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537 Status (Must be approved or waived for application to be admin. complete)	537 Approved	537 Waived	537 Required BAM 5/13/25
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On May 5, 2025, we received a permit application for a plan approval for the construction of a new data center
consisting of 76 diesel-fired emergency engines, 72 of which will have emissions control devices installed.

Act 14 Notification Received: MISPSMunicipality: Y N N/ACounty: Y N N/AThe application is administratively complete: ☐ YES ☐ NO(RDO USE ONLY) PERMIT COORDINATION REQUIREMENTS: ☐ NONE

DATE: _____ INTL: _____

Circle: AQ 537 WQPER WTSD WSCH DAMS WM RP EC PNDI M&R CZM Other

PROGRAM		No Permit Approval Required	Prior Approval Required	Permit Required Application on Hand	Permit Required Application Needed	Estimated Review Time
AIR QUALITY				JM 05/05/2025		
WATER QUALITY	Planning	BAM 5/13/25				
	Permits	7/23/2025 KMCD	Kmed 5/7/25			
WATERSHED	102/ NPDES	AR 5/8/2025				
	105/ Encroachment	5/13/25 PS				
	Water Allocation					
WATER SUPPLY & COMMUNITY HEALTH		BK 5/9/2025				
RADIATION PROTECTION						
ENVIRONMENTAL CLEANUP						
WASTE MANAGEMENT		KD 5/9/2025				
DAMS						
FORESTRY (PNDI)						
MINING AND RECLAMATION						
COASTAL ZONE MGMT						
DELAWARE RIVER BASIN COMMISSION						

Template 2A-3

(9) Circle Optional Paragraph A, B, or C

Optional Paragraph A

1. See Description in Letter

Optional Paragraph B

1.

2.

3.

Optional Paragraph C

1.

Circle

(complete 9a, 9b, 9c, & 9d for each program)

9a. (Circle one) D, E, F, G, H, I, J, K, L, M, N, O, P

9b. Mr. / Ms.

9c. 484.

9d. (Circle if applicable) 1C

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9b. Mr. / Ms.

9c. 484.

9d. (Circle if applicable) 1C

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9b. Mr. / Ms.

9c. 484.

9d. (Circle if applicable) 1C

9a. (Circle one) D, E, F, G, H, I, J, K, L, M, N, O, P

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9c. 484.

9d. (Circle if applicable) 1C

(10) Circle Additional Optional Paragraphs:

Optional Paragraph #1A

1.

Optional Paragraph(s) #2B, #3, OR #4

(11) (Contact)

Mr./Ms.

484.

CCs:

(12) (Municipality)

*See Front Page

(check box for envelopes)

☐

(13) (County)

**Indicate above which county facility

☐

(14) (Consultant)

See Front Page

☐

(Additional CCs)

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Intended for
Pennsylvania Department of Environmental Protection

Date
May 2025

APPLICATION FOR A MINOR NSR PLAN APPROVAL

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1. INTRODUCTION

Amazon Data Services, Inc. ("ADS") is submitting this Plan Approval application to the Pennsylvania Department of Environmental Protection (PADEP) to request authority to construct a new data center in Bucks County at 600 Ben Fairless Drive, Fairless Hills, Pennsylvania 19030. The proposed facility will include 76 diesel-fired emergency generators, 72 of which will have installed devices for additional emissions control that will provide electricity to the facility in the event of an emergency. A site location map and a site layout map are provided in **Appendix 1**.

Additionally, ADS proposes to request the use of both ultra-low sulfur diesel fuel (ULSD) and renewable diesel conforming to ASTM D975 specifications for petroleum, including hydrotreated vegetable oil (HVO), in all proposed emergency generators. This application refers to ULSD and HVO as "diesel" throughout.

The proposed facility will request a site-wide limitation to be classified as a synthetic minor source of air emissions with respect to the Title V and New Source Review (NSR) permitting programs. ADS is hereby submitting this application for a Plan Approval for the proposed facility in accordance with Title 25, Chapter 127 of the Pennsylvania Administrative Code. The General Information Form and Air Pollution Control Act Compliance Review Form are in **Appendix 2** of this report, the copy and proof of County and Municipal notifications are in **Appendix 3**, the invoice of fee payment is included in **Appendix 4**, the generator manufacturer specifications are included in **Appendix 5**, and the potential emissions calculations are included in **Appendix 6**.

There is a potential that this site may be expanded in the future. The equipment included in this permit application is referred to as the Phase 1 facility. A potential future Phase 2 expansion may include additional data center buildings with additional generation and/or fuel storage. A potential Phase 2 expansion is not included in this application because it is conceptual and non-binding in nature. Phase 1 is not contingent on Phase 2. If the Phase 1 facility is expanded, the Phase 2 expansion will be aggregated with the Phase 1 facility as one source and remain a synthetic minor source with respect to the Title V and NSR permitting process. Phase 1 generators are scheduled to be installed on or about August 2025.

2. PROJECT DESCRIPTION

ADS is proposing to construct a new data center in Falls Township, Bucks County, Pennsylvania at 600 Ben Fairless Drive. The facility will include 76 diesel-fired generators, consisting of 72 critical diesel-fired emergency generators, and four (4) diesel-fired house generators. All of the critical generators will be equipped with controls including selective catalyst reduction (SCR) to control nitrogen oxide (NO_x) emissions, diesel particulate filter (DPF) to control particulate matter (PM) emissions, and diesel oxidation catalyst (DOC) to control carbon monoxide (CO) and volatile organic compound (VOC) emissions. The diesel-fired emergency generators will provide backup electricity to facility operations in the event of an emergency. NorthPoint Development is the owner and developer of the land and will be responsible for constructing and maintaining the infrastructure at the site, while ADS will maintain operational control and ownership of the diesel-fired emergency generators. A list of the proposed generator identification (ID) numbers is provided in **Table 1**. The engine certificates of conformity, manufacturer's specification sheets for the generators, and operation and maintenance manuals for the control devices are provided in **Appendix 5**.

Table 1. Generator IDs

Engine Type	Quantity	Proposed Emission Point ID Numbers for Generators
2,750 kW Engines – Caterpillar model 3516E with SCR, DOC, and DPF	72	CEG1 through CEG72
1,000 kW Engines – Caterpillar model C32	2	HG1 through HG2
750 kW Engines – Caterpillar model C18	2	HG3 through HG4

Other sources of emissions at the proposed facility will consist of diesel belly storage tanks for each generator. The facility will also be installing fire pumps, all of which are electric fire pumps and will not produce emissions. There will be no other stationary sources of air emissions present at the facility.

2.1 Proposed Site-Wide Emission Limitations

In order to be classified as a Title V and NSR synthetic minor source located in Bucks County, Pennsylvania, ADS is requesting a federally enforceable site-wide annual emission limitation of 24.9 tons per year (tpy) of NO_x on an aggregate, 365-day rolling basis. To demonstrate compliance with this limitation, the fuel usage for each generator will be recorded. The 365-day rolling fuel usage will be tracked by engine type on a daily basis and multiplied by the worst-case emission factor (in pounds per gallon [lb/gal]) for that engine type. This will provide a conservative emission estimate to indicate compliance with the NO_x limit.

As part of this compliance demonstration, the facility will track fuel usage during controlled operations and fuel usage during uncontrolled operations (i.e., during catalyst bed warmup for controlled generators and/or during control device malfunction for controlled generators). Emissions for NO_x will be uncontrolled until the catalyst bed of the SCR reaches a temperature that will effectively control emissions. Typically, the SCR catalyst bed reaches its effective temperature of

572°F within 6-15 minutes of generator start-up, dependent on ambient conditions and generator load. The generators will be equipped with SCR preheaters that can be manually activated in advance of any planned runs, which would result in immediate control of NO_x emissions. Start-up and shut-down emissions during planned operations are not anticipated for the DPF or DOC control devices as the catalyst bed is expected to reach appropriate temperatures quickly upon generator operation.

To capture startup emissions for the SCR, emissions will be calculated by using the worst-case uncontrolled lb/gal emissions rate for the critical generators until the catalyst bed temperature reaches the optimal level per the manufacturer's technical data sheet. The facility will monitor catalyst bed temperature and once the appropriate temperature is reached, emissions will be calculated as controlled emissions and the worst-case controlled emission rate for the critical generators will be used to calculate emissions. The temperature will be monitored and recorded every 15 minutes during operation to ensure emissions are controlled effectively.

For the uncontrolled house generators, emissions will be conservatively calculated using the worst-case uncontrolled lb/gal emissions rate across all engine loads.

By limiting NO_x, the other pollutants will consequently also remain below their respective major source thresholds. This is shown in the detailed emission calculations provided in **Appendix 6**. Additionally, all generators will be equipped with a non-resettable hour meter, and the duration and purpose of each run will be recorded.

2.1.1 Proposed Permit Condition

The facility is proposing the following permit condition to ensure compliance with the site-wide emission limitation:

The maximum facility-wide fuel usage shall be limited by the following formulas for each rolling 12-month period:

$$24.9 \text{ tons of NO}_x \geq \sum_{i=1}^n \frac{EF_{NO_x,i,controlled} * Q_i}{2,000 \text{ lb/ton}} + \sum_{i=1}^n \frac{EF_{NO_x,i,uncontrolled} * Q_i}{2,000 \text{ lb/ton}}$$

Where:

i = each emissions unit, CEG1 through CEG72, and HG1 through HG4

*EF_{NO_x,i,controlled} = the NO_x controlled emissions factor for the engine type, in lb/gal, for each controlled emissions unit, i, based on the manufacturer's technical specifications. The pollutant-specific emissions factors for each engine are provided in **Table 2** below.*

*EF_{NO_x,i,uncontrolled} = the NO_x uncontrolled emissions factor for the engine type, in lb/gal, for each emissions unit, i, based on the manufacturer's technical specifications. The pollutant-specific emissions factors for each engine are provided in **Table 2** below.*

Q_i = the number of gallons of ultra-low sulfur diesel (ULSD) fuel used by each emissions unit, i, during the rolling, 365-day period per day of operation.

Table 2. Proposed Worst-Case Emission Rates

Pollutant	Worst-Case Fuel Usage-Based Emission Factors (lb/gal/gen)		
	2,750 kW Engines CAT 3516E with SCR, DOC, and DPF	1,000 kW Engines CAT C32	750 kW Engines CAT C18
NO _x (Uncontrolled)	0.29	0.27	0.27
NO _x (Controlled)	0.02	--	--

3. FACILITY-WIDE EMISSIONS ESTIMATES

Pollutants emitted from the diesel-fired emergency generator engines will include NO_x; CO; VOC; sulfur dioxide (SO₂); PM, including PM less than 10 microns in diameter (PM₁₀) and PM less than 2.5 microns in diameter (PM_{2.5}); hazardous air pollutants (HAPs); and greenhouse gases (GHGs) in the form of carbon dioxide equivalent (CO₂e).

All proposed engines will be fueled by ULSD and/or renewable diesel conforming to ASTM D975 specification for petroleum (including HVO). Refer to **Appendix 8** for additional details. For simplicity and conservative purposes, ADS will conservatively default to the ULSD load-specific emission factors.

The methodology used to estimate the potential emissions from each source is discussed in the sections below. The manufacturer's specification sheets for each generator type and applicable controls are provided in **Appendix 5**, and detailed calculations are provided in **Appendix 6**.

3.1 Diesel-Fired Emergency Generator Engines and Other Engines

Operation of the diesel-fired emergency generator engines will result in emissions of byproducts of combustion. The following emission factors were used to calculate the potential emissions from the generators.

3.1.1 Derivation of Run-time Hours-based Potential Emissions

The following emission factors were used to estimate the potential hourly emissions from the emergency critical generators and house generators:

- Engine-specific emission factors for the emergency generators were provided by the manufacturer for NO_x, VOC (hydrocarbons), CO, and filterable PM or PM_{2.5}/PM₁₀.
 - Emission factors represent potential site variation (i.e., not-to-exceed) emission rates.
 - These emission factors were used to estimate emissions at each engine load.
 - It was conservatively assumed that all particulate matter present in engine exhaust is PM_{2.5}.
 - Control device efficiencies were provided by the manufacturer for the critical generators.
- Diesel fuel emission factors in the USEPA's AP-42, Section 3.4, *Large Stationary Diesel and All Stationary Dual-fuel Engines* (October 1996) were used for emissions of condensable PM, SO₂, and HAPs from the emergency generators.
 - The emissions calculations assumed a diesel high heating value of 0.137 MMBtu/gal, based on AP-42, Table 3.4-1, footnote a.
 - The emission factor for SO₂ was calculated based on the maximum allowable diesel fuel sulfur content of 0.0015% by weight, per 40 CFR 60 Subpart IIII (see **Section 4.3.2** of this report).
- GHG emission factors and global warming potentials provided in 40 CFR 98 were used to estimate emissions of CO₂e from diesel fuel combustion for the emergency generators.

3.1.2 Derivation of Potential Annual Emissions – All Operations

The applicant is requesting a federally enforceable site-wide NO_x limitation of 24.9 tpy on an aggregate, 365-day rolling basis. To demonstrate worst-case emissions for the remaining criteria pollutants, potential emissions were based on the lower of either:

- 1) The maximum ratio of each pound (lb) of pollutant to the corresponding lb of NO_x emissions was evaluated for each engine at each load. The highest lb pollutant to lb of NO_x ratio across

all engines and all loads was used for each pollutant, and the ratio was multiplied by the requested NO_x emission limitation of 24.9 tpy; or,

- 2) The sum of emissions from each individual generator operating at its maximum hourly pollutant emission rate up to 500 hours annually.

Potential Emission values are shown in **Table 3**, with calculation details available in **Appendix 6**.

3.2 Diesel Fuel Tanks

Emissions of VOCs from the diesel belly tanks result from standing and working losses. These emissions were estimated using the equations from AP-42, Section 7.1, *Organic Liquid Storage Tanks* (October 2024). The maximum annual fuel throughput for each belly tank was based on:

- The maximum hourly diesel fuel consumption for each generator, per the manufacturer's specifications; and
- A maximum of 500 hours of operation per engine annually.

Detailed emission calculations for the tanks are available in **Appendix 6**.

3.3 Facility-Wide Potential Emissions

A summary of the potential emissions for the facility are provided in **Table 3** and indicate that the facility will be a synthetic minor source of air emissions due to the requested facility-wide NO_x emission limitation.

Table 3. Facility-Wide Potential Emissions

Pollutant	Potential Annual Emissions (tpy)		Facility-Wide Potential Annual Emissions (tpy)	Title V Major Source Threshold (tpy)	Above Thresholds?
	Generators	Diesel Tanks			
NO _x	24.90	--	24.90	25	No
CO	59.59	--	59.59	100	No
VOC	10.75	0.11	10.86	25	No
Filt. PM	3.80	--	3.80	100	No
PM ₁₀ / PM _{2.5}	5.93	--	5.93	100	No
SO ₂	0.42	--	0.42	100	No
Max. Individual HAP (Benzene)	0.22	--	0.22	10	No
Total HAP	0.38	--	0.38	25	No
CO ₂ e	45,482	--	45,482	--	--

3.4 Planned Maintenance and Readiness Testing

Below is an example of ADS's planned non-emergency operation schedule on a per generator basis. ADS is not requesting a limit on planned maintenance and readiness testing at this time but is providing this information at the request of PADEP. Actual maintenance and readiness testing may vary based on site needs.

Table 4. Planned Non-Emergency Operations Schedule for Site Generators

Type of Engine Operations	All Engines
Readiness Testing	Frequency: Every other week Duration: 6 minutes
6 Month/12 Month Preventative Maintenance	Frequency: Twice per year Duration: 15 mins
Live Load Testing (LLT)	Frequency: Once per year Duration: 30 mins
Load Bank Testing (LBT)	Frequency: Once per year Duration: 60 mins
Stack Testing	Frequency: Every 5 years (See proposed stack testing schedule in Section 5.2.6) Duration: 4 hours
Total Average Expected Non-Emergency Hours	< 10 hours per year

4. FEDERAL AND STATE REGULATORY APPLICABILITY

The following sections outline the federal and state air regulations that are potentially applicable to the facility. Specifically, requirements under the federal New Source Review (NSR) permitting program, Title V of the Clean Air Act Amendments, New Source Performance Standards (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAP), Chemical Accident Prevention Provisions, and Pennsylvania Code Title 25 are discussed herein.

4.1 Federal New Source Review

The federal NSR permitting program regulates emissions from major stationary sources of regulated air pollutants. NSR is comprised of two elements: Nonattainment NSR (NNSR) and Prevention of Significant Deterioration (PSD). NNSR permitting is applicable in areas that have been designated as nonattainment for a regulated pollutant under the National Ambient Air Quality Standards (NAAQS). PSD permitting applies in areas that have been designated as attainment or unclassifiable. The facility is located in Bucks County, which is in marginal non-attainment area for the 2008 8-hour ozone standard and serious non-attainment for the 2015 8-hour ozone standard.¹ Additionally, the entire state of Pennsylvania is in the Ozone Transport Region. As such, NNSR is the applicable permitting program for NO_x and VOC, which are precursors to ozone formation, and PSD is the applicable permitting program for all other criteria pollutants.

The NNSR major source threshold for NO_x and VOC in areas of serious non-attainment for ozone is 50 tpy. However, Pennsylvania has anti-backsliding measures in place which lower the major source threshold in certain areas. Bucks County is subject to these anti-backsliding requirements due to the County's status as severe non-attainment with regard to the revoked 1979 1-hour ozone standard. This makes the major source threshold for NO_x and VOC 25 tpy.² The applicable PSD major source threshold for all other NSR-regulated criteria pollutants is 250 tpy each.³ The facility is requesting a federally enforceable site-wide emission limit of 24.9 tpy NO_x on an aggregate, 365-day rolling basis in order to maintain the site-wide potential emissions below NNSR and PSD major source thresholds. The site's potential emissions will be below the PSD and NNSR major source permitting thresholds for all other criteria pollutants. Therefore, the site will be classified as a synthetic minor source with regard to the NSR program.

4.2 Title V Operating Permits

The Title V Operating Permit program, promulgated in 40 CFR 70, requires a facility to obtain a Title V operating permit if it has potential emissions of a regulated criteria pollutant exceeding the major source thresholds. Major source thresholds in Bucks County include 25 tpy of NO_x, 25 tpy of VOC, 100 tpy for all other criteria pollutants, 10 tpy of any single HAP, or 25 tpy of the aggregate of all HAPs. As presented in **Table 3** of this application and in **Appendix 6**, site-wide potential emission rates for all criteria pollutants and HAPs are below the respective major source thresholds. As discussed previously, the facility will operate under a federally enforceable site-wide emission limitation to remain below the applicable Title V major source thresholds. As such, the site will be classified as a synthetic minor source with respect to the Title V Operating Permits program.

¹ 40 CFR 81.339

² 25 Pa Code §121.1

³ Data centers are not on the list of 28 source categories for which there is a lower major source threshold of 100 tpy for regulated criteria pollutants.

4.3 New Source Performance Standards

New Source Performance Standards (NSPS), promulgated in 40 CFR 60, provide emissions standards for criteria pollutant emissions from new, modified, and reconstructed sources. The following sections discuss the NSPS that are potentially applicable to the proposed facility operations.

4.3.1 40 CFR 60, Subpart A – General Provisions (**Applicable**)

NSPS Subpart A provides generally applicable requirements for testing, monitoring, notifications, and recordkeeping. Any source that is subject to another subpart under 40 CFR 60 is also subject to Subpart A, unless otherwise stated in the specific subpart.

4.3.2 40 CFR 60, Subpart IIII – Stationary Compression Ignition Internal Combustion Engines (**Applicable**)

NSPS Subpart IIII applies to new, modified, and reconstructed compression ignition (CI) internal combustion engines (ICE). New engines are subject to this regulation if construction of the CI ICE commenced after July 11, 2005, and if the engine was manufactured after April 1, 2006, for CI ICE that are not fire pump engines, or July 1, 2006, for CI ICE that are fire pump engines.⁴ This rule is applicable to each of the proposed CI ICE that will be operated at the facility.

4.3.2.1 Emissions Standards for Emergency Generators

All generators at the site will be classified as emergency generators under this regulation and will each have a displacement of less than 30 liters per cylinder. Per 40 CFR 60.4205(a)(2) and 60.4205(b), each generator will be subject to the applicable emissions standards in 40 CFR Part 1039, Appendix I. The Tier 2 emissions standards for nonroad engines are depicted in **Table 5**.⁵ The USEPA Tier rating standards for nonroad engines are based on a weighted cycle and cannot be used for comparison to the actual emissions from the engine.

Table 5. US EPA Tier 2 Emission Standards

Pollutant	Emission Standard kW > 560 (g/kW-hr)
NO _x + Non-Methane Hydrocarbons (NMHC)	6.4
CO	3.5
PM	0.20

Additionally, the facility is required to only combust in its generators fuel that complies with the following requirements in 40 CFR 80.510(b) for nonroad diesel fuel:⁶

- Maximum sulfur content of 15 ppm; and
- Either a minimum cetane index of 40 or a maximum aromatic content of 35 volume percent.

⁴ 40 CFR 60.4200(a)(2)

⁵ 40 CFR 89.112(a), Table 1.

⁶ 40 CFR 60.4207(b)

The applicant will comply with the emission standards in 40 CFR 89.112-113 by purchasing engines certified by the manufacturer to comply with the emission standards.⁷ Further, the site will operate and maintain each engine according to the manufacturer's emission-related written instructions and only change those emission-related settings that are permitted by the manufacturer.⁸

4.3.2.2 *Run Time Restrictions for Emergency ICE*

In order for a stationary engine to be considered an emergency ICE under NSPS Subpart IIII, it must meet the run time restrictions in 40 CFR 60.4211(f).

There is no restriction on usage of an emergency ICE in emergency situations.⁹ Each engine is restricted to a maximum of 100 hours per calendar year of operation for maintenance checks and readiness testing.¹⁰ Each engine is allowed up to 50 hours per calendar year of non-emergency operation other than maintenance, testing, and emergency demand response; however, any non-emergency run time must be counted as part of the 100 hours per calendar year for maintenance and testing.¹¹ Any other operations are prohibited.

The facility will equip each emergency ICE with a non-resettable hour meter prior to startup of the unit in order to verify compliance with the run time restrictions for emergency and non-emergency runs.¹²

4.3.2.3 *Modifications and the Use of an Alternative Fuel Source*

The use of an alternative fuel source shall not be considered a modification, as defined in 40 CFR Part 60.14, if the site is designed to accommodate that alternative use. The proposed Site will install engines that are designed to combust ULSD and/or renewable diesel conforming to ASTM D975 specifications including HVO. Therefore, the use of HVO will not be considered a modification under the NSPS rules.¹³

4.3.2.4 *Notifications, Reporting, and Recordkeeping*

An Initial Notification under NSPS Subpart A is not required for emergency stationary ICE. The facility will retain records of the emergency and non-emergency runs for each engine, as recorded through the engine's non-resettable hour meter. The records will indicate the time of operation of the engine and the reason the engine was in operation during that time.¹⁴

4.3.3 40 CFR 60, Subpart K – Storage Vessels for Petroleum Liquids for Which Construction, Reconstruction, or Modification Commenced After June 11, 1973, and Prior to May 19, 1978 (Not Applicable)

NSPS Subpart K is applicable to petroleum storage tanks which were constructed, reconstructed, or modified between June 1973 and May 1978, and which have a storage capacity greater than 40,000 gallons.¹⁵ The facility will maintain diesel belly tanks for its proposed generators; however, each of these tanks will be new units constructed after 1978. Furthermore, none of the belly tanks will have a storage capacity greater than 40,000 gallons. Therefore, NSPS Subpart K does not apply.

⁷ 40 CFR 60.4211(c)

⁸ 40 CFR 60.4211(a)

⁹ 40 CFR 60.4211(f)(1)

¹⁰ 40 CFR 60.4211(f)(2)

¹¹ 40 CFR 60.4211(f)(3)

¹² 40 CFR 60.4209(a)

¹³ 40 CFR Part 60.14(e)(4)

¹⁴ 40 CFR 60.4214(b)

¹⁵ 40 CFR 60.110

4.3.4 40 CFR 60, Subpart Ka – Storage Vessels for Petroleum Liquids for Which Construction, Reconstruction, or Modification Commenced After May 18, 1978, and Prior to July 23, 1984
(Not Applicable)

Similar to NSPS Subpart K, NSPS Subpart Ka is applicable to petroleum storage tanks which were constructed, reconstructed, or modified between May 1978 and July 1984, and which have a storage capacity greater than 40,000 gallons.¹⁶ The proposed diesel belly tanks will be new units constructed after 1984. Furthermore, none of the belly tanks will have a storage capacity greater than 40,000 gallons. Therefore, NSPS Subpart Ka is also not applicable.

4.3.5 40 CFR 60, Subpart Kb – Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984
(Not Applicable)

NSPS Subpart Kb applies to volatile organic liquid (VOL) storage vessels which were constructed, reconstructed, or modified after July 1984. VOL storage tanks are only subject to this rule if they meet one of the following criteria:¹⁷

- The storage vessel has a maximum storage capacity greater than or equal to 151 m³ (39,890 gallons) and which stores a VOL with a maximum true vapor pressure exceeding 3.5 kPa (0.51 psia); or
- The storage vessel has a maximum storage capacity greater than or equal to 75 m³ (19,812.9 gallons) but less than 151 m³ and which stores a VOL with a maximum true vapor pressure exceeding 15.0 kPa (2.2 psia).

The new diesel belly tanks for the proposed generators each will have a storage capacity less than 19,812.9 gallons. In addition, diesel fuel has a maximum true vapor pressure less than 2.2 psia. Therefore, NSPS Subpart Kb does not apply.

4.3.6 40 CFR 60, Subpart Kc – Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After October 4, 2023
(Not Applicable)

NSPS Subpart Kc applies to VOL storage vessels which were constructed, reconstructed, or modified after October 4, 2023 and which have a storage capacity greater than 20,000 gallons with maximum true vapor pressure greater than or equal to 1.5 pounds per square inch absolute (psia), or greater than 40,000 gallons with maximum true vapor pressure greater than 0.5 psia.¹⁸ The diesel belly tanks for the proposed generators will each have a storage capacity less than 20,000 gallons. The maximum true vapor pressure of diesel is less than 0.5 psia. Therefore, NSPS Subpart Kc does not apply to the belly tanks.

4.3.7 40 CFR 60, Subpart JJJJ – Stationary Spark Ignition Internal Combustion Engines (Not Applicable)
NSPS Subpart JJJJ is applicable to new, modified, and reconstructed stationary spark ignition (SI) ICE. All of the proposed engines will be categorized as CI ICE. As such, NSPS Subpart JJJJ does not apply.

4.4 National Emission Standards for Hazardous Air Pollutants

NESHAPs, promulgated in 40 CFR 63, regulate emissions of HAPs from specific source categories. A facility that has potential emissions exceeding 10 tpy for any individual HAP and/or emissions

¹⁶ 40 CFR 60.110a

¹⁷ 40 CFR 60.110b(b)

¹⁸ <https://www.govinfo.gov/content/pkg/FR-2024-10-15/pdf/2024-22823.pdf>

exceeding 25 tpy for the sum of all HAPs is classified as a major source of HAP emissions. A facility that is not a major source of HAPs is classified as an area source.

The facility will be classified as an area source since it has potential HAP emissions less than the major source thresholds. The following sections discuss the potentially applicable NESHAP standards to the facility.

4.4.1 40 CFR 63, Subpart A – General Provisions (*Applicable*)

NESHAP Subpart A provides generally applicable requirements for testing, monitoring, notifications, and recordkeeping. Any source that is subject to another subpart under 40 CFR 63 is also subject to Subpart A, unless otherwise stated in the specific subpart.

4.4.2 40 CFR 63, Subpart EEEE – Organic Liquids Distribution (Non-Gasoline) (*Not Applicable*)

NESHAP Subpart EEEE is applicable to organic liquids distribution operations, including organic liquid storage tanks, located at major sources of HAP emissions.¹⁹ This regulation does not apply since the facility will be an area source of HAP emissions.

4.4.3 40 CFR 63, Subpart ZZZZ – Stationary Compression Ignition Internal Combustion Engines (*Applicable*)

NESHAP Subpart ZZZZ applies to new and existing stationary reciprocating internal combustion engines (RICE) located at both major and area sources of HAP emissions. Per 40 CFR 63.6590(c), for new or reconstructed stationary RICE located at an area source of HAP emissions, the only requirement under NESHAP Subpart ZZZZ is to meet the requirements of NSPS Subpart IIII for CI ICE and of NSPS Subpart JJJJ for SI ICE. Since all the CI ICE at the facility will be operated in compliance with NSPS Subpart IIII, the units will also be in compliance with NESHAP Subpart ZZZZ. No further requirements apply for these engines under this regulation.

4.5 Chemical Accident Prevention Provisions

The Chemical Accident Prevention Provisions, promulgated in 40 CFR 68, provide requirements for the development of risk management prevention (RMP) plans for regulated substances. Applicability to RMP plan requirements is based on the types and amounts of chemicals stored at a facility. In addition to diesel, diesel exhaust fluid (DEF) will be used as the reducing agent in the SCR system. DEF is comprised of water and urea. Diesel fuel, water, and urea are not on the list of regulated substances in Subpart F of this rule; therefore, the facility is not required to develop an RMP plan under 40 CFR 68.

4.6 Title 25 of the Pennsylvania Code

In addition to the federal regulations, Chapters 123 and 129 of Pennsylvania Code (Pa. Code) Title 25 establishes regulations applicable at the emission unit level and at the facility level. The state regulations also include general requirements for facilities, such as the requirement to obtain construction and operating permits. Source-specific standards in 25 Pa. Code that are potentially applicable to the facility are discussed in the following sections.

4.6.1 25 Pa. Code 123.1 – Prohibition of Fugitive Emissions (*Applicable*)

This regulation prohibits fugitive emissions from sources other than those listed in Section 123.1a. The facility will not cause fugitive emissions from sources other than those listed and will take all reasonably feasible measures to prevent fugitive dust from becoming airborne if the listed activities occur (i.e., during construction).

¹⁹ 40 CFR 63.2330

4.6.2 25 Pa. Code 123.2 – Fugitive Particulate Matter (**Applicable**)

This regulation prohibits fugitive particulate matter emissions from any listed source which are visible past the property line. As stated above, the facility will take all reasonable measures to prevent fugitive dust from becoming airborne.

4.6.3 25 Pa. Code 123.11 – Particulate Matter Emissions from Combustion Units (*Not Applicable*)

This regulation applies to combustion units. Per 24 Pa. Code 123.11, a combustion unit is "A stationary equipment used to burn fuel primarily for the purpose of producing power or heat by indirect heat transfer." The emergency generators proposed by the facility do not operate using indirect heat transfer; as such, they do not meet the definition of combustion units, and this regulation does not apply.

4.6.4 25 Pa. Code 123.13 – Particulate Matter Emissions from Processes (**Applicable**)

This regulation limits particulate matter emissions from a process to either an allowable emission limit in grains per dry standard cubic feet (gr/dscf) determined by Table 1 of this rule, or an allowable emission limit based on the process' effluent gas volume in dscf. Diesel engines are not listed in Table 1 of this rule, and therefore are limited to 0.04 gr/dscf since the effluent gas volume of each type of generator is less than 150,000 dscf. The facility will comply with this limitation by purchasing Tier 2 certified generators and maintaining the generators per the manufacturer specifications.

4.6.5 25 Pa. Code 123.21 – Sulfur Compound Emissions - General (**Applicable**)

Under this regulation, no sulfur dioxide emissions greater than 500 ppm, by volume, on a dry basis is permitted. The facility will comply with this regulation through the exclusive use of ultra-low sulfur diesel fuel (maximum allowable sulfur content of No. 2 fuel oil is 15 ppm) in its generator engines.

4.6.6 25 Pa. Code 123.22 – Sulfur Compound Emissions from Combustion Units (*Not Applicable*)

This regulation limits sulfur compound emissions from combustion units. As stated above, the diesel-fired generator engines will not meet the definition of a combustion unit and therefore Rule 123.22 does not apply.

4.6.7 25 Pa. Code 123.25 – Sulfur Compound Emissions Monitoring Requirements (*Not Applicable*)

This regulation applies to combustion units, certain fossil fuel-fired steam generators, and certain sulfuric acid plants. As the emergency generators do not meet the definition of combustion unit or fossil-fuel fired steam generator and the facility is not a sulfuric acid plant, this regulation does not apply.

4.6.8 25 Pa. Code 123.31 – Odor Emissions Limitations (**Applicable**)

This regulation prohibits malodorous emissions that are detectable outside of the property line. The facility does not anticipate odor emissions but will comply with this regulation by applying odor control techniques should the need arise.

4.6.9 25 Pa. Code 123.41 – Visible Emissions Limitations (**Applicable**)

This regulation requires that visible emissions from all sources are limited to less than 20% for a period or period aggregating more than three minutes in any one hour. The emissions opacity must also be less than 60% at any time. The facility will comply with this limitation through the exclusive use of ultra-low sulfur diesel in its engines, which will result in negligible visible emissions.

4.6.10 25 Pa. Code 123.46 – Visible Emissions Monitoring Requirements (*Not Applicable*)

This regulation applies to certain fossil fuel-fired steam generators and certain catalyst regenerators. The emergency generators do meet the definition of either; as such, this regulation does not apply.

4.6.11 25 Pa. Code 127.12 – Content of Applications (**Applicable**)

Pursuant to 25 Pa. Code 127.12(a)(6), an application for approval shall show that the source will not prevent or adversely affect the attainment or maintenance or ambient air quality standards. The diesel-fired emergency generators will provide backup electricity to the facility in the event of an emergency. It is very costly and inefficient for the facility to operate these generators, as such, their operation is minimized to the extent possible. The generators will only operate as emergency generators as defined in the federal rules under 40 CFR 60, Subpart IIII. Planned maintenance and testing events are typically scheduled for less than 10 hours per year per generator, and many of these events are at low engine load or no engine load (refer to **Table 4**), thereby consuming little fuel with subsequently less emissions than at higher loads. Although the facility is requesting a 24.9 tpy NO_x emission limit in order to be classified as a Title V and NNSR synthetic minor source, actual emissions are expected to be significantly less than requested emissions limit and minimal adverse impact are expected on the air quality in the area.

Ozone Season and Weather Considerations

Ozone is the primary pollutant of concern in Bucks County, but the generators associated with this facility are not likely to impact the NAAQS for ozone. Under normal circumstances, emergency generators operate infrequently and are mainly operated for planned maintenance and testing. Outside of generator maintenance, the engines infrequently operate to provide backup power in the event of an emergency (i.e., in the case of a power grid outage). To determine past frequency of grid-related outages that may have caused the back-up generators to run for emergency power for the proposed facility, ADS contacted Lotus Infrastructure Partners ("Lotus"), who owns/operates the Fairless Power Station, which is on the same substation and transmission lines as the proposed facility. Lotus stated that there have been no instances of any unplanned outages at Emelie substation or the transmission lines that have impacted the plant in the past five (5) years. As a result, ADS expects minimal operation of the emergency generators at the facility.

Regardless of the operating schedule, ADS will take proactive measures to mitigate the impact on ozone in the area. Ozone trends show the highest concentrations of ozone occur during the summer (specifically July) and the lowest concentrations occur during the winter (specifically December). To further mitigate adverse effects on the ozone NAAQS, ADS is proposing that no emergency diesel engine generator will be operated for scheduled maintenance checks and readiness testing, stack testing, or operational training that involves fuel if the forecasted Air Quality Index (AQI) is 100 or higher as published on the EPA AirNow website.²⁰ An AQI of over 100 indicates that the air quality in the area is unhealthy for sensitive groups. In 2023, Philadelphia experienced 14 days with an AQI above 100.²¹

ADS also proposes to track fuel usage and calculate emissions on a daily basis instead of a monthly basis to more closely monitor actual emissions to indicate compliance against the requested NO_x limit of 24.9 tpy. ADS is proposing to track fuel usage (uncontrolled and controlled) and NO_x emissions on a 365-day rolling basis.

The annual weather cycle for the surrounding area is typical for a mid-latitude, continental site with hot summers, cold winters, and transition seasons in between. Freezing temperatures commonly occur between November and March; temperatures above 90°F occur occasionally (approximately 30 days per year). The site experiences precipitation throughout the year with heavier amounts during the summer months. Thunderstorms can occur any time of the year; however, severe thunderstorms

²⁰ The EPA AirNow Interactive Air Quality Map: <https://gispub.epa.gov/airnow/?tab=forecast>

generally occur during the warmer months of March through October. A typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. The typical weather is not expected to cause adverse impact on the air quality in the area.

Publicly Available Documentation

To evaluate comparably sized facilities with expected similar grid conditions and ambient conditions, ADS proposes comparing the potential PNE100 site with three existing facilities in Ohio: CMH50, CMH51, and CMH52 Campuses. Each of those separate facilities operates 94 Tier 2 emergency generators with no added emissions controls. The average actual NO_x emissions over the last 5 years for each facility are less than 10 tpy. This example demonstrates how low actual emissions are from operation of emergency generators. The site discussed in this application will have fewer generators and additional controls that will reduce NO_x emissions of 72 of its 76 generators by 91.7%. Therefore, actual emissions are expected to be low, and there is minimal risk for adverse impact in the local air quality.

The Joint Legislative Audit and Review Commission (JLARC) published Report 598 in December of 2024 that reported on data centers in Virginia to the Governor and General Assembly of Virginia.²² The Virginia Department of Environmental Quality (VDEQ) provided JLARC with air permit data for Virginia data centers to create the report. Chapter 5 of the document reports on the Natural and Historical Resource Impacts including air pollution from the state's approximately 8,000 permitted generators. Based on 2023 data, "the industry's actual emissions were only 7 percent of what permits allowed, with most emissions coming from maintenance and testing." The document also reports, "based on National Emission Inventory data, in Northern Virginia, where most data centers are concentrated, data center emissions make up less than 4 percent of regional nitrogen oxide emissions." Air quality in Northern Virginia has not worsened during the time that the industry has grown, indicating that emissions from the proposed data center has a low risk of worsening air quality in the area.

4.6.12 25 Pa. Code 129.56 – Storage tanks greater than 40,000 gallons capacity containing VOCs (*Not Applicable*)

This regulation sets requirements for storage tanks with a capacity greater than 40,000 gallons which hold VOCs with a vapor pressure greater than 1.5 psia. The diesel belly tanks at the facility will each be less than 40,000 gallons and the diesel contained in the tanks has a vapor pressure of less than 1.5 psia. This regulation is not applicable.

4.6.13 25 Pa. Code 129.56 – Storage tanks less than or equal to 40,000 gallons capacity containing VOCs (*Not Applicable*)

This regulation sets requirements for storage tanks with a capacity between 2,000 gallons and 40,000 gallons containing VOCs with a vapor pressure greater than 1.5 psia. As stated above, diesel has a vapor pressure of less than 1.5 psia. Hence, this regulation does not apply to the facility's proposed diesel belly tanks.

4.6.14 25 Pa. Code 129.91 – Control of major sources of NO_x and VOCs (*Not Applicable*)

Chapter 129.91 through 129.100 describe additional RACT requirements which apply to major sources of NO_x and VOC. Since this facility will employ emission limitations to remain under major source thresholds, these regulations are not applicable.

²² Joint Legislative Audit and Review Commission Report 598: <https://jlarc.virginia.gov/pdfs/reports/Rpt598.pdf>
Federal and State Regulatory Applicability

4.6.15 25 Pa. Code 129.203 – Stationary Internal Combustion Engines (***Applicable***)

Under this regulation, stationary internal combustion engines rated at greater than 1,000 horsepower (hp) located in Bucks, Chester, Delaware, Montgomery, or Philadelphia County are subject to additional NO_x requirements. Under this rule, the facility must calculate their allowable emissions during ozone season (May 1st to September 30th) by multiplying the hours of operation by the allowable NO_x limit, 2.3 grams NO_x per hp-hr. Any additional emissions beyond this limit will require the facility to purchase NO_x allowances to demonstrate compliance. The proposed facility will be located in Bucks County; as such, this regulation is applicable.

5. BEST AVAILABLE TECHNOLOGY

Pursuant to 25 Pa. Code 127.12(a)(5), an application for approval shall show that the emissions from a new source will be the minimum attainable through the use of the best available technology. The following sections outline potential Best Available Technology (BAT) for diesel-fired emergency generators.

5.1 BAT Based on General Permit for Diesel or No. 2 Fuel-fired Internal Combustion Engines

General permit for Diesel or No. 2 Fuel-fired Internal Combustion Engines (i.e., GP-9) outlines BAT requirements for any diesel engine that commenced construction after July 1, 1972.²³ Specifically,

- Total hydrocarbons (THC) shall not exceed 1.0 grams per brake horsepower hour (g/bhp-hr). At full standby load, the proposed generators meet this limitation.
- Emissions of NO_x must be controlled to a minimum of 80% if the generators exceed the hours of operation threshold listed in **Table 6**. The emergency generators are not anticipated to exceed the hours of operation thresholds. In other words, the only applicable requirement will be the federal requirement under NSPS Subpart IIII, which will be addressed by purchasing a certified engine, as described in **Section 4.3.2** above. Additionally, ADS has elected to install SCR control on the critical emergency generators (CEG1 through CEG72), which will control NO_x emissions to 91.7%.

Table 6. Operating Hours Thresholds for NO_x Control

Engine Rating	Actual Annual Operating Hours ¹
>1,000 BHP (CAT 3516E, CAT C32, CAT C18)	500

1. Although Bucks County is in serious ozone nonattainment (2015 standard) and moderate ozone nonattainment (2008 standard), control requirements were only listed for facilities located in moderate (or lower classified) nonattainment and for facilities located in severe nonattainment. The values above represent hours thresholds for facilities located in a severe ozone nonattainment area.

- NO_x emissions shall not exceed 6.9 g/bhp-hr. At full standby load, all the proposed generators meet this limitation. Further, ADS has elected to install SCR control on the critical emergency generators (CEG1 through CEG72), which will reduce NO_x emissions to 0.6 g/bhp-hr at full standby load. **should this be 0.5**
- Emissions of CO must be controlled to a minimum of 90% if the generators exceed the hours of operation threshold listed in **Table 7**. As outlined in **Table 4**, each emergency generator is scheduled to run for less than 10 hours per year for non-emergency maintenance and testing. Any runs above 10 hours per year are likely for emergencies as defined in the federal rules under 40 CFR 60, Subpart IIII. Based on US EPA guidance for estimating emissions from emergency generators, 500 hours of operation per year per generator is a conservative estimate of actual runtime. Emergencies will be case-by-case but are expected to far below 500 hours per year per generator. However, as this potential number exceeds the operating hours threshold of 100 hours per year for engines larger than 2,500 bhp, a full BAT analysis is included in **Section 5.2** below. In summary, ADS has elected to install DOC control on the critical emergency generators (CEG1 through CEG72), which will control CO emissions to 70%.

²³ <https://greenport.pa.gov/elibrary//GetFolder?FolderID=3641>

Table 7. Operating Hours Thresholds for CO Control

Engine Rating	Actual Annual Operating Hours
>2,500 BHP (CAT 3516E)	100
>1,000 BHP and ≤1,500 BHP (CAT C32, CAT C18)	700

GP9 Condition #7(b)(iii)

- CO emissions shall not exceed 2.0 g/bhp-hr. At full standby load, all the proposed generators meet this limitation. Further, ADS has elected to install DOC control on the critical emergency generators (CEG1 through CEG72), which will reduce CO emissions to 0.3 g/bhp-hr at full standby load.
- Sulfur content of fuel shall not exceed 0.3 percent by weight. Pursuant to 40 CFR 60 Subpart IIII, the sulfur content of the fuel combusted by the emergency generators will be limited to 0.0015 percent by weight; also GP9 (7)(b)(v)
- PM emissions shall not exceed 0.4 g/bhp-hr. At full standby load, the proposed generators meet this limitation. Further, ADS has elected to install DPF control on the critical emergency generators (CEG1 through CEG72), which will reduce filterable PM emissions to 0.02 g/bhp-hr at full standby load.
- Visible emissions (VE) shall not exceed 10% for a period or periods aggregating more than three (3) minutes in any one (1) hour and 30% at one time. The generators will meet this requirement during steady state operations; and,
- Odors must be undetectable outside of the property.

The emergency generator engines to be installed at the proposed facility will be certified by the manufacturer to meet the requirements of USEPA's emission standards, in accordance with the requirements of 40 CFR 60 Subpart IIII. Additionally, as mentioned above, a majority of the emergency generators will be equipped with add-on controls to reduce NO_x, CO, VOC, and PM. As such, the emissions from the proposed generators source will meet the best available technology requirements as outlined by GP-9.

5.2 Additional BAT Considerations for Diesel or No. 2 Fuel-fired Internal Combustion Engines

Based on recent discussions with PADEP, ADS understands that NO_x is a pollutant of concern due to the area's ozone nonattainment status. As such, although GP-9 establishes precedent for BAT expectations for diesel-fired internal combustion engines, ADS explored alternative BAT options beyond GP-9 for the proposed facility.

Additionally, the C3516E emergency generators (CEG1 through CEG72) at the proposed site are not capable of being limited below the operating thresholds for CO Control in **Table 7**, so a full BAT analysis is required for CO emissions.

5.2.1 Identify Available Control Technologies

The first step is to identify available control technologies and emission reduction options for the emissions unit and pollutant undergoing the BAT analysis. Available control technologies are those with a practical potential for application to the particular pollutant and emission unit under review, which have been demonstrated in practice on full scale operations and are commercially available. Pollutant emission reduction options can be grouped into two categories:

- Inherently lower-emitting processes, practices, or designs; and

- Add-on control technologies.

In addition, emission reduction options can sometimes be used in combination.

ADS is proposing to install Tier 4-equivalent engines for the critical emergency generators (CEG1 through CEG72) in this project, and based on past discussions with PADEP, ADS is aware that PADEP is primarily interested in the evaluation of engines that meet the Tier 4 standards. Therefore, this BAT analysis will only focus on Tier 4 engines. Potentially available NO_x control technologies include:

- Tier 4 equivalent engines (Tier 2 engine with add-on SCR/DOC/DPF); and
- Tier 4 certified engines.

ADS is not proposing to limit the operating hours of the C3516E emergency generators (CEG1 through CEG72) to 100 hours per year. Therefore, they will be subject to CO BAT requirements. The analysis is based on the RACT/BACT/LAER Clearinghouse (RBLC) database located on USEPA's Technology Transfer Network in the USEPA electronic bulletin board system, vendor data, and professional engineering judgement and experience. **Table 8** below provides a summary of the results of the RBLC database search for BACT-PSD. An expanded table with the results of the search is included in **Appendix 7**.

Table 8: Summary of RBLC Review for Diesel-Fired Internal Combustion Engines > 500 hp

Pollutant	Range of Emissions Limits from RBLC		Possible Control Devices / Work Practices
	Limit	Units	
CO	0.15 – 2.61	g/hp-hr	• Catalytic Oxidation; and • Good Combustion Practices
	1.21 – 4.38	g/kW-hr	
	0.51 – 28.8	lb/hr	
	0.006	lb/hp-hr	

Potentially available CO control technologies include:

- Catalytic Oxidation/Diesel Oxidation Catalyst; and
- Good combustion practices.

5.2.2 Eliminate Technically Infeasible Options

The second step is to evaluate the technical feasibility of the control options identified and to eliminate any options that are technically infeasible based on engineering evaluation or due to chemical or physical principles. Criteria such as the following may be considered in determining technical feasibility: previous commercial-scale demonstrations, precedents based on previous permits, and technology transfer from similar emission units.

If any of the control techniques cannot be successfully used on the emission units due to technical difficulties, this finding should be documented, and such control techniques are not considered further in this BAT analysis.

Catalytic Oxidation

A catalytic oxidizer uses a metal-enriched catalyst to oxidize CO to CO₂ and H₂O. For diesel-fired internal combustion engines, the specific catalytic oxidation device is a diesel oxidation catalyst. DOCs are exhaust aftertreatment devices that reduce emissions of CO, VOC, and PM. This analysis focuses on CO emissions control. The control device performs best when the engine combusts ULSD exclusively, which complies with the requirements of 40 CFR 60 Subpart IIII. The CO destruction efficiency is dependent upon factors such as CO composition and concentration, operating temperature, oxygen concentration, catalyst characteristics, and space velocity. DOC is available for purchase through multiple vendors of which ADS has identified three (CAT, MiraTech, and Safety Power). The DOCs available from these vendors can control emissions of CO at an efficiency between 70-80%. This level of control is consistent with Tier 4 equivalent engine standards.

Tier 4 equivalent engines are engines equipped with SCR, DOC, and DPF, similar to Tier 4 certified engines. Both Tier 4 certified and Tier 4 equivalent engines result in the same level of emissions post control. However, Tier 4 engines are certified by the manufacturer with the US EPA and are guaranteed to meet the emissions standards. As part of the certification process, a shutdown interlock system is incorporated into the engines to ensure that the engines will only operate if the emission control devices are properly operating. While this feature ensures operation of emission controls, it makes these engines unsuitable for emergency purposes at mission critical facilities. Emergency engines are needed at the proposed data center in order to provide electricity to the facility in the event of an emergency. The main purpose of the engines is to provide certainty that the flow of electricity to the facility will not be interrupted and as such, adding an interlock will not meet the permittee's availability standards. Further, there are currently no suppliers that the permittee is aware of who can supply Tier 4 certified engines at scale which meet the internal reliability and engineering standards required to supply power to their critical infrastructure.

The add-on controls that the facility has proposed for the critical generators will comply with Tier 4 emission standards. However, these engines will provide the needed certainty that the facility will remain operational in the event of an emergency. Note that it is statistically improbable that all three control devices malfunction during an emergency. If these engines were Tier 4 certified engines and any single component of the aftertreatment system was malfunctioning, the entire engine would not operate. Regardless, ADS regularly tests and maintains the emission control devices in accordance with manufacturer's written instructions to ensure that they are operational. ADS will be measuring and recording the temperature of the SCR catalyst bed at least once every 15 minutes during operation and will monitor NO_x emissions in parts per million (ppm) exiting the stack to indicate that emissions are being controlled effectively. The NO_x monitor is not a continuous emissions monitoring system (CEMS), nor is it calibrated to accurately measure emissions of NO_x for emissions tracking purposes. Its purpose is to provide an additional measure to ensure the SCR is operating properly and emissions are being controlled effectively. The generators equipped with SCR are also equipped with SCR preheaters to minimize start-up emissions of controlled pollutants by heating up the catalyst bed to its effective temperature prior to planned start-up.

5.2.3 Rank Remaining Control Technologies

Neither option to control CO emissions was eliminated during the feasibility analysis. DOC ranks above Good Combustion Practices because the available DOC vendors can achieve a CO control efficiency of 70-80% and Good Combustion Practices does not. ADS has chosen to install controls to meet Tier 4 equivalent standards for their engines.

5.2.4 Evaluate Energy, Environmental, and Economic Impacts and Other Costs

SCR, DOC, and DPF are the most effective control technology for minimizing emissions of NO_x, CO, VOC, and PM from diesel-fired internal combustion engines. As such, ADS has selected to install these control devices for its C3516E emergency generators (CEG1 through CEG72).

5.2.5 Select BAT

ADS will utilize an SCR/DOC/DPF control system on the Tier 2 certified critical engines. With the addition of these controls, the critical engines will comply with Tier 4 exhaust emission standards during normal operation.

ADS has not yet selected a vendor for the control systems. To be conservative, the lowest control efficiency of each pollutant between the three vendors is used for emissions calculations. That is a control efficiency of 91.7% for NO_x, 70% for CO, 40% for VOC, and 68.6% for PM.

5.2.6 Proposed Compliance Demonstration

The emergency generator engines to be installed at the proposed facility will be certified by the manufacturer to meet the requirements of USEPA's Tier 2 emission standards, in accordance with the requirements of 40 CFR 60 Subpart IIII. The primary pollutants of concern from these generators are NO_x and CO, as indicated by the potential emissions of the generators. For the critical emergency generators, ADS proposes to obtain Tier 2 certified engines, install add-on SCR/DOC/DPF controls, and operate the emergency generators in accordance with good engine design to satisfy the requirements of BAT. For the smaller emergency generators, ADS proposes to obtain Tier 2 certified engines and operate the facility's emergency generators in accordance with good engine design to satisfy the requirements of BAT.

ADS is proposing NO_x emission limits of 4.44 lb/hr for the CAT 3516E engines, 19.52 lb/hr for the CAT C32 engines, and 14.34 lb/hr for the CAT C18 engines. ADS is proposing a CO emission limit of 3.10 lb/hr for the CAT 3516E engines, 2.78 lb/hr for the CAT C32 engines, 4.73 lb/hr for the CAT C18 engines. Compliance with the proposed emission limits will be demonstrated through stack testing using USEPA Method 7 or 7E for NO_x, USEPA Method 10 for CO, and Conditional Test Method 027 for Ammonia slip. ADS is proposing initial stack testing for NO_x and CO for 20% of the total number of generators for each generator model. Following initial stack testing, ADS is proposing annual stack testing on 20% of emergency generators. Testing shall occur on a rotating basis such that different engines are tested during each rotation prior to any engine being retested. As discussed in **Section 4.6.11.1**, engines will not be tested during days with AQI above 100 without prior approval from PADEP.

APPENDIX 1
FACILITY LOCATION & LAYOUT MAPS



0 1,500 3,000 Feet

SITE LOCATION

FIGURE 01

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

PNE100 DATA CENTER
600 BEN FAIRLESS DRIVE
FALLS TOWNSHIP, BUCKS COUNTY, PA

RAMBOLL



- 2,750 kW Critical Engines
- 1,000 kW House Engines
- 750 kW House Engines

FACILITY LAYOUT

PNE100 DATA CENTER
600 BEN FAIRLESS DRIVE
FALLS TOWNSHIP, BUCKS COUNTY, PA

FIGURE 02

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY



APPENDIX 2
AIR PERMIT APPLICATION FORMS



GENERAL INFORMATION FORM – AUTHORIZATION APPLICATION

Before completing this General Information Form (GIF), read the step-by-step instructions provided in this application package. This form is used by the Department of Environmental Protection (DEP) to inform our programs regarding what other DEP permits or authorizations may be needed for the proposed project or activity. This version of the General Information Form (GIF) must be completed and returned with any program-specific application being submitted to the DEP.

Related ID#s (If Known)		DEP USE ONLY
Client ID# _____	APS ID# _____	Date Received & General Notes
Site ID# _____	Auth ID# _____	
Facility ID# _____		

CLIENT INFORMATION

DEP Client ID# _____	Client Type/Code NPACO	Dun & Bradstreet ID# _____
Legal Organization Name or Registered Fictitious Name Amazon Data Services, Inc.		Employer ID# (EIN) _____ Is the EIN a SSN? ☐ Yes ☐ No
State of Incorporation or Registration of Fictitious Name Washington	☒ Corporation ☐ LLC ☐ Partnership ☐ LLP ☐ LP ☐ Sole Proprietorship ☐ Association/Organization ☐ Estate/Trust ☐ Other	
Individual Last Name	First Name	MI Suffix
Additional Individual Last Name	First Name	MI Suffix
Mailing Address Line 1 13200 Woodland Park Road		Mailing Address Line 2
Address Last Line – City Herndon	State VA	ZIP+4 20171
Country USA		
Client Contact Last Name Truedinger	First Name Robb	MI Suffix
Client Contact Title Authorized Representative	Phone (724) 674-4033 c/o Andrew Cangey	Ext Cell Phone
Email Address cangeyac@amazon.com c/o Andrew Cangey	FAX	

SITE INFORMATION

DEP Site ID# TBD	Site Name PNE100
EPA ID# TBD	Estimated Number of Employees to be Present at Site Approximately 90
Description of Site Data center campus	
Tax Parcel ID(s): 13-051-001-034	
County Name(s) Bucks County	Municipality(ies) Falls Township
City	Boro
Twp	State
	PA

	☐	☐	☐	
Site Location Line 1	Site Location Line 2			
600 Ben Fairless Drive				
Site Location Last Line – City	State	ZIP+4		
Fairless Hills	PA	19030-5024		
Detailed Written Directions to Site				
Head south on S Pennsylvania Ave towards Old Bordentown Rd. Turn left onto Ben Fairless Drive. Destination will be on the right				
Site Contact Last Name	First Name	MI	Suffix	
Cangey	Andrew			
Site Contact Title		Site Contact Firm		
Senior Air Permitting Engineer		Amazon Data Services, Inc.		
Mailing Address Line 1		Mailing Address Line 2		
13200 Woodland Park Road				
Mailing Address Last Line – City		State	ZIP+4	
Herndon		VA	20171	
Phone	Ext	FAX	Email Address	
(724) 674-4033			cangeyac@amazon.com	
NAICS Codes (Two- & Three-Digit Codes – List All That Apply)			6-Digit Code (Optional)	
51			518210	
Client to Site Relationship				
OWNOP				

FACILITY INFORMATION

Modification of Existing Facility		Yes	No
1.	Will this project modify an existing facility, system, or activity?	☐	☒
2.	Will this project involve an addition to an existing facility, system, or activity?	☐	☒
<i>If "Yes", check all relevant facility types and provide DEP facility identification numbers below.</i>			
Facility Type	DEP Fac ID#	Facility Type	DEP Fac ID#
☐ Air Emission Plant		☐ Industrial Minerals Mining Operation	
☐ Beneficial Use (water)		☐ Laboratory Location	
☐ Blasting Operation		☐ Land Recycling Cleanup Location	
☐ Captive Hazardous Waste Operation		☐ Mine Drainage Treatment / Land Recycling Project Location	
☐ Coal Ash Beneficial Use Operation		☐ Municipal Waste Operation	
☐ Coal Mining Operation		☐ Oil & Gas Encroachment Location	
☐ Coal Pillar Location		☐ Oil & Gas Location	
☐ Commercial Hazardous Waste Operation		☐ Oil & Gas Water Poll Control Facility	
☐ Dam Location		☐ Public Water Supply System	
☐ Deep Mine Safety Operation -Anthracite		☐ Radiation Facility	
☐ Deep Mine Safety Operation -Bituminous		☐ Residual Waste Operation	
☐ Deep Mine Safety Operation -Ind Minerals		☐ Storage Tank Location	
☐ Encroachment Location (water, wetland)		☐ Water Pollution Control Facility	
☐ Erosion & Sediment Control Facility		☐ Water Resource	
☐ Explosive Storage Location		☐ Other:	

Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
	40	9	19.90	-74	44	57.45
Horizontal Accuracy Measure	Feet			--or-- Meters		
Horizontal Reference Datum Code	☐ North American Datum of 1927 ☒ North American Datum of 1983 ☐ World Geodetic System of 1984					
Horizontal Collection Method Code	NTDEP					
Reference Point Code	CNTAR					
Altitude	Feet 20			--or-- Meters		
Altitude Datum Name	☐ The National Geodetic Vertical Datum of 1929 ☒ The North American Vertical Datum of 1988 (NAVD88)					
Altitude (Vertical) Location Datum Collection Method Code	UNK					
Geometric Type Code	POINT					
Data Collection Date	10/22/2024					
Source Map Scale Number	Inch(es)			=	Feet	
	--or--			=	Centimeter(s) Meters	

PROJECT INFORMATION

Project Name	PNE100		
Project Description	Data center facility containing emergency diesel-fired generator engines		
Project Consultant Last Name	First Name	MI	Suffix
Bencosme	Kaitlyn		
Project Consultant Title	Consulting Firm		
Senior Managing Consultant	Ramboll		
Mailing Address Line 1	Mailing Address Line 2		
4245 North Fairfax Drive	Suite 700		
Address Last Line – City	State	ZIP+4	
Arlington	VA	22203-1619	
Phone	Ext	FAX	Email Address
912-656-6256			kbencosme@ramboll.com
Time Schedules	Project Milestone (Optional)		

1. Is the project located in or within a 0.5-mile ☐ Yes ☒ No
radius of an Environmental Justice community as defined by DEP?

To determine if the project is located in or within a 0.5-mile radius of an environmental justice community, please use [the online PennEnviroScreen tool](#). To see specific EJ areas, select the appropriate year of your submittal from the themes box on the right.

2. Have you informed the surrounding community ☐ Yes ☒ No
prior to submitting the application to the Department?

Method of notification:

3. Have you addressed community concerns ☐ Yes ☐ No ☒ N/A
that were identified?

If no, please briefly describe the community concerns that have been expressed and not addressed.

4. Is your project funded by state or federal ☐ Yes ☒ No
grants?

Note: If "Yes", specify what aspect of the project is related to the grant and provide the grant source, contact person and grant expiration date.

Aspect of Project Related to Grant

Grant Source: _____

Grant Contact Person: _____

Grant Expiration Date: _____

5. Is this application for an authorization on ☒ Yes ☐ No
Appendix A of the Land Use Policy? (For
referenced list, see Appendix A of the Land
Use Policy attached to GIF instructions)

Note: If "No" to Question 5, the application is not subject to the Land Use Policy.

If "Yes" to Question 5, the application is subject to this policy and the Applicant should answer the additional questions in the **Land Use Information** section.

LAND USE INFORMATION

Note: Applicants should submit copies of local land use approvals or other evidence of compliance with local comprehensive plans and zoning ordinances.

- | | | | | |
|--|-------------------------------------|-----|--------------------------|----|
| 1. Is there an adopted county or multi-county comprehensive plan? | ☒ | Yes | ☐ | No |
| 2. Is there a county stormwater management plan? | ☒ | Yes | ☐ | No |
| 3. Is there an adopted municipal or multi-municipal comprehensive plan? | ☒ | Yes | ☐ | No |
| 4. Is there an adopted county-wide zoning ordinance, municipal zoning ordinance or joint municipal zoning ordinance? | ☒ | Yes | ☐ | No |
| Note: If the Applicant answers "No" to either Questions 1, 3 or 4, the provisions of the PA MPC are not applicable and the Applicant does not need to respond to questions 5 and 6 below.
If the Applicant answers "Yes" to questions 1, 3 and 4, the Applicant should respond to questions 5 and 6 below. | | | | |
| 5. Does the proposed project meet the provisions of the zoning ordinance or does the proposed project have zoning approval? If zoning approval has been received, attach documentation. | ☒ | Yes | ☐ | No |
| 6. Have you attached Municipal and County Land Use Letters for the project? | ☒ | Yes | ☐ | No |

COORDINATION INFORMATION

Note: The PA Historical and Museum Commission must be notified of proposed projects in accordance with DEP Technical Guidance Document 012-0700-001 [at PHMC's online portal, PA-SHARE](#).

If the activity will be a mining project (i.e., mining of coal or industrial minerals, coal refuse disposal and/or the operation of a coal or industrial minerals preparation/processing facility), respond to questions 1.0 through 2.5 below.

If the activity will not be a mining project, skip questions 1.0 through 2.5 and begin with question 3.0.

1.0	Is this a coal mining project? If "Yes", respond to 1.1-1.6. If "No", skip to Question 2.0.	☐	Yes	☒	No
1.1	Will this coal mining project involve coal preparation/processing activities in which the total amount of coal prepared/processed will be equal to or greater than 200 tons/day?	☐	Yes	☐	No
1.2	Will this coal mining project involve coal preparation/processing activities in which the total amount of coal prepared/processed will be greater than 50,000 tons/year?	☐	Yes	☐	No
1.3	Will this coal mining project involve coal preparation/processing activities in which thermal coal dryers or pneumatic coal cleaners will be used?	☐	Yes	☐	No
1.4	For this coal mining project, will sewage treatment facilities be constructed and treated waste water discharged to surface waters?	☐	Yes	☐	No
1.5	Will this coal mining project involve the construction of a permanent impoundment meeting one or more of the following criteria: (1) a contributory drainage area exceeding 100 acres; (2) a depth of water measured by the upstream toe of the dam at maximum storage elevation exceeding 15 feet; (3) an impounding capacity at maximum storage elevation exceeding 50 acre-feet?	☐	Yes	☐	No
1.6	Will this coal mining project involve underground coal mining to be conducted within 500 feet of an oil or gas well?	☐	Yes	☐	No
2.0	Is this a non-coal (industrial minerals) mining project? If "Yes", respond to 2.1-2.6. If "No", skip to Question 3.0.	☐	Yes	☒	No
2.1	Will this non-coal (industrial minerals) mining project involve the crushing and screening of non-coal minerals other than sand and gravel?	☐	Yes	☐	No
2.2	Will this non-coal (industrial minerals) mining project involve the crushing and/or screening of sand and gravel with the exception of wet sand and gravel operations (screening only) and dry sand and gravel operations with a capacity of less than 150 tons/hour of unconsolidated materials?	☐	Yes	☐	No
2.3	Will this non-coal (industrial minerals) mining project involve the construction, operation and/or modification of a portable non-metallic (i.e., non-coal) minerals processing plant under the authority of the General Permit for Portable Non-metallic Mineral Processing Plants (i.e., BAQ-PGPA/GP-3)?	☐	Yes	☐	No
2.4	For this non-coal (industrial minerals) mining project, will sewage treatment facilities be constructed and treated waste water discharged to surface waters?	☐	Yes	☐	No

2.5	Will this non-coal (industrial minerals) mining project involve the construction of a permanent impoundment meeting one or more of the following criteria: (1) a contributory drainage area exceeding 100 acres; (2) a depth of water measured by the upstream toe of the dam at maximum storage elevation exceeding 15 feet; (3) an impounding capacity at maximum storage elevation exceeding 50 acre-feet?	☐	Yes	☐	No
3.0	Will your project, activity, or authorization have anything to do with a well related to oil or gas production, have construction within 200 feet of, affect an oil or gas well, involve the waste from such a well, or string power lines above an oil or gas well? If "Yes", respond to 3.1-3.3. If "No", skip to Question 4.0.	☐	Yes	☒	No
3.1	Does the oil- or gas-related project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a watercourse, floodway or body of water (including wetlands)?	☐	Yes	☐	No
3.2	Will the oil- or gas-related project involve discharge of industrial wastewater or stormwater to a dry swale, surface water, ground water or an existing sanitary sewer system or storm water system? If "Yes", discuss in <i>Project Description</i> .	☐	Yes	☐	No
3.3	Will the oil- or gas-related project involve the construction and operation of industrial waste treatment facilities?	☐	Yes	☐	No
4.0	Will the project involve a construction activity that results in earth disturbance? If "Yes", specify the total disturbed acreage.	☒	Yes	☐	No
4.0.1	Total Disturbed Acreage 59.45				
4.0.2	Will the project discharge or drain to a special protection water (EV or HQ) or an EV wetland?	☐	Yes	☒	No
4.0.3	Will the project involve a construction activity that results in earth disturbance in the area of the earth disturbance that are contaminated at levels exceeding residential or non-residential medium-specific concentrations (MSCs) in 25 Pa. Code Chapter 250 at residential or non-residential construction sites, respectively?	☐	Yes	☒	No
5.0	Does the project involve any of the following: water obstruction and/or encroachment, wetland impacts, or floodplain project by the Commonwealth/political subdivision or public utility? If "Yes", respond to 5.1-5.7. If "No", skip to Question 6.0.	☐	Yes	☒	No
5.1	Water Obstruction and Encroachment Projects – Does the project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a watercourse, floodway or body of water?	☐	Yes	☐	No
5.2	Wetland Impacts – Does the project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a wetland?	☐	Yes	☐	No

5.3	Floodplain Projects by the Commonwealth, a Political Subdivision of the Commonwealth or a Public Utility – Does the project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a floodplain?	☐	Yes	☐	No
5.4	Is your project an interstate transmission natural gas pipeline?	☐	Yes	☐	No
5.5	Does your project consist of linear construction activities which result in earth disturbance in two or more DEP regions AND three or more counties?	☐	Yes	☐	No
5.6	Does your project utilize Floodplain Restoration as a best management practice for Post Construction Stormwater Management?	☐	Yes	☐	No
5.7	Does your project utilize Class V Gravity / Injection Wells as a best management practice for Post Construction Stormwater Management?	☐	Yes	☐	No
6.0	Will the project involve discharge of construction related stormwater to a dry swale, surface water, ground water or separate storm water system?	☒	Yes	☐	No
6.1	Will the project involve discharge of industrial waste stormwater or wastewater from an industrial activity or sewage to a dry swale, surface water, ground water or an existing sanitary sewer system or separate storm water system?	☐	Yes	☒	No
7.0	Will the project involve the construction and operation of industrial waste treatment facilities?	☒	Yes	☐	No
8.0	Will the project involve construction of sewage treatment facilities, sanitary sewers, or sewage pumping stations? If “Yes”, indicate estimated proposed flow (gal/day). Also, discuss the sanitary sewer pipe sizes and the number of pumping stations/treatment facilities/name of downstream sewage facilities in the <i>Project Description</i>, where applicable.	☒	Yes	☐	No
	8.0.1 Estimated Proposed Flow (gal/day) 5,400				
9.0	Will the project involve the subdivision of land, or the generation of 800 gpd or more of sewage on an existing parcel of land or the generation of an additional 400 gpd of sewage on an already-developed parcel, or the generation of 800 gpd or more of industrial wastewater that would be discharged to an existing sanitary sewer system?	☒	Yes	☐	No
9.0.1	Was Act 537 sewage facilities planning submitted and approved by DEP? If “Yes” attach the approval letter. Approval required prior to 105/NPDES approval.	☒	Yes	☐	No
10.0	Is this project for the beneficial use of biosolids for land application within Pennsylvania? If “Yes” indicate how much (i.e. gallons or dry tons per year).	☐	Yes	☒	No
10.0.1	Gallons Per Year (residential septage)				
10.0.2	Dry Tons Per Year (biosolids)				

11.0	Does the project involve construction, modification or removal of a dam? If "Yes", identify the dam.	☐ Yes	☒ No
11.0.1	Dam Name		
12.0	Will the project interfere with the flow from, or otherwise impact, a dam? If "Yes", identify the dam.	☐ Yes	☒ No
12.0.1	Dam Name		
13.0	Will the project involve operations (excluding during the construction period) that produce air emissions (i.e., NOX, VOC, etc.)?	☒ Yes	☐ No
13.0.1	If "Yes", is the operation subject to the agricultural exemption in 35 P.S. § 4004.1?	☐ Yes	☒ No
13.0.2	If the answer to 13.0.1 is "No", identify each type of emission followed by the estimated amount of that emission. Enter all types & amounts of emissions; separate each set with semicolons. NO _x 24.90; CO 59.59; VOC 10.86; PM/PM ₁₀ /PM _{2.5} 5.93; SO ₂ 0.42; Benzene 0.22; Total HAPs 0.38; CO ₂ e 45,482		
14.0	Does the project include the construction or modification of a drinking water supply to serve 15 or more connections or 25 or more people, at least 60 days out of the year? If "Yes," check all proposed sub-facilities.	☐ Yes	☒ No
14.0.1	Number of Persons Served		
14.0.2	Number of Employee/Guests		
14.0.3	Number of Connections		
14.0.4	Sub-Fac: Distribution System	☐ Yes	☐ No
14.0.5	Sub-Fac: Water Treatment Plant	☐ Yes	☐ No
14.0.6	Sub-Fac: Source	☐ Yes	☐ No
14.0.7	Sub-Fac: Pump Station	☐ Yes	☐ No
14.0.8	Sub-Fac: Transmission Main	☐ Yes	☐ No
14.0.9	Sub-Fac: Storage Facility	☐ Yes	☐ No
15.0	Will your project include infiltration of storm water or waste water to ground water within one-half mile of a public water supply well, spring or infiltration gallery?	☐ Yes	☒ No
16.0	Is your project to be served by an existing public water supply? If "Yes", indicate name of supplier and attach letter from supplier stating that it will serve the project.	☒ Yes	☐ No
16.0.1	Supplier's Name <u>Morrisville Municipal Authority</u>		
16.0.2	Letter of Approval from Supplier is Attached	☒ Yes	☐ No
17.0	Will this project be served by on-lot drinking water wells?	☐ Yes	☒ No
18.0	Will this project involve a new or increased drinking water withdrawal from a river, stream, spring, lake, well or other water bod(ies)? If "Yes," reference Safe Drinking Water Program.	☐ Yes	☒ No
18.0.1	Source Name		

19.0	Will the construction or operation of this project involve treatment, storage, reuse, or disposal of waste? If "Yes," indicate what type (i.e., hazardous, municipal (including infectious & chemotherapeutic), residual) and the amount to be treated, stored, re-used or disposed.	☒ Yes ☐ No
19.0.1	Type & Amount	During construction, construction related building material waste may be generated & appropriately disposed. During operations, general trash will be generated, and incidental amounts of residual waste tangential to normal warehouse operations may be generated & appropriately disposed.
20.0	Will your project involve the removal of coal, minerals, contaminated media, or solid waste as part of any earth disturbance activities?	☐ Yes ☒ No
21.0	Does your project involve installation of a field constructed underground storage tank? If "Yes," list each Substance & its Capacity. Note: Applicant may need a Storage Tank Site Specific Installation Permit.	☐ Yes ☒ No
21.0.1	Enter all substances & capacity of each; separate each set with semicolons.	
22.0	Does your project involve installation of an aboveground storage tank greater than 21,000 gallons capacity at an existing facility? If "Yes," list each Substance & its Capacity. Note: Applicant may need a Storage Tank Site Specific Installation Permit.	☐ Yes ☒ No
22.0.1	Enter all substances & capacity of each; separate each set with semicolons.	
23.0	Does your project involve installation of a tank greater than 1,100 gallons which will contain a highly hazardous substance as defined in DEP's Regulated Substances List, 2570-BK-DEP2724? If "Yes," list each Substance & its Capacity. Note: Applicant may need a Storage Tank Site Specific Installation Permit.	☐ Yes ☒ No
23.0.1	Enter all substances & capacity of each; separate each set with semicolons.	
24.0	Does your project involve installation of a storage tank at a new facility with a total AST capacity greater than 21,000 gallons? If "Yes", list each Substance & its Capacity. Note: Applicant may need a Storage Tank Site Specific Installation Permit.	☒ Yes ☐ No
24.0.1	Enter all substances & capacity of each; separate each set with semicolons.	All ASTs are belly tanks that contain diesel . 74 x 6,300 gal tanks; 2 x 1,367 gal tanks
NOTE: If the project includes the installation of a regulated storage tank system, including diesel emergency generator systems, the project may require the use of a Department Certified Tank Handler. For a full list of regulated storage tanks and substances, please go to www.dep.pa.gov search term storage tanks		
25.0	Will the intended activity involve the use of a radiation source?	☐ Yes ☒ No

4700-PM-CEE0001 10/2023
Application

CERTIFICATION

I certify that I have the authority to submit this application on behalf of the applicant named herein and that the information provided in this application is true and correct to the best of my knowledge and information.

