Ms. Suna Yi Sariscak
Manager, Air Quality Permits Program
Air and Radiation Administration
Maryland Department of the Environment
1800 Washington Boulevard, Suite 720
Baltimore, MD 21230

RE: ***Permit to Construct Application for Emergency Generators – Amazon Data Services, Inc. BWI-150, BWI-151, BWI-152, and BWI-153 Data Centers***

To Ms. Sariscak,

Amazon Data Services, Inc (Amazon) is submitting the enclosed application for a Permit to Construct for ninety-nine diesel-fired emergency generators to be located at a planned data center in Frederick County, Maryland. The data centers will be identified as BWI-150, BWI-151, BWI-152, and BWI-153. The enclosed application contains the following documentation:

- Application Narrative;
- Maryland Department of the Environment (MDE) Permit to Construct Forms 6 and 42;
- Detailed Potential Emissions Calculations;
- Specification Sheets for the Proposed Emergency Generators;
- Letter to Confirm Proper Zoning;
- Facility Map;
- Confirmation of Noise Compliance;
- Environmental Justice (EJ) Screening Report;
- Renewable Diesel Fuel Information;
- Fuel Meter Accuracy Information; and
- New Source Performance Standards Emissions Certifications.

If you have any questions on the application, please do not hesitate to contact Blake Carruthers at (940) 704-1439 or bcarrut@amazon.com.

Sincerely,

Signed by:
Robb Truedinger
83B51630A138463...

Robert Truedinger
Authorized Representative
Amazon Data Services, Inc.

Enclosures

PERMIT TO CONSTRUCT APPLICATION

Amazon Data Services, Inc. / BWI-150, BWI-151, BWI-152, and BWI-153

Prepared By:

TRINITY CONSULTANTS
5320 Spectrum Dr.
Suite A
Frederick, MD 21703
240.379.7490

October 2024

Project 242101.0081

Trinity Consultants

TABLE OF CONTENTS

LIST OF TABLES

1. EXECUTIVE SUMMARY

Amazon Data Services, Inc. (Amazon) is proposing to construct a data center in Frederick County, Maryland identified as BWI-150, BWI-151, BWI-152, and BWI-153 (the facility). Frederick County is designated as a nonattainment area for ozone and is also part of the Ozone Transport Region (OTR). Nitrogen oxides (NO_X) and volatile organic compounds (VOC) are regulated precursors for ozone in Maryland. Emissions from this facility are due to diesel fuel combustion in the emergency generators.[1]

In this application, Amazon is proposing a site-wide emissions limit for all the stationary diesel-fired emergency generators to limit the facility-wide potential to emit (PTE) to below the applicable major source thresholds for the New Source Review (NSR) and Title V permitting programs. As such, this facility will be classified as a synthetic minor source under both the NSR and Title V programs.

This application is to the Maryland Department of the Environment (MDE) for a Permit to Construct. The remainder of this application consists of the following parts:

- Section 2: Description of the facility and emission units
- Section 3: Describes the emission calculation methodology
- Section 4: Details potentially applicable regulations for this facility
- Appendix A: MDE Forms 6 and 42
- Appendix B: Detailed emission calculations
- Appendix C: Manufacturer specification and emission sheets
- Appendix D: Noise Study
- Appendix E: MDE Environmental Justice Screening Report
- Appendix F: Zoning Letter
- Appendix G: Facility Map
- Appendix H: Renewable Diesel Fuel Information
- Appendix I: Fuel Accuracy Information
- Appendix J: New Source Performance Standards Emissions Certifications

[1] "Diesel" is used to generally refer to both traditional diesel fuel and renewable diesel fuel throughout this application.

2. DESCRIPTION OF FACILITY

Emission units at the proposed facility will consist of diesel-fired emergency generators to be located at multiple buildings within the data center campus. Appendix G provides a map of the proposed facility and Table 2-1 provides a listing of proposed emission units.

Table 2-1. Proposed Emission Units

Emission Unit Number	Manufacturer	Model Number	Count	Fuel	Generating Capacity (kW)
EG1-EG92	Caterpillar	3516E	92	Diesel	2,750
EG93-EG98	Caterpillar	C18	6	Diesel	750
EG99[2]	Caterpillar	C9	1	Diesel	250

Each of the 2,750 kW generators (EG1 through EG92) will be equipped with a closed-loop selective catalytic reduction (SCR) system for controlling NOx emissions along with a catalyzed diesel particulate filter (DPF) for controlling particulate, carbon monoxide (CO) and volatile organic compound (VOC) emissions. There are multiple candidate emissions controls for the Caterpillar Model 3516E engine-generators. Controlled emissions are calculated using the engine-generator manufacturer's specifications and a control efficiency that all candidate emission controls are capable of meeting.

The emergency generators are composed of two distinct parts, the diesel engine and associated electric generator. These generators are used to supply power to protect critical data center functions if off-site power is lost. The diesel-fired engines will be powered by ultra-low sulfur diesel (ULSD) or renewable diesel. The proposed renewable diesel meets the sulfur content requirements for ULSD and meets the requirement under ASTM D975 to be considered diesel fuel. Example specifications for two potential suppliers of renewable diesel are provided in Appendix H. Without controls, the emergency generators are certified as meeting the United States Environmental Protection Agency (U.S. EPA) Tier 2 emission standards. Each engine will be equipped with an individual belly tank for storage of fuel.

[2] EG99 is exempt from obtaining a Permit to Construct per COMAR 26.11.02.10E. However, Amazon is including this engine to ensure compliance with synthetic minor limitations.

3. EMISSION CALCULATIONS

This section describes the methodology used to quantify potential emissions of the facility. Emissions from the facility are primarily from the combustion of fuel in the diesel-fired engines. These emissions include the following:

- Nitrogen oxides (NO_X)
- Carbon monoxide (CO)
- Volatile organic compounds (VOC)
- Sulfur dioxide (SO_2)
- Particulate matter (PM)
- Particulate matter less than 10 microns in diameter (PM_{10})
- Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$)
- Hazardous air pollutants (HAPs)
- Greenhouse gases (GHGs)

Detailed emission calculations are included in Appendix B.

3.1 Emergency Generator Emissions Calculation Methodology

To quantify emissions from the diesel-fired engine-driven emergency generators, Amazon is using exhaust emission data from the equipment manufacturer for the engine model and emissions controls, emission factors from U.S. EPA's AP-42, Section 3.4, Large Stationary Diesel and All Stationary Dual-fuel Engines (October 1996), and Title 40 of the Code of Federal Regulations (40 CFR) Part 98. The manufacturer data includes emission factors in mass per power output per hour (i.e., grams per brake horsepower hour or g/BHP-hr) at various operating loads. Emissions for CO, NO_X, VOC, PM, PM_{10}, and $PM_{2.5}$ are calculated using emission factors from the unit manufacturer for uncontrolled operation. Controlled emissions are calculated using the engine-generator manufacturer's specifications and a control efficiency that all candidate emission controls are capable of meeting. It is assumed that the manufacturer emission specifications include both condensable and filterable particulate matter. Emissions of SO_2 and HAPs are calculated using the appropriate emission factors from AP-42, Section 3.4 and GHGs using the appropriate emission factors from 40 CFR Part 98.

Ninety-two (92) of the stationary emergency generators are Caterpillar Model 3516E each of which power a generator with an electrical output rating of 2,750 kW. Six (6) of the stationary emergency generators are Caterpillar Model C18 each of which power a generator with an electrical output rating of 750 kW. The remaining stationary emergency generator is a Caterpillar Model C9 which powers a generator with an electrical output rating of 250 kW. The engine manufacturer emission specification sheets for each engine model and information on the control device are included in Appendix C.

To calculate the PTE for all pollutants, the fuel throughput limit is multiplied by an emission factor in pound per gallon (lb/gal) of fuel input. The PTE for each pollutant from all generators is calculated using the highest emission factor for each engine type across all load levels. The facility-wide PTE is calculated by using the worst-case scenario of fuel usage by all engine-generator models.

The following steps are used to calculate the emission factors for each pollutant in lb/gal:

1. The manufacturer or AP-42 emission factors (in units of g/BHP-hr, pounds per horsepower hour [lb/BHP-hr]) are multiplied by the manufacturer specified engine rating in horsepower (hp) to determine an emission factor in units of g/hr or lb/hr.

2. Each emission factor in terms of g/hr or lb/hr is divided by manufacturer's specified fuel consumption rate in gallons per hour (gal/hr).

3. Emission factors in units of g/gal are converted to lb/gal.

Amazon is proposing facility-wide emission limits as shown in Table 3-1 to qualify as a synthetic minor source under both the NSR and Title V programs. Amazon will demonstrate compliance with these limits by monitoring fuel consumption and using the lb/gal emission factors for each model engine-generator in Table B-2 of Appendix B. The potential emissions shown per engine-generator model throughout this application are based on estimated fuel usage split between controlled and uncontrolled operation of the Caterpillar 3516E engine-generators. Amazon is not requesting these emissions or fuel usages as limits in the permit to allow for operational flexibility.

Table 3-1. Proposed Synthetic Minor Emission Limits

Pollutant	Proposed Facility-Wide Emission Limit
CO	8.8
NO_2	24.3
NO_X	24.3
VOC	2.4
PM	0.6
PM_{10}	0.6
$PM_{2.5}$	0.6

Each generator will also be limited to 100 hours per year for maintenance, testing, and nonemergency operation in accordance with U.S. EPA regulations (refer to Section 4).

Amazon proposes to demonstrate compliance with the proposed limits by tracking actual fuel usage in the generators and using emission factors in units of pounds of pollutant emissions per gallon of diesel fuel (lb/gal). These emission factors are provided in Table B-2 of Appendix B.

Amazon's proposed emission and operating limits are protective of the major source threshold. The major source threshold for NO_X is 25 tpy. As shown in Appendix I, the generator manufacturer guarantees a fuel meter accuracy of ±3%. Accordingly, Amazon has proposed a NO_X limit of 24.3 tpy which allows for an additional 3% without exceeding the NO_X major source threshold. In addition, all emissions calculations are conservatively based on manufacturer's not-to-exceed emissions data.

The proposed emission limits account for all manufacturer-required maintenance and readiness testing and stack testing as required by MDE, and reasonably foreseeable emergency operation. The estimated fuel consumption usage for controlled operation is based on 25 hours per year per generator at 100% load. The estimated fuel consumption usage for uncontrolled operation is equivalent to approximately 7.4 hours per year per generator at 100% load. Maintenance checks and readiness testing is expected to be less than 10 hours per year per generator, much of which is done at no load and during load testing or emergencies, the generators typically operate at 75 to 80% load. As such, the estimated fuel consumption usage leaves several hours of operation available for emergencies.

4. REGULATORY APPLICABILITY

This facility is subject to both federal air regulations and Maryland state air regulations. This section summarizes the various air regulatory requirements that potentially apply to the facility. The applicability of NSR, Title V, New Source Performance Standards (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAP), and Maryland state air regulations is addressed below.

4.1 Major New Source Review Applicability

Major NSR applicability is based on a stationary source's PTE. The PTE of a source can account for the effects of a proposed air pollution control device, as well as a proposed enforceable facility-wide emission limit on specific pollutants. The PTE from this facility is equivalent to the proposed emission limits for the facility.

Frederick County, where this facility will be constructed, has been designated as nonattainment for ozone, as well as being part of the OTR. In areas designated nonattainment or part of the OTR, the major NSR program that applies is nonattainment New Source Review (NNSR) for the pollutant(s) that the area is designated as in nonattainment (i.e., NO_X and VOC as ozone precursors). For pollutants other than NO_X, VOC, the major NSR program that applies is Prevention of Significant Deterioration (PSD). To determine if this facility is subject to NNSR or PSD, the site-wide PTE is compared with the NNSR definition of Major Stationary Source from Title 26 of the Code of Maryland Regulations Subtitle 11 Chapter 17 Section 01 (COMAR 26.11.17.01) for NO_X and VOC and the PSD definition of Major Stationary Source from 40 CFR 52.21, which is incorporated into COMAR 26.11.06.14 by reference. Table 4-1 shows that this project does not trigger NNSR or PSD as it does not meet the definition of a major stationary source.

Table 4-1. Major NSR Applicability

Pollutant	Facility Wide PTE (tpy)	Major Stationary Source Threshold (tpy)	Major NSR Program	Above Threshold?
CO	8.8	250	PSD	No
NO_2	24.3	250	PSD	No
NO_X	24.3	25	NNSR	No
VOC	2.4	25	NNSR	No
SO_2	0.1	250	PSD	No
PM	0.6	250	PSD	No
PM_{10}	0.6	250	PSD	No
$PM_{2.5}$	0.6	250	PSD	No

4.2 Title V Applicability

Per COMAR 26.11.03.01A(1), major sources in Maryland are required to obtain a Title V Operating Permit. For the purposes of the Title V permitting program, the major source thresholds are found in COMAR 26.11.02.01C. Table 4-2 provides the applicable major source thresholds compared to facility potential emissions. As shown in Table 4-2, the facility is not subject to Title V permitting. This facility will be classified as a synthetic minor source for Title V due to the proposed limits on 12-month rolling facility-wide NO_x emissions and corresponding fuel usage limits.

Table 4-2. Title V Applicability

Pollutant	Facility-Wide PTE (tpy)	Title V Applicability Threshold (tpy)	Above Threshold?
CO	8.8	100	No
NO_X	24.3	25	No
VOC	2.4	25	No
SO_2	0.1	100	No
PM	0.6	100	No
PM_{10}	0.6	100	No
$PM_{2.5}$	0.6	100	No
Single HAP	<0.1	10	No
Total HAP	<0.1	25	No

4.3 New Source Performance Standards

NSPS, promulgated in 40 CFR 60, require new, modified, or reconstructed sources to control emissions to the level achievable by the best-demonstrated technology as specified in the applicable provisions. The following section details the applicability of NSPS regulations to the proposed facility.

4.3.1 40 CFR 60 Subpart A – General Provisions

All affected sources subject to a source-specific NSPS are subject to the general provisions of NSPS Subpart A unless specifically excluded by the source-specific NSPS. Subpart A requires initial notification, performance testing, recordkeeping and monitoring, provides reference methods, and mandates general control device requirements for all other subparts as applicable.

4.3.2 40 CFR 60 Subpart Kb – Volatile Organic Liquid Storage Vessel

NSPS Subpart Kb applies to storage vessels with a capacity greater than or equal to 75 cubic meters (approximately 19,800 gallons) used to store volatile organic liquids with a maximum true vapor pressure greater than 15 kilopascals (kPa) that were constructed after July 23, 1984. All tanks being installed at the facility are below the applicability threshold of 19,800 gallons, and each will store diesel fuel or renewable diesel fuel which has a maximum true vapor pressure less than 1 kPa. Therefore, Subpart Kb is not applicable to any of the proposed storage tanks at the facility.

4.3.3 40 CFR 60 Subpart IIII – NSPS for CI Internal Combustion Engines

This NSPS applies to owners and operators of stationary compression ignition (CI) internal combustion engines (ICE) that are not fire pumps and are manufactured after April 1, 2006; fire pumps that are manufactured after July 1, 2006; and CI ICEs that are modified or reconstructed after July 11, 2005. The proposed diesel-fired emergency generators are subject to this NSPS because each unit has an associated CI ICE manufactured after 2006. Units subject to this subpart are also subject to the provisions of 40 CFR 60 Subpart A, except where expressly noted.

NSPS Subpart IIII has specific requirements based on several criteria, including model year, engine displacement, and status as a fire pump. Amazon will operate all proposed engines to meet the definition of emergency generator per 40 CFR 60.4219. The engines powering the generators are newly constructed after 2006, are emergency CI ICE, and have displacements less than 30 liters per cylinder. Per 40 CFR 60.4205(b) and 40 CFR 60.4202(a)(2), engines must meet the emission standards for either Tier 2 or Tier 3 engines. Both emission standards are outlined in 40 CFR 89.112 and 40 CFR 1039, Appendix I. Further, per 40 CFR 60.4205(b) and 40 CFR 60.4202(a)(2), each engine must meet the opacity standards in 40 CFR 89.113 and 40 CFR 1039.105. The engine-generators are certified as meeting their respective Tier 2 or Tier 3 standards under 40 CFR 89.112 and 40 CFR 1039, Appendix I. The proposed control devices are not intended for NSPS compliance.

Per 40 CFR 60.4207(b), all engines must use non-road diesel fuel with a maximum sulfur content of 15 ppm. As the units are fueled using either ULSD, which by definition has a maximum sulfur content of 15 ppm, or renewable diesel, which also meets the sulfur requirement and is defined as diesel per ASTM D975 as shown in Appendix H, the units meet this requirement.

Per 40 CFR 60.4209(a), each emergency unit must have installed a non-resettable hour meter prior to startup of the engine. The proposed generators will have hour meters prior to startup. To maintain the emergency stationary reciprocating internal combustion engine (RICE) classification, the RICE must meet the operational requirements of 40 CFR 60.4211(f).

4.4 National Emission Standards for Hazardous Air Pollutants

NESHAP, located in 40 CFR 61 and 63, have been promulgated for source categories that emit HAPs. A facility that is a major source of HAP is defined as having potential emissions greater than 25 tpy of total HAPs or 10 tpy of any single HAP. Facilities with a potential to emit HAPs at an amount less than these major source thresholds are considered area sources. The facility has potential HAP emissions below the major source thresholds and is, therefore, an area source for HAP.

The NESHAP allowable emissions limits are most often established on the basis of a maximum achievable control technology (MACT) determination for the particular source. The determination of applicability to NESHAP requirements are detailed in the following sections.

4.4.1 40 CFR 63 Subpart A – General Provisions

All affected sources subject to an industrial source category NESHAP are also subject to the provisions of 40 CFR 63 Subpart A unless specifically excluded by the source-specific NESHAP.

4.4.2 40 CFR 63 Subpart ZZZZ – NESHAP for Stationary RICE

The RICE MACT is the common reference to the NESHAP for Reciprocating Internal Combustion Engines (RICE). The rule is codified in 40 CFR 63 Subpart ZZZZ. The RICE MACT applies to both area and major sources of HAPs. The proposed generators at BWI-150 are stationary RICE constructed after June 12, 2006. These generators meet the area source requirements of the RICE MACT by meeting NSPS Subpart IIII. There are no further requirements for compliance under 40 CFR 63 Subpart ZZZZ besides compliance with 40 CFR 60 Subpart IIII.

4.5 Maryland State Regulatory Applicability

Maryland's air quality regulations are codified under COMAR 26.11. These regulations, where potentially applicable to the facility, have been reviewed in this section. The regulations are not discussed in detail where the facility is categorically exempt, or where general regulations are not specific to the proposed operations.

4.5.1 COMAR 26.11.02.09 - Source Subject to Permits to Construct and Approvals

This regulation applies to the construction or modification of potential air emission sources. Air Quality Permits to Construct are required before construction or modification can begin for various source types. The emergency generators require a Permit to Construct since they do not meet any of the exemption criteria in COMAR 26.11.02.10. Submittal of this permit application meets the requirements of this section. The emergency generators under this project do not meet the definition of a "generating station" under the Maryland Public Service Commission (PSC) Certificate of Public Convenience and Necessity (CPCN) process since they are emergency backup units to be used at a critical infrastructure site and will have equipment installed that prevents the flow of electricity produced by the generators to the grid. In addition, the facility will comply with all applicable regulations regarding noise levels (refer to Appendix D) and testing hours. As such, the generators do not require a CPCN or formal CPCN exemption from the PSC and this application is being submitted directly to MDE.

Per COMAR 26.11.02.10E, the Caterpillar C9 generator does not require a Permit to Construct since it is rated below 373 kW. However, Amazon is including this unit in the Permit to Construct application to include emissions under the requested synthetic minor limitations.

Per COMAR 26.11.02.10Q(6), tanks used for storage of No. 2 fuel oil do not require a Permit to Construct. As such, the fuel storage tanks for this facility are not required to obtain a Permit to Construct and are therefore not included in this application.

4.5.2 COMAR 26.11.06.08 & 26.11.06.09 – Nuisance and Odors

COMAR 26.11.06.08 and COMAR 26.11.06.09 establish general provisions for the control of nuisances and odor, respectively. The facility will be subject to these general requirements.

4.5.3 COMAR 26.11.09.05 – Control of Fuel Burning Equipment and Stationary Internal Combustion – Visible Emissions

The diesel-fired generators will be subject to COMAR 26.11.09.05E which limits visible emissions to 10 percent when operating at idle and to 40 percent when operating at conditions other than idle. These limits do not apply while maintenance, repair, or testing is being performed by qualified mechanics. The 10 percent limit for idling does not apply for a period of two consecutive minutes after a period of idling of 15 consecutive minutes for the purpose of clearing the exhaust system. The 10 percent limit also does not apply to emissions resulting directly from cold engine start-up and warm-up for a maximum of 30 minutes if engine is idle continuously when not in service or a maximum of 15 minutes for all other engines.

4.5.4 COMAR 26.11.09.07 – Control of Sulfur Oxides from Fuel Burning Equipment

This regulation establishes limits for SO_x emissions from fuel burning equipment. Amazon will comply with a limit of 0.3 percent sulfur content in diesel fuel/renewable diesel burned in the generator per COMAR 26.11.09.07A(2)(b) by complying with 40 CFR 60.4207(b), as discussed in Section 4.3.3.

4.5.5 COMAR 26.11.15 & 26.11.16 – Toxic Air Pollutants (Not Applicable)

These regulations establish requirements for sources that emit Toxic Air Pollutants (TAPs). The proposed emissions sources requiring a Permit to Construct at the facility are all fuel burning equipment which are exempt from the TAP regulations as specified in COMAR 26.11.15.03B(2)(a).

4.5.6 COMAR 26.11.36 – Distributed Generation

COMAR 26.11.36.03 contains requirements for all stationary engines which will apply to the proposed diesel-fired generators. Under this regulation, the engines will need to meet the requirements under 40 CFR 60 Subpart IIII or 40 CFR 60 Subpart JJJJ. Refer to Section 4.3.3 for applicable requirements under 40 CFR 60 Subpart IIII. 40 CFR 60 Subpart JJJJ does not apply to diesel-fired engines.

5. MONITORING & RECORDKEEPING

To ensure compliance with the limits proposed in this application, Amazon proposes the following monitoring and recordkeeping practices:

- Amazon will follow the manufacturer's operation and maintenance (O&M) requirements for each generator and emissions control system and maintain records of all maintenance.[3] Manufacturer O&M manuals can be provided upon request.
- Each emergency generator will be equipped with a non-resettable hour meter.
  - Hours of operation will be rolled up monthly to 12-monthly rolling total hours of operation per generator.
  - Each run reason will be identified as maintenance/testing, emergency, etc. to demonstrate compliance with emergency generator operating restrictions.
- Each generator will be equipped with a fuel usage meter.
  - This data will be rolled up monthly into a 12-month rolling fuel usage for each generator and a facility-wide total.
  - Data from the SCR will be used to identify controlled versus uncontrolled fuel usage.
- Each emission control system will monitor the following:
  - NO_X concentration after the catalyst
    - Note that NO_X sensors are meant to ensure proper SCR operation and are not calibrated for use as a continuous emissions monitor or for determining compliance with NO_X emission rates.
  - Differential pressure across the combined emission control system
  - Catalyst bed outlet temperature
    - The SCR will be a closed loop design and equipped with a temperature probe to continuously monitor the catalyst bed exhaust temperature. The SCR will begin injection at a catalyst bed exhaust temperature of 572°F. This temperature ensures proper urea hydrolysis within the mixing section.
  - If any of the sensors is out of the manufacturer's suggested operating range, an alarm will sound to alert operators.
- To demonstrate compliance with the NO_X synthetic minor limit:
  - Amazon will use the monitored fuel usages and pound per gallon (lb/gal) emission factors (refer to Table B-2 of Appendix B) to calculate monthly NO_X emissions.
  - Facility-wide emissions will be calculated monthly and 12-month rolling total emissions will be used to demonstrate compliance.
- Amazon will conduct stack testing as required by MDE to demonstrate compliance with the short-term emission rates provided in this application. Amazon will conduct testing based on the number of generators and pollutants identified by MDE in the Permit to Construct.

[3] O&M manuals can be provided to MDE if requested. O&M manuals will be maintained onsite.

APPENDIX A. MDE FORMS 6 AND 42

MARYLAND DEPARTMENT OF THE ENVIRONMENT

1800 Washington Blvd ▪ Baltimore, Maryland 21230
(410) 537-3230 ▪ 1-800-633-6101 ▪ www.mde.state.md.us

Air and Radiation Management Administration ▪ Air Quality Permits Program

Application for Permit to Construct
Gas Cleaning or Emission Control Equipment

1. Owner of Installation Amazon Data Services, Inc.	**Telephone No.** (940) 704-1439		**Date of Application** October 2024
2. Mailing Address 13820 Sunrise Valley Drive	**City** Herndon	**Zip Code** 20171	**County** Fairfax
3. Equipment Location 3250 Digital Drive	**City/Town or P.O.** Frederick		**County** Frederick
4. Signature of Owner or Operator Signed by: Robb Truedinger 83D51630A138463...	**Title** Authorized Representative		**Print or Type Name** Robert Truedinger

5. Application Type: **Alteration** [ ] **New Construction** [X]

6. Date Construction is to Start: TBD

Completion Date (Estimate): May 2025 (gens land)

7. Type of Gas Cleaning or Emission Control Equipment:

Simple Cyclone [ ] **Multiple Cyclone** [ ] **Afterburner** [ ] **Electrostatic Precipitator** [ ]

Scrubber [ ] _____ (type) **Other** [X] Selective Catalytic Reduction (SCR) Systems for NOx, and catalyzed diesel particulate filters (DPF) for particulate, CO, and VOC (type)

8. Gas Cleaning Equipment Manufacturer TBD **Model No.** TBD

Collection Efficiency (Design Criteria) Control efficiencies are as follows: NOx is 91.7%, CO is 70%, VOC is 45%, and PM10 is 68.6%

9. Type of Equipment which Control Equipment is to Service:

Emergency generators. One (1) SCR System and DPF per 2,750 kW emergency generator (92 total).

10. Stack Test to be Conducted:

Yes [ ] **No** [X] As requested by MDE (Stack Test to be Conducted By) _____ (Date)

11. Cost of Equipment TBD

Estimated Erection Cost TBD

12. The Following Shall Be Design Criteria:

	INLET	OUTLET
Gas Flow Rate	22,051.6 ACFM*	22,051.6 ACFM*
Gas Temperature	897 °F	897 °F
Gas Pressure	___ INCHES W.G.	INCHES W.G.

PRESSURE DROP ____<= 40.2 in-Hg

Dust Loading	TBD GRAINS/ACFD**	TBD GRAINS/ACFD**
Moisture Content OR Wet Bulb Temperature	TBD %	TBD %
	____ °F	____ °F

Liquid Flow Rate _____ GALLONS/MINUTE
(Wet Scrubber)

(WHEN SCRUBBER LIQUID OTHER THAN WATER INDICATE COMPOSITION OF SCRUBBING MEDIUM IN WEIGHT %)

*= ACTUAL CUBIC FEET PER MINUTE **= ACTUAL CUBIC FEET DRY

WHEN APPLICATION INVOLVES THE REDUCTION OF GASEOUS POLLUTANTS, PROVIDE THE CONCENTRATION OF EACH POLLUTANT IN THE GAS STREAM IN VOLUME PERCENT. INCLUDE THE COMPOSITION OF THE GASES ENTERING THE CLEANING DEVICE AND THE COMPOSITION OF EXHAUSTED GASES BEING DISCHARGED INTO THE ATMOSPHERE. USE AVAILABLE SPACE IN ITEM 15 ON PAGE 3.

13. Particle Size Analysis

Size of Dust Particles Entering Cleaning Unit	% of Total Dust	% to be Collected
0 to 10 Microns	_____	_____
10 to 44 Microns	_____	_____
Larger than 44 Microns	_____	_____

14. For Afterburner Construction Only:

Volume of Contaminated Air _____ CFM (DO NOT INCLUDE COMBUSTION AIR)

Gas Inlet Temperature _____ °F

Capacity of Afterburner _____ BTU/HR

Diameter (or area) of Afterburner Throat_____

Combustion Chamber_____ _____ Operating Temperature at Afterburner _____ °F
(diameter) (length)

Retention Time of Gases _____

15. Show Location of Dust Cleaning Equipment in the System. Draw or Sketch Flow Diagram Showing Emission Path from Source to Exhaust Point to Atmosphere.

NA

Date Received: Local _____ _____ **State** _____

Acknowledgement Date: _____

By _____

Reviewed By:

Local _____

State _____

Returned to Local:

Date_____

By _____

Application Returned to Applicant:

Date_____

By _____

REGISTRATION NUMBER OF ASSOCIATED EQUIPMENT: ☐ ☐☐☐☐

PREMISES NUMBER: ☐☐ ☐☐☐☐

Emission Calculations Revised By _____ **Date** _____

AIR QUALITY PERMIT TO CONSTRUCT
APPLICATION CHECKLIST

OWNER OF EQUIPMENT/PROCESS	
COMPANY NAME:	Amazon Data Services, Inc.
COMPANY ADDRESS:	13820 Sunrise Valley Drive Herndon, VA 20171
LOCATION OF EQUIPMENT/PROCESS	
PREMISES NAME:	BWI-150, BWI-151, BWI-152, BWI-153
PREMISES ADDRESS:	3250 Digital Drive, Frederick, MD 21703
CONTACT INFORMATION FOR THIS PERMIT APPLICATION	
CONTACT NAME:	Blake Carruthers
JOB TITLE:	Air Quality Engineer
PHONE NUMBER:	940.704.1439
EMAIL ADDRESS:	bcarrut@amazon.com
DESCRIPTION OF EQUIPMENT OR PROCESS	
92 emergency generators rated at 2,750 kW with Selective Catalytic Reduction (SCR) Systems and catalyzed diesel particulate filters (DPFs), 6 emergency generators rated at 750 kW, and 1 emergency generator rated at 250 kW	

Application is hereby made to the Department of the Environment for a Permit to Construct for the following equipment or process as required by the State of Maryland Air Quality Regulation, COMAR 26.11.02.09.

Check each item that you have submitted as part of your application package.

☒ Application package cover letter describing the proposed project

☒ Complete application forms (Note the number of forms included or NA if not applicable.)

No. **N/A** Form 5
No. **N/A** Form 5T
No. **N/A** Form 5EP
No. **1** Form 6
No. **N/A** Form 10
No. **N/A** Form 11
No. **N/A** Form 41
No. **3** Form 42
No. **N/A** Form 44

☒ Vendor/manufacturer specifications/guarantees

☐ Evidence of Workman's Compensation Insurance

☐ Process flow diagrams with emission points

☒ Site plan including the location of the proposed source and property boundary

☒ Material balance data and all emissions calculations

☐ Material Safety Data Sheets (MSDS) or equivalent information for materials processed and manufactured.

☐ Certificate of Public Convenience and Necessity (CPCN) waiver documentation from the Public Service Commission (1)

☒ Documentation that the proposed installation complies with local zoning and land use requirements (2)

(1) Required for emergency and non-emergency generators installed on or after October 1, 2001 and rated at 2001 kW or more. Generators providing backup power to critical infrastructure are exempt from the CPCN process.

(2) Required for applications subject to Expanded Public Participation Requirements.

MARYLAND DEPARTMENT OF THE ENVIRONMENT

Air and Radiation Management Administration ● Air Quality Permits Program
1800 Washington Boulevard ● Baltimore, Maryland 21230
(410)537-3230 ● 1-800-633-6101● www.mde.state.md.us

Mail application to

MDE/ARMA
1800 Washington Blvd, Suite 720
Baltimore, MD 21230-1720

Air Quality Permit to Construct & Registration Application for

EMERGENCY GENERATOR

You must check off all of the following items to be able to use this application form

☒ This generator is a dedicated emergency backup generator, and will not be used for peak or load shaving.
☒ This generator is powered by an internal combustion engine, not a turbine
☒ This generator's engine is at least 500 brake horsepower (373 kilowatts)
(Smaller emergency engines do not need a permit)

AND

You must check off one of the following items to be able to use this application form*

☐ I do not need a CPCN Exemption because the generator is rated at 2000 kW or less
☐ I do not need a CPCN Exemption because the generator was installed before October 1, 2001
☐ I have a CPCN Exemption from the Public Service Commission for this generator
(Contact the Public Service Commission at 410.767.8131)

* N/A. Generators providing backup power to critical infrastructure are exempt from the CPCN process.

1) Business/Institution/Facility where the equipment will be located ☐ **Check if this is a federal facility**

Business/Institution/Facility Name: BWI-150, BWI-151, BWI-152, BWI-153 Phone: (940) 704-1439

Contact Person's Name: Blake Carruthers Email Address: bcarrut@amazon.com

Street Address: 3250 Digital Drive

City: Frederick State: Maryland Zip Code: 21703 County: Frederick

2) Owner ☒ **Check if different from above. If checked, complete the following:**

Name: Amazon Data Services, Inc. Phone: (940) 704-1439

Mailing Address: 13820 Sunrise Valley Drive

City: Herndon State: VA Zip Code: 20171

3) Installer ☒ **Check if different from above. If checked, complete the following:**

Contact Name: TBD Contact Company: TBD Phone: TBD

4) Equipment Information

Manufacturer / Model: Caterpillar

Installation Date: Estimated installation of first generator : 05/2025

☐ Yes ☒ No This generator will be operated as part of an emergency demand response program.

Number Installed: 92	Number Removed: 0	Stack Height (feet, estimated): 44	Stack Diameter (inches, estimated): 24	
Engine Make / Model: Caterpillar 3516E	EPA Tier Certified: 2	Engine Horsepower : 4,043	Engine Manufacture Date: ≥ 2019	Fuel Type: Ultra-Low Sulfur Diesel or Renewable Diesel

5) Required Attachments (check that you've included them)

☒ Vendor literature

☐ CPCN Exemption from the Public Service Commission
(not needed for generators installed before October 1, 2001, or rated at 1500 kW or less)

6) Workers Compensation Information (Environmental Article §1-202)

Workers insurance policy or binder number: American Zurich Insurance Company No. 40142 WC402028202

☐ Check if self-employed or otherwise exempt from this requirement

"I CERTIFY UNDER PENALTY OF LAW THAT THE INFORMATION SUBMITTED IN THIS REQUEST FOR COVERAGE IS, TO THE BEST OF MY KNOWLEDGE AND BELIEF, TRUE, ACCURATE, AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE INFORMATION, INCLUDING THE POSSIBILITY OF FINE AND IMPRISONMENT FOR KNOWING VIOLATIONS."

Signed by: Robb Truedinger 83B51630A138463...

Owners Signature	Robert Truedinger, Authorized Representative Printed Name and Title	October 16, 2024 Date

LEAVE BLANK
MDE USE ONLY

☐ Permit
☐ Registration (Less than 1,000 brake horsepower & installed prior to 11/24/03)

Permit/Registration Number: _____ - _____ - _____ - _____

AI: _____

Emissions

	Sox	Nox	CO	VOC	PM	PM-10
Stack	_____	_____	_____	_____	_____	_____
Fugitive	_____	_____	_____	_____	_____	_____

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Business/Institution/Facility Name: BWI-150, BWI-151, BWI-152, BWI-153 Phone: (940) 704-1439

Contact Person's Name: Blake Carruthers Email Address: bcarrut@amazon.com

Street Address: 3250 Digital Drive

City: Frederick State: Maryland Zip Code: 21703 County: Frederick

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Mailing Address: 13820 Sunrise Valley Drive

City: Herndon State: VA Zip Code: 20171

3) Installer ☒ **Check if different from above. If checked, complete the following:**

Contact Name: TBD Contact Company: TBD Phone: TBD

4) Equipment Information

Manufacturer / Model: Caterpillar

Installation Date: Estimated installation of first generator: 05/2025

☐ Yes ☒ No This generator will be operated as part of an emergency demand response program.

Number Installed: 6	Number Removed: 0	Stack Height (feet, estimated): 10.3 (2, Aux Water Bldg) and 44 (4, House)	Stack Diameter (inches, estimated): 12	
Engine Make / Model: Caterpillar C18	EPA Tier Certified: 2	Engine Horsepower : 1,112	Engine Manufacture Date: ≥ 2019	Fuel Type: Ultra-Low Sulfur Diesel or Renewable Diesel

5) Required Attachments (check that you've included them)

☒ Vendor literature

☐ CPCN Exemption from the Public Service Commission
(not needed for generators installed before October 1, 2001, or rated at 1500 kW or less)

6) Workers Compensation Information (Environmental Article §1-202)

Workers insurance policy or binder number: American Zurich Insurance Company No. 40142 WC402028202

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Signed by: Robb Truedinger 83B51630A138463...

Owners Signature	Robert Truedinger, Authorized Representative Printed Name and Title	October 16, 2024 Date

LEAVE BLANK
MDE USE ONLY

☐ Permit
☐ Registration (Less than 1,000 brake horsepower & installed prior to 11/24/03)

Permit/Registration Number: _____ - _____ - _____ - _____

AI: _____

Emissions

	Sox	Nox	CO	VOC	PM	PM-10
Stack	_____	_____	_____	_____	_____	_____
Fugitive	_____	_____	_____	_____	_____	_____

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Business/Institution/Facility Name: BWI-150, BWI-151, BWI-152, BWI-153 Phone: (940) 704-1439

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Street Address: 3250 Digital Drive

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City: Herndon State: VA Zip Code: 20171

3) Installer ☒ **Check if different from above. If checked, complete the following:**

Contact Name: TBD Contact Company: TBD Phone: TBD

4) Equipment Information

Manufacturer / Model: Caterpillar

Installation Date: Estimated installation of first generator: 05/2025

☐ Yes ☒ No This generator will be operated as part of an emergency demand response program.

Number Installed: 1	Number Removed: 0	Stack Height (feet, estimated): 8	Stack Diameter (inches, estimated): 6	
Engine Make / Model: Caterpillar C9	EPA Tier Certified: 2	Engine Horsepower : 398	Engine Manufacture Date: ≥ 2019	Fuel Type: Ultra-Low Sulfur Diesel or Renewable Diesel

5) Required Attachments (check that you've included them)

☒ Vendor literature

☐ CPCN Exemption from the Public Service Commission
(not needed for generators installed before October 1, 2001, or rated at 1500 kW or less)

6) Workers Compensation Information (Environmental Article §1-202)

Workers insurance policy or binder number: American Zurich Insurance Company No. 40142 WC402028202

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Signed by: Robb Truedinger 82B81630A138463...

Owners Signature	Robert Truedinger, Authorized Representative Printed Name and Title	October 16, 2024 Date

LEAVE BLANK
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☐ Permit
☐ Registration (Less than 1,000 brake horsepower & installed prior to 11/24/03)

Permit/Registration Number: _____ - _____ - _____ - _____

AI: _____

Emissions

	Sox	Nox	CO	VOC	PM	PM-10
Stack	_____	_____	_____	_____	_____	_____
Fugitive	_____	_____	_____	_____	_____	_____

APPENDIX B. DETAILED EMISSION CALCULATIONS

Appendix B - Emission Calculations

Table B-1. Facility-Wide Potential Emissions

Emission Unit	Description	Potential Annual Emissions (tpy)[1]								
		CO	NO_X	VOC	SO_2	PM	PM_{10}	$PM_{2.5}$	Single HAP	Combined HAP
EG1-92	Caterpillar Model 3516E Engines	3.6	5.1	0.6	4.64E-02	0.23	0.23	0.23	3.10E-02	6.28E-02
		1.1	19.1	0.2	1.40E-02	0.07	0.07	0.07		
EG93-98	Caterpillar Model C18 Engines	4.3	4.0	1.7	3.36E-03	0.28	0.28	0.28	1.72E-03	3.49E-03
EG99	Caterpillar Model C9 Engine	0.1	0.14	0.03	2.00E-04	0.02	0.02	0.02	1.02E-04	2.07E-04
Total Facility-Wide Potential Emissions:		**8.8**	**24.3**	**2.4**	**0.1**	**0.6**	**0.6**	**0.6**	**0.03**	**0.06**

1. Potential emissions are calculated based on estimated fuel usages. Amazon is requesting site-wide emissions limits matching the totals above and will limit fuel such that these limits are not exceeded when emissions are calculated using the lb/gal emission factors in Table B-2.

Fuel Used in PTE (gal/yr)	
3516E Uncontrolled	134,177
C18	32,160
C9	1,910
Total Limit:	134,177

	Emission Factors (lb/gal)						
	CO	NO_X	VOC	SO_2	PM	PM_{10}	$PM_{2.5}$
3516E Uncontrolled	1.61E-02	2.85E-01	2.54E-03	2.09E-04	1.02E-03	1.02E-03	1.02E-03
C18	2.67E-01	2.48E-01	1.06E-01	2.09E-04	1.73E-02	1.73E-02	1.73E-02
C9	1.37E-01	1.44E-01	3.64E-02	2.09E-04	1.73E-02	1.73E-02	1.73E-02

	Emission Factor Rank (1=highest, 3=lowest)						
	CO	NO_X	VOC	SO_2	PM	PM_{10}	$PM_{2.5}$
3516E Uncontrolled	3	1	3	1	3	3	3
C18	1	2	1	1	2	2	2
C9	2	3	2	1	1	1	1

	Fuel for Facility-wide Uncontrolled Generator PTE (gal/yr)						
	CO	NO_X	VOC	SO_2	PM	PM_{10}	$PM_{2.5}$
3516E Uncontrolled	100,107	134,177	100,107	134,177	100,107	100,107	100,107
C18	32,160		32,160		32,160	32,160	32,160
C9	1,910		1,910		1,910	1,910	1,910
Total	134,177	134,177	134,177	134,177	134,177	134,177	134,177

Appendix B - Emission Calculations

Using the emission factor rankings as a guide, the estimated fuel usage is divided between the generator groups to maximize emissions and calculate a PTE. For example, for CO:

- Highest emission factor is for the Model C18 generators which can potentially use 32,160 gallons per year.
- The second highest emission factor is for the Model C9 generator which can potentially use 1,910 gallons per year.
- The remaining 100,107 gallons is allocated to the Model 3516E generators. These engines could burn additional fuel but it is already allocated as discussed above and therefore using values above will result in the maximum possible emissions from 134,177 gallons of fuel.

