BUILDING E EXPANSION NOTICE OF CONSTRUCTION

Sabey Data Center Properties / Quincy, WA

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1. EXECUTIVE SUMMARY

Sabey Data Center Properties (Sabey) is proposing a change in the number of permitted engines at Intergate Quincy (IGQ) data center campus in Quincy, Washington. The IGQ campus currently consists of three buildings (Building A, Building B, and Building C) with plans for construction of two more (Building D and Building E) under Approval Order (AO) 20AQ-E022.

The current permit allows for the construction of two new buildings (Buildings D and E) with a total of 30 diesel-fired main generator sets (gensets) of up to 2,500 kW each and one - 300 kW support genset per building. Sabey proposes Building D design will have 18 – up to 2,500 kW main gensets and one – 300 kW support genset. The Building E design will be modified to increase from 12 engines to 39 – up to 2,500 kW main gensets and one – up to 1,500 kW support genset. The main gensets will be used to provide standby electrical power to the data center and the support genset will provide emergency lighting during periods of interrupted power supply.

In addition to the proposed increase in gensets, Sabey is revising the list of manufacturers and engine models and proposing that Building D and E gensets under AO 20AQ-E022 be reduced from 55 maximum operating hours per genset per year for Buildings D and E to 30 hours per genset per year. Note that Buildings A, B, C will remain unaffected by the proposed design changes for Buildings D and E.

Overall Sabey is not proposing an increase in facility-wide emissions with this project. The increase in number of engines is offset by the reduced runtime per engine and engine models being evaluated.

This Notice of Construction (NOC) application contains the following elements:

- Section 2. Description of Facility
- Section 3. Emission Calculations
- Section 4. Regulatory Applicability
- Section 5. Best Available Control Technology
- Section 6. Air Quality Dispersion Modeling
- Appendix A: Application Form and SEPA Documentation
- Appendix B: Site Plan
- Appendix C: Emission Calculations and Supporting Documentation
- Appendix D: BACT Cost Calculations
- Appendix E: AERMOD Modeling Parameters
- Appendix F: AERMOD Load Analysis Results
- Appendix G: Model Files

A Determination of Nonsignificance was issued by the State of Washington Department of Ecology (Ecology) on July 1, 2019 after a review of the completed SEPA checklist for the initial proposal of Building D and E. The design includes a different configuration of Building E and revised air emissions for Building D and E, but the exemption determination is expected to remain representative of the project. A copy of the Determination of Nonsignificance is included in Appendix A for reference.

This application demonstrates that the proposed project meets the requirements for a NOC application under Washington Administrative Code (WAC) 173-400-110(2)(a). The required NOC form can be found in Appendix A.

2. DESCRIPTION OF FACILITY

Sabey's IGQ facility Buildings D and E will be used as an electronic data storage facility. In the event of interrupted power supply from the utility, the facility will have diesel-fired gensets to provide power. In addition, the units may operate for maintenance and testing purposes. The following equipment will be installed for the operation of the proposed data center buildings.

- Building D: 18 – up to 2,500 kW diesel-fired main gensets with attached approximately 12,000-gallon diesel fuel tanks;
- Building D: 1 – 300 kW support genset;
- Building E: 39 – up to 2,500 kW diesel-fired main gensets with attached approximately 12,000-gallon diesel fuel tanks; and
- Building E: 1 – up to 1,500 kW support genset

A site plan is included in Appendix B.

2.1 New Standby Gensets

Building D will have the same number of gensets but the potential genset models for Building D are updated to align with the genset models included in the Building E expansion. This project will not result in any changes to the Building D support genset as currently included in the existing NOC permit. Building E will have a total of 39 diesel-fired main gensets of up to 2,500 kW and 1 support genset of up to 1,500 kW. The site plan (Appendix B) shows the locations of the proposed gensets. The main gensets will provide standby electrical power to the data center and the support genset will provide power for the building for emergency lighting during periods of interrupted power supply. All the Building D and E gensets will be operated in accordance with the following:

- Maximum of thirty (30) hours per year per genset at any load for all intended purposes, including emergency operations, maintenance, and testing operations;
- In compliance with Tier 2 certification requirements for main gensets;
- In compliance with Tier 2 certification requirements for the support genset at Building E; and
- In compliance with Tier 3 certification requirements for support genset at Building D.

Sabey has evaluated four models for the proposed main gensets for Buildings D and E, including:

- Caterpillar 3516C, 2,500 kW Standby Generator Set
- Cummins DQKAF, 2,250 kW Standby Generator Set (Maximum of 5 gensets at Building E only)
- Cummins DQKAF with Diesel Oxidation Trapping Catalyst (DOTC), 2,250 kW Standby Generator Set
- Kohler KD2250 with Oxidation Catalyst and Diesel Particulate Filter (DPF), 2,500 kW Standby Generator Set

If alternative genset models are identified, Sabey will evaluate for emissions and modeling implications and submit an appropriate revision request to Ecology, as applicable.

Sabey has evaluated six models for the proposed support gensets at Building E, including:

- Caterpillar C32, 1,000 kW Generator Set;
- Caterpillar 3512C, 1,500 kW Generator Set;

- Kohler KD1000, 1,000 kW Generator Set;
- Kohler KD1500, 1,500 kW Generator Set;
- Cummins DQFAD, 1,000 kW Generator Set; and
- Cummins DQGAB, 1,500 kW Generator Set

Sabey has not determined the model for the support gensets to be installed at IGQ. Therefore, all models are considered in this NOC application. There are no proposed changes to the support genset models permitted for Building D, which are summarized below:

- Caterpillar C9, 300 kW Generator Set; and
- Cummins DQDAC, 300 kW Generator Set

The specifications from the vendors are included in Appendix C. Table 2-1 below summarizes the operation scenarios for all gensets.

Table 2-1. Operation Scenarios Summary

Operation Scenario	Operations for Each Genset [a] (hr/day/genset)	Operations for Each Genset [a] (hr/yr/genset)	Total Operations for All Gensets [b] (engine-hr/hr)	Total Operations for All Gensets [b] (engine-hr/day)	Total Operations for All Gensets [b] (engine-hr/yr)
Main Genset Running at Any Load	24	30	57	1,368	1,710
Support Genset Running at Any Load	24	30	2	48	60

a. The operating scenario includes all categories of operations, including emergency run, maintenance and testing runs. When all engines are required to be operated at the same time (e.g., emergency operation), the maximum number of days of such operation will be 2 days in any given year while keeping the total number of hours per engine per year equal to or below 30.

b. All 57 main gensets will be operated up to 24 hr/day/genset which corresponds to maximum of 1,368 engine-hrs in any single day.

2.2 Existing Standby Gensets

Approval Order (AO) 20AQ-E022 for the IGQ facility permitted the installation of 37 – 2.5 MW or smaller gensets for Buildings A, B and C. The actual models and quantities of as-built and planned engines are as follows:

Buildings A, B, and C:

- 1 – Caterpillar C9, 300 kW unit;
- 2 – Caterpillar C9, 250 kW units;
- 23 – Caterpillar 3516C, 2.0 MW units;
- 6 – Caterpillar 3512C, 1.5 MW units; and
- 5 – Planned engines ≤2.0 MW in size

The 2.5 MW, 2.0 MW, and 1.5 MW engines are main gensets used to provide power to the data center during periods of interrupted power supply. The 300 kW and 250 kW engines are used as support gensets to provide power for emergency lighting. Facility-wide potential to emit calculations are performed based on the engines actually installed or planned. Emission calculations for as-built engines are discussed in 3.1.3

and included in Appendix C. All as-built generators operate in accordance with AO 20AQ-E022 and the following:

- Maximum of fifty-seven and a half (57.5) hours per year per genset at any load for all intended purposes, including emergency operations, maintenance and testing operations;
- In compliance with Tier 2 certification requirements for main gensets; and
- In compliance with Tier 3 certification requirements for support gensets.

2.3 Building D and E Fuel Equipment

Each planned genset is equipped with an attached tank that is approximately 12,000 gallons. Since the attached tanks are larger no bulk fuel storage will be needed. In the application for Permit 20AQ-E022, Sabey was proposing 2,000 gallon attached tanks to each genset plus 20 stand-alone diesel fuel storage tanks with a capacity of 15,000 gallons. As discussed in Section 4.1, Sabey expects these fuel storage tanks will continue to be exempt from NOC permitting.

2.4 Cooling Units

Permit AO 20 AQ-E022 added 120 Munters Oasis indirect evaporative cooling units for Buildings D and E with a water consumption rate of 241 gal/hr. As part of this application Sabey is proposing to increase the number of cooling units to 132 Munters Oasis indirect evaporative cooling units for Building D, and Building E will be using chillers and will not be a source of air emissions. PM emissions are conservatively calculated for the 132 Munters Oasis cooling units based on total water consumption of 241 gal/hr plus the recirculation flowrate of 84 gal/min, total dissolved solids of 550 ppm, and drift loss of 0.001%. The cooling units are equipped with a mist eliminator to achieve the 0.001% drift loss rate. As shown in Section 3, the cooling units are collectively smaller than the WAC 173-400-110(5) de minimis thresholds, so the units were not further evaluated in this application.

3. EMISSION CALCULATIONS

This section describes each of the emission sources as well as the methodologies used to calculate criteria pollutant, HAP, and TAP emissions from each source at the IGQ facility. Detailed supporting calculations and supporting documentation for the emission calculations, including manufacturer specifications, can be found in Appendix C.

3.1 METHODOLOGY

Criteria pollutants emitted from the gensets include particulate matter (PM), particulate matter with aerodynamic diameter less than 10 microns (PM_{10}), particulate matter with aerodynamic diameter less than 2.5 microns ($PM_{2.5}$), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NO_X), and volatile organic compounds (VOC).

3.1.1 Calculation Methodologies for Building D and E Main Gensets

Vendor supplied emissions data was reviewed in order to estimate the maximum emissions from the main gensets. Vendor specifications for all models confirm that the engines are Tier 2 certified[1] standby engines. As noted in Section 5, the emissions controls included in this evaluation for the Cummins DQKAF and Kohler KD2250 engine models are proposed in order to demonstrate compliance with NAAQS, but the controls represent a level of emissions control that exceeds best available control technology (BACT) standards. The following specification information is provided by the vendors. Specification sheets are provided in Appendix C:

- ► Caterpillar provides the genset power at various loads (10%, 25%, 50%, 75%, and 100%), corresponding engine power, fuel consumption rate, and emission data in gram per horsepower-hr (g/hp-hr) and pound per hour (lb/hr) for PM, NO_X, CO, and hydrocarbons. A single Caterpillar model is assessed, CAT 3516C – 2,500 kW.
- ► Cummins provides the genset power at various loads (10%, 25%, 50%, 75%, and 100%), corresponding engine power, fuel consumption rate, and guaranteed emission levels accounting for site variations in g/hp-hr for PM, NO_X, CO, and hydrocarbons. A single Cummins model is assessed, DQKAF – 2,250 kW.
- ► In addition to the parameters provided by Cummins for the DQKAF model, supplementary data is provided for the same genset model with additional controls. This supplementary data includes data for PM emissions at various loads (10%, 25%, 50%, 75%, and 100%). Per correspondence with Cummins, the use of DOTC will correspond with an increase in exhaust temperature of 20 °F.
- ► Kohler provides the genset power at various loads (10%, 25%, 50%, 75%, and 100%), corresponding engine power, fuel consumption rate, and guaranteed emission levels accounting for site variations in g/kW-hr for PM, NO_X, CO, and hydrocarbons for the KD2250 engine model. This data is supplemented with PM data for the addition of the oxidation catalysts and DPFs.

An hourly emission rate is calculated based on the provided g/hp-hr or g/kWh emission data for Cummins and Kohler, and lb/hr emission data for Caterpillar. Vendor performance emission data is provided in

[1] Tier 2 certified engines to meet the emission standards set forth under 40 CFR Part 60, Subpart IIII.

Appendix C. For each main genset, the maximum hourly emissions are calculated based on the following conservative approaches:

- Maximum performance data across all loads and vendors is used to determine the hourly emission rate for NO_X, CO, and PM.
- Maximum hydrocarbons (HC) performance data across all loads and vendors is used to determine the hourly emission rate for VOC. The HC emission rates are also conservatively assumed to estimate condensable particulate matter (CPM) emissions.
- PM_{10} and $PM_{2.5}$ emissions are the sum of filterable PM and CPM emissions determined above.
- An upper limit of 15 ppm sulfur content, per 40 CFR 80.510(b), is used to determine SO_2 emissions. Emission factors from Table 3.4-1, AP-42 are used to calculate emissions of SO_2 from the main gensets and support gensets. Emission factors on a lb/hp-hr basis are used, and the corresponding engine power is calculated by linearly scaling the maximum engine power at 100% load by the corresponding operating load.
- Cold-start emissions occurring during the first minute of engine start-up are calculated for VOC, NO_X, CO, and PM based on data from California Energy Commission (CEC) "Air Quality Implications of Backup Generators in California". Maximum emission rate calculations conservatively assume 28 cold-start periods per year. Each cold start assumes the first minute of operation is impacted by the cold-start and the remaining 59 minutes in an hour is normal emission rates. Detailed cold-start emission calculations are provided in Appendix C.

For HAP and TAP emissions emitted by the main gensets, emission factors in units of pounds per million British thermal unit (lb/MMBtu) are obtained from Tables 3.4-3 and 3.4-4, AP-42. The maximum hourly fuel consumption rate across all loads and vendors and the default diesel heat content of 0.137 MMBtu per gallon diesel fuel are used to determine the emission rates for each HAP/TAP, except for diesel particulate matter (DPM). DPM is characterized as the filterable portion of particulate matter and based on the filterable particulate matter emissions calculated for the criteria pollutant. SO_2, CO, and NO_X are also criteria pollutants and TAPs (notably, NO_X is a criteria pollutant, while NO_2 is the associated TAP). Values calculated for these criteria pollutants are presented for the TAP emissions for these pollutants. It is conservatively assumed that 10% of NO_X is emitted in the form of NO_2.

3.1.2 Calculation Methodologies for Building D and E Support Gensets

Similar calculation methodologies for the main gensets are applied to support gensets:

- Caterpillar provides the genset power at various loads (10%, 25%, 50%, 75%, and 100%), corresponding engine power, fuel consumption rate, and emission data in gram per horsepower-hr (g/hp-hr) and pound per hour (lb/hr) for PM, NO_X, CO, and hydrocarbons. One Caterpillar model is assessed for Building D, CAT C9 – 300 kW. Two Caterpillar models are assessed for Building E, CAT C32 – 1,000 kW and CAT 3512C – 1,500 kW.
- Cummins provides the genset power at various loads (10%, 25%, 50%, 75%, and 100%), corresponding engine power, fuel consumption rate, and guaranteed emission levels accounting for site variations in g/hp-hr for PM, NO_X, CO, and hydrocarbons. One Cummins model is assessed for Building D, DQDAC – 300 kW. Two Cummins models are assessed for Building E, DQFAD – 1,000 kW and DQGAB – 1,500 kW.
- Kohler provides the genset power at various loads (10%, 25%, 50%, 75%, and 100%), corresponding engine power, fuel consumption rate, and guaranteed emission levels accounting for site variations in g/kWh for PM, NO_X, CO, and hydrocarbons. Two Kohler models are assessed for Building E, KD1000 – 1,000 kW and KD1500 – 1,500 kW.

- The maximum hourly emission rates across all loads and models are used. Maximum emission rates account for cold-start emissions during the first minute of engine start-up, as described in Section 3.1.1. Detailed emission calculations and vendor supplied specification sheets are provided in Appendix C.
- PM_{10} and $PM_{2.5}$ emissions are the sum of PM and CPM emissions determined above.
- Emission factors from Table 3.4-1, AP-42 for engines larger than 600 hp is used to determine SO_2 emissions. The maximum engine power at 100% load is used.
- HAP and TAP emissions are estimated based on factors from Table 3.4-3 and 3.4-4, AP-42 for engines larger than 600 hp. The maximum hourly fuel consumption rate across all loads is used for each HAP/TAP, except for DPM and other criteria pollutants that are also TAPs (i.e., SO_2, CO and NO_2).

3.1.3 Calculation Methodologies for Diesel Storage Tanks

Consistent with the conclusions of the previous permit application, minimal VOC emissions are expected from the working losses and standing losses of the diesel storage tanks proposed for Buildings D and E. Due to the low vapor pressure of diesel (<0.01 psia) and the maximum operation of the gensets being at or below 30 hours per year per genset, the VOC emissions from each diesel storage tank is expected to be minimal (< 1 tpy). Diesel generally contains trace amounts of HAPs, but the emissions are expected to be negligible. Therefore, the VOC and HAP emissions are not quantified for the diesel storage tanks.

3.1.4 Calculation Methodologies for New Cooling Systems

PM emissions from the cooling systems are calculated based on specification data for Munters Oasis units. PM emissions are conservatively calculated based on total water consumption of 241 gal/hr plus a recirculation flow rate of 84 gal/min, total dissolved solids content of 550 ppm, and a drift loss rate of 0.001%. The cooling units are equipped with a mist eliminator to achieve the 0.001% drift loss rate. Emissions of PM from operation of the cooling towers are summarized in Table 3-1 below and are below the WAC 173-400-110(5) de minimis thresholds. Furthermore, Sabey does not add any products or chemicals that contain a toxic air pollutant.

3.2 Emission Summary

Project emissions are summarized in Table 3-1. Maximum hourly emission rate across all vendors and loads, determined by the approach discussed in Section 3.1, are used to determine the hourly, daily, and annual emission rates for this project. Detailed emission calculations are provided in Appendix C. Annual facility-wide emissions are not proposed to increase from current permit 20AQ-E022.

Table 3-1. Project Emission Summary

Pollutant	Maximum Emissions for All Building D and E Engines [a] (lb/hr)	Maximum Emissions for All Building D and E Engines [a] (lb/day)	Maximum Emissions for All Building D and E Engines [a] (tpy)	Diesel Storage Tanks (tpy)	Cooling Systems (tpy)	Project Emissions (tpy)	Facility-Wide PTE (tpy)
PM_{10} [b]	123	2,952	1.35	--	1.40E-01	1.49	5.07
$PM_{2.5}$ [b]	123	2,952	1.35	--	1.40E-01	1.49	5.07
SO_2 [c]	5	111	0.05	--	--	0.05	0.16
CO [d]	888	21,310	10.42	--	--	10.42	14.60
NO_X [d]	5,406	129,735	53.94	--	--	53.94	93.47
VOC	85	2,038	1.04	<1	--	1.04	4.13
HAPs	2	51	0.03	<0.01	--	0.03	0.08

a. Emissions calculated follow the operation scenarios in Table 2-1.
b. Diesel filterable PM hourly emissions are the maximum based on engine specifications across all loads and models. PM_{10} and $PM_{2.5}$ emissions are the filterable PM emission rates plus the CPM emission rate for each. CPM emissions are conservatively assumed to be the same as hydrocarbon emissions from vendor data.
c. SO_2 emissions are calculated conservatively for 100% load (i.e., maximum engine power). SO_2 emissions are based on maximum sulfur content allowed in ULSD (15 ppm) for main gensets.
d. NO_X and CO hourly emissions are the maximum based on engine specifications across all loads and models.

4. REGULATORY APPLICABILITY

The facility is located in Quincy, Washington, which is in attainment for all criteria pollutants. The following section analyzes the regulatory requirements potentially applicable to the emission sources identified for the IGQ facility expansion project.

4.1 NOC APPLICABILITY

A NOC permit application must be filed, and an approval order issued by Ecology prior to the construction or modification of an affected facility per WAC 173-400-110(2)(a), unless the installation meets exemptions under WAC 173-400-110(4) or (5). These proposed units do not qualify for an exemption and therefore the construction requires NOC approval. The proposed project involves adding 27 additional main gensets to Building E plus narrowed down genset models for the main gensets, different proposed Building E support genset, and revised hours per year operation. Total there will be 18 gensets with one support genset at Building D and 39 main gensets with one support genset at Building E. Sabey will not construct any gensets that have not been previously permitted and authorized via AO 20AQ-E022 until a revised Approval Order is issued. Sabey's understanding is that units previously permitted may be installed as long as the units meet all requirements of the AO.

The diesel storage tanks do not meet the categorical exemptions under WAC 173-400-110(4); however, "Ecology strongly recommends that an owner or operator contact the permitting authority to determine the exemption status of the storage tanks prior to their installation". As discussed in Section 3, the emissions from the diesel storage tanks are expected to be minimal and well below the VOC exemption level. Sabey believes these storage tanks are exempt from NOC approval, and requests Ecology's review and concurrence on this determination.

4.2 NEW SOURCE REVIEW AND TITLE V

A project in an attainment area is subject to the Prevention of Significant Deterioration (PSD) permitting program under WAC 173-400-700 if the project is either a "major modification" to an existing "major source," or is a new major source itself.

The IGQ facility is not a listed source category with a major source threshold of 100 tpy. Therefore, the major source threshold for the IGQ facility is 250 tpy of any regulated pollutant. As shown in Table 3-1, the PTE of the IGQ facility will be below the 250 tpy threshold for all criteria pollutants. Therefore, the IGQ facility is not considered a major source and does not trigger major source review.

Furthermore, Table 3-1 shows the facility will be below the Title V thresholds per WAC 173-401.

4.3 NEW SOURCE PERFORMANCE STANDARDS (NSPS)

WAC 173-400-115 adopts federal NSPS by reference. NSPS apply to certain types of equipment that are newly constructed, modified, or reconstructed after a given applicability date. NSPS applicability is reviewed below for each emission unit for the expansion project.

4.3.1 NSPS Subpart A

All affected sources subject to an NSPS are also subject to the applicable general provisions of NSPS Subpart A unless specifically excluded by the source-specific NSPS. NSPS Subpart A addresses the following for facilities subject to a source-specific NSPS:

- Initial construction/reconstruction notification
- Initial startup notification
- Performance tests
- Performance test date initial notification
- General monitoring requirements
- General recordkeeping requirements
- Semi-annual monitoring system and/or excess emission reports

The NSPS requirements are different depending on whether the source is classified as a new construction, reconstruction, or modification. The following definitions in 40 CFR 60.2 are pertinent to this classification:

> *Existing facility means, with reference to a stationary source, any apparatus of the type for which a standard is promulgated in this part, and the construction or modification of which was commenced before the date of proposal of that standard; or any apparatus which could be altered in such a way as to be of that type.*
>
> *Modification means any physical change in, or change in the method of operation of, an existing facility which increases the amount of any air pollutant (to which a standard applies) emitted into the atmosphere by that facility or which results in the emission of any air pollutant (to which a standard applies) into the atmosphere not previously emitted.*

The IGQ Buildings D and E will be a newly constructed facility. Therefore, the new construction classification is used to determine the applicable requirements in the subsequent NSPS regulations.

4.3.2 NSPS Subpart IIII

Subpart IIII applies to non-fire pump compression ignition (CI) internal combustion engines (ICE) manufactured after April 2006 and fire pump CI ICE manufactured after July 1, 2006. Therefore, the emergency gensets are subject to Subpart IIII. The requirements for each of the genset include:

- Purchase a certified engine
- Use ultra-low sulfur diesel (ULSD) with sulfur content less than 15 ppm
- Operate and maintain the engines according to manufacturer's emission-related written instructions.
- Operate for less than 100 hours per year for maintenance and testing, 50 of which can be non-emergency operations
- Install a non-resettable hour meter to record time of operation of the engine and reason the engine was in operation

As shown in the vendor specifications (Appendix C), the genset options Sabey is proposing are certified Tier 2 engines for the main gensets and Building E support genset, and Tier 3 for the Building D support genset. Sabey will purchase certified engines and will operate in accordance with the requirements set forth under NSPS Subpart IIII.

4.4 NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS

National Emission Standards for Hazardous Air Pollutants (NESHAPs) have been established in 40 CFR Part 61 and Part 63 to control emissions of Hazardous Air Pollutants (HAP) from stationary sources. The applicability of NESHAP rules often depends on a facility's major source status with respect to HAP emissions. Under 40 CFR Part 63, a major source is defined as "any stationary source or group of stationary sources located within a contiguous area and under common control that emits or has the potential to emit considering controls, in the aggregate, 10 tons per year or more of any HAP or 25 tons per year or more of any combination of HAP." The IGQ facility is considered an area source (not a major source) of HAP based on its PTE, as represented in Appendix C. The new emissions units from the IGQ facility expansion project are not subject to any Part 61 NESHAPs.

4.4.1 NESHAP Subpart A

All affected sources subject to a Part 63 NESHAP are also subject to the general provisions of Part 63 Subpart A unless specifically excluded by the source-specific NESHAP. Per NESHAP Subpart A, the following definitions are important when characterizing whether the affected source is new, reconstructed, or existing:

Affected source means the collection of equipment, activities, or both within a single contiguous area and under common control that is included in a section 112(c) source category or subcategory for which a section 112(d) standard or other relevant standard is established pursuant to section 112 of the Act. Each relevant standard will define the "affected source," as defined in this paragraph.

New Source means any affected source the construction or reconstruction of which is commenced after the Administrator first proposes a relevant emission standard under this part establishing an emission standard applicable to such source.

Reconstruction, unless otherwise defined in a relevant standard, means the replacement of components of an affected or a previously non-affected source to such an extent that the fixed capital cost of the new components exceeds 50 percent of the fixed capital cost that would be required to construct a comparable new source.

Existing Source means any affected source that is not a new source.

NESHAP Subpart A applies to the IGQ facility because the proposed emergency gensets are considered new sources under Subpart ZZZZ.

4.4.2 NESHAP Subpart ZZZZ

The proposed emergency gensets will meet the requirements of NESHAP Subpart ZZZZ by meeting the applicable requirements of NSPS Subpart IIII. Pursuant to 40 CFR 63.6590(c), "no further requirements apply for such engines under this part." Therefore, compliance with NSPS Subpart IIII will ensure that the facility is also in compliance with NESHAP Subpart ZZZZ.

4.5 STATE AND LOCAL REGULATORY APPLICABILITY

4.5.1 Washington Toxic Air Pollutant Regulations

In Washington, all new sources emitting TAPs are required to show compliance with the Washington TAP program pursuant to WAC 173-460. Ecology has established a de minimis emission rate, a small quantity emission rate (SQER), and an acceptable source impact level (ASIL) for each listed TAP. If the total project-related TAP emissions increase exceeds the de minimis level for a pollutant, then permitting and a control technology review is triggered. If the emissions increase exceeds its respective SQER, further determination of compliance with the ASIL using air dispersion modeling is required. Table 4-1 summarizes the project TAP emissions from both Buildings D and E, and the detailed calculations are included in Appendix C.

Table 4-1. Project TAP Emission Summary

Pollutant	Averaging Period	De Minimis	SQER	Project Total	Modeling Required?
		(lbs/averaging period)			
Acetaldehyde	year	3.00	60.00	1.09	De Minimis
Acrolein	24-hr	1.30E-03	0.03	0.26	Yes
Benzene	year	1.00	21.00	31.28	Yes
Benzo(a)anthracene	year	0.05	0.89	0.03	De Minimis
Benzo(a)pyrene	year	8.20E-03	0.16	1.03E-02	No
Benzo(b)fluoranthene	year	0.05	0.89	0.04	De Minimis
Benzo(k)fluoranthene	year	0.05	0.89	8.78E-03	De Minimis
1,3-Butadiene	year	0.27	5.40	3.71E-03	De Minimis
Chrysene	year	0.45	8.90	0.06	De Minimis
Dibenz(a,h)anthracene	year	4.10E-03	0.08	1.40E-02	No
Formaldehyde	year	1.40	27.00	3.28	No
Indeno(1,2,3-cd)pyrene	year	0.05	0.89	0.02	De Minimis
Naphthalene	year	0.24	4.80	5.23	Yes
Propylene	24-hr	11.00	220	9.17	De Minimis
Toluene	24-hr	19.00	370	9.07	De Minimis
Xylenes	24-hr	0.82	16.00	6.23	No
Diesel engine exhaust, particulate	year	0.03	0.54	797	Yes
SO_2	1-hr	0.46	1.20	4.64	Yes
CO	1-hr	1.10	43.00	888	Yes
NO_2	1-hr	0.46	0.87	541	Yes

Air dispersion modeling was performed for TAPs exceeding their respective SQERs, including acrolein, benzene, naphthalene, SO_2, CO, NO_2 and diesel engine exhaust particulate (DPM). The results presented in Table 6-18 demonstrate that modeled emissions are below the ASILs for acrolein, benzene, naphthalene, SO_2 and CO. Sabey will perform a Second Tier Review in accordance with WAC 173-460-090 for DPM and NO_2. The Second Tier Review will be submitted under a separate cover based on this NOC application.

4.5.2 State Regulatory Applicability

The following general Ecology regulations are relevant to the IGQ facility per WAC 173-400-040:

- ► No air contaminant shall exceed the opacity limit of 20% for more than 3 minutes in any one hour;
- ► SO_2 emissions shall be limited to less than 1,000 ppm on a dry basis, corrected to 7% oxygen.

In addition, WAC 173-400-050(1) limits particulate matter emissions of combustion sources to 0.1 grains/dscf. Table 4-2 below demonstrates that all engines under any operating load or scenario would demonstrate compliance with this limit and actual emissions would be lower.

Table 4-2. Grain Loading Limit Compliance Demonstration

Emission Unit	Maximum PM Emission Rate [a] (lb/hr)	Minimum Flow Rate [b] (scfm)	Maximum PM Grain Loading Rate [c] (gr/dscf)	PM Combustion Limit (gr/dscf)	In compliance?
Main Genset	0.60	1,976	0.03	0.1	Yes
D Support Genset	0.19	333	0.03	0.1	Yes
E Support Genset	0.96	915	0.07	0.1	Yes

a. Maximum PM filterable emission rate including cold start emissions for a single engine across all loads and models. Based on 100% load for both the main genset and Building E support genset, and 50% load for Building D support genset.

b. Minimum flow rate across all loads and models for a single engine. Based on 10% load for both the main genset and support gensets.

c. Maximum grain loading rate for the main genset is for the 10% load, which has a maximum emission rate of 0.44 lb/hr/engine and a minimum flow rate of 1,976 scfm across the models considered. Maximum grain loading rate for the D support engine is for the 25% load, which has a maximum emission rate of 0.13 lb/hr/engine and a minimum flow rate of 510 scfm across the models considered. Maximum grain loading rate for the E support engine is for the 10% load, which has a maximum emission rate of 0.55 lb/hr/engine and a minimum flow rate of 915 scfm across the models considered.

5. BEST AVAILABLE CONTROL TECHNOLOGY

Under WAC 173-400-113, Ecology requires all new sources or modifications to existing sources to use BACT for all pollutants not previously emitted or whose emissions would increase as a result of the new source or modification. A BACT analysis is included in this section for all emission units subject to NOC permitting.

5.1 BACT METHODOLOGY

In a memorandum dated December 1, 1987, the EPA stated its preference for a "top-down" analysis for PSD applications.[2] For this minor New Source Review (NSR) BACT analysis, Sabey is using the same top-down approach. The first step in this approach is to determine, for the emission unit in question, the most stringent control available for a similar or identical source or source category. If it can be shown that this level of control is technically, environmentally, or economically infeasible or inappropriate on the basis of energy concerns for the unit in question, then the next most stringent level of control is determined and similarly evaluated. This process continues until the BACT level under consideration cannot be eliminated by any substantial or unique technical, environmental, economic, or energy-related objections.

Presented below are the five basic steps of a top-down BACT review as identified by the EPA.[3]

STEP 1 – IDENTIFY ALL CONTROL TECHNOLOGIES

Available control technologies are identified for each emission unit in question.

STEP 2 – ELIMINATE TECHNICALLY INFEASIBLE OPTIONS

After the identification of control options, an analysis is conducted to eliminate technically infeasible options. A control option is eliminated from consideration if there are process-specific conditions that prohibit the implementation of the control.

STEP 3 – RANK REMAINING CONTROL TECHNOLOGIES BY CONTROL EFFECTIVENESS

Once technically infeasible options are removed from consideration, the remaining options are ranked based on their control effectiveness. If there is only one remaining option, or if all of the remaining technologies could achieve equivalent control efficiencies, ranking based on control efficiency is not required.

STEP 4 – EVALUATE MOST EFFECTIVE CONTROLS AND DOCUMENT RESULTS

Beginning with the most efficient control option in the ranking, detailed economic, energy, and environmental impact evaluations are performed. If a control option is determined to be economically feasible without adverse energy or environmental impacts, it is not necessary to evaluate the remaining options with lower control efficiencies.

The economic evaluation centers on the cost effectiveness of the control option. Costs of installing and operating control technologies are estimated and annualized following the methodologies outlined in the

[2] U.S. EPA, Office of Air and Radiation. Memorandum from J.C. Potter to the Regional Administrators. Washington, D.C. December 1, 1987.

[3] U.S. EPA. Draft New Source Review Workshop Manual, Chapter B. Research Triangle Park, North Carolina. October 1990.

EPA's *Control Cost Manual* (CCM)[4] and other industry resources. Cost effectiveness is expressed in dollars per ton of pollutant controlled. Objective analyses of energy and environmental impacts associated with each option are also conducted.

STEP 5 – SELECT BACT

In the final step, one pollutant-specific control option is proposed as BACT for each emission unit under review based on evaluations from the previous step.

Since there have been many BACT analyses performed for other data centers in Washington recently (Sabey Data Centers, Vantage Data Center, CyrusOne with permits issued in 2020, 2017 and 2019, respectively),[5] Sabey completed the BACT analysis based on cost information available in the CCM and in the applications for these similar facilities. Detailed cost calculations are available in Appendix D.

5.2 BACT ANALYSIS FOR NO_X EMISSIONS

Typical NO_X emission control technologies include add-on controls, such as selective catalytic reduction (SCR), Tier 4 integrated control systems, selective non-catalytic reduction (SNCR), non-selective catalytic reduction (NSCR), and other technologies without add-on controls, such as combustion technology meeting EPA standards. Other emerging technologies, including NO_X adsorbers, water injection, ozone injection, and activated carbon adsorption, which are not commercially available for stationary diesel generators, are not discussed in this case.

SCR has higher control effectiveness than SNCR and NSCR for the following reasons:

- SNCR does not use a catalyst for the reaction between ammonia or urea with NO_X to reduce NO_X emissions, unlike SCR. Lack of a catalyst requires a higher temperature to achieve the chemical reaction, which makes SCR applicable to more combustion sources.
- NSCR requires that no excess air is present in the stream and requires a catalyst without a reagent. However, diesel exhaust oxygen levels vary widely depending on engine load, which does not meet the requirement of zero excess air. Therefore, NSCR is not considered technologically applicable to the proposed diesel combustion engines.

Control technologies that are not add-on controls, including combustion technology meeting EPA Tier 2 emission standards for the larger gensets and Tier 3 emission standards for the smaller gensets as well as the operating and maintenance requirements under 40 CFR Part 60 Subpart IIII, are considered feasible options for this project.

A cost analysis was performed for the SCR and Tier 4 Integrated Control options for the main gensets and support gensets in accordance with the EPA's CCM methodologies as well as the information available from the applications for similar data centers recently permitted. The cost analysis is based on the following conservative assumptions:

- The direct emission control package cost for the main gensets is conservatively determined based on the average unit price of a 3 mega-watt equivalent (MWe) genset from the Vantage application and a

[4] U.S. EPA, Office of Air Quality Planning and Standards. EPA Control Cost Manual, 7th edition, updating in progress. https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-reports-and-guidance-air-pollution

[5] Vantage Data Center, Approval Order No. 16AQ-E026; CyrusOne Data Center, Approval Order 19AQ-E052

2,250 kWe genset from the CyrusOne application. Costs for the support gensets are estimated using the 0.6 power rule.

- ► Indirect costs for SCR and Tier 4 Integrated Control are calculated using the most conservative ratio or fixed-cost approach presented in the Vantage and CyrusOne applications.
- ► It is conservatively assumed that the costs of operating labor, supervisory labor, and electricity associated with operating the SCR and Tier 4 Integrated Control System are negligible.
- ► The acceptable control cost threshold is assumed to be $12,000 per ton NO_X.[6]

The calculated cost to control per ton of NO_X is $33,678 for the SCR based on the conservative assumptions listed above for cost calculations. SCR is therefore cost prohibitive for the project. The cost to control per ton of NO_X for the Tier 4 Integrated Control System is $38,920. Tier 4 Integrated Control is cost prohibitive for the project.[7] Sabey proposes meeting EPA Tier 2 standards as BACT for NOX for the main gensets and EPA Tier 3 standards for the support gensets.

5.3 BACT ANALYSIS FOR CO, PM, AND VOC EMISSIONS

Available add-on control technologies for controlling CO, PM, and VOC emissions include diesel oxidation catalyst (DOC), diesel particulate filter (DPF), Tier 4 Integrated Control systems, and three-way catalyst. Stack tests at Titan Data Center in Moses Lake, WA indicate that use of three-way catalysts may result in a NO_X emission increase. Therefore, three-way catalysts are not considered further in this assessment. Technologies without add-on controls, such as meeting EPA Tier 2 standards, are also considered feasible options for this project. The control efficiencies of the feasible control technologies are summarized in Table 5-1.

Table 5-1. Criteria Pollutant Control Efficiencies

Pollutant	DPF Removal %	DOC Removal %	Tier 4 Removal %
Particulate Matter (PM)	90%	25%	88%
Carbon Monoxide (CO)	80%	80%	80%
Volatile Organic Compounds (VOC)	70%	70%	70%

A cost analysis is performed for DPF, DOC, and Tier 4 Integrated Control for the main and support gensets following similar approaches to the NO_X cost analysis, including the following conservative assumptions:

- ► The main gensets direct emission control package costs for DPF, DOC, and Tier 4 Integrated Control are conservatively determined based on the average unit price of a 3 MWe genset from the Vantage application and a 2,250 kWe genset from the CyrusOne application. Costs for the support gensets are estimated using the 0.6 power rule.
- ► Indirect costs for DPF, DOC, and Tier 4 Integrated Control are calculated using the most conservative ratio or fixed-cost approach presented in the Vantage and CyrusOne applications.
- ► It is conservatively assumed that the operating labor, supervisory labor, and electricity associated with operating the DPF, DOC, and Tier 4 Integrated Control are negligible.

[6] Consistent with Vantage and CyrusOne applications' assessment of acceptable unit costs.

[7] Consistent with Vantage and CyrusOne BACT cost effectiveness assessments.

- ► It is also conservatively assumed that the maintenance cost will be negligible, even though DPF will require regular cleaning when actually operated.
- ► The acceptable control cost thresholds are assumed to be $12,000 per ton PM, $5,000 per ton CO, and $12,000 per ton VOC.

The annualized cost of each control technology and the cost effectiveness of each control technology with respect to the quantity of PM, CO, and VOC removed is presented in Table 5-2 below. Detailed control cost calculations are provided in Appendix D.

Table 5-2. Criteria Pollutant Control Cost Effectiveness

Technology	Annualized Cost ($/yr)	Cost Effectiveness ($/ton removed)			Total Reasonable Annual Cost for Combined Pollutants [a]	Reasonable Control Device Cost?
		PM	CO	VOC		
DPF	$737,115	$1,544,096	$88,420	$1,011,765	$56,154	No
DOC	$164,582	$1,241,150	$19,742	$225,906	$52,016	No
Tier 4	$1,889,648	$4,048,366	$226,672	$2,593,733	$638,648	No

a. Reasonable annual costs are calculated by multiplying Ecology's Acceptable Unit Costs (consistent with recent CyrusOne and Vantage applications) by the calculated total pollutants removed for each pollutant. The sum of the reasonable annual cost for each individual pollutant is then compared to the calculated annualized cost of the given control.

Each $/ton value is cost prohibitive. Therefore, Sabey proposes meeting EPA Tier 2 emission standards for the main engines and support engine, as well as the operating and maintenance requirements under 40 CFR Part 60 Subpart IIII as BACT for PM, CO, and VOC.

5.4 BACT ANALYSIS FOR SO_2 EMISSIONS

Commercially available add-on control technologies are not generally available for SO_2 emissions from engines. The main source of SO_2 from engines is the sulfur in the fuel. As discussed in Section 4.3.2, the engines are required to fire ULSD with sulfur content less than 15 ppm. Therefore, Sabey proposes using ULSD as BACT for SO_2 emissions.

5.5 BACT ANALYSIS FOR TAP EMISSIONS

WAC 173-460-060 requires all projects with emissions exceeding the de minimis value for a TAP to employ BACT for that TAP, called tBACT. As shown in Table 4-1, there are 11 TAPs with emissions greater than the respective de minimis levels. These TAPs are either also criteria pollutants (i.e., SO_2, CO, and NO_2) or are emitted as PM or VOC. Reasonable annual costs for TAPs that are also criteria pollutants are calculated as described in Section 5.2 to 5.4.

Reasonable annual costs for other TAPs that are emitted as PM or VOC are calculated assuming an expected control efficiency consistent with that for PM or VOC, respectively. Expected control efficiencies are outlined in Table 5-3 below.

Table 5-3. TAP and Control Efficiencies

Pollutant	DPF Removal %	DOC Removal %	Tier 4 Removal %
TAP Emitted as PM	90%	25%	88%
TAP Emitted as VOC	70%	70%	70%

The annualized cost of each control technology and the total reasonable annual cost of each control technology with respect to the total quantity of TAP removed is presented in Table 5-4 below. Total reasonable annual cost is calculated using the Hanford ceiling cost method.[8] Detailed cost calculations are provided in Appendix D.

Table 5-4. Total TAP Control Cost Effectiveness

Technology	Annualized Cost ($/yr)	Total Reasonable Annual Cost for Combined TAP ($/yr) [a]	Reasonable Control Device Cost?
SCR [b]	$1,635,128	$89,684	No
DPF	$737,115	$41,602	No
DOC	$164,582	$16,576	No
Tier 4	$1,889,648	$130,515	No

a. Reasonable annual costs are calculated by multiplying the maximum ceiling value (based on the Hanford method) by the calculated total pollutants removed for each pollutant. The sum of the reasonable annual cost for each individual pollutant is then compared to the calculated annualized cost of the given control.

b. SCR only controls the TAP NO_2.

The annualized cost for each control technology is higher than its respective total reasonable annual cost for combined TAP, meaning that each control device is cost prohibitive. Therefore, the proposed tBACT for controlling these 11 TAPs is meeting EPA Tier 2 emission standards for main gensets and support genset as well as the operating and maintenance requirements under 40 CFR Part 60 Subpart IIII.

[8] Haass, C, Kovach, J., Kelly,S., & Turner, D. (2010). Evaluation of Best Available Control Technology for Toxics (tBACT), Double Shell Tank Farms Primary Ventilation Systems Supporting Waste Transfer Operations https://www.osti.gov/servlets/purl/991923

6. AIR DISPERSION MODELING

As discussed in Section 4.5.1, air dispersion modeling was performed for the TAPs showing emissions greater than their respective SQER. Additionally, an analysis for IGQ facility to demonstrate compliance with the National Ambient Air Quality Standards (NAAQS) for PM_{10}, $PM_{2.5}$, NO_2, CO, and SO_2 is also completed. This section discusses the methodologies applied for the air dispersion modeling analysis and presents the results for the TAP analysis and NAAQS analysis.

6.1 DISPERSION MODEL SELECTION

The American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC) modeling system, the most recent AERMOD dispersion model version 21112 with Plume Rise Model Enhancements (PRIME) advanced downwash algorithms, is used as the dispersion model in the air quality analysis.

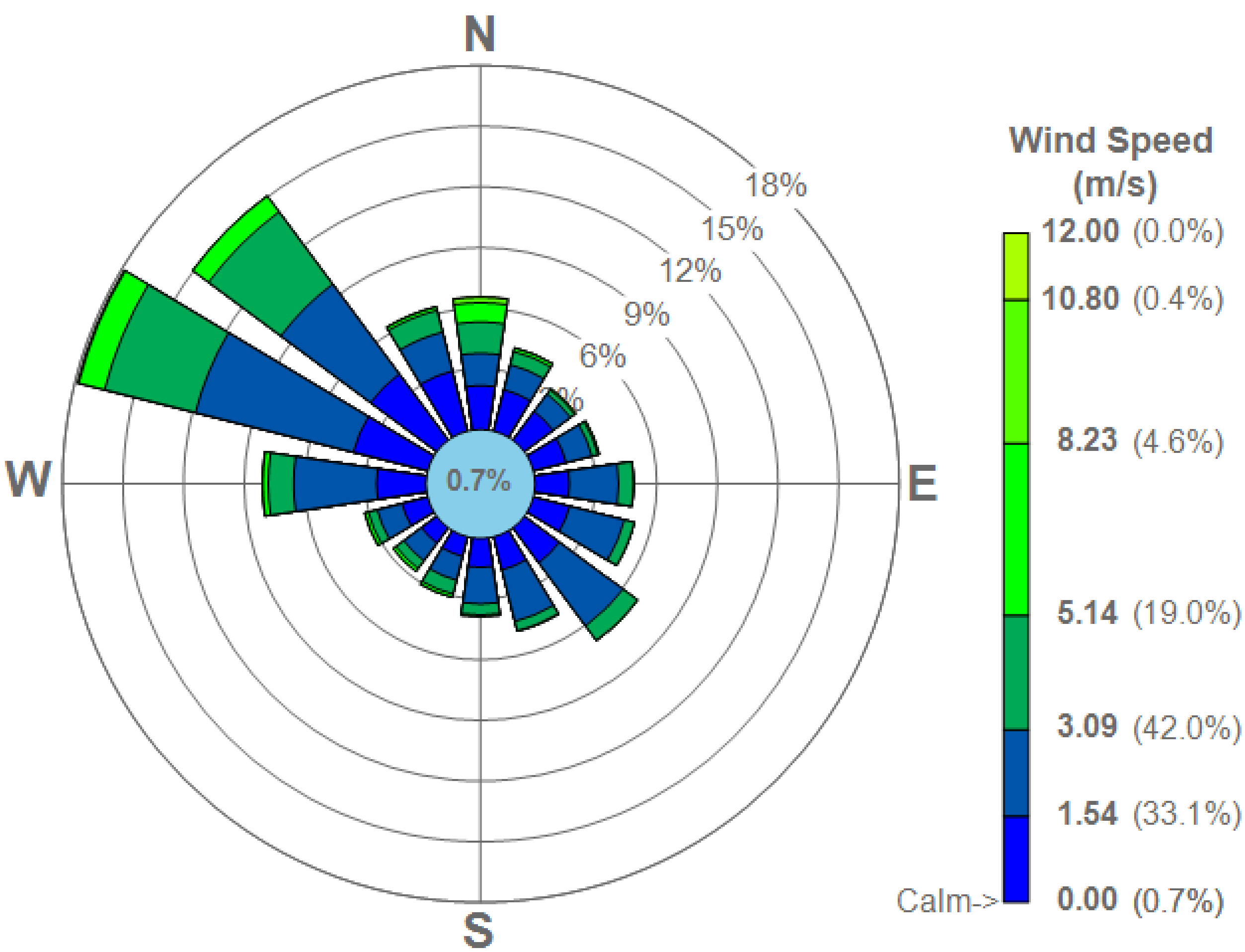
6.2 METEOROLOGICAL DATA

Three years of surface meteorological data are taken from a local meteorological tower located in Quincy, Washington at 330 3rd Ave NE (47.241, -119.847). The data from the three most recent years (2018 through 2020) are used. The meteorological data is processed using AERMET version 21112. Note that for one quarter of 2018 there is temperature data missing due to a failed audit. Per discussions with Ecology, the data for this quarter is substituted with data from Grant County International Airport. Cloud cover data is also obtained from Grant County International Airport for the 2018-2020 period. The wind rose for the modeled period (2018-2020) is provided in Figure 6-1.

Trinity also reviewed the percentage of calm and missing data for the modeled period. The AERMOD-ready data shows 0.75% of calm wind data and 0.03% of missing data.

The upper air data is taken from the nearest upper air station in Spokane, Washington (OTX) for the corresponding period. All data is processed using regulatory default options, including the use of ADJ_U* for processing low wind speed stable conditions.

Figure 6-1. 2018-2020 Wind Rose at Local Quincy, WA Met Station



6.3 COORDINATE SYSTEM

The location of the emission sources, structures, and receptors for this modeling analysis are represented in the Universal Transverse Mercator (UTM) coordinate system using the North American 1983, CONUS (NAD83) projection. The UTM grid divides the world into coordinates that are measured in north meters (measured from the equator) and east meters (measured from the central meridian of a particular zone, which is set at 500 km). UTM coordinates for this analysis are based on UTM Zone 11. The location of the proposed IGQ facility (point between Building D and E) is approximately 5,236,221.7 meters Northing and 286,829.4 meters Easting in UTM Zone 11.

6.4 TERRAIN ELEVATIONS

Terrain elevations for receptors, buildings, and sources are determined using National Elevation Dataset (NED) supplied by the United States Geological Survey (USGS).[9] The NED is a seamless dataset with the best available raster elevation data of the contiguous United States. NED data retrieved for this model have a grid spacing of 1/3 arc-second or 10 m. The AERMOD preprocessor, AERMAP version 18081, is used to compute model object elevations from the NED grid spacing. AERMAP also calculates hill height data for all receptors. All data obtained from the NED files are checked for completeness and spot-checked for accuracy.

6.5 RECEPTOR GRIDS

Six (6) square Cartesian receptor grids are used in the analysis, in alignment with Ecology's guidance document for TAP reviews.

- A grid containing 12.5-meter spaced receptors and extending roughly 450 meters from the center of Building D and E.
- A grid containing 25-meter spaced receptors extending from 450 meters to 800 meters from the center of the project location.
- A grid containing 50-meter spaced receptors extending from 800 meters to 1,500 meters from the center of the project location.
- A grid containing 100-meter spaced receptors extending from 1,500 meters to 2,100 meters from the center of the project location.
- A grid containing 300-meter spaced receptors extending from 2,100 meters to 4,500 meters from the center of the project location.
- A grid containing 600-meter spaced receptors extending from 4,500 meters to 10,000 meters from the center project location.

In addition, 10-meter spaced receptors are included along the property fenceline. All receptors are placed at 1.5 m flagpole height, as requested by Ecology, for the NAAQS and TAP analyses.

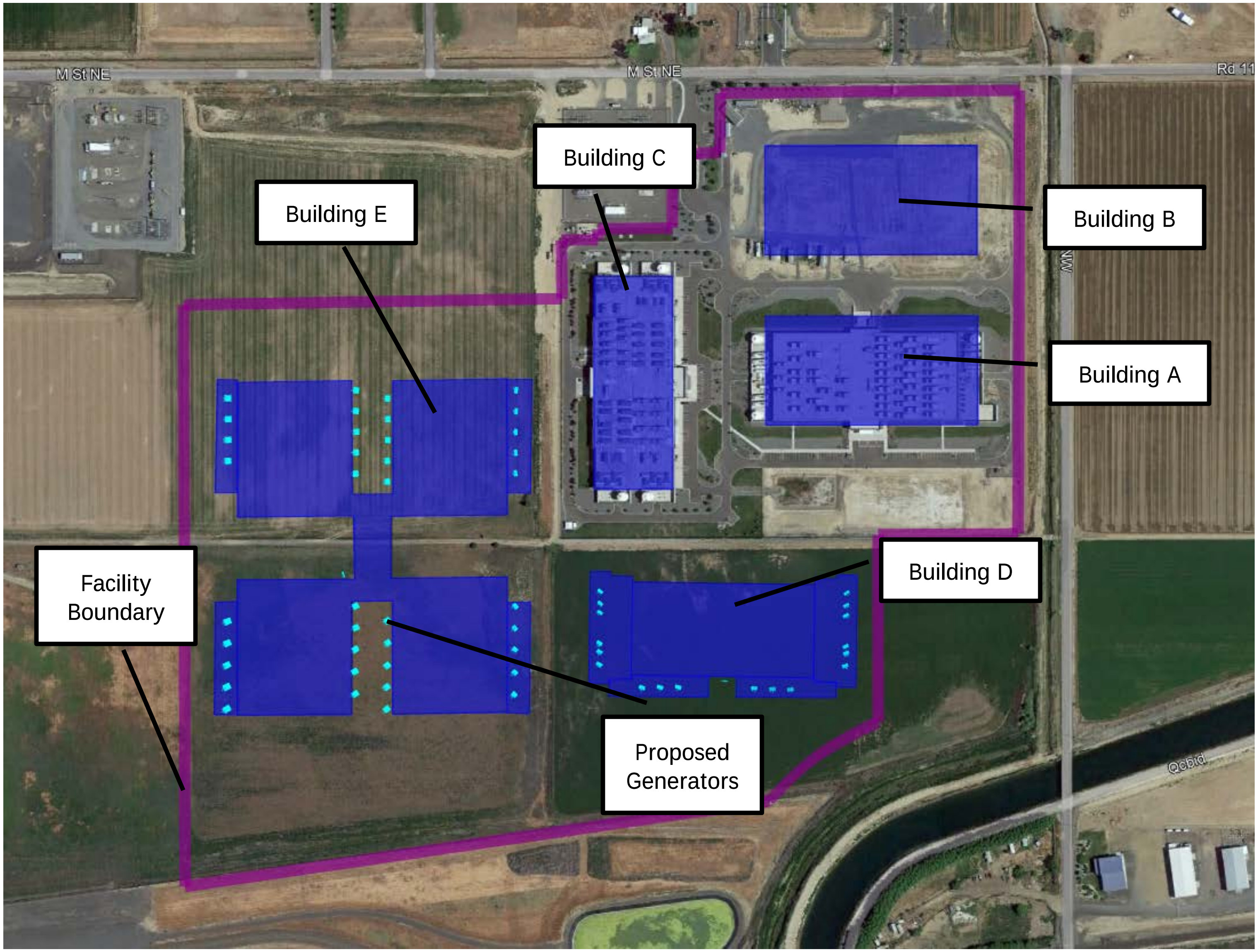
6.6 BUILDING DOWNWASH

Emissions from each source are evaluated in terms of their proximity to nearby structures. The purpose of this evaluation is to determine if stack discharges might become caught in the turbulent wakes of these structures. Wind blowing around a building creates zones of turbulence that are greater than if the buildings were absent. The concepts and procedures expressed in the GEP Technical Support document, the Building Downwash Guidance document, and other related documents are applied to all structures at the IGQ facility.

Figure 6-2 shows the buildings included in this modeling analysis. Detailed building parameters are provided in Appendix E.

[9] NED data retrieved from the National Map website at https://viewer.nationalmap.gov/basic/. Data is converted to the GeoTIFF format for use in the AERMOD models.

Figure 6-2. Modeled Buildings and Fenceline



6.7 EMISSION SOURCE PARAMETERS

The sources included for TAP modeling are the 59 gensets. Each of Buildings D and E will have utility yards on the east and west side of each building, with an option for a utility yard also on the south side of Building D. Building D will have up to eighteen (18) main gensets with one (1) support genset located near the loading dock on the south side of the building. Building E will have four quadrants. The northeast, southeast, and southwest quadrants will have ten (10) main gensets, and the northwest quadrant will have nine (9). Each main genset at Building E will be one of the CAT 3516C, Cummins DQKAF with DOTC, or Kohler KD2250 with oxidation catalyst and DPF with the exception of five (5) that will be Cummins DQKAF without the DOTC. Building E will also have a support genset located at the loading dock in the west central location of the building. The site plan (Appendix B) shows the locations of the utility yards, loading docks and the position of the gensets. Table 6-1 shows the model ID and each genset's UTM location.

Table 6-1. Modeled Sources

Model Unit ID [a]	Description	UTM Easting (m)	UTM Northing (m)	Elevation (m)
D1	D1 - Building D	286,886.10	5,236,186.20	396.24
D2	D2 - Building D	286,885.80	5,236,175.60	396.15
D3	D3 - Building D	286,885.20	5,236,167.80	396.09
D4	D4 - Building D	286,883.90	5,236,141.40	395.90
D5	D5 - Building D	286,883.60	5,236,133.90	395.85
D6	D6 - Building D	286,883.00	5,236,123.00	395.76
D7	D7 - Building D	287,099.40	5,236,176.80	395.35
D8	D8 - Building D	287,098.70	5,236,166.20	395.25
D9	D9 - Building D	287,098.10	5,236,157.40	395.16
D10	D10 - Building D	287,096.90	5,236,130.80	394.87
D11	D11 - Building D	287,097.20	5,236,124.90	394.80
D12	D12 - Building D	287,095.90	5,236,113.90	394.70
D13	D13 - Building D	286,919.30	5,236,101.70	395.37
D14	D14 - Building D	286,934.90	5,236,101.40	395.28
D15	D15 - Building D	286,950.60	5,236,101.00	395.22
D16	D16 - Building D	287,016.40	5,236,097.60	394.89
D17	D17 - Building D	287,032.00	5,236,096.40	394.83
D18	D18 - Building D	287,047.70	5,236,095.40	394.74
E1	E1 - Building E	286,570.90	5,236,364.20	398.02
E2	E2 - Building E	286,570.50	5,236,346.20	397.83
E3	E3 - Building E	286,569.70	5,236,328.40	397.66
E4	E4 - Building E	286,568.90	5,236,310.20	397.47
E6	E6 - Building E	286,681.70	5,236,367.10	397.94
E7	E7 - Building E	286,680.90	5,236,349.30	397.77
E8	E8 - Building E	286,680.50	5,236,331.30	397.69
E9	E9 - Building E	286,679.50	5,236,313.50	397.50
E10	E10 - Building E	286,678.40	5,236,295.20	397.34
E11	E11 - Building E	286,708.50	5,236,359.10	397.87
E12	E12 - Building E	286,708.10	5,236,341.30	397.78

Model Unit ID [a]	Description	UTM Easting (m)	UTM Northing (m)	Elevation (m)
E13	E13 - Building E	286,707.30	5,236,323.30	397.60
E14	E14 - Building E	286,706.30	5,236,305.30	397.45
E15	E15 - Building E	286,705.70	5,236,287.40	397.35
E16	E16 - Building E	286,820.00	5,236,362.20	397.87
E17	E17 - Building E	286,819.30	5,236,344.00	397.71
E18	E18 - Building E	286,818.30	5,236,326.20	397.54
E19	E19 - Building E	286,817.70	5,236,308.30	397.46
E20	E20 - Building E	286,816.90	5,236,290.70	397.28
E21	E21 - Building E	286,563.00	5,236,171.80	396.39
E22	E22 - Building E	286,562.20	5,236,153.10	396.20
E23	E23 - Building E	286,561.10	5,236,134.10	396.03
E24	E24 - Building E	286,560.30	5,236,115.40	395.92
E25	E25 - Building E	286,559.60	5,236,096.30	395.73
E26	E26 - Building E	286,674.00	5,236,181.00	396.48
E27	E27 - Building E	286,673.60	5,236,162.30	396.29
E28	E28 - Building E	286,672.40	5,236,143.60	396.17
E29	E29 - Building E	286,671.30	5,236,124.50	396.02
E30	E30 - Building E	286,670.90	5,236,105.10	395.82
E31*	E31 - Building E	286,701.00	5,236,167.30	396.35
E32*	E32 - Building E	286,700.60	5,236,148.20	396.23
E33*	E33 - Building E	286,699.50	5,236,128.70	396.06
E34*	E34 - Building E	286,698.40	5,236,110.10	395.93
E35*	E35 - Building E	286,697.60	5,236,091.00	395.74
E36	E36 - Building E	286,812.40	5,236,176.00	396.33
E37	E37 - Building E	286,811.20	5,236,157.00	396.21
E38	E38 - Building E	286,810.50	5,236,138.70	396.07
E39	E39 - Building E	286,809.70	5,236,118.80	395.96
E40	E40 - Building E	286,808.60	5,236,099.80	395.78
S1	Support Genset	286,991.00	5,236,103.40	395.07
S2	Support Genset	286,662.60	5,236,207.90	396.65

a. Note that Model IDs identified with an "*" are the individual gensets that are Cummins DQKAF model gensets. The remaining main gensets are either CAT 3516C, Cummins DQKAF with DOTC, or Kohler KD2250 with oxidation catalyst and DPF model gensets. Support gensets are noted with an "S" and could be a variety of manufacturers as noted previously.

6.8 LOAD ANALYSIS

A load analysis was performed for each pollutant to determine which load would result in the highest offsite concentration for each of the pollutants. The following load analysis was performed for the main gensets:

- For NO_X, $PM_{2.5}$, CO, SO_2, and filterable PM/DPM, the load analysis was performed for the CAT, Cummins, and Kohler gensets at each load using the worst-case dispersion parameters across genset models provided in the vendor specifications. The corresponding vendor emission rate, flow rate and temperature for the overall worst-case operating load across all units are used. Within this load analysis, the five (5) gensets that have been identified as Cummins DQKAF (no add-on controls) relied on the singe engine model parameters.
- For TAPs, the hourly maximum fuel consumption rate from all vendors at each load and corresponding worst-case parameters are used to represent the variations of resultant TAP emissions. TAP emissions are calculated based on the fuel consumption rates.

Since the support gensets may be operated separately from the main gensets, the following load analysis was performed for the support gensets:

- For NO_X, $PM_{2.5}$, CO, and SO_2, highest hourly emissions across all vendors are included for each generator at each of 10%, 25%, 50%, 75% and 100% load. For each load, the worst-case (i.e., lowest) flow rate and temperature from vendor provided information is applied for all generators modeled at the specified load.
- For filterable PM/DPM, the load analysis was performed for CAT and Cummins at each load where the dispersion parameters are provided in the vendor specifications. The corresponding vendor emission rate, the flow rate and temperature are used.
- For TAPs, the hourly fuel consumption rate at each load and corresponding worst-case parameters are used to represent the variations of resultant TAP emissions. TAP emissions are calculated based on the fuel consumption rates.

The modeling parameters are available in Appendix E. The load analysis results are summarized in Table 6-2, and more details are provided in Appendix F. Based on the load analysis results, the following are used for compliance demonstration in Sections 6.10 and 6.11:

- For the NO_X 1-hour averaging period, 100% load results in the maximum offsite concentration across all loads on 1-hour basis for the main gensets. For the support gensets, the 100% load results for the Building D support genset and the 10% load results for the Building E support genset represent the worst-cased modeled loads. Out of all gensets, five engines located at Building E (model IDs E10, E13, E14, E15 and E26) are the highest-impacting units that result in maximum offsite 1-hour concentrations. These units are further discussed as part of the Monte Carlo analysis in Section 6.10.2.
- For the NO_X annual averaging period, 100% load results in the maximum offsite concentration across all loads on an annual basis for the main gensets. For the support gensets, the 100% load results for the Building D support genset and the 10% load results for the Building E support genset represent the worst-cased modeled loads.
- For the PM_{10} and $PM_{2.5}$ 24-hour averaging period, 10% load results in maximum offsite 24-hour averaged concentration across all loads for the main gensets. For the support gensets, the 10% load results for the Building D support genset and the 100% load results for the Building E support genset represent the worst-cased modeled loads. Out of all gensets, five engines located at Building E (model IDs E10, E14, E15, E26, and E27) are the highest-impacting units that result in maximum offsite 24-hour concentrations. These units are further discussed as part of the Monte Carlo analysis in Section 6.10.2.
- For $PM_{2.5}$ annual, 10% load results in the maximum offsite annual averaged concentration across all loads for the main gensets. For the support gensets, the 10% load results for the Building D support genset and the 100% load results for the Building E support genset represent the worst-case modeled loads.
- For DPM, the individual genset model and the corresponding engine load parameters are evaluated individually, rather than assessing overall worst-case load across all gensets. The 10% load emissions from the CAT 3516C gensets resulted in the maximum annual averaged offsite concentrations for the main gensets, with the 10% load emissions from the Cummins DQKAF gensets resulting in the maximum annual averaged offsite concentrations for the five gensets specified as Cummins DQKAF gensets. For the support gensets, the 50% load for the Cummins DQDAC genset at Building D and the 100% load for the Cummins DQFAD genset at Building E represented the worst-case modeled loads.
- For CO, 25% load results in maximum offsite concentration across all loads on 1-hour and 8-hour basis for the main gensets. For the support gensets, the 50% load results at Building D and the 100% load results at Building E resulted in the highest impacts for both averaging periods.

- For SO_2, 100% load results in maximum offsite concentration across all loads on 1-hour and 3-hour basis for all main and support gensets.
- For TAPs that are not criteria pollutants or DPM, 100% load results in maximum offsite 24-hour averaged and annual averaged concentrations across all loads.

Table 6-2. Load Analysis Results

Pollutant	Averaging Period	Main Genset Worst-Case Load [a]		Support Genset Worst-Case Load [a]	
		Buildings D and E (E1-E4, E6-E30, E36-E40)	Building E (E31-E35)	Building D	Building E
NO_X	1-hr	100%		100%	10%
NO_X	Annual	100%		100%	10%
$PM_{2.5}$	24-hr	10%		10%	100%
$PM_{2.5}$	Annual	10%		10%	100%
PM_{10}	24-hr	10%		10%	100%
CO	1-hr and 8-hr	25%		50%	100%
SO_2	1-hr and 3-hr	100%		100%	100%
Acrolein	24-hr	100%		100%	100%
Benzene	year	100%		100%	100%
Naphthalene	year	100%		100%	100%
Diesel Engine Exhaust, Particulate	year	10%	10%	50% Cummins DQDAC	100% Cummins DQFAD

a. Determined based on load analysis results presented in Appendix F.

6.9 NO_X TO NO_2 CONVERSION

NO_X is formed when nitrogen in ambient air is exposed to high temperatures during the combustion process. At these temperatures, some nitrogen is converted to NO and NO_2 (collectively referred to as NO_X). This project includes NO_X emitted from the gensets from IGQ project. Emission factors for these units are for emissions of NO_X, while the ambient air quality objective is for NO_2. In order to estimate the amount of NO_2 concentration from the amount of emitted NO_X, the following modeling approaches are applied to AERMOD inputs:

- Plume Volume Molar Ratio Method (PVMRM) in AERMOD;
- In-stack ratio (ISR) of 0.1 for all generators. The ISR is aligned with other recent approved data center analyses, and is a conservative value based on EPA's ISR data base for uncontrolled engines firing diesel or kerosene.[10]
- Ozone background concentration of 52 ppb, based on NW-AIRQUEST at the site location.[11]

6.10 NAAQS ANALYSIS

This section discusses the modeling analysis performed to demonstrate compliance with the NO_2, PM_{10}, $PM_{2.5}$, CO, and SO_2 NAAQS. NAAQS compliance demonstration is required to protect the human health and public welfare.

6.10.1 Background Concentration

The background concentration of a pollutant is based on other industrial sites, residential pollutions, and/or naturally occurring impacts. In order to appropriately predict the overall air quality in the area after the IGQ project is constructed, a background concentration is included for PM_{10}, $PM_{2.5}$, NO_2, SO_2 and CO for NAAQS compliance demonstration. The background concentrations used for this modeling analysis are summarized in Table 6-3, which are obtained from NW-AIRQUEST and Ecology's Quincy DPM and NO2 analysis to represent both a local and regional concentration to be added to the project modeling analysis.[12]

[10] Filtered available entries in Excel file "NO_2_ISR_database.xlsx", EPA NO_2/NO_X in-stack ratio database, available at https://www.epa.gov/scram/nitrogen-dioxidenitrogen-oxide-stack-ratio-isr-database, accessed September 24, 2021. The average ISR for RICE firing diesel or kerosene is 0.07.

[11] Northwest Airquest data hosted by Idaho Department of Environmental Quality, available at https://idahodeq.maps.arcgis.com/apps/MapSeries/index.html?appid=0c8a006e11fe4ec5939804b873098dfe accessed on September 24, 2021.

[12] Quincy DPM and NO2 Analyses, Wasington Department of Ecology, available at https://waecy.maps.arcgis.com/apps/MapSeries/index.html?appid=12d296d4ce9c41ffba73175b76ad8716 and accessed on September 24, 2021.

Table 6-3. Background Concentrations for NAAQS Analysis

Pollutant	Averaging Period	Local Background Concentration [a] (µg/m³)	Regional Background Concentration [b] (µg/m³)	NAAQS (µg/m³)
PM_{10}	24-hour	13	77.9	150
$PM_{2.5}$	24-hour	3.0	18.5	35
$PM_{2.5}$	Annual	0.71	5.7	12
NO_2 [c]	1-hour	--	55.6	188
NO_2	Annual	1.3	5.6	100
SO_2	1-hour	24	8.0	196
SO_2	3-hour	14	14.7	1,300
CO	1-hour	269	1,293.6	40,000
CO	8-hour	77	904.4	10,000

a. Local background concentration, per Ecology's direction, are the modeled project impacts from the most recent permit application for a data center in the area, those of the MWH Data Center. https://ecology.wa.gov/DOE/files/5b/5bd1b11d-7c93-443e-807c-bddd44ef912c.pdf. Note that the maximum model concentration from Attachment 4-3 was conservatively selected rather than the impact at Sabey's fenceline.

b. The background concentrations for pollutants other than PM_{10}, $PM_{2.5}$, and NO_2 are provided in ppb. The concentrations are converted in accordance with EPA's standard condition (i.e., 760 mmHg ambient pressure and 25 °C ambient temperature).

c. The background NO_2 1-hr value was obtained from hyper-local background concentrations in Quincy developed by Ecology using modeling of local sources and regional background data. This background concentration, per conversations with Ecology, represents the average of background values for those receptors included in the hyper-local model located just outside the facility boundary.

6.10.2 Monte Carlo

The 1-hour NO_2 and 24-hour $PM_{2.5}$ NAAQS are in a probabilistic format. The generators will not be operated continuously throughout the year; rather, the generators' emissions will be intermittent and only during testing and emergency operations. Therefore, in order to account for the intermittent nature of the modeled sources and the likelihood of those periods of operation aligning with the worst-case meteorological conditions for pollutant dispersion, the ambient impact analysis was performed using the Monte Carlo statistical approach with a script developed by Ecology for the software "R".[13] This script takes into account the low probability of all intermittent emission sources occurring on days with meteorological conditions for poor pollutant dispersion within a year. It processes post files generated in AERMOD for the intermittent sources and uses random sampling to assign days of operation to days of meteorological conditions. The script then calculates the median 98th percentile 1-hour or 24-hour concentrations among 1,000 iterations for all receptors to determine the design value used for comparison to the 1-hour NO_2 NAAQS and 24-hour $PM_{2.5}$ NAAQS.