For applicants supplying an EIN number: I am applying for a permit or authorization from the Pennsylvania Department of Environmental Protection (DEP. As part of this application, I will provide DEP with an accurate EIN number for the applicant entity. By filing this application with DEP, I hereby authorize DEP to confirm the accuracy of the EIN number provided with the Pennsylvania Department of Revenue. As applicant, I further consent to the Department of Revenue discussing the same with DEP prior to issuance of the Commonwealth permit or authorization.

Type or Print Name	Robb Truedinger	Authorized Representative	April 30, 2025
Signature		Title	Date

Signed by:
Robb Truedinger

1. PROJECT INFORMATION

Project Name: **North Point Keystone Trade Center Phase 2**

Date of Review: **2/2/2022 08:35:51 AM**

Project Category: **Development, Other**

Project Area: **331.89 acres**

County(s): **Bucks**

Township/Municipality(s): **FALLS TOWNSHIP**

ZIP Code:

Quadrangle Name(s): **TRENTON WEST**

Watersheds HUC 8: **Crosswicks-Neshaminy**

Watersheds HUC 12: **Van Sciver Lake-Delaware River**

Decimal Degrees: **40.158266, -74.752461**

Degrees Minutes Seconds: **40° 9' 29.7573" N, 74° 45' 8.8578" W**

2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	No Known Impact	No Further Review Required
PA Department of Conservation and Natural Resources	Potential Impact	FURTHER REVIEW IS REQUIRED, See Agency Response
PA Fish and Boat Commission	Potential Impact	FURTHER REVIEW IS REQUIRED, See Agency Response
U.S. Fish and Wildlife Service	No Known Impact	No Further Review Required

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate there may be potential impacts to threatened and endangered and/or special concern species and resources within the project area. If the response above indicates "No Further Review Required" no additional communication with the respective agency is required. If the response is "Further Review Required" or "See Agency Response," refer to the appropriate agency comments below. Please see the DEP Information Section of this receipt if a PA Department of Environmental Protection Permit is required.



Pennsylvania State Historic Preservation Office

PENNSYLVANIA HISTORICAL AND MUSEUM COMMISSION

September 28, 2021

Timothy Casey
Gilmore & Associates, Inc.
65 E. Butler Ave, Suite 100
New Britain PA 189015106

RE: ER Project # 2021PR06143.001, NorthPoint-Phase 2 Redevelopment, Department of Environmental Protection, Falls Township, Bucks County

Dear Timothy Casey:

Thank you for submitting information concerning the above referenced project. The Pennsylvania State Historic Preservation Office (PA SHPO) reviews projects in accordance with state and federal laws. Section 106 of the National Historic Preservation Act of 1966, and the implementing regulations (36 CFR Part 800) of the Advisory Council on Historic Preservation, is the primary federal legislation. The Environmental Rights amendment, Article 1, Section 27 of the Pennsylvania Constitution and the Pennsylvania History Code, 37 Pa. Cons. Stat. Section 500 et seq. (1988) is the primary state legislation. These laws include consideration of the project's potential effects on both historic and archaeological resources.

Above Ground Resources

No Above Ground Concerns - Environmental Review - No Historic Properties - Above Ground

Thank you for submitting information concerning the above-referenced project. Based on the information received and available in our files, it is our opinion that there are no above ground historic properties (resources listed in or eligible for listing in the National Register) present in the project area of potential effect. Therefore, no above ground historic properties will be affected by the project as proposed. Should the scope of the project change and/or new information be brought to your attention regarding historic properties located within the project area of potential effect, please notify the PA SHPO at pashare@pa.gov for reconsideration of the project.

For questions concerning above ground resources, please contact Emma Diehl at emdiehl@pa.gov.

Archaeological Resources

No Archaeological Concerns - Environmental Review - No Effect - Archaeological

Thank you for submitting information concerning the above-referenced project. Based on the information received and available in our files, in our opinion, the activity described in your proposal should have no effect on archaeological resources. Our analysis indicates

that archaeological resources are potentially located in this project area. Should the scope of the project be amended to include additional ground disturbing activity and/or should you be made aware of historic property concerns, you will need to notify the PA SHPO at pashare@pa.gov. A Phase I Archaeological Survey may be necessary to locate all potentially significant archaeological resources.

For questions concerning archaeological resources, please contact Casey Hanson at chanson@pa.gov.

Sincerely,

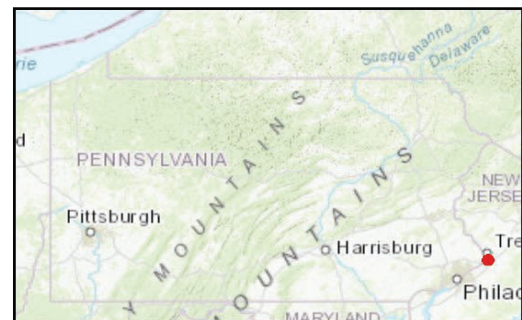
A handwritten signature in blue ink, appearing to read "Andrea MacDonald".

Andrea MacDonald
Director, State Historic Preservation Office

North Point Keystone Trade Center Phase 2



- ☐ Project Boundary
- ☐ Buffered Project Boundary



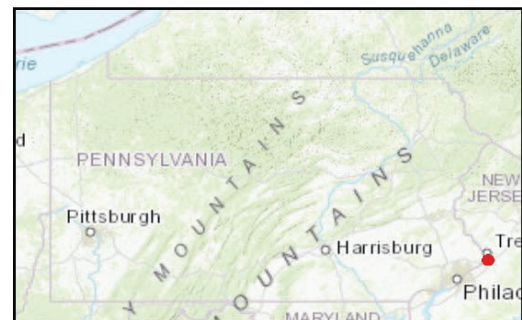
Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China

North Point Keystone Trade Center Phase 2



- ☐ Project Boundary
- ☐ Buffered Project Boundary

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community



RESPONSE TO QUESTION(S) ASKED

Q1: The proposed project is in the range of the Indiana bat. Describe how the project will affect bat habitat (forests, woodlots and trees) and indicate what measures will be taken in consideration of this. Round acreages up to the nearest acre (e.g., 0.2 acres = 1 acre).

Your answer is: The project will affect 1 to 39 acres of forests, woodlots and trees.

Q2: Is tree removal, tree cutting or forest clearing of 40 acres or more necessary to implement all aspects of this project?

Your answer is: No

3. AGENCY COMMENTS

Regardless of whether a DEP permit is necessary for this proposed project, any potential impacts to threatened and endangered species and/or special concern species and resources must be resolved with the appropriate jurisdictional agency. In some cases, a permit or authorization from the jurisdictional agency may be needed if adverse impacts to these species and habitats cannot be avoided.

These agency determinations and responses are **valid for two years** (from the date of the review), and are based on the project information that was provided, including the exact project location; the project type, description, and features; and any responses to questions that were generated during this search. If any of the following change: 1) project location, 2) project size or configuration, 3) project type, or 4) responses to the questions that were asked during the online review, the results of this review are not valid, and the review must be searched again via the PNDI Environmental Review Tool and resubmitted to the jurisdictional agencies. The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer impacts than what is listed on this PNDI receipt. The jurisdictional agencies **strongly advise against** conducting surveys for the species listed on the receipt prior to consultation with the agencies.

PA Game Commission

RESPONSE:

No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Department of Conservation and Natural Resources

RESPONSE:

Further review of this project is necessary to resolve the potential impact(s). Please send project information to this agency for review (see WHAT TO SEND).

DCNR Species: (Note: The Pennsylvania Conservation Explorer tool is a primary screening tool, and a desktop review may reveal more or fewer species than what is listed below. After desktop review, if a botanical survey is required by DCNR, we recommend the DCNR Botanical Survey Protocols, available here:

<https://conservationexplorer.dcnr.pa.gov/content/survey-protocols>)

Scientific Name	Common Name	Current Status	Proposed Status	Survey Window
<i>Bidens laevis</i>	Beggar-ticks	Special Concern Species*	Endangered	Flowers August - October
<i>Heteranthera multiflora</i>	Multiflowered Mud-plantain	Endangered	Endangered	Flowers July - early October
<i>Lycopus rubellus</i>	Bugleweed	Endangered	Endangered	Flowers June - early September

PA Fish and Boat Commission

RESPONSE:

Further review of this project is necessary to resolve the potential impact(s). Please send project information to this agency for review (see WHAT TO SEND).

PFBC Species: (Note: The Pennsylvania Conservation Explorer tool is a primary screening tool, and a desktop review may reveal more or fewer species than what is listed below.)

Scientific Name	Common Name	Current Status
Sensitive Species**		Endangered
Sensitive Species**		Endangered
Sensitive Species**		Endangered
Sensitive Species**		Endangered
Sensitive Species**		Threatened
Sensitive Species**		Threatened

U.S. Fish and Wildlife Service

RESPONSE:

No impacts to **federally** listed or proposed species are anticipated. Therefore, no further consultation/coordination under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq. is required. Because no take of federally listed species is anticipated, none is authorized. This response does not reflect potential Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act or other authorities.

* Special Concern Species or Resource - Plant or animal species classified as rare, tentatively undetermined or candidate as well as other taxa of conservation concern, significant natural communities, special concern populations (plants or animals) and unique geologic features.

** Sensitive Species - Species identified by the jurisdictional agency as collectible, having economic value, or being susceptible to decline as a result of visitation.

WHAT TO SEND TO JURISDICTIONAL AGENCIES

If project information was requested by one or more of the agencies above, upload* or email the following information to the agency(s) (see AGENCY CONTACT INFORMATION). Instructions for uploading project materials can be found [here](#). This option provides the applicant with the convenience of sending project materials to a single location accessible to all three state agencies (but not USFWS).

*If information was requested by USFWS, applicants must email, or mail, project information to IR1_ESPenn@fws.gov to initiate a review. USFWS will not accept uploaded project materials.

Check-list of Minimum Materials to be submitted:

☒ Project narrative with a description of the overall project, the work to be performed, current physical characteristics of the site and acreage to be impacted.

☒ A map with the project boundary and/or a basic site plan (particularly showing the relationship of the project to the physical features such as wetlands, streams, ponds, rock outcrops, etc.)

In addition to the materials listed above, USFWS REQUIRES the following

☒ **SIGNED** copy of a Final Project Environmental Review Receipt

The inclusion of the following information may expedite the review process.

☒ Color photos keyed to the basic site plan (i.e. showing on the site plan where and in what direction each photo was taken and the date of the photos)

☒ Information about the presence and location of wetlands in the project area, and how this was determined (e.g., by a qualified wetlands biologist), if wetlands are present in the project area, provide project plans showing the location of all project features, as well as wetlands and streams.

4. DEP INFORMATION

The Pa Department of Environmental Protection (DEP) requires that a signed copy of this receipt, along with any required documentation from jurisdictional agencies concerning resolution of potential impacts, be submitted with applications for permits requiring PNDI review. Two review options are available to permit applicants for handling PNDI coordination in conjunction with DEP's permit review process involving either T&E Species or species of special concern. Under sequential review, the permit applicant performs a PNDI screening and completes all coordination with the appropriate jurisdictional agencies prior to submitting the permit application. The applicant will include with its application, both a PNDI receipt and/or a clearance letter from the jurisdictional agency if the PNDI Receipt shows a Potential Impact to a species or the applicant chooses to obtain letters directly from the jurisdictional agencies. Under concurrent review, DEP, where feasible, will allow technical review of the permit to occur concurrently with the T&E species consultation with the jurisdictional agency. The applicant must still supply a copy of the PNDI Receipt with its permit application. The PNDI Receipt should also be submitted to the appropriate agency according to directions on the PNDI Receipt. The applicant and the jurisdictional agency will work together to resolve the potential impact(s). See the DEP PNDI policy at <https://conservationexplorer.dcnr.pa.gov/content/resources>.



5. ADDITIONAL INFORMATION

The PNDI environmental review website is a preliminary screening tool. There are often delays in updating species status classifications. Because the proposed status represents the best available information regarding the conservation status of the species, state jurisdictional agency staff give the proposed statuses at least the same consideration as the current legal status. If surveys or further information reveal that a threatened and endangered and/or special concern species and resources exist in your project area, contact the appropriate jurisdictional agency/agencies immediately to identify and resolve any impacts.

For a list of species known to occur in the county where your project is located, please see the species lists by county found on the PA Natural Heritage Program (PNHP) home page (www.naturalheritage.state.pa.us). Also note that the PNDI Environmental Review Tool only contains information about species occurrences that have actually been reported to the PNHP.

6. AGENCY CONTACT INFORMATION

PA Department of Conservation and Natural Resources

Bureau of Forestry, Ecological Services Section
400 Market Street, PO Box 8552
Harrisburg, PA 17105-8552
Email: RA-HeritageReview@pa.gov

PA Fish and Boat Commission

Division of Environmental Services
595 E. Rolling Ridge Dr., Bellefonte, PA 16823
Email: RA-FBPACENOTIFY@pa.gov

U.S. Fish and Wildlife Service

Pennsylvania Field Office
Endangered Species Section
110 Radnor Rd; Suite 101
State College, PA 16801
Email: IR1_ESPenn@fws.gov
NO Faxes Please

PA Game Commission

Bureau of Wildlife Habitat Management
Division of Environmental Planning and Habitat Protection
2001 Elmerton Avenue, Harrisburg, PA 17110-9797
Email: RA-PGC_PNDI@pa.gov
NO Faxes Please

7. PROJECT CONTACT INFORMATION

Name: Scott Bush

Company/Business Name: GHD

Address: 410 Eagleview Blvd, STE 110

City, State, Zip: Exton, PA 19341

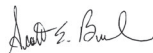
Phone: (610) 646-7486

Fax: () _____

Email: scott.bush@ghd.com

8. CERTIFICATION

I certify that ALL of the project information contained in this receipt (including project location, project size/configuration, project type, answers to questions) is true, accurate and complete. In addition, if the project type, location, size or configuration changes, or if the answers to any questions that were asked during this online review change, I agree to re-do the online environmental review.



applicant/project proponent signature

2-2-2022

date

BUREAU OF FORESTRY

February 3, 2022

PNDI Number: 742949

Version: Final_3; 2/2/22

Scott Bush

GHD Services.com

410 Eagleview Blvd, STE 110

Exton, PA 19341

Email: scott.bush@ghd.com (hard copy will not follow)

**Re: North Point Keystone Trade Center Phase 2
Falls Township, Bucks County, PA**

Dear Scott Bush,

Thank you for the submission of the Pennsylvania Natural Diversity Inventory (PNDI) Environmental Review Receipt Number **742949 (Final_3)**. PA Department of Conservation and Natural Resources screened this project for potential impacts to species and resources under DCNR's responsibility, which includes plants, terrestrial invertebrates, natural communities, and geologic features only.

No Impact Anticipated

PNDI records indicate species or resources under DCNR's jurisdiction are located in the vicinity of the project. However, based on the habitat assessment, site photographs, information you submitted concerning the nature of the project, the immediate location, and our detailed resource information, DCNR has determined that no impact is likely. No further coordination with our agency is needed for this project.

Recommended Voluntary Best Management Practices for Ecologically Sensitive Areas:

- Use a conservative approach to project design that minimizes permanent and temporary disturbances to soil and native vegetation. This will conserve habitat and limit opportunities for invasive plants.
- Clean boot treads, tools, construction equipment, and vehicles thoroughly (especially the undercarriage and wheels) before they are brought on site. This will remove invasive plant seeds and invasive earthworms/cocoons that may have been picked up at other worksites.
- Use clean project materials (e.g., weed-free straw) or materials native to the worksite to avoid introducing invasive species from contaminated sources.
- Revegetate or cover disturbed soil and stockpiles quickly to discourage the germination of invasive plants. Implement proper erosion control practices to stabilize soil and reduce runoff.
- If planting, do not use seed mixes that include invasive species. More information about invasive plants in Pennsylvania can be found at the following link: <http://www.dcnr.pa.gov/Conservation/WildPlants/InvasivePlants/Pages/default.aspx>
- Use habitat appropriate seed mixes. For example, use a riparian seed mix when reseeding along a waterway. The *Bureau of Forestry Planting & Seeding Guidelines* can be found at the following link for recommendations: http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr_20031083.pdf

conserve

sustain

enjoy

P.O. Box 8552, Harrisburg, PA 17015-8552 717-787-3444 (fax) 717-772-0271

- Use native plants for landscaping, revegetation, and stormwater management. Do not use nonnative invasive species. Reduce the area of lawn and impermeable surfaces to the fullest extent practicable in favor of native gardens or habitat restoration (e.g., forest, meadow, wetland, etc.). More information about lawn conversion can be found at the following link: <https://www.dcnr.pa.gov/Conservation/Water/LawnConversion/Pages/default.aspx>
- Plant forest buffers where trees were historically present along streams, wetlands, and bodies of water. Buffers should be a minimum of 35 feet in width (ideally at least 100 feet in width). Where trees are not appropriate (e.g., powerline rights-of-way), buffer with native shrubs and herbaceous plants. More information about riparian buffers can be found at the following link: <https://www.dcnr.pa.gov/Conservation/Water/RiparianBuffers/Pages/default.aspx>
- Manage rights-of-way for diverse native plant communities and wildlife (e.g., monarch butterfly). In seed mixes, include wildflowers that have overlapping bloom periods and provide forage for pollinators throughout the growing season. Avoid blanket herbicide applications; instead, spot-treat undesirable tall woody vegetation and invasive weeds. Where mowing is necessary, reduce frequency to once every few years during the dormant season (i.e., after first frost in late fall and before bird nesting in early spring), leaving some refugia for overwintering wildlife.

This response represents the most up-to-date review of the PNDI data files and is valid for two (2) years only. If project plans change or more information on listed or proposed species becomes available, our determination may be reconsidered. Should the proposed work continue beyond the period covered by this letter and a permit has not been acquired, please resubmit the project to this agency as an “Update” (including an updated PNDI receipt, project narrative, description of project changes and accurate map). As a reminder, this finding applies to potential impacts under DCNR’s jurisdiction only. Visit the PNHP website for directions on contacting the Commonwealth’s other resource agencies for environmental review.

Should you have any questions or concerns, please contact Stephanie Seymour, Ecological Information Specialist, by phone (717-705-2819) or via email (c-steseymo@pa.gov).

Sincerely,



Greg Podniesinski, Section Chief
Natural Heritage Section



Pennsylvania Fish & Boat Commission

Division of Environmental Services

Natural Diversity Section
595 E Rolling Ridge Dr.
Bellefonte, PA 16823
814-359-5237

February 28, 2022

IN REPLY REFER TO

SIR# 55688

GHD Services, Inc.
Scott Bush
410 Eagleview Blvd.
Exton, Pennsylvania 19341

**RE: Species Impact Review (SIR) – Rare, Candidate, Threatened and Endangered Species
PNDI Search No. 742949_3
North Point Keystone Trade Center Phase 2
BUCKS County: Falls Township**

Dear Mr. Bush:

This responds to your inquiry about a Pennsylvania Natural Diversity Inventory (PNDI) Internet Database search “potential conflict” or a threatened and endangered species impact review. These projects are screened for potential conflicts with rare, candidate, threatened or endangered species under Pennsylvania Fish & Boat Commission jurisdiction (fish, reptiles, amphibians, aquatic invertebrates only) using the Pennsylvania Natural Diversity Inventory (PNDI) database and our own files. These species of special concern are listed under the Endangered Species Act of 1973, the Wild Resource Conservation Act, and the Pennsylvania Fish & Boat Code (Chapter 75), or the Wildlife Code.

Based on records maintained in the Pennsylvania Natural Diversity Inventory (PNDI) database and our own files, the following rare or protected species are known from the vicinity of the project site:

Common Name (Scientific Name, PA Status)

Southeastern Mud Turtle (*Kinosternon subrubrum subrubrum*, Endangered)

Northern Red-bellied Cooter (*Pseudemys rubriventris*, Threatened)

Eastern Spadefoot (*Scaphiopus holbrookii*, Threatened)

New Jersey Chorus Frog (*Pseudacris kalmi*, Endangered)

Eastern Cricket Frog (*Acris crepitans*, Endangered)

Coastal Plains Leopard Frog complex (*Lithobates sphenoccephalus/kauffeldi*, Endangered)

You evaluated the habitats on site to determine their potential to support the species of concern. According to the report, the site does not contain potential habitat for the Southeastern Mud Turtle, Eastern Spadefoot, New Jersey Chorus Frog, Eastern Cricket Frog or Coastal Plains Leopard Frog complex. It also does not provide potential permanent habitat for the Northern Red-bellied Cooter;

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www.fish.state.pa.us

To protect, conserve and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities.

however, I contend that given the transient habits of this turtle known to occur in waterbodies aquatically connected to the "Central Canal," that there could be turtles in the "Central Canal" habitat during project construction. This waterbody is slated for fill and removal; therefore, additional measures shall be required to determine if Northern Red-bellied Cooters could be impacted by this project.

We recommend that a herpetologist that is qualified/recognized to survey for the Northern Red-bellied Cooter conduct a modified presence/absence survey in the project area. The goal of this particular survey is to establish whether or not the Central Canal is occupied by the Northern Red-bellied Cooter. We recommend that the surveyor conduct 4 visual surveys of the canal from various vantage points in order to identify any basking turtles. These surveys shall be conducted during the active season of the turtle (April 15-October 15) during weather conditions likely to promote basking. Prior to the survey it may be useful to place basking structures in the water to draw turtles to them. All available basking habitat within the survey area shall be examined as much as possible through an ocular device. A high-power ocular device such as a spotting scope that allows the surveyor to differentiate between the red-bellied cooter and red-eared slider must be used. Cameras that can take clear photographs from afar or through the spotting scope are highly recommended for vouchering observations. Number of basking objects observed and number and species of turtles identified should be recorded, as well as weather conditions. Upon the completion of the survey, the qualified biologist is to submit an email report to this office for review and comment.

If it can be shown that Northern Red-bellied Cooter have not colonized the Central Canal, then I do not foresee the proposed project resulting in adverse impacts to the species of concern listed above. If, however, the surveyor finds the canal occupied, then further consultation will be necessary to remove the turtles prior to project construction, given that the Central Canal has been determined to not provide critical habitat for the species. As per Title 58, Chapter 75.4, PFBC has authorization to issue Special Permits for "taking" threatened and endangered species in unique and extraordinary circumstances such as this one. If site conditions are determined too hazardous for removal of the turtles prior to construction, then a take permit may be warranted.

This response represents the most up-to-date summary of the PNDI data and our files and is valid for two (2) years from the date of this letter. An absence of recorded species information does not necessarily imply species absence. Our data files and the PNDI system are continuously being updated with species occurrence information. Should project plans change or additional information on listed or proposed species become available, this determination may be reconsidered, and consultation shall be re-initiated.

If you have any questions regarding this review, please contact Kathy Gipe at 814-359-5186 and refer to the SIR # 55688. Thank you for your cooperation and attention to this important matter of species conservation and habitat protection.

Sincerely,

A handwritten signature in black ink that reads "Christopher A. Urban". The signature is fluid and cursive, with the first name being the most prominent.

Christopher A. Urban, Chief
Natural Diversity Section



July 5, 2022

IN REPLY REFER TO

SIR# 55688

GHD Services, Inc.
Scott Bush
410 Eagleview Blvd.
Exton, Pennsylvania 19341

**RE: Species Impact Review (SIR) – Rare, Candidate, Threatened and Endangered Species
PNDI Search No. 742949_3
North Point Keystone Trade Center Phase 2
Falls Township: BUCKS County**

Dear Scott Bush:

As a follow up to our letter of February 28, 2022, you conducted a Northern Red-bellied Cooter (*Pseudemys rubriventris*) presence/absence survey (Phase 2) in the Central Canal at the above site. According to the resulting report, no species of concern were found and the site likely is not occupied by the Northern Red-bellied Cooter (*Pseudemys rubriventris*). I concur with the results of this evaluation; therefore, I do not foresee the proposed project resulting in adverse impacts to the Northern Red-bellied Cooter or the other species of concern listed in our prior correspondence.

This response represents the most up-to-date summary of the PNDI data and our files and is valid for two (2) years from the date of this letter. An absence of recorded species information does not necessarily imply species absence. Our data files and the PNDI system are continuously being updated with species occurrence information. Should project plans change or additional information on listed or proposed species become available, this determination may be reconsidered, and consultation shall be re-initiated.

If you have any questions regarding this review, please contact Kathy Gipe at 814-359-5186 or kgipe@pa.gov and refer to the SIR # 55688. Thank you for your cooperation and attention to this important matter of species conservation and habitat protection.

Sincerely,

A handwritten signature in black ink that reads "Christopher A. Urban".

Christopher A. Urban, Chief
Natural Diversity Section

CAU//KDG/dn



THE PLANNING & ZONING RESOURCE COMPANY

1300 South Meridian Avenue, Suite 400 • Oklahoma City, Oklahoma 73108
Telephone (405) 840-4344 • Fax (405) 840-2608

ZONING AND SITE REQUIREMENTS SUMMARY

***PZR REPORT*[®] FOR:**
KEYSTONE TRADE CENTER BUILDING 6
600 BEN FAIRLESS DRIVE
FAIRLESS HILLS, PENNSYLVANIA 19030

Prepared For:

THE NORTHWESTERN MUTUAL LIFE INSURANCE COMPANY

Date: Final (1) – 01/03/2024

PZR SITE NUMBER: 169782-1

NATIONAL PLANNING & ZONING CONSULTING SERVICE

THE PLANNING & ZONING RESOURCE COMPANY

1300 SOUTH MERIDIAN AVENUE, SUITE 400
OKLAHOMA CITY, OKLAHOMA 73108
(405) 840-4344
(405) 840-2608 FAX

ZONING AND SITE REQUIREMENTS SUMMARY

I. Property Location and Size

1. Jurisdiction:	<i>Falls Township, Buck County, Pennsylvania</i>
2. Name:	<i>Keystone Trade Center Building 6</i>
3. Address:	<i>600 Ben Fairless Drive</i>
4. Size:	<i>59.45 Acres / 2,589,560 Sq. Ft. +/- (Per Survey)</i>

II. Existing Land Use and Zoning

1. Date of Existing Ordinance:	<i>August 16, 2021</i>
2. Existing Zoning Designation:	<i>"MPM" Materials Processing and Manufacturing District</i>
3. Adjacent Zoning Designation and or Uses if Applicable:	<i>Surrounded by "MPM"</i>
4. Existing Land Use:	<i>Warehouse</i>
<i>Is The Existing Use in Conformance?</i>	<i>Yes, as a Permitted Use. (See Sections 209-30.B, 209-26.B & 209-27.B for Code reference)</i>

III. Zoning Regulations

1. Are copies of zoning regulations available for this site?	<i>Yes, Attached</i>
2. If any aspect of the property is not in conformance with current zoning, does the municipality provide ordinances dealing with non-conforming use?	<i>Yes, Attached (For Information Only)</i>

IV. Property Specification

1. Building Set-Back Lines		
	Required	Existing
a. Front:	100 Ft; 150 Ft when abutting Residential (100 Ft Required)	Ben Fairless Drive: Exceeds 100 Ft (Per Approximate Scale of Survey)
b. Side:	20 Ft; 70 Ft when abutting Residential (20 Ft Required)	Eastern Lot Line: Exceeds 200 Ft Western Lot Line: Exceeds 200 Ft (Per Approximate Scale of Survey)
c. Rear:	20 Ft; 70 Ft when abutting Residential (20 Ft Required)	Northern Lot Line: Exceeds 300 Ft (Per Approximate Scale of Survey)

Is The Existing Building in Conformance?

Yes (See Table 5 for Code reference)

2. Building Size

- a. Maximum Building Height or Stories: **No Height Limit**
- b. Existing Building Height or Stories: **Not Shown on Survey
49 Ft (Per Client Info Provided)**
- c. Building Site Area Requirements:
- Minimum Tract Area: 50 Acres
Existing: 59.45 Acres (Per Survey)**
- Minimum Lot Area: 5 Acres
Existing: 59.45 Acres (Per Survey)**
- Minimum Lot Frontage: 100 Ft
Existing: 1,529.69 Ft (Per Survey)**
- Minimum Lot Width: 100 Ft
Existing: 1,529.69 Ft (Per Survey)**
- Minimum Lot Depth: 200 Ft
Existing: 675.19 Ft (Per Survey)**

Is The Existing Building in Conformance?

Yes (See Table 5 for Code reference)

3. Density

a. Building Density Formula:

Maximum Building coverage: 40%
Existing: 39.9%
(1,035,696 / 2,589,560 = 0.399 or 39.9%)

Maximum Impervious Surface: 80%
Existing: Does not exceed 80% (Per
Review of Survey and Aerial Imagery)

b. Approximate Building Footprint:

Not Shown on Survey
1,035,696 Sq. Ft. (Per Client Provided
Record Plan)

Is The Building Coverage in Conformance?

Yes (See Table 5 for Code reference)

4. Parking

a. Parking Space Formula:

Industrial: 1.25 spaces for each
employee on the major shift, two spaces
for each managerial personnel and one
additional parking space for each
business related vehicle located on the
premises or; one space for each 500
square feet of manufacturing area, plus
one space for each 400 square feet of
office area (460 Employees and 75
Managers per previous information
provided) (460 x 1.25 = 575) (75 x 2 =
150) (725 Total Parking Spaces)

b. Parking Spaces Required:

725 Total Parking Spaces

c. Existing Parking Spaces:

725 total Parking Spaces Including 16
Handicapped Spaces (Per Survey)

Is The Existing Parking in Conformance?

Yes (See Section 20-42.H(22) for Code
reference)

V. Site History

- | | |
|---|---|
| 1. Was special permitting or condition(s) applied to existing zoning? | Yes |
| a. Site Plan Approval or Planned Unit Development? | Site Plan Approval
(Copy Unavailable) |
| b. Other? | Not Applicable |
| 2. Violation Information | |
| a. Are there any outstanding zoning code violations on file? | No, according to the information provided by Matthew Takita, Township Manager and Open Records Officer, there are no responsive records located. (See Attached) |
| b. Are there any outstanding building code violations on file? | No, according to the information provided by Matthew Takita, Township Manager and Open Records Officer, there are no responsive records located. (See Attached) |
| c. Are there any outstanding fire code violations on file? | No, according to the information provided by Matthew Takita, Township Manager and Open Records Officer, there are no responsive records located. (See Attached) |
| 3. Is a Certificate of Occupancy available for the site? | Yes, attached are available copies of Certificates of Occupancy for the subject property, as provided by the City. Please note, the absence of a Certificate of Occupancy for the project would not be considered a violation and would not give rise to any enforcement action affecting the project, and a new Certificate of Occupancy would only be issued in the event of a change in use, change of owner, new tenant or to the extent of any construction activity, restoring, renovating or expanding the project or any part thereof. |

VI. Conclusions

- | | |
|---|-------------------------|
| 1. Conformance Status: | Legal Conforming |
| 2. Nonconforming Characteristics of the Site: | None |
| 3. Recommended Action: | None |
| 4. Rebuildability Clause: | Not Applicable |

Other Comments: A zoning verification letter issued December 12, 2023 has been attached.

The Planning & Zoning Resource Company has relied on information provided by the following:

Municipal Officials

***Falls Township, Buck County, Pennsylvania
Matthew Takita, Township Manager
188 Lincoln Highway, Suite 100
Fairless Hills, PA 19030
215-949-9000***

Surveyor

***Beyond KC
3315 N. Oak Trafficway
Kansas City, MO 64116
816-888-7380
Survey Dated: 12/06/2023***

This report was prepared by Moneice Perry. Questions may be directed to Sheri Klatt at 405.840.4344, Extension 4424 or by email to s.klatt@pzs.com. Please reference PZR Site Number 169872-1.

Municipal Documents

Falls Township

188 Lincoln Highway, Suite 100, Fairless Hills, PA 19030
(215) 949-9000



December 12, 2023

Via email only: myisha.schoolcraft@pzs.com

Myisha Schoolcraft
Planning Zoning Resource
1300 S. Meridian Avenue
Oklahoma City, OK 73108

RE: 600 Ben Fairless Drive, Fairless Hills, PA 19030
TMP #13-051-001-034

Dear Ms. Schoolcraft:

In response to your zoning verification application, the subject property is zoned MPM, Materials Processing and Manufacturing district. The proposed use of the premises as a warehouse is permissible. Section 209-30.

Sincerely,

A handwritten signature in black ink, appearing to read "Matthew K. Takita", is written over a horizontal line.

Matthew K. Takita, AIA, MCP
Township Manager
Director of Building, Planning & Zoning



(1 of 2)

Zoning - Materials Processing and Manufacturing

Zoning Abbreviation	MPM
Acres	2642.194368
Municipality	Falls Township
Zoning Code Website	Click Here

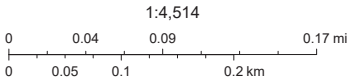
[Zoom to](#) ***

Parcel: 13-051-001-034



12/7/2023, 1:27:42 PM

- Municipal Boundary
- Bucks County Parcels
- Parcel Annotation



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13-051-001-034

(2 of 2)

13-051-001-034

Parcel Number	13-051-001-034
Address	
Municipality	Falls Township
Deed Area (Acres)	59.45000000 AC
Owner 1	NP KEYSTONE BLDG 6 LLC
Owner 2	
Land Use Code	2310

[View Parcel Information](#)

Zoom to ***

Parcel	
Included Parcel	No
Included Parcel Parent	
Has Included Parcel	
Property Address	BEN FAIRLESS DR
Unit Desc	-
Unit #	
City	
State	
Zip	
File Code	1 - Taxable
Class	I - Industrial
LUC	2310 - 10 to 19.99 Ac
Additional LUC	5993 - Keystone Opport. Zone
School District	S12 - PENNSBURY SD
Special Sch Dist	-
Topo	-
Utilities	1 - All Public
Roads	1 - Paved
Total Cards	
Living Units	0
CAMA Acres	59.45

Parcel Mailing Details

In Care Of	ATTN: NATHANIEL HAGEDORN
Mailing Address	3315 N OAK TRAFFICWAY
	KANSAS CITY MO 64116

Current Owner Details

Name	NP KEYSTONE BLDG 6 LLC
In Care Of	ATTN: NATHANIEL HAGEDORN
Mailing Address	3315 N OAK TRAFFICWAY
	KANSAS CITY MO 64116

Book	
Page	

Owner History

Date	Owner Name 1	Owner Name 2	Address	Recorded Dt	Sale Date	Book	Page
14-APR-23	NP KEYSTONE BLDG 6 LLC		3315 N OAK TRAFFICWAY	25-AUG-22	09-AUG-22		
23-JAN-23	NP KEYSTONE BLDG 6 LLC		4825 NW 41 ST	25-AUG-22	09-AUG-22		

Land

Line Number	1
Frontage	
Depth	
Units	
CAMA Square Feet	793,663
CAMA Acres	18.2200

Legal Description

Municipality	13
School District	S12
Property Location	BEN FAIRLESS DR
Description	-
Building/Unit #	
Subdivision Parent Parcel	13-051-001
Legal 1	59.45AC TOT (18.22 TX & 41.23 EX)
Legal 2	KEYSTONE TRADE CENTER
Legal 3	UNIT 6 LOT #16 BLDG 6
Deeded Acres	59
Deeded Sq Ft	

Values

Exempt Land	494,760
Exempt Building	0
Total Exempt Value	494,760
Assessed Land	218,640
Assessed Building	0
Total Assessed Value	218,640
Estimated Market Value	9,772,580

Assessment History

Date	Reason CD	Notice Date	Effective Date	Land Asmt	Bldg Asmt	Total Asmt	319 Land	319 Bldg	319 Homestead Total Mailed?	Tax Year
29-JUN-23	390 - School	02-MAR-23	01-JAN-23	\$218,640	\$0	\$218,640	\$0	\$0	\$0	2023
09-MAR-23	290 - New Parcel	02-MAR-23	01-JAN-23	\$218,640	\$0	\$218,640	\$0	\$0	\$0	2023
31-JAN-23	999 - Year End Certification			\$0	\$0	\$0	\$0	\$0	\$0	2023

ASSESSMENT HISTORY

Note: To find the current assessment for totally exempt parcels you MUST refer to the Values Tab. Parcels that are partially taxable and partially exempt will show the assessed taxable portion only in the Assessment History Tab.

Exemptions

Taxyr	Exemption	Amount
2023	PARTIALLY EXEMPT LAND	\$494,760.00

Sales

Sale Date	Sale Price	New Owner	Old Owner
09-AUG-22	17,843,426	NP KEYSTONE BLDG 6 LLC	NP FALLS TOWNSHIP INDUSTRIAL LLC

Sale Details

Sale Date	09-AUG-22
Sales Price	17,843,426
New Owner	NP KEYSTONE BLDG 6 LLC
Previous Owner	NP FALLS TOWNSHIP INDUSTRIAL LLC
Transfer Tax	178434.26
Recorded Date	25-AUG-22
Instrument Type	Deed
Book	
Page	
Instrument No.	2022052813

Estimated Tax Information

County		
Municipal		
School		\$40,729.09
	Total	\$40,729.09



Township of Falls

BUCKS COUNTY, PA

Board of Supervisors

Jeffrey E. Dence • Jeffrey M. Boraski • Brian M. Galloway • John W. Palmer • Erin M. Mullen

December 13, 2023

Via E-Mail Only: myisha.schoolcraft@pzt.com

Myisha Schoolcraft

Re: *Right to Know Request Received December 8, 2023*

Dear Myisha Schoolcraft,

You previously wrote to the Township requesting the following records: “Please provide copies of any open/unresolved Zoning, Building and Fire code violations, copies of Certificates of Occupancy, Variances, Special/Conditional use permits and a final approved site plan issued 2022- present for property located at 600 Ben Fairless Drive, parcel 13-051-001-034. Please do not exceed \$50.00 in fees without prior approval. Thanks (PZR Ref#169872-1).”

Your request is approved in part and denied in part. Please see the attached records. The site plan records you have requested are protected by copyright. The Federal Copyright Act prohibits the duplication of any copyrighted information. Engineered site plans are protected by copyright. Therefore, the Township is unable to provide copies of those records; however, the plans can be viewed in person at the Township building. Please contact Township staff to arrange for a time to view the records. The portion of your request for copies of any open/unresolved Zoning, Building and Fire code violations is denied. The denial of your request is made due to no responsive records being located as a result of the Township search.

You have a right to appeal this response in writing to Executive Director, Office of Open Records, 333 Market Street, 16th Floor, Harrisburg, PA 17101-2234.

If you choose to file an appeal you must do so within 15 business days of the mailing date of the Agency’s response. Please note that a copy of your original Right-To-Know request and this denial letter must be included when filing an appeal. The law also requires that you state the reasons why the record is a public record and address the reasons the Agency denies your request. Visit the Office of Open Records website for additional information.

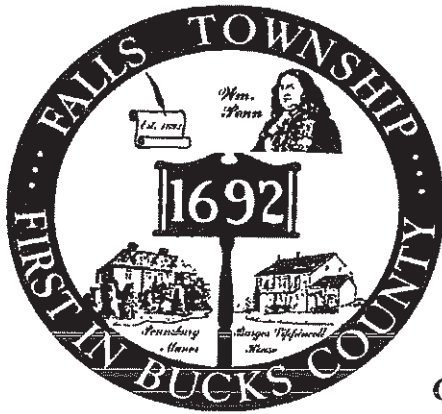
Please be advised that this correspondence will serve to close this record with our offices as permitted by law.

Sincerely,

Matthew Takita, rm

Matthew Takita
Township Manager and
Open Records Officer

450 Lincoln Highway • Fairless Hills, PA 19030
(215) 949-9000 • E-mail: admin@fallstwp.com • Website: www.fallstwp.com



COMMERCIAL
CERTIFICATE OF OCCUPANCY
Township of Falls

188 Lincoln Highway, Suite 100
Fairless Hills, PA 19030

Certificate # **OT2300826**

ADDRESS: **600 BEN FAIRLESS DR** **13-051-001-034**

This building has been inspected and found to be in compliance with the Pennsylvania Construction Law (1999, November 10, P.L. 491, No. 45) and the plans approved by the Department under the file number and date listed

BUILDING CODE IN EFFECT: 2018 INTERNATIONAL CODES

Use Group: **B-S-1/F-1** Construction Type **VB** Permit # **PB227848**

Plan Approval Date: **09/08/2022** Final Inspection Date: **11/30/2023**

NP FALLS TOWNSHIP IND, LLC

BUSINESS LICENSE # **600 BEN FAIRLESS DR**
FAIRLESS HILLS PA 19030

OCCUPANCY LOAD: 2071

Description: **FOOTINGS, FOUNDATION CORE & SHELL BLD 6**

FINAL U & O

PERMITS PB227848, PF221923, PE226911, PM226255, PF221921, PP224583

***CORE & SHELL ONLY**

***EXTERIOR STABILIZATION AND SITE WORK TO BE COMPLETED. AT 70% NOW.**

***MUST INSTALL A FULL FIRE ALARM IN THE BUILDING. I.E. PULL BOXES AT EVERY EXIT.**

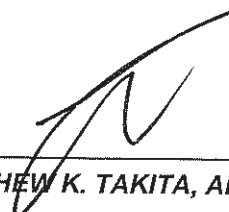
***HORN/STROBES THROUGHOUT**

***WILL NEED TO INSTALL A BDA IF RADIO COVERAGE FAILS IN THE BUILDING.**

NP FALLS TOWNSHIP IND, LLC

OWNER/OCCUPANT

Receipt #


MATTHEW K. TAKITA, AIA, MCP, BCO



COMMONWEALTH OF PENNSYLVANIA
TOWNSHIP OF FALLS
COUNTY OF BUCKS

The following building or structure and the plans approved by the Department under the permit number(s) and date listed below have been inspected and found to be in compliance with the Uniform Construction Code of the Commonwealth of Pennsylvania (1999, November 10, P.L. 491, No. 45)

Applicant/Permit holder: NP FALLS TOWNSHIP IND		Date approved: 12/1/23	
Address: 1802 PENNSYLVANIA AVE FAIRLESS HILLS PA 19030		Date of final approval: 12/1/23	
Building/Structure Name:		Approved Use Group: B-S-1/F-1	
Building Structure Address: 600 BEN FAIRLESS DR FAIRLESS HILLS PA 19030		Sprinkler type: NFPA 13	
Description of work being performed: FOOTINGS, FOUNDATION, CORE AND SHELL BLDG 6			
Occupant load: 2071	Construction Type: V-B	Code Version: 2015/2018	Total Sq. Ft. 1,035,696

This Certificate of occupancy authorizes occupancy and use of the above-named building or structure as long as it is maintained in accordance with the Pennsylvania Construction Code Act, its regulations and all plans and specifications approved by the Department.

Applicable Appeal Board Decisions:
Applicable Accessibility Advisory Board Variance(s) - Labor & Industry:
Special Stipulations/Conditions

Fire Code Approval <i>Rich DiPpolito</i>	Permit# PF221923 PF221921	Date <i>8/25/23</i>
Building Code Approval <i>Joseph Mikstas</i>	Permit# PB227848	Date 12/1/23
Plumbing Code Approval <i>Joseph Mikstas</i>	Permit# PP224583	Date 12/1/23
Mechanical Code Approval <i>Joseph Mikstas</i>	Permit# PM226255	Date 12/1/23
Electrical Code Approval <i>Thomas R. O'Brien</i>	Permit# PE226911	Date 12/12/23
Building Code Official Approval <i>[Signature]</i>		Date <i>12/12/23</i>

SENT VIA ELECTRONIC MAIL ONLY

January 7, 2022

Mr. Matthew Takita, Manager
Falls Township
188 Lincoln Highway
Suite 100
Fairless Hills, PA 19030

Re: Approval Letter - Revision
Northpoint KIPC Redevelopment (a.k.a. Keystone Trade Center)
DEP CODE NO. 1-09002-276-3
APS No. 1049251, AUTH ID No. 1379236
Falls Township
Bucks County

Dear Mr. Takita:

The Department of Environmental Protection (“DEP”) has reviewed the proposed Official Plan revision for the redevelopment of the Keystone Industrial Port Complex (“KIPC”) which will now be known as the Keystone Trade Center (“KTC”). During the initial five-year period of the redevelopment, thirteen buildings will be constructed with a total of 7,638,500 square feet of commercial/industrial space. The project is located along River Road, Middle Drive, Dean Sievers Place, Solar Drive, Energy Drive, Sinter Road, Sorrells Boulevard, and South Port Road within the KTC, in Falls Township (“Township”), Bucks County on Tax Map Parcels 13-051-001, 13-051-001-005, 13-051-001-011, 13-051-001-021, 13-051-001-023, and 13-050-007. This plan revision is approved.

This project will be connected to the USS Real Estate (a.k.a. U.S. Steel) collection system and will generate 95,300 gallons of sewage per day (“gpd”) to be treated at the USS Real Estate Wastewater Treatment Facility.

It is noted that as part of this redevelopment, several existing pump stations will be upgraded. A separate planning approval provides for these pump station upgrades as well as for the sale of the USS Real Estate sewer system to Northpoint Development Corporation (“Northpoint”) who will then transfer ownership of the sewer system to Morrisville Municipal Authority (“MMA”).

Please be advised that the project sponsor must submit an application mailer to DEP in order for us to determine whether additional sewage facilities planning is required for any future redevelopment or should any further subdivision, improvements and/or additional uses be proposed for any lot within the KTC.

This approval is specifically made contingent upon the applicant acquiring all necessary property rights by easement or otherwise, providing for the satisfactory construction, operation, maintenance,

and replacement of all sewerage structures associated with the approved discharge in, along, or across private property, with full rights of ingress, egress and regress.

Other DEP permits may be required for construction if encroachment to streams or wetlands will result. Information regarding the requirements for such permits or approvals can be obtained from DEP's Watershed Management Program at the letterhead address, by telephone at 484.250-5970.

Any person aggrieved by this action may appeal the action to the Environmental Hearing Board (Board), pursuant to Section 4 of the Environmental Hearing Board Act, 35 P.S. § 7514, and the Administrative Agency Law, 2 Pa.C.S. Chapter 5A. The Board's address is:

Environmental Hearing Board
Rachel Carson State Office Building, Second Floor
400 Market Street
P.O. Box 8457
Harrisburg, PA 17105-8457

TDD users may contact the Environmental Hearing Board through the Pennsylvania Relay Service, 800-654-5984.

Appeals must be filed with the Board within 30 days of receipt of notice of this action unless the appropriate statute provides a different time. This paragraph does not, in and of itself, create any right of appeal beyond that permitted by applicable statutes and decisional law.

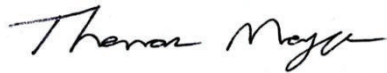
A Notice of Appeal form and the Board's rules of practice and procedure may be obtained online at <http://ehb.courtapps.com> or by contacting the Secretary to the Board at 717-787-3483. The Notice of Appeal form and the Board's rules are also available in braille and on audiotape from the Secretary to the Board.

IMPORTANT LEGAL RIGHTS ARE AT STAKE. YOU SHOULD SHOW THIS DOCUMENT TO A LAWYER AT ONCE. IF YOU CANNOT AFFORD A LAWYER, YOU MAY QUALIFY FOR FREE PRO BONO REPRESENTATION. CALL THE SECRETARY TO THE BOARD AT 717-787-3483 FOR MORE INFORMATION. YOU DO NOT NEED A LAWYER TO FILE A NOTICE OF APPEAL WITH THE BOARD.

IF YOU WANT TO CHALLENGE THIS ACTION, YOUR APPEAL MUST BE FILED WITH AND RECEIVED BY THE BOARD WITHIN 30 DAYS OF RECEIPT OF NOTICE OF THIS ACTION.

If you have any questions or concerns, please contact Ms. Kelly Boettlin at 484.250.5184 and refer to DEP Code No. 1-09002-276-3.

Sincerely,

A handwritten signature in black ink, appearing to read "Thomas Magge". The signature is fluid and cursive, with the first name "Thomas" and last name "Magge" clearly distinguishable.

Mr. Thomas Magge
Regional Manager
Clean Water

cc: Mr. Stone - Bucks County Planning Commission (via email)
Ms. Kostick - Bucks County Health Department (via email)
Ms. Moyer and Ms. Seykot - Bucks County Conservation District (via email)
Ms. Ryan - Gilmore & Associates, Inc. (via email)
Mr. Campbell - Pennoni Associates, Inc. (via email)
Mr. Gaston - Northpoint (via email)
USS Real Estate (via email)
Mr. Warenda - Morrisville Municipal Authority (via email)
Mr. Smith - DEP SERO Waterways Engineering & Wetlands (via email)
Planning Section
Re



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

AIR POLLUTION CONTROL ACT COMPLIANCE REVIEW FORM

Fully and accurately provide the following information, as specified. Attach additional sheets as necessary.

Type of Compliance Review Form Submittal (check all that apply)

- ☒ Original Filing
☐ Amended Filing

Date of Last Compliance Review Form Filing:

____/____/____

Type of Submittal

- ☒ New Plan Approval ☐ New Operating Permit ☐ Renewal of Operating Permit
☐ Extension of Plan Approval ☐ Change of Ownership ☐ Periodic Submission (@ 6 mos)
☐ Other: _____

SECTION A. GENERAL APPLICATION INFORMATION

Name of Applicant/Permittee/("applicant")

(non-corporations-attach documentation of legal name)

Amazon Data Services, Inc.

Address 600 Ben Fairless Drive

Fairless Hills, PA 19030

Telephone (541) 303-2380

Taxpayer ID# 91-1986543

Permit, Plan Approval or Application ID# _____

Identify the form of management under which the applicant conducts its business (check appropriate box)

- ☐ Individual ☐ Syndicate ☐ Government Agency
☐ Municipality ☐ Municipal Authority ☐ Joint Venture
☐ Proprietorship ☐ Fictitious Name ☐ Association
☐ Public Corporation ☐ Partnership ☐ Other Type of Business, specify below:
☒ Private Corporation ☐ Limited Partnership

Describe below the type(s) of business activities performed.

Amazon Data Services, Inc. is requesting authority to construct a new data center containing diesel-fired emergency generators that will provide electricity to the facility in the event of an emergency. In addition to the emergency generators, the facility will include diesel belly tanks.

SECTION B. GENERAL INFORMATION REGARDING "APPLICANT"

If applicant is a corporation or a division or other unit of a corporation, provide the names, principal places of business, state of incorporation, and taxpayer ID numbers of all domestic and foreign parent corporations (including the ultimate parent corporation), and all domestic and foreign subsidiary corporations of the ultimate parent corporation with operations in Pennsylvania. Please include all corporate divisions or units, (whether incorporated or unincorporated) and privately held corporations. (A diagram of corporate relationships may be provided to illustrate corporate relationships.) Attach additional sheets as necessary.

Unit Name	Principal Places of Business	State of Incorporation	Taxpayer ID	Relationship to Applicant
See attached table				

SECTION C. SPECIFIC INFORMATION REGARDING APPLICANT AND ITS "RELATED PARTIES"

Pennsylvania Facilities. List the name and location (mailing address, municipality, county), telephone number, and relationship to applicant (parent, subsidiary or general partner) of applicant and all Related Parties' places of business, and facilities in Pennsylvania. Attach additional sheets as necessary.

Unit Name	Street Address	County and Municipality	Telephone No.	Relationship to Applicant
See attached table				

Provide the names and business addresses of all general partners of the applicant and parent and subsidiary corporations, if any.

Name	Business Address
See attached table	

Name	County	Municipality	Mailing Address	
AMAZON - RDG1	Berks	Upper Bern Township		
AMAZON.COM	Luzerne	Hazle Township		
AMAZON.DAEB.EAST.NORRITON	Montgomery	East Norriton Township	PO BOX 80842	SEATTLE WA 98108-0842
AMAZON.DAEB.EAST.NORRITON	Montgomery	East Norriton Township	53 WEST GERMANTOWN PIKE	EAST NORRITON PA 19401
AMAZON.DPL4.FAIRLESS.HILLS.FACILITY	Bucks	Falls Township	P. O. BOX 80842	SEATTLE WA 98108-0842
AMAZON.DPL4.FAIRLESS.HILLS.FACILITY	Bucks	Falls Township	1 GEOFFREY DRIVE	FAIRLESS HILLS PA 19030
AMAZON.PHILA.MEETING.HOUSE.FACILITY	Philadelphia	Philadelphia City	PO BOX 80842	SEATTLE WA 98108-0842
AMAZON.PHILA.MEETING.HOUSE.FACILITY	Philadelphia	Philadelphia City	3025 MEETING HOUSE RD	PHILADELPHIA PA 19154
AMAZON.PIT2	Allegheny	Findlay Township	1200 WESTPORT RD	IMPERIAL PA 15126-1002
AMAZON.SCV.LLC - DAE7	Allegheny	North Versailles Township	PO BOX 80842	SEATTLE WA 98108-0842
AMAZON.SCV.LLC - DAE7	Allegheny	North Versailles Township	833 E PITTSBURGH MCKEESPORT BLVD	NORTH VERSAILLES PA 15137-1703
AMAZON.SVC.UPA1	Philadelphia	Philadelphia City	PO BOX 80842	SEATTLE WA 98108-0842
AMAZON.SVC.UPA1	Philadelphia	Philadelphia City	4101 SANSON ST	PHILADELPHIA PA 19104
AMAZON.DATA.SERVICES, INC - PHL100	Luzerne	Salem Township	2570 BEECH RD NW	NEW ALBANY OH 43054-7377
AMAZON.COM.SERVICES.LLC.HPH2.FACILITY (QUAKERTOWN FACILITY)	Bucks	Richland Township	P.O. BOX 80842	SEATTLE WA 98108
AMAZON.COM.SERVICES.LLC.HPH2.FACILITY (QUAKERTOWN FACILITY)	Bucks	Richland Township	120 W PUMPING STATION RD	QUAKERTOWN PA 18951-4214
AMAZON.COM.SERVICES - BREWSTER	Philadelphia	Philadelphia City	7575 BREWSTER AVE	PHILADELPHIA PA 19153-3206
AMAZON.COM.SERVICES - BREWSTER	Philadelphia	Philadelphia City	PO BOX 80842	SEATTLE WA 98108-0842
AMAZON.COM.SERVICES - DEW4.LANGHORNE.FACILITY	Bucks	Langhorne Borough	P.O. BOX 80842	SEATTLE WA 98108-0842
AMAZON.COM.SERVICES - DEW4.LANGHORNE.FACILITY	Bucks	Langhorne Borough	2251 W. CABOT BOULEVARD	LANGHORNE PA 19047-1806
AMAZON.COM.SERVICES.DDP5.BRISTOL.FACILITY	Bucks	Bristol Township	P. O. BOX 80842	SEATTLE WA 98108-0842
AMAZON.COM.SERVICES.DDP5.BRISTOL.FACILITY	Bucks	Bristol Township	6300 BRISTOL PIKE	LEVITTOWN PA 19057-4914
AMAZON.COM.SERVICES INC - MDT1	Cumberland	Dickinson Township	PO BOS 80842	SEATTLE WA 98108-0842
AMAZON.COM.SERVICES INC - MDT1	Cumberland	Dickinson Township	2 AMES DRIVE	CARLSIE PA 17015-7871
AMAZON.COM.SERVICES INC - PHL5	Cumberland	Dickinson Township	PO BOX 80842	SEATTLE WA 98108-0842
AMAZON.COM.SERVICES INC - PHL5	Cumberland	Dickinson Township	PO BOX 80842	SEATTLE WA 98108-0842
AMAZON.COM.SERVICES INC - PHL5	York	Fairview Township	PO BOX 80842	SEATTLE WA 98108-0842
AMAZON.COM.SERVICES INC - PHL5	York	Fairview Township	PO BOX 80842	SEATTLE WA 98108-0842
AMAZON.COM.SERVICES INC - PHL6	York	Fairview Township	500 MCCARTHY DRIVE	LEWISBERRY PA 17339-8725
AMAZON.COM.SERVICES INC - PHL6	Cumberland	South Middleton Township	675 ALLEN ROAD	CARLSIE PA 17015-7788
AMAZON.COM.SERVICES INC - PHL6	Cumberland	South Middleton Township	PO BOX 80842	SEATTLE WA 98108-0842
AMAZON.COM.SERVICES INC - PHL6	Cumberland	South Middleton Township	PO BOX 80842	SEATTLE WA 98108-0842
AMAZON.COM.SERVICES.LLC - ABES.NORRISTOWN.FACILITY	Montgomery	West Norriton Township	2455 BOULEVARDS OF THE GENERALS	NORRISTOWN PA 19403
AMAZON.COM.SERVICES.LLC - ABES.NORRISTOWN.FACILITY	Montgomery	West Norriton Township	345 BOREN AVE N	SEATTLE WA 98109-5306
AMAZON.COM.SERVICES.LLC - AVP1	Luzerne	Hazle Township	550 OAK RIDGE ROAD	HAZLE TOWNSHIP PA 18202-9361
AMAZON.COM.SERVICES.LLC - AVP1	Luzerne	Hazle Township	PO BOX 80842	SEATTLE WA 98108-0842
AMAZON.COM.SERVICES.LLC - AVP8	Luzerne	Pittston Township	P.O. BOX 80842	SEATTLE WA 98108-0842
AMAZON.COM.SERVICES.LLC - AVP8	Luzerne	Pittston Township	250 ENTERPRISE WAY	PITTSSTON PA 18640-5000
AMAZON.COM.SERVICES.LLC - DDP1.GRANT.PHILA.FACILITY	Philadelphia	Philadelphia City	P.O. BOX 80842	SEATTLE WA 98108-0842
AMAZON.COM.SERVICES.LLC - DDP1.GRANT.PHILA.FACILITY	Philadelphia	Philadelphia City	2900 GRANT AVE	PHILADELPHIA PA 19114-2310
AMAZON.COM.SERVICES.LLC - DDP9.PKG.PHILADELPH5	Philadelphia	Philadelphia City	P.O. BOX 80842	SEATTLE WA 98108
AMAZON.COM.SERVICES.LLC - DDP9.PKG.PHILADELPH5	Philadelphia	Philadelphia City	2703 BLACK LAKE PLACE	PHILADELPHIA PA 19154
AMAZON.COM.SERVICES.LLC - DPH7	Lancaster	West Donegal Township	10 INDUSTRIAL ROAD	ELIZABETHTOWN PA 17022-9425
AMAZON.COM.SERVICES.LLC - DPH7	Lancaster	West Donegal Township	TTN: AMAZON.COM, NA ENVIRONMENTAL DEF	SEATTLE WA 98108-0842
AMAZON.COM.SERVICES.LLC - DPH7	Lancaster	West Donegal Township	345 WOODCLIFF DRIVE	FAIRPORT NY 14450-4210
AMAZON.COM.SERVICES.LLC - DPH9.CONSHOHOCKEN.FACILITY	Montgomery	Plymouth Township	1103-1113 RIDGE PIKE	CONSHOHOCKEN PA 19428

Name	County	Municipality	Mailing Address		
AMAZON.COM SERVICES LLC - DPH9 CONSHOHOCKEN FACILITY	Montgomery	Plymouth Township	P.O. BOX 80842	SEATTLE	WA 98108
AMAZON.COM SERVICES LLC - MDT4	York	Jackson Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC - MDT4	York	Jackson Township	4775 W MARKET ST	YORK	PA 17408-6032
AMAZON.COM SERVICES LLC - MDT9	Schuylkill	Frailey Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC - MDT9	Schuylkill	Frailey Township	251 WESTWOOD HILLS	FRAILEY TOWNSHIP	PA 17981
AMAZON.COM SERVICES LLC - PH14	Cumberland	Middlesex Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC - PH14	Cumberland	Carlisle Borough	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC - PH14	Cumberland	Carlisle Borough	21 ROADWAY DR	CARLISLE	PA 17015-8806
AMAZON.COM SERVICES LLC - PH14	Cumberland	Middlesex Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC - PH14	Cumberland	Middlesex Township	21 ROADWAY DRIVE	CARLISLE	PA 17015
AMAZON.COM SERVICES LLC - TEN1	Berks	Reading City	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC - TEN1	Berks	Reading City	1002 PATRIOT PKWY	READING	PA 19605-2874
AMAZON.COM SERVICES LLC DAE3	Luzerne	Hazle Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC DAE3	Luzerne	Hazle Township	2150 NORTH PARK DRIVE	HAZLETON	PA 18202-9701
AMAZON.COM SERVICES LLC DDP3	Philadelphia	Philadelphia City	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC DDP3	Philadelphia	Philadelphia City	6901 ELMWOOD AVE	PHILADELPHIA	PA 19142-1815
AMAZON.COM SERVICES LLC DDP5	Bucks	Bristol Township	6300 BRISTOL PIKE	LEVITTOWN	PA 19057-4914
AMAZON.COM SERVICES LLC DDP5	Bucks	Bristol Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC DDP7	Bucks	Bensalem Township	P. O. BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC DDP7 BENSALEM FACILITY	Bucks	Bensalem Township	3750 STATE ROAD	BENSALEM	PA 19020
AMAZON.COM SERVICES LLC DPH7	Lancaster	West Donegal Township	10 INDUSTRIAL RD	ELIZABETHTOWN	PA 17022-9425
AMAZON.COM SERVICES LLC DPH7	Lancaster	West Donegal Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC DPH8 PKG PHILADELPH4	Philadelphia	Philadelphia City	6729-6733 ESSINGTON AVE	PHILADELPHIA	PA 19153
AMAZON.COM SERVICES LLC DPH8 PKG PHILADELPH4	Philadelphia	Philadelphia City	P.O. BOX 80842	SEATTLE	WA 98108
AMAZON.COM SERVICES LLC DPL2	Dauphin	Swatara Township	7125 GRAYSON RD	HARRISBURG	PA 17111-5143
AMAZON.COM SERVICES LLC DPL2	Dauphin	Swatara Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC DPL4	Bucks	Falls Township	1 GEOFFREY DR	FAIRLESS HILLS	PA 19030-4317
AMAZON.COM SERVICES LLC DPL4	Bucks	Falls Township	30 HUNTER LN	CAMP HILL	PA 17011-2400
AMAZON.COM SERVICES LLC DPL7	Lancaster	Rapho Township	1156 FOUR STAR DR	MOUNT JOY	PA 17552-8884
AMAZON.COM SERVICES LLC DPL7	Lancaster	Rapho Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC HDC3	Berks	Bethel Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC HDC3	Berks	Bethel Township	270 MIDWAY RD	BETHEL	PA 19507-9517
AMAZON.COM SERVICES LLC HGR5	Franklin	Southampton Township			
AMAZON.COM SERVICES LLC HGR5	Franklin	Southampton Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC HGR5	Franklin	Southampton Township	1480 UNITED DR	SHIPPENSBURG	PA 17257-9552
AMAZON.COM SERVICES LLC RDG1	Berks	Upper Bern Township	3563 MOUNTAIN RD	HAMBURG	PA 19526-7947
AMAZON.COM SERVICES LLC RDG1	Berks	Upper Bern Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC RDG1	Berks	Upper Bern Township			
AMAZON.COM SERVICES LLC WEE1	Erie	Erie City	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC WEE1	Erie	Erie City	2424 W 23RD ST	ERIE	PA 16506-2921
AMAZON.COM SERVICES LLC WOO1	Blair	Altoona City	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC WOO1	Blair	Altoona City	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES LLC WOO1	Blair	Altoona City	3121 PLEASANT VALLEY BLVD	ALTOONA	PA 16602-4308
AMAZON.COM SERVICES LLC - DPH7 PKG ELIZABETHT3	Lancaster	West Donegal Township	35 INDUSTRIAL RD	ELIZABETHTOWN	PA 17022-0703
AMAZON.COM SERVICES LLC - DPH7 PKG ELIZABETHT3	Lancaster	West Donegal Township	PO BOX 80842	SEATTLE	WA 98108-0842

Name	County	Municipality	Mailing Address		
AMAZON.COM SERVICES LLC- DPH6	Montgomery	Towamencin Township	2001 GEHMAN RD	HARLEYSVILLE	PA 19438-3612
AMAZON.COM SERVICES LLC- DPH6	Montgomery	Towamencin Township	P.O. BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES, LLC - DAE1	Northampton	Bethlehem Township	2595 BRODHEAD ROAD	BETHLEHEM	PA 18020
AMAZON.COM SERVICES, LLC - DAE1	Northampton	Bethlehem Township	P.O. BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES, LLC - DPH2	Montgomery	Upper Merion Township	500 AMERICAN AVENUE	KING OF PRUSSIA	PA 19406-1405
AMAZON.COM SERVICES, LLC - DPH2	Montgomery	Upper Merion Township	P.O. BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES, LLC - MDT5	York	Newberry Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES, LLC - MDT5	York	Newberry Township	200 GOODMAN DR	LEWISBERRY	PA 17339-9680
AMAZON.COM SVC	Lackawanna	Jessup Borough	45 VALLEY VIEW CIR	JESSUP BOROUGH	PA 18434
AMAZON.COM SVC	Lackawanna	Jessup Borough	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SVC LLC - DPP1	Allegheny	Aleppo Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SVC LLC - DPP1	Allegheny	Aleppo Township	501 NORTH DR	SEWICKLEY	PA 15143-2339
AMAZON.COM SVC LLC - PIT9	Allegheny	Findlay Township	17 WILLIAM DR	IMPERIAL	PA 15126-2134
AMAZON.COM SVC LLC - PIT9	Allegheny	Findlay Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SVC LLC HPT1	Allegheny	Findlay Township	4000 MCCLAREN WOODS DR	CORAOPOLIS	PA 15108
AMAZON.COM SVC LLC HPT1	Allegheny	Findlay Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SVC LLC LBE1	Westmoreland	New Stanton Borough	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SVC LLC LBE1	Westmoreland	New Stanton Borough	165 GLENN FOX RD	NEW STANTON	PA 15672-9703
AMAZON.COM SVC LLC PITS WHSE	Allegheny	Pittsburgh City	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SVC LLC PITS WHSE	Allegheny	Pittsburgh City	2250 ROSWELL DR	PITTSBURGH	PA 15205
AMAZON.COM SVC LLC WEE1	Erie	Milcreek Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SVC LLC WEE1	Erie	Milcreek Township	2424 W 23RD ST	ERIE	PA 16506-2921
AMAZON.COM SVC LLC VWS1	Lycoming	Clinton Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SVC LLC VWS1	Lycoming	Clinton Township	776 SAEGERS STATION RD	MONTGOMERY	PA 17752-8532
AMAZON.COM SVC, LLC. - ABE2	Lehigh	Upper Macungie Township	P.O. BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SVC, LLC. - ABE2	Lehigh	Upper Macungie Township	705 BOULDER DR	BREINIGSVILLE	PA 18031-1533
AMAZON.COM SVC, LLC. - ABE2	Lehigh	Upper Macungie Township	PO BOX 80841	SEATTLE	WA 98108-0841
AMAZON.COM SVC,LLC - ABE3	Lehigh	Upper Macungie Township	650 BOULDER DR	BREINIGSVILLE	PA 18031-1536
AMAZON.COM SVC,LLC - ABE3	Lehigh	Upper Macungie Township	P.O. BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SVCS LLC - DPP7	Allegheny	Findlay Township	177 MCCLAREN RD	CORAOPOLIS	PA 15108-7752
AMAZON.COM SVCS LLC - DPP7	Allegheny	Findlay Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SVCS LLC - PIT2	Allegheny	Findlay Township	101 N CAMPUS DR	IMPERIAL	PA 15126-2402
AMAZON.COM SVCS LLC - PIT2	Allegheny	Findlay Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES, LLC (ABE4)	Northampton	Palmer Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SERVICES, LLC (ABE4)	Northampton	Palmer Township	1610 VAN BUREN RD	EASTON	PA 18045-7807
AMAZON.COM SVC LLC- AVP3	Lackawanna	Covington Township	298 1ST AVE	GOULDSBORO	PA 18424-9492
AMAZON.COM SVC LLC- AVP3	Lackawanna	Covington Township	PO BOX 80842	SEATTLE	WA 98108-0842
AMAZON.COM SVC LLC- AVP3	Lackawanna	Covington Township	P.O. BOX 80842	SEATTLE	WA 98108-0842
AMAZON/NORRISTOWN	Montgomery	West Norriton Township	NA ENVIRONMENTAL DEPT-AMAZON.COM	SEATTLE	WA 98108-0842
AMAZON/NORRISTOWN	Montgomery	West Norriton Township	2455 BOULEVARD OF THE GENERALS	NORRISTOWN	PA 19403-3661
AMAZON/NORRISTOWN	Montgomery	West Norriton Township	NA ENVIRONMENTAL DEPT-AMAZON.COM	SEATTLE	WA 98108
GXO LOGISTICS SUPPLY CHAIN PA-AMAZON (HARRISBURG)	Dauphin	Swatara Township	6111 GRAYSON RD	HARRISBURG	PA 17111-3385
XPO LOGISTICE PA AMAZON CARLSLE	Cumberland	South Middleton Township	4043 PIEDMONT PARKWAY	HIGH POINT	NC 27265
XPO LOGISTICE PA AMAZON CARLSLE	Cumberland	South Middleton Township	40 LOGISTICS DR	CARLSLE	PA 17013-7904

List the names and business address of persons with overall management responsibility for the process being permitted (i.e. plant manager).