- PTE from uncontrolled generator operation = (32,160 gal/yr x 0.267 lb/gal + 1,910 gal/yr x 0.137 lb/gal + 100,107 gal/yr x 0.016 lb/gal) / 2,000 lb/ton = 5.2 tpy

Appendix B - Emission Calculations

Table B-2. Emergency Generator Maximum Emissions - per Unit

Pollutant	Units	CO	Controlled NO_X	Uncontrolled NO_X	VOC	SO_2	PM	PM_{10}	$PM_{2.5}$
3516E Stationary Emergency Engine-Generators	lb/hr	10.34	4.44	53.48	0.89	0.040	0.62	0.62	0.62
	lb/gal	0.115	0.023	0.285	0.015	2.1E-04	0.007	0.007	0.007
C18 Stationary Emergency Engine-Generators	lb/hr	2.53	N/A	13.29	1.01	0.011	0.16	0.16	0.16
	lb/gal	0.267	N/A	0.248	0.106	2.1E-04	0.017	0.017	0.017
C9 Stationary Emergency Engine-Generator	lb/hr	0.63	N/A	2.76	0.20	0.004	0.15	0.15	0.15
	lb/gal	0.137	N/A	0.144	0.036	2.1E-04	0.017	0.017	0.017

Appendix B - Emission Calculations

B.3 Fuel Based Emission Factors and Fuel Throughput Calculation

3516E Stationary Engines (EG1-92) Criteria Pollutant Emission Factors

Pollutant	Emission Factors *100% Load*	Emission Factors *75% Load*	Emission Factors *50% Load*	Emission Factors *25% Load*	Emission Factors *10% Load*	Units	Notes
CO	1.16	0.56	0.57	1.68	3.43	g/hp-hr	1
NO_X	6.00	4.83	3.65	3.73	8.51	g/hp-hr	1
VOC	0.10	0.12	0.17	0.29	0.46	g/hp-hr	1, 2
SO_2	1.21E-05	1.21E-05	1.21E-05	1.21E-05	1.21E-05	lb/hp-hr	3
PM	0.07	0.05	0.07	0.15	0.21	g/hp-hr	1, 4
PM_{10}	0.07	0.05	0.07	0.15	0.21	g/hp-hr	1, 4
$PM_{2.5}$	0.07	0.05	0.07	0.15	0.21	g/hp-hr	1, 4

3516E Stationary Engines (EG1-92) Criteria Pollutant Emission Factors

Pollutant	Emission Factors *100% Load*	Emission Factors *75% Load*	Emission Factors *50% Load*	Emission Factors *25% Load*	Emission Factors *10% Load*	Units	Notes
Engine Rating	4,043	3,072	2,102	1,131	549	hp	1
Fuel Consumption	192.9	147.3	107.5	62.9	36.1	gal/hr	1
CO	0.054	0.026	0.025	0.067	0.115	lb/gal	5
NO_X	0.277	0.222	0.157	0.148	0.285	lb/gal	5
VOC	0.005	0.006	0.007	0.011	0.015	lb/gal	5
SO_2	2.09E-04	2.09E-04	2.09E-04	2.09E-04	2.09E-04	lb/gal	3
PM	0.003	0.002	0.003	0.006	0.007	lb/gal	5
PM_{10}	0.003	0.002	0.003	0.006	0.007	lb/gal	5
$PM_{2.5}$	0.003	0.002	0.003	0.006	0.007	lb/gal	5

Appendix B - Emission Calculations

B.3 Fuel Based Emission Factors and Fuel Throughput Calculation

Caterpillar 3516E Controlled (EG1-92) Criteria Pollutant Emission Factors

Pollutant	Control Technology Control Efficiency	Emission Factors *100% Load*	Units	Notes
CO	70.00%	0.35	g/hp-hr	8
NO_X	91.70%	0.50	g/hp-hr	8
VOC	45.00%	0.06	g/hp-hr	8
SO_2	0.00%	1.21E-05	lb/hp-hr	8
PM	68.60%	0.02	g/hp-hr	8
PM_{10}	68.60%	0.02	g/hp-hr	8
$PM_{2.5}$	68.60%	0.02	g/hp-hr	8

Caterpillar 3516E Controlled (EG1-92) Criteria Pollutant Emission Factors

Pollutant	Emission Factors *100% Load*	Units	Notes
Engine Rating	4,043	hp	1
Fuel Consumption	192.9	gal/hr	1
CO	0.016	lb/gal	5
NO_X	0.023	lb/gal	5
VOC	0.003	lb/gal	5
SO_2	2.09E-04	lb/gal	5
PM	0.001	lb/gal	5
PM_{10}	0.001	lb/gal	5
$PM_{2.5}$	0.001	lb/gal	5

Appendix B - Emission Calculations

B.3 Fuel Based Emission Factors and Fuel Throughput Calculation

C18 Stationary Engines (EG93-98) Criteria Pollutant Emission Factors

Pollutant	Emission Factors *100% Load*	Emission Factors *75% Load*	Emission Factors *50% Load*	Emission Factors *25% Load*	Emission Factors *10% Load*	Units	Notes
CO	0.22	0.28	0.13	0.99	7.41	g/hp-hr	1
NO_X	5.42	3.75	3.59	4.27	5.02	g/hp-hr	1
VOC	0.06	0.08	0.08	0.17	2.96	g/hp-hr	1, 2
SO_2	1.21E-05	1.21E-05	1.21E-05	1.21E-05	1.21E-05	lb/hp-hr	3
PM	0.03	0.04	0.04	0.08	0.48	g/hp-hr	1, 4
PM_{10}	0.03	0.04	0.04	0.08	0.48	g/hp-hr	1, 4
$PM_{2.5}$	0.03	0.04	0.04	0.08	0.48	g/hp-hr	1, 4

C18 Stationary Engines (EG93-98) Criteria Pollutant Emission Factors

Pollutant	Emission Factors *100% Load*	Emission Factors *75% Load*	Emission Factors *50% Load*	Emission Factors *25% Load*	Emission Factors *10% Load*	Units	Notes
Engine Rating	1,112	840	575	315	155	hp	1
Fuel Consumption	53.6	42.8	28.4	16.6	9.5	gal/hr	1
CO	0.010	0.012	0.006	0.041	0.267	lb/gal	5
NO_X	0.248	0.162	0.160	0.179	0.181	lb/gal	5
VOC	0.003	0.003	0.004	0.007	0.106	lb/gal	5
SO_2	2.09E-04	2.09E-04	2.09E-04	2.09E-04	2.09E-04	lb/gal	3
PM	0.001	0.002	0.002	0.003	0.017	lb/gal	5
PM_{10}	0.001	0.002	0.002	0.003	0.017	lb/gal	5
$PM_{2.5}$	0.001	0.002	0.002	0.003	0.017	lb/gal	5

Appendix B - Emission Calculations

B.3 Fuel Based Emission Factors and Fuel Throughput Calculation

C9 Stationary Engine (EG99) Criteria Pollutant Emission Factors

Pollutant	Emission Factors *100% Load*	Emission Factors *75% Load*	Emission Factors *50% Load*	Emission Factors *25% Load*	Emission Factors *10% Load*	Units	Notes
CO	0.68	0.90	1.01	2.30	3.89	g/hp-hr	1
NO_X	3.14	2.38	2.16	2.27	3.22	g/hp-hr	1
VOC	0.17	0.29	0.44	0.57	1.03	g/hp-hr	1, 2
SO_2	1.21E-05	1.21E-05	1.21E-05	1.21E-05	1.21E-05	lb/hp-hr	3
PM	0.16	0.22	0.23	0.40	0.49	g/hp-hr	1, 4
PM_{10}	0.16	0.22	0.23	0.40	0.49	g/hp-hr	1, 4
$PM_{2.5}$	0.16	0.22	0.23	0.40	0.49	g/hp-hr	1, 4

C9 Stationary Engine (EG99) Criteria Pollutant Emission Factors

Pollutant	Emission Factors *100% Load*	Emission Factors *75% Load*	Emission Factors *50% Load*	Emission Factors *25% Load*	Emission Factors *10% Load*	Units	Notes
Engine Rating	398	302	211	124	68.9	hp	1
Fuel Consumption	19.1	15.3	11.4	7.2	4.3	gal/hr	1
CO	0.031	0.039	0.041	0.087	0.137	lb/gal	5
NO_X	0.144	0.104	0.088	0.086	0.114	lb/gal	5
VOC	0.008	0.013	0.018	0.022	0.036	lb/gal	5
SO_2	2.09E-04	2.09E-04	2.09E-04	2.09E-04	2.09E-04	lb/gal	3
PM	0.007	0.010	0.009	0.015	0.017	lb/gal	5
PM_{10}	0.007	0.010	0.009	0.015	0.017	lb/gal	5
$PM_{2.5}$	0.007	0.010	0.009	0.015	0.017	lb/gal	5

Appendix B - Emission Calculations

B.3 Fuel Based Emission Factors and Fuel Throughput Calculation

Maximum Emissions

Pollutant	Stationary Engine Maximum (lb/gal)	Major Source Threshold (tpy)	Maximum Fuel Consumption for Uncontrolled Stationary Engine Group (gal/yr)	Notes
CO	0.267	93	701,062	6,7
NO_X	0.285	19	134,177	6,7
VOC	0.106	24	444,922	6,7
SO_2	2.09E-04	97	927,474,879	6,7
PM	0.017	97	11,181,746	6,7
PM_{10}	0.017	97	11,181,746	6,7
$PM_{2.5}$	0.017	97	11,181,746	6,7

[1] Engine rating, fuel consumption, and NO_X, CO, HC (VOC), and PM emission factors are based on performance data at specified loads from the engines' emission data sheets.

[2] AP-42 Table 3.4-1 indicates that as much as three-fourths of total organic compounds are methane emissions for dual fuel engines. To conservatively over-estimate emissions, all hydrocarbon (HC) emissions are assumed to be VOC.

[3] Sulfur dioxide emission factor is from AP-42 Table 3.4-1. SO_2 (lb/bhp-hr) = 8.09E-03 x (sulfur content of fuel, %). Emission factor in lb/bhp-hr. Sulfur content of fuel is 15 ppm (ULSD).

[4] All particulates are assumed to be <1 micron in size, consistent with AP-42 Section 3.3, Table 3.3-1 "Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines," Supplement B, October 1996.

[5] Emission Factor (lb/gal) = Emission Factor (lb/hr) / Fuel Usage Rate (gal/hr)

[6] Maximum emissions per gallon of fuel for each engine group is used to determine maximum fuel consumption for each group of engines based on proposed contribution of operation of the uncontrolled engines.

[7] Major source threshold target is desired site-wide potential emissions minus controlled emissions.

[8] Control efficiencies are based on minimum control efficiency based on all potential control vendors.

Appendix B - Emission Calculations

Table B-4. 3516E Stationary Generators (EG1-92) Potential to Emit

Source Designation:	Engine	Generator
Number of Emergency Generators[1]:	92	
Year Manufactured:	≥ 2019	
Manufacturer[1]:	Caterpillar	
Model No.[1]:	3516E	
Engine Tier[1]:	2	--
Stroke Cycle[1]:	4-Stroke	--
Fuel Used[1]:	Ultra-Low Sulfur Diesel or Renewable Diesel	--
Fuel Sulfur Content (%)[2]:	0.0015	--
Displacement (L per cylinder):	4.9	
Fuel Heating Value (Btu [HHV]/gal)[3]:	138,000	--
Rated Horsepower at Specified Load (bhp @ 1,800 rpm)[1]:	--	--
100%	4,043	--
75%	3,072	--
50%	2,102	--
25%	1,131	--
10%	549	--
Generating Capacity (kW)[1]:	--	2,750
Maximum Fuel Consumption at Specified Load (gal/hr)[1]:	--	--
100%	192.9	--
75%	147.3	--
50%	107.5	--
25%	62.9	--
10%	36.1	--
Heat Input (MMBtu [HHV]/hr)[3]:	--	--
100%	26.6	--
75%	20.3	--
50%	14.8	--
25%	8.7	--
10%	5.0	--

Operational Details:

Estimated Aggregate Fuel Consumption for Controlled Operation (gal/yr)[4]:	444,000
Estimated Fuel Consumption for Uncontrolled Operation (gal/yr)[4]:	134,177

Appendix B - Emission Calculations

Table B-4. 3516E Stationary Generators (EG1-92) Potential to Emit

Criteria and Greenhouse Gas Potential Emissions:

Pollutant	Controlled Emission Factors	Uncontrolled Emission Factors	Units	Notes
CO	0.016	0.016	lb/gal	5, 8
NO_X	0.023	0.285	lb/gal	5
VOC	0.003	0.003	lb/gal	5, 8
SO_2	2.09E-04	2.09E-04	lb/gal	5
PM	0.001	0.001	lb/gal	5, 8
PM_{10}	0.001	0.001	lb/gal	5, 8
$PM_{2.5}$	0.001	0.001	lb/gal	5, 8
CO_2	73.96	73.96	kg/MMBtu	6
CH_4	3.0E-03	3.0E-03	kg/MMBtu	6
N_2O	6.0E-04	6.0E-04	kg/MMBtu	6
CO_2e	74.2	74.2	kg/MMBtu	7

Criteria and Greenhouse Gas Potential Emissions:

Pollutant	Potential Controlled Emissions All Units (tpy)[9]	Potential Uncontrolled Emissions All Units (tpy)[9]	Combined Potential Emissions All Units (tpy)[9]
CO	3.57	1.08	4.65
NO_X	5.11	19.14	24.25
VOC	0.56	0.17	0.73
SO_2	0.05	0.01	0.06
PM	0.23	0.07	0.29
PM_{10}	0.23	0.07	0.29
$PM_{2.5}$	0.23	0.07	0.29
CO_2	4,995	1,510	6,505
CH_4	2.03E-01	6.12E-02	0.26
N_2O	4.05E-02	1.22E-02	0.05
CO_2e	5,012	1,515	6,527

Hazardous Air Pollutant (HAP) Potential Emissions:

Pollutant	Emission Factor[10] (lb/MMBtu)	Potential Emissions All Units (tpy)[9]
Benzene	7.76E-04	3.1E-02
Toluene	2.81E-04	1.1E-02
Xylenes	1.93E-04	7.7E-03
Formaldehyde	7.89E-05	3.1E-03
Acetaldehyde	2.52E-05	1.0E-03
Acrolein	7.88E-06	3.1E-04
Polycyclic Aromatic Hydrocarbons (PAH)	2.12E-04	8.5E-03
Total HAP		6.3E-02

[1] Engine specification sheet.

[2] Per 40 CFR 80 Subpart I, maximum sulfur content of ULSD is 15 ppm (i.e. 0.0015%).

[3] Diesel heat content is from 40 CFR 98, Subpart C, Table C-1 - Default CO2 Emission Factors and High Heat Values for Various Types of Fuel. Value is calculated from the fuel's heating value and engine's hourly fuel consumption rate and is on an individual unit basis.

[4] Estimated fuel consumption based on 25 hours per year of SCR-controlled operation

[5] Refer to Table B-3 for calculation of lb/gal emission factors.

[6] GHG emission factors from Tables C-1 and C-2, 40 CFR 98, Subpart C.

[7] CO2e is the sum of GHG constituents multiplied by their respective global warming potential (i.e. 1 for CO2, 25 for CH4, and 298 for N2O), per Table A-1, 40 CFR 98, Subpart A.

[8] The minimum activation temperature for PM, VOC, and CO controls is lower than the engine exhaust temperature at no load. As such, the controls will be active nearly instantly and the controlled emission factors are used for all operation.

[9] Potential Emissions (tpy) are based on annual fuel throughput times emission factors on a fuel or heat input basis.

[10] Emission factors from AP-42 Section 3.4, Table 3.4-3 "Speciated Organic Compound Emission Factors for Large Uncontrolled Stationary Diesel Engines" and Table 3.4.-4 "PAH Emission Factors for Large Uncontrolled Stationary Diesel Engines," Supplement B, October 1996.

Appendix B - Emission Calculations

Table B-5. C18 Stationary Generators (93-98) Potential to Emit

Source Designation:	Engine	Generator
Number of Emergency Generators[1]:	6	
Year Manufactured:	≥ 2019	
Manufacturer[1]:	Caterpillar	
Model No.[1]:	C18	
Engine Tier[1]:	2	--
Stroke Cycle[1]:	4-Stroke	--
Fuel Used[1]:	Ultra-Low Sulfur Diesel or Renewable Diesel	--
Fuel Sulfur Content (%)[2]:	0.0015	--
Displacement (L per cylinder):	3.0	
Fuel Heating Value (Btu [HHV]/gal)[3]:	138,000	--
Rated Horsepower at Specified Load (bhp @ 1,800 rpm)[2]:	--	--
100%	1,112	--
75%	840	--
50%	575	--
25%	315	--
10%	155	
Generating Capacity (kW)[2]:	--	750
Maximum Fuel Consumption at Specified Load (gal/hr)[2]:	--	--
100%	53.6	--
75%	42.8	--
50%	28.4	--
25%	16.6	--
10%	9.5	
Heat Input (MMBtu [HHV]/hr)[3]:	--	--
100%	7.4	--
75%	5.9	--
50%	3.9	--
25%	2.3	--
10%	1.3	

Operational Details:

Maximum Fuel Consumption (gal/yr)[4]:	32,160

Appendix B - Emission Calculations

Table B-5. C18 Stationary Generators (93-98) Potential to Emit

Criteria and Greenhouse Gas Potential Emissions:

Pollutant	Maximum Hourly Emissions	Units	Notes
CO	0.27	lb/gal	5
NO_X	0.25	lb/gal	5
VOC	0.11	lb/gal	5
SO_2	2.09E-04	lb/gal	5
PM	0.02	lb/gal	5
PM_{10}	0.02	lb/gal	5
$PM_{2.5}$	0.02	lb/gal	5
CO_2	73.96	kg/MMBtu	6
CH_4	3.00E-03	kg/MMBtu	6
N_2O	6.0E-04	kg/MMBtu	6
CO_2e	74.2	kg/MMBtu	7

Criteria and Greenhouse Gas Potential Emissions:

Pollutant	Potential Emissions All Units (tpy)[8]
CO	4.29
NO_X	3.99
VOC	1.71
SO_2	3.36E-03
PM	0.28
PM_{10}	0.28
$PM_{2.5}$	0.28
CO_2	362
CH_4	1.47E-02
N_2O	2.9E-03
CO_2e	363

Hazardous Air Pollutant (HAP) Potential Emissions:

Pollutant	Emission Factor[9] (lb/MMBtu)	Potential Emissions All Units (tpy)[8]
Benzene	7.76E-04	1.72E-03
Toluene	2.81E-04	6.2E-04
Xylenes	1.93E-04	4.3E-04
Formaldehyde	7.89E-05	1.8E-04
Acetaldehyde	2.52E-05	5.6E-05
Acrolein	7.88E-06	1.7E-05
Polycyclic Aromatic Hydrocarbons (PAH)	2.12E-04	4.7E-04
Total HAP		3.5E-03

[1] Engine specification sheet.

[2] Per 40 CFR 80 Subpart I, maximum sulfur content of ULSD is 15 ppm (i.e. 0.0015%).

[3] Diesel heat content is from 40 CFR 98, Subpart C, Table C-1 - Default CO2 Emission Factors and High Heat Values for Various Types of Fuel. Value is calculated from the fuel's heating value and engine's hourly fuel consumption rate and is on an individual unit basis.

[4] Maximum fuel consumption based on 100 hr/yr for each engine.

[5] Refer to Table B-3 for calculation of lb/gal emission factors.

[6] GHG emission factors from Tables C-1 and C-2, 40 CFR 98, Subpart C.

[7] CO2e is the sum of GHG constituents multiplied by their respective global warming potential (i.e. 1 for CO2, 25 for CH4, and 298 for N2O), per Table A-1, 40 CFR 98, Subpart A.

[8] Potential Emissions (tpy) are based on annual throughput times emission factors on a fuel or heat input basis.

[9] Emission factors from AP-42 Section 3.4, Table 3.4-3 "Speciated Organic Compound Emission Factors for Large Uncontrolled Stationary Diesel Engines" and Table 3.4.-4 "PAH Emission Factors for Large Uncontrolled Stationary Diesel Engines," Supplement B, October 1996.

Appendix B - Emission Calculations

Table B-6. C9 Stationary Generator (EG99) Potential to Emit

Source Designation:	Engine	Generator
Number of Emergency Generators[1]:	1	
Year Manufactured:	≥ 2019	
Manufacturer[1]:	Caterpillar	
Model No.[1]:	C9	
Engine Tier[1]:	2	--
Stroke Cycle[1]:	4-Stroke	--
Fuel Used[1]:	Ultra-Low Sulfur Diesel or Renewable Diesel	--
Fuel Sulfur Content (%)[2]:	0.0015	--
Displacement (L per cylinder):	1.5	
Fuel Heating Value (Btu [HHV]/gal)[3]:	138,000	--
Rated Horsepower at Specified Load (bhp @ 1,800 rpm)[1]:	--	--
100%	398	--
75%	302	--
50%	211	--
25%	124	--
10%	68.9	--
Generating Capacity (kW)[1]:	--	250
Maximum Fuel Consumption at Specified Load (gal/hr)[1]:	--	--
100%	19.1	--
75%	15.3	--
50%	11.4	--
25%	7.2	--
10%	4.3	--
Heat Input (MMBtu [HHV]/hr)[3]:	--	--
100%	2.6	--
75%	2.1	--
50%	1.6	--
25%	1.0	--
10%	0.6	--

Operational Details:

Maximum Fuel Consumption (gal/yr)[4]:	1,910

Appendix B - Emission Calculations

Table B-6. C9 Stationary Generator (EG99) Potential to Emit

Criteria and Greenhouse Gas Potential Emissions:

Pollutant	Maximum Hourly Emissions	Units	Notes
CO	0.14	lb/gal	5
NO_X	0.14	lb/gal	5
VOC	0.04	lb/gal	5
SO_2	2.09E-04	lb/gal	5
PM	0.02	lb/gal	5
PM_{10}	0.02	lb/gal	5
$PM_{2.5}$	0.02	lb/gal	5
CO_2	73.96	kg/MMBtu	6
CH_4	3.00E-03	kg/MMBtu	6
N_2O	6.0E-04	kg/MMBtu	6
CO_2e	74.2	kg/MMBtu	7

Criteria and Greenhouse Gas Potential Emissions:

Pollutant	Potential Emissions (tpy)[8]
CO	0.13
NO_X	0.14
VOC	0.03
SO_2	2.00E-04
PM	0.02
PM_{10}	0.02
$PM_{2.5}$	0.02
CO_2	21
CH_4	8.72E-04
N_2O	1.7E-04
CO_2e	22

Hazardous Air Pollutant (HAP) Potential Emissions:

Pollutant	Emission Factor[9] (lb/MMBtu)	Potential Emissions (tpy)[8]
Benzene	7.76E-04	1.0E-04
Toluene	2.81E-04	3.7E-05
Xylenes	1.93E-04	2.5E-05
Formaldehyde	7.89E-05	1.0E-05
Acetaldehyde	2.52E-05	3.3E-06
Acrolein	7.88E-06	1.0E-06
Polycyclic Aromatic Hydrocarbons (PAH)	2.12E-04	2.8E-05
Total HAP		2.1E-04

[1] Engine specification sheet.

[2] Per 40 CFR 80 Subpart I, maximum sulfur content of ULSD is 15 ppm (i.e. 0.0015%).

[3] Diesel heat content is from 40 CFR 98, Subpart C, Table C-1 - Default CO2 Emission Factors and High Heat Values for Various Types of Fuel. Value is calculated from the fuel's heating value and engine's hourly fuel consumption rate and is on an individual unit basis.

[4] Maximum fuel consumption based on 100 hr/yr for the engine.

[5] Refer to Table B-3 for calculation of lb/gal emission factors.

[6] GHG emission factors from Tables C-1 and C-2, 40 CFR 98, Subpart C.

[7] CO2e is the sum of GHG constituents multiplied by their respective global warming potential (i.e. 1 for CO2, 25 for CH4, and 298 for N2O), per Table A-1, 40 CFR 98, Subpart A.

[8] Potential Emissions (tpy) are based on annual throughput times emission factors on a fuel or heat input basis.

[9] Emission factors from AP-42 Section 3.4, Table 3.4-3 "Speciated Organic Compound Emission Factors for Large Uncontrolled Stationary Diesel Engines" and Table 3.4.-4 "PAH Emission Factors for Large Uncontrolled Stationary Diesel Engines," Supplement B, October 1996.

APPENDIX C. MANUFACTURER SPECIFICATION AND EMISSION SHEETS

Cat® 3516E

Diesel Generator Sets

Image shown may not reflect actual configuration

Bore – mm (in)	170 (6.69)
Stroke – mm (in)	215 (8.47)
Displacement – L (in^3)	78.1 (4766)
Compression Ratio	14.7:1
Aspiration	TA
Fuel System	EUI
Governor Type	ADEM™ A5

Standby 60 Hz ekW (kVA)	Mission Critical 60 Hz ekW (kVA)	Prime 60 Hz ekW (kVA)	Emissions Performance
2750 (3438)	2750 (3438)	2500 (3125)	U.S. EPA Certified for Emergency Stationary Applications (Tier 2)

Features

Cat® Diesel Engine

- Meets U.S. EPA Stationary Emergency Use Only (Tier 2) emission standards
- Reliable performance proven in thousands of applications worldwide

Generator Set Package

- Accepts 100% block load in one step and meets NFPA 110 loading requirements
- Conforms to ISO 8528-5 G3 load acceptance requirements
- Reliability verified through torsional vibration, fuel consumption, oil consumption, transient performance, and endurance testing

Alternators

- Superior motor starting capability minimizes need for oversizing generator
- Designed to match performance and output characteristics of Cat diesel engines

Cooling System

- Cooling systems available to operate in ambient temperatures up to 50°C (122°F)
- Tested to ensure proper generator set cooling

EMCP 4 Control Panels

- User-friendly interface and navigation
- Scalable system to meet a wide range of installation requirements
- Expansion modules and site specific programming for specific customer requirements

Warranty

- 24 months/1000-hour warranty for standby and mission critical ratings
- 12 months/unlimited hour warranty for prime and continuous ratings
- Extended service protection is available to provide extended coverage options

Worldwide Product Support

- Cat dealers have over 1,800 dealer branch stores operating in 200 countries
- Your local Cat dealer provides extensive post-sale support, including maintenance and repair agreements

Financing

- Caterpillar offers an array of financial products to help you succeed through financial service excellence
- Options include loans, finance lease, operating lease, working capital, and revolving line of credit
- Contact your local Cat dealer for availability in your region

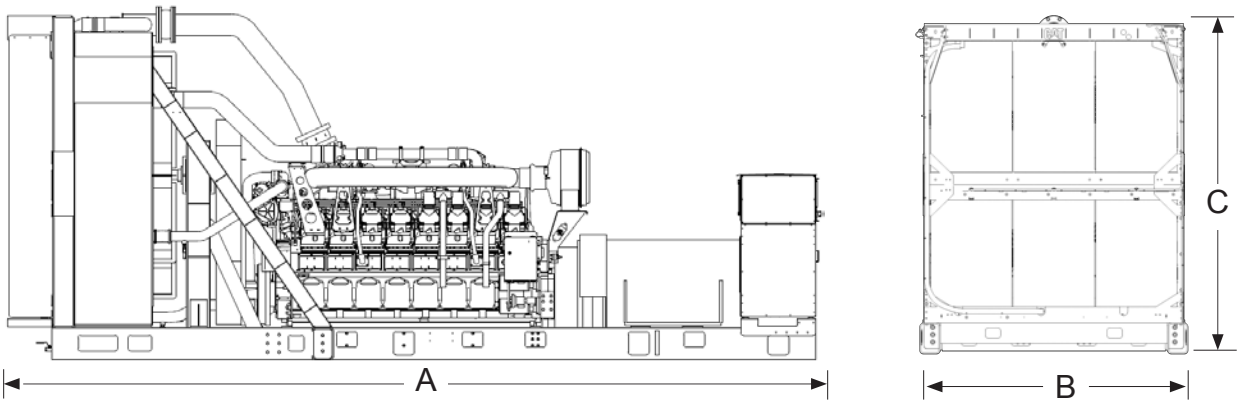
Package Performance

Performance	Standby		Mission Critical		Prime	
Frequency	60 Hz		60 Hz		60 Hz	
Gen set power rating with fan	2750 ekW		2750 ekW		2500 ekW	
Gen set power rating with fan @ 0.8 power factor	3438 kVA		3438 kVA		3125 kVA	
Emissions	EPA ESE (TIER 2)		EPA ESE (TIER 2)		EPA ESE (TIER 2)	
Performance number	EM5400-00		EM5402-00		EM5404-00	
Fuel Consumption						
100% load with fan – L/hr (gal/hr)	716.3	(189.2)	716.3	(189.2)	645.8	(170.6)
75% load with fan – L/hr (gal/hr)	547.0	(144.5)	547.0	(144.5)	505.8	(133.6)
50% load with fan – L/hr (gal/hr)	399.0	(105.4)	399.0	(105.4)	370.6	(97.9)
25% load with fan – L/hr (gal/hr)	233.5	(61.7)	233.5	(61.7)	218.7	(57.8)
Cooling System						
Radiator air flow restriction (system) – kPa (in. water)	0.12	(0.48)	0.12	(0.48)	0.12	(0.48)
Radiator air flow – m^3/min (cfm)	3026	(106862)	3026	(106862)	3026	(106862)
Engine coolant capacity – L (gal)	233.0	(61.6)	233.0	(61.6)	233.0	(61.6)
Radiator coolant capacity – L (gal)	202.0	(53.3)	202.0	(53.3)	202.0	(53.3)
Total coolant capacity – L (gal)	435.0	(114.9)	435.0	(114.9)	435.0	(114.9)
Inlet Air						
Combustion air inlet flow rate – m^3/min (cfm)	236.0	(8332.4)	236.0	(8332.4)	223.7	(7898.4)
Exhaust System						
Exhaust stack gas temperature – °C (°F)	480.0	(896.1)	480.0	(896.1)	459.3	(858.7)
Exhaust gas flow rate – m^3/min (cfm)	624.5	(22051.6)	624.5	(22051.6)	574.2	(20277.1)
Exhaust system backpressure (maximum allowable) – kPa (in. water)	6.7	(27.0)	6.7	(27.0)	6.7	(27.0)
Heat Rejection						
Heat rejection to jacket water – kW (Btu/min)	894	(50827)	894	(50827)	827	(47027)
Heat rejection to exhaust (total) – kW (Btu/min)	2849	(162025)	2849	(162025)	2514	(142941)
Heat rejection to aftercooler – kW (Btu/min)	941	(53492)	941	(53492)	844	(47998)
Heat rejection to atmosphere from engine – kW (Btu/min)	160	(9124)	160	(9124)	147	(8364)
Heat rejection from alternator – kW (Btu/min)	126	(7172)	126	(7172)	112	(6386)
Emissions* (Nominal)						
NOx mg/Nm^3 (g/hp-h)	2319.2	(5.00)	2319.2	(5.00)	2275.1	(4.82)
CO mg/Nm^3 (g/hp-h)	321.4	(0.69)	321.4	(0.69)	183.8	(0.39)
HC mg/Nm^3 (g/hp-h)	30.7	(0.08)	30.7	(0.08)	33.1	(0.08)
PM mg/Nm^3 (g/hp-h)	20.0	(0.05)	20.0	(0.05)	14.6	(0.04)
Emissions* (Potential Site Variation)						
NOx mg/Nm^3 (g/hp-h)	2783.0	(6.00)	2783.0	(6.00)	2730.1	(5.79)
CO mg/Nm^3 (g/hp-h)	536.7	(1.16)	536.7	(1.16)	307.0	(0.65)
HC mg/Nm^3 (g/hp-h)	40.8	(0.10)	40.8	(0.10)	44.1	(0.11)
PM mg/Nm^3 (g/hp-h)	28.1	(0.07)	28.1	(0.07)	20.4	(0.05)

**mg/Nm^3 levels are corrected to 5% O_2. Contact your local Cat dealer for further information.*

3516E Diesel Generator Sets
Electric Power

Weights and Dimensions



Dim "A" mm (in)	Dim "B" mm (in)	Dim "C" mm (in)	Dry Weight kg (lb)
7703 (303.3)	2640 (104.0)	3342 (131.6)	18 480 (40,750)

Note: *For reference only. Do not use for installation design. Contact your local Cat dealer for precise weights and dimensions.*

Ratings Definitions

Standby
Output available with varying load for the duration of the interruption of the normal source power. Average power output is 70% of the standby rated ekW. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year.

Mission Critical
Output available with varying load for the duration of the interruption of the normal source power. Average power output is 85% of the mission critical rated ekW. Typical peak demand up to 100% of rated ekW for up to 5% of the operating time. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year.

Prime
Output available with varying load for an unlimited time. Average power output is 70% of the prime rated ekW. Typical peak demand is 100% of prime rated ekW with 10% overload capability for emergency use for a maximum of 1 hour in 12. Overload operation cannot exceed 25 hours per year.

Applicable Codes and Standards
AS 1359, CSA C22.2 No. 100-04, UL 142, UL 489, UL 869, UL 2200, IBC, IEC 60034-1, ISO 3046, ISO 8528, NEMA MG1-22, NEMA MG1-33, 2014/35/EU, 2006/42/EC, 2014/30/EU and facilitates compliance to NFPA 37, NFPA 70, NFPA 99, NFPA 110.

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

Data Center Applications
- All ratings Tier III/Tier IV compliant per Uptime Institute requirements.
- All ratings ANSI/TIA-942 compliant for Rated-1 through Rated-4 data centers.

Fuel Rates
Fuel consumption reported in accordance with ISO 3046-1, based on fuel oil of 35º API [16°C (60ºF)] gravity having an LHV of 42,780 kJ/kg (18,390 Btu/lb) when used at 15ºC (59ºF) and weighing 850 g/liter (7.0936 lbs/U.S. gal.) All fuel consumption values refer to rated engine power.

3516 PGFL
LEHE1351-09 (03/22)

PERFORMANCE DATA[EM5402]

February 12, 2023

Performance Number: EM5402 **Change Level: 00**

SALES MODEL:	3516E	**COMBUSTION:**	DIRECT INJECTION
BRAND:	CAT	**ENGINE SPEED (RPM):**	1,800
MACHINE SALES MODEL:		**HERTZ:**	60
ENGINE POWER (BHP):	4,043	**FAN POWER (HP):**	160.9
GEN POWER WITH FAN (EKW):	2,750.0	**ASPIRATION:**	TA
COMPRESSION RATIO:	14.7	**AFTERCOOLER TYPE:**	ATAAC
RATING LEVEL:	MISSION CRITICAL STANDBY	**AFTERCOOLER CIRCUIT TYPE:**	JW+OC, ATAAC
PUMP QUANTITY:	1	**INLET MANIFOLD AIR TEMP (F):**	122
FUEL TYPE:	DIESEL	**JACKET WATER TEMP (F):**	219.2
MANIFOLD TYPE:	DRY	**TURBO CONFIGURATION:**	PARALLEL
GOVERNOR TYPE:	ADEM5	**TURBO QUANTITY:**	4
ELECTRONICS TYPE:	ADEM5	**TURBOCHARGER MODEL:**	GTB6051N-44T-1.25
IGNITION TYPE:	CI	**CERTIFICATION YEAR:**	2017
INJECTOR TYPE:	EUI	**CRANKCASE BLOWBY RATE (FT3/HR):**	4,039.5
FUEL INJECTOR:	3920221	**FUEL RATE (RATED RPM) NO LOAD (GAL/HR):**	15.6
UNIT INJECTOR TIMING (IN):	64.34	**PISTON SPD @ RATED ENG SPD (FT/MIN):**	2,539.4
REF EXH STACK DIAMETER (IN):	12		
MAX OPERATING ALTITUDE (FT):	2,461		

INDUSTRY	SUBINDUSTRY	APPLICATION
ELECTRIC POWER	STANDARD	PACKAGED GENSET

General Performance Data

THE INLET MANIFOLD AIR TEMP LISTED IN THE HEADER, AND IN THE GENERAL PERFORMANCE DATA, IS THE AVERAGE INLET MANIFOLD TEMP FRONT TO REAR ON THE ENGINE.

THIS STANDBY RATING IS FOR A STANDBY ONLY ENGINE ARRANGEMENT. RERATING THE ENGINE TO A STANDARD PRIME OR CONTINUOUS RATING IS NOT PERMITTED.

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BSFC)	ISO BRAKE SPEC FUEL CONSUMPTN (BSFC)	VOL FUEL CONSUMPTN (VFC)	ISO VOL FUEL CONSUMPTN (VFC)	ELEC SPEC FUEL CONSUMPTN (ESFC)	ISO ELEC SPEC FUEL CONSUMPTN (ESFC)
EKW	%	BHP	PSI	LB/BHP-HR	LB/BHP-HR	GAL/HR	GAL/HR	LB/EKW-HR	LB/EKW-HR
2,750.0	100	4,043	373	0.338	0.332	192.9	189.2	0.498	0.488
2,475.0	90	3,655	337	0.334	0.328	172.3	169.0	0.494	0.484
2,200.0	80	3,266	302	0.338	0.331	155.6	152.6	0.502	0.492
2,062.5	75	3,072	284	0.340	0.334	147.3	144.5	0.507	0.497
1,925.0	70	2,878	266	0.343	0.336	139.1	136.5	0.513	0.503
1,650.0	60	2,490	230	0.351	0.344	123.2	120.9	0.530	0.520
1,375.0	50	2,102	194	0.363	0.356	107.5	105.4	0.554	0.544
1,100.0	40	1,714	158	0.373	0.366	90.1	88.4	0.581	0.570
825.0	30	1,325	122	0.384	0.377	71.8	70.5	0.618	0.606
687.5	25	1,131	104	0.394	0.387	62.9	61.7	0.649	0.636
550.0	20	937	87	0.409	0.402	54.1	53.1	0.698	0.684
275.0	10	549	51	0.467	0.458	36.1	35.4	0.932	0.914

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP
EKW	%	BHP	IN-HG	DEG F	DEG F	IN-HG	DEG F	IN-HG	DEG F
2,750.0	100	4,043	89.7	120.9	1,247.2	69.7	896.1	96	465.2
2,475.0	90	3,655	79.9	102.0	1,177.6	61.5	857.1	86	428.6
2,200.0	80	3,266	71.9	98.5	1,145.5	54.8	848.2	77	401.0
2,062.5	75	3,072	67.8	97.4	1,131.8	51.5	846.4	73	387.5
1,925.0	70	2,878	63.6	96.2	1,118.6	48.2	844.6	69	374.0
1,650.0	60	2,490	55.3	93.9	1,093.3	42.0	841.3	60	346.7
1,375.0	50	2,102	46.9	91.1	1,067.7	36.0	838.3	51	316.6
1,100.0	40	1,714	36.6	89.9	1,032.0	28.7	832.3	40	275.0
825.0	30	1,325	25.4	88.2	974.3	21.2	811.3	28	227.7
687.5	25	1,131	20.4	87.3	934.9	17.9	791.9	23	205.6
550.0	20	937	16.0	86.6	884.2	15.0	762.1	18	185.1
275.0	10	549	8.0	84.6	714.9	9.7	636.4	10	144.3

General Performance Data (Continued)

GENSET POWER	PERCENT LOAD	ENGINE POWER	WET INLET AIR VOL	ENGINE OUTLET	WET INLET AIR	WET EXH GAS	WET EXH VOL	DRY EXH VOL

PERFORMANCE DATA[EM5402]

February 12, 2023

WITH FAN			FLOW RATE	WET EXH GAS VOL FLOW RATE	MASS FLOW RATE	MASS FLOW RATE	FLOW RATE (32 DEG F AND 29.98 IN HG)	FLOW RATE (32 DEG F AND 29.98 IN HG)
EKW	%	BHP	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
2,750.0	100	4,043	8,332.4	22,051.6	36,608.0	37,975.1	7,997.3	7,319.2
2,475.0	90	3,655	7,853.4	20,133.0	34,488.6	35,710.8	7,517.4	6,906.2
2,200.0	80	3,266	7,346.5	18,607.4	32,131.3	33,232.9	6,995.3	6,441.4
2,062.5	75	3,072	7,067.4	17,824.4	30,845.3	31,888.9	6,710.2	6,183.4
1,925.0	70	2,878	6,782.6	17,045.8	29,542.6	30,529.2	6,425.6	5,925.8
1,650.0	60	2,490	6,233.4	15,564.7	27,073.1	27,946.5	5,882.4	5,438.9
1,375.0	50	2,102	5,678.9	14,065.9	24,551.5	25,313.7	5,328.0	4,936.7
1,100.0	40	1,714	4,977.5	12,157.1	21,327.5	21,966.5	4,626.4	4,295.6
825.0	30	1,325	4,151.9	9,893.9	17,669.9	18,179.6	3,827.4	3,562.6
687.5	25	1,131	3,769.2	8,812.6	16,008.2	16,454.6	3,462.1	3,227.8
550.0	20	937	3,431.9	7,819.9	14,554.5	14,938.7	3,146.9	2,941.1
275.0	10	549	2,823.3	5,742.8	11,937.6	12,194.1	2,576.0	2,431.3

Heat Rejection Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXHAUST RECOVERY TO 350F	FROM OIL COOLER	FROM AFTERCOOLER	WORK ENERGY	LOW HEAT VALUE ENERGY	HIGH HEAT VALUE ENERGY
EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
2,750.0	100	4,043	50,827	9,124	162,025	87,978	22,342	53,492	171,445	419,468	446,839
2,475.0	90	3,655	46,700	8,321	141,538	76,477	19,956	47,423	154,983	374,677	399,125
2,200.0	80	3,266	43,252	7,985	129,537	69,793	18,018	40,903	138,521	338,278	360,350
2,062.5	75	3,072	41,519	7,846	123,724	66,690	17,061	37,707	130,290	320,314	341,215

Emissions Data

DIESEL

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN		EKW	2,750.0	2,062.5	1,375.0	687.5	275.0
PERCENT LOAD		%	100	75	50	25	10
ENGINE POWER		BHP	4,043	3,072	2,102	1,131	549
TOTAL NOX (AS NO2)		G/HR	20,001	12,263	6,348	3,506	3,883
TOTAL CO		G/HR	2,776	1,017	711	1,134	1,123
TOTAL HC		G/HR	305	285	264	243	189
TOTAL CO2		KG/HR	1,954	1,489	1,082	626	359
PART MATTER		G/HR	206.9	114.2	111.5	119.5	82.4
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,319.2	1,872.1	1,335.4	1,271.3	2,728.6
TOTAL CO	(CORR 5% O2)	MG/NM3	321.4	155.3	149.5	421.2	689.5
TOTAL HC	(CORR 5% O2)	MG/NM3	30.7	37.7	48.2	77.4	97.9
PART MATTER	(CORR 5% O2)	MG/NM3	20.0	14.8	20.1	37.3	44.3
TOTAL NOX (AS NO2)	(CORR 15% O2)	MG/NM3	860.6	694.7	495.5	471.7	1,012.5
TOTAL CO	(CORR 15% O2)	MG/NM3	119.3	57.6	55.5	156.3	255.9
TOTAL HC	(CORR 15% O2)	MG/NM3	11.4	14.0	17.9	28.7	36.3
PART MATTER	(CORR 15% O2)	MG/NM3	7.4	5.5	7.5	13.8	16.4
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,130	912	650	619	1,329
TOTAL CO	(CORR 5% O2)	PPM	257	124	120	337	552
TOTAL HC	(CORR 5% O2)	PPM	57	70	90	144	183
TOTAL NOX (AS NO2)	(CORR 15% O2)	PPM	419	338	241	230	493
TOTAL CO	(CORR 15% O2)	PPM	95	46	44	125	205
TOTAL HC	(CORR 15% O2)	PPM	21	26	33	54	68
TOTAL NOX (AS NO2)		G/HP-HR	5.00	4.03	3.04	3.11	7.09
TOTAL CO		G/HP-HR	0.69	0.33	0.34	1.01	2.05
TOTAL HC		G/HP-HR	0.08	0.09	0.13	0.22	0.34
PART MATTER		G/HP-HR	0.05	0.04	0.05	0.11	0.15
TOTAL NOX (AS NO2)		G/KW-HR	6.80	5.47	4.13	4.23	9.65
TOTAL CO		G/KW-HR	0.94	0.45	0.46	1.37	2.79
TOTAL HC		G/KW-HR	0.10	0.13	0.17	0.29	0.47

PERFORMANCE DATA[EM5402]

February 12, 2023

PART MATTER	G/KW-HR	0.07	0.05	0.07	0.14	0.20
TOTAL NOX (AS NO2)	LB/HR	44.09	27.03	13.99	7.73	8.56
TOTAL CO	LB/HR	6.12	2.24	1.57	2.50	2.48
TOTAL HC	LB/HR	0.67	0.63	0.58	0.54	0.42
TOTAL CO2	LB/HR	4,307	3,282	2,386	1,381	792
PART MATTER	LB/HR	0.46	0.25	0.25	0.26	0.18
OXYGEN IN EXH	%	9.7	10.7	11.5	12.4	14.4
DRY SMOKE OPACITY	%	2.7	1.8	2.1	3.0	2.3
BOSCH SMOKE NUMBER		0.98	0.58	0.70	1.07	0.75

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN		**EKW**	**2,750.0**	**2,062.5**	**1,375.0**	**687.5**	**275.0**
PERCENT LOAD		**%**	**100**	**75**	**50**	**25**	**10**
ENGINE POWER		**BHP**	**4,043**	**3,072**	**2,102**	**1,131**	**549**
TOTAL NOX (AS NO2)		G/HR	24,002	14,715	7,618	4,207	4,659
TOTAL CO		G/HR	4,637	1,698	1,187	1,894	1,876
TOTAL HC		G/HR	405	379	352	324	251
PART MATTER		G/HR	289.7	159.8	156.1	167.3	115.3
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,783.0	2,246.6	1,602.5	1,525.6	3,274.4
TOTAL CO	(CORR 5% O2)	MG/NM3	536.7	259.4	249.6	703.4	1,151.5
TOTAL HC	(CORR 5% O2)	MG/NM3	40.8	50.1	64.1	102.9	130.2
PART MATTER	(CORR 5% O2)	MG/NM3	28.1	20.7	28.2	52.2	62.0
TOTAL NOX (AS NO2)	(CORR 15% O2)	MG/NM3	1,032.7	833.6	594.6	566.1	1,215.0
TOTAL CO	(CORR 15% O2)	MG/NM3	199.2	96.3	92.6	261.0	427.3
TOTAL HC	(CORR 15% O2)	MG/NM3	15.1	18.6	23.8	38.2	48.3
PART MATTER	(CORR 15% O2)	MG/NM3	10.4	7.7	10.5	19.4	23.0
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,356	1,094	781	743	1,595
TOTAL CO	(CORR 5% O2)	PPM	429	208	200	563	921
TOTAL HC	(CORR 5% O2)	PPM	76	94	120	192	243
TOTAL NOX (AS NO2)	(CORR 15% O2)	PPM	503	406	290	276	592
TOTAL CO	(CORR 15% O2)	PPM	159	77	74	209	342
TOTAL HC	(CORR 15% O2)	PPM	28	35	44	71	90
TOTAL NOX (AS NO2)		G/HP-HR	6.00	4.83	3.65	3.73	8.51
TOTAL CO		G/HP-HR	1.16	0.56	0.57	1.68	3.43
TOTAL HC		G/HP-HR	0.10	0.12	0.17	0.29	0.46
PART MATTER		G/HP-HR	0.07	0.05	0.07	0.15	0.21
TOTAL NOX (AS NO2)		G/KW-HR	8.16	6.57	4.96	5.08	11.57
TOTAL CO		G/KW-HR	1.58	0.76	0.77	2.28	4.66
TOTAL HC		G/KW-HR	0.14	0.17	0.23	0.39	0.62
PART MATTER		G/KW-HR	0.10	0.07	0.10	0.20	0.29
TOTAL NOX (AS NO2)		LB/HR	52.91	32.44	16.79	9.27	10.27
TOTAL CO		LB/HR	10.22	3.74	2.62	4.17	4.13
TOTAL HC		LB/HR	0.89	0.84	0.78	0.71	0.55
PART MATTER		LB/HR	0.64	0.35	0.34	0.37	0.25

Regulatory Information

EPA EMERGENCY STATIONARY			**2011 - —**	
GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 60 SUBPART IIII AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE EMERGENCY STATIONARY REGULATIONS.				
Locality	**Agency**	**Regulation**	**Tier/Stage**	**Max Limits - G/BKW - HR**
U.S. (INCL CALIF)	EPA	STATIONARY	EMERGENCY STATIONARY	CO: 3.5 NOx + HC: 6.4 PM: 0.20

Altitude Derate Data

THE TEMPERATURES LISTED IN THE CHART ARE AMBIENT TEMPERATURES. THE FOLLOWING DERATE CHART WAS CALCULATED ASSUMING A 5 DEG C RISE IN AIR TEMPERATURE BETWEEN AMBIENT AND THE TURBOCHARGER INLET.