In addition to using the Monte Carlo analysis for the probabilistic 1-hour NO_2 and 24-hour $PM_{2.5}$ standards, Sabey has implemented the Monte Carlo analysis for the PM_{10} 24-hour standard. Though not a probabilistic standard, the PM_{10} emissions from the project are similarly intermittent in nature (in fact, emission rates of $PM_{2.5}$ and PM_{10} are identical for this analysis). As such, Sabey developed a modified version of Ecology's Monte Carlo R script to more closely align with the PM_{10} NAAQS standard. In this modified script, the selected percentile for the "PM2.5" formula in the script is modified from the 98th percentile to the 99.7th percentile. This corresponds with the second-high in a 3 year dataset, and therefore represents the value that would otherwise be selected for a PM_{10} NAAQS modeling analysis. In using the Monte Carlo analysis, the intermittent nature of the source and the associated likelihood of those emissions overlapping with worst-case meteorological conditions for pollutant dispersion are more accurately accounted for.

[13] The Monte Carlo script is provided by Ranil Dhammapala (Ecology) on June 11, 2021.

The inputs to the Monte Carlo script include the AERMOD post files that represent all possible monthly and annual operations, including:

- 59 generators (57 main gensets and 2 support gensets) operating simultaneously for emergency, maintenance, or testing operations, for up to 2 calendar days per year.
- Each engine may be tested monthly for 11 months per year. In order to test all 59 generators in a given month, the testing may take up to 5 calendar days per month (assuming up to 12 hours per day of testing). The five generators that result in the highest offsite concentrations on an hourly or daily basis (model IDs E10, E13, E14, E15 and E26 for NO_X and E10, E14, E15, E26, and E27 for $PM_{2.5}$/PM_{10}) based on the NO_X and $PM_{2.5}$/PM_{10} load analysis are conservatively included to represent the monthly testing scenario.
- Each engine may be operated for annual load testing and maintenance testing for up to 6 hours per year (i.e., 354 engine-hours per year). In order to conservatively represent this operation scenario, the generator that results in the highest offsite concentration on hourly basis (model ID E15 for NO_X and E26 for $PM_{2.5}$/PM_{10}) based on the NO_X and $PM_{2.5}$/PM_{10} load analysis is modeled for 45 days per year. Based on a conservative 8-hour operating day for maintenance and testing.

Note that on an annual basis each engine associated with Building D and E is limited to 30 hours per year of operation.

6.10.3 NO_2 NAAQS Analysis

NO_2 NAAQS includes a 1-hour standard and an annual standard. The 1-hour NO_2 is in the form of 3-year average of 98th percentile 1-hour daily maximum concentrations, and the annual NO_2 is in the form of annual mean concentration. As discussed in Section 6.7, modeling parameters corresponding to 100% load are used for NO_2 modeling for all engines.

6.10.3.1 1-hour NO_2 NAAQS Compliance Demonstration

The 1-hour NO_2 NAAQS analysis relied on the Monte Carlo methodology. The source parameters for all generators modeled for the NO_2 NAAQS demonstration are summarized in Table 6-4.

Table 6-4. 1-hr NO_2 NAAQS Model Source Parameters

Pollutant	Averaging Period	Load Scenario [a]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Modeled Emission Rate (g/s/genset)
NO_2	1-hour	Buildings D and E (E1-E4, E6-E30, E36-E40)	18.29	724.15	47.23	0.46	7.846E+00
		Building E (E31-E35)	18.29	751.48	47.23	0.46	7.846E+00
		Building D Support Genset	3.66	770.48	58.97	0.15	8.632E-01
		Building E Support Genset	3.66	505.37	11.04	0.30	1.885E-01

a. Based on load analysis results as discussed in Section 6.7.

According to Ecology's instructions, the median of all iterations from Monte Carlo output should be used to determine compliance with NAAQS. The results are summarized in Table 6-5, which demonstrates compliance with 1-hour NO_2 NAAQS.

Table 6-5. 1-hr NO_2 NAAQS Model Results

Pollutant and Averaging Period	Monte Carlo Design Value [1] (µg/m³)	UTM Easting (m)	UTM Northing (m)	Background (µg/m³)	1-hr NO_2 NAAQS (µg/m³)
NO_2 1-hour	183.46	286,519.8	5,236,106.7	56	188

a. The design value from the Monte Carlo output is the maximum of the median 98th percentile 1-hour concentrations across all modeled receptors for the 1,000 iterations of the analysis. This design value is inclusive of the background concentration provided in this table.

6.10.3.2 Annual NO_2 NAAQS Compliance Demonstration

Sabey proposes 30 hrs/yr limit on all of the Building D and E generators. Therefore, an annual emission rate representing annual generator operations are modeled for all generators. The source parameters for all generators are summarized in Table 6-6.

Table 6-6. Annual NO_2 NAAQS Model Source Parameters

Pollutant	Averaging Period	Load Scenario [a]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Modeled Emission Rate (g/s/genset)
NO_2	Annual	Buildings D and E (E1-E4, E6-E30, E36-E40)	18.29	724.15	47.23	0.460.46	2.684E-02
		Building E (E31-E35)	18.29	751.48	47.23	0.46	2.684E-02
		Building D Support Genset	3.66	770.48	58.97	0.15	2.953E-03
		Building E Support Genset	3.66	505.37	11.04	0.30	6.451E-04

a. Based on load analysis results as discussed in Section 6.7.
b. Annual emissions are scaled to 30 hrs/yr based on the maximum hourly emission rate at 100% load.

Annual NO_2 model result is presented in Table 6-7, which shows the maximum modeled concentration plus background will be below the annual NO_2 NAAQS.

Table 6-7. Annual NO_2 NAAQS Model Result

Pollutant and Averaging Period	Maximum Modeled Concentration [a] (µg/m³)	UTM Easting (m)	UTM Northing (m)	Local Background (µg/m³)	Regional Background (µg/m³)	Total Modeled Concentration (µg/m³)	Annual NO_2 NAAQS (µg/m³)
NO_2 Annual	2.9	287,062.5	5,236,030.1	1.3	5.6	9.9	100

a. The corresponding year with the maximum modeled concentration is 2020.

6.10.4 $PM_{2.5}$ NAAQS Analysis

$PM_{2.5}$ NAAQS includes a 24-hour standard and an annual standard. The 24-hour $PM_{2.5}$ NAAQS is in the form of 3-year average of 98th percentile 24-hour daily maximum concentrations, and the annual $PM_{2.5}$ NAAQS is in the form of annual mean concentration averaged over 3 years. As discussed in Section 6.7, modeling parameters corresponding to 10% load are used for $PM_{2.5}$ 24-hour and annual modeling for all main gensets and the support genset at Building D. Those modeling parameters corresponding to 100% load are used for $PM_{2.5}$ 24-hour and annual modeling for the support genset at Building E.

6.10.4.1 24-hour $PM_{2.5}$ NAAQS Compliance Demonstration

$PM_{2.5}$ 24-hour NAAQS used the Monte Carlo scenario described in Section 6.10.2. The individual engines selected for use in the Monte Carlo analysis to conservatively represent expected operating scenarios are described in Section 6.10.2 as well. The overall genset parameters for all units are selected based on the load analysis outlined in Section 6.7, and the source parameters are summarized in Table 6-8.

Table 6-8. 24-hr $PM_{2.5}$ NAAQS Model Source Parameters

Pollutant	Averaging Period	Load Scenario [a]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Modeled Emission Rate (g/s/genset)
$PM_{2.5}$	24-hr	Buildings D and E (E1-E4, E6-E30, E36-E40)	18.29	605.93	12.66	0.46	1.687E-01
		Building E (E31-E35)	18.29	594.82	12.66	0.46	1.148E-01
		Building D Support Genset	3.66	540.93	15.91	0.15	4.891E-02
		Building E Support Genset	3.66	675.71	47.13	0.30	3.060E-02

a. Based on load analysis results as discussed in Section 6.7.

As shown in Table 6-9, the maximum median concentration from the Monte Carlo analysis plus background will remain below the NAAQS.

Table 6-9. 24-hr $PM_{2.5}$ NAAQS Model Result

Pollutant and Averaging Period	Monte Carlo Design Value [a] (μg/m³)	UTM Easting (m)	UTM Northing (m)	Local Background (μg/m³)	Regional Background (μg/m³)	24-hr $PM_{2.5}$ NAAQS (μg/m³)
$PM_{2.5}$ 24-hr	27.12	286,522.4	5,236,176.7	3.0	18.5	35

a. The design value from the Monte Carlo output is the maximum of the median 98th percentile 24-hour concentrations across all modeled receptors for the 1,000 iterations of the analysis. This design value is inclusive of the background concentrations provided in this table.

6.10.4.2 Annual $PM_{2.5}$ NAAQS Compliance Demonstration

The annual $PM_{2.5}$ NAAQS is in the form of 3-year average of annual arithmetic mean. As discussed in Section 6.7, 10% load for the main gensets, 10% load for the support genset at Building D and 100% load for the support genset at Building E are the worst-case loads on an annual basis for $PM_{2.5}$. Therefore, modeling parameters, including emission rates, corresponding to those operating loads are used for annual $PM_{2.5}$ modeling, which are summarized in Table 6-10. The emission rates for all units are scaled to 30 hrs/yr for each generator.

Table 6-10. Annual $PM_{2.5}$ NAAQS Model Source Parameters

Pollutant	Averaging Period	Load Scenario [a]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Modeled Emission Rate [b] (g/s/genset)
$PM_{2.5}$	Annual	Buildings D and E (E1-E4, E6-E30, E36-E40)	18.29	605.93	12.66	0.46	5.759E-04
		Building E (E31-E35)	18.29	594.82	12.66	0.46	3.918E-04
		Building D Support Genset	3.66	540.93	15.91	0.15	1.669E-04
		Building E Support Genset	3.66	675.71	47.13	0.30	1.044E-04

a. Based on load analysis results as discussed in Section 6.7.
b. Annual emissions are scaled to 30 hrs/yr based on the maximum hourly emission rate and an assumed 28 cold-start hours per year per genset.

The 5-year average annual $PM_{2.5}$ model result plus the background is summarized in Table 6-11, which demonstrates compliance with the NAAQS.

Table 6-11. Annual $PM_{2.5}$ NAAQS Model Result

Pollutant and Averaging Period	Maximum Modeled Concentration [a] (µg/m³)	UTM Easting (m)	UTM Northing (m)	Local Background (µg/m³)	Regional Background (µg/m³)	Total Modeled Concentration (µg/m³)	Annual $PM_{2.5}$ NAAQS (µg/m³)
$PM_{2.5}$ Annual	0.18	287,062.5	5,236,030.1	0.71	5.7	6.6	12

a. The highest 1st high modeled concentration over the 5 modeled years for all receptors is listed here.

6.10.5 PM_{10} NAAQS Compliance Demonstration

PM_{10} 24-hr NAAQS standard allows one exceedance per year. As mentioned previously, in order to represent the intermittent nature of the genset operations accurately, PM_{10} 24-hour NAAQS uses the Monte Carlo scenario described in Section 6.10.2. As discussed in Section 6.7, 10% load for the main gensets, 10% load for the support genset at Building D and 100% load for the support genset at Building E are the worst-case loads on a 24-hour basis for PM_{10}. The input parameters for each generator are summarized in Table 6-12.

Table 6-12. PM_{10} NAAQS Model Source Parameters

Pollutant	Averaging Period	Load Scenario [a]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Modeled Emission Rate [b] (g/s/genset)
PM_{10}	24-hr	Buildings D and E (E1-E4, E6-E30, E36-E40)	18.29	605.93	12.66	0.46	1.687E-01
		Building E (E31-E35)	18.29	594.82	12.66	0.46	1.148E-01
		Building D Support Genset	3.66	540.93	15.91	0.15	4.891E-02
		Building E Support Genset	3.66	675.71	47.13	0.30	3.060E-02

a. Based on load analysis results as discussed in Section 6.7.

As shown in Table 6-13, the maximum median concentration from the Monte Carlo analysis (using the modified Monte Carlo R script for PM_{10}) plus background will remain below the NAAQS.

Table 6-13. PM_{10} NAAQS Model Results

Pollutant and Averaging Period	Monte Carlo Design Value [a] (μg/m³)	UTM Easting (m)	UTM Northing (m)	Local Background (μg/m³)	Regional Background (μg/m³)	24-hour PM_{10} NAAQS (μg/m³)
PM_{10} 24-hr	132.50	287,062.5	5,236,030.1	13	77.9	150

a. The PM_{10} 24-hr NAAQS shall not be exceeded more than once per year. The design value from the Monte Carlo output is the maximum of the median 99.7th percentile 24-hour concentrations (corresponding with the highest second-high value over a 3-year dataset) across all modeled receptors for the 1,000 iterations of the analysis. This design value is inclusive of the background concentrations provided in this table.

6.10.6 CO NAAQS Compliance Demonstration

CO NAAQS includes a 1-hour and a 3-hour standard both of which are not to be exceeded once per year (i.e., the 2nd highest modeled results are used for compliance demonstration). As discussed in Section 6.7, 10% load model parameters for the main gensets, 50% load model parameters for the support genset at Building D, and 100% load model parameters for the support genset at Building E are used for CO NAAQS modeling. All generators are modeled. The input parameters for each generator are summarized in Table 6-14.

Table 6-14. CO NAAQS Model Source Parameters

Pollutant	Averaging Period	Load Scenario [a]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Modeled Emission Rate [b] (g/s/genset)
CO	1-hr and 8-hr	Buildings D and E (E1-E4, E6-E30, E36-E40)	18.29	672.59	19.46	0.46	1.594E+00
		Building E (E31-E35)	18.29	661.48	19.46	0.46	3.569E-01
		Building D Support Genset	3.66	691.21	44.37	0.15	4.541E-01
		Building E Support Genset	3.66	675.71	47.13	0.30	1.468E+00

a. Based on load analysis results as discussed in Section 6.7.

The second highest model results, plus the background corresponding to the modeled averaging period, are summarized in Table 6-15, which demonstrates compliance with the CO NAAQS.

Table 6-15. CO NAAQS Model Results

Pollutant and Averaging Period	H2H Modeled Concentration [1] (µg/m³)	UTM Easting (m)	UTM Northing (m)	Local Background (µg/m³)	Background (µg/m³)	Total Modeled Concentration (µg/m³)	CO NAAQS (µg/m³)
CO 1-hr	4,985.2	286,519.4	5,236,096.7	269	1,293.6	6,547.8	40,000
CO 8-hr	2,040.8	286,519.8	5,236,106.7	77	904.4	3,022.1	10,000

a. The CO 1-hr and 8-hr NAAQS shall not be exceeded more than once in each year. Therefore, the highest 2nd high concentration across all receptors is listed here. The listed 1-hr concentration occurred in 2019 and the listed 8-hr concentration occurred in modeled year 2018.

6.10.7 SO_2 NAAQS Compliance Demonstration

The primary SO_2 1-hour NAAQS is in the form of 3-year average of 99th percentile of the annual distribution of daily maximum 1-hour concentration. Therefore, the highest 4th high result over the modeled 3-year period is used for SO_2 1-hour compliance demonstration. The SO_2 3-hour NAAQS is a secondary standard, which is not to be exceeded more than once per calendar year. Therefore, the maximum highest 2nd high result over each modeled year is used for SO_2 3-hour compliance demonstration. As discussed in Section 6.7, 100% load model parameters are used for all main and support gensets for SO_2 NAAQS modeling. All generators are modeled. The input parameters for each generator are summarized in Table 6-16.

Table 6-16. SO_2 NAAQS Model Source Parameters

Pollutant	Averaging Period	Load Scenario [a]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Modeled Emission Rate [b] (g/s/genset)
SO_2	1-hr and 3-hr	Buildings D and E (E1-E4, E6-E30, E36-E40)	18.29	724.15	47.23	0.46	5.555E-03
		Building E (E31-E35)	18.29	751.48	47.23	0.46	4.952E-03
		Building D Support Genset	3.66	770.48	58.97	0.15	1.240E-01
		Building E Support Genset	3.66	675.71	47.13	0.30	3.394E-03

a. Based on load analysis results as discussed in Section 6.7.
b. Hourly emission rates are based on AP-42 emission factors and the maximum engine horsepower.

The model results matching the form of the standard for each averaging period, plus the background corresponding to the modeled averaging period, are summarized in Table 6-17, which demonstrates compliance with the SO_2 NAAQS.

Table 6-17. SO_2 NAAQS Model Results

Pollutant and Averaging Period	Modeled Concentration [1] (µg/m³)	UTM Easting (m)	UTM Northing (m)	Local Background (µg/m³)	Regional Background (µg/m³)	Total Modeled Concentration (µg/m³)	SO_2 NAAQS (µg/m³)
SO_2 1-hour	77.9	287,126.9	5,236,153.0	24	8.0	109.8	196
SO_2 3-hour	56.9	287,070.9	5,236,035.6	14	14.7	85.6	1,300

a. The highest 4th high result over the modeled 3-year period is used for 1-hour SO_2 NAAQS compliance demonstration. The highest 2nd high result from the maximum modeled year (in this case 2019) is used for 3-hour SO_2 NAAQS compliance demonstration.

6.11 TAP ANALYSIS

As discussed in Section 4.5.1, dispersion modeling is required for acrolein, benzene, naphthalene, SO_2, CO, DPM, and NO_2 using the following approaches:

- The load analysis performed for TAPs with emissions determined based on fuel usage (see Appendix F for acrolein, benzene, and naphthalene) showed that 100% load has the maximum impact on both 24-hour averaging period and annual averaging period concentrations for the main gensets. Therefore, for both the main and support gensets, the 100% load source parameters, including corresponding emission rates, are used for modeling acrolein, benzene, and naphthalene.
- A comprehensive load analysis for the main gensets was performed for DPM with the load-specific data across all vendors (see Appendix F). It was determined that the maximum offsite impact results from modeling all engines with the Cummins DQKAF 10% load emission profile and the CAT 3516C 10% load emission profile. Therefore, the DPM models are set up using Cummins' DQKAF 10% load emission profile and source parameters for the five identified main gensets at Building E and CAT 3516C 10% load emission profile and source parameters for the remaining main gensets. 50% load with the Cummins' DQDAC support genset represents the worst-case load for the support genset at Building D and the operations at 100% load for the Cummins DQFAD engine represent the worst-case load for the support genset at Building E. The corresponding emission rates and parameters are used for modeling DPM emissions from the support gensets.
- SO_2, CO and NO_2 modeling parameters are consistent with the NAAQS analysis for the 1-hour averaging period. All engines are modeled with the parameters presented in Table 6-4, Table 6-14, and Table 6-16 for simultaneous operation. Additionally, NO_2 modeling applied the same NO_2 to NO_X conversion approach as described in Section 6.9.

Table 6-18 shows the maximum modeled concentration and corresponding meteorological year for each TAP. Model files are provided in Appendix G.

Table 6-18. Maximum Modeled TAP Concentrations

Year	Toxic Air Pollutant	Averaging Period	Maximum Modeled Concentration (μg/m³)	UTM Easting (m)	UTM Northing (m)	ASIL (μg/m³)	% of ASIL
2018	Acrolein	24-hr	1.35E-02	287,062.5	5,236,030.1	3.50E-01	3.9%
2020	Benzene	Annual	1.01E-03	287,062.5	5,236,030.1	1.30E-01	0.8%
2019	CO	1-hr	5.05E+03	286,519.4	5,236,096.7	2.30E+04	22.0%
2020	DPM	Annual	5.11E-02	287,062.5	5,236,030.1	3.30E-03	1549.4%
2020	Naphthalene	Annual	1.60E-04	287,062.5	5,236,030.1	2.90E-02	0.6%
2018	NO2	1-hr	2.40E+03	281,629.4	5,243,621.7	4.70E+02	511.6%
2019	SO2	1-hr	8.80E+01	287,127.3	5,236,163.0	6.60E+02	13.3%

As shown in Table 6-18, acrolein, benzene, naphthalene, SO_2, and CO are in compliance with their corresponding ASIL, but DPM and NO_2 are in exceedance of the ASIL. Therefore, a second tier review will be conducted to demonstrate that DPM and NO_2 emissions from the project do not have significant health impacts on the community.

APPENDIX A. APPLICATION FORMS AND SEPA DOCUMENTATION

DEPARTMENT OF ECOLOGY State of Washington

Notice of Construction Application

A notice of construction permit is required before installing a new source of air pollution or modifying an existing source of air pollution. This application applies to facilities in Ecology's jurisdiction. Submit this application for review of your project. For general information about completing the application, refer to Ecology Forms ECY 070-410a-g, "Instructions for Ecology's Notice of Construction Application."

Ecology offers up to two hours of free pre-application assistance. We encourage you to schedule a pre-application meeting with the contact person specified for the location of your proposal, below. If you use up your two hours of free pre-application assistance, we will continue to assist you after you submit Part 1 of the application and the application fee. You may schedule a meeting with us at any point in the process.

Upon completion of the application, please enclose a check for the initial fee and mail to:

Department of Ecology
Cashiering Unit
P.O. Box 47611
Olympia, WA 98504-7611

For Fiscal Office Use Only:
001-NSR-216-0299-000404

Check the box for the location of your proposal. For assistance, call the contact listed below:		
	Ecology Permitting Office	**Contact**
☐ **CRO**	**Chelan, Douglas, Kittitas, Klickitat, or Okanogan County** Ecology Central Regional Office – Air Quality Program	Lynnette Haller (509) 457-7126 lynnette.haller@ecy.wa.gov
☒ **ERO**	**Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Stevens, Walla Walla or Whitman County** Ecology Eastern Regional Office – Air Quality Program	Karin Baldwin (509) 329-3452 karin.baldwin@ecy.wa.gov
☐ **NWRO**	**San Juan County** Ecology Northwest Regional Office – Air Quality Program	David Adler (425) 649-7267 david.adler@ecy.wa.gov
☐ **IND**	**For actions taken at Kraft and Sulfite Paper Mills and Aluminum Smelters** Ecology Industrial Section – Waste 2 Resources Program Permit manager: ______________________	James DeMay (360) 407-6868 james.demay@ecy.wa.gov
☐ **NWP**	**For actions taken on the US Department of Energy Hanford Reservation** Ecology Nuclear Waste Program	Lilyann Murphy (509) 372-7951 lilyann.murphy@ecy.wa.gov

Check the box below for the fee that applies to your application.

To request ADA accommodation, call (360) 407-6800, 711 (relay service), or 877-833-6341(TTY).

Notice of Construction Application

New project or equipment:

☐	**$1,500: Basic project** initial fee covers up to 16 hours of review.
☒	**$10,000: Complex project** initial fee covers up to 106 hours of review.

Change to an existing permit or equipment:

☐	**$200: Administrative or simple change** initial fee covers up to 3 hours of review Ecology may determine your change is complex during completeness review of your application. If your project is complex, you must pay the additional $675 before we will continue working on your application.
☐	**$875: Complex change** initial fee covers up to 10 hours of review
☐	**$350** flat fee: **Replace or alter control technology equipment under WAC 173-400-114** Ecology will contact you if we determine your change belongs in another fee category. You must pay the fee associated with that category before we will continue working on your application.

Read each statement, then check the box next to it to acknowledge that you agree.

☒	The initial fee you submitted may not cover the cost of processing your application. Ecology will track the number of hours spent on your project. If the number of hours Ecology spends exceeds the hours included in your initial fee, Ecology will bill you $95 per hour for the extra time.
☒	You must include all information requested by this application. Ecology may not process your application if it does not include all the information requested.
☒	Submittal of this application allows Ecology staff to visit and inspect your facility.

DEPARTMENT OF ECOLOGY State of Washington

Notice of Construction Application

Part 1: General Information

I. Project, Facility, and Company Information

1. Project Name Building E Expansion Notice of Construction	
2. Facility Name Intergate Quincy	
3. Facility Street Address 2200 M Street NE, Quincy, WA 98848	
4. Facility Legal Description S9 T20N R24E	
5. Company Legal Name (if different from Facility Name) Sabey Data Center Properties	
6. Company Mailing Address (street, city, state, zip) 12201 Tukwila International Boulevard, 4th Floor, Seattle, WA 98168	

II. Contact Information and Certification

1. Facility Contact Name (who will be onsite) Shaun Devine	
2. Facility Contact Mailing Address (if different than Company Mailing Address) Same as company mailing address	
3. Facility Contact Phone Number shaund@sabey.com	4. Facility Contact E-mail 206-277-5343
5. Billing Contact Name (who should receive billing information) Lisa Carr	
6. Billing Contact Mailing Address (if different than Company Mailing Address) Same as company mailing address	
7. Billing Contact Phone Number 206-281-8700	8. Billing Contact E-mail lisac@sabey.com
9. Consultant Name (optional – if 3rd party hired to complete application elements) Ashley Jones	
10. Consultant Organization/Company Trinity Consultants	
11. Consultant Mailing Address (street, city, state, zip) 1391 N Speer Blvd, Suite 350	
12. Consultant Phone Number 720-638-7647	13.Consultant E-mail avjones@trinityconsultants.com
14. Responsible Official Name and Title (who is responsible for project policy or decision-making) Dave Buckner – Director of Engineering	
16. Responsible Official Phone 206-277-5303	17. Responsible Official E-mail daveb@sabey.com
18. Responsible Official Certification and Signature I certify that the information on this application is accurate and complete. Signature [signature] Dave R Buckner (Nov 19, 2021 08:53 PST)	Date Nov 19, 2021

To request ADA accommodation, call (360) 407-6800, 711 (relay service), or 877-833-6341(TTY).

DEPARTMENT OF ECOLOGY
State of Washington

Notice of Construction Application

Part 2: Technical Information

The Technical Information may be sent with this application form to the Cashiering Unit, or may be sent directly to the Ecology regional office with jurisdiction along with a copy of this application form.

For all sections, check the box next to each item as you complete it.

III. Project Description

Please attach the following to your application.

☒ Written narrative describing your proposed project.
☒ Projected construction start and completion dates.
☒ Operating schedule and production rates.
☒ List of all major process equipment with manufacturer and maximum rated capacity.
☐ Process flow diagram with all emission points identified. N/A
☒ Plan view site map.

☒ Manufacturer specification sheets for major process equipment components.
☐ Manufacturer specification sheets for pollution control equipment. N/A
☒ Fuel specifications, including type, consumption (per hour & per year) and percent sulfur.

IV. State Environmental Policy Act (SEPA) Compliance

Check the appropriate box below.

☒ SEPA review is complete:
Include a copy of the final SEPA checklist and SEPA determination (e.g., DNS, MDNS, EIS) with your application.

☐ SEPA review has not been conducted:

☐ If review will be conducted by another agency, list the agency. You must provide a copy of the final SEPA checklist and SEPA determination before Ecology will issue your permit.
Agency Reviewing SEPA:

____

☐ If the review will be conducted by Ecology, fill out a SEPA checklist and submit it with your application. You can find a SEPA checklist online at https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-document-templates

Notice of Construction Application

V. Emissions Estimations of Criteria Pollutants

Does your project generate criteria air pollutant emissions? ☒ Yes ☐ No

If yes, please provide the following information regarding your criteria emissions in your application.

☒ The names of the criteria air pollutants emitted (i.e., NO_x, SO_2, CO, $PM_{2.5}$, PM_{10}, TSP, VOC, and Pb)

☒ Potential emissions of criteria air pollutants in tons per hour, tons per day, and tons per year (include calculations)

☐ If there will be any fugitive criteria pollutant emissions, clearly identify the pollutant and quantity

VI. Emissions Estimations of Toxic Air Pollutants

Does your project generate toxic air pollutant emissions? ☒ Yes ☐ No

If yes, please provide the following information regarding your toxic air pollutant emissions in your application.

☒ The names of the toxic air pollutants emitted (specified in WAC 173-460-150[1])

☒ Potential emissions of toxic air pollutants in pounds per hour, pounds per day, and pounds per year (include calculations)

☐ If there will be any fugitive toxic air pollutant emissions, clearly identify the pollutant and quantity

VII. Emission Standard Compliance

☒ Provide a list of all applicable new source performance standards, national emission standards for hazardous air pollutants, national emission standards for hazardous air pollutants for source categories, and emission standards adopted under Chapter 70.94 RCW.
Does your project comply with all applicable standards identified? ☒ Yes ☐ No

VIII. Best Available Control Technology

☒ Provide a complete evaluation of Best Available Control Technology (BACT) for your proposal.

[1] http://apps.leg.wa.gov/WAC/default.aspx?cite=173-460-150

IX. Ambient Air Impacts Analyses

Please provide the following:

☒ Ambient air impacts analyses for Criteria Air Pollutants (including fugitive emissions)

☒ Ambient air impacts analyses for Toxic Air Pollutants (including fugitive emissions)

☒ Discharge point data for each point included in air impacts analyses (include only if modeling is required)

- ☒ Exhaust height
- ☒ Exhaust inside dimensions (ex. diameter or length and width)
- ☒ Exhaust gas velocity or volumetric flow rate
- ☒ Exhaust gas exit temperature
- ☒ The volumetric flow rate
- ☒ Description of the discharges (i.e., vertically or horizontally) and whether there are any obstructions (ex., raincap)
- ☒ Identification of the emission unit(s) discharging from the point
- ☒ The distance from the stack to the nearest property line
- ☒ Emission unit building height, width, and length
- ☒ Height of tallest building on-site or in the vicinity and the nearest distance of that building to the exhaust
- ☒ Whether the facility is in an urban or rural location

Does your project cause or contribute to a violation of any ambient air quality standard or acceptable source impact level? ☒ Yes ☐ No - Tier 2 TAP Analysis will be submitted. Project complies with NAAQS.

DETERMINATION OF NONSIGNIFICANCE

Description of proposal: Construction of approximately 140,000 square foot data center building and associated site work for Phase 1. With Phase 2 likely beginning in 2021 of 550,000 square foot data center and associated site work. A pre-application meeting was held with the applicant and City departments regarding the project and mitigation of utility requirements will be part of the permit process. Additionally the applicant will be required to mitigate air quality through the Department of Ecology Air Quality permitting process.

Proponent: Sabey Intergate.Quincy VI LLC

Location of proposal, including street address, 2200 M Street NE, Quincy, WA 98848

Lead agency: City of Quincy

The lead agency for this proposal has determined that it does not have a probable significant adverse impact on the environment. An environmental impact statement (EIS) is not required under RCW 43.21C.030 (2)(c). This decision was made after review of a completed environmental checklist and other information on file with the lead agency. This information is available to the public on request.

☐ There is no comment period for this DNS.

☐ This DNS is issued after using the optional DNS process in WAC 197-11-355. There is no further comment period on the DNS.

X This DNS is issued under WAC 197-11-340(2); the lead agency will not act on this proposal for 14 days from the date below. Comments must be submitted by July 18, 2019

Responsible official: Carl Worley

Position/title: Building Official Phone: 509 787 3523

Address PO Box 338 Quincy WA 98848

Date. July 1, 2019 _ Signature Carl Worley

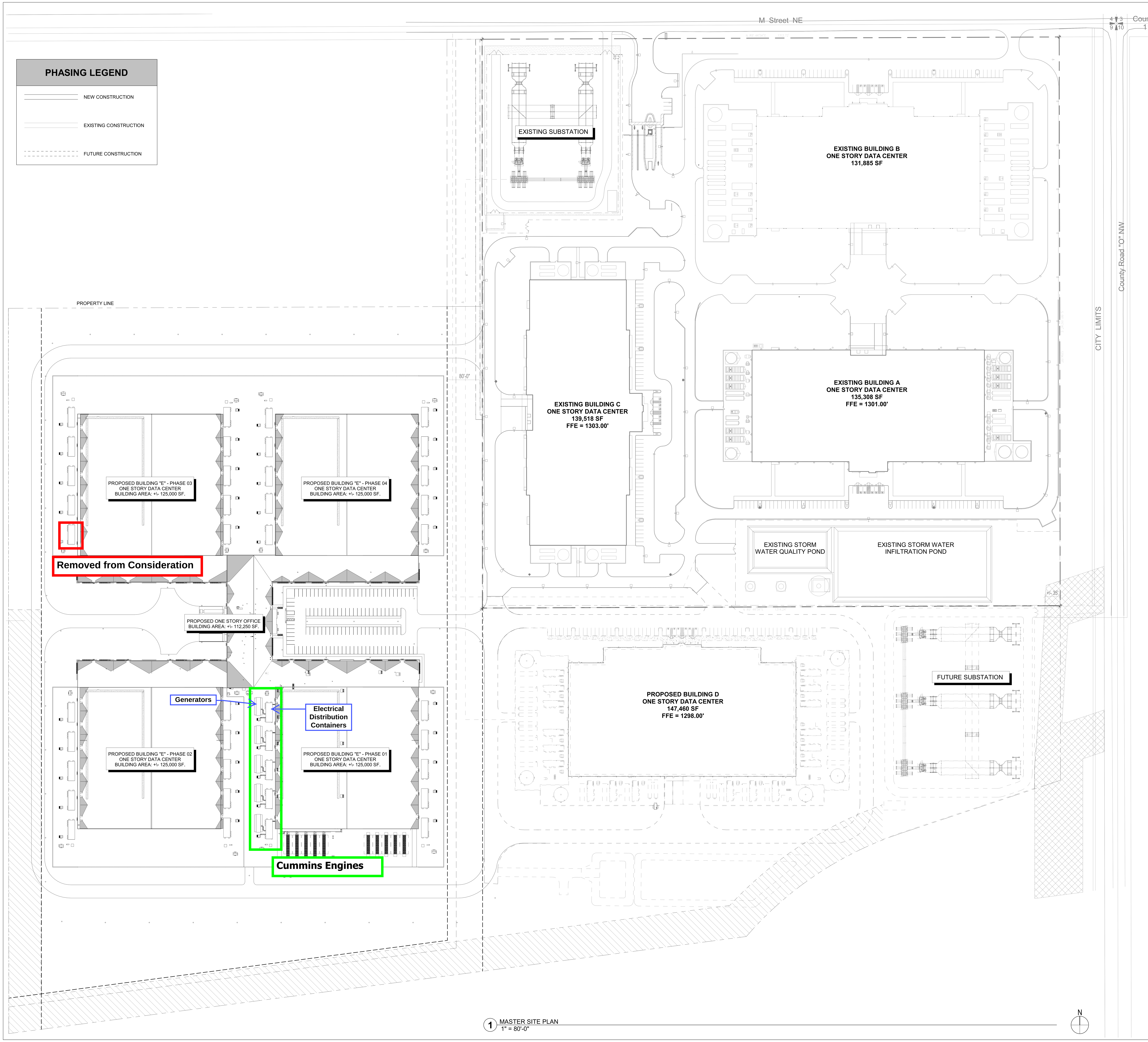
(OPTIONAL)

X You may appeal this determination to: Carl Worley
at 115 First Ave SW
no later than July 18, 2019
by (method) Written

You should be prepared to make specific factual objections.
Contact Carl Worley to read or ask about the procedures for SEPA appeals.

☐ There is no agency appeal.

APPENDIX B. SITE PLAN



SITE PLAN GENERAL NOTES

1. ALL SITE IMPROVEMENTS, INCLUDING LANDSCAPE AND SITE CLEAN UP, MUST BE COMPLETED PRIOR TO CERTIFICATE OF OCCUPANCY FOR ANY BUILDING WITHIN A PHASE.
2. LIGHTING NOTE: ALL EXTERNAL LIGHTING SHALL BE LOCATED AND DESIGNED TO PREVENT RAYS FROM BEING DIRECTED OFF OF THE PROPERTY UPON WHICH THE LIGHTING IS LOCATED. PREVENT RAYS FROM BEING DIRECTED OFF OF THE PROPERTY UPON WHICH THE LIGHTING IS LOCATED
3. MECHANICAL EQUIPMENT NOTES:
   A. ALL ROOF MOUNTED MECHANICAL EQUIPMENT SHALL BE FULLY SCREENED BY PARAPET WALL EQUAL TO, OR GREATER THAN, THE HIGHEST POINT ON THE MECHANICAL EQUIPMENT
   B. SOLID CONCRETE WALLS AND GATES EQUAL TO, OR GREATER THAN, THE HIGHEST POINT ON THE MECHANICAL EQUIPMENT SHALL SCREEN ALL GROUND MOUNTED MECHANICAL EQUIPMENT
4. REFER TO LANDSCAPE PLANS FOR ADDITIONAL INFORMATION
5. THERE SHALL BE NO OBSTRUCTION OF SITE SIGNAGE BY LANDSCAPE PLANT MATERIAL, AND THAT SUCH MAY BE RELOCATED/CORRECTED BEFORE THE FIELD INSPECTION WILL ACCEPT/PASS THE SIGN IN THE FIELD OR ISSUE A CERTIFICATE OF OCCUPANCY FOR A PROJECT.
6. FUTURE PROJECT IDENTIFICATION AND MONUMENT SIGNAGE - SHALL BE SUBMITTED TO THE CITY OF QUINCY FOR APPROVAL OF DESIGN AND LOCATION UNDER SEPARATE PERMIT.
7. ALL SITE IMPROVEMENT: PAVING, CONCRETE CURBS, GUTTERS, ETC. SHALL BE DESIGNED AND INSTALLED PER THE GEOTECHNICAL SOILS REPORTS.
8. ALL PEDESTRIAN SIDEWALKS, CROSSWALKS, AND AISLES THROUGHOUT THE SITE AND INCLUDING CONNECTIONS TO THE PUBLIC WAY ARE PART OF THE ACCESSIBLE ROUTE AND SHALL HAVE BEEN DESIGNED TO MEET ACCESSIBLE ROUTE GUIDELINES AND REQUIREMENTS.
9. CURBING ALONG ALL FIRE ACCESS LANES, OTHER THAN THAT WITHIN PARKING STALLS, SHALL BE PAINTED AND MARKED "NO PARKING - FIRE LANE" PER CITY OF QUINCY
10. FIRE DEPARTMENT: DOUBLE CHECK ASSEMBLY SHALL BE PAINTED TO MATCH ADJACENT WALL COLOR.
11. REQUIRED ACCESS FOR CONSTRUCTION PROJECTS: APPROVED VEHICLE ACCESS OF EMERGENCY VEHICLES SHALL BE PROVIDED TO ALL CONSTRUCTION OR DEMOLITION SITES. VEHICLE ACCESS SHALL BE PROVIDED BY TEMPORARY ROADS, CAPABLE OF SUPPORTING VEHICLES LOADING UNDER ALL WEATHER CONDITIONS. TEMPORARY ACCESS ROADS ACCESS SHALL BE MAINTAINED UNTIL APPROVED PERMANENT ROADS ARE AVAILABLE (FD107). PROVIDE TEMPORARY ACCESS (ROADWAY) TO FURTHEST POINT OF THE FIRST FLOOR OF THE FURTHEST BUILDING TO WITHIN 150 FEET FROM WHERE THE TRUCK CAN STOP. THE ROUTE IS TO BE MEASURED AROUND THE BUILDING(S) ALONG THE ACCESS ROAD(S). AT THE END OF THIS AN APPROVED TURN AROUND OR "T" SHALL BE PROVIDED IN ACCORDANCE CFD DETAIL FD141.
12. ALL STUB OUT AND TEMPORARY FIRE LINE TERMINATIONS (PHASED PROJECTS) SHALL END WITH A PIV PAINTED FOREST GREEN.
13. ALL FIRE HYDRANTS INSTALLED ON PRIVATE AND PUBLIC WATER LINES SHALL BE PROVIDED WITH "OUT OF SERVICE" SIGNS. UPON COMPLETION OF REQUIRED INSPECTIONS, TEST ACCEPTANCE AND APPROVAL OF THE WATER SYSTEM AND THE SYSTEM IS VERIFIED TO BE IN SERVICE, THE "OUT OF SERVICE" SIGNS SHALL BE REMOVED. SIGNS SHALL BE IN ACCORDANCE WITH FD123.
14. ALL GATES WILL BE USED BY THE FIRE DEPARTMENT AND SHALL BE INSTALLED IN ACCORDANCE WITH FIRE DEPARTMENT AND CITY STANDARDS, INCLUDING EXIT ONLY GATES. GATES SHALL BE DESIGNED IN ACCORDANCE WITH ASHBURN FIRE DEPARTMENT DETAIL FD108.
15. ELECTRICALLY OPERATED OR LOCKED GATES INSTALLED ACROSS REQUIRED FIRE APPARATUS ACCESS ROADWAYS SHALL BE PROVIDED WITH PRE-EMPTION DEVICES AND KEY SWITCH. THE GATE(S) WITH THE PRE-EMPTION DEVICES SHALL REMAIN OPEN FOR 30 MINUTES AFTER THE FIRST UNIT ENTERS, TO ALLOW OTHER UNITS OR AMBULANCES TO ENTER DURING EMERGENCIES.
16. G.C. SHALL FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO START OF ANY DEMOLITION, SALVAGING, CONSTRUCTION, ETC.... AND NOTIFY THE ARCHITECT OF ANY DISCREPANCIES IMMEDIATELY AND PRIOR TO COMMENCEMENT OF WORK.
17. AUTHORIZATION FROM OWNER AND APPLICABLE JURISDICTIONS, AGENCIES, COMPANIES, ETC., SHALL BE OBTAINED BY CONTRACTOR PRIOR TO INITIALIZATION OF DEMOLITION WORK AND PRIOR TO SHUTTING OFF, CAPPING, RELOCATING, AND CONTINUING ANY EXISTING SERVICES AND OR UTILITIES.
18. ANY AND ALL SUSPECTED HAZARDOUS MATERIALS SUCH AS LEAD PAINT, ASBESTOS OR OTHER TOXIC MATERIALS DISCOVERED DURING DEMOLITION AND CONSTRUCTION OF NEW WORK MUST BE REPORTED IMMEDIATELY TO THE OWNER FOR ACTION AND ABATEMENT PROCESS AS DIRECTED BY THE OWNER.
19. CONTRACTOR SHALL VERIFY ALL EXISTING AND PROPOSED SITE ELEMENTS AND NOTIFY ARCHITECT OF ANY DISCREPANCIES.
20. CONTRACTOR SHALL LOCATE ALL EXISTING UNDERGROUND UTILITIES AND NOTIFY ARCHITECT OF ANY CONFLICTS. CONTRACTOR SHALL EXERCISE CAUTION WHEN WORKING IN THE VICINITY OF UNDERGROUND UTILITIES.
21. CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL REQUIRED LANDSCAPE AND IRRIGATION PERMITS.
22. ADD NEW SOD OR GROUND COVER AS REQUIRED; RE: LANDSCAPE PLANS.
23. RELOCATED AND/OR ADD IRRIGATION LINES AND HEADS TO PROVIDE NECESSARY COVERAGE AS REQUIRED; RE: LANDSCAPE PLANS.
24. CONTRACTOR TO PROVIDE A MINIMUM OF 2% SLOPE AWAY FROM ALL STRUCTURES.
25. SIDEWALKS AND ACCESSIBLE ROUTES SHALL HAVE A RUNNING SLOPE NO GREATER THAN 5% (UNLESS NOTED OTHERWISE) AND A CROSS SLOPE NO GREATER THAN 2%.
26. ALL DRIVE AND WALK DIMENSIONS ARE FROM THE BACK FACE OF CURB, UNLESS NOTED OTHERWISE.
27. ALL STRIPING SHALL BE 4" WIDE UNLESS NOTED OTHERWISE.
28. FIRE LANE STRIPING SHALL CONFORM TO GENERAL DESIGN STANDARDS AS OUTLINED BY THE CITY OF QUINCY.
29. CONTRACTOR SHALL SUBMIT A JOINT SPACING PLAN TO THE ENGINEER AND ARCHITECTS FOR APPROVAL. EXPANSION JOINT SPACING SHALL BE 90' MAX. EACH WAY WITH NO KEYWAYS AND SAWED DUMMY JOINTS SHALL BE 15' EACH WAY UNLESS NOTED OTHERWISE.
30. SECURITY FENCE/GATE CONTROL MECHANISMS SHALL BE INACCESSIBLE/SECURE/ENCLOSED FROM EXTERIOR, EXCEPT FOR REQUIRED FIRE DEPARTMENT ACCESS.
31. CONTRACTOR TO COORDINATE FENCE ELEVATION WITH SURROUNDING GRADES TO MINIMIZE GAPS BELOW FENCE/GATES AS REASONABLY AS POSSIBLE. FENCE SHALL HAVE NO GAPS GREATER THAN 6" AT GRADE LEVEL.
32. FENCE SHALL NOT HAVE ELEVATION JOGS OR SLOPE CHANGES IN A SINGLE PANEL RUN WITHOUT CONSULTING ARCHITECT.
33. CONTRACTOR TO COORDINATE ALL ELECTRICAL SITE CONDUIT STUB UPS.
34. CONCRETE PAVING JOINTS SHALL BE CONSTRUCTED AS RECOMMENDED IN THE GEOTECHNICAL REPORT. EXPANSION JOINTS SHALL BE PLACED AT CHANGES IN DIRECTION OF PAVING, AT DRIVEWAY AND/OR AS SHOWN ON THE DRAWING ON THE DRAWINGS. REF. CITY OF QUINCY GENERAL DESIGN GUIDELINES FOR EXPANSION JOINT DTL.

CORGAN
401 N. Houston St
Dallas, TX 75202
T: 214-748-2000

McKinstry
For The Life Of Your Building

ENW STRUCTURAL ENGINEERS
Engineers Northwest Inc., P.S.

HOLMES ELECTRIC

DAVID EVANS AND ASSOCIATES INC.

ISSUES		
1	12.16.2020	DESIGN DEVELOPMENT
2	01.25.2021	ISSUE FOR PERMIT
3		
4		
5		
6		
7		
8		
9		
10		

REVISIONS

This Document was produced by or under the authority of Registered Architect:

JASON HANNA

This document is incomplete and may not be used for regulatory approval, permit or construction.

Date of issue:
01.25.2020

SABEY
Data Center Properties
12201 Tukwila Int'l Blvd - 4th Floor, Seattle, WA 98168
206.281.8700 sabeydatacenter.com

INTERGATE QUINCY
BUILDING E
2200 M STREET NE
QUINCY, WA 98848

KEYPLAN

A
B C
D E
F G

MASTER SITE PLAN

PROJECT NUMBER M6635.0000
DATE 12.16.2020

SHEET NUMBER
A01.00

APPENDIX C. EMISSION CALCULATIONS AND SUPPORTING DOCUMENTATION

1. Emission Calculation Summary
2. Engine Specifications – Project

   <u>Main Gensets</u>
   - Caterpillar 3516C 2500 kW Specifications
   - Cummins DQKAF 2250 kW Specifications
   - Kohler KD2250 2500 kW Specifications

   Supplementary Controls Data for Main Gensets
   - Cummins DQKAF with DOTC Specifications
   - Kohler KD2250 with Oxidation Catalyst and DPF Specifications

   Support Gensets
   - Caterpillar C9 300 kW Specifications
   - Cummins DQDAC 300 kW Specifications
   - Caterpillar C32 1000 kW Specifications
   - Caterpillar C3512C 1500 kW Specifications
   - Cummins DQFAD 1000 kW Specifications
   - Cummins DQGAB 1500 kW Specifications
   - Kohler KD1000 1000 kW Specifications
   - Kohler KD1500 1500 kW Specifications

Table C-1. Potential Emission Summary

Emission Point	Annual Emission Rate (tpy)							
	PM	PM_{10}	$PM_{2.5}$	SO_2	NO_X	VOC	CO	HAP
Existing Engines and Cooling Units [a]	2.50	3.59	3.59	0.11	39.52	1.09	4.18	0.03
Existing + Proposed Diesel Storage Tanks	--	--	--	--	--	2.00	--	2.00E-02
Building D Main Gensets	0.12	0.43	0.43	0.01	16.80	0.34	3.39	0.01
Building D Support Gensets	2.77E-03	0.01	0.01	0.01	0.10	0.00	0.05	1.84E-04
Building E Main Gensets	0.26	0.89	0.89	0.03	36.39	0.68	6.88	0.02
Building E Support Gensets	1.44E-02	0.02	0.02	0.00	0.66	0.01	0.10	3.49E-04
Buildings D and E Cooling Unit Emissions	1.40E-01	1.40E-01	1.40E-01	--	--	--	--	--
Project Emissions	**0.54**	**1.49**	**1.49**	**0.05**	**53.94**	**1.04**	**10.42**	**0.03**
WAC Exemption Levels [b]	1.25	0.75	0.50	2.00	2.00	2.00	5.00	N/A
NSR Required?	No	Yes	Yes	No	Yes	No	Yes	N/A
Facility-Wide Potential Emissions	**2.90**	**4.94**	**4.94**	**0.16**	**93.47**	**4.13**	**14.60**	**0.08**
Title V Threshold	**--**	100	100	100	100	100	100	25
Title V Required?	**N/A**	No	No	No	No	No	No	No
PSD Major Source Threshold	**--**	250	250	250	250	250	250	N/A
PSD Major Source?	**N/A**	No	No	No	No	No	No	No

a. PTE from existing engines and cooling units are calculated based on the quantity and type of units actually installed and planned. These emissions include permitted emissions for the cooling units and diesel storage tanks included in Approval Order No. 20AQ-E022. HAP emissions are the sum of PTE for the TAPs that are HAPs too, assuming the unlisted HAPs are emitted in negligible amount.

b. WAC exemption levels are listed in WAC 173-400-110 Table 110(5).

Table C-2. Potential Facility-Wide TAP and HAP Emissions

Pollutant	Project Emission Rate	Existing Equipment PTE	Total
	(tpy)		
Acenaphthene	8.68E-05	8.31E-05	1.70E-04
Acenaphthylene	1.71E-04	1.65E-04	3.36E-04
Acetaldehyde	5.03E-04	6.32E-04	1.13E-03
Acrolein	1.50E-04	1.62E-04	3.12E-04
Anthracene	2.29E-05	2.22E-05	4.51E-05
Benzene	1.44E-02	1.40E-02	0.03
Benzo(a)anthracene	1.16E-05	1.14E-05	2.30E-05
Benzo(a)pyrene	4.77E-06	4.59E-06	9.36E-06
Benzo(b)fluoranthene	2.06E-05	1.97E-05	4.02E-05
Benzo(g,h,l)perylene	1.03E-05	9.95E-06	2.03E-05
Benzo(k)fluoranthene	4.05E-06	3.89E-06	7.94E-06
1,3-Butadiene	1.85E-06	9.47E-06	1.13E-05
Chrysene	2.84E-05	2.72E-05	5.55E-05
Dibenz(a,h)anthracene	6.44E-06	6.26E-06	1.27E-05
Fluoranthene	7.50E-05	7.31E-05	1.48E-04
Fluorene	2.39E-04	2.34E-04	4.72E-04
Formaldehyde	1.52E-03	1.68E-03	3.20E-03
Indeno(1,2,3-cd)pyrene	7.69E-06	7.42E-06	1.51E-05
Naphthalene	2.41E-03	2.32E-03	4.73E-03
Phenanthrene	7.57E-04	7.29E-04	1.49E-03
Propylene	5.29E-03	5.56E-03	1.09E-02
Pyrene	6.90E-05	6.68E-05	1.36E-04
Toluene	5.23E-03	5.07E-03	1.03E-02
Xylenes	3.59E-03	3.48E-03	7.07E-03
Diesel engine exhaust, particulate	0.35	0.55	0.90
SO_2	0.05	0.11	0.16
CO	9.94	4.18	14.11
NO_2	4.93	3.95	8.88

Table C-3. Project Operation Scenario Summary

Operation Scenario	Maximum Operations for Each Engine (hr/day/engine)	(hr/yr/engine)	Maximum Operations for All Engines [b] (engine-hr/hr)	(engine-hr/day)	(engine-hr/yr)
Main Genset Running at Any Load [a]	24	30	57	1,368	1,710
Support Genset Running at Any Load	24	30	2	48	60

a. This operating scenario includes all categories of operations, including emergency run, maintenance and testing runs. When all engines are required to be operated at the same time (e.g., emergency operation, certain testing), the maximum number of days of such operation will be 2 days in any given year while keeping the total number of hours per engine per calendar year equal to or below 30. Maintenance and testing runs outside of these 2 days will be operated for a single engine at any hour, up to 24 engine-hours in any day.

b. The project includes 57 main gensets and 2 support genset.

Table C-4. Maximum Project Emissions for All Engines

Pollutant	Maximum Emission for All Engines: Hourly Total for All Engines (lb/hr)	Daily Totals for All Engines (lb/day)	Annual Total for All Engines (tpy)
Particulate Matter (PM)	44	1,059	0.40
Condensable PM	85	2,038	1.04
Particulate Matter <10 microns (PM_{10})	123	2,952	1.35
Particulate Matter < 2.5 microns ($PM_{2.5}$)	123	2,952	1.35
Sulfur Dioxide (SO_2)	5	111	0.05
Carbon Monoxide (CO)	888	21,310	10.42
Nitrogen Oxides (NO_X)	5406	129,735	53.94
Volatile Organic Compounds (VOC)	85	2,038	1.04
Hazardous Air Pollutants (HAPs)	2	51	0.03

Table C-5. Project Worst-Case Hourly Emission Rates Including Startup

Pollutant	Worst-case Emission Rate (lb/hr/engine): Main Genset: Warm	Main Genset: Cold-Start	Main Genset: Startup Emission Rate [a]	Support Genset: Warm	Support Genset: Cold-Start	Support Genset: Startup Emission Rate [a]
Total Hydrocarbons (HC)	1.20	5.12	1.27	0.84	3.58	0.89
Nitrogen Oxides (NO_X)	62.27	58.33	62.20	43.76	40.99	43.71
Carbon Monoxide (CO)	11.16	100.45	12.65	5.68	51.10	6.43
DEEP/PM	0.57	2.44	0.60	0.91	3.90	0.96
$PM_{10}/PM_{2.5}$	1.51	6.44	1.59	1.33	5.69	1.41

a. Startup hourly emission rate assumes one minute of cold-start emissions and 59 minutes of warm engine emissions.

Table C-6. Project TAP Emissions Summary

Pollutant	CAS Number	Averaging Period	Main Gensets (tpy)	Support Gensets (tpy)	De Minimis (lb/averaging period)	SQER (lb/averaging period)	Project Emissions (lb/averaging period)	Modeling Required?
Acetaldehyde	75-07-0	year	5.01E-04	4.20E-05	3.00E+00	60.00	1.09	De Minimis
Acrolein	107-02-8	24-hr	1.57E-04	6.13E-06	1.30E-03	0.03	0.26	Yes
Benzene	71-43-2	year	1.54E-02	2.16E-04	1.00	21.00	31.28	Yes
Benzo(a)anthracene	56-55-3	year	1.24E-05	2.18E-07	0.05	0.89	0.03	De Minimis
Benzo(a)pyrene	50-32-8	year	5.11E-06	6.60E-08	8.20E-03	0.16	1.03E-02	No
Benzo(b)fluoranthene	205-99-2	year	2.21E-05	2.51E-07	0.05	0.89	0.04	De Minimis
Benzo(k)fluoranthene	207-08-9	year	4.33E-06	5.57E-08	0.05	0.89	8.78E-03	De Minimis
1,3-Butadiene	106-99-0	year	0.00E+00	1.85E-06	0.27	5.40	3.71E-03	De Minimis
Chrysene	218-01-9	year	3.04E-05	3.56E-07	0.45	8.90	0.06	De Minimis
Dibenz(a,h)anthracene	53-70-3	year	6.88E-06	1.04E-07	4.10E-03	0.08	1.40E-02	No
Formaldehyde	50-00-0	year	1.57E-03	7.35E-05	1.40	27.00	3.28	No
Indeno(1,2,3-cd)pyrene	193-39-5	year	8.23E-06	1.10E-07	0.05	0.89	0.02	De Minimis
Naphthalene	91-20-3	year	2.58E-03	3.29E-05	0.24	4.80	5.23	Yes
Propylene	115-07-1	24-hr	5.55E-03	1.84E-04	11.00	220	9.17	De Minimis
Toluene	108-88-3	24-hr	5.59E-03	8.18E-05	19.00	370	9.07	De Minimis
Xylenes	1330-20-7	24-hr	3.84E-03	5.63E-05	0.82	16.00	6.23	No
Diesel engine exhaust, particulate	--	year	3.81E-01	1.72E-02	0.03	0.54	797	Yes
SO_2	7446-09-05	1-hr	3.73E-02	1.52E-02	0.46	1.20	4.64	Yes
CO	630-08-0	1-hr	1.03E+01	1.49E-01	1.10	43.00	888	Yes
NO_2	10102-44-0	1-hr	5.32E+00	7.58E-02	0.46	0.87	541	Yes

Table C-7. Building D Load Emission Tables

CAT C9 | **GenSet Power (kW):** 300
Engine size (hp): 480 | **Tier:** 3

	Factor at Various Load % (g/hp-hr)					Hourly Emissions at Various Load % (lb/hr)				
	100	75	50	25	10	100	75	50	25	10
NO_X	4.27	2.92	2.13	1.94	2.61	4.48	2.31	1.19	0.64	0.48
CO	0.45	0.46	0.96	1.36	2.3	0.47	0.37	0.53	0.45	0.42
HC	0.11	0.15	0.32	0.51	0.79	0.11	0.12	0.18	0.17	0.14
PM	0.06	0.08	0.26	0.29	0.34	0.07	0.07	0.15	0.10	0.06
Exhaust Flow Rate (acfm)						2,460.9	2,109.4	1,810.5	1,299.8	851.2
Exhaust Flow Rate (scfm)						936.3	865.5	767.9	569.3	404.7
Exhaust Temperature (°F)						927.2	826.3	784.5	745.0	650.3
Fuel Consumption Rate (gal/hr)						22.7	17.6	13.6	8.7	5.2

Cummins DQDAC | **GenSet Power (kW):** 300
Engine size (hp): 455 | **Tier:** 3

	Factor at Various Load % (g/hp-hr)					Hourly Emissions at Various Load % (lb/hr)				
	100	75	50	25	10	100	75	50	25	10
NO_X	6.83	3.45	2.21	2.08	2.21	6.85	2.60	1.11	0.52	0.22
CO	0.60	1.46	6.34	6.40	6.26	0.60	1.10	3.18	1.60	0.63
HC	0.08	0.09	0.22	0.43	2.92	0.08	0.07	0.11	0.11	0.29
PM	0.08	0.10	0.35	0.50	0.75	0.08	0.08	0.18	0.13	0.08
Exhaust Flow Rate (acfm)						2,279.4	2,118.6	1,714.8	1,099.6	615.0
Exhaust Flow Rate (scfm)						829.7	813.2	727.0	510.0	333.3
Exhaust Temperature (°F)						990	915	785	678	514
Fuel Combustion Rate (gal/hr)						23.07	17.65	12.23	6.82	3.34

Cummins DQKAF with DOTC | **GenSet Power (kW):** 2250
Engine size (hp): 3239 | **Tier:** 2

	Factor at Various Load % (g/hp-hr)					Hourly Emissions at Various Load % (lb/hr)				
	100	75	50	25	10	100	75	50	25	10
NO_X	8.72	5.95	4.55	5.23	8.33	62.27	31.87	16.25	9.34	5.95
CO	0.80	0.40	0.60	1.40	4.40	5.71	2.14	2.14	2.50	3.14
HC	0.07	0.05	0.12	0.26	0.63	0.50	0.27	0.43	0.46	0.45
PM	--	--	--	--	--	0.29	0.16	0.25	0.28	0.24
Exhaust Flow Rate (acfm)						16,429	14,037	11,174	6,770	4,403
Exhaust Flow Rate (scfm)						6,315.5	5,557.9	4,533.2	2,950.7	2,130.2
Exhaust Temperature (°F)						913	873	841	751	631
Fuel Combustion Rate (gal/hr)						153	120	87	50	29

Factors, hourly emission rates, and exhaust flow characteristics are obtained from the Performance Data section in "2250 DQKAF Tier 2.pdf" and "Cummins Exhaust Emission 10 Percent Load Values.docx".

Kohler KD2250 with Oxidation Catalyst and DI | **GenSet Power (kW):** 2500
Engine size (bkW): 2500 | **Tier:** 2
Engine size (hp): 3352

	Factor at Various Load % (g/kWh)					Hourly Emissions at Various Load % (lb/hr)				
	100	75	50	25	10	100	75	50	25	10
NO_X	9.00	5.60	5.80	6.10	9.70	49.60	23.15	15.98	8.41	5.35
CO	1.30	2.60	2.20	8.10	8.00	7.17	10.75	6.06	11.16	4.41
HC	0.14	0.15	0.22	0.35	0.89	0.77	0.62	0.61	0.48	0.49
PM	0.014	0.04	0.03	0.09	0.06	0.09	0.15	0.07	0.13	0.02
Exhaust Flow Rate (kg/hr)						15,017	14,404	9,978	5,904	4,042
Exhaust Flow Rate (acfm)						18,132	17,296	12,031	7,148	4,469
Exhaust Flow Rate (scfm)						7,340.1	7,040.5	4,877.1	2,885.8	1,975.7
Exhaust Temperature (°F)						844	837	842	847	734
Fuel Combustion Rate (gal/hr)						167.1	136.9	95.2	55.4	29.9

Factors, hourly emission rates, and exhaust flow characteristics are obtained from the Performance Data section in "Sabey Data Centers - Quincy Bldg E - Kohler KD Generator Air Quality Information.pdf" under the "KD2500-4" section.

The exhaust flow rate is converted using the following approach:

$$\text{Volume rate} = \frac{\frac{\text{mass in kg/hr} \times 1000\text{ g/kg}}{\text{MW of exhaust air (g/mol)}} \times \text{Gas Constant } \left(\text{m}^3\cdot\text{Pa/(K}\cdot\text{mol)}\right) \times \text{Temperature(K)}}{\text{Ambient Pressure (Pa)}} \times \left(\frac{\text{ft}}{0.3048\text{ m}}\right)^3 \times \frac{1\text{ hr}}{60\text{ min}}$$

Gas constant	8.314	m^3-Pa/(K-mol)
MW of exhaust	28.9647	g/mol (assuming equal to ambient air)
Ambient pressure	101325	Pa

CAT 3516C | **GenSet Power (kW):** 2500
Engine size (hp): 3,633 | **Tier:** 2

	Factor at Various Load % (g/hp-hr)					Hourly Emissions at Various Load % (lb/hr)				
	100	75	50	25	10	100	75	50	25	10
NO_X	6.38	5.15	3.74	3.50	6.47	50.59	31.09	15.44	7.87	7.02
CO	0.76	0.48	0.58	1.47	4.26	6.01	2.88	2.41	3.30	4.62
HC	0.14	0.18	0.29	0.40	0.89	1.10	1.10	1.20	0.90	0.96
PM	0.05	0.05	0.07	0.14	0.29	0.41	0.27	0.29	0.31	0.31
Exhaust Flow Rate (acfm)						19,578.8	15,893.2	12,413.0	7,844.6	4,800.2
Exhaust Flow Rate (scfm)						7,514.3	6,362.1	4,998.6	3,206.9	2,288.2
Exhaust Temperature (°F)						915.20	858.50	850.70	831.10	647.30
Fuel Combustion Rate (gal/hr)						171.3	133.2	97.1	57.2	30.9

Table C-8. Building E Load Emission Tables

CAT 3512C — **GenSet Power (kW):** 1500
Engine size (hp): 2206 — **Tier:** 2

	Factor at Various Load % (g/hp-hr)					Hourly Emissions at Various Load % (lb/hr)				
	100	75	50	25	10	100	75	50	25	10
NO_X	6.58	4.41	4.26	5.85	9.14	31.67	16.02	10.66	8.10	6.24
CO	0.87	0.71	1.47	3.13	6.13	4.17	2.59	3.67	4.33	4.18
HC	0.16	0.23	0.32	0.45	1.06	0.77	0.84	0.79	0.62	0.73
PM	0.04	0.06	0.13	0.29	0.36	0.22	0.22	0.33	0.41	0.25
Exhaust Flow Rate (acfm)						11,734.1	9,868.8	7,435.0	4,776.5	3,338.5
Exhaust Flow Rate (scfm)						5,090.8	4,464.7	3,392.7	2,241.2	1,761.2
Exhaust Temperature (°F)						756.6	706.7	696.7	664.9	540.6
Fuel Consumption Rate (gal/hr)						103.2	81	57.3	33.5	19.5

Factors, hourly emission rates, and exhaust flow characteristics are obtained from the Performance Data section in "3512C 1.5M Tier 2 Technical Data.pdf".

CAT 3516C — **GenSet Power (kW):** 2500
Engine size (hp): 3633 — **Tier:** 2

	Factor at Various Load % (g/hp-hr)					Hourly Emissions at Various Load % (lb/hr)				
	100	75	50	25	10	100	75	50	25	10
NO_X	6.38	5.15	3.74	3.50	6.47	50.59	31.09	15.44	7.87	7.02
CO	0.76	0.48	0.58	1.47	4.26	6.01	2.88	2.41	3.30	4.62
HC	0.14	0.18	0.29	0.40	0.89	1.10	1.10	1.20	0.90	0.96
PM	0.05	0.05	0.07	0.14	0.29	0.41	0.27	0.29	0.31	0.31
Exhaust Flow Rate (acfm)						19,578.8	15,893.2	12,413.0	7,844.6	4,800.2
Exhaust Flow Rate (scfm)						7,514.3	6,362.1	4,998.6	3,206.9	2,288.2
Exhaust Temperature (°F)						915.20	858.50	850.70	831.10	647.30
Fuel Combustion Rate (gal/hr)						171.3	133.2	97.1	57.2	30.9

Factors, hourly emission rates, and exhaust flow characteristics are obtained from the Performance Data section in "3516C 2.5M Tier 2 Technical Data.pdf".

CAT C32 — **GenSet Power (kW):** 1000
Engine size (hp): 1474 — **Tier:** 2

	Factor at Various Load % (g/hp-hr)					Hourly Emissions at Various Load % (lb/hr)				
	100	75	50	25	10	100	75	50	25	10
NO_X	5.97	4.59	4.38	5.37	6.45	19.24	11.23	7.35	4.96	2.93
CO	0.24	0.21	0.66	1.95	6.14	0.79	0.52	1.10	1.81	2.78
HC	0.03	0.09	0..13	0.18	0.74	0.08	0.23	0.22	0.17	0.34
PM	0.04	0.04	0.09	0.25	0.4	0.11	0.09	0.15	0.23	0.18
Exhaust Flow Rate (acfm)						8,065.3	6,813.1	4,775.6	2,856.8	1,981.6
Exhaust Flow Rate (scfm)						3,154.4	2,807.2	2,051.8	1,367.1	1,102.2
Exhaust Temperature (°F)						889.5	821.0	768.5	643.0	489.0
Fuel Consumption Rate (gal/hr)						71	55.6	37.7	21.5	12.4

Factors, hourly emission rates, and exhaust flow characteristics are obtained from the Performance Data section in "C32 1M Tier 2 Technical Data.pdf".

Cummins DQFAD — **GenSet Power (kW):** 1000
Engine size (hp): 1482 — **Tier:** 2

	Factor at Various Load % (g/hp-hr)					Hourly Emissions at Various Load % (lb/hr)				
	100	75	50	25	10	100	75	50	25	10
NO_X	5.4	5.15	5.06	6.7	8.8	17.64	12.62	8.27	5.47	2.88
CO	1.34	0.94	0.72	1.34	4.58	4.38	2.30	1.18	1.09	1.50
HC	0.12	0.15	0.17	0.2	0.58	0.39	0.37	0.28	0.16	0.19
PM	0.28	0.3	0.38	0.48	0.45	0.91	0.74	0.62	0.39	0.15
Exhaust Flow Rate (acfm)						7,540.0	6,370.0	4,500.0	2,780.0	1,918.0
Exhaust Flow Rate (scfm)						2,947.9	2,639.0	1,946.9	1,358.7	1,112.6
Exhaust Temperature (°F)						890.0	814.0	760.0	620.0	450.0
Fuel Consumption Rate (gal/hr)						72.2	54.1	35.8	19.1	10

Factors, hourly emission rates, and exhaust flow characteristics are obtained from the Performance Data section in "1000 DQFAD Tier 2 Info.pdf", "1000 DQFAD NTE.pdf" and "10% Load Engine Data_Apr27_2021.xlsx".

Table C-8. Building E Load Emission Tables

Cummins DQGAB — **GenSet Power (kW):** 1500
Engine size (hp): 2220 — **Tier:** 2

	Factor at Various Load % (g/hp-hr)					Hourly Emissions at Various Load % (lb/hr)				
	100	**75**	**50**	**25**	**10**	**100**	**75**	**50**	**25**	**10**
NO_X	6.99	5.71	5.11	4.55	5.59	34.21	20.96	12.50	5.57	2.74
CO	1.16	0.64	1.02	1.9	4.5	5.68	2.35	2.50	2.32	2.20
HC	0.12	0.19	0.32	0.54	1.39	0.59	0.70	0.78	0.66	0.68
PM	0.05	0.08	0.2	0.55	1.03	0.24	0.29	0.49	0.67	0.50
Exhaust Flow Rate (acfm)						11,783.0	9,751.0	7,557.0	4,755.0	3,112.0
Exhaust Flow Rate (scfm)						4,641.1	4,271.1	3,412.1	2,242.9	1,634.5
Exhaust Temperature (°F)						880.0	745.0	709.0	659.0	545.0
Fuel Consumption Rate (gal/hr)						108	82	57	33	19

Factors, hourly emission rates, and exhaust flow characteristics are obtained from the Performance Data section in "1500 DQGAB Tier 2.pdf", "1500 DQGAB NTE.pdf" and "10% Load Engine Data_Apr27_2021.xlsx".