Name	Business Address
Matt McGury	13820 Sunrise Valley Dr, Herndon, VA 20171

Plan Approvals or Operating Permits. List all plan approvals or operating permits issued by the Department or an approved local air pollution control agency under the APCA to the applicant or related parties that are currently in effect or have been in effect at any time 5 years prior to the date on which this form is notarized. This list shall include the plan approval and operating permit numbers, locations, issuance and expiration dates. Attach additional sheets as necessary.

Air Contamination Source	Plan Approval/ Operating Permit#	Location	Issuance Date	Expiration Date
N/A	N/A	N/A	N/A	N/A

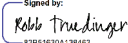
Compliance Background. (Note: Copies of specific documents, if applicable, must be made available to the Department upon its request.) List all documented conduct of violations or enforcement actions identified by the Department pursuant to the APCA, regulations, terms and conditions of an operating permit or plan approval or order by applicant or any related party, using the following format grouped by source and location in reverse chronological order. Attach additional sheets as necessary. See the definition of "documented conduct" for further clarification. Unless specifically directed by the Department, deviations which have been previously reported to the Department in writing, relating to monitoring and reporting, need not be reported.

Date	Location	Plan Approval/ Operating Permit#	Nature of Documented Conduct	Type of Department Action	Status: Litigation Existing/Continuing or Corrected/Date	Dollar Amount Penalty
N/A	N/A	N/A	N/A	N/A	N/A	\$ N/A
						\$
						\$
						\$
						\$
						\$
						\$
						\$
						\$
						\$
						\$

List all incidents of deviations of the APCA, regulations, terms and conditions of an operating permit or plan approval or order by applicant or any related party, using the following format grouped by source and location in reverse chronological order. This list must include items both currently known and unknown to the Department. Attach additional sheets as necessary. See the definition of "deviations" for further clarification.

Date	Location	Plan Approval/ Operating Permit#	Nature of Deviation	Incident Status: Litigation Existing/Continuing Or Corrected/Date
N/A	N/A	N/A	N/A	N/A

CONTINUING OBLIGATION. Applicant is under a continuing obligation to update this form using the Compliance Review Supplemental Form if any additional deviations occur between the date of submission and Department action on the application.

VERIFICATION STATEMENT	
Subject to the penalties of Title 18 Pa.C.S. Section 4904 and 35 P.S. Section 4009(b)(2), I verify under penalty of law that I am authorized to make this verification on behalf of the Applicant/Permittee. I further verify that the information contained in this Compliance Review Form is true and complete to the best of my belief formed after reasonable inquiry. I further verify that reasonable procedures are in place to ensure that “documented conduct” and “deviations” as defined in 25 Pa Code Section 121.1 are identified and included in the information set forth in this Compliance Review Form.	
Signed by:  83B5163DA13B163...	April 30, 2025
Signature	Date
Robb Truedinger	
Name (Print or Type)	
Authorized Representative	
Title	

2700-PM-AQ0021 Rev. 6/2004



Submit in Triplicate

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

COMBUSTION UNIT

Application for Plan Approval to Construct, Modify or Reactivate an Air Contamination Source and/or Install an Air Cleaning Device

This application and the General Information Form (GIF) must be included in the submittal

Before completing this form, read the instructions provided with this form.

Section A - Facility Name, Checklist And Certification

Organization Name or Registered Fictitious Name/Facility Name: Amazon Data Services, Inc

DEP Client ID# (If Known): TBD

Type of Review required and Fees:

Source which is not subject to NSPS, NESHAPs, MACT, NSR and PSD: \$ _____

Source requiring approval under NSPS or NESHAPs or both: \$ 2,500

Source requiring approval under NSR: \$ _____

Source requiring the establishment of a MACT limitation: \$ _____

Source requiring approval under PSD: \$ _____

Applicant's Checklist

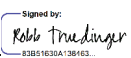
Check the following list to make sure that all the required documents are included.

- ☒ **General Information Form (GIF)**
- ☒ **Combustion Unit Plan Approval Application**
- ☒ **Compliance Review Form** or provide reference of most recently submitted compliance review form for facilities submitting on a periodic basis: _____
- ☒ **Proof of County and Municipal Notifications**
- ☒ **Permit Fees**

NA **Addendum A:** Source Applicable Requirements (only applicable to existing Title V facility)

Certification of Truth, Accuracy and Completeness by a Responsible Official

I, Robb Truedinger, certify under penalty of law in 18 Pa. C. S. A. §4904, and 35 P.S. §4009(b) (2) that based on information and belief formed after reasonable inquiry, the statements and information in this application are true, accurate and complete.

(Signature): 

Date: April 30, 2025

Name (Print): Robb Truedinger

Title: Authorized Representative

OFFICIAL USE ONLY

Application No. _____ Unit ID _____ Site ID _____

DEP Client ID #: _____ APS. ID _____ AUTH. ID _____

Date Received _____ Date Assigned _____ Reviewed By _____

Date of 1st Technical Deficiency _____ Date of 2nd Technical Deficiency _____

Comments: _____

Combustion Unit Information - CAT C18 Generators

Section B - Combustion Unit Information

1. Combustion Units: ☐ Coal ☒ Oil ☐ Natural Gas Other: _____

Description: 2 x 750 kW CAT C18 emergency internal combustion engines

Manufacturer Caterpillar	Model No. C18	Number of units: 2	
Maximum heat input (Btu/hr) 7,344,808	Rated heat input (Btu/hr) 7,344,808	Typical heat input (Btu/hr) 7,344,808	Furnace Volume N/A
Grate Area (if applicable) N/A		Method of firing Compression ignition internal combustion engine (CI ICE)	

Indicate how combustion air is supplied to boiler
N/A - internal combustion engine

Indicate the Steam Usage: N/A - internal combustion engine

Mark and describe soot Cleaning Method: N/A - internal combustion engine

- | | |
|---------------------------|--------------------------------|
| i. Air Blown | iv. Other _____ |
| ii. Steam Blown | v. Frequency of Cleaning _____ |
| iii. Brushed and Vacuumed | |

Maximum Operating schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 500 (emergency generator assumption)
-----------------	----------------	------------------	--

Operational restrictions taken or requested, if any (e.g., bottlenecks or voluntary restrictions to limit potential to emit)

Capacity (specify units)

Per hour	Per day	Per week	Per year See Note (*) below
----------	---------	----------	-----------------------------

Typical Operating schedule

Hours/Day 0.5	Days/Week 1	Days/Year 14	Hours/Year 7
------------------	----------------	-----------------	-----------------

Seasonal variations (Months): If variations exist, describe them.

Operating using primary fuel: 12 Months	From January _____ to December _____
Operating using secondary fuel: N/A	From _____ to _____
Non-operating: From N/A	to N/A

2. Specify the primary, secondary and startup fuel. Furnish the details in item 3.
The emergency generator engines will only burn ultra low sulfur diesel fuel and/or renewable diesel as the primary fuel.

*Note: Facility is requesting a site-wide emissions limitation of 24.9 tpy NO_x.

Section B - Combustion Unit Information (Continued)

3. Fuel

Type	Quantity Hourly	Annually	Sulfur	% Ash (Weight)	BTU Content
Oil Number 2	53.6 GPH @ 60°F	26.8X 10 ³ Gal	0.0015% by wt	N/A	137,381Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Natural Gas	SCFH	X 10 ⁶ Gal	gr/100 SCF		Btu/SCF
Gas (other)	SCFH	X 10 ⁶ Gal	gr/100 SCF		Btu/SCF
Coal					
Other*					

* Note: Describe and furnish information separately for other fuels in Addendum B.

4. Burner

Manufacturer N/A - internal combustion engine	Model Number N/A	Type of Atomization (Steam, air, press, mech., rotary cup) N/A
Number of Burners N/A	Maximum fuel firing rate (all burners) N/A	Normal fuel firing rate N/A
If oil, temperature and viscosity. N/A		
Maximum theoretical air requirement N/A		
Percent excess air 100% rating N/A		
Turndown ratio N/A		
Combustion modulation control (on/off, low-high fire, full automatic, manual). Describe. N/A		
Main burner flame ignition method (electric spark, auto gas pilot, hand-held torch, other). Describe. N/A		

5. Nitrogen Oxides (NO_x) control Options - N/A

Mark and describe the NO_x control options adopted

Low excess air (LEA)

Flue gas recirculation

Other. _____

Over fire air (OFA)

Burner out of service

Low-NO_x burner

Reburning

Low NO_x burners with over fire
air

Flue gas treatment (SCR /
SNCR)

Section B - Combustion Unit Information (Continued)

6. Miscellaneous Information

Describe fly ash reinjection operation
N/A

Describe, in detail, the equipment provided to monitor and to record the source(s) operating conditions, which may affect emissions of air contaminants. Show that they are reasonable and adequate.

All engines are equipped with a non-resettable hour meter and a fuel meter to measure fuel usage. The fuel meter is accurate within a tolerance of $\pm 3\%$. The facility will record time of operation and fuel usage during each period of operation.

Describe each proposed modification to an existing source.

N/A

Describe how emissions will be minimized especially during start up, shut down, combustion upsets and/or disruptions. Provide emission estimates for start up, shut down and upset conditions. Provide duration of start up and shut down.

All generators will be EPA-certified and maintained in accordance with manufacturer specifications. The engine certificate of conformity is provided in Appendix 5. See Section C below for emission rates.

Describe in detail with a schematic diagram of the control options adopted for SO₂ (if applicable).

N/A. The facility will combust ultra low sulfur diesel and/or renewable diesel with a maximum sulfur content of 15 parts per million. This will be verified via fuel receipts from fuel suppliers.

Anticipated milestones:

Expected commencement date of construction/reconstruction:	<u>September 2025</u>
Expected completion date of construction/reconstruction:	<u>October 2025</u>
Anticipated date(s) of start-up:	<u>December 2025</u>

*Dates will vary slightly due to large quantity of generators

Section C - Air Cleaning Device

1. Precontrol Emissions*

Emission Rate

Pollutant	Maximum Emission Rate				Calculation/ Estimation Method
	Specify Units	Pounds/Hour	Hours/Year	Tons/Year	
PM	per engine	0.33		N/A**	
PM ₁₀		0.33			
SO _x		0.01			
CO		4.73			
NO _x		14.34			
VOC		1.91			
Others: (e.g., HAPs)	-----	-----	-----		-----

* These emissions must be calculated based on the requested operating schedule and/or process rate, e.g., operating schedule for maximum limits or restricted hours of operation and/or restricted throughput. Describe how the emission values were determined. Attach calculations. **Calculations included in Appendix 6. Emissions calculated based on worst-case generator emission factor and a site-wide emissions limit of 24.9 tpy NO_x.**

2. Gas Conditioning N/A

 Water quenching ☐ YES ☐ NO Water injection rate _____ GPM

 Radiation and convection cooling ☐ YES ☐ NO Air dilution ☐ YES ☐ NO
 If YES, _____ CFM

 Forced draft ☐ YES ☐ NO Water cooled duct work ☐ YES ☐ NO

Other _____

Inlet volume _____ ACFM@ _____ °F	Outlet volume _____ ACFM@ _____ °F _____ % Moisture
--------------------------------------	--

Describe the system in detail.

**Note: Facility is requesting a site-wide emissions limitation of 24.9 tpy NO_x. Hours/Year and Tons/Year were not calculated on a per engine basis but will remain below site-wide emissions limitations.

Section C - Air Cleaning Device (Continued)

10. Costs

Indicate cost associated with air cleaning device and its operating cost (attach documentation if necessary)

Device	Direct Cost	Indirect Cost	Total Cost	Operating Cost
N/A	N/A	N/A	N/A	N/A

11 MISCELLANEOUS

Describe in detail the removal, handling and disposal of dust, effluent, etc. from the air cleaning device including proposed methods of controlling fugitive emissions.

N/A

Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system).

N/A

Attach the maintenance schedule for the control equipment and any part of the process equipment that, if in disrepair, would increase air contaminant emissions.

N/A

Section D - Additional Information

Will the construction, modification, etc. of the sources covered by this application increase emissions from other sources at the facility? If so, describe and quantify.

N/A - new facility

If this project is subject to any one of the following, attach a demonstration to show compliance with applicable standards

- | | | |
|--|---|--|
| a. Prevention of Significant Deterioration permit (PSD), 40 CFR Part 52? | ☐ YES | ☒ NO |
| b. New Source Review, 25 Pa. Code Chapter 127, Subchapter E? | ☐ YES | ☒ NO |
| c. New Source Performance Standards, 40 CFR Part 60?
(If Yes, which subpart) <u>A, IIII</u> | ☒ YES | ☐ NO |
| d. National Emissions Standards for Hazardous Air Pollutants (NESHAPS), 40 CFR Part 61?
If Yes, which subpart) <u>A, ZZZZ</u> | ☒ YES | ☐ NO |
| e. Maximum Achievable Control Technology (MACT), 40 CFR Part 63?
(If Yes, which subpart) _____ | ☐ YES | ☒ NO |

Attach a demonstration showing that the emissions from any new source will be the minimum attainable through the use of best available technology (BAT).

See application narrative.

Provide emission increases and decreases in allowable (or potential) and actual emissions within the last 5 years for applicable PSD pollutant(s) if the facility is an existing major facility (for PSD purposes)

N/A - new PSD minor facility.

Section D - Additional Information (Continued)

Indicate emission increases and decreases in tons per year (tpy), for volatile organic compounds (VOCs) and nitrogen oxides (NOx) for NSR applicability since January 1, 1991 or other applicable dates (See other applicable date in instructions). The emissions increases include all emissions including stack, fugitive, material transfer, other emission generating activities, quantifiable emissions from the exempted source(s), etc.

[illegible]

If the source is subject to 25 Pa. Code Chapter 127, Subchapter E, New Source Review requirements,

- a. Identify Emission Reduction Credits (ERCs) for emission offsets or demonstrate ability to obtain suitable ERCs for emission offsets.
- b. Provide a demonstration that the lowest achievable emission rate (LAER) control techniques will be implemented (if applicable).
- c. Provide an analysis of alternate sites, sizes, production processes and environmental control techniques demonstrating that the benefits of the proposed source outweigh the environmental and social costs (if applicable).

Attach calculations and any additional information necessary to thoroughly evaluate compliance with all the applicable requirements of 25 Pa. Code Article III and applicable requirements of the Clean Air Act and regulations adopted there under. The Department may request additional information to evaluate the application such as a stand by plan, a plan for air pollution emergencies, air quality modeling, etc.

See Appendix 6 and application narrative.

Section E - Compliance Demonstration

Note: Complete this section if the facility is not a Title V facility. Title V facilities must complete Addendum A.

Method of Compliance Type: Check all that apply and complete all appropriate sections below.

- ☐ Monitoring
 ☒ Testing
 ☐ Reporting
☒ Recordkeeping
 ☒ Work Practice Standard

Monitoring: N/A

- a. Monitoring device type (stack test, CEM etc.):
- b. Monitoring device location:
- c. Describe all parameters being monitored along with the frequency and duration of monitoring each parameter:

Testing:

- a. Reference Test Method Citation: USEPA Method 7 or 7E for NOX and USEPA Method 10 for CO.
- b. Reference Test Method Description: Method 7: Determination of Nitrogen Oxide Emissions from Stationary Sources, Method 7E: Determination of Nitrogen Oxide Emissions from Stationary Sources (Instrument Analyzer Procedure), Method 10: Determination of Carbon Monoxide Emissions from Stationary Sources (Instrument Analyzer Procedure) Refer to narrative for proposed testing frequency.

Recordkeeping:

Describe the parameters that will be recorded and the recording frequency:
 For each engine run, record hours of operation, quantity of fuel consumed, and reason for operation.

Reporting: N/A

- a. Describe the type of information to be reported and the reporting frequency:
- b. Reporting start date:

Work Practice Standard: Describe each

All generators will be certified by the manufacturer to meet US EPA emission standards.
 The engine certificate of conformity is provided in Appendix 5.
 The applicant proposes to maintain the generators in accordance with manufacturer specifications.

Section F - Flue and Air Contaminant Emission

1. Estimated Maximum Emissions*

Pollutant	Maximum emission rate			Calculation/ Estimation Method
	specify units	lbs/hr	tons/yr.	
PM	per engine	0.33	N/A***	Manufacturer Data
PM ₁₀		0.33		
SO _x		0.01		
CO		4.73		
NO _x		14.34		
VOC		1.91		
Others: (e.g., HAPs)	-----	-----	-----	-----

* These emissions must be calculated based on the requested operating schedule and/or process rate e.g., operating schedule for maximum limits or restricted hours of operation and /or restricted throughput. Describe how the emission values were determined. Attach calculations. **See Appendix 6. Emissions calculated based on worst-case generator**

2. Stack and Exhauster emission factor and a site-wide emissions limit of 24.9 tpy NO_x.

Stack Designation/Number HG3 through HG4

List Source(s) or source ID exhausted
to this stack: HG3 through HG4

% of flow exhausted to stack:

Each generator exhausts 100% flow to its dedicated stack

Stack height above grade (ft.) 43' w/ 8" ID
Grade elevation (ft.)

Stack diameter (ft) or Outlet duct area (sq. ft.)
~0.83

Weather Cap*

☒ YES ☐ NO

Distance of discharge to nearest property line (ft.). Locate on topographic map.
TBD

*No loss weather heads.

Does stack height meet Good Engineering Practice (GEP)?
Yes

If modeling (estimating) of ambient air quality impacts is needed, attach a site plan with buildings and their dimensions and other obstructions.

Location of Stack** Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
TBD	TBD	TBD	TBD	TBD	TBD	TBD

Stack Exhaust

Volume 6,028 ACFM Temperature 847 °F Moisture 8 %

Exhauster (attach fan curves) TBD in. of water _____ HP @ _____ RPM.

** If the datum and collection method information and codes differ from those provided on the General Information Form - Authorization Application, provide the additional required by that form on a separate sheet.

***Note: Facility is requesting a site-wide emissions limitation of 24.9 tpy NO_x. Tons/Year was not calculated on a per engine basis but will remain below site-wide emissions limitations.

Section G - Attachments

Number and list all attachments submitted with this application below:

Appendix 1 - Facility Location and Layout Map

Appendix 2 - Air Permit Application Forms

Appendix 3 - Municipal Notification

Appendix 4 - Fee Payment Invoice

Appendix 5 - Generator Specification Sheets

Appendix 6 - Potential Emission Calculations

Appendix 7 - Summary of RBLC Review for Diesel-Fired Emergency Engines

Appendix 8 - Renewable Diesel Fuel Specifications

Combustion Unit Information - CAT C32 Generators

Section B - Combustion Unit Information

1. Combustion Units: ☐ Coal ☒ Oil ☐ Natural Gas Other: _____

Description: 2 x 1,000 kW CAT C32 emergency internal combustion engine

Manufacturer Caterpillar	Model No. C32	Number of units: 2	
Maximum heat input (Btu/hr) 9,797,645	Rated heat input (Btu/hr) 9,797,645	Typical heat input (Btu/hr) 9,797,645	Furnace Volume N/A
Grate Area (if applicable) N/A		Method of firing Compression ignition internal combustion engine (CI ICE)	

Indicate how combustion air is supplied to boiler
N/A - internal combustion engine

Indicate the Steam Usage: N/A - internal combustion engine

Mark and describe soot Cleaning Method: N/A - internal combustion engine

- | | |
|---------------------------|--------------------------------|
| i. Air Blown | iv. Other _____ |
| ii. Steam Blown | v. Frequency of Cleaning _____ |
| iii. Brushed and Vacuumed | |

Maximum Operating schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 500 (emergency generator assumption)
-----------------	----------------	------------------	--

Operational restrictions taken or requested, if any (e.g., bottlenecks or voluntary restrictions to limit potential to emit)

Capacity (specify units)

Per hour	Per day	Per week	Per year
----------	---------	----------	----------

Typical Operating schedule

Hours/Day 0.5	Days/Week 1	Days/Year 14	Hours/Year 7
------------------	----------------	-----------------	-----------------

Seasonal variations (Months): If variations exist, describe them.

Operating using primary fuel: 12 Months From January _____ to December _____
 Operating using secondary fuel: N/A From _____ to _____
 Non-operating: From N/A _____ to N/A _____

2. Specify the primary, secondary and startup fuel. Furnish the details in item 3.
 The emergency generator engines will only burn ultra low sulfur diesel fuel and/or renewable diesel as the primary fuel.

*Note: Facility is requesting a site-wide emissions limitation of 24.9 tpy NO_x.

Section B - Combustion Unit Information (Continued)

3. Fuel

Type	Quantity Hourly	Annually	Sulfur	% Ash (Weight)	BTU Content
Oil Number 2	71.5 GPH @ 60°F	35.8 X 10 ³ Gal	0.0015% by wt	N/A	137,381Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Natural Gas	SCFH	X 10 ⁶ Gal	gr/100 SCF		Btu/SCF
Gas (other)	SCFH	X 10 ⁶ Gal	gr/100 SCF		Btu/SCF
Coal					
Other*					

* Note: Describe and furnish information separately for other fuels in Addendum B.

4. Burner

Manufacturer N/A - internal combustion engine	Model Number N/A	Type of Atomization (Steam, air, press, mech., rotary cup) N/A
Number of Burners N/A	Maximum fuel firing rate (all burners) N/A	Normal fuel firing rate N/A
If oil, temperature and viscosity. N/A		
Maximum theoretical air requirement N/A		
Percent excess air 100% rating N/A		
Turndown ratio N/A		
Combustion modulation control (on/off, low-high fire, full automatic, manual). Describe. N/A		
Main burner flame ignition method (electric spark, auto gas pilot, hand-held torch, other). Describe. N/A		

5. Nitrogen Oxides (NO_x) control Options

Mark and describe the NO_x control options adopted

Low excess air (LEA)

Flue gas recirculation

Other. _____

Over fire air (OFA)

Burner out of service

Low-NO_x burner

Reburning

Low NO_x burners with over fire
air

Flue gas treatment (SCR /
SNCR)

Section B - Combustion Unit Information (Continued)

6. Miscellaneous Information

Describe fly ash reinjection operation
N/A

Describe, in detail, the equipment provided to monitor and to record the source(s) operating conditions, which may affect emissions of air contaminants. Show that they are reasonable and adequate.

All engines are equipped with a non-resettable hour meter and a fuel meter to measure fuel usage. The fuel meter is accurate within a tolerance of $\pm 3\%$. The facility will record time of operation and fuel usage during each period of operation.

Describe each proposed modification to an existing source.

N/A

Describe how emissions will be minimized especially during start up, shut down, combustion upsets and/or disruptions. Provide emission estimates for start up, shut down and upset conditions. Provide duration of start up and shut down.

All generators will be EPA-certified and maintained in accordance with manufacturer specifications. The engine certificate of conformity is provided in Appendix 5. See Section C below for emission rates.

Describe in detail with a schematic diagram of the control options adopted for SO₂ (if applicable).

N/A. The facility will combust ultra low sulfur diesel and/or renewable diesel with a maximum sulfur content of 15 parts per million. This will be verified via fuel receipts from fuel suppliers.

Anticipated milestones:

Expected commencement date of construction/reconstruction:	<u>September 2025</u>
Expected completion date of construction/reconstruction:	<u>October 2025</u>
Anticipated date(s) of start-up:	<u>December 2025</u>

Section C - Air Cleaning Device

1. Precontrol Emissions*

Emission Rate

Pollutant	Maximum Emission Rate				Calculation/ Estimation Method
	Specify Units	Pounds/Hour	Hours/Year	Tons/Year	
PM	per engine	0.26	N/A**	N/A**	
PM ₁₀		0.26			
SO _x		0.01			
CO		2.78			
NO _x		19.52			
VOC		0.34			
Others: (e.g., HAPs)	-----	-----	-----		-----

* These emissions must be calculated based on the requested operating schedule and/or process rate, e.g., operating schedule for maximum limits or restricted hours of operation and/or restricted throughput. Describe how the emission values were determined. Attach calculations. **See Appendix 6. Emissions calculated based on worst-case generator emission factor and a site-wide emissions limit of 24.9 tpy NO_x.**

2. Gas Conditioning N/A

 Water quenching ☐ YES ☐ NO Water injection rate _____ GPM

 Radiation and convection cooling ☐ YES ☐ NO Air dilution ☐ YES ☐ NO
 If YES, _____ CFM

 Forced draft ☐ YES ☐ NO Water cooled duct work ☐ YES ☐ NO

Other _____

Inlet volume _____ ACFM@ _____ °F	Outlet volume _____ ACFM@ _____ °F _____ % Moisture
--------------------------------------	--

Describe the system in detail.

**Note: Facility is requesting a site-wide emissions limitation of 24 tpy NO_x. Hours/Year and Tons/Year were not calculated on a per engine basis but will remain below site-wide emissions limitations.

Section C - Air Cleaning Device (Continued)

10. Costs

Indicate cost associated with air cleaning device and its operating cost (attach documentation if necessary)

Device	Direct Cost	Indirect Cost	Total Cost	Operating Cost
N/A	N/A	N/A	N/A	N/A

11 MISCELLANEOUS

Describe in detail the removal, handling and disposal of dust, effluent, etc. from the air cleaning device including proposed methods of controlling fugitive emissions.

N/A

Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system).

N/A

Attach the maintenance schedule for the control equipment and any part of the process equipment that, if in disrepair, would increase air contaminant emissions.

N/A

Section D - Additional Information

Will the construction, modification, etc. of the sources covered by this application increase emissions from other sources at the facility? If so, describe and quantify.

N/A - new facility

If this project is subject to any one of the following, attach a demonstration to show compliance with applicable standards

- | | | |
|--|---|--|
| a. Prevention of Significant Deterioration permit (PSD), 40 CFR Part 52? | ☐ YES | ☒ NO |
| b. New Source Review, 25 Pa. Code Chapter 127, Subchapter E? | ☐ YES | ☒ NO |
| c. New Source Performance Standards, 40 CFR Part 60?
(If Yes, which subpart) <u>A, IIII</u> | ☒ YES | ☐ NO |
| d. National Emissions Standards for Hazardous Air Pollutants (NESHAPS), 40 CFR Part 61?
If Yes, which subpart) <u>A, ZZZZ</u> | ☒ YES | ☐ NO |
| e. Maximum Achievable Control Technology (MACT), 40 CFR Part 63?
(If Yes, which subpart) _____ | ☐ YES | ☒ NO |

Attach a demonstration showing that the emissions from any new source will be the minimum attainable through the use of best available technology (BAT).

See application narrative.

Provide emission increases and decreases in allowable (or potential) and actual emissions within the last 5 years for applicable PSD pollutant(s) if the facility is an existing major facility (for PSD purposes)

N/A - new facility. See Appendix 6 for facility wide emissions.

Section D - Additional Information (Continued)

Indicate emission increases and decreases in tons per year (tpy), for volatile organic compounds (VOCs) and nitrogen oxides (NOx) for NSR applicability since January 1, 1991 or other applicable dates (See other applicable date in instructions). The emissions increases include all emissions including stack, fugitive, material transfer, other emission generating activities, quantifiable emissions from the exempted source(s), etc.

[illegible]

If the source is subject to 25 Pa. Code Chapter 127, Subchapter E, New Source Review requirements,

- a. Identify Emission Reduction Credits (ERCs) for emission offsets or demonstrate ability to obtain suitable ERCs for emission offsets.
- b. Provide a demonstration that the lowest achievable emission rate (LAER) control techniques will be implemented (if applicable).
- c. Provide an analysis of alternate sites, sizes, production processes and environmental control techniques demonstrating that the benefits of the proposed source outweigh the environmental and social costs (if applicable).

Attach calculations and any additional information necessary to thoroughly evaluate compliance with all the applicable requirements of 25 Pa. Code Article III and applicable requirements of the Clean Air Act and regulations adopted there under. The Department may request additional information to evaluate the application such as a stand by plan, a plan for air pollution emergencies, air quality modeling, etc.

See Appendix 6 and application narrative.

Section E - Compliance Demonstration

Note: Complete this section if the facility is not a Title V facility. Title V facilities must complete Addendum A.

Method of Compliance Type: Check all that apply and complete all appropriate sections below.

- ☐ Monitoring
 ☒ Testing
 ☐ Reporting
☒ Recordkeeping
 ☒ Work Practice Standard

Monitoring: N/A

- a. Monitoring device type (stack test, CEM etc.):
- b. Monitoring device location:
- c. Describe all parameters being monitored along with the frequency and duration of monitoring each parameter:

Testing:

- a. Reference Test Method Citation: USEPA Method 7 or 7E for NO_x and USEPA Method 10 for CO.
- b. Reference Test Method Description: Method 7: Determination of Nitrogen Oxide Emissions from Stationary Sources, Method 7E: Determination of Nitrogen Oxide Emissions from Stationary Sources (Instrument Analyzer Procedure), Method 10: Determination of Carbon Monoxide Emissions from Stationary Sources (Instrument Analyzer Procedure) Refer to narrative for proposed testing frequency.

Recordkeeping:

Describe the parameters that will be recorded and the recording frequency:
 For each engine run, record hours of operation, quantity of fuel consumed, and reason for operation.

Reporting: N/A

- a. Describe the type of information to be reported and the reporting frequency:
- b. Reporting start date:

Work Practice Standard: Describe each

All generators will be certified by the manufacturer to meet US EPA emission standards.
 The engine certificate of conformity is provided in Appendix 5.
 The applicant proposes to maintain the generators in accordance with manufacturer specifications.

Section F - Flue and Air Contaminant Emission

1. Estimated Maximum Emissions*

Pollutant	Maximum emission rate			Calculation/ Estimation Method
	specify units	lbs/hr	tons/yr.	
PM	per engine	0.26	N/A***	Manufacturer data
PM ₁₀		0.26		
SO _x		0.01		
CO		2.78		
NO _x		19.52		
VOC		0.34		
Others: (e.g., HAPs)	-----	-----	-----	-----

* These emissions must be calculated based on the requested operating schedule and/or process rate e.g., operating schedule for maximum limits or restricted hours of operation and /or restricted throughput. Describe how the emission values were determined. Attach calculations. **See Appendix 6 Emissions calculated based on worst-case generator**

2. Stack and Exhauster emission factor and a site-wide emissions limit of 24.9 tpy NO_x.

Stack Designation/Number HG1 - HG2

List Source(s) or source ID exhausted to this stack:
HG1 - HG2

% of flow exhausted to stack: 100%

Stack height above grade (ft.)
Grade elevation (ft.)

43' w/
8" ID

Stack diameter (ft) or Outlet duct area (sq. ft.)
~0.66

Weather Cap*

☒ YES ☐ NO

Distance of discharge to nearest property line (ft.). Locate on topographic map.
TBD

*No loss weather heads.

Does stack height meet Good Engineering Practice (GEP)?
Yes

If modeling (estimating) of ambient air quality impacts is needed, attach a site plan with buildings and their dimensions and other obstructions.

Location of Stack** Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
TBD	TBD	TBD	TBD	TBD	TBD	TBD

Stack Exhaust

Volume 8,115 ACFM Temperature 829.5 °F Moisture 8 %

Exhauster (attach fan curves) TBD in. of water _____ HP @ _____ RPM.

** If the datum and collection method information and codes differ from those provided on the General Information Form - Authorization Application, provide the additional required by that form on a separate sheet.

***Note: Facility is requesting a site-wide emissions limitation of 24.9 tpy NO_x. Tons/Year was not calculated on a per engine basis but will remain below site-wide emissions limitations.

Section G - Attachments

Number and list all attachments submitted with this application below:

Appendix 1 - Facility Location and Layout Map

Appendix 2 - Air Permit Application Forms

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Appendix 5 - Generator Specification Sheets

Appendix 6 - Potential Emission Calculations

Appendix 7 - Summary of RBLC Review for Diesel-Fired Emergency Engines

Appendix 8 - Renewable Diesel Fuel Specifications

Combustion Unit Information - CAT 3516E Generators

Section B - Combustion Unit Information

1. Combustion Units: ☐ Coal ☒ Oil ☐ Natural Gas Other: _____

Description: 72 x 2,750 kW Caterpillar 3516E emergency internal combustion engines

Manufacturer Caterpillar	Model No. 3516E	Number of units: 72	
Maximum heat input (Btu/hr) 26,433,087	Rated heat input (Btu/hr) 26,433,087	Typical heat input (Btu/hr) 26,433,087	Furnace Volume N/A
Grate Area (if applicable) N/A		Method of firing Compression ignition internal combustion engine (CI ICE)	

Indicate how combustion air is supplied to boiler
N/A - internal combustion engine

Indicate the Steam Usage: N/A - internal combustion engine

Mark and describe soot Cleaning Method: N/A - internal combustion engine

- | | |
|---------------------------|--------------------------------|
| i. Air Blown | iv. Other _____ |
| ii. Steam Blown | v. Frequency of Cleaning _____ |
| iii. Brushed and Vacuumed | |

Maximum Operating schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 500 (emergency generator assumption)
-----------------	----------------	------------------	--

Operational restrictions taken or requested, if any (e.g., bottlenecks or voluntary restrictions to limit potential to emit)

Capacity (specify units)

Per hour	Per day	Per week	Per year See Note (*) below
----------	---------	----------	-----------------------------

Typical Operating schedule

Hours/Day 0.5	Days/Week 1	Days/Year 14	Hours/Year 7
------------------	----------------	-----------------	-----------------

Seasonal variations (Months): If variations exist, describe them.

Operating using primary fuel: 12 Months	From January to December
Operating using secondary fuel: N/A	From to
Non-operating: From N/A	to N/A

2. Specify the primary, secondary and startup fuel. Furnish the details in item 3.
The emergency generator engines will only burn ultra low sulfur diesel fuel and/or renewable diesel as the primary fuel.

*Note: Facility is requesting a site-wide emissions limitation of 24.9 tpy NO_x.

Section B - Combustion Unit Information (Continued)

3. Fuel

Type	Quantity Hourly	Annually	Sulfur	% Ash (Weight)	BTU Content
Oil Number 2	192.9 GPH @ 60°F	96.5 X 10 ³ Gal	0.0015% by wt	N/A	137,381Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Natural Gas	SCFH	X 10 ⁶ Gal	gr/100 SCF		Btu/SCF
Gas (other)	SCFH	X 10 ⁶ Gal	gr/100 SCF		Btu/SCF
Coal					
Other*					

* Note: Describe and furnish information separately for other fuels in Addendum B.

4. Burner

Manufacturer N/A - internal combustion engine	Model Number N/A	Type of Atomization (Steam, air, press, mech., rotary cup) N/A
Number of Burners N/A	Maximum fuel firing rate (all burners) N/A	Normal fuel firing rate N/A
If oil, temperature and viscosity. N/A		
Maximum theoretical air requirement N/A		
Percent excess air 100% rating N/A		
Turndown ratio N/A		
Combustion modulation control (on/off, low-high fire, full automatic, manual). Describe. N/A		
Main burner flame ignition method (electric spark, auto gas pilot, hand-held torch, other). Describe. N/A		

5. Nitrogen Oxides (NO_x) control Options

Mark and describe the NO_x control options adopted

Low excess air (LEA)

Flue gas recirculation

Other. Diesel Particulate Filter,
Diesel Oxidation Catalyst

Over fire air (OFA)

Burner out of service

Low-NO_x burner

Reburning

Low NO_x burners with over fire
air

Flue gas treatment (SCR /
SNCR)

Section B - Combustion Unit Information (Continued)

6. Miscellaneous Information

Describe fly ash reinjection operation
N/A

Describe, in detail, the equipment provided to monitor and to record the source(s) operating conditions, which may affect emissions of air contaminants. Show that they are reasonable and adequate.

All engines are equipped with a non-resettable hour meter and a fuel meter to measure fuel usage. The fuel meter is accurate within a tolerance of $\pm 3\%$. The facility will record time of operation and fuel usage during each period of operation. The facility will record when each engine is operating with emissions controls and when it operates uncontrolled. The engines are equipped with electric preheaters to achieve an effective catalyst bed temperature prior to planned start-up to minimize uncontrolled emissions.

Describe each proposed modification to an existing source.

N/A

Describe how emissions will be minimized especially during start up, shut down, combustion upsets and/or disruptions. Provide emission estimates for start up, shut down and upset conditions. Provide duration of start up and shut down.

All generators will be EPA-certified and maintained in accordance with manufacturer specifications. Emissions for NO_x will be uncontrolled until the catalyst bed of the selective catalytic reduction (SCR) reaches a temperature that will effectively control emissions. Typically, the SCR catalyst bed reaches its effective temperature of 572°F within 6-15 minutes of generator start-up, dependent on ambient conditions and generator load. The generators will be equipped with SCR preheaters that can be manually activated in advance of any planned runs, which would result in immediate control of NO_x emissions. Start-up and shut-down emissions during planned operations are not anticipated for the DPF or DOC control devices as the catalyst bed is expected to reach appropriate temperatures quickly upon generator operation. See Section C and Section F below for emission rates.

Describe in detail with a schematic diagram of the control options adopted for SO₂ (if applicable).

N/A. The facility will combust ultra low sulfur diesel and/or renewable diesel with a maximum sulfur content of 15 parts per million. This will be verified via fuel receipts from fuel suppliers.

Anticipated milestones:

Expected commencement date of construction/reconstruction:	<u>September 2025</u>
Expected completion date of construction/reconstruction:	<u>October 2025</u>
Anticipated date(s) of start-up:	<u>December 2025</u>

*Dates will vary due to quantity of engines

Section C - Air Cleaning Device

1. Precontrol Emissions*

Emission Rate

Pollutant	Maximum Emission Rate				Calculation/ Estimation Method
	Specify Units	Pounds/Hour	Hours/Year	Tons/Year	
PM	per engine	0.83	N/A**	N/A**	
PM ₁₀		0.83			
SO _x		0.04			
CO		10.34			
NO _x		53.48			
VOC		0.89			
Others: (e.g., HAPs)	-----	-----	-----		-----

* These emissions must be calculated based on the requested operating schedule and/or process rate, e.g., operating schedule for maximum limits or restricted hours of operation and/or restricted throughput. Describe how the emission values were determined. Attach calculations. **See Appendix 6. Emissions calculated based on worst-case generator emission factor and a site-wide emissions limit of 24.9 tpy NO_x.**

2. Gas Conditioning N/A

 Water quenching ☐ YES ☐ NO Water injection rate _____ GPM

 Radiation and convection cooling ☐ YES ☐ NO Air dilution ☐ YES ☐ NO
 If YES, _____ CFM

 Forced draft ☐ YES ☐ NO Water cooled duct work ☐ YES ☐ NO

Other _____

Inlet volume _____ ACFM@ _____ °F	Outlet volume _____ ACFM@ _____ °F _____ % Moisture
--------------------------------------	--

Describe the system in detail.

**Note: Facility is requesting a site-wide emissions limitation of 24.9 tpy NO_x. Hours/Year and Tons/Year were not calculated on a per engine basis but will remain below site-wide emissions limitations.

Section C - Air Cleaning Device (Continued)

8. ☒ **SELECTIVE CATALYTIC REDUCTION (SCR)**
☐ **SELECTIVE NON-CATALYTIC REDUCTION (SNCR)**
☐ **NON-SELECTIVE CATALYTIC REDUCTION (NSCR)**

Equipment specifications

Manufacturer TBD - CAT, MiraTech, or Safety Power	Type TBD	Model No TBD
--	-------------	-----------------

Design inlet volume (SCFM) up to 22,051.6	Design operating temperature (°F) 897
--	--

Is the system equipped with process controls for proper mixing/control of the reducing agent in gas stream? If yes, give details.

System doses urea at optimal rate to control emissions. Additional details for each SCR manufacturer are provided in Appendix 5

Attach efficiency and other pertinent information (e.g., Ammonia, urea slip).

See Appendix 5

Operating parameters

Volume of gases handled (ACFM) up to 22,051.6 @ 897 (°F)

Operating temperature range for the SCR/SNCR/NSCR system (°F) From 572 To greater than 572

Reducing agent used, if any. Urea	Oxidation catalyst used, if any. Diesel Oxidation Catalyst
--------------------------------------	---

State expected range of usage rate and concentration.

Approx 10.3 USG/hr

Service life of catalyst Approx 8,000 operating hours	Ammonia slip (ppm) Approx 8 ppm
--	------------------------------------

Describe fully with a sketch giving locations of equipment, controls system, important parameters and method of operation.

See diagram included in Appendix 5. Important Parameters: Urea dosing and catalyst bed temperature.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

The system is equipped with safety alarms; exhaust temperature sensor and alarm; urea low level alarm; and general system alarm.

Emissions data

Pollutant	Inlet	Outlet	Removal Efficiency (%)
NOx	6.00 g/bhp-hr	0.50 g/bhp-hr	91.7% (min all manufacturers)
CO	1.16 g/bhp-hr	0.35 g/bhp-hr	70% (min all manufacturers)
HC	0.10 g/bhp-hr	0.06 g/bhp-hr	40% (min all manufacturers)

Section C - Air Cleaning Device (Continued)

9. Other Control Equipment: Diesel Particulate Filter (DPF)

Equipment specifications

Manufacturer TBD - CAT, MiraTech, or Safety Power	Type Filter	Model No TBD	
Design inlet volume (SCFM) up to 22,051.6	Capacity See attached		
Describe pH monitoring and pH adjustment, if any. N/A			
Indicate the liquid flow rate and describe equipment provided to measure pressure drop and flow rate, if any. N/A			
Attach efficiency curve and/ or other efficiency information. See Appendix 5 for control efficiencies from manufacturers			
Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment. See Appendix 5			
Operating parameters			
Volume of gas handled up to 22,051.6 @ 897 °F 8 % Moisture			
Describe, in detail, important parameters and method of operation. For SCR and DOC, important parameters include urea dosing amount and catalyst bed temperature. For DPF, important parameters include exhaust system backpressure. Refer to specifications in Appendix 5 for more details.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements. The system is equipped with safety alarms; DPF trouble alarm; and general system alarm.			
Emissions data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)
PM	0.07 g/bhp-hr	0.02 g/bhp-hr	68.6% (min all manufacturers)

Section C - Air Cleaning Device (Continued)

10. Costs

Indicate cost associated with air cleaning device and its operating cost (attach documentation if necessary)

Device	Direct Cost	Indirect Cost	Total Cost	Operating Cost
SCR/DOC/DPF	TBD	TBD	TBD	TBD

11 MISCELLANEOUS

Describe in detail the removal, handling and disposal of dust, effluent, etc. from the air cleaning device including proposed methods of controlling fugitive emissions.

N/A

Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system).

See Appendix 5.

Attach the maintenance schedule for the control equipment and any part of the process equipment that, if in disrepair, would increase air contaminant emissions.

ADS will follow the manufacturer recommended maintenance schedule to ensure proper operation of the control equipment. Manuals have been provided in Appendix 5.

Section D - Additional Information

Will the construction, modification, etc. of the sources covered by this application increase emissions from other sources at the facility? If so, describe and quantify.

N/A - new facility

If this project is subject to any one of the following, attach a demonstration to show compliance with applicable standards

- | | | |
|--|---|--|
| a. Prevention of Significant Deterioration permit (PSD), 40 CFR Part 52? | ☐ YES | ☒ NO |
| b. New Source Review, 25 Pa. Code Chapter 127, Subchapter E? | ☐ YES | ☒ NO |
| c. New Source Performance Standards, 40 CFR Part 60?
(If Yes, which subpart) <u>A, IIII</u> | ☒ YES | ☐ NO |
| d. National Emissions Standards for Hazardous Air Pollutants (NESHAPS), 40 CFR Part 61?
If Yes, which subpart) <u>A, ZZZZ</u> | ☒ YES | ☐ NO |
| e. Maximum Achievable Control Technology (MACT), 40 CFR Part 63?
(If Yes, which subpart) _____ | ☐ YES | ☒ NO |

Attach a demonstration showing that the emissions from any new source will be the minimum attainable through the use of best available technology (BAT).

See application narrative.

Provide emission increases and decreases in allowable (or potential) and actual emissions within the last 5 years for applicable PSD pollutant(s) if the facility is an existing major facility (for PSD purposes)

N/A - new PSD minor facility.

Section D - Additional Information (Continued)

Indicate emission increases and decreases in tons per year (tpy), for volatile organic compounds (VOCs) and nitrogen oxides (NOx) for NSR applicability since January 1, 1991 or other applicable dates (See other applicable date in instructions). The emissions increases include all emissions including stack, fugitive, material transfer, other emission generating activities, quantifiable emissions from the exempted source(s), etc.

Permit number (if applicable)	Date issued	Indicate Yes or No if emission increases and decreases were used previously for netting	Source I.D. or Name	VOCs		NOx	
				Emission increases in potential to emit (tpy)	Creditable emission decreases in actual emissions (tpy)	Emission increases in potential to emit (tpy)	Creditable emission decreases in actual emissions (tpy)
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

If the source is subject to 25 Pa. Code Chapter 127, Subchapter E, New Source Review requirements,

- a. Identify Emission Reduction Credits (ERCs) for emission offsets or demonstrate ability to obtain suitable ERCs for emission offsets.
- b. Provide a demonstration that the lowest achievable emission rate (LAER) control techniques will be implemented (if applicable).
- c. Provide an analysis of alternate sites, sizes, production processes and environmental control techniques demonstrating that the benefits of the proposed source outweigh the environmental and social costs (if applicable).

Attach calculations and any additional information necessary to thoroughly evaluate compliance with all the applicable requirements of 25 Pa. Code Article III and applicable requirements of the Clean Air Act and regulations adopted there under. The Department may request additional information to evaluate the application such as a stand by plan, a plan for air pollution emergencies, air quality modeling, etc.

See attached.

Section E - Compliance Demonstration

Note: Complete this section if the facility is not a Title V facility. Title V facilities must complete Addendum A.

Method of Compliance Type: Check all that apply and complete all appropriate sections below.

- ☒ Monitoring
 ☒ Testing
 ☐ Reporting
☒ Recordkeeping
 ☒ Work Practice Standard

Monitoring:

- a. Monitoring device type (stack test, CEM etc.): SCR catalyst bed temperature measurement
- b. Monitoring device location: Engine exhaust inlet to SCR
- c. Describe all parameters being monitored along with the frequency and duration of monitoring each parameter: The SCR catalyst bed temperature will be monitored and recorded once every 15 minutes during operation. When the catalyst bed temperature is greater than 572°F, the emissions for NO_x will be considered controlled emissions. ADS will assume DOC/DPF are controlling CO, VOC, and/or PM emissions at all times unless the unit is experiencing alarms and/or downtime.

Testing:

- a. Reference Test Method Citation: USEPA Method 7 or 7E for NO_x, USEPA Method 10 for CO, and USEPA Conditional Test Method 027 for Ammonia Slip.
- b. Reference Test Method Description: Method 7: Determination of Nitrogen Oxide Emissions from Stationary Sources, Method 7E: Determination of Nitrogen Oxide Emissions from Stationary Sources (Instrument Analyzer Procedure), Method 10: Determination of Carbon Monoxide Emissions from Stationary Sources (Instrument Analyzer Procedure), Method 027: Procedure for Collection and Analysis of Ammonia in Stationary Sources
Refer to narrative for proposed testing frequency.

Recordkeeping:

Describe the parameters that will be recorded and the recording frequency:

For each engine run, record hours of operation, quantity of fuel consumed, emission control status (controlled or uncontrolled), and reason for operation. The SCR catalyst bed temperature will be monitored and recorded once every 15 minutes during operation. When the catalyst bed temperature is greater than 572°F, and urea is dosing, the emissions for NO_x will be considered controlled emissions. ADS will assume DOC/DPF are controlling CO, VOC, and/or PM emissions at all times unless the unit is experiencing alarms and/or downtime.

Reporting: N/A

- a. Describe the type of information to be reported and the reporting frequency:
- b. Reporting start date:

Work Practice Standard: Describe each

All generators will be certified by the manufacturer to meet US EPA emission standards. The engine certificate of conformity and control device manuals have been provided in Appendix 5. The applicant proposes to maintain the generators and control devices in accordance with manufacturer specifications.

Section F - Flue and Air Contaminant Emission

1. Estimated Maximum Emissions*

Pollutant	Maximum emission rate			Calculation/ Estimation Method
	specify units	lbs/hr	tons/yr.	
PM	per engine	0.40		Manufacturer data
PM ₁₀		0.40		
SO _x		0.04		
CO		3.10		
NO _x		4.44		
VOC		0.53		
Others: (e.g., HAPs)	-----	-----	-----	-----

* These emissions must be calculated based on the requested operating schedule and/or process rate e.g., operating schedule for maximum limits or restricted hours of operation and /or restricted throughput. Describe how the emission values were determined. Attach calculations. **See Appendix 6. Emissions calculated based on worst-case generator**

2. Stack and Exhauster emission factor and a site-wide emissions limit of 24.9 tpy NO_x.

Stack Designation/Number CEG1 through CEG72

List Source(s) or source ID exhausted to this stack: CEG1 through CEG72	% of flow exhausted to stack: Each generator exhausts 100% flow to its dedicated stack
---	---

Stack height above grade (ft.) 44' w/ 8' ID Grade elevation (ft.)	Stack diameter (ft) or Outlet duct area (sq. ft.) 1	Weather Cap* ☒ YES ☐ NO
--	--	---

Distance of discharge to nearest property line (ft.). Locate on topographic map. *No loss weather heads.
TBD

Does stack height meet Good Engineering Practice (GEP)?

Yes

If modeling (estimating) of ambient air quality impacts is needed, attach a site plan with buildings and their dimensions and other obstructions.

Location of Stack** Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
TBD	TBD	TBD	TBD	TBD	TBD	TBD

Stack Exhaust

Volume Up to 22,051.6 ACFM Temperature 897 °F Moisture 8 %

Exhauster (attach fan curves) TBD in. of water _____ HP @ _____ RPM.

** If the datum and collection method information and codes differ from those provided on the General Information Form - Authorization Application, provide the additional required by that form on a separate sheet.

***Note: Facility is requesting a site-wide emissions limitation of 24.9 tpy NO_x. Tons/Year was not calculated on a per engine basis but will remain below site-wide emissions limitations.

Section G - Attachments

Number and list all attachments submitted with this application below:

Appendix 1 - Facility Location and Layout Map

Appendix 2 - Air Permit Application Forms

Appendix 3 - Municipal Notification

Appendix 4 - Fee Payment Invoice

Appendix 5 - Generator Specification Sheets

Appendix 6 - Potential Emission Calculations

Appendix 7 - Summary of RBLC Review for Diesel-Fired Emergency Engines

Appendix 8 - Renewable Diesel Fuel Specifications

Processes - Diesel Belly Tanks

2700-PM-AQ0007 Rev. 7/2004



Submit in Triplicate

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

PROCESSES

Application for Plan Approval to Construct, Modify or Reactivate an Air Contamination Source and/or Install an Air Cleaning Device

This application must be submitted with the General Information Form (GIF).

Before completing this form, read the instructions provided for the form.

Section A - Facility Name, Checklist And Certification

Organization Name or Registered Fictitious Name/Facility Name: Amazon Data Services, Inc

DEP Client ID# (if known): TBD

Type of Review required and Fees:

- ☒ Source which is not subject to NSPS, NESHAPs, MACT, NSR and PSD: \$ _____
- ☐ Source requiring approval under NSPS or NESHAPS or both: \$ _____
- ☐ Source requiring approval under NSR regulations: \$ _____
- ☐ Source requiring the establishment of a MACT limitation: \$ _____
- ☐ Source requiring approval under PSD: \$ _____

Applicant's Checklist

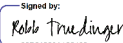
Check the following list to make sure that all the required documents are included.

- ☒ **General Information Form (GIF)**
- ☒ **Processes Plan Approval Application**
- ☒ **Compliance Review Form** or provide reference of most recently submitted compliance review form for facilities submitting on a periodic basis: _____
- ☒ **Copy and Proof of County and Municipal Notifications**
- ☒ **Permit Fees**

NA **Addendum A:** Source Applicable Requirements (only applicable to existing Title V facility)

Certification of Truth, Accuracy and Completeness by a Responsible Official

I, Robb Truedinger, certify under penalty of law in 18 Pa. C. S. A. §4904, and 35 P.S. §4009(b) (2) that based on information and belief formed after reasonable inquiry, the statements and information in this application are true, accurate and complete.

(Signature): 

Date: April 30, 2025

Name (Print): Robb Truedinger

Title: Authorized Representative

OFFICIAL USE ONLY

Application No. _____ Unit ID _____ Site ID _____

DEP Client ID #: _____ APS. ID _____ AUTH. ID _____

Date Received _____ Date Assigned _____ Reviewed By _____

Date of 1st Technical Deficiency _____ Date of 2nd Technical Deficiency _____

Comments: _____

Section B - Processes Information

1. Source Information

Source Description (give type, use, raw materials, product, etc). Attach additional sheets as necessary.

76 diesel belly storage tanks to provide fuel for the 76 diesel emergency generator engines. The tank design varies slightly between the engines. Worst case information is provided here. See **Appendix 6** for more information.

Manufacturer CAT	Model No. varies	Number of Sources 76
Source Designation DBT1-DBT76	Maximum Capacity 6,300 gal	Rated Capacity 96,450 gal/yr/tank
Type of Material Processed Diesel Fuel		

Maximum Operating Schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8,760
Operational restrictions existing or requested, if any (e.g., bottlenecks or voluntary restrictions to limit PTE)			

Capacity (specify units)

Per Hour 192.9 gal	Per Day 4,630 gal	Per Week 32,407 gal	Per Year 96,450 gal
-----------------------	----------------------	------------------------	------------------------

Operating Schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8,760
-----------------	----------------	------------------	---------------------

Seasonal variations (Months) From January to December

If variations exist, describe them
N/A

2. Fuel

Type	Quantity Hourly	Annually	Sulfur	% Ash (Weight)	BTU Content
Oil Number 2	192.9 GPH @ 60°F	96.5 X 10 ³ Gal	0.0015% by wt	N/A	137,381 Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number _____	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Natural Gas	SCFH	X 10 ⁶ SCF	grain/100 SCF		Btu/SCF
Gas (other) _____	SCFH	X 10 ⁶ SCF	grain/100 SCF		Btu/SCF
Coal _____	TPH	Tons	% by wt		Btu/lb
Other * _____					

*Note: Describe and furnish information separately for other fuels in Addendum B.

Section B - Processes Information (Continued)

3. Burner - N/A

Manufacturer	Type and Model No.	Number of Burners
Description:		
Rated Capacity	Maximum Capacity	

4. Process Storage Vessels - N/A

A. For Liquids:

Name of material stored		
Tank I.D. No.	Manufacturer	Date Installed
Maximum Pressure	Capacity (gallons/Meter ³)	
Type of relief device (pressure set vent/conservation vent/emergency vent/open vent)		
Relief valve/vent set pressure (psig)	Vapor press. of liquid at storage temp. (psia/kPa)	
Type of Roof: Describe:		
Total Throughput Per Year	Number of fills per day (fill/day): Filling Rate (gal./min.): Duration of fill hr./fill):	

B. For Solids

Type: ☐ Silo ☐ Storage Bin ☐ Other, Describe		Name of Material Stored
Silo/Storage Bin I.D. No.	Manufacturer	Date Installed
State whether the material will be stored in loose or bags in silos		Capacity (Tons)
Turn over per year in tons		Turn over per day in tons
Describe fugitive dust control system for loading and handling operations		
Describe material handling system		

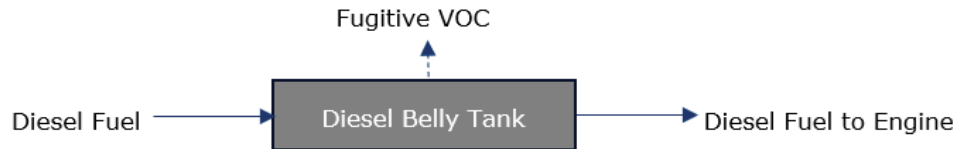
5. Request for Confidentiality

Do you request any information on this application to be treated as "Confidential"? ☐ Yes ☒ No
 If yes, include justification for confidentiality. Place such information on separate pages marked "confidential".

Section B - Processes Information (Continued)

6. Miscellaneous Information

Attach flow diagram of process giving all (gaseous, liquid and solid) flow rates. Also, list all raw materials charged to process equipment, and the amounts charged (tons/hour, etc.) at rated capacity (give maximum, minimum and average charges describing fully expected variations in production rates). Indicate (on diagram) all points where contaminants are controlled (location of water sprays, collection hoods, or other pickup points, etc.). Describe collection hoods location, design, airflow and capture efficiency. Describe any restriction requested and how it will be monitored.



Describe fully the facilities provided to monitor and to record process operating conditions, which may affect the emission of air contaminants. Show that they are reasonable and adequate.

N/A

Describe each proposed modification to an existing source.

N/A

Identify and describe all fugitive emission points, all relief and emergency valves and any by-pass stacks. All tanks are associated with an emergency generator engine. Emissions are fugitive in nature.

Describe how emissions will be minimized especially during start up, shut down, process upsets and/or disruptions.

N/A

Anticipated Milestones:

- | | |
|--|-----------------------|
| i. Expected commencement date of construction/reconstruction/installation: | <u>September 2025</u> |
| ii. Expected completion date of construction/reconstruction/installation: | <u>October 2025</u> |
| iii. Anticipated date of start-up: | <u>December 2025</u> |

*Dates may vary due to quantity of tanks

Section C - Air Cleaning Device

1. Precontrol Emissions*

Pollutant	Maximum Emission Rate				Calculation/ Estimation Method
	Specify Units	Pounds/Hour	Hours/Year	Tons/Year	
PM					
PM ₁₀					
SO _x					
CO					
NO _x					
VOC	per tank	0.0003	8,760	0.0015	AP-42
Others: (e.g., HAPs)	-----	-----	-----	-----	-----

* These emissions must be calculated based on the requested operating schedule and/or process rate, e.g., operating schedule for maximum limits or restricted hours of operation and/or restricted throughput. Describe how the emission values were determined. Attach calculations. See Appendix 6

2. Gas Cooling N/A

Water quenching ☐ Yes ☐ No		Water injection rate _____ GPM	
Radiation and convection cooling ☐ Yes ☐ No		Air dilution ☐ Yes ☐ No If yes, _____ CFM	
Forced Draft ☐ Yes ☐ No		Water cooled duct work ☐ Yes ☐ No	
Other			
Inlet Volume _____ ACFM @ _____ °F _____ % Moisture		Outlet Volume _____ ACFM @ _____ °F _____ % Moisture	

Describe the system in detail.

Section C - Air Cleaning Device (Continued)

14. Costs

Indicate cost associated with air cleaning device and its operating cost (attach documentation if necessary)

Device	Direct Cost	Indirect Cost	Total Cost	Annual Operating Cost
N/A	N/A	N/A	N/A	N/A

15. Miscellaneous

Describe in detail the removal, handling and disposal of dust, effluent, etc. from the air cleaning device including proposed methods of controlling fugitive emissions.

N/A

Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system).

N/A

Attach the maintenance schedule for the control equipment and any part of the process equipment that if in disrepair would increase air contaminant emissions.

N/A

Section D - Additional Information

Will the construction, modification, etc. of the sources covered by this application increase emissions from other sources at the facility? If so, describe and quantify.

N/A - New Facility

If this project is subject to any one of the following, attach a demonstration to show compliance with applicable standards.

- | | | |
|---|------------------------------|--|
| a. Prevention of Significant Deterioration permit (PSD), 40 CFR 52? | ☐ YES | ☒ NO |
| b. New Source Review (NSR), 25 Pa. Code Chapter 127, Subchapter E? | ☐ YES | ☒ NO |
| c. New Source Performance Standards (NSPS), 40 CFR Part 60?
(If Yes, which subpart) _____ | ☐ YES | ☒ NO |
| d. National Emissions Standards for Hazardous Air Pollutants (NESHAP),
40 CFR Part 61? (If Yes, which subpart) _____ | ☐ YES | ☒ NO |
| e. Maximum Achievable Control Technology (MACT) 40 CFR Part 63?
(If Yes, which part) _____ | ☐ YES | ☒ NO |

Attach a demonstration showing that the emissions from any new sources will be the minimum attainable through the use of best available technology (BAT).

N/A

Provide emission increases and decreases in allowable (or potential) and actual emissions within the last five (5) years for applicable PSD pollutant(s) if the facility is an existing major facility (PSD purposes).

N/A - new PSD minor facility.

Section D - Additional Information (Continued)

Indicate emission increases and decreases in tons per year (tpy), for volatile organic compounds (VOCs) and nitrogen oxides (NOx) for NSR applicability since January 1, 1991 or other applicable dates (see other applicable dates in instructions). The emissions increases include all emissions including stack, fugitive, material transfer, other emission generating activities, quantifiable emissions from exempted source(s), etc.

Permit number (if applicable)	Date issued	Indicate Yes or No if emission increases and decreases were used previously for netting	Source I. D. or Name	VOCs		NOx	
				Emission increases in potential to emit (tpy)	Creditable emission decreases in actual emissions (tpy)	Emission increases in potential to emit (tpy)	Creditable emission decreases in actual emissions (tpy)
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

If the source is subject to 25 Pa. Code Chapter 127, Subchapter E, New Source Review requirements,

- a. Identify Emission Reduction Credits (ERCs) for emission offsets or demonstrate ability to obtain suitable ERCs for emission offsets.
- b. Provide a demonstration that the lowest achievable emission rate (LAER) control techniques will be employed (if applicable).
- c. Provide an analysis of alternate sites, sizes, production processes and environmental control techniques demonstrating that the benefits of the proposed source outweigh the environmental and social costs (if applicable).

Attach calculations and any additional information necessary to thoroughly evaluate compliance with all the applicable requirements of Article III and applicable requirements of the Clean Air Act adopted thereunder. The Department may request additional information to evaluate the application such as a standby plan, a plan for air pollution emergencies, air quality modeling, etc.

Section F - Flue and Air Contaminant Emission

1. Estimated Atmospheric Emissions* See Appendix 6.

Pollutant	Maximum emission rate			Calculation/ Estimation Method
	specify units	lbs/hr	tons/yr.	
PM				
PM ₁₀				
SO _x				
CO				
NO _x				
VOC	per tank	0.0003	0.0015	AP-42
Others: (e.g., HAPs)	-----	-----	-----	-----

* These emissions must be calculated based on the requested operating schedule and/or process rate e.g., operating schedule for maximum limits or restricted hours of operation and /or restricted throughput. Describe how the emission values were determined. Attach calculations.

2. Stack and Exhauster N/A - all tanks are fugitive sources.

Stack Designation/Number

List Source(s) or source ID exhausted to this stack:

% of flow exhausted to stack:

Stack height above grade (ft.)
Grade elevation (ft.)

Stack diameter (ft) or Outlet duct area (sq. ft.)

f. Weather Cap
☐ YES ☐ NO

Distance of discharge to nearest property line (ft.). Locate on topographic map.

Does stack height meet Good Engineering Practice (GEP)?

If modeling (estimating) of ambient air quality impacts is needed, attach a site plan with buildings and their dimensions and other obstructions.

Location of stack** Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds

Stack exhaust

Volume _____ ACFM

Temperature _____ °F

Moisture _____ %

Indicate on an attached sheet the location of sampling ports with respect to exhaust fan, breeching, etc. Give all necessary dimensions.

Exhauster (attach fan curves) _____ in. of water _____ HP @ _____ RPM.

** If the data and collection method codes differ from those provided on the General Information Form-Authorization Application, provide the additional detail required by that form on a separate form.

Section G - Attachments

Number and list all attachments submitted with this application below:

- Appendix 1 - Facility Location and Layout Map
- Appendix 2 - Air Permit Application Forms
- Appendix 3 - Municipal Notification
- Appendix 4 - Fee Payment Invoice
- Appendix 5 - Generator Specification Sheets
- Appendix 6 - Potential Emission Calculations
- Appendix 7 - Summary of RBLC Review for Diesel-Fired Emergency Engines
- Appendix 8 - Renewable Diesel Specifications

APPENDIX 3
MUNICIPAL NOTIFICATION

May 1, 2025

Bucks County Administration Building
55 East Court Street
Doylestown, PA 18901

**NOTIFICATION OF APPLICATION FOR A MINOR NEW SOURCE REVIEW
PLAN APPROVAL**

To Whom It May Concern:

Ramboll Americas Engineering Solutions, Inc. (Ramboll) has submitted a Minor New Source Review (NSR) Plan Approval application to the Pennsylvania Department of Environmental Protection (PADEP) on behalf of our client, Amazon Data Services, Inc. (ADS).

ADS is proposing to construct a data center in Falls Township, Bucks County, Pennsylvania at 600 Ben Fairless Drive. The facility will include 76 diesel-fired emergency generators as well as their respective diesel belly storage tanks.

Through this letter, Ramboll is notifying Bucks County that the application has been submitted. Per 25 Pa. Code 127.43a, there is a 30-day comment period which begins upon your receipt of this notice. If you have any questions, please feel free to contact us at your convenience.

Yours sincerely,



Kaitlyn Bencosme

Senior Managing Consultant
912-656-6256
kbencosme@ramboll.com



Ali Farnoud

Principal
703-516-2417
afarnoud@ramboll.com



May 05, 2025

Dear Customer,

The following is the proof-of-delivery for tracking number: 880951542900

Delivery Information:

Status:	Delivered	Delivered To:	Shipping/Receiving
Signed for by:	O.Morris	Delivery Location:	
Service type:	FedEx 2Day AM		
Special Handling:	Deliver Weekday		DOYLESTOWN, PA,
		Delivery date:	May 5, 2025 09:06

Shipping Information:

Tracking number:	880951542900	Ship Date:	May 1, 2025
		Weight:	0.5 LB/0.23 KG
Recipient:		Shipper:	
DOYLESTOWN, PA, US,		ARLINGTON, VA, US,	

Reference 1940110031

Proof-of-delivery details appear below; however, no signature is available for this FedEx Express shipment because a signature was not required.

Thank you for choosing FedEx

May 1, 2025

Falls Township Administration Office
450 Lincoln Highway
Fairless Hills, PA 19030

**NOTIFICATION OF APPLICATION FOR A MINOR NEW SOURCE REVIEW
PLAN APPROVAL**

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Through this letter, Ramboll is notifying Falls Township that the application has been submitted. Per 25 Pa. Code 127.43a, there is a 30-day comment period which begins upon your receipt of this notice. If you have any questions, please feel free to contact us at your convenience.

Yours sincerely,



Kaitlyn Bencosme

Senior Managing Consultant
912-656-6256
kbencosme@ramboll.com



Ali Farnoud

Principal
703-516-2417
afarnoud@ramboll.com



May 05, 2025

Dear Customer,

The following is the proof-of-delivery for tracking number: 880951642464

Delivery Information:

Status:	Delivered	Delivered To:	Shipping/Receiving
Signed for by:	M.Haxel	Delivery Location:	
Service type:	FedEx 2Day AM		
Special Handling:	Deliver Weekday		FAIRLESS HILLS, PA,
		Delivery date:	May 5, 2025 10:22

Shipping Information:

Tracking number:	880951642464	Ship Date:	May 1, 2025
		Weight:	0.5 LB/0.23 KG
Recipient:		Shipper:	
FAIRLESS HILLS, PA, US,		ARLINGTON, VA, US,	

Reference 1940110031

FedEx Express proof-of-delivery details appear below; however, no signature is currently available for this shipment. Please check again later for a signature.

Thank you for choosing FedEx

APPENDIX 4
FEE PAYMENT INVOICE



AIR QUALITY FEES FOR NEW PLAN APPROVAL

Company Information				
Federal Tax ID: 91-1986543		Firm Name: Amazon Data Services, Inc		
Permit # (If any): N/A		Facility Name: PNE100		
Municipality: Falls Township		County: Bucks		
Contact Person Name: Andrew Cangey		Telephone Number: (724) 674-4033		
E-mail: cangeyac@amazon.com				
New Plan Approval (The following fees are cumulative.)				
Line #	Check the appropriate boxes below	Type of review requested	Fee 2021 - 2025	Total Fees
1	Base Fee	Subchapter B	\$2,500	\$2,500
2	☐	New Source Review, Subchapter E	\$7,500	
3	☒	NSPS/NESHAP /MACT standard A. # of NSPS: 1 B. # of NESHAP/MACT: 1 C. Add lines A and B: 2 D. Maximum applicable standards: 3 E. Enter smaller of line C or line D: 2 Multiply line E by \$2,500 and enter the amount in the "Total Fees" column.	\$2,500	\$5,000
4	☐	Case-by-Case MACT	\$9,500	
5	☐	Prevention of Significant Deterioration (PSD) requirements. Subchapter D	\$32,500	
6	☐	Plantwide Applicability Limit (PAL) for NSR regulated pollutants or PAL for PSD regulated pollutants or both	\$7,500	
7	☐	Risk Assessment Analysis – Inhalation only	\$10,000	
8	☐	Risk Assessment Analysis – Multi-pathway	\$25,000	
Add Lines 1 thru 8 of Total Fees column and write it here. —————→				\$7,500

APPENDIX 5.A
2,750 KW GENERATOR MANUFACTURER SPECIFICATIONS
AND EMISSIONS DATA SHEETS

Cat® 3516E

Diesel Generator Sets

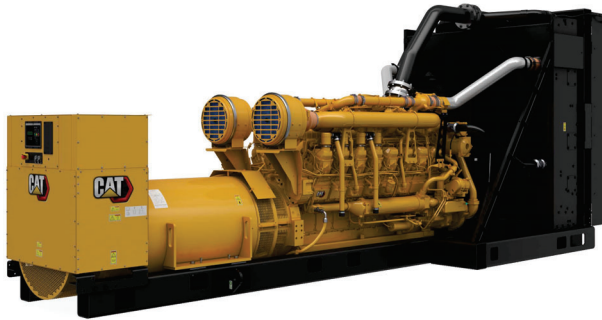


Image shown may not reflect actual configuration

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

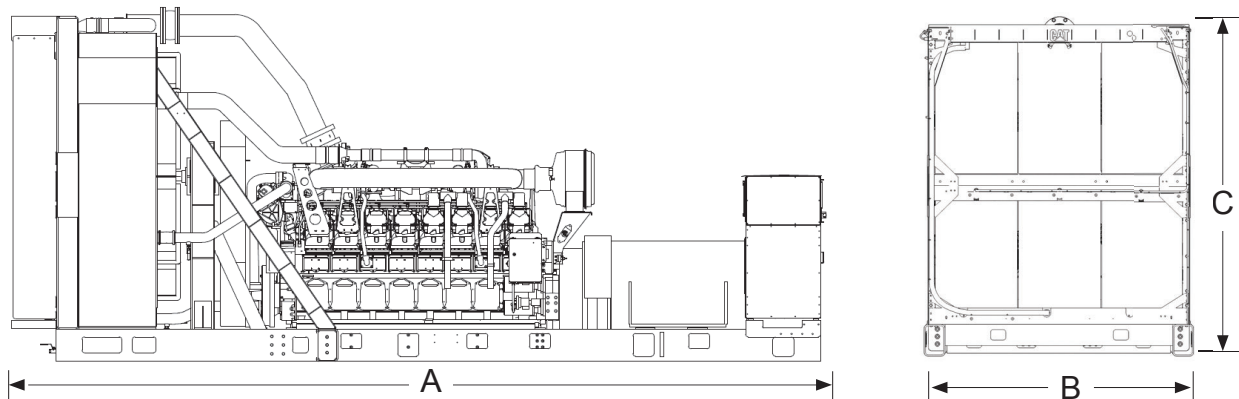
- Caterpillar offers an array of financial products to help you succeed through financial service excellence
- Options include loans, finance lease, operating lease, working capital, and revolving line of credit
- Contact your local Cat dealer for availability in your region

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 – m³/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 – m³/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 – m³/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/Nm³ (g/hp-h)	2319.2	(5.00)	2319.2	(5.00)	2275.1	(4.82)
CO mg/Nm³ (g/hp-h)	321.4	(0.69)	321.4	(0.69)	183.8	(0.39)
HC mg/Nm³ (g/hp-h)	30.7	(0.08)	30.7	(0.08)	33.1	(0.08)
PM mg/Nm³ (g/hp-h)	20.0	(0.05)	20.0	(0.05)	14.6	(0.04)
Emissions* (Potential Site Variation)						
NOx mg/Nm³ (g/hp-h)	2783.0	(6.00)	2783.0	(6.00)	2730.1	(5.79)
CO mg/Nm³ (g/hp-h)	536.7	(1.16)	536.7	(1.16)	307.0	(0.65)
HC mg/Nm³ (g/hp-h)	40.8	(0.10)	40.8	(0.10)	44.1	(0.11)
PM mg/Nm³ (g/hp-h)	28.1	(0.07)	28.1	(0.07)	20.4	(0.05)

*mg/Nm³ levels are corrected to 5% O₂. Contact your local Cat dealer for further information.