STANDARD

ALTITUDE CORRECTED POWER CAPABILITY (BHP)

PERFORMANCE DATA[EM5402]

February 12, 2023

AMBIENT OPERATING TEMP (F)	30	40	50	60	70	80	90	100	110	120	130	140	NORMAL
ALTITUDE (FT)													
0	4,043	4,043	4,043	4,043	4,043	4,043	4,043	4,043	4,043	4,043	4,043	3,991	4,043
1,000	4,043	4,043	4,043	4,043	4,043	4,043	4,043	4,043	4,043	4,043	4,016	3,914	4,043
2,000	4,043	4,043	4,043	4,043	4,043	4,043	4,043	4,043	4,043	3,988	3,874	3,729	4,043
3,000	3,907	3,906	3,905	3,904	3,904	3,901	3,809	3,675	3,532	3,458	3,456	3,453	3,904
4,000	3,786	3,784	3,783	3,781	3,780	3,742	3,629	3,483	3,375	3,346	3,343	3,340	3,781
5,000	3,679	3,678	3,675	3,673	3,671	3,628	3,511	3,386	3,276	3,251	3,249	3,246	3,673
6,000	3,572	3,570	3,568	3,566	3,564	3,515	3,415	3,289	3,164	3,135	3,131	3,128	3,567
7,000	3,451	3,449	3,447	3,445	3,443	3,398	3,295	3,141	2,983	2,960	2,957	2,954	3,446
8,000	3,333	3,331	3,329	3,327	3,325	3,275	3,140	2,951	2,795	2,780	2,777	2,774	3,329
9,000	3,201	3,199	3,197	3,195	3,193	3,115	2,957	2,770	2,630	2,622	2,620	2,617	3,198
10,000	3,051	3,049	3,047	3,045	3,043	2,957	2,798	2,623	2,486	2,483	2,481	2,478	3,048
11,000	2,943	2,941	2,939	2,937	2,935	2,842	2,693	2,514	2,399	2,397	2,395	2,392	2,941
12,000	2,839	2,837	2,835	2,834	2,832	2,741	2,589	2,417	2,347	2,346	2,344	2,342	2,838
13,000	2,748	2,747	2,746	2,744	2,742	2,643	2,486	2,363	2,293	2,292	2,290	2,289	2,748
14,000	2,634	2,634	2,632	2,631	2,630	2,523	2,398	2,289	2,217	2,216	2,216	2,214	2,635
15,000	2,485	2,484	2,483	2,482	2,481	2,408	2,306	2,182	2,091	2,090	2,090	2,089	2,485

Cross Reference

Test Spec	Setting	Engine Arrangement	Engineering Model	Engineering Model Version	Start Effective Serial Number	End Effective Serial Number
5644208	LL2333	5898066	PG266	-	JD700379	
6351348	GG3123	6316330	PG571	XJ	JC700001	

Performance Parameter Reference

Parameters Reference:DM9600-14
PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600
APPLICATION:
Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test cell at SAE J1995 standard reference conditions. Caterpillar maintains ISO9001:2000 certified quality management systems for engine test Facilities to assure accurate calibration of test equipment. Engine test data is corrected in accordance with SAE J1995. Additional reference material SAE J1228, J1349, ISO 8665, 3046-1:2002E, 3046-3:1989, 1585, 2534, 2288, and 9249 may apply in part or are similar to SAE J1995. Special engine rating request (SERR) test data shall be noted.
PERFORMANCE PARAMETER TOLERANCE FACTORS:
Power +/- 3%
Torque +/- 3%
Exhaust stack temperature +/- 8%
Inlet airflow +/- 5%
Intake manifold pressure-gage +/- 10%
Exhaust flow +/- 6%
Specific fuel consumption +/- 3%
Fuel rate +/- 5%
Specific DEF consumption +/- 3%
DEF rate +/- 5%
Heat rejection +/- 5%
Heat rejection exhaust only +/- 10%
Heat rejection CEM only +/- 10%
Heat Rejection values based on using treated water.
Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications.
On C7 - C18 engines, at speeds of 1100 RPM and under these values are provided for reference only, and may not meet the tolerance listed.
On 3500 and C175 engines, at speeds below Peak Torque these values are provided for reference only, and may not meet the tolerance listed.
These values do not apply to C280/3600. For these models, see the tolerances listed below.
C280/3600 HEAT REJECTION TOLERANCE FACTORS:
Heat rejection +/- 10%
Heat rejection to Atmosphere +/- 50%

1/2/2024

Romeo Macatula
Carter Machinery Co.
11441 Robertson Drive
Manassas, VA 20109

Phone: 571-539-6662
E-Mail: Romeo_Macatula@CarterMachinery.com

Submittal Revision:	3
Project Reference:	CAT3516E, 2750kW
MIRATECH Kit Number:	SP-KIT-M3-SW550-TLI-23120476

Dear Romeo,

The following drawings and documents are contained in this submittal for review and signature.

Group A – Drawings & Documents (Requiring Signature)

1. Master Scope of Supply (2 Sheets)
2. M3-ACIS-3 System Interconnect
3. ACIS-3 Wiring Interconnect (3 Sheets)
4. M3Z-72-63-J-23060132 Submittal Drawing
5. Pre-Commissioning Checklist for SCR Systems
6. Water and Urea Quality for SCR Systems
7. Limits of Poisonous Substances for SCR Catalysts
8. Application and Performance Warranty Datasheet (2 Sheets)
9. Guidelines for Successful Operation of LTR™ DPF (5 Sheets)
10. Bid Specification Exceptions, Deviations, and Clarifications

Group B – Drawings & Documents (Not Requiring Signature)

1. A3C-60-HMI Controller Submittal Drawing
2. SP-CA75-ULC-19030058 Air Compressor Submittal Drawing
3. SP-VPNU75-UL-23080035 Booster Pump Submittal Drawing
4. FILTER115 Reactant Filter Submittal Drawing
5. SEN60-U-WT Dosing Box Submittal Drawing
6. DEN75-700-U Injector Submittal Drawing
7. TT-14-FLEX60-32-1112 Temperature Sensor Submittal Drawing
8. NP-18 NOx Sensor Probe Submittal Drawing
9. PT-0-40 Pressure Transmitter Submittal Drawing
10. SW550 Reactant Tank Submittal Drawing
11. US06 Reactant Tank Level Transmitter Submittal Drawing
12. LI55 Reactant Tank Level Controller Submittal Drawing

MIRATECH

Master Scope of Supply

Project Reference: CAT3516E, 2750kW
Kit Number: SP-KIT-M3-SW550-TLI-23120476

Date: 1/2/2024
Revision: 2

MIRATECH Scope of Supply		
Model Number	**Description**	**Quantity Per Engine**
SP-KIT-M3-SW550-TLI-23120476	**SCR/DOC/DPF Combo Housing, Tank, HT & Dosing System Kit**	
SP-M3-KIT-23080079	**SCR/DOC/DPF Combination Housing & Dosing System Kit**	1
M3Z-72-63-J-23060132	**DOC/SCR/DPF Housing**	-
M3Z-72-63-J-23060132-HSG	DOC/SCR/DPF Housing	1
STS-M3Z-63-23060132	SCR Tray Set	2
DTS-M3-72	DPF Tray Set	1
SCRC-044-075-450	SCR Catalyst	126
MECR-OX-SB2069-2400-1450-291	Oxidation Catalyst	4
LTR2-DPF-Filter-Block	DPF Block	72
ACIS-3	**SCR Control System**	-
A3C-60-HMI	SCR Controller	1
SP-CA75-ULC-19030058	Air Compressor	1
SP-VPNU75-UL-23080035	Reactant Pump	1
FILTER115	Reactant Filter	1
SEN60-U-WT	Dosing Box	1
DEN75-700-U	Injector	1
TT-14-FLEX60-32-1112	Temperature Sensor	2
NP-18	Bypass Probe	2
PT-0-40	Differential Pressure Sensor	1
NOX-24V	NOx Sensor	2
WH-NOX-24V-50-SL	Wiring Harness	2
FACINS-M3Z-72-63-23060132	**3" Thick Mineral Wool Insulation with Aluminum Sheathing**	1
Commissioning & Startup	**Commissioning & Startup**	Per Project
SW550.ht.ins-TLI-KIT-ADDER		
SW550.ht.ins	**Single Wall Reactant Tank, Heat Traced & Insulated**	1
TLI	**Reactant Tank Level Indicator**	-
US06	Level Transmitter	1
LI55	Level Controller	1
LM92	Level Controller Enclosure	1

Master Scope of Supply

Project Reference: CAT3516E, 2750kW
Kit Number: SP-KIT-M3-SW550-TLI-23120476

Date: 1/2/2024
Revision: 2

Customer Equipment Scope of Supply

Description	Item / Set Quantity Per Engine
Exhaust Piping entering/exiting SCR system	
Reactant Tank & Tank Level Indicator	
1/2" Reactant Drain Ball Valve	3
Expansion Joints	
26" ANSI Flange Hardware and Gasket Set	1
30" ANSI Flange Hardware and Gasket Set	1

Customer Tubing Scope of Supply

Beginning and End Location	Description
Reactant Tank - Reactant Pump Tubing	1/2" Stainless Steel Tubing - 32' Max
Reactant Pump - Reactant Tank Tubing	1/2" Stainless Steel Tubing - 32' Max
Reactant Pump - Dosing Box Tubing	3/8" Stainless Steel Tubing - 164' Max
Reactant Dosing Box - Injector Tubing	3/8" Stainless Steel Tubing - 6.5' Max
Air Compressor - Dosing Box Tubing	3/4" Stainless Steel Tubing - 65' Max
Air Dosing Box - Injector Tubing	3/4" Stainless Steel Tubing - 6.5' Max
M3 Housing Inlet - Pressure Sensor Tubing	3/16" Stainless Steel Tubing (2' Min) & 1/4" Polyurethane Tubing
M3 Post-DPF - Pressure Sensor Tubing	3/16" Stainless Steel Tubing (2' Min) & 1/4" Polyurethane Tubing

Customer Wiring Scope of Supply

Gauge and Signal Required
14 AWG - 230 VAC
14 AWG - 120 VAC
18 AWG - 24 VDC
Shielded - 18 AWG - 4-20 mA
CAT 6 Ethernet

Table of Revisions

Description	Revision	Date
Original Release	0	9/1/2023
Removed SW60 and TLI components (US06, LI55, LM92) from MIRATECH's scope of supply	1	9/14/2023
Created New Kits to Include SW550 and TLI components (US06, LI55, LM92)	2	1/2/2024

Pre-Commissioning Checklist for SCR Equipment

Project Name: CAT3516E, 2750kW
Customer Name: Carter Machinery Co.
Converter Model: M3Z-72-63-J-23060132
Kit Number: SP-KIT-M3-SW550-TLI-23120476

Date: 9/1/2023
Project Location: Various

MIRATECH	Customer	
☐	☐	Installation of converter, mixing section, control equipment and exhaust piping is complete per the supplied project drawings.
☐	☐	Installation of any heat recovery or co-generation devices is complete and is operational.
☐	☐	All wiring, including, power, load signal, run signal, and interconnects are complete per project wiring diagram.
☐	☐	All wiring and devices should be away from heat sources and accessible while the engine is in operation.
☐	☐	Isolated load signal has been verified at SCR Control Equipment
☐	☐	Run signal has been verified at SCR control equipment
☐	☐	Voltage to SCR Controller and equipment is per the ACIS-3 wiring interconnect.
☐	☐	If SCR Controller is located in enclosure the enclosure is temperature controller not to exceed 122° F and is well ventilated.
☐	☐	Engine has been successfully operated and untreated emissions have been confirmed with a calibrated analyzer to be within guaranteed levels at full and minimum load conditions.
☐	☐	The genset has the ability to operate at various loads including minimum load and 100% manufactured stated full load. If 100% manufactured stated load is not possible a load bank must be provided at time of commissioning.
☐	☐	All tubing associated with the SCR system (urea supply, urea return, air injection, urea injection, and exhaust gas sample if required) are properly installed per the project piping diagram and free of debris.
☐	☐	Urea in accordance with the MIRATECH Specification is on site and has been supplied and tested by an approved vendor. Attach copy of the urea analysis.
☐	☐	Engine is available to be out of operation for 24 hours prior to entering the converter housing and for 8 hours during the catalyst loading process.
☐	☐	All equipment and labor required for handling catalyst during the catalyst loading process has been coordinated with MIRATECH Technical Services Department, will be on site, and available for use.
☐	☐	Safety alarms, annunciation, and engine shutdown sequence are programmed and tested.
☐	☐	Engine and qualified operator will be made available to MIRATECH Technical Service personnel and will be available to be locked at various loads upon request.

Customer Signature Date

MIRATECH Representative Date

Company Name

WATER AND UREA QUALITY FOR SCR SYSTEMS

1/21/2021

Water Quality

The water quality of urea or ammonia solutions for SCR units is critical for the overall performance. Solid and solubilized substances contained in water create particles that can clog the honeycombs or injector, reducing life and performance. The increased number of particles also increases the cleaning frequency of the system components. Furthermore, these particles are commonly composed of known catalyst poisons, which can reduce catalyst performance.

The recommended specifications to minimize catalyst clogging and poisoning from substances coming from the water are:

- Utilization of demineralized water for urea or ammonia solutions. This can be done by reverse osmosis or by utilizing ion exchange cartridges.
- Salt should be minimized because it can create solid deposits. Salt content of the water should be below 0.005 lb/gal

Caution: Water softening cartridges (Ca- and Mg- Ion exchangers) cannot be utilized. These cartridges cannot remove evaporation residues, or remove them only in part. These cartridges use Na as an exchange ion for Ca and Mg.

Urea Quality

Chemical Names: Urea, Carbonyldiamide, Carbamide
Molecular Formula: $(H_2N)_2CO$
Molecular Weight: 60.06

The urea used in the SCR injection solution should be commercial or technical grade (99.45% pure). A typical solution consists of 32.5 wt% or 40 wt% urea. This can be obtained from mixing urea granulates and water or purchased in a solution form. The urea consumption of an SCR system will vary depending on the urea concentration used. It is important to check the SCR system proposal to ensure that the correct urea concentration is used for the design of the system. As urea dissolves it absorbs heat from the solution which can make it dissolve slowly. If mixing the urea solution, hot water is recommended to decrease the dissolving time, or an immersion heater should be added to the tank.

Storage and Safety

32.5% and 40% urea solutions can begin to stratify or form precipitates when temperatures fall below 32 F. This can cause the urea concentration to be inconsistent in the tank or could result in solid deposits on the bottom of the tank. For this reason it is recommended to keep the urea solution above freezing temperatures. Because of the risks of chemical reactions, urea must be kept away from nitrates and substances that contain nitrites. They must also be transported in separate containers. Urea is not classified as a dangerous substance, but should be stored carefully because of small concentration of ammonia vapors on the surface of urea solutions.

Chemical Analysis of Commercial/Technical Grade Urea

	Value
Specific Weight (at 68 °F)	69.4 lb/ft^3
Biuret	< 0.30 wt%
Aldehyde	< 5 ppm
Insoluble	< 20 ppm
Phosphate	< 0.5 ppm
Calcium	< 0.5 ppm
Iron	< 0.5 ppm
Copper	< 0.2 ppm
Zinc	< 0.2 ppm
Chromium	< 0.2 ppm
Nickel	< 0.2 ppm
Aluminum	< 0.5 ppm
Magnesium	< 0.5 ppm
Sodium	< 0.5 ppm
Potassium	< 0.5 ppm

Limits of poisonous substances for SCR catalysts

Element	Symbol	Max concentration in fuel			Effect	
		Liquid bio-fuels[05]	Liquid fossil fuels	Gaseous fuels	SCR	Oxi/ Filter
		[mg/kg] (elementary)				
Aluminium	Al	0.5	0.5	0.5	02	02
Antimony	Sb	0.5	0.5	0.5	02	02
Arsenic	As	1	0.2	0.2	04	02
Lead	Pb	0.5	0.5	0.5	03	04
Boron	B	0.5	0.5	0.5	02	02
Bromine	Br	1	1	1	02	02
Cadmium	Cd	1	05	0.5	02	04
Calcium	Ca	12	5	5	02	02
Chlorine	Cl	1	5	5	03	02
Chromium	Cr	0.5	0.5	0.5	02	02
Iron	Fe	15	0.5	0.5	03	02
Fluorine	F	1	0.5	0.5	03	02
Iodine	J	1	1	1	03	02
Potassium	K	5	1	1	04	02
Cobalt	Co	0.5	0.5	0.5	02	02
Copper	Cu	0.5	0.5	0.5	02	02
Lithium	Li	0.5	0.5	0.5	02	02
Magnesium	Mg	12	5	5	02	02
Manganese	Mn	0.5	0.5	0.5	02	02
Molybdenum	Mo	0.5	0.5	0.5	02	02
Sodium	Na	8	5	5	03	02
Nickel	Ni	0.5	0.5	0.5	03	02
Phosphorous	P	16	5	5	04	02
Mercury	Hg	0.5	0.5	0.5	04	04
Sulfur	S	20	15'000 [06]	20	01	03
Selenium	Se	0.5	0.5	0.5	02	02
Silicon organic	Si	0.5	0.5	0.5	03	03
Silicon inorganic	Si	15	15	15	02	02
Tin	Sn	0.5	0.5	0.5	02	03
Vanadium	V	1	15'000 [07]	1	01	04
Zinc	Zn	0.5	0.5	0.5	03	03

01 *Positive effect*
02 *Lightly harmful*
03 *harmful*
04 *strongly harmful*
05 → *Limitations*
06 → *Limitations*
07 → *Limitations*

The limits of catalyst poisons in the exhaust gas can be calculated as follows ($\lambda \cong 2$):

$$\frac{\text{Limit in fuel [mg/kg]}}{30} = \text{Limit in exhaust gas [mg/kg]}$$

In the exhaust gas there are also the poisons that originate in the lube oil. According to our experience the common, approved lube oils do not harm our catalyst. Exceptions see "Guidelines to catalyst lifetime"

The reactant that is used for the SCR reaction has to be free of catalyst poisons, see also C.00214 "Reactant specifications"

Limitations:

05 Phosphorous

Fuel	Phosphorous-content	Limitations
Bio fuel	P ≤ 16 mg/kg	• SCR volume needs to be adapted (→ layout rules for SCR catalyst)

06 Sulphur

Fuel	Sulphur content	Limitations
Light fuel oil (Diesel)	S ≤ 0,1%	• No Limitations
Marine fuel oil MDO	S > 0,1%	• No precious metal oxidation catalyst (Pt, Pd)
Heavy fuel oil HFO	S ≥ 0,5%	• No Oxidation catalysts • Dust blowers for all catalyst layers
Heavy fuel oil HFO	S ≥1,5%	• Special case, requires detailed analysis

07 Vanadium

Fuel	Vanadium content	Limitations
all	V > 1 mg/kg	• No Oxidation catalysts

Application & Performance Warranty Data

Project Information

Site Location:	Various
Project Name:	CAT3516E, 2750kW
Application:	Standby Power
Number Of Engines:	Various
Operating Hours per Year:	100

Engine Specifications

Engine Manufacturer:	Caterpillar
Model Number:	3516E
Rated Speed:	1800 RPM
Type of Fuel:	Ultra-Low Sulfur Diesel (ULSD)
Type of Lube Oil:	1 wt% sulfated ash or less
Lube Oil Consumption:	0.1 % Fuel Consumption
Number of Exhaust Manifolds:	1

Engine Cycle Data

Load	Speed	Power	Exhaust Flow	Exhaust Temp.	Fuel Cons.	NO_x	CO	NMHC	PM_{10}	O_2	H_2O
%		*bhp*	*acfm (cfm)*	*° F*	*gal/hr*	*g/bhp-hr*	*g/bhp-hr*	*g/bhp-hr*	*g/bhp-hr*	*%*	*%*
100	Rated	4,043	22,051	897	192.9	6	1.16	0.1	0.07	9.4	10

Emission Data (100% Load)

Emission	Raw Engine Emissions						Target Outlet Emissions						Calculated Reduction
	g/bhp-hr	*tons/yr*	*ppmvd @ 15% O_2*	*ppmvd*	*g/kW-hr*	*lb/MW-hr*	*g/bhp-hr*	*tons/yr*	*ppmvd @ 15% O_2*	*ppmvd*	*g/kW-hr*	*lb/MW-hr*	
NO_x*	6	2.67	496	966	8.046	17.74	0.5	0.22	41	81	0.671	1.48	91.7%
CO	1.16	0.52	157	307	1.556	3.43	0.35	0.16	47	92	0.467	1.03	70%
NMHC**	0.1	0.04	24	46	0.134	0.3	0.05	0.02	12	23	0.067	0.15	50%
PM_{10}	0.07	0.03	22	43	0.094	0.21	0.02	0.01	7	14	0.03	0.07	68.6%

* MW referenced as NO_2

** MW referenced as CH_4. Propane in the exhaust shall not exceed 15% by volume of the NMHC compounds in the exhaust, excluding aldehydes. The 15% (vol.) shall be established on a wet basis, reported on a methane molecular weight basis. The measurement of exhaust NMHC composition shall be based upon EPA method 320 (FTIR), and shall exclude formaldehyde.

System Specifications (SP-KIT-M3-SW550-TLI-23120476)

DOC/SCR/DPF/ACIS-3 Kit System Specifications (M3Z-72-63-J-23060132-R4, ACIS-3, Commissioning & Startup, FACINS-M3Z-72-63-23060132, SW550.ht.ins, TLI)

SCR Catalyst Space Velocity:	11,234 1/hr
Sound Attenuation:	25-30 dBA insertion loss
Reactant:	Urea
Percent Concentration:	32.5%
Design Exhaust Flow Rate:	22,051 acfm (cfm)
Design Exhaust Temperature[1]:	897° F
Exhaust Temperature Limits:	572° F – 977° F
Minimum Regeneration Temperature[2]:	500° F
SCR Catalyst Volume:	45 ft³
System Dosing Capacity:	60 L/hr
System Pressure Loss:	17.0 inH_2O (Clean)
Total Catalyst Volume:	45 ft³
Estimated Reactant Consumption:	13.5 gal/hr (51 L/hr) / Per Engine

Special Notes & Conditions

1. For housings and exhaust components that are insulated, internally or externally, please refer to the Limited Warranty section of the negotiated Terms and Conditions document to prevent voiding MIRATECH product warranty. - Carbon steel is suitable for temperatures up to 900° F / 482° C continuously, when covered with external insulation or a heat shield. For continuous operation above 900° F / 482° C, where the equipment is externally insulated or has a heat shield, stainless steel should be used.

2. Diesel Particulate Filters depend on exhaust temperature to keep soot regenerated and the filter back pressure within acceptable levels. If the engine will be operated consistently at low loads/low exhaust temperatures, the customer should make provisions to add load via facility operations or a load bank. Refer to the included *Guidelines for Successful Operation of LTR™ DPF*.

- A packed silencer installed upstream of the MIRATECH catalyst system will void MIRATECH's limited warranty.
- Any sound attenuation listed is based on housing with catalyst elements installed.
- MIRATECH Corporation warrants that the emissions reductions requested for this inquiry will be achieved at the design and test load point as outlined in the proposal. Tier 4 is an engine certificate designation, not an actual tons/yr or g/bhp-hr measurement. MIRATECH will utilize the engine manufacturer's emission data at 100% load to provide our warranty. This is the maximum volume potential point for pollutants to be emitted. Permitting is normally done on a mass flow or tons per year basis, therefore the system will be sized accordingly. The MIRATECH design is to achieve the blended Tier 4 emission targets from the D2 test cycle, measured at 100% engine load conditions.
- Any emission reductions listed are based on housing with catalyst elements installed.

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Safety Power ecoCUBE® SCR Emission Control System

CAT 3516E (2,750kW) Diesel Generator Sets

Prepared for: Carter CAT
Tim Long Ph. 540-682-2544 Dated December 20, 2023

Prepared by:

Safety Power Inc.
Jacob Rozenblit
Applications Engineering Manager
Office (514) 927-2898
Fax 416.477.2709
www.safetypowerinc.com

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SUMMARY

The submitted pricing is based on the supply and commissioning only – installation will be by OTHERS.

Overview	Item Description	Price (USD)
Engine	Engine Option	CAT 3516E
ecoCUBE® System	System Style	**SCR + DPF**
	ecoCUBE® Part #	(9550-H3C29)
	Factory installed sensors & reactor wiring	Included
	4" insulation & metal cladding	Included
	Commissioning & training (allocation = 2 days/system, excludes travel & living)	Included
	CP100 control and dosing panel	Included
System Accessories	Breather Valve, Urea Tank	
	Dual Tankless Compact Oil-less Air Compressor	
	Level Sensor, Urea Tank	
	270 USG (1023 L) single wall urea tank w/ fittings	

Safety Power Inc
26-5155 Spectrum Way
Mississauga, On L4W 5A1
Canada
www.safetypower.com

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*270 USG urea tank added per Carter CAT request. Please note that this tank does not comply with AWS spec. The spec asked for a custom subbase tank with 36hr capacity. This is a standard HDPE tank which will provide about 26hours at full engine load operation.

Safety Power is a global innovator and a leading supplier for large stationary engines. Safety Power has the **technical resources** to provide support during installation and throughout the life of the equipment.

Key features and benefits of the proposed system include:

- Safety Power's ecoCUBE® system will be designed with its proprietary **Closed Loop control** system to provide NOx emissions reduction performance throughout varying engine loads while minimizing ammonia slip
- SCR reactor housing, mixing duct are fabricated from durable **409 stainless steel** and the static mixers, turning vanes and injection lance from **304 stainless steel.**
- The proprietary catalyst used in the SCR reactor is a homogeneous design providing superior emissions reduction in a compact configuration with superior spalling and degradation resistance over the life of the catalyst.
- The SCR control and dosing system is designed with an industrial grade **urea injection pump system** for maximum reliability and precise control
- Each ecoCUBE® equipped with DPF includes Safety Power's patented **Internal Diverter Valve** technology that continuously monitors overall system backpressure and will automatically divert a portion of exhaust gas flow to prevent exceeding Engine OEM max allowable back pressure. Passive regeneration of the DPF is promoted without the addition of external heat source.
- All ecoCUBE® emissions control systems are capable of withstanding operating pressures up to 40" W.C., further design pressure can be achieved if required.
- The system supplied comes equipped with **remote monitoring & diagnostics** capability
- The system comes supplied with all necessary exhaust temperature, differential pressure and NOx sensor field instruments for monitoring and control

The ecoCUBE® system proposed by Safety Power has been tested & verified by independent consultants and regulatory authorities to meet some of the toughest global emissions standards.

Included within this proposal is the recommended servicing of the ecoCUBE® units.

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Table of Contents

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DESIGN PARAMETERS

The design of the Safety Power emissions reduction system is based on the following conditions.
Note: NOx is calculated as NO_2.

Table 1 – Engine Data

Engine Type:	CAT 3516E
Application	Stand-by
Engine Power	2750 ekW
Exhaust Temperature	897 °F
Design Exhaust Flow Rate	21724 (CFM)
Fuel Type	Diesel

Table 2 – Emissions Data at Full Engine Load

Engine Option	Emissions	Not to Exceed Catalyst Inlet (g/bhp-h)	Emissions Requirement (g/bhp-h)	Catalyst Outlet (g/bhp-hr)	Catalyst Outlet (g/kwh)	Catalyst Outlet (lbs/MW-h)	Catalyst Outlet (ppmvd at @15%O2)	Catalyst Outlet (% reduction)
CAT 3516E (2,750 ekW)	NOx	6.0	0.50	0.50	0.67	1.62	40	91.9
	CO *	1.16	2.60	0.23	0.31	0.75	31	80.0
	VOC *	0.10	0.14	0.06	0.08	0.18	5	60.0
	PM	0.07	0.022	0.022	0.03	0.07	***	75.6

* Reductions assume an exhaust temp of 662 degF (350 degC) or more.
*** Particulate matter is a mass quantity and must be determined and reported gravimetrically. As per EPA Method 5 measurement method, PM emissions should not be reported in ppmvd. We would always advise that PM measurements to be taken with front half as this is the most appropriate for this application.

Table 3 – SCR System Data

Engine Option	CAT 3516E
Max. Ammonia Slip @ 15% O2	8 ppm
Urea Consumption - 32.5% solution (+/- 15%)	10.3 USG/hr
System Pressure Loss	19.5" WC
System Inlet/Outlet ANSI Flange Inches	28/28

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SOUND ATTENUATION

The ecoCUBE® systems will provide the following sound reductions:

Description	CAT 3516E
Insertion Loss (IL) dB*	35-42

*(1) All stated sound reductions assume 1/1 octave band resolution, from 63 Hz to 8000 Hz.
(2) If engine datasheet does not include complete sound data from the 63 Hz to 8000 Hz frequency range, then the above analysis and guarantee is limited to the frequency range that was provided.
(3) Insertion loss (IL) measured based on ISO 6798-1995 in a survey grade 3 environment.
(4) SPL predictions assume hemispherical sound propagation; it does not account for site-specific conditions.
(5) For outdoor or enclosure mounted ecoCUBE®s, acoustic measurement point is assumed to be at least 7 meters laterally from the enclosure wall (or SCR wall if no enclosure), at a height of 1.5 meters above ground.
(6) For indoor ecoCUBE®s, acoustic measurement point is assumed to be to be at least 7 meters from the edge of the stack opening, perpendicular to the axis of the stack.

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ECOCUBE® SYSTEM SCOPE OF SUPPLIES AND SERVICES

Table 4 – Components Supplied for Each System

ecoCUBE System Components Description (For Each Engine)	CAT 3516E
1. Reactor Assembly (Part Number)	**5 Series (9550-H3C29)**
1.1 ecoCUBE system configuration	SCR + DPF
1.2 ecoCUBE SCR Reactor assembly 409 s/s c/w temperature, pressure and NOx sensors	1
1.3 Reactor assembly weight with catalyst	12,450 lbs
1.4 SCR Catalyst - layers of catalyst material (each system)	3
1.5 DPF Filter Modules	29
2. Control and Dosing Assembly	
2.1 Control Panel – with embedded control, on-off switch, on-off status indicator light, and power distribution. Ability for remote monitoring and troubleshooting if Internet connection provided. Dosing System – with automatic flow rate adjustment, system purge valve, air regulator, air pressure switch, check valves, overpressure regulator and injection valves, injection pumps.	Included
3. Insulation of each ecoCUBE with 4 inches MW insulation and metal cladding. Note: skin surface temperature does not exceed 70 deg C except for exhaust and access door flanges.	Included
4. Duration of warranty (warranty is limited to parts only):	24 months
5. Commissioning (excludes travel expenses)	Included
6. Operation & Maintenance Manuals (digital version)	Included

SCR Commissioning/Training

Our normal practice is to complete this activity on a time and material basis to allow greater flexibility to meet the customer's schedule. Proposal includes 2-day cost allowance per engine as noted above plus technical support during design and installation as noted. Any additional time required as a result of delays not caused by Safety Power will be charged at $1,600 per day or part thereof. Travel and living will be charged at cost.

SCR commissioning requires a customer supplied load bank to operate the generator at various load points and establish the controls load map. The customer should allow 4 hours per machine for the SCR load map to be established, 4 hours of testing and verifying SCR system operation, and where required, 1 hour for a third party witnessing of the SCR operation and performance.

The customer MUST provide a minimum of 2-weeks notification for the scheduling of the SPI pre-commissioning inspection and a minimum of 2-weeks between pre-commissioning and commissioning activities.

System Maintenance

The honeycomb catalyst installed in the ecoCUBE® system is supplied by Safety Power to ensure reliable performance over the life of the system. Operating in accordance with the manufacturer's recommendations the catalyst is warranted from defects 8,000 operating hours or 2-years pro-rata, whichever comes first. Periodic inspection of the catalyst by measuring and noting the differential pressure across the catalyst should be the only maintenance required over the life of this system.

NOTE: Safety Power's Warranty coverage does not negate the requirement for annual maintenance and inspection of the system to ensure peak performance. During the Warranty Period any parts found to be defective will be replaced at no additional charge. Safety Power recommends a minimum of one visit per year to inspect, clean and adjust the system.

Periodic Inspection

1. Prior to operation of the generator check urea tank and top up if necessary. Use a urea concentration analyzer to verify that the urea is at a concentration of approximately 32.5% by weight.

2. Visually inspect all urea fittings, dosing pump, urea lines for signs of leaks and correct if necessary. Leaks will be evident by signs of crystallization.

3. Check SCR control panel for programming faults. If any faults are observed contact your Safety Power™ technical representative.

4. Ensure secure power to the control panel and dosing system.

5. Check that air compressor is operational and receiver is charged and there are no leaks.

Annual Maintenance & Testing

In order to ensure the reliable operation and performance of the SCR system periodic maintenance is required. Safety Power recommends that the owner enter into a service agreement with Safety Power. Annual maintenance inspections include but not limited to:

Scope of Work (Maintenance, Inspection, Warranty Repairs)
Frequency: Every Twelve (12) Months

Prior to the Measurement & Verification services Safety Power's Technician will carry out the following recommended maintenance & inspection services:

1. Air compressor – inspect and as required adjust pressure for atomization and purging functions.

2. Inspect SCR catalyst - by comparing delta pressure changes since the last inspection found in historical data-logger. Note differential pressure for final report.

3. If included, inspect DPF cartridges – by comparing delta pressure (dP) changes since last inspection found in historical data-logger. Note dP pressure for final report.

4. Check injection lance - done by verifying flow at various engine loads. Once every 500 operating hours (SCR) remove and visually inspect injection nozzle for build-up and wear due to exposure to high temperatures. The lance tip may need replacement after several years (5 - 10) as it is exposed to high temperature - the replacement parts are not covered by the Service Agreement.

5. Inspect system for urea and air leaks. Tighten fittings as needed.

6. Inspect dosing pump. Verify pump operation. Typically, the replacement parts may include the gear assembly required after several years (5 - 10) – replacement parts are not covered by the Service Agreement.

7. Check urea level in day tank prior to measurement & verification testing. Check urea concentration using a urea concentration analyzer.

8. Participate in testing of the generator to ensure the total system functions in conjunction with the generator controls.

9. Check control panel PLC software revision and upgrade to most recent revision if applicable. The cost of maintaining the most current revision of software for the SCR system is included in the Service Agreement.

Scope of Work (Measurement & Verification)
Frequency: Every Twelve (12) Months

Sampling will be performed as follows:

- One sample for oxides of nitrogen (NOx) will be collected from the exhaust of each of the generators. Sampling will be performed utilizing a calibrated portable combustion analyzer using accepted procedures for the Determination of Nitrogen Oxides Emissions for Stationary Sources.

- Sampling will be performed at each unit (after approximately 15-minute warm-up period) for a period required to show stable operation of the unit (expected to be 15 to 20 minutes in length).

- Results will be reported as lbs/hour NOx at 15% oxygen.

During sampling Safety Power's Technician will monitor and record the engine loads and other operating conditions including the feed rate of Urea for inclusion in the final report. Safety Power will obtain the manufacturer's specification data for each of the engines to determine exhaust flow rates during testing.

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EXCLUSIONS & EXCEPTIONS

1. Installation of SPI supplied equipment is by OTHERS.
2. Transition ductwork from ecoCUBE® to stack.
3. Connection from engine exhaust to ecoCUBE® inlet.
4. Gaskets used upstream of the ecoCUBE® shall not contain silica as this can harm the catalyst and will void the catalyst warranty.
5. Structural supports or anchors
6. Power supplies for SCR control panel, air compressor or urea transfer pump skid.
7. Engine on/off signal – Note: required for automatic starting of ecoCUBE® system.
8. Permits and/or certification testing, etc.
9. Emissions performance will be met provided that the actual engine emissions parameters correspond to the engine data sheet and that the fuel composition information provided corresponds to conditions at the site.
10. NOx reduction is achieved once SCR catalyst temperature exceeds 540 degF
11. Certain regulators may require the use of specific components that have been pre-certified to their standards. Unless stated otherwise in this proposal, Safety Power's guarantee is based on emissions performance of its entire system; there is no guarantee that the system contains specific internal components required by a local regulator.
12. Urea piping from urea tank(s) to the dosing panel. Urea and air piping between dosing panel and injection lances.
13. Customer to ensure that any gaskets upstream of ecoCUBE® are rated for the appropriate engine exhaust temp. Decomposition of gasket material may poison catalyst and will void catalyst warranties offered by Safety Power.
14. Air compressor connections (electrical and tubing). Note: a clean dry supply of air (as per ISO 8573.1 Class 1.4.2) 10CFM @ 80psi per system is required.
15. **Please refer to AWS Clarifications - Safety Power - Apr 21, 2023.pdf for additional clarifications specific to AWS**

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COMMENTS, CLARIFICATIONS & CUSTOMER REQUIREMENTS

1. This proposal is based upon full load engine data.
2. The Urea used shall be 32.5% concentration (ISO 22241 standard). The dosing panel, tanks and lines with urea must be protected from freezing e.g. by heat tracing and insulating, locating the panel, tank & lines in an area that is maintained at a temperature above the freezing temperature. Set heat trace to 5°C (41°F). Optionally use Unitherm part No. 2266-44B49-141012.
3. Systems with diesel particulate filters (DPF) must be operated with ultra-low sulfur diesel only. In order to properly regenerate the DPF canisters the temperature must be above 280°C (536°F) for 30% of the engine operating time and greater than 40% engine load.
4. **Please note that a load bank would be required to periodically regenerate the DPF filters.**
   - Under ideal conditions the system can accommodate up to 24 cold starts or more. That said, regeneration may be required in as little as 18 cold starts depending on operating conditions. Depending on the number of cold starts and other items related to use of the system, Diesel Particulate Filters may require regular cleaning. The SPI system incorporates a virtual soot sensor which indicates the number of expected Run Hours Available (RHA) so that the operator is aware of when the next cleaning cycle is required. It is important that the operator monitor RHA to avoid high engine back pressure. **Safety Power recommends that operators monitor RHA & dP across the DPF system and regenerate the system based on observed conditions. The minimum regeneration temperature is 260 degC.**
   - 10% Load Run Time: 180-720 minutes, depending on the available pressure drop in the exhaust system and the engine loading/transient heat up time performance.
   - 80% and 100% Load, Hours of Run Time: regeneration time 1- 2hrs. This varies based on soot load and if periodic load tests have been completed.
5. Unless expressly included in SPI's scope of supply the responsibility for allowing for thermal expansion of the products supplied by SPI is "by others".
6. Under no circumstances should the ecoCUBE® be placed downstream of a silencer with absorptive acoustical material.
7. SCR commissioning requires a customer supplied load bank to operate the generator at various load points and establish the controls load map. The customer should allow 4 hours per machine for the SCR load map to be established, 4 hours of testing and verifying SCR system operation, and where required, 1 hour for a third party witnessing of the SCR operation and performance.
8. A 4-20mA signal proportional to engine load must be provided and connected into ecoCUBE® control panel. Customer must provide the current transducer and current transformer for 1-phase.
9. An ethernet connection with access to the internet through Port 80 is requried for each ecoCUBE® control panel; this connection is used for remote montioring, product support and client web browser access.
10. Siloxanes can't be present in the exhaust stream as they will poison the catalyst. Please note that the presence of Siloxanes in the exhaust will void Safety Power's warranty.

11. Please note that a $600/ecoCUBE® shrink wrapping fee will be charged for any unit that's being shipped more than 120 miles away on a flatbed truck, or if the project is delayed by more than 2 weeks which will result in the requirement for outside storage. Please note that storage fees may apply for projects delayed by more than 4 weeks.
12. HDPE (high-density polyethylene) urea storage tanks are designed for atmospheric pressures only. Piping to/from the tank must ensure that no static head from either the vent or fill connection can occur. HDPE tanks situated below grade and filled from a grade level fill station will require the vent to be open to the same room/level as the tank and at at a height no greater than 10" above the top of the tank. Pressurized installations will require the use of a stainless steel tank engineered for the customer's specific site requirements.
13. Access considerations should be made for servicing of the ecoCUBE® components. If the ecoCUBE® reactor is placed on a roof or platform, either a walk way or fall arrest tie off points should be provided by others. If the site will not have safe access for work done on ecoCUBE® reactors on a roof or platform then the optional integrated fall arrest tie off points on the ecoCUBE® reactor housing must be purchased.
14. For outdoor SCR installations, shell/breakout noise of SCR reactor cannot be attenuated via downstream muffler/silencer.
15. **Please refer to AWS Clarifications - Safety Power - Apr 21, 2023.pdf for additional clarifications specific to AWS**

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Technical Guarantee

The system and catalytic material shall be warranted in accordance with the standard Performance & System Warranty (attached).