Cummins DQKAF with DOTC — **GenSet Power (kW):** 2250
Engine size (hp): 3239 — **Tier:** 2

	Factor at Various Load % (g/hp-hr)					Hourly Emissions at Various Load % (lb/hr)				
	100	**75**	**50**	**25**	**10**	**100**	**75**	**50**	**25**	**10**
NO_X	8.72	5.95	4.55	5.23	8.33	62.27	31.87	16.25	9.34	5.95
CO	0.80	0.40	0.60	1.40	4.40	5.71	2.14	2.14	2.50	3.14
HC	0.07	0.05	0.12	0.26	0.63	0.50	0.27	0.43	0.46	0.45
PM	--	--	--	--	--	0.29	0.16	0.25	0.28	0.24
Exhaust Flow Rate (acfm)						16,429	14,037	11,174	6,770	4,403
Exhaust Flow Rate (scfm)						6,315.5	5,557.9	4,533.2	2,950.7	2,130.2
Exhaust Temperature (°F)						913	873	841	751	631
Fuel Combustion Rate (gal/hr)						153	120	87	50	29

Factors, hourly emission rates, and exhaust flow characteristics are obtained from the Performance Data section in "2250 DQKAF Tier 2.pdf" and "Cummins Exhaust Emission 10 Percent Load Values.docx". PM emission rates are obtained from "Cummins DQKAF with Additional Controls.pdf"

Cummins DQKAF — **GenSet Power (kW):** 2250
Engine size (hp): 3239 — **Tier:** 2

	Factor at Various Load % (g/hp-hr)					Hourly Emissions at Various Load % (lb/hr)				
	100	**75**	**50**	**25**	**10**	**100**	**75**	**50**	**25**	**10**
NO_X	8.72	5.95	4.55	5.23	8.33	62.27	31.87	16.25	9.34	5.95
CO	0.80	0.40	0.60	1.40	4.40	5.71	2.14	2.14	2.50	3.14
HC	0.07	0.05	0.12	0.26	0.63	0.50	0.27	0.43	0.46	0.45
PM	0.08	0.06	0.14	0.30	0.58	0.57	0.32	0.50	0.54	0.41
Exhaust Flow Rate (acfm)						16,429	14,037	11,174	6,770	4,403
Exhaust Flow Rate (scfm)						6,408.9	5,642.6	4,604.0	3,000.3	2,170.0
Exhaust Temperature (°F)						893	853	821	731	611
Fuel Combustion Rate (gal/hr)						153	120	87	50	29

Factors, hourly emission rates, and exhaust flow characteristics are obtained from the Performance Data section in "2250 DQKAF Tier 2.pdf" and "Cummins Exhaust Emission 10 Percent Load Values.docx".

Kohler KD1000 — **GenSet Power (kW):** 1000
Engine size (hp): 1494 — **Tier:** 2
Engine size (kW): 1114

	Factor at Various Load % (g/kWh)					Hourly Emissions at Various Load % (lb/hr)				
	100	**75**	**50**	**25**	**10**	**100**	**75**	**50**	**25**	**10**
NO_X	11.4	7.4	4.8	3.3	7.4	28.00	13.63	5.89	2.03	1.82
CO	1.3	1.4	2.3	5.8	19.5	3.19	2.58	2.82	3.56	4.79
HC	0.03	0.04	0.08	0.13	0.35	0.07	0.07	0.10	0.08	0.09
PM	0.03	0.03	0.14	0.88	0.26	0.07	0.06	0.17	0.54	0.06
Exhaust Flow Rate (kg/hr)						5368	4924	4436	3065	1871
Exhaust Flow Rate (acfm)						7,287	6,208	4,890	3,231	1,707
Exhaust Flow Rate (scfm)						2,623.8	2,406.8	2,168.3	1,498.1	914.5
Exhaust Temperature (°F)						1005.8	901.4	730.4	678.2	525.2
Fuel Combustion Rate (gal/hr)						70.90	55.30	38.60	22.20	12.40

Factors, hourly emission rates, and exhaust flow characteristics are obtained from the Performance Data section in "Sabey Data Centers - Quincy Bldg E - Kohler KD Generator Air Quality Information.pdf" under the "KD1000" section.

The exhaust flow rate is converted using the following approach:

$$\text{Volume rate} = \frac{\frac{\text{mass in kg/hr} \times 1000\ \text{g/kg}}{\text{MW of exhaust air (g/mol)}} \times \text{Gas Constant}\ \left(\text{m}^3\text{·Pa/(K·mol)}\right) \times \text{Temperature(K)}}{\text{Ambient Pressure (Pa)}} \times \left(\frac{\text{ft}}{0.3048\ \text{m}}\right)^3 \times \frac{1\ \text{hr}}{60\ \text{min}}$$

Gas constant	8.314	m^3-Pa/(K-mol)
MW of exhaust	28.9647	g/mol (assuming equal to ambient air)
Ambient pressure	101325	Pa

Table C-8. Building E Load Emission Tables

Kohler KD1250 — **GenSet Power (kW):** 1250
Engine size (hp): 1865 — **Tier:** 4
Engine size (kW): 1391

	Factor at Various Load % (g/kWh)					Hourly Emissions at Various Load % (lb/hr)				
	100	75	50	25	10	100	75	50	25	10
NO_X	0.12	0.07	0.16	0.18	0.36	0.37	0.16	0.25	0.14	0.11
CO	0.11	0.08	0.08	0.11	0.44	0.34	0.18	0.12	0.08	0.13
HC	0.01	0.02	0.02	0.03	0.08	0.03	0.05	0.03	0.02	0.02
PM	0.02	0.02	0.02	0.03	0.04	0.06	0.05	0.03	0.02	0.01
Exhaust Flow Rate (kg/hr)						6687	6061	4763	3446	2842
Exhaust Flow Rate (acfm)						8,810	6,964	5,020	3,333	2,512
Exhaust Flow Rate (scfm)						3,268.5	2,962.5	2,328.1	1,684.4	1,389.1
Exhaust Temperature (°F)						962.6	780.8	678.2	584.6	494.6
Fuel Combustion Rate (gal/hr)						88.20	65.20	44.10	24.90	13.20

Factors, hourly emission rates, and exhaust flow characteristics are obtained from the Performance Data section in "Sabey Data Centers - Quincy Bldg E - Kohler KD Generator Air Quality Information.pdf" under the "KD1250-4" section.

The exhaust flow rate is converted using the following approach:

$$\text{Volume rate} = \frac{\frac{\text{mass in kg/hr} \times 1000\text{ g/kg}}{\text{MW of exhaust air (g/mol)}} \times \text{Gas Constant } \left(\text{m}^3\text{·Pa/(K·mol)}\right) \times \text{Temperature(K)}}{\text{Ambient Pressure (Pa)}} \times \left(\frac{\text{ft}}{0.3048\text{ m}}\right)^3 \times \frac{1\text{ hr}}{60\text{ min}}$$

Gas constant 8.314 m^3-Pa/(K-mol)
MW of exhaust 28.9647 g/mol (assuming equal to ambient air)
Ambient pressure 101325 Pa

Kohler KD1500 — **GenSet Power (kW):** 1500
Engine size (hp): 2218 — **Tier:** 2
Engine size (kW): 1654

	Factor at Various Load % (g/kWh)					Hourly Emissions at Various Load % (lb/hr)				
	100	75	50	25	10	100	75	50	25	10
NO_X	12.00	6.70	5.00	4.50	6.40	43.76	18.32	9.12	4.10	2.33
CO	0.60	1.60	2.30	6.10	11.70	2.19	4.38	4.19	5.56	4.27
HC	0.03	0.04	0.07	0.12	0.36	0.11	0.11	0.13	0.11	0.13
PM	0.03	0.08	0.20	0.44	1.43	0.11	0.22	0.36	0.40	0.52
Exhaust Flow Rate (kg/hr)						8639	7564	6521	4539	3243
Exhaust Flow Rate (acfm)						10,820	9,461	7,286	4,792	2,915
Exhaust Flow Rate (scfm)						4,222.6	3,697.2	3,187.4	2,218.6	1,585.1
Exhaust Temperature (°F)						892.4	890.6	746.6	680.0	510.8
Fuel Combustion Rate (gal/hr)						105.90	83.50	58.60	32.80	15.10

Factors, hourly emission rates, and exhaust flow characteristics are obtained from the Performance Data section in "Sabey Data Centers - Quincy Bldg E - Kohler KD Generator Air Quality Information.pdf" under the "KD1500" section.

The exhaust flow rate is converted using the following approach:

$$\text{Volume rate} = \frac{\frac{\text{mass in kg/hr} \times 1000\text{ g/kg}}{\text{MW of exhaust air (g/mol)}} \times \text{Gas Constant } \left(\text{m}^3\text{·Pa/(K·mol)}\right) \times \text{Temperature(K)}}{\text{Ambient Pressure (Pa)}} \times \left(\frac{\text{ft}}{0.3048\text{ m}}\right)^3 \times \frac{1\text{ hr}}{60\text{ min}}$$

Gas constant 8.314 m^3-Pa/(K-mol)
MW of exhaust 28.9647 g/mol (assuming equal to ambient air)
Ambient pressure 101325 Pa

Kohler KD2250 with Oxidation Catalyst and DPF — **GenSet Power (kW):** 2500
Engine size (bkW): 2500 — **Tier:** 2
Engine size (hp): 3352

	Factor at Various Load % (g/kWh)					Hourly Emissions at Various Load % (lb/hr)				
	100	75	50	25	10	100	75	50	25	10
NO_X	9.00	5.60	5.80	6.10	9.70	49.60	23.15	15.98	8.41	5.35
CO	1.30	2.60	2.20	8.10	8.00	7.17	10.75	6.06	11.16	4.41
HC	0.14	0.15	0.22	0.35	0.89	0.77	0.62	0.61	0.48	0.49
PM	0.014	0.04	0.03	0.09	0.06	0.09	0.15	0.07	0.13	0.02
Exhaust Flow Rate (kg/hr)						15,017	14,404	9,978	5,904	4,042
Exhaust Flow Rate (acfm)						18,132	17,296	12,031	7,148	4,469
Exhaust Flow Rate (scfm)						7,340.1	7,040.5	4,877.1	2,885.8	1,975.7
Exhaust Temperature (°F)						844	837	842	847	734
Fuel Combustion Rate (gal/hr)						167.1	136.9	95.2	55.4	29.9

Factors, hourly PM emission rates, and exhaust flow characteristics are obtained from "Kohler KD2250 with Ox Cat and DPF.pdf", and emission factors for NOx, CO, and HC are obtained from the Performance Data section in "Kohler KD Generator Air Quality Information.pdf" under the "KD2250" section.

The exhaust flow rate is converted using the following approach:

$$\text{Volume rate} = \frac{\frac{\text{mass in kg/hr} \times 1000\text{ g/kg}}{\text{MW of exhaust air (g/mol)}} \times \text{Gas Constant } \left(\text{m}^3\text{·Pa/(K·mol)}\right) \times \text{Temperature(K)}}{\text{Ambient Pressure (Pa)}} \times \left(\frac{\text{ft}}{0.3048\text{ m}}\right)^3 \times \frac{1\text{ hr}}{60\text{ min}}$$

Gas constant 8.314 m^3-Pa/(K-mol)
MW of exhaust 28.9647 g/mol (assuming equal to ambient air)
Ambient pressure 101325 Pa

Table C-9a. Cold Start Scaling Factors

Pollutant	Spike Duration (seconds)[1]	Cold-Start Emission Spike [a] (ppm)	Steady-State (Warm) Emissions [a] (ppm)	Cold-Start Scaling Factor
PM+HC	14	900	30	4.27
NO_X	8	40	38	0.94
CO	20	750	30	9.00

a. Spike duration, cold-start emission spike, and steady-state (warm) emissions based on data from California Energy Commission (CEC) "Air Quality Implications of Backup Generators in California. The cold-start scaling factor is derived as the ratio of the spike concentration and duration to the steady-state emissions for the initial 60 seconds. An example calculation is provided below for HC. Since a cold-start curve was not developed by CEC, it is assumed that the PM will experience the same trend as HC.

Table C-9b. Building D Cold Start Emission Rates

Pollutant	Worst-case Emission Rate (lb/hr/engine)					
	Main Genset			Support Genset		
	Warm	Cold-Start	Startup Emission Rate [a]	Warm	Cold-Start	Startup Emission Rate [a]
HC	1.20	5.12	1.27	0.29	1.25	0.31
NO_X	62.27	58.33	62.20	6.85	6.42	6.84
CO	11.16	100.45	12.65	3.18	28.62	3.60
DEEP/PM	0.41	1.75	0.43	0.18	0.75	0.19
$PM_{10}/PM_{2.5}$	1.51	6.44	1.59	0.37	1.57	0.39

a. Startup hourly emission rate assumes one minute of cold-start emissions and 59 minutes of warm engine emissions.

Table C-9c. Building D Cold Start Emissions

Pollutant	Annual Emissions from Cold Start Hours - Main Gensets [a] (tpy)	Annual Emissions from Cold Start Hours - Support Gensets [a] (tpy)
HC	0.32	4.32E-03
NO_X	15.67	9.58E-02
CO	3.19	5.05E-02
DEEP	0.11	2.59E-03
$PM_{10}/PM_{2.5}$	0.40	5.43E-03

a. Calculations conservatively assume 28 cold starts per engine, per year.

Table C-9d. Building E Cold Start Emission Rates

Pollutant	Worst-case Emission Rate (lb/hr/engine)								
	Main Genset - Worst Case			Main Genset - Cummins			Support Genset		
	Warm	Cold-Start	Startup Emission Rate [1]	Warm	Cold-Start	Startup Emission Rate [1]	Warm	Cold-Start	Startup Emission Rate [1]
HC	1.20	5.12	1.27	0.50	2.13	0.53	0.84	3.58	0.89
NO_X	62.27	58.33	62.20	62.27	58.33	62.20	43.76	40.99	43.71
CO	11.16	100.45	12.65	5.71	51.41	6.47	5.68	51.10	6.43
DEEP/PM	0.41	1.75	0.43	0.57	2.44	0.60	0.91	3.90	0.96
$PM_{10}/PM_{2.5}$	1.51	6.44	1.59	1.07	4.57	1.13	1.33	5.69	1.41

a. Startup hourly emission rate assumes one minute of cold-start emissions and 59 minutes of warm engine emissions.

Table C-9e. Building E Cold Start Emissions

Pollutant	Annual Emissions from Cold Start Hours - Main Gensets	Annual Emissions from Cold Start Hours - Support Gensets
	(tpy)	(tpy)
HC	0.69	1.24E-02
NO_X	33.96	6.12E-01
CO	6.91	9.01E-02
DEEP	0.24	1.35E-02
$PM_{10}/PM_{2.5}$	0.87	1.97E-02

a. Calculations conservatively assume 28 cold starts per engine, per year.

Table C-10a. Building D HAP and TAP Emissions

Pollutant	CAS Number	HAP?	TAP?	Diesel Fired Industrial Engines for Main Gensets [1] (lb/MMBtu)	Building D Main Genset Emissions [2] (lb/hr)	(lb/day)	(tpy)	Diesel Fired Industrial Engines for Support Gensets [1] (lb/MMBtu)	Building D Support Genset Emissions [2] (lb/hr)	(lb/day)	(tpy)
Acenaphthene [4]	83-32-9	Yes	No	4.68E-06	1.98E-03	0.05	2.97E-05	1.42E-06	4.49E-06	1.08E-04	6.73E-08
Acenaphthylene [4]	208-96-8	Yes	No	9.23E-06	3.90E-03	0.09	5.85E-05	5.06E-06	1.60E-05	3.84E-04	2.40E-07
Acetaldehyde [4]	75-07-0	Yes	Yes	2.52E-05	1.06E-02	0.26	1.60E-04	7.67E-04	2.42E-03	0.06	3.64E-05
Acrolein	107-02-8	Yes	Yes	7.88E-06	3.33E-03	0.08	4.99E-05	9.25E-05	2.92E-04	7.02E-03	4.39E-06
Anthracene [4]	120-12-7	Yes	No	1.23E-06	5.20E-04	1.25E-02	7.79E-06	1.87E-06	5.91E-06	1.42E-04	8.87E-08
Benzene	71-43-2	Yes	Yes	7.76E-04	0.33	7.87	4.92E-03	9.33E-04	2.95E-03	0.07	4.42E-05
Benzo(a)anthracene [4]	56-55-3	Yes	Yes	6.22E-07	2.63E-04	6.31E-03	3.94E-06	1.68E-06	5.31E-06	1.27E-04	7.96E-08
Benzo(a)pyrene [4]	50-32-8	Yes	Yes	2.57E-07	1.09E-04	2.61E-03	1.63E-06	1.88E-07	5.94E-07	1.43E-05	8.91E-09
Benzo(b)fluoranthene [4]	205-99-2	Yes	Yes	1.11E-06	4.69E-04	1.13E-02	7.03E-06	9.91E-08	3.13E-07	7.52E-06	4.70E-09
Benzo(g,h,l)perylene [4]	--	Yes	No	5.56E-07	2.35E-04	5.64E-03	3.52E-06	4.89E-07	1.55E-06	3.71E-05	2.32E-08
Benzo(k)fluoranthene [4]	207-08-9	Yes	Yes	2.18E-07	9.21E-05	2.21E-03	1.38E-06	1.55E-07	4.90E-07	1.18E-05	7.35E-09
1,3-Butadiene	106-99-0	Yes	Yes	--	--	--	--	3.91E-05	1.24E-04	2.97E-03	1.85E-06
Chrysene	218-01-9	Yes	Yes	1.53E-06	6.46E-04	0.02	9.69E-06	3.53E-07	1.12E-06	2.68E-05	1.67E-08
Dibenz(a,h)anthracene [4]	53-70-3	Yes	Yes	3.46E-07	1.46E-04	3.51E-03	2.19E-06	5.83E-07	1.84E-06	4.42E-05	2.76E-08
Fluoranthene [4]	206-44-0	Yes	No	4.03E-06	1.70E-03	0.04	2.55E-05	7.61E-06	2.41E-05	5.77E-04	3.61E-07
Fluorene [4]	86-73-7	Yes	No	1.28E-05	5.41E-03	0.13	8.11E-05	2.92E-05	9.23E-05	2.21E-03	1.38E-06
Formaldehyde [4]	50-00-0	Yes	Yes	7.89E-05	0.03	0.80	5.00E-04	1.18E-03	3.73E-03	0.09	5.59E-05
Indeno(1,2,3-cd)pyrene	193-39-5	Yes	Yes	4.14E-07	1.75E-04	4.20E-03	2.62E-06	3.75E-07	1.19E-06	2.84E-05	1.78E-08
Naphthalene [4]	91-20-3	Yes	Yes	1.30E-04	0.05	1.32	8.24E-04	8.48E-05	2.68E-04	6.43E-03	4.02E-06
Phenanthrene	85-01-8	Yes	No	4.08E-05	0.02	0.41	2.59E-04	2.94E-05	9.29E-05	2.23E-03	1.39E-06
Propylene [4]	115-07-1	No	Yes	2.79E-04	0.12	2.83	1.77E-03	2.58E-03	8.15E-03	0.20	1.22E-04
Pyrene [4]	129-00-0	Yes	No	3.71E-06	1.57E-03	0.04	2.35E-05	4.78E-06	1.51E-05	3.63E-04	2.27E-07
Toluene	108-88-3	Yes	Yes	2.81E-04	0.12	2.85	1.78E-03	4.09E-04	1.29E-03	0.03	1.94E-05
Xylenes	1330-20-7	Yes	Yes	1.93E-04	0.08	1.96	1.22E-03	2.85E-04	9.01E-04	0.02	1.35E-05
Diesel engine exhaust, particulate [5]	--	No	Yes	See Table C-3b.	7.78	17.21	0.12	See Table C-3c.	0.19	4.22	2.77E-03
SO_2 [6]	7446-09-05	No	Yes	See Table C-3b.	0.79	1.81	1.19E-02	See Table C-3c.	0.98	23.62	1.48E-02
CO [6]	630-08-0	No	Yes	See Table C-3b.	227.68	484.38	3.39	See Table C-3c.	3.60	76.74	0.05
NO_2 [6]	10102-44-0	No	Yes	See Table C-3b.	112.08	2,689.96	1.68	See Table C-3c.	0.69	16.44	1.03E-02
Total HAP Emissions:					0.66	15.95	9.97E-03		1.22E-02	0.29	1.84E-04
Total TAP Emissions:					349.09	3,211.36	5.21		5.48	121.51	0.08

1. Emission factors for the main gensets are from AP-42 Tables 3.4-3 and 3.4-4 and from Tables 3.3-2 for the support gensets.

2. Diesel heat content 0.137 MMBtu/gal per AP-42, Appendix A. Fuel consumption rate is provided in Table 1c. Emissions in this table represent the maximum hourly, daily, and annual emission for each pollutant.

3. Modeling is required if the project emissions are greater than the respective Small Quantity Emission Rate.

4. These are categorized as polycyclic organic matter (POM), which is a HAP.

5. Diesel particulate matter is assumed to be equivalent to filterable particulate matter.

6. SO_2, CO and NO_X emissions with maximum operation scenario (when all emergency generators are in operation) are listed here. It is conservatively assumed that 10% of NO_X are emitted in the form of NO_2.

Table C-10b. Building E HAP and TAP Emissions

Pollutant	CAS Number	HAP?	TAP?	Diesel Fired Industrial Engines for Main Gensets[1] (lb/MMBtu)	Building E Main Genset Emissions - Worst Case[2] (lb/hr)	(lb/day)	(tpy)	Diesel Fired Industrial Engines for Main Gensets[1] (lb/MMBtu)	Building E Main Genset Emissions - Cummins DQKAF[2] (lb/hr)	(lb/day)	(tpy)	Diesel Fired Industrial Engines for Support Gensets[1] (lb/MMBtu)	Building E Support Genset Emissions[2] (lb/hr)	(lb/day)	(tpy)
Acenaphthene [4]	83-32-9	Yes	No	4.68E-06	3.73E-03	0.09	5.60E-05	4.68E-06	4.90E-04	1.18E-02	7.36E-06	4.68E-06	6.92E-05	1.66E-03	1.04E-06
Acenaphthylene [4]	208-96-8	Yes	No	9.23E-06	7.36E-03	0.18	1.10E-04	9.23E-06	9.67E-04	0.02	1.45E-05	9.23E-06	1.37E-04	3.28E-03	2.05E-06
Acetaldehyde [4]	75-07-0	Yes	Yes	2.52E-05	0.02	0.48	3.02E-04	2.52E-05	2.64E-03	0.06	3.96E-05	2.52E-05	3.73E-04	8.95E-03	5.59E-06
Acrolein	107-02-8	Yes	Yes	7.88E-06	6.29E-03	0.15	9.43E-05	7.88E-06	8.26E-04	0.02	1.24E-05	7.88E-06	1.17E-04	2.80E-03	1.75E-06
Anthracene [4]	120-12-7	Yes	No	1.23E-06	9.81E-04	0.02	1.47E-05	1.23E-06	1.29E-04	3.09E-03	1.93E-06	1.23E-06	1.82E-05	4.37E-04	2.73E-07
Benzene	71-43-2	Yes	Yes	7.76E-04	0.62	14.86	9.29E-03	7.76E-04	0.08	1.95	1.22E-03	7.76E-04	1.15E-02	0.28	1.72E-04
Benzo(a)anthracene [4]	56-55-3	Yes	Yes	6.22E-07	4.96E-04	1.19E-02	7.44E-06	6.22E-07	6.52E-05	1.56E-03	9.78E-07	6.22E-07	9.20E-06	2.21E-04	1.38E-07
Benzo(a)pyrene [4]	50-32-8	Yes	Yes	2.57E-07	2.05E-04	4.92E-03	3.08E-06	2.57E-07	2.69E-05	6.46E-04	4.04E-07	2.57E-07	3.80E-06	9.13E-05	5.70E-08
Benzo(b)fluoranthene [4]	205-99-2	Yes	Yes	1.11E-06	8.86E-04	0.02	1.33E-05	1.11E-06	1.16E-04	2.79E-03	1.75E-06	1.11E-06	1.64E-05	3.94E-04	2.46E-07
Benzo(g,h,l)perylene [4]	--	Yes	No	5.56E-07	4.44E-04	1.06E-02	6.65E-06	5.56E-07	5.83E-05	1.40E-03	8.74E-07	5.56E-07	8.23E-06	1.97E-04	1.23E-07
Benzo(k)fluoranthene [4]	207-08-9	Yes	Yes	2.18E-07	1.74E-04	4.17E-03	2.61E-06	2.18E-07	2.28E-05	5.48E-04	3.43E-07	2.18E-07	3.23E-06	7.74E-05	4.84E-08
1,3-Butadiene	106-99-0	Yes	Yes	--	--	--	--	--	--	--	--	--	--	--	--
Chrysene	218-01-9	Yes	Yes	1.53E-06	1.22E-03	0.03	1.83E-05	1.53E-06	1.60E-04	3.85E-03	2.41E-06	1.53E-06	2.26E-05	5.43E-04	3.40E-07
Dibenz(a,h)anthracene [4]	53-70-3	Yes	Yes	3.46E-07	2.76E-04	6.63E-03	4.14E-06	3.46E-07	3.63E-05	8.70E-04	5.44E-07	3.46E-07	5.12E-06	1.23E-04	7.68E-08
Fluoranthene [4]	206-44-0	Yes	No	4.03E-06	3.22E-03	0.08	4.82E-05	4.03E-06	4.22E-04	1.01E-02	6.34E-06	4.03E-06	5.96E-05	1.43E-03	8.94E-07
Fluorene [4]	86-73-7	Yes	No	1.28E-05	1.02E-02	0.25	1.53E-04	1.28E-05	1.34E-03	0.03	2.01E-05	1.28E-05	1.89E-04	4.55E-03	2.84E-06
Formaldehyde [4]	50-00-0	Yes	Yes	7.89E-05	0.06	1.51	9.44E-04	7.89E-05	8.27E-03	0.20	1.24E-04	7.89E-05	1.17E-03	0.03	1.75E-05
Indeno(1,2,3-cd)pyrene	193-39-5	Yes	Yes	4.14E-07	3.30E-04	7.93E-03	4.96E-06	4.14E-07	4.34E-05	1.04E-03	6.51E-07	4.14E-07	6.13E-06	1.47E-04	9.19E-08
Naphthalene [4]	91-20-3	Yes	Yes	1.30E-04	0.10	2.49	1.56E-03	1.30E-04	1.36E-02	0.33	2.04E-04	1.30E-04	1.92E-03	0.05	2.89E-05
Phenanthrene	85-01-8	Yes	No	4.08E-05	0.03	0.78	4.88E-04	4.08E-05	4.28E-03	0.10	6.41E-05	4.08E-05	6.04E-04	1.45E-02	9.06E-06
Propylene [4]	115-07-1	No	Yes	2.79E-04	0.22	5.34	3.34E-03	2.79E-04	0.03	0.70	4.39E-04	2.79E-04	4.13E-03	0.10	6.19E-05
Pyrene [4]	129-00-0	Yes	No	3.71E-06	2.96E-03	0.07	4.44E-05	3.71E-06	3.89E-04	9.33E-03	5.83E-06	3.71E-06	5.49E-05	1.32E-03	8.23E-07
Toluene	108-88-3	Yes	Yes	2.81E-04	0.22	5.38	3.36E-03	2.81E-04	0.03	0.71	4.42E-04	2.81E-04	4.16E-03	0.10	6.24E-05
Xylenes	1330-20-7	Yes	Yes	1.93E-04	0.15	3.70	2.31E-03	1.93E-04	0.02	0.49	3.03E-04	1.93E-04	2.86E-03	0.07	4.28E-05
Diesel engine exhaust, particulate [5]	--	No	Yes	See Table C-3b.	14.70	24.13	0.22	See Table C-3b.	20.48	33.62	0.05	See Table C-3c.	0.96	22.01	1.44E-02
SO_2 [6]	7446-09-05	No	Yes	See Table C-3b.	1.50	2.51	0.02	See Table C-3b.	1.34	2.24	2.95E-03	See Table C-3c.	0.03	0.65	4.04E-04
CO [6]	630-08-0	No	Yes	See Table C-3b.	430.07	686.77	6.40	See Table C-3b.	220.13	351.52	0.48	See Table C-3c.	6.43	137.01	0.10
NO_2 [6]	10102-44-0	No	Yes	See Table C-3b.	211.71	5,081.03	3.17	See Table C-3b.	211.71	5,081.03	0.47	See Table C-3c.	4.38	105.02	0.07
Total HAP Emissions:					1.26	30.13	0.02		0.16	3.96	2.47E-03		0.02	0.56	3.49E-04
Total TAP Emissions:					659.39	5,828.44	9.84		453.84	5,472.87	1.00		11.83	265.31	0.18

1. Emission factors are from AP-42 Tables 3.4-3 and 3.4-4.
2. Diesel heat content 0.137 MMBtu/gal per AP-42, Appendix A. Fuel consumption rate is provided in Table 1c. Emissions in this table represent the maximum hourly, daily, and annual emission for each pollutant.
3. Modeling is required if the project emissions are greater than the respective Small Quantity Emission Rate.
4. These are categorized as polycyclic organic matter (POM), which is a HAP.
5. Diesel particulate matter is assumed to be equivalent to filterable particulate matter.
6. SO_2, CO and NO_X emissions with maximum operation scenario (when all emergency generators are in operation) are listed here. It is conservatively assumed that 10% of NO_X are emitted in the form of NO_2.

Table C-11. Project Cooling Unit Emissions

Value	PM	PM_{10}	$PM_{2.5}$
Hours of Operation (hr/yr)	8,760	8,760	8,760
Cooling Units	132	132	132
Total Water Consumption Flowrate (gal/hr)	241	241	241
Recirculation Flowrate (gal/min-unit)	84	84	84
Total Annual Throughput [1] (tpy water recirculated)	25,464,213	25,464,213	25,464,213
Total Dissolved Solids (TDS) [2] (ppm)	550	550	550
Drift Loss [2] (wt%)	0.001%	0.001%	0.001%
Total Emissions (tpy)	1.40E-01	1.40E-01	1.40E-01

a. Recirculation flowrate was provided by Munters Corporation on March 17, 2020 and is consistent with the value provided in Sabey's previous permit application.

b. Total Dissolved Solids (TDS) were provided by Munters Corporation on December 20, 2019. Drift loss is conservatively assumed to be the drift rate limit listed in the existing site permit. These assumptions are consistent with those provided in Sabey's previous permit application.

c. $PM_{2.5}$ and PM_{10} are conservatively assumed to be equal to total PM.

Generator Set Data Sheet

Model: DQFAD
Frequency: 60 Hz
Fuel Type: Diesel
kW Rating: 1000 Standby
900 Prime
Emissions level: EPA NSPS Stationary Emergency Tier 2

Exhaust emission data sheet:	**EDS-1063**
Exhaust emission compliance sheet:	**EPA-1097**
Sound performance data sheet:	**MSP-1038**
Cooling performance data sheet:	**MCP-156**
Prototype test summary data sheet:	**PTS-266**
Standard set-mounted radiator cooling outline:	**A049K674**
Optional remote radiator cooling outline:	**A053G787**

Fuel Consumption

	Standby				Prime				Continuous
	kW (kVA)				**kW (kVA)**				**kW (kVA)**
Ratings	1000 (1250)				900 (1125)				
Load	**1/4**	**1/2**	**3/4**	**Full**	**1/4**	**1/2**	**3/4**	**Full**	**Full**
US gph	18.7	36.4	54.2	71.9	16.9	32.4	48.0	63.5	
L/hr	70.6	137.8	205.1	272.3	64.0	122.8	181.5	240.3	

Engine

Engine	Standby rating	Prime rating	Continuous rating
Engine manufacturer	Cummins Inc.		
Engine model	QST30-G5 NR2		
Configuration	Cast iron, V 12 cylinder		
Aspiration	Turbocharged and low temperature after-cooled		
Gross engine power output, kWm (bhp)	1112 (1490)	1007 (1350)	
BMEP at set rated load, kPa (psi)	2417 (351)	2160 (313)	
Bore, mm (in.)	140 (5.51)		
Stroke, mm (in.)	165 (6.5)		
Rated speed, rpm	1800		
Piston speed, m/s (ft/min)	9.91 (1950)		
Compression ratio	14.7:1		
Lube oil capacity, L (qt)	154 (162.8)		
Overspeed limit, rpm	2100 ±50		
Regenerative power, kW	82		

Fuel Flow

Maximum fuel flow, L/hr (US gph)	570 (150)	
Maximum fuel inlet restriction, kPa (in Hg)	27 (8.0)	
Maximum fuel inlet temperature, °C (°F)	66 (150)	

Air

Air	Standby rating	Prime rating	Continuous rating
Combustion air, m^3/min (scfm)	88 (3150)	81 (2880)	
Maximum air cleaner restriction, kPa (in H_2O)	6.2 (25)		
Alternator cooling air, m^3/min (cfm)	204 (7300)		

Exhaust

Exhaust	Standby rating	Prime rating	Continuous rating
Exhaust flow at set rated load, m^3/min (cfm)	211 (7540)	195 (6950)	
Exhaust temperature, °C (°F)	477 (890)	467 (873)	
Maximum back pressure, kPa (in H_2O)	6.8 (27)		

Standard Set-Mounted Radiator Cooling

Standard Set-Mounted Radiator Cooling	Standby rating	Prime rating	Continuous rating
Ambient design, °C (°F)	50 (122)		
Fan load, kW_m (HP)	33.1 (44.4)		
Coolant capacity (with radiator), L (US gal)	167 (44)		
Cooling system air flow, m^3/min (scfm)	1097.5 (38753)		
Total heat rejection, MJ/min (Btu/min)	49.1 (46545)	44.07 (41775)	
Maximum cooling air flow static restriction, kPa (in H_2O)	0.12 (0.5)		
Maximum fuel return line restriction kPa (in Hg)	67.5 (20)		

Optional Heat Exchanger Cooling

Optional Heat Exchanger Cooling	
Set coolant capacity, L (US gal)	
Heat rejected, jacket water circuit, MJ/min (Btu/min)	
Heat rejected, aftercooler circuit, MJ/min (Btu/min)	
Heat rejected, fuel circuit, MJ/min (Btu/min)	
Total heat radiated to room, MJ/min (Btu/min)	
Maximum raw water pressure, jacket water circuit, kPa (psi)	
Maximum raw water pressure, aftercooler circuit, kPa (psi)	
Maximum raw water pressure, fuel circuit, kPa (psi)	
Maximum raw water flow, jacket water circuit, L/min (US gal/min)	
Maximum raw water flow, aftercooler circuit, L/min (US gal/min)	
Maximum raw water flow, fuel circuit, L/min (US gal/min)	
Minimum raw water flow at 27 °C (80 °F) inlet temp, jacket water circuit, L/min (US gal/min)	
Minimum raw water flow at 27 °C (80 °F) inlet temp, aftercooler circuit, L/min (US gal/min)	
Minimum raw water flow at 27 °C (80 °F) inlet temp, fuel circuit, L/min (US gal/min)	
Raw water delta P at min flow, jacket water circuit, kPa (psi)	
Raw water delta P at min flow, aftercooler circuit, kPa (psi)	
Raw water delta P at min flow, fuel circuit, kPa (psi)	
Maximum jacket water outlet temp, °C (°F)	
Maximum aftercooler inlet temp, °C (°F)	
Maximum aftercooler inlet temp at 25 °C (77 °F) ambient, °C (°F)	
Maximum fuel return line restriction, kPa (in Hg)	

Optional Remote Radiator Cooling[1]

Optional Remote Radiator Cooling[1]	Standby rating	Prime rating	Continuous rating
Set coolant capacity, L (US gal)			
Max flow rate at max friction head, jacket water circuit, L/min (US gal/min)	992 (262)		
Max flow rate at max friction head, aftercooler circuit, L/min (US gal/min)	303 (80)		
Heat rejected, jacket water circuit, MJ/min (Btu/min)	22.67 (21500)	21.01 (19925)	
Heat rejected, aftercooler circuit, MJ/min (Btu/min)	18.35 (17400)	15.69 (14885)	
Heat rejected, fuel circuit, MJ/min (Btu/min)			
Total heat radiated to room, MJ/min (Btu/min)	6.1 (5753)	5.6 (5301)	
Maximum friction head, jacket water circuit, kPa (psi)	69 (10)		
Maximum friction head, aftercooler circuit, kPa (psi)	48 (7)		
Maximum static head, jacket water circuit, m (ft)	14 (46)		
Maximum static head, aftercooler circuit, m (ft)	14 (46)		
Maximum jacket water outlet temp, °C (°F)	104 (220)	100 (212)	
Maximum aftercooler inlet temp at 25 °C (77 °F) ambient, °C (°F)	41 (105)		
Maximum aftercooler inlet temp, °C (°F)	62 (143)	56 (133)	
Maximum fuel flow, L/hr (US gph)			
Maximum fuel return line restriction, kPa (in Hg)	67.5 (20)		

Weights[2]

Unit dry weight kgs (lbs)	7594 (16742)
Unit wet weight kgs (lbs)	7857 (17322)

Notes:

[1] For non-standard remote installations contact your local Cummins representative.

[2] Weights represent a set with standard features. See outline drawing for weights of other configurations.

Derating Factors

Standby	Engine power available up to 701 m (2300 ft) at ambient temperatures up to 40 °C (104 °F). Above these elevations, derate at 3.5% per 305 m (1000 ft) and 7% per 10 °C (18°F).
Prime	Engine power available up to 727 m (2385 ft) at ambient temperatures up to 40 °C (104 °F). Above these elevations, derate at 3.5% per 305 m (1000 ft) and 7% per 10 °C (18 °F).
Continuous	

Ratings Definitions

Emergency Standby Power (ESP):	Limited-Time Running Power (LTP):	Prime Power (PRP):	Base Load (Continuous) Power (COP):
Applicable for supplying power to varying electrical load for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Fuel stop power in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.	Applicable for supplying power to a constant electrical load for limited hours. Limited-Time Running Power (LTP) is in accordance with ISO 8528.	Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.	Applicable for supplying power continuously to a constant electrical load for unlimited hours. Continuous Power (COP) is in accordance with ISO 8528, ISO 3046, AS 2789, DIN 6271 and BS 5514. No sustained overload capability is available at this rating.

Alternator Data

Voltage	Connection[1]	Temp rise degrees C	Duty[2]	Single phase factor[3]	Max surge kVA[4]	Surge kW	Alternator data sheet	Feature code
120/208-139/240	12-lead	125/105	S/P		4234	1019	ADS-312	B252
240/416-277/480	12-lead	125/105	S/P		4234	1019	ADS-312	B252
277/480	Wye, 3-phase	125/105	S/P		3866	1018	ADS-311	B276
220/380-277/480	Wye, 3-phase	125/105	S/P		4602	1018	ADS-330	B282
220/380-277/480	Wye, 3-phase	105/80	S/P		4602	1018	ADS-330	B283
210/380-277/480	Wye, 3-phase	80	S		5521	1024	ADS-331	B284
240/416-277/480	Wye	125/105	S/P		4234	1019	ADS-312	B288
347/600	3-phase	125/105	S/P		3866	1021	ADS-311	B300
347/600	3-phase	105/80	S/P		4234	1024	ADS-312	B301
347/600	3-phase	80	S		4602	1004	ADS-330	B604

Notes:

[1] Limited single phase capability is available from some three phase rated configurations. To obtain single phase rating, multiply the three phase kW rating by the Single Phase Factor[3]. All single phase ratings are at unity power factor.

[2] Standby (S), Prime (P) and Continuous ratings (C).

[3] Factor for the *Single phase output from Three phase alternator* formula listed below.

[4] Maximum rated starting kVA that results in a minimum of 90% of rated sustained voltage during starting.

Formulas for Calculating Full Load Currents:

Three phase output

$$\frac{\text{kW} \times 1000}{\text{Voltage} \times 1.73 \times 0.8}$$

Single phase output

$$\frac{\text{kW} \times \text{SinglePhaseFactor} \times 1000}{\text{Voltage}}$$

Warning: Back feed to a utility system can cause electrocution and/or property damage. Do not connect to any building's electrical system except through an approved device or after building main switch is open.

For more information contact your local Cummins distributor or visit power.cummins.com

Our energy working for you.™

Exhaust emission data sheet
1000DQFAD
60 Hz Diesel generator set

Engine information:			
Model:	Cummins Inc. QST30-G5 NR2	Bore:	5.51 in. (139 mm)
Type:	4 Cycle, 50° V, 12 cylinder diesel	Stroke:	6.5 in. (165 mm)
Aspiration:	Turbocharged and low temperature after-cooled	Displacement:	1860 cu. in. (30.4 liters)
Compression ratio:	14.7:1		
Emission control device:	After-cooled (air-to-air)		

Performance data	1/4 Standby	1/2 Standby	3/4 Standby	Full Standby	Full Prime
BHP @ 1800 RPM (60 Hz)	371	741	1112	1482	1322
Fuel consumption (gal/Hr)	19.1	35.8	54.1	72.2	63.9
Exhaust gas flow (CFM)	2780	4500	6370	7540	6950
Exhaust gas temperature (°F)	620	760	814	890	873
Exhaust emission data					
HC (Total unburned hydrocarbons)	0.12	0.10	0.08	0.07	0.08
NOx (Oxides of nitrogen as NO2)	4.17	5.20	3.87	3.95	4.00
CO (Carbon monoxide)	0.66	0.36	0.48	0.66	0.58
PM (Particular matter)	0.19	0.15	0.12	0.11	0.11
SO2 (Sulfur dioxide)	0.11	0.10	0.10	0.11	0.10
Smoke (Bosch)	0.88	0.80	0.79	0.73	0.75

All values are Grams/HP-Hour, Smoke is Bosch #

Test conditions

Data was recorded during steady-state rated engine speed (± 25 RPM) with full load (± 2%). Pressures, temperatures, and emission rates were stabilized.

Fuel specification:	46.5 Cetane Number, 0.035 Wt.% Sulfur; Reference ISO8178-5, 40CFR86. 1313-98 Type 2-D and ASTM D975 No. 2-D.
Fuel temperature:	99 ± 9 °F (at fuel pump inlet)
Intake air temperature:	77 ± 9 °F
Barometric pressure:	29.6 ± 1 in. Hg
Humidity:	NOx measurement corrected to 75 grains H2O/lb dry air
Reference standard:	ISO 8178

The NOx, HC, CO and PM emission data tabulated here were taken from a single engine under the test conditions shown above. Data for the other components are estimated. These data are subjected to instrumentation and engine-to-engine variability. Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures and instrumentation. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may results in elevated emission levels.

Generator Set Model	DQFAD
Engine Model	QST30-G5
Fuel Rating	
Emissions Level	Tier 2

			ISO Standby			
Generator Set Load		%	25	50	75	100
		kWe	250	500	750	1000
Engine Load		hp	371	741	1112	1482
Nominal	HC	g/bhp·hr	0.12	0.10	0.08	0.07
	NOx	g/bhp·hr	4.17	5.20	3.87	3.95
	CO	g/bhp·hr	0.66	0.36	0.48	0.66
	PM	g/bhp·hr	0.19	0.15	0.12	0.11
Potential Site Va	HC	g/bhp·hr	0.20	0.17	0.14	0.12
	NOx	g/bhp·hr	5.42	6.76	5.03	5.14
	CO	g/bhp·hr	1.32	0.72	0.96	1.32
	PM	g/bhp·hr	0.48	0.38	0.30	0.28

Power Generation

Generator set data sheet

Model:	DQGAB
Frequency:	60 Hz
Fuel type:	Diesel
KW rating:	1500 standby
	1350 prime
Emissions level:	EPA NSPS Stationary Emergency Tier 2

Exhaust emission data sheet:	EDS-1059
Exhaust emission compliance sheet:	EPA-1093
Sound performance data sheet:	MSP-1034
Cooling performance data sheet:	MCP-152
Prototype test summary data sheet:	PTS-265
Standard set-mounted radiator cooling outline:	0500-4357
Optional remote radiator cooling outline:	0500-4309

Fuel consumption

	Standby				Prime			
	kW (kVA)				kW (kVA)			
Ratings	1500 (1875)				1350 (1688)			
Load	1/4	1/2	3/4	Full	1/4	1/2	3/4	Full
US gph	35.4	58.2	81	103.8	33.1	53.6	74.2	94.7
L/hr	133.9	220.3	306.6	393	125.3	203	208.7	358.4

Engine

	Standby rating	Prime rating
Engine manufacturer	Cummins Inc.	
Engine model	QSK50-G4 NR2	
Configuration	Cast iron, V 16 cylinder	
Aspiration	Turbocharged and low temperature aftercooled	
Gross engine power output, kWm (bhp)	1656 (2220)	1470 (1971)
BMEP at set rated load, kPa (psi)	2192 (318)	1957 (284)
Bore, mm (in)	159 (6.25)	
Stroke, mm (in)	159 (6.25)	
Rated speed, rpm	1800	
Piston speed, m/s (ft/min)	9.5 (1875)	
Compression ratio	15:1	
Lube oil capacity, L (qt)	235 (248)	
Overspeed limit, rpm	2100 ±50	
Regenerative power, kW	168	

Maximum fuel flow, L/hr (US gph)	912 (241)
Maximum fuel inlet restriction, kPa (in Hg)	16.9 (5)
Maximum fuel inlet temperature, °C (°F)	71 (160)

Air

	Standby rating	Prime rating
Combustion air, m^3/min (scfm)	139 (4895)	133 (4700)
Maximum air cleaner restriction, kPa (in H_2O)	3.7 (15)	
Alternator cooling air, m^3/min (cfm)	207 (7300)	

Exhaust

Exhaust flow at set rated load, m^3/min (cfm)	342 (12065)	312 (11000)
Exhaust temperature, °C (°F)	491 (915)	446 (835)
Maximum back pressure, kPa (in H_2O)	6.78 (27)	

Standard set-mounted radiator cooling

Ambient design, °C (°F)	40 (104)	
Fan load, kW_m (HP)	45 (60)	
Coolant capacity (with radiator), L (US gal)	541 (143)	
Cooling system air flow, m^3/min (scfm)	1705 (60150)	
Total heat rejection, MJ/min (Btu/min)	72.3 (68580)	64.8 (61510)
Maximum cooling air flow static restriction, kPa (in H_2O)	0.12 (0.5)	
Maximum fuel return line restriction kPa (in Hg)	34 (10)	

Optional remote radiator cooling[1]

Set coolant capacity, L (US gal)		
Max flow rate at max friction head, jacket water circuit, L/min (US gal/min)	1893 (500)	
Max flow rate at max friction head, aftercooler circuit, L/min (US gal/min)	537 (142)	
Heat rejected, jacket water circuit, MJ/min (Btu/min)	35.44 (33610)	32.11 (30455)
Heat rejected, aftercooler circuit, MJ/min (Btu/min)	26.93 (25545)	23.96 (22725)
Heat rejected, fuel circuit, MJ/min (Btu/min)		
Total heat radiated to room, MJ/min (Btu/min)	13.1 (12420)	11.9 (11275)
Maximum friction head, jacket water circuit, kPa (psi)	67 (10)	
Maximum friction head, aftercooler circuit, kPa (psi)	48 (7)	
Maximum static head, jacket water circuit, m (ft)	18.3 (60)	
Maximum static head, aftercooler circuit, m (ft)	18.3 (60)	
Maximum jacket water outlet temp, °C (°F)	104 (220)	100 (212)
Maximum aftercooler inlet temp at 25 °C (77 °F) ambient, °C (°F)	49 (120)	
Maximum aftercooler inlet temp, °C (°F)	71 (160)	66 (150)
Maximum fuel flow, L/hr (US gph)	469 (124)	
Maximum fuel return line restriction, kPa (in Hg)	34 (10)	

Weights[2]

Unit dry weight kgs (lbs)	12700 (28000)
Unit wet weight kgs (lbs)	13270 (29260)

Notes:

[1] For non-standard remote installations contact your local Cummins Power Generation representative.
[2] Weights represent a set with standard features. See outline drawing for weights of other configurations.

Derating factors

Standby	Full rated power available up to 1134.0m (3719.6 ft) elevation at ambient temperatures up to 40 °C (104 °F). Full rated power available up to 702.5m (2304.2 ft) elevation at ambient temperatures up to 50 °C (120 °F). Above these conditions derate by 6.6% per 305m (1000 ft) and derate by an additional 10.3% per 10 °C (18 °F).
Prime	Full rated power available up to 1334.9m (4378.6 ft) elevation at ambient temperatures up to 40 °C (104 °F). Above these conditions derate by 5.8% per 305m (1000 ft) and derate by an additional 14.0% per 10 °C (18 °F).

Ratings definitions

Emergency standby power (ESP):	Limited-time running power (LTP):	Prime power (PRP):	Base load (continuous) power (COP):
Applicable for supplying power to varying electrical load for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Fuel Stop power in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.	Applicable for supplying power to a constant electrical load for limited hours. Limited Time Running Power (LTP) is in accordance with ISO 8528.	Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.	Applicable for supplying power continuously to a constant electrical load for unlimited hours. Continuous Power (COP) is in accordance with ISO 8528, ISO 3046, AS 2789, DIN 6271 and BS 5514.

Alternator data

Voltage	Connection[1]	Temp rise degrees C	Duty[2]	Single phase factor[3]	Max surge kVA[4]	Winding No.	Alternator data sheet	Feature Code
380	Wye, 3-phase	125	P		5743		ADS-332	B596-2
380	Wye, 3-phase	150/105	S/P		6716		ADS-333	B595-2
380	Wye, 3-phase	80	P		6716		ADS-333	B687-2
380	Wye, 3-phase	105/80	S/P		7361		ADS-334	B599-2
380	Wye, 3-phase	80	S		7695		ADS-335	B660-2
440	Wye, 3-phase	125	P		4602		ADS-330	B692-2
440	Wye, 3-phase	150/125	S/P		5521		ADS-331	B691-2
440	Wye, 3-phase	125/105	S/P		5743		ADS-332	B663-2
440	Wye, 3-phase	80	S		6716		ADS-333	B688-2
440	Wye, 3-phase	80	P		7695		ADS-331	B689-2
480	Wye, 3-phase	105	P		4602		ADS-330	B693-2
480	Wye, 3-phase	125/105	S/P		5521		ADS-331	B276-2
480	Wye, 3-phase	80	P		5521		ADS-331	B694-2
480	Wye, 3-phase	105/80	S/P		5743		ADS-332	B600-2
480	Wye, 3-phase	80	S		6716		ADS-333	B601-2
600	Wye, 3-phase	105	P		4602		ADS-330	B581-2
600	Wye, 3-phase	125/105	S/P		5521		ADS-331	B602-2
600	Wye, 3-phase	80	P		5521		ADS-331	B695-2
600	Wye, 3-phase	105/80	S/P		5743		ADS-332	B603-2
600	Wye, 3-phase	80	S		6716		ADS-333	B604-2
4160	Wye, 3-phase	105	P		6204		ADS-322	B312-2
4160	Wye, 3-phase	105/80	S/P		7005		ADS-323	B313-2

Notes:

[1] Limited single phase capability is available from some three phase rated configurations. To obtain single phase rating, multipy the three phase kW rating by the Single Phase Factor[3]. All single phase ratings are at unity power factor.

[2] Standby (S), Prime (P) and Continuous ratings (C).

[3] Factor for the *Single Phase Output from Three Phase Alternator* formula listed below.

[4] Maximum rated starting kVA that results in a minimum of 90% of rated sustained voltage during starting.

Formulas for calculating full load currents:

Three phase output	Single phase output
$\frac{kW \times 1000}{Voltage \times 1.73 \times 0.8}$	$\frac{kW \times SinglePhaseFactor \times 1000}{Voltage}$

Warning: Back feed to a utility system can cause electrocution and/or property damage. Do not connect to any building's electrical system except through an approved device or after building main switch is open.

North America
1400 73rd Avenue N.E.
Minneapolis, MN 55432
USA

Phone 763 574 5000
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Our energy working for you.™

D-3334k (6/15)

power.cummins.com

Exhaust emission data sheet 1500DQGAB

60 Hz Diesel generator set

Engine information:

Model:	Cummins Inc. QSK50-G4 NR2	Bore:	6.25 in. (159 mm)
Type:	4 cycle, 60 °V, 16 cylinder diesel	Stroke:	6.25 in. (159 mm)
Aspiration:	Turbocharged and low temperature after-cooled	Displacement:	3067 cu. in. (50.2 liters)
Compression ratio:	15.0:1		
Emission control device:	Turbocharged and low temperature after-cooled		

Performance data	**1/4 Standby**	**1/2 Standby**	**3/4 Standby**	**Full Standby**	**Full Prime**
BHP @ 1800 RPM (60 Hz)	555	1110	1665	2220	1971
Fuel consumption (gal/hr)	33	57	82	108	96
Exhaust gas flow (CFM)	4755	7557	9751	11783	10838
Exhaust gas temperature (°F)	659	709	745	880	811
Exhaust emission data					
HC (Total unburned hydrocarbons)	0.32	0.19	0.11	0.07	0.08
NOx (Oxides of nitrogen as NO2)	3.5	3.93	4.38	5.38	5.1
CO (Carbon monoxide)	0.95	0.51	0.32	0.58	0.45
PM (Particular matter)	0.22	0.08	0.03	0.02	0.02
SO2 (Sulfur dioxide)	0.01	0.01	0.01	0.01	0.01
Smoke (Bosch)	0.63	0.33	0.14	0.12	0.12

All values are Grams per HP-Hour, Smoke is Bosch#

Test conditions

Data was recorded during steady-state rated engine speed (± 25 RPM) with full load (±2%). Pressures, temperatures, and emission rates were stabilized.

Fuel specification:	ASTM D975 No. 2-D diesel fuel with ULSD, and 40-48 cetane number.
Fuel temperature:	99 ±9 °F (at fuel pump inlet)
Intake air temperature:	77 ±9 °F
Barometric pressure:	29.6 ±1 in. Hg
Humidity:	NO_X measurement corrected to 75 grains H_2O/lb dry air
Reference standard:	ISO 8178

The NO_X, HC, CO and PM emission data tabulated here are representative of test data taken from a single engine under the test conditions shown above. Data for the other components are estimated. These data are subjected to instrumentation and engine-to-engine variability. Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures and instrumentation. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may results in elevated emission levels.

Generator Set Model	DQGAB
Engine Model	QSK50-G4
Fuel Rating	
Emissions Level	Tier 2

			ISO Standby			
Generator Set Load		%	25	50	75	100
		kWe	375	750	1125	1500
Engine Load		hp	555	1110	1665	2220
Nominal	HC	g/bhp·hr	0.32	0.19	0.11	0.07
	NOx	g/bhp·hr	3.50	3.93	4.38	5.38
	CO	g/bhp·hr	0.95	0.51	0.32	0.45
	PM	g/bhp·hr	0.22	0.08	0.03	0.02

Potential Site V	HC	g/bhp·hr	0.54	0.32	0.19	0.12
	NOx	g/bhp·hr	4.55	5.11	5.69	6.99
	CO	g/bhp·hr	1.90	1.02	0.64	0.90
	PM	g/bhp·hr	0.55	0.20	0.08	0.05

TECHNICAL DATA

CAT 3512C TIER 2 GENERATOR SET

RATED 1500eKW STANDBY POWER, 277/480 VOLT, 3-PHASE, 60 Hz,
UL LISTED

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Cat® 3512C

Diesel Generator Sets

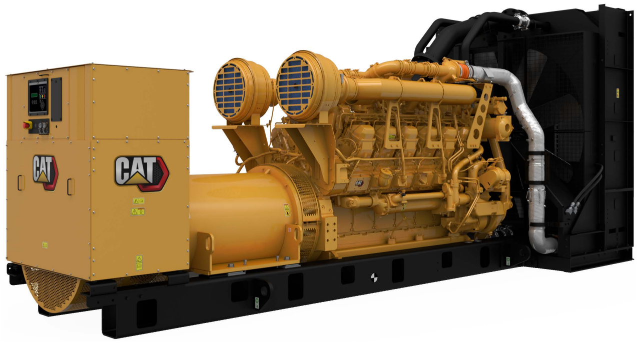


Image shown may not reflect actual configuration

Bore – mm (in)	170 (6.69)
Stroke – mm (in)	190 (7.48)
Displacement – L (in³)	51.8 (3161.03)
Compression Ratio	14.7:1
Aspiration	TA
Fuel System	EUI
Governor Type	ADEM™ A3

Mission Critical 60 Hz ekW (kVA)	Emissions Performance
1500 (1875)	U.S. EPA Stationary Emergency Use Only. (Tier 2)

Standard 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

Optional Equipment

Engine

Air Cleaner
■ Single element
❑ Dual element
❑ Heavy duty

Muffler
❑ Industrial grade (15 dB)

Starting
❑ Standard batteries
■ Oversized batteries
■ Standard electric starter(s)
❑ Dual electric starter(s)
❑ Air starter(s)
■ Jacket water heater

Alternator

Output voltage
❑ 380V ❑ 6600V
❑ 440V ❑ 6900V
■ 480V ❑ 12470V
❑ 600V ❑ 13200V
❑ 4160V ❑ 13800V
❑ 6300V

Temperature Rise (over 40°C ambient)
❑ 150°C
■ 125°C/130°C
❑ 105°C
❑ 80°C

Winding type
❑ Random wound
❑ Form wound

Excitation
❑ Internal excitation (IE)
■ Permanent magnet (PM)

Attachments
■ Anti-condensation heater
❑ Stator and bearing temperature monitoring and protection

Power Termination

Type
❑ Bus bar
■ Circuit breaker
❑ 1600A ❑ 2000A
■ 2500A ❑ 3200A
❑ 3000A
❑ UL ❑ IEC
■ 3-pole ❑ 4-pole
■ Manually operated
❑ Electrically operated

Trip Unit
❑ LSI ❑ LSI-G
■ LSIG-P

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 – 10A
■ Battery charger – 20A
❑ Battery charger – 35A

Vibration Isolators
❑ 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

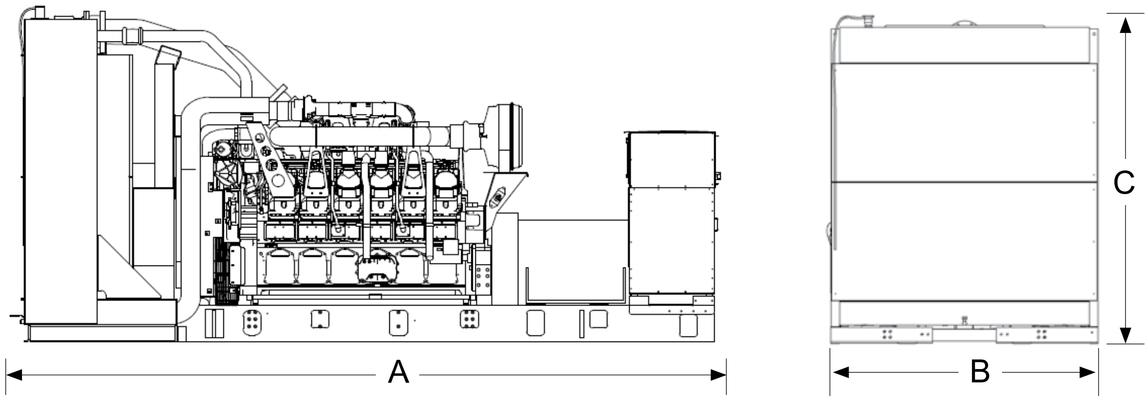
Note: *Some options may not be available on all models. Certifications may not be available with all model configurations. Consult factory for availabilit .*

Package Performance

Performance	Mission Critical	
Frequency	60 Hz	
Gen set power rating with fan	1500 ekW	
Gen set power rating with fan @ 0.8 power factor	1875 kVA	
Emissions	EPA Stationary Emergency (Tier 2)	
Performance number	EM1899-00	
Fuel Consumption		
100% load with fan – L/hr (gal/hr)	395.9	(104.6)
75% load with fan – L/hr (gal/hr)	310.5	(82.0)
50% load with fan – L/hr (gal/hr)	219.7	(58.0)
25% load with fan – L/hr (gal/hr)	128.4	(33.9)
Cooling System		
Radiator air flow restriction (system) – kPa (in. water)	0.12	(0.48)
Radiator air flow – m^3/min (cfm)	2075	(73278)
Engine coolant capacity – L (gal)	156.8	(41.4)
Radiator coolant capacity – L (gal)	234.0	(61.0)
Total coolant capacity – L (gal)	390.8	(102.4)
Inlet Air		
Combustion air inlet flow rate – m^3/min (cfm)	139.8	(4937.2)
Exhaust System		
Exhaust stack gas temperature – °C (°F)	402.6	(756.6)
Exhaust gas flow rate – m^3/min (cfm)	332.3	(11734.1)
Exhaust system backpressure (maximum allowable – kPa (in. water)	6.7	(27.0)
Heat Rejection		
Heat rejection to jacket water – kW (Btu/min)	502	(28541)
Heat rejection to exhaust (total) – kW (Btu/min)	1398	(79477)
Heat rejection to aftercooler – kW (Btu/min)	519	(29539)
Heat rejection to atmosphere from engine – kW (Btu/min)	124	(7072)
Heat rejection from alternator – kW (Btu/min)	74	(4208)
Emissions* (Nominal)		
NOx mg/Nm^3 (g/hp-h)	2373.9	(5.48)
CO mg/Nm^3 (g/hp-h)	237.3	(0.48)
HC mg/Nm^3 (g/hp-h)	51.7	(0.12)
PM mg/Nm^3 (g/hp-h)	13.0	(0.03)
Emissions* (Potential Site Variation)		
NOx mg/Nm^3 (g/hp-h)	2848.7	(6.58)
CO mg/Nm^3 (g/hp-h)	427.2	(0.87)
HC mg/Nm^3 (g/hp-h)	68.8	(0.16)
PM mg/Nm^3 (g/hp-h)	18.2	(0.04)

**mg/Nm^3 levels are corrected to 5% O_2. 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)
5920 (233.1)	2281 (89.8)	2794 (110.0)	13 970 (30,790)

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

Ratings Definitions

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 35º API [16°C (60ºF)] gravity having an LHV of 42,780 kJ/kg (18,390 Btu/lb) when used at 29ºC (85ºF) and weighing 838.9 g/liter (7.001 lbs/U.S. gal.)

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PERFORMANCE DATA[EM1899]

March 25, 2021

Performance Number: EM1899 **Change Level: 00**

SALES MODEL:	3512C
BRAND:	CAT
ENGINE POWER (BHP):	2,206
GEN POWER WITH FAN (EKW):	1,500.0
COMPRESSION RATIO:	14.7
RATING LEVEL:	MISSION CRITICAL STANDBY
PUMP QUANTITY:	1
FUEL TYPE:	DIESEL
MANIFOLD TYPE:	DRY
GOVERNOR TYPE:	ADEM3
ELECTRONICS TYPE:	ADEM3
CAMSHAFT TYPE:	STANDARD
IGNITION TYPE:	CI
INJECTOR TYPE:	EUI
FUEL INJECTOR:	3920220
UNIT INJECTOR TIMING (IN):	64.34
REF EXH STACK DIAMETER (IN):	10
MAX OPERATING ALTITUDE (FT):	3,937
COMBUSTION:	DIRECT INJECTION
ENGINE SPEED (RPM):	1,800
HERTZ:	60
FAN POWER (HP):	88.5
ASPIRATION:	TA
AFTERCOOLER TYPE:	ATAAC
AFTERCOOLER CIRCUIT TYPE:	JW+OC, ATAAC
INLET MANIFOLD AIR TEMP (F):	122
JACKET WATER TEMP (F):	210.2
TURBO CONFIGURATION:	PARALLEL
TURBO QUANTITY:	4
TURBOCHARGER MODEL:	GTB4708BN-52T-0.96
CERTIFICATION YEAR:	2006
CRANKCASE BLOWBY RATE (FT3/HR):	2,203.4
FUEL RATE (RATED RPM) NO LOAD (GAL/HR):	9.8
PISTON SPD @ RATED ENG SPD (FT/MIN):	2,244.1

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

General Performance Data

THIS STANDBY RATING IS FOR A STANDBY ONLY ENGINE ARRANGEMENT. RERATING THE ENGINE TO A 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)	VOL FUEL CONSUMPTN (VFC)	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP
EKW	%	BHP	PSI	LB/BHP-HR	GAL/HR	IN-HG	DEG F	DEG F	IN-HG	DEG F
1,500.0	100	2,206	307	0.332	103.2	77.5	120.9	1,145.6	74.6	756.6
1,350.0	90	1,983	276	0.336	94.0	72.2	116.1	1,102.7	68.8	727.5
1,200.0	80	1,768	246	0.343	85.5	66.9	113.2	1,069.1	63.0	713.4
1,125.0	75	1,662	232	0.346	81.0	63.4	111.5	1,052.3	59.5	706.7
1,050.0	70	1,556	217	0.348	76.4	59.7	109.8	1,035.2	55.8	700.0
900.0	60	1,349	188	0.352	67.0	51.1	107.1	1,000.5	47.6	687.3
750.0	50	1,144	159	0.355	57.3	40.6	107.5	963.6	38.4	696.7
600.0	40	940	131	0.359	47.6	30.0	108.4	921.9	29.4	702.2
450.0	30	736	103	0.368	38.1	20.9	107.1	856.0	21.9	685.3
375.0	25	632	88	0.376	33.5	16.9	106.2	809.5	18.8	664.9
300.0	20	527	73	0.388	28.8	13.3	105.2	754.5	16.0	636.4
150.0	10	312	43	0.443	19.5	7.3	103.2	609.7	11.4	540.6

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	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	IN-HG	DEG F	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
1,500.0	100	2,206	82	449.8	4,937.2	11,734.1	21,796.5	22,529.1	4,743.3	4,317.6
1,350.0	90	1,983	77	428.8	4,734.5	10,945.3	20,885.8	21,551.9	4,532.9	4,136.4
1,200.0	80	1,768	71	409.0	4,506.7	10,265.9	19,853.4	20,459.8	4,302.7	3,938.4
1,125.0	75	1,662	68	396.6	4,371.2	9,868.8	19,223.0	19,797.6	4,160.2	3,812.8
1,050.0	70	1,556	64	382.6	4,218.1	9,442.4	18,511.1	19,053.3	4,003.2	3,672.9
900.0	60	1,349	55	350.3	3,862.4	8,508.3	16,857.2	17,332.4	3,647.3	3,352.3
750.0	50	1,144	44	309.9	3,375.7	7,435.0	14,666.1	15,072.5	3,161.3	2,907.1
600.0	40	940	33	266.6	2,868.4	6,329.0	12,406.6	12,744.3	2,678.2	2,465.5
450.0	30	736	23	224.6	2,431.9	5,278.8	10,481.3	10,752.0	2,266.9	2,093.3
375.0	25	632	19	204.3	2,243.0	4,776.5	9,654.1	9,891.7	2,088.3	1,933.3
300.0	20	527	15	184.2	2,069.9	4,283.3	8,899.4	9,103.9	1,921.3	1,784.5
150.0	10	312	9	148.8	1,782.1	3,338.5	7,648.3	7,786.4	1,641.0	1,539.0

Heat Rejection Data

PERFORMANCE DATA[EM1899]

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
1,500.0	100	2,206	28,541	7,072	79,477	38,355	11,956	29,539	93,547	224,476	239,123
1,350.0	90	1,983	26,761	6,706	72,346	33,940	10,882	26,874	84,110	204,315	217,647
1,200.0	80	1,768	25,085	6,393	66,713	30,942	9,897	24,071	74,958	185,825	197,950
1,125.0	75	1,662	24,176	6,249	63,549	29,350	9,376	22,404	70,466	176,039	187,526
1,050.0	70	1,556	23,227	6,110	60,309	27,693	8,845	20,631	66,004	166,069	176,905
900.0	60	1,349	21,222	5,841	53,634	24,225	7,759	16,788	57,205	145,683	155,189
750.0	50	1,144	19,059	5,564	46,826	21,662	6,636	12,311	48,509	124,586	132,716
600.0	40	940	16,790	5,286	39,874	18,604	5,512	8,066	39,882	103,489	110,241
450.0	30	736	14,427	4,840	32,601	14,897	4,416	4,955	31,201	82,917	88,327
375.0	25	632	13,189	4,570	28,900	12,838	3,876	3,774	26,809	72,772	77,520
300.0	20	527	11,900	4,299	25,149	10,707	3,336	2,793	22,353	62,628	66,715
150.0	10	312	9,090	3,818	17,468	6,020	2,253	1,375	13,214	42,301	45,061

Sound Data

SOUND PRESSURE DATA FOR THIS RATING CAN BE FOUND IN PERFORMANCE NUMBER - DM8779.