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 35° API [16°C (60°F)] gravity having an LHV of 42,780 kJ/kg (18,390 Btu/lb) when used at 15°C (59°F) and weighing 850 g/liter (7.0936 lbs/U.S. gal.) All fuel consumption values refer to rated engine power.

www.cat.com/electricpower

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Materials and specifications are subject to change without notice.
The International System of Units (SI) is used in this publication.

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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		

Type text here

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
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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 5% 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)

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%

PERFORMANCE DATA[EM5402]

February 12, 2023

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.

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 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 : 10/27/21

DESIGN PARAMETERS

The design of the Safety Power emissions reduction system is based on the following conditions.

Note: NOx is calculated as NO₂.

Table 1 – Engine Data

Engine Type:	CAT 3516E
Application	Stand-by
Engine Power	2,750 ekW
Exhaust Temperature	897 °F
Design Exhaust Flow Rate	21,724 (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	91.7
	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	40.0
	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.

*Please note that any % reductions used for air permitting purposes should be based off of NTE values.

Notes: (1) The EPA does not treat methane and ethane as VOC's. Safety Power can achieve a stated reduction of VOC's based on the EPA definition assuming that the VOC's manifest themselves as propene. (2) all emissions reductions are based on an average at steady state using SCAQMD method 100.1 for NOx and SCAQMD/EPA methods 25.1/25.3 for CO and VOC's or mutually agreed test method approved in writing. (3) if NMHC/VOC data isn't provided 0.6 g/hp-hr is to be assumed (unless otherwise stated).

Table 3 – SCR System Data

Engine Option	CAT 3516E (2,750 ekW)
Max. Ammonia Slip □ 15% O2	8 ppm
Urea Consumption - 32.5% solution (□/- 15%)	10.3 USG/hr
System Pressure Loss	17.5" WC*
System Inlet/Outlet ANSI Flange Inches	26/30

*Carter CAT systems starting 2025 will have 17.5"WC pressure drop. Previous systems were 19.5"WC



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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.

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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.

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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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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.

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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 (NO_x) 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 NO_x at 15% oxygen.

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Safety Power ecoCUBE® SCR Emission Control System

Prepared by:

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SUMMARY

Overview	Item Description	Price (USD)
ecoCUBE[®] System	System Style	SCR □ catalyzed 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	

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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
- 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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DESIGN PARAMETERS

The design of the Safety Power emissions reduction system is based on the following conditions.

Note: NOx is calculated as NO₂.

Table 1 – Engine Data

Engine Type:	CAT 3516E
Application	Stand-by
Engine Power	2,750 ekW
Exhaust Temperature	897 °F
Design Exhaust Flow Rate	21,724 (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%O ₂)	Catalyst Outlet (% reduction)
CAT 3516E (2,750 ekW)	NOx	6.0	0.50	0.50	0.67	1.62	40	91.7
	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.

*Please note that any % reductions used for air permitting purposes should be based off of NTE values.

Notes: (1) The EPA does not treat methane and ethane as VOC's. Safety Power can achieve a stated reduction of VOC's based on the EPA definition assuming that the VOC's manifest themselves as propene. (2) all emissions reductions are based on an average at steady state using SCAQMD method 100.1 for NOx and SCAQMD/EPA methods 25.1/25.3 for CO and VOC's or mutually agreed test method approved in writing. (3) if NMHC/VOC data isn't provided 0.6 g/hp-hr is to be assumed (unless otherwise stated).

Table 3 – SCR System Data

Engine Option	CAT 3516E (2,750 ekW)
Max. Ammonia Slip □ 15% O₂	8 ppm
Urea Consumption - 32.5% solution (□- 15%)	10.3 USG/hr
Nominal System Pressure Loss	17.5" WC*
Maximum System Pressure Loss	40.1" WC
System Inlet/Outlet ANSI Flange Inches	26/30

*Carter CAT systems starting 2025 will have 17.5"WC pressure drop. Previous systems were 19.5"WC



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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

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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 572 deg F
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.

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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 system and regenerate the system based on observed conditions. The minimum regeneration temperature is 260 degC.**
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 required for each ecoCUBE® control panel; this connection is used for remote monitoring, 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.

* Use of Renewable Diesel, including HVO also approved, see email confirmation from Safety Power (pages 63 - 104)



clean essential energy

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 1022° F (for NOx reduction) for up to 4 hours. Operations at Catalyst temperatures above 1022° F may lead to degraded Catalyst activity over 4 hours. 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 572°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.

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 (NO_x) 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 NO_x 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 >572° F/300° 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 1022° F/550° C for more than 4 hours may cause damage to the catalyst.

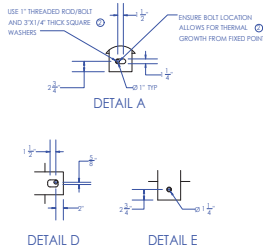
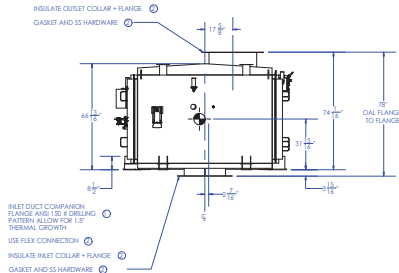
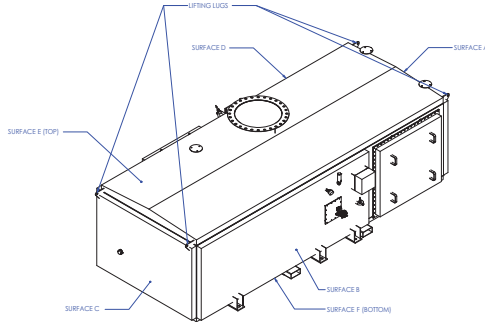
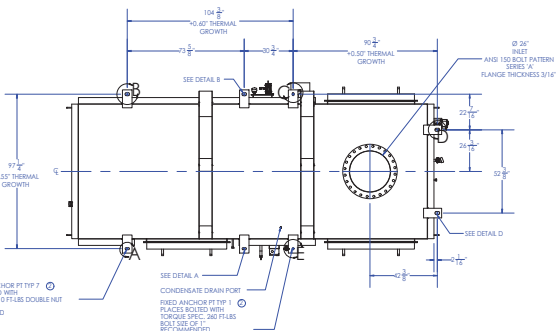
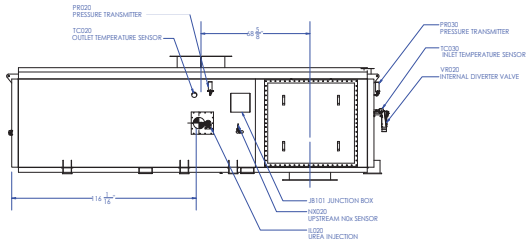
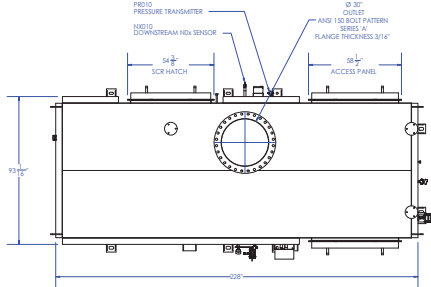
At the SCR catalytic reactor, the nitrogen oxides (NO_x) react with the ammonia (NH₃) to form molecular nitrogen (N₂) and steam (H₂O). The purified air can be let into the atmosphere, passing a heat exchanger installation and the silencer (if installed) downstream of the reactor.

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.

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



FILE NAME: 15572000-2-29 XXXXX DM-01 ecoCUBE Series 5 Rev3 AS BUILT

REVISION			CUSTOMER:	
REV	DESCRIPTION	APPROVED DATE	DATE:	TITLE:
1	FROM TEMPLATE REV11.4 / 22113	06 JUN 2023	01 APR 2024	
2	WATERPROOF JUNIT, CHANGED OUTLET AND INLET SIZE AND LOCATION	19 OCT 2023		
3	AS BUILT	01 APR 2024	DM-01	

Carter CAT
ecoCUBE® Series 5

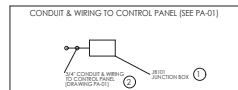
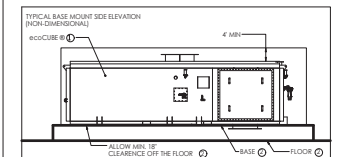
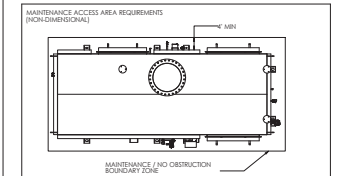
PROPRIETARY INFORMATION OF SAFETY POWER INC. Not to be reproduced, copied or distributed without the express prior written consent of Safety Power Inc.	SCALE: NTS
CONFIDENTIAL PROPERTY OF	PROJECT NO. XXXXX
SAFETY POWER INC.	ENGINEER: R/J/AL
	PLANT:

FOR SYSTEM PERFORMANCE SPECIFICATIONS AND INSTALLATION INFO, PLEASE SEE DWG PRODUCT DESIGN CRITERIA - ecoCUBE® MATERIAL, SADDY OR GREATER
SHIPPING DIMENSIONS: H = 78" X L = 242" X W = 111"
DIMENSIONS SHOWN WITH 4" THICK INSULATION EXCEPT BOTTOM SURFACE SHOWN WITH 3" THICK INSULATION
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 RE-OFF POINTS SHOULD BE PROVIDED BY OTHERS.
INSTALLER SHALL PROVIDE CLEARANCE AND ACCESS TO ecoCUBE® WITH NECESSARY MAN LIFTS, SCAFFOLDING AND/OR LADDER.

MAINTENANCE ACCESS AREA REQUIREMENTS:
ALLOW MINIMUM 4 FT WIDE ACCESS ON SURFACE A, B, D, & E
DO NOT OBSTRUCT ACCESS TO: SENSOR (P/B, TC, NO, EGG), JB101, ACCESS PANEL, SCR HATCH

☐ MATERIAL SUPPLIED BY SCR VENDOR AND INSTALLED BY CONTRACTOR
☐ MATERIAL SUPPLIED AND INSTALLED BY CONTRACTOR

AS BUILT



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

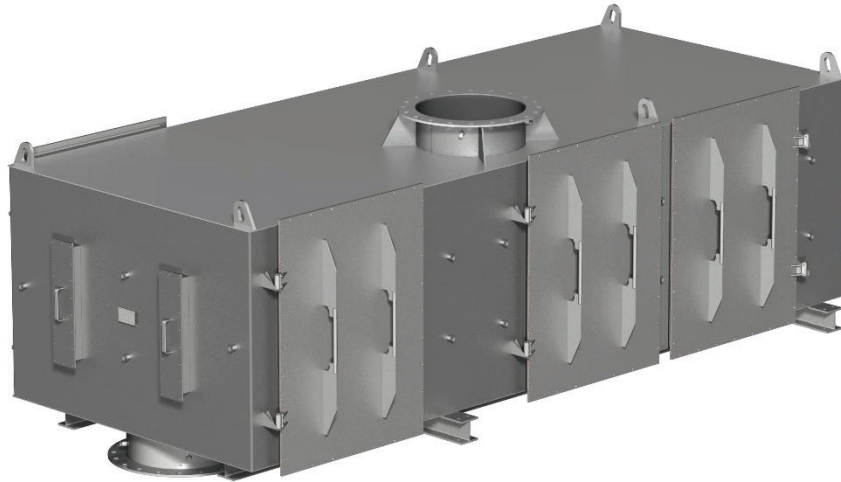
Load	Speed	Power	Exhaust Flow	Exhaust Temp.	Fuel Cons.	NO _x	CO	NMHC	PM ₁₀	O ₂	H ₂ O
%		bhp	acfm (cfm)	° F	gal/hr	g/bhp-hr	g/bhp-hr	g/bhp-hr	g/bhp-hr	%	%
100	Rated	4,043	22,051	897	192.9	6	1.16	0.1	0.07	9.4	10

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 NO₂

** MW referenced as CH₄. 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.



MIRATECH [□] MIRA-CUBE Z™
DOC DPF SCR System

Installation, Operation and Maintenance Manual

**CAUTION**

Read this entire manual and any other publications relevant to this project prior to installing, modifying, or operating the equipment described herein. Follow safe work practices, observe all local, state and federal codes, and use this manual for safe, effective operation. Improper installation, operation or other use of this product could result in any combination of poor performance, equipment damage, human injury, or possible death.

This manual is the sole property of MIRATECH. Copying, faxing, e-mailing, altering or in any way reproducing this manual in whole or in part is forbidden without the express written consent of MIRATECH.

MIRATECH reserves the right to change or alter any and all specifications at any time without prior notification and without incurring any obligation to such changes. The information included in this publication is believed to be accurate at the time of publication; however, no responsibility is taken by MIRATECH unless expressly given.

Please inspect each housing prior to installation and commissioning. The catalyst elements are pre-loaded and ready for operation unless otherwise specified at the time of order.

To place an order, or for technical assistance, please refer to the contact list on page 27.

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1. Introduction

The MIRA-CUBE Z is designed for the reduction of engine exhaust emissions such as Nitrogen Oxides (NO_x), Carbon Monoxide (CO), Unburned Hydrocarbons (HC), Volatile Organic Compounds (VOC), Hazardous Air Pollutants (HAP), and Particulate Matter (PM). The MIRA-CUBE Z is an assembly of a Diesel Oxidation Catalyst (DOC), Diesel Particulate Filter (DPF), and Selective Catalyst Reduction (SCR) system integrated into a single housing. The particulate filter contained within the MIRA-CUBE Z has been optimized for Low Temperature Regeneration, a capability for regenerating at temperatures as low as 500°F (260°C). For many engines, it will be possible to regenerate the DPF portion of the MIRA-CUBE Z at engine loads above 20%, with properly insulated exhaust piping. With proper engine control and maintenance practices, the MIRA-CUBE Z will provide years of trouble free emissions abatement.

This manual provides information to maximize the performance and life span of your MIRA-CUBE Z. Therefore, it is imperative that operators or anyone working on this emission control system read and understand these instructions prior to installing or performing any work on the MIRA-CUBE Z. All installation and maintenance work must be carried out in accordance with applicable codes and safety standards.

The DOC module is constructed of proven VORTEX™ substrate and is coated with precious metals to promote specific oxidation reactions to convert:

- CO to CO₂
- Unburned Hydrocarbons to CO₂ and H₂O (Water)
- Some NO will be converted to NO₂, to support the regeneration process in the DPF module

The DPF module is comprised of multiple DPF blocks made of porous Mullite substrate which captures the particulate matter (PM) with a filtration efficiency of 85% or better. Once the PM is captured, it can be catalytically oxidized with the support of NO₂.

Regeneration occurs when PM is oxidized on the DPF. The captured particulate matter is burned off passively (no additional heat input required) through catalytic oxidation with the available exhaust gas temperature. When the oxidation rate of the PM exceeds the PM rate coming from the engine, the pressure drop through the DPF will reduce. The temperature where this occurs is the “Balance Point Temperature”.

The regeneration process requires sufficient quantities of the following in the exhaust stream:

- NO₂, O₂, & Temperature (heat)

The SCR module is comprised of an integrated mixing section, injection lance, and multiple SCR blocks made of ceramic elements whose honeycomb structure is impregnated with Vanadium. Multiple catalyst blocks are installed to form a single layer, and multiple layers may be employed within the reinforced steel housing to meet the specified emissions targets. The MIRA-CUBE Z supports up to three (3) layers of SCR catalyst.

Please contact the MIRATECH Technical Service Department if you have any questions or encounter any problems with your MIRATECH MIRA-CUBE Z system. Our company goal is to provide the highest quality products and customer service.

2. Installation

A. Housing Location & Orientation

The location of the MIRA-CUBE Z housing in the exhaust stream is extremely important for the operation and maintenance of the system. The MIRA-CUBE Z housing is designed to connect into the exhaust pipe with the inlet and outlet flanges. All MIRA-CUBE Z housings come standard with flat faced flanges with 150lb ANSI standard bolt pattern. Piping and housing flanges should be mated using a flange gasket, nuts and bolts suitable for the maximum exhaust temperature of the engine. The physical location of the MIRA-CUBE Z housing is recommended to be as close to the outlet of the engine to retain as much heat as possible. The housing must be installed horizontally unless specially designed for vertical installation. If a packed silencer is used in conjunction with the MIRA-CUBE Z, it must be placed downstream of the MIRA-CUBE Z housing.

MIRATECH discourages an exhaust piping design with close-coupled elbows (whether short-radius or long-radius) directly connected to the inlet of the MIRA-CUBE Z housing because of a number of potential problems that may be encountered. These problems include poor distribution of exhaust gas flow, elevated pressure drop, and impaired emissions conversion efficiencies. These problems may not exist in all cases, but it can be costly to reconfigure exhaust piping should a problem arise.

Many exhaust piping designers employ a two to three pipe diameter rule-of-thumb because, in most cases, a straight piping run of two to three pipe diameters in length generally allows for the exhaust gas to return to fully-developed flow after a flow disturbance such as an elbow. Sound piping design practices should be used when designing the layout of the exhaust system.

For ease of service, the housing should be installed such that catalyst removal for visual inspection and cleaning may be performed with ease and the least amount of engine downtime. Non-slip walking grids and/or safety railings are recommended in the area surrounding the housing. Alternately, room for an adequate personnel lift should be provided. Refer to the project-specific drawings for clearance requirements.

B. Hoisting & Mounting

The MIRA-CUBE Z employs structural members as part of the housing for mounting the equipment. These members can be used to assist in lifting the unit, but they are not the primary lifting supports.



Figure 1: Example Mounting Location

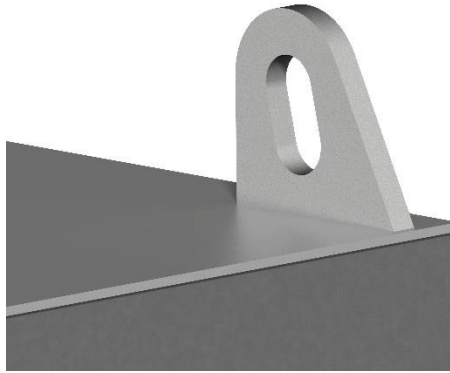


Figure 2: Example Lifting Location

The MIRA-CUBE Z also provides 6 lifting members on the top of the housing unit. It is the responsibility of the customer to adhere to national and local safety and lifting regulations. MIRATECH recommends using all provided lifting locations to hoist the equipment. Lifting locations are designed to be hoisted vertically with the unit in a horizontal position.

The structural members are meant to support the full housing weight when stationary. All provided mounting locations must be used to properly lift the unit. The MIRA-CUBE Z must be supported in such a way as to allow access to the inlet flange fasteners and the drain plugs.



NOTE:

Some MIRA-CUBE housings may be delivered to the site with SCR blocks pre-installed. When this is the case, care must be taken to keep the MIRA-CUBE oriented properly. Excessive vibration or jarring of the housing should be avoided.

High temperature exhaust causes thermal expansion of exhaust components during engine operation. Expansion joints should be fitted to the exhaust piping to ensure that no forces are transferred to the inlet or outlet connections as a result of thermal expansion of the exhaust piping or other exhaust components. Inlet piping must be supported separately from the MIRA-CUBE; no additional moments or forces should be added to the MIRA-CUBE Z inlet connections. The outlet connection has been designed to support a short top stack, no longer than 2.5X the diameter of the outlet pipe.

C. Insulation

In most cases, MIRATECH recommends insulating the exhaust piping, between the engine exhaust flanges and the MIRA-CUBE Z housing inlet flange, and the MIRA-CUBE Z itself to minimize heat loss. This will allow passive PM regeneration with a lower partial engine load than with bare steel. By insulating the MIRA-CUBE Z housing, retained heat can extend the operating window for passive PM regeneration.

Carbon steel housings must not be insulated if exhaust temperatures will exceed 900°F (482°C). Insulating carbon steel housings at high temperatures will severely shorten the life of the housing and void the warranty. If insulating a housing where exhaust temperatures exceed 900°F (482°C) stainless steel is required.

In all cases the customer must refer to national or local regulations regarding the use of

insulation for personnel protection. If specific surface temperatures are required it is the customer's responsibility to provide the insulation specifications prior to installation and start up.

When installing insulation on the MIRA-CUBE Z housing, special care should be taken to allow proper clearance and access to all service and access doors and all sample ports located on the housing. Refer to the specific project drawings for locations of access doors and sample ports.

If ambient temperatures will be below 40°F, MIRATECH recommends insulating and heat tracing all urea lines up to the injector fitting. This will prevent urea crystallization in the supply lines.

D. Catalyst Installation

Initial catalyst installation will be performed by MIRATECH, either at the factory or at the customer's location. Proper installation of the catalyst is critical to system performance, as even a small leak around the catalysts can cause non-compliance. During commissioning of the system, MIRATECH's Technical Service staff will provide training that covers proper installation and maintenance practices for the catalysts. See the Maintenance section for the installation and cleaning process of catalysts.

Gloves should be worn while handling catalysts to prevent contact with hot elements or abrasive surfaces. Care should be taken when handling the catalysts to prevent accidental cracking or chipping.

3. Operation

The MIRA-CUBE Z includes a passively regenerated particulate filter. The advantage of a passive system is that no additional heat input from an auxiliary burner or electric heater is required. It is suitable for applications where the exhaust temperature and flow rates are high enough to oxidize the particulate matter that has been accumulated. In order for the MIRA-CUBE Z to work properly simple practices as detailed in this section must be followed to ensure trouble-free operation.

A. Catalyst Poisons

Poisons are materials that chemically combine with the catalyst and reduce catalyst activity. The poisoning process cannot be reversed, and the catalysts will require replacement. The following elements are known to poison catalysts and must be avoided:

*Iron, Zinc, Calcium, Nickel, Lead, Arsenic, Chromium,
Bismuth, Antimony, Copper, Mercury, and Phosphorous*

The catalyst elements in the MIRA-CUBE Z are designed to resist poisoning. However, excessive levels of poisons will cause damage. There are several sources for poisons in normal engine operation. These sources include the engine fuel, lube oil, coolant packages, soap, antifreeze, raw motor oil, petroleum products, anti-seize, and RTV silicone. Airborne contaminants can be ingested by the engine and deposited on the catalyst. Poison concentrations in excess of 5 ppm in the fuel are not recommended. A complete poison list can be provided upon request.

B. Engine Lube Oil

Operators must follow all engine manufacturer requirements for compatible lube oil (e.g. ash content, TBN) and monitor lube oil consumption rate to ensure it meets manufacturer's requirements. Lube oil sulfated ash is a common source of catalyst masking and/or fouling. To reduce the risk of masking and/or fouling it is important to minimize the lube oil consumption rate and use lube oil with low sulfated ash, compatible with and formulated for exhaust after-treatment systems. Ash from burned lube oil collects in the DPF blocks and does not regenerate. Over time, ash accumulates in the DPF resulting in increased backpressure. Therefore, the filter must be cleaned periodically to remove the ash. Using the lowest ash content lube oil allowed by the engine manufacturer, and ensuring low oil consumption rate, will maximize the filter maintenance interval and service life. The lube oil ash content and consumption rate should be maintained at or below the levels called out in the project-specific documents provided by MIRATECH. MIRATECH requires a lube oil with less than 1% ash content by weight for use with the MIRA-CUBE Z.

C. Fuel

The engines operating with a MIRA-CUBE Z after-treatment system must use ultra-low sulfur diesel fuel with a sulfur content of less than 50 ppm. Alternative fuels, such as biodiesel or heavy fuel oil MUST be approved by MIRATECH prior to use with the MIRA-CUBE Z.

D. Engine Operation

During initial engine installation/commissioning repeated cold starts and excessive idling may occur. It is recommended that new engines (or engines that have been recently overhauled or had major repairs performed such as cylinder head or piston changes) be run at the maximum available load for a period consistent with the engine manufacturer specification and guidelines. Damage to the MIRA-CUBE Z system due to engine failure or operation outside the application design guidelines is not warrantable. If possible, to prevent the DPF from becoming plugged the DPF blocks should not be installed or should be removed from the MIRA-CUBE Z housing during the commissioning of a new or overhauled engine. The engine, the driven equipment (e.g. a generator), interconnects, and other system components in a new installation will usually require test runs, de-bugging, and the like, which often requires numerous starts and stops and prolonged idle periods. Further, if the DPF blocks were to reach a plugged condition and require regeneration, the installation may not be at a stage at which load can be applied to the engine to create the necessary regeneration conditions and duration. If the MIRA-CUBE Z is left installed and operated at conditions with zero regeneration possible (e.g. cold starts, prolonged idling), the DPF blocks will plug with accumulated particulate. For some engines, the not-to-exceed published PM emission rate at idle will plug the blocks in as little as 12 operating hours. At that plugged condition, the DPF must be regenerated immediately: further operation will either plug the DPF irreversibly (requiring complete replacement), or leave the DPF at risk of a runaway regeneration (i.e. a meltdown) when regeneration next initiates. Once project installation is completed, the system components are de-bugged and functioning correctly, and the operating duty cycle of the engine is following its "normal" design profile, the DPF blocks should then be installed, sparing them from the heavy particulate deposition that often occurs during the final stages of completing the project installation.

Once the engine installation and commissioning is completed there are several best practices when operating an engine installed with an MIRA-CUBE Z. The operator must follow the engine manufacturers recommended startup/shutdown practices to avoid accumulation of particulate in the DPF without the opportunity for it to regenerate. Operators should maximize engine

operating conditions in which the regeneration burn-off rate of the DPF exceeds the particulate deposition rate of the engine. The burn-off rate and ideal temperatures are discussed in the Filter PM Regeneration section. The most important thing for an operator to pay attention to when running their engine is to minimize the amount of time at which the engine is operating at an idle or low load condition at which there is not adequate exhaust temperature at the MIRA-CUBE inlet for regeneration.

Engines are not expected to be in "like new" condition. However, engines in which excessive wear exists can compromise the system's performance. Make sure the cylinder pressure, oil consumption, injection timing, fuel pressure, and other indicators are within normal limits.

E. Filter PM Regeneration

For standby generator applications, the LTR DPF used in the MIRA-CUBE Z has demonstrated the capability to undergo 18 consecutive cold start cycles without resulting in unacceptable backpressure. However, backpressure should always be monitored to determine when regeneration is required so that full load-carrying capability remains without exceeding the engine's maximum allowable exhaust backpressure.

The need for regeneration is due to particulate build up in the filter with no regeneration occurring. There are many things that affect the diesel particulate deposition rate in the DPF. The first is the particulate matter concentration in the exhaust stream. Higher particulate concentrations will plug the DPF more quickly than lower concentrations. This can fluctuate due to engine transients (e.g. turbo lag, cold start emissions), inlet air density changes (e.g. elevation), clogged intake air filters, changes in turbo-charger performance or efficiency (as could be induced by an excessive backpressure on the engine exhaust system), inter-cooler performance, worn fuel injectors, lube oil consumption, lube oil ash content, etc. The second is the exhaust flow rate. Higher exhaust flow rates will yield higher backpressures across the DPF. A high exhaust flow rate with a high particulate concentration accelerates the plugging of DPF's. If an operator has a high back-pressure on the engine at idle or low load conditions and then increases the load and exhaust flow rate, a much higher back-pressure will be observed. The third thing that affects the particulate deposition rate is the DPF temperature relative to the exhaust temperature. Cold DPF blocks in a hot exhaust (e.g. immediately after startup, during warm-up) will not regenerate. DPF block temperatures must be high enough to activate and sustain the oxidation reactions which burn out the accumulated particulate.

To better understand how to regenerate the filter it is important to understand what affects the regeneration or "burn-off" rate of the filter. Engine exhaust flow and temperatures play a major role in this. Lower exhaust flow rates, typically associated with lower engine loads, generally have lower exhaust temperatures and lower velocities through the DPF blocks which both impede the regeneration reaction. Along with exhaust gas temperature the actual DPF block temperature is a factor in regeneration rate. A "cold" DPF will not burn off and remove diesel particulate, it will only accumulate particulate matter. Depending on the engine warm-up procedures and operating load on the engine, DPF blocks may require 10 – 60 minutes of engine run time before the DPF blocks reach a temperature where regeneration is possible. The next thing that can affect the regeneration rate is the exhaust chemistry. Wet particulate and diesel aerosols in the exhaust will plug a DPF more quickly than dry particulate. NO₂ present in diesel exhaust will accelerate the oxidation reactions in a DPF. The MIRA-CUBE Z uses a diesel oxidation catalyst to oxidize both diesel aerosols and NO, yielding drier particulate and higher NO₂ concentrations, both of which enhance DPF regeneration reactions. The other factor affecting regeneration rate is the composition of the ash/PM loading on the DPF block. As the DPF accumulates operating hours, it will also accumulate ash from combusted particulate and lube oil. As the ratio of ash to diesel particulate within the DPF changes, so

does the regeneration activity. This will be observed by changes in regeneration burn-off rate at a given temperature (i.e. slower burn-off rates are indicated by a lower inches WC/hour decrease in DPF backpressure).

To better understand when regeneration is required the operator should monitor the back pressure on the filter, exhaust temperature at the inlet of the MIRA-CUBE Z housing, engine load and operating hours since the last service. When operating the engine the operator must monitor the back pressure on the MIRA-CUBE Z housing to determine if regeneration or service is required. The chart below shows a sample operating curve for the LTR DPF used in a MIRA-CUBE housing. A plot representative for each installation will be provided after commissioning of the system. If after regeneration the back pressure decreases and stabilizes at a back pressure in the service interval area (or region) the filter has accumulated enough ash to warrant cleaning as described in the Maintenance section. Operating the filter in the service interval region will limit the number of hours your engine can operate before regeneration is required.

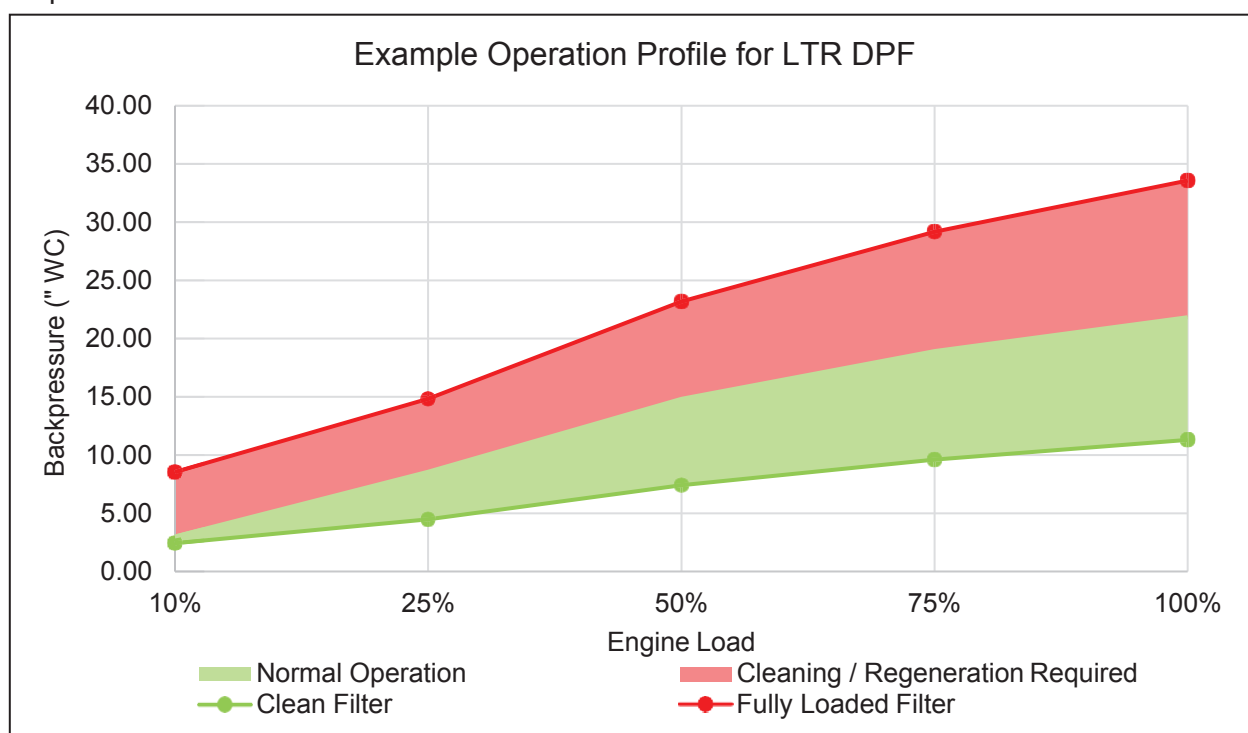


Figure 3: Example Operation Profile for the LTR DPF used in the MIRA-CUBE Z

Due to the many variables that affect DPF regeneration, the regeneration performance can be very dynamic. In general, there are a few guidelines on how a system performs, based on field data from installed systems. All guidelines assume the system is in equilibrium and DPF blocks are at the same temperature as the exhaust. All temperatures are approximate, may vary from installation to installation, and will often drift over time as the DPF blocks age.

- **Below 500°F (260°C)**

The particulate accumulation rate will typically exceed the regeneration burn-off rate within the DPF: the particulate from current operation is accumulating faster than it is being combusted by the reactions within the DPF. The operator will observe an increase in the pressure drop across the DPF. The pressure drop can increase at a rate of 2 inches WC/hour or higher! As exhaust temperature decreases below 500°F (260°C), the rate of pressure drop increase (inches WC/hour) will accelerate as the reactions slow and combustion of particulate is extinguished. With pressure drop across the DPF

increasing at a rate of 2 inches WC/hour, the DPF can reach a plugged condition in as little as three hours, or sooner if the DPF is already loaded with accumulated particulate from prior operation.

- **Between 500 and 525 °F (260 and 274 °C)**

The operator will find an engine condition at which the regeneration burn-off rate equals the particulate deposition rate: the particulate from current operation is combusting as quickly as it is accumulating within the DPF. The operator will observe no net change in the pressure drop across the DPF at this equilibrium condition.

- **Above 525 °F (274 °C)**

The particulate from current operation as well as accumulated particulate from prior operation are burning off. The operator will observe a decrease in the pressure drop across the DPF. At about 525°F (274°C), the pressure drop will decrease at a rate of 0.80 inches WC/hour. As exhaust temperature increases above 525°F (274°C), the rate of decrease (inches WC/hour) will increase as the reactions accelerate (e.g. 2.80 inches WC/hr at 650°F [343°C], 6 inches WC/hr at 700°F [371°C]). When all of the accumulated particulate from prior operation is combusted, the pressure drop across the DPF will stabilize.

Reliance upon temperature alone as the metric for engine and DPF operating decisions can lead to irreversible plugging and/or the catastrophic failure of runaway regeneration.

4. Commissioning

Commissioning the MIRA-CUBE Z product ensures that all equipment has been installed properly, the equipment is performing as it was designed, and that the operator is trained on proper operating parameters and items to watch for during engine operation. A template of the commissioning report can be provided upon request.

A. Pre-Commissioning Inspection

A pre-commissioning checklist is provided with the project specific submittal and must be completed and returned to MIRATECH prior to commissioning of the system. This should be completed once all MIRATECH equipment is installed and prior to the engine being run for the first time. During this walk through the following items should be inspected for proper installation.

Inlet & Outlet Connections – Standard MIRA-CUBE Z housings come with flat faced flanges with 150# ANSI standard bolt pattern. Flanges should be sealed together with a flange gasket between the piping flange and housing flange and secured using all bolt holes available in flange. Engine should not be commissioned until all bolts are present to prevent any exhaust gas leaks.

Access & Service Doors Installed – Prior to shipment from the factory all access and service doors are gasketed and installed. By visual inspection ensure that the gasket material is present between the door(s) and housing. If gasket material is not present the door(s) that do not have gasket material should be removed and gasket applied.

SCR Control System Installation – Check to ensure the SCR Control System and all reactant injection are installed correctly. All connections between the various sensors and the housing should be tight and secured using anti-seize. The pressure monitoring tubing directly adjacent to the housing should be stainless steel. The routing of all

pressure tubing should either (a) slope down to the moisture separator or (b) slope down towards the housing. The injection tubing (both reactant and air) should be stainless steel, and their diameters should match those listed in MIRATECH's technical submittal. The reactant dosing panel should be located a maximum of 6.5ft away from the reactant injector. All wiring should be routed away from any hot surfaces.

General Exhaust Train Inspection – An overall inspection of the exhaust train should be completed. Notes and pictures, if allowed, should be taken of the location of the MIRA-CUBE Z housing relative to the engine. A schematic should be drawn showing all piping and components installed. Lengths and diameters of piping should be noted as appropriate. If there is a silencer installed upstream of the MIRA-CUBE Z housing it should be confirmed that it is not internally packed. If insulation is installed on the exhaust train or on the MIRA-CUBE Z housing, the thickness, type of insulation, and what is insulated should be documented.

Application Specific Notes – While this manual tries to capture all items related to every installation there can always be certain things that stand out from application to application. For issues requiring MIRATECH assistance, please contact Technical Service at 1-918-794-9369.

B. MIRATECH Technician Commissioning

To physically commission the system means checking installation and operation of all components, running the engine at different load points, and adjusting the reactant injection rate for each load condition. The MIRATECH technician validates that the system operation aligns with the Application & Performance Warranty Datasheet included in MIRATECH's submittal(s) using a handheld analyzer. Commissioning begins by starting the engine per the engine manufacture's recommended startup/warm up procedures. Once the engine is warmed, operators begin applying a load to the engine. At each load condition and after the engine is allowed to stabilize at the given condition for 10-15 minutes, the MIRATECH technician will collect data on the key process variables and will make the required control system adjustments. Once stable emissions control at the current operating conditions are met, the next load can be applied and same process completed.

It is recommended that data be taken at 5 engine loads to properly map the operating window of the emissions treatment system. Typical engine load points are 10% (or Idle), 25%, 50%, 75% and 100% engine load. During each load point the technician will adjust the reactant injection rate and monitor the key process variables. The system's back pressure at any given load point may fluctuate due to the complex interaction between soot/ash loading and regeneration rates. The load point at which the back pressure begins to decrease should be noted during commissioning. Knowing the approximate time and load at which this occurs allows the technician to review the log reports and know the approximate temperature at which regeneration occurred over the load profile. Keep in mind that the regeneration temperature and balance point can change over time based on how the filter is loaded with soot and ash.

Once 100% load is achieved it is recommended to run an additional 30 minutes or until the back pressure stabilizes which means the filter has completely regenerated any soot that accumulated during commissioning. Since the run time for commissioning is typically less than 4 hours, the amount of ash accumulation should be negligible under normal operating conditions.

Once the engine has been run through the load curve a new data plot similar to that of Figure 3 in the operation section will be created by MIRATECH, and along with the data collected during

commissioning, will be included in the Commissioning Report. To understand the use of this chart please review the [Operation](#) section of this manual.

5. Maintenance / Troubleshooting

A. Warning & Fault Alarms

The SCR Controller has many alarm events that can indicate to the operator that there is a potential problem with the emissions control system. A full list of alarms can be found in the installation and operation manual for the controller specific to your project.

B. Effects of Engine Maintenance on MIRA-CUBE Z Performance

The mechanical condition of an engine can have a significant effect on the performance of the MIRA-CUBE Z. Operators should follow all maintenance procedures required by the Engine Manufacturer. A poorly maintained engine will produce more soot which will plug the emissions control system more quickly. Some of the maintenance items are:

- **Fuel injectors:** Repair and replace at intervals required by the engine manufacturer's maintenance schedule. Worn fuel injectors can lead to excessive fueling and more soot generation and accumulation in the filter. Fix worn hydraulic injectors to stop lube oil leaks into the fuel.
- **Air filters:** Replace at intervals required by the engine manufacturer. Dirty air filters reduce air flow to the engine leading to more soot generation.
- **Turbo chargers:** Check turbo charger for proper operation and excessive wear. Turbo chargers that do not produce sufficient air or have leaking seals lead to more soot or the presence of lube oil in the exhaust.
- **Fuel filter:** Replace at prescribed intervals. Look for the presence of lube oil in the fuel filter during regularly scheduled maintenance. A blackening of the filter may indicate that oil from the crank case is mixing with the fuel due to a leaky injector or worn seals.
- **Coolant:** Monitor your coolant consumption by keeping a log of the coolant added to the engine. Coolant leakage can poison the DPF catalyst leading to filter plugging.
- **Lube oil:** Change the lube oil at intervals indicated by the engine manufacturer and track its' usage. Lube oil ash collects in the DPF leading to filter plugging. Therefore, it is important to ensure that the engine is not consuming lube oil at a rate higher than recommended by the engine manufacturer. If the lube oil consumption exceeds specifications, the engine must be repaired. Increased lube oil consumption also leads to increased ash load, resulting in more frequent cleanings. The ash is not destroyed by the regeneration process that breaks down the soot.



WARNING

Operators should comply with all applicable safety standards and OSHA regulations when installing or servicing the MIRA-CUBE. Protective gear such as gloves, hard hats, goggles, air filtration masks, and ear protection, should be worn to reduce the risk of injury during the course of cleaning and maintaining the MIRA-CUBE. Collected particulate should be disposed of in accordance with applicable regulations.

C. Periodic Inspections

During normal operation or preventative maintenance visual inspections should be made of the MIRA-CUBE Z housing and SCR control equipment. While inspecting the housing some of the items to look for are exhaust gas leaks around service & access doors and inlet and outlet flanges. All mounting supports should be inspected for weaknesses or failures. All pressure lines should be inspected for cracks, heat induced damage and that they are secured at both locations. Catalyst material should be visually inspected for damage or poisoning. Any issues observed through visual inspections should be addressed in a timely manner to prevent future downtime of the engine.

After the first thermal cycle to 80% of maximum temperatures, the external bolts should be checked to ensure they are tight.

D. DOC Removal and Installation

The DOC catalyst element(s) should be inspected periodically for physical damage and fouling. If conversion efficiency or regeneration profile changes significantly over time, physical inspection should be performed. After removing the catalyst element, inspect for cell blockage or other obstruction. Excessive cell blockage must be cleaned before catalyst is re-installed.

A close visual inspection of the foil structures and outer frame of the element may indicate thermal deactivation. Typical signs of thermal deactivation are pinholes in the foil substrate, blue discoloration of the stainless steel frame, or in severe cases, meltdown of the metal substrate.

Prior to performing any service it is recommended to have spare element and lid gasket on hand. For reference, appendix A contains the process for ordering materials, and appendix B contains a list of common replacement materials. To purchase additional gasket kits please contact MIRATECH.

1. Element Removal

To remove the DOC in MIRA-CUBE Z housings, locate the oxidation catalyst access door. The access door is a small rectangular access door that is identified in the project specific drawings. Once located, remove and retain the nuts and bolts in the access door for future use. Once the access door is removed the lid gasket material should be inspected. If the gasket has a glassy appearance or is brittle to the touch it should be removed and discarded.

The DOC element can then be removed by grabbing the top portion of the element and pulling from the housing. Once the element is removed the gasket should be removed from the catalyst and discarded. Clean out any gasket or ash residue from the housing.

2. DOC Element Installation

To install the DOC into the MIRA-CUBE Z housing, gasket must first be applied to the element. The gasket material has double-sided tape to hold it in place during assembly. Remove the paper backing from the tape and wrap the element gasket around the catalyst element. The gasket should be centered on the element with the ends meeting on the top. Trim one end of the gasket so the frayed edges slightly overlap.



Figure 4: Example Gasketed Element

Once the element gasket has been installed slide the catalyst element into the oxidation track(s) with the open side of the handle facing downstream. Ensure the element slides completely into the track.



Figure 5: Oxidation Element Being Installed in Housing

Once the element(s) are installed in the housing the lid gasket should be applied to the oxidation access flange. Cut the lid gasket into 4 pieces of proper length to cover the entire mating surface. Remove the plastic backing from the two-sided tape on the lid gasket and apply the lid gasket to the entire mating surface. The gasket has a “bolt weave” in the middle to make it easier to install the lid bolts. Install the gasket with the bolt-weave centered over the bolt holes.

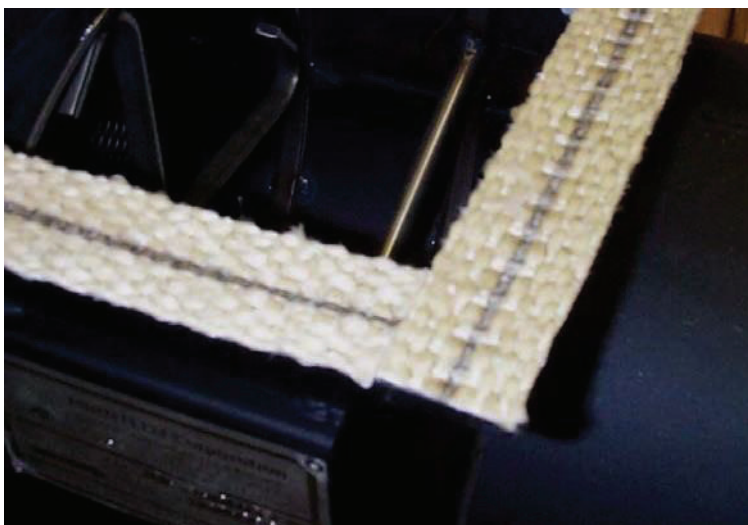


Figure 6: Lid Gasket Installed

Install the oxidation access lid and insert the bolts through the lid gasket. Tighten to complete the assembly. When tightening the lid bolts, begin in the center and work in a crisscross pattern to ensure that the lid is secured tightly and sealed properly. High-temperature anti-seize compound should be used on all threaded components (i.e. nuts, bolts, plugs).

E. DPF Removal and Installation



Warning

DO NOT REMOVE ACCESS DOORS UNTIL THE UNIT HAS COOLED COMPLETELY. DO NOT BLOW AIR INTO THE FILTER BLOCKS UNTIL THEY HAVE COOLED COMPLETELY. EXPOSING HOT FILTER BLOCKS TO COOLER AIR WILL CAUSE THEM TO CRACK OR BREAK, DUE TO EXCESSIVE THERMAL GRADIENTS. FILTER BLOCKS THAT ARE CRACKED OR BROKEN DUE TO RAPID COOLING ARE NOT WARRANTABLE. WEAR SAFETY GLOVES, SAFETY GLASSES, AND DUST MASKS WHEN SERVICING THE DOC/DPF/SCR CATALYST ELEMENT(S).

The following instructions apply to the DPF blocks. The DPF blocks are loaded one row at a time into a single layer array that is located in close proximity to the DOC catalyst element(s). While the DPF and SCR arrays are loaded and sealed in a similar fashion, both the blocks and the tray sets for each are unique and are not interchangeable.

1. DPF Removal

Once the entire unit has cooled, remove the access door and proceed as follows:

- Inspect the access door gasket; if it does not appear glassy and is not brittle it may be reused. Otherwise, it will need to be replaced.
- Dispose of all expansion mat and fire curtain in accordance with all local and federal regulations. Expansion mat may not be reused. A vacuum may be helpful in collecting small pieces/particles.
- Remove the top tray and set aside.
- Starting at the top, remove the first row of blocks followed by the steel tray.
- Keep all trays; they can be reused if not damaged.
- Carefully remove each row of blocks and their steel tray and set aside.
- Inspect each block for cracks, breaks, or other damage; damaged blocks should not be reused.
- Discard the ceramic felt wrap from each block. Do not reuse.

2. DPF Installation

To load the DPF blocks into the MIRA-CUBE Z housing, unbolt the access door and open the unit. The access door will rest on two wide-tolerance hinges. When removing the door take care not to discard any hardware as they will be reused when reattaching the door(s). If existing blocks are to be re-loaded into the housing, ensure that new ceramic felt wrap material is applied to each block before installation.

Each DPF block has a Unidirectional Device Design (UDD). This is a tab at the upstream end of the DPF block's metal cap. With this tab and the MIRA-CUBE Z trays, it is impossible to flip the DPF block in the housing. All MIRA-CUBE Z DPF blocks must be installed with the UDD tabs pointing upstream. When installing the DPF blocks in the tray ensure that the UDD tab lines up with slot in tray as shown in Figure 7. Any other direction (flipping the tab to the downstream side) is prevented by the physical layout of the tray and the housing internals. Any attempts to modify the MIRATECH MIRA-CUBE Z DPF blocks, tabs, and trays will void the warranty.

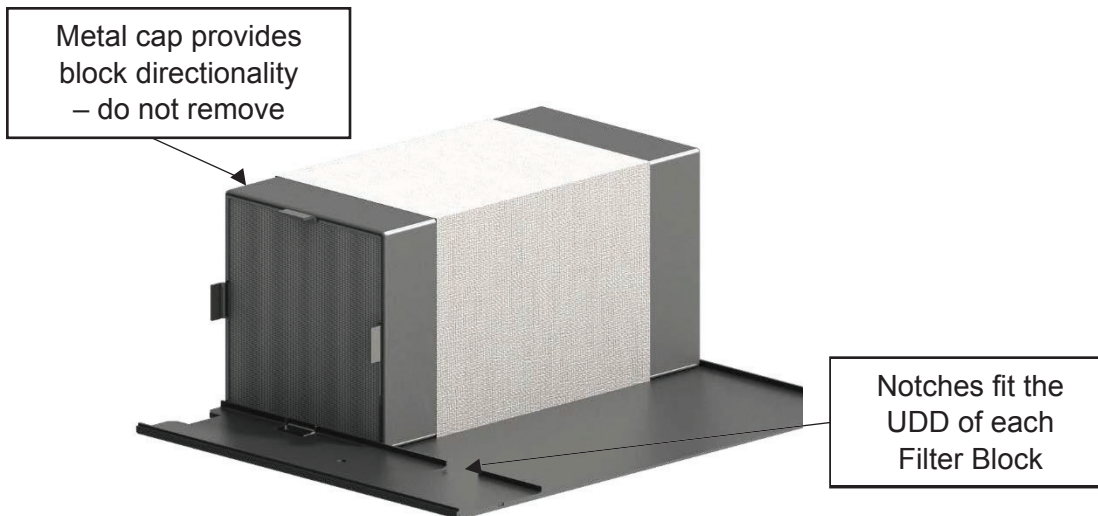


Figure 7: DPF Block on Tray

Blocks are stacked in row horizontally separated by trays. The base row of blocks is placed on a steel tray between vertical alignment tracks inside the housing. There is a tray notch on one side of the housing to ensure that the trays (and subsequently, the blocks) are loaded in the correct orientation. Thermal expansion mat must be placed between the outside block and the housing walls on each row. To begin installing the first layer install a tray and ensure it fits between the alignment tracks and against the walls of the housing as shown in Figure 8.

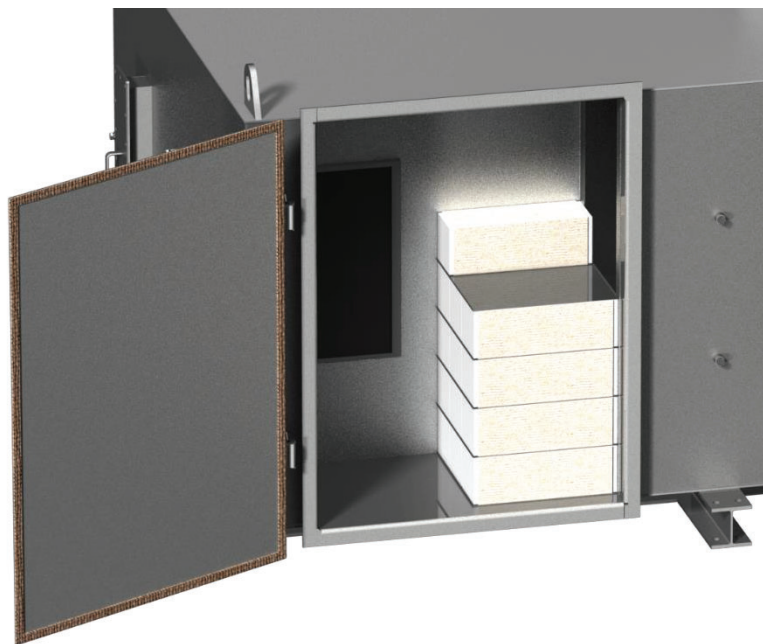


Figure 8: DPF Installation

Once the bottom row of blocks is installed, a steel tray is placed atop this row and on each consecutive row thereafter. The purpose of the tray is to provide a consistent sealing surface for the blocks and to assist with vertical alignment between rows.

The final steps to loading the DPF block array are the same as for the SCR array. See [Final Steps for DPF or SCR Block Installation](#) for more information.

F. SCR Removal and Installation

	Warning DO NOT REMOVE ACCESS DOORS UNTIL THE UNIT HAS COOLED COMPLETELY. DO NOT BLOW AIR INTO THE FILTER BLOCKS UNTIL THEY HAVE COOLED COMPLETELY. EXPOSING HOT FILTER BLOCKS TO COOLER AIR WILL CAUSE THEM TO CRACK OR BREAK, DUE TO EXCESSIVE THERMAL GRADIENTS. FILTER BLOCKS THAT ARE CRACKED OR BROKEN DUE TO RAPID COOLING ARE NOT WARRANTABLE. WEAR SAFETY GLOVES, SAFETY GLASSES, AND DUST MASKS WHEN SERVICING THE DOC/DPF/SCR CATALYST ELEMENT(S).
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The following instructions apply to the SCR blocks. The SCR blocks are loaded one row at a time into a single layer array that is located in close proximity to the outlet connection. There may be more than one layer of SCR blocks in the MIRA-CUBE Z depending on project specifications. While the DPF and SCR arrays are loaded and sealed in a similar fashion, both the blocks and the tray sets for each are unique and are not interchangeable.

3. SCR Removal

Once the entire unit has cooled, remove the access door and proceed as follows:

- Inspect the access door gasket; if it does not appear glassy and is not brittle it may be reused. Otherwise, it will need to be replaced.
- Dispose of all expansion mat and fire curtain in accordance with all local and federal regulations. Expansion mat may not be reused. A vacuum may be helpful in collecting small pieces/particles.
- Remove the top tray and set aside.
- Starting at the top, remove the first row of blocks followed by the steel tray.
- Keep all trays; they can be reused if not damaged.
- Carefully remove each row of blocks and their steel tray and set aside.
- Inspect each block for cracks, breaks, or other damage; damaged blocks should not be reused.
- Discard the ceramic felt wrap from each block. Do not reuse.

4. SCR Installation

To load the SCR blocks into the MIRA-CUBE Z housing, unbolt the access door and open the unit. The door will rest on two wide-tolerance hinges. When removing the door take care not to discard any hardware as they will be reused when reattaching the door(s). If existing blocks are to be re-loaded into the housing, ensure that new ceramic felt wrap material is applied to each block before installation.

SCR blocks do not use a uni-directional feature as they do not have a directional bias. The blocks do not employ a UDD sleeve or tabs. The SCR trays do not include the spacer channel used on the DPF trays, and the SCR blocks fill of the tray as indicated in Figure 9.

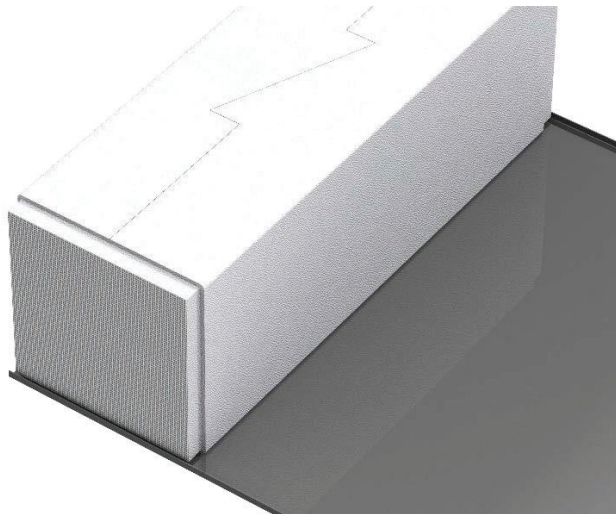


Figure 9: SCR Block on Tray

Blocks are stacked in rows horizontally separated by trays. The base row of SCR blocks is placed on a steel tray between vertical alignment tracks inside the housing. Thermal expansion mat must be placed between the outside block and the housing walls on each row. To begin installing the first row, install a tray and ensure it fits between the alignment tracks and against the walls of the housing.

Once the bottom row of blocks is installed, a steel tray is placed atop this layer and on each consecutive row thereafter as shown in Figure 10. The purpose of the tray is to provide vertical alignment and tie the previous layer to the next and a consistent sealing surface.

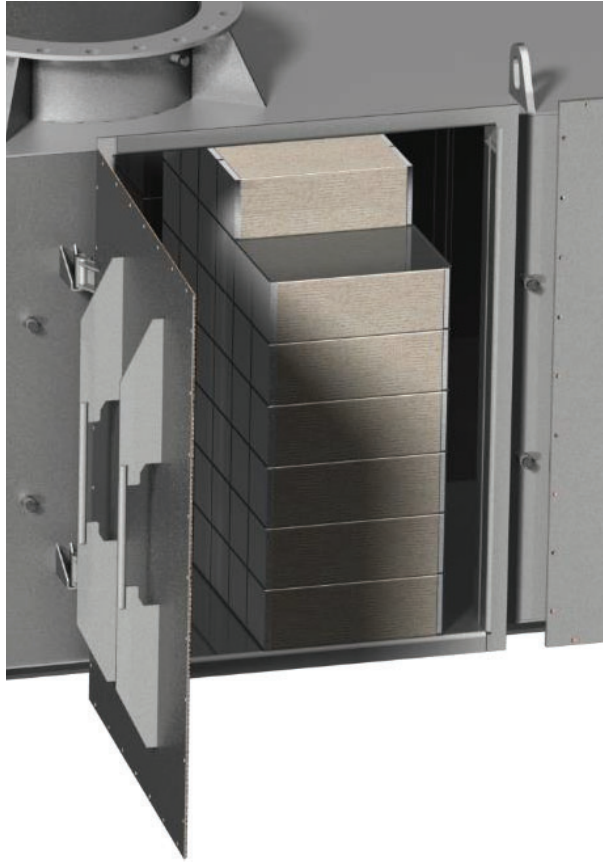


Figure 10: SCR Installation

G. Final Steps for DPF or SCR Block Installation

Once all blocks are installed, a top tray, designed to hold bundled expansion mat layers, is used to cap the top layer of blocks and seal the space between the top tray and the access lid to eliminate blow-by of untreated exhaust gas. Once the tray is installed, stack several expansion mats to fill the gap between the housing ceiling and top tray to determine the number of layers of expansion mat are required as shown in Figure 11. Allow between 1/16" to 1/8" gap between the expansion mat and the top of the housing as this will be taken up by the fire curtain.



Figure 11: Top Tray Installation

With the number of expansion mat layers identified, the next step is to prepare the bundle of expansion mat layers. The expansion mat bundle must extend the full length of the top tray. If a single piece of expansion mat is not long enough to extend the full length of the top tray, cut a second piece so that it fills the remaining gap. Use a piece of masking tape to temporarily hold the two pieces of expansion mat together. Consider this a single layer of expansion mat.

Begin assembling the layers of expansion mat into a bundle. When multiple pieces of expansion mat are used to make a single layer, ensure that the transitions between pieces are staggered as the layers are assembled (visually similar to how bricks are layered with overlapping edges). Once the final number of layers is reached, you are ready to wrap the layers of expansion mat in the fire curtain material.

Begin with one edge of the fire curtain secured in a few places with masking tape to the top of the expansion mat bundle as shown in Figure 12. Begin to roll and wrap the bundle tightly with the fire curtain. Secure the remaining edge of the fire curtain with masking tape in a few places to hold it in place. Proceed to wrap around the entire bundle circumferentially every 8-12 inches with masking tape to ensure that the fire curtain does not separate from the expansion mat bundle.

For larger expansion mat bundles, more than one piece of fire curtain may be required. When this is the case, ensure that there is at least two (2) inches of overlap between the pieces of fire curtain, and seal the full length and both sides of the fire curtain seam with masking tape.

For larger expansion mat bundles, it is helpful to have an extra set of hands helping to ensure that the fire curtain remains tight during wrapping and taping.



Figure 12: Assembling an Expansion Mat Bundle

After the expansion mat bundle is complete place the bundle in the center of the top tray. The raised lip of the top tray should be facing towards the direction of flow, with the expansion mat bundle immediately following. An example of an expansion mat bundle installed in a top tray is shown in Figure 13. To keep the expansion mat bundle from moving on the tray, a small amount of masking tape can be used to secure the bundle to the top tray.



Figure 13: Example of an Expansion Mat Bundle Installed in a Top Tray

To eliminate blow-by, a separate door tray, designed to hold bundled expansion mat layers, is used to seal the vertical space between access door and the catalyst blocks. To prepare the door tray lay it on a flat surface with the channel in the center of the tray facing up. The top of the tray must be identified in order to properly install the expansion mat. It is easiest to identify the downstream side of the tray which is the side that has two tabs bent 180 degrees from the rest of the lip. By identifying the downstream side the orientation of the tray should now be established. Install two or three layers of expansion mat into the channel leaving approximately 1 ½" of extra expansion mat at the top of the tray as shown in Figure 14.

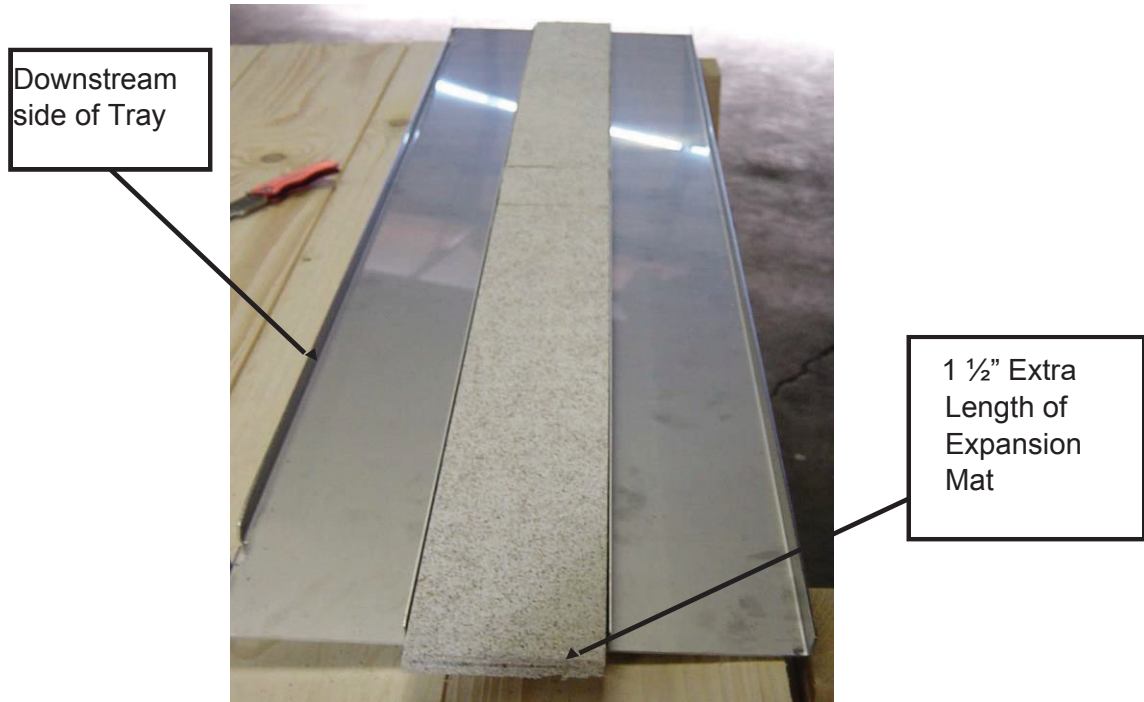


Figure 14: Example of an Expansion Mat Bundle Installed in a Door Tray

Once the expansion mat lengths have been determined secure the expansion mat to the door using masking tape along each edge as shown in Figure 15. This will hold the expansion mat in place during installation while still allowing it to expand once heat is applied.



Figure 15: Securing Expansion Mat on Door Tray

Install the door tray in the housing by sliding the tabs on the right side of the tray behind the catalyst blocks. The tray and expansion mat should fill the space between the sides of the block to where the access door will be installed.

Before the access door is re-installed, door gasket should be installed. If gasket is already on the door or access flange and it does not appear glassy or is not brittle it may be reused. If new gasket is required, remove the plastic backing from the two-sided tape on the door gasket and wrap it around the edge of the access door flange. When completing each corner cut each gasket piece clean so there are no frayed ends and gasket pieces create a tight seal minimizing any risk of blow by of exhaust gas. The gasket has a “bolt weave” in the middle to make it easier to install the lid bolts. Install the gasket with the bolt weave centered over the bolt holes.

Once the access door has fresh gasket installed, secure the door(s) to the housing using the bolts provided. **High-temperature anti-seize compound should be used on any threaded components (i.e. nuts, bolts, plugs).**

H. Safe Handling Practices

Handling the MIRA-CUBE Z requires the same safety precautions as other large exhaust system components. During installation of the MIRA-CUBE Z housing, one should:

- Follow site-specific safety rules/procedures (such as use of hard hats, safety glasses, gloves, steel-toe shoes, etc.).
- Lift the MIRA-CUBE Z by the structure provided on the housing. Follow safe rigging and lifting practices as dictated by local authorities and/or site specific requirements.

During operation, one should:

- Be aware of hot surfaces and take precautions to avoid burns. Operations/maintenance personnel should always wear long sleeves and long pants (no shorts) when working around hot equipment.
- Wear proper ear and eye protection.
- Use appropriate gloves around hot surfaces.

- Comply with all local safety rules.

While performing maintenance or inspections on the MIRA-CUBE Z's DOC, DPF, or SCR catalyst, additional precautions must be followed. The state of California has determined that ash/soot collected is hazardous waste. As such, personnel must wear appropriate breathing protection and prevent ash from being released into the air.

- Always wear a NIOSH approved dust mask.
- Wear safety glasses or goggles.
- Wear gloves when handling the catalyst or filter blocks as they may have rough or sharp edges.
- Wear steel or hard toe shoes as required by site specific safety rules.

If the particulate filter blocks will be removed to send out for cleaning, you may wish to wear disposable coveralls to avoid getting soot on your clothing.

If any ash will be vacuumed out of the housing or off the blocks, the vacuum must be equipped with a suitable HEPA filter and bag. The bagged ash and HEPA filter should be disposed of as hazardous waste according to local regulations.

If the DOC, DPF, or SCR catalyst element(s) will be removed from the housing, either to send out for cleaning or to return to MIRATECH for disposal, the blocks and/or elements should be bagged (and the bag sealed) prior to boxing for shipment. If a large number of DPF blocks are to be shipped, line a crate with a plastic bag and stack the blocks inside. Use Styrofoam or other padding between the blocks and the box/crate to prevent damage. If the Expansion Mat attached to the blocks has been removed, place Styrofoam padding between the blocks. Seal the bag and the crate or box prior to shipping.

I. Cleaning

Blocks and DOC elements should only be cleaned by qualified personnel using equipment that can prevent ash from being released into the air. Upon request MIRATECH can provide specific cleaning recommendations for authorized cleaning companies.

6. MIRATECH Contact Information

Any technical questions about the Application, Installation, Maintenance or Troubleshooting of the MIRATECH MIRA-CUBE Z or its control system should be directed to the contacts below.

CORPORATE OFFICE

MIRATECH
420 S. 145th East Ave., Mail Drop A
Tulsa, OK 74108-1305
Phone – (918) 622-7077
Toll Free (800) 640-3141
Fax – (918) 622-3928
www.miratechcorp.com

Pre-Sales Application Assistance – Application Engineering

applicationengineering@miratechcorp.com
(918) 622-7077 Opt – 4

Post-Sales Product Support and Training – Technical Service Department

technicalservicegroup@miratechcorp.com
(918) 622-7077 Opt – 9

To Order Parts or to check Order Status – Inside Sales

info@miratechcorp.com
(918) 622-7077 Opt – 3

Appendix A: Ordering Parts or Returning Materials

1. Obtain the model number and serial number of the unit. The model number and serial number are on the nameplate affixed to the unit and also on the invoice.
2. Contact Inside Sales.
3. Inside Sales will confirm product part numbers, product lead times and current pricing. In a warranty situation, an RMA (Return Material Authorization) number will be issued. A list of part numbers for common replacement parts is provided in the Appendix D: Spare Parts for your reference.
4. Send a purchase order to Inside Sales, and Inside Sales will give you a sales order number to use for future reference.
5. The RMA or Sales Order number must be included when shipping any returned material.

No equipment may be returned to MIRATECH without first obtaining a Sales Order or RMA (Return Material Authorization) Number. Returned equipment must be packed securely to reach MIRATECH without shipping damages and shipped prepaid by an appropriate carrier.

Appendix B: Spare Parts

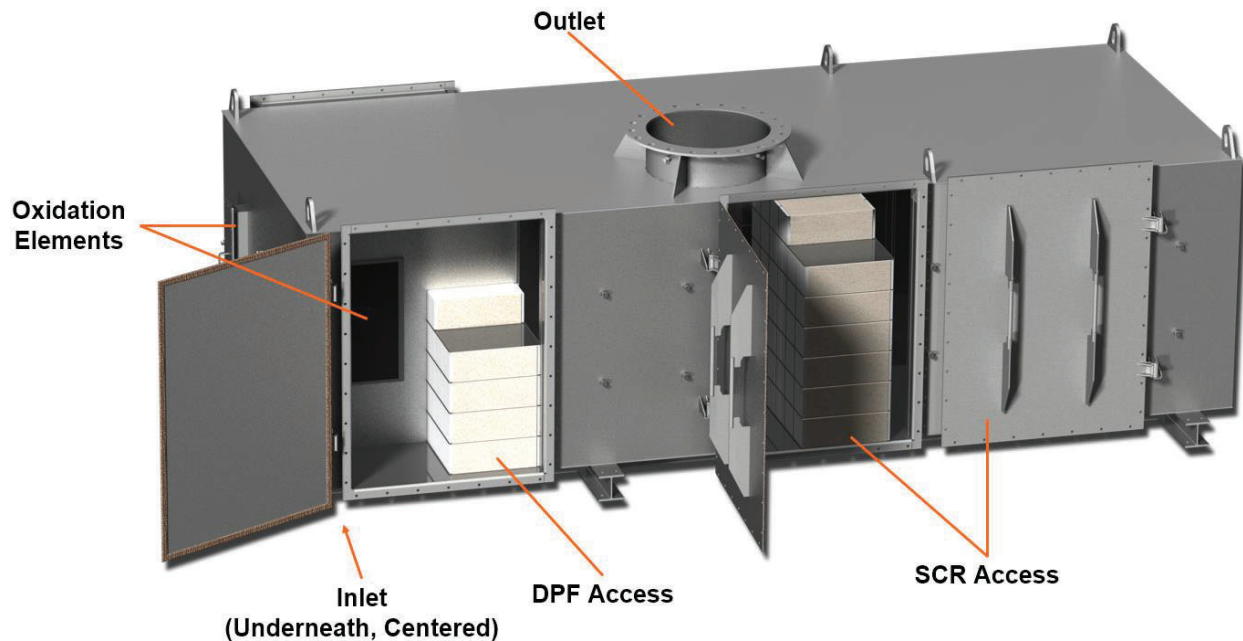
A. MIRA-CUBE Z Spare Gaskets and Expansion Mats

All replacement gaskets and expansion mats for the MIRA-CUBE Z can be found in the table below.

