16520	9.10	11.91	3.53	92.81	5.90	2.05	0.85	11.10	0.80	0.72	1.01	417.41	-0.60	13.50
09/01/21 10:37:27	16550	9.11	11.35	3.52	92.70	5.86	2.11	0.80	10.63	0.72	0.79	1.05	416.14	-0.50	13.96
09/01/21 10:37:57	16580	9.10	10.93	3.93	92.36	5.91	2.05	0.72	10.22	0.71	0.82	1.01	420.27	-0.29	13.24
09/01/21 10:38:27	16610	9.12	10.18	3.96	92.36	5.92	2.08	0.70	9.89	0.29	0.76	1.01	419.51	-0.27	13.13
09/01/21 10:38:57	16640	9.12	9.99	3.98	92.28	5.92	2.09	0.65	9.07	0.92	0.76	1.01	421.75	-0.32	13.12
09/01/21 10:39:27	16670	9.12	9.84	4.04	92.08	5.94	2.06	0.65	9.75	0.09	0.68	1.04	419.46	-0.31	12.98
09/01/21 10:39:57	16700	9.13	10.03	4.04	92.56	5.95	2.06	0.68	9.38	0.65	0.73	1.02	419.79	-0.35	12.82
09/01/21 10:40:27	16730	9.13	10.20	4.11	92.74	5.95	2.05	0.76	9.55	0.65	0.80	1.02	421.15	-0.39	12.74
09/01/21 10:40:57	16760	9.13	9.77	4.10	92.69	5.93	2.11	0.74	9.42	0.35	0.79	0.99	420.08	-0.36	12.86
09/01/21 11:19:57	19100	9.13	9.83	1.47	92.40	5.64	0.19	0.91	9.06	0.77	1.06	0.72	386.10	0.58	12.92
09/01/21 11:20:27	19130	9.14	9.52	1.52	92.04	5.63	0.14	1.01	9.28	0.25	1.04	0.69	384.29	0.53	12.89
09/01/21 11:20:57	19160	9.16	9.84	1.57	91.43	5.64	0.17	0.98	9.41	0.43	1.08	0.68	382.45	0.46	12.83
09/01/21 11:21:27	19190	9.13	8.90	1.48	92.93	5.64	0.16	0.94	8.85	0.05	1.07	0.71	385.14	0.50	12.83
09/01/21 11:21:57	19220	9.12	8.91	1.47	94.59	5.64	0.18	0.96	8.43	0.48	1.03	0.73	386.35	0.56	12.83
09/01/21 11:22:27	19250	9.13	9.57	1.59	95.23	5.65	0.18	0.94	9.05	0.52	0.99	0.70	385.74	0.57	12.78
09/01/21 11:22:57	19280	9.13	9.12	1.51	96.70	5.66	0.16	0.86	8.55	0.57	0.99	0.71	386.92	0.53	12.74
09/01/21 11:23:27	19310	9.14	9.22	1.54	97.02	5.66	0.17	0.94	8.56	0.66	0.95	0.70	384.21	0.50	12.72
09/01/21 11:23:57	19340	9.13	9.05	1.53	94.70	5.67	0.18	0.91	8.31	0.73	0.97	0.69	385.10	0.47	12.71
09/01/21 11:24:27	19370	9.13	9.11	1.51	90.93	5.67	0.17	0.95	8.16	0.95	0.97	0.72	383.32	0.49	12.71
09/01/21 11:24:57	19400	9.12	8.84	1.62	90.99	5.67	0.19	0.94	7.96	0.89	0.96	0.67	385.77	0.54	12.68
09/01/21 11:25:27	19430	9.10	8.21	1.46	91.15	5.67	0.19	0.94	8.08	0.13	0.90	0.72	388.70	0.58	12.69
09/01/21 11:25:57	19460	9.10	9.17	1.50	91.11	5.65	0.19	1.04	8.46	0.70	0.89	0.70	387.60	0.53	12.69
09/01/21 11:26:27	19490	9.10	9.48	1.56	90.72	5.66	0.17	0.89	8.81	0.68	0.88	0.68	387.71	0.50	12.68
09/01/21 11:26:57	19520	9.11	8.98	1.48	91.72	5.66	0.18	0.93	8.60	0.38	0.96	0.71	385.46	0.48	12.67
09/01/21 11:27:27	19550	9.08	8.55	0.82	91.56	5.47	0.17	-0.28	8.32	0.24	1.49	0.64	366.29	1.65	15.26
09/01/21 11:27:57	19580	9.10	9.20	1.56	91.15	5.66	0.14	0.93	8.62	0.58	1.75	0.74	385.12	0.48	12.86
09/01/21 11:28:27	19610	9.10	9.17	1.37	91.47	5.65	0.15	1.01	8.32	0.85	1.19	0.71	386.86	0.68	12.47
09/01/21 11:28:57	19640	9.09	8.81	1.40	91.46	5.66	0.12	0.99	8.24	0.57	1.07	0.69	386.87	0.64	12.41
09/01/21 11:29:27	19670	9.08	8.29	1.33	90.05	5.67	0.16	1.00	7.93	0.36	0.95	0.71	380.96	0.62	12.39
09/01/21 11:29:57	19700	9.09	8.35	1.47	89.21	5.67	0.15	0.96	8.09	0.26	0.87	0.69	383.01	0.69	12.39
09/01/21 11:30:27	19730	9.07	8.22	1.46	89.57	5.66	0.17	1.01	7.70	0.51	0.89	0.71	394.32	0.76	12.32
09/01/21 11:30:57	19760	9.06	8.36	1.49	89.92	5.64	0.11	0.87	7.89	0.47	0.85	0.69	405.01	0.97	12.28
09/01/21 11:31:27	19790	9.05	8.46	1.45	89.80	5.65	0.18	1.00	8.02	0.44	0.86	0.69	401.42	0.85	12.19
09/01/21 11:31:57	19820	9.06	8.95	1.51	90.19	5.66	0.15	0.95	8.25	0.70	0.79	0.70	396.77	0.76	12.21
09/01/21 11:32:27	19850	9.06	8.67	1.48	90.23	5.67	0.15	1.07	8.98	-0.31	0.80	0.70	389.36	0.80	12.33
09/01/21 11:32:57	19880	9.07	9.01	1.54	90.66	5.65	0.14	0.93	8.87	0.14	0.80	0.67	387.85	0.73	12.45
09/01/21 11:33:27	19910	9.08	10.33	1.42	90.27	5.64	0.16	1.12	9.37	0.96	0.77	0.69	388.53	0.75	12.54
09/01/21 11:33:57	19940	9.08	8.74	1.42	91.42	5.66	0.17	0.95	8.16	0.59	0.92	0.68	388.58	0.55	12.60
09/01/21 11:34:27	19970	9.10	9.31	1.50	90.99	5.66	0.18	0.96	8.67	0.64	0.91	0.68	385.32	0.55	12.58
09/01/21 11:34:57	20000	9.08	9.12	1.63	90.81	5.67	0.16	0.93	8.58	0.54	0.88	0.66	387.04	0.48	12.59
09/01/21 11:35:27	20030	9.10	9.04	1.59	90.39	5.66	0.17	0.97	8.31	0.73	0.84	0.67	383.78	0.49	12.65
09/01/21 11:35:57	20060	9.09	9.00	1.50	89.96	5.66	0.18	0.97	8.40	0.60	0.80	0.66	382.67	0.51	12.64
09/01/21 11:36:27	20090	9.09	8.80	1.47	90.89	5.65	0.17	0.98	8.28	0.52	0.83	0.67	388.40	0.55	12.59
09/01/21 11:36:57	20120	9.06	8.73	1.40	91.08	5.64	0.12	1.01	8.35	0.38	0.73	0.72	385.69	0.70	12.53
09/01/21 11:37:27	20150	9.08	8.62	1.44	90.90	5.65	0.14	0.99	8.13	0.49	0.78	0.68	387.06	0.77	12.44
09/01/21 11:37:57	20180	9.06	8.64	1.46	90.51	5.66	0.13	1.01	8.42	0.22	0.71	0.68	386.21	0.72	12.34
09/01/21 11:38:27	20210	9.09	8.75	1.50	90.54	5.67	0.17	0.96	8.36	0.39	0.72	0.64	389.77	0.72	12.20
09/01/21 11:38:57	20240	9.09	9.33	1.46	89.88	5.68	0.15	1.05	8.78	0.55	0.68	0.66	386.33	0.64	12.07
09/01/21 11:39:27	20270	9.12	8.88	1.41	90.16	5.71	0.17	0.97	9.02	-0.14	0.67	0.67	389.41	0.60	11.79
09/01/21 11:39:57	20300	9.12	9.61	1.04	90.23	5.77	0.15	1.00	8.71	0.89	0.71	0.63	388.87	0.55	11.21
09/01/21 11:40:27	20330	9.11	8.52	1.20	90.92	5.81	0.16	1.07	8.05	0.47	0.66	0.63	387.92	0.37	10.75
09/01/21 11:40:57	20360	9.11	9.15	1.49	90.33	5.83	0.18	0.98	8.61	0.54	0.63	0.64	393.60	0.69	10.38
09/01/21 11:41:27	20390	9.13	9.74	1.50	89.92	5.82	0.19	0.95	9.09	0.66	0.65	0.65	392.46	0.65	10.39
09/01/21 11:41:57	20420	9.13	9.12	1.05	90.85	5.76	0.16	1.08	8.72	0.40	0.81	0.66	387.99	0.52	11.34
09/01/21 11:42:27	20450	9.15	9.45	1.54	90.61	5.68	0.14	1.02	8.72	0.73	0.71	0.71	389.72	0.70	12.25
09/01/21 11:42:57	20480	9.14	8.65	1.62	90.80	5.68	0.17	0.91	8.34	0.31	0.84	0.68	386.74	0.49	12.66
09/01/21 11:43:27	20510	9.13	8.74	1.68	90.79	5.69	0.21	0.96	8.46	0.28	0.77	0.67	379.77	0.48	12.67
09/01/21 11:43:57	20540	9.13	8.37	1.47	90.79	5.69	0.16	-0.33	8.33	0.04	0.75	0.51	364.77	1.64	13.21
09/01/21 11:44:27	20570	9.12	8.45	1.11	91.42	5.64	0.19	1.02	8.13	0.32	0.75	0.70	381.16	0.33	13.53
09/01/21 11:44:57	20600	9.10	7.99	1.50	92.23	5.64	0.14	0.98	7.92	0.08	0.75	0.68	387.41	0.63	13.26
09/01/21 11:45:27	20630	9.10	8.30	1.59	91.44	5.66	0.15	0.87	8.16	0.14	0.71	0.68	389.89	0.56	12.99
09/01/21 11:45:57	20660	9.11	9.13	0.93	91.18	5.56	0.19	1.03	8.42	0.70	0.78	0.74	380.54	0.63	14.40
09/01/21 11:46:27	20690	9.11	8.60	1.23	91.31	5.64	0.21	1.06	8.77	-0.17	1.04	0.68	379.87	0.36	13.53
09/01/21 11:46:57	20720	9.12	9.01	1.36	91.67	5.66	0.56	0.82	8.74	0.28	0.93	0.63	383.12	0.51	13.20
09/01/21 11:47:27	20750	9.12	8.53	1.36	92.91	5.65	0.61	0.87	7.93	0.60	0.81	0.59	381.49	0.59	13.23
09/01/21 11:47:57	20780	9.12	9.17	1.40	92.75	5.66	0.65	0.78	8.22	0.95	0.74	0.58	379.89	0.55	13.17
09/01/21 11:48:27	20810	9.14	9.09	1.39	92.08	5.68	0.66	0.81	8.81	0.28	0.83	0.56	383.25	0.51	12.84
09/01/21 11:48:57	20840	9.12	8.40	1.43	92.97	5.69	0.66	0.88	8.16	0.24	0.80	0.56	384.86	0.50	12.66
09/01/21 11:49:27	20870	9.11	8.74	1.26	92.94	5.67	0.67	0.92	8.25	0.49	0.81	0.57	383.78	0.52	13.01
09/01/21 11:49:57	20900	9.13	8.76	1.36	92.49	5.67	0.70	0.86	8.61	0.15	0.91	0.57	382.48	0.58	13.15
09/01/21 11:50:27	20930	9.13	8.71	1.42	92.73	5.68	0.72	0.78	8.29	0.42	1.33	0.56	382.83	0.50	12.99
09/01/21 11:50:57	20960	9.16	9.85	1.47	91.32	5.69	0.76	0.80	9.06	0.79	2.13	0.55	381.22	0.52	12.92
09/01/21 11:51:27	20990	9.17	9.49	1.44	91.22	5.67	0.74	0.83	9.12	0.36	2.99	0.55	379.61	0.51	13.09
09/01/21 11:51:57	21020	9.15	8.77	1.39	92.26	5.67	0.75	0.76	8.51	0.26	3.82	0.52	383.46	0.51	12.99
09/01/21 11:52:27	21050	9.17	8.63	1.48	91.98	5.71	0.73	0.75	8.49	0.14	4.44	0.51	389.34	0.54	12.67
09/01/21 11:52:57	21080	9.17	8.96	1.28	91.67	5.74	0.73	0.87	8.41	0.55	4.52	0.56	387.83	0.63	12.09
09/01/21 11:53:27	21110	9.18	8.55	0.90	92.22	5.79	0.72	0.97	8.57	-0.02	4.19	0.55	388.03	0.50	11.47
09/01/21 11:53:57	21140	9.16	8.32	0.95	92.51	5.81	0.71	0.97	7.98	0.34	3.87	0.55	392.71	0.47	10.95
09/01/21 11:54:27	21170	9.19	9.33	0.88	92.24	5.82	0.71	1.00	8.23	1.10	3.82	0.53	392.62	0.46	10.97
09/01/21 11:54:57	21200	9.19	9.60	1.40	91.96	5.76	0.70	0.90	9.32	0.27	3.96	0.54	391.09	0.59	11.77
09/01/21 11:55:27	21230	9.21	8.46	1.31	93.02	5.69	0.73	0.82	8.44	0.02	4.84	0.57	383.13	0.46	12.98
09/01/21 11:55:57	21260	9.19	8.76	1.36	93.33	5.65	0.67	0.88	8.57	0.20	5.89	0.51	386.06	0.64	13.38

Catalytic Combustion Corporation
September 1, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	26,278	SCFH

Weather Data

Barometric Pressure	29.73	in. Hg
Relative Humidity	57	%
Ambient Temperature	93	°F
Specific Humidity	0.019207	lb H_2O / lb air

Unit Data

Unit Load	3,598.0	horsepower
Meas. Stack Moisture	12.9	%
Stack Exhaust Flow (M19)	399,898	SCFH

100% Load, Run - 3-2

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	NOx (ppmvd)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvd)	NO_2 (ppmvd)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (as C_3H_8) (ppmvw)	C_2H_6 (as C_3H_8) (ppmvw)	H_2O (%)
09/01/21 11:56:27	21290	9.19	8.39	1.39	94.33	5.66	0.71	0.86	7.90	0.49	7.12	0.53	384.79	0.66	13.46
09/01/21 11:56:57	21320	9.19	9.16	1.26	94.11	5.67	0.70	0.85	8.23	0.93	8.09	0.53	383.51	0.61	13.42
09/01/21 11:57:27	21350	9.20	8.84	1.34	94.21	5.70	0.71	0.85	8.56	0.28	8.45	0.53	380.88	0.52	13.17
09/01/21 11:57:57	21380	9.20	8.57	1.33	94.69	5.70	0.69	0.87	8.47	0.10	8.73	0.55	381.37	0.53	13.13
09/01/21 11:58:27	21410	9.20	8.53	1.49	95.06	5.71	0.71	0.85	8.32	0.21	8.69	0.53	384.53	0.53	12.94
09/01/21 11:58:57	21440	9.21	8.63	1.37	94.76	5.70	0.69	0.90	8.33	0.31	9.00	0.51	384.68	0.51	13.03
09/01/21 11:59:27	21470	9.21	8.33	1.29	95.18	5.72	0.69	0.87	8.05	0.28	9.28	0.52	382.22	0.53	13.05
09/01/21 11:59:57	21500	9.19	8.51	1.32	95.08	5.72	0.72	0.85	8.28	0.23	9.32	0.52	380.93	0.48	12.98
09/01/21 12:00:27	21530	9.21	8.51	0.75	95.15	5.50	0.70	-0.37	7.90	0.61	13.44	0.37	360.69	1.59	16.29
09/01/21 12:00:57	21560	9.19	8.54	1.33	94.65	5.70	0.71	0.81	8.15	0.38	11.42	0.53	381.65	0.59	13.46
09/01/21 12:01:27	21590	9.19	8.61	1.22	94.96	5.69	0.75	0.80	7.97	0.64	11.61	0.53	380.56	0.67	13.48
09/01/21 12:01:57	21620	9.16	8.79	0.86	94.88	5.61	0.79	-0.41	8.31	0.49	13.55	0.36	366.56	1.24	14.82
09/01/21 12:02:27	21650	9.18	9.53	1.00	93.89	5.71	0.79	0.93	9.08	0.45	12.76	0.55	380.90	0.30	13.50
09/01/21 12:02:57	21680	9.19	8.79	0.94	93.82	5.65	0.78	0.91	8.81	-0.02	13.04	0.53	368.61	0.42	14.38
RAW AVERAGE		**9.05**	**9.38**	**1.90**	**93.36**	**5.73**	**1.01**	**0.83**	**8.67**	**0.71**	**2.31**	**0.71**	**392.98**	**0.37**	**12.89**

		O_2 (%)	NOx (ppmvd)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvd)	NO_2 (ppmvd)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (as C_3H_8) (ppmvw)	C_2H_6 (as C_3H_8) (ppmvw)	H_2O (%)
	Serial Number:	INST-O2-0026	INST-NX-0025	INST-IR-0005	INST-VC-0004	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-NX-0025	INST-NX-0025	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005
Bias	**Initial Zero**	0.02			0.20										
	Final Zero	0.02			0.20										
	Avg. Zero	0.02			0.20										
	Initial UpScale	11.94			300.31										
	Final UpScale	11.95			300.00										
	Avg. UpScale	11.95			300.16										
Upscale Cal Gas		11.96			299.00										

EMISSIONS DATA	O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4 (as C_3H_8)	C_2H_6 (as C_3H_8)	VOC (as C_3H_8)
Corrected Raw Average (ppm/% dry basis)	9.06	9.38	2.18	107.19	6.58	1.16	0.96	8.67	0.71	2.65	0.82	165.42	0.28	0.00
Corrected Raw Average (ppm/% wet basis)	7.89	8.17	1.90	93.36	5.73	1.01	0.83	7.55	0.61	2.31	0.71	144.09	0.24	0.00
Concentration (ppm@ 15%O_2)	N/A	4.67	1.09	46.52	3.28	0.58	0.48	4.32	0.35	1.32	0.41	82.43	0.14	0.00
Emission Rate (g/kw*hr)	N/A	0.0757	0.0107	0.7210	508	0.0090	0.0074	0.0457	0.0057	0.0079	0.0043	1.2803	0.0022	0.0000
Non-Bias Adjusted Averages Include:		*	*	*	*	*	*			*	*	*	*	*

Catalytic Combustion Corporation
September 2, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	26,278	SCFH

Weather Data

Barometric Pressure	29.74	in. Hg
Relative Humidity	46	%
Ambient Temperature	95	°F
Specific Humidity	0.016410	lb H_2O / lb air

Unit Data

Unit Load	3,598.0	horsepower
Meas. Stack Moisture	13.0	%
Stack Exhaust Flow (M19)	406,400	SCFH

100% Load, Run - 3-3

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	NOx (ppmvw)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvd)	NO_2 (ppmvd)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (as C_3H_8) (ppmvw)	C_2H_6 (as C_3H_8) (ppmvw)	H_2O (%)
09/01/21 12:03:27	21710	9.20	8.82	1.25	94.00	5.72	0.75	0.76	8.39	0.43	12.99	0.51	379.09	0.56	13.46
09/01/21 12:03:57	21740	9.18	8.68	1.45	94.39	5.75	0.73	0.85	8.35	0.33	12.29	0.55	380.60	0.45	13.14
09/01/21 12:04:27	21770	9.19	8.42	0.90	95.02	5.68	0.74	0.98	7.81	0.60	12.27	0.57	369.55	0.34	14.12
09/01/21 12:04:57	21800	9.19	8.53	1.51	94.89	5.74	0.68	0.86	8.30	0.23	11.67	0.52	380.73	0.51	13.21
09/01/21 12:05:27	21830	9.19	8.80	1.39	94.85	5.75	0.72	0.79	8.20	0.60	10.89	0.53	370.24	0.40	12.86
09/01/21 12:05:57	21860	9.21	8.64	1.49	94.50	5.75	0.70	0.88	8.40	0.24	10.27	0.52	380.22	0.46	12.79
09/01/21 12:06:27	21890	9.21	8.76	1.49	94.15	5.74	0.72	0.92	8.17	0.60	10.28	0.54	384.31	0.47	12.84
09/01/21 12:06:57	21920	9.23	8.75	1.40	93.96	5.74	0.70	0.81	8.73	0.02	10.45	0.55	380.65	0.45	12.89
09/01/21 12:07:27	21950	9.23	9.33	0.90	93.20	5.63	0.71	0.90	8.92	0.41	11.19	0.55	369.54	0.54	14.31
09/01/21 12:07:57	21980	9.24	9.04	0.95	93.14	5.68	0.72	0.96	7.98	1.06	11.38	0.57	371.13	0.34	13.81
09/01/21 12:08:27	22010	9.24	8.81	0.91	92.33	5.70	0.72	0.99	8.20	0.61	11.19	0.53	371.09	0.27	13.56
09/01/21 12:08:57	22040	9.24	8.76	1.36	92.33	5.70	0.71	0.86	8.23	0.53	10.95	0.52	380.94	0.54	13.31
09/01/21 12:09:27	22070	9.26	9.03	1.48	92.91	5.71	0.71	0.82	8.59	0.45	10.71	0.55	380.08	0.51	13.20
09/01/21 12:09:57	22100	9.24	9.23	1.39	93.01	5.72	0.71	0.82	8.53	0.69	10.73	0.53	382.54	0.51	13.20
09/01/21 12:10:27	22130	9.24	8.66	1.38	93.57	5.72	0.72	0.85	8.19	0.47	10.83	0.54	380.95	0.55	13.20
09/01/21 12:10:57	22160	9.24	9.07	1.50	93.99	5.71	0.71	0.75	8.27	0.80	11.12	0.55	380.52	0.47	13.32
09/01/21 12:11:27	22190	9.24	8.76	1.06	94.38	5.54	0.69	-0.13	8.20	0.56	13.80	0.40	362.95	1.39	15.94
09/01/21 12:11:57	22220	9.24	8.59	1.10	94.46	5.68	0.73	0.85	8.12	0.47	12.22	0.53	369.62	0.22	13.74
09/01/21 12:12:27	22250	9.24	8.44	1.38	94.87	5.71	0.70	0.90	7.89	0.55	11.27	0.50	380.67	0.56	13.26
09/01/21 12:12:57	22280	9.24	8.48	1.41	95.22	5.70	0.70	0.80	7.90	0.58	10.95	0.56	371.17	0.47	13.13
09/01/21 12:13:27	22310	9.24	8.29	0.98	95.31	5.63	0.75	0.88	8.06	0.23	11.58	0.56	369.15	0.45	14.18
09/01/21 12:13:57	22340	9.21	8.34	1.38	95.52	5.71	0.69	0.93	7.90	0.44	11.56	0.54	381.76	0.55	13.24
09/01/21 12:14:27	22370	9.21	8.33	1.51	95.11	5.72	0.66	0.83	7.70	0.63	11.28	0.52	379.37	0.47	13.12
09/01/21 12:14:57	22400	9.22	8.71	1.43	94.66	5.72	0.74	0.86	8.37	0.34	10.70	0.55	378.82	0.53	12.98
09/01/21 12:15:27	22430	9.21	8.47	1.05	95.11	5.56	0.81	-0.30	8.03	0.44	11.59	0.37	363.41	1.33	14.84
09/01/21 12:15:57	22460	9.23	8.82	1.05	94.45	5.69	0.73	0.92	8.27	0.56	11.93	0.54	378.92	0.29	13.50
09/01/21 12:16:27	22490	9.22	8.61	1.43	94.01	5.70	0.76	0.82	8.53	0.08	11.65	0.53	382.00	0.53	13.13
09/01/21 12:16:57	22520	9.24	8.98	1.07	94.17	5.62	0.81	0.86	7.92	1.06	13.01	0.51	369.32	0.11	14.41
09/01/21 12:17:27	22550	9.24	8.35	1.41	95.01	5.68	0.71	0.77	8.04	0.32	12.81	0.53	383.23	0.60	13.41
09/01/21 12:17:57	22580	9.24	8.01	1.48	95.11	5.69	0.72	0.83	7.74	0.28	12.41	0.47	383.22	0.56	13.30
09/01/21 12:18:27	22610	9.22	7.83	1.42	94.98	5.69	0.73	0.85	7.30	0.53	11.92	0.54	386.66	0.60	13.30
09/01/21 12:18:57	22640	9.21	7.91	0.85	94.40	5.57	0.75	0.89	7.54	0.37	13.59	0.51	370.07	0.29	15.04
09/01/21 12:22:57	22880	9.22	10.09	1.41	94.04	5.71	0.68	0.90	9.52	0.56	10.74	0.52	383.50	0.68	12.52
09/01/21 12:23:27	22910	9.21	9.30	1.47	93.98	5.74	0.71	0.73	9.15	0.15	11.02	0.52	386.84	0.40	12.55
09/01/21 12:23:57	22940	9.22	9.11	1.64	93.69	5.74	0.72	0.86	8.58	0.54	11.10	0.49	385.22	0.46	12.56
09/01/21 12:24:27	22970	9.22	8.35	1.48	93.88	5.76	0.72	0.73	8.68	-0.32	10.90	0.53	383.27	0.44	12.57
09/01/21 12:24:57	23000	9.21	8.62	0.89	94.15	5.60	0.76	0.85	8.37	0.25	12.26	0.48	368.19	0.29	14.59
09/01/21 12:25:27	23030	9.21	8.65	1.43	94.41	5.69	0.70	0.87	7.78	0.87	12.32	0.51	369.70	0.54	13.39
09/01/21 12:25:57	23060	9.21	8.47	1.42	94.41	5.73	0.72	0.83	8.14	0.33	11.10	0.52	368.24	0.43	12.73
09/01/21 12:26:27	23090	9.21	8.49	1.56	94.65	5.72	0.75	0.82	8.11	0.38	11.02	0.51	382.43	0.48	12.69
09/01/21 12:26:57	23120	9.21	8.85	1.44	94.59	5.71	0.70	0.87	8.23	0.62	11.50	0.53	385.57	0.59	12.85
09/01/21 12:27:27	23150	9.21	8.77	1.03	94.43	5.65	0.76	0.95	8.25	0.52	12.45	0.54	379.50	0.37	13.74
09/01/21 12:27:57	23180	9.21	8.76	1.03	94.66	5.65	0.72	0.87	8.11	0.65	12.93	0.53	381.47	0.32	13.68
09/01/21 12:28:27	23210	9.22	8.50	1.41	94.45	5.69	0.72	0.82	8.31	0.19	11.85	0.53	383.29	0.59	13.04
09/01/21 12:28:57	23240	9.22	8.68	1.48	95.01	5.69	0.71	0.81	8.24	0.44	11.58	0.53	384.86	0.58	13.03
09/01/21 12:29:27	23270	9.22	8.19	1.35	94.77	5.70	0.72	0.91	8.44	-0.25	11.53	0.49	382.18	0.53	12.99
09/01/21 12:29:57	23300	9.23	8.80	1.04	95.08	5.58	0.77	-0.39	8.24	0.56	12.84	0.37	363.85	1.27	14.62
09/01/21 12:30:27	23330	9.22	8.20	1.38	95.59	5.68	0.68	0.83	7.80	0.40	11.63	0.54	380.69	0.46	12.96
09/01/21 12:30:57	23360	9.24	8.33	1.50	95.07	5.70	0.72	0.75	7.93	0.40	11.23	0.51	385.14	0.47	12.73
09/01/21 12:31:27	23390	9.22	8.62	1.48	94.91	5.70	0.73	0.83	7.84	0.78	11.05	0.53	384.18	0.44	12.64
09/01/21 12:31:57	23420	9.22	8.60	1.47	95.01	5.69	0.71	0.79	7.99	0.61	11.15	0.54	389.72	0.53	12.58
09/01/21 12:32:27	23450	9.22	8.66	1.33	95.13	5.68	0.67	0.88	7.99	0.67	11.14	0.53	386.42	0.67	12.46
09/01/21 12:32:57	23480	9.20	8.32	1.44	95.01	5.69	0.70	0.82	8.08	0.23	10.98	0.56	386.39	0.62	12.37
09/01/21 12:33:27	23510	9.22	8.55	1.43	94.97	5.68	0.71	0.92	7.56	0.99	11.03	0.57	389.28	0.65	12.34
09/01/21 12:33:57	23540	9.22	8.52	1.34	94.89	5.68	0.72	0.91	8.20	0.32	11.02	0.55	389.00	0.71	12.29
09/01/21 12:34:27	23570	9.22	8.37	1.34	95.20	5.69	0.66	0.84	7.98	0.39	10.97	0.53	388.62	0.61	12.22
09/01/21 12:34:57	23600	9.22	8.33	1.44	94.75	5.69	0.68	0.95	8.54	-0.20	10.97	0.54	389.14	0.68	12.19
09/01/21 12:35:27	23630	9.23	8.29	1.46	95.16	5.71	0.72	0.94	7.89	0.41	10.95	0.55	389.44	0.69	12.09
09/01/21 12:35:57	23660	9.21	8.14	1.44	95.65	5.72	0.68	0.93	7.85	0.29	10.82	0.51	389.83	0.60	11.99
09/01/21 12:36:27	23690	9.21	8.64	1.49	95.26	5.72	0.73	0.84	8.17	0.47	11.01	0.50	389.48	0.72	12.05
09/01/21 12:36:57	23720	9.21	8.73	1.37	95.23	5.71	0.69	0.89	7.84	0.89	11.15	0.53	388.48	0.67	12.11
09/01/21 12:37:27	23750	9.21	8.47	1.35	95.24	5.71	0.72	0.87	8.20	0.27	11.29	0.53	389.96	0.71	12.18
09/01/21 12:37:57	23780	9.23	8.17	1.48	95.47	5.66	0.70	0.83	7.99	0.18	12.02	0.53	384.67	0.69	13.14
09/01/21 12:38:27	23810	9.22	8.14	1.40	95.79	5.66	0.70	0.71	7.96	0.18	12.65	0.55	379.21	0.61	13.31
09/01/21 12:38:57	23840	9.23	8.48	1.31	95.72	5.72	0.68	0.85	7.92	0.55	11.23	0.52	384.88	0.65	12.15
09/01/21 12:39:27	23870	9.22	8.50	1.52	95.62	5.71	0.69	0.84	7.93	0.57	11.12	0.53	385.55	0.65	12.19
09/01/21 12:39:57	23900	9.23	8.39	1.38	95.52	5.70	0.70	0.95	7.84	0.55	11.25	0.53	387.23	0.69	12.32
09/01/21 12:40:27	23930	9.21	8.30	1.44	95.33	5.72	0.69	0.89	8.04	0.26	11.32	0.54	388.65	0.73	12.29
09/01/21 12:40:57	23960	9.21	8.37	1.43	94.80	5.64	0.70	0.83	8.42	-0.05	12.55	0.54	385.29	0.61	13.42
09/01/21 12:41:27	23990	9.22	8.77	1.36	95.02	5.72	0.68	0.88	8.26	0.51	11.55	0.54	388.04	0.71	12.18
09/01/21 12:41:57	24020	9.23	8.63	1.51	95.44	5.73	0.69	0.85	8.06	0.57	11.28	0.52	388.07	0.64	12.03
09/01/21 12:42:27	24050	9.21	8.53	1.44	95.30	5.71	0.69	0.93	8.31	0.22	11.15	0.54	386.78	0.62	12.13
09/01/21 12:42:57	24080	9.21	8.68	1.38	94.73	5.70	0.66	0.91	8.06	0.62	11.20	0.52	384.84	0.60	12.16
09/01/21 12:43:27	24110	9.21	8.74	1.43	94.68	5.69	0.67	0.96	8.28	0.46	11.16	0.55	387.19	0.69	12.28
09/01/21 12:43:57	24140	9.20	8.74	1.41	94.27	5.68	0.69	0.90	8.10	0.64	11.37	0.55	383.85	0.70	12.43
09/01/21 12:44:27	24170	9.23	8.56	1.60	93.94	5.68	0.70	0.95	8.21	0.34	11.63	0.50	384.25	0.42	12.67
09/01/21 12:44:57	24200	9.21	8.43	1.43	94.36	5.66	0.71	0.83	8.18	0.25	12.16	0.53	384.02	0.63	12.99
09/01/21 12:45:27	24230	9.22	8.52	1.39	95.11	5.62	0.69	0.84	7.82	0.71	13.24	0.55	383.81	0.64	13.38
09/01/21 12:45:57	24260	9.22	8.46	1.42	95.16	5.63	0.67	0.82	8.02	0.44	13.27	0.51	383.46	0.69	13.45
09/01/21 12:46:27	24290	9.22	8.68	1.51	95.11	5.64	0.69	0.88	8.45	0.23	13.02	0.50	383.61	0.64	13.30
09/01/21 12:46:57	24320	9.21	8.77	1.16	95.45	5.47	0.69	-0.03	8.10	0.67	15.31	0.41	363.59	1.45	15.59
09/01/21 12:47:27	24350	9.23	9.23	1.34	95.04	5.64	0.69	0.82	8.37	0.86	13.04	0.55	383.31	0.63	13.17
09/01/21 12:47:57	24380	9.24	8.68	1.57	94.98	5.66	0.71	0.84	8.33	0.35	12.67	0.53	384.86	0.60	12.94
09/01/21 12:48:27	24410	9.22	8.69	1.49	95.32	5.67	0.73	0.73	8.11	0.59	12.38	0.54	384.15	0.57	12.74
09/01/21 12:48:57	24440	9.24	8.68	1.47	95.51	5.67	0.71	0.85	8.24	0.44	12.47	0.53	386.14	0.58	12.73
09/01/21 12:49:27	24470	9.22	9.02	1.58	95.29	5.68	0.71	0.74	8.25	0.77	12.51	0.52	385.54	0.55	12.64
09/01/21 12:49:57	24500	9.22	8.01	1.45	95.76	5.61	0.66	0.72	8.22	-0.21	13.22	0.54	384.78	0.77	13.44
09/01/21 12:50:27	24530	9.23	8.89	1.44	95.42	5.65	0.68	0.77	8.36	0.53	13.66	0.53	387.09	0.68	13.15
09/01/21 12:50:57	24560	9.23	9.07	1.39	94.85	5.67	0.69	0.91	8.30	0.77	12.48	0.53	389.36	0.79	12.44
09/01/21 12:51:27	24590	9.24	8.53	1.25	94.72	5.68	0.70	0.89	7.99	0.54	12.34	0.55	390.79	0.73	12.41
09/01/21 12:51:57	24620	9.25	8.43	1.41	94.52	5.68	0.69	0.83	8.29	0.14	12.57	0.54	389.19	0.81	12.46
09/01/21 12:52:27	24650	9.25	8.48	1.40	94.51	5.68	0.69	0.91	7.72	0.76	12.56	0.54	388.90	0.73	12.42
09/01/21 12:52:57	24680	9.24	8.32	1.44	94.52	5.69	0.68	0.88	7.77	0.55	12.29	0.53	386.59	0.62	12.33
09/01/21 12:53:27	24710	9.23	8.13	1.32	94.27	5.70	0.69	0.90	7.77	0.37	11.92	0.53	387.71	0.67	12.15
09/01/21 12:53:57	24740	9.22	8.34	1.52	93.62	5.70	0.67	0.91	8.24	0.10	11.96	0.53	385.08	0.64	12.27
09/01/21 12:54:27	24770	9.23	8.33	1.31	93.30	5.68	0.67	0.85	8.44	-0.11	12.25	0.55	385.85	0.70	12.48
09/01/21 12:54:57	24800	9.24	8.36	1.48	93.64	5.69	0.73	0.87	7.94	0.42	12.44	0.52	386.25	0.42	12.56
09/01/21 12:55:27	24830	9.21	8.42	1.37	94.25	5.66	0.69	0.88	7.79	0.63	12.24	0.52	388.19	0.77	12.53
09/01/21 12:55:57	24860	9.23	8.51	1.44	93.81	5.68	0.72	0.85	7.97	0.54	12.60	0.51	389.87	0.53	12.60
09/01/21 12:56:27	24890	9.24	8.51	1.47	93.41	5.66	0.70	0.81	8.07	0.44	13.08	0.50	390.67	0.64	12.82

Catalytic Combustion Corporation
September 2, 2021
Caterpillar, G3520 TALE
Stewart & Stevenson Integration Center

Fuel Data

Fuel Fd factor	8,632	SCF exh/MMBtu
Fuel Heating Value (HHV)	999	Btu/SCF fuel
Engine Fuel Flow	26,278	SCFH

Weather Data

Barometric Pressure	29.74	in. Hg
Relative Humidity	46	%
Ambient Temperature	95	°F
Specific Humidity	0.016410	lb H_2O / lb air

Unit Data

Unit Load	3,598.0	horsepower
Meas. Stack Moisture	13.0	%
Stack Exhaust Flow (M19)	406,400	SCFH

100% Load, Run - 3-3

Date/Time (mm/dd/yy hh:mm:ss)	Elapsed Time (seconds)	O_2 (%)	NOx (ppmvw)	CO (ppmvw)	THC (as C_3H_8) (ppmvw)	CO_2 (%)	N_2O (ppmvw)	C_2H_4O (ppmvw)	NO (ppmvd)	NO_2 (ppmvd)	NH_3 (ppmvw)	HCHO (ppmvw)	CH_4 (as C_3H_8) (ppmvw)	C_2H_6 (as C_3H_8) (ppmvw)	H_2O (%)
09/01/21 12:56:57	24920	9.27	8.90	1.02	92.98	5.58	0.72	0.91	8.60	0.29	14.90	0.55	384.09	0.61	14.16
09/01/21 12:57:27	24950	9.27	8.99	0.99	93.05	5.64	0.74	0.90	8.28	0.71	14.98	0.54	386.67	0.38	13.51
09/01/21 12:57:57	24980	9.25	8.38	1.38	93.31	5.64	0.51	0.85	8.01	0.38	14.34	0.53	386.40	0.61	13.24
09/01/21 12:58:27	25010	9.25	8.27	1.56	93.45	5.64	0.17	0.83	7.93	0.34	11.26	0.59	383.02	0.62	13.27
09/01/21 12:58:57	25040	9.26	8.72	1.66	93.61	5.62	0.17	0.91	8.15	0.58	8.75	0.66	383.84	0.67	13.27
09/01/21 12:59:27	25070	9.25	8.72	1.61	93.23	5.63	0.38	0.95	8.62	0.10	7.35	0.65	383.56	0.61	13.25
09/01/21 12:59:57	25100	9.26	9.57	1.49	93.36	5.63	0.62	0.84	8.17	1.40	6.80	0.58	384.97	0.59	13.21
09/01/21 13:00:27	25130	9.26	8.92	1.38	93.56	5.63	0.62	0.82	8.22	0.70	7.25	0.57	385.54	0.63	13.18
09/01/21 13:00:57	25160	9.26	8.64	1.45	93.69	5.63	0.65	0.82	8.14	0.50	7.80	0.56	387.60	0.59	13.14
09/01/21 13:01:27	25190	9.25	8.25	1.51	94.00	5.65	0.63	0.75	7.99	0.26	8.00	0.52	384.73	0.61	13.04
09/01/21 13:01:57	25220	9.26	8.21	1.47	94.11	5.65	0.66	0.81	7.99	0.22	8.36	0.55	386.38	0.68	13.01
09/01/21 13:02:27	25250	9.25	8.34	1.58	94.00	5.66	0.65	0.91	8.18	0.16	9.09	0.54	384.14	0.56	13.02
09/01/21 13:02:57	25280	9.24	8.36	1.46	94.18	5.66	0.68	0.84	7.62	0.74	9.96	0.50	385.19	0.67	13.02
09/01/21 13:03:27	25310	9.24	8.08	1.54	94.32	5.67	0.71	0.71	7.61	0.47	10.72	0.56	384.31	0.57	12.98
09/01/21 13:03:57	25340	9.25	7.91	1.55	94.48	5.66	0.71	0.83	8.06	-0.15	11.27	0.54	385.28	0.56	12.94
09/01/21 13:04:27	25370	9.23	7.66	1.47	95.32	5.67	0.73	0.83	7.43	0.22	11.55	0.50	385.02	0.59	12.92
09/01/21 13:04:57	25400	9.24	7.81	1.60	95.08	5.68	0.70	0.80	7.69	0.12	11.79	0.54	387.14	0.57	12.84
09/01/21 13:05:27	25430	9.23	8.14	1.56	94.16	5.69	0.70	0.81	8.03	0.12	11.93	0.52	386.98	0.58	12.77
09/01/21 13:05:57	25460	9.22	8.31	1.61	94.23	5.70	0.72	0.79	7.79	0.52	12.16	0.55	385.55	0.53	12.70
09/01/21 13:06:27	25490	9.23	8.50	1.17	94.16	5.60	0.77	0.93	8.05	0.45	13.16	0.57	379.72	0.50	13.81
RAW AVERAGE		**9.23**	**8.57**	**1.38**	**94.52**	**5.68**	**0.69**	**0.82**	**8.13**	**0.44**	**11.60**	**0.53**	**382.57**	**0.59**	**13.03**

		O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4 (as C_3H_8)	C_2H_6 (as C_3H_8)	H_2O
	Serial Number:	INST-O2-0026	INST-NX-0025	INST-IR-0005	INST-VC-0004	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-NX-0025	INST-NX-0025	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005	INST-IR-0005
		(%)			(ppmvw)										
Bias	**Initial Zero**	0.02			0.20										
	Final Zero	0.02			0.21										
	Avg. Zero	0.02			0.21										
	Initial UpScale	11.95			300.00										
	Final UpScale	11.90			299.31										
	Avg. UpScale	11.93			299.66										
Upscale Cal Gas		11.96			299.00										

EMISSIONS DATA	O_2	NOx	CO	THC (as C_3H_8)	CO_2	N_2O	C_2H_4O	NO	NO_2	NH_3	HCHO	CH_4 (as C_3H_8)	C_2H_6 (as C_3H_8)	VOC (as C_3H_8)
Corrected Raw Average (ppm/% dry basis)	9.25	9.85	1.58	108.68	6.53	0.80	0.94	9.35	0.50	13.33	0.61	161.29	0.45	0.00
Corrected Raw Average (ppm/% wet basis)	8.04	8.57	1.38	94.52	5.68	0.69	0.82	8.13	0.44	11.60	0.53	140.27	0.39	0.00
Concentration (ppm@ 15%O_2)	N/A	4.99	0.80	47.86	3.31	0.40	0.48	4.12	0.90	6.75	0.31	81.68	0.23	0.00
Emission Rate (g/hp*hr)	N/A	0.0808	0.0079	0.7417	512	0.0062	0.0074	0.0500	0.0041	0.0405	0.0033	1.2686	0.0036	0.0000
Non-Bias Adjusted Averages Include:		*	*	*	*	*	*			*	*	*	*	*

EMISSION DATA RECORDS

50% Load
PM
Reference Method Data

METHOD 5 (FRONT) AND 202 (BACK) SOURCE SAMPLING TITLE PAGE

Source Information	
Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Fuel Type	Gas, Natural

Test Information			
Project #		catc-21-houston.tx-start#1	
Operator		JLW	
Date for Preliminary Run	(mm/dd/yy)	07/28/21	
Standard Temperature		68	°F
Standard Pressure		29.92	in Hg
Run Duration	≥ 2 min/point	90	minutes
Unit Number		1	
Base Run Number		R-1 50%	
Number of Ports Available		2	
Number of Ports Used		2	
Port Inside Diameter		4.00	in
Stack Shape		Circular	

Test Equipment Information					
Run		**1**	**2**	**3**	
Test Date	(mm/dd/yy)	07/29/21	07/29/21	07/29/21	
Load		50%	50%	50%	% or w/DB
Fuel F-Factor		8631.70	8631.70	8631.70	dscf/MMBtu
Meter Box Number	from ACS	samp-cp-0022	samp-cp-0022	samp-cp-0022	
Meter Calibration Factor	(Y)	0.986	0.986	0.986	
Orifice Meter Coefficient	($\Delta H_@$)	1.831	1.831	1.831	in H_2O
Non-Console Manometer Used		No	No	No	
Pitot Identification	from ACS	A6223	A5708	A6223	
Pitot Tube Coefficient	(C_p)	0.8215	0.8230	0.8215	
Nozzle Number	from ACS	G-10	G-10	G-10	
Nozzle Diameter	(D_n)	0.311	0.311	0.311	in
Probe Number	from ACS	samp-hp-0014	samp-hp-0079	samp-hp-0014	
Probe Length		60.0	60.0	60.0	in
(SS, Glass ….) Liner Material	from list	glass	glass	glass	
Sample Case / Oven Number	from ACS	samp-BH-0018	samp-BH-0018	samp-BH-0018	
Impinger Case Number	from ACS	samp-cc-0011	samp-cc-0011	samp-cc-0011	

Testing Company Information	
Company Name	Air Hygiene International, Inc. (Tulsa, Oklahoma)
Address	1600 W Tacoma Street
City, State Zip	Broken Arrow, Oklahoma 74012
Project Manager	Pat McGovern, Jr.
Phone Number	(918) 307-8865
Fax Number	(918) 307-9131

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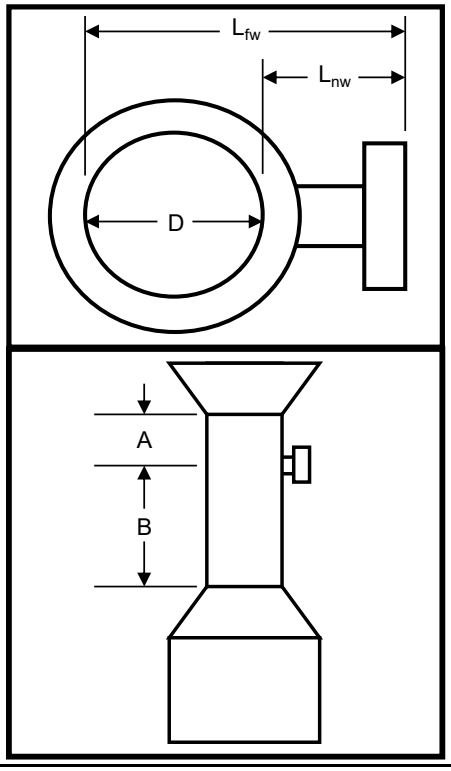
METHOD 1 - SAMPLE AND VELOCITY TRAVERSES FOR CIRCULAR SOURCES

Plant Name	Stewart and Stevenson Integration Center	**Date**	07/28/21
Sampling Location	Caterpillar G3520 TALE	**Stack Type**	Circular
Operator	JLW	**Ports Available**	2
Project #	catc-21-houston.tx-start#1	**Ports Used**	2
Stack Size	Large (>24 inch diameter)	**Port ID (inches)**	4.00

Circular Stack or Duct Diameter			
Distance to Far Wall of Stack	(L_{fw})	32.00	in
Distance to Near Wall of Stack	(L_{nw})	0.125	in
Diameter of Stack	(D)	31.88	in
Area of Stack	(A_s)	5.54	ft²

Distance from Port to Disturbances			
Distance Upstream	(A)	16.00	in
Diameters Upstream	(A_D)	0.50	diameters
Distance Downstream	(B)	64.00	in
Diameters Downstream	(B_D)	2.01	diameters



Number of Traverse Points Required			
Diameters to Flow Disturbance		**Minimum Number of[1] Traverse Points**	
Down Stream	**Up Stream**	**Particulate Points**	**Velocity Points**
2.00-4.99	0.50-1.24	24	16
5.00-5.99	1.25-1.49	20	16
6.00-6.99	1.50-1.74	16	12
7.00-7.99	1.75-1.99	12	12
>= 8.00	>=2.00	8 or 12[2]	8 or 12[2]
Upstream Spec		24	16
Downstream Spec		24	16
Traverse Pts Required		24	16

[1] Check Minimum Number of Points for the Upstream and Downstream conditions, then use the largest.

[2] 8 for Circular Stacks 12 to 24 inches
12 for Circular Stacks over 24 inches

◉ Method 1 Trav

○ 12 Point PM Trav (M201a ONLY)

○ Velocity

Number of Traverse Points Used			
2	**Ports by**	12	**Across**
24	**Pts Used**	24	**Required**
Adjust Sample Points Out of Boundary Layer			

Location of Traverse Points in Circular Stacks									
Traverse	(Fraction of Stack Dimension from Inside Wall to Traverse Point)								
Point	**Number of Traverse Points Across the Stack**								
Number	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
1	.146	.067	.044	.032	.026	.021	.018	.016	.014
2	.854	.250	.146	.105	.082	.067	.057	.049	.044
3		.750	.296	.194	.146	.118	.099	.085	.075
4		.933	.704	.323	.226	.177	.146	.125	.109
5			.854	.677	.342	.250	.201	.169	.146
6			.956	.806	.658	.356	.269	.220	.188
7				.895	.774	.644	.366	.283	.236
8				.968	.854	.750	.634	.375	.296
9					.918	.823	.731	.625	.382
10					.974	.882	.799	.717	.618
11						.933	.854	.780	.704
12						.979	.901	.831	.764

Traverse Point Number	**Fraction of Stack Diameter**	**Distance from Inside Wall**	**Distance Including Reference Length**
		in	in
1	0.021	5/8	6/8
2	0.067	2 1/8	2 2/8
3	0.118	3 6/8	3 7/8
4	0.177	5 5/8	5 6/8
5	0.250	8	8 1/8
6	0.356	11 3/8	11 4/8
7	0.644	20 4/8	20 5/8
8	0.750	23 7/8	24
9	0.823	26 2/8	26 3/8
10	0.882	28 1/8	28 2/8
11	0.933	29 6/8	29 7/8
12	0.979	31 2/8	31 3/8

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	Stewart and Stevenson Integration Center			
Sampling Location	Caterpillar G3520 TALE			
Operator	JLW			
Project #	catc-21-houston.tx-start#1			
Pitot Leak Check	x	**PreTest**	x	**PostTest**

Preliminary Run Date	07/28/21		
Stack Type	Circular		
Ports Available	2		
Thermocouple ID	samp-hp-0014		
Pitot Coefficient	0.8300	**Pitot Identification**	A6904

Stack Dimensions			
Area of Stack	(A_s)	5.54	ft²
Diameter of Stack	(D)	31.88	in

Pressures			
Barometric Pressure	(P_b)	29.87	in Hg
Static Pressure	(P_{static})	0.07	in H_2O
Absolute Stack Pressure	(P_s)	29.88	in Hg

Stack Gas Composition			
Composition Data:	**Estimated Composition**		
Carbon Dioxide Concentration	(%CO_2)	6.80	%vd
Oxygen Concentration	(%O_2)	8.60	%vd
Carbon Monoxide Concentration	(ppmCO)	5.00	ppmvd
Nitrogen Concentration	(%N_2)	84.60	%vd
Stack Moisture Content	(B_{ws})	14.00	%
Stack Dry Molecular Weight	(M_d)	29.43	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	27.83	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	37.77	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	246,184	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	4,103	dscf/min
Avg Stack Wet Flow Rate	(Q_{aw})	12,560	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	286,261	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data

Run Number		R-1 50%-V1			
Run Time		08:46	**Start**	08:59	**End**
Traverse Point	**Velocity Head** (Δp)	**Null Angle** (N_a)	**Zero Deg Pressure** (0^o_a)	**Stack Temp** (t_s)	**Local Velocity** ($v_{s(l)}$)
	in H_2O	deg	in H_2O	°F	ft/sec
A-1	0.15	0	0.00	873	34.80
A-2	0.17	5	0.03	896	37.36
A-3	0.17	0	0.00	923	37.73
A-4	0.15	0	0.00	929	35.52
A-5	0.17	5	0.03	930	37.83
A-6	0.18	5	0.02	932	38.95
A-7	0.19	0	0.00	928	39.96
A-8	0.18	0	0.00	930	38.92
A-9	0.19	0	0.00	933	40.03
A-10	0.18	5	0.04	933	38.97
A-11	0.18	0	0.00	933	38.97
A-12	0.17	0	0.00	933	37.87
B-1	0.15	0	0.00	933	35.57
B-2	0.15	0	0.00	933	35.57
B-3	0.16	5	0.03	933	36.74
B-4	0.17	5	0.03	933	37.87
B-5	0.18	0	0.00	933	38.97
B-6	0.18	0	0.00	933	38.97
B-7	0.18	0	0.00	933	38.97
B-8	0.17	0	0.00	933	37.87
B-9	0.17	0	0.00	933	37.87
B-10	0.17	0	0.00	933	37.87
B-11	0.16	0	0.00	933	36.74
B-12	0.16	0	0.00	933	36.74
Average	0.17	1		928	
	0.41	**= Square roots of Δp**			
Standard deviation of null angles =				2.2	

METHOD 3a - DETERMINATION OF DRY MOLECULAR WEIGHT BY ANALYZER

Plant Name	Stewart and Stevenson Integration Center	**Preliminary Run Date**	07/28/21		
Sampling Location	Caterpillar G3520 TALE	**Operator**	JLW		
Project #	catc-21-houston.tx-start#1	**# of Ports Used**	1 (gas probe)		
Fuel Type	Gas, Natural	**Min. Fuel Factor**	1.600	**Max. Fuel Factor**	1.836

Gas Analysis Data									
Run Number	R-1 50%-1		**Date**	07/29/21	**Run Start Time**	09:34		**Run Stop Time**	11:24
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	(Fo)avg		(%EA)avg	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:50	6.71	8.67	6.03	84.6	29.42	1.822		63.4	YES

Gas Analysis Data									
Run Number	R-1 50%-2		**Date**	07/29/21	**Run Start Time**	12:05		**Run Stop Time**	13:59
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	(Fo)avg		(%EA)avg	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:54	6.69	8.74	5.97	84.6	29.42	1.817		64.4	YES

Gas Analysis Data									
Run Number	R-1 50%-3		**Date**	07/29/21	**Run Start Time**	14:23		**Run Stop Time**	15:58
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	(Fo)avg		(%EA)avg	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:35	6.75	8.79	6.40	84.5	29.43	1.793		65.1	YES

METHOD 4 - DETERMINATION OF MOISTURE CONTENT IN STACK GASES

Plant Name	Stewart and Stevenson Integration Center	**Preliminary Run Date**	07/28/21
Sampling Location	Caterpillar G3520 TALE	**Operator**	JLW
Project #	catc-21-houston.tx-start#1	**Ports Used**	2

Scale Daily Calibration					
Scale Number	Extra	**Standard**	**Result**	**Difference**	**Pass/Fail**
Date		(g)	(g)	(g)	(± 0.5 g)
Preliminary Date	07/28/21	500	499.5	-0.5	Pass
Test Day 1	07/29/21	500	500.5	0.5	Pass

Moisture Content Data									
Run Number	R-1 50%-1		**Date**	07/29/21	**Start Time**	09:34	**Stop Time**	11:24	
Meter Box Number	samp-cp-0022				**Meter Cal Factor**	(Y)	0.986		
Total Meter Volume	(V_m)	36.989	dcf		**Barometric Pressure**	(P_b)	29.87	in Hg	
Average Stack Temp	$(t_s)_{avg}$	906	°F		**Stack Static Pressure**	(P_{static})	0.07	in H_2O	
Average Meter Temp	$(t_m)_{avg}$	87	°F		**Avg Orifice Pressure**	$(\Delta H)_{avg}$	0.52	in H_2O	
	Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**	
	(g)	(g)	(g)	(g)					
Contents	Dry	Dry	DI Water	Sil Gel					
Final Value (V_f),(W_f)	456.80	612.90	720.10	856.20					
Initial Value (V_i),(W_i)	350.70	612.50	708.90	847.80					
Net Value (V_n),(W_n)	106.1	0.4	11.2	8.4					
Results									
Total Weight	(W_t)	126.10	g		**Water Vol Weighed**	($V_{wsg(std)}$)	5.946	scf	
Std Meter Volume	($V_{m(std)}$)	35.190	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%	
Calc Moisture Content	($B_{ws(calc)}$)	14.45	%		**Final Moisture Content**	(B_{ws})	14.45	%	

Moisture Content Data									
Run Number	R-1 50%-2		**Date**	07/29/21	**Start Time**	12:05	**Stop Time**	13:59	
Meter Box Number	samp-cp-0022				**Meter Cal Factor**	(Y)	0.986		
Total Meter Volume	(V_m)	37.647	dcf		**Barometric Pressure**	(P_b)	29.90	in Hg	
Average Stack Temp	$(t_s)_{avg}$	905	°F		**Stack Static Pressure**	(P_{static})	0.07	in H_2O	
Average Meter Temp	$(t_m)_{avg}$	95	°F		**Avg Orifice Pressure**	$(\Delta H)_{avg}$	0.53	in H_2O	
	Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**	
	(g)	(g)	(g)	(g)					
Contents	Dry	Dry	DI Water	Sil Gel					
Final Value (V_f),(W_f)	473.40	601.90	721.10	823.40					
Initial Value (V_i),(W_i)	357.60	600.50	720.50	816.50					
Net Value (V_n),(W_n)	115.8	1.4	0.6	6.9					
Results									
Total Weight	(W_t)	124.70	g		**Water Vol Weighed**	($V_{wsg(std)}$)	5.880	scf	
Std Meter Volume	($V_{m(std)}$)	35.360	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%	
Calc Moisture Content	($B_{ws(calc)}$)	14.26	%		**Final Moisture Content**	(B_{ws})	14.26	%	

Moisture Content Data									
Run Number	R-1 50%-3		**Date**	07/29/21	**Start Time**	14:23	**Stop Time**	15:58	
Meter Box Number	samp-cp-0022				**Meter Cal Factor**	(Y)	0.986		
Total Meter Volume	(V_m)	37.385	dcf		**Barometric Pressure**	(P_b)	29.85	in Hg	
Average Stack Temp	$(t_s)_{avg}$	923	°F		**Stack Static Pressure**	(P_{static})	0.07	in H_2O	
Average Meter Temp	$(t_m)_{avg}$	94	°F		**Avg Orifice Pressure**	$(\Delta H)_{avg}$	0.53	in H_2O	
	Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**	
	(g)	(g)	(g)	(g)					
Contents	Dry	Dry	DI Water	Sil Gel					
Final Value (V_f),(W_f)	463.70	614.80	722.80	863.20					
Initial Value (V_i),(W_i)	351.30	614.60	720.10	856.20					
Net Value (V_n),(W_n)	112.4	0.2	2.7	7.0					
Results									
Total Weight	(W_t)	122.30	g		**Water Vol Weighed**	($V_{wsg(std)}$)	5.766	scf	
Std Meter Volume	($V_{m(std)}$)	35.098	dscf		**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%	
Calc Moisture Content	($B_{ws(calc)}$)	14.11	%		**Final Moisture Content**	(B_{ws})	14.11	%	

METHOD 5 (FRONT) AND 202 (BACK) SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Date	07/29/21
Operator	JLW
Run Number	R-1 50%-1

Filter #
00713
R-1 50%-1-CPM

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient / ID	(C_p)	0.8215	A6223
Average Stack Temp	(t_s)	906.0	°F
Average Meter Temp	(t_m)	87.0	
Orifice Meter Coefficient	($\Delta H@$)	1.831	in H_2O
Square Root ΔP	($\Delta p^{1/2}{}_{avg}$)	0.41	in H_2O
Stack Moisture Content	(B_{ws})	14.45	%
Stack Dry Molecular Weight	(M_d)	29.42	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.75	acfm
ΔP to ΔH Isokinetic Factor	(K)	3.05	

Leak Checks		*[change]*		*[level]*		*[time]*	
Train	**Pre**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
PASS	**Post**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
Pitot	**Pre (+)**	0.00	in H_2O	7.0	in H_2O for	15.0	sec [≥15]
PASS	**Pre (-)**	0.00	in H_2O	5.0	in H_2O for	15.0	sec [≥15]
	Post (+)	0.00	in H_2O	6.0	in H_2O for	15.0	sec [≥15]
	Post (-)	0.00	in H_2O	5.0	in H_2O for	15.0	sec [≥15]

Sampling Equipment			
Meter Box Number	samp-cp-0022		
Meter Cal Factor	(Y)	0.986	
Nozzle Number	G-10		
Average Nozzle Diameter	(D_{na})	0.3113	in
Suggested Nozzle Diameter	(D_{ni})	0.3148	in
Probe Number	samp-hp-0014		in
Probe Length	60		in
Liner Material	glass		
Sample Case / Oven Number	samp-BH-0018		
Impinger Case Number	samp-cc-0011		

Pressures			
Barometric Pressure	(P_b)	29.87	in Hg
Stack Static Pressure	(P_{static})	0.07	in H_2O
Absolute Stack Pressure	(P_s)	29.88	in Hg
Absolute Meter Pressure	(P_m)	30.00	in Hg

Nozzle Measurements				**ID: G-10**
Pre	0.311	0.311	0.312	**PASS**
Post	0.311	0.311	0.312	**PASS**

Barometer ID
SAMP-WE-0014
Scale ID
Extra

Run Time			
Start	09:34	**End**	11:24

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	350.7	612.5	708.9	847.8				
Post	456.8	612.9	720.1	856.2				

Wash Volumes					
					ml
					ml

Identification Nos.		samp-cp-0022	samp-cp-0022	samp-cp-0022			samp-hp-0014	samp-hp-0014	samp-BH-0018	samp-cc-0011			samp-cp-0022		samp-cp-0022					
Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Probe Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤85°F)**	**CPM Filter Temp (76.5±8.5°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	59.000	0.15	0.457	0.45	900	250	249	62	70	81	81	81	1.0	0.39	34.83	1.318	96.0	31.623
A-2	3.8	00:03:45	60.370	0.18	0.549	0.54	905	250	249	60	73	81	81	81	1.0	0.42	38.22	2.789	97.1	33.473
A-3	7.5	00:07:30	61.900	0.17	0.518	0.51	906	250	249	60	72	80	81	81	1.0	0.41	37.16	4.213	97.3	33.704
A-4	11.3	00:11:15	63.380	0.15	0.457	0.45	905	250	250	60	74	80	82	82	1.0	0.39	34.89	5.567	97.6	33.400
A-5	15.0	00:15:00	64.790	0.17	0.518	0.51	910	250	251	58	52	80	82	82	1.0	0.41	37.21	7.016	98.0	33.679
A-6	18.8	00:18:45	66.300	0.20	0.610	0.60	912	250	250	58	50	80	83	83	1.0	0.45	40.39	8.617	98.7	34.469
A-7	22.5	00:22:30	67.970	0.19	0.579	0.57	908	250	249	57	50	79	83	83	1.0	0.44	39.31	10.122	98.5	34.704
A-8	26.3	00:26:15	69.540	0.18	0.549	0.54	911	250	249	57	51	79	84	84	1.0	0.42	38.30	11.615	98.7	34.844
A-9	30.0	00:30:00	71.100	0.19	0.579	0.57	911	250	252	58	52	79	85	85	1.0	0.44	39.35	13.152	98.8	35.072
A-10	33.8	00:33:45	72.710	0.19	0.579	0.57	912	250	251	58	52	79	86	86	1.0	0.44	39.37	14.696	99.0	35.271
A-11	37.5	00:37:30	74.330	0.18	0.549	0.54	910	250	249	58	54	80	87	87	1.0	0.42	38.29	16.238	99.3	35.427
A-12	41.3	00:41:15	75.950	0.17	0.518	0.51	908	250	249	57	55	79	87	87	1.0	0.41	37.18	17.636	99.1	35.272
B-1	45.0	00:45:00	77.420	0.15	0.457	0.45	891	250	249	66	61	81	89	89	1.0	0.39	34.71	19.020	99.2	35.113
B-2	48.8	00:48:45	78.880	0.16	0.488	0.48	902	250	249	62	60	79	89	89	1.0	0.40	35.99	20.404	99.1	34.978
B-3	52.5	00:52:30	80.340	0.16	0.488	0.48	906	250	249	62	71	79	89	89	1.0	0.40	36.05	21.806	99.1	34.890
B-4	56.3	00:56:15	81.820	0.17	0.518	0.51	908	250	249	60	71	80	89	89	1.0	0.41	37.18	23.285	99.2	34.928
B-5	60.0	01:00:00	83.380	0.18	0.549	0.54	908	252	250	60	74	80	89	89	1.0	0.42	38.26	24.679	98.9	34.840
B-6	63.8	01:03:45	84.850	0.18	0.549	0.54	906	248	248	60	74	79	90	90	1.0	0.42	38.23	26.325	99.5	35.100
B-7	67.5	01:07:30	86.590	0.18	0.549	0.54	910	251	250	62	75	80	91	91	1.0	0.42	38.29	27.798	99.5	35.114
B-8	71.3	01:11:15	88.150	0.17	0.518	0.51	905	249	251	64	77	81	91	91	1.0	0.41	37.14	29.215	99.4	35.058
B-9	75.0	01:15:00	89.650	0.17	0.518	0.51	902	250	252	64	77	81	91	91	1.0	0.41	37.10	30.632	99.3	35.008
B-10	78.8	01:18:45	91.150	0.17	0.518	0.51	905	248	251	62	75	80	92	92	1.0	0.41	37.14	32.197	99.6	35.124
B-11	82.5	01:22:30	92.810	0.16	0.488	0.48	903	250	250	62	75	80	93	93	1.0	0.40	36.01	33.589	99.6	35.050
B-12	86.3	01:26:15	94.290	0.16	0.488	0.48	900	250	249	62	75	79	93	93	1.0	0.40	35.97	35.188	100.2	35.188
Last Pt	90.0	01:30:00	95.989																	
Final Val	90.0	01:30:00	95.989											**Max Vac**	1.0	**Final Values**		35.188	100.2	
Average Values				0.17		0.52	906	250	250	60	65	80	87	87		0.41	37.36			
													87							

Notes:

METHOD 5 (FRONT) AND 202 (BACK) SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Date	07/29/21
Operator	JLW
Run Number	R-1 50%-2

Filter #
0652
R-1 50%-2-CPM

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient / ID	(C_p)	0.8230	A5708
Average Stack Temp	(t_s)	904.8	°F
Average Meter Temp	(t_m)	94.6	
Orifice Meter Coefficient	($\Delta H@$)	1.831	in H_2O
Square Root ΔP	($\Delta p^{1/2}{}_{avg}$)	0.42	in H_2O
Stack Moisture Content	(B_{ws})	14.26	%
Stack Dry Molecular Weight	(M_d)	29.42	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.39	acfm
ΔP to ΔH Isokinetic Factor	(K)	3.12	

Leak Checks		*[change]*		*[level]*		*[time]*	
Train	**Pre**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
PASS	**Post**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
Pitot	**Pre (+)**	0.00	in H_2O	7.0	in H_2O for	15.0	sec [≥15]
PASS	**Pre (-)**	0.00	in H_2O	5.0	in H_2O for	15.0	sec [≥15]
	Post (+)	0.00	in H_2O	6.0	in H_2O for	15.0	sec [≥15]
	Post (-)	0.00	in H_2O	4.0	in H_2O for	15.0	sec [≥15]

Sampling Equipment			
Meter Box Number	samp-cp-0022		
Meter Cal Factor	(Y)	0.986	
Nozzle Number	G-10		
Average Nozzle Diameter	(D_{na})	0.3113	in
Suggested Nozzle Diameter	(D_{ni})	0.2255	in
Probe Number	samp-hp-0079		in
Probe Length	60		in
Liner Material	glass		
Sample Case / Oven Number	samp-BH-0018		
Impinger Case Number	samp-cc-0011		

Pressures			
Barometric Pressure	(P_b)	29.90	in Hg
Stack Static Pressure	(P_{static})	0.07	in H_2O
Absolute Stack Pressure	(P_s)	29.91	in Hg
Absolute Meter Pressure	(P_m)	30.03	in Hg

Nozzle Measurements				**ID: G-10**
Pre	0.311	0.312	0.311	**PASS**
Post	0.311	0.312	0.311	**PASS**

Barometer ID
SAMP-WE-0014
Scale ID
Extra

Run Time			
Start	12:05	**End**	13:59

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	357.6	600.5	720.5	816.5				
Post	473.4	601.9	721.1	823.4				

Wash Volumes					
					ml
					ml

Identification Nos.		samp-cp-0022	samp-cp-0022	samp-cp-0022			samp-hp-0079	samp-hp-0079	samp-BH-0018	samp-cc-0011			samp-cp-0022		samp-cp-0022					
Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Probe Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤85°F)**	**CPM Filter Temp (76.5±8.5°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	96.035	0.17	0.530	0.52	910	248	250	53	50	70	92	92	2.0	0.41	37.24	1.430	97.8	34.313
A-2	3.8	00:03:45	97.550	0.16	0.499	0.49	908	250	249	53	51	70	92	92	2.0	0.40	36.11	2.845	98.7	34.142
A-3	7.5	00:07:30	99.050	0.16	0.499	0.49	908	251	250	55	49	71	92	92	2.0	0.40	36.11	4.261	99.0	34.085
A-4	11.3	00:11:15	100.550	0.17	0.530	0.53	910	250	250	55	50	71	93	93	2.0	0.41	37.24	5.730	99.4	34.381
A-5	15.0	00:15:00	102.110	0.18	0.561	0.56	909	249	251	56	52	73	93	93	2.0	0.42	38.31	7.256	99.8	34.831
A-6	18.8	00:18:45	103.730	0.19	0.592	0.60	912	250	251	56	52	73	93	93	2.0	0.44	39.40	8.830	100.2	35.319
A-7	22.5	00:22:30	105.400	0.18	0.561	0.56	908	249	249	57	52	73	94	94	2.0	0.42	38.30	10.316	100.0	35.368
A-8	26.3	00:26:15	106.980	0.17	0.530	0.52	905	250	249	57	53	74	94	94	2.0	0.41	37.18	11.773	99.9	35.319
A-9	30.0	00:30:00	108.530	0.17	0.530	0.52	903	251	250	57	53	74	94	94	2.0	0.41	37.15	13.221	99.8	35.256
A-10	33.8	00:33:45	110.070	0.16	0.499	0.49	903	250	249	58	55	75	95	95	2.0	0.40	36.04	14.620	99.6	35.087
A-11	37.5	00:37:30	111.560	0.16	0.499	0.49	903	249	252	57	56	75	95	95	2.0	0.40	36.04	16.065	99.8	35.051
A-12	41.3	00:41:15	113.100	0.16	0.499	0.49	903	250	250	57	56	75	95	95	2.0	0.40	36.04	17.465	99.7	34.930
B-1	45.0	00:45:00	114.592	0.16	0.499	0.49	903	249	249	65	52	73	95	95	2.0	0.40	36.04	18.862	99.6	34.822
B-2	48.8	00:48:45	116.080	0.17	0.530	0.52	899	250	251	56	53	73	95	95	2.0	0.41	37.10	20.326	99.6	34.845
B-3	52.5	00:52:30	117.640	0.17	0.530	0.52	900	251	250	56	53	73	95	95	2.0	0.41	37.11	21.753	99.4	34.804
B-4	56.3	00:56:15	119.160	0.16	0.499	0.49	902	251	250	56	53	74	96	96	2.0	0.40	36.03	23.214	99.7	34.821
B-5	60.0	01:00:00	120.720	0.17	0.530	0.52	904	250	252	56	53	74	96	96	2.0	0.41	37.16	24.666	99.6	34.823
B-6	63.8	01:03:45	122.270	0.19	0.592	0.58	904	250	250	56	54	75	96	96	2.0	0.44	39.29	26.212	99.6	34.950
B-7	67.5	01:07:30	123.920	0.18	0.561	0.55	902	251	251	56	54	75	96	96	2.0	0.42	38.21	27.740	99.7	35.040
B-8	71.3	01:11:15	125.550	0.18	0.561	0.55	904	250	249	57	56	76	96	96	2.0	0.42	38.24	29.276	99.8	35.132
B-9	75.0	01:15:00	127.190	0.19	0.592	0.58	906	250	250	57	56	76	96	96	2.0	0.44	39.32	30.851	99.9	35.258
B-10	78.8	01:18:45	128.870	0.19	0.592	0.58	906	249	250	57	56	76	96	96	2.0	0.44	39.32	32.425	100.0	35.373
B-11	82.5	01:22:30	130.550	0.18	0.561	0.55	904	251	250	57	56	76	96	96	2.0	0.42	38.24	33.933	100.0	35.409
B-12	86.3	01:26:15	132.160	0.17	0.530	0.52	900	250	250	57	56	76	96	96	2.0	0.41	37.11	35.359	99.9	35.359
Last Pt	90.0	01:30:00	133.682																	
Final Val	90.0	01:30:00	133.682											**Max Vac**	2.0	**Final Values**		35.359	99.9	
Average Values				0.17		0.53	905	250	250	57	53	74	95	95		0.42	37.43			
													95							

Notes: PAUSED 14:39 in

METHOD 5 (FRONT) AND 202 (BACK) SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Date	07/29/21
Operator	JLW
Run Number	R-1 50%-3

Filter #
0722
R-1 50%-3-CPM

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient / ID	(C_p)	0.8215	A6223
Average Stack Temp	(t_s)	922.7	°F
Average Meter Temp	(t_m)	94.0	
Orifice Meter Coefficient	($\Delta H@$)	1.831	in H_2O
Square Root ΔP	($\Delta p^{1/2}_{avg}$)	0.41	in H_2O
Stack Moisture Content	(B_{ws})	14.11	%
Stack Dry Molecular Weight	(M_d)	29.43	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.39	acfm
ΔP to ΔH Isokinetic Factor	(K)	3.07	

Leak Checks		*[change]*		*[level]*		*[time]*	
Train	**Pre**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
PASS	**Post**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
Pitot	**Pre (+)**	0.00	in H_2O	6.0	in H_2O for	15.0	sec [≥15]
PASS	**Pre (-)**	0.00	in H_2O	6.0	in H_2O for	15.0	sec [≥15]
	Post (+)	0.00	in H_2O	7.0	in H_2O for	15.0	sec [≥15]
	Post (-)	0.00	in H_2O	5.0	in H_2O for	15.0	sec [≥15]

Sampling Equipment			
Meter Box Number	samp-cp-0022		
Meter Cal Factor	(Y)	0.986	
Nozzle Number	G-10		
Average Nozzle Diameter	(D_{na})	0.3113	in
Suggested Nozzle Diameter	(D_{ni})	0.2273	in
Probe Number	samp-hp-0014		in
Probe Length	60		in
Liner Material	glass		
Sample Case / Oven Number	samp-BH-0018		
Impinger Case Number	samp-cc-0011		

Pressures			
Barometric Pressure	(P_b)	29.85	in Hg
Stack Static Pressure	(P_{static})	0.07	in H_2O
Absolute Stack Pressure	(P_s)	29.86	in Hg
Absolute Meter Pressure	(P_m)	29.98	in Hg

Nozzle Measurements				**ID: G-10**
Pre	0.312	0.311	0.311	**PASS**
Post	0.312	0.311	0.311	**PASS**

Barometer ID
SAMP-WE-0014
Scale ID
Extra

Run Time			
Start	14:23	**End**	15:58

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	351.3	614.6	720.1	856.2				
Post	463.7	614.8	722.8	863.2				

Wash Volumes					
					ml
					ml

Identification Nos.		samp-cp-0022	samp-cp-0022	samp-cp-0022			samp-hp-0014	samp-hp-0014	samp-BH-0018	samp-cc-0011			samp-cp-0022		samp-cp-0022					
Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Probe Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤85°F)**	**CPM Filter Temp (76.5±8.5°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	133.977	0.15	0.461	0.47	926	248	250	59	53	79	92	92	2.0	0.39	35.14	1.406	103.1	33.754
A-2	3.8	00:03:45	135.470	0.16	0.491	0.50	928	250	249	59	53	79	92	92	2.0	0.40	36.32	2.801	101.1	33.609
A-3	7.5	00:07:30	136.950	0.16	0.491	0.50	925	251	250	59	53	79	92	92	2.0	0.40	36.28	4.261	102.0	34.087
A-4	11.3	00:11:15	138.500	0.17	0.522	0.53	927	250	250	57	56	80	92	92	2.0	0.41	37.42	5.655	100.5	33.932
A-5	15.0	00:15:00	139.980	0.18	0.553	0.56	925	251	249	58	57	80	92	92	2.0	0.42	38.48	7.172	100.7	34.427
A-6	18.8	00:18:45	141.590	0.18	0.553	0.56	923	250	250	58	57	80	92	92	2.0	0.42	38.45	8.708	101.1	34.832
A-7	22.5	00:22:30	143.220	0.18	0.553	0.56	922	251	249	57	55	81	93	93	2.0	0.42	38.44	10.194	100.8	34.951
A-8	26.3	00:26:15	144.800	0.17	0.522	0.53	923	250	250	57	55	81	93	93	2.0	0.41	37.37	11.680	101.0	35.040
A-9	30.0	00:30:00	146.380	0.17	0.522	0.53	925	249	251	57	55	81	93	93	2.0	0.41	37.39	13.138	100.9	35.034
A-10	33.8	00:33:45	147.930	0.17	0.522	0.53	922	250	250	58	56	80	94	94	2.0	0.41	37.35	14.612	101.0	35.068
A-11	37.5	00:37:30	149.500	0.15	0.461	0.47	924	251	249	58	57	80	94	94	2.0	0.39	35.11	15.963	100.8	34.829
A-12	41.3	00:41:15	150.940	0.16	0.491	0.50	922	250	250	58	57	79	94	94	2.0	0.40	36.24	17.409	100.9	34.818
B-1	45.0	00:45:00	152.480	0.16	0.491	0.50	918	249	252	60	59	81	94	94	2.0	0.40	36.18	18.845	101.0	34.791
B-2	48.8	00:48:45	154.010	0.16	0.491	0.50	924	249	250	59	58	81	94	94	2.0	0.40	36.26	20.262	101.0	34.735
B-3	52.5	00:52:30	155.520	0.17	0.522	0.53	922	250	249	58	57	80	94	94	2.0	0.41	37.35	21.727	101.0	34.763
B-4	56.3	00:56:15	157.080	0.17	0.522	0.53	919	248	249	58	57	80	95	95	2.0	0.41	37.31	23.161	100.8	34.741
B-5	60.0	01:00:00	158.610	0.18	0.553	0.56	922	249	251	56	55	78	95	95	2.0	0.42	38.44	24.697	100.9	34.867
B-6	63.8	01:03:45	160.250	0.19	0.584	0.59	922	250	250	56	55	78	95	95	2.0	0.44	39.49	26.244	100.9	34.992
B-7	67.5	01:07:30	161.900	0.18	0.553	0.56	924	251	253	56	56	78	95	95	2.0	0.42	38.46	27.724	100.8	35.020
B-8	71.3	01:11:15	163.480	0.18	0.553	0.56	923	249	247	56	58	79	96	96	2.0	0.42	38.45	29.193	100.7	35.032
B-9	75.0	01:15:00	165.050	0.19	0.584	0.59	922	248	248	56	58	79	96	96	2.0	0.44	39.49	30.709	100.6	35.096
B-10	78.8	01:18:45	166.670	0.18	0.553	0.56	922	250	249	57	60	80	96	96	2.0	0.42	38.44	32.168	100.4	35.092
B-11	82.5	01:22:30	168.230	0.18	0.553	0.56	920	249	250	57	60	80	96	96	2.0	0.42	38.41	33.665	100.4	35.128
B-12	86.3	01:26:15	169.830	0.17	0.522	0.53	915	251	250	57	60	80	96	96	2.0	0.41	37.26	35.098	100.3	35.098
Last Pt	90.0	01:30:00	171.362																	
Final Val	90.0	01:30:00	171.362											**Max Vac**	2.0	**Final Values**		35.098	100.3	
Average Values				0.17		0.53	923	250	250	58	57	80	94	94		0.41	37.48			
													94							

Notes:

AIR HYGIENE

PM (EPA METHOD 5) DATA SHEET

Project Code: catc-21-houston.tx-start#1

Site Info.

Plant Name. . . . . .
Sampling Location. . . . . .
Unit # . . . . . .
Date. 7.29.21

Console Info.

Console. samp-cp-0022
Meter Calibratrion Factor 0.986
Orifice Meter Coefficient 1.831

PM RUNS

Run#: 1		Load: 50% normal					Box#: 5310	
		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7
		(g)	(g)	(g)	(g)			
Contents		Dry	Di Water	Dry	Sil Gel			
Final Value	$(V_f),(W_f)$	456.8	612.9	720.1	856.2			
Initial Value	$(V_i),(W_i)$	350.7	~~708.9~~ 612.5	~~708.9~~ 612.5	847.8			
Filter #	00713		Probe #		Probe (in.)			
Pitot #			Nozzle #		Nozzle Meas			

CPM - 5736 EXIT - 8471 COND. - 3006

Run#: 2		Load: 50% normal					Box#: samp-cc-0011	
		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7
		(g)	(g)	(g)	(g)			
Contents		Dry	Di Water	Dry	Sil Gel			
Final Value	$(V_f),(W_f)$	473.4	601.9	721.1	823.4			
Initial Value	$(V_i),(W_i)$	357.6	600.5	720.5	816.5			
Filter #	0652		Probe #		Probe (in.)			
Pitot #			Nozzle #		Nozzle Meas			

CPM - 1004 EXIT - 8609 COND. - 2917

Run#: 3		Load: 50% normal					Box#:	
		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7
		(g)	(g)	(g)	(g)			
Contents		Dry	Di Water	Dry	Sil Gel			
Final Value	$(V_f),(W_f)$	463.7	614.8	722.8	863.2			
Initial Value	$(V_i),(W_i)$	351.3	614.6	720.1	856.2			
Filter #	0722		Probe #		Probe (in.)			
Pitot #			Nozzle #		Nozzle Meas			

Run#:		Load: normal					Box#:	
		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7
		(g)	(g)	(g)	(g)			
Contents		Dry	Di Water	Dry	Sil Gel			
Final Value	$(V_f),(W_f)$							
Initial Value	$(V_i),(W_i)$							
Filter #			Probe #		Probe (in.)			
Pitot #			Nozzle #		Nozzle Meas			

Signature

EMISSION DATA RECORDS

75% Load
PM
Reference Method Data

METHOD 5 (FRONT) AND 202 (BACK) SOURCE SAMPLING TITLE PAGE

Source Information	
Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Fuel Type	Gas, Natural

Test Information			
Project #		catc-21-houston.tx-start#1	
Operator		JLW	
Date for Preliminary Run	(mm/dd/yy)	07/28/21	
Standard Temperature		68	°F
Standard Pressure		29.92	in Hg
Run Duration	≥ 2 min/point	90	minutes
Unit Number		1	
Base Run Number		R-1 75%	
Number of Ports Available		2	
Number of Ports Used		2	
Port Inside Diameter		4.00	in
Stack Shape		Circular	

Test Equipment Information					
Run		**1**	**2**	**3**	
Test Date	(mm/dd/yy)	07/30/21	07/30/21	07/30/21	
Load		75%	75%	75%	% or w/DB
Fuel F-Factor		8632.09	8632.09	8632.09	dscf/MMBtu
Meter Box Number	from ACS	samp-cp-0022	samp-cp-0022	samp-cp-0022	
Meter Calibration Factor	(Y)	0.986	0.986	0.986	
Orifice Meter Coefficient	($\Delta H_@$)	1.831	1.831	1.831	in H_2O
Non-Console Manometer Used		No	No	No	
Pitot Identification	from ACS	A5708	A5708	A5708	
Pitot Tube Coefficient	(C_p)	0.8230	0.8230	0.8230	
Nozzle Number	from ACS	G-10	G-10	G-10	
Nozzle Diameter	(D_n)	0.311	0.311	0.311	in
Probe Number	from ACS	samp-hp-0079	samp-hp-0079	samp-hp-0079	
Probe Length		60.0	60.0	60.0	in
(SS, Glass ….) Liner Material	from list	glass	glass	glass	
Sample Case / Oven Number	from ACS	samp-BH-0018	samp-BH-0018	samp-BH-0018	
Impinger Case Number	from ACS	samp-cc-0011	samp-cc-0011	samp-cc-0011	

Testing Company Information	
Company Name	Air Hygiene International, Inc. (Tulsa, Oklahoma)
Address	1600 W Tacoma Street
City, State Zip	Broken Arrow, Oklahoma 74012
Project Manager	Pat McGovern, Jr.
Phone Number	(918) 307-8865
Fax Number	(918) 307-9131

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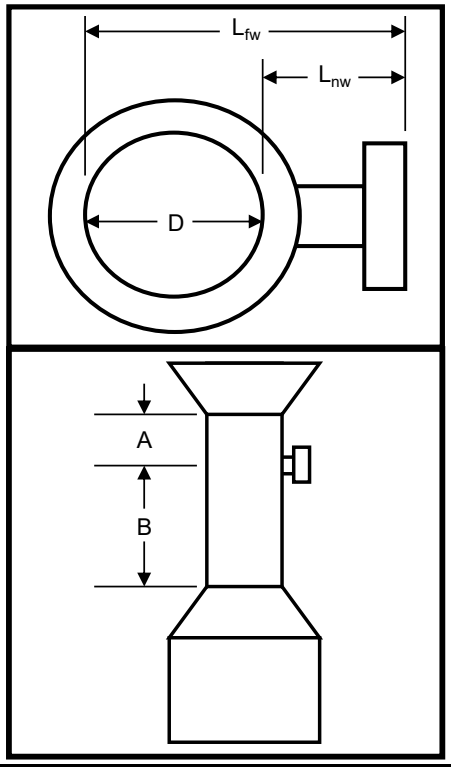
METHOD 1 - SAMPLE AND VELOCITY TRAVERSES FOR CIRCULAR SOURCES

Plant Name	Stewart and Stevenson Integration Center	**Date**	07/28/21
Sampling Location	Caterpillar G3520 TALE	**Stack Type**	Circular
Operator	JLW	**Ports Available**	2
Project #	catc-21-houston.tx-start#1	**Ports Used**	2
Stack Size	Large (>24 inch diameter)	**Port ID (inches)**	4.00

Circular Stack or Duct Diameter			
Distance to Far Wall of Stack	(L_{fw})	32.00	in
Distance to Near Wall of Stack	(L_{nw})	0.13	in
Diameter of Stack	(D)	31.88	in
Area of Stack	(A_s)	5.54	ft²

Distance from Port to Disturbances			
Distance Upstream	(A)	16.00	in
Diameters Upstream	(A_D)	0.50	diameters
Distance Downstream	(B)	64.00	in
Diameters Downstream	(B_D)	2.01	diameters



Number of Traverse Points Required			
Diameters to Flow Disturbance		**Minimum Number of[1] Traverse Points**	
Down Stream	**Up Stream**	**Particulate Points**	**Velocity Points**
2.00-4.99	0.50-1.24	24	16
5.00-5.99	1.25-1.49	20	16
6.00-6.99	1.50-1.74	16	12
7.00-7.99	1.75-1.99	12	12
>= 8.00	>=2.00	8 or 12[2]	8 or 12[2]
Upstream Spec		24	16
Downstream Spec		24	16
Traverse Pts Required		24	16

[1] Check Minimum Number of Points for the Upstream and Downstream conditions, then use the largest.

[2] 8 for Circular Stacks 12 to 24 inches
12 for Circular Stacks over 24 inches

◉ Method 1 Trav

○ 12 Point PM Trav (M201a ONLY)

○ Velocity

Number of Traverse Points Used			
2	**Ports by**	12	**Across**
24	**Pts Used**	24	**Required**
Adjust Sample Points Out of Boundary Layer			

Traverse Point Number	**Fraction of Stack Diameter**	**Distance from Inside Wall**	**Distance Including Reference Length**
		in	in
1	0.021	5/8	6/8
2	0.067	2 1/8	2 2/8
3	0.118	3 6/8	3 7/8
4	0.177	5 5/8	5 6/8
5	0.250	8	8 1/8
6	0.356	11 3/8	11 4/8
7	0.644	20 4/8	20 5/8
8	0.750	23 7/8	24
9	0.823	26 2/8	26 3/8
10	0.882	28 1/8	28 2/8
11	0.933	29 6/8	29 7/8
12	0.979	31 2/8	31 3/8

Location of Traverse Points in Circular Stacks

Traverse Point Number	(Fraction of Stack Dimension from Inside Wall to Traverse Point) Number of Traverse Points Across the Stack								
	2	4	6	8	10	12	14	16	18
1	.146	.067	.044	.032	.026	.021	.018	.016	.014
2	.854	.250	.146	.105	.082	.067	.057	.049	.044
3		.750	.296	.194	.146	.118	.099	.085	.075
4		.933	.704	.323	.226	.177	.146	.125	.109
5			.854	.677	.342	.250	.201	.169	.146
6			.956	.806	.658	.356	.269	.220	.188
7				.895	.774	.644	.366	.283	.236
8				.968	.854	.750	.634	.375	.296
9					.918	.823	.731	.625	.382
10					.974	.882	.799	.717	.618
11						.933	.854	.780	.704
12						.979	.901	.831	.764

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	Stewart and Stevenson Integration Center			
Sampling Location	Caterpillar G3520 TALE			
Operator	JLW			
Project #	catc-21-houston.tx-start#1			
Pitot Leak Check	x	**PreTest**	x	**PostTest**

Preliminary Run Date	07/28/21		
Stack Type	Circular		
Ports Available	2		
Thermocouple ID	samp-hp-0079		
Pitot Coefficient	0.8215	**Pitot Identification**	A6223

Stack Dimensions			
Area of Stack	(A_s)	5.54	ft²
Diameter of Stack	(D)	31.88	in

Pressures			
Barometric Pressure	(P_b)	29.89	in Hg
Static Pressure	(P_{static})	0.21	in H_2O
Absolute Stack Pressure	(P_s)	29.91	in Hg

Stack Gas Composition			
Composition Data:	**Estimated Composition**		
Carbon Dioxide Concentration	($\%CO_2$)	5.80	%vd
Oxygen Concentration	($\%O_2$)	8.80	%vd
Carbon Monoxide Concentration	(ppmCO)	5.00	ppmvd
Nitrogen Concentration	($\%N_2$)	85.40	%vd
Stack Moisture Content	(B_{ws})	14.00	%
Stack Dry Molecular Weight	(M_d)	29.28	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	27.70	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	52.84	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	363,978	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	6,066	dscf/min
Avg Stack Wet Flow Rate	(Q_{aw})	17,569	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	423,231	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data

Run Number		R-1 75%-V1			
Run Time		07:06	**Start**	07:21	**End**
Traverse Point	**Velocity Head** (Δp)	**Null Angle** (N_a)	**Zero Deg Pressure** (0^o_a)	**Stack Temp** (t_s)	**Local Velocity** ($v_{s(l)}$)
	in H_2O	deg	in H_2O	°F	ft/sec
A-1	0.40	5	0.07	826	55.34
A-2	0.39	5	0.06	830	54.73
A-3	0.38	10	0.12	834	54.11
A-4	0.41	5	0.04	838	56.29
A-5	0.41	10	0.10	838	56.29
A-6	0.41	5	0.05	839	56.31
A-7	0.40	5	0.05	841	55.66
A-8	0.39	10	0.10	843	55.01
A-9	0.38	5	0.04	842	54.27
A-10	0.37	0	0.00	842	53.56
A-11	0.37	5	0.04	844	53.60
A-12	0.35	0	0.00	846	52.17
B-1	0.30	0	0.00	854	48.45
B-2	0.27	5	0.06	863	46.12
B-3	0.28	5	0.04	871	47.11
B-4	0.30	5	0.04	873	48.80
B-5	0.32	0	0.00	872	50.38
B-6	0.34	5	0.06	873	51.95
B-7	0.35	0	0.00	874	52.72
B-8	0.35	5	0.04	875	52.74
B-9	0.35	5	0.05	874	52.72
B-10	0.36	0	0.00	874	53.47
B-11	0.36	0	0.00	872	53.43
B-12	0.35	0	0.00	869	52.63
Average	0.36	4		854	
	0.60	**= Square roots of Δp**			
Standard deviation of null angles =				3.3	

METHOD 3a - DETERMINATION OF DRY MOLECULAR WEIGHT BY ANALYZER

Plant Name	Stewart and Stevenson Integration Center	**Preliminary Run Date**	07/28/21		
Sampling Location	Caterpillar G3520 TALE	**Operator**	JLW		
Project #	catc-21-houston.tx-start#1	**# of Ports Used**	1 (gas probe)		
Fuel Type	Gas, Natural	**Min. Fuel Factor**	1.600	**Max. Fuel Factor**	1.836

Gas Analysis Data									
Run Number	R-1 75%-1		**Date**	07/30/21	**Run Start Time**	08:08	**Run Stop Time**		09:42
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	(Fo)avg		(%EA)avg	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:34	6.57	8.95	3.23	84.5	29.41	1.819		67.1	YES

Gas Analysis Data									
Run Number	R-1 75%-2		**Date**	07/30/21	**Run Start Time**	13:17	**Run Stop Time**		14:56
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	(Fo)avg		(%EA)avg	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:39	6.55	8.96	4.20	84.5	29.41	1.823		67.1	YES

Gas Analysis Data									
Run Number	R-1 75%-3		**Date**	07/30/21	**Run Start Time**	15:25	**Run Stop Time**		17:01
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	(Fo)avg		(%EA)avg	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:36	6.66	8.94	3.59	84.4	29.42	1.796		66.9	YES

METHOD 4 - DETERMINATION OF MOISTURE CONTENT IN STACK GASES

Plant Name	Stewart and Stevenson Integration Center	**Preliminary Run Date**	07/28/21
Sampling Location	Caterpillar G3520 TALE	**Operator**	JLW
Project #	catc-21-houston.tx-start#1	**Ports Used**	2

Scale Daily Calibration					
Scale Number	Extra	**Standard**	**Result**	**Difference**	**Pass/Fail**
Date		(g)	(g)	(g)	(± 0.5 g)
Preliminary Date	07/28/21	500	499.5	-0.5	Pass
Test Day 1	07/30/21	500	499.5	-0.5	Pass

Moisture Content Data									
Run Number		R-1 75%-1		**Date**	07/30/21	**Start Time**	08:08	**Stop Time**	09:42
Meter Box Number		samp-cp-0022				**Meter Cal Factor**	(Y)	0.986	
Total Meter Volume	(V_m)	52.714	dcf			**Barometric Pressure**	(P_b)	29.89	in Hg
Average Stack Temp	$(t_s)_{avg}$	912	°F			**Stack Static Pressure**	(P_{static})	0.21	in H_2O
Average Meter Temp	$(t_m)_{avg}$	82	°F			**Avg Orifice Pressure**	$(\Delta H)_{avg}$	1.14	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		Dry	Dry	DI Water	Sil Gel				
Final Value	(V_f),(W_f)	524.30	605.50	724.50	832.60				
Initial Value	(V_i),(W_i)	360.00	604.30	721.10	823.40				
Net Value	(V_n),(W_n)	164.3	1.2	3.4	9.2				
Results									
Total Weight	(W_t)	178.10	g			**Water Vol Weighed**	($V_{wsg(std)}$)	8.397	scf
Std Meter Volume	($V_{m(std)}$)	50.693	dscf			**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content	($B_{ws(calc)}$)	14.21	%			**Final Moisture Content**	(B_{ws})	14.21	%

Moisture Content Data									
Run Number		R-1 75%-2		**Date**	07/30/21	**Start Time**	13:17	**Stop Time**	14:56
Meter Box Number		samp-cp-0022				**Meter Cal Factor**	(Y)	0.986	
Total Meter Volume	(V_m)	53.576	dcf			**Barometric Pressure**	(P_b)	29.90	in Hg
Average Stack Temp	$(t_s)_{avg}$	909	°F			**Stack Static Pressure**	(P_{static})	0.21	in H_2O
Average Meter Temp	$(t_m)_{avg}$	92	°F			**Avg Orifice Pressure**	$(\Delta H)_{avg}$	1.09	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		Dry	Dry	DI Water	Sil Gel				
Final Value	(V_f),(W_f)	505.30	615.70	730.50	872.90				
Initial Value	(V_i),(W_i)	351.70	615.10	722.80	863.20				
Net Value	(V_n),(W_n)	153.6	0.6	7.7	9.7				
Results									
Total Weight	(W_t)	171.60	g			**Water Vol Weighed**	($V_{wsg(std)}$)	8.091	scf
Std Meter Volume	($V_{m(std)}$)	50.619	dscf			**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content	($B_{ws(calc)}$)	13.78	%			**Final Moisture Content**	(B_{ws})	13.78	%

Moisture Content Data									
Run Number		R-1 75%-3		**Date**	07/30/21	**Start Time**	15:25	**Stop Time**	17:01
Meter Box Number		samp-cp-0022				**Meter Cal Factor**	(Y)	0.986	
Total Meter Volume	(V_m)	53.946	dcf			**Barometric Pressure**	(P_b)	29.86	in Hg
Average Stack Temp	$(t_s)_{avg}$	910	°F			**Stack Static Pressure**	(P_{static})	0.21	in H_2O
Average Meter Temp	$(t_m)_{avg}$	95	°F			**Avg Orifice Pressure**	$(\Delta H)_{avg}$	1.12	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		Dry	Dry	DI Water	Sil Gel				
Final Value	(V_f),(W_f)	516.00	603.50	726.60	834.40				
Initial Value	(V_i),(W_i)	359.80	604.60	724.50	823.30				
Net Value	(V_n),(W_n)	156.2	-1.1	2.1	11.1				
Results									
Total Weight	(W_t)	168.30	g			**Water Vol Weighed**	($V_{wsg(std)}$)	7.935	scf
Std Meter Volume	($V_{m(std)}$)	50.659	dscf			**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content	($B_{ws(calc)}$)	13.54	%			**Final Moisture Content**	(B_{ws})	13.54	%

METHOD 5 (FRONT) AND 202 (BACK) SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Date	07/30/21
Operator	JLW
Run Number	R-1 75%-1

Filter #
0523
R-1 75%-1-CPM

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient / ID	(C_p)	0.8230	A5708
Average Stack Temp	(t_s)	911.5	°F
Average Meter Temp	(t_m)	82.3	
Orifice Meter Coefficient	($\Delta H@$)	1.831	in H_2O
Square Root ΔP	($\Delta p^{1/2}{}_{avg}$)	0.60	in H_2O
Stack Moisture Content	(B_{ws})	14.21	%
Stack Dry Molecular Weight	(M_d)	29.41	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.75	acfm
ΔP to ΔH Isokinetic Factor	(K)	3.04	

Leak Checks		*[change]*		*[level]*		*[time]*	
Train	**Pre**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
PASS	**Post**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
Pitot	**Pre (+)**	0.00	in H_2O	6.0	in H_2O for	15.0	sec [≥15]
PASS	**Pre (-)**	0.00	in H_2O	7.0	in H_2O for	15.0	sec [≥15]
	Post (+)	0.00	in H_2O	5.0	in H_2O for	15.0	sec [≥15]
	Post (-)	0.00	in H_2O	6.0	in H_2O for	15.0	sec [≥15]

Sampling Equipment			
Meter Box Number	samp-cp-0022		
Meter Cal Factor	(Y)	0.986	
Nozzle Number	G-10		
Average Nozzle Diameter	(D_{na})	0.3113	in
Suggested Nozzle Diameter	(D_{ni})	0.2888	in
Probe Number	samp-hp-0079		in
Probe Length	60		in
Liner Material	glass		
Sample Case / Oven Number	samp-BH-0018		
Impinger Case Number	samp-cc-0011		

Pressures			
Barometric Pressure	(P_b)	29.89	in Hg
Stack Static Pressure	(P_{static})	0.21	in H_2O
Absolute Stack Pressure	(P_s)	29.91	in Hg
Absolute Meter Pressure	(P_m)	30.02	in Hg

Nozzle Measurements				**ID: G-10**
Pre	0.312	0.311	0.311	**PASS**
Post	0.312	0.311	0.311	**PASS**

Barometer ID
SAMP-WE-0014
Scale ID
Extra

Run Time			
Start	08:08	**End**	09:42

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	360.0	604.3	721.1	823.4				
Post	524.3	605.5	724.5	832.6				

Wash Volumes					
					ml
					ml

Identification Nos.		samp-cp-0022	samp-cp-0022	samp-cp-0022			samp-hp-0079	samp-hp-0079	samp-BH-0018	samp-cc-0011	2917	1004	samp-cp-0022		samp-cp-0022					
Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Probe Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤85°F)**	**CPM Filter Temp (76.5±8.5°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	171.591	0.40	1.215	1.30	884	250	250	60	64	83	74	74	3.0	0.63	56.59	2.324	102.6	55.786
A-2	3.8	00:03:45	173.970	0.39	1.185	1.20	911	248	248	60	66	82	74	74	3.0	0.62	56.44	4.542	101.4	54.502
A-3	7.5	00:07:30	176.240	0.39	1.185	1.20	912	248	247	62	65	81	74	74	3.0	0.62	56.46	6.769	101.1	54.152
A-4	11.3	00:11:15	178.520	0.41	1.245	1.30	912	250	249	63	66	81	75	75	3.0	0.64	57.89	9.070	101.2	54.423
A-5	15.0	00:15:00	180.880	0.41	1.245	1.30	914	250	250	63	68	81	76	76	3.0	0.64	57.93	11.397	101.4	54.705
A-6	18.8	00:18:45	183.270	0.40	1.215	1.30	911	250	250	64	71	82	77	77	3.0	0.63	57.16	13.651	101.3	54.604
A-7	22.5	00:22:30	185.590	0.40	1.215	1.30	911	250	250	62	72	83	78	78	3.0	0.63	57.16	15.940	101.4	54.651
A-8	26.3	00:26:15	187.950	0.39	1.185	1.20	912	248	250	62	53	80	79	79	3.0	0.62	56.46	18.146	101.2	54.439
A-9	30.0	00:30:00	190.230	0.37	1.124	1.20	910	249	249	62	50	79	80	80	3.0	0.61	54.95	20.349	101.3	54.263
A-10	33.8	00:33:45	192.510	0.37	1.124	1.20	912	250	250	62	50	78	81	81	3.0	0.61	54.99	22.537	101.3	54.090
A-11	37.5	00:37:30	194.780	0.36	1.094	1.20	910	249	249	63	51	79	82	82	3.0	0.60	54.20	24.684	101.2	53.855
A-12	41.3	00:41:15	197.010	0.35	1.063	1.10	909	250	250	63	53	79	83	83	3.0	0.59	53.43	26.756	101.0	53.512
B-1	45.0	00:45:00	199.168	0.30	0.911	0.96	915	250	251	59	42	84	84	84	3.0	0.55	49.57	28.751	101.2	53.079
B-2	48.8	00:48:45	201.250	0.27	0.820	0.86	917	248	250	60	42	83	84	84	3.0	0.52	47.06	30.591	101.1	52.441
B-3	52.5	00:52:30	203.170	0.28	0.851	0.90	915	250	249	61	43	82	85	85	3.0	0.53	47.89	32.494	101.1	51.990
B-4	56.3	00:56:15	205.160	0.29	0.881	0.93	915	249	251	61	44	82	85	85	3.0	0.54	48.74	34.426	101.1	51.639
B-5	60.0	01:00:00	207.180	0.32	0.972	1.00	914	250	250	61	46	82	86	86	3.0	0.57	51.18	36.431	101.1	51.432
B-6	63.8	01:03:45	209.280	0.33	1.002	1.10	913	250	251	61	48	82	87	87	3.0	0.57	51.95	38.462	101.0	51.283
B-7	67.5	01:07:30	211.410	0.35	1.063	1.10	913	250	249	60	47	82	87	87	3.0	0.59	53.50	40.493	100.8	51.149
B-8	71.3	01:11:15	213.540	0.35	1.063	1.10	916	249	251	61	49	82	88	88	3.0	0.59	53.56	42.520	100.6	51.023
B-9	75.0	01:15:00	215.670	0.35	1.063	1.10	917	249	250	61	50	83	89	89	3.0	0.59	53.58	44.533	100.4	50.895
B-10	78.8	01:18:45	217.790	0.37	1.124	1.20	915	250	250	61	51	83	89	89	3.0	0.61	55.05	46.614	100.2	50.852
B-11	82.5	01:22:30	219.980	0.36	1.094	1.20	911	248	251	61	53	83	89	89	3.0	0.60	54.22	48.676	100.1	50.792
B-12	86.3	01:26:15	222.150	0.34	1.033	1.10	908	250	250	61	54	83	90	90	3.0	0.58	52.64	50.719	100.0	50.719
Last Pt	90.0	01:30:00	224.305																	
Final Val	90.0	01:30:00	224.305											**Max Vac**	3.0	**Final Values**		50.719	100.0	
Average Values				0.36		1.14	912	249	250	61	54	82	82	82		0.60	53.86			
													82							

Notes:

METHOD 5 (FRONT) AND 202 (BACK) SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Date	07/30/21
Operator	JLW
Run Number	R-1 75%-2

Filter #
0916
R-1 75%-2-CPM

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient / ID	(C_p)	0.8230	A5708
Average Stack Temp	(t_s)	908.8	°F
Average Meter Temp	(t_m)	92.1	
Orifice Meter Coefficient	($\Delta H@$)	1.831	in H_2O
Square Root ΔP	($\Delta p^{1/2}{}_{avg}$)	0.59	in H_2O
Stack Moisture Content	(B_{ws})	13.78	%
Stack Dry Molecular Weight	(M_d)	29.41	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.56	acfm
ΔP to ΔH Isokinetic Factor	(K)	3.12	

Leak Checks		*[change]*		*[level]*		*[time]*	
Train	**Pre**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
PASS	**Post**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
Pitot	**Pre (+)**	0.00	in H_2O	6.0	in H_2O for	15.0	sec [≥15]
PASS	**Pre (-)**	0.00	in H_2O	5.0	in H_2O for	15.0	sec [≥15]
	Post (+)	0.00	in H_2O	7.0	in H_2O for	15.0	sec [≥15]
	Post (-)	0.00	in H_2O	6.0	in H_2O for	15.0	sec [≥15]

Sampling Equipment			
Meter Box Number	samp-cp-0022		
Meter Cal Factor	(Y)	0.986	
Nozzle Number	G-10		
Average Nozzle Diameter	(D_{na})	0.3113	in
Suggested Nozzle Diameter	(D_{ni})	0.2482	in
Probe Number	samp-hp-0079		in
Probe Length	60		in
Liner Material	glass		
Sample Case / Oven Number	samp-BH-0018		
Impinger Case Number	samp-cc-0011		

Pressures			
Barometric Pressure	(P_b)	29.90	in Hg
Stack Static Pressure	(P_{static})	0.21	in H_2O
Absolute Stack Pressure	(P_s)	29.92	in Hg
Absolute Meter Pressure	(P_m)	30.03	in Hg

Nozzle Measurements				**ID: G-10**
Pre	0.311	0.312	0.311	**PASS**
Post	0.311	0.312	0.311	**PASS**

Barometer ID
SAMP-WE-0014
Scale ID
Extra

Run Time			
Start	13:17	**End**	14:56

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	351.7	615.1	722.8	863.2				
Post	505.3	615.7	730.5	872.9				

Wash Volumes					ml
					ml

Identification Nos.		samp-cp-0022	samp-cp-0022	samp-cp-0022			samp-hp-0079	samp-hp-0079	samp-BH-0018	samp-cc-0011	3006	8471	samp-cp-0022		samp-cp-0022					
Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Probe Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤85°F)**	**CPM Filter Temp (76.5±8.5°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	224.575	0.28	0.875	0.86	896	250	249	66	65	72	85	85	2.0	0.53	47.51	1.822	96.1	43.737
A-2	3.8	00:03:45	226.480	0.27	0.844	0.82	904	247	250	65	56	74	86	86	2.0	0.52	46.79	3.636	96.9	43.637
A-3	7.5	00:07:30	228.380	0.28	0.875	0.86	908	249	251	65	55	74	86	86	2.0	0.53	47.72	5.508	97.7	44.064
A-4	11.3	00:11:15	230.340	0.29	0.906	0.89	911	249	252	64	55	74	87	87	2.0	0.54	48.62	7.405	98.0	44.429
A-5	15.0	00:15:00	232.330	0.31	0.969	0.95	911	249	250	64	57	74	88	88	2.0	0.56	50.27	9.384	98.4	45.044
A-6	18.8	00:18:45	234.410	0.32	1.000	0.98	914	250	250	65	60	73	88	88	2.0	0.57	51.13	11.354	98.3	45.417
A-7	22.5	00:22:30	236.480	0.35	1.093	1.10	912	251	249	65	62	74	89	89	2.0	0.59	53.43	13.445	98.4	46.096
A-8	26.3	00:26:15	238.680	0.35	1.093	1.10	912	250	250	64	63	74	90	90	2.0	0.59	53.43	15.541	98.6	46.622
A-9	30.0	00:30:00	240.890	0.36	1.125	1.10	912	250	251	64	60	75	91	91	2.0	0.60	54.19	17.624	98.4	46.996
A-10	33.8	00:33:45	243.090	0.37	1.156	1.10	911	250	249	63	60	75	92	92	2.0	0.61	54.92	19.712	98.2	47.309
A-11	37.5	00:37:30	245.300	0.36	1.125	1.10	911	250	250	63	60	75	92	92	2.0	0.60	54.17	21.857	98.4	47.689
A-12	41.3	00:41:15	247.570	0.34	1.062	1.00	910	250	251	63	60	75	93	93	2.0	0.58	52.62	23.891	98.4	47.782
B-1	45.0	00:45:00	249.726	0.40	1.250	1.20	893	248	250	55	63	78	93	93	2.0	0.63	56.72	26.103	98.3	48.189
B-2	48.8	00:48:45	252.070	0.40	1.250	1.20	899	251	250	59	63	78	93	93	2.0	0.63	56.85	28.320	98.3	48.548
B-3	52.5	00:52:30	254.420	0.39	1.218	1.20	905	250	249	59	65	79	94	94	2.0	0.62	56.26	30.552	98.4	48.883
B-4	56.3	00:56:15	256.790	0.40	1.250	1.20	909	250	250	60	65	79	94	94	2.0	0.63	57.06	32.831	98.6	49.247
B-5	60.0	01:00:00	259.210	0.41	1.281	1.30	911	249	249	60	66	78	95	95	2.0	0.64	57.81	35.201	98.9	49.696
B-6	63.8	01:03:45	261.730	0.40	1.250	1.20	912	251	250	60	66	78	95	95	2.0	0.63	57.12	37.505	99.1	50.006
B-7	67.5	01:07:30	264.180	0.39	1.218	1.20	912	249	249	58	66	78	96	96	2.0	0.62	56.40	39.804	99.4	50.279
B-8	71.3	01:11:15	266.630	0.39	1.218	1.20	915	249	250	58	65	77	96	96	2.0	0.62	56.46	42.085	99.6	50.501
B-9	75.0	01:15:00	269.060	0.38	1.187	1.20	912	249	251	58	66	78	97	97	2.0	0.62	55.67	44.352	99.8	50.687
B-10	78.8	01:18:45	271.480	0.37	1.156	1.10	911	250	251	58	67	78	97	97	2.0	0.61	54.92	46.468	99.7	50.693
B-11	82.5	01:22:30	273.740	0.35	1.093	1.10	911	250	249	58	67	78	97	97	2.0	0.59	53.41	48.519	99.6	50.629
B-12	86.3	01:26:15	275.930	0.35	1.093	1.10	909	250	251	58	67	78	97	97	2.0	0.59	53.37	50.599	99.5	50.599
Last Pt	90.0	01:30:00	278.151																	
Final Val	90.0	01:30:00	278.151											**Max Vac**	2.0	**Final Values**		50.599	99.5	
Average Values				0.35		1.09	909	250	250	61	62	76	92	92		0.59	53.62			
													92							

Notes:

METHOD 5 (FRONT) AND 202 (BACK) SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Date	07/30/21
Operator	JLW
Run Number	R-1 75%-3

Filter #
0917
R-1 75%-3-CPM

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient / ID	(C_p)	0.8230	A5708
Average Stack Temp	(t_s)	910.2	°F
Average Meter Temp	(t_m)	94.8	
Orifice Meter Coefficient	($\Delta H@$)	1.831	in H_2O
Square Root ΔP	($\Delta p^{1/2}{}_{avg}$)	0.60	in H_2O
Stack Moisture Content	(B_{ws})	13.54	%
Stack Dry Molecular Weight	(M_d)	29.42	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.56	acfm
ΔP to ΔH Isokinetic Factor	(K)	3.15	

Leak Checks		*[change]*		*[level]*		*[time]*	
Train	**Pre**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
PASS	**Post**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
Pitot	**Pre (+)**	0.00	in H_2O	6.0	in H_2O for	15.0	sec [≥15]
PASS	**Pre (-)**	0.00	in H_2O	7.0	in H_2O for	15.0	sec [≥15]
	Post (+)	0.00	in H_2O	5.0	in H_2O for	15.0	sec [≥15]
	Post (-)	0.00	in H_2O	6.0	in H_2O for	15.0	sec [≥15]

Sampling Equipment			
Meter Box Number	samp-cp-0022		
Meter Cal Factor	(Y)	0.986	
Nozzle Number	G-10		
Average Nozzle Diameter	(D_{na})	0.3113	in
Suggested Nozzle Diameter	(D_{ni})	0.2474	in
Probe Number	samp-hp-0079		in
Probe Length	60		in
Liner Material	glass		
Sample Case / Oven Number	samp-BH-0018		
Impinger Case Number	samp-cc-0011		

Pressures			
Barometric Pressure	(P_b)	29.86	in Hg
Stack Static Pressure	(P_{static})	0.21	in H_2O
Absolute Stack Pressure	(P_s)	29.88	in Hg
Absolute Meter Pressure	(P_m)	29.99	in Hg

Nozzle Measurements				**ID: G-10**
Pre	0.311	0.312	0.311	**PASS**
Post	0.311	0.312	0.311	**PASS**

Barometer ID
SAMP-WE-0014
Scale ID
Extra

Run Time			
Start	15:25	**End**	17:01

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	359.8	604.6	724.5	823.3				
Post	516.0	603.5	726.6	834.4				

Wash Volumes					
					ml
					ml

Identification Nos.		samp-cp-0022	samp-cp-0022	samp-cp-0022			samp-hp-0079	samp-hp-0079	samp-BH-0018	samp-cc-0011	2917	1004	samp-cp-0022		samp-cp-0022					
Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Probe Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤85°F)**	**CPM Filter Temp (76.5±8.5°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	278.408	0.38	1.197	1.20	909	249	252	64	60	81	91	91	3.0	0.62	55.61	2.253	102.3	54.066
A-2	3.8	00:03:45	280.790	0.39	1.229	1.20	911	250	252	64	60	80	91	91	3.0	0.62	56.38	4.418	99.8	53.022
A-3	7.5	00:07:30	283.080	0.39	1.229	1.20	912	248	250	63	61	79	91	91	3.0	0.62	56.40	6.688	100.5	53.506
A-4	11.3	00:11:15	285.480	0.41	1.292	1.30	914	250	252	63	61	78	91	91	3.0	0.64	57.87	8.864	99.3	53.184
A-5	15.0	00:15:00	287.780	0.41	1.292	1.30	913	250	249	62	62	78	92	92	3.0	0.64	57.85	11.262	100.5	54.059
A-6	18.8	00:18:45	290.320	0.40	1.260	1.30	915	249	252	62	64	78	93	93	3.0	0.63	57.18	13.694	101.8	54.776
A-7	22.5	00:22:30	292.900	0.39	1.229	1.20	914	251	250	62	64	78	93	93	3.0	0.62	56.44	15.880	101.3	54.447
A-8	26.3	00:26:15	295.220	0.38	1.197	1.20	912	248	251	62	65	78	94	94	3.0	0.62	55.67	18.044	101.0	54.131
A-9	30.0	00:30:00	297.520	0.38	1.197	1.20	912	249	249	63	65	79	94	94	3.0	0.62	55.67	20.217	100.7	53.911
A-10	33.8	00:33:45	299.830	0.37	1.166	1.20	913	250	250	63	65	79	95	95	3.0	0.61	54.95	22.442	100.9	53.860
A-11	37.5	00:37:30	302.200	0.36	1.134	1.10	911	249	252	63	66	80	95	95	3.0	0.60	54.16	24.544	100.7	53.551
A-12	41.3	00:41:15	304.440	0.35	1.103	1.10	909	250	250	64	67	80	96	96	3.0	0.59	53.37	26.650	100.6	53.300
B-1	45.0	00:45:00	306.687	0.30	0.945	0.94	895	250	250	65	68	79	95	95	3.0	0.55	49.16	28.595	100.5	52.791
B-2	48.8	00:48:45	308.760	0.28	0.882	0.88	905	249	250	65	68	79	95	95	3.0	0.53	47.66	30.471	100.4	52.237
B-3	52.5	00:52:30	310.760	0.29	0.914	0.91	908	249	249	64	67	79	95	95	3.0	0.54	48.56	32.376	100.3	51.802
B-4	56.3	00:56:15	312.790	0.30	0.945	0.94	911	249	250	64	67	79	96	96	3.0	0.55	49.44	34.296	100.2	51.444
B-5	60.0	01:00:00	314.840	0.32	1.008	1.00	910	250	252	64	67	79	96	96	3.0	0.57	51.05	36.301	100.2	51.248
B-6	63.8	01:03:45	316.980	0.33	1.040	1.00	912	248	250	65	68	80	97	97	3.0	0.57	51.88	38.311	100.1	51.082
B-7	67.5	01:07:30	319.130	0.35	1.103	1.10	912	248	250	65	68	80	97	97	3.0	0.59	53.43	40.350	99.9	50.969
B-8	71.3	01:11:15	321.310	0.35	1.103	1.10	911	249	252	65	68	80	97	97	3.0	0.59	53.41	42.352	99.6	50.822
B-9	75.0	01:15:00	323.450	0.35	1.103	1.10	911	248	249	65	67	79	97	97	3.0	0.59	53.41	44.494	99.7	50.850
B-10	78.8	01:18:45	325.740	0.36	1.134	1.10	910	250	251	66	67	79	98	98	3.0	0.60	54.14	46.529	99.5	50.759
B-11	82.5	01:22:30	327.920	0.36	1.134	1.10	909	251	250	66	67	79	98	98	3.0	0.60	54.12	48.602	99.4	50.715
B-12	86.3	01:26:15	330.140	0.34	1.071	1.10	905	249	250	66	67	79	98	98	3.0	0.58	52.52	50.669	99.4	50.669
Last Pt	90.0	01:30:00	332.354																	
Final Val	90.0	01:30:00	332.354											**Max Vac**	3.0	**Final Values**		50.669	99.4	
Average Values				0.36		1.12	910	249	251	64	65	79	95	95		0.60	53.76			
													95							

Notes:

AIR HYGIENE

PM (EPA METHOD 5) DATA SHEET

Project Code: catc-21-houston.tx-start#1

Site Info.

Plant Name. . . . . .
Sampling Location. . . . . .
Unit # . . . . . .
Date. 7.30.21

Console Info.

Console. samp-cp-0022
Meter Calibratrion Factor 0.986
Orifice Meter Coefficient 1.831

PM RUNS

Run#: 1		Load: 75% normal						Box#: samp-ee-0011
		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7
		(g)	(g)	(g)	(g)			
Contents		Dry	Di Water	Dry	Sil Gel			
Final Value	$(V_f),(W_f)$	524.3	605.5	724.5	~~823.4~~	832.6		
Initial Value	$(V_i),(W_i)$	360.0	604.3	721.1	823.4			
Filter #	0523		Probe #		Probe (in.)			
Pitot #			Nozzle #		Nozzle Meas			

Run#: 2		Load: 75% normal						Box#:
		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7
		(g)	(g)	(g)	(g)			
Contents		Dry	Di Water	Dry	Sil Gel			
Final Value	$(V_f),(W_f)$	505.3	615.7	730.5	872.9			
Initial Value	$(V_i),(W_i)$	351.7	615.1	722.8	863.2			
Filter #	0916		Probe #		Probe (in.)			
Pitot #			Nozzle #		Nozzle Meas			

Run#: 3		Load: normal						Box#:
		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7
		(g)	(g)	(g)	(g)			
Contents		Dry	Di Water	Dry	Sil Gel			
Final Value	$(V_f),(W_f)$	516.0	603.5	726.6	834.4			
Initial Value	$(V_i),(W_i)$	359.8	604.6	724.5	823.3			
Filter #	0917		Probe #		Probe (in.)			
Pitot #			Nozzle #		Nozzle Meas			

Run#:		Load: normal						Box#:
		Impinger 1	Impinger 2	Impinger 3	Impinger 4	Impinger 5	Impinger 6	Impinger 7
		(g)	(g)	(g)	(g)			
Contents		Dry	Di Water	Dry	Sil Gel			
Final Value	$(V_f),(W_f)$							
Initial Value	$(V_i),(W_i)$							
Filter #			Probe #		Probe (in.)			
Pitot #			Nozzle #		Nozzle Meas			

Signature

EMISSION DATA RECORDS

100% Load
PM
Reference Method Data

METHOD 5 (FRONT) AND 202 (BACK) SOURCE SAMPLING TITLE PAGE

Source Information	
Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Fuel Type	Gas, Natural

Test Information			
Project #		catc-21-houston.tx-start#1	
Operator		TP	
Date for Preliminary Run	(mm/dd/yy)	08/31/21	
Standard Temperature		68	°F
Standard Pressure		29.92	in Hg
Run Duration	≥ 2 min/point	90	minutes
Unit Number		1	
Base Run Number		R-1 100%	
Number of Ports Available		2	
Number of Ports Used		2	
Port Inside Diameter		4.00	in
Stack Shape		Circular	

Test Equipment Information					
Run		**1**	**2**	**3**	
Test Date	(mm/dd/yy)	08/31/21	08/31/21	08/31/21	
Load		100%	100%	100%	% or w/DB
Fuel F-Factor		8631.42	8631.42	8631.42	dscf/MMBtu
Meter Box Number	from ACS	samp-cp-0021	samp-cp-0021	samp-cp-0021	
Meter Calibration Factor	(Y)	0.970	0.970	0.970	
Orifice Meter Coefficient	($\Delta H_@$)	1.812	1.812	1.812	in H_2O
Non-Console Manometer Used		No	No	No	
Pitot Identification	from ACS	A5708	A5708	A5708	
Pitot Tube Coefficient	(C_p)	0.8230	0.8230	0.8230	
Nozzle Number	from ACS	H-10	H-10	H-10	
Nozzle Diameter	(D_n)	0.293	0.293	0.293	in
Probe Number	from ACS	samp-hp-0079	samp-hp-0079	samp-hp-0079	
Probe Length		60.0	60.0	60.0	in
(SS, Glass ….) Liner Material	from list	glass	glass	glass	
Sample Case / Oven Number	from ACS	samp-BH-0036	samp-BH-0036	samp-BH-0036	
Impinger Case Number	from ACS	samp-cc-0009	samp-cc-0009	samp-cc-0009	

Testing Company Information	
Company Name	Air Hygiene International, Inc. (Tulsa, Oklahoma)
Address	1600 W Tacoma Street
City, State Zip	Broken Arrow, Oklahoma 74012
Project Manager	Matt McBride
Phone Number	(918) 307-8865
Fax Number	(918) 307-9131

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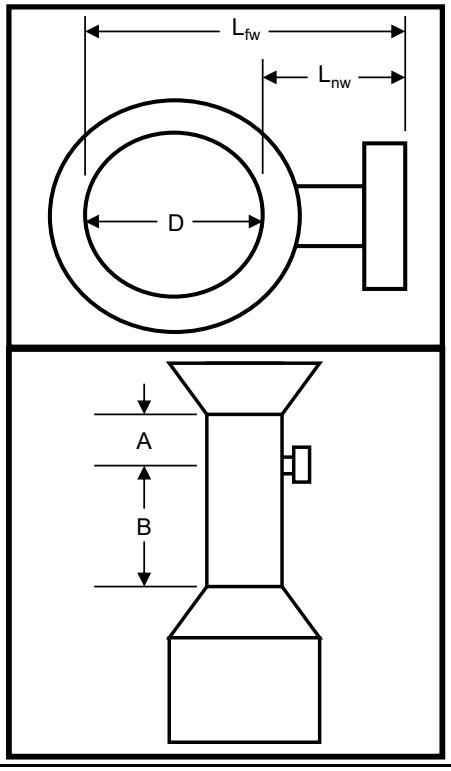
METHOD 1 - SAMPLE AND VELOCITY TRAVERSES FOR CIRCULAR SOURCES

Plant Name	Stewart and Stevenson Integration Center	**Date**	08/31/21
Sampling Location	Caterpillar G3520 TALE	**Stack Type**	Circular
Operator	TP	**Ports Available**	2
Project #	catc-21-houston.tx-start#1	**Ports Used**	2
Stack Size	Large (>24 inch diameter)	**Port ID (inches)**	4.00

Circular Stack or Duct Diameter			
Distance to Far Wall of Stack	(L_{fw})	32.00	in
Distance to Near Wall of Stack	(L_{nw})	0.125	in
Diameter of Stack	(D)	31.88	in
Area of Stack	(A_s)	5.54	ft²

Distance from Port to Disturbances			
Distance Upstream	(A)	16.00	in
Diameters Upstream	(A_D)	0.50	diameters
Distance Downstream	(B)	64.00	in
Diameters Downstream	(B_D)	2.01	diameters



Number of Traverse Points Required			
Diameters to Flow Disturbance		**Minimum Number of[1] Traverse Points**	
Down Stream	**Up Stream**	**Particulate Points**	**Velocity Points**
2.00-4.99	0.50-1.24	24	16
5.00-5.99	1.25-1.49	20	16
6.00-6.99	1.50-1.74	16	12
7.00-7.99	1.75-1.99	12	12
>= 8.00	>=2.00	8 or 12[2]	8 or 12[2]
Upstream Spec		24	16
Downstream Spec		24	16
Traverse Pts Required		24	16

[1] Check Minimum Number of Points for the Upstream and Downstream conditions, then use the largest.

[2] 8 for Circular Stacks 12 to 24 inches
12 for Circular Stacks over 24 inches

◉ Method 1 Trav

○ 12 Point PM Trav (M201a ONLY)

○ Velocity

Number of Traverse Points Used			
2	**Ports by**	12	**Across**
24	**Pts Used**	24	**Required**
Adjust Sample Points Out of Boundary Layer			

Location of Traverse Points in Circular Stacks									
Traverse Point	(Fraction of Stack Dimension from Inside Wall to Traverse Point)								
	Number of Traverse Points Across the Stack								
Number	2	4	6	8	10	12	14	16	18
1	.146	.067	.044	.032	.026	.021	.018	.016	.014
2	.854	.250	.146	.105	.082	.067	.057	.049	.044
3		.750	.296	.194	.146	.118	.099	.085	.075
4		.933	.704	.323	.226	.177	.146	.125	.109
5			.854	.677	.342	.250	.201	.169	.146
6			.956	.806	.658	.356	.269	.220	.188
7				.895	.774	.644	.366	.283	.236
8				.968	.854	.750	.634	.375	.296
9					.918	.823	.731	.625	.382
10					.974	.882	.799	.717	.618
11						.933	.854	.780	.704
12						.979	.901	.831	.764

Traverse Point Locations			
Traverse Point Number	**Fraction of Stack Diameter**	**Distance from Inside Wall**	**Distance Including Reference Length**
		in	in
1	0.021	5/8	6/8
2	0.067	2 1/8	2 2/8
3	0.118	3 6/8	3 7/8
4	0.177	5 5/8	5 6/8
5	0.250	8	8 1/8
6	0.356	11 3/8	11 4/8
7	0.644	20 4/8	20 5/8
8	0.750	23 7/8	24
9	0.823	26 2/8	26 3/8
10	0.882	28 1/8	28 2/8
11	0.933	29 6/8	29 7/8
12	0.979	31 2/8	31 3/8

METHOD 2 - DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant Name	Stewart and Stevenson Integration Center			
Sampling Location	Caterpillar G3520 TALE			
Operator	TP			
Project #	catc-21-houston.tx-start#1			
Pitot Leak Check	x	**PreTest**	x	**PostTest**

Preliminary Run Date	08/31/21		
Stack Type	Circular		
Ports Available	2		
Thermocouple ID	samp-hp-0079		
Pitot Coefficient	0.8300	**Pitot Identification**	A6904

Stack Dimensions			
Area of Stack	(A_s)	5.54	ft²
Diameter of Stack	(D)	31.88	in

Pressures			
Barometric Pressure	(P_b)	29.69	in Hg
Static Pressure	(P_{static})	-0.36	in H_2O
Absolute Stack Pressure	(P_s)	29.66	in Hg

Stack Gas Composition			
Composition Data:	**Estimated Composition**		
Carbon Dioxide Concentration	($\%CO_2$)	6.66	%vd
Oxygen Concentration	($\%O_2$)	8.94	%vd
Carbon Monoxide Concentration	(ppmCO)	3.59	ppmvd
Nitrogen Concentration	($\%N_2$)	84.40	%vd
Stack Moisture Content	(B_{ws})	14.00	%
Stack Dry Molecular Weight	(M_d)	29.42	lb/lb-mole
Stack Wet Molecular Weight	(M_w)	27.82	lb/lb-mole

Results			
Avg Stack Gas Velocity	(v_s)	62.17	ft/sec
Avg Stack Dry Std Flow Rate	(Q_{sd})	418,383	dscf/hr
Avg Stack Dry Std Flow Rate	(Q_{sd})	6,973	dscf/min
Avg Stack Wet Flow Rate	(Q_{aw})	20,670	acf/min
Avg Stack Wet Std Flow Rate	(Q_{sw})	486,492	ascf/hr

40 CFR 60, Method 2G, Section 8.11.1 (but applies to all Method 2 type static pressure measurements):
If a Type S probe is used for this measurement, position the probe at or between any traverse point(s) and rotate the probe until a null differential pressure reading is obtained. Disconnect the tubing from one of the pressure ports; read and record the ΔP. For pressure devices with one-directional scales, if a deflection in the positive direction is noted with the negative side disconnected, then the static pressure is positive. Likewise, if a deflection in the positive direction is noted with the positive side disconnected, then the static pressure is negative.