Emissions Data

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN		EKW	1,500.0	1,125.0	750.0	375.0	150.0
PERCENT LOAD		%	100	75	50	25	10
ENGINE POWER		BHP	2,206	1,662	1,144	632	312
TOTAL NOX (AS NO2)		G/HR	14,366	7,266	4,835	3,673	2,831
TOTAL CO		G/HR	1,890	1,176	1,665	1,965	1,898
TOTAL HC		G/HR	351	381	358	283	329
PART MATTER		G/HR	97.6	99.1	150.9	184.0	112.2
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,848.7	1,803.1	1,671.1	2,214.1	2,967.2
TOTAL CO	(CORR 5% O2)	MG/NM3	427.2	336.3	712.5	1,486.6	2,381.4
TOTAL HC	(CORR 5% O2)	MG/NM3	68.8	95.6	123.3	175.3	360.2
PART MATTER	(CORR 5% O2)	MG/NM3	18.2	23.5	54.8	110.0	115.7
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,388	878	814	1,078	1,445
TOTAL CO	(CORR 5% O2)	PPM	342	269	570	1,189	1,905
TOTAL HC	(CORR 5% O2)	PPM	128	178	230	327	672
TOTAL NOX (AS NO2)		G/HP-HR	6.58	4.41	4.26	5.85	9.14
TOTAL CO		G/HP-HR	0.87	0.71	1.47	3.13	6.13
TOTAL HC		G/HP-HR	0.16	0.23	0.32	0.45	1.06
PART MATTER		G/HP-HR	0.04	0.06	0.13	0.29	0.36
TOTAL NOX (AS NO2)		LB/HR	31.67	16.02	10.66	8.10	6.24
TOTAL CO		LB/HR	4.17	2.59	3.67	4.33	4.18
TOTAL HC		LB/HR	0.77	0.84	0.79	0.62	0.73
PART MATTER		LB/HR	0.22	0.22	0.33	0.41	0.25

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN		EKW	1,500.0	1,125.0	750.0	375.0	150.0
PERCENT LOAD		%	100	75	50	25	10
ENGINE POWER		BHP	2,206	1,662	1,144	632	312
TOTAL NOX (AS NO2)		G/HR	11,972	6,055	4,029	3,061	2,359
TOTAL CO		G/HR	1,050	653	925	1,092	1,055
TOTAL HC		G/HR	264	286	269	213	248
TOTAL CO2		KG/HR	1,096	853	602	352	204
PART MATTER		G/HR	69.7	70.8	107.8	131.4	80.1
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,373.9	1,502.6	1,392.6	1,845.1	2,472.7
TOTAL CO	(CORR 5% O2)	MG/NM3	237.3	186.8	395.9	825.9	1,323.0
TOTAL HC	(CORR 5% O2)	MG/NM3	51.7	71.9	92.7	131.8	270.9
PART MATTER	(CORR 5% O2)	MG/NM3	13.0	16.8	39.1	78.6	82.6
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,156	732	678	899	1,204
TOTAL CO	(CORR 5% O2)	PPM	190	149	317	661	1,058

TOTAL HC	(CORR 5% O2)	PPM	97	134	173	246	506
TOTAL NOX (AS NO2)		G/HP-HR	5.48	3.68	3.55	4.87	7.62
TOTAL CO		G/HP-HR	0.48	0.40	0.81	1.74	3.40
TOTAL HC		G/HP-HR	0.12	0.17	0.24	0.34	0.80
PART MATTER		G/HP-HR	0.03	0.04	0.09	0.21	0.26
TOTAL NOX (AS NO2)		LB/HR	26.39	13.35	8.88	6.75	5.20
TOTAL CO		LB/HR	2.32	1.44	2.04	2.41	2.32
TOTAL HC		LB/HR	0.58	0.63	0.59	0.47	0.55
TOTAL CO2		LB/HR	2,417	1,881	1,327	776	449
PART MATTER		LB/HR	0.15	0.16	0.24	0.29	0.18
OXYGEN IN EXH		%	11.2	12.3	12.9	13.9	15.8
DRY SMOKE OPACITY		%	1.0	1.3	2.9	5.0	3.0
BOSCH SMOKE NUMBER			0.37	0.45	1.06	1.60	1.11

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

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	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,096	2,206
1,000	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,162	2,074	2,206
2,000	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,176	2,118	2,007	2,206
3,000	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,173	2,135	2,098	2,052	1,919	2,206
4,000	2,201	2,201	2,201	2,201	2,201	2,171	2,132	2,094	2,057	2,021	1,963	1,831	2,201
5,000	2,129	2,129	2,129	2,129	2,129	2,092	2,054	2,017	1,982	1,947	1,875	1,743	2,129
6,000	2,059	2,059	2,059	2,059	2,053	2,015	1,978	1,943	1,909	1,876	1,765	1,677	2,059
7,000	1,992	1,992	1,992	1,992	1,976	1,940	1,904	1,870	1,838	1,787	1,677	1,588	1,992
8,000	1,927	1,927	1,927	1,927	1,902	1,867	1,833	1,800	1,769	1,699	1,610	1,522	1,927
9,000	1,865	1,865	1,865	1,865	1,831	1,797	1,764	1,733	1,699	1,610	1,522	1,412	1,865
10,000	1,805	1,805	1,805	1,795	1,761	1,729	1,697	1,667	1,610	1,522	1,368	1,279	1,805
11,000	1,522	1,522	1,522	1,522	1,522	1,522	1,522	1,522	1,434	1,324	1,213	1,125	1,522
12,000	1,478	1,478	1,478	1,478	1,478	1,478	1,478	1,390	1,279	1,169	1,081	993	1,478
13,000	1,434	1,434	1,434	1,434	1,434	1,434	1,346	1,235	1,147	1,037	971	882	1,434
14,000	1,390	1,390	1,390	1,390	1,390	1,279	1,191	1,103	1,015	927	860	794	1,390
15,000	1,346	1,346	1,346	1,346	1,235	1,147	1,059	971	882	816	772	728	1,346

Cross Reference

Test Spec	Setting	Engine Arrangement	Engineering Model	Engineering Model Version	Start Effective Serial Number	End Effective Serial Number
4577180	LL1862	5084278	GS656	LS	CT200463	
4577180	LL1862	5157729	PG242	-	LYH00001	

Supplementary Data

Type	Classification	Performance Number
SOUND	SOUND PRESSURE	DM8779

Performance Parameter Reference

Parameters Reference:DM9600-12
PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600
APPLICATION:
Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test cell at SAE J1995 standard reference conditions. Caterpillar maintains ISO9001:2000 certified quality management systems for engine test Facilities to assure accurate calibration of test equipment. Engine test data is corrected in accordance with SAE J1995. Additional reference material SAE J1228, J1349, ISO 8665, 3046-1:2002E, 3046-3:1989, 1585, 2534, 2288, and 9249 may apply in part or are similar to SAE J1995. Special engine rating request (SERR) test data shall be noted.
PERFORMANCE PARAMETER TOLERANCE FACTORS:
Power +/- 3%
Torque +/- 3%
Exhaust stack temperature +/- 8%
Inlet airflow +/- 5%
Intake manifold pressure-gage +/- 10%
Exhaust flow +/- 6%
Specific fuel consumption +/- 3%
Fuel rate +/- 5%
Specific DEF consumption +/- 3%
DEF rate +/- 5%
Heat rejection +/- 5%
Heat rejection exhaust only +/- 10%
Heat rejection CEM only +/- 10%
Heat Rejection values based on using treated water.
Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications.
On C7 - C18 engines, at speeds of 1100 RPM and under these values are provided for reference only, and may not meet the tolerance listed.
These values do not apply to C280/3600. For these models, see the tolerances listed below.
C280/3600 HEAT REJECTION TOLERANCE FACTORS:
Heat rejection +/- 10%
Heat rejection to Atmosphere +/- 50%
Heat rejection to Lube Oil +/- 20%
Heat rejection to Aftercooler +/- 5%
TEST CELL TRANSDUCER TOLERANCE FACTORS:
Torque +/- 0.5%
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.
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 : 07/10/19

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AIR INTAKE SYSTEM		
THE INSTALLED SYSTEM MUST COMPLY WITH THE SYSTEM LIMITS BELOW FOR ALL EMISSIONS CERTIFIED ENGINES TO ASSURE REGULATORY COMPLIANCE.		
MAXIMUM ALLOWABLE INTAKE RESTRICTION WITH CLEAN ELEMENT	15	IN-H20
MAXIMUM ALLOWABLE INTAKE RESTRICTION WITH DIRTY ELEMENT	25	IN-H20
MAXIMUM PRESSURE DROP FROM COMPRESSOR OUTLET TO MANIFOLD INLET (OR MIXER INLET FOR EGR)	4.4	IN-HG
CHARGE AIR FLOW AT RATED SPEED	337.7	LB/MIN
TURBO COMPRESSOR OUTLET TEMPERATURE AT RATED SPEED	451	DEG F
MAXIMUM ALLOWABLE STATIC WEIGHT ON AIR INLET	59.5	LB
MAXIMUM ALLOWABLE STATIC WEIGHT ON AIR INLET (AIR SHUT OFF INCLUDED)	17.6	LB
MAXIMUM ALLOWABLE STATIC BENDING MOMENT ON AIR INLET	9.6	LB-FT
MAXIMUM ALLOWABLE STATIC WEIGHT ON TURBO OUTLET CONNECTION	0	LB
MAXIMUM ALLOWABLE STATIC BENDING MOMENT ON TURBO OUTLET CONNECTION	0	LB-FT
COOLING SYSTEM		
ENGINE ONLY COOLANT CAPACITY	41.4	GAL
MAXIMUM ALLOWABLE JACKET WATER OUTLET TEMPERATURE	210	DEG F
REGULATOR LOCATION FOR JW (HT) CIRCUIT	OUTLET	
MAXIMUM UNINTERRUPTED FILL RATE	5.0	G/MIN
ENGINE SPEC SYSTEM		
CYLINDER ARRANGEMENT	VEE	
NUMBER OF CYLINDERS	12	
CYLINDER BORE DIAMETER	6.7	IN
PISTON STROKE	7.5	IN
TOTAL CYLINDER DISPLACEMENT	3161	CU IN
STANDARD CRANKSHAFT ROTATION FROM FLYWHEEL END	CCW	
STANDARD CYLINDER FIRING ORDER	1-12-9-4-5-8-11-2-3-10-7-6	
NUMBER 1 CYLINDER LOCATION	RIGHT FRONT	
STROKES/COMBUSTION CYCLE	4	
EXHAUST SYSTEM		
THE INSTALLED SYSTEM MUST COMPLY WITH THE SYSTEM LIMITS BELOW FOR ALL EMISSIONS CERTIFIED ENGINES TO ASSURE REGULATORY COMPLIANCE.		
MAXIMUM ALLOWABLE SYSTEM BACK PRESSURE	27	IN-H20
MANIFOLD TYPE	DRY	
MAXIMUM ALLOWABLE STATIC WEIGHT ON EXHAUST CONNECTION	63.9	LB
MAXIMUM ALLOWABLE STATIC BENDING MOMENT ON EXHAUST CONNECTION	31.7	LB-FT

FUEL SYSTEM		
MAXIMUM FUEL FLOW FROM TRANSFER PUMP TO ENGINE	332.9	G/HR
MAXIMUM ALLOWABLE FUEL SUPPLY LINE RESTRICTION	8.9	IN-HG
MAXIMUM ALLOWABLE FUEL TEMPERATURE AT TRANSFER PUMP INLET	151	DEG F
MAXIMUM FUEL FLOW TO RETURN LINE FROM ENGINE	322.3	G/HR
MAXIMUM ALLOWABLE FUEL RETURN LINE RESTRICTION	8.0	IN-HG
NORMAL FUEL PRESSURE IN A CLEAN SYSTEM	60.2	PSI
FUEL SYSTEM TYPE	EUI	
MAXIMUM TRANSFER PUMP PRIMING LIFT WITHOUT PRIMING PUMP	12.1	FT
MAXIMUM HEAT REJECTION TO FUEL	540	BTU/MIN
LUBE SYSTEM		
CRANKCASE VENTILATION TYPE	TO ATM	
MOUNTING SYSTEM		
CENTER OF GRAVITY LOCATION - X DIMENSION - FROM REAR FACE OF BLOCK - (REFERENCE TM7077)	37.4	IN
CENTER OF GRAVITY LOCATION - Y DIMENSION - FROM CENTERLINE OF CRANKSHAFT - (REFERENCE TM7077)	9.8	IN
CENTER OF GRAVITY LOCATION - Z DIMENSION - FROM CENTERLINE OF CRANKSHAFT - (REFERENCE TM7077)	0.0	IN
MASS MOMENT OF INERTIA - X AXIS	8851	LB IN SEC2
MASS MOMENT OF INERTIA - Y AXIS	61955	LB IN SEC2
MASS MOMENT OF INERTIA - Z AXIS	61955	LB IN SEC2
STARTING SYSTEM		
MINIMUM CRANKING SPEED REQUIRED FOR START	120	RPM

Test Spec [LF2923]

March 25, 2021
For Help Desk Phone Numbers Click here (/tmi/tmihome/TMIContactInfo.htm)

Reference Number: 4577180
Effective Serial Number: LYH00491
Model: 3512C DI TA AAAC

Make from Spec:

Test Spec Data				
Description	Measure	Nominal	Ceiling	Floor
Corr Full Load Power	hp	2,253	2,298	2,208
Full Load Speed	RPM	1800	1810	1790
Governor Setting Speed	RPM			
High Idle Speed	RPM	1818	1836	1800
Low Idle Speed	RPM	900	910	890
FL Static Fuel Setting	in	1.063		
FT Static Fuel Setting	in	1.063		
Corrected Fuel Rate	GAL/HR	108.6	116.3	100.9
CSFC	LB/HP.H	0.341	0.360	0.322
Adjusted Boost	IN_HG	78.2	89.9	66.5
Torque Check Speed	RPM	1700	1710	1690
Corr Torq Rise at TC RPM	%	6.4		
Corr Torque at TC RPM	LB.FT	6,890	7,372	6,407
C Fuel Rate at TC RPM	GAL/HR	113.5	121.4	105.5
CSFC at TC RPM	LB/HP.H	0.360	0.378	0.340
ADJ Boost at TC RPM	IN_HG	82.0	87.4	64.6
Power Loss/Cyl	% C FL PWR			
Specific Blowby	CU FT/HP.H			
Temp Jacket Water Pump Inlet	F	192	197	186
Delta T Jacket Water (out-in)	F	10	19	1

Test Spec Data				
Description	Measure	Nominal	Ceiling	Floor
Inlet Manifold Temp	F	122	127	116
Water Temp to Scac	F			
Scac Water Flow	GAL/MIN			
Oil Pressure	PSI	57	87	44
Oil Pressure Low Idle	PSI	53	87	36
Fuel Pressure	PSI	68	90	45
Inlet Fuel Pressure	PSI		6	
Inlet Fuel Temp	F	86	91	80
Inlet Air Pressure	IN_HG		31	26
Inlet Air Restriction	IN_HG		1.18	
Inlet Air Temperature	F		122	50
Fuel Density	DEG API		36.0	34.0
Boost Constant				
Governor Setting Constant				
Governor Setting Torque	% RTD TRQ	90.0	91.0	89.0
High Idle Stability	RPM			
Low Idle Stability	RPM			
Set Point RPM	RPM	1820	1830	1810
Adjusted Boost (Gas Blending)	HG			
Corrected Fuel Rate - Diesel (Gas Blending)	GAL/HR			
Corrected Fuel Rate - Gas (Gas Blending	BTU/MIN			
Full Load Fueling (Gas Blending)	MM3/ST			
Gas Substitution Ratio (Gas Blending)	%			
Corr Full Load Power (Gas Blending)	HP			
Full Load Speed (Gas Blending)	RPM			
Exhaust Back Pressure	PSI			

Test Spec Data

Description	Measure	Nominal	Ceiling	Floor
TQ CK Exhaust Back Pressure	PSI			
Ataac Delta Pressure	PSI			

Engine Reference Information

Description	Measure	Data
FL Static/FT Static Fuel Settings	in	1.063 / 1.063
Fuel Valve Part Number		
Unit Injector Part Number		3920220
Timing Dimension Field Service	in	2.533
Timing Dimension Factory		
Torque Control Group Number		Change Level:
Fuel Pump/Gov Grp Part Number		1008780
Fuel Pump Type		EUI
Flyweight Part Number/Attitude		
Turbo Part No and Model		5905664 / GTB47-52T-.96A/R
Advertised Power / Governor Speed		2,206hp 1,800 RPM
Compression Ratio		14.7
Torque Rise Cam Part Number		
Manifold Type		DRY
Engine Flash File Part Number		5457022
Rating Number		2
Flash File Change Number		
ASM Flash File Part Number		
ISM Flash File Part Number		
Advisor Flash File Part Number		

Engine Reference Information		
Description	Measure	Data
Secondary Module Flash File Part Number		
Messenger Flash File Part Number		
Tandem Software Flash File Part Number		
Governor Type		ADEM3

Torque Control Group Spring Data		
Part No	Thickness	Quantity
No data available in table		

Torque Control Group Spacer Data		
Part No	Thickness	Quantity
No data available in table		

Timing Data
Mechanical Advance Part Number:
Chg. Level:
Advance: 0.0 DEG
Dog Leg Differentials: RPM: -- KW: --

Description	Measure	Spec	Minimum	Maximum
Timing Static @ 0 RPM BTDC	DEG			

Application/Performance Data		
Description	Measure	Data
Application Identification		297 GS STANDBY
Engine Sales Model and Series		3512 C
Combustion System type		DI
Aspiration Type		TA
Engine Source Factory Ref Number		88
Multi Engine Torq/Rating		4577179

Application/Performance Data		
Description	Measure	Data
Emissions Family		
Generator Rating W/O Fan	EKW	
Generator	HZ	60
Brakesaver test		
Certified Engine Rating	hp	
Engineering Model Ref		PG242
Low Idle In-Veh Speed	RPM	
Sales Model		
Machine Facility		
Usage		
Transmission		
Description		GS
Serial Number Prefixs		

Altitude Derating Information		
Description	Measure	Data
Altitude - Maximum	FT	3,937
Engine Power (ADV)	hp	2,206
Engine Power (Test)	hp	2,253
High Idle Speed	RPM	
FL Static Fuel Setting	in	

Altitude Derating Information		
Description	Measure	Data
FT Static Fuel Setting	in	1.063
Corrected Fuel Rate	GAL/HR	108.6
FL Boost Pressure	IN_HG	

Spec Number vs. Arrangement Number Cross Reference		
Arrangement	5084278	5157729

For Help Desk Phone Numbers Click here

Component Performance Number: DM9057

Radiator Data

Radiator Part Number: 4160484
Radiator Type: ASF44.0CV
Front Area: 44.02 ft2
Radiator Dry Weight: 5,101.5 lbs
Radiator Wet Weight: 5,601.9 lbs
Radiator Water Capacity High Temp Circuit: 61.0 gal
Radiator Water Capacity Low Temp Circuit: NA gal
Center of Gravity (X): 25.00 in (Distance from front face of core)
Center of Gravity (Y): 41.73 in (Distance from bottom of radiator support)
Center of Gravity (Z): 0.68 in (Distance from center line of core)

Engine Data

Performance Number: DM8761
Sales Model: 3512
EKW: 1250
Rating: STANDBY
Speed: 1800
Settings: NA
IM ATAAC Temp Deg F: 113

Combination Data

Pully Ratio: 0.44
Fan Power: 88.50732 hp

Ambient Restrictions (1/2 inH2O)			Ambient Restrictions (3/4 inH2O)			Ambient Restrictions (1.00 inH2O)		
984 Feet	2460 Feet	4921 Feet	984 Feet	2460 Feet	4921 Feet	984 Feet	2460 Feet	4921 Feet
--------- Max Ambient Pre-alarm Deg F ---------								
125	122	113	120	114	105	NA	NA	NA

Air Flow Restrictions (1/2 inH2O)	Air Flow Restrictions (3/4 inH2O)	Air Flow Restrictions (1.00 inH2O)
--------- scfm ---------		
73278	68863	NA

No Graph data available...

Reference Number: DM9057

No notes found...

Parameters Reference: TM6016

RADIATOR CORE DATA:

FOR OPEN GENERATOR SET ELECTRIC POWER APPLICATIONS, CORE AIR FLOW RESISTANCE DATA INCLUDES ENGINE, GENERATOR, AND COOLING PACKAGE. ADDITIONAL AIRFLOW RESISTANCE DUE TO CUSTOMER SUPPLIED ITEMS SUCH AS INLET/EXHAUST LOUVERS, SOUND ATTENUATION, OR INLET/EXHAUST AIR PIPEWORK IS NOT INCLUDED.

ALL OTHER APPLICATIONS OUTSIDE OF OPEN ELECTRIC POWER, CORE AIR FLOW RESISTANCE IS FOR FREE STANDING CORE ONLY.

CORE PERFORMANCE DATA IS BASED ON AN AIR DENSITY OF 1.20 KG/M3 (0.075 LB/CU FT)

AMBIENT CAPABILITY:

AMBIENT CAPABILITY AND ALTITUDE CAPABILITY LISTED ON THIS PAGE REFLECTS THE CAPABILITY OF THE COOLING SYSTEM AT THE MAXIMUM GENERATOR RATING. AMBIENT CAPABILITY FOR STANDBY AND MISSION CRITICAL STANDBY RATINGS REPORTED AGAINST A JACKET WATER ENGINE EXIT TEMPERATURE LIMIT OF 104C (219F). ALL OTHER RATINGS REPORTED AT 99C (210F).

AMBIENT AND ALTITUDE CAPABILITY MUST BE VERIFIED FOR THE ENGINE AND GENERATOR IN THE ENGINE PERFORMANCE SECTION OF TMI.

NON TIER 4 EMISSION RATINGS ASSUME 4C (7F) AIR TO CORE RISE, TIER 4 EMISSION RATINGS ASSUME 6C (9F).

ALL PERFORMANCE SHOWN WITH 50/50 GLYCOL COOLANT.

LAST UPDATED: 09/11/2020

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Selected Model

Engine: 3512	**Generator Frame:** 1447	**Genset Rating (kW):** 1500.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 5873760	**Genset Rating (kVA):** 1875.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2255.3
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 20205 /20191 /20205 /675304

Spec Information

Generator Specification

Frame: 1447 **Type:** SR5	**No. of Bearings:** 1
Winding Type: RANDOM WOUND	**Flywheel:** 21.0
Connection: SERIES STAR	**Housing:** 00
Phases: 3	**No. of Leads:** 6
Poles: 4	**Wires per Lead:** 4
Sync Speed: 1800	**Generator Pitch:** 0.6667

Generator Efficiency

Per Unit Load	kW	Efficiency %
0.25	375.0	93.5
0.5	750.0	95.4
0.75	1125.0	95.6
1.0	1500.0	95.2

Reactances	Per Unit	Ohms
SUBTRANSIENT - DIRECT AXIS X''_d	0.1416	0.0174
SUBTRANSIENT - QUADRATURE AXIS X''_q	0.1603	0.0197
TRANSIENT - SATURATED X'_d	0.1766	0.0217
SYNCHRONOUS - DIRECT AXIS X_d	3.9355	0.4836
SYNCHRONOUS - QUADRATURE AXIS X_q	2.3633	0.2904
NEGATIVE SEQUENCE X_2	0.1514	0.0186
ZERO SEQUENCE X_0	0.0342	0.0042

Time Constants	Seconds
OPEN CIRCUIT TRANSIENT - DIRECT AXIS T'_{d0}	3.9100
SHORT CIRCUIT TRANSIENT - DIRECT AXIS T'_d	0.1800
OPEN CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_{d0}	0.0320
SHORT CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_d	0.0180
OPEN CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_{q0}	0.2650
SHORT CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_q	0.0180
EXCITER TIME CONSTANT T_e	0.0600
ARMATURE SHORT CIRCUIT T_a	0.0270

Short Circuit Ratio: 0.34 | Stator Resistance = 0.0025 Ohms | Field Resistance = 0.506 Ohms

Voltage Regulation

Voltage level adjustment: +/-	5.0%
Voltage regulation, steady state: +/-	0.5%
Voltage regulation with 3% speed change: +/-	0.5%
Waveform deviation line - line, no load: less than	2.0%
Telephone influence factor: less than	100

Generator Excitation

	No Load	Full Load, (rated) pf Series	Full Load, (rated) pf Parallel
Excitation voltage:	10.34 Volts	57.26 Volts	Volts
Excitation current	0.81 Amps	3.7 Amps	Amps

Selected Model

Engine: 3512	**Generator Frame:** 1447	**Genset Rating (kW):** 1500.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 5873760	**Genset Rating (kVA):** 1875.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2255.3
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 20205 /20191 /20205 /675304

Generator Mechanical Information

Center of Gravity

Dimension X	-686.5 mm	-27.0 IN.
Dimension Y	0.0 mm	0.0 IN.
Dimension Z	0.0 mm	0.0 IN.

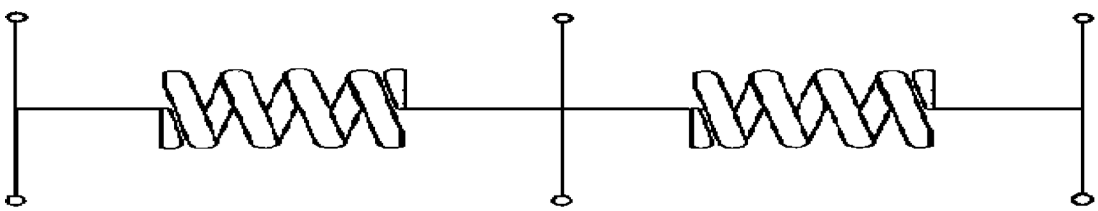
- "X" is measured from driven end of generator and parallel to rotor. Towards engine fan is positive. See General Information for details
- "Y" is measured vertically from rotor center line. Up is positive.
- "Z" is measured to left and right of rotor center line. To the right is positive.

Generator WT = 2900 kg	* Rotor WT = 1104 kg	* Stator WT = 1796 kg
6,393 LB	2,434 LB	3,959 LB

Rotor Balance = 0.0508 mm deflection PTP

Overspeed Capacity = 125% of synchronous speed

Generator Torsional Data



J1 = Coupling and Fan **J2 = Rotor TOTAL J = J1 + J2 + J3** **J3 = Exciter End**

K1 = Shaft Stiffness between J1 + J2 (Diameter 1) **K2 = Shaft Stiffness between J2 + J3 (Diameter 2)**

J1	K1	Min Shaft Dia 1	J2	K2	Min Shaft Dia 2	J3
30.2 LB IN. s^2	155.8 MLB IN./rad	6.7 IN.	184.1 LB IN. s^2	119.5 MLB IN./rad	5.5 IN.	7.1 LB IN. s^2
3.41 N m s^2	17.6 MN m/rad	170.0 mm	20.8 N m s^2	13.5 MN m/rad	140.0 mm	0.8 N m s^2

Total J

221.4 LB IN. s^2

25.01 N m s^2

Selected Model

Engine: 3512	**Generator Frame:** 1447	**Genset Rating (kW):** 1500.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 5873760	**Genset Rating (kVA):** 1875.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2255.3
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 20205 /20191 /20205 /675304

Generator Cooling Requirements - Temperature - Insulation Data

Cooling Requirements:		Temperature Data: (Ambient 40 ^{0}C)	
Heat Dissipated:	76.0 kW	**Stator Rise:**	125.0 ^{0}C
Air Flow:	132.0 m^3/min	**Rotor Rise:**	125.0 ^{0}C

Insulation Class: H

Insulation Reg. as shipped: 100.0 MΩ minimum at 40 ^{0}C

Thermal Limits of Generator

Frequency:	60 Hz
Line to Line Voltage:	480 Volts
B BR 80/40	1500.0 kVA
F BR -105/40	1706.0 kVA
H BR - 125/40	1875.0 kVA
F PR - 130/40	1875.0 kVA
H PR - 150/40	1992.0 kVA
H PR27 - 163/27	2072.0 kVA

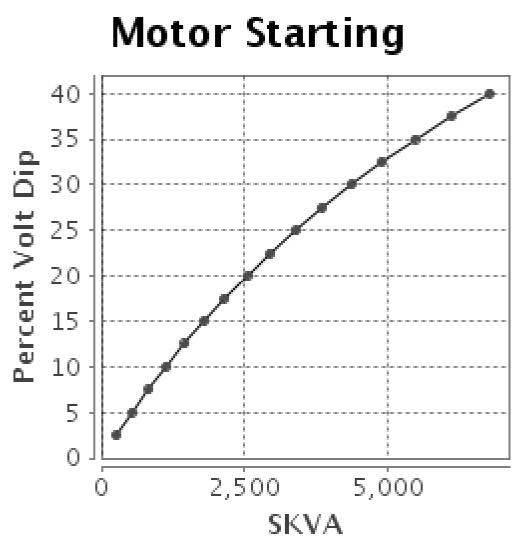
Selected Model

Engine: 3512	**Generator Frame:** 1447	**Genset Rating (kW):** 1500.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 5873760	**Genset Rating (kVA):** 1875.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2255.3
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 20205 /20191 /20205 /675304

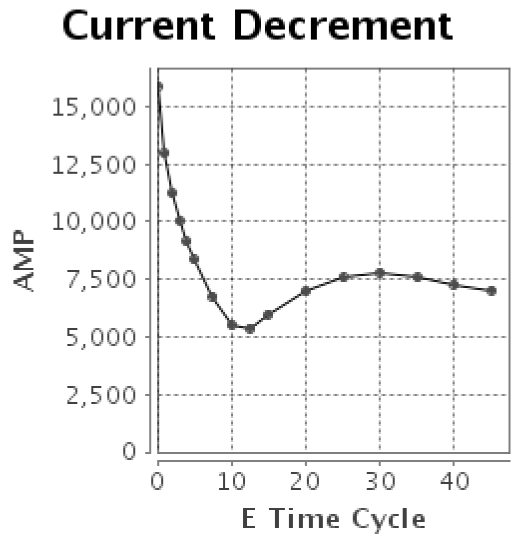
Starting Capability & Current Decrement
Motor Starting Capability (0.4 pf)

SKVA	Percent Volt Dip
260	2.5
534	5.0
823	7.5
1,128	10.0
1,450	12.5
1,791	15.0
2,153	17.5
2,538	20.0
2,947	22.5
3,384	25.0
3,850	27.5
4,350	30.0
4,888	32.5
5,466	35.0
6,091	37.5
6,767	40.0



Current Decrement Data

E Time Cycle	AMP
0.0	15,887
1.0	12,954
2.0	11,229
3.0	10,048
4.0	9,125
5.0	8,346
7.5	6,758
10.0	5,518
12.5	5,375
15.0	5,994
20.0	6,997
25.0	7,566
30.0	7,800
35.0	7,579
40.0	7,272
45.0	7,023



Instantaneous 3 Phase Fault Current: 15887 Amps **Instantaneous Line - Line Fault Current:** 13300 Amps

Instantaneous Line - Neutral Fault Current: 20629 Amps

Selected Model

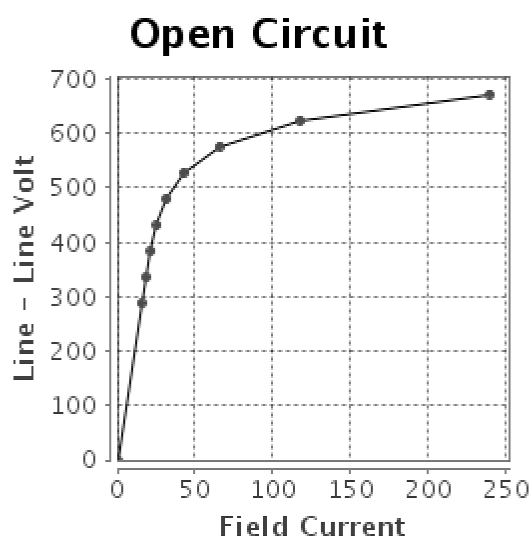
Engine: 3512	**Generator Frame:** 1447	**Genset Rating (kW):** 1500.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 5873760	**Genset Rating (kVA):** 1875.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2255.3
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 20205 /20191 /20205 /675304

Generator Output Characteristic Curves

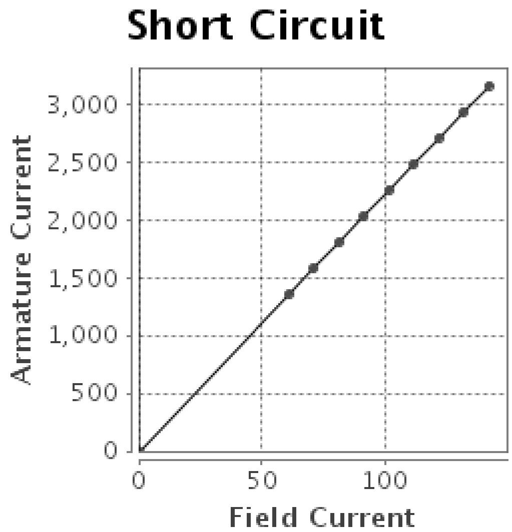
Open Circuit Curve

Field Current	Line - Line Volt
0.0	0
15.6	288
18.4	336
21.6	384
25.6	432
31.7	480
42.8	528
65.8	576
117.8	624
239.7	672



Short Circuit Curve

Field Current	Armature Current
0.0	0
61.0	1,353
71.1	1,579
81.3	1,804
91.4	2,030
101.6	2,255
111.7	2,481
121.9	2,706
132.1	2,932
142.2	3,157



Selected Model

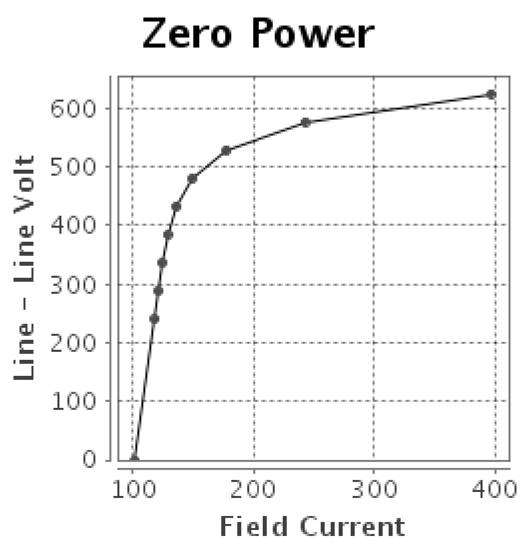
Engine: 3512
Generator Frame: 1447
Genset Rating (kW): 1500.0
Line Voltage: 480
Fuel: Diesel
Generator Arrangement: 5873760
Genset Rating (kVA): 1875.0
Phase Voltage: 277
Frequency: 60
Excitation Type: Permanent Magnet
Pwr. Factor: 0.8
Rated Current: 2255.3
Duty: STANDBY
Connection: SERIES STAR
Application: EPG
Status: Current

Version: 20205 /20191 /20205 /675304

Generator Output Characteristic Curves

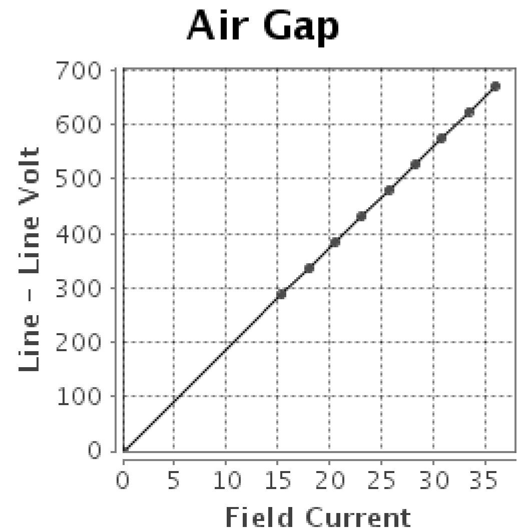
Zero Power Factor Curve

Field Current	Line - Line Volt
101.6	0
117.6	240
120.6	288
123.9	336
128.4	384
135.4	432
148.7	480
177.3	528
242.5	576
396.3	624



Air Gap Curve

Field Current	Line - Line Volt
0.0	0
15.4	288
18.0	336
20.5	384
23.1	432
25.7	480
28.3	528
30.8	576
33.4	624
36.0	672

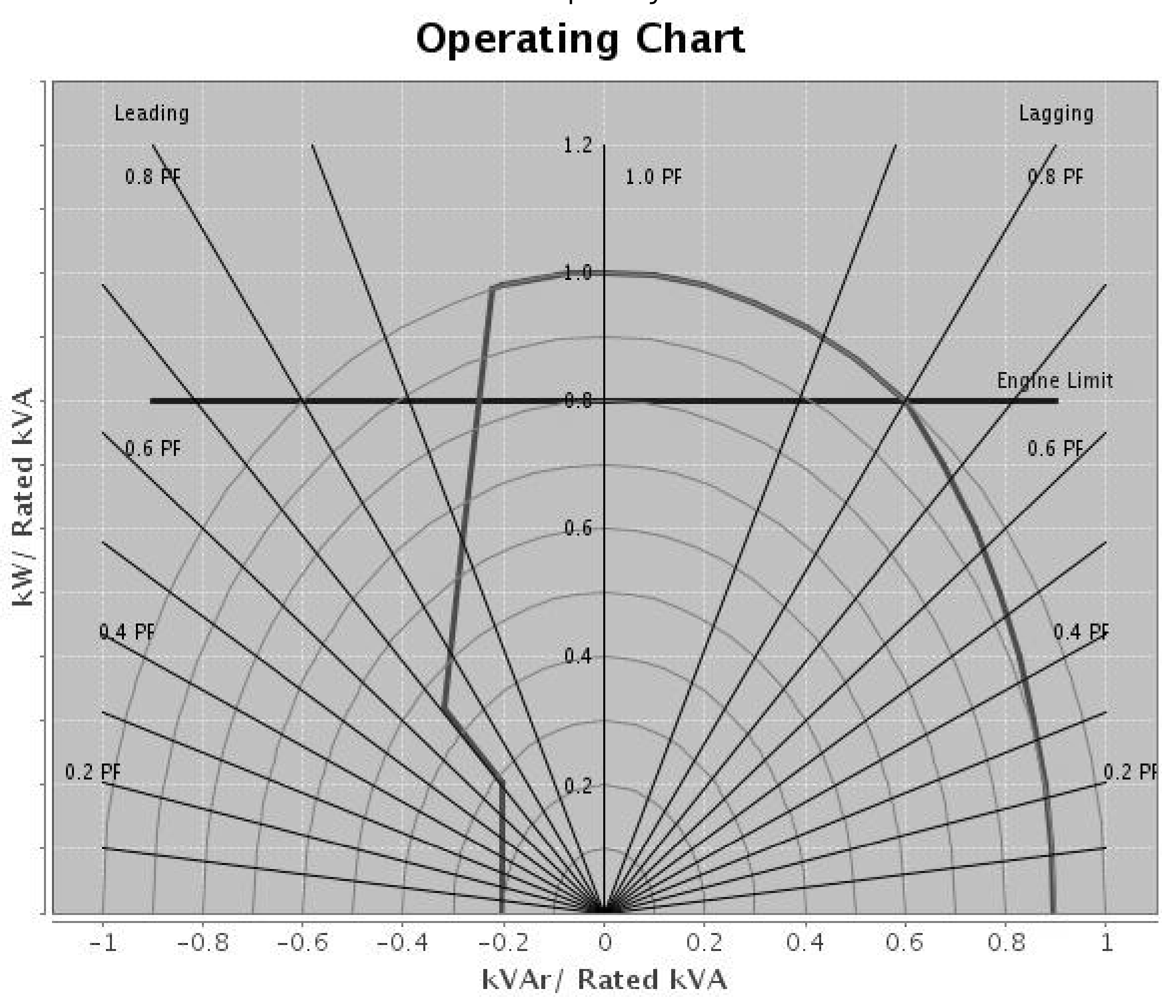


Selected Model

Engine: 3512	**Generator Frame:** 1447	**Genset Rating (kW):** 1500.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 5873760	**Genset Rating (kVA):** 1875.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2255.3
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 20205 /20191 /20205 /675304

Reactive Capability Curve



Selected Model

Engine: 3512	**Generator Frame:** 1447	**Genset Rating (kW):** 1500.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 5873760	**Genset Rating (kVA):** 1875.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2255.3
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 20205 /20191 /20205 /675304

General Information

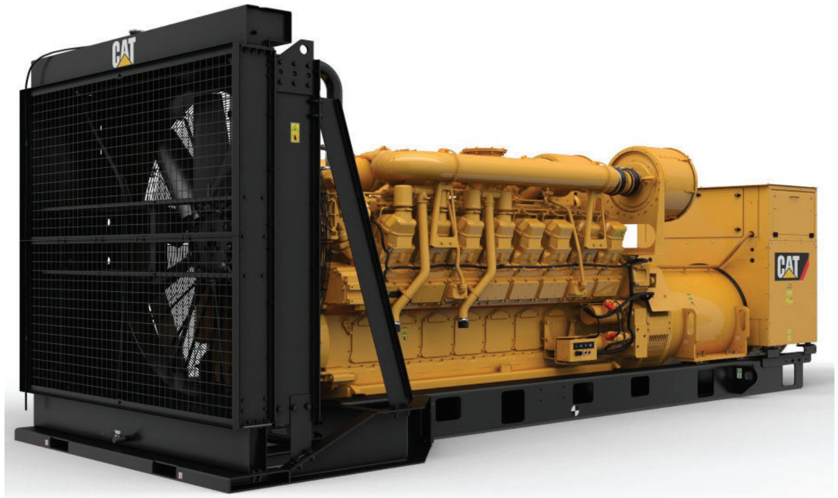
DM7825 Caterpillar SR5 Generators (50 Hz, 60 Hz)
Data for 1400, 1600, 1700, 1800 and 1900 frames Caterpillar SR5 generators built by Leroy Somer - USA and Leroy Somer France.

Refer to DM7821 for explanation of all generator data in Technical Marketing Information (TMI) except generator efficiency for which the explanation is given below.

GENERATOR EFFICIENCY
Generator efficiency is the percentage of engine flywheel (or other prime mover) power that is converted into electrical output. The generator efficiency shown is calculated by the summation of all losses method, and is determined in accordance with the IEC Standard 60034. The efficiency considers only the generator. There is no consideration of engine or parasitic losses here.

Refer to DM7829 for low and medium voltage protective setting values a nd limits.

N C POWER SYSTEMS



TECHNICAL DATA

CAT 3516C TIER 2 GENERATOR SET

RATED 2500eKW STANDBY POWER, 277/480 VOLT, 3-PHASE, 60 Hz,
UL LISTED

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Cat® 3516C

Diesel Generator Sets

Image shown may not reflect actual configuration

Bore – mm (in)	170 (6.69)
Stroke – mm (in)	215 (8.46)
Displacement – L (in³)	78 (4764.73)
Compression Ratio	14.7:1
Aspiration	TA
Fuel System	EUI
Governor Type	ADEM™ A3

Standby 60 Hz ekW (kVA)	Mission Critical 60 Hz ekW (kVA)	Prime 60 Hz ekW (kVA)	Continuous 60 Hz ekW (kVA)	Emissions Performance
	2500 (3125)			U.S. EPA Stationary Emergency Use Only (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

Standard and Optional Equipment

Engine

Air Cleaner
- ❑ Single element
- ❑ Dual element

Muffler
- ❑ Industrial grade (15 dB)

Starting
- ❑ Standard batteries
- ❑ Oversized batteries
- ❑ Standard electric starter(s)
- ❑ Heavy duty electric starter(s)
- ❑ Air starter(s)
- ❑ Jacket water heater

Alternator

Output voltage
- ❑ 380V ❑ 6300V
- ❑ 440V ❑ 6600V
- ❑ 480V ❑ 6900V
- ❑ 600V ❑ 12470V
- ❑ 2400V ❑ 13200V
- ❑ 4160V ❑ 13800V

Temperature Rise (over 40°C ambient)
- ❑ 150°C
- ❑ 125°C/130°C
- ❑ 105°C
- ❑ 80°C

Winding type
- ❑ Random wound
- ❑ Form wound

Excitation
- ❑ Internal excitation (IE)
- ❑ Permanent magnet (PM)

Attachments
- ❑ Anti-condensation heater
- ❑ Stator and bearing temperature monitoring and protection

Power Termination

Type
- ❑ Bus bar
- ❑ Circuit breaker
- ❑ 1600A ❑ 2000A
- ❑ 2500A ❑ 3000A
- ❑ 3200A ❑ 4000A
- ❑ 5000A
- ❑ IEC ❑ UL
- ❑ 3-pole ❑ 4-pole
- ❑ Manually operated
- ❑ Electrically operated

Trip Unit
- ❑ LSI ❑ LSI-G
- ❑ LSIG-P

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 – 10A
- ❑ Battery charger – 20A
- ❑ Battery charger – 35A

Vibration Isolators
- ❑ Rubber
- ❑ Spring
- ❑ Seismic rated

Cat Connect

Connectivity
- ❑ Ethernet
- ❑ Cellular

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)
- ❑ Paralleling switchgear
- ❑ Paralleling controls

Certifications
- ❑ UL 2200 Listed
- ❑ CSA
- ❑ IBC seismic certification
- ❑ OSHPD pre-approval

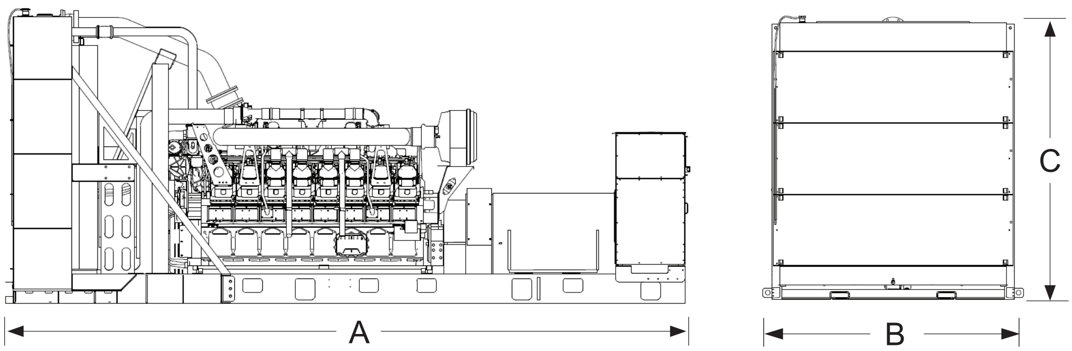
Note: *Some options may not be available on all models. Certifications may not be available with all model configurations. Consult factory for availability.*

Package Performance

Performance	Mission Critical	
Frequency	60 Hz	
Gen set power rating with fan	2500 ekW	
Gen set power rating with fan @ 0.8 power factor	3125 kVA	
Emissions	EPA ESE (TIER 2)	
Performance number	EM1895-02	
Fuel Consumption		
100% load with fan – L/hr (gal/hr)	656.8	(175.3)
75% load with fan – L/hr (gal/hr)	510.8	(134.9)
50% load with fan – L/hr (gal/hr)	372.4	(98.4)
25% load with fan – L/hr (gal/hr)	219.3	(57.9)
Cooling System		
Radiator air flow restriction (system) – kPa (in. water)	0.12	(0.48)
Radiator air flow – m^3/min (cfm)	2356	(83201)
Engine coolant capacity – L (gal)	233.0	(61.6)
Radiator coolant capacity – L (gal)	180.0	(47.6)
Total coolant capacity – L (gal)	413.0	(109.2)
Inlet Air		
Combustion air inlet flow rate – m^3/min (cfm)	242.2	(7212.2)
Exhaust System		
Exhaust stack gas temperature – °C (°F)	490.7	(915.2)
Exhaust gas flow rate – m^3/min (cfm)	554.5	(19578.8)
Exhaust system backpressure (maximum allowable) – kPa (in. water)	6.7	(27.0)
Heat Rejection		
Heat rejection to jacket water – kW (Btu/min)	826	(46992)
Heat rejection to exhaust (total) – kW (Btu/min)	2502	(142265)
Heat rejection to aftercooler – kW (Btu/min)	786	(44723)
Heat rejection to atmosphere from engine – kW (Btu/min)	161	(9146)
Heat rejection from alternator – kW (Btu/min)	121	(6853)
Emissions* (Nominal)		
NOx mg/Nm^3 (g/hp-h)	2349.1	(5.32)
CO mg/Nm^3 (g/hp-h)	195.4	(0.42)
HC mg/Nm^3 (g/hp-h)	42.1	(0.10)
PM mg/Nm^3 (g/hp-h)	14.1	(0.04)
Emissions* (Potential Site Variation)		
NOx mg/Nm^3 (g/hp-h)	2818.9	(6.38)
CO mg/Nm^3 (g/hp-h)	351.8	(0.76)
HC mg/Nm^3 (g/hp-h)	55.9	(0.14)
PM mg/Nm^3 (g/hp-h)	19.7	(0.05)

**mg/Nm^3 levels are corrected to 5% O_2. 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)
6800 (267.7)	2339 (92.1)	2997 (118.0)	17 590 (38,780)

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 power rating. 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 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.

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

Continuous
Output available with non-varying load for an unlimited time. Average power output is 70-100% of the continuous power rating. Typical peak demand is 100% of continuous rated kW for 100% of the operating hours.

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

- ISO 8528-1 Data Center Power (DCP) compliant per DCP application of Cat diesel generator set prime power rating.
- 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 35º API [16°C (60ºF)] gravity having an LHV of 42,780 kJ/kg (18,390 Btu/lb) when used at 29ºC (85ºF) and weighing 838.9 g/liter (7.001 lbs/U.S. gal.)

www.cat.com/electricpower

PERFORMANCE DATA[EM1895]

March 25, 2021

Performance Number: EM1895 **Change Level: 05**

SALES MODEL:	3516C	**COMBUSTION:**	DIRECT INJECTION
BRAND:	CAT	**ENGINE SPEED (RPM):**	1,800
ENGINE POWER (BHP):	3,634	**HERTZ:**	60
GEN POWER WITH FAN (EKW):	2,500.0	**FAN POWER (HP):**	130.1
COMPRESSION RATIO:	14.7	**ASPIRATION:**	TA
RATING LEVEL:	MISSION CRITICAL STANDBY	**AFTERCOOLER TYPE:**	ATAAC
PUMP QUANTITY:	1	**AFTERCOOLER CIRCUIT TYPE:**	JW+OC, ATAAC
FUEL TYPE:	DIESEL	**INLET MANIFOLD AIR TEMP (F):**	122
MANIFOLD TYPE:	DRY	**JACKET WATER TEMP (F):**	219.2
GOVERNOR TYPE:	ADEM3	**TURBO CONFIGURATION:**	PARALLEL
ELECTRONICS TYPE:	ADEM3	**TURBO QUANTITY:**	4
CAMSHAFT TYPE:	STANDARD	**TURBOCHARGER MODEL:**	GT6041BN-48T-1.10
IGNITION TYPE:	CI	**CERTIFICATION YEAR:**	2006
INJECTOR TYPE:	EUI	**CRANKCASE BLOWBY RATE (FT3/HR):**	3,619.4
FUEL INJECTOR:	3920221	**FUEL RATE (RATED RPM) NO LOAD (GAL/HR):**	16.0
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):	2,953		

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

General Performance Data

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

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.

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BSFC)	VOL FUEL CONSUMPTN (VFC)	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP
EKW	%	BHP	PSI	LB/BHP-HR	GAL/HR	IN-HG	DEG F	DEG F	IN-HG	DEG F
2,500.0	100	3,633	336	0.334	171.3	78.1	121.9	1,235.6	67.6	915.2
2,250.0	90	3,283	303	0.335	155.1	71.3	119.4	1,190.0	61.3	881.2
2,000.0	80	2,935	271	0.339	140.4	64.3	116.9	1,158.9	55.3	864.0
1,875.0	75	2,760	255	0.342	133.2	60.7	115.8	1,145.6	52.3	858.5
1,750.0	70	2,586	239	0.346	125.9	57.0	114.7	1,133.3	49.3	854.6
1,500.0	60	2,237	207	0.354	111.5	49.5	112.7	1,112.4	43.2	851.2
1,250.0	50	1,889	174	0.365	97.1	41.3	111.0	1,091.8	36.8	850.7
1,000.0	40	1,547	143	0.373	81.4	31.4	109.4	1,061.5	29.3	856.6
750.0	30	1,203	111	0.385	65.3	21.7	107.9	1,010.3	22.1	848.2
625.0	25	1,029	95	0.394	57.2	17.2	107.2	968.3	18.7	831.1
500.0	20	854	79	0.403	48.6	12.7	106.4	902.0	15.5	796.1
250.0	10	497	46	0.441	30.9	4.8	104.1	700.7	9.8	647.3

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	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	IN-HG	DEG F	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
2,500.0	100	3,633	85	466.7	7,212.2	19,578.8	32,046.3	33,260.4	7,001.7	6,362.4
2,250.0	90	3,283	78	443.0	6,831.8	17,980.7	30,219.3	31,318.8	6,593.0	6,013.7
2,000.0	80	2,935	70	417.8	6,404.5	16,560.6	28,284.6	29,277.2	6,151.5	5,625.4
1,875.0	75	2,760	66	404.7	6,173.3	15,893.2	27,261.3	28,202.4	5,928.1	5,427.1
1,750.0	70	2,586	63	391.2	5,929.9	15,232.6	26,196.0	27,086.8	5,698.4	5,222.0
1,500.0	60	2,237	55	363.5	5,411.9	13,879.0	23,947.5	24,739.5	5,205.5	4,779.1
1,250.0	50	1,889	46	334.6	4,843.3	12,413.0	21,444.3	22,133.2	4,657.5	4,283.2
1,000.0	40	1,547	36	297.5	4,121.4	10,609.5	18,262.0	18,840.0	3,963.0	3,647.2
750.0	30	1,203	25	249.8	3,423.0	8,763.8	15,175.3	15,640.3	3,294.6	3,037.8
625.0	25	1,029	21	223.4	3,104.6	7,844.6	13,765.1	14,171.8	2,988.1	2,760.8
500.0	20	854	16	197.2	2,791.2	6,823.5	12,376.2	12,722.2	2,671.7	2,476.1
250.0	10	497	7	152.3	2,237.9	4,800.2	9,917.6	10,136.8	2,132.0	1,999.8

PERFORMANCE DATA[EM1895]

March 25, 2021

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
2,500.0	100	3,633	46,992	9,146	142,265	79,907	19,835	44,723	154,077	372,403	396,702
2,250.0	90	3,283	44,242	8,557	127,929	70,449	17,960	39,380	139,243	337,204	359,207
2,000.0	80	2,935	41,477	8,162	116,879	63,561	16,262	34,167	124,444	305,311	325,233
1,875.0	75	2,760	40,076	8,007	111,588	60,518	15,425	31,612	117,053	289,608	308,505
1,750.0	70	2,586	38,657	7,874	106,293	57,637	14,588	29,085	109,651	273,881	291,752
1,500.0	60	2,237	35,755	7,684	95,729	52,220	12,915	24,201	94,874	242,485	258,307
1,250.0	50	1,889	32,626	7,527	85,184	46,626	11,245	19,401	80,109	211,118	224,893
1,000.0	40	1,547	29,235	7,262	72,693	40,153	9,427	13,873	65,583	176,995	188,544
750.0	30	1,203	25,476	6,784	59,425	32,726	7,565	8,706	51,005	142,037	151,305
625.0	25	1,029	23,394	6,435	52,542	28,568	6,621	6,496	43,653	124,317	132,429
500.0	20	854	21,006	5,995	44,739	23,683	5,624	4,534	36,223	105,594	112,484
250.0	10	497	15,737	5,026	27,795	12,371	3,578	1,916	21,071	67,181	71,564

Sound Data

SOUND PRESSURE DATA FOR THIS RATING CAN BE FOUND IN PERFORMANCE NUMBER - DM8779.

Emissions Data

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN		EKW	2,500.0	1,875.0	1,250.0	625.0	250.0
PERCENT LOAD		%	100	75	50	25	10
ENGINE POWER		BHP	3,633	2,760	1,889	1,029	497
TOTAL NOX (AS NO2)		G/HR	22,948	14,101	7,004	3,568	3,185
TOTAL CO		G/HR	2,726	1,304	1,092	1,496	2,098
TOTAL HC		G/HR	500	499	543	408	437
PART MATTER		G/HR	185.5	123.7	132.1	139.5	141.0
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,818.9	2,229.5	1,544.3	1,352.7	2,230.2
TOTAL CO	(CORR 5% O2)	MG/NM3	351.8	213.9	252.3	594.6	1,552.7
TOTAL HC	(CORR 5% O2)	MG/NM3	55.9	72.8	108.8	140.7	282.4
PART MATTER	(CORR 5% O2)	MG/NM3	19.7	16.5	25.8	48.5	88.2
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,373	1,086	752	659	1,086
TOTAL CO	(CORR 5% O2)	PPM	281	171	202	476	1,242
TOTAL HC	(CORR 5% O2)	PPM	104	136	203	263	527
TOTAL NOX (AS NO2)		G/HP-HR	6.38	5.15	3.74	3.50	6.47
TOTAL CO		G/HP-HR	0.76	0.48	0.58	1.47	4.26
TOTAL HC		G/HP-HR	0.14	0.18	0.29	0.40	0.89
PART MATTER		G/HP-HR	0.05	0.05	0.07	0.14	0.29
TOTAL NOX (AS NO2)		LB/HR	50.59	31.09	15.44	7.87	7.02
TOTAL CO		LB/HR	6.01	2.88	2.41	3.30	4.62
TOTAL HC		LB/HR	1.10	1.10	1.20	0.90	0.96
PART MATTER		LB/HR	0.41	0.27	0.29	0.31	0.31

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN		EKW	2,500.0	1,875.0	1,250.0	625.0	250.0
PERCENT LOAD		%	100	75	50	25	10
ENGINE POWER		BHP	3,633	2,760	1,889	1,029	497
TOTAL NOX (AS NO2)		G/HR	19,123	11,751	5,837	2,974	2,654
TOTAL CO		G/HR	1,515	725	607	831	1,165
TOTAL HC		G/HR	376	375	408	307	329
TOTAL CO2		KG/HR	1,740	1,340	966	559	296
PART MATTER		G/HR	132.5	88.4	94.3	99.6	100.7
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,349.1	1,857.9	1,286.9	1,127.3	1,858.5
TOTAL CO	(CORR 5% O2)	MG/NM3	195.4	118.8	140.1	330.3	862.6
TOTAL HC	(CORR 5% O2)	MG/NM3	42.1	54.8	81.8	105.8	212.3
PART MATTER	(CORR 5% O2)	MG/NM3	14.1	11.8	18.4	34.7	63.0
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,144	905	627	549	905

TOTAL CO	(CORR 5% O2)	PPM	156	95	112	264	690
TOTAL HC	(CORR 5% O2)	PPM	79	102	153	197	396
TOTAL NOX (AS NO2)		G/HP-HR	5.32	4.30	3.12	2.92	5.39
TOTAL CO		G/HP-HR	0.42	0.26	0.32	0.82	2.37
TOTAL HC		G/HP-HR	0.10	0.14	0.22	0.30	0.67
PART MATTER		G/HP-HR	0.04	0.03	0.05	0.10	0.20
TOTAL NOX (AS NO2)		LB/HR	42.16	25.91	12.87	6.56	5.85
TOTAL CO		LB/HR	3.34	1.60	1.34	1.83	2.57
TOTAL HC		LB/HR	0.83	0.83	0.90	0.68	0.72
TOTAL CO2		LB/HR	3,836	2,955	2,130	1,233	654
PART MATTER		LB/HR	0.29	0.19	0.21	0.22	0.22
OXYGEN IN EXH		%	9.4	10.4	11.3	12.2	14.4
DRY SMOKE OPACITY		%	1.7	1.4	1.9	2.6	4.0
BOSCH SMOKE NUMBER			0.58	0.49	0.62	0.92	1.27

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

ALTITUDE CORRECTED POWER CAPABILITY (BHP)

AMBIENT OPERATING TEMP (F)	30	40	50	60	70	80	90	100	110	120	NORMAL
ALTITUDE (FT)											
0	3,634	3,634	3,634	3,634	3,634	3,634	3,634	3,634	3,634	3,634	3,634
1,000	3,634	3,634	3,634	3,634	3,634	3,634	3,634	3,634	3,634	3,561	3,634
2,000	3,634	3,634	3,634	3,634	3,634	3,634	3,634	3,604	3,541	3,480	3,634
3,000	3,628	3,628	3,628	3,628	3,628	3,603	3,537	3,474	3,413	3,354	3,628
4,000	3,504	3,504	3,504	3,504	3,504	3,471	3,408	3,347	3,289	3,232	3,504
5,000	3,384	3,384	3,384	3,384	3,384	3,344	3,283	3,225	3,168	3,113	3,384
6,000	3,269	3,269	3,269	3,269	3,269	3,221	3,162	3,105	3,051	2,998	3,269
7,000	3,159	3,159	3,159	3,159	3,159	3,101	3,044	2,990	2,937	2,887	3,159
8,000	3,052	3,052	3,052	3,052	3,041	2,985	2,930	2,878	2,827	2,779	3,052
9,000	2,950	2,950	2,950	2,950	2,926	2,872	2,820	2,769	2,721	2,674	2,950
10,000	2,851	2,851	2,851	2,851	2,815	2,763	2,713	2,664	2,617	2,544	2,851

Cross Reference

Test Spec	Setting	Engine Arrangement	Engineering Model	Engineering Model Version	Start Effective Serial Number	End Effective Serial Number
4577176	LL1858	5084280	GS336	-	SBK02483	
4581567	LL6760	5157721	PG243	-	LYM00001	

Supplementary Data

Type	Classification	Performance Number
SOUND	SOUND PRESSURE	DM8779

Performance Parameter Reference

Parameters Reference:DM9600-12

PERFORMANCE DEFINITIONS

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

PERFORMANCE DATA[EM1895]

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.

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 : 07/10/19

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AIR INTAKE SYSTEM		
THE INSTALLED SYSTEM MUST COMPLY WITH THE SYSTEM LIMITS BELOW FOR ALL EMISSIONS CERTIFIED ENGINES TO ASSURE REGULATORY COMPLIANCE.		
MAXIMUM ALLOWABLE INTAKE RESTRICTION WITH CLEAN ELEMENT	15	IN-H20
MAXIMUM ALLOWABLE INTAKE RESTRICTION WITH DIRTY ELEMENT	25	IN-H20
MAXIMUM PRESSURE DROP FROM COMPRESSOR OUTLET TO MANIFOLD INLET (OR MIXER INLET FOR EGR)	7.1	IN-HG
MAXIMUM ALLOWABLE STATIC WEIGHT ON AIR INLET	101.4	LB
MAXIMUM ALLOWABLE STATIC WEIGHT ON AIR INLET (AIR SHUT OFF INCLUDED)	19.8	LB
MAXIMUM ALLOWABLE STATIC BENDING MOMENT ON AIR INLET	11.8	LB-FT
MAXIMUM ALLOWABLE STATIC WEIGHT ON TURBO OUTLET CONNECTION	0	LB
MAXIMUM ALLOWABLE STATIC BENDING MOMENT ON TURBO OUTLET CONNECTION	0	LB-FT
COOLING SYSTEM		
ENGINE ONLY COOLANT CAPACITY	61.6	GAL
MAXIMUM ALLOWABLE JACKET WATER OUTLET TEMPERATURE	219	DEG F
REGULATOR LOCATION FOR JW (HT) CIRCUIT	OUTLET	
MAXIMUM UNINTERRUPTED FILL RATE	5.0	G/MIN
ENGINE SPEC SYSTEM		
CYLINDER ARRANGEMENT	VEE	
NUMBER OF CYLINDERS	16	
CYLINDER BORE DIAMETER	6.7	IN
PISTON STROKE	8.5	IN
TOTAL CYLINDER DISPLACEMENT	4765	CU IN
STANDARD CRANKSHAFT ROTATION FROM FLYWHEEL END	CCW	
STANDARD CYLINDER FIRING ORDER	1-2-5-6-3-4-9-10-15-16-11-12-13-14-7-8	
NUMBER 1 CYLINDER LOCATION	RIGHT FRONT	
STROKES/COMBUSTION CYCLE	4	
EXHAUST SYSTEM		
THE INSTALLED SYSTEM MUST COMPLY WITH THE SYSTEM LIMITS BELOW FOR ALL EMISSIONS CERTIFIED ENGINES TO ASSURE REGULATORY COMPLIANCE.		
MAXIMUM ALLOWABLE SYSTEM BACK PRESSURE	27	IN-H20
MANIFOLD TYPE	DRY	
MAXIMUM ALLOWABLE STATIC WEIGHT ON EXHAUST CONNECTION	61.7	LB
MAXIMUM ALLOWABLE STATIC BENDING MOMENT ON EXHAUST CONNECTION	31.0	LB-FT
FUEL SYSTEM		

MAXIMUM FUEL FLOW FROM TRANSFER PUMP TO ENGINE	443.8	G/HR
MAXIMUM ALLOWABLE FUEL SUPPLY LINE RESTRICTION	8.9	IN-HG
MAXIMUM ALLOWABLE FUEL TEMPERATURE AT TRANSFER PUMP INLET	151	DEG F
MAXIMUM FUEL FLOW TO RETURN LINE FROM ENGINE	429.8	G/HR
MAXIMUM ALLOWABLE FUEL RETURN LINE RESTRICTION	8.0	IN-HG
NORMAL FUEL PRESSURE IN A CLEAN SYSTEM	60.2	PSI
FUEL SYSTEM TYPE	EUI	
MAXIMUM TRANSFER PUMP PRIMING LIFT WITHOUT PRIMING PUMP	12.1	FT
MAXIMUM HEAT REJECTION TO FUEL	722	BTU/MIN
LUBE SYSTEM		
CRANKCASE VENTILATION TYPE	TO ATM	
MOUNTING SYSTEM		
CENTER OF GRAVITY LOCATION - X DIMENSION - FROM REAR FACE OF BLOCK - (REFERENCE TM7077)	47.2	IN
CENTER OF GRAVITY LOCATION - Y DIMENSION - FROM CENTERLINE OF CRANKSHAFT - (REFERENCE TM7077)	8.0	IN
CENTER OF GRAVITY LOCATION - Z DIMENSION - FROM CENTERLINE OF CRANKSHAFT - (REFERENCE TM7077)	0.0	IN
MASS MOMENT OF INERTIA - X AXIS	10621	LB IN SEC2
MASS MOMENT OF INERTIA - Y AXIS	123910	LB IN SEC2
MASS MOMENT OF INERTIA - Z AXIS	132761	LB IN SEC2
STARTING SYSTEM		
MINIMUM CRANKING SPEED REQUIRED FOR START	120	RPM

Reference Number: 4581567
Effective Serial Number: LYM02236
Model: 3516C DI TA AAAC

Make from Spec:

Test Spec Data				
Description	Measure	Nominal	Ceiling	Floor
Corr Full Load Power	hp	3,701	3,775	3,627
Full Load Speed	RPM	1800	1810	1790
Governor Setting Speed	RPM			
High Idle Speed	RPM	1818	1836	1800
Low Idle Speed	RPM	900	910	890
FL Static Fuel Setting	in	1.209		
Corrected Fuel Rate	GAL/HR	177.0	185.8	168.1
CSFC	LB/HP.H	0.338	0.357	0.320
Adjusted Boost	IN_HG	80.0	92.0	68.0
Torque Check Speed	RPM			
Corr Torq Rise at TC RPM	%			
Corr Torque at TC RPM	LB.FT			
C Fuel Rate at TC RPM	GAL/HR			
CSFC at TC RPM	LB/HP.H			
ADJ Boost at TC RPM	IN_HG			
Power Loss/Cyl	% C FL PWR	6.3	6.7	5.9
Specific Blowby	CU FT/HP.H			
Temp Jacket Water Pump Inlet	F	192	197	186
Delta T Jacket Water (out-in)	F	16	25	7
Inlet Manifold Temp	F	122	127	116

Test Spec Data				
Description	Measure	Nominal	Ceiling	Floor
Water Temp to Scac	F			
Scac Water Flow	GAL/MIN			
Oil Pressure	PSI	63	87	43
Oil Pressure Low Idle	PSI	59	87	34
Fuel Pressure	PSI	75	102	51
Inlet Fuel Pressure	PSI		6	
Inlet Fuel Temp	F	86	91	80
Inlet Air Pressure	IN_HG		31	26
Inlet Air Restriction	IN_HG		1.18	
Inlet Air Temperature	F		122	50
Fuel Density	DEG API		36.0	34.0
Boost Constant				
Governor Setting Constant				
Governor Setting Torque	% RTD TRQ	90.0	91.0	89.0
High Idle Stability	RPM			
Low Idle Stability	RPM			
Set Point RPM	RPM	1820	1830	1810
Adjusted Boost (Gas Blending)	HG			
Corrected Fuel Rate - Diesel (Gas Blending)	GAL/HR			
Corrected Fuel Rate - Gas (Gas Blending	BTU/MIN			
Full Load Fueling (Gas Blending)	MM3/ST			
Gas Substitution Ratio (Gas Blending)	%			
Corr Full Load Power (Gas Blending)	HP			
Full Load Speed (Gas Blending)	RPM			
Exhaust Back Pressure	PSI			
TQ CK Exhaust Back Pressure	PSI			

Test Spec Data				
Description	Measure	Nominal	Ceiling	Floor
Ataac Delta Pressure	PSI			

Engine Reference Information		
Description	Measure	Data
FL Static/FT Static Fuel Settings	in	1.209 /
Fuel Valve Part Number		
Unit Injector Part Number		3920221
Timing Dimension Field Service	in	2.533
Timing Dimension Factory		
Torque Control Group Number		Change Level:
Fuel Pump/Gov Grp Part Number		1008780
Fuel Pump Type		EUI
Flyweight Part Number/Attitude		
Turbo Part No and Model		2870421 / GT6041BN-48T-1.1
Advertised Power / Governor Speed		3,634hp 1,800 RPM
Compression Ratio		14.7
Torque Rise Cam Part Number		
Manifold Type		DRY
Engine Flash File Part Number		5224589
Rating Number		1
Flash File Change Number		
ASM Flash File Part Number		
ISM Flash File Part Number		
Advisor Flash File Part Number		
Secondary Module Flash File Part Number		

Engine Reference Information		
Description	Measure	Data
Messenger Flash File Part Number		
Tandem Software Flash File Part Number		
Governor Type		ADEM3

Torque Control Group Spring Data		
Part No	Thickness	Quantity
No data available in table		

Torque Control Group Spacer Data		
Part No	Thickness	Quantity
No data available in table		

Timing Data
Mechanical Advance Part Number:
Chg. Level:
Advance: 0.0 DEG
Dog Leg Differentials: RPM: -- KW: --

Description	Measure	Spec	Minimum	Maximum
Timing Static @ 0 RPM BTDC	DEG			

Application/Performance Data		
Description	Measure	Data
Application Identification		297 GS STANDBY
Engine Sales Model and Series		3516 C
Combustion System type		DI
Aspiration Type		TA
Engine Source Factory Ref Number		88
Power Setting PL/PP Ref Number		LL6760

Application/Performance Data

Description	Measure	Data
Engine Perf Data Ref No and Change Level		EM1895
Multi Engine Torq/Rating		
Emissions Family		
Generator Rating W/O Fan	EKW	
Generator	HZ	60
Brakesaver test		
Certified Engine Rating	hp	
Engineering Model Ref		PG243
Low Idle In-Veh Speed	RPM	
Sales Model		
Machine Facility		
Usage		
Transmission		
Description		GS
Serial Number Prefixs		

Altitude Derating Information

Description	Measure	Data
Altitude - Maximum	FT	2,952
Engine Power (ADV)	hp	
Engine Power (Test)	hp	3,634
High Idle Speed	RPM	

Altitude Derating Information

Description	Measure	Data
FL Static Fuel Setting	in	
FT Static Fuel Setting	in	
Corrected Fuel Rate	GAL/HR	177.0
FL Boost Pressure	IN_HG	

Spec Number vs. Arrangement Number Cross Reference

Arrangement	5157721

For Help Desk Phone Numbers Click here

Component Performance Number: EM4892

Radiator Data

Radiator Part Number: 5558093
Radiator Type: A59.0ATS
Front Area: 58.99 ft2
Radiator Dry Weight: 4,360.7 lbs
Radiator Wet Weight: 4,757.6 lbs
Radiator Water Capacity High Temp Circuit: 47.0 gal
Radiator Water Capacity Low Temp Circuit: NA gal
Center of Gravity (X): 22.52 in (Distance from front face of core)
Center of Gravity (Y): 48.43 in (Distance from bottom of radiator support)
Center of Gravity (Z): 0.12 in (Distance from center line of core)

Engine Data

Performance Number: EM1895
Sales Model: 3516
EKW: 2500
Rating: MCSTNDBY
Speed: 1800
Settings: NA
IM ATAAC Temp Deg F: 122

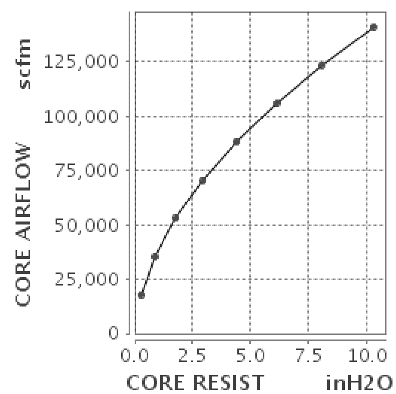
Combination Data

Pully Ratio: 0.499
Fan Power: 128.73792 hp

Ambient Restrictions (1/2 inH2O)			Ambient Restrictions (3/4 inH2O)			Ambient Restrictions (1.00 inH2O)		
984 Feet	2460 Feet	4921 Feet	984 Feet	2460 Feet	4921 Feet	984 Feet	2460 Feet	4921 Feet
--------- Max Ambient Pre-alarm Deg F ---------								
113	107	100	111	107	100	NA	NA	NA

Air Flow Restrictions (1/2 inH2O)	Air Flow Restrictions (3/4 inH2O)	Air Flow Restrictions (1.00 inH2O)
--------- scfm ---------		
83201	81753	NA

CORE RESIST inH2O	CORE AIRFLOW scfm
0.27	17,657.35
0.87	35,314.7
1.77	52,972.05
2.95	70,629.4
4.4	88,286.75
6.1	105,944.1
8.06	123,601.45
10.28	141,258.8



Reference Number: EM4892

No notes found...