COMPONENT	PART NUMBER
DOC ELEMENT GASKET	GASKET-ELEMENT-2.000X0.170
DOC ACCESS DOOR GASKET	GASKET-DOOR-0.75X0.170
DPF BLOCK FELT	3060.0032
SCR BLOCK FELT	3060.0049
DPF/SCR TOP TRAY EXPANSION MAT	EXPANSION MAT - TRAY
36" DPF/SCR TOP TRAY FIRE CURTAIN	1303.0026
51" DPF/SCR TOP TRAY FIRE CURTAIN	3010.0002
DPF/SCR BLOCK EXPANSION MAT	EXPANSION MAT - 450MM
DPF/SCR ACCESS DOOR GASKET	GASKET-DOOR-0.75X0.170

Appendix C: Layout Reference

The below shows the general layout of a standard MIRA-CUBE Z. Exhaust flows from the inlet to outlet through the oxidation elements, DPF, and SCR, in that order.





**420 S. 145th E. Ave
Tulsa, OK 74108-1305**

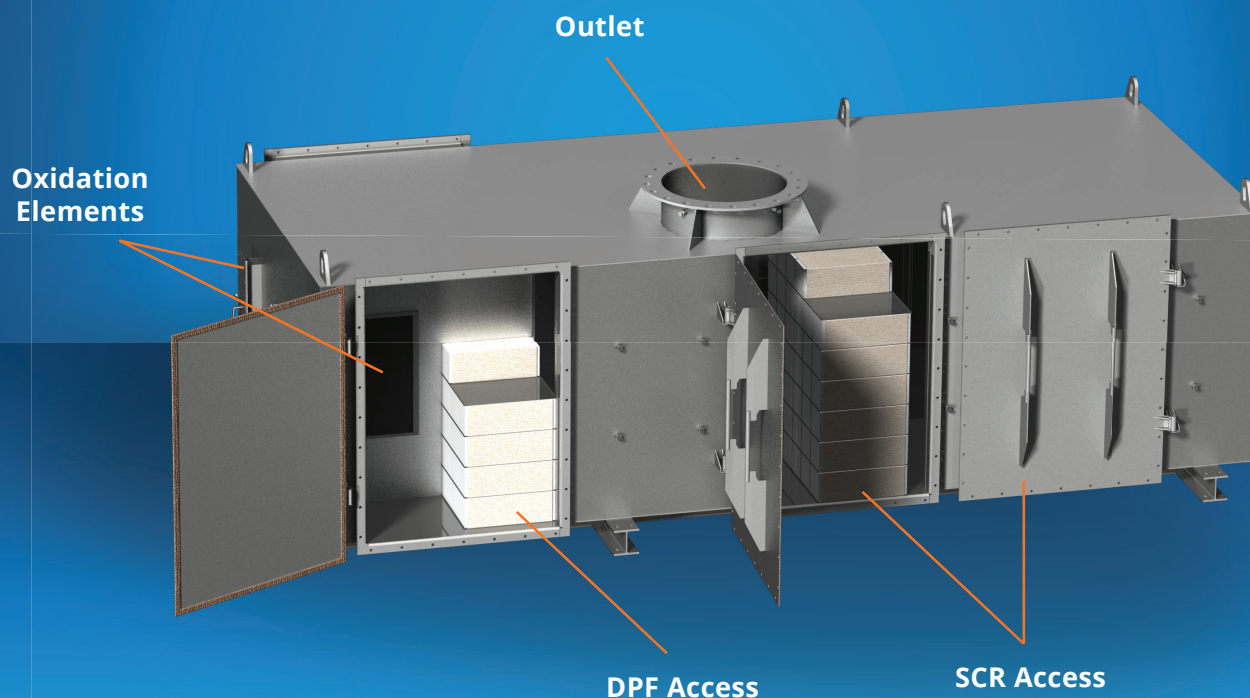
MIRATECH reserves the right to charge or alter any and all of this publication at any time without incurring any obligation to such changes.

The MIRATECH[®] MIRA-CUBE[™]

**Compact, Integrated SCR for
Natural Gas and Diesel Engines.**

*Designed to Offer an Integrated
Pre-packaged Solution.*

- Compact design fits on generator enclosures or inside engine rooms.
- Flexible inlet/outlet locations to simplify pipe routing.
- For diesel applications, can achieve Tier 4 Final or better emission requirements. Can reduce NOx, CO, VOC, CH₂O and PM₁₀ emissions.
- Integrates proven passive LTR[™] low-temperature regeneration DPF (500°F regen).
- For natural gas applications, can be supplied as SCR or SCR/Oxidation. Can reduce NOx, CO, VOC and CH₂O emissions.
- Can be supplied as SCR-only or DPF-only—additional catalysts may be added later in order to meet future requirements.
- Integrated silencing.



ENGINEERED TO PERFORM[™]
+1 800-640-3134 | MIRATECHCORP.COM



MIRA-CUBE™ Integrated SCR/DPF | SCR/OXI System

INTEGRATED TECHNOLOGIES IN A SINGLE-HOUSING ASSEMBLY

The MIRA-CUBE builds on proven MIRATECH technologies and offers stationary engine owners/operators a more compact packaging option. For diesel engines, the MIRA-CUBE can contain LTR™ low-temperature regeneration DPF, diesel oxidation catalyst and SCR. Natural gas engine versions can contain MIRATECH BEAST oxidation catalysts and SCR. Any version can be supplied SCR-ready with DPF and/or oxidation catalyst installed, ready for simply adding SCR catalyst and controls later.

Everything is assembled into a compact, integrated package. The MIRA-CUBE is designed for diesel or natural gas engines from 1000 to 4000 kw. The MIRA-CUBE is your solution for a combined, pre-packed, single-housing system.

EASY INSTALLATION AND BUILT-IN SOUND ATTENUATION

The MIRA-CUBE system comes complete with mounting rails suitable for supporting from below or suspending from overhead. Inlet and outlet location flexibility means the system can be tailored to fit your installation constraints. The system provides integrated silencing.

RETROFIT READY

The MIRA-CUBE's compact size makes it ideal for retrofits of existing engines. Paired with a reactant tank system (The MIRA-POD) that combines a urea tank and all control/dosing equipment into one housing, retrofits are easier than ever.



FULL SUPPORT, CLOSE TO HOME

Technical services and training provided by MIRATECH, along with field service from authorized MIRATECH representatives, ensures prompt, reliable product support that is just a phone call away anywhere in the world.

NEED EMISSIONS AND ACOUSTIC SOLUTIONS? CONTACT MIRATECH.

For over 27 years, MIRATECH has been at the forefront in helping industries handle emissions and acoustic standards. Whatever your emissions needs may be, count on us for solutions. Just give us a call or visit our website at MIRATECHcorp.com.

Sign up on our website for your free subscription to our fact-filled electronic newsletter: THE EMISSIONS MONITOR.



Sales/Technical Support
+1 800-640-3134



MIRATECHcorp.com



info@MIRATECHcorp.com



3/18/2024

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

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

Submittal Revision:
Project Reference:
MIRATECH Kit Number:

SP-KIT-M3-SW550-TLI-23120476

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

SYSTEM OPERATION

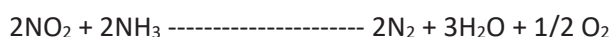
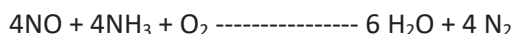
A MIRATECH SCR System consists of numerous pieces of equipment, that work with each other to achieve emissions reduction. A typical SCR system will consist of the following:

- Selective Catalytic Reduction (SCR) Housing
- Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) Housing **or**,
- Oxidation Catalyst Housing
- Mixing Section
- Dosing Box
- Air Compressor
- Reactant Booster Pump
- SCR Controller
- Temperature Sensor

Note: Please reference the MIRATECH scope of supply located with the Technical Submittal in Appendix A.

Selective Catalytic Reduction (SCR)

SCR is applied to reduce NOx emissions when the waste gas stream contains more than 2% O₂. Oxides of nitrogen (NOx) and ammonia react in the presence of a selective catalyst to form water vapor and nitrogen gas:



Operating Temperature: 572 - 977° F (300 - 525° C) Continuous 1,022° F Maximum (</= 4 hours)

Catalyst Material: Metallic-Oxide catalyst, on the base of Titanium oxide, Tungsten oxide, and Vanadium pentoxide. Ceramic honeycombs are extruded with these materials.

Catalytic Function:

1. Urea (CO(NH₂)₂) or Ammonia (NH₃) is injected into the waste gas stream via the injector mounted on the mixing section in front of the SCR housing. The temperature control system will only allow reactant (urea or ammonia) injection when exhaust gases are in the proper temperature range. The rate of ammonia or urea injection is based on feedback from continuous NOx or engine load measurements.
2. The oxides of nitrogen, NO and NO₂, are transformed by the SCR process into Nitrogen N₂ and water vapor by means of a reducing agent (urea or ammonia). This process is used with high oxygen-content exhaust gases. Extremely low NOx concentrations can be attained. The

urea solution is injected into the stream of exhaust gas using compressed air by means of a specially developed dual medium nozzle. Open cross flow static mixers guarantee optimum blending with the exhaust gases.

3. NH_3 is adsorbed into the micropores of the catalyst and reacts with NO_x .
4. The reaction products, N_2 and H_2O vapor, desorb from the catalyst surface.

DOC/DPF and Oxidation Catalyst

A DOC/DPF housing for diesel fuel applications is located upstream of the reactant injector and SCR housing. The DPF blocks are made of a porous ceramic substrate which captures the particulate matter (PM) with a filtration efficiency of 85% or better. Once the PM is captured, it can be catalytically oxidized with the support of NO_2 for the oxidation process. The DOC is coated with precious metals to promote specific oxidation reactions to convert:

- CO to CO_2
- Unburned Hydrocarbons (HC) to CO_2 and H_2O (Water)
- Some NO will be converted to NO_2 , to support the regeneration process in the DPF blocks.

For gaseous fuel applications, the oxidation catalyst can be located upstream of the SCR in its own housing. In some applications the oxidation catalyst can be placed downstream of the SCR catalyst within the SCR housing. Like the DOC, the oxidation catalyst addresses the HC and CO reductions.

SCR Controller

The MIRATECH SCR Controller is used to control the amount of reactant injected in the SCR System and can operate with liquid urea or liquid ammonia as the reactant. The controller meters the flow of reactant to maintain system set points based on a load curve programmed during commissioning. It also controls various pumps, compressors, and metering agents to control the dosing rate of reactant.

The SCR control system requires the following conditions to be met before reactant injection will take place:

- Engine Running
 - 24V signal
- Engine load signal
 - 4-20 mA signal
- Minimum injection temperature reached
 - 300C / 572F
- System in automatic mode
- No critical faults

When the engine run signal is received, the SCR controller will signal the air compressor to turn on keeping the injector cool from the hot exhaust gases. Once the above permissives have been met, the

system will begin reactant injection based on the load curve programmed during commissioning. When the permissives are no longer met, the system will cease injection and go into purge mode which serves two purposes 1) remove urea from the urea tubing between the dosing box and injector 2) injector cooling. If the permissives are satisfied, injection will resume. Otherwise, the system will continue to purge the injector as long as the run signal is active. When the engine shuts down (run signal removed), the system will continue to purge for approximately ten minutes, after which the compressor is shut off and the systems enters a standby state.



IMPORTANT SCR OPERATING TEMPERATURES

Like any catalyst system, the SCR process is dependent on temperature to function properly. There are two key temperatures to remember: 572°F (300°C) and 977°F (525°C). The first key temperature is for urea (also known as DEF - Diesel Exhaust Fluid) injection to initiate and the second is the maximum continuous operating temperature for SCR catalyst.

Figure 1 below shows a MIRATECH Mixing Section. The Mixing Section is designed to introduce DEF to the exhaust gas stream and to facilitate hydrolysis (the process of breaking urea down to ammonia, which reacts with NOx at the catalyst). Urea hydrolysis is most active at exhaust temperatures above 572°F (300°C). The SCR control system monitors the exhaust temperature immediately downstream of the SCR catalyst and starts DEF injection when the temperature reaches 572°F (300°C).

Operating below 572°F (300°C) will not harm the SCR system, however since DEF injection will not turn on, NOx will not be reduced. Engines should be operated according to the engine manufacturers recommendations regarding prolonged low or no-load operation. If an engine is “wet stacking” there is a risk that unburned (wet) lube oil and/or fuel can accumulate in the SCR catalyst which could lead to the catalyst being poisoned. A list of Catalyst poisons is included in the manual but include zinc, phosphorous, and other metals that may be additives in the lube oil. Pure ULSD fuel based hydrocarbons are not ‘poisons’ and should have little to no effect on the SCR performance once they are burned off during normal operation.

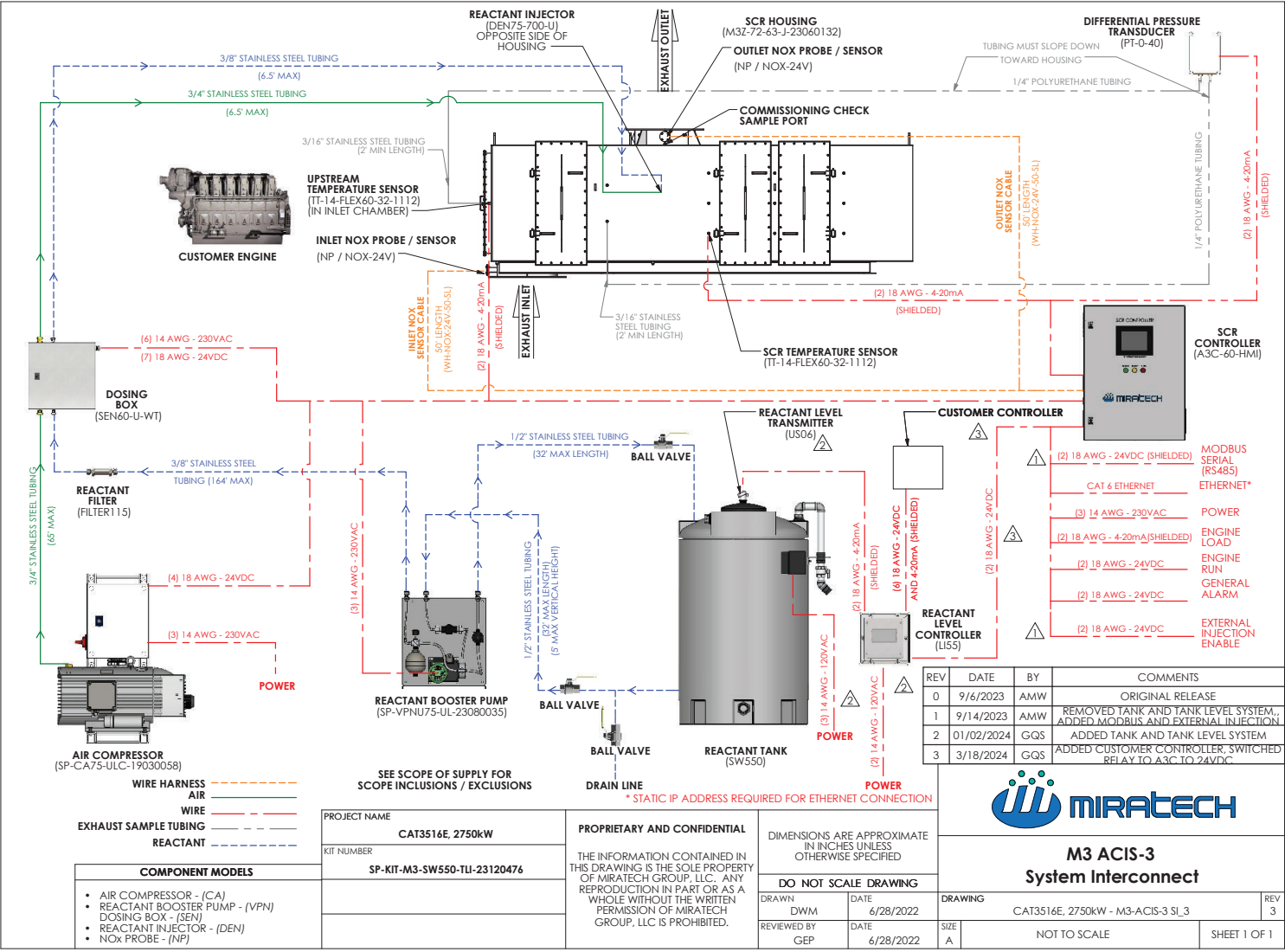


Figure 1: SCR Mixing Section

The second key temperature is the maximum continuous operating temperature of the SCR catalyst. A typical SCR catalyst block is shown in Figure 2. The extruded ceramic base material has varying amounts of Vanadium and Tungsten distributed throughout. The maximum continuous operating temperature is 977°F (525°C). Above this temperature, some of the ammonia created during urea hydrolysis will oxidize into NOx, meaning one must over-inject DEF to compensate. Prolonged operation above 977°F (525°C) also shortens the catalyst life. The catalyst can withstand short term operation up to 1022°F (550°C), so it can tolerate upset conditions such as an engine misfire or overload. The SCR control system provides temperature alarms to alert the operator of high temperature conditions.



Figure 2: SCR Catalyst Block



PROJECT NAME	CAT3516E, 2750kW
KIT NUMBER	SP-KIT-M3-SW550-TLI-23120476

PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF MIRATECH GROUP, LLC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF MIRATECH GROUP, LLC IS PROHIBITED.

DIMENSIONS ARE APPROXIMATE IN INCHES UNLESS OTHERWISE SPECIFIED	
DO NOT SCALE DRAWING	
DRAWN	DATE
DWM	6/28/2022
REVIEWED BY	DATE
GEP	6/28/2022

REV	DATE	BY	COMMENTS
0	9/6/2023	AMW	ORIGINAL RELEASE
1	9/14/2023	AMW	REMOVED TANK AND TANK LEVEL SYSTEM, ADDED MODBUS AND EXTERNAL INJECTION
2	01/02/2024	GQS	ADDED TANK AND TANK LEVEL SYSTEM
3	3/18/2024	GQS	ADDED CUSTOMER CONTROLLER, SWITCHED RELAY TO A3C TO 24VDC



M3 ACIS-3
System Interconnect

DRAWING	CAT3516E, 2750kW - M3-ACIS-3 SL3	REV 3
SIZE	NOT TO SCALE	SHEET 1 OF 1

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 ₂ O
%		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 NO₂

** MW referenced as CH₄. 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 lb/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
Urea Feed Temperature : Minimum	572° F
Regeneration Temperature ² : cDPF	500° F
Catalyst Volume:	45 ft ³
System Dosing Capacity:	60 L/hr
System Pressure Loss:	17.0 inH ₂ O (Clean)
Maximum Pressure Loss:	40.2 inH ₂ O
Total Catalyst Volume:	45 ft ³
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.



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: NO_x (NO₂ & NO)

Oxides of Nitrogen (NO_x) emissions are reported as 100% NO₂ per US EPA 40 CFR Part 1065. Typical non-aftertreatment equipped diesel exhaust NO_x 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, NO_x 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, NO_x, 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 NO_x 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 PM_{2.5} data. PM₁₀ is all particulate matter below 10 microns in size. PM_{2.5} is all particulate matter below 2.5 microns on size. For Caterpillar engines PM_{2.5} = PM₁₀ since the PM in the exhaust is PM_{2.5} data. PM data provided by Caterpillar is a more accurate representation of expected PM_{2.5} 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.

$SO_2 \text{ (g/kw-hr)} = 0.01998 \times (\text{fuel rate g/bkw-hr}) \times (\% \text{ fuel Sulfur by weight})$

Where the factor 0.01998 is:

$0.01998 = (\text{molecular weight of } SO_2) / (\text{molecular weight of S})$

$0.01998 = (\text{molecular weight of S} + \text{O} + \text{O}) / (\text{molecular weight of S} \times 100\%)$

$0.01998 = (32.06 + 15.9994 + 15.9994) / (32.06 \times 100)$

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

$$\text{SO}_2 = 0.01998 \times (200 \text{ g/bkw-hr}) \times (0.2 \% \text{ sulfur})$$
$$\text{SO}_2 = 0.799 \text{ g/bkw-hr}$$

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

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

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Application & Installation Guide

Retrofit SCR with Optional DOC or DPF Aftertreatment System

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1.0 Introduction

Purpose

This document is a reference and guide for the correct installation of the retrofit selective catalytic reduction (SCR) system. The two main components of the system are the dosing cabinet and the reactor housing/CEM (Clean Emissions Module). The primary purpose of this document is to assist engineers and designers specializing in engine installations. The Engine Application and Installation Guide and Engine Data Sheets complement this booklet.

Note: The information in this document is subject to change as engine exhaust aftertreatment systems are revised and improved as required for emission reduction standards.

Cat engines are designed and built to provide superior value; however, achieving the end user's value expectations depends greatly on the performance of the complete installation to assure proper function over the design life of the installation. This proper detail will allow the engine to produce its published rated power and fuel consumption and meet applicable emission standards.

Caterpillar exercises all reasonable effort to assure the engine and Cat CEM perform properly. However, it is the responsibility of the OEM/installer to properly install the engine and Cat SCR system. Caterpillar assumes no responsibility for deficiencies in the installation. It is the responsibility of the OEM/installer to meet all Caterpillar requirements as provided in this Application and Installation Guide.

When operating the engine with light loads, short operation cycles, excessive idling, or applications where normal operating temperatures are seldom reached, the catalyst could become clogged or loaded with unburned fuel, which will increase engine back pressure or damage the catalyst if sudden high load is applied to the engine. See operation section in OMM - M0075634 for operation information.

Caterpillar does not guarantee or approve the validity or correctness of any installation. Caterpillar's sole obligation with respect to any product is as set forth in the applicable Caterpillar warranty statement.

It is the installer's responsibility to consider and avoid possible hazardous conditions, which could develop from the systems involved in the specific engine installation. The suggestions provided in this guide should be considered general examples only and are in no way intended to cover every possible hazard in every installation.

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Contact the appropriate application support group for the latest information on Cat SCR system guidelines and requirements.

Scope

The following prime product serial number prefixes are included in the scope of this document.

Common Arrangement Serial Number Prefix	SCR Catalyst Cassette Array	Catalyst Options
EH9	5x4x3	SCR Only -or- SCR+DOC -or- SCR+DPF
EH8	4x4x3	
EH7	4x3x3	
EH6	3x3x3	

Table 1.1 – Product Scope

Safety

Most accidents that involve product operation, maintenance, and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. An OEM installer must be alert to potential hazards. An OEM installer should also have the necessary training, skills, and tools to perform these functions properly.

The information in this publication was based upon current information at the time of publication. Check for the most current information before you start any job. Cat dealers will have the most current information.

WARNING

Improper operation, maintenance, or repair of this product may be dangerous. Improper operation, maintenance, or repair of this product may result in injury or death. Do not operate or perform any maintenance or repair on this product until you have read and understood the operation, maintenance, and repair information. Burns and fire hazards are possible. Failure to properly connect the aftertreatment and properly route the exhaust gases away from the module may result in personal injury or death.

Caterpillar cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are not all-inclusive. If a tool, a procedure, a work method, or an operating technique that is not specifically recommended by Caterpillar is used, you must be certain that it is safe for you and for other personnel. You must also be certain that the product will not be damaged or made unsafe.

WARNING

Before performing any work on the dosing cabinet, make sure electrical supply lines are de-energized and compressed air and diesel exhaust fluid lines are shut off and drained. Wear proper safety gear (glasses or goggles, hard hat, steel-toed shoes, safety vest, long pants and sleeves, etc.) when installing any part of the Cat CEM system.

Electrical

This safety message is located on the side panels of the dosing cabinet: Do not operate or work on this product unless you have read and understand the instructions and warnings in the Operation and Maintenance Manual (OMM). Failure to follow the instructions or heed the warnings could result in injury or death. Contact any Cat dealer for replacement manuals. Proper care is your responsibility.



Pressurized Air and Water

Always wear approved personal protective equipment (PPE) when cleaning components with pressurized air or water. The maximum air pressure for cleaning purposes must be reduced to 205 kPa (30 psi) when the air nozzle is deadheaded and used with effective chip guarding (if applicable) and PPE. The maximum water pressure for cleaning purposes must be below 275 kPa (40 psi).

High-pressure Wash

NOTICE

High-pressure wash systems, including high-pressure spray washers and water cannons, are now in frequent use by maintenance personnel. Connector seals will fail when hit directly with high-pressure spray. Many connection systems have adapters available that can be attached to the back of the connector to protect the wire seals from direct high-pressure wash. Where direct exposure to high-pressure wash systems cannot be avoided, protective shields will need to be designed and installed. For the benefit of service, connectors should be placed in accessible locations.

Welding

NOTICE

Welding on a Cat CEM is not recommended. If welding is required, follow ECM protection guidelines for all ECMs on the installation: sensor boxes, dosing cabinet, and engine ECMs are all included. If welding is required, all materials must be compatible with 409 stainless steel. Any attachment must not affect the thermal expansion of the CEM. Failures as a result of adding attachments is not warrantable.

Painting

Painting of the Cat CEM Reactor is NOT recommended and is strongly discouraged. Skin temperatures on the CEM body can reach as high as 500°C (977°F) during operation and will cause charring or burning of the paint. Because the module is constructed using 409 stainless steel, it will develop surface discoloration and an oxidation layer during normal use.

Cleanliness

Air lines and DEF lines that connect to the CEM, dosing cabinet, or engine should meet Caterpillar cleanliness specifications contained in the A&I guide LEBW0019 Flushing and Cleaning of System Piping, Cleanliness Group B.

Replacement Parts

WARNING

When replacement parts are required for this product, Caterpillar recommends using genuine Caterpillar replacement parts or parts with equivalent specifications. This includes, but is not limited to, physical dimensions, type, strength, and material. Failure to heed this warning can lead to premature failures, product damage, personal injury, or death.

Fluid Recommendations

Refer to the specific OMM for the engine model being utilized with the retrofit SCR system for the proper fuel, lubricants, and coolants compatible with that engine. The proper fuels, lubricants, and coolants must be used to enable the engine to produce its published rated power, fuel consumption, and emission output. If the engine is not operating properly, the aftertreatment system may not meet tail pipe emissions targets or, in some cases, may be damaged.

In addition to the engine OMM, refer to Table 1.2, which details fluid requirements for the individual catalyst types.

Typical diesel applications utilize vanadia SCR. Copper zeolite catalyst is reserved for very high exhaust temperatures, particularly in gas applications.

JP8 fuel is not compatible with Cat SCR systems.

NOTICE

Oils that have more than 1% total sulfated ash should not be used in aftertreatment device-equipped engines. To achieve expected ash service intervals, performance, and life, particulate filter-equipped diesel engines require the use of Cat DEO-ULS™ or oils meeting the Cat ECF-3 specification and the API CJ-4 oil category. Oils that meet the Cat ECF-2 specification and that have a maximum sulfated ash level of 1% are also acceptable for use in most aftertreatment-equipped engines. Use of oils with more than 1% total sulfated ash in particulate filter-equipped engines will cause the need for more frequent ash service intervals and/or loss of performance. Refer to your engine-specific OMM and your aftertreatment OMM for additional guidance.

Engine Operating Fluids by Catalyst Design		
Fuel Tolerance - Sulfur (ppm)	DPF	15 or less
Fuel Tolerance - Sulfur (ppm)	Copper Zeolite SCR	50 or less
Fuel Tolerance - Sulfur (ppm)	DOC	500 or less
Fuel Tolerance - Sulfur (ppm)	Vanadia SCR	1000 or less
Oil Tolerance (ash content)	All Catalyst	CJ4 or better
Fuel Tolerance - Biofuels (ASTM 6751-075 B100)	All Catalyst	B20 or less
NOx Sensors Replace at 9000 hrs - 15 ppm Sulfur Diesel Fuel		
NOx Sensors Replace at 3000 hrs - 1000 ppm Sulfur Fuel		

Table 1.2

NOTICE

Use of Oil Renewal System (ORS) is strictly forbidden. Any ORS that extends the oil life through the combustion process and topping off the oil reservoir with new oil will damage the aftertreatment device. Failures that result from the use of any oil are not Caterpillar factory defects. Therefore, the cost of repair would NOT be considered by the Caterpillar warranty for materials and/or the warranty for workmanship.

Note: The CEM system should only be used with a properly applied and maintained engine. Excessive slobber (oil in the exhaust caused by extended low-power operation or poorly maintained piston rings) may result in poor performance and impact the system's warranty. The engines must operate within the maintenance and performance standards of the engine manufacturer.

READ THROUGH THE ENTIRE MANUAL BEFORE PROCEEDING WITH ACTUAL INSTALLATION.

Terminology

Terminology used in this document:

ASFT	Aftertreatment System Functional Test
AT	Aftertreatment
AUS	Aqueous Urea Solution
AWG	American Wire Gauge
BPV	Back Pressure Valve
CAN	Controller Area Network
CDL	Cat Data Link
CEM	Clean Emissions Module
CG	Center of Gravity
CO	Carbon Monoxide
DEF	Diesel Exhaust Fluid (also referred to as AUS32)
Delta P	Differential Pressure
DPF	Diesel Particulate Filter
DOC	Diesel Oxidation Catalyst
DPI	Delta Pressure Indicator
ECM	Electronic Control Module
EDDC	Engine Drawing Design Center
EH&S	Environment of Health & Safety
EMCP	Electronic Modular Control Panel
EPA	Environmental Protection Agency
GFCI	Ground-Fault Circuit Interrupter
GND	Ground
HC	Hydrocarbons
MSDS	Material Safety Data Sheet
NC	Normally Closed
NO	Normally Open
NOx	Nitrogen Oxides – NO and NO ₂
NVM	Non-volatile Memory
OC	Oxidation Catalyst
OEM	Original Equipment Manufacturer
OMM	Operation and Maintenance Manual
ORS	Oil Renewal System
PETU	Pump, Electronics, Tank Unit (Control Cabinet)
PM	Particulate Matter
P/N	Part Number
PPE	Personal Protective Equipment
PSI	Pounds per Square Inch
SCR	Selective Catalytic Reduction
SOTA	Systems Operation Testing and Adjusting
TMI	Technical Marketing Information
ULSD	Ultra Low Sulfur Diesel Fuel

2.0 Cat Selective Catalytic Reduction (SCR) System Overview

The primary function of the SCR system is to actively reduce nitrogen oxides (NO_x) which are a normal by-product of internal combustion engines. Selective catalytic reduction is a process in which NO_x reacts selectively with second compound across a catalyst where it is chemically reduced into harmless nitrogen and water. The retrofit SCR system uses diesel exhaust fluid (DEF) as the second compound, specifically the ammonia portion of DEF.

The SCR system may combine SCR technology with oxidation catalysts or particulate filters (Figure 2.1) that reduce particulate matter (PM), hydrocarbons (HC), and carbon monoxide (CO) as well as NO_x.

The two main components of the SCR system are the stainless-steel reactor housing (CEM) and a dosing cabinet with a control module.

The stainless-steel reactor housing contains SCR catalysts, a DEF injection system, and a mixing section, and may contain oxidation catalysts or diesel particulate filters.

Exhaust flows into the CEM through the inlet tube and then through the oxidation catalyst or diesel particulate filter (if equipped). Here, CO and HC are oxidized into water (H₂O) and CO₂. PM is reduced as well, being trapped and oxidized into CO₂. Exhaust then flows into a mixing chamber, where DEF is injected into the exhaust stream in precise amounts, vaporized, and thoroughly integrated into the exhaust stream where it decomposes into ammonia (NH₃) and CO₂, the NH₃ being the reactant needed for the SCR process. The NH₃ in conjunction with the SCR catalyst converts the NO_x to harmless nitrogen (N₂) and H₂O. The treated exhaust then exits the module via the outlet flange.

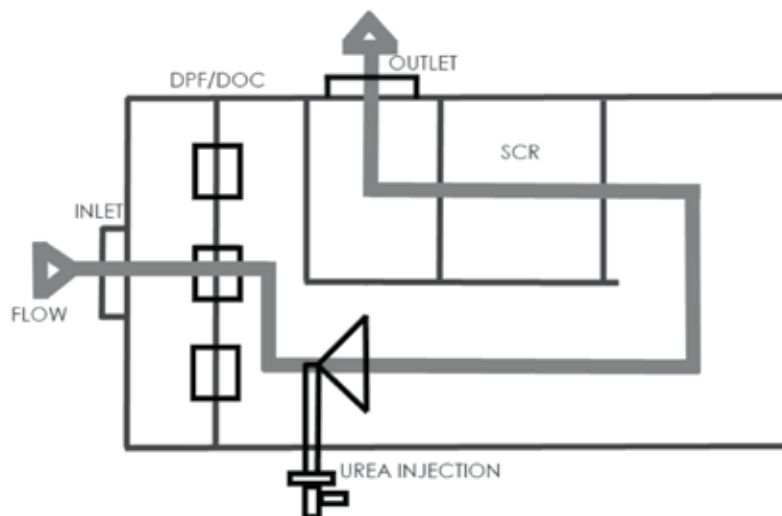


Figure 2.1 – Exhaust Flow Through a Typical Retrofit CEM

Cat Selective Catalytic Reduction (SCR) System Overview

Dosing System Operations

The control system consists of a dosing cabinet equipped with a programmable electronic controller, a DEF dosing pump, a compressed air regulation system, sensor kits for monitoring engine exhaust backpressure, exhaust temperature, and exhaust NO_x levels, and a CAN A (J1939) data link to communicate with the engine and CAN B (J1939) to communicate with the CEM. As shown in Figure 2.2, air pressure must be present at the input to the dosing cabinet before dosing can begin. The system controller monitors various inputs during operational cycles. The system controller first checks compressed air system pressure at 200 rpm on engine start up (Table 2.1). If the air pressure meets specifications, an enable signal is logged in the system controller. Another enable signal is set when the exhaust temperature (CEM inlet) reaches 195°C. The dosing pump will prime and wait until the exhaust temperature reaches 300°C then dosing will commence. Favorable DEF temperatures are listed in Table 2.1.

The air pressure supplied to the nozzle is regulated to 441 kPa ± 28 kPa (64 psi ± 4 psi) and passes through the solenoid valve #1. (See air manifold adjustment procedure in Appendix D.) When dosing requirements are met, solenoid valve #1 is energized, and the pressure sensor (P1) monitors the system air pressure. If the required air pressure is present, solenoid valve #2 is energized to close, and DEF will flow to the injector, installed in the CEM, through the DEF line from the dosing cabinet.

System Operational Requirements		
Input	Data Point	Data Point
CEM Inlet Temperature	>195°C (383°F)	Enable Dosing – pump primed and ready to dose DEF
CEM Inlet Temperature	>300°C (572°F)	Controller commences dosing DEF
DEF Temperature	-11°C to 35°C	DEF temperature best between -11°C and 35°C (95°F)
Compressed Air Supply	586 kPa (85 psi)	Controller checks air pressure at 200 engine rpm during start-up

Table 2.1 – Operational Requirements

The DEF dosing pump pulses fluid from the buffer tank to the CEM injector as a result of the closed loop operation cycle monitored and controlled by the dosing cabinet controller. The dosing action will continue while the SCR system operational requirements are being met (Table 2.1). When the system temperature drops below the minimum level or the engine is shut down, a purge cycle is initiated to purge the DEF lines, diminishing the chance of DEF crystallizing and plugging the lines and injector components.

Purging is accomplished by energizing solenoid valve #1 and de-energizing solenoid valve #2, directing compressed air back through the DEF line to the buffer tank via solenoid valve #2 then venting to an approved DEF container (Figure 2.2). The purging operation will continue until the exhaust outlet temperature reaches 195°C, requiring compressed air during the entire purge cycle. The duration of the purge cycle requires the air compressor to be powered continuously by grid power or backup power.

Note: Air pressure and 24VDC power to the dosing control cabinet must be maintained during engine operation and until the purge cycle is complete. AC power is required only during engine operation; it is not required during the shutdown purge cycle.

The DEF fill to the buffer tank, which is mounted in the dosing cabinet, is controlled by the dosing cabinet controller. When the buffer tank fluid level is lowered and the DEF level sensor detects a low-level condition, the dosing cabinet controller enables a transfer pump relay (Figure 4.8 and Figure 4.9) and energizes solenoid valve #3 (Figure 2.2), which fills the buffer tank to maintain an adequate supply of available fluid. The maximum DEF pressure allowed at the input to solenoid valve #3 is 10 psi. The appropriate range of DEF pressure and flow rate is 5 to 10 psi and 1.25 to 2.5 gallons per minute respectively. A 10-psi maximum pressure relief valve is recommended in series with the DEF supply tank (Figure 2.2).

Cat Selective Catalytic Reduction (SCR) System Overview

Piping and Instrument Diagram (P & ID)

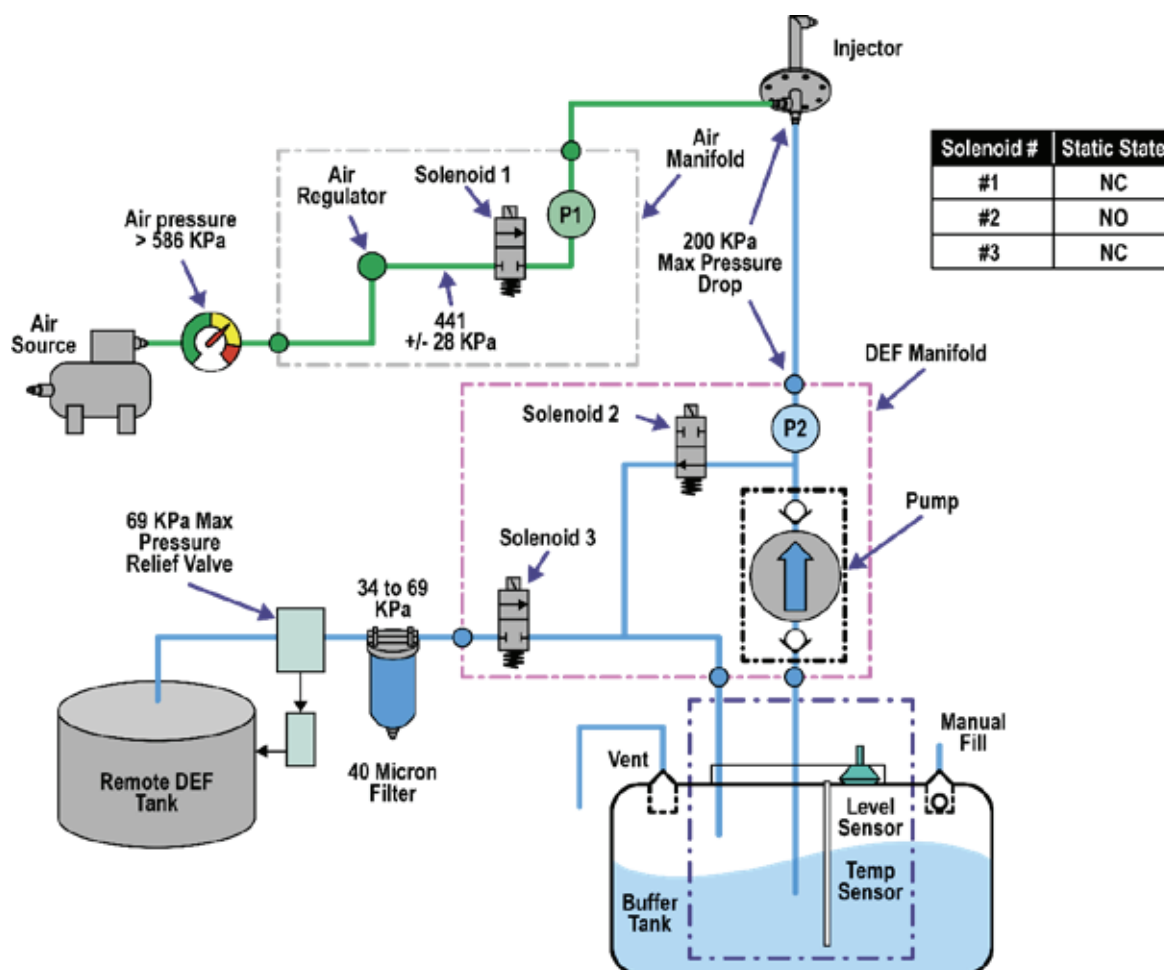


Figure 2.2 – CEM System

Note: The DEF vent port must have a vent line installed to route buffer tank fumes to meet regulatory guidelines for ammonia fumes and the following routing requirements:

- DEF vent line exit must be below DEF injector.
- Vent line must have a drain line routed back to a storage tank or a regulatory approved waste container in the unlikely event of buffer tank overfill and return flow of DEF during purge cycle.
- DEF vent line must be routed continuously upward away from vent port without kinks, loops, or mechanical components that could create a blockage.
- DEF vent line exit must be equipped with a filter/breather with a 40-micron element.

Cat Selective Catalytic Reduction (SCR) System Overview

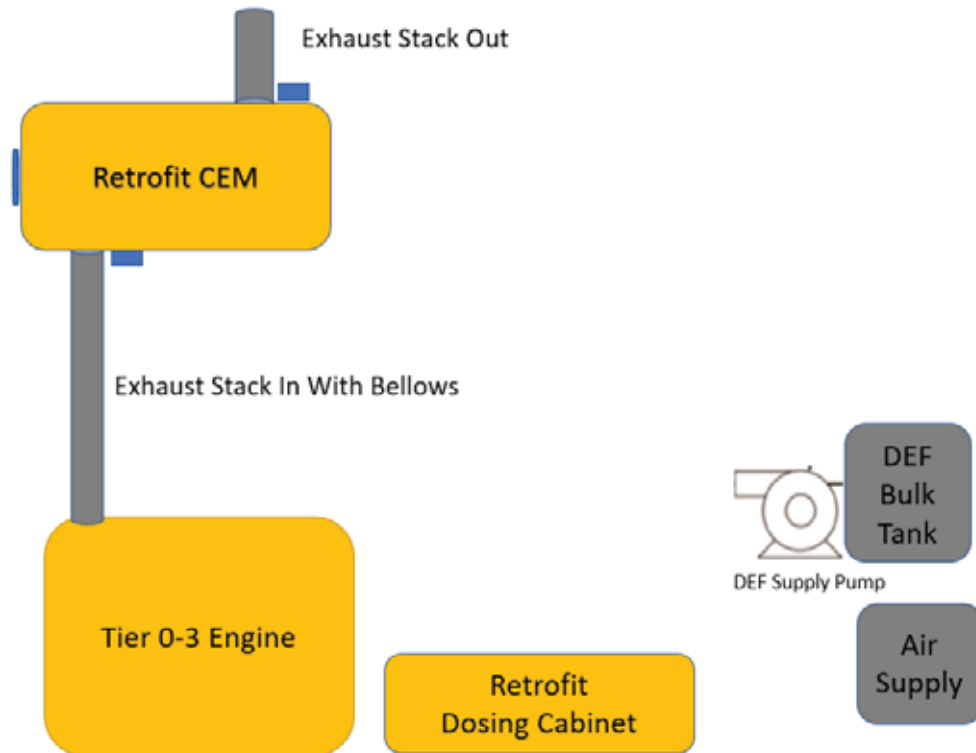


Figure 2.3 – Typical Retrofit Aftertreatment System Components Arrangement

Customer-supplied Installation Components

The following components will be supplied by the customer or installer (Figure 2.3).

- DEF storage tank
- DEF transfer pump and pressure relief valve (where applicable)
- DEF supply line 40-micron filter (Refer to Table 3.4 for more details)
- Compressed air source for dosing cabinet air assist
- AC electrical supply for the dosing cabinet power
- A 24VDC power harness from primary DC power source to dosing cabinet junction box
- Global CAN A (J1939 harness) from the engine controller to the dosing cabinet junction box
- Electrical jumper harness between CEM terminal strip and dosing cabinet terminal strip boxes
- Air piping from the compressed air source to the dosing cabinet
- DEF piping or tubing from bulk storage to the dosing cabinet including a pressure relief valve
- Vent line tubing and associated components
- Exhaust piping from turbo outlet to CEM inlet (inclusive of applicable flexible coupling)
- Exhaust piping from CEM outlet (inclusive of applicable flexible coupling)
- CEM support frame

Cat Selective Catalytic Reduction (SCR) System Overview

Initial Installation – Common Arrangement Serial Number

Important: As supplied from the factory, the dosing cabinet and CEM are serialized together under one product common arrangement – AFTM. When installed, the common arrangement – AFTM serial number of the CEM and of the dosing cabinet must match. If the two components are not paired correctly, a fault code will be activated. The common arrangement – AFTM serial number can be found on the CEM to the left or right of the SCR catalyst access hatch. The corresponding common arrangement – AFTM dosing cabinet-mounted serial number plate is just off-center of the dosing cabinets front connection face. The common arrangement – AFTM part number, serial number, and config group must all match in order that the system work correctly. If the labels do not match, contact your dealer for assistance.

Note: The common arrangement 8-digit serial number should be referenced when contacting your Cat dealer for service in addition to the engine serial number. This action will indicate to the Cat dealer that there is an aftertreatment unit installed in addition to the engine and allow the dealer to work effectively to address your service needs. There may be other serial numbers present on the CEM and dosing cabinet; these are for manufacturing only and will most likely be 10 digits in length.



Figure 2.4 – Dosing Cabinet and CEM Common Arrangement Identification Plate Examples

3.0 Cat CEM Interface Connections

Electrical Power

The standard retrofit SCR system dosing cabinet requires a 100/240-50/60 Hz VAC 15A electrical connection to the AC terminal strip inside the cabinet (Figure 4.5) and should be powered from a dedicated GFCI circuit.

The dosing cabinet must be installed per national and local electrical codes. Electrical conduit or similar devices should not be fastened to the side wall or top panels of the cabinet. The cabinet must not be used for the routing of external electrical circuits that are not part of the CEM electrical system.

The dosing cabinet is equipped with a dosing pump and EMI filter that will operate from 100/240-50/60 Hz VAC single-phase electrical power (L1 -Common-Ground) (Figure 4.5). The cabinet mounted programmable controller and system sensors are powered by the engine 24VDC power system.

Air System

Clean dry compressed air is used:

- To assist in the atomizing of the liquid DEF as it is injected into the exhaust stream.
- To shield the liquid DEF in the injector from the exhaust heat until injection to prevent crystallization, which could plug the injector nozzle.
- To purge the DEF line during shutdown to prevent crystallization.

Dosing Cabinet Air Supply	
Air quality (-40°C minimum air temp)	ISO 8573-1:2010 [5:2:X] (X=25 mg/m ³)
Air quality (3°C minimum air temp)	ISO 8573-1:2010 [5:4:X] (X=25 mg/m ³)
Air temperature	-40°C to 50°C (-40°F to 122°F)
Air flow	0.28 m ³ /min (10 SCFM)
Air consumption	Continuous during engine operation, purge, and after shutdown
OEM supply operational air pressure	Minimum 551 kPa (80 psi)
(Measured at dosing cabinet air strainer inlet)	Recommended: 724-1068 kPa (105-155 psi)
Internally regulated system air pressure target (pressure used for system diagnostics)	441 ± 27 kPa (64 ± 4 psi)
Air pressure at start-up	Aftertreatment ECM will activate low air pressure alarm ONLY after CEM inlet temperature reaches a temperature threshold – AND – system internally regulated pressure is <375 kPa. Alarm will de-activate once pressure is >375 kPa.
Purge air pressure at shutdown (purges back to buffer tank)	>482 kPa (70 psi) for 180 sec
Maximum airline pressure drop from dosing cabinet to lance	6.89 kPa (1 psi)
Coalescing filter/separator – min rating (OEM supplied)	90% efficient pressure: 1069 kPa (155 psi) Flow: 0.85 m ³ /min (30 SCFM)

Table 3.1 – Air Supply Requirements at Dosing Cabinet Inlet

Typically, compressed air will carry some oil from the compressor and some sediment from the piping. This debris can collect in the DEF injection nozzle and clog the unit. Use a coalescing air filter/separator that meets the requirements listed in Table 3.1.

Note: Water in the compressed air supply may allow ice crystals to form, which may cause damage to system components or temporarily impede the operation of the system. For applications which will encounter freezing temperatures, it is recommended to utilize an air supply that meets ISO 8573-1:2010 [5:2:X] (X=25 mg/m³). For non-freezing applications, ISO 8573-1:2010 [5:4:X] (X=25 mg/m³) is acceptable.

DEF System

Overview

Diesel exhaust fluid is a relatively inexpensive urea solution that enables Cat engines equipped with SCR to reduce NOx emissions. DEF is a colorless liquid made up of high-purity urea and deionized water.

DEF Selection

For retrofit SCR applications, the required DEF solution must meet ISO 22241-1 (DEF 32.5%) or ISO 18611 (DEF 40%). Consult Caterpillar publication SEBU6251 for additional details. These standards are designed around DEF solutions of approximately 32.5% and 40% concentrations.

NOTICE

Do not use agriculture grade urea solutions. Do not use any fluids that do not meet ISO 22241-1 requirements in SCR emissions reduction systems. Use of these fluids can result in numerous problems, including damage to SCR equipment and a reduction in NOx conversion efficiency.

The advantage of 32.5% concentration is that it provides the lowest possible freezing point, -11°C (12°F), while 40% concentration freezes is at 0°C (32°F). The 40% solution, having a higher concentration, has the advantage of using less DEF per the amount of fuel used and potentially a smaller main DEF tank design.

DEF	32.5%	40%
Freezing Point	-11°C (12°F)	0°C (32°F)

Table 3.2 – DEF Freezing Temperatures

The quality of DEF rapidly degrades when stored at high temperatures. The ideal storage temperature for DEF is shown below. DEF that is stored above 35°C (95°F) for longer than one month must be tested before use.

Refer to ISO 22241 and ISO 18611 for the most updated information storage temperature information.

Expected DEF Life	32.5% DEF Storage Temperature	40% DEF Storage Temperature
Ideal Storage Temperature	-9°C to 25°C (15°F to 77°F)	2°C to 25°C (36°F to 77°F)
18 Months	Below 25°C (77°F)	
12 Months	25°C to 30°C (77°F to 86°F)	
6 Months	30°C to 35°C (86°F to 95°F)	
1 Month – Test Before Use	Above 35°C (95°F)	

Table 3.3 – DEF Expected Life Based on Storage Temperature

Changes in DEF concentration can occur for a variety of reasons, including evaporation of water, degradation of urea, or contamination. Caterpillar offers two refractometers for concentration testing, a Brix Digital (360-0774) and an Analog Refractometer (431-7087).



Figure 3.1 – Cat Brix & Analog Refractometer Offerings, 360-0774 and 431-7087

DEF is typically colorless and clear. A visual inspection should also be performed as any changes in color and clarity indicate a change in quality.

For DEF testing procedures, consult the Retrofit SOTA manual M0070376 available from your Cat dealer.

Material Selection for DEF

Material compatibilities must be considered in the DEF storage and delivery system due to the caustic, corrosive nature of the liquid. Refer to ISO 22241 and ISO 18611 prior to any material selection.

Recommended Materials Include:

- Stainless Steel (304, 304L, 316, 316L, 409, 439)
- Highly alloyed austenitic Cr-Ni and Cr-Ni-Mo steels
- Titanium
- Polyethylene
- Polypropylene
- Polyisobutylene
- Perfluoroalkoxyl alkane (PFA)
- Polyfluoroethylene (PFE)
- Polyvinylidene fluoride (PVDF)
- Polytetrafluoroethylene (PTFE)
- Teflon (PFA)

Seal/Hose Materials:

- Ethylene propylene diene monomer (EPDM) rubber
- Nitrile rubber (NBR)

Non-recommended Materials Include:

- Unalloyed steel
- Galvanized steel
- Aluminum/aluminum alloys
- Magnesium
- Copper
- Brass
- Metals and plastics coated with nickel
- Non-ferrous metals and alloys (copper, copper alloys, zinc, and lead)

DEF Dosing Cabinet Supply

The dosing cabinet requires a 40-micron DEF filter (not included with system) to be installed prior to the dosing cabinet inlet. This filter must have a maximum particle size of 40 microns and have a 99.9% or higher efficiency (Beta =1000) at 40 microns or smaller. Filtration in alignment with the cleanliness recommendation in SEBU6251 is encouraged. The filter needs to be able to handle a minimum of 9.5 L/min (2.5 gal/min). The DEF filter/screen should be installed as close as possible to the inlet port of the dosing cabinet utilizing isolation valves to minimize DEF spillage while servicing the filter. DEF filtration parts are available through Cat dealers.

DEF Supply	
DEF quality	ISO 22241/ISO 18611
Dosing Cabinet inlet buffer tank refill pressure	5-10 psi
Required filtration	40 microns*
Required DEF Filter Efficiency	99.9 @ 40 microns*
Operating temperature (32% DEF)	-9°C to 35°C (15°F to 95°F)

*Cat DEF Filter P/N 491-6779 meets these requirements. Work with your Cat dealer regarding availability of this filter for your application.

Table 3.4 – DEF Supply Requirements at Dosing Cabinet Inlet

DEF Handling

DEF is a colorless liquid with a slight ammonia (pungent) odor.

Note: Consult the Material Safety Data Sheet (MSDS) provided by your DEF supplier.

DEF should be transported at -5°C to 25°C (23°F to 77°F). All fluid transfer equipment and intermediate containers should be used exclusively for DEF and should not be reused for other fluids such as coolants, oils, windshield washer fluid, etc. Ensure that transfer equipment is made from recommended materials. Hoses and other non-metallic transfer equipment made from NBR, Fluoroelastomer (FKM), and/or EPDM are recommended.

Numerous suppliers of DEF transfer equipment exist. Filtering DEF as it is dispensed is recommended. Filters should be compatible with DEF and should be used exclusively with DEF. Check with the filter supplier to confirm compatibility with DEF before using. Mesh-type strainers using compatible metals, such as stainless steel, are recommended. Paper (cellulose) media and some synthetic filter media may degrade during use. Contact your local Cat dealer for assistance with sourcing DEF filtering units and filters.

Spills and leaks: Take care when dispensing DEF. Spills should be cleaned immediately, and vehicle surfaces should be wiped clean and rinsed. Use caution when dispensing DEF near an engine that has recently been running. Spilling DEF onto hot components will cause it to vaporize, which can be harmful.

Due to the corrosive nature of DEF, the condition of hoses and other non-metallic components should be monitored for signs of degradation. DEF leaks are easily recognizable by white urea crystals that accumulate at the site of the leak. Solid urea can be very corrosive to galvanized or unalloyed steel, aluminum, copper, and brass, so leaks should be fixed immediately to ensure no damage to surrounding hardware.

A 40 percent DEF solution has more urea per unit of volume than the 32.5 percent solution. However, the 40 percent solution freezes at a higher temperature of 0.5°C (33°F). The 40 percent DEF will also come out of solution (salt out) through freezing, which could plug the SCR catalyst.

DEF is corrosive. Do not store DEF in a tank or use supply lines or supply pumps that are made of the following materials: aluminum, brass, or steel. Use only corrosion-resistant materials such as PVC or stainless steel. Any O-rings must be EPDM. DEF must be kept below 50°C (122°F) to delay decomposition.

DEF Storage Tank

The end user or installer must provide a DEF main storage tank and delivery system. The tank manufacturer or installer must provide a means to sample DEF in the tank to determine DEF quality.

DEF storage tanks must be designed to industry best practices, following all local regulations for fluid storage tanks, but also with consideration for DEF freezing and effective thawing with a heat exchanger. Unlike other common operating fluids such as diesel fuel and coolant, DEF freezes at a temperature within the operating limits of the engine.

Bulk tank breathers should be fitted with filtration to keep airborne debris from entering the tank. Desiccant breathers should not be used because water will be absorbed, which potentially can alter DEF concentration. Appropriately vent indoor tanks. Plan for control of overflow of the tank.

DEF in the tank freezes from the outside to the center. The density of frozen DEF is lower than the density of the liquid DEF. This means that the frozen DEF floats on the liquid DEF. To ensure that the complete tank of DEF is thawed, at least part of the heating source must be located at the bottom of the tank. The DEF pick-up location needs to be very close to the heating source and draw from the bottom of the tank as well. As the DEF is consumed, the DEF level in the tank reduces and the cold DEF approaches the heater. Tank shapes vary from application to application based on design and space limitations. Irregularity in these shapes is acceptable if air pockets and/or chunks of frozen DEF embedded in tank ridges or other contours of the tank can be avoided. It is also preferable to have the width of the tank equal to or smaller than the height of the tank. Short and long tanks are not favorable for DEF freeze protection.

Tank Volume

Tank volume should be sized based on required refill frequency, DEF freeze expansion, and the volume of internal tank components. Also consider the regulatory implications of running out of DEF before running out of fuel, particularly if infrastructure is not in place to fill both fuel and DEF tanks at every location. Tank sizes will depend on operating profile and anticipated normal fueling locations. DEF tanks must be sized such that sufficient DEF is always available to adequately operate the SCR system. The amount of DEF usage can be reasonably estimated as a direct fraction of the engine fuel burn. The DEF tank should then be sized to accommodate the requisite fraction of DEF as outlined in the following DEF Bulk Tank Sizing Guidance table.

As an example, if an analysis of the operating profile of a 3500 sized engine shows that it could burn 1,000 liters of fuel between DEF fill opportunities, the DEF tanks would need to be sized to hold at least 100 liters of 32.5% DEF over and above any space required by the tank and tank inserts like level switches or heating provisions. Caterpillar recommends at least 8% of the total tank volume to account for freeze protection and safety margin. Thus, a tank which is fully topped off still has at least 8% of its volume filled with air. This highest point where air is trapped is also where the tank vent should be located. Ensure that the tank filling provisions not only indicate a full tank, but also that overflow will occur prior to consuming the designed expansion volume.

Ratio of DEF to Fuel for DEF Tank Design		
Fuel	32.5% DEF	40% DEF (if allowed)
100	10	8.1

Table 3.5 – Ratio of DEF to Fuel

DEF Bulk Tank Volumetric Considerations	
DEF Freeze Expansion Allowance	3-5%
Recommended Expansion Air Volume	5%
Total Recommended Air Volume	8-10%

Table 3.6 – DEF Bulk Tank Sizing Guidance

Lifting the Dosing Cabinet

The preferred method of lifting the dosing cabinet is to use two straps wrapped around and through the openings in the base frame as shown (Figure 3.2). The wet weight of the dosing cabinet can be found in the dosing cabinet specifications table (Table 3.8). Check the Technical Marketing Information (TMI) for the latest physical data for the dosing cabinet or work through your Cat dealer.

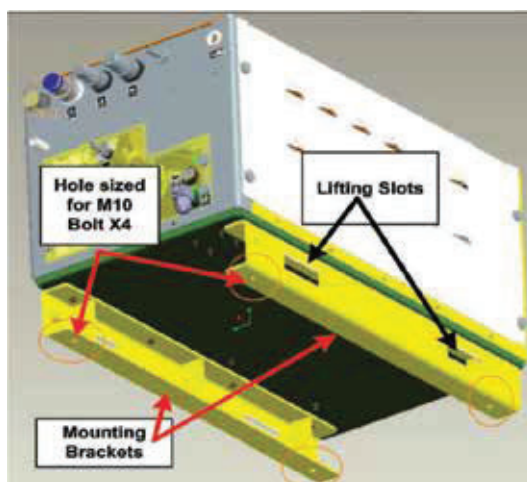


Figure 3.2 – Lifting Brackets on Dosing Cabinet

Mounting of the Dosing Cabinet

Dosing cabinet installation drawings are available in the Engine Drawing Design Center (EDDC) which will depict the mounting hole pattern and detail on connection points.

The dosing cabinet can be mounted using bolt holes in the frame rails. The dosing cabinet frame rails have four M4 bolt holes on the inside of the rails. The unit can be hard mounted or isolation mounted to engine enclosure. The dosing cabinet should not be mounted to the engine or engine frame rails due to vibration concerns.

The dosing cabinet installation location must meet several criteria:

- Ambient temperature around dosing cabinet between 0°C (32°F) (Assuming 40% DEF) and 38°C (100°F)
- Adequate service access to the dosing cabinet
- The cabinet must be below the CEM to facilitate the automatic purge process (See DEF Injection Lance Lines Installation)
- A maximum DEF line pressure drop of 200 kPa (29 psi) dosing cabinet DEF out to CEM lance.

Note: The pressure drop is the sum of both the head loss and fluid line resistance. Assume 60 liters per hour as the assumed worst-case flow rate for calculation purposes. The optional supplied DEF line is 7.5 mm (0.3 in) inside diameter.

Ambient Temperature Requirements

The unit must be mounted inside an environmentally controlled building or enclosure – **do not install this unit outside unprotected**. The building or enclosure must maintain an environment suitable for electronics, with an ambient temperature maintained between 0°C (32°F) and 38°C (100°F) to protect them from premature failure (reference LEBW4971 Engine Room Ventilation). The dosing pump and DEF tank require the same ambient temperature range as described for the system electronics. Installing the dosing cabinet in any way that does not protect the cabinet and its components could impact the warranty. Consult Table 3.7 for component temperature limits and Appendix E for sensor temperature zones.

Max SCR System Temperature Requirements	
Component/Parameter	Temperature (°C)
Electronics	
Temperature Sensor	120
NOx Sensor Control Box	105
Pressure Sensor	125
DEF Pressure Line	
DEF Pressure Line Skin Temp	85

Table 3.7 – Component Temperature Limits

Dosing Cabinet Clearance

The dosing cabinet must be mounted in the vertical position, and the dosing cabinet is required to have a 2-foot access clearance on at least one of the sides of the cabinet. Clearance is also required on the front face of the cabinet to allow room to hook up the air and DEF lines along with the electrical harnesses. The model in Figure 3.3 shows the required access dimensions. Side access is only required on one side of the cabinet keeping in mind there are serviceable parts inside the cabinet. Free space above the cabinet combined with side space clearance will enhance the ability to access internal cabinet parts. See Table 3.8 for cabinet dimensions.

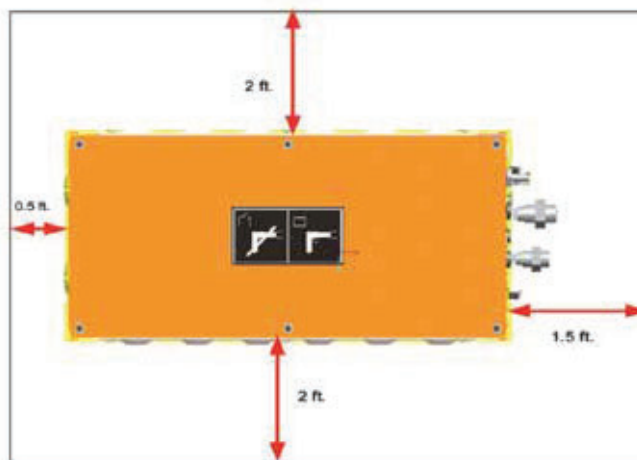


Figure 3.3 – Dosing Cabinet Mounting Clearance Requirements

Dosing Cabinet	
Height	845 mm (33 in)
Width	500 mm (20 in)
Depth	940 mm (37 in)
Weight (Dry)	123 kg (265 lb)
Weight (Wet)	138 kg (303 lb)

Table 3.8 – Dosing Cabinet Specifications

Check EDDC and TMI for the latest physical data for the dosing cabinet or work through your Cat dealer.

Assembly of Cat SCR System Components

- When tightening fittings, torque to specifications.
- Use Teflon tape on compressed air NPT threaded fitting.
- Use DEF sealant on DEF NPT fitting (if equipped).
- Use high temperature anti-seize on all threaded parts in contact with the exhaust system.

Dosing Cabinet DEF Vent

The DEF vent port must have a vent line installed to route buffer tank fumes to meet regulatory guidelines for ammonia fumes and the following routing requirements:

- DEF vent line exit must be below DEF injector.
- Vent line must have a drain line routed back to storage tank or a regulatory-approved waste container in the unlikely event of buffer tank overflow and return flow of DEF during purge cycle.
- DEF vent line must be routed continuously upward away from vent port without kinks, loops, or mechanical components that could create a blockage.
- DEF vent line exit must be equipped with a filter/breather with a 40-micron element.
- DEF vent design must facilitate periodic inspection and flushing to remove any DEF crystals.

Guidelines for CEM Installation

- Use all mounting brackets when securing the CEM into its operating position.
- The CEM is designed to be installed in one orientation only, with the mounting bracket and catalyst assemblies inside parallel to the ground. Do not rotate or flip the housing with the catalyst assemblies inside the unit. Rotating or flipping the unit with the catalyst inside will damage the catalyst.
- Make sure all ports, openings, and connections are clear from obstruction. The injection lance and NOx sensors are serviceable parts and require room to remove for cleaning or service. Minimum clearances for serviceable components are listed in the EDDC keeping in mind that humans will need to be factored into the clearance equation as well.
- Evaluate installing the optional insulation blankets prior to lifting the CEM onto the support frame. Check SIS Web for insulation assembly special instructions.
- Check lengths of all harnesses prior to installation.
- The top of the dosing cabinet must be lower than the DEF injection lance.
- Effective electrical grounding is essential for all personnel when working around and inside electronic enclosures that contain sensitive electronic equipment such as controllers. Static discharges from personnel can damage sensitive electronic equipment.

Lifting the CEM

The CEM is shipped on a pallet and is equipped with lifting eyes. The lifting eyes can be used to remove the unit from the bed of the delivery truck and to install on the support system. When using the lifting eyes to lift the CEM, use all the provided eyes. Failure to do so could result in accidents, potential injury, and equipment damage. These recommended angles produce the least amount of strain on the lifting eyes. The lifting eye design accommodates lifting straps (Figure 3.4). For additional lifting information, consult NEHS1064.

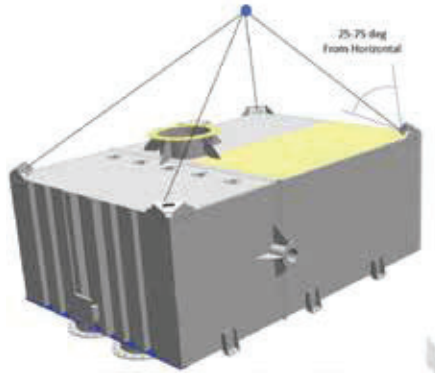


Figure 3.4 – CEM Lifting



WARNING

Follow CEM lifting procedures as described in this document, including do not use a spreader bar. Failure to follow proper lifting techniques and procedures can lead to a loss of control of the load and result in personal injury or death.

NOTICE

Rough handling, shock loads, and improper lifting procedure can damage internal components, mounting systems, and substrates.

CEM Reactor Weight

Installation specifications and information is available in the EDDC and TMI. Check with your local Cat dealer for the weight of your specific CEM reactor.

CEM Mounting Instructions

Bolt the CEM housing to the support frame using the mounting brackets, which include a slotted hole running parallel to the short axis of the unit on the exhaust inlet end of the housing, allowing width expansion, and a rectangular slot on the other mounting brackets, allowing thermal expansion in both length and width (Figure 3.5).

Retainer plates should be used on the top of the mounting brackets and a flat washer must be placed on top of the retainer plate and on the bottom side of the support frame when installing the unit.

The torque collar rests on the supporting frame and inside the slots in the mounting bracket. The threaded fastener holds the torque collar in place, and the unit can expand by shifting around the torque collar (Figure 3.5). The torque collar dimensions are 15 mm thick, ID – 17 mm, and OD – 30 mm.

The customer-installed mounting frame should have pre-drilled 22 mm (.875 inch) holes, per drawing dimensions, for a smooth installation. Recommend SAE grade eight (8) M16 bolts and torque to 240±40 N•m.

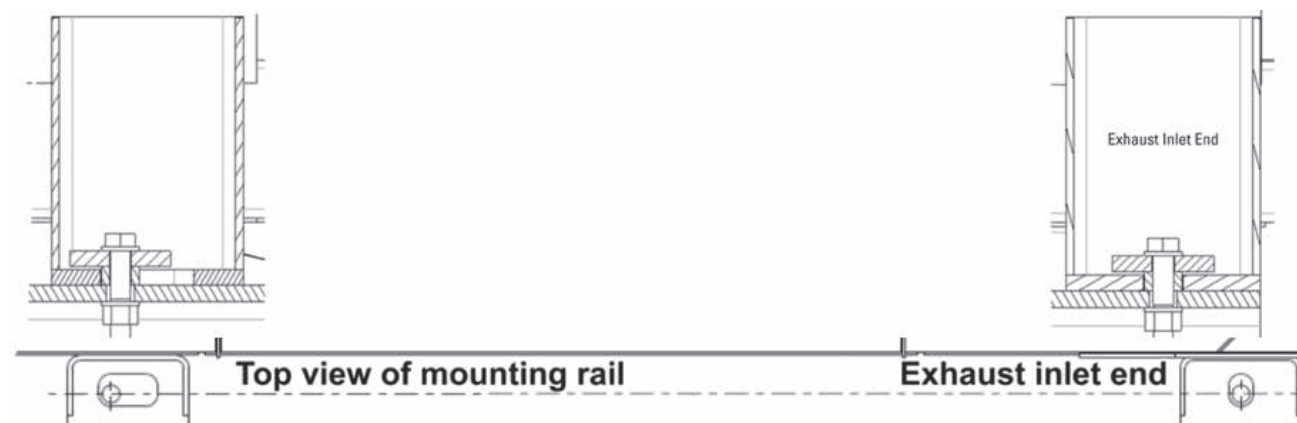


Figure 3.5 – CEM Mounting Technique

Note: It is mandatory that all mounting brackets are in contact with the mounting surface, using shims if necessary, to distribute the load over the entire support frame surface. The dimensions for mounting bracket hole spacing are available in the EDDC.

Thermal Expansion

From its cold state, 409 stainless steel will expand 0.18 mm (.007 in) per 305 mm (1 ft) of reactor length per 50°C (122°F) temperature rise (Table 3.9). If not accounted for, the thermal growth can exert undue stress on the engine exhaust system and CEM connections, as well as the pipe supports.

										0.54%	Expansion Percentage
										0.47%	
										0.41%	
										0.35%	
										0.29%	
										0.23%	
										0.17%	
										0.11%	
										0.05%	
27C	77C	127C	177C	227C	277C	327C	377C	427C	477C		

Temperature Rise Table

Table 3.9 – Thermal Expansion Specifications

NOTICE

If CEM is mounted rigid without thermal expansion allowance, weld failures and metal fatigue in the mounting bracket and the shell of the CEM could result in damage to the CEM structure. Do not weld the CEM mounting brackets to the supporting frame. The CEM fastener guide table below lists the various fasteners required to install a CEM reactor at the mounting points shown in Figure 3.6. The exhaust flanges vary per engine bore size, so the required size will depend on the flange used. It is recommended that high temperature (>600°C) anti-seize compound be used on all exhaust bolts.

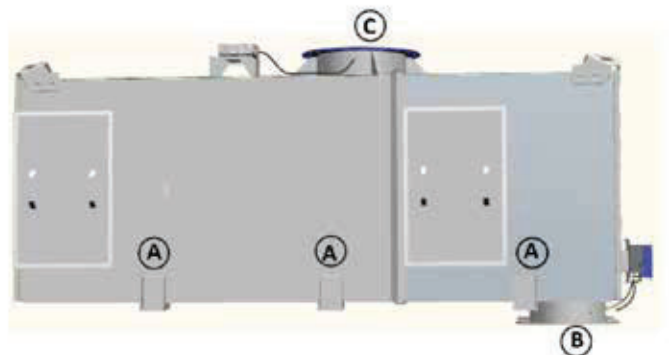


Figure 3.6 – CEM Fastener Guide Connections to the Exhaust System

CEM Fastener Guide		
Mounting Point	Description	Fastener Type/Size
A	Elongated Base Mounting Brackets	M16 torque $240 \pm 40 \text{ N}\cdot\text{m}$
B	Exhaust Inlet Flange	As required by flange bolt size
C	Exhaust Outlet Flange	As required by flange bolt size

Table 3.10 – CEM Fastener Guide

Connections to the Exhaust System

The Cat CEM reactor must be isolated from engine vibration. Use bellows on the inlet connection as shown in Figure 3.7. The Cat SCR system inlets and outlets are not designed to handle the significant loads that can come from thermal expansion of piping. Bellows are required on the outlet stack, especially if a long run of piping is required to direct the exhaust out of the building or structure. Install bellows within two stack diameters of the SCR system outlet and in the same direction of flow from the outlet. If stack plenum has multiple directional changes, use bellows along each straight run to accommodate thermal expansion. The exhaust inlet requires a minimum of 305 mm (12 in) of stack length at full inlet flange diameter between transition and/or bellows and CEM inlet flange (Figure 3.7).