Stack Cross Section Schematic

Velocity Traverse Data

Run Number		R-1 100%-V1			
Run Time		07:14	**Start**	07:38	**End**
Traverse Point	**Velocity Head** (Δp)	**Null Angle** (N_a)	**Zero Deg Pressure** (0^o_a)	**Stack Temp** (t_s)	**Local Velocity** ($v_{s(l)}$)
	in H_2O	deg	in H_2O	°F	ft/sec
A-1	0.53	-5	0.20	878	65.77
A-2	0.53	-5	0.20	879	65.80
A-3	0.53	5	-0.05	878	65.77
A-4	0.56	10	-0.10	879	67.63
A-5	0.58	15	-0.10	882	68.91
A-6	0.60	-5	0.20	882	70.08
A-7	0.50	15	-0.05	873	63.76
A-8	0.43	0	0.00	866	58.98
A-9	0.39	5	-0.03	867	56.19
A-10	0.37	0	0.00	866	54.71
A-11	0.36	0	0.00	865	53.94
A-12	0.36	0	0.00	865	53.94
B-1	0.50	-5	0.04	877	63.86
B-2	0.50	-5	0.04	878	63.88
B-3	0.51	5	-0.04	878	64.52
B-4	0.53	10	-0.05	879	65.80
B-5	0.61	5	-0.10	880	70.61
B-6	0.63	5	-0.06	881	71.79
B-7	0.52	-5	0.05	874	65.05
B-8	0.44	5	-0.03	873	59.82
B-9	0.40	5	-0.04	873	57.03
B-10	0.39	-5	0.04	872	56.29
B-11	0.36	0	0.00	872	54.08
B-12	0.36	0	0.00	871	54.06
Average	0.48	5		875	
	0.69	**= Square roots of Δp**			
Standard deviation of null angles =				4.2	

METHOD 3a - DETERMINATION OF DRY MOLECULAR WEIGHT BY ANALYZER

Plant Name	Stewart and Stevenson Integration Center	**Preliminary Run Date**	08/31/21		
Sampling Location	Caterpillar G3520 TALE	**Operator**	TP		
Project #	catc-21-houston.tx-start#1	**# of Ports Used**	1 (gas probe)		
Fuel Type	Gas, Natural	**Min. Fuel Factor**	1.600	**Max. Fuel Factor**	1.836

Gas Analysis Data									
Run Number	R-1 100%-1		**Date**	08/31/21	**Run Start Time**	09:36		**Run Stop Time**	11:17
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	(Fo)avg		(%EA)avg	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:41	6.81	8.64	4.36	84.6	29.44	1.800		63.1	YES

Gas Analysis Data									
Run Number	R-1 100%-2		**Date**	08/31/21	**Run Start Time**	12:05		**Run Stop Time**	13:44
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	(Fo)avg		(%EA)avg	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:39	6.58	9.06	2.18	84.4	29.41	1.800		68.6	YES

Gas Analysis Data									
Run Number	R-1 100%-3		**Date**	08/31/21	**Run Start Time**	14:24		**Run Stop Time**	16:05
Sample Analysis Time	**CO_2 Conc.**	**O_2 Conc.**	**CO Conc.**	**N_2 Conc.**	**Dry Molecular Weight**	**Calculated Fuel Factor**		**Excess Air**	**Fuel Factor in Range**
	(%CO_2)	(%O_2)	(ppmCO)	(%N_2)	(M_d)	(Fo)avg		(%EA)avg	
hh:mm	%	%	ppm	%	lb/lb-mole			%	
01:41	6.58	9.06	2.18	84.4	29.41	1.800		68.6	YES

METHOD 4 - DETERMINATION OF MOISTURE CONTENT IN STACK GASES

Plant Name	Stewart and Stevenson Integration Center	**Preliminary Run Date**	08/31/21
Sampling Location	Caterpillar G3520 TALE	**Operator**	TP
Project #	catc-21-houston.tx-start#1	**Ports Used**	2

Scale Daily Calibration					
Scale Number	SAMP-SC-0025	**Standard**	**Result**	**Difference**	**Pass/Fail**
Date		(g)	(g)	(g)	(± 0.5 g)
Test Day 1	08/31/21	500	499.5	-0.5	Pass

Moisture Content Data									
Run Number		R-1 100%-1		**Date**	08/31/21	**Start Time**	09:36	**Stop Time**	11:17
Meter Box Number		samp-cp-0021				**Meter Cal Factor**	(Y)	0.970	
Total Meter Volume	(V_m)	62.495	dcf			**Barometric Pressure**	(P_b)	29.72	in Hg
Average Stack Temp	$(t_s)_{avg}$	878	°F			**Stack Static Pressure**	(P_{static})	-0.36	in H_2O
Average Meter Temp	$(t_m)_{avg}$	84	°F			**Avg Orifice Pressure**	$(\Delta H)_{avg}$	1.41	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		Dry	Dry	DI Water	Sil Gel				
Final Value	(V_f),(W_f)	540.00	641.60	676.30	874.30				
Initial Value	(V_i),(W_i)	360.60	635.70	672.50	859.20				
Net Value	(V_n),(W_n)	179.4	5.9	3.8	15.1				
Results									
Total Weight	(W_t)	204.20	g			**Water Vol Weighed**	($V_{wsg(std)}$)	9.628	scf
Std Meter Volume	($V_{m(std)}$)	58.697	dscf			**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content	($B_{ws(calc)}$)	14.09	%			**Final Moisture Content**	(B_{ws})	14.09	%

Moisture Content Data									
Run Number		R-1 100%-2		**Date**	08/31/21	**Start Time**	12:05	**Stop Time**	13:44
Meter Box Number		samp-cp-0021				**Meter Cal Factor**	(Y)	0.970	
Total Meter Volume	(V_m)	62.465	dcf			**Barometric Pressure**	(P_b)	29.71	in Hg
Average Stack Temp	$(t_s)_{avg}$	878	°F			**Stack Static Pressure**	(P_{static})	-0.36	in H_2O
Average Meter Temp	$(t_m)_{avg}$	91	°F			**Avg Orifice Pressure**	$(\Delta H)_{avg}$	1.43	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		Dry	Dry	DI Water	Sil Gel				
Final Value	(V_f),(W_f)	521.40	609.40	723.30	860.10				
Initial Value	(V_i),(W_i)	346.10	604.10	719.20	844.50				
Net Value	(V_n),(W_n)	175.3	5.3	4.1	15.6				
Results									
Total Weight	(W_t)	200.30	g			**Water Vol Weighed**	($V_{wsg(std)}$)	9.444	scf
Std Meter Volume	($V_{m(std)}$)	57.810	dscf			**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content	($B_{ws(calc)}$)	14.04	%			**Final Moisture Content**	(B_{ws})	14.04	%

Moisture Content Data									
Run Number		R-1 100%-3		**Date**	08/31/21	**Start Time**	14:24	**Stop Time**	16:05
Meter Box Number		samp-cp-0021				**Meter Cal Factor**	(Y)	0.970	
Total Meter Volume	(V_m)	62.265	dcf			**Barometric Pressure**	(P_b)	29.66	in Hg
Average Stack Temp	$(t_s)_{avg}$	877	°F			**Stack Static Pressure**	(P_{static})	-0.36	in H_2O
Average Meter Temp	$(t_m)_{avg}$	77	°F			**Avg Orifice Pressure**	$(\Delta H)_{avg}$	1.47	in H_2O
		Impinger 1	**Impinger 2**	**Impinger 3**	**Impinger 4**	**Impinger 5**	**Impinger 6**	**Impinger 7**	**Impinger 8**
		(g)	(g)	(g)	(g)				
Contents		Dry	Dry	DI Water	Sil Gel				
Final Value	(V_f),(W_f)	573.90	618.50	758.30	870.70				
Initial Value	(V_i),(W_i)	347.60	615.30	754.70	855.40				
Net Value	(V_n),(W_n)	226.3	3.2	3.6	15.3				
Results									
Total Weight	(W_t)	248.40	g			**Water Vol Weighed**	($V_{wsg(std)}$)	11.712	scf
Std Meter Volume	($V_{m(std)}$)	59.138	dscf			**Sat. Moisture Content**	($B_{ws(svp)}$)	100.00	%
Calc Moisture Content	($B_{ws(calc)}$)	16.53	%			**Final Moisture Content**	(B_{ws})	16.53	%

METHOD 5 (FRONT) AND 202 (BACK) SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Date	08/31/21
Operator	TP
Run Number	R-1 100%-1

Filter #
0523
R-1 100%-1-CPM

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient / ID	(C_p)	0.8230	A5708
Average Stack Temp	(t_s)	877.8	°F
Average Meter Temp	(t_m)	83.5	
Orifice Meter Coefficient	($\Delta H@$)	1.812	in H_2O
Square Root ΔP	($\Delta p^{1/2}{}_{avg}$)	0.76	in H_2O
Stack Moisture Content	(B_{ws})	14.09	%
Stack Dry Molecular Weight	(M_d)	29.44	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.75	acfm
ΔP to ΔH Isokinetic Factor	(K)	2.43	

Leak Checks		*[change]*		*[level]*		*[time]*	
Train	**Pre**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
PASS	**Post**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
Pitot	**Pre (+)**	0.00	in H_2O	4.5	in H_2O for	15.0	sec [≥15]
	Pre (-)	0.00	in H_2O	5.1	in H_2O for	15.0	sec [≥15]
PASS	**Post (+)**	0.00	in H_2O	5.0	in H_2O for	15.0	sec [≥15]
	Post (-)	0.00	in H_2O	5.2	in H_2O for	15.0	sec [≥15]

Sampling Equipment			
Meter Box Number	samp-cp-0021		
Meter Cal Factor	(Y)	0.970	
Nozzle Number	H-10		
Average Nozzle Diameter	(D_{na})	0.2930	in
Suggested Nozzle Diameter	(D_{ni})	0.2696	in
Probe Number	samp-hp-0079		in
Probe Length	60		in
Liner Material	glass		
Sample Case / Oven Number	samp-BH-0036		
Impinger Case Number	samp-cc-0009		

Pressures			
Barometric Pressure	(P_b)	29.72	in Hg
Stack Static Pressure	(P_{static})	-0.36	in H_2O
Absolute Stack Pressure	(P_s)	29.69	in Hg
Absolute Meter Pressure	(P_m)	29.85	in Hg

Nozzle Measurements				**ID: H-10**
Pre	0.293	0.292	0.294	**PASS**
Post	0.293	0.292	0.294	**PASS**

Barometer ID
SAMP-WE-0014
Scale ID
SAMP-SC-0025

Run Time			
Start	09:36	**End**	11:17

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	360.6	635.7	672.5	859.2				
Post	540.0	641.6	676.3	874.3				

Wash Volumes					
					ml
					ml

Identification Nos.		samp-cp-0021	samp-cp-0021	samp-cp-0021			samp-hp-0079	samp-hp-0079	samp-BH-0036	samp-cc-0009	2917	1004	samp-cp-0021		samp-cp-0021					
Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Probe Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤85°F)**	**CPM Filter Temp (76.5±8.5°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	921.610	0.65	1.577	1.60	888	888	252	53	73	84	77	77	4.5	0.81	72.46	2.402	94.3	57.638
A-2	3.8	00:03:45	924.135	0.66	1.601	1.60	890	890	253	56	77	85	79	79	5.0	0.81	73.07	5.097	100.0	61.170
A-3	7.5	00:07:30	926.980	0.65	1.577	1.60	888	888	249	56	85	84	79	79	5.0	0.81	72.46	7.817	102.3	62.536
A-4	11.3	00:11:15	929.850	0.71	1.722	1.70	887	887	249	54	83	82	79	79	5.0	0.84	75.70	10.566	102.6	63.394
A-5	15.0	00:15:00	932.750	0.72	1.746	1.80	885	885	250	58	85	81	81	81	5.0	0.85	76.17	13.584	104.8	65.201
A-6	18.8	00:18:45	935.945	0.75	1.819	1.80	882	882	253	55	82	79	80	80	5.0	0.87	77.66	15.836	101.5	63.343
A-7	22.5	00:22:30	938.325	0.65	1.577	1.60	875	875	252	57	81	81	81	81	5.0	0.81	72.11	18.607	102.5	63.794
A-8	26.3	00:26:15	941.260	0.56	1.358	1.30	874	874	248	61	82	83	83	83	3.5	0.75	66.90	21.079	102.7	63.236
A-9	30.0	00:30:00	943.890	0.49	1.188	1.20	862	862	256	63	73	83	82	82	3.5	0.70	62.30	23.437	103.0	62.498
A-10	33.8	00:33:45	946.395	0.40	0.970	0.98	863	863	246	60	74	83	84	84	3.5	0.63	56.31	25.762	104.1	61.828
A-11	37.5	00:37:30	948.875	0.39	0.946	0.95	855	855	248	61	69	83	84	84	3.0	0.62	55.43	27.754	103.8	60.553
A-12	41.3	00:41:15	951.000	0.39	0.946	0.95	855	855	256	66	74	85	84	84	3.0	0.62	55.43	29.628	103.2	59.257
B-1	45.0	00:45:00	953.000	0.51	1.237	1.20	882	882	256	66	73	85	85	85	3.5	0.71	64.04	31.805	102.7	58.717
B-2	48.8	00:48:45	955.325	0.53	1.286	1.30	884	884	246	52	77	82	84	84	4.0	0.73	65.33	34.198	102.8	58.624
B-3	52.5	00:52:30	957.875	0.57	1.383	1.40	884	884	251	50	75	78	85	85	4.0	0.75	67.75	36.600	102.6	58.560
B-4	56.3	00:56:15	960.440	0.61	1.480	1.50	885	885	250	54	55	78	84	84	4.0	0.78	70.11	39.003	102.3	58.505
B-5	60.0	01:00:00	963.000	0.63	1.528	1.50	886	886	254	55	55	79	85	85	4.0	0.79	71.28	41.486	102.1	58.568
B-6	63.8	01:03:45	965.650	0.66	1.601	1.60	886	886	250	57	57	80	86	86	4.5	0.81	72.96	44.077	102.0	58.769
B-7	67.5	01:07:30	968.420	0.71	1.722	1.70	882	882	253	58	60	79	86	86	4.5	0.84	75.56	46.631	101.7	58.903
B-8	71.3	01:11:15	971.150	0.65	1.577	1.60	878	878	253	58	66	84	86	86	4.5	0.81	72.19	49.297	101.8	59.157
B-9	75.0	01:15:00	974.000	0.58	1.407	1.40	876	876	249	59	62	85	87	87	4.5	0.76	68.14	51.836	102.0	59.241
B-10	78.8	01:18:45	976.720	0.56	1.358	1.40	875	875	251	60	59	85	87	87	4.5	0.75	66.93	54.286	102.0	59.221
B-11	82.5	01:22:30	979.345	0.47	1.140	1.10	870	870	251	56	57	85	88	88	3.5	0.69	61.20	56.515	102.0	58.972
B-12	86.3	01:26:15	981.740	0.46	1.116	1.10	874	874	255	63	61	85	89	89	3.5	0.68	60.64	58.713	102.0	58.713
Last Pt	90.0	01:30:00	984.105																	
Final Val	90.0	01:30:00	984.105											**Max Vac**	5.0	**Final Values**		58.713	102.0	
Average Values				0.58		1.41	878	878	251	58	71	82	84	84		0.76	68.00			
													84							

Notes:

Probe temp out of specification due to: stack temp

METHOD 5 (FRONT) AND 202 (BACK) SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Date	08/31/21
Operator	TP
Run Number	R-1 100%-2

Filter #
0916
R-1 100%-2-CPM

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient / ID	(C_p)	0.8230	A5708
Average Stack Temp	(t_s)	878.1	°F
Average Meter Temp	(t_m)	91.5	
Orifice Meter Coefficient	($\Delta H@$)	1.812	in H_2O
Square Root ΔP	($\Delta p^{1/2}{}_{avg}$)	0.76	in H_2O
Stack Moisture Content	(B_{ws})	14.04	%
Stack Dry Molecular Weight	(M_d)	29.41	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.65	acfm
ΔP to ΔH Isokinetic Factor	(K)	2.46	

Leak Checks		*[change]*		*[level]*		*[time]*	
Train	**Pre**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
PASS	**Post**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
Pitot	**Pre (+)**	0.00	in H_2O	4.6	in H_2O for	15.0	sec [≥15]
	Pre (-)	0.00	in H_2O	4.3	in H_2O for	15.0	sec [≥15]
PASS	**Post (+)**	0.00	in H_2O	5.1	in H_2O for	15.0	sec [≥15]
	Post (-)	0.00	in H_2O	4.3	in H_2O for	15.0	sec [≥15]

Sampling Equipment			
Meter Box Number	samp-cp-0021		
Meter Cal Factor	(Y)	0.970	
Nozzle Number	H-10		
Average Nozzle Diameter	(D_{na})	0.2930	in
Suggested Nozzle Diameter	(D_{ni})	0.2494	in
Probe Number	samp-hp-0079		in
Probe Length	60		in
Liner Material	glass		
Sample Case / Oven Number	samp-BH-0036		
Impinger Case Number	samp-cc-0009		

Pressures			
Barometric Pressure	(P_b)	29.71	in Hg
Stack Static Pressure	(P_{static})	-0.36	in H_2O
Absolute Stack Pressure	(P_s)	29.68	in Hg
Absolute Meter Pressure	(P_m)	29.84	in Hg

Nozzle Measurements				**ID: H-10**
Pre	0.293	0.292	0.294	**PASS**
Post	0.293	0.292	0.294	**PASS**

Barometer ID
SAMP-WE-0014
Scale ID
SAMP-SC-0025

Run Time			
Start	12:05	**End**	13:44

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	346.1	604.1	719.2	844.5				
Post	521.4	609.4	723.3	860.1				

Wash Volumes					
					ml
					ml

Identification Nos.		samp-cp-0021	samp-cp-0021	samp-cp-0021			samp-hp-0079	samp-hp-0079	samp-BH-0036	samp-cc-0009	3006	8471	samp-cp-0021		samp-cp-0021					
Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Probe Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤85°F)**	**CPM Filter Temp (76.5±8.5°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	984.410	0.60	1.477	1.50	883	883	255	64	46	84	88	88	4.5	0.77	69.51	2.534	103.3	60.807
A-2	3.8	00:03:45	987.130	0.60	1.477	1.50	881	881	251	59	47	84	87	87	4.5	0.77	69.46	5.025	102.4	60.303
A-3	7.5	00:07:30	989.800	0.64	1.576	1.60	883	883	247	56	50	76	88	88	4.5	0.80	71.79	7.541	101.3	60.327
A-4	11.3	00:11:15	992.500	0.63	1.551	1.50	883	883	254	56	51	73	88	88	4.5	0.79	71.23	10.009	100.6	60.056
A-5	15.0	00:15:00	995.150	0.64	1.576	1.60	882	882	250	56	57	73	89	89	4.5	0.80	71.76	12.627	101.1	60.611
A-6	18.8	00:18:45	997.965	0.68	1.674	1.70	882	882	247	56	63	77	90	90	4.5	0.82	73.97	15.074	99.9	60.296
A-7	22.5	00:22:30	1000.600	0.62	1.527	1.50	878	878	251	57	49	76	92	92	4.5	0.79	70.53	17.686	100.6	60.639
A-8	26.3	00:26:15	1003.425	0.56	1.379	1.40	874	874	250	56	49	72	91	91	4.5	0.75	66.93	20.104	100.7	60.311
A-9	30.0	00:30:00	1006.035	0.53	1.305	1.30	873	873	253	55	47	71	92	92	4.0	0.73	65.09	22.414	100.6	59.772
A-10	33.8	00:33:45	1008.535	0.47	1.157	1.10	872	872	253	56	48	70	93	93	3.5	0.69	61.27	24.637	100.7	59.128
A-11	37.5	00:37:30	1010.945	0.44	1.083	1.10	867	867	256	57	50	71	93	93	3.5	0.66	59.17	26.785	100.8	58.441
A-12	41.3	00:41:15	1013.275	0.44	1.083	1.10	862	862	251	56	52	71	94	94	3.5	0.66	59.06	28.880	100.7	57.759
B-1	45.0	00:45:00	1015.550	0.63	1.551	1.50	884	884	254	68	59	85	94	94	4.0	0.79	71.25	31.321	100.4	57.824
B-2	48.8	00:48:45	1018.200	0.63	1.551	1.50	886	886	252	56	64	84	94	94	4.0	0.79	71.31	33.781	100.2	57.911
B-3	52.5	00:52:30	1020.870	0.64	1.576	1.60	889	889	247	57	69	83	94	94	4.5	0.80	71.95	36.279	100.1	58.046
B-4	56.3	00:56:15	1023.580	0.67	1.650	1.60	884	884	248	61	52	80	96	96	4.5	0.82	73.48	38.915	100.2	58.372
B-5	60.0	01:00:00	1026.450	0.67	1.650	1.60	883	883	247	64	55	69	97	97	4.5	0.82	73.45	41.344	99.8	58.368
B-6	63.8	01:03:45	1029.100	0.69	1.699	1.70	882	882	249	63	55	70	96	96	4.5	0.83	74.51	44.145	100.3	58.860
B-7	67.5	01:07:30	1032.150	0.69	1.699	1.70	882	882	256	64	61	71	95	95	4.5	0.83	74.51	46.519	99.7	58.761
B-8	71.3	01:11:15	1034.730	0.70	1.724	1.70	887	887	254	64	66	73	93	93	4.5	0.84	75.19	49.124	99.7	58.948
B-9	75.0	01:15:00	1037.550	0.55	1.354	1.30	879	879	249	67	71	74	90	90	4.0	0.74	66.45	51.526	99.8	58.887
B-10	78.8	01:18:45	1040.140	0.45	1.108	1.10	878	878	254	64	52	74	88	88	3.5	0.67	60.09	53.764	100.0	58.652
B-11	82.5	01:22:30	1042.545	0.41	1.010	1.00	860	860	255	63	50	72	87	87	3.0	0.64	56.97	55.801	100.0	58.227
B-12	86.3	01:26:15	1044.730	0.42	1.034	1.00	860	860	248	67	48	73	86	86	3.0	0.65	57.66	57.804	99.9	57.804
Last Pt	90.0	01:30:00	1046.875																	
Final Val	90.0	01:30:00	1046.875											**Max Vac**	4.5	**Final Values**		57.804	99.9	
Average Values				0.58		1.43	878	878	251	60	55	75	91	91		0.76	68.19			
													91							

Notes:

Probe temp out of specification due to: stack temp

METHOD 5 (FRONT) AND 202 (BACK) SOURCE SAMPLING TITLE PAGE ISOKINETIC SAMPLING DATA

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Date	08/31/21
Operator	TP
Run Number	R-1 100%-3

Filter #
0917
R-1 100%-3-CPM

Ideal Nozzle Diameter and IsoKinetic Factor Setup			
Pitot Coefficient / ID	(C_p)	0.8230	A5708
Average Stack Temp	(t_s)	876.7	°F
Average Meter Temp	(t_m)	76.5	
Orifice Meter Coefficient	($\Delta H@$)	1.812	in H_2O
Square Root ΔP	($\Delta p^{1/2}{}_{avg}$)	0.76	in H_2O
Stack Moisture Content	(B_{ws})	16.53	%
Stack Dry Molecular Weight	(M_d)	29.41	lb/lb-mole
Estimated Orifice Flow Rate	(Q_m)	0.64	acfm
ΔP to ΔH Isokinetic Factor	(K)	2.28	

Leak Checks		*[change]*		*[level]*		*[time]*	
Train	**Pre**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
PASS	**Post**	0.000	ft³/min@	15.0	in Hg for	60.0	sec [≥60]
Pitot	**Pre (+)**	0.00	in H_2O	5.0	in H_2O for	15.0	sec [≥15]
	Pre (-)	0.00	in H_2O	6.0	in H_2O for	15.0	sec [≥15]
PASS	**Post (+)**	0.00	in H_2O	5.8	in H_2O for	15.0	sec [≥15]
	Post (-)	0.00	in H_2O	5.2	in H_2O for	15.0	sec [≥15]

Sampling Equipment			
Meter Box Number	samp-cp-0021		
Meter Cal Factor	(Y)	0.970	
Nozzle Number	H-10		
Average Nozzle Diameter	(D_{na})	0.2930	in
Suggested Nozzle Diameter	(D_{ni})	0.2501	in
Probe Number	samp-hp-0079		in
Probe Length	60		in
Liner Material	glass		
Sample Case / Oven Number	samp-BH-0036		
Impinger Case Number	samp-cc-0009		

Pressures			
Barometric Pressure	(P_b)	29.66	in Hg
Stack Static Pressure	(P_{static})	-0.36	in H_2O
Absolute Stack Pressure	(P_s)	29.63	in Hg
Absolute Meter Pressure	(P_m)	29.79	in Hg

Nozzle Measurements				**ID: H-10**
Pre	0.293	0.292	0.294	**PASS**
Post	0.293	0.292	0.294	**PASS**

Barometer ID
SAMP-WE-0014
Scale ID
SAMP-SC-0025

Run Time			
Start	14:24	**End**	16:05

Weights	**Imp 1**	**Imp 2**	**Imp 3**	**Imp 4**	**Imp 5**	**Imp 6**	**Imp 7**	**Imp 8**
Pre	347.6	615.3	754.7	855.4				
Post	573.9	618.5	758.3	870.7				

Wash Volumes					
					ml
					ml

Identification Nos.		samp-cp-0021	samp-cp-0021	samp-cp-0021			samp-hp-0079	samp-hp-0079	samp-BH-0036	samp-cc-0009	2917	1004	samp-cp-0021		samp-cp-0021					
Traverse Point #	**Sampling Time (Θ)**	**Timer Time**	**Dry Gas Meter Reading (V_m)**	**Velocity Head (Δp)**	**Desired Orifice ΔH (ΔH_d)**	**Actual Orifice ΔH (ΔH_a)**	**Stack Temp (t_s)**	**Probe Temp (248±25°F)**	**Filter Temp (248±25°F)**	**Impinger Exit Temp (≤68°F)**	**Cond. Temp (≤85°F)**	**CPM Filter Temp (76.5±8.5°F)**	**Meter Inlet Temp (t_{mi})**	**Meter Outlet Temp (t_{mo})**	**Pump Vacuum**	**Square Root ΔP ($\Delta p^{1/2}$)**	**Local Stack Velocity (v_s)$_l$**	**Cumul. Meter Volume (V_m)$_{std}$**	**Cumul. Percent IsoKinetic (I)**	**Est-Run Meter Volume (V_m)$_{std}$**
	min	hh:mm:ss	ft³	in H_2O	in H_2O	in H_2O	°F	°F	°F	°F	°F	°F	°F	°F	in Hg	√(in H_2O)	ft/sec	dscf	%	dscf
A-1	0.0	00:00:00	48.125	0.63	1.439	1.60	885	885	251	67	38	84	72	72	3.5	0.79	71.71	2.597	106.0	62.317
A-2	3.8	00:03:45	50.835	0.63	1.439	1.60	888	888	252	58	41	76	73	73	3.5	0.79	71.79	5.140	105.0	61.684
A-3	7.5	00:07:30	53.495	0.72	1.645	1.80	890	890	249	55	43	71	75	75	3.5	0.85	76.80	7.843	104.4	62.742
A-4	11.3	00:11:15	56.330	0.75	1.713	1.90	886	886	255	55	43	68	75	75	3.5	0.87	78.27	10.675	104.8	64.047
A-5	15.0	00:15:00	59.300	0.75	1.713	1.90	885	885	254	55	43	68	75	75	3.5	0.87	78.24	13.487	104.9	64.739
A-6	18.8	00:18:45	62.250	0.72	1.645	1.80	881	881	254	54	44	68	76	76	3.5	0.85	76.55	16.246	104.9	64.986
A-7	22.5	00:22:30	65.150	0.66	1.508	1.60	880	880	255	52	44	68	76	76	3.5	0.81	73.26	18.862	104.8	64.668
A-8	26.3	00:26:15	67.900	0.60	1.371	1.50	877	877	255	52	46	69	76	76	3.5	0.77	69.77	21.476	105.3	64.428
A-9	30.0	00:30:00	70.650	0.48	1.097	1.20	877	877	253	52	43	68	76	76	3.0	0.69	62.41	23.937	106.3	63.831
A-10	33.8	00:33:45	73.240	0.40	0.914	1.00	865	865	257	52	41	69	77	77	2.5	0.63	56.71	26.060	106.4	62.544
A-11	37.5	00:37:30	75.480	0.37	0.845	0.91	862	862	249	51	42	69	77	77	2.5	0.61	54.48	28.040	106.3	61.179
A-12	41.3	00:41:15	77.570	0.36	0.822	0.90	854	854	254	54	44	70	77	77	2.5	0.60	53.58	29.954	106.0	59.909
B-1	45.0	00:45:00	79.590	0.65	1.485	1.60	882	882	248	63	38	74	75	75	3.0	0.81	72.76	32.489	105.7	59.979
B-2	48.8	00:48:45	82.250	0.65	1.485	1.60	882	882	250	50	38	68	75	75	3.0	0.81	72.76	35.061	105.5	60.105
B-3	52.5	00:52:30	84.950	0.71	1.622	1.80	883	883	251	49	38	68	75	75	3.5	0.84	76.07	37.635	105.1	60.216
B-4	56.3	00:56:15	87.650	0.74	1.691	1.80	884	884	248	52	41	68	77	77	3.5	0.86	77.69	40.484	105.2	60.726
B-5	60.0	01:00:00	90.650	0.75	1.713	1.85	881	881	251	51	39	68	78	78	3.5	0.87	78.12	43.186	104.9	60.968
B-6	63.8	01:03:45	93.500	0.75	1.713	1.85	882	882	249	51	40	69	78	78	3.5	0.87	78.15	45.982	104.9	61.310
B-7	67.5	01:07:30	96.450	0.55	1.257	1.40	874	874	252	51	39	69	78	78	3.0	0.74	66.73	48.416	105.0	61.157
B-8	71.3	01:11:15	99.020	0.53	1.211	1.30	875	875	248	51	40	70	79	79	3.0	0.73	65.53	50.797	105.0	60.957
B-9	75.0	01:15:00	101.540	0.46	1.051	1.10	870	870	255	50	39	70	79	79	2.5	0.68	60.93	52.932	104.8	60.494
B-10	78.8	01:18:45	103.800	0.39	0.891	1.00	862	862	251	51	40	70	79	79	2.0	0.62	55.94	54.986	104.9	59.985
B-11	82.5	01:22:30	105.975	0.44	1.005	1.10	868	868	255	52	39	69	79	79	2.5	0.66	59.55	57.064	104.7	59.545
B-12	86.3	01:26:15	108.175	0.44	1.005	1.10	867	867	249	53	39	70	79	79	2.5	0.66	59.52	59.156	104.6	59.156
Last Pt	90.0	01:30:00	110.390																	
Final Val	90.0	01:30:00	110.390											**Max Vac**	3.5	**Final Values**		59.156	104.6	
Average Values				0.59		1.47	877	877	252	53	41	70	77	77		0.76	68.64			
													77							

Notes:

Probe temp out of specification due to: stack temp

APPENDIX C

CALIBRATION GAS CERTIFICATIONS

Assay Laboratory: Red Ball TGS
555 Craig Kennedy Way
Shreveport, LA 71107
800-551-8150

CERTIFICATE OF ANALYSIS
(Zero Ambient Nitrogen)

Cylinder Number:	CC727745	**Certification Date:**	03/16/2021
Product ID Number:	121026	**Expiration Date:**	03/14/2029
Cylinder Pressure:	1900 PSIG	**MFG Facility:**	RBTGS-Shreveport-LA
COA #	CC727745.20210316-0	**Lot Number:**	CC727745.20210316
Customer PO. NO.:		**Tracking Number:**	098853339
Customer:		**Previous Certification Dates:**	

This mixture is for laboratory use only, not for drug, household or other use.
This mixture is certified in Mole % to be within ±2% of the actual number reported with a confidence of 95%.
This mixture was manufactured by scale; weights traceable to N.I.S.T. Certificate #822/266926-02.
Do Not Use This Cylinder Below 100 psig (0.7 Megapascal).

Composing Material: Zero Ambient Nitrogen, Cert., Sz152

Component	Specification	Concentration
Nitrogen	Balance	Balance
Oxygen as Impurity	<1.0 PPM	<1.0 PPM
Carbon Dioxide as Impurity	<0.5 PPM	<0.5 PPM
Carbon Monoxide as Impurity	<0.5 PPM	<0.5 PPM
Total Oxides of Nitrogen as Impurity	<0.1 PPM	<0.1 PPM
Sulfur Dioxide as Impurity	<0.1 PPM	<0.1 PPM
Total Hydrocarbons as Impurity	<0.1 PPM	<0.1 PPM

Red Ball Technical Gas Service
PGVP Vendor ID # G12021
Information and Ordering
800-551-8150
Fax (318-425-6309)

Accreditation #62754

Brandon Theus
Laboratory Supervisor

Version 02-B, Revised on 2015-05-27

Red Ball Technical Gas Service
555 Craig Kennedy Way
Shreveport, LA 71107
800-551-8150
PGVP Vendor ID # G12018

PJLA Calibration and Testing
Accreditation #62754

EPA PROTOCOL GAS CERTIFICATE OF ANALYSIS

Cylinder Number:	EB0059402	**Certification Date:**	06/06/2018
Product ID Number:	124605	**Expiration Date:**	06/04/2026
Cylinder Pressure:	1900 PSIG	**MFG Facility:**	- Shreveport - LA
COA #	EB0059402.20180530-0	**Lot Number:**	EB0059402.20180530
Customer PO. NO.:		**Tracking Number:**	074332991
Customer:		**Previous Certification Dates:**	

This calibration standard has been certified per the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531, using procedure G2.

Do Not Use This Cylinder Below 100 psig (0.7 Megapascal).

Certified Concentration(s)

Component	Concentration	Uncertainty	Analytical Principle	Assayed On
Carbon Dioxide	**19.0 %**	±0.19 %	NDIR	06/06/2018
Oxygen	**21.0 %**	±0.11 %	MPA	06/05/2018
Nitrogen	Balance			

Analytical Measurement Data Available Online.

Reference Standard(s)

Serial Number	Lot	Expiration	Type	Balance	Component	Concentration	Uncertainty(%)	NIST Reference
CC237204	CC237204.071001a	04/05/2023	NTRM	N2	O2	24.31 %	0.49	071001
EB0034340	EB0034340.20170209	05/09/2026	GMIS	N2	O2	20 %	0.5	071001
EB0072967	EB0072967.20170424	11/25/2025	GMIS	N2	CO2	9.52 %	0.753	C1309410.01

Analytical Instrumentation

Component	Principle	Make	Model	Serial	MPC Date
O2	MPA	Thermo	410i	1162980025	05/11/2018
CO2	NDIR	Thermo	410i	1162980025	06/06/2018

SMART-CERT

This is to certify the gases referenced have been calibrated/tested, and verified to meet the defined specifications. This calibration/test was performed using Gases or Scales that are traceable through National Institute of Standards and Technology (NIST) to the International System of Units (SI). The basis of compliance stated is a comparison of the measurement parameters to the specified or required calibration/testing process. The expanded uncertainties use a coverage factor of k=2 to approximate the 95% confidence level of the measurement, unless otherwise noted. This calibration certificate applies only to the item described and shall not be reproduced other than in full, without written approval from Red Ball Technical Gas Services. If not included, the uncertainty of calibrations are available upon request and were taken into account when determining pass or fail.

Brandon Theus
Analytical Chemist
Assay Laboratory: Red Ball TGS
Version 02-I, Revised on 2017-09-07

Red Ball Technical Gas Service
555 Craig Kennedy Way
Shreveport, LA 71107
800-551-8150
PGVP Vendor ID # G12021

PJLA Calibration and Testing
Accreditation #62754

EPA PROTOCOL GAS CERTIFICATE OF ANALYSIS

Cylinder Number:	CC712952	**Certification Date:**	04/16/2021
Product ID Number:	124606	**Expiration Date:**	04/14/2029
Cylinder Pressure:	1900 PSIG	**MFG Facility:**	- Shreveport - LA
COA #	CC712952.20210412-0	**Lot Number:**	CC712952.20210412
Customer PO. NO.:		**Tracking Number:**	097024578
Customer:		**Previous Certification Dates:**	

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

Do Not Use This Cylinder Below 100 psig (0.7 Megapascal).

Certified Concentration(s)

Component	Concentration	Uncertainty	Analytical Principle	Assayed On
Carbon Dioxide	**8.95 %**	±0.08 %	NDIR	04/16/2021
Oxygen	**11.99 %**	±0.03 %	MPA	04/16/2021
Nitrogen	Balance			

Analytical Measurement Data Available Online.

Reference Standard(s)

Serial Number	Lot	Expiration	Type	Balance	Component	Concentration	Uncertainty(%)	NIST Reference
FF61011	71-F-34	02/27/2026	SRM	N2	O2	20.753 %	0.101	SRM 2659a
EB0007615	EB0007615.20190610	11/24/2027	GMIS	N2	CO2	24.71 %	0.274	C1579010.02
EB0059422	EB0059422.20191017	01/07/2028	GMIS	N2	O2	12.02 %	0.139	SRM 2659a
EB0087520	EB0087520.20191025	03/08/2029	GMIS	N2	CO2	9.48 %	0.331	C1847810.03

Analytical Instrumentation

Component	Principle	Make	Model	Serial	MPC Date
CO2	NDIR	Thermo	410i	1162980025	04/09/2021
O2	MPA	Thermo	410i	1162980025	04/08/2021

SMART-CERT

This is to certify the gases referenced have been calibrated/tested, and verified to meet the defined specifications. This calibration/test was performed using Gases or Scales that are traceable through National Institute of Standards and Technology (NIST) to the International System of Units (SI). The basis of compliance stated is a comparison of the measurement parameters to the specified or required calibration/testing process. The expanded uncertainties use a coverage factor of k=2 to approximate the 95% confidence level of the measurement, unless otherwise noted. This calibration certificate applies only to the item described and shall not be reproduced other than in full, without written approval from Red Ball Technical Gas Services. If not included, the uncertainty of calibrations are available upon request and were taken into account when determining pass or fail.

Amisha Jewitt
Analytical Chemist
Assay Laboratory: Red Ball TGS
Version 02-J, Revised on 2018-09-17

Assay Laboratory: Red Ball TGS
555 Craig Kennedy Way
Shreveport, LA 71107
800-551-8150

EPA PROTOCOL GAS CERTIFICATE OF ANALYSIS

Cylinder Number:	EB0034654	**Certification Date**:	03/10/2014
Product ID Number:	125021	**Expiration Date:**	03/08/2022
Cylinder Pressure:	1900 PSIG	**MFG Facility:**	RBTGS-Shreveport-LA
COA #	EB0034654.20140306-0	**Lot Number:**	EB0034654.20140306
Customer PO. NO.:		**Tracking Number:**	056563667
Customer:		**Previous Certification Dates:**	

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

Do Not Use This Cylinder Below 100 psig (0.7 Megapascal).

Certified Concentration(s)

Component	Concentration	Uncertainty	Analytical Principle
Propane	**802 PPM**	±2 PPM	FTIR
Nitrogen	Balance		

Analyitcal Measurement Data Available Online.

Reference Standard(s)

Lot	Expiration	Type	Balance	Component	Concentration	Uncertainty(%)	NIST Reference
GC1302210752	06/14/2021	GMIS	N2	C3H8	1003 PPM	0.587	2647a

Analytical Instrumentation

Component	Analytical Principle	Make	Model	Serial	MPC Date
C3H8	FTIR	MKS	MKS 2031DJG2EKVS13T	017146467	3/10/2014 10:30:00 AM

Red Ball Technical Gas Service
PGVP Vendor ID # G12014
Information and Ordering
800-551-8150
Fax (318-425-6309)

Fred Holt
Analyst

Assay Laboratory: Red Ball TGS
555 Craig Kennedy Way
Shreveport, LA 71107
800-551-8150

EPA PROTOCOL GAS CERTIFICATE OF ANALYSIS

Cylinder Number:	EB0093622	**Certification Date:**	05/16/2017
Product ID Number:	125267	**Expiration Date:**	05/14/2025
Cylinder Pressure:	1900 PSIG	**MFG Facility:**	RBTGS-Shreveport-LA
COA #	EB0093622.20170427-0	**Lot Number:**	EB0093622.20170427
Customer PO. NO.:		**Tracking Number:**	095483935
Customer:		**Previous Certification Dates:**	

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

Do Not Use This Cylinder Below 100 psig (0.7 Megapascal).

Certified Concentration(s)

Component	Concentration	Uncertainty	Analytical Principle	Assayed On
Propane	**456 PPM**	±1.5 PPM	FTIR	05/16/2017
Nitrogen	Balance			

Analytical Measurement Data Available Online.

Reference Standard(s)

Serial Number	Lot	Expiration	Type	Balance	Component	Concentration	Uncertainty(%)	NIST Reference
EB0031829	EB0031829.20160114g	05/17/2024	GMIS	N2	C3H8	2461 PPM	0.57	2647a

Analytical Instrumentation

Component	Analytical Principle	Make	Model	Serial	MPC Date
C3H8	FTIR	MKS	MKS 2031DJG2EKVS13T	017146467	05/16/2017

Red Ball Technical Gas Service
PGVP Vendor ID # G12017
Information and Ordering
800-551-8150
Fax (318-425-6309)

PJLA Calibration and Testing
Accreditation #62754

Brandon Theus
Analytical Chemist

This is to certify the gases referenced have been calibrated/tested, and verified to meet the defined specifications. This calibration/test was performed using Gases or Scales that are traceable through National Institute of Standards and Technology (NIST) to the International System of Units (SI). The basis of compliance stated is a comparison of the measurement parameters to the specified or required calibration/testing process. The expanded uncertainties use a coverage factor of k=2 to approximate the 95% confidence level of the measurement, unless otherwise noted. This calibration certificate applies only to the item described and shall not be reproduced other than in full, without written approval from Red Ball Technical Gas Services. If not included, the uncertainty of calibrations are available upon request and were taken into account when determining pass or fail.

Version 02-E, Revised on 2016-04-27

Assay Laboratory: Red Ball TGS
555 Craig Kennedy Way
Shreveport, LA 71107
800-551-8150

EPA PROTOCOL GAS CERTIFICATE OF ANALYSIS

Cylinder Number:	EB0032453	**Certification Date**:	03/10/2014
Product ID Number:	125020	**Expiration Date:**	03/08/2022
Cylinder Pressure:	1900 PSIG	**MFG Facility:**	RBTGS-Shreveport-LA
COA #	EB0032453.20140306-0	**Lot Number:**	EB0032453.20140306
Customer PO. NO.:		**Tracking Number:**	056560484
Customer:		**Previous Certification Dates:**	

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

Do Not Use This Cylinder Below 100 psig (0.7 Megapascal).

Certified Concentration(s)

Component	Concentration	Uncertainty	Analytical Principle
Propane	**302 PPM**	±2 PPM	FTIR
Nitrogen	Balance		

Analyitcal Measurement Data Available Online.

Reference Standard(s)

Lot	Expiration	Type	Balance	Component	Concentration	Uncertainty(%)	NIST Reference
GC1302210752	06/14/2021	GMIS	N2	C3H8	1003 PPM	0.587	2647a

Analytical Instrumentation

Component	Analytical Principle	Make	Model	Serial	MPC Date
C3H8	FTIR	MKS	MKS 2031DJG2EKVS13T	017146467	3/10/2014 10:30:00 AM

Red Ball Technical Gas Service
PGVP Vendor ID # G12014
Information and Ordering
800-551-8150
Fax (318-425-6309)

Fred Holt
Analyst

APPENDIX D

QUALITY ASSURANCE AND QUALITY CONTROL DATA

QA/QC PROGRAM

AIR HYGIENE ensures the quality and validity of its emission measurement and reporting procedures through a rigorous quality assurance (QA) program. The program is developed and administered by an internal QA team and encompasses six major areas:

1. Field Qualifications
2. QA reviews of reports, laboratory work, and field testing;
3. Equipment calibration and maintenance;
4. Chain-of-custody;
5. Training; and
6. Knowledge of current test methods

Field Qualifications

Air Hygiene personnel are required to gain and maintain competence with testing methods and techniques according to their job titles and the roles they play during field testing events. Qualifications for each job description include:

Staff Technician - An entry level position with responsibility to test on the stack by performing duties that include: keep trucks and trailers stocked and clean, travel to and from job site, be the “hands of the test” on the stack; stay on a stack during the sample test, set up and tear down equipment on-site, perform maintenance on equipment in the shop and on-site.

Test Technician or Specialist - Acts as the “hands of the test” on the stack by performing duties that include: stay on a stack during the sample test, migrate to the testing trailer and learn the different analyzers and testing methods used on site, set up and tear down testing equipment on site, learn the system for testing from Testing Managers and Project Managers, travel to and from job site; including driving responsibilities under DOT requirements, follow directions of Testing Managers and Project Managers, learn the proper way to conduct on-site test of stationary stacks

Test Manager or Engineer - Directs and coordinates all aspects of a successful test by performing the following duties personally or through subordinate supervisors including: operating analyzers and consoles during testing along with QA/QC procedures, supervise set up and tear down of equipment on site, writing, reviewing, and revising final test reports, working with the client or state personnel while on the job site, managing pre-test checklists and onsite testing procedures, diagnose and repair any problems that may arise with the equipment, safely operate a man lift and drive a truck with or without a trailer, act as crew leader in the field, write protocols and reports, maintain project log of services performed on the job, verify all equipment needed for a job was loaded on the trailer. Test Managers must hold at least one QSTI certificate.

Project Manager - Directs and coordinates all aspects of a successful test by performing the following duties personally or through subordinate supervisors including: operating analyzers and consoles during testing along with QA/QC procedures, supervise set up and tear down of equipment on site, writing, reviewing, and revising final test reports, working with the client or state personnel while on the job site, managing pre-test checklists and onsite testing procedures, diagnose and repair any problems that may arise with the equipment, safely operate a man lift and drive a truck with or without a trailer, act as crew leader in the field, write protocols and reports, maintain project log of services performed on the job, verify all equipment needed for a job was loaded on the trailer. Project Managers typically hold QSTI certificates in Groups 1 through 4.

QA Reviews

Air Hygiene’s review procedure includes review of each source test report, along with laboratory and fieldwork, by the QA Team. The most important review is the one that takes place before a test program begins. The QA Team works closely with technical division personnel to prepare and review test protocols. Test protocol review includes selection of appropriate test procedures, evaluation of interferences or other restrictions that might preclude use of standard test procedures, and evaluation and/or development of alternate procedures.

Equipment Calibration and Maintenance

The equipment used to conduct the emission measurements is maintained according to the manufacturer’s instructions to ensure proper operation. In addition to the maintenance program, calibrations are carried out on each measurement device according to the schedule outlined by the Environmental Protection Agency. Quality control checks are also conducted in the field for each test program. In conformance with ASTM D7036 Section 15.3.15, all metering and monitoring equipment meets or exceeds the uncertainty criteria contained in the method language that pertains to that equipment.

Chain-of-Custody

Air Hygiene maintains full chain-of-custody documentation on all samples and data sheets. In addition to normal documentation of changes between field sample custodians, laboratory personnel, and field test personnel, Air Hygiene documents every individual who handles any test component in the field (e.g., probe wash, impinger loading and recovery, filter loading and recovery, etc.). Samples are stored in a locked area to which only Air Hygiene personnel have access. Field data sheets are secured at Air Hygiene's offices upon return from the field.

Training

Personnel's training is essential to ensure quality testing. Air Hygiene has formal and informal training programs, which include:

1. Attendance at EPA-sponsored training courses
2. Enrollment in EPA correspondence courses
3 A requirement for all technicians to read and understand Air Hygiene's QA manual
4. In-house training and QA meetings on a regular basis
5. Maintenance of training records

Knowledge of Current Test Methods

With the constant updating of standard test methods and the wide variety of emerging test procedures, it is essential that any qualified source tester keep abreast of new developments. Air Hygiene subscribes to services, which provide updates on EPA reference methods, rules, and regulations. Additionally, source test personnel regularly attend and present papers at testing and emission-related seminars and conferences. Air Hygiene personnel maintain membership in the Air and Waste Management Association and the American Industrial Hygiene Association.

Reproduction and Distribution Policy

Reproducing portions of this test report may omit critical or substantial documentation or be taken out of context and due care must be exercised in this regard. Furthermore, this test report and its associated data shall not be reproduced in full or in part without the written consent of the customer.

Data Provided by Client

Data provided by the Client is clearly identified in the report. Air Hygiene accepts data provided by the Client as accurate.

COMBUSTION TESTING QUALITY ASSURANCE ACTIVITIES

In conformance with ASTM D7036 Section 15.3.11 and 13, all testing was performed without any real or apparent errors, with the exception of those that would be listed in Section 2.0 of this report. In addition, all testing was conducted according to the approved testing protocol, test methods, Air Hygiene Quality Manual, or ASTM D7036, with the exception of specifics noted in Section 2.0 of this report. A number of quality assurance activities were undertaken before, during, and after this testing project. This section of the report combined with the documentation in Appendix C describes each of those activities.

Each instrument's response was checked and adjusted in the field prior to the collection of data via multi-point calibration. The instrument's linearity was checked by adjusting its zero and span responses to zero nitrogen and an upscale calibration gas in the range of the expected concentrations. The instrument response was then challenged with other calibration gases of known concentration and accepted as being linear if the response of the other calibration gases agreed within plus or minus two percent of the range of predicted values. NO_2 to NO conversion was checked via direct connect with an EPA Protocol certified concentration of NO_2 in a balance of air or nitrogen. Conversion was verified to be between 90 and 110 percent.

After each test run, the analyzers were checked for zero and span drift. This allowed each test run to be bracketed by calibrations and documents the precision of the data just collected. The criterion for acceptable data is that the instrument drift is no more than three percent of the full-scale response. The quality assurance worksheets in the following pages summarize all multipoint calibration checks and zero to span checks performed during the tests. These worksheets (as prepared from the data records of Appendix A) show that no drifts in excess of three percent occurred in the zero to span checks following each test run.

The sampling systems were leak checked by demonstrating that a vacuum greater than 10 in Hg could be held for at least one minute with a decline of less than one inch of Hg. A leak test was conducted after the sample system was set up and before the system was dismantled. This test was conducted to ensure that ambient air had not diluted the sample. Any leakage detected prior to the tests would be repaired and another leak check conducted before testing commenced. No leaks were found during the pre or post-test leak checks.

The absence of leaks in the sampling system was also verified by a sampling system bias check. The sampling system's integrity was tested by comparing the responses of the analyzers to the calibration gases introduced via two paths. The first path was directly into the analyzer and the second path via the sample system at the sample probe. Any difference in the instrument responses by these two methods was attributed to sampling system bias or leakage. The criterion for acceptance is agreement within five percent of the span of the analyzer.

The control gases used to calibrate the instruments were analyzed and certified by the compressed gas vendors to plus or minus one percent accuracy for all gases. EPA Protocol No. 1 was used, where applicable to assign the concentration values traceable to the National Institute of Standards and Technology (NIST), Standard Reference Materials (SRM's). The gas calibration sheets as prepared by the vendor are contained in Appendix C.

Air Hygiene collected and reported the enclosed test data in accordance with the procedures and quality assurance activities described in this test report. Air Hygiene makes no warranty as to the suitability of the test methods. Air Hygiene also assumes no liability relating to the interpretation and use of the test data.

INSTRUMENTAL ANALYSIS
QUALITY ASSURANCE DATA

Date: July 29-30, 2021
Company: Catalytic Combustion Corporation
Location: Houston, Texas
Techs: PM / CK / WN

Sample System Leak Check

Date	Sample System	Leak Rate (l/min)
July 29-30, 2021	1	0

catc-21-houston.tx-start#1-rpt

Accredited Laboratory

A2LA has accredited

AIR HYGIENE INTERNATIONAL, INC.

Broken Arrow, OK

for technical competence in the field of

Environmental Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the A2LA *R219 – Specific Requirements – TNI Field Sampling and Measurement Organization Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 18th day of December 2019

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3796.01
Valid to August 31, 2021

For the tests to which this accreditation applies, please refer to the laboratory's Envrionmental Scope of Accreditation.

STAC STACK TESTING ACCREDITATION COUNCIL

A2LA American Association for Laboratory Accreditation

Accredited Air Emission Testing Body

A2LA has accredited

AIR HYGIENE INTERNATIONAL, INC.

In recognition of the successful completion of the joint A2LA and Stack Testing Accreditation Council (STAC) evaluation process, this laboratory is accredited to perform testing activities in compliance with ASTM D7036:2004 - Standard Practice for Competence of Air Emission Testing Bodies.

Presented this 18th day of December 2019.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3796.02
Valid to August 31, 2021

This accreditation program is not included under the A2LA ILAC Mutual Recognition Arrangement.

Texas Commission on Environmental Quality

NELAP-Recognized Laboratory Accreditation is hereby awarded to

Air Hygiene International, Inc.

1600 West Tacoma
Broken Arrow, OK 74102-1483

in accordance with Texas Water Code Chapter 5, Subchapter R, Title 30 Texas Administrative Code Chapter 25, and the National Environmental Laboratory Accreditation Program.

The laboratory's scope of accreditation includes the fields of accreditation that accompany this certificate. Continued accreditation depends upon successful ongoing participation in the program. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current location(s) and accreditation status for particular methods and analyses (www.tceq.texas.gov/goto/lab). Accreditation does not imply that a product, process, system or person is approved by the Texas Commission on Environmental Quality.

Certificate Number: T104704523-21-9
Effective Date: 3/1/2021
Expiration Date: 2/28/2022

Executive Director Texas Commission on Environmental Quality

Texas Commission on Environmental Quality

NELAP-Recognized Laboratory Accreditation is hereby awarded to

Air Hygiene International, Inc. - Mobile Lab (OK 6782JZ)

1600 West Tacoma
Broken Arrow, OK 74102-1483

in accordance with Texas Water Code Chapter 5, Subchapter R, Title 30 Texas Administrative Code Chapter 25, and the National Environmental Laboratory Accreditation Program.

The laboratory's scope of accreditation includes the fields of accreditation that accompany this certificate. Continued accreditation depends upon successful ongoing participation in the program. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current location(s) and accreditation status for particular methods and analyses (www.tceq.texas.gov/goto/lab). Accreditation does not imply that a product, process, system or person is approved by the Texas Commission on Environmental Quality.

Certificate Number: 1M104704523-21-9
Effective Date: 3/1/2021
Expiration Date: 2/28/2022

Executive Director Texas Commission on Environmental Quality

SOURCE EVALUATION SOCIETY

Qualified Source Testing Individual

LET IT BE KNOWN THAT

PATRICK K. McGOVERN, Jr.

HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

MANUAL GAS VOLUME MEASUREMENTS AND ISOKINETIC PARTICULATE SAMPLING METHODS

ISSUED THIS 4TH DAY OF SEPTEMBER 2020 AND EFFECTIVE UNTIL SEPTEMBER 3RD, 2025

Peter R. Westlin, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

Tina Sanderson, QSTI/QSTO Review Board

J. Wade Bice, QSTI/QSTO Review Board

Karen D. Kajiya-Mills , QSTI/QSTO Review Board

Bruce Randall QSTI/QSTO Review Board

CERTIFICATE NO. 2008-133

SOURCE EVALUATION SOCIETY

Qualified Source Testing Individual

LET IT BE KNOWN THAT

PATRICK K. McGOVERN, Jr.

HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

GASEOUS POLLUTANTS INSTRUMENTAL SAMPLING METHODS

ISSUED THIS 10TH DAY OF NOVEMBER 2017 AND EFFECTIVE UNTIL NOVEMBER 9TH, 2022

Peter R. Westlin, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

Theresa Lowe, QSTI/QSTO Review Board

J. Wade Bice, QSTI/QSTO Review Board

Karen D. Kajiya-Mills , QSTI/QSTO Review Board

Bruce Randall QSTI/QSTO Review Board

CERTIFICATE NO. 2008-133

QUALITY ASSURANCE AND QUALITY CONTROL DATA

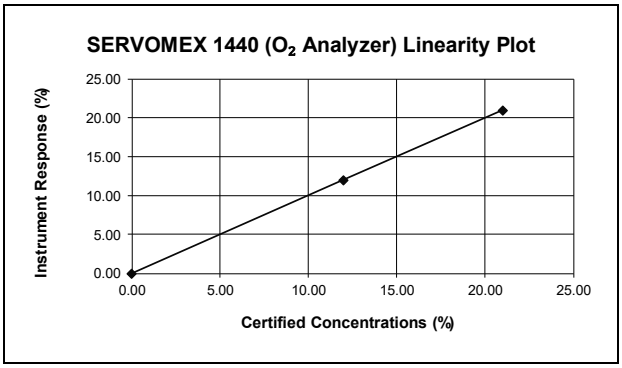
Reference Method Analyzer Daily Calibration Data

Calibration Date: July 29, 2021 **Location: Stewart & Stevenson Integration Center -**

Client: Catalytic Combustion Corporation

O_2 Span (%) = 21.00

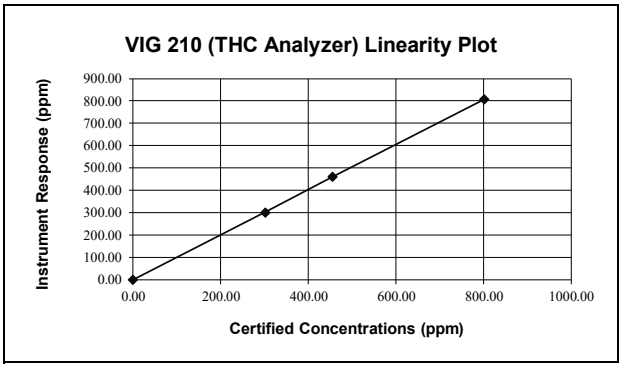
SERVOMEX 1440 (O_2 Analyzer)				
Certified Concentration (%)	**Instrument Response (%)**	**Calibration Error (%)**	**Absolute Conc. (%)**	**Pass (±2%, ≤0.5%)**
0.00	0.05	0.24	0.05	YES (%)
11.99	12.02	0.14	0.03	YES (%)
21.00	21.01	0.05	0.01	YES (%)
Linearity = 1.002				



THC (as C_3H_8) Range (ppm) = 1000

VIG 210 (THC Analyzer)				
Certified Concentration (ppm)	**Instrument Response (ppm)**	**Calibration Error (%)**	**Estimated Point (ppm)**	**Pass (±2,5%)[1]**
0.00	1.42	0.14	N/A	YES
302.00	304.24	-0.36	305.31	YES
456.00	461.70	0.31	460.28	YES
802.00	808.45	0.65	N/A	YES
Linearity = 0.993				

[1]-zero/high based on 2% of span, low/mid based on 5% of concentration

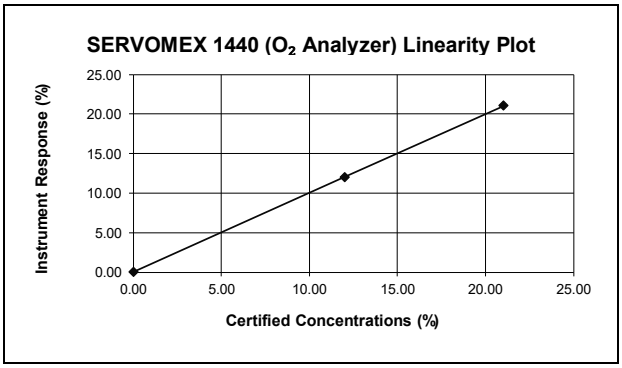


Calibration Date: July 30, 2021 **Location: Stewart & Stevenson Integration Center -**

Client: Catalytic Combustion Corporation

O_2 Span (%) = 21.00

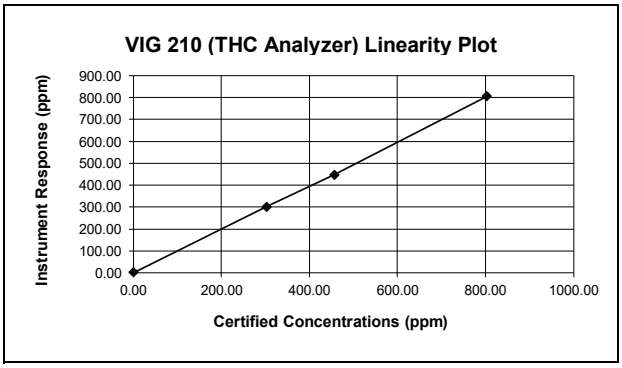
SERVOMEX 1440 (O_2 Analyzer)				
Certified Concentration (%)	**Instrument Response (%)**	**Calibration Error (%)**	**Absolute Conc. (%)**	**Pass (±2%, ≤0.5%)**
0.00	0.06	0.29	0.06	YES (%)
11.99	12.03	0.19	0.04	YES (%)
21.00	21.06	0.29	0.06	YES (%)
Linearity = 1.000				



THC (as C_3H_8) Range (ppm) = 1000

VIG 210 (THC Analyzer)				
Certified Concentration (ppm)	**Instrument Response (ppm)**	**Calibration Error (%)**	**Estimated Point (ppm)**	**Pass (±2,5%)[1]**
0.00	1.86	0.19	N/A	YES
302.00	301.28	-1.04	304.43	YES
456.00	446.31	-2.72	458.72	YES
802.00	805.37	0.34	N/A	YES
Linearity = 0.987				

[1]-zero/high based on 2% of span,low/mid based on 5% of concentration

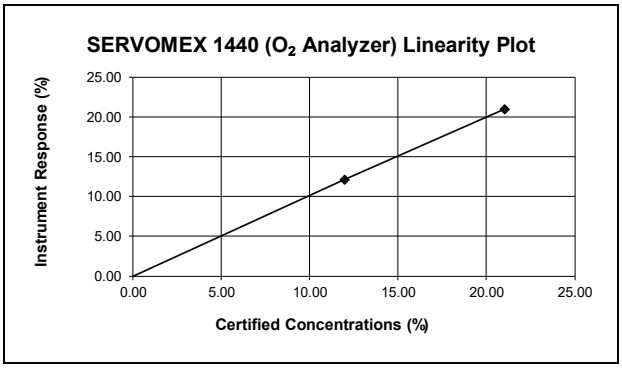


Calibration Date: September 1, 2021 **Location:** Stewart & Stevenson Integration Center

Client: Catalytic Combustion Corporation

O_2 Span (%) = 21.00

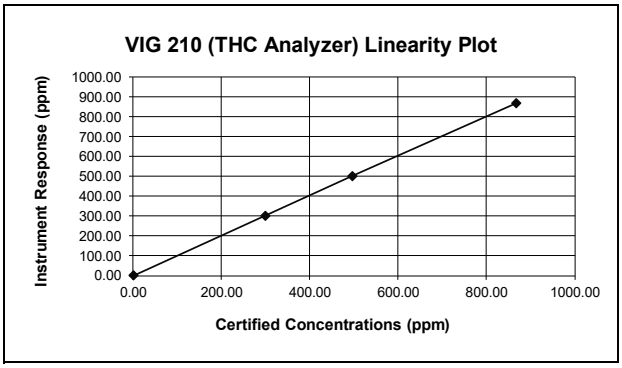
SERVOMEX 1440 (O_2 Analyzer)				
Certified Concentration (%)	Instrument Response (%)	Calibration Error (%)	Absolute Conc. (%)	Pass (±2%, ≤0.5%)
0.00	0.00	-0.01	0.00	YES (%)
11.96	12.09	0.62	0.13	YES (%)
21.00	20.97	-0.14	0.03	YES (%)
Linearity = 1.001				



THC (as C_3H_8) Range (ppm) = 1000

VIG 210 (THC Analyzer)				
Certified Concentration (ppm)	Instrument Response (ppm)	Calibration Error (%)	Estimated Point (ppm)	Pass (±2,5%)[1]
0.00	0.19	0.02	N/A	YES
299.00	300.99	0.50	299.51	YES
495.00	500.30	0.93	495.71	YES
867.00	868.10	0.11	N/A	YES
Linearity = 1.003				

[1]-zero/high based on 2% of span,low/mid based on 5% of concentration



DRIFT AND BIAS CHECK AND RESPONSE TIME CALCULATOR		
Strat Test Pre and Post QA/QC Check	**O_2**	**NOx**
Initial Zero	0.03	0.66
Final Zero	0.05	0.21
Avg. Zero	0.04	0.44
Initial UpScale	11.98	10.99
Final UpScale	11.97	10.97
Avg. UpScale	11.98	10.98
Sys Resp (Zero)	0.05	0.00
Sys Resp (Upscale)	12.02	11.00
Upscale Cal Gas	11.99	10.80
Initial Zero Bias	-0.10%	3.03%
Final Zero Bias	0.00%	0.96%
Zero Drift	0.10%	2.06%
Initial Upscale Bias	-0.19%	-0.05%
Final Upscale Bias	-0.24%	-0.14%
Upscale Drift	0.05%	0.09%
Alternative Specification Abs Diff **Initial Zero**	0.02	0.66
Final Zero	0.00	0.21
Initial Upscale	0.04	0.01
Final Upscale	0.05	0.03
Calibration Span	21.00	21.80
3% of Cal. Span (drift)	0.63	0.65
5% of Cal. Span (bias)	1.05	1.09

Response Time (min)	0.8	1.2
Sys. Response (min)	1.2	

Date/Time mm/dd/yy hh:mm:ss	z	O_2 %-10	s	z	NOx ppm-10	s	INJECTIONS
07/30/21 10:20:43		8.92			6.51		x
07/30/21 10:20:53		8.92			6.51		
07/30/21 10:21:03		8.91			6.56		
07/30/21 10:21:13		8.79			6.62		
07/30/21 10:21:23		10.25			6.73		
07/30/21 10:21:33		**11.72**	x		6.63		
07/30/21 10:21:43		**11.94**			3.53		
07/30/21 10:21:53		**11.96**		x	**0.70**		
07/30/21 10:22:03		**11.97**			**0.64**		
07/30/21 10:22:13		**11.97**			**0.56**		
07/30/21 10:22:23		**11.97**			**0.66**		
07/30/21 10:22:33		**11.98**			**0.77**		x
07/30/21 10:22:43		**11.98**			**0.52**		
07/30/21 10:22:53		**11.79**			**0.39**		
07/30/21 10:23:03		8.98			**0.88**		
07/30/21 10:23:13		2.37			1.65		
07/30/21 10:23:23	x	**0.38**			6.15		
07/30/21 10:23:33		**0.16**			10.27		
07/30/21 10:23:43		**0.04**			**10.59**	x	
07/30/21 10:23:53		**0.04**			**10.95**		
07/30/21 10:24:03		**0.03**			**10.95**		
07/30/21 10:24:13		**0.03**			**10.99**		

DRIFT AND BIAS CHECK		
50% Load, Run - 1-1	**O_2**	**THC (as C_3H_8)**
Raw Average	8.69	157.35
Corrected Average	8.67	183.85
Initial Zero	0.03	2.53
Final Zero	0.07	0.12
Avg. Zero	0.05	1.33
Initial UpScale	12.03	306.71
Final UpScale	11.98	307.25
Avg. UpScale	12.01	306.98
Sys Resp (Zero)	0.05	1.42
Sys Resp (Upscale)	12.02	304.24
Upscale Cal Gas	11.99	302.00
Initial Zero Bias	-0.10%	0.11%
Final Zero Bias	0.10%	-0.13%
Zero Drift	0.19%	0.24%
Initial Upscale Bias	0.05%	0.25%
Final Upscale Bias	-0.19%	0.30%
Upscale Drift	0.24%	0.05%
Alternative Specification Abs Diff **Initial Zero**	0.02	--
Alternative Specification Abs Diff **Final Zero**	0.02	--
Alternative Specification Abs Diff **Initial Upscale**	0.01	--
Alternative Specification Abs Diff **Final Upscale**	0.04	--
Calibration Span	21.00	1,000.00
3% of Cal. Span (drift)	0.63	30.00
5% of Cal. Span (bias)	1.05	50.00

DRIFT AND BIAS CHECK		
50% Load, Run - 1-2	**O_2**	**THC (as C_3H_8)**
Raw Average	8.75	163.11
Corrected Average	8.74	190.60
Initial Zero	0.07	0.12
Final Zero	0.08	0.21
Avg. Zero	0.08	0.17
Initial UpScale	11.98	307.25
Final UpScale	11.97	317.42
Avg. UpScale	11.98	312.34
Sys Resp (Zero)	0.05	1.42
Sys Resp (Upscale)	12.02	304.24
Upscale Cal Gas	11.99	302.00
Initial Zero Bias	0.10%	-0.13%
Final Zero Bias	0.14%	-0.12%
Zero Drift	0.05%	0.01%
Initial Upscale Bias	-0.19%	0.30%
Final Upscale Bias	-0.24%	1.32%
Upscale Drift	0.05%	1.02%
Alternative Specification Abs Diff **Initial Zero**	0.02	--
Alternative Specification Abs Diff **Final Zero**	0.03	--
Alternative Specification Abs Diff **Initial Upscale**	0.04	--
Alternative Specification Abs Diff **Final Upscale**	0.05	--
Calibration Span	21.00	1,000.00
3% of Cal. Span (drift)	0.63	30.00
5% of Cal. Span (bias)	1.05	50.00

DRIFT AND BIAS CHECK		
50% Load, Run - 1-3	O_2	THC (as C_3H_8)
Raw Average	8.80	168.64
Corrected Average	8.79	197.00
Initial Zero	0.08	0.21
Final Zero	0.09	0.17
Avg. Zero	0.09	0.19
Initial UpScale	11.97	317.42
Final UpScale	11.98	314.03
Avg. UpScale	11.98	315.73
Sys Resp (Zero)	0.05	1.42
Sys Resp (Upscale)	12.02	304.24
Upscale Cal Gas	11.99	302.00
Initial Zero Bias	0.14%	-0.12%
Final Zero Bias	0.19%	-0.13%
Zero Drift	0.05%	0.00%
Initial Upscale Bias	-0.24%	1.32%
Final Upscale Bias	-0.19%	0.98%
Upscale Drift	0.05%	0.34%
Alternative Specification Abs Diff: Initial Zero	0.03	--
Alternative Specification Abs Diff: Final Zero	0.04	--
Alternative Specification Abs Diff: Initial Upscale	0.05	--
Alternative Specification Abs Diff: Final Upscale	0.04	--
Calibration Span	21.00	1,000.00
3% of Cal. Span (drift)	0.63	30.00
5% of Cal. Span (bias)	1.05	50.00

DRIFT AND BIAS CHECK		
75% Load, Run - 2-1	O_2	THC (as C_3H_8)
Raw Average	8.97	151.87
Corrected Average	8.95	176.40
Initial Zero	0.07	0.13
Final Zero	0.06	0.27
Avg. Zero	0.07	0.20
Initial UpScale	12.01	304.51
Final UpScale	11.97	310.21
Avg. UpScale	11.99	307.36
Sys Resp (Zero)	0.06	1.86
Sys Resp (Upscale)	12.03	301.28
Upscale Cal Gas	11.99	302.00
Initial Zero Bias	0.05%	-0.17%
Final Zero Bias	0.00%	-0.16%
Zero Drift	0.05%	0.01%
Initial Upscale Bias	-0.10%	0.32%
Final Upscale Bias	-0.29%	0.89%
Upscale Drift	0.19%	0.57%
Alternative Specification Abs Diff: Initial Zero	0.01	--
Alternative Specification Abs Diff: Final Zero	0.00	--
Alternative Specification Abs Diff: Initial Upscale	0.02	--
Alternative Specification Abs Diff: Final Upscale	0.06	--
Calibration Span	21.00	1,000.00
3% of Cal. Span (drift)	0.63	30.00
5% of Cal. Span (bias)	1.05	50.00

DRIFT AND BIAS CHECK		
75% Load, Run - 2-2	O_2	THC (as C_3H_8)
Raw Average	8.95	169.71
Corrected Average	8.96	197.01
Initial Zero	0.06	0.27
Final Zero	0.04	0.44
Avg. Zero	0.05	0.36
Initial UpScale	11.97	310.21
Final UpScale	11.95	303.21
Avg. UpScale	11.96	306.71
Sys Resp (Zero)	0.06	1.86
Sys Resp (Upscale)	12.03	301.28
Upscale Cal Gas	11.99	302.00
Initial Zero Bias	0.00%	-0.16%
Final Zero Bias	-0.10%	-0.14%
Zero Drift	0.10%	0.02%
Initial Upscale Bias	-0.29%	0.89%
Final Upscale Bias	-0.38%	0.19%
Upscale Drift	0.10%	0.70%
Alternative Specification Abs Diff: Initial Zero	0.00	--
Alternative Specification Abs Diff: Final Zero	0.02	--
Alternative Specification Abs Diff: Initial Upscale	0.06	--
Alternative Specification Abs Diff: Final Upscale	0.08	--
Calibration Span	21.00	1,000.00
3% of Cal. Span (drift)	0.63	30.00
5% of Cal. Span (bias)	1.05	50.00

DRIFT AND BIAS CHECK		
75% Load, Run - 2-3	O_2	THC (as C_3H_8)
Raw Average	8.91	164.95
Corrected Average	8.94	190.89
Initial Zero	0.04	0.44
Final Zero	0.06	1.21
Avg. Zero	0.05	0.83
Initial UpScale	11.95	303.21
Final UpScale	11.94	312.59
Avg. UpScale	11.95	307.90
Sys Resp (Zero)	0.06	1.86
Sys Resp (Upscale)	12.03	301.28
Upscale Cal Gas	11.99	302.00
Initial Zero Bias	-0.10%	-0.14%
Final Zero Bias	0.00%	-0.07%
Zero Drift	0.10%	0.08%
Initial Upscale Bias	-0.38%	0.19%
Final Upscale Bias	-0.43%	1.13%
Upscale Drift	0.05%	0.94%
Alternative Specification Abs Diff: Initial Zero	0.02	--
Alternative Specification Abs Diff: Final Zero	0.00	--
Alternative Specification Abs Diff: Initial Upscale	0.08	--
Alternative Specification Abs Diff: Final Upscale	0.09	--
Calibration Span	21.00	1,000.00
3% of Cal. Span (drift)	0.63	30.00
5% of Cal. Span (bias)	1.05	50.00

DRIFT AND BIAS CHECK		
100% Load, Run - 3-1	O_2	THC (as C_3H_8)
Raw Average	8.60	99.12
Corrected Average	8.64	114.77
Initial Zero	0.01	0.19
Final Zero	0.02	0.20
Avg. Zero	0.02	0.20
Initial UpScale	11.85	300.98
Final UpScale	11.94	300.31
Avg. UpScale	11.90	300.65
Sys Resp (Zero)	0.00	0.19
Sys Resp (Upscale)	12.09	300.99
Upscale Cal Gas	11.96	299.00
Initial Zero Bias	0.08%	0.00%
Final Zero Bias	0.11%	0.00%
Zero Drift	0.03%	0.00%
Initial Upscale Bias	-1.14%	0.00%
Final Upscale Bias	-0.71%	-0.07%
Upscale Drift	0.43%	0.07%
Alternative Specification Abs Diff: Initial Zero	0.02	--
Alternative Specification Abs Diff: Final Zero	0.02	--
Alternative Specification Abs Diff: Initial Upscale	0.24	--
Alternative Specification Abs Diff: Final Upscale	0.15	--
Calibration Span	21.00	1,000.00
3% of Cal. Span (drift)	0.63	30.00
5% of Cal. Span (bias)	1.05	50.00

DRIFT AND BIAS CHECK		
100% Load, Run - 3-2	O_2	THC (as C_3H_8)
Raw Average	9.05	93.36
Corrected Average	9.06	107.19
Initial Zero	0.02	0.20
Final Zero	0.02	0.20
Avg. Zero	0.02	0.20
Initial UpScale	11.94	300.31
Final UpScale	11.95	300.00
Avg. UpScale	11.95	300.16
Sys Resp (Zero)	0.00	0.19
Sys Resp (Upscale)	12.09	300.99
Upscale Cal Gas	11.96	299.00
Initial Zero Bias	0.11%	0.00%
Final Zero Bias	0.11%	0.00%
Zero Drift	0.00%	0.00%
Initial Upscale Bias	-0.71%	-0.07%
Final Upscale Bias	-0.67%	-0.10%
Upscale Drift	0.05%	0.03%
Alternative Specification Abs Diff: Initial Zero	0.02	--
Alternative Specification Abs Diff: Final Zero	0.02	--
Alternative Specification Abs Diff: Initial Upscale	0.15	--
Alternative Specification Abs Diff: Final Upscale	0.14	--
Calibration Span	21.00	1,000.00
3% of Cal. Span (drift)	0.63	30.00
5% of Cal. Span (bias)	1.05	50.00

DRIFT AND BIAS CHECK		
100% Load, Run - 3-3	**O_2**	**THC (as C_3H_8)**
Raw Average	9.23	94.52
Corrected Average	9.25	108.68
Initial Zero	0.02	0.20
Final Zero	0.02	0.21
Avg. Zero	0.02	0.21
Initial UpScale	11.95	300.00
Final UpScale	11.90	299.31
Avg. UpScale	11.93	299.66
Sys Resp (Zero)	0.00	0.19
Sys Resp (Upscale)	12.09	300.99
Upscale Cal Gas	11.96	299.00
Initial Zero Bias	0.11%	0.00%
Final Zero Bias	0.11%	0.00%
Zero Drift	0.00%	0.00%
Initial Upscale Bias	-0.67%	-0.10%
Final Upscale Bias	-0.90%	-0.17%
Upscale Drift	0.24%	0.07%
Alternative Specification Abs Diff **Initial Zero**	0.02	--
Alternative Specification Abs Diff **Final Zero**	0.02	--
Alternative Specification Abs Diff **Initial Upscale**	0.14	--
Alternative Specification Abs Diff **Final Upscale**	0.19	--
Calibration Span	21.00	1,000.00
3% of Cal. Span (drift)	0.63	30.00
5% of Cal. Span (bias)	1.05	50.00

ENGINE TEST - FIELD DATA SHEET

Company:	Catalytic Combustion Corporation
Facility Name:	Stewart & Stevenson Intergration Center
Location (county & state):	Houston, Texas
Physical Address or GPS Coordinates:	10750 Telge Road Houston, Texas
Project Code:	catc-21-houston.tx-start#1
Date:	7/29/2021
Unit Make and Model:	
Unit Number:	
Serial Number:	
Data Recorded By:	CK
Tested With AHI Unit(s):	Truck(s): 173 Trailer(s): 217
LDEQ Warmup/Cal Req:	On (Day/Time): Cal (Day/Time):

RUN INFORMATION	Run #1	Run #2	Run #3
Time Start (hh:mm:ss)	9:34:23	12:05:23	14:27:23
Time Stop (hh:mm:ss)	10:33:53	13:04:53	15:22:53
Barometric Pressure (in. Hg)	29.9	29.9	29.84
Ambient Temperature (°F)	98	99	96
Relative Humidity (%)	53	49	49
Stack Temperature (°F)			
Fuel Usage (btu/hp*hr or SCFM)			
Rated Horsepower (hp)			
Rated Engine RPM			
Load % or BHP from panel	50%	50%	50%
Engine Speed RPM	1799	1799	1800
Air Manifold Pressure (psig or in. Hg)	25.2	25.4	25.3
Air Manifold Temperature (°F)	122	122	124
Kilowatts (KW)	1350	1352	1350
Amperes (A)	56	57	56
Engine Operating Hours			
Engine Timing (degrees)	23	23	23

CYLINDER SERIAL NUMBERS		O_2	VOC
	N2/Low	CC727745	EB0032453
	Mid	CC712952	EB0093622
	High	EB0059402	EB0034654
		NOx	CO
	N2/Low		
	Mid		
	High		

NO_2 CONVERSION	
NO_2 Gas (ppm)	
NO Reading (ppm)	
NOx Reading (ppm)	
Cylinder Num	
Time	

Probe Used:	Multi Point Rake Pre-Hung Shepherd's hook Ports where used

REPORT INFORMATION		
INSTRUMENT		SERIAL #
O_2		
NOX		
CO		
Dilutor		
VOC		
FTIR		

Customer Number:	
Regulated Entity Number:	
Permit ID:	

Stack Height	Stack Diameter

High Level Diluted Gas Validation Table		
Trial #	Diluter Output (18.0%)	Instrument Response (%)
1		
2		
3		

Mid Level Diluted Gas Validation Table		
Trial #	Diluter Output (11.0%)	Instrument Response (%)
1		
2		
3		

Mid Level Protocol Gas Validation Table		
Trial #	Certified Value (%)	Instrument Response (%)
1		
2		
3		

CALIBRATION	O_2		NOx		CO		VOC			
	Conc.	Actual	Conc.	Actual	Conc.	Actual	Conc.	Actual	Conc.	Actual
Zero Gas	0	.05					0	1.42		
Low Gas							302	304.28		
Mid Gas	12.0	12.02					456	461.70		
High Gas	21	21.01					802	804.45		

BIAS	O_2		NOx		CO		VOC			
	Zero	Mid	Zero	Mid	Zero	Mid	Zero	Mid	Zero	Mid
Initial/Run #1	.03	12.03					2.53	306.71		
Run #1/Run #2	.07	11.96					.12	307.25		
Run #2/Run #3	.08	11.97					.21	317.92		
Run #3/Run #4										
Run #4/Final										
Bias Gas Actual Conc.										

AIR HYGIENE

Signature:

Scanned with CamScanner

ENGINE TEST - FIELD DATA SHEET

Company:	Catalytic Combustion Corporation
Facility Name:	Stewart & Stevenson Intergration Center
Location (county & state):	Houston, Texas
Physical Address or GPS Coordinates:	10750 Telge Road Houston, Texas
Project Code:	catc-21-houston.tx-start#1
Date:	7/30/2021
Unit Make and Model:	
Unit Number:	
Serial Number:	
Data Recorded By:	CK
Tested With AHI Unit(s):	Truck(s): 173 Trailer(s): 217
LDEQ Warmup/Cal Req:	On (Day/Time): Cal (Day/Time):

RUN INFORMATION	Run #1	Run #2	Run #3
Time Start (hh:mm:ss)	13:45:23	15:00:23	16:27:23
Time Stop (hh:mm:ss)	14:44:53	15:59:53	17:26:53
Barometric Pressure (In. Hg)	29.89	29.87	29.85
Ambient Temperature (°F)	94	97	97
Relative Humidity (%)	53	47	42
Stack Temperature (°F)			
Fuel Usage (btu/hp*hr or SCFM)			
Rated Horsepower (hp)			
Rated Engine RPM			
Load % or BHP from panel	75	75	75
Engine Speed RPM	1800	1800	1800
Air Manifold Pressure (psig or In. Hg)	36.4	36.7	35.6
Air Manifold Temperature (°F)	131	131	129
Kilowatts (KW)	2007	2012	1951
Amperes (A)	89	90	87
Engine Operating Hours			
Engine Timing (degrees)	23	23	23

CYLINDER SERIAL NUMBERS		O_2	VOC	
	N2/Low	CC727745	EB0032453	
	Mid	CC712952	EB0093622	
	High	EB0059402	EB0034654	
		NOx	CO	
	N2/Low			
	Mid			
	High			

NO_2 CONVERSION	
NO_2 Gas (ppm)	
NO Reading (ppm)	
NOx Reading (ppm)	
Cylinder Num	
Time	

Stack Height	Stack Diameter

Probe Used:	Multi Point Rake Pre-Hung Shepherd's hook Ports where used

REPORT INFORMATION		
INSTRUMENT		SERIAL #
O_2		
NOX		
CO		
Dilutor		
VOC		
FTIR		

Customer Number:	
Regulated Entity Number:	
Permit ID:	

High Level Diluted Gas Validation Table		
Trial #	Diluter Output (18.0%)	Instrument Response (%)
1		
2		
3		

Mid Level Diluted Gas Validation Table		
Trial #	Diluter Output (11.0%)	Instrument Response (%)
1		
2		
3		

Mid Level Protocol Gas Validation Table		
Trial #	Certified Value (%)	Instrument Response (%)
1		
2		
3		

CALIBRATION	O_2		NOx		CO		VOC			
	Conc.	Actual	Conc.	Actual	Conc.	Actual	Conc.	Actual	Conc.	Actual
Zero Gas	0	.06					0	1.86		
Low Gas							302	301.29		
Mid Gas	12.0	12.03					456	446.31		
High Gas	21	21.06					802	805.37		

BIAS	O_2		NOx		CO		VOC			
	Zero	Mid	Zero	Mid	Zero	Mid	Zero	Mid	Zero	Mid
Initial/Run #1	.07	12.01					.13	304.51		
Run #1/Run #2	.06	11.97					.27	310.21		
Run #2/Run #3	.04	11.95					.44	307.2		
Run #3/Run #4										
Run #4/Final										
Bias Gas Actual Conc.										

AIR HYGIENE

Signature:

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QUALITY ASSURANCE AND QUALITY CONTROL DATA

Fourier Transform Infrared Analyzer Daily QA Data

Catalytic Combustion Corporation

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Caterpillar, G3520 TALE

Stewart & Stevenson Integration Center

Sampling System Leak Check	Flow (LPM)	Date (dd/mm/yy)	Time (hh:mm)
	≤0.2	07/29/21	6:00

FTIR No: 509/ INST-IR-0005
Make Model: MKS 2030

Analytical System Leak Checks — **Vacuum Leak Check**

Spectrum	Date (dd/mm/yy)	Time (hh:mm:ss)	Vacuum (atm)
0729-PRE_000015.LAB	07/29/21	6:11:04	0.99216
0729-PRE_000016.LAB	07/29/21	6:11:34	0.99222
0729-PRE_000017.LAB	07/29/21	6:12:04	0.99226
0729-PRE_000018.LAB	07/29/21	6:12:34	0.99232
0729-PRE_000019.LAB	07/29/21	6:13:04	0.99235
0729-PRE_000020.LAB	07/29/21	6:13:34	0.99241
0729-PRE_000021.LAB	07/29/21	6:14:04	0.99239
0729-PRE_000022.LAB	07/29/21	6:14:34	0.99237
0729-PRE_000023.LAB	07/29/21	6:15:04	0.99289

Pressure Elements	Vacuum (atm)
Average, P_s	0.99237
Maximum	0.99289
Minimum	0.99216
Difference, ΔP_v	0.00073

Time Elements	Results (min)
Signal Integration, t_{ss}	0.50
Test Duration, t_d	4.00

Analytical System Leak Checks — **Pressure Leak Check**

Spectrum	Date (dd/mm/yy)	Time (hh:mm:ss)	Pressure (atm)
0729-PRE_000002.LAB	07/29/21	6:04:33	1.10579
0729-PRE_000003.LAB	07/29/21	6:05:03	1.10579
0729-PRE_000004.LAB	07/29/21	6:05:33	1.10579
0729-PRE_000005.LAB	07/29/21	6:06:03	1.10579
0729-PRE_000006.LAB	07/29/21	6:06:33	1.10579
0729-PRE_000007.LAB	07/29/21	6:07:03	1.10579
0729-PRE_000008.LAB	07/29/21	6:07:33	1.10579
0729-PRE_000009.LAB	07/29/21	6:08:03	1.10579
0729-PRE_000010.LAB	07/29/21	6:08:33	1.10579
0729-PRE_000011.LAB	07/29/21	6:09:03	1.10579

Pressure Elements	Pressure (atm)
Average, P_s	1.10579
Maximum	1.10579
Minimum	1.10579
Difference, ΔP_p	0.00000

Station Pressure (in. Hg)	29.90

Time Elements	Results (min)
Signal Integration, t_{ss}	0.50
Test Duration, t_d	4.50

Parameter	Vacuum	Pressure	Max ΔP
Test Duration, t_d	4.00	4.50	4.00
Signal Integ., t_{ss}	0.50	0.50	0.50
Difference, ΔP	0.00073	0.00000	0.00073
Average, P_s	0.99237	1.10579	0.99237
Leak Volume, $\%V_L$	0.009	0.000	0.009
Pass, ≤4%	yes	yes	yes

$$\%V_L = \frac{100\%}{t_d} t_{ss} \frac{\Delta P_{max}}{P_S}$$

Method 320, Section 8.2.2.4, Equation 2
expanded to account for sample duration

Catalytic Combustion Corporation

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Stewart & Stevenson Integration Center

Protocol No. 1, CO_2 Cylinder Concentration:	8.95 %vd

Pre-Test Background **FTIR:** 509/ INST-IR-0005

Date (mm/dd/yy)	Time (hh:mm:ss)	Spectrum (File Name)	Cell Temp (°C)	Cell Press (atm)	CO_2	H_2O (%)
07/29/21	6:21:13	0729-PRE_000032BKG.LAB	191.3	0.99	0.0000	0.0000

Pre-Test Direct Zero

Date (mm/dd/yy)	Time (hh:mm:ss)	Spectrum (File Name)	Cell Temp (°C)	Cell Press (atm)	CO_2	H_2O (%)
07/29/21	6:18:04	0729-PRE_000029.LAB	191.3	0.99	0.0060	0.0092
07/29/21	6:18:35	0729-PRE_000030.LAB	191.3	0.99	-0.0087	0.0085
07/29/21	6:19:04	0729-PRE_000031.LAB	191.3	0.99	-0.0089	0.0019

Pre-Test Direct Calibration Transfer Spectra

Date (mm/dd/yy)	Time (hh:mm:ss)	Spectrum (File Name)	Cell Temp (°C)	Cell Press (atm)	CO_2	H_2O (%)
07/29/21	6:22:49	0729-PRE_000035.LAB	191.3	0.99	8.9948	0.0225
07/29/21	6:23:19	0729-PRE_000036.LAB	191.3	0.99	9.0258	0.0065
07/29/21	6:23:49	0729-PRE_000037.LAB	191.3	0.99	9.0322	-0.0002
07/29/21	6:24:19	0729-PRE_000038.LAB	191.3	0.99	9.0356	0.0066
07/29/21	6:24:49	0729-PRE_000039.LAB	191.3	0.99	9.0464	0.0034
Average			**191.3**	**0.99**	**9.0270**	**0.0078**

Post-Test Direct Calibration Transfer Spectra

Date (mm/dd/yy)	Time (hh:mm:ss)	Spectrum (File Name)	Cell Temp (°C)	Cell Press (atm)	CO_2	H_2O (%)
07/29/21	17:07:51	0729-R3_000460.LAB	191.4	0.99	9.1068	0.8887
07/29/21	17:08:21	0729-R3_000461.LAB	191.4	0.99	9.1768	0.2897
07/29/21	17:09:51	0729-R3_000464.LAB	191.4	0.99	9.2146	0.1001
07/29/21	17:10:21	0729-R3_000465.LAB	191.3	0.99	9.2266	0.1005
07/29/21	17:10:51	0729-R3_000466.LAB	191.4	0.99	9.2030	0.0946
Average			**191.4**	**0.99**	**9.1856**	**0.2947**

Post-Test Direct Zero

Date (mm/dd/yy)	Time (hh:mm:ss)	Spectrum (File Name)	Cell Temp (°C)	Cell Press (atm)	CO_2	H_2O (%)
07/29/21	17:45:10	0729-R3_000534.LAB	191.4	0.99	0.0618	-0.0234
07/29/21	17:45:40	0729-R3_000535.LAB	191.5	0.99	0.0086	-0.0113
07/29/21	17:46:10	0729-R3_000536.LAB	191.4	0.99	0.0130	-0.0153

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Post-Test Background							
Date	**Time**	**Spectrum**	**Cell Temp**	**Cell Press**	**CO_2**	**H_2O**	
(mm/dd/yy)	**(hh:mm:ss)**	**(File Name)**	**(°C)**	**(atm)**		**(%)**	
07/29/21	17:48:27	0729-R3_000537BKG.LAB	191.4	0.99	0.0000	0.0000	

CTS Results	Protocol No. 1 Concentration	FTIR CO_2 Average	Error (%)	Pass (≤5%)
Pre-Test Direct	8.95	9.03	0.86	YES
Post-Test Direct	8.95	9.19	2.63	YES

Pre / Post Comparison	FTIR CO_2 Maximum	FTIR CO_2 Pre/Post Mean	Error (%)	Pass (≤5%)
Pre-Test Direct	9.05	9.11	0.66	YES
Post-Test Direct	9.23		1.30	YES

Catalytic Combustion Corporation

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Stewart & Stevenson Integration Center

Certified, NH_3 Cylinder Concentration:	49 ppmvd

Pre-Test Background **FTIR:** 509/ INST-IR-0005

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	6:21:13	0729-PRE_000032BKG.LAB	191.3	0.99	0.0000	0.0000	0.0000

Pre-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	6:18:04	0729-PRE_000029.LAB	191.3	0.99	0.0060	0.0092	0.0729
07/29/21	6:18:35	0729-PRE_000030.LAB	191.3	0.99	-0.0087	0.0085	0.0730
07/29/21	6:19:04	0729-PRE_000031.LAB	191.3	0.99	-0.0089	0.0019	0.0763

Pre-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	7:26:34	0729-PRE_000163.LAB	191.3	0.99	0.0016	0.0092	46.2851
07/29/21	7:28:34	0729-PRE_000167.LAB	191.3	0.99	-0.0024	0.0120	47.2974
07/29/21	7:29:04	0729-PRE_000168.LAB	191.3	0.99	0.0013	0.0064	46.2767
07/29/21	7:29:34	0729-PRE_000169.LAB	191.3	0.99	0.0097	0.0036	47.1397
07/29/21	7:30:04	0729-PRE_000170.LAB	191.3	0.99	0.0069	0.0053	46.8958
Average			**191.3**	**0.99**	**0.0034**	**0.0073**	**46.7789**

Post-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	17:31:53	0729-R3_000508.LAB	191.4	0.99	0.0023	-0.0039	46.6088
07/29/21	17:32:24	0729-R3_000509.LAB	191.4	0.99	0.0178	0.0033	46.7044
07/29/21	17:32:54	0729-R3_000510.LAB	191.4	0.99	0.0233	-0.0043	46.6023
07/29/21	17:33:24	0729-R3_000511.LAB	191.4	0.99	0.0205	-0.0039	46.8212
07/29/21	17:33:54	0729-R3_000512.LAB	191.4	0.99	0.0073	0.0111	46.7872
Average			**191.4**	**0.99**	**0.0142**	**0.0005**	**46.7048**

Post-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	17:45:10	0729-R3_000534.LAB	191.4	0.99	0.0618	-0.0234	0.7380
07/29/21	17:45:40	0729-R3_000535.LAB	191.5	0.99	0.0086	-0.0113	0.7408
07/29/21	17:46:10	0729-R3_000536.LAB	191.4	0.99	0.0130	-0.0153	0.7300

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Post-Test Background							
Date	**Time**	**Spectrum**	**Cell Temp**	**Cell Press**	**CO_2**	**H_2O**	**NH_3**
(mm/dd/yy)	**(hh:mm:ss)**	**(File Name)**	**(°C)**	**(atm)**	**(ppmvw)**	**(%)**	**(ppmvw)**
07/29/21	17:48:27	0729-R3_000537BKG.LAB	191.4	0.99	0.0000	0.0000	0.0000

CTS Results	Certified Concentration	FTIR NH_3 Average	Error (%)	Pass (≤5%)
Pre-Test Direct	49.00	46.78	4.53	YES
Post-Test Direct	49.00	46.70	4.68	YES

Pre / Post Comparison	FTIR NH_3 Maximum	FTIR NH_3 Pre/Post Mean	Error (%)	Pass (≤5%)
Pre-Test Direct	47.30	46.74	1.17	YES
Post-Test Direct	46.82		0.17	YES

Catalytic Combustion Corporation

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Caterpillar, G3520 TALE

Stewart & Stevenson Integration Center

Certified, C_2H_6 Cylinder Concentration:	100 ppmvd

Pre-Test Background **FTIR:** 509/ INST-IR-0005

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	6:21:13	0729-PRE_000032BKG.LAB	191.3	0.99	0.0000	0.0000	0.0000

Pre-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	6:18:04	0729-PRE_000029.LAB	191.3	0.99	0.0060	0.0092	-0.0143
07/29/21	6:18:35	0729-PRE_000030.LAB	191.3	0.99	-0.0087	0.0085	-0.2806
07/29/21	6:19:04	0729-PRE_000031.LAB	191.3	0.99	-0.0089	0.0019	-0.1091

Pre-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	6:26:19	0729-PRE_000042.LAB	191.3	0.99	0.0046	0.0038	101.0654
07/29/21	6:26:49	0729-PRE_000043.LAB	191.3	0.99	0.0091	-0.0046	101.3680
07/29/21	6:27:19	0729-PRE_000044.LAB	191.3	0.99	-0.0013	0.0043	101.0983
07/29/21	6:27:50	0729-PRE_000045.LAB	191.3	0.99	0.0055	-0.0011	101.4527
07/29/21	6:28:20	0729-PRE_000046.LAB	191.3	0.99	0.0024	-0.0025	101.4251
Average			**191.3**	**0.99**	**0.0040**	**0.0000**	**101.2819**

Post-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	17:15:52	0729-R3_000476.LAB	191.4	0.99	0.0099	0.0079	99.9658
07/29/21	17:16:22	0729-R3_000477.LAB	191.4	0.99	0.0164	0.0016	99.3676
07/29/21	17:16:52	0729-R3_000478.LAB	191.4	0.99	0.0052	0.0063	99.9686
07/29/21	17:17:22	0729-R3_000479.LAB	191.4	0.99	0.0139	0.0039	99.3839
07/29/21	17:17:52	0729-R3_000480.LAB	191.4	0.99	0.0141	-0.0024	99.2374
Average			**191.4**	**0.99**	**0.0119**	**0.0035**	**99.5847**

Post-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	17:45:10	0729-R3_000534.LAB	191.4	0.99	0.0618	-0.0234	-0.4644
07/29/21	17:45:40	0729-R3_000535.LAB	191.5	0.99	0.0086	-0.0113	-0.3360
07/29/21	17:46:10	0729-R3_000536.LAB	191.4	0.99	0.0130	-0.0153	-0.7831

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Post-Test Background							
Date	**Time**	**Spectrum**	**Cell Temp**	**Cell Press**	**CO_2**	**H_2O**	**C_2H_6**
(mm/dd/yy)	**(hh:mm:ss)**	**(File Name)**	**(°C)**	**(atm)**	**(ppmvw)**	**(%)**	**(ppmvw)**
07/29/21	17:48:27	0729-R3_000537BKG.LAB	191.4	0.99	0.0000	0.0000	0.0000

CTS Results	Certified Concentration	FTIR C_2H_6 Average	Error (%)	Pass (≤5%)
Pre-Test Direct	100.00	101.28	1.28	YES
Post-Test Direct	100.00	99.58	0.42	YES

Pre / Post Comparison	FTIR C_2H_6 Maximum	FTIR C_2H_6 Pre/Post Mean	Error (%)	Pass (≤5%)
Pre-Test Direct	101.45	100.43	1.00	YES
Post-Test Direct	99.97		0.46	YES

Catalytic Combustion Corporation

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Caterpillar, G3520 TALE

Stewart & Stevenson Integration Center

Protocol No. 1, NOx Cylinder Concentration:	116.1 ppmvd

Pre-Test Background **FTIR:** 509/ INST-IR-0005

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	6:21:13	0729-PRE_000032BKG.LAB	191.3	0.99	0.0000	0.0000	0.0000

Pre-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	6:18:04	0729-PRE_000029.LAB	191.3	0.99	0.0060	0.0092	-0.1679
07/29/21	6:18:35	0729-PRE_000030.LAB	191.3	0.99	-0.0087	0.0085	-0.0946
07/29/21	6:19:04	0729-PRE_000031.LAB	191.3	0.99	-0.0089	0.0019	-0.1183

Pre-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	6:29:20	0729-PRE_000048.LAB	191.3	0.99	-0.0356	0.0132	118.4758
07/29/21	6:29:50	0729-PRE_000049.LAB	191.3	0.99	-0.0345	0.0001	118.2633
07/29/21	6:30:20	0729-PRE_000050.LAB	191.3	0.99	-0.0255	-0.0019	117.9127
07/29/21	6:30:50	0729-PRE_000051.LAB	191.3	0.99	-0.0344	0.0022	118.9113
07/29/21	6:31:20	0729-PRE_000052.LAB	191.3	0.99	-0.0412	0.0002	119.3122
Average			**191.3**	**0.99**	**-0.0342**	**0.0028**	**118.5751**

Post-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	17:12:22	0729-R3_000469.LAB	191.4	0.99	-0.0204	0.0499	120.3651
07/29/21	17:12:52	0729-R3_000470.LAB	191.4	0.99	-0.0230	0.0303	120.2399
07/29/21	17:13:22	0729-R3_000471.LAB	191.4	0.99	-0.0332	0.0140	120.4058
07/29/21	17:13:52	0729-R3_000472.LAB	191.4	0.99	-0.0284	0.0138	120.5176
07/29/21	17:14:22	0729-R3_000473.LAB	191.4	0.99	-0.0239	0.0099	120.2993
Average			**191.4**	**0.99**	**-0.0258**	**0.0236**	**120.3655**

Post-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	17:45:10	0729-R3_000534.LAB	191.4	0.99	0.0618	-0.0234	-0.7746
07/29/21	17:45:40	0729-R3_000535.LAB	191.5	0.99	0.0086	-0.0113	-0.2312
07/29/21	17:46:10	0729-R3_000536.LAB	191.4	0.99	0.0130	-0.0153	-0.1751

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Post-Test Background							
Date	**Time**	**Spectrum**	**Cell Temp**	**Cell Press**	**CO_2**	**H_2O**	**NOx**
(mm/dd/yy)	**(hh:mm:ss)**	**(File Name)**	**(°C)**	**(atm)**	**(ppmvw)**	**(%)**	**(ppmvw)**
07/29/21	17:48:27	0729-R3_000537BKG.LAB	191.4	0.99	0.0000	0.0000	0.0000

CTS Results	Protocol No. 1 Concentration	FTIR NOx Average	Error (%)	Pass (≤5%)
Pre-Test Direct	116.10	118.58	2.13	YES
Post-Test Direct	116.10	120.37	3.67	YES

Pre / Post Comparison	FTIR NOx Maximum	FTIR NOx Pre/Post Mean	Error (%)	Pass (≤5%)
Pre-Test Direct	119.31	119.47	0.13	YES
Post-Test Direct	120.52		0.87	YES

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Protocol No. 1, CO Cylinder Concentration:	122 ppmvd

Pre-Test Background **FTIR:** 509/ INST-IR-0005

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	6:21:13	0729-PRE_000032BKG.LAB	191.3	0.99	0.0000	0.0000	0.0000

Pre-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	6:18:04	0729-PRE_000029.LAB	191.3	0.99	0.0060	0.0092	-0.0233
07/29/21	6:18:35	0729-PRE_000030.LAB	191.3	0.99	-0.0087	0.0085	-0.0104
07/29/21	6:19:04	0729-PRE_000031.LAB	191.3	0.99	-0.0089	0.0019	0.0645

Pre-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	6:29:20	0729-PRE_000048.LAB	191.3	0.99	-0.0356	0.0132	121.3862
07/29/21	6:29:50	0729-PRE_000049.LAB	191.3	0.99	-0.0345	0.0001	120.7858
07/29/21	6:30:20	0729-PRE_000050.LAB	191.3	0.99	-0.0255	-0.0019	120.6875
07/29/21	6:30:50	0729-PRE_000051.LAB	191.3	0.99	-0.0344	0.0022	121.4610
07/29/21	6:31:20	0729-PRE_000052.LAB	191.3	0.99	-0.0412	0.0002	121.9527
Average			**191.3**	**0.99**	**-0.0342**	**0.0028**	**121.2546**

Post-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	17:12:22	0729-R3_000469.LAB	191.4	0.99	-0.0204	0.0499	122.9462
07/29/21	17:12:52	0729-R3_000470.LAB	191.4	0.99	-0.0230	0.0303	122.7267
07/29/21	17:13:22	0729-R3_000471.LAB	191.4	0.99	-0.0332	0.0140	123.2405
07/29/21	17:13:52	0729-R3_000472.LAB	191.4	0.99	-0.0284	0.0138	122.9788
07/29/21	17:14:22	0729-R3_000473.LAB	191.4	0.99	-0.0239	0.0099	122.6847
Average			**191.4**	**0.99**	**-0.0258**	**0.0236**	**122.9154**

Post-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	17:45:10	0729-R3_000534.LAB	191.4	0.99	0.0618	-0.0234	0.1207
07/29/21	17:45:40	0729-R3_000535.LAB	191.5	0.99	0.0086	-0.0113	0.2300
07/29/21	17:46:10	0729-R3_000536.LAB	191.4	0.99	0.0130	-0.0153	0.0047

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Post-Test Background							
Date	**Time**	**Spectrum**	**Cell Temp**	**Cell Press**	**CO_2**	**H_2O**	**CO**
(mm/dd/yy)	**(hh:mm:ss)**	**(File Name)**	**(°C)**	**(atm)**	**(ppmvw)**	**(%)**	**(ppmvw)**
07/29/21	17:48:27	0729-R3_000537BKG.LAB	191.4	0.99	0.0000	0.0000	0.0000

CTS Results	Protocol No. 1 Concentration	FTIR CO Average	Error (%)	Pass (≤5%)
Pre-Test Direct	122.00	121.25	0.61	YES
Post-Test Direct	122.00	122.92	0.75	YES

Pre / Post Comparison	FTIR CO Maximum	FTIR CO Pre/Post Mean	Error (%)	Pass (≤5%)
Pre-Test Direct	121.95	122.09	0.11	YES
Post-Test Direct	123.24		0.94	YES

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Certified, C_2H_4O Cylinder Concentration:	47.4 ppmvd

Pre-Test Background **FTIR:** 509/ INST-IR-0005

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	6:21:13	0729-PRE_000032BKG.LAB	191.3	0.99	0.0000	0.0000	0.0000

Pre-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	6:18:04	0729-PRE_000029.LAB	191.3	0.99	0.0060	0.0092	-0.3305
07/29/21	6:18:35	0729-PRE_000030.LAB	191.3	0.99	-0.0087	0.0085	-0.1519
07/29/21	6:19:04	0729-PRE_000031.LAB	191.3	0.99	-0.0089	0.0019	-0.4129

Pre-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	6:32:20	0729-PRE_000054.LAB	191.3	0.99	0.0102	-0.0025	46.1720
07/29/21	6:32:50	0729-PRE_000055.LAB	191.3	0.99	0.0016	-0.0038	47.2898
07/29/21	6:33:20	0729-PRE_000056.LAB	191.3	0.99	0.0070	-0.0048	47.6549
07/29/21	6:33:50	0729-PRE_000057.LAB	191.3	0.99	0.0126	-0.0068	47.3384
07/29/21	6:34:20	0729-PRE_000058.LAB	191.3	0.99	0.0030	-0.0075	47.8559
Average			**191.3**	**0.99**	**0.0069**	**-0.0051**	**47.2622**

Post-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	17:18:52	0729-R3_000482.LAB	191.4	0.99	0.0101	0.0408	49.2208
07/29/21	17:19:22	0729-R3_000483.LAB	191.4	0.99	0.0057	-0.0063	49.2790
07/29/21	17:19:52	0729-R3_000484.LAB	191.4	0.99	0.0063	-0.0058	48.3237
07/29/21	17:20:22	0729-R3_000485.LAB	191.4	0.99	0.0040	-0.0059	49.9271
07/29/21	17:20:52	0729-R3_000486.LAB	191.4	0.99	0.0152	-0.0042	49.7117
Average			**191.4**	**0.99**	**0.0083**	**0.0037**	**49.2925**

Post-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/29/21	17:45:10	0729-R3_000534.LAB	191.4	0.99	0.0618	-0.0234	0.6676
07/29/21	17:45:40	0729-R3_000535.LAB	191.5	0.99	0.0086	-0.0113	0.4959
07/29/21	17:46:10	0729-R3_000536.LAB	191.4	0.99	0.0130	-0.0153	0.3050

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Post-Test Background							
Date	**Time**	**Spectrum**	**Cell Temp**	**Cell Press**	**CO_2**	**H_2O**	**C_2H_4O**
(mm/dd/yy)	**(hh:mm:ss)**	**(File Name)**	**(°C)**	**(atm)**	**(ppmvw)**	**(%)**	**(ppmvw)**
07/29/21	17:48:27	0729-R3_000537BKG.LAB	191.4	0.99	0.0000	0.0000	0.0000

CTS Results	Certified Concentration	FTIR C_2H_4O Average	Error (%)	Pass (≤5%)
Pre-Test Direct	47.40	47.26	0.29	YES
Post-Test Direct	47.40	49.29	3.99	YES

Pre / Post Comparison	FTIR C_2H_4O Maximum	FTIR C_2H_4O Pre/Post Mean	Error (%)	Pass (≤5%)
Pre-Test Direct	47.86	48.28	0.88	YES
Post-Test Direct	49.93		3.30	YES

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Trial #1		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005		
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	7:26:34	0729-PRE_000163.LAB	191.3	0.99	0.0016	0.0092	11.0529	46.2851
07/29/21	7:28:34	0729-PRE_000167.LAB	191.3	0.99	-0.0024	0.0120	11.0578	47.2974
07/29/21	7:29:04	0729-PRE_000168.LAB	191.3	0.99	0.0013	0.0064	11.0505	46.2767
07/29/21	7:29:34	0729-PRE_000169.LAB	191.3	0.99	0.0097	0.0036	11.0187	47.1397
		Average	**191.3**	**0.99**	**0.0026**	**0.0078**	**11.0450**	**46.7497**

Trial #1		Pre-Spike - Native Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	13:27:28	0729-R3_000020.LAB	191.4	1.03	5.7788	13.7763	-0.0029	0.2584
07/29/21	13:27:58	0729-R3_000021.LAB	191.4	1.03	5.7773	13.8252	-0.0016	0.2776
07/29/21	13:28:28	0729-R3_000022.LAB	191.4	1.03	5.8095	13.3030	-0.0010	0.2552
07/29/21	13:28:59	0729-R3_000023.LAB	191.4	1.03	5.8209	13.3611	0.0007	0.2444
		Average	**191.4**	**1.03**	**5.7966**	**13.5664**	**-0.0012**	**0.2589**

Trial #1		Spiked Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	13:50:01	0729-R3_000065.LAB	191.4	1.02	5.2051	16.0779	0.7052	2.5695
07/29/21	13:50:31	0729-R3_000066.LAB	191.4	1.02	5.2154	16.1184	0.7046	2.2878
07/29/21	13:51:01	0729-R3_000067.LAB	191.4	1.02	5.1984	15.5626	0.6996	2.3897
07/29/21	13:51:31	0729-R3_000068.LAB	191.4	1.03	5.1159	17.0782	0.7039	2.0829
		Average	**191.4**	**1.03**	**5.1837**	**16.2093**	**0.7033**	**2.3325**

Trial #2		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005		
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	7:26:34	0729-PRE_000163.LAB	191.3	0.99	0.0016	0.0092	11.0529	46.2851
07/29/21	7:28:34	0729-PRE_000167.LAB	191.3	0.99	-0.0024	0.0120	11.0578	47.2974
07/29/21	7:29:04	0729-PRE_000168.LAB	191.3	0.99	0.0013	0.0064	11.0505	46.2767
07/29/21	7:29:34	0729-PRE_000169.LAB	191.3	0.99	0.0097	0.0036	11.0187	47.1397
		Average	**191.3**	**0.99**	**0.0026**	**0.0078**	**11.0450**	**46.7497**

Trial #2		Pre-Spike - Native Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	15:29:41	0729-R3_000264.LAB	191.4	1.03	6.0871	10.4932	0.0086	0.3996
07/29/21	15:30:11	0729-R3_000265.LAB	191.4	1.03	6.0964	10.4971	0.0088	0.4470
07/29/21	15:30:41	0729-R3_000266.LAB	191.4	1.03	6.0418	10.9671	0.0082	0.4291
07/29/21	15:31:11	0729-R3_000267.LAB	191.4	1.03	6.0821	10.6008	0.0035	0.4249
		Average	**191.4**	**1.03**	**6.0768**	**10.6396**	**0.0073**	**0.4251**

Trial #2		Spiked Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	15:36:42	0729-R3_000278.LAB	191.4	1.02	5.0614	16.8342	0.8971	3.3038
07/29/21	15:37:12	0729-R3_000279.LAB	191.4	1.02	5.2201	14.6879	0.8932	2.9650
07/29/21	15:37:42	0729-R3_000280.LAB	191.4	1.02	5.2446	14.2924	0.9011	2.9494
07/29/21	15:38:12	0729-R3_000281.LAB	191.4	1.03	5.3618	12.4385	0.9063	2.8430
		Average	**191.4**	**1.02**	**5.2220**	**14.5633**	**0.8995**	**3.0153**

Trial #3		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005		
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	7:26:34	0729-PRE_000163.LAB	191.3	0.99	0.0016	0.0092	11.0529	46.2851
07/29/21	7:28:34	0729-PRE_000167.LAB	191.3	0.99	-0.0024	0.0120	11.0578	47.2974
07/29/21	7:29:04	0729-PRE_000168.LAB	191.3	0.99	0.0013	0.0064	11.0505	46.2767
07/29/21	7:29:34	0729-PRE_000169.LAB	191.3	0.99	0.0097	0.0036	11.0187	47.1397
		Average	**191.3**	**0.99**	**0.0026**	**0.0078**	**11.0450**	**46.7497**

Trial #3		Pre-Spike - Native Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	15:53:14	0729-R3_000311.LAB	191.4	1.03	5.8236	13.9644	0.0020	0.7851
07/29/21	15:53:43	0729-R3_000312.LAB	191.4	1.03	5.8299	13.9946	0.0003	0.7793
07/29/21	15:54:14	0729-R3_000313.LAB	191.4	1.03	5.8400	13.9150	0.0015	0.7948
07/29/21	15:54:44	0729-R3_000314.LAB	191.4	1.03	5.8328	13.9310	-0.0022	0.7720
		Average	**191.4**	**1.03**	**5.8316**	**13.9513**	**0.0004**	**0.7828**

Trial #3		Spiked Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	16:08:15	0729-R3_000341.LAB	191.4	1.03	5.4136	13.4491	0.7531	3.9385
07/29/21	16:08:45	0729-R3_000342.LAB	191.4	1.03	5.4074	13.4088	0.7539	3.8026
07/29/21	16:09:15	0729-R3_000343.LAB	191.4	1.03	5.4029	13.3926	0.7544	3.7165
07/29/21	16:09:45	0729-R3_000344.LAB	191.4	1.03	5.4003	13.3926	0.7529	3.6759
		Average	**191.4**	**1.03**	**5.4061**	**13.4108**	**0.7536**	**3.7834**

Parameter	Units	Trial #1	Trial #2	Trial #3
Direct Verified Concentration of Sulfur Hexafluoride (SF_6)	(ppmvw)	11.04	11.04	11.04
Direct Verified Concentration of Ammonia (NH_3)	(ppmvw)	46.75	46.75	46.75
Stack (Native, Unspiked) CO_2 Concentration	(%vw)	5.797	6.077	5.832
Stack (Native, Unspiked) H_2O Concentration	(%)	13.566	10.640	13.951
Stack (Native, Unspiked) SF_6 Concentration	(ppmvw)	-0.001	0.007	0.000
Stack (Native, Unspiked) NH_3 Concentration	(ppmvw)	0.259	0.425	0.783
Stack + Spike CO_2 Concentration	(%vw)	5.184	5.222	5.406
Stack + Spike H_2O Concentration	(%)	16.209	14.563	13.411
Stack + Spike SF_6 Concentration	(ppmvw)	0.703	0.899	0.754
Stack + Spike NH_3 Concentration	(ppmvw)	2.332	3.015	3.783
Dilution Factor, calc. from SF_6 (ppmvw)		0.064	0.081	0.068
Dilution Factor, as the ratio of dir to spk	(ratio)	15.7 : 1	12.4 : 1	14.7 : 1
Expected Concentration of the SF_6 Spike+Native, CS	(ppmvw)	0.703	0.899	0.754
Expected Concentration of the NH_3 Spike+Native, CS	(ppmvw)	3.225	4.167	3.917
Method 320 Spiked / Expected SF_6	%	99.99	100.07	100.00
Method 320 Spiked / Expected NH_3	%	72.33	72.36	96.58
Method 320 Passing SF_6 (70-130%)		YES	YES	YES
Method 320 Passing NH_3 (70-130%)		YES	YES	YES

Catalytic Combustion Corporation

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Caterpillar, G3520 TALE

Stewart & Stevenson Integration Center

Trial #1		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	6:26:19	0729-PRE_000042.LAB	191.3	0.99	0.0046	0.0038	101.0654
07/29/21	6:26:49	0729-PRE_000043.LAB	191.3	0.99	0.0091	-0.0046	101.3680
07/29/21	6:27:19	0729-PRE_000044.LAB	191.3	0.99	-0.0013	0.0043	101.0983
07/29/21	6:27:50	0729-PRE_000045.LAB	191.3	0.99	0.0055	-0.0011	101.4527
		Average	**191.3**	**0.99**	**0.0045**	**0.0006**	**101.2461**

Trial #1		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	7:54:07	0729-PRE_000218.LAB	191.4	1.03	5.9875	11.5338	0.6056
07/29/21	7:54:37	0729-PRE_000219.LAB	191.4	1.03	5.9302	12.1485	0.4878
07/29/21	7:55:07	0729-PRE_000220.LAB	191.4	1.03	5.9536	11.8260	0.6502
07/29/21	7:55:37	0729-PRE_000221.LAB	191.4	1.03	5.7779	12.4808	0.5425
		Average	**191.4**	**1.03**	**5.9123**	**11.9973**	**0.5715**

Trial #1		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	7:57:37	0729-PRE_000225.LAB	191.4	1.03	5.4423	13.3304	6.8719
07/29/21	7:58:07	0729-PRE_000226.LAB	191.4	1.03	5.4336	13.4652	6.6892
07/29/21	7:58:37	0729-PRE_000227.LAB	191.3	1.03	5.4348	13.3763	6.6564
07/29/21	7:59:07	0729-PRE_000228.LAB	191.4	1.03	5.4500	13.4160	6.8767
		Average	**191.4**	**1.03**	**5.4402**	**13.3970**	**6.7735**

Trial #2		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	6:26:19	0729-PRE_000042.LAB	191.3	0.99	0.0046	0.0038	101.0654
07/29/21	6:26:49	0729-PRE_000043.LAB	191.3	0.99	0.0091	-0.0046	101.3680
07/29/21	6:27:19	0729-PRE_000044.LAB	191.3	0.99	-0.0013	0.0043	101.0983
07/29/21	6:27:50	0729-PRE_000045.LAB	191.3	0.99	0.0055	-0.0011	101.4527
		Average	**191.3**	**0.99**	**0.0045**	**0.0006**	**101.2461**

Trial #2		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	9:07:29	0729-R1_000016.LAB	191.4	1.03	5.6801	15.1958	0.4539
07/29/21	9:07:59	0729-R1_000017.LAB	191.4	1.03	5.7495	14.5253	0.4642
07/29/21	9:08:29	0729-R1_000018.LAB	191.4	1.03	5.7714	14.4530	0.6337
07/29/21	9:08:59	0729-R1_000019.LAB	191.4	1.03	5.7488	14.5817	0.6257
		Average	**191.4**	**1.03**	**5.7375**	**14.6889**	**0.5444**

Trial #2		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	9:11:29	0729-R1_000024.LAB	191.4	1.03	5.3331	13.9803	7.4505
07/29/21	9:11:59	0729-R1_000025.LAB	191.4	1.03	5.3881	13.5880	7.4152
07/29/21	9:12:29	0729-R1_000026.LAB	191.4	1.03	5.3839	13.3244	7.6570
07/29/21	9:12:59	0729-R1_000027.LAB	191.4	1.03	5.4045	12.8692	7.9010
		Average	**191.4**	**1.03**	**5.3774**	**13.4405**	**7.6059**

Trial #3		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	6:26:19	0729-PRE_000042.LAB	191.3	0.99	0.0046	0.0038	101.0654
07/29/21	6:26:49	0729-PRE_000043.LAB	191.3	0.99	0.0091	-0.0046	101.3680
07/29/21	6:27:19	0729-PRE_000044.LAB	191.3	0.99	-0.0013	0.0043	101.0983
07/29/21	6:27:50	0729-PRE_000045.LAB	191.3	0.99	0.0055	-0.0011	101.4527
		Average	**191.3**	**0.99**	**0.0045**	**0.0006**	**101.2461**

Trial #3		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	9:14:30	0729-R1_000030.LAB	191.4	1.03	5.8943	12.9276	0.5478
07/29/21	9:15:00	0729-R1_000031.LAB	191.4	1.03	5.8058	13.9653	0.5314
07/29/21	9:15:30	0729-R1_000032.LAB	191.4	1.03	5.7807	14.0679	0.6174
07/29/21	9:16:00	0729-R1_000033.LAB	191.4	1.02	5.5559	16.7870	0.5112
		Average	**191.4**	**1.03**	**5.7592**	**14.4370**	**0.5519**

Trial #3		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	9:17:30	0729-R1_000036.LAB	191.4	1.03	5.3371	13.5885	7.9238
07/29/21	9:18:00	0729-R1_000037.LAB	191.4	1.03	5.4023	12.9546	8.1480
07/29/21	9:18:30	0729-R1_000038.LAB	191.4	1.03	5.3772	13.1870	8.0203
07/29/21	9:19:00	0729-R1_000039.LAB	191.4	1.03	5.4150	12.7563	8.1687
		Average	**191.4**	**1.03**	**5.3829**	**13.1216**	**8.0652**

Parameter	Units	Trial #1	Trial #2	Trial #3
Direct Verified Concentration of Ethane (C_2H_6)	(ppmvw)	101.25	101.25	101.25
Stack (Native, Unspiked) CO_2 Concentration	(%vw)	5.912	5.737	5.759
Stack (Native, Unspiked) H_2O Concentration	(%)	11.997	14.689	14.437
Stack (Native, Unspiked) C_2H_6 Concentration	(ppmvw)	0.572	0.544	0.552
Stack + Spike CO_2 Concentration	(%vw)	5.440	5.377	5.383
Stack + Spike H_2O Concentration	(%)	13.397	13.440	13.122
Stack + Spike C_2H_6 Concentration	(ppmvw)	6.774	7.606	8.065
Dilution Factor, calc. from CO_2 (%vw)		0.080	0.063	0.065
Dilution Factor, as the ratio of dir to spk	(ratio)	12.5 : 1	15.9 : 1	15.3 : 1
Expected Concentration of the C_2H_6 Spike+Native, CS	(ppmvw)	8.611	6.864	7.131
Method 320 Spiked / Expected C_2H_6	%	78.66	110.81	113.10
Method 320 Passing C_2H_6 (70-130%)		YES	YES	YES

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Trial #1		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	6:29:20	0729-PRE_000048.LAB	191.3	0.99	-0.0356	0.0132	118.4758
07/29/21	6:29:50	0729-PRE_000049.LAB	191.3	0.99	-0.0345	0.0001	118.2633
07/29/21	6:30:20	0729-PRE_000050.LAB	191.3	0.99	-0.0255	-0.0019	117.9127
07/29/21	6:30:50	0729-PRE_000051.LAB	191.3	0.99	-0.0344	0.0022	118.9113
		Average	**191.3**	**0.99**	**-0.0325**	**0.0034**	**118.3908**

Trial #1		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	8:03:08	0729-PRE_000236.LAB	191.3	1.03	5.3847	13.9361	18.9449
07/29/21	8:03:38	0729-PRE_000237.LAB	191.3	1.03	5.5921	14.3319	19.4786
07/29/21	8:04:08	0729-PRE_000238.LAB	191.4	1.03	5.7245	14.8875	19.1555
07/29/21	8:04:38	0729-PRE_000239.LAB	191.4	1.02	5.4752	18.0467	19.5173
		Average	**191.3**	**1.02**	**5.5441**	**15.3006**	**19.2741**

Trial #1		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	8:09:08	0729-PRE_000248.LAB	191.2	1.03	5.1639	14.2613	28.2136
07/29/21	8:09:38	0729-PRE_000249.LAB	191.1	1.03	5.2596	13.4329	29.8942
07/29/21	8:10:08	0729-PRE_000250.LAB	191.1	1.03	5.2123	13.9439	29.3501
07/29/21	8:10:39	0729-PRE_000251.LAB	191.2	1.03	5.2120	13.9711	28.4101
		Average	**191.2**	**1.03**	**5.2119**	**13.9023**	**28.9670**

Trial #2		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	6:29:20	0729-PRE_000048.LAB	191.3	0.99	-0.0356	0.0132	118.4758
07/29/21	6:29:50	0729-PRE_000049.LAB	191.3	0.99	-0.0345	0.0001	118.2633
07/29/21	6:30:20	0729-PRE_000050.LAB	191.3	0.99	-0.0255	-0.0019	117.9127
07/29/21	6:30:50	0729-PRE_000051.LAB	191.3	0.99	-0.0344	0.0022	118.9113
		Average	**191.3**	**0.99**	**-0.0325**	**0.0034**	**118.3908**

Trial #2		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	10:41:16	0729-R1_000203.LAB	191.4	1.04	6.0667	9.8749	6.6883
07/29/21	10:41:46	0729-R1_000204.LAB	191.4	1.04	6.0394	10.4201	7.0146
07/29/21	10:42:17	0729-R1_000205.LAB	191.4	1.04	6.0349	10.5369	7.0232
07/29/21	10:42:47	0729-R1_000206.LAB	191.4	1.04	5.9472	10.1020	7.0688
		Average	**191.4**	**1.04**	**6.0221**	**10.2335**	**6.9487**

Trial #2		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	10:44:16	0729-R1_000209.LAB	191.4	1.04	5.5818	9.2504	15.0471
07/29/21	10:44:47	0729-R1_000210.LAB	191.4	1.03	5.3310	12.2215	14.6741
07/29/21	10:45:17	0729-R1_000211.LAB	191.4	1.03	5.2587	13.6691	14.9002
07/29/21	10:45:47	0729-R1_000212.LAB	191.4	1.03	5.2719	13.6722	15.1687
		Average	**191.4**	**1.03**	**5.3609**	**12.2033**	**14.9475**

Trial #3		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	6:29:20	0729-PRE_000048.LAB	191.3	0.99	-0.0356	0.0132	118.4758
07/29/21	6:29:50	0729-PRE_000049.LAB	191.3	0.99	-0.0345	0.0001	118.2633
07/29/21	6:30:20	0729-PRE_000050.LAB	191.3	0.99	-0.0255	-0.0019	117.9127
07/29/21	6:30:50	0729-PRE_000051.LAB	191.3	0.99	-0.0344	0.0022	118.9113
		Average	**191.3**	**0.99**	**-0.0325**	**0.0034**	**118.3908**

Trial #3		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	10:46:47	0729-R1_000214.LAB	191.4	1.03	5.6735	14.9820	6.0733
07/29/21	10:47:17	0729-R1_000215.LAB	191.4	1.02	5.4686	17.7606	5.7500
07/29/21	10:47:47	0729-R1_000216.LAB	191.4	1.02	5.5923	16.5758	6.2012
07/29/21	10:48:17	0729-R1_000217.LAB	191.4	1.03	5.6718	15.1855	5.8747
		Average	**191.4**	**1.03**	**5.6015**	**16.1260**	**5.9748**

Trial #3		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	10:51:47	0729-R1_000224.LAB	191.4	1.03	5.1912	14.5061	14.5892
07/29/21	10:52:17	0729-R1_000225.LAB	191.4	1.03	5.1831	14.6822	14.4297
07/29/21	10:52:47	0729-R1_000226.LAB	191.4	1.03	5.1944	14.6065	14.5221
07/29/21	10:53:17	0729-R1_000227.LAB	191.3	1.03	5.2487	13.9940	14.6695
		Average	**191.4**	**1.03**	**5.2044**	**14.4472**	**14.5526**

Parameter	Units	Trial #1	Trial #2	Trial #3
Direct Verified Concentration of Nitrogen Oxides (NOx)	(ppmvw)	118.39	118.39	118.39
Stack (Native, Unspiked) CO_2 Concentration	(%vw)	5.544	6.022	5.602
Stack (Native, Unspiked) H_2O Concentration	(%)	15.301	10.233	16.126
Stack (Native, Unspiked) NOx Concentration	(ppmvw)	19.274	6.949	5.975
Stack + Spike CO_2 Concentration	(%vw)	5.212	5.361	5.204
Stack + Spike H_2O Concentration	(%)	13.902	12.203	14.447
Stack + Spike NOx Concentration	(ppmvw)	28.967	14.948	14.553
Dilution Factor, calc. from CO_2 (%vw)		0.060	0.110	0.071
Dilution Factor, as the ratio of dir to spk	(ratio)	16.7 : 1	9.1 : 1	14.1 : 1
Expected Concentration of the NOx Spike+Native, CS	(ppmvw)	25.213	19.185	13.946
Method 320 Spiked / Expected NOx	%	114.89	77.91	104.35
Method 320 Passing NOx (70-130%)		YES	YES	YES

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Trial #1		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	6:29:20	0729-PRE_000048.LAB	191.3	0.99	-0.0356	0.0132	121.3862
07/29/21	6:29:50	0729-PRE_000049.LAB	191.3	0.99	-0.0345	0.0001	120.7858
07/29/21	6:30:20	0729-PRE_000050.LAB	191.3	0.99	-0.0255	-0.0019	120.6875
07/29/21	6:30:50	0729-PRE_000051.LAB	191.3	0.99	-0.0344	0.0022	121.4610
		Average	**191.3**	**0.99**	**-0.0325**	**0.0034**	**121.0801**

Trial #1		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	8:03:08	0729-PRE_000236.LAB	191.3	1.03	5.3847	13.9361	3.9106
07/29/21	8:03:38	0729-PRE_000237.LAB	191.3	1.03	5.5921	14.3319	4.0740
07/29/21	8:04:08	0729-PRE_000238.LAB	191.4	1.03	5.7245	14.8875	4.3006
07/29/21	8:04:38	0729-PRE_000239.LAB	191.4	1.02	5.4752	18.0467	4.1830
		Average	**191.3**	**1.02**	**5.5441**	**15.3006**	**4.1170**

Trial #1		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	8:08:38	0729-PRE_000247.LAB	191.3	1.03	5.1809	14.2651	14.3805
07/29/21	8:09:08	0729-PRE_000248.LAB	191.2	1.03	5.1639	14.2613	14.4930
07/29/21	8:09:38	0729-PRE_000249.LAB	191.1	1.03	5.2596	13.4329	14.6522
07/29/21	8:10:08	0729-PRE_000250.LAB	191.1	1.03	5.2123	13.9439	14.5963
		Average	**191.2**	**1.03**	**5.2042**	**13.9758**	**14.5305**

Trial #2		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	6:29:20	0729-PRE_000048.LAB	191.3	0.99	-0.0356	0.0132	121.3862
07/29/21	6:29:50	0729-PRE_000049.LAB	191.3	0.99	-0.0345	0.0001	120.7858
07/29/21	6:30:20	0729-PRE_000050.LAB	191.3	0.99	-0.0255	-0.0019	120.6875
07/29/21	6:30:50	0729-PRE_000051.LAB	191.3	0.99	-0.0344	0.0022	121.4610
		Average	**191.3**	**0.99**	**-0.0325**	**0.0034**	**121.0801**

Trial #2		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	10:41:46	0729-R1_000204.LAB	191.4	1.04	6.0394	10.4201	5.1958
07/29/21	10:42:17	0729-R1_000205.LAB	191.4	1.04	6.0349	10.5369	5.1412
07/29/21	10:42:47	0729-R1_000206.LAB	191.4	1.04	5.9472	10.1020	5.0784
07/29/21	10:43:17	0729-R1_000207.LAB	191.4	1.04	5.5778	9.5137	4.7623
		Average	**191.4**	**1.04**	**5.8998**	**10.1432**	**5.0444**

Trial #2		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	10:44:16	0729-R1_000209.LAB	191.4	1.04	5.5818	9.2504	13.6473
07/29/21	10:44:47	0729-R1_000210.LAB	191.4	1.03	5.3310	12.2215	14.0312
07/29/21	10:45:17	0729-R1_000211.LAB	191.4	1.03	5.2587	13.6691	13.9973
07/29/21	10:45:47	0729-R1_000212.LAB	191.4	1.03	5.2719	13.6722	14.0508
		Average	**191.4**	**1.03**	**5.3609**	**12.2033**	**13.9317**

Trial #3		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	6:29:20	0729-PRE_000048.LAB	191.3	0.99	-0.0356	0.0132	121.3862
07/29/21	6:29:50	0729-PRE_000049.LAB	191.3	0.99	-0.0345	0.0001	120.7858
07/29/21	6:30:20	0729-PRE_000050.LAB	191.3	0.99	-0.0255	-0.0019	120.6875
07/29/21	6:30:50	0729-PRE_000051.LAB	191.3	0.99	-0.0344	0.0022	121.4610
		Average	**191.3**	**0.99**	**-0.0325**	**0.0034**	**121.0801**

Trial #3		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	10:47:17	0729-R1_000215.LAB	191.4	1.02	5.4686	17.7606	4.9024
07/29/21	10:47:47	0729-R1_000216.LAB	191.4	1.02	5.5923	16.5758	4.8346
07/29/21	10:48:17	0729-R1_000217.LAB	191.4	1.03	5.6718	15.1855	5.0380
07/29/21	10:48:47	0729-R1_000218.LAB	191.4	1.03	5.7312	14.3712	5.0990
		Average	**191.4**	**1.03**	**5.6160**	**15.9733**	**4.9685**

Trial #3		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/29/21	10:50:17	0729-R1_000221.LAB	191.4	1.03	5.3414	12.8845	14.0327
07/29/21	10:50:47	0729-R1_000222.LAB	191.3	1.03	5.2080	14.3284	13.9683
07/29/21	10:51:17	0729-R1_000223.LAB	191.3	1.03	5.1211	15.2920	13.8946
07/29/21	10:51:47	0729-R1_000224.LAB	191.4	1.03	5.1912	14.5061	13.8609
		Average	**191.4**	**1.03**	**5.2154**	**14.2527**	**13.9391**

Parameter	Units	Trial #1	Trial #2	Trial #3
Direct Verified Concentration of Carbon Monoxide (CO)	(ppmvw)	121.08	121.08	121.08
Stack (Native, Unspiked) CO_2 Concentration	(%vw)	5.544	5.900	5.616
Stack (Native, Unspiked) H_2O Concentration	(%)	15.301	10.143	15.973
Stack (Native, Unspiked) CO Concentration	(ppmvw)	4.117	5.044	4.968
Stack + Spike CO_2 Concentration	(%vw)	5.204	5.361	5.215
Stack + Spike H_2O Concentration	(%)	13.976	12.203	14.253
Stack + Spike CO Concentration	(ppmvw)	14.530	13.932	13.939
Dilution Factor, calc. from CO_2 (%vw)		0.061	0.091	0.071
Dilution Factor, as the ratio of dir to spk	(ratio)	16.3 : 1	10.9 : 1	14 : 1
Expected Concentration of the CO Spike+Native, CS	(ppmvw)	11.289	15.645	13.250
Method 320 Spiked / Expected CO	%	128.71	89.05	105.20
Method 320 Passing CO (70-130%)		YES	YES	YES

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Trial #1		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005		
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	6:32:20	0729-PRE_000054.LAB	191.3	0.99	0.0102	-0.0025	5.6174	46.1720
07/29/21	6:32:50	0729-PRE_000055.LAB	191.3	0.99	0.0016	-0.0038	5.6081	47.2898
07/29/21	6:33:20	0729-PRE_000056.LAB	191.3	0.99	0.0070	-0.0048	5.6041	47.6549
07/29/21	6:33:50	0729-PRE_000057.LAB	191.3	0.99	0.0126	-0.0068	5.6117	47.3384
		Average	**191.3**	**0.99**	**0.0078**	**-0.0045**	**5.6103**	**47.1138**

Trial #1		Pre-Spike - Native Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	8:13:09	0729-PRE_000256.LAB	191.3	1.03	5.8412	13.6062	-0.0029	0.1604
07/29/21	8:13:39	0729-PRE_000257.LAB	191.4	1.03	5.7654	14.4985	-0.0054	0.4411
07/29/21	8:14:09	0729-PRE_000258.LAB	191.4	1.03	5.7930	14.2263	-0.0039	0.8452
07/29/21	8:14:39	0729-PRE_000259.LAB	191.4	1.03	5.4426	14.6566	-0.0013	0.3062
		Average	**191.4**	**1.03**	**5.7106**	**14.2469**	**-0.0034**	**0.4382**

Trial #1		Spiked Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	8:17:09	0729-PRE_000264.LAB	191.4	1.03	5.4266	12.7225	0.4138	3.7061
07/29/21	8:17:39	0729-PRE_000265.LAB	191.4	1.03	5.2023	15.0338	0.4087	3.6254
07/29/21	8:18:09	0729-PRE_000266.LAB	191.4	1.03	5.3755	13.2563	0.4079	3.6457
07/29/21	8:18:39	0729-PRE_000267.LAB	191.4	1.03	5.3797	13.4089	0.4026	3.5155
		Average	**191.4**	**1.03**	**5.3460**	**13.6054**	**0.4082**	**3.6232**

Trial #2		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005		
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	6:32:20	0729-PRE_000054.LAB	191.3	0.99	0.0102	-0.0025	5.6174	46.1720
07/29/21	6:32:50	0729-PRE_000055.LAB	191.3	0.99	0.0016	-0.0038	5.6081	47.2898
07/29/21	6:33:20	0729-PRE_000056.LAB	191.3	0.99	0.0070	-0.0048	5.6041	47.6549
07/29/21	6:33:50	0729-PRE_000057.LAB	191.3	0.99	0.0126	-0.0068	5.6117	47.3384
		Average	**191.3**	**0.99**	**0.0078**	**-0.0045**	**5.6103**	**47.1138**

Trial #2		Pre-Spike - Native Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	10:58:18	0729-R1_000237.LAB	191.4	1.03	5.8150	13.6099	0.0006	0.3406
07/29/21	10:58:48	0729-R1_000238.LAB	191.4	1.03	5.8728	12.9194	-0.0025	0.5241
07/29/21	10:59:18	0729-R1_000239.LAB	191.4	1.03	5.8676	12.9379	-0.0025	0.6039
07/29/21	10:59:48	0729-R1_000240.LAB	191.4	1.03	5.4829	12.5593	0.0002	0.3223
		Average	**191.4**	**1.03**	**5.7596**	**13.0067**	**-0.0011**	**0.4477**

Trial #2		Spiked Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	11:01:49	0729-R1_000244.LAB	191.5	1.03	5.2712	13.8200	0.4242	3.7331
07/29/21	11:02:19	0729-R1_000245.LAB	191.5	1.03	5.3219	13.2850	0.4282	4.2742
07/29/21	11:02:49	0729-R1_000246.LAB	191.5	1.03	5.3687	12.7560	0.4313	4.0858
07/29/21	11:03:18	0729-R1_000247.LAB	191.5	1.03	5.3000	13.5442	0.4326	4.3084
		Average	**191.5**	**1.03**	**5.3154**	**13.3513**	**0.4291**	**4.1004**

Trial #3		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005		
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	6:32:20	0729-PRE_000054.LAB	191.3	0.99	0.0102	-0.0025	5.6174	46.1720
07/29/21	6:32:50	0729-PRE_000055.LAB	191.3	0.99	0.0016	-0.0038	5.6081	47.2898
07/29/21	6:33:20	0729-PRE_000056.LAB	191.3	0.99	0.0070	-0.0048	5.6041	47.6549
07/29/21	6:33:50	0729-PRE_000057.LAB	191.3	0.99	0.0126	-0.0068	5.6117	47.3384
		Average	**191.3**	**0.99**	**0.0078**	**-0.0045**	**5.6103**	**47.1138**

Trial #3		Pre-Spike - Native Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	11:04:19	0729-R1_000249.LAB	191.5	1.03	5.8610	12.4156	0.0084	0.5578
07/29/21	11:04:49	0729-R1_000250.LAB	191.4	1.03	5.7812	13.8925	-0.0013	0.2429
07/29/21	11:05:19	0729-R1_000251.LAB	191.4	1.03	5.8004	13.6536	0.0004	0.3584
07/29/21	11:05:49	0729-R1_000252.LAB	191.5	1.03	5.7415	14.2661	-0.0004	0.2898
		Average	**191.5**	**1.03**	**5.7960**	**13.5570**	**0.0018**	**0.3622**

Trial #3		Spiked Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/29/21	11:08:19	0729-R1_000257.LAB	191.5	1.03	5.3438	13.0895	0.4337	4.2009
07/29/21	11:08:49	0729-R1_000258.LAB	191.4	1.03	5.3372	12.6090	0.4378	4.1634
07/29/21	11:09:19	0729-R1_000259.LAB	191.5	1.03	5.3282	12.4337	0.4382	4.3737
07/29/21	11:09:49	0729-R1_000260.LAB	191.4	1.04	5.3419	13.0188	0.4436	4.5190
		Average	**191.5**	**1.03**	**5.3378**	**12.7877**	**0.4383**	**4.3142**

Parameter	Units	Trial #1	Trial #2	Trial #3
Direct Verified Concentration of Sulfur Hexafluoride (SF_6)	(ppmvw)	5.61	5.61	5.61
Direct Verified Concentration of Acetaldehyde (C_2H_4O)	(ppmvw)	47.11	47.11	47.11
Stack (Native, Unspiked) CO_2 Concentration	(%vw)	5.711	5.760	5.796
Stack (Native, Unspiked) H_2O Concentration	(%)	14.247	13.007	13.557
Stack (Native, Unspiked) SF_6 Concentration	(ppmvw)	-0.003	-0.001	0.002
Stack (Native, Unspiked) C_2H_4O Concentration	(ppmvw)	0.438	0.448	0.362
Stack + Spike CO_2 Concentration	(%vw)	5.346	5.315	5.338
Stack + Spike H_2O Concentration	(%)	13.605	13.351	12.788
Stack + Spike SF_6 Concentration	(ppmvw)	0.408	0.429	0.438
Stack + Spike C_2H_4O Concentration	(ppmvw)	3.623	4.100	4.314
Dilution Factor, calc. from SF_6 (ppmvw)		0.073	0.077	0.078
Dilution Factor, as the ratio of dir to spk	(ratio)	13.6 : 1	13 : 1	12.9 : 1
Expected Concentration of the SF_6 Spike+Native, CS	(ppmvw)	0.408	0.429	0.438
Expected Concentration of the C_2H_4O Spike+Native, CS	(ppmvw)	3.863	4.026	4.000
Method 320 Spiked / Expected SF_6	%	99.94	99.98	100.03
Method 320 Spiked / Expected C_2H_4O	%	93.80	101.86	107.85
Method 320 Passing SF_6 (70-130%)		YES	YES	YES
Method 320 Passing C_2H_4O (70-130%)		YES	YES	YES

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Sampling System Leak Check	Flow (LPM)	Date (dd/mm/yy)	Time (hh:mm)
	≤0.2	07/30/21	5:30

FTIR No: 509/ INST-IR-0005
Make Model: MKS 2030

Analytical System Leak Checks — **Vacuum Leak Check**

Spectrum	Date (dd/mm/yy)	Time (hh:mm:ss)	Vacuum (atm)
0730-PRE_000014.LAB	07/30/21	6:03:12	0.99459
0730-PRE_000015.LAB	07/30/21	6:03:42	0.99447
0730-PRE_000016.LAB	07/30/21	6:04:12	0.99512
0730-PRE_000017.LAB	07/30/21	6:04:42	0.99520
0730-PRE_000018.LAB	07/30/21	6:05:12	0.99500
0730-PRE_000019.LAB	07/30/21	6:05:42	0.99504
0730-PRE_000020.LAB	07/30/21	6:06:12	0.99529
0730-PRE_000021.LAB	07/30/21	6:06:42	0.99537
0730-PRE_000022.LAB	07/30/21	6:07:12	0.99551