Parameters Reference: TM6016

RADIATOR CORE DATA:

FOR OPEN GENERATOR SET ELECTRIC POWER APPLICATIONS, CORE AIR FLOW RESISTANCE DATA INCLUDES ENGINE, GENERATOR, AND COOLING PACKAGE. ADDITIONAL AIRFLOW RESISTANCE DUE TO CUSTOMER SUPPLIED ITEMS SUCH AS INLET/EXHAUST LOUVERS, SOUND ATTENUATION, OR INLET/EXHAUST AIR PIPEWORK IS NOT INCLUDED.

ALL OTHER APPLICATIONS OUTSIDE OF OPEN ELECTRIC POWER, CORE AIR FLOW RESISTANCE IS FOR FREE STANDING CORE ONLY.

CORE PERFORMANCE DATA IS BASED ON AN AIR DENSITY OF 1.20 KG/M3 (0.075 LB/CU FT)

AMBIENT CAPABILITY:

AMBIENT CAPABILITY AND ALTITUDE CAPABILITY LISTED ON THIS PAGE REFLECTS THE CAPABILITY OF THE COOLING SYSTEM AT THE MAXIMUM GENERATOR RATING. AMBIENT CAPABILITY FOR STANDBY AND MISSION CRITICAL STANDBY RATINGS REPORTED AGAINST A JACKET WATER ENGINE EXIT TEMPERATURE LIMIT OF 104C (219F). ALL OTHER RATINGS REPORTED AT 99C (210F).

AMBIENT AND ALTITUDE CAPABILITY MUST BE VERIFIED FOR THE ENGINE AND GENERATOR IN THE ENGINE PERFORMANCE SECTION OF TMI.

NON TIER 4 EMISSION RATINGS ASSUME 4C (7F) AIR TO CORE RISE, TIER 4 EMISSION RATINGS ASSUME 6C (9F).

ALL PERFORMANCE SHOWN WITH 50/50 GLYCOL COOLANT.

LAST UPDATED: 09/11/2020

Generator Data

(AT400240)-Engine (BAA126422A)-CEM

March 23, 2021

For Help Desk Phone Numbers Click here

Selected Model

Engine: 3516	**Generator Frame:** 1844	**Genset Rating (kW):** 2500.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 3723056	**Genset Rating (kVA):** 3125.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 3758.8
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 41205 /40749 /40681 /9309

Spec Information

Generator Specification

Frame: 1844	**Type:** SR5	**No. of Bearings:** 2
Winding Type: FORM WOUND		**Flywheel:** 21.0
Connection: SERIES STAR		**Housing:** 00
Phases: 3		**No. of Leads:** 6
Poles: 4		**Wires per Lead:** 8
Sync Speed: 1800		**Generator Pitch:** 0.6667

Generator Efficiency

Per Unit Load	kW	Efficiency %
0.25	625.0	92.8
0.5	1250.0	95.3
0.75	1875.0	95.8
1.0	2500.0	95.7

Reactances	Per Unit	Ohms
SUBTRANSIENT - DIRECT AXIS X''_d	0.1194	0.0088
SUBTRANSIENT - QUADRATURE AXIS X''_q	0.1139	0.0084
TRANSIENT - SATURATED X'_d	0.1804	0.0133
SYNCHRONOUS - DIRECT AXIS X_d	2.8673	0.2114
SYNCHRONOUS - QUADRATURE AXIS X_q	1.2709	0.0937
NEGATIVE SEQUENCE X_2	0.1166	0.0086
ZERO SEQUENCE X_0	0.0081	0.0006

Time Constants	Seconds
OPEN CIRCUIT TRANSIENT - DIRECT AXIS T'_{d0}	5.3930
SHORT CIRCUIT TRANSIENT - DIRECT AXIS T'_d	0.3395
OPEN CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_{d0}	0.0079
SHORT CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_d	0.0066
OPEN CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_{q0}	0.0071
SHORT CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_q	0.0060
EXCITER TIME CONSTANT T_e	0.2580
ARMATURE SHORT CIRCUIT T_a	0.0414

Short Circuit Ratio: 0.48 | Stator Resistance = 0.0012 Ohms | Field Resistance = 0.9703 Ohms

Voltage Regulation

Voltage level adjustment: +/-	5.0%
Voltage regulation, steady state: +/-	0.5%
Voltage regulation with 3% speed change: +/-	0.5%
Waveform deviation line - line, no load: less than	3.0%
Telephone influence factor: less than	50

Generator Excitation

	No Load	Full Load, (rated) pf	
		Series	Parallel
Excitation voltage:	12.98 Volts	52.73 Volts	Volts
Excitation current	1.19 Amps	3.99 Amps	Amps

Selected Model

Engine: 3516	**Generator Frame:** 1844	**Genset Rating (kW):** 2500.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 3723056	**Genset Rating (kVA):** 3125.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 3758.8
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 41205 /40749 /40681 /9309

Generator Mechanical Information

Center of Gravity

Dimension X	-1145.5 mm	-45.1 IN.
Dimension Y	0.0 mm	0.0 IN.
Dimension Z	0.0 mm	0.0 IN.

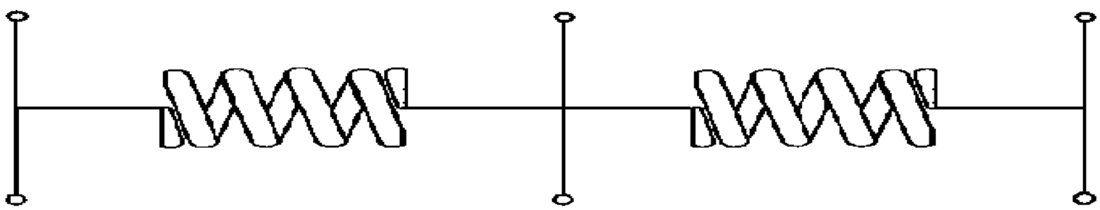
- "X" is measured from driven end of generator and parallel to rotor. Towards engine fan is positive. See General Information for details
- "Y" is measured vertically from rotor center line. Up is positive.
- "Z" is measured to left and right of rotor center line. To the right is positive.

Generator WT = 4938 kg	* Rotor WT = 1835 kg	* Stator WT = 2452 kg
10,886 LB	4,045 LB	5,406 LB

Rotor Balance = 0.0508 mm deflection PTP

Overspeed Capacity = 125% of synchronous speed

Generator Torsional Data



J1 = Coupling and Fan **J2 = Rotor** **TOTAL J = J1 + J2 + J3** **J3 = Exciter End**

K1 = Shaft Stiffness between J1 + J2 (Diameter 1) **K2 = Shaft Stiffness between J2 + J3 (Diameter 2)**

J1	K1	Min Shaft Dia 1	J2	K2	Min Shaft Dia 2	J3
30.1 LB IN. s^2	61.3 MLB IN./rad	5.0 IN.	557.6 LB IN. s^2	58.4 MLB IN./rad	3.8 IN.	3.8 LB IN. s^2
3.397 N m s^2	6.93 MN m/rad	127.0 mm	63.0 N m s^2	6.6 MN m/rad	96.5 mm	0.43 N m s^2

Total J

591.5 LB IN. s^2

66.827 N m s^2

Selected Model

Engine: 3516	**Generator Frame:** 1844	**Genset Rating (kW):** 2500.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 3723056	**Genset Rating (kVA):** 3125.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 3758.8
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 41205 /40749 /40681 /9309

Generator Cooling Requirements - Temperature - Insulation Data

Cooling Requirements:

Heat Dissipated: 112.3 kW

Air Flow: 199.2 m^3/min

Temperature Data: (Ambient 40 ^{0}C)

Stator Rise: 125.0 ^{0}C

Rotor Rise: 125.0 ^{0}C

Insulation Class: H

Insulation Reg. as shipped: 100.0 MΩ minimum at 40 ^{0}C

Thermal Limits of Generator

Frequency:	60 Hz
Line to Line Voltage:	480 Volts
B BR 80/40	2500.0 kVA
F BR -105/40	2844.0 kVA
H BR - 125/40	3125.0 kVA
F PR - 130/40	3125.0 kVA
H PR - 150/40	3438.0 kVA

Selected Model

Engine: 3516	**Generator Frame:** 1844	**Genset Rating (kW):** 2500.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 3723056	**Genset Rating (kVA):** 3125.0	**Phase Voltage:** 277
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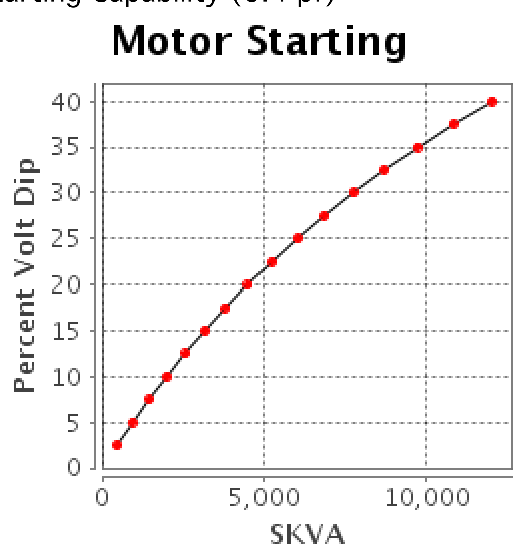
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 41205 /40749 /40681 /9309

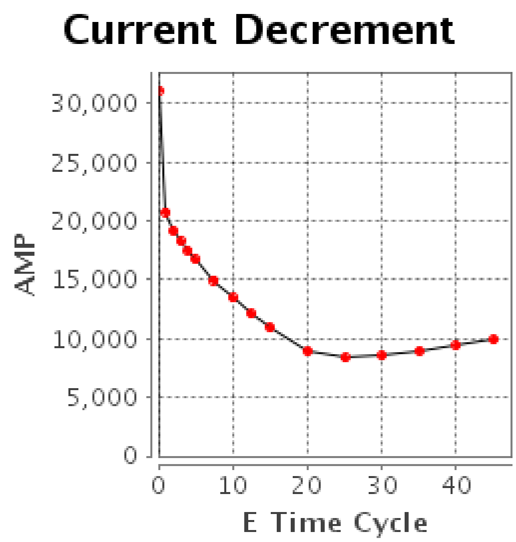
Starting Capability & Current Decrement
Motor Starting Capability (0.4 pf)

SKVA	Percent Volt Dip
463	2.5
950	5.0
1,464	7.5
2,006	10.0
2,579	12.5
3,185	15.0
3,829	17.5
4,513	20.0
5,240	22.5
6,017	25.0
6,847	27.5
7,736	30.0
8,691	32.5
9,719	35.0
10,830	37.5
12,034	40.0



Current Decrement Data

E Time Cycle	AMP
0.0	31,132
1.0	20,768
2.0	19,122
3.0	18,234
4.0	17,442
5.0	16,692
7.5	14,973
10.0	13,452
12.5	12,107
15.0	10,917
20.0	8,934
25.0	8,359
30.0	8,564
35.0	8,968
40.0	9,431
45.0	9,915



Instantaneous 3 Phase Fault Current: 31132 Amps **Instantaneous Line - Line Fault Current:** 27270 Amps
Instantaneous Line - Neutral Fault Current: 45568 Amps

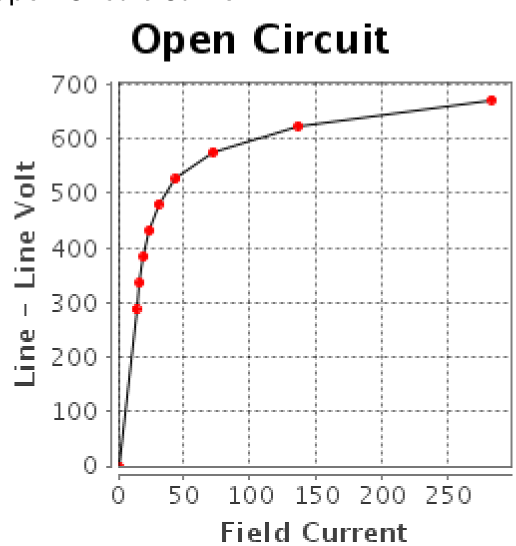
Selected Model

Engine: 3516 **Generator Frame:** 1844 **Genset Rating (kW):** 2500.0 **Line Voltage:** 480
Fuel: Diesel **Generator Arrangement:** 3723056 **Genset Rating (kVA):** 3125.0 **Phase Voltage:** 277
Frequency: 60 **Excitation Type:** Permanent Magnet **Pwr. Factor:** 0.8 **Rated Current:** 3758.8
Duty: STANDBY **Connection:** SERIES STAR **Application:** EPG **Status:** Current

Version: 41205 /40749 /40681 /9309

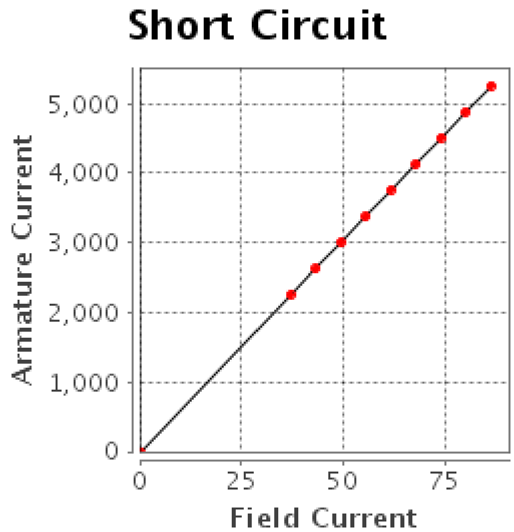
Generator Output Characteristic Curves
Open Circuit Curve

Field Current	Line - Line Volt
0.0	0
13.7	288
16.3	336
19.4	384
23.7	432
30.6	480
44.0	528
72.4	576
136.3	624
283.6	672



Short Circuit Curve

Field Current	Armature Current
0.0	0
37.0	2,255
43.2	2,631
49.4	3,007
55.5	3,383
61.7	3,759
67.9	4,135
74.1	4,511
80.2	4,886
86.4	5,262



Selected Model

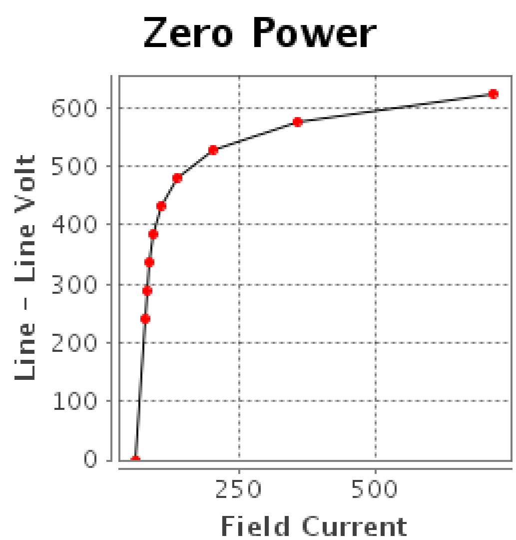
Engine: 3516
Fuel: Diesel
Frequency: 60
Duty: STANDBY
Generator Frame: 1844
Generator Arrangement: 3723056
Excitation Type: Permanent Magnet
Connection: SERIES STAR
Genset Rating (kW): 2500.0
Genset Rating (kVA): 3125.0
Pwr. Factor: 0.8
Application: EPG
Line Voltage: 480
Phase Voltage: 277
Rated Current: 3758.8
Status: Current

Version: 41205 /40749 /40681 /9309

Generator Output Characteristic Curves

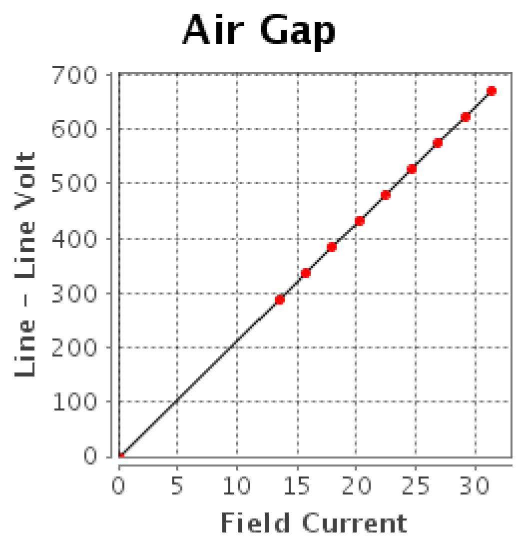
Zero Power Factor Curve

Field Current	Line - Line Volt
61.7	0
77.7	240
80.9	288
85.2	336
92.4	384
106.3	432
135.8	480
202.4	528
356.0	576
714.8	624



Air Gap Curve

Field Current	Line - Line Volt
0.0	0
13.5	288
15.7	336
17.9	384
20.2	432
22.4	480
24.7	528
26.9	576
29.2	624
31.4	672

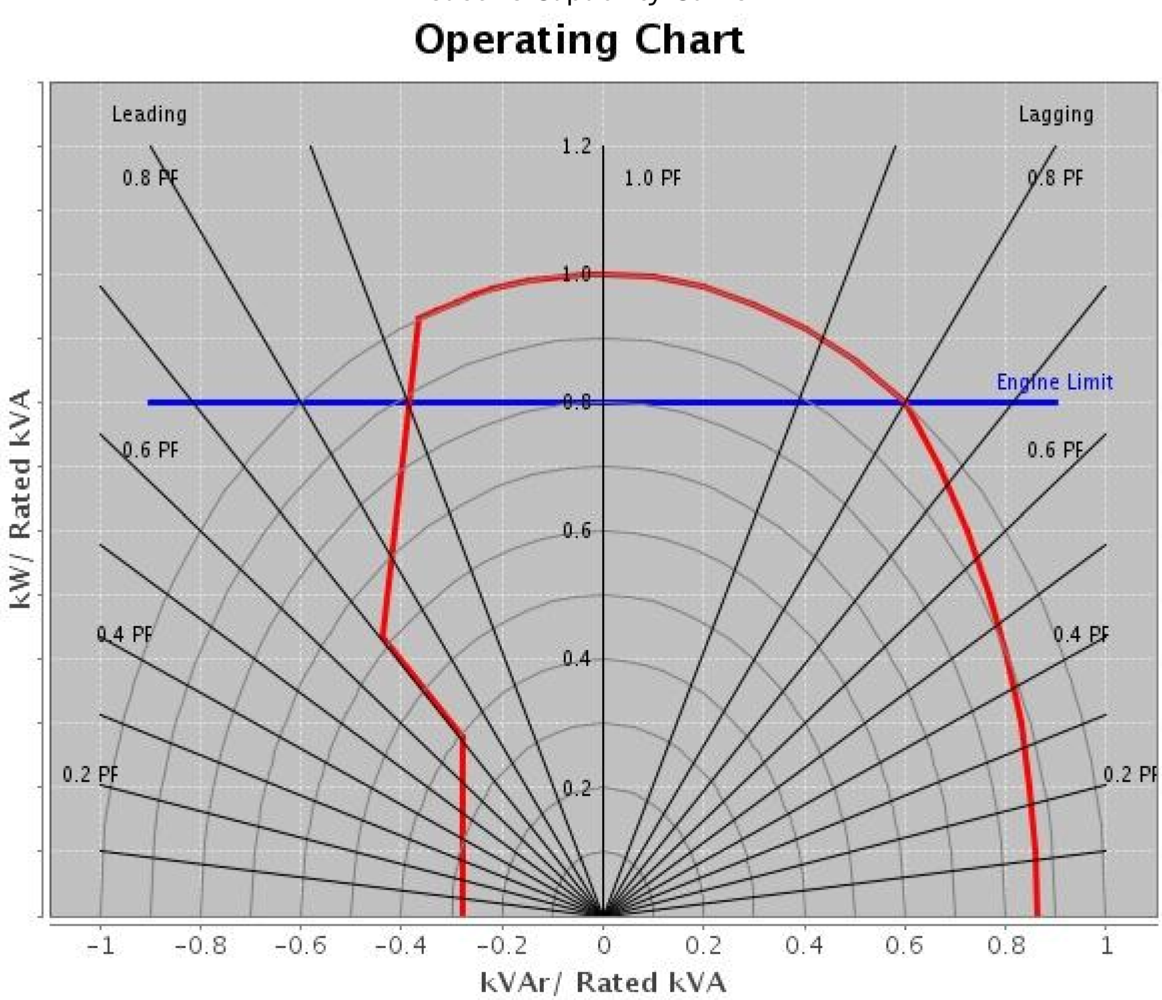


Selected Model

Engine: 3516 **Generator Frame:** 1844 **Genset Rating (kW):** 2500.0 **Line Voltage:** 480
Fuel: Diesel **Generator Arrangement:** 3723056 **Genset Rating (kVA):** 3125.0 **Phase Voltage:** 277
Frequency: 60 **Excitation Type:** Permanent Magnet **Pwr. Factor:** 0.8 **Rated Current:** 3758.8
Duty: STANDBY **Connection:** SERIES STAR **Application:** EPG **Status:** Current

Version: 41205 /40749 /40681 /9309

Reactive Capability Curve



Selected Model

Engine: 3516	**Generator Frame:** 1844	**Genset Rating (kW):** 2500.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 3723056	**Genset Rating (kVA):** 3125.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 3758.8
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 41205 /40749 /40681 /9309

General Information

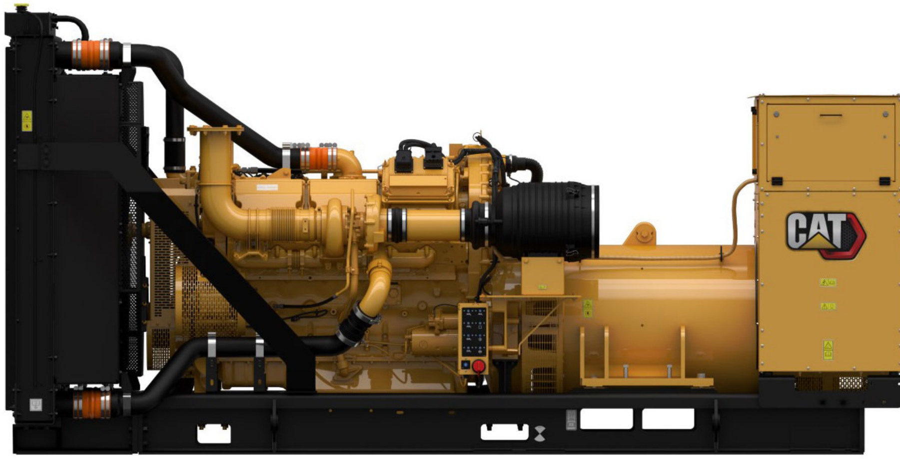
DM7825 Caterpillar SR5 Generators (50 Hz, 60 Hz)
Data for 1400, 1600, 1700, 1800 and 1900 frames Caterpillar SR5 generators built by Leroy Somer - USA and Leroy Somer France.

Refer to DM7821 for explanation of all generator data in Technical Marketing Information (TMI) except generator efficiency for which the explanation is given below.

GENERATOR EFFICIENCY
Generator efficiency is the percentage of engine flywheel (or other prime mover) power that is converted into electrical output. The generator efficiency shown is calculated by the summation of all losses method, and is determined in accordance with the IEC Standard 60034. The efficiency considers only the generator. There is no consideration of engine or parasitic losses here.

Refer to DM7829 for low and medium voltage protective setting values a nd limits.

NC POWER SYSTEMS CAT



TECHNICAL DATA

CAT C32 TIER 2 GENERATOR SET

RATED 1000eKW STANDBY POWER, 277/480 VOLT, 3-PHASE, 60 Hz,
UL LISTED

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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 (in³)	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)

Standard 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

Optional Equipment

Engine

Air Cleaner

- ☑ 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

☐ 220V	☑ 480V
☐ 240V	☐ 600V
☐ 380V	☐ 2400V
☐ 400V	☐ 4160V

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

☐ 400A	☐ 800A
☐ 1200A	☐ 1600A
☐ 2000A	☑ 2500A
☐ 3000A	☐ 3200A
☐ 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 – 10A

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

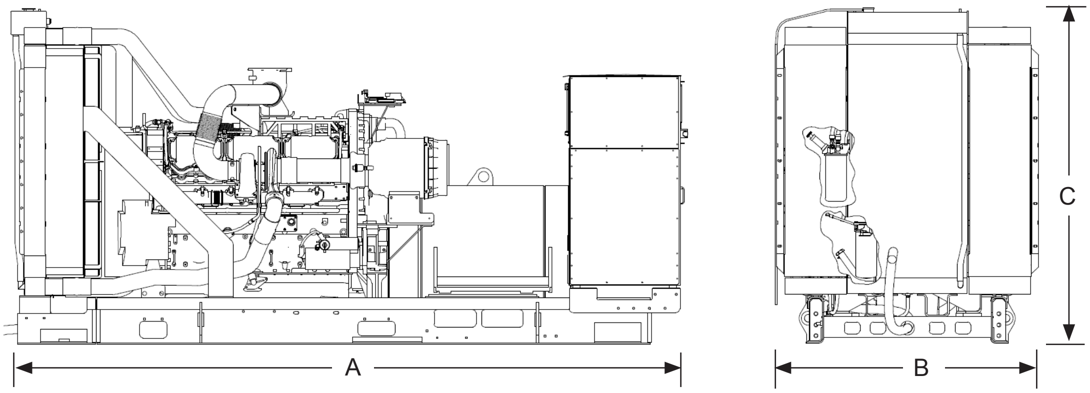
Note: *Some options may not be available on all models. Certifications may not be available with all model configurations. Consult factory for availability.*

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 – m^3/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 – m^3/min (cfm)	87.6	(3094.1)
Exhaust System		
Exhaust stack gas temperature – °C (°F)	476.4	(889.5)
Exhaust gas flow rate – m^3/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/Nm^3 (g/hp-h)	2348.6	(4.93)
CO mg/Nm^3 (g/hp-h)	62.1	(0.13)
HC mg/Nm^3 (g/hp-h)	5.5	(0.01)
PM mg/Nm^3 (g/hp-h)	7.2	(0.02)
Emissions* (Potential Site Variation)		
NOx mg/Nm^3 (g/hp-h)	2841.6	(5.97)
CO mg/Nm^3 (g/hp-h)	116.1	(0.24)
HC mg/Nm^3 (g/hp-h)	10.3	(0.03)
PM mg/Nm^3 (g/hp-h)	14.1	(0.04)

**mg/Nm^3 levels are corrected to 5% O_2. 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 Definitions

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 35º API [16°C (60ºF)] gravity having an LHV of 42,780 kJ/kg (18,390 Btu/lb) when used at 29ºC (85ºF) and weighing 838.9 g/liter (7.001 lbs/U.S. gal.)

PERFORMANCE DATA[EM0449]

March 25, 2021

Performance Number: EM0449 **Change Level: 00**

SALES MODEL:	C32
BRAND:	CAT
ENGINE POWER (BHP):	1,474
GEN POWER WITH FAN (EKW):	1,000.0
COMPRESSION RATIO:	15.0
RATING LEVEL:	MISSION CRITICAL STANDBY
PUMP QUANTITY:	1
FUEL TYPE:	DIESEL
MANIFOLD TYPE:	DRY
ELECTRONICS TYPE:	ADEM4
IGNITION TYPE:	CI
INJECTOR TYPE:	EUI
REF EXH STACK DIAMETER (IN):	8
MAX OPERATING ALTITUDE (FT):	997
COMBUSTION:	DIRECT INJECTION
ENGINE SPEED (RPM):	1,800
HERTZ:	60
FAN POWER (HP):	56.3
ADDITIONAL PARASITICS (HP):	1.3
ASPIRATION:	TA
AFTERCOOLER TYPE:	ATAAC
AFTERCOOLER CIRCUIT TYPE:	JW+OC, ATAAC
INLET MANIFOLD AIR TEMP (F):	120
JACKET WATER TEMP (F):	210.2
TURBO CONFIGURATION:	PARALLEL
TURBO QUANTITY:	2
TURBOCHARGER MODEL:	GTB45518BS-52T-1.37
CERTIFICATION YEAR:	2007
PISTON SPD @ RATED ENG SPD (FT/MIN):	1,913.4

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)	VOL FUEL CONSUMPTN (VFC)	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP
EKW	%	BHP	PSI	LB/BHP-HR	GAL/HR	IN-HG	DEG F	DEG F	IN-HG	DEG F
1,000.0	100	1,474	331	0.342	71.0	70.3	118.2	1,209.3	58.1	889.5
900.0	90	1,330	299	0.341	63.9	64.0	111.0	1,150.9	51.9	855.4
800.0	80	1,187	267	0.349	58.4	60.4	106.5	1,116.3	48.6	832.2
750.0	75	1,116	251	0.354	55.6	57.9	103.8	1,100.0	46.6	821.0
700.0	70	1,046	235	0.354	52.2	53.7	99.5	1,077.6	43.2	810.0
600.0	60	905	203	0.353	45.1	43.7	90.1	1,025.8	35.3	788.8
500.0	50	765	172	0.350	37.7	32.9	80.8	964.8	27.0	768.5
400.0	40	628	141	0.351	31.1	23.9	74.7	895.9	20.5	731.2
300.0	30	490	110	0.357	24.7	15.7	70.4	812.1	15.1	676.7
250.0	25	420	94	0.363	21.5	12.0	68.9	764.0	12.7	643.0
200.0	20	350	79	0.374	18.4	8.7	67.9	708.9	10.6	601.8
100.0	10	206	46	0.425	12.4	4.5	67.5	569.8	7.8	489.0

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	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	IN-HG	DEG F	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
1,000.0	100	1,474	76	422.1	3,094.1	8,065.3	13,465.4	13,968.9	2,939.2	2,688.4
900.0	90	1,330	69	391.5	2,939.0	7,417.0	12,749.0	13,202.3	2,773.0	2,544.8
800.0	80	1,187	65	375.1	2,856.2	7,051.1	12,358.8	12,773.3	2,683.6	2,472.3
750.0	75	1,116	63	363.9	2,783.7	6,813.1	12,021.7	12,415.6	2,615.7	2,413.9
700.0	70	1,046	58	343.3	2,639.5	6,395.9	11,355.9	11,723.5	2,476.8	2,288.3
600.0	60	905	48	302.6	2,355.5	5,576.9	10,061.2	10,377.6	2,196.4	2,033.1
500.0	50	765	37	262.3	2,076.5	4,775.6	8,810.4	9,077.6	1,911.9	1,773.0
400.0	40	628	27	223.0	1,805.8	4,001.6	7,595.0	7,814.6	1,652.1	1,535.9
300.0	30	490	18	183.7	1,537.6	3,237.7	6,435.6	6,610.0	1,400.8	1,306.8
250.0	25	420	14	163.9	1,403.3	2,856.8	5,874.1	6,026.7	1,273.8	1,190.9
200.0	20	350	11	146.2	1,286.2	2,507.0	5,386.7	5,517.7	1,161.2	1,089.1
100.0	10	206	6	122.6	1,147.6	1,981.6	4,797.2	4,885.1	1,027.0	974.3

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

PERFORMANCE DATA[EM0449]

EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
1,000.0	100	1,474	20,033	7,238	58,206	31,961	8,218	16,385	62,497	154,292	164,360
900.0	90	1,330	18,378	6,464	52,445	28,178	7,400	14,318	56,390	138,929	147,994
800.0	80	1,187	16,891	5,941	48,853	25,916	6,766	13,293	50,345	127,034	135,323
750.0	75	1,116	16,127	6,236	46,672	24,565	6,445	12,521	47,342	121,002	128,897
700.0	70	1,046	15,231	6,920	43,437	22,625	6,051	11,086	44,338	113,600	121,012
600.0	60	905	13,439	6,738	37,282	19,058	5,220	8,561	38,371	97,997	104,392
500.0	50	765	11,741	5,267	31,535	15,862	4,369	6,404	32,440	82,034	87,386
400.0	40	628	10,827	4,384	25,642	12,387	3,599	4,511	26,618	67,572	71,982
300.0	30	490	9,885	3,711	19,869	8,929	2,858	2,920	20,779	53,663	57,165
250.0	25	420	9,298	3,442	17,092	7,276	2,495	2,235	17,832	46,843	49,899
200.0	20	350	8,559	3,149	14,473	5,698	2,136	1,689	14,848	40,103	42,719
100.0	10	206	6,645	2,319	9,873	2,744	1,432	1,058	8,742	26,884	28,638

Emissions Data

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	1,474	1,116	765	420	206
TOTAL NOX (AS NO2)		G/HR	8,726	5,093	3,335	2,252	1,328
TOTAL CO		G/HR	356	235	501	819	1,263
TOTAL HC		G/HR	37	104	99	75	153
PART MATTER		G/HR	51.8	39.2	67.6	105.5	83.2
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,841.8	2,105.6	2,041.6	2,429.4	2,417.2
TOTAL CO	(CORR 5% O2)	MG/NM3	116.1	93.7	305.5	894.8	2,570.4
TOTAL HC	(CORR 5% O2)	MG/NM3	10.3	37.8	52.6	69.6	283.1
PART MATTER	(CORR 5% O2)	MG/NM3	14.1	13.5	35.5	106.1	135.6
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,384	1,026	994	1,183	1,177
TOTAL CO	(CORR 5% O2)	PPM	93	75	244	716	2,056
TOTAL HC	(CORR 5% O2)	PPM	19	71	98	130	528
TOTAL NOX (AS NO2)		G/HP-HR	5.97	4.59	4.38	5.37	6.45
TOTAL CO		G/HP-HR	0.24	0.21	0.66	1.95	6.14
TOTAL HC		G/HP-HR	0.03	0.09	0.13	0.18	0.74
PART MATTER		G/HP-HR	0.04	0.04	0.09	0.25	0.40
TOTAL NOX (AS NO2)		LB/HR	19.24	11.23	7.35	4.96	2.93
TOTAL CO		LB/HR	0.79	0.52	1.10	1.81	2.78
TOTAL HC		LB/HR	0.08	0.23	0.22	0.17	0.34
PART MATTER		LB/HR	0.11	0.09	0.15	0.23	0.18

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	1,474	1,116	765	420	206
TOTAL NOX (AS NO2)		G/HR	7,212	4,209	2,756	1,861	1,097
TOTAL CO		G/HR	191	126	268	438	676
TOTAL HC		G/HR	19	55	52	40	81
TOTAL CO2		KG/HR	721	564	380	217	124
PART MATTER		G/HR	26.6	20.1	34.7	54.1	42.7
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,348.6	1,740.1	1,687.3	2,007.8	1,997.7
TOTAL CO	(CORR 5% O2)	MG/NM3	62.1	50.1	163.4	478.5	1,374.6
TOTAL HC	(CORR 5% O2)	MG/NM3	5.5	20.0	27.8	36.8	149.8
PART MATTER	(CORR 5% O2)	MG/NM3	7.2	6.9	18.2	54.4	69.5
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,144	848	822	978	973
TOTAL CO	(CORR 5% O2)	PPM	50	40	131	383	1,100
TOTAL HC	(CORR 5% O2)	PPM	10	37	52	69	280
TOTAL NOX (AS NO2)		G/HP-HR	4.93	3.79	3.62	4.43	5.33
TOTAL CO		G/HP-HR	0.13	0.11	0.35	1.04	3.28
TOTAL HC		G/HP-HR	0.01	0.05	0.07	0.09	0.39
PART MATTER		G/HP-HR	0.02	0.02	0.05	0.13	0.21
TOTAL NOX (AS NO2)		LB/HR	15.90	9.28	6.08	4.10	2.42
TOTAL CO		LB/HR	0.42	0.28	0.59	0.97	1.49
TOTAL HC		LB/HR	0.04	0.12	0.12	0.09	0.18
TOTAL CO2		LB/HR	1,589	1,244	839	478	273
PART MATTER		LB/HR	0.06	0.04	0.08	0.12	0.09
OXYGEN IN EXH		%	10.1	11.5	12.2	13.5	15.7
DRY SMOKE OPACITY		%	0.7	0.7	1.4	3.0	2.2
BOSCH SMOKE NUMBER			0.18	0.16	0.58	1.31	0.99

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

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	1,474	1,474	1,474	1,474	1,474	1,474	1,474	1,468	1,442	1,417	1,393	1,370	1,474
1,000	1,474	1,474	1,474	1,474	1,474	1,466	1,439	1,413	1,388	1,365	1,341	1,319	1,474
2,000	1,474	1,474	1,474	1,465	1,437	1,411	1,385	1,360	1,337	1,313	1,291	1,270	1,434
3,000	1,474	1,466	1,438	1,410	1,383	1,358	1,333	1,309	1,286	1,264	1,242	1,222	1,389
4,000	1,439	1,410	1,383	1,356	1,331	1,306	1,282	1,259	1,237	1,216	1,195	1,175	1,345
5,000	1,384	1,356	1,330	1,304	1,280	1,256	1,233	1,211	1,190	1,169	1,149	1,130	1,302
6,000	1,330	1,304	1,278	1,254	1,230	1,207	1,185	1,164	1,144	1,124	1,105	1,086	1,260
7,000	1,278	1,253	1,228	1,205	1,182	1,160	1,139	1,119	1,099	1,080	1,062	1,044	1,220
8,000	1,228	1,203	1,180	1,157	1,135	1,114	1,094	1,074	1,056	1,037	1,020	1,003	1,180
9,000	1,179	1,156	1,133	1,111	1,090	1,070	1,050	1,032	1,014	996	979	963	1,141
10,000	1,132	1,109	1,087	1,066	1,046	1,027	1,008	990	973	956	940	924	1,103
11,000	1,086	1,064	1,043	1,023	1,004	985	967	950	933	917	902	887	1,066
12,000	1,041	1,021	1,001	981	963	945	928	911	895	880	865	850	1,029
13,000	998	978	959	941	923	906	889	873	858	843	829	815	994
14,000	957	937	919	901	884	868	852	837	822	808	794	781	959
15,000	916	898	880	863	847	831	816	802	788	774	761	748	926

Cross Reference

Test Spec	Setting	Engine Arrangement	Engineering Model	Engineering Model Version	Start Effective Serial Number	End Effective Serial Number
0K4311	GG0776	3801431	GS471	-	PRH00001	
0K4311	GG0776	4259340	GS471	-	PRH00001	
0K4311	GG0776	4447558	GS471	-	PRH00001	
0K4311	GG0776	4447562	GS471	-	PRH00001	
0K4311	GG0776	5233431	GS471	-	PRH00001	
0K4311	GG0776	5612763	GS471	DK	PRH00001	

Performance Parameter Reference

Parameters Reference:DM9600-12
PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600
APPLICATION:
Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test

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

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 : 07/10/19

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AIR INTAKE SYSTEM		
THE INSTALLED SYSTEM MUST COMPLY WITH THE SYSTEM LIMITS BELOW FOR ALL EMISSIONS CERTIFIED ENGINES TO ASSURE REGULATORY COMPLIANCE.		
MAXIMUM ALLOWABLE INTAKE RESTRICTION WITH CLEAN ELEMENT	15	IN-H20
MAXIMUM ALLOWABLE INTAKE RESTRICTION WITH DIRTY ELEMENT	25	IN-H20
MAXIMUM PRESSURE DROP FROM COMPRESSOR OUTLET TO MANIFOLD INLET (OR MIXER INLET FOR EGR)	4.4	IN-HG
MAXIMUM TURBO INLET AIR TEMPERATURE	122	DEG F
MAXIMUM AIR FILTER INLET AIR TEMPERATURE	122	DEG F
MAXIMUM ALLOWABLE STATIC WEIGHT ON AIR INLET	0	LB
MAXIMUM ALLOWABLE STATIC BENDING MOMENT ON AIR INLET	0	LB-FT
MAXIMUM ALLOWABLE STATIC WEIGHT ON TURBO OUTLET CONNECTION	0	LB
MAXIMUM ALLOWABLE STATIC BENDING MOMENT ON TURBO OUTLET CONNECTION	0	LB-FT
COOLING SYSTEM		
ENGINE ONLY COOLANT CAPACITY	14.5	GAL
MAXIMUM ALLOWABLE JACKET WATER OUTLET TEMPERATURE	210	DEG F
REGULATOR LOCATION FOR JW (HT) CIRCUIT	OUTLET	
MAXIMUM UNINTERRUPTED FILL RATE	5.0	G/MIN
MINIMUM COOLANT LOSS WITHOUT IMPACTING RADIATOR PERFORMANCE (PERCENT OF TOTAL)	12	PERCENT
COOLANT LOSS-MAXIMUM PERCENTAGE OF PUMP PRESSURE RISE LOSS	10	PERCENT
ENGINE SPEC SYSTEM		
CYLINDER ARRANGEMENT	VEE	
NUMBER OF CYLINDERS	12	
CYLINDER BORE DIAMETER	5.7	IN
PISTON STROKE	6.4	IN
TOTAL CYLINDER DISPLACEMENT	1959	CU IN
STANDARD CYLINDER FIRING ORDER	1-10-9-6-5-12-11-4-3-8-7-2	
NUMBER 1 CYLINDER LOCATION	LEFT FRONT	
STROKES/COMBUSTION CYCLE	4	
EXHAUST SYSTEM		
THE INSTALLED SYSTEM MUST COMPLY WITH THE SYSTEM LIMITS BELOW FOR ALL EMISSIONS CERTIFIED ENGINES TO ASSURE REGULATORY COMPLIANCE.		
MAXIMUM ALLOWABLE SYSTEM BACK PRESSURE	27	IN-H20
MANIFOLD TYPE	DRY	
MAXIMUM ALLOWABLE STATIC WEIGHT ON EXHAUST CONNECTION	110.2	LB
MAXIMUM ALLOWABLE STATIC BENDING MOMENT ON EXHAUST CONNECTION	0	LB-FT

FUEL SYSTEM		
MAXIMUM FUEL FLOW FROM TRANSFER PUMP TO ENGINE	227.2	G/HR
MAXIMUM ALLOWABLE FUEL SUPPLY LINE RESTRICTION	-8.9	IN-HG
MAXIMUM ALLOWABLE FUEL TEMPERATURE AT TRANSFER PUMP INLET	149	DEG F
MAXIMUM FUEL FLOW TO RETURN LINE FROM ENGINE	198.1	G/HR
MAXIMUM ALLOWABLE FUEL RETURN LINE RESTRICTION	10.2	IN-HG
NORMAL FUEL PRESSURE IN A CLEAN SYSTEM	90.9	PSI
FUEL SYSTEM TYPE	EUI	
MAXIMUM TRANSFER PUMP PRIMING LIFT WITHOUT PRIMING PUMP	12.1	FT
LUBE SYSTEM		
CRANKCASE VENTILATION TYPE	TO ATM	
MOUNTING SYSTEM		
CENTER OF GRAVITY LOCATION - X DIMENSION - FROM REAR FACE OF BLOCK - (REFERENCE TM7077)	23.0	IN
CENTER OF GRAVITY LOCATION - Y DIMENSION - FROM CENTERLINE OF CRANKSHAFT - (REFERENCE TM7077)	11.5	IN
CENTER OF GRAVITY LOCATION - Z DIMENSION - FROM CENTERLINE OF CRANKSHAFT - (REFERENCE TM7077)	0	IN
DRY WEIGHT - ENGINE ONLY (REFERENCE VALUE)	6462	LB
STARTING SYSTEM		
MINIMUM CRANKING SPEED REQUIRED FOR START	100	RPM
LOWEST AMBIENT START TEMPERATURE WITHOUT AIDS	32	DEG F

Reference Number: 0K4311
Effective Serial Number: PRH08159
Model: C32 DI TA AAAC

Make from Spec:

Test Spec Data

Description	Measure	Nominal	Ceiling	Floor
Corr Full Load Power	hp	1,502	1,547	1,457
Full Load Speed	RPM	1800	1810	1790
High Idle Speed	RPM	1945	1955	1935
Low Idle Speed	RPM	1100	1110	1090
FL Static Fuel Setting	in	0.326		
FT Static Fuel Setting	in	0.351		
FLS (Intercept)		1		
FTS (Slope)		1		
Corrected Fuel Rate	GAL/HR	73.4	77.1	69.7
CSFC	LB/HP.H	0.335	0.357	0.316
Adjusted Boost	IN_HG	78.8	90.6	67.0
Torque Check Speed	RPM	1500	1510	1490
Corr Torq Rise at TC RPM	%	14.5		
Corr Torque at TC RPM	LB.FT	5,019	5,371	4,668
C Fuel Rate at TC RPM	GAL/HR	73.8	75.6	68.4
CSFC at TC RPM	LB/HP.H	0.347	0.369	0.327
ADJ Boost at TC RPM	IN_HG	90.5	104.1	76.9
Power Loss/Cyl	% C FL PWR	10.5	16.0	
Specific Blowby	CU FT/HP.H			
Temp Jacket Water Pump Inlet	F	192	197	186

Test Spec Data				
Description	Measure	Nominal	Ceiling	Floor
Delta T Jacket Water (out-in)	F	12	21	3
Inlet Manifold Temp	F	120	132	107
Water Temp to Scac	F			
Scac Water Flow	GAL/MIN			
Oil Pressure	PSI	59	80	44
Oil Pressure Low Idle	PSI	48	65	15
Fuel Pressure	PSI	107	143	71
Inlet Fuel Pressure	PSI		4	
Inlet Fuel Temp	F	86	95	77
Inlet Air Pressure	IN_HG		31	26
Inlet Air Restriction	IN_HG		1.18	
Inlet Air Temperature	F		122	50
Fuel Density	DEG API		36.0	34.0
Boost Constant		1.0		
Governor Setting Constant				
Governor Setting Torque	% RTD TRQ			
High Idle Stability	RPM			
Low Idle Stability	RPM			
Set Point RPM	RPM	1820	1830	1810
Adjusted Boost (Gas Blending)	HG			
Corrected Fuel Rate - Diesel (Gas Blending)	GAL/HR			
Corrected Fuel Rate - Gas (Gas Blending	BTU/MIN			
Full Load Fueling (Gas Blending)	MM3/ST			
Gas Substitution Ratio (Gas Blending)	%			
Corr Full Load Power (Gas Blending)	HP			
Full Load Speed (Gas Blending)	RPM			

Test Spec Data

Description	Measure	Nominal	Ceiling	Floor
Exhaust Back Pressure	PSI			
TQ CK Exhaust Back Pressure	PSI			
Ataac Delta Pressure	PSI			

Engine Reference Information

Description	Measure	Data
FL Static/FT Static Fuel Settings	in	0.326 / 0.351
Fuel Valve Part Number		2605562
Unit Injector Part Number		2768307
Timing Dimension Field Service	in	
Timing Dimension Factory		
Torque Control Group Number		Change Level:
Fuel Pump/Gov Grp Part Number		2610048
Fuel Pump Type		EUI
Flyweight Part Number/Attitude		
Turbo Part No and Model		3021407 / GTB5518BS-1.37DH
Advertised Power / Governor Speed		1,474hp 1,800 RPM
Compression Ratio		15.0
Torque Rise Cam Part Number		
Manifold Type		DRY
Engine Flash File Part Number		5728122
Rating Number		
Flash File Change Number		
ASM Flash File Part Number		
ISM Flash File Part Number		

Engine Reference Information		
Description	Measure	Data
Advisor Flash File Part Number		
Secondary Module Flash File Part Number		
Messenger Flash File Part Number		
Tandem Software Flash File Part Number		
Governor Type		ELEC

Torque Control Group Spring Data		
Part No	Thickness	Quantity
No data available in table		

Torque Control Group Spacer Data		
Part No	Thickness	Quantity
No data available in table		

Timing Data
Mechanical Advance Part Number:
Chg. Level:
Advance: 0.0 DEG
Dog Leg Differentials: RPM: -- KW: --

Description	Measure	Spec	Minimum	Maximum
Timing Static @ 0 RPM BTDC	DEG		-2.0	2.0

Application/Performance Data		
Description	Measure	Data
Application Identification		297 GS STANDBY
Engine Sales Model and Series		C32
Combustion System type		DI
Aspiration Type		TA
Engine Source Factory Ref Number		LE

Application/Performance Data		
Description	Measure	Data
Power Setting PL/PP Ref Number		GG0776
Engine Perf Data Ref No and Change Level		EM0449
Multi Engine Torq/Rating		
Emissions Family		
Generator Rating W/O Fan	EKW	
Generator	HZ	60
Brakesaver test		
Certified Engine Rating	hp	
Engineering Model Ref		GS471
Low Idle In-Veh Speed	RPM	
Sales Model		
Machine Facility		
Usage		
Transmission		
Description		GS
Serial Number Prefixs		

Altitude Derating Information		
Description	Measure	Data
Altitude - Maximum	FT	997
Engine Power (ADV)	hp	1,474
Engine Power (Test)	hp	1,502

Altitude Derating Information		
Description	Measure	Data
High Idle Speed	RPM	
FL Static Fuel Setting	in	
FT Static Fuel Setting	in	0.351
Corrected Fuel Rate	GAL/HR	73.4
FL Boost Pressure	IN_HG	

Spec Number vs. Arrangement Number Cross Reference							
Arrangement	3801431	4259340	4391323	4447558	4447562	5233431	5612763

For Help Desk Phone Numbers Click here

Component Performance Number: DM7730

Radiator Data

Radiator Part Number: 3992338
Radiator Type: AB27.5
Front Area: 27.56 ft2
Radiator Dry Weight: 1,230.2 lbs
Radiator Wet Weight: 1,433.0 lbs
Radiator Water Capacity High Temp Circuit: 45.0 gal
Radiator Water Capacity Low Temp Circuit: NA gal
Center of Gravity (X): 7.48 in (Distance from front face of core)
Center of Gravity (Y): 34.89 in (Distance from bottom of radiator support)
Center of Gravity (Z): 0.43 in (Distance from center line of core)

Engine Data

Performance Number: EM0449
Sales Model: C32
EKW: 1000
Rating: MCSTNDBY
Speed: 1800
Settings: NA
IM ATAAC Temp Deg F: 120

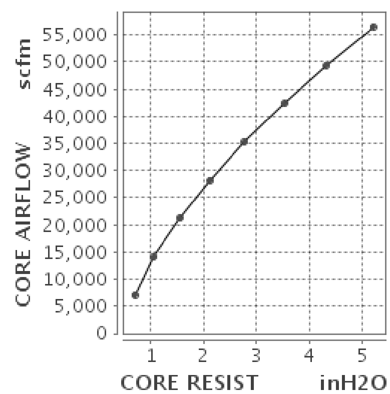
Combination Data

Pully Ratio: 0.625
Fan Power: 52.29978 hp

Ambient Restrictions (1/2 inH2O)			**Ambient Restrictions (3/4 inH2O)**			**Ambient Restrictions (1.00 inH2O)**		
984 Feet	**2460 Feet**	**4921 Feet**	**984 Feet**	**2460 Feet**	**4921 Feet**	**984 Feet**	**2460 Feet**	**4921 Feet**
--------- Max Ambient Pre-alarm Deg F ---------								
127	123	114	122	116	107	NA	NA	NA

Air Flow Restrictions (1/2 inH2O)	**Air Flow Restrictions (3/4 inH2O)**	**Air Flow Restrictions (1.00 inH2O)**
	--------- scfm ---------	
34855	32983	NA

CORE RESIST inH2O	CORE AIRFLOW scfm
0.7	7,062.94
1.06	14,125.88
1.55	21,188.82
2.12	28,251.76
2.78	35,314.7
3.52	42,377.64
4.32	49,440.58
5.2	56,503.52



Reference Number: DM7730

No notes found...

Parameters Reference: DM7332

RADIATOR CORE DATA

CONDITIONS:
CORE AIR FLOW RESISTANCE DATA IS FOR A FREE STANDING CORE ONLY. ADDITIONAL AIR FLOW RESISTANCE DUE TO SHROUDS, DUCTING, COOLERS AND ENGINE COMPONENTS MUST BE ADDED IN ORDER TO CALCULATE TOTAL SYSTEM PERFORMANCE.

CORE PERFORMANCE DATA IS BASED ON AN AIR DENSITY OF 1.20 KG/M3 (.075 LB/CU FT).

AMBIENT CAPABILITY:
THE AMBIENT CAPABILITY AND ALTITUDE CAPABILITY LISTED ON THIS PAGE REFLECTS THE THE CAPABILITY OF THE COOLING SYSTEM AT THE MAXIMUM GENERATOR SET RATING. THE AMBIENT AND ALTITUDE CAPABILITY MUST BE VERIFIED FOR THE ENGINE AND GENERATOR IN THE ENGINE PERFORMANCE SECTION OF TMI. AMBIENT CAPABILITY CALCULATIONS ARE BASED ON A 50/50 GLYCOL COOLANT MIX AND 4°C (7°F) AIR TO CORE RISE.
ASSUME 2°C ADDITIONAL AMBIENT CAPABILITY WITH TREATED WATER INSTEAD OF 50/50 GLYCOL AS COOLANT. THE CORE AIRFLOW VS CORE RESISTANCE CHARTS REPRESENT CORE ONLY DATA. ALL OTHER DATA IS FOR THE COMPLETE PACKAGE.

Data Privacy Statement.

Generator Data

March 25, 2021

(AT400240)-Engine (BAA126422A)-CEM

For Help Desk Phone Numbers Click here

Selected Model

Engine: C32	**Generator Frame:** 1402	**Genset Rating (kW):** 1000.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 4326120	**Genset Rating (kVA):** 1250.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 1503.5
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 41205 /41596 /41282 /9708

Spec Information

Generator Specification

Frame: 1402	**Type:** SR5	**No. of Bearings:** 1
Winding Type: RANDOM WOUND		**Flywheel:** 18.0
Connection: SERIES STAR		**Housing:** 0
Phases: 3		**No. of Leads:** 6
Poles: 4		**Wires per Lead:** 4
Sync Speed: 1800		**Generator Pitch:** 0.6667

Generator Efficiency

Per Unit Load	kW	Efficiency %
0.25	250.0	92.2
0.5	500.0	94.6
0.75	750.0	94.9
1.0	1000.0	94.8

Reactances	Per Unit	Ohms
SUBTRANSIENT - DIRECT AXIS X''_d	0.1573	0.0290
SUBTRANSIENT - QUADRATURE AXIS X''_q	0.1861	0.0343
TRANSIENT - SATURATED X'_d	0.2799	0.0516
SYNCHRONOUS - DIRECT AXIS X_d	3.9453	0.7272
SYNCHRONOUS - QUADRATURE AXIS X_q	2.3698	0.4368
NEGATIVE SEQUENCE X_2	0.1725	0.0318
ZERO SEQUENCE X_0	0.0374	0.0069

Time Constants	Seconds
OPEN CIRCUIT TRANSIENT - DIRECT AXIS T'_{d0}	2.5090
SHORT CIRCUIT TRANSIENT - DIRECT AXIS T'_d	0.1800
OPEN CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_{d0}	0.0320
SHORT CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_d	0.0180
OPEN CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_{q0}	0.2290
SHORT CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_q	0.0180
EXCITER TIME CONSTANT T_e	0.0600
ARMATURE SHORT CIRCUIT T_a	0.0270

Short Circuit Ratio: 0.31 | Stator Resistance = 0.0042 Ohms | Field Resistance = 0.39 Ohms

Voltage Regulation

Voltage level adjustment: +/-	5.0%
Voltage regulation, steady state: +/-	0.5%
Voltage regulation with 3% speed change: +/-	0.5%
Waveform deviation line - line, no load: less than	2.0%
Telephone influence factor: less than	50

Generator Excitation

	No Load	Full Load, (rated) pf	
		Series	Parallel
Excitation voltage:	10.12 Volts	54.56 Volts	Volts
Excitation current	0.92 Amps	4.08 Amps	Amps

Selected Model

Engine: C32	**Generator Frame:** 1402	**Genset Rating (kW):** 1000.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 4326120	**Genset Rating (kVA):** 1250.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 1503.5
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 41205 /41596 /41282 /9708

Generator Mechanical Information

Center of Gravity

Dimension X	-581.5 mm	-22.9 IN.
Dimension Y	0.0 mm	0.0 IN.
Dimension Z	0.0 mm	0.0 IN.

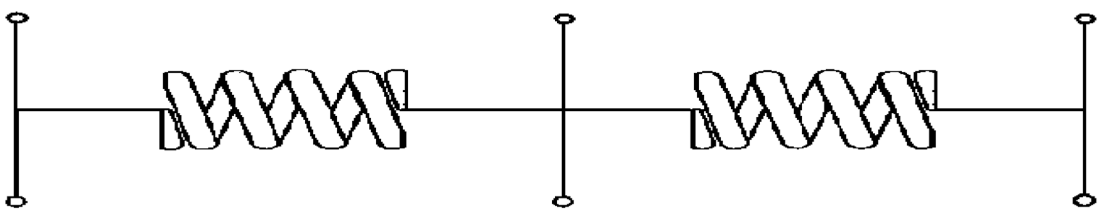
- "X" is measured from driven end of generator and parallel to rotor. Towards engine fan is positive. See General Information for details
- "Y" is measured vertically from rotor center line. Up is positive.
- "Z" is measured to left and right of rotor center line. To the right is positive.

Generator WT = 2200 kg	* Rotor WT = 854 kg	* Stator WT = 1346 kg
4,850 LB	1,883 LB	2,967 LB

Rotor Balance = 0.0508 mm deflection PTP

Overspeed Capacity = 125% of synchronous speed

Generator Torsional Data



J1 = Coupling and Fan   **J2 = Rotor TOTAL J = J1 + J2 + J3**   **J3 = Exciter End**

K1 = Shaft Stiffness between J1 + J2 (Diameter 1)   **K2 = Shaft Stiffness between J2 + J3 (Diameter 2)**

J1	K1	Min Shaft Dia 1	J2	K2	Min Shaft Dia 2	J3
0.0 LB IN. s^2	0.0 MLB IN./rad	6.7 IN.	127.5 LB IN. s^2	128.3 MLB IN./rad	5.5 IN.	7.1 LB IN. s^2
0.0 N m s^2	0.0 MN m/rad	170.0 mm	14.4 N m s^2	14.5 MN m/rad	140.0 mm	0.8 N m s^2
			Total J			
			134.5 LB IN. s^2			
			15.2 N m s^2			

Selected Model

Engine: C32	**Generator Frame:** 1402	**Genset Rating (kW):** 1000.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 4326120	**Genset Rating (kVA):** 1250.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 1503.5
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 41205 /41596 /41282 /9708

Generator Cooling Requirements - Temperature - Insulation Data

Cooling Requirements:		**Temperature Data: (Ambient 40 ^{0}C)**	
Heat Dissipated:	54.9 kW	**Stator Rise:**	125.0 ^{0}C
Air Flow:	132.0 m^3/min	**Rotor Rise:**	125.0 ^{0}C

Insulation Class: H

Insulation Reg. as shipped: 100.0 MΩ minimum at 40 ^{0}C

Thermal Limits of Generator

Frequency:	60 Hz
Line to Line Voltage:	480 Volts
B BR 80/40	1040.0 kVA
F BR -105/40	1183.0 kVA
H BR - 125/40	1300.0 kVA
F PR - 130/40	1300.0 kVA
H PR - 150/40	1378.0 kVA
H PR27 - 163/27	1430.0 kVA

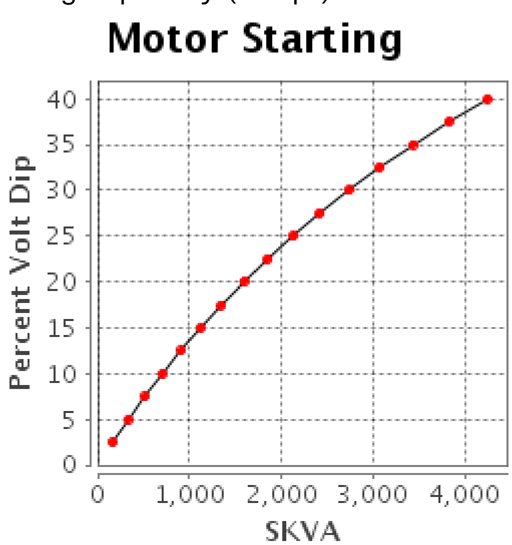
Selected Model

Engine: C32	**Generator Frame:** 1402	**Genset Rating (kW):** 1000.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 4326120	**Genset Rating (kVA):** 1250.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 1503.5
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 41205 /41596 /41282 /9708

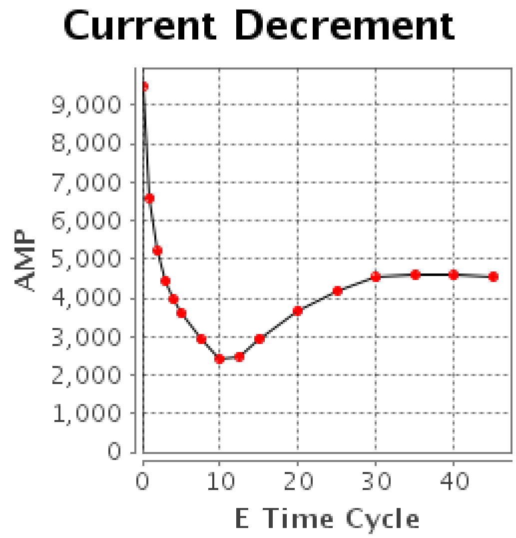
Starting Capability & Current Decrement
Motor Starting Capability (0.4 pf)

SKVA	Percent Volt Dip
164	2.5
336	5.0
517	7.5
709	10.0
911	12.5
1,126	15.0
1,353	17.5
1,595	20.0
1,852	22.5
2,126	25.0
2,419	27.5
2,734	30.0
3,071	32.5
3,435	35.0
3,827	37.5
4,252	40.0



Current Decrement Data

E Time Cycle	AMP
0.0	9,500
1.0	6,590
2.0	5,197
3.0	4,441
4.0	3,956
5.0	3,595
7.5	2,921
10.0	2,411
12.5	2,490
15.0	2,943
20.0	3,680
25.0	4,187
30.0	4,523
35.0	4,592
40.0	4,576
45.0	4,554



Instantaneous 3 Phase Fault Current: 9500 Amps **Instantaneous Line - Line Fault Current:** 7854 Amps

Instantaneous Line - Neutral Fault Current: 12227 Amps

Selected Model

Engine: C32 **Generator Frame:** 1402 **Genset Rating (kW):** 1000.0 **Line Voltage:** 480

Fuel: Diesel **Generator Arrangement:** 4326120 **Genset Rating (kVA):** 1250.0 **Phase Voltage:** 277

Frequency: 60 **Excitation Type:** Permanent Magnet **Pwr. Factor:** 0.8 **Rated Current:** 1503.5

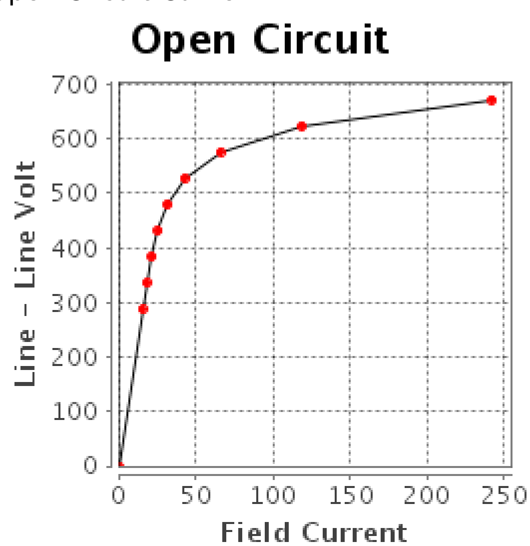
Duty: STANDBY **Connection:** SERIES STAR **Application:** EPG **Status:** Current

Version: 41205 /41596 /41282 /9708

Generator Output Characteristic Curves

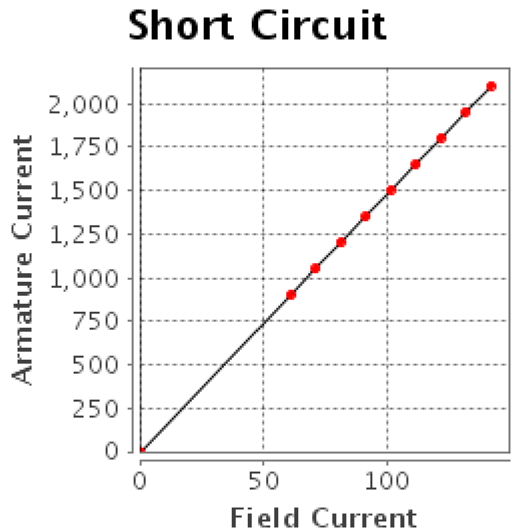
Open Circuit Curve

Field Current	Line - Line Volt
0.0	0
15.6	288
18.4	336
21.6	384
25.7	432
31.8	480
42.9	528
66.2	576
118.9	624
242.2	672



Short Circuit Curve

Field Current	Armature Current
0.0	0
60.9	902
71.1	1,052
81.2	1,203
91.4	1,353
101.5	1,504
111.7	1,654
121.8	1,804
132.0	1,955
142.1	2,105



Selected Model

Engine: C32 **Generator Frame:** 1402 **Genset Rating (kW):** 1000.0 **Line Voltage:** 480

Fuel: Diesel **Generator Arrangement:** 4326120 **Genset Rating (kVA):** 1250.0 **Phase Voltage:** 277

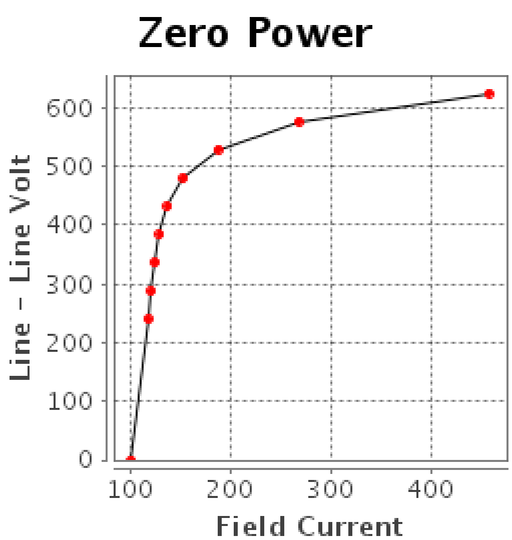
Frequency: 60 **Excitation Type:** Permanent Magnet **Pwr. Factor:** 0.8 **Rated Current:** 1503.5

Duty: STANDBY **Connection:** SERIES STAR **Application:** EPG **Status:** Current

Version: 41205 /41596 /41282 /9708

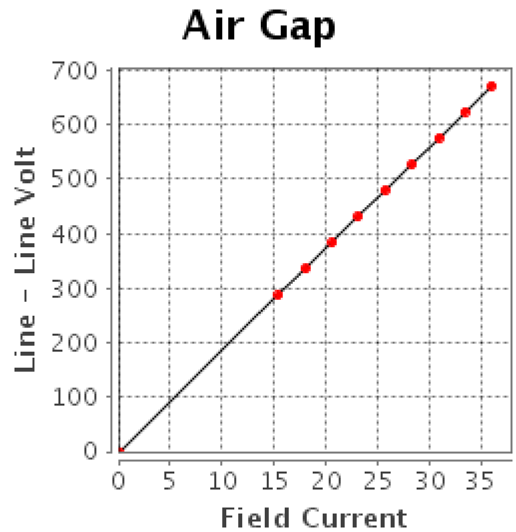
Generator Output Characteristic Curves
Zero Power Factor Curve

Field Current	Line - Line Volt
101.5	0
118.1	240
121.2	288
124.7	336
129.6	384
137.7	432
153.5	480
188.2	528
268.3	576
458.2	624



Air Gap Curve

Field Current	Line - Line Volt
0.0	0
15.4	288
18.0	336
20.6	384
23.1	432
25.7	480
28.3	528
30.9	576
33.4	624
36.0	672

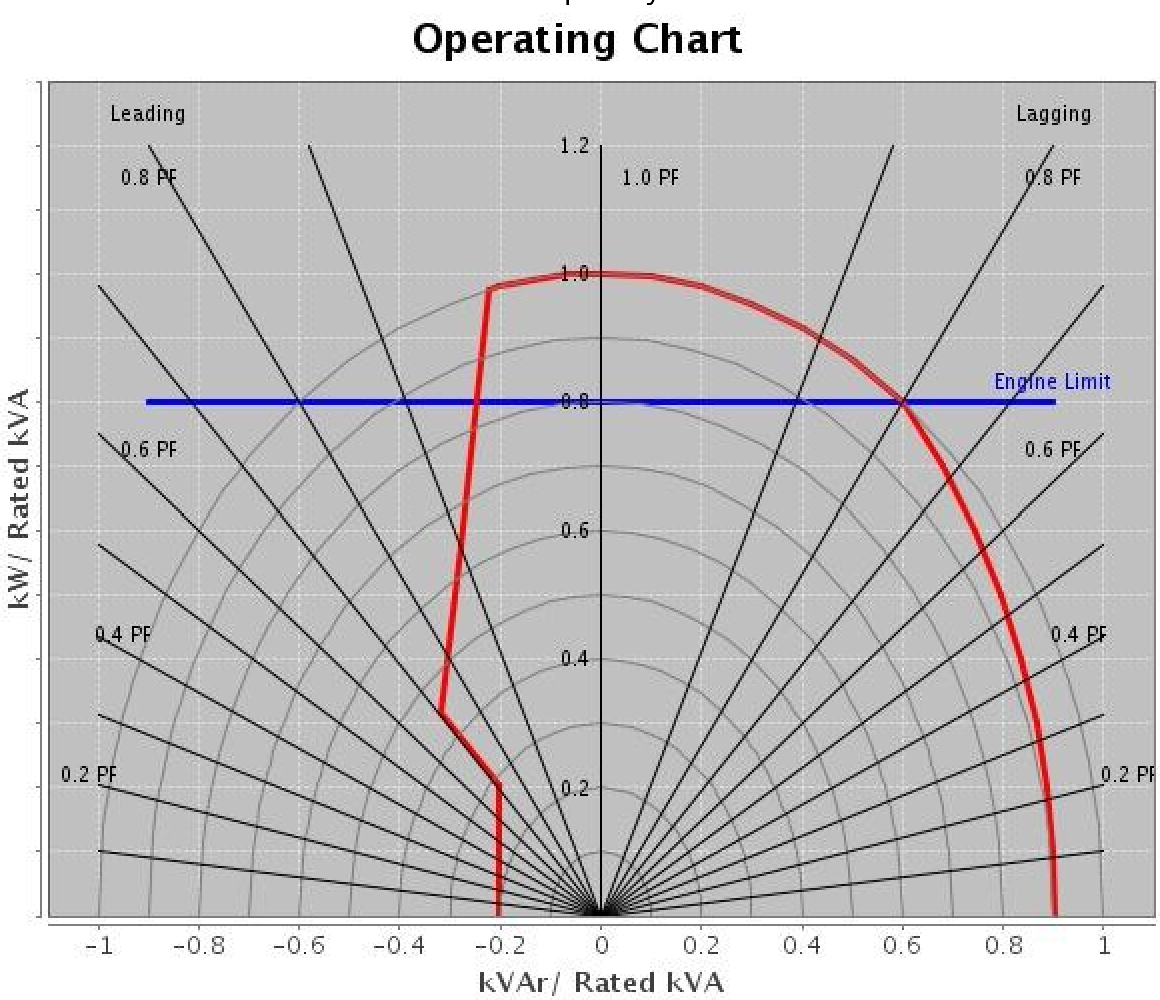


Selected Model

Engine: C32
Fuel: Diesel
Frequency: 60
Duty: STANDBY
Generator Frame: 1402
Generator Arrangement: 4326120
Excitation Type: Permanent Magnet
Connection: SERIES STAR
Genset Rating (kW): 1000.0
Genset Rating (kVA): 1250.0
Pwr. Factor: 0.8
Application: EPG
Line Voltage: 480
Phase Voltage: 277
Rated Current: 1503.5
Status: Current

Version: 41205 /41596 /41282 /9708

Reactive Capability Curve



Selected Model

Engine: C32	**Generator Frame:** 1402	**Genset Rating (kW):** 1000.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 4326120	**Genset Rating (kVA):** 1250.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 1503.5
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 41205 /41596 /41282 /9708

General Information

DM7825 Caterpillar SR5 Generators (50 Hz, 60 Hz)
Data for 1400, 1600, 1700, 1800 and 1900 frames Caterpillar SR5 generators built by Leroy Somer - USA and Leroy Somer France.