Safety Power warrants the quality and suitability of the materials, design and construction of the supplies and services and their qualification for the application. Provided the design data is adhered to, Safety Power guarantees the output values as shown in Table 2 and the Performance & System Warranty.

The maximum allowed temperature entering the Catalyst is 950°F (for NOx reduction). Above 950° F, the SCR catalyst activity can be degraded over time. System performance can't be guaranteed if large variations exist in the full load NOx output of the engine (> +/- 20%) while the generator is operating at a steady state electrical output.

If the engine runs with an exhaust temperature below 410°F (for ULSD or Pipe Line Natural Gas), the SCR control system will stop the injection of urea. This will prevent the formation of ammonium (bi) sulfate on the SCR catalyst surface. Full load NOx reduction will not be achieved at exhaust temperatures less than 540°F.

The SCR Catalyst is warranted from defects for a period of 8,000 hours (2-years pro-rata), based in accordance with the operation manual. If the proposed system also includes an Oxidation Catalyst or Oxidation Catalyst Modules, this catalyst is warranted for 8,000 hours (2-years pro-rata), based in accordance with the operation manual. Any deficiencies in the supplies and services provided by Safety Power must be reported by the buyer in writing without delay. These deficiencies will be remedied to the exclusion of any further guarantee claims and rights, accordingly to our warranty statement and our standard terms and conditions. The supplied equipment, excluding the catalyst and labor, is guaranteed for 12 months starting from the date of commissioning and acceptance of the system but no longer than 18 months after delivery or purchase order required ship date. This warranty is not transferable.

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Appendix B – Performance & System Warranty & Limitation of Remedy & Liability

1) Safety Power Inc (SPI) strictly for the period (12 months from date of acceptance), warrants subject to all terms and conditions herein, that the catalyst furnished by Safety Power, when operated in accordance with the Design Criteria and Recommended Maintenance section of proposal , shall provide minimum contaminant removal/destruction efficiency (xx%) or not exceed maximum allowable unconverted contaminant concentration (xx%) in the stack gas, whichever is less stringent, as shown in drawing DC-01. Any other performance curves submitted are for the Buyer's convenience and the performance indicated thereon is not offered by SPI, and not to be construed by the Buyer as a proposal or contractual obligation. The term "contaminant removal/destruction efficiency" shall be defined:

$$\frac{[\text{Emissions}]_{in} - [\text{Emissions}]_{out}}{[\text{Emissions}]_{in}} \times 100\%$$

Following commissioning & acceptance, performance tests, if required, will be conducted at Buyer's expense. The emissions reduction system shall be considered accepted based on the Final Commissioning.

Evidence of noncompliance, including catalyst performance test data shall be submitted promptly in writing by Buyers to SPI, SPI reserves the right within 30 days notice of noncompliance, with proper notice to Buyer, to perform any analytical measurements for the purpose of determining compliance or noncompliance with performance and operating conditions. Failure of Buyer to meet any conditions set forth in this paragraph shall relieve SPI of any responsibility under this warranty.

2) In the event the catalyst fails to perform as described in Paragraph 1 above, SPI shall have the option of either:

a) Replacing FOB shipping point, the non-performing catalyst.
b) Providing FOB shipping point, additional catalyst.
c) Make whatever repairs or modifications to the catalyst configuration it considers necessary to enable the catalyst to meet guarantees. The cost of providing such modifications, including materials, labour and engineering shall be borne by SPI during the Warranty Period. Costs of installing modifications shall be borne by SPI, provided SPI or its designate performs such modifications.
d) Refund purchase price to customer in exchange for return of SPI equipment.

In the event SPI chooses to provide a replacement charge of catalyst, Buyer agrees to provide adequate access for the field installation for the new catalyst and return the original catalyst to SPI and accept replacement catalyst as fulfillment of all obligations borne by SPI and agrees to make no further demands.

For the avoidance of doubt, the election by SPI of any of the above remedies shall not extend the warranty period.

3) The maximum liability of SPI under this warranty shall not exceed the system purchase price. SPI, in no event shall be liable for production losses or indirect or consequential damages resulting from failure to meet warranty. SPI shall not be held liable for any damages resulting from unauthorized changes or modifications, nor from a failure to follow proper operation and maintenance procedures as provided in the Safety Power Inc. Operation and Maintenance Manual, nor from a failure to follow proper operation and maintenance procedures for the engine and generator set.

4) After expiration of the catalyst base warranty in 1) above, The SCR catalyst and oxidation catalyst (if included) material supplied is warranted (2-years pro-rata) and (2-years pro-rata) respectively for materials and workmanship from date of acceptance. During the Pro-Rata Warranty period Safety Power will be responsible for the catalyst replacement cost proportional to the number of hours remaining on the warranty. For example, if the catalyst pro-rata warranty is valid for 8,000 hours, the seller will be responsible for the portion of the replacement cost proportional to (8,000-N / 8,000), where N is the number of hours the catalyst has been in service. Provided the design and installation of the exhaust system is per NFPA 68, this Pro-Rata Warranty will include catalyst damage caused by engine backfire or other engine malfunction. This extended Pro-Rata Warranty is for materials only. Buyer is responsible for shipping and labour costs to remove and supply. Buyer agrees to promptly notify SPI, in writing of its claim under this warranty coverage. Failure to notify SPI voids this warranty.

5)

a) The following contaminants are known catalyst deactivators and contribute to shortened catalyst life; heavy and base metals such as lead, mercury, arsenic, antimony, zinc, copper, tin, iron, nickel, chromium, sulfur and phosphorous. Hence the total content of these elements(s) analyzed on the catalyst by quantitative methods must not exceed 10 grams/ft3 with the exceptions shown below in 5(c). **Contaminants in excess of these amounts shall void the warranty.**

b) Exposure to excessive temperatures significantly reduces catalyst life. At no time shall the catalyst outlet temperature be permitted to exceed 950°F for more than 15 minutes during any 24 hour period. Normal continuous operating temperature shall not exceed 915°F. The housing may be damaged if temperature exceeds 1000°F. **Operating the system above these temperature limits will void the warranty.**

c) Chlorinated compounds in the exhaust shall not exceed 10 ppm. Sulfur compounds in the exhaust shall not exceed 5 ppm. Silicon compounds in the exhaust are not to be present. **Contaminants in excess of these amounts shall void the warranty.**

d) Periodic cleaning of particulates, etc., may be found necessary to maintain catalyst activity. If required, this shall not be construed as evidence of catalyst non-performance. For systems with Diesel Particulate Filters (DPF) the warranty does not cover plugged filters. Buyer shall conduct catalyst and DPF cleaning in strict accordance with SPI procedure during warranty period.

System Warranty

6) The warranty period for the SCR reactor housing, urea injection and control system is (12 months from date of acceptance) set forth in the Warranty Section of proposal but not longer than 18 months after delivery or PO required ship date. This warranty assumes that the Buyer adheres to proper operation and maintenance procedures as provided in the Safety Power Inc. Operation and Maintenance Manual. The items listed in items a) through g) below should be considered when using the Safety Power Inc. emissions reduction system:

a) The warranty for the urea injection system does not include parts that need to be replaced due to normal wear from use of the system. The following are considered normal wear parts: spray nozzle liquid cap and air cap, pumps, urea filters, pressure gauges, valves, and flow meters.

b) The functionality of the SCR system is based on the Buyer purchasing a urea that is compatible with the Safety Power Inc. injection system and catalyst. A urea solution that is high in particulate matter may cause the urea filter to clog prematurely. A urea solution that contains high concentrations of the known catalyst poisons stated in section 5a will result in premature failure of the SCR catalyst. Failure to use a Safety Power approved urea supplier will void the warranty.

c) The Safety Power urea injection system was designed based on the information in the Design Parameters Section of proposal

d) Unless otherwise expressly indicated in the Proposal, use of fuels containing in excess of 15 ppm sulphur or other contaminants will void the warranty.

e) Unless expressly included in SPI's scope of supply the responsibility for allowing for thermal expansion of the products supplied by SPI is "by others". Any damage caused as a result of inadequate thermal expansion allowance at installation or design time is not the responsibility of SPI.

f) Provided the exhaust system meets design criteria as stipulated in NFPA 68, damage to the System caused by an engine backfire or other engine malfunction is covered by the warranty.

g) Unless otherwise expressly indicated in the Proposal, this warranty is for materials only. Buyer is responsible for shipping and labour costs to install or replace any of the materials supplied by SPI.

h) The supply of replacement parts under this warranty shall not extend the warranty period.

7) THE LIMITED WARRANTY PROVIDED ABOVE IS THE SOLE AND EXCLUSIVE WARRANTY OF SPI IN CONNECTION WITH THE SUPPLY OF THE SPI CATALYST SYSTEM. SPI MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR ANY PARTICULAR PURPOSE. FURTHER, THE LIMITED WARRANTY SET FORTH DOES NOT APPLY TO THE RESULTS OF ACCIDENT, ABUSE, NEGLECT, VANDALISM, ACT OF GOD, USE CONTRARY TO SPI'S INSTRUCTIONS OR THE TERMS AND CONDITIONS OF THIS WARRANTY, IMPROPER INSTALLATION, REPAIR, REPLACEMENT OR MODIFICATION BY ANYONE OTHER THAN SPI (EXCEPT WITH SPI'S WRITTEN APPROVAL).

8) The foregoing is Seller's only obligation and Buyer's exclusive remedy for breach of warranty and, except for gross negligence, wilful misconduct and remedies permitted under the performance, inspection and acceptance and the patent clauses hereof, the foregoing is Buyer's exclusive remedy against Seller for all claims arising hereunder or relating hereto whether such claims are based on breach of contract, (or) (including negligence and strict liability) or other theories.

Buyer's failure to submit a claim as provided above shall specifically waive all claims based on latent defects. In no event shall Buyer be entitled to incidental or consequential damages. Any action arising hereunder or relating hereto whether based on breach of contract (or) (including negligence and strict liability) or other theories, must be commenced within one (1) year after the cause of action accrues or it shall be barred.

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Appendix C – SCR - Brief Description

The exhaust gases from Internal Combustion Engine units that occur during the combustion process and consist primarily of nitrogen oxides (NOx) are directly transferred to the SCR catalytic reactors and a 32.5% aqueous solution of urea is added as reducing agent (SCR technique).

Urea is supplied to the SCR system from a storage tank by means of a feed or proportioning pump. For operation of the engine at one load point only, a fixed quantity of urea is added to the SCR system. In contrast, if the engine is operated at various loads, the quantity of urea fed into the exhaust gas duct upstream of the SCR catalytic reactor can be tailored to the engine power. In this case, a characteristic curve is established during startup for the load-dependent NOx emissions from the engine, which is programmed into the SCR control equipment. The interface between engine and SCR control is formed using the active engine or generator power which is required as standard signal (e.g. 4...20 mA) for the SCR controls. A dry contact signal for "Engine in Operation" must be provided as permissive for the SCR system to operate. After shutdown, the compressed air and voltage supply must be maintained for at least 10 minutes.

The control equipment of the SCR exhaust-gas cleaning system is fully automatic.
Via dry contact signals, the operator can monitor system operation using the signals "SCR System in Operation", "SCR System Fault" and "Low Urea Level". The signal "Low Urea Level" appears when the tank content drops to the minimum level. The SCR system switches off automatically as soon as the tank is empty.

The urea pump is switched on after release by the requirement that "Engine start and exhaust gas temperature > temperature set point downstream of Catalytic Reactor" (at temperatures >540°F/280°C). The urea solution is finely injected into the exhaust gas duct by a binary nozzle using compressed air as auxiliary medium. A suitable compressor must provide compressed air. The urea is converted into ammonia and carbon dioxide in a section of the exhaust gas pipe (mixing duct) designed as an ammonia generator. The mixing duct is installed upstream of the reactor to ensure optimum mixing of the exhaust gas and the ammonia produced from the urea. Please note that exhaust gas temperatures of more than 950°F/510°C will cause irreversible damage to the catalyst.

At the SCR catalytic reactor, the nitrogen oxides (NO_x) react with the ammonia (NH_3) to form molecular nitrogen (N_2) and steam (H_2O). The purified air can be let into the atmosphere, passing a heat exchanger installation and the silencer (if installed) downstream of the reactor.

Due to different influences (like type and consumption of lubricating oil, gas quality, urea quality, etc.) clogging of the catalysts may occur. The catalysts may therefore need to be cleaned from time to time using a local compressed air source.

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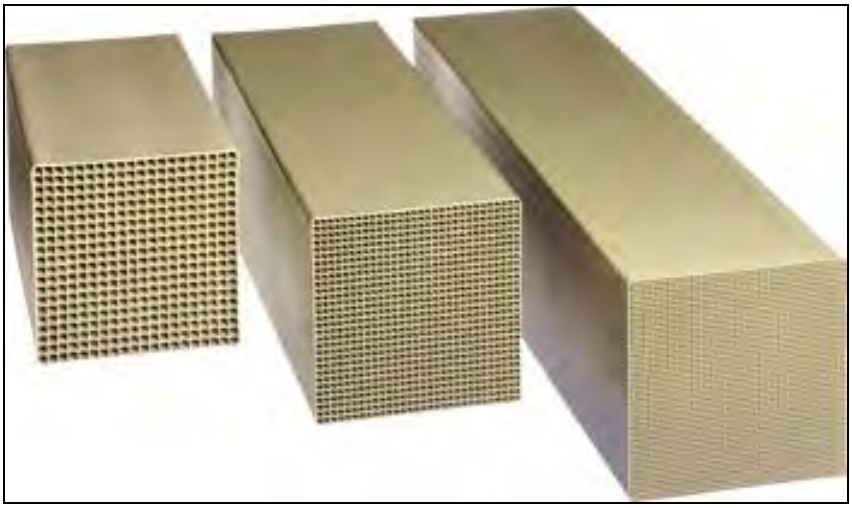
Appendix D – Typical SCR Catalyst



- ✓ 100% homogenous extruded catalyst
- ✓ No wash-coating like other suppliers
- ✓ High surface activity area
- ✓ Pressure-drop is minimized/optimized
- ✓ Honeycomb length and cells is variable
- ✓ Good resistance to thermal shock
- ✓ Good resistance to poisoning
- ✓ Long life-time (hours) of catalyst use

CATERPILLAR®

Electric Power Division
P.O. Box 610- AC6109
Mossville, IL 61552

July 18, 2023

Project Reference: Caterpillar Aftertreatment Systems for AWS MacGuyver IAD107 Project

PROJECT DETAILS	
Site Location	Virginia
Application	Standby Power
Number of Engines	26
Operating Hours per Year	100
ENGINE DETAILS	
Engine Model	3516E
Engine Serial Number	N/A
Performance Number	EM5402-00
Power	4,043 Bhp @ 100% load
Rated Speed	1,800 rpm
Exhaust Flow Rate	22,051.6 acfm @ 100% load
Engine Outlet Temp	896.1 °F @ 100% load
Fuel:	ULSD

EMISSIONS DETAILS

PSV Emissions @ 100% load	Engine Out Emissions					Target Post-Aftertreatment Emissions					Calculated Reduction
	g/hr	mg/Nm3 @ 5% O2	g/hp-hr	g/kw-hr	lbs/hr	g/hr	mg/Nm3 @ 5% O2	g/hp-hr	g/kw-hr	lbs/hr	
NOx	240002	2783.00	6.00	8.16	52.91	19920.17	230.99	0.50	0.68	4.39	91.7%
CO	4637	536.70	1.16	1.58	10.22	1159.25	134.18	0.29	0.40	2.56	75.0%
HC	405	40.80	0.10	0.14	0.89	222.75	22.44	0.06	0.08	0.49	45.0%
PM10	289.7	28.10	0.07	0.10	0.64	90.97	8.82	0.02	0.03	0.20	68.6%

AFTERTREATMENT SYSTEM DESCRIPTION
5X4X3 SCR + DPF system - CEM Part #: 547-2580

PERFORMANCE PARAMETERS [DM1176]

JULY 18, 2023

For Help Desk Phone Numbers Click here

Performance Number: DM1176 **Change Level:** 08

TMI EMISSION DATA USERS

Guideline for the use of factory emissions data for use in local air permit applications.

Emission Data Level:

Emission data is expressed as two values. The "Nominal" value presents data measured from an engine operated at ISO 8178 conditions. The Nominal value does not include a "Tolerance Factor" to allow for engine to engine, ambient, or measurement variation. Because the Nominal value represents the average expected emissions from this particular engine model and rating, the Nominal value can be used to develop a reasonable estimate of expected emissions from the entire population of this engine model and rating located in the airshed (if the total population and average operating hours are known). The Nominal value **does not** represent the highest emissions level expected during on-site measurement.

The other value provided is called "Potential Site Variation", which replaces "Not To Exceed" values that Caterpillar provided in the past. These Potential Site Variation emissions values include potential site variation due to engine-to-engine variability, ambient conditions , and emissions measurement methods. Consequently, these values are always higher than the Nominal values. These numbers are based on Caterpillar experience and expected variation in emissions during on site tests. Neither Potential Site Variation Emission values nor results of site or stack testing should be used to set permit limits as these values will not accurately represent the engine population. Nominal Emissions should be used for the purposes of setting permit limits. The Potential Site Variation values are provided by engine load. Points in between published load points can be derived by linear interpolation.

Care should be taken to permit only to one unit of measure. For example, Caterpillar strongly recommends mass/hour for the regulated pollutant. Power specific values (e.g. g/hp-hr or g/kW-hr) introduce more measurement error in the field. The simplest means of checking emissions performance on site is verifying that the concentration of regulated pollutants in the exhaust is at or below Potential Site Variation values (in ppm or mg/nm3) at a specified steady-state load.

Note: Crankcase Emissions

For engines with open crankcase ventilation (OCV) systems, the crankcase emissions are not included in the Nominal or Potential Site Variation data. For engines with closed crankcase ventilation (CCV) systems, the crankcase emissions are included in the Nominal and

Potential Site variation data.

Note: NOx (NO2 & NO)
Oxides of Nitrogen (NOx) emissions are reported as 100% NO2 per US EPA 40 CFR Part 1065. Typical non-aftertreatment equipped diesel exhaust NOx is comprised of approximately 10% NO2 and 90% NO at the stack outlet.

Unit of Measure:

The units provided are (g/bhp-hr), (g/hr), (mg/normal cubic meter at 5 % O2), (ppm at 5% O2), or (lb/hr). If opacity data is required, contact Caterpillar (Application Support Center).

Note:
g/bhp-hr emission unit is calculated using observed power during factory testing. The column heading is shown as corrected power, Reference DM9600, to match the general performance data section in TMI. Observed power was used to represent site conditions.

Measurement Procedure:

The measurement procedures used to obtain the emission data provided to the EPA are consistent with those described in 40 CFR Parts 89, 94, 1033, 1039, 1042 and 1065 and ISO 8178 for measuring HC, CO, CO2, NOx and particulate matter.

TMI emission data are determined with measurement methods similar to 40 CFR Parts 89, 94, 1033, 1039, 1042, 1065 and ISO 8178 for measuring HC, CO, CO2, NOx, and particulate matter, with minor modifications from those procedures. For example, test fuel, back pressure, or load points may be different for TMI data publication purposes but the data collection process is representative of these methods.

Data presented in TMI is for an engine that has had some reasonable break-in period. This can range from 40 to 80 hours. A proper break-in period for the engine being tested on site will generally improve agreement between TMI data and on-site test data.

Humidity correction to the NOx concentration is found in 40 CFR section 1065.670. Humidity correction should be applied first to the concentration and then corrected to the appropriate oxygen level.

Concentration data, ppm and mg/normal meter cubed, are corrected to standard oxygen levels to accurately compare concentration levels from different sources.

Concentration Corrected @ %O2Ref = (Concentration Measured)x(20.9 - %O2Ref)/(20.9 - %StackO2)

Concentration Corrected = Exhaust Concentration corrected to reference O2 concentration.

%O2Ref = Typically 5% for Metric units and 15% for English units. See local requirements for guidance.

%StackO2 = The measured exhaust oxygen content in %.

Particulate Matter:

The laboratory PM measurement method is not the same as "on-site" or field EPA methods. EPA specifies several methods for measuring particulate matter in the field. The most common is Method 5. Method 5 has larger measurement error than laboratory methods.

Caterpillar measures particulate matter for stationary and off-highway certification with a micro-dilution tunnel system. The system follows ISO 8178 procedures and is used to certify engines for non-road applications for both CARB & EPA, and is representative of Method 5 data.

Caterpillar published PM values are considered to be PM2.5 data. PM10 is all particulate matter below 10 microns in size. PM2.5 is all particulate matter below 2.5 microns on size. For Caterpillar engines PM2.5 = PM10 since the PM in the exhaust is PM2.5 data. PM data provided by Caterpillar is a more accurate representation of expected PM2.5 than a field test usually used for stationary sources (EPA method 5) described below.

Method 5 can be used to measure particulate matter in two ways.

The first requires a hot filter sample and accompanying front half wash. This means that the sampling system from the stack to the filters must be flushed with solvent and the extract weighed. When this procedure is used, the results of Method 5 can be slightly less than results obtained with the ISO procedure. This is because the filter temperature used in Method 5 is higher than the filter temperature used in the ISO procedure. The lower filter temperature of the micro-dilution system condenses more soluble organic matter and thus gives a higher particulate matter weight than Method 5.

The second way to use Method 5 requires a front and back half wash. If this procedure is used, additional organic fractions are condensed after the filter by passing the sample through a condenser with outlet gas temperature of 20 Deg C (68 Deg F). Generally, an impinger in an ice bath is used thereby increasing condensation of volatile organics. With this procedure, many of the hydrocarbons in the exhaust will be measured as particulate matter. For air permitting purposes, if a back half wash is to be used in a stack test, the hydrocarbons produced by the engine should be added to the particulate matter data in TMI.

Tests that require back half wash with Method 5 will also be influenced by the fuel sulfur level. If any form of Method 5 is to be used in the field test, contact Caterpillar (Application Support Center).

Sulfur Oxides:

All sulfur present in the fuel is assumed to be converted to SO2 during combustion and in the atmosphere.

SO2 (g/kw-hr)=0.01998x(fuel rate g/bkw-hr)x(% fuel Sulfur by weight)

Where the factor 0.01998 is:
0.01998 = (molecular weight of SO2)/(molecular weight of S)
0.01998 = (molecular weight of S+O+O)/(molecular weight of S x 100%)
0.01998 = (32.06 + 15.9994 + 15.9994)/(32.06 x 100)

Molecular weight of Sulfur, S = 32.06
Molecular weight of Oxygen, O = 15.9994

For SO2 in terms of lb/bhp-hr, use a fuel rate measured in lb/bhp-hr
For SO2 in terms of lb/hr, use a fuel rate measured in lb/hr

For SO2 in terms of g/hr, use a fuel rate measured in g/hr
For SO2 in terms of g/bkw-hr, use a fuel rate measured in g/bkw-hr

Example Calculation:
If fuel has 0.2% Sulfur content
If fuel Rate = 200 g/bkw-hr

SO2 = 0.01998 x (200 g/bkw-hr) x (0.2 % sulfur)
SO2 = 0.799 g/bkw-hr

If SOx is provided in the emission data, the following sentence should be included with the data:

The SOx value is based on fuel sulfur content of 0.2% by weight.

Date Released : 03/16/2023

Cat® C18 DIESEL GENERATOR SETS

Standby & Prime: 60Hz

Image shown might not reflect actual configuration

Engine Model	Cat® C18 ATAAC™ In-line 6, 4-cycle diesel
Bore x Stroke	145mm x 183mm (5.7in x 7.2in)
Displacement	18.13 L (1106.3 in³)
Compression Ratio	14:1
Aspiration	Turbocharged Air-to-Air Aftercooled
Fuel Injection System	Electronic Unit Injection
Governor	Electronic ADEM™ A4

Model	Standby	Prime	Emission Strategy
C18	750 ekW, 938 kVA	680 ekW, 850 kVA	EPA TIER II

PACKAGE PERFORMANCE

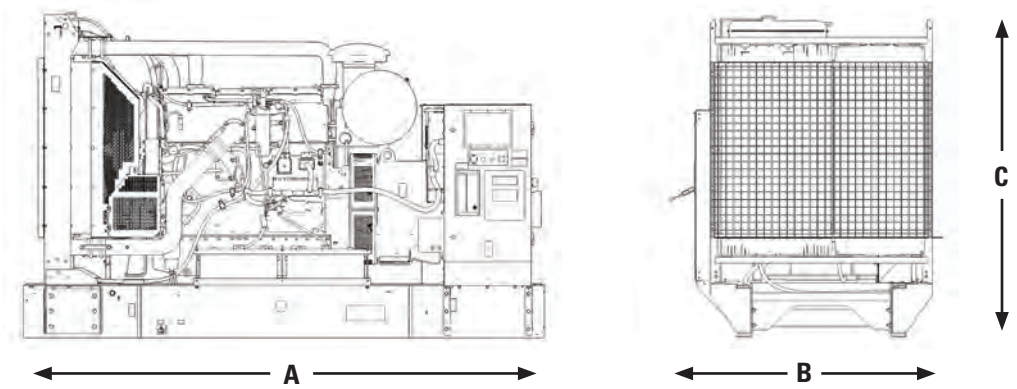
Performance	Standby	Prime
Frequency	60 Hz	
Genset Power Rating	938 kVA	850 kVA
Genset power rating with fan @ 0.8 power factor	750 ekW	680 ekW
Emissions	EPA TIER II	
Performance Number	EM3842	EM3843
Fuel Consumption		
100% load with fan, L/hr (gal/hr)	205.5 (54.2)	188.5 (49.7)
75% load with fan, L/hr (gal/hr)	164.3 (43.4)	146.3 (38.6)
50% load with fan, L/hr (gal/hr)	108.9 (28.7)	100.3 (26.5)
25% load with fan, L/hr (gal/hr)	63.5 (16.7)	59.4 (15.6)
Cooling System[1]		
Radiator air flow restriction (system), kPa (in. Water)	0.12 (0.48)	0.12 (0.48)
Radiator air flow, m³/min (cfm)	900 (31783)	900 (31783)
Engine coolant capacity, L (gal)	20.8 (5.5)	20.8 (5.5)
Radiator coolant capacity, L (gal)	77 (20.3)	77 (20.3)
Total coolant capacity, L (gal)	97.8 (25.8)	97.8 (25.8)
Inlet Air		
Combustion air inlet flow rate, m³/min (cfm)	67.3 (2376)	65.6 (2316)
Max. Allowable Combustion Air Inlet Temp, °C (°F)	49 (120)	49 (120)
Exhaust System		
Exhaust stack gas temperature, °C (°F)	452.9 (847.2)	432.9 (811.2)
Exhaust gas flow rate, m³/min (cfm)	170.7 (6028)	161 (5686)
Exhaust system backpressure (maximum allowable) kPa (in. water)	10.0 (40.0)	10.0 (40.0)
Heat Rejection		
Heat rejection to jacket water, kW (Btu/min)	225 (12795)	208 (11828)
Heat rejection to exhaust (total) kW (Btu/min)	714 (40604)	664 (37761)
Heat rejection to aftercooler, kW (Btu/min)	272 (15468)	253 (14387)
Heat rejection to atmosphere from engine, kW (Btu/min)	142 (8075)	123 (6995)

Cat® C18 DIESEL GENERATOR SETS

Emissions (Nominal)[2]	Standby	Prime
NOx, mg/Nm³ (g/hp-hr)	2468 (5.42)	2213 (4.91)
CO, mg/Nm³ (g/hp-hr)	100.1 (0.22)	75.6 (0.17)
HC, mg/Nm³ (g/hp-hr)	23.5 (0.06)	24.1 (0.06)
PM, mg/Nm³ (g/hp-hr)	11.7 (0.03)	10.6 (0.03)

Alternator[3]					
Voltages	**208V**	**220V**	**240V**	**480V**	**600V**
Motor starting capability @ 30% Voltage Dip	1917 skVA	2129 skVA	2501 skVA	2512 skVA	2512 skVA
Current	2602.2 amps	2460.3 amps	2512 amps	1127.6 amps	902.1 amps
Frame Size	LC7224N	LC7224L	LC7224L	LC7224L	LC7224L
Excitation	AREP	AREP	AREP	AREP	AREP
Temperature Rise	130 °C	130 °C	130 °C	105 °C	130 °C

WEIGHTS & DIMENSIONS



Dim "A" mm (in)	Dim "B" mm (in)	Dim "C" mm (in)	Dry Weight kg (lb)
3512 (138)	**1746 (69)**	**2322 (92)**	**4863 (10721)**

APPLICABLE CODES AND STANDARDS:

AS1359, CSA C22.2 No100-04, UL142, UL489, UL869, UL2200, NFPA37, NFPA70, NFPA99, NFPA110, IBC, 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.

STANDBY: Output available with varying load for the duration of the interruption of the normal source power. Average power output is 70% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year.

PRIME: Output available with varying load for an unlimited time. Average power output is 70% of the prime power rating. Typical peak demand is 100% of prime rated ekW with 10% overload capability for emergency use for a maximum of 1 hour in 12. Overload operation cannot exceed 25 hours per year

RATINGS: Ratings are based on SAE J1349 standard conditions. These ratings also apply at ISO3046 standard conditions.

DEFINITIONS AND CONDITIONS

[1] For ambient and altitude capabilities consult your Cat dealer. Air flow restriction (system) is added to existing restriction from factory.

[2] Emissions data measurement procedures are consistent with those described in EPA CFR 40 Part 89, Subpart D & E and ISO8178-1 for measuring HC, CO, PM, NOx. Data shown is based on steady state operating conditions of 77° F, 28.42 in HG and number 2 diesel fuel with 35° API and LHV of 18,390 BTU/lb. The nominal emissions data shown is subject to instrumentation, measurement, facility and engine to engine variations. Emissions data is based on 100% load and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle.

[3] UL 2200 Listed packages may have oversized generators with a different temperature rise and motor starting characteristics. Generator temperature rise is based on a 40° C ambient per NEMA MG1-32.

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LEHE1772-04 (05/20)

PERFORMANCE DATA[EM3842]

September 27, 2021

Performance Number: EM3842 **Change Level: 02**

SALES MODEL:	C18	**COMBUSTION:**	DIRECT INJECTION
BRAND:	CAT	**ENGINE SPEED (RPM):**	1,800
ENGINE POWER (BHP):	1,112	**HERTZ:**	60
GEN POWER WITH FAN (EKW):	750.0	**FAN POWER (HP):**	42.2
COMPRESSION RATIO:	14	**ADDITIONAL PARASITICS (HP):**	3.4
RATING LEVEL:	STANDBY	**ASPIRATION:**	TA
PUMP QUANTITY:	1	**AFTERCOOLER TYPE:**	ATAAC
FUEL TYPE:	DIESEL	**AFTERCOOLER CIRCUIT TYPE:**	JW+OC, ATAAC
MANIFOLD TYPE:	DRY	**INLET MANIFOLD AIR TEMP (F):**	120
GOVERNOR TYPE:	ELEC	**JACKET WATER TEMP (F):**	192.2
CAMSHAFT TYPE:	STANDARD	**TURBO CONFIGURATION:**	PARALLEL
IGNITION TYPE:	CI	**TURBO QUANTITY:**	2
INJECTOR TYPE:	EUI	**TURBOCHARGER MODEL:**	GTD5008 0.75 A/R
REF EXH STACK DIAMETER (IN):	6	**CERTIFICATION YEAR:**	2018
MAX OPERATING ALTITUDE (FT):	3,553	**PISTON SPD @ RATED ENG SPD (FT/MIN):**	2,161.4

INDUSTRY	SUBINDUSTRY	APPLICATION
ELECTRIC POWER	STANDARD	PACKAGED GENSET

General Performance Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BSFC)	ISO BRAKE SPEC FUEL CONSUMPTN (BSFC)	VOL FUEL CONSUMPTN (VFC)	ELEC SPEC FUEL CONSUMPTN (ESFC)	ISO ELEC SPEC FUEL CONSUMPTN (ESFC)
EKW	%	BHP	PSI	LB/BHP-HR	LB/BHP-HR	GAL/HR	LB/EKW-HR	LB/EKW-HR
750.0	100	1,112	442	0.342	0.335	53.6	0.507	0.497
675.0	90	1,002	399	0.345	0.339	48.8	0.513	0.503
600.0	80	894	356	0.355	0.348	44.8	0.529	0.519
562.5	75	840	334	0.362	0.355	42.8	0.540	0.530
525.0	70	787	313	0.357	0.350	39.6	0.535	0.525
450.0	60	680	271	0.347	0.340	33.3	0.524	0.514
375.0	50	575	229	0.350	0.344	28.4	0.537	0.527
300.0	40	471	187	0.356	0.349	23.6	0.559	0.548
225.0	30	367	146	0.365	0.358	18.9	0.596	0.585
187.5	25	315	125	0.373	0.366	16.6	0.627	0.615
150.0	20	262	104	0.384	0.377	14.2	0.672	0.660
75.0	10	155	62	0.436	0.428	9.5	0.903	0.886

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP
EKW	%	BHP	IN-HG	DEG F	DEG F	IN-HG	DEG F	IN-HG	DEG F
750.0	100	1,112	99.6	120.6	1,297.4	91.1	847.3	106	491.8
675.0	90	1,002	94.8	116.3	1,237.8	85.6	808.8	101	471.6
600.0	80	894	90.6	110.2	1,190.8	81.2	779.6	97	456.4
562.5	75	840	88.9	106.0	1,168.7	79.4	765.3	95	449.8
525.0	70	787	83.3	102.6	1,123.3	73.0	732.9	89	427.8
450.0	60	680	70.0	97.1	1,044.2	59.2	681.5	75	378.6
375.0	50	575	58.7	92.6	995.6	48.8	659.1	63	343.0
300.0	40	471	46.1	89.2	946.5	38.8	636.5	50	296.8
225.0	30	367	33.0	85.9	891.7	28.9	613.3	36	248.4
187.5	25	315	26.7	84.2	861.7	23.9	601.4	30	224.2
150.0	20	262	20.9	82.5	823.8	19.2	583.1	23	199.8
75.0	10	155	10.7	79.1	696.6	12.2	500.0	13	150.3

General Performance Data (Continued)

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	WET INLET AIR VOL FLOW RATE	ENGINE OUTLET WET EXH GAS VOL FLOW RATE	WET INLET AIR MASS FLOW RATE	WET EXH GAS MASS FLOW RATE	WET EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)	DRY EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)
EKW	%	BHP	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
750.0	100	1,112	2,375.0	6,028.4	10,393.9	10,773.8	2,267.8	2,078.6
675.0	90	1,002	2,311.8	5,661.5	10,079.7	10,425.9	2,194.5	2,019.7
600.0	80	894	2,255.1	5,366.3	9,808.8	10,125.6	2,129.1	1,967.2

PERFORMANCE DATA[EM3842]

September 27, 2021

562.5	75	840	2,232.7	5,242.8	9,695.0	9,998.8	2,104.4	1,948.0
525.0	70	787	2,128.6	4,886.8	9,201.8	9,479.4	2,014.8	1,868.9
450.0	60	680	1,924.5	4,154.8	8,250.4	8,484.5	1,790.1	1,665.9
375.0	50	575	1,724.0	3,614.1	7,338.5	7,539.3	1,588.3	1,481.3
300.0	40	471	1,496.1	3,059.1	6,324.6	6,492.2	1,372.1	1,282.4
225.0	30	367	1,252.4	2,494.4	5,258.7	5,392.8	1,143.0	1,070.6
187.5	25	315	1,129.6	2,211.4	4,728.5	4,845.9	1,024.7	960.8
150.0	20	262	1,009.9	1,930.2	4,215.5	4,316.3	910.1	854.6
75.0	10	155	782.1	1,374.8	3,253.5	3,321.2	704.3	665.3

Heat Rejection Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXHAUST RECOVERY TO 350F	FROM OIL COOLER	FROM AFTERCOOLER	WORK ENERGY	LOW HEAT VALUE ENERGY	HIGH HEAT VALUE ENERGY
EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
750.0	100	1,112	12,818	8,047	40,603	22,636	6,204	15,452	47,163	116,484	124,084
675.0	90	1,002	11,743	6,958	37,522	20,109	5,654	14,340	42,509	106,146	113,072
600.0	80	894	10,952	6,200	35,048	18,214	5,186	13,597	37,916	97,360	103,713
562.5	75	840	10,640	5,836	33,785	17,352	4,962	13,346	35,638	93,166	99,245
525.0	70	787	9,859	5,705	30,827	15,116	4,587	11,983	33,363	86,117	91,736
450.0	60	680	8,318	5,623	24,979	11,650	3,854	9,300	28,853	72,352	77,073
375.0	50	575	7,503	5,062	21,470	9,629	3,289	7,357	24,380	61,743	65,772
300.0	40	471	6,805	4,763	17,924	7,664	2,736	5,257	19,977	51,373	54,726
225.0	30	367	6,315	4,137	14,360	5,834	2,190	3,423	15,572	41,123	43,806
187.5	25	315	6,146	3,592	12,622	4,998	1,918	2,650	13,357	36,017	38,367
150.0	20	262	5,811	3,166	10,852	4,120	1,647	1,979	11,122	30,914	32,931
75.0	10	155	4,464	2,714	7,429	2,021	1,106	928	6,579	20,759	22,114

Emissions Data

DIESEL

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN		EKW	750.0	562.5	375.0	187.5	75.0
PERCENT LOAD		%	100	75	50	25	10
ENGINE POWER		BHP	1,112	840	575	315	155
TOTAL NOX (AS NO2)		G/HR	5,965	3,126	2,054	1,344	778
TOTAL CO		G/HR	243	232	76	312	1,148
TOTAL HC		G/HR	66	67	47	55	458
TOTAL CO2		KG/HR	552	441	292	172	96
PART MATTER		G/HR	33.7	34.4	21.3	25.5	73.8
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,468.0	1,615.7	1,594.0	1,789.0	1,769.3
TOTAL CO	(CORR 5% O2)	MG/NM3	100.1	120.0	57.8	462.4	3,203.4
TOTAL HC	(CORR 5% O2)	MG/NM3	23.5	29.8	32.1	65.0	1,156.1
PART MATTER	(CORR 5% O2)	MG/NM3	11.7	15.2	14.2	30.4	185.1
TOTAL NOX (AS NO2)	(CORR 15% O2)	MG/NM3	915.8	599.5	591.5	663.9	656.5
TOTAL CO	(CORR 15% O2)	MG/NM3	37.1	44.5	21.4	171.6	1,188.7
TOTAL HC	(CORR 15% O2)	MG/NM3	8.7	11.1	11.9	24.1	429.0
PART MATTER	(CORR 15% O2)	MG/NM3	4.3	5.7	5.3	11.3	68.7
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,202	787	776	871	862
TOTAL CO	(CORR 5% O2)	PPM	80	96	46	370	2,563
TOTAL HC	(CORR 5% O2)	PPM	44	56	60	121	2,158
TOTAL NOX (AS NO2)	(CORR 15% O2)	PPM	446	292	288	323	320
TOTAL CO	(CORR 15% O2)	PPM	30	36	17	137	951
TOTAL HC	(CORR 15% O2)	PPM	16	21	22	45	801
TOTAL NOX (AS NO2)		G/HP-HR	5.42	3.75	3.59	4.27	5.02
TOTAL CO		G/HP-HR	0.22	0.28	0.13	0.99	7.41
TOTAL HC		G/HP-HR	0.06	0.08	0.08	0.17	2.96
PART MATTER		G/HP-HR	0.03	0.04	0.04	0.08	0.48
TOTAL NOX (AS NO2)		G/KW-HR	7.37	5.09	4.88	5.81	6.83
TOTAL CO		G/KW-HR	0.30	0.38	0.18	1.35	10.07

PERFORMANCE DATA[EM3842]

September 27, 2021

TOTAL HC	G/KW-HR	0.08	0.11	0.11	0.24	4.02
PART MATTER	G/KW-HR	0.04	0.06	0.05	0.11	0.65
TOTAL NOX (AS NO2)	LB/HR	13.15	6.89	4.53	2.96	1.72
TOTAL CO	LB/HR	0.54	0.51	0.17	0.69	2.53
TOTAL HC	LB/HR	0.14	0.15	0.10	0.12	1.01
TOTAL CO2	LB/HR	1,217	971	644	380	211
PART MATTER	LB/HR	0.07	0.08	0.05	0.06	0.16
OXYGEN IN EXH	%	9.8	11.5	12.7	13.5	14.9
DRY SMOKE OPACITY	%	0.5	0.8	0.5	1.0	0.5
BOSCH SMOKE NUMBER		0.71	0.79	0.71	0.86	0.71

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN		**EKW**	**750.0**	**562.5**	**375.0**	**187.5**	**75.0**
PERCENT LOAD		**%**	**100**	**75**	**50**	**25**	**10**
ENGINE POWER		**BHP**	**1,112**	**840**	**575**	**315**	**155**
TOTAL NOX (AS NO2)		G/HR	6,442	3,376	2,219	1,451	840
TOTAL CO		G/HR	454	434	142	583	2,147
TOTAL HC		G/HR	124	126	89	103	866
PART MATTER		G/HR	65.6	67.1	41.6	49.7	144.0
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,665.4	1,745.0	1,721.5	1,932.2	1,910.9
TOTAL CO	(CORR 5% O2)	MG/NM3	187.1	224.5	108.1	864.7	5,990.4
TOTAL HC	(CORR 5% O2)	MG/NM3	44.4	56.3	60.6	122.9	2,185.0
PART MATTER	(CORR 5% O2)	MG/NM3	22.8	29.7	27.7	59.3	361.0
TOTAL NOX (AS NO2)	(CORR 15% O2)	MG/NM3	989.1	647.5	638.8	717.0	709.1
TOTAL CO	(CORR 15% O2)	MG/NM3	69.4	83.3	40.1	320.9	2,222.8
TOTAL HC	(CORR 15% O2)	MG/NM3	16.5	20.9	22.5	45.6	810.8
PART MATTER	(CORR 15% O2)	MG/NM3	8.4	11.0	10.3	22.0	134.0
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,298	850	839	941	931
TOTAL CO	(CORR 5% O2)	PPM	150	180	86	692	4,792
TOTAL HC	(CORR 5% O2)	PPM	83	105	113	229	4,079
TOTAL NOX (AS NO2)	(CORR 15% O2)	PPM	482	315	311	349	345
TOTAL CO	(CORR 15% O2)	PPM	56	67	32	257	1,778
TOTAL HC	(CORR 15% O2)	PPM	31	39	42	85	1,513
TOTAL NOX (AS NO2)		G/HP-HR	5.85	4.05	3.88	4.62	5.42
TOTAL CO		G/HP-HR	0.41	0.52	0.25	1.85	13.85
TOTAL HC		G/HP-HR	0.11	0.15	0.16	0.33	5.59
PART MATTER		G/HP-HR	0.06	0.08	0.07	0.16	0.93
TOTAL NOX (AS NO2)		G/KW-HR	7.95	5.50	5.27	6.28	7.37
TOTAL CO		G/KW-HR	0.56	0.71	0.34	2.52	18.83
TOTAL HC		G/KW-HR	0.15	0.21	0.21	0.45	7.60
PART MATTER		G/KW-HR	0.08	0.11	0.10	0.22	1.26
TOTAL NOX (AS NO2)		LB/HR	14.20	7.44	4.89	3.20	1.85
TOTAL CO		LB/HR	1.00	0.96	0.31	1.28	4.73
TOTAL HC		LB/HR	0.27	0.28	0.20	0.23	1.91
PART MATTER		LB/HR	0.14	0.15	0.09	0.11	0.32

Regulatory Information

EPA EMERGENCY STATIONARY			**2011 - ----**	
GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 60 SUBPART IIII AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE EMERGENCY STATIONARY REGULATIONS.				
Locality	**Agency**	**Regulation**	**Tier/Stage**	**Max Limits - G/BKW - HR**
U.S. (INCL CALIF)	EPA	STATIONARY	EMERGENCY STATIONARY	CO: 3.5 NOx + HC: 6.4 PM: 0.20

Altitude Derate Data

STANDARD

ALTITUDE CORRECTED POWER CAPABILITY (BHP)

PERFORMANCE DATA[EM3842]

September 27, 2021

AMBIENT OPERATING TEMP (F)	50	60	70	80	90	100	110	120	130	140	NORMAL
ALTITUDE (FT)											
0	1,112	1,112	1,112	1,111	1,106	1,101	1,096	1,089	1,054	987	1,112
1,000	1,112	1,112	1,112	1,107	1,102	1,097	1,092	1,066	1,006	957	1,110
2,000	1,112	1,111	1,106	1,101	1,096	1,091	1,063	1,002	956	916	1,105
3,000	1,110	1,105	1,100	1,095	1,088	1,058	996	954	915	854	1,101
4,000	1,103	1,097	1,082	1,069	1,051	990	950	912	852	793	1,090
5,000	1,067	1,045	1,023	1,002	981	944	907	845	792	739	1,043
6,000	1,039	1,013	993	975	955	918	862	805	776	696	1,020
7,000	1,020	1,000	984	969	943	900	835	793	757	680	1,013
8,000	999	982	967	954	923	867	808	764	723	670	999
9,000	973	958	944	932	898	826	769	720	703	665	979
10,000	944	930	917	906	851	795	748	720	698	670	956
11,000	912	898	886	875	817	772	736	710	685	654	928
12,000	879	867	856	845	791	753	722	690	657	621	899
13,000	843	832	822	811	772	733	694	656	618	590	864
14,000	800	791	781	772	730	688	648	610	587	567	825
15,000	754	744	733	714	672	635	602	583	564	544	780

Cross Reference

Test Spec	Setting	Engine Arrangement	Engineering Model	Engineering Model Version	Start Effective Serial Number	End Effective Serial Number
4581998	PP7270	5365365	GS668	-	LTH00001	
4582018	PP7585	5407425	EE563	-	LT400001	
4582018	PP7585	5407426	EE563	-	LT400001	
4581998	PP7270	5411973	GS668	-	LTH00001	

Performance Parameter Reference

Parameters Reference:DM9600-12

PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600
APPLICATION:
Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test cell at SAE J1995 standard reference conditions. Caterpillar maintains ISO9001:2000 certified quality management systems for engine test Facilities to assure accurate calibration of test equipment. Engine test data is corrected in accordance with SAE J1995. Additional reference material SAE J1228, J1349, ISO 8665, 3046-1:2002E, 3046-3:1989, 1585, 2534, 2288, and 9249 may apply in part or are similar to SAE J1995. Special engine rating request (SERR) test data shall be noted.
PERFORMANCE PARAMETER TOLERANCE FACTORS:
Power +/- 3%
Torque +/- 3%
Exhaust stack temperature +/- 8%
Inlet airflow +/- 5%
Intake manifold pressure-gage +/- 10%
Exhaust flow +/- 6%
Specific fuel consumption +/- 3%
Fuel rate +/- 5%
Specific DEF consumption +/- 3%
DEF rate +/- 5%
Heat rejection +/- 5%
Heat rejection exhaust only +/- 10%
Heat rejection CEM only +/- 10%
Heat Rejection values based on using treated water.
Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications.
On C7 - C18 engines, at speeds of 1100 RPM and under these values are provided for reference only, and may not meet the tolerance listed.
These values do not apply to C280/3600. For these models, see the tolerances listed below.
C280/3600 HEAT REJECTION TOLERANCE FACTORS:
Heat rejection +/- 10%
Heat rejection to Atmosphere +/- 50%
Heat rejection to Lube Oil +/- 20%
Heat rejection to Aftercooler +/- 5%
TEST CELL TRANSDUCER TOLERANCE FACTORS:
Torque +/- 0.5%

Cat® D250 GC
Diesel Generator Sets

Standby : 60 Hz

Image shown may not reflect actual configuration.