Note: If insulation is applied to a bellows connection, adequate clearance must be provided to prevent friction wear between the thin wall of the bellows and inner surface of the insulation.

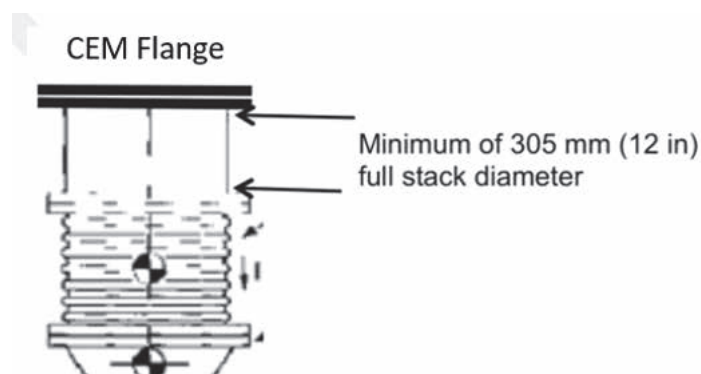


Figure 3.7 – Exhaust Bellows Connection

CEM Outlet Flange Capability to Support an Exhaust Stack

The following table depicts the capability of the CEM outlet flange to support an exhaust stack.

Horizontal Axis – Bending moment applied to the flange expressed in kN•m.

Vertical Axis – Force applied to the flange vertically downward (weight of the stack) expressed in kN.

Tabular Data – The safety factor derived by Caterpillar engineering given a downward force (vertical axis) and bending moment (horizontal axis). A safety factor of >2 is considered acceptable. The green area in the table contains safety factors >2.

Note: The limit of vertical force on the outlet flange is 2 kN, and the maximum bending moment on the flange is 1.4 kN•m.

Note: Only horizontal stack guy wires are recommended. Angled stack guy wires should not be used to limit bending moment because they will impart a significant vertical downward force on the outlet flange.

Example:

An exhaust stack is estimated to have a 200 kg mass.

The stack will be installed with a stabilizing support structure which will prevent the stack from tipping and hence will not impart a bending moment on the CEM outlet flange.

$$\begin{aligned}\text{Vertical Force (N)} &= \text{mass of exhaust stack} \times \text{gravity (9.81 m/s}^2\text{)} \\ &= 200 \text{ kg} \times 9.81 \text{ m/s}^2 \\ &= 1962 \text{ N} = 1.962 \text{ kN}\end{aligned}$$

Using the table – This would result in a safety factor of between 4.59 and 4.55 as seen in the lower left of the table.

OUTLET(Rated Temp)		Moment (KNm)										
		0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2
FORCE (kN)	0	5.04	5.00	4.97	4.56	3.57	2.93	2.48	2.15	1.90	1.71	1.54
	0.2	4.99	4.95	4.91	4.28	3.39	2.81	2.40	2.09	1.85	1.66	1.51
	0.4	4.93	4.90	4.86	4.03	3.23	2.70	2.32	2.03	1.80	1.63	1.48
	0.6	4.88	4.85	4.81	3.81	3.09	2.60	2.24	1.97	1.76	1.59	1.45
	0.8	4.83	4.80	4.63	3.61	2.96	2.50	2.17	1.92	1.72	1.55	1.42
	1	4.78	4.75	4.34	3.43	2.84	2.42	2.11	1.86	1.67	1.52	1.39
	1.2	4.73	4.70	4.09	3.27	2.72	2.34	2.04	1.82	1.63	1.49	1.36
	1.4	4.69	4.65	3.86	3.12	2.62	2.26	1.98	1.77	1.60	1.45	1.34
	1.6	4.64	4.61	3.66	2.99	2.53	2.19	1.93	1.73	1.56	1.42	1.31
	1.8	4.59	4.41	3.47	2.86	2.44	2.12	1.88	1.68	1.53	1.40	1.29
	2	4.55	4.15	3.31	2.75	2.35	2.06	1.83	1.64	1.49	1.37	1.26

Table 3.11 – Load Limit Capability for Exhaust Out Flange at 400°C Expressed in Safety Factor

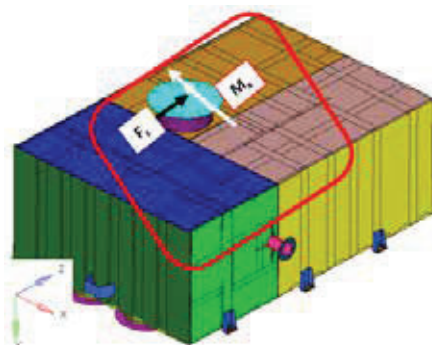


Figure 3.8 – Force and Moment

Note: If the Fatigue Factor of Moment (kN•m)/Force (kN) (Figure 3.8) falls within the green data points, your stack weight should be within specifications (Fatigue Factor >2). The outlet (rated temp) is 400°C.

Wires must not be used to secure the stack to eliminate a moment on the exhaust flange. Stacks should be supported by a sleeve or support system which will allow the stack to grow under thermal expansion but still prevent any moment being placed on the exhaust flange and outlet wall.

Water Ingress Prevention

The presence of water in the CEM can cause failures such as cracking of the catalyst from freeze/thaw cycles, cracking of the catalyst by water causing thermal gradients across the catalyst substrate, and potential for loss of mat retention. Exhaust system outlets must be provided with an appropriate means of preventing snow, rainwater, or sea spray from entering the CEM through the exhaust piping. This can be accomplished by several methods but must be given careful consideration. The selected method can impose significant restrictions that must be considered when calculating system backpressure. One simple method, used primarily with horizontal exhaust pipes, is to angle cut the end of the exhaust pipe with the point at the top.

A common method used with vertical exhaust pipes is to angle the pipe at 45° or 90° from vertical using an appropriate elbow, then angle cutting the pipe end as previously described.

For applications where none of the previous methods are possible, it may be necessary to fit some form of rain cap to the end of the vertical pipe section. This method can provide a positive means of water ingress prevention but not without imposing a significant backpressure restriction.

Additional information related to exhaust system installation can be found in the Caterpillar publication LEBW4970.

General Exhaust Requirements Summary

Attention should be given to exhaust gas flow restriction with the following recommendations:

- The exhaust backpressure must not exceed the limits given for each engine family and the Cat CEM installation. Reference TMI System Data or Engine Sales Manual for commercial applications and engine technical specifications.
- The exhaust piping must allow for movement and thermal expansion so that undue stresses are not imposed on the turbocharger structure or exhaust manifold.
- Never allow the turbocharger to support more than allowable loads. Reference TMI System Data or Engine Sales Manual for commercial applications and engine technical specifications.

Backpressure Verification

Excessive backpressure drop in the exhaust system will adversely affect the performance of the engine and the Cat SCR system. It is required that the systems meet these criteria for optimal performance. Excessive pressure drops can yield higher than expected exhaust temperatures, lower fuel economy, reduced altitude capability, decreased engine response, and less than rated power.

For retrofit SCR systems, it is recommended that exhaust backpressure be measured and recorded prior to installing the SCR system. Once installed, the exhaust backpressure should be measured and recorded for future comparison as an indicator of catalyst performance.

Measuring Backpressure

Exhaust backpressure is measured as the engine is operating under full rated load and speed conditions (High Idle for Naturally Aspirated engines). Either a water manometer or a gauge may be used. It is recommended exhaust backpressure is tested and recorded on new installations to be available for future reference. An electronic backpressure sensor is located in the sensor box mounted on the exhaust inlet end of the CEM, and the sensor pressure pick-up unit is installed in the nearest exhaust inlet tube. This pressure sensor monitors the exhaust pressure in real time, and the data is recorded and displayed using the dosing cabinet controller and interface screen (MECP1).

Insulation Requirements

It is very important to retain as much heat in the CEM as possible, as the SCR reaction process and the regeneration process of the DPFs, if equipped, are more efficient at higher exhaust temperatures. Insulate all piping prior to the Cat CEM, as shown in Figure 3.9. Check with your local Cat dealer regarding insulation practices related to exhaust system components. Refer to LEBE0039 Retrofit Diesel Particulate Filter (DPF) Reactor manual for additional requirements when using DPFs including regeneration strategies.

Note: CEM insulation is available in the pricelist as an option. Selecting this option is recommended because the insulation components are available as replacement parts, which will allow for cost effective replacement or repair. Each insulation kit is supported by an installation special instruction. Contact your Cat dealer who can access the installation special instructions via SIS Web using the serial number prefix of the aftertreatment Common Arrangement.



Figure 3.9 – Exhaust Piping Insulation

The CEM surface temperature and/or exhaust gas temperatures are difficult to specify and depend upon many factors including: the design and packaging of the SCR system, the engine speed/load conditions, the condition of the SCR catalyst, if insulation blankets are installed, and ambient conditions. Therefore, the potential surface temperature of an insulated CEM can exceed 100°C (212°F). An uninsulated CEM can reach surface temperatures of 450°C to 500°C (842°F to 932°F). For a safe project design, the proper precautions should be taken to ensure the aftertreatment device is properly shielded and not mounted near surrounding components that may be damaged by heat. Ensure that heat sensitive wire harnesses or other components are not installed between insulation blankets and the CEM body. See Appendix D.

See Figure 3.10 for an example of a custom-made insulation (thermal) blanket.



Figure 3.10 – Custom Thermal Blanket

Dosing Cabinet

Normal functions/operations of the dosing cabinet include:

- Monitor and dose DEF
- Monitor and regulate compressed air
- House dosing controller
- Provide monitoring connections and display system conditions on the MECP1 screen (see OMM M0075634-04 for instructions of MECP-1)

The dosing cabinet works within specified operating conditions. If the operating conditions change beyond the specification, take additional care to address these issues. Whenever a critical component is replaced, recalibration might be required.

DEF Supply to the Dosing Cabinet

Desired fill rate is about 5.8 liters (1.5 gal) per min at 34-69 kPa (5-10 psi) DEF supply pressure at the dosing cabinet fill port. For example, a 10-foot height difference generates 32 kPa (4.6 psi) DEF pressure.

Fill rate and overall flow restriction in valves, lines, and filters upstream to the dosing cabinet need to be accounted for when designing the DEF supply system (Table 3.4).

If a transfer pump is used to supply DEF to the dosing cabinet buffer tank the transfer pump must be sized to provide 34-69 kPa (5-10 psi). The pump must supply no more than a max of 69 kPa (10 psi) of pressure at the DEF fill port based on the flow rate and total flow restriction in the line from the remote tank to the buffer tank. A 10-psi pressure relief valve is recommended in the supply line between the DEF pump discharge and the DEF filter (Figure 2.2).

The dosing cabinet interacts with external components via its connection points. These connections could be electrical, electronic, compressed air, or liquid (DEF). The Cat retrofit SCR systems include the DEF and compressed air hoses and associated fittings to connect the cabinet to the DEF injector. Maintain tubing diameter from the cabinet outlet connector to the injection lance inlet connector. The included fluid and air hoses measure 18 300 mm (60 ft) in length and may need to be trimmed to fit. The hose kit is a non-heat traced package for basic installation between the dosing cabinet and DEF injector.

If operation in climates below -11°C (12°F) is certain, it is recommended that a self-regulated heat trace cable be applied to the DEF line to protect DEF or condensation from freezing. Small droplets of DEF or condensation may freeze into crystals, which could impact the operation of components or plug the DEF injector nozzle. Freeze protection must include DEF supply lines, valves, and the DEF filter.

Dosing Cabinet Connection Points

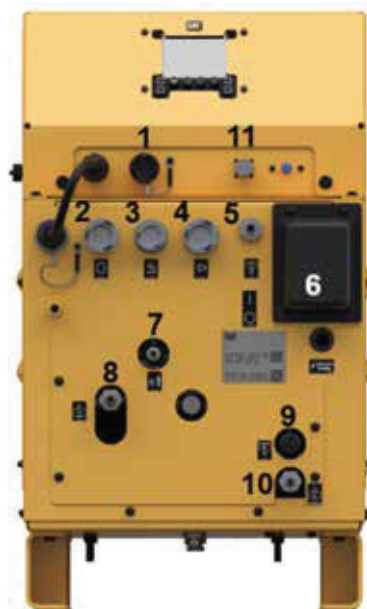


Figure 3.11 – Dosing Cabinet

Connection Point	Description	Fitting Type
1	Service tool connector	9 Pin
2	Electrical harness from dosing cabinet to engine ECM	23 Pin Connector
3	Electrical harness from dosing cabinet to main DEF tank (level sensor/transfer pump)	14 Pin Connector
4	Electrical harness from CEM to dosing cabinet	21 Pin Connector
5	DEF vent port (see “DEF Vent Line Requirements” below)	1/2" Hose Bead SAE AS5131
6	Electrical harness from dosing cabinet to 120V AC source	Grommet for wiring & 3 Terminal Blocks
7	DEF line from dosing cabinet to CEM	No. 6 STOR (Straight Thread O-Ring)
8	DEF inlet line to strainer on dosing cabinet	1/2" JIC
9	Air line from dosing cabinet to CEM	No. 6 STOR (Straight Thread O-Ring)
10	Air line into dosing cabinet	3/8" JIC
11	DC power for display	3 pin connector

Table 3.12 – Dosing Cabinet Connection Points

DEF Vent Line Requirements

The DEF vent port must have a vent line installed to route buffer tank fumes to meet local regulatory guidelines for ammonia fumes and the following routing requirements:

- DEF vent line exit must be below DEF injector.
- Vent line must be routed back to storage tank or a regulatory-approved waste container in the unlikely event of buffer tank overflow.
- Vent line must be routed continuously away from vent port without kinks or loops that would allow DEF pooling in line.

Installation of the DEF Injection Lance

In some cases, the DEF lance may be shipped loose to minimize overall shipping packaging size and width from the factory.

Be sure to inspect the DEF injection lance for damage and ensure that the nozzle orifices are clear of debris. Do not disassemble the nozzle from the DEF injection lance unless an issue is noted.

Be sure that gasket surfaces are clean and free of debris or shipping material residue. Ensure the flange gasket is installed.

The DEF lance and nozzle are installed as one component. The nozzle sprays in the downstream direction. A flow direction arrow is marked on the lance assembly to indicate the correct direction of flow. Note that there is a feature included in the CEM to ensure the correct flow direction when the DEF lance assembly is installed.

Note: Torque DEF lance mounting bolts to 370 ± 50 N·m (275 ± 37 lb·ft).

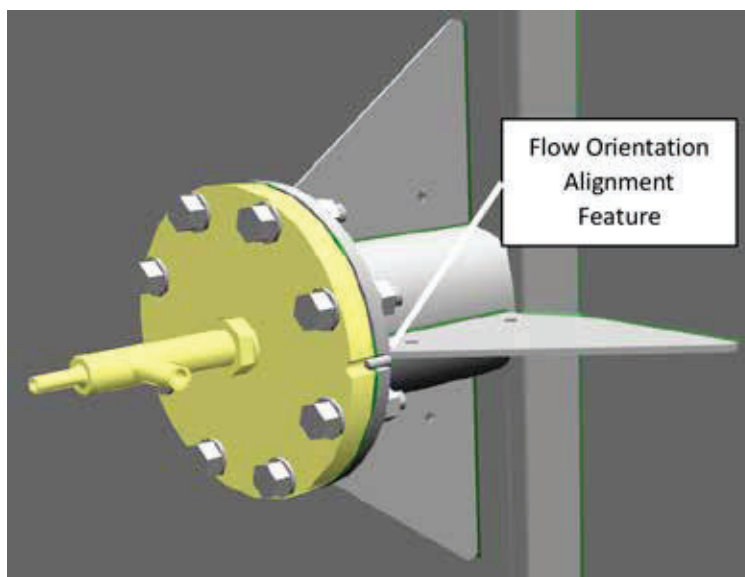


Figure 3.12 – DEF Injection Lance

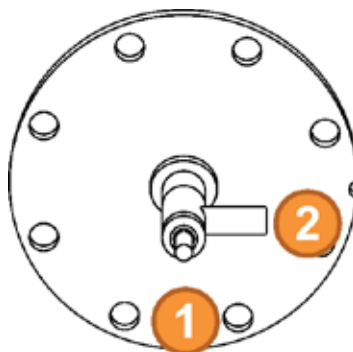


Figure 3.13 – DEF Injection Lance

Name	Location	Description	Fitting Type
DEF Port	1	DEF supply line 1/4" male NPT	Mechanical
Compressed Air Inlet	2	Compressed air line 1/2" male NPT	Mechanical

Table 3.13 – Injector Lance Threaded Port Connections

DEF Injection Lance Lines Installation

Prior to hose line installation, be sure to thoroughly blow out the lines. Particles in the air or DEF lines will clog the spray nozzle, causing a system failure.

The DEF and compressed air lines are to be installed following general routing and clipping rules keeping the lines from contacting sharp edges that could fatigue and fail the line from vibration or system operating movements. Other considerations should include routing continuously upwards without kinks, low spots, extreme bends, or loops that could restrict DEF/compressed air flow throughout the operating temperature extremes. The routing recommendations assist the dosing operation and promotes a complete purge cycle.

To connect the DEF line to the injector, fasten the threaded elbow onto 1/4" NPT fitting (Table 3.13) of the injector with DEF thread sealant as needed (Figure 3.13). Push the barbed hose fitting into the hose and secure with hose clamp provided.

Note: The hose will need to be seated against the hex portion of the fitting before applying clamp (Figure 3.14).

Connect the hose barb fitting to the threaded 1/4" elbow to complete the DEF line connection to the injection lance.



Figure 3.14 – DEF Line Connection to the Injector Lance

To connect the DEF line to the dosing cabinet, slip the hose clamp onto the DEF hose then push the hose onto the quick connect coupler which will make up with the fitting on the front of the cabinet (Figure 3.15).



Figure 3.15 – DEF Line Connection to the Dosing Cabinet

To connect the compressed air line to the injector lance, fit the 1/2" NPT elbow, using thread sealant as required, to the 1/2" male NPT fitting on the lance (Figure 3.13). Push the #8 hose onto the hose barb adapter until the hose is seated firmly against the yellow collar, then thread the hose barb adapter to the elbow. Do not install a hose clamp on the barbed adapter (Figure 3.16).



Figure 3.16 – Compressed Air Line Connection to the Injector Lance

To install the compressed air line to the dosing cabinet, push the #8 hose barb adaptor onto the hose until the yellow collar is seated firmly against the hose – do not use a hose clamp (Figure 3.17). Fit the 3/4 – 16 STOR/JIC to the appropriate port on the dosing cabinet air manifold (Figure 3.11). Then fasten the barbed adapter to the JIC fitting (Figure 3.17).



Figure 3.17 – Compressed Air Line Connection to the Dosing Cabinet

Introduction and Purpose

Installation of CEM Sensor Boxes

In some cases, inlet and outlet sensor boxes may be shipped loose to minimize overall shipping packaging size and width from the factory.

NOTICE

The sensor boxes are CEM serial number specific; there is an imbedded A1E1 (electronic memory chip) in the inlet sensor box harness describing the CEM's performance via a performance code and the serial number and part number of the CEM which is visible via Cat Electronic Technician (Cat ET). Be sure that the serial number on the sensor box matches the serial number plate on the CEM before installation. Failure to match serial numbers could lead to performance issues or fault codes which will not allow commissioning to be completed until corrected.

NOTICE

If insulation blankets are to be installed, install the blanket insulation first. Sensor wiring and pressure sensor tubing must be installed outside the insulation. Covering the sensor wires with insulation will cause the wire insulation thermal capability to be exceeded, leading to sensor failures.

Utilize hardware included in the factory-shipped loose materials to mount the sensor boxes as shown in the figures below. The sensor boxes must be mounted utilizing the thermally insulated mica spacers as shown. Hardware is included inside the sensor boxes when shipped from the factory. Remove the cover to access the hardware and uncoil the sensor wiring.

Do not use sensors that have been dropped or exposed to other forms of mishandling. Damage to the sensor may have occurred that is not visible.

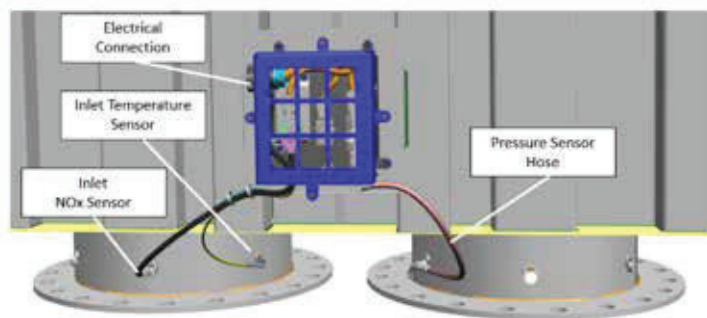


Figure 3.18 – Inlet Sensor Box Installation

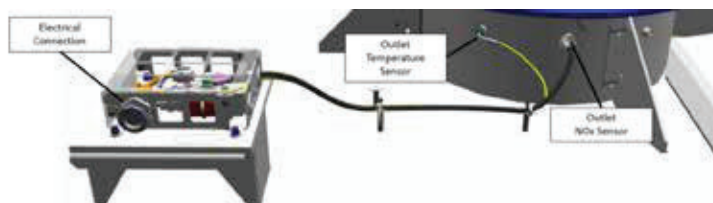


Figure 3.19 – Outlet Sensor Box Installation

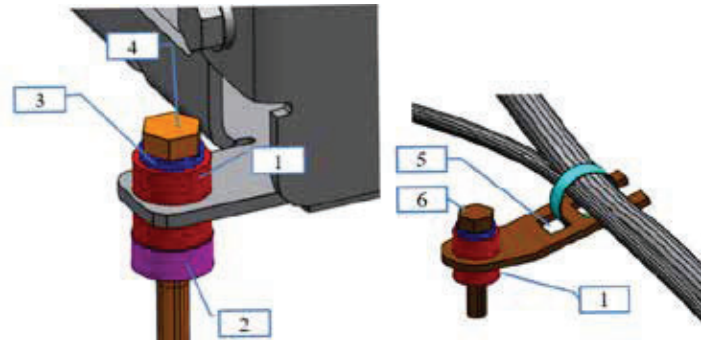


Figure 3.20 – Typical Thermal Isolated Mounting

Item #	Part Name
1	Thermal Mica Spacer (Two Required per Bolt)
2	Spacer
3	Washer
4	Bolt
5	Ladder Clip
6	Bolt

Table 3.14 – Typical Thermal Isolated Mounting

Note: Two thermal isolating mica spacers are required per joint. Mica thermal spacers are brittle and may crack if overly compressed. Torque thermal isolation joint bolts to 6 ± 1 N·m.

Inlet/Outlet NO_x Sensors

- Do not use sensors that have been dropped or exposed to other forms of mishandling. Damage to the sensor may have occurred that is not visible.
- Retain sensor tip protective caps until just prior to installation. Keep the sensor tip clean.
- Sensor threads are factory coated with high temperature anti-seize grease. Do not apply additional grease prior to installation.
- Use 468-8116 Slotted Socket (22mm) to tighten the sensor.
- Torque to $50 \text{ N·m} \pm 10 \text{ N·m}$.
- Ensure that the NO_x sensor is not covered with insulation. The insulation would trap heat in the sensor body and cable. This heat may cause sensor failure.

Inlet/Outlet Temperature Sensors

- Apply high-temperature, nickel-based anti-seize to both sides of threaded joint.
- Sensor – Torque to 45 ± 5 N·m.
- Ensure that the temperature sensor is not covered with insulation. The insulation would trap heat in the sensor body and cable. This heat may cause sensor failure.
- Ensure wiring is secured utilizing thermally insulated clipping points.

Inlet Pressure Sensor

- The pressure sensor is mounted in the sensor box. The box must be oriented as shown in the diagram above which will ensure that the sensor tip is pointed down, which will eliminate the possibility that the sensor function will be interrupted by condensation in the sensor connection hose.
- Hose must be routed and secured using thermal isolation to prevent vibration-induced hose wear or thermal damage.
- Sensor – Torque to $10 \text{ N·m} \pm 2 \text{ N·m}$.

CEM Electrical Harness Installation

Wire Harness Routing

Wiring shall be routed to ensure reliability and to offer protection from the following:

1. Harnesses shall be located a minimum of 50 mm from high heat sources (e.g. exhaust manifolds, turbochargers, hydraulic components, etc.) to avoid insulation and/or connector deterioration
2. Chafing/rubbing/vibrating against other parts
3. Use as handholds or as support for personal equipment
4. Damage by personnel moving around the installation
5. Damage by impact or thrown or falling debris
6. Damage by battery acid fumes, engine and hydraulic oil, fuel, and coolant
7. Abrasion or damage when exposed to rocks, ice, mud, etc.
8. Vandalism damage (to the maximum extent practicable)
9. Damage by moving parts
10. Harsh environments such as nitrite mines, high temperatures, or areas susceptible to significant fluid or fume concentration
11. Wire harnesses shall not be near oil and fuel fluid fill areas or below fuel and oil filter locations. If these locations cannot be avoided, additional protective covers and shields must be provided to protect the harness.

Harness Maintenance Considerations

The maintainability of the wiring system must be an important consideration in the selection, design, and installation of harnesses, cable assemblies, and other wiring system components. All wiring components shall be accessible, repairable, and replaceable (i.e. connector terminals).

Harness Appearance

The primary purpose for the wiring system is to provide electrical and electronic component function. There is, however, another important and intangible value to consider when designing the wiring system. The appearance of the wire harness and its routing path should reflect an orderly, well-thought-out design plan. A poorly executed plan can have a negative impact on OEM/installer perceptions of the entire product. Use the product's horizontal and vertical lines for routing paths. Design preformed bends into large harnesses to facilitate product assembly and improve appearance. Use other product elements to shield or hide the harness from view. Benchmark new automotive product applications for ideas.

Harness Bends

Routing of the harness should ensure connector seals are not stressed because the harness curvature is too close to the connector. This applies to routing of OEM/installer lines on or near the engine harness as well as the ECU OEM/installer connector (J1/P1).

The minimum bend radius for a braided wire harness as measured from the inside of the bend shall be four times the outer diameter of the harness. Tighter bends are possible if the bend is performed during harness manufacture. The bend radius size and location must be specified on the wire harness drawing.

Bends in jacketed cables must be based on manufacturer recommendations. A bend must not adversely affect the operating characteristics of the cable. For flexible coaxial cables, the bend radius must not be less than six times the outside diameter. For semi-rigid coaxial cable, the bend radius must not be less than ten times the outside diameter of the cable.

The minimum bend radius for flexible conduit must be six times the outer diameter of the conduit. Conduit bends shall not cause internal chafing of the wiring.

Harness Bends Near Connectors

Avoid wire harness bends within 25 mm (1.0 in) of the connector. When a harness bend is too close to the connector, the connector seal is stretched away from the wire, providing an opening for moisture entry. The wire should exit perpendicular to the connector before curving as necessary for routing. Refer to illustration in Figure 3.21.

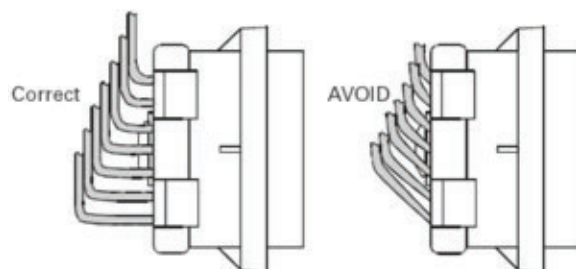


Figure 3.21 – Example of Wire Harness Routing at the PJ-C1, C2 Connectors

Wire harness bends near a connector must be no less than twice the wire harness diameter. Special consideration shall be given to connectors with large wire counts. Stresses placed upon the retention system of the connector can cause contact retention failures and wire pull-out. To avoid this problem, consider the following options:

1. Pre-form the harness to the required bend. The harness assembly drawing must detail the harness bend requirements (e.g. location and radius). The harness braid protection should be applied up to the tangent point of the bend furthest from the connector. Connector orientation to the bend may be necessary and should be specified on the harness print.
2. If harness braiding is used, increase the unbraided harness length to 150 mm. This will allow the wires to fan out when the harness is bent, greatly reducing the forces placed on the connector contact retention system. The connector should also be oriented properly with respect to the harness so that upon installation to the product, the harness will not need to be twisted to align the connector.

Drip Loop

When a harness is routed downward to a connector, terminal block, panel, or junction box, a trap or drip loop must be provided in the harness. This feature will prevent fluids or condensate from running into the above devices.

Wire Connection Guidelines

The following requirements ensure the correct installation of solid contacts into connector terminals:

- Do not solder the contact (socket or pin) to the wire.
- Never crimp more than one wire into a contact. Connector contacts are designed to accept only one wire of a specified gauge or gauge range; do NOT insert multiple wires of a smaller gauge.
- All contacts should be crimped on the wires. Use the crimp tool (Cat part number 1U-5804) for 12 to 18 AWG wire.

Perform the pull test on each wire. The pull test is used to verify that the wire is properly crimped in the contact and the contact is properly inserted in the connector terminal. Each contact and connector terminal should easily withstand 45 N (10 lb) of pull such that the wire remains in the connector body.

Sealing Splices and Ring Terminals

Caterpillar requires all ring terminals and splices connected to the engine ECM be sealed using Raychem ES2000 adhesive lined heat shrink tubing or equivalent. Refer to Table 3.15 for heat shrink tubing size information.

Cat Part Number	ID Before Shrink		ID After Shrink	
	mm	inch	mm	inch
125-7874	5.72	0.225	1.27	0.050
125-7875	7.44	0.293	1.65	0.065
119-3662	10.85	0.427	2.41	0.095
125-7876	17.78	0.700	4.45	0.175

Table 3.15 – Heat Shrink Tubing Reference

Wire Type

Wire must be of a type suitable for the application. Wire must be selected so that the rated maximum conductor temperature is not exceeded for any combination of electrical loading, ambient temperature, and heating effects of bundles, protective braid, conduit, and other enclosures. Typical factors to be considered in the selection are voltage, current, ambient temperature, mechanical strength, connector sealing range, abrasion, flexure, and extreme environments such as areas or locations susceptible to significant fluid concentrations.

Wire Size

The minimum conductor size used on Cat machines is 0.8 mm² (18 AWG). Smaller conductors are susceptible to breakage and fatigue failures. SAE J1614 wiring distribution systems for construction, agricultural, and off-road work machines require wire sizes no smaller than 0.8 mm² (18 AWG).

Jumper harness wire size requirements per connection are defined in the Cat CEM and Engine Jumper Harness Definition tables below (Tables 3.15 and 3.16).

Wire Insulation

Note: Thermoplastic polyvinyl chloride (PVC) insulation shall not be used in wire harness designs because of its low operating temperature range (-40 to 85°C) and melting and flammability characteristics.

Cross-linked polyethylene (XLPE) is the primary wire insulation type used in chassis, cab, and engine compartment locations. It has a temperature rating of -50 to 120°C. The voltage rating for Cat 1E0815 wire and SAE J1128, Type GXL is 50 volts. The circuit voltage shall be considered when making wire selections. This wire insulation is also available with 50, 150, 300, or 600-volt ratings. Outside diameter insulation range is 2.26 to 3.33 mm (0.089 to 0.131 in). The table below provides insulation diameter range for each gauge and wire type.

Connector Wire Insulation Size and Gauge		
Wire Type	Wire Gauge	Insulation Diameter
GXL	14	0.114 – 0.125
	16	0.098 – 0.112
	18	0.089 – 0.098

Table 3.16 – Wire Insulation

Metric Equivalents for AWG Wire Numbers						
AWG	20	19	18	16	14	12
Diameter (mm ²)	0.5	0.65	0.8	1	2	3

Table 3.17 Connector Seal Plug

All unused cavities for sockets and pins must be filled with seal plugs to ensure that the connector is sealed (Figure 3.22). Two options are available for plugging unused connector cavities. Either the Deutsch 114017 (Cat part number 8T-8737) or PEI Genesis 225-0093-000 (Cat part number 9G-3695) sealing plugs can be used.

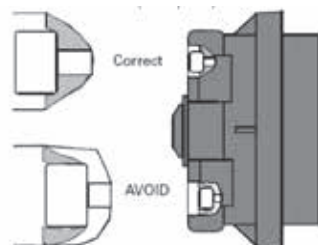


Figure 3.22 – Plug Insertion in Unused Connector Cavity

The seal plugs are installed from the wire insertion side of the plug or receptacle. Correct installation of either of these cavity plugs is critical to maintain connector sealing integrity. The figure above illustrates the correct insertion of the plug. The seal plug cap is designed to rest against the seal, not to be inserted into the hole in the seal.

Connection Points on the CEM Exhaust Inlet Sensor Box

The CEM junction box harness will electrically quick-connect to the provided fitting on the inlet sensor box and outlet sensor box (Table 3.18). The quick-connector is keyed to match to the appropriate sensor box.

Connection Point for CEM Harness			
Connection Point	Reference Number	Description	Fitting
A	Figure 3.23	Inlet Sensor Group to CEM Junction Box	CE-C913 18 Pin Connector
B	Figure 3.24	Outlet Sensor Group to CEM Junction Box	CE-C912 19 Pin Connector

Table 3.18 – Connection Points on CEM Exhaust Outlet

The CEM exhaust inlet NO_x sensor, exhaust back pressure sensor, and inlet exhaust temperature sensor are installed in the exhaust inlet flange ring and contained in the sensor enclosure (Figure 3.23).

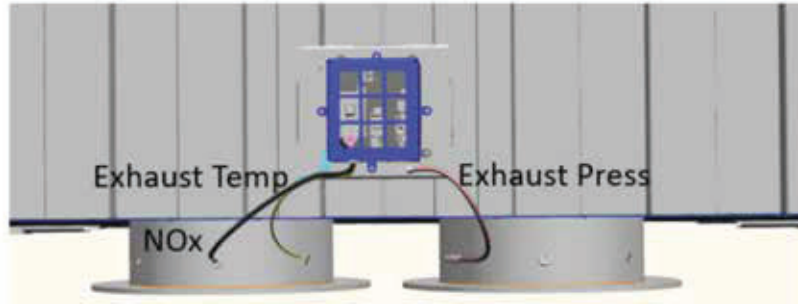


Figure 3.23 – Typical View of Exhaust Inlet Flange(s) and CEM Sensor Box

Connection Points on the CEM Exhaust Outlet Sensor Box

The CEM outlet NOx sensor and exhaust temperature sensor is installed in the exhaust outlet flange ring and contained in the sensor enclosure (Figure 3.24). The outlet sensor enclosure also contains the CEM ID module.

Caution: The NOx sensor is a precision instrument and can be damaged by rough handling or sudden temperature changes. Take care when handling and installing. See REHS8151 for additional information. (NOx in and NOx out sensors are different part numbers).



Figure 3.24 – Exhaust Outlet Flange

CEM Harness Connection Points

The CEM terminal box harness will electrically quick-connect to the provided fitting on the exhaust inlet and outlet sensor enclosures (Figures 3.23 and 3.24). The quick-connectors are keyed to match to the appropriate jack on the CEM (Figure 3.25).

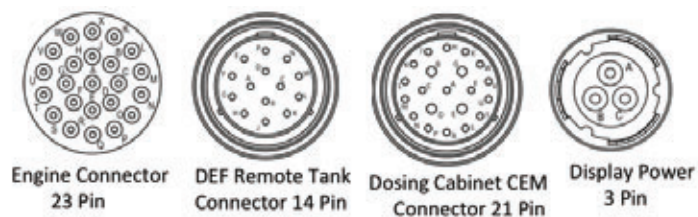


CEM Junction Box harness length is 3878 mm (152 in)

Figure 3.25 – Threaded Mountings for CEM Wire Harness

Cat CEM Interface Connections

The dosing cabinet terminal box harness will electrically quick-connect to the appropriate fittings on the front of the dosing cabinet (Figure 3.11). There are four multi-pin keyed quick-connectors on the harness from the dosing cabinet terminal box (Table 3.12 and Figure 3.26).



The Dosing Cabinet Junction Box harness length is 4077mm (160in)

Figure 3.26 – Dosing Cabinet Electrical Connections and Terminal Strip Box

CEM and Dosing Cabinet Component Overview

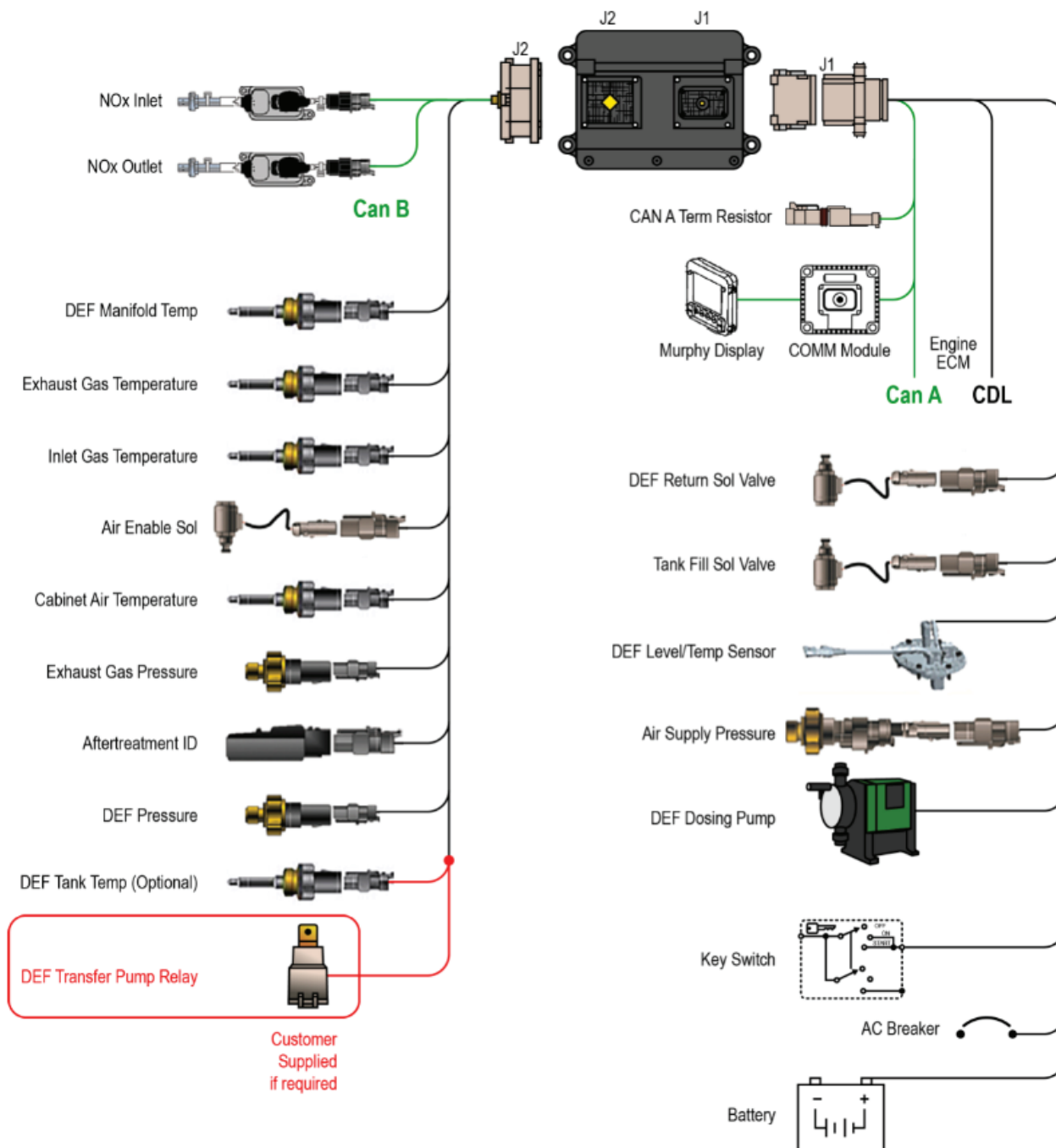


Figure 3.27 – Dosing Cabinet Wire Harness, Terminal Box, and Connectors

4.0 Cat CEM and Control System

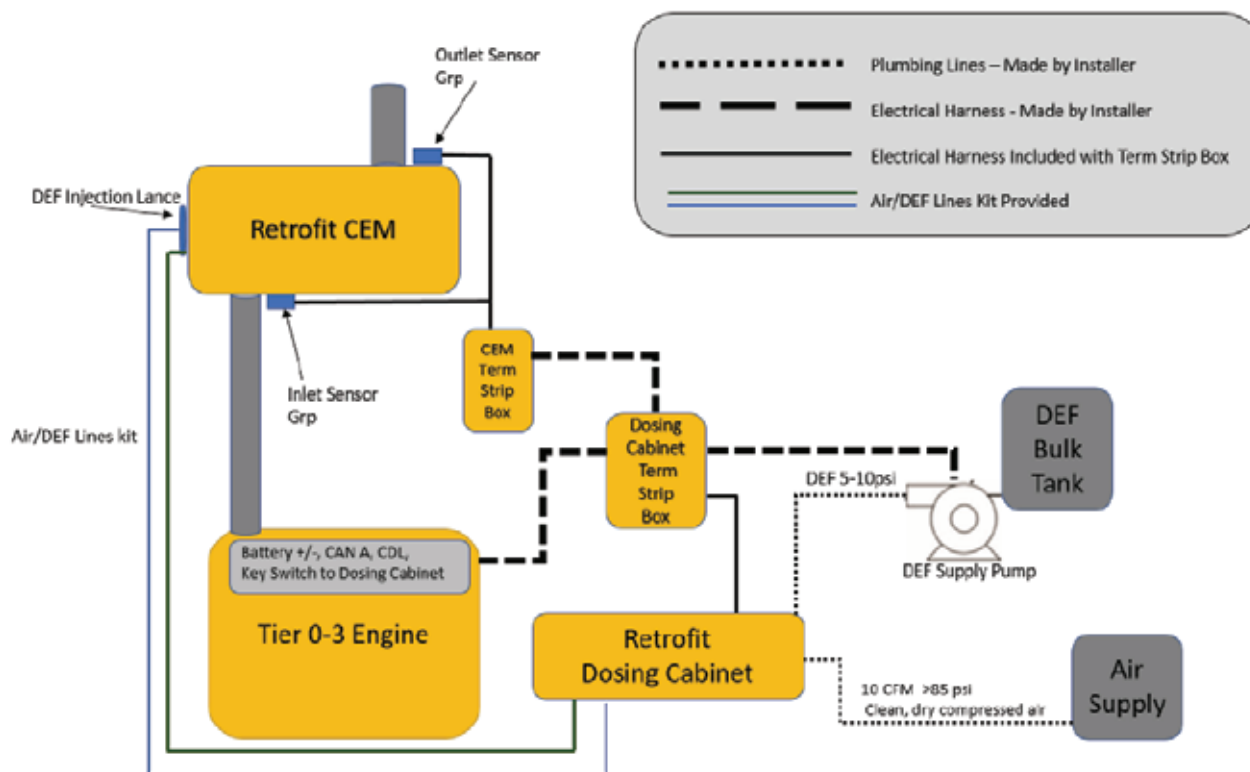


Figure 4.1 – CEM System Arrangement

CEM Control Power

The supplied wiring harnesses for the dosing cabinet and CEM are equipped with terminal strip junction boxes that will need to be electrically connected by a customer-supplied jumper harness built on-site (Figure 4.4). This harness will be point to point from the CEM terminal strip box to the dosing cabinet terminal strip box. Use the CEM terminal box information on the following pages for termination guidance. There is also a terminal identification film on the inside of the terminal box cover for additional terminating information (Figure 4.3). The supplied harness lengths are shown in Figures 3.25 and 3.26.

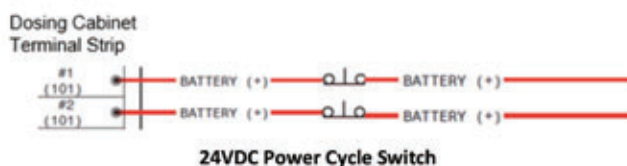
The dosing cabinet junction box harness connects to the front of the dosing cabinet with keyed connectors. See Figure 3.11 for dosing cabinet connector layout. The CEM terminal strip junction box connects to the inlet and outlet sensor enclosures with keyed connectors and the sensor enclosures are mounted on the CEM close to the exhaust inlet and exhaust outlet flanges.

A 24VDC power harness is required between the engine power system or the EMCP (Electronic Modular Control Panel) and the dosing cabinet terminal strip box (Figure 4.1). Consult the dosing cabinet terminal pin out film on the terminal box cover (Figure 4.2). Battery positive, battery negative, keyswitch, and CAN A conductors will need to be installed.

Optional dosing cabinet power cycle and keyswitch circuit interrupt techniques are shown below and described in the Cat Retrofit SCR Commissioning document (media number UENR4339).

The 24VDC electric power to the dosing cabinet needs to be cycled off to unlatch fault codes so the exhaust aftertreatment controller can function properly and the dosing pump will be enabled to operate once the appropriate parameters are attained.

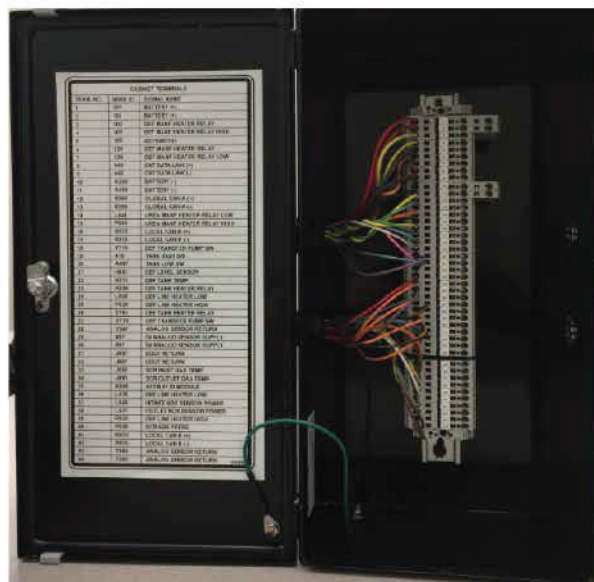
A recommended process for cycling power to the dosing cabinet only is the use of a momentary normally closed multiple contact switch. When the switch is activated, the 24VDC power to the aftertreatment controller will be interrupted, and existing fault codes will be unlatched. A convenient mounting location for the switch is in the dosing cabinet junction box.



Once the commissioning process is completed, the NVM (non-volatile memory) needs to be saved, and this process is accomplished by interrupting power to the keyswitch circuit to the dosing cabinet (see below). This action will force a save operation within the aftertreatment ECM. This can be achieved by installing a momentary normally closed switch on the keyswitch conductor.



Dosing Cabinet Terminal Strip Box



CABINET TERMINALS		
TERM NO.	WIRE ID	SIGNAL NAME
1	101	BATTERY(+)
2	101	BATTERY(+)
3	103	DEF MANF HEATER RELAY
4	103	DEF MANF HEATER RELAY HIGH
5	105	KEYSWITCH
6	229	DEF MANF HEATER RELAY
7	229	DEF MANF HEATER RELAY LOW
8	944	CAT DATA LINK(+)
9	945	CAT DATA LINK(-)
10	A250	BATTERY(-)
11	A250	BATTERY(-)
12	K900	GLOBAL CAN A (+)
13	K990	GLOBAL CAN A (-)
14	L838	UREA MANF HEATER RELAY LOW
15	P830	UREA MANF HEATER RELAY HIGH
16	R970	LOCAL CAN B (+)
17	R976	LOCAL CAN B (-)
18	Y719	DEF TRANSFER PUMP SW
19	410	TANK HIGH SW
20	A487	TANK LOW SW
21	H857	DEF LEVEL SENSOR
22	H811	DEF TANK TEMP
23	H839	DEF TANK HEATER RELAY
24	H838	DEF LINE HEATER LOW
25	P830	DEF LINE HEATER HIGH
26	T791	DEF TANK HEATER RELAY
27	Y719	DEF TRANSFER PUMP SW
28	Y947	ANALOG SENSOR RETURN
29	997	5V ANALOG SENSOR SUPPLY
30	997	5V ANALOG SENSOR SUPPLY
31	J807	DOUT RETURN
32	J807	DOUT RETURN
33	J890	SCR INLET GAS TEMP
34	J891	SCR OUTLET GAS TEMP
35	K895	AFTM #1 ID MODULE
36	L838	DEF LINE HEATER LOW
37	L920	INTAKE NOX SENSOR POWER
38	L921	OUTLET NOX SENSOR POWER
39	P930	DEF LINE HEATER HIGH
40	P938	SCR ABS PRESS
41	R970	LOCAL CAN B (+)
42	R976	LOCAL CAN B (-)
43	T993	ANALOG SENSOR RETURN
44	T993	ANALOG SENSOR RETURN

Figure 4.2 – Dosing Cabinet Junction Box and Terminal Strip Connections

CEM Terminal Strip Box

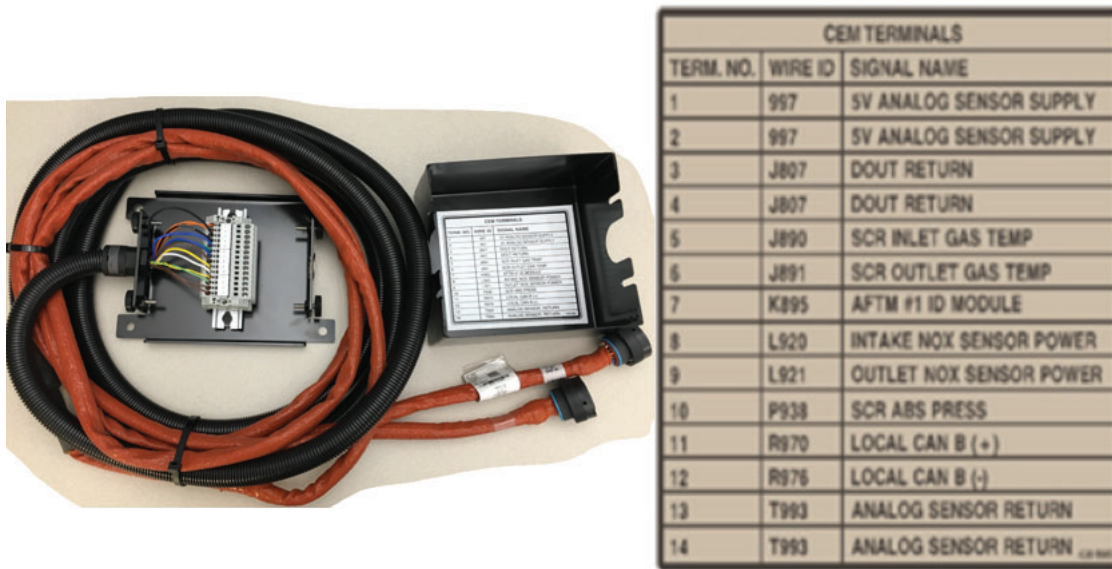


Figure 4.3 – CEM Terminal Strip Connections

Note: Replacement terminal box labels are available through the Cat parts system.

CEM to Dosing Cabinet Jumper Harness

A customer-supplied jumper harness will need to be run between the dosing cabinet terminal box and the CEM terminal box. There are 14 terminals in the CEM terminal box that will be wired point-to-point to terminals 29 through 44, except for pins 36 and 39, in the dosing cabinet terminal box. See Table 3.16 and Table 3.17 for conductor specifications. The supplied CEM terminal box harness length is 3878 mm (152 in), and the dosing cabinet terminal box harness length is 4077 mm (160 in).

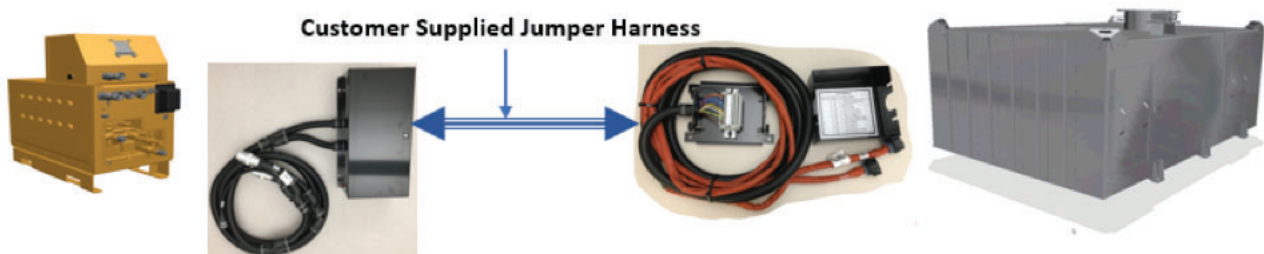


Figure 4.4 – CEM to Dosing Cabinet Jumper Harness

Cat CEM and Control System

Panel Connection Tables

If a Cat control panel is installed, the aftertreatment wiring connections can be made directly in connector C1 at the bottom of the panel using the appropriate crimp on sockets.

Panel Connections

Pinouts

The following tables provide wiring information for each of the junction boxes. They are color-coded by destination and type for easy reference.

Destination	Description
Customer Supplied	+ VDC
CEM Terminal Box	0 VDC
Engine Connector	Signal
	Communications

Control Panel					
Control Panel	ID	Description	Color	Size	PETU Terminal
C1:12	105	Keyswitch	BR	18	5
C1:17	K900	Global CAN +	YL	18	12
C1:18	K990	Global CAN -	GN	18	13
C1:50	101	System Power 24V	RD	14	1
C1:51	101	System Power 24V	RD	14	2
C1:52	A250	System Power 0V	BK	14	10
C1:53	A250	System Power 0V	BK	14	11

CEM Terminal Box					
SCR Terminal	ID	Description	Color	Size	PETU Terminal
1	997	5V Analog Sensor Power	OR	18	29
2	997	5V Analog Sensor Power	OR	18	30
3	J807	Dout Return	BK	18	31
4	J807	Dout Return	BK	18	32
5	J890	CEM Inlet Gas Temp	BU	18	33
6	J891	CEM Outlet Gas Temp	GN	18	34
7	K895	Aft #1 Module ID	BU	18	35
8	L920	Intake NOx Sensor 24V	BR	18	37
9	L921	Outlet NOx Sensor 24V	YL	18	38
10	P938	CEM Abs Pressure	WH	18	40
11	R970	Local CAN +	YL	18	41
12	R976	Local CAN -	GN	18	42
13	T993	Analog Sensor Return	BR	18	43
14	T993	Analog Sensor Return	BR	18	44

Dosing Cabinet Terminal Box					
Terminal	ID	Description	Color	Size	Destination
1	101	System Power 24V	RD	14	Control Panel C1:50
2	101	System Power 24V	RD	14	Control Panel C1:51
5	105	Keyswitch	BR	18	Control Panel C1:12
6	229	DEF Heater Relay 0V			Not used
7	229	DEF Heater Relay 0V			Not used
8	893	CDL +	GN	18	Engine CDL+
9	892	CDL -	BR	18	Engine CDL-
10	A250	System Power 0V	BK	14	Control Panel C1:52
11	A250	System Power 0V	BK	14	Control Panel C1:53
12	K900	Global CAN +	YL	18	Control Panel C1:17
13	K990	Global CAN -	GN	18	Control Panel C1:18
14	L838	DEF Heater Relay 24V			Not used
15	P830	DEF Heater Relay 0V			Not used
16	R970	Local CAN +			Not used
17	R976	Local CAN -			Not used
18	Y719	DEF Transfer Pump Switch			Not used
19	410	DEF Tank Hi Switch	WH	18	DEF Tank Hi Switch
20	A487	DEF Tank Lo Switch	PU	18	DEF Tank Lo Switch
21	H857	Local DEF Tank Level Sensor			Not used
22	K811	Local DEF Tank Temp Sensor			Not used
23	K839	DEF Heater Relay 24V			Not used
24	L838	DEF Line Heater 0V			Not used
25	P830	DEF Line Heater 24V			Not used
26	T791	DEF Heater Relay 0V			Not used
27	Y719	DEF Transfer Pump Switch	BU	18	DEF Pump Relay Coil -
28	Y947	Analog Sensor Return			Not used
29	997	5V Analog Sensor Power	OR	18	CEM Terminal Box terminal 1
30	997	5V Analog Sensor Power	OR	18	CEM Terminal Box terminal 2
31	J807	Dout Return	BK	18	CEM Terminal Box terminal 3
32	J807	Dout Return	BK	18	CEM Terminal Box terminal 4
33	J890	CEM Inlet Gas Temp	BU	18	CEM Terminal Box terminal 5
34	J891	CEM Outlet Gas Temp	GN	18	CEM Terminal Box terminal 6
35	K895	Aft #1 Module ID	BU	18	CEM Terminal Box terminal 7
36	L838	DEF Line Heater 0V			Not used
37	L920	Intake NOx Sensor 24V	BR	18	CEM Terminal Box terminal 8
38	L921	Outlet NOx Sensor 24V	YL	18	CEM Terminal Box terminal 9
39	P830	DEF Line Heater 24V			Not used
40	P938	SCR Abs Pressure	WH	18	CEM Terminal Box terminal 10
41	R970	Local CAN +	YL	18	CEM Terminal Box terminal 11
42	R976	Local CAN -	GN	18	CEM Terminal Box terminal 12
43	T993	Analog Sensor Return	BR	18	CEM Terminal Box terminal 13
44	T993	Analog Sensor Return	BR	18	CEM Terminal Box terminal 14

AC Power

Customer-supplied

Dosing Cabinet AC Electrical Power

The standard retrofit CEM dosing cabinet requires a 120VAC 15A (North America) circuit connected to the AC terminal strip inside the cabinet (Figure 4.5) and should be powered from a dedicated GFCI circuit. The dosing cabinet must be installed per national and local electrical codes. Electrical conduits or similar devices should not be installed on the side walls or the top of the dosing cabinet since these are service access panels.

This cabinet must not be used for the routing of external electrical circuits that are not part of the CEM electrical system.

AC Termination Location

The AC power connections are inside the dosing cabinet. They can be accessed by removing either the top or side panel (Figure 4.5). The terminal strip is marked COM for the white neutral wire, PWR for the black power wire, and GND for the green ground wire. The AC connection can operate between 100 to 240 volts single phase AC, at 50 or 60 Hertz. The 100-240VAC powers the dosing pump and an EMI filter only. Take note that various AC power ratings must be wired as L1 (power), Common, and Ground (Figure 4.5). The dosing cabinet controller can detect if the AC power is interrupted and will disable the cabinet operation as well.

The remaining SCR system components are powered from the engine 24VDC power source.

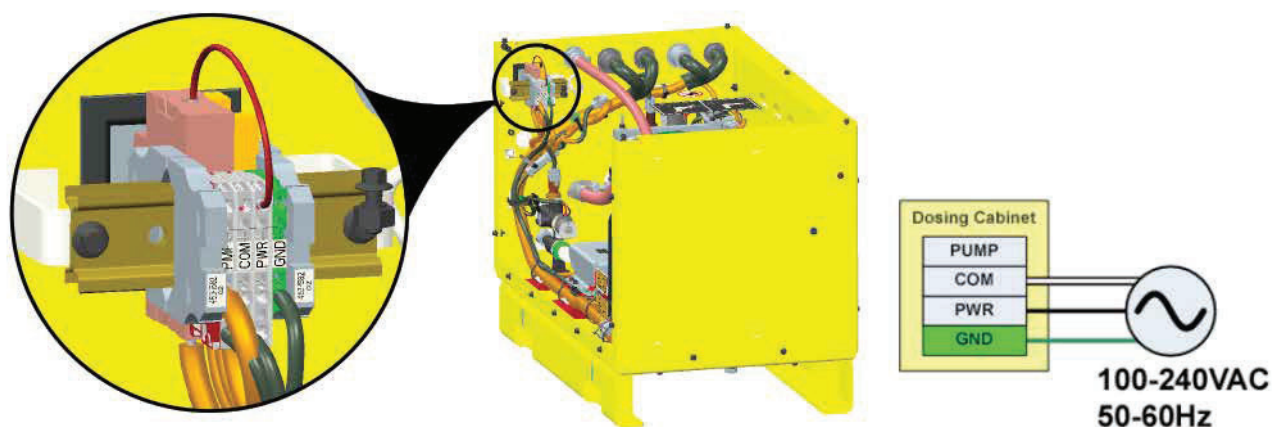


Figure 4.5 – Dosing Cabinet AC Power Connections

Label Dosing Cabinet Power Disconnect Switches

It is recommended to label the dosing cabinet power disconnect switch with a warning:

NOTICE

Do not disconnect electrical power to the dosing cabinet unless the local monitor screen displays "dormant."

Parameters are saved once per hour into flash memory. Disconnecting power when the system is not ready will cause data to be lost. The dosing cabinet must not be powered down during a purge cycle. System state is shown on the local control panel or display.

The following schematic (Figure 4.6) includes AC and DC power, keyswitch circuitry, and DEF transfer pump circuitry.

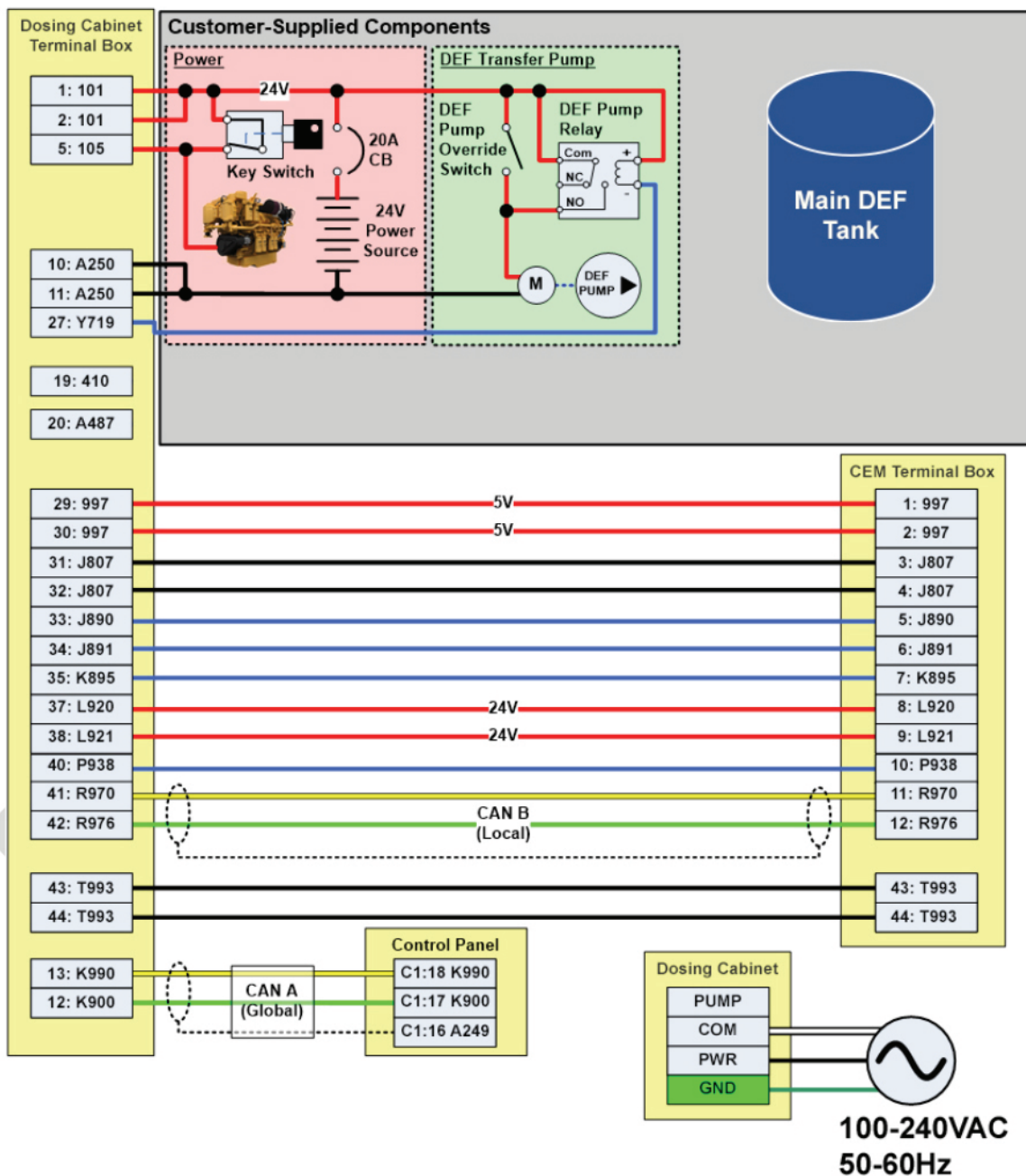


Figure 4.6 – Dosing Cabinet Wiring Diagram

DC Power

Customer-supplied

Main DC Power

A 24VDC power source is required for the CEM system (Figure 4.7). If the 24VDC power source is interrupted during normal operation, the system will not purge or operate properly.

Circuit Breaker

A 20A breaker is recommended for circuit protection of the system.

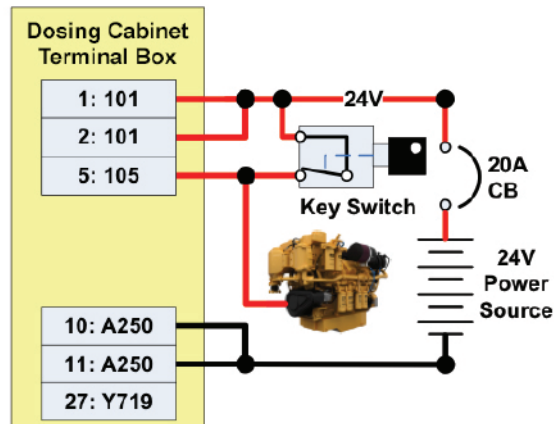


Figure 4.7 – Main DC Power

DEF Transfer Pump

Common Power Source

The DEF transfer pump is supplied by the customer. When the buffer tank level in the dosing cabinet is low, the controller will send a signal on terminal 27 (0V = active) to activate the DEF pump relay. It will also open the cabinet's buffer tank fill valve (Solenoid #3, Figure 2.2). A DEF transfer pump override switch can be installed if desired (Figure 4.8).

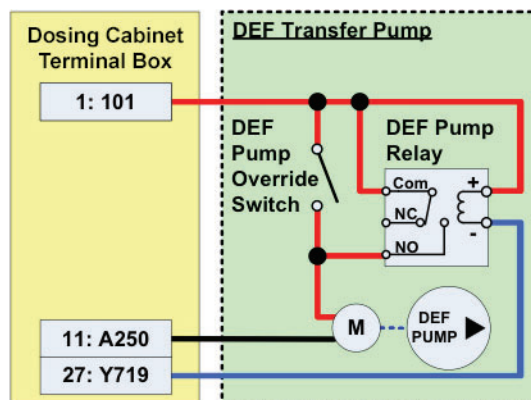


Figure 4.8 – Common DC Power

Independent Power Source

If the DEF transfer pump requires a different voltage, it must be wired as shown in Figure 4.9. The DEF pump relay will still be powered by the dosing cabinet 24V circuits and controlled by the signal on terminal 27, but the DEF transfer pump and DEF pump override switch will be connected to an independent power source.

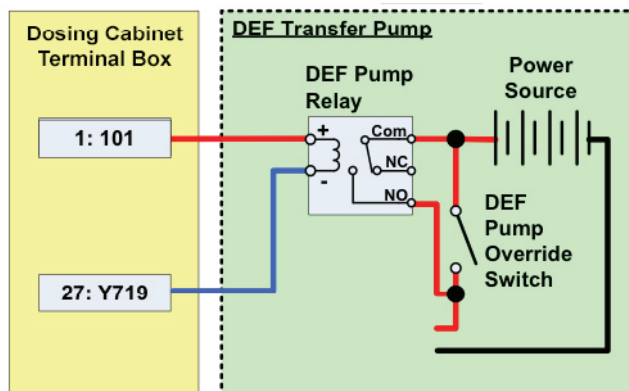


Figure 4.9 – Independent Power Source

Relay

A relay should be used even if using a common power supply, and it needs to be sized for the pump selected.

Override Switch

The optional override switch (Figure 4.8 or Figure 4.9) is recommended in case of relay problems with the DEF transfer pump circuitry.

Keyswitch

A keyswitch is required, and the same keyswitch must be used for the engine and its aftertreatment system. If different keyswitches are used, a mismatch in the state of the different switches can cause the aftertreatment system to be inoperable while the engine is running.

5.0 Cat CEM Communication Network

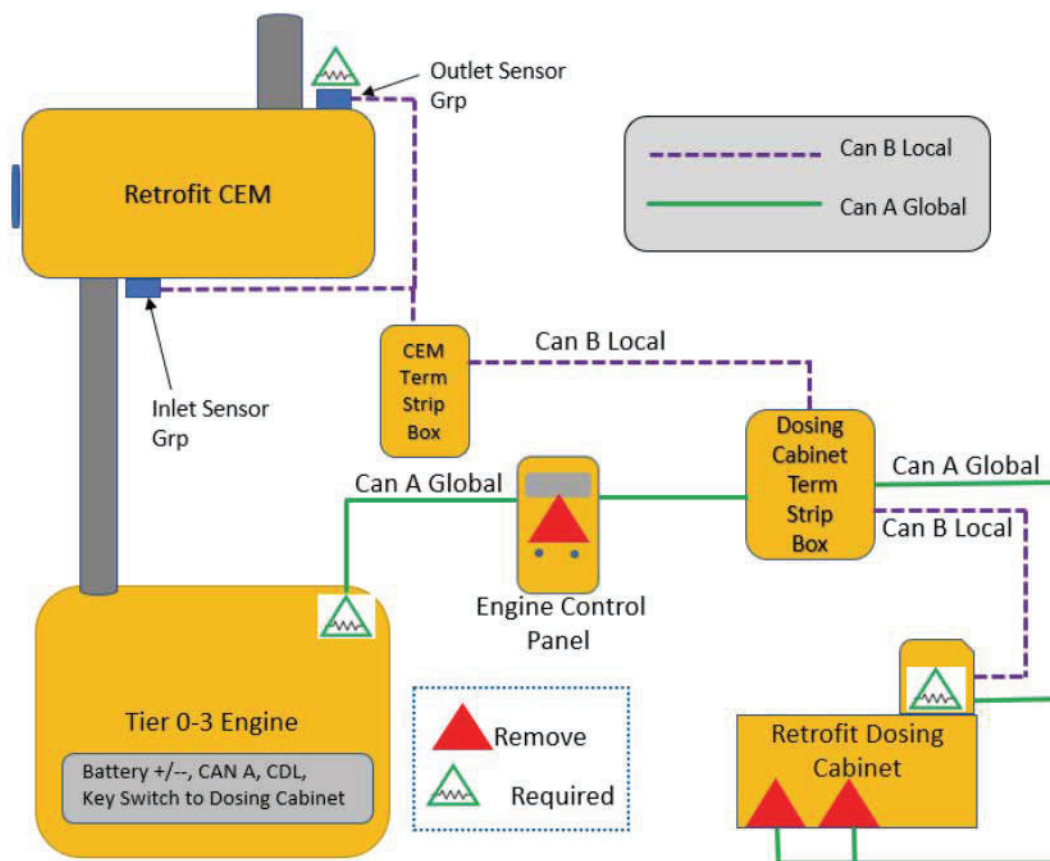


Figure 5.1 – Communication Network and Devices

Control Panels and Displays

There are numerous displays and control panels available from Caterpillar. Refer to your display or control panel A&I Guide for installation and configuration instructions. Check on termination resistors to ensure the correct number of resistor per CAN data link are installed (Figure 5.1).