Refer to DM7821 for explanation of all generator data in Technical Marketing Information (TMI) except generator efficiency for which the explanation is given below.

GENERATOR EFFICIENCY
Generator efficiency is the percentage of engine flywheel (or other prime mover) power that is converted into electrical output. The generator efficiency shown is calculated by the summation of all losses method, and is determined in accordance with the IEC Standard 60034. The efficiency considers only the generator. There is no consideration of engine or parasitic losses here.

Refer to DM7829 for low and medium voltage protective setting values a nd limits.

SABEY DATA CENTER
Cummins Pacific NW QSK60-14 diesels
www.CatalyticCombustion.com
001-00-273397 Rev 1, 10-06-2021

CATALYTIC COMBUSTION EMISSION TECHNOLOGIES

Diesel Oxidation Catalyst (DOC) Housing - GOOD					
Load	**10%**	**25%**	**50%**	**75%**	**100%**
BHP @ 1800 RPM (60HZ)	379	851	1637	2422	3239
Power Output (kWe)	225	563	1125	1688	2250
Exhaust Flow Rate CFM	4403	6770	11174	14037	16429
Exhaust Temperature F	611	731	821	853	893
Raw Particulate Matter (PM) g/bhp-hr	0.58	0.30	0.14	0.06	0.08
Treated PM (25%) g/bhp-hr	0.44	0.23	0.11	0.05	0.06
Raw Particulate Matter (PM) lbs/hr	0.48	0.56	0.51	0.32	0.57
Treated PM (25%) lbs/hr	**0.36**	**0.42**	**0.38**	0.24	**0.43**
Per Engine					

Diesel Oxidation Trapping Catalyst (DOTC) Housing - BETTER					
Load	**10%**	**25%**	**50%**	**75%**	**100%**
BHP @ 1800 RPM (60HZ)	379	851	1637	2422	3239
Power Output (kWe)	225	563	1125	1688	2250
Exhaust Flow Rate CFM	4403	6770	11174	14037	16429
Exhaust Temperature F	611	731	821	853	893
Raw Particulate Matter (PM) g/bhp-hr	0.58	0.30	0.14	0.06	0.08
Treated PM (50%) g/bhp-hr	0.29	0.15	0.07	0.03	0.04
Raw Particulate Matter (PM) lbs/hr	0.48	0.56	0.51	0.32	0.57
Treated PM (50%) lbs/hr	0.24	0.28	0.25	0.16	0.29
Per Engine					

Diesel Oxidation Catalyst (DOC) and Diesel Particualte Filter (DPF) Housing - BEST					
Load	**10%**	**25%**	**50%**	**75%**	**100%**
BHP @ 1800 RPM (60HZ)	379	851	1637	2422	3239
Power Output (kWe)	225	563	1125	1688	2250
Exhaust Flow Rate CFM	4403	6770	11174	14037	16429
Exhaust Temperature F	611	731	821	853	893
Raw Particulate Matter (PM) g/bhp-hr	0.58	0.30	0.14	0.06	0.08
Treated PM (85%) g/bhp-hr	0.09	0.05	0.02	0.01	0.01
Raw Particulate Matter (PM) lbs/hr	0.48	0.56	0.51	0.32	0.57
Treated PM (85%) lbs/hr	0.07	0.08	0.08	0.05	0.09
Per Engine					

	Standby				
PERFORMANCE DATA	**10%**	**25%**	**50%**	**75%**	**100%**
BHP @ 1800 RPM (60 Hz)	379	851	1637	2422	3239
POWER OUTPUT (kWe)	225	563	1125	1688	2250
NMHC (Nonmethane Hydrocarbons)	0.63	0.26	0.12	0.05	0.07
NOx (Oxides of Nitrogen)	8.33	5.23	4.55	5.95	8.72
CO (Carbon Monoxide)	4.4	1.4	0.6	0.4	0.8
PM (Particulate Matter)	0.58	0.30	0.14	0.06	0.08

All emissions values above are cited as g/bhp-hr

Potential Site variation values provided above are accounted for Engine, Ambient variation and measurement with no correction factors.

POWER SYSTEMS WEST

SABEY Data Centers

GENERATORS

PARTS

SERVICE

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Contacts:

Rob Jackson
Sales Engineer
M:503.504.2011
E: Rob.Jackson@PowerSystemsWest.com

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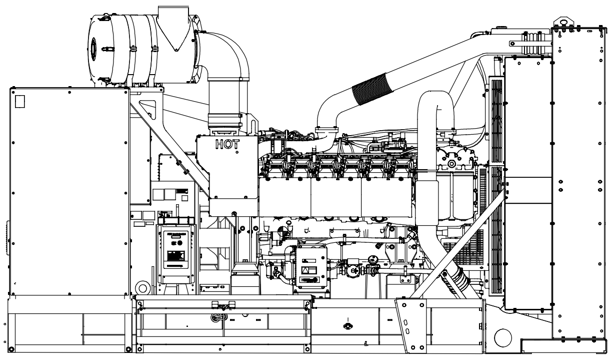
TABLE OF CONTENTS

KOHLER

Industrial Diesel Generator Set - KD1000

Tier 2 EPA-Certified for Stationary Emergency Applications



KDxxxx designates a generator set with a Tier 2 EPA-Certified engine.
KDxxxx-F designates a 60 Hz generator set with a fuel optimized engine.

Ratings Range

		60 Hz
Standby:	**kW**	975-1000
	kVA	1219-1250
Prime:	**kW**	810-900
	kVA	1012-1125

Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The 60 Hz generator set offers a UL 2200 listing.
- The generator set accepts rated load in one step.
- The 60 Hz generator set meets NFPA 110, Level 1, when equipped with the necessary accessories and installed per NFPA standards.
- A standard three-year or 1000-hour limited warranty for standby applications. Five-year basic, five-year comprehensive, and ten-year extended limited warranties are also available.
- A standard two-year or 8700-hour limited warranty for prime power applications.
- Other features:
  - Kohler designed controllers for one-source system integration and remote communication. See Controllers on page 4.
  - The low coolant level shutdown prevents overheating (standard on radiator models only).

General Specifications

Orderable Generator Model Number	GMKD1000
Manufacturer	Kohler
Engine: model	KD27V12
Alternator Choices	KH04070TO4D KH04830TO4D KH05520TO4D
Performance Class	Per ISO 8528-5
One Step Load Acceptance	100%
Voltage	Wye or 600 V
Controller	APM603, APM802
Fuel Tank Capacity, L (gal.)	3475-19381 (918-5120)
Fuel Consumption, L/hr (gal./hr) 100% at Standby	269 (70.9)
Fuel Consumption, L/hr (gal./hr) 100% at Prime Power	247 (65.3)
Emission Level Compliance (KDxxxx)	Tier 2
Open Unit Noise Level @ 7 m dB(A) at Rated Load	96
Data Center Continuous (DCC) Rating (Refer to TIB-101 for definitions)	Same as the Standby Rating below

Generator Set Ratings

				150°C Rise Standby Rating		130°C Rise Standby Rating		125°C Rise Prime Rating		105°C Rise Prime Rating	
Alternator	**Voltage**	**Ph**	**Hz**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**
KH04070TO4D	120/208	3	60	1000/1250	3470	1000/1250	3470	900/1125	3123	810/1012	2810
	127/220	3	60	1000/1250	3281	1000/1250	3281	900/1125	2953	810/1012	2656
	139/240	3	60	1000/1250	3008	975/1219	2933	900/1125	2707	—	—
	220/380	3	60	1000/1250	1900	1000/1250	1899	900/1125	1710	900/1125	1710
	240/416	3	60	1000/1250	1735	1000/1250	1735	900/1125	1562	870/1088	1510
	254/440	3	60	1000/1250	1641	1000/1250	1641	900/1125	1477	900/1125	1477
	277/480	3	60	1000/1250	1504	1000/1250	1504	900/1125	1354	900/1125	1354
	347/600	3	60	1000/1250	1203	1000/1250	1203	900/1125	1083	900/1125	1083
KH04830TO4D	230/400	3	60	1000/1250	1805	1000/1250	1805	900/1125	1624	900/1125	1624
	240/416	3	60	1000/1250	1735	1000/1250	1735	900/1125	1562	900/1125	1562
	254/440	3	60	1000/1250	1641	1000/1250	1641	900/1125	1477	900/1125	1477
	277/480	3	60	1000/1250	1504	1000/1250	1504	900/1125	1354	900/1125	1354

RATINGS: All three-phase units are rated at 0.8 power factor. *Standby Ratings:* The standby rating is applicable to varying loads for the duration of a power outage. There is no overload capability for this rating. *Prime Power Ratings:* At varying load, the number of generator set operating hours is unlimited. A 10% overload capacity is available for one hour in twelve. Ratings are in accordance with ISO-8528-1 and ISO-3046-1. For limited running time and continuous ratings, consult the factory. Obtain technical information bulletin (TIB-101) for ratings guidelines, complete ratings definitions, and site condition derates. The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever.

KOHLER.

Industrial Diesel Generator Set - KD1000
Tier 2 EPA-Certified for Stationary Emergency Applications

Alternator	Voltage	Ph	Hz	150°C Rise Standby Rating kW/kVA	150°C Rise Standby Rating Amps	130°C Rise Standby Rating kW/kVA	130°C Rise Standby Rating Amps	125°C Rise Prime Rating kW/kVA	125°C Rise Prime Rating Amps	105°C Rise Prime Rating kW/kVA	105°C Rise Prime Rating Amps
KH05520TO4D	220/380	3	60	1000/1250	1900	1000/1250	1900	900/1125	1710	900/1125	1710
	230/400	3	60	1000/1250	1805	1000/1250	1805	900/1125	1624	900/1125	1624
	240/416	3	60	1000/1250	1735	1000/1250	1735	900/1125	1562	900/1125	1562
	254/440	3	60	1000/1250	1641	1000/1250	1641	900/1125	1477	900/1125	1477
	277/480	3	60	1000/1250	1504	1000/1250	1504	900/1125	1354	900/1125	1354
	347/600	3	60	1000/1250	1203	1000/1250	1203	900/1125	1083	900/1125	1083

Engine Specifications	60 Hz
Manufacturer	Kohler
Engine: model	KD27V12
Engine: type	4-Cycle, Turbocharged, Charge Air Cooled
Cylinder arrangement	12-V
Displacement, L (cu. in.)	27 (1648)
Bore and stroke, mm (in.)	135 x 157 (5.31 x 6.18)
Compression ratio	15.0:1
Piston speed, m/min. (ft./min.)	565 (1854)
Main bearings: quantity, type	7, Precision Half Shells
Rated rpm	1800
Max. power at rated rpm, kWm (BHP)	1114 (1494)
Cylinder head material	Cast Iron
Crankshaft material	Steel
Valve (exhaust) material	Steel
Governor: type, make/model	KODEC Electronic Control
Frequency regulation, no-load to-full load	Isochronous
Frequency regulation, steady state	±0.25%
Frequency	Fixed
Air cleaner type, all models	Dry

Lubricating System	60 Hz
Type	Full Pressure
Oil pan capacity dipstick mark max., L (qt.) §	79 (83.5)
Oil pan capacity, initial filling, L (qt.) §	101 (106.7)
Oil filter: quantity, type §	2, Cartridge
Oil cooler	Water-Cooled

§ Kohler recommends the use of Kohler Genuine oil and filters.

Fuel System	60 Hz
Fuel supply line, min. ID, mm (in.)	14 (0.55)
Fuel return line, min. ID, mm (in.)	14 (0.55)
Max. fuel flow, Lph (gph)	380 (100)
Min./max. fuel pressure at engine supply connection, kPa (in. Hg)	-30/30 (-8.8/8.8)
Max. return line restriction, kPa (in. Hg)	20 (5.9)
Fuel filter: quantity, type	1, Primary Engine Filter 1, Fuel/Water Separator
Recommended fuel	#2 Diesel ULSD

Fuel Consumption	60 Hz
Diesel, Lph (gph) at % load	**Standby Rating**
100%	269 (70.9)
75%	209 (55.3)
50%	146 (38.6)
25%	84 (22.2)
10%	47 (12.4)
Diesel, Lph (gph) at % load	**Prime Rating**
100%	247 (65.3)
75%	191 (50.4)
50%	135 (35.6)
25%	79 (20.8)

Radiator System	60 Hz	
Ambient temperature, °C (°F)*	40 (104)	50 (122)
Radiator system capacity, including engine, L (gal.)	113 (29.5)	123 (32.4)
Engine jacket water capacity, L (gal.)	55 (14.4)	
Engine jacket water flow, Lpm (gpm)	1015 (268)	
Charge cooler air inlet temperature at 25°C (77°F) ambient, °C (°F)	219 (426)	
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	404 (22996)	
Heat rejected to charge air cooler at rated kW, dry exhaust, kW (Btu/min.)	260 (14799)	
Turbocharger boost (abs) bar (psi)	3.4 (49)	
Water pump type	Vane Wheel	
Fan diameter, including blades, mm (in.)	1350 (53.1)	
Fan, kWm (HP)	48 (64.3)	
Max. restriction of cooling air, intake and discharge side of radiator, kPa (in. H_2O)	0.125 (0.5)	

* Enclosure with enclosed silencer reduces ambient temperature capability by 5°C (9°F).

Remote Radiator System†	60 Hz
Exhaust manifold type	Dry
Connection sizes:	
Water inlet/outlet, mm (in.)	85 (3.35)
Charge air cooler inlet/outlet (pipe dia. of flange), mm (in.)	127 (5)
Static head allowable above engine, kPa (ft. H_2O)	70 (23.5)

† Contact your local distributor for cooling system options and specifications based on your specific requirements.

Exhaust System	60 Hz
Exhaust flow at rated kW, m^3/min. (cfm)	201.6 (7119)
Exhaust temperature at rated kW at 25°C (77°F) ambient, dry exhaust, °C (°F)	530 (986)
Maximum allowable back pressure, kPa (in. Hg)	8.5 (2.5)
Exh. outlet size at eng. hookup, mm (in.)	See ADV drawing

Electrical System	60 Hz
Battery charging alternator:	
Ground (negative/positive)	Negative
Volts (DC)	24
Ampere rating	140
Starter motor qty. at starter motor power rating, rated voltage (DC)	Standard: 1 @ 7.8 kW, 24; Redundant (optional): 2 @ 7.8 kW, 24
Battery, recommended cold cranking amps (CCA):	
Quantity, CCA rating each, type (with standard starter)	2, 1110, AGM
Quantity, CCA rating each, type (with optional redundant starters)	4, 1110, AGM
Battery voltage (DC)	12

Air Requirements	60 Hz
Radiator-cooled cooling air, m^3/min. (scfm)‡	1212 (42801)
High ambient radiator- cooled cooling air, m^3/min (scfm)‡	1350 (47700)
Cooling air required for generator set when equipped with city water cooling or remote radiator, based on 14°C (25°F) rise, m^3/min. (scfm)‡	653.9 (23092)
Combustion air, m^3/min. (cfm)	72.7 (2566)
Heat rejected to ambient air:	
Engine, kW (Btu/min.)	136 (7741)
Alternator, kW (Btu/min.)	48 (2732)

‡ Air density = 1.20 kg/m^3 (0.075 lbm/ft^3)

Alternator Specifications		60 Hz
Type		4-Pole, Rotating-Field
Exciter type		Brushless, Permanent-Magnet Pilot Exciter
Voltage regulator		Solid-State, Volts/Hz
Insulation:		NEMA MG1, UL 1446, Vacuum Pressure Impregnated (VPI)
Material		Class H, Synthetic, Nonhygroscopic
Temperature rise		130°C, 150°C Standby
Bearing: quantity, type		1, Sealed
Coupling type		Flexible Disc
Amortisseur windings		Full
Alternator winding type		Random Wound
Rotor balancing		125%
Voltage regulation, no-load to full-load		±0.25%
One-step load acceptance		100% of Rating
Unbalanced load capability		100% of Rated Standby Current
Peak motor starting kVA:		(35% dip for voltages below)
480 V	KH04070TO4D	3774
480 V	KH04830TO4D	4193
480 V	KH05520TO4D	4612

Alternator Standard Features

- The pilot-excited, permanent magnet (PM) alternator provides superior short-circuit capability.
- All models are brushless, rotating-field alternators.
- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds.
- Sustained short-circuit current enabling downstream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and dripproof construction.
- Superior voltage waveform from two-thirds pitch windings and skewed stator.
- Brushless alternator with brushless pilot exciter for excellent load response.

NOTE: See TIB- 102 Alternator Data Sheets for alternator application data and ratings, efficiency curves, voltage dip with motor starting curves, and short circuit decrement curves.

KOHLER®

KD1000

60 Hz. Diesel Generator Set
Tier 2 EPA Certified for Stationary Emergency Applications
EMISSION OPTIMIZED DATA SHEET

ENGINE INFORMATION

Model:	KD27V12	Bore:	135 mm (5.31 in.)
Type:	4-Cycle, 12-V Cylinder	Stroke:	157 mm (6.18 in.)
Aspiration:	Turbocharged, Intercooled	Displacement:	27 L (1648 cu. in.)
Compression ratio:	15:0:1		
Emission Control Device:	Direct Diesel Injection, Engine Control Module, Turbocharger, Charge Air Cooler		

NOMINAL EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP
Power [kW]	1114	836	557	279
Speed [rpm]	1800	1800	1800	1800
Exhaust Gas Flow [kg/h]	5368	4924	4436	3065
Exhaust Gas Temperature [C]	541	483	388	359
NO_X [g/kWh]	10.1	6.5	4.2	2.9
CO [g/kWh]	0.3	0.3	0.5	1.1
HC [g/kWh]	0.02	0.03	0.06	0.11
PM [g/kWh]	0.01	0.01	0.04	0.27

NOT TO EXCEED EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP
NO_X [g/kWh]	11.4	7.4	4.8	3.3
CO [g/kWh]	1.3	1.4	2.3	5.8
HC [g/kWh]	0.03	0.04	0.08	0.13
PM [g/kWh]	0.03	0.03	0.14	0.88

10% ESP

Frequency	Rating ESP/PRP/COP	NRSC-D2 mode	Rated Power	Rated Speed	Exhaust temperature after turbine	Exhaust mass flow	NOx	CO	HC	PM
Hz	-	-	kW	rpm	°C	kg/h	g/kWh	g/kWh	g/kWh	g/kWh
60	ESP	10%	1114	1800	274	1871	7.4	19.50	0.35	0.26

TEST METHODS AND CONDITIONS

Test Methods:
Steady-State emissions recorded per EPA CFR 40 Part 89, and ISO8178-1 during operation at rated engine speed (+/-2%) and stated constant load (+/-2%) with engine temperatures, pressures and emission rated stabilized.

Fuel Specification:
40-48 Cetane Number, 0.05 Wt. % max. Sulfur; Reference ISO8178-5, 40CFR86.1313-98 Type 2-D and ASTM D975 No. 2-D.

Reference Conditions:
25 °C (77 °F) Air Inlet Temperature, 40 °C (104 °F) Fuel Inlet Temperature, 100 kPa (29.53 in Hg) Barometric Pressure; 10.7 g/kg (75 grains H2O/lb.) of dry air Humidity (required for NOx correction); Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back pressure set to maximum allowable limit.

Data was taken from a single engine test according to the test methods, fuel specification and reference conditions stated above and is subjected to instrumentation and engine-to-engine variability. Tests conducted with alternate test methods, instrumentation, fuel or reference conditions can yield different results.

Data and specifications subject to change without notice.

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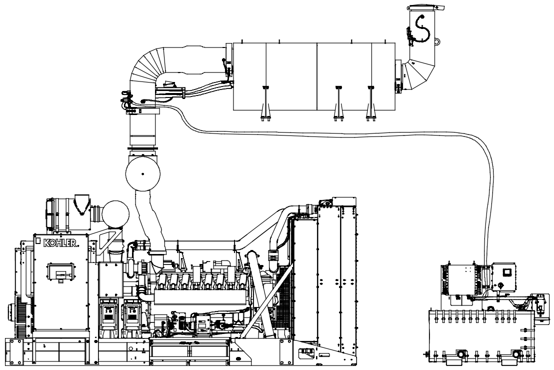
Industrial Diesel Generator Set - KD1250-4

Tier 4 EPA-Certified for Stationary, Prime, Continuous Applications



KDxxxx-4 designates a generator set with a Tier 4 EPA-Certified engine.

Ratings Range

		60 Hz
Standby:	**kW**	1180-1250
	kVA	1475-1562
Prime:	**kW**	1070-1130
	kVA	1338-1412
Continuous:	**kW**	920-970
	kVA	1150-1212

Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The 60 Hz generator set offers a UL 2200 listing.
- The generator set accepts rated load in one step.
- The 60 Hz generator set meets NFPA 110, Level 1, when equipped with the necessary accessories and installed per NFPA standards.
- A standard three-year or 1000-hour limited warranty for standby applications. Five-year basic, five-year comprehensive, and ten-year extended limited warranties are also available.
- A standard two-year or 8700-hour limited warranty for prime power applications. Five-year basic and five-year comprehensive warranties are also available.
- A standard one-year warranty with unlimited hours for continuous power applications.
- Other features:
  - Kohler designed controllers for one-source system integration and remote communication. See Controller on page 4.
  - The low coolant level shutdown prevents overheating (standard on radiator models only).

General Specifications

Orderable Generator Model Number	GMKD1250-4
Manufacturer	Kohler
Alternator Choices	KH03850TO4D KH04590TO4D KH04830TO4D KH05520TO4D KH05641TO4D KH06721TO4D KH06810TO4D
Performance Class	Per ISO 8528-5
One Step Load Acceptance	100%
Voltage	Wye, 600 V., or 4160 V
Controller	APM603
Fuel Tank Capacity, L (gal.)	5863-21985 (1549-5808)
Fuel Consumption, L/hr (gal./hr) 100% at Standby	334 (88.2)
Fuel Consumption, L/hr (gal./hr) 100% at Prime Power	301 (79.4)
Fuel Consumption, L/hr (gal./hr) 100% at Continuous Power	249 (65.9)
DEF Consumption, L/hr (gal./hr) 100% at Standby	31.5 (8.3)
DEF Consumption, L/hr (gal./hr) 100% at Prime Power	27.5 (7.3)
DEF Consumption, L/hr (gal./hr) 100% at Continuous Power	21.7 (5.7)
Emission Level Compliance (KDxxxx)	Tier 4
Open Unit Noise Level @ 7 m dB(A) at Rated Load	97
Data Center Continuous (DCC) Rating (Refer to TIB-101 for definitions)	Same as the Standby Rating below

Generator Set Ratings

				150°C Rise Standby Rating		130°C Rise Standby Rating		125°C Rise Prime Rating		105°C Rise Prime Rating		80°C Rise Continuous Rating	
Alternator	**Voltage**	**Ph**	**Hz**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**
KH03850TO4D	220/380	3	60	1250/1562	2374	1250/1562	2374	1130/1412	2146	1130/1412	2146	960/1200	1824
	240/416	3	60	1250/1562	2168	1250/1562	2168	1130/1412	1960	1130/1412	1960	960/1200	1666
	277/480	3	60	1250/1562	1879	1250/1562	1879	1130/1412	1699	1130/1412	1699	960/1200	1444
	347/600	3	60	1250/1562	1504	1250/1562	1504	1130/1412	1359	1130/1412	1359	960/1200	1155
KH04590TO4D	220/380	3	60	1250/1562	2374	1250/1562	2374	1130/1412	2146	1130/1412	2146	960/1200	1824
	240/416	3	60	1250/1562	2168	1250/1562	2168	1130/1412	1960	1130/1412	1960	960/1200	1666
	277/480	3	60	1250/1562	1879	1250/1562	1879	1130/1412	1699	1130/1412	1699	970/1212	1458
	347/600	3	60	1250/1562	1504	1250/1562	1504	1130/1412	1359	1130/1412	1359	970/1212	1167

RATINGS: All three-phase units are rated at 0.8 power factor. *Standby Ratings:* The standby rating is applicable to varying loads for the duration of a power outage. There is no overload capability for this rating. *Prime Power Ratings:* At varying load, the number of generator set operating hours is unlimited. A 10% overload capacity is available for one hour in twelve. Ratings are in accordance with ISO-8528-1 and ISO-3046-1. For limited running time and continuous ratings, consult the factory. Obtain technical information bulletin (TIB-101) for ratings guidelines, complete ratings definitions, and site condition derates. The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever.

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Industrial Diesel Generator Set - KD1250-4

Tier 4 EPA-Certified for Stationary, Prime, Continuous Applications

Alternator	Voltage	Ph	Hz	150°C Rise Standby Rating kW/kVA	150°C Rise Standby Rating Amps	130°C Rise Standby Rating kW/kVA	130°C Rise Standby Rating Amps	125°C Rise Prime Rating kW/kVA	125°C Rise Prime Rating Amps	105°C Rise Prime Rating kW/kVA	105°C Rise Prime Rating Amps	80°C Rise Continuous Rating kW/kVA	80°C Rise Continuous Rating Amps
KH04830TO4D	220/380	3	60	1250/1562	2374	1250/1562	2374	1130/1412	2146	1130/1412	2146	960/1200	1824
	240/416	3	60	1210/1512	2099	1180/1475	2048	1130/1412	1960	1070/1338	1857	920/1150	1597
	277/480	3	60	1250/1562	1879	1250/1562	1879	1130/1412	1699	1130/1412	1699	960/1200	1444
	347/600	3	60	1250/1562	1504	1250/1562	1504	1130/1412	1359	1130/1412	1359	960/1200	1155
KH05520TO4D	220/380	3	60	1250/1562	2374	1250/1562	2374	1130/1412	2146	1130/1412	2146	960/1200	1824
	240/416	3	60	1250/1562	2168	1250/1562	2168	1130/1412	1960	1130/1412	1960	960/1200	1666
	277/480	3	60	1250/1562	1879	1250/1562	1879	1130/1412	1699	1130/1412	1699	970/1212	1458
	347/600	3	60	1250/1562	1504	1250/1562	1504	1130/1412	1359	1130/1412	1359	960/1200	1155
KH06810TO4D	220/380	3	60	1250/1562	2374	1250/1562	2374	1130/1412	2146	1130/1412	2146	970/1212	1842
	240/416	3	60	1250/1562	2168	1250/1562	2168	1130/1412	1960	1130/1412	1960	970/1212	1683
	277/480	3	60	1250/1562	1879	1250/1562	1879	1130/1412	1699	1130/1412	1699	970/1212	1458
	347/600	3	60	1250/1562	1504	1250/1562	1504	1130/1412	1359	1130/1412	1359	970/1212	1167
KH05641TO4D	2400/4160	3	60	1250/1562	217	1250/1562	217	1130/1412	196	1130/1412	196	950/1188	165
KH06721TO4D	2400/4160	3	60	1250/1562	217	1250/1562	217	1130/1412	196	1130/1412	196	950/1188	165

Engine Specifications	60 Hz
Manufacturer	Kohler
Engine: model	KD36V16
Engine: type	4-Cycle, Turbocharged, Intercooled
Cylinder arrangement	16-V
Displacement, L (cu. in.)	36 (2197)
Bore and stroke, mm (in.)	135 x 157 (5.31 x 6.18)
Compression ratio	15.0:1
Piston speed, m/min. (ft./min.)	565 (1854)
Main bearings: quantity, type	11, Precision Half Shells
Rated rpm	1800
Max. power at rated rpm, kWm (BHP)	1391 (1865)
Cylinder head material	Cast Iron
Crankshaft material	Steel
Valve (exhaust) material	Steel
Governor: type, make/model	KODEC Electronic Control
Frequency regulation, no-load to-full load	Isochronous
Frequency regulation, steady state	±0.25%
Frequency	Fixed
Air cleaner type, all models	Dry

Lubricating System	60 Hz
Type	Full Pressure
Oil pan capacity with filter (dipstick max. mark), L (qt.) §	135 (143)
Oil pan capacity with filter (initial fill), L (qt.) §	152 (161)
Oil filter: quantity, type §	4, Cartridge
Oil cooler	Water-Cooled

§ Kohler recommends the use of Kohler Genuine oil and filters.

Exhaust System	60 Hz
Exhaust flow at rated kW, m³/min. (cfm)	250 (8840)
Exhaust temperature at rated kW at 25°C (77°F) ambient, dry exhaust, °C (°F)	520 (968)
Maximum allowable back pressure, kPa (in. Hg)	See TIB-119
Exh. outlet size at eng. hookup, mm (in.)	See ADV drawing

Fuel System	60 Hz
Fuel supply line, min. ID, mm (in.)	19 (0.75)
Fuel return line, min. ID, mm (in.)	12 (0.5)
Max. fuel flow, Lph (gph)	327 (86)
Min./max. fuel pressure at engine supply connection, kPa (in. Hg)	-50/50 (-14.8/14.8)
Maximum diesel fuel lift, m (ft.)	3.7 (12)
Max. return line restriction, kPa (in. Hg)	20 (5.9)
Fuel filter: quantity, type	1, Primary Engine Filter 1, Fuel/Water Separator
Recommended fuel	#2 Diesel ULSD

% load	Diesel Fuel Consumption: Standby Rating Lph (gph)	DEF Consumption: Standby Rating Lph (gph)
100%	334 (88.2)	31.5 (8.3)
75%	247 (65.2)	22.0 (5.8)
50%	167 (44.1)	13.7 (3.6)
25%	94 (24.9)	5.6 (1.5)
10%	50 (13.2)	

% load	Prime Rating Lph (gph)	Prime Rating Lph (gph)
100%	301 (79.4)	27.5 (7.3)
75%	224 (59.3)	19.5 (5.1)
50%	153 (40.3)	12.5 (3.3)
25%	88 (23.2)	4.7 (1.3)

% load	Continuous Rating Lph (gph)	Continuous Rating Lph (gph)
100%	249 (65.9)	21.7 (5.7)
75%	188 (49.6)	15.1 (4.0)
50%	131 (34.6)	9.4 (2.5)
25%	78 (20.6)	3.6 (1.0)

Radiator System	60 Hz
Ambient temperature, °C (°F)*	50 (122)
Engine jacket water capacity, L (gal.)	124 (33)
Radiator system capacity, including engine, L (gal.)	283 (74.7)
Engine jacket water flow, Lpm (gpm)	2241 (592)
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	ESP & PRP 520 (29572) COP 305 (17345)
Heat rejected to charge air cooler at rated kW, dry exhaust, kW (Btu/min.)	ESP & PRP 332 (18880) COP 258 (14559)
Charge cooling air inlet temperature at 25°C (77°F) ambient, °C (°F)	215 (419)
Turbocharger boost (abs), bar (psi)	3.62 (53)
Water pump type	Centrifugal
Fan diameter, including blades, mm (in.)	1750 (68.9)
Fan, kWm (HP)	33 (44.2)
Max. restriction of cooling air, intake and discharge side of radiator, kPa (in. H_2O)	0.125 (0.5)

* Enclosure with enclosed silencer reduces ambient temperature capability by 5°C (9°F).

Remote Radiator System†	60 Hz
Exhaust manifold type	Dry
Connection sizes:	
Water inlet/outlet, mm (in.)	—
Charge air cooler inlet/outlet (pipe dia. of flange), mm (in.)	—
Static head allowable above engine, kPa (ft. H_2O)	70 (23.5)

† Contact your local distributor for cooling system options and specifications based on your specific requirements.

Electrical System	60 Hz
Battery charging alternator:	
Ground (negative/positive)	Negative
Volts (DC)	24
Ampere rating	140
Starter motor qty. at starter motor power rating, rated voltage (DC)	Standard: 2 @ 8.4 kW, 24; Redundant (optional): 4 @ 8.4 kW, 24
Battery, recommended cold cranking amps (CCA):	
Quantity, CCA rating each, type (with standard starters)	4, 1110, AGM
Quantity, CCA rating each, type (with optional redundant starters)	8, 1110, AGM
Battery voltage (DC)	12

Air Requirements	60 Hz
Radiator-cooled cooling air, m^3/min. (scfm)‡	1470 (51913)
Cooling air required for generator set when equipped with city water cooling or remote radiator, based on 14°C (25°F) rise, m^3/min. (scfm)‡	938 (33131)
Combustion air, m^3/min. (cfm)	ESP & PRP 90.2 (3185) COP 81.8 (2890)
Heat rejected to ambient air:	
Engine, kW (Btu/min.)	171 (9733)
Alternator, kW (Btu/min.)	93 (5325)

‡ Air density = 1.20 kg/m^3 (0.075 lbm/ft^3)

Alternator Specifications		60 Hz
Type		4-Pole, Rotating-Field
Exciter type		Brushless, Permanent-Magnet Pilot Exciter
Voltage regulator		Solid-State, Volts/Hz
Insulation:		NEMA MG1, UL 1446, Vacuum Pressure Impregnated (VPI)
Material		Class H, Synthetic, Nonhygroscopic
Temperature rise		130°C, 150°C Standby
Bearing: quantity, type		1, Sealed
Coupling		Flexible Disc
Amortisseur windings		Full
Alternator winding type (up to 600 V)		Random Wound
Alternator winding type (above 600 V)		Form Wound
Rotor balancing		125%
Voltage regulation, no-load to full-load		±0.25%
Unbalanced load capability		100% of Rated Standby Current
Peak motor starting kVA:		(35% dip for voltages below)
480 V	KH03850TO4D	5351
480 V	KH04590TO4D	6030
480 V	KH04830TO4D	4193
480 V	KH05520TO4D	4612
480 V	KH06810TO4D	8466

Alternator Standard Features

- The pilot-excited, permanent magnet (PM) alternator provides superior short-circuit capability.
- All models are brushless, rotating-field alternators.
- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds.
- Sustained short-circuit current enabling downstream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and dripproof construction.
- Superior voltage waveform from two-thirds pitch windings and skewed stator.
- Brushless alternator with brushless pilot exciter for excellent load response.

NOTE: See TIB- 102 Alternator Data Sheets for alternator application data and ratings, efficiency curves, voltage dip with motor starting curves, and short circuit decrement curves.

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KD1250-4

60 Hz. Diesel Generator Set
Tier 4 EPA Certified for Stationary and Mobile Applications

ENGINE INFORMATION

Model:	KD36V16	Bore:	135 mm (5.31 in.)
Type:	4-Cycle, 16-V Cylinder	Stroke:	157 mm (6.18 in.)
Aspiration:	Turbocharged, Intercooled	Displacement:	36 L (2197 cu. in.)
Compression ratio:	15:0:1		
Emission Control Device:	Direct Diesel Injection, Engine Control Module, Turbocharger, Charge Air Cooler, Ammonia Slip Catalyst, Selective Catalytic Reduction		

NOMINAL EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP
Power [kW]	1391	1043	696	348
Speed [rpm]	1800	1800	1800	1800
Exhaust Gas Flow [kg/h]	6687	6061	4763	3446
Exhaust Gas Temperature [C]	517	416	359	307
NO_X [g/kWh]	0.10	0.06	0.14	0.15
CO [g/kWh]	0.07	0.05	0.05	0.08
HC [g/kWh]	0.01	0.01	0.01	0.02
PM [g/kWh]	0.01	0.01	0.01	0.02

NOT TO EXCEED EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP
NO_X [g/kWh]	0.12	0.07	0.16	0.18
CO [g/kWh]	0.11	0.08	0.08	0.11
HC [g/kWh]	0.01	0.02	0.02	0.03
PM [g/kWh]	0.02	0.02	0.02	0.03

10% ESP

Frequency	Rating ESP/PRP/COP	RMC-D2 mode	Rated Power	Rated Speed	Exhaust Mass Flow	Exhaust back pressure at SCR inlet	Exhaust temperature at SCR inlet	NOx Tailpipe	CO Tailpipe	HC Tailpipe	PM Tailpipe
Hz	-	-	kW	rpm	kg/h	mbar	°C	g/kWh	g/kWh	g/kWh	g/kWh
60	ESP	10%	1391	1800	2842	28	257	0.36	0.44	0.08	0.040

TEST METHODS AND CONDITIONS

Test Methods:
Steady-State emissions recorded per EPA CFR 40 Part 89, and ISO8178-1 during operation at rated engine speed (+/-2%) and stated constant load (+/-2%) with engine temperatures, pressures and emission rates stabilized using Ramped Mode Cycle.

Fuel Specification:
40-48 Cetane Number, ≤15ppm Sulfur; Reference ISO8178-5, 40CFR86.1313-98 Type 2-D and ASTM D975 No. 2-D.

Diesel Exhaust Fluid Specification:
32.5% urea in de-ionized water meeting ISO-22241

Reference Conditions:
25 °C (77 °F) Air Inlet Temperature, 40 °C (104 °F) Fuel Inlet Temperature, 100 kPa (29.53 in Hg) Barometric Pressure; 10.7 g/kg (75 grains H2O/lb.) of dry air Humidity (required for NOx correction); Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back pressure set to maximum allowable limit.

Data was taken from a single engine test according to the test methods, fuel specification and reference conditions stated above and is subjected to instrumentation and engine-to-engine variability. Tests conducted with alternate test methods, instrumentation, fuel or reference conditions can yield different results.

NOMINAL EMISSION DATA

Cycle point	100% PRP	75% PRP	50% PRP	25% PRP
Power [kW]	1265	949	633	316
Speed [rpm]	1800	1800	1800	1800
Exhaust Gas Flow [kg/h]	6482	5736	4503	3358
Exhaust Gas Temperature [C]	480	399	349	295
NO_X [g/kWh]	0.08	0.10	0.12	0.14
CO [g/kWh]	0.07	0.05	0.05	0.10
HC [g/kWh]	0.00	0.01	0.01	0.02
PM [g/kWh]	0.01	0.01	0.01	0.02

NOT TO EXCEED EMISSION DATA

Cycle point	100% PRP	75% PRP	50% PRP	25% PRP
NO_X [g/kWh]	0.10	0.12	0.15	0.17
CO [g/kWh]	0.10	0.08	0.08	0.14
HC [g/kWh]	0.01	0.02	0.02	0.03
PM [g/kWh]	0.02	0.02	0.02	0.03

NOMINAL EMISSION DATA

Cycle point	100% COP	75% COP	50% COP	25% COP
Power [kW]	1054	791	527	264
Speed [rpm]	1800	1800	1800	1800
Exhaust Gas Flow [kg/h]	6025	5116	4088	3145
Exhaust Gas Temperature [C]	421	379	340	293
NO_X [g/kWh]	0.19	0.29	0.17	0.45
CO [g/kWh]	0.06	0.06	0.08	0.15
HC [g/kWh]	0.01	0.02	0.02	0.03
PM [g/kWh]	0.01	0.01	0.01	0.02

NOT TO EXCEED EMISSION DATA

Cycle point	100% COP	75% COP	50% COP	25% COP
NO_X [g/kWh]	0.23	0.35	0.21	0.55
CO [g/kWh]	0.10	0.09	0.12	0.22
HC [g/kWh]	0.02	0.03	0.03	0.04
PM [g/kWh]	0.02	0.02	0.02	0.03

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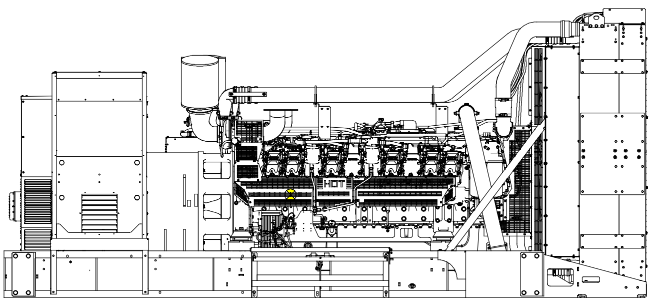
Industrial Diesel Generator Set - KD1500

Tier 2 EPA-Certified for Stationary Emergency Applications



KDxxxx designates a generator set with a Tier 2 EPA-Certified engine.
KDxxxx-F designates a 60 Hz generator set with a fuel optimized engine.

Ratings Range

		60 Hz
Standby:	**kW**	1300-1500
	kVA	1625-1875
Prime:	**kW**	1150-1350
	kVA	1438-1688

Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The 60 Hz generator set offers a UL 2200 listing.
- The generator set accepts rated load in one step.
- The 60 Hz generator set meets NFPA 110, Level 1, when equipped with the necessary accessories and installed per NFPA standards.
- A standard three-year unlimited-hour limited warranty for standby applications in the U.S. And Canada. Five-year basic, five-year comprehensive, and ten-year extended limited warranties are also available.
- A standard two-year or 8700-hour limited warranty for prime power applications.
- Other features:
  - Kohler designed controllers for one-source system integration and remote communication. See Controllers on page 4.
  - The low coolant level shutdown prevents overheating (standard on radiator models only).

General Specifications

Orderable Generator Model Number	GMKD1500
Manufacturer	Kohler
Engine: model	KD45V20
Alternator Choices	KH03850TO4D KH04590TO4D KH04920TO4D KH05641TO4D KH05740TO4D KH06721TO4D KH06810TO4D
Performance Class	Per ISO 8528-5
One Step Load Acceptance	100%
Voltage	Wye, 600 V., or 4160 V
Controller	APM603, APM802
Fuel Tank Capacity, L (gal.)	5863-21985 (1549-5808)
Fuel Consumption, L/hr (gal./hr) 100% at Standby	401 (105.9)
Fuel Consumption, L/hr (gal./hr) 100% at Prime Power	371 (98.0)
Emission Level Compliance (KDxxxx)	Tier 2
Open Unit Noise Level @ 7 m dB(A) at Rated Load	97
Data Center Continuous (DCC) Rating (Refer to TIB-101 for definitions)	Same as the Standby Rating below

Generator Set Ratings

				150°C Rise Standby Rating		130°C Rise Standby Rating		125°C Rise Prime Rating		105°C Rise Prime Rating	
Alternator	**Voltage**	**Ph**	**Hz**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**
KH03850TO4D	240/416	3	60	1320/1650	2290	1300/1625	2255	1280/1600	2221	1150/1438	1996
	277/480	3	60	1500/1875	2256	1500/1875	2256	1350/1688	2031	1300/1625	1955
KH04590TO4D	240/416	3	60	1430/1788	2482	1410/1762	2446	1350/1688	2343	1260/1575	2186
	277/480	3	60	1500/1875	2256	1500/1875	2256	1350/1688	2031	1350/1688	2031
KH04920TO4D	230/400	3	60	1500/1875	2707	1500/1875	2707	1350/1688	2437	1350/1688	2437
	240/416	3	60	1500/1875	2603	1500/1875	2603	1350/1688	2343	1350/1688	2343
	277/480	3	60	1500/1875	2256	1500/1875	2256	1350/1688	2031	1350/1688	2031
KH05740TO4D	220/380	3	60	1500/1875	2849	1500/1875	2849	1350/1688	2565	1350/1688	2565
	230/400	3	60	1500/1875	2707	1500/1875	2707	1350/1688	2437	1350/1688	2437
	240/416	3	60	1500/1875	2603	1500/1875	2603	1350/1688	2343	1350/1688	2343
	277/480	3	60	1500/1875	2256	1500/1875	2256	1350/1688	2031	1350/1688	2031
	347/600	3	60	1500/1875	1805	1500/1875	1805	1350/1688	1625	1350/1688	1625

RATINGS: All three-phase units are rated at 0.8 power factor. *Standby Ratings:* The standby rating is applicable to varying loads for the duration of a power outage. There is no overload capability for this rating. *Prime Power Ratings:* At varying load, the number of generator set operating hours is unlimited. A 10% overload capacity is available for one hour in twelve. Ratings are in accordance with ISO-8528-1 and ISO-3046-1. For limited running time and continuous ratings, consult the factory. Obtain technical information bulletin (TIB-101) for ratings guidelines, complete ratings definitions, and site condition derates. The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever.

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Industrial Diesel Generator Set - KD1500
Tier 2 EPA-Certified for Stationary Emergency Applications

Alternator	Voltage	Ph	Hz	150°C Rise Standby Rating kW/kVA	Amps	130°C Rise Standby Rating kW/kVA	Amps	125°C Rise Prime Rating kW/kVA	Amps	105°C Rise Prime Rating kW/kVA	Amps
KH06810TO4D	220/380	3	60	1500/1875	2849	1500/1875	2849	1350/1688	2565	1350/1662	2565
	230/400	3	60	1500/1875	2707	1500/1875	2707	1350/1688	2437	1350/1688	2437
	240/416	3	60	1500/1875	2603	1500/1875	2603	1350/1688	2343	1350/1688	2343
	277/480	3	60	1500/1875	2256	1500/1875	2256	1350/1688	2031	1350/1688	2031
	347/600	3	60	1500/1875	1805	1500/1875	1805	1350/1688	1625	1350/1662	1625
KH05641TO4D	2400/4160	3	60	1500/1875	261	1500/1875	261	1340/1675	233	1340/1675	233
KH06721TO4D	2400/4160	3	60	1500/1875	261	1500/1875	261	1340/1675	233	1340/1675	233

Engine Specifications	60 Hz
Manufacturer	Kohler
Engine: model	KD45V20
Engine: type	4-Cycle, Turbocharged, Intercooled
Cylinder arrangement	20-V
Displacement, L (cu. in.)	45 (2746)
Bore and stroke, mm (in.)	135 x 157 (5.31 x 6.18)
Compression ratio	15.0:1
Piston speed, m/min. (ft./min.)	565 (1854)
Main bearings: quantity, type	11, Precision Half Shells
Rated rpm	1800
Max. power at rated rpm, kWm (BHP)	1654 (2218)
Cylinder head material	Cast Iron
Crankshaft material	Steel
Valve (exhaust) material	Steel
Governor: type, make/model	KODEC Electronic Control
Frequency regulation, no-load to-full load	Isochronous
Frequency regulation, steady state	±0.25%
Frequency	Fixed
Air cleaner type, all models	Dry

Lubricating System	60 Hz
Type	Full Pressure
Oil pan capacity with filter (dipstick max. mark), L (qt.) §	165 (174)
Oil pan capacity with filter (initial fill), L (qt.) §	180 (190)
Oil filter: quantity, type §	4, Cartridge
Oil cooler	Water-Cooled

§ Kohler recommends the use of Kohler Genuine oil and filters.

Fuel System	60 Hz
Fuel supply line, min. ID, mm (in.)	19 (0.75)
Fuel return line, min. ID, mm (in.)	12 (0.5)
Max. fuel flow, Lph (gph)	555 (147)
Min./max. fuel pressure at engine supply connection, kPa (in. Hg)	- 30/30 (- 8.8/8.8)
Max. return line restriction, kPa (in. Hg)	20 (5.9)
Fuel filter: quantity, type	1, Primary Engine Filter 1, Fuel/Water Separator
Recommended fuel	#2 Diesel ULSD

Fuel Consumption	60 Hz
Diesel, Lph (gph) at % load	**Standby Rating**
100%	401 (105.9)
75%	316 (83.5)
50%	222 (58.6)
25%	124 (32.8)
10%	57 (15.1)

Diesel, Lph (gph) at % load	Prime Rating
100%	371 (98.0)
75%	287 (75.8)
50%	203 (53.6)
25%	119 (31.4)

Radiator System	60 Hz
Ambient temperature, °C (°F)*	50 (122)
Engine jacket water capacity, L (gal.)	143 (37)
Radiator system capacity, including engine, L (gal.)	278 (73.4)
Engine jacket water flow, Lpm (gpm)	2339 (618)
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	623 (35429)
Heat rejected to charge air cooler at rated kW, dry exhaust, kW (Btu/min.)	454 (25818)
Charge cooling air inlet temperature at 25°C (77°F) ambient, °C (°F)	229 (444)
Turbocharger boost (abs), bar (psi)	3.45 (50.0)
Water pump type	Centrifugal
Fan diameter, including blades, mm (in.)	1750 (68.9)
Fan, kWm (HP)	70 (93.9)
Max. restriction of cooling air, intake and discharge side of radiator, kPa (in. H_2O)	0.125 (0.5)

* Enclosure with enclosed silencer reduces ambient temperature capability by 5°C (9°F).

Remote Radiator System†	60 Hz
Exhaust manifold type	Dry
Connection sizes:	
Water inlet/outlet, mm (in.)	—
Charge air cooler inlet/outlet (pipe dia. of flange), mm (in.)	—
Static head allowable above engine, kPa (ft. H_2O)	70 (23.5)

† Contact your local distributor for cooling system options and specifications based on your specific requirements.

Exhaust System	60 Hz
Exhaust flow at rated kW, m^3/min. (cfm)	331 (11689)
Exhaust temperature at rated kW at 25°C (77°F) ambient, dry exhaust, °C (°F)	502 (935)
Maximum allowable back pressure, kPa (in. Hg)	8.5 (2.5)
Exh. outlet size at eng. hookup, mm (in.)	See ADV drawing

Electrical System	60 Hz
Battery charging alternator:	
Ground (negative/positive)	Negative
Volts (DC)	24
Ampere rating	140
Starter motor qty. at starter motor power rating, rated voltage (DC)	Standard: 2 @ 8.4 kW, 24; Redundant (optional): 4 @ 8.4 kW, 24
Battery, recommended cold cranking amps (CCA):	
Quantity, CCA rating each, type (with standard starters)	4, 1110, AGM
Quantity, CCA rating each, type (with optional redundant starters)	8, 1110, AGM
Battery voltage (DC)	12

Air Requirements	60 Hz
Radiator-cooled cooling air, m^3/min. (scfm)‡	1980 (69923)
Cooling air required for generator set when equipped with city water cooling or remote radiator, based on 14°C (25°F) rise, m^3/min. (scfm)‡	1076 (37993)
Combustion air, m^3/min. (cfm)	119 (4202)
Heat rejected to ambient air:	
Engine, kW (Btu/min.)	204 (11772)
Alternator, kW (Btu/min.)	93 (5325)

‡ Air density = 1.20 kg/m^3 (0.075 lbm/ft^3)

Alternator Specifications		60 Hz
Type		4-Pole, Rotating-Field
Exciter type		Brushless, Permanent-Magnet Pilot Exciter
Voltage regulator		Solid-State, Volts/Hz
Insulation:		NEMA MG1, UL 1446, Vacuum Pressure Impregnated (VPI)
Material		Class H, Synthetic, Nonhygroscopic
Temperature rise		130°C, 150°C Standby
Bearing: quantity, type		1, Sealed
Coupling type		Flexible Disc
Amortisseur windings		Full
Alternator winding type (up to 600 V)		Random Wound
Alternator winding type (above 600 V)		Form Wound
Rotor balancing		125%
Voltage regulation, no-load to full-load		±0.25%
Unbalanced load capability		100% of Rated Standby Current
Peak motor starting kVA:		(35% dip for voltages below)
480 V	KH03850TO4D	5351
480 V	KH04590TO4D	6030
480 V	KH04920TO4D	6509
480 V	KH05740TO4D	6749
480 V	KH06810TO4D	8466

Alternator Standard Features

- The pilot-excited, permanent magnet (PM) alternator provides superior short-circuit capability.
- All models are brushless, rotating-field alternators.
- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds.
- Sustained short-circuit current enabling downstream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and dripproof construction.
- Superior voltage waveform from two-thirds pitch windings and skewed stator.
- Brushless alternator with brushless pilot exciter for excellent load response.

NOTE: See TIB- 102 Alternator Data Sheets for alternator application data and ratings, efficiency curves, voltage dip with motor starting curves, and short circuit decrement curves.

KOHLER®

KD1500

60 Hz. Diesel Generator Set
Tier 2 EPA Certified for Stationary Emergency Applications
EMISSION OPTIMIZED DATA SHEET

ENGINE INFORMATION

Model:	KD45V20	Bore:	135 mm (5.31 in.)
Type:	4-Cycle, 20-V Cylinder	Stroke:	157 mm (6.18 in.)
Aspiration:	Turbocharged, Intercooled	Displacement:	45 L (2197 cu. in.)
Compression ratio:	15:0:1		
Emission Control Device:	Direct Diesel Injection, Engine Control Module, Turbocharger, Charge Air Cooler		

NOMINAL EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP
Power [kW]	1654	1241	827	414
Speed [rpm]	1800	1800	1800	1800
Exhaust Gas Flow [kg/h]	8639	7564	6521	4539
Exhaust Gas Temperature [C]	478	477	397	360
NO_X [g/kWh]	11.1	6.2	4.6	4.2
CO [g/kWh]	0.1	0.3	0.4	1.2
HC [g/kWh]	0.02	0.03	0.06	0.11
PM [g/kWh]	0.01	0.04	0.09	0.19

NOT TO EXCEED EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP
NO_X [g/kWh]	12.0	6.7	5.0	4.5
CO [g/kWh]	0.6	1.6	2.3	6.1
HC [g/kWh]	0.03	0.04	0.07	0.12
PM [g/kWh]	0.03	0.08	0.20	0.44

	Frequency	Rating ESP/PRP/COP	NRSC-D2 mode	Rated Power	Rated Speed	Exhaust temperature after turbine	Exhaust mass flow	NOx	CO	HC	PM
10% ESP	Hz	-	-	kW	rpm	°C	kg/h	g/kWh	g/kWh	g/kWh	g/kWh
	60	ESP	10%	1654	1800	266	3243	6.4	11.70	0.36	1.43

TEST METHODS AND CONDITIONS

Test Methods:
Steady-State emissions recorded per EPA CFR 40 Part 89, and ISO8178-1 during operation at rated engine speed (+/-2%) and stated constant load (+/-2%) with engine temperatures, pressures and emission rated stabilized.

Fuel Specification:
40-48 Cetane Number, 0.05 Wt. % max. Sulfur; Reference ISO8178-5, 40CFR86.1313-98 Type 2-D and ASTM D975 No. 2-D.

Reference Conditions:
25 °C (77 °F) Air Inlet Temperature, 40 °C (104 °F) Fuel Inlet Temperature, 100 kPa (29.53 in Hg) Barometric Pressure; 10.7 g/kg (75 grains H2O/lb.) of dry air Humidity (required for NOx correction); Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back pressure set to maximum allowable limit.

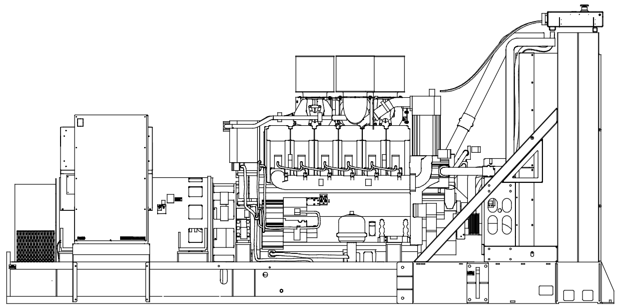
Data was taken from a single engine test according to the test methods, fuel specification and reference conditions stated above and is subjected to instrumentation and engine-to-engine variability. Tests conducted with alternate test methods, instrumentation, fuel or reference conditions can yield different results.

Data and specifications subject to change without notice.

KOHLER

Industrial Diesel Generator Set - KD2250

Tier 2 EPA-Certified for Stationary Emergency Applications



KDxxxx designates a generator set with a Tier 2 EPA-Certified engine.
KDxxxx-F designates a 60 Hz generator set with a fuel optimized engine.

Ratings Range

		60 Hz
Standby:	**kW**	2210-2250
	kVA	2762-2812
Prime:	**kW**	1980-2040
	kVA	2475-2550

Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The 60 Hz generator set offers a UL 2200 listing.
- The generator set accepts rated load in one step.
- The 60 Hz generator set meets NFPA 110, Level 1, when equipped with the necessary accessories and installed per NFPA standards.
- A standard three-year or 1000-hour limited warranty for standby applications. Five-year basic, five-year comprehensive, and ten-year extended limited warranties are also available.
- A standard two-year or 8700-hour limited warranty for prime power applications.
- Other features:
  - Kohler designed controllers for one-source system integration and remote communication. See Controllers on page 4.
  - The low coolant level shutdown prevents overheating (standard on radiator models only).

General Specifications

Orderable Generator Model Number	GMKD2250
Manufacturer	Kohler
Engine: model	KD62V12
Alternator Choices	KH05790TO4D KH06220TO4D KH06930TO4D KH07000TO4D KH07630TO4D KH07770TO4D KH08100TO4D KH08430TO4D KH09270TO4D
Performance Class	Per ISO 8528-5
One Step Load Acceptance	100%
Voltage	Wye, 600 V., 4160 V, or 6600-13800 V
Controller	APM603, APM802
Fuel Tank Capacity, L (gal.)	8577-16383 (2266-4328)
Fuel Consumption, L/hr (gal./hr) 100% at Standby	632 (167.1)
Fuel Consumption, L/hr (gal./hr) 100% at Prime Power	592 (156.5)
Emission Level Compliance (KDxxxx)	Tier 2
Open Unit Noise Level @ 7 m dB(A) at Rated Load	—
Data Center Continuous (DCC) Rating (Refer to TIB-101 for definitions)	Same as the Standby Rating below

Generator Set Ratings

				150°C Rise Standby Rating		130°C Rise Standby Rating		125°C Rise Prime Rating		105°C Rise Prime Rating	
Alternator	**Voltage**	**Ph**	**Hz**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**
KH05790TO4D	277/480	3	60	2250/2812	3383	2250/2812	3383	2040/2550	3068	2040/2550	3068
KH06930TO4D	277/480	3	60	2250/2812	3383	2250/2812	3383	2040/2550	3068	2040/2550	3068
KH07770TO4D	220/380	3	60	2250/2812	4273	2210/2762	4197	2040/2550	3875	1980/2475	3761
	240/416	3	60	2250/2812	3903	2250/2812	3903	2040/2550	3540	2040/2550	3540
	347/600	3	60	2250/2812	2706	2250/2812	2706	2040/2550	2454	2040/2550	2454
KH08430TO4D	220/380	3	60	2250/2812	4273	2250/2812	4273	2040/2550	3874	2040/2550	3874
	240/416	3	60	2250/2812	3903	2250/2812	3903	2040/2550	3540	2040/2550	3540
	277/480	3	60	2250/2812	3383	2250/2812	3383	2040/2550	3068	2040/2550	3068
	347/600	3	60	2250/2812	2706	2250/2812	2706	2040/2550	2454	2040/2550	2454
	2400/4160	3	60	2250/2812	391	2250/2812	391	2040/2550	354	2040/2550	354
KH07000TO4D	347/600	3	60	2250/2812	2706	2250/2812	2706	2040/2550	2454	2040/2550	2454
	2400/4160	3	60	2250/2812	391	2250/2812	391	2040/2550	354	2040/2550	354
KH06220TO4D	2400/4160	3	60	2250/2812	391	2250/2812	391	2040/2550	354	2000/2500	347

RATINGS: All three-phase units are rated at 0.8 power factor. *Standby Ratings:* The standby rating is applicable to varying loads for the duration of a power outage. There is no overload capability for this rating. *Prime Power Ratings:* At varying load, the number of generator set operating hours is unlimited. A 10% overload capacity is available for one hour in twelve. Ratings are in accordance with ISO-8528-1 and ISO-3046-1. For limited running time and continuous ratings, consult the factory. Obtain technical information bulletin (TIB-101) for ratings guidelines, complete ratings definitions, and site condition derates. The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever.

Alternator	Voltage	Ph	Hz	130°C Rise Standby Rating kW/kVA	Amps	105°C Rise Prime Rating kW/kVA	Amps
KH07630TO4D	3810/6600	3	60	2250/2812	246	2040/2550	224
	7200/12470	3	60	2250/2812	131	2040/2550	119
	7620/13200	3	60	2250/2812	123	2040/2550	112
	7970/13800	3	60	2250/2812	118	2040/2550	107
KH08100TO4D	3810/6600	3	60	2250/2812	246	2040/2550	224
	7200/12470	3	60	2250/2812	131	2040/2550	119
	7620/13200	3	60	2250/2812	123	2040/2550	112
	7970/13800	3	60	2250/2812	118	2040/2550	107
KH09270TO4D	3810/6600	3	60	2250/2812	246	2040/2550	224
	7200/12470	3	60	2250/2812	131	2040/2550	119
	7620/13200	3	60	2250/2812	123	2040/2550	112
	7970/13800	3	60	2250/2812	118	2040/2550	107

Engine Specifications	60 Hz
Manufacturer	Kohler
Engine: model	KD62V12
Engine: type	4-Cycle, Turbocharged, Intercooled
Cylinder arrangement	12-V
Displacement, L (cu. in.)	62 (3783)
Bore and stroke, mm (in.)	175 x 215 (6.89 x 8.46)
Compression ratio	16.0:1
Piston speed, m/min. (ft./min.)	774 (2539)
Main bearings: quantity, type	7, Precision Half Shells
Rated rpm	1800
Max. power at rated rpm, kWm (BHP)	2500 (3352)
Cylinder head material	Cast Iron
Crankshaft material	Steel
Valve (exhaust) material	Steel
Governor: type, make/model	KODEC Electronic Control
Frequency regulation, no-load to-full load	Isochronous
Frequency regulation, steady state	±0.25%
Frequency	Fixed
Air cleaner type, all models	Dry

Lubricating System	60 Hz
Type	Full Pressure
Oil pan capacity with filter (initial fill), L (qt.) §	335 (354)
Oil filter: quantity, type §	6, Cartridge
Oil cooler	Water-Cooled

§ Kohler recommends the use of Kohler Genuine oil and filters.

Fuel System	60 Hz
Fuel supply line, min. ID, mm (in.)	25 (1.0)
Fuel return line, min. ID, mm (in.)	19 (0.75)
Max. fuel flow, Lph (gph)	848 (224.0)
Min./max. fuel pressure at engine supply connection, kPa (in. Hg)	-30/30 (-8.8/8.8)
Max. return line restriction, kPa (in. Hg)	30 (8.9)
Fuel filter: quantity, type	2, Primary Engine Filter 2, Fuel/Water Separator
Recommended fuel	#2 Diesel ULSD

Fuel Consumption	60 Hz
Diesel, Lph (gph) at % load	**Standby Rating**
100%	632 (167.1)
75%	518 (136.9)
50%	360 (95.2)
25%	210 (55.4)
10%	113 (29.9)

Diesel, Lph (gph) at % load	Prime Rating
100%	592 (156.5)
75%	463 (122.2)
50%	333 (87.9)
25%	203 (53.7)

Radiator System	60 Hz	
Ambient temperature, °C (°F)*	50 (122)	40 (104)
Engine jacket water capacity, L (gal.)	356 (94)	
Radiator system capacity, including engine, L (gal.)	643 (170)	539 (142)
Engine jacket water flow, Lpm (gpm)	2082 (550)	
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	820 (46632)	
Charge cooler water flow, Lpm (gpm)	662 (174)	
Heat rejected to charge cooling water at rated kW, dry exhaust, kW (Btu/min.)	730 (41514)	
Water pump type	Centrifugal	
Fan diameter, including blades, mm (in.)	2235 (88)	1901 (75)
Fan, kWm (HP)	90 (120.7)	85 (114)
Max. restriction of cooling air, intake and discharge side of radiator, kPa (in. H_2O)	0.125 (0.5)	

* Enclosure with enclosed silencer reduces ambient temperature capability by 5°C (9°F).

Remote Radiator System†	60 Hz
Exhaust manifold type	Dry
Connection sizes:	Class 150 ANSI Flange
Water inlet/outlet, mm (in.)	216 (8.5) Bolt Circle
Intercooler inlet/outlet, mm (in.)	178 (7.0) Bolt Circle
Static head allowable above engine, kPa (ft. H_2O)	70 (23.5)

† Contact your local distributor for cooling system options and specifications based on your specific requirements.

Exhaust System	60 Hz
Exhaust flow at rated kW, m^3/min. (cfm)	536 (18928)
Exhaust temperature at rated kW at 25°C (77°F) ambient, dry exhaust, °C (°F)	510 (950)
Maximum allowable back pressure, kPa (in. Hg)	8.5 (2.5)
Exh. outlet size at eng. hookup, mm (in.)	See ADV drawing

Electrical System	60 Hz
Battery charging alternator:	
Ground (negative/positive)	Negative
Volts (DC)	24
Ampere rating	140
Starter motor qty. at starter motor power rating, rated voltage (DC)	Standard: 2 @ 9 kW, 24; Redundant (optional); 2 @ 15 kW, 24
Battery, recommended cold cranking amps (CCA):	
Quantity, CCA rating each, type (with standard starters)	4, 1110, AGM
Quantity, CCA rating each, type (with redundant starters)	8, 1110, AGM
Battery voltage (DC)	12

Air Requirements	60 Hz	
	50°C	40°C
Radiator-cooled cooling air, m^3/min. (scfm)‡	2549 (90000)	2321 (82000)
Cooling air required for generator set when equipped with city water cooling or remote radiator, based on 14°C (25°F) rise, m^3/min. (scfm)‡	1002 (35385)	
Combustion air, m^3/min. (cfm)	191 (6745)	
Heat rejected to ambient air:		
Engine, kW (Btu/min.)	120 (6824)	
Alternator, kW (Btu/min.)	160 (9099)	

‡ Air density = 1.20 kg/m^3 (0.075 lbm/ft^3)

Alternator Specifications		60 Hz
Type		4-Pole, Rotating-Field
Exciter type		Brushless, Permanent-Magnet Pilot Exciter
Voltage regulator		Solid-State, Volts/Hz
Insulation:		NEMA MG1, UL 1446, Vacuum Pressure Impregnated (VPI)
Material		Class H, Synthetic, Nonhygroscopic
Temperature rise		130°C, 150°C Standby
Bearing: quantity, type		1 or 2, Sealed
Coupling type		Flexible Disc or Coupling
Amortisseur windings		Full
Alternator winding type (up to 600 V)		Random Wound
Alternator winding type (above 600 V)		Form Wound
Rotor balancing		125%
Voltage regulation, no-load to full-load		±0.25%
Unbalanced load capability		100% of Rated Standby Current
Peak motor starting kVA:		(35% dip for voltages below)
480 V	KH05790TO4D	5225
480 V	KH06930TO4D	5990
480 V	KH08430TO4D	9908

Alternator Standard Features

- The pilot-excited, permanent magnet (PM) alternator provides superior short-circuit capability.
- All models are brushless, rotating-field alternators.
- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds.
- Sustained short-circuit current enabling downstream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and dripproof construction.
- Superior voltage waveform from two-thirds pitch windings and skewed stator.
- Brushless alternator with brushless pilot exciter for excellent load response.

NOTE: See TIB-102 Alternator Data Sheets for alternator application data and ratings, efficiency curves, voltage dip with motor starting curves, and short circuit decrement curves.