Engine Model	Cat® C9 In-line 6, 4-cycle diesel
Bore x Stroke	112 mm x 149 mm (4.4 in x 5.9 in)
Displacement	8.8 L (538 in³)
Compression Ratio	16.3:1
Aspiration	Turbocharged Air-to-Air Aftercooled
Fuel Injection System	HEUI
Governor	Electronic ADEM™ A4

Model	Standby	Emission Strategy
D250 GC	250 ekW, 312.5 kVA	EPA Certified for Stationary Emergency Application

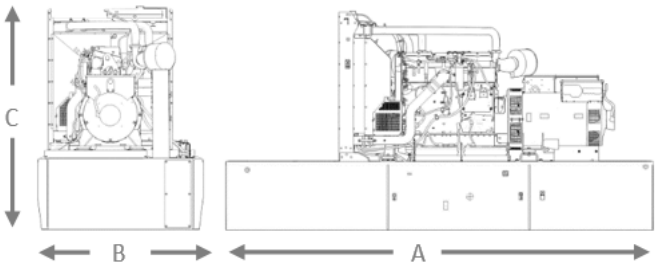
PACKAGE PERFORMANCE

Performance	Standby
Frequency	60 Hz
Genset Power Rating	312.5 kVA
Genset power rating with fan @ 0.8 power factor	250 ekW
Emissions	EPA TIER 3
Performance Number	DM8501
Fuel Consumption	
100% load with fan, L/hr (gal/hr)	73.3 (19.4)
75% load with fan, L/hr (gal/hr)	58.8 (15.5)
50% load with fan, L/hr (gal/hr)	43.8 (11.6)
25% load with fan, L/hr (gal/hr)	27.4 (7.3)
Cooling System[1]	
Radiator air flow restriction (system), kPa (in water)	0.12 (0.48)
Radiator air flow, m³/min (cfm)	497 (17551)
Engine coolant capacity, L (gal)	14 (3.69)
Radiator coolant capacity, L (gal)	25 (6.6)
Total coolant capacity, L (gal)	45 (11.88)
Inlet Air	
Combustion air inlet flow rate m³/min (cfm)	23.83 (841.5)
Max. Allowable Combustion Air Inlet Temp, °C (°F)	49 (120)
Exhaust System	
Exhaust stack gas temperature, °C (°F)	460 (860)
Exhaust gas flow rate, m³/min (cfm)	63.6 (2246)
Exhaust system backpressure (maximum allowable) kPa (in. water)	10.0 (40.0)
Heat Rejection	
Heat rejection to jacket water, kW (Btu/min)	104 (5928)
Heat rejection to exhaust (total), kW (Btu/min)	277 (15772)
Heat rejection to aftercooler, kW (Btu/min)	82 (4686)
Heat rejection to atmosphere from engine, kW (Btu/min)	18 (1004)
Heat rejection from alternator, kW (Btu/min)	20 (1120)
Emissions (Nominal)[2]	
NOx, mg/Nm³ (g/hp-hr)	1637.5 (3.14)
CO, mg/Nm³ (g/hp-hr)	323.2 (0.68)
HC, mg/Nm³ (g/hp-hr)	71.2 (0.17)
PM, mg/Nm³ (g/hp-hr)	63.7 (0.16)

D250 GC Diesel Generator Sets
Electric Power

Alternator[3]			
Voltages	480V	208	600V
Motor starting capability @ 30% Voltage Dip, skVA	567	544	1006
Current Amps	375.9	867.4	300.7
Frame Size	M2754L4	M2774L4	M2754L4
Excitation	S.E	S.E	AREP
Temperature Rise, °C	105	105	105

WEIGHTS & DIMENSIONS – OPEN SET



FUEL TANK CAPACITY

Tank Design	Total Capacity L (gal)	Useable Capacity L (gal)
Integral	2270 (600)	2059 (554)

Base	Length "A" mm (in)	Width "B" mm (in)	Height "C" mm (in)	Generator Set Weight kg (lb)
Skid (Wide Base)	3950 (155.5)	1440 (56.7)	1706 (67.2)	2415 (5324.2)
Integral Tank Base	3950 (155.5)	1430 (56.3)	2202 (86.7)	3055 (6735.1)

Note: General configuration not to be used for installation. See general dimension drawings for detail.

APPLICABLE CODES AND STANDARDS:

AS1359, CSA C22.2 No100-04, UL142, UL489, UL869, UL2200, NFPA37, NFPA70, NFPA99, NFPA110, IBC, 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.

STANDBY: Output available with varying load for the duration of the interruption of the normal source power. Average power output is 70% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year.

RATINGS: Ratings are based on SAE J1349 standard conditions. These ratings also apply at ISO3046 standard conditions.

FUEL RATES: Based on fuel oil of 35º API [16º C (60º F)] gravity having an LHV of 42 780 kJ/kg (18,390 Btu/lb) when used at 29º C (85º F) and weighing 838.9 g/litre (7.001 lbs/U.S. gal.). Additional ratings may be available for specific customer requirements, contact your Caterpillar representative for details. For information regarding Low Sulfur fuel and Biodiesel capability, please consult your Cat dealer.

DEFINITIONS AND CONDITIONS

[1] For ambient and altitude capabilities consult your Cat dealer. Air flow restriction (system) is added to existing restriction from factory.

[2] Emissions data measurement procedures are consistent with those described in EPA CFR 40 Part 89, Subpart D & E and ISO8178-1 for measuring HC, CO, PM, NOx. Data shown is based on steady state operating conditions of 77° F, 28.42 in HG and number 2 diesel fuel with 35° API and LHV of 18,390 BTU/lb. The nominal emissions data shown is subject to instrumentation, measurement, facility and engine to engine variations. Emissions data is based on 100% load and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle.

[3] UL 2200 Listed packages may have oversized generators with a different temperature rise and motor starting characteristics. Generator temperature rise is based on a 40° C ambient per NEMA MG1-32.

LET'S DO THE WORK.™

LEHE2023-03 (06/22)

PERFORMANCE DATA[DM8501]

May 22, 2024

Performance Number: DM8501 **Change Level: 03**

SALES MODEL:	C9	**COMBUSTION:**	DIRECT INJECTION
BRAND:	CAT	**ENGINE SPEED (RPM):**	1,800
MACHINE SALES MODEL:		**HERTZ:**	60
ENGINE POWER (BHP):	398	**FAN POWER (HP):**	30.2
GEN POWER W/O FAN (EKW):	265.0	**ASPIRATION:**	TA
GEN POWER WITH FAN (EKW):	250.0	**AFTERCOOLER TYPE:**	ATAAC
COMPRESSION RATIO:	16.1	**AFTERCOOLER CIRCUIT TYPE:**	JW+OC, ATAAC
RATING LEVEL:	STANDBY	**INLET MANIFOLD AIR TEMP (F):**	122
PUMP QUANTITY:	1	**JACKET WATER TEMP (F):**	192.2
FUEL TYPE:	DIESEL	**TURBO CONFIGURATION:**	SINGLE
MANIFOLD TYPE:	DRY	**TURBO QUANTITY:**	1
GOVERNOR TYPE:	ELEC	**TURBOCHARGER MODEL:**	S310-1.25
CAMSHAFT TYPE:	STANDARD	**CERTIFICATION YEAR:**	2005
IGNITION TYPE:	CI	**PISTON SPD @ RATED ENG SPD (FT/MIN):**	1,759.8
INJECTOR TYPE:	EUI		
REF EXH STACK DIAMETER (IN):	4		
MAX OPERATING ALTITUDE (FT):	3,281		

INDUSTRY	SUBINDUSTRY	APPLICATION
ELECTRIC POWER	STANDARD	PACKAGED GENSET
OIL AND GAS	LAND PRODUCTION	PACKAGED GENSET

General Performance Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BSFC)	ISO BRAKE SPEC FUEL CONSUMPTN (BSFC)	VOL FUEL CONSUMPTN (VFC)	ISO VOL FUEL CONSUMPTN (VFC)
EKW	%	BHP	PSI	LB/BHP-HR	LB/BHP-HR	GAL/HR	GAL/HR
250.0	100	398	326	0.341	0.337	19.1	18.9
225.0	90	359	294	0.346	0.343	17.5	17.3
200.0	80	321	263	0.355	0.351	16.0	15.9
187.5	75	302	247	0.360	0.356	15.3	15.2
175.0	70	284	232	0.364	0.361	14.6	14.4
150.0	60	247	202	0.374	0.371	13.0	12.9
125.0	50	211	172	0.385	0.381	11.4	11.3
100.0	40	176	144	0.394	0.390	9.8	9.7
75.0	30	141	116	0.404	0.400	8.0	8.0
62.5	25	124	101	0.410	0.406	7.2	7.1
50.0	20	106	87	0.418	0.414	6.2	6.2
25.0	10	68.9	56	0.445	0.441	4.3	4.3

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP
EKW	%	BHP	IN-HG	DEG F	DEG F	IN-HG	DEG F	IN-HG	DEG F
250.0	100	398	77.7	122.3	1,142.4	55.4	852.0	79	425.2
225.0	90	359	74.1	121.6	1,094.4	51.6	823.5	75	407.9
200.0	80	321	70.7	122.1	1,050.1	48.2	800.5	72	390.0
187.5	75	302	69.0	122.5	1,029.4	46.4	790.7	70	380.5
175.0	70	284	66.6	122.4	1,010.3	44.2	782.4	67	370.2
150.0	60	247	60.6	122.2	973.8	39.4	768.3	61	346.6
125.0	50	211	53.2	121.8	937.9	33.9	755.8	54	318.8
100.0	40	176	43.3	121.2	899.4	27.4	742.4	44	280.7
75.0	30	141	32.2	120.7	857.9	20.5	727.9	33	236.6
62.5	25	124	26.7	120.5	835.9	17.2	720.5	27	214.1
50.0	20	106	21.3	120.3	812.9	14.1	712.7	22	191.5
25.0	10	68.9	12.1	120.5	671.3	9.1	612.1	13	150.2

General Performance Data (Continued)

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	WET INLET AIR VOL FLOW RATE	ENGINE OUTLET WET EXH GAS VOL FLOW RATE	WET INLET AIR MASS FLOW RATE	WET EXH GAS MASS FLOW RATE	WET EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)	DRY EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)
EKW	%	BHP	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN

PERFORMANCE DATA[DM8501]

May 22, 2024

250.0	100	398	889.8	2,245.6	3,863.5	3,999.1	841.8	776.8
225.0	90	359	866.1	2,131.2	3,753.5	3,877.8	816.6	756.7
200.0	80	321	845.5	2,029.1	3,641.7	3,755.4	791.7	736.4
187.5	75	302	833.2	1,976.5	3,583.9	3,692.5	777.2	724.2
175.0	70	284	815.6	1,915.7	3,500.2	3,603.4	758.3	707.7
150.0	60	247	770.3	1,777.1	3,290.5	3,382.8	711.5	666.0
125.0	50	211	711.6	1,616.1	3,025.9	3,107.0	653.7	613.6
100.0	40	176	631.2	1,409.7	2,668.7	2,738.1	576.6	542.5
75.0	30	141	539.6	1,189.0	2,266.0	2,323.1	492.3	464.1
62.5	25	124	493.0	1,076.6	2,063.6	2,114.4	448.5	423.3
50.0	20	106	447.1	961.4	1,865.3	1,909.6	403.2	380.9
25.0	10	68.9	365.7	720.7	1,521.7	1,552.4	330.6	314.7

Heat Rejection Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXHAUST RECOVERY TO 350F	FROM OIL COOLER	FROM AFTERCOOLER	WORK ENERGY	LOW HEAT VALUE ENERGY	HIGH HEAT VALUE ENERGY
EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
250.0	100	398	5,928	1,004	15,772	8,470	2,214	4,686	16,886	41,564	44,276
225.0	90	359	5,517	890	14,624	7,716	2,028	4,305	15,231	38,081	40,566
200.0	80	321	5,156	844	13,650	7,085	1,859	3,906	13,615	34,894	37,171
187.5	75	302	4,986	796	13,203	6,804	1,775	3,702	12,819	33,332	35,507
175.0	70	284	4,811	750	12,693	6,507	1,688	3,474	12,026	31,686	33,754
150.0	60	247	4,487	657	11,600	5,894	1,508	2,957	10,466	28,319	30,167
125.0	50	211	4,177	565	10,395	5,241	1,323	2,387	8,931	24,835	26,456
100.0	40	176	3,834	664	8,956	4,456	1,131	1,704	7,458	21,230	22,615
75.0	30	141	3,407	764	7,418	3,634	932	1,052	5,989	17,489	18,630
62.5	25	124	3,174	722	6,658	3,239	829	773	5,246	15,560	16,575
50.0	20	106	2,926	591	5,915	2,861	723	532	4,490	13,570	14,455
25.0	10	68.9	2,390	520	4,011	1,661	501	182	2,923	9,412	10,026

Emissions Data

DIESEL

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN		EKW	250.0	187.5	125.0	62.5	25.0
PERCENT LOAD		%	100	75	50	25	10
ENGINE POWER		BHP	398	302	211	124	68.9
TOTAL NOX (AS NO2)		G/HR	1,150	661	419	260	205
TOTAL CO		G/HR	144	145	113	152	144
TOTAL HC		G/HR	36	47	48	37	38
TOTAL CO2		KG/HR	193	155	115	71	43
PART MATTER		G/HR	32.1	33.9	25.1	25.1	17.5
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	1,516.2	1,083.8	918.3	939.9	1,312.7
TOTAL CO	(CORR 5% O2)	MG/NM3	172.8	215.5	229.8	496.4	785.9
TOTAL HC	(CORR 5% O2)	MG/NM3	37.7	59.9	83.6	111.9	195.8
PART MATTER	(CORR 5% O2)	MG/NM3	32.6	43.3	43.2	76.0	79.5
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	739	528	447	458	639
TOTAL CO	(CORR 5% O2)	PPM	138	172	184	397	629
TOTAL HC	(CORR 5% O2)	PPM	70	112	156	209	365
TOTAL NOX (AS NO2)		G/HP-HR	2.91	2.20	2.00	2.11	2.98
TOTAL CO		G/HP-HR	0.36	0.48	0.54	1.23	2.08
TOTAL HC		G/HP-HR	0.09	0.15	0.23	0.30	0.55
PART MATTER		G/HP-HR	0.08	0.11	0.12	0.20	0.25
TOTAL NOX (AS NO2)		LB/HR	2.54	1.46	0.92	0.57	0.45
TOTAL CO		LB/HR	0.32	0.32	0.25	0.34	0.32
TOTAL HC		LB/HR	0.08	0.10	0.11	0.08	0.08
TOTAL CO2		LB/HR	425	342	255	156	94
PART MATTER		LB/HR	0.07	0.07	0.06	0.06	0.04
OXYGEN IN EXH		%	10.2	11.6	12.7	13.7	15.0

PERFORMANCE DATA[DM8501]

May 22, 2024

DRY SMOKE OPACITY	%	0.5	0.8	0.8	1.4	0.9
BOSCH SMOKE NUMBER		0.39	0.67	0.66	1.21	0.84

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN		**EKW**	**250.0**	**187.5**	**125.0**	**62.5**	**25.0**
PERCENT LOAD		**%**	**100**	**75**	**50**	**25**	**10**
ENGINE POWER		**BHP**	**398**	**302**	**211**	**124**	**68.9**
TOTAL NOX (AS NO2)		G/HR	1,242	714	452	281	222
TOTAL CO		G/HR	270	271	211	284	268
TOTAL HC		G/HR	69	88	92	70	71
PART MATTER		G/HR	62.6	66.0	49.0	49.0	34.1
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	1,637.5	1,170.5	991.8	1,015.1	1,417.8
TOTAL CO	(CORR 5% O2)	MG/NM3	323.2	403.0	429.8	928.3	1,469.7
TOTAL HC	(CORR 5% O2)	MG/NM3	71.2	113.1	157.9	211.5	370.0
PART MATTER	(CORR 5% O2)	MG/NM3	63.7	84.4	84.3	148.3	155.0
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	798	570	483	494	691
TOTAL CO	(CORR 5% O2)	PPM	259	322	344	743	1,176
TOTAL HC	(CORR 5% O2)	PPM	133	211	295	395	691
TOTAL NOX (AS NO2)		G/HP-HR	3.14	2.38	2.16	2.27	3.22
TOTAL CO		G/HP-HR	0.68	0.90	1.01	2.30	3.89
TOTAL HC		G/HP-HR	0.17	0.29	0.44	0.57	1.03
PART MATTER		G/HP-HR	0.16	0.22	0.23	0.40	0.49
TOTAL NOX (AS NO2)		LB/HR	2.74	1.57	1.00	0.62	0.49
TOTAL CO		LB/HR	0.59	0.60	0.47	0.63	0.59
TOTAL HC		LB/HR	0.15	0.19	0.20	0.15	0.16
PART MATTER		LB/HR	0.14	0.15	0.11	0.11	0.08

Regulatory Information

EPA TIER 3		**2005 - 2010**		
GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 89 SUBPART D AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE NON-ROAD REGULATIONS.				
Locality	**Agency**	**Regulation**	**Tier/Stage**	**Max Limits - G/BKW - HR**
U.S. (INCL CALIF)	EPA	NON-ROAD	TIER 3	CO: 3.5 NOx + HC: 4.0 PM: 0.20

EPA EMERGENCY STATIONARY		**2011 - ----**		
GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 60 SUBPART IIII AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE EMERGENCY STATIONARY REGULATIONS.				
Locality	**Agency**	**Regulation**	**Tier/Stage**	**Max Limits - G/BKW - HR**
U.S. (INCL CALIF)	EPA	STATIONARY	EMERGENCY STATIONARY	CO: 3.5 NOx + HC: 4.0 PM: 0.20

Altitude Derate Data

STANDARD

ALTITUDE CORRECTED POWER CAPABILITY (BHP)

AMBIENT OPERATING TEMP (F)	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**NORMAL**
ALTITUDE (FT)													
0	398	398	398	398	398	398	398	398	398	398	398	398	398
1,000	398	398	398	398	398	398	398	398	398	398	395	389	398
2,000	398	398	398	398	398	398	398	398	394	387	380	374	398
3,000	398	398	398	398	398	398	393	386	379	372	366	360	398
4,000	398	398	398	398	392	385	378	371	365	358	352	346	396
5,000	398	398	392	384	377	370	363	357	351	345	339	333	384
6,000	392	384	377	370	363	356	349	343	337	331	326	320	372
7,000	377	369	362	355	349	342	336	330	324	318	313	308	360

PERFORMANCE DATA[DM8501]

May 22, 2024

8,000	362	355	348	341	335	329	323	317	311	306	301	296	348
9,000	348	341	334	328	322	316	310	304	299	294	289	284	337
10,000	334	327	321	315	309	303	297	292	287	282	277	273	325
11,000	320	314	308	302	296	291	285	280	275	271	266	262	314
12,000	307	301	295	290	284	279	274	269	264	260	255	251	304
13,000	295	289	283	278	272	267	263	258	253	249	245	241	293
14,000	282	277	271	266	261	256	252	247	243	239	235	231	283
15,000	271	265	260	255	250	246	241	237	233	229	225	221	273

Cross Reference

Test Spec	Setting	Engine Arrangement	Engineering Model	Engineering Model Version	Start Effective Serial Number	End Effective Serial Number
0K6612	NAP	2575707	GS279	-	S9L00001	
0K6612	NAP	3950368	GS279	-	S9P00001	
4150078	PP5548	3950368	GS279	-	S9P00001	
4150078	PP5548	4529865	GS857	LS	S9P00001	
4150078	PP5548	5664658	PG350	G	RG300001	
4150078	PP5548	5664658	PG375	G	RE300001	

Performance Parameter Reference

Parameters Reference:DM9600-15

PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600
APPLICATION:
Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test cell at SAE J1995 standard reference conditions. Caterpillar maintains ISO9001:2000 certified quality management systems for engine test Facilities to assure accurate calibration of test equipment. Engine test data is corrected in accordance with SAE J1995. Additional reference material SAE J1228, J1349, ISO 8665, 3046-1:2002E, 3046-3:1989, 1585, 2534, 2288, and 9249 may apply in part or are similar to SAE J1995. Special engine rating request (SERR) test data shall be noted.
PERFORMANCE PARAMETER TOLERANCE FACTORS:
Power +/- 3%
Torque +/- 3%
Exhaust stack temperature +/- 8%
Inlet airflow +/- 5%
Intake manifold pressure-gage +/- 10%
Exhaust flow +/- 6%
Specific fuel consumption +/- 3%
Specific fuel consumption (C7-C18) +/- 4%
Fuel rate +/- 5%
Specific DEF consumption +/- 3%
DEF rate +/- 5%
Heat rejection +/- 5%
Heat rejection exhaust only +/- 10%
Heat rejection CEM only +/- 10%
Heat Rejection values based on using treated water.
Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications.
On C7 - C18 engines, at speeds of 1100 RPM and under these values are provided for reference only, and may not meet the tolerance listed.
On 3500 and C175 engines, at speeds below Peak Torque these values are provided for reference only, and may not meet the tolerance listed.
These values do not apply to C280/3600. For these models, see the tolerances listed below.
C280/3600 HEAT REJECTION TOLERANCE FACTORS:
Heat rejection +/- 10%
Heat rejection to Atmosphere +/- 50%
Heat rejection to Lube Oil +/- 20%
Heat rejection to Aftercooler +/- 5%
TEST CELL TRANSDUCER TOLERANCE FACTORS:
Torque +/- 0.5%
Speed +/- 0.2%
Fuel flow +/- 1.0%
Temperature +/- 2.0 C degrees
Intake manifold pressure +/- 0.1 kPa
OBSERVED ENGINE PERFORMANCE IS CORRECTED TO SAE J1995 REFERENCE
AIR AND FUEL CONDITIONS.

PERFORMANCE DATA[DM8501]

REFERENCE ATMOSPHERIC INLET AIR
FOR 3500 ENGINES AND SMALLER
SAE J1228 AUG2002 for marine engines, and J1995 JAN2014 for other engines, reference atmospheric pressure is 100 KPA (29.61 in hg), and standard temperature is 25deg C (77 deg F) at 30% relative humidity at the stated aftercooler water temp, or inlet manifold temp.
FOR 3600 ENGINES
Engine rating obtained and presented in accordance with ISO 3046/1 and SAE J1995 JANJAN2014 reference atmospheric pressure is 100 KPA (29.61 in hg), and standard temperature is 25deg C (77 deg F) at 30% relative humidity and 150M altitude at the stated aftercooler water temperature.
MEASUREMENT LOCATION FOR INLET AIR TEMPERATURE
Location for air temperature measurement air cleaner inlet at stabilized operating conditions.
REFERENCE EXHAUST STACK DIAMETER
The Reference Exhaust Stack Diameter published with this dataset is only used for the calculation of Smoke Opacity values displayed in this dataset. This value does not necessarily represent the actual stack diameter of the engine due to the variety of exhaust stack adapter options available. Consult the price list, engine order or general dimension drawings for the actual stack diameter size ordered or options available.
REFERENCE FUEL
DIESEL
Reference fuel is #2 distillate diesel with a 35API gravity;
A lower heating value is 42,780 KJ/KG (18,390 BTU/LB) when used at 15 deg C (59 deg F), where the density is
850 G/Liter (7.0936 Lbs/Gal).
GAS
Reference natural gas fuel has a lower heating value of 33.74 KJ/L (905 BTU/CU Ft). Low BTU ratings are based on 18.64 KJ/L (500 BTU/CU FT) lower heating value gas. Propane ratings are based on 87.56 KJ/L (2350 BTU/CU Ft) lower heating value gas.
ENGINE POWER (NET) IS THE CORRECTED FLYWHEEL POWER (GROSS) LESS
EXTERNAL AUXILIARY LOAD
Engine corrected gross output includes the power required to drive standard equipment; lube oil, scavenge lube oil, fuel transfer, common rail fuel, separate circuit aftercooler and jacket water pumps. Engine net power available for the external (flywheel) load is calculated by subtracting the sum of auxiliary load from the corrected gross flywheel out put power. Typical auxiliary loads are radiator cooling fans, hydraulic pumps, air compressors and battery charging alternators. For Tier 4 ratings additional Parasitic losses would also include Intake, and Exhaust Restrictions.
ALTITUDE CAPABILITY
Altitude capability is the maximum altitude above sea level at standard temperature and standard pressure at which the engine could develop full rated output power on the current performance data set.
Standard temperature values versus altitude could be seen on TM2001.
When viewing the altitude capability chart the ambient temperature is the inlet air temp at the compressor inlet.
Engines with ADEM MEUI and HEUI fuel systems operating at conditions above the defined altitude capability derate for atmospheric pressure and temperature conditions outside the values defined, see TM2001.
Mechanical governor controlled unit injector engines require a setting change for operation at conditions above the altitude defined on the engine performance sheet. See your Caterpillar technical representative for non standard ratings.
REGULATIONS AND PRODUCT COMPLIANCE
TMI Emissions information is presented at 'nominal' and 'Potential Site Variation' values for standard ratings. No tolerances are applied to the emissions data. These values are subject to change at any time. The controlling federal and local emission requirements need to be verified by your Caterpillar technical representative.
Customer's may have special emission site requirements that need to be verified by the Caterpillar Product Group engineer.
EMISSION CYCLE LIMITS:
Cycle emissions Max Limits apply to cycle-weighted averages only. Emissions at individual load points may exceed the cycle-weighted limit.
WET & DRY EXHAUST/EMISSIONS DESCRIPTION:
Wet - Total exhaust flow or concentration of total exhaust flow
Dry - Total exhaust flow minus water vapor or concentration of exhaust flow with water vapor excluded
EMISSIONS DEFINITIONS:
Emissions : DM1176
EMISSION CYCLE DEFINITIONS
1. For constant-speed marine engines for ship main propulsion, including,diesel-electric drive, test cycle E2 shall be applied, for controllable-pitch propeller sets

PERFORMANCE DATA[DM8501]

test cycle E2 shall be applied.
2. For propeller-law-operated main and propeller-law-operated auxiliary engines the test cycle E3 shall be applied.
3. For constant-speed auxiliary engines test cycle D2 shall be applied.
4. For variable-speed, variable-load auxiliary engines, not included above, test cycle C1 shall be applied.
HEAT REJECTION DEFINITIONS:
Diesel Circuit Type and HHV Balance : DM9500
HIGH DISPLACEMENT (HD) DEFINITIONS:
3500: EM1500
RATING DEFINITIONS:
Agriculture : TM6008
Fire Pump : TM6009
Generator Set : TM6035
Generator (Gas) : TM6041
Industrial Diesel : TM6010
Industrial (Gas) : TM6040
Irrigation : TM5749
Locomotive : TM6037
Marine Auxiliary : TM6036
Marine Prop (Except 3600) : TM5747
Marine Prop (3600 only) : TM5748
MSHA : TM6042
Oil Field (Petroleum) : TM6011
Off-Highway Truck : TM6039
On-Highway Truck : TM6038
SOUND DEFINITIONS:
Sound Power : DM8702
Sound Pressure : TM7080
Date Released : 03/12/24

Image shown might not reflect actual configuration

SOUND ATTENUATED LEVEL 2 ENCLOSURES

D250GC – D600GC

60 Hz

FEATURES

Robust / Highly Corrosion Resistant Construction

- Factory installed on skid base or tanks base
- Environmentally friendly, polyester powder baked paint
- Enclosure constructed with 18-gauge steel
- Interior zinc plated fasteners
- Internally mounted exhaust silencing system
- Comply with ASCE /SEI 7 for Wind loads up to 100mph
- Designed and tested to comply with UL 2200 Listed generator set package

Excellent Access

- Large cable entry area for installation ease.
- Accommodates side mounted single or multiple breakers.
- Two doors on both sides.
- Vertically hinged allow 180° opening rotation
- Radiator fill cover.

Security and Safety

- Lockable access doors which give full access to control panel and breaker.
- Cooling fan and battery charging alternator fully guarded.
- Fuel fill, oil fill and battery can only be reached via lockable access.
- Externally mounted emergency stop button (Optional).
- Designed for spreader bar lifting to ensure safety.
- Stub-up area is rodent proof.

Sound Attenuated Level 2

- Caterpillar white paint
- UL Listed integral fuel tank with 24 hours running time capacity (Optional).
- DC lighting package (Optional)

Cat® GC ENCLOSURES

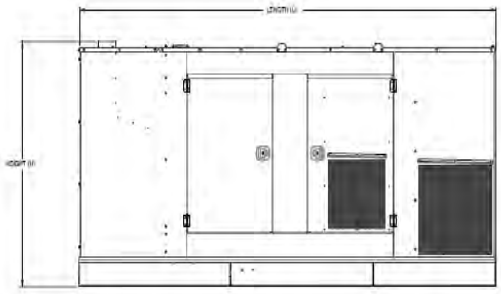
Enclosure Package Operating Characteristics

Enclosure Type	Standby ekW	Cooling Air Flow Rate		Ambient Capability*		Sound Pressure Levels (dBA) at 7m (23 ft)
		m^3/s	cfm	°C	°F	100% Load
Level 2 Sound Attenuated Enclosure (Steel)	250	6.4	13561	57	135	74
	300	6.4	13561	51	125	74
	350	7.4	15680	57	134	71
	400	7.4	15680	53	127	71
	450	8.4	17692	54	130	73
	500	8.4	17692	50	122	73
	550	11.2	23731	56	133	73
	600	11.2	23731	53	127	73

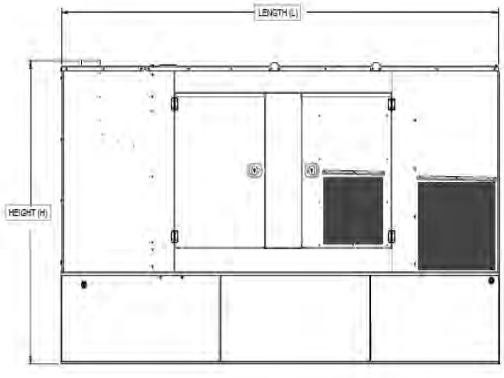
*Cooling system performance at sea level. Consult your Cat® dealer for site specific ambient and altitude capabilities.

Note: Sound level measurements are subject to instrumentation, installation and manufacturing variability, as well as ambient site conditions.

DIMENSIONS



Sound Attenuated Enclosure on Skid Base



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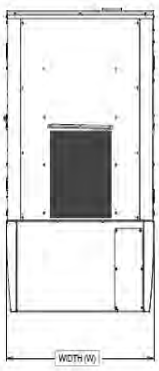


Sound Attenuated Enclosure on a UL Listed Integral Fuel Tank Base

WEIGHTS & DIMENSIONS

Enclosure Type	Standby Ratings, ekW	Length, L		Width, W		Height, H		Package Weights	
		mm	in	mm	in	mm	in	kg	lb
Sound Attenuated Enclosure on Skid Base	250	3958	155.8	1440	56.7	1991	78.4	2857	6298.6
	300							2945	6492.6
	350	4633	182.4	1630	64.2	2227	87.7	3983	8781.0
	400							4017	8856.0
	450	4823	189.8	1630	64.2	2227	87.7	4408	9718.0
	500							4457	9826.0
	550	4980	196.1	1865	73.4	2172	85.5	4754	10480.8
	600							4837	10663.8
Sound Attenuated Enclosure on UL Listed Integral Fuel Tank Base	250	3958	155.8	1440	56.7	2487	97.9	3497	7709.6
	300							3585	7903.6
	350	4633	182.4	1630	64.2	2644	104.1	4765	10505.0
	400							4799	10580.0
	450	4823	189.8	1630	64.2	2777	109.3	5345	11783.7
	500							5394	11891.7
	550	4980	196.1	1865	73.4	2723	107.2	5973	13168.2
	600							6056	13351.2
Sound Attenuated Enclosure on UL Listed Extended Integral Fuel Tank Base	250	4608	181.4	1430	56.3	2379	93.7	3590	7914.6
	300							3678	8108.6
	350	5251	203.7	1620	63.8	2561	100.8	4876	10749.7
	400							4910	10824.7
	450	5909	232.6	1620	63.8	2612	102.8	5497	12118.8
	500							5546	12226.8
	550	6759	266.1	1865	73.4	2487	97.9	6237	13750.2
	600							6320	13933.2

LET'S DO THE WORK.™

LEHE2014-4(11-20)

APPENDIX D. NOISE STUDY

Intended for
Rowan Digital Infrastructure

Document type
Environmental Noise Assessment Report

Date
December 15, 2023

BAUXITE DATA CENTER
ENVIRONMENTAL NOISE ASSESSMENT

Frederick County, Maryland

RAMBOLL
Bright ideas.
Sustainable change.

Bauxite Data Center

Environmental Noise Assessment

Version	Date	Prepared by	Checked by	Approved by	Description
1.0	2023-11-07	Jeff Szymanski	Brent Ferren	Greg Mentel	Environmental Noise Assessment to accompany site permitting application.
1.1	2023-12-15	Jeff Szymanski	Brent Ferren	Greg Mentel	Updated to include up-to-date design information and to address comments from Rowan and Authority Having Jurisdiction (AHJ).

Contents

Executive Summary

Rowan Digital Infrastructure retained Ramboll to conduct an environmental noise assessment for the proposed Bauxite data center site. The approximately 150-acre site is generally bounded by Ballenger Creek Pike and Mountville Road to the southwest, in Frederick County, Maryland.

The environmental noise assessment has been prepared at the request of Frederick County to support the permit application process. It presents the results of acoustical modeling for the conceptual design of the project and a summary of the proposed project's compliance with applicable regulatory requirements.

The Bauxite data center site will consist of three (3) 1-story 12-pod data halls, one (1) 1-story 6-pod data hall, an auxiliary water building (AWB), a central security building (CSB), and an associated substation surrounded by an 8-ft masonry wall. The data center will operate 24 hours per day, 7 days per week. The primary sources of sound from the facility are expected to include ventilation and air conditioning equipment. Additionally, the facility may include emergency generators (within acoustical enclosures) that would be operated occasionally during maintenance and testing activities.

The sound emissions associated with the proposed data center operation were assessed through predictive acoustical modeling. The project is expected to comply with the regulatory requirements of Frederick County Code of Ordinances during normal and generator maintenance testing scenarios. The projected is expected to comply with the requirements during an emergency scenario with incorporation of mitigation options such as acoustical barriers.

1. Introduction

An environmental noise assessment was conducted for the proposed Bauxite data center site within Frederick County, Maryland, to consider applicable regulations pertaining to sound emissions, and to inform the acoustical design of the project. This report, prepared in support of the permitting process at the request of Frederick County, summarizes the findings of the assessment and details a proposed acoustical design of the facility to ensure regulatory compliance.

2. Acoustical Principles and Terminology

To familiarize the reader with terminology used throughout this report, this section introduces general acoustical terminology and describes basic acoustical parameters.

2.1 Basics of Sound

Sound is the transmission of energy in the form of fluctuating pressure waves from a vibrating source through an elastic medium, such as air, that is detectable by the human ear. The pressure fluctuates above and below atmospheric pressure. The amplitude of the pressure fluctuation is typically described in terms of decibels (dB), while the rate of fluctuation per unit time (frequency) is described in hertz (Hz).

The decibel is a logarithmic ratio of a given sound pressure to a reference sound pressure. A logarithmic ratio is used for decibels since human hearing is roughly logarithmic, rather than linear. The reference sound pressure is roughly equal to the threshold of human hearing. Sound pressure levels below the human threshold of hearing are less than 0 dB, while levels above the human threshold of hearing are greater than 0 dB. Differences in sound level are also described in decibels. A 3-dB difference is considered "just noticeable", a 5-dB difference is considered "clearly noticeable", while a 10-dB difference is perceived as a doubling (or halving) in loudness. Table 2-1 provides a list of common noise sources, their sound level, and their subjective loudness.

Because the decibel is logarithmic, a doubling of sound energy from a noise source produces a 3-dB increase in sound level from that source, not a doubling of the loudness of the sound (which requires a 10-dB increase). For example, if a stationary lawn mower is creating a sound level of 60 dBA at 100 feet, adding a second lawn mower next to the first would cause the sound level at the same 100-foot location to increase to 63 dBA. Such an increase might not be discernible in a complex acoustical environment.

Equipment sound level data are often provided as sound power levels (L_w or L_{wA}), also expressed in decibels referenced to 1 picowatt (pW). L_w is the level resulting from sound energy produced by a source and is useful as acoustical modeling input. L_w does not require a distance reference since it is a physical property of the sound source.

The range of frequencies a healthy human ear can hear is approximately 20 Hz to 20,000 Hz. The human ear is not equally sensitive to all frequencies across the audible frequency spectrum. The human ear is most sensitive to mid frequencies (the frequency range associated with speech) and is less sensitive at low frequencies and very high frequencies. To account for this, frequency weighting networks have been developed to approximate the human ear's frequency response at different sound pressure levels. The A-weighting network is used to approximate the frequency response of the human ear at normal sound levels. Measurements using the A weighting network are described in terms of A-weighted decibels, often abbreviated colloquially as dBA or dB(A).

Table 2-1. Typical Sound Pressure Levels Associated with Common Noise Sources			
Sound Pressure Level (dBA)	Subjective Evaluation	Environment	
		Outdoor	Indoor
140	Deafening	Jet aircraft at 75 ft	
130	Threshold of pain	Jet aircraft at 300 ft during takeoff	
120	Threshold of feeling		Rock band concert
110	Extremely Loud	Accelerating motorcycle at a few feet away.	
100	Very Loud	Auto horn at 10 ft	
90		Jackhammer at 50 ft	Noisy factory
80	Loud	Diesel truck (40 mph) at 50 ft Noisy urban street	Cafeteria with sound-reflecting surfaces
70	Moderately Loud	Busy highway at 100 ft	Vacuum cleaner at 10 ft
60	Moderate		Face-to-face conversation
50	Quiet	Small town residence	Open office area Quiet dishwasher
40			
30	Very quiet		Bedroom, typical residence (without TV or sound system)
20		Rustling leaves	Audiometric testing room Whisper
10	Just audible		Human breathing
0	Threshold of hearing		

Source: Adapted from *Architectural Acoustics*, M. David Egan (1988) and *Noise Control in Buildings*, Cyril M. Harris, (1994).

2.2 Environmental Sound Level Metrics

Noise in the environment is constantly fluctuating. In a neighborhood setting, this may occur due to traffic, overhead aircraft, barking dogs, etc. Noise metrics have been developed to quantify fluctuating environmental noise levels. Common environmental noise metrics include the equivalent-continuous sound level, the day-night sound level, and percentile sound levels.

Equivalent-Continuous Sound Level - The equivalent-continuous sound level, L_{eq}, is used to represent the equivalent sound pressure level over a specified time period. The L_{eq} metric is the sound level of a steady-state sound that has the same (equivalent) total energy as the time-varying sound of interest, taken over a specified time period and covering a specified set of conditions. Thus, L_{eq} is a single-value level that expresses the time-averaged total energy of a widely varying or fluctuating sound level.

Percentile Sound Level - The percentile sound level, L_x, is the sound level exceeded "x" percent of the sampling period and is referred to as a statistical sound level. Common percentile sound level metrics include L_{90}, L_{50}, and L_{10}. L_{90} is the sound level exceeded 90 percent of the sampling period. The L_{90} sound level represents the sound level without the influence of loud, transient noise sources and is therefore often referred to as the residual or background sound level. The L_{50} sound level is the sound level exceeded 50 percent of the sampling period or the median sound level. The L_{10} sound level is the sound level exceeded 10 percent of the sampling period. The L_{10} sound level represents the occasional louder noises and is often referred to as the intrusive sound level. The variation between the L_{90}, L_{50}, and L_{10} sound levels can provide an indication of the variability of the acoustical environment. If the acoustical environment is perfectly steady, all values are identical. A large variation between the values indicates the environment experiences highly fluctuating sound levels. For instance, measurements near a roadway with frequent passing vehicles may cause a large variation in the percentile sound levels.

3. Environmental Setting

The approximately 150-acre site is generally bounded by Ballenger Creek Pike and Mountville Road to the southwest, in Frederick County, Maryland. The project vicinity is generally rural / suburban in nature. The project site and vicinity include industrial and residential land uses, as shown in Figure 3.1.