Pressure Elements	Vacuum (atm)
Average, P_s	0.99507
Maximum	0.99551
Minimum	0.99447
Difference, ΔP_v	0.00104

Time Elements	Results (min)
Signal Integration, t_{ss}	0.50
Test Duration, t_d	4.00

Analytical System Leak Checks — **Pressure Leak Check**

Spectrum	Date (dd/mm/yy)	Time (hh:mm:ss)	Pressure (atm)
0730-PRE_000002.LAB	07/30/21	5:57:11	1.10579
0730-PRE_000003.LAB	07/30/21	5:57:41	1.10579
0730-PRE_000004.LAB	07/30/21	5:58:11	1.10579
0730-PRE_000005.LAB	07/30/21	5:58:41	1.10579
0730-PRE_000006.LAB	07/30/21	5:59:11	1.10579
0730-PRE_000007.LAB	07/30/21	5:59:42	1.10579
0730-PRE_000008.LAB	07/30/21	6:00:12	1.10579
0730-PRE_000009.LAB	07/30/21	6:00:42	1.10579
0730-PRE_000010.LAB	07/30/21	6:01:12	1.10579
0730-PRE_000011.LAB	07/30/21	6:01:42	1.10579

Pressure Elements	Pressure (atm)
Average, P_s	1.10579
Maximum	1.10579
Minimum	1.10579
Difference, ΔP_p	0.00000

Station Pressure (in. Hg)	29.89

Time Elements	Results (min)
Signal Integration, t_{ss}	0.50
Test Duration, t_d	4.50

Parameter	**Vacuum**	**Pressure**	**Max ΔP**
Test Duration, t_d	4.00	4.50	4.00
Signal Integ., t_{ss}	0.50	0.50	0.50
Difference, ΔP	0.00104	0.00000	0.00104
Average, P_s	0.99507	1.10579	0.99507
Leak Volume, $\%V_L$	0.013	0.000	0.013
Pass, ≤4%	yes	yes	yes

$$\%V_L = \frac{100\%}{t_d} t_{ss} \frac{\Delta P_{max}}{P_S}$$

Method 320, Section 8.2.2.4, Equation 2
expanded to account for sample duration

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Protocol No. 1, CO_2 Cylinder Concentration:	8.95 %vd

Pre-Test Background **FTIR:** 509/ INST-IR-0005

Date (mm/dd/yy)	Time (hh:mm:ss)	Spectrum (File Name)	Cell Temp (°C)	Cell Press (atm)	CO_2	H_2O (%)
07/30/21	6:13:32	0730-PRE_000031BKG.LAB	191.4	1.00	0.0000	0.0000

Pre-Test Direct Zero

Date (mm/dd/yy)	Time (hh:mm:ss)	Spectrum (File Name)	Cell Temp (°C)	Cell Press (atm)	CO_2	H_2O (%)
07/30/21	6:14:09	0730-PRE_000032.LAB	191.3	1.00	-0.0033	0.0042
07/30/21	6:14:38	0730-PRE_000033.LAB	191.4	1.00	0.0086	-0.0009
07/30/21	6:15:08	0730-PRE_000034.LAB	191.3	1.00	-0.0026	0.0014

Pre-Test Direct Calibration Transfer Spectra

Date (mm/dd/yy)	Time (hh:mm:ss)	Spectrum (File Name)	Cell Temp (°C)	Cell Press (atm)	CO_2	H_2O (%)
07/30/21	6:16:09	0730-PRE_000036.LAB	191.3	1.00	8.9894	0.0085
07/30/21	6:16:39	0730-PRE_000037.LAB	191.3	1.00	9.0392	0.0043
07/30/21	6:17:09	0730-PRE_000038.LAB	191.4	1.00	9.0308	0.0029
07/30/21	6:17:39	0730-PRE_000039.LAB	191.4	1.00	8.9392	-0.0020
07/30/21	6:18:09	0730-PRE_000040.LAB	191.4	1.00	8.9547	0.0015
Average			**191.4**	**1.00**	**8.9907**	**0.0030**

Post-Test Direct Calibration Transfer Spectra

Date (mm/dd/yy)	Time (hh:mm:ss)	Spectrum (File Name)	Cell Temp (°C)	Cell Press (atm)	CO_2	H_2O (%)
07/30/21	20:08:00	0730-R3_000443.LAB	191.4	0.99	9.0504	0.0024
07/30/21	20:08:30	0730-R3_000444.LAB	191.4	0.99	9.0830	-0.0011
07/30/21	20:09:00	0730-R3_000445.LAB	191.4	0.99	9.0399	0.0029
07/30/21	20:09:30	0730-R3_000446.LAB	191.4	0.99	9.0417	-0.0021
07/30/21	20:10:00	0730-R3_000447.LAB	191.4	0.99	9.0313	-0.0045
Average			**191.4**	**0.99**	**9.0492**	**-0.0005**

Post-Test Direct Zero

Date (mm/dd/yy)	Time (hh:mm:ss)	Spectrum (File Name)	Cell Temp (°C)	Cell Press (atm)	CO_2	H_2O (%)
07/30/21	20:15:00	0730-R3_000457.LAB	191.4	0.99	0.0107	-0.0023
07/30/21	20:15:30	0730-R3_000458.LAB	191.4	0.99	0.0023	-0.0021
07/30/21	20:16:00	0730-R3_000459.LAB	191.4	0.99	0.0115	-0.0060

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Post-Test Background							
Date	**Time**	**Spectrum**	**Cell Temp**	**Cell Press**	**CO_2**	**H_2O**	
(mm/dd/yy)	**(hh:mm:ss)**	**(File Name)**	**(°C)**	**(atm)**		**(%)**	
07/30/21	20:18:25	0730-R3_000460BKG.LAB	191.3	0.99	0.0000	0.0000	

CTS Results	Protocol No. 1 Concentration	FTIR CO_2 Average	Error (%)	Pass (≤5%)
Pre-Test Direct	8.95	8.99	0.45	YES
Post-Test Direct	8.95	9.05	1.11	YES

Pre / Post Comparison	FTIR CO_2 Maximum	FTIR CO_2 Pre/Post Mean	Error (%)	Pass (≤5%)
Pre-Test Direct	9.04	9.02	0.21	YES
Post-Test Direct	9.08		0.69	YES

Catalytic Combustion Corporation

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Caterpillar, G3520 TALE

Stewart & Stevenson Integration Center

Certified, NH_3 Cylinder Concentration:	49 ppmvd

Pre-Test Background **FTIR:** 509/ INST-IR-0005

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:13:32	0730-PRE_000031BKG.LAB	191.4	1.00	0.0000	0.0000	0.0000

Pre-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:14:09	0730-PRE_000032.LAB	191.3	1.00	-0.0033	0.0042	0.0083
07/30/21	6:14:38	0730-PRE_000033.LAB	191.4	1.00	0.0086	-0.0009	-0.0388
07/30/21	6:15:08	0730-PRE_000034.LAB	191.3	1.00	-0.0026	0.0014	-0.0227

Pre-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:38:41	0730-PRE_000081.LAB	191.4	1.00	0.0045	0.0037	46.4683
07/30/21	6:39:11	0730-PRE_000082.LAB	191.4	1.00	0.0114	0.0074	46.4068
07/30/21	6:39:41	0730-PRE_000083.LAB	191.4	1.00	0.0126	0.0106	47.4780
07/30/21	6:40:11	0730-PRE_000084.LAB	191.4	1.00	0.0086	0.0062	47.5915
07/30/21	6:41:11	0730-PRE_000086.LAB	191.4	1.00	0.0281	0.7565	48.0381
Average			**191.4**	**1.00**	**0.0130**	**0.1569**	**47.1965**

Post-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	19:53:28	0730-R3_000414.LAB	191.3	1.00	-0.0003	0.0082	47.5248
07/30/21	19:53:58	0730-R3_000415.LAB	191.3	1.00	0.0067	0.0095	46.4149
07/30/21	19:54:28	0730-R3_000416.LAB	191.3	1.00	0.0161	0.0061	45.7153
07/30/21	19:54:58	0730-R3_000417.LAB	191.2	1.00	0.0057	0.0043	45.8208
07/30/21	19:55:28	0730-R3_000418.LAB	191.2	1.00	0.0145	0.0039	47.3945
Average			**191.3**	**1.00**	**0.0085**	**0.0064**	**46.5741**

Post-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	20:15:00	0730-R3_000457.LAB	191.4	0.99	0.0107	-0.0023	1.0692
07/30/21	20:15:30	0730-R3_000458.LAB	191.4	0.99	0.0023	-0.0021	0.9469
07/30/21	20:16:00	0730-R3_000459.LAB	191.4	0.99	0.0115	-0.0060	0.8690

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Stewart & Stevenson Integration Center

Post-Test Background							
Date	**Time**	**Spectrum**	**Cell Temp**	**Cell Press**	**CO_2**	**H_2O**	**NH_3**
(mm/dd/yy)	**(hh:mm:ss)**	**(File Name)**	**(°C)**	**(atm)**	**(ppmvw)**	**(%)**	**(ppmvw)**
07/30/21	20:18:25	0730-R3_000460BKG.LAB	191.3	0.99	0.0000	0.0000	0.0000

CTS Results	Certified Concentration	FTIR NH_3 Average	Error (%)	Pass (≤5%)
Pre-Test Direct	49.00	47.20	3.68	YES
Post-Test Direct	49.00	46.57	4.95	YES

Pre / Post Comparison	FTIR NH_3 Maximum	FTIR NH_3 Pre/Post Mean	Error (%)	Pass (≤5%)
Pre-Test Direct	48.04	46.89	2.40	YES
Post-Test Direct	47.52		1.35	YES

Catalytic Combustion Corporation

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Caterpillar, G3520 TALE

Stewart & Stevenson Integration Center

Certified, C_2H_6 Cylinder Concentration:	100 ppmvd

Pre-Test Background **FTIR:** 509/ INST-IR-0005

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:13:32	0730-PRE_000031BKG.LAB	191.4	1.00	0.0000	0.0000	0.0000

Pre-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:14:09	0730-PRE_000032.LAB	191.3	1.00	-0.0033	0.0042	-0.0546
07/30/21	6:14:38	0730-PRE_000033.LAB	191.4	1.00	0.0086	-0.0009	0.0040
07/30/21	6:15:08	0730-PRE_000034.LAB	191.3	1.00	-0.0026	0.0014	-0.0639

Pre-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:19:39	0730-PRE_000043.LAB	191.3	1.00	0.0072	0.0011	100.6868
07/30/21	6:20:09	0730-PRE_000044.LAB	191.4	1.00	0.0030	-0.0006	100.9227
07/30/21	6:20:39	0730-PRE_000045.LAB	191.4	1.00	0.0058	-0.0020	100.6889
07/30/21	6:21:09	0730-PRE_000046.LAB	191.4	1.00	-0.0050	-0.0002	101.1251
07/30/21	6:21:39	0730-PRE_000047.LAB	191.4	1.00	0.0032	0.0017	101.2393
Average			**191.4**	**1.00**	**0.0028**	**0.0000**	**100.9326**

Post-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	20:04:59	0730-R3_000437.LAB	191.5	0.99	0.0128	0.0883	94.9111
07/30/21	20:05:29	0730-R3_000438.LAB	191.4	0.99	0.0051	0.0921	96.0914
07/30/21	20:05:59	0730-R3_000439.LAB	191.4	0.99	-0.0016	0.1057	95.6295
07/30/21	20:06:29	0730-R3_000440.LAB	191.4	0.99	0.0089	0.1073	95.1082
07/30/21	20:06:59	0730-R3_000441.LAB	191.4	0.99	0.0170	0.0381	99.3170
Average			**191.4**	**0.99**	**0.0084**	**0.0863**	**96.2115**

Post-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	20:15:00	0730-R3_000457.LAB	191.4	0.99	0.0107	-0.0023	-0.2236
07/30/21	20:15:30	0730-R3_000458.LAB	191.4	0.99	0.0023	-0.0021	-0.1017
07/30/21	20:16:00	0730-R3_000459.LAB	191.4	0.99	0.0115	-0.0060	-0.3388

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Post-Test Background							
Date	**Time**	**Spectrum**	**Cell Temp**	**Cell Press**	**CO_2**	**H_2O**	**C_2H_6**
(mm/dd/yy)	**(hh:mm:ss)**	**(File Name)**	**(°C)**	**(atm)**	**(ppmvw)**	**(%)**	**(ppmvw)**
07/30/21	20:18:25	0730-R3_000460BKG.LAB	191.3	0.99	0.0000	0.0000	0.0000

CTS Results	Certified Concentration	FTIR C_2H_6 Average	Error (%)	Pass (≤5%)
Pre-Test Direct	100.00	100.93	0.93	YES
Post-Test Direct	100.00	96.21	3.79	YES

Pre / Post Comparison	FTIR C_2H_6 Maximum	FTIR C_2H_6 Pre/Post Mean	Error (%)	Pass (≤5%)
Pre-Test Direct	101.24	98.57	2.63	YES
Post-Test Direct	99.32		0.75	YES

Catalytic Combustion Corporation

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Caterpillar, G3520 TALE

Stewart & Stevenson Integration Center

Protocol No. 1, NOx Cylinder Concentration:	116.1 ppmvd

Pre-Test Background **FTIR:** 509/ INST-IR-0005

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:13:32	0730-PRE_000031BKG.LAB	191.4	1.00	0.0000	0.0000	0.0000

Pre-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:14:09	0730-PRE_000032.LAB	191.3	1.00	-0.0033	0.0042	0.0301
07/30/21	6:14:38	0730-PRE_000033.LAB	191.4	1.00	0.0086	-0.0009	-0.0634
07/30/21	6:15:08	0730-PRE_000034.LAB	191.3	1.00	-0.0026	0.0014	0.0144

Pre-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:22:39	0730-PRE_000049.LAB	191.4	1.00	-0.0302	0.0182	118.1741
07/30/21	6:23:09	0730-PRE_000050.LAB	191.4	1.00	-0.0389	0.0025	118.8564
07/30/21	6:23:39	0730-PRE_000051.LAB	191.4	1.00	-0.0431	-0.0001	118.6155
07/30/21	6:24:09	0730-PRE_000052.LAB	191.4	1.00	-0.0383	-0.0029	117.8215
07/30/21	6:24:39	0730-PRE_000053.LAB	191.4	1.00	-0.0356	-0.0027	118.2811
Average			**191.4**	**1.00**	**-0.0372**	**0.0030**	**118.3497**

Post-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	20:01:59	0730-R3_000431.LAB	191.4	0.99	-0.0372	0.0002	119.2568
07/30/21	20:02:29	0730-R3_000432.LAB	191.4	0.99	-0.0273	-0.0001	118.8093
07/30/21	20:02:59	0730-R3_000433.LAB	191.4	0.99	-0.0241	0.0010	118.7938
07/30/21	20:03:29	0730-R3_000434.LAB	191.4	0.99	-0.0204	-0.0029	118.3085
07/30/21	20:03:59	0730-R3_000435.LAB	191.4	0.99	-0.0253	-0.0007	118.3400
Average			**191.4**	**0.99**	**-0.0268**	**-0.0005**	**118.7017**

Post-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	20:15:00	0730-R3_000457.LAB	191.4	0.99	0.0107	-0.0023	-0.0462
07/30/21	20:15:30	0730-R3_000458.LAB	191.4	0.99	0.0023	-0.0021	-0.1749
07/30/21	20:16:00	0730-R3_000459.LAB	191.4	0.99	0.0115	-0.0060	-0.0298

Catalytic Combustion Corporation

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Caterpillar, G3520 TALE

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Post-Test Background							
Date	**Time**	**Spectrum**	**Cell Temp**	**Cell Press**	**CO_2**	**H_2O**	**NOx**
(mm/dd/yy)	**(hh:mm:ss)**	**(File Name)**	**(°C)**	**(atm)**	**(ppmvw)**	**(%)**	**(ppmvw)**
07/30/21	20:18:25	0730-R3_000460BKG.LAB	191.3	0.99	0.0000	0.0000	0.0000

CTS Results	Protocol No. 1 Concentration	FTIR NOx Average	Error (%)	Pass (≤5%)
Pre-Test Direct	116.10	118.35	1.94	YES
Post-Test Direct	116.10	118.70	2.24	YES

Pre / Post Comparison	FTIR NOx Maximum	FTIR NOx Pre/Post Mean	Error (%)	Pass (≤5%)
Pre-Test Direct	118.86	118.53	0.28	YES
Post-Test Direct	119.26		0.61	YES

Catalytic Combustion Corporation

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Caterpillar, G3520 TALE

Stewart & Stevenson Integration Center

Protocol No. 1, CO Cylinder Concentration:	122 ppmvd

Pre-Test Background **FTIR:** 509/ INST-IR-0005

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:13:32	0730-PRE_000031BKG.LAB	191.4	1.00	0.0000	0.0000	0.0000

Pre-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:14:09	0730-PRE_000032.LAB	191.3	1.00	-0.0033	0.0042	0.0440
07/30/21	6:14:38	0730-PRE_000033.LAB	191.4	1.00	0.0086	-0.0009	-0.0435
07/30/21	6:15:08	0730-PRE_000034.LAB	191.3	1.00	-0.0026	0.0014	0.0030

Pre-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:22:39	0730-PRE_000049.LAB	191.4	1.00	-0.0302	0.0182	120.7373
07/30/21	6:23:09	0730-PRE_000050.LAB	191.4	1.00	-0.0389	0.0025	121.4913
07/30/21	6:23:39	0730-PRE_000051.LAB	191.4	1.00	-0.0431	-0.0001	121.2086
07/30/21	6:24:09	0730-PRE_000052.LAB	191.4	1.00	-0.0383	-0.0029	120.4047
07/30/21	6:24:39	0730-PRE_000053.LAB	191.4	1.00	-0.0356	-0.0027	120.4995
Average			**191.4**	**1.00**	**-0.0372**	**0.0030**	**120.8683**

Post-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	20:01:59	0730-R3_000431.LAB	191.4	0.99	-0.0372	0.0002	122.2379
07/30/21	20:02:29	0730-R3_000432.LAB	191.4	0.99	-0.0273	-0.0001	121.5142
07/30/21	20:02:59	0730-R3_000433.LAB	191.4	0.99	-0.0241	0.0010	121.3072
07/30/21	20:03:29	0730-R3_000434.LAB	191.4	0.99	-0.0204	-0.0029	120.9053
07/30/21	20:03:59	0730-R3_000435.LAB	191.4	0.99	-0.0253	-0.0007	120.6371
Average			**191.4**	**0.99**	**-0.0268**	**-0.0005**	**121.3203**

Post-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	20:15:00	0730-R3_000457.LAB	191.4	0.99	0.0107	-0.0023	-0.0600
07/30/21	20:15:30	0730-R3_000458.LAB	191.4	0.99	0.0023	-0.0021	-0.1378
07/30/21	20:16:00	0730-R3_000459.LAB	191.4	0.99	0.0115	-0.0060	-0.0268

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Caterpillar, G3520 TALE

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Post-Test Background							
Date	**Time**	**Spectrum**	**Cell Temp**	**Cell Press**	**CO_2**	**H_2O**	**CO**
(mm/dd/yy)	**(hh:mm:ss)**	**(File Name)**	**(°C)**	**(atm)**	**(ppmvw)**	**(%)**	**(ppmvw)**
07/30/21	20:18:25	0730-R3_000460BKG.LAB	191.3	0.99	0.0000	0.0000	0.0000

CTS Results	Protocol No. 1 Concentration	FTIR CO Average	Error (%)	Pass (≤5%)
Pre-Test Direct	122.00	120.87	0.93	YES
Post-Test Direct	122.00	121.32	0.56	YES

Pre / Post Comparison	FTIR CO Maximum	FTIR CO Pre/Post Mean	Error (%)	Pass (≤5%)
Pre-Test Direct	121.49	121.09	0.33	YES
Post-Test Direct	122.24		0.94	YES

Catalytic Combustion Corporation

July 30, 2021

Caterpillar, G3520 TALE

Stewart & Stevenson Integration Center

Certified, C_2H_4O Cylinder Concentration:	47.4 ppmvd

Pre-Test Background **FTIR:** 509/ INST-IR-0005

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:13:32	0730-PRE_000031BKG.LAB	191.4	1.00	0.0000	0.0000	0.0000

Pre-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:14:09	0730-PRE_000032.LAB	191.3	1.00	-0.0033	0.0042	0.2031
07/30/21	6:14:38	0730-PRE_000033.LAB	191.4	1.00	0.0086	-0.0009	0.0650
07/30/21	6:15:08	0730-PRE_000034.LAB	191.3	1.00	-0.0026	0.0014	0.1599

Pre-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	6:25:40	0730-PRE_000055.LAB	191.4	1.00	0.0066	0.0047	46.2794
07/30/21	6:26:10	0730-PRE_000056.LAB	191.4	1.00	0.0073	-0.0029	47.4824
07/30/21	6:26:40	0730-PRE_000057.LAB	191.4	1.00	-0.0018	0.0002	48.0103
07/30/21	6:27:10	0730-PRE_000058.LAB	191.4	1.00	-0.0025	-0.0030	48.0884
07/30/21	6:27:40	0730-PRE_000059.LAB	191.4	1.00	0.0059	-0.0068	48.1908
Average			**191.4**	**1.00**	**0.0031**	**-0.0015**	**47.6103**

Post-Test Direct Calibration Transfer Spectra

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	19:58:59	0730-R3_000425.LAB	191.4	0.99	0.0109	-0.0057	44.9843
07/30/21	19:59:29	0730-R3_000426.LAB	191.4	0.99	0.0138	-0.0121	45.1049
07/30/21	19:59:59	0730-R3_000427.LAB	191.4	0.99	0.0118	-0.0089	45.3844
07/30/21	20:00:29	0730-R3_000428.LAB	191.4	0.99	0.0115	-0.0111	45.3527
07/30/21	20:00:59	0730-R3_000429.LAB	191.4	0.99	0.0119	-0.0026	45.4163
Average			**191.4**	**0.99**	**0.0120**	**-0.0081**	**45.2485**

Post-Test Direct Zero

Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(ppmvw)	(%)	(ppmvw)
07/30/21	20:15:00	0730-R3_000457.LAB	191.4	0.99	0.0107	-0.0023	-0.0450
07/30/21	20:15:30	0730-R3_000458.LAB	191.4	0.99	0.0023	-0.0021	0.2411
07/30/21	20:16:00	0730-R3_000459.LAB	191.4	0.99	0.0115	-0.0060	0.3815

Catalytic Combustion Corporation

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Caterpillar, G3520 TALE

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Post-Test Background							
Date	**Time**	**Spectrum**	**Cell Temp**	**Cell Press**	**CO_2**	**H_2O**	**C_2H_4O**
(mm/dd/yy)	**(hh:mm:ss)**	**(File Name)**	**(°C)**	**(atm)**	**(ppmvw)**	**(%)**	**(ppmvw)**
07/30/21	20:18:25	0730-R3_000460BKG.LAB	191.3	0.99	0.0000	0.0000	0.0000

CTS Results	Certified Concentration	FTIR C_2H_4O Average	Error (%)	Pass (≤5%)
Pre-Test Direct	47.40	47.61	0.44	YES
Post-Test Direct	47.40	45.25	4.54	YES

Pre / Post Comparison	FTIR C_2H_4O Maximum	FTIR C_2H_4O Pre/Post Mean	Error (%)	Pass (≤5%)
Pre-Test Direct	48.19	46.43	3.66	YES
Post-Test Direct	45.42		2.23	YES

Catalytic Combustion Corporation

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Caterpillar, G3520 TALE

Stewart & Stevenson Integration Center

Trial #1		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005		
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	6:38:41	0730-PRE_000081.LAB	191.4	1.00	0.0045	0.0037	11.0592	46.4683
07/30/21	6:39:11	0730-PRE_000082.LAB	191.4	1.00	0.0114	0.0074	11.0565	46.4068
07/30/21	6:39:41	0730-PRE_000083.LAB	191.4	1.00	0.0126	0.0106	11.0569	47.4780
07/30/21	6:40:11	0730-PRE_000084.LAB	191.4	1.00	0.0086	0.0062	11.0642	47.5915
		Average	**191.4**	**1.00**	**0.0093**	**0.0070**	**11.0592**	**46.9861**

Trial #1		Pre-Spike - Native Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	17:29:43	0730-R3_000127.LAB	191.4	1.03	5.8899	13.0638	-0.0051	13.1427
07/30/21	17:30:13	0730-R3_000128.LAB	191.4	1.02	5.8880	13.1952	-0.0051	13.2455
07/30/21	17:30:43	0730-R3_000129.LAB	191.5	1.03	5.9085	12.4733	-0.0025	13.0278
07/30/21	17:31:13	0730-R3_000130.LAB	191.5	1.03	5.9130	12.4050	-0.0035	13.1000
		Average	**191.5**	**1.03**	**5.8999**	**12.7843**	**-0.0041**	**13.1290**

Trial #1		Spiked Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	17:41:44	0730-R3_000151.LAB	191.4	1.01	5.1125	16.8425	4.0957	21.6241
07/30/21	17:42:14	0730-R3_000152.LAB	191.4	1.03	4.5930	11.9125	4.0952	21.1914
07/30/21	17:42:44	0730-R3_000153.LAB	191.4	1.03	4.7731	13.8540	4.0957	22.1734
07/30/21	17:43:14	0730-R3_000154.LAB	191.3	1.02	5.1449	13.8670	4.0952	22.5789
		Average	**191.4**	**1.02**	**4.9059**	**14.1190**	**4.0954**	**21.8920**

Trial #2		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005		
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	6:38:41	0730-PRE_000081.LAB	191.4	1.00	0.0045	0.0037	11.0592	46.4683
07/30/21	6:39:11	0730-PRE_000082.LAB	191.4	1.00	0.0114	0.0074	11.0565	46.4068
07/30/21	6:39:41	0730-PRE_000083.LAB	191.4	1.00	0.0126	0.0106	11.0569	47.4780
07/30/21	6:40:11	0730-PRE_000084.LAB	191.4	1.00	0.0086	0.0062	11.0642	47.5915
		Average	**191.4**	**1.00**	**0.0093**	**0.0070**	**11.0592**	**46.9861**

Trial #2		Pre-Spike - Native Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	18:52:21	0730-R3_000292.LAB	191.3	1.04	5.5552	14.4346	-0.0093	1.8100
07/30/21	18:52:51	0730-R3_000293.LAB	191.3	1.03	5.5539	14.6010	-0.0090	1.5328
07/30/21	18:53:22	0730-R3_000294.LAB	191.3	1.03	5.5866	14.1337	-0.0094	1.3203
07/30/21	18:53:52	0730-R3_000295.LAB	191.3	1.03	5.6429	13.7381	-0.0080	1.1878
Average			**191.3**	**1.03**	**5.5847**	**14.2269**	**-0.0089**	**1.4628**

Trial #2		Spiked Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	19:15:54	0730-R3_000339.LAB	191.3	1.03	4.6391	13.2155	0.8064	4.0219
07/30/21	19:16:24	0730-R3_000340.LAB	191.2	1.03	4.9884	11.5188	0.8079	4.1450
07/30/21	19:16:54	0730-R3_000341.LAB	191.3	1.03	4.5691	11.4957	0.8030	3.3466
07/30/21	19:17:24	0730-R3_000342.LAB	191.3	1.03	4.3604	10.6202	0.7988	3.0584
		Average	**191.3**	**1.03**	**4.6393**	**11.7125**	**0.8040**	**3.6430**

Trial #3		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005		
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	6:38:41	0730-PRE_000081.LAB	191.4	1.00	0.0045	0.0037	11.0592	46.4683
07/30/21	6:39:11	0730-PRE_000082.LAB	191.4	1.00	0.0114	0.0074	11.0565	46.4068
07/30/21	6:39:41	0730-PRE_000083.LAB	191.4	1.00	0.0126	0.0106	11.0569	47.4780
07/30/21	6:40:11	0730-PRE_000084.LAB	191.4	1.00	0.0086	0.0062	11.0642	47.5915
		Average	**191.4**	**1.00**	**0.0093**	**0.0070**	**11.0592**	**46.9861**

Trial #3		Pre-Spike - Native Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	19:20:24	0730-R3_000348.LAB	191.3	1.02	5.4440	16.3774	-0.0033	1.9032
07/30/21	19:20:55	0730-R3_000349.LAB	191.3	1.02	5.5524	14.7458	-0.0042	1.7367
07/30/21	19:21:24	0730-R3_000350.LAB	191.4	1.02	5.6631	13.6230	-0.0057	1.6003
07/30/21	19:21:55	0730-R3_000351.LAB	191.3	1.03	5.6113	14.0821	-0.0035	1.5597
		Average	**191.3**	**1.02**	**5.5677**	**14.7071**	**-0.0042**	**1.7000**

Trial #3		Spiked Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	NH_3
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	19:28:55	0730-R3_000365.LAB	191.3	1.03	5.1457	13.9195	0.8066	4.5177
07/30/21	19:29:25	0730-R3_000366.LAB	191.3	1.02	5.1848	13.5242	0.8021	3.9342
07/30/21	19:29:55	0730-R3_000367.LAB	191.3	1.03	5.2114	13.0419	0.8058	3.4876
07/30/21	19:30:25	0730-R3_000368.LAB	191.3	1.03	5.2138	12.5100	0.8088	3.5619
		Average	**191.3**	**1.03**	**5.1889**	**13.2489**	**0.8058**	**3.8754**

Parameter	Units	Trial #1	Trial #2	Trial #3
Direct Verified Concentration of Sulfur Hexafluoride (SF_6)	(ppmvw)	11.06	11.06	11.06
Direct Verified Concentration of Ammonia (NH_3)	(ppmvw)	46.99	46.99	46.99
Stack (Native, Unspiked) CO_2 Concentration	(%vw)	5.900	5.585	5.568
Stack (Native, Unspiked) H_2O Concentration	(%)	12.784	14.227	14.707
Stack (Native, Unspiked) SF_6 Concentration	(ppmvw)	-0.004	-0.009	-0.004
Stack (Native, Unspiked) NH_3 Concentration	(ppmvw)	13.129	1.463	1.700
Stack + Spike CO_2 Concentration	(%vw)	4.906	4.639	5.189
Stack + Spike H_2O Concentration	(%)	14.119	11.713	13.249
Stack + Spike SF_6 Concentration	(ppmvw)	4.095	0.804	0.806
Stack + Spike NH_3 Concentration	(ppmvw)	21.892	3.643	3.875
Dilution Factor, calc. from SF_6 (ppmvw)		0.371	0.074	0.073
Dilution Factor, as the ratio of dir to spk	(ratio)	2.7 : 1	13.6 : 1	13.7 : 1
Expected Concentration of the SF_6 Spike+Native, CS	(ppmvw)	4.097	0.805	0.806
Expected Concentration of the NH_3 Spike+Native, CS	(ppmvw)	25.679	4.809	5.017
Method 320 Spiked / Expected SF_6	%	99.96	99.92	99.96
Method 320 Spiked / Expected NH_3	%	85.25	75.75	77.25
Method 320 Passing SF_6 (70-130%)		YES	YES	YES
Method 320 Passing NH_3 (70-130%)		YES	YES	YES

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Trial #1		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	6:19:39	0730-PRE_000043.LAB	191.3	1.00	0.0072	0.0011	100.6868
07/30/21	6:20:09	0730-PRE_000044.LAB	191.4	1.00	0.0030	-0.0006	100.9227
07/30/21	6:20:39	0730-PRE_000045.LAB	191.4	1.00	0.0058	-0.0020	100.6889
07/30/21	6:21:09	0730-PRE_000046.LAB	191.4	1.00	-0.0050	-0.0002	101.1251
		Average	**191.4**	**1.00**	**0.0027**	**-0.0004**	**100.8559**

Trial #1		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	7:07:14	0730-PRE_000138.LAB	191.4	1.04	6.0532	8.9759	0.7175
07/30/21	7:07:44	0730-PRE_000139.LAB	191.4	1.04	6.0684	8.6764	1.0738
07/30/21	7:08:14	0730-PRE_000140.LAB	191.4	1.04	5.4819	8.8570	0.7126
07/30/21	7:08:44	0730-PRE_000141.LAB	191.4	1.03	5.4148	11.0471	0.4528
		Average	**191.4**	**1.03**	**5.7546**	**9.3891**	**0.7392**

Trial #1		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	7:10:14	0730-PRE_000144.LAB	191.4	1.03	5.4320	10.5697	8.4013
07/30/21	7:10:44	0730-PRE_000145.LAB	191.4	1.03	5.2716	13.0538	8.3076
07/30/21	7:11:14	0730-PRE_000146.LAB	191.4	1.03	5.2550	12.5253	8.4825
07/30/21	7:11:44	0730-PRE_000147.LAB	191.4	1.03	5.3563	11.4675	8.3991
		Average	**191.4**	**1.03**	**5.3287**	**11.9041**	**8.3976**

Trial #2		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	6:19:39	0730-PRE_000043.LAB	191.3	1.00	0.0072	0.0011	100.6868
07/30/21	6:20:09	0730-PRE_000044.LAB	191.4	1.00	0.0030	-0.0006	100.9227
07/30/21	6:20:39	0730-PRE_000045.LAB	191.4	1.00	0.0058	-0.0020	100.6889
07/30/21	6:21:09	0730-PRE_000046.LAB	191.4	1.00	-0.0050	-0.0002	101.1251
		Average	**191.4**	**1.00**	**0.0027**	**-0.0004**	**100.8559**

Trial #2		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	7:12:45	0730-PRE_000149.LAB	191.4	1.03	5.8000	12.8597	0.7345
07/30/21	7:13:15	0730-PRE_000150.LAB	191.4	1.03	5.8314	11.8100	0.7608
07/30/21	7:13:45	0730-PRE_000151.LAB	191.4	1.03	5.6332	14.6153	0.7099
07/30/21	7:14:15	0730-PRE_000152.LAB	191.4	1.02	5.5540	16.2007	0.7127
		Average	**191.4**	**1.03**	**5.7047**	**13.8714**	**0.7295**

Trial #2		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	7:15:45	0730-PRE_000155.LAB	191.4	1.02	5.1139	14.9382	8.2753
07/30/21	7:16:15	0730-PRE_000156.LAB	191.4	1.03	5.1541	14.3975	8.4375
07/30/21	7:16:45	0730-PRE_000157.LAB	191.4	1.03	5.2980	12.8197	8.5701
07/30/21	7:17:15	0730-PRE_000158.LAB	191.4	1.03	5.2867	12.7394	8.4587
		Average	**191.4**	**1.03**	**5.2132**	**13.7237**	**8.4354**

Trial #3		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	6:19:39	0730-PRE_000043.LAB	191.3	1.00	0.0072	0.0011	100.6868
07/30/21	6:20:09	0730-PRE_000044.LAB	191.4	1.00	0.0030	-0.0006	100.9227
07/30/21	6:20:39	0730-PRE_000045.LAB	191.4	1.00	0.0058	-0.0020	100.6889
07/30/21	6:21:09	0730-PRE_000046.LAB	191.4	1.00	-0.0050	-0.0002	101.1251
		Average	**191.4**	**1.00**	**0.0027**	**-0.0004**	**100.8559**

Trial #3		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	7:18:15	0730-PRE_000160.LAB	191.4	1.03	5.7401	13.4425	0.7732
07/30/21	7:18:45	0730-PRE_000161.LAB	191.4	1.02	5.5498	15.5749	0.5713
07/30/21	7:19:15	0730-PRE_000162.LAB	191.4	1.03	5.6786	14.0766	0.7417
07/30/21	7:19:45	0730-PRE_000163.LAB	191.4	1.03	5.5581	15.0022	0.8356
		Average	**191.4**	**1.03**	**5.6316**	**14.5241**	**0.7304**

Trial #3		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	C_2H_6
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	7:21:15	0730-PRE_000166.LAB	191.4	1.03	5.2190	13.6704	8.3180
07/30/21	7:21:46	0730-PRE_000167.LAB	191.4	1.03	5.2700	13.0154	8.5543
07/30/21	7:22:16	0730-PRE_000168.LAB	191.5	1.03	5.2269	13.5371	8.5568
07/30/21	7:22:46	0730-PRE_000169.LAB	191.4	1.03	5.2680	13.1603	8.5293
		Average	**191.4**	**1.03**	**5.2460**	**13.3458**	**8.4896**

Parameter	Units	Trial #1	Trial #2	Trial #3
Direct Verified Concentration of Ethane (C_2H_6)	(ppmvw)	100.86	100.86	100.86
Stack (Native, Unspiked) CO_2 Concentration	(%vw)	5.755	5.705	5.632
Stack (Native, Unspiked) H_2O Concentration	(%)	9.389	13.871	14.524
Stack (Native, Unspiked) C_2H_6 Concentration	(ppmvw)	0.739	0.729	0.730
Stack + Spike CO_2 Concentration	(%vw)	5.329	5.213	5.246
Stack + Spike H_2O Concentration	(%)	11.904	13.724	13.346
Stack + Spike C_2H_6 Concentration	(ppmvw)	8.398	8.435	8.490
Dilution Factor, calc. from CO_2 (%vw)		0.074	0.086	0.068
Dilution Factor, as the ratio of dir to spk	(ratio)	13.5 : 1	11.6 : 1	14.6 : 1
Expected Concentration of the C_2H_6 Spike+Native, CS	(ppmvw)	8.148	9.356	7.587
Method 320 Spiked / Expected C_2H_6	%	103.06	90.16	111.89
Method 320 Passing C_2H_6 (70-130%)		YES	YES	YES

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Trial #1		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	6:22:39	0730-PRE_000049.LAB	191.4	1.00	-0.0302	0.0182	118.1741
07/30/21	6:23:09	0730-PRE_000050.LAB	191.4	1.00	-0.0389	0.0025	118.8564
07/30/21	6:23:39	0730-PRE_000051.LAB	191.4	1.00	-0.0431	-0.0001	118.6155
07/30/21	6:24:09	0730-PRE_000052.LAB	191.4	1.00	-0.0383	-0.0029	117.8215
		Average	**191.4**	**1.00**	**-0.0376**	**0.0044**	**118.3669**

Trial #1		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	7:23:46	0730-PRE_000171.LAB	191.4	1.03	5.6918	13.9245	16.6396
07/30/21	7:24:16	0730-PRE_000172.LAB	191.4	1.03	5.7387	13.4806	16.3643
07/30/21	7:24:46	0730-PRE_000173.LAB	191.4	1.03	5.6194	14.7534	16.1108
07/30/21	7:25:16	0730-PRE_000174.LAB	191.4	1.02	5.5866	15.0709	15.4793
		Average	**191.4**	**1.03**	**5.6591**	**14.3073**	**16.1485**

Trial #1		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	7:27:16	0730-PRE_000178.LAB	191.4	1.03	5.1608	13.8424	24.2100
07/30/21	7:27:46	0730-PRE_000179.LAB	191.4	1.03	5.2530	12.8052	25.1630
07/30/21	7:28:16	0730-PRE_000180.LAB	191.4	1.03	5.2479	12.9054	25.2521
07/30/21	7:28:46	0730-PRE_000181.LAB	191.4	1.03	5.2082	13.2288	24.2115
		Average	**191.4**	**1.03**	**5.2175**	**13.1954**	**24.7091**

Trial #2		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	6:22:39	0730-PRE_000049.LAB	191.4	1.00	-0.0302	0.0182	118.1741
07/30/21	6:23:09	0730-PRE_000050.LAB	191.4	1.00	-0.0389	0.0025	118.8564
07/30/21	6:23:39	0730-PRE_000051.LAB	191.4	1.00	-0.0431	-0.0001	118.6155
07/30/21	6:24:09	0730-PRE_000052.LAB	191.4	1.00	-0.0383	-0.0029	117.8215
		Average	**191.4**	**1.00**	**-0.0376**	**0.0044**	**118.3669**

Trial #2		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	14:44:02	0730-PRE_001049.LAB	191.4	1.03	5.7369	12.4441	5.0561
07/30/21	14:44:32	0730-PRE_001050.LAB	191.4	1.03	5.7460	12.4431	5.0416
07/30/21	14:45:02	0730-PRE_001051.LAB	191.4	1.03	5.7463	12.4741	4.9203
07/30/21	14:45:32	0730-PRE_001052.LAB	191.4	1.03	5.7250	12.5610	4.9086
		Average	**191.4**	**1.03**	**5.7386**	**12.4806**	**4.9816**

Trial #2		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	14:47:32	0730-PRE_001056.LAB	191.5	1.03	5.2360	13.3371	13.5438
07/30/21	14:48:02	0730-PRE_001057.LAB	191.5	1.02	5.1899	13.6994	13.3789
07/30/21	14:48:32	0730-PRE_001058.LAB	191.4	1.02	5.1590	13.9761	13.0878
07/30/21	14:49:02	0730-PRE_001059.LAB	191.5	1.02	5.1399	14.2498	13.1142
		Average	**191.5**	**1.02**	**5.1812**	**13.8156**	**13.2812**

Trial #3		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	6:22:39	0730-PRE_000049.LAB	191.4	1.00	-0.0302	0.0182	118.1741
07/30/21	6:23:09	0730-PRE_000050.LAB	191.4	1.00	-0.0389	0.0025	118.8564
07/30/21	6:23:39	0730-PRE_000051.LAB	191.4	1.00	-0.0431	-0.0001	118.6155
07/30/21	6:24:09	0730-PRE_000052.LAB	191.4	1.00	-0.0383	-0.0029	117.8215
		Average	**191.4**	**1.00**	**-0.0376**	**0.0044**	**118.3669**

Trial #3		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	14:50:03	0730-PRE_001061.LAB	191.5	1.02	5.5992	14.9701	5.0871
07/30/21	14:50:32	0730-PRE_001062.LAB	191.5	1.02	5.5984	14.7950	5.0964
07/30/21	14:51:02	0730-PRE_001063.LAB	191.4	1.02	5.6097	14.6418	5.1337
07/30/21	14:51:32	0730-PRE_001064.LAB	191.4	1.02	5.5973	14.7381	5.1409
		Average	**191.4**	**1.02**	**5.6012**	**14.7862**	**5.1145**

Trial #3		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	NOx
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	14:53:03	0730-PRE_001067.LAB	191.4	1.02	5.1934	13.8151	13.2145
07/30/21	14:53:33	0730-PRE_001068.LAB	191.4	1.03	5.2220	13.6576	13.4804
07/30/21	14:54:03	0730-PRE_001069.LAB	191.4	1.02	5.2084	13.5414	13.4392
07/30/21	14:54:33	0730-PRE_001070.LAB	191.4	1.03	5.2343	13.4546	13.7276
		Average	**191.4**	**1.03**	**5.2145**	**13.6172**	**13.4654**

Parameter	Units	Trial #1	Trial #2	Trial #3
Direct Verified Concentration of Nitrogen Oxides (NOx)	(ppmvw)	118.37	118.37	118.37
Stack (Native, Unspiked) CO_2 Concentration	(%vw)	5.659	5.739	5.601
Stack (Native, Unspiked) H_2O Concentration	(%)	14.307	12.481	14.786
Stack (Native, Unspiked) NOx Concentration	(ppmvw)	16.149	4.982	5.115
Stack + Spike CO_2 Concentration	(%vw)	5.217	5.181	5.215
Stack + Spike H_2O Concentration	(%)	13.195	13.816	13.617
Stack + Spike NOx Concentration	(ppmvw)	24.709	13.281	13.465
Dilution Factor, calc. from CO_2 (%vw)		0.078	0.097	0.069
Dilution Factor, as the ratio of dir to spk	(ratio)	12.8 : 1	10.3 : 1	14.5 : 1
Expected Concentration of the NOx Spike+Native, CS	(ppmvw)	24.125	15.995	12.932
Method 320 Spiked / Expected NOx	%	102.42	83.03	104.12
Method 320 Passing NOx (70-130%)		YES	YES	YES

Catalytic Combustion Corporation

July 30, 2021

Caterpillar, G3520 TALE

Stewart & Stevenson Integration Center

Trial #1		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	6:22:39	0730-PRE_000049.LAB	191.4	1.00	-0.0302	0.0182	120.7373
07/30/21	6:23:09	0730-PRE_000050.LAB	191.4	1.00	-0.0389	0.0025	121.4913
07/30/21	6:23:39	0730-PRE_000051.LAB	191.4	1.00	-0.0431	-0.0001	121.2086
07/30/21	6:24:09	0730-PRE_000052.LAB	191.4	1.00	-0.0383	-0.0029	120.4047
		Average	**191.4**	**1.00**	**-0.0376**	**0.0044**	**120.9605**

Trial #1		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	7:23:46	0730-PRE_000171.LAB	191.4	1.03	5.6918	13.9245	2.4183
07/30/21	7:24:16	0730-PRE_000172.LAB	191.4	1.03	5.7387	13.4806	2.4016
07/30/21	7:24:46	0730-PRE_000173.LAB	191.4	1.03	5.6194	14.7534	2.4795
07/30/21	7:25:16	0730-PRE_000174.LAB	191.4	1.02	5.5866	15.0709	2.5247
		Average	**191.4**	**1.03**	**5.6591**	**14.3073**	**2.4560**

Trial #1		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	7:27:16	0730-PRE_000178.LAB	191.4	1.03	5.1608	13.8424	11.6753
07/30/21	7:27:46	0730-PRE_000179.LAB	191.4	1.03	5.2530	12.8052	11.8689
07/30/21	7:28:16	0730-PRE_000180.LAB	191.4	1.03	5.2479	12.9054	12.0123
07/30/21	7:28:46	0730-PRE_000181.LAB	191.4	1.03	5.2082	13.2288	12.0099
		Average	**191.4**	**1.03**	**5.2175**	**13.1954**	**11.8916**

Trial #2		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	6:22:39	0730-PRE_000049.LAB	191.4	1.00	-0.0302	0.0182	120.7373
07/30/21	6:23:09	0730-PRE_000050.LAB	191.4	1.00	-0.0389	0.0025	121.4913
07/30/21	6:23:39	0730-PRE_000051.LAB	191.4	1.00	-0.0431	-0.0001	121.2086
07/30/21	6:24:09	0730-PRE_000052.LAB	191.4	1.00	-0.0383	-0.0029	120.4047
		Average	**191.4**	**1.00**	**-0.0376**	**0.0044**	**120.9605**

Trial #2		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	14:43:02	0730-PRE_001047.LAB	191.4	1.03	5.7266	12.6880	2.9336
07/30/21	14:43:32	0730-PRE_001048.LAB	191.4	1.03	5.7343	12.5239	2.8088
07/30/21	14:44:02	0730-PRE_001049.LAB	191.4	1.03	5.7369	12.4441	3.0307
07/30/21	14:44:32	0730-PRE_001050.LAB	191.4	1.03	5.7460	12.4431	2.9345
		Average	**191.4**	**1.03**	**5.7360**	**12.5248**	**2.9269**

Trial #2		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	14:47:32	0730-PRE_001056.LAB	191.5	1.03	5.2360	13.3371	11.4735
07/30/21	14:48:02	0730-PRE_001057.LAB	191.5	1.02	5.1899	13.6994	11.3942
07/30/21	14:48:32	0730-PRE_001058.LAB	191.4	1.02	5.1590	13.9761	11.3660
07/30/21	14:49:02	0730-PRE_001059.LAB	191.5	1.02	5.1399	14.2498	11.5300
		Average	**191.5**	**1.02**	**5.1812**	**13.8156**	**11.4409**

Trial #3		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005	
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	6:22:39	0730-PRE_000049.LAB	191.4	1.00	-0.0302	0.0182	120.7373
07/30/21	6:23:09	0730-PRE_000050.LAB	191.4	1.00	-0.0389	0.0025	121.4913
07/30/21	6:23:39	0730-PRE_000051.LAB	191.4	1.00	-0.0431	-0.0001	121.2086
07/30/21	6:24:09	0730-PRE_000052.LAB	191.4	1.00	-0.0383	-0.0029	120.4047
		Average	**191.4**	**1.00**	**-0.0376**	**0.0044**	**120.9605**

Trial #3		Pre-Spike - Native Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	14:50:03	0730-PRE_001061.LAB	191.5	1.02	5.5992	14.9701	2.9415
07/30/21	14:50:32	0730-PRE_001062.LAB	191.5	1.02	5.5984	14.7950	2.9191
07/30/21	14:51:02	0730-PRE_001063.LAB	191.4	1.02	5.6097	14.6418	2.8402
07/30/21	14:51:32	0730-PRE_001064.LAB	191.4	1.02	5.5973	14.7381	2.8936
		Average	**191.4**	**1.02**	**5.6012**	**14.7862**	**2.8986**

Trial #3		Spiked Samples					
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	CO
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)
07/30/21	14:53:03	0730-PRE_001067.LAB	191.4	1.02	5.1934	13.8151	11.4955
07/30/21	14:53:33	0730-PRE_001068.LAB	191.4	1.03	5.2220	13.6576	11.5884
07/30/21	14:54:03	0730-PRE_001069.LAB	191.4	1.02	5.2084	13.5414	11.5316
07/30/21	14:54:33	0730-PRE_001070.LAB	191.4	1.03	5.2343	13.4546	11.4985
		Average	**191.4**	**1.03**	**5.2145**	**13.6172**	**11.5285**

Parameter	Units	Trial #1	Trial #2	Trial #3
Direct Verified Concentration of Carbon Monoxide (CO)	(ppmvw)	120.96	120.96	120.96
Stack (Native, Unspiked) CO_2 Concentration	(%vw)	5.659	5.736	5.601
Stack (Native, Unspiked) H_2O Concentration	(%)	14.307	12.525	14.786
Stack (Native, Unspiked) CO Concentration	(ppmvw)	2.456	2.927	2.899
Stack + Spike CO_2 Concentration	(%vw)	5.217	5.181	5.215
Stack + Spike H_2O Concentration	(%)	13.195	13.816	13.617
Stack + Spike CO Concentration	(ppmvw)	11.892	11.441	11.529
Dilution Factor, calc. from CO_2 (%vw)		0.078	0.097	0.069
Dilution Factor, as the ratio of dir to spk	(ratio)	12.8 : 1	10.3 : 1	14.5 : 1
Expected Concentration of the CO Spike+Native, CS	(ppmvw)	11.704	14.343	11.048
Method 320 Spiked / Expected CO	%	101.60	79.77	104.35
Method 320 Passing CO (70-130%)		YES	YES	YES

Catalytic Combustion Corporation

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Caterpillar, G3520 TALE

Stewart & Stevenson Integration Center

Trial #1		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005		
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	6:25:40	0730-PRE_000055.LAB	191.4	1.00	0.0066	0.0047	5.6053	46.2794
07/30/21	6:26:10	0730-PRE_000056.LAB	191.4	1.00	0.0073	-0.0029	5.6165	47.4824
07/30/21	6:26:40	0730-PRE_000057.LAB	191.4	1.00	-0.0018	0.0002	5.6054	48.0103
07/30/21	6:27:10	0730-PRE_000058.LAB	191.4	1.00	-0.0025	-0.0030	5.6293	48.0884
		Average	**191.4**	**1.00**	**0.0024**	**-0.0002**	**5.6141**	**47.4651**

Trial #1		Pre-Spike - Native Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	16:08:24	0730-R2_000146.LAB	191.4	1.02	5.7713	13.7720	-0.0059	3.6044
07/30/21	16:08:54	0730-R2_000147.LAB	191.4	1.02	5.7267	13.9990	-0.0055	3.7065
07/30/21	16:09:24	0730-R2_000148.LAB	191.4	1.02	5.7083	14.1170	-0.0069	3.7018
07/30/21	16:09:54	0730-R2_000149.LAB	191.4	1.02	5.7255	14.1603	-0.0066	4.5399
		Average	**191.4**	**1.02**	**5.7330**	**14.0121**	**-0.0062**	**3.8881**

Trial #1		Spiked Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	16:12:54	0730-R2_000155.LAB	191.4	1.02	5.2999	13.0120	0.4156	7.8255
07/30/21	16:13:24	0730-R2_000156.LAB	191.4	1.02	5.3080	12.8405	0.4238	7.8915
07/30/21	16:13:54	0730-R2_000157.LAB	191.4	1.03	5.3199	12.7503	0.4258	7.8579
07/30/21	16:14:25	0730-R2_000158.LAB	191.5	1.03	5.3166	12.7834	0.4263	7.4489
		Average	**191.4**	**1.03**	**5.3111**	**12.8465**	**0.4229**	**7.7559**

Trial #2		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005		
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	6:25:40	0730-PRE_000055.LAB	191.4	1.00	0.0066	0.0047	5.6053	46.2794
07/30/21	6:26:10	0730-PRE_000056.LAB	191.4	1.00	0.0073	-0.0029	5.6165	47.4824
07/30/21	6:26:40	0730-PRE_000057.LAB	191.4	1.00	-0.0018	0.0002	5.6054	48.0103
07/30/21	6:27:10	0730-PRE_000058.LAB	191.4	1.00	-0.0025	-0.0030	5.6293	48.0884
		Average	**191.4**	**1.00**	**0.0024**	**-0.0002**	**5.6141**	**47.4651**

Trial #2		Pre-Spike - Native Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	16:15:55	0730-R2_000161.LAB	191.4	1.02	5.7123	14.0511	-0.0053	4.6214
07/30/21	16:16:25	0730-R2_000162.LAB	191.4	1.02	5.7120	14.1027	-0.0031	3.8296
07/30/21	16:16:55	0730-R2_000163.LAB	191.5	1.02	5.4558	17.3753	-0.0039	4.3182
07/30/21	16:17:25	0730-R2_000164.LAB	191.5	1.02	5.6095	15.7793	-0.0044	3.8522
		Average	**191.4**	**1.02**	**5.6224**	**15.3271**	**-0.0042**	**4.1554**

Trial #2		Spiked Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	16:18:55	0730-R2_000167.LAB	191.4	1.03	5.2392	13.7149	0.4266	7.5391
07/30/21	16:19:25	0730-R2_000168.LAB	191.5	1.02	5.2282	13.8275	0.4253	7.4193
07/30/21	16:19:55	0730-R2_000169.LAB	191.5	1.03	5.2383	13.7240	0.4255	7.7933
07/30/21	16:20:25	0730-R2_000170.LAB	191.5	1.03	5.2524	13.6092	0.4256	7.9073
		Average	**191.5**	**1.03**	**5.2395**	**13.7189**	**0.4257**	**7.6648**

Trial #3		Spike Gas Direct Verification				FTIR: 509/ INST-IR-0005		
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	6:25:40	0730-PRE_000055.LAB	191.4	1.00	0.0066	0.0047	5.6053	46.2794
07/30/21	6:26:10	0730-PRE_000056.LAB	191.4	1.00	0.0073	-0.0029	5.6165	47.4824
07/30/21	6:26:40	0730-PRE_000057.LAB	191.4	1.00	-0.0018	0.0002	5.6054	48.0103
07/30/21	6:27:10	0730-PRE_000058.LAB	191.4	1.00	-0.0025	-0.0030	5.6293	48.0884
		Average	**191.4**	**1.00**	**0.0024**	**-0.0002**	**5.6141**	**47.4651**

Trial #3		Pre-Spike - Native Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	16:21:25	0730-R2_000172.LAB	191.5	1.02	5.7333	13.6223	-0.0018	3.9788
07/30/21	16:21:55	0730-R2_000173.LAB	191.5	1.02	5.7138	14.0067	-0.0041	3.9006
07/30/21	16:22:25	0730-R2_000174.LAB	191.4	1.02	5.7115	14.1215	-0.0078	3.8331
07/30/21	16:22:56	0730-R2_000175.LAB	191.5	1.02	5.6979	14.2024	-0.0028	4.1707
		Average	**191.5**	**1.02**	**5.7142**	**13.9882**	**-0.0041**	**3.9708**

Trial #3		Spiked Samples						
Date	Time	Spectrum	Cell Temp	Cell Press	CO_2	H_2O	SF_6	C_2H_4O
(mm/dd/yy)	(hh:mm:ss)	(File Name)	(°C)	(atm)	(%vw)	(%)	(ppmvw)	(ppmvw)
07/30/21	16:23:56	0730-R2_000177.LAB	191.4	1.02	5.1967	14.0712	0.4185	7.4727
07/30/21	16:24:26	0730-R2_000178.LAB	191.4	1.03	5.2160	13.7566	0.4194	7.6900
07/30/21	16:24:56	0730-R2_000179.LAB	191.5	1.03	5.2569	13.4089	0.4242	7.6490
07/30/21	16:25:26	0730-R2_000180.LAB	191.4	1.03	5.2622	13.4270	0.4228	7.9476
		Average	**191.4**	**1.03**	**5.2329**	**13.6659**	**0.4212**	**7.6898**

Parameter	Units	Trial #1	Trial #2	Trial #3
Direct Verified Concentration of Sulfur Hexafluoride (SF_6)	(ppmvw)	5.61	5.61	5.61
Direct Verified Concentration of Acetaldehyde (C_2H_4O)	(ppmvw)	47.47	47.47	47.47
Stack (Native, Unspiked) CO_2 Concentration	(%vw)	5.733	5.622	5.714
Stack (Native, Unspiked) H_2O Concentration	(%)	14.012	15.327	13.988
Stack (Native, Unspiked) SF_6 Concentration	(ppmvw)	-0.006	-0.004	-0.004
Stack (Native, Unspiked) C_2H_4O Concentration	(ppmvw)	3.888	4.155	3.971
Stack + Spike CO_2 Concentration	(%vw)	5.311	5.240	5.233
Stack + Spike H_2O Concentration	(%)	12.847	13.719	13.666
Stack + Spike SF_6 Concentration	(ppmvw)	0.423	0.426	0.421
Stack + Spike C_2H_4O Concentration	(ppmvw)	7.756	7.665	7.690
Dilution Factor, calc. from SF_6 (ppmvw)		0.076	0.077	0.076
Dilution Factor, as the ratio of dir to spk	(ratio)	13.1 : 1	13.1 : 1	13.2 : 1
Expected Concentration of the SF_6 Spike+Native, CS	(ppmvw)	0.423	0.426	0.422
Expected Concentration of the C_2H_4O Spike+Native, CS	(ppmvw)	7.219	7.472	7.266
Method 320 Spiked / Expected SF_6	%	99.89	99.93	99.93
Method 320 Spiked / Expected C_2H_4O	%	107.44	102.58	105.83
Method 320 Passing SF_6 (70-130%)		YES	YES	YES
Method 320 Passing C_2H_4O (70-130%)		YES	YES	YES

QUALITY ASSURANCE AND QUALITY CONTROL DATA

50% Load
PM Laboratory Data

SAMPLE RECOVERY AND INTEGRITY DATA SHEET

Plant Name	Stewart and Stevenson Integration Center	**Date**	07/28/21
Sampling Location	Caterpillar G3520 TALE	**Operator**	JLW
Project #	catc-21-houston.tx-start#1		

Run History Data				
Run Number	R-1 50%-1	R-1 50%-2	R-1 50%-3	
Run Start Time	09:34	12:05	14:23	(hh:mm)
Run Stop Time	11:24	13:59	15:58	(hh:mm)
Train Prepared By	PKM	PKM	PKM	
Train Recovered By	PKM	PKM	PKM	
Recovery Date	07/29/21	07/29/21	07/29/21	(mm/dd/yy)
Relinquished By	PKM	PKM	PKM	
Relinquished Date	08/02/21	08/02/21	08/02/21	(mm/dd/yy)

Equipment Identification Numbers			
Impinger Case	samp-BH-0018	samp-BH-0018	samp-BH-0018
Sample Box	samp-cc-0011	samp-cc-0011	samp-cc-0011
PM Filter	00713	0652	0722
CPM Filter	R-1 50%-1-CPM	R-1 50%-2-CPM	R-1 50%-3-CPM

Sample Blank Taken ☑ YES

Moisture Content Data					
Impingers 1, 2, and 3 - Liquid Weight					
Final Weight	(W_f)	1789.8	1796.4	1801.3	g
Initial Weight	(W_i)	1672.1	1678.6	1686.0	g
Net Weight	(W_n)	117.7	117.8	115.3	g
Comments					
Impinger 4 - Silica Gel Weight					
Final Weight	(W_f)	856.2	823.4	863.2	g
Initial Weight	(W_i)	847.8	816.5	856.2	g
Net Weight	(W_n)	8.4	6.9	7.0	g
Comments					
Total Water Collected					
Total Weight	(W_{lc})	126.1	124.7	122.3	g
Total Volume	(V_{lc})	126.3	124.9	122.5	ml

SAMPLE ANALYTICAL DATA SHEET

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Analytical Data		**Run**	R-1 50%-1		
Sample Leakage Evident	NO	**Estimated Leak Volume**		0.00	(mg)

Sample Type	Sample Number	Date	Time
Filter	0652	08/11/21	14:10
Probe Wash	250-747	08/11/21	14:10
Inorganic Impinger Contents	250-302	08/11/21	14:10
Organic Impinger Contents	439	08/11/21	14:10

Weight Data			**Run**		1	**Start Time**	09:34
Filter and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	48.7912	08/17/21	07:43	45%	66.6		
Measurement 2	48.7914	08/17/21	14:14	43%	68.9		
Probe Wash and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	125.9982	08/17/21	07:43	45%	66.6		
Measurement 2	125.9986	08/17/21	14:14	43%	68.9		
Inorganic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	118.6959	08/17/21	07:43	45%	66.6		
Measurement 2	118.6962	08/17/21	14:14	43%	68.9		
Organic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	1.7596	08/17/21	07:43	45%	66.6		
Measurement 2	1.7597	08/17/21	14:14	43%	68.9		

Blank and Titration Concentrations				
Blank Type	**Weight**	**Volume**	**Concentration**	**Mass**
	(g)	(ml)	(mg/ml)	(mg)
Acetone Blank Weight of Solids	0.0004	137.0000	0.002555	--
DI Water Blank Weight of Solids	0.0002	224.0000	0.000759	--
Hexane Blank Weight of Solids	0.0000	123.0000	0.000000	--
0.1N NH_4OH Correction	--	0.0000	--	0.0000

Gravimetric Concentrations			**Run**		1	**Start Time**	09:34
Sample Portion	**Final**	**Tare**	**Gain**	**Volume**	**Blank Adjustment**	**Adjusted Gain**	
	(g)	(g)	(mg)	(ml)	(mg)	(mg)	
Filter	48.7913	0.3503	2.7000	--	--	2.7000	
Filter Beaker		48.4383		--	--		
Probe Wash	125.9984	125.9889	9.5000	200.0000	0.5109	8.9891	
Inorganic Impinger Contents	118.6961	118.6933	2.7500	333.3080	1.2703	1.4797	
Organic Impinger Contents	1.7597	1.7540	5.6500	66.0000	0.7297	4.9203	

SAMPLE ANALYTICAL DATA SHEET

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Analytical Data		**Run**	R-1 50%-2		
Sample Leakage Evident	NO	**Estimated Leak Volume**		0.00	(mg)

Sample Type	Sample Number	Date	Time
Filter	0713	08/11/21	14:10
Probe Wash	250-494	08/11/21	14:10
Inorganic Impinger Contents	250-685	08/11/21	14:10
Organic Impinger Contents	430	08/11/21	14:10

Weight Data			**Run**		2	**Start Time**	12:05
Filter and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	68.0982	08/17/21	07:43	45%	66.6		
Measurement 2	68.0984	08/17/21	14:14	43%	68.9		
Probe Wash and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	120.7377	08/17/21	07:43	45%	66.6		
Measurement 2	120.7381	08/17/21	14:14	43%	68.9		
Inorganic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	122.7244	08/17/21	07:43	45%	66.6		
Measurement 2	122.7249	08/17/21	14:14	43%	68.9		
Organic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	1.7682	08/17/21	07:43	45%	66.6		
Measurement 2	1.7683	08/17/21	14:14	43%	68.9		

Blank and Titration Concentrations				
Blank Type	**Weight**	**Volume**	**Concentration**	**Mass**
	(g)	(ml)	(mg/ml)	(mg)
Acetone Blank Weight of Solids	0.0004	137.0000	0.002555	--
DI Water Blank Weight of Solids	0.0002	224.0000	0.000759	--
Hexane Blank Weight of Solids	0.0000	123.0000	0.000000	--
0.1N NH_4OH Correction	--	0.0000	--	0.0000

Gravimetric Concentrations			**Run**		2	**Start Time**	12:05
Sample Portion	**Final**	**Tare**	**Gain**	**Volume**	**Blank Adjustment**	**Adjusted Gain**	
	(g)	(g)	(mg)	(ml)	(mg)	(mg)	
Filter	68.0983	0.3468	5.2000	--	--	5.2000	
Filter Beaker		67.7464		--	--		
Probe Wash	120.7379	120.7318	6.1000	162.0000	0.4139	5.6861	
Inorganic Impinger Contents	122.7247	122.7208	3.8500	342.5887	1.2703	2.5797	
Organic Impinger Contents	1.7683	1.7665	1.8000	60.0000	0.7297	1.0703	

SAMPLE ANALYTICAL DATA SHEET

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Analytical Data		**Run**	R-1 50%-3		
Sample Leakage Evident	NO	**Estimated Leak Volume**		0.00	(mg)

Sample Type	Sample Number	Date	Time
Filter	0722	08/11/21	14:10
Probe Wash	250-665	08/11/21	14:10
Inorganic Impinger Contents	250-741	08/11/21	14:10
Organic Impinger Contents	446	08/11/21	14:10

Weight Data			**Run**		3	**Start Time**	14:23
Filter and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	48.2665	08/17/21	07:43	45%	66.6		
Measurement 2	48.2668	08/17/21	14:14	43%	68.9		
Probe Wash and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	123.1212	08/17/21	07:43	45%	66.6		
Measurement 2	123.1211	08/17/21	14:14	43%	68.9		
Inorganic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	127.5165	08/17/21	07:43	45%	66.6		
Measurement 2	127.5170	08/17/21	14:14	43%	68.9		
Organic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	1.7761	08/17/21	07:43	45%	66.6		
Measurement 2	1.7763	08/17/21	14:14	43%	68.9		

Blank and Titration Concentrations				
Blank Type	**Weight**	**Volume**	**Concentration**	**Mass**
	(g)	(ml)	(mg/ml)	(mg)
Acetone Blank Weight of Solids	0.0004	137.0000	0.002555	--
DI Water Blank Weight of Solids	0.0002	224.0000	0.000759	--
Hexane Blank Weight of Solids	0.0000	123.0000	0.000000	--
0.1N NH_4OH Correction	--	0.0000	--	0.0000

Gravimetric Concentrations			**Run**		3	**Start Time**	14:23
Sample Portion	**Final**	**Tare**	**Gain**	**Volume**	**Blank Adjustment**	**Adjusted Gain**	
	(g)	(g)	(mg)	(ml)	(mg)	(mg)	
Filter	48.2667	0.3583	2.3500	--	--	2.3500	
Filter Beaker		47.9060		--	--		
Probe Wash	123.1212	123.1152	5.9500	124.0000	0.3168	5.6332	
Inorganic Impinger Contents	127.5168	127.5147	2.1000	407.1970	1.2703	0.8297	
Organic Impinger Contents	1.7762	1.7746	1.6000	72.0000	0.7297	0.8703	

SAMPLE ANALYTICAL DATA SHEET

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Analytical Data		**Run**	R-1 50%-FB		
Sample Leakage Evident	NO	**Estimated Leak Volume**		0.00	(mg)

Sample Type	Sample Number	Date	Time
Inorganic Impinger Contents	250-478	08/11/21	14:10
Organic Impinger Contents	464	08/11/21	14:10

Weight Data			**Run**		R-1 50%-FB	**Start Time**	
Inorganic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	121.8241	08/17/21	07:43	45%	66.6		
Measurement 2	121.8246	08/17/21	14:14	43%	68.9		
Organic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	1.7720	08/17/21	07:43	45%	66.6		
Measurement 2	1.7721	08/17/21	14:14	43%	68.9		

Gravimetric Concentrations					
Sample Portion	**Final**	**Tare**	**Gain**		**Actual Gain**
	(g)	(g)	(mg)		(mg)
Inorganic Impinger Contents	121.8244	121.8220	1.2703	max 2 mg total blank adjustment, proportioned	2.3500
Organic Impinger Contents	1.7721	1.7707	0.7297		1.3500

EQUIPMENT / INSTRUMENTATION IDENTIFICATION

Equipment / Instrumentation	Identification No.
Acetone Lot	20120533
Hexane Lot	21030109
Filterable Particulate Matter Oven ID	SAMP-OV-0007
Condensable Particulate Matter Oven ID	SAMP-OV-0008
Sonic Bath ID	SAMP-UB-0001
SAMP-SC-0003 Scale Weight Set ID (1st weights)	LABS-WT-0001
SAMP-SC-0003 Scale Weight Set ID (2nd weights)	
SAMP-SC-0003 Scale Weight Set ID (3rd weights)	
SAMP-SC-0003 Scale Weight Set ID (4th weights)	

Requested Standard Analysis - 5-10 business days after receipt at lab

SAMPLE DESCRIPTION AND LABELING RECORD

Contact Information (deliver results to)
Name:
Phone: (918) 307-8865
Email:

Air Hygiene International, Inc.
1600 W Tacoma Street
Broken Arrow, Oklahoma 74012
(888) 461-8778
www.airhygiene.com

Project Number:	catc-21-houston.tx-start#1	Laboratory Analysis Requested:
Person Taking Samples:	JLW	Gravimetric

Sample Number	Location	Date	Volume	Analysis Method			
				RM 5	RM 202	--	--
R-1 50%-1-F	40 Unit R-1 50% - Run 1 - Filter	07/29/21	N/A	X	100-284	0652	
R-1 50%-1-PW	41 Unit R-1 50% - Run 1 - Probe Wash	07/29/21	Sheets	X	28-741	200	
R-1 50%-1-IC	42 Unit R-1 50% - Run 1 - Inorganic Impinger Contents	07/29/21			X	28-302	440
R-1 50%-1-Hex	43 Unit R-1 50% - Organic Impinger Contents	07/29/21			X	439	66
R-1 50%-1-CPM	44 Unit R-1 50% - Run 1 - CPM Filter	07/29/21	N/A		X		
R-1 50%-2-F	45 Unit R-1 50% - Run 2 - Filter	07/29/21	N/A	X	100-648	0713	
R-1 50%-2-PW	46 Unit R-1 50% - Run 2 - Probe Wash	07/29/21	Sheets	X	28-494	162	
R-1 50%-2-IC	47 Unit R-1 50% - Run 2 - Inorganic Impinger Contents	07/29/21			X	28-685	460
R-1 50%-2-Hex	48 Unit R-1 50% - Organic Impinger Contents	07/29/21			X	430	60
R-1 50%-2-CPM	49 Unit R-1 50% - Run 2 - CPM Filter	07/29/21	N/A		X		
R-1 50%-3-F	50 Unit R-1 50% - Run 3 - Filter	07/29/21	N/A	X	100-782	0722	
R-1 50%-3-PW	51 Unit R-1 50% - Run 3 - Probe Wash	07/29/21	Sheets	X	28-665	124	
R-1 50%-3-IC	52 Unit R-1 50% - Run 3 - Inorganic Impinger Contents	07/29/21			X	28-741	520
R-1 50%-3-Hex	53 Unit R-1 50% - Organic Impinger Contents	07/29/21			X	446	72
R-1 50%-3-CPM	54 Unit R-1 50% - Run 3 - CPM Filter	07/29/21	N/A		X		
R-1 50%-FB-IC	70 Unit R-1 50% - Run FB - Inorganic Impinger Contents	FB			X	28-478	375
R-1 50%-FB-Hex	71 Unit R-1 50% - Run FB - Organic Impinger Contents	FB			X	464	74
R-1 50%-FB-CPM	72 Unit R-1 50% - Run FB - CPM Filter	FB	N/A		X		
R-1 50%-B1-Acetone	210 810-37 Unit R-1 50% - Blank - Acetone	07/30/21	200		X	491	137
R-1 50%-B2-DI Water	38 Unit R-1 50% - Blank - DI Water	07/30/21	200	X		100-652	224
R-1 50%-B3-Hexane	39 Unit R-1 50% - Blank - Hexane	07/30/21	200		X	507	123

Signature 8/2/21 13:30 Date Time

Signature 8/5/21 10:40 Date Time

Signature Date Time

Signature Date Time

QUALITY ASSURANCE AND QUALITY CONTROL DATA

75% Load
PM Laboratory Data

SAMPLE RECOVERY AND INTEGRITY DATA SHEET

Plant Name	Stewart and Stevenson Integration Center	**Date**	07/28/21
Sampling Location	Caterpillar G3520 TALE	**Operator**	JLW
Project #	catc-21-houston.tx-start#1		

Run History Data				
Run Number	R-1 75%-1	R-1 75%-2	R-1 75%-3	
Run Start Time	08:08	13:17	15:25	(hh:mm)
Run Stop Time	09:42	14:56	17:01	(hh:mm)
Train Prepared By	PKM	PKM	PKM	
Train Recovered By	PKM	PKM	PKM	
Recovery Date	07/30/21	07/30/21	07/30/21	(mm/dd/yy)
Relinquished By	PKM	PKM	PKM	
Relinquished Date	08/02/21	08/02/21	08/02/21	(mm/dd/yy)

Equipment Identification Numbers			
Impinger Case	samp-BH-0018	samp-BH-0018	samp-BH-0018
Sample Box	samp-cc-0011	samp-cc-0011	samp-cc-0011
PM Filter	0523	0916	0917
CPM Filter	R-1 75%-1-CPM	R-1 75%-2-CPM	R-1 75%-3-CPM

Sample Blank Taken ☑ YES

Moisture Content Data					
Impingers 1, 2, and 3 - Liquid Weight					
Final Weight	(W_f)	1854.3	1851.5	1846.1	g
Initial Weight	(W_i)	1685.4	1689.6	1688.9	g
Net Weight	(W_n)	168.9	161.9	157.2	g
Comments					
Impinger 4 - Silica Gel Weight					
Final Weight	(W_f)	832.6	872.9	834.4	g
Initial Weight	(W_i)	823.4	863.2	823.3	g
Net Weight	(W_n)	9.2	9.7	11.1	g
Comments					
Total Water Collected					
Total Weight	(W_{lc})	178.1	171.6	168.3	g
Total Volume	(V_{lc})	178.4	171.9	168.6	ml

SAMPLE ANALYTICAL DATA SHEET

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Analytical Data		**Run**	R-1 75%-1		
Sample Leakage Evident	NO	**Estimated Leak Volume**		0.00	(mg)

Sample Type	Sample Number	Date	Time
Filter	0523	08/11/21	14:10
Probe Wash	250-853	08/11/21	14:10
Inorganic Impinger Contents	250-338	08/11/21	14:10
Organic Impinger Contents	438	08/11/21	14:10

Weight Data			**Run**		1	**Start Time**	08:08
Filter and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	69.3936	08/17/21	07:43	45%	66.6		
Measurement 2	69.3938	08/17/21	14:14	43%	68.9		
Probe Wash and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	121.8107	08/17/21	07:43	45%	66.6		
Measurement 2	121.8110	08/17/21	14:14	43%	68.9		
Inorganic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	112.7466	08/17/21	07:43	45%	66.6		
Measurement 2	112.7470	08/17/21	14:14	43%	68.9		
Organic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	1.7471	08/17/21	07:43	45%	66.6		
Measurement 2	1.7473	08/17/21	14:14	43%	68.9		

Blank and Titration Concentrations				
Blank Type	**Weight**	**Volume**	**Concentration**	**Mass**
	(g)	(ml)	(mg/ml)	(mg)
Acetone Blank Weight of Solids	0.0004	137.0000	0.002555	--
DI Water Blank Weight of Solids	0.0002	224.0000	0.000759	--
Hexane Blank Weight of Solids	0.0000	123.0000	0.000000	--
0.1N NH_4OH Correction	--	0.0000	--	0.0000

Gravimetric Concentrations			**Run**		1	**Start Time**	08:08
Sample Portion	**Final**	**Tare**	**Gain**	**Volume**	**Blank Adjustment**	**Adjusted Gain**	
	(g)	(g)	(mg)	(ml)	(mg)	(mg)	
Filter	69.3937	0.3451	1.2500	--	--	1.2500	
Filter Beaker		69.0474		--	--		
Probe Wash	121.8109	121.8075	3.4000	134.0000	0.3423	3.0577	
Inorganic Impinger Contents	112.7468	112.7446	2.2000	279.2016	1.2703	0.9297	
Organic Impinger Contents	1.7472	1.7456	1.6000	118.0000	0.7297	0.8703	

SAMPLE ANALYTICAL DATA SHEET

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Analytical Data		**Run**	R-1 75%-2		
Sample Leakage Evident	NO	**Estimated Leak Volume**		0.00	(mg)

Sample Type	Sample Number	Date	Time
Filter	0916	08/11/21	14:10
Probe Wash	250-506	08/11/21	14:10
Inorganic Impinger Contents	250-510	08/11/21	14:10
Organic Impinger Contents	463	08/11/21	14:10

Weight Data			**Run**		2	**Start Time**	13:17
Filter and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	66.5723	08/17/21	07:43	45%	66.6		
Measurement 2	66.5724	08/17/21	14:14	43%	68.9		
Probe Wash and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	119.5037	08/17/21	07:43	45%	66.6		
Measurement 2	119.5042	08/17/21	14:14	43%	68.9		
Inorganic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	115.4424	08/17/21	07:43	45%	66.6		
Measurement 2	115.4429	08/17/21	14:14	43%	68.9		
Organic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	1.7476	08/17/21	07:43	45%	66.6		
Measurement 2	1.7478	08/17/21	14:14	43%	68.9		

Blank and Titration Concentrations				
Blank Type	**Weight**	**Volume**	**Concentration**	**Mass**
	(g)	(ml)	(mg/ml)	(mg)
Acetone Blank Weight of Solids	0.0004	137.0000	0.002555	--
DI Water Blank Weight of Solids	0.0002	224.0000	0.000759	--
Hexane Blank Weight of Solids	0.0000	123.0000	0.000000	--
0.1N NH_4OH Correction	--	0.0000	--	0.0000

Gravimetric Concentrations			**Run**		2	**Start Time**	13:17
Sample Portion	**Final**	**Tare**	**Gain**	**Volume**	**Blank Adjustment**	**Adjusted Gain**	
	(g)	(g)	(mg)	(ml)	(mg)	(mg)	
Filter	66.5724	0.3617	0.9000	--	--	0.9000	
Filter Beaker		66.2098		--	--		
Probe Wash	119.5040	119.4984	5.5500	210.0000	0.5365	5.0135	
Inorganic Impinger Contents	115.4427	115.4407	2.0000	320.5219	1.2703	0.7297	
Organic Impinger Contents	1.7477	1.7463	1.4500	102.0000	0.7297	0.7203	

SAMPLE ANALYTICAL DATA SHEET

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Analytical Data		**Run**	R-1 75%-3		
Sample Leakage Evident	NO	**Estimated Leak Volume**		0.00	(mg)

Sample Type	Sample Number	Date	Time
Filter	0917	08/11/21	14:10
Probe Wash	250-497	08/11/21	14:10
Inorganic Impinger Contents	250-748	08/11/21	14:10
Organic Impinger Contents	455	08/11/21	14:10

Weight Data			**Run**		3	**Start Time**	15:25
Filter and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	49.3830	08/17/21	07:43	45%	66.6		
Measurement 2	49.3833	08/17/21	14:14	43%	68.9		
Probe Wash and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	119.3830	08/17/21	07:43	45%	66.6		
Measurement 2	119.3834	08/17/21	14:14	43%	68.9		
Inorganic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	125.3623	08/17/21	07:43	45%	66.6		
Measurement 2	125.3624	08/17/21	14:14	43%	68.9		
Organic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	1.7394	08/17/21	07:43	45%	66.6		
Measurement 2	1.7395	08/17/21	14:14	43%	68.9		

Blank and Titration Concentrations				
Blank Type	**Weight**	**Volume**	**Concentration**	**Mass**
	(g)	(ml)	(mg/ml)	(mg)
Acetone Blank Weight of Solids	0.0004	137.0000	0.002555	--
DI Water Blank Weight of Solids	0.0002	224.0000	0.000759	--
Hexane Blank Weight of Solids	0.0000	123.0000	0.000000	--
0.1N NH_4OH Correction	--	0.0000	--	0.0000

Gravimetric Concentrations			**Run**		3	**Start Time**	15:25
Sample Portion	**Final**	**Tare**	**Gain**	**Volume**	**Blank Adjustment**	**Adjusted Gain**	
	(g)	(g)	(mg)	(ml)	(mg)	(mg)	
Filter	49.3832	0.3598	1.0000	--	--	1.0000	
Filter Beaker		49.0224		--	--		
Probe Wash	119.3832	119.3800	3.2500	140.0000	0.3577	2.8923	
Inorganic Impinger Contents	125.3624	125.3607	1.7000	319.6203	1.2703	0.4297	
Organic Impinger Contents	1.7395	1.7377	1.7500	96.0000	0.7297	1.0203	

SAMPLE ANALYTICAL DATA SHEET

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Analytical Data		**Run**	R-1 75%-FB		
Sample Leakage Evident	NO	**Estimated Leak Volume**		0.00	(mg)

Sample Type	Sample Number	Date	Time
Inorganic Impinger Contents	250-478	08/11/21	14:10
Organic Impinger Contents	464	08/11/21	14:10

Weight Data			**Run**		R-1 75%-FB	**Start Time**	
Inorganic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	121.8241	08/17/21	07:43	45%	66.6		
Measurement 2	121.8246	08/17/21	14:14	43%	68.9		
Organic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	1.7720	08/17/21	07:43	45%	66.6		
Measurement 2	1.7721	08/17/21	14:14	43%	68.9		

Gravimetric Concentrations					
Sample Portion	**Final**	**Tare**	**Gain**		**Actual Gain**
	(g)	(g)	(mg)		(mg)
Inorganic Impinger Contents	121.8244	121.8220	1.2703	max 2 mg total blank adjustment, proportioned	2.3500
Organic Impinger Contents	1.7721	1.7707	0.7297		1.3500

Requested Standard Analysis - 5-10 business days after receipt at lab

SAMPLE DESCRIPTION AND LABELING RECORD

Contact Information (deliver results to)
Name: Pat McGovern, Jr.
Phone: (918) 307-8865
Email:

Air Hygiene International, Inc.
1600 W Tacoma Street
Broken Arrow, Oklahoma 74012
(888) 461-8778
www.airhygiene.com

Project Number:	catc-21-houston.tx-start#1
Person Taking Samples:	JLW

Sample Number	Location	Date	Volume	Laboratory Analysis Requested: Gravimetric Analysis Method RM 5	RM 202	--	--
R-1 75%-1-F	21 0810-54 Unit R-1 75% - Run 1 - Filter	07/30/21	N/A	X	1a-746	0523	
R-1 75%-1-PW	56 Unit R-1 75% - Run 1 - Probe Wash	07/30/21	5 rec's	X	250-853	134	
R-1 75%-1-IC	57 Unit R-1 75% - Run 1 - Inorganic Impinger Contents	07/30/21			X	250-338	445
R-1 75%-1-Hex	58 Unit R-1 75% - Run 1 - Organic Impinger Contents	07/30/21			X	438	118
R-1 75%-1-CPM	59 Unit R-1 75% - Run 1 - CPM Filter	07/30/21	N/A		X		
R-1 75%-2-F	60 Unit R-1 75% - Run 2 - Filter	07/30/21	N/A	X	1a-633	0916	
R-1 75%-2-PW	61 Unit R-1 75% - Run 2 - Probe Wash	07/30/21		X	250-506	210	
R-1 75%-2-IC	62 Unit R-1 75% - Run 2 - Inorganic Impinger Contents	07/30/21			X	250-510	475
R-1 75%-2-Hex	63 Unit R-1 75% - Run 2 - Organic Impinger Contents	07/30/21			X	463	102
R-1 75%-2-CPM	64 Unit R-1 75% - Run 2 - CPM Filter	07/30/21	N/A		X		
R-1 75%-3-F	65 Unit R-1 75% - Run 3 - Filter	07/30/21	N/A	X	101-083	0917	
R-1 75%-3-PW	66 Unit R-1 75% - Run 3 - Probe Wash	07/30/21		X	250-497	140	
R-1 75%-3-IC	67 Unit R-1 75% - Run 3 - Inorganic Impinger Contents	07/30/21			X	250-748	475
R-1 75%-3-Hex	68 Unit R-1 75% - Run 3 - Organic Impinger Contents	07/30/21			X	455	96
R-1 75%-3-CPM	69 Unit R-1 75% - Run 3 - CPM Filter	07/30/21	N/A		X		

Signature	Date	Time		Signature	Date	Time
[signature]	8/2/21	13:30	@ log	[signature]	8/3/21	10:00
Signature	Date	Time		Signature	Date	Time

A: 2020533

QUALITY ASSURANCE AND QUALITY CONTROL DATA

100% Load
PM Laboratory Data

SAMPLE RECOVERY AND INTEGRITY DATA SHEET

Plant Name	Stewart and Stevenson Integration Center	**Date**	08/31/21
Sampling Location	Caterpillar G3520 TALE	**Operator**	TP
Project #	catc-21-houston.tx-start#1		

Run History Data				
Run Number	R-1 100%-1	R-1 100%-2	R-1 100%-3	
Run Start Time	09:36	12:05	14:24	(hh:mm)
Run Stop Time	11:17	13:44	16:05	(hh:mm)
Train Prepared By	PKM	PKM	PKM	
Train Recovered By	PKM	PKM	PKM	
Recovery Date	07/30/21	07/30/21	07/30/21	(mm/dd/yy)
Relinquished By	PKM	PKM	PKM	
Relinquished Date	08/02/21	08/02/21	08/02/21	(mm/dd/yy)

Equipment Identification Numbers			
Impinger Case	samp-BH-0036	samp-BH-0036	samp-BH-0036
Sample Box	samp-cc-0009	samp-cc-0009	samp-cc-0009
PM Filter	0523	0916	0917
CPM Filter	R-1 100%-1-CPM	R-1 100%-2-CPM	R-1 100%-3-CPM

Sample Blank Taken ☑ YES

Moisture Content Data					
Impingers 1, 2, and 3 - Liquid Weight					
Final Weight	(W_f)	1857.9	1854.1	1950.7	g
Initial Weight	(W_i)	1668.8	1669.4	1717.6	g
Net Weight	(W_n)	189.1	184.7	233.1	g
Comments					
Impinger 4 - Silica Gel Weight					
Final Weight	(W_f)	874.3	860.1	870.7	g
Initial Weight	(W_i)	859.2	844.5	855.4	g
Net Weight	(W_n)	15.1	15.6	15.3	g
Comments					
Total Water Collected					
Total Weight	(W_{lc})	204.2	200.3	248.4	g
Total Volume	(V_{lc})	204.6	200.7	248.8	ml

SAMPLE ANALYTICAL DATA SHEET

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Analytical Data		**Run**	R-1 100%-1		
Sample Leakage Evident	NO	**Estimated Leak Volume**		0.00	(mg)

Sample Type	Sample Number	Date	Time
Filter	1023	09/10/21	15:42
Probe Wash	250-726	09/10/21	15:42
Inorganic Impinger Contents	250-802	09/10/21	15:42
Organic Impinger Contents	0597	09/10/21	15:42

Weight Data			**Run**		1	**Start Time**	09:36
Filter and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	48.0276	09/14/21	11:15	45%	68		
Measurement 2	48.0279	09/15/21	13:55	45%	68		
Probe Wash and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	122.1851	09/14/21	11:15	45%	68		
Measurement 2	122.1854	09/15/21	13:55	45%	68		
Inorganic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	126.0307	09/14/21	11:15	45%	68		
Measurement 2	126.0310	09/15/21	13:55	45%	68		
Organic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	1.7512	09/14/21	11:15	45%	68		
Measurement 2	1.7513	09/15/21	13:55	45%	68		

Blank and Titration Concentrations				
Blank Type	**Weight**	**Volume**	**Concentration**	**Mass**
	(g)	(ml)	(mg/ml)	(mg)
Acetone Blank Weight of Solids	0.0000	420.0000	0.000000	--
DI Water Blank Weight of Solids	0.0001	240.0000	0.000417	--
Hexane Blank Weight of Solids	0.0002	430.0000	0.000349	--
0.1N NH_4OH Correction	--	0.0000	--	0.0000

Gravimetric Concentrations			**Run**		1	**Start Time**	09:36
Sample Portion	**Final**	**Tare**	**Gain**	**Volume**	**Blank Adjustment**	**Adjusted Gain**	
	(g)	(g)	(mg)	(ml)	(mg)	(mg)	
Filter	48.0278	0.3602	-0.4000	--	--	0.0000	
Filter Beaker		47.6680		--	--		
Probe Wash	122.1853	122.1817	3.6000	140.0000	0.0000	3.6000	
Inorganic Impinger Contents	126.0309	126.0276	3.2500	484.3659	1.5904	1.6596	
Organic Impinger Contents	1.7513	1.7501	1.2000	80.0000	0.4096	0.7904	

SAMPLE ANALYTICAL DATA SHEET

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Analytical Data		**Run**	R-1 100%-2		
Sample Leakage Evident	NO	**Estimated Leak Volume**		0.00	(mg)

Sample Type	Sample Number	Date	Time
Filter	0806	09/10/21	15:42
Probe Wash	250-846	09/10/21	15:42
Inorganic Impinger Contents	250-857	09/10/21	15:42
Organic Impinger Contents	0594	09/10/21	15:42

Weight Data			**Run**		2	**Start Time**	12:05
Filter and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	67.0374	09/14/21	11:15	45%	68		
Measurement 2	67.0376	09/15/21	13:55	45%	68		
Probe Wash and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	123.8782	09/14/21	11:15	45%	68		
Measurement 2	123.8785	09/15/21	13:55	45%	68		
Inorganic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	123.3015	09/14/21	11:15	45%	68		
Measurement 2	123.3018	09/15/21	13:55	45%	68		
Organic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	1.7514	09/14/21	11:15	45%	68		
Measurement 2	1.7515	09/15/21	13:55	45%	68		

Blank and Titration Concentrations				
Blank Type	**Weight**	**Volume**	**Concentration**	**Mass**
	(g)	(ml)	(mg/ml)	(mg)
Acetone Blank Weight of Solids	0.0000	420.0000	0.000000	--
DI Water Blank Weight of Solids	0.0001	240.0000	0.000417	--
Hexane Blank Weight of Solids	0.0002	430.0000	0.000349	--
0.1N NH_4OH Correction	--	0.0000	--	0.0000

Gravimetric Concentrations			**Run**		2	**Start Time**	12:05
Sample Portion	**Final**	**Tare**	**Gain**	**Volume**	**Blank Adjustment**	**Adjusted Gain**	
	(g)	(g)	(mg)	(ml)	(mg)	(mg)	
Filter	67.0375	0.3586	-0.6500	--	--	0.0000	
Filter Beaker		66.6796		--	--		
Probe Wash	123.8784	123.8773	1.0500	235.0000	0.0000	1.0500	
Inorganic Impinger Contents	123.3017	123.3002	1.5000	509.0743	1.5904	0.0000	
Organic Impinger Contents	1.7515	1.7505	1.0000	66.0000	0.4096	0.5904	

SAMPLE ANALYTICAL DATA SHEET

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Analytical Data		**Run**	R-1 100%-3		
Sample Leakage Evident	NO	**Estimated Leak Volume**		0.00	(mg)

Sample Type	Sample Number	Date	Time
Filter	0852	09/10/21	15:42
Probe Wash	250-357	09/10/21	15:42
Inorganic Impinger Contents	250-083	09/10/21	15:42
Organic Impinger Contents	0584	09/10/21	15:42

Weight Data			**Run**		3	**Start Time**	14:24
Filter and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	68.7259	09/14/21	11:15	45%	68		
Measurement 2	68.7262	09/15/21	13:55	45%	68		
Probe Wash and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	113.7084	09/14/21	11:15	45%	68		
Measurement 2	113.7087	09/15/21	13:55	45%	68		
Inorganic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	101.7787	09/14/21	11:15	45%	68		
Measurement 2	101.7791	09/15/21	13:55	45%	68		
Organic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	1.7379	09/14/21	11:15	45%	68		
Measurement 2	1.7380	09/15/21	13:55	45%	68		

Blank and Titration Concentrations				
Blank Type	**Weight**	**Volume**	**Concentration**	**Mass**
	(g)	(ml)	(mg/ml)	(mg)
Acetone Blank Weight of Solids	0.0000	420.0000	0.000000	--
DI Water Blank Weight of Solids	0.0001	240.0000	0.000417	--
Hexane Blank Weight of Solids	0.0002	430.0000	0.000349	--
0.1N NH_4OH Correction	--	0.0000	--	0.0000

Gravimetric Concentrations			**Run**		3	**Start Time**	14:24
Sample Portion	**Final**	**Tare**	**Gain**	**Volume**	**Blank Adjustment**	**Adjusted Gain**	
	(g)	(g)	(mg)	(ml)	(mg)	(mg)	
Filter	68.7261	0.3657	-0.3000	--	--	0.0000	
Filter Beaker		68.3607		--	--		
Probe Wash	113.7086	113.7088	-0.2500	190.0000	-0.2500	0.0000	
Inorganic Impinger Contents	101.7789	101.7746	4.3000	480.0862	1.5904	2.7096	
Organic Impinger Contents	1.7380	1.7375	0.4500	60.0000	0.4096	0.0404	

SAMPLE ANALYTICAL DATA SHEET

Plant Name	Stewart and Stevenson Integration Center
Sampling Location	Caterpillar G3520 TALE
Project #	catc-21-houston.tx-start#1

Analytical Data		**Run**	R-1 100%-FB		
Sample Leakage Evident	NO	**Estimated Leak Volume**		0.00	(mg)

Sample Type	Sample Number	Date	Time
Inorganic Impinger Contents	250-374	09/10/21	15:42
Organic Impinger Contents	0571	09/10/21	15:42

Weight Data			**Run**		R-1 100%-FB	**Start Time**	
Inorganic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	116.6108	09/14/21	11:15	45%	68		
Measurement 2	116.6112	09/15/21	13:55	45%	68		
Organic Impinger Contents and Beaker Weight	**Weight**	**Date**	**Time**	**Humidity**	**Temp**	**Calibration Audit**	
	(g)	(mm/dd/yy)	(hh:mm)	(%)	°F	(g)	
Measurement 1	1.7403	09/14/21	11:15	45%	68		
Measurement 2	1.7404	09/15/21	13:55	45%	68		

Gravimetric Concentrations					**Actual Gain**
Sample Portion	**Final**	**Tare**	**Gain**		
	(g)	(g)	(mg)		(mg)
Inorganic Impinger Contents	116.6110	116.6077	1.5904	max 2 mg total blank adjustment, proportioned	3.3000
Organic Impinger Contents	1.7404	1.7395	0.4096		0.8500

EQUIPMENT / INSTRUMENTATION IDENTIFICATION

Equipment / Instrumentation	Identification No.
Acetone Lot	21040287
Hexane Lot	21030109
Filterable Particulate Matter Oven ID	LABS-OV-0007
Condensable Particulate Matter Oven ID	LABS-0V-0008
Sonic Bath ID	LABS-UB-0001
LABS-SC-0004 Scale Weight Set ID (1st weights)	LABS-WT--0001
LABS-SC-0004 Scale Weight Set ID (2nd weights)	LABS-WT--0001
LABS-SC-0004 Scale Weight Set ID (3rd weights)	
LABS-SC-0004 Scale Weight Set ID (4th weights)	

A - 21040287
H - 2103010 9

Requested Standard Analysis - 5-10 business days after receipt at lab

SAMPLE DESCRIPTION AND LABELING RECORD

Contact Information (deliver results to)

Name: Matt McBride
Phone: (918) 307-8865
Email: mmcbride@airhygiene.com

Air Hygiene International, Inc.
1600 W Tacoma Street
Broken Arrow, Oklahoma 74012
(888) 461-8778
www.airhygiene.com

Project Number:	catc-21-houston.tx-start#1	Laboratory Analysis Requested:
Person Taking Samples:	TP	Gravimetric

Sample Number	Location	Date	Volume	Analysis Method			
				RM 5	RM 202	--	--
R-1 100%-1-F	4 Unit R-1 100% - Run 1 - Filter	08/31/21	N/A	X		1023	100-766
R-1 100%-1-PW	5 Unit R-1 100% - Run 1 - Probe Wash	08/31/21	As Marked	X		140mL	250-726
R-1 100%-1-IC	6 Unit R-1 100% - Run 1 - Inorganic Impinger Contents	08/31/21	As Marked		X	670mL	250-802
R-1 100%-1-Hex	7 Unit R-1 100% - Run 1 - Organic Impinger Contents	08/31/21	As Marked		X	80mL	597
R-1 100%-1-CPM	8 Unit R-1 100% - Run 1 - CPM Filter	08/31/21	N/A		X		
R-1 100%-2-F	9 Unit R-1 100% - Run 2 - Filter	08/31/21	N/A	X		806	100-669
R-1 100%-2-PW	10 Unit R-1 100% - Run 2 - Probe Wash	08/31/21	As Marked	X		235mL	250-846
R-1 100%-2-IC	11 Unit R-1 100% - Run 2 - Inorganic Impinger Contents	08/31/21	As Marked		X	690mL	250-857
R-1 100%-2-Hex	12 Unit R-1 100% - Run 2 - Organic Impinger Contents	08/31/21	As Marked		X	66mL	594
R-1 100%-2-CPM	13 Unit R-1 100% - Run 2 - CPM Filter	08/31/21	N/A		X		
R-1 100%-3-F	14 Unit R-1 100% - Run 3 - Filter	08/31/21	N/A	X		852	100-745
R-1 100%-3-PW	15 Unit R-1 100% - Run 3 - Probe Wash	08/31/21	As Marked	X		190mL	250-357
R-1 100%-3-IC	16 Unit R-1 100% - Run 3 - Inorganic Impinger Contents	08/31/21	As Marked		X	710mL	250-083
R-1 100%-3-Hex	17 Unit R-1 100% - Run 3 - Organic Impinger Contents	08/31/21	As Marked		X	60mL	584
R-1 100%-3-CPM	18 Unit R-1 100% - Run 3 - CPM Filter	08/31/21	N/A		X		
R-1 100%-FB-IC	19 Unit R-1 100% - Run FB - Inorganic Impinger Contents	FB	As Marked		X	385mL	250-374
R-1 100%-FB-Hex	20 Unit R-1 100% - Run FB - Organic Impinger Contents	FB	As Marked		X	80mL	571
R-1 100%-FB-CPM	21 Unit R-1 100% - Run FB - CPM Filter	FB	N/A		X		
R-1 100%-B1-Acetone	22 1y907-1. Unit R-1 100% - Blank - Acetone	08/31/21	200		X	420mL	606
R-1 100%-B2-DI Water	2 Unit R-1 100% - Blank - DI Water	08/31/21	200	X		240mL	100-658
R-1 100%-B3-Hexane	3 Unit R-1 100% - Blank - Hexane	08/31/21	200		X	430mL	610

Signature	Date	Time	Signature	Date	Time
	9/2/21	21:00	@ Lab	9/3/21	9:00
Signature	Date	Time	Signature	Date	Time

APPENDIX E

FUEL ANALYSIS RECORDS

Client: Catalytic Combustion Corporation
Location: Stewart & Stevenson Integration Center
Date: July 29, 2021
Project #: catc-21-houston.tx-start#1

Natural Gas - Fuel Analysis

Standardized to 68 deg F and 14.696 psia - EPA Standards

Gas Component		Mole (%)	Molecular[1] Weight (lb/lb-mole)	Lbs Component per Lb-Mole of Gas	Wt. % of Component	Ideal Gross[1,3] Heating Value (Btu/ft^3)	Fuel Heat Value [HHV] (Btu/SCF)	Ideal Net[1,3] Heating Value (Btu/ft^3)	Fuel Heat Value [LHV] (Btu/SCF)
Methane	CH_4	98.3548	16.0430	15.78	96.76	994.85	978.48	895.75	881.02
Ethane	C_2H_6	1.1343	30.0700	0.34	2.09	1,743.15	19.77	1,594.41	18.09
Propane	C_3H_8	0.0197	44.0970	0.01	0.05	2,478.35	0.49	2,280.17	0.45
iso-Butane	iC_4H_{10}	0.0005	58.1230	0.00	0.00	3,203.11	0.02	2,955.38	0.01
n-Butane	nC_4H_{10}	0.0005	58.1230	0.00	0.00	3,213.35	0.02	2,965.62	0.01
Iso-Pentane	iC_5H_{12}	0.0000	72.1500	0.00	0.00	3,940.87	0.00	3,643.50	0.00
n-Pentane	nC_5H_{12}	0.0000	72.1500	0.00	0.00	3,948.75	0.00	3,648.32	0.00
Hexanes	C_6H_{14}	0.0001	86.1770	0.00	0.00	4,684.54	0.00	4,337.82	0.00
Heptanes	C_7H_{16}	0.0000	100.2040	0.00	0.00	5,419.94	0.00	5,023.77	0.00
Octanes	C_8H_{18}	0.0000	114.2310	0.00	0.00	6,155.14	0.00	5,709.23	0.00
Carbon Dioxide	CO_2	0.2558	44.0100	0.11	0.69	0.00	0.00	0.00	0.00
Nitrogen	N_2	0.2239	28.0134	0.06	0.38	0.00	0.00	0.00	0.00
Hydrogen Sulfide	H_2S	0.0000	34.0800	0.00	0.00	627.54	0.00	578.00	0.00
Oxygen	O_2	0.0057	31.9988	0.00	0.01	0.00	0.00	0.00	0.00
Helium	He	0.0000	4.0026	0.00	0.00	0.00	0.00	0.00	0.00
Hydrogen	H_2	0.0047	2.0159	0.00	0.00	319.34	0.02	269.82	0.01
Totals		**100.0000**		**16.31**	**100.00**	**dry**	**998.79**	**dry**	**899.60**
						wet[2,5]	**975.76**	**wet[2,5]**	**878.86**

Characteristics of Fuel Gas		
Molecular Weight of gas =	16.307	lb/lb-mole
Btu per lb. of gas[4] =	23,595.430	gross (HHV)
Btu per lb. of gas[4] =	21,252.128	net (LHV)
Density of fuel gas[2] =	0.0423	lb/cu. ft
Wt % VOC in fuel gas =	0.06	%
Specific Gravity[1] =	0.5630	

Component	Wt%
carbon	74.35
oxygen	0.51
hydrogen	24.75
nitrogen	0.38
helium	0.00
sulfur	0.00
Total	**100.00**

F-Factor (SCF dry exhaust per MMBtu [HHV]) = 8,631.70
(Based on EPA RM-19) at 68 deg F and 14.696 psia

F-Factor Calculation:

F-Factor = 1,000,000*((3.64*%H)+(1.53*%C)+(0.57*%S)+(0.14*%N)-(0.46*%O))/GCV

GCV = Gross Btu per lb. of gas (HHV)

%H, %C, %S, %N, & %O are percent weight values calculated from fuel analysis and have units of (scf/lb)/%

Density of natural gas based on specific gravity multiplied by density of air at 68 deg F and 14.696 psia.

References:

[1] ASTM D 3588

[2] Civil Engineering Reference Manual, 7th ed. - Michael R. Lindeburg

[3] Mark's Standard Handbook for Mechanical Engineers, 10th ed. - Eugene A. Avallone, Theodore Baumeister III

[4] Introduction to Fluid Mechanics, 3rd ed. - William S. Janna

[5] GPA Reference Bulletin 181-86, revised 1986, reprinted 1995

Client: Catalytic Combustion Corporation
Location: Stewart & Stevenson Integration Center
Date: July 30, 2021
Project #: catc-21-houston.tx-start#1

Natural Gas - Fuel Analysis

Standardized to 68 deg F and 14.696 psia - EPA Standards

Gas Component		Mole (%)	Molecular[1] Weight (lb/lb-mole)	Lbs Component per Lb-Mole of Gas	Wt. % of Component	Ideal Gross[1,3] Heating Value (Btu/ft^3)	Fuel Heat Value [HHV] (Btu/SCF)	Ideal Net[1,3] Heating Value (Btu/ft^3)	Fuel Heat Value [LHV] (Btu/SCF)
Methane	CH_4	98.2687	16.0430	15.77	96.57	994.85	977.62	895.75	880.25
Ethane	C_2H_6	1.2050	30.0700	0.36	2.22	1,743.15	21.00	1,594.41	19.21
Propane	C_3H_8	0.0205	44.0970	0.01	0.06	2,478.35	0.51	2,280.17	0.47
iso-Butane	iC_4H_{10}	0.0003	58.1230	0.00	0.00	3,203.11	0.01	2,955.38	0.01
n-Butane	nC_4H_{10}	0.0002	58.1230	0.00	0.00	3,213.35	0.01	2,965.62	0.01
Iso-Pentane	iC_5H_{12}	0.0000	72.1500	0.00	0.00	3,940.87	0.00	3,643.50	0.00
n-Pentane	nC_5H_{12}	0.0000	72.1500	0.00	0.00	3,948.75	0.00	3,648.32	0.00
Hexanes	C_6H_{14}	0.0003	86.1770	0.00	0.00	4,684.54	0.01	4,337.82	0.01
Heptanes	C_7H_{16}	0.0000	100.2040	0.00	0.00	5,419.94	0.00	5,023.77	0.00
Octanes	C_8H_{18}	0.0000	114.2310	0.00	0.00	6,155.14	0.00	5,709.23	0.00
Carbon Dioxide	CO_2	0.2992	44.0100	0.13	0.81	0.00	0.00	0.00	0.00
Nitrogen	N_2	0.1976	28.0134	0.06	0.34	0.00	0.00	0.00	0.00
Hydrogen Sulfide	H_2S	0.0000	34.0800	0.00	0.00	627.54	0.00	578.00	0.00
Oxygen	O_2	0.0033	31.9988	0.00	0.01	0.00	0.00	0.00	0.00
Helium	He	0.0000	4.0026	0.00	0.00	0.00	0.00	0.00	0.00
Hydrogen	H_2	0.0049	2.0159	0.00	0.00	319.34	0.02	269.82	0.01
Totals		**100.000**		**16.33**	**100.00**	**dry**	**999.18**	**dry**	**899.97**
						wet[2,5]	**976.14**	**wet[2,5]**	**879.22**

Characteristics of Fuel Gas		
Molecular Weight of gas =	16.325	lb/lb-mole
Btu per lb. of gas[4] =	23,577.669	gross (HHV)
Btu per lb. of gas[4] =	21,236.549	net (LHV)
Density of fuel gas[2] =	0.0424	lb/cu. ft
Wt % VOC in fuel gas =	0.06	%
Specific Gravity[1] =	0.5637	

Component	Wt%
carbon	74.34
oxygen	0.59
hydrogen	24.73
nitrogen	0.34
helium	0.00
sulfur	0.00
Total	**100.00**

F-Factor (SCF dry exhaust per MMBtu [HHV]) = 8,632.09
(Based on EPA RM-19) at 68 deg F and 14.696 psia

F-Factor Calculation:

F-Factor = 1,000,000*((3.64*%H)+(1.53*%C)+(0.57*%S)+(0.14*%N)-(0.46*%O))/GCV

GCV = Gross Btu per lb. of gas (HHV)

%H, %C, %S, %N, & %O are percent weight values calculated from fuel analysis and have units of (scf/lb)/%

Density of natural gas based on specific gravity multiplied by density of air at 68 deg F and 14.696 psia.

References:

[1] ASTM D 3588

[2] Civil Engineering Reference Manual, 7th ed. - Michael R. Lindeburg

[3] Mark's Standard Handbook for Mechanical Engineers, 10th ed. - Eugene A. Avallone, Theodore Baumeister III

[4] Introduction to Fluid Mechanics, 3rd ed. - William S. Janna

[5] GPA Reference Bulletin 181-86, revised 1986, reprinted 1995

Client: Catalytic Combustion Corporation
Location: Stewart & Stevenson Integration Center
Date: August 31, 2021
Project #: catc-21-houston.tx-start#1

Natural Gas - Fuel Analysis

Standardized to 68 deg F and 14.696 psia - EPA Standards

Gas Component		Mole (%)	Molecular[1] Weight (lb/lb-mole)	Lbs Component per Lb-Mole of Gas	Wt. % of Component	Ideal Gross[1,3] Heating Value (Btu/ft^3)	Fuel Heat Value [HHV] (Btu/SCF)	Ideal Net[1,3] Heating Value (Btu/ft^3)	Fuel Heat Value [LHV] (Btu/SCF)
Methane	CH_4	98.4117	16.0430	15.79	96.85	994.85	979.04	895.75	881.53
Ethane	C_2H_6	1.0600	30.0700	0.32	1.96	1,743.15	18.48	1,594.41	16.90
Propane	C_3H_8	0.0198	44.0970	0.01	0.05	2,478.35	0.49	2,280.17	0.45
iso-Butane	iC_4H_{10}	0.0003	58.1230	0.00	0.00	3,203.11	0.01	2,955.38	0.01
n-Butane	nC_4H_{10}	0.0002	58.1230	0.00	0.00	3,213.35	0.01	2,965.62	0.01
Iso-Pentane	iC_5H_{12}	0.0000	72.1500	0.00	0.00	3,940.87	0.00	3,643.50	0.00
n-Pentane	nC_5H_{12}	0.0000	72.1500	0.00	0.00	3,948.75	0.00	3,648.32	0.00
Hexanes	C_6H_{14}	0.0000	86.1770	0.00	0.00	4,684.54	0.00	4,337.82	0.00
Heptanes	C_7H_{16}	0.0000	100.2040	0.00	0.00	5,419.94	0.00	5,023.77	0.00
Octanes	C_8H_{18}	0.0000	114.2310	0.00	0.00	6,155.14	0.00	5,709.23	0.00
Carbon Dioxide	CO_2	0.2813	44.0100	0.12	0.76	0.00	0.00	0.00	0.00
Nitrogen	N_2	0.2106	28.0134	0.06	0.36	0.00	0.00	0.00	0.00
Hydrogen Sulfide	H_2S	0.0000	34.0800	0.00	0.00	627.54	0.00	578.00	0.00
Oxygen	O_2	0.0115	31.9988	0.00	0.02	0.00	0.00	0.00	0.00
Helium	He	0.0000	4.0026	0.00	0.00	0.00	0.00	0.00	0.00
Hydrogen	H_2	0.0046	2.0159	0.00	0.00	319.34	0.01	269.82	0.01
Totals		**100.0000**		**16.30**	**100.00**	**dry**	**998.04**	**dry**	**898.91**
						wet[2,5]	**975.03**	**wet[2,5]**	**878.18**

Characteristics of Fuel Gas		
Molecular Weight of gas =	16.303	lb/lb-mole
Btu per lb. of gas[4] =	23,583.835	gross (HHV)
Btu per lb. of gas[4] =	21,241.243	net (LHV)
Density of fuel gas[2] =	0.0423	lb/cu. ft
Wt % VOC in fuel gas =	0.06	%
Specific Gravity[1] =	0.5629	

Component	Wt%
carbon	74.32
oxygen	0.57
hydrogen	24.74
nitrogen	0.36
helium	0.00
sulfur	0.00
Total	**100.00**

F-Factor (SCF dry exhaust per MMBtu [HHV]) = 8,631.42
(Based on EPA RM-19) at 68 deg F and 14.696 psia

F-Factor Calculation:

F-Factor = 1,000,000*((3.64*%H)+(1.53*%C)+(0.57*%S)+(0.14*%N)-(0.46*%O))/GCV
GCV = Gross Btu per lb. of gas (HHV)
%H, %C, %S, %N, & %O are percent weight values calculated from fuel analysis and have units of (scf/lb)/%
Density of natural gas based on specific gravity multiplied by density of air at 68 deg F and 14.696 psia.

References:

[1] ASTM D 3588
[2] Civil Engineering Reference Manual, 7th ed. - Michael R. Lindeburg
[3] Mark's Standard Handbook for Mechanical Engineers, 10th ed. - Eugene A. Avallone, Theodore Baumeister III
[4] Introduction to Fluid Mechanics, 3rd ed. - William S. Janna
[5] GPA Reference Bulletin 181-86, revised 1986, reprinted 1995

Certificate of Analysis

SINCE 1985

Quality Controlled Through Analysis

10630 FALLSTONE RD. HOUSTON, TEXAS 77099
P.O. BOX 741905, HOUSTON, TEXAS 77274

TEL: (281) 495-2400
FAX: (281) 495-2410

CLIENT:	Air Hygiene International	**REQUESTED BY:**	Dr. Sean Barnes
CLIENT PROJECT:	catc-21-houston-start#1	**PURCHASE ORDER NO:**	PENDING
LABORATORY NO:	95248-001 Page 1 of 2	**REPORT DATE:**	August 06, 2021
SAMPLE:	Natural Gas (Primary # 4651) (4651) 2021-07-29		

Composition of Natural Gas by Gas Chromatography (TCD/FID), GPA 2261

	Results, Mol %
Hydrogen	0.0047
Oxygen	0.0057
Nitrogen	0.2239
Carbon Dioxide	0.2558
Methane	98.3548
Ethane	1.1343
Propane	0.0197
iso-Butane	0.0005
n-Butane	0.0005
iso-Pentane	0.0000
n-Pentane	0.0000
Hexane Plus	0.0001
TOTAL	**100.0000**

Calorific Value and Specific Gravity, Calculated at 14.696 psia and 60°F, ASTM D 3588.e

	Results
NET (Dry basis), BTU/scf	913.3
Gross (Dry basis), BTU/scf	1,014
NET (Dry basis), BTU/lb	21,257
Gross (Dry basis), BTU/lb	23,599

Calorific Value and Specific Gravity, Calculated at 14.696 psia and 68°F, ASTM D 3588.e

	Results
NET (Dry basis), BTU/scf	899.5
Gross (Dry basis), BTU/scf	998.6
NET (Dry basis), BTU/lb	21,257
Gross (Dry basis), BTU/lb	23,599

Cert # L19-636,C2018-02457
Quality Management System Certified to ISO 9001:2015, and ISO/IEC 17025:2017
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Quality Controlled Through Analysis

10630 FALLSTONE RD. HOUSTON, TEXAS 77099
P.O. BOX 741905, HOUSTON, TEXAS 77274

TEL: (281) 495-2400
FAX: (281) 495-2410

CLIENT:	Air Hygiene International	**REQUESTED BY:**	Dr. Sean Barnes
CLIENT PROJECT:	catc-21-houston-start#1	**PURCHASE ORDER NO:**	PENDING
LABORATORY NO:	95248-001 Page 2 of 2	**REPORT DATE:**	August 06, 2021
SAMPLE:	Natural Gas (Primary # 4651) (4651) 2021-07-29		

Respectfully submitted
For Texas OilTech Laboratories, L.P.

Mr. Ikenna “Ike” Ezeji
Laboratory Director

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Quality Controlled Through Analysis

10630 FALLSTONE RD. HOUSTON, TEXAS 77099
P.O. BOX 741905, HOUSTON, TEXAS 77274

TEL: (281) 495-2400
FAX: (281) 495-2410

CLIENT:	Air Hygiene International	**REQUESTED BY:**	Dr. Sean Barnes
CLIENT PROJECT:	catc-21-houston-start#1	**PURCHASE ORDER NO:**	PENDING
LABORATORY NO:	95248-003 Page 1 of 2	**REPORT DATE:**	August 06, 2021
SAMPLE:	Natural Gas (Primary # 4893) (4893) 2021-07-30		

Composition of Natural Gas by Gas Chromatography (TCD/FID), GPA 2261

	Results, Mol %
Hydrogen	0.0049
Oxygen	0.0033
Nitrogen	0.1976
Carbon Dioxide	0.2992
Methane	98.2687
Ethane	1.2050
Propane	0.0205
iso-Butane	0.0003
n-Butane	0.0002
iso-Pentane	0.0000
n-Pentane	0.0000
Hexane Plus	0.0003
TOTAL	**100.0000**

Calorific Value and Specific Gravity, Calculated at 14.696 psia and 60°F, ASTM D 3588.e

	Results
NET (Dry basis), BTU/scf	913.7
Gross (Dry basis), BTU/scf	1,014
NET (Dry basis), BTU/lb	21,241
Gross (Dry basis), BTU/lb	23,581

Calorific Value and Specific Gravity, Calculated at 14.696 psia and 68°F, ASTM D 3588.e

	Results
NET (Dry basis), BTU/scf	899.8
Gross (Dry basis), BTU/scf	999.0
NET (Dry basis), BTU/lb	21,241
Gross (Dry basis), BTU/lb	23,581

Cert # L19-636,C2018-02457
Quality Management System Certified to ISO 9001:2015, and ISO/IEC 17025:2017
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Certificate of Analysis

SINCE 1985

Quality Controlled Through Analysis

10630 FALLSTONE RD. HOUSTON, TEXAS 77099
P.O. BOX 741905, HOUSTON, TEXAS 77274

TEL: (281) 495-2400
FAX: (281) 495-2410

CLIENT:	Air Hygiene International	**REQUESTED BY:**	Dr. Sean Barnes
CLIENT PROJECT:	catc-21-houston-start#1	**PURCHASE ORDER NO:**	PENDING
LABORATORY NO:	95248-003 Page 2 of 2	**REPORT DATE:**	August 06, 2021
SAMPLE:	Natural Gas (Primary # 4893) (4893) 2021-07-30		

Respectfully submitted
For Texas OilTech Laboratories, L.P.

Mr. Ikenna “Ike” Ezeji
Laboratory Director

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TEL: (281) 495-2400
FAX: (281) 495-2410

Conversion Factors (Gas Analysis) to adjust BTU/ft^3 and Sulfur content @60ºF and 68ºF

NET (Dry Basis) BTU/scf @60ºF, factor= 1

NET (Dry Basis) BTU/scf @68ºF, factor= 0.984839

Gross (Dry Basis) BTU/scf @60ºF, factor = 1

Gross (Dry Basis) BTU/scf @68ºF, factor = 0.984839

NET (Dry Basis) BTU/lb @60ºF, factor = 1

NET (Dry Basis) BTU/lb @68ºF, factor = 1

GROSS (Dry Basis) BTU/lb @60ºF, factor= 1

GROSS (Dry Basis) BTU/lb @68ºF, factor= 1

Sulfur Total Volatile, ASTM D 6667 @60ºF, wt% or ppmwt, factor= 1

Sulfur Total Volatile, ASTM D 6667 @68ºF, wt% or ppmwt, factor= 0.984839

Sulfur Total Volatile, ASTM D 6667 @60ºF, grains/100scf = ppmwt @60ºF x 0.0300

Sulfur Total Volatile, ASTM D 6667 @68ºF, grains/100scf = ppmwt @60ºF x 0.0295

Conversion Factors (Liquid Fuel Analysis)

Liquid Fuel BTU/lb @60ºF= Liquid fuel BTU/lb @68ºF

Cert. No.: 0005085, 17025
Quality Management System Certified to ISO 9001:2008, and ISO 17025:2005

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SAMPLE DESCRIPTION AND CHAIN OF CUSTODY RECORD

pmcgovern@airhygiene.com

Air Hygiene International, Inc.
1600 W Tacoma Street
Broken Arrow, Oklahoma 74012
(888) 461-8778
www.airhygiene.com

Project Number:	catc-21-houston.tx-start#1	Laboratory Analysis Requested:	
Person Taking Samples:	C.King	Fuel Component Analysis	

Sample Number	Location	Date	Volume	Analysis Method(s) [and target(s)]						
				GPA2261/ASTM 1945 [component analysis]						
4651	Natural Gas Sample [Primary]	07/29/21		x						
4611	Natural Gas Sample [Backup]	07/29/21		as necessary						
4893	Natural Gas Sample [primary]	7/30/21		X						
5109	Natural Gas Sample [backup]	7/30/21		as necessary						
	~~Natural Gas Sample [primary]~~			~~X~~						
	~~Natural Gas Sample [backup]~~			~~as necessary~~						

Relinquished by: (Signature) — Date: 8/2/21 — Time: 13:30

Received by: (Signature) — Date: 8/3/21 — Time: 10:47

Relinquished by: (Signature) — Date: — Time:

Received by: (Signature) — Date: — Time:

Certificate of Analysis

SINCE 1985
Quality Controlled Through Analysis

10630 FALLSTONE RD. HOUSTON, TEXAS 77099
P.O. BOX 741905, HOUSTON, TEXAS 77274

TEL: (281) 495-2400
FAX: (281) 495-2410

CLIENT:	Air Hygiene International	**REQUESTED BY:**	Dr. Sean Barnes
CLIENT PROJECT:	catc-21-Houston-Tx-Start#1	**PURCHASE ORDER NO:**	21011220
LABORATORY NO:	95477-001	**REPORT DATE:**	September 08, 2021
SAMPLE:	Primary Fuel line (3713) 2021-08-31		

TEST **RESULT**

Composition of Natural Gas by Gas Chromatography (TCD/FID), GPA 2261

	Results, Mol %
Hydrogen	0.0046
Oxygen	0.0115
Nitrogen	0.2106
Carbon Dioxide	0.2813
Methane	98.4117
Ethane	1.0600
Propane	0.0198
iso-Butane	0.0003
n-Butane	0.0002
iso-Pentane	0.0000
n-Pentane	0.0000
Hexane Plus	0.0000
TOTAL	**100.0000**

Calorific Value and Specific Gravity, Calculated at 14.696 psia and 60°F, ASTM D 3588.e

	Results
NET (Dry basis), BTU/scf	912.6
Gross (Dry basis), BTU/scf	1,013
NET (Dry basis), BTU/lb	21,246
Gross (Dry basis), BTU/lb	23,587

Calorific Value and Specific Gravity, Calculated at 14.696 psia and 68°F, ASTM D 3588.e

	Results
NET (Dry basis), BTU/scf	898.8
Gross (Dry basis), BTU/scf	997.9
NET (Dry basis), BTU/lb	21,246
Gross (Dry basis), BTU/lb	23,587

Respectfully submitted
For Texas OilTech Laboratories, L.P.

Mr. Ikenna “Ike” Ezeji
Laboratory Director

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SINCE 1985
Quality Controlled Through Analysis

10630 FALLSTONE RD. HOUSTON, TEXAS 77099
P.O. BOX 741905, HOUSTON, TEXAS 77274

TEL: (281) 495-2400
FAX: (281) 495-2410

Conversion Factors (Gas Analysis) to adjust BTU/ft^3 and Sulfur content @60ºF and 68ºF

NET (Dry Basis) BTU/scf @60ºF, factor= 1

NET (Dry Basis) BTU/scf @68ºF, factor= 0.984839

Gross (Dry Basis) BTU/scf @60ºF, factor = 1

Gross (Dry Basis) BTU/scf @68ºF, factor = 0.984839

NET (Dry Basis) BTU/lb @60ºF, factor = 1

NET (Dry Basis) BTU/lb @68ºF, factor = 1

GROSS (Dry Basis) BTU/lb @60ºF, factor= 1

GROSS (Dry Basis) BTU/lb @68ºF, factor= 1

Sulfur Total Volatile, ASTM D 6667 @60ºF, wt% or ppmwt, factor= 1

Sulfur Total Volatile, ASTM D 6667 @68ºF, wt% or ppmwt, factor= 0.984839

Sulfur Total Volatile, ASTM D 6667 @60ºF, grains/100scf = ppmwt @60ºF x 0.0300

Sulfur Total Volatile, ASTM D 6667 @68ºF, grains/100scf = ppmwt @60ºF x 0.0295

Conversion Factors (Liquid Fuel Analysis)

Liquid Fuel BTU/lb @60ºF= Liquid fuel BTU/lb @68ºF

Cert. No.: 0005085, 17025
Quality Management System Certified to ISO 9001:2008, and ISO 17025:2005

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SAMPLE DESCRIPTION AND CHAIN OF CUSTODY RECORD

Air Hygiene International, Inc.
1600 W Tacoma Street
Broken Arrow, Oklahoma 74012
(888) 461-8778
www.airhygiene.com

Project Number:	catc-21-houston.tx-start#1	Laboratory Analysis Requested:	Fuel analysis
Person Taking Samples:	MM	GPA-2261-M	

Sample Number	Location	Date	Volume	Analysis Method			
				GPA-2261-M			
3713	Primary Fuel Line	31-Aug	2000	X			
4108	Primary Fuel Line (Backup Sample)	31-Aug	2000	X (If needed)			

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
	9/2/2021	21:00	Glen Sen Gray	9/3/21	9:00
			N W Alvarez	9/7/21	9:10

APPENDIX F

STRATIFICATION TEST DATA

Source Information	
Company	Catalytic Combustion
Plant Name	Stewart and Stevenson Integration Center
Equipment	Caterpillar engine
Location	Houston, Texas

Test Information	
Date	07/29/21
Project #	catc-21-houston.tx-start#1
Unit Number	G3520 TALE
Load	50%
Number of Ports Available	2
Number of Ports Used	2

Stack and Test Type				
○	Isokinetic Traverse (Wet Chemistry Testing)			**Circular Stack**
○	Velocity Traverse (Flow and Flow RATA Test)			
◉	**Stratification Traverse (Compliance Test)**		☐ RM 20	
○	Stratification Traverse (RATA)	☐ Part 60	☐ Part 75	

Created with Traverse-AHI v20200108

METHOD 1 - STRATIFICATION TEST FOR A CIRCULAR SOURCE

Company	Catalytic Combustion	**Date**	07/29/21
Plant Name	Stewart and Stevenson Integration Center	**Project #**	catc-21-houston.tx-start#1
Equipment	Caterpillar engine	**# of Ports Available**	2
Location	Houston, Texas	**# of Ports Used**	2

Circular Stack or Duct Diameter			
Distance to Far Wall of Stack	(L_{fw})	32.00	in.
Distance to Near Wall of Stack	(L_{nw})	0.125	in.
Diameter of Stack	(D)	31.88	in.
Area of Stack	(A_s)	5.54	ft^2

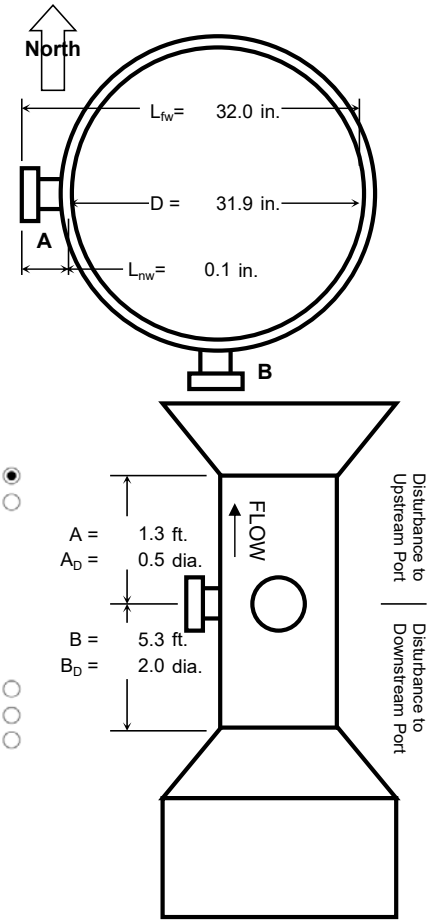
Distance from Disturbances to Port			
Distance Upstream	(A)	16.00	in.
Diameters Upstream	(A_D)	0.50	diameters
Distance Downstream	(B)	64.00	in.
Diameters Downstream	(B_D)	2.01	diameters

Number of Traverse Points Required					
Diameters to		Minimum Number of[1]		**Minimum Number of**	
Flow Disturbance		Traverse Points		**Traverse Points**	
Down (B_D)	Up (A_D)	Particulate	Velocity	**Comp Stratification**	
Stream	Stream	Points	Points	**Criteria**	**Points**
2.00-4.99	0.50-1.24	24	16	RM 7E 8.1.2	12 RM1 pts
5.00-5.99	1.25-1.49	20	16	Alt 7E 8.1.2	3 points
6.00-6.99	1.50-1.74	16	12	12 points	
7.00-7.99	1.75-1.99	12	12		
>= 8.00	>=2.00	8 or 12[2]	8 or 12[2]	Minimum Number of	
Upstream Spec		24	16	Traverse Points	
Downstream Spec		24	16	RATA Stratification	
Traverse Pts Required		24	16	Criteria	Points
				Part75/60	12 RM1 pts
				75 abrv (a)	3 points
				75 abrv (b)	6 points

[1] Check Minimum Number of Points for the Upstream and Downstream conditions, then use the largest.

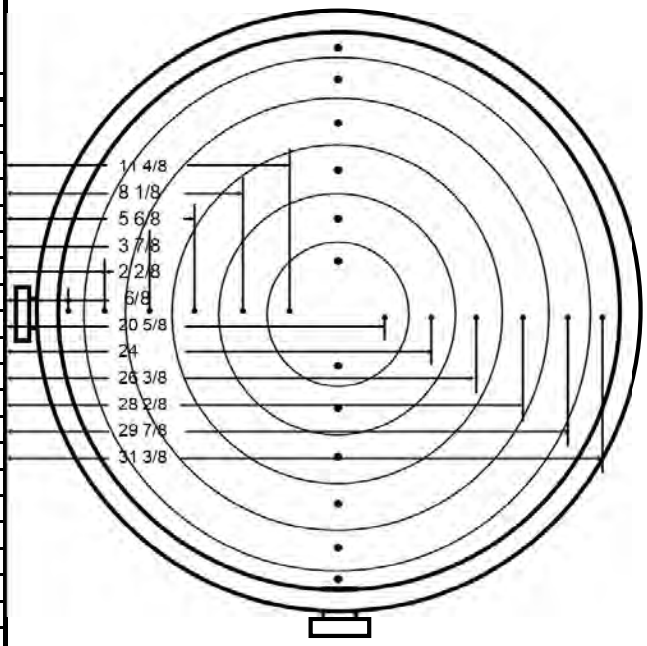
[2] 8 for Circular Stacks 12 to 24 inches
12 for Circular Stacks over 24 inches

Number of Traverse Points Used				
2	**Ports by**	12	**Pts / port**	**Stratification Traverse (Compliance Test)**
24	**Pts Used**	12	**Required**	



Traverse Point Locations			
Traverse Point Number	**Percent of Stack Diameter**	**Distance from Inside Wall**	**Distance Including Reference Length**
	%	in.	in.
1	2.1%	5/8	6/8
2	6.7%	2 1/8	2 2/8
3	11.8%	3 6/8	3 7/8
4	17.7%	5 5/8	5 6/8
5	25.0%	8	8 1/8
6	35.6%	11 3/8	11 4/8
7	64.4%	20 4/8	20 5/8
8	75.0%	23 7/8	24
9	82.3%	26 2/8	26 3/8
10	88.2%	28 1/8	28 2/8
11	93.3%	29 6/8	29 7/8
12	97.9%	31 2/8	31 3/8
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

Adjust Sample Points
Out of Boundary Layer



STRATIFICATION TRAVERSE (COMPLIANCE TEST) RESULTS

Company	Catalytic Combustion	**Date**	07/29/21
Plant Name	Stewart and Stevenson Integration Center	**Project #**	catc-21-houston.tx-start#1
Equipment	Caterpillar engine	**# of Ports Available**	2
Location	Houston, Texas	**# of Ports Used**	2

Stack Dimensions				**Traverse Data**			
Diameter or Length of Stack	(D)	31.88	in.	2	**Ports by**	12	**Pts / port**
Width of Stack	(W)		in.	24	**Pts Used**	12	**Required**
Area of Stack	(A_s)	5.54	ft^2	**Run Start**	11:00:23	**Run End**	12:10:23

Traverse Point	**Time Per Point**	**Point Start Time**	**Point Stop Time (Reading)**	**O_2**	**Percent Difference**	**NOx**	**Percent Difference**	
	min.	hh:mm:ss	hh:mm:ss	%	%	ppm	%	
B-12	2.50	11:00:23	11:02:53	8.90	0.44%	4.85	4.17%	
B-11	2.50	11:02:53	11:05:23	8.89	0.55%	4.62	0.77%	side
B-10	2.50	11:05:23	11:07:53	8.88	0.67%	4.59	1.42%	
B-9	2.50	11:07:53	11:10:23	8.88	0.67%	4.84	3.95%	
B-8	2.50	11:10:23	11:12:53	8.88	0.67%	4.27	8.29%	
B-7	2.50	11:12:53	11:15:23	8.87	0.78%	4.74	1.80%	
B-6	2.50	11:15:23	11:17:53	8.88	0.67%	4.36	6.36%	
B-5	2.50	11:17:53	11:20:23	8.90	0.44%	4.02	13.66%	
B-4	2.50	11:20:23	11:22:53	8.88	0.67%	3.77	19.03%	
B-3	2.50	11:22:53	11:25:23	8.87	0.78%	4.04	13.23%	
B-2	2.50	11:25:23	11:27:53	8.92	0.22%	3.65	21.61%	
B-1	2.50	11:27:53	11:30:23	8.90	0.44%	3.47	**25.47%**	
A-12	2.50	11:40:23	11:42:53	9.00	0.68%	5.32	14.26%	
A-11	2.50	11:42:53	11:45:23	8.96	0.23%	5.01	7.60%	front
A-10	2.50	11:45:23	11:47:53	8.95	0.12%	4.54	2.49%	
A-9	2.50	11:47:53	11:50:23	8.94	0.00%	4.76	2.23%	
A-8	2.50	11:50:23	11:52:53	8.91	0.33%	4.53	2.71%	
A-7	2.50	11:52:53	11:55:23	8.89	0.55%	4.26	8.51%	
A-6	2.50	11:55:23	11:57:53	8.92	0.22%	4.79	2.88%	
A-5	2.50	11:57:53	12:00:23	8.88	0.67%	4.64	0.34%	
A-4	2.50	12:00:23	12:02:53	8.88	0.67%	5.47	17.48%	
A-3	2.50	12:02:53	12:05:23	9.09	1.68%	5.74	23.28%	
A-2	2.50	12:05:23	12:07:53	9.14	2.24%	5.80	24.66%	
A-1	2.50	12:07:53	12:10:23	9.34	**4.48%**	5.66	21.56%	
Average				8.94		4.66		

			O_2		NOx		
			Criteria	**Results**	**Criteria**	**Results**	**AND criteria**
Strat Method 7E	Non-Stratified %	≤	5%	Non (%)	5%		Under Method 7E criteria at least one measured pollutant or diluent demonstrates a stratified stack with subsequent testing from 12 points.
	Non-Stratified Δ	≤	0.3		0.5		
	Minimally-Stratified %	≤	10%		10%		
	Minimally-Stratified Δ	≤	0.5		1		
	Stratified	>	10%		10%	Strat (%)	

Outcome		1 point		12 points		
Location		closest to the mean		Method 1 points		
Maximum Concentration		9.34		5.80		
Upscale Δ = Max Concentration - Average		0.40	Mini	1.15	Strat	
Upscale % Difference		4.48%	Non	24.66%	Strat	
Minimum Concentration		8.87		3.47		
Downscale Δ = Average - Min Concentration		0.07	Non	1.19	Strat	
Downscale % Difference		0.78%	Non	25.47%	Strat	
First Point on List Closest to Average		A-8		A-4		
Port Averages with Maximum Concentration Indicator	**Port A Average**	9.00	<max	5.07	<max	
	Port B Average	8.89		4.13		
	Port C Average					
	Port D Average					
	Port E Average					
	Port F Average					
	Port G Average					

STRAT TEST DETERMINED SAMPLE POINTS FOR CIRCULAR STACK

Company	Catalytic Combustion	**Date**	07/29/21
Plant Name	Stewart and Stevenson Integration Center	**Project #**	catc-21-houston.tx-start#1
Equipment	Caterpillar engine	**# of Ports Available**	2
Location	Houston, Texas	**# of Ports Used**	2

Stack Dimensions				**Traverse Data**			
Diameter or Length of Stack	(D)	31.88	in.	2	**Ports by**	12	**Pts / port**
Width of Stack	(W)		in.	24	**Pts Used**	12	**Required**
Area of Stack	(A_s)	5.54	ft^2	**Run Start**	11:00:23	**Run End**	12:10:23

40 CFR 60, Appendix A, Method 7E Criteria

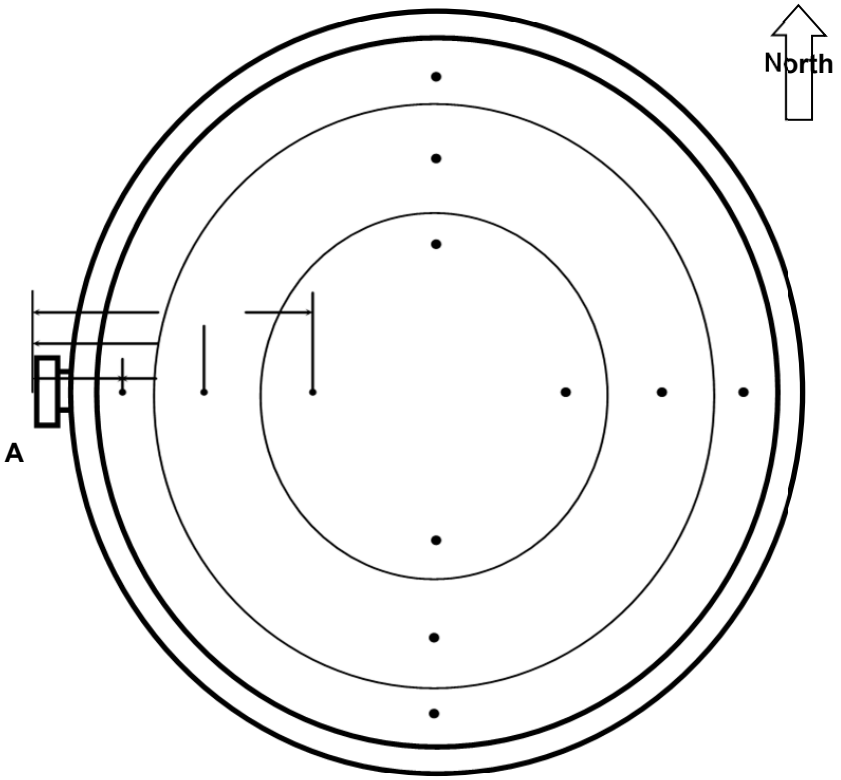
Stratification Results	
Maximum Percent Difference	25.47 % for NOx
Maximum Pollutant Conc. Diff.	1.19 ppm for NOx
Maximum Diluent Conc. Diff.	0.40 % for O_2
Stratification Conclusions	
Comparison	all diluents/pollutants
Stack Diameter	D ≤ 93.6 in.