KOHLER®

KD2250

60 Hz. Diesel Generator Set
Tier 2 EPA Certified for Stationary Emergency Applications
EMISSION OPTIMIZED DATA SHEET

ENGINE INFORMATION

Model:	KD62V12	Bore:	175 mm (6.89 in.)
Type:	4-Cycle, 12-V Cylinder	Stroke:	215 mm (8.46 in.)
Aspiration:	Turbocharged, Intercooled	Displacement:	62 L (3783 cu. in.)
Compression ratio:	16:0:1		
Emission Control Device:	Direct Diesel Injection, Engine Control Module, Turbocharger, Charge Air Cooler		

NOMINAL EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP
Power [kW]	2500	1875	1250	625
Speed [rpm]	1800	1800	1800	1800
Exhaust Gas Flow [kg/h]	15017	14404	9978	5904
Exhaust Gas Temperature [C]	451	447	450	453
NO_X [g/kWh]	7.6	4.7	4.9	5.1
CO [g/kWh]	0.4	0.8	0.7	2.5
HC [g/kWh]	0.12	0.13	0.19	0.30
PM [g/kWh]	0.05	0.12	0.09	0.32

NOT TO EXCEED EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP
NO_X [g/kWh]	9.0	5.6	5.8	6.1
CO [g/kWh]	1.3	2.6	2.2	8.1
HC [g/kWh]	0.14	0.15	0.22	0.35
PM [g/kWh]	0.07	0.18	0.13	0.47

10% ESP	nom	Rating ESP/PRP/COP	NRSC-D2 mode	Rated Power	Rated Speed	Exhaust temperature after turbine	Exhaust mass flow	NOx	CO	HC	PM (EPA) Measured from Sampler
	Hz	-	-	kW	rpm	°C	kg/h	g/kWh	g/kWh	g/kWh	g/kWh
	60	ESP - Standard	10%	2500	1800	404	4140	9.7	8	0.89	0.28

TEST METHODS AND CONDITIONS

Test Methods:
Steady-State emissions recorded per EPA CFR 40 Part 89, and ISO8178-1 during operation at rated engine speed (+/-2%) and stated constant load (+/-2%) with engine temperatures, pressures and emission rated stabilized.

Fuel Specification:
40-48 Cetane Number, 0.05 Wt. % max. Sulfur; Reference ISO8178-5, 40CFR86.1313-98 Type 2-D and ASTM D975 No. 2-D.

Reference Conditions:
25 °C (77 °F) Air Inlet Temperature, 40 °C (104 °F) Fuel Inlet Temperature, 100 kPa (29.53 in Hg) Barometric Pressure; 10.7 g/kg (75 grains H2O/lb.) of dry air Humidity (required for NOx correction); Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back pressure set to maximum allowable limit.

Data was taken from a single engine test according to the test methods, fuel specification and reference conditions stated above and is subjected to instrumentation and engine-to-engine variability. Tests conducted with alternate test methods, instrumentation, fuel or reference conditions can yield different results.

Data and specifications subject to change without notice.

KOHLER®

KD2250

60 Hz. Diesel Generator Set
Tier 2 EPA Certified for Stationary Emergency Applications
Data Center Emphasis-Low NO_x
EMISSION OPTIMIZED DATA SHEET

ENGINE INFORMATION

Model:	KD62V12	Bore:	175 mm (6.89 in.)
Type:	4-Cycle, 16-V Cylinder	Stroke:	215 mm (8.46 in.)
Aspiration:	Turbocharged, Intercooled	Displacement:	62 L (3783 cu. in.)
Compression ratio:	16:0:1		
Emission Control Device:	Direct Diesel Injection, Engine Control Module, Turbocharger, Charge Air Cooler		

NOMINAL EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP
Power [kW]	2500	1875	1250	625
Speed [rpm]	1800	1800	1800	1800
Exhaust Gas Flow [kg/h]	15123	14494	10205	5831
Exhaust Gas Temperature [C]	441	424	424	455
NO_X [g/kWh]	7.4	4.7	4.9	5.7
CO [g/kWh]	0.2	0.5	0.5	2.0
HC [g/kWh]	0.31	0.40	0.57	1.03
PM [g/kWh]	0.04	0.10	0.09	0.31

NOT TO EXCEED EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP
NO_X [g/kWh]	8.0	5.4	5.6	6.5
CO [g/kWh]	0.3	0.7	0.8	3.0
HC [g/kWh]	0.37	0.48	0.69	1.23
PM [g/kWh]	0.06	0.13	0.12	0.39

10% ESP

nom	Rating ESP/PRP/COP	NRSC-D2 mode	Rated Power	Rated Speed	Exhaust temperature after turbine	Exhaust mass flow	NOx	CO	HC	PM (EPA) Measured from Sampler
Hz	-	-	kW	rpm	°C	kg/h	g/kWh	g/kWh	g/kWh	g/kWh
60	ESP - Low NOx	10%	2500	1800	386	4053	8.90	6.99	3.30	0.42

TEST METHODS AND CONDITIONS

Test Methods:
Steady-State emissions recorded per EPA CFR 40 Part 89, and ISO8178-1 during operation at rated engine speed (+/-2%) and stated constant load (+/-2%) with engine temperatures, pressures and emission rated stabilized.

Fuel Specification:
40-48 Cetane Number, 0.05 Wt. % max. Sulfur; Reference ISO8178-5, 40CFR86.1313-98 Type 2-D and ASTM D975 No. 2-D.

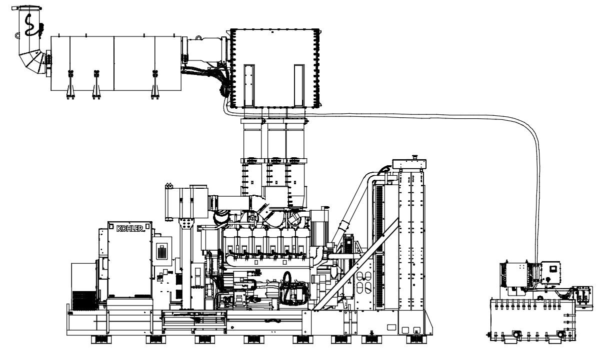
Reference Conditions:
25 °C (77 °F) Air Inlet Temperature, 40 °C (104 °F) Fuel Inlet Temperature, 100 kPa (29.53 in Hg) Barometric Pressure; 10.7 g/kg (75 grains H2O/lb.) of dry air Humidity (required for NOx correction); Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back pressure set to maximum allowable limit.

Data was taken from a single engine test according to the test methods, fuel specification and reference conditions stated above and is subjected to instrumentation and engine-to-engine variability. Tests conducted with alternate test methods, instrumentation, fuel or reference conditions can yield different results.

Data and specifications subject to change without notice.

Industrial Diesel Generator Set - KD2500-4

Tier 4 EPA-Certified for Stationary, Prime, Continuous Applications



KDxxxx-4 designates a 60 Hz generator set with a Tier 4 EPA-Certified engine.

Ratings Range

		60 Hz
Standby:	**kW**	2250-2500
	kVA	2812-3125
Prime:	**kW**	2050-2270
	kVA	2562-2838
Continuous:	**kW**	1720-1900
	kVA	2150-2375

Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The 60 Hz generator set offers a UL 2200 listing.
- The generator set accepts rated load in one step.
- The 60 Hz generator set meets NFPA 110, Level 1, when equipped with the necessary accessories and installed per NFPA standards.
- A standard three-year or 1000-hour limited warranty for standby applications. Five-year basic, five-year comprehensive, and ten-year extended limited warranties are also available.
- A standard two-year or 8700-hour limited warranty for prime power applications. Five-year basic and five-year comprehensive warranties are also available.
- A standard one-year warranty with unlimited hours for continuous power applications.
- Other features:
    - Kohler designed controllers for one-source system integration and remote communication. See Controller on page 4.
    - The low coolant level shutdown prevents overheating (standard on radiator models only).

General Specifications

Orderable Generator Model Number	GMKD2500-4
Manufacturer	Kohler
Engine: model	KD62V12
Alternator Choices	KH06930TO4D KH07000TO4D KH07770TO4D KH08100TO4D KH08430TO4D KH09270TO4D
Performance Class	Per ISO 8528-5
One Step Load Acceptance	100%
Voltage	Wye, 600 V., 4160 V, or 6600-13800 V
Controller	APM603
Fuel Tank Capacity, L (gal.)	16383 (4328)
Fuel Consumption, L/hr (gal./hr) 100% at Standby	661 (174.6)
Fuel Consumption, L/hr (gal./hr) 100% at Prime Power	595 (157.2)
Fuel Consumption, L/hr (gal./hr) 100% at Continuous Power	484 (127.8)
DEF Consumption, L/hr (gal./hr) 100% at Standby	46.2 (12.2)
DEF Consumption, L/hr (gal./hr) 100% at Prime Power	53.5 (14.2)
DEF Consumption, L/hr (gal./hr) 100% at Continuous Power	45.9 (12.1)
Emission Level Compliance (KDxxxx)	Tier 4
Open Unit Noise Level @ 7 m dB(A) at Rated Load	—
Data Center Continuous (DCC) Rating (Refer to TIB-101 for definitions)	Same as the Standby Rating below

Generator Set Ratings

				150°C Rise Standby Rating		130°C Rise Standby Rating		125°C Rise Prime Rating		105°C Rise Prime Rating		80°C Rise Continuous Rating	
Alternator	**Voltage**	**Ph**	**Hz**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**
KH06930TO4D	277/480	3	60	2500/3125	3759	2500/3125	3759	2270/2838	3414	2270/2838	3414	1890/2362	2842
KH07000TO4D	347/600	3	60	2500/3125	3008	2500/3125	3008	2270/2838	2731	2250/2812	2706	1880/2350	2262
	2400/4160	3	60	2500/3125	434	2500/3125	434	2270/2838	394	2250/2812	391	1880/2350	327
KH07770TO4D	277/480	3	60	2500/3125	3759	2500/3125	3759	2270/2838	3414	2270/2838	3414	1880/2350	2827
	347/600	3	60	2500/3125	3008	2500/3125	3008	2270/2838	2731	2270/2838	2731	1880/2350	2262
	2400/4160	3	60	2500/3125	434	2500/3125	434	2270/2838	394	2270/2838	394	1900/2375	330
KH08430TO4D	240/416	3	60	2500/3125	4338	2500/3125	4338	2270/2838	3939	2270/2838	3939	1880/2350	3262
	277/480	3	60	2500/3125	3759	2500/3125	3759	2270/2838	3414	2270/2838	3414	1880/2350	2827
	347/600	3	60	2500/3125	3008	2500/3125	3008	2270/2838	2731	2270/2838	2731	1890/2362	2273
	2400/4160	3	60	2500/3125	434	2500/3125	434	2270/2838	394	2270/2838	394	1880/2350	327

RATINGS: All three-phase units are rated at 0.8 power factor. *Standby Ratings:* The standby rating is applicable to varying loads for the duration of a power outage. There is no overload capability for this rating. *Prime Power Ratings:* At varying load, the number of generator set operating hours is unlimited. A 10% overload capacity is available for one hour in twelve. Ratings are in accordance with ISO-8528-1 and ISO-3046-1. For limited running time and continuous ratings, consult the factory. Obtain technical information bulletin (TIB-101) for ratings guidelines, complete ratings definitions, and site condition derates. The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever.

KOHLER

Industrial Diesel Generator Set - KD2500-4

Tier 4 EPA-Certified for Stationary, Prime, Continuous Applications

Alternator	Voltage	Ph	Hz	130°C Rise Standby Rating kW/kVA	Amps	105°C Rise Prime Rating kW/kVA	Amps	80°C Rise Continuous Rating kW/kVA	Amps
KH08100TO4D	3810/6600	3	60	2500/3125	274	2270/2838	249	1880/2350	206
	7200/12470	3	60	2250/2812	131	2050/2562	119	1720/2150	100
	7620/13200	3	60	2380/2975	131	2180/2725	120	1820/2275	100
	7970/13800	3	60	2500/3125	131	2270/2838	119	1880/2350	99
KH09270TO4D	3810/6600	3	60	2500/3125	274	2270/2838	249	1890/2362	207
	7200/12470	3	60	2500/3125	145	2270/2838	132	1880/2350	109
	7620/13200	3	60	2500/3125	137	2270/2838	125	1880/2350	103
	7970/13800	3	60	2500/3125	131	2270/2838	119	1880/2350	99

Engine Specifications	60 Hz
Manufacturer	Kohler
Engine: model	KD62V12
Engine: type	4-Cycle, Turbocharged, Intercooled
Cylinder arrangement	12-V
Displacement, L (cu. in.)	62 (3783)
Bore and stroke, mm (in.)	175 x 215 (6.89 x 8.46)
Compression ratio	16.0:1
Piston speed, m/min. (ft./min.)	774 (2539)
Main bearings: quantity, type	7, Precision Half Shells
Rated rpm	1800
Max. power at rated rpm, kWm (BHP)	2700 (3621)
Cylinder head material	Cast Iron
Crankshaft material	Steel
Valve (exhaust) material	Steel
Governor: type, make/model	KODEC Electronic Control
Frequency regulation, no-load to-full load	Isochronous
Frequency regulation, steady state	±0.25%
Frequency	Fixed
Air cleaner type, all models	Dry

Lubricating System	60 Hz
Type	Full Pressure
Oil pan capacity with filter (initial fill), L (qt.) §	335 (354)
Oil filter: quantity, type §	6, Cartridge
Oil cooler	Water-Cooled

§ Kohler recommends the use of Kohler Genuine oil and filters.

Fuel System	60 Hz
Fuel supply line, min. ID, mm (in.)	25 (1.0)
Fuel return line, min. ID, mm (in.)	19 (0.75)
Max. fuel flow, Lph (gph)	881 (232.7)
Min./max. fuel pressure at engine supply connection, kPa (in. Hg)	- 50/50 (- 14.8/14.8)
Max. return line restriction, kPa (in. Hg)	30 (8.9)
Fuel filter: quantity, type	2, Primary Engine Filter 2, Fuel/Water Separator
Recommended fuel	#2 Diesel ULSD

	Diesel Fuel Consumption	DEF Consumption
	Standby Rating	Standby Rating
% load	Lph (gph)	Lph (gph)
100%	661 (174.6)	46.2 (12.2)
75%	479 (126.5)	45.5 (12.0)
50%	334 (88.1)	35.0 (9.3)
25%	195 (51.4)	19.5 (5.1)
10%	108 (28.5)	9.7 (2.6)
	Prime Rating	Prime Rating
% load	Lph (gph)	Lph (gph)
100%	595 (157.2)	53.5 (14.2)
75%	440 (116.2)	44.0 (11.6)
50%	310 (82.0)	32.6 (8.6)
25%	184 (48.7)	18.4 (4.9)
10%	107 (28.2)	9.6 (2.5)
	Continuous Rating	Continuous Rating
% load	Lph (gph)	Lph (gph)
100%	484 (127.8)	45.9 (12.1)
75%	372 (98.2)	37.2 (9.8)
50%	265 (69.9)	27.8 (7.3)
25%	159 (42.1)	15.1 (4.0)
10%	95 (25.1)	8.6 (2.3)

Radiator System	60 Hz	
Ambient temperature, °C (°F)*	50 (122)	40 (104)
Engine jacket water capacity, L (gal.)	356 (94)	
Radiator system capacity, including engine, L (gal.)	643 (170)	539 (142)
Engine jacket water flow, Lpm (gpm)	2082 (550)	
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	ESP 920 (52320) PRP 850 (48339) COP 770 (43790)	
Charge cooler water flow, Lpm (gpm)	662 (174)	
Heat rejected to charge cooling water at rated kW, dry exhaust, kW (Btu/min.)	ESP 870 (49476) PRP 750 (42652) COP 530 (30141)	
Water pump type	Centrifugal	
Fan diameter, including blades, mm (in.)	2235 (88)	1901 (75)
Fan, kWm (HP)	90 (120.7)	85 (114)
Max. restriction of cooling air, intake and discharge side of radiator, kPa (in. H_2O)	0.125 (0.5)	

* Enclosure with enclosed silencer reduces ambient temperature capability by 5°C (9°F).

Remote Radiator System†	60 Hz
Exhaust manifold type	Dry
Connection sizes:	Class 150 ANSI Flange
Water inlet/outlet, mm (in.)	216 (8.5) Bolt Circle
Intercooler inlet/outlet, mm (in.)	178 (7.0) Bolt Circle
Static head allowable above engine, kPa (ft. H_2O)	70 (23.5)

† Contact your local distributor for cooling system options and specifications based on your specific requirements.

Exhaust System	60 Hz
Exhaust flow at rated kW, m^3/min. (cfm)	551 (19468)
Exhaust temperature at rated kW at 25°C (77°F) ambient, dry exhaust, °C (°F)	490 (914)
Maximum allowable back pressure, kPa (in. Hg)	See TIB-119
Exh. outlet size at eng. hookup, mm (in.)	See ADV drawing

Electrical System	60 Hz
Battery charging alternator:	
Ground (negative/positive)	Negative
Volts (DC)	24
Ampere rating	140
Starter motor qty. at starter motor power rating, rated voltage (DC)	Standard: 2 @ 9 kW, 24; Redundant (optional); 2 @ 15 kW, 24
Battery, recommended cold cranking amps (CCA):	
Quantity, CCA rating each, type (with standard starters)	4, 1110, AGM
Quantity, CCA rating each, type (with redundant starters)	8, 1110, AGM
Battery voltage (DC)	12

Air Requirements	60 Hz	
Radiator-cooled cooling air, m^3/min. (scfm)‡	50°C 2549 (90000)	40°C 2321 (82000)
Cooling air required for generator set when equipped with city water cooling or remote radiator, based on 14°C (25°F) rise, m^3/min. (scfm)‡	1116 (39398)	
Combustion air, m^3/min. (cfm)	ESP 207 (7310) PRP 194.3 (6863) COP 168 (5943)	
Heat rejected to ambient air:		
Engine, kW (Btu/min.)	ESP 130 (7393) PRP 120 (6824) COP 100 (5687)	
Alternator, kW (Btu/min.)	160 (9099)	

‡ Air density = 1.20 kg/m^3 (0.075 lbm/ft^3)

Alternator Specifications		60 Hz
Type		4-Pole, Rotating-Field
Exciter type		Brushless, Permanent-Magnet Pilot Exciter
Voltage regulator		Solid-State, Volts/Hz
Insulation:		NEMA MG1, UL 1446, Vacuum Pressure Impregnated (VPI)
Material		Class H, Synthetic, Nonhygroscopic
Temperature rise		130°C, 150°C Standby
Bearing: quantity, type		1 or 2, Sealed
Coupling type		Flexible Disc or Coupling
Amortisseur windings		Full
Alternator winding type (up to 600 V)		Random Wound
Alternator winding type (above 600 V)		Form Wound
Rotor balancing		125%
Voltage regulation, no-load to full-load		±0.25%
Unbalanced load capability		100% of Rated Standby Current
Peak motor starting kVA:		(35% dip for voltages below)
480 V	KH06930TO4D	5990
480 V	KH07770TO4D	7170
480 V	KH08430TO4D	9908

Alternator Standard Features

- The pilot-excited, permanent magnet (PM) alternator provides superior short-circuit capability.
- All models are brushless, rotating-field alternators.
- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds.
- Sustained short-circuit current enabling downstream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and dripproof construction.
- Superior voltage waveform from two-thirds pitch windings and skewed stator.
- Brushless alternator with brushless pilot exciter for excellent load response.

NOTE: See TIB-102 Alternator Data Sheets for alternator application data and ratings, efficiency curves, voltage dip with motor starting curves, and short circuit decrement curves.

KOHLER®

KD2500-4

60 Hz. Diesel Generator Set

Tier 4 EPA Certified for Stationary and Mobile Applications

ENGINE INFORMATION

Model:	KD62V12	Bore:	175 mm (6.89 in.)
Type:	4-Cycle, 12-V Cylinder	Stroke:	215 mm (8.46 in.)
Aspiration:	Turbocharged, Intercooled	Displacement:	62 L (3783 cu. in.)
Compression ratio:	16:0:1		
Emission Control Device:	Direct Diesel Injection, Engine Control Module, Turbocharger, Charge Air Cooler, Ammonia Slip Catalyst, Selective Catalytic Reduction		

NOMINAL EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP
Power [kW]	2700	2025	1350	675
Speed [rpm]	1800	1800	1800	1800
Exhaust Gas Flow [kg/h]	15300	12310	8690	5220
Exhaust Gas Temperature [C]	490	425	430	430
NO_X [g/kWh]	0.44	0.44	0.40	0.40
CO [g/kWh]	0.22	0.20	0.20	0.20
HC [g/kWh]	0.05	0.05	0.05	0.05
PM [g/kWh]	0.02	0.02	0.03	0.03

NOT TO EXCEED EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP
NO_X [g/kWh]	0.53	0.53	0.48	0.48
CO [g/kWh]	0.33	0.30	0.30	0.30
HC [g/kWh]	0.07	0.07	0.07	0.07
PM [g/kWh]	0.03	0.03	0.04	0.04

	Frequency	Rating ESP/PRP/COP	NRSC-D2 mode	Rated Power	Rated Speed	Exhaust temperature after turbine	Exhaust mass flow	NOx	CO	HC	PM Tailpipe
10% ESP	Hz	-	-	kW	rpm	°C	kg/h	g/kWh	g/kWh	g/kWh	g/kWh
	60	ESP	10%	2700	1800	340	3750	1.80	0.30	0.06	0.04

TEST METHODS AND CONDITIONS

Test Methods:
Steady-State emissions recorded per EPA CFR 40 Part 89, and ISO8178-1 during operation at rated engine speed (+/-2%) and stated constant load (+/-2%) with engine temperatures, pressures and emission rates stabilized using Ramped Mode Cycle.

Fuel Specification:
40-48 Cetane Number, ≤15ppm Sulfur; Reference ISO8178-5, 40CFR86.1313-98 Type 2-D and ASTM D975 No. 2-D.

Diesel Exhaust Fluid Specification:
32.5% urea in de-ionized water meeting ISO-22241

Reference Conditions:
25 °C (77 °F) Air Inlet Temperature, 40 °C (104 °F) Fuel Inlet Temperature, 100 kPa (29.53 in Hg) Barometric Pressure; 10.7 g/kg (75 grains H2O/lb.) of dry air Humidity (required for NOx correction); Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back pressure set to maximum allowable limit.

Data was taken from a single engine test according to the test methods, fuel specification and reference conditions stated above and is subjected to instrumentation and engine-to-engine variability. Tests conducted with alternate test methods, instrumentation, fuel or reference conditions can yield different results.

NOMINAL EMISSION DATA

Cycle point	100% COP	75% COP	50% COP	25% COP
Power [kW]	2045	1534	1023	511
Speed [rpm]	1800	1800	1800	1800
Exhaust Gas Flow [kg/h]	12370	9720	6930	4540
Exhaust Gas Temperature [C]	425	425	430	430
NO_X [g/kWh]	0.40	0.35	0.35	0.50
CO [g/kWh]	0.20	0.20	0.20	0.20
HC [g/kWh]	0.05	0.05	0.05	0.05
PM [g/kWh]	0.02	0.02	0.03	0.03

NOT TO EXCEED EMISSION DATA

Cycle point	100% COP	75% COP	50% COP	25% COP
NO_X [g/kWh]	0.48	0.42	0.42	0.60
CO [g/kWh]	0.30	0.30	0.30	0.30
HC [g/kWh]	0.07	0.07	0.07	0.07
PM [g/kWh]	0.03	0.03	0.04	0.04

NOMINAL EMISSION DATA

Cycle point	100% PRP	75% PRP	50% PRP	25% PRP
Power [kW]	2455	1841	1228	614
Speed [rpm]	1800	1800	1800	1800
Exhaust Gas Flow [kg/h]	14310	11380	8020	4960
Exhaust Gas Temperature [C]	465	425	430	430
NO_X [g/kWh]	0.40	0.40	0.40	0.50
CO [g/kWh]	0.20	0.20	0.20	0.20
HC [g/kWh]	0.05	0.05	0.05	0.05
PM [g/kWh]	0.02	0.02	0.03	0.03

NOT TO EXCEED EMISSION DATA

Cycle point	100% PRP	75% PRP	50% PRP	25% PRP
NO_X [g/kWh]	0.48	0.48	0.48	0.60
CO [g/kWh]	0.30	0.30	0.30	0.30
HC [g/kWh]	0.07	0.07	0.07	0.07
PM [g/kWh]	0.03	0.03	0.04	0.04

DQDAC data is below.

Generator Set Model	DQDAC
Engine Model	QSL9-G7
Emissions Level	Tier 2

			ISO Standby				
Generator Set Load		%	10	25	50	75	100
		kWe	30	75	150	225	300
Engine Load		hp	43.5	113.75	227.5	341.25	455
Fuel Consumption		gal/hr	3.34	6.82	12.23	17.65	23.07
Exhaust Gas Temperature		deg F	514	678	785	915	990
Exhaust Gas Flow		CFM	615	1099.6	1714.8	2118.6	2279.4
Nominal	HC	g/bhp·hr	1.72	0.25	0.129	0.052	0.046
	NOx	g/bhp·hr	1.70	1.60	1.70	2.65	5.25
	CO	g/bhp·hr	3.13	3.20	3.17	0.73	0.30
	PM	g/bhp·hr	0.30	0.20	0.14	0.04	0.03

Potential Site Variation	HC	g/bhp·hr	2.92	0.43	0.22	0.09	0.08
	NOx	g/bhp·hr	2.21	2.08	2.21	3.45	6.83
	CO	g/bhp·hr	6.26	6.40	6.34	1.46	0.60
	PM	g/bhp·hr	0.75	0.50	0.35	0.10	0.08

Engine outlet = 6”

Exhaust outlet height 114" above grade

PACKAGE DATA [C09DE48] OCTOBER 14, 2019

For Help Desk Phone Numbers Click here

Feature Code:	C09DE48	**Rating Type:**	STANDBY	**Sales model Package:**	PGS300
Engine Sales Model:	C9	**Engine Arrangement Number:**	4529685	**Hertz:**	60
EKW W/F:	300.0	**Noise Reduction:**	0 dBA	**Back Pressure:**	0.0 inH2O

Engine Package Information

Engine Package Data

Package Cooling Information

SA Level 2 Canopy Cooling Data

% Load	Airflow Rate scfm	Ambient Capability Sea Level (Deg F)	Ambient Capability 300 m (Deg F)	Ambient Capability 600 m (Deg F)	Ambient Capability 900 m (Deg F)
100.0	12395	114	111	107	104
75.0	12395	132	129	125	122

Package Sound Information

Sound Comments :

SA Level 2 Canopy Sound Data

Distance: 3.3 Feet

EKW W/F	% LOAD	OVERALL SOUND DB(A)	OBCF 63HZ DB	OBCF 125HZ DB	OBCF 250HZ DB	OBCF 500HZ DB	OBCF 1000HZ DB	OBCF 2000HZ DB	OBCF 4000HZ DB	OBCF 8000HZ DB
300.0	100.0	83.0	88.9	90.5	85.6	78.4	76.1	73.4	70.3	66.4
225.0	75.0	82.8	87.7	90.2	85.6	78.3	75.9	73.1	69.6	65.7
150.0	50.0	82.7	86.6	89.9	85.6	78.4	75.9	73.0	68.8	64.4
75.0	25.0	82.7	85.5	89.7	85.6	78.4	76.1	73.1	68.1	62.5

Distance: 23.0 Feet

EKW W/F	% LOAD	OVERALL SOUND DB(A)	OBCF 63HZ DB	OBCF 125HZ DB	OBCF 250HZ DB	OBCF 500HZ DB	OBCF 1000HZ DB	OBCF 2000HZ DB	OBCF 4000HZ DB	OBCF 8000HZ DB
300.0	100.0	71.3	82.0	81.2	74.8	66.7	60.3	59.9	57.8	54.9
225.0	75.0	71.2	80.9	80.9	75.1	66.5	59.9	60.1	57.3	54.6
150.0	50.0	71.1	80.0	80.5	75.2	66.4	59.9	60.2	56.6	53.4
75.0	25.0	70.9	79.1	80.2	75.0	66.6	60.2	60.1	55.7	51.2

Distance: 49.2 Feet

EKW W/F	% LOAD	OVERALL SOUND DB(A)	OBCF 63HZ DB	OBCF 125HZ DB	OBCF 250HZ DB	OBCF 500HZ DB	OBCF 1000HZ DB	OBCF 2000HZ DB	OBCF 4000HZ DB	OBCF 8000HZ DB
300.0	100.0	65.3	76.0	75.2	68.8	60.7	54.3	53.9	51.8	48.9
225.0	75.0	65.2	74.9	74.9	69.1	60.5	53.9	54.1	51.3	48.6
150.0	50.0	65.1	74.0	74.5	69.2	60.4	53.9	54.2	50.6	47.4
75.0	25.0	64.9	73.1	74.2	69.0	60.6	54.2	54.1	49.7	45.2

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PERFORMANCE DATA[DM8168]

Performance Number: DM8168 **Change Level: 04**

SALES MODEL:	C9
BRAND:	CAT
ENGINE POWER (BHP):	480
GEN POWER W/O FAN (EKW):	319.0
GEN POWER WITH FAN (EKW):	300.0
COMPRESSION RATIO:	16.1
RATING LEVEL:	STANDBY
PUMP QUANTITY:	1
FUEL TYPE:	DIESEL
MANIFOLD TYPE:	DRY
GOVERNOR TYPE:	ELEC
CAMSHAFT TYPE:	STANDARD
IGNITION TYPE:	CI
INJECTOR TYPE:	EUI
REF EXH STACK DIAMETER (IN):	4
MAX OPERATING ALTITUDE (FT):	3,281
COMBUSTION:	DIRECT INJECTION
ENGINE SPEED (RPM):	1,800
HERTZ:	60
FAN POWER (HP):	36.5
ASPIRATION:	TA
AFTERCOOLER TYPE:	ATAAC
AFTERCOOLER CIRCUIT TYPE:	JW+OC, ATAAC
INLET MANIFOLD AIR TEMP (F):	120
JACKET WATER TEMP (F):	192.2
TURBO CONFIGURATION:	SINGLE
TURBO QUANTITY:	1
TURBOCHARGER MODEL:	S310-1.25
CERTIFICATION YEAR:	2005
PISTON SPD @ RATED ENG SPD (FT/MIN):	1,759.8

INDUSTRY	SUBINDUSTRY	APPLICATION
ELECTRIC POWER	STANDARD	PACKAGED GENSET

General Performance Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BSFC)	VOL FUEL CONSUMPTN (VFC)	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP
EKW	%	BHP	PSI	LB/BHP-HR	GAL/HR	IN-HG	DEG F	DEG F	IN-HG	DEG F
300.0	100	480	393	0.332	22.7	82.5	122.6	1,247.3	60.6	927.2
270.0	90	430	352	0.334	20.5	78.7	121.1	1,179.5	55.9	877.6
240.0	80	383	314	0.339	18.5	74.9	121.5	1,120.8	51.5	840.4
225.0	75	361	295	0.342	17.6	73.0	121.6	1,094.5	49.4	826.3
210.0	70	339	277	0.347	16.8	71.0	121.7	1,071.1	47.3	817.6
180.0	60	296	242	0.360	15.2	66.4	121.7	1,028.3	43.1	800.8
150.0	50	253	207	0.376	13.6	61.1	121.7	988.0	38.7	784.5
120.0	40	212	173	0.390	11.8	52.8	121.7	944.9	32.8	768.7
90.0	30	170	139	0.403	9.8	42.5	121.6	899.1	25.9	752.9
75.0	25	149	122	0.411	8.7	36.9	121.6	875.4	22.3	745.0
60.0	20	127	104	0.419	7.6	30.8	121.6	850.8	18.7	737.0
30.0	10	82.9	68	0.441	5.2	17.9	121.5	723.0	11.7	650.3

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	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	IN-HG	DEG F	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
300.0	100	480	83	450.8	916.6	2,460.9	3,985.8	4,144.9	872.5	798.0
270.0	90	430	80	428.0	893.4	2,306.9	3,884.5	4,028.0	848.2	780.6
240.0	80	383	76	406.4	870.9	2,173.0	3,772.3	3,902.1	821.8	760.2
225.0	75	361	74	396.1	859.8	2,109.4	3,711.7	3,835.1	806.5	747.8
210.0	70	339	72	386.3	846.8	2,047.1	3,649.5	3,766.9	788.0	732.2
180.0	60	296	67	367.7	814.1	1,926.8	3,499.4	3,605.2	751.6	701.1
150.0	50	253	62	350.2	772.8	1,810.5	3,315.8	3,410.8	715.5	669.7
120.0	40	212	54	321.8	707.1	1,643.7	3,018.0	3,100.6	657.9	617.9
90.0	30	170	43	282.8	623.3	1,424.8	2,642.8	2,711.5	577.7	544.3
75.0	25	149	38	260.3	576.0	1,299.8	2,434.3	2,495.5	530.5	500.6
60.0	20	127	31	235.4	524.5	1,162.9	2,209.5	2,262.9	477.8	451.6
30.0	10	82.9	18	178.8	412.8	851.2	1,728.1	1,764.7	377.1	358.8

Heat Rejection Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXHUAST RECOVERY TO 350F	FROM OIL COOLER	FROM AFTERCOOLER	WORK ENERGY	LOW HEAT VALUE ENERGY	HIGH HEAT VALUE ENERGY

PERFORMANCE DATA[DM8168]

October 14, 2019

EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
300.0	100	480	6,838	1,312	18,223	10,196	2,598	5,239	20,357	48,785	51,968
270.0	90	430	6,227	1,100	16,530	8,999	2,344	4,774	18,249	44,009	46,881
240.0	80	383	5,718	954	15,163	8,062	2,120	4,304	16,263	39,804	42,402
225.0	75	361	5,492	885	14,576	7,680	2,017	4,080	15,306	37,868	40,339
210.0	70	339	5,288	827	14,082	7,393	1,922	3,868	14,366	36,078	38,432
180.0	60	296	4,912	823	13,054	6,800	1,739	3,448	12,536	32,644	34,774
150.0	50	253	4,565	786	11,966	6,184	1,555	3,034	10,749	29,195	31,100
120.0	40	212	4,219	770	10,567	5,402	1,348	2,419	8,983	25,307	26,959
90.0	30	170	3,811	699	8,973	4,534	1,120	1,706	7,210	21,028	22,400
75.0	25	149	3,554	623	8,129	4,085	999	1,352	6,312	18,747	19,970
60.0	20	127	3,271	492	7,247	3,625	871	1,008	5,399	16,350	17,417
30.0	10	82.9	2,624	519	4,878	2,172	597	397	3,514	11,200	11,931

Emissions Data

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN		EKW	300.0	225.0	150.0	75.0	30.0
PERCENT LOAD		**%**	**100**	**75**	**50**	**25**	**10**
ENGINE POWER		**BHP**	**480**	**361**	**253**	**149**	**82.9**
TOTAL NOX (AS NO2)		G/HR	2,032	1,047	539	288	217
TOTAL CO		G/HR	214	166	242	203	191
TOTAL HC		G/HR	50	54	81	76	65
PART MATTER		G/HR	30.2	29.7	66.7	43.9	28.4
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,371.7	1,572.5	1,056.2	887.0	1,244.7
TOTAL CO	(CORR 5% O2)	MG/NM3	216.0	218.7	414.7	579.4	974.9
TOTAL HC	(CORR 5% O2)	MG/NM3	43.7	62.4	119.7	182.7	276.3
PART MATTER	(CORR 5% O2)	MG/NM3	24.8	34.3	101.8	98.2	126.1
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,155	766	514	432	606
TOTAL CO	(CORR 5% O2)	PPM	173	175	332	464	780
TOTAL HC	(CORR 5% O2)	PPM	82	116	223	341	516
TOTAL NOX (AS NO2)		G/HP-HR	4.27	2.92	2.13	1.94	2.61
TOTAL CO		G/HP-HR	0.45	0.46	0.96	1.36	2.30
TOTAL HC		G/HP-HR	0.11	0.15	0.32	0.51	0.79
PART MATTER		G/HP-HR	0.06	0.08	0.26	0.29	0.34
TOTAL NOX (AS NO2)		LB/HR	4.48	2.31	1.19	0.64	0.48
TOTAL CO		LB/HR	0.47	0.37	0.53	0.45	0.42
TOTAL HC		LB/HR	0.11	0.12	0.18	0.17	0.14
PART MATTER		LB/HR	0.07	0.07	0.15	0.10	0.06

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN		EKW	300.0	225.0	150.0	75.0	30.0
PERCENT LOAD		**%**	**100**	**75**	**50**	**25**	**10**
ENGINE POWER		**BHP**	**480**	**361**	**253**	**149**	**82.9**
TOTAL NOX (AS NO2)		G/HR	1,881	970	499	267	201
TOTAL CO		G/HR	115	89	129	109	102
TOTAL HC		G/HR	26	29	43	40	35
TOTAL CO2		KG/HR	225	175	135	86	51
PART MATTER		G/HR	15.5	15.2	34.2	22.5	14.6
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,196.0	1,456.1	978.0	821.3	1,152.5
TOTAL CO	(CORR 5% O2)	MG/NM3	115.5	117.0	221.7	309.8	521.3
TOTAL HC	(CORR 5% O2)	MG/NM3	23.1	33.0	63.3	96.7	146.2
PART MATTER	(CORR 5% O2)	MG/NM3	12.7	17.6	52.2	50.4	64.7
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,070	709	476	400	561
TOTAL CO	(CORR 5% O2)	PPM	92	94	177	248	417
TOTAL HC	(CORR 5% O2)	PPM	43	62	118	180	273
TOTAL NOX (AS NO2)		G/HP-HR	3.95	2.70	1.98	1.79	2.42
TOTAL CO		G/HP-HR	0.24	0.25	0.51	0.73	1.23
TOTAL HC		G/HP-HR	0.06	0.08	0.17	0.27	0.42
PART MATTER		G/HP-HR	0.03	0.04	0.14	0.15	0.18
TOTAL NOX (AS NO2)		LB/HR	4.15	2.14	1.10	0.59	0.44
TOTAL CO		LB/HR	0.25	0.20	0.29	0.24	0.22
TOTAL HC		LB/HR	0.06	0.06	0.09	0.09	0.08
TOTAL CO2		LB/HR	496	387	297	189	112
PART MATTER		LB/HR	0.03	0.03	0.08	0.05	0.03
OXYGEN IN EXH		%	9.2	11.2	12.6	13.6	15.0
DRY SMOKE OPACITY		%	0.3	0.4	1.0	0.8	0.8
BOSCH SMOKE NUMBER			0.07	0.20	0.90	0.76	0.68

PERFORMANCE DATA[DM8168]

Regulatory Information

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

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

Altitude Derate Data

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	480	480	480	480	480	477	474	465	452	433	412	395	478
1,000	480	480	480	480	477	475	470	457	441	422	402	386	476
2,000	480	480	479	477	474	470	463	446	427	410	392	376	473
3,000	480	478	475	470	463	457	449	434	418	403	386	370	464
4,000	475	469	463	456	450	444	436	422	407	391	374	358	453
5,000	462	456	449	442	436	430	422	408	393	377	360	343	442
6,000	449	442	435	428	422	416	408	394	379	362	346	329	430
7,000	434	428	421	414	408	402	394	379	364	348	332	315	418
8,000	420	413	406	400	394	387	380	365	350	334	318	302	406
9,000	405	398	392	385	379	373	365	350	335	320	305	289	394
10,000	390	384	377	371	365	359	352	337	322	307	293	278	382
11,000	376	369	363	357	351	345	339	334	320	305	291	277	370
12,000	361	355	348	342	337	331	326	320	315	303	288	270	357
13,000	347	340	334	329	323	318	312	307	302	290	274	257	345
14,000	332	326	321	315	310	304	299	294	289	276	261	246	333
15,000	319	313	307	302	297	291	286	282	276	263	249	235	322

Cross Reference

Test Spec	Setting	Engine Arrangement	Engineering Model	Engineering Model Version	Start Effective Serial Number	End Effective Serial Number
0K6616	NAP	2531644	GS279	-	S9L00001	
4150068	PP5547	3950369	GS279	-	S9P00001	
4150068	PP5547	4529865	GS857	LS	S9P00001	
4150068	PP5547	5664658	PG350	G	RG300001	
4150068	PP5547	5664658	PG375	G	RE300001	

Performance Parameter Reference

Parameters Reference:DM9600-11
PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600
APPLICATION:
Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test cell at SAE J1995 standard reference conditions. Caterpillar

maintains ISO9001:2000 certified quality management systems for engine test Facilities to assure accurate calibration of test equipment. Engine test data is corrected in accordance with SAE J1995. Additional reference material SAE J1228, J1349, ISO 8665, 3046-1:2002E, 3046-3:1989, 1585, 2534, 2288, and 9249 may apply in part or are similar to SAE J1995. Special engine rating request (SERR) test data shall be noted.
PERFORMANCE PARAMETER TOLERANCE FACTORS:
Power +/- 3%
Torque +/- 3%
Exhaust stack temperature +/- 8%
Inlet airflow +/- 5%
Intake manifold pressure-gage +/- 10%
Exhaust flow +/- 6%
Specific fuel consumption +/- 3%
Fuel rate +/- 5%
Specific DEF consumption +/- 3%
DEF rate +/- 5%
Heat rejection +/- 5%
Heat rejection exhaust only +/- 10%
Heat rejection CEM only +/- 10%
Heat Rejection values based on using treated water.
Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications.
On C7 - C18 engines, at speeds of 1100 RPM and under these values are provided for reference only, and may not meet the tolerance listed.
These values do not apply to C280/3600. For these models, see the tolerances listed below.
C280/3600 HEAT REJECTION TOLERANCE FACTORS:
Heat rejection +/- 10%
Heat rejection to Atmosphere +/- 50%
Heat rejection to Lube Oil +/- 20%
Heat rejection to Aftercooler +/- 5%
TEST CELL TRANSDUCER TOLERANCE FACTORS:
Torque +/- 0.5%
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 29 deg C (84.2 deg F), where the density is 838.9 G/Liter (7.001 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.
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 : 07/10/19

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Systems Data
Reference Number: DM8168

CATERPILLAR

October 14, 2019
For Help Desk Phone Numbers [Click Here]

AIR INTAKE SYSTEM		
THE INSTALLED SYSTEM MUST COMPLY WITH THE SYSTEM LIMITS BELOW FOR ALL EMISSIONS CERTIFIED ENGINES TO ASSURE REGULATORY COMPLIANCE.		
MAXIMUM ALLOWABLE INTAKE RESTRICTION WITH CLEAN ELEMENT		IN-H20
MAXIMUM ALLOWABLE INTAKE RESTRICTION WITH DIRTY ELEMENT		IN-H20
MAXIMUM PRESSURE DROP FROM COMPRESSOR OUTLET TO MANIFOLD INLET (OR MIXER INLET FOR EGR)	4.4	IN-HG
MAXIMUM TURBO INLET AIR TEMPERATURE		DEG F
MAXIMUM AIR FILTER INLET AIR TEMPERATURE		DEG F
CHARGE AIR FLOW AT RATED SPEED	62.8	LB/MIN
TURBO COMPRESSOR OUTLET PRESSURE AT RATED SPEED (ABSOLUTE)	108.8	IN-HG
COOLING SYSTEM		
ENGINE ONLY COOLANT CAPACITY		GAL
MAXIMUM ALLOWABLE JACKET WATER OUTLET TEMPERATURE		DEG F
REGULATOR LOCATION FOR JW (HT) CIRCUIT		
MAXIMUM UNINTERRUPTED FILL RATE	5.0	G/MIN
MINIMUM COOLANT LOSS WITHOUT IMPACTING RADIATOR PERFORMANCE (PERCENT OF TOTAL)		PERCENT
COOLANT LOSS-MAXIMUM PERCENTAGE OF PUMP PRESSURE RISE LOSS		PERCENT
AIR VENT CAPABILITY AT 35% PUMP PRESSURE RISE LOSS		PT/MIN
ENGINE SPEC SYSTEM		
CYLINDER ARRANGEMENT	INLINE	
NUMBER OF CYLINDERS	6	
CYLINDER BORE DIAMETER		IN
PISTON STROKE		IN
TOTAL CYLINDER DISPLACEMENT		CU IN
STANDARD CRANKSHAFT ROTATION FROM FLYWHEEL END	CCW	
STANDARD CYLINDER FIRING ORDER		
NUMBER 1 CYLINDER LOCATION	FRONT	
STROKES/COMBUSTION CYCLE	4	
EXHAUST SYSTEM		
THE INSTALLED SYSTEM MUST COMPLY WITH THE SYSTEM LIMITS BELOW FOR ALL EMISSIONS CERTIFIED ENGINES TO ASSURE REGULATORY COMPLIANCE.		
MAXIMUM ALLOWABLE SYSTEM BACK PRESSURE		IN-H20
MANIFOLD TYPE		
FUEL SYSTEM		
MAXIMUM FUEL FLOW FROM TRANSFER PUMP TO ENGINE	46.5	G/HR
MAXIMUM ALLOWABLE FUEL SUPPLY LINE RESTRICTION		IN-HG
MAXIMUM ALLOWABLE FUEL TEMPERATURE AT TRANSFER PUMP INLET		DEG F

MAXIMUM FUEL FLOW TO RETURN LINE FROM ENGINE	29.9	G/HR
MAXIMUM ALLOWABLE FUEL RETURN LINE RESTRICTION		IN-HG
NORMAL FUEL PRESSURE IN A CLEAN SYSTEM		PSI
FUEL SYSTEM TYPE		
LUBE SYSTEM		
LUBE SYSTEM OIL COOLER TYPE	PLATE	
CRANKCASE VENTILATION TYPE		
MOUNTING SYSTEM		
CENTER OF GRAVITY LOCATION - X DIMENSION - FROM REAR FACE OF BLOCK - (REFERENCE TM7077)		IN
CENTER OF GRAVITY LOCATION - Y DIMENSION - FROM CENTERLINE OF CRANKSHAFT - (REFERENCE TM7077)		IN
CENTER OF GRAVITY LOCATION - Z DIMENSION - FROM CENTERLINE OF CRANKSHAFT - (REFERENCE TM7077)		IN
STARTING SYSTEM		
LOWEST AMBIENT START TEMPERATURE WITHOUT AIDS		DEG F

TEST SPEC [C09DE48]

OCTOBER 14, 2019

For Help Desk Phone Numbers Click here

Reference Number: 4150068

Effective Serial Number: S9P02089

Model: C9 DI TA AAAC

Make from Spec:

Test Spec Data

Description	Measure	Nominal	Ceiling	Floor
Corr Full Load Power	hp	480	485	475
Full Load Speed	RPM	1800	1810	1790
High Idle Speed	RPM	1945	1955	1935
Low Idle Speed	RPM	1369	1379	1359
FL Static Fuel Setting	in	1.007		
FT Static Fuel Setting	in	1.037		
FLS (Intercept)		-27		
FTS (Slope)		-1		
Corrected Fuel Rate	GAL/HR	23.2	24.4	22.0
CSFC	LB/HP.H	0.342	0.363	0.323
Adjusted Boost	IN_HG	78.5	89.2	65.9
Torque Check Speed	RPM	1650	1660	1640
Corr Torq Rise at TC RPM	%	7.0		
Corr Torque at TC RPM	LB.FT	1,499	1,604	1,393
C Fuel Rate at TC RPM	GAL/HR	22.2	23.3	21.1
CSFC at TC RPM	LB/HP.H	0.334	0.356	0.313
ADJ Boost at TC RPM	IN_HG	81.1	91.3	67.5
Power Loss/Cyl	% C FL PWR	21.0	27.0	10.0
Specific Blowby	CU FT/HP.H			
Temp Jacket Water Pump Inlet	F	192	197	186
Delta T Jacket Water (out-in)	F	10	19	1
Inlet Manifold Temp	F	122	131	113
Water Temp to Scac	F	125	131	120
Scac Water Flow	GAL/MIN	13	10	
Oil Pressure	PSI	49	87	26
Oil Pressure Low Idle	PSI	50	70	32
Fuel Pressure	PSI	84	102	59
Inlet Fuel Pressure	PSI		4	
Inlet Fuel Temp	F	86	95	77
Inlet Air Pressure	IN_HG		31	26
Inlet Air Restriction	IN_HG		1.18	
Inlet Air Temperature	F		122	50
Fuel Density	DEG API		36.0	34.0
Boost Constant		1.0		
Governor Setting Constant				
Governor Setting Torque	% RTD TRQ			
High Idle Stability	RPM			
Low Idle Stability	RPM			
Set Point RPM	RPM	1820	1830	1810
Adjusted Boost (Gas Blending)	HG			
Corrected Fuel Rate - Diesel (Gas Blending)	GAL/HR			
Corrected Fuel Rate - Gas (Gas Blending	BTU/MIN			
Full Load Fueling (Gas Blending)	MM3/ST			
Gas Substitution Ratio (Gas Blending)	%			

Corr Full Load Power (Gas Blending)	HP			
Full Load Speed (Gas Blending)	RPM			
Exhaust Back Pressure	PSI			
TQ CK Exhaust Back Pressure	PSI			
Ataac Delta Pressure	PSI			

Engine Reference Information

Description	Measure	Data
FL Static/FT Static Fuel Settings	in	1.007 / 1.037
Fuel Valve Part Number		
Unit Injector Part Number		5734231
Timing Dimension Field Service	in	
Timing Dimension Factory		
Torque Control Group Number		Change Level:
Fuel Pump/Gov Grp Part Number		3282580
Fuel Pump Type		HUI
Flyweight Part Number/Attitude		
Turbo Part No and Model		2550051 / S310-1.25VTF 2550051 / S310-1.25VTF
Advertised Power / Governor Speed		480hp 1,800 RPM
Compression Ratio		16.1
Torque Rise Cam Part Number		
Manifold Type		DRY
Engine Flash File Part Number		5781990
Rating Number		2
Flash File Change Number		
ASM Flash File Part Number		
ISM Flash File Part Number		
Advisor Flash File Part Number		
Secondary Module Flash File Part Number		
Messenger Flash File Part Number		
Tandem Software Flash File Part Number		
Governor Type		ELEC

Torque Control Group Spring Data

Part No	Thickness	Quantity
No data found...		

Torque Control Group Spacer Data

Part No	Thickness	Quantity
No data found...		

Timing Data
Mechanical Advance Part Number:
Chg. Level:
Advance: 0.0 DEG
Dog Leg Differentials: RPM: -- KW: --

Description	Measure	Spec	Minimum	Maximum
Timing Static @ 0 RPM BTDC	DEG		-2.0	2.0

Application/Performance Data

Description	Measure	Data
Application Identification		224 GS STANDBY
Engine Sales Model and Series		C9
Combustion System type		DI
Aspiration Type		TA
Engine Source Factory Ref Number		40
Power Setting PL/PP Ref Number		PP5547
Engine Perf Data Ref No and Change Level		DM8168
Multi Engine Torq/Rating		

Emissions Family		
Generator Rating W/O Fan	EKW	319
Generator	HZ	60
Brakesaver test		
Certified Engine Rating	hp	
Engineering Model Ref		GS279 GS322
Low Idle In-Veh Speed	RPM	
Sales Model		
Machine Facility		
Usage		
Transmission		
Description		GS
Serial Number Prefixs		
Sales Model		
Machine Facility		
Usage		
Transmission		
Description		GS
Serial Number Prefixs		

Altitude Derating Information		
Description	**Measure**	**Data**
Altitude - Maximum	FT	3,280
Engine Power (ADV)	hp	480
Engine Power (Test)	hp	480
High Idle Speed	RPM	1945
FL Static Fuel Setting	in	1.007
FT Static Fuel Setting	in	1.037
Corrected Fuel Rate	GAL/HR	23.2
FL Boost Pressure	IN_HG	80.6

Spec Number vs. Arrangement Number Cross Reference				
Arrangement	2531644	3950369	4529865	5664658

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RADIATOR PERFORMANCE DATA [LS1849]

OCTOBER 14, 2019

For Help Desk Phone Numbers Click here

Component Performance Number: EM0499

Radiator Data

Radiator Part Number: 4490660
Radiator Type: AS13.3CTS
Front Area: 13.24 ft2
Radiator Dry Weight: 269.0 lbs
Radiator Wet Weight: NA lbs
Radiator Water Capacity High Temp Circuit: 6.0 gal
Radiator Water Capacity Low Temp Circuit: NA gal
Center of Gravity (X): 0.00 in (Distance from front face of core)
Center of Gravity (Y): 0.00 in (Distance from bottom of radiator support)
Center of Gravity (Z): 0.00 in (Distance from center line of core)

Engine Data

Performance Number: DM8168
Sales Model: C9
EKW: 300
Rating: STANDBY
Speed: 1800
Settings: NA
IM ATAAC Temp Deg F: 120

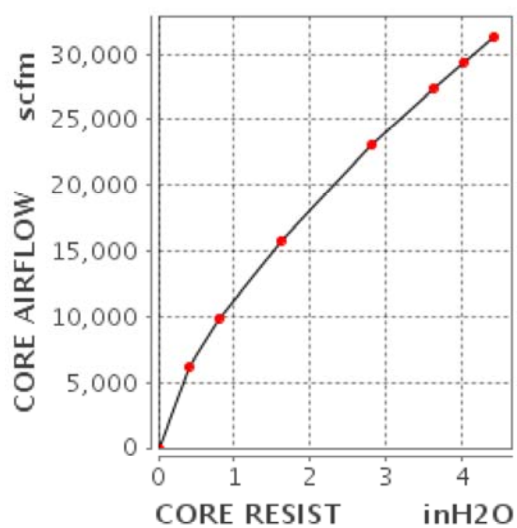
Combination Data

Pully Ratio: 0.76
Fan Power: 22.79734 hp

Ambient Restrictions (1/2 inH2O)			Ambient Restrictions (3/4 inH2O)		
984 Feet	2460 Feet	4921 Feet	984 Feet	2460 Feet	4921 Feet
--------- Max Ambient Pre-alarm Deg F ---------					
138	132	125	134	129	122

Air Flow Restrictions (1/2 inH2O)	Air Flow Restrictions (3/4 inH2O)
--------- scfm ---------	
13984	12289

CORE RESIST inH2O	CORE AIRFLOW scfm
0	0
0.4	6,179.08
0.8	9,880.77
1.61	15,799.66
2.81	23,080.98
3.62	27,363.24
4.02	29,386.78
4.42	31,346.74



Reference Number: EM0499

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Parameters Reference:

No notes found...

GENERATOR DATA

OCTOBER 14, 2019

For Help Desk Phone Numbers Click here

Spec Info   Mechanical Data   Cooling Data   Motor Starting Curve   Open Circuit Curve   Zero Power Factor Curve   Reactive Capability Chart   General Information

Selected Model

Engine: C9	**Generator Frame:** LC6114B	**Genset Rating (kW):** 300.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 4183863	**Genset Rating (kVA):** 375.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Self Excited	**Pwr. Factor:** 0.8	**Rated Current:** 451.1
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current
			Version: 41764 /40476 /41800 /10592

Spec Information

Generator Specification

Frame: LC6114B **Type:** LC	**No. of Bearings:** 1
Winding Type: RANDOM WOUND	**Flywheel:** 14.0
Connection: SERIES STAR	**Housing:** 1
Phases: 3	**No. of Leads:** 12
Poles: 4	**Wires per Lead:** 2
Sync Speed: 1800	**Generator Pitch:** 0.6667

Generator Efficiency

Per Unit Load	kW	Efficiency %
0.25	75.0	89.5
0.5	150.0	92.7
0.75	225.0	93.7
1.0	300.0	93.7

Reactances	Per Unit	Ohms
SUBTRANSIENT - DIRECT AXIS X''_d	0.1156	0.0710
SUBTRANSIENT - QUADRATURE AXIS X''_q	0.1567	0.0963
TRANSIENT - SATURATED X'_d	0.1652	0.1015
SYNCHRONOUS - DIRECT AXIS X_d	2.8711	1.7640
SYNCHRONOUS - QUADRATURE AXIS X_q	1.7227	1.0584
NEGATIVE SEQUENCE X_2	0.1357	0.0834
ZERO SEQUENCE X_0	0.0081	0.0050

Time Constants	Seconds
OPEN CIRCUIT TRANSIENT - DIRECT AXIS T'_{d0}	1.7380
SHORT CIRCUIT TRANSIENT - DIRECT AXIS T'_d	0.1000
OPEN CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_{d0}	0.0130
SHORT CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_d	0.0100
OPEN CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_{q0}	0.1100
SHORT CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_q	0.0100
EXCITER TIME CONSTANT T_e	0.0300
ARMATURE SHORT CIRCUIT T_a	0.0150

Short Circuit Ratio: 0.44	Stator Resistance = 0.0163 Ohms	Field Resistance = 0.768 Ohms

Voltage Regulation

Voltage level adjustment: +/-	5.0%
Voltage regulation, steady state: +/-	0.5%
Voltage regulation with 3% speed change: +/-	0.5%
Waveform deviation line - line, no load: less than	2.0%
Telephone influence factor: less than	50

Generator Excitation

	No Load	Full Load, (rated) pf Series	Parallel
Excitation voltage:	10.2 Volts	41.75 Volts	Volts
Excitation current	1.0 Amps	3.37 Amps	Amps

Top...

Selected Model

Engine: C9	**Generator Frame:** LC6114B	**Genset Rating (kW):** 300.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 4183863	**Genset Rating (kVA):** 375.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Self Excited	**Pwr. Factor:** 0.8	**Rated Current:** 451.1
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current
			Version: 41764 /40476 /41800 /10592

Generator Mechanical Information

Center of Gravity

Dimension X	-431.0 mm	-17.0 IN.
Dimension Y	0.0 mm	0.0 IN.
Dimension Z	0.0 mm	0.0 IN.

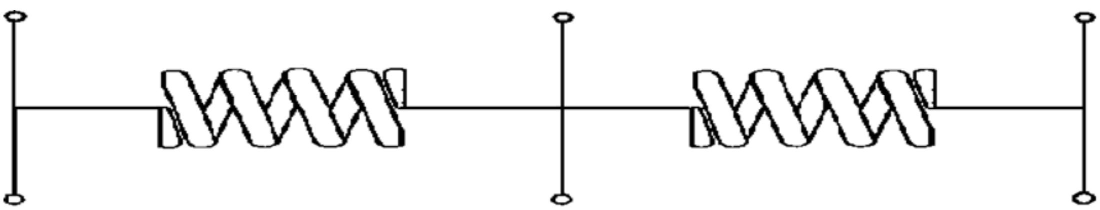
- "X" is measured from driven end of generator and parallel to rotor. Towards engine fan is positive. See General Information for details
- "Y" is measured vertically from rotor center line. Up is positive.
- "Z" is measured to left and right of rotor center line. To the right is positive.

Generator WT = 996 kg	* Rotor WT = 387 kg	* Stator WT = 609 kg
2,196 LB	853 LB	1,343 LB

Rotor Balance = 0.0508 mm deflection PTP

Overspeed Capacity = 125% of synchronous speed

Generator Torsional Data



J1 = Coupling and Fan

J2 = Rotor
TOTAL J = J1 + J2 + J3

J3 = Exciter End

K1 = Shaft Stiffness between J1 + J2 (Diameter 1)

K2 = Shaft Stiffness between J2 + J3 (Diameter 2)

J1	K1	Min Shaft Dia 1	J2	K2	Min Shaft Dia 2	J3
17.1 LB IN. s^2	55.5 MLB IN./rad	4.5 IN.	35.4 LB IN. s^2	40.8 MLB IN./rad	4.3 IN.	1.5 LB IN. s^2
1.93 N m s^2	6.27 MN m/rad	115.0 mm	4.0 N m s^2	4.61 MN m/rad	110.0 mm	0.17 N m s^2
			Total J			
			54.0 LB IN. s^2			
			6.1 N m s^2			

Top...

Selected Model

Engine: C9	**Generator Frame:** LC6114B	**Genset Rating (kW):** 300.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 4183863	**Genset Rating (kVA):** 375.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Self Excited	**Pwr. Factor:** 0.8	**Rated Current:** 451.1
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current
			Version: 41764 /40476 /41800 /10592

Generator Cooling Requirements - Temperature - Insulation Data

Cooling Requirements:		**Temperature Data: (Ambient 40 ^{0}C)**	
Heat Dissipated:	20.2 kW	**Stator Rise:**	105.0 ^{0}C
Air Flow:	66.0 m^3/min	**Rotor Rise:**	105.0 ^{0}C

Insulation Class: H

Insulation Reg. as shipped: 100.0 MΩ minimum at 40 ^{0}C

Thermal Limits of Generator

Frequency:	60 Hz
Line to Line Voltage:	480 Volts
B BR 80/40	384.0 kVA
F BR -105/40	436.8 kVA
H BR - 125/40	480.0 kVA
F PR - 130/40	480.0 kVA
H PR - 150/40	508.8 kVA
H PR27 - 163/27	528.0 kVA

Top...

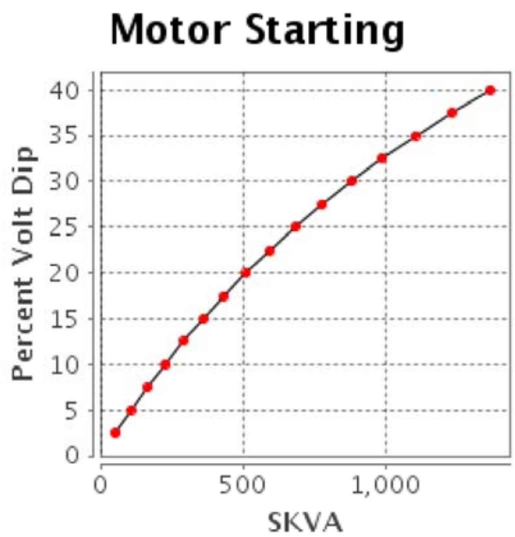
Selected Model

Engine: C9	**Generator Frame:** LC6114B	**Genset Rating (kW):** 300.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 4183863	**Genset Rating (kVA):** 375.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Self Excited	**Pwr. Factor:** 0.8	**Rated Current:** 451.1
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current
			Version: 41764 /40476 /41800 /10592

Starting Capability & Current Decrement

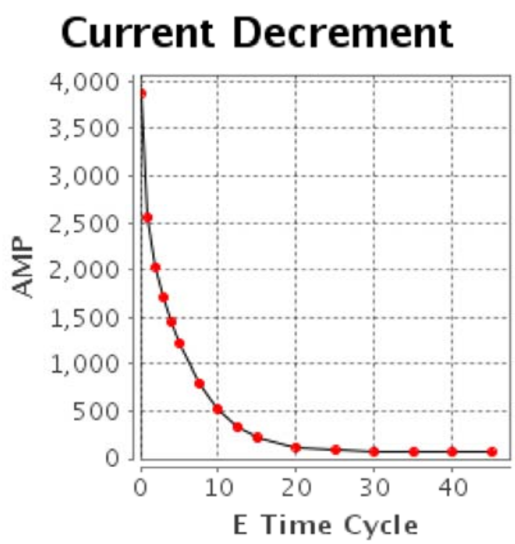
Motor Starting Capability (0.6 pf)

SKVA	Percent Volt Dip
53	2.5
108	5.0
166	7.5
228	10.0
293	12.5
362	15.0
435	17.5
513	20.0
596	22.5
684	25.0
779	27.5
880	30.0
988	32.5
1,105	35.0
1,232	37.5
1,369	40.0



Current Decrement Data

E Time Cycle	AMP
0.0	3,877
1.0	2,556
2.0	2,035
3.0	1,705
4.0	1,444
5.0	1,223
7.5	803
10.0	520
12.5	329
15.0	217
20.0	121
25.0	88
30.0	75
35.0	70
40.0	68
45.0	67



Instantaneous 3 Phase Fault Current: 3877 Amps **Instantaneous Line - Line Fault Current:** 3089 Amps
Instantaneous Line - Neutral Fault Current: 5181 Amps

Top...

Selected Model

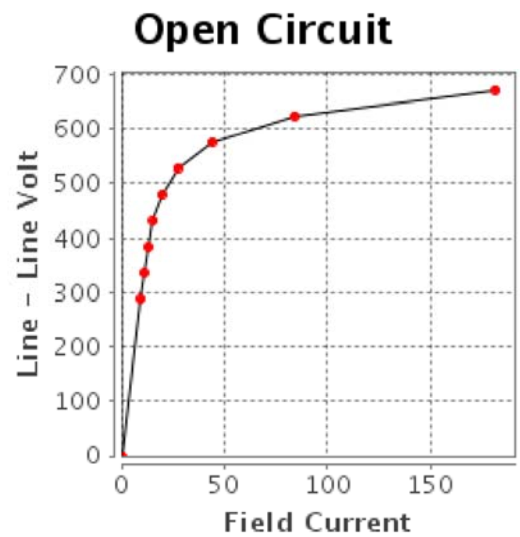
Engine: C9	**Generator Frame:** LC6114B	**Genset Rating (kW):** 300.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 4183863	**Genset Rating (kVA):** 375.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Self Excited	**Pwr. Factor:** 0.8	**Rated Current:** 451.1
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version:
41764 /40476 /41800 /10592

Generator Output Characteristic Curves

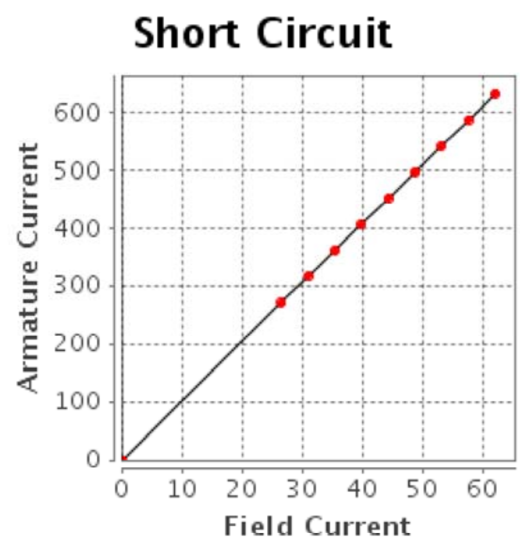
Open Circuit Curve

Field Current	Line - Line Volt
0.0	0
9.4	288
11.1	336
13.0	384
15.5	432
19.6	480
27.3	528
44.2	576
84.2	624
181.6	672



Short Circuit Curve

Field Current	Armature Current
0.0	0
26.6	271
31.0	316
35.5	361
39.9	406
44.3	451
48.8	496
53.2	541
57.6	586
62.1	631



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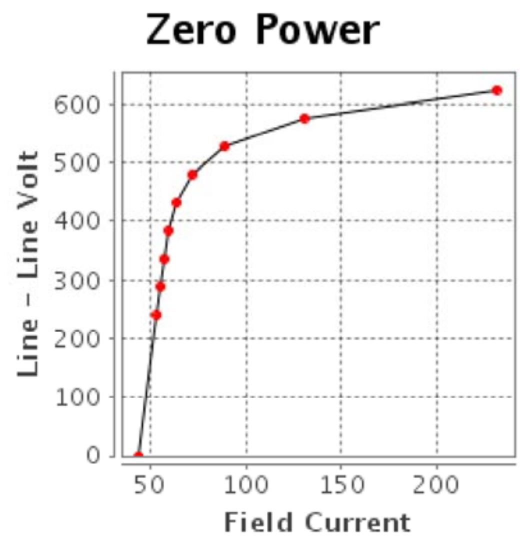
Selected Model

Engine: C9	**Generator Frame:** LC6114B	**Genset Rating (kW):** 300.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 4183863	**Genset Rating (kVA):** 375.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Self Excited	**Pwr. Factor:** 0.8	**Rated Current:** 451.1
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current
			Version: 41764 /40476 /41800 /10592

Generator Output Characteristic Curves

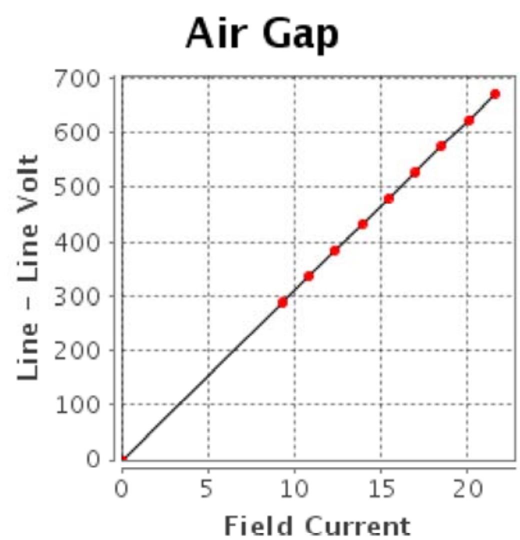
Zero Power Factor Curve

Field Current	Line - Line Volt
44.3	0
53.7	240
55.4	288
57.3	336
59.9	384
64.0	432
71.9	480
89.4	528
130.6	576
231.2	624



Air Gap Curve

Field Current	Line - Line Volt
0.0	0
9.3	288
10.8	336
12.3	384
13.9	432
15.4	480
17.0	528
18.5	576
20.1	624
21.6	672

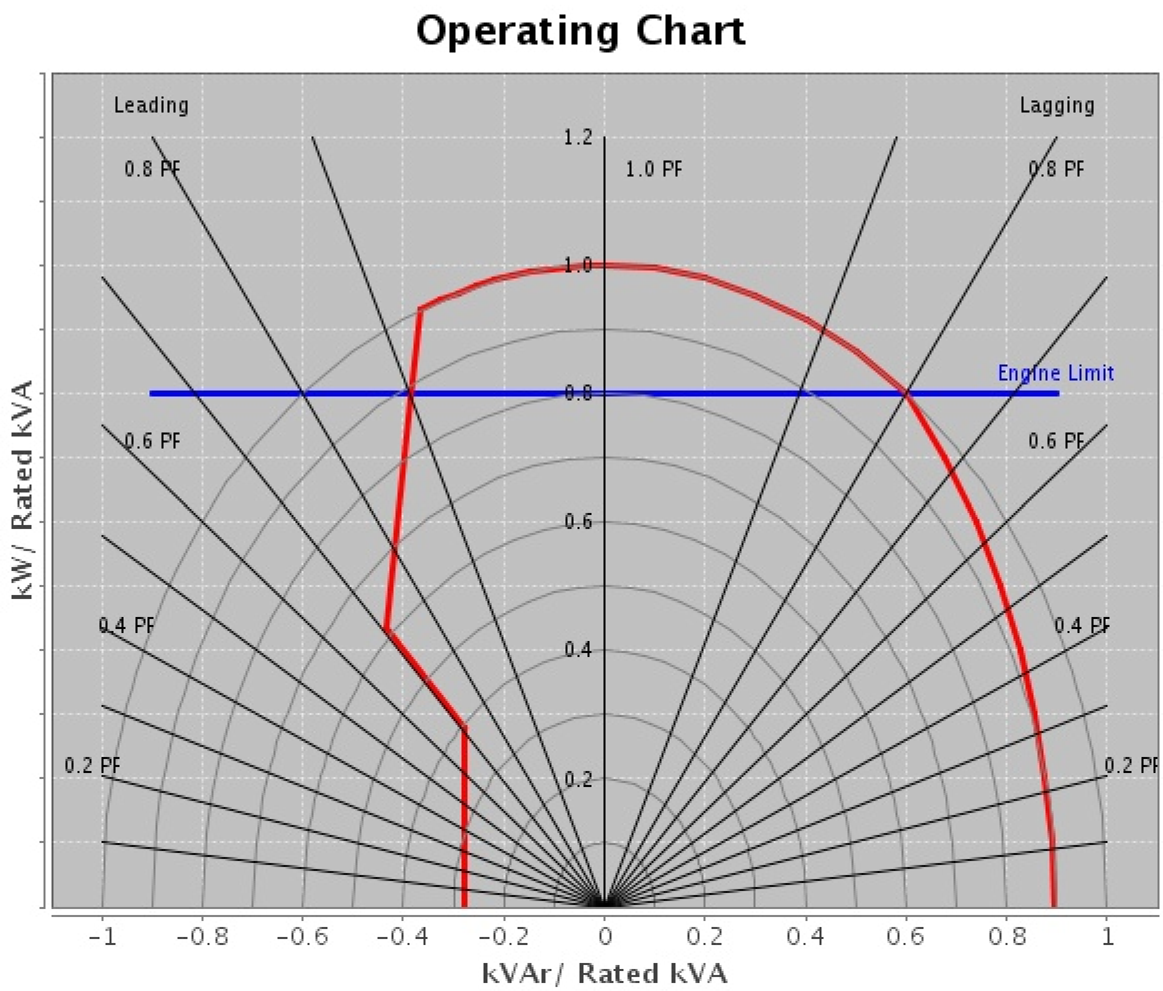


Top...