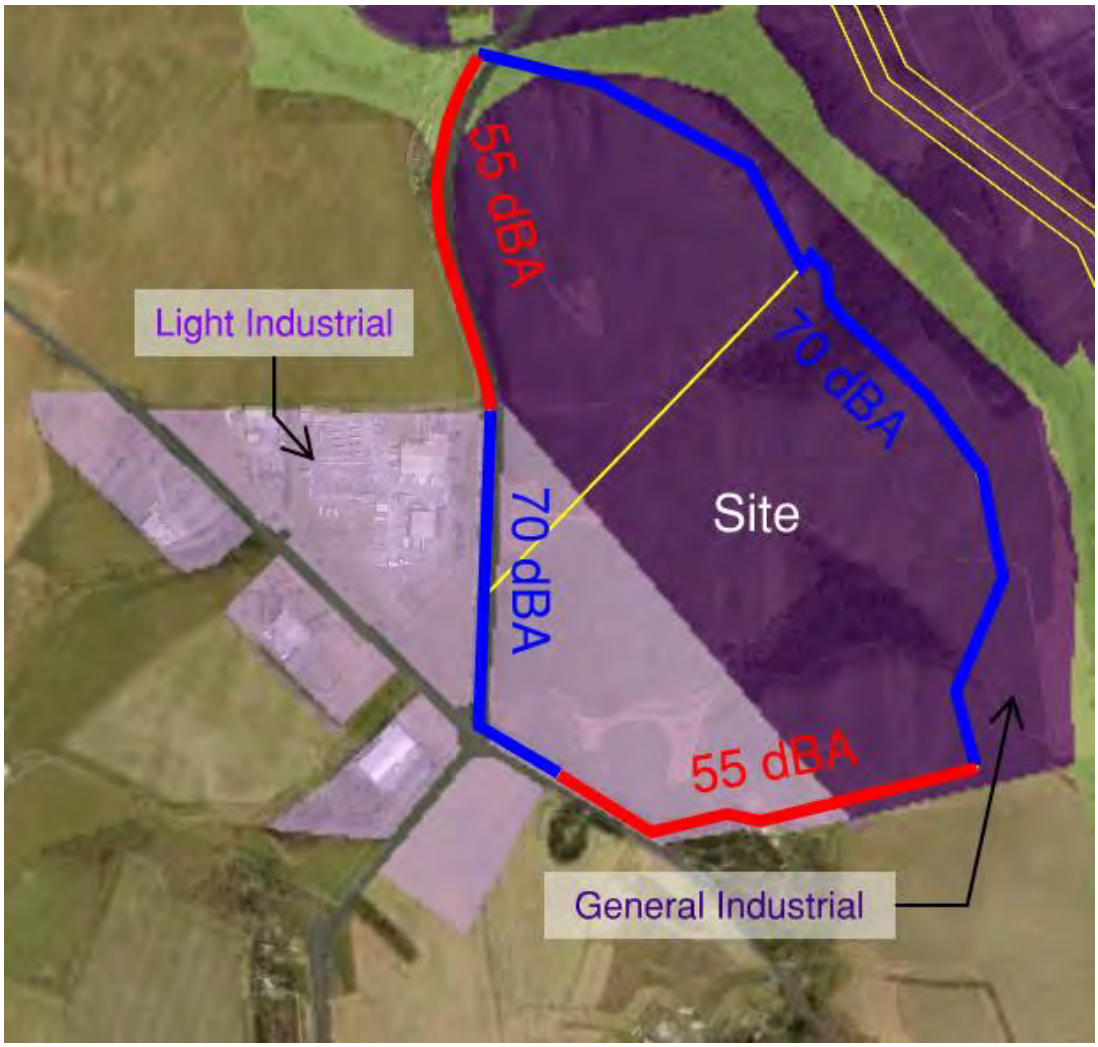


Figure 3.1. Bauxite data center project site and surrounding area showing land use (dark purple areas are "I – Industrial").

4. Regulatory Setting

4.1 State of Maryland

The Code of Maryland Regulations (COMAR), Section 26.02.03.02, provides sound level limits that are dependent on land use of the receiving property and time of day. However, Frederick County has established more stringent limits specific to Critical Digital Infrastructure ("CDI") land uses. The county requirements are discussed in detail in the next section.

4.2 Frederick County

The site is in unincorporated Frederick County. Frederick County has established sound level limits specific to CDI land uses, which include data centers. Section 1-19-8.402 (D) of the Frederick County Code of Ordinances establishes overall A-weighted sound pressure level limits dependent on land use and clarifies that generator operation is included. The maximum allowable sound levels (dBA) measured at a receiving property are listed in Table 4.1.

Table 4.1. Frederick County, Maryland Code of Ordinances – Section 1-19-8.402 (D)	
CDI Maximum Permissible Sound Pressure Levels (dBA)	
Land Use Categories	All Time
Industrial	70
Commercial	64
Residential in any zoning district	55
Institutional	55
All other uses	55
Generator Testing, Maintenance, and Emergency Operation: No exemptions noted. Construction Activities: The provisions of this section do not apply to temporary construction activity between 7:00 a.m. and 7:00 p.m.	

5. Predicted Project Sound Levels

5.1 Project Description

The Bauxite data center site is expected to include four (4) data center buildings—three (3) 12-pod 1-story data halls and one (1) 6-pod 1-story data hall; an auxiliary water building (AWB), a central security building (CSB); and an associated substation surrounded by an 8-ft masonry wall. It is understood the data center will operate 24 hours per day, 7 days per week.

5.2 Methodology

Potential project-related noise emissions were evaluated using a sound prediction software package, Cadna/A, published by Datakustik GmbH, which is configured to implement the ISO 9613 environmental sound propagation algorithms. It allows the creation of complex acoustical models and predicts sound pressure levels due to sound emissions from a specific source(s). The modeling considers many factors that influence sound propagation including source sound level and directivity, distance attenuation, source-receptor geometry, barrier effects of buildings and topography, and ground and atmospheric attenuation. Modeling parameters are shown in Table 5-1.

Table 5-1. Model Setup	
Parameter	Value
G (ground absorption)	0.6
Reflection Order	2
Receptor / Grid Height	~5 ft
Terrain	USGS data

Table 5-1. Model Setup	
Parameter	Value
Meteorology	ISO 9613 default augmented with regional 30-year wind data, and annual temperature and humidity averages: (56 F / 66% R.H. / ~7 mph avg. wind speed)

5.3 Modeling Input

The acoustical model included the following equipment assumptions, with mitigation measures as listed in Table 5-2.

Table 5-2. Acoustical Model Input Data				
Sound Source	Location	Quantity [a]	Input Sound Level (L_{wA} re 1 picowatt [pW])	Mitigation Included
Rooftop Exhaust Fans	Building roofs	520	L_{wA}: 92 dBA	None
Substation Transformer	Switchyards	4	L_{wA}: 83 dBA	None
Direct Air Handling Unit Inlets	Building facades	184	L_{wA}: 82 dBA / 88 dBA [b]	Acoustical duct liner; silencers; acoustical louvers
2.75-Megawatt (MW) Emergency Generators (if included)	Generator yard	92	L_{wA}: 105 dBA	Acoustical enclosures; exhaust silencers; acoustical "end cap" barrier walls
750-kilowatt (kW) House Generators (if included)	Generator yard	4 (1 per building)	L_{wA}: 105 dBA	Acoustical enclosures; exhaust silencers; acoustical "end cap" barrier walls
AWB Building 750-Kilowatt (kW) Generator (if included)	Adjacent to building	2	L_{wA}: 105 dBA	Acoustical enclosures; exhaust silencers
CSB 250-kW Generator (if included)	Adjacent to building	1	L_{wA}: 90 dBA	Acoustical enclosures; exhaust silencers

Note:
[a] Determined from review of preliminary Site Plan and associated design drawings.
[b] Level is dependent on side of building.

For the potential generators, the relative capacity (in kW or MW above) should be noted. There are different sized generators, per the building design, which have different rated sound levels. In general, smaller capacity generators are quieter than larger capacity generators. Further, the IW Building Generator has been conservatively assumed to have the same sound power level as the larger Emergency Generators; the actual sound power level of the IW Building Generator will likely be lower, but the exact rating was not available at the time of preparing the acoustical model.

5.4 Acoustical Model Configuration & Results

The model included the implementation of acoustical mitigation measures as necessary to reduce the facility's overall sound emissions and support compliance with regulatory requirements—see

Table 5.2 above. Mitigation measures include air handling unit inlet duct lining, inlet silencers, and acoustical louvers; if utilized, improved generator acoustical performance, including acoustical enclosures, generator exhaust silencers, and noise barrier walls. Each building includes an "end cap" barrier wall for the generator yard at the end closest to the property boundary. The wall height is assumed to be approximately 20 to 30 feet tall. The purpose of the wall is to provide visual screening, as well as to provide some acoustical shielding. The walls interrupt the path of sound propagation. A generalized depiction of the function of an acoustical barrier is depicted in Figure 5.1. Note that barriers do not stop all sound energy. Some sound will diffract around the edges. However, the net effect is a reduction of sound level on the receiving side of the barrier wall.

Three (3) operational scenarios were evaluated:

- A normal operation, "full load" scenario including all normally operating mechanical and electrical equipment operating at 100% load. Equipment includes exhaust fans, transformers, and direct air handling units.
- A generator maintenance and testing scenario. Equipment includes exhaust fans, transformers, direct air handling units and one generator per data hall in operation. For "worst-case" modeling purposes, the potential generator for each building that is closest to the property boundary or noise-sensitive receptor is selected.
- A worst-case emergency scenario with all potential generators in operation at 100% load. Equipment includes exhaust fans, transformers, direct air handling units and all generators in operation.

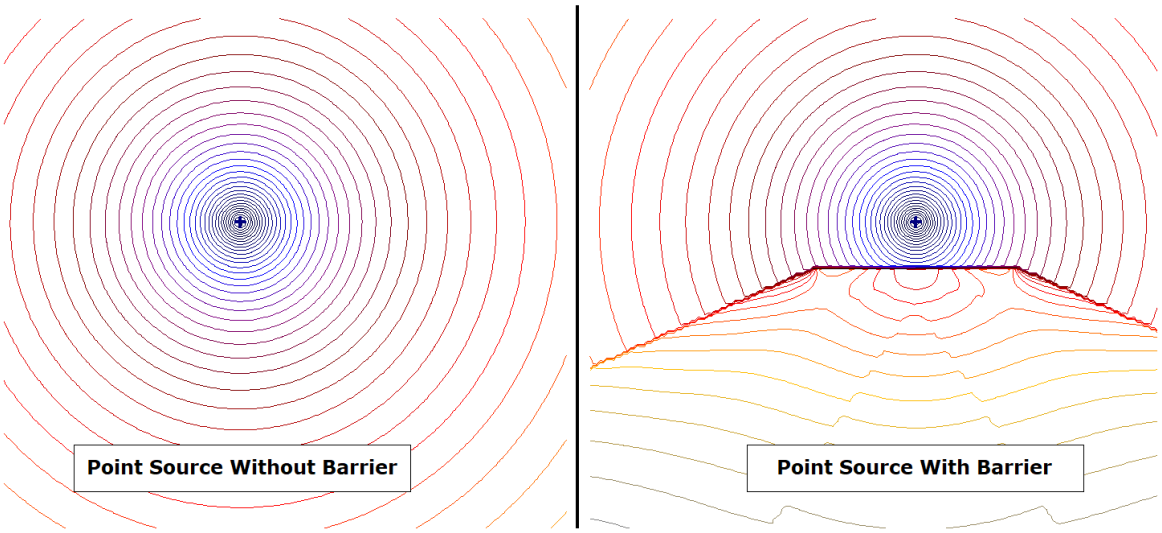


Figure 5.1. Generalized depiction of acoustical barrier wall function.

5.4.1 Normal **"Full Load" Operation Scenario Modeling Results**

Project-only sound levels during normal "full load" operation of the data centers with acoustical mitigation are not expected to exceed 55 dBA at the site property boundary in accordance with applicable regulatory property boundary limits. "Full load" assumes all mechanical and electrical equipment required for normal data center operation are operating at 100% load. Predicted sound level contours for the "full load" operations scenario are presented in Figure 5.2.

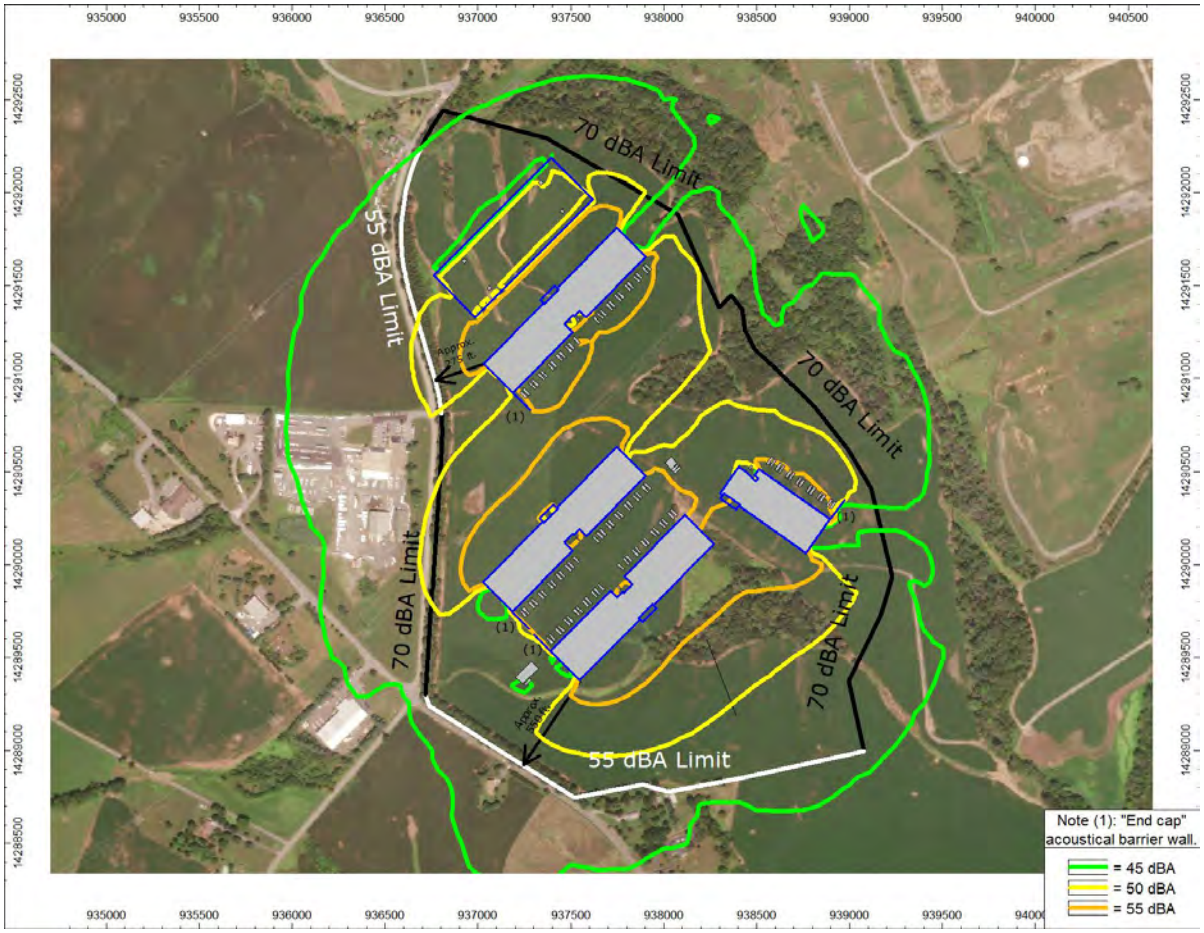


Figure 5.2. Predicted Sound Level Contours for Normal "Full Load" Operations.

5.4.2 Generator Testing and Maintenance Scenario Modeling Results

Generator testing is expected to take place infrequently and during daytime hours. The Generator Testing and Maintenance operating scenario includes the same modeling setup as Section 5.4.1 with the addition of one (1) generator for each building. The resulting sound levels along the property boundaries are not expected to exceed the applicable regulatory limits. Predicted sound level contours for the Generator Testing and Maintenance scenario are presented in Figure 5.3.

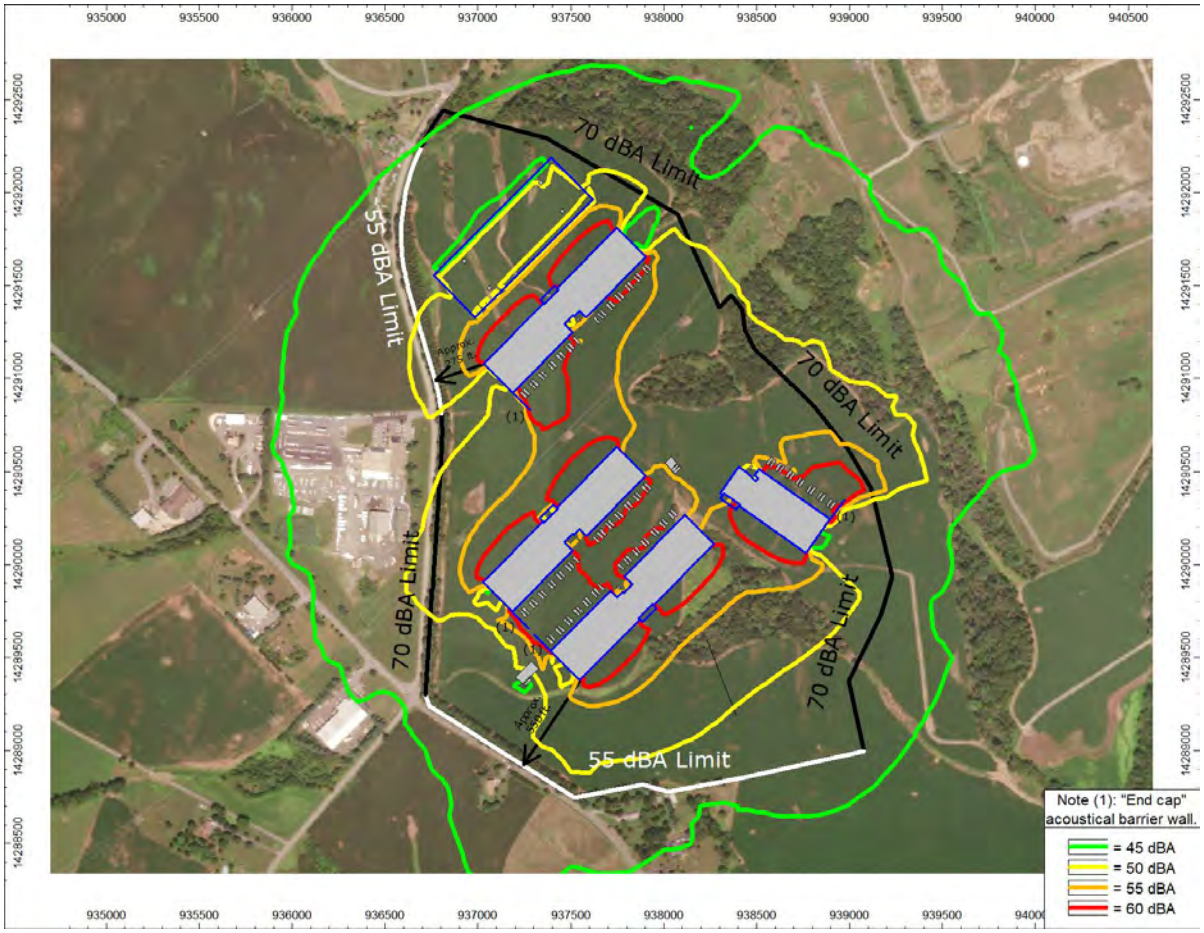


Figure 5.3. Predicted Sound Level Contours for Generator Testing & Maintenance.

5.4.3 Emergency Scenario Modeling Results

The Emergency scenario includes the same modeling setup as Section 5.4.1 with the addition of all potential generators operating at 100% load. It should be noted that if generators are utilized for the project, their combined use during an emergency power outage would be rare. Nonetheless, the resulting sound levels along the property boundaries are not expected to exceed the applicable regulatory limits with incorporation of generator acoustical enclosures and generator yard "end cap" barrier walls as shown in Figure 5.4. An elevation view of a typical "end cap" barrier wall is provided in Figure 5.5.

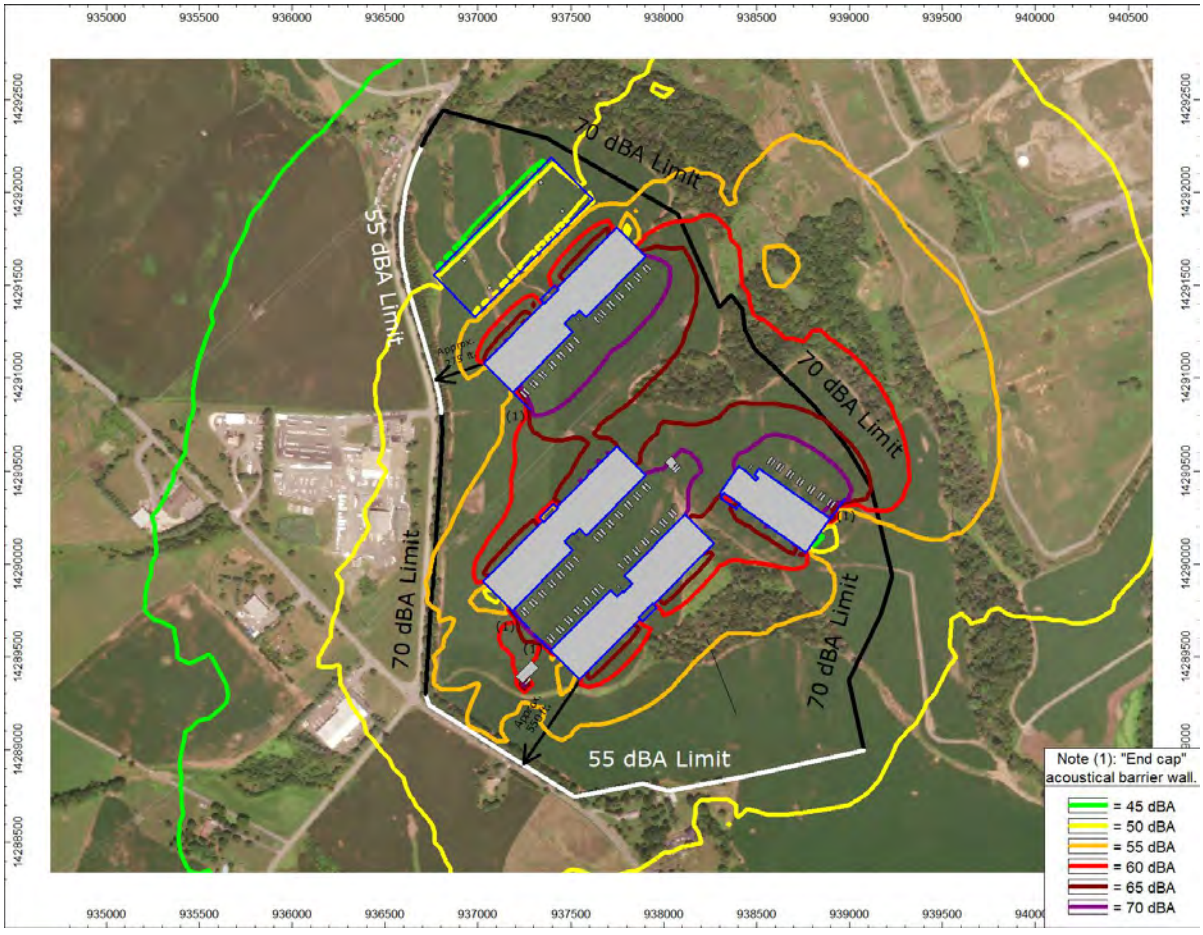


Figure 5.4. Predicted Sound Level Contours for Emergency Operations.

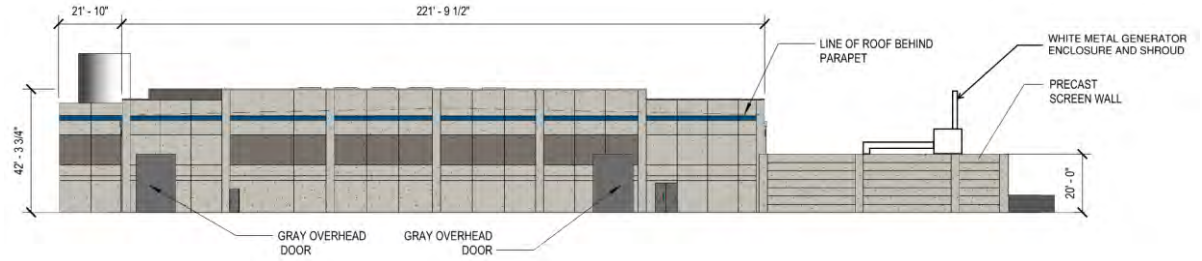


Figure 5.5. Elevation view of a typical "end cap" barrier wall ("Precast Screen Wall").

6. Conclusions

This environmental noise assessment has been prepared for Rowan Digital Infrastructure in support of the permit application process for the proposed Bauxite data center within Frederick County, Maryland. This report presents an assessment of the potential noise emissions from the proposed data center facility compared to applicable regulatory requirements. The assessment was prepared based on information available at the current stage of project design. Models have been completed in accordance with the methodologies outlined in ISO 9613. Given the preliminary stage of project design, the equipment modeled in this assessment represent reasonable assumptions for a typical data center facility and will be confirmed during the design engineering phase of the project.

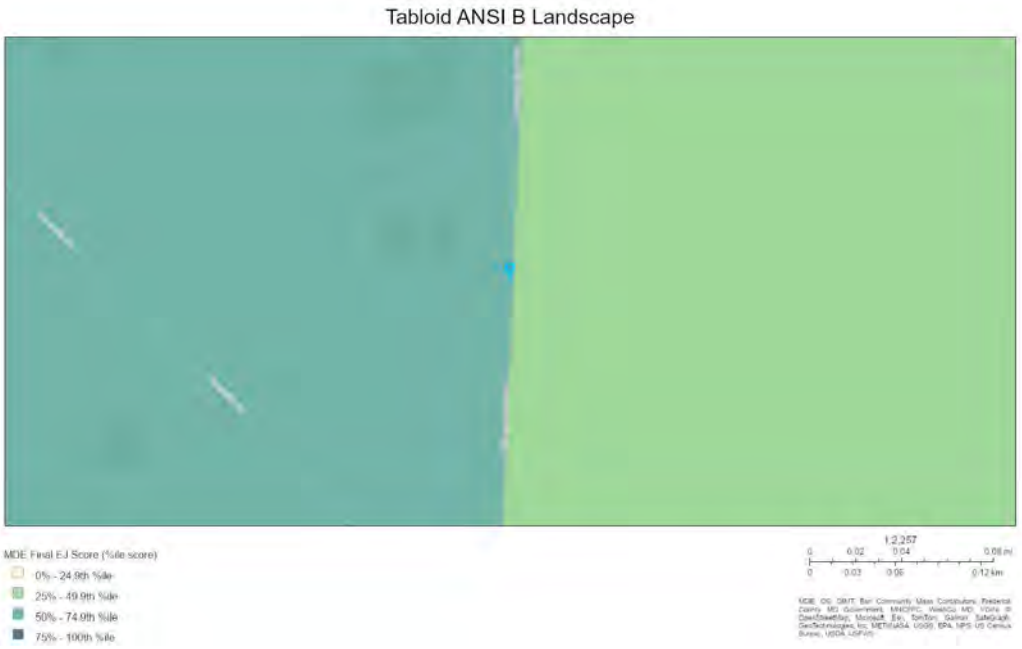
The project is expected to comply with the regulatory requirements of Frederick County Code of Ordinances during normal and generator maintenance testing scenarios. The projected is expected to comply with the requirements during an emergency scenario with incorporation of mitigation options such as acoustical barriers.

APPENDIX E. MDE ENVIRONMENTAL JUSTICE SCREENING REPORT

MDE Screening Report

Area of Interest (AOI) Information

Jul 27 2024 16:18:07 Eastern Daylight Time



Summary

Name	Count	Area(mi²)	Length(mi)
MDE Final EJ Score (%ile score)	2	N/A	N/A
Overburdened Communities Combined Score	2	N/A	N/A
Overburdened Pollution Environmental Score (%ile score)	2	N/A	N/A
Overburdened Exposure Score (%ile score)	2	N/A	N/A
Overburdened Sensitive Population (%ile score)	2	N/A	N/A
Socioeconomic/Demographic Score 2020 (Percentile score) (Underserved Community)	2	N/A	N/A
Air Emissions Facilities	0	N/A	N/A
Sulfur Dioxide (2010)	0	N/A	N/A
Ozone (2015)	1	N/A	N/A
Fine Particles (2012)	1	N/A	N/A
Biosolids FY 2020 and Current Permit Details	0	N/A	N/A
Biosolids FY2010 - 2014 Permit Details	0	N/A	N/A
Biosolids FY2009 Expired Permit Details	0	N/A	N/A
Biosolids FY 2020 and Current Permits Distribution By Acreage	1	N/A	N/A
Biosolids FY2015 - 2019 Permits Distribution By Acreage	1	N/A	N/A
Biosolids FY2010 - 2014 Permits Distribution By Acreage	1	N/A	N/A
Biosolids FY2009 Permits Expired Distribution By Acreage	1	N/A	N/A
Biosolids FY 2020 and Current Permit Distribution By Percent Coverage	1	N/A	N/A
Biosolids FY2015 - 2019 Permit Distribution By Percent Coverage	1	N/A	N/A
Biosolids FY2010 - 2014 Permit Distribution By Percent Coverage	1	N/A	N/A
Biosolids FY2009 Expired Permit Distribution By Percent Coverage	1	N/A	N/A
Concentrated Animal Feeding Operations (CAFOs)	0	N/A	N/A
Composting Facilities	0	N/A	N/A
Food Scrap Acceptors	0	N/A	N/A
Landfills	0	N/A	N/A
Correctional Facilities	0	N/A	N/A
Industrial Food Suppliers	0	N/A	N/A
Residential Colleges	0	N/A	N/A
Non-Residential Colleges	0	N/A	N/A
Hospitals	0	N/A	N/A
High Schools	0	N/A	N/A
Grocery Stores	0	N/A	N/A
10 Miles from Landfill	7	N/A	N/A
10 Miles from Composting Facility	2	N/A	N/A
General Composting Facilities Tier 2 (MD)	0	N/A	N/A
Commercial Anaerobic Digester (MD)	0	N/A	N/A
Out of State Facilities	0	N/A	N/A
30 mile buffer (Maryland)	1	N/A	N/A
30 Mile Buffer (Out of State)	1	N/A	N/A
Land Restoration Facilities	0	N/A	N/A
Determinations (points)	0	N/A	N/A
Determinations (areas)	0	N/A	N/A
Entities	0	N/A	N/A
Active Coal Mine Sites	0	N/A	N/A
Historic Mine Facilities	0	N/A	N/A

All Permitted Solid Waste Acceptance Facilities	0	N/A	N/A
Municipal Solid Waste Acceptance Facilities	0	N/A	N/A
Maryland Dam Locations	0	N/A	N/A
Maryland Pond Locations	0	N/A	N/A
Surface Water Intakes	0	N/A	N/A
Wastewater Discharge Facilities	0	N/A	N/A
Drinking Water	0	N/A	N/A
Clean Water	0	N/A	N/A

MDE Final EJ Score (%ile score)

#	Census tract identifier	Geographic Area Name	Total Population	Final EJ Score Percent (for this tract)	Final EJ Score Percentile (Distribution across Maryland)	Area(mi²)
1	24021752303	Census Tract 7523.03, Frederick County, Maryland	3293	32.83	69.31	N/A
2	24021752302	Census Tract 7523.02, Frederick County, Maryland	4216	26.64	31.51	N/A

Overburdened Communities Combined Score

#	GEOID20	Geographic_Area_Name	TotalPop	Overburd_Exposure_Percent	Overburd_Exposure_Percentile	Overburd_Poll_Enviro_Percent	Overburd_Poll_Enviro_Percentile	Sensitive_Population_Percent
1	24021752303	Census Tract 7523.03, Frederick County, Maryland	3,293	41.30	20.30	7.99	53.59	93.74
2	24021752302	Census Tract 7523.02, Frederick County, Maryland	4,216	45.29	39.64	3.78	23.58	65.60

#	Sensitive_Population_Percentile	OverburdenedAllPercent	OverburdenedAllPercentile	Area(mi²)
1	99.86	91.66	43.34	N/A
2	63.09	55.84	63.91	N/A

Overburdened Pollution Environmental Score (%ile score)

#	GEOID20	Geographic_Area_Name	RentalsOccupiedPre79Percent	Percentile	PercentRMP	PercentRMPEJ	PercentHazWaste	PercentHazWasteEJ
1	24021752303	Census Tract 7523.03, Frederick County, Maryland	3.07	14.22	2.66	5.99	2.79	8.21
2	24021752302	Census Tract 7523.02, Frederick County, Maryland	5.74	31.10	2.43	5.57	1.54	6.70

#	PercentSuperFundNPL	PercentSuperFundNPLEJ	PercentHazWW	PercentHazWWEJ	BrownFPercent	Percentile_1	PercentPowerPlants	Percentile_12
1	5.84	10.39	57.53	34.72	0.00	0.00	0.00	0.00
2	5.23	9.97	16.86	10.91	0.00	0.00	0.00	0.00

#	PercentCAFOS	Percentile_12_13	PercentActiveMines	Percentile_12_13_14	PollutionEnvironmentalPercent	PollnEnvironmentalPercentile	Area(mi²)
1	2.17	95.69	0.00	0.00	7.99	53.59	N/A
2	0.00	0.00	0.00	0.00	3.78	23.58	N/A

Overburdened Exposure Score (%ile score)

#	GEOID20	Geographic_Area_Name	Total_Pop	PercentNATA_Cancer	Percentile_NATA_Cancer	PercentNATA_Resp_HI	Percentile_NATA_Resp_HI	PercentNATA_Diesel
1	24021752303	Census Tract 7523.03, Frederick County, Maryland	3,293.00	60.00	13.68	60.00	9.04	19.31
2	24021752302	Census Tract 7523.02, Frederick County, Maryland	4,216.00	60.00	13.82	60.00	9.13	18.90

#	Percentile_NATA_Diesel	PercentNATA_PM25	PercentileNATA_PM25	PercentOzone	PercentileOzone	PercentTraffic	PercentileTraffic	PercentTRI
1	6.98	94.08	11.47	90.32	9.14	1.46	6.03	5.26
2	6.88	94.77	11.87	90.85	9.60	0.12	1.35	21.05

#	PercentileTRI	PercentHazWasteLF	Percentile_HazWasteLF	PollutionExposurePercent	PollutionExposurePercentile	Area(mi²)
1	80.18	0.00	0.00	41.30	20.30	N/A
2	97.20	16.67	95.49	45.29	39.64	N/A

Overburdened Sensitive Population (%ile score)

#	GEOID20	Geographic_Area_Name	PerAstma	PercentileAst	PerMyo	PercentileMyo	PerLow	PercentileLow
1	24021752303	Census Tract 7523.03, Frederick County, Maryland	95.90	75.12	95.50	72.25	91.60	77.79
2	24021752302	Census Tract 7523.02, Frederick County, Maryland	89.00	83.46	88.80	80.72	0.00	0.00

#	PercentBroad	PercentileBroad	PercentSens	PercentileSens	Area(mi²)
1	7.43	33.15	72.61	64.58	N/A
2	14.77	75.60	48.14	59.96	N/A

Socioeconomic/Demographic Score 2020 (Percentile score) (Underserved Community)

#	Census tract identifier	Geographic Area Name	Total Population	Percent Poverty	Percent Minority	Percent Limited English Proficiency	Demographic Score (Percent for this tract)	Demographic Score (Percentile Distribution acoss Maryland)	Area(mi²)
1	24021752303	Census Tract 7523.03, Frederick County, Maryland	3,293	6.53	21.17	0.51	9.40	14.46	N/A
2	24021752302	Census Tract 7523.02, Frederick County, Maryland	4,216	7.75	20.23	0.00	9.33	14.12	N/A

Ozone (2015)

#	STATEFP10	COUNTYFP10	COUNTYNS10	GEOID10	NAME10	Ozone NAA Area	8-Hr Ozone (2015) Designation	8-HR Ozone (2015) Classification	8-Hr Ozone (2015) Status	Area(mi²)
1	24	021	01711211	24021	Frederick	Washington DC-MD-VA	Nonattainment	Moderate	*No Data*	N/A

Fine Particles (2012)

#	STATEFP10	COUNTYFP10	COUNTYNS10	GEOID10	NAME10	PM2.5 (2012) Status	Area(mi²)
1	24	021	01711211	24021	Frederick	Attainment/Unclassifiable	N/A

Biosolids FY 2020 and Current Permits Distribution By Acreage

#	County Name	FY2020andAfter	Area(mi²)
1	Frederick	2,894.50	N/A

Biosolids FY2015 - 2019 Permits Distribution By Acreage

#	County Name	FY2015to2019	Area(mi²)
1	Frederick	2,068.60	N/A

Biosolids FY2010 - 2014 Permits Distribution By Acreage

#	County Name	FY2010to2014	Area(mi²)
1	Frederick	2,639.00	N/A

Biosolids FY2009 Permits Expired Distribution By Acreage

#	County Name	FY2009	Area(mi²)
1	Frederick	152.70	N/A

Biosolids FY 2020 and Current Permit Distribution By Percent Coverage

#	County Name	FY2020andAfter	Area(mi²)
1	Frederick	2,894.50	N/A

Biosolids FY2015 - 2019 Permit Distribution By Percent Coverage

#	County Name	FY2015to2019	Area(mi²)
1	Frederick	2,068.60	N/A

Biosolids FY2010 - 2014 Permit Distribution By Percent Coverage

#	County Name	FY2010to2014	Area(mi²)
1	Frederick	2,639.00	N/A

Biosolids FY2009 Expired Permit Distribution By Percent Coverage

#	County Name	FY2009	Area(mi²)
1	Frederick	152.70	N/A

10 Miles from Landfill

#	County	Type	Facility_N	ADDRESS	FILL	SITE__ACRE	AI_No_	Owner_Type
1	FREDERICK	WIF	EASTALCO Industrial WasteLF	5601 Manor Wood Road, Frederick MD 21703.	10.2	20.00	8,459.00	PRI
2	FREDERICK	WIF	Essroc Industrial WasteLF	4120 Buckeystown Pike, Buckeystown MD 21717	25	50.00	69,053.00	PRI
3	FREDERICK	WIN	Fort Detrick IncineratorComplex	9031 Reichs Ford Road Frederick MD	-	1.00	1,827.00	FED
4	FREDERICK	WMF	Site B Municipal Landfill -VE	9031 Reichs Ford Road, Frederick MD 21704.	58	184.00	37,448.00	CTY
5	FREDERICK	WPT	Site B Solid WastePF&TS	9031 Reichs Ford Road, Frederick MD 21704.	58	184.00	37,448.00	CTY
6	MONTGOMERY	WTE	MCRRF	21204 Martinsburg Road, Dickerson MD 20842.	-	35.00	17,118.00	CTY
7	MONTGOMERY	WMF	Montgomery Co. Site 2LF	3 miles southwest of Dickerson, MD 20842.	125	650.00	37,661.00	CTY

#	MD_GRID__E	PERMITNUMB	EXPIRATION	Area(mi²)
1	650 /535	2014-WIF-0537	11/29/2019, 7:00 PM	N/A
2	672 /547	2010-WIF-0640	1/21/2017, 7:00 PM	N/A
3	678 /582	2010-WIN-0341	11/28/2015, 7:00 PM	N/A
4	702 /561	2013-WMF-0582	6/10/2018, 8:00 PM	N/A
5	702 /561	2011-WPT-0604	7/24/2016, 8:00 PM	N/A
6	671 /501	2013-WTE-0538	12/25/2018, 7:00 PM	N/A
7	680 /490	2014-WMF-0237	5/10/2019, 8:00 PM	N/A

10 Miles from Composting Facility

#	County	Facility	Address	Accepts_Fo	Location_o	Area(mi²)
1	*No Data*	Frederick County Department of Solid Waste Management	9031 Reichs Ford Rd, Frederick, MD 21704	No	9031 Reichs Ford Rd, Frederick, MD 21704	N/A
2	*No Data*	Montgomery County Yard Trim Composting Facility	21210 Martinsburg Road, Dickerson, MD 20842	No	21210 Martinsburg Rd, Dickerson, MD 20842	N/A

30 mile buffer (Maryland)

#	Facility_Name_1	Facility_Contact_1	Contact_Phone	Contact_Email_1	Contact_2	Contact_2_Phone	Contact_2_Email	URL	Area(mi²)
1	Key City Compost at Utica Bridge Farm	Phil Westcott	(240) 608-0283	info@keycompost.com	*No Data*	*No Data*	*No Data*	https://www.keycompost.com/	N/A

30 Mile Buffer (Out of State)

#	FacilityName	Contact	Area(mi²)
1	Ayrshire Farm	https://www.gentleharvest.com/pages/ayrshire-farm	N/A

APPENDIX F. ZONING LETTER

Jessica Fitzwater
County Executive

FREDERICK COUNTY GOVERNMENT

DIVISION OF PLANNING & PERMITTING
Department of Development Review

Deborah A. Carpenter, AICP, Division Director
Michael Wilkins, Acting Director

Tess MacMorris
1800 Wazee Street
Suite 300
Denver, DE 80202

August 21, 2024

Re: Digital Drive
Frederick MD 21703
Tax Map 94,
Tax ID # 01607167, **V276811**

To Whom It May Concern,

This letter is in response to your zoning verification application submitted on July 31, 2024. In your application, you requested zoning confirmation for the above referenced property and that *"Critical Digital Infrastructure Facility*" is an allowed use under the subject properties zoning. The properties under the above referenced Tax ID# are zoned General Industrial (GI) and Limited Industrial (LI).

§ 1-19-5.250. INDUSTRIAL ZONING DISTRICTS.

(A) The purpose of the industrial districts is to provide for the development of varied industrial uses that would supply needed employment opportunities for the county. Industrial development has inherent characteristics that require special attention and protection. Due regard must be given to industrial needs for adequate site locations with concentration on terrain, availability of water and sewer systems, transportation, and compatibility with surrounding development.

(B) The Limited Industrial District (LI) is intended to provide adequate area for development of industrial uses whose operations have a relatively minor nuisance value and provides a healthful operating environment secure from the encroachment of residential uses and protected from adverse effects of incompatible industries.

(C) The General Industrial District (GI) is intended to provide areas for industries involving manufacturing or processing and for those industrial uses which cannot meet the performance criteria of the Limited Industrial District.

CRITICAL DIGITAL INFRASTRUCTURE FACILITY. A facility consisting of one or more buildings used primarily for the storage, management, processing, and transmission of digital data, and which houses computer or network equipment, systems, servers, appliances, and other associated components related to digital data operations. The facility may also include customary accessory uses such as an office use, air handlers, power generators and storage, water cooling and storage facilities, and associated utility infrastructure needed to support sustained operations of the digital infrastructure.