Under Method 7E criteria at least one measured pollutant or diluent demonstrates a stratified stack with subsequent testing from 12 points.

Traverse Point Number	**Percent of Stack Diameter**	**Distance from Inside Wall**	**Distance Including Reference Length**
	%	in.	in.
1			
2			
3			

Test Type
- ☐ Moisture, for MW
- ☐ Moisture, for wet-to-dry
- ☑ Gas

☐ 6.5.6(b)(2) alt. points do not apply



APPENDIX G

EQUIPMENT CALIBRATION RECORDS

APEX SOURCE TESTING EQUIPMENT INSTRUMENTS

Apex Instruments, Inc.
204 Technology Park Lane
Fuquay-Varina, NC 27526

S-TYPE PITOT TUBE CALIBRATION SHEET

Reference USEPA Reference Method 2 (40CFR60, App. A, Meth. 2)

PITOT SERIAL#	A5708	CALIBRATION DATE:	17-Nov-14
PITOT TYPE:	S	BAROMETRIC PRESSURE:	29.40 in Hg
STD. PITOT TYPE:	HEMISPHERICAL	STATIC PRESSURE	-0.6 in H_2O
Cp(std):	0.990	BLOCKAGE %:	<2%
PROBE SERIAL#	N/A	CORRECTION FACTOR:	1.00

SIDE "A" CALIBRATION

RUN NO.	Δ Pstd in H_2O	Δ Ps in H_2O	Cp(s)	DEVIATION Cp(s) - avg.Cp(s)
1	0.550	0.793	0.824	0.001
2	0.550	0.798	0.822	-0.001
3	0.550	0.795	0.823	0.000
		"A" AVERAGE	0.823	0.0013 (must be ≤ 0.01)

SIDE "B" CALIBRATION

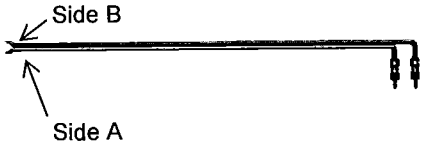
RUN NO.	Δ Pstd in H_2O	Δ Ps in H_2O	Cp(s)	DEVIATION Cp(s) - avg.Cp(s)
1	0.551	0.793	0.825	0.002
2	0.550	0.797	0.822	0.000
3	0.551	0.802	0.821	-0.002
		"B" AVERAGE	0.823	0.0023 (must be ≤ 0.01)

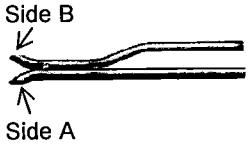
ACCEPTANCE CRITERIA

AVERAGE 0.0005 AVG. Cp (A) - AVG. Cp (B) must be ≤ 0.01

If the Average and both Deviation Averages "A" & "B" are ≤ 0.01, then the OVERALL AVERAGE below may be used.
*** If NOT, use the "A" Average OR "B" Average.**

OVERALL AVERAGE 0.8230





I certify that the above pitot tube was tested in accordance with the US EPA Method 2 standards.
See the Code of Federal Regulations, Title 40, Part 60, Appendix A, Method 2, Item 4.

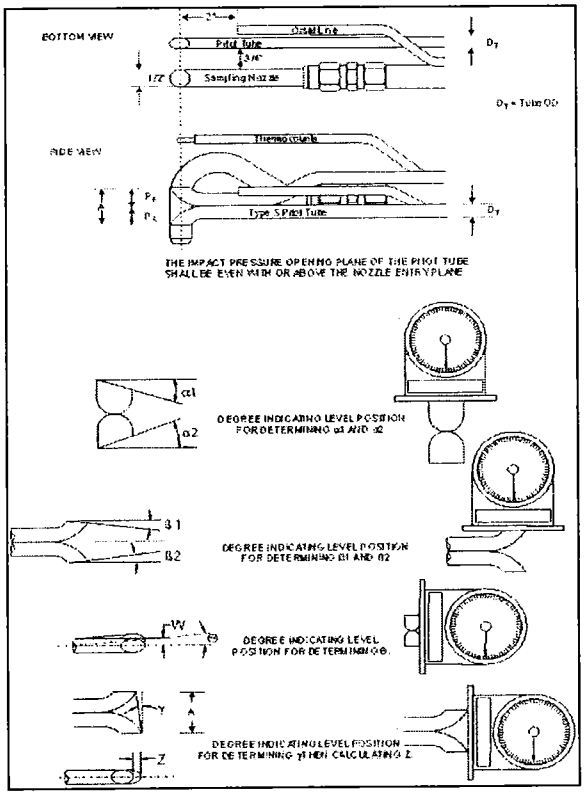
Print Name: ~~BO~~ PRITCHARD

Signature: BP

Date 11/17/2014

APEX INSTRUMENTS SOURCE TESTING EQUIPMENT

Type S Pitot Tube Inspection Form



PITOT TUBE/PROBE # 5708

Parameter	Value	Allowable Range	Check
Assembly Level?	yes	Yes	OK
Ports Damaged?	no	No	OK
$\alpha 1$	0	$-10° < \alpha 1 < +10°$	OK
$\alpha 2$	0	$-10° < \alpha 2 < +10°$	OK
1	0	$-5° < b1 < +5°$	OK
1	1	$-5° < \beta 2 < +5°$	OK
γ	0		
θ	1		
$Z = A \tan \gamma$	0.000	$Z \leq .125"$	OK
$W = A \tan \theta$	0.015	$W \leq .031"$	OK
Dt	0.375	.188" to .375"	OK
A/2Dt	1.136	$1.05 \leq P_A/D_t \leq 1.5$	OK
A	0.852	$2.1D_t \leq A \leq 3D_t$	OK

Certification

I certify that pitot tube/probe number 5708 meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube certification factor of 0.84. See 40 CFR Pt. 60, App. A, EPA Method 2.

Certified by: Rob Platt 11-12-14
Personnel (Signature/Date)

Apex Instruments, Inc.
204 Technology Park Lane
Fuquay-Varina, NC 27526

S-TYPE PITOT TUBE CALIBRATION SHEET

Reference USEPA Reference Method 2 (40CFR60, App. A, Meth. 2)

PITOT SERIAL#	A6223	**CALIBRATION DATE:**	11-Aug-15
PITOT TYPE:	S	**BAROMETRIC PRESSURE:**	29.65 in Hg
STD. PITOT TYPE:	ELLIPSOIDAL	**STATIC PRESSURE**	-0.6 in H_2O
Cp(std):	0.990	**BLOCKAGE %:**	N/A
PROBE SERIAL#	N/A	**CORRECTION FACTOR:**	1.00

SIDE "A" CALIBRATION

RUN NO.	Δ Pstd in H_2O	Δ Ps in H_2O	Cp(s)	DEVIATION Cp(s) - avg.Cp(s)
1	0.560	0.808	0.824	-0.002
2	0.560	0.806	0.825	-0.001
3	0.561	0.802	0.828	0.002
		"A" AVERAGE	0.826	0.0020

(must be ≤ 0.01)

SIDE "B" CALIBRATION

RUN NO.	Δ Pstd in H_2O	Δ Ps in H_2O	Cp(s)	DEVIATION Cp(s) - avg.Cp(s)
1	0.559	0.823	0.816	-0.001
2	0.559	0.822	0.816	-0.001
3	0.561	0.819	0.819	0.002
		"B" AVERAGE	0.817	0.0019

(must be ≤ 0.01)

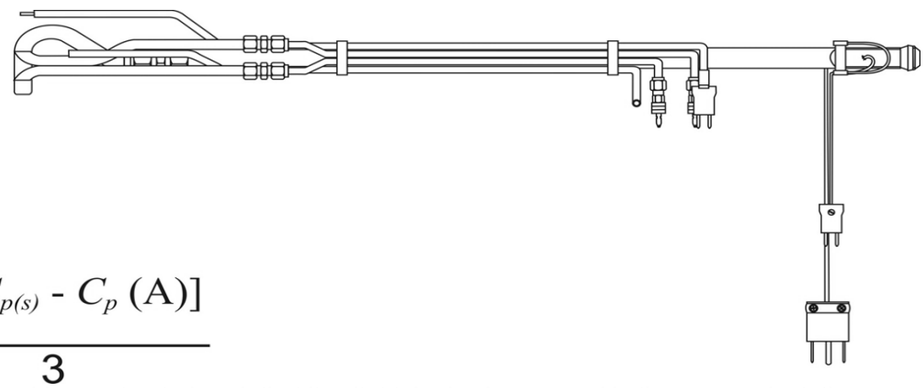
ACCEPTANCE CRITERIA

AVERAGE 0.0086 AVG. Cp (A) - AVG. Cp (B) must be ≤ 0.01

If the Average and both Deviation Averages "A" & "B" are ≤ 0.01, then the OVERALL AVERAGE below may be used.
*** If NOT, use the "A" Average OR "B" Average.**

OVERALL AVERAGE 0.8215

$$C_{p(s)} = C_{p(std)} \sqrt{\frac{\Delta p_{std}}{\Delta p_s}}$$



$$\text{Deviation} = C_{p(s)} - \overline{C_p}(\text{A})$$

$$\text{Avg Dev} = \sigma\,(\text{A}) = \frac{\sum_{1}^{3} [C_{p(s)} - C_p\,(\text{A})]}{3}$$

Method 2 Section 10.1.4.3 For a probe assembly constructed such that its pitot tube is always used in the same orientation, only one side of the pitot tube need be calibrated (the side which will face the flow). The pitot tube must still meet the alignment specifications of Figure 2-2 or 2-3, however, and must have an average deviation (σ) value of 0.01 or less (see section 10.1.4.4).

I certify that the above pitot tube was tested in accordance with the US EPA Method 2 standards.
See the Code of Federal Regulations, Title 40, Part 60, Appendix A, Method 2, Item 4.

Print Name: BO PRITCHARD Date 8/11/2015

Signature:

APEX SOURCE TESTING EQUIPMENT INSTRUMENTS

Apex Instruments, Inc.
204 Technology Park Lane
Fuquay-Varina, NC 27526

S-TYPE PITOT TUBE CALIBRATION SHEET

Reference USEPA Reference Method 2 (40CFR60, App. A, Meth. 2)

PITOT SERIAL#	A6904	CALIBRATION DATE:	27-May-16
PITOT TYPE:	S	BAROMETRIC PRESSURE:	30.16 in Hg
STD. PITOT TYPE:	ELLIPSOIDAL	STATIC PRESSURE	-0.6 in H_2O
Cp(std):	0.990	BLOCKAGE %:	N/A
PROBE SERIAL#	N/A	CORRECTION FACTOR:	1.00

	SIDE "A" CALIBRATION			
RUN NO.	Δ Pstd in H_2O	Δ Ps in H_2O	Cp(s)	DEVIATION Cp(s) - avg.Cp(s)
1	0.565	0.804	0.830	0.001
2	0.561	0.803	0.827	-0.002
3	0.562	0.800	0.830	0.001
		"A" AVERAGE	0.829	0.0014
				(must be ≤ 0.01)

	SIDE "B" CALIBRATION			
RUN NO.	Δ Pstd in H_2O	Δ Ps in H_2O	Cp(s)	DEVIATION Cp(s) - avg.Cp(s)
1	0.565	0.804	0.830	-0.001
2	0.566	0.803	0.831	0.000
3	0.565	0.801	0.831	0.001
		"B" AVERAGE	0.831	0.0008
				(must be ≤ 0.01)

ACCEPTANCE CRITERIA

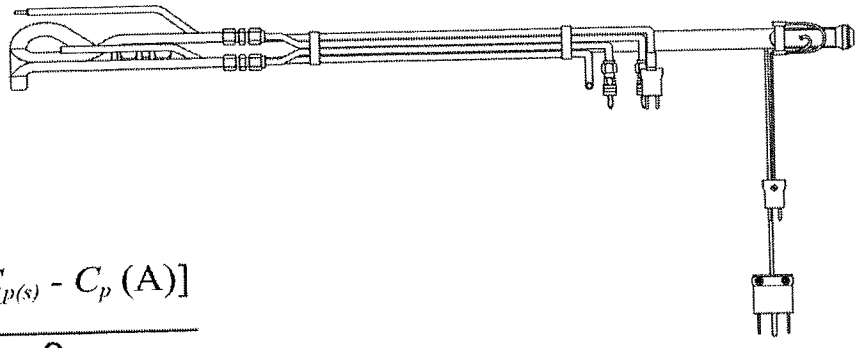
AVERAGE -0.0018 AVG. Cp (A) - AVG. Cp (B) must be ≤ 0.01

If the Average and both Deviation Averages "A" & "B" are ≤ 0.01, then the OVERALL AVERAGE below may be used.

*** If NOT, use the "A" Average OR "B" Average.**

OVERALL AVERAGE 0.8300

$$C_{p(s)} = C_{p(std)} \sqrt{\frac{\Delta p_{std}}{\Delta p_s}}$$



$$\text{Deviation} = C_{p(s)} - \overline{C_p}(\text{A})$$

$$\text{Avg Dev} = \sigma\,(\text{A}) = \frac{\sum_{1}^{3} [C_{p(s)} - C_p\,(\text{A})]}{3}$$

Method 2 Section 10.1.4.3 For a probe assembly constructed such that its pitot tube is always used in the same orientation, only one side of the pitot tube need be calibrated (the side which will face the flow). The pitot tube must still meet the alignment specifications of Figure 2-2 or 2-3, however, and must have an average deviation (σ) value of 0.01 or less (see section 10.1.4.4).

I certify that the above pitot tube was tested in accordance with the US EPA Method 2 standards.
See the Code of Federal Regulations, Title 40, Part 60, Appendix A, Method 2, Item 4.

Print Name: Scott Bulger

Signature: _____

Date 5/27/2016

METERING SYSTEM DRY GAS METER CALIBRATION SHEET
EPA Reference Method
Metering System Pre-Test Calibration
Air Hygiene Assett ID: samp-cp-0021

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0021 Calibration 11-11-20.xls]Original (5 point)

Make: apex
Model #: 522
Serial #: 1204012

Date: 11/11/20
Barometric Pressure: 29.28 (in. Hg)
Theoretical Critical Vacuum: 13.81 (in. Hg)

DRY GAS METER READINGS

ΔH (in. H2O)	Time (min)	Volume Initial (ft³)	Volume Final (ft³)	Volume Total (ft³)	Initial Temperature Inlet (°F)	Initial Temperature Outlet (°F)
0.33	17.00	490.230	495.820	5.590	76.0	76.0
0.67	12.00	495.820	501.510	5.690	77.0	77.0
1.10	10.00	501.510	507.780	6.270	77.0	77.0
2.00	10.00	507.780	515.930	8.150	78.0	78.0
3.50	10.00	515.930	527.070	11.140	79.0	79.0

Final Temperature Inlet (°F)	Final Temperature Outlet (°F)	Orifice Serial# (number)	K' Orifice Coefficient (see above)	Actual Vacuum (in. Hg)	Ambient Temperature Initial (°F)	Ambient Temperature Final (°F)	Ambient Temperature Average (°F)
77.0	77.0	214	0.2433	16.0	73.2	73.5	73.4
77.0	77.0	240	0.3500	16.0	73.5	73.4	73.5
78.0	78.0	255	0.4634	16.0	73.4	73.8	73.6
79.0	79.0	263	0.5993	16.0	73.8	74.1	74.0
80.0	80.0	273	0.8208	16.0	74.1	74.0	74.1

RESULTS

DRY GAS METER VOLUME CORRECTED Vm(std) (ft³)	DRY GAS METER VOLUME CORRECTED Vm(std) (liters)	ORIFICE VOLUME CORRECTED Vcr(std) (ft³)	ORIFICE VOLUME CORRECTED Vcr(std) (liters)	ORIFICE VOLUME NOMINAL Vcr (ft³)
5.386	152.53	5.244	148.5	5.415
5.482	155.25	5.324	150.8	5.499
6.042	171.10	5.874	166.3	6.068
7.856	222.49	7.594	215.1	7.850
10.759	304.69	10.400	294.5	10.753

DRY GAS METER CALIBRATION FACTOR Y Variation (number)	DRY GAS METER CALIBRATION FACTOR Y Value (number)	ORIFICE CALIBRATION FACTOR ΔH@ Value (in. H2O)	ORIFICE CALIBRATION FACTOR ΔH@ Value (mm H2O)	ORIFICE CALIBRATION FACTOR ΔH@ Variation (in. H2O)
0.004	0.974	1.879	47.72	0.067
0.001	0.971	1.842	46.79	0.030
0.002	0.972	1.724	43.79	-0.088
-0.003	0.967	1.872	47.55	0.060
-0.003	0.967	1.743	44.28	-0.069
AVERAGE:	**0.970**	**1.812**	46.02	**PASSED**

Notes:

For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter,acceptable tolerance of individual values from the average is +/- 0.02. For Orifice Calibration Factor dH@, the orifice differential pressure in inches of H_20 that equates to 0.75 cfm of air at 68 °F and 29.92 inches of Hg, acceptable tolerance of individual values from the average is +/- 0.2. For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above. The Critical Orifice Coefficient, K', must be entered in English units, (ft)^3*(deg R)^0.5/((in.Hg)*(min)).

SIGNATURE: Craig McCarty

DATE: 11/11/20 11/11/20

METERING SYSTEM THERMOCOUPLE CALIBRATION SHEET
EPA Reference Method
Metering System Pre-Test Calibration
Air Hygiene Assett ID: samp-cp-0021

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0021 Calibration 11-11-20.xls]Original (5 point)

Make: apex
Model #: 522
Serial #: 1204012

Date: 11/11/20
Barometric Pressure: 29.28 (in. Hg)
Temperature (ASTM cal): 72.00 (°F)

Thermocouple	100 (°F)		600 (°F)		1200 (°F)	
	Reading	% Error	Reading	% Error	Reading	% Error
Stack	101.00	0.50	602.00	0.33	1206.00	0.50
Probe	101.00	0.50	602.00	0.33	1206.00	0.50
Filter	101.00	0.50	602.00	0.33	1206.00	0.50
Dryer	101.00	0.50	602.00	0.33	1206.00	0.50
Aux.	101.00	0.50	602.00	0.33	1206.00	0.50

Note: Calibrated against an ALTEK Thermocouple Source Series 22, ID: samp-tc-0004
Direct temperature output calibrated to ASTM and IPTS standards as outlined in ALTEK Data Sheet 22.

Thermocouple	72.00 (°F)		Responded to heating/cooling with the anticipated outcome?
	Reading	(±°F)	
DGM In	72.0	0.00	yes
DGM Out	72.0	0.00	yes

Note: Calibrated against Reference Thermometer ID: a070800

SIGNATURE: Craig McCarty DATE: 11/11/20 11/11/20

Standard for Calibration of Console Thermocouple Systems

40 CFR, Part 60
Appendix A, Method 5
10.3.2 The temperature data recorded in the field shall be considered valid. If, during calibration, the absolute temperature measured with the sensor being calibrated and the reference sensor **agree within 1.5 percent**, the temperature data taken in the field shall be considered valid.

Standard for Calibration of Individual Thermocouples

EMC, ALT-011: After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature, or any other temperature, within the range specified by the manufacturer, using a reference thermometer (either ASTM reference thermometer or a thermometer that has been calibrated against an ASTM reference thermometer). The temperatures of the thermocouple and reference thermometers shall **agree to within ±2°F**.

Check the continuity of the thermocouple by subjecting it to a change in the temperature (e.g.., removing it from the stack or touching an ice cube). This step will also check for loose connections and reversed connections (noted by a wrong change in the temperature).

PROBE (STACK), HOTBOX (FILTER), AND GOOSENECK (EXIT) THERMOCOUPLE CALIBRATION SHEET
EPA Reference Method
Metering System Pre-Test Calibration

Air Hygiene Assett ID(s): **Probe:** samp-hp-0086 **Hotbox:** samp-bh-0012 **Gooseneck:** samp-ad-0046

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0021 Calibration 11-11-20.xls]Original (5 point)

Barometric Pressure: 29.26

Thermo-couples		Temps (°F)	Signature		Date	
Stack	Ref	72.00	Craig McCarty		11/11/20	11/11/20
	Read	72.00				
	±°F	0.00				
Probe	Ref	72.00	Craig McCarty		11/11/20	11/11/20
	Read	72.00				
	±°F	0.00				
Filter	Ref	72.00	Craig McCarty		11/11/20	11/11/20
	Read	72.00				
	±°F	0.00				
Cond.	Ref	72.00	Craig McCarty		11/11/20	11/11/20
	Read	72.00				
	±°F	0.00				
CPM	Ref	72.00	Craig McCarty		11/11/20	11/11/20
	Read	72.00				
	±°F	0.00				
Exit	Ref	72.00	Craig McCarty		11/11/20	11/11/20
	Read	72.00				
	±°F	0.00				

Note: Calibrated against Reference Thermometer ID: a070800

Thermocouple	Responded to heating/cooling with the anticipated outcome?
Stack	yes
Probe	yes
Filter	yes
Cond.	yes
CPM	yes
Exit	yes

Standard for Calibration of Individual Thermocouples

EMC, ALT-011: After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature, or any other temperature, within the range specified by the manufacturer, using a reference thermometer (either ASTM reference thermometer or a thermometer that has been calibrated against an ASTM reference thermometer). The temperatures of the thermocouple and reference thermometers shall **agree to within ±2°F**.

Check the continuity of the thermocouple by subjecting it to a change in the temperature (e.g.., removing it from the stack or touching an ice cube). This step will also check for loose connections and reversed connections (noted by a wrong change in the temperature).

METERING SYSTEM DRY GAS METER CALIBRATION SHEET
EPA Reference Method
Metering System Post-Test Calibration
Air Hygiene Assett ID: samp-cp-0021

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0021 Calibration 11-11-20.xls]9-7-21 (3 point)

Make: Apex
Model #: XC-522
Serial #: 1204012

Date: 09/08/21
Barometric Pressure: 29.22 (in. Hg)
Theoretical Critical Vacuum: 13.78 (in. Hg)

DRY GAS METER READINGS

ΔH (in. H2O)	Time (min)	Volume Initial (ft³)	Volume Final (ft³)	Volume Total (ft³)	Initial Temperature Inlet (°F)	Initial Temperature Outlet (°F)
1.90	10.00	111.800	119.800	8.000	72.0	72.0
1.90	10.00	119.800	127.800	8.000	72.0	72.0
1.90	10.00	127.800	135.810	8.010	73.0	73.0

Final Temperature Inlet (°F)	Final Temperature Outlet (°F)	Orifice Serial# (number)	K' Orifice Coefficient (see above)	Actual Vacuum (in. Hg)	Ambient Temperature Initial (°F)	Ambient Temperature Final (°F)	Ambient Temperature Average (°F)
72.0	72.0	163	0.5930	16.0	72.2	72.7	72.5
73.0	73.0	163	0.5930	16.0	72.7	73.1	72.9
74.0	74.0	163	0.5930	16.0	73.1	73.7	73.4

RESULTS

DRY GAS METER VOLUME CORRECTED Vm(std) (ft³)	DRY GAS METER VOLUME CORRECTED Vm(std) (liters)	ORIFICE VOLUME CORRECTED Vcr(std) (ft³)	ORIFICE VOLUME CORRECTED Vcr(std) (liters)	ORIFICE VOLUME NOMINAL Vcr (ft³)
7.788	220.56	7.509	212.7	7.757
7.781	220.35	7.506	212.6	7.760
7.776	220.21	7.503	212.5	7.764

DRY GAS METER CALIBRATION FACTOR Y Variation (number)	DRY GAS METER CALIBRATION FACTOR Y Value (number)	ORIFICE CALIBRATION FACTOR ΔH@ Value (in. H2O)	ORIFICE CALIBRATION FACTOR ΔH@ Value (mm H2O)	ORIFICE CALIBRATION FACTOR ΔH@ Variation (in. H2O)
0.000	0.964	1.837	46.66	0.001
0.000	0.965	1.837	46.66	0.001
0.000	0.965	1.835	46.61	-0.001
AVERAGE:	**0.965**	**1.836**	46.64	**PASSED**
LAST 5-PT:	**0.970**	**1.812**	**PASSED**	5-PT Date:
% DIFF:	**0.6%**	**1.3%**		11/11/20

40 CFR - CHAPTER I - PART 60
Appendix A, Method 5
10.3.2 Calibration After Use
After each field use, the calibration of the metering system shall be checked by performing three calibration runs at a single, intermediate orifice setting (based on the previous field test)....Calculate the average value of the DGM calibration factor. If the value has changed by more than 5 percent, recalibrate the meter over the full range of orifice settings, as detailed in Section 10.3.1.

10.3.3 Acceptable Variation in Calibration
If the DGM coefficient values obtained before and after a test series differ by more than 5 percent, the test series shall either be voided, or calculations for the test series shall be performed using whichever meter coefficient value (i.e., before or after) gives the lower value of total sample volume.

Notes: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter,acceptable tolerance of individual values from the average is +/- 0.02. For Orifice Calibration Factor dH@, the orifice differential pressure in inches of H_20 that equates to 0.75 cfm of air at 68 °F and 29.92 inches of Hg, acceptable tolerance of individual values from the average is +/- 0.2. For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above. The Critical Orifice Coefficient, K', must be entered in English units, (ft)^3*(deg R)^0.5/((in.Hg)*(min)).

SIGNATURE: Craig McCarty DATE: 09/08/21 09/08/21

METERING SYSTEM THERMOCOUPLE CALIBRATION SHEET
EPA Reference Method
Metering System Post-Test Calibration
Air Hygiene Assett ID: samp-cp-0021

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0021 Calibration 11-11-20.xls]9-7-21 (3 point)

Make: Apex
Model #: XC-522
Serial #: 1204012

Date: 09/08/21
Barometric Pressure: 29.22 (in. Hg)
Temperature (ASTM cal): 73.70 (°F)

Thermocouple	100 (°F)		600 (°F)		1200 (°F)	
	Reading	% Error	Reading	% Error	Reading	% Error
Stack	101.00	0.50	604.00	0.67	1206.00	0.50
Probe	101.00	0.50	604.00	0.67	1206.00	0.50
Filter	101.00	0.50	604.00	0.67	1206.00	0.50
Dryer	101.00	0.50	604.00	0.67	1206.00	0.50
Aux.	101.00	0.50	604.00	0.67	1206.00	0.50

Note: Calibrated against an ALTEK Thermocouple Source Series 22, ID: samp-tc-0004
Direct temperature output calibrated to ASTM and IPTS standards as outlined in ALTEK Data Sheet 22.

Thermocouple	73.70 (°F)		Responded to heating/cooling with the anticipated outcome?
	Reading	(±°F)	
DGM In	74.0	0.30	yes
DGM Out	74.0	0.30	yes

Note: Calibrated against Reference Thermometer ID: a070717

SIGNATURE: Craig McCarty DATE: 09/08/21 09/08/21

Standard for Calibration of Console Thermocouple Systems

40 CFR, Part 60
Appendix A, Method 5
10.3.2 The temperature data recorded in the field shall be considered valid. If, during calibration, the absolute temperature measured with the sensor being calibrated and the reference sensor **agree within 1.5 percent**, the temperature data taken in the field shall be considered valid.

Standard for Calibration of Individual Thermocouples

EMC, ALT-011: After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature, or any other temperature, within the range specified by the manufacturer, using a reference thermometer (either ASTM reference thermometer or a thermometer that has been calibrated against an ASTM reference thermometer). The temperatures of the thermocouple and reference thermometers shall **agree to within ±2°F**.

Check the continuity of the thermocouple by subjecting it to a change in the temperature (e.g.., removing it from the stack or touching an ice cube). This step will also check for loose connections and reversed connections (noted by a wrong change in the temperature).

PROBE (STACK), HOTBOX (FILTER), AND GOOSENECK (EXIT) THERMOCOUPLE CALIBRATION SHEET
EPA Reference Method
Metering System Post-Test Calibration

Air Hygiene Assett ID(s): **Probe:** samp-hp-0086 **Hotbox:** samp-bh-0012 **Gooseneck:** samp-ad-0046

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0021 Calibration 11-11-20.xls]9-7-21 (3 point)

Barometric Pressure: 29.22

Thermo-couples		Temps (°F)	Signature		Date	
Stack	Ref	73.20	Craig McCarty		09/08/21	09/08/21
	Read	74.00				
	±°F	0.80				
Probe	Ref	73.20	Craig McCarty		09/08/21	09/08/21
	Read	74.00				
	±°F	0.80				
Filter	Ref	73.20	Craig McCarty		09/08/21	09/08/21
	Read	74.00				
	±°F	0.80				
Cond.	Ref	73.20	Craig McCarty		09/08/21	09/08/21
	Read	74.00				
	±°F	0.80				
CPM	Ref	73.20	Craig McCarty		09/08/21	09/08/21
	Read	74.00				
	±°F	0.80				
Exit	Ref	73.20	Craig McCarty		09/08/21	09/08/21
	Read	74.00				
	±°F	0.80				

Note: Calibrated against Reference Thermometer ID: a070717

Thermocouple	Responded to heating/cooling with the anticipated outcome?
Stack	yes
Probe	yes
Filter	yes
Cond.	yes
CPM	yes
Exit	yes

Standard for Calibration of Individual Thermocouples

EMC, ALT-011: After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature, or any other temperature, within the range specified by the manufacturer, using a reference thermometer (either ASTM reference thermometer or a thermometer that has been calibrated against an ASTM reference thermometer). The temperatures of the thermocouple and reference thermometers shall **agree to within ±2°F**.

Check the continuity of the thermocouple by subjecting it to a change in the temperature (e.g.., removing it from the stack or touching an ice cube). This step will also check for loose connections and reversed connections (noted by a wrong change in the temperature).

METERING SYSTEM DRY GAS METER CALIBRATION SHEET
EPA Reference Method
Metering System Pre-Test Calibration
Air Hygiene Assett ID: samp-cp-0022

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0022 Calibration 7-14-21.xls]Original (5 point)

Make: apex
Model #: 522
Serial #:

Date: 07/14/21
Barometric Pressure: 29.29 (in. Hg)
Theoretical Critical Vacuum: 13.82 (in. Hg)

DRY GAS METER READINGS

ΔH (in. H2O)	Time (min)	Volume Initial (ft³)	Volume Final (ft³)	Volume Total (ft³)	Initial Temperature Inlet (°F)	Initial Temperature Outlet (°F)
0.31	17.00	23.400	28.710	5.310	75.0	75.0
0.62	12.00	28.710	34.060	5.350	75.0	75.0
1.10	10.00	34.060	40.120	6.060	76.0	76.0
1.90	10.00	40.120	48.000	7.880	77.0	77.0
3.50	10.00	48.000	58.830	10.830	78.0	78.0

Final Temperature Inlet (°F)	Final Temperature Outlet (°F)	Orifice Serial# (number)	K' Orifice Coefficient (see above)	Actual Vacuum (in. Hg)	Ambient Temperature Initial (°F)	Ambient Temperature Final (°F)	Ambient Temperature Average (°F)
75.0	75.0	140	0.2355	16.0	76.7	76.9	76.8
76.0	76.0	148	0.3374	16.0	76.9	77.2	77.1
77.0	77.0	155	0.4565	16.0	77.0	77.4	77.2
78.0	78.0	163	0.5930	16.0	77.4	77.6	77.5
80.0	80.0	173	0.8149	15.0	77.6	77.8	77.7

RESULTS

DRY GAS METER VOLUME CORRECTED Vm(std) (ft³)	DRY GAS METER VOLUME CORRECTED Vm(std) (liters)	ORIFICE VOLUME CORRECTED Vcr(std) (ft³)	ORIFICE VOLUME CORRECTED Vcr(std) (liters)	ORIFICE VOLUME NOMINAL Vcr (ft³)
5.132	145.34	5.061	143.3	5.258
5.170	146.41	5.117	144.9	5.319
5.852	165.73	5.769	163.4	5.998
7.611	215.54	7.492	212.2	7.794
10.473	296.59	10.293	291.5	10.712

DRY GAS METER CALIBRATION FACTOR Y Variation (number)	DRY GAS METER CALIBRATION FACTOR Y Value (number)	ORIFICE CALIBRATION FACTOR ΔH@ Value (in. H2O)	ORIFICE CALIBRATION FACTOR ΔH@ Value (mm H2O)	ORIFICE CALIBRATION FACTOR ΔH@ Variation (in. H2O)
0.000	0.986	1.901	48.28	0.069
0.004	0.990	1.851	47.02	0.020
0.000	0.986	1.791	45.50	-0.040
-0.001	0.984	1.831	46.51	0.000
-0.003	0.983	1.782	45.26	-0.049
AVERAGE:	**0.986**	**1.831**	46.51	**PASSED**

Notes:

For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter,acceptable tolerance of individual values from the average is +/- 0.02. For Orifice Calibration Factor dH@, the orifice differential pressure in inches of H_20 that equates to 0.75 cfm of air at 68 °F and 29.92 inches of Hg, acceptable tolerance of individual values from the average is +/- 0.2. For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above. The Critical Orifice Coefficient, K', must be entered in English units, (ft)^3*(deg R)^0.5/((in.Hg)*(min)).

SIGNATURE: Craig McCarty DATE: 07/14/21 07/14/21

METERING SYSTEM THERMOCOUPLE CALIBRATION SHEET
EPA Reference Method
Metering System Pre-Test Calibration
Air Hygiene Assett ID: samp-cp-0022

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0022 Calibration 7-14-21.xls]Original (5 point)

Make: apex
Model #: 522
Serial #:

Date: 07/14/21
Barometric Pressure: 29.29 (in. Hg)
Temperature (ASTM cal): 76.70 (°F)

Thermocouple	100 (°F)		600 (°F)		1200 (°F)	
	Reading	% Error	Reading	% Error	Reading	% Error
Stack	100.00	0.00	599.00	0.17	1199.00	0.08
Probe	100.00	0.00	599.00	0.17	1199.00	0.08
Filter	100.00	0.00	599.00	0.17	1199.00	0.08
Dryer	100.00	0.00	599.00	0.17	1199.00	0.08
Aux.	100.00	0.00	599.00	0.17	1199.00	0.08

Note: Calibrated against an ALTEK Thermocouple Source Series 22, ID: samp-tc-0004
Direct temperature output calibrated to ASTM and IPTS standards as outlined in ALTEK Data Sheet 22.

Thermocouple	76.70 (°F)		Responded to heating/cooling with the anticipated outcome?
	Reading	(±°F)	
DGM In	75.0	1.70	yes
DGM Out	75.0	1.70	yes

Note: Calibrated against Reference Thermometer ID: a070717

SIGNATURE: Craig McCarty DATE: 07/14/21 07/14/21

Standard for Calibration of Console Thermocouple Systems

40 CFR, Part 60
Appendix A, Method 5
10.3.2 The temperature data recorded in the field shall be considered valid. If, during calibration, the absolute temperature measured with the sensor being calibrated and the reference sensor **agree within 1.5 percent**, the temperature data taken in the field shall be considered valid.

Standard for Calibration of Individual Thermocouples

EMC, ALT-011: After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature, or any other temperature, within the range specified by the manufacturer, using a reference thermometer (either ASTM reference thermometer or a thermometer that has been calibrated against an ASTM reference thermometer). The temperatures of the thermocouple and reference thermometers shall **agree to within ±2°F**.

Check the continuity of the thermocouple by subjecting it to a change in the temperature (e.g.., removing it from the stack or touching an ice cube). This step will also check for loose connections and reversed connections (noted by a wrong change in the temperature).

PROBE (STACK), HOTBOX (FILTER), AND GOOSENECK (EXIT) THERMOCOUPLE CALIBRATION SHEET
EPA Reference Method
Metering System Pre-Test Calibration

Air Hygiene Assett ID(s): **Probe:** samp-hp-0086 **Hotbox:** samp-bh-0012 **Gooseneck:** samp-ad-0046

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0022 Calibration 7-14-21.xls]Original (5 point)

Barometric Pressure: 29.29

Thermo-couples		Temps (°F)	Signature		Date	
Stack	Ref	76.80	Craig McCarty		07/14/21	07/14/21
	Read	77.00				
	±°F	0.20				
Probe	Ref	76.80	Craig McCarty		07/14/21	07/14/21
	Read	77.00				
	±°F	0.20				
Filter	Ref	76.80	Craig McCarty		07/14/21	07/14/21
	Read	77.00				
	±°F	0.20				
Cond.	Ref	76.80	Craig McCarty		07/14/21	07/14/21
	Read	77.00				
	±°F	0.20				
CPM	Ref	76.80	Craig McCarty		07/14/21	07/14/21
	Read	77.00				
	±°F	0.20				
Exit	Ref	76.80	Craig McCarty		07/14/21	07/14/21
	Read	77.00				
	±°F	0.20				

Note: Calibrated against Reference Thermometer ID: a070717

Thermocouple	Responded to heating/cooling with the anticipated outcome?
Stack	yes
Probe	yes
Filter	yes
Cond.	yes
CPM	yes
Exit	yes

Standard for Calibration of Individual Thermocouples

EMC, ALT-011: After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature, or any other temperature, within the range specified by the manufacturer, using a reference thermometer (either ASTM reference thermometer or a thermometer that has been calibrated against an ASTM reference thermometer). The temperatures of the thermocouple and reference thermometers shall **agree to within ±2°F**.

Check the continuity of the thermocouple by subjecting it to a change in the temperature (e.g.., removing it from the stack or touching an ice cube). This step will also check for loose connections and reversed connections (noted by a wrong change in the temperature).

METERING SYSTEM DRY GAS METER CALIBRATION SHEET
EPA Reference Method
Metering System Post-Test Calibration
Air Hygiene Assett ID: samp-cp-0022

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0022 Calibration 7-14-21.xls]8-18-21 (3 point)

Make: Apex
Model #: XC-522
Serial #: 1204013

Date: 08/18/21
Barometric Pressure: 29.20 (in. Hg)
Theoretical Critical Vacuum: 13.77 (in. Hg)

DRY GAS METER READINGS

ΔH (in. H2O)	Time (min)	Volume Initial (ft³)	Volume Final (ft³)	Volume Total (ft³)	Initial Temperature Inlet (°F)	Initial Temperature Outlet (°F)
1.90	10.00	862.800	870.790	7.990	78.0	78.0
1.90	10.00	870.790	878.790	8.000	77.0	77.0
1.90	10.00	878.790	886.800	8.010	78.0	78.0

Final Temperature Inlet (°F)	Final Temperature Outlet (°F)	Orifice Serial# (number)	K' Orifice Coefficient (see above)	Actual Vacuum (in. Hg)	Ambient Temperature Initial (°F)	Ambient Temperature Final (°F)	Ambient Temperature Average (°F)
77.0	77.0	163	0.5930	16.0	74.0	73.9	74.0
78.0	78.0	163	0.5930	16.0	73.9	74.1	74.0
78.0	78.0	163	0.5930	16.0	74.1	74.1	74.1

RESULTS

DRY GAS METER VOLUME CORRECTED Vm(std) (ft³)	DRY GAS METER VOLUME CORRECTED Vm(std) (liters)	ORIFICE VOLUME CORRECTED Vcr(std) (ft³)	ORIFICE VOLUME CORRECTED Vcr(std) (liters)	ORIFICE VOLUME NOMINAL Vcr (ft³)
7.693	217.88	7.494	212.2	7.768
7.703	218.15	7.493	212.2	7.768
7.706	218.22	7.492	212.2	7.769

DRY GAS METER CALIBRATION FACTOR Y Variation (number)	DRY GAS METER CALIBRATION FACTOR Y Value (number)	ORIFICE CALIBRATION FACTOR ΔH@ Value (in. H2O)	ORIFICE CALIBRATION FACTOR ΔH@ Value (mm H2O)	ORIFICE CALIBRATION FACTOR ΔH@ Variation (in. H2O)
0.001	0.974	1.825	46.35	0.000
0.000	0.973	1.825	46.35	0.001
-0.001	0.972	1.823	46.32	-0.001
AVERAGE:	**0.973**	**1.824**	46.34	**PASSED**
LAST 5-PT:	**0.986**	**1.831**	**PASSED**	5-PT Date:
% DIFF:	**1.3%**	**0.4%**		07/14/21

40 CFR - CHAPTER I - PART 60
Appendix A, Method 5
10.3.2 Calibration After Use
After each field use, the calibration of the metering system shall be checked by performing three calibration runs at a single, intermediate orifice setting (based on the previous field test)....Calculate the average value of the DGM calibration factor. If the value has changed by more than 5 percent, recalibrate the meter over the full range of orifice settings, as detailed in Section 10.3.1.

10.3.3 Acceptable Variation in Calibration
If the DGM coefficient values obtained before and after a test series differ by more than 5 percent, the test series shall either be voided, or calculations for the test series shall be performed using whichever meter coefficient value (i.e., before or after) gives the lower value of total sample volume.

Notes: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter,acceptable tolerance of individual values from the average is +/- 0.02. For Orifice Calibration Factor dH@, the orifice differential pressure in inches of H_20 that equates to 0.75 cfm of air at 68 °F and 29.92 inches of Hg, acceptable tolerance of individual values from the average is +/- 0.2. For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above. The Critical Orifice Coefficient, K', must be entered in English units, (ft)^3*(deg R)^0.5/((in.Hg)*(min)).

SIGNATURE: Craig McCarty DATE: 08/18/21 08/18/21

METERING SYSTEM THERMOCOUPLE CALIBRATION SHEET
EPA Reference Method
Metering System Post-Test Calibration
Air Hygiene Assett ID: samp-cp-0022

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0022 Calibration 7-14-21.xls]8-18-21 (3 point)

Make: Apex
Model #: XC-522
Serial #: 1204013

Date: 08/18/21
Barometric Pressure: 29.19 (in. Hg)
Temperature (ASTM cal): 74.00 (°F)

Thermocouple	100 (°F)		600 (°F)		1200 (°F)	
	Reading	% Error	Reading	% Error	Reading	% Error
Stack	100.00	0.00	599.00	0.17	1198.00	0.17
Probe	100.00	0.00	599.00	0.17	1198.00	0.17
Filter	100.00	0.00	599.00	0.17	1198.00	0.17
Dryer	100.00	0.00	599.00	0.17	1198.00	0.17
Aux.	100.00	0.00	599.00	0.17	1198.00	0.17

Note: Calibrated against an ALTEK Thermocouple Source Series 22, ID: samp-tc-0004
Direct temperature output calibrated to ASTM and IPTS standards as outlined in ALTEK Data Sheet 22.

Thermocouple	74.00 (°F)		Responded to heating/cooling with the anticipated outcome?
	Reading	(±°F)	
DGM In	75.0	1.00	yes
DGM Out	75.0	1.00	yes

Note: Calibrated against Reference Thermometer ID: a070717

SIGNATURE: Craig McCarty DATE: 08/18/21 08/18/21

Standard for Calibration of Console Thermocouple Systems

40 CFR, Part 60
Appendix A, Method 5
10.3.2 The temperature data recorded in the field shall be considered valid. If, during calibration, the absolute temperature measured with the sensor being calibrated and the reference sensor **agree within 1.5 percent**, the temperature data taken in the field shall be considered valid.

Standard for Calibration of Individual Thermocouples

EMC, ALT-011: After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature, or any other temperature, within the range specified by the manufacturer, using a reference thermometer (either ASTM reference thermometer or a thermometer that has been calibrated against an ASTM reference thermometer). The temperatures of the thermocouple and reference thermometers shall **agree to within ±2°F**.

Check the continuity of the thermocouple by subjecting it to a change in the temperature (e.g.., removing it from the stack or touching an ice cube). This step will also check for loose connections and reversed connections (noted by a wrong change in the temperature).

PROBE (STACK), HOTBOX (FILTER), AND GOOSENECK (EXIT) THERMOCOUPLE CALIBRATION SHEET
EPA Reference Method
Metering System Post-Test Calibration

Air Hygiene Assett ID(s): **Probe:** samp-hp-0086 **Hotbox:** samp-bh-0012 **Gooseneck:** samp-ad-0046

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\PM-Equipment\M-5 Consoles\Calibration Sheet v4.1\Current\[SAMP-CP-0022 Calibration 7-14-21.xls]8-18-21 (3 point)

Barometric Pressure: 29.19

Thermo-couples		Temps (°F)	Signature		Date	
Stack	Ref	74.00	Craig McCarty		08/18/21	08/18/21
	Read	74.00				
	±°F	0.00				
Probe	Ref	74.00	Craig McCarty		08/18/21	08/18/21
	Read	74.00				
	±°F	0.00				
Filter	Ref	74.00	Craig McCarty		08/18/21	08/18/21
	Read	74.00				
	±°F	0.00				
Cond.	Ref	74.00	Craig McCarty		08/18/21	08/18/21
	Read	75.00				
	±°F	1.00				
CPM	Ref	74.00	Craig McCarty		08/18/21	08/18/21
	Read	75.00				
	±°F	1.00				
Exit	Ref	74.00	Craig McCarty		08/18/21	08/18/21
	Read	74.00				
	±°F	0.00				

Note: Calibrated against Reference Thermometer ID: a070717

Thermocouple	Responded to heating/cooling with the anticipated outcome?
Stack	yes
Probe	yes
Filter	yes
Cond.	yes
CPM	yes
Exit	yes

Standard for Calibration of Individual Thermocouples

EMC, ALT-011: After each test run series, check the accuracy (and, hence, the calibration) of each thermocouple system at ambient temperature, or any other temperature, within the range specified by the manufacturer, using a reference thermometer (either ASTM reference thermometer or a thermometer that has been calibrated against an ASTM reference thermometer). The temperatures of the thermocouple and reference thermometers shall **agree to within ±2°F**.

Check the continuity of the thermocouple by subjecting it to a change in the temperature (e.g.., removing it from the stack or touching an ice cube). This step will also check for loose connections and reversed connections (noted by a wrong change in the temperature).

Field Balance Weight Verfication
Annual 500g Field Balance Stock Weight vs. 500g ISO 17025 Traceable Weight
Air Hygiene Asset ID: samp-sc-0025

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\Field Balance Weights\2021\[samp-sc-0025_225.xlsm]Balance
Make: Ohaus
Model #: Scout Pro SP2001-US
Serial #: 7130410278
Field Weight #: sc-0025
Trailer #: 221

ISO 17025 Weight ID LABS-WT-0005
ISO S/N 1000128090
ISO Cal Due 8/4/2021

ISO 17025 Certfified Weight (g)	Field Balance Weight (g)	± g
500.00	499.60	0.40

must be <0.5

Sean Barnes _____ 01/19/21

(signature) *(date)*

ISO 17025 Certfified Weight (g)	Field Balance Weight (g)	± g
500.00	500.10	0.10

must be <0.5

Sean Barnes _____ 01/19/21

(signature) *(date)*

ISO 17025 Certfified Weight (g)	Field Balance Weight (g)	± g
500.00	500.00	0.00

must be <0.5

Sean Barnes _____ 01/19/21

(signature) *(date)*

Note: Calibrated against ISO 17025 Certified weight LABS-WT-0005

EPA Method 4 - Section 10.3, EPA Method 5 - Section 10.7, EPA Method 202 - Section 10.3: Field Balance Calibration Check. Check the calibration of the balance used to weigh impingers with a weight that is at least 500g or within 50g of a loaded impinger. The weight must be ASTM E617-13 "Standard Specification for Laboratory Weights and Precision Mass Standards" Class 6 (or better). Daily before used, the field balance must meausure within ±0.5g of the certified mass. If the daily balance calibration check fails, perform corrective measures and repeat the check before using balance.

ISO 17025 Certified 500g Weight is certified annually. Certified weight is used to verify Class 6 or better weight that accompanies each field balance on the balance it will be used. Acceptance critieria is certified weight must be within ±0.5g of Class 6 or better weight.

Field Balance Weight Verfication
Annual 500g Field Balance Stock Weight vs. 500g ISO 17025 Traceable Weight
Air Hygiene Asset ID: samp-sc-0015

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\Field Balance Weights\2021\[samp-sc-7130100125_Extra.xlsm]Balance
Make: Ohaus
Model #: Scout Pro SP2001-US
Serial #: 7130100125
Field Weight #:
Trailer #: extra

ISO 17025 Weight ID LABS-WT-0005
ISO S/N 1000128090
ISO Cal Due 8/4/2021

ISO 17025 Certfified Weight (g)	Field Balance Weight (g)	± g
500.00	500.00	0.00

must be <0.5

Sean Barnes _____ 01/19/21

(signature) *(date)*

ISO 17025 Certfified Weight (g)	Field Balance Weight (g)	± g
500.00	499.70	0.30

must be <0.5

Sean Barnes _____ 01/19/21

(signature) *(date)*

ISO 17025 Certfified Weight (g)	Field Balance Weight (g)	± g
500.00	499.80	0.20

must be <0.5

Sean Barnes _____ 01/19/21

(signature) *(date)*

Note: Calibrated against ISO 17025 Certified weight LABS-WT-0005

EPA Method 4 - Section 10.3, EPA Method 5 - Section 10.7, EPA Method 202 - Section 10.3: Field Balance Calibration Check. Check the calibration of the balance used to weigh impingers with a weight that is at least 500g or within 50g of a loaded impinger. The weight must be ASTM E617-13 "Standard Specification for Laboratory Weights and Precision Mass Standards" Class 6 (or better). Daily before used, the field balance must meausure within ±0.5g of the certified mass. If the daily balance calibration check fails, perform corrective measures and repeat the check before using balance.

ISO 17025 Certified 500g Weight is certified annually. Certified weight is used to verify Class 6 or better weight that accompanies each field balance on the balance it will be used. Acceptance critieria is certified weight must be within ±0.5g of Class 6 or better weight.

WEATHER STATION CALIBRATION SHEET
Temperature, Barometric Pressure, and Relative Humidity Periodic Calibration
Air Hygiene Asset ID: samp-we-0014

Filename: \\AHI-FILESVR\public\Shared\QAQC\Calibrations\Weather Stations\2021\[SAMP-WE-0014_224-012221.xlsm]112013
Make: Kestrel
Model #: 4000
Serial #: 671144
ISO 17025 Weather Station ID SAMP-WE-0033
ISO 17025 S/N A026334
ISO 17025 Cal Due 7/22/2021

ASTM Temp (deg F) (±1.5°)	Thermo. (deg F)	± deg F	ASTM Barometer (in. Hg) (±0.1 in Hg)	Barometric (in. Hg)	± in. Hg	Time
68.60	67.90	0.70	29.31	29.30	0.01	12:05

Sean Barnes — Sean Barnes — 01/22/21
(signature) *(date)*

ASTM Temp (deg F) (±1.5°)	Thermo. (deg F)	± deg F	ASTM Barometer (in. Hg) (±0.1 in Hg)	Barometric (in. Hg)	± in. Hg	Time
69.30	69.20	0.10	29.28	29.30	0.02	12:35

Sean Barnes — Sean Barnes — 01/22/21
(signature) *(date)*

ASTM Temp (deg F) (±1.5°)	Thermo. (deg F)	± deg F	ASTM Barometer (in. Hg) (±0.1 in Hg)	Barometric (in. Hg)	± in. Hg	Time
68.90	69.00	0.10	29.27	29.29	0.02	12:55

Sean Barnes — Sean Barnes — 01/22/21
(signature) *(date)*

ASTM Temp (deg F) (±1.5°)	Thermo. (deg F)	± deg F	ASTM Barometer (in. Hg) (±0.1 in Hg)	Barometric (in. Hg)	± in. Hg	Time
68.70	68.80	0.10	29.27	29.28	0.01	13:20

Sean Barnes — Sean Barnes — 01/22/21
(signature) *(date)*

Note: Verified against ISO 17025 Traceable Barometer and Thermometer (SAMP-WE-0033).

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end of report

APPENDIX C. EMISSION CALCULATIONS

Mine Development
Plan I PTE

Table A-1a. Project Emission Summary

Change	Fugitive? (Y/N)	PM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead Compounds	Max Single HAP (Acetaldehyde)	Total HAPs	CO_2e
Project Emissions												
Permitted NG Engines PTE[1]	N	38.13	38.13	38.13	163.88	1.22	72.84	84.33	0.00	39.80	68.00	1,133,794
Proposed NG Engines PTE		52.42	52.42	52.42	113.02	2.76	23.19	58.16	0.00	27.46	40.98	781,927
Change to PTE - NG Engines		14.28	14.28	14.28	-50.86	1.54	-49.65	-26.17	0.00	-12.34	-27.02	-351,867
Permitted Diesel Engine PTE	N	0.99	0.99	0.99	40.47	3.12	79.19	16.77	0.00	0.01	0.44	43,135
Proposed Diesel Engine PTE		1.09	1.09	1.09	40.45	2.63	79.03	17.12	0.00	0.01	0.51	50,247
Change to PTE - Diesel Engines		0.10	0.10	0.10	-0.02	-0.49	-0.16	0.35	0.00	9.49E-04	6.97E-02	7,112
Permitted Aboveground Road PTE	Y	181.79	46.90	4.69	--	--	--	--	1.85E-02	--	1.69E-01	--
Proposed Aboveground Road PTE		179.95	46.42	4.64	--	--	--	--	1.84E-02	--	1.67E-01	--
Change to PTE - Aboveground Roads		-1.84	-0.48	-0.05	--	--	--	--	-1.43E-04	--	-2.00E-03	--
Permitted Tailings Operations PTE	Y	27.66	10.97	2.36	--	--	--	--	0.118	--	1.36	--
Proposed Tailings Operations PTE		26.67	10.71	2.26	--	--	--	--	0.114	--	1.31	--
Change to PTE - Tailings Operations		-0.99	-0.26	-0.10	--	--	--	--	-4.20E-03	--	-0.05	--
Project Non-Fugitive PTE		14.39	14.39	14.39	-50.88	1.05	-49.81	-25.82	0.00E+00	-12.33	-26.95	-344,755
Project Fugitive PTE		-2.83	-0.73	-0.15	0.00	0.00	0.00	0.00	-4.34E-03	0.00	-0.05	0.00
Permitting Threshold Comparison												
Minor New Source Review (mNSR) Thresholds[1]		--	7.50	5.00	20.00	20.00	50.00	20.00	0.30	--	--	--
Does Project Non-Fugitive PTE exceed mNSR Thresholds?		--	Yes	Yes	No	No	No	No	No	--	--	--
Permitted Non-Fugitive PTE[2]		212.39	92.33	54.59	205.61	6.87	220.37	107.94	1.85	39.84	73.53	1,176,929
Permitted Non-Fugitive PTE + Project Non-Fugitive PTE Increases		226.78	106.71	68.97	154.74	7.92	170.56	82.11	1.85	27.50	46.58	832,174
Class I Title V Major Source Thresholds[1]		100	100	100	100	100	100	100	10	10	25	--
Does Non-Fugitive PTE exceed Class I Title V Major Source Thresholds?		Yes	Yes	No	Yes	No	Yes	No	No	Yes	Yes	--
Class I PSD Major Source Thresholds		250	250	250	250	250	250	250	--	--	--	100,000
Does Non-Fugitive PTE exceed Class I PSD Major Source Thresholds?[3]		No	No	No	No	No	No	No	--	--	--	No

1. Per Arizona Administrative Code (A.A.C.)
   R18-2-101.110 - For "Potential to emit" (PTE)
   R18-2-101.75 - For "Major Source"
   R18-2-101.101 - For "Permitting Exemption Thresholds" which is the mNSR Threshold per R18-2-334.A.3
2. Permitted PTE is based on post MPR No. 109292 PTE.
3. Sources exceeding 100,000 tons of CO_2e are only subject to PSD if they also trigger PSD for another regulated NSR pollutant. The Hermosa Project does not trigger PSD for any other NSR pollutant. While CO_2e is not included under the definition of "regulated NSR pollutant" at A.A.C. R18-2-101.124, GHGs are considered a "regulated NSR pollutant" under the federal Prevention of Significant Deterioration (PSD) program at 40 C.F.R. § 52.21(b)(50). South32 is therefore providing estimates of GHG (i.e., CO_2e) emissions for purposes of demonstrating non-applicability of the federal PSD program for GHGs, which ADEQ implements via a delegation agreement with EPA.

Table A-1b. Total Site-Wide Emissions

Pollutant	Regulated NSR Pollutant? [2]	Estimated Potential Emissions (tpy) [1,2]	
		Non-Fugitive	Non-Fugitive & Fugitive
PM	Yes	228.47	459.80
PM_{10}	Yes	108.03	176.02
$PM_{2.5}$	Yes	69.82	78.64
NO_X	Yes	154.74	154.74
SO_2	Yes	7.92	7.92
CO	Yes	170.56	170.56
VOC	Yes	82.11	99.23
Lead compounds	No	1.15	1.59
Elemental Lead	Yes	1.15	1.59
Total HAPs	No	50.81	53.77
HCN	No	5.38	5.41
H_2S	Yes	10.12	10.12
CO_2e [4]	-	833,346	833,346

1. PM, PM_{10}, and $PM_{2.5}$ include both filterable and condensable fractions, which conservatively overestimates PM emissions from an NSR perspective.
2. Per Arizona Administrative Code (A.A.C.)
   R18-2-101.110 - For "Potential to emit"
   R18-2-101.124 - For "Regulated NSR Pollutant"

Table A-1c. Total Emissions - Source Specific

Emission Point Number	Emissions Activity	Include? Yes/No	Source Type [1]	Underground/Aboveground?	Controlled Emissions Summary - Annual										
					PM	PM_{10}	$PM_{2.5}$	Lead Compounds	NO_X	CO	SO_2	VOC	Total HAPs	H_2S	CO_2e
DRILL-1	Drilling	Yes	Non-fugitive	Underground	0.06	0.03	0.03	3.01E-03	--	--	--	--	0.01	--	--
BLAST-1	Blasting	Yes	Non-fugitive	Underground	0.55	0.28	0.11	0.03	1.13	60.75	2.25	--	0.05	9.00	1,042.15
CRUSH-1	Primary Crushing	Yes	Non-fugitive	Underground	0.35	0.16	0.19	0.02	--	--	--	--	0.03	--	--
BREAK-1	Clark Rock Breaker	Yes	Non-fugitive	Aboveground	3.99E-03	1.89E-03	2.85E-04	7.01E-05	--	--	--	--	7.74E-04	--	--
BREAK-2	Underground Waste Rock Breaker	Yes	Non-fugitive	Underground	0.01	2.45E-03	3.70E-04	1.83E-05	--	--	--	--	4.92E-05	--	--
BREAK-3 - BREAK-7	Various Underground Ore Rock Breakers	Yes	Non-fugitive	Underground	0.05	0.02	3.64E-03	2.40E-03	--	--	--	--	4.69E-03	--	--
BREAK-8	Underground Crusher Rock Breaker	Yes	Non-fugitive	Underground	0.14	0.06	0.01	0.01	--	--	--	--	0.01	--	--
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	Yes	Non-fugitive	Aboveground	2.47	1.17	0.18	0.10	--	--	--	--	0.19	--	--
DP-4	Drop from Shaft to Waste Chute	Yes	Fugitive	Aboveground	0.96	0.46	0.07	0.01	--	--	--	--	0.01	--	--
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	Yes	Fugitive	Aboveground	0.36	0.17	0.03	0.02	--	--	--	--	0.03	--	--
DP-22	Transfer from face to loader	Yes	Non-Fugitive	Underground	0.02	0.01	0.01	7.08E-04	--	--	--	--	1.39E-03	--	--
DP-23	Transfer from loader to haul truck, as needed	Yes	Non-Fugitive	Underground	0.02	0.01	0.01	7.08E-04	--	--	--	--	1.39E-03	--	--
DP-24	Drop from loader or haul truck through grizzly to ore pass	Yes	Non-Fugitive	Underground	0.01	0.01	0.01	6.69E-04	--	--	--	--	1.28E-03	--	--
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	Yes	Non-Fugitive	Underground	0.01	0.01	0.01	6.69E-04	--	--	--	--	1.28E-03	--	--
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	Yes	Non-Fugitive	Underground	0.01	0.01	0.01	6.95E-04	--	--	--	--	1.36E-03	--	--
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	Yes	Non-Fugitive	Underground	0.01	0.01	0.01	6.95E-04	--	--	--	--	1.36E-03	--	--
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	Yes	Non-Fugitive	Underground	0.01	0.01	0.01	6.95E-04	--	--	--	--	1.36E-03	--	--
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	Yes	Non-Fugitive	Underground	0.10	0.05	0.05	4.88E-03	--	--	--	--	0.01	--	--
DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	Yes	Non-Fugitive	Underground	0.03	0.01	0.01	8.87E-05	--	--	--	--	2.38E-04	--	--
DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	Yes	Non-Fugitive	Underground	0.02	0.01	0.01	1.05E-03	--	--	--	--	2.06E-03	--	--
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	Yes	Non-Fugitive	Underground	0.01	2.56E-03	2.56E-03	1.92E-05	--	--	--	--	5.14E-05	--	--
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	Yes	Non-Fugitive	Underground	0.03	0.01	0.01	1.07E-03	--	--	--	--	2.11E-03	--	--
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	Yes	Non-Fugitive	Underground	0.03	0.01	0.01	1.07E-03	--	--	--	--	2.11E-03	--	--
DP-82	Drop on West Rock Stockpile	Yes	Fugitive	Aboveground	0.67	0.32	0.05	2.37E-03	--	--	--	--	0.01	--	--
DP-83	Drop on East Ore Stockpile	Yes	Fugitive	Aboveground	0.36	0.17	0.03	0.02	--	--	--	--	0.03	--	--
DP-84	Drop on TSF	Yes	Fugitive	Aboveground	1.25	0.59	0.09	0.01	--	--	--	--	0.06	--	--

Emission Point Number	Emissions Activity	Include? Yes/No	Source Type [1]	Underground/Aboveground?	Controlled Emissions Summary - Annual										
					PM	PM_{10}	$PM_{2.5}$	Lead Compounds	NO_X	CO	SO_2	VOC	Total HAPs	H_2S	CO_2e
DP-94	Transfer from Agg Stockpile to Loader	Yes	Fugitive	Aboveground	0.08	0.04	0.01	--	--	--	--	--	--	--	--
DP-95	Transfer of Agg Material from Loader to Haul Truck	Yes	Fugitive	Aboveground	0.08	0.04	0.01	--	--	--	--	--	--	--	--
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	Yes	Fugitive	Aboveground	0.08	0.04	0.01	--	--	--	--	--	--	--	--
DP-97	Transfer from East Ore Stockpile to Loader	Yes	Fugitive	Aboveground	0.36	0.17	0.03	0.02	--	--	--	--	0.03	--	--
DP-98	Transfer from Loader to Haul Truck	Yes	Fugitive	Aboveground	0.36	0.17	0.03	0.02	--	--	--	--	0.03	--	--
DP-99	Transfer from Waste Chute Stockpile to Loader	Yes	Fugitive	Aboveground	3.21	1.52	0.23	0.02	--	--	--	--	0.04	--	--
DP-100	Transfer from Loader to Haul Truck	Yes	Fugitive	Aboveground	3.21	1.52	0.23	0.02	--	--	--	--	0.04	--	--
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	Yes	Fugitive	Aboveground	7.92E-05	3.75E-05	5.68E-06	--	--	--	--	--	--	--	--
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	Yes	Fugitive	Aboveground	3.57E-08	1.69E-08	2.56E-09	--	--	--	--	--	--	--	--
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	Yes	Fugitive	Aboveground	9.97E-04	4.71E-04	7.14E-05	--	--	--	--	--	--	--	--
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	Yes	Fugitive	Aboveground	2.26E-03	1.07E-03	1.62E-04	--	--	--	--	--	--	--	--
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	Yes	Fugitive	Aboveground	1.09E-03	5.13E-04	7.77E-05	--	--	--	--	--	--	--	--
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	Yes	Fugitive	Aboveground	1.18E-05	5.58E-06	8.45E-07	--	--	--	--	--	--	--	--
DP-149	Drop of Sodium Bicarbonate	Yes	Fugitive	Aboveground	1.18E-05	5.58E-06	8.45E-07	--	--	--	--	--	--	--	--
DC-1	21210-CX-00002 Main Shaft Ore Discharge Dust Collector 7	Yes	Non-fugitive	Aboveground	0.24	0.24	0.24	0.01					0.02		
DC-2	21210-CX-00001 Coarse Ore Overland Conveyor Dust Collector 7	Yes	Non-fugitive	Aboveground	0.38	0.38	0.38	0.02					0.03		
DC-3	21210-CX-00003 Transfer Tower Silo Dust Collector 4	Yes	Non-fugitive	Aboveground	2.25	2.25	2.25	0.09					0.17		
DC-4	21510-CX-00001 Coarse Ore Silo Dust Collector 4	Yes	Non-fugitive	Aboveground	0.83	0.83	0.83	0.04					0.08		
DC-5	21710-CX-00002 Silo Discharge Dust Collector 5	Yes	Non-fugitive	Aboveground	0.81	0.81	0.81	0.04					0.08		
DC-12	22620-CX-00001 Copper Sulphate Mix Tank Dust Collector	Yes	Non-fugitive	Aboveground	0.30	0.30	0.30	--					--		
DC-13	22620-CX-00002 10% Zinc Sulphate Mix Tank Dust Collector	Yes	Non-fugitive	Aboveground	0.30	0.30	0.30	--					--		
DC-14	22620-CX-00005 50% Zinc Sulphate Mix Tank Dust Collector	Yes	Non-fugitive	Aboveground	0.30	0.30	0.30	--					--		
DC-15	22620-CX-00004 Caustic Mix Tank Dust Collector	Yes	Non-fugitive	Aboveground	0.30	0.30	0.30	--					--		
DC-16	22210-CX-00001 Pebble Crusher Dust Collector 4	Yes	Non-fugitive	Aboveground	0.93	0.93	0.93	0.04					0.09		
DC-PPBSS1	18610-SI-00001 Paste Plant Binder Storage Silo 1 6	Yes	Non-fugitive	Aboveground	0.14	0.14	0.14	--					--		
DC-PPBSS2	18610-SI-00002 Paste Plant Binder Storage Silo 2 6	Yes	Non-fugitive	Aboveground	0.14	0.14	0.14	--					--		
DC-PPBDS3	18610-SI-10003 Paste Plant Binder Dosage Silo 3 6	Yes	Non-fugitive	Aboveground	0.28	0.28	0.28	--					--		
DC-PPBDS4	18610-SI-20004 Paste Plant Binder Dosage Silo 4 6	Yes	Non-fugitive	Aboveground	0.28	0.28	0.28	--					--		
DC-PPM1M	18610-DC-20002 Paste Plant Module 1 Mixer 6	Yes	Non-fugitive	Aboveground	0.56	0.56	0.56	--					--		
DC-PPM2M	18610-DC-20002 Paste Plant Module 2 Mixer 6	Yes	Non-fugitive	Aboveground	0.56	0.56	0.56	--					--		
DC-7	Coarse Ore Dust Collection System,23100-FAN-0001	Yes	Non-fugitive	Aboveground	0.12	0.12	0.12	2.11E-03	--	--	--	--	0.02	--	--
DC-8	Coarse Ore Dust Collection System,23100-FAN-0002	Yes	Non-fugitive	Aboveground	0.12	0.12	0.12	2.11E-03	--	--	--	--	0.02	--	--
DC-CPPBS1	Paste Plant Binder Silo 1 6	Yes	Non-fugitive	Aboveground	0.14	0.14	0.14	--	--	--	--	--	--	--	--
DC-CPPBS2	Paste Plant Binder Silo 2 6	Yes	Non-fugitive	Aboveground	0.14	0.14	0.14	--	--	--	--	--	--	--	--
DC-CPPBS3	Paste Plant Binder Silo 3 6	Yes	Non-fugitive	Aboveground	0.28	0.28	0.28	--	--	--	--	--	--	--	--
DC-CPPBS4	Paste Plant Binder Silo 4 6	Yes	Non-fugitive	Aboveground	0.28	0.28	0.28	--	--	--	--	--	--	--	--
DC-CPPM1M	Paste Plant Module 1 Mixer 6	Yes	Non-fugitive	Aboveground	0.56	0.56	0.56	--					--		
DC-CPPM2M	Paste Plant Module 2 Mixer 6	Yes	Non-fugitive	Aboveground	0.56	0.56	0.56	--					--		
DC-10	Coarse Ore Dust Collection System,23100-DCD-0005	Yes	Non-fugitive	Aboveground	0.12	0.12	0.12	2.11E-03					0.02		
WTP1LS	Waste Water Treatment Plant #1 Lime Silo	Yes	Non-fugitive	Aboveground	0.19	0.19	0.19						--		
WTP2 DC	Sodium Sulfate Indoor Dust Collector 5	Yes	Non-fugitive	Aboveground	0.01	0.01	0.01						--		
TNK-040	F549/MIBC	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	0.29	0.26	--	--
TNK-041	3407-A	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	1.48E-03	9.52E-05	--	--
TNK-044	Solvay 5100	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	0.01	3.67E-05	--	--
TNK-045	Copper Sulphate	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-046	Copper Sulphate	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--

Emission Point Number	Emissions Activity	Include? Yes/No	Source Type [1]	Underground/Aboveground?	Controlled Emissions Summary - Annual										
					PM	PM_{10}	$PM_{2.5}$	Lead Compounds	NO_X	CO	SO_2	VOC	Total HAPs	H_2S	CO_2e
TNK-047	Zinc Sulphate	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-048	Zinc Sulphate	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-051	Zinc Cyanide	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-052	Zinc Cyanide	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-053	SMBS	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-054	SMBS	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-057	Tailings Flocculant(SNF AN910-VHM)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-058	Tailings Flocculant(SNF AN910-VHM)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-059	Tailings Flocculant(SNF AN910-VHM)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-060	3418-A	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	1.90E-04	--	--	--
TNK-061	Shaft ANE	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	2.38E-04	--	--	--
TSF_1	Tailing Storage Facility	Yes	Fugitive	Aboveground	16.45	8.23	1.23	0.07	--	--	--	--	0.81	--	--
WRS	West Rock Stockpile	Yes	Fugitive	Aboveground	0.67	0.34	0.05	2.37E-03	--	--	--	--	0.01	--	--
EOS	East Ore Stockpile	Yes	Fugitive	Aboveground	0.74	0.37	0.06	0.04	--	--	--	--	0.07	--	--
TAGG	Taylor Agg Stockpile	Yes	Fugitive	Aboveground	4.53E-04	2.27E-04	3.40E-05	--	--	--	--	--	--	--	--
TSHOT	Taylor Shotcrete Stockpile	Yes	Fugitive	Aboveground	8.06E-04	4.03E-04	6.04E-05	--	--	--	--	--	--	--	--
HRS	Hardshell Rock Stockpile	Yes	Fugitive	Aboveground	3.95	1.98	0.30	0.02	--	--	--	--	0.05		
ORE	Clark Ore Stockpile	Yes	Fugitive	Aboveground	0.12	0.06	0.01	2.12E-03	--	--	--	--	0.02		
ROM	Clark ROM Stockpile	Yes	Fugitive	Aboveground	0.04	0.02	2.68E-03	6.29E-04	--	--	--	--	0.01		
AGG	Clark Agg Stockpile	Yes	Fugitive	Aboveground	4.53E-04	2.27E-04	3.40E-05	--	--	--	--	--	--		
SHOT	Clark Shotcrete Stockpile	Yes	Fugitive	Aboveground	8.06E-04	4.03E-04	6.04E-05	--	--	--	--	--	--		
CHUTE	Waste Chute Stockpile	Yes	Fugitive	Aboveground	2.59E-03	1.30E-03	1.94E-04	1.49E-05	--	--	--	--	3.54E-05		
WTP2CT	Cooling Towers	Yes	Fugitive	Aboveground	0.02	0.02	4.07E-04	--	--	--	--	--	--	--	--
PRODREF	Refrigeration Plant[3]	Yes	Non-fugitive	Aboveground	0.05	0.03	0.01	--	--	--	--	--	--	--	--
BBREF	Refrigeration Plant[3]	Yes	Non-fugitive	Aboveground	0.08	0.04	0.01	--	--	--	--	--	--	--	--
MILLREF	Primary Mill Cooling Tower	Yes	Non-fugitive	Aboveground	3.51E-03	1.83E-03	6.37E-04						--		
SCRUBBER-1	Tank Exhaust HCN Scrubber	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	5.38		
Tanks Exhaust	Process Tanks Exhaust	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	--	0.03		
CBP1_11	Taylor Concrete Batch Plant[2]	Yes	Non-fugitive	Aboveground	0.79	0.32	0.32	--	--	--	--	--	--	--	--
CCBP1_11	Clark Concrete Batch Plant	Yes	Non-fugitive	Aboveground	0.04	0.02	0.02	--	--	--	--	--	--	--	--
DOZER-WRS	Dozer Emissions	Yes	Fugitive	Aboveground	1.09	0.14	0.11	3.84E-03	--	--	--	--	0.01	--	--
DOZER-HRS	Dozer Emissions	Yes	Fugitive	Aboveground	1.09	0.14	0.11	0.01	--	--	--	--	0.01	--	--
DOZER-TSF	Dozer Emissions	Yes	Fugitive	Aboveground	8.96	1.89	0.94	0.04	--	--	--	--	0.44	--	--
DOZER-EOS	Dozer Emissions	Yes	Fugitive	Aboveground	1.09	0.14	0.11	0.05	--	--	--	--	0.10	--	--
MEVAP1	Mechanical Evaporator	Yes	Fugitive	Aboveground	--	0.04	0.01	--	--	--	--	--	--	--	--
MEVAP2	Mechanical Evaporator	Yes	Fugitive	Aboveground	--	0.04	0.01	--	--	--	--	--	--	--	--
MEVAP3	Mechanical Evaporator	Yes	Fugitive	Aboveground	--	0.04	0.01	--	--	--	--	--	--	--	--
22310-FC-00001	Lead Rougher	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.06	--	--	--
22310-FC-00004	Lead Rougher Scavenger	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.06	--	--	--
22310-FC-00008	Lead Cleaner Scalper	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.19	--	--	--
22310-FC-00007	Lead Cleaner	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.16	--	--	--
22310-FC-00009	Lead Cleaner Scavenger	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.15	--	--	--
22310-FC-00005	Zinc Rougher	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.12	--	--	--
22310-FC-00006	Zinc Rougher Scavenger	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.11	--	--	--
22310-FC-00011	Zinc Cleaner Scalper	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.12	--	--	--
22310-FC-00010	Zinc Cleaner	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.10	--	--	--
22310-FC-00012	Zinc Cleaner Scavenger	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.09	--	--	--
22430-TN-00001	Lead Concentrate Tank	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	6.02	--		
22430-TN-00002	Zinc Concentrate Tank	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	7.60	--		
22310-TN-00003	Lead Conditioning Tank	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.50	--		
22310-TN-00001	Zinc Conditioning Tank No. 1	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.28	--		
22310-TN-00002	Zinc Conditioning Tank No. 2	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.28	--		
DRILL-2	Drilling	Yes	Non-fugitive	Underground	0.02	0.01	0.01	3.39E-04	--	--	--	--	3.74E-03	--	--
BLAST-2	Blasting	Yes	Non-fugitive	Underground	0.31	0.16	0.04	0.01	0.14	7.59	0.28	--	0.06	1.12	130.15
DP-103	Dump into Primary Crusher Feed Hopper	Yes	Fugitive	Aboveground	0.29	0.14	0.02	0.01	--	--	--	--	0.06	--	--
DP-104	Drop from silo to trucks	Yes	Fugitive	Aboveground	0.96	0.46	0.07	0.02	--	--	--	--	0.19	--	--
DP-105	Transfer of Ore from Ore Stockpile to Loader	Yes	Fugitive	Aboveground	0.58	0.27	0.04	0.01	--	--	--	--	0.11	--	--
DP-106	Transfer of Ore Mined from Loader to Haul Truck	Yes	Fugitive	Aboveground	0.58	0.27	0.04	0.01	--	--	--	--	0.11	--	--
DP-107	Transfer from ROM Stockpile to Loader	Yes	Fugitive	Aboveground	0.16	0.08	0.01	2.79E-03	--	--	--	--	0.03	--	--
DP-109	Transfer from Agg Stockpile to Loader	Yes	Fugitive	Aboveground	0.08	0.04	0.01	--	--	--	--	--	--	--	--

Emission Point Number	Emissions Activity	Include? Yes/No	Source Type [1]	Underground/Aboveground?	Controlled Emissions Summary - Annual										
					PM	PM_{10}	$PM_{2.5}$	Lead Compounds	NO_X	CO	SO_2	VOC	Total HAPs	H_2S	CO_2e
DP-110	Transfer of Agg Material from Loader to Haul Truck	Yes	Fugitive	Aboveground	0.08	0.04	0.01	--	--	--	--	--	--	--	--
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	Yes	Fugitive	Aboveground	0.08	0.04	0.01	--	--	--	--	--	--	--	--
DP-113	Hardshell Rock Storage	Yes	Fugitive	Aboveground	2.60	1.23	0.19	0.01	--	--	--	--	0.06	--	--
DP-114	Ore Stockpile	Yes	Fugitive	Aboveground	0.58	0.27	0.04	0.01	--	--	--	--	0.11	--	--
DP-115	ROM Stockpile	Yes	Fugitive	Aboveground	0.16	0.08	0.01	2.79E-03	--	--	--	--	0.03	--	--
DP-124	Transfer of Development Ore from Face to Loader	Yes	Non-fugitive	Underground	9.01E-04	4.26E-04	2.67E-04	1.16E-05	--	--	--	--	9.79E-05	--	--
DP-125	Transfer of Development Ore from Loader to Stockpile	Yes	Non-fugitive	Underground	9.01E-04	4.26E-04	2.67E-04	1.16E-05	--	--	--	--	9.79E-05	--	--
DP-126	Transfer of Development Ore from Stockpile to Loader	Yes	Non-fugitive	Underground	9.01E-04	4.26E-04	2.67E-04	1.16E-05	--	--	--	--	9.79E-05	--	--
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	Yes	Non-fugitive	Underground	9.01E-04	4.26E-04	2.67E-04	1.16E-05	--	--	--	--	9.79E-05	--	--
DP-129	Transfer of Development Waste Mined from Face to Loader	Yes	Non-fugitive	Underground	4.67E-03	2.21E-03	1.38E-03	2.65E-05	--	--	--	--	1.08E-04	--	--
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	Yes	Non-fugitive	Underground	4.67E-03	2.21E-03	1.38E-03	2.65E-05	--	--	--	--	1.08E-04	--	--
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	Yes	Non-fugitive	Underground	4.67E-03	2.21E-03	1.38E-03	2.65E-05	--	--	--	--	1.08E-04	--	--
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	Yes	Non-fugitive	Underground	4.67E-03	2.21E-03	1.38E-03	2.65E-05	--	--	--	--	1.08E-04	--	--
DP-134	Transfer of Stope Ore from Stope to Loader	Yes	Non-fugitive	Underground	2.57E-03	1.21E-03	7.62E-04	4.52E-05	--	--	--	--	4.99E-04	--	--
DP-135	Transfer of Stope Ore from Loader to Stockpile	Yes	Non-fugitive	Underground	2.57E-03	1.21E-03	7.62E-04	4.52E-05	--	--	--	--	4.99E-04	--	--
DP-136	Transfer of Stope Ore from Stockpile to Loader	Yes	Non-fugitive	Underground	2.57E-03	1.21E-03	7.62E-04	4.52E-05	--	--	--	--	4.99E-04	--	--
DP-137	Transfer of Stope Ore from Loader to Haul Truck	Yes	Non-fugitive	Underground	2.57E-03	1.21E-03	7.62E-04	4.52E-05	--	--	--	--	4.99E-04	--	--
PP-1	Truck Pneumatic Loadout to Silo 1	Yes	Non-fugitive	Aboveground	4.24E-02	1.46E-02	3.04E-03	0.00E+00	--	--	--	--	--	--	--
PP-2	Truck Pneumatic Loadout to Silo 2	Yes	Non-fugitive	Aboveground	4.24E-02	1.46E-02	3.04E-03	0.00E+00	--	--	--	--	--	--	--
PP-3	Truck Pneumatic Loadout to Silo 1	Yes	Non-fugitive	Aboveground	2.12E-02	7.29E-03	1.52E-03	0.00E+00	--	--	--	--	--	--	--
PP-4	Truck Pneumatic Loadout to Silo 2	Yes	Non-fugitive	Aboveground	2.12E-02	7.29E-03	1.52E-03	0.00E+00	--	--	--	--	--	--	--
ROADS	Road Emissions	Yes	Fugitive	Aboveground	179.95	46.42	4.64	0.02					0.17		
UGTROADS	Underground Taylor Roads	Yes	Non-fugitive	Underground	77.04	19.88	1.99	0.273	--	--	--	--	0.73	--	--
UGCROADS	Underground Clark Roads	Yes	Non-fugitive	Underground	81.39	21.00	2.10	0.461	--	--	--	--	1.88	--	--
ENGINE 0013 - 0056	CAT 3520 DSL 2600 kW	Yes	Non-fugitive	Aboveground	52.42	52.42	52.42	--	113.02	23.19	2.76	58.16	40.98	--	781,926.73
ENGINE 0007 - 0012	CAT C18, 589 bkW	Yes	Non-fugitive	Aboveground	0.68	0.68	0.68	--	7.80	40.00	8.28E-04	15.00	0.47	--	47,547.05
ENGINE 0002 - 0006	CAT C175 3000 kW	Yes	Non-fugitive	Aboveground	0.36	0.36	0.36	--	31.83	31.83	0.07	1.73	0.01	--	1,267.09
ENGINE 0001	C200D2RE	Yes	Non-fugitive	Aboveground	0.04	0.04	0.04	--	0.82	7.20	2.56	0.39	0.03	--	1,432.87
AGGDF-T	Aboveground Gasoline Dispensing Facility - Taylor	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.85	0.15	--	--
AGGDF-C	Aboveground Gasoline Dispensing Facility - Clark	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.41	0.08	--	--
T-01	Unleaded Gasoline (S32)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	0.38	0.01	--	--
T-02	Diesel (Red Dyed S32)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	1.64E-03	1.51E-04	--	--
T-03	Diesel (Red Dyed S32)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	1.64E-03	1.51E-04	--	--
T-04	Diesel (Red Dyed Rummel)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	2.04E-03	1.88E-04	--	--
T-05	Unleaded Gasoline (Rummel)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	0.33	0.01	--	--
T-06	Diesel (Rummel)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	4.74E-04	4.36E-05	--	--
T-07	Unleaded Gasoline	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	1.92	0.04	--	--
T-08	Unleaded Gasoline	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	1.92	0.04	--	--
T-09	Unleaded Gasoline	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	1.92	0.04	--	--
T-10	Diesel	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	0.04	3.60E-03	--	--
T-11	Diesel	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	0.04	3.30E-03	--	--
Total - Non-Fugitive & Fugitive Emissions					459.80	176.02	78.64	1.59	154.74	170.56	7.92	99.23	53.77	10.12	833346.03
Total - Non-Fugitive Emissions					228.47	108.03	69.82	1.15	154.74	170.56	7.92	82.11	50.81	10.12	833346.03

1. Underground emissions conservatively taken as non-fugitive. South32 reserves the right to update this conservative assumption.
2. The concrete batch plant is conservatively assumed to be a non-fugitive source of emissions. South32 reserves the right to update this representation once we have more clarity on the concrete batch plant design per correspondance with ADEQ on Jan 13th 2023.
3. The surface refrigeration plant is considered a non-fugitive source of emissions based on correspondance with ADEQ on Jan 13th 2023.

Table A-2a. Facility HAPs Summary

Pollutant	Emissions (tpy)
Benzene	0.51
Toluene	0.41
Xylene	0.25
1,3-Butadiene	0.14
Formaldehyde	6.78
Acetaldehyde	27.48
Acrolein	2.47
Naphthalene	0.07
1,1,2,2-Tetrachloroethane	0.19
1,1,2-Trichloroethane	0.15
1,3-Dichloropropene	0.01
2-Methylnaphthalene	0.02
2,2,4-Trimethylpentane	0.12
Biphenyl	0.10
Carbon Tetrachloride	0.17
Chlorobenzene	0.14
Chloroform	0.13
Ethylbenzene	0.04
Ethylene Dibromide	0.21
Methanol	1.20
Methylene Chloride	0.09
Hexane	0.55
PAH	0.39
Phenol	0.11
Tetrachloroethane	0.01
Vinyl Chloride	0.07
Cresol	9.52E-05
Ethylene Glycol Dimethyl Ether	0.26
Urethane	3.67E-05
Cumene	4.46E-04
Isooctane	0.04
PAC's	5.84E-05
Hydrogen Cyanide	5.41E+00
Antimony Compounds	1.79E-02
Arsenic Compounds	2.37E-02
Beryllium Compounds	6.34E-04
Cadmium Compounds	9.07E-03
Chromium Compounds	1.24E-02
Cobalt Compounds	4.57E-03
Manganese Compounds	4.57
Nickel Compounds	7.77E-03
Selenium Compounds	2.08E-03
Lead Compounds	1.59

Table A-2b. Metal HAP in PM - Constituents Summary

Emission Point Number	Emissions Activity	Emissions[1]												
		Include? Yes/No	PM	Antimony Compounds	Arsenic Compounds	Beryllium Compounds	Cadmium Compounds	Chromium Compounds	Cobalt Compounds	Manganese Compounds	Nickel Compounds	Selenium Compounds	Lead Compounds	Mercury Compounds	Total
DRILL-1	Drilling	Yes	0.06	1.29E-05	9.44E-06	7.28E-08	1.18E-05	2.00E-06	1.58E-06	2.71E-03	6.07E-07	1.58E-06	3.01E-03	--	5.76E-03
BLAST-1	Blasting	Yes	0.55	1.16E-04	8.48E-05	6.55E-07	1.06E-04	1.80E-05	1.42E-05	2.44E-02	5.45E-06	1.42E-05	2.71E-02	--	5.18E-02
CRUSH-1	Primary Crushing	Yes	0.35	7.42E-05	5.44E-05	4.20E-07	6.79E-05	1.15E-05	9.10E-06	1.56E-02	3.50E-06	9.10E-06	1.74E-02	--	3.32E-02
BREAK-1	Clark Rock Breaker	Yes	0.00	1.80E-06	2.16E-06	6.70E-09	4.88E-07	1.71E-07	2.39E-08	7.00E-04	3.11E-08	1.99E-08	7.01E-05	--	7.74E-04
BREAK-2	Underground Waste Rock Breaker	Yes	0.01	8.98E-08	2.61E-07	7.25E-09	1.85E-08	1.41E-07	1.96E-08	3.03E-05	4.05E-08	1.68E-08	1.83E-05	--	4.92E-05
BREAK-3 - BREAK-7	Various Underground Ore Rock Breakers	Yes	0.05	1.03E-05	7.78E-06	6.05E-08	9.29E-06	1.69E-06	1.27E-06	2.25E-03	5.07E-07	1.27E-06	2.40E-03	--	4.69E-03
BREAK-8	Underground Crusher Rock Breaker	Yes	0.14	2.79E-05	2.10E-05	1.64E-07	2.51E-05	4.57E-06	3.43E-06	6.10E-03	1.37E-06	3.43E-06	6.50E-03	--	1.27E-02
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	Yes	2.47	4.11E-04	3.28E-04	3.04E-06	3.65E-04	7.92E-05	5.13E-05	9.09E-02	2.36E-05	5.11E-05	9.56E-02	--	1.88E-01
DP-4	Drop from Shaft to Waste Chute	Yes	0.96	2.57E-05	5.36E-05	1.34E-06	1.21E-05	2.66E-05	4.67E-06	7.49E-03	7.64E-06	4.18E-06	5.52E-03	--	1.31E-02
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	Yes	0.36	7.37E-05	5.57E-05	4.33E-07	6.65E-05	1.21E-05	9.06E-06	1.61E-02	3.62E-06	9.07E-06	1.72E-02	--	3.35E-02
DP-22	Transfer from face to loader	Yes	0.02	3.04E-06	2.43E-06	2.25E-08	2.70E-06	5.86E-07	3.80E-07	6.73E-04	1.75E-07	3.79E-07	7.08E-04	--	1.39E-03
DP-23	Transfer from loader to haul truck, as needed	Yes	0.02	3.04E-06	2.43E-06	2.25E-08	2.70E-06	5.86E-07	3.80E-07	6.73E-04	1.75E-07	3.79E-07	7.08E-04	--	1.39E-03
DP-24	Drop from loader or haul truck through grizzly to ore pass	Yes	0.01	2.74E-06	2.07E-06	1.61E-08	2.47E-06	4.48E-07	3.36E-07	5.98E-04	1.35E-07	3.37E-07	6.69E-04	--	1.28E-03
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	Yes	0.01	2.74E-06	2.07E-06	1.61E-08	2.47E-06	4.48E-07	3.36E-07	5.98E-04	1.35E-07	3.37E-07	6.69E-04	--	1.28E-03
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	Yes	0.01	2.98E-06	2.25E-06	1.75E-08	2.69E-06	4.88E-07	3.66E-07	6.52E-04	1.47E-07	3.67E-07	6.95E-04	--	1.36E-03
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	Yes	0.01	2.98E-06	2.25E-06	1.75E-08	2.69E-06	4.88E-07	3.66E-07	6.52E-04	1.47E-07	3.67E-07	6.95E-04	--	1.36E-03
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	Yes	0.01	2.98E-06	2.25E-06	1.75E-08	2.69E-06	4.88E-07	3.66E-07	6.52E-04	1.47E-07	3.67E-07	6.95E-04	--	1.36E-03
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	Yes	0.10	2.09E-05	1.58E-05	1.23E-07	1.89E-05	3.43E-06	2.57E-06	4.57E-03	1.03E-06	2.57E-06	4.88E-03	--	9.51E-03
DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	Yes	0.03	4.35E-07	1.27E-06	3.51E-08	8.94E-08	6.85E-07	9.50E-08	1.47E-04	1.96E-07	8.14E-08	8.87E-05	--	2.38E-04
DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	Yes	0.02	4.52E-06	3.41E-06	2.65E-08	4.07E-06	7.40E-07	5.55E-07	9.88E-04	2.22E-07	5.56E-07	1.05E-03	--	2.06E-03
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Convevor	Yes	0.01	9.40E-08	2.74E-07	7.59E-09	1.93E-08	1.48E-07	2.05E-08	3.17E-05	4.23E-08	1.76E-08	1.92E-05	--	5.14E-05
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	Yes	0.03	4.61E-06	3.68E-06	3.41E-08	4.09E-06	8.88E-07	5.76E-07	1.02E-03	2.64E-07	5.74E-07	1.07E-03	--	2.11E-03
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	Yes	0.03	4.61E-06	3.68E-06	3.41E-08	4.09E-06	8.88E-07	5.76E-07	1.02E-03	2.64E-07	5.74E-07	1.07E-03	--	2.11E-03
DP-82	Drop on West Rock Stockpile	Yes	0.67	1.16E-05	3.38E-05	9.37E-07	2.38E-06	1.83E-05	2.53E-06	3.91E-03	5.23E-06	2.17E-06	2.37E-03	--	6.35E-03
DP-83	Drop on East Ore Stockpile	Yes	0.36	7.37E-05	5.57E-05	4.33E-07	6.65E-05	1.21E-05	9.06E-06	1.61E-02	3.62E-06	9.07E-06	1.72E-02	--	3.35E-02
DP-84	Drop on TSF	Yes	1.25	2.54E-04	1.92E-04	1.49E-06	2.29E-04	4.16E-05	3.12E-05	5.55E-02	1.25E-05	3.12E-05	5.33E-03	--	6.16E-02
DP-94	Transfer from Agg Stockpile to Loader	Yes	0.08												0.00E+00
DP-95	Transfer of Agg Material from Loader to Haul Truck	Yes	0.08												0.00E+00
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	Yes	0.08												0.00E+00
DP-97	Transfer from East Ore Stockpile to Loader	Yes	0.36	7.37E-05	5.57E-05	4.33E-07	6.65E-05	1.21E-05	9.06E-06	1.61E-02	3.62E-06	9.07E-06	1.72E-02	--	3.35E-02
DP-98	Transfer from Loader to Haul Truck	Yes	0.36	7.37E-05	5.57E-05	4.33E-07	6.65E-05	1.21E-05	9.06E-06	1.61E-02	3.62E-06	9.07E-06	1.72E-02	--	3.35E-02
DP-99	Transfer from Waste Chute Stockpile to Loader	Yes	3.21	8.55E-05	1.79E-04	4.47E-06	4.02E-05	8.88E-05	1.56E-05	2.50E-02	2.55E-05	1.39E-05	1.84E-02	--	4.38E-02
DP-100	Transfer from Loader to Haul Truck	Yes	3.21	8.55E-05	1.79E-04	4.47E-06	4.02E-05	8.88E-05	1.56E-05	2.50E-02	2.55E-05	1.39E-05	1.84E-02	--	4.38E-02
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	Yes	7.92E-05												0.00E+00
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	Yes	3.57E-08												0.00E+00
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	Yes	9.97E-04												0.00E+00
DP-144	Drop of Taillings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	Yes	2.26E-03												0.00E+00
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	Yes	1.09E-03												0.00E+00
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	Yes	1.18E-05												0.00E+00
DP-149	Drop of Sodium Bicarbonate	Yes	1.18E-05												0.00E+00
DC-1	21210-CX-00002 Main Shaft Ore Discharge Dust Collector 7	Yes	0.24	4.07E-05	3.25E-05	3.01E-07	3.61E-05	7.83E-06	5.08E-06	8.99E-03	2.33E-06	5.06E-06	9.46E-03	--	1.86E-02
DC-2	21210-CX-00001 Coarse Ore Overland Conveyor Dust Collector 7	Yes	0.38	7.62E-05	5.75E-05	4.47E-07	6.87E-05	1.25E-05	9.36E-06	1.67E-02	3.74E-06	9.37E-06	1.78E-02	--	3.47E-02
DC-3	21210-CX-00003 Transfer Tower Silo Dust Collector 4	Yes	2.25	3.75E-04	3.00E-04	2.78E-06	3.33E-04	7.23E-05	4.69E-05	8.30E-02	2.15E-05	4.67E-05	8.73E-02	--	1.71E-01
DC-4	21510-CX-00001 Coarse Ore Silo Dust Collector 4	Yes	0.83	1.68E-04	1.27E-04	9.84E-07	1.51E-04	2.74E-05	2.06E-05	3.66E-02	8.24E-06	2.06E-05	3.91E-02	--	7.62E-02
DC-5	21710-CX-00002 Silo Discharge Dust Collector 5	Yes	0.81	1.65E-04	1.25E-04	9.71E-07	1.49E-04	2.71E-05	2.03E-05	3.61E-02	8.13E-06	2.03E-05	3.85E-02	--	7.52E-02
DC-12	22620-CX-00001 Copper Sulphate Mix Tank Dust Collector	Yes	0.30												0.00E+00
DC-13	22620-CX-00002 10% Zinc Sulphate Mix Tank Dust Collector	Yes	0.30												0.00E+00
DC-14	22620-CX-00005 50% Zinc Sulphate Mix Tank Dust Collector	Yes	0.30												0.00E+00
DC-15	22620-CX-00004 Caustic Mix Tank Dust Collector	Yes	0.30												0.00E+00
DC-16	22210-CX-00001 Pebble Crusher Dust Collector 4	Yes	0.93	1.88E-04	1.42E-04	1.10E-06	1.70E-04	3.08E-05	2.31E-05	4.11E-02	9.25E-06	2.32E-05	4.39E-02	--	8.56E-02
DC-PPBSS1	18610-SI-00001 Paste Plant Binder Storage Silo 1 6	Yes	0.14											--	0.00E+00
DC-PPBSS2	18610-SI-00002 Paste Plant Binder Storage Silo 2 6	Yes	0.14											--	0.00E+00
DC-PPBDS3	18610-SI-10003 Paste Plant Binder Dosage Silo 3 6	Yes	0.28											--	0.00E+00
DC-PPBDS4	18610-SI-20004 Paste Plant Binder Dosage Silo 4 6	Yes	0.28											--	0.00E+00
DC-PPM1M	18610-DC-20002 Paste Plant Module 1 Mixer 6	Yes	0.56											--	0.00E+00
DC-PPM2M	18610-DC-20002 Paste Plant Module 2 Mixer 6	Yes	0.56											--	0.00E+00
DC-7	Coarse Ore Dust Collection System,23100-FAN-0001	Yes	0.12	5.42E-05	6.52E-05	2.02E-07	1.47E-05	5.17E-06	7.21E-07	2.11E-02	9.37E-07	6.01E-07	2.11E-03	--	2.33E-02
DC-8	Coarse Ore Dust Collection System,23100-FAN-0002	Yes	0.12	5.42E-05	6.52E-05	2.02E-07	1.47E-05	5.17E-06	7.21E-07	2.11E-02	9.37E-07	6.01E-07	2.11E-03	--	2.33E-02
DC-CPPBS1	Paste Plant Binder Silo 1 6	Yes	0.14												0.00E+00
DC-CPPBS2	Paste Plant Binder Silo 2 6	Yes	0.14												0.00E+00
DC-CPPBS3	Paste Plant Binder Silo 3 6	Yes	0.28												0.00E+00
DC-CPPBS4	Paste Plant Binder Silo 4 6	Yes	0.28												0.00E+00
DC-CPPM1M	Paste Plant Module 1 Mixer 6	Yes	0.56												0.00E+00
DC-CPPM2M	Paste Plant Module 2 Mixer 6	Yes	0.56												0.00E+00
DC-10	Coarse Ore Dust Collection System,23100-DCD-0005	Yes	0.12	5.42E-05	6.52E-05	2.02E-07	1.47E-05	5.17E-06	7.21E-07	2.11E-02	9.37E-07	6.01E-07	2.11E-03	--	2.33E-02
WTP1LS	Waste Water Treatment Plant #1 Lime Silo	Yes	0.19											--	0.00E+00
WTP2 DC	Sodium Sulfate Indoor Dust Collector 5	Yes	0.01											--	0.00E+00
TNK-040	F549/MIBC	Yes	--											--	0.00E+00
TNK-041	3407-A	Yes	--											--	0.00E+00
TNK-044	Solvay 5100	Yes	--											--	0.00E+00
TNK-045	Copper Sulphate	Yes	--											--	0.00E+00
TNK-046	Copper Sulphate	Yes	--											--	0.00E+00
TNK-047	Zinc Sulphate	Yes	--											--	0.00E+00
TNK-048	Zinc Sulphate	Yes	--											--	0.00E+00

TNK-051	Zinc Cyanide	Yes	--	See Table A.2f for HAPs not included in this table.										--	0.00E+00
TNK-052	Zinc Cyanide	Yes	--											--	0.00E+00
TNK-053	SMBS	Yes	--											--	0.00E+00
TNK-054	SMBS	Yes	--											--	0.00E+00
TNK-057	Tailings Flocculant (SNF AN910-VHM)	Yes	--											--	0.00E+00
TNK-058	Tailings Flocculant (SNF AN910-VHM)	Yes	--											--	0.00E+00
TNK-059	Tailings Flocculant (SNF AN910-VHM)	Yes	--											--	0.00E+00
TNK-060	3418-A	Yes	--											--	0.00E+00
TNK-061	Shaft ANE	Yes	--											--	0.00E+00
TSF_1	Tailing Storage Facility	Yes	16.45	3.34E-03	2.52E-03	1.96E-05	3.01E-03	5.47E-04	4.10E-04	0.73	1.64E-04	4.11E-04	7.01E-02	--	8.10E-01
WRS	West Rock Stockpile	Yes	0.67	1.16E-05	3.39E-05	9.40E-07	2.39E-06	1.83E-05	2.54E-06	3.92E-03	5.24E-06	2.18E-06	2.37E-03	--	6.37E-03
EOS	East Ore Stockpile	Yes	0.74	1.51E-04	1.14E-04	8.84E-07	1.36E-04	2.47E-05	1.85E-05	3.29E-02	7.40E-06	1.85E-05	3.51E-02	--	6.85E-02
TAGG	Taylor Agg Stockpile	Yes	4.53E-04										--	--	0.00E+00
TSHOT	Taylor Shotcrete Stockpile	Yes	8.06E-04										--	--	0.00E+00
HRS	Hardshell Rock Stockpile	Yes	3.95	6.86E-05	2.00E-04	5.54E-06	1.41E-05	1.08E-04	1.50E-05	2.31E-02	3.09E-05	1.28E-05	2.24E-02	--	4.60E-02
ORE	Clark Ore Stockpile	Yes	0.12	5.43E-05	6.54E-05	2.02E-07	1.48E-05	5.18E-06	7.23E-07	2.11E-02	9.39E-07	6.02E-07	2.12E-03	--	2.34E-02
ROM	Clark ROM Stockpile	Yes	0.04	1.61E-05	1.94E-05	6.01E-08	4.38E-06	1.54E-06	2.14E-07	6.27E-03	2.79E-07	1.79E-07	6.29E-04	--	6.94E-03
AGG	Clark Agg Stockpile	Yes	0.00										--	--	0.00E+00
SHOT	Clark Shotcrete Stockpile	Yes	0.00										--	--	0.00E+00
CHUTE	Waste Chute Stockpile	Yes	0.00	6.91E-08	1.44E-07	3.61E-09	3.25E-08	7.17E-08	1.26E-08	2.02E-05	2.06E-08	1.12E-08	1.49E-05	--	3.54E-05
WTP2CT	Cooling Towers	Yes	0.02											--	0.00E+00
PRODREF	Refrigeration Plant3	Yes	0.05												0.00E+00
BBREF	Refrigeration Plant3	Yes	0.08												0.00E+00
MILLREF	Primary Mill Cooling Tower	Yes	0.00												0.00E+00
SCRUBBER-1	Tank Exhaust HCN Scrubber	Yes	--	See Table A.2f for HAPs not included in this table.											0.00E+00
Tanks Exhaust	Process Tanks Exhaust	Yes	--												0.00E+00
CBP1_11	Taylor Concrete Batch Plant2	Yes	0.79												0.00E+00
CCBP1_11	Clark Concrete Batch Plant	Yes	0.04												0.00E+00
DOZER-WRS	Dozer Emissions	Yes	1.09	1.89E-05	5.49E-05	1.52E-06	3.88E-06	2.97E-05	4.12E-06	6.35E-03	8.49E-06	3.53E-06	3.84E-03		1.03E-02
DOZER-HRS	Dozer Emissions	Yes	1.09	1.89E-05	5.49E-05	1.52E-06	3.88E-06	2.97E-05	4.12E-06	6.35E-03	8.49E-06	3.53E-06	6.15E-03		1.26E-02
DOZER-TSF	Dozer Emissions	Yes	8.96	1.82E-03	1.37E-03	1.07E-05	1.64E-03	2.98E-04	2.24E-04	3.98E-01	8.94E-05	2.24E-04	3.82E-02		4.42E-01
DOZER-EOS	Dozer Emissions	Yes	1.09	2.20E-04	1.66E-04	1.29E-06	1.99E-04	3.61E-05	2.71E-05	4.82E-02	1.08E-05	2.71E-05	5.14E-02		1.00E-01
MEVAP1	Mechanical Evaporator	Yes	--												0.00E+00
MEVAP2	Mechanical Evaporator	Yes	--												0.00E+00
MEVAP3	Mechanical Evaporator	Yes	--												0.00E+00
22310-FC-00001	Lead Rougher	Yes	--												0.00E+00
22310-FC-00004	Lead Rougher Scavenger	Yes	--												0.00E+00
22310-FC-00008	Lead Cleaner Scalper	Yes	--												0.00E+00
22310-FC-00007	Lead Cleaner	Yes	--												0.00E+00
22310-FC-00009	Lead Cleaner Scavenger	Yes	--												0.00E+00
22310-FC-00005	Zinc Rougher	Yes	--												0.00E+00
22310-FC-00006	Zinc Rougher Scavenger	Yes	--												0.00E+00
22310-FC-00011	Zinc Cleaner Scalper	Yes	--												0.00E+00
22310-FC-00010	Zinc Cleaner	Yes	--												0.00E+00
22310-FC-00012	Zinc Cleaner Scavenger	Yes	--												0.00E+00
22430-TN-00001	Lead Concentrate Tank	Yes	--												0.00E+00
22430-TN-00002	Zinc Concentrate Tank	Yes	--												0.00E+00
22310-TN-00003	Lead Conditioning Tank	Yes	--												0.00E+00
22310-TN-00001	Zinc Conditioning Tank No. 1	Yes	--												0.00E+00
22310-TN-00002	Zinc Conditioning Tank No. 2	Yes	--												0.00E+00
DRILL-2	Drilling	Yes	0.02	8.68E-06	1.05E-05	3.23E-08	2.36E-06	8.28E-07	1.15E-07	3.38E-03	1.50E-07	9.62E-08	3.39E-04		3.74E-03
BLAST-2	Blasting	Yes	0.31	1.38E-04	1.67E-04	5.16E-07	3.76E-05	1.32E-05	1.84E-06	5.39E-02	2.39E-06	1.53E-06	5.40E-03		5.96E-02
DP-103	Dump into Primary Crusher Feed Hopper	Yes	0.29	1.31E-04	1.57E-04	4.86E-07	3.55E-05	1.24E-05	1.74E-06	5.08E-02	2.26E-06	1.45E-06	5.09E-03		5.62E-02
DP-104	Drop from silo to trucks	Yes	0.96	4.35E-04	5.24E-04	1.62E-06	1.18E-04	4.15E-05	5.79E-06	1.69E-01	7.53E-06	4.82E-06	1.70E-02		1.87E-01
DP-105	Transfer of Ore from Ore Stockpile to Loader	Yes	0.58	2.61E-04	3.14E-04	9.73E-07	7.09E-05	2.49E-05	3.47E-06	1.02E-01	4.52E-06	2.89E-06	1.02E-02		1.12E-01
DP-106	Transfer of Ore Mined from Loader to Haul Truck	Yes	0.58	2.61E-04	3.14E-04	9.73E-07	7.09E-05	2.49E-05	3.47E-06	1.02E-01	4.52E-06	2.89E-06	1.02E-02		1.12E-01
DP-107	Transfer from ROM Stockpile to Loader	Yes	0.16	7.16E-05	8.62E-05	2.67E-07	1.94E-05	6.82E-06	9.52E-07	2.79E-02	1.24E-06	7.94E-07	2.79E-03		3.08E-02
DP-109	Transfer from Agg Stockpile to Loader	Yes	0.08												0.00E+00
DP-110	Transfer of Agg Material from Loader to Haul Truck	Yes	0.08												0.00E+00
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	Yes	0.08												0.00E+00
DP-113	Hardshell Rock Storage	Yes	2.60	1.22E-04	2.20E-04	2.82E-06	3.29E-05	8.02E-05	5.79E-06	4.48E-02	1.68E-05	7.67E-06	1.47E-02		6.00E-02
DP-114	Ore Stockpile	Yes	0.58	2.61E-04	3.14E-04	9.73E-07	7.09E-05	2.49E-05	3.47E-06	1.02E-01	4.52E-06	2.89E-06	1.02E-02		1.12E-01
DP-115	ROM Stockpile	Yes	0.16	7.16E-05	8.62E-05	2.67E-07	1.94E-05	6.82E-06	9.52E-07	2.79E-02	1.24E-06	7.94E-07	2.79E-03		3.08E-02
DP-124	Transfer of Development Ore from Face to Loader	Yes	0.00	2.20E-07	2.98E-07	1.08E-09	6.02E-08	4.61E-08	4.14E-09	8.56E-05	7.77E-09	3.91E-09	1.16E-05		9.79E-05
DP-125	Transfer of Development Ore from Loader to Stockpile	Yes	0.00	2.20E-07	2.98E-07	1.08E-09	6.02E-08	4.61E-08	4.14E-09	8.56E-05	7.77E-09	3.91E-09	1.16E-05		9.79E-05
DP-126	Transfer of Development Ore from Stockpile to Loader	Yes	0.00	2.20E-07	2.98E-07	1.08E-09	6.02E-08	4.61E-08	4.14E-09	8.56E-05	7.77E-09	3.91E-09	1.16E-05		9.79E-05
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	Yes	0.00	2.20E-07	2.98E-07	1.08E-09	6.02E-08	4.61E-08	4.14E-09	8.56E-05	7.77E-09	3.91E-09	1.16E-05		9.79E-05
DP-129	Transfer of Development Waste Mined from Face to Loader	Yes	0.00	2.19E-07	3.96E-07	5.07E-09	5.91E-08	1.44E-07	1.04E-08	8.06E-05	3.02E-08	1.38E-08	2.65E-05		1.08E-04
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	Yes	0.00	2.19E-07	3.96E-07	5.07E-09	5.91E-08	1.44E-07	1.04E-08	8.06E-05	3.02E-08	1.38E-08	2.65E-05		1.08E-04
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	Yes	0.00	2.19E-07	3.96E-07	5.07E-09	5.91E-08	1.44E-07	1.04E-08	8.06E-05	3.02E-08	1.38E-08	2.65E-05		1.08E-04
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	Yes	0.00	2.19E-07	3.96E-07	5.07E-09	5.91E-08	1.44E-07	1.04E-08	8.06E-05	3.02E-08	1.38E-08	2.65E-05		1.08E-04
DP-134	Transfer of Stope Ore from Stope to Loader	Yes	0.00	1.16E-06	1.39E-06	4.31E-09	3.14E-07	1.10E-07	1.54E-08	4.50E-04	2.00E-08	1.28E-08	4.52E-05		4.99E-04
DP-135	Transfer of Stope Ore from Loader to Stockpile	Yes	0.00	1.16E-06	1.39E-06	4.31E-09	3.14E-07	1.10E-07	1.54E-08	4.50E-04	2.00E-08	1.28E-08	4.52E-05		4.99E-04
DP-136	Transfer of Stope Ore from Stockpile to Loader	Yes	0.00	1.16E-06	1.39E-06	4.31E-09	3.14E-07	1.10E-07	1.54E-08	4.50E-04	2.00E-08	1.28E-08	4.52E-05		4.99E-04
DP-137	Transfer of Stope Ore from Loader to Haul Truck	Yes	0.00	1.16E-06	1.39E-06	4.31E-09	3.14E-07	1.10E-07	1.54E-08	4.50E-04	2.00E-08	1.28E-08	4.52E-05		4.99E-04
PP-1	Truck Pneumatic Loadout to Silo 1	Yes	0.04												0.00E+00
PP-2	Truck Pneumatic Loadout to Silo 2	Yes	0.04												0.00E+00
PP-3	Truck Pneumatic Loadout to Silo 1	Yes	0.02												0.00E+00
PP-4	Truck Pneumatic Loadout to Silo 2	Yes	0.02												0.00E+00
ROADS	Road Emissions	Yes	179.95	2.61E-03	3.71E-03	3.60E-04	8.35E-05	5.79E-03	3.04E-03	1.26E-01	6.08E-03	5.40E-04	1.84E-02		1.67E-01
UGTROADS	Underground Taylor Roads	Yes	77.04	1.34E-03	3.90E-03	1.08E-04	2.75E-04	2.11E-03	2.92E-04	4.51E-01	6.03E-04	2.50E-04	2.73E-01		7.33E-01
UGCROADS	Underground Clark Roads	Yes	81.39	3.83E-03	6.90E-03	8.84E-05	1.03E-03	2.51E-03	1.82E-04	1.41E+00	5.27E-04	2.40E-04	4.61E-01		1.88E+00
ENGINE 0013 - 0056	CAT 3520 DSL 2600 kW	Yes	52.42	See Table A.2e for HAPs not included in this table.											--
ENGINE 0007 - 0012	CAT C18, 589 bkW	Yes	0.68												--
ENGINE 0002 - 0006	CAT C175 3000 kW	Yes	0.36												--
ENGINE 0001	C200D2RE	Yes	0.04												--
AGGDF-T	Aboveground Gasoline Dispensing Facility - Taylor	Yes	--	See Table A.2f for HAPs not included in this table.											--
AGGDF-C	Aboveground Gasoline Dispensing Facility - Clark	Yes	--												--
T-01	Unleaded Gasoline (S32)	Yes	--												--
T-02	Diesel (Red Dyed S32)	Yes	--												--
T-03	Diesel (Red Dyed S32)	Yes	--												--
T-04	Diesel (Red Dyed Rummel)	Yes	--												--
T-05	Unleaded Gasoline (Rummel)	Yes	--												--
T-06	Diesel (Rummel)	Yes	--												--
T-07	Unleaded Gasoline	Yes	--												--
T-08	Unleaded Gasoline	Yes	--												--
T-09	Unleaded Gasoline	Yes	--												--
T-10	Diesel	Yes	--												--
T-11	Diesel	Yes	--												--
Total			459.80	1.79E-02	2.37E-02	6.34E-04	9.07E-03	1.24E-02	4.57E-03	4.57E+00	7.77E-03	2.08E-03	1.59E+00	--	6.23

Table A-2c. Constituent Mass Fraction in LOM

HAP	Taylor				Clark			Taylor Weighted Average		
	Development Ore	Stope Ore	Rock	Tailings[1,2]	Development Ore	Stope Ore	Rock	All Material	Stope + Development Ore	Waste Chute Material
Antimony Compounds	0.01%	0.0212%	0.0017%	0.0203%	0.024%	0.045%	0.005%	0.017%	0.020%	0.003%
Arsenic Compounds	0.0127%	0.0156%	0.0051%	0.0153%	0.033%	0.054%	0.008%	0.013%	0.015%	0.006%
Beryllium Compounds	0.0001%	0.0001%	0.0001%	0.0001%	0.0001%	0.0002%	0.0001%	0.000%	0.000%	0.000%
Cadmium Compounds	0.0060%	0.0194%	0.0004%	0.0183%	0.007%	0.012%	0.001%	0.015%	0.018%	0.001%
Chromium Compounds	0.0036%	0.0033%	0.0027%	0.0033%	0.005%	0.004%	0.003%	0.003%	0.003%	0.003%
Cobalt Compounds	0.0013%	0.0026%	0.0004%	0.0025%	0.0005%	0.001%	0.0002%	0.002%	0.002%	0.000%
Manganese Compounds	4.0637%	4.4700%	0.5852%	4.4366%	9.497%	17.550%	1.726%	3.684%	4.437%	0.778%
Mercury Compounds	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nickel Compounds	0.0010%	0.0010%	0.0008%	0.0010%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%
Radionuclides	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Selenium Compounds	0.0013%	0.0026%	0.0003%	0.0025%	0.000%	0.001%	0.000%	0.002%	0.002%	0.000%
Lead Compounds	2.1756%	4.9606%	0.3541%	0.4259%	1.2896%	1.759%	0.5669%	3.876%	4.732%	0.573%

1. For constituents other than lead, tailings based on the weighted average of the development and stope ore throughput and mass fraction.
2. Estimated 91% recovery for lead ore. Since the recovery fractions for other metals are not known yet, it is conservatively assumed that all of those metals pass through to the tailings.

Notes on Lead

Material	Notes
Development Ore	Based on average inside domains
Stope Ore	Based on assays within stope design
Rock	Based on average lithology grades minus inside

Stope numbers based on evaluation of drillhole data through stope designs
Rock is the evauation of assays within lithological units.

Table A-2d. Metal Content in Road Surface

Metal	Content (kg/kg)
Antimony	1.45E-05
Arsenic	2.06E-05
Beryllium	2.00E-06
Cadmium	4.64E-07
Chromium	3.22E-05
Cobalt	1.69E-05
Nickel	3.38E-05
Selenium	3.00E-06
Mercury	0.00E+00

Mean of 61 rock samples collected on Trachyandesite of Meadow Valley geologic base (Ka) reported in "Geochemical and Mineralogical Study of the Red Mountain Porphyry Copper-Molybdenum Deposit and Vicinity, Santa Cruz County, Arizona" 2020 prepared by USGS.

Table A-2e. Generator HAPs Summary

Emission ID	Description	HAP Annual Emissions (tpy)																							
		Benzene	Toluene	Xylene	1,3-Butadiene	Formaldehyde	Acetaldehyde	Acrolein	Naphthalene	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,3-Dichloropropene	2-Methylnaphthalene	2,2,4-Trimethylpentane	Biphenyl	Carbon Tetrachloride	Chlorobenzene	Chloroform	Ethylbenzene	Ethylene Dibromide	Methanol	Methylene Chloride	Hexane	PAH	Phenol	Tetrachloroethane	Vinyl Chloride	Total
ENGINE 0013 - 0056	Trench	2.11E-01	1.95E-01	8.81E-02	1.28E-01	6.75E+00	2.75E+01	2.46E+00	3.56E-02	1.88E-01	1.49E-01	1.26E-02	1.59E-02	1.20E-01	1.02E-01	1.72E-01	1.43E-01	1.34E-01	1.90E-02	2.08E-01	1.20E+00	9.39E-02	5.32E-01	3.64E-01	1.13E-01	1.16E-02	7.00E-02	**40.98**
ENGINE 0007 - 0012	Hardshell	2.26E-01	8.17E-02	5.61E-02	1.14E-02	2.29E-02	7.32E-03	2.29E-03	3.78E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.38E-02	--	--	--	**0.47**
ENGINE 0002 - 0006	Taylor	6.01E-03	2.18E-03	1.49E-03	3.03E-04	6.11E-04	1.95E-04	6.10E-05	1.01E-03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.35E-04	--	--	--	**1.25E-02**
ENGINE 0001	WW1	8.17E-03	3.58E-03	2.50E-03	3.42E-04	1.03E-02	6.72E-03	8.10E-04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.29E-04	--	--	--	**3.32E-02**
	Total	**4.50E-01**	**2.83E-01**	**1.48E-01**	**1.40E-01**	**6.78E+00**	**2.75E+01**	**2.47E+00**	**7.44E-02**	**1.88E-01**	**1.49E-01**	**1.26E-02**	**1.59E-02**	**1.20E-01**	**1.02E-01**	**1.72E-01**	**1.43E-01**	**1.34E-01**	**1.90E-02**	**2.08E-01**	**1.20E+00**	**9.39E-02**	**5.32E-01**	**3.89E-01**	**1.13E-01**	**1.16E-02**	**7.00E-02**	**41.49**

Table A-2f. Emission Source - Other HAPs and Lead Compounds Summary

Emission ID	Description	HAP Annual Emissions (tpy)													
		Hydrogen Cyanide	Cresol	Ethylene Glycol Dimethyl Ether	Urethane	Benzene	Benzo(g,h,i)perylene	Cumene	Ethylbenzene	Hexane	Isooctane	Naphthalene	PAC's	Toluene	Xylene	Total
T-01	Unleaded Gasoline (S32)		--	--	--	2.02E-03	1.49E-19	2.59E-05	1.52E-04	1.52E-04	2.32E-03	1.18E-06	1.18E-06	2.32E-03	6.66E-04	**7.7E-03**
T-02	Diesel (Red Dyed S32)		--	--	--	3.20E-06	1.60E-18	0.00E+00	5.03E-06	5.03E-06	0.00E+00	7.69E-07	7.69E-07	3.77E-05	9.81E-05	**1.5E-04**
T-03	Diesel (Red Dyed S32)		--	--	--	3.20E-06	1.60E-18	0.00E+00	5.03E-06	5.03E-06	0.00E+00	7.69E-07	7.69E-07	3.77E-05	9.81E-05	**1.5E-04**
T-04	Diesel (Red Dyed Rummel)		--	--	--	3.98E-06	2.01E-18	0.00E+00	6.27E-06	6.27E-06	0.00E+00	9.61E-07	9.61E-07	4.70E-05	1.22E-04	**1.9E-04**
T-05	Unleaded Gasoline (Rummel)		--	--	--	1.76E-03	1.29E-19	2.25E-05	1.32E-04	1.32E-04	2.01E-03	1.02E-06	1.02E-06	2.01E-03	5.78E-04	**6.6E-03**
T-06	Diesel (Rummel)		--	--	--	9.36E-07	4.61E-19	0.00E+00	1.46E-06	1.46E-06	0.00E+00	2.23E-07	2.23E-07	1.09E-05	2.84E-05	**4.4E-05**
T-07	Unleaded Gasoline		--	--	--	1.03E-02	7.62E-19	1.33E-04	7.78E-04	7.78E-04	1.19E-02	6.03E-06	6.03E-06	1.19E-02	3.40E-03	**3.9E-02**
T-08	Unleaded Gasoline		--	--	--	1.03E-02	7.62E-19	1.33E-04	7.78E-04	7.78E-04	1.19E-02	6.03E-06	6.03E-06	1.19E-02	3.40E-03	**3.9E-02**
T-09	Unleaded Gasoline		--	--	--	1.03E-02	7.62E-19	1.33E-04	7.78E-04	7.78E-04	1.19E-02	6.03E-06	6.03E-06	1.19E-02	3.40E-03	**3.9E-02**
T-10	Diesel		--	--	--	7.64E-05	3.86E-17	0.00E+00	1.20E-04	1.20E-04	0.00E+00	1.84E-05	1.84E-05	9.02E-04	2.35E-03	**3.6E-03**
T-11	Diesel		--	--	--	7.00E-05	3.54E-17	0.00E+00	1.10E-04	1.10E-04	0.00E+00	1.69E-05	1.69E-05	8.26E-04	2.15E-03	**3.3E-03**
TNK-040	F549/MIBC		--	2.62E-01	--	--	--	--	--	--	--	--	--	--	--	**2.6E-01**
TNK-041	3407-A		9.52E-05	--	--	--	--	--	--	--	--	--	--	--	--	**9.5E-05**
TNK-044	Solvay S100		--	--	3.67E-05	--	--	--	--	--	--	--	--	--	--	**3.7E-05**
AGGDF-T	Aboveground Gasoline Dispensing Facility - Taylor		--	--	--	1.52E-02	--	--	1.18E-02	8.45E-03	--	--	--	5.92E-02	5.92E-02	**1.5E-01**
AGGDF-C	Aboveground Gasoline Dispensing Facility - Clark		--	--	--	7.45E-03	--	--	5.80E-03	4.14E-03	--	--	--	2.90E-02	2.90E-02	**7.5E-02**
SCRUBBER-1	Tank Exhaust HCN Scrubber	5.38														**5.4E+00**
Tanks Exhaust	Process Tanks Exhaust	3.50E-02														**3.5E-02**
	Total	**5.41E+00**	**9.52E-05**	**2.62E-01**	**3.67E-05**	**5.76E-02**	**8.22E-17**	**4.46E-04**	**2.05E-02**	**1.55E-02**	**3.99E-02**	**5.84E-05**	**5.84E-05**	**1.30E-01**	**1.04E-01**	**6.04**

Table A-2c. Taylor Lead Content

Material	Lead Content (%)
Stope Ore	4.96%
Waste Rock	0.35%
Developmental Ore	2.18%
Tailings	0.43%
Stope Ore & Developmental Ore	4.73%
Stope Ore & Developmental Ore & Waste Rock	3.88%
Waste Chute Material	0.57%

Table A-3a. Taylor Drilling - Parameters and Emission Factors

Emission Point Number	Activity	Throughput [1]		Controlled Emission Factor[3]				Control [4]		
		(tons/hr)	(ton/year)	PM (lb/ton)	PM_{10}[2] (lb/ton)	$PM_{2.5}$ (lb/ton)	Lead Compounds [5] (lb/ton)	Type	$PM/PM_{10}/Pb$ Efficiency (%)	$PM_{2.5}$ Efficiency (%)
DRILL-1	Drilling	657	5,739,000	1.69E-04	8.00E-05	1.21E-05	8.39E-06	Gravity Settling due to underground drilling (underground only)	87%	17%

1. Per Total tonnes w/ backfill used from "Mined tonnes and Pb grade.xlsx" recd. on 7/12/2021
2. Per AP-42 Section 11.19.2, Table 11.19.2-2 (08/2004) for "Wet Drilling - Unfragmented Stone".
3. Per U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, the particle size multiplier used for calculating emission factors for PM10 and PM2.5 is as follows:
   PM: 0.74
   PM_{10}: 0.35
   $PM_{2.5}$: 0.053
4. Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32. Detailed calculations are included in the Gravity Settling Tab of this spreadsheet
5. Lead percentage in stope ore used conservatively for drilling 4.96 %

Table A-3b. Taylor Drilling - Emissions

Emission Point Number	Activity	Controlled Emissions [1]											
		Annual Emissions (tpy)				Daily Emissions (lb/day)				Hourly Emissions (lb/hr)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DRILL-1	Drilling	0.06	0.03	2.87E-02	3.01E-03	0.33	0.16	0.16	0.02	1.39E-02	6.57E-03	6.57E-03	6.89E-04

1. Controlled Emissions have been calculated for drilling since gravity settling is a part of an inherent process for underground mines.
Pursuant to 40 CFR §64.1, "control device" means "equipment, other than inherent process equipment, that is used to destroy or remove air pollutant(s) prior to discharge to the atmosphere." Furthermore, "inherent process equipment" means "equipment that is necessary for the proper or safe functioning of the process, or material recovery equipment that the owner or operator documents is installed and operated primarily for purposes other than compliance with air pollution regulations." The gravity settling is an inherent part of the process.

Table A-4a. Clark Drilling - Parameters and Emission Factors

Emission Point Number	Activity	Throughput [1]		Controlled Emission Factor[3]				Control [4]		
				PM	PM_{10}[2]	$PM_{2.5}$	Lead Compounds [5]	Type	PM/PM_{10}/Pb Efficiency	$PM_{2.5}$ Efficiency
		(tons/hr)	(ton/year)	(lb/ton)	(lb/ton)	(lb/ton)	(lb/ton)		(%)	(%)
DRILL-2	Drilling	128	1,125,000	1.69E-04	8.00E-05	1.21E-05	2.98E-06	Gravity Settling due to underground drilling (underground only)	80%	16%

1. Per email "Clark Updated Inputs for Air Permit" from Cayley Hoffman received on 9/8/2022
2. Per AP-42 Section 11.19.2, Table 11.19.2-2 (08/2004) for "Wet Drilling - Unfragmented Stone".
3. Per U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, the particle size multiplier used for calculating emission factors for PM10 and PM2.5 is as follows:
   PM: 0.74
   PM_{10}: 0.35
   $PM_{2.5}$: 0.053
4. Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.

Detailed calculations are included in the Gravity Settling Tab of this spreadsheet

5. Lead percentage in stope ore used conservatively for drilling 1.76 %

Table A-4b. Clark Drilling - Emissions

Emission Point Number	Activity	Controlled Emissions [1]											
		Annual Emissions (tpy)				Daily Emissions (lb/day)				Hourly Emissions (lb/hr)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DRILL-2	Drilling	0.02	0.009	0.0057	0.0003	0.11	0.05	0.031	0.002	0.004	0.002	1.30E-03	7.73E-05

1. Controlled Emissions have been calculated for drilling since gravity settling is a part of an inherent process for underground mines.
Pursuant to 40 CFR §64.1, "control device" means "equipment, other than inherent process equipment, that is used to destroy or remove air pollutant(s) prior to discharge to the atmosphere." Furthermore, "inherent process equipment" means "equipment that is necessary for the proper or safe functioning of the process, or material recovery equipment that the owner or operator documents is installed and operated primarily for purposes other than compliance with air pollution regulations." The gravity settling is an inherent part of the process.

Table A-5a. Taylor Blasting - Parameters

Emission Point No.	Location	Blast Area (ft^2/blast) [1]	Throughput [1]		Blasting Rates [1]
		Maximum	(ton/hr)	(ton/yr)	(blasts/yr)
BLAST-1	Blasting	9,000	17.42	4,500	730

1. Per meetings with Kevin Mccoy on 9/9/2022, 10/14/2022, and 10/17/2022
Maximum Hourly emulsion usage = 17.42 ton/hr

Table A-5b. Taylor Blasting Emissions

Emission Point No.	Location	Pollutant	Emission Factor [1,2,3,4,5]	Unit	Controlled Emissions[6,7]		
					(tpy)	(lb/day)	(lb/hr)
BLAST-1	Blasting	NO_x	0.50	(lb/ton Emulsion)	1.13	--	8.71
		CO	27.00	(lb/ton Emulsion)	60.75	--	470.25
		H_2S	4.00	(lb/ton Emulsion)	9.00	--	69.67
		SO_2	1.00	(lb/ton Emulsion)	2.25	--	17.42
		PM	1.49	(Max lb/Blast)	0.55	2.99	1.49
		PM_{10}	0.78	(Max lb/Blast)	0.28	1.55	0.78
		$PM_{2.5}$	0.30	(Max lb/Blast)	0.11	0.59	0.30
		Lead (from ore)	0.07	(Max lb/Blast)	0.03	0.15	0.074
		CO_2	463.18	(lb/ton)	1,042.15	--	8,066.92

1. NO_X and CO emission factors based on "Fume Memo WESCO Aug 2021" pdf dated 19 August 2021 provided by Seth Fredrick Dyno Nobel Inc.

2. H_2S and SO_2 emission factors per AP-42 Section 13.3, Table 13.3-1 for dynamite, gelatin (January 1995).
This emission factor was used by FMI Climax Mine, Colorado (underground mine) per permit application in October 2013 for CDPHE Air Permit No. 95CC899.

3. PM emission factor calculated per AP-42 Section 11.9, Table 11.9-1 for blasting (July 1998)

$0.000014(A)^{1.5}$ where, A = horizontal area (ft^2), with blasting depth ≤ 70 ft

The following scaling factors are applied to PM emission factor to calculate PM_{10} and $PM_{2.5}$ emission factors per AP-42 Table 11.9-1:

PM_{10}: 0.52
$PM_{2.5}$: 0.03

4. CO_2 emission factor is based on "Testing of mining explosives with regard to the content of carbon oxides and nitrogen oxides in their detonation products" - Iwona Zawadzka-Malota, January 7, 2016.

5. Lead content in ore 4.96 %

6. Hourly emissions are based on 1 blast/hr (7 Developmental and 1 Stope sub-blasts per Blast). 1.00 blast/hr per meeting with Kevin McCoy on 9/9/2022
2.00 blasts/day per meeting with Kevin McCoy on 9/9/2022

Table A-6a. Clark Blasting - Parameters

Emission Point No.	Location	Blast Area (ft^2/blast) [1]	Throughput [1]		Blasting Rates [1]
		Maximum	(ton/hr)	(ton/yr)	(blasts/yr)
BLAST-2	Blasting	4,450	4.60	562	730

1. Per email "Clark Updated Inputs for Air Permit" from Cayley Hoffman received on 9/8/2022 and meetings on 10/2022
Maximum total emulsion usage = 4.60 tonnes/hr

Table A-6b. Clark Blasting Emissions

Emission Point No.	Location	Pollutant	Emission Factor [1,2,3,4,5]	Unit	Controlled Emissions[6,7]		
					(tpy)	(lb/day)	(lb/hr)
BLAST-2	Blasting	NO_x	0.50	(lb/ton Emulsion)	0.14	--	2.30
		CO	27.00	(lb/ton Emulsion)	7.59	--	124.11
		H_2S	4.00	(lb/ton Emulsion)	1.12	--	18.39
		SO_2	1.00	(lb/ton Emulsion)	0.28	--	4.60
		PM	0.84	(Max lb/Blast)	0.31	1.68	0.84
		PM_{10}	0.44	(Max lb/Blast)	0.16	0.87	0.437
		$PM_{2.5}$	0.10	(Max lb/Blast)	0.038	0.21	0.1045
		Lead (from ore)	0.01	(Max lb/Blast)	0.0054	0.03	0.0148
		CO_2	463.18	(lb/ton)	130.15	--	2,129.05

1. NO_X and CO emission factors based on "Fume Memo WESCO Aug 2021" pdf dated 19 August 2021 provided by Seth Fredrick Dyno Nobel Inc.

2. H_2S and SO_2 emission factors per AP-42 Section 13.3, Table 13.3-1 for dynamite, gelatin (January 1995).
This emission factor was used by FMI Climax Mine, Colorado (underground mine) per permit application in October 2013 for CDPHE Air Permit No. 95CC899.

3. PM emission factor calculated per AP-42 Section 11.9, Table 11.9-1 for blasting (July 1998)

$0.000014(A)^{1.5}$ where, A = horizontal area (ft^2), with blasting depth ≤ 70 ft

The following scaling factors are applied to PM emission factor to calculate PM_{10} and $PM_{2.5}$ emission factors per AP-42 Table 11.9-1:

PM_{10}: 0.52

$PM_{2.5}$: 0.03

4. CO_2 emission factor is based on "Testing of mining explosives with regard to the content of carbon oxides and nitrogen oxides in their detonation products" - Iwona Zawadzka-Malota, January 7, 2016.

5. Lead content in ore 1.76 %

6. Hourly emissions are based on 1 blast/hr (4 Developmental and 1 Stope sub-blasts per Blast).
1.00 blast/hr per meeting with Cayley Hoffman on 9/9/2022
2.00 blasts/day per meeting with Cayley Hoffman on 9/9/2022

Table A-7a. Crushing - Emission Factors

Emission Point Number	Description	Activity	Throughput [1,2]		Material	Lead Grade	Controlled Emission Factor [3,4,5]				Control [6]		
							PM	PM_{10}	$PM_{2.5}$	Lead Compounds	Type	PM/PM_{10} Efficiency	$PM_{2.5}$ Efficiency
			(ton ore/hr)	(ton ore/yr)			(lb/ton ore)	(lb/ton ore)	(lb/ton ore)	(lb/ton ore)		(%)	(%)
CRUSH-1	Underground Crushing	Primary Crushing	1,543	4,665,131	Stope Ore	4.96%	0.0012	0.00054	0.0001	5.95E-05	Gravity Settling	87%	17%
BREAK-1	Clark Rock Breaker	Rock Breaker	12	47,131	Clark Ore	1.76%	1.69E-04	8.00E-05	1.21E-05	2.98E-06	No Control as a Controlled Emission Factor is being used	0%	0%
BREAK-2	Underground Waste Rock Breaker	Rock Breaker	29	61,138	Waste Rock	0.35%	1.69E-04	8.00E-05	1.21E-05	5.99E-07	No Control as a Controlled Emission Factor is being used	0%	0%
BREAK-3 - BREAK-7	Various Underground Ore Rock Breakers	Rock Breaker	69	600,453	Stope Ore & Developmental Ore	4.73%	1.69E-04	8.00E-05	1.21E-05	8.00E-06	No Control as a Controlled Emission Factor is being used	0%	0%
BREAK-8	Underground Crusher Rock Breaker	Rock Breaker	538	1,624,871	Stope Ore & Developmental Ore	4.73%	1.69E-04	8.00E-05	1.21E-05	8.00E-06	No Control as a Controlled Emission Factor is being used	0%	0%

1. Annual Taylor rock breaker throughputs per meeting with Kevin McCoy on 5/3/2024

Hourly taylor rock breakers throughputs based on hourly drop throughput

Hourly crusher throughputs based on "thyssenkrupp ERC Product Range Sizes.pdf" recd. on 7/12/2021.

2. Rock breakers are hydraulic-type hammers that break down rock pieces that are too large for the Clark Grizzly Screen. As such, the throughput will correspond to a percent (%) of the total grizzly screen throughput. Emission factor is similar to drilling.

3. Crushing emission factors obtained from AP-42 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing for tertiary crushing

4. For rock breakers, per U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, the particle size multiplier used for calculating emission factors for PM_{10} and $PM_{2.5}$ is as follows:

PM: 0.74

PM_{10}: 0.35

$PM_{2.5}$: 0.053

5. Emission factors per AP-42 Section 11.19.2, Table 11.19.2-2 (08/2004) for "Wet Drilling - Unfragmented Stone".

6. Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.