CDL Circuit

Use twisted pair wires to connect the CDL wiring between the dosing cabinet terminal box and the engine connector. The system will transmit aftertreatment parameters over CDL to the engine ECM, which re-broadcasts them over the J1939 global data link to the control panel and remote displays (Figure 5.2).

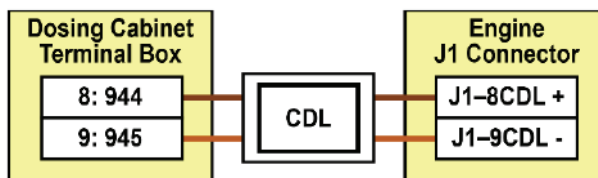


Figure 5.2 – Dosing Cabinet to Engine Data Link

J1939 Circuit

Installation

Use approved J1939 cable to wire between the dosing cabinet terminal box and the CEM terminal box (Figure 5.3).

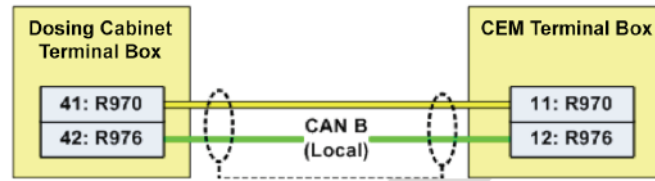


Figure 5.3 – CAN Data Link

SAE J1939/11 – Data Bus Wiring J1939 Data Bus Harness Design

The data bus connector that Caterpillar uses is a modified DT connector, special wedge, cable, and extended socket. The harness assembly requirements are unique to typical Cat wire harnesses. Caterpillar recommends two conductor shielded cable for all J1939 data link wiring. This cable must meet J1939 specifications for conductors. For additional information regarding the electrical system design, see the SAE publication J1939/11 “Physical Layer.” The minimum bend radius for the data bus cable is 40 mm.

J1939 Specifications for Conductors			
	Minimum	Nominal	Maximum
Impedance (ohm)	108	120	132
Capacitance between conductors (pF/m)	0	40	75
Capacitance between the conductors and the shield (pF/m)	0	70	110

Table 5.1 – J1939 Conductor Specifications

For the data bus to function as intended, the following requirements must be identified on the customer wire harness print.

1. Remove 75 mm of the outer jacket of data link shielded cable. (Reference Cat part number 153-2707.)
2. Remove the foil shield from the exposed wires to within 3 mm of the cable jacket end.
3. Crimp gold-plated socket terminals to the wires and the extended socket terminal to the drain wire. Slide heat shrink tube over the cable end. (Reference Cat part number 125-7876.)
4. Install the terminals into the appropriate connector cavity positions.
5. Install the wedge into the connector.
6. Apply the heat shrink tube over the back of the connector body and the jacket of the cable.

The following components and assembly procedures (Figure 5.4) must be used to ensure the cable to connector joint will be sealed. Failure to conform to these requirements will result in cable contamination and loss of shield performance.

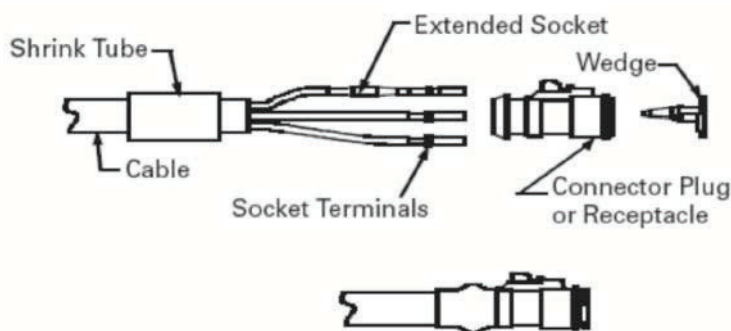


Figure 5.4 – SAE J1939 Connector

Assembly Note: Refer to SAE J1939-11 “Physical Layer” document for more information.

Connecting Modules to the CAN Data Link

The SAE J1939 data link is used to communicate engine information to an SAE J1939 compatible display or other desired SAE J1939 compatible modules. Refer to SENR9764 “Installation Guide for Industrial Electronic Engine Displays” for more information on connecting J1939 displays to Cat industrial engines. The illustration in Figure 5.5 shows multiple J1939 modules properly connected to the J1939 data bus. The key components to note are as follows:

- The total length of the data link between terminal resistors must not exceed 40 m (130 ft).
- Length of each branch, or stub length, must not exceed 1 m (3.3 ft). Reference cable assembly (Cat part number 165-0200) that is 0.15 m long with Deutsch DT 3-pin plug on one end and J1939 signal and shield wires with appropriate crimped socket on the other end for insertion into J1939 module connector.
- All splices and end nodes can be implemented using a connector tee. (Reference Deutsch DT receptacle assembly – Cat part number 133-0970.)
- Two terminal resistors must be installed. One resistor is required at each end of the data link to ensure proper operation. These two terminal resistors are critical for the proper operation of the network. (Reference Deutsch DT plug with integrated termination resistor – Cat part number 174-3016.)

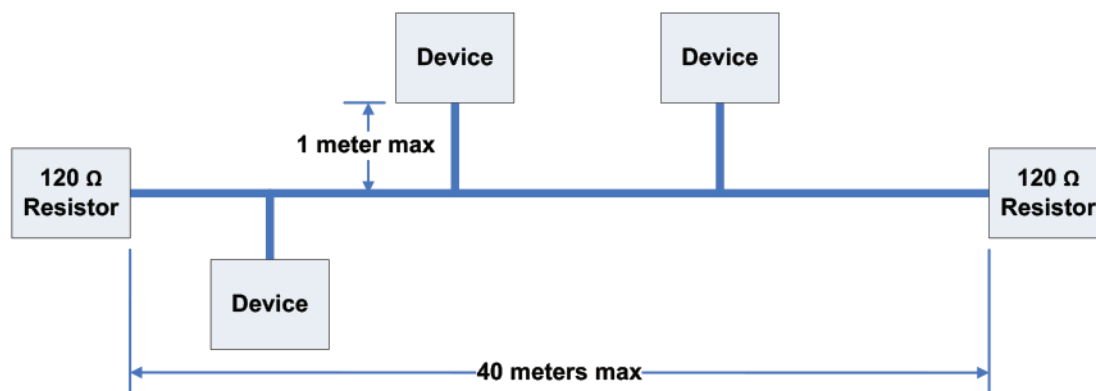


Figure 5.5 – SAE J1939 Multiple Module Installation Example

Terminating resistors – The bus is terminated at each end by 120 ohm resistors.

Bus length – The total bus length must not exceed 40 meters.

Drop length – The drop length to each device on the bus must not exceed 1 meter.

Long Distances

If the project layout does not allow for the standard 40-meter bus, two separate buses can be connected using a J1939 repeater (available through aftermarket suppliers).

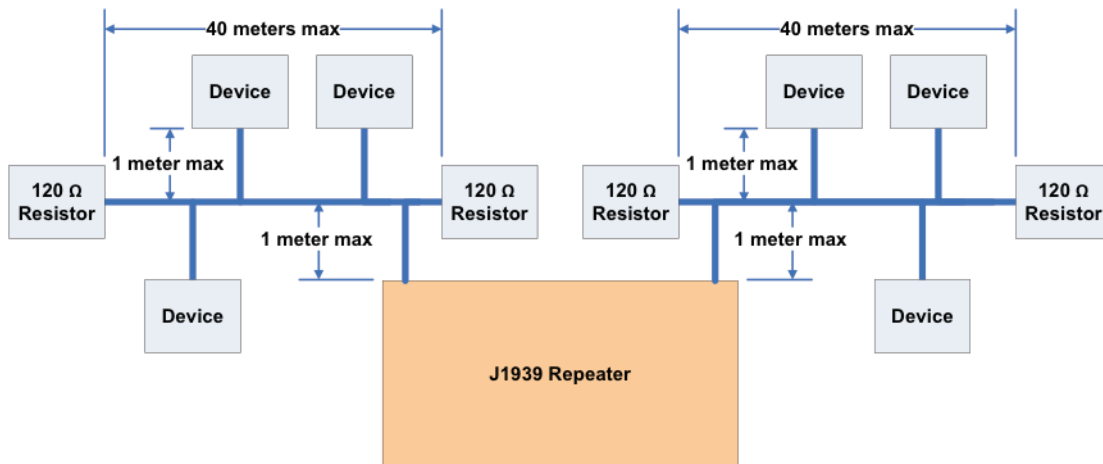


Figure 5.6 – SAE J1939 Multiple Module Repeater Installation Example

1. Two terminal resistors are required. Optional customer harness provides the resistor at the ECM if installed.
2. Maximum stub length = 1 m (3.3 ft).
3. Fabricate 153-2707 cable to length.

Note: If the requirements for J1939 data link connections are met, any number of display modules or service tool connectors may be connected to the J1939 data link.

Note: One terminal resistor for the J1939 data link is included in the optional customer harness. If the optional customer harness is not present, two terminal resistors must be installed. Any J1939 data link must have a terminal resistor at each end of the data link.

Note: A terminal resistor is required at the terminal ends of the data link cable. A terminal resistor is not required at each node on the data link.

Parameters

The table below shows the aftertreatment parameters on the J1939 bus. Scaling is not required on industrial protocol parameters. Parameter values are pre-scaled using 32-bit float. Status parameters are 16 bits.

Parameter Name	PGN	SPN	MODBUS	Retrofit
Aftertreatment 1 SCR System State	61475	4332	44400	Y
Aftertreatment 1 SCR Intake Temp	64830	4360	44405	Y
Desired Aftertreatment 1 SCR Catalyst Conversion Efficiency			44396	N/A
Aftertreatment 1 DEF Buffer Tank Temperature	64829	4368	44403	Y
Aftertreatment 1 SCR Conversion	64878	4364	44409	Y
Aftertreatment 1 Outlet Corrected NOx	64782	7351	44276	Y
Aftertreatment 1 Inlet Corrected NOx	64784	7353	44278	Y
Aftertreatment 1 SCR Outlet Temp	64830	4363	44407	Y
Aftertreatment 1 SCR Intake Pressure	64831	6586	44421	Y
Aftertreatment 1 Supply Air Pressure	64927	3485	44398	Y
Aftertreatment 1 DEF Doser Pressure	64590	6875	44423	Y
Aftertreatment 1 DEF Quick Thaw Temp	64829	4368	44413	Y
Aftertreatment 1 DEF Quick Thaw Tank Volume	64829	4367	44411	Y
Aftertreatment 1 SCR Dosing Air Assist Valve	64833	4336	44401	Y
Aftertreatment 1 DEF Dosing Unit 1 Diverter Valve	64828	4376	44415	Y
Aftertreatment 1 DEF Tank Fill Valve Command	64828	5434	44417	Y
Aftertreatment 1 DEF Pump Drive Percentage	64828	4375	44425	Y
Aftertreatment 1 Total DEF Used	64701	5963	44419	Y
Aftertreatment 1 SCR System Hydrocarbon	64514	7934	44392	Y
Aftertreatment System Enable Status	33024	7851	44391	Y
Aftertreatment System Enable Command	34048	8148	N/A	Y
Total Operating Hour	64585	8629	40152	Y
Aftertreatment Desired NOx Conv Efficiency	64878	4364	44409	Y
Engine – Speed	61444	190	40100	Y
Engine – Intake Manifold 1 Pressure (IMP)	65270	102	40150	Y
Engine – Intake Manifold 1 Temp (IMT)	65270	105	40112	Y
Engine – Fuel Rate	64737	1600	40607	Y
Engine – Barometric Pressure	65269	108	44881	Y

	Blue – Comes from display
	Yellow – Comes from engine
	Green – Supported in Stationary Retrofit SCR Software

Diagnostics

In addition to the parameters listed above, the following SPNs can be transmitted as diagnostic messages (DM1).

Parameter Name	SPN
Battery Potential/Power Input #1	168
Ambient Air Temperature	171
Engine Exhaust Gas Temperature	173
Calibration Memory	630
Calibration Module	631
J1939 Network #1	639
J1939 Network #2	1231
Aftertreatment #1 DEF Tank Volume #1	1761
Engine Exhaust Manifold Bank #1 Temperature #1	2434
Aftertreatment #1 Intake NOx	3216
Aftertreatment #1 Intake O2	3217
Aftertreatment #1 Outlet NOx	3226
Aftertreatment #1 Outlet O2	3227
Aftertreatment #2 Outlet NOx	3265
Aftertreatment #2 Outlet % O2	3266
Aftertreatment #1 DEF Controller	3360
Aftertreatment #1 DEF Dosing Unit Input Lines	3362
Sensor Supply Voltage 1	3509
Sensor Supply Voltage 2	3510
Aftertreatment #1 DEF Concentration	3516
Aftertreatment #1 SCR Dosing Air Assist Absolute Pressure	4335
Aftertreatment #1 SCR Catalyst Conversion Efficiency	4364
Aftertreatment #1 Identification	5576
Aftertreatment #1 Intake Gas Sensor Power Supply	5758
Aftertreatment #1 Outlet Gas Sensor Power Supply	5759
Aftertreatment #1 SCR Intake Absolute Pressure	6797
ECU Interface Mismatch	6806
Aftertreatment #1 Inconsistent Configuration Detected	7105
Aftertreatment #1 DEF Pump	7107
Aftertreatment #1 DEF Pump Power Relay	7416
Aftertreatment #1 DEF Control Module Circuit Breaker	7417
Aftertreatment #1 SCR System Sulfation Level	7504

Cat ET Configuration File Programming

Connect Cat ET to the engine service tool connector. Configure the engine serial number as shown below circled in red.

Description	Value	TT
ECM Identification Parameters		
Engine Serial Number	SBK02098	1
ECM Serial Number	31356195RH	
Software Group Part Number	5335970-00	
Software Group Release Date	10Mar	
Software Group Description	50wLab3516CesLabTestHcCali	
Engine Type		
Rating Number	4	
Test Spec	3516	
Engine Rating Interlock	Unavailable	
Aftertreatment Configuration		
Factory Installed Aftertreatment #1 Identification Number	EH900014	1
Aftertreatment DEF Pump Electronics Tank Unit Identification Number	EH900014	1
Aftertreatment #1 NOx Sensor Installation Status	Installed	0
Aftertreatment #1 DEF Concentration Configuration	32.5 %	1
Desired Aftertreatment #1 SCR Catalyst Conversion Efficiency	90 %	1
Aftertreatment System Enable Status	Enabled	0
Aftertreatment System Configuration Group Code	FY	1

The next four parameters (inside the red border) will configure automatically on the initial ET connection.

Description	Value	TT
ECM Identification Parameters		
Engine Serial Number	SBK02098	1
ECM Serial Number	31356195RH	
Software Group Part Number	5335970-00	
Software Group Release Date	10Mar	
Software Group Description	50wLab3516CesLabTestHcCali	
Engine Type		
Rating Number	4	
Test Spec	3516	
Engine Rating Interlock	Unavailable	
Aftertreatment Configuration		
Factory Installed Aftertreatment #1 Identification Number	EH900014	1
Aftertreatment DEF Pump Electronics Tank Unit Identification Number	EH900014	1
Aftertreatment #1 NOx Sensor Installation Status	Installed	0
Aftertreatment #1 DEF Concentration Configuration	32.5 %	1
Desired Aftertreatment #1 SCR Catalyst Conversion Efficiency	90 %	1
Aftertreatment System Enable Status	Enabled	0
Aftertreatment System Configuration Group Code	FY	1

Completing the Configuration Programming for Customer and Site Emissions Permit

- Work from top down of ET configure file and input values that are missing as shown in the figure below.
- Select rating: 1 is C27 and goes up sequentially.**
- Once all sensors and boxes are plugged in, change them on config to: Installed.**
- Test DEF concentration and input the value.**
- Input desired aftertreatment SCR catalyst conversion efficiency.**
- Enable the system.**
- Aftertreatment code is input at Factory (red border). If missing, contact product support rep.

Description	Value	TT
ECM Identification Parameters		
Engine Serial Number	SBK02098	1
ECM Serial Number	31356195RH	
Software Group Part Number	5335970-00	
Software Group Release Date	10Mar	
Software Group Description	50wLab3516CesLab TestHcCall	
Engine Type		
Rating Number	4	
Test Spec	3516	
Engine Rating Interlock	Unavailable	
Aftertreatment Configuration		
Factory Installed Aftertreatment #1 Identification Number	EH900014	1
Aftertreatment DEF Pump Electronics Tank Unit Identification Number	EH900014	1
Aftertreatment #1 NOx Sensor Installation Status	Installed	0
Aftertreatment #1 DEF Concentration Configuration	32.5 %	1
Desired Aftertreatment #1 SCR Catalyst Conversion Efficiency	90 %	1
Aftertreatment System Enable Status	Enabled	0
Aftertreatment System Configuration Group Code	FY	1

Verifying Current Software Revision

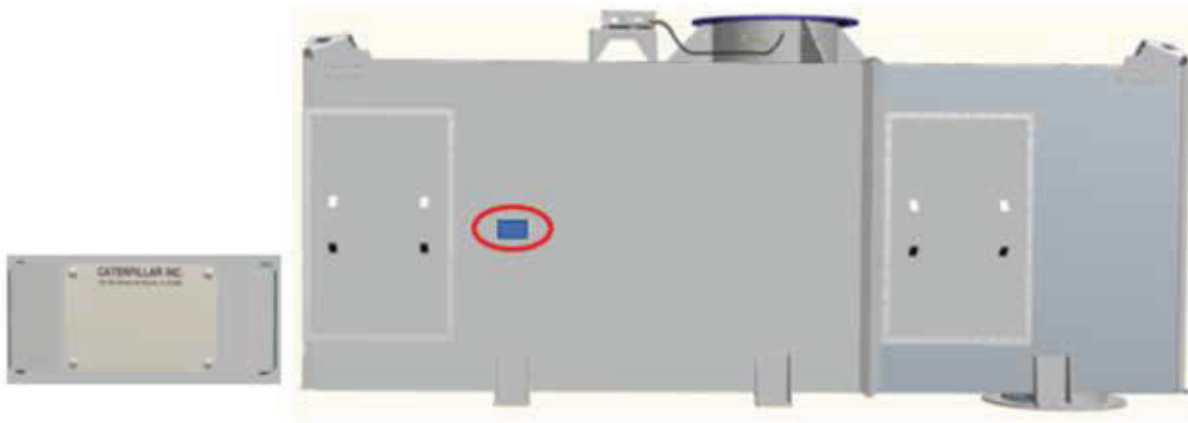
Using the dosing cabinet software number listed in Cat ET, open SIS and verify that this is still the latest software part number. (If an update is made later, all parameters that have been configured will remain configured after the software update.)

Commissioning

Refer to the last section of this publication or consult UENR4339 for additional commissioning information and a copy of the commissioning document.

6.0 Appendices

Appendix A – Serial Number Plate Locations

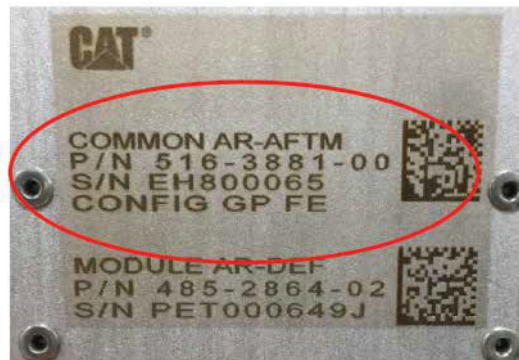


CEM Serial Number Plate Location



Dosing Cabinet Serial Number Plate Location

It is essential that the serial number plates for the CEM and dosing cabinet match as shown in the example below (serial numbers and common arrangement numbers).



Dosing Cabinet Serial Number Plate



CEM Serial Number Plate

Appendix B — DEF Handling

Refer to the MSDS provided by your DEF supplier or the Caterpillar Fluid document PELJ1160-01 for additional information on DEF fluids.

The ammonia, which is soluble in the liquid, will cause the corrosiveness of DEF solution to increase as it ages due to its increasing concentration. That is, a higher ammonia concentration makes it more caustic. Note that high storage temperatures increase the rate of this decomposition.

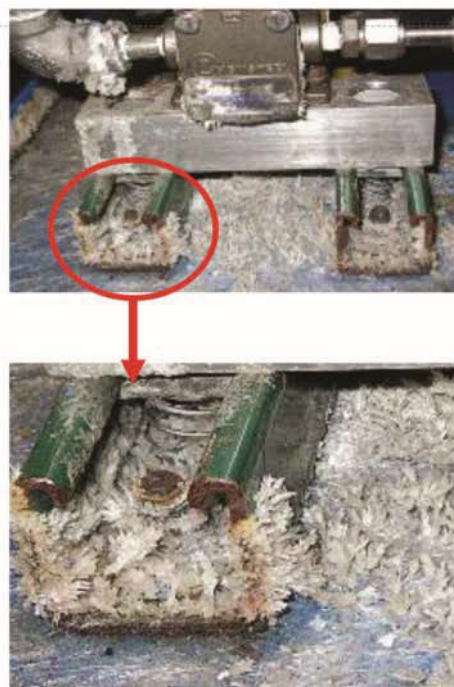
Since DEF liquor is caustic, delivery and storage require materials that are not susceptible to corrosion.

Recommended Installation Materials:

- Stainless steel
 - 300 series: OK
 - 400 series: Slow corrosion
 - Corrosion rate increases with temperatures > 60°C
- Plastics

Materials to Avoid:

- Unalloyed steel
- Aluminum
- Brass
- Galvanized steel
- Copper



Eye contact may cause mild eye irritation, including stinging, watering, and redness. Wear safety glasses. Safety shield may be needed in some conditions.

Skin contact may cause mild skin irritation including redness and burning. No harmful effects from skin absorption have been reported. Use rubber gloves to prevent skin contact (all rubber types OK).

Vapor inhalation may cause irritation leading to cough or difficulty breathing.

Note: Contact hazards are from the caustic pH (7.5 to 10) factor of solution. DEF in solution slowly decomposes into ammonia, causing the caustic reaction. “Aged” DEF solution is more caustic (high pH) than “fresh.”

Leaks and/or Spills

There is visible evidence should a leak occur (see picture):



- DEF stalactites and stalagmites
 - Formed from slow leaks and evaporation of water
 - Rate of water evaporation determines size of crystal formation
- Need to verify that joints are tight
 - Stop leaks when first noticed
 - Solid DEF will continue to accumulate
 - DEF solution is corrosive to steel and other metals
- Solid DEF is water soluble
 - But... may be slow to get into solution
- Clean up spills and leaks before components can corrode
 - Minor spills: Use paper towels or absorbent mat
- Solid DEF is highly water soluble
 - Hot water will re-dissolve solid DEF faster
 - Small amount of soap or detergent in hot water may enhance clean up
 - Plenty of hot water is key to removing dry DEF
- DEF solution contains small amount of ammonia
 - Skin irritant
 - Wear gloves

Appendix C – Dosing Cabinet Symbols



Air In – Compressed air in from its source.



DEF Vent – DEF Vent Port



Air Out – Compressed air out to the injector.



Connector to Engine ECM – 23 Pin Connector



DEF In – DEF in from the main tank



OEM Connector – 14 Pin Connector to main DEF tank (level sensor / transfer pump)



DEF Out – DEF out to injector



Connector to CEM – 21 Pin Connector



CAUTION: 100-240Vac 50/60Hz
Electric Power Present



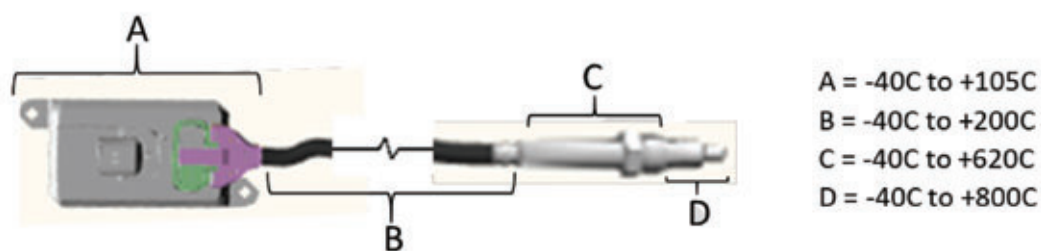
Grounding Point

The Below Lights are on the Pump Control Panel inside the Dosing Cabinet

Pump Operating – The green light indicates that the dosing pump is running

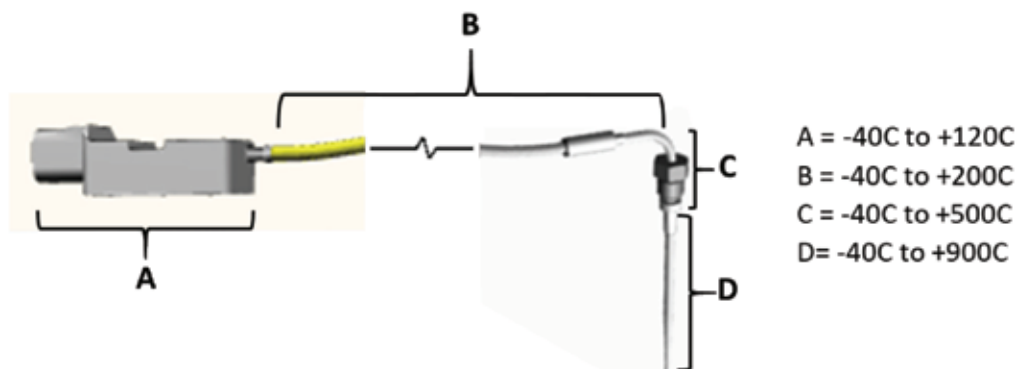
Shut Down – A red light indicates that the system has received a shutdown event, and the dosing pump has stopped

Appendix D – Sensor Temperature Zones

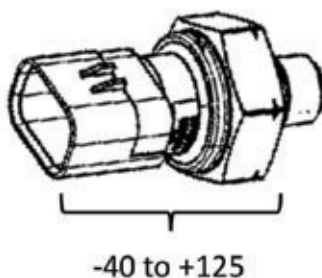


NOx Sensor

Temperature zone B has a maximum temperature value of 200°C (392°F). If the optional insulation package is used, care must be taken to ensure the insulation collar doesn't cover the electrical harness that makes up zone C.



CEM Temperature Sensor



CEM Pressure Sensor

Appendix E – Aftertreatment Commissioning Checklist

For S/N Prefixes: ESF, EH6, EH7, EH8 & EH9 ONLY

1. This is a Prime Product: All information and files, refer to aftertreatment common arrangement serial number
2. Use latest version of Cat ET and flash files in SIS Web using aftertreatment common arrangement serial number
3. Perform all service letters, service magazines, or engine news prior to commissioning
4. All warranty claims on this system should be made against the aftertreatment common arrangement serial number
5. COMM adapter with LAN port is needed to communicate with dosing cabinet
6. Cat aftertreatment system must be registered, following REHS5097
7. Exhaust system design use LEBW4970 A&I Guide - Exhaust Systems
8. Generator set must be capable of block loads: 70, 80, 90, and 100% for extended periods of time during commissioning. Using same load on all points may be required
9. Technician Toolbox™ needed to download data from Product Link™ controller
10. Power cycle dosing cabinet, interrupt ALL power to dosing cabinet (unlatch all codes)
11. Interrupt keyswitch circuit for 15 sec to force non-volatile memory (NVM)
12. Complete pre-commissioning section before attempting tests
13. Active Code: 4332-11 will remain active until both Aftertreatment System Functional Test (ASFT) & Commissioning Service Test are successful. Then, cycle keyswitch to aftertreatment ECM, forcing NVM save in ECM
14. Save a product status report via Cat ET when successfully commissioned and ASFT are both successful
15. Once all steps are completed and engine is in standby, perform a keyswitch cycle again
16. Match: CEM common arrangement serial number with dosing cabinet common arrangement serial number, they must match!

Retrofit SCR – Service Information: EH6, EH7, EH8 & EH9

- LEBE0035 Application and Installation Guide
- M0075634 Operation Maintenance Manual
- M0070376 Systems Operation/Testing and Adjusting Manual
- M0081346 Disassembly and Assembly Guide
- M0077572 Parts Book
- UENR4339 Aftertreatment System Commissioning Report
- UENR4742 Schematic – Retrofit SCR Electrical System
- UENR7845 Schematic – Retrofit SCR Display Electrical System
- REHS8151 NOx Sensor Handling Guide
- M0077328 Asset IQ A&I Guide (For Mechanical Engines)
- Insulation blanket installation procedure special instructions are available on SIS Web. Due to design changes, they are serial number specific.

Aftertreatment Commissioning Checklist

Section 1: Site and Machine Setup			
Site & Machine Information			
In Service Date:		Config Group: 2 digits	
Site Name:		Primary DEF Filter Grp:	
Servicing Dealer:		Aftertreatment Flash File:	
Engine Model S/N:		Product Link Config File:	
Aftertreatment Package S/N:		Product Link Flash File:	
CEM S/N:		CAN A Global Ohms:	
Dosing Cabinet S/N:		CAN B Local Ohms:	

Pre-Commissioning Check List – Aftertreatment Installation and Setup		
Y	N	Description: If answered No, describe in Notes section – Use LEBE0035 for more detailed information
		1. Match CEM S/N to dosing cabinet S/N: Must match for each system
		2. Install CEM insulation blankets prior to CEM being lifted into place: (if no blankets, skip to step 4)
		3. Install same sensor groups from step 2, NOx probe protruding blanket, do not cover wire harnesses
		4. Install CEM: Rig and lift in place, use torque collars installed on each mounting foot per A&I Guide
		5. Install exhaust piping from engine out to CEM inlet/bellows – LEBW4970
		6. Commission engine, generator, and switchgear prior to Aft system startup: Aft powered down
		7. Install and open-air supply to dosing cabinet. Verify supply air meets A&I specs for air consumption
		8. Install air and DEF lines kits from dosing cabinet to injector, with gradual fall to dosing cabinet
		9. Verify DEF transfer pump meets specs in A&I. If Cat DEF transfer pump skid is used: Skip to 15
		10. Wire DEF transfer pump switch – Term 18 & 27 in dosing cabinet term box to control transfer pump
		11. Install DEF filter grp after transfer pump
		12. Install DEF pressure relief valve if needed. IF tank fill valve fails to open and not fill tank. (optional)
		13. Flush DEF supply lines to dosing cabinet into a suitable container and dispose of DEF properly
		14. Fill dosing cabinet buffer tank, using tank fill override: Check for leaks
		15. Fill DEF bulk tank with 32.5 or 40% technical grade DEF and meets ISO 22241-1 (See item 26)
		16. Wire electrical supply to dosing cabinet and breaker closed. Pump powered 120-208VAC/50-60hz
		17. Wire electrical connections between CEM and dosing cabinet terminal strip boxes are complete
		18. Wire battery power & keyswitch to dosing cabinet terminal box. Refer to A&I Guide for reference
		19. Wire data link CAN A & CDL from dosing cabinet term box to engine or EMCP: Data link/J1939
		20. Wire data link CAN B interconnect: dosing cabinet term box & CEM terminal box: Data link/J1939
		21. Remove resistors: global & local data links have 2 terminating resistors per data link – see A&I
		22. Download and perform: Service letters or magazine or engine news before proceeding
		23. Adjust air regulator in dosing cabinet to 65 psi. With air supply valve open (air flowing) M0070376
		24. Record air supply & DEF supply pressure at dosing cabinet – before strainers
		25. Troubleshoot and clear active codes before running engine or attempting commissioning M0070376
		26. Configure in ET: Enter Aft ECM parameters: (Enter DEF % from item 10) M0070376
		27. Configure in ET: Enter Product Link ECM site parameters: Unit and necessary parameters
		28. Configure in ET: Enter site emissions regulation via site permit – Enter in Section 2 below also
		29. Power cycle dosing cabinet prior to commissioning attempt
Notes:		

Aftertreatment Commissioning Checklist

Section 2: Input All Data Points							
Permit Site Emissions Requirement (Quote)		Desired Target set in Cat ET:		DEF Supply Press to Cabinet		Air Supply Pressure to Cabinet (A&I)	
Engine Load Factor Steps	Boost Press	CEM Inlet Pressure	SCR Outlet Temp	SCR Inlet Temp	Pump Output %	EO Analyzer NOx ppm (optional)	CEM Stack Out Analyzer-NOx ppm (optional)
1 st 100%							
2 nd 90-100%							
3 rd 80-100%							
4 th 70-100%							

Aftertreatment Commissioning Steps	
Aftertreatment Commissioning Steps and Tests	
	1. Start engine and apply 100% load to engine – allow to stabilize 45-60 min or <50-degree delta
	2. Start air compressor and DEF transfer pump
	3. Perform system communication test in Cat ET
	4. Troubleshoot active codes & events. 4332-11 will only clear upon successful commissioning
	5. Ensure DEF buffer tank in dosing cabinet is full using overrides in Cat ET or manually filling
	6. Override air assist valve ONLY: Record pressures. Air supply: 65 DEF doser:
	7. Override air valve & DEF valve: Record pressures. Air supply: 65 DEF doser:
	8. Once correct pressures and temps (290°C) are achieved, the system will attempt to dose
	9. Perform ASFT: This test takes approx. 15 min to pass
	10. Start commission process – Cat ET. Service>Service procedure>Aftertreatment Test. Press Start
	11. Perform commissioning. Allow Cat ET to calibrate all 4 steps. May need same load for all steps
	12. Record if Code 4332-11 cleared: 3 failed tests, contact your TC for further assistance
	13. Once engine is off and all codes are clear, interrupt keyswitch to AFT ECM for 15 sec. (NVM Save)
	14. On Cat ET download and save a copy of PSR and ECM Configuration and Datalog from VIMSpC

Commissioning Sign-Off			
I acknowledge the SCR system is operating properly and all settings are as stated.			
Dealer Technician:		Date:	

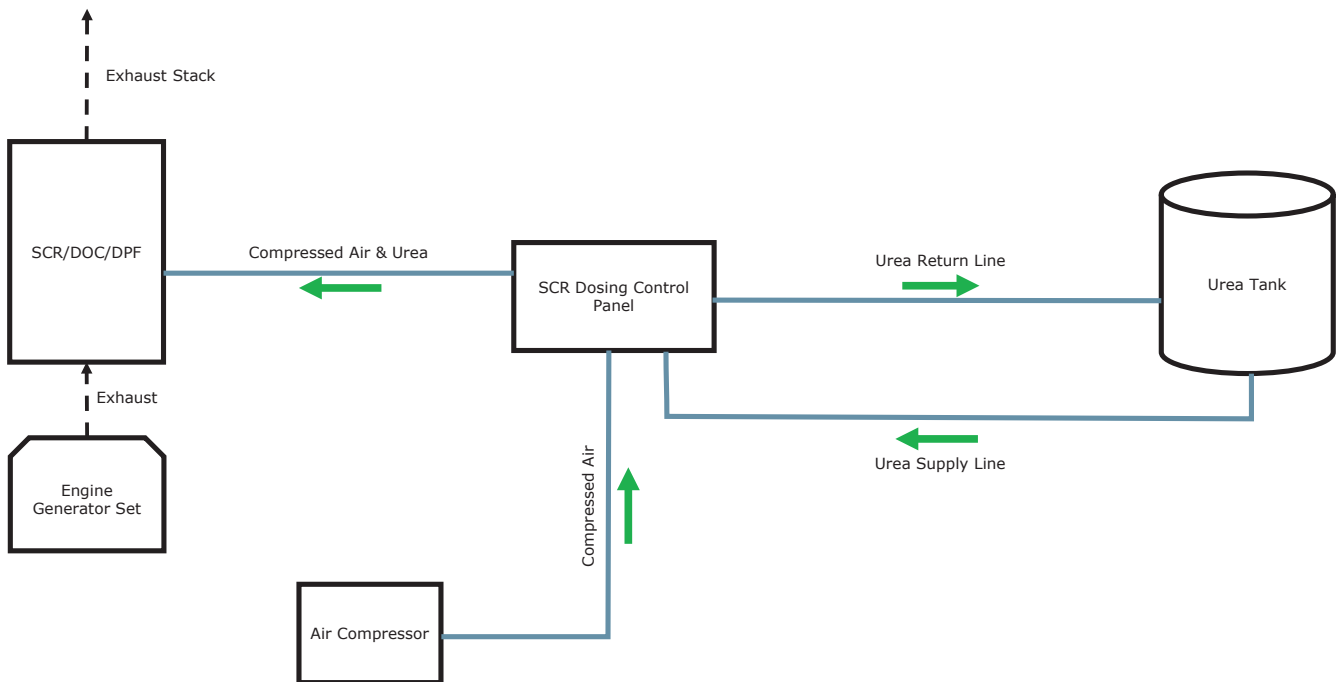
Retrofit Aftertreatment Systems Assistance Use the Cat Dealer Service Network

LEBE0035-05 (07-20)

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**Typical Process Flow Diagram
SCR, DOC, DPF**



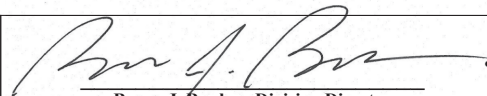


UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2024 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

OFFICE OF TRANSPORTATION
AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: **Caterpillar Inc.**
(U.S. Manufacturer or Importer)
Certificate Number: **RCPXL78.1NZS-030**

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: RCPXL78.1NZS

Mobile/Stationary Indicator: Stationary
Emissions Power Category: kW>560
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.

APPENDIX 5.B
1,000 KW GENERATOR MANUFACTURER SPECIFICATIONS
AND EMISSIONS DATA SHEETS

Cat® C32

Diesel Generator Sets



Image shown may not reflect actual configuration.

Bore – mm (in)	145 (5.7)
Stroke – mm (in)	162 (6.4)
Displacement – L (in ³)	32.1 (1959)
Compression Ratio	15.0:1
Aspiration	TA
Fuel System	EUI
Governor Type	ADEM™ A4

Mission Critical 60 Hz ekW (kVA)	Emissions Performance
1000 (1250)	U.S. EPA Certified for Emergency Stationary Applications (Tier 2)

Features

Cat® Diesel Engine

- Designed and tested to meet the U.S. EPA Emergency Stationary (Tier 2) emissions
- Reliable and consistent 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 is verified through prototype testing, which includes torsional vibration, fuel consumption, oil consumption, transient performance, and endurance testing

Alternators

- Superior motor starting capability minimizes the need for oversizing the generator
- Designed to match the 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

Standard and Optional Equipment

Engine

Filtro de aire

- ☒ Single element
- ☐ Dual element
- ☐ Heavy duty

Muffler

- ☐ Industrial grade (15 dB)

Starting

- ☒ Standard batteries
- ☐ Oversized batteries
- ☐ Standard electric starter
- ☒ Dual electric starter
- ☒ Jacket water heater

Alternator

Output voltage

- ☐ 220 V ☒ 480 V
- ☐ 240 V ☐ 600 V
- ☐ 380 V ☐ 2.400 V
- ☐ 400 V ☐ 4.160 V

Temperature Rise (over 40°C ambient)

- ☐ 150°C
- ☒ 125°C/130°C
- ☐ 105°C
- ☐ 80°C

Winding type

- ☐ Random wound
- ☒ Form wound

Excitation

- ☐ Self excited
- ☐ Internal excitation (IE)
- ☒ Permanent magnet (PM)

Attachments

- ☒ Anti-condensation heater
- ☐ Stator and bearing temperature monitoring and protection

Power Termination

Type

- ☐ Bus bar
- ☒ Circuit breaker
- ☐ 400 A ☐ 800 A
- ☐ 1.200 A ☒ 1.600 A
- ☐ 2.000 A ☐ 2.500 A
- ☐ 3.000 A ☐ 3.200 A
- ☐ UL ☐ IEC
- ☒ 3 pole ☐ 4 pole
- ☒ Manually operated
- ☐ Electrically operated

Trip Unit

- ☐ LSI ☐ LSI-G
- ☒ LSIG-P

Factory Enclosure

- ☐ Weather protective
- ☒ Sound attenuated

Attachments

- ☒ Cold weather bundle
- ☒ DC lighting package
- ☒ AC lighting package
- ☒ Motorized louvers

Fuel Tank

- ☐ Sub-base
- ☐ 1000 gal (3875 L)
- ☒ 2000 gal (7570 L)
- ☐ 3600 gal (13627 L)

Control System

Controller

- ☐ EMCP 4.2B
- ☒ EMCP 4.3
- ☐ EMCP 4.4

Attachments

- ☒ Local annunciator module
- ☒ Remote annunciator module
- ☐ Expansion I/O module
- ☐ Remote monitoring software

Charging

- ☒ Battery charger – 10 A

Vibration Isolators

- ☐ Rubber
- ☒ Spring
- ☒ Seismic rated

Cat Connect

Connectivity

- ☐ Ethernet
- ☐ Cellular
- ☐ Satellite

Extended Service Options

Terms

- ☒ 2 year (prime)
- ☐ 3 year
- ☐ 5 year
- ☐ 10 year

Coverage

- ☐ Silver
- ☐ Gold
- ☒ Platinum
- ☐ Platinum Plus

Ancillary Equipment

- ☐ Automatic transfer switch (ATS)
- ☐ Uninterruptible power supply (UPS)
- ☐ Paralleling switchgear
- ☐ Paralleling controls

Certifications

- ☒ UL 2200 Listed
- ☐ CSA
- ☒ IBC seismic certification
- ☐ OSHPD pre-approval

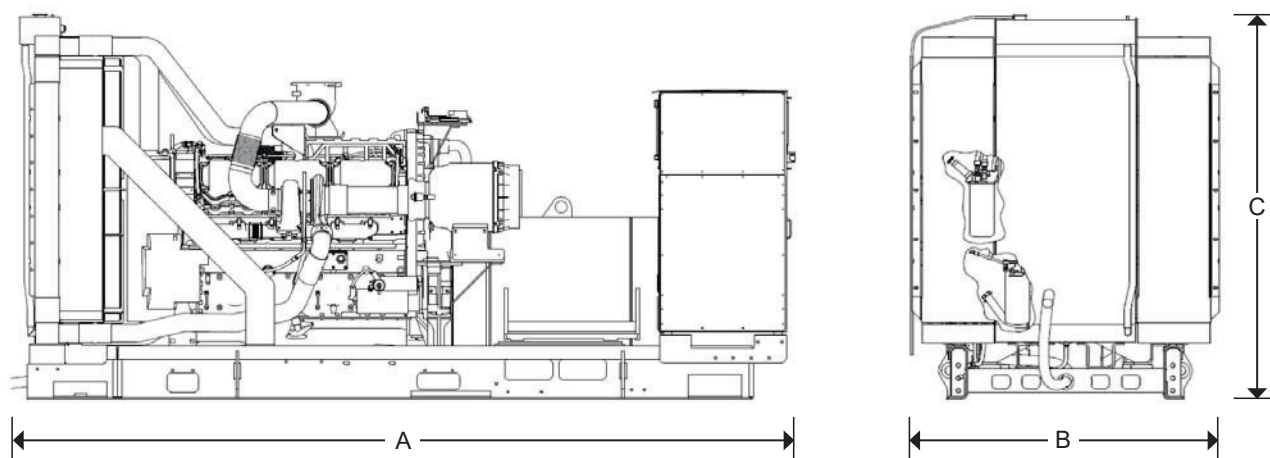
Note: Some options may not be available on all models. Certifications may not be available with all model configurations. Consult factory for availability.

Package Performance

Performance	Mission Critical	
Frequency	60 Hz	
Gen set power rating with fan	1000 ekW	
Gen set power rating with fan @ 0.8 power factor	1250 kVA	
Fueling strategy	EPA ESE (Tier 2)	
Performance number	EM0449-00	
Fuel Consumption		
100% load with fan – L/hr (gal/hr)	272.1	(71.9)
75% load with fan – L/hr (gal/hr)	213.4	(56.4)
50% load with fan – L/hr (gal/hr)	144.7	(38.2)
25% load with fan – L/hr (gal/hr)	82.6	(21.8)
Cooling System		
Radiator air flow restriction (system) – kPa (in. water)	0.12	(0.48)
Radiator air flow – m³/min (cfm)	1175	(41494)
Engine coolant capacity – L (gal)	55.0	(14.5)
Radiator coolant capacity – L (gal)	36.0	(9.0)
Total coolant capacity – L (gal)	91.0	(23.5)
Inlet Air		
Combustion air inlet flow rate – m³/min (cfm)	87.6	(3094.1)
Exhaust System		
Exhaust stack gas temperature – °C (°F)	476.4	(889.5)
Exhaust gas flow rate – m³/min (cfm)	228.4	(8065.3)
Exhaust system backpressure maximum allowable) – kPa (in. water)	6.7	(27.0)
Heat Rejection		
Heat rejection to jacket water – kW (Btu/min)	352	(20033)
Heat rejection to exhaust (total) – kW (Btu/min)	1024	(58206)
Heat rejection to aftercooler – kW (Btu/min)	288	(16385)
Heat rejection to atmosphere from engine – kW (Btu/min)	127	(7238)
Heat rejection from alternator – kW (Btu/min)	55	(3131)
Emissions* (Nominal)		
NOx mg/Nm³ (g/hp-h)	2348.6	(4.93)
CO mg/Nm³ (g/hp-h)	62.1	(0.13)
HC mg/Nm³ (g/hp-h)	5.5	(0.01)
PM mg/Nm³ (g/hp-h)	7.2	(0.02)
Emissions* (Potential Site Variation)		
NOx mg/Nm³ (g/hp-h)	2841.6	(5.97)
CO mg/Nm³ (g/hp-h)	116.1	(0.24)
HC mg/Nm³ (g/hp-h)	10.3	(0.03)
PM mg/Nm³ (g/hp-h)	14.1	(0.04)

*mg/Nm³ levels are corrected to 5% O₂. Contact your local Cat dealer for further information.

Weights and Dimensions



Dim "A" mm (in)	Dim "B" mm (in)	Dim "C" mm (in)	Dry Weight kg (lb)
4165 (164.0)	1684 (66.3)	2162 (85.1)	6668 (14,700)

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

Ratings Definition

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 power rating. Typical peak demand up to 100% of rated power for up to 5% of the operating time. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year.

Applicable Codes and Standards

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

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 rates are based on fuel oil of 35° API [16°C (60°F)] gravity having an LHV of 42,780 kJ/kg (18,390 Btu/lb) when used at 29°C (85°F) and weighing 838.9 g/liter (7.001 lbs/U.S. gal.)

www.cat.com/electricpower

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Materials and specifications are subject to change without notice. The International System of Units (SI) is used in this publication.

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Performance Number: DM9933

Change Level: 04

SALES MODEL:	C32	COMBUSTION:	DIRECT INJECTION
BRAND:	CAT	ENGINE SPEED (RPM):	1,800
MACHINE SALES MODEL:		HERTZ:	60
ENGINE POWER (BHP):	1,474	FAN POWER (HP):	56.3
GEN POWER WITH FAN (EKW):	1,000.0	ASPIRATION:	TA
COMPRESSION RATIO:	15.0	AFTERCOOLER TYPE:	ATAAC
RATING LEVEL:	STANDBY	AFTERCOOLER CIRCUIT TYPE:	JW+OC, ATAAC
PUMP QUANTITY:	1	INLET MANIFOLD AIR TEMP (F):	120
FUEL TYPE:	DIESEL	JACKET WATER TEMP (F):	210.2
MANIFOLD TYPE:	DRY	TURBO CONFIGURATION:	PARALLEL
GOVERNOR TYPE:	ADEM4	TURBO QUANTITY:	2
ELECTRONICS TYPE:	ADEM4	TURBOCHARGER MODEL:	GTB45518BS-52T-1.37
IGNITION TYPE:	CI	CERTIFICATION YEAR:	2007
INJECTOR TYPE:	EUI	PISTON SPD @ RATED ENG SPD (FT/MIN):	1,913.4
REF EXH STACK DIAMETER (IN):	8		
MAX OPERATING ALTITUDE (FT):	997		

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
1,000.0	100	1,483	333	0.342	0.337	71.5	70.4
900.0	90	1,338	301	0.341	0.336	64.2	63.3
800.0	80	1,195	268	0.348	0.343	58.7	57.9
750.0	75	1,124	252	0.353	0.348	56.0	55.2
700.0	70	1,053	237	0.354	0.349	52.6	51.9
600.0	60	912	205	0.353	0.348	45.4	44.8
500.0	50	772	173	0.350	0.345	38.1	37.5
400.0	40	635	143	0.351	0.346	31.4	30.9
300.0	30	496	111	0.357	0.352	25.0	24.6
250.0	25	426	96	0.363	0.358	21.8	21.5
200.0	20	355	80	0.373	0.367	18.7	18.4
100.0	10	209	47	0.424	0.418	12.5	12.3

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
1,000.0	100	1,483	70.8	118.8	1,214.1	58.6	892.5	76	424.5
900.0	90	1,338	64.3	111.4	1,153.5	52.2	856.8	70	392.7
800.0	80	1,195	60.6	106.7	1,117.9	48.8	833.4	66	375.9
750.0	75	1,124	58.4	104.2	1,102.3	47.0	822.2	63	366.1
700.0	70	1,053	54.2	100.0	1,080.1	43.6	811.1	59	345.5
600.0	60	912	44.3	90.6	1,028.7	35.7	789.8	49	304.7
500.0	50	772	33.5	81.3	968.0	27.4	769.5	37	264.3
400.0	40	635	24.3	74.9	899.7	20.8	733.5	27	224.9
300.0	30	496	16.1	70.5	816.3	15.3	679.6	19	185.5
250.0	25	426	12.3	69.0	768.2	12.9	646.0	15	165.6
200.0	20	355	8.9	67.9	713.3	10.7	605.3	11	147.2
100.0	10	209	4.5	67.5	572.6	7.8	491.3	6	123.0

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
1,000.0	100	1,483	3,105.2	8,115.3	13,517.7	14,024.8	2,950.9	2,698.6

900.0	90	1,338	2,944.7	7,443.4	12,775.8	13,231.6	2,780.0	2,550.6
800.0	80	1,195	2,860.8	7,069.3	12,380.1	12,796.7	2,687.9	2,475.7
750.0	75	1,124	2,799.4	6,858.4	12,094.1	12,491.0	2,630.6	2,427.3
700.0	70	1,053	2,654.6	6,439.5	11,425.3	11,795.7	2,491.4	2,301.6
600.0	60	912	2,369.9	5,618.4	10,126.3	10,445.3	2,210.8	2,046.3
500.0	50	772	2,090.3	4,815.2	8,871.8	9,141.4	1,926.2	1,786.0
400.0	40	635	1,819.3	4,039.9	7,654.2	7,876.2	1,664.7	1,547.4
300.0	30	496	1,549.9	3,272.7	6,487.7	6,664.2	1,412.4	1,317.4
250.0	25	426	1,414.6	2,888.8	5,920.9	6,075.3	1,284.6	1,200.7
200.0	20	355	1,292.4	2,528.2	5,413.4	5,545.9	1,167.2	1,094.3
100.0	10	209	1,149.4	1,989.9	4,805.1	4,893.7	1,028.8	975.8

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
1,000.0	100	1,483	20,153	7,292	58,664	32,275	8,277	16,551	62,887	155,406	165,547
900.0	90	1,338	18,470	6,522	52,678	28,324	7,440	14,394	56,743	139,692	148,807
800.0	80	1,195	16,970	5,949	49,043	26,036	6,799	13,345	50,677	127,654	135,984
750.0	75	1,124	16,223	6,124	47,027	24,781	6,486	12,683	47,666	121,777	129,723
700.0	70	1,053	15,326	6,876	43,772	22,824	6,093	11,231	44,653	114,394	121,858
600.0	60	912	13,529	6,786	37,588	19,231	5,263	8,681	38,675	98,811	105,259
500.0	50	772	11,822	5,357	31,812	16,013	4,411	6,504	32,735	82,825	88,230
400.0	40	635	10,869	4,421	25,935	12,562	3,637	4,598	26,908	68,277	72,732
300.0	30	496	9,934	3,738	20,129	9,084	2,892	2,986	21,049	54,294	57,837
250.0	25	426	9,352	3,463	17,322	7,412	2,525	2,290	18,081	47,414	50,508
200.0	20	355	8,620	3,178	14,651	5,809	2,162	1,718	15,065	40,584	43,232
100.0	10	209	6,683	2,334	9,950	2,795	1,444	1,067	8,853	27,118	28,888

Emissions Data

DIESEL

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN	EKW	1,000.0	750.0	500.0	250.0	100.0
PERCENT LOAD	%	100	75	50	25	10
ENGINE POWER	BHP	1,483	1,124	772	426	209
TOTAL NOX (AS NO2)	G/HR	7,256	4,250	2,777	1,877	1,108
TOTAL CO	G/HR	192	123	265	435	672
TOTAL HC	G/HR	19	55	53	40	80
TOTAL CO2	KG/HR	726	568	384	219	125
PART MATTER	G/HR	26.9	19.9	34.3	53.7	43.0
TOTAL NOX (AS NO2)	(CORR 5% O2) MG/NM3	2,346.5	1,746.8	1,683.5	2,004.0	1,999.0
TOTAL CO	(CORR 5% O2) MG/NM3	62.1	49.6	159.5	470.0	1,358.8
TOTAL HC	(CORR 5% O2) MG/NM3	5.4	19.7	27.7	36.7	147.6
PART MATTER	(CORR 5% O2) MG/NM3	7.3	6.9	17.8	53.8	69.4
TOTAL NOX (AS NO2)	(CORR 5% O2) PPM	1,143	851	820	976	974
TOTAL CO	(CORR 5% O2) PPM	50	40	128	376	1,087
TOTAL HC	(CORR 5% O2) PPM	10	37	52	68	275
TOTAL NOX (AS NO2)	G/HP-HR	4.93	3.81	3.61	4.41	5.32
TOTAL CO	G/HP-HR	0.13	0.11	0.34	1.02	3.22
TOTAL HC	G/HP-HR	0.01	0.05	0.07	0.09	0.38
PART MATTER	G/HP-HR	0.02	0.02	0.04	0.13	0.21
TOTAL NOX (AS NO2)	LB/HR	16.00	9.37	6.12	4.14	2.44
TOTAL CO	LB/HR	0.42	0.27	0.58	0.96	1.48
TOTAL HC	LB/HR	0.04	0.12	0.12	0.09	0.18
TOTAL CO2	LB/HR	1,600	1,252	847	484	275
PART MATTER	LB/HR	0.06	0.04	0.08	0.12	0.09
OXYGEN IN EXH	%	10.0	11.4	12.2	13.4	15.7
DRY SMOKE OPACITY	%	0.7	0.7	1.3	3.0	2.2

BOSCH SMOKE NUMBER	0.18	0.16	0.57	1.30	1.00
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Type text here

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN	EKW	1,000.0	750.0	500.0	250.0	100.0
PERCENT LOAD	%	100	75	50	25	10
ENGINE POWER	BHP	1,483	1,124	772	426	209
TOTAL NOX (AS NO2)	G/HR	8,780	5,143	3,360	2,272	1,341
TOTAL CO	G/HR	359	231	495	813	1,256
TOTAL HC	G/HR	36	104	100	76	151
PART MATTER	G/HR	52.5	38.7	66.9	104.7	83.8
TOTAL NOX (AS NO2) (CORR 5% O2)	MG/NM3	2,839.3	2,113.6	2,037.0	2,424.8	2,418.8
TOTAL CO (CORR 5% O2)	MG/NM3	116.2	92.7	298.2	879.0	2,541.0
TOTAL HC (CORR 5% O2)	MG/NM3	10.2	37.3	52.3	69.3	278.9
PART MATTER (CORR 5% O2)	MG/NM3	14.2	13.4	34.8	104.9	135.3
TOTAL NOX (AS NO2) (CORR 5% O2)	PPM	1,383	1,030	992	1,181	1,178
TOTAL CO (CORR 5% O2)	PPM	93	74	239	703	2,033
TOTAL HC (CORR 5% O2)	PPM	19	70	98	129	521
TOTAL NOX (AS NO2)	G/HP-HR	5.97	4.60	4.37	5.34	6.43
TOTAL CO	G/HP-HR	0.24	0.21	0.64	1.91	6.03
TOTAL HC	G/HP-HR	0.02	0.09	0.13	0.18	0.73
PART MATTER	G/HP-HR	0.04	0.03	0.09	0.25	0.40
TOTAL NOX (AS NO2)	LB/HR	19.36	11.34	7.41	5.01	2.96
TOTAL CO	LB/HR	0.79	0.51	1.09	1.79	2.77
TOTAL HC	LB/HR	0.08	0.23	0.22	0.17	0.33
PART MATTER	LB/HR	0.12	0.09	0.15	0.23	0.18

Regulatory Information

EPA TIER 2		2006 - 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 2	CO: 3.5 NOx + HC: 6.4 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: 6.4 PM: 0.20

Altitude Derate Data

STANDARD

ALTITUDE CORRECTED POWER CAPABILITY (BHP)

AMBIENT OPERATING TEMP (F)	50	60	70	80	90	100	110	120	130	NORMAL
ALTITUDE (FT)										
0	1,474	1,474	1,474	1,474	1,474	1,468	1,442	1,417	1,393	1,474
1,000	1,474	1,474	1,474	1,466	1,439	1,413	1,388	1,364	1,341	1,474
2,000	1,474	1,465	1,438	1,411	1,385	1,360	1,336	1,314	1,291	1,434
3,000	1,438	1,410	1,383	1,358	1,333	1,309	1,286	1,264	1,242	1,389
4,000	1,383	1,356	1,331	1,306	1,282	1,259	1,237	1,216	1,195	1,345
5,000	1,330	1,304	1,280	1,256	1,233	1,211	1,190	1,169	1,149	1,302
6,000	1,278	1,254	1,230	1,207	1,185	1,164	1,144	1,124	1,105	1,260
7,000	1,228	1,205	1,182	1,160	1,139	1,119	1,099	1,080	1,062	1,220
8,000	1,180	1,157	1,135	1,114	1,094	1,074	1,056	1,037	1,020	1,180
9,000	1,133	1,111	1,090	1,070	1,050	1,032	1,014	996	979	1,141

10,000	1,087	1,066	1,046	1,027	1,008	990	973	956	940	1,103
11,000	1,043	1,023	1,004	985	967	950	933	917	902	1,066
12,000	1,001	981	963	945	928	911	895	880	865	1,029
13,000	959	941	923	906	889	874	858	843	829	994
14,000	919	901	884	868	852	837	822	808	794	959
15,000	880	863	847	831	816	802	788	774	761	926

Cross Reference

Test Spec	Setting	Engine Arrangement	Engineering Model	Engineering Model Version	Start Effective Serial Number	End Effective Serial Number
0K7838	GG0346	3208618	GS490	-	JDB00001	
0K8987	PP6050	3249750	GS277	-	SYC00001	
0K8987	PP6050	3367659	GS471	-	PRH00001	
0K8987	PP6050	3801431	GS471	-	PRH00001	
0K8987	PP6050	4391323	GS471	-	PRH03719	
0K8987	PP6050	4447558	GS471	-	PRH00001	
0K8987	PP6050	4447562	GS471	-	PRH00001	
0K8987	PP6050	5233431	GS471	-	PRH00001	
0K8987	PP6050	5612763	GS471	DK	PRH00001	
0K8987	PP6050	6034725	PG457	-	PRH00001	

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%

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

PERFORMANCE DATA[DM9933]

February 28, 2024

AIR AND FUEL CONDITIONS.

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

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 : 10/27/21

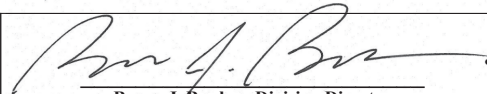


UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2024 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

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.

APPENDIX 5.C
750 KW GENERATOR MANUFACTURER SPECIFICATIONS
AND EMISSIONS DATA SHEETS

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

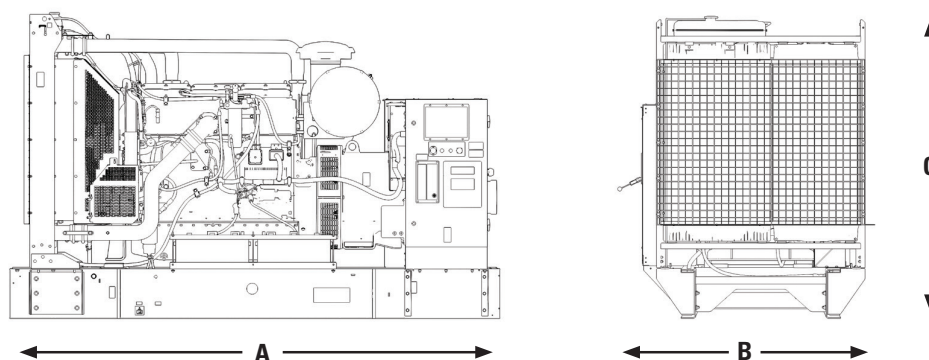
Model	Standby	Prime	Emission Strategy
C18	750 ekW, 938 kVA	680 ekW, 850 kVA	EPA TIER II

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 System¹		
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)

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 kW 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.

LET'S DO THE WORK.™

LEHE1772-04 (05/20)

Materials and specifications are subject to change without notice. The International System of Units (SI) is used in this publication.
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www.Cat.com/electricpower
 All rights reserved.

Performance Number: DM93Ch

gLanve l e0e4 Sh

AEI DA MOBDI :	C32	gOMUTAI RON:	DIRECT INJECTION
UGENB:	CAT	DN(RND APDDB)GPMH	32, ,
MEgZ RND AEI DA MOBDI :		ZDGI W	8,
DN(RND POF DG)UZPH	3B30	KEN POF DG)ZPH	6040
(DN POF DG F RZ KEN)DYF H	75, 4	EBBR RONEI PEGEAR RgA)ZPH	. 46
gOMPGDAAARON GEI RO:	36	EAPRGEI RON:	TA
GEI RN(I DVDI :	STANDBY	EKI DGgOOI DG I QPD:	ATAAC
PTMP J TENI R Q:	3	EKI DGgOOI DG gRgTR I QPD:	JW+OC1ATAAC
KT DI I QPD:	DIESEL	RNI DI MENRKOI B ERG I DMP)KH	30,
MENRKOI B I QPD:	DRY	@gYDI F EI DGI DMP)KH	3P040
(OVDGNOG I QPD:	ELEC	I TGUO gONKR TGEI RON:	MARALLEL
gE MAZEKI I QPD:	STANDARD	I TGUO J TENI R Q:	0
R NR RON I QPD:	CI	I TGUOgZEG(DG MOBDI :	GTD5, , 2, 475 A-R
RN@gI OG I QPD:	EUI	gDGI RgEI RON QDEG:	0, 32
GDKD/ Z AI EgY BREMDI DG)RNH	8	PRAI ON APB X GEI DB DN(APB)KI tMRNH	038346
ME/ OPDGEI RN(EI I RTBD)KI H	. 65.		