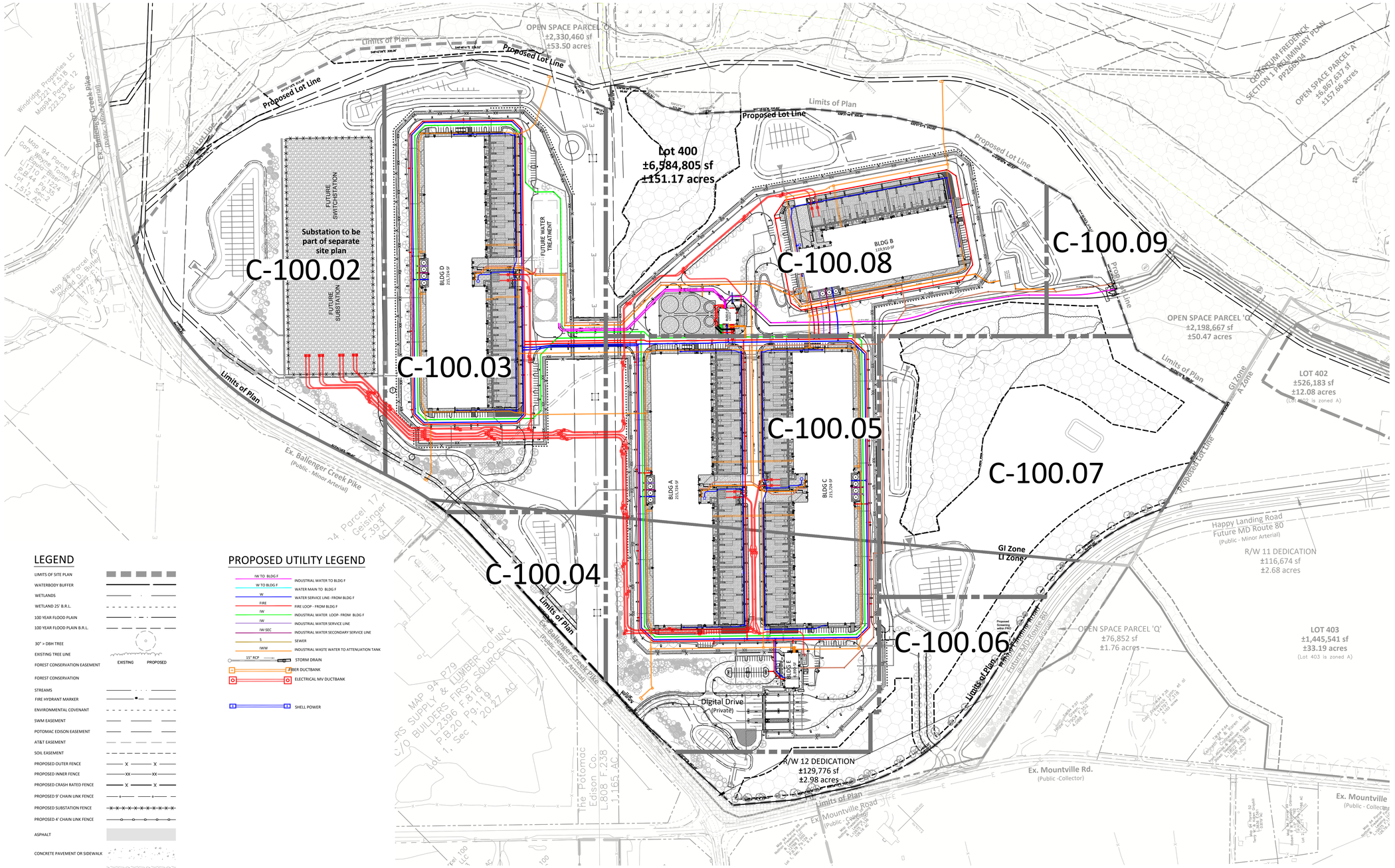
A *"Critical Digital Infrastructure Facility"* is an allowed use within the General Industrial and Limited Industrial zoning districts, subject to site plan approval as well as approval of all State of Maryland and Frederick County permits. A review of the records in this office does not reflect any existing zoning violations at this Property at this time. If you have any questions or need further assistance, please contact me at 301-600-1491.

Sincerely,

Tolson DeSa
Zoning Administrator

Cc: M. Wilkins,
K. Michell,
T. Sinton

APPENDIX G. FACILITY MAP



LEGEND

- LIMITS OF SITE PLAN
- WATERBODY BUFFER
- WETLANDS
- WETLAND 25' B.R.L.
- 100 YEAR FLOOD PLAIN
- 100 YEAR FLOOD PLAIN B.R.L.
- 30" > DBH TREE
- EXISTING TREE LINE
- FOREST CONSERVATION EASEMENT (EXISTING / PROPOSED)
- FOREST CONSERVATION
- STREAMS
- FIRE HYDRANT MARKER
- ENVIRONMENTAL COVENANT
- SWM EASEMENT
- POTOMAC EDISON EASEMENT
- AT&T EASEMENT
- SOIL EASEMENT
- PROPOSED OUTER FENCE
- PROPOSED INNER FENCE
- PROPOSED CRASH RATED FENCE
- PROPOSED 9' CHAIN LINK FENCE
- PROPOSED SUBSTATION FENCE
- PROPOSED 4' CHAIN LINK FENCE
- ASPHALT
- CONCRETE PAVEMENT OR SIDEWALK
- GRAVEL
- HEAVY DUTY REINFORCED SIDEWALK

PROPOSED UTILITY LEGEND

- IW TO BLDG F — INDUSTRIAL WATER TO BLDG F
- W TO BLDG F — WATER MAIN TO BLDG F
- W — WATER SERVICE LINE- FROM BLDG F
- FIRE — FIRE LOOP - FROM BLDG F
- IW — INDUSTRIAL WATER LOOP- FROM BLDG F
- IW — INDUSTRIAL WATER SERVICE LINE
- IW-SEC — INDUSTRIAL WATER SECONDARY SERVICE LINE
- S — SEWER
- IWW — INDUSTRIAL WASTE WATER TO ATTENUATION TANK
- 15" RCP — STORM DRAIN
- FIBER DUCTBANK
- ELECTRICAL MV DUCTBANK
- SHELL POWER

NORTH

0 150 300 450 600 feet

1" = 150'

PROJECT:	BWI 150 - BAUXITE
TITLE:	OVERALL UTILITY PLAN & SHEET KEY
DRAWING:	C-100.01
1"=150'	AGILE NO: / REV:

APPENDIX H. RENEWABLE DIESEL FUEL INFORMATION

Renewable and Alternative Fuels For Use in Diesel Engines

ABSTRACT

A number of renewable and alternative fuels can be used as drop-in replacements for diesel fuel. These fuels must meet the specifications and characteristics described below in order to be used in Cat® engines and reduce the risk of downtime.

CATERPILLAR®

INTRODUCTION

Renewable fuels are derived from renewable resources such as planted crops (soy, palm, rapeseed, etc.), used cooking oil, animal fat, biomass, algae, and others. Renewable fuels reduce the carbon footprint of diesel engines on a Life Cycle Analysis basis. Renewable fuels that are derived from fats and oils may be processed through hydrotreating. The result is a high paraffinic renewable diesel (RD), also called hydrotreated vegetable oil (HVO), that can be used in diesel engines.

Biomass and syn gas, which can be produced from methane gas and gas-to-liquid (GTL), can be converted into renewable fuel through various processes and is typically called biomass-to-liquid (BTL). BTL, GTL and HVO have the same chemistry and performance specifications, and all can be used in diesel engines.

Guidelines

Note that alternative and renewable fuels covered in this paper are different than biodiesel fuel, which is covered in other publications.

In order to be applicable for Cat® diesel engines, Caterpillar recommends that renewable and alternative fuels meet the latest version of any of the following specifications:

- EN15940, which defines quality requirements for BTL, GTL and HVO. This is the preferred specification for renewable and alternative fuels covered in this paper.
- ASTM D975, which is the specification for diesel fuel in the United States.
- EN 590, except for its density provisions. This is the specification for diesel fuel in Europe.
- The Cat Diesel Fuel Specification, except for its density provisions.

Renewable and alternative fuels that meet the requirements listed above can be used at:

- 100 percent (may be called RD100, HVO100, or GTL 100);
- Any blend level with diesel fuel;
- Any blend level with biodiesel fuel; and
- Any blend level with a combination of biodiesel and diesel fuels.

Renewable and alternative fuels are typically paraffinic hydrocarbons, which are included in a subset of diesel fuel composition. Hence these fuels, whether at 100% or blended, can be used as drop-in replacements for diesel fuel. These fuels have many benefits:

- HVO / RD fuels are renewable, which can reduce the carbon footprint or Greenhouse Gas (GHG) impact of the engine.
- They have a high cetane number.
- They can be formulated to provide low temperature capability. Consult with your supplier to ensure the fuel meets the ambient temperature requirements of the application.
- They can reduce the emissions of certain products of incomplete combustion, such as unburned hydrocarbons (UHC), soot, and carbon monoxide (CO). They may also reduce NOx emissions under certain engine loads and cycles.

Here are Caterpillar's guidance and potential impacts for the use of renewable and alternative fuels according to the specifications detailed above:

- No specific engine conversion process is needed when these fuels are used for the first time or thereafter.
- These fuels may reduce the power output of engines due to their low density. Up to a 5% reduction may be noted at 100%.
- They are compatible with aftertreatment technologies such as DPF, DOC and SCR, and they can be used on engines that meet Tier4, Stage V, and similar advanced emission standards.
- They are compatible with filters and engine oils used with typical diesel fuels. No impact on maintenance intervals is expected. In general, it is recommended that oil drain intervals are based on oil analysis.
- They are compatible with elastomeric materials and hoses used on most modern engines. Certain elastomers used in older engines, such as those manufactured prior to the early 1990s, may not be compatible with the new alternative fuels. Refer to your Cat dealer for guidance.
- They can be stored in the same tanks used for diesel fuel, and they have a similar aging life as diesel fuel.
- As with all fuels, renewable and alternative fuels have to be managed to reduce contamination and water ingress.
- Standard warranty is not impacted with the use of renewable and alternative fuels that meet recommended specifications.
- EPA emissions certifications are not impacted with the use of renewable and alternative fuels that meet recommended specifications; refer to your local and state regulations for site requirements.

Summary

The use of fuels with low carbon footprints supports Caterpillar's sustainability initiatives. Caterpillar is continuously following the development of renewable and alternative fuels, and is involved in the development of appropriate specifications to ensure the successful application of these fuels in Cat engines.

LET'S DO THE WORK.™

LEXE20433-01 August 2021

CATERPILLAR®

SAFETY DATA SHEET

1. Identification

Product identifier **Green Diesel R100 Renewable Diesel**

Other means of identification

SDS number R100-GHS

Synonyms Green Diesel, Renewable Diesel, R99, R100

Recommended use This product is intended for use as a refinery feedstock, fuel or for use in engineered processes. Use in other applications may result in higher exposures and require additional controls, such as local exhaust ventilation and personal protective equipment.

Recommended restrictions No other uses are advised.

Manufacturer/Importer/Supplier/Distributor information

Company name Diamond Green Diesel

Address 14891 Airline Drive
Norco, LA 70079
US

Telephone General Assistance 504-471-1400

E-mail Not available.

Emergency phone number 24 Hour Emergency 866-565-5220
1-800-424-9300 (CHEMTREC USA)

2. Hazard(s) identification

Physical hazards	Flammable liquids	Category 3
Health hazards	Aspiration hazard	Category 1
OSHA defined hazards	Not classified.	

Label elements

Signal word Danger

Hazard statement Flammable liquid and vapor. May be fatal if swallowed and enters airways.

Precautionary statement

Prevention Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Keep container tightly closed. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/lighting equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Wear protective gloves/eye protection/face protection.

Response If swallowed: Immediately call a poison center/doctor. Do NOT induce vomiting. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. In case of fire: Use appropriate media to extinguish.

Storage Store in a well-ventilated place. Keep cool. Store locked up.

Disposal Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC) None known.

Supplemental information Repeated exposure may cause skin dryness or cracking.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Fuels, diesel, C9-18-alkane branched and linear	1159170-26-9	100

Composition comments A complex combination of hydrocarbons obtained by the hydrodeoxygenation and catalytic hydroisomerization of animal fats and vegetable oils followed by distillative fractionation. It consists predominantly of branched and linear paraffins having carbon numbers in the range of C9 to C18 and boiling in the range of approximately 179.degree.C to 309.degree.C (354.2.degree.F to 588.3.degree.F).

4. First-aid measures

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Call a physician if symptoms develop or persist.

Skin contact Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention if irritation develops and persists. Wash contaminated clothing before reuse. Destroy or thoroughly clean contaminated shoes.

Eye contact Immediately flush with plenty of water for at least 15 minutes. If easy to do, remove contact lenses. Rinse with water. Get medical attention if irritation develops and persists.

Ingestion Call a physician or poison control center immediately. Rinse mouth. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs.

Most important symptoms/effects, acute and delayed Droplets of the product aspirated into the lungs through ingestion or vomiting may cause a serious chemical pneumonia. Direct contact with eyes may cause temporary irritation. Repeated exposure may cause skin dryness or cracking.

Indication of immediate medical attention and special treatment needed Provide general supportive measures and treat symptomatically. In case of shortness of breath, give oxygen. Keep victim under observation. Symptoms may be delayed. The toxicological properties of this material have not been fully investigated.

General information If exposed or concerned: get medical attention/advice. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance. Wash contaminated clothing before re-use.

5. Fire-fighting measures

Suitable extinguishing media Water fog. Foam. Dry chemical powder. Carbon dioxide (CO2).

Unsuitable extinguishing media Do not use water unless flooding amounts are available. Do not use water jet as an extinguisher, as this will spread the fire.

Specific hazards arising from the chemical Flammable liquid and vapor. Vapor may cause flash fire. Vapors can flow along surfaces to distant ignition source and flash back. Sensitive to static discharge. The product can accumulate electrostatic charges, which may cause an electrical spark (ignition source). Fire may produce irritating, corrosive and/or toxic gases.

Special protective equipment and precautions for firefighters Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask.

Fire fighting equipment/instructions In case of fire and/or explosion do not breathe fumes. Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask. Withdraw immediately in case of rising sound from venting safety devices or any discoloration of tanks due to fire. Do not move cargo or vehicle if cargo has been exposed to heat. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Move containers from fire area if you can do it without risk. Move containers from fire area if you can do so without risk. In the event of fire, cool tanks with water spray. Cool containers exposed to flames with water until well after the fire is out. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Water runoff can cause environmental damage. Vapors may form explosive air mixtures even at room temperature. Prevent buildup of vapors or gases to explosive concentrations. Use compatible foam to minimize vapor generation as needed.

Specific methods Use water spray to cool unopened containers. Prevent build-up of vapors or gasses to explosive concentrations.

General fire hazards Flammable liquid and vapor.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Keep out of low areas. Ventilate closed spaces before entering. Wear appropriate protective equipment and clothing during clean-up. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.

Methods and materials for containment and cleaning up

ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Keep combustibles (wood, paper, oil, etc.) away from spilled material. The product is immiscible with water and will spread on the water surface.

Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Following product recovery, flush area with water.

Small Spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.

Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.

Environmental precautions

Avoid discharge into drains, water courses or onto the ground. If facility or operation has an "oil or hazardous substance contingency plan", activate its procedures. Stay upwind and away from spill. Wear appropriate protective equipment including respiratory protection as conditions warrant. Do not enter or stay in area unless monitoring indicates that it is safe to do so. Isolate hazard area and restrict entry to emergency crew. Flammable. Review Firefighting Measures, Section 5, before proceeding with clean up. Keep all sources of ignition (flames , smoking, flares, etc.) and hot surfaces away from release. Contain spill in smallest possible area. Recover as much product as possible (e.g. by vacuuming). Stop leak if it can be done without risk. Use water spray to disperse vapors. Spilled material may be absorbed by an appropriate absorbent, and then handled in accordance with environmental regulations. Prevent spilled material from entering sewers, storm drains, other unauthorized treatment or drainage systems and natural waterways. Contact fire authorities and appropriate federal, state and local agencies. If spill of any amount is made into or upon navigable waters, the contiguous zone, or adjoining shorelines, contact the National Response Center at 1-800-424-8802. For highway or railways spills, contact Chemtrec at 1-800-424-9300.

7. Handling and storage

Precautions for safe handling

DO NOT handle, store or open near an open flame, sources of heat or sources of ignition. Protect material from direct sunlight. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. Use non-sparking tools and explosion-proof equipment. Use only with adequate ventilation. Do not breathe gas/fumes/vapor/spray. Do not taste or swallow. Avoid contact with eyes, skin, and clothing. Avoid prolonged exposure. When using, do not eat, drink or smoke. Wear appropriate personal protective equipment. Wash thoroughly after handling. Avoid release to the environment. Observe good industrial hygiene practices. Eliminate sources of ignition. Avoid spark promoters. Ground/bond container and equipment. These alone may be insufficient to remove static electricity.

Conditions for safe storage, including any incompatibilities

Store locked up. The pressure in sealed containers can increase under the influence of heat. Do not handle or store near an open flame, heat or other sources of ignition. This material can accumulate static charge which may cause spark and become an ignition source. Store in a cool, dry place out of direct sunlight. Store in original tightly closed container. Store in a well-ventilated place. Keep away from food, drink and animal feedingstuffs. Keep out of the reach of children. Keep in an area equipped with sprinklers. Store away from incompatible materials (see Section 10 of the SDS).

8. Exposure controls/personal protection

Occupational exposure limits

No exposure limits noted for ingredient(s).

Biological limit values

No biological exposure limits noted for the ingredient(s).

Appropriate engineering controls

Good general ventilation should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Use explosion-proof equipment. Provide eyewash station and safety shower.

Individual protection measures, such as personal protective equipment

Eye/face protection

Wear safety glasses. If splash potential exists, wear full face shield or chemical goggles.

Skin protection

Hand protection

Wear appropriate chemical resistant gloves.

Skin protection

Other

Wear suitable protective clothing.

Respiratory protection	Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. If workplace exposure limits for product or components are exceeded, NIOSH approved equipment should be worn. Proper respirator selection should be determined by adequately trained personnel, based on the contaminants, the degree of potential exposure and published respiratory protection factors. This equipment should be available for nonroutine and emergency use.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	When using do not smoke. Avoid contact with eyes. Avoid contact with skin. Keep away from food and drink. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Consult supervisor for special handling instructions.

9. Physical and chemical properties

Appearance	Colorless liquid.
Physical state	Liquid.
Form	Liquid.
Color	Colorless.
Odor	Odorless to mild paraffin.
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	Not available.
Initial boiling point and boiling range	354.2 - 588.2 °F (179 - 309 °C)
Flash point	> 130.0 °F (> 54.4 °C)
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Vapor pressure	< 1 mm Hg
Vapor density	> 1
Relative density	Not available.
Solubility(ies)	
Solubility (water)	Insoluble
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	494.6 °F (257 °C)
Decomposition temperature	Not available.
Viscosity	1.9 - 4.1 cP (40°C)
Other information	
Density	0.77 g/ml (15°C)
Explosive properties	Not explosive.
Oxidizing properties	Not oxidizing.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Stable under normal temperature conditions and recommended use.
Possibility of hazardous reactions	Hazardous polymerization does not occur.

Conditions to avoid	Do not pressurize, cut, weld, braze, solder, drill, grind or expose empty containers to heat, flame, sparks, static electricity, or other sources of ignition; they may explode and cause injury or death. Avoid temperatures exceeding the flash point. Contact with incompatible materials. Ignition sources.
Incompatible materials	Strong oxidizing agents. Reducing agents. Acids. Alkalis.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Inhalation	Inhalation of mist or vapor may cause respiratory tract irritation.
Skin contact	Repeated exposure may cause skin dryness or cracking.
Eye contact	Direct contact with eyes may cause temporary irritation.
Ingestion	Droplets of the product aspirated into the lungs through ingestion or vomiting may cause a serious chemical pneumonia. May cause lung damage if swallowed.
Symptoms related to the physical, chemical and toxicological characteristics	Droplets of the product aspirated into the lungs through ingestion or vomiting may cause a serious chemical pneumonia. Direct contact with eyes may cause temporary irritation. Repeated exposure may cause skin dryness or cracking.

Information on toxicological effects

Acute toxicity	Not expected to be acutely toxic.
Skin corrosion/irritation	Repeated exposure may cause skin dryness or cracking.
Serious eye damage/eye irritation	Direct contact with eyes may cause temporary irritation.

Respiratory or skin sensitization

Respiratory sensitization	Not a respiratory sensitizer.
Skin sensitization	Not a skin sensitizer.

Germ cell mutagenicity	Based on available data, the classification criteria are not met.
Carcinogenicity	Not classifiable as to carcinogenicity to humans.

IARC Monographs. Overall Evaluation of Carcinogenicity

Not listed.

NTP Report on Carcinogens

Not listed.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)

Not listed.

Reproductive toxicity	Based on available data, the classification criteria are not met.
Specific target organ toxicity - single exposure	Based on available data, the classification criteria are not met.
Specific target organ toxicity - repeated exposure	Based on available data, the classification criteria are not met.
Aspiration hazard	May be fatal if swallowed and enters airways.
Further information	Symptoms may be delayed.

12. Ecological information

Ecotoxicity	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.
Persistence and degradability	No data is available on the degradability of this product.
Bioaccumulative potential	No data available.
Mobility in soil	The product is insoluble in water.
Other adverse effects	The product is a volatile organic compound which has a photochemical ozone creation potential.

13. Disposal considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Incinerate the material under controlled conditions in an approved incinerator. Do not allow this material to drain into sewers/water supplies. Do not contaminate ponds, waterways or ditches with chemical or used container. Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations	Dispose in accordance with all applicable regulations.
Hazardous waste code	D001: Waste Flammable material with a flash point <140 °F The waste code should be assigned in discussion between the user, the producer and the waste disposal company.
Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal. Offer rinsed packaging material to local recycling facilities.

14. Transport information

DOT

UN number	UN1202
UN proper shipping name	Diesel fuel
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Label(s)	3
Packing group	III
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Special provisions	144, B1, IB3, T2, TP1
Packaging exceptions	150
Packaging non bulk	203
Packaging bulk	242

IATA

UN number	UN1202
UN proper shipping name	DIESEL FUEL
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Packing group	III
Environmental hazards	No.
ERG Code	3L
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

IMDG

UN number	UN1202
UN proper shipping name	DIESEL FUEL
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Packing group	III
Environmental hazards	
Marine pollutant	No.
EmS	F-E, S-E
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not applicable.
General information	Shipping descriptions in this section are offered as examples only. Classification for transport must accurately reflect the material hazards as designated under a variety of regulations and is solely the responsibility of the person offering the material into transport for commerce.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)

Not listed.

Toxic Substances Control Act (TSCA) All components of the mixture on the TSCA 8(b) inventory are designated "active".

Superfund Amendments and Reauthorization Act of 1986 (SARA)

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical Yes

Classified hazard categories Flammable (gases, aerosols, liquids, or solids)
Aspiration hazard

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations

US. Massachusetts RTK - Substance List

Not regulated.

US. New Jersey Worker and Community Right-to-Know Act

Not listed.

US. Pennsylvania Worker and Community Right-to-Know Law

Not listed.

US. Rhode Island RTK

Not regulated.

California Proposition 65

California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins. For more information go to www.P65Warnings.ca.gov.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	No
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	Yes
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	No
New Zealand	New Zealand Inventory	No
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	No
Taiwan	Taiwan Chemical Substance Inventory (TCSI)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 21-June-2014

Revision date 10-February-2020

Version # 04

NFPA ratings

References

ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices
EPA: AQUIRE database
HSDB® - Hazardous Substances Data Bank
National Toxicology Program (NTP) Report on Carcinogens
IARC Monographs. Overall Evaluation of Carcinogenicity

Disclaimer

The information in this Safety Data Sheet (SDS) was obtained from sources believed to be reliable and accurate, and is not represented as being absolutely complete. The end user of this product has the responsibility for evaluating the adequacy of the data for the intended application and conditions of use; for determining the safety, toxicity, regulatory requirements, and suitability of the product under these conditions; and for obtaining additional or clarifying data where uncertainty exists. The data serves as general guidance when used in combination with professional judgement of persons experienced in a specific application, use or process; and additional data may be required. Diamond Green Diesel provides this data without any warranty, expressed or implied regarding its correctness or accuracy; and does not assume any liability arising out of product handling, storage, use or disposal by others.

Certificate of Analysis

Vessel / Object:	S/T 254	**Job No:**	170-24-03980
Location:	St. Rose, LA / IMTT (United States)	**Date Sampled:**	06/07/24
Job Type:	Sample & Analysis	**Date Tested:**	06/07/24
Product Grade:	Distillate / R99 Diesel	**Version:**	1 / 07 Jun 2024 20:39
Client Reference:	Diamond Green Diesel LLC / 2733242		

Sample	**Sample ID, Type & Description**
170-24-03980-001	ST 254 Running Sample

Method	Test	Min	Max	Result	Units	Remarks
ASTM D4052	API Gravity @60°F	30		48.7	°	
ASTM D445	Kinematic Viscosity @104°F/40°C	1.9	4.1	3.440	cSt	
ASTM D5453	Total Sulfur Content		11	< 1.0	mg/kg	
ASTM D93A	Flash Point	54.4		93.0	°C	
ASTM D1500	ASTM Color		1.5	L0.5		
ASTM D130	Copper Strip Corrosion Rating @50°C/122°F for 3 Hours		1b	1A		
ASTM D482	Ash Content					
	Ash Content		0.01	< 0.010	mass%	
	Test Specimen Mass			100.63	g	
ASTM D524	Ramsbottom Carbon Residue on 10% Distillation Residue		0.35	< 0.01	%wt	
Dupont	Pad Rating		7	1		
ASTM D4176 proc. 2	Haze Number Distillate Fuels					
	Temperature of Sample			21	°C	
	Haze Rating		2	1		
TM-0172	Nace Corrosion Rating		B++	B++		
ASTM D2624	Electrical Conductivity of Aviation and Distillate Fuels					
	Temperature of Sample			70	°F	
	Electrical Conductivity		250	< 1	pS/m	
ASTM D86	Distillation					
	IBP			235.5	°C	
	5%			273.0	°C	
	10%			279.2	°C	
	20%			284.4	°C	
	30%			287.2	°C	
	40%			289.3	°C	
	50%			291.1	°C	
	60%			292.9	°C	
	70%			294.9	°C	
	80%			297.4	°C	
	85%			299.1	°C	
	90%	282	338	301.9	°C	
	95%			315.0	°C	
	FBP		366	331.8	°C	
	Recovery			97.4	%vol	
	Residue			1.3	mL	
	Loss			1.3	%vol	

Certificate of Analysis

Vessel / Object:	S/T 254	**Job No:**	170-24-03980
Location:	St. Rose, LA / IMTT (United States)	**Date Sampled:**	06/07/24
Job Type:	Sample & Analysis	**Date Tested:**	06/07/24
Product Grade:	Distillate / R99 Diesel	**Version:**	1 / 07 Jun 2024 20:39
Client Reference:	Diamond Green Diesel LLC / 2733242		

Sample	**Sample ID, Type & Description**
170-24-03980-001	ST 254 Running Sample

Method	Test	Min	Max	Result	Units	Remarks
ASTM D6079	Lubricity of Diesel Fuels by HFRR					
	Wear Scar Appearance			Normal	µm	
	Lubricity Major Axis			600	µm	
	Lubricity Minor Axis			740	µm	
	Lubricity Average Wear Scar Diameter			670	µm	
ASTM D2500	Cloud Point of Petroleum Products and Liquid Fuels					
	Cloud Point		20	18	°F (calc)	
	Cloud Point			-8	°C	
ASTM D97	Pour Point					
	Pour Point			-9	°C	
	Pour Point		20	15.8	°F	
ASTM D4737	Cetane Index Method A	40.0		95.9		
ASTM D976	Calculated Cetane Index	40.0		77.2		
ASTM D664A	Total Acid Number			< 0.10	mg KOH/g	
ASTM D1796	Water and Sediment		0.05	<0.05		
ASTM D1319	Aromatics		31.7	< 5.0	%vol	
ASTM D5186-CARB	Total Aromatics		35	3.0	%vol	

Kylie Arguelles
Reported by: Kylie Arguelles
Title: Laboratory Admin Technician

3269215

Certificate of Analysis

Vessel / Object:	Submitted Sample	**Job No:**	195-24-00250
Location:	Baltimore, MD / AmSpec Lab - Baltimore MD (United States)	**Date Sampled:**	06/18/24
Job Type:	Submitted Sample	**Date Tested:**	06/24/24
Product Grade:	Bio Fuel / Renewable Diesel R99	**Version:**	1 / 24 Jun 2024 12:57
Client Reference:	Diamond Green R-99		

Sample	**Sample ID, Type & Description**
195-24-00250-001	Diamond Green R-99 Submitted

Method	Test	Result	Units
ASTM D7371	Biodiesel (FAME) Content (in Diesel)	< 1.00	%vol
ASTM D6866 - Method C	Biogenic Carbon Content	100	%

Frank Glendon

Frank Glendon
Branch Manager

SAFETY DATA SHEET
Neste Renewable Diesel; Neste Renewable Diesel 100 %; Neste MY Renewable Diesel

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product name	Neste Renewable Diesel; Neste Renewable Diesel 100 %; Neste MY Renewable Diesel
Chemical name	Renewable hydrocarbons (diesel type fraction)
Product number	ID 13898
REACH registration number	01-2119450077-42-0000
REACH registration notes	01-2119450077-42-0000 / -0001 / -0002

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses	Formulation & (re)packing of substances and mixtures (ES 02) Distribution of substance (ES 04) Use as an intermediate (ES 05) Use as a fuel (ES 06, 14, 23)

1.3. Details of the supplier of the safety data sheet

Supplier	Neste Oyj Keilaranta 21, Espoo, P.O.B. 95, FIN-00095 NESTE, FINLAND Tel. +358 10 45811 SDS@neste.com (chemical safety)

1.4. Emergency telephone number

National emergency telephone number	+358 800 147 111, +358 9 471 977, Poison Information Centre

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification (EC 1272/2008)

Physical hazards	Not Classified
Health hazards	Asp. Tox. 1 - H304
Environmental hazards	Not Classified

2.2. Label elements

Hazard pictograms

Signal word	Danger
Hazard statements	H304 May be fatal if swallowed and enters airways.
Precautionary statements	P301+P310 IF SWALLOWED: Immediately call a POISON CENTER/ doctor. P331 Do NOT induce vomiting. P501 Dispose of contents/ container in accordance with national regulations.

Neste Renewable Diesel; Neste Renewable Diesel 100 %; Neste MY Renewable Diesel

Supplemental label information EUH066 Repeated exposure may cause skin dryness or cracking.

Contains Renewable hydrocarbons (diesel type fraction)

2.3. Other hazards

Other hazards Combustible liquid. Risk of soil and ground water contamination.

SECTION 3: Composition/information on ingredients

3.2. Mixtures

Renewable hydrocarbons (diesel type fraction) **ca. 100%**

CAS number: — REACH registration number: 01-2119450077-42-XXXX

Classification
Asp. Tox. 1 - H304

The Full Text for all R-Phrases and Hazard Statements are Displayed in Section 16.

Other information Mixture of renewable raw material fuel and additives., Contains middle distillate-range iso- and n-paraffinic hydrocarbons., Total aromatics at maximum 1,0 Weight %., Renewable hydrocarbons (diesel type fraction):, REACH Nr: 01-2119450077-42-0000 / -0001 / -0002., Identity outside the EU (CAS number and name of the substance):, Alkanes, C10-20-branched and linear, CAS 928771-01-1.

SECTION 4: First aid measures

4.1. Description of first aid measures

Inhalation Unlikely to be hazardous by inhalation because of the low vapour pressure of the product at ambient temperature. If spray/mist has been inhaled, proceed as follows. Remove person to fresh air and keep comfortable for breathing. Get medical attention if symptoms are severe or persist.

Ingestion Do not induce vomiting. Get medical attention immediately.

Skin contact Remove contaminated clothing immediately and wash skin with soap and water. Get medical attention if irritation persists after washing.

Eye contact Rinse immediately with plenty of water. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention if irritation persists after washing.

4.2. Most important symptoms and effects, both acute and delayed

General information Repeated exposure may cause skin dryness or cracking. Spray/mists may cause respiratory tract irritation. Entry into the lungs following ingestion or vomiting may cause chemical pneumonitis.

4.3. Indication of any immediate medical attention and special treatment needed

Notes for the doctor Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media Water spray, foam, dry powder or carbon dioxide.

Unsuitable extinguishing media Water may be ineffective for extinguishment, unless used under favorable conditions by experienced fire fighters

5.2. Special hazards arising from the substance or mixture

Neste Renewable Diesel; Neste Renewable Diesel 100 %; Neste MY Renewable Diesel

Specific hazards Combustible liquid. Containers can burst violently or explode when heated, due to excessive pressure build-up.

Hazardous combustion products Carbon dioxide (CO2). Carbon monoxide (CO).

5.3. Advice for firefighters

Protective actions during firefighting Cool containers exposed to heat with water spray and remove them from the fire area if it can be done without risk.

Special protective equipment for firefighters Wear positive-pressure self-contained breathing apparatus (SCBA) and appropriate protective clothing.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions Wear adequate protective equipment at all operations.

For emergency responders Prevent unauthorized access. Eliminate all ignition sources if safe to do so. Take precautionary measures against static discharge.

6.2. Environmental precautions

Environmental precautions Avoid release to the environment. Stop leak if safe to do so. Avoid the spillage or runoff entering drains, sewers or watercourses. Inform the relevant authorities if environmental pollution occurs (sewers, waterways, soil or air). Risk of soil and ground water contamination.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up Immediately start clean-up of the liquid and contaminated soil. Contain spillage with sand, earth or other suitable non-combustible material. Pay attention to the fire and health hazards caused by the product.

6.4. Reference to other sections

Reference to other sections For personal protection, see Section 8.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Usage precautions Avoid heat, flames and other sources of ignition. Take precautionary measures against static discharges. Use only outdoors or in a well-ventilated area. Avoid inhalation of vapours and contact with skin and eyes. Use personal protective equipment and/or local ventilation when needed. Do not eat, drink or smoke when using this product. Wash hands and any other contaminated areas of the body with soap and water before leaving the work site. During tank operations follow special instructions (risk of oxygen displacement and hydrocarbons).

7.2. Conditions for safe storage, including any incompatibilities

Storage precautions Flammable liquid storage. Store in accordance with local regulations. Store in a demarcated bunded area to prevent release to drains and/or watercourses. Only store in correctly labelled containers. Use containers made of the following materials: Carbon steel. Stainless steel.

7.3. Specific end use(s)

Specific end use(s) Not known.

SECTION 8: Exposure controls/Personal protection

8.1. Control parameters

Ingredient comments The individual limit values can be applied for the hydrocarbons. Diesel fuel as total hydrocarbons; ACGIH TLV®-TWA (8h) 100 mg/m3 (IFV).

Neste Renewable Diesel; Neste Renewable Diesel 100 %; Neste MY Renewable Diesel

PNEC Not available.

Renewable hydrocarbons (diesel type fraction)

DNEL
Workers - Inhalation; Long term systemic effects: 147 mg/m³
Workers - Dermal; Long term systemic effects: 42 mg/kg/day
Consumer - Inhalation; Long term systemic effects: 94 mg/m³
Consumer - Dermal; Long term systemic effects: 18 mg/kg/day

8.2. Exposure controls

Appropriate engineering controls Provide adequate ventilation. Use personal protective equipment and/or local ventilation when needed. Handle in accordance with good industrial hygiene and safety practice. During tank operations follow special instructions (risk of oxygen displacement and hydrocarbons).

Eye/face protection Spectacles.

Hand protection Wear protective gloves. It is recommended that gloves are made of the following material: Nitrile rubber. Neoprene. Polyvinyl chloride (PVC). The breakthrough time for any glove material may be different for different glove manufacturers. Protective gloves according to standard EN 374. Change protective gloves regularly.

Other skin and body protection Protective clothing when needed. Wear anti-static protective clothing if there is a risk of ignition from static electricity.

Respiratory protection Respiratory protection must be used if the airborne contamination exceeds the recommended occupational exposure limit. Wear a respirator fitted with the following cartridge: Combination filter, type A2/P2. Filter must be changed often enough. Gas and combination filter cartridges should comply with European Standard EN14387. At high concentrations a breathing apparatus must be used (self-contained or fresh air hose breathing apparatus).

Environmental exposure controls Store in a demarcated bunded area to prevent release to drains and/or watercourses.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance Liquid.

Colour Clear.

Odour Mild.

Odour threshold -

pH -

Melting point Pour point < -20°C @ 1013 hPa (BS4633, EC A1)

Initial boiling point and range 180-320°C (EN ISO 3405)

Flash point > 61°C (EN ISO 2719, EC A9)

Upper/lower flammability or explosive limits -

Vapour pressure 0,087 kPa @ 25°C (EC A4)

Vapour density -

Relative density 0,77 - 0,79 @ 15/4°C (EN ISO 12185, EC A3)

Solubility(ies) Insoluble in water. ~ 0,075 mg/l water @ 25°C (calculated) Soluble in the following materials: Methanol. Hydrocarbons.

Neste Renewable Diesel; Neste Renewable Diesel 100 %; Neste MY Renewable Diesel

Partition coefficient	log Kow: > 6,5 (EC A8)
Auto-ignition temperature	204°C (EC A15)
Decomposition Temperature	-
Viscosity	Kinematic viscosity 4.0 mm2/s @ 20°C 2.6 mm2/s @ 40°C (OECD 114) Dynamic viscosity ≤ 5 mPa s @ 20°C
Explosive properties	Not considered to be explosive. (EC A14)
Oxidising properties	Does not meet the criteria for classification as oxidising.

9.2. Other information

Other information	Not known.

SECTION 10: Stability and reactivity

10.1. Reactivity

Reactivity	There are no known reactivity hazards associated with this product.

10.2. Chemical stability

Stability	Stable at normal ambient temperatures and when used as recommended.

10.3. Possibility of hazardous reactions

Possibility of hazardous reactions	No potentially hazardous reactions known.

10.4. Conditions to avoid

Conditions to avoid	Keep away from heat, sparks and open flame.

10.5. Incompatible materials

Materials to avoid	Oxidising agents.

10.6. Hazardous decomposition products

Hazardous decomposition products	Does not decompose when used and stored as recommended.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Toxicological effects	Based on available data the classification criteria are not met.

Skin corrosion/irritation

Skin corrosion/irritation	Based on available data the classification criteria are not met. (EC B4) Repeated exposure may cause skin dryness or cracking. The product irritates mucous membranes and may cause abdominal discomfort if swallowed. May cause respiratory system irritation.

Serious eye damage/irritation

Serious eye damage/irritation	Based on available data the classification criteria are not met. (EC B5)

Skin sensitisation

Skin sensitisation	Based on available data the classification criteria are not met. (EC B6)

Germ cell mutagenicity

Genotoxicity - in vitro	Based on available data the classification criteria are not met. (EC B10, B13/14 & B17).

Carcinogenicity

Carcinogenicity	Based on available data the classification criteria are not met.

Neste Renewable Diesel; Neste Renewable Diesel 100 %; Neste MY Renewable Diesel

Reproductive toxicity

Reproductive toxicity - fertility Based on available data the classification criteria are not met. (OECD 416)

Specific target organ toxicity - single exposure

STOT - single exposure Not classified as a specific target organ toxicant after a single exposure.

Specific target organ toxicity - repeated exposure

STOT - repeated exposure Based on available data the classification criteria are not met. (OECD 408)

Aspiration hazard

Aspiration hazard May be fatal if swallowed and enters airways. Entry into the lungs following ingestion or vomiting may cause chemical pneumonitis.

Toxicological information on ingredients.

Renewable hydrocarbons (diesel type fraction)

Acute toxicity - oral

Notes (oral LD_{50}) LD_{50} >2000 mg/kg, Oral, Rat (EC B1 tris)

Acute toxicity - dermal

Notes (dermal LD_{50}) LD_{50} > 2000 mg/kg, Dermal, Rat (EC B3)

SECTION 12: Ecological information

12.1. Toxicity

Toxicity Based on available data the classification criteria are not met.

Ecological information on ingredients.

Renewable hydrocarbons (diesel type fraction)

Acute aquatic toxicity

Acute toxicity - fish LL_{50}, 96 hours: > 1000 mg/l,
WAF (OECD 203)

Acute toxicity - aquatic invertebrates EL50, 48 hours: > 100 mg/l,
WAF (OECD 202)

Acute toxicity - aquatic plants EL50, 72 hours: > 100 mg/l, Algae
WAF (OECD 201)

Acute toxicity - microorganisms EC_{50}, 30-180 minutes: > 1000 mg/l, Micro-organisms (wastewater sludge)
(OECD 209)

Chronic aquatic toxicity

Chronic toxicity - aquatic invertebrates NOEC, 21 days: 1 mg/l,
LOEC, 21 days: 3,2 mg/l,
WAF (OECD 211)
Sediment organisms
NOEC, 10 days: 373 mg/kg,
LOEC, 10 days: 1165 mg/kg,
LC_{50}, 10 days: 1200 mg/kg,
(OSPAR Protocols, Part A: Sediment Bioassay, 2005)

12.2. Persistence and degradability

Stability (hydrolysis) No significant reaction in water.

Neste Renewable Diesel; Neste Renewable Diesel 100 %; Neste MY Renewable Diesel

Biodegradation Rapidly degradable (OECD 301B).

Ecological information on ingredients.

Renewable hydrocarbons (diesel type fraction)

Biodegradation Rapidly degradable (OECD 301B).

12.3. Bioaccumulative potential

Bioaccumulative potential Possibly bioaccumulative.

Partition coefficient log Kow: > 6,5 (EC A8)

12.4. Mobility in soil

Mobility Evaporates slowly. The product has poor water-solubility. The product contains substances which are bound to particulate matter and are retained in soil. Log Koc > 5.6 (EC C19).

12.5. Results of PBT and vPvB assessment

Results of PBT and vPvB assessment This product does not contain any substances classified as PBT or vPvB.

12.6. Other adverse effects

Other adverse effects Not known.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Disposal methods Dispose of waste to licensed waste disposal site in accordance with the requirements of the local Waste Disposal Authority. When handling waste, the safety precautions applying to handling of the product should be considered. Care should be taken when handling emptied containers that have not been thoroughly cleaned or rinsed out. Product residues retained in emptied containers can be hazardous. Waste packaging should be collected for reuse or recycling.

SECTION 14: Transport information

Sea transport notes This cargo is considered an Energy-rich fuel and effective 1 January 2019 should be carried subject to Annex I of MARPOL, see Annex 12 of MEPC.2/Circ.24. Please also refer to MEPC.1/Circ.879 - GUIDELINES FOR THE CARRIAGE OF ENERGY-RICH FUELS AND THEIR BLENDS

14.1. UN number

UN No. (ADR/RID) 1202

UN No. (IMDG) Not classified under IMDG.

14.2. UN proper shipping name

Proper shipping name (ADR/RID) UN 1202 DIESEL FUEL

14.3. Transport hazard class(es)

ADR/RID class 3

ADN subsidiary risk F (floater)

14.4. Packing group

Neste Renewable Diesel; Neste Renewable Diesel 100 %; Neste MY Renewable Diesel

ADR/RID packing group III

14.5. Environmental hazards

Environmentally hazardous substance/marine pollutant
No.

14.6. Special precautions for user

Hazard Identification Number (ADR/RID) 30

Tunnel restriction code (D/E)

14.7. Transport in bulk according to Annex II of MARPOL and the IBC Code

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

National regulations UK REACH Registration number: UK-01-9638319484-0-XXXX.
Only Representative UK: Penman Consulting Limited 41, Aspect House, Waylands Avenue, Grove Business Park, Wantage, Oxon, OX12 9FF, United Kingdom; Telephone: 01367 718474, Email: pcltd41@penmanconsulting.com.
Location of manufacture: Neste Rotterdam Refinery, the Netherlands.

EU legislation Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) (as amended).
Commission Regulation (EU) No 2015/830 of 28 May 2015.
Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures (as amended).

15.2. Chemical safety assessment

A chemical safety assessment has been carried out.

SECTION 16: Other information

Abbreviations and acronyms used in the safety data sheet DNEL = Derived No-Effect Level
PNEC = Predicted No-Effect Concentration
WAF = Water Accommodated Fraction

Key literature references and sources for data Regulations, databases, literature, own research. Chemical Safety Report Renewable hydrocarbons (diesel type fraction), 2017.

Revision comments Updated, sections: 15.1. NOTE: Lines within the margin indicate significant changes from the previous revision.

Revision date 17/12/2021

Supersedes date 12/11/2021

SDS number 5359

Hazard statements in full H304 May be fatal if swallowed and enters airways.