For Watering	70%
Gravity Settling (underground only) (PM/PM_{10}/Pb)	87%
Gravity Settling (underground only) ($PM_{2.5}$)	17%

Table A-7b. Crushing - Emissions

Emission Point Number	Activity	Controlled Emissions											
		Annual Emissions (tpy)				Daily Emissions (lb/day)				Hourly Emissions (lb/hr)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
CRUSH-1	Underground Crushing[1]	0.349936	0.16	0.19	0.02	5.56	2.50	3.06	0.28	0.23	0.10	0.13	0.01
BREAK-1	Clark Rock Breaker	3.99E-03	1.89E-03	2.85E-04	7.01E-05	0.05	0.02	3.52E-03	8.64E-04	2.05E-03	9.68E-04	1.47E-04	3.60E-05
BREAK-2	Underground Waste Rock Breaker	5.17E-03	2.45E-03	3.70E-04	1.83E-05	0.12	0.06	0.01	4.13E-04	4.86E-03	2.30E-03	3.48E-04	1.72E-05
BREAK-3 - BREAK-7	Various Underground Ore Rock Breakers	5.08E-02	2.40E-02	3.64E-03	2.40E-03	0.28	0.13	0.02	0.01	0.01	0.01	8.30E-04	5.49E-04
BREAK-8	Underground Crusher Rock Breaker	1.37E-01	6.50E-02	9.84E-03	6.50E-03	2.18	1.03	0.16	0.10	0.09	0.04	0.01	4.30E-03
Total		**0.55**	**0.25**	**0.21**	**0.03**	**8.18**	**3.74**	**3.25**	**0.39**	**0.34**	**0.16**	**0.14**	**0.02**

1. Controlled Emissions have been calculated for underground crushing since gravity settling is a part of an inherent process for underground mines.

Pursuant to 40 CFR §64.1, "control device" means "equipment, other than inherent process equipment, that is used to destroy or remove air pollutant(s) prior to discharge to the atmosphere." Furthermore, "inherent process equipment" means "equipment that is necessary for the proper or safe functioning of the process, or material recovery equipment that the owner or operator documents is installed and operated primarily for purposes other than compliance with air pollution regulations." The gravity settling is an inherent part of the process.

Table A-8a. Crushing Monthly - Emission Factors

Emission Point Number	Description	Activity	Throughput [1,2] (ton ore/month)	Material	Lead Grade	Controlled Emission Factor [3,4,5] PM (lb/ton ore)	PM_{10} (lb/ton ore)	$PM_{2.5}$ (lb/ton ore)	Lead Compounds (lb/ton ore)	Control [6] Type	PM/PM_{10} Efficiency (%)	$PM_{2.5}$ Efficiency (%)
CRUSH-1	Underground Crushing	Primary Crushing	388,761	Stope Ore	4.96%	0.0012	0.00054	0.0001	5.95E-05	Gravity Settling	87%	70%
BREAK-1	Clark Rock Breaker	Rock Breaker	3,927.6	Clark Ore	1.76%	1.69E-04	8.00E-05	1.21E-05	2.98E-06	No Control as a Controlled Emission Factor is being used	0%	0%
BREAK-2	Underground Waste Rock Breaker	Rock Breaker	5,095	Waste Rock	0.35%	1.69E-04	8.00E-05	1.21E-05	5.99E-07	No Control as a Controlled Emission Factor is being used	0%	0%
BREAK-3 - BREAK-7	Various Underground Ore Rock Breakers	Rock Breaker	50,038	Stope Ore & Developmental Ore	4.73%	1.69E-04	8.00E-05	1.21E-05	8.00E-06	No Control as a Controlled Emission Factor is being used	0%	0%
BREAK-8	Underground Crusher Rock Breaker	Rock Breaker	135,406	Stope Ore & Developmental Ore	4.73%	1.69E-04	8.00E-05	1.21E-05	8.00E-06	No Control as a Controlled Emission Factor is being used	0%	0%

1. Annual Taylor rock breaker throughputs per meeting with Kevin McCoy on 5/3/2024
Hourly taylor rock breakers throughputs based on hourly drop throughput
Hourly crusher throughputs based on "thyssenkrupp ERC Product Range Sizes.pdf" recd. on 7/12/2021.
2. Rock breakers are hydraulic-type hammers that break down rock pieces that are too large for the Clark Grizzly Screen. As such, the throughput will correspond to a percent (%) of the total grizzly screen throughput. Emission factor is similar to drilling.
3. Crushing emission factors obtained from AP-42 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing for tertiary crushing
4. For rock breakers, per U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, the particle size multiplier used for calculating emission factors for PM_{10} and $PM_{2.5}$ is as follows:

PM: 0.74
PM_{10}: 0.35
$PM_{2.5}$: 0.053

5. Emission factors per AP-42 Section 11.19.2, Table 11.19.2-2 (08/2004) for "Wet Drilling - Unfragmented Stone".
6. Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs

For Watering	70%
Gravity Settling (underground only) (PM/PM_{10}/Pb)	87%
Gravity Settling (underground only) ($PM_{2.5}$)	17%

Table A-8b. Crushing Monthly - Emissions

Emission Point Number	Activity	Controlled Emissions Monthly Emissions (lb/month) PM	PM_{10}	$PM_{2.5}$	Lead Compounds
CRUSH-1	Underground Crushing [1]	58.32	26.25	11.66	2.89E+00
BREAK-1	Clark Rock Breaker	6.64E-01	3.14E-01	4.76E-02	1.17E-02
BREAK-2	Underground Waste Rock Breaker	8.62E-01	4.08E-01	6.17E-02	3.05E-03
BREAK-3 - BREAK-7	Various Underground Ore Rock Breakers	8.46E+00	4.00E+00	6.06E-01	4.00E-01
BREAK-8	Underground Crusher Rock Breaker	2.29E+01	1.08E+01	1.64E+00	1.08E+00
Total		**91.22**	**41.80**	**14.02**	**4.39**

1. Controlled Emissions have been calculated for underground crushing since gravity settling is a part of an inherent process for underground mines.

Pursuant to 40 CFR §64.1, "control device" means "equipment, other than inherent process equipment, that is used to destroy or remove air pollutant(s) prior to discharge to the atmosphere." Furthermore, "inherent process equipment" means "equipment that is necessary for the proper or safe functioning of the process, or material recovery equipment that the owner or operator documents is installed and operated primarily for purposes other than compliance with air pollution regulations." The gravity settling is an inherent part of the process.

Table A-9a. Taylor Drops - Emissions - Inputs - Hourly/Daily

Emission Point Number	Description	Throughput [1] (tph)	Material	Lead Grade [1]	Water Content (%) [1]	Control Method	Control Factor [2]		Windspeed [3]	Uncontrolled Emission Factor [4]			
							PM/PM_{10} Efficiency (%)	$PM_{2.5}$ Efficiency (%)	(mph)	PM (lb/ton)	PM_{10} (lb/ton)	$PM_{2.5}$ (lb/ton)	Lead Compounds (lb/ton)
Coarse Ore Delivery and Storage													
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	714.04	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Full Enclosure, Watering	85%	85%	19.49	5.26E-03	2.49E-03	3.77E-04	2.04E-04
DP-2	Drop from 21210-FE-00001 Main Shaft Ore Discharge Feeder to 21210-CV-00003 Main Shaft Outfeed Conveyor	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00002 Main Shaft Ore Discharge Dust Collector (DC-1)			19.49	--	--	--	--
DP-3	Drop from 21210-CV-00003 Main Shaft Outfeed Conveyor to 21210-CV-00001 Coarse Ore Overland Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21210-CX-00001 Coarse Ore Overland Conveyor Dust Collector (DC-2)			19.49	--	--	--	--
DP-4	Drop from Shaft to Waste Chute	126.67	Waste Chute Material	0.57%	4.00	Watering	70%	70%	19.49	5.26E-03	2.49E-03	3.77E-04	3.01E-05
DP-5	Drop from 21210-CV-00003 Main Shaft Outfeed Conveyor to 21210-BN-00002 Transfer Tower Storage Bin	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00003 Transfer Tower Dust Collector (DC-3)			19.49	--	--	--	--
DP-6	Drop from 21210-BN-00002 Transfer Tower Storage Bin to Haul Truck	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00003 Transfer Tower Dust Collector			19.49	--	--	--	--
DP-7	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00001 Coarse Ore Silo No. 1	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-8	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00002 Coarse Ore Silo No. 2	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-9	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00003 Coarse Ore Silo No. 3	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-10	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00004 Coarse Ore Silo No. 4	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-11	Drop from 21710-FE-00001/00002 Coarse Ore Silo No.1 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-12	Drop from 21710-FE-00003/00005 Coarse Ore Silo No.2 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-13	Drop from 21710-FE-00006/00007 Coarse Ore Silo No. 3 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-14	Drop from 21710-FE-00008/00009 Coarse Ore Silo No.4 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-15	Drop from 21710-CV-00001 Primary Mill Feed Conveyor to 22110-CH-00001 Primary Mill Feed Chute	--	Stope Ore & Developmental Ore	4.73%	25.00	Wet Stream, no emissions expected			19.49	--	--	--	--
DP-16	Drop from 22110-ML-00001 Primary Mill to 22110-SN-00002 Primary Mill Discharge Screen	--	Stope Ore & Developmental Ore	4.73%	25.00	Wet Stream, no emissions expected			19.49	--	--	--	--
DP-17	Drop from 22110-SN-00002 Primary Mill Discharge Screen to 22210-CV-00002 Primary Screen Discharge Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-18	Drop from 22210-CV-00002 Primary Screen Discharge Conveyor to 22210-CV-00001 Pebble Crusher Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-19	Drop from 22210-CV-00001 Pebble Crusher Feed Conveyor to 22210-BN-00001 Pebble Crusher Feed Bin/Bunker/22210-FE-00002 Pebble Crusher Product Return Feeder	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-20	Drop from 22210-FE-00002 Pebble Crusher Product Return Feeder to 21710-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	459.12	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	5.26E-03	2.49E-03	3.77E-04	2.49E-04
Underground Drops													
DP-22	Transfer from face to loader	714.04	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	6.04E-06
DP-23	Transfer from loader to haul truck, as needed	714.04	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	6.04E-06
DP-24	Drop from loader or haul truck through grizzly to ore pass	527.27	Stope Ore	4.96%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.73E-06
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	527.27	Stope Ore	4.96%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.73E-06
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	574.46	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	574.46	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	574.46	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	574.46	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	5.82	1.09E-03	5.17E-04	7.82E-05	5.17E-05
DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	139.58	Waste Rock	0.35%	4.00	Gravity Settling, Watering	96%	75%	5.82	1.09E-03	5.17E-04	7.82E-05	3.87E-06

DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	574.46	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	1.12E-05
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	139.58	Waste Rock	0.35%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	8.36E-07
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	714.04	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	9.15E-06
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	714.04	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	9.15E-06
					WTP2								
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	1.19E-02	Dry Anionic Flocculant	0.00%	0.25	Enclosure by building	80%	80%	1.30	0.0076	0.0036	0.0005	--
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	5.39E-06	Dry Cationic Flocculant	0.00%	0.25	Enclosure by building	80%	80%	1.30	0.0076	0.0036	0.0005	--
DP-140	Drop of Sodium Sulfate to Bulk Handling System	3.72E-02	Sodium Sulfate	0.00%	0.25	Controlled by WTP2 DC			19.49	--	--	--	--
					Reagents								
DP-141	Drop of Copper Sulphate into 22620-TN-00005 Copper Sulphate Mix Tank	--	Copper Sulphate	0%	0.25	Controlled by DC-12 22620-CX-00001 Copper Sulphate Mix Tank Dust Collector			19.49	0.2551	0.1207	0.0183	--
DP-142	Drop of 50% Zinc Sulphate into 22620-TN-00025 50% Zinc Sulphate Mix/Holding Tank	--	50% Zinc Sulphate	0%	0.25	Controled by DC-14 22620-CX-00005 50% Zinc Sulphate Mix Tank Dust Collector			19.49	0.2551	0.1207	0.0183	--
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	0.08	Lead Concentrate Flocculant	0%	0.25	No Control	0%	0%	19.49	0.2551	0.1207	0.0183	--
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	3.31	Tailings Flocculant	0%	0.25	No Control	0%	0%	19.49	0.2551	0.1207	0.0183	--
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	0.05	Zinc Concentrate Flocculant	0%	0.25	No Control	0%	0%	19.49	0.2551	0.1207	0.0183	--
DP-146	Drop of 10% Zinc Sulphate to 22620-TN-00007 10% Zinc Sulphate Mix Tank	--	10% Zinc Sulphate	0%	0.25	Controled by DC-13 22620-CX-00002 10% Zinc Sulphate Mix Tank Dust Collector			19.49	0.2551	0.1207	0.0183	--
DP-147	Drop of Caustic to 22620-TN-00023 Caustic Mix/Holding Tank	--	Caustic	0%	0.25	Controlled by DC-15 22620-CX-00004 Caustic Mix Tank			19.49	0.2551	0.1207	0.0183	--
					Stockpile Drops								
DP-82	Drop on West Rock Stockpile	29.00	Waste Rock	0.35%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	1.86E-05
DP-83	Drop on East Ore Stockpile	643.01	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-84	TSF	247.02	Tailings	0.43%	11.80	No Control	0%	0%	19.49	0.0012	0.0005	0.0001	4.93E-06
					From Stockpiles								
DP-94	Transfer from Agg Stockpile to Loader	9.19	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-95	Transfer of Agg Material from Loader to Haul Truck	9.19	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	6.43	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-97	Transfer from East Ore Stockpile to Loader	643.01	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-98	Transfer from Loader to Haul Truck	643.01	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-99	Transfer from Waste Chute Stockpile to Loader	126.67	Waste Chute Material	0.57%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	3.01E-05
DP-100	Transfer from Loader to Haul Truck	126.67	Waste Chute Material	0.57%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	3.01E-05
					WTP1								
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	8.92E-04	Anionic Flocculant	0.00%	0.25	No Control	0%	0%	1.3	7.55E-03	3.57E-03	5.41E-04	--
DP-149	Drop of Sodium Bicarbonate	8.92E-04	Sodium Bicarbonate	0.00%	0.25	No Control	0%	0%	1.3	7.55E-03	3.57E-03	5.41E-04	--

1. Per February 2021 dated Process Flow Diagram, provided by South32 in May 2021.
Confirmed by RFI provided by South32, Sarah Richman, on 7/12/2021.
Per August 2023 date Process Flow Diagrams, provided by South32 in April 2024.
Reagent throughputs per RFI responses from Matt Novak on 4/26/2024 and 6/19/2024

2. Control Factor based on conservative assumptions using "Nevada DEP - Guidance on Emission Factors for the Mining Industry" and West Virginia DEP Nonmetallic Mineral Processing Plants Application Instructions and Forms for General Permit G40-C - Table A

For Watering	70%	
Moisture Content (Moisture Content taken into account in AP-42 Drop Equation)	0%	
Gravity Settling (underground only) ($PM/PM_{10}/Pb$)	87%	Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.
Gravity Settling (underground only) ($PM_{2.5}$)	17%	Detailed calculations are included in the Gravity Settling Tab of this spreadsheet
For Full Enclosure/Enclosure by building	80%	
For Partial Enclosure	50%	
No control	0%	

3. Underground wind speeds at various drop locations based on ventilation design wind speeds provied in emails from Kevin McCoy (South32) on 05/18/2023 and Cayley Hoffman (South32) on 05/22/2023. For wind speeds under 1.3 miles/hour, a minimum wind speed of 1.3 was conservatively used

4. Uncontrolled emission factors using the "drop equation" contained in U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, as follows:

$$E = k(0.0032)\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where E = Emission factor (lb/ton)

k = Particle size multiplier (dimensionless)	PM	PM_{10}	$PM_{2.5}$
	0.74	0.35	0.053
U = Mean wind speed (miles per hour [mph]), which is equal to:	19.49	Based on 2019-2021 On-Site Met Data	
	1.3	For indoor activities, based on minimum value of wind speed per AP-42 Section 13.2.4.	

M = Moisture Content (%) (Assuming 0.25 if water content not specified per EPA AP-42, Section 13.2.4 Equation 1
0.25 %

Table A-9b. Taylor Drops - Hourly/Daily Emissions - Controlled

Emission Point Number	Description	Controlled Emissions							
		Hourly Emissions (lb/hr)				Daily Emissions (lb/day)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	0.56	0.27	0.04	2.18E-02	13.52	6.39	0.97	5.24E-01
DP-4	Drop from Shaft to Waste Chute	0.20	0.09	0.01	1.15E-03	4.80	2.27	0.34	2.75E-02
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	2.41	1.14	0.173	1.14E-01	57.95	27.41	4.15	2.74E+00
DP-22	Transfer from face to loader	0.004	0.002	0.002	1.62E-04	0.10	0.05	0.05	3.88E-03
DP-23	Transfer from loader to haul truck, as needed	0.004	0.002	0.002	1.62E-04	0.10	0.05	0.05	3.88E-03
DP-24	Drop from loader or haul truck through grizzly to ore pass	0.003	0.001	0.001	1.53E-04	0.07	0.03	0.03	3.67E-03
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	0.003	0.001	0.001	1.53E-04	0.07	0.03	0.03	3.67E-03
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	0.003	0.002	0.002	1.59E-04	0.08	0.04	0.04	3.81E-03
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	0.003	0.002	0.002	1.59E-04	0.08	0.04	0.04	3.81E-03
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	0.003	0.002	0.002	1.59E-04	0.08	0.04	0.04	3.81E-03
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	0.024	0.011	0.011	1.11E-03	0.56	0.27	0.27	2.67E-02
DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	0.006	0.003	0.003	2.02E-05	0.14	0.06	0.06	4.86E-04
DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	0.005	0.002	0.002	2.41E-04	0.12	0.06	0.06	5.77E-03
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	0.001	0.001	0.001	4.37E-06	0.03	0.01	0.01	1.05E-04
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	0.006	0.003	0.003	2.45E-04	0.15	0.07	0.07	5.88E-03
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	0.006	0.003	0.003	2.45E-04	0.15	0.07	0.07	5.88E-03
DP-82	Drop on West Rock Stockpile	0.15	0.07	0.01	5.40E-04	3.66	1.73	0.26	1.30E-02
DP-83	Drop on East Ore Stockpile	3.38	1.60	0.24	1.60E-01	81.16	38.39	5.81	3.84E+00
DP-84	TSF	0.29	0.14	0.02	1.22E-03	6.86	3.24	0.49	2.92E-02
DP-94	Transfer from Agg Stockpile to Loader	0.15	0.07	0.01	--	3.63	1.72	0.26	--
DP-95	Transfer of Agg Material from Loader to Haul Truck	0.15	0.07	0.01	--	3.63	1.72	0.26	--
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	0.11	0.05	0.01	--	2.54	1.20	0.18	--
DP-97	Transfer from East Ore Stockpile to Loader	3.38	1.60	0.24	0.16	81.16	38.39	5.81	3.84E+00
DP-98	Transfer from Loader to Haul Truck	3.38	1.60	0.24	0.16	81.16	38.39	5.81	3.84E+00
DP-99	Transfer from Waste Chute Stockpile to Loader	0.67	0.32	0.05	0.00	15.99	7.56	1.15	9.16E-02
DP-100	Transfer from Loader to Haul Truck	0.67	0.32	0.05	0.00	15.99	7.56	1.15	9.16E-02
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	1.80E-05	8.50E-06	1.29E-06	--	4.31E-04	2.04E-04	3.09E-05	--
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	8.14E-09	3.85E-09	5.84E-10	--	1.95E-07	9.24E-08	1.40E-08	--
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	0.02	0.01	0.00	--	0.46	0.22	0.03	--
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	0.84	0.40	0.06	--	20.25	9.58	1.45	--
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	0.01	0.01	0.00	--	0.31	0.14	0.02	--
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	6.74E-06	3.19E-06	4.83E-07	--	1.62E-04	7.65E-05	1.16E-05	--
DP-149	Drop of Sodium Bicarbonate	6.74E-06	3.19E-06	4.83E-07	--	1.62E-04	7.65E-05	1.16E-05	--
Total		**16.45**	**7.78**	**1.21**	**0.63**	**394.82**	**186.74**	**28.98**	**15.11**

Table A-10a. Taylor Drops - Emissions - Inputs - Hourly/Daily

Emission Point Number	Description	Throughput [1] (tons/month)	Material	Lead Grade [1]	Water Content (%) [1]	Control Method	Control Factor [2]		Windspeed [3]	Uncontrolled Emission Factor [4]			
							PM/PM_{10} Efficiency (%)	$PM_{2.5}$ Efficiency (%)	(mph)	PM (lb/ton)	PM_{10} (lb/ton)	$PM_{2.5}$ (lb/ton)	Lead Compounds (lb/ton)
Coarse Ore Delivery and Storage													
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	521,251	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Full Enclosure, Watering	85%	85%	19.49	5.26E-03	2.49E-03	3.77E-04	2.04E-04
DP-2	Drop from 21210-FE-00001 Main Shaft Ore Discharge Feeder to 21210-CV-00003 Main Shaft Outfeed Conveyor	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00002 Main Shaft Ore Discharge Dust Collector			19.49	5.26E-03	2.49E-03	3.77E-04	2.04E-04
DP-3	Drop from 21210-CV-00003 Main Shaft Outfeed Conveyor to 21210-CV-00001 Coarse Ore Overland Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21210-CX-00001 Coarse Ore Overland Conveyor Dust Collector			19.49	5.26E-03	2.49E-03	3.77E-04	2.49E-04
DP-4	Drop from Shaft to Waste Chute	101,710	Waste Chute Material	0.57%	4.00	Watering	70%	70%	19.49	5.26E-03	2.49E-03	3.77E-04	3.01E-05
DP-5	Drop from 21210-CV-00003 Main Shaft Outfeed Conveyor to 21210-BN-00002 Transfer Tower Storage Bin	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00003 Transfer Tower Dust Collector (DC-3)			--	--	--	--	--
DP-6	Drop from 21210-BN-00002 Transfer Tower Storage Bin to Haul Truck	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00003 Transfer Tower Dust Collector (DC-3)			--	--	--	--	--
DP-7	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00001 Coarse Ore Silo No. 1	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			--	--	--	--	--
DP-8	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00002 Coarse Ore Silo No. 2	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			--	--	--	--	--
DP-9	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00003 Coarse Ore Silo No. 3	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			--	--	--	--	--
DP-10	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00004 Coarse Ore Silo No. 4	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			--	--	--	--	--
DP-11	Drop from 21710-FE-00001/00002 Coarse Ore Silo No.1 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			--	--	--	--	--
DP-12	Drop from 21710-FE-00003/00005 Coarse Ore Silo No.2 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			--	--	--	--	--
DP-13	Drop from 21710-FE-00006/00007 Coarse Ore Silo No. 3 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			--	--	--	--	--
DP-14	Drop from 21710-FE-00008/00009 Coarse Ore Silo No.4 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			--	--	--	--	--
DP-15	Drop from 21710-CV-00001 Primary Mill Feed Conveyor to 22110-CH-00001 Primary Mill Feed Chute	--	Stope Ore & Developmental Ore	4.73%	25.00	Wet Stream, no emissions expected			--	--	--	--	--
DP-16	Drop from 22110-ML-00001 Primary Mill to 22110-SN-00002 Primary Mill Discharge Screen	--	Stope Ore & Developmental Ore	4.73%	25.00	Wet Stream, no emissions expected			--	--	--	--	--
DP-17	Drop from 22110-SN-00002 Primary Mill Discharge Screen to 22210-CV-00002 Primary Screen Discharge Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			--	--	--	--	--
DP-18	Drop from 22210-CV-00002 Primary Screen Discharge Conveyor to 22210-CV-00001 Pebble Crusher Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			--	--	--	--	--
DP-19	Drop from 22210-CV-00001 Pebble Crusher Feed Conveyor to 22210-BN-00001 Pebble Crusher Feed Bin/Bunker/22210-FE-00002 Pebble Crusher Product Return Feeder	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			--	--	--	--	--
DP-20	Drop from 22210-FE-00002 Pebble Crusher Product Return Feeder to 21710-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			--	--	--	--	--
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	11,516	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	5.26E-03	2.49E-03	3.77E-04	2.49E-04
Underground Drops													
DP-22	Transfer from face to loader	521,251	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.30	1.56E-04	7.37E-05	1.12E-05	6.04E-06
DP-23	Transfer from loader to haul truck, as needed	521,251	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.30	1.56E-04	7.37E-05	1.12E-05	6.04E-06
DP-24	Drop from loader or haul truck through grizzly to ore pass	384,906	Stope Ore	4.96%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.30	1.56E-04	7.37E-05	1.12E-05	7.73E-06
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	384,906	Stope Ore	4.96%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.30	1.56E-04	7.37E-05	1.12E-05	7.73E-06
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	419,355	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	419,355	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	419,355	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	419,355	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96.25%	75.22%	5.82	1.09E-03	5.17E-04	7.82E-05	5.17E-05
DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	101,897	Waste Rock	0.35%	4.00	Gravity Settling, Watering	96.25%	75.22%	5.82	1.09E-03	5.17E-04	7.82E-05	3.87E-06

DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	419,355	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.79	2.36E-04	1.12E-04	1.69E-05	1.12E-05
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	101,897	Waste Rock	0.35%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.79	2.36E-04	1.12E-04	1.69E-05	8.36E-07
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	521,251	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.79	2.36E-04	1.12E-04	1.69E-05	9.15E-06
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	521,251	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	9.15E-06
Stockpile Drops													
DP-82	Drop on West Rock Stockpile	21,167	Waste Rock	0.35%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	1.86E-05
DP-83	Drop on East Ore Stockpile	11,516	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-84	TSF	180,323	Tailings	0.43%	11.80	No Control	0%	0%	19.49	0.0012	0.0005	0.0001	4.93E-06
From Stockpiles													
DP-94	Transfer from Agg Stockpile to Loader	6,834	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-95	Transfer of Agg Material from Loader to Haul Truck	6,834	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	4,784	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-97	Transfer of Ore from East Ore Stockpile to Loader	11,516	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-98	Transfer of Ore from Loader to Haul Truck	11,516	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-99	Transfer from Waste Chute to Loader	101,710	Waste Chute Material	0.57%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	3.01E-05
DP-100	Transfer from Loader to Haul Truck	101,710	Waste Chute Material	0.57%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	3.01E-05
WTP2													
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	1.08E-03	Dry Anionic Flocculant	0.00%	0.25	Enclosure by building	80%	80%	1.30	0.0076	0.0036	0.0005	--
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	5.39E-06	Dry Cationic Flocculant	0.00%	0.25	Enclosure by building	80%	80%	1.30	0.0076	0.0036	0.0005	--
DP-140	Drop of Sodium Sulfate to Bulk Handling System	3.72E-02	Sodium Sulfate	0.00%	0.25	Controlled by WTP2 DC			1.30	0.0076	0.0036	0.0005	--
Reagents													
DP-141	Drop of Copper Sulphate into 22620-TN-00005 Copper Sulphate Mix Tank	--	Copper Sulphate	0%	0.25	Controlled by DC-12 22620-CX-00001 Copper Sulphate Mix Tank Dust Collector			19.49	0.26	0.12	0.02	0
DP-142	Drop of 50% Zinc Sulphate into 22620-TN-00025 50% Zinc Sulphate Mix/Holding Tank	--	50% Zinc Sulphate	0%	0.25	Controlled by DC-14 22620-CX-00005 50% Zinc Sulphate Mix Tank Dust Collector			19.49	0.26	0.12	0.02	0
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	0.72	Lead Concentrate Flocculant	0%	25%	No Control	0%	0%	19.49	0.26	0.12	0.02	0
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	0.72	Tailings Flocculant	0%	0.25	No Control	0%	0%	19.49	0.26	0.12	0.02	0
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	1.51	Zinc Concentrate Flocculant	0%	0.25	No Control	0%	0%	19.49	0.26	0.12	0.02	0
DP-146	Drop of 10% Zinc Sulphate to 22620-TN-00007 10% Zinc Sulphate Mix Tank	--	10% Zinc Sulphate	0%	0.25	Controlled by DC-13 22620-CX-00002 10% Zinc Sulphate Mix Tank Dust Collector			19.49	0.26	0.12	0.02	0.00E+00
DP-147	Drop of Caustic to 22620-TN-00023 Caustic Mix/Holding Tank	--	Caustic	0%	0.25	Controlled by DC-15 22620-CX-00004 Caustic Mix Tank			19.49	0.26	0.12	0.02	0.00E+00
WTP1													
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	0.65	Anionic Flocculant	0%	0.25	No Control	0%	0%	1.30	7.55E-03	3.57E-03	5.41E-04	0
DP-149	Drop of Sodium Bicarbonate	0.65	Sodium Bicarbonate	0%	0.25	No Control	0%	0%	1.30	7.55E-03	3.57E-03	5.41E-04	0

1. Per February 2021 dated Process Flow Diagram, provided by South32 in May 2021.
Confirmed by RFI provided by South32, Sarah Richman, on 7/12/2021.
Per August 2023 date Process Flow Diagrams, provided by South32 in April 2024.
Reagent throughputs per RFI responses from Matt Novak on 4/26/2024 and 6/19/2024

2. Control Factor based on conservative assumptions using "Nevada DEP - Guidance on Emission Factors for the Mining Industry" and West Virginia DEP Nonmetallic Mineral Processing Plants Application Instructions and Forms for General Permit G40-C - Table A

For Watering	70%
Moisture Content (Moisture Content taken into account in AP-42 Drop Equation)	0%
Gravity Settling (underground only) ($PM/PM_{10}/Pb$)	87%
Gravity Settling (underground only) ($PM_{2.5}$)	17%
For Full Enclosure/Enclosure by building	80%
For Partial Enclosure	50%
No control	0%

Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.
Detailed calculations are included in the Gravity Settling Tab of this spreadsheet

3. Underground wind speeds at various drop locations based on ventilation design wind speeds provied in emails from Kevin McCoy (South32) on 05/18/2023 and Cayley Hoffman (South32) on 05/22/2023. For wind speeds under 1.3 miles/hour, a minimum wind speed of 1.3 was conservatively used

4. Uncontrolled emission factors using the "drop equation" contained in U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, as follows:

$$E = k(0.0032)\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where E = Emission factor (lb/ton)

	PM	PM_{10}	$PM_{2.5}$	
k = Particle size multiplier (dimensionless)	0.74	0.35	0.053	
U = Mean wind speed (miles per hour [mph]), which is equal to:	19.49			Based on 2019-2021 On-Site Met Data
	1.3			For indoor activities, based on minimum value of wind speed per AP-42 Section 13.2.4.

M = Moisture Content (%) (Assuming 0.25 if water content not specified per EPA AP-42, Section 13.2.4 Equation 1

0.25	%

Table A-10b. Taylor Drops - Monthly Emissions - Controlled

Emission Point Number	Description	Controlled Emissions							
		Monthly Emissions (lb/month)				Daily Emissions (lb/day)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	411.22	194.50	29.45	1.59E+01	13.48	6.38	0.97	5.23E-01
DP-4	Drop from Shaft to Waste Chute	160.48	75.90	11.49	9.20E-01	5.26	2.49	0.38	3.01E-02
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	60.57	28.65	4.34	2.87E+00	1.99	0.94	0.14	9.40E-02
DP-22	Transfer from face to loader	3.04	1.44	1.44	1.18E-01	0.10	0.05	0.05	3.87E-03
DP-23	Transfer from loader to haul truck, as needed	3.04	1.44	1.44	1.18E-01	0.10	0.05	0.05	3.87E-03
DP-24	Drop from loader or haul truck through grizzly to ore pass	2.25	1.06	1.06	1.12E-01	0.07	0.03	0.03	3.66E-03
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	2.25	1.06	1.06	1.12E-01	0.07	0.03	0.03	3.66E-03
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	2.45	1.16	1.16	1.16E-01	0.08	0.04	0.04	3.80E-03
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	2.45	1.16	1.16	1.16E-01	0.08	0.04	0.04	3.80E-03
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	2.45	1.16	1.16	1.16E-01	0.08	0.04	0.04	3.80E-03
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	17.18	8.12	8.13	8.13E-01	0.56	0.27	0.27	2.66E-02
DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	4.17	1.97	1.98	1.48E-02	0.14	0.06	0.06	4.85E-04
DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	3.71	1.76	1.76	1.76E-01	0.12	0.06	0.06	5.76E-03
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	0.90	0.43	0.43	3.19E-03	0.03	0.01	0.01	1.05E-04
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	4.61	2.18	2.18	1.79E-01	0.15	0.07	0.07	5.86E-03
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	4.61	2.18	2.18	1.79E-01	0.15	0.07	0.07	5.86E-03
DP-82	Drop on West Rock Stockpile	111.33	52.65	7.97	3.94E-01	3.65	1.73	0.26	1.29E-02
DP-83	Drop on East Ore Stockpile	60.57	28.65	4.34	2.87E+00	1.99	0.94	0.14	9.40E-02
DP-84	TSF	208.56	98.64	14.94	8.88E-01	6.84	3.23	0.49	2.91E-02
DP-94	Transfer from Agg Stockpile to Loader	112.55	53.23	8.06	--	3.690	1.745	0.2643	--
DP-95	Transfer of Agg Material from Loader to Haul Truck	112.55	53.23	8.06	--	3.690	1.745	0.2643	--
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	78.79	37.26	5.64	--	2.583	1.222	0.1850	--
DP-97	Transfer of Ore from East Ore Stockpile to Loader	60.57	28.65	4.34	2.87	1.99	0.94	0.14	9.40E-02
DP-98	Transfer of Ore from Loader to Haul Truck	60.57	28.65	4.34	2.87	1.99	0.94	0.14	9.40E-02
DP-99	Transfer from Waste Chute to Loader	534.93	253.01	38.31	3.07	17.54	8.30	1.26	1.00E-01
DP-100	Transfer from Loader to Haul Truck	534.93	253.01	38.31	3.07	17.54	8.30	1.26	1.00E-01
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	1.63E-06	7.72E-07	1.17E-07	--	5.35E-08	2.53E-08	3.83E-09	--
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	8.15E-09	3.85E-09	5.84E-10	--	2.67E-10	1.26E-10	1.91E-11	--
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	1.84E-01	8.72E-02	1.32E-02	--	0.01	0.00	0.00	--
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	1.84E-01	8.72E-02	1.32E-02	--	0.01	0.00	0.00	--
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	3.84E-01	1.82E-01	2.75E-02	--	0.01	0.01	0.00	--
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	4.92E-03	2.33E-03	3.52E-04	--	1.61E-04	7.63E-05	1.15E-05	--
DP-149	Drop of Sodium Bicarbonate	4.92E-03	2.33E-03	3.52E-04	--	1.61E-04	7.63E-05	1.15E-05	--
Total		**2,561**	**1,212**	**205**	**38**	**84**	**40**	**7**	**1**

Table A-11a. Taylor Drops - Emissions - Inputs - Annual

Emission Point Number	Description	Throughput [1] (tpy)	Material	Lead Grade [1]	Water Content (%) [1]	Control Method	Control Factor [2]		Windspeed [3]	Uncontrolled Emission Factor [4]			
							PM/PM_{10} Efficiency (%)	$PM_{2.5}$ Efficiency (%)	(mph)	PM (lb/ton)	PM_{10} (lb/ton)	$PM_{2.5}$ (lb/ton)	Lead Compounds (lb/ton)
Coarse Ore Delivery and Storage													
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	6,255,015	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Full Enclosure, Watering	85%	85%	19.49	0.0053	0.0025	0.0004	0.0002
DP-2	Drop from 21210-FE-00001 Main Shaft Ore Discharge Feeder to 21210-CV-00003 Main Shaft Outfeed Conveyor	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00002 Main Shaft Ore Discharge Dust Collector (DC-1)			19.49	--	--	--	--
DP-3	Drop from 21210-CV-00003 Main Shaft Outfeed Conveyor to 21210-CV-00001 Coarse Ore Overland Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21210-CX-00001 Coarse Ore Overland Conveyor Dust Collector (DC-2)			19.49	--	--	--	--
DP-4	Drop from Shaft to Waste Chute	1,220,522	Waste Chute Material	0.57%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	0.00003
DP-5	Drop from 21210-CV-00003 Main Shaft Outfeed Conveyor to 21210-BN-00002 Transfer Tower Storage Bin	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00003 Transfer Tower Dust Collector (DC-3)			19.49	--	--	--	--
DP-6	Drop from 21210-BN-00002 Transfer Tower Storage Bin to Haul Truck	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00003 Transfer Tower Dust Collector (DC-3)			19.49	--	--	--	--
DP-7	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00001 Coarse Ore Silo No. 1	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-8	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00002 Coarse Ore Silo No. 2	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-9	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00003 Coarse Ore Silo No. 3	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-10	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00004 Coarse Ore Silo No. 4	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-11	Drop from 21710-FE-00001/00002 Coarse Ore Silo No.1 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-12	Drop from 21710-FE-00003/00005 Coarse Ore Silo No.2 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-13	Drop from 21710-FE-00006/00007 Coarse Ore Silo No. 3 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-14	Drop from 21710-FE-00008/00009 Coarse Ore Silo No.4 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-15	Drop from 21710-CV-00001 Primary Mill Feed Conveyor to 22110-CH-00001 Primary Mill Feed Chute	--	Stope Ore & Developmental Ore	4.73%	25.00	Wet Stream, no emissions expected			19.49	--	--	--	--
DP-16	Drop from 22110-ML-00001 Primary Mill to 22110-SN-00002 Primary Mill Discharge Screen	--	Stope Ore & Developmental Ore	4.73%	25.00	Wet Stream, no emissions expected			19.49	--	--	--	--
DP-17	Drop from 22110-SN-00002 Primary Mill Discharge Screen to 22210-CV-00002 Primary Screen Discharge Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-18	Drop from 22210-CV-00002 Primary Screen Discharge Conveyor to 22210-CV-00001 Pebble Crusher Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-19	Drop from 22210-CV-00001 Pebble Crusher Feed Conveyor to 22210-BN-00001 Pebble Crusher Feed Bin/Bunker/22210-FE-00002 Pebble Crusher Product Return Feeder	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-20	Drop from 22210-FE-00002 Pebble Crusher Product Return Feeder to 21710-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	138,188	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	0.00025
Underground Drops													
DP-22	Transfer from face to loader	6,255,015	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	6.04E-06
DP-23	Transfer from loader to haul truck, as needed	6,255,015	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	6.04E-06
DP-24	Drop from loader or haul truck through grizzly to ore pass	4,618,867	Stope Ore	4.96%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.73E-06
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	4,618,867	Stope Ore	4.96%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.73E-06
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	5,032,256	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	5,032,256	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	5,032,256	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	5,032,256	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	5.82	1.09E-03	5.17E-04	7.82E-05	5.17E-05

DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	1,222,759	Waste Rock	0.35%	4.00	Gravity Settling, Watering	96%	75%	5.82	1.09E-03	5.17E-04	7.82E-05	3.87E-06
DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	5,032,256	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	1.12E-05
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Convevor	1,222,759	Waste Rock	0.35%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	8.36E-07
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	6,255,015	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	9.15E-06
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	6,255,015	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	9.15E-06
					.								
DP-82	Drop on West Rock Stockpile	254,005	Waste Rock	0.35%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	1.86E-05
DP-83	Drop on East Ore Stockpile	138,188	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-84	Drop on TSF	2,163,873	Tailings	0.43%	11.80	No Control	0%	0%	19.49	0.0012	0.0005	0.0001	4.93E-06
					From Stockpiles								
DP-94	Transfer from Agg Stockpile to Loader	10,000	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-95	Transfer of Agg Material from Loader to Haul Truck	10,000	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	10,000	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-97	Transfer from East Ore Stockpile to Loader	138,188	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-98	Transfer from Loader to Haul Truck	138,188	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-99	Transfer from Waste Chute Stockpile to Loader	1,220,522	Waste Chute Material	0.57%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	3.01E-05
DP-100	Transfer from Loader to Haul Truck	1,220,522	Waste Chute Material	0.57%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	3.01E-05
					Reagents								
DP-141	Drop of Copper Sulphate into 22620-TN-00005 Copper Sulphate Mix Tank	--	Copper Sulphate	0.00%	0.25	Controlled by DC-12 22620-CX-00001 Copper Sulphate Mix Tank Dust Collector			19.49	0.2551	0.1207	0.0183	--
DP-142	Drop of 50% Zinc Sulphate into 22620-TN-00025 50% Zinc Sulphate Mix/Holding Tank	--	50% Zinc Sulphate	0.00%	0.25	Controlled by DC-14 22620-CX-00005 50% Zinc Sulphate Mix Tank Dust Collector			19.49	0.2551	0.1207	0.0183	--
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	7.81	Lead Concentrate Flocculant	0.00%	0.25	No Control	0%	0%	19.49	0.2551	0.1207	0.0183	--
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	17.73	Tailings Flocculant	0.00%	0.25	No Control	0%	0%	19.49	0.2551	0.1207	0.0183	--
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	8.51	Zinc Concentrate Flocculant	0.00%	0.25	No Control	0%	0%	19.49	0.2551	0.1207	0.0183	--
DP-146	Drop of 10% Zinc Sulphate to 22620-TN-00007 10% Zinc Sulphate Mix Tank	--	10% Zinc Sulphate	0.00%	0.25	Controlled by DC-13 22620-CX-00002 10% Zinc Sulphate Mix Tank Dust Collector			19.49	0.2551	0.1207	0.0183	--
DP-147	Drop of Caustic to 22620-TN-00023 Caustic Mix/Holding Tank	--	Caustic	0.00%	0.25	Controlled by DC-15 22620-CX-00004 Caustic Mix Tank			19.49	0.2551	0.1207	0.0183	--
					WTP2								
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	104.90	Dry Anionic Flocculant	0.00%	0.25	Enclosure by building	80%	80%	1.30	0.0076	0.0036	0.0005	--
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	0.05	Dry Cationic Flocculant	0.00%	0.25	Enclosure by building	80%	80%	1.30	0.0076	0.0036	0.0005	--
DP-140	Drop of Sodium Sulfate to Bulk Handling System	325.50	Sodium Sulfate	0.00%	0.25	Controlled by WTP2 DC			1.30	0.0076	0.0036	0.0005	--
					WTP1								
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	3.13	Anionic Flocculant	0.00%	0.25	No Control	0%	0%	1.3	0.0076	0.0036	0.0005	--
DP-149	Drop of Sodium Bicarbonate	3.13	Sodium Bicarbonate	0.00%	0.25	No Control	0%	0%	1.3	0.0076	0.0036	0.0005	--

1. Per February 2021 dated Process Flow Diagram, provided by South32 in May 2021.
Confirmed by RFI provided by South32, Sarah Richman, on 7/12/2021.
Per August 2023 date Process Flow Diagrams, provided by South32 in April 2024.
Reagent throughputs per RFI responses from Matt Novak on 4/26/2024 and 6/19/2024
2. Control Factor based on conservative assumptions using "Nevada DEP - Guidance on Emission Factors for the Mining Industry" and West Virginia DEP Nonmetallic Mineral Processing Plants Application Instructions and Forms for General Permit G40-C - Table A

For Watering	70%
Moisture Content (Moisture Content taken into account in AP-42 Drop Equation)	0%
Gravity Settling (underground only) ($PM/PM_{10}/Pb$)	87%
Gravity Settling (underground only) ($PM_{2.5}$)	17%
For Full Enclosure/Enclosure by building	80%
For Partial Enclosure	50%
No control	0%

Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.
Detailed calculations are included in the Gravity Settling Tab of this spreadsheet

3. Underground wind speeds at various drop locations based on ventilation design wind speeds provied in emails from Kevin McCoy (South32) on 05/18/2023 and Cayley Hoffman (South32) on 05/22/2023. For wind speeds under 1.3 miles/hour, a minimum wind speed of 1.3 was conservatively used
4. Uncontrolled emission factors using the "drop equation" contained in U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, as follows:

$$E = k(0.0032)\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where E = Emission factor (lb/ton)

	PM	PM_{10}	$PM_{2.5}$	
k = Particle size multiplier (dimensionless)	0.74	0.35	0.053	
U = Mean wind speed (miles per hour [mph]), which is equal to:	19.49			Based on 2019-2021 On-Site Met Data
	1.3			For indoor activities, based on minimum value of wind speed per AP-42 Section 13.2.4.

M = Moisture Content (%) (Assuming 0.25 if water content not specified per EPA AP-42, Section 13.2.4 Equation 1
0.25 %

Table A-11b. Taylor Drops - Annual Emissions - Controlled

Emission Point Number	Description	Fugitive (Y/N)	Controlled Emissions				Uncontrolled Emissions			
			Annual Emissions (tpy)				Annual Emissions (tpy)			
			PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	Y	2.47	1.166971	0.176713	9.56E-02	16.45	7.78	1.18	0.638
DP-4	Drop from Shaft to Waste Chute	N	0.96	0.455415	0.068963	5.52E-03	3.21	1.52	0.23	0.018
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	Y	0.36	0.171874	0.026027	1.72E-02	0.36	0.17	0.03	0.017
DP-22	Transfer from face to loader	N	0.02	0.008640	0.008645	7.08E-04	0.49	0.23	0.03	0.019
DP-23	Transfer from loader to haul truck, as needed	N	0.02	0.008640	0.008645	7.08E-04	0.49	0.23	0.03	0.019
DP-24	Drop from loader or haul truck through grizzly to ore pass	N	0.01	0.006380	0.006384	6.69E-04	0.36	0.17	0.03	0.018
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	N	0.01	0.006380	0.006384	6.69E-04	0.36	0.17	0.03	0.018
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	N	0.01	0.006951	0.006955	6.95E-04	0.39	0.19	0.03	0.019
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	N	0.01	0.006951	0.006955	6.95E-04	0.39	0.19	0.03	0.019
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	N	0.01	0.006951	0.006955	6.95E-04	0.39	0.19	0.03	0.019
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	N	0.10	0.048748	0.048773	4.88E-03	2.75	1.30	0.20	0.130
DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	N	0.03	0.011845	0.011851	8.87E-05	0.67	0.32	0.05	0.002
DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Convevor	N	0.02	0.010532	0.010537	1.05E-03	0.59	0.28	0.04	0.028
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Convevor	N	0.01	0.002559	0.002560	1.92E-05	0.14	0.07	0.01	0.001
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	N	0.03	0.013091	0.013098	1.07E-03	0.74	0.35	0.05	0.029
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	N	0.03	0.013091	0.013098	1.07E-03	0.74	0.35	0.05	0.029
DP-82	Drop on West Rock Stockpile	Y	0.67	0.32	0.05	2.37E-03	0.67	0.32	0.05	0.00
DP-83	Drop on East Ore Stockpile	Y	0.36	0.17	0.03	1.72E-02	0.36	0.17	0.03	0.02
DP-84	Drop on TSF	Y	1.25	0.59	0.09	5.33E-03	1.25	0.59	0.09	0.01
DP-94	Transfer from Agg Stockpile to Loader	Y	0.08	0.04	0.01	--	0.08	0.04	0.01	--
DP-95	Transfer of Agg Material from Loader to Haul Truck	Y	0.08	0.04	0.01	--	0.08	0.04	0.01	--
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	Y	0.08	0.04	0.01	--	0.08	0.04	0.01	--
DP-97	Transfer from East Ore Stockpile to Loader	Y	0.36	0.17	0.03	1.72E-02	0.36	0.17	0.03	0.02
DP-98	Transfer from Loader to Haul Truck	Y	0.36	0.17	0.03	1.72E-02	0.36	0.17	0.03	0.02
DP-99	Transfer from Waste Chute Stockpile to Loader	Y	3.21	1.52	0.23	1.84E-02	3.21	1.52	0.23	0.02
DP-100	Transfer from Loader to Haul Truck	Y	3.21	1.52	0.23	1.84E-02	3.21	1.52	0.23	0.02
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	Y	7.92E-05	3.75E-05	5.68E-06	--	0.00	0.00	0.00	--
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	Y	3.57E-08	1.69E-08	2.56E-09	--	0.00	0.00	0.00	--
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	Y	9.97E-04	4.71E-04	7.14E-05	--	9.97E-04	4.71E-04	7.14E-05	--
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	Y	2.26E-03	1.07E-03	1.62E-04	--	2.26E-03	1.07E-03	1.62E-04	--
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	Y	1.09E-03	5.13E-04	7.77E-05	--	1.09E-03	5.13E-04	7.77E-05	--
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	Y	1.18E-05	5.58E-06	8.45E-07	--	1.18E-05	5.58E-06	8.45E-07	--
DP-149	Drop of Sodium Bicarbonate	Y	1.18E-05	5.58E-06	8.45E-07	--	1.18E-05	5.58E-06	8.45E-07	--
Total			**13.79**	**6.52**	**1.12**	**0.23**	**38.20**	**18.07**	**2.74**	**1.12**

Table A-12a. Clark Drops - Emissions - Inputs

Emission Point Number	Description	Throughput [1] (tph)	Lead Grade [1]	Water Content (%) [1]	Control Method	Control Factor [2]		Windspeed [4] (mph)	Uncontrolled Emission Factor [3]			
						PM/PM_{10} Efficiency	$PM_{2.5}$ Efficiency		PM	PM_{10}	$PM_{2.5}$	Lead Compounds
						%	%		(lb/ton)	(lb/ton)	(lb/ton)	(lb/ton)
Surface Activities												
Coarse Ore Delivery and Storage												
DP-103	Dump into Primary Crusher Feed Hopper	129	1.76%	4.00	Spray Bar, Partial Enclosure	85%	85%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-104	Drop from silo to trucks	90	1.76%	4.00	Partial Enclosure, Dust Extractor	50%	50%	19.49	0.0053	0.0025	0.0004	9.25E-05
From Stockpiles												
DP-105	Transfer of Ore from Ore Stockpile to Loader	83.77	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25274E-05
DP-106	Transfer of Ore Mined from Loader to Haul Truck	83.77	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	0.0001
DP-107	Transfer from ROM Stockpile to Loader	22.96	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	0.0001
DP-109	Transfer from Agg Stockpile to Loader	9.19	0.00%	1.77	No control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-110	Transfer of Agg Material from Loader to Haul Truck	9.19	0.00%	1.77	No control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	6.43	0.00%	1.77	No control	0%	0%	19.49	0.0165	0.0078	0.0012	--
Stockpile Drops												
DP-113	Hardshell Rock Storage Drop	112.71	0.57%	4.00	No control	0%	0%	19.49	0.0053	0.0025	0.0004	2.98E-05
DP-114	Ore Stockpile Drop	83.77	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-115	ROM Stockpile Drop	22.96	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
Underground												
DP-124	Transfer of Development Ore from Face to Loader	22	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-125	Transfer of Development Ore from Loader to Stockpile	22	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-126	Transfer of Development Ore from Stockpile to Loader	22	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	22	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-129	Transfer of Development Waste Mined from Face to Loader	113	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	113	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	113	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	113	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-134	Transfer of Stope Ore from Stope to Loader	62	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06
DP-135	Transfer of Stope Ore from Loader to Stockpile	62	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06
DP-136	Transfer of Stope Ore from Stockpile to Loader	62	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06
DP-137	Transfer of Stope Ore from Loader to Haul Truck	62	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06

1. Per March 2022 dated Process Flow Diagram, provided by South32 in March 2022.

2. Control Factor based on conservative assumptions using "Nevada DEP - Guidance on Emission Factors for the Mining Industry" and West Virginia DEP Nonmetallic Mineral Processing Plants Application Instructions and Forms for General Permit G40-C - Table A

For Watering	70%	
Moisture Content (Moisture taken into account within drop equation)	0%	
Gravity Settling (underground only) ($PM/PM_{10}/Pb$)	80%	Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.
Gravity Settling (underground only) ($PM_{2.5}$)	16%	Detailed calculations are included in the Gravity Settling Tab of this spreadsheet
For Full Enclosure/Enclosure by building	80%	
For Partial Enclosure	50%	
No control	0%	

3. Underground wind speeds at various drop locations based on ventilation design wind speeds provied in emails from Kevin McCoy (South32) on 05/18/2023 and Cayley Hoffman (South32) on 05/22/2023. For wind speeds under 1.3 miles/hour, a minimum wind speed of 1.3 was conservatively used

4. Uncontrolled emission factors using the "drop equation" contained in U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, as follows:

$$E = k(0.0032)\ \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where E = Emission factor (lb/ton)

k = Particle size multiplier (dimensionless)	PM	PM_{10}	$PM_{2.5}$
	0.74	0.35	0.053
U = Mean wind speed (miles per hour [mph]), which is equal to:	19.49	Based on 2019-2021 On-Site Met Data	
	1.3	For indoor activities, based on minimum value of wind speed per AP-42 Section 13.2.4.	

M = Moisture Content (%) (Assuming 0.25 if water content not specified per EPA AP-42, Section 13.2.4 Equation 1

0.25 %

Moisture Content of Aggregate taken to be 1.7 per AP-42 Section 11.12 Table 11.12-1 Footnote b

Table A-12b. Clark Drops - Emissions - Controlled

Emission Point Number	Description	Controlled Emissions							
		Hourly Emissions (lb/hr)				Daily Emissions (lb/day)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DP-103	Dump into Primary Crusher Feed Hopper	0.10	0.05	0.007	0.002	2.44	1.15	0.17	0.04
DP-104	Drop from silo to trucks	0.24	0.11	0.02	0.004	5.69	2.69	0.41	0.10
DP-105	Transfer of Ore from Ore Stockpile to Loader	0.13	0.06	0.01	0.00	3.17	1.50	0.23	0.06
DP-106	Transfer of Ore Mined from Loader to Haul Truck	0.13	0.06	0.01	0.00	3.17	1.50	0.23	0.06
DP-107	Transfer from ROM Stockpile to Loader	0.04	0.02	0.00	0.00	0.87	0.41	0.06	0.02
DP-109	Transfer from Agg Stockpile to Loader	0.15	0.07	0.01	--	3.63	1.72	0.26	--
DP-110	Transfer of Agg Material from Loader to Haul Truck	0.15	0.07	0.01	--	3.63	1.72	0.26	--
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	0.11	0.05	0.01	--	2.54	1.20	0.18	--
DP-113	Hardshell Rock Storage Drop	0.59	0.28	0.04	0.003	14.23	6.73	1.02	0.08
DP-114	Ore Stockpile Drop	0.13	0.06	0.01	0.00	3.17	1.50	0.23	0.06
DP-115	ROM Stockpile Drop	0.04	0.02	0.00	0.001	0.87	0.41	0.06	0.02
DP-124	Transfer of Development Ore from Face to Loader	2.06E-04	9.73E-05	6.11E-05	2.65E-06	0.00	0.00	0.001	0.000
DP-125	Transfer of Development Ore from Loader to Stockpile	2.06E-04	9.73E-05	6.11E-05	2.65E-06	0.00	0.00	0.001	0.000
DP-126	Transfer of Development Ore from Stockpile to Loader	2.06E-04	9.73E-05	6.11E-05	2.65E-06	0.00	0.00	0.001	0.000
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	2.06E-04	9.73E-05	6.11E-05	2.65E-06	0.00	0.00	0.001	0.000
DP-129	Transfer of Development Waste Mined from Face to Loader	1.07E-03	5.04E-04	3.16E-04	6.04E-06	0.03	0.01	0.008	0.000
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	1.07E-03	5.04E-04	3.16E-04	6.04E-06	0.03	0.01	0.008	0.000
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	1.07E-03	5.04E-04	3.16E-04	6.04E-06	0.03	0.01	0.008	0.000
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	1.07E-03	5.04E-04	3.16E-04	6.04E-06	0.03	0.01	0.008	0.000
DP-134	Transfer of Stope Ore from Stope to Loader	5.86E-04	2.77E-04	1.74E-04	1.03E-05	0.01	0.01	0.004	0.000
DP-135	Transfer of Stope Ore from Loader to Stockpile	5.86E-04	2.77E-04	1.74E-04	1.03E-05	0.01	0.01	0.004	0.000
DP-136	Transfer of Stope Ore from Stockpile to Loader	5.86E-04	2.77E-04	1.74E-04	1.03E-05	0.01	0.01	0.004	0.000
DP-137	Transfer of Stope Ore from Loader to Haul Truck	5.86E-04	2.77E-04	1.74E-04	1.03E-05	0.01	0.01	0.004	0.000
Total		**1.82**	**0.86**	**0.13**	**0.02**	**43.60**	**20.62**	**3.16**	**0.42**

Table A-13a. Clark Drops - Emissions - Inputs

Emission Point Number	Description	Throughput [1] (tph)	Lead Grade [1]	Water Content (%) [1]	Control Method	Control Factor [2]		Windspeed [3] (mph)	Uncontrolled Emission Factor [4]			
						PM/PM_{10} Efficiency (%)	$PM_{2.5}$ Efficiency (%)		PM (lb/ton)	PM_{10} (lb/ton)	$PM_{2.5}$ (lb/ton)	Lead Compounds (lb/ton)
Surface Activities												
Coarse Ore Delivery and Storage												
DP-103	Dump into Primary Crusher Feed Hopper	86	1.76%	4.00	Spray Bar, Partial Enclosure	85%	85%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-104	Drop from silo to trucks	86	1.76%	4.00	Partial Enclosure, Dust Extractor	50%	50%	19.49	0.0053	0.0025	0.0004	9.25E-05
From Stockpiles												
DP-105	Transfer of Ore from Ore Stockpile to Loader	83.77	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25274E-05
DP-106	Transfer of Ore Mined from Loader to Haul Truck	83.77	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	0.0001
DP-107	Transfer from ROM Stockpile to Loader	22.96	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	0.0001
DP-109	Transfer from Agg Stockpile to Loader	9.19	0.00%	1.77	No control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-110	Transfer of Agg Material from Loader to Haul Truck	9.19	0.00%	1.77	No control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	6.43	0.00%	1.77	No control	0%	0%	19.49	0.0165	0.0078	0.0012	--
Stockpile Drops												
DP-113	Hardshell Rock Storage Drop	112.71	0.57%	4.00	No control	0%	0%	19.49	0.0053	0.0025	0.0004	2.98E-05
DP-114	Ore Stockpile Drop	83.77	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-115	ROM Stockpile Drop	22.96	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
Underground												
DP-124	Transfer of Development Ore from Face to Loader	53	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-125	Transfer of Development Ore from Loader to Stockpile	53	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-126	Transfer of Development Ore from Stockpile to Loader	53	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	53	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-129	Transfer of Development Waste Mined from Face to Loader	74	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	74	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	74	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	74	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-134	Transfer of Stope Ore from Stope to Loader	81	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06
DP-135	Transfer of Stope Ore from Loader to Stockpile	81	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06
DP-136	Transfer of Stope Ore from Stockpile to Loader	81	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06
DP-137	Transfer of Stope Ore from Loader to Haul Truck	81	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06

1. Per March 2022 dated Process Flow Diagram, provided by South32 in March 2022.

2. Control Factor based on conservative assumptions using "Nevada DEP - Guidance on Emission Factors for the Mining Industry" and West Virginia DEP Nonmetallic Mineral Processing Plants Application Instructions and Forms for General Permit G40-C - Table A

For Watering	70%	
Moisture Content (Moisture taken into account within drop equation)	0%	
Gravity Settling (underground only) (PM/PM_{10}/Pb)	80%	Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.
Gravity Settling (underground only) ($PM_{2.5}$)	16%	Detailed calculations are included in the Gravity Settling Tab of this spreadsheet
For Full Enclosure/Enclosure by building	80%	
For Partial Enclosure	50%	
No control	0%	

3. Underground wind speeds at various drop locations based on ventilation design wind speeds provied in emails from Kevin McCoy (South32) on 05/18/2023 and Cayley Hoffman (South32) on 05/22/2023. For wind speeds under 1.3 miles/hour, a minimum wind speed of 1.3 was conservatively used

4. Uncontrolled emission factors using the "drop equation" contained in U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, as follows:

$$E = k(0.0032) \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where E = Emission factor (lb/ton)

k = Particle size multiplier (dimensionless)

PM	PM_{10}	$PM_{2.5}$
0.74	0.35	0.053

U = Mean wind speed (miles per hour [mph]), which is equal to: 19.49 Based on 2019-2021 On-Site Met Data

1.3 For indoor activities, based on minimum value of wind speed per AP-42 Section 13.2.4.

M = Moisture Content (%) (Assuming 0.25 if water content not specified per EPA AP-42, Section 13.2.4 Equation 1

0.25 %

Moisture Content of Aggregate taken to be 1.7 per AP-42 Section 11.12 Table 11.12-1 Footnote b

Table A-13b. Clark Drops - Emissions - Controlled

Emission Point Number	Description	Controlled Emissions							
		Hourly Emissions (lb/hr)				Daily Emissions (lb/day)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DP-103	Dump into Primary Crusher Feed Hopper	0.07	0.03	0.005	0.001	1.63	0.77	0.12	0.03
DP-104	Drop from silo to trucks	0.23	0.11	0.02	0.004	5.43	2.57	0.39	0.10
DP-105	Transfer of Ore from Ore Stockpile to Loader	0.13	0.06	0.01	0.00	3.17	1.50	0.23	0.06
DP-106	Transfer of Ore Mined from Loader to Haul Truck	0.13	0.06	0.01	0.00	3.17	1.50	0.23	0.06
DP-107	Transfer from ROM Stockpile to Loader	0.04	0.02	0.00	0.00	0.87	0.41	0.06	0.02
DP-109	Transfer from Agg Stockpile to Loader	0.15	0.07	0.01	--	3.63	1.72	0.26	--
DP-110	Transfer of Agg Material from Loader to Haul Truck	0.15	0.07	0.01	--	3.63	1.72	0.26	--
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	0.11	0.05	0.01	--	2.54	1.20	0.18	--
DP-113	Hardshell Rock Storage Drop	0.59	0.28	0.04	0.003	14.23	6.73	1.02	0.08
DP-114	Ore Stockpile Drop	0.13	0.06	0.01	0.00	3.17	1.50	0.23	0.06
DP-115	ROM Stockpile Drop	0.04	0.02	0.00	0.001	0.87	0.41	0.06	0.02
DP-124	Transfer of Development Ore from Face to Loader	5.00E-04	2.36E-04	1.48E-04	6.45E-06	0.01	0.01	0.004	0.000
DP-125	Transfer of Development Ore from Loader to Stockpile	5.00E-04	2.36E-04	1.48E-04	6.45E-06	0.01	0.01	0.004	0.000
DP-126	Transfer of Development Ore from Stockpile to Loader	5.00E-04	2.36E-04	1.48E-04	6.45E-06	0.01	0.01	0.004	0.000
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	5.00E-04	2.36E-04	1.48E-04	6.45E-06	0.01	0.01	0.004	0.000
DP-129	Transfer of Development Waste Mined from Face to Loader	6.99E-04	3.31E-04	2.07E-04	3.96E-06	0.02	0.01	0.005	0.000
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	6.99E-04	3.31E-04	2.07E-04	3.96E-06	0.02	0.01	0.005	0.000
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	6.99E-04	3.31E-04	2.07E-04	3.96E-06	0.02	0.01	0.005	0.000
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	6.99E-04	3.31E-04	2.07E-04	3.96E-06	0.02	0.01	0.005	0.000
DP-134	Transfer of Stope Ore from Stope to Loader	7.63E-04	3.61E-04	2.26E-04	1.34E-05	0.02	0.01	0.005	0.000
DP-135	Transfer of Stope Ore from Loader to Stockpile	7.63E-04	3.61E-04	2.26E-04	1.34E-05	0.02	0.01	0.005	0.000
DP-136	Transfer of Stope Ore from Stockpile to Loader	7.63E-04	3.61E-04	2.26E-04	1.34E-05	0.02	0.01	0.005	0.000
DP-137	Transfer of Stope Ore from Loader to Haul Truck	7.63E-04	3.61E-04	2.26E-04	1.34E-05	0.02	0.01	0.005	0.000
Total		**1.77**	**0.84**	**0.13**	**0.02**	**42.54**	**20.12**	**3.09**	**0.41**

Table A-14a. Clark Drops - Emissions - Inputs

Emission Point Number	Description	Throughput [1] (tpy)	Lead Grade [1]	Water Content (%) [1]	Control Method	Control Factor [2]		Windspeed [3] (mph)	Uncontrolled Emission Factor [4]			
						PM/PM_{10} Efficiency	$PM_{2.5}$ Efficiency		PM	PM_{10}	$PM_{2.5}$	Lead Compounds
						%	%		(lb/ton)	(lb/ton)	(lb/ton)	(lb/ton)
Surface Activities												
Coarse Ore Delivery and Storage												
DP-103	Dump into Primary Crusher Feed Hopper	733,798	1.76%	4.00	Spray Bar, Partial Enclosure	85%	85%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-104	Drop from silo to trucks	733,798	1.76%	4.00	Partial Enclosure, Dust Extractor	50%	50%	19.49	0.0053	0.0025	0.0004	9.25E-05
From Stockpiles												
DP-105	Transfer of Ore from Ore Stockpile to Loader	733794	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-106	Transfer of Ore Mined from Loader to Haul Truck	733794	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-107	Transfer from ROM Stockpile to Loader	201172	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-109	Transfer from Agg Stockpile to Loader	10,000	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-110	Transfer of Agg Material from Loader to Haul Truck	10,000	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	10,000	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
Stockpile Drops												
DP-113	Hardshell Rock Storage	987,351	0.57%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.98E-05
DP-114	Ore Stockpile	733,794	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-115	ROM Stockpile	201,172	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
Underground												
DP-124	Transfer of Development Ore from Face to Loader	190,691	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000002
DP-125	Transfer of Development Ore from Loader to Stockpile	190,691	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000002
DP-126	Transfer of Development Ore from Stockpile to Loader	190,691	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000002
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	190,691	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000002
DP-129	Transfer of Development Waste Mined from Face to Loader	987,351	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000001
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	987,351	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000001
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	987,351	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000001
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	987,351	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000001
DP-134	Transfer of Stope Ore from Stope to Loader	543,107	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000003
DP-135	Transfer of Stope Ore from Loader to Stockpile	543,107	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000003
DP-136	Transfer of Stope Ore from Stockpile to Loader	543,107	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000003
DP-137	Transfer of Stope Ore from Loader to Haul Truck	543,107	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000003

1. Per March 2022 dated Process Flow Diagram, provided by South32 in March 2022.
2. Control Factor based on conservative assumptions using "Nevada DEP - Guidance on Emission Factors for the Mining Industry" and West Virginia DEP Nonmetallic Mineral Processing Plants Application Instructions and Forms for General Permit G40-C - Table A

For Watering	70%	
For Moisture Content	0%	
Gravity Settling (underground only) (PM/PM_{10}/Pb)	80%	Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.
Gravity Settling (underground only) ($PM_{2.5}$)	16%	Detailed calculations are included in the Gravity Settling Tab of this spreadsheet
For Full Enclosure/Enclosure by building	80%	
For Partial Enclosure	50%	
No control	0%	

3. Underground wind speeds at various drop locations based on ventilation design wind speeds provied in emails from Kevin McCoy (South32) on 05/18/2023 and Cayley Hoffman (South32) on 05/22/2023. For wind speeds under 1.3 miles/hour, a minimum wind speed of 1.3 was conservatively used
4. Uncontrolled emission factors using the "drop equation" contained in U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, as follows:

$$E = k(0.0032) \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where E = Emission factor (lb/ton)

	PM	PM_{10}	$PM_{2.5}$	
k = Particle size multiplier (dimensionless)	0.74	0.35	0.053	
U = Mean wind speed (miles per hour [mph]), which is equal to:	19.49			Based on 2019-2021 On-Site Met Data
	1.3			For indoor activities, based on minimum value of wind speed per AP-42 Section 13.2.4.

M = Moisture Content (%) (Assuming 0.25 if water content not specified per EPA AP-42, Section 13.2.4 Equation 1
0.25 %
Moisture Content of Aggregate taken to be 1.7 per AP-42 Section 11.12 Table 11.12-1 Footnote b

Table A-14b. Clark Drops - Emissions - Controlled

Emission Point Number	Description	Controlled Emissions				Uncontrolled Emissions			
		Annual Emissions (tpy)				Annual Emissions (tpy)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DP-103	Dump into Primary Crusher Feed Hopper	0.29	0.14	0.02	0.01	1.93	0.91	0.14	0.03
DP-104	Drop from silo to trucks	0.96	0.46	0.07	0.02	1.93	0.91	0.14	0.03
DP-105	Transfer of Ore from Ore Stockpile to Loader	0.58	0.27	0.04	0.01	1.93	0.91	0.14	0.03
DP-106	Transfer of Ore Mined from Loader to Haul Truck	0.58	0.27	0.04	0.01	1.93	0.91	0.14	0.03
DP-107	Transfer from ROM Stockpile to Loader	0.16	0.08	0.011	0.003	0.53	0.25	0.04	0.01
DP-109	Transfer from Agg Stockpile to Loader	0.08	0.04	0.006	--	0.08	0.04	0.01	--
DP-110	Transfer of Agg Material from Loader to Haul Truck	0.08	0.04	0.006	--	0.08	0.04	0.01	--
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	0.08	0.04	0.006	--	0.08	0.04	0.01	--
DP-113	Hardshell Rock Storage	2.60	1.23	0.186	0.015	2.60	1.23	0.19	0.01
DP-114	Ore Stockpile	0.58	0.27	0.041	0.010	1.93	0.91	0.14	0.03
DP-115	ROM Stockpile	0.16	0.08	0.011	0.003	0.53	0.25	0.04	0.01
DP-124	Transfer of Development Ore from Face to Loader	9.01E-04	4.26E-04	2.67E-04	1.16E-05	0.01	0.01	0.00	0.00
DP-125	Transfer of Development Ore from Loader to Stockpile	9.01E-04	4.26E-04	2.67E-04	1.16E-05	0.01	0.01	0.00	0.00
DP-126	Transfer of Development Ore from Stockpile to Loader	9.01E-04	4.26E-04	2.67E-04	1.16E-05	0.01	0.01	0.00	0.00
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	9.01E-04	4.26E-04	2.67E-04	1.16E-05	0.01	0.01	0.00	0.00
DP-129	Transfer of Development Waste Mined from Face to Loader	4.67E-03	2.21E-03	1.38E-03	2.65E-05	0.08	0.04	0.01	0.00
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	4.67E-03	2.21E-03	1.38E-03	2.65E-05	0.08	0.04	0.01	0.00
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	4.67E-03	2.21E-03	1.38E-03	2.65E-05	0.08	0.04	0.01	0.00
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	4.67E-03	2.21E-03	1.38E-03	2.65E-05	0.08	0.04	0.01	0.00
DP-134	Transfer of Stope Ore from Stope to Loader	2.57E-03	1.21E-03	7.62E-04	4.52E-05	0.04	0.02	0.00	0.00
DP-135	Transfer of Stope Ore from Loader to Stockpile	2.57E-03	1.21E-03	7.62E-04	4.52E-05	0.04	0.02	0.00	0.00
DP-136	Transfer of Stope Ore from Stockpile to Loader	2.57E-03	1.21E-03	7.62E-04	4.52E-05	0.04	0.02	0.00	0.00
DP-137	Transfer of Stope Ore from Loader to Haul Truck	2.57E-03	1.21E-03	7.62E-04	4.52E-05	0.04	0.02	0.00	0.00
Total		**6.18**	**2.93**	**0.45**	**0.07**	**14.09**	**6.66**	**1.01**	**0.21**

Table A-15. Dust Collectors - Emissions

Emission Point Number	Description	Max Outlet Grain Loading [1]	Stack Flow Rate [2]	Hours of Operation	Material	Lead Content in Material	Annual Emissions [3]				Hourly Emissions [3]				Daily Emissions [3]			
							PM	PM_{10}	$PM_{2.5}$	Lead Compounds [4]	PM	PM_{10}	$PM_{2.5}$	Lead Compounds [4]	PM	PM_{10}	$PM_{2.5}$	Lead Compounds [4]
		(gr/dscf)	(cfm)	(hr/yr)		(%)	(tpy)	(tpy)	(tpy)	(tpy)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/day)	(lb/day)	(lb/day)	(lb/day)
Taylor																		
DC-1	21210-CX-00002 Main Shaft Ore Discharge Dust Collector [7]	0.002	3,250	8,760	Stope Ore & Developmental Ore & Waste Rock	3.88%	0.24	0.24	0.24	9.46E-03	0.06	0.06	0.06	0.00	1.34	1.34	1.34	0.05
DC-2	21210-CX-00001 Coarse Ore Overland Conveyor Dust Collector [7]	0.002	5,000	8,760	Stope Ore & Developmental Ore	4.73%	0.38	0.38	0.38	1.78E-02	0.09	0.09	0.09	0.00	2.06	2.06	2.06	0.10
DC-3	21210-CX-00003 Transfer Tower Silo Dust Collector [4]	0.002	30,000	8,760	Stope Ore & Developmental Ore & Waste Rock	3.88%	2.25	2.25	2.25	8.73E-02	0.51	0.51	0.51	0.02	12.34	12.34	12.34	0.48
DC-4	21510-CX-00001 Coarse Ore Silo Dust Collector [4]	0.002	11,000	8,760	Stope Ore & Developmental Ore	4.73%	0.83	0.83	0.83	3.91E-02	0.19	0.19	0.19	0.01	4.53	4.53	4.53	0.21
DC-5	21710-CX-00002 Silo Discharge Dust Collector [5]	0.002	10,850	8,760	Stope Ore & Developmental Ore	4.73%	0.81	0.81	0.81	3.85E-02	0.19	0.19	0.19	8.80E-03	4.46	4.46	4.46	2.11E-01
DC-12	22620-CX-00001 Copper Sulphate Mix Tank Dust Collector	0.008	1,000	8,760	Copper Sulphate	0.00%	0.30	0.30	0.30	0.00E+00	0.07	0.07	0.07	0.00	1.65	1.65	1.65	0.00
DC-13	22620-CX-00002 10% Zinc Sulphate Mix Tank Dust Collector	0.008	1,000	8,760	10% Zinc Sulphate	0.00%	0.30	0.30	0.30	0.00E+00	0.07	0.07	0.07	0.00	1.65	1.65	1.65	0.00
DC-14	22620-CX-00005 50% Zinc Sulphate Mix Tank Dust Collector	0.008	1,000	8,760	50% Zinc Sulphate	0.00%	0.30	0.30	0.30	0.00E+00	0.07	0.07	0.07	0.00	1.65	1.65	1.65	0.00
DC-15	22620-CX-00004 Caustic Mix Tank Dust Collector	0.008	1,000	8,760	Caustic Mix	0.00%	0.30	0.30	0.30	0.00E+00	0.07	0.07	0.07	0.00	1.65	1.65	1.65	0.00
DC-16	22210-CX-00001 Pebble Crusher Dust Collector [4]	0.002	12,350	8,760	Stope Ore & Developmental Ore	4.73%	0.93	0.93	0.93	4.39E-02	0.21	0.21	0.21	0.01	5.08	5.08	5.08	0.24
DC-PPBSS1	18610-SI-00001 Paste Plant Binder Storage Silo 1 [6]	0.005	750	8,760	Binder	0%	0.14	0.14	0.14	0.00E+00	0.03	0.03	0.03	0.00	0.77	0.77	0.77	0.00
DC-PPBSS2	18610-SI-00002 Paste Plant Binder Storage Silo 2 [6]	0.005	750	8,760	Binder	0%	0.14	0.14	0.14	0.00E+00	0.03	0.03	0.03	0.00	0.77	0.77	0.77	0.00
DC-PPBDS3	18610-SI-10003 Paste Plant Binder Dosage Silo 3 [6]	0.005	1,500	8,760	Binder	0%	0.28	0.28	0.28	0.00E+00	0.06	0.06	0.06	0.00	1.54	1.54	1.54	0.00
DC-PPBDS4	18610-SI-20004 Paste Plant Binder Dosage Silo 4 [6]	0.005	1,500	8,760	Binder	0%	0.28	0.28	0.28	0.00E+00	0.06	0.06	0.06	0.00	1.54	1.54	1.54	0.00
DC-PPM1M	18610-DC-20002 Paste Plant Module 1 Mixer [6]	0.005	3,000	8,760	Paste	0%	0.56	0.56	0.56	0.00E+00	0.13	0.13	0.13	0.00	3.09	3.09	3.09	0.00
DC-PPM2M	18610-DC-20002 Paste Plant Module 2 Mixer [6]	0.005	3,000	8,760	Paste	0%	0.56	0.56	0.56	0.00E+00	0.13	0.13	0.13	0.00	3.09	3.09	3.09	0.00
Clark																		
DC-7	Coarse Ore Dust Collection System.23100-FAN-0001	0.001	3,200	8,760	Clark Stope Ore	1.76%	0.12	0.12	0.12	2.11E-03	0.03	0.03	0.03	0.00	0.66	0.66	0.66	0.01
DC-8	Coarse Ore Dust Collection System.23100-FAN-0002	0.001	3,200	8,760	Clark Stope Ore	1.76%	0.12	0.12	0.12	2.11E-03	0.03	0.03	0.03	0.00	0.66	0.66	0.66	0.01
DC-CPPBS1	Paste Plant Binder Silo 1 [6]	0.005	750	8,760	Binder	0.00%	0.14	0.14	0.14	0.00E+00	0.03	0.03	0.03	0.00	0.77	0.77	0.77	0.00
DC-CPPBS2	Paste Plant Binder Silo 2 [6]	0.005	750	8,760	Binder	0.00%	0.14	0.14	0.14	0.00E+00	0.03	0.03	0.03	0.00	0.77	0.77	0.77	0.00
DC-CPPBS3	Paste Plant Binder Silo 3 [6]	0.005	1,500	8,760	Binder	0.00%	0.28	0.28	0.28	0.00E+00	0.06	0.06	0.06	0.00	1.54	1.54	1.54	0.00
DC-CPPBS4	Paste Plant Binder Silo 4 [6]	0.005	1,500	8,760	Binder	0.00%	0.28	0.28	0.28	0.00E+00	0.06	0.06	0.06	0.00	1.54	1.54	1.54	0.00
DC-CPPM1M	Paste Plant Module 1 Mixer [6]	0.005	3,000	8,760	Paste	0.00%	0.56	0.56	0.56	0.00E+00	0.13	0.13	0.13	0.00	3.09	3.09	3.09	0.00
DC-CPPM2M	Paste Plant Module 2 Mixer [6]	0.005	3,000	8,760	Paste	0.00%	0.56	0.56	0.56	0.00E+00	0.13	0.13	0.13	0.00	3.09	3.09	3.09	0.00
DC-10	Coarse Ore Dust Collection System.23100-DCD-0005	0.001	3,200	8,760	Clark Stope Ore	1.76%	0.12	0.12	0.12	2.11E-03	0.03	0.03	0.03	0.00	0.66	0.66	0.66	0.01
General																		
WTP1LS	Waste Water Treatment Plant #1 Lime Silo	0.005	1,001	8,760	Lime	0%	0.19	0.19	0.19	0.00E+00	0.04	0.04	0.04	0.00	1.03	1.03	1.03	0.00
WTP2 DC	Sodium Sulfate Indoor Dust Collector [5]	0.010	77	8,760	Sodium Sulfate	0%	5.78E-03	5.78E-03	5.78E-03	0.00E+00	1.32E-03	1.32E-03	1.32E-03	0.00E+00	3.17E-02	3.17E-02	3.17E-02	0.00
						Total	**11.14**	**11.14**	**11.14**	**0.24**	**2.54**	**2.54**	**2.54**	**0.06**	**61.03**	**61.03**	**61.03**	**1.33**

1. Per email from Sarah Richman, South32, on 07/06/2021 (Per Fluor Canada Ltd. Engineering)
   Per RFI responses from Rodolfo Moctezuma on 4/29/2024
   Per "Clark Deposit General RFI for Air Permit 030922" RFI received on 3/3/2022
2. Per RFI responses from Rodolfo Moctezuma on 4/29/2024
3. Using the conversion factors given below:

	7000 grains/lb	
	2000 lb/ton	
	60 min/hr	
4. Lead Conc.	4.96 %	For Taylor deposit
	1.76 %	For Clark deposit
	0.00 %	Lead at paste plant assumed to be negligible

5. Per email from Sarah Richman, South32, on 08/24/2022 (Per Fluor Canada Ltd. Engineering)
6. Per email from Sarah Richman, South32, on 08/31/2022 (Per Fluor Canada Ltd. Engineering and Paterson Cooke)
7. Per PFD's received on 5/29/2024 from Sarah Richman, South32.

Table A-16a. Engines - Emission Factors

Pollutant	Value	Unit	Source
NO_x	7.87E-02	g/kW-hr	Per Natural Gas Generator 100% load Emissions Performance on G3520 Caterpillar engine provided by Brad Kaufman, VoltaGrid, on 9/22/2021
NO_2	7.50E-03	g/kW-hr	
CO	1.31E-02	g/kW-hr	
$PM/PM_{10}/PM_{2.5}$	2.00E-03	g/kW-hr	
VOC	1.18E-02	g/kW-hr	
CO_2	5.09E+02	g/kW-hr	
CH_4	1.29E+00	g/kW-hr	
N_2O	1.10E-02	g/kW-hr	
Acetaldehyde	7.10E-03	g/kW-hr	
Formaldehyde	4.70E-03	g/kW-hr	
NO_x	5.26E-02	g/kW-hr	Per Natural Gas Generator 75% load Emissions Performance on G3520 Caterpillar engine provided by Brad Kaufman, VoltaGrid, on 9/22/2021
NO_2	3.00E-04	g/kW-hr	
CO	1.88E-02	g/kW-hr	
$PM/PM_{10}/PM_{2.5}$	2.21E-02	g/kW-hr	
VOC	5.40E-02	g/kW-hr	
CO_2	5.30E+02	g/kW-hr	
CH_4	1.48E+00	g/kW-hr	
N_2O	1.40E-02	g/kW-hr	
Acetaldehyde	2.55E-02	g/kW-hr	
Formaldehyde	0.00E+00	g/kW-hr	
NO_x	6.27E-02	g/kW-hr	Per Natural Gas Generator 50% load Emissions Performance on G3520 Caterpillar engine provided by Brad Kaufman, VoltaGrid, on 9/22/2021
NO_2	0.00E+00	g/kW-hr	
CO	3.23E-02	g/kW-hr	
$PM/PM_{10}/PM_{2.5}$	7.30E-02	g/kW-hr	
VOC	5.30E-02	g/kW-hr	
CO_2	5.56E+02	g/kW-hr	
CH_4	1.53E+00	g/kW-hr	
N_2O	1.55E-02	g/kW-hr	
Acetaldehyde	1.45E-02	g/kW-hr	
Formaldehyde	4.00E-04	g/kW-hr	
NOx	7.80	tpy	Per voluntary limit accepted by South32, as referenced in South32 Response to Public Comments, Supplement #1, on May 17, 2024
CO	40.00	tpy	
VOC	15.00	tpy	
$PM/PM_{10}/PM_{2.5}$	1.00E-02	g/kW-hr	Per Caterpillar engine emissions certification, provided by Kara Haas, South32, on 7/18/2022
SO_2	5.88E-04	lb/MMBtu	AP-42 Section 3.2, Natural Gas Engines (Maximum Emission Factor Available), dated October 2024
VOC	1.20E-01	lb/MMBtu	AP-42 Section 3.2, Natural Gas Engines (4 Stroke Lean Burn) dated October 2024. The emission factor for PAH (which are HAPs because they are POMs) is the sum of the value listed for 'PAH' in AP-42 and all other PAHs listed in the AP-42 that are not specifically listed HAPs.
Benzene	4.40E-04	lb/MMBtu	
Toluene	4.08E-04	lb/MMBtu	
Xylene	1.84E-04	lb/MMBtu	
1,3-Butadiene	2.67E-04	lb/MMBtu	
Acrolein	5.14E-03	lb/MMBtu	
Naphthalene	7.44E-05	lb/MMBtu	
1,1,2,2-Tetrachloroethane	4.00E-05	lb/MMBtu	
1,1,2-Trichloroethane	3.18E-05	lb/MMBtu	
1,3-Dichloropropene	2.64E-05	lb/MMBtu	
2-Methylnaphthalene	3.32E-05	lb/MMBtu	
2,2,4-Trimethylpentane	2.50E-04	lb/MMBtu	
Acenaphthene	1.25E-06	lb/MMBtu	
Acenaphthylene	5.53E-06	lb/MMBtu	
Benzo(b)fluoranthene	1.66E-07	lb/MMBtu	
Benzo(e)pyrene	4.15E-07	lb/MMBtu	
Benzo(g,h,i)perylene	4.14E-07	lb/MMBtu	
Biphenyl	2.12E-04	lb/MMBtu	
Carbon Tetrachloride	3.67E-05	lb/MMBtu	
Chlorobenzene	3.04E-05	lb/MMBtu	
Chloroform	2.85E-05	lb/MMBtu	
Chrysene	6.93E-07	lb/MMBtu	
Ethylbenzene	3.97E-05	lb/MMBtu	
Ethylene Dibromide	4.43E-05	lb/MMBtu	
Formaldehyde	5.28E-02	lb/MMBtu	
Fluoranthene	1.11E-06	lb/MMBtu	
Fluorene	5.67E-06	lb/MMBtu	
Methanol	2.50E-03	lb/MMBtu	
Methylene Chloride	2.00E-05	lb/MMBtu	
Hexane	1.11E-03	lb/MMBtu	
PAH	7.75E-05	lb/MMBtu	
Phenanthrene	1.04E-05	lb/MMBtu	
Phenol	2.40E-05	lb/MMBtu	
Pyrene	1.36E-06	lb/MMBtu	
Styrene	2.36E-05	lb/MMBtu	
Tetrachloroethane	2.48E-06	lb/MMBtu	
Vinyl Chloride	1.49E-05	lb/MMBtu	
$PM/PM_{10}/PM_{2.5}$	4.00E-02	g/kW-hr	Tier 4 emission factors for diesel engines from Table 1 of §1039.101
NO_x	3.50E+00	g/kW-hr	
CO	3.50E+00	g/kW-hr	
VOC	1.90E-01	g/kW-hr	Tier 4 NMHC emission factors for diesel engines from Table 1 of §1039.101
SO_x	1.21E-05	lb/hp-hr	AP-42, Table 3.4-1 (April 2025) based on Ultra Low Sulfur Diesel (15 ppm sulfur or 0.0015%) for Large Uncontrolled Stationary Diesel Engines (>600 HP).
CO_2	7.40E+01	kg/MMBtu	40 CFR Part 98, Subpart C, Table C-1 for Distillate Fuel Oil No. 2 (diesel)
CH_4	3.00E-03	kg/MMBtu	
N_2O	6.00E-04	kg/MMBtu	
PM (condensable)	9.91E-03	lb/MMBtu	AP-42 Section 3.2, Natural Gas Engines (4 stroke lean burn) dated October 2024
CO_2	5.31E+01	kg/MMBtu	40 CFR Part 98, Subpart C, Table C-1 and C-2 for Natural Gas (Weighted U.S Average)
CH_4	1.00E-03	kg/MMBtu	
N_2O	1.00E-04	kg/MMBtu	
Benzene	7.76E-04	lb/MMBtu	AP-42 Section 3.4, HAP Emission Factors For Large Uncontrolled Stationary Diesel Engines (>600 HP) dated April 2025. The emission factor for PAH (which are HAPs because they are POMs) is the value for 'Total PAH' listed in AP-42 minus the value listed for napthalene, as it is speciated here.
Toluene	2.81E-04	lb/MMBtu	
Xylene	1.93E-04	lb/MMBtu	
1,3-Butadiene	3.91E-05	lb/MMBtu	
Formaldehyde	7.89E-05	lb/MMBtu	
Acetaldehyde	2.52E-05	lb/MMBtu	
Acrolein	7.88E-06	lb/MMBtu	
Naphthalene	1.30E-04	lb/MMBtu	
Propylene	2.79E-03	lb/MMBtu	
Acenaphthylene	9.23E-06	lb/MMBtu	
Acenaphthene	4.68E-06	lb/MMBtu	
Fluorene	1.28E-05	lb/MMBtu	
Phenanthrene	4.08E-05	lb/MMBtu	
Anthracene	1.23E-06	lb/MMBtu	
Fluoranthene	4.03E-06	lb/MMBtu	
Pyrene	3.71E-06	lb/MMBtu	
Benz[a]anthracene	6.22E-07	lb/MMBtu	
Chrysene	1.53E-06	lb/MMBtu	
Benzo(b)fluoranthene	1.11E-06	lb/MMBtu	
Benzo(k)fluoranthene	2.18E-07	lb/MMBtu	
Benzo(a)pyrene	2.57E-07	lb/MMBtu	
Indeno(1,2,3-cd)pyrene	4.14E-07	lb/MMBtu	
Dibenz(a,h)anthracene	3.46E-07	lb/MMBtu	
Benzo(g,h,i)perylene	5.56E-07	lb/MMBtu	
PAH	8.20E-05	lb/MMBtu	
SO2	2.05E-03	lb/hp-hr	AP-42 Section 3.3 for Diesel Engines (<600 HP) dated April 2025

NOx	4.00E-01	g/kW-hr	Tier 4 emission factors for diesel engines of rated capacity 130 ≤ kW < 560 from Table 1 of §1039.101
CO	3.50E+00	g/kW-hr	
PM	2.00E-02	g/kW-hr	
PM_{10}	2.00E-02	g/kW-hr	
$PM_{2.5}$	2.00E-02	g/kW-hr	
VOC	1.90E-01	g/kW-hr	
Benzene	9.33E-04	lb/MMBtu	AP-42 Section 3.3 Table 3.3-2 Speciated Organic Compound Emission Factors For Uncontrolled Diesel Engines (< 600 HP) dated April 2025. The emission factor for PAH (which are HAPs because they are POMs) is the value for 'Total PAH' listed in AP-42 minus the value listed for napthalene, as it is speciated here.
Toluene	4.09E-04	lb/MMBtu	
Xylene	2.85E-04	lb/MMBtu	
1,3-Butadiene	3.91E-05	lb/MMBtu	
Formaldehyde	1.18E-03	lb/MMBtu	
Acetaldehyde	7.67E-04	lb/MMBtu	
Acrolein	9.25E-05	lb/MMBtu	
Napthalene	8.48E-05	lb/MMBtu	
PAH	8.32E-05	lb/MMBtu	

Table A-16b. Generator - Criteria Pollutant Emissions (Annual)

Emission Point Number	Location	Equipment Name	Number of Engines	Engine Rating (kW)		Fuel Type	Operation Hours	Criteria Pollutants Annual Emissions (tpy)								GHG Annual Emissions (tpy)			
				(Electrical)	(Mechanical)		(hrs/yr)	NO_x	NO_2	CO	PM	PM_{10}	$PM_{2.5}$	VOC[1]	SO_2	CO_2	CH_4	N_2O	CO_2e
ENGINE 0013 - 0056 (50% Load)	Trench	CAT 3520 DSL 2600 kW	40	52000	57,200	NG	8,760	45.02	0.00	23.19	52.42	52.42	52.42	38.06	1.53	399,229.42	1,100.04	11.13	430,046.92
ENGINE 0013 - 0056 (75% Load)	Trench			78,000	85,800	NG	8,760	56.65	0.32	20.25	23.80	23.80	23.80	58.16	2.15	570,840.63	1,591.78	15.08	615,128.71
ENGINE 0013 - 0056 (100% Load)	Trench			104,000	114,400	NG	8,760	113.02	10.77	18.81	2.87	2.87	2.87	16.95	2.76	730,963.23	1,850.24	15.80	781,926.73
ENGINE 0007 - 0012[2]	Hardshell	CAT C18, 589 bkW	6	2,730	3,534	Diesel	8,760	3.9	1.95	20	0.34	0.34	0.34	7.5	4.14E-04	23,692.22	9.61E-01	1.92E-01	23,773.52
		CAT C18, 589 bkW	6	2,730	3,534	Diesel	8,760	3.9	1.95	20	0.34	0.34	0.34	7.5	4.14E-04	23,692.22	9.61E-01	1.92E-01	23,773.52
ENGINE 0002 - 0006	Taylor	CAT C175 3000 kW	5	3,000	3,300	Diesel	500	31.83	31.83	31.83	3.64E-01	3.64E-01	3.64E-01	1.73E+00	6.71E-02	1,262.75	0.05	0.01	1,267.09
ENGINE 0001	WW1	C200D2RE	1	198	213	Diesel	8,760	0.82	0.82	7.20	0.04	0.04	0.04	0.39	2.56	1,427.97	0.06	0.01	1,432.87
Total Annual Emissions								**153.47**	**47.32**	**102.22**	**53.50**	**53.50**	**53.50**	**75.28**	**5.39**	**781038.39**	**1852.27**	**16.20**	**832173.73**

1. VOC emission factors for NG engines assumed to be total of VOC, Acetaldehyde, and Formaldehyde emission factors from performance test.
2. ENGINE 0007 - 0012 generators will be CAT XQ1140 make/model. Each XQ1140 generator set will consist of two CAT C18 engines exhausting to a shared stack

Table A-16c. Generator - HAP Emissions (Annual)[1]

Emission Point Number	ENGINE 0013 - 0056 (50%)	ENGINE 0013 - 0056 (75%)	ENGINE 0013 - 0056 (100%)	ENGINE 0007 - 0012		ENGINE 0002 - 0006	ENGINE 0001	Total Annual Emissions (tpy)
Engine Rating (kW)	**57.200**	**85.800**	**114.400**	**3.534**	**3.534**	**3.300**	**213**	
Fuel Consumption Rate (SCFH)	**582,360**	**818,200**	**1,051,120**	**-**	**-**	**-**	**-**	
Fuel Input (MMBtu/hr)	**594.01**	**834.56**	**1,072.14**	**33.17**	**33.17**	**30.98**	**2.00**	
Benzene	1.17E-01	1.64E-01	2.11E-01	1.13E-01	1.13E-01	6.01E-03	8.17E-03	0.450
Toluene	1.08E-01	1.52E-01	1.95E-01	4.08E-02	4.08E-02	2.18E-03	3.58E-03	0.283
Xylene	4.88E-02	6.86E-02	8.81E-02	2.80E-02	2.80E-02	1.49E-03	2.50E-03	0.148
1,3-Butadiene	7.09E-02	9.95E-02	1.28E-01	5.68E-03	5.68E-03	3.03E-04	3.42E-04	0.140
Formaldehyde	2.87E-01	0.00E+00	6.75E+00	1.15E-02	1.15E-02	6.11E-04	1.03E-02	6.783
Acetaldehyde	1.04E+01	2.75E+01	1.02E+01	3.66E-03	3.66E-03	1.95E-04	6.72E-03	27.479
Acrolein	1.36E+00	1.92E+00	2.46E+00	1.14E-03	1.14E-03	6.10E-05	8.10E-04	2.465
Naphthalene	1.97E-02	2.77E-02	3.56E-02	1.89E-02	1.89E-02	1.01E-03	--	0.074
1,1,2,2-Tetrachloroethane	1.04E-01	1.46E-01	1.88E-01	--	--	--	--	0.188
1,1,2-Trichloroethane	8.27E-02	1.16E-01	1.49E-01	--	--	--	--	0.149
1,3-Dichloropropene	7.01E-03	9.84E-03	1.26E-02	--	--	--	--	0.013
2-Methylnaphthalene	8.81E-03	1.24E-02	1.59E-02	--	--	--	--	0.016
2,2,4-Trimethylpentane	6.63E-02	9.32E-02	1.20E-01	--	--	--	--	0.120
Biphenyl	5.63E-02	7.90E-02	1.02E-01	--	--	--	--	0.102
Carbon Tetrachloride	9.55E-02	1.34E-01	1.72E-01	--	--	--	--	0.172
Chlorobenzene	7.91E-02	1.11E-01	1.43E-01	--	--	--	--	0.143
Chloroform	7.41E-02	1.04E-01	1.34E-01	--	--	--	--	0.134
Ethylbenzene	1.05E-02	1.48E-02	1.90E-02	--	--	--	--	0.019
Ethylene Dibromide	1.15E-01	1.62E-01	2.08E-01	--	--	--	--	0.208
Methanol	6.63E-01	9.32E-01	1.20E+00	--	--	--	--	1.197
Methylene Chloride	5.20E-02	7.31E-02	9.39E-02	--	--	--	--	0.094
Hexane	2.95E-01	4.14E-01	5.32E-01	--	--	--	--	0.532
PAH	2.02E-01	2.83E-01	3.64E-01	1.19E-02	1.19E-02	6.35E-04	7.29E-04	0.389
Phenol	6.24E-02	8.77E-02	1.13E-01	--	--	--	--	0.113
Tetrachloroethane	6.45E-03	9.07E-03	1.16E-02	--	--	--	--	0.012
Vinyl Chloride	3.88E-02	5.45E-02	7.00E-02	--	--	--	--	0.070
							Total Annual HAP emisions (tpy)	**41.49**

1. The CAT NG engines (EU: T_ENG) are Tier 4 emissions certified and equipped with oxidation catalysts. Oxidation catalysts reduce emissions of organic HAPS. To develop an appropriate control effiency (CE) for the HAP emissions from these engines that could be applied to the AP-42 Ch. 3.2 HAP Emission factors, Formaldehyde and VOC emission factors determined through stack testing were compared with Formaldehyde and VOC emission factors from AP-42 for natural gas engines, and the resulting ratio was applied to all organic HAPs.

100% Load CAT 3520 engines CE based on formaldehyde or VOC emission factors: CE % = (1 - (Stack Testing Emission Factor) / (AP-42 Ch. 3.2 Emission Factor)) x 100
Formaldehyde CE = 97.9%
VOC CE = 97.7%

75% Load CAT 3520 engines CE based on formaldehyde emission factors: CE % = (Stack Testing Emission Factor) / (AP-42 Ch. 3.2 Emission Factor) x 100
Formaldehyde CE = 100.0%
VOC CE = 89.8%

50% Load CAT 3520 engines CE based on formaldehyde emission factors: CE % = (Stack Testing Emission Factor) / (AP-42 Ch. 3.2 Emission Factor) x 100
Formaldehyde CE = 99.8%
VOC CE = 90.6%

Based on the calculations above, a conservative CE of **89.8%** was applied to all AP-42 organic HAP emission factors for these engines.

Table A-16d. Generator - Criteria Pollutant Emissions (Daily)

Emission Point Number	Location	Equipment Name	Number of Engines	Engine Rating (kW) [1,2]		Fuel Type	Operation Hours	Criteria Pollutants Daily Emissions (lb/day) [3,4,5]							
				(Electrical)	(Mechanical)		(hrs/yr)	NO_x	NO_2	CO	PM	PM_{10}	$PM_{2.5}$	VOC	SO_2
ENGINE 0013 - 0056 (50%)	Trench	CAT 3520 DSL 2600 kW	40	78,000	85,800	NG	8,760	310.43	1.77	110.95	130.43	130.43	130.43	318.69	11.78
ENGINE 0013 - 0056 (75%)	Trench	CAT 3520 DSL 2600 kW		104,000	114,400	NG	8,760	619.28	59.02	103.08	15.74	15.74	15.74	92.85	15.13
ENGINE 0013 - 0056 (100%)	Trench	CAT 3520 DSL 2600 kW		52,000	57,200	NG	8,760	246.69	0.00	127.08	287.22	287.22	287.22	208.53	8.38
ENGINE 0007 - 0012	Hardshell	CAT C18, 589 bkW	6	2,730	3,534	Diesel	8,760	21.37	10.68	109.59	1.87	1.87	1.87	41.10	2.27E-03
		CAT C18, 589 bkW	6	2,730	3,534	Diesel	8,760	21.37	10.68	109.59	1.87	1.87	1.87	41.10	2.27E-03
ENGINE 0002 - 0006	Taylor	CAT C175 3000 kW	5	3000	3,300	Diesel	500	3055.61	3055.61	3055.61	34.92	34.92	34.92	165.88	6.44
ENGINE 0001	WW1	C200D2RE	1	198	213	Diesel	8,760	4.51	4.51	39.45	0.23	0.23	0.23	2.14	14.05
Total Daily Emissions								**3,722.14**	**3,140.50**	**3,441.31**	**326.10**	**326.10**	**326.10**	**568.90**	**35.63**

Table A-16e. Generator - Criteria Pollutant Emissions (Hourly)

Emission Point Number	Location	Equipment Name	Number of Engines	Engine Rating (kW) [1,2]		Fuel Type	Operation Hours	Criteria Pollutants Hourly Emissions (lb/hr) [3,4,5]							
				(Electrical)	(Mechanical)		(hrs/yr)	NO_x	NO_2	CO	PM	PM_{10}	$PM_{2.5}$	VOC	SO_2
ENGINE 0013 - 0056 (50%)	Trench	CAT 3520 DSL 2600 kW	40	78,000	85,800	NG	8,760	12.93	0.07	4.62	5.43	5.43	5.43	13.28	0.49
ENGINE 0013 - 0056 (75%)	Trench	CAT 3520 DSL 2600 kW		104,000	114,400	NG	8,760	25.80	2.46	4.30	0.66	0.66	0.66	3.87	0.63
ENGINE 0013 - 0056 (100%)	Trench	CAT 3520 DSL 2600 kW		52,000	57,200	NG	8,760	10.28	0.00	5.30	11.97	11.97	11.97	8.69	0.35
ENGINE 0007 - 0012	Hardshell	CAT C18, 589 bkW	6	2,730	3,534	Diesel	8760	0.89	0.45	4.57	0.08	0.08	0.08	1.71	9.45E-05
		CAT C18, 589 bkW	6	2,730	3,534	Diesel	8760	0.89	0.45	4.57	0.08	0.08	0.08	1.71	9.45E-05
ENGINE 0002 - 0006	Taylor	CAT C175 3000 kW	5	3,000	3,300	Diesel	500	127.32	127.32	127.32	1.46	1.46	1.46	6.91	0.27
ENGINE 0001	WW1	C200D2RE	1	198	213	Diesel	8760	0.19	0.19	1.64	0.01	0.01	0.01	0.09	0.59
Total Hourly Emissions								**155.09**	**130.85**	**143.39**	**13.59**	**13.59**	**13.59**	**23.70**	**1.48**

1. A 10% increase in rating in the 2.6MW engines has been accounted for the change in electrical to mechanical rating. 10.00% Increase
2. Engine rating per Request for Information dated 02/16/2021
3. Average brake specific fuel consumption of
   7,000 Btu/hp-hr, Per AP-42 Chapter 3.3, is used to convert from lb/MMBtu to lb/hp-hr for diesel generators
   1.34 hp/kW
   1020 Btu/scf, per AP-42 Chapter 1.4 for natural gas engines
4. GHG emissions were converted to CO_2e emissions based on the GWP for each GHG.
   GWP of CO_2 1 lbs CO_2e/lb CO_2
   GWP of CH_4 25 lbs CO_2e/lb CH_4
   GWP of N_2O 298 lbs CO_2e/lb N_2O
5. Safety factor of 30% has been added to the emission factors for 2.6MW NG engines. 30.00% Increase

Table A-16f. Number of Generators

Power Supplied by CAT 3520 DSL 2600 kW	Parasitic[1]	2,500	kW
	Total	2,600	kW
Number of Engines		40	Generators
Power Supplied by CAT XQ1140 - 910kW		910	kW
Engines per CAT XQ1140 Generator		2	Engines/Generator
Engine mechanical rating		589	bkW
CAT 3520 DSL 2600 kW - Hardshell		6	Generators

1. Actual output is 2,500 kW due to 100kW of parasitic load, per email from Sebastian Gutierrez on 5/1/2024. Engine certified to perform optimally up to 5,500 ft of elevation based on email from Sebastian Gutierrez on 5/1/2024
Parastitic load of 2.500 kW is used to determine the number of engine needed. The total output of 2.600 kW is used for emission calculations

Table A-17a. Wind Erosion Emission Factors

Type of Material	Particulate Matter Emission Factors [1,2,3,4]				Particulate Matter Emission Factor Inputs [5,6]				Notes
	PM/TSP	PM_{10}	$PM_{2.5}$	Units	Max 5-minute wind speed (m/s)	u_{10}^{+}	u^{*}	u_t	
Aggregate/shotcrete	0.02	0.01	0.002	ton/acre-yr	16.71	27.9	1.48	1.33	$u^{*} = (0.053)(u_{10}^{+})$, where u_{10}^{+} = fastest mile for the time period between disturbances (see below for information on fastest mile calculation). The fastest mile was calculated using the linear regression proposed by ADEQ. The maximum 5-minute wind speed is the max 5-minute wind speed collected at the onsite meteorological station.
TSF	0.33	0.17	0.025	ton/acre-yr	16.71	27.9	1.48	0.54	
Rock/Ore/ROM	0.10	0.05	0.008	ton/acre-yr	16.71	27.9	1.48	1.02	

1. u_{10}+ is calculated as 1.662 * the max 5-minute wind speed + 0.0913. The 1.662 and 0.0913 value was determined from the linear regression analysis.
2. Per AP-42 13.2.5 Equation 3:

$$P = 58\,(u^{*} - u_t^{*})^2 + 25\,(u^{*} - u_t^{*})$$

$$P = 0 \text{ for } u^{*} \le u_t^{*}$$

where

u_t = threshold velocity

3. Threshold friction velocity per AP-42 Table 13.2.5-2:

1.02	m/s	Overburden can be used to represent Rock/Ore/ROM
1.33	m/s	Roadbed material can be used to represent TSFs/aggregate/shotcrete
0.54	m/s	Conservatively assumed that fine coal dust on concrete pad can be used to represent TSFs

4. Particle size multiplier for emission factors per AP-42 13.2.5:

PM	1
PM_{10}	0.5
$PM_{2.5}$	0.075

5. k = particle size multiplier, u^{*} = friction velocity, u_t = threshold friction velocity
6. The fastest mile was calculated using linear regression method historically accepted by ADEQ for other facilities. The maximum 5-minute wind speed is the max 5-minute wind speed collected at the onsite meteorological station.

Table A-17b. Wind Erosion Emissions

Emission Point Number	Location	Annual Potential Emissions [1,2,3] (tpy)				Daily Potential Emissions [1,2,3] (lb/day)				Hourly Potential Emissions [1,2,3] (lb/hr)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
TSF_1	Tailing Storage Facility	16.45	8.23	1.23	0.07	90.15	45.08	6.76	3.84E-01	3.76	1.88	0.28	0.02
WRS	West Rock Stockpile	0.67	0.34	0.05	0.0024	3.67	1.84	0.28	1.30E-02	0.15	0.08	0.01	0.001
EOS	East Ore Stockpile	0.74	0.37	0.06	0.04	4.07	2.03	0.30	1.92E-01	0.17	0.08	0.01	0.008
TAGG	Taylor Agg Stockpile	0.0005	0.0002	0.0000	--	0.00	0.00	0.00	--	0.00	0.00	0.00	--
TSHOT	Taylor Shotcrete Stockpile	0.0008	0.0004	0.0001	--	0.00	0.00	0.00	--	0.00	0.00	0.00	--
HRS	Hardshell Rock Stockpile	3.95	1.98	0.30	2.24E-02	21.66	10.83	1.62	0.12	0.90	0.45	0.07	0.005
ORE	Clark Ore Stockpile	0.12	0.06	0.01	2.12E-03	0.66	0.33	0.05	1.16E-02	0.03	0.01	0.00	0.0005
ROM	Clark ROM Stockpile	0.0357	0.0179	0.0027	6.29E-04	0.20	0.10	0.01	3.45E-03	0.01	0.00	0.00	0.0001
AGG	Clark Agg Stockpile	0.0005	0.0002	0.0000	--	0.00	0.00	0.00	--	0.00	0.00	0.00	--
SHOT	Clark Shotcrete Stockpile	0.0008	0.0004	0.0001	--	0.00	0.00	0.00	--	0.00	0.00	0.00	--
CHUTE	Waste Chute Stockpile	2.59E-03	1.30E-03	1.94E-04	1.49E-05	1.42E-02	7.10E-03	1.07E-03	8.14E-05	5.92E-04	2.96E-04	4.44E-05	3.39E-06
Total		**21.98**	**10.99**	**1.65**	**0.13**	**120.43**	**60.22**	**9.03**	**0.73**	**5.02**	**2.51**	**0.38**	**0.03**

1. Emissions based on maximum hours 8760 hrs
2. Conversion from grams to pounds 453.6 g/lb
3. Percent of lead in PM emissions and total exposed surface are in table below

Taylor Shotcrete Stockpile	Lead	0.00	%
	Material	Shotcrete	
	Area	1,600	ft^2
		0.04	acre
Taylor Agg Stockpile	Lead	0.00	%
	Material	Aggregate	
	Area	900	ft^2
		0.02	acre
Hardshell Rock Stockpile	Lead Grade	0.57	%
	Material	Waste Rock	
	Area	1,641,033	ft^2
		37.7	acre
Clark Shotcrete Stockpile	Lead	0.00	%
	Material	Shotcrete	
	Area	1,600	ft^2
		0.04	acre
Clark Agg Stockpile	Lead	0.00	%
	Material	Aggregate	
	Area	900	ft^2
		0.02	acre

Tailings Storage Facility	Lead	0.43%	%
	Material	Tailings	
	Area	2,161,944	ft^2
		50	acre
East Ore Stockpile	Lead Grade	4.73%	
	Material	Stope Ore & Developmental Ore	
	Area	308,126	ft^2
		7	acre
West Rock Stockpile	Lead	0.35	%
	Material	Waste Rock	
	Area	278,225	ft^2
		6	acre
Clark Ore Stockpile	Lead	1.76	%
	Material	Clark Stope & Developmental Ore	
	Area	50,001	ft^2
		1.15	acre
Clark ROM Stockpile	Lead	1.76	%
	Material	Clark Stope & Developmental Ore	
	Area	14,842	ft^2
		0.34	acre
Waste Chute Stockpile	Lead Grade	0.57%	
	Material	Waste Chute Material	
	Area	1,076	ft^2
		0.02	acre

Table A-18a. WTP2 Cooling Tower Parameters

Emission Point Number	Flowrate [1] (gal/min)	Drift [2] (%)	TDS [3] (ppm)
WTP2CT	4500	0.0005	455

1. Flowrate per July 18th, 2022 email from Sarah Richman
2. Drift % per July 18th, 2022 email from Sarah Richman
3. Influent TDS (455 ppm) concentration per July 18th, 2022 email from Sarah Richman

Drift loss	0.0005%		High Efficiency
Circulating water flow rate	4,500	gpm	
Total dissolved solids	455	ppm	
Density of TDS constituents	2.5	g/cc	*Average density of common salts (CaCO3, CaSO4, CaCl2, NaCl, Na2SO4, Na2CO3)*

Volume of a sphere $V = 4/3*\pi*r^3$

Annual drift 11 lb H_2O/hr

Table A-18b. Water Drop Size Distribution for Low Efficiency Drift Eliminators*

Based on a drift rate of 0.001%

Droplet Dia. (micron)	% mass	% mass smaller	H_2O Droplet Mass (g)	Solids Vol. (cc)	Solids Dia. (micron)	Emissions PM (lb/hr)	Emissions PM_{10} (lb/hr)	Emissions $PM_{2.5}$ (lb/hr)
22	0.43	0.43	5.6E-09	1.0E-12	1.2			
29	1.49	1.92	1.3E-08	2.3E-12	1.6			
44	3.76	5.68	4.5E-08	8.1E-12	2.5			
58	2.09	7.77	1.0E-07	1.9E-11	3.3			7.8%
65	1.86	9.63	1.4E-07	2.6E-11	3.7			
87	1.56	11.19	3.4E-07	6.3E-11	4.9			
108	1.43	12.62	6.6E-07	1.2E-10	6.1			
120	1.26	13.88	9.0E-07	1.6E-10	6.8			
132	1.09	14.97	1.2E-06	2.2E-10	7.5			
144	1.32	16.29	1.6E-06	2.8E-10	8.2			
174	5.81	22.1	2.8E-06	5.0E-10	9.9			
300	5.04	27.14	1.4E-05	2.6E-09	17.0		27.1%	
450**	4.17	31.31	4.8E-05	8.7E-09	25.5	31.3%		
600	4.01	35.32	1.1E-04	2.1E-08	34.0			
750	4.00	39.32	2.2E-04	4.0E-08	42.5			
900	4.03	43.35	3.8E-04	6.9E-08	51.0			
1,050	4.57	47.92	6.1E-04	1.1E-07	59.5			
1,200	5.46	53.38	9.0E-04	1.6E-07	68.0			
1,350	6.80	60.18	1.3E-03	2.3E-07	76.5			
2,250	17.99	78.17	6.0E-03	1.1E-06	127.5			
2,400	21.83	100	7.2E-03	1.3E-06	136.0			

** EPA. 1979. Effects of Pathogenic and Toxic Material Transport Via Cooling Device Drift - Vol. 1 Technical Report. EPA-600/7-79-251a. November 1979.*

*** Maximum droplet size governed by atmospheric dispersion. Larger droplets fall to the ground before evaporating into a particle (EPA 1979).*

Table A-18c. Water Drop Size Distribution for High Efficiency Drift Eliminators*

Based on a drift rate of 0.0003%

Droplet Dia. (micron)	% mass smaller	H_2O Droplet Mass (g)	Solids Vol. (cc)	Solids Dia. (micron)	Emissions PM (lb/hr)	Emissions PM_{10} (lb/hr)	Emissions $PM_{2.5}$ (lb/hr)
10	0	5.2E-10	9.5E-14	0.6			
20	0.196	4.2E-09	7.6E-13	1.1			
30	0.226	1.4E-08	2.6E-12	1.7			
40	0.514	3.4E-08	6.1E-12	2.3			
50	1.816	6.5E-08	1.2E-11	2.8			1.8%
60	5.702	1.1E-07	2.1E-11	3.4			
70	21.348	1.8E-07	3.3E-11	4.0			
90	49.812	3.8E-07	6.9E-11	5.1			
110	70.509	7.0E-07	1.3E-10	6.2			
130	82.023	1.2E-06	2.1E-10	7.4			
150	88.012	1.8E-06	3.2E-10	8.5			
180	91.032	3.1E-06	5.6E-10	10.2		91.0%	
210	92.468	4.8E-06	8.8E-10	11.9			
240	94.091	7.2E-06	1.3E-09	13.6			
270	94.689	1.0E-05	1.9E-09	15.3			
300	96.288	1.4E-05	2.6E-09	17.0			
350	97.011	2.2E-05	4.1E-09	19.8			
400	98.34	3.4E-05	6.1E-09	22.7			
450**	99.071	4.8E-05	8.7E-09	25.5	99.1%		
500	99.071	6.5E-05	1.2E-08	28.3			
600	100	1.1E-04	2.1E-08	34.0			

** Reisman, J. and G. Frisbie. 2002. "Calculating Realistic PM10 Emissions from Cooling Towers." Environmental Progress & Sustainable Energy. American Institute of Chemical Engineers. Volume 21, Issue 2, pp. 127-130. July 2002.*

*** Maximum droplet size governed by atmospheric dispersion. Larger droplets fall to the ground before evaporating into a particle (EPA 1979).*

Table A-18d. WTP2 Cooling Towers - Emissions

Emission Point Number	Annual Emissions (tpy)			Daily Emissions (lb/day)			Hourly Emissions (lb/hr)		
	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
WTP2CT	2.22E-02	2.04E-02	4.07E-04	1.22E-01	1.12E-01	2.23E-03	5.07E-03	4.66E-03	9.29E-05
TOTAL	**0.0222**	**0.0204**	**4.07E-04**	**0.122**	**0.112**	**2.23E-03**	**0.0051**	**4.66E-03**	**9.29E-05**

Table A-19a. Surface Refrigeration Plant Parameters

Emission Point Number	Flowrate [1] (gal/min)	Drift [2] (%)	TDS [2,3] (ppm)
PRODREF	7,529	0.001	1000
BBREF	11,095	0.001	1000
MILLREF	512	0.001	1000

1. Provided by Ross Wilson (BBE Consulting) on 07/06/2023 via email.
2. Per parameters provided by South32 on 09/07/2021.
3. MILLREF TDS Provided by Matt Novak on 04/26/2024 via RFI

PRODREF:

Drift loss	0.0010%		Low Efficiency
Circulating water flow rate	7,529	gpm	
Total dissolved solids	1,000	ppm	
Density of TDS constituents	2.5	g/cc	*Average density of common salts (CaCO3, CaSO4, CaCl2, NaCl, Na2SO4, Na2CO3)*
Volume of a sphere	$V = 4/3*\pi*r^3$		
Annual drift	38	lb H_2O/hr	

BBREF:

Drift loss	0.0010%		Low Efficiency
Circulating water flow rate	11,095	gpm	
Total dissolved solids	1,000	ppm	
Density of TDS constituents	2.5	g/cc	*Average density of common salts (CaCO3, CaSO4, CaCl2, NaCl, Na2SO4, Na2CO3)*
Volume of a sphere	$V = 4/3*\pi*r^3$		
Annual drift	55	lb H_2O/hr	

MILLREF

Drift loss	0.0010%		Low Efficiency
Circulating water flow rate	512	gpm	
Total dissolved solids	1,000	ppm	
Density of TDS constituents	2.5	g/cc	*Average density of common salts (CaCO3, CaSO4, CaCl2, NaCl, Na2SO4, Na2CO3)*
Volume of a sphere	$V = 4/3*\pi*r^3$		
Annual drift	0	lb H_2O/hr	

Table A-19b. Water Drop Size Distribution for Low Efficiency Drift Eliminators*

Based on a drift rate of 0.001%

Droplet Dia. (micron)	% mass	% mass smaller	H_2O Droplet Mass (g)	Solids Vol. (cc)	Solids Dia. (micron)	Emissions PM (lb/hr)	Emissions PM_{10} (lb/hr)	Emissions $PM_{2.5}$ (lb/hr)
22	0.43	0.43	5.6E-09	2.2E-12	1.6			
29	1.49	1.92	1.3E-08	5.1E-12	2.1			
44	3.76	5.68	4.5E-08	1.8E-11	3.2			5.7%
58	2.09	7.77	1.0E-07	4.1E-11	4.3			
65	1.86	9.63	1.4E-07	5.8E-11	4.8			
87	1.56	11.19	3.4E-07	1.4E-10	6.4			
108	1.43	12.62	6.6E-07	2.6E-10	8.0			
120	1.26	13.88	9.0E-07	3.6E-10	8.8			
132	1.09	14.97	1.2E-06	4.8E-10	9.7			
144	1.32	16.29	1.6E-06	6.3E-10	10.6		16.3%	
174	5.81	22.1	2.8E-06	1.1E-09	12.8			
300	5.04	27.14	1.4E-05	5.7E-09	22.1			
450**	4.17	31.31	4.8E-05	1.9E-08	33.2	31.3%		
600	4.01	35.32	1.1E-04	4.5E-08	44.2			
750	4.00	39.32	2.2E-04	8.8E-08	55.3			
900	4.03	43.35	3.8E-04	1.5E-07	66.3			
1,050	4.57	47.92	6.1E-04	2.4E-07	77.4			
1,200	5.46	53.38	9.0E-04	3.6E-07	88.4			
1,350	6.80	60.18	1.3E-03	5.2E-07	99.5			
2,250	17.99	78.17	6.0E-03	2.4E-06	165.8			
2,400	21.83	100	7.2E-03	2.9E-06	176.8			

** EPA. 1979. Effects of Pathogenic and Toxic Material Transport Via Cooling Device Drift - Vol. 1 Technical Report. EPA-600/7-79-251a. November 1979.*

*** Maximum droplet size governed by atmospheric dispersion. Larger droplets fall to the ground before evaporating into a particle (EPA 1979).*

Table A-19c. Water Drop Size Distribution for High Efficiency Drift Eliminators*

Based on a drift rate of 0.0003%

Droplet Dia. (micron)	% mass smaller	H_2O Droplet Mass (g)	Solids Vol. (cc)	Solids Dia. (micron)	Emissions PM (lb/hr)	Emissions PM_{10} (lb/hr)	Emissions $PM_{2.5}$ (lb/hr)
10	0	5.2E-10	2.1E-13	0.7			
20	0.196	4.2E-09	1.7E-12	1.5			
30	0.226	1.4E-08	5.7E-12	2.2			
40	0.514	3.4E-08	1.3E-11	2.9			0.5%
50	1.816	6.5E-08	2.6E-11	3.7			
60	5.702	1.1E-07	4.5E-11	4.4			
70	21.348	1.8E-07	7.2E-11	5.2			
90	49.812	3.8E-07	1.5E-10	6.6			
110	70.509	7.0E-07	2.8E-10	8.1			
130	82.023	1.2E-06	4.6E-10	9.6			
150	88.012	1.8E-06	7.1E-10	11.1		88.0%	
180	91.032	3.1E-06	1.2E-09	13.3			
210	92.468	4.8E-06	1.9E-09	15.5			
240	94.091	7.2E-06	2.9E-09	17.7			
270	94.689	1.0E-05	4.1E-09	19.9			
300	96.288	1.4E-05	5.7E-09	22.1			
350	97.011	2.2E-05	9.0E-09	25.8			
400	98.34	3.4E-05	1.3E-08	29.5			
450**	99.071	4.8E-05	1.9E-08	33.2	99.1%		
500	99.071	6.5E-05	2.6E-08	36.8			
600	100	1.1E-04	4.5E-08	44.2			

** Reisman, J. and G. Frisbie. 2002. "Calculating Realistic PM10 Emissions from Cooling Towers." Environmental Progress & Sustainable Energy. American Institute of Chemical Engineers. Volume 21, Issue 2, pp. 127-130. July 2002.*

*** Maximum droplet size governed by atmospheric dispersion. Larger droplets fall to the ground before evaporating into a particle (EPA 1979).*

EXAMPLE CALCULATIONS: *Low Efficiency*

Annual drift:

$$\frac{7{,}529 \text{ gal water}}{1 \text{ min}} \left| \frac{8.33 \text{ lb}}{1 \text{ gal water}} \right| \frac{60 \text{ min}}{1 \text{ hr}} \left| 0.001\% \text{ (drift)} \right. = \mathbf{38 \text{ lb water drift / hr}}$$

Total Particulate Emissions

$$\frac{38 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| 31.3\% \text{ PM} = \frac{0.012 \text{ lb PM}}{\text{hr}} = \mathbf{0.052 \text{ ton PM / yr}}$$

PM_{10} Emissions

$$\frac{38 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| 16.3\% \text{ } PM_{10} = \frac{0.006 \text{ lb PM10}}{\text{hr}} = \mathbf{0.027 \text{ ton PM10 / yr}}$$

$PM_{2.5}$ Emissions

$$\frac{38 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| 5.7\% \text{ } PM_{2.5} = \frac{0.002 \text{ lb PM2.5}}{\text{hr}} = \mathbf{0.009 \text{ ton PM2.5 / yr}}$$

Water Drop Size Distribution for Low Efficiency Drift Eliminators*

Based on a drift rate of 0.001%

Droplet Dia. (micron)	% mass	% mass smaller	H_2O Droplet Mass (g)	Solids Vol. (cc)	Solids Dia. (micron)	Emissions PM (lb/hr)	Emissions PM_{10} (lb/hr)	Emissions $PM_{2.5}$ (lb/hr)
22	0.43	0.43	5.6E-09	2.2E-12	1.6			
29	1.49	1384.139	1.3E-08	5.1E-12	2.1			
44	3.76	5.68	4.5E-08	1.8E-11	3.2			5.7%
58	2.09	7.77	1.0E-07	4.1E-11	4.3			
65	1.86	9.63	1.4E-07	5.8E-11	4.8			
87	1.56	11.19	3.4E-07	1.4E-10	6.4			
108	1.43	12.62	6.6E-07	2.6E-10	8.0			
120	1.26	13.88	9.0E-07	3.6E-10	8.8			
132	1.09	14.97	1.2E-06	4.8E-10	9.7			
144	1.32	16.29	1.6E-06	6.3E-10	10.6		16.3%	
174	5.81	22.1	2.8E-06	1.1E-09	12.8			
300	5.04	27.14	1.4E-05	5.7E-09	22.1			
450**	4.17	31.31	4.8E-05	1.9E-08	33.2	31.3%		
600	4.01	35.32	1.1E-04	4.5E-08	44.2			
750	4.00	39.32	2.2E-04	8.8E-08	55.3			
900	4.03	43.35	3.8E-04	1.5E-07	66.3			
1,050	4.57	47.92	6.1E-04	2.4E-07	77.4			
1,200	5.46	53.38	9.0E-04	3.6E-07	88.4			
1,350	6.80	60.18	1.3E-03	5.2E-07	99.5			
2,250	17.99	78.17	6.0E-03	2.4E-06	165.8			
2,400	21.83	100	7.2E-03	2.9E-06	176.8			

** EPA. 1979. Effects of Pathogenic and Toxic Material Transport Via Cooling Device Drift - Vol. 1 Technical Report. EPA-600/7-79-251a. November 1979.*

*** Maximum droplet size governed by atmospheric dispersion. Larger droplets fall to the ground before evaporating into a particle (EPA 1979).*

Water Drop Size Distribution for High Efficiency Drift Eliminators*

Based on a drift rate of 0.0003%

Droplet Dia. (micron)	% mass smaller	H_2O Droplet Mass (g)	Solids Vol. (cc)	Solids Dia. (micron)	Emissions PM (lb/hr)	Emissions PM_{10} (lb/hr)	Emissions $PM_{2.5}$ (lb/hr)
10	0	5.2E-10	2.1E-13	0.7			
20	0.196	4.2E-09	1.7E-12	1.5			
30	0.226	1.4E-08	5.7E-12	2.2			
40	0.514	3.4E-08	1.3E-11	2.9			0.5%
50	1.816	6.5E-08	2.6E-11	3.7			
60	5.702	1.1E-07	4.5E-11	4.4			
70	21.348	1.8E-07	7.2E-11	5.2			
90	49.812	3.8E-07	1.5E-10	6.6			
110	70.509	7.0E-07	2.8E-10	8.1			
130	82.023	1.2E-06	4.6E-10	9.6			
150	88.012	1.8E-06	7.1E-10	11.1		88.0%	
180	91.032	3.1E-06	1.2E-09	13.3			
210	92.468	4.8E-06	1.9E-09	15.5			
240	94.091	7.2E-06	2.9E-09	17.7			
270	94.689	1.0E-05	4.1E-09	19.9			
300	96.288	1.4E-05	5.7E-09	22.1			
350	97.011	2.2E-05	9.0E-09	25.8			
400	98.34	3.4E-05	1.3E-08	29.5			
450**	99.071	4.8E-05	1.9E-08	33.2	99.1%		
500	99.071	6.5E-05	2.6E-08	36.8			
600	100	1.1E-04	4.5E-08	44.2			

** Reisman, J. and G. Frisbie. 2002. "Calculating Realistic PM10 Emissions from Cooling Towers." Environmental Progress & Sustainable Energy. American Institute of Chemical Engineers. Volume 21, Issue 2, pp. 127-130. July 2002.*

*** Maximum droplet size governed by atmospheric dispersion. Larger droplets fall to the ground before evaporating into a particle (EPA 1979).*

EXAMPLE CALCULATIONS: *Low Efficiency*

Annual drift:

$$\frac{11{,}095 \text{ gal water}}{1 \text{ min}} \left| \frac{8.33 \text{ lb}}{1 \text{ gal water}} \right| \frac{60 \text{ min}}{1 \text{ hr}} \left| 0.001\% \text{ (drift)} \right. = \mathbf{55 \text{ lb water drift / hr}}$$

Total Particulate Emissions

$$\frac{55 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| 31.3\% \text{ PM} = \frac{0.017 \text{ lb PM}}{\text{hr}} = \mathbf{0.076 \text{ ton PM / yr}}$$

PM_{10} Emissions

$$\frac{55 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| 16.3\% \text{ } PM_{10} = \frac{0.009 \text{ lb PM10}}{\text{hr}} = \mathbf{0.040 \text{ ton PM10 / yr}}$$

$PM_{2.5}$ Emissions

$$\frac{55 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| 5.7\% \text{ } PM_{2.5} = \frac{0.003 \text{ lb PM2.5}}{\text{hr}} = \mathbf{0.014 \text{ ton PM2.5 / yr}}$$

EXAMPLE CALCULATIONS: *Low Efficiency* MILLREF

Annual drift:

$$\frac{512 \text{ gal water}}{1 \text{ min}} \left| \frac{8.33 \text{ lb}}{1 \text{ gal water}} \right| \frac{60 \text{ min}}{1 \text{ hr}} \left| 0.001\% \text{ (drift)} \right. = \mathbf{3 \text{ lb water drift / hr}}$$

Total Particulate Emissions

$$\frac{3 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| 31.3\% \text{ PM} = \frac{0.001 \text{ lb PM}}{\text{hr}} = \mathbf{0.004 \text{ ton PM / yr}}$$

PM_{10} Emissions

3 lb water / hr	1,000 lb PM / 1E+6 lb water	16.3% PM_{10}	=	0.000 lb PM10 / hr	=	**0.002 ton PM10 / yr**

$PM_{2.5}$ Emissions

3 lb water / hr	1,000 lb PM / 1E+6 lb water	5.7% $PM_{2.5}$	=	0.000 lb PM2.5 / hr	=	**0.001 ton PM2.5 / yr**

Table A-19d. Surface Refrigeration Plant - Emissions

Emission Point Number	Annual Emissions (tpy)			Daily Emissions (lb/day)			Hourly Emissions (lb/hr)		
	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
PRODREF	0.052	0.027	0.009	2.83E-01	1.47E-01	5.13E-02	1.18E-02	6.13E-03	2.14E-03
BBREF	0.076	0.040	0.014	4.17E-01	2.17E-01	7.56E-02	1.74E-02	9.03E-03	3.15E-03
MILLREF	0.004	0.002	0.001	1.92E-02	1.00E-02	3.49E-03	8.01E-04	4.17E-04	1.45E-04
TOTAL:	**0.13**	**0.07**	**0.02**	**0.72**	**0.37**	**0.13**	**0.03**	**0.02**	**0.01**

Table A-20a. Taylor Concrete Batch Plant Emission Factors and Parameters

Operation	Equipment	Activity	Material	Maximum Rates Capacity [1] (tpy)	Emission Factors [2]		
					PM	$PM_{10}/PM_{2.5}$	Units
Concrete Batch Plant	Aggregate delivery to ground storage	Unloading of Aggregate Material	Aggregate	18,666	0.0069	0.0033	lb/ton
	Sand delivery to ground storage	Unloading of Sand	Sand	14,292	0.0021	0.00099	lb/ton
	Aggregate transfer to hopper	Transferring aggregate material	Aggregate	18,666	0.0069	0.0033	lb/ton
	Sand transfer to hopper	Transferring Sand	Sand	14,292	0.0021	0.00099	lb/ton
	Aggregate transfer from hopper to conveyor	Transferring aggregate material	Aggregate	18,666	0.0069	0.0033	lb/ton
	Sand transfer from hopper to conveyor	Transferring Sand	Sand	14,292	0.0021	0.00099	lb/ton
	Aggregate transfer to elevated storage	Transferring aggregate material	Aggregate	18,666	0.0069	0.0033	lb/ton
	Sand transfer to elevated storage	Transferring Sand	Sand	14,292	0.0021	0.00099	lb/ton
	Cement delivery to silo	Unloading of Cement	Cement	4,914	0.00099	0.00034	lb/ton
	Cement supplement delivery to silo	Unloading of Cement Supplement	Cement	731	0.0089	0.0049	lb/ton
	Weigh hopper loading	Loading of Weigh hopper	Concrete	40,274	0.0048	0.0028	lb/ton
	Central mix loading	Loading of Mixer	Concrete	40,274	0.0184	0.0055	lb/ton

1. EPA AP-42 Section 11.12, mixing ratios used:

Concrete	1
Aggregate	0.46
Sand	0.35
Cement	0.12
Cement Supplement	0.02

2. EPA AP-42 Section 11.12, Table 11.12-2. emission factors were utilized. If a controlled emission factor was unavailable, an uncontrolled emission factor was used.

Table A-20b. Taylor Concrete Batch Plant - Emissions

Operation	Activity	Annual Emissions (tpy)			Daily Emissions (lb/day)			Hourly Emissions (lb/hr)		
		PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Concrete Batch Plant	Unloading of Aggregate Material	0.06	0.03	0.03	0.35	0.17	0.17	0.01	0.01	0.01
	Unloading of Sand	0.02	0.01	0.01	0.08	0.04	0.04	0.00	0.00	0.00
	Transferring aggregate material	0.06	0.03	0.03	0.35	0.17	0.17	1.47E-02	7.03E-03	7.03E-03
	Transferring Sand	0.02	0.01	0.01	0.08	0.04	0.04	3.43E-03	1.62E-03	1.62E-03
	Transferring aggregate material	0.06	0.03	0.03	0.35	0.17	0.17	0.01	0.01	0.01
	Transferring Sand	0.02	0.01	0.01	0.08	0.04	0.04	0.00	0.00	0.00
	Transferring aggregate material	0.06	0.03	0.03	0.35	0.17	0.17	1.47E-02	7.03E-03	7.03E-03
	Transferring Sand	0.02	0.01	0.01	0.08	0.04	0.04	3.43E-03	1.62E-03	1.62E-03
	Unloading of Cement	2.43E-03	8.35E-04	8.35E-04	0.01	0.00	0.005	0.00	0.00	0.00
	Unloading of Cement Supplement	3.25E-03	1.79E-03	1.79E-03	0.02	0.01	0.01	0.00	0.00	0.00
	Loading of Weigh hopper	0.10	0.06	0.06	0.53	0.31	0.31	0.02	0.01	0.01
	Loading of Mixer	0.37	0.11	0.11	2.03	0.61	0.61	0.08	0.03	0.03
	Total:	**0.79**	**0.32**	**0.32**	**4.33**	**1.76**	**1.76**	**0.18**	**0.07**	**0.07**

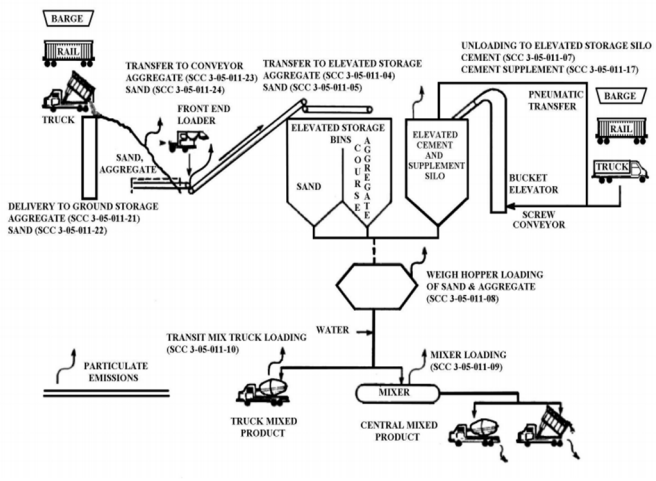

Figure 11.12-1. Typical Concrete Batching Process.

Table A-21a. Clark Concrete Batch Plant Emission Factors and Parameters

Operation	Equipment	Activity	Material	Maximum Rates Capacity [1] (tpy)	Emission Factors [2]		
					PM	$PM_{10}/PM_{2.5}$	Units
Concrete Batch Plant	Aggregate delivery to ground storage	Unloading of Aggregate Material	Aggregate	920	0.0069	0.0033	lb/ton
	Sand delivery to ground storage	Unloading of Sand	Sand	704	0.0021	0.00099	lb/ton
	Aggregate transfer to hopper	Transferring aggregate material	Aggregate	920	0.0069	0.0033	lb/ton
	Sand transfer to hopper	Transferring Sand	Sand	704	0.0021	0.00099	lb/ton
	Aggregate transfer from hopper to conveyor	Transferring aggregate material	Aggregate	920	0.0069	0.0033	lb/ton
	Sand transfer from hopper to conveyor	Transferring Sand	Sand	704	0.0021	0.00099	lb/ton
	Aggregate transfer to elevated storage	Transferring aggregate material	Aggregate	920	0.0069	0.0033	lb/ton
	Sand transfer to elevated storage	Transferring Sand	Sand	704	0.0021	0.00099	lb/ton
	Cement delivery to silo	Unloading of Cement	Cement	242	0.00099	0.00034	lb/ton
	Cement supplement delivery to silo	Unloading of Cement Supplement	Cement	242	0.0089	0.0049	lb/ton
	Weigh hopper loading	Loading of Weigh hopper	Concrete	1,984	0.0048	0.0028	lb/ton
	Central mix loading	Loading of Mixer	Concrete	1,984	0.0184	0.0055	lb/ton

1. EPA AP-42 Section 11.12, mixing ratios used:

Concrete	1
Aggregate	0.46
Sand	0.35
Cement	0.12
Cement Supplement	0.02

2. EPA AP-42 Section 11.12, Table 11.12-2. emission factors were utilized. If a controlled emission factor was unavailable, an uncontrolled emission factor was used.