RNBTAI GQ	ATURNBTAI GQ	EPPI RgEI RON
ELECTRIC MOWER	STANDARD	MAC9AGED GENSET

(enera4Performance Baia

(DNADI POF DG F RZ KEN	PDGgDNI I OEB	DN(RND POF DG	UGEYD MDEN DKK PGDA)UMDPH	UGEYD APDg KT DI gONATMPI N)UAKg H	RRO UGEYD APDg KT DI gONATMPI N)UAKg H	VOI KT DI gONATMPI N)VKg H	RRO VOI KT DI gONATMPI N)VKg H	DI Dg APDg KT DI gONATMPI N)DAKg H	RRO DI Dg APDg KT DI gONATMPI N)DAKg H
E9W	K	B%M	MSI	LB-B%M%R	LB-B%M%R	GAL-%R	GAL-%R	LB-E9WH%R	LB-E9WH%R
75, 4	3, ,	3B30	660	, 4 60	, 4 . 7	5. 48	5042	, 46, 7	, 46P7
8754	P,	31, , 0	. PP	, 4 65	, 4 6,	6242	6248	, 463,	, 46,
8, , 4	2,	2P6	. 58	, 4 55	, 4 5,	6642	6648	, 460P	, 463P
58046	75	26,	. 6	, 4 80	, 4 58	6042	6040	, 466,	, 46,
5054	7,	727	. 3	, 4 57	, 4 50	. P48	. P4	, 46, 5	, 4605
65, 4	8,	82,	073	, 4 67	, 4 60	. 4	. 042	, 4606	, 4636
. 754	5,	575	00P	, 4 5,	, 4 65	0246	024	, 46, 7	, 4607
. , , 4	6,	673	327	, 4 58	, 4 53	0. 48	0. 4	, 465P	, 4662
0054	. ,	. 87	368	, 4 85	, 4 8,	324P	3248	, 46P8	, 4625
32746	05	. 35	305	, 4 7,	, 4 82	3848	384	, 4607	, 4635
35, 4	0,	080	3, 6	, 4 26	, 4 7P	3640	364	, 4670	, 468,
754	3,	355	80	, 46. 8	, 46, ,	P46	P46	, 4P, .	, 4628

(DNADI POF DG F RZ KEN	PDGgDNI I OEB	DN(RND POF DG	RNI DI MKI B PGDA	RNI DI MKI B I DMP	D/ Z MKI B I DMP	D/ Z MKI B PGDA	DN(RND OTI I DI I DMP	gOMPGDAAOG OTI I DI PGDA	gOMPGDAAOG OTI I DI I DMP
E9W	K	B%M	INH%G	DEG /	DEG /	INH%G	DEG /	INH%G	DEG /
75, 4	3, ,	3B30	PP48	30, 48	310P746	P348	2674	3, 8	6P342
8754	P,	31, , 0	P642	3384	310. 742	2548	2, 242	3, 3	67348
8, , 4	2,	2P6	P. 48	33, 40	318P, 42	2340	77P48	P7	65846
58046	75	26,	224P	3, 84	318247	7P46	7854	P5	66P42
5054	7,	727	2. 4	3, 048	3180. 4	7. 4	7. 04P	2P	60742
65, 4	8,	82,	7, 4	P748	31 6640	5P40	82346	75	. 7248
. 754	5,	575	5247	P048	PP548	6242	85P48	8,	. 6. 4
. , , 4	6,	673	6848	2P40	P6846	. 242	8, 846	5,	0P842
0054	. ,	. 87	. 4	254P	2P347	024P	83. 4	. 8	06246
32746	05	. 35	0847	2640	28347	0. 4P	8, 346	. ,	00640
35, 4	0,	080	0. 4P	2046	20. 42	3P40	52. 48	0.	3PP42
754	3,	355	3, 47	7P48	8P848	3040	5, , 4	3.	35, 4

(enera4Performance Baia)gonichue2H

(DNADI POF DG F RZ KEN	PDGgDNI I OEB	DN(RND POF DG	F DI RNI DI ERG VOI KI OF GEI D	DN(RND OTI I DI F DI DI/ Z (EA VOI KI OF GEI D	F DI RNI DI ERG MEAA KI OF GEI D	F DI DI/ Z (EA MEAA KI OF GEI D	F DI DI/ Z VOI KI OF GEI D)9h BD(KENB h. 8 3 RN Z(H	BGQD/ Z VOI KI OF GEI D)9h BD(KENB h. 8 3 RN Z(H
E9W	K	B%M	C/ F	C/ F	LB-%R	LB-%R	/ T. -F IN	/ T. -F IN
75, 4	3, ,	3B30	01 754	81 0246	3, 1 P. 4P	3, 177. 42	008742	01 7248

8754	P,	31, 0	01 3342	5B8346	3, 1 7P47	3, 6054P	0B646	01 3P47
8, , 4	2,	2P6	0D5548	51 884	P2, 242	3, 60546	0B0P48	3P8740
58046	75	26,	0D, 047	5D6042	P8P54	PFP242	0B, 646	3P624
5054	7,	727	0B0248	6D2842	PD, 342	P67P46	01 3642	3D824P
65, 4	8,	82,	3P0646	6B5642	2D5, 46	2D2646	3P7P, 48	3B854P
. 754	5,	575	3P064	. B3648	71, 246	7B, P4	3B224	3B234
... 4	6,	673	3B6848	. 1 5P48	81 0648	8B6P040	31 7048	3D2046
0054	..	. 87	3D5046	0B6P46	5D5247	51 P042	3B6, 4	31 7, 48
32746	05	. 35	3B0P48	0D3346	6P70246	6D654P	31 0647	P8, 42
35, 4	0,	080	31, P4P	3P, , 40	6D3546	61 384	P3, 48	25648
754	3,	355	72048	31 7642	. D5, 46	. 1 0340	7, 64	8854

Zaei Gejecidbn Baia

(DNADI POF DG F R Z KEN	PDGgDNI I OEB	DN(RND POF DG	GD@gI RDN I O @gYDI F EI DG	GD@gI RDN I O EI MOAPZDGD	GD@gI RDN I O D/ Z	D/ ZETAI GDgOVDGQ I O 95SK	KGOM OR g OOI DG	KGOM EKI DGg OOI DG DNDG(Q	F OGY BTU-F IN	I OF ZDEI VEI TD DNDG(Q	ZR Z ZDEI VEI TD DNDG(Q
E9W	K	B%M	BTU-F IN	BTU-F IN	BTU-F IN	BTU-F IN	BTU-F IN	BTU-F IN	BTU-F IN	BTU-F IN	BTU-F IN
75, 4	3, ,	3B30	30D32	21 67	6, B, .	00B, 8	8D, 6	35B50	67B8,	338B26	3061 26
8754	P,	31, 0	33P6,	8P52	. 7B00	0, B, P	5B56	361 6,	60B, P	3, 8B68	33, 1 70
8, , 4	2,	2P6	3, P50	8D, ,	. 51 62	32D36	5B28	3, 6P7	. 7P38	P71 8,	3, . P3,
58046	75	26,	3, B6,	5D, 8	.. P25	371 50	6P80	3, 1 68	. 5B, 2	P, B88	PPD65
5054	7,	727	P25P	5P7, 5	.. D07	35B38	6B27	33P2,	.. 1 8,	28B37	P3P7, 8
65, 4	8,	82,	21 32	5B0,	06P7P	33B5,	. D56	P1, ,	02D5,	701 50	771 7,
. 754	5,	575	7B, .	51 80	03B7,	P80P	. D2P	71 57	061 2,	83P6,	85P70
... 4	6,	673	8D, 5	6P78,	37P06	7B86	0P7, 8	5D57	3PP77	531 7,	56P708
0054	..	. 87	81 35	6B, 7	361 8,	5D, 6	0B6P,	. B0,	35B70	63B0,	6, D, 8
32746	05	. 35	8B68	. B6P0	30B00	6PP2	3P32	0B5,	3, 1 57	. 81 37	. 21 87
35, 4	0,	080	5D233	. B88	3, D50	6B0,	3B67	3P7P	33B00	.. P36	. 0P, 3
754	3,	355	6B86	0P36	7B0P	01 03	3B, 8	P02	8B7P	0, P5P	00B36

Dmðssðns Baia

BÐADI

GEI DB APDDB NOMÑEI BEI E: 13SS GPM

(DNADI POF DG F R Z KEN	DYF	75S86	5P86	97586	13786	7586
PDGgDNI I OEB	6	1SS	75	5S	h5	1S
DN(RND POF DG	UZP	1,11h	3CS	575	915	155
TOTAL NOX (AS NO0)	G-%R	5P85	. B08	01 56	31 66	772
TOTAL CO	G-%R	06,	0, 0	78	. 30	3B62
TOTAL %C	G-%R	88	87	67	55	652
TOTAL CO0	9G-%R	550	663	0P0	370	P8
MART FATTER	G-%R	.. 47	. 646	034	0546	7, 42
TOTAL NOX (AS NO0)	(CORR 5K O0)	F G-NF .	0B824	3B3547	3B6P4	3P78P4
TOTAL CO	(CORR 5K O0)	F G-NF .	3, , 48	30, 4	5742	68046
TOTAL %C	(CORR 5K O0)	F G-NF .	0, 46	0P42	. 048	854
MART FATTER	(CORR 5K O0)	F G-NF .	3347	3540	3640	.. 46
TOTAL NOX (AS NO0)	(CORR 35K O0)	F G-NF .	P3542	5PP46	5P346	88, 4P
TOTAL CO	(CORR 35K O0)	F G-NF .	. 748	6646	0346	3P348
TOTAL %C	(CORR 35K O0)	F G-NF .	247	3348	334P	0648
MART FATTER	(CORR 35K O0)	F G-NF .	64	547	54	334
TOTAL NOX (AS NO0)	(CORR 5K O0)	MF	3D, 0	727	778	273
TOTAL CO	(CORR 5K O0)	MF	2,	P8	68	. 7,
TOTAL %C	(CORR 5K O0)	MF	66	58	8,	303
TOTAL NOX (AS NO0)	(CORR 35K O0)	MF	668	0P0	022	. 0,
TOTAL CO	(CORR 35K O0)	MF	..	. 8	37	3, 7
TOTAL %C	(CORR 35K O0)	MF	38	03	00	65
TOTAL NOX (AS NO0)	G-%MHR	5460	. 4P5	. 46P	6407	54 0
TOTAL CO	G-%MHR	. 400	. 402	. 48,	. 4P	7463
TOTAL %C	G-%MHR	. 4 8	. 4 2	. 4 2	. 487	04P8
MART FATTER	G-%MHR	. 4 .	. 4 6	. 4 6	. 4 2	. 42

TOTAL NOX (AS NO0)	G-9WH%R	74 7	54 P	642	543	842
TOTAL CO	G-9WH%R	, 4 ,	, 4 2	, 42	34 5	3, 4 7
TOTAL %C	G-9WH%R	, 4 2	, 43	, 43	, 46	64 0
MART FATTER	G-9WH%R	, 4 6	, 4 8	, 4 5	, 43	, 45
TOTAL NOX (AS NO0)	LB-%R	3. 45	842P	646.	048	3470
TOTAL CO	LB-%R	, 46	, 43	, 47	, 4P	046.
TOTAL %C	LB-%R	, 46	, 45	, 48.	, 40	34 3
TOTAL CO0	LB-%R	31037	P73	866	. 2,	033
MART FATTER	LB-%R	, 4 7	, 4 2	, 4 5	, 4 8	, 48
OXYGEN IN EX%	K	P42	3346	3047	3. 46	364P
DRY SF O9E OMACITY	K	, 46	, 42	, 46	34	, 46
BOSC%SF O9E		, 473	, 47P	, 473	, 428	, 473
NUF BER						

GEI DB APDDB POI DNI REI AR D VEGREI RON: 13SS GPM

(DNADI POF DG F R Z KEN	DYF	75S8S	5%h8S	9758S	1378S	758S
PDGgDNI I OEB	6	1SS	75	5S	h5	1S
DN(RND POF DG	UZP	1,11h	3CS	575	915	155
TOTAL NOX (AS NO0)	G-%R	81660	. 1 78	0103P	31653	26.
TOTAL CO	G-%R	656	6. 6	360	52.	0167
TOTAL %C	G-%R	306	308	2P	3. .	288
MART FATTER	G-%R	8548	8748	6348	6P47	3664
TOTAL NOX (AS NO0) (CORR 5K O0)	F G-NF .	018546	317654	3170346	31P. 040	31P3, 4P
TOTAL CO (CORR 5K O0)	F G-NF .	32748	00646	3, 248	28647	51P1, 46
TOTAL %C (CORR 5K O0)	F G-NF .	6646	584	8. 48	3004P	01254
MART FATTER (CORR 5K O0)	F G-NF .	0042	0P47	0747	5P4	. 834
TOTAL NOX (AS NO0) (CORR 35K O0)	F G-NF .	P2P48	86746	8. 242	7374	7, P48
TOTAL CO (CORR 35K O0)	F G-NF .	8P46	2. 4	6, 48	. 0, 4P	010042
TOTAL %C (CORR 35K O0)	F G-NF .	3846	0, 4P	0046	6548	23, 42
MART FATTER (CORR 35K O0)	F G-NF .	246	334	3, 4	004	3. 64
TOTAL NOX (AS NO0) (CORR 5K O0)	MMF	310P2	25,	2. P	P63	P. 3
TOTAL CO (CORR 5K O0)	MMF	35,	32,	28	8P0	617P0
TOTAL %C (CORR 5K O0)	MMF	2.	3, 5	33.	00P	61 7P
TOTAL NOX (AS NO0) (CORR 35K O0)	MMF	620	. 35	. 33	. 6P	. 65
TOTAL CO (CORR 35K O0)	MMF	58	87	. 0	057	31772
TOTAL %C (CORR 35K O0)	MMF	. 3	. P	60	25	3163.
TOTAL NOX (AS NO0)	G-%MH%R	5425	64 5	. 422	640	540
TOTAL CO	G-%MH%R	, 463	, 460	, 405	3425	3. 425
TOTAL %C	G-%MH%R	, 483	, 485	, 488	, 4 .	546P
MART FATTER	G-%MH%R	, 4 8	, 4 2	, 4 7	, 48	, 4P.
TOTAL NOX (AS NO0)	G-9WH%R	74P5	546.	5407	8402	74 7
TOTAL CO	G-9WH%R	, 468	, 473	, 4 6	0460	3242.
TOTAL %C	G-9WH%R	, 485	, 403	, 403	, 465	748,
MART FATTER	G-9WH%R	, 4 2	, 483	, 48,	, 400	3408
TOTAL NOX (AS NO0)	LB-%R	3640,	7466	642P	. 40,	3425
TOTAL CO	LB-%R	34 ,	, 4P8	, 4 3	3402	647.
TOTAL %C	LB-%R	, 407	, 402	, 40,	, 40,	34P3
MART FATTER	LB-%R	, 486	, 485	, 4 P	, 483	, 4 0

Gevu4iory Riformaidon

DPE DMDG(DNgQAI EI RONEGQ		hS11 - ----		
GASEOUS EF ISSIONS DATA F EASUREF ENTS MROVIDED TO T%E EMA ARE CONSISTENT WIT%T%OSE DESCRIBED IN EMA 6, C/ R MART 8, SUBMART IIII AND ISO 2372 / OR F EASURING %C1 CO1MF 1AND NOX4T%E "FAX LIF ITS" S%OWN BELOW ARE WEIG%TED CYCLE AVERAGES AND ARE IN COF MLIANCE WIT%T%E EF ERGENCY STATIONARY REGULATIONS4				
I oca4ty U4S4(INCL CALI/)	Evency EMA	Gevu4aidon STATIONARY	I 4rt4iave EF ERGENCY STATIONARY	Max I 4nds - (tUYF - ZG CO: . 46 NOx + %C: 846 MF : , 40,

E4du2e Beraie Baia

AI ENBEGB

EI I RTBD gOGGDgI DB POF DG gEPEUR R Q)UZPH

EMURDNI OPDGEI R(I DMP)KH	5S	%S	7S	3S	. S	1SS	11S	1hS	19S	1CS	NOGMEI
ALTITUDE (/ T)											
.	3B30	3B30	3B30	3B33	3B. 8	3B. 3	31 P8	31 2P	31 56	P27	3B30
31. .	3B30	3B30	3B30	3B. 7	3B. 0	31 P7	31 P0	31 88	31. 8	P57	3B3.
01. .	3B30	3B33	3B. 8	3B. 3	31 P8	31 P3	31 8.	31. 0	P58	P38	3B. 5
. 1. .	3B3.	3B. 5	3B. .	31 P5	31 22	31 52	PP8	P56	P35	256	3B. 3
61. .	3B. .	31 P7	31 20	31 8P	31 53	PP.	P5.	P30	250	7P.	31 P.
51. .	31 87	31 65	31 0.	31. 0	P23	P66	P. 7	265	7P0	7. P	31 6.
81. .	31. P	31 3.	PP.	P75	P55	P32	280	2. 5	778	8P8	31 0.
71. .	31 0.	31. .	P26	P8P	P6.	P. .	2. 5	7P.	757	82.	31 3.
21. .	PPP	P20	P87	P56	P0.	287	2. 2	786	70.	87.	PPP
P1. .	P7.	P52	P66	P. 0	2P2	208	78P	70.	7. .	885	P7P
3. 1. .	P66	P. .	P37	P. 8	253	7P5	762	70.	8P2	87.	P58
331. .	P30	2P2	228	275	237	770	7. 8	73.	825	856	P02
301. .	27P	287	258	265	7P3	75.	700	8P.	857	803	2PP
3. 1. .	26.	2. 0	200	233	770	7. .	8P6	858	832	5P.	286
361. .	2. .	7P3	723	770	7. .	822	862	83.	527	587	205
351. .	756	766	7. .	736	870	8. 5	8. 0	52.	586	566	72.

gross Geference

I esi Apec	Aeiidhv	Dnvthe Erranvemeni	Dnvtheerdhv Mo2e4	Dnvtheerdhv Mo2e4 Versdñ	Alari Dffecid0e Aerð4 Number	Dn2 Dffecid0e Aerð4 Number
6523PP2	MM707.	5. 85. 85	GS882	H	LT% . . . 3	
6520. 32	MM7525	56. 7605	EE58.	H	LT6. . . 3	
6520. 32	MM7525	56. 7608	EE58.	H	LT6. . . 3	
6523PP2	MM707.	5633P7.	GS882	H	LT% . . . 3	

Performance Parameier Geference

Parameiers Geference:BM. %SS-1C PDGKOGMENg D BDKMR RONA
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MER/ ORFANCE DE/ INITIONS DF P8. ,
AMMLICATION:
Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test cell at SAE J3PP5 standard reference conditions4Caterpillar maintains ISOP, , 3:0. . , certified quality management systems for engine test / acilities to assure accurate calibration of test equipment4Engine test data is corrected in accordance with SAE J3PP54Additional reference material SAE J30021J3. 6P1ISO 28851 . . 68H:0. , 0E1. . 68H:3P2P13525105. 6100221and P06P may apply in part or are similar to SAE J3PP54Special engine rating request (SERR) test data shall be noted4
MER/ ORFANCE MARAF ETER TOLERANCE / ACTORS:
Mower +-H. K
Torque +-H. K
Exhaust stack temperature +-H2K
Inlet airflow +-H5K
Intake manifold pressureHage +-H3, K
Exhaust flow +-H8K
Specific fuel consumption +-H. K
/ uel rate +-H5K
Specific DE/ consumption +-H. K
DE/ rate +-H5K
%eat rejection +-H5K
%eat rejection exhaust only +-H3, K
%eat rejection CEF only +-H3, K
%eat Rejection values based on using treated water4
Torque is included for truck and industrial applications1do not use for Gen Set or steady state applications4
On C7 HC32 engines1at speeds of 33. , RMF and under these values are provided for reference only1and may not meet the tolerance listed4
On . 5. , and C375 engines1at speeds below Meak Torque these values are provided for reference only1and may not meet the tolerance listed4
These values do not apply to C02, -. 8. , 4/ or these models1see the tolerances listed below4
C02, -. 8. , %EAT REJECTION TOLERANCE / ACTORS:
%eat rejection +-H3, K

%eat rejection to Atmosphere +-H5, K
 %eat rejection to Lube Oil +-H0, K
 %eat rejection to Aftercooler +-H5K
 TEST CELL TRANSDUCER TOLERANCE / ACTORS:
 Torque +-H, 45K
 Speed +-H, 40K
 / uel flow +-H34 K
 Temperature +-H04 C degrees
 Intake manifold pressure +-H, 48 kMa
 OBSERVED ENGINE MER/ ORFANCE IS CORRECTED TO SAE J3PP5 RE/ ERENCE
 AIR AND / UEL CONDITIONS4
 RE/ ERENCE ATF OSM%ÆRIC INLET AIR
 / OR . 5, , ENGINES AND SFALLER
 SAE J3002 AUG0, , 0 for marine engines1and J3PP5 JAN0, 36 for other
 engines1reference atmospheric pressure is 3, , 9MA (0P43 in hg)1
 and standard temperature is 05deg C (77 deg /) at . , K relative
 humidity at the stated aftercooler water temp1or inlet manifold
 temp4
 / OR . 8, , ENGINES
 Engine rating obtained and presented in accordance with ISO . , 68-3
 and SAE J3PP5 JANJAN0, 36 reference atmospheric pressure is 3, ,
 9MA (0P43 in hg)1and standard temperature is 05deg C (77 deg /)
 at . , K relative humidity and 35, F altitude at the stated
 aftercooler water temperature4
 F EASUREF ENT LOCATION / OR INLET AIR TEF MERATURE
 Location for air temperature measurement air cleaner inlet at
 stabilized operating conditions4
 RE/ ERENCE EX%AUST STAC9 DIAF ETER
 The Reference Exhaust Stack Diameter published with this dataset
 is only used for the calculation of Smoke Opacity values displayed
 in this dataset4This value does not necessarily represent the
 actual stack diameter of the engine due to the variety of exhaust
 stack adapter options available4Consult the price list1engine
 order or general dimension drawings for the actual stack diameter
 size ordered or options available4
 RE/ ERENCE / UEL
 DIESEL
 Reference fuel is #0 distillate diesel with a . 5AM gravity;
 A lower heating value is 60172, 9J-9G (321 P, BTU-LB) when used at
 35 deg C (5P deg /)1where the density is
 25, G-Liter (74 P. 8 Lbs-Gal)4
 GAS
 Reference natural gas fuel has a lower heating value of . . 476 9J-L
 (P, 5 BTU-CU / t)4Low BTU ratings are based on 3246 9J-L (5, ,
 BTU-CU / T) lower heating value gas4Mropane ratings are based on
 27468 9J-L (0. 5, BTU-CU / t) lower heating value gas4
 ENGINE MOWER (NET) IS T%Æ CORRECTED / LYW%ÆEL MOWER (GROSS) LESS
 EXTERNAL AUXILIARY LOAD
 Engine corrected gross output includes the power required to drive
 standard equipment; lube oil1scavenge lube oil1fuel transfer1
 common rail fuel1separate circuit aftercooler and jacket water
 pumps4Engine net power available for the external (flywheel)
 load is calculated by subtracting the sum of auxiliary load from
 the corrected gross flywheel out put power4Typical auxiliary
 loads are radiator cooling fans1hydraulic pumps1air compressors
 and battery charging alternators4/ or Tier 6 ratings additional
 Marasitic losses would also include Intake1and Exhaust
 Restrictions4
 ALTITUDE CAMABILITY
 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 set4
 Standard temperature values versus altitude could be seen on
 TF 0, , 34
 When viewing the altitude capability chart the ambient temperature
 is the inlet air temp at the compressor inlet4
 Engines with ADEF F EU1 and %EU1 fuel systems operating at
 conditions above the defined altitude capability derate for
 atmospheric pressure and temperature conditions outside the values
 defined1see TF 0, , 34
 F echanical governor controlled unit injector engines require a
 setting change for operation at conditions above the altitude
 defined on the engine performance sheet4See your Caterpillar
 technical representative for non standard ratings4
 REGULATIONS AND MRODUCT COF MLIANCE
 TF I Emissions information is presented at 'nominal' and 'Motential
 Site Variation' values for standard ratings4No tolerances are
 applied to the emissions data4These values are subject to change
 at any time4The controlling federal and local emission
 requirements need to be verified by your Caterpillar technical
 representative4
 Customer's may have special emission site requirements that need
 to be verified by the Caterpillar Mroduct Group engineer4
 EF ISSION CYCLE LIF ITS:
 Cycle emissions F ax Limits apply to cycle1weighted averages only4
 Emissions at individual load points may exceed the cycle1weighted
 limit4

WET & DRY EXHAUST EMISSIONS DESCRIPTION:
Wet HTotal exhaust flow or concentration of total exhaust flow
Dry HTotal exhaust flow minus water vapor or concentration of exhaust
flow with water vapor excluded
EMISSIONS DESCRIPTIONS:
Emissions : DF 3378
EMISSION CYCLE DESCRIPTIONS:
34/ or constant speed marine engines for ship main propulsion
including diesel electric drive test cycle E0 shall be applied
for controllable pitch propeller sets
test cycle E0 shall be applied
04/ or propellerHawtoperated main and propellerHawtoperated
auxiliary engines the test cycle E. shall be applied
. 4/ or constant speed auxiliary engines test cycle D0 shall be
applied
64/ or variable speed variable load auxiliary engines not
included above test cycle C3 shall be applied
EAT REJECTION DESCRIPTIONS:
Diesel Circuit Type and % Balance : DF P5, ,
% DISPLACEMENT (%) DESCRIPTIONS:
. 5, , : EF 35, ,
RATING DESCRIPTIONS:
Agriculture : TF 8, , 2
/ ire Mump : TF 8, , P
Generator Set : TF 8, . 5
Generator (Gas) : TF 8, 63
Industrial Diesel : TF 8, 3,
Industrial (Gas) : TF 8, 6,
Irrigation : TF 576P
Locomotive : TF 8, . 7
Farine Auxiliary : TF 8, . 8
Farine Mop (Except . 8, .) : TF 5767
Farine Mop (. 8, . only) : TF 5762
FS%A : TF 8, 60
Oil / ield (Metroleum) : TF 8, 33
OffHghway Truck : TF 8, . P
OnHghway Truck : TF 8, . 2
SOUND DESCRIPTIONS:
Sound Mower : DF 27, 0
Sound Messure : TF 7, 2,
Date Released : 3, -07-03

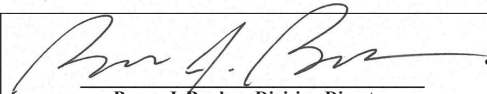


UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2024 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

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.

APPENDIX 6
POTENTIAL EMISSIONS CALCULATIONS

Potential Emissions Calculations Facility-Wide Summary

Facility-Wide Potential Emissions

Pollutant	Potential Annual Emissions (tpy)		Facility-Wide Potential Emissions (tpy)	Title V Major Source Threshold (tpy)	Above Threshold?
	Emergency Generators	Diesel Belly Tanks			
NO _x ¹	24.90	-	24.90	25	No
CO	59.59	-	59.59	100	No
VOC	10.75	0.11	10.86	25	No
Filterable PM	3.80	-	3.80	100	No
PM ₁₀ /PM _{2.5}	5.93	-	5.93	100	No
SO ₂	0.42	-	0.42	100	No
Max. Facility-Wide Individual HAP (Benzene)	0.22	-	0.22	10	No
Total HAP	0.38	-	0.38	25	No
CO ₂ e	45,482	-	45,482	N/A	N/A

Notes:

(1) The applicant is requesting a site-wide NO_x emissions limitation of 24.9 tpy.

Potential Emissions Calculations Diesel-Fired Generators

Number of Generator Engines

Generator Model	Capacity (kW, ea.)	Tier	Add-On Controls	Quantity
CAT 3516E	2,750	Tier 2	SCR, DOC, DPF	72
CAT C32	1,000	Tier 2	None	2
CAT C18	750	Tier 2	None	2
Total				76

Power Output by Load

Engine Type	Power Output ¹					Units of Power Provided
	10% Load	25% Load	50% Load	75% Load	Full Standby	
2750 kW (CAT 3516E)	549	1,131	2,102	3,072	4,043	bhp
1000 kW (CAT C32)	209	426	772	1,124	1,483	bhp
750 kW (CAT C18)	155	315	575	840	1,112	bhp

Notes:

- (1) Per the manufacturer specification sheets and performance data.

Fuel Usage by Load

Engine Type	Diesel Fuel Consumption ¹ (gal/hr)					Heat Input ² (MMBtu/hr/engine)				
	10% Load	25% Load	50% Load	75% Load	Full Standby	10% Load	25% Load	50% Load	75% Load	Full Standby
2750 kW (CAT 3516E)	36.1	62.9	107.5	147.3	192.9	4.9	8.6	14.7	20.2	26.4
1000 kW (CAT C32)	12.5	21.8	38.1	56.0	71.5	1.7	3.0	5.2	7.7	9.8
750 kW (CAT C18)	9.5	16.6	28.4	42.8	53.6	1.3	2.3	3.9	5.9	7.3

Notes:

- (1) Refer to enclosed manufacturer specification sheets and performance data for each engine model.
 (2) Diesel fuel consumption was converted to heat input based on the diesel high heating value from the USEPA's AP-42, Section 3.4, Large Stationary Diesel and All Stationary Dual-fuel Engines, Table 3.4-1, footnote a (October 1996):

$$\text{Diesel HHV} = 0.137 \text{ MMBtu/gal}$$

Manufacturer-Provided Emission Factors by Load

Pollutant	CAT 3516E - Uncontrolled Emission Factors ¹ (g/hp-hr)					CAT C32 - Uncontrolled Emission Factors ¹ (g/hp-hr)				
	10% Load	25% Load	50% Load	75% Load	Full Standby	10% Load	25% Load	50% Load	75% Load	Full Standby
NO _x	8.51	3.73	3.65	4.83	6.00	6.43	5.34	4.37	4.60	5.97
CO	3.43	1.68	0.57	0.56	1.16	6.03	1.91	0.64	0.21	0.24
VOC ²	0.46	0.29	0.17	0.12	0.10	0.73	0.18	0.13	0.09	0.02
Filterable PM ³	0.21	0.15	0.07	0.05	0.07	0.40	0.25	0.09	0.03	0.04

Pollutant	CAT C18 - Uncontrolled Emission Factors ¹ (g/hp-hr)				
	10% Load	25% Load	50% Load	75% Load	Full Standby
NO _x	5.42	4.62	3.88	4.05	5.85
CO	13.85	1.85	0.25	0.52	0.41
VOC ²	5.59	0.33	0.16	0.15	0.11
Filterable PM ³	0.93	0.16	0.07	0.08	0.06

CAT 3516E
control efficiencies

NO_x 91.7%
CO 70.0%
VOC 40.0%
PM filt 68.6%

Notes:

- (1) Refer to enclosed manufacturer specification sheets and performance data for each engine model. The performance data sheets provide nominal emission data and potential site variation data. For a conservative estimate of the potential emissions, the potential site variation data are used in the emission calculations.
 (2) Assumes that all hydrocarbons (HC) are VOC.
 (3) Assumes that all filterable PM is less than 2.5 microns in diameter (i.e., PM = PM₁₀ = PM_{2.5}).

Potential Emissions Calculations Diesel-Fired Generators

AP-42 Emission Factors

Pollutant	Emission Factor (Gens > 600 hp) ¹
	(lb/MMBtu)
SO ₂ ²	1.52E-03
Condensable PM	7.70E-03
Benzene	7.76E-04
Toluene	2.81E-04
Xylenes	1.93E-04
Formaldehyde	7.89E-05
Acetaldehyde	2.52E-05
Acrolein	7.88E-06
Total PAH ³	2.12E-04

Notes:

- (1) Emission factors are from the U.S. EPA's AP-42, Section 3.4, Large Stationary Diesel And All Stationary Dual-fuel Engines, Tables 3.4-1, 3.4-2, 3.4-3, and 3.4-4 (October 1996).
- (2) The SO₂ emission factor was calculated based on the maximum allowable diesel fuel sulfur content under NSPS Subpart IIII:
 Diesel Sulfur Content = 0.0015 wt.% Sulfur
 It is assumed that all SO_x is SO₂.
- (3) PAH = Polycyclic Aromatic Hydrocarbons

GHG Emission Factors

Pollutant	Emission Factor - Heat Input-Based ¹
	(lb/MMBtu)
CO ₂	163.05
CH ₄	6.61E-03
N ₂ O	1.32E-03
CO ₂ e ²	163.59

Notes:

- (1) Per 40 CFR 98, Subpart C, Tables C-1 and C-2 for No. 2 fuel oil combustion. The emission factors were converted from kg/MMBtu to lb/MMBtu.
- (2) The CO₂e emission factor is calculated as the sum of each GHG pollutant multiplied by its global warming potential, per 40 CFR 98, Subpart A, Table A-1:

CO ₂ :	1
CH ₄ :	28
N ₂ O:	265

Potential Emissions Calculations Diesel-Fired Generators

Hourly Uncontrolled Emission Rate

Pollutant	CAT 3516E - Hourly Uncontrolled Emission Factors ^{1,2} (lb/hr/gen)					CAT C32 - Hourly Uncontrolled Emission Factors ^{1,2} (lb/hr/gen)				
	10% Load	25% Load	50% Load	75% Load	Full Standby	10% Load	25% Load	50% Load	75% Load	Full Standby
<i>Criteria Pollutants</i>										
NO _x	10.30	9.30	16.91	32.71	53.48	2.96	5.02	7.44	11.40	19.52
CO	4.15	4.19	2.64	3.79	10.34	2.78	1.79	1.09	0.52	0.78
VOC	0.56	0.72	0.79	0.81	0.89	0.34	0.17	0.22	0.22	0.07
Filt. PM	0.25	0.37	0.32	0.34	0.62	0.18	0.23	0.15	0.07	0.13
PM/PM ₁₀ /PM _{2.5} ³	0.29	0.44	0.44	0.49	0.83	0.20	0.26	0.19	0.13	0.21
SO ₂	7.49E-03	0.01	0.02	0.03	0.04	2.60E-03	4.53E-03	7.91E-03	0.01	0.01
<i>Hazardous Air Pollutants</i>										
Benzene	3.84E-03	6.69E-03	0.01	0.02	0.02	1.33E-03	2.32E-03	4.05E-03	5.95E-03	7.60E-03
Toluene	1.39E-03	2.42E-03	4.14E-03	5.67E-03	7.43E-03	4.81E-04	8.39E-04	1.47E-03	2.16E-03	2.75E-03
Xylenes	9.55E-04	1.66E-03	2.84E-03	3.90E-03	5.10E-03	3.31E-04	5.77E-04	1.01E-03	1.48E-03	1.89E-03
Formaldehyde	3.90E-04	6.80E-04	1.16E-03	1.59E-03	2.09E-03	1.35E-04	2.36E-04	4.12E-04	6.05E-04	7.73E-04
Acetaldehyde	1.25E-04	2.17E-04	3.71E-04	5.09E-04	6.66E-04	4.32E-05	7.53E-05	1.32E-04	1.93E-04	2.47E-04
Acrolein	3.90E-05	6.79E-05	1.16E-04	1.59E-04	2.08E-04	1.35E-05	2.35E-05	4.11E-05	6.05E-05	7.72E-05
Total PAH	1.05E-03	1.83E-03	3.12E-03	4.28E-03	5.60E-03	3.63E-04	6.33E-04	1.11E-03	1.63E-03	2.08E-03
Total HAP	6.74E-03	0.01	0.02	0.03	0.04	2.33E-03	4.07E-03	7.11E-03	0.01	0.01
<i>Greenhouse Gases</i>										
CO ₂	806.59	1,405.39	2,401.90	3,291.16	4,310.02	279.29	487.08	851.28	1,251.22	1,597.54
CH ₄	0.03	0.06	0.10	0.13	0.17	0.01	0.02	0.03	0.05	0.06
N ₂ O	6.54E-03	0.01	0.02	0.03	0.03	2.27E-03	3.95E-03	6.91E-03	0.01	0.01
CO ₂ e	809.24	1,410.01	2,409.79	3,301.98	4,324.18	280.21	488.68	854.08	1,255.33	1,602.79

Hourly Uncontrolled Emission Rate (continued)

Pollutant	CAT C18 - Hourly Uncontrolled Emission Factors ^{1,2} (lb/hr/gen)					Worst-Case Hourly Uncontrolled Emission Factors ^{1,2} (lb/hr/gen)					
	10% Load	25% Load	50% Load	75% Load	Full Standby	10% Load	25% Load	50% Load	75% Load	Full Standby	Maximum
<i>Criteria Pollutants</i>											
NO _x	1.85	3.21	4.92	7.50	14.34	10.30	9.30	16.91	32.71	53.48	53.48
CO	4.73	1.28	0.32	0.96	1.01	4.73	4.19	2.64	3.79	10.34	10.34
VOC	1.91	0.23	0.20	0.28	0.27	1.91	0.72	0.79	0.81	0.89	1.91
Filt. PM	0.32	0.11	0.09	0.15	0.15	0.32	0.37	0.32	0.34	0.62	0.62
PM/PM ₁₀ /PM _{2.5} ³	0.33	0.13	0.12	0.19	0.20	0.33	0.44	0.44	0.49	0.83	0.83
SO ₂	1.97E-03	3.45E-03	5.90E-03	8.89E-03	0.01	7.49E-03	0.01	0.02	0.03	0.04	0.04
<i>Hazardous Air Pollutants</i>											
Benzene	1.01E-03	1.77E-03	3.02E-03	4.55E-03	5.70E-03	3.84E-03	6.69E-03	0.01	0.02	0.02	0.02
Toluene	3.66E-04	6.39E-04	1.09E-03	1.65E-03	2.06E-03	1.39E-03	2.42E-03	4.14E-03	5.67E-03	7.43E-03	7.43E-03
Xylenes	2.51E-04	4.39E-04	7.51E-04	1.13E-03	1.42E-03	9.55E-04	1.66E-03	2.84E-03	3.90E-03	5.10E-03	5.10E-03
Formaldehyde	1.03E-04	1.79E-04	3.07E-04	4.63E-04	5.80E-04	3.90E-04	6.80E-04	1.16E-03	1.59E-03	2.09E-03	2.09E-03
Acetaldehyde	3.28E-05	5.73E-05	9.81E-05	1.48E-04	1.85E-04	1.25E-04	2.17E-04	3.71E-04	5.09E-04	6.66E-04	6.66E-04
Acrolein	1.03E-05	1.79E-05	3.07E-05	4.62E-05	5.79E-05	3.90E-05	6.79E-05	1.16E-04	1.59E-04	2.08E-04	2.08E-04
Total PAH	2.76E-04	4.82E-04	8.25E-04	1.24E-03	1.56E-03	1.05E-03	1.83E-03	3.12E-03	4.28E-03	5.60E-03	5.60E-03
Total HAP	1.77E-03	3.10E-03	5.30E-03	7.99E-03	0.01	6.74E-03	0.01	0.02	0.03	0.04	0.04
<i>Greenhouse Gases</i>											
CO ₂	212.26	370.90	634.55	956.29	1,197.60	806.59	1,405.39	2,401.90	3,291.16	4,310.02	4,310.02
CH ₄	8.61E-03	0.02	0.03	0.04	0.05	0.03	0.06	0.10	0.13	0.17	0.17
N ₂ O	1.72E-03	3.01E-03	5.15E-03	7.76E-03	9.72E-03	6.54E-03	0.01	0.02	0.03	0.03	0.03
CO ₂ e	212.96	372.12	636.63	959.43	1,201.53	809.24	1,410.01	2,409.79	3,301.98	4,324.18	4,324.18

Notes:

- (1) For engine-specific emission factors:
Hourly Emissions at Load X (lb/hr/gen) = Emission Factor at Load X (g/hp-hr) x Engine Power at Load X (bhp/gen) / (453.6 g/lb)
- (2) For AP-42 & GHG emission factors:
Hourly Emissions at Load X (lb/hr/gen) = Emission Factor (lb/MMBtu) x Heat Input at Load X (MMBtu/hr/gen)
- (3) Total PM/PM₁₀/PM_{2.5} is the sum of filterable PM/PM₁₀/PM_{2.5} and condensable PM.

Potential Emissions Calculations Diesel-Fired Generators

Fuel Usage-Based Uncontrolled Emission Rate for Emissions Tracking

Pollutant	CAT 3516E - Fuel Usage-Based Uncontrolled Emission Factors ^{1,2} (lb/gal/gen)					CAT C32 - Fuel Usage-Based Uncontrolled Emission Factors ^{1,2} (lb/gal/gen)				
	10% Load	25% Load	50% Load	75% Load	Full Standby	10% Load	25% Load	50% Load	75% Load	Full Standby
NO _x	0.29	0.15	0.16	0.22	0.28	0.24	0.23	0.20	0.20	0.27

Pollutant	CAT C18 - Fuel Usage-Based Uncontrolled Emission Factors ^{1,2} (lb/gal/gen)				
	10% Load	25% Load	50% Load	75% Load	Full Standby
NO _x	0.19	0.19	0.17	0.18	0.27

Pollutant	Worst-Case Fuel Usage-Based Uncontrolled Emission Factors ¹ (lb/gal/gen)		
	CAT 3516E	CAT C32	CAT C18
NO _x	0.29	0.27	0.27

Notes:

- (1) For engine-specific emission factors:
Per-Gallon Emissions at Load X (lb/gal/gen) = {Emission Factor at Load X (g/hp-hr) x Engine Power at Load X (bhp/gen) / (453.6 g/lb)} / {Engine-Specific Fuel Usage at Load X (gal/hr)}
- (2) The applicant is requesting a federally enforceable site-wide annual emission limitation of 24.9 tpy of NO_x on an aggregate, 12-month rolling basis. To demonstrate compliance with this limitation, the fuel usage for each generator will be recorded. The 12-month rolling fuel usage will be tracked by engine type on a monthly basis and multiplied by the worst-case emission factor (in pounds per gallon) for that engine type. This will provide a conservative emission estimate to indicate compliance with each pollutant's respective limit.

Emissions Reductions from Control Equipment

Pollutant	Control Efficiencies		
	CAT 3516E ¹	CAT C32 ²	CAT C18 ²
NO _x	91.7%	--	--
CO	70.0%	--	--
VOC	40.0%	--	--
Filterable PM	68.6%	--	--

Notes:

- (1) Worst case control efficiency between Caterpillar Aftertreatment, MiraTech, and Safety Power ecoCUBE SCR Emission Control System specifications.
- (2) No control equipment associated with the CAT C32 or CAT C18 generators.

Potential Emissions Calculations Diesel-Fired Generators

Hourly Emission Rate with Add-on Controls

Pollutant	CAT 3516E - Hourly Controlled Emission Factors ¹ (lb/hr/gen)				
	10% Load	25% Load	50% Load	75% Load	Full Standby
<i>Criteria Pollutants</i>					
NO _x	0.85	0.77	1.40	2.72	4.44
CO	1.25	1.26	0.79	1.14	3.10
VOC	0.33	0.43	0.47	0.49	0.53
Filt. PM	0.08	0.12	0.10	0.11	0.20
PM/PM ₁₀ /PM _{2.5}	0.12	0.18	0.22	0.26	0.40
SO ₂	7.49E-03	0.01	0.02	0.03	0.04
<i>Hazardous Air Pollutants</i>					
Benzene	3.84E-03	6.69E-03	0.01	0.02	0.02
Toluene	1.39E-03	2.42E-03	4.14E-03	5.67E-03	7.43E-03
Xylenes	9.55E-04	1.66E-03	2.84E-03	3.90E-03	5.10E-03
Formaldehyde	3.90E-04	6.80E-04	1.16E-03	1.59E-03	2.09E-03
Acetaldehyde	1.25E-04	2.17E-04	3.71E-04	5.09E-04	6.66E-04
Acrolein	3.90E-05	6.79E-05	1.16E-04	1.59E-04	2.08E-04
Total PAH	1.05E-03	1.83E-03	3.12E-03	4.28E-03	5.60E-03
Total HAP	6.74E-03	0.01	0.02	0.03	0.04
<i>Greenhouse Gases</i>					
CO ₂	806.59	1,405.39	2,401.90	3,291.16	4,310.02
CH ₄	0.03	0.06	0.10	0.13	0.17
N ₂ O	6.54E-03	0.01	0.02	0.03	0.03
CO ₂ e	809.24	1,410.01	2,409.79	3,301.98	4,324.18

Notes:

- (1) Worst case control system was selected for CAT 3516E generator.

Fuel Usage-Based Controlled Emission Rate for Emissions Tracking

Pollutant	CAT 3516E - Fuel Usage-Based Controlled Emission Factors ^{1,2} (lb/gal/gen)				
	10% Load	25% Load	50% Load	75% Load	Full Standby
NO _x	0.02	0.01	0.01	0.02	0.02

Notes:

- (1) Control systems were selected for the CAT 3516E generators. The CAT C32 and CAT C18 generators do not have controls.
- (2) The applicant is requesting a federally enforceable site-wide annual emission limitation of 24.9 tpy of NO_x on an aggregate, 12-month rolling basis. To demonstrate compliance with this limitation, the fuel usage for each generator will be recorded. The 12-month rolling fuel usage will be tracked by engine type on a monthly basis and multiplied by the worst-case emission factor (in pounds per gallon) for that engine type. This will provide a conservative emission estimate to indicate compliance with each pollutant's respective limit.

Potential Emissions Calculations Diesel-Fired Generators

Ratio of All Pollutants to NO_x

Pollutant	CAT 3516E - Ratio Emission Factors ¹					CAT C32 - Ratio Emission Factors ¹				
	10% Load	25% Load	50% Load	75% Load	Full Standby	10% Load	25% Load	50% Load	75% Load	Full Standby
<i>Criteria Pollutants</i>										
NO _x	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
CO	1.46	1.63	0.56	0.42	0.70	0.94	0.36	0.15	0.05	0.04
VOC	0.39	0.56	0.34	0.18	0.12	0.11	0.03	0.03	0.02	3.35E-03
Filt. PM	0.09	0.15	0.07	0.04	0.04	0.06	0.05	0.02	6.52E-03	6.70E-03
PM/PM ₁₀ /PM _{2.5}	0.14	0.24	0.15	0.10	0.09	0.07	0.05	0.03	0.01	0.01
SO ₂	8.77E-03	0.02	0.02	0.01	9.02E-03	8.76E-04	9.02E-04	1.06E-03	1.02E-03	7.60E-04
<i>Hazardous Air Pollutants</i>										
Benzene	4.49E-03	8.66E-03	8.14E-03	5.77E-03	4.62E-03	4.49E-04	4.62E-04	5.45E-04	5.22E-04	3.90E-04
Toluene	1.63E-03	3.14E-03	2.95E-03	2.09E-03	1.67E-03	1.62E-04	1.67E-04	1.97E-04	1.89E-04	1.41E-04
Xylenes	1.12E-03	2.15E-03	2.03E-03	1.43E-03	1.15E-03	1.12E-04	1.15E-04	1.35E-04	1.30E-04	9.69E-05
Formaldehyde	4.57E-04	8.81E-04	8.28E-04	5.87E-04	4.70E-04	4.56E-05	4.70E-05	5.54E-05	5.31E-05	3.96E-05
Acetaldehyde	1.46E-04	2.81E-04	2.64E-04	1.87E-04	1.50E-04	1.46E-05	1.50E-05	1.77E-05	1.70E-05	1.26E-05
Acrolein	4.56E-05	8.80E-05	8.27E-05	5.86E-05	4.69E-05	4.56E-06	4.69E-06	5.53E-06	5.30E-06	3.96E-06
Total PAH	1.23E-03	2.37E-03	2.22E-03	1.58E-03	1.26E-03	1.23E-04	1.26E-04	1.49E-04	1.43E-04	1.06E-04
Total HAP	7.88E-03	0.02	0.01	0.01	8.11E-03	7.87E-04	8.11E-04	9.56E-04	9.17E-04	6.84E-04
<i>Greenhouse Gases</i>										
CO ₂	943.50	1,820.60	1,710.87	1,212.18	970.98	94.27	97.12	114.46	109.77	81.85
CH ₄	0.04	0.07	0.07	0.05	0.04	3.82E-03	3.94E-03	4.64E-03	4.45E-03	3.32E-03
N ₂ O	7.65E-03	0.01	0.01	9.83E-03	7.88E-03	7.65E-04	7.88E-04	9.29E-04	8.90E-04	6.64E-04
CO ₂ e	946.60	1,826.58	1,716.49	1,216.17	974.17	94.58	97.44	114.83	110.13	82.12

Ratio of All Pollutants to NO_x (continued)

Pollutant	CAT C18 - Ratio Emission Factors ¹					Worst Case - Ratio Emission Factors ¹					
	10% Load	25% Load	50% Load	75% Load	Full Standby	10% Load	25% Load	50% Load	75% Load	Full Standby	Maximum
<i>Criteria Pollutants</i>											
NO _x	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
CO	2.56	0.40	0.06	0.13	0.07	2.56	1.63	0.56	0.42	0.70	2.56
VOC	1.03	0.07	0.04	0.04	0.02	1.03	0.56	0.34	0.18	0.12	1.03
Filt. PM	0.17	0.03	0.02	0.02	0.01	0.17	0.15	0.07	0.04	0.04	0.17
PM/PM ₁₀ /PM _{2.5}	0.18	0.04	0.02	0.03	0.01	0.18	0.24	0.15	0.10	0.09	0.24
SO ₂	1.06E-03	1.07E-03	1.20E-03	1.18E-03	7.76E-04	8.77E-03	0.02	0.02	0.01	9.02E-03	0.02
<i>Hazardous Air Pollutants</i>											
Benzene	5.45E-04	5.50E-04	6.14E-04	6.07E-04	3.97E-04	4.49E-03	8.66E-03	8.14E-03	5.77E-03	4.62E-03	8.66E-03
Toluene	1.98E-04	1.99E-04	2.22E-04	2.20E-04	1.44E-04	1.63E-03	3.14E-03	2.95E-03	2.09E-03	1.67E-03	3.14E-03
Xylenes	1.36E-04	1.37E-04	1.53E-04	1.51E-04	9.88E-05	1.12E-03	2.15E-03	2.03E-03	1.43E-03	1.15E-03	2.15E-03
Formaldehyde	5.55E-05	5.59E-05	6.24E-05	6.17E-05	4.04E-05	4.57E-04	8.81E-04	8.28E-04	5.87E-04	4.70E-04	8.81E-04
Acetaldehyde	1.77E-05	1.79E-05	1.99E-05	1.97E-05	1.29E-05	1.46E-04	2.81E-04	2.64E-04	1.87E-04	1.50E-04	2.81E-04
Acrolein	5.54E-06	5.59E-06	6.23E-06	6.16E-06	4.04E-06	4.56E-05	8.80E-05	8.27E-05	5.86E-05	4.69E-05	8.80E-05
Total PAH	1.49E-04	1.50E-04	1.68E-04	1.66E-04	1.09E-04	1.23E-03	2.37E-03	2.22E-03	1.58E-03	1.26E-03	2.37E-03
Total HAP	9.57E-04	9.66E-04	1.08E-03	1.07E-03	6.98E-04	7.88E-03	0.02	0.01	0.01	8.11E-03	0.02
<i>Greenhouse Gases</i>											
CO ₂	114.61	115.60	129.01	127.50	83.51	943.50	1,820.60	1,710.87	1,212.18	970.98	1,820.60
CH ₄	4.65E-03	4.69E-03	5.23E-03	5.17E-03	3.39E-03	0.04	0.07	0.07	0.05	0.04	0.07
N ₂ O	9.30E-04	9.38E-04	1.05E-03	1.03E-03	6.77E-04	7.65E-03	0.01	0.01	9.83E-03	7.88E-03	0.01
CO ₂ e	114.98	115.98	129.44	127.92	83.78	946.60	1,826.58	1,716.49	1,216.17	974.17	1,826.58

Notes:

- (1) The ratio of all pollutants to NO_x emission was calculated by:
Ratio = {Pollutant Emission Rate at Load X} / {NO_x Emission Rate at Load X}
- (2) The ratio emission factors represent the worst case ratio for each pollutant. The applicant reserves the right to operate in case of SCR downtime. Because the hourly NO_x emission rate will increase in the event of SCR downtime, the ratio of lb pollutant to lb NO_x will decrease.

Potential Emissions Calculations Diesel-Fired Generators

Potential Emission Rates from Emergency Generators

Pollutant	Total Potential Annual Emissions for All Generators ^{1,2} (tpy)
<i>Criteria Pollutants</i>	
NO _x	24.90
CO	59.59
VOC	10.75
Filt. PM	3.80
PM ₁₀ /PM _{2.5}	5.93
SO ₂	0.42
<i>Hazardous Air Pollutants</i>	
Benzene	0.22
Toluene	0.08
Xylenes	0.05
Formaldehyde	0.02
Acetaldehyde	7.01E-03
Acrolein	2.19E-03
Total PAH	0.06
Total HAP	0.38
<i>Greenhouse Gases</i>	
CO ₂	45,332.85
CH ₄	1.84
N ₂ O	0.37
CO ₂ e	45,481.79

Notes:

- (1) The applicant is requesting a site-wide NO_x emissions limitation of 24.9 tpy.
- (2) For all other pollutants, the total potential annual emissions from all generators were based on the lower of the emissions calculated from the following two equations:

Total Potential Annual Pollutant Emissions from All Generators (tpy) =
[24.9 (tpy NO_x)] × [Maximum Ratio of Pollutant Emissions to NO_x Emissions (lb pollutant/lb NO_x) For All Generator Types]

OR

Total Potential Annual Pollutant Emissions from All Generators (tpy) =
[Max Hourly Pollutant Emissions per **CAT 3516E** Generator (lb/hr/gen) × Number of **CAT 3516E** Generators × Potential Annual Hours of Operation (500 hours/yr/gen) / (2,000 lb/ton)]
+ [Max Hourly Pollutant Emissions per **CAT C32** Generator (lb/hr/gen) × Number of **CAT C32** Generators × Potential Annual Hours of Operation (500 hours/yr/gen) / (2,000 lb/ton)]
+ [Max Hourly Pollutant Emissions per **CAT C18** Generator (lb/hr/gen) × Number of **CAT C18** Generators × Potential Annual Hours of Operation (500 hours/yr/gen) / (2,000 lb/ton)]

Potential Emissions Calculations Diesel Fuel Tanks

Potential Annual Throughput for Diesel Belly Tanks

Source Type	Maximum Hourly Fuel Usage Rate per Generator ¹ (gal/hr/gen)	Potential Hours of Operation per Generator ² (hr/yr/gen)	Potential Annual Fuel Usage per Generator ³ (gal/yr/gen)
Belly Tanks (CAT 3516E) Generators	192.9	500	96,450
Belly Tanks (CAT C32) Generators	71.5	500	35,750
Belly Tanks (CAT C18) Generators	53.6	500	26,800

Notes:

- (1) Per the manufacturer specification sheets and performance data.
- (2) Default assumption for calculating potential to emit from emergency generators, consistent with September 6, 1995 memo from USEPA.
- (3) Potential Fuel Usage per Engine (gal/yr/engine) = Diesel Fuel Consumption (gal/hr/engine) * Potential Hours of Operation per Engine (hrs/yr/engine)

Potential VOC Emissions from Diesel Belly Tanks

Parameter	Units	Belly Tanks (CAT 3516E) Generators	Belly Tanks (CAT C32) Generators	Belly Tanks (CAT C18) Generators
Number of Belly Tanks	--	72	2	2
Belly Tank Dimensions ¹	Length (ft)	36.0	36.0	22.1
	Width (ft)	14.0	14.0	7.6
	Height (ft)	1.7	1.7	2.5
Belly Tank Storage Capacity ²	(gal)	6,300	6,300	1,367
Potential VOC Emissions per Tank	(lb/yr/tank)	3.1	1.4	1.0
Total Potential VOC Emissions from Belly Tanks³	(tpy)	0.11		

Notes:

- (1) Dimensions were obtained from generator enclosure drawings, except length, which was estimated using capacity, width, and height.
- (2) Volumes are based off tanks used for identical engines at another facility where the usable volumes were provided by the manufacturer.
- (3) Potential VOC Emissions for All Tanks (tpy) = Potential VOC Emissions per Tank (lb/yr/tank) * Number of Tanks / (2,000 lb/ton)

Belly Tank Emissions Calculations

Diesel Belly Tank Emissions Calculations

Parameter Description ^(a)	Equation	Belly Tanks (CAT 3516E) Generators	Belly Tanks (CAT C32) Generators	Belly Tanks (CAT C18) Generators
Tank Contents		Diesel Fuel	Diesel Fuel	Diesel Fuel
Tank Width (W) (ft)		14.0	14.0	7.6
Tank Length (L) (ft)		36.02	36.02	22.11
Tank Dome Roof Radius (R _R), ft	Dome Roofs: Assumed R _R = D Flat Roofs: N/A	N/A	N/A	N/A
Tank Shell Height (H _S), ft	[Use height of rectangular tank]	1.7	1.7	2.5
Effective Height (H _E), ft	[Use height of rectangular tank]	1.7	1.7	2.5
Nominal Capacity, ft ³		842.2	842.2	182.7
Nominal Capacity (gal)		6,300	6,300	1,367
Liquid Height (H _L), ft	Assumed = 0.9H _S	1.5	1.5	2.3
Tank Cone Roof Slope (S _R), ft/ft	No roof on rectangular tank	0	0	0
Tank Roof Height (H _R), ft	No roof on rectangular tank	0	0	0
Roof Outage (H _{RO}), ft	Dome Roofs: H _{RO} = H _R [(1/2)+(1/6)(H _R /R _S) ²] Cone Roofs: H _{RO} = 1/3H _R Flat Roofs: H _{RO} = 0	0	0	0
Vapor Space Outage (H _{VO}), ft	Vertical tanks (used for rectangular tank): H _{VO} = H _S - H _L + H _{RO} Horizontal tanks: H _{VO} = 1/2H _E	0.2	0.2	0.3
Vapor Space Volume (V _V), ft ³	For rectangular tank: H _{VO} x W x L	84.2	84.2	42.0
Ideal Gas Constant (R), psia ft ³ /lb-mole R	Constant	10.731	10.731	10.731
Daily Maximum Ambient Temperature (T _{AX}), R ^(b)	AP-42, Table 7.1-7	523.9	523.9	523.9
Daily Minimum Ambient Temperature (T _{AN}), R ^(b)	AP-42, Table 7.1-7	507.9	507.9	507.9
Daily Average Ambient Temperature (T _{AA}), R	T _{AA} = (T _{AX} + T _{AN})/2	515.9	515.9	515.9
Paint Solar Absorptance (α), dimensionless ^(c)	AP-42, Table 7.1-6	0.97	0.97	0.97
Liquid Bulk Temperature (T _B), R	T _B = T _{AA} + 6a - 1	520.7	520.7	520.7
Daily Total Solar Insolation Factor (I), Btu/ft ² d ^(b)	AP-42, Table 7.1-7	1,261	1,261	1,261
Daily Average Liquid Surface Temperature (T _{LA}), R	T _{LA} = 0.44T _{AA} + 0.56T _B + 0.0079 αI	528.2	528.2	528.2
Vapor Molecular Weight (M _V), lb/lb-mole	Vapor Molecular weight of diesel fuel	130	130	130
Vapor Pressure Constant, A	AP-42, Table 7.1-2, No 2 Fuel Oil	12	12	12
Vapor Pressure Constant, B	AP-42, Table 7.1-2, No 2 Fuel Oil	8907	8907	8907
Vapor Pressure at T _{LA} (P _{VA}), psia	Raoult's Law or Antoine Equation	0.0086	0.0086	0.0086
Vapor Density (W _V), lb/ft ³	W _V = M _V P _{VA} /RT _{LA}	0.00020	0.00020	0.00020
Daily Ambient Temperature Range (T _A), R	T _A = T _{AX} - T _{AN}	16.0	16.0	16.0
Daily Vapor Temperature Range (T _V), R	T _V = 0.72T _A + 0.028 αI	45.8	45.8	45.8
Vapor Pressure at T _{AN} (P _{VN}), psia	Raoult's Law or Antoine Equation	0.0044	0.0044	0.0044
Vapor Pressure at T _{AX} (P _{VX}), psia	Raoult's Law or Antoine Equation	0.0074	0.0074	0.0074
Daily Vapor Pressure Range (P _V), psia	P _V = P _{VX} - P _{VN}	0.0031	0.0031	0.0031
Breather Vent Pressure Setting Range (P _B), psig	P _B = P _{BP} - P _{BV} (Assumed = 0.06)	0.06	0.06	0.06
Atmospheric Pressure (P _A), psia	Constant	14.7	14.7	14.7
Vapor Space Expansion Factor (K _E), dimensionless	K _E = T _V /T _{LA} + (P _V - P _B)/(P _A - P _{VA})	0.08	0.08	0.08
Vented Vapor Saturation Factor (K _S), dimensionless	K _S = 1/(1 + 0.053P _{VA} H _{VO})	1.0	1.0	1.0
Number of Days/Year in Operation	Constant	365	365	365
Standing Storage Losses (L _S), lb/year	L _S = 365 W _V V _V K _E K _S	0.50	0.50	0.25
Liquid Density (lb/gal)	Density of diesel fuel	7.10	7.10	7.10
Potential Throughput (Q), gal	500 hours of operation at 100% load	96,450	35,750	26,800
Potential Throughput (Q), bbl	Throughput is in bbls (42 gal/bbl)	2,296.4	851.2	638.1
Maximum Liquid Height (H _{LX}), ft	Assumed = 0.9H _S	1.5	1.5	2.3
Tank Maximum Liquid Volume (V _{LX}), ft ³	Assumed = 0.9*Nominal Capacity	758.0	758.0	164.5
Turnovers (N), dimensionless	N = 5.614Q/V _{LX}	17.0	6.3	21.8
Turnover Factor (K _N), dimensionless	For N ≤ 36 K _N = 1, For N > 36 K _N = (180 + N)/6N	1.0	1.0	1.0
Working Loss Factor (K _P), dimensionless	For Organic Liquids, K _P = 1	1.0	1.0	1.0
Working Losses (L _W), lb/year	L _W = 0.001M _V P _{VA} QK _N K _P	2.55	0.95	0.71
Total Uncontrolled Losses (L _T), lb/year/tank	T _L = L _S + L _W	3.05	1.45	0.96
Total Uncontrolled Losses (L _T), ton/year/tank		0.0015	0.0007	0.0005
Total Uncontrolled Losses (L _T), lb/hr/tank	8,760 hr/yr	0.0003	0.0002	0.0001

Notes:

^(a) Emissions calculated according to the methodology presented in AP-42, Section 7.1 with adjustments made to account for vapor space volume of the proposed rectangular diesel tank.

^(b) Meteorological data from AP-42, Table 7.1-7 for Philadelphia, PA was used.

^(c) Paint solar absorptance from AP-42, Table 7.1-6 for black tanks in good condition.

APPENDIX 7
RACT/BACT/LAER CLEARINGHOUSE SUMMARY TABLE FOR LARGE
INTERNAL COMBUSTION ENGINES (> 500 HP) FOR CO CONTROL

BACT-PSD Emission Factors from USEPA's RACT/BACT/LAER Clearinghours (RBLC) for Diesel-Fired Internal Combustion Engines >500 hp

RBLC ID	Fuel Type	State	Process Description	Permit Date	Throughput		CO Primary Emission Limit			Process Notes
					Amount	Units	Limit	Units	Basis	
AK-0084	Diesel	AK	Black Start and Emergency Internal Combustion Engines	6/30/2017	1500	kWe	4.38	G/KW-HR	BACT-PSD	Two (2) 600 kWe black start diesel generators and four (4) 1,500 kWe emergency diesel generators.
FL-0367	ULSD	FL	1,500 kW Emergency Diesel Generator	7/27/2018	14.82	MMBtu/hr	3.5	G/KW-HR	BACT-PSD	The emergency generator will operate a combined total of 100 hr/yr for maintenance checks, and readiness testing, which includes a maximum 50 hr/yr for non-emergency operation.
IN-0263	Distillate Oil	IN	EMERGENCY GENERATORS (EU014A AND EU-014B)	3/23/2017	3600	hp	2.61	G/HP-HR	BACT-PSD	
IN-0317	Diesel	IN	Emergency generator EU-6006	6/11/2019	2800	hp	3.5	G/KW-HR	BACT-PSD	
IN-0359	Diesel	IN	Emergency Generator (CC-GEN1)	3/30/2023	3000	hp	2.61	G/HP-HR	BACT-PSD	
IN-0382	Diesel	IN	Emergency Generators	2/14/2025	2000	hp	2.61	G/HP-HR	BACT-PSD	Two (2) 2000 hp emergency generators
IN-0384	ULSD	IN	Black Start Emergency Generators	3/31/2025	3000	kWe	2.6	G/HP-HR	BACT-PSD	Four (4) ultra-low diesel fuel-fired black start emergency generators, identified as 7 through 10, approved in 2025 for construction, with a maximum capacity of 3,000 kWe, using no control, and exhausting to stack S7 through S14.
IN-0384	ULSD	IN	plant emergency generator	3/31/2025	1500	kWe	2.6	G/HP-HR	BACT-PSD	One (1) ultra-low diesel fuel-fired plant emergency generator, identified as 6, approved in 2025 for construction, with a maximum capacity of 1,500 kWe, using no control, and exhausting to stack S6.
KY-0110	Diesel	KY	EP 10-02 - North Water System Emergency Generator	7/23/2020	2922	hp	2.61	G/HP-HR	BACT-PSD	Diesel emergency generator used to provide emergency power supply for critical operations should the facility power supply be interrupted. This generator has a displacement of less than 30 liters per cylinder.
KY-0110	Diesel	KY	EP 10-03 - South Water System Emergency Generator	7/23/2020	2922	hp	2.61	G/HP-HR	BACT-PSD	Diesel emergency generator used to provide emergency power supply for critical operations should the facility power supply be interrupted. This generator has a displacement of less than 30 liters per cylinder.
KY-0110	Diesel	KY	EP 10-07 - Air Separation Plant Emergency Generator	7/23/2020	700	hp	2.61	G/HP-HR	BACT-PSD	Diesel emergency generator used to provide emergency power supply for critical operations should the facility power supply be interrupted. This generator has a displacement of less than 30 liters per cylinder.
KY-0110	Diesel	KY	EP 10-01 - Caster Emergency Generator	7/23/2020	2922	hp	2.61	G/HP-HR	BACT-PSD	Diesel emergency generator used to provide emergency power supply for critical operations should the facility power supply be interrupted. This generator has a displacement of less than 30 liters per cylinder.
*LA-0312	Diesel	LA	DEG1-13 - Diesel Fired Emergency Generator Engine (EOT0012)	6/30/2017	1474	hp	0.51	LB/HR	BACT-PSD	Operating hours limit: 100 hr/yr.
LA-0313	Diesel	LA	SCPS Emergency Diesel Generator 1	8/31/2016	2584	hp	14.81	LB/HR	BACT-PSD	
LA-0324	Diesel	LA	Generator Engines (EOT0016)	3/28/2023	4290	kW	1.21	G/KW-HR	BACT-PSD	
LA-0331	Diesel	LA	Large Emergency Engines (8gt;50kW)	9/21/2018	5364	hp	3.5	G/KW-HR	BACT-PSD	Three emergency black-start engines and two emergency generators
LA-0391	Diesel	LA	Emergency Diesel Generator Engine	6/3/2022	2937	hp	2.6	G/HP-HR	BACT-PSD	
*LA-0394	Diesel	LA	06-22 - AO-5 Emergency Generator	12/12/2023	670.5	hp	3.81	LB/HR	BACT-PSD	
*LA-0394	Diesel	LA	53-22 - PAO Emergency Generator	12/12/2023	670.5	hp	3.81	LB/HR	BACT-PSD	
*LA-0401	Diesel	LA	EGCH - Plant Emergency Generator	12/20/2023	3634	hp	20.91	LB/HR	BACT-PSD	
*LA-0401	Diesel	LA	E_GEN 01 - Generac SD 2000	12/20/2023	2923	hp	2.9	LB/HR	BACT-PSD	
*LA-0401	Diesel	LA	E_GEN 02 - Generac SD 2000	12/20/2023	2923	hp	2.9	LB/HR	BACT-PSD	
*LA-0403	Diesel	LA	4C-6A - C/A Emergency Generator A	12/16/2024	2346	hp	13.5	LB/HR	BACT-PSD	Operates for 100 hours per year.
*LA-0403	Diesel	LA	4C-6B - C/A Emergency Generator B	12/16/2024	2346	hp	13.5	LB/HR	BACT-PSD	Operates for 100 hours per year.
*LA-0403	Diesel	LA	4C-6C - C/A Emergency Generator C	12/16/2024	2346	hp	13.5	LB/HR	BACT-PSD	Operates for 100 hours per year.
*LA-0403	Diesel	LA	4U-10 - Utility Emergency Generator	12/16/2024	2012	hp	11.57	LB/HR	BACT-PSD	Operates for 65 hours per year.
*LA-0403	Diesel	LA	4U-12 - VCM/CA/UT CCR Emergency Generator	12/16/2024	760	hp	4.37	LB/HR	BACT-PSD	Operates for 65 hours per year
*LA-0403	Diesel	LA	4M-11A - VCM Emergency Generator A	12/16/2024	2346	hp	13.5	LB/HR	BACT-PSD	Operates for 100 hours per year.
*LA-0403	Diesel	LA	4M-11B - VCM Emergency Generator B	12/16/2024	2346	hp	13.5	LB/HR	BACT-PSD	Operates for 100 hours per year.
MI-0423	Diesel	MI	EUENGINE (Diesel fuel emergency engine)	1/4/2017	22.68	MMBtu/hr	3.5	G/KW-HR	BACT-PSD	A 2,922 horsepower (HP) (2,179 kilowatts (kW)) diesel fueled emergency engine manufactured in 2011 or later and a displacement of <10 liters/cylinder. Restricted to 4 hours/day, except during emergency conditions and stack testing, and 500 hours/year on a 12-month rolling time period basis.
MI-0433	Diesel	MI	EUENGINE (North Plant): Emergency Engine	6/29/2018	1341	hp	3.5	G/KW-HR	BACT-PSD	A 1,341 HP (1,000 kilowatts (kW)) diesel-fired emergency engine with a model year of 2011 or later, and a displacement of <10 liters/cylinder. The engine is designed to be compliant with Tier IV emission standards. Equipped with a diesel particulate filter.
MI-0433	Diesel	MI	EUENGINE (South Plant): Emergency Engine	6/29/2018	1341	hp	3.5	G/KW-HR	BACT-PSD	A 1,341 HP (1,000 kilowatts (kW)) diesel-fired emergency engine with a model year of 2011 or later, and a displacement of <10 liters/cylinder. The engine is designed to be compliant with Tier IV emission standards. Equipped with a diesel particulate filter.
MI-0435	Diesel	MI	EUENGINE: Emergency engine	7/16/2018	2	MW	3.5	G/KW-HR	BACT-PSD	A nominal 2 MW diesel-fueled emergency engine with a model year of 2011 or later, and a displacement of <10 liters/cylinder. The engine is an EPA Tier 2 certified engine subject to NSPS IIII.
MI-0441	Diesel	MI	EUEMGD1--A 1500 HP diesel fueled emergency engine	12/21/2018	1500	hp	3.5	G/KW-HR	BACT-PSD	A 1500 HP diesel-fueled emergency engine manufactured after 2006 serving a 1,000 kW engine generator with associated fuel oil tank. The engine generator is used to charge the batteries in the uninterruptible power supply battery system.
MI-0441	Diesel	MI	EUEMGD2--A 6000 HP diesel fuel fired emergency engine	12/21/2018	6000	hp	3.5	G/KW-HR	BACT-PSD	A 6000 HP diesel-fueled emergency engine manufactured after 2006 serving a 4000 kW generator with associated fuel oil tank. The engine generator is used to facilitate operations during idling of the plan for routine maintenance checks and readiness testing.
MI-0442	Diesel	MI	FGENGINE	8/21/2019	1100	kW	0.15	G/HP-HR	BACT-PSD	Two (2) diesel-fired emergency engines, each 1,474 HP (1,100 kW) with a model year of 2011 or later, and a displacement of <10 liters/cylinder. The engines are designed to be compliant with Tier 2 emission standards.
*MI-0445	Diesel	MI	EUENGINE (diesel fuel emergency engine)	11/26/2019	22.68	MMBtu/hr	3.5	G/KW-HR	BACT-PSD	A 2,922 horsepower (HP) (2,179 kilowatts (kW)) natural gas-fueled emergency engine (EUENGINE) manufactured in 2011 or later and a displacement of <10 liters/cylinder. Restricted to 4 hours/day, except during emergency conditions and stack testing, and 500 hours/year on a 12-month rolling time period basis.
MI-0447	Diesel	MI	EUEMGD--emergency engine	1/7/2021	4474.2	kW	3.5	G/KW-HR	BACT-PSD	EUEMGD--A 2,206 HP diesel-fueled emergency engine manufactured after 2006 serving a 1,500 kW generator with associated fuel oil tank. The engine generator is used to charge the batteries in the uninterruptible power supply battery system and to facilitate operations during idling of the plant for routine maintenance checks and readiness testing.
MI-0451	Diesel	MI	EUENGINE (North Plant): Emergency engine	6/23/2022	1341	hp	3.5	G/KW-HR	BACT-PSD	A 1,341 HP (1,000 kilowatts (kW)) diesel-fired emergency engine with a model year of 2011 or later, and a displacement of <10 liters/cylinder. The engine is designed to be compliant with Tier IV emission standards. Equipped with a diesel particulate filter.
MI-0452	Diesel	MI	EUENGINE (South Plant): Emergency engine	6/23/2022	1341	hp	3.5	G/KW-HR	BACT-PSD	A 1,341 HP (1,000 kilowatts (kW)) diesel-fired emergency engine with a model year of 2011 or later, and a displacement of <10 liters/cylinder. The engine is designed to be compliant with Tier IV emission standards. Equipped with a diesel particulate filter.
MI-0454	Diesel	MI	EUEMGD	12/20/2022	4474.2	kW	3.5	G/KW-HR	BACT-PSD	EUEMGD-A 2,206 HP diesel-fueled emergency engine manufactured after 2006 serving a 1,500 kW generator with associated fuel oil tank. The engine generator is used to charge the batteries in the uninterruptible power supply battery system and to facilitate operations during idling of the plant for routine maintenance checks and readiness testing.
MI-0459	Diesel	MI	EUEMGEN	6/27/2024	762	hp	3.5	G/KW-HR	BACT-PSD	The engine has a maximum horsepower of 762 brake horsepower (bhp).
MN-0095	ULSD	MN	Emergency Generator 2 (EQUI 26)	8/7/2024	1049	hp	2.6	G/HP-HR	BACT-PSD	
MN-0095	ULSD	MN	Emergency Generator 3 (EQUI 27)	8/7/2024	1049	hp	2.6	G/HP-HR	BACT-PSD	
MN-0095	ULSD	MN	Emergency Generator 4 (EQUI 28)	8/7/2024	1049	hp	2.6	G/HP-HR	BACT-PSD	
MN-0095	ULSD	MN	Emergency Generator 5 (EQUI 43)	8/7/2024	772	hp	2.6	G/HP-HR	BACT-PSD	
MN-0095	ULSD	MN	Emergency Generator 6 (EQUI 43)	8/7/2024	772	hp	2.6	G/HP-HR	BACT-PSD	
NY-0103	ULSD	NY	Black start generator	2/3/2016	3000	kW	2.6	G/HP-HR	BACT-PSD	
OH-0366	Diesel	OH	Emergency generator (P003)	8/25/2015	2346	hp	13.5	LB/HR	BACT-PSD	1,750 kW (2,346 hp) emergency generator
OH-0367	Diesel	OH	Emergency generator (P003)	9/23/2016	2947	hp	16.96	LB/HR	BACT-PSD	2,000 kW electric, 2,198 kW mechanical (2,947 hp) emergency diesel generator
OH-0368	Diesel	OH	Emergency Generator (P009)	4/19/2017	5000	hp	28.8	LB/HR	BACT-PSD	5,000 HP ac 3,729 kW Emergency Generator Diesel Engine
OH-0370	Diesel	OH	Emergency generator (P003)	9/7/2017	1529	hp	8.8	LB/HR	BACT-PSD	Emergency Generator 1000 kW (electrical), 1,140 kW (mechanical), 1,529 hp
OH-0372	Diesel	OH	Emergency generator (P003)	9/27/2017	1529	hp	8.8	LB/HR	BACT-PSD	1,000 kW (1,140 kW mechanical) emergency diesel-fired generator
OH-0374	Diesel	OH	Emergency Generators (2 identical, P004 and P005)	10/23/2017	2206	hp	12.69	LB/HR	BACT-PSD	Two identical Emergency Generators; 1,645 kW (2,206 HP) emergency diesel-fired generator to provide on-site emergency power capabilities independent of the utility grid. Throughputs and limits are for a single generator except as noted.
OH-0375	Diesel	OH	Emergency Diesel Generator Engine (P001)	11/7/2017	2206	hp	12.64	LB/HR	BACT-PSD	1,645 kW (2,206 HP) emergency diesel-fired generator to provide on-site emergency power capabilities independent of the utility grid.
OH-0376	Diesel	OH	Emergency diesel-fired generator (P007)	2/9/2018	2682	hp	15.4	LB/HR	BACT-PSD	2,000 kW (2,682 hp) emergency diesel-fired generator
OH-0378	Diesel	OH	Emergency Diesel-fired Generator Engine (P007)	12/21/2018	3353	hp	19.25	LB/HR	BACT-PSD	2,500 kW (3,353 HP) emergency diesel-fired generator engine
OH-0378	Diesel	OH	1,000 kW Emergency Generators (P008 - P010)	12/21/2018	1341	hp	7.7	LB/HR	BACT-PSD	Three identical ECU Generators 1 to 3; 1,000 kW (1,341 HP) emergency diesel-fired generator engine. Limits are for single generator except as noted.
OH-0387	Diesel	OH	5,051 bhp (3,768 kWm) Diesel-Fired Emergency Generators: P001 through P046	9/20/2022	5051	hp	3.5	G/KW-HR	BACT-PSD	Forty-six 5,051 bhp (3,768 kWm) Diesel-Fired Emergency Generators: P001 through P046
TX-0939	Diesel	TX	EMERGENCY GENERATOR	3/13/2023	18.7	MMBTU/hour	0.006	LB/HP HR	BACT-PSD	
WI-0300	Diesel	WI	Emergency Diesel Generator (P07)	9/1/2020	1490	hp	2.6	G/HP-HR	BACT-PSD	
*WV-0033	ULSD	WV	Emergency Generator	1/5/2022	2100	hp	1.94	LB/HR	BACT-PSD	45LB Diesel-Fired Emergency Engine - Subpart IIII

Notes:

- The search inputs for this RBLC Database report were the following:
Permit Date Range = 10 years
Process Type = 17.110 - Large Internal Combustion Engines (>500 hp) using Fuel Oil
Pollutant = CO
All states included
- The search results were filtered to better represent the possible CO emission reduction for the CAT 3516E emergency generators. As such the filter removed fire pump engines and listings that had a throughput of zero or were left blank.

APPENDIX 8
RENEWABLE DIESEL FUEL SPECIFICATIONS

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.

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.

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LEXE20433-01 August 2021

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Service type:	FedEx 2Day AM		
Special Handling:	Deliver Weekday		DOYLESTOWN, PA, 18901
		Delivery date:	May 5, 2025 09:06

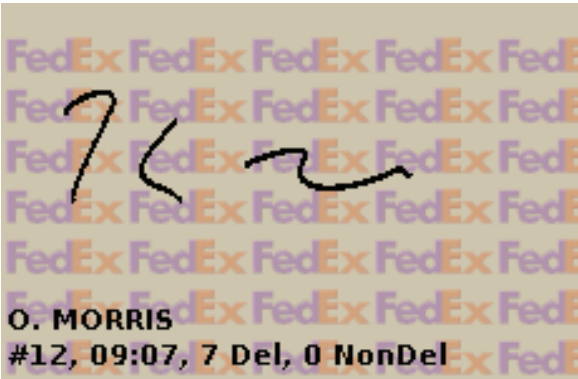
Shipping Information:

Tracking number:	880951542900	Ship Date:	May 1, 2025
		Weight:	0.5 LB/0.23 KG

Recipient:
Bucks County Admin. Building,
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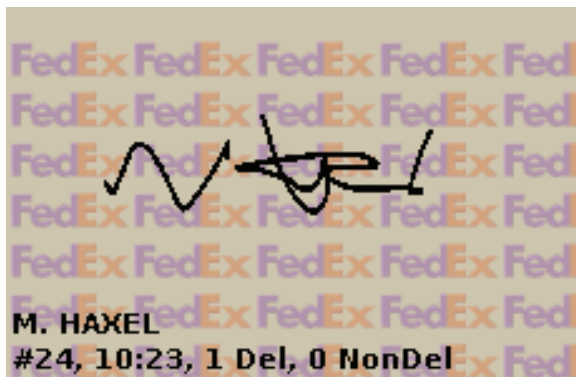
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