Exposure scenario
Distribution of Substance - Industrial

Identification

Product name	Renewable hydrocarbons (diesel type fraction)
REACH registration number	01-2119450077-42-XXXX
Version number	2017
Es reference	04

1. Title of exposure scenario

Main title	Distribution of Substance - Industrial
Process scope	Loading (including marine vessel/barge, rail/road car and IBC loading) and repacking (including drums and small packs) of substance, including its sampling, storage, unloading distribution and associated laboratory activities.
Main sector	SU3 Industrial uses

Environment

Environmental release category	ERC7 Use of functional fluid at industrial site
SPERC	ESVOC SPERC 1.1b.v1

Worker

Process category	PROC2 Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions PROC3 Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition PROC8a Transfer of substance or mixture (charging and discharging) at non-dedicated facilities PROC8b Transfer of substance or mixture (charging and discharging) at dedicated facilities PROC9 Transfer of substance or mixture into small containers (dedicated filling line, including weighing) PROC15 Use as laboratory reagent.

2. Conditions of use affecting exposure (Industrial - Environment 1)

Amounts used

Fraction of EU tonnage used in region: 1
Daily amount per site: ≤ 5000 t
Annual amount per site: ≤ 1 500 000 t

Frequency and duration of use

Emission days: 300 days/year

Other given operational conditions affecting environmental exposure

Emission factor - air	0,001%
Emission factor - water	4E-7%.
Emission factor - soil	0,001%

Environmental factors not influenced by risk management measures

Distribution of Substance - Industrial

Dilution	Local freshwater dilution factor: 10 Local marine water dilution factor: 100

Risk management measures

STP type	Aerobic biological treatment
STP details	Assumed domestic sewage treatment plant flow (m³/day): 2000.

Conditions and measures related to external treatment of waste for disposal

Waste treatment	Dispose of waste in accordance with environmental legislation.

Conditions and measures related to external recovery of waste

Recovery method	All waste product is assumed to be collected and returned for re-processing or use as a fuel.

2. Conditions of use affecting exposure (Workers - Health 1)

Product characteristics

Physical state	Liquid
Concentration details	Covers percentage substance in the product up to 100% (unless stated differently).

Frequency and duration of use

Covers daily exposures up to 8 hours (unless stated differently).

Human factors not influenced by risk management

Potentially exposed body parts	PROC 3, PROC 15: Covers skin contact area up to 240 cm². Palm of one hand. PROC 2, PROC 9: Covers skin contact area up to 480 cm². Palm of both hands. PROC 8a, 8b: Covers skin contact area up to 960 cm². Both hands.

Other given operational conditions affecting workers exposure

Setting	Indoor use.
Temperature	≤ 40°C
Ventilation rate	1 -3 air changes per hour Unless otherwise stated. Assumes a good basic standard of occupational hygiene is implemented.

Risk management measures

Distribution of Substance - Industrial

General exposures (closed systems)
With occasional controlled exposure
(PROC 3)
No specific measures identified.

Process sampling
(PROC 3)
Wear suitable gloves tested to EN374.

Laboratory activities
(PROC 15)
Provide adequate general and local exhaust ventilation.
Wear suitable gloves tested to EN374.
Recommendation:
Handle in a fume cupboard or under extract ventilation.

Bulk transfers
Road tanker/rail car loading.
(closed systems)
(PROC 8b)
Recommendation:
Use vapour recovery units when necessary.
Wear suitable gloves tested to EN374.

Bulk transfers
Marine vessel/barge (un)loading.
(closed systems)
(PROC 8b)
Recommendation:
Wear suitable gloves tested to EN374.

Equipment cleaning and maintenance
(PROC 8a)
Provide adequate general and local exhaust ventilation.
Recommendation:
Drain down and flush system prior to equipment break-in or maintenance.
Wear suitable gloves tested to EN374.

Storage
With occasional controlled exposure
(PROC 2)
No specific measures identified.

Drum and small package filling
(PROC 9)
Recommendation:
Wear suitable gloves tested to EN374.

3. Exposure estimation (Environment 1)

Assessment method Used Petrorisk model.

3. Exposure estimation (Health 1)

Assessment method Used CHESAR model.

Exposure scenario
Formulation & (re)packing - Industrial

Identification

Product name	Renewable hydrocarbons (diesel type fraction)
REACH registration number	01-2119450077-42-XXXX
Version number	2017
Es reference	02

1. Title of exposure scenario

Main title	Formulation & (re)packing - Industrial
Process scope	Formulation, packing and re-packing of the substance and its mixtures in batch or continuous operations, including storage, materials transfers, mixing, tabletting, compression, pelletisation, extrusion, large and small scale packing, sampling, maintenance and associated laboratory activities.
Main sector	SU3 Industrial uses

Environment

Environmental release category	ERC2 Formulation into mixture
SPERC	ESVOC SPERC 2.2.v1

Worker

Process category	PROC1 Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions PROC2 Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions PROC3 Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition PROC5 Mixing or blending in batch processes PROC8a Transfer of substance or mixture (charging and discharging) at non-dedicated facilities PROC8b Transfer of substance or mixture (charging and discharging) at dedicated facilities PROC9 Transfer of substance or mixture into small containers (dedicated filling line, including weighing) PROC15 Use as laboratory reagent.

2. Conditions of use affecting exposure (Industrial - Environment 1)

Amounts used

Fraction of EU tonnage used in region: 1
Daily amount per site: ≤ 100 t
Annual amount per site: ≤ 1 500 000 t

Frequency and duration of use

Emission days: 300 days/year

Other given operational conditions affecting environmental exposure

Emission factor - air	0,25%
Emission factor - water	0,005%

Formulation & (re)packing - Industrial

Emission factor - soil	0.01%

Environmental factors not influenced by risk management measures

Dilution	Local freshwater dilution factor: 10 Local marine water dilution factor: 100

Risk management measures

STP type	Aerobic biological treatment
STP details	Assumed domestic sewage treatment plant flow (m³/day): 2000.

Conditions and measures related to external treatment of waste for disposal

Disposal method	Dispose of waste in accordance with environmental legislation.

Conditions and measures related to external recovery of waste

Recovery method	All waste product is assumed to be collected and returned for re-processing or use as a fuel.

2. Conditions of use affecting exposure (Workers - Health 1)

Product characteristics

Physical state	Liquid
Concentration details	Covers percentage substance in the product up to 100% (unless stated differently).

Frequency and duration of use

Covers daily exposures up to 8 hours (unless stated differently).

Human factors not influenced by risk management

Potentially exposed body parts	PROC 1, PROC 3, PROC 15: Covers skin contact area up to 240 cm². Palm of one hand. PROC 2, PROC 5, PROC 9: Covers skin contact area up to 480 cm². Palm of both hands. PROC 8a, 8b: Covers skin contact area up to 960 cm². Both hands.

Other given operational conditions affecting workers exposure

Setting	Indoor use.
Temperature	≤ 40 °C
Ventilation rate	1 - 3 air changes per hour Unless otherwise stated. Assumes a good basic standard of occupational hygiene is implemented.

Risk management measures

Formulation & (re)packing - Industrial

Mixing operations
(PROC 3)
No specific measures identified.

Batch processes at elevated temperatures
(PROC 3)
No specific measures identified.

Process sampling
(PROC 3)
Wear suitable gloves tested to EN374.

Laboratory activities
(PROC 15)
Provide adequate general and local exhaust ventilation.
Wear suitable gloves tested to EN374.
Recommendation:
Handle in a fume cupboard or under extract ventilation.

Bulk transfers
(PROC 8b)
No specific measures identified.

Mixing operations
(open systems)
With potential for aerosol generation
(PROC 5)
Recommendation:
Wear suitable gloves tested to EN374.

Transfer from/pouring from containers
Manual
(PROC 8a)
Wear suitable gloves tested to EN374.

Drum/batch transfers
(PROC 8b)
No specific measures identified.

Drum and small package filling
(PROC 9)
Provide adequate general and local exhaust ventilation.
Recommendation:
Fill containers/cans at dedicated fill points supplied with local extract ventilation.

Equipment cleaning and maintenance
(PROC 8a)
Provide adequate general and local exhaust ventilation.
Recommendation:
Drain down and flush system prior to equipment break-in or maintenance.
Wear suitable gloves tested to EN374.

Storage
(PROC 1, PROC 2)
No specific measures identified.

Formulation & (re)packing - Industrial

3. Exposure estimation (Environment 1)

Assessment method Used Petrorisk model.

3. Exposure estimation (Health 1)

Assessment method Used CHESAR model.

Exposure scenario
Use as a fuel - Industrial

Identification

Product name	Renewable hydrocarbons (diesel type fraction)
REACH registration number	01-2119450077-42-XXXX
Version number	2017
Es reference	06

1. Title of exposure scenario

Main title	Use as a fuel - Industrial
Process scope	Covers the use as a fuel (or fuel additive) and includes activities associated with its transfer, use, equipment maintenance and handling of waste.
Main sector	SU3 Industrial uses

Environment

Environmental release category	ERC7 Use of functional fluid at industrial site
SPERC	ESVOC SPERC 7.12a.v1

Worker

Process category	PROC1 Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions PROC2 Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions PROC3 Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition PROC4 Chemical production where opportunity for exposure arises PROC8a Transfer of substance or mixture (charging and discharging) at non-dedicated facilities PROC8b Transfer of substance or mixture (charging and discharging) at dedicated facilities PROC15 Use as laboratory reagent. PROC16 Use of fuels

2. Conditions of use affecting exposure (Industrial - Environment 1)

Amounts used

Fraction of EU tonnage used in region: 1
Daily amount per site: ≤ 5000 t
Annual amount per site: ≤ 10 000 t

Frequency and duration of use

Emission days: 300 days/year

Other given operational conditions affecting environmental exposure

Emission factor - air	0.025%
Emission factor - water	0,001%
Emission factor - soil	0%

Environmental factors not influenced by risk management measures

Use as a fuel - Industrial

Dilution	Local freshwater dilution factor: 10 Local marine water dilution factor: 100

Risk management measures

STP type	Aerobic biological treatment
STP details	Assumed domestic sewage treatment plant flow (m³/day): 2000.

Conditions and measures related to external treatment of waste for disposal

Disposal method	Dispose of waste in accordance with environmental legislation.

Conditions and measures related to external recovery of waste

Recovery method	Retain drain-downs in sealed storage pending disposal or for subsequent recycle.

2. Conditions of use affecting exposure (Workers - Health 1)

Product characteristics

Physical state	Liquid
Concentration details	Covers percentage substance in the product up to 100% (unless stated differently).

Frequency and duration of use

Covers daily exposures up to 8 hours (unless stated differently).

Human factors not influenced by risk management

Potentially exposed body parts	PROC 1, PROC 3, PROC 15, PROC 16: Covers skin contact area up to 240 cm². Palm of one hand. PROC 2, PROC 4: Covers skin contact area up to 480 cm². Palm of both hands. PROC 8a, 8b: Covers skin contact area up to 960 cm². Both hands.

Other given operational conditions affecting workers exposure

Setting	Indoor use.
Temperature	≤ 40 °C
Ventilation rate	1 - 3 air changes per hour Unless otherwise stated. Assumes a good basic standard of occupational hygiene is implemented.

Risk management measures

Use as a fuel - Industrial

Bulk transfers
(PROC 4)
Recommendation:
Wear suitable gloves tested to EN374.

Drum/batch transfers
(PROC 8b)
Provide adequate general and local exhaust ventilation.
Recommendation:
Use drum pumps or carefully pour from container.
Wear suitable gloves tested to EN374.

Bulk transfers
(PROC 8b)
Recommendation:
Use drum pumps or carefully pour from container.
Wear suitable gloves tested to EN374.

General exposures (closed systems)
Continuous process
(PROC 1)
No specific measures identified.

General exposures (closed systems)
Continuous process
With sample collection
(PROC 2)
Recommendation:
Ensure material transfers are under containment or extract ventilation.

General exposures (closed systems)
Batch process
(PROC 3)
Recommendation:
Ensure material transfers are under containment or extract ventilation.

General exposures (open systems)
(PROC 16)
Recommendation:
Ensure material transfers are under containment or extract ventilation.

Process sampling
(PROC 3)
Recommendation:
Wear suitable gloves tested to EN374.

Equipment cleaning and maintenance
(PROC 8a)
Provide adequate general and local exhaust ventilation.
Recommendation:
Drain down and flush system prior to equipment break-in or maintenance.
Wear suitable gloves tested to EN374.

Vessel and container cleaning
(PROC 8a)

Use as a fuel - Industrial

Provide adequate general and local exhaust ventilation.
Recommendation:
Drain down and flush system prior to equipment break-in or maintenance.
Provide enhanced general ventilation by mechanical means.
If above technical/organisational control measures are not feasible, then adopt following PPE:
Wear positive-pressure self-contained breathing apparatus (SCBA) and appropriate protective clothing.
Wear suitable gloves tested to EN374.
Wear suitable coveralls to prevent exposure to the skin.

Storage
(PROC 1, PROC 2)
No specific measures identified.

Refuelling
(PROC 8b)
Recommendation:
Use drum pumps or carefully pour from container.
Use vapour recovery units when necessary.
Wear suitable gloves tested to EN374.

Laboratory activities
(PROC 15)
Recommendation:
Handle in a fume cupboard or under extract ventilation.
Wear suitable gloves (tested to EN374), coverall and eye protection.

3. Exposure estimation (Environment 1)

Assessment method Used Petrorisk model.

3. Exposure estimation (Health 1)

Assessment method Used CHESAR model.

Exposure scenario
Use as a fuel - Professional

Identification

Product name	Renewable hydrocarbons (diesel type fraction)
REACH registration number	01-2119450077-42-XXXX
Version number	2017
Es reference	14

1. Title of exposure scenario

Main title	Use as a fuel - Professional
Process scope	Covers the use as a fuel (or fuel additive) and includes activities associated with its transfer, use, equipment maintenance and handling of waste.
Main sector	SU22 Professional uses

Environment

Environmental release category	ERC9a Widespread use of functional fluid (indoor) ERC9b Widespread use of functional fluid (outdoor)
SPERC	ESVOC SPERC 9.12b.v1

Worker

Process category	PROC1 Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions PROC2 Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions PROC3 Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition PROC8a Transfer of substance or mixture (charging and discharging) at non-dedicated facilities PROC8b Transfer of substance or mixture (charging and discharging) at dedicated facilities PROC16 Use of fuels

2. Conditions of use affecting exposure (Industrial - Environment 1)

Amounts used

Fraction of EU tonnage used in region: 0.1
Daily amount per site: ≤ 160 kg

Frequency and duration of use

Emission days: 365 days/year

Other given operational conditions affecting environmental exposure

Emission factor - air	0,01 %
Emission factor - water	0,001 %
Emission factor - soil	0,001 %

Environmental factors not influenced by risk management measures

Dilution	Local freshwater dilution factor: 10 Local marine water dilution factor: 100

Use as a fuel - Professional

Risk management measures

STP type	Aerobic biological treatment
STP details	Assumed domestic sewage treatment plant flow (m³/day): 2000.

Conditions and measures related to external treatment of waste for disposal

Disposal method	Dispose of waste in accordance with environmental legislation.

2. Conditions of use affecting exposure (Workers - Health 1)

Product characteristics

Physical state	Liquid
Concentration details	Covers percentage substance in the product up to 100% (unless stated differently).

Frequency and duration of use

Covers daily exposures up to 8 hours (unless stated differently).

Human factors not influenced by risk management

Potentially exposed body parts	PROC 1, PROC 3, PROC 16: Covers skin contact area up to 240 cm². Palm of one hand. PROC 2: Covers skin contact area up to 480 cm². Palm of both hands. PROC 8a, 8b: Covers skin contact area up to 960 cm². Both hands.

Other given operational conditions affecting workers exposure

Setting	Indoor use.
Temperature	≤ 40 °C
Ventilation rate	1 - 3 air changes per hour Unless otherwise stated.

Risk management measures

Use as a fuel - Professional

Bulk transfers
Heating oil and diesel deliveries
(PROC 8b)
Provide adequate general and local exhaust ventilation.
Recommendation:
Handle substance within a closed system.
Wear suitable gloves tested to EN374.
.
Drum/batch transfers
(PROC 8b)
Provide adequate general and local exhaust ventilation.
Recommendation:
Use drum pumps or carefully pour from container.
Wear suitable gloves tested to EN374.
.
Refuelling
(PROC 8b)
Provide adequate general and local exhaust ventilation.
Recommendation:
Use drum pumps or carefully pour from container.
Wear suitable gloves tested to EN374.
.
Dipping, immersion and pouring
(PROC 8b)
Wear suitable gloves tested to EN374.
.
General exposures
(PROC 1, PROC 2, PROC 3, PROC 16)
No specific measures identified.
.
Equipment cleaning and maintenance
(PROC 8a)
Provide adequate general and local exhaust ventilation.
Recommendation:
Drain down and flush system prior to equipment break-in or maintenance.
Wear suitable gloves tested to EN374.
.
Vessel and container cleaning
(PROC 8a)
Provide adequate general and local exhaust ventilation.
Recommendation:
Drain down and flush system prior to equipment break-in or maintenance.
Wear suitable gloves tested to EN374.
.
Storage
(PROC 1, PROC 2)
No specific measures identified.

3. Exposure estimation (Environment 1)

Assessment method Used Petrorisk model.

3. Exposure estimation (Health 1)

Assessment method Used CHESAR model.

Exposure scenario
Use as a fuel - Consumer

Identification

Product name	Renewable hydrocarbons (diesel type fraction)
REACH registration number	01-2119450077-42-XXXX
Version number	2017
Es reference	23

1. Title of exposure scenario

Main title	Use as a fuel - Consumer
Process scope	Covers the use as a fuel (or fuel additive) and includes activities associated with its transfer, use, equipment maintenance and handling of waste.
Product category	PC13 Fuels.
Main sector	SU21 Consumer uses

Environment

Environmental release category	ERC9a Widespread use of functional fluid (indoor) ERC9b Widespread use of functional fluid (outdoor)
SPERC	ESVOC SPERC 9.12c.v1

Non-industrial

Product sub-category	PC13_1 Liquid: automotive refuelling PC13_2 Liquid: scooter refuelling PC13_3 Liquid: garden equipment - use PC13_4 Liquid: Garden equipment - Refuelling PC13_5 Liquid: lamp oil PC13_6 Liquid: home space heater fuel PC13_n Liquid: refuelling of boats

2. Conditions of use affecting exposure (Non-industrial - Environment 1)

Amounts used

Fraction of EU tonnage used in region: 0,1
Daily amount per site: ≤ 550 kg

Frequency and duration of use

Emission days: 365 days/year

Other given operational conditions affecting environmental exposure

Emission factor - air	0,01 %
Emission factor - water	0,001 %
Emission factor - soil	0,001 %

Environmental factors not influenced by risk management measures

Dilution	Local freshwater dilution factor: 10 Local marine water dilution factor: 100

Risk management measures

Use as a fuel - Consumer

Technical measures	Indoor/outdoor use.
STP type	Aerobic biological treatment
STP details	Assumed domestic sewage treatment plant flow (m³/day): 2000.

Conditions and measures related to external treatment of waste for disposal

Disposal method	Dispose of waste in accordance with environmental legislation.

2. Conditions of use affecting exposure (Non-industrial - Health 1)

Product characteristics

Concentration details Covers percentage substance in the product up to 100% (unless stated differently).

Amounts used

PC13_1 Liquid: automotive refuelling
For each use event, covers use amounts up to 38,6 kg.
PC13_2 Liquid: scooter refuelling
For each use event, covers use amounts up to 7,5 kg.
PC13_3 Liquid: garden equipment - use
For each use event, covers use amounts up to 772 g.
PC13_4 Liquid: Garden equipment - Refuelling
For each use event, covers use amounts up to 772 g.
PC13_5 Liquid: lamp oil
For each use event, covers use amounts up to 100 g.
PC13_6 Liquid: home space heater fuel
For each use event, covers use amounts up to 3320 g.
PC13_n Liquid: refuelling of boats
For each use event, covers use amounts up to 156,0 kg.

Frequency and duration of use

Use as a fuel - Consumer

Covers use up to 1 time(s)/day.
.
PC13_1 Liquid: automotive refuelling
Covers exposure up to 0,05 hours per event.
(occasional use over a year)
.
PC13_2 Liquid: scooter refuelling
Covers exposure up to 0,02 hours per event.
(frequent use over a year)
.
PC13_3 Liquid: garden equipment - use
Covers exposure up to 2,00 hours per event.
(occasional use over a year)
.
PC13_4 Liquid: Garden equipment - Refuelling
Covers exposure up to 0,03 hours per event.
(occasional use over a year)
.
PC13_5 Liquid: lamp oil
Covers exposure up to 0,01 hours per event.
(occasional use over a year)
.
PC13_6 Liquid: home space heater fuel
Covers exposure up to 0,1 hours per event.
(frequent use over a year)
.
PC13_n Liquid: refuelling of boats
Covers exposure up to 0,25 hours per event.
(infrequent use over a year)

Human factors not influenced by risk management

Potentially exposed body parts	Palm of one hand. Unless otherwise stated. PC13_4 Liquid: Garden equipment - Refuelling : Palm of both hands.

Other given operational conditions affecting Non-industrial exposure

Setting	Outdoor use. Unless otherwise stated. PC13_5 Liquid: lamp oil : Indoor/outdoor use.

Other given operational conditions affecting Non-industrial exposure

Avoid contact with skin, eyes and clothing. Wash promptly if skin becomes contaminated. All handling should only take place in well-ventilated areas. Do not ingest. If swallowed, then seek immediate medical assistance.

3. Exposure estimation (Environment 1)

Assessment method Used Petrorisk model.

3. Exposure estimation (Health 1)

Assessment method Used CHESAR model.

Exposure scenario
Use as Intermediate - Industrial

Identification

Product name	Renewable hydrocarbons (diesel type fraction)
REACH registration number	01-2119450077-42-XXXX
Version number	2017
Es reference	05

1. Title of exposure scenario

Main title	Use as Intermediate - Industrial
Process scope	Use of substance as an intermediate (not related to Strictly Controlled Conditions). Includes recycling/recovery, material transfers, storage, sampling, associated laboratory activities, maintenance and loading (including marine vessel/barge, road/rail car and bulk container).
Main sector	SU3 Industrial uses

Environment

Environmental release category	ERC6a Use of intermediate
SPERC	ESVOC SPERC 6.1a.v1

Worker

Process category	PROC1 Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions PROC2 Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions PROC3 Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition PROC4 Chemical production where opportunity for exposure arises PROC8a Transfer of substance or mixture (charging and discharging) at non-dedicated facilities PROC8b Transfer of substance or mixture (charging and discharging) at dedicated facilities PROC15 Use as laboratory reagent.

2. Conditions of use affecting exposure (Industrial - Environment 1)

Amounts used

Fraction of EU tonnage used in region: 1
Daily amount per site: ≤ 50 t
Annual amount per site: ≤ 15 000 t

Frequency and duration of use

Emission days: 300 days/year

Other given operational conditions affecting environmental exposure

Emission factor - air	0,002%
Emission factor - water	0,001%
Emission factor - soil	0.1%

Environmental factors not influenced by risk management measures

Use as Intermediate - Industrial

Dilution	Local freshwater dilution factor: 10 Local marine water dilution factor: 100

Risk management measures

STP type	Aerobic biological treatment
STP details	Assumed domestic sewage treatment plant flow (m³/day): 2000.

Conditions and measures related to external treatment of waste for disposal

Disposal method	Dispose of waste in accordance with environmental legislation.

Conditions and measures related to external recovery of waste

Recovery method	Retain drain-downs in sealed storage pending disposal or for subsequent recycle.

2. Conditions of use affecting exposure (Workers - Health 1)

Product characteristics

Physical state	Liquid
Concentration details	Covers percentage substance in the product up to 100% (unless stated differently).

Frequency and duration of use

Covers daily exposures up to 8 hours (unless stated differently).

Human factors not influenced by risk management

Potentially exposed body parts	PROC 1, PROC 3, PROC 15: Covers skin contact area up to 240 cm². Palm of one hand. PROC 2, PROC 4: Covers skin contact area up to 480 cm². Palm of both hands. PROC 8a, 8b: Covers skin contact area up to 960 cm². Both hands.

Other given operational conditions affecting workers exposure

Setting	Indoor use.
Temperature	≤ 40 °C
Ventilation rate	1 - 3 air changes per hour Unless otherwise stated. Assumes a good basic standard of occupational hygiene is implemented.

Risk management measures

Use as Intermediate - Industrial

General exposures (closed systems)
(PROC 1)
No specific measures identified.

General exposures (closed systems)
With sample collection
With occasional controlled exposure
(PROC 2)
No specific measures identified.

General exposures (closed systems)
Batch process
(PROC 3)
No specific measures identified.

General exposures (open systems)
Batch process
With sample collection
(PROC 4)
No specific measures identified.

Sampling
(PROC 8b)
No specific measures identified.

Laboratory activities
(PROC 15)
Provide adequate general and local exhaust ventilation.
Wear suitable gloves tested to EN374.
Recommendation:
Handle in a fume cupboard or under extract ventilation.

Bulk transfers
(closed systems)
(PROC 8b)
No specific measures identified.

Equipment cleaning and maintenance
(PROC 8a)
Provide adequate general and local exhaust ventilation.
Recommendation:
Drain down and flush system prior to equipment break-in or maintenance.
Wear suitable gloves tested to EN374.

Storage
(PROC 1, PROC 2)
No specific measures identified.

3. Exposure estimation (Environment 1)

Assessment method Used Petrorisk model.

3. Exposure estimation (Health 1)

Assessment method Used CHESAR model.

Technical Data Sheet

Neste MY Renewable Diesel

Neste Renewable Diesel is a bio-based paraffinic diesel fuel defined in ASTM D975 and EN 15940 specifications.

Properties	Unit	Neste MY Renewable Diesel		ASTM D975 Diesel limits			EN 15940 Paraffinic Diesel Ilimits		
		min	max	min	max	Test Method	min	max	Test Method
Cetane number	-	70	-	40	-	ASTM D6890	70	-	EN 15195
Sulfur content	mg/kg	-	5	-	15	ASTM D5453	-	5	EN ISO 20846
Flash point	°C	61	-	52	-	ASTM D93	55	-	EN ISO 2719
Carbon residue (on 10% distillation residue)	% (m/m)	-	0.1	-	0.35	ASTM D4530	-	0.3	EN ISO 10370
Ash content	% (m/m)	-	0.001	-	0.01	ASTM D482	-	0.01	EN ISO 6245
Water and sediment	% (m/m)	-	0.02	-	0.05	ASTM D2709	-	0.02	EN ISO 12937
Copper strip corrosion (3h at 50°C)	rating	Class 1		Class 3		ASTM D130	Class 1		EN ISO 2160
Oxidation stability	g/m³	-	25	-	25	ASTM D2274	-	25	EN ISO 12205
Lubricity, corrected wear scar diameter (wsd 1.4) at 60°C	µm	-	460	-	520	ASTM D6079	-	460	EN ISO 12156-1
Viscosity at 40°C	mm²/s	2	4	1.9	4.1	ASTM D445	2	4.5	EN ISO 3104
Distillation 90% (V/V) recovered at	°C	282	338	282	338	ASTM D86	-	-	-
Distillation 95% (V/V) recovered at	°C	-	360	-	-	-	-	360	EN ISO 3405
Cloud Point	°C	-20*C Winter / -12*C Summer		-	-	ASTM D7689	-	-	EN 23015 & EN 116
Appearance		Clear and bright		-	-	Visual	-	-	Visual
Total aromatics content	% (m/m)	-	1.1	-	35	ASTM D1319	-	1.1	EN 12916
Conductivity	pS/m	50	-	25	-	ASTM D2624	-	-	-
Total acid number	mg KOH/g	-	-	-	-	-	-	-	-
Oxidation stability	mg KOH/g	-	-	-	-	-	-	-	-

The supplier guarantees no FAME is added in the product.

Certificate of Analysis

Bureau Veritas Commodities and Trade
Vancouver Laboratory
2119 SE Columbia Way, Suite 280
Vancouver, WA, 98661, USA
360-574-7060
Vancouver.Lab_CTD@bureauveritas.com

Asset	Tri Cities Voyager	**Submitted By**	Vancouver
Product	Renewable Diesel	**Date Sampled**	26-Jul-2023
Client Reference	---	**Date Received**	27-Jul-2023
Job Location	Zenith Energy	**Date Analyzed**	28-Jul-2023
TOCM Job ID	USVAN-23-00651	**Date Reported**	28-Jul-2023

Barge Tri Cities Voyager 3 P/S Composite After Loading				
USVAN-23-00651-001				Specification
Test	**Method**	**Unit**	**Result**	**Min/Max**
API Gravity @60°F	ASTM D4052	°API	49.4	--
Cetane Number	ASTM D613[1]	--	>74.8	70.0 min
Total Sulfur	ASTM D7039	mg/kg	<3.2	5.0 max
Flash Applications	ASTM D93A	--	-	--
Corrected Flash Point	ASTM D93A	°C	88.0	61.0 min
Corrected Flash Point	ASTM D93A	°F	190	--
MCRT on 10% Distillation Residue	ASTM D4530	% (m/m)	<0.10	--
Ash	ASTM D482	% (m/m)	<0.010	0.001 max
Oven Verification	ASTM D482	--	Yes	--
Water and Sediment	ASTM D2709	% (V/V)	< 0.01	--
Corrosion Copper Strip - 3h at 50°C (122°F)	ASTM D130	--	1a	1a, 1b Max.
Filterable Insolubles	ASTM D2274[1]	mg/100mL	0.1	--
Adherent Insolubles	ASTM D2274[1]	mg/100mL	0.6	--
Total Insolubles(Oxidation Stability)	ASTM D2274[1]	mg/100mL	0.7	25 max
Total Insolubles(Oxidation Stability)	ASTM D2274[1]	g/m³	7.0	--
Test Temperature	ASTM D6079-04	°C	60	--
Wear Scar Diameter	ASTM D6079-04	µm	620	--
Wear Scar Area Desc.	ASTM D6079-04	--	None	--
Bath Temp Before	ASTM D445	°C	40.00	--
Bath Temp After	ASTM D445	°C	40.00	--
Kinematic Viscosity at 40°C	ASTM D445	mm²/s	3.103	2.00 - 4.00
Manual/Automated	ASTM D86	--	Automatic	--
IBP	ASTM D86	°C	218.2	--
5% Recovered	ASTM D86	°C	255.5	--
10% Recovered	ASTM D86	°C	267.5	--
15% Recovered	ASTM D86	°C	273.1	--
20% Recovered	ASTM D86	°C	275.8	--
30% Recovered	ASTM D86	°C	279.6	--
40% Recovered	ASTM D86	°C	281.8	--
50% Recovered	ASTM D86	°C	284.0	--
60% Recovered	ASTM D86	°C	286.1	--
70% Recovered	ASTM D86	°C	288.4	--
80% Recovered	ASTM D86	°C	291.2	--
85% Recovered	ASTM D86	°C	292.9	--
90% Recovered	ASTM D86	°C	295.4	282 - 338
95% Recovered	ASTM D86	°C	300.7	--
Endpoint	ASTM D86	°C	312.4	--
Recovery	ASTM D86	% (V/V)	97.8	--
Residue	ASTM D86	% (V/V)	1.3	--
Loss	ASTM D86	% (V/V)	0.9	--
Biodiesel	ASTM D7371[2]	% (V/V)	0.23	--
Cloud Point	ASTM D5773	°C	-23.1	--
Cloud Point	ASTM D5773	°F	-9.6	--
Cold Filter Plugging Point (CFPP)	ASTM D6371	°C	-26	--
Cold Filter Plugging Point (CFPP)	ASTM D6371	°F	-15	--
Appearance	ASTM D4176 Proc. 1	--	Pass	--
Visual Observance	ASTM D4176 Proc. 1	--	Clear and Bright	Clear and Bright
Vortex Observance	ASTM D4176 Proc. 1	--	No Particulate	--
Sample Temperature	ASTM D4176 Proc. 1	°C	20.0	--
UOP Dyed Gel Lot Number	ASTM D1319	--	3000001010	--
Aromatics	ASTM D1319	% (V/V)	0.7	--
Elec. Conductivity	ASTM D2624	pS/m	109	50 min
Sample Temperature	ASTM D2624	°C	20	--

Comments:

[1] *Analysis performed by other Bureau Veritas laboratory*

[2] *Reported outside the scope of the method*

Eileen Claudia DIAZ, Lab Technician

End of Report

APPENDIX I. FUEL ACCURACY INFORMATION

Advertised Volumetric Fuel Consumption

Background Information

Few if any standards exist that bring consistency to the volumetric fuel consumption values published by Diesel Generator manufactures in their specification sheets. The purpose of this information is to bring awareness to some differences and help sales teams perform a more accurate competitive comparison on fuel consumption.

Caterpillar

Cat® C9 through C175 diesel generator volumetric fuel consumption rates are based upon nominal engine power and fuel oil of 35° API (16°C or 60°F) gravity having an LHV of 42780 kJ/kg (18390 Btu/lb) when used at 29°C (85°F) and weighing 838.9 g/liter (7.001 lbs/U.S. gal.).

These fuel heat values (kJ/kg) and fuel density values (g/liter) are typically referenced in the RATING DEFINITIONS AND CONDITIONS section of Cat Diesel Generator specification.

Adjustment Factors

When comparing the advertised spec sheet volumetric/mass specific fuel consumption values published by various diesel generator manufactures, you should consider a minimum of three fuel parameters:

1) Fuel Density
2) Fuel Heat Value
3) Brake Specific Fuel Consumption Tolerance

Adjustments should be made for all three factors to get the best comparison.

1) Fuel Density Correction Factor:

Use of a fuel density different from the 838.9 g/l used by Caterpillar will affect the published volumetric fuel consumption. Correct the competitive fuel consumption value to Caterpillar's standard by using the following formula or Chart 1:

Formula Method

$$\text{Adjuster Volumetric/Mass Specific Fuel Consumption} = \text{Published Fuel Consumption (l/hr or g/hr)} \times \frac{\text{Published Fuel Density (g/l)}}{838.9 \text{ g/l}}$$

Chart Method

Multiply competitor's published fuel consumption (liters/hr or g/hr) by the appropriate factor in the following table to adjust to Caterpillar reference fuel density.

Fuel Density					
API 35 used at 29C (85F) Caterpillar Fuel Standard (C9 through C175)	Comp 1	Comp 2	Comp 3	Comp 4	Comp 5
838.9 kg/m^3 838.9 g/l 0.8389 g/ml 7.001 lb/US gal	820 kg/m^3 820 g/l 0.82 g/ml 6.8433 lb/US gal	840 kg/m^3 840 g/l 0.84 g/ml 7.010 lb/US gal	850 kg/m^3 850 g/l 0.85 g/ml 7.094 lb/US gal	851.8 kg/m^3 851.8 g/l 0.8518 g/ml 7.109 lb/US gal	860 kg/m^3 860 g/l 0.86 g/ml 7.177 lb/US gal
	Factor				
	0.977	1.001	1.013	1.015	1.025

Chart 1: Correction Factors for Various Fuel Densities

2) Fuel Heat Value Correction

Use of a fuel heat value different from the 42780 kJ/kg used by Caterpillar will affect the published volumetric fuel consumption. Correct the competitive fuel consumption value to Caterpillar's standard by using the following formula or Chart 2:

Formula Method

$$\text{Adjusted Volumetric/Mass Specific Fuel Consumption} = \text{Published Fuel Consumption (l/hr or g/hr)} \times \frac{\text{Published Heat Value (kJ/kg)}}{\text{42780 kJ/kg}}$$

Chart Method

Multiply competitor's published fuel consumption by the appropriate factor in the following chart to adjust to Caterpillar's reference fuel heat value.

Heating Value (Low or High for Diesel)			
API 35 used at 29C (85F) Caterpillar Fuel Standard (C9 through C175)	Comp 1	Comp 2	Comp 3
42780 kJ/kg 42.780 MJ/kg 18390 BTU/lb	42700 kJ/kg 42.700 MJ/kg 18360 BTU/lb	42800 kJ/kg 42.8 MJ/kg 18399 BTU/lb	44897 kJ/kg 44.897MJ/kg 19300 BTU/lb
	Factor		
	0.998	1.00	1.049

Chart 2: Correction Factors for Various Fuel Heat Values

3) Ajust Caterpillar Published Fuel Consumption to Competitor's Standard

To perform the inverse of the above calculations (i.e. to adjust Caterpillar published fuel consumption to a competitor's reference fuel properties), use the following formulas for density and heat value:

A) Fuel Density Correction

$$\text{Adjusted Volumetric/Mass Specific Fuel Consumption} = \text{Caterpillar Published Fuel Consumption (l/hr or g/hr)} \times \frac{838.9\ \text{g/l}}{\text{Competitor's Reference Density (g/l)}}$$

B) Fuel Heat Value Correction

$$\text{Adjusted Volumetric/Mass Specific Fuel Consumption} = \text{Caterpillar Published Fuel Consumption (l/hr or g/hr)} \times \frac{42780\ \text{kJ/kg}}{\text{Competitor's Reference Heat Value (kJ/kg)}}$$

4) Fuel Consumption Error Tolerance

Caterpillar typically calculates and publishes a nominal volumetric fuel consumption using nominal engine brake power (bkw) and nominal brake specific fuel consumption (g/bkw-hr).

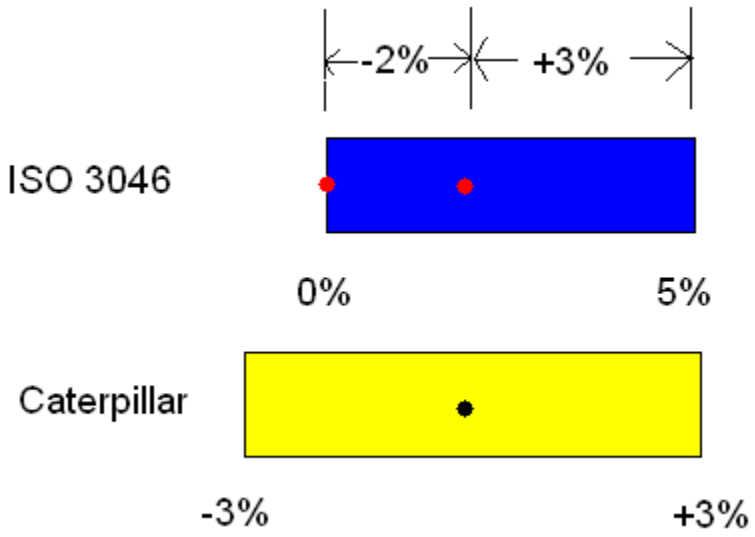
Competitors typically follow Caterpillar's lead and use nominal brake power (bkw) in their volumetric fuel consumption calculation, but **do not** use nominal brake specific consumption.

Several competitors gain a significant advantage by publishing volumetric fuel consumption based upon a –0% /+5% tolerance on the brake specific fuel consumption per the ISO 3046 standard. This results in their published value being based upon the minimum brake specific fuel consumption with a tolerance of +5%. Caterpillar's brake specific fuel consumption has a +/- 3% tolerance.

Since Caterpillar has a 6% brake specific fuel consumption tolerance band (+/-3%) and ISO 3046 has a 5% tolerance band (-0 / +5%) an exact published volumetric fuel consumption comparison can't be made. However, a fair comparison is to normalize the competitors ISO 3046 specific fuel consumption to a value with a –2% /+3% tolerance. This puts the max allowable specific fuel consumption value at +3% for both the Caterpillar and adjusted ISO values.

Product Update

Advertised Volumetric Fuel Consumption



Sample Calculation using all three parameters:

Cat C27- 750 ekW Standby Low BSFC (DM9068)

Spec Sheet Fuel Consumption:
100% load with fan 200.3 L/hr
75% load with fan 154.4 L/hr
50% load with fan 111.1 L/hr

Competitive: 750 ekw Standby Low BSFC Unit*

Published Fuel Consumption:
100% load with fan 192 L/hr
75% load with fan 152 L/hr
50% load with fan 105 L/hr

*+ 5%; EN 590 (42,800 kJ / kg), fuel density 860 g/l

$$\text{Adjusted Competitive Vol. Fuel Consumption} = \text{Published Vol. Fuel Consumption (l/hr)} \times \frac{\text{Published Fuel Density (g/l)}}{838.9\ \text{g/l}} \times \frac{\text{Published Heat Value (kJ/kg)}}{42{,}780\ \text{kJ/kg}} \times 1.02$$

$$= 192\ \text{g/l} \times \frac{860\ \text{g/l}}{838.9\ \text{g/l}} \times \frac{42{,}800\ \text{kJ/kg}}{42{,}780\ \text{kJ/kg}} \times 1.02$$

= 201 l/hr at Caterpillar Fuel Standards with nominal engine bkW and Normalized specific fuel consumption

APPENDIX J. NEW SOURCE PERFORMANCE STANDARDS EMISSIONS CERTIFICATIONS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2024 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

OFFICE OF TRANSPORTATION AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: **Caterpillar Inc.**
(U.S. Manufacturer or Importer)

Certificate Number: RCPXL18.1NYS-033

Effective Date: 08/08/2023

Expiration Date: 12/31/2024

Byron J. Bunker, Division Director
Compliance Division

Issue Date: 08/08/2023

Revision Date: N/A

Model Year: 2024
Manufacturer Type: Original Engine Manufacturer
Engine Family: RCPXL18.1NYS

Mobile/Stationary Indicator: Stationary
Emissions Power Category: 560<kW<=2237
Fuel Type: Diesel
After Treatment Devices: No After Treatment Devices Installed
Non-after Treatment Devices: Electronic Control, Engine Design Modification

Pursuant to Section 111 and Section 213 of the Clean Air Act (42 U.S.C. sections 7411 and 7547) and 40 CFR Part 60, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following engines, by engine family, more fully described in the documentation required by 40 CFR Part 60 and produced in the stated model year.

This certificate of conformity covers only those new compression-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 60 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 60.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 60. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 60.

This certificate does not cover engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2024 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

OFFICE OF TRANSPORTATION AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: **Caterpillar Inc.**
(U.S. Manufacturer or Importer)

Certificate Number: RCPXL18.1NYS-033

Effective Date: 08/08/2023

Expiration Date: 12/31/2024

Byron J. Bunker, Division Director
Compliance Division

Issue Date: 08/08/2023

Revision Date: N/A

Model Year: 2024
Manufacturer Type: Original Engine Manufacturer
Engine Family: RCPXL18.1NYS

Mobile/Stationary Indicator: Stationary
Emissions Power Category: 560<kW<=2237
Fuel Type: Diesel
After Treatment Devices: No After Treatment Devices Installed
Non-after Treatment Devices: Electronic Control, Engine Design Modification

Pursuant to Section 111 and Section 213 of the Clean Air Act (42 U.S.C. sections 7411 and 7547) and 40 CFR Part 60, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following engines, by engine family, more fully described in the documentation required by 40 CFR Part 60 and produced in the stated model year.

This certificate of conformity covers only those new compression-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 60 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 60.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 60. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 60.

This certificate does not cover engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2024 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

OFFICE OF TRANSPORTATION AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: **Caterpillar Inc.**
(U.S. Manufacturer or Importer)

Certificate Number: RCPXL08.8NZS-023

Effective Date: 07/26/2023

Expiration Date: 12/31/2024

Byron J. Bunker, Division Director
Compliance Division

Issue Date: 07/26/2023

Revision Date: N/A

Model Year: 2024
Manufacturer Type: Original Engine Manufacturer
Engine Family: RCPXL08.8NZS

Mobile/Stationary Indicator: Stationary
Emissions Power Category: 225<=kW<450
Fuel Type: Diesel
After Treatment Devices: No After Treatment Devices Installed
Non-after Treatment Devices: Electronic Control, Engine Design Modification

Pursuant to Section 111 and Section 213 of the Clean Air Act (42 U.S.C. sections 7411 and 7547) and 40 CFR Part 60, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following engines, by engine family, more fully described in the documentation required by 40 CFR Part 60 and produced in the stated model year.

This certificate of conformity covers only those new compression-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 60 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 60.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 60. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 60.

This certificate does not cover engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.