Table A-21b. Clark Concrete Batch Plant - Emissions

Operation	Activity	Annual Emissions (tpy)			Daily Emissions (lb/day)			Hourly Emissions (lb/hr)		
		PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Concrete Batch Plant	Unloading of Aggregate Material	3.17E-03	1.52E-03	1.52E-03	1.74E-02	8.31E-03	8.31E-03	7.24E-04	3.46E-04	3.46E-04
	Unloading of Sand	7.39E-04	3.49E-04	3.49E-04	4.05E-03	1.91E-03	1.91E-03	1.69E-04	7.96E-05	7.96E-05
	Transferring aggregate material	3.17E-03	1.52E-03	1.52E-03	1.74E-02	8.31E-03	8.31E-03	7.24E-04	3.46E-04	3.46E-04
	Transferring Sand	7.39E-04	3.49E-04	3.49E-04	4.05E-03	1.91E-03	1.91E-03	1.69E-04	7.96E-05	7.96E-05
	Transferring aggregate material	3.17E-03	1.52E-03	1.52E-03	1.74E-02	8.31E-03	8.31E-03	7.24E-04	3.46E-04	3.46E-04
	Transferring Sand	7.39E-04	3.49E-04	3.49E-04	4.05E-03	1.91E-03	1.91E-03	1.69E-04	7.96E-05	7.96E-05
	Transferring aggregate material	3.17E-03	1.52E-03	1.52E-03	1.74E-02	8.31E-03	8.31E-03	7.24E-04	3.46E-04	3.46E-04
	Transferring Sand	7.39E-04	3.49E-04	3.49E-04	4.05E-03	1.91E-03	1.91E-03	1.69E-04	7.96E-05	7.96E-05
	Unloading of Cement	1.20E-04	4.12E-05	4.12E-05	6.57E-04	2.26E-04	2.26E-04	2.74E-05	9.40E-06	9.40E-06
	Unloading of Cement Supplement	1.08E-03	5.93E-04	5.93E-04	5.90E-03	3.25E-03	3.25E-03	2.46E-04	1.35E-04	1.35E-04
	Loading of Weigh hopper	4.76E-03	2.78E-03	2.78E-03	2.61E-02	1.52E-02	1.52E-02	1.09E-03	6.34E-04	6.34E-04
	Loading of Mixer	1.83E-02	5.46E-03	5.46E-03	1.00E-01	2.99E-02	2.99E-02	4.17E-03	1.25E-03	1.25E-03
Total:		**0.040**	**0.016**	**0.016**	**0.22**	**0.09**	**0.09**	**0.009**	**0.0037**	**0.0037**

6/06

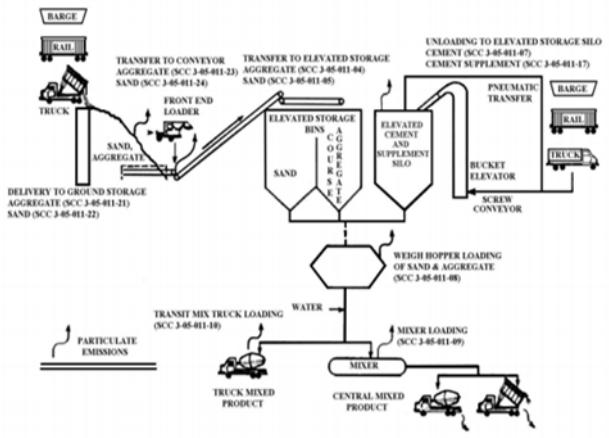

Figure 11.12-1. Typical Concrete Batching Process.

11.12-3

Table A-22. Evaporation Pond Mechanical Evaporators - PM Emissions

Unit	Evaporator Type	TDS Conc. (mg/L)	System Flow Rate [1] (gpm)	Operation Time [2] (hr/yr)	Calculated Emission Rate (lb/hr) [3]		Calculated Emission Rate (lb/day) [3,4]		Calculated Emission Rate (tpy) [3]	
					PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
MEVAP1	Nozzles	2,100	66	876	0.0911	0.014	1.30	0.19	3.99E-02	5.94E-03
MEVAP2	Nozzles	2,100	66	876	0.0911	0.014	1.30	0.19	3.99E-02	5.94E-03
MEVAP3	Nozzles	2,100	66	876	0.0911	0.014	1.30	0.19	3.99E-02	5.94E-03

1. Volume (gpm) calculated based on 66 gpm
2. Only 3 our of 4 units operating at once and 10% of the year based on meeting notes from 7/19/2022 with Sarah Richman
3. Emission rates are calculated using the following equation and parameters, provided by ADEQ via meeting on 5/30/2023:

$$PM = TDS\left(\frac{mg}{L}\right) \times \frac{Drift(\%)}{100\ \%} \times Q\ Rate\left(\frac{gal}{min}\right) \times 3.78\frac{L}{gal} \times \frac{2.2lb}{10^6 mg} \times \frac{60min}{hr}$$

Where:
Drift loss: 0.327%
PM_{10}: 40.3% of PM
$PM_{2.5}$: 6% of PM

4. For daily emissions, evaporators can run during the daylight hours only; conservatively, daylight hour of the summer solstice (14.25 hours) is used.

Table A-23a. Aboveground Gasoline Dispensing Facility - Taylor - VOC Emissions

Emission Unit	Maximum Estimated Rate			Emission Factor [2]	VOC Emissions		
	(gals/hr)	(gals/day)	(gals/yr) [1]	(lbs/10 [3] gal)	lb/hr	lb/day	ton/yr
AGGDF-T	17	411	150,000	11.3	0.19	4.63	0.85
				Total:	**0.19**	**4.63**	**0.85**

1. Based on aboveground annual gasoline usage provided by South32. All gasoline is treated as being emitted aboveground, despite some being dispensed underground.
2. Emission factor for gasoline is based on petroleum loading loss equation in USEPA publication AP-42, Table 5.2-7, Evaporative Emissions from Gasoline Service Station Operations (7/08). The loading loss equation is :

Loading Loss (lb/1000 gal) = 12.46 x SPM/T

where,

S= saturation factor (assume 1.00 for submerged loading),

P = true vapor pressure of liquid loaded, pounds per square inch absolute (assume 7.4 psia for Gasoline RVP 10 @ 80°F),

M = molecular weight of vapors, pounds per pound-mole (assume 66 lb/lb-mole),

T = temperature of bulk liquid loaded, °R (80°F + 460 = 540°R), based on AP-42 Chapter 7 Tucson average daily maximum ambient temperature

Sample Calculations

VOC emissions (lb/hr) = 17.12 gal/day x 11.3 lb/1,000 gal x 1.0 day/24 hours = 0.19 lb/hr
VOC emissions (ton/yr) = 150000 gal/yr x 11.3 lb/1,000 gal x 1.0 ton/2,000 lbs = 0.85 ton/yr

Table A-23b. Aboveground Gasoline Dispensing Facility - Taylor - HAP Emissions

Emission Unit	Source Description	VOC Emissions [1]		HAP Emissions [2]									
				Benzene		Hexane		Toluene		Xylene		Ethylbenzene	
		lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
AGGDF-T	Aboveground Gasoline Dispensing Facility	0.19	0.85	3.47E-03	0.02	1.93E-03	0.01	1.35E-02	0.06	1.35E-02	0.06	2.70E-03	0.01
			Total HAPs (ton/yr):	**0.15**									

1. Based on emission calculations in Table A-23a
2. Mass percent is based on the average percent content of the HAP constituent in gasoline per TankESP Gasoline RVP_X speciation:

Storage Tank Content	HAP Mass Percent				
	Benzene	Hexane	Toluene	Xylene	Ethylbenzene
Gasoline	1.80%	1.00%	7.00%	7.00%	1.40%

Table A-24a. Aboveground Gasoline Dispensing Facility - Clark - VOC Emissions

Emission Unit	Maximum Estimated Rate			Emission Factor [2] (lbs/10 [3] gal)	VOC Emissions		
	gals/hr	gals/day	gals/yr [1]		lb/hr	lb/day	ton/yr
AGGDF-C	8	201	73,500	11.3	0.09	2.27	0.41
				Total:	**0.09**	**2.27**	**0.41**

1. Based on aboveground annual gasoline usage provided by South32. All gasoline is treated as being emitted aboveground, despite some being dispensed underground.

2. Emission factor for gasoline is based on petroleum loading loss equation in USEPA publication AP-42, Table 5.2-7, Evaporative Emissions from Gasoline Service Station Operations (7/08). The loading loss equation is :

Loading Loss (lb/1000 gal) = 12.46 x SPM/T

where,

S= saturation factor (assume 1.00 for submerged loading),

P = true vapor pressure of liquid loaded, pounds per square inch absolute (assume 7.4 psia for Gasoline RVP 10 @ 80°F),

M = molecular weight of vapors, pounds per pound-mole (assume 66 lb/lb-mole),

T = temperature of bulk liquid loaded, °R (80°F + 460 = 540°R), based on AP-42 Chapter 7 Tucson average daily maximum ambient temperature

Sample Calculations

VOC emissions (lb/hr) = 8.39 gal/day x 11.3 lb/1,000 gal x 1.0 day/24 hours = 0.09 lb/hr
VOC emissions (ton/yr) = 73500 gal/yr x 11.3 lb/1,000 gal x 1.0 ton/2,000 lbs = 0.41 ton/yr

Table A-24b. Aboveground Gasoline Dispensing Facility - Clark - HAP Emissions

Emission Unit	Source Description	VOC Emissions [1]		HAP Emissions [2]									
				Benzene		Hexane		Toluene		Xylene		Ethylbenzene	
		lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
AGGDF-C	Aboveground Gasoline Dispensing Facility	0.09	0.41	0.002	0.01	0.001	0.00	0.01	0.03	0.007	0.03	0.001	0.01
Total HAPs (ton/yr):				**0.08**									

1. Based on emission calculations in Table A-24a

2. Mass percent is based on the average percent content of the HAP constituent in gasoline per TankESP Gasoline RVP_X speciation:

Storage Tank Content	HAP Mass Percent				
	Benzene	Hexane	Toluene	Xylene	Ethylbenzene
Gasoline	1.80%	1.00%	7.00%	7.00%	1.40%

Table A-25a. Roads - Dozer - Input Parameters

Emission Point No.	Road Surface	Equipment	Total Combined Operation Hour [1]			Emission Factor (lb/hr) [2]						Material	Lead	Control	
			Hourly	Daily	Annual	Short Term			Long Term					Type	Efficiency [3]
			(hr/hr)	(hr/day)	(hr/yr)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$		(%)		(%)
DOZER-WRS	Unpaved	Bulldozer	1	12	4,380	1.65	0.22	0.17	1.65	0.22	0.17	Waste Rock	0.35%	Watering	70%
DOZER-HRS	Unpaved	Bulldozer	1	12	4,380	1.65	0.22	0.17	1.65	0.22	0.17	Clark Waste Rock	0.57%	Watering	70%
DOZER-TSF	Unpaved	Bulldozer	1	12	4,380	4.09	0.86	0.43	4.09	0.86	0.43	Tailings	0.43%	No Control	0%
DOZER-EOS	Unpaved	Bulldozer	1	12	4,380	1.65	0.22	0.17	1.65	0.22	0.17	Stope Ore & Developmental Ore	4.73%	Watering	70%

1. Assumed to operate 12 hours a day and 365 days a year.
2. Emission factors for bulldozers per Table 11.9-1, U.S. EPA AP-42, Section 11.9 (Western Surface Coal Mining), October 1998

PM = TSP = k * $\frac{5.7\ (s)^{1.2}}{(M)^{1.3}}$

PM10 = k * PM15 = k * $\frac{1.0\ (s)^{1.5}}{(M)^{1.4}}$

PM2.5 = k * TSP = k * $\frac{5.7\ (s)^{1.2}}{(M)^{1.3}}$

where k = Scaling factor

	PM	PM_{10}	$PM_{2.5}$
k =	1	0.75	0.105

Per AP-42, Table 11.9-1

s = Material silt content (%)

1.6 Rock silt content assumed as to be similar to Crushed limestone in Western Surface Coal Mining in AP-42, Section 13.2.4 (11/2006)

11 Tailings silt content assumed as to be similar to Taconite mining tailings in Western Surface Coal Mining in AP-42, Section 13.2.4 (11/2006)

M = Material moisture content (%)

11.80 for Tailings 4 for ore/rock

	PM	PM_{10}	$PM_{2.5}$
a =	5.7	1	5.7
b =	1.2	1.5	1.2
c =	1.3	1.4	1.3

3. At South32, watering will be performed to sufficiently to achieve a control efficiency of 70%

Table A-25b. Roads -Dozer - Controlled Emissions

Emission Point No.	Road Surface	Equipment	Controlled Emissions [1,2]											Uncontrolled Emissions (tpy)			
			Hourly (lb/hr)				Daily (lb/day)				Annual (tpy)				Annual (tpy)			
			PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead
DOZER-WRS	Unpaved	Bulldozer	0.50	0.07	0.05	1.76E-03	5.95	0.78	0.62	0.02	1.09	0.14	0.11	3.84E-03	3.62	0.48	0.38	1.28E-02
DOZER-HRS	Unpaved	Bulldozer	0.50	0.07	0.052	2.81E-03	5.95	0.78	0.62	0.03	1.09	0.14	0.11	6.15E-03	3.62	0.48	0.38	2.05E-02
DOZER-TSF	Unpaved	Bulldozer	4.09	0.86	0.430	1.74E-02	49.12	10.37	5.16	0.21	8.96	1.89	0.94	3.82E-02	8.96	1.89	0.94	3.82E-02
DOZER-EOS	Unpaved	Bulldozer	0.50	0.07	0.052	2.35E-02	5.95	0.78	0.62	0.28	1.09	0.14	0.11	5.14E-02	3.62	0.48	0.38	1.71E-01

1. Controlled hourly and daily emissions calculated based on short term emission factors and control efficiency.
2. Controlled annual emissions calculated based on long term emission factors and control efficiency.

Table A-26a. South32 Hermosa non-fuel Tank Emissions Summary †

Tank ID	Max Capacity (gal)	Stock	Losses (tpy)			Speciated HAP Emissions (tpy)			Total HAP (tpy)
			Standing	Working	Total VOC	Cresol	Ethylene Glycol Dimethyl Ether	Urethane	
TNK-040 [1]	5,283	F549/MIBC	0.166	0.122	0.289	-	0.262	-	0.262
TNK-041 [2]	2,642	3407-A	4.65E-04	1.02E-03	1.48E-03	9.52E-05	-	-	9.52E-05
TNK-044 [3]	2,642	Solvay 5100	6.26E-03	8.67E-03	1.49E-02	-	-	3.67E-05	3.67E-05
TNK-045	2,642	Copper Sulphate	No VOC Emissions			No HAPs Emissions			
TNK-046	3,963	Copper Sulphate							
TNK-047	17,171	Zinc Sulphate							
TNK-048	1,320	Zinc Sulphate							
TNK-051	0	Zinc Cyanide							
TNK-052	1,000	Zinc Cyanide							
TNK-053	5,000	SMBS							
TNK-054	5,000	SMBS							
TNK-057	12,000	Tailings Flocculant (SNF AN910-VHM)							
TNK-058	1,000	Tailings Flocculant (SNF AN910-VHM)							
TNK-059	1,000	Tailings Flocculant (SNF AN910-VHM)							
TNK-060	10,000	3418-A	2.14E-05	1.68E-04	1.90E-04				
TNK-061	10,000	Shaft ANE	1.43E-04	9.54E-05	2.38E-04				
Total			**0.17**	**0.13**	**0.31**	**9.52E-05**	**0.262**	**3.67E-05**	**0.263**

† Based on the SDS for tanks TNK-045 through TNK-059, there are no VOC or HAP emissions associated witht these tanks.

1. This tank contains a 50/50 mixture of MIBC and F-549. F-549 is comprised of "mixed glycol ethers" according to Section 3 of the SDS. As such, it was conservatively modeled as 100% ethylene glycol dimethyl ether (1,2-dimethoxyethane), the lightest glycol ether.

2. The "test reagent" is not always the same stock, so a representative chemical, 3407-A, was used to estimate tank emissions. "Dithiophosphate" and "modified dithiophosphinate" listed in Section 3 of the SDS are assumed to be sodium diisobutyldithiophosphinate. Due to the unavailablity for Antoine coefficients of this chemical, the A and B coefficients for No. 6 fuel oil are used as a conservative estimate.

3. Due to unavailability of Antoine coefficients for the majority constituent chemical (Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester), the vapor pressure given in the SDS was assumed to be constant to generate usable Antoine coefficients.

Table A-26b. Diesel & Gasoline Storage Tanks - VOC Emissions

Tank ID	Max Capacity (gal)	Stock	VOC Emissions [1]	
			(lb/yr)	(tpy)
T-01	1,000	Unleaded Gasoline (S32)	750.03	0.38
T-02	5,000	Diesel (Red Dyed S32)	3.27	1.64E-03
T-03	5,000	Diesel (Red Dyed S32)	3.27	1.64E-03
T-04	12,000	Diesel (Red Dyed Rummel)	4.08	2.04E-03
T-05	1,000	Unleaded Gasoline (Rummel)	650.59	0.33
T-06	1,000	Diesel (Rummel)	0.95	4.74E-04
T-07	10,000	Unleaded Gasoline	3831.10	1.92
T-08	10,000	Unleaded Gasoline	3831.10	1.92
T-09	10,000	Unleaded Gasoline	3831.10	1.92
T-10	50,000	Diesel	78.34	0.04
T-11	50,000	Diesel	71.75	3.59E-02
Total VOC			**13,055.59**	**6.53**
Max VOC			**3831.10**	**1.92**

1. VOC Emissions per EPA-approved TankESP Software (AP-42 Chapter 7.1, June 2020)

Table A-26c. Diesel & Gasoline Storage Tanks - HAP Weight Percent's

Tank ID	Stock	HAP Liquid Weight Percent's [1]									
		Benzene	Benzo(g,h,i)perylene	Cumene	Ethylbenzene	Hexane	Iso-octane (2,2,4-Trimethylpentane)	Naphthalene	PAC's	Toluene	Xylene
T-01	Unleaded Gasoline (S32)	1.80%	0.00%	0.50%	1.40%	1.00%	4.00%	0.42%	0.00%	7.00%	7.00%
T-02	Diesel (Red Dyed S32)	0.0008%	0.0009%	--	0.01%	0.0001%	--	0.08%	0.002%	0.03%	0.29%
T-03	Diesel (Red Dyed S32)	0.0008%	0.0009%	--	0.01%	0.0001%	--	0.08%	0.002%	0.03%	0.29%
T-04	Diesel (Red Dyed Rummel)	0.0008%	0.0009%	--	0.01%	0.0001%	--	0.08%	0.002%	0.03%	0.29%
T-05	Unleaded Gasoline (Rummel)	1.80%	0.00%	0.50%	1.40%	1.00%	4.00%	0.42%	0.00%	7.00%	7.00%
T-06	Diesel (Rummel)	0.0008%	0.0009%	--	0.01%	0.0001%	--	0.080%	0.002%	0.030%	0.290%
T-07	Unleaded Gasoline	1.80%	0.00%	0.50%	1.40%	1.00%	4.00%	0.42%	0.00%	7.00%	7.00%
T-08	Unleaded Gasoline	1.80%	0.00%	0.50%	1.40%	1.00%	4.00%	0.42%	0.00%	7.00%	7.00%
T-09	Unleaded Gasoline	1.80%	0.00%	0.50%	1.40%	1.00%	4.00%	0.42%	0.00%	7.00%	7.00%
T-10	Diesel	0.0008%	0.0009%	--	0.01%	0.0001%	--	0.08%	0.002%	0.03%	0.29%
T-11	Diesel	0.0008%	0.0009%	--	0.01%	0.0001%	--	0.08%	0.002%	0.03%	0.29%

1. Speciation data for each HAP is based on individual content speciation.

Table A-26d. Diesel and Gasoline Storage Tanks - HAP Emissions (lb/yr)

Tank ID	Stock	HAP Emissions (lb/yr) [1]										
		Benzene	Benzo(g,h,i)perylene	Cumene	Ethylbenzene	Hexane	Isooctane	Naphthalene	PAC's	Toluene	Xylene	Total HAPs
T-01	Unleaded Gasoline (S32)	4.05E+00	2.98E-16	5.19E-02	3.05E-01	3.05E-01	4.64E+00	2.36E-03	2.36E-03	4.64E+00	1.33E+00	15.33
T-02	Diesel (Red Dyed S32)	6.39E-03	3.20E-15	0.00E+00	1.01E-02	1.01E-02	0.00E+00	1.54E-03	1.54E-03	7.54E-02	1.96E-01	0.30
T-03	Diesel (Red Dyed S32)	6.39E-03	3.20E-15	0.00E+00	1.01E-02	1.01E-02	0.00E+00	1.54E-03	1.54E-03	7.54E-02	1.96E-01	0.30
T-04	Diesel (Red Dyed Rummel)	7.96E-03	4.02E-15	0.00E+00	1.25E-02	1.25E-02	0.00E+00	1.92E-03	1.92E-03	9.40E-02	2.45E-01	0.38
T-05	Unleaded Gasoline (Rummel)	3.51E+00	2.59E-16	4.50E-02	2.64E-01	2.64E-01	4.03E+00	2.05E-03	2.05E-03	4.03E+00	1.16E+00	13.30
T-06	Diesel (Rummel)	1.85E-03	9.22E-16	0.00E+00	2.91E-03	2.91E-03	0.00E+00	4.45E-04	4.45E-04	2.18E-02	5.68E-02	0.09
T-07	Unleaded Gasoline	2.07E+01	1.52E-15	2.65E-01	1.56E+00	1.56E+00	2.37E+01	1.21E-02	1.21E-02	2.37E+01	6.80E+00	78.31
T-08	Unleaded Gasoline	2.07E+01	1.52E-15	2.65E-01	1.56E+00	1.56E+00	2.37E+01	1.21E-02	1.21E-02	2.37E+01	6.80E+00	78.31
T-09	Unleaded Gasoline	2.07E+01	1.52E-15	2.65E-01	1.56E+00	1.56E+00	2.37E+01	1.21E-02	1.21E-02	2.37E+01	6.80E+00	78.31
T-10	Diesel	1.53E-01	7.72E-14	0.00E+00	2.41E-01	2.41E-01	0.00E+00	3.69E-02	3.69E-02	1.80E+00	4.69E+00	7.21
T-11	Diesel	1.40E-01	7.07E-14	0.00E+00	2.20E-01	2.20E-01	0.00E+00	3.38E-02	3.38E-02	1.65E+00	4.30E+00	6.60
Total HAPs		**6.99E+01**	**1.64E-13**	**8.92E-01**	**5.74E+00**	**5.74E+00**	**7.98E+01**	**1.17E-01**	**1.17E-01**	**8.35E+01**	**3.26E+01**	**278.42**
Max HAP		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**8.35E+01**	**-**	**-**

1. HAP emissions are calculated based on the HAP weight percent of the content of the tank.

Table A-26e. Diesel and Gasoline Storage Tanks - HAP Emissions (tpy)

Tank ID	Stock	HAP Emissions (tpy)										
		Benzene	Benzo(g,h,i)perylene	Cumene	Ethylbenzene	Hexane	Isooctane	Naphthalene	PAC's	Toluene	Xylene	Total HAPs
T-01	Unleaded Gasoline (S32)	2.02E-03	1.49E-19	2.59E-05	1.52E-04	1.52E-04	2.32E-03	1.18E-06	1.18E-06	2.32E-03	6.66E-04	7.67E-03
T-02	Diesel (Red Dyed S32)	3.20E-06	1.60E-18	0.00E+00	5.03E-06	5.03E-06	0.00E+00	7.69E-07	7.69E-07	3.77E-05	9.81E-05	1.51E-04
T-03	Diesel (Red Dyed S32)	3.20E-06	1.60E-18	0.00E+00	5.03E-06	5.03E-06	0.00E+00	7.69E-07	7.69E-07	3.77E-05	9.81E-05	1.51E-04
T-04	Diesel (Red Dyed Rummel)	3.98E-06	2.01E-18	0.00E+00	6.27E-06	6.27E-06	0.00E+00	9.61E-07	9.61E-07	4.70E-05	1.22E-04	1.88E-04
T-05	Unleaded Gasoline (Rummel)	1.76E-03	1.29E-19	2.25E-05	1.32E-04	1.32E-04	2.01E-03	1.02E-06	1.02E-06	2.01E-03	5.78E-04	6.65E-03
T-06	Diesel (Rummel)	9.26E-07	4.61E-19	0.00E+00	1.46E-06	1.46E-06	0.00E+00	2.23E-07	2.23E-07	1.09E-05	2.84E-05	4.36E-05
T-07	Unleaded Gasoline	1.03E-02	7.62E-19	1.33E-04	7.78E-04	7.78E-04	1.19E-02	6.03E-06	6.03E-06	1.19E-02	3.40E-03	3.92E-02
T-08	Unleaded Gasoline	1.03E-02	7.62E-19	1.33E-04	7.78E-04	7.78E-04	1.19E-02	6.03E-06	6.03E-06	1.19E-02	3.40E-03	3.92E-02
T-09	Unleaded Gasoline	1.03E-02	7.62E-19	1.33E-04	7.78E-04	7.78E-04	1.19E-02	6.03E-06	6.03E-06	1.19E-02	3.40E-03	3.92E-02
T-10	Diesel	7.64E-05	3.86E-17	0.00E+00	1.20E-04	1.20E-04	0.00E+00	1.84E-05	1.84E-05	9.02E-04	2.35E-03	3.60E-03
T-11	Diesel	7.00E-05	3.54E-17	0.00E+00	1.10E-04	1.10E-04	0.00E+00	1.69E-05	1.69E-05	8.26E-04	2.15E-03	3.30E-03
Total HAPs		**3.50E-02**	**8.22E-17**	**4.46E-04**	**2.87E-03**	**2.87E-03**	**3.99E-02**	**5.84E-05**	**5.84E-05**	**4.17E-02**	**1.63E-02**	**1.39E-01**
Max HAP		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**4.17E-02**	**-**	**-**

Table A-27. South32 Hermosa Process Tanks Emission Summary

Tank	Equipment Description	CAS #	Chemical	VOC?	HAP?	Pure Component Molecular Weight M (lb/lbmol)	Pure Component Vapor Pressure P (psia)	Henry's Law Solubility Constant H^{cc}_{v} (Dimensionless)	Henry's Law Solubility Constant H^{px}_{v} (psi/mol% liq)	Liquid Mol% Liq. mol% (mol%liq)	Liquid Temperature T (K)	Liquid Surface Area A (ft2)	Pure Component Mass Transfer Coefficient K (ft/hr)	Vapor Partial Pressure pp (psia)	Hourly Emission Rate [1,2] E (hourly) (lb/hr)	Annual Emissions [1,2] E (annual) (lb/yr)	(tpy)
22310-FC-00001	Lead Rougher	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	207.74	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	2.63E-06	301.54	207.74	54.97	3.82E-05	0.02	123.32	0.06
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	1.16E-06	301.54	207.74	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	0.00E+00	301.54	207.74	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	0.00E+00	301.54	207.74	61.19	0.00E+00	0.00	0.00	0.00
22310-FC-00004	Lead Rougher Scavenger	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	207.74	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	2.59E-06	301.54	207.74	54.97	3.76E-05	0.02	121.38	0.06
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	1.14E-06	301.54	207.74	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	0.00E+00	301.54	207.74	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	0.00E+00	301.54	207.74	61.19	0.00E+00	0.00	0.00	0.00
22310-FC-00008	Lead Cleaner Scalper	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	73.19	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	2.30E-05	301.54	73.19	54.97	3.34E-04	0.05	380.65	0.19
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	1.01E-05	301.54	73.19	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	0.00E+00	301.54	73.19	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	0.00E+00	301.54	73.19	61.19	0.00E+00	0.00	0.00	0.00
22310-FC-00007	Lead Cleaner	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	73.19	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	1.97E-05	301.54	73.19	54.97	2.87E-04	0.04	326.11	0.16
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	8.68E-06	301.54	73.19	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	0.00E+00	301.54	73.19	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	0.00E+00	301.54	73.19	61.19	0.00E+00	0.00	0.00	0.00
22310-FC-00009	Lead Cleaner Scavenger	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	73.19	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	1.84E-05	301.54	73.19	54.97	2.67E-04	0.04	303.85	0.15
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	8.08E-06	301.54	73.19	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	0.00E+00	301.54	73.19	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	0.00E+00	301.54	73.19	61.19	0.00E+00	0.00	0.00	0.00
22310-FC-00005	Zinc Rougher	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	207.74	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	4.74E-06	301.54	207.74	54.97	6.88E-05	0.03	222.26	0.11
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	0.00E+00	301.54	207.74	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	7.37E-06	301.54	207.74	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	2.35E-06	301.54	207.74	61.19	4.27E-06	1.38E-03	11.12	0.01
22310-FC-00006	Zinc Rougher Scavenger	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	207.74	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	4.63E-06	301.54	207.74	54.97	6.72E-05	0.03	217.22	0.11
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	0.00E+00	301.54	207.74	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	7.21E-06	301.54	207.74	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	2.30E-06	301.54	207.74	61.19	4.17E-06	1.35E-03	10.87	0.01
22310-FC-00011	Zinc Cleaner Scalper	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	124.86	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	8.12E-06	301.54	124.86	54.97	1.18E-04	0.03	229.12	0.11
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	0.00E+00	301.54	124.86	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	1.26E-05	301.54	124.86	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	4.03E-06	301.54	124.86	61.19	7.32E-06	1.42E-03	11.47	0.01
22310-FC-00010	Zinc Cleaner	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	124.86	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	6.88E-06	301.54	124.86	54.97	1.00E-04	0.02	194.10	0.10
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	0.00E+00	301.54	124.86	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	1.07E-05	301.54	124.86	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	3.42E-06	301.54	124.86	61.19	6.20E-06	1.21E-03	9.71	4.86E-03
22310-FC-00012	Zinc Cleaner Scavenger	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	124.86	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	6.41E-06	301.54	124.86	54.97	9.31E-05	0.02	180.70	0.09
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	0.00E+00	301.54	124.86	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	9.97E-06	301.54	124.86	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	3.18E-06	301.54	124.86	61.19	5.77E-06	1.12E-03	9.04	4.52E-03
22430-TN-00001	Lead Concentrate Tank	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	1,017.00	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	5.14E-05	301.54	1,017.00	54.97	7.47E-04	1.47	11819.26	5.91
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	4.72E-06	301.54	1,017.00	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	2.93E-05	301.54	1,017.00	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	9.33E-06	301.54	1,017.00	61.19	1.69E-05	0.03	216.05	0.11
22430-TN-00002	Zinc Concentrate Tank	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	1,257.00	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	5.26E-05	301.54	1,257.00	54.97	7.64E-04	1.85	14931.99	7.47
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	4.82E-06	301.54	1,257.00	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	2.99E-05	301.54	1,257.00	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	9.53E-06	301.54	1,257.00	61.19	1.73E-05	0.03	272.95	0.14
22310-TN-00003	Lead Conditioning Tank	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	294.07	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	1.52E-05	301.54	294.07	54.97	2.21E-04	0.13	1008.48	0.50
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	3.99E-06	301.54	294.07	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	0.00E+00	301.54	294.07	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	0.00E+00	301.54	294.07	61.19	0.00E+00	0.00	0.00	0.00
22310-TN-00001	Zinc Conditioning Tank No. 1	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	330.06	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	7.27E-06	301.54	330.06	54.97	1.06E-04	0.07	542.33	0.27
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	1.33E-06	301.54	330.06	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	8.27E-06	301.54	330.06	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	2.64E-06	301.54	330.06	61.19	4.79E-06	2.46E-03	19.83	0.01
22310-TN-00002	Zinc Conditioning Tank No. 2	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	330.06	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	7.27E-06	301.54	330.06	54.97	1.06E-04	0.07	542.33	0.27
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	1.33E-06	301.54	330.06	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	8.27E-06	301.54	330.06	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	2.64E-06	301.54	330.06	61.19	4.79E-06	2.46E-03	19.83	0.01
															3.94	31723.98	15.86

Process Tank Emission Calculation Notes

Emission Factors calculated using:
Ref: Section 3.7.1 - Evaporation from an Open Top Vessel or a Spill
Methods for Estimating Air Emissions from Chemical Manufacturing Facilities, Vol. II Chapter 16
STAPPA/ALAPCO/EPA EIIP, August 2007

E	Hourly or Annual Emission Rate, lb/hr or lb/yr [3]	=(M K A P) / (R T)
M	Molecular Weight, lb/lb-mol	See Table
K	Mass Transfer Coefficient, ft/hr [4]	$= K_0 (M_0/M)^{1/3}$
K_0	Reference Mass Transfer Coefficient of Water, ft/hr	0.83
M_0	Molecular Weight of Water, lb/lb-mol	18.02
A	Liquid Surface Area, ft2	See Table
P	Vapor Pressure, psia	See Table
T	Liquid temperature, °R [5]	542.77
R	Ideal Gas Constant, Psia-ft^3/lb-mole °R [6]	10.73159
H	Annual Hours of Operations, hrs/yr [7]	8060
H^{pa}_v	Henry's Law Volatility Constant, psi/(mol%)$_{aq}$ [8]	$= H^{cc}_v$ x R x T x d(solv) / M(solv)
pp^a	Gas Partial Pressure using Henry's Law Constant, psi	= Liq Mol% * H^{pp}_v
H^{cc}_v	Henry's Law Volatility Constant, Dimensionless [9]	See Table
M(solv)	Mol. Wt. of Solvent, lb/lb-mol [10]	18.02
d(solv)	Density of Solvent, lb/ft^3 [10]	62.42771972

1. 100% Safety factor added while calculating emission rate to account for any atomization from material movement at the surface, such as spraying
2. Emissions from low volatile compounds (sodium diisobutyldithiophosphinate & Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester) assumed to be negligible.
3. EIIP, Vol. II, Ch. 16, Eq. 3-24
4. EIIP, Vol. II, Ch. 16, Eq. 3-27
5. For conservative estimate - Hourly Average Max. Ambient Temperature for Tucson, AZ. As per AP 42 Section 7.1, Table 7.1-7 (Jun, 2020) is used
6. Table 1-9 Perry's Chemical Engineers' Handbook, 6th ed.
7. Provided by South32
8. Referenced from https://www.degruyter.com/document/doi/10.1515/pac-2020-0302/html?lang=en
9. Referenced from Toxchem 4.4 Mar-25-2019
10. Assume as water

Table A-28. Taylor Emission Factor Inputs

Road Surface	Max Miles Traveled Per Unit			Vehicle Type	Vehicle Model	Max Vehicle Count	Particulate Matter Emission Factor Inputs [1]											
							k			Avg. W		s	P	a			b		
	Day	Month	Year				PM	PM_{10}	$PM_{2.5}$	(kg)	(ton)	(%)	(days/yr)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Unpaved	2	60.83	730	Dev Drill Rig	DD422i	3	4.9	1.5	0.15	26,000	28.66	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Support Drill Rig	DS412i	5	4.9	1.5	0.15	29,000	31.97	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Cable bolter	DS421	2	4.9	1.5	0.15	25,000	27.56	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	LHD (LH517i)	LH517i	2	4.9	1.5	0.15	46,500	51.26	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	20	608.33	7300	Haul Truck	TH551i	4	4.9	1.5	0.15	97,870	107.88	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Scissor lift	Utilift MF 540	2	4.9	1.5	0.15	13,100	14.44	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Light vehicle (general usage) Fleet 1	Mahindra Roxor	2	4.9	1.5	0.15	1,678	1.85	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Charging Rig Fleet 1	Charmec MF 605 D(V)	2	4.9	1.5	0.15	14,600	16.09	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	1	30.42	365	LH Rigs	DL422i	6	4.9	1.5	0.15	22,000	24.25	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	1	30.42	365	LH Rig (Ore Passes/Geo)	DL422i	1	4.9	1.5	0.15	22,000	24.25	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	LHD (LH518B)	LH518B	5	4.9	1.5	0.15	70,000	77.16	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	20	608.33	7300	Haul Trucks (Haul Loop)	TH663i	3	4.9	1.5	0.15	111,440	122.84	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	20	608.33	7300	Haul Trucks	TH663i	5	4.9	1.5	0.15	111,440	122.84	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	6	182.50	2190	Material transporter	Multimec MF100	2	4.9	1.5	0.15	22,200	24.47	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	4	121.67	1460	Light vehicle (general usage) Fleet 2	Mahindra Roxor	2	4.9	1.5	0.15	1,678	1.85	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Charging Rig Fleet 2	Charmec MF 605 D(V)	2	4.9	1.5	0.15	14,600	16.09	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	6	182.50	2190	Personnel transporter	Utimec MF 205 PER	3	4.9	1.5	0.15	15,200	16.76	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Shotcreter	Spraymec MF 050 D(V)	2	4.9	1.5	0.15	18,000	19.84	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.67	5840	Transmixer	Utimec MF 500	4	4.9	1.5	0.15	22,200	24.47	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	6	182.50	2190	Water vehicle	MF 350 Water	2	4.9	1.5	0.15	15,700	17.31	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	0.0027	0.08	1	Mobile rockbreaker	Maclean RB3	3	4.9	1.5	0.15	17,700	19.51	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	6	182.50	2190	Grader	Maclean GR5	2	4.9	1.5	0.15	18,200	20.06	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	1	30.42	365	Skid Steer	Manitou 4200 V	3	4.9	1.5	0.15	5,291	5.83	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Light vehicle (tech services)	Mahindra Roxor	4	4.9	1.5	0.15	1,678	1.85	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	6	182.50	2190	Material transporter (logistics/Construct)	Multimec MF100	2	4.9	1.5	0.15	22,200	24.47	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	6	182.50	2190	Scissor lift (Construction)	Utilift MF 540	2	4.9	1.5	0.15	13,100	14.44	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Telehandler	GTH - 1056	3	4.9	1.5	0.15	14,470	15.95	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	4	121.67	1460	Maintenance Vehicle	Maclean FL3	3	4.9	1.5	0.15	33,000	36.38	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	8	243.33	2920	Fuel/Lube vehicle	Maclean FL3	2	4.9	1.5	0.15	33,000	36.38	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	0.1	3.04	36.5	Mobile Grapple equipment	Brokk 900	3	4.9	1.5	0.15	11,600	12.79	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	1	30.42	365	Blind Bore Machine	Rhino	2	4.9	1.5	0.15	52,000	57.32	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45

[1] Emission factors for vehicular traffic on unpaved roads per U.S. EPA AP-42, Section 13.2.2 (Unpaved Roads), November 2006.

Short-Term $E = k\,(s/12)^a (W/3)^b$ (1a)

Annual $E_{ext} = E\,[(365 - P)/365]$ (2)

where E = Size-specific emission factor (lb/VMT)

k, a, b = Constants for equation 1a

	PM	PM_{10}	$PM_{2.5}$
k =	4.9	1.5	0.15
a =	0.7	0.9	0.9
b =	0.45	0.45	0.45

Per AP-42 Table 13.2.2-2, November 2006

s = surface material silt content (%), per AP-42 Table 13.2.2-1, 11/06, Western surface coal mining Plant Road
5.1

W = Mean vehicle weight (tons)

P = Days per year with at least 0.01 inch precipitation, based on precipitation data from 2019-2021 for Hermosa Trench Met Station, using the lowest annual value between 2019-2021.
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Table A-29. Taylor Underground Roads - Emission Factors

Road Surface	Vehicle Type	Averaging Period	Emission Factor [1]				Process Rate Unit	Particulate Matter Emission Factor Inputs [1]												Reference
								k			W	s	P	a			b			
			PM	PM_{10}	$PM_{2.5}$	Unit		PM	PM_{10}	$PM_{2.5}$	(ton)	(%)	(days/yr)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	
Unpaved	Dev Drill Rig	Hourly/Daily	7.43	1.92	0.19	lb/VMT	VMT	4.90	1.50	0.15	28.66	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Dev Drill Rig	Annual	6.17	1.59	0.16	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Support Drill Rig	Hourly/Daily	7.81	2.01	0.20	lb/VMT	VMT	4.90	1.50	0.15	31.97	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Support Drill Rig	Annual	6.48	1.67	0.17	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Cable bolter	Hourly/Daily	7.30	1.88	0.19	lb/VMT	VMT	4.90	1.50	0.15	27.56	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Cable bolter	Annual	6.06	1.56	0.16	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	LHD (LH517i)	Hourly/Daily	9.66	2.49	0.25	lb/VMT	VMT	4.90	1.50	0.15	51.26	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	LHD (LH517i)	Annual	8.02	2.07	0.21	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Haul Truck	Hourly/Daily	13.50	3.48	0.35	lb/VMT	VMT	4.90	1.50	0.15	107.88	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Haul Truck	Annual	11.20	2.89	0.29	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Scissor lift	Hourly/Daily	5.46	1.41	0.14	lb/VMT	VMT	4.90	1.50	0.15	14.44	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Scissor lift	Annual	4.53	1.17	0.12	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Light vehicle (general usage) Fleet 1	Hourly/Daily	2.17	0.56	0.06	lb/VMT	VMT	4.90	1.50	0.15	1.85	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Light vehicle (general usage) Fleet 1	Annual	1.80	0.46	0.05	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Charging Rig Fleet 1	Hourly/Daily	5.73	1.48	0.15	lb/VMT	VMT	4.90	1.50	0.15	16.09	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Charging Rig Fleet 1	Annual	4.76	1.23	0.12	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	LH Rigs	Hourly/Daily	6.89	1.78	0.18	lb/VMT	VMT	4.90	1.50	0.15	24.25	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	LH Rigs	Annual	5.72	1.48	0.15	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	LH Rig (Ore Passes/Geo)	Hourly/Daily	6.89	1.78	0.18	lb/VMT	VMT	4.90	1.50	0.15	24.25	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	LH Rig (Ore Passes/Geo)	Annual	5.72	1.48	0.15	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	LHD (LH518B)	Hourly/Daily	11.61	2.99	0.30	lb/VMT	VMT	4.90	1.50	0.15	77.16	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	LHD (LH518B)	Annual	9.63	2.49	0.25	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Haul Trucks (Haul Loop)	Hourly/Daily	14.31	3.69	0.37	lb/VMT	VMT	4.90	1.50	0.15	122.84	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Haul Trucks (Haul Loop)	Annual	11.88	3.06	0.31	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Haul Trucks	Hourly/Daily	14.31	3.69	0.37	lb/VMT	VMT	4.90	1.50	0.15	122.84	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Haul Trucks	Annual	11.88	3.06	0.31	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Material transporter	Hourly/Daily	6.92	1.79	0.18	lb/VMT	VMT	4.90	1.50	0.15	24.47	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Material transporter	Annual	5.75	1.48	0.15	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Light vehicle (general usage) Fleet 2	Hourly/Daily	2.17	0.56	0.06	lb/VMT	VMT	4.90	1.50	0.15	1.85	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Light vehicle (general usage) Fleet 2	Annual	1.80	0.46	0.05	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Charging Rig Fleet 2	Hourly/Daily	5.73	1.48	0.15	lb/VMT	VMT	4.90	1.50	0.15	16.09	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	AP-42, Section 13.2.2, Expression 1a (11/06)
Unpaved	Charging Rig Fleet 2	Annual	4.76	1.23	0.12	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	AP-42, Section 13.2.2, Expressions 1a and 2 (11/06)
Unpaved	Personnel transporter	Hourly/Daily	5.84	1.51	0.15	lb/VMT	VMT	4.90	1.50	0.15	16.76	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Personnel transporter	Annual	4.85	1.25	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Shotcreter	Hourly/Daily	6.30	1.62	0.16	lb/VMT	VMT	4.90	1.50	0.15	19.84	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Shotcreter	Annual	5.23	1.35	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Transmixer	Hourly/Daily	6.92	1.79	0.18	lb/VMT	VMT	4.90	1.50	0.15	24.47	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Transmixer	Annual	5.75	1.48	0.15	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Water vehicle	Hourly/Daily	5.92	1.53	0.15	lb/VMT	VMT	4.90	1.50	0.15	17.31	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Water vehicle	Annual	4.92	1.27	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Mobile rockbreaker	Hourly/Daily	6.25	1.61	0.16	lb/VMT	VMT	4.90	1.50	0.15	19.51	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Mobile rockbreaker	Annual	5.19	1.34	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Grader	Hourly/Daily	6.33	1.63	0.16	lb/VMT	VMT	4.90	1.50	0.15	20.06	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Grader	Annual	5.26	1.36	0.14	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Skid Steer	Hourly/Daily	3.63	0.94	0.09	lb/VMT	VMT	4.90	1.50	0.15	5.83	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Skid Steer	Annual	3.01	0.78	0.08	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Light vehicle (tech services)	Hourly/Daily	2.17	0.56	0.06	lb/VMT	VMT	4.90	1.50	0.15	1.85	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Light vehicle (tech services)	Annual	1.80	0.46	0.05	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Material transporter (logistics/Construct)	Hourly/Daily	6.92	1.79	0.18	lb/VMT	VMT	4.90	1.50	0.15	24.47	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Material transporter (logistics/Construct)	Annual	5.75	1.48	0.15	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Scissor lift (Construction)	Hourly/Daily	5.46	1.41	0.14	lb/VMT	VMT	4.90	1.50	0.15	14.44	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Scissor lift (Construction)	Annual	4.53	1.17	0.12	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Telehandler	Hourly/Daily	5.71	1.47	0.15	lb/VMT	VMT	4.90	1.50	0.15	15.95	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Telehandler	Annual	4.74	1.22	0.12	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Maintenance Vehicle	Hourly/Daily	8.27	2.13	0.21	lb/VMT	VMT	4.90	1.50	0.15	36.38	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Maintenance Vehicle	Annual	6.87	1.77	0.18	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Fuel/Lube vehicle	Hourly/Daily	8.27	2.13	0.21	lb/VMT	VMT	4.90	1.50	0.15	36.38	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Fuel/Lube vehicle	Annual	6.87	1.77	0.18	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Mobile Grapple equipment	Hourly/Daily	5.17	1.33	0.13	lb/VMT	VMT	4.90	1.50	0.15	12.79	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Mobile Grapple equipment	Annual	4.29	1.11	0.11	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Blind Bore Machine	Hourly/Daily	10.15	2.62	0.26	lb/VMT	VMT	4.90	1.50	0.15	57.32	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Blind Bore Machine	Annual	8.43	2.17	0.22	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	

[1] Emission factors for vehicular traffic on unpaved roads per U.S. EPA AP-42, Section 13.2.2 (Unpaved Roads), November 2006.

Short-Term $E = k\,(s/12)^{a}(W/3)^{b}$ (1a)

Annual $E_{ext} = E\,[(365 - P)/365]$ (2)

where E = Size-specific emission factor (lb/VMT) (Per AP-42 Table 13.2.2-2, November 2006)

k, a, b = Constants for equation 1a

	PM	PM_{10}	$PM_{2.5}$
k =	4.9	1.5	0.15
a =	0.7	0.9	0.9
b =	0.45	0.45	0.45

s = surface material silt content (%) (Silt content assumed as to be similar to Plant Road in Western Surface Coal Mining in AP-42, Section 13.2.4 (11/2006) per conversation with AMI, 10/14/22)
5.1

W = Mean vehicle weight (tons)

P = 62 Days per year with at least 0.01 inch precipitation, based on precipitation data from 2019-2021 for Hermosa Trench Met Station, using the lowest annual value between 2019-2021.

Table A-30a. Taylor Roads - Vehicles - Input Parameters

Road Surface	Vehicle Type	Trip Type	Number of Vehicles	Trip Distance (miles/vehicle/day)	Vehicle Miles Travelled (VMT)			Uncontrolled Emission Factor (lb/VMT)						Control	
								Short Term			Long Term			Type	Efficiency [1,2]
					(VMT/hr)	(VMT/day)	(VMT/yr)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$		(%)
Unpaved	Dev Drill Rig	Round	3	2	0.250	6.00	2,190	7.43	1.92	0.19	6.17	1.59	0.16	Watering	90%
Unpaved	Support Drill Rig	Round	5	2	0.417	10.00	3,650	7.81	2.01	0.20	6.48	1.67	0.17	Watering	90%
Unpaved	Cable bolter	Round	2	2	0.167	4.00	1,460	7.30	1.88	0.19	6.06	1.56	0.16	Watering	90%
Unpaved	LHD (LH517i)	Round	2	2	0.167	4.00	1,460	9.66	2.49	0.25	8.02	2.07	0.21	Watering	90%
Unpaved	Haul Truck	Round	4	20	3.333	80.00	29,200	13.50	3.48	0.35	11.20	2.89	0.29	Watering	90%
Unpaved	Scissor lift	Round	2	2	0.167	4.00	1,460	5.46	1.41	0.14	4.53	1.17	0.12	Watering	90%
Unpaved	Light vehicle (general usage) Fleet 1	Round	2	2	0.167	4.00	1,460	2.17	0.56	0.06	1.80	0.46	0.05	Watering	90%
Unpaved	Charging Rig Fleet 1	Round	2	2	0.167	4.00	1,460	5.73	1.48	0.15	4.76	1.23	0.12	Watering	90%
Unpaved	LH Rigs	Round	6	1	0.250	6.00	2,190	6.89	1.78	0.18	5.72	1.48	0.15	Watering	90%
Unpaved	LH Rig (Ore Passes/Geo)	Round	1	1	0.042	1.00	365	6.89	1.78	0.18	5.72	1.48	0.15	Watering	90%
Unpaved	LHD (LH518B)	Round	5	2	0.417	10.00	3,650	11.61	2.99	0.30	9.63	2.49	0.25	Watering	90%
Unpaved	Haul Trucks (Haul Loop)	Round	3	20	2.500	60.00	21,900	14.31	3.69	0.37	11.88	3.06	0.31	Watering	90%
Unpaved	Haul Trucks	Round	5	20	4.167	100.00	36,500	14.31	3.69	0.37	11.88	3.06	0.31	Watering	90%
Unpaved	Material transporter	Round	2	6	0.500	12.00	4,380	6.92	1.79	0.18	5.75	1.48	0.15	Watering	90%
Unpaved	Light vehicle (general usage) Fleet 2	Round	2	4	0.333	8.00	2,920	2.17	0.56	0.06	1.80	0.46	0.05	Watering	90%
Unpaved	Charging Rig Fleet 2	Round	2	2	0.167	4.00	1,460	5.73	1.48	0.15	4.76	1.23	0.12	Watering	90%
Unpaved	Personnel transporter	Round	3	6	0.750	18.00	6,570	5.84	1.51	0.15	4.85	1.25	0.13	Watering	90%
Unpaved	Shotcreter	Round	2	2	0.167	4.00	1,460	6.30	1.62	0.16	5.23	1.35	0.13	Watering	90%
Unpaved	Transmixer	Round	4	16	2.667	64.00	23,360	6.92	1.79	0.18	5.75	1.48	0.15	Watering	90%
Unpaved	Water vehicle	Round	2	6	0.500	12.00	4,380	5.92	1.53	0.15	4.92	1.27	0.13	Watering	90%
Unpaved	Mobile rockbreaker	Round	3	0.0027	0.00034	0.01	3	6.25	1.61	0.16	5.19	1.34	0.13	Watering	90%
Unpaved	Grader	Round	2	6	0.500	12.00	4,380	6.33	1.63	0.16	5.26	1.36	0.14	Watering	90%
Unpaved	Skid Steer	Round	3	1	0.125	3.00	1,095	3.63	0.94	0.09	3.01	0.78	0.08	Watering	90%
Unpaved	Light vehicle (tech services)	Round	4	2	0.333	8.00	2,920	2.17	0.56	0.06	1.80	0.46	0.05	Watering	90%
Unpaved	Material transporter (logistics/Construct)	Round	2	6	0.500	12.00	4,380	6.92	1.79	0.18	5.75	1.48	0.15	Watering	90%
Unpaved	Scissor lift (Construction)	Round	2	6	0.500	12.00	4,380	5.46	1.41	0.14	4.53	1.17	0.12	Watering	90%
Unpaved	Telehandler	Round	3	2	0.250	6.00	2,190	5.71	1.47	0.15	4.74	1.22	0.12	Watering	90%
Unpaved	Maintenance Vehicle	Round	3	4	0.500	12.00	4,380	8.27	2.13	0.21	6.87	1.77	0.18	Watering	90%
Unpaved	Fuel/Lube vehicle	Round	2	8	0.667	16.00	5,840	8.27	2.13	0.21	6.87	1.77	0.18	Watering	90%
Unpaved	Mobile Grapple equipment	Round	3	0.1	0.013	0.30	110	5.17	1.33	0.13	4.29	1.11	0.11	Watering	90%
Unpaved	Blind Bore Machine	Round	2	1	0.083	2.00	730	10.15	2.62	0.26	8.43	2.17	0.22	Watering	90%

1. Road Watering is not contemplated every hour, but only as needed to maintain control levels.

2. At South32, the roads will be watered sufficiently to achieve a control efficiency of 90%

Lead Content = 3.54E-03 kg/kg

Table A-30b. Taylor Roads -Vehicles - Emissions

Vehicle Type	Road Surface	Uncontrolled Emissions												Controlled Emissions									
		Hourly (lb/hr) [1]				Daily (lb/day) [1]				Annual (tpy) [2]				Hourly (lb/hr) [1]				Daily (lb/day) [1]				Annual (tpy) [2]			
		PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead
Dev Drill Rig	Unpaved	1.86	0.48	0.05	6.58E-03	44.60	11.50	1.15	0.16	6.76	1.74	0.17	0.02	0.19	0.05	0.00	6.58E-04	4.46	1.15	0.12	1.58E-02	0.68	0.17	0.02	2.39E-03
Support Drill Rig	Unpaved	3.25	0.84	0.08	0.01	78.07	20.14	2.01	0.28	11.83	3.05	0.31	0.04	0.33	0.08	0.01	1.15E-03	7.81	2.01	0.20	2.76E-02	1.18	0.31	0.03	4.19E-03
Cable bolter	Unpaved	1.22	0.31	0.03	4.31E-03	29.21	7.54	0.75	0.10	4.43	1.14	0.11	0.02	0.12	0.03	0.00	4.31E-04	2.92	0.75	0.08	1.03E-02	0.44	0.11	0.01	1.57E-03
LHD (LH517i)	Unpaved	1.61	0.42	0.04	5.70E-03	38.62	9.96	1.00	0.14	5.85	1.51	0.15	0.02	0.16	0.04	0.00	5.70E-04	3.86	1.00	0.10	1.37E-02	0.59	0.15	0.02	2.07E-03
Haul Truck	Unpaved	44.99	11.60	1.16	0.16	1079.65	278.52	27.85	3.82	163.57	42.20	4.22	0.58	4.50	1.16	0.12	1.59E-02	107.96	27.85	2.79	3.82E-01	16.36	4.22	0.42	5.79E-02
Scissor lift	Unpaved	0.91	0.23	0.02	3.22E-03	21.84	5.63	0.56	0.08	3.31	0.85	0.09	0.01	0.09	0.02	0.00	3.22E-04	2.18	0.56	0.06	7.73E-03	0.33	0.09	0.01	1.17E-03
Light vehicle (general usage) Fleet 1	Unpaved	0.36	0.09	0.01	1.28E-03	8.66	2.23	0.22	0.03	1.31	0.34	0.03	4.65E-03	0.04	0.01	0.00	1.28E-04	0.87	0.22	0.02	3.07E-03	0.13	0.03	0.00	4.65E-04
Charging Rig Fleet 1	Unpaved	0.96	0.25	0.02	3.38E-03	22.93	5.92	0.59	0.08	3.47	0.90	0.09	0.01	0.10	0.02	0.00	3.38E-04	2.29	0.59	0.06	8.12E-03	0.35	0.09	0.01	1.23E-03
LH Rigs	Unpaved	1.72	0.44	0.04	6.10E-03	41.37	10.67	1.07	0.15	6.27	1.62	0.16	0.02	0.17	0.04	0.00	6.10E-04	4.14	1.07	0.11	1.46E-02	0.63	0.16	0.02	2.22E-03
LH Rig (Ore Passes/Geo)	Unpaved	0.29	0.07	0.01	1.02E-03	6.89	1.78	0.18	0.02	1.04	0.27	0.03	3.70E-03	0.03	0.01	0.00	1.02E-04	0.69	0.18	0.02	2.44E-03	0.10	0.03	0.00	3.70E-04
LHD (LH518B)	Unpaved	4.84	1.25	0.12	0.02	116.06	29.94	2.99	0.41	17.58	4.54	0.45	0.06	0.48	0.12	0.01	1.71E-03	11.61	2.99	0.30	4.11E-02	1.76	0.45	0.05	6.23E-03
Haul Trucks (Haul Loop)	Unpaved	35.77	9.23	0.92	0.13	858.46	221.46	22.15	3.04	130.06	33.55	3.36	0.46	3.58	0.92	0.09	1.27E-02	85.85	22.15	2.21	3.04E-01	13.01	3.36	0.34	4.61E-02
Haul Trucks	Unpaved	59.62	15.38	1.54	0.21	1430.77	369.10	36.91	5.07	216.76	55.92	5.59	0.77	5.96	1.54	0.15	2.11E-02	143.08	36.91	3.69	5.07E-01	21.68	5.59	0.56	7.68E-02
Material transporter	Unpaved	3.46	0.89	0.09	0.01	83.07	21.43	2.14	0.29	12.59	3.25	0.32	0.04	0.35	0.09	0.01	1.23E-03	8.31	2.14	0.21	2.94E-02	1.26	0.32	0.03	4.46E-03
Light vehicle (general usage) Fleet 2	Unpaved	0.72	0.19	0.02	2.56E-03	17.33	4.47	0.45	0.06	2.62	0.68	0.07	9.29E-03	0.07	0.02	0.00	2.56E-04	1.73	0.45	0.04	6.14E-03	0.26	0.07	0.01	9.29E-04
Charging Rig Fleet 2	Unpaved	0.96	0.25	0.02	3.38E-03	22.93	5.92	0.59	0.08	3.47	0.90	0.09	0.01	0.10	0.02	0.00	3.38E-04	2.29	0.59	0.06	8.12E-03	0.35	0.09	0.01	1.23E-03
Personnel transporter	Unpaved	4.38	1.13	0.11	0.02	105.08	27.11	2.71	0.37	15.92	4.11	0.41	0.06	0.44	0.11	0.01	1.55E-03	10.51	2.71	0.27	3.72E-02	1.59	0.41	0.04	5.64E-03
Shotcreter	Unpaved	1.05	0.27	0.03	3.72E-03	25.20	6.50	0.65	0.09	3.82	0.98	0.10	0.01	0.10	0.03	0.00	3.72E-04	2.52	0.65	0.06	8.92E-03	0.38	0.10	0.01	1.35E-03
Transmixer	Unpaved	18.46	4.76	0.48	0.07	443.04	114.29	11.43	1.57	67.12	17.32	1.73	0.24	1.85	0.48	0.05	6.54E-03	44.30	11.43	1.14	1.57E-01	6.71	1.73	0.17	2.38E-02
Water vehicle	Unpaved	2.96	0.76	0.08	0.01	71.08	18.34	1.83	0.25	10.77	2.78	0.28	0.04	0.30	0.08	0.01	1.05E-03	7.11	1.83	0.18	2.52E-02	1.08	0.28	0.03	3.81E-03
Mobile rockbreaker	Unpaved	0.00	0.00	0.00	7.58E-06	0.05	0.01	0.00	1.82E-04	0.01	0.00	0.00	2.76E-05	0.00	0.00	0.00	7.58E-07	0.01	0.00	0.00	1.82E-05	0.00	0.00	0.00	2.76E-06
Grader	Unpaved	3.17	0.82	0.08	0.01	75.97	19.60	1.96	0.27	11.51	2.97	0.30	0.04	0.32	0.08	0.01	1.12E-03	7.60	1.96	0.20	2.69E-02	1.15	0.30	0.03	4.08E-03
Skid Steer	Unpaved	0.45	0.12	0.01	1.61E-03	10.89	2.81	0.28	0.04	1.65	0.43	0.04	5.84E-03	0.05	0.01	0.00	1.61E-04	1.09	0.28	0.03	3.86E-03	0.17	0.04	0.00	5.84E-04
Light vehicle (tech services)	Unpaved	0.72	0.19	0.02	2.56E-03	17.33	4.47	0.45	0.06	2.62	0.68	0.07	9.29E-03	0.07	0.02	0.00	2.56E-04	1.73	0.45	0.04	6.14E-03	0.26	0.07	0.01	9.29E-04
Material transporter (logistics/Construct)	Unpaved	3.46	0.89	0.09	0.01	83.07	21.43	2.14	0.29	12.59	3.25	0.32	0.04	0.35	0.09	0.01	1.23E-03	8.31	2.14	0.21	2.94E-02	1.26	0.32	0.03	4.46E-03
Scissor lift (Construction)	Unpaved	2.73	0.70	0.07	9.67E-03	65.52	16.90	1.69	0.23	9.93	2.56	0.26	0.04	0.27	0.07	0.01	9.67E-04	6.55	1.69	0.17	2.32E-02	0.99	0.26	0.03	3.51E-03
Telehandler	Unpaved	1.43	0.37	0.04	5.05E-03	34.26	8.84	0.88	0.12	5.19	1.34	0.13	0.02	0.14	0.04	0.00	5.05E-04	3.43	0.88	0.09	1.21E-02	0.52	0.13	0.01	1.84E-03
Maintenance Vehicle	Unpaved	4.14	1.07	0.11	0.01	99.29	25.61	2.56	0.35	15.04	3.88	0.39	0.05	0.41	0.11	0.01	1.47E-03	9.93	2.56	0.26	3.52E-02	1.50	0.39	0.04	5.33E-03
Fuel/Lube vehicle	Unpaved	5.52	1.42	0.14	0.02	132.39	34.15	3.42	0.47	20.06	5.17	0.52	0.07	0.55	0.14	0.01	1.95E-03	13.24	3.42	0.34	4.69E-02	2.01	0.52	0.05	7.10E-03
Mobile Grapple equipment	Unpaved	0.06	0.02	0.00	2.29E-04	1.55	0.40	0.04	5.49E-03	0.23	0.06	0.01	8.32E-04	0.01	0.00	0.00	2.29E-05	0.16	0.04	0.00	5.49E-04	0.02	0.01	0.00	8.32E-05
Blind Bore Machine	Unpaved	0.85	0.22	0.02	3.00E-03	20.31	5.24	0.52	0.07	3.08	0.79	0.08	0.01	0.08	0.02	0.00	3.00E-04	2.03	0.52	0.05	7.19E-03	0.31	0.08	0.01	1.09E-03
Total Emissions		**211.89**	**54.66**	**5.47**	**0.75**	**5,085.46**	**1,311.91**	**131.19**	**18.01**	**770.45**	**198.75**	**19.88**	**2.73**	**21.19**	**5.47**	**0.55**	**7.50E-02**	**508.55**	**131.19**	**13.12**	**1.80E+00**	**77.04**	**19.88**	**1.99**	**2.73E-01**

1. Controlled hourly and daily emissions calculated based on short term emission factors and control efficiency.
2. Controlled annual emissions calculated based on long term emission factors and control efficiency.

Table A-31. Clark Emission Factor Inputs

Road Surface	Max Miles Traveled			Vehicle Type	Vehicle Model	Max Vehicle Count	Particulate Matter Emission Factor Inputs [1]													
							k					s	P	a			b			
	Day	Month	Year				PM	PM_{10}	$PM_{2.5}$	Avg (kg)	(ton)	(%)	(days/ yr)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Unpaved	8	243.3	2920	Jumbo	DD422i	2	4.9	1.5	0.15	26,000	28.7	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	8	243.3	2920	Bolter	DD411	3	4.9	1.5	0.15	23,000	25.4	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	60	1825.0	21900	Haul Truck	TH430	5	4.9	1.5	0.15	44,500	49.1	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	LHD	LH410	4	4.9	1.5	0.15	33,500	36.9	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	8	243.3	2920	Production Drill	Simba ME7C	2	4.9	1.5	0.15	29,500	32.5	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	8	243.3	2920	Slot-Raise Drill	Easer L	1	4.9	1.5	0.15	37,300	41.1	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	8	243.3	2920	Blockholer	BH3	1	4.9	1.5	0.15	28,000	30.9	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Powder Truck	EC3	2	4.9	1.5	0.15	17,950	19.8	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Grader	120 AWD	1	4.9	1.5	0.15	16,700	18.4	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Lube Truck	FL3	1	4.9	1.5	0.15	13,600	15.0	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Shotcrete Sprayer	SSX & SS3 T4F	1	4.9	1.5	0.15	19,200	21.2	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Transit Mixer	TM3	2	4.9	1.5	0.15	25,050	27.6	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Scissor Deck	SL3	2	4.9	1.5	0.15	15,400	17.0	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Boom Truck	BT3	1	4.9	1.5	0.15	17,300	19.1	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Light Vehicle	F-250	6	4.9	1.5	0.15	3,750	4.1	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	24	730.0	8760	Water Vehicle	WS3	1	4.9	1.5	0.15	16,100	17.7	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45

[1] Emission factors for vehicular traffic on unpaved roads per U.S. EPA AP-42, Section 13.2.2 (Unpaved Roads), November 2006.

Short-Term $E = k\,(s/12)^a (W/3)^b$ (1a)

Annual $E_{ext} = E\,[(365 - P)/365]$ (2)

where E = Size-specific emission factor (lb/VMT)

k, a, b = Constants for equation 1a

	PM	PM_{10}	$PM_{2.5}$
k =	4.9	1.5	0.15
a =	0.7	0.9	0.9
b =	0.45	0.45	0.45

Per AP-42 Table 13.2.2-2, November 2006

s = surface material silt content (%), per AP-42 Table 13.2.2-1, 11/06, Western surface coal mining Plant Road
5.1

W = Mean vehicle weight (tons)

P = Days per year with at least 0.01 inch precipitation, based on precipitation data from 2019-2021 for Hermosa Trench Met Station, using the lowest annual value between 2019-2021.
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Table A-32. Clark Underground Roads - Emission Factors

Road Surface	Vehicle Type	Averaging Period	Emission Factor [1]				Process Rate Unit	Particulate Matter Emission Factor Inputs [1]												Reference
								k			W	s	P	a			b			
			PM	PM_{10}	$PM_{2.5}$	Unit		PM	PM_{10}	$PM_{2.5}$	(ton)	(%)	(days/yr)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	
Unpaved	Jumbo	Hourly/Daily	7.43	1.92	0.19	lb/VMT	VMT	4.90	1.50	0.15	28.66	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	AP-42, Section 13.2.2, Expression 1a (11/06) AP-42, Section 13.2.2, Expressions 1a and 2 (11/06)
Unpaved	Jumbo	Annual	6.17	1.59	0.16	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Bolter	Hourly/Daily	7.03	1.81	0.18	lb/VMT	VMT	4.90	1.50	0.15	25.35	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Bolter	Annual	5.84	1.51	0.15	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Haul Truck	Hourly/Daily	9.47	2.44	0.24	lb/VMT	VMT	4.90	1.50	0.15	49.05	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Haul Truck	Annual	7.86	2.03	0.20	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	LHD	Hourly/Daily	8.33	2.15	0.21	lb/VMT	VMT	4.90	1.50	0.15	36.93	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	LHD	Annual	6.92	1.78	0.18	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Production Drill	Hourly/Daily	7.87	2.03	0.20	lb/VMT	VMT	4.90	1.50	0.15	32.52	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Production Drill	Annual	6.53	1.68	0.17	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Slot-Raise Drill	Hourly/Daily	8.74	2.26	0.23	lb/VMT	VMT	4.90	1.50	0.15	41.12	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Slot-Raise Drill	Annual	7.26	1.87	0.19	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Blockholer	Hourly/Daily	7.68	1.98	0.20	lb/VMT	VMT	4.90	1.50	0.15	30.86	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Blockholer	Annual	6.38	1.65	0.16	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Powder Truck	Hourly/Daily	6.29	1.62	0.16	lb/VMT	VMT	4.90	1.50	0.15	19.79	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Powder Truck	Annual	5.22	1.35	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Grader	Hourly/Daily	6.09	1.57	0.16	lb/VMT	VMT	4.90	1.50	0.15	18.41	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Grader	Annual	5.06	1.30	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Lube Truck	Hourly/Daily	5.55	1.43	0.14	lb/VMT	VMT	4.90	1.50	0.15	14.99	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Lube Truck	Annual	4.61	1.19	0.12	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Shotcrete Sprayer	Hourly/Daily	6.48	1.67	0.17	lb/VMT	VMT	4.90	1.50	0.15	21.16	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Shotcrete Sprayer	Annual	5.38	1.39	0.14	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Transit Mixer	Hourly/Daily	7.31	1.89	0.19	lb/VMT	VMT	4.90	1.50	0.15	27.61	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Transit Mixer	Annual	6.07	1.57	0.16	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Scissor Deck	Hourly/Daily	5.87	1.51	0.15	lb/VMT	VMT	4.90	1.50	0.15	16.98	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Scissor Deck	Annual	4.87	1.26	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Boom Truck	Hourly/Daily	6.19	1.60	0.16	lb/VMT	VMT	4.90	1.50	0.15	19.07	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Boom Truck	Annual	5.14	1.33	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Light Vehicle	Hourly/Daily	3.11	0.80	0.08	lb/VMT	VMT	4.90	1.50	0.15	4.13	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Light Vehicle	Annual	2.58	0.67	0.07	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Water Vehicle	Hourly/Daily	5.99	1.55	0.15	lb/VMT	VMT	4.90	1.50	0.15	17.75	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Water Vehicle	Annual	4.97	1.28	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	

[1] Emission factors for vehicular traffic on unpaved roads per U.S. EPA AP-42, Section 13.2.2 (Unpaved Roads), November 2006.

Short-Term $E = k\,(s/12)^a (W/3)^b$ (1a)

Annual $E_{ext} = E\,[(365 - P)/365]$ (2)

where E = Size-specific emission factor (lb/VMT)

k, a, b = Constants for equation 1a

	PM	PM_{10}	$PM_{2.5}$
k =	4.9	1.5	0.15
a =	0.7	0.9	0.9
b =	0.45	0.45	0.45

Per AP-42 Table 13.2.2-2, November 2006

s = surface material silt content (%)

5.1

Silt content assumed as to be similar to Plant Road in Western Surface Coal Mining in AP-42, Section 13.2.4 (11/2006) per conversation with AMI, 10/14/22.

W = Mean vehicle weight (tons)

P = Days per year with at least 0.01 inch precipitation, based on precipitation data from 2019-2021 for Hermosa Trench Met Station, using the lowest annual value between 2019-2021.

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Table A-33a. Clark Roads - Vehicles - Input Parameters

Road Surface	Vehicle Type	Trip Type	Number of Vehicles	Trip Distance (miles/vehicle/day)	Vehicle Miles Travelled (VMT)			Uncontrolled Emission Factor (lb/VMT)						Control	
								Short Term			Long Term			Type	Efficiency[1,2]
					(VMT/hr)	(VMT/day)	(VMT/yr)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$		(%)
Unpaved	Jumbo	Round	2	8	0.667	16.00	5,840	7.43	1.92	0.19	6.17	1.59	0.16	Watering	90%
Unpaved	Bolter	Round	3	8	1.000	24.00	8,760	7.03	1.81	0.18	5.84	1.51	0.15	Watering	90%
Unpaved	Haul Truck	Round	5	60	12.500	300.00	109,500	9.47	2.44	0.24	7.86	2.03	0.20	Watering	90%
Unpaved	LHD	Round	4	16	2.667	64.00	23,360	8.33	2.15	0.21	6.92	1.78	0.18	Watering	90%
Unpaved	Production Drill	Round	2	8	0.667	16.00	5,840	7.87	2.03	0.20	6.53	1.68	0.17	Watering	90%
Unpaved	Slot-Raise Drill	Round	1	8	0.333	8.00	2,920	8.74	2.26	0.23	7.26	1.87	0.19	Watering	90%
Unpaved	Blockholer	Round	1	8	0.333	8.00	2,920	7.68	1.98	0.20	6.38	1.65	0.16	Watering	90%
Unpaved	Powder Truck	Round	2	16	1.333	32.00	11,680	6.29	1.62	0.16	5.22	1.35	0.13	Watering	90%
Unpaved	Grader	Round	1	16	0.667	16.00	5,840	6.09	1.57	0.16	5.06	1.30	0.13	Watering	90%
Unpaved	Lube Truck	Round	1	16	0.667	16.00	5,840	5.55	1.43	0.14	4.61	1.19	0.12	Watering	90%
Unpaved	Shotcrete Sprayer	Round	1	16	0.667	16.00	5,840	6.48	1.67	0.17	5.38	1.39	0.14	Watering	90%
Unpaved	Transit Mixer	Round	2	16	1.333	32.00	11,680	7.31	1.89	0.19	6.07	1.57	0.16	Watering	90%
Unpaved	Scissor Deck	Round	2	16	1.333	32.00	11,680	5.87	1.51	0.15	4.87	1.26	0.13	Watering	90%
Unpaved	Boom Truck	Round	1	16	0.667	16.00	5,840	6.19	1.60	0.16	5.14	1.33	0.13	Watering	90%
Unpaved	Light Vehicle	Round	6	16	4.000	96.00	35,040	3.11	0.80	0.08	2.58	0.67	0.07	Watering	90%
Unpaved	Water Vehicle	Round	1	24	1.000	24.00	8,760	5.99	1.55	0.15	4.97	1.28	0.13	Watering	90%

1. Road Watering is not contemplated every hour, but only as needed to maintain control levels.

2. At South32, the roads will be watered sufficiently to achieve a control efficiency of 90%

Lead Content = 5.67E-03 kg/kg

Table A-33b. Clark Roads -Vehicles - Emissions

Vehicle Type	Road Surface	Uncontrolled Emissions												Controlled Emissions									
		Hourly (lb/hr) [1]				Daily (lb/day) [1]				Annual (tpy) [2]				Hourly (lb/hr) [1]				Daily (lb/day) [1]				Annual (tpy) [2]			
		PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead
Jumbo	Unpaved	4.96	1.28	0.13	0.03	118.92	30.68	3.07	0.67	18.02	4.65	0.46	0.10	0.50	0.13	0.01	2.81E-03	11.89	3.07	0.31	6.74E-02	1.80	0.46	0.05	1.02E-02
Bolter	Unpaved	7.03	1.81	0.18	0.04	168.81	43.55	4.35	0.96	25.57	6.60	0.66	0.14	0.70	0.18	0.02	3.99E-03	16.88	4.35	0.44	9.57E-02	2.56	0.66	0.07	1.45E-02
Haul Truck	Unpaved	118.32	30.52	3.05	0.67	2839.78	732.58	73.26	16.10	430.23	110.99	11.10	2.44	11.83	3.05	0.31	6.71E-02	283.98	73.26	7.33	1.61E+00	43.02	11.10	1.11	2.44E-01
LHD	Unpaved	22.21	5.73	0.57	0.13	533.15	137.54	13.75	3.02	80.77	20.84	2.08	0.46	2.22	0.57	0.06	1.26E-02	53.32	13.75	1.38	3.02E-01	8.08	2.08	0.21	4.58E-02
Production Drill	Unpaved	5.24	1.35	0.14	0.03	125.88	32.47	3.25	0.71	19.07	4.92	0.49	0.11	0.52	0.14	0.01	2.97E-03	12.59	3.25	0.32	7.14E-02	1.91	0.49	0.05	1.08E-02
Slot-Raise Drill	Unpaved	2.91	0.75	0.08	0.02	69.95	18.04	1.80	0.40	10.60	2.73	0.27	0.06	0.29	0.08	0.01	1.65E-03	6.99	1.80	0.18	3.97E-02	1.06	0.27	0.03	6.01E-03
Blockholer	Unpaved	2.56	0.66	0.07	0.01	61.48	15.86	1.59	0.35	9.31	2.40	0.24	0.05	0.26	0.07	0.01	1.45E-03	6.15	1.59	0.16	3.49E-02	0.93	0.24	0.02	5.28E-03
Powder Truck	Unpaved	8.39	2.16	0.22	0.05	201.32	51.93	5.19	1.14	30.50	7.87	0.79	0.17	0.84	0.22	0.02	4.76E-03	20.13	5.19	0.52	1.14E-01	3.05	0.79	0.08	1.73E-02
Grader	Unpaved	4.06	1.05	0.10	0.02	97.44	25.14	2.51	0.55	14.76	3.81	0.38	0.08	0.41	0.10	0.01	2.30E-03	9.74	2.51	0.25	5.52E-02	1.48	0.38	0.04	8.37E-03
Lube Truck	Unpaved	3.70	0.95	0.10	0.02	88.84	22.92	2.29	0.50	13.46	3.47	0.35	0.08	0.37	0.10	0.01	2.10E-03	8.88	2.29	0.23	5.04E-02	1.35	0.35	0.03	7.63E-03
Shotcrete Sprayer	Unpaved	4.32	1.12	0.11	0.02	103.75	26.77	2.68	0.59	15.72	4.06	0.41	0.09	0.43	0.11	0.01	2.45E-03	10.38	2.68	0.27	5.88E-02	1.57	0.41	0.04	8.91E-03
Transit Mixer	Unpaved	9.75	2.51	0.25	0.06	233.89	60.34	6.03	1.33	35.43	9.14	0.91	0.20	0.97	0.25	0.03	5.52E-03	23.39	6.03	0.60	1.33E-01	3.54	0.91	0.09	2.01E-02
Scissor Deck	Unpaved	7.83	2.02	0.20	0.04	187.90	48.47	4.85	1.07	28.47	7.34	0.73	0.16	0.78	0.20	0.02	4.44E-03	18.79	4.85	0.48	1.07E-01	2.85	0.73	0.07	1.61E-02
Boom Truck	Unpaved	4.13	1.06	0.11	0.02	99.00	25.54	2.55	0.56	15.00	3.87	0.39	0.09	0.41	0.11	0.01	2.34E-03	9.90	2.55	0.26	5.61E-02	1.50	0.39	0.04	8.50E-03
Light Vehicle	Unpaved	12.44	3.21	0.32	0.07	298.53	77.01	7.70	1.69	45.23	11.67	1.17	0.26	1.24	0.32	0.03	7.05E-03	29.85	7.70	0.77	1.69E-01	4.52	1.17	0.12	2.56E-02
Water Vehicle	Unpaved	5.99	1.55	0.15	0.03	143.78	37.09	3.71	0.82	21.78	5.62	0.56	0.12	0.60	0.15	0.02	3.40E-03	14.38	3.71	0.37	8.15E-02	2.18	0.56	0.06	1.23E-02
Total Emissions		**223.85**	**57.75**	**5.77**	**1.27E+00**	**5,372.41**	**1,385.93**	**138.59**	**3.05E+01**	**813.92**	**209.97**	**21.00**	**4.61E+00**	**22.39**	**5.77**	**0.58**	**1.27E-01**	**537.24**	**138.59**	**13.86**	**3.05E+00**	**81.39**	**21.00**	**2.10**	**4.61E-01**

1. Controlled hourly and daily emissions calculated based on short term emission factors and control efficiency.
2. Controlled annual emissions calculated based on long term emission factors and control efficiency.

Table A-34. Truck Pneumatic Loadout Emissions

Emission Point Number	Description	Max Daily Throughput (ton/day)	Max Yearly Throughput (ton/yr)	Hourly Emissions [1,2]			Daily Emissions [1,2]			Annual Emissions [1,2]		
				PM (lb/hr)	PM_{10} (lb/hr)	$PM_{2.5}$ (lb/hr)	PM (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	PM (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)
Taylor												
PP-1	Truck Pneumatic Loadout to Silo 1	235	85,746	9.69E-03	3.33E-03	6.94E-04	2.33E-01	7.99E-02	1.67E-02	4.24E-02	1.46E-02	3.04E-03
PP-2	Truck Pneumatic Loadout to Silo 2	235	85,746	9.69E-03	3.33E-03	6.94E-04	2.33E-01	7.99E-02	1.67E-02	4.24E-02	1.46E-02	3.04E-03
Clark												
PP-3	Truck Pneumatic Loadout to Silo 1	117	42,873	4.85E-03	1.66E-03	3.47E-04	1.16E-01	3.99E-02	8.33E-03	2.12E-02	7.29E-03	1.52E-03
PP-4	Truck Pneumatic Loadout to Silo 2	117	42,873	4.85E-03	1.66E-03	3.47E-04	1.16E-01	3.99E-02	8.33E-03	2.12E-02	7.29E-03	1.52E-03

1. Emission factors based on AP-42 Chapter 11 Section 12, Table 11.12-2.
2. Throughput based on email from South32 on June 14, 2023.

PM	PM10	PM2.5		k = Particle size multiplier (dimensionless)		
				PM	PM_{10}	$PM_{2.5}$
0.00099	0.00034	7.0905E-05	lb of pollutant/ton of material	0.74	0.35	0.053

TABLE 11.12-2 (ENGLISH UNITS)
EMISSION FACTORS FOR CONCRETE BATCHING [a]

Source (SCC)	Uncontrolled				Controlled			
	Total PM	Emission Factor Rating	Total PM_{10}	Emission Factor Rating	Total PM	Emission Factor Rating	Total PM_{10}	Emission Factor Rating
Aggregate transfer [b] (3-05-011-04,-21,23)	0.0069	D	0.0033	D	ND		ND	
Sand transfer [b] (3-05-011-05,22,24)	0.0021	D	0.00099	D	ND		ND	
Cement unloading to elevated storage silo [pneumatic][c] (3-05-011-07)	0.73	E	0.47	E	0.00099	D	0.00034	D
Cement supplement unloading to elevated storage silo (pneumatic)[c] (3-05-011-17)	3.14	E	1.10	E	0.0089	D	0.0049	E
Weigh hopper loading [c] (3-05-011-08)	0.0048	D	0.0028	D	ND		ND	
Mixer loading (central mix)[c] (3-05-011-09)	0.572 or Eqn. 11.12-1	B	0.156 or Eqn. 11.12-1	B	0.0184 or Eqn. 11.12-1	B	0.0055 or Eqn. 11.12-1	B
Truck loading (truck mix)[c] (3-05-011-10)	1.118	B	0.310	B	0.098 or Eqn. 11.12-1	B	0.0263 or Eqn. 11.12-1	B
Vehicle traffic (paved roads)	See AP-42 Section 13.2.1, Paved Roads							
Vehicle traffic (unpaved roads)	See AP-42 Section 13.2.2, Unpaved Roads							
Wind erosion from aggregate and sand storage piles	See AP-42 Section 13.2.5, Industrial Wind Erosion							

[c] The uncontrolled PM & PM-10 emission factors were developed from Reference 9. The controlled emission factor for PM was developed from References 9, 10, 11, and 12. The controlled emission factor for PM-10 was developed from References 9 and 10.
[d] The controlled PM emission factor was developed from Reference 10 and Reference 12, whereas the controlled PM-10 emission factor was developed from only Reference 10.

Reference 10:

Tanker trucks are contracted from outside sources to deliver cement to the storage silos of the Johnson and Erie batch plants. The Johnson plant has a single cement storage silo. The Erie plant has two cement storage silos designated east and west. To transport the cement from the tanker to the silo, a 4-inch flexible line is attached to the rear of the tanker truck. The cement is then pneumatically conveyed to the top of the storage silo. It takes approximately 45-minutes to unload one tanker truck.

Each storage silo has its own dust collector attached to its roof. The dust collectors vent to the atmosphere and are not equipped with any fans or blowers. The air flow out of each silo is a result of the air being displaced by the incoming cement.

Reference 11:

TEST RESULTS

During the test, a truck load of cement (44,340 lbs. net) was conveyed into the cement storage silo being tested, by an air compressor mounted on the truck. The air was exhausted through two identical Tiberi Engineering Company dust collectors mounted on top of the bin. Only one of the dust collectors was tested. The test results are as follows:

Table A-35. WTP2 Scrubber Emissions

Emission Point Number	Unit	CN Concentration[1] (ppm)	Gas Flow Rate[1] (cfm)	Operating Hours[2] (hrs/yr)	HCN Emissions [3] (lb/hr)	HCN Emissions (stpy)
SCRUBBER-1	Tank Exhaust HCN Scrubber	600	500	8760	1.23	5.38
Tanks Exhaust	Process Tanks Exhaust	39	50	8760	7.98E-03	3.50E-02

[1.] Cyanide concentration uncontrolled is 2,000 ppm based on discussion with Eric H. and gas flow rate assumed to be 500 cfm based on engineering judgement.
39 ppm based on discussion with Eric H. and 50 cfm based on engineering judgment (minimal flow rate for natural ventilation).

[2.] Control Efficiency of scrubber 70% conservative assumption

[3.] Assumed the following output parameters

542.77	Rankine	*Based on the temperature in the Process Tanks tab of "S32 - Mine Development - Emis Calc - 2024-1105".*
0.73	ft^3.atm/R.lbmol	
1	atm	
27.03	Molecular Weight of Hydrogen Cyanide (g/mol)	

Mine Development
Plan II PTE

Table A-1a. Criteria Pollutants & GHG Emission Summary

Change	Fugitive?[2] (Y/N)	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC	Lead Compounds	Max Single HAP (Acetaldehyde)	Total HAPs	CO_2e
Project Emissions												
Permitted NG Engines PTE[1]	N	38.13	38.13	38.13	163.88	1.22	72.84	84.33	0.00	39.80	68.00	1,133,794
Proposed NG Engines PTE		52.42	52.42	52.42	113.02	2.76	23.19	58.16	0.00	27.46	40.98	781,927
Change to PTE - NG Engines		14.28	14.28	14.28	-50.86	1.54	-49.65	-26.17	0.00	-12.34	-27.02	-351,867
Permitted Diesel Engine PTE	N	0.99	0.99	0.99	40.47	3.12	79.19	16.77	0.00	0.01	0.44	43,135
Proposed Diesel Engine PTE		1.09	1.09	1.09	40.45	2.63	79.03	17.12	0.00	0.01	0.51	50,247
Change to PTE - Diesel Engines		0.10	0.10	0.10	-0.02	-0.49	-0.16	0.35	0.00	9.49E-04	6.97E-02	7,112
Permitted Aboveground Road PTE	Y	316.99	81.78	8.18	--	--	--	--	0.03	--	0.29	--
Proposed Aboveground Road PTE		311.25	80.29	8.03	--	--	--	--	0.03	--	0.29	--
Change to PTE - Aboveground Roads		-5.74	-1.48	-0.15	--	--	--	--	-5.86E-04	--	-5.32E-03	--
Permitted Tailings Operations PTE	Y	88.43	35.69	7.51	--	--	--	--	0.38	--	4.36	--
Proposed Tailings Operations PTE		85.67	35.01	7.23	--	--	--	--	0.36	--	4.22	--
Change to PTE - Tailings Operations		-2.76	-0.68	-0.28	--	--	--	--	-0.01	--	-0.14	--
Project Non-Fugitive PTE		14.39	14.39	14.39	-50.88	1.05	-49.81	-25.82	0.00	-12.33	-26.95	-344,755
Project Fugitive PTE		-8.50	-2.16	-0.43	0.00	0.00	0.00	0.00	-0.01	0.00	-0.14	0.00
Permitting Threshold Comparison												
Minor New Source Review (mNSR) Thresholds[1]		--	7.50	5.00	20.00	20.00	50.00	20.00	0.30	--	--	--
Does Non-Fugitive PTE exceed mNSR Thresholds?		--	Yes	Yes	No	No	No	No	No	--	--	--
Permitted Non-Fugitive PTE[2]		212.39	92.33	54.59	205.61	6.87	220.37	107.94	2.09	39.84	81.58	1,176,929
Permitted Non-Fugitive PTE + Project Non-Fugitive PTE Increases		226.78	106.71	68.97	154.74	7.92	170.56	82.11	2.09	27.51	54.63	832,174
Class I Title V Major Source Thresholds[1]		100	100	100	100	100	100	100	10	10	25	--
Does Non-Fugitive PTE exceed Title V Major Source Thresholds?		Yes	Yes	No	Yes	No	Yes	No	No	Yes	Yes	No
Class I PSD Major Source Thresholds		250	250	250	250	250	250	250	--	--	--	100,000
Does Non-Fugitive PTE exceed Class I PSD Major Source Thresholds?[3]		No	No	No	No	No	No	No	--	--	--	No

1. Per Arizona Administrative Code (A.A.C.)
   R18-2-101.110 - For "Potential to emit" (PTE)
   R18-2-101.75 - For "Major Source"
   R18-2-101.101 - For "Permitting Exemption Thresholds" which is the mNSR Threshold per R18-2-334.A.3
2. Permitted PTE is based on post MPR No. 109292 PTE.
3. Sources exceeding 100,000 tons of CO_2e are only subject to PSD if they also trigger PSD for another regulated NSR pollutant. The Hermosa Project does not trigger PSD for any other NSR pollutant. While CO_2e is not included under the definition of "regulated NSR pollutant" at A.A.C. R18-2-101.124, GHGs are considered a "regulated NSR

Table A-1b. Total Site-Wide Emissions

Pollutant	Regulated NSR Pollutant? [2]	Estimated Potential Emissions (tpy) [1,2]	
		Non-Fugitive	Non-Fugitive & Fugitive
PM	Yes	228.47	649.75
PM_{10}	Yes	108.02	234.02
$PM_{2.5}$	Yes	69.82	86.97
NO_X	Yes	154.74	154.74
SO_2	Yes	7.92	7.92
CO	Yes	170.56	170.56
VOC	Yes	82.11	99.23
Lead compounds	No	1.15	1.85
Elemental Lead	Yes	1.15	1.85
Total HAPs	No	50.81	56.80
HCN	No	5.38	5.41
H_2S	Yes	10.12	10.12
CO_2e [4]	-	833,346	833,346

1. PM, PM_{10}, and $PM_{2.5}$ include both filterable and condensable fractions, which conservatively overestimates PM emissions from an NSR perspective.
2. Per Arizona Administrative Code (A.A.C.)
   R18-2-101.110 - For "Potential to emit"
   R18-2-101.124 - For "Regulated NSR Pollutant"

Table A-1c. Total Emissions - Source Specific

Emission Point Number	Emissions Activity	Include? Yes/No	Source Type [1]	Underground/Aboveground?	Controlled Emissions Summary - Annual										
					PM	PM_{10}	$PM_{2.5}$	Lead Compounds	NO_X	CO	SO_2	VOC	Total HAPs	H_2S	CO_2e
DRILL-1	Drilling	Yes	Non-fugitive	Underground	0.06	0.03	0.03	3.02E-03	--	--	--	--	0.01	--	--
BLAST-1	Blasting	Yes	Non-fugitive	Underground	0.55	0.28	0.11	0.03	1.13	60.75	2.25	--	0.05	9.00	1,042.15
CRUSH-1	Primary Crushing	Yes	Non-fugitive	Underground	0.35	0.16	0.19	0.02	--	--	--	--	0.03	--	--
BREAK-1	Clark Rock Breaker	Yes	Non-fugitive	Aboveground	3.99E-03	1.89E-03	2.85E-04	7.01E-05	--	--	--	--	7.74E-04	--	--
BREAK-2	Underground Waste Rock Breaker	Yes	Non-fugitive	Underground	0.01	2.45E-03	3.70E-04	1.83E-05	--	--	--	--	4.92E-05	--	--
BREAK-3 - BREAK-7	Various Underground Ore Rock Breakers	Yes	Non-fugitive	Underground	0.05	0.02	3.64E-03	2.40E-03	--	--	--	--	4.69E-03	--	--
BREAK-8	Underground Crusher Rock Breaker	Yes	Non-fugitive	Underground	0.14	0.06	0.01	0.01	--	--	--	--	0.01	--	--
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	Yes	Non-fugitive	Aboveground	2.47	1.17	0.18	0.10	--	--	--	--	0.19	--	--
DP-4	Drop from Shaft to Waste Chute	Yes	Fugitive	Aboveground	0.96	0.46	0.07	0.01	--	--	--	--	0.01	--	--
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	Yes	Fugitive	Aboveground	0.36	0.17	0.03	0.02	--	--	--	--	0.03	--	--
DP-22	Transfer from face to loader	Yes	Non-Fugitive	Underground	0.02	0.01	0.01	7.08E-04	--	--	--	--	1.39E-03	--	--
DP-23	Transfer from loader to haul truck, as needed	Yes	Non-Fugitive	Underground	0.02	0.01	0.01	7.08E-04	--	--	--	--	1.39E-03	--	--
DP-24	Drop from loader or haul truck through grizzly to ore pass	Yes	Non-Fugitive	Underground	0.01	0.01	0.01	6.69E-04	--	--	--	--	1.28E-03	--	--
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	Yes	Non-Fugitive	Underground	0.01	0.01	0.01	6.69E-04	--	--	--	--	1.28E-03	--	--
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	Yes	Non-Fugitive	Underground	0.01	0.01	0.01	6.95E-04	--	--	--	--	1.36E-03	--	--
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	Yes	Non-Fugitive	Underground	0.01	0.01	0.01	6.95E-04	--	--	--	--	1.36E-03	--	--
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	Yes	Non-Fugitive	Underground	0.01	0.01	0.01	6.95E-04	--	--	--	--	1.36E-03	--	--
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	Yes	Non-Fugitive	Underground	0.10	0.05	0.05	4.88E-03	--	--	--	--	0.01	--	--
DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	Yes	Non-Fugitive	Underground	0.03	0.01	0.01	8.87E-05	--	--	--	--	2.38E-04	--	--
DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	Yes	Non-Fugitive	Underground	0.02	0.01	0.01	1.05E-03	--	--	--	--	2.06E-03	--	--
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	Yes	Non-Fugitive	Underground	0.01	2.56E-03	2.56E-03	1.92E-05	--	--	--	--	5.14E-05	--	--
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	Yes	Non-Fugitive	Underground	0.03	0.01	0.01	1.07E-03	--	--	--	--	2.11E-03	--	--
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	Yes	Non-Fugitive	Underground	0.03	0.01	0.01	1.07E-03	--	--	--	--	2.11E-03	--	--
DP-82	Drop on West Rock Stockpile	Yes	Fugitive	Aboveground	0.32	0.15	0.02	1.13E-03	--	--	--	--	3.03E-03	--	--
DP-83	Drop on East Ore Stockpile	Yes	Fugitive	Aboveground	0.36	0.17	0.03	0.02	--	--	--	--	0.03	--	--
DP-84	Drop on TSF	Yes	Fugitive	Aboveground	0.60	0.28	0.04	2.54E-03	--	--	--	--	0.03	--	--

Emission Point Number	Emissions Activity	Include? Yes/No	Source Type [1]	Underground/Aboveground?	Controlled Emissions Summary - Annual										
					PM	PM_{10}	$PM_{2.5}$	Lead Compounds	NO_X	CO	SO_2	VOC	Total HAPs	H_2S	CO_2e
DP-85	Drops on TSF2	Yes	Fugitive	Aboveground	1.25	0.59	0.09	0.01	--	--	--	--	0.06	--	--
DP-94	Transfer from Agg Stockpile to Loader	Yes	Fugitive	Aboveground	0.08	0.04	0.01	--	--	--	--	--	--	--	--
DP-95	Transfer of Agg Material from Loader to Haul Truck	Yes	Fugitive	Aboveground	0.08	0.04	0.01	--	--	--	--	--	--	--	--
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	Yes	Fugitive	Aboveground	0.08	0.04	0.01	--	--	--	--	--	--	--	--
DP-97	Transfer from East Ore Stockpile to Loader	Yes	Fugitive	Aboveground	0.36	0.17	0.03	0.02	--	--	--	--	0.03	--	--
DP-98	Transfer of Ore from Loader to Haul Truck	Yes	Fugitive	Aboveground	0.36	0.17	0.03	0.02	--	--	--	--	0.03	--	--
DP-99	Transfer from Waste Chute Stockpile to Loader	Yes	Fugitive	Aboveground	3.21	1.52	0.23	0.02	--	--	--	--	0.04	--	--
DP-100	Transfer of Waste Chute Material from Loader to Haul Truck	Yes	Fugitive	Aboveground	3.21	1.52	0.23	0.02	--	--	--	--	0.04	--	--
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	Yes	Fugitive	Aboveground	7.92E-05	3.75E-05	5.68E-06	--	--	--	--	--	--	--	--
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	Yes	Fugitive	Aboveground	3.57E-08	1.69E-08	2.56E-09	--	--	--	--	--	--	--	--
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	Yes	Fugitive	Aboveground	9.97E-04	4.71E-04	7.14E-05	--	--	--	--	--	--	--	--
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	Yes	Fugitive	Aboveground	2.26E-03	1.07E-03	1.62E-04	--	--	--	--	--	--	--	--
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	Yes	Fugitive	Aboveground	1.09E-03	5.13E-04	7.77E-05	--	--	--	--	--	--	--	--
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	Yes	Fugitive	Aboveground	1.18E-05	5.58E-06	8.45E-07	--	--	--	--	--	--	--	--
DP-149	Drop of Sodium Bicarbonate	Yes	Fugitive	Aboveground	1.18E-05	5.58E-06	8.45E-07	--	--	--	--	--	--	--	--
DC-1	21210-CX-00002 Main Shaft Ore Discharge Dust Collector 7	Yes	Non-fugitive	Aboveground	0.24	0.24	0.24	0.01					0.02		
DC-2	21210-CX-00001 Coarse Ore Overland Dust Collector 7	Yes	Non-fugitive	Aboveground	0.38	0.38	0.38	0.02					0.03		
DC-3	21210-CX-00003 Transfer Tower Silo Dust Collector 4	Yes	Non-fugitive	Aboveground	2.25	2.25	2.25	0.09					0.17		
DC-4	21510-CX-00001 Coarse Ore Silo Dust Collector 4	Yes	Non-fugitive	Aboveground	0.83	0.83	0.83	0.04					0.08		
DC-5	21710-CX-00002 Silo Discharge Dust Collector 5	Yes	Non-fugitive	Aboveground	0.81	0.81	0.81	0.04					0.08		
DC-12	22620-CX-00001 Copper Sulphate Mix Tank Dust Collector	Yes	Non-fugitive	Aboveground	0.30	0.30	0.30	--					--		
DC-13	22620-CX-00002 10% Zinc Sulphate Mix Tank Dust Collector	Yes	Non-fugitive	Aboveground	0.30	0.30	0.30	--					--		
DC-14	22620-CX-00005 50% Zinc Sulphate Mix Tank Dust Collector	Yes	Non-fugitive	Aboveground	0.30	0.30	0.30	--					--		
DC-15	22620-CX-00004 Caustic Mix Tank Dust Collector	Yes	Non-fugitive	Aboveground	0.30	0.30	0.30	--					--		
DC-16	22210-CX-00001 Pebble Crusher Dust Collector 4	Yes	Non-fugitive	Aboveground	0.93	0.93	0.93	0.04					0.09		
DC-PPBSS1	18610-SI-00001 Paste Plant Binder Storage Silo 1 6	Yes	Non-fugitive	Aboveground	0.14	0.14	0.14	--					--		
DC-PPBSS2	18610-SI-00002 Paste Plant Binder Storage Silo 2 6	Yes	Non-fugitive	Aboveground	0.14	0.14	0.14	--					--		
DC-PPBDS3	18610-SI-10003 Paste Plant Binder Dosage Silo 3 6	Yes	Non-fugitive	Aboveground	0.28	0.28	0.28	--					--		
DC-PPBDS4	18610-SI-20004 Paste Plant Binder Dosage Silo 4 6	Yes	Non-fugitive	Aboveground	0.28	0.28	0.28	--					--		
DC-PPM1M	18610-DC-20002 Paste Plant Module 1 Mixer 6	Yes	Non-fugitive	Aboveground	0.56	0.56	0.56	--					--		
DC-PPM2M	18610-DC-20002 Paste Plant Module 2 Mixer 6	Yes	Non-fugitive	Aboveground	0.56	0.56	0.56	--					--		
DC-7	Coarse Ore Dust Collection System,23100-FAN-0001	Yes	Non-fugitive	Aboveground	0.12	0.12	0.12	2.11E-03	--	--	--	--	0.02	--	--
DC-8	Coarse Ore Dust Collection System,23100-FAN-0002	Yes	Non-fugitive	Aboveground	0.12	0.12	0.12	2.11E-03	--	--	--	--	0.02	--	--
DC-CPPBS1	Paste Plant Binder Silo 1 6	Yes	Non-fugitive	Aboveground	0.14	0.14	0.14	--	--	--	--	--	--	--	--
DC-CPPBS2	Paste Plant Binder Silo 2 6	Yes	Non-fugitive	Aboveground	0.14	0.14	0.14	--	--	--	--	--	--	--	--
DC-CPPBS3	Paste Plant Binder Silo 3 6	Yes	Non-fugitive	Aboveground	0.28	0.28	0.28	--	--	--	--	--	--	--	--
DC-CPPBS4	Paste Plant Binder Silo 4 6	Yes	Non-fugitive	Aboveground	0.28	0.28	0.28	--	--	--	--	--	--	--	--
DC-CPPM1M	Paste Plant Module 1 Mixer 6	Yes	Non-fugitive	Aboveground	0.56	0.56	0.56	--					--		
DC-CPPM2M	Paste Plant Module 2 Mixer 6	Yes	Non-fugitive	Aboveground	0.56	0.56	0.56	--					--		
DC-10	Coarse Ore Dust Collection System,23100-DCD-0005	Yes	Non-fugitive	Aboveground	0.12	0.12	0.12	2.11E-03					0.02		
WTP1LS	Waste Water Treatment Plant #1 Lime Silo	Yes	Non-fugitive	Aboveground	0.19	0.19	0.19						--		
WTP2 DC	Sodium Sulfate Indoor Dust Collector 5	Yes	Non-fugitive	Aboveground	0.01	0.01	0.01						--		
TNK-040	F549/MIBC	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	0.29	0.26	--	--

Emission Point Number	Emissions Activity	Include? Yes/No	Source Type [1]	Underground/Aboveground?	Controlled Emissions Summary - Annual										
					PM	PM_{10}	$PM_{2.5}$	Lead Compounds	NO_X	CO	SO_2	VOC	Total HAPs	H_2S	CO_2e
TNK-041	3407-A	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	1.48E-03	9.52E-05	--	--
TNK-044	Solvay 5100	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	0.01	3.67E-05	--	--
TNK-045	Copper Sulphate	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-046	Copper Sulphate	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-047	Zinc Sulphate	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-048	Zinc Sulphate	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-051	Zinc Cyanide	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-052	Zinc Cyanide	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-053	SMBS	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-054	SMBS	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-057	Tailings Flocculant(SNF AN910-VHM)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-058	Tailings Flocculant(SNF AN910-VHM)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-059	Tailings Flocculant(SNF AN910-VHM)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	--	--	--
TNK-060	3418-A	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	1.90E-04	--	--	--
TNK-061	Shaft ANE	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	2.38E-04	--	--	--
TSF2	USFS Tailings Storage Facility	Yes	Fugitive	Aboveground	40.47	20.24	3.04	0.17	--	--	--	--	1.99	--	--
TSF_1	Tailing Storage Facility	Yes	Fugitive	Aboveground	16.45	8.23	1.23	0.07	--	--	--	--	0.81	--	--
WRS	West Rock Stockpile	Yes	Fugitive	Aboveground	0.67	0.34	0.05	2.37E-03	--	--	--	--	0.01	--	--
EOS	East Ore Stockpile	Yes	Fugitive	Aboveground	0.74	0.37	0.06	0.04	--	--	--	--	0.07	--	--
TAGG	Taylor Agg Stockpile	Yes	Fugitive	Aboveground	4.53E-04	2.27E-04	3.40E-05	--	--	--	--	--	--	--	--
TSHOT	Taylor Shotcrete Stockpile	Yes	Fugitive	Aboveground	8.06E-04	4.03E-04	6.04E-05	--	--	--	--	--	--	--	--
HRS	Hardshell Rock Stockpile	Yes	Fugitive	Aboveground	3.95	1.98	0.30	0.02	--	--	--	--	0.05		
ORE	Clark Ore Stockpile	Yes	Fugitive	Aboveground	0.12	0.06	0.01	2.12E-03	--	--	--	--	0.02		
ROM	Clark ROM Stockpile	Yes	Fugitive	Aboveground	0.04	0.02	2.68E-03	6.29E-04	--	--	--	--	0.01		
AGG	Clark Agg Stockpile	Yes	Fugitive	Aboveground	4.53E-04	2.27E-04	3.40E-05	--	--	--	--	--	--		
SHOT	Clark Shotcrete Stockpile	Yes	Fugitive	Aboveground	8.06E-04	4.03E-04	6.04E-05	--	--	--	--	--	--		
CHUTE	Waste Chute Stockpile	Yes	Fugitive	Aboveground	2.59E-03	1.30E-03	1.94E-04	1.49E-05	--	--	--	--	3.54E-05		
WTP2CT	Cooling Towers	Yes	Fugitive	Aboveground	0.02	0.02	4.07E-04	--	--	--	--	--		--	--
PRODREF	Refrigeration Plant[3]	Yes	Non-fugitive	Aboveground	0.05	0.03	0.01	--	--	--	--	--	--	--	--
BBREF	Refrigeration Plant[3]	Yes	Non-fugitive	Aboveground	0.08	0.04	0.01	--	--	--	--	--	--	--	--
MILLREF	Primary Mill Cooling Tower	Yes	Non-fugitive	Aboveground	3.51E-03	1.83E-03	6.37E-04						--		
SCRUBBER-1	Tank Exhaust HCN Scrubber	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	--	5.38		
Tanks Exhaust	Process Tanks Exhaust	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	--	0.03		
CBP1_11	Taylor Concrete Batch Plant[2]	Yes	Non-fugitive	Aboveground	0.79	0.32	0.32	--	--	--	--	--	--	--	--
CCBP1_11	Clark Concrete Batch Plant	Yes	Non-fugitive	Aboveground	0.04	0.02	0.02	--	--	--	--	--	--	--	--
DOZER1-TSF2	Dozer Emissions	Yes	Fugitive	Aboveground	8.96	1.89	0.94	0.04	--	--	--	--	0.44	--	--
DOZER2-TSF2	Dozer Emissions	Yes	Fugitive	Aboveground	8.96	1.89	0.94	0.04	--	--	--	--	0.44	--	--
DOZER-WRS	Dozer Emissions	Yes	Fugitive	Aboveground	1.09	0.14	0.11	3.84E-03	--	--	--	--	0.01	--	--
DOZER-HRS	Dozer Emissions	Yes	Fugitive	Aboveground	1.09	0.14	0.11	0.01	--	--	--	--	0.01	--	--
DOZER-TSF	Dozer Emissions	Yes	Fugitive	Aboveground	8.96	1.89	0.94	0.04	--	--	--	--	0.44	--	--
DOZER-EOS	Dozer Emissions	Yes	Fugitive	Aboveground	1.09	0.14	0.11	0.05	--	--	--	--	0.10	--	--
MEVAP1	Mechanical Evaporator	Yes	Fugitive	Aboveground	--	0.04	0.01	--	--	--	--	--	--	--	--
MEVAP2	Mechanical Evaporator	Yes	Fugitive	Aboveground	--	0.04	0.01	--	--	--	--	--	--	--	--
MEVAP3	Mechanical Evaporator	Yes	Fugitive	Aboveground	--	0.04	0.01	--	--	--	--	--	--	--	--
22310-FC-00001	Lead Rougher	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.06	--	--	--
22310-FC-00004	Lead Rougher Scavenger	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.06	--	--	--
22310-FC-00008	Lead Cleaner Scalper	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.19	--	--	--
22310-FC-00007	Lead Cleaner	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.16	--	--	--
22310-FC-00009	Lead Cleaner Scavenger	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.15	--	--	--
22310-FC-00005	Zinc Rougher	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.12	--	--	--
22310-FC-00006	Zinc Rougher Scavenger	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.11	--	--	--
22310-FC-00011	Zinc Cleaner Scalper	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.12	--	--	--
22310-FC-00010	Zinc Cleaner	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.10	--	--	--
22310-FC-00012	Zinc Cleaner Scavenger	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.09	--	--	--
22430-TN-00001	Lead Concentrate Tank	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	6.02	--		
22430-TN-00002	Zinc Concentrate Tank	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	7.60	--		
22310-TN-00003	Lead Conditioning Tank	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.50	--		
22310-TN-00001	Zinc Conditioning Tank No. 1	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.28	--		
22310-TN-00002	Zinc Conditioning Tank No. 2	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.28	--		
DRILL-2	Drilling	Yes	Non-fugitive	Underground	0.02	0.01	0.01	3.39E-04	--	--	--	--	3.74E-03	--	--
BLAST-2	Blasting	Yes	Non-fugitive	Underground	0.31	0.16	0.04	0.01	0.14	7.59	0.28	--	0.06	1.12	130.15
DP-103	Dump into Primary Crusher Feed Hopper	Yes	Fugitive	Aboveground	0.29	0.14	0.02	0.01	--	--	--	--	0.06	--	--

Emission Point Number	Emissions Activity	Include? Yes/No	Source Type [1]	Underground/Aboveground?	Controlled Emissions Summary - Annual										
					PM	PM_{10}	$PM_{2.5}$	Lead Compounds	NO_X	CO	SO_2	VOC	Total HAPs	H_2S	CO_2e
DP-104	Drop from silo to trucks	Yes	Fugitive	Aboveground	0.96	0.46	0.07	0.02	--	--	--	--	0.19	--	--
DP-105	Transfer of Ore from Ore Stockpile to Loader	Yes	Fugitive	Aboveground	0.58	0.27	0.04	0.01	--	--	--	--	0.11	--	--
DP-106	Transfer of Ore Mined from Loader to Haul Truck	Yes	Fugitive	Aboveground	0.58	0.27	0.04	0.01	--	--	--	--	0.11	--	--
DP-107	Transfer from ROM Stockpile to Loader	Yes	Fugitive	Aboveground	0.16	0.08	0.01	2.79E-03	--	--	--	--	0.03	--	--
DP-109	Transfer from Agg Stockpile to Loader	Yes	Fugitive	Aboveground	0.08	0.04	0.01	--	--	--	--	--	--	--	--
DP-110	Transfer of Agg Material from Loader to Haul Truck	Yes	Fugitive	Aboveground	0.08	0.04	0.01	--	--	--	--	--	--	--	--
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	Yes	Fugitive	Aboveground	0.08	0.04	0.01	--	--	--	--	--	--	--	--
DP-113	Hardshell Rock Storage	Yes	Fugitive	Aboveground	2.60	1.23	0.19	0.01	--	--	--	--	0.06	--	--
DP-114	Ore Stockpile	Yes	Fugitive	Aboveground	0.58	0.27	0.04	0.01	--	--	--	--	0.11	--	--
DP-115	ROM Stockpile	Yes	Fugitive	Aboveground	0.16	0.08	0.01	2.79E-03	--	--	--	--	0.03	--	--
DP-124	Transfer of Development Ore from Face to Loader	Yes	Non-fugitive	Underground	9.01E-04	4.26E-04	2.67E-04	1.16E-05	--	--	--	--	9.79E-05	--	--
DP-125	Transfer of Development Ore from Loader to Stockpile	Yes	Non-fugitive	Underground	9.01E-04	4.26E-04	2.67E-04	1.16E-05	--	--	--	--	9.79E-05	--	--
DP-126	Transfer of Development Ore from Stockpile to Loader	Yes	Non-fugitive	Underground	9.01E-04	4.26E-04	2.67E-04	1.16E-05	--	--	--	--	9.79E-05	--	--
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	Yes	Non-fugitive	Underground	9.01E-04	4.26E-04	2.67E-04	1.16E-05	--	--	--	--	9.79E-05	--	--
DP-129	Transfer of Development Waste Mined from Face to Loader	Yes	Non-fugitive	Underground	4.67E-03	2.21E-03	1.38E-03	2.65E-05	--	--	--	--	1.08E-04	--	--
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	Yes	Non-fugitive	Underground	4.67E-03	2.21E-03	1.38E-03	2.65E-05	--	--	--	--	1.08E-04	--	--
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	Yes	Non-fugitive	Underground	4.67E-03	2.21E-03	1.38E-03	2.65E-05	--	--	--	--	1.08E-04	--	--
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	Yes	Non-fugitive	Underground	4.67E-03	2.21E-03	1.38E-03	2.65E-05	--	--	--	--	1.08E-04	--	--
DP-134	Transfer of Stope Ore from Stope to Loader	Yes	Non-fugitive	Underground	2.57E-03	1.21E-03	7.62E-04	4.52E-05	--	--	--	--	4.99E-04	--	--
DP-135	Transfer of Stope Ore from Loader to Stockpile	Yes	Non-fugitive	Underground	2.57E-03	1.21E-03	7.62E-04	4.52E-05	--	--	--	--	4.99E-04	--	--
DP-136	Transfer of Stope Ore from Stockpile to Loader	Yes	Non-fugitive	Underground	2.57E-03	1.21E-03	7.62E-04	4.52E-05	--	--	--	--	4.99E-04	--	--
DP-137	Transfer of Stope Ore from Loader to Haul Truck	Yes	Non-fugitive	Underground	2.57E-03	1.21E-03	7.62E-04	4.52E-05	--	--	--	--	4.99E-04	--	--
PP-1	Truck Pneumatic Loadout to Silo 1	Yes	Non-fugitive	Aboveground	4.24E-02	1.46E-02	3.04E-03	0.00E+00	--	--	--	--	--	--	--
PP-2	Truck Pneumatic Loadout to Silo 2	Yes	Non-fugitive	Aboveground	4.24E-02	1.46E-02	3.04E-03	0.00E+00	--	--	--	--	--	--	--
PP-3	Truck Pneumatic Loadout to Silo 1	Yes	Non-fugitive	Aboveground	2.12E-02	7.29E-03	1.52E-03	0.00E+00	--	--	--	--	--	--	--
PP-4	Truck Pneumatic Loadout to Silo 2	Yes	Non-fugitive	Aboveground	2.12E-02	7.29E-03	1.52E-03	0.00E+00	--	--	--	--	--	--	--
ROADS	Road Emissions	Yes	Fugitive	Aboveground	311.25	80.29	8.03	0.03					0.29		
UGTROADS	Underground Taylor Roads	Yes	Non-fugitive	Underground	77.04	19.88	1.99	0.273	--	--	--	--	0.73	--	--
UGCROADS	Underground Clark Roads	Yes	Non-fugitive	Underground	81.39	21.00	2.10	0.461	--	--	--	--	1.88	--	--
ENGINE 0013 - 0056	CAT 3520 DSL 2600 kW	Yes	Non-fugitive	Aboveground	52.42	52.42	52.42	--	113.02	23.19	2.76	58.16	40.98	--	781,926.73
ENGINE 0007 - 0012	CAT C18, 589 bkW	Yes	Non-fugitive	Aboveground	0.68	0.68	0.68	--	7.80	40.00	8.28E-04	15.00	0.47	--	47,547.05
ENGINE 0002 - 0006	CAT C175 3000 kW	Yes	Non-fugitive	Aboveground	0.36	0.36	0.36	--	31.83	31.83	0.07	1.73	0.01	--	1,267.09
ENGINE 0001	C200D2RE	Yes	Non-fugitive	Aboveground	0.04	0.04	0.04	--	0.82	7.20	2.56	0.39	0.03	--	1,432.87
AGGDF-T	Aboveground Gasoline Dispensing Facility - Taylor	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.85	0.15	--	--
AGGDF-C	Aboveground Gasoline Dispensing Facility - Clark	Yes	Fugitive	Aboveground	--	--	--	--	--	--	--	0.41	0.08	--	--
T-01	Unleaded Gasoline (S32)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	0.38	0.01	--	--
T-02	Diesel (Red Dyed S32)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	1.64E-03	1.51E-04	--	--
T-03	Diesel (Red Dyed S32)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	1.64E-03	1.51E-04	--	--
T-04	Diesel (Red Dyed Rummel)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	2.04E-03	1.88E-04	--	--
T-05	Unleaded Gasoline (Rummel)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	0.33	0.01	--	--
T-06	Diesel (Rummel)	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	4.74E-04	4.36E-05	--	--
T-07	Unleaded Gasoline	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	1.92	0.04	--	--
T-08	Unleaded Gasoline	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	1.92	0.04	--	--
T-09	Unleaded Gasoline	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	1.92	0.04	--	--
T-10	Diesel	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	0.04	3.60E-03	--	--
T-11	Diesel	Yes	Non-fugitive	Aboveground	--	--	--	--	--	--	--	0.04	3.30E-03	--	--
Total - Non-Fugitive & Fugitive Emissions					649.75	234.02	86.97	1.85	154.74	170.56	7.92	99.23	56.80	10.12	833346.03
Total - Non-Fugitive Emissions					228.47	108.02	69.82	1.15	154.74	170.56	7.92	82.11	50.81	10.12	833346.03

1. Underground emissions conservatively taken as non-fugitive. South32 reserves the right to update this conservative assumption.
2. The concrete batch plant is conservatively assumed to be a non-fugitive source of emissions. South32 reserves the right to update this representation once we have more clarity on the concrete batch plant design per correspondance with ADEQ on Jan 13th 2023.
3. The surface refrigeration plant is considered a non-fugitive source of emissions based on correspondance with ADEQ on Jan 13th 2023.

Table A-2a. Facility HAPs Summary

Pollutant	Emissions (tpy)
Benzene	0.51
Toluene	0.41
Xylene	0.25
1,3-Butadiene	0.14
Formaldehyde	6.78
Acetaldehyde	27.48
Acrolein	2.47
Naphthalene	0.07
1,1,2,2-Tetrachloroethane	0.19
1,1,2-Trichloroethane	0.15
1,3-Dichloropropene	0.01
2-Methylnaphthalene	0.02
2,2,4-Trimethylpentane	0.12
Biphenyl	0.10
Carbon Tetrachloride	0.17
Chlorobenzene	0.14
Chloroform	0.13
Ethylbenzene	0.04
Ethylene Dibromide	0.21
Methanol	1.20
Methylene Chloride	0.09
Hexane	0.55
PAH	0.39
Phenol	0.11
Tetrachloroethane	0.01
Vinyl Chloride	0.07
Cresol	9.52E-05
Ethylene Glycol Dimethyl Ether	0.26
Urethane	3.67E-05
Cumene	4.46E-04
Isooctane	0.04
PAC's	5.84E-05
Hydrogen Cyanide	5.41E+00
Antimony Compounds	3.18E-02
Arsenic Compounds	3.54E-02
Beryllium Compounds	9.66E-04
Cadmium Compounds	1.99E-02
Chromium Compounds	1.86E-02
Cobalt Compounds	8.26E-03
Manganese Compounds	7.27
Nickel Compounds	1.28E-02
Selenium Compounds	3.95E-03
Lead Compounds	1.85

Table A-2b. Metal HAP in PM - Constituents Summary

Emission Point Number	Emissions Activity	Emissions[1]												
		Include? Yes/No	PM	Antimony Compounds	Arsenic Compounds	Beryllium Compounds	Cadmium Compounds	Chromium Compounds	Cobalt Compounds	Manganese Compounds	Nickel Compounds	Selenium Compounds	Lead Compounds	Mercury Compounds	Total
DRILL-1	Drilling	Yes	0.06	1.29E-05	9.46E-06	7.30E-08	1.18E-05	2.01E-06	1.58E-06	2.72E-03	6.08E-07	1.58E-06	3.02E-03	--	5.78E-03
BLAST-1	Blasting	Yes	0.55	1.16E-04	8.48E-05	6.55E-07	1.06E-04	1.80E-05	1.42E-05	2.44E-02	5.45E-06	1.42E-05	2.71E-02	--	5.18E-02
CRUSH-1	Primary Crushing	Yes	0.35	7.42E-05	5.44E-05	4.20E-07	6.79E-05	1.15E-05	9.10E-06	1.56E-02	3.50E-06	9.10E-06	1.74E-02	--	3.32E-02
BREAK-1	Clark Rock Breaker	Yes	0.00	1.80E-06	2.16E-06	6.70E-09	4.88E-07	1.71E-07	2.39E-08	7.00E-04	3.11E-08	1.99E-08	7.01E-05	--	7.74E-04
BREAK-2	Underground Waste Rock Breaker	Yes	0.01	9.00E-08	2.62E-07	7.24E-09	1.86E-08	1.42E-07	1.96E-08	3.03E-05	4.03E-08	1.71E-08	1.83E-05	--	4.92E-05
BREAK-3 - BREAK-7	Various Underground Ore Rock Breakers	Yes	0.05	1.03E-05	7.78E-06	6.05E-08	9.29E-06	1.69E-06	1.27E-06	2.25E-03	5.07E-07	1.27E-06	2.40E-03	--	4.69E-03
BREAK-8	Underground Crusher Rock Breaker	Yes	0.14	2.79E-05	2.10E-05	1.64E-07	2.51E-05	4.57E-06	3.43E-06	6.10E-03	1.37E-06	3.43E-06	6.50E-03	--	1.27E-02
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	Yes	2.47	4.11E-04	3.28E-04	3.04E-06	3.65E-04	7.92E-05	5.13E-05	9.09E-02	2.36E-05	5.12E-05	9.56E-02	--	1.88E-01
DP-4	Drop from Shaft to Waste Chute	Yes	0.96	2.57E-05	5.37E-05	1.34E-06	1.21E-05	2.67E-05	4.68E-06	7.49E-03	7.62E-06	4.22E-06	5.52E-03	--	1.31E-02
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	Yes	0.36	7.37E-05	5.57E-05	4.33E-07	6.65E-05	1.21E-05	9.06E-06	1.61E-02	3.62E-06	9.08E-06	1.72E-02	--	3.35E-02
DP-22	Transfer from face to loader	Yes	0.02	3.04E-06	2.43E-06	2.25E-08	2.70E-06	5.86E-07	3.80E-07	6.73E-04	1.74E-07	3.79E-07	7.08E-04	--	1.39E-03
DP-23	Transfer from loader to haul truck, as needed	Yes	0.02	3.04E-06	2.43E-06	2.25E-08	2.70E-06	5.86E-07	3.80E-07	6.73E-04	1.74E-07	3.79E-07	7.08E-04	--	1.39E-03
DP-24	Drop from loader or haul truck through grizzly to ore pass	Yes	0.01	2.74E-06	2.07E-06	1.61E-08	2.47E-06	4.48E-07	3.36E-07	5.98E-04	1.35E-07	3.37E-07	6.69E-04	--	1.28E-03
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	Yes	0.01	2.74E-06	2.07E-06	1.61E-08	2.47E-06	4.48E-07	3.36E-07	5.98E-04	1.35E-07	3.37E-07	6.69E-04	--	1.28E-03
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	Yes	0.01	2.98E-06	2.25E-06	1.75E-08	2.69E-06	4.88E-07	3.67E-07	6.52E-04	1.47E-07	3.67E-07	6.95E-04	--	1.36E-03
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	Yes	0.01	2.98E-06	2.25E-06	1.75E-08	2.69E-06	4.88E-07	3.67E-07	6.52E-04	1.47E-07	3.67E-07	6.95E-04	--	1.36E-03
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	Yes	0.01	2.98E-06	2.25E-06	1.75E-08	2.69E-06	4.88E-07	3.67E-07	6.52E-04	1.47E-07	3.67E-07	6.95E-04	--	1.36E-03
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	Yes	0.10	2.09E-05	1.58E-05	1.23E-07	1.89E-05	3.42E-06	2.57E-06	4.57E-03	1.03E-06	2.57E-06	4.88E-03	--	9.51E-03
DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	Yes	0.03	4.36E-07	1.27E-06	3.51E-08	9.02E-08	6.86E-07	9.52E-08	1.47E-04	1.95E-07	8.26E-08	8.87E-05	--	2.38E-04
DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	Yes	0.02	4.52E-06	3.41E-06	2.65E-08	4.07E-06	7.40E-07	5.55E-07	9.88E-04	2.22E-07	5.56E-07	1.05E-03	--	2.06E-03
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	Yes	0.01	9.41E-08	2.74E-07	7.57E-09	1.95E-08	1.48E-07	2.06E-08	3.17E-05	4.22E-08	1.79E-08	1.92E-05	--	5.14E-05
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	Yes	0.03	4.61E-06	3.68E-06	3.41E-08	4.09E-06	8.88E-07	5.76E-07	1.02E-03	2.64E-07	5.74E-07	1.07E-03	--	2.11E-03
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	Yes	0.03	4.61E-06	3.68E-06	3.41E-08	4.09E-06	8.88E-07	5.76E-07	1.02E-03	2.64E-07	5.74E-07	1.07E-03	--	2.11E-03
DP-82	Drop on West Rock Stockpile	Yes	0.32	5.54E-06	1.61E-05	4.46E-07	1.15E-06	8.73E-06	1.21E-06	1.86E-03	2.48E-06	1.05E-06	1.13E-03	--	3.03E-03
DP-83	Drop on East Ore Stockpile	Yes	0.36	7.37E-05	5.57E-05	4.33E-07	6.65E-05	1.21E-05	9.06E-06	1.61E-02	3.62E-06	9.08E-06	1.72E-02	--	3.35E-02
DP-84	Drop on TSF	Yes	0.60	1.21E-04	9.14E-05	7.11E-07	1.09E-04	1.98E-05	1.49E-05	2.65E-02	5.95E-06	1.49E-05	2.54E-03	--	2.94E-02
DP-85	Drops on TSF2	Yes	1.25	2.54E-04	1.92E-04	1.49E-06	2.29E-04	4.16E-05	3.12E-05	5.55E-02	1.25E-05	3.13E-05	5.33E-03	--	6.16E-02
DP-94	Transfer from Agg Stockpile to Loader	Yes	0.08												0.00E+00
DP-95	Transfer of Agg Material from Loader to Haul Truck	Yes	0.08												0.00E+00
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	Yes	0.08												0.00E+00
DP-97	Transfer from East Ore Stockpile to Loader	Yes	0.36	7.37E-05	5.57E-05	4.33E-07	6.65E-05	1.21E-05	9.06E-06	1.61E-02	3.62E-06	9.08E-06	1.72E-02	--	3.35E-02
DP-98	Transfer of Ore from Loader to Haul Truck	Yes	0.36	7.37E-05	5.57E-05	4.33E-07	6.65E-05	1.21E-05	9.06E-06	1.61E-02	3.62E-06	9.08E-06	1.72E-02	--	3.35E-02
DP-99	Transfer from Waste Chute Stockpile to Loader	Yes	3.21	8.56E-05	1.79E-04	4.46E-06	4.03E-05	8.89E-05	1.56E-05	2.50E-02	2.54E-05	1.41E-05	1.84E-02	--	4.38E-02
DP-100	Transfer of Waste Chute Material from Loader to Haul Truck	Yes	3.21	8.56E-05	1.79E-04	4.46E-06	4.03E-05	8.89E-05	1.56E-05	2.50E-02	2.54E-05	1.41E-05	1.84E-02	--	4.38E-02
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	Yes	7.92E-05												0.00E+00
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	Yes	3.57E-08												0.00E+00
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	Yes	9.97E-04												0.00E+00
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	Yes	2.26E-03												0.00E+00
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	Yes	1.09E-03												0.00E+00
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	Yes	1.18E-05												0.00E+00
DP-149	Drop of Sodium Bicarbonate	Yes	1.18E-05												0.00E+00
DC-1	21210-CX-00002 Main Shaft Ore Discharge Dust Collector 7	Yes	0.24	4.07E-05	3.25E-05	3.01E-07	3.61E-05	7.83E-06	5.08E-06	8.99E-03	2.33E-06	5.06E-06	9.46E-03	--	1.86E-02
DC-2	21210-CX-00001 Coarse Ore Overland Dust Collector 7	Yes	0.38	7.62E-05	5.75E-05	4.47E-07	6.87E-05	1.25E-05	9.36E-06	1.67E-02	3.75E-06	9.38E-06	1.78E-02	--	3.47E-02
DC-3	21210-CX-00003 Transfer Tower Silo Dust Collector 4	Yes	2.25	3.75E-04	3.00E-04	2.78E-06	3.33E-04	7.23E-05	4.69E-05	8.30E-02	2.15E-05	4.67E-05	8.73E-02	--	1.71E-01
DC-4	21510-CX-00001 Coarse Ore Silo Dust Collector 4	Yes	0.83	1.68E-04	1.27E-04	9.84E-07	1.51E-04	2.74E-05	2.06E-05	3.66E-02	8.24E-06	2.06E-05	3.91E-02	--	7.62E-02
DC-5	21710-CX-00002 Silo Discharge Dust Collector 5	Yes	0.81	1.65E-04	1.25E-04	9.71E-07	1.49E-04	2.71E-05	2.03E-05	3.61E-02	8.13E-06	2.03E-05	3.85E-02	--	7.52E-02
DC-12	22620-CX-00001 Copper Sulphate Mix Tank Dust Collector	Yes	0.30												0.00E+00
DC-13	22620-CX-00002 10% Zinc Sulphate Mix Tank Dust Collector	Yes	0.30												0.00E+00
DC-14	22620-CX-00005 50% Zinc Sulphate Mix Tank Dust Collector	Yes	0.30												0.00E+00
DC-15	22620-CX-00004 Caustic Mix Tank Dust Collector	Yes	0.30												0.00E+00
DC-16	22210-CX-00001 Pebble Crusher Dust Collector 4	Yes	0.93	1.88E-04	1.42E-04	1.11E-06	1.70E-04	3.08E-05	2.31E-05	4.11E-02	9.25E-06	2.32E-05	4.39E-02	--	8.56E-02
DC-PPBSS1	18610-SI-00001 Paste Plant Binder Storage Silo 1 6	Yes	0.14											--	0.00E+00
DC-PPBSS2	18610-SI-00002 Paste Plant Binder Storage Silo 2 6	Yes	0.14											--	0.00E+00
DC-PPBDS3	18610-SI-10003 Paste Plant Binder Dosage Silo 3 6	Yes	0.28											--	0.00E+00
DC-PPBDS4	18610-SI-20004 Paste Plant Binder Dosage Silo 4 6	Yes	0.28											--	0.00E+00
DC-PPM1M	18610-DC-20002 Paste Plant Module 1 Mixer 6	Yes	0.56											--	0.00E+00
DC-PPM2M	18610-DC-20002 Paste Plant Module 2 Mixer 6	Yes	0.56											--	0.00E+00
DC-7	Coarse Ore Dust Collection System,23100-FAN-0001	Yes	0.12	5.42E-05	6.52E-05	2.02E-07	1.47E-05	5.17E-06	7.21E-07	2.11E-02	9.37E-07	6.01E-07	2.11E-03	--	2.33E-02
DC-8	Coarse Ore Dust Collection System,23100-FAN-0002	Yes	0.12	5.42E-05	6.52E-05	2.02E-07	1.47E-05	5.17E-06	7.21E-07	2.11E-02	9.37E-07	6.01E-07	2.11E-03	--	2.33E-02
DC-CPPBS1	Paste Plant Binder Silo 1 6	Yes	0.14												0.00E+00
DC-CPPBS2	Paste Plant Binder Silo 2 6	Yes	0.14												0.00E+00
DC-CPPBS3	Paste Plant Binder Silo 3 6	Yes	0.28												0.00E+00
DC-CPPBS4	Paste Plant Binder Silo 4 6	Yes	0.28												0.00E+00
DC-CPPM1M	Paste Plant Module 1 Mixer 6	Yes	0.56												0.00E+00
DC-CPPM2M	Paste Plant Module 2 Mixer 6	Yes	0.56												0.00E+00
DC-10	Coarse Ore Dust Collection System,23100-DCD-0005	Yes	0.12	5.42E-05	6.52E-05	2.02E-07	1.47E-05	5.17E-06	7.21E-07	2.11E-02	9.37E-07	6.01E-07	2.11E-03	--	2.33E-02
WTP1LS	Waste Water Treatment Plant #1 Lime Silo	Yes	0.19											--	0.00E+00
WTP2 DC	Sodium Sulfate Indoor Dust Collector 5	Yes	0.01											--	0.00E+00
TNK-040	F549/MIBC	Yes	--	See Table A.2f for HAP emissions not included in this table.										--	0.00E+00
TNK-041	3407-A	Yes	--											--	0.00E+00
TNK-044	Solvay 5100	Yes	--											--	0.00E+00
TNK-045	Copper Sulphate	Yes	--											--	0.00E+00
TNK-046	Copper Sulphate	Yes	--											--	0.00E+00
TNK-047	Zinc Sulphate	Yes	--											--	0.00E+00
TNK-048	Zinc Sulphate	Yes	--											--	0.00E+00
TNK-051	Zinc Cyanide	Yes	--											--	0.00E+00
TNK-052	Zinc Cyanide	Yes	--											--	0.00E+00
TNK-053	SMBS	Yes	--											--	0.00E+00
TNK-054	SMBS	Yes	--											--	0.00E+00
TNK-057	Tailings Flocculant (SNF AN910-VHM)	Yes	--											--	0.00E+00
TNK-058	Tailings Flocculant (SNF AN910-VHM)	Yes	--											--	0.00E+00

TNK-059	Tailings Flocculant (SNF AN910-VHM)	Yes	--											--	0.00E+00
TNK-060	3418-A	Yes	--											--	0.00E+00
TNK-061	Shaft ANE	Yes	--											--	0.00E+00
TSF2	USFS Tailings Storage Facility	Yes	40.47	8.21E-03	6.20E-03	4.82E-05	7.40E-03	1.34E-03	1.01E-03	1.80	4.04E-04	1.01E-03	1.72E-01	--	1.99E+00
TSF_1	Tailing Storage Facility	Yes	16.45	3.34E-03	2.52E-03	1.96E-05	3.01E-03	5.47E-04	4.10E-04	0.73	1.64E-04	4.11E-04	7.01E-02	--	8.10E-01
WRS	West Rock Stockpile	Yes	0.67	1.17E-05	3.39E-05	9.38E-07	2.41E-06	1.84E-05	2.55E-06	3.92E-03	5.23E-06	2.21E-06	2.37E-03	--	6.37E-03
EOS	East Ore Stockpile	Yes	0.74	1.51E-04	1.14E-04	8.84E-07	1.36E-04	2.47E-05	1.85E-05	3.29E-02	7.40E-06	1.85E-05	3.51E-02	--	6.85E-02
TAGG	Taylor Agg Stockpile	Yes	4.53E-04											--	0.00E+00
TSHOT	Taylor Shotcrete Stockpile	Yes	8.06E-04											--	0.00E+00
HRS	Hardshell Rock Stockpile	Yes	3.95	6.88E-05	2.00E-04	5.53E-06	1.42E-05	1.08E-04	1.50E-05	2.31E-02	3.08E-05	1.30E-05	2.25E-02	--	4.61E-02
ORE	Clark Ore Stockpile	Yes	0.12	5.43E-05	6.54E-05	2.02E-07	1.48E-05	5.18E-06	7.23E-07	2.11E-02	9.39E-07	6.02E-07	2.12E-03	--	2.34E-02
ROM	Clark ROM Stockpile	Yes	0.04	1.61E-05	1.94E-05	6.00E-08	4.38E-06	1.54E-06	2.14E-07	6.27E-03	2.79E-07	1.79E-07	6.29E-04	--	6.94E-03
AGG	Clark Agg Stockpile	Yes	0.00											--	0.00E+00
SHOT	Clark Shotcrete Stockpile	Yes	0.00											--	0.00E+00
CHUTE	Waste Chute Stockpile	Yes	0.00	6.92E-08	1.44E-07	3.60E-09	3.26E-08	7.18E-08	1.26E-08	2.02E-05	2.05E-08	1.14E-08	1.49E-05	--	3.54E-05
WTP2CT	Cooling Towers	Yes	0.02											--	0.00E+00
PRODREF	Refrigeration Plant3	Yes	0.05												0.00E+00
BBREF	Refrigeration Plant3	Yes	0.08												0.00E+00
MILLREF	Primary Mill Cooling Tower	Yes	0.00												0.00E+00
SCRUBBER-1	Tank Exhaust HCN Scrubber	Yes	--	See Table A.2f for HAP emissions not included in this table.											0.00E+00
Tanks Exhaust	Process Tanks Exhaust	Yes	--												0.00E+00
CBP1_11	Taylor Concrete Batch Plant2	Yes	0.79												0.00E+00
CCBP1_11	Clark Concrete Batch Plant	Yes	0.04												0.00E+00
DOZER1-TSF2	Dozer Emissions	Yes	8.96	1.82E-03	1.37E-03	1.07E-05	1.64E-03	2.98E-04	2.24E-04	3.98E-01	8.94E-05	2.24E-04	3.82E-02		4.42E-01
DOZER2-TSF2	Dozer Emissions	Yes	8.96	1.82E-03	1.37E-03	1.07E-05	1.64E-03	2.98E-04	2.24E-04	3.98E-01	8.94E-05	2.24E-04	3.82E-02		4.42E-01
DOZER-WRS	Dozer Emissions	Yes	1.09	1.89E-05	5.49E-05	1.52E-06	3.91E-06	2.97E-05	4.13E-06	6.35E-03	8.47E-06	3.58E-06	3.84E-03		1.03E-02
DOZER-HRS	Dozer Emissions	Yes	1.09	1.89E-05	5.49E-05	1.52E-06	3.91E-06	2.97E-05	4.13E-06	6.35E-03	8.47E-06	3.58E-06	6.19E-03		1.27E-02
DOZER-TSF	Dozer Emissions	Yes	8.96	1.82E-03	1.37E-03	1.07E-05	1.64E-03	2.98E-04	2.24E-04	3.98E-01	8.94E-05	2.24E-04	3.82E-02		4.42E-01
DOZER-EOS	Dozer Emissions	Yes	1.09	2.20E-04	1.66E-04	1.29E-06	1.99E-04	3.61E-05	2.71E-05	4.82E-02	1.08E-05	2.71E-05	5.14E-02		1.00E-01
MEVAP1	Mechanical Evaporator	Yes	--												0.00E+00
MEVAP2	Mechanical Evaporator	Yes	--												0.00E+00
MEVAP3	Mechanical Evaporator	Yes	--												0.00E+00
22310-FC-00001	Lead Rougher	Yes	--												0.00E+00
22310-FC-00004	Lead Rougher Scavenger	Yes	--												0.00E+00
22310-FC-00008	Lead Cleaner Scalper	Yes	--												0.00E+00
22310-FC-00007	Lead Cleaner	Yes	--												0.00E+00
22310-FC-00009	Lead Cleaner Scavenger	Yes	--												0.00E+00
22310-FC-00005	Zinc Rougher	Yes	--												0.00E+00
22310-FC-00006	Zinc Rougher Scavenger	Yes	--												0.00E+00
22310-FC-00011	Zinc Cleaner Scalper	Yes	--												0.00E+00
22310-FC-00010	Zinc Cleaner	Yes	--												0.00E+00
22310-FC-00012	Zinc Cleaner Scavenger	Yes	--												0.00E+00
22430-TN-00001	Lead Concentrate Tank	Yes	--												0.00E+00
22430-TN-00002	Zinc Concentrate Tank	Yes	--												0.00E+00
22310-TN-00003	Lead Conditioning Tank	Yes	--												0.00E+00
22310-TN-00001	Zinc Conditioning Tank No. 1	Yes	--												0.00E+00
22310-TN-00002	Zinc Conditioning Tank No. 2	Yes	--												0.00E+00
DRILL-2	Drilling	Yes	0.02	8.68E-06	1.05E-05	3.23E-08	2.36E-06	8.28E-07	1.15E-07	3.38E-03	1.50E-07	9.62E-08	3.39E-04		3.74E-03
BLAST-2	Blasting	Yes	0.31	1.38E-04	1.67E-04	5.16E-07	3.76E-05	1.32E-05	1.84E-06	5.39E-02	2.39E-06	1.53E-06	5.40E-03		5.96E-02
DP-103	Dump into Primary Crusher Feed Hopper	Yes	0.29	1.31E-04	1.57E-04	4.86E-07	3.55E-05	1.24E-05	1.74E-06	5.08E-02	2.26E-06	1.45E-06	5.09E-03		5.62E-02
DP-104	Drop from silo to trucks	Yes	0.96	4.35E-04	5.24E-04	1.62E-06	1.18E-04	4.15E-05	5.79E-06	1.69E-01	7.53E-06	4.82E-06	1.70E-02		1.87E-01
DP-105	Transfer of Ore from Ore Stockpile to Loader	Yes	0.58	2.61E-04	3.14E-04	9.73E-07	7.09E-05	2.49E-05	3.47E-06	1.02E-01	4.52E-06	2.89E-06	1.02E-02		1.12E-01
DP-106	Transfer of Ore Mined from Loader to Haul Truck	Yes	0.58	2.61E-04	3.14E-04	9.73E-07	7.09E-05	2.49E-05	3.47E-06	1.02E-01	4.52E-06	2.89E-06	1.02E-02		1.12E-01
DP-107	Transfer from ROM Stockpile to Loader	Yes	0.16	7.16E-05	8.62E-05	2.67E-07	1.94E-05	6.82E-06	9.52E-07	2.79E-02	1.24E-06	7.94E-07	2.79E-03		3.08E-02
DP-109	Transfer from Agg Stockpile to Loader	Yes	0.08												0.00E+00
DP-110	Transfer of Agg Material from Loader to Haul Truck	Yes	0.08												0.00E+00
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	Yes	0.08												0.00E+00
DP-113	Hardshell Rock Storage	Yes	2.60	1.22E-04	2.20E-04	2.82E-06	3.29E-05	8.02E-05	5.79E-06	4.48E-02	1.68E-05	7.67E-06	1.47E-02		6.00E-02
DP-114	Ore Stockpile	Yes	0.58	2.61E-04	3.14E-04	9.73E-07	7.09E-05	2.49E-05	3.47E-06	1.02E-01	4.52E-06	2.89E-06	1.02E-02		1.12E-01
DP-115	ROM Stockpile	Yes	0.16	7.16E-05	8.62E-05	2.67E-07	1.94E-05	6.82E-06	9.52E-07	2.79E-02	1.24E-06	7.94E-07	2.79E-03		3.08E-02
DP-124	Transfer of Development Ore from Face to Loader	Yes	0.00	2.20E-07	2.98E-07	1.08E-09	6.02E-08	4.61E-08	4.14E-09	8.56E-05	7.77E-09	3.91E-09	1.16E-05		9.79E-05
DP-125	Transfer of Development Ore from Loader to Stockpile	Yes	0.00	2.20E-07	2.98E-07	1.08E-09	6.02E-08	4.61E-08	4.14E-09	8.56E-05	7.77E-09	3.91E-09	1.16E-05		9.79E-05
DP-126	Transfer of Development Ore from Stockpile to Loader	Yes	0.00	2.20E-07	2.98E-07	1.08E-09	6.02E-08	4.61E-08	4.14E-09	8.56E-05	7.77E-09	3.91E-09	1.16E-05		9.79E-05
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	Yes	0.00	2.20E-07	2.98E-07	1.08E-09	6.02E-08	4.61E-08	4.14E-09	8.56E-05	7.77E-09	3.91E-09	1.16E-05		9.79E-05
DP-129	Transfer of Development Waste Mined from Face to Loader	Yes	0.00	2.19E-07	3.96E-07	5.07E-09	5.91E-08	1.44E-07	1.04E-08	8.06E-05	3.02E-08	1.38E-08	2.65E-05		1.08E-04
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	Yes	0.00	2.19E-07	3.96E-07	5.07E-09	5.91E-08	1.44E-07	1.04E-08	8.06E-05	3.02E-08	1.38E-08	2.65E-05		1.08E-04
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	Yes	0.00	2.19E-07	3.96E-07	5.07E-09	5.91E-08	1.44E-07	1.04E-08	8.06E-05	3.02E-08	1.38E-08	2.65E-05		1.08E-04
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	Yes	0.00	2.19E-07	3.96E-07	5.07E-09	5.91E-08	1.44E-07	1.04E-08	8.06E-05	3.02E-08	1.38E-08	2.65E-05		1.08E-04
DP-134	Transfer of Stope Ore from Stope to Loader	Yes	0.00	1.16E-06	1.39E-06	4.31E-09	3.14E-07	1.10E-07	1.54E-08	4.50E-04	2.00E-08	1.28E-08	4.52E-05		4.99E-04
DP-135	Transfer of Stope Ore from Loader to Stockpile	Yes	0.00	1.16E-06	1.39E-06	4.31E-09	3.14E-07	1.10E-07	1.54E-08	4.50E-04	2.00E-08	1.28E-08	4.52E-05		4.99E-04
DP-136	Transfer of Stope Ore from Stockpile to Loader	Yes	0.00	1.16E-06	1.39E-06	4.31E-09	3.14E-07	1.10E-07	1.54E-08	4.50E-04	2.00E-08	1.28E-08	4.52E-05		4.99E-04
DP-137	Transfer of Stope Ore from Loader to Haul Truck	Yes	0.00	1.16E-06	1.39E-06	4.31E-09	3.14E-07	1.10E-07	1.54E-08	4.50E-04	2.00E-08	1.28E-08	4.52E-05		4.99E-04
PP-1	Truck Pneumatic Loadout to Silo 1	Yes	0.04												0.00E+00
PP-2	Truck Pneumatic Loadout to Silo 2	Yes	0.04												0.00E+00
PP-3	Truck Pneumatic Loadout to Silo 1	Yes	0.02												0.00E+00
PP-4	Truck Pneumatic Loadout to Silo 2	Yes	0.02												0.00E+00
ROADS	Road Emissions	Yes	311.25	4.51E-03	6.41E-03	6.23E-04	1.44E-04	1.00E-02	5.26E-03	2.19E-01	1.05E-02	9.34E-04	3.17E-02		2.89E-01
UGTROADS	Underground Taylor Roads	Yes	77.04	1.34E-03	3.90E-03	1.08E-04	2.77E-04	2.11E-03	2.93E-04	4.51E-01	6.01E-04	2.54E-04	2.73E-01		7.33E-01
UGCROADS	Underground Clark Roads	Yes	81.39	3.83E-03	6.90E-03	8.84E-05	1.03E-03	2.51E-03	1.82E-04	1.41E+00	5.27E-04	2.40E-04	4.61E-01		1.88E+00
ENGINE 0013 - 0056	CAT 3520 DSL 2600 kW	Yes	52.42	See Table A.2e for HAPs not included in this table.											--
ENGINE 0007 - 0012	CAT C18. 589 bkW	Yes	0.68												--
ENGINE 0002 - 0006	CAT C175 3000 kW	Yes	0.36												--
ENGINE 0001	C200D2RE	Yes	0.04												--
AGGDF-T	Aboveground Gasoline Dispensing Facility - Taylor	Yes	--	See Table A.2f for HAPs not included in this table.											--
AGGDF-C	Aboveground Gasoline Dispensing Facility - Clark	Yes	--												--
T-01	Unleaded Gasoline (S32)	Yes	--												--
T-02	Diesel (Red Dyed S32)	Yes	--												--
T-03	Diesel (Red Dyed S32)	Yes	--												--
T-04	Diesel (Red Dyed Rummel)	Yes	--												--
T-05	Unleaded Gasoline (Rummel)	Yes	--												--
T-06	Diesel (Rummel)	Yes	--												--
T-07	Unleaded Gasoline	Yes	--												--
T-08	Unleaded Gasoline	Yes	--												--
T-09	Unleaded Gasoline	Yes	--												--
T-10	Diesel	Yes	--												--
T-11	Diesel	Yes	--												--
	Total		649.75	3.18E-02	3.54E-02	9.66E-04	1.99E-02	1.86E-02	8.26E-03	7.27E+00	1.28E-02	3.95E-03	1.85E+00		9.26E+00

1. Table of HAP Constituents received from South32 in "Copy of Air Permitting Final 0 HAPs"

Table A-2c. Constituent Mass Fraction in LOM

HAP	Taylor				Clark			Taylor Weighted Average		
	Development Ore	Stope Ore	Rock	Tailings[1,2]	Development Ore	Stope Ore	Rock	All Material	Stope + Development Ore	Waste Chute Material
Antimony Compounds	0.0101%	0.0212%	0.0017%	0.0203%	0.024%	0.045%	0.005%	0.017%	0.020%	0.003%
Arsenic Compounds	0.0127%	0.0156%	0.0051%	0.0153%	0.033%	0.054%	0.008%	0.013%	0.015%	0.006%
Beryllium Compounds	0.0001%	0.0001%	0.0001%	0.0001%	0.0001%	0.0002%	0.0001%	0.000%	0.000%	0.000%
Cadmium Compounds	0.0060%	0.0194%	0.0004%	0.0183%	0.007%	0.012%	0.001%	0.015%	0.018%	0.001%
Chromium Compounds	0.0036%	0.0033%	0.0027%	0.0033%	0.005%	0.004%	0.003%	0.003%	0.003%	0.003%
Cobalt Compounds	0.0013%	0.0026%	0.0004%	0.0025%	0.0005%	0.001%	0.0002%	0.002%	0.002%	0.000%
Cyanide Compounds	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Manganese Compounds	4.0637%	4.4700%	0.5852%	4.4366%	9.497%	17.550%	1.726%	3.684%	4.437%	0.778%
Mercury Compounds	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nickel Compounds	0.0010%	0.0010%	0.0008%	0.0010%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%
Radionuclides	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Selenium Compounds	0.0014%	0.0026%	0.0003%	0.0025%	0.000%	0.001%	0.000%	0.002%	0.002%	0.000%
Lead Compounds	2.1756%	4.9606%	0.3541%	0.4259%	1.2896%	1.759%	0.5669%	3.876%	4.732%	0.573%

1. For constituents other than lead, tailings based on the weighted average of the development and stope ore throughput and mass fraction.

2. Estimated 91% recovery for lead ore. Since the recovery fractions for other metals are not known yet, it is conservatively assumed that all of those metals pass through to the tailings.

Notes on Lead

Material	Notes
Development Ore	Based on average inside domains
Stope Ore	Based on assays within stope design
Rock	Based on average lithology grades minus inside domains

Stope numbers based on evaluation of drillhole data through stope designs
Rock is the evaluation of assays within lithological units.

Table A-2d. Metal Content in Road Surface

Metal	Content (kg/kg)
Antimony	1.45E-05
Arsenic	2.06E-05
Beryllium	2.00E-06
Cadmium	4.64E-07
Chromium	3.22E-05
Cobalt	1.69E-05
Nickel	3.38E-05
Selenium	3.00E-06
Mercury	0.00E+00

Mean of 61 rock samples collected on Trachyandesite of Meadow Valley geologic base (Ka) reported in "Geochemical and Mineralogical Study of the Red Mountain Porphyry Copper-Molybdenum Deposit and Vicinity, Santa Cruz County, Arizona" 2020 prepared by USGS.

Table A-2e. Generator HAPs Summary

Emission ID	Description	HAP Annual Emissions (tpy)																								
		Benzene	Toluene	Xylene	1,3-Butadiene	Formaldehyde	Acetaldehyde	Acrolein	Naphthalene	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,3-Dichloropropene	2-Methylnaphthalene	2,2,4-Trimethylpentane	Biphenyl	Carbon Tetrachloride	Chlorobenzene	Chloroform	Ethylbenzene	Ethylene Dibromide	Methanol	Methylene Chloride	Hexane	PAH	Phenol	Tetrachloroethane	Vinyl Chloride	Total
ENGINE 0013 - 0056	Trench	2.11E-01	1.99E-01	0.09	0.13	6.75	27.46	2.46	0.04	0.19	0.15	0.01	0.02	0.12	0.10	0.17	0.14	0.13	0.02	0.21	1.20	0.09	0.53	0.36	0.11	0.01	0.07	**40.98**
ENGINE 0007 - 0017	Marshall	2.79E-01	8.17E-02	5.61E-02	1.14E-02	2.79E-02	2.70E-02	2.79E-03	3.78E-03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.78E-02	--	--	--	**0.47**
ENGINE 0002 - 0006	Taylor	6.01E-03	2.18E-03	1.49E-03	3.03E-04	6.11E-04	1.95E-04	6.10E-05	1.01E-03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.35E-04	--	--	--	**1.25E-02**
ENGINE 0001	WW1	8.17E-03	3.58E-03	2.50E-03	3.42E-04	1.03E-02	6.72E-03	8.10E-04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.29E-04	--	--	--	**3.32E-02**
	Total	**4.50E-01**	**2.83E-01**	**1.48E-01**	**1.40E-01**	**6.78E+00**	**2.75E+01**	**2.47E+00**	**7.44E-02**	**1.88E-01**	**1.49E-01**	**1.26E-02**	**1.59E-02**	**1.20E-01**	**1.02E-01**	**1.72E-01**	**1.43E-01**	**1.34E-01**	**1.90E-02**	**2.08E-01**	**1.20E+00**	**9.39E-02**	**5.32E-01**	**3.89E-01**	**1.13E-01**	**1.16E-02**	**7.00E-02**	**41.49**

Table A-2f. Emission Source - Other HAPs and Lead Compounds Summary

Emission ID	Description	HAP Annual Emissions (tpy)													
		Hydrogen Cyanide	Cresol	Ethylene Glycol Dimethyl Ether	Urethane	Benzene	Benzo(g,h,i)perylene	Cumene	Ethylbenzene	Hexane	Isooctane	Naphthalene	PAC's	Toluene	Xylene	Total
T-01	Unleaded Gasoline (CT2)		--	--	--	2.70E-03	1.48E-19	2.50E-05	1.57E-04	1.57E-04	2.72E-03	1.19E-06	1.19E-06	2.72E-03	6.66E-04	**7.2E-03**
T-02	Diesel (Red Dyed S32)		--	--	--	3.20E-06	1.60E-18	0.00E+00	5.01E-06	5.03E-06	0.00E+00	7.69E-07	7.69E-07	3.77E-05	9.81E-05	**1.5E-04**
T-03	Diesel (Red Dyed S32)		--	--	--	3.20E-06	1.60E-18	0.00E+00	5.01E-06	5.03E-06	0.00E+00	7.69E-07	7.69E-07	3.77E-05	9.81E-05	**1.5E-04**
T-04	Diesel (Red Dyed Rummel)		--	--	--	3.98E-06	2.01E-18	0.00E+00	6.77E-06	6.77E-06	0.00E+00	9.61E-07	9.61E-07	4.70E-05	1.23E-04	**1.9E-04**
T-05	Unleaded Gasoline (Rummel)		--	--	--	1.76E-03	1.29E-19	2.25E-05	1.32E-04	1.32E-04	2.01E-03	1.02E-06	1.02E-06	2.01E-03	5.78E-04	**6.6E-03**
T-06	Diesel (Rummel)		--	--	--	9.36E-07	4.61E-19	0.00E+00	1.46E-06	1.46E-06	0.00E+00	2.23E-07	2.23E-07	1.09E-05	2.84E-05	**4.4E-05**
T-07	Unleaded Gasoline		--	--	--	1.03E-02	7.62E-19	1.33E-04	7.78E-04	7.78E-04	1.19E-02	6.03E-06	6.03E-06	1.19E-02	3.40E-03	**3.9E-02**
T-08	Unleaded Gasoline		--	--	--	1.03E-02	7.62E-19	1.33E-04	7.78E-04	7.78E-04	1.19E-02	6.03E-06	6.03E-06	1.19E-02	3.40E-03	**3.9E-02**
T-09	Unleaded Gasoline		--	--	--	1.03E-02	7.62E-19	1.33E-04	7.78E-04	7.78E-04	1.19E-02	6.03E-06	6.03E-06	1.19E-02	3.40E-03	**3.9E-02**
T-10	Diesel		--	--	--	7.64E-05	3.86E-17	0.00E+00	1.20E-04	1.20E-04	0.00E+00	1.84E-05	1.84E-05	9.02E-04	2.35E-03	**3.6E-03**
T-11	Diesel		--	--	--	7.00E-05	3.54E-17	0.00E+00	1.10E-04	1.10E-04	0.00E+00	1.69E-05	1.69E-05	8.26E-04	2.15E-03	**3.3E-03**
TNK-040	F549/MIBC		--	2.62E-01	--	--	--	--	--	--	--	--	--	--	--	**2.6E-01**
TNK-041	1407-A		9.52E-05	--	--	--	--	--	--	--	--	--	--	--	--	**9.5E-05**
TNK-044	Solvay S100		--	--	3.67E-05	--	--	--	--	--	--	--	--	--	--	**3.7E-05**
AGGDF-T	Aboveground Gasoline Dispensing Facility - Taylor		--	--	--	1.52E-02	--	--	1.18E-02	8.45E-03	--	--	--	5.92E-02	5.92E-02	**1.5E-01**
AGSDF-C	Aboveground Gasoline Dispensing Facility - Clark		--	--	--	7.45E-03	--	--	5.80E-03	4.14E-03	--	--	--	2.90E-02	2.90E-02	**7.5E-02**
SCRUBBER-1	Tank Exhaust HCN Scrubber	5.38														**5.4E+00**
Tanks Exhaust	Process Tanks Exhaust	3.50E-02														**3.5E-02**
	Total	**5.41E+00**	**9.52E-05**	**2.62E-01**	**3.67E-05**	**5.76E-02**	**8.22E-17**	**4.46E-04**	**2.05E-02**	**1.55E-02**	**3.99E-02**	**5.84E-05**	**5.84E-05**	**1.30E-01**	**1.04E-01**	**6.04**

Table A-2g. Taylor Lead Content

Material	Lead Content (%)
Stope Ore	4.96%
Waste Rock	0.35%
Developmental Ore	2.18%
Tailings	0.43%
Stope Ore & Developmental Ore	4.73%
Stope Ore & Developmental Ore & Waste Rock	3.88%
Waste Chute Material	0.57%

Table A-3a. Taylor Drilling - Parameters and Emission Factors

Emission Point Number	Activity	Throughput [1]		Controlled Emission Factor[3]				Control [4]		
				PM	PM_{10}[2]	$PM_{2.5}$	Lead Compounds [5]	Type	$PM/PM_{10}/Pb$ Efficiency	$PM_{2.5}$ Efficiency
		(tons/hr)	(ton/year)	(lb/ton)	(lb/ton)	(lb/ton)	(lb/ton)		(%)	(%)
DRILL-1	Drilling	657	5,755,000	1.69E-04	8.00E-05	1.21E-05	8.39E-06	Gravity Settling due to underground drilling (underground only)	87%	17%

1. Per Total tonnes w/ backfill used from "Mined tonnes and Pb grade.xlsx" recd. on 7/12/2021
2. Per AP-42 Section 11.19.2, Table 11.19.2-2 (08/2004) for "Wet Drilling - Unfragmented Stone".
3. Per U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, the particle size multiplier used for calculating emission factors for PM_{10} and $PM_{2.5}$ is as follows:
   PM: 0.74
   PM_{10}: 0.35
   $PM_{2.5}$: 0.053
4. Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.Detailed calculations are included in the Gravity Settling Tab of this spreadsheet
5. Lead percentage in stope ore used conservatively for drilling 4.96 %

Table A-3b. Taylor Drilling - Emissions

Emission Point Number	Activity	Controlled Emissions [1]											
		Annual Emissions (tpy)				Daily Emissions (lb/day)				Hourly Emissions (lb/hr)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DRILL-1	Drilling	0.06	0.03	2.88E-02	3.02E-03	0.33	0.16	0.16	0.02	1.39E-02	6.57E-03	6.57E-03	6.89E-04

1. Controlled Emissions have been calculated for drilling since gravity settling is a part of an inherent process for underground mines.
Pursuant to 40 CFR §64.1, "control device" means "equipment, other than inherent process equipment, that is used to destroy or remove air pollutant(s) prior to discharge to the atmosphere." Furthermore, "inherent process equipment" means "equipment that is necessary for the proper or safe functioning of the process, or material recovery equipment that the owner or operator documents is installed and operated primarily for purposes other than compliance with air pollution regulations." The gravity settling is an inherent part of the process.

Table A-4a. Clark Drilling - Parameters and Emission Factors

Emission Point Number	Activity	Throughput [1]		Controlled Emission Factor[3]				Control [4]		
		(tons/hr)	(ton/year)	PM (lb/ton)	PM_{10}[2] (lb/ton)	$PM_{2.5}$ (lb/ton)	Lead Compounds [5] (lb/ton)	Type	PM/PM_{10}/Pb Efficiency (%)	$PM_{2.5}$ Efficiency (%)
DRILL-2	Drilling	128	1,125,000	1.69E-04	8.00E-05	1.21E-05	2.98E-06	Gravity Settling due to underground drilling (underground only)	80%	16%

1. Per email "Clark Updated Inputs for Air Permit" from Cayley Hoffman received on 9/8/2022
2. Per AP-42 Section 11.19.2, Table 11.19.2-2 (08/2004) for "Wet Drilling - Unfragmented Stone".
3. Per U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, the particle size multiplier used for calculating emission factors for PM10 and PM2.5 is as follows:
   PM: 0.74
   PM_{10}: 0.35
   $PM_{2.5}$: 0.053
4. Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.Detailed calculations are included in the Gravity Settling Tab of this spreadsheet
5. Lead percentage in stope ore used conservatively for drilling 1.76 %

Table A-4b. Clark Drilling - Emissions

Emission Point Number	Activity	Controlled Emissions [1]											
		Annual Emissions (tpy)				Daily Emissions (lb/day)				Hourly Emissions (lb/hr)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DRILL-2	Drilling	0.02	0.009	0.0057	0.0003	0.11	0.05	0.031	0.002	0.004	0.002	1.30E-03	7.73E-05

1. Controlled Emissions have been calculated for drilling since gravity settling is a part of an inherent process for underground mines.
Pursuant to 40 CFR §64.1, "control device" means "equipment, other than inherent process equipment, that is used to destroy or remove air pollutant(s) prior to discharge to the atmosphere." Furthermore, "inherent process equipment" means "equipment that is necessary for the proper or safe functioning of the process, or material recovery equipment that the owner or operator documents is installed and operated primarily for purposes other than compliance with air pollution regulations." The gravity settling is an inherent part of the process.

Table A-5a. Taylor Blasting - Parameters

Emission Point No.	Location	Blast Area (ft^2/blast) [1]	Throughput [1]		Blasting Rates [1]
		Maximum	(ton/hr)	(ton/yr)	(blasts/yr)
BLAST-1	Blasting	9,000	17.42	4,500	730

1. Per meetings with Kevin Mccoy on 9/9/2022, 10/14/2022, and 10/17/2022
Maximum Hourly emulsion usage = 17.42 ton/hr

Table A-5b. Taylor Blasting Emissions

Emission Point No.	Location	Pollutant	Emission Factor [1,2,3,4,5]	Unit	Controlled Emissions[6,7]		
					(tpy)	(lb/day)	(lb/hr)
BLAST-1	Blasting	NO_x	0.50	(lb/ton Emulsion)	1.13	--	8.71
		CO	27.00	(lb/ton Emulsion)	60.75	--	470.25
		H_2S	4.00	(lb/ton Emulsion)	9.00	--	69.67
		SO_2	1.00	(lb/ton Emulsion)	2.25	--	17.42
		PM	1.49	(Max lb/Blast)	0.55	2.99	1.49
		PM_{10}	0.78	(Max lb/Blast)	0.28	1.55	0.78
		$PM_{2.5}$	0.30	(Max lb/Blast)	0.11	0.59	0.30
		Lead (from ore)	0.07	(Max lb/Blast)	0.03	0.15	0.074
		CO_2	463.18	(lb/ton)	1,042.15	--	8,066.92

1. NO_X and CO emission factors based on "Fume Memo WESCO Aug 2021" pdf dated 19 August 2021 provided by Seth Fredrick Dyno Nobel Inc.

2. H_2S and SO_2 emission factors per AP-42 Section 13.3, Table 13.3-1 for dynamite, gelatin (January 1995).
This emission factor was used by FMI Climax Mine, Colorado (underground mine) per permit application in October 2013 for CDPHE Air Permit No. 95CC899.

3. PM emission factor calculated per AP-42 Section 11.9, Table 11.9-1 for blasting (July 1998)

$0.000014(A)^{1.5}$ where, A = horizontal area (ft^2), with blasting depth ≤ 70 ft

The following scaling factors are applied to PM emission factor to calculate PM_{10} and $PM_{2.5}$ emission factors per AP-42 Table 11.9-1:

PM_{10}: 0.52
$PM_{2.5}$: 0.03

4. CO_2 emission factor is based on "Testing of mining explosives with regard to the content of carbon oxides and nitrogen oxides in their detonation products" - Iwona Zawadzka-Malota, January 7, 2016.

5. Lead content in ore 4.96 %

6. Hourly emissions are based on 1 blast/hr (7 Developmental and 1 Stope sub-blasts per Blast). 1.00 blast/hr per meeting with Kevin McCoy on 9/9/2022
2.00 blasts/day per meeting with Kevin McCoy on 9/9/2022

Table A-6a. Clark Blasting - Parameters

Emission Point No.	Location	Blast Area (ft^2/blast) [1]	Throughput [1]		Blasting Rates [1]
		Maximum	(ton/hr)	(ton/yr)	(blasts/yr)
BLAST-2	Blasting	4,450	4.60	562	730

1. Per email "Clark Updated Inputs for Air Permit" from Cayley Hoffman received on 9/8/2022 and meetings on 10/2022
Maximum total emulsion usage = 4.60 tonnes/hr

Table A-6b. Clark Blasting Emissions

Emission Point No.	Location	Pollutant	Emission Factor [1,2,3,4,5]	Unit	Controlled Emissions[6,7]		
					(tpy)	(lb/day)	(lb/hr)
BLAST-2	Blasting	NO_x	0.50	(lb/ton Emulsion)	0.14	--	2.30
		CO	27.00	(lb/ton Emulsion)	7.59	--	124.11
		H_2S	4.00	(lb/ton Emulsion)	1.12	--	18.39
		SO_2	1.00	(lb/ton Emulsion)	0.28	--	4.60
		PM	0.84	(Max lb/Blast)	0.31	1.68	0.84
		PM_{10}	0.44	(Max lb/Blast)	0.16	0.87	0.437
		$PM_{2.5}$	0.10	(Max lb/Blast)	0.038	0.21	0.1045
		Lead (from ore)	0.01	(Max lb/Blast)	0.0054	0.03	0.0148
		CO_2	463.18	(lb/ton)	130.15	--	2,129.05

1. NO_X and CO emission factors based on "Fume Memo WESCO Aug 2021" pdf dated 19 August 2021 provided by Seth Fredrick Dyno Nobel Inc.

2. H_2S and SO_2 emission factors per AP-42 Section 13.3, Table 13.3-1 for dynamite, gelatin (January 1995).
This emission factor was used by FMI Climax Mine, Colorado (underground mine) per permit application in October 2013 for CDPHE Air Permit No. 95CC899.

3. PM emission factor calculated per AP-42 Section 11.9, Table 11.9-1 for blasting (July 1998)

$0.000014(A)^{1.5}$ where, A = horizontal area (ft^2), with blasting depth ≤ 70 ft

The following scaling factors are applied to PM emission factor to calculate PM_{10} and $PM_{2.5}$ emission factors per AP-42 Table 11.9-1:

PM_{10}: 0.52

$PM_{2.5}$: 0.03

4. CO_2 emission factor is based on "Testing of mining explosives with regard to the content of carbon oxides and nitrogen oxides in their detonation products" - Iwona Zawadzka-Malota, January 7, 2016.

5. Lead content in ore 1.76 %

6. Hourly emissions are based on 1 blast/hr (4 Developmental and 1 Stope sub-blasts per Blast). 1.00 blast/hr per meeting with Cayley Hoffman on 9/9/2022

2.00 blasts/day per meeting with Cayley Hoffman on 9/9/2022

Table A-7a. Crushing - Emission Factors

Emission Point Number	Description	Activity	Throughput [1,2]		Material	Lead Grade	Controlled Emission Factor [3,4,5]				Control [6]		
							PM	PM_{10}	$PM_{2.5}$	Lead Compounds	Type	PM/PM_{10} Efficiency	$PM_{2.5}$ Efficiency
			(ton ore/hr)	(ton ore/yr)			(lb/ton ore)	(lb/ton ore)	(lb/ton ore)	(lb/ton ore)		(%)	(%)
CRUSH-1	Underground Crushing	Primary Crushing	1,543	4,665,131	Stope Ore	4.96%	0.0012	0.00054	0.0001	5.95E-05	Gravity Settling	87%	17%
BREAK-1	Clark Rock Breaker	Rock Breaker	12	47,131	Clark Ore	1.76%	1.69E-04	8.00E-05	1.21E-05	2.98E-06	No Control as a Controlled Emission Factor is being used	0%	0%
BREAK-2	Underground Waste Rock Breaker	Rock Breaker	29	61,138	Waste Rock	0.35%	1.69E-04	8.00E-05	1.21E-05	5.99E-07	No Control as a Controlled Emission Factor is being used	0%	0%
BREAK-3 - BREAK-7	Various Underground Ore Rock Breakers	Rock Breaker	69	600,453	Stope Ore & Developmental Ore	4.73%	1.69E-04	8.00E-05	1.21E-05	8.00E-06	No Control as a Controlled Emission Factor is being used	0%	0%
BREAK-8	Underground Crusher Rock Breaker	Rock Breaker	538	1,624,871	Stope Ore & Developmental Ore	4.73%	1.69E-04	8.00E-05	1.21E-05	8.00E-06	No Control as a Controlled Emission Factor is being used	0%	0%

1. Annual Taylor rock breaker throughputs per meeting with Kevin McCoy on 5/3/2024

Hourly taylor rock breakers throughputs based on hourly drop throughput

Hourly crusher throughputs based on "thyssenkrupp ERC Product Range Sizes.pdf" recd. on 7/12/2021.

2. Rock breakers are hydraulic-type hammers that break down rock pieces that are too large for the Clark Grizzly Screen. As such, the throughput will correspond to a percent (%) of the total grizzly screen throughput. Emission factor is similar to drilling.

3. Crushing emission factors obtained from AP-42 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing for tertiary crushing

4. For rock breakers, per U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, the particle size multiplier used for calculating emission factors for PM_{10} and $PM_{2.5}$ is as follows:

PM: 0.74

PM_{10}: 0.35

$PM_{2.5}$: 0.053

5. Emission factors per AP-42 Section 11.19.2, Table 11.19.2-2 (08/2004) for "Wet Drilling - Unfragmented Stone".

6. Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.

For Watering	70%
Gravity Settling (underground only) (PM/PM_{10}/Pb)	87%
Gravity Settling (underground only) ($PM_{2.5}$)	17%

Table A-7b. Crushing - Emissions

Emission Point Number	Activity	Controlled Emissions											
		Annual Emissions (tpy)				Daily Emissions (lb/day)				Hourly Emissions (lb/hr)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
CRUSH-1	Underground Crushing[1]	0.35	0.16	0.19	0.02	5.56	2.50	3.06	0.28	0.23	0.10	0.13	0.01
BREAK-1	Clark Rock Breaker	3.99E-03	1.89E-03	2.85E-04	7.01E-05	0.05	0.02	3.50E-03	8.61E-04	2.04E-03	9.64E-04	1.46E-04	3.59E-05
BREAK-2	Underground Waste Rock Breaker	5.17E-03	2.45E-03	3.70E-04	1.83E-05	0.12	0.06	0.01	4.13E-04	4.86E-03	2.30E-03	3.48E-04	1.72E-05
BREAK-3 - BREAK-7	Various Underground Ore Rock Breakers	5.08E-02	2.40E-02	3.64E-03	2.40E-03	0.28	0.13	0.02	0.01	0.01	0.01	8.30E-04	5.49E-04
BREAK-8	Underground Crusher Rock Breaker	1.37E-01	6.50E-02	9.84E-03	6.50E-03	2.18	1.03	0.16	0.10	0.09	0.04	0.01	4.30E-03
Total		**0.55**	**0.25**	**0.21**	**0.03**	**8.18**	**3.74**	**3.25**	**0.39**	**0.34**	**0.16**	**0.14**	**0.02**

1. Controlled Emissions have been calculated for underground crushing since gravity settling is a part of an inherent process for underground mines.

Pursuant to 40 CFR §64.1, "control device" means "equipment, other than inherent process equipment, that is used to destroy or remove air pollutant(s) prior to discharge to the atmosphere." Furthermore, "inherent process equipment" means "equipment that is necessary for the proper or safe functioning of the process, or material recovery equipment that the owner or operator documents is installed and operated primarily for purposes other than compliance with air pollution regulations." The gravity settling is an inherent part of the process.

Table A-8a. Crushing Monthly - Emission Factors

Emission Point Number	Description	Activity	Throughput [1,2] (ton ore/month)	Material	Lead Grade	Controlled Emission Factor [3,4,5] PM (lb/ton ore)	PM_{10} (lb/ton ore)	$PM_{2.5}$ (lb/ton ore)	Lead Compounds (lb/ton ore)	Control [6] Type	PM/PM_{10} Efficiency (%)	$PM_{2.5}$ Efficiency (%)
CRUSH-1	Underground Crushing	Primary Crushing	388,761	Stope Ore	4.96%	0.0012	0.00054	0.0001	5.95E-05	Gravity Settling	87%	17%
BREAK-1	Clark Rock Breaker	Rock Breaker	3,927.6	Clark Ore	1.76%	1.69E-04	8.00E-05	1.21E-05	2.98E-06	No Control as a Controlled Emission Factor is being used	0%	0%
BREAK-2	Underground Waste Rock Breaker	Rock Breaker	5,095	Waste Rock	0.35%	1.69E-04	8.00E-05	1.21E-05	5.99E-07	No Control as a Controlled Emission Factor is being used	0%	0%
BREAK-3 - BREAK-7	Various Underground Ore Rock Breakers	Rock Breaker	50,038	Stope Ore & Developmental Ore	4.73%	1.69E-04	8.00E-05	1.21E-05	8.00E-06	No Control as a Controlled Emission Factor is being used	0%	0%
BREAK-8	Underground Crusher Rock Breaker	Rock Breaker	135,406	Stope Ore & Developmental Ore	4.73%	1.69E-04	8.00E-05	1.21E-05	8.00E-06	No Control as a Controlled Emission Factor is being used	0%	0%

1. Monthly throughput per email from Sarah Richman (South32) dated 5/18/2023

Monthly rock breaker throughput per Kevin McCoy (South32) on 4/31/2024

2. Rock breakers are hydraulic-type hammers that break down rock pieces that are too large for the Clark Grizzly Screen. As such, the throughput will correspond to a percent (%) of the total grizzly screen throughput. Emission factor is similar to drilling.

3. Crushing emission factors obtained from AP-42 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing for tertiary crushing

4. Assumed that $PM_{2.5}$ is approximately 30% of PM_{10} per AP-42, as calculated below and described in AP-42 Appendix B.2, Category 3, September 1990.

	% cumulative size	
$PM_{2.5}$	15	%
PM_{10}	51	%
Ratio $PM_{2.5}/PM_{10}$	0.29	

5. Emission factors per AP-42 Section 11.19.2, Table 11.19.2-2 (08/2004) for "Wet Drilling - Unfragmented Stone".

6. Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.

For Watering	70%
Gravity Settling (underground only) ($PM/PM_{10}/Pb$)	87%
Gravity Settling (underground only) ($PM_{2.5}$)	17%

Table A-8b. Crushing Monthly - Emissions

Emission Point Number	Activity	Controlled Emissions Monthly Emissions (lb/month) PM	PM_{10}	$PM_{2.5}$	Lead Compounds
CRUSH-1	Underground Crushing [1]	58.32	26.25	32.11	2.89E+00
BREAK-1	Clark Rock Breaker	6.64E-01	3.14E-01	4.76E-02	1.17E-02
BREAK-2	Underground Waste Rock Breaker	8.62E-01	4.08E-01	6.17E-02	3.05E-03
BREAK-3 - BREAK-7	Various Underground Ore Rock Breakers	8.46E+00	4.00E+00	6.06E-01	4.00E-01
BREAK-8	Underground Crusher Rock Breaker	2.29E+01	1.08E+01	1.64E+00	1.08E+00
Total		**91.22**	**41.80**	**34.47**	**4.39**

1. Controlled Emissions have been calculated for underground crushing since gravity settling is a part of an inherent process for underground mines.

Pursuant to 40 CFR §64.1, "control device" means "equipment, other than inherent process equipment, that is used to destroy or remove air pollutant(s) prior to discharge to the atmosphere." Furthermore, "inherent process equipment" means "equipment that is necessary for the proper or safe functioning of the process, or material recovery equipment that the owner or operator documents is installed and operated primarily for purposes other than compliance with air pollution regulations." The gravity settling is an inherent part of the process.

Table A-9a. Taylor Drops - Emissions - Inputs - Hourly/Daily

Emission Point Number	Description	Throughput [1] (tph)	Material	Lead Grade [1]	Water Content (%) [1]	Control Method	Control Factor [2]		Windspeed [3]	Uncontrolled Emission Factor [4]			
							PM/PM_{10} Efficiency (%)	$PM_{2.5}$ Efficiency (%)	(mph)	PM (lb/ton)	PM_{10} (lb/ton)	$PM_{2.5}$ (lb/ton)	Lead Compounds (lb/ton)
Coarse Ore Delivery and Storage													
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	714.04	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Full Enclosure, Watering	85%	85%	19.49	5.26E-03	2.49E-03	3.77E-04	2.04E-04
DP-2	Drop from 21210-FE-00001 Main Shaft Ore Discharge Feeder to 21210-CV-00003 Main Shaft Outfeed Conveyor	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00002 Main Shaft Ore Discharge Dust Collector (DC-1)			19.49	--	--	--	--
DP-3	Drop from 21210-CV-00003 Main Shaft Outfeed Conveyor to 21210-CV-00001 Coarse Ore Overland Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21210-CX-00001 Coarse Ore Overland Conveyor Dust Collector (DC-2)			19.49	--	--	--	--
DP-4	Drop from Shaft to Waste Chute	126.67	Waste Chute Material	0.57%	4.00	Watering	70%	70%	19.49	5.26E-03	2.49E-03	3.77E-04	3.01E-05
DP-5	Drop from 21210-CV-00003 Main Shaft Outfeed Conveyor to 21210-BN-00002 Transfer Tower Storage Bin	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00003 Transfer Tower Dust Collector (DC-3)			19.49	--	--	--	--
DP-6	Drop from 21210-BN-00002 Transfer Tower Storage Bin to Haul Truck	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00003 Transfer Tower Dust Collector			19.49	--	--	--	--
DP-7	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00001 Coarse Ore Silo No. 1	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-8	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00002 Coarse Ore Silo No. 2	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-9	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00003 Coarse Ore Silo No. 3	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-10	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00004 Coarse Ore Silo No. 4	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-11	Drop from 21710-FE-00001/00002 Coarse Ore Silo No.1 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-12	Drop from 21710-FE-00003/00005 Coarse Ore Silo No.2 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-13	Drop from 21710-FE-00006/00007 Coarse Ore Silo No. 3 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-14	Drop from 21710-FE-00008/00009 Coarse Ore Silo No.4 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-15	Drop from 21710-CV-00001 Primary Mill Feed Conveyor to 22110-CH-00001 Primary Mill Feed Chute	--	Stope Ore & Developmental Ore	4.73%	25.00	Wet Stream, no emissions expected			19.49	--	--	--	--
DP-16	Drop from 22110-ML-00001 Primary Mill to 22110-SN-00002 Primary Mill Discharge Screen	--	Stope Ore & Developmental Ore	4.73%	25.00	Wet Stream, no emissions expected			19.49	--	--	--	--
DP-17	Drop from 22110-SN-00002 Primary Mill Discharge Screen to 22210-CV-00002 Primary Screen Discharge Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-18	Drop from 22210-CV-00002 Primary Screen Discharge Conveyor to 22210-CV-00001 Pebble Crusher Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-19	Drop from 22210-CV-00001 Pebble Crusher Feed Conveyor to 22210-BN-00001 Pebble Crusher Feed Bin/Bunker/22210-FE-00002 Pebble Crusher Product Return Feeder	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-20	Drop from 22210-FE-00002 Pebble Crusher Product Return Feeder to 21710-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	459.12	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	5.26E-03	2.49E-03	3.77E-04	2.49E-04
Underground Drops													
DP-22	Transfer from face to loader	714.04	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	6.04E-06
DP-23	Transfer from loader to haul truck, as needed	714.04	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	6.04E-06
DP-24	Drop from loader or haul truck through grizzly to ore pass	527.27	Stope Ore	4.96%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.73E-06
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	527.27	Stope Ore	4.96%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.73E-06
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	574.46	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	574.46	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	574.46	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	574.46	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	5.82	1.09E-03	5.17E-04	7.82E-05	5.17E-05
DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	139.58	Waste Rock	0.35%	4.00	Gravity Settling, Watering	96%	75%	5.82	1.09E-03	5.17E-04	7.82E-05	3.87E-06

DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	574.46	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	1.12E-05
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	139.58	Waste Rock	0.35%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	8.36E-07
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	714.04	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	9.15E-06
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	714.04	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	9.15E-06
WTP2													
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	1.19E-02	Dry Anionic Flocculant	0.00%	0.25	Enclosure by building	80%	80%	1.30	0.0076	0.0036	0.0005	--
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	5.39E-06	Dry Cationic Flocculant	0.00%	0.25	Enclosure by building	80%	80%	1.30	0.0076	0.0036	0.0005	--
DP-140	Drop of Sodium Sulfate to Bulk Handling System	3.72E-02	Sodium Sulfate	0.00%	0.25	Controlled by WTP2 DC			19.49	--	--	--	--
Reagents													
DP-141	Drop of Copper Sulphate into 22620-TN-00005 Copper Sulphate Mix Tank	--	Copper Sulphate	0%	0.25	Controlled by DC-12 22620-CX-00001 Copper Sulphate Mix Tank Dust Collector			19.49	0.2551	0.1207	0.0183	--
DP-142	Drop of 50% Zinc Sulphate into 22620-TN-00025 50% Zinc Sulphate Mix/Holding Tank	--	50% Zinc Sulphate	0%	0.25	Controled by DC-14 22620-CX-00005 50% Zinc Sulphate Mix Tank Dust Collector			19.49	0.2551	0.1207	0.0183	--
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	0.08	Lead Concentrate Flocculant	0%	0.25	No Control	0%	0%	19.49	0.2551	0.1207	0.0183	--
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	3.31	Tailings Flocculant	0%	0.25	No Control	0%	0%	19.49	0.2551	0.1207	0.0183	--
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	0.05	Zinc Concentrate Flocculant	0%	0.25	No Control	0%	0%	19.49	0.2551	0.1207	0.0183	--
DP-146	Drop of 10% Zinc Sulphate to 22620-TN-00007 10% Zinc Sulphate Mix Tank	--	10% Zinc Sulphate	0%	0.25	Controled by DC-13 22620-CX-00002 10% Zinc Sulphate Mix Tank Dust Collector			19.49	0.2551	0.1207	0.0183	--
DP-147	Drop of Caustic to 22620-TN-00023 Caustic Mix/Holding Tank	--	Caustic	0%	0.25	Controlled by DC-15 22620-CX-00004 Caustic Mix Tank			19.49	0.2551	0.1207	0.0183	--
Stockpile Drops													
DP-82	Drop on West Rock Stockpile	13.82	Waste Rock	0.35%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	1.86E-05
DP-83	Drop on East Ore Stockpile	643.01	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-84	TSF	117.77	Tailings	0.43%	11.80	No Control	0%	0%	19.49	0.0012	0.0005	0.0001	4.93E-06
DP-85	Drops on TSF2	247.02	Tailings	0.43%	11.80	No Control	0%	0%	19.49	0.0012	0.0005	0.0001	4.93E-06
From Stockpiles													
DP-94	Transfer from Agg Stockpile to Loader	9.19	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-95	Transfer of Agg Material from Loader to Haul Truck	9.19	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	6.43	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-97	Transfer from East Ore Stockpile to Loader	643.01	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-98	Transfer of Ore from Loader to Haul Truck	643.01	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-99	Transfer from Waste Chute Stockpile to Loader	126.67	Waste Chute Material	0.57%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	3.01E-05
DP-100	Transfer of Waste Chute Material from Loader to Haul Truck	126.67	Waste Chute Material	0.57%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	3.01E-05
WTP1													
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	8.92E-04	Anionic Flocculant	0.00%	0.25	No Control	0%	0%	1.3	7.55E-03	3.57E-03	5.41E-04	--
DP-149	Drop of Sodium Bicarbonate	8.92E-04	Sodium Bicarbonate	0.00%	0.25	No Control	0%	0%	1.3	7.55E-03	3.57E-03	5.41E-04	--

1. Per February 2021 dated Process Flow Diagram, provided by South32 in May 2021.
Confirmed by RFI provided by South32, Sarah Richman, on 7/12/2021.
Per August 2023 date Process Flow Diagrams, provided by South32 in April 2024.
Reagent throughputs per RFI responses from Matt Novak on 4/26/2024 and 6/19/2024

2. Control Factor based on conservative assumptions using "Nevada DEP - Guidance on Emission Factors for the Mining Industry" and West Virginia DEP Nonmetallic Mineral Processing Plants Application Instructions and Forms for General Permit G40-C - Table A

For Watering	70%
Moisture Content (Moisture Content taken into account in AP-42 Drop Equation)	0%
Gravity Settling (underground only) ($PM/PM_{10}/Pb$)	87%
Gravity Settling (underground only) ($PM_{2.5}$)	17%
For Full Enclosure/Enclosure by building	80%
For Partial Enclosure	50%
No control	0%

Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.

Detailed calculations are included in the Gravity Settling Tab of this spreadsheet

3. Underground wind speeds at various drop locations based on ventilation design wind speeds provied in emails from Kevin McCoy (South32) on 05/18/2023 and Cayley Hoffman (South32) on 05/22/2023. For wind speeds under 1.3 miles/hour, a minimum wind speed of 1.3 was conservatively used

4. Uncontrolled emission factors using the "drop equation" contained in U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, as follows:

$$E = k(0.0032)\ \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where E = Emission factor (lb/ton)

	PM	PM_{10}	$PM_{2.5}$	
k = Particle size multiplier (dimensionless)	0.74	0.35	0.053	
U = Mean wind speed (miles per hour [mph]), which is equal to:	19.49	Based on 2019-2021 On-Site Met Data		
	1.3	For indoor activities, based on minimum value of wind speed per AP-42 Section 13.2.4.		

M = Moisture Content (%) (Assuming 0.25 if water content not specified per EPA AP-42, Section 13.2.4 Equation 1

0.25 %

Table A-9b. Taylor Drops - Hourly/Daily Emissions - Controlled

Emission Point Number	Description	Controlled Emissions							
		Hourly Emissions (lb/hr)				Daily Emissions (lb/day)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	0.56	0.27	0.04	2.18E-02	13.52	6.39	0.97	5.24E-01
DP-4	Drop from Shaft to Waste Chute	0.20	0.09	0.01	1.15E-03	4.80	2.27	0.34	2.75E-02
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	2.41	1.14	0.173	1.14E-01	57.95	27.41	4.15	2.74E+00
DP-22	Transfer from face to loader	0.004	0.002	0.002	1.62E-04	0.10	0.05	0.05	3.88E-03
DP-23	Transfer from loader to haul truck, as needed	0.004	0.002	0.002	1.62E-04	0.10	0.05	0.05	3.88E-03
DP-24	Drop from loader or haul truck through grizzly to ore pass	0.003	0.001	0.001	1.53E-04	0.07	0.03	0.03	3.67E-03
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	0.003	0.001	0.001	1.53E-04	0.07	0.03	0.03	3.67E-03
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	0.003	0.002	0.002	1.59E-04	0.08	0.04	0.04	3.81E-03
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	0.003	0.002	0.002	1.59E-04	0.08	0.04	0.04	3.81E-03
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	0.003	0.002	0.002	1.59E-04	0.08	0.04	0.04	3.81E-03
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	0.024	0.011	0.011	1.11E-03	0.56	0.27	0.27	2.67E-02
DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	0.006	0.003	0.003	2.02E-05	0.14	0.06	0.06	4.86E-04
DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	0.005	0.002	0.002	2.41E-04	0.12	0.06	0.06	5.77E-03
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	0.001	0.001	0.001	4.37E-06	0.03	0.01	0.01	1.05E-04
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	0.006	0.003	0.003	2.45E-04	0.15	0.07	0.07	5.88E-03
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	0.006	0.003	0.003	2.45E-04	0.15	0.07	0.07	5.88E-03
DP-82	Drop on West Rock Stockpile	0.07	0.03	0.01	2.57E-04	1.74	0.83	0.12	6.18E-03
DP-83	Drop on East Ore Stockpile	3.38	1.60	0.24	1.60E-01	81.16	38.39	5.81	3.84E+00
DP-84	TSF	0.14	0.06	0.01	5.80E-04	3.27	1.55	0.23	1.39E-02
DP-85	Drops on TSF2	0.29	0.14	0.02	1.22E-03	6.86	3.24	0.49	2.92E-02
DP-94	Transfer from Agg Stockpile to Loader	0.15	0.07	0.01	--	3.63	1.72	0.26	--
DP-95	Transfer of Agg Material from Loader to Haul Truck	0.15	0.07	0.01	--	3.63	1.72	0.26	--
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	0.11	0.05	0.01	--	2.54	1.20	0.18	--
DP-97	Transfer from East Ore Stockpile to Loader	3.38	1.60	0.24	0.16	81.16	38.39	5.81	3.84E+00
DP-98	Transfer of Ore from Loader to Haul Truck	3.38	1.60	0.24	0.16	81.16	38.39	5.81	3.84E+00
DP-99	Transfer from Waste Chute Stockpile to Loader	0.67	0.32	0.05	0.00	15.99	7.56	1.15	9.16E-02
DP-100	Transfer of Waste Chute Material from Loader to Haul Truck	0.67	0.32	0.05	0.00	15.99	7.56	1.15	9.16E-02
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	1.80E-05	8.50E-06	1.29E-06	--	4.31E-04	2.04E-04	3.09E-05	--
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	8.14E-09	3.85E-09	5.84E-10	--	1.95E-07	9.24E-08	1.40E-08	--
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	0.02	0.01	0.00	--	0.46	0.22	0.03	--
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	0.84	0.40	0.06	--	20.25	9.58	1.45	--
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	0.01	0.01	0.00	--	0.31	0.14	0.02	--
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	6.74E-06	3.19E-06	4.83E-07	--	1.62E-04	7.65E-05	1.16E-05	--
DP-149	Drop of Sodium Bicarbonate	6.74E-06	3.19E-06	4.83E-07	--	1.62E-04	7.65E-05	1.16E-05	--
Total		**16.51**	**7.81**	**1.21**	**0.63**	**396.17**	**187.38**	**29.08**	**15.12**

Table A-10a. Taylor Drops - Emissions - Inputs - Hourly/Daily

Emission Point Number	Description	Throughput [1] (tons/month)	Material	Lead Grade [1]	Water Content (%) [1]	Control Method	Control Factor [2]		Windspeed [3]	Uncontrolled Emission Factor [4]			
							PM/PM_{10} Efficiency (%)	$PM_{2.5}$ Efficiency (%)	(mph)	PM (lb/ton)	PM_{10} (lb/ton)	$PM_{2.5}$ (lb/ton)	Lead Compounds (lb/ton)
Coarse Ore Delivery and Storage													
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	521,251	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Full Enclosure, Watering	85%	85%	19.49	5.26E-03	2.49E-03	3.77E-04	2.04E-04
DP-2	Drop from 21210-FE-00001 Main Shaft Ore Discharge Feeder to 21210-CV-00003 Main Shaft Outfeed Conveyor	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00002 Main Shaft Ore Discharge Dust Collector			19.49	5.26E-03	2.49E-03	3.77E-04	2.04E-04
DP-3	Drop from 21210-CV-00003 Main Shaft Outfeed Conveyor to 21210-CV-00001 Coarse Ore Overland Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21210-CX-00001 Coarse Ore Overland Conveyor Dust Collector			19.49	5.26E-03	2.49E-03	3.77E-04	2.49E-04
DP-4	Drop from Shaft to Waste Chute	101,710	Waste Chute Material	0.57%	4.00	Watering	70%	70%	19.49	5.26E-03	2.49E-03	3.77E-04	3.01E-05
DP-5	Drop from 21210-CV-00003 Main Shaft Outfeed Conveyor to 21210-BN-00002 Transfer Tower Storage Bin	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00003 Transfer Tower Dust Collector (DC-3)			--	--	--	--	--
DP-6	Drop from 21210-BN-00002 Transfer Tower Storage Bin to Haul Truck	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00003 Transfer Tower Dust Collector (DC-3)			--	--	--	--	--
DP-7	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00001 Coarse Ore Silo No. 1	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			--	--	--	--	--
DP-8	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00002 Coarse Ore Silo No. 2	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			--	--	--	--	--
DP-9	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00003 Coarse Ore Silo No. 3	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			--	--	--	--	--
DP-10	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00004 Coarse Ore Silo No. 4	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			--	--	--	--	--
DP-11	Drop from 21710-FE-00001/00002 Coarse Ore Silo No.1 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			--	--	--	--	--
DP-12	Drop from 21710-FE-00003/00005 Coarse Ore Silo No.2 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			--	--	--	--	--
DP-13	Drop from 21710-FE-00006/00007 Coarse Ore Silo No. 3 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			--	--	--	--	--
DP-14	Drop from 21710-FE-00008/00009 Coarse Ore Silo No.4 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			--	--	--	--	--
DP-15	Drop from 21710-CV-00001 Primary Mill Feed Conveyor to 22110-CH-00001 Primary Mill Feed Chute	--	Stope Ore & Developmental Ore	4.73%	25.00	Wet Stream, no emissions expected			--	--	--	--	--
DP-16	Drop from 22110-ML-00001 Primary Mill to 22110-SN-00002 Primary Mill Discharge Screen	--	Stope Ore & Developmental Ore	4.73%	25.00	Wet Stream, no emissions expected			--	--	--	--	--
DP-17	Drop from 22110-SN-00002 Primary Mill Discharge Screen to 22210-CV-00002 Primary Screen Discharge Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			--	--	--	--	--
DP-18	Drop from 22210-CV-00002 Primary Screen Discharge Conveyor to 22210-CV-00001 Pebble Crusher Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			--	--	--	--	--
DP-19	Drop from 22210-CV-00001 Pebble Crusher Feed Conveyor to 22210-BN-00001 Pebble Crusher Feed Bin/Bunker/22210-FE-00002 Pebble Crusher Product Return Feeder	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			--	--	--	--	--
DP-20	Drop from 22210-FE-00002 Pebble Crusher Product Return Feeder to 21710-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			--	--	--	--	--
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	11,516	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	5.26E-03	2.49E-03	3.77E-04	2.49E-04
Underground Drops													
DP-22	Transfer from face to loader	521,251	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.30	1.56E-04	7.37E-05	1.12E-05	6.04E-06
DP-23	Transfer from loader to haul truck, as needed	521,251	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.30	1.56E-04	7.37E-05	1.12E-05	6.04E-06
DP-24	Drop from loader or haul truck through grizzly to ore pass	384,906	Stope Ore	4.96%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.30	1.56E-04	7.37E-05	1.12E-05	7.73E-06
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	384,906	Stope Ore	4.96%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.30	1.56E-04	7.37E-05	1.12E-05	7.73E-06
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	419,355	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	419,355	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	419,355	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	419,355	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96.25%	75.22%	5.82	1.09E-03	5.17E-04	7.82E-05	5.17E-05
DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	101,897	Waste Rock	0.35%	4.00	Gravity Settling, Watering	96.25%	75.22%	5.82	1.09E-03	5.17E-04	7.82E-05	3.87E-06

DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	419,355	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.79	2.36E-04	1.12E-04	1.69E-05	1.12E-05
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	101,897	Waste Rock	0.35%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.79	2.36E-04	1.12E-04	1.69E-05	8.36E-07
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	521,251	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96.25%	75.22%	1.79	2.36E-04	1.12E-04	1.69E-05	9.15E-06
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	521,251	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	9.15E-06
Stockpile Drops													
DP-82	Drop on West Rock Stockpile	10,091	Waste Rock	0.35%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	1.86E-05
DP-83	Drop on East Ore Stockpile	11,516	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-84	TSF	85,969	Tailings	0.43%	11.80	No Control	0%	0%	19.49	0.0012	0.0005	0.0001	4.93E-06
DP-85	Drops on TSF2	180,323	Tailings	0.43%	11.80	No Control	0%	0%	19.49	0.0012	0.0005	0.0001	4.93E-06
From Stockpiles													
DP-94	Transfer from Agg Stockpile to Loader	6,834	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-95	Transfer of Agg Material from Loader to Haul Truck	6,834	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	4,784	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-97	Transfer of Ore from East Ore Stockpile to Loader	11,516	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-98	Transfer of Ore from Loader to Haul Truck	11,516	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-99	Transfer from Waste Chute to Loader	101,710	Waste Chute Material	0.57%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	3.01E-05
DP-100	Transfer from Loader to Haul Truck	101,710	Waste Chute Material	0.57%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	3.01E-05
WTP2													
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	1.08E-03	Dry Anionic Flocculant	0.00%	0.25	Enclosure by building	80%	80%	1.30	0.0076	0.0036	0.0005	--
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	5.39E-06	Dry Cationic Flocculant	0.00%	0.25	Enclosure by building	80%	80%	1.30	0.0076	0.0036	0.0005	--
DP-140	Drop of Sodium Sulfate to Bulk Handling System	3.72E-02	Sodium Sulfate	0.00%	0.25	Controlled by WTP2 DC			1.30	0.0076	0.0036	0.0005	--
Reagents													
DP-141	Drop of Copper Sulphate into 22620-TN-00005 Copper Sulphate Mix Tank	--	Copper Sulphate	0%	0.25	Controlled by DC-12 22620-CX-00001 Copper Sulphate Mix Tank Dust Collector			19.49	0.26	0.12	0.02	0
DP-142	Drop of 50% Zinc Sulphate into 22620-TN-00025 50% Zinc Sulphate Mix/Holding Tank	--	50% Zinc Sulphate	0%	0.25	Controlled by DC-14 22620-CX-00005 50% Zinc Sulphate Mix Tank Dust Collector			19.49	0.26	0.12	0.02	0
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	0.72	Lead Concentrate Flocculant	0%	25%	No Control	0%	0%	19.49	0.26	0.12	0.02	0
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	0.72	Tailings Flocculant	0%	0.25	No Control	0%	0%	19.49	0.26	0.12	0.02	0
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	1.51	Zinc Concentrate Flocculant	0%	0.25	No Control	0%	0%	19.49	0.26	0.12	0.02	0
DP-146	Drop of 10% Zinc Sulphate to 22620-TN-00007 10% Zinc Sulphate Mix Tank	--	10% Zinc Sulphate	0%	0.25	Controlled by DC-13 22620-CX-00002 10% Zinc Sulphate Mix Tank Dust Collector			19.49	0.26	0.12	0.02	0.00E+00
DP-147	Drop of Caustic to 22620-TN-00023 Caustic Mix/Holding Tank	--	Caustic	0%	0.25	Controlled by DC-15 22620-CX-00004 Caustic Mix Tank			19.49	0.26	0.12	0.02	0.00E+00
WTP1													
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	0.65	Anionic Flocculant	0%	0.25	No Control	0%	0%	1.30	7.55E-03	3.57E-03	5.41E-04	0
DP-149	Drop of Sodium Bicarbonate	0.65	Sodium Bicarbonate	0%	0.25	No Control	0%	0%	1.30	7.55E-03	3.57E-03	5.41E-04	0

1. Per February 2021 dated Process Flow Diagram, provided by South32 in May 2021.
Confirmed by RFI provided by South32, Sarah Richman, on 7/12/2021.
Per August 2023 date Process Flow Diagrams, provided by South32 in April 2024.
Reagent throughputs per RFI responses from Matt Novak on 4/26/2024 and 6/19/2024

2. Control Factor based on conservative assumptions using "Nevada DEP - Guidance on Emission Factors for the Mining Industry" and West Virginia DEP Nonmetallic Mineral Processing Plants Application Instructions and Forms for General Permit G40-C - Table A

For Watering	70%
Moisture Content (Moisture Content taken into account in AP-42 Drop Equation)	0%
Gravity Settling (underground only) (PM/PM_{10}/Pb)	87%
Gravity Settling (underground only) ($PM_{2.5}$)	17%
For Full Enclosure/Enclosure by building	80%
For Partial Enclosure	50%
No control	0%

Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.

Detailed calculations are included in the Gravity Settling Tab of this spreadsheet

4. Underground wind speeds at various drop locations based on ventilation design wind speeds provied in emails from Kevin McCoy (South32) on 05/18/2023 and Cayley Hoffman (South32) on 05/22/2023. For wind speeds under 1.3 miles/hour, a minimum wind speed of 1.3 was conservatively used

3. Uncontrolled emission factors using the "drop equation" contained in U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, as follows:

$$E = k(0.0032)\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where E = Emission factor (lb/ton)

	PM	PM_{10}	$PM_{2.5}$	
k = Particle size multiplier (dimensionless)	0.74	0.35	0.053	
U = Mean wind speed (miles per hour [mph]), which is equal to:	19.49			Based on 2019-2021 On-Site Met Data
	1.3			For indoor activities, based on minimum value of wind speed per AP-42 Section 13.2.4.

M = Moisture Content (%) (Assuming 0.25 if water content not specified per EPA AP-42, Section 13.2.4 Equation 1

0.25 %

Table A-10b. Taylor Drops - Monthly Emissions - Controlled

Emission Point Number	Description	Controlled Emissions							
		Monthly Emissions (lb/month)				Daily Emissions (lb/day)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	411.22	194.50	29.45	1.59E+01	13.48	6.38	0.97	5.23E-01
DP-4	Drop from Shaft to Waste Chute	160.48	75.90	11.49	9.20E-01	5.26	2.49	0.38	3.01E-02
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	60.57	28.65	4.34	2.87E+00	1.99	0.94	0.14	9.40E-02
DP-22	Transfer from face to loader	3.04	1.44	1.44	1.18E-01	0.10	0.05	0.05	3.87E-03
DP-23	Transfer from loader to haul truck, as needed	3.04	1.44	1.44	1.18E-01	0.10	0.05	0.05	3.87E-03
DP-24	Drop from loader or haul truck through grizzly to ore pass	2.25	1.06	1.06	1.12E-01	0.07	0.03	0.03	3.66E-03
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	2.25	1.06	1.06	1.12E-01	0.07	0.03	0.03	3.66E-03
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	2.45	1.16	1.16	1.16E-01	0.08	0.04	0.04	3.80E-03
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	2.45	1.16	1.16	1.16E-01	0.08	0.04	0.04	3.80E-03
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	2.45	1.16	1.16	1.16E-01	0.08	0.04	0.04	3.80E-03
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	17.18	8.12	8.13	8.13E-01	0.56	0.27	0.27	2.66E-02
DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	4.17	1.97	1.98	1.48E-02	0.14	0.06	0.06	4.85E-04
DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	3.71	1.76	1.76	1.76E-01	0.12	0.06	0.06	5.76E-03
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	0.90	0.43	0.43	3.19E-03	0.03	0.01	0.01	1.05E-04
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	4.61	2.18	2.18	1.79E-01	0.15	0.07	0.07	5.86E-03
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	4.61	2.18	2.18	1.79E-01	0.15	0.07	0.07	5.86E-03
DP-82	Drop on West Rock Stockpile	53.07	25.10	3.80	1.88E-01	1.74	0.82	0.12	6.16E-03
DP-83	Drop on East Ore Stockpile	60.57	28.65	4.34	2.87E+00	1.99	0.94	0.14	9.40E-02
DP-84	TSF	99.43	47.03	7.12	4.23E-01	3.26	1.54	0.23	1.39E-02
DP-85	Drops on TSF2	208.56	98.64	14.94	8.88E-01	6.84	3.23	0.49	2.91E-02
DP-94	Transfer from Agg Stockpile to Loader	112.55	53.23	8.06	--	3.690	1.745	0.2643	--
DP-95	Transfer of Agg Material from Loader to Haul Truck	112.55	53.23	8.06	--	3.690	1.745	0.2643	--
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	78.79	37.26	5.64	--	2.583	1.222	0.1850	--
DP-97	Transfer of Ore from East Ore Stockpile to Loader	60.57	28.65	4.34	2.87	1.99	0.94	0.14	9.40E-02
DP-98	Transfer of Ore from Loader to Haul Truck	60.57	28.65	4.34	2.87	1.99	0.94	0.14	9.40E-02
DP-99	Transfer from Waste Chute to Loader	534.93	253.01	38.31	3.07	17.54	8.30	1.26	1.00E-01
DP-100	Transfer from Loader to Haul Truck	534.93	253.01	38.31	3.07	17.54	8.30	1.26	1.00E-01
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	1.63E-06	7.72E-07	1.17E-07	--	5.35E-08	2.53E-08	3.83E-09	--
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	8.15E-09	3.85E-09	5.84E-10	--	2.67E-10	1.26E-10	1.91E-11	--
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	1.84E-01	8.72E-02	1.32E-02	--	0.01	0.00	0.00	--
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	1.84E-01	8.72E-02	1.32E-02	--	0.01	0.00	0.00	--
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	3.84E-01	1.82E-01	2.75E-02	--	0.01	0.01	0.00	--
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	4.92E-03	2.33E-03	3.52E-04	--	1.61E-04	7.63E-05	1.15E-05	--
DP-149	Drop of Sodium Bicarbonate	4.92E-03	2.33E-03	3.52E-04	--	1.61E-04	7.63E-05	1.15E-05	--
Total		**2,603**	**1,231**	**208**	**38**	**85**	**40**	**7**	**1**

Table A-11a. Taylor Drops - Emissions - Inputs - Annual

Emission Point Number	Description	Throughput [1] (tpy)	Material	Lead Grade [1]	Water Content (%) [1]	Control Method	Control Factor [2]		Windspeed [3]	Uncontrolled Emission Factor [4]			
							PM/PM_{10} Efficiency (%)	$PM_{2.5}$ Efficiency (%)	(mph)	PM (lb/ton)	PM_{10} (lb/ton)	$PM_{2.5}$ (lb/ton)	Lead Compounds (lb/ton)
Coarse Ore Delivery and Storage													
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	6,255,015	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Full Enclosure, Watering	85%	85%	19.49	0.0053	0.0025	0.0004	0.0002
DP-2	Drop from 21210-FE-00001 Main Shaft Ore Discharge Feeder to 21210-CV-00003 Main Shaft Outfeed Conveyor	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00002 Main Shaft Ore Discharge Dust Collector (DC-1)			19.49	--	--	--	--
DP-3	Drop from 21210-CV-00003 Main Shaft Outfeed Conveyor to 21210-CV-00001 Coarse Ore Overland Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21210-CX-00001 Coarse Ore Overland Conveyor Dust Collector (DC-2)			19.49	--	--	--	--
DP-4	Drop from Shaft to Waste Chute	1,220,522	Waste Chute Material	0.57%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	0.00003
DP-5	Drop from 21210-CV-00003 Main Shaft Outfeed Conveyor to 21210-BN-00002 Transfer Tower Storage Bin	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00003 Transfer Tower Dust Collector (DC-3)			19.49	--	--	--	--
DP-6	Drop from 21210-BN-00002 Transfer Tower Storage Bin to Haul Truck	--	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Controlled by 21210-CX-00003 Transfer Tower Dust Collector (DC-3)			19.49	--	--	--	--
DP-7	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00001 Coarse Ore Silo No. 1	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-8	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00002 Coarse Ore Silo No. 2	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-9	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00003 Coarse Ore Silo No. 3	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-10	Drop from 21210-CV-00001 Coarse Ore Overland Conveyor to 21510-SI-00004 Coarse Ore Silo No. 4	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by 21510-CX-00001 Coarse Ore Silo Dust Collector (DC-4)			19.49	--	--	--	--
DP-11	Drop from 21710-FE-00001/00002 Coarse Ore Silo No.1 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-12	Drop from 21710-FE-00003/00005 Coarse Ore Silo No.2 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-13	Drop from 21710-FE-00006/00007 Coarse Ore Silo No. 3 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-14	Drop from 21710-FE-00008/00009 Coarse Ore Silo No.4 Discharge Feeder No.1/2 to 27210-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	4.00	Controlled by Coarse Ore Silo Loadout Dust Collector (DC-5)			19.49	--	--	--	--
DP-15	Drop from 21710-CV-00001 Primary Mill Feed Conveyor to 22110-CH-00001 Primary Mill Feed Chute	--	Stope Ore & Developmental Ore	4.73%	25.00	Wet Stream, no emissions expected			19.49	--	--	--	--
DP-16	Drop from 22110-ML-00001 Primary Mill to 22110-SN-00002 Primary Mill Discharge Screen	--	Stope Ore & Developmental Ore	4.73%	25.00	Wet Stream, no emissions expected			19.49	--	--	--	--
DP-17	Drop from 22110-SN-00002 Primary Mill Discharge Screen to 22210-CV-00002 Primary Screen Discharge Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-18	Drop from 22210-CV-00002 Primary Screen Discharge Conveyor to 22210-CV-00001 Pebble Crusher Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-19	Drop from 22210-CV-00001 Pebble Crusher Feed Conveyor to 22210-BN-00001 Pebble Crusher Feed Bin/Bunker/22210-FE-00002 Pebble Crusher Product Return Feeder	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-20	Drop from 22210-FE-00002 Pebble Crusher Product Return Feeder to 21710-CV-00001 Primary Mill Feed Conveyor	--	Stope Ore & Developmental Ore	4.73%	5.00	Controlled by 22210-CX-00001 Pebble Crusher Dust Collector (DC-16)			19.49	--	--	--	--
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	138,188	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	0.00025
Underground Drops													
DP-22	Transfer from face to loader	6,255,015	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	6.04E-06
DP-23	Transfer from loader to haul truck, as needed	6,255,015	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	6.04E-06
DP-24	Drop from loader or haul truck through grizzly to ore pass	4,618,867	Stope Ore	4.96%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.73E-06
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	4,618,867	Stope Ore	4.96%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.73E-06
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	5,032,256	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	5,032,256	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	5,032,256	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.30	1.56E-04	7.37E-05	1.12E-05	7.37E-06
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	5,032,256	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	5.82	1.09E-03	5.17E-04	7.82E-05	5.17E-05

DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	1,222,759	Waste Rock	0.35%	4.00	Gravity Settling, Watering	96%	75%	5.82	1.09E-03	5.17E-04	7.82E-05	3.87E-06
DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	5,032,256	Stope Ore & Developmental Ore	4.73%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	1.12E-05
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Convevor	1,222,759	Waste Rock	0.35%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	8.36E-07
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	6,255,015	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	9.15E-06
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	6,255,015	Stope Ore & Developmental Ore & Waste Rock	3.88%	4.00	Gravity Settling, Watering	96%	75%	1.79	2.36E-04	1.12E-04	1.69E-05	9.15E-06
Stockpile Drops													
DP-82	Drop on West Rock Stockpile	121,097	Waste Rock	0.35%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	1.86E-05
DP-83	Drop on East Ore Stockpile	138,188	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-84	Drop on TSF	1,031,627	Tailings	0.43%	11.80	No Control	0%	0%	19.49	0.0012	0.0005	0.0001	4.93E-06
DP-85	Drops on TSF2	2,163,873	Tailings	0.43%	11.80	No Control	0%	0%	19.49	0.0012	0.0005	0.0001	4.93E-06
From Stockpiles													
DP-94	Transfer from Agg Stockpile to Loader	10,000	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-95	Transfer of Agg Material from Loader to Haul Truck	10,000	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	10,000	Aggregate	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-97	Transfer from East Ore Stockpile to Loader	138,188	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-98	Transfer of Ore from Loader to Haul Truck	138,188	Stope Ore & Developmental Ore	4.73%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.49E-04
DP-99	Transfer from Waste Chute Stockpile to Loader	1,220,522	Waste Chute Material	0.57%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	3.01E-05
DP-100	Transfer of Waste Chute Material from Loader to Haul Truck	1,220,522	Waste Chute Material	0.57%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	3.01E-05
Reagents													
DP-141	Drop of Copper Sulphate into 22620-TN-00005 Copper Sulphate Mix Tank	--	Copper Sulphate	0.00%	0.25	Controlled by DC-12 22620-CX-00001 Copper Sulphate Mix Tank Dust Collector			19.49	0.2551	0.1207	0.0183	--
DP-142	Drop of 50% Zinc Sulphate into 22620-TN-00025 50% Zinc Sulphate Mix/Holding Tank	--	50% Zinc Sulphate	0.00%	0.25	Controlled by DC-14 22620-CX-00005 50% Zinc Sulphate Mix Tank Dust Collector			19.49	0.2551	0.1207	0.0183	--
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	7.81	Lead Concentrate Flocculant	0.00%	0.25	No Control	0%	0%	19.49	0.2551	0.1207	0.0183	--
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	17.73	Tailings Flocculant	0.00%	0.25	No Control	0%	0%	19.49	0.2551	0.1207	0.0183	--
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	8.51	Zinc Concentrate Flocculant	0.00%	0.25	No Control	0%	0%	19.49	0.2551	0.1207	0.0183	--
DP-146	Drop of 10% Zinc Sulphate to 22620-TN-00007 10% Zinc Sulphate Mix Tank	--	10% Zinc Sulphate	0.00%	0.25	Controlled by DC-13 22620-CX-00002 10% Zinc Sulphate Mix Tank Dust Collector			19.49	0.2551	0.1207	0.0183	--
DP-147	Drop of Caustic to 22620-TN-00023 Caustic Mix/Holding Tank	--	Caustic	0.00%	0.25	Controlled by DC-15 22620-CX-00004 Caustic Mix Tank			19.49	0.2551	0.1207	0.0183	--
WTP2													
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	104.90	Dry Anionic Flocculant	0.00%	0.25	Enclosure by building	80%	80%	1.30	0.0076	0.0036	0.0005	--
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	0.05	Dry Cationic Flocculant	0.00%	0.25	Enclosure by building	80%	80%	1.30	0.0076	0.0036	0.0005	--
DP-140	Drop of Sodium Sulfate to Bulk Handling System	325.50	Sodium Sulfate	0.00%	0.25	Controlled by WTP2 DC			1.30	0.0076	0.0036	0.0005	--
WTP1													
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	3.13	Anionic Flocculant	0.00%	0.25	No Control	0%	0%	1.3	0.0076	0.0036	0.0005	--
DP-149	Drop of Sodium Bicarbonate	3.13	Sodium Bicarbonate	0.00%	0.25	No Control	0%	0%	1.3	0.0076	0.0036	0.0005	--

1. Per February 2021 dated Process Flow Diagram, provided by South32 in May 2021.
Confirmed by RFI provided by South32, Sarah Richman, on 7/12/2021.
Per August 2023 date Process Flow Diagrams, provided by South32 in April 2024.
Reagent throughputs per RFI responses from Matt Novak on 4/26/2024 and 6/19/2024

2. Control Factor based on conservative assumptions using "Nevada DEP - Guidance on Emission Factors for the Mining Industry" and West Virginia DEP Nonmetallic Mineral Processing Plants Application Instructions and Forms for General Permit G40-C - Table A

For Watering	70%
Moisture Content (Moisture Content taken into account in AP-42 Drop Equation)	0%
Gravity Settling (underground only) (PM/PM_{10}/Pb)	87%
Gravity Settling (underground only) ($PM_{2.5}$)	17%
For Full Enclosure/Enclosure by building	80%
For Partial Enclosure	50%
No control	0%

Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.
Detailed calculations are included in the Gravity Settling Tab of this spreadsheet

3. Underground wind speeds at various drop locations based on ventilation design wind speeds provied in emails from Kevin McCoy (South32) on 05/18/2023 and Cayley Hoffman (South32) on 05/22/2023. For wind speeds under 1.3 miles/hour, a minimum wind speed of 1.3 was conservatively used

4. Uncontrolled emission factors using the "drop equation" contained in U.S. EPA AP-42. Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, as follows:

$$E = k(0.0032)\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where E = Emission factor (lb/ton)

	PM	PM_{10}	$PM_{2.5}$	
k = Particle size multiplier (dimensionless)	0.74	0.35	0.053	
U = Mean wind speed (miles per hour [mph]), which is equal to:	19.49	Based on 2019-2021 On-Site Met Data		
	1.3	For indoor activities, based on minimum value of wind speed per AP-42 Section 13.2.4.		

M = Moisture Content (%) (Assuming 0.25 if water content not specified per EPA AP-42, Section 13.2.4 Equation 1

0.25	%

Table A-11b. Taylor Drops - Annual Emissions - Controlled

Emission Point Number	Description	Fugitive (Y/N)	Controlled Emissions				Uncontrolled Emissions			
			Annual Emissions (tpy)				Annual Emissions (tpy)			
			PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DP-1	Drop of crushed ore from underground to 21210-BN-00001 Main Shaft Ore Surge Bin	Y	2.47	1.17	0.18	9.56E-02	16.45	7.78	1.18	0.638
DP-4	Drop from Shaft to Waste Chute	N	0.96	0.46	0.07	5.52E-03	3.21	1.52	0.23	0.018
DP-21	Drop from Haul Truck to 21710-CV-00001 Primary Mill Feed Conveyor Hopper	Y	0.36	0.17	0.03	1.72E-02	0.36	0.17	0.03	0.017
DP-22	Transfer from face to loader	N	0.02	0.01	0.01	7.08E-04	0.49	0.23	0.03	0.019
DP-23	Transfer from loader to haul truck, as needed	N	0.02	0.01	0.01	7.08E-04	0.49	0.23	0.03	0.019
DP-24	Drop from loader or haul truck through grizzly to ore pass	N	0.01	0.01	0.01	6.69E-04	0.36	0.17	0.03	0.018
DP-25	Drop from 128Z0-FD-0001 Ore Pass Vibrating Feeder to Haul Truck	N	0.01	0.01	0.01	6.69E-04	0.36	0.17	0.03	0.018
DP-26	Drop from loader or haul truck through grizzly to 128Z0-BN-0005 Primary Crusher Bin	N	0.01	0.01	0.01	6.95E-04	0.39	0.19	0.03	0.019
DP-27	Drop from 128Z0-CH-0006 Primary Crusher Apron Feeder Dribble Chute to 128Z0-CV-0001 Primary Crusher Transfer Conveyor	N	0.01	0.01	0.01	6.95E-04	0.39	0.19	0.03	0.019
DP-28	Drop from 128Z0-CV-0001 Primary Crusher Transfer Conveyor to 128Z0-CV-0002 Side Tipping Conveyor	N	0.01	0.01	0.01	6.95E-04	0.39	0.19	0.03	0.019
DP-29	Drop from 128Z0-CV-002 Side Tipping Conveyor/Haul Truck to 128Z0-BN-0008/0009/0010 Ore Storage Bin 1/2/3	N	0.10	0.05	0.05	4.88E-03	2.75	1.30	0.20	0.130
DP-30	Drop from loader or haul truck through grizzly to 128Z0-BN-0011 Waste Storage Bin or as rock fill	N	0.03	0.01	0.01	8.87E-05	0.67	0.32	0.05	0.002
DP-31	Drop 128Z0-FD-0003/0004/0005 Vibrating Feeders to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	N	0.02	0.01	0.01	1.05E-03	0.59	0.28	0.04	0.028
DP-32	Drop from 128Z0-FD-0006 Vibrating Feeder to 128Z0-CV-0003 Ore/Waste Transfer Conveyor	N	0.01	0.00	0.00	1.92E-05	0.14	0.07	0.01	0.001
DP-33	Drop from 128Z0-CV-0003 Ore/Waste Transfer Conveyor to 128Z0-CH-0016/0017 Flask Feed Chutes	N	0.03	0.01	0.01	1.07E-03	0.74	0.35	0.05	0.029
DP-34	Drop from 128Z0-CH-0016/0017 Flask Feed Chute to 128Z0-CH-0018/0019 Skip Feed Chute	N	0.03	0.01	0.01	1.07E-03	0.74	0.19	0.05	0.029
DP-82	Drop on West Rock Stockpile	Y	0.32	0.15	0.02	1.13E-03	0.32	0.15	0.02	0.00
DP-83	Drop on East Ore Stockpile	Y	0.36	0.17	0.03	1.72E-02	0.36	0.17	0.03	0.02
DP-84	Drop on TSF	Y	0.60	0.28	0.04	2.54E-03	0.60	0.28	0.04	0.00
DP-85	Drops on TSF2	Y	1.25	0.59	0.09	5.33E-03	1.25	0.59	0.09	0.01
DP-94	Transfer from Agg Stockpile to Loader	Y	0.08	0.04	0.01	--	0.08	0.04	0.01	--
DP-95	Transfer of Agg Material from Loader to Haul Truck	Y	0.08	0.04	0.01	--	0.08	0.04	0.01	--
DP-96	Transfer of Shotcrete Aggregate from Stockpile to Loader	Y	0.08	0.04	0.01	--	0.08	0.04	0.01	--
DP-97	Transfer from East Ore Stockpile to Loader	Y	0.36	0.17	0.03	1.72E-02	0.36	0.17	0.03	0.02
DP-98	Transfer of Ore from Loader to Haul Truck	Y	0.36	0.17	0.03	1.72E-02	0.36	0.17	0.03	0.02
DP-99	Transfer from Waste Chute Stockpile to Loader	Y	3.21	1.52	0.23	1.84E-02	3.21	1.52	0.23	0.02
DP-100	Transfer of Waste Chute Material from Loader to Haul Truck	Y	3.21	1.52	0.23	1.84E-02	3.21	1.52	0.23	0.02
DP-138	Drop of Dry Anionic Flocculant to Open Top Dump Hopper	Y	7.92E-05	3.75E-05	5.68E-06	--	0.00	0.00	0.00	--
DP-139	Drop of Dry Cationic Flocculant via Manual Addition	Y	3.57E-08	1.69E-08	2.56E-09	--	0.00	0.00	0.00	--
DP-143	Drop of Lead Concentrate Flocculant to 22620-EP-00002 Lead Concentrate Flocculant Preparation Module	Y	9.97E-04	4.71E-04	7.14E-05	--	9.97E-04	4.71E-04	7.14E-05	--
DP-144	Drop of Tailings Flocculant to 22620-EP-00001 Tailings Flocculant Preparation Module	Y	2.26E-03	1.07E-03	1.62E-04	--	2.26E-03	1.07E-03	1.62E-04	--
DP-145	Drop of Zinc Concentrate Flocculant to 22620-EP-00003 Zinc Concentrate Flocculant Preparation Module	Y	1.09E-03	5.13E-04	7.77E-05	--	1.09E-03	5.13E-04	7.77E-05	--
DP-148	Drop of Anionic Flocculant (Hydrex 6161)	Y	1.18E-05	5.58E-06	8.45E-07	--	1.18E-05	5.58E-06	8.45E-07	--
DP-149	Drop of Sodium Bicarbonate	Y	1.18E-05	5.58E-06	8.45E-07	--	1.18E-05	5.58E-06	8.45E-07	--
Total			**14.04**	**6.63**	**1.13**	**0.23**	**38.45**	**18.02**	**2.75**	**1.12**

Table A-12a. Clark Drops - Emissions - Inputs

Emission Point Number	Description	Throughput [1] (tph)	Lead Grade [1]	Water Content (%) [1]	Control Method	Control Factor [2]		Windspeed [3] (mph)	Uncontrolled Emission Factor [4]			
						PM/PM_{10} Efficiency	$PM_{2.5}$ Efficiency		PM	PM_{10}	$PM_{2.5}$	Lead Compounds
						%	%		(lb/ton)	(lb/ton)	(lb/ton)	(lb/ton)
Surface Activities												
Coarse Ore Delivery and Storage												
DP-103	Dump into Primary Crusher Feed Hopper	129	1.76%	4.00	Spray Bar, Partial Enclosure	85%	85%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-104	Drop from silo to trucks	90	1.76%	4.00	Partial Enclosure, Dust Extractor	50%	50%	19.49	0.0053	0.0025	0.0004	9.25E-05
From Stockpiles												
DP-105	Transfer of Ore from Ore Stockpile to Loader	83.77	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25274E-05
DP-106	Transfer of Ore Mined from Loader to Haul Truck	83.77	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	0.0001
DP-107	Transfer from ROM Stockpile to Loader	22.96	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	0.0001
DP-109	Transfer from Agg Stockpile to Loader	9.19	0.00%	1.77	No control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-110	Transfer of Agg Material from Loader to Haul Truck	9.19	0.00%	1.77	No control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	6.43	0.00%	1.77	No control	0%	0%	19.49	0.0165	0.0078	0.0012	--
Stockpile Drops												
DP-113	Hardshell Rock Storage Drop	112.71	0.57%	4.00	No control	0%	0%	19.49	0.0053	0.0025	0.0004	2.98E-05
DP-114	Ore Stockpile Drop	83.77	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-115	ROM Stockpile Drop	22.96	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
Underground												
DP-124	Transfer of Development Ore from Face to Loader	22	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-125	Transfer of Development Ore from Loader to Stockpile	22	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-126	Transfer of Development Ore from Stockpile to Loader	22	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	22	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-129	Transfer of Development Waste Mined from Face to Loader	113	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	113	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	113	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	113	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-134	Transfer of Stope Ore from Stope to Loader	62	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06
DP-135	Transfer of Stope Ore from Loader to Stockpile	62	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06
DP-136	Transfer of Stope Ore from Stockpile to Loader	62	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06
DP-137	Transfer of Stope Ore from Loader to Haul Truck	62	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06

1. Per March 2022 dated Process Flow Diagram, provided by South32 in March 2022.

2. Control Factor based on conservative assumptions using "Nevada DEP - Guidance on Emission Factors for the Mining Industry" and West Virginia DEP Nonmetallic Mineral Processing Plants Application Instructions and Forms for General Permit G40-C - Table A

For Watering	70%	
Moisture Content (Moisture taken into account within drop equation)	0%	
Gravity Settling (underground only) (PM/PM_{10}/Pb)	80%	Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.
Gravity Settling (underground only) ($PM_{2.5}$)	16%	Detailed calculations are included in the Gravity Settling Tab of this spreadsheet
For Full Enclosure/Enclosure by building	80%	
For Partial Enclosure	50%	
No control	0%	

3. Underground wind speeds at various drop locations based on ventilation design wind speeds provied in emails from Kevin McCoy (South32) on 05/18/2023 and Cayley Hoffman (South32) on 05/22/2023. For wind speeds under 1.3 miles/hour, a minimum wind speed of 1.3 was conservatively used

4. Uncontrolled emission factors using the "drop equation" contained in U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, as follows:

$$E = k(0.0032) \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where E = Emission factor (lb/ton)

k = Particle size multiplier (dimensionless)	PM	PM_{10}	$PM_{2.5}$
	0.74	0.35	0.053
U = Mean wind speed (miles per hour [mph]), which is equal to:	19.49	Based on 2019-2021 On-Site Met Data	
	1.3	For indoor activities, based on minimum value of wind speed per AP-42 Section 13.2.4.	

M = Moisture Content (%) (Assuming 0.25 if water content not specified per EPA AP-42, Section 13.2.4 Equation 1

0.25 %

Moisture Content of Aggregate taken to be 1.7 per AP-42 Section 11.12 Table 11.12-1 Footnote b

Table A-12b. Clark Drops - Emissions - Controlled

Emission Point Number	Description	Controlled Emissions							
		Hourly Emissions (lb/hr)				Daily Emissions (lb/day)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DP-103	Dump into Primary Crusher Feed Hopper	0.10	0.05	0.007	0.002	2.44	1.15	0.17	0.04
DP-104	Drop from silo to trucks	0.24	0.11	0.02	0.004	5.69	2.69	0.41	0.10
DP-105	Transfer of Ore from Ore Stockpile to Loader	0.13	0.06	0.01	0.00	3.17	1.50	0.23	0.06
DP-106	Transfer of Ore Mined from Loader to Haul Truck	0.13	0.06	0.01	0.00	3.17	1.50	0.23	0.06
DP-107	Transfer from ROM Stockpile to Loader	0.04	0.02	0.00	0.00	0.87	0.41	0.06	0.02
DP-109	Transfer from Agg Stockpile to Loader	0.15	0.07	0.01	--	3.63	1.72	0.26	--
DP-110	Transfer of Agg Material from Loader to Haul Truck	0.15	0.07	0.01	--	3.63	1.72	0.26	--
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	0.11	0.05	0.01	--	2.54	1.20	0.18	--
DP-113	Hardshell Rock Storage Drop	0.59	0.28	0.04	0.003	14.23	6.73	1.02	0.08
DP-114	Ore Stockpile Drop	0.13	0.06	0.01	0.00	3.17	1.50	0.23	0.06
DP-115	ROM Stockpile Drop	0.04	0.02	0.00	0.001	0.87	0.41	0.06	0.02
DP-124	Transfer of Development Ore from Face to Loader	2.06E-04	9.73E-05	6.11E-05	2.65E-06	0.00	0.00	0.001	0.000
DP-125	Transfer of Development Ore from Loader to Stockpile	2.06E-04	9.73E-05	6.11E-05	2.65E-06	0.00	0.00	0.001	0.000
DP-126	Transfer of Development Ore from Stockpile to Loader	2.06E-04	9.73E-05	6.11E-05	2.65E-06	0.00	0.00	0.001	0.000
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	2.06E-04	9.73E-05	6.11E-05	2.65E-06	0.00	0.00	0.001	0.000
DP-129	Transfer of Development Waste Mined from Face to Loader	1.07E-03	5.04E-04	3.16E-04	6.04E-06	0.03	0.01	0.008	0.000
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	1.07E-03	5.04E-04	3.16E-04	6.04E-06	0.03	0.01	0.008	0.000
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	1.07E-03	5.04E-04	3.16E-04	6.04E-06	0.03	0.01	0.008	0.000
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	1.07E-03	5.04E-04	3.16E-04	6.04E-06	0.03	0.01	0.008	0.000
DP-134	Transfer of Stope Ore from Stope to Loader	5.86E-04	2.77E-04	1.74E-04	1.03E-05	0.01	0.01	0.004	0.000
DP-135	Transfer of Stope Ore from Loader to Stockpile	5.86E-04	2.77E-04	1.74E-04	1.03E-05	0.01	0.01	0.004	0.000
DP-136	Transfer of Stope Ore from Stockpile to Loader	5.86E-04	2.77E-04	1.74E-04	1.03E-05	0.01	0.01	0.004	0.000
DP-137	Transfer of Stope Ore from Loader to Haul Truck	5.86E-04	2.77E-04	1.74E-04	1.03E-05	0.01	0.01	0.004	0.000
Total		**1.82**	**0.86**	**0.13**	**0.02**	**43.60**	**20.62**	**3.16**	**0.42**

Table A-13a. Clark Drops - Emissions - Inputs

Emission Point Number	Description	Throughput [1] (tph)	Lead Grade [1]	Water Content (%) [1]	Control Method	Control Factor [2]		Windspeed [3] (mph)	Uncontrolled Emission Factor [4]			
						PM/PM_{10} Efficiency (%)	$PM_{2.5}$ Efficiency (%)		PM (lb/ton)	PM_{10} (lb/ton)	$PM_{2.5}$ (lb/ton)	Lead Compounds (lb/ton)
Surface Activities												
Coarse Ore Delivery and Storage												
DP-103	Dump into Primary Crusher Feed Hopper	86	1.76%	4.00	Spray Bar, Partial Enclosure	85%	85%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-104	Drop from silo to trucks	86	1.76%	4.00	Partial Enclosure, Dust Extractor	50%	50%	19.49	0.0053	0.0025	0.0004	9.25E-05
From Stockpiles												
DP-105	Transfer of Ore from Ore Stockpile to Loader	83.77	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25274E-05
DP-106	Transfer of Ore Mined from Loader to Haul Truck	83.77	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	0.0001
DP-107	Transfer from ROM Stockpile to Loader	22.96	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	0.0001
DP-109	Transfer from Agg Stockpile to Loader	9.19	0.00%	1.77	No control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-110	Transfer of Agg Material from Loader to Haul Truck	9.19	0.00%	1.77	No control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	6.43	0.00%	1.77	No control	0%	0%	19.49	0.0165	0.0078	0.0012	--
Stockpile Drops												
DP-113	Hardshell Rock Storage Drop	112.71	0.57%	4.00	No control	0%	0%	19.49	0.0053	0.0025	0.0004	2.98E-05
DP-114	Ore Stockpile Drop	83.77	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-115	ROM Stockpile Drop	22.96	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
Underground												
DP-124	Transfer of Development Ore from Face to Loader	53	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-125	Transfer of Development Ore from Loader to Stockpile	53	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-126	Transfer of Development Ore from Stockpile to Loader	53	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	53	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.01E-06
DP-129	Transfer of Development Waste Mined from Face to Loader	74	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	74	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	74	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	74	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	8.83E-07
DP-134	Transfer of Stope Ore from Stope to Loader	81	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06
DP-135	Transfer of Stope Ore from Loader to Stockpile	81	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06
DP-136	Transfer of Stope Ore from Stockpile to Loader	81	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06
DP-137	Transfer of Stope Ore from Loader to Haul Truck	81	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.0001	0.00001	2.74E-06

1. Per March 2022 dated Process Flow Diagram, provided by South32 in March 2022.

2. Control Factor based on conservative assumptions using "Nevada DEP - Guidance on Emission Factors for the Mining Industry" and West Virginia DEP Nonmetallic Mineral Processing Plants Application Instructions and Forms for General Permit G40-C - Table A

For Watering	70%	
Moisture Content (Moisture taken into account within drop equation)	0%	
Gravity Settling (underground only) (PM/PM_{10}/Pb)	80%	Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.
Gravity Settling (underground only) ($PM_{2.5}$)	16%	Detailed calculations are included in the Gravity Settling Tab of this spreadsheet
For Full Enclosure/Enclosure by building	80%	
For Partial Enclosure	50%	
No control	0%	

3. Underground wind speeds at various drop locations based on ventilation design wind speeds provied in emails from Kevin McCoy (South32) on 05/18/2023 and Cayley Hoffman (South32) on 05/22/2023. For wind speeds under 1.3 miles/hour, a minimum wind speed of 1.3 was conservatively used

4. Uncontrolled emission factors using the "drop equation" contained in U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, as follows:

$$E = k(0.0032) \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where E = Emission factor (lb/ton)

k = Particle size multiplier (dimensionless)

PM	PM_{10}	$PM_{2.5}$	
0.74	0.35	0.053	

U = Mean wind speed (miles per hour [mph]), which is equal to: 19.49 Based on 2019-2021 On-Site Met Data

1.3 For indoor activities, based on minimum value of wind speed per AP-42 Section 13.2.4.

M = Moisture Content (%) (Assuming 0.25 if water content not specified per EPA AP-42, Section 13.2.4 Equation 1

0.25 %

Moisture Content of Aggregate taken to be 1.7 per AP-42 Section 11.12 Table 11.12-1 Footnote b

Table A-13b. Clark Drops - Emissions - Controlled

Emission Point Number	Description	Controlled Emissions							
		Hourly Emissions (lb/hr)				Daily Emissions (lb/day)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DP-103	Dump into Primary Crusher Feed Hopper	0.07	0.03	0.005	0.001	1.63	0.77	0.12	0.03
DP-104	Drop from silo to trucks	0.23	0.11	0.02	0.004	5.43	2.57	0.39	0.10
DP-105	Transfer of Ore from Ore Stockpile to Loader	0.13	0.06	0.01	0.00	3.17	1.50	0.23	0.06
DP-106	Transfer of Ore Mined from Loader to Haul Truck	0.13	0.06	0.01	0.00	3.17	1.50	0.23	0.06
DP-107	Transfer from ROM Stockpile to Loader	0.04	0.02	0.00	0.00	0.87	0.41	0.06	0.02
DP-109	Transfer from Agg Stockpile to Loader	0.15	0.07	0.01	--	3.63	1.72	0.26	--
DP-110	Transfer of Agg Material from Loader to Haul Truck	0.15	0.07	0.01	--	3.63	1.72	0.26	--
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	0.11	0.05	0.01	--	2.54	1.20	0.18	--
DP-113	Hardshell Rock Storage Drop	0.59	0.28	0.04	0.003	14.23	6.73	1.02	0.08
DP-114	Ore Stockpile Drop	0.13	0.06	0.01	0.00	3.17	1.50	0.23	0.06
DP-115	ROM Stockpile Drop	0.04	0.02	0.00	0.001	0.87	0.41	0.06	0.02
DP-124	Transfer of Development Ore from Face to Loader	5.00E-04	2.36E-04	1.48E-04	6.45E-06	0.01	0.01	0.004	0.000
DP-125	Transfer of Development Ore from Loader to Stockpile	5.00E-04	2.36E-04	1.48E-04	6.45E-06	0.01	0.01	0.004	0.000
DP-126	Transfer of Development Ore from Stockpile to Loader	5.00E-04	2.36E-04	1.48E-04	6.45E-06	0.01	0.01	0.004	0.000
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	5.00E-04	2.36E-04	1.48E-04	6.45E-06	0.01	0.01	0.004	0.000
DP-129	Transfer of Development Waste Mined from Face to Loader	6.99E-04	3.31E-04	2.07E-04	3.96E-06	0.02	0.01	0.005	0.000
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	6.99E-04	3.31E-04	2.07E-04	3.96E-06	0.02	0.01	0.005	0.000
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	6.99E-04	3.31E-04	2.07E-04	3.96E-06	0.02	0.01	0.005	0.000
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	6.99E-04	3.31E-04	2.07E-04	3.96E-06	0.02	0.01	0.005	0.000
DP-134	Transfer of Stope Ore from Stope to Loader	7.63E-04	3.61E-04	2.26E-04	1.34E-05	0.02	0.01	0.005	0.000
DP-135	Transfer of Stope Ore from Loader to Stockpile	7.63E-04	3.61E-04	2.26E-04	1.34E-05	0.02	0.01	0.005	0.000
DP-136	Transfer of Stope Ore from Stockpile to Loader	7.63E-04	3.61E-04	2.26E-04	1.34E-05	0.02	0.01	0.005	0.000
DP-137	Transfer of Stope Ore from Loader to Haul Truck	7.63E-04	3.61E-04	2.26E-04	1.34E-05	0.02	0.01	0.005	0.000
Total		**1.77**	**0.84**	**0.13**	**0.02**	**42.54**	**20.12**	**3.09**	**0.41**

Table A-14a. Clark Drops - Emissions - Inputs

Emission Point Number	Description	Throughput [1] (tpy)	Lead Grade [1]	Water Content (%) [1]	Control Method	Control Factor [2]		Windspeed [3] (mph)	Uncontrolled Emission Factor [4]			
						PM/PM_{10} Efficiency	$PM_{2.5}$ Efficiency		PM	PM_{10}	$PM_{2.5}$	Lead Compounds
						%	%		(lb/ton)	(lb/ton)	(lb/ton)	(lb/ton)
Surface Activities												
Coarse Ore Delivery and Storage												
DP-103	Dump into Primary Crusher Feed Hopper	733,798	1.76%	4.00	Spray Bar, Partial Enclosure	85%	85%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-104	Drop from silo to trucks	733,798	1.76%	4.00	Partial Enclosure, Dust Extractor	50%	50%	19.49	0.0053	0.0025	0.0004	9.25E-05
From Stockpiles												
DP-105	Transfer of Ore from Ore Stockpile to Loader	733794	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-106	Transfer of Ore Mined from Loader to Haul Truck	733794	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-107	Transfer from ROM Stockpile to Loader	201172	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-109	Transfer from Agg Stockpile to Loader	10,000	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-110	Transfer of Agg Material from Loader to Haul Truck	10,000	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	10,000	0.00%	1.77	No Control	0%	0%	19.49	0.0165	0.0078	0.0012	--
Stockpile Drops												
DP-113	Hardshell Rock Storage	987,351	0.57%	4.00	No Control	0%	0%	19.49	0.0053	0.0025	0.0004	2.98E-05
DP-114	Ore Stockpile	733,794	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
DP-115	ROM Stockpile	201,172	1.76%	4.00	Watering	70%	70%	19.49	0.0053	0.0025	0.0004	9.25E-05
Underground												
DP-124	Transfer of Development Ore from Face to Loader	190,691	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000002
DP-125	Transfer of Development Ore from Loader to Stockpile	190,691	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000002
DP-126	Transfer of Development Ore from Stockpile to Loader	190,691	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000002
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	190,691	1.29%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000002
DP-129	Transfer of Development Waste Mined from Face to Loader	987,351	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000001
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	987,351	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000001
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	987,351	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000001
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	987,351	0.57%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000001
DP-134	Transfer of Stope Ore from Stope to Loader	543,107	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000003
DP-135	Transfer of Stope Ore from Loader to Stockpile	543,107	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000003
DP-136	Transfer of Stope Ore from Stockpile to Loader	543,107	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000003
DP-137	Transfer of Stope Ore from Loader to Haul Truck	543,107	1.76%	4.00	Gravity Settling, Watering	94%	75%	1.30	0.0002	0.00007	0.00001	0.000003

1. Per March 2022 dated Process Flow Diagram, provided by South32 in March 2022.
2. Control Factor based on conservative assumptions using "Nevada DEP - Guidance on Emission Factors for the Mining Industry" and West Virginia DEP Nonmetallic Mineral Processing Plants Application Instructions and Forms for General Permit G40-C - Table A

For Watering	70%	
For Moisture Content	0%	
Gravity Settling (underground only) (PM/PM_{10}/Pb)	80%	Control efficiencies for underground gravity settling are a combination of vertical settling and horizontal settling based on discussions with ADEQ in May 2023. Vertical settling is based on various technical papers and per ADEQ meeting on May 18th 2023. Horizontal settling is based on Stoke's Equation and inputs from South32.
Gravity Settling (underground only) ($PM_{2.5}$)	16%	Detailed calculations are included in the Gravity Settling Tab of this spreadsheet
For Full Enclosure/Enclosure by building	80%	
For Partial Enclosure	50%	
No control	0%	

3. Underground wind speeds at various drop locations based on ventilation design wind speeds provied in emails from Kevin McCoy (South32) on 05/18/2023 and Cayley Hoffman (South32) on 05/22/2023. For wind speeds under 1.3 miles/hour, a minimum wind speed of 1.3 was conservatively used
4. Uncontrolled emission factors using the "drop equation" contained in U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006, as follows:

$$E = k(0.0032) \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where E = Emission factor (lb/ton)

	PM	PM_{10}	$PM_{2.5}$	
k = Particle size multiplier (dimensionless)	0.74	0.35	0.053	
U = Mean wind speed (miles per hour [mph]), which is equal to:	19.49			Based on 2019-2021 On-Site Met Data
	1.3			For indoor activities, based on minimum value of wind speed per AP-42 Section 13.2.4.

M = Moisture Content (%) (Assuming 0.25 if water content not specified per EPA AP-42, Section 13.2.4 Equation 1
0.25 %
Moisture Content of Aggregate taken to be 1.7 per AP-42 Section 11.12 Table 11.12-1 Footnote b

Table A-14b. Clark Drops - Emissions - Controlled

Emission Point Number	Description	Controlled Emissions				Uncontrolled Emissions			
		Annual Emissions (tpy)				Annual Emissions (tpy)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
DP-103	Dump into Primary Crusher Feed Hopper	0.29	0.14	0.02	0.01	1.93	0.91	0.14	0.03
DP-104	Drop from silo to trucks	0.96	0.46	0.07	0.02	1.93	0.91	0.14	0.03
DP-105	Transfer of Ore from Ore Stockpile to Loader	0.58	0.27	0.04	0.01	1.93	0.91	0.14	0.03
DP-106	Transfer of Ore Mined from Loader to Haul Truck	0.58	0.27	0.04	0.01	1.93	0.91	0.14	0.03
DP-107	Transfer from ROM Stockpile to Loader	0.16	0.08	0.011	0.003	0.53	0.25	0.04	0.01
DP-109	Transfer from Agg Stockpile to Loader	0.08	0.04	0.006	--	0.08	0.04	0.01	--
DP-110	Transfer of Agg Material from Loader to Haul Truck	0.08	0.04	0.006	--	0.08	0.04	0.01	--
DP-111	Transfer of Shotcrete Aggregate from Stockpile to Loader	0.08	0.04	0.006	--	0.08	0.04	0.01	--
DP-113	Hardshell Rock Storage	2.60	1.23	0.186	0.015	2.60	1.23	0.19	0.01
DP-114	Ore Stockpile	0.58	0.27	0.041	0.010	1.93	0.91	0.14	0.03
DP-115	ROM Stockpile	0.16	0.08	0.011	0.003	0.53	0.25	0.04	0.01
DP-124	Transfer of Development Ore from Face to Loader	9.01E-04	4.26E-04	2.67E-04	1.16E-05	0.01	0.01	0.00	0.00
DP-125	Transfer of Development Ore from Loader to Stockpile	9.01E-04	4.26E-04	2.67E-04	1.16E-05	0.01	0.01	0.00	0.00
DP-126	Transfer of Development Ore from Stockpile to Loader	9.01E-04	4.26E-04	2.67E-04	1.16E-05	0.01	0.01	0.00	0.00
DP-127	Transfer of Development Ore Mined from Loader to Haul Truck	9.01E-04	4.26E-04	2.67E-04	1.16E-05	0.01	0.01	0.00	0.00
DP-129	Transfer of Development Waste Mined from Face to Loader	4.67E-03	2.21E-03	1.38E-03	2.65E-05	0.08	0.04	0.01	0.00
DP-130	Transfer of Development Waste Mined from Loader to Stockpile	4.67E-03	2.21E-03	1.38E-03	2.65E-05	0.08	0.04	0.01	0.00
DP-131	Transfer of Development Waste Mined from Stockpile to Loader	4.67E-03	2.21E-03	1.38E-03	2.65E-05	0.08	0.04	0.01	0.00
DP-132	Transfer of Development Waste Mined from Loader to Haul Truck	4.67E-03	2.21E-03	1.38E-03	2.65E-05	0.08	0.04	0.01	0.00
DP-134	Transfer of Stope Ore from Stope to Loader	2.57E-03	1.21E-03	7.62E-04	4.52E-05	0.04	0.02	0.00	0.00
DP-135	Transfer of Stope Ore from Loader to Stockpile	2.57E-03	1.21E-03	7.62E-04	4.52E-05	0.04	0.02	0.00	0.00
DP-136	Transfer of Stope Ore from Stockpile to Loader	2.57E-03	1.21E-03	7.62E-04	4.52E-05	0.04	0.02	0.00	0.00
DP-137	Transfer of Stope Ore from Loader to Haul Truck	2.57E-03	1.21E-03	7.62E-04	4.52E-05	0.04	0.02	0.00	0.00
Total		**6.18**	**2.93**	**0.45**	**0.07**	**14.09**	**6.66**	**1.01**	**0.21**

Table A-15. Dust Collectors - Emissions

Emission Point Number	Description	Max Outlet Grain Loading [1]	Stack Flow Rate [2]	Hours of Operation	Material	Lead Content in Material	Annual Emissions [3]				Hourly Emissions [3]				Daily Emissions [3]			
							PM	PM_{10}	$PM_{2.5}$	Lead Compounds [4]	PM	PM_{10}	$PM_{2.5}$	Lead Compounds [4]	PM	PM_{10}	$PM_{2.5}$	Lead Compounds [4]
		(gr/dscf)	(cfm)	(hr/yr)		(%)	(tpy)	(tpy)	(tpy)	(tpy)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/day)	(lb/day)	(lb/day)	(lb/day)
Taylor																		
DC-1	21210-CX-00002 Main Shaft Ore Discharge Dust Collector [7]	0.002	3,250	8,760	Stope Ore & Developmental Ore & Waste Rock	3.88%	0.24	0.24	0.24	9.46E-03	0.06	0.06	0.06	0.00	1.34	1.34	1.34	0.05
DC-2	21210-CX-00001 Coarse Ore Overland Dust Collector [7]	0.002	5,000	8,760	Stope Ore & Developmental Ore	4.73%	0.38	0.38	0.38	1.78E-02	0.09	0.09	0.09	0.00	2.06	2.06	2.06	0.10
DC-3	21210-CX-00003 Transfer Tower Silo Dust Collector [4]	0.002	30,000	8,760	Stope Ore & Developmental Ore & Waste Rock	3.88%	2.25	2.25	2.25	8.73E-02	0.51	0.51	0.51	0.02	12.34	12.34	12.34	0.48
DC-4	21510-CX-00001 Coarse Ore Silo Dust Collector [4]	0.002	11,000	8,760	Stope Ore & Developmental Ore	4.73%	0.83	0.83	0.83	3.91E-02	0.19	0.19	0.19	0.01	4.53	4.53	4.53	0.21
DC-5	21710-CX-00002 Silo Discharge Dust Collector [5]	0.002	10,850	8,760	Stope Ore & Developmental Ore	4.73%	0.81	0.81	0.81	3.85E-02	0.19	0.19	0.19	8.80E-03	4.46	4.46	4.46	2.11E-01
DC-12	22620-CX-00001 Copper Sulphate Mix Tank Dust Collector	0.008	1,000	8,760	Copper Sulphate	0.00%	0.30	0.30	0.30	0.00E+00	0.07	0.07	0.07	0.00	1.65	1.65	1.65	0.00
DC-13	22620-CX-00002 10% Zinc Sulphate Mix Tank Dust Collector	0.008	1,000	8,760	10% Zinc Sulphate	0.00%	0.30	0.30	0.30	0.00E+00	0.07	0.07	0.07	0.00	1.65	1.65	1.65	0.00
DC-14	22620-CX-00005 50% Zinc Sulphate Mix Tank Dust Collector	0.008	1,000	8,760	50% Zinc Sulphate	0.00%	0.30	0.30	0.30	0.00E+00	0.07	0.07	0.07	0.00	1.65	1.65	1.65	0.00
DC-15	22620-CX-00004 Caustic Mix Tank Dust Collector	0.008	1,000	8,760	Caustic Mix	0.00%	0.30	0.30	0.30	0.00E+00	0.07	0.07	0.07	0.00	1.65	1.65	1.65	0.00
DC-16	22210-CX-00001 Pebble Crusher Dust Collector [4]	0.002	12,350	8,760	Stope Ore & Developmental Ore	4.73%	0.93	0.93	0.93	4.39E-02	0.21	0.21	0.21	0.01	5.08	5.08	5.08	0.24
DC-PPBSS1	18610-SI-00001 Paste Plant Binder Storage Silo 1 [6]	0.005	750	8,760	Binder	0%	0.14	0.14	0.14	0.00E+00	0.03	0.03	0.03	0.00	0.77	0.77	0.77	0.00
DC-PPBSS2	18610-SI-00002 Paste Plant Binder Storage Silo 2 [6]	0.005	750	8,760	Binder	0%	0.14	0.14	0.14	0.00E+00	0.03	0.03	0.03	0.00	0.77	0.77	0.77	0.00
DC-PPBDS3	18610-SI-10003 Paste Plant Binder Dosage Silo 3 [6]	0.005	1,500	8,760	Binder	0%	0.28	0.28	0.28	0.00E+00	0.06	0.06	0.06	0.00	1.54	1.54	1.54	0.00
DC-PPBDS4	18610-SI-20004 Paste Plant Binder Dosage Silo 4 [6]	0.005	1,500	8,760	Binder	0%	0.28	0.28	0.28	0.00E+00	0.06	0.06	0.06	0.00	1.54	1.54	1.54	0.00
DC-PPM1M	18610-DC-20002 Paste Plant Module 1 Mixer [6]	0.005	3,000	8,760	Paste	0%	0.56	0.56	0.56	0.00E+00	0.13	0.13	0.13	0.00	3.09	3.09	3.09	0.00
DC-PPM2M	18610-DC-20002 Paste Plant Module 2 Mixer [6]	0.005	3,000	8,760	Paste	0%	0.56	0.56	0.56	0.00E+00	0.13	0.13	0.13	0.00	3.09	3.09	3.09	0.00
Clark																		
DC-7	Coarse Ore Dust Collection System,23100-FAN-0001	0.001	3,200	8,760	Clark Stope Ore	1.76%	0.12	0.12	0.12	2.11E-03	0.03	0.03	0.03	0.00	0.66	0.66	0.66	0.01
DC-8	Coarse Ore Dust Collection System,23100-FAN-0002	0.001	3,200	8,760	Clark Stope Ore	1.76%	0.12	0.12	0.12	2.11E-03	0.03	0.03	0.03	0.00	0.66	0.66	0.66	0.01
DC-CPPBS1	Paste Plant Binder Silo 1 [6]	0.005	750	8,760	Binder	0.00%	0.14	0.14	0.14	0.00E+00	0.03	0.03	0.03	0.00	0.77	0.77	0.77	0.00
DC-CPPBS2	Paste Plant Binder Silo 2 [6]	0.005	750	8,760	Binder	0.00%	0.14	0.14	0.14	0.00E+00	0.03	0.03	0.03	0.00	0.77	0.77	0.77	0.00
DC-CPPBS3	Paste Plant Binder Silo 3 [6]	0.005	1,500	8,760	Binder	0.00%	0.28	0.28	0.28	0.00E+00	0.06	0.06	0.06	0.00	1.54	1.54	1.54	0.00
DC-CPPBS4	Paste Plant Binder Silo 4 [6]	0.005	1,500	8,760	Binder	0.00%	0.28	0.28	0.28	0.00E+00	0.06	0.06	0.06	0.00	1.54	1.54	1.54	0.00
DC-CPPM1M	Paste Plant Module 1 Mixer [6]	0.005	3,000	8,760	Paste	0.00%	0.56	0.56	0.56	0.00E+00	0.13	0.13	0.13	0.00	3.09	3.09	3.09	0.00
DC-CPPM2M	Paste Plant Module 2 Mixer [6]	0.005	3,000	8,760	Paste	0.00%	0.56	0.56	0.56	0.00E+00	0.13	0.13	0.13	0.00	3.09	3.09	3.09	0.00
DC-10	Coarse Ore Dust Collection System,23100-DCD-0005	0.001	3,200	8,760	Clark Stope Ore	1.76%	0.12	0.12	0.12	2.11E-03	0.03	0.03	0.03	0.00	0.66	0.66	0.66	0.01
General																		
WTP1LS	Waste Water Treatment Plant #1 Lime Silo	0.005	1,001	8,760	Lime	0%	0.19	0.19	0.19	0.00E+00	0.04	0.04	0.04	0.00	1.03	1.03	1.03	0.00
WTP2 DC	Sodium Sulfate Indoor Dust Collector [5]	0.010	77	8,760	Sodium Sulfate	0%	5.78E-03	5.78E-03	5.78E-03	0.00E+00	1.32E-03	1.32E-03	1.32E-03	0.00E+00	3.17E-02	3.17E-02	3.17E-02	0.00
						Total	**11.14**	**11.14**	**11.14**	**0.24**	**2.54**	**2.54**	**2.54**	**0.06**	**61.03**	**61.03**	**61.03**	**1.33**

1. Per email from Sarah Richman, South32, on 07/06/2021 (Per Fluor Canada Ltd. Engineering)
Per RFI responses from Rodolfo Moctezuma on 4/29/2024
Per "Clark Deposit General RFI for Air Permit 030922" RFI received on 3/3/2022
2. Per RFI responses from Rodolfo Moctezuma on 4/29/2024
3. Using the conversion factors given below:

	7000	grains/lb
	2000	lb/ton
	60	min/hr
4. Lead Conc.	4.96	% For Taylor deposit
	1.76	% For Clark deposit
	0.00	% Lead at paste plant assumed to be negligible

5. Per email from Sarah Richman, South32, on 08/24/2022 (Per Fluor Canada Ltd. Engineering)
6. Per email from Sarah Richman, South32, on 08/31/2022 (Per Fluor Canada Ltd. Engineering and Paterson Cooke)
7. Per PFD's received on 5/29/2024 from Sarah Richman, South32.

Table A-16a. Engines - Emission Factors

Pollutant	Value	Unit	Source
NO_x	7.87E-02	g/kW-hr	Per Natural Gas Generator 100% load Emissions Performance on G3520 Caterpillar engine provided by Brad Kaufman, VoltaGrid, on 9/22/2021
NO_2	7.50E-03	g/kW-hr	
CO	1.31E-02	g/kW-hr	
$PM/PM_{10}/PM_{2.5}$	2.00E-03	g/kW-hr	
VOC	1.18E-02	g/kW-hr	
CO_2	5.09E+02	g/kW-hr	
CH_4	1.29E+00	g/kW-hr	
N_2O	1.10E-02	g/kW-hr	
Acetaldehyde	7.10E-03	g/kW-hr	
Formaldehyde	4.70E-03	g/kW-hr	
NO_x	5.26E-02	g/kW-hr	Per Natural Gas Generator 75% load Emissions Performance on G3520 Caterpillar engine provided by Brad Kaufman, VoltaGrid, on 9/22/2021
NO_2	3.00E-04	g/kW-hr	
CO	1.88E-02	g/kW-hr	
$PM/PM_{10}/PM_{2.5}$	2.21E-02	g/kW-hr	
VOC	5.40E-02	g/kW-hr	
CO_2	5.30E+02	g/kW-hr	
CH_4	1.48E+00	g/kW-hr	
N_2O	1.40E-02	g/kW-hr	
Acetaldehyde	2.55E-02	g/kW-hr	
Formaldehyde	0.00E+00	g/kW-hr	
NO_x	6.27E-02	g/kW-hr	Per Natural Gas Generator 50% load Emissions Performance on G3520 Caterpillar engine provided by Brad Kaufman, VoltaGrid, on 9/22/2021
NO_2	0.00E+00	g/kW-hr	
CO	3.23E-02	g/kW-hr	
$PM/PM_{10}/PM_{2.5}$	7.30E-02	g/kW-hr	
VOC	5.30E-02	g/kW-hr	
CO_2	5.56E+02	g/kW-hr	
CH_4	1.53E+00	g/kW-hr	
N_2O	1.55E-02	g/kW-hr	
Acetaldehyde	1.45E-02	g/kW-hr	
Formaldehyde	4.00E-04	g/kW-hr	
NOx	7.80	tpy	Per voluntary limit accepted by South32, as referenced in South32 Response to Public Comments, Supplement #1, on May 17, 2024
CO	40.00	tpy	
VOC	15.00	tpy	
$PM/PM_{10}/PM_{2.5}$	1.00E-02	g/kW-hr	Per Caterpillar engine emissions certification, provided by Kara Haas, South32, on 7/18/2022
SO_2	5.88E-04	lb/MMBtu	AP-42 Section 3.2, Natural Gas Engines (Maximum Emission Factor Available), dated October 2024
VOC	1.20E-01	lb/MMBtu	AP-42 Section 3.2, Natural Gas Engines (4 Stroke Lean Burn) dated October 2024. The emission factor for PAH (which are HAPs because they are POMs) is the sum of the value listed for 'PAH' in AP-42 and all other PAHs listed in the AP-42 that are not specifically listed HAPs.
Benzene	4.40E-04	lb/MMBtu	
Toluene	4.08E-04	lb/MMBtu	
Xylene	1.84E-04	lb/MMBtu	
1,3-Butadiene	2.67E-04	lb/MMBtu	
Acrolein	5.14E-03	lb/MMBtu	
Naphthalene	7.44E-05	lb/MMBtu	
1,1,2,2-Tetrachloroethane	4.00E-05	lb/MMBtu	
1,1,2-Trichloroethane	3.18E-05	lb/MMBtu	
1,3-Dichloropropene	2.64E-05	lb/MMBtu	
2-Methylnaphthalene	3.32E-05	lb/MMBtu	
2,2,4-Trimethylpentane	2.50E-04	lb/MMBtu	
Acenaphthene	1.25E-06	lb/MMBtu	
Acenaphthylene	5.53E-06	lb/MMBtu	
Benzo(b)fluoranthene	1.66E-07	lb/MMBtu	
Benzo(e)pyrene	4.15E-07	lb/MMBtu	
Benzo(g,h,i)perylene	4.14E-07	lb/MMBtu	
Biphenyl	2.12E-04	lb/MMBtu	
Carbon Tetrachloride	3.67E-05	lb/MMBtu	
Chlorobenzene	3.04E-05	lb/MMBtu	
Chloroform	2.85E-05	lb/MMBtu	
Chrysene	6.93E-07	lb/MMBtu	
Ethylbenzene	3.97E-05	lb/MMBtu	
Ethylene Dibromide	4.43E-05	lb/MMBtu	
Formaldehyde	5.28E-02	lb/MMBtu	
Fluoranthene	1.11E-06	lb/MMBtu	
Fluorene	5.67E-06	lb/MMBtu	
Methanol	2.50E-03	lb/MMBtu	
Methylene Chloride	2.00E-05	lb/MMBtu	
Hexane	1.11E-03	lb/MMBtu	
PAH	7.75E-05	lb/MMBtu	
Phenanthrene	1.04E-05	lb/MMBtu	
Phenol	2.40E-05	lb/MMBtu	
Pyrene	1.36E-06	lb/MMBtu	
Styrene	2.36E-05	lb/MMBtu	
Tetrachloroethane	2.48E-06	lb/MMBtu	
Vinyl Chloride	1.49E-05	lb/MMBtu	
$PM/PM_{10}/PM_{2.5}$	4.00E-02	g/kW-hr	Tier 4 emission factors for diesel engines from Table 1 of §1039.101
NO_x	3.50E+00	g/kW-hr	
CO	3.50E+00	g/kW-hr	
VOC	1.90E-01	g/kW-hr	Tier 4 NMHC emission factors for diesel engines from Table 1 of §1039.101
SO_x	1.21E-05	lb/hp-hr	AP-42, Table 3.4-1 (April 2025) based on Ultra Low Sulfur Diesel (15 ppm sulfur or 0.0015%) for Large Uncontrolled Stationary Diesel Engines (>600 HP).
CO_2	7.40E+01	kg/MMBtu	40 CFR Part 98, Subpart C, Table C-1 for Distillate Fuel Oil No. 2 (diesel)
CH_4	3.00E-03	kg/MMBtu	
N_2O	6.00E-04	kg/MMBtu	
PM (condensable)	9.91E-03	lb/MMBtu	AP-42 Section 3.2, Natural Gas Engines (4 stroke lean burn) dated October 2024
CO_2	5.31E+01	kg/MMBtu	40 CFR Part 98, Subpart C, Table C-1 and C-2 for Natural Gas (Weighted U.S Average)
CH_4	1.00E-03	kg/MMBtu	
N_2O	1.00E-04	kg/MMBtu	
Benzene	7.76E-04	lb/MMBtu	AP-42 Section 3.4, HAP Emission Factors For Large Uncontrolled Stationary Diesel Engines (>600 HP) dated April 2025. The emission factor for PAH (which are HAPs because they are POMs) is the value for 'Total PAH' listed in AP-42 minus the value listed for napthalene, as it is speciated here.
Toluene	2.81E-04	lb/MMBtu	
Xylene	1.93E-04	lb/MMBtu	
1,3-Butadiene	3.91E-05	lb/MMBtu	
Formaldehyde	7.89E-05	lb/MMBtu	
Acetaldehyde	2.52E-05	lb/MMBtu	
Acrolein	7.88E-06	lb/MMBtu	
Naphthalene	1.30E-04	lb/MMBtu	
Propylene	2.79E-03	lb/MMBtu	
Acenaphthylene	9.23E-06	lb/MMBtu	
Acenaphthene	4.68E-06	lb/MMBtu	
Fluorene	1.28E-05	lb/MMBtu	
Phenanthrene	4.08E-05	lb/MMBtu	
Anthracene	1.23E-06	lb/MMBtu	
Fluoranthene	4.03E-06	lb/MMBtu	
Pyrene	3.71E-06	lb/MMBtu	
Benz(a)anthracene	6.22E-07	lb/MMBtu	
Chrysene	1.53E-06	lb/MMBtu	
Benzo(b)fluoranthene	1.11E-06	lb/MMBtu	
Benzo(k)fluoranthene	2.18E-07	lb/MMBtu	
Benzo(a)pyrene	2.57E-07	lb/MMBtu	
Indeno(1,2,3-cd)pyrene	4.14E-07	lb/MMBtu	
Dibenz(a,h)anthracene	3.46E-07	lb/MMBtu	
Benzo(g,h,i)perylene	5.56E-07	lb/MMBtu	
PAH	8.20E-05	lb/MMBtu	
SO2	2.05E-03	lb/hp-hr	AP-42 Section 3.3 for Diesel Engines (<600 HP) dated April 2025

NOx	4.00E-01	g/kW-hr	Tier 4 emission factors for diesel engines of rated capacity 130 ≤ kW < 560 from Table 1 of §1039.101
CO	3.50E+00	g/kW-hr	
PM	2.00E-02	g/kW-hr	
PM_{10}	2.00E-02	g/kW-hr	
$PM_{2.5}$	2.00E-02	g/kW-hr	
VOC	1.90E-01	g/kW-hr	
Benzene	9.33E-04	lb/MMBtu	AP-42 Section 3.3 Table 3.3-2 Speciated Organic Compound Emission Factors For Uncontrolled Diesel Engines (< 600 HP) dated April 2025. The emission factor for PAH (which are HAPs because they are POMs) is the value for 'Total PAH' listed in AP-42 minus the value listed for napthalene, as it is speciated here.
Toluene	4.09E-04	lb/MMBtu	
Xylene	2.85E-04	lb/MMBtu	
1,3-Butadiene	3.91E-05	lb/MMBtu	
Formaldehyde	1.18E-03	lb/MMBtu	
Acetaldehyde	7.67E-04	lb/MMBtu	
Acrolein	9.25E-05	lb/MMBtu	
Napthalene	8.48E-05	lb/MMBtu	
PAH	8.32E-05	lb/MMBtu	

Table A-16b. Generator - Criteria Pollutant Emissions (Annual)

Emission Point Number	Location	Equipment Name	Number of Engines	Engine Rating (kW)		Fuel Type	Operation Hours	Criteria Pollutants Annual Emissions (tpy)								GHG Annual Emissions (tpy)			
				(Electrical)	(Mechanical)		(hrs/yr)	NO_x	NO_2	CO	PM	PM_{10}	$PM_{2.5}$	VOC[1]	SO_2	CO_2	CH_4	N_2O	CO_2e
ENGINE 0013 - 0056 (50% Load)	Trench	CAT 3520 DSL 2600 kW	40	52000	57,200	NG	8,760	45.02	0.00	23.19	52.42	52.42	52.42	38.06	1.53	399,229.42	1,100.04	11.13	430,046.92
ENGINE 0013 - 0056 (75% Load)	Trench			78,000	85,800	NG	8,760	56.65	0.32	20.25	23.80	23.80	23.80	58.16	2.15	570,840.63	1,591.78	15.08	615,128.71
ENGINE 0013 - 0056 (100% Load)	Trench			104,000	114,400	NG	8,760	113.02	10.77	18.81	2.87	2.87	2.87	16.95	2.76	730,963.23	1,850.24	15.80	781,926.73
ENGINE 0007 - 0012[2]	Hardshell	CAT C18, 589 bkW	6	2,730	3,534	Diesel	8,760	3.9	1.95	20	0.34	0.34	0.34	7.5	4.14E-04	23,692.22	0.96	0.19	23,773.52
		CAT C18, 589 bkW	6	2,730	3,534	Diesel	8,760	3.9	1.95	20	0.34	0.34	0.34	7.5	4.14E-04	23,692.22	0.96	0.19	23,773.52
ENGINE 0002 - 0006	Taylor	CAT C175 3000 kW	5	3,000	3,300	Diesel	500	31.83	31.83	31.83	3.64E-01	3.64E-01	3.64E-01	1.73E+00	6.71E-02	1,262.75	0.05	0.01	1,267.09
ENGINE 0001	WW1	C200D2RE	1	200	213	Diesel	8,760	0.82	0.82	7.20	0.04	0.04	0.04	0.39	2.56	1,427.97	0.06	0.01	1,432.87
Total Annual Emissions								**153.47**	**47.32**	**102.22**	**53.50**	**53.50**	**53.50**	**75.28**	**5.39**	**781038.39**	**1852.27**	**16.20**	**832173.73**

1. VOC emission factors for NG engines assumed to be total of VOC, Acetaldehyde, and Formaldehyde emission factors from performance test.
2. ENGINE 0007 - 0012 generators will be CAT XQ1140 make/model. Each XQ1140 generator set will consist of two CAT C18 engines exhausting to a shared stack

Table A-16c. Generator - HAP Emissions (Annual)[1]

Emission Point Number	ENGINE 0013 - 0056 (50%)	ENGINE 0013 - 0056 (75%)	ENGINE 0013 - 0056 (100%)	ENGINE 0007 - 0012		ENGINE 0002 - 0006	ENGINE 0001	Total Annual Emissions (tpy)
Engine Rating (kW)	**57.200**	**85.800**	**114.400**	**3.534**	**3.534**	**3.300**	**213**	
Fuel Consumption Rate (SCFH)	**582,360**	**818,200**	**1,051,120**	**-**	-	**-**	**-**	
Fuel Input (MMBtu/hr)	**594.01**	**834.56**	**1,072.14**	**33.17**	**33.17**	**30.98**	**2.00**	
Benzene	1.17E-01	1.64E-01	2.11E-01	1.13E-01	1.13E-01	6.01E-03	8.17E-03	0.450
Toluene	1.08E-01	1.52E-01	1.95E-01	4.08E-02	4.08E-02	2.18E-03	3.58E-03	0.283
Xylene	4.88E-02	6.86E-02	8.81E-02	2.80E-02	2.80E-02	1.49E-03	2.50E-03	0.148
1,3-Butadiene	7.09E-02	9.95E-02	1.28E-01	5.68E-03	5.68E-03	3.03E-04	3.42E-04	0.140
Formaldehyde	2.87E-01	0.00E+00	6.75E+00	1.15E-02	1.15E-02	6.11E-04	1.03E-02	6.783
Acetaldehyde	1.04E+01	2.75E+01	1.02E+01	3.66E-03	3.66E-03	1.95E-04	6.72E-03	27.479
Acrolein	1.36E+00	1.92E+00	2.46E+00	1.14E-03	1.14E-03	6.10E-05	8.10E-04	2.465
Naphthalene	1.97E-02	2.77E-02	3.56E-02	1.89E-02	1.89E-02	1.01E-03	--	0.074
1,1,2,2-Tetrachloroethane	1.04E-01	1.46E-01	1.88E-01	--	--	--	--	0.188
1,1,2-Trichloroethane	8.27E-02	1.16E-01	1.49E-01	--	--	--	--	0.149
1,3-Dichloropropene	7.01E-03	9.84E-03	1.26E-02	--	--	--	--	0.013
2-Methylnaphthalene	8.81E-03	1.24E-02	1.59E-02	--	--	--	--	0.016
2,2,4-Trimethylpentane	6.63E-02	9.32E-02	1.20E-01	--	--	--	--	0.120
Biphenyl	5.63E-02	7.90E-02	1.02E-01	--	--	--	--	0.102
Carbon Tetrachloride	9.55E-02	1.34E-01	1.72E-01	--	--	--	--	0.172
Chlorobenzene	7.91E-02	1.11E-01	1.43E-01	--	--	--	--	0.143
Chloroform	7.41E-02	1.04E-01	1.34E-01	--	--	--	--	0.134
Ethylbenzene	1.05E-02	1.48E-02	1.90E-02	--	--	--	--	0.019
Ethylene Dibromide	1.15E-01	1.62E-01	2.08E-01	--	--	--	--	0.208
Methanol	6.63E-01	9.32E-01	1.20E+00	--	--	--	--	1.197
Methylene Chloride	5.20E-02	7.31E-02	9.39E-02	--	--	--	--	0.094
Hexane	2.95E-01	4.14E-01	5.32E-01	--	--	--	--	0.532
PAH	2.02E-01	2.83E-01	3.64E-01	1.19E-02	1.19E-02	6.35E-04	7.29E-04	0.389
Phenol	6.24E-02	8.77E-02	1.13E-01	--	--	--	--	0.113
Tetrachloroethane	6.45E-03	9.07E-03	1.16E-02	--	--	--	--	0.012
Vinyl Chloride	3.88E-02	5.45E-02	7.00E-02	--	--	--	--	0.070
							Total Annual HAP emisions (tpy)	**41.49**

1. The CAT NG engines (EU: T_ENG) are Tier 4 emissions certified and equipped with oxidation catalysts. Oxidation catalysts reduce emissions of organic HAPS. To develop an appropriate control effiency (CE) for the HAP emissions from these engines that could be applied to the AP-42 Ch. 3.2 HAP Emission factors, Formaldehyde and VOC emission factors determined through stack testing were compared with Formaldehyde and VOC emission factors from AP-42 for natural gas engines, and the resulting ratio was applied to all organic HAPs.

100% Load CAT 3520 engines CE based on formaldehyde or VOC emission factors: CE % = (1 - (Stack Testing Emission Factor) / (AP-42 Ch. 3.2 Emission Factor)) x 100
Formaldehyde CE = *97.9%*
VOC CE = *97.7%*

75% Load CAT 3520 engines CE based on formaldehyde emission factors: CE % = (Stack Testing Emission Factor) / (AP-42 Ch. 3.2 Emission Factor) x 100
Formaldehyde CE = *100.0%*
VOC CE = *89.8%*

50% Load CAT 3520 engines CE based on formaldehyde emission factors: CE % = (Stack Testing Emission Factor) / (AP-42 Ch. 3.2 Emission Factor) x 100
Formaldehyde CE = *99.8%*
VOC CE = *90.6%*

Based on the calculations above, a conservative CE of **89.8%** was applied to all AP-42 organic HAP emission factors for these engines.

Table A-16d. Generator - Criteria Pollutant Emissions (Daily)

Emission Point Number	Location	Equipment Name	Number of Engines	Engine Rating (kW) [1,2]		Fuel Type	Operation Hours	Criteria Pollutants Daily Emissions (lb/day) [3,4,5]							
				(Electrical)	(Mechanical)		(hrs/yr)	NO_x	NO_2	CO	PM	PM_{10}	$PM_{2.5}$	VOC	SO_2
ENGINE 0013 - 0056 (50%)	Trench	CAT 3520 DSL 2600 kW	40	78,000	85,800	NG	8,760	310.43	1.77	110.95	130.43	130.43	130.43	318.69	11.78
ENGINE 0013 - 0056 (75%)	Trench	CAT 3520 DSL 2600 kW		104,000	114,400	NG	8,760	619.28	59.02	103.08	15.74	15.74	15.74	92.85	15.13
ENGINE 0013 - 0056 (100%)	Trench	CAT 3520 DSL 2600 kW		52,000	57,200	NG	8,760	246.69	0.00	127.08	287.22	287.22	287.22	208.53	8.38
ENGINE 0007 - 0012	Hardshell	CAT C18, 589 bkW	6	2,730	3,534	Diesel	8,760	21.37	10.68	109.59	1.87	1.87	1.87	41.10	2.27E-03
		CAT C18, 589 bkW	6	2,730	3,534	Diesel	8,760	21.37	10.68	109.59	1.87	1.87	1.87	41.10	2.27E-03
ENGINE 0002 - 0006	Taylor	CAT C175 3000 kW	5	3000	3,300	Diesel	500	3055.61	3055.61	3055.61	34.92	34.92	34.92	165.88	6.44
ENGINE 0001	WW1	C200D2RE	1	200	213	Diesel	8,760	4.51	4.51	39.45	0.23	0.23	0.23	2.14	14.05
Total Daily Emissions								**3,722.14**	**3,140.50**	**3,441.31**	**326.10**	**326.10**	**326.10**	**568.90**	**35.63**

Table A-16e. Generator - Criteria Pollutant Emissions (Hourly)

Emission Point Number	Location	Equipment Name	Number of Engines	Engine Rating (kW) [1,2]		Fuel Type	Operation Hours	Criteria Pollutants Hourly Emissions (lb/hr) [3,4,5]							
				(Electrical)	(Mechanical)		(hrs/yr)	NO_x	NO_2	CO	PM	PM_{10}	$PM_{2.5}$	VOC	SO_2
ENGINE 0013 - 0056 (50%)	Trench	CAT 3520 DSL 2600 kW	40	78,000	85,800	NG	8,760	12.93	0.07	4.62	5.43	5.43	5.43	13.28	0.49
ENGINE 0013 - 0056 (75%)	Trench	CAT 3520 DSL 2600 kW		104,000	114,400	NG	8,760	25.80	2.46	4.30	0.66	0.66	0.66	3.87	0.63
ENGINE 0013 - 0056 (100%)	Trench	CAT 3520 DSL 2600 kW		52,000	57,200	NG	8,760	10.28	0.00	5.30	11.97	11.97	11.97	8.69	0.35
ENGINE 0007 - 0012	Hardshell	CAT C18, 589 bkW	6	2,730	3,534	Diesel	8760	0.89	0.45	4.57	0.08	0.08	0.08	1.71	9.45E-05
		CAT C18, 589 bkW	6	2,730	3,534	Diesel	8760	0.89	0.45	4.57	0.08	0.08	0.08	1.71	9.45E-05
ENGINE 0002 - 0006	Taylor	CAT C175 3000 kW	5	3,000	3,300	Diesel	500	127.32	127.32	127.32	1.46	1.46	1.46	6.91	0.27
ENGINE 0001	WW1	C200D2RE	1	200	213	Diesel	8760	0.19	0.19	1.64	0.01	0.01	0.01	0.09	0.59
Total Hourly Emissions								**155.09**	**130.85**	**143.39**	**13.59**	**13.59**	**13.59**	**23.70**	**1.48**

1. A 10% increase in rating in the 2.6MW engines has been accounted for the change in electrical to mechanical rating. 10.00% Increase
2. Engine rating per Request for Information dated 02/16/2021
3. Average brake specific fuel consumption of 7,000 Btu/hp-hr, Per AP-42 Chapter 3.3, is used to convert from lb/MMBtu to lb/hp-hr for diesel generators
1.34 hp/kW
1020 Btu/scf, per AP-42 Chapter 1.4 for natural gas engines
4. GHG emissions were converted to CO2e emissions based on the GWP for each GHG.
GWP of CO_2 1 lbs CO_2e/lb CO_2
GWP of CH_4 25 lbs CO_2e/lb CH_4
GWP of N_2O 298 lbs CO_2e/lb N_2O
5. Safety factor of 30% has been added to the emission factors for 2.6MW NG engines. 30.00% Increase

Table A-16f. Number of Generators

Power Supplied by CAT 3520 DSL 2600 kW	Parasitic[1]	2,500	kW
	Total	2,600	kW
Number of Engines		40	Generators
Power Supplied by CAT XQ1140 - 910kW		910	kW
Engines per CAT XQ1140 Generator		2	Engines/Generator
Engine mechanical rating		589	bkW
CAT 3520 DSL 2600 kW - Hardshell		6	Generators

1. Actual output is 2,500 kW due to 100kW of parasitic load, per email from Sebastian Gutierrez on 5/1/2024. Engine certified to perform optimally up to 5,500 ft of elevation based on email from Sebastian Gutierrez on 5/1/2024

Table A-17a. Wind Erosion Emission Factors

Type of Material	Particulate Matter Emission Factors [1,2,3,4]				Particulate Matter Emission Factor Inputs [5,6]				Notes
	PM/TSP	PM_{10}	$PM_{2.5}$	Units	Max 5-minute wind speed (m/s)	u_{10}^{+}	u^{*}	u_t	
Aggregate/shotcrete	0.02	0.01	0.002	ton/acre-yr	16.71	27.9	1.48	1.33	$u^{*} = (0.053)(u_{10}^{+})$, where u_{10}^{+} = fastest mile for the time period between disturbances (see below for information on fastest mile calculation). The fastest mile was calculated using the linear regression proposed by ADEQ. The maximum 5-minute wind speed is the max 5-minute wind speed collected at the onsite meteorological station.
TSF	0.33	0.17	0.025	ton/acre-yr	16.71	27.9	1.48	0.54	
Rock/Ore/ROM	0.10	0.05	0.008	ton/acre-yr	16.71	27.9	1.48	1.02	

1. u10+ is calculated as 1.662 * the max 5-minute wind speed + 0.0913. The 1.662 and 0.0913 value was determined from the linear regression analysis.
2. Per AP-42 13.2.5 Equation 3:

$$P = 58\,(u^{*} - u_t^{*})^2 + 25\,(u^{*} - u_t^{*})$$

$$P = 0 \text{ for } u^{*} \le u_t^{*}$$

where

u_t = threshold velocity

3. Threshold friction velocity per AP-42 Table 13.2.5-2:

1.02	m/s	Overburden can be used to represent Rock/Ore/ROM
1.33	m/s	Roadbed material can be used to represent TSFs/aggregate/shotcrete
0.54	m/s	Conservatively assumed that fine coal dust on concrete pad can be used to represent TSFs

4. Particle size multiplier for emission factors per AP-42 13.2.5:

PM	1
PM_{10}	0.5
$PM_{2.5}$	0.075

5. k = particle size multiplier, u^{*} = friction velocity, u_t = threshold friction velocity
6. The fastest mile was calculated using linear regression method historically accepted by ADEQ for other facilities. The maximum 5-minute wind speed is the max 5-minute wind speed collected at the onsite meteorological station.

Table A-17b. Wind Erosion Emissions

Emission Point Number	Location	Annual Potential Emissions [1,2,3] (tpy)				Daily Potential Emissions [1,2,3] (lb/day)				Hourly Potential Emissions [1,2,3] (lb/hr)			
		PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds	PM	PM_{10}	$PM_{2.5}$	Lead Compounds
TSF2	USFS Tailings Storage Facility	40.47	20.24	3.04	0.17	221.75	110.88	16.63	0.94	9.24	4.62	0.69	0.039
TSF_1	Tailing Storage Facility	16.45	8.23	1.23	0.07	90.15	45.08	6.76	3.84E-01	3.76	1.88	0.28	0.02
WRS	West Rock Stockpile	0.67	0.34	0.05	0.0024	3.67	1.84	0.28	1.30E-02	0.15	0.08	0.01	0.001
EOS	East Ore Stockpile	0.74	0.37	0.06	0.04	4.07	2.03	0.30	1.92E-01	0.17	0.08	0.01	0.008
TAGG	Taylor Agg Stockpile	0.0005	0.0002	0.0000	--	0.00	0.00	0.00	--	0.00	0.00	0.00	--
TSHOT	Taylor Shotcrete Stockpile	0.0008	0.0004	0.0001	--	0.00	0.00	0.00	--	0.00	0.00	0.00	--
HRS	Hardshell Rock Stockpile	3.95	1.98	0.30	2.25E-02	21.66	10.83	1.62	0.12	0.90	0.45	0.07	0.005
ORE	Clark Ore Stockpile	0.12	0.06	0.01	2.12E-03	0.66	0.33	0.05	1.16E-02	0.03	0.01	0.00	0.0005
ROM	Clark ROM Stockpile	0.0357	0.0179	0.0027	6.29E-04	0.20	0.10	0.01	3.45E-03	0.01	0.00	0.00	0.0001
AGG	Clark Agg Stockpile	0.0005	0.0002	0.0000	--	0.00	0.00	0.00	--	0.00	0.00	0.00	--
SHOT	Clark Shotcrete Stockpile	0.0008	0.0004	0.0001	--	0.00	0.00	0.00	--	0.00	0.00	0.00	--
CHUTE	Waste Chute Stockpile	2.59E-03	1.30E-03	1.94E-04	1.49E-05	1.42E-02	7.10E-03	1.07E-03	8.14E-05	5.92E-04	2.96E-04	4.44E-05	3.39E-06
Total		**62.45**	**31.22**	**4.68**	**0.31**	**342.19**	**171.09**	**25.66**	**1.67**	**14.26**	**7.13**	**1.07**	**0.07**

1. Emissions based on maximum hours 8760 hrs
2. Conversion from grams to pounds 453.6 g/lb
3. Percent of lead in PM emissions and total exposed surface are in table below

USFS Tailings Storage Facility	Lead	0.43%	%	Tailings Storage Facility	Lead	0.43%	%
	Material	Tailings			Material	Tailings	
	Area	5,317,757	ft^2		Area	2,161,944	ft^2
		122	acre			50	acre
Taylor Shotcrete Stockpile	Lead	0.00	%	East Ore Stockpile	Lead Grade	4.73%	
	Material	Shotcrete			Material	Stope Ore & Developmental Ore	
	Area	1,600	ft^2		Area	308,126	ft^2
		0.04	acre			7	acre
Taylor Agg Stockpile	Lead	0.00	%	West Rock Stockpile	Lead	0.35	%
	Material	Aggregate			Material	Waste Rock	
	Area	900	ft^2		Area	278,225	ft^2
		0.02	acre			6	acre
Hardshell Rock Stockpile	Lead Grade	0.57%		Clark Ore Stockpile	Lead	1.76	%
	Material	Waste Rock			Material	Clark Stope & Developmental Ore	
	Area	1,641,033	ft^2		Area	50,001	ft^2
		37.7	acre			1.15	acre
Clark Shotcrete Stockpile	Lead	0.00	%	Clark ROM Stockpile	Lead	1.76	%
	Material	Shotcrete			Material	Clark Stope & Developmental Ore	
	Area	1,600	ft^2		Area	14,840	ft^2
		0.04	acre			0.34	acre
Clark Agg Stockpile	Lead	0.00	%	Waste Chute Stockpile	Lead Grade	0.57%	
	Material	Aggregate			Material	Waste Chute Material	
	Area	900	ft^2		Area	1,076	ft^2
		0.02	acre			0.02	acre

Table A-18a. WTP2 Cooling Tower Parameters

Emission Point Number	Flowrate [1] (gal/min)	Drift [2] (%)	TDS [3] (ppm)
WTP2CT	4500	0.0005	455

1. Flowrate per July 18th, 2022 email from Sarah Richman
2. Drift % per July 18th, 2022 email from Sarah Richman
3. Influent TDS (455 ppm) concentration per July 18th, 2022 email from Sarah Richman

Drift loss	0.0005%		High Efficiency
Circulating water flow rate	4,500	gpm	
Total dissolved solids	455	ppm	
Density of TDS constituents	2.5	g/cc	*Average density of common salts (CaCO3, CaSO4, CaCl2, NaCl, Na2SO4, Na2CO3)*

Volume of a sphere $V = 4/3*\pi*r^3$

Annual drift 11 lb H_2O/hr

Table A-18b. Water Drop Size Distribution for Low Efficiency Drift Eliminators*

Based on a drift rate of 0.001%

Droplet Dia. (micron)	% mass	% mass smaller	H_2O Droplet Mass (g)	Solids Vol. (cc)	Solids Dia. (micron)	Emissions PM (lb/hr)	Emissions PM_{10} (lb/hr)	Emissions $PM_{2.5}$ (lb/hr)
22	0.43	0.43	5.6E-09	1.0E-12	1.2			
29	1.49	1.92	1.3E-08	2.3E-12	1.6			
44	3.76	5.68	4.5E-08	8.1E-12	2.5			
58	2.09	7.77	1.0E-07	1.9E-11	3.3			7.8%
65	1.86	9.63	1.4E-07	2.6E-11	3.7			
87	1.56	11.19	3.4E-07	6.3E-11	4.9			
108	1.43	12.62	6.6E-07	1.2E-10	6.1			
120	1.26	13.88	9.0E-07	1.6E-10	6.8			
132	1.09	14.97	1.2E-06	2.2E-10	7.5			
144	1.32	16.29	1.6E-06	2.8E-10	8.2			
174	5.81	22.1	2.8E-06	5.0E-10	9.9			
300	5.04	27.14	1.4E-05	2.6E-09	17.0		27.1%	
450**	4.17	31.31	4.8E-05	8.7E-09	25.5	31.3%		
600	4.01	35.32	1.1E-04	2.1E-08	34.0			
750	4.00	39.32	2.2E-04	4.0E-08	42.5			
900	4.03	43.35	3.8E-04	6.9E-08	51.0			
1,050	4.57	47.92	6.1E-04	1.1E-07	59.5			
1,200	5.46	53.38	9.0E-04	1.6E-07	68.0			
1,350	6.80	60.18	1.3E-03	2.3E-07	76.5			
2,250	17.99	78.17	6.0E-03	1.1E-06	127.5			
2,400	21.83	100	7.2E-03	1.3E-06	136.0			

** EPA. 1979. Effects of Pathogenic and Toxic Material Transport Via Cooling Device Drift - Vol. 1 Technical Report. EPA-600/7-79-251a. November 1979.*

*** Maximum droplet size governed by atmospheric dispersion. Larger droplets fall to the ground before evaporating into a particle (EPA 1979).*

Table A-18c. Water Drop Size Distribution for High Efficiency Drift Eliminators*

Based on a drift rate of 0.0003%

Droplet Dia. (micron)	% mass smaller	H_2O Droplet Mass (g)	Solids Vol. (cc)	Solids Dia. (micron)	Emissions PM (lb/hr)	Emissions PM_{10} (lb/hr)	Emissions $PM_{2.5}$ (lb/hr)
10	0	5.2E-10	9.5E-14	0.6			
20	0.196	4.2E-09	7.6E-13	1.1			
30	0.226	1.4E-08	2.6E-12	1.7			
40	0.514	3.4E-08	6.1E-12	2.3			
50	1.816	6.5E-08	1.2E-11	2.8			1.8%
60	5.702	1.1E-07	2.1E-11	3.4			
70	21.348	1.8E-07	3.3E-11	4.0			
90	49.812	3.8E-07	6.9E-11	5.1			
110	70.509	7.0E-07	1.3E-10	6.2			
130	82.023	1.2E-06	2.1E-10	7.4			
150	88.012	1.8E-06	3.2E-10	8.5			
180	91.032	3.1E-06	5.6E-10	10.2		91.0%	
210	92.468	4.8E-06	8.8E-10	11.9			
240	94.091	7.2E-06	1.3E-09	13.6			
270	94.689	1.0E-05	1.9E-09	15.3			
300	96.288	1.4E-05	2.6E-09	17.0			
350	97.011	2.2E-05	4.1E-09	19.8			
400	98.34	3.4E-05	6.1E-09	22.7			
450**	99.071	4.8E-05	8.7E-09	25.5	99.1%		
500	99.071	6.5E-05	1.2E-08	28.3			
600	100	1.1E-04	2.1E-08	34.0			

** Reisman, J. and G. Frisbie. 2002. "Calculating Realistic PM10 Emissions from Cooling Towers." Environmental Progress & Sustainable Energy. American Institute of Chemical Engineers. Volume 21, Issue 2, pp. 127-130. July 2002.*

*** Maximum droplet size governed by atmospheric dispersion. Larger droplets fall to the ground before evaporating into a particle (EPA 1979).*

Table A-18d. WTP2 Cooling Towers - Emissions

Emission Point Number	Annual Emissions (tpy)			Daily Emissions (lb/day)			Hourly Emissions (lb/hr)		
	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
WTP2CT	2.22E-02	2.04E-02	4.07E-04	1.22E-01	1.12E-01	2.23E-03	5.07E-03	4.66E-03	9.29E-05
TOTAL	**0.0222**	**0.0204**	**4.07E-04**	**0.122**	**0.112**	**2.23E-03**	**0.0051**	**4.66E-03**	**9.29E-05**

Table A-19a. Surface Refrigeration Plant Parameters

Emission Point Number	Flowrate [1] (gal/min)	Drift [2] (%)	TDS [2,3] (ppm)
PRODREF	7,529	0.001	1000
BBREF	11,095	0.001	1000
MILLREF	512	0.001	1000

1. Provided by Ross Wilson (BBE Consulting) on 07/06/2023 via email.
2. Per parameters provided by South32 on 09/07/2021.
3. Provided by Matt Novak on 04/26/2024 via RFI

PRODREF:

Drift loss	0.0010%		Low Efficiency
Circulating water flow rate	7,529	gpm	
Total dissolved solids	1,000	ppm	
Density of TDS constituents	2.5	g/cc	*Average density of common salts (CaCO3, CaSO4, CaCl2, NaCl, Na2SO4, Na2CO3)*
Volume of a sphere	$V = 4/3*\pi*r^3$		
Annual drift	38	lb H_2O/hr	

BBREF:

Drift loss	0.0010%		Low Efficiency
Circulating water flow rate	11,095	gpm	
Total dissolved solids	1,000	ppm	
Density of TDS constituents	2.5	g/cc	*Average density of common salts (CaCO3, CaSO4, CaCl2, NaCl, Na2SO4, Na2CO3)*
Volume of a sphere	$V = 4/3*\pi*r^3$		
Annual drift	55	lb H_2O/hr	

MILLREF

Drift loss	0.0010%		Low Efficiency
Circulating water flow rate	512	gpm	
Total dissolved solids	1,000	ppm	
Density of TDS constituents	2.5	g/cc	*Average density of common salts (CaCO3, CaSO4, CaCl2, NaCl, Na2SO4, Na2CO3)*
Volume of a sphere	$V = 4/3*\pi*r^3$		
Annual drift	0	lb H_2O/hr	

Table A-19b. Water Drop Size Distribution for Low Efficiency Drift Eliminators*

Based on a drift rate of 0.001%

Droplet Dia. (micron)	% mass	% mass smaller	H_2O Droplet Mass (g)	Solids Vol. (cc)	Solids Dia. (micron)	Emissions PM (lb/hr)	Emissions PM_{10} (lb/hr)	Emissions $PM_{2.5}$ (lb/hr)
22	0.43	0.43	5.6E-09	2.2E-12	1.6			
29	1.49	1.92	1.3E-08	5.1E-12	2.1			
44	3.76	5.68	4.5E-08	1.8E-11	3.2			5.7%
58	2.09	7.77	1.0E-07	4.1E-11	4.3			
65	1.86	9.63	1.4E-07	5.8E-11	4.8			
87	1.56	11.19	3.4E-07	1.4E-10	6.4			
108	1.43	12.62	6.6E-07	2.6E-10	8.0			
120	1.26	13.88	9.0E-07	3.6E-10	8.8			
132	1.09	14.97	1.2E-06	4.8E-10	9.7			
144	1.32	16.29	1.6E-06	6.3E-10	10.6		16.3%	
174	5.81	22.1	2.8E-06	1.1E-09	12.8			
300	5.04	27.14	1.4E-05	5.7E-09	22.1			
450**	4.17	31.31	4.8E-05	1.9E-08	33.2	31.3%		
600	4.01	35.32	1.1E-04	4.5E-08	44.2			
750	4.00	39.32	2.2E-04	8.8E-08	55.3			
900	4.03	43.35	3.8E-04	1.5E-07	66.3			
1,050	4.57	47.92	6.1E-04	2.4E-07	77.4			
1,200	5.46	53.38	9.0E-04	3.6E-07	88.4			
1,350	6.80	60.18	1.3E-03	5.2E-07	99.5			
2,250	17.99	78.17	6.0E-03	2.4E-06	165.8			
2,400	21.83	100	7.2E-03	2.9E-06	176.8			

** EPA. 1979. Effects of Pathogenic and Toxic Material Transport Via Cooling Device Drift - Vol. 1 Technical Report. EPA-600/7-79-251a. November 1979.*

*** Maximum droplet size governed by atmospheric dispersion. Larger droplets fall to the ground before evaporating into a particle (EPA 1979).*

Table A-19c. Water Drop Size Distribution for High Efficiency Drift Eliminators*

Based on a drift rate of 0.0003%

Droplet Dia. (micron)	% mass smaller	H_2O Droplet Mass (g)	Solids Vol. (cc)	Solids Dia. (micron)	Emissions PM (lb/hr)	Emissions PM_{10} (lb/hr)	Emissions $PM_{2.5}$ (lb/hr)
10	0	5.2E-10	2.1E-13	0.7			
20	0.196	4.2E-09	1.7E-12	1.5			
30	0.226	1.4E-08	5.7E-12	2.2			
40	0.514	3.4E-08	1.3E-11	2.9			0.5%
50	1.816	6.5E-08	2.6E-11	3.7			
60	5.702	1.1E-07	4.5E-11	4.4			
70	21.348	1.8E-07	7.2E-11	5.2			
90	49.812	3.8E-07	1.5E-10	6.6			
110	70.509	7.0E-07	2.8E-10	8.1			
130	82.023	1.2E-06	4.6E-10	9.6			
150	88.012	1.8E-06	7.1E-10	11.1		88.0%	
180	91.032	3.1E-06	1.2E-09	13.3			
210	92.468	4.8E-06	1.9E-09	15.5			
240	94.091	7.2E-06	2.9E-09	17.7			
270	94.689	1.0E-05	4.1E-09	19.9			
300	96.288	1.4E-05	5.7E-09	22.1			
350	97.011	2.2E-05	9.0E-09	25.8			
400	98.34	3.4E-05	1.3E-08	29.5			
450**	99.071	4.8E-05	1.9E-08	33.2	99.1%		
500	99.071	6.5E-05	2.6E-08	36.8			
600	100	1.1E-04	4.5E-08	44.2			

** Reisman, J. and G. Frisbie. 2002. "Calculating Realistic PM10 Emissions from Cooling Towers." Environmental Progress & Sustainable Energy. American Institute of Chemical Engineers. Volume 21, Issue 2, pp. 127-130. July 2002.*

*** Maximum droplet size governed by atmospheric dispersion. Larger droplets fall to the ground before evaporating into a particle (EPA 1979).*

EXAMPLE CALCULATIONS: *Low Efficiency*

Annual drift:

$$\frac{7{,}529 \text{ gal water}}{1 \text{ min}} \left| \frac{8.33 \text{ lb}}{1 \text{ gal water}} \right| \frac{60 \text{ min}}{1 \text{ hr}} \left| \frac{0.001\% \text{ (drift)}}{} \right. = \mathbf{\frac{38 \text{ lb water drift}}{\text{hr}}}$$

Total Particulate Emissions

$$\frac{38 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| \frac{31.3\% \text{ PM}}{} = \frac{0.012 \text{ lb PM}}{\text{hr}} = \mathbf{\frac{0.052 \text{ ton PM}}{\text{yr}}}$$

PM_{10} Emissions

$$\frac{38 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| \frac{16.3\% \text{ PM}_{10}}{} = \frac{0.006 \text{ lb PM10}}{\text{hr}} = \mathbf{\frac{0.027 \text{ ton PM10}}{\text{yr}}}$$

$PM_{2.5}$ Emissions

$$\frac{38 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| \frac{5.7\% \text{ PM}_{2.5}}{} = \frac{0.002 \text{ lb PM2.5}}{\text{hr}} = \mathbf{\frac{0.009 \text{ ton PM2.5}}{\text{yr}}}$$

Water Drop Size Distribution for Low Efficiency Drift Eliminators*

Based on a drift rate of 0.001%

Droplet Dia. (micron)	% mass	% mass smaller	H_2O Droplet Mass (g)	Solids Vol. (cc)	Solids Dia. (micron)	Emissions PM (lb/hr)	Emissions PM_{10} (lb/hr)	Emissions $PM_{2.5}$ (lb/hr)
22	0.43	0.43	5.6E-09	2.2E-12	1.6			
29	1.49	1384.139	1.3E-08	5.1E-12	2.1			
44	3.76	5.68	4.5E-08	1.8E-11	3.2			5.7%
58	2.09	7.77	1.0E-07	4.1E-11	4.3			
65	1.86	9.63	1.4E-07	5.8E-11	4.8			
87	1.56	11.19	3.4E-07	1.4E-10	6.4			
108	1.43	12.62	6.6E-07	2.6E-10	8.0			
120	1.26	13.88	9.0E-07	3.6E-10	8.8			
132	1.09	14.97	1.2E-06	4.8E-10	9.7			
144	1.32	16.29	1.6E-06	6.3E-10	10.6		16.3%	
174	5.81	22.1	2.8E-06	1.1E-09	12.8			
300	5.04	27.14	1.4E-05	5.7E-09	22.1			
450**	4.17	31.31	4.8E-05	1.9E-08	33.2	31.3%		
600	4.01	35.32	1.1E-04	4.5E-08	44.2			
750	4.00	39.32	2.2E-04	8.8E-08	55.3			
900	4.03	43.35	3.8E-04	1.5E-07	66.3			
1,050	4.57	47.92	6.1E-04	2.4E-07	77.4			
1,200	5.46	53.38	9.0E-04	3.6E-07	88.4			
1,350	6.80	60.18	1.3E-03	5.2E-07	99.5			
2,250	17.99	78.17	6.0E-03	2.4E-06	165.8			
2,400	21.83	100	7.2E-03	2.9E-06	176.8			

** EPA. 1979. Effects of Pathogenic and Toxic Material Transport Via Cooling Device Drift - Vol. 1 Technical Report. EPA-600/7-79-251a. November 1979.*

*** Maximum droplet size governed by atmospheric dispersion. Larger droplets fall to the ground before evaporating into a particle (EPA 1979).*

Water Drop Size Distribution for High Efficiency Drift Eliminators*

Based on a drift rate of 0.0003%

Droplet Dia. (micron)	% mass smaller	H_2O Droplet Mass (g)	Solids Vol. (cc)	Solids Dia. (micron)	Emissions PM (lb/hr)	Emissions PM_{10} (lb/hr)	Emissions $PM_{2.5}$ (lb/hr)
10	0	5.2E-10	2.1E-13	0.7			
20	0.196	4.2E-09	1.7E-12	1.5			
30	0.226	1.4E-08	5.7E-12	2.2			
40	0.514	3.4E-08	1.3E-11	2.9			0.5%
50	1.816	6.5E-08	2.6E-11	3.7			
60	5.702	1.1E-07	4.5E-11	4.4			
70	21.348	1.8E-07	7.2E-11	5.2			
90	49.812	3.8E-07	1.5E-10	6.6			
110	70.509	7.0E-07	2.8E-10	8.1			
130	82.023	1.2E-06	4.6E-10	9.6			
150	88.012	1.8E-06	7.1E-10	11.1		88.0%	
180	91.032	3.1E-06	1.2E-09	13.3			
210	92.468	4.8E-06	1.9E-09	15.5			
240	94.091	7.2E-06	2.9E-09	17.7			
270	94.689	1.0E-05	4.1E-09	19.9			
300	96.288	1.4E-05	5.7E-09	22.1			
350	97.011	2.2E-05	9.0E-09	25.8			
400	98.34	3.4E-05	1.3E-08	29.5			
450**	99.071	4.8E-05	1.9E-08	33.2	99.1%		
500	99.071	6.5E-05	2.6E-08	36.8			
600	100	1.1E-04	4.5E-08	44.2			

** Reisman, J. and G. Frisbie. 2002. "Calculating Realistic PM10 Emissions from Cooling Towers." Environmental Progress & Sustainable Energy. American Institute of Chemical Engineers. Volume 21, Issue 2, pp. 127-130. July 2002.*

*** Maximum droplet size governed by atmospheric dispersion. Larger droplets fall to the ground before evaporating into a particle (EPA 1979).*

EXAMPLE CALCULATIONS: *Low Efficiency*

Annual drift:

$$\frac{11{,}095 \text{ gal water}}{1 \text{ min}} \left| \frac{8.33 \text{ lb}}{1 \text{ gal water}} \right| \frac{60 \text{ min}}{1 \text{ hr}} \left| 0.001\% \text{ (drift)} \right. = \mathbf{55 \text{ lb water drift / hr}}$$

Total Particulate Emissions

$$\frac{55 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| 31.3\% \text{ PM} = \frac{0.017 \text{ lb PM}}{\text{hr}} = \mathbf{0.076 \text{ ton PM / yr}}$$

PM_{10} Emissions

$$\frac{55 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| 16.3\% \text{ } PM_{10} = \frac{0.009 \text{ lb PM10}}{\text{hr}} = \mathbf{0.040 \text{ ton PM10 / yr}}$$

$PM_{2.5}$ Emissions

$$\frac{55 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| 5.7\% \text{ } PM_{2.5} = \frac{0.003 \text{ lb PM2.5}}{\text{hr}} = \mathbf{0.014 \text{ ton PM2.5 / yr}}$$

EXAMPLE CALCULATIONS: *Low Efficiency* MILLREF

Annual drift:

$$\frac{512 \text{ gal water}}{1 \text{ min}} \left| \frac{8.33 \text{ lb}}{1 \text{ gal water}} \right| \frac{60 \text{ min}}{1 \text{ hr}} \left| 0.001\% \text{ (drift)} \right. = \mathbf{3 \text{ lb water drift / hr}}$$

Total Particulate Emissions

$$\frac{3 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| 31.3\% \text{ PM} = \frac{0.001 \text{ lb PM}}{\text{hr}} = \mathbf{0.004 \text{ ton PM / yr}}$$

PM_{10} Emissions

$$\frac{3 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| \frac{16.3\% \ PM_{10}}{} = \frac{0.000 \text{ lb PM10}}{\text{hr}} = \mathbf{\frac{0.002 \text{ ton PM10}}{\text{yr}}}$$

$PM_{2.5}$ Emissions

$$\frac{3 \text{ lb water}}{\text{hr}} \left| \frac{1{,}000 \text{ lb PM}}{1\text{E+6 lb water}} \right| \frac{5.7\% \ PM_{2.5}}{} = \frac{0.000 \text{ lb PM2.5}}{\text{hr}} = \mathbf{\frac{0.001 \text{ ton PM2.5}}{\text{yr}}}$$

Table A-19d. Surface Refrigeration Plant - Emissions

Emission Point Number	Annual Emissions (tpy)			Daily Emissions (lb/day)			Hourly Emissions (lb/hr)		
	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
PRODREF	0.052	0.027	0.009	2.83E-01	1.47E-01	5.13E-02	1.18E-02	6.13E-03	2.14E-03
BBREF	0.076	0.040	0.014	4.17E-01	2.17E-01	7.56E-02	1.74E-02	9.03E-03	3.15E-03
MILLREF	0.004	0.002	0.001	1.92E-02	1.00E-02	3.49E-03	8.01E-04	4.17E-04	1.45E-04
TOTAL:	**0.13**	**0.07**	**0.02**	**0.72**	**0.37**	**0.13**	**0.03**	**0.02**	**0.01**

Table A-20a. Taylor Concrete Batch Plant Emission Factors and Parameters

Operation	Equipment	Activity	Material	Maximum Rates Capacity [1] (tpy)	Emission Factors [2]		
					PM	$PM_{10}/PM_{2.5}$	Units
Concrete Batch Plant	Aggregate delivery to ground storage	Unloading of Aggregate Material	Aggregate	18,666	0.0069	0.0033	lb/ton
	Sand delivery to ground storage	Unloading of Sand	Sand	14,292	0.0021	0.00099	lb/ton
	Aggregate transfer to hopper	Transferring aggregate material	Aggregate	18,666	0.0069	0.0033	lb/ton
	Sand transfer to hopper	Transferring Sand	Sand	14,292	0.0021	0.00099	lb/ton
	Aggregate transfer from hopper to conveyor	Transferring aggregate material	Aggregate	18,666	0.0069	0.0033	lb/ton
	Sand transfer from hopper to conveyor	Transferring Sand	Sand	14,292	0.0021	0.00099	lb/ton
	Aggregate transfer to elevated storage	Transferring aggregate material	Aggregate	18,666	0.0069	0.0033	lb/ton
	Sand transfer to elevated storage	Transferring Sand	Sand	14,292	0.0021	0.00099	lb/ton
	Cement delivery to silo	Unloading of Cement	Cement	4,914	0.00099	0.00034	lb/ton
	Cement supplement delivery to silo	Unloading of Cement Supplement	Cement	731	0.0089	0.0049	lb/ton
	Weigh hopper loading	Loading of Weigh hopper	Concrete	40,274	0.0048	0.0028	lb/ton
	Central mix loading	Loading of Mixer	Concrete	40,274	0.0184	0.0055	lb/ton

1. EPA AP-42 Section 11.12, mixing ratios used:

Concrete	1
Aggregate	0.46
Sand	0.35
Cement	0.12
Cement Supplement	0.02

2. EPA AP-42 Section 11.12, Table 11.12-2. emission factors were utilized. If a controlled emission factor was unavailable, an uncontrolled emission factor was used.

Table A-20b. Taylor Concrete Batch Plant - Emissions

Operation	Activity	Annual Emissions (tpy)			Daily Emissions (lb/day)			Hourly Emissions (lb/hr)		
		PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Concrete Batch Plant	Unloading of Aggregate Material	0.06	0.03	0.03	0.35	0.17	0.17	0.01	0.01	0.01
	Unloading of Sand	0.02	0.01	0.01	0.08	0.04	0.04	0.00	0.00	0.00
	Transferring aggregate material	0.06	0.03	0.03	0.35	0.17	0.17	1.47E-02	7.03E-03	7.03E-03
	Transferring Sand	0.02	0.01	0.01	0.08	0.04	0.04	3.43E-03	1.62E-03	1.62E-03
	Transferring aggregate material	0.06	0.03	0.03	0.35	0.17	0.17	0.01	0.01	0.01
	Transferring Sand	0.02	0.01	0.01	0.08	0.04	0.04	0.00	0.00	0.00
	Transferring aggregate material	0.06	0.03	0.03	0.35	0.17	0.17	1.47E-02	7.03E-03	7.03E-03
	Transferring Sand	0.02	0.01	0.01	0.08	0.04	0.04	3.43E-03	1.62E-03	1.62E-03
	Unloading of Cement	0.00	0.00	0.00	0.01	0.00	0.005	0.00	0.00	0.00
	Unloading of Cement Supplement	0.00	0.00	0.00	0.02	0.01	0.01	0.00	0.00	0.00
	Loading of Weigh hopper	0.10	0.06	0.06	0.53	0.31	0.31	0.02	0.01	0.01
	Loading of Mixer	0.37	0.11	0.11	2.03	0.61	0.61	0.08	0.03	0.03
	Total:	**0.79**	**0.32**	**0.32**	**4.33**	**1.76**	**1.76**	**0.18**	**0.07**	**0.07**

6/06

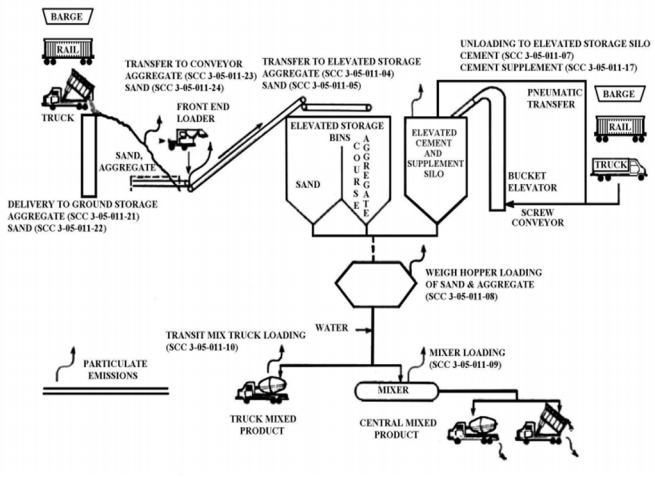

Figure 11.12-1. Typical Concrete Batching Process.

11.12-3

Table A-21a. Clark Concrete Batch Plant Emission Factors and Parameters

Operation	Equipment	Activity	Material	Maximum Rates Capacity [1] (tpy)	Emission Factors [2]		
					PM	$PM_{10}/PM_{2.5}$	Units
Concrete Batch Plant	Aggregate delivery to ground storage	Unloading of Aggregate Material	Aggregate	920	0.0069	0.0033	lb/ton
	Sand delivery to ground storage	Unloading of Sand	Sand	704	0.0021	0.00099	lb/ton
	Aggregate transfer to hopper	Transferring aggregate material	Aggregate	920	0.0069	0.0033	lb/ton
	Sand transfer to hopper	Transferring Sand	Sand	704	0.0021	0.00099	lb/ton
	Aggregate transfer from hopper to conveyor	Transferring aggregate material	Aggregate	920	0.0069	0.0033	lb/ton
	Sand transfer from hopper to conveyor	Transferring Sand	Sand	704	0.0021	0.00099	lb/ton
	Aggregate transfer to elevated storage	Transferring aggregate material	Aggregate	920	0.0069	0.0033	lb/ton
	Sand transfer to elevated storage	Transferring Sand	Sand	704	0.0021	0.00099	lb/ton
	Cement delivery to silo	Unloading of Cement	Cement	242	0.00099	0.00034	lb/ton
	Cement supplement delivery to silo	Unloading of Cement Supplement	Cement	242	0.0089	0.0049	lb/ton
	Weigh hopper loading	Loading of Weigh hopper	Concrete	1,984	0.0048	0.0028	lb/ton
	Central mix loading	Loading of Mixer	Concrete	1,984	0.0184	0.0055	lb/ton

1. EPA AP-42 Section 11.12, mixing ratios used:

Concrete	1
Aggregate	0.46
Sand	0.35
Cement	0.12
Cement Supplement	0.02

2. EPA AP-42 Section 11.12, Table 11.12-2. emission factors were utilized. If a controlled emission factor was unavailable, an uncontrolled emission factor was used.

Table A-21b. Clark Concrete Batch Plant - Emissions

Operation	Activity	Annual Emissions (tpy)			Daily Emissions (lb/day)			Hourly Emissions (lb/hr)		
		PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Concrete Batch Plant	Unloading of Aggregate Material	3.17E-03	1.52E-03	1.52E-03	1.74E-02	8.31E-03	8.31E-03	7.24E-04	3.46E-04	3.46E-04
	Unloading of Sand	7.39E-04	3.49E-04	3.49E-04	4.05E-03	1.91E-03	1.91E-03	1.69E-04	7.96E-05	7.96E-05
	Transferring aggregate material	3.17E-03	1.52E-03	1.52E-03	1.74E-02	8.31E-03	8.31E-03	7.24E-04	3.46E-04	3.46E-04
	Transferring Sand	7.39E-04	3.49E-04	3.49E-04	4.05E-03	1.91E-03	1.91E-03	1.69E-04	7.96E-05	7.96E-05
	Transferring aggregate material	3.17E-03	1.52E-03	1.52E-03	1.74E-02	8.31E-03	8.31E-03	7.24E-04	3.46E-04	3.46E-04
	Transferring Sand	7.39E-04	3.49E-04	3.49E-04	4.05E-03	1.91E-03	1.91E-03	1.69E-04	7.96E-05	7.96E-05
	Transferring aggregate material	3.17E-03	1.52E-03	1.52E-03	1.74E-02	8.31E-03	8.31E-03	7.24E-04	3.46E-04	3.46E-04
	Transferring Sand	7.39E-04	3.49E-04	3.49E-04	4.05E-03	1.91E-03	1.91E-03	1.69E-04	7.96E-05	7.96E-05
	Unloading of Cement	1.20E-04	4.12E-05	4.12E-05	6.57E-04	2.26E-04	2.26E-04	2.74E-05	9.40E-06	9.40E-06
	Unloading of Cement Supplement	1.08E-03	5.93E-04	5.93E-04	5.90E-03	3.25E-03	3.25E-03	2.46E-04	1.35E-04	1.35E-04
	Loading of Weigh hopper	4.76E-03	2.78E-03	2.78E-03	2.61E-02	1.52E-02	1.52E-02	1.09E-03	6.34E-04	6.34E-04
	Loading of Mixer	1.83E-02	5.46E-03	5.46E-03	1.00E-01	2.99E-02	2.99E-02	4.17E-03	1.25E-03	1.25E-03
Total:		**0.040**	**0.016**	**0.016**	**0.22**	**0.09**	**0.09**	**0.009**	**0.0037**	**0.0037**

6/06

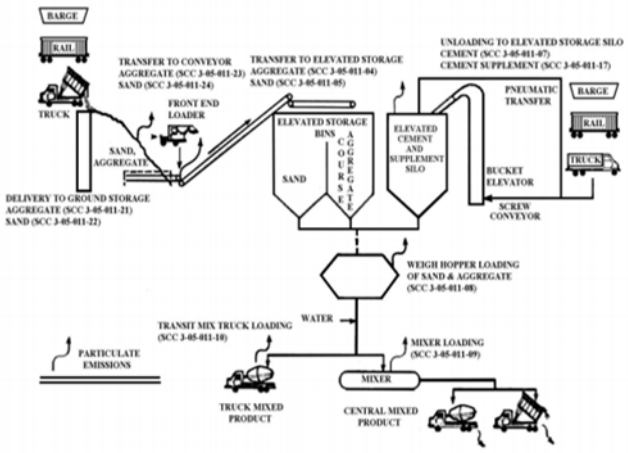

Figure 11.12-1 Typical Concrete Batching Process.

11.12-3

Table A-22. Evaporation Pond Mechanical Evaporators - PM Emissions

Unit	Evaporator Type	TDS Conc. (mg/L)	System Flow Rate [1] (gpm)	Operation Time [2] (hr/yr)	Calculated Emission Rate (lb/hr) [3]		Calculated Emission Rate (lb/day) [3,4]		Calculated Emission Rate (tpy) [3]	
					PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
MEVAP1	Nozzles	2,100	66	876	0.0911	0.014	1.30	0.19	3.99E-02	5.94E-03
MEVAP2	Nozzles	2,100	66	876	0.0911	0.014	1.30	0.19	3.99E-02	5.94E-03
MEVAP3	Nozzles	2,100	66	876	0.0911	0.014	1.30	0.19	3.99E-02	5.94E-03

1. Volume (gpm) calculated based on 66 gpm
2. Only 3 our of 4 units operating at once and 10% of the year based on meeting notes from 7/19/2022 with Sarah Richman
3. Emission rates are calculated using the following equation and parameters, provided by ADEQ via meeting on 5/30/2023:

$$PM = TDS\left(\frac{mg}{L}\right) \times \frac{Drift(\%)}{100\ \%} \times Q\ Rate\left(\frac{gal}{min}\right) \times 3.78\frac{L}{gal} \times \frac{2.2lb}{10^6 mg} \times \frac{60min}{hr}$$

Where:

Drift loss:	0.327%
PM_{10}:	40.3% of PM
$PM_{2.5}$:	6% of PM

4. For daily emissions, evaporators can run during the daylight hours only; conservatively, daylight hour of the summer solstice (14.25 hours) is used.

Table A-23a. Aboveground Gasoline Dispensing Facility - Taylor - VOC Emissions

Emission Unit	Maximum Estimated Rate			Emission Factor [2]	VOC Emissions		
	(gals/hr)	(gals/day)	(gals/yr) [1]	(lbs/10 [3] gal)	lb/hr	lb/day	ton/yr
AGGDF-T	17	411	150,000	11.3	0.19	4.63	0.85
				Total:	**0.19**	**4.63**	**0.85**

1. Based on aboveground annual gasoline usage provided by South32. All gasoline is treated as being emitted aboveground, despite some being dispensed underground.
2. Emission factor for gasoline is based on petroleum loading loss equation in USEPA publication AP-42, Table 5.2-7, Evaporative Emissions from Gasoline Service Station Operations (7/08). The loading loss equation is :

Loading Loss (lb/1000 gal) = 12.46 x SPM/T

where,

S= saturation factor (assume 1.00 for submerged loading),

P = true vapor pressure of liquid loaded, pounds per square inch absolute (assume 7.4 psia for Gasoline RVP 10 @ 80°F),

M = molecular weight of vapors, pounds per pound-mole (assume 66 lb/lb-mole),

T = temperature of bulk liquid loaded, °R (80°F + 460 = 540°R), based on AP-42 Chapter 7 Tucson average daily maximum ambient temperature

Sample Calculations

VOC emissions (lb/hr) = 17.12 gal/day x 11.3 lb/1,000 gal x 1.0 day/24 hours = 0.19 lb/hr
VOC emissions (ton/yr) = 150000 gal/yr x 11.3 lb/1,000 gal x 1.0 ton/2,000 lbs = 0.85 ton/yr

Table A-23b. Aboveground Gasoline Dispensing Facility - Taylor - HAP Emissions

Emission Unit	Source Description	VOC Emissions [1]		HAP Emissions [2]									
				Benzene		Hexane		Toluene		Xylene		Ethylbenzene	
		lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
AGGDF-T	Aboveground Gasoline Dispensing Facility	0.19	0.85	3.47E-03	0.02	1.93E-03	0.01	1.35E-02	0.06	1.35E-02	0.06	2.70E-03	0.01
			Total HAPs (ton/yr):	**0.15**									

1. Based on emission calculations in Table A-23a
2. Mass percent is based on the average percent content of the HAP constituent in gasoline per TankESP Gasoline RVP_X speciation:

Storage Tank Content	HAP Mass Percent				
	Benzene	Hexane	Toluene	Xylene	Ethylbenzene
Gasoline	1.80%	1.00%	7.00%	7.00%	1.40%

Table A-24a. Aboveground Gasoline Dispensing Facility - Clark - VOC Emissions

Emission Unit	Maximum Estimated Rate			Emission Factor [2] (lbs/10 [3] gal)	VOC Emissions		
	gals/hr	gals/day	gals/yr [1]		lb/hr	lb/day	ton/yr
AGGDF-C	8	201	73,500	11.3	0.09	2.27	0.41
				Total:	**0.09**	**2.27**	**0.41**

1. Based on aboveground annual gasoline usage provided by South32. All gasoline is treated as being emitted aboveground, despite some being dispensed underground.

2. Emission factor for gasoline is based on petroleum loading loss equation in USEPA publication AP-42, Table 5.2-7, Evaporative Emissions from Gasoline Service Station Operations (7/08). The loading loss equation is :

Loading Loss (lb/1000 gal) = 12.46 x SPM/T

where,

S= saturation factor (assume 1.00 for submerged loading),

P = true vapor pressure of liquid loaded, pounds per square inch absolute (assume 7.4 psia for Gasoline RVP 10 @ 80°F),

M = molecular weight of vapors, pounds per pound-mole (assume 66 lb/lb-mole),

T = temperature of bulk liquid loaded, °R (80°F + 460 = 540°R), based on AP-42 Chapter 7 Tucson average daily maximum ambient temperature

Sample Calculations

VOC emissions (lb/hr) = 8.39 gal/day x 11.3 lb/1,000 gal x 1.0 day/24 hours = 0.09 lb/hr
VOC emissions (ton/yr) = 73500 gal/yr x 11.3 lb/1,000 gal x 1.0 ton/2,000 lbs = 0.41 ton/yr

Table A-24b. Aboveground Gasoline Dispensing Facility - Clark - HAP Emissions

Emission Unit	Source Description	VOC Emissions [1]		HAP Emissions [2]									
				Benzene		Hexane		Toluene		Xylene		Ethylbenzene	
		lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
AGGDF-C	Aboveground Gasoline Dispensing Facility	0.09	0.41	0.002	0.01	0.001	0.00	0.01	0.03	0.007	0.03	0.001	0.01
Total HAPs (ton/yr):				**0.08**									

1. Based on emission calculations in Table A-24a

2. Mass percent is based on the average percent content of the HAP constituent in gasoline per TankESP Gasoline RVP_X speciation:

Storage Tank Content	HAP Mass Percent				
	Benzene	Hexane	Toluene	Xylene	Ethylbenzene
Gasoline	1.80%	1.00%	7.00%	7.00%	1.40%

Table A-25a. Roads - Dozer - Input Parameters

Emission Point No.	Road Surface	Equipment	Total Combined Operation Hour [1]			Emission Factor (lb/hr) [3]						Material	Lead	Control	
			Hourly	Daily	Annual	Short Term			Long Term					Type	Efficiency [2]
			(hr/hr)	(hr/day)	(hr/yr)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$		(%)		(%)
DOZER1-TSF2	Unpaved	Bulldozer	1	12	4,380	4.09	0.86	0.43	4.09	0.86	0.43	Tailings	0.43%	No Control	0%
DOZER2-TSF2	Unpaved	Bulldozer	1	12	4,380	4.09	0.86	0.43	4.09	0.86	0.43	Tailings	0.43%	No Control	0%
DOZER-WRS	Unpaved	Bulldozer	1	12	4,380	1.65	0.22	0.17	1.65	0.22	0.17	Waste Rock	0.35%	Watering	70%
DOZER-HRS	Unpaved	Bulldozer	1	12	4,380	1.65	0.22	0.17	1.65	0.22	0.17	Waste Rock	0.57%	Watering	70%
DOZER-TSF	Unpaved	Bulldozer	1	12	4,380	4.09	0.86	0.43	4.09	0.86	0.43	Tailings	0.43%	No Control	0%
DOZER-EOS	Unpaved	Bulldozer	1	12	4,380	1.65	0.22	0.17	1.65	0.22	0.17	Stope Ore & Developmental Ore	4.73%	Watering	70%

1. Assumed to operate 12 hours a day and 365 days a year.
2. At South32, watering will be performed to sufficiently to achieve a control efficiency of 70%
3. Emission factors for bulldozers per Table 11.9-1, U.S. EPA AP-42, Section 11.9 (Western Surface Coal Mining), October 1998

PM = TSP = k * $\frac{5.7\ (s)^{1.2}}{(M)^{1.3}}$

PM10 = k * PM15 = k * $\frac{1.0\ (s)^{1.5}}{(M)^{1.4}}$

PM2.5 = k * TSP = k * $\frac{5.7\ (s)^{1.2}}{(M)^{1.3}}$

where

k = Scaling factor

	PM	PM_{10}	$PM_{2.5}$
k =	1	0.75	0.105

Per AP-42, Table 11.9-1

s = Material silt content (%)

1.6 Rock silt content assumed as to be similar to Crushed limestone in Western Surface Coal Mining in AP-42, Section 13.2.4 (11/2006)

11 Tailings silt content assumed as to be similar to Taconite mining tailings in Western Surface Coal Mining in AP-42, Section 13.2.4 (11/2006)

M = Material moisture content (%)

11.80 for Tailings 4 for ore/rock

	PM	PM_{10}	$PM_{2.5}$
a =	5.7	1	5.7
b =	1.2	1.5	1.2
c =	1.3	1.4	1.3

Table A-25b. Roads -Dozer - Controlled Emissions

Emission Point No.	Road Surface	Equipment	Controlled Emissions [1,2]												Uncontrolled Emissions (tpy)			
			Hourly (lb/hr)				Daily (lb/day)				Annual (tpy)				Annual (tpy)			
			PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead
DOZER1-TSF2	Unpaved	Bulldozer	4.09	0.86	0.43	1.74E-02	49.12	10.37	5.16	0.21	8.96	1.89	0.94	3.82E-02	8.96	1.89	0.94	3.82E-02
DOZER2-TSF2	Unpaved	Bulldozer	4.09	0.86	0.43	1.74E-02	49.12	10.37	5.16	0.21	8.96	1.89	0.94	3.82E-02	8.96	1.89	0.94	3.82E-02
DOZER-WRS	Unpaved	Bulldozer	0.50	0.07	0.05	1.76E-03	5.95	0.78	0.62	0.02	1.09	0.14	0.11	3.84E-03	3.62	0.48	0.38	1.28E-02
DOZER-HRS	Unpaved	Bulldozer	0.50	0.07	0.052	2.83E-03	5.95	0.78	0.62	0.03	1.09	0.14	0.11	6.19E-03	3.62	0.48	0.38	2.06E-02
DOZER-TSF	Unpaved	Bulldozer	4.09	0.86	0.430	1.74E-02	49.12	10.37	5.16	0.21	8.96	1.89	0.94	3.82E-02	8.96	1.89	0.94	3.82E-02
DOZER-EOS	Unpaved	Bulldozer	0.50	0.07	0.052	2.35E-02	5.95	0.78	0.62	0.28	1.09	0.14	0.11	5.14E-02	3.62	0.48	0.38	1.71E-01

1. Controlled hourly and daily emissions calculated based on short term emission factors and control efficiency.
2. Controlled annual emissions calculated based on long term emission factors and control efficiency.

Table A-26a. South32 Hermosa non-fuel Tank Emissions Summary †

Tank ID	Max Capacity (gal)	Stock	Losses (tpy)			Speciated HAP Emissions (tpy)			Total HAP (tpy)
			Standing	Working	Total VOC	Cresol	Ethylene Glycol Dimethyl Ether	Urethane	
TNK-040 [1]	7,925	F549/MIBC	0.166	0.122	0.289	-	0.262	-	0.262
TNK-041 [2]	6,604	3407-A	4.65E-04	1.02E-03	1.48E-03	9.52E-05	-	-	9.52E-05
TNK-044 [3]	6,604	Solvay 5100	6.26E-03	8.67E-03	1.49E-02	-	-	3.67E-05	3.67E-05
TNK-045	2,642	Copper Sulphate	No VOC Emissions			No HAPs Emissions			
TNK-046	5,283	Copper Sulphate							
TNK-047	2,642	Zinc Sulphate							
TNK-048	5,283	Zinc Sulphate							
TNK-051	2,642	Zinc Cyanide							
TNK-052	3,963	Zinc Cyanide							
TNK-053	#REF!	SMBS							
TNK-054	#REF!	SMBS							
TNK-057	17,171	Tailings Flocculant (SNF AN910-VHM)							
TNK-058	1,320	Tailings Flocculant (SNF AN910-VHM)							
TNK-059	#REF!	Tailings Flocculant (SNF AN910-VHM)							
TNK-060	6,604	3418-A	2.14E-05	1.68E-04	1.90E-04				
TNK-061	10,293	Shaft ANE	1.43E-04	9.54E-05	2.38E-04				
Total			**0.17**	**0.13**	**0.31**	**9.52E-05**	**0.262**	**3.67E-05**	**0.263**

† Based on the SDS for tanks TNK-045 through TNK-059, there are no VOC or HAP emissions associated with these tanks.

1. This tank contains a 50/50 mixture of MIBC and F-549. F-549 is comprised of "mixed glycol ethers" according to Section 3 of the SDS. As such, it was conservatively modeled as 100% ethylene glycol dimethyl ether (1,2-dimethoxyethane), the lightest glycol ether.

2. The "test reagent" is not always the same stock, so a representative chemical, 3407-A, was used to estimate tank emissions. "Dithiophosphate" and "modified dithiophosphinate" listed in Section 3 of the SDS are assumed to be sodium diisobutyldithiophosphinate. Due to the unavailability for Antoine coefficients of this chemical, the A and B coefficients for No. 6 fuel oil are used as a conservative estimate.

3. Due to unavailability of Antoine coefficients for the majority constituent chemical (Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester), the vapor pressure given in the SDS was assumed to be constant to generate usable Antoine coefficients.

Table A-26b. Diesel & Gasoline Storage Tanks - VOC Emissions

Tank ID	Max Capacity (gal)	Stock	VOC Emissions [1]	
			(lb/yr)	(tpy)
T-01	1,000	Unleaded Gasoline (S32)	750.03	0.38
T-02	5,000	Diesel (Red Dyed S32)	3.27	1.64E-03
T-03	5,000	Diesel (Red Dyed S32)	3.27	1.64E-03
T-04	12,000	Diesel (Red Dyed Rummel)	4.08	2.04E-03
T-05	1,000	Unleaded Gasoline (Rummel)	650.59	0.33
T-06	1,000	Diesel (Rummel)	0.95	4.74E-04
T-07	10,000	Unleaded Gasoline	3831.10	1.92
T-08	10,000	Unleaded Gasoline	3831.10	1.92
T-09	10,000	Unleaded Gasoline	3831.10	1.92
T-10	50,000	Diesel	78.34	0.04
T-11	50,000	Diesel	71.75	3.59E-02
Total VOC			**13,055.59**	**6.53**
Max VOC			**3831.10**	**1.92**

1. VOC Emissions per EPA-approved TankESP Software (AP-42 Chapter 7.1, June 2020)

Table A-26c. Diesel & Gasoline Storage Tanks - HAP Weight Percent's

Tank ID	Stock	HAP Liquid Weight Percent's [1]									
		Benzene	Benzo(g,h,i)perylene	Cumene	Ethylbenzene	Hexane	Iso-octane (2,2,4-Trimethylpentane)	Naphthalene	PAC's	Toluene	Xylene
T-01	Unleaded Gasoline (S32)	1.80%	0.00%	0.50%	1.40%	1.00%	4.00%	0.42%	0.00%	7.00%	7.00%
T-02	Diesel (Red Dyed S32)	0.0008%	0.0009%	--	0.01%	0.0001%	--	0.08%	0.002%	0.03%	0.29%
T-03	Diesel (Red Dyed S32)	0.0008%	0.0009%	--	0.01%	0.0001%	--	0.08%	0.002%	0.03%	0.29%
T-04	Diesel (Red Dyed Rummel)	0.0008%	0.0009%	--	0.01%	0.0001%	--	0.08%	0.002%	0.03%	0.29%
T-05	Unleaded Gasoline (Rummel)	1.80%	0.00%	0.50%	1.40%	1.00%	4.00%	0.42%	0.00%	7.00%	7.00%
T-06	Diesel (Rummel)	0.0008%	0.0009%	--	0.01%	0.0001%	--	0.080%	0.002%	0.030%	0.290%
T-07	Unleaded Gasoline	1.80%	0.00%	0.50%	1.40%	1.00%	4.00%	0.42%	0.00%	7.00%	7.00%
T-08	Unleaded Gasoline	1.80%	0.00%	0.50%	1.40%	1.00%	4.00%	0.42%	0.00%	7.00%	7.00%
T-09	Unleaded Gasoline	1.80%	0.00%	0.50%	1.40%	1.00%	4.00%	0.42%	0.00%	7.00%	7.00%
T-10	Diesel	0.0008%	0.0009%	--	0.01%	0.0001%	--	0.08%	0.002%	0.03%	0.29%
T-11	Diesel	0.0008%	0.0009%	--	0.01%	0.0001%	--	0.08%	0.002%	0.03%	0.29%

1. Speciation data for each HAP is based on individual content speciation.

Table A-26d. Diesel and Gasoline Storage Tanks - HAP Emissions (lb/yr)

Tank ID	Stock	HAP Emissions (lb/yr) [1]										
		Benzene	Benzo(g,h,i)perylene	Cumene	Ethylbenzene	Hexane	Isooctane	Naphthalene	PAC's	Toluene	Xylene	Total HAPs
T-01	Unleaded Gasoline (S32)	4.05E+00	2.98E-16	5.19E-02	3.05E-01	3.05E-01	4.64E+00	2.36E-03	2.36E-03	4.64E+00	1.33E+00	15.33
T-02	Diesel (Red Dyed S32)	6.39E-03	3.20E-15	0.00E+00	1.01E-02	1.01E-02	0.00E+00	1.54E-03	1.54E-03	7.54E-02	1.96E-01	0.30
T-03	Diesel (Red Dyed S32)	6.39E-03	3.20E-15	0.00E+00	1.01E-02	1.01E-02	0.00E+00	1.54E-03	1.54E-03	7.54E-02	1.96E-01	0.30
T-04	Diesel (Red Dyed Rummel)	7.96E-03	4.02E-15	0.00E+00	1.25E-02	1.25E-02	0.00E+00	1.92E-03	1.92E-03	9.40E-02	2.45E-01	0.38
T-05	Unleaded Gasoline (Rummel)	3.51E+00	2.59E-16	4.50E-02	2.64E-01	2.64E-01	4.03E+00	2.05E-03	2.05E-03	4.03E+00	1.16E+00	13.30
T-06	Diesel (Rummel)	1.85E-03	9.22E-16	0.00E+00	2.91E-03	2.91E-03	0.00E+00	4.45E-04	4.45E-04	2.18E-02	5.68E-02	0.09
T-07	Unleaded Gasoline	2.07E+01	1.52E-15	2.65E-01	1.56E+00	1.56E+00	2.37E+01	1.21E-02	1.21E-02	2.37E+01	6.80E+00	78.31
T-08	Unleaded Gasoline	2.07E+01	1.52E-15	2.65E-01	1.56E+00	1.56E+00	2.37E+01	1.21E-02	1.21E-02	2.37E+01	6.80E+00	78.31
T-09	Unleaded Gasoline	2.07E+01	1.52E-15	2.65E-01	1.56E+00	1.56E+00	2.37E+01	1.21E-02	1.21E-02	2.37E+01	6.80E+00	78.31
T-10	Diesel	1.53E-01	7.72E-14	0.00E+00	2.41E-01	2.41E-01	0.00E+00	3.69E-02	3.69E-02	1.80E+00	4.69E+00	7.21
T-11	Diesel	1.40E-01	7.07E-14	0.00E+00	2.20E-01	2.20E-01	0.00E+00	3.38E-02	3.38E-02	1.65E+00	4.30E+00	6.60
Total HAPs		**6.99E+01**	**1.64E-13**	**8.92E-01**	**5.74E+00**	**5.74E+00**	**7.98E+01**	**1.17E-01**	**1.17E-01**	**8.35E+01**	**3.26E+01**	**278.42**
Max HAP		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**8.35E+01**	**-**	**-**

1. HAP emissions are calculated based on the HAP weight percent of the content of the tank.

Table A-26e. Diesel and Gasoline Storage Tanks - HAP Emissions (tpy)

Tank ID	Stock	HAP Emissions (tpy)										
		Benzene	Benzo(g,h,i)perylene	Cumene	Ethylbenzene	Hexane	Isooctane	Naphthalene	PAC's	Toluene	Xylene	Total HAPs
T-01	Unleaded Gasoline (S32)	2.02E-03	1.49E-19	2.59E-05	1.52E-04	1.52E-04	2.32E-03	1.18E-06	1.18E-06	2.32E-03	6.66E-04	7.67E-03
T-02	Diesel (Red Dyed S32)	3.20E-06	1.60E-18	0.00E+00	5.03E-06	5.03E-06	0.00E+00	7.69E-07	7.69E-07	3.77E-05	9.81E-05	1.51E-04
T-03	Diesel (Red Dyed S32)	3.20E-06	1.60E-18	0.00E+00	5.03E-06	5.03E-06	0.00E+00	7.69E-07	7.69E-07	3.77E-05	9.81E-05	1.51E-04
T-04	Diesel (Red Dyed Rummel)	3.98E-06	2.01E-18	0.00E+00	6.27E-06	6.27E-06	0.00E+00	9.61E-07	9.61E-07	4.70E-05	1.22E-04	1.88E-04
T-05	Unleaded Gasoline (Rummel)	1.76E-03	1.29E-19	2.25E-05	1.32E-04	1.32E-04	2.01E-03	1.02E-06	1.02E-06	2.01E-03	5.78E-04	6.65E-03
T-06	Diesel (Rummel)	9.26E-07	4.61E-19	0.00E+00	1.46E-06	1.46E-06	0.00E+00	2.23E-07	2.23E-07	1.09E-05	2.84E-05	4.36E-05
T-07	Unleaded Gasoline	1.03E-02	7.62E-19	1.33E-04	7.78E-04	7.78E-04	1.19E-02	6.03E-06	6.03E-06	1.19E-02	3.40E-03	3.92E-02
T-08	Unleaded Gasoline	1.03E-02	7.62E-19	1.33E-04	7.78E-04	7.78E-04	1.19E-02	6.03E-06	6.03E-06	1.19E-02	3.40E-03	3.92E-02
T-09	Unleaded Gasoline	1.03E-02	7.62E-19	1.33E-04	7.78E-04	7.78E-04	1.19E-02	6.03E-06	6.03E-06	1.19E-02	3.40E-03	3.92E-02
T-10	Diesel	7.64E-05	3.86E-17	0.00E+00	1.20E-04	1.20E-04	0.00E+00	1.84E-05	1.84E-05	9.02E-04	2.35E-03	3.60E-03
T-11	Diesel	7.00E-05	3.54E-17	0.00E+00	1.10E-04	1.10E-04	0.00E+00	1.69E-05	1.69E-05	8.26E-04	2.15E-03	3.30E-03
Total HAPs		**3.50E-02**	**8.22E-17**	**4.46E-04**	**2.87E-03**	**2.87E-03**	**3.99E-02**	**5.84E-05**	**5.84E-05**	**4.17E-02**	**1.63E-02**	**1.39E-01**
Max HAP		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**4.17E-02**	**-**	**-**

Table A-27. South32 Hermosa Process Tanks Emission Summary

Tank	Equipment Description	CAS #	Chemical	VOC?	HAP?	Pure Component Molecular Weight M (lb/lbmol)	Pure Component Vapor Pressure P (psia)	Henry's Law Solubility Constant H^{cc}_{v} (Dimensionless)	Henry's Law Solubility Constant H^{px}_{v} (psi/mol% liq)	Liquid Mol% Liq. mol% (mol%liq)	Liquid Temperature T (K)	Liquid Surface Area A (ft2)	Pure Component Mass Transfer Coefficient K (ft/hr)	Vapor Partial Pressure pp (psia)	Hourly Emission Rate [1,2] E (hourly) (lb/hr)	Annual Emissions [1,2] E (annual) (lb/yr)	(tpy)
22310-FC-00001	Lead Rougher	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	207.74	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	2.63E-06	301.54	207.74	54.97	3.82E-05	0.02	123.32	0.06
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	1.16E-06	301.54	207.74	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	0.00E+00	301.54	207.74	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	0.00E+00	301.54	207.74	61.19	0.00E+00	0.00	0.00	0.00
22310-FC-00004	Lead Rougher Scavenger	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	207.74	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	2.59E-06	301.54	207.74	54.97	3.76E-05	0.02	121.38	0.06
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	1.14E-06	301.54	207.74	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	0.00E+00	301.54	207.74	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	0.00E+00	301.54	207.74	61.19	0.00E+00	0.00	0.00	0.00
22310-FC-00008	Lead Cleaner Scalper	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	73.19	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	2.30E-05	301.54	73.19	54.97	3.34E-04	0.05	380.65	0.19
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	1.01E-05	301.54	73.19	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	0.00E+00	301.54	73.19	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	0.00E+00	301.54	73.19	61.19	0.00E+00	0.00	0.00	0.00
22310-FC-00007	Lead Cleaner	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	73.19	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	1.97E-05	301.54	73.19	54.97	2.87E-04	0.04	326.11	0.16
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	8.68E-06	301.54	73.19	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	0.00E+00	301.54	73.19	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	0.00E+00	301.54	73.19	61.19	0.00E+00	0.00	0.00	0.00
22310-FC-00009	Lead Cleaner Scavenger	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	73.19	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	1.84E-05	301.54	73.19	54.97	2.67E-04	0.04	303.85	0.15
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	8.08E-06	301.54	73.19	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	0.00E+00	301.54	73.19	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	0.00E+00	301.54	73.19	61.19	0.00E+00	0.00	0.00	0.00
22310-FC-00005	Zinc Rougher	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	207.74	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	4.74E-06	301.54	207.74	54.97	6.88E-05	0.03	222.26	0.11
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	0.00E+00	301.54	207.74	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	7.37E-06	301.54	207.74	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	2.35E-06	301.54	207.74	61.19	4.27E-06	1.38E-03	11.12	0.01
22310-FC-00006	Zinc Rougher Scavenger	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	207.74	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	4.63E-06	301.54	207.74	54.97	6.72E-05	0.03	217.22	0.11
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	0.00E+00	301.54	207.74	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	7.21E-06	301.54	207.74	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	2.30E-06	301.54	207.74	61.19	4.17E-06	1.35E-03	10.87	0.01
22310-FC-00011	Zinc Cleaner Scalper	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	124.86	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	8.12E-06	301.54	124.86	54.97	1.18E-04	0.03	229.12	0.11
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	0.00E+00	301.54	124.86	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	1.26E-05	301.54	124.86	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	4.03E-06	301.54	124.86	61.19	7.32E-06	1.42E-03	11.47	0.01
22310-FC-00010	Zinc Cleaner	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	124.86	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	6.88E-06	301.54	124.86	54.97	1.00E-04	0.02	194.10	0.10
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	0.00E+00	301.54	124.86	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	1.07E-05	301.54	124.86	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	3.42E-06	301.54	124.86	61.19	6.20E-06	1.21E-03	9.71	4.86E-03
22310-FC-00012	Zinc Cleaner Scavenger	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	124.86	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	6.41E-06	301.54	124.86	54.97	9.31E-05	0.02	180.70	0.09
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	0.00E+00	301.54	124.86	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	9.97E-06	301.54	124.86	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	3.18E-06	301.54	124.86	61.19	5.77E-06	1.12E-03	9.04	4.52E-03
22430-TN-00001	Lead Concentrate Tank	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	1,017.00	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	5.14E-05	301.54	1,017.00	54.97	7.47E-04	1.47	11819.26	5.91
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	4.72E-06	301.54	1,017.00	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	2.93E-05	301.54	1,017.00	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	9.33E-06	301.54	1,017.00	61.19	1.69E-05	0.03	216.05	0.11
22430-TN-00002	Zinc Concentrate Tank	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	1,257.00	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	5.26E-05	301.54	1,257.00	54.97	7.64E-04	1.85	14931.99	7.47
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	4.82E-06	301.54	1,257.00	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	2.99E-05	301.54	1,257.00	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	9.53E-06	301.54	1,257.00	61.19	1.73E-05	0.03	272.95	0.14
22310-TN-00003	Lead Conditioning Tank	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	294.07	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	1.52E-05	301.54	294.07	54.97	2.21E-04	0.13	1008.48	0.50
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	3.99E-06	301.54	294.07	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	0.00E+00	301.54	294.07	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	0.00E+00	301.54	294.07	61.19	0.00E+00	0.00	0.00	0.00
22310-TN-00001	Zinc Conditioning Tank No. 1	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	330.06	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	7.27E-06	301.54	330.06	54.97	1.06E-04	0.07	542.33	0.27
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	1.33E-06	301.54	330.06	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	8.27E-06	301.54	330.06	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	2.64E-06	301.54	330.06	61.19	4.79E-06	2.46E-03	19.83	0.01
22310-TN-00002	Zinc Conditioning Tank No. 2	7732-18-5	Water	No	No	18.02	5.66E-01	-	-	1.00E+00	301.54	330.06	98.03	-	N/A	N/A	N/A
		108-11-2	Methyl Isobutyl Carbinol	Yes	No	102.20	6.77E-02	7.20E-04	1.45E+01	7.27E-06	301.54	330.06	54.97	1.06E-04	0.07	542.33	0.27
		13360-78-6	sodium diisobutyldithiophosphinate	Yes	No	232.32	4.37E-01	-	-	1.33E-06	301.54	330.06	41.81	-	N/A	N/A	N/A
		86329-09-1	Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester	Yes	No	173.28	1.07E-03	-	-	8.27E-06	301.54	330.06	46.10	-	N/A	N/A	N/A
		78-83-1	1-Propanol, 2-methyl-	Yes	No	74.12	3.51E-01	8.99E-05	1.81E+00	2.64E-06	301.54	330.06	61.19	4.79E-06	2.46E-03	19.83	0.01
															3.94	31723.98	15.86

Process Tank Emission Calculation Notes

Emission Factors calculated using:
Ref: Section 3.7.1 - Evaporation from an Open Top Vessel or a Spill
Methods for Estimating Air Emissions from Chemical Manufacturing Facilities, Vol. II Chapter 16
STAPPA/ALAPCO/EPA EIIP, August 2007

E	Hourly or Annual Emission Rate, lb/hr or lb/yr [3]	=(M K A P) / (R T)
M	Molecular Weight, lb/lb-mol	See Table
K	Mass Transfer Coefficient, ft/hr [4]	$= K_0 (M_0/M)^{1/3}$
K_0	Reference Mass Transfer Coefficient of Water, ft/hr	0.83
M_0	Molecular Weight of Water, lb/lb-mol	18.02
A	Liquid Surface Area, ft2	See Table
P	Vapor Pressure, psia	See Table
T	Liquid temperature, ^{o}R [5]	542.77
R	Ideal Gas Constant, Psia-ft^3/lb-mole ^{o}R [6]	10.73159
H	Annual Hours of Operations, hrs/yr [7]	8060
H^{ps}_v	Henry's Law Volatility Constant, psi/(mol%)$_{lq}$ [8]	$= H^{cc}_v$ x R x T x d(solv) / M(solv)
pp^{ps}	Gas Partial Pressure using Henry's Law Constant, psi	= Liq Mol% * H^{ps}_v
H^{cc}_v	Henry's Law Volatility Constant, Dimensionless [9]	See Table
M(solv)	Mol. Wt. of Solvent, lb/lb-mol [10]	18.02
d(solv)	Density of Solvent, lb/ft^3 [10]	62.42771972

1. 100% Safety factor added while calculating emission rate to account for any atomization from material movement at the surface, such as spraying
2. Emissions from low volatile compounds (sodium diisobutyldithiophosphinate & Carbamothioic acid, N-2-propen-1-yl-, O-(2-methylpropyl) ester) assumed to be negligible.
3. EIIP, Vol. II, Ch. 16, Eq. 3-24
4. EIIP, Vol. II, Ch. 16, Eq. 3-27
5. For conservative estimate - Hourly Average Max. Ambient Temperature for Tucson, AZ. As per AP 42 Section 7.1, Table 7.1-7 (Jun, 2020) is used
6. Table 1-9 Perry's Chemical Engineers' Handbook, 6th ed.
7. Provided by South32
8. Referenced from https://www.degruyter.com/document/doi/10.1515/pac-2020-0302/html?lang=en
9. Referenced from Toxchem 4.4 Mar-25-2019
10. Assume as water

Table A-28. Taylor Emission Factor Inputs

Road Surface	Max Miles Traveled Per Unit			Vehicle Type	Vehicle Model	Max Vehicle Count	Particulate Matter Emission Factor Inputs [1]											
							k			Avg. W		s	P	a			b		
	Day	Month	Year				PM	PM_{10}	$PM_{2.5}$	(kg)	(ton)	(%)	(days/yr)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Unpaved	2	60.83	730	Dev Drill Rig	DD422i	3	4.9	1.5	0.15	26,000	28.66	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Support Drill Rig	DS412i	5	4.9	1.5	0.15	29,000	31.97	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Cable bolter	DS421	2	4.9	1.5	0.15	25,000	27.56	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	LHD (LH517i)	LH517i	2	4.9	1.5	0.15	46,500	51.26	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	20	608.33	7300	Haul Truck	TH551i	4	4.9	1.5	0.15	97,870	107.88	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Scissor lift	Utilift MF 540	2	4.9	1.5	0.15	13,100	14.44	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Light vehicle (general usage) Fleet 1	Mahindra Roxor	2	4.9	1.5	0.15	1,678	1.85	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Charging Rig Fleet 1	Charmec MF 605 D(V)	2	4.9	1.5	0.15	14,600	16.09	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	1	30.42	365	LH Rigs	DL422i	6	4.9	1.5	0.15	22,000	24.25	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	1	30.42	365	LH Rig (Ore Passes/Geo)	DL422i	1	4.9	1.5	0.15	22,000	24.25	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	LHD (LH518B)	LH518B	5	4.9	1.5	0.15	70,000	77.16	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	20	608.33	7300	Haul Trucks (Haul Loop)	TH663i	3	4.9	1.5	0.15	111,440	122.84	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	20	608.33	7300	Haul Trucks	TH663i	5	4.9	1.5	0.15	111,440	122.84	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	6	182.50	2190	Material transporter	Multimec MF100	2	4.9	1.5	0.15	22,200	24.47	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	4	121.67	1460	Light vehicle (general usage) Fleet 2	Mahindra Roxor	2	4.9	1.5	0.15	1,678	1.85	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Charging Rig Fleet 2	Charmec MF 605 D(V)	2	4.9	1.5	0.15	14,600	16.09	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	6	182.50	2190	Personnel transporter	Utimec MF 205 PER	3	4.9	1.5	0.15	15,200	16.76	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Shotcreter	Spraymec MF 050 D(V)	2	4.9	1.5	0.15	18,000	19.84	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.67	5840	Transmixer	Utimec MF 500	4	4.9	1.5	0.15	22,200	24.47	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	6	182.50	2190	Water vehicle	MF 350 Water	2	4.9	1.5	0.15	15,700	17.31	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	0.0027	0.08	1	Mobile rockbreaker	Maclean RB3	3	4.9	1.5	0.15	17,700	19.51	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	6	182.50	2190	Grader	Maclean GR5	2	4.9	1.5	0.15	18,200	20.06	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	1	30.42	365	Skid Steer	Manitou 4200 V	3	4.9	1.5	0.15	5,291	5.83	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Light vehicle (tech services)	Mahindra Roxor	4	4.9	1.5	0.15	1,678	1.85	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	6	182.50	2190	Material transporter (logistics/Construct)	Multimec MF100	2	4.9	1.5	0.15	22,200	24.47	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	6	182.50	2190	Scissor lift (Construction)	Utilift MF 540	2	4.9	1.5	0.15	13,100	14.44	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	2	60.83	730	Telehandler	GTH - 1056	3	4.9	1.5	0.15	14,470	15.95	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	4	121.67	1460	Maintenance Vehicle	Maclean FL3	3	4.9	1.5	0.15	33,000	36.38	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	8	243.33	2920	Fuel/Lube vehicle	Maclean FL3	2	4.9	1.5	0.15	33,000	36.38	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	0.1	3.04	36.5	Mobile Grapple equipment	Brokk 900	3	4.9	1.5	0.15	11,600	12.79	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	1	30.42	365	Blind Bore Machine	Rhino	2	4.9	1.5	0.15	52,000	57.32	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45

[1] Emission factors for vehicular traffic on unpaved roads per U.S. EPA AP-42, Section 13.2.2 (Unpaved Roads), November 2006.

Short-Term $E = k\,(s/12)^a (W/3)^b$ (1a)

Annual $E_{ext} = E\,[(365 - P)/365]$ (2)

where E = Size-specific emission factor (lb/VMT)

k, a, b = Constants for equation 1a

	PM	PM_{10}	$PM_{2.5}$
k =	4.9	1.5	0.15
a =	0.7	0.9	0.9
b =	0.45	0.45	0.45

Per AP-42 Table 13.2.2-2, November 2006

s = surface material silt content (%), per AP-42 Table 13.2.2-1, 11/06, Western surface coal mining Plant Road
5.1

W = Mean vehicle weight (tons)

P = Days per year with at least 0.01 inch precipitation, based on precipitation data from 2019-2021 for Hermosa Trench Met Station, using the lowest annual value between 2019-2021.
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Table A-29. Taylor Underground Roads - Emission Factors

Road Surface	Vehicle Type	Averaging Period	Emission Factor [1]				Process Rate Unit	Particulate Matter Emission Factor Inputs [1]												Reference
								k			W	s	P	a			b			
			PM	PM_{10}	$PM_{2.5}$	Unit		PM	PM_{10}	$PM_{2.5}$	(ton)	(%)	(days/yr)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	
Unpaved	Dev Drill Rig	Hourly/Daily	7.43	1.92	0.19	lb/VMT	VMT	4.90	1.50	0.15	28.66	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Dev Drill Rig	Annual	6.17	1.59	0.16	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Support Drill Rig	Hourly/Daily	7.81	2.01	0.20	lb/VMT	VMT	4.90	1.50	0.15	31.97	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Support Drill Rig	Annual	6.48	1.67	0.17	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Cable bolter	Hourly/Daily	7.30	1.88	0.19	lb/VMT	VMT	4.90	1.50	0.15	27.56	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Cable bolter	Annual	6.06	1.56	0.16	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	LHD (LH517i)	Hourly/Daily	9.66	2.49	0.25	lb/VMT	VMT	4.90	1.50	0.15	51.26	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	LHD (LH517i)	Annual	8.02	2.07	0.21	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Haul Truck	Hourly/Daily	13.50	3.48	0.35	lb/VMT	VMT	4.90	1.50	0.15	107.88	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Haul Truck	Annual	11.20	2.89	0.29	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Scissor lift	Hourly/Daily	5.46	1.41	0.14	lb/VMT	VMT	4.90	1.50	0.15	14.44	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Scissor lift	Annual	4.53	1.17	0.12	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Light vehicle (general usage) Fleet 1	Hourly/Daily	2.17	0.56	0.06	lb/VMT	VMT	4.90	1.50	0.15	1.85	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Light vehicle (general usage) Fleet 1	Annual	1.80	0.46	0.05	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Charging Rig Fleet 1	Hourly/Daily	5.73	1.48	0.15	lb/VMT	VMT	4.90	1.50	0.15	16.09	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Charging Rig Fleet 1	Annual	4.76	1.23	0.12	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	LH Rigs	Hourly/Daily	6.89	1.78	0.18	lb/VMT	VMT	4.90	1.50	0.15	24.25	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	LH Rigs	Annual	5.72	1.48	0.15	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	LH Rig (Ore Passes/Geo)	Hourly/Daily	6.89	1.78	0.18	lb/VMT	VMT	4.90	1.50	0.15	24.25	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	LH Rig (Ore Passes/Geo)	Annual	5.72	1.48	0.15	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	LHD (LH518B)	Hourly/Daily	11.61	2.99	0.30	lb/VMT	VMT	4.90	1.50	0.15	77.16	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	LHD (LH518B)	Annual	9.63	2.49	0.25	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Haul Trucks (Haul Loop)	Hourly/Daily	14.31	3.69	0.37	lb/VMT	VMT	4.90	1.50	0.15	122.84	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Haul Trucks (Haul Loop)	Annual	11.88	3.06	0.31	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Haul Trucks	Hourly/Daily	14.31	3.69	0.37	lb/VMT	VMT	4.90	1.50	0.15	122.84	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Haul Trucks	Annual	11.88	3.06	0.31	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Material transporter	Hourly/Daily	6.92	1.79	0.18	lb/VMT	VMT	4.90	1.50	0.15	24.47	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Material transporter	Annual	5.75	1.48	0.15	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Light vehicle (general usage) Fleet 2	Hourly/Daily	2.17	0.56	0.06	lb/VMT	VMT	4.90	1.50	0.15	1.85	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Light vehicle (general usage) Fleet 2	Annual	1.80	0.46	0.05	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Charging Rig Fleet 2	Hourly/Daily	5.73	1.48	0.15	lb/VMT	VMT	4.90	1.50	0.15	16.09	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	AP-42, Section 13.2.2, Expression 1a (11/06)
Unpaved	Charging Rig Fleet 2	Annual	4.76	1.23	0.12	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	AP-42, Section 13.2.2, Expressions 1a and 2 (11/06)
Unpaved	Personnel transporter	Hourly/Daily	5.84	1.51	0.15	lb/VMT	VMT	4.90	1.50	0.15	16.76	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Personnel transporter	Annual	4.85	1.25	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Shotcreter	Hourly/Daily	6.30	1.62	0.16	lb/VMT	VMT	4.90	1.50	0.15	19.84	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Shotcreter	Annual	5.23	1.35	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Transmixer	Hourly/Daily	6.92	1.79	0.18	lb/VMT	VMT	4.90	1.50	0.15	24.47	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Transmixer	Annual	5.75	1.48	0.15	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Water vehicle	Hourly/Daily	5.92	1.53	0.15	lb/VMT	VMT	4.90	1.50	0.15	17.31	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Water vehicle	Annual	4.92	1.27	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Mobile rockbreaker	Hourly/Daily	6.25	1.61	0.16	lb/VMT	VMT	4.90	1.50	0.15	19.51	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Mobile rockbreaker	Annual	5.19	1.34	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Grader	Hourly/Daily	6.33	1.63	0.16	lb/VMT	VMT	4.90	1.50	0.15	20.06	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Grader	Annual	5.26	1.36	0.14	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Skid Steer	Hourly/Daily	3.63	0.94	0.09	lb/VMT	VMT	4.90	1.50	0.15	5.83	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Skid Steer	Annual	3.01	0.78	0.08	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Light vehicle (tech services)	Hourly/Daily	2.17	0.56	0.06	lb/VMT	VMT	4.90	1.50	0.15	1.85	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Light vehicle (tech services)	Annual	1.80	0.46	0.05	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Material transporter (logistics/Construct)	Hourly/Daily	6.92	1.79	0.18	lb/VMT	VMT	4.90	1.50	0.15	24.47	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Material transporter (logistics/Construct)	Annual	5.75	1.48	0.15	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Scissor lift (Construction)	Hourly/Daily	5.46	1.41	0.14	lb/VMT	VMT	4.90	1.50	0.15	14.44	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Scissor lift (Construction)	Annual	4.53	1.17	0.12	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Telehandler	Hourly/Daily	5.71	1.47	0.15	lb/VMT	VMT	4.90	1.50	0.15	15.95	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Telehandler	Annual	4.74	1.22	0.12	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Maintenance Vehicle	Hourly/Daily	8.27	2.13	0.21	lb/VMT	VMT	4.90	1.50	0.15	36.38	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Maintenance Vehicle	Annual	6.87	1.77	0.18	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Fuel/Lube vehicle	Hourly/Daily	8.27	2.13	0.21	lb/VMT	VMT	4.90	1.50	0.15	36.38	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Fuel/Lube vehicle	Annual	6.87	1.77	0.18	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Mobile Grapple equipment	Hourly/Daily	5.17	1.33	0.13	lb/VMT	VMT	4.90	1.50	0.15	12.79	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Mobile Grapple equipment	Annual	4.29	1.11	0.11	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Blind Bore Machine	Hourly/Daily	10.15	2.62	0.26	lb/VMT	VMT	4.90	1.50	0.15	57.32	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Blind Bore Machine	Annual	8.43	2.17	0.22	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	

[1] Emission factors for vehicular traffic on unpaved roads per U.S. EPA AP-42, Section 13.2.2 (Unpaved Roads), November 2006.

Short-Term $E = k\,(s/12)^{a}(W/3)^{b}$ (1a)

Annual $E_{ext} = E\,[(365-P)/365]$ (2)

where E = Size-specific emission factor (lb/VMT) (Per AP-42 Table 13.2.2-2, November 2006)

k, a, b = Constants for equation 1a

	PM	PM_{10}	$PM_{2.5}$
k =	4.9	1.5	0.15
a =	0.7	0.9	0.9
b =	0.45	0.45	0.45

s = surface material silt content (%) (Silt content assumed as to be similar to Plant Road in Western Surface Coal Mining in AP-42, Section 13.2.4 (11/2006) per conversation with AMI, 10/14/22)
5.1

W = Mean vehicle weight (tons)

P = 62 Days per year with at least 0.01 inch precipitation, based on precipitation data from 2019-2021 for Hermosa Trench Met Station, using the lowest annual value between 2019-2021.

Table A-30a. Taylor Roads - Vehicles - Input Parameters

Road Surface	Vehicle Type	Trip Type	Number of Vehicles	Trip Distance (miles/vehicle/day)	Vehicle Miles Travelled (VMT)			Uncontrolled Emission Factor (lb/VMT)						Control	
								Short Term			Long Term			Type	Efficiency [1,2] (%)
					(VMT/hr)	(VMT/day)	(VMT/yr)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$		
Unpaved	Dev Drill Rig	Round	3	2	0.250	6.00	2,190	7.43	1.92	0.19	6.17	1.59	0.16	Watering	90%
Unpaved	Support Drill Rig	Round	5	2	0.417	10.00	3,650	7.81	2.01	0.20	6.48	1.67	0.17	Watering	90%
Unpaved	Cable bolter	Round	2	2	0.167	4.00	1,460	7.30	1.88	0.19	6.06	1.56	0.16	Watering	90%
Unpaved	LHD (JH5170)	Round	2	2	0.167	4.00	1,460	9.66	2.49	0.25	8.02	2.07	0.21	Watering	90%
Unpaved	Haul Truck	Round	4	20	3.333	80.00	29,200	13.50	3.48	0.35	11.20	2.89	0.29	Watering	90%
Unpaved	Scissor lift	Round	2	2	0.167	4.00	1,460	5.46	1.41	0.14	4.53	1.17	0.12	Watering	90%
Unpaved	Light vehicle (general usage) Fleet 1	Round	2	2	0.167	4.00	1,460	2.17	0.56	0.06	1.80	0.46	0.05	Watering	90%
Unpaved	Charging Rig Fleet 1	Round	2	2	0.167	4.00	1,460	5.73	1.48	0.15	4.76	1.23	0.12	Watering	90%
Unpaved	LH Rigs	Round	6	1	0.250	6.00	2,190	6.89	1.78	0.18	5.72	1.48	0.15	Watering	90%
Unpaved	LH Rig (Ore Passes/Geo)	Round	1	1	0.042	1.00	365	6.89	1.78	0.18	5.72	1.48	0.15	Watering	90%
Unpaved	LHD (JH518B)	Round	5	2	0.417	10.00	3,650	11.61	2.99	0.30	9.63	2.49	0.25	Watering	90%
Unpaved	Haul Trucks (Haul Loop)	Round	3	20	2.500	60.00	21,900	14.31	3.69	0.37	11.88	3.06	0.31	Watering	90%
Unpaved	Haul Trucks	Round	5	20	4.167	100.00	36,500	14.31	3.69	0.37	11.88	3.06	0.31	Watering	90%
Unpaved	Material transporter	Round	2	6	0.500	12.00	4,380	6.92	1.79	0.18	5.75	1.48	0.15	Watering	90%
Unpaved	Light vehicle (general usage) Fleet 2	Round	2	4	0.333	8.00	2,920	2.17	0.56	0.06	1.80	0.46	0.05	Watering	90%
Unpaved	Charging Rig Fleet 2	Round	2	2	0.167	4.00	1,460	5.73	1.48	0.15	4.76	1.23	0.12	Watering	90%
Unpaved	Personnel transporter	Round	3	6	0.750	18.00	6,570	5.84	1.51	0.15	4.85	1.25	0.13	Watering	90%
Unpaved	Shotcreter	Round	2	2	0.167	4.00	1,460	6.30	1.62	0.16	5.23	1.35	0.13	Watering	90%
Unpaved	Transmixer	Round	4	16	2.667	64.00	23,360	6.92	1.79	0.18	5.75	1.48	0.15	Watering	90%
Unpaved	Water vehicle	Round	2	6	0.500	12.00	4,380	5.92	1.53	0.15	4.92	1.27	0.13	Watering	90%
Unpaved	Mobile rockbreaker	Round	3	0.0027	0.00034	0.01	3	6.25	1.61	0.16	5.19	1.34	0.13	Watering	90%
Unpaved	Grader	Round	2	6	0.500	12.00	4,380	6.33	1.63	0.16	5.26	1.36	0.14	Watering	90%
Unpaved	Skid Steer	Round	3	1	0.125	3.00	1,095	3.63	0.94	0.09	3.01	0.78	0.08	Watering	90%
Unpaved	Light vehicle (tech services)	Round	4	2	0.333	8.00	2,920	2.17	0.56	0.06	1.80	0.46	0.05	Watering	90%
Unpaved	Material transporter (logistics/Construct)	Round	2	6	0.500	12.00	4,380	6.92	1.79	0.18	5.75	1.48	0.15	Watering	90%
Unpaved	Scissor lift (Construction)	Round	2	6	0.500	12.00	4,380	5.46	1.41	0.14	4.53	1.17	0.12	Watering	90%
Unpaved	Telehandler	Round	3	2	0.250	6.00	2,190	5.71	1.47	0.15	4.74	1.22	0.12	Watering	90%
Unpaved	Maintenance Vehicle	Round	3	4	0.500	12.00	4,380	8.27	2.13	0.21	6.87	1.77	0.18	Watering	90%
Unpaved	Fuel/Lube vehicle	Round	2	8	0.667	16.00	5,840	8.27	2.13	0.21	6.87	1.77	0.18	Watering	90%
Unpaved	Mobile Grapple equipment	Round	3	0.1	0.013	0.30	110	5.17	1.33	0.13	4.29	1.11	0.11	Watering	90%
Unpaved	Blind Bore Machine	Round	2	1	0.083	2.00	730	10.15	2.62	0.26	8.43	2.17	0.22	Watering	90%

1. Road Watering is not contemplated every hour, but only as needed to maintain control levels.

2. At South32, the roads will be watered sufficiently to achieve a control efficiency of 90%

Lead Content = 3.54E-03 kg/kg

Table A-30b. Taylor Roads -Vehicles - Emissions

Vehicle Type	Road Surface	Uncontrolled Emissions												Controlled Emissions									
		Hourly (lb/hr) [1]				Daily (lb/day) [1]				Annual (tpy) [2]				Hourly (lb/hr) [1]				Daily (lb/day) [1]				Annual (tpy) [2]			
		PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead
Dev Drill Rig	Unpaved	1.86	0.48	0.05	6.58E-03	44.60	11.50	1.15	0.16	6.76	1.74	0.17	0.02	0.19	0.05	0.00	6.58E-04	4.46	1.15	0.12	1.58E-02	0.68	0.17	0.02	2.39E-03
Support Drill Rig	Unpaved	3.25	0.84	0.08	0.01	78.07	20.14	2.01	0.28	11.83	3.05	0.31	0.04	0.33	0.08	0.01	1.15E-03	7.81	2.01	0.20	2.76E-02	1.18	0.31	0.03	4.19E-03
Cable bolter	Unpaved	1.22	0.31	0.03	4.31E-03	29.21	7.54	0.75	0.10	4.43	1.14	0.11	0.02	0.12	0.03	0.00	4.31E-04	2.92	0.75	0.08	1.03E-02	0.44	0.11	0.01	1.57E-03
LHD (LH517i)	Unpaved	1.61	0.42	0.04	5.70E-03	38.62	9.96	1.00	0.14	5.85	1.51	0.15	0.02	0.16	0.04	0.00	5.70E-04	3.86	1.00	0.10	1.37E-02	0.59	0.15	0.02	2.07E-03
Haul Truck	Unpaved	44.99	11.60	1.16	0.16	1079.65	278.52	27.85	3.82	163.57	42.20	4.22	0.58	4.50	1.16	0.12	1.59E-02	107.96	27.85	2.79	3.82E-01	16.36	4.22	0.42	5.79E-02
Scissor lift	Unpaved	0.91	0.23	0.02	3.22E-03	21.84	5.63	0.56	0.08	3.31	0.85	0.09	0.01	0.09	0.02	0.00	3.22E-04	2.18	0.56	0.06	7.73E-03	0.33	0.09	0.01	1.17E-03
Light vehicle (general usage) Fleet 1	Unpaved	0.36	0.09	0.01	1.28E-03	8.66	2.23	0.22	0.03	1.31	0.34	0.03	4.65E-03	0.04	0.01	0.00	1.28E-04	0.87	0.22	0.02	3.07E-03	0.13	0.03	0.00	4.65E-04
Charging Rig Fleet 1	Unpaved	0.96	0.25	0.02	3.38E-03	22.93	5.92	0.59	0.08	3.47	0.90	0.09	0.01	0.10	0.02	0.00	3.38E-04	2.29	0.59	0.06	8.12E-03	0.35	0.09	0.01	1.23E-03
LH Rigs	Unpaved	1.72	0.44	0.04	6.10E-03	41.37	10.67	1.07	0.15	6.27	1.62	0.16	0.02	0.17	0.04	0.00	6.10E-04	4.14	1.07	0.11	1.46E-02	0.63	0.16	0.02	2.22E-03
LH Rig (Ore Passes/Geo)	Unpaved	0.29	0.07	0.01	1.02E-03	6.89	1.78	0.18	0.02	1.04	0.27	0.03	3.70E-03	0.03	0.01	0.00	1.02E-04	0.69	0.18	0.02	2.44E-03	0.10	0.03	0.00	3.70E-04
LHD (LH518B)	Unpaved	4.84	1.25	0.12	0.02	116.06	29.94	2.99	0.41	17.58	4.54	0.45	0.06	0.48	0.12	0.01	1.71E-03	11.61	2.99	0.30	4.11E-02	1.76	0.45	0.05	6.23E-03
Haul Trucks (Haul Loop)	Unpaved	35.77	9.23	0.92	0.13	858.46	221.46	22.15	3.04	130.06	33.55	3.36	0.46	3.58	0.92	0.09	1.27E-02	85.85	22.15	2.21	3.04E-01	13.01	3.36	0.34	4.61E-02
Haul Trucks	Unpaved	59.62	15.38	1.54	0.21	1430.77	369.10	36.91	5.07	216.76	55.92	5.59	0.77	5.96	1.54	0.15	2.11E-02	143.08	36.91	3.69	5.07E-01	21.68	5.59	0.56	7.68E-02
Material transporter	Unpaved	3.46	0.89	0.09	0.01	83.07	21.43	2.14	0.29	12.59	3.25	0.32	0.04	0.35	0.09	0.01	1.23E-03	8.31	2.14	0.21	2.94E-02	1.26	0.32	0.03	4.46E-03
Light vehicle (general usage) Fleet 2	Unpaved	0.72	0.19	0.02	2.56E-03	17.33	4.47	0.45	0.06	2.62	0.68	0.07	9.29E-03	0.07	0.02	0.00	2.56E-04	1.73	0.45	0.04	6.14E-03	0.26	0.07	0.01	9.29E-04
Charging Rig Fleet 2	Unpaved	0.96	0.25	0.02	3.38E-03	22.93	5.92	0.59	0.08	3.47	0.90	0.09	0.01	0.10	0.02	0.00	3.38E-04	2.29	0.59	0.06	8.12E-03	0.35	0.09	0.01	1.23E-03
Personnel transporter	Unpaved	4.38	1.13	0.11	0.02	105.08	27.11	2.71	0.37	15.92	4.11	0.41	0.06	0.44	0.11	0.01	1.55E-03	10.51	2.71	0.27	3.72E-02	1.59	0.41	0.04	5.64E-03
Shotcreter	Unpaved	1.05	0.27	0.03	3.72E-03	25.20	6.50	0.65	0.09	3.82	0.98	0.10	0.01	0.10	0.03	0.00	3.72E-04	2.52	0.65	0.06	8.92E-03	0.38	0.10	0.01	1.35E-03
Transmixer	Unpaved	18.46	4.76	0.48	0.07	443.04	114.29	11.43	1.57	67.12	17.32	1.73	0.24	1.85	0.48	0.05	6.54E-03	44.30	11.43	1.14	1.57E-01	6.71	1.73	0.17	2.38E-02
Water vehicle	Unpaved	2.96	0.76	0.08	0.01	71.08	18.34	1.83	0.25	10.77	2.78	0.28	0.04	0.30	0.08	0.01	1.05E-03	7.11	1.83	0.18	2.52E-02	1.08	0.28	0.03	3.81E-03
Mobile rockbreaker	Unpaved	0.00	0.00	0.00	7.58E-06	0.05	0.01	0.00	1.82E-04	0.01	0.00	0.00	2.76E-05	0.00	0.00	0.00	7.58E-07	0.01	0.00	0.00	1.82E-05	0.00	0.00	0.00	2.76E-06
Grader	Unpaved	3.17	0.82	0.08	0.01	75.97	19.60	1.96	0.27	11.51	2.97	0.30	0.04	0.32	0.08	0.01	1.12E-03	7.60	1.96	0.20	2.69E-02	1.15	0.30	0.03	4.08E-03
Skid Steer	Unpaved	0.45	0.12	0.01	1.61E-03	10.89	2.81	0.28	0.04	1.65	0.43	0.04	5.84E-03	0.05	0.01	0.00	1.61E-04	1.09	0.28	0.03	3.86E-03	0.17	0.04	0.00	5.84E-04
Light vehicle (tech services)	Unpaved	0.72	0.19	0.02	2.56E-03	17.33	4.47	0.45	0.06	2.62	0.68	0.07	9.29E-03	0.07	0.02	0.00	2.56E-04	1.73	0.45	0.04	6.14E-03	0.26	0.07	0.01	9.29E-04
Material transporter (logistics/Construct)	Unpaved	3.46	0.89	0.09	0.01	83.07	21.43	2.14	0.29	12.59	3.25	0.32	0.04	0.35	0.09	0.01	1.23E-03	8.31	2.14	0.21	2.94E-02	1.26	0.32	0.03	4.46E-03
Scissor lift (Construction)	Unpaved	2.73	0.70	0.07	9.67E-03	65.52	16.90	1.69	0.23	9.93	2.56	0.26	0.04	0.27	0.07	0.01	9.67E-04	6.55	1.69	0.17	2.32E-02	0.99	0.26	0.03	3.51E-03
Telehandler	Unpaved	1.43	0.37	0.04	5.05E-03	34.26	8.84	0.88	0.12	5.19	1.34	0.13	0.02	0.14	0.04	0.00	5.05E-04	3.43	0.88	0.09	1.21E-02	0.52	0.13	0.01	1.84E-03
Maintenance Vehicle	Unpaved	4.14	1.07	0.11	0.01	99.29	25.61	2.56	0.35	15.04	3.88	0.39	0.05	0.41	0.11	0.01	1.47E-03	9.93	2.56	0.26	3.52E-02	1.50	0.39	0.04	5.33E-03
Fuel/Lube vehicle	Unpaved	5.52	1.42	0.14	0.02	132.39	34.15	3.42	0.47	20.06	5.17	0.52	0.07	0.55	0.14	0.01	1.95E-03	13.24	3.42	0.34	4.69E-02	2.01	0.52	0.05	7.10E-03
Mobile Grapple equipment	Unpaved	0.06	0.02	0.00	2.29E-04	1.55	0.40	0.04	5.49E-03	0.23	0.06	0.01	8.32E-04	0.01	0.00	0.00	2.29E-05	0.16	0.04	0.00	5.49E-04	0.02	0.01	0.00	8.32E-05
Blind Bore Machine	Unpaved	0.85	0.22	0.02	3.00E-03	20.31	5.24	0.52	0.07	3.08	0.79	0.08	0.01	0.08	0.02	0.00	3.00E-04	2.03	0.52	0.05	7.19E-03	0.31	0.08	0.01	1.09E-03
Total Emissions		**211.89**	**54.66**	**5.47**	**0.75**	**5,085.46**	**1,311.91**	**131.19**	**18.01**	**770.45**	**198.75**	**19.88**	**2.73**	**21.19**	**5.47**	**0.55**	**7.50E-02**	**508.55**	**131.19**	**13.12**	**1.80E+00**	**77.04**	**19.88**	**1.99**	**2.73E-01**

1. Controlled hourly and daily emissions calculated based on short term emission factors and control efficiency.
2. Controlled annual emissions calculated based on long term emission factors and control efficiency.

Table A-31. Clark Emission Factor Inputs

Road Surface	Max Miles Traveled			Vehicle Type	Vehicle Model	Max Vehicle Count	Particulate Matter Emission Factor Inputs [1]													
							k					s	P	a			b			
	Day	Month	Year				PM	PM_{10}	$PM_{2.5}$	Avg (kg)	(ton)	(%)	(days/ yr)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Unpaved	8	243.3	2920	Jumbo	DD422i	2	4.9	1.5	0.15	26,000	28.7	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	8	243.3	2920	Bolter	DD411	3	4.9	1.5	0.15	23,000	25.4	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	60	1825.0	21900	Haul Truck	TH430	5	4.9	1.5	0.15	44,500	49.1	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	LHD	LH410	4	4.9	1.5	0.15	33,500	36.9	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	8	243.3	2920	Production Drill	Simba ME7C	2	4.9	1.5	0.15	29,500	32.5	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	8	243.3	2920	Slot-Raise Drill	Easer L	1	4.9	1.5	0.15	37,300	41.1	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	8	243.3	2920	Blockholer	BH3	1	4.9	1.5	0.15	28,000	30.9	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Powder Truck	EC3	2	4.9	1.5	0.15	17,950	19.8	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Grader	120 AWD	1	4.9	1.5	0.15	16,700	18.4	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Lube Truck	FL3	1	4.9	1.5	0.15	13,600	15.0	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Shotcrete Sprayer	SSX & SS3 T4F	1	4.9	1.5	0.15	19,200	21.2	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Transit Mixer	TM3	2	4.9	1.5	0.15	25,050	27.6	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Scissor Deck	SL3	2	4.9	1.5	0.15	15,400	17.0	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Boom Truck	BT3	1	4.9	1.5	0.15	17,300	19.1	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	16	486.7	5840	Light Vehicle	F-250	6	4.9	1.5	0.15	3,750	4.1	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45
Unpaved	24	730.0	8760	Water Vehicle	WS3	1	4.9	1.5	0.15	16,100	17.7	5.1	62	0.7	0.9	0.9	0.45	0.45	0.45

[1] Emission factors for vehicular traffic on unpaved roads per U.S. EPA AP-42, Section 13.2.2 (Unpaved Roads), November 2006.

Short-Term $E = k\,(s/12)^a (W/3)^b$ (1a)

Annual $E_{ext} = E\,[(365 - P)/365]$ (2)

where E = Size-specific emission factor (lb/VMT)

k, a, b = Constants for equation 1a

	PM	PM_{10}	$PM_{2.5}$
k =	4.9	1.5	0.15
a =	0.7	0.9	0.9
b =	0.45	0.45	0.45

Per AP-42 Table 13.2.2-2, November 2006

s = surface material silt content (%), per AP-42 Table 13.2.2-1, 11/06, Western surface coal mining Plant Road
5.1

W = Mean vehicle weight (tons)

P = Days per year with at least 0.01 inch precipitation, based on precipitation data from 2019-2021 for Hermosa Trench Met Station, using the lowest annual value between 2019-2021.
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Table A-32. Clark Underground Roads - Emission Factors

Road Surface	Vehicle Type	Averaging Period	Emission Factor [1]				Process Rate Unit	Particulate Matter Emission Factor Inputs [1]												Reference
								k			W	s	P	a			b			
			PM	PM_{10}	$PM_{2.5}$	Unit		PM	PM_{10}	$PM_{2.5}$	(ton)	(%)	(days/yr)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	
Unpaved	Jumbo	Hourly/Daily	7.43	1.92	0.19	lb/VMT	VMT	4.90	1.50	0.15	28.66	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	AP-42, Section 13.2.2, Expression 1a (11/06) AP-42, Section 13.2.2, Expressions 1a and 2 (11/06)
Unpaved	Jumbo	Annual	6.17	1.59	0.16	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Bolter	Hourly/Daily	7.03	1.81	0.18	lb/VMT	VMT	4.90	1.50	0.15	25.35	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Bolter	Annual	5.84	1.51	0.15	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Haul Truck	Hourly/Daily	9.47	2.44	0.24	lb/VMT	VMT	4.90	1.50	0.15	49.05	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Haul Truck	Annual	7.86	2.03	0.20	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	LHD	Hourly/Daily	8.33	2.15	0.21	lb/VMT	VMT	4.90	1.50	0.15	36.93	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	LHD	Annual	6.92	1.78	0.18	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Production Drill	Hourly/Daily	7.87	2.03	0.20	lb/VMT	VMT	4.90	1.50	0.15	32.52	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Production Drill	Annual	6.53	1.68	0.17	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Slot-Raise Drill	Hourly/Daily	8.74	2.26	0.23	lb/VMT	VMT	4.90	1.50	0.15	41.12	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Slot-Raise Drill	Annual	7.26	1.87	0.19	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Blockholer	Hourly/Daily	7.68	1.98	0.20	lb/VMT	VMT	4.90	1.50	0.15	30.86	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Blockholer	Annual	6.38	1.65	0.16	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Powder Truck	Hourly/Daily	6.29	1.62	0.16	lb/VMT	VMT	4.90	1.50	0.15	19.79	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Powder Truck	Annual	5.22	1.35	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Grader	Hourly/Daily	6.09	1.57	0.16	lb/VMT	VMT	4.90	1.50	0.15	18.41	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Grader	Annual	5.06	1.30	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Lube Truck	Hourly/Daily	5.55	1.43	0.14	lb/VMT	VMT	4.90	1.50	0.15	14.99	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Lube Truck	Annual	4.61	1.19	0.12	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Shotcrete Sprayer	Hourly/Daily	6.48	1.67	0.17	lb/VMT	VMT	4.90	1.50	0.15	21.16	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Shotcrete Sprayer	Annual	5.38	1.39	0.14	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Transit Mixer	Hourly/Daily	7.31	1.89	0.19	lb/VMT	VMT	4.90	1.50	0.15	27.61	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Transit Mixer	Annual	6.07	1.57	0.16	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Scissor Deck	Hourly/Daily	5.87	1.51	0.15	lb/VMT	VMT	4.90	1.50	0.15	16.98	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Scissor Deck	Annual	4.87	1.26	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Boom Truck	Hourly/Daily	6.19	1.60	0.16	lb/VMT	VMT	4.90	1.50	0.15	19.07	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Boom Truck	Annual	5.14	1.33	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Light Vehicle	Hourly/Daily	3.11	0.80	0.08	lb/VMT	VMT	4.90	1.50	0.15	4.13	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Light Vehicle	Annual	2.58	0.67	0.07	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	
Unpaved	Water Vehicle	Hourly/Daily	5.99	1.55	0.15	lb/VMT	VMT	4.90	1.50	0.15	17.75	5.10	62.00	0.70	0.90	0.90	0.45	0.45	0.45	
Unpaved	Water Vehicle	Annual	4.97	1.28	0.13	lb/VMT	VMT	-	-	-		-	62.00	-	-	-	-	-	-	

[1] Emission factors for vehicular traffic on unpaved roads per U.S. EPA AP-42, Section 13.2.2 (Unpaved Roads), November 2006.

Short-Term $E = k\,(s/12)^a (W/3)^b$ (1a)

Annual $E_{ext} = E\,[(365 - P)/365]$ (2)

where E = Size-specific emission factor (lb/VMT)

k, a, b = Constants for equation 1a

	PM	PM_{10}	$PM_{2.5}$
k =	4.9	1.5	0.15
a =	0.7	0.9	0.9
b =	0.45	0.45	0.45

Per AP-42 Table 13.2.2-2, November 2006

s = surface material silt content (%)

5.1

Silt content assumed as to be similar to Plant Road in Western Surface Coal Mining in AP-42, Section 13.2.4 (11/2006) per conversation with AMI, 10/14/22.

W = Mean vehicle weight (tons)

P = Days per year with at least 0.01 inch precipitation, based on precipitation data from 2019-2021 for Hermosa Trench Met Station, using the lowest annual value between 2019-2021.

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Table A-33a. Clark Roads - Vehicles - Input Parameters

Road Surface	Vehicle Type	Trip Type	Number of Vehicles	Trip Distance (miles/vehicle/day)	Vehicle Miles Travelled (VMT)			Uncontrolled Emission Factor (lb/VMT)						Control	
								Short Term			Long Term			Type	Efficiency[1,2]
					(VMT/hr)	(VMT/day)	(VMT/yr)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$		(%)
Unpaved	Jumbo	Round	2	8	0.667	16.00	5,840	7.43	1.92	0.19	6.17	1.59	0.16	Watering	90%
Unpaved	Bolter	Round	3	8	1.000	24.00	8,760	7.03	1.81	0.18	5.84	1.51	0.15	Watering	90%
Unpaved	Haul Truck	Round	5	60	12.500	300.00	109,500	9.47	2.44	0.24	7.86	2.03	0.20	Watering	90%
Unpaved	LHD	Round	4	16	2.667	64.00	23,360	8.33	2.15	0.21	6.92	1.78	0.18	Watering	90%
Unpaved	Production Drill	Round	2	8	0.667	16.00	5,840	7.87	2.03	0.20	6.53	1.68	0.17	Watering	90%
Unpaved	Slot-Raise Drill	Round	1	8	0.333	8.00	2,920	8.74	2.26	0.23	7.26	1.87	0.19	Watering	90%
Unpaved	Blockholer	Round	1	8	0.333	8.00	2,920	7.68	1.98	0.20	6.38	1.65	0.16	Watering	90%
Unpaved	Powder Truck	Round	2	16	1.333	32.00	11,680	6.29	1.62	0.16	5.22	1.35	0.13	Watering	90%
Unpaved	Grader	Round	1	16	0.667	16.00	5,840	6.09	1.57	0.16	5.06	1.30	0.13	Watering	90%
Unpaved	Lube Truck	Round	1	16	0.667	16.00	5,840	5.55	1.43	0.14	4.61	1.19	0.12	Watering	90%
Unpaved	Shotcrete Sprayer	Round	1	16	0.667	16.00	5,840	6.48	1.67	0.17	5.38	1.39	0.14	Watering	90%
Unpaved	Transit Mixer	Round	2	16	1.333	32.00	11,680	7.31	1.89	0.19	6.07	1.57	0.16	Watering	90%
Unpaved	Scissor Deck	Round	2	16	1.333	32.00	11,680	5.87	1.51	0.15	4.87	1.26	0.13	Watering	90%
Unpaved	Boom Truck	Round	1	16	0.667	16.00	5,840	6.19	1.60	0.16	5.14	1.33	0.13	Watering	90%
Unpaved	Light Vehicle	Round	6	16	4.000	96.00	35,040	3.11	0.80	0.08	2.58	0.67	0.07	Watering	90%
Unpaved	Water Vehicle	Round	1	24	1.000	24.00	8,760	5.99	1.55	0.15	4.97	1.28	0.13	Watering	90%

1. Road Watering is not contemplated every hour, but only as needed to maintain control levels.

2. At South32, the roads will be watered sufficiently to achieve a control efficiency of 90%

Lead Content = 5.67E-03 kg/kg

Table A-33b. Clark Roads -Vehicles - Emissions

Vehicle Type	Road Surface	Uncontrolled Emissions												Controlled Emissions									
		Hourly (lb/hr) [1]				Daily (lb/day) [1]				Annual (tpy) [2]				Hourly (lb/hr) [1]				Daily (lb/day) [1]				Annual (tpy) [2]			
		PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead	PM	PM_{10}	$PM_{2.5}$	Lead
Jumbo	Unpaved	4.96	1.28	0.13	0.03	118.92	30.68	3.07	0.67	18.02	4.65	0.46	0.10	0.50	0.13	0.01	2.81E-03	11.89	3.07	0.31	6.74E-02	1.80	0.46	0.05	1.02E-02
Bolter	Unpaved	7.03	1.81	0.18	0.04	168.81	43.55	4.35	0.96	25.57	6.60	0.66	0.14	0.70	0.18	0.02	3.99E-03	16.88	4.35	0.44	9.57E-02	2.56	0.66	0.07	1.45E-02
Haul Truck	Unpaved	118.32	30.52	3.05	0.67	2839.78	732.58	73.26	16.10	430.23	110.99	11.10	2.44	11.83	3.05	0.31	6.71E-02	283.98	73.26	7.33	1.61E+00	43.02	11.10	1.11	2.44E-01
LHD	Unpaved	22.21	5.73	0.57	0.13	533.15	137.54	13.75	3.02	80.77	20.84	2.08	0.46	2.22	0.57	0.06	1.26E-02	53.32	13.75	1.38	3.02E-01	8.08	2.08	0.21	4.58E-02
Production Drill	Unpaved	5.24	1.35	0.14	0.03	125.88	32.47	3.25	0.71	19.07	4.92	0.49	0.11	0.52	0.14	0.01	2.97E-03	12.59	3.25	0.32	7.14E-02	1.91	0.49	0.05	1.08E-02
Slot-Raise Drill	Unpaved	2.91	0.75	0.08	0.02	69.95	18.04	1.80	0.40	10.60	2.73	0.27	0.06	0.29	0.08	0.01	1.65E-03	6.99	1.80	0.18	3.97E-02	1.06	0.27	0.03	6.01E-03
Blockholer	Unpaved	2.56	0.66	0.07	0.01	61.48	15.86	1.59	0.35	9.31	2.40	0.24	0.05	0.26	0.07	0.01	1.45E-03	6.15	1.59	0.16	3.49E-02	0.93	0.24	0.02	5.28E-03
Powder Truck	Unpaved	8.39	2.16	0.22	0.05	201.32	51.93	5.19	1.14	30.50	7.87	0.79	0.17	0.84	0.22	0.02	4.76E-03	20.13	5.19	0.52	1.14E-01	3.05	0.79	0.08	1.73E-02
Grader	Unpaved	4.06	1.05	0.10	0.02	97.44	25.14	2.51	0.55	14.76	3.81	0.38	0.08	0.41	0.10	0.01	2.30E-03	9.74	2.51	0.25	5.52E-02	1.48	0.38	0.04	8.37E-03
Lube Truck	Unpaved	3.70	0.95	0.10	0.02	88.84	22.92	2.29	0.50	13.46	3.47	0.35	0.08	0.37	0.10	0.01	2.10E-03	8.88	2.29	0.23	5.04E-02	1.35	0.35	0.03	7.63E-03
Shotcrete Sprayer	Unpaved	4.32	1.12	0.11	0.02	103.75	26.77	2.68	0.59	15.72	4.06	0.41	0.09	0.43	0.11	0.01	2.45E-03	10.38	2.68	0.27	5.88E-02	1.57	0.41	0.04	8.91E-03
Transit Mixer	Unpaved	9.75	2.51	0.25	0.06	233.89	60.34	6.03	1.33	35.43	9.14	0.91	0.20	0.97	0.25	0.03	5.52E-03	23.39	6.03	0.60	1.33E-01	3.54	0.91	0.09	2.01E-02
Scissor Deck	Unpaved	7.83	2.02	0.20	0.04	187.90	48.47	4.85	1.07	28.47	7.34	0.73	0.16	0.78	0.20	0.02	4.44E-03	18.79	4.85	0.48	1.07E-01	2.85	0.73	0.07	1.61E-02
Boom Truck	Unpaved	4.13	1.06	0.11	0.02	99.00	25.54	2.55	0.56	15.00	3.87	0.39	0.09	0.41	0.11	0.01	2.34E-03	9.90	2.55	0.26	5.61E-02	1.50	0.39	0.04	8.50E-03
Light Vehicle	Unpaved	12.44	3.21	0.32	0.07	298.53	77.01	7.70	1.69	45.23	11.67	1.17	0.26	1.24	0.32	0.03	7.05E-03	29.85	7.70	0.77	1.69E-01	4.52	1.17	0.12	2.56E-02
Water Vehicle	Unpaved	5.99	1.55	0.15	0.03	143.78	37.09	3.71	0.82	21.78	5.62	0.56	0.12	0.60	0.15	0.02	3.40E-03	14.38	3.71	0.37	8.15E-02	2.18	0.56	0.06	1.23E-02
Total Emissions		**223.85**	**57.75**	**5.77**	**1.27E+00**	**5,372.41**	**1,385.93**	**138.59**	**3.05E+01**	**813.92**	**209.97**	**21.00**	**4.61E+00**	**22.39**	**5.77**	**0.58**	**1.27E-01**	**537.24**	**138.59**	**13.86**	**3.05E+00**	**81.39**	**21.00**	**2.10**	**4.61E-01**

1. Controlled hourly and daily emissions calculated based on short term emission factors and control efficiency.
2. Controlled annual emissions calculated based on long term emission factors and control efficiency.

Table A-34. Truck Pneumatic Loadout Emissions

Emission Point Number	Description	Max Daily Throughput (ton/day)	Max Yearly Throughput (ton/yr)	Hourly Emissions [1,2]			Daily Emissions [1,2]			Annual Emissions [1,2]		
				PM (lb/hr)	PM_{10} (lb/hr)	$PM_{2.5}$ (lb/hr)	PM (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	PM (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)
Taylor												
PP-1	Truck Pneumatic Loadout to Silo 1	235	85,746	9.69E-03	3.33E-03	6.94E-04	2.33E-01	7.99E-02	1.67E-02	4.24E-02	1.46E-02	3.04E-03
PP-2	Truck Pneumatic Loadout to Silo 2	235	85,746	9.69E-03	3.33E-03	6.94E-04	2.33E-01	7.99E-02	1.67E-02	4.24E-02	1.46E-02	3.04E-03
Clark												
PP-3	Truck Pneumatic Loadout to Silo 1	117	42,873	4.85E-03	1.66E-03	3.47E-04	1.16E-01	3.99E-02	8.33E-03	2.12E-02	7.29E-03	1.52E-03
PP-4	Truck Pneumatic Loadout to Silo 2	117	42,873	4.85E-03	1.66E-03	3.47E-04	1.16E-01	3.99E-02	8.33E-03	2.12E-02	7.29E-03	1.52E-03

1. Emission factors based on AP-42 Chapter 11 Section 12, Table 11.12-2.
2. Throughput based on email from South32 on June 14, 2023.

PM	PM10	PM2.5		k = Particle size multiplier (dimensionless)		
				PM	PM_{10}	$PM_{2.5}$
0.00099	0.00034	7.0905E-05	lb of pollutant/ton of material	0.74	0.35	0.053

TABLE 11.12-2 (ENGLISH UNITS)
EMISSION FACTORS FOR CONCRETE BATCHING [a]

Source (SCC)	Uncontrolled				Controlled			
	Total PM	Emission Factor Rating	Total PM_{10}	Emission Factor Rating	Total PM	Emission Factor Rating	Total PM_{10}	Emission Factor Rating
Aggregate transfer [b] (3-05-011-04,-21,23)	0.0069	D	0.0033	D	ND		ND	
Sand transfer [b] (3-05-011-05,22,24)	0.0021	D	0.00099	D	ND		ND	
Cement unloading to elevated storage silo [pneumatic][f] (3-05-011-07)	0.73	E	0.47	E	0.00099	D	0.00034	D
Cement supplement unloading to elevated storage silo (pneumatic)[f] (3-05-011-17)	3.14	E	1.10	E	0.0089	D	0.0049	E
Weigh hopper loading [c] (3-05-011-08)	0.0048	D	0.0028	D	ND		ND	
Mixer loading (central mix)[f] (3-05-011-09)	0.572 or Eqn. 11.12-1	B	0.156 or Eqn. 11.12-1	B	0.0184 or Eqn. 11.12-1	B	0.0055 or Eqn. 11.12-1	B
Truck loading (truck mix)[g] (3-05-011-10)	1.118	B	0.310	B	0.098 or Eqn. 11.12-1	B	0.0263 or Eqn. 11.12-1	B
Vehicle traffic (paved roads)	See AP-42 Section 13.2.1, Paved Roads							
Vehicle traffic (unpaved roads)	See AP-42 Section 13.2.2, Unpaved Roads							
Wind erosion from aggregate and sand storage piles	See AP-42 Section 13.2.5, Industrial Wind Erosion							

[c] The uncontrolled PM & PM-10 emission factors were developed from Reference 9. The controlled emission factor for PM was developed from References 9, 10, 11, and 12. The controlled emission factor for PM-10 was developed from References 9 and 10.
[d] The controlled PM emission factor was developed from Reference 10 and Reference 12, whereas the controlled PM-10 emission factor was developed from only Reference 10.

Reference 10:

Tanker trucks are contracted from outside sources to deliver cement to the storage silos of the Johnson and Erie batch plants. The Johnson plant has a single cement storage silo. The Erie plant has two cement storage silos designated east and west. To transport the cement from the tanker to the silo, a 4-inch flexible line is attached to the rear of the tanker truck. The cement is then pneumatically conveyed to the top of the storage silo. It takes approximately 45-minutes to unload one tanker truck.

Each storage silo has its own dust collector attached to its roof. The dust collectors vent to the atmosphere and are not equipped with any fans or blowers. The air flow out of each silo is a result of the air being displaced by the incoming cement.

Reference 11:

TEST RESULTS

During the test, a truck load of cement (44,340 lbs. net) was conveyed into the cement storage silo being tested, by an air compressor mounted on the truck. The air was exhausted through two identical Tiberi Engineering Company dust collectors mounted on top of the bin. Only one of the dust collectors was tested. The test results are as follows:

Table A-35. WTP2 Scrubber Emissions

Emission Point Number	Unit	CN Concentration[1] (ppm)	Gas Flow Rate[1] (cfm)	Operating Hours[2] (hrs/yr)	HCN Emissions [3] (lb/hr)	HCN Emissions (stpy)
SCRUBBER-1	Tank Exhaust HCN Scrubber	600	500	8760	1.23	5.38
Tanks Exhaust	Process Tanks Exhaust	39	50	8760	7.98E-03	3.50E-02

[1.] Cyanide concentration uncontrolled is 2,000 ppm based on discussion with Eric H. and gas flow rate assumed to be 500 cfm based on engineering judgement.
39 ppm based on discussion with Eric H. and 50 cfm based on engineering judgment (minimal flow rate for natural ventilation).

[2.] Control Efficiency of scrubber 70% conservative assumption

[3.] Assumed the following output parameters

542.77	Rankine	*Based on the temperature in the Process Tanks tab of "S32 - Mine Development - Emis Calc - 2024-1105".*
0.73	ft^3.atm/R.lbmol	
1	atm	
27.03	Molecular Weight of Hydrogen Cyanide (g/mol)	

Equipment Type	Max. Capacity	Units	Make*	Model*	Serial Number*	Installation/Mfg. Date*	Equipment ID Number	A.A.C / NSPS / NESHAP
Generators								
Natural Gas Engine CAT 3520 DSL 2600 kW (40 and 4 backups) ~~(58, and 1 Backup)~~	2600	ekW	Caterpillar	3520 DSL	TBD	TBD	ENGINE 0013 - ENGINE 0056 ~~0071~~	NSPS 40 CFR Part 60 Subpart JJJJ and NESHAP 40 CFR Part 63 Subpart ZZZZ
Diesel CAT XQ1140 (6) (2 CAT C18 engines per package with each package displacement 3.02 liter/cylinder)	910	ekW	Caterpillar	C18	TBD	TBD	ENGINE 0007 - ENGINE 0012	NSPS 40 CFR Part 60 Subpart JJJJ and NESHAP 40 CFR Part 63 Subpart ZZZZ
Diesel C200D2RE (Displacement 1.12 liter/cylinder)	200	ekW	Cummins	QSB7-G9	TBD	TBD	ENGINE 0001	NSPS 40 CFR Part 60 Subpart IIII
Diesel CAT C175 3000 kW (5) (Displacement 5.3 liter/cylinder)	3000	ekW	Caterpillar	C175-16	TBD	TBD	ENGINE 0002 - ENGINE 0006	NSPS 40 CFR Part 60 Subpart JJJJ and NESHAP 40 CFR Part 63 Subpart ZZZZ

APPENDIX E. DRAFT PERMIT LANGUAGE

South32 has provided a redline draft permit to facilitate review of this Significant Permit Revision. This includes suggested permit condition changes to Attachment B of the permit as well as changes to the Equipment List.

[A.A.C. R18-2-312]

A. New Non-Emergency Diesel Engines Subject to New Source Performance Standards (NSPS) Subpart IIII Requirements

6. Compliance Requirements

c. The Permittee shall demonstrate compliance with Condition IV.A.4.c as follows:
[A.A.C. R18-2-306.A.3.c]

(1) For the lb/hr limit, by testing pursuant to Condition IV.A.7 multiplying the emission rate for each engine in g/hp-hr or g/kwhr by the horsepower or kilowatt of the engine, depending upon the form of the standard, and dividing by 453.592 to calculate the lb/hr for each engine and summing the results for all engines subject to Condition IV.A. to compare to the pound per hour limit. This compliance demonstration shall be completed within two weeks of receipt of any stack test results pursuant to Condition IV.A.7.

(2) For the ton/year limit, by taking the operating hours for each engine within two weeks of the end of the calendar month and multiplying it by the current lb/hr for that engine calculated in Condition IV.A.6.c(1) by the number of operating hours during the prior 12 months, summing the results for all engines subject to Condition IV.A, and dividing by 2000 to compare to the ton/year limit.

(3) For certified engines operated in accordance with Condition IV.A.6.a, the Permittee may use the certified emission rate in g/hp-hr or g/kWh in lieu of stack testing rates in Condition IV.A.7.c(1) and (2).

7. Testing Requirements

b. **Except for certified engines operated in accordance with Condition IV.A.6.a, t**he Permittee shall test each engine subject to Condition IV.A.4.c within 60 days of achieving maximum load or 180 days of startup or transfer from the E&VRP pursuant to Condition I.A.4, and annually thereafter. The Permittee may propose, and ADEQ may approve, an annual schedule for testing all affected units to facilitate efficient testing.

[A.A.C. R18-2-312]

B. New Non-Emergency Natural Gas Engines Subject to New Source Performance Standards (NSPS) Subpart JJJJ Requirements

1. Applicability

This Section applies to the natural gas spark ignition (SI) internal combustion engines (ICEs) as identified in the Equipment List in Attachment "C".

2. General Requirements

a. *The Permittee shall install selective catalytic reduction (SCR) and oxidation catalysts (OxCat) on the natural gas engines and program and monitor ~~interlock~~ all engines to ensure that the associated SCR and OxCat will operate at all times **they** are above the operating temperature and load specified for each control device by the engine vendor, including periods of startup, shutdown and malfunction,* ***but excluding SCR system validation checks after 4000 hour maintenance and injector clog/urea line blockage procedures, which time shall be limited to the extent practicable.***

[A.A.C. R18-2-306.01 and -331.A.3.a]
[Material Permit Conditions are indicated with underline and italics]

b. *Except during startup and shutdown* ***and specified maintenance****, the Permittee* ***may*** *operate* ***up to 14 of*** *the natural gas engines* ***from 50 to 100% load, including 100% load, and shall operate the balance of the natural gas engines*** *from 75% and up to 100% load, including 100% load.* **Periods of startup, shutdown and specified maintenance are not included in the hourly load % calculation.** ***The following required maintenance procedures are permissible at less than the 50 or 75% minimum load range but the duration of such maintenance shall be limited to a reasonable time:***

(1) Engine coolant sample, Level 1, every 250 operating hours
(2) Engine oil sample, every 250 operating hours
(3) Alternator inspection, every 1000 operating hours
(4) Generator bearing lubrication, every 1000 operating hours
(5) Prelube pump inspection, every 12 months
(6) Crankcase blowby inspection, test and record every 4000 operating hours
(7) Corrective action to an engine malfunction event requiring one or more of the maintenance activities listed in (1) through (6) preceding.

[A.A.C. R18-2-306.01 and -331.A.3.a]
[Material Permit Conditions are indicated with underline and italics]

c. ***If an engine, oxidation catalyst or SCR unit malfunctions while in service, the Permittee is allowed 15 minutes to assess whether the unit can be repaired in less time than it would take to start up another engine and engage its SCR unit, in which case running repair is authorized; if not, the Permittee shall start up an alternative engine and control unit and shut down the malfunctioning unit once the replacement unit is operating. If no other engine and control unit is available and shutdown creates a life-safety risk, the Permittee may continue to operate the malfunctioning unit until repaired or another unit can be brought on-line as soon as practicable but such operation must be reported together with the justification as a deviation. Operation in such situations without an objectively reasonable justification is a violation.***

d. **Startup and Shutdown.**

(1) **NOx. For purposes of this Section, startup shall be the time from cold start until the unit achieves both the vendor's specified operating temperature and 50% or greater load, plus the time for an SCR system validation check, if required, and any other time when operating load is less than 50% for more than 15 consecutive minutes until the unit again achieves both load the vendor's specified operating temperature and**

50% or greater load; shutdown is the time from the start of a planned shutdown or any time the operating load drops below 50% for 15 consecutive minutes until combustion ceases.

(2) **CO and VOC. For purposes of this Section, startup shall be the time from cold start until the control unit achieves 200°C and a shutdown is any other time the control unit temperature is less than 200°C until combustion ceases. A shutdown during which the control unit temperature never drops below 200°C beforel combustion ceases is not a shutdown for purposes of Condition IV.B.4.e.(2)(a)(ii).**

(3) **Particulate matter emissions must meet the limits during startup, shutdown and planned maintenance.**

[A.A.C. R18-2-306.B.3]

3. Emission Standards

b. The Permittee shall comply with the emission limits in the following table for the group of permitted natural gas engines:

[A.A.C. R18-2-306.01]

Pollutant	Lb/hr	Ton/year
NOx	37.4	163.9
CO	16.6	72.8
VOC	19.3	84.3
$PM_{10}/PM_{2.5}$	**7.72**	**33.8**

For purposes of compliance with these limits, when calculating emissions of volatile organic compounds, emissions of formaldehyde should not be included.

4. Compliance Requirements

d. The Permittee shall program **and monitor** ~~**interlocks on**~~ the natural gas engines to ensure they operate **within the range set by Condition IV.B.2.b** ~~**at 50**~~**75% to 100%** ~~**load**~~ except during startup and shutdown **and maintenance allowed pursuant to Condition IV.B.2.b**. **The Permittee shall record each incidence of startup, shutdown, specified maintenance, each incidence of SCR unit validation, and the date, time, duration and justification for any operation pursuant to Condition IV.B.2.c for life safety reasons.**

[A.A.C. R18-2-306.01 and -331.A.3.a]

(1) "Program and monitor" means that the Permittee shall ensure that the units are programmed to inject **aqueous urea solution** when operating above 50% load after achieving the manufacturer's SCR catalyst target temperature**, monitor and record the hourly average loads,** and will alarm if the average load drops below 50% **or 75% load, as applicable**. Similarly, the system shall provide alarms if the control unit temperature drops below 350°C and 200°C.

(2) The Permittee shall take corrective action upon receiving an alarm to prevent, to the extent reasonably possible:

a. The hourly average load from dropping below 50% **or 75%** load, **as applicable**. An hourly average load below 50% **or 75%** shall be counted as a permit deviation for the hour.

b. The hourly average temperature of the control unit falling below 350°C. An hourly average load below 350°C is a deviation for the SCR unit and below 200°C is a deviation for the oxidation catalyst unit.

[A.A.C. R18-2-306.01 and -331.A.3.a]

e. The Permittee shall demonstrat~~ion~~ compliance with Condition IV.B.3.b as follows:

(1) In lieu of Condition IV.B.4.e.(1), each time an engine is installed or a performance test completed, the Permittee shall demonstrate compliance with the lb/hr limit in Condition IV.B.3.b as follows:

(a) For the up to 14 engines allowed to operate in the 50-100% load range, the Permittee shall calculate lb/hr emissions for each pollutant subject to a Condition IV.B.3.b limit by using the highest emissions obtained from the low, medium, moderate or high load (as defined in Condition IV.B.5.c) emission factor, in lb/MWh multiplied by the upper end MWh of each range (using nameplate as the upper end for the high load range), and multiplying this value by the number of engines logged as operating in the 50 to 100% load range.

(b) For the remaining engines operating in the 75 to 100% load range, the Permittee shall calculate the lb/hr emissions for each pollutant subject to a Condition IV.B.3.b limit by using the highest emissions obtained from the moderate or high load (as defined in Condition IV.B.5.c) emission factor, in lb/MWh multiplied by the upper end MWh of each range (using nameplate as the upper end for the high load range), and multiplying this value by the number of engines logged as operating in the 75 to 100% load range.

(c) Compliance is demonstrated if the sum of emissions for each pollutant for all engines under paragraphs (a) and (b), in lb/hr, is less than the limit for that pollutant in Condition IV.B.3.b.

(2) In lieu of Condition IV.B.4.e.(2), the Permittee shall demonstrate compliance with the tons/year limit in Condition IV.B.3.b as follows by the fifth working day of the month for the preceding month:

(a) For each pollutant for each engine, calculate hourly emissions as follows:

(i) For each operating hour, multiply the MWh in that hour by the applicable load emission factor, in lb/MWh, as determined in Condition IV.B.5.c;

(ii) For each hour in which a startup event occurs, for NOx, substitute 3.34 lbs/hour; for CO add 1.68 lbs; for VOC add 0.54 lbs. For each hour in which a shutdown event occurs, for NOx substitute 1.69 lbs/hr; for CO add 0.36 lbs; for VOC add 0.08 lbs. If both a startup and shutdown occur in the same hour, for NOx substitute 4.17 lbs/hour and for CO and VOC add emissions as specified.

(iii) For any period in which the engine is running but not in startup, shutdown or malfunction, and the associated control device is off-line as allowed under Condition IV.B.2, substitute the following values: For SCR offline, substitute 3.11 lb/MW-hr; for oxidation catalyst offline, substitute 6.22 lb/MW-hr for CO and 2.18 lb/MW-hr for VOC.

(b) Sum all the hourly emissions for each pollutant for each engine for the month.

(c) Sum the hourly emissions for each pollutant from all installed engines for the month and divide by 2000.

(d) Sum the 12 prior consecutive months for each pollutant for all installed engines. Compliance is demonstrated if the the calculated value is less than the limit for that pollutant in Condition IV.B.3.b.

5. Testing Requirements

c. **Within 60 days of achieving maximum production after the issuance of SPR No. ____, but no later than 180 days after the initial startup, whichever occurs first, the Permittee shall conduct a performance test on one engine with each different control configuration for NOx, CO, VOC, PM_{10} and $PM_{2.5}$ emissions using EPA Methods 7E, 10, 25A, 5, 201A and Method 202, or an EPA-approved alternative method.** The performance test shall be conducted with at least one run at 50% load or slightly higher; one run at approximately 75% load, and one run at the maximum achievable load, where load percent is defined as the gross MWh generated during the run divided by the generator nameplate capacity for the run period. Each run shall last at least one hour. The Permittee shall record the heat input, in MMBtu/hr, and the energy output, in gross megawatt hour (MWh), during each run. **The performance test report shall set forth the load, in percent, PM10 and PM2.5 emissions in lbs/hr and lbs/MWh for PM_{10}/$PM_{2.5}$, the emissions from each run (or group of runs) at 50%, 75% and maximum achievable load. The report shall calculate and report the following emission factors for NOx, CO, VOC, PM_{10} and $PM_{2.5}$:**

[A.A.C. R18-2-312]

(1) For low load (any load less than 50%), the emission factor shall be the 50% test value in lb/MWh;

(2) For medium load (any load of 50% or greater, but less than 75%), the emission factor shall be the average of the 50% and 75% test values in lb/MWH;

(3) For moderate load (any load of 75% or greater, but less than the maximum achieved load), the emission factor shall be the average of the 75% and maximum achieved load test values in lb/MWh; and

(4) For high load (any load at or above the maximum achieved load), the emission factor shall be the maximum achieved load test value in lb/MWh.