Selected Model

Engine: C9	**Generator Frame:** LC6114B	**Genset Rating (kW):** 300.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 4183863	**Genset Rating (kVA):** 375.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Self Excited	**Pwr. Factor:** 0.8	**Rated Current:** 451.1
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current
			Version: 41764 /40476 /41800 /10592

Reactive Capability Curve



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Selected Model

Engine: C9	**Generator Frame:** LC6114B	**Genset Rating (kW):** 300.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 4183863	**Genset Rating (kVA):** 375.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Self Excited	**Pwr. Factor:** 0.8	**Rated Current:** 451.1
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version:
41764 /40476 /41800 /10592

General Information

GENERATOR INFORMATION (DM7900)

----

1. Motor Starting
Motor starting curves are obtained in accordance with IEC60034, and are displayed at 0.6 power factor.

2. Voltage Dip
Prediction of the generator synchronous voltage dip can be made by consulting the plot for the voltage dip value that corresponds to the desired motor starting kVA value.

3. Definitions
A) Generator Keys
Frame: abbreviation of generator frame size
Freq: frequency in hertz.
PP/SB: prime/standby duty respectively
Volts: line - line terminal voltage
kW: rating in electrical kilo watts
Model: engine sales model

B) Generator Temperature Rise
The indicated temperature rises are the IEC/NEMA limits for standby or prime power applications. The quoted rise figures are maximum limits only and are not necessarily indicative of the actual temperature rise of a given machine winding.

C) Centre of Gravity
The specified centre of gravity is for the generator only. For single bearing, and two bearing close coupled generators, the center of gravity is measured from the generator/engine flywheel-housing interface and from the centreline of the rotor Shaft.

For two bearing, standalone generators, the center of gravity is measured from the end of the rotor shaft and from the centerline of the rotor shaft.

D) Generator Current Decrement Curves
The generator current decrement curve indicates the generator armature current arising from a symmetrical three-phase fault at the generator terminals. Generators equipped with AREP or PMG excitation systems will sustain 300% of rated armature current for 10 seconds.

E) Generator Efficiency Curves
The efficiency curve is displayed for the generator only under the given conditions of rating, voltage, frequency and power factor. This is not the overall generating set efficiency curve.

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APPENDIX D. BACT COST CALCULATIONS

Table D-1. General Cost Calculation Inputs

Number of Main Engines	57
Number of Support Engines	2
Bank Prime Rate (Aug 2021) [a]	3.25%
Lifespan of SCR (yrs.) [b]	25
Lifespan of DPF (yrs.) [b]	25
Lifespan of DOC (yrs.) [b]	25
Lifespan of Tier 4 Integrated Control System (yrs.)	25
CECPI 2016 ($)	541.7
CECPI 2020 ($)	596.2

a. Capital recovery is calculated using a 3.25% annual interest rate, which is the bank prime rate as of August 2021.

b. A 25-yr life span is conservatively assumed for the SCR system, consistent with the recent Vantage and CyrusOne applications and in accordance with Section 4, Chapter 2 of EPA APCCM, 7th Edition. A 25-year life span is conservatively assumed for the DPF, DOC, and Tier 4 Integrated Control System, consistent with the recent Vantage and CyrusOne applications.

Table D-2. Criteria Pollutant Emission Rates and Control Efficiencies [a]

Pollutant	Main [b] tpy	Support tpy	SCR Removal %	DPF Removal %	DOC Removal %	Tier 4 Removal %
Particulate Matter (PM)	0.51	1.72E-02	0%	90%	25%	88%
Carbon Monoxide (CO)	10.27	0.15	0%	80%	80%	80%
Volatile Organic Compounds (VOC)	1.02	1.78E-02	0%	70%	70%	70%
Nitrogen Oxides (NO_X)	53.19	0.76	90%	0%	0%	90%

a. Control technology removal efficiencies are consistent with calculations from recent Vantage and CyrusOne applications.

b. In the case of PM, the worst-case PM emission rate among uncontrolled gensets is the Cummins DQKAF genset model. To accurately account for uncontrolled emissions, the uncontrolled emission rate assuming all gensets are Cummins DQKAF is used to conservatively represent total uncontrolled PM emissions.

Table D-3. Toxic Air Pollutant Emission Rates and Control Efficiencies [a]

Pollutant	Main [b] tpy	Support tpy	SCR Removal %	DPF Removal %	DOC Removal %	Tier 4 Removal %
Acrolein	1.57E-04	6.13E-06	0%	70%	70%	70%
Benzene	1.54E-02	2.16E-04	0%	70%	70%	70%
Benzo(a)pyrene	5.11E-06	6.60E-08	0%	70%	70%	70%
Dibenz(a,h)anthracene	6.88E-06	1.04E-07	0%	70%	70%	70%
Formaldehyde	1.57E-03	7.35E-05	0%	70%	70%	70%
Naphthalene	2.58E-03	3.29E-05	0%	70%	70%	70%
Xylenes	3.84E-03	5.63E-05	0%	70%	70%	70%
Diesel engine exhaust, particulate	5.13E-01	1.72E-02	0%	90%	25%	88%
Sulfur Dioxide (SO_2)	3.73E-02	1.52E-02	0%	0%	0%	0%
Carbon Monoxide (CO)	1.03E+01	1.49E-01	0%	80%	80%	80%
Nitrogen Dioxide (NO_2)	5.32E+00	7.58E-02	90%	0%	0%	90%

a. Control technology removal efficiencies are consistent with calculations from recent Vantage and CyrusOne applications.

b. Diesel partciulate emissions represent the only TAP emissions subject to BACT review that are emitted as PM. For consistency with PM emissions represented in Table D-2, the project potential to emit for diesel particulate is scaled using the uncontorlled emissions for the Cummins DQKAF genset model.

Table D-4. SCR Cost Calculation Inputs

MW of NH_3 (g/mol)	17.03
MW of NO_X (g/mol)	46.01
Ammonia Cost ($/gal)	0.293
Operational Hours (hr/yr/engine)	55
Aqueous Ammonia Concentration (%w/w)	29%
Specific Gravity 29% ammonia [a]	0.9
Water density (lb/gal)	8.35
Size of main engines (MW)	2.25
NRF [b]	1.125
$CC_{replace}$ ($/ft^3) [c]	227
Size of support engines (MW) [d]	0.3

a. The specific gravity of 29% ammonia is estimated as 0.9, per the aqua ammonia specific gravity chart from Inyo Process (https://inyoprocess.com/images/chem_appl/aqua_ammonia_specific_gravity_chart.pdf)

b. NRF is the NO_X removal, as defined in the EPA Control Cost Manual, 7th Edition, Equation 2.41.

c. $CC_{replace}$ is the cost of catalyst replacement. The value used is the catalyst replacement cost used in EPA Control Cost Manual, 7th Edition, Section 4, Chapter 2.5, Example Problem #1.

d. Conservatively set support engine size to the smallest option across Building D and E

BACT Cost Analysis for NO_X - SCR Option - Main and Support Gensets

Table D-5a. Capital Costs

Capital Cost	**Description**	**Calculated Cost**		**Reference**
Direct Cost				
	Emission Control Package for 57 Main Engines	$	9,657,254 [a]	A
	Emission Control Package for 2 Support Engine	$	101,151 [i]	B
	Sales Tax	$	634,296 [b]	C = WA State Tax of 6.5% x (A + B)
	Shipping	$	487,920 [b]	D = 5% of package price x (A + B)
	Installation for 57 Main Engines	$	741,000 [c]	E
	Installation for 2 Support Engine	$	26,000 [c]	F
Total Direct Cost		*$*	*11,647,621*	TDC = A + B + C + D + E + F
Indirect Cost				
	Engineering	$	177,000 [d]	G
	Construction and Field Expenses	$	177,000 [d]	H
	Contractor Fees	$	792,038 [d]	I = 6.8% x (A + B + C + D + E + F)
	Startup	$	177,000 [d]	J
	Performance Test	$	116,476.21 [d]	K = 1% x (A + B + C + D + E + F)
	Contingencies	$	349,428.64 [d]	L = 3% x (A + B + C + D + E + F)
Total Indirect Cost		*$*	*1,788,943*	TIC = G + H + I + J + K + L
Total Capital Investment		**$**	**13,436,565**	TCI = TDC + TIC

Table D-5b. Operating Costs

Operating Cost			**Reference**
Direct Annual Cost			
	Maintenance	$ 67,183 [e]	M = 0.5% x TCI
	Catalyst Cost	$ 494,193 [e]	N = {Cost of replacement catalyst}
	Reagent Consumption	$ 5,088 [f]	O = {NO_X removal, cost of ammonia}
Total Direct Annual Costs		$ *566,464*	DAC = M + N + O
Indirect Annual Costs			
	Administrative Charges	$ 6,647 [b]	P = 3% x ((Op. Labor Cost) + 40% x K)
	Property Tax	$ 134,365.65 [b]	Q = 1% x TCI
	Insurance	$ 134,365.65 [b]	R = 1% x TCI
	Capital Recovery	$ 793,285.71 [g]	CRC_S = TCI x CRF
Total Indirect Annual Costs		$ *1,068,664*	IDAC = P + Q + R + CRC
Total Annual Cost [h]		**$ 1,635,128**	TAC = DAC + IDAC

a. Cost for SCR control package is the average unit price from Vantage (for the 3 MWe unit) and CyrusOne (for the 2250 kWe unit) Data Centers.

b. Shipping costs are calculated in accordance to Table 2.4, Section 2.6.4, Chapter 2, Section 1 of EPA Air Pollution Control Cost Manual (APCCM), 7th Edition. Sales tax is calculated using the Washington state sales tax rate. Administrative charges calculated in accordance with Equation 2.69, Chapter 2, Section 4 of EPA Air Pollution Control Cost Manual. Operator labor cost used in the calculation of administrative charges is calculated assuming a maximum labor usage of 55 hr/yr/engine, which is the maximum number of operational hours for each engine. Operator labor cost is calculated using the labor rate in Section 4, Chapter 2, 2.5 of the EPA Air Pollution Control Cost Manual Example Problem #1. Administrative charges, property tax, and insurance are calculated according to Section 1, Chapter 2, 2.6.5.8 of the APCCM.

c. Cost for SCR instalation is the average unit price from Vantage (for the 3 MWe unit) and CyrusOne (for the 2250 unit) Data Centers.

d. Each of the indirect capital costs are calculated following the most conservative approach between the Vantage and CyrusOne applications.

e. Maintenance cost is calculated in accordance with Equation 2.57 of Chapter 2, Section 4 of EPA APCCM, 7th Edition. Catalyst cost is calculated per Equation 2.67, Chapter 2, Section 4 of EPA APCCM, 7th Edition.

f. Reagent consumption is calculated in accordance to Equation 2.35, Chapter 2, Section 4 of EPA APCCM. It is assumed that anhydrous ammonia is used for this BACT cost analysis, because "anhydrous ammonia typically has the lowest capital and operating costs" (page 2-12 of Chapter 2, Section 4 of EPA APCCM). It is assumed that the NO_X removal efficiency is 90%, and the cost of ammonia is at the EPA default value of $0.293/gal ammonia, as listed in Chapter 2, Section 4, 2.6 of the EPA APCCM. The control efficiency used in the Vantage and CyrusOne applications is 90%. Additionally, using anhydrous ammonia will bring additional cost for equipment to store the anhydrous ammonia and other cost associated with demonstrating compliance with Risk Management Program, which are not included in this conservative cost calculation.

g. Capital recovery is calculated using a 3.25% annual interest rate, which is the bank prime rate as of August 2021, and a 25-yr life span for the SCR system, in accordance with Section 4, Chapter 2 of EPA APCCM, 7th Edition.

h. For annual operating cost, it is conservatively assumed that operating labor, supervisory labor, and electricity are negligible since the emission units will not be operated continuously.

i. Costs for support genset control technology are scaled from main genset costs according to the 0.6 power rule.

Table D-5c. Criteria Pollutant Control Cost Effectiveness

Annual Control Cost for SCR		$ 1,635,128	
	Ecology Acceptable Unit Cost ($/ton)	**Total Removal (tpy)**	**Reasonable Annual Cost ($/yr)**
Removal efficiency of 90% for NOx	$12,000	48.55 [a,c]	$ 582,621.55
	Total Reasonable Annual Cost for Combined Pollutants [a,b]		$ 582,621.55
	Is the control device cost reasonable?		No

a. Removal efficiencies are consistent with recent CyrusOne and Vantage cost calculations.

b. The total reasonable annual cost compared to the actual annual control cost demonstrates that the control is cost prohibitive. This is consistent with CyrusOne and Vantage applications.

c. "Ecology Acceptable Unit Costs" are consistent with the cost thresholds used in CyrusOne and Vantage applications.

Table D-5d. Toxic Air Pollutant Control Cost Effectiveness

Pollutant [a]	ASIL ($\mu g/m^3$)	ASIL Based Cost Factor [b]	Ecology Acceptable Unit Cost ($/ton) [c]	Total Removal (tpy)	Reasonable Annual Cost ($/yr) [d]
Removal efficiency of 0% for Acrolein	3.50E-01	4.9	$ 51,317	0.00E+00	$ -
Removal efficiency of 0% for Benzene	1.30E-01	5.3	$ 55,833	0.00E+00	$ -
Removal efficiency of 0% for Benzo(a)pyrene	1.00E-03	7.4	$ 78,029	0.00E+00	$ -
Removal efficiency of 0% for Dibenz(a,h)anthracene	5.00E-04	7.7	$ 81,190	0.00E+00	$ -
Removal efficiency of 0% for Formaldehyde	1.70E-01	5.2	$ 54,610	0.00E+00	$ -
Removal efficiency of 0% for Naphthalene	2.90E-02	6.0	$ 62,674	0.00E+00	$ -
Removal efficiency of 0% for Xylenes	2.20E+02	2.1	$ 21,934	0.00E+00	$ -
Removal efficiency of 0% for Diesel engine exhaust, particulate	3.30E-03	6.9	$ 72,585	0.00E+00	$ -
Removal efficiency of 0% for Sulfur Dioxide (SO2)	6.60E+02	1.6	$ 16,924	0.00E+00	$ -
Removal efficiency of 0% for Carbon Monoxide (CO)	2.30E+04	0.1	$ 731	0.00E+00	$ -
Removal efficiency of 90% for Nitrogen Dioxide (NO2)	4.70E+02	1.8	$ 18,472	4.86E+00	$ 89,683.58
Total Reasonable Annual Cost for Combined Pollutants					$ 89,683.58
Is the control device cost reasonable?					No

a. Removal efficiencies are consistent with recent CyrusOne and Vantage cost calculations.

b. ASIL Based Cost Factor derived from the Hanford Methodology. https://www.osti.gov/servlets/purl/991923 . Cost Factor = Log_{10}(27,000 / ASIL)

c. Assumes a maximum ceiling value of $10,500/ton, as described in the Hanford Evaluation of Best Available Control Technology for Toxics (tBACT) Double Sheel Tank Farms Primary Ventilation Systems Supporting Waste Transfer Operations and consistent with other recent data center NOC applications.

d. The total reasonable annual cost compared to the actual annual control cost demonstrates that the control is cost prohibitive. This is consistent with CyrusOne and Vantage applications.

BACT Cost Analysis for CO, PM and VOC - Diesel Particulate Filter - Main and Support Gensets

Table D-6a. Capital Costs

Capital Cost	**Description**	**Calculated Cost**	**Reference**
Direct Cost			
	Emission Control Package for 57 Main Engines	$ 5,745,002 [a]	A
	Emission Control Package for 2 Support Engines	$ 60,174 [g]	B
	Sales Tax	$ 377,336 [b]	C = WA State Tax of 6.5% x (A + B)
	Shipping	$ 290,258.77 [b]	D = 5% x (A + B)
	Instrumentation	$ 58,051.75 [b]	E = 1% x (A + B)
Total Direct Cost		*$ 6,530,822*	TDC = A + B + C + D + E
Indirect Cost			
	Engineering	$ 118,000 [c]	F
	Construction and Field Expenses	$ - [c]	G
	Contractor Fees	$ 444,096 [c]	H = 6.8% x (A + B + C + D + E)
	Startup	$ 88,500.00 [c]	I
	Performance Test	$ 65,308.22 [c]	J = 1% x (A + B + C + D + E)
	Contingencies	$ 195,924.67 [c]	K = 3% x (A + B + C + D + E)
Total Indirect Cost		*$ 911,829*	TIC = F + G + H + I + J + K
Total Capital Investment		**$ 7,442,651**	TCI = TDC + TIC

Table D-6b. Operating Costs

Operating Cost			Reference
Indirect Annual Costs [e]			
	Administrative Charges	$ 148,853 [b]	L = 2% × TCI
	Property Tax	$ 74,427 [b]	M = 1% × TCI
	Insurance	$ 74,427 [b]	N = 1% × TCI
	Capital Recovery	$ 439,409.11 [d]	CRC_S = TCI x CRF
Total Indirect Annual Costs		$ *737,115*	IDAC = L + M + N + CRC
Total Annual Cost[f]		**$ 737,115** [f]	TAC = IDAC

a. Cost for diesel particulate filter control package is the average unit price from Vantage (for the 3 MWe unit) and CyrusOne (for the 2250 KWe unit) Data Centers.

b. Shipping costs and instrumentation costs are calculated in accordance to Table 2.4, Section 2.6.4, Chapter 2, Section 1 of EPA Air Pollution Control Cost Manual (APCCM), 7th Edition. Sales tax is calculated using the Washington state sales tax rate. Indirect annual costs are calculated per EPA APCCM Section 1, Chapter 2, 2.6.5.8.

c. Each of the indirect capital costs are calculated following the most conservative approach between the EPA Air Pollution Control Cost Manual - Sixth Edition, Section 6, Chapter 1, Vantage application and CyrusOne application.

d. Capital recovery is calculated using a 3.25% annual interest rate, which is the bank prime rate as of August 2021, and a 25-yr life span for the DPF, following the precedent of the Vantage and CyrusOne permit applications.

e. Indirect annual costs calculated in accordance with EPA Air Pollution Control Cost Manual - Sixth Edition, Section 6, Chapter 1.

f. For direct annual operating cost, it is conservatively assumed that operating labor, supervisory labor, and electricity are negligible since the emission units will not be operated continuously. The cost for maintenance is also conservatively assumed negligible, though the diesel particulate filter will require regular cleaning and maintenance.

g. Costs for support genset control technology are scaled from main genset costs according to the 0.6 power rule.

Table D-6c. Criteria Pollutant Control Cost Effectiveness

Annual Control Cost for Diesel Particulate Filter		$ 737,115	
	Ecology Acceptable Unit Cost ($/ton)	**Total Removal (tpy)**	**Cost Effectiveness ($/ton)**
Removal efficiency of 90% for PM	$12,000	0.48 [a,c]	$ 5,728.52
Removal efficiency of 80% for CO	$5,000	8.34 [a,c]	$ 41,682.48
Removal efficiency of 70% for VOC	$12,000	0.73 [a,c]	$ 8,742.52
		Total Reasonable Annual Cost for Combined Pollutants [a,b]	$ 56,153.52
		Is the control device cost reasonable?	No

a. Removal efficiencies are consistent with recent CyrusOne and Vantage cost calculations.

b. The total reasonable annual cost compared to the actual annual control cost demonstrates that the control is cost prohibitive. This is consistent with CyrusOne and Vantage applications.

c. "Ecology Acceptable Unit Costs" are consistent with the cost thresholds used in CyrusOne and Vantage applications.

Table D-6d. Toxic Air Pollutant Control Cost Effectiveness

Pollutant[a]	ASIL (µg/m^3)	ASIL Based Cost Factor [b]	Ecology Acceptable Unit Cost ($/ton)[c]	Total Removal (tpy)	Reasonable Annual Cost ($/yr)[d]
Removal efficiency of 70% for Acrolein	3.50E-01	4.9	$ 51,317	1.14E-04	$ 5.85
Removal efficiency of 70% for Benzene	1.30E-01	5.3	$ 55,833	1.09E-02	$ 611.30
Removal efficiency of 70% for Benzo(a)pyrene	1.00E-03	7.4	$ 78,029	3.62E-06	$ 0.28
Removal efficiency of 70% for Dibenz(a,h)anthracene	5.00E-04	7.7	$ 81,190	4.89E-06	$ 0.40
Removal efficiency of 70% for Formaldehyde	1.70E-01	5.2	$ 54,610	1.15E-03	$ 62.76
Removal efficiency of 70% for Naphthalene	2.90E-02	6.0	$ 62,674	1.83E-03	$ 114.81
Removal efficiency of 70% for Xylenes	2.20E+02	2.1	$ 21,934	2.72E-03	$ 59.77
Removal efficiency of 90% for Diesel engine exhaust, particulate	3.30E-03	6.9	$ 72,585	4.77E-01	$ 34,651.42
Removal efficiency of 0% for Sulfur Dioxide (SO2)	6.60E+02	1.6	$ 16,924	0.00E+00	$ -
Removal efficiency of 80% for Carbon Monoxide (CO)	2.30E+04	0.1	$ 731	8.34E+00	$ 6,095.10
Removal efficiency of 0% for Nitrogen Dioxide (NO2)	4.70E+02	1.8	$ 18,472	0.00E+00	$ -
Total Reasonable Annual Cost for Combined Pollutants					$ 41,601.69
Is the control device cost reasonable?					No

a. Removal efficiencies are consistent with recent CyrusOne and Vantage cost calculations.

b. ASIL Based Cost Factor derived from the Hanford Methodology. https://www.osti.gov/servlets/purl/991923 . Cost Factor = Log_{10}(27,000 / ASIL)

c. Assumes a maximum ceiling value of $10,500/ton, as described in the Hanford Evaluation of Best Available Control Technology for Toxics (tBACT) Double Sheel Tank Farms Primary Ventilation Systems Supporting Waste Transfer Operations and consistent with other recent data center NOC applications.

d. The total reasonable annual cost compared to the actual annual control cost demonstrates that the control is cost prohibitive. This is consistent with CyrusOne and Vantage applications.

BACT Cost Analysis for CO, PM and VOC - Diesel Oxidation Catalyst - Main and Support Gensets

Table D-7a. Capital Costs

Capital Cost	Description	Calculated Cost	Reference
Direct Cost			
	Emission Control Package for 57 Main Engines	$ 1,267,851 [a]	A
	Emission Control Package for 2 Support Engines	$ 13,280 [g]	B
	Sales Tax	$ 83,273 [b]	C = WA State Tax of 6.5% x (A + B)
	Shipping	$ 64,056.53 [b]	D = 5% x (A +B)
	Instrumentation	$ 12,811.31 [b]	E = 1% x (A + B)
Total Direct Cost		*$ 1,441,272*	TDC = A + B + C + D + E
Indirect Cost			
	Engineering	$ 36,032 [c]	F = 2.5% x (A + B + C + D + E)
	Construction and Field Expenses	$ - [c]	G
	Contractor Fees	$ 98,006 [c]	H = 6.8% x (A + B + C + D + E)
	Startup	$ 28,825.44 [c]	I = 2% x (A + B + C + D + E)
	Performance Test	$ 14,412.72 [c]	J = 1% x (A + B + C + D + E)
	Other instrumentation	$ 43,238.16 [c]	K = 3% x (A + B + C + D + E)
Total Indirect Cost		*$ 220,515*	TIC = F + G + H + I + J + K
Total Capital Investment		**$ 1,661,787**	TCI = TDC + TIC

Table D-7b. Operating Costs

Operating Cost			Reference
Indirect Annual Costs [e]			
	Administrative Charges	$ 33,236 [b]	L = 2% × TCI
	Property Tax	$ 16,618 [b]	M = 1% × TCI
	Insurance	$ 16,618 [b]	N = 1% × TCI
	Capital Recovery	$ 98,110.76 [d]	CRC_S = TCI x CRF
Total Indirect Annual Costs		$ *164,582*	IDAC = L + M + N + CRC
Total Annual Cost [f]		**$ 164,582** [f]	TAC = DAC

a. Cost for diesel oxidation catalyst control package is the average unit price from Vantage (for the 3 MWe unit) and CyrusOne (for the 2250 kWe unit) Data Centers.

b. Shipping costs and instrumentation costs are calculated in accordance to Table 2.4, Section 2.6.4, Chapter 2, Section 1 of EPA Air Pollution Control Cost Manual (APCCM), 7th Edition. Sales tax is calculated using the Washington state sales tax rate. Indirect annual costs are calculated per EPA APCCM Section 1, Chapter 2, 2.6.5.8.

c. Each of the indirect capital costs are calculated following the most conservative approach between the Vantage and CyrusOne applications.

d. Capital recovery is calculated using a 3.25% annual interest rate, which is the bank prime rate as of August 2021, and a 25-yr life span for the DPF, following the precedent of the Vantage and CyrusOne permit applications.

e. Indirect annual costs calculated in accordance with EPA Air Pollution Control Cost Manual - Sixth Edition, Section 6, Chapter 1.

f. For direct annual operating cost, it is conservatively assumed that operating labor, supervisory labor, and electricity are negligible since the emission units will not be operated continuously. The cost for maintenance is also assumed negligible, since diesel oxidation catalyst requires minimal maintenance once properly installed. The cost for catalyst replacement is conservatively assumed to be zero.

g. Costs for support genset control technology are scaled from main genset costs according to the 0.6 power rule.

Table D-7c. Criteria Pollutant Control Cost Effectiveness

Annual Control Cost for Diesel Oxidation Catalyst		$ 164,582	
	Ecology Acceptable Unit Cost ($/ton)	**Total Removal (tpy)**	**Reasonable Annual Cost ($/yr)**
Removal efficiency of 25% for PM	$12,000	0.13 [a,c]	$ 1,591.25
Removal efficiency of 80% for CO	$5,000	8.34 [a,c]	$ 41,682.48
Removal efficiency of 70% for VOC	$12,000	0.73 [a,c]	$ 8,742.52
		Total Reasonable Annual Cost for Combined Pollutants [a,b]	$ 52,016.26
		Is the control device cost reasonable?	No

a. Removal efficiencies are consistent with recent CyrusOne and Vantage cost calculations.

b. The total reasonable annual cost compared to the actual annual control cost demonstrates that the control is cost prohibitive. This is consistent with CyrusOne and Vantage applications.

c. "Ecology Acceptable Unit Costs" are consistent with the cost thresholds used in CyrusOne and Vantage applications.

Table D-7d. Toxic Air Pollutant Control Cost Effectiveness

Pollutant[a]	ASIL (µg/m³)	ASIL Based Cost Factor [b]	Ecology Acceptable Unit Cost ($/ton)[c]	Total Removal (tpy)	Reasonable Annual Cost ($/yr)[d]
Removal efficiency of 70% for Acrolein	3.50E-01	4.89	$ 51,317	1.14E-04	$ 5.85
Removal efficiency of 70% for Benzene	1.30E-01	5.32	$ 55,833	1.09E-02	$ 611.30
Removal efficiency of 70% for Benzo(a)pyrene	1.00E-03	7.43	$ 78,029	3.62E-06	$ 0.28
Removal efficiency of 70% for Dibenz(a,h)anthracene	5.00E-04	7.73	$ 81,190	4.89E-06	$ 0.40
Removal efficiency of 70% for Formaldehyde	1.70E-01	5.20	$ 54,610	1.15E-03	$ 62.76
Removal efficiency of 70% for Naphthalene	2.90E-02	5.97	$ 62,674	1.83E-03	$ 114.81
Removal efficiency of 70% for Xylenes	2.20E+02	2.09	$ 21,934	2.72E-03	$ 59.77
Removal efficiency of 25% for Diesel engine exhaust, particulate	3.30E-03	6.91	$ 72,585	1.33E-01	$ 9,625.40
Removal efficiency of 0% for Sulfur Dioxide (SO2)	6.60E+02	1.61	$ 16,924	0.00E+00	$ -
Removal efficiency of 80% for Carbon Monoxide (CO)	2.30E+04	0.07	$ 731	8.34E+00	$ 6,095.10
Removal efficiency of 0% for Nitrogen Dioxide (NO2)	4.70E+02	1.76	$ 18,472	0.00E+00	$ -
Total Reasonable Annual Cost for Combined Pollutants					$ 16,575.66
Is the control device cost reasonable?					No

a. Removal efficiencies are consistent with recent CyrusOne and Vantage cost calculations.

b. ASIL Based Cost Factor derived from the Hanford Methodology. https://www.osti.gov/servlets/purl/991923 . Cost Factor = Log_{10}(27,000 / ASIL)

c. Assumes a maximum ceiling value of $10,500/ton, as described in the Hanford Evaluation of Best Available Control Technology for Toxics (tBACT) Double Sheel Tank Farms Primary Ventilation Systems Supporting Waste Transfer Operations and consistent with other recent data center NOC applications.

d. The total reasonable annual cost compared to the actual annual control cost demonstrates that the control is cost prohibitive. This is consistent with CyrusOne and Vantage applications.

BACT Cost Analysis for CO, PM, NO_X and VOC - Tier 4 Integrated Control Package - Main and Support Gensets

Table D-8a. Capital Costs

Capital Cost	**Description**	**Calculated Cost**	**Reference**
Direct Cost			
	Emission Control Package for 57 Main Engines	$ 14,632,755 [a]	A
	Emission Control Package for 2 Support Engines	$ 153,266 [f]	B
	Sales Tax	$ 961,091 [b]	C = WA State Tax of 6.5% x (A + B)
	Shipping	$ 739,301.03 [b]	D = 5% x (A + B)
	Instrumentation	$ 147,860.21 [b]	E = 1% x (A + B)
Total Direct Cost		*$ 16,634,273*	TDC = A + B + C + D + E
Indirect Cost			
	Engineering	$ 295,000 [c]	F
	Construction and Field Expenses	$ 177,000 [c]	G
	Contractor Fees	$ 1,131,131 [c]	H = 6.8% x (A + B + C + D + E)
	Startup	$ 177,000.00 [c]	I
	Performance Test	$ 166,342.73 [c]	J = 1% x (A + B + C + D + E)
	Contingencies	$ 499,028.19 [c]	K = 3% x (A + B + C + D + E)
Total Indirect Cost		*$ 2,445,501*	TIC = F + G + H + I + J + K
Total Capital Investment		**$ 19,079,775**	TCI = TDC + TIC

Table D-8b. Operating Costs

Operating Cost			Reference
Indirect Annual Costs			
	Administrative Charges	$ 381,595 [b]	L = 2% × TCI
	Property Tax	$ 190,798 [b]	M = 1% × TCI
	Insurance	$ 190,798 [b]	N = 1% × TCI
	Capital Recovery	$ 1,126,457.02 [d]	CRC_S = TCI x CRF
Total Indirect Annual Costs		$ *1,889,648*	IDAC = L + M + N + CRC
Total Annual Cost [e]		**$ 1,889,648** [e]	TAC = IDAC

a. Cost for tier 4 integrated control package is the average unit price from Vantage (for the 3 MWe unit) and CyrusOne (for the 2250 kWe unit) Data Centers.

b. Shipping costs and instrumentation costs are calculated in accordance to Table 2.4, Section 2.6.4, Chapter 2, Section 1 of EPA Air Pollution Control Cost Manual (APCCM), 7th Edition. Sales tax is calculated using the Washington state sales tax rate. Indirect annual costs are calculated per EPA APCCM Section 1, Chapter 2, 2.6.5.8.

c. Each of the indirect capital costs are calculated following the most conservative approach between the Vantage and CyrusOne applications.

d. Capital recovery is calculated using a 3.25% annual interest rate, which is the bank prime rate as of August 2021, and a 25-yr life span for the DPF, following the precedent of the Vantage and CyrusOne permit applications.

e. For annual operating cost, it is conservatively assumed that operating labor, supervisory labor, and electricity are negligible since the emission units will not be operated continuously. The cost for maintenance is also conservatively assumed negligible.

f. Costs for support genset control technology are scaled from main genset costs according to the 0.6 power rule.

Table D-8c. Criteria Pollutant Control Cost Effectiveness

Annual Control Cost for Diesel Oxidation Catalyst		**$ 1,889,648**	
	Ecology Acceptable Unit Cost ($/ton)	**Total Removal (tpy)**	**Reasonable Annual Cost ($/yr)**
Removal efficiency of 88% for PM	$12,000	0.47 [a,c]	$ 5,601.22
Removal efficiency of 80% for CO	$5,000	8.34 [a,c]	$ 41,682.48
Removal efficiency of 70% for VOC	$12,000	0.73 [a,c]	$ 8,742.52
Removal efficiency of 90% for NOx	$12,000	48.55 [a,c]	$ 582,621.55
		Total Reasonable Annual Cost for Combined Pollutants [a,b]	$ 638,647.77
		Is the control device cost reasonable?	No

a. Removal efficiencies are consistent with recent CyrusOne and Vantage cost calculations.

b. The total reasonable annual cost compared to the actual annual control cost demonstrates that the control is cost prohibitive. This is consistent with CyrusOne and Vantage applications.

c. "Ecology Acceptable Unit Costs" are consistent with the cost thresholds used in CyrusOne and Vantage applications.

Table D-8d. Toxic Air Pollutant Control Cost Effectiveness

Pollutant [a]	ASIL (µg/m^3)	ASIL Based Cost Factor [b]	Ecology Acceptable Unit Cost ($/ton) [c]	Total Removal (tpy)	Reasonable Annual Cost ($/yr) [d]
Removal efficiency of 70% for Acrolein	3.50E-01	4.89	$ 51,317	1.14E-04	$ 5.85
Removal efficiency of 70% for Benzene	1.30E-01	5.32	$ 55,833	1.09E-02	$ 611.30
Removal efficiency of 70% for Benzo(a)pyrene	1.00E-03	7.43	$ 78,029	3.62E-06	$ 0.28
Removal efficiency of 70% for Dibenz(a,h)anthracene	5.00E-04	7.73	$ 81,190	4.89E-06	$ 0.40
Removal efficiency of 70% for Formaldehyde	1.70E-01	5.20	$ 54,610	1.15E-03	$ 62.76
Removal efficiency of 70% for Naphthalene	2.90E-02	5.97	$ 62,674	1.83E-03	$ 114.81
Removal efficiency of 70% for Xylenes	2.20E+02	2.09	$ 21,934	2.72E-03	$ 59.77
Removal efficiency of 88% for Diesel engine exhaust, particulate	3.30E-03	6.91	$ 72,585	4.67E-01	$ 33,881.39
Removal efficiency of 0% for Sulfur Dioxide (SO2)	6.60E+02	1.61	$ 16,924	0.00E+00	$ -
Removal efficiency of 80% for Carbon Monoxide (CO)	2.30E+04	0.07	$ 731	8.34E+00	$ 6,095.10
Removal efficiency of 90% for Nitrogen Dioxide (NO2)	4.70E+02	1.76	$ 18,472	4.86E+00	$ 89,683.58
Total Reasonable Annual Cost for Combined Pollutants					$ 130,515.24
Is the control device cost reasonable?					No

a. Removal efficiencies are consistent with recent CyrusOne and Vantage cost calculations.

b. ASIL Based Cost Factor derived from the Hanford Methodology. https://www.osti.gov/servlets/purl/991923 . Cost Factor = Log_{10}(27,000 / ASIL)

c. Assumes a maximum ceiling value of $10,500/ton, as described in the Hanford Evaluation of Best Available Control Technology for Toxics (tBACT) Double Shell Tank Farms Primary Ventilation Systems Supporting Waste Transfer Operations and consistent with other recent data center NOC applications.

d. The total reasonable annual cost compared to the actual annual control cost demonstrates that the control is cost prohibitive. This is consistent with CyrusOne and Vantage applications.

APPENDIX E. AERMOD MODELING PARAMETERS

Table E-1a. For Each Main Genset - Criteria Pollutant Model Parameters

Pollutant	Averaging Period	Modeled Load Scenario [a]	Buildings D and E (E1-E4, E6-E30, E36-E40)					Building E (E31-E35)				
			Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Emission Rate [b] (g/s/engine)	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Emission Rate [b] (g/s/engine)
NO_X	1-hr	100%	18.29	724.15	47.23	0.46	7.846E+00	18.29	751.48	47.23	0.46	7.846E+00
NO_X	Annual	100%	18.29	724.15	47.23	0.46	2.684E-02	18.29	751.48	47.23	0.46	2.684E-02
$PM_{10}/PM_{2.5}$	24-hr	10%	18.29	605.93	12.66	0.46	1.687E-01	18.29	594.82	12.66	0.46	1.148E-01
$PM_{2.5}$	Annual	10%	18.29	605.93	12.66	0.46	5.759E-04	18.29	594.82	12.66	0.46	3.918E-04
CO	1-hr	25%	18.29	672.59	19.46	0.46	1.594E+00	18.29	661.48	19.46	0.46	3.569E-01
CO	8-hr	25%	18.29	672.59	19.46	0.46	1.594E+00	18.29	661.48	19.46	0.46	3.569E-01
SO_2	1-hr	100%	18.29	724.15	47.23	0.46	5.555E-03	18.29	751.48	47.23	0.46	4.952E-03
SO_2	3-hr	100%	18.29	724.15	47.23	0.46	5.555E-03	18.29	751.48	47.23	0.46	4.952E-03

a. Stack temperature and exit velocity are specific to the percent engine load. The load that would result in maximum offsite concentration specific to the pollutant is listed here based on the load analysis results. For the purposes of these analyses, it is assumed that the worst-case load is consistent across engine models.

b. The emission rates for short-term (1-hr, 3-hr, 8-hr and 24-hr) models are calculated assuming each engine operates continuously for the modeled period (except for 1-hr NO_2 and 24-hr $PM_{2.5}$ NAAQS modeling where not all engines are modeled with simultaneous operations). Maximum hourly emission rates across all vendors corresponding to the modeled load scenario are listed here. For annual models, the maximum hourly emission rates corresponding to the modeled load are scaled based on the proposed hours of operations per year below to obtain the annual modeled emission rate:

Maximum Hours of Operation per Year: 30

Table E-1b. For Each Support Genset - Criteria Pollutant Model Parameters

Pollutant	Averaging Period	Modeled Load Scenario [a]		Building D					Building E				
		Building D	Building E	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Emission Rate [b] (g/s/engine)	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Emission Rate [b] (g/s/engine)
NO_X	1-hr	100%	10%	3.66	770.48	58.97	0.15	8.632E-01	3.66	505.37	11.04	0.30	1.885E-01
NO_X	Annual	100%	10%	3.66	770.48	58.97	0.15	2.953E-03	3.66	505.37	11.04	0.30	6.451E-04
$PM_{10}/PM_{2.5}$	24-hr	10%	100%	3.66	540.93	15.91	0.15	4.891E-02	3.66	675.71	47.13	0.30	3.060E-02
$PM_{2.5}$	Annual	10%	100%	3.66	540.93	15.91	0.15	1.669E-04	3.66	675.71	47.13	0.30	1.044E-04
CO	1-hr	50%	100%	3.66	691.21	44.37	0.15	4.541E-01	3.66	675.71	47.13	0.30	1.468E+00
CO	8-hr	50%	100%	3.66	691.21	44.37	0.15	4.541E-01	3.66	675.71	47.13	0.30	1.468E+00
SO_2	1-hr	100%	100%	3.66	770.48	58.97	0.15	1.240E-01	3.66	675.71	47.13	0.30	3.394E-03
SO_2	3-hr	100%	100%	3.66	770.48	58.97	0.15	1.240E-01	3.66	675.71	47.13	0.30	3.394E-03

a. Stack temperature and exit velocity are specific to the percent engine load. The load that would result in maximum offsite concentration specific to the pollutant is listed here based on the load analysis results. For support gensets, the minimum stack temperature and exit velocity across all possible manufacturers is used for conservatism.

b. The emission rates for short-term (1-hr, 3-hr, 8-hr and 24-hr) models are calculated assuming each engine operates continuously for the modeled period (except for 1-hr NO_2 and 24-hr $PM_{2.5}$ NAAQS modeling where not all engines are modeled with simultaneous operations). Maximum hourly emission rates across all vendors corresponding to the modeled load scenario are listed here. For annual models, the maximum hourly emission rates corresponding to the modeled load are scaled based on the proposed hours of operations per year below to obtain the annual modeled emission rate:

Maximum Hours of Operation per Year: 30

Table E-2a. For Each Main Genset - TAP Model Parameters

Pollutant	Averaging Period	Modeled Load Scenario [a]		Buildings D and E (E1-E4, E6-E30, E36-E40)					Building E (E31-E35)				
		Buildings D and E (E1-E4, E6-E30, E36-E40)	Building E (E31-E35)	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Emission Rate [b,c] (g/s/engine)	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Emission Rate [b,c] (g/s/engine)
Acrolein	24-hr	100%	100%	18.29	724.15	47.23	0.46	2.330E-05	18.29	751.48	47.23	0.46	2.081E-05
Naphthalene	year	100%	100%	18.29	724.15	47.23	0.46	1.316E-06	18.29	751.48	47.23	0.46	1.176E-06
Benzene	year	100%	100%	18.29	724.15	47.23	0.46	7.858E-06	18.29	751.48	47.23	0.46	7.019E-06
Diesel engine exhaust, particulate	year	10% - CAT 3516C	10% - Cummins DQKAF	18.29	614.98	13.80	0.46	1.406E-04	18.29	594.82	12.66	0.46	1.878E-04
CO	1-hr	25%	25%	18.29	672.59	19.46	0.46	1.594E+00	18.29	661.48	19.46	0.46	3.569E-01
SO_2	1-hr	100%	100%	18.29	724.15	47.23	0.46	5.555E-03	18.29	751.48	47.23	0.46	4.952E-03
NO_2	1-hr	100%	100%	18.29	724.15	47.23	0.46	7.846E+00	18.29	751.48	47.23	0.46	7.846E+00

a. Stack temperature and exit velocity are specific to the percent engine load. The load that would result in maximum offsite concentration specific to the pollutant is listed here based on the load analysis results.

b. The emission rates for annual averaging period models are calculated assuming the following total number of hours of operation per year for each engine:

Maximum Hours of Operation per Year: 30

c. The emission rates for 24-hr and 1-hr models are calculated assuming each engine operates continuously for an entire day or hour, respectively. The CO emission rate is calculated using the Tier 2 standard under 40 CFR 89.112(a) and the maximum horsepowerfor each engine option. The NO_x emission rate is calculated using the maximum NO_x emission rate of each engine option.

Table E-2b. For Each Support Genset - TAP Model Parameters

Pollutant	Averaging Period	Modeled Load Scenario [a]		Building D					Building E				
		Building D	Building E	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Emission Rate [b,c] (g/s/engine)	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Emission Rate [b,c] (g/s/engine)
Acrolein	24-hr	100%	100%	3.66	770.48	58.97	0.15	3.684E-05	3.66	675.71	47.13	0.30	1.469E-05
Naphthalene	year	100%	100%	3.66	770.48	58.97	0.15	1.156E-07	3.66	675.71	47.13	0.30	8.300E-07
Benzene	year	100%	100%	3.66	770.48	58.97	0.15	1.272E-06	3.66	675.71	47.13	0.30	4.954E-06
Diesel engine exhaust, particulate	year	50% - Cummins DQDAC	100% - Cummins DQFAD	3.66	691.48	44.37	0.15	7.960E-05	3.66	749.82	48.77	0.30	4.148E-04
CO	1-hr	50%	100%	3.66	691.21	44.37	0.15	4.541E-01	3.66	675.71	47.13	0.30	1.468E+00
SO_2	1-hr	100%	100%	3.66	770.48	58.97	0.15	1.240E-01	3.66	675.71	47.13	0.30	3.394E-03
NO_2	1-hr	100%	10%	3.66	770.48	58.97	0.15	8.632E-01	3.66	505.37	11.04	0.30	1.885E-01

a. Stack temperature and exit velocity are specific to the percent engine load. The load that would result in maximum offsite concentration specific to the pollutant is listed here based on the load analysis results. The minimum stack temperature and exit velocity across all possible manufacturers is used for conservatism, except for the diesel engine exhaust particulate model. A separate analysis was conducted to determine the worst-case manufacturer specifications, which paired the manufacturer emission rate and stack temperature and velocity. Cummins was determined to have the specifications that would result in the highest offsite concentration based on the load analysis for diesel engine exhaust particulate.

b. The emission rates for annual averaging period models are calculated assuming the following total number of hours of operation per year for each engine:

Maximum Hours of Operation per Year: 30

c. The emission rates for 24-hr and 1-hr models are calculated assuming each engine operates continuously for an entire day or hour, respectively. The CO emission rate is calculated using the Tier 2 standard under 40 CFR 89.112(a) and the maximum horsepower of all of the possible engine options. The NO_x emission rate is calculated using the maximum NO_x emission rate of all of the possible engine options.

Table E-3. Engine Locations

Engine Model ID	Description	UTM X (m)	UTM Y (m)	Elevation (m)
D1	D1 - Building D	286,886.10	5,236,186.20	396.24
D2	D2 - Building D	286,885.80	5,236,175.60	396.15
D3	D3 - Building D	286,885.20	5,236,167.80	396.09
D4	D4 - Building D	286,883.90	5,236,141.40	395.90
D5	D5 - Building D	286,883.60	5,236,133.90	395.85
D6	D6 - Building D	286,883.00	5,236,123.00	395.76
D7	D7 - Building D	287,099.40	5,236,176.80	395.35
D8	D8 - Building D	287,098.70	5,236,166.20	395.25
D9	D9 - Building D	287,098.10	5,236,157.40	395.16
D10	D10 - Building D	287,096.90	5,236,130.80	394.87
D11	D11 - Building D	287,097.20	5,236,124.90	394.80
D12	D12 - Building D	287,095.90	5,236,113.90	394.70
D13	D13 - Building D	286,919.30	5,236,101.70	395.37
D14	D14 - Building D	286,934.90	5,236,101.40	395.28
D15	D15 - Building D	286,950.60	5,236,101.00	395.22
D16	D16 - Building D	287,016.40	5,236,097.60	394.89
D17	D17 - Building D	287,032.00	5,236,096.40	394.83
D18	D18 - Building D	287,047.70	5,236,095.40	394.74
S1	Support Genset	286,991.0	5,236,103.4	395.07
E1	E1 - Building E	286,570.90	5,236,364.20	398.02
E2	E2 - Building E	286,570.50	5,236,346.20	397.83
E3	E3 - Building E	286,569.70	5,236,328.40	397.66
E4	E4 - Building E	286,568.90	5,236,310.20	397.47
E6	E6 - Building E	286,681.70	5,236,367.10	397.94
E7	E7 - Building E	286,680.90	5,236,349.30	397.77
E8	E8 - Building E	286,680.50	5,236,331.30	397.69
E9	E9 - Building E	286,679.50	5,236,313.50	397.50
E10	E10 - Building E	286,678.40	5,236,295.20	397.34
E11	E11 - Building E	286,708.50	5,236,359.10	397.87
E12	E12 - Building E	286,708.10	5,236,341.30	397.78
E13	E13 - Building E	286,707.30	5,236,323.30	397.60
E14	E14 - Building E	286,706.30	5,236,305.30	397.45
E15	E15 - Building E	286,705.70	5,236,287.40	397.35
E16	E16 - Building E	286,820.00	5,236,362.20	397.87
E17	E17 - Building E	286,819.30	5,236,344.00	397.71
E18	E18 - Building E	286,818.30	5,236,326.20	397.54
E19	E19 - Building E	286,817.70	5,236,308.30	397.46
E20	E20 - Building E	286,816.90	5,236,290.70	397.28
E21	E21 - Building E	286,563.00	5,236,171.80	396.39
E22	E22 - Building E	286,562.20	5,236,153.10	396.20
E23	E23 - Building E	286,561.10	5,236,134.10	396.03
E24	E24 - Building E	286,560.30	5,236,115.40	395.92
E25	E25 - Building E	286,559.60	5,236,096.30	395.73
E26	E26 - Building E	286,674.00	5,236,181.00	396.48
E27	E27 - Building E	286,673.60	5,236,162.30	396.29
E28	E28 - Building E	286,672.40	5,236,143.60	396.17
E29	E29 - Building E	286,671.30	5,236,124.50	396.02
E30	E30 - Building E	286,670.90	5,236,105.10	395.82
E31	E31 - Building E	286,701.00	5,236,167.30	396.35
E32	E32 - Building E	286,700.60	5,236,148.20	396.23
E33	E33 - Building E	286,699.50	5,236,128.70	396.06
E34	E34 - Building E	286,698.40	5,236,110.10	395.93
E35	E35 - Building E	286,697.60	5,236,091.00	395.74
E36	E36 - Building E	286,812.40	5,236,176.00	396.33
E37	E37 - Building E	286,811.20	5,236,157.00	396.21
E38	E38 - Building E	286,810.50	5,236,138.70	396.07
E39	E39 - Building E	286,809.70	5,236,118.80	395.96
E40	E40 - Building E	286,808.60	5,236,099.80	395.78
S2	Support Genset	286,662.60	5,236,207.90	396.65

Table E-4b. For Each Cummins DQKAF Main Genset - Load Analysis Parameters

Operation Load	Flow Rate [a] (acfm)	Diameter (ft)	Temperature [a] (°F)	Stack Height (ft)	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Maximum Hourly Emission Rate, Warm Engine [a] (lb/hr/engine)			Maximum Hourly Emission Rate, Cold Start (lb/hr/engine)			Annual Emission Rate (tpy/engine)			Maximum Hourly Modeled Emission Rate [b] (g/s/engine)				Annual Modeled Emission Rate (g/s/engine)			Modeled Emission Rate for TAPs [c] (g/s/engine)
									NO_X	$PM_{10}/PM_{2.5}$	CO	NO_X	$PM_{10}/PM_{2.5}$	CO	NO_X	$PM_{10}/PM_{2.5}$	CO	NO_X	$PM_{10}/PM_{2.5}$	CO	SO_2	NO_X	$PM_{10}/PM_{2.5}$	CO	
10%	4,403	1.50	611	60.0	18.29	594.82	12.66	0.46	5.95	0.86	3.14	5.94	0.91	3.56	0.09	0.01	0.05	7.495E-01	1.148E-01	4.487E-01	4.952E-04	2.564E-03	3.918E-04	1.52E-03	29.00
25%	6,770	1.50	731	60.0	18.29	661.48	19.46	0.46	9.34	1.00	2.50	9.33	1.05	2.83	0.14	0.02	0.04	1.176E+00	1.328E-01	3.569E-01	1.238E-03	4.02E-03	4.53E-04	1.21E-03	50.00
50%	11,174	1.50	821	60.0	18.29	711.48	32.12	0.46	16.25	0.93	2.14	16.23	0.98	2.43	0.24	0.01	0.04	2.047E+00	1.233E-01	3.059E-01	2.476E-03	7.00E-03	4.21E-04	1.04E-03	87.00
75%	14,037	1.50	853	60.0	18.29	729.26	40.35	0.46	31.87	0.59	2.14	31.83	0.62	2.43	0.48	0.01	0.04	4.015E+00	7.827E-02	3.059E-01	3.714E-03	1.37E-02	2.67E-04	1.04E-03	120.00
100%	16,429	1.50	893	60.0	18.29	751.48	47.23	0.46	62.27	1.07	5.71	62.20	1.13	6.47	0.93	0.02	0.10	7.846E+00	1.423E-01	8.157E-01	4.952E-03	2.684E-02	4.86E-04	2.77E-03	153.00

a. Flow rate, temperature, and maximum NO_X, PM, and CO hourly emission rates are derived from unit specifications for the Cummins DQKAF genset for each load.

b. SO_2 emissions are calculated based on maximum sulfur content allowed in ULSD (15 ppm) and are calculated according to methodology presented in AP-42, Chapter 3.4, Table 3.4-1. Scaling of emission rates to a specific operation load are assumed to be linear.

c. Emissions for TAPs are assumed to scale linearly with the fuel consumption rate. Therefore, the load analysis for TAPs used the maximum hourly consumption rate across all vendors (see Load Emissions tables) in lieu of the emission rate in g/s for each load to evaluate which load may contribute the maximum offsite concentration.

Table E-4c. For Each Building D Support Genset - Load Analysis Parameters

Operation Load	Flow Rate [a] (acfm)	Diameter (ft)	Temperature [a] (°F)	Stack Height (ft)	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Maximum Hourly Emission Rate, Warm Engine [b] (lb/hr/engine)			Maximum Hourly Emission Rate, Cold Start (lb/hr/engine)			Annual Emission Rate (tpy/engine)			Maximum Hourly Modeled Emission Rate [c] (g/s/engine)				Annual Modeled Emission Rate (g/s/engine)			Modeled Emission Rate for TAPs [d] (g/s/engine)
									NO_X	$PM_{10}/PM_{2.5}$	CO	NO_X	$PM_{10}/PM_{2.5}$	CO	NO_X	$PM_{10}/PM_{2.5}$	CO	NO_X	$PM_{10}/PM_{2.5}$	CO	SO_2	NO_X	$PM_{2.5}$	CO	
10%	615	0.50	514	12.0	3.66	540.93	15.91	0.15	0.48	0.37	0.63	0.48	0.39	0.71	0.01	0.01	0.01	6.048E-02	4.891E-02	8.967E-02	1.240E-02	2.069E-04	1.669E-04	3.047E-04	5.20
25%	1,100	0.50	678	12.0	3.66	632.04	28.45	0.15	0.64	0.27	1.60	0.64	0.28	1.82	0.01	0.00	0.03	8.064E-02	3.587E-02	2.292E-01	3.100E-02	2.759E-04	1.224E-04	7.787E-04	8.70
50%	1,715	0.50	785	12.0	3.66	691.21	44.37	0.15	1.19	0.33	3.18	1.19	0.35	3.60	0.02	0.01	0.05	1.499E-01	4.384E-02	4.541E-01	6.199E-02	5.130E-04	1.496E-04	1.543E-03	13.60
75%	2,109	0.50	826	12.0	3.66	714.43	54.57	0.15	2.60	0.19	1.10	2.59	0.20	1.24	0.04	0.00	0.02	3.270E-01	2.524E-02	1.568E-01	9.299E-02	1.119E-03	8.615E-05	5.329E-04	17.65
100%	2,279	0.50	927	12.0	3.66	770.48	58.97	0.15	6.85	0.18	0.60	6.84	0.19	0.68	0.10	0.00	0.01	8.632E-01	2.391E-02	8.594E-02	1.240E-01	2.953E-03	8.162E-05	2.920E-04	23.07

a. Flow rate and temperature are the lowest (i.e., most conservative) parameters across both vendors.

b. Maximum hourly emission rate across both vendors (see Load Emissions tables) for each load.

c. SO_2 emissions are calculated based on maximum sulfur content allowed in ULSD (15 ppm) and are calculated according to methodology presented in AP-42, Chapter 3.4, Table 3.4-1. Scaling of emission rates to a specific operation load are assumed to be linear.

d. Emissions for TAPs are on linear scale with the fuel consumption rate. Therefore, the load analysis for TAPs used the maximum hourly consumption rate across all vendors (see Load Emissions tables) in lieu of the emission rate in g/s for each load to evaluate which load may contribute the maximum offsite concentration.

Table E-4d. For Each Building E Support Genset - Load Analysis Parameters

Operation Load	Flow Rate [a] (acfm)	Diameter (ft)	Temperature [a] (°F)	Stack Height (ft)	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Maximum Hourly Emission Rate, Warm Engine [b] (lb/hr/engine)			Maximum Hourly Emission Rate, Cold Start (lb/hr/engine)			Annual Emission Rate (tpy/engine)			Maximum Hourly Modeled Emission Rate [c] (g/s/engine)				Annual Modeled Emission Rate (g/s/engine)			Modeled Emission Rate for TAPs [d] (g/s/engine)
									NO_X	$PM_{10}/PM_{2.5}$	CO	NO_X	$PM_{10}/PM_{2.5}$	CO	NO_X	$PM_{10}/PM_{2.5}$	CO	NO_X	$PM_{10}/PM_{2.5}$	CO	SO_2	NO_X	$PM_{10}/PM_{2.5}$	CO	
10%	1,707	1.00	450	12.0	3.66	505.37	11.04	0.30	1.50	0.06	2.82	1.49	0.06	3.19	0.02	0.00	0.05	1.885E-01	7.803E-03	4.026E-01	3.394E-04	6.45E-04	2.66E-05	1.37E-03	19.50
25%	2,780	1.00	620	12.0	3.66	599.82	17.98	0.30	0.80	0.06	4.55	0.79	0.06	5.16	0.01	0.00	0.08	1.002E-01	8.128E-03	6.500E-01	8.486E-04	3.43E-04	2.77E-05	2.21E-03	33.50
50%	4,500	1.00	697	12.0	3.66	642.43	29.11	0.30	1.20	0.07	4.80	1.20	0.08	5.44	0.02	0.00	0.08	1.511E-01	9.754E-03	6.849E-01	1.697E-03	5.17E-04	3.33E-05	2.33E-03	58.60
75%	6,208	1.00	707	12.0	3.66	647.98	40.15	0.30	1.47	0.12	4.85	1.47	0.13	5.49	0.02	0.00	0.08	1.850E-01	1.644E-02	6.919E-01	2.546E-03	6.33E-04	5.61E-05	2.35E-03	83.50
100%	7,287	1.00	757	12.0	3.66	675.71	47.13	0.30	2.15	0.23	10.28	2.15	0.24	11.65	0.03	0.00	0.17	2.713E-01	3.060E-02	1.468E+00	3.394E-03	9.28E-04	1.04E-04	4.99E-03	108.00

a. Flow rate and temperature are the lowest (i.e., most conservative) parameters across all vendors.

b. Maximum hourly emission rate across all vendors (see Load Emissions tables) for each load.

c. SO_2 emissions are calculated based on maximum sulfur content allowed in ULSD (15 ppm) and are calculated according to methodology presented in AP-42, Chapter 3.4, Table 3.4-1. Scaling of emission rates to a specific operation load are assumed to be linear.

d. Emissions for TAPs are on linear scale with the fuel consumption rate. Therefore, the load analysis for TAPs used the maximum hourly consumption rate across all vendors (see Load Emissions tables) in lieu of the emission rate in g/s for each load to evaluate which load may contribute the maximum offsite concentration.

Table E-5a. DPM Load Analysis - Building D Engines

Operation Load	Flow Rate [a] (acfm)	Diameter (ft)	Temperature [a] (°F)	Stack Height (ft)	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	DPM Maximum Hourly Emission Rate [a] (lb/hr/engine)	DPM Maximum Hourly Emission Rate [a] (g/s/engine)	DPM Maximum Hourly Emission Rate, Cold Start [a] (lb/hr/engine)	DPM Maximum Hourly Emission Rate, Cold Start [a] (g/s/engine)	DPM Annual Emissions (lb/yr/engine)	Maximum Annualized Modeled Emission Rate (g/s/engine)
CAT C9 - 300 kW														
10%	851	0.50	650.3	12.0	3.66	616.65	22.02	0.15	0.06	7.560E-03	0.06	7.971E-03	1.89	2.721E-05
25%	1300	0.50	745.0	12.0	3.66	669.26	33.63	0.15	0.10	1.260E-02	0.11	1.329E-02	3.15	4.534E-05
50%	1811	0.50	784.5	12.0	3.66	691.21	46.84	0.15	0.15	1.890E-02	0.16	1.993E-02	4.73	6.801E-05
75%	2109	0.50	826.3	12.0	3.66	714.43	54.57	0.15	0.07	8.820E-03	0.07	9.300E-03	2.21	3.174E-05
100%	2461	0.50	927.2	12.0	3.66	770.48	63.67	0.15	0.07	8.820E-03	0.07	9.300E-03	2.21	3.174E-05
Cummins DQDAC - 300 kW														
10%	615	0.50	514.0	12.0	3.66	540.93	15.91	0.15	0.08	9.479E-03	0.08	9.995E-03	2.37	3.411E-05
25%	1,100	0.50	678.0	12.0	3.66	632.04	28.45	0.15	0.13	1.580E-02	0.13	1.666E-02	3.95	5.685E-05
50%	1,715	0.50	785.0	12.0	3.66	691.48	44.37	0.15	0.18	2.212E-02	0.19	2.332E-02	5.53	7.960E-05
75%	2,119	0.50	915.0	12.0	3.66	763.71	54.81	0.15	0.08	9.479E-03	0.08	9.995E-03	2.37	3.411E-05
100%	2,279	0.50	990.0	12.0	3.66	805.37	58.97	0.15	0.08	1.011E-02	0.08	1.066E-02	2.53	3.639E-05
CAT 3516C - Tier 2, 2,500 kW														
10%	4,800	1.50	647.3	60.0	18.29	614.98	13.80	0.46	0.31	3.906E-02	0.33	4.119E-02	9.77	1.406E-04
25%	7,845	1.50	831.1	60.0	18.29	717.09	22.55	0.46	0.31	3.906E-02	0.33	4.119E-02	9.77	1.406E-04
50%	12,413	1.50	850.7	60.0	18.29	727.98	35.68	0.46	0.29	3.654E-02	0.31	3.853E-02	9.14	1.315E-04
75%	15,893	1.50	858.5	60.0	18.29	732.32	45.69	0.46	0.27	3.402E-02	0.28	3.587E-02	8.51	1.224E-04
100%	19,579	1.50	915.2	60.0	18.29	763.82	56.28	0.46	0.41	5.166E-02	0.43	5.447E-02	12.93	1.859E-04
Cummins DQKAF - Tier 2, 2,250 kW														
10%	4,403	1.83	611.0	60.0	18.29	594.82	8.47	0.56	0.41	5.218E-02	0.44	5.503E-02	13.06	1.878E-04
25%	6,770	1.83	731.0	60.0	18.29	661.48	13.03	0.56	0.54	6.748E-02	0.56	7.115E-02	16.88	2.428E-04
50%	11,174	1.83	821.0	60.0	18.29	711.48	21.50	0.56	0.50	6.298E-02	0.53	6.641E-02	15.76	2.266E-04
75%	14,037	1.83	853.0	60.0	18.29	729.26	27.01	0.56	0.32	4.049E-02	0.34	4.269E-02	10.13	1.457E-04
100%	16,429	1.83	893.0	60.0	18.29	751.48	31.62	0.56	0.57	7.198E-02	0.60	7.590E-02	18.01	2.590E-04

a. Flow rate, temperature and corresponding hourly emission rate are summarized for each vendor and load where data is available.

Table E-5b. DPM Load Analysis - Building E Engines

Operation Load	Flow Rate [1] (acfm)	Diameter (ft)	Temperature [a] (°F)	Stack Height (ft)	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	DPM Maximum Hourly Emission Rate [1] (lb/hr/engine)	DPM Maximum Hourly Emission Rate [1] (g/s/engine)	DPM Maximum Hourly Emission Rate, Cold Start [1] (lb/hr/engine)	DPM Maximum Hourly Emission Rate, Cold Start [1] (g/s/engine)	DPM Annual Emissions (lb/yr/engine)	Maximum Annualized Modeled Emission Rate (g/s/engine)
CAT C32 - Tier 2, 1,000 kW														
10%	1,982	1.00	489	12.0	3.66	527.04	12.82	0.30	0.18	2.268E-02	0.19	2.391E-02	5.67	8.162E-05
25%	2,857	1.00	643.0	12.0	3.66	612.59	18.48	0.30	0.23	2.898E-02	0.24	3.056E-02	7.25	1.043E-04
50%	4,776	1.00	768.5	12.0	3.66	682.32	30.89	0.30	0.15	1.890E-02	0.16	1.993E-02	4.73	6.801E-05
75%	6,813	1.00	821.0	12.0	3.66	711.48	44.07	0.30	0.09	1.134E-02	0.09	1.196E-02	2.84	4.081E-05
100%	8,065	1.00	889.5	12.0	3.66	749.54	52.17	0.30	0.11	1.386E-02	0.12	1.461E-02	3.47	4.988E-05
CAT 3512C - Tier 2, 1,500 kW														
10%	3,339	1.00	541	12.0	3.66	555.71	21.59	0.30	0.25	3.150E-02	0.26	3.321E-02	7.88	1.134E-04
25%	4,777	1.00	665	12.0	3.66	624.76	30.89	0.30	0.41	5.166E-02	0.43	5.447E-02	12.93	1.859E-04
50%	7,435	1.00	697	12.0	3.66	642.43	48.09	0.30	0.33	4.158E-02	0.35	4.384E-02	10.40	1.496E-04
75%	9,869	1.00	707	12.0	3.66	647.98	63.83	0.30	0.22	2.772E-02	0.23	2.923E-02	6.94	9.975E-05
100%	11,734	1.00	757	12.0	3.66	675.71	75.90	0.30	0.22	2.772E-02	0.23	2.923E-02	6.94	9.975E-05
Cummins DQFAD - Tier 2, 1,000 kW														
10%	1,918	1.00	450	12.0	3.66	505.37	12.41	0.30	0.15	1.853E-02	0.16	1.953E-02	4.63	6.667E-05
25%	2,780	1.00	620	12.0	3.66	599.82	17.98	0.30	0.39	4.940E-02	0.41	5.209E-02	12.36	1.778E-04
50%	4,500	1.00	760	12.0	3.66	677.59	29.11	0.30	0.62	7.822E-02	0.65	8.248E-02	19.57	2.815E-04
75%	6,370	1.00	814	12.0	3.66	707.59	41.20	0.30	0.74	9.263E-02	0.78	9.767E-02	23.17	3.333E-04
100%	7,540	1.00	890	12.0	3.66	749.82	48.77	0.30	0.91	1.153E-01	0.96	1.215E-01	28.84	4.148E-04
Cummins DQFAH - Tier 4, 1,000 kW														
10%	1,918	1.00	450	12.0	3.66	505.37	12.41	0.30	0.00	0.000E+00	0.00	0.000E+00	0.00	0.000E+00
25%	2,780	1.00	620	12.0	3.66	599.82	17.98	0.30	0.00	5.146E-05	0.00	5.426E-05	0.01	1.852E-07
50%	4,500	1.00	760	12.0	3.66	677.59	29.11	0.30	0.00	1.029E-04	0.00	1.085E-04	0.03	3.704E-07
75%	6,370	1.00	814	12.0	3.66	707.59	41.20	0.30	0.00	1.544E-04	0.00	1.628E-04	0.04	5.555E-07
100%	7,540	1.00	890	12.0	3.66	749.82	48.77	0.30	0.00	2.058E-04	0.00	2.170E-04	0.05	7.407E-07
Cummins DQGAB - Tier 2, 1,500kW														
10%	3,112	1.00	545	12.0	3.66	558.15	20.13	0.30	0.50	6.352E-02	0.53	6.697E-02	15.89	2.286E-04
25%	4,755	1.00	659	12.0	3.66	621.48	30.76	0.30	0.67	8.479E-02	0.71	8.941E-02	21.21	3.051E-04
50%	7,557	1.00	709	12.0	3.66	649.26	48.88	0.30	0.49	6.167E-02	0.52	6.502E-02	15.43	2.219E-04
75%	9,751	1.00	745	12.0	3.66	669.26	63.07	0.30	0.29	3.700E-02	0.31	3.901E-02	9.26	1.332E-04
100%	11,783	1.00	880	12.0	3.66	744.26	76.21	0.30	0.24	3.083E-02	0.26	3.251E-02	7.71	1.110E-04
Kohler KD1000 - Tier 2, 1,000 kW														
10%	1,707	1.00	525	12.0	3.66	547.15	11.04	0.30	0.06	8.046E-03	0.07	8.484E-03	2.01	2.896E-05
25%	3,231	1.00	678	12.0	3.66	632.15	20.90	0.30	0.54	6.808E-02	0.57	7.179E-02	17.03	2.450E-04
50%	4,890	1.00	730	12.0	3.66	661.15	31.63	0.30	0.17	2.166E-02	0.18	2.284E-02	5.42	7.796E-05
75%	6,208	1.00	901	12.0	3.66	756.15	40.15	0.30	0.06	6.963E-03	0.06	7.342E-03	1.74	2.506E-05
100%	7,287	1.00	1,006	12.0	3.66	814.15	47.13	0.30	0.07	9.284E-03	0.08	9.789E-03	2.32	3.341E-05
Kohler KD1500 - Tier 2, 1,500 kW														
10%	2,915	1.00	511	12.0	3.66	539.15	18.86	0.30	0.52	6.570E-02	0.55	6.928E-02	16.44	2.364E-04
25%	4,792	1.00	680	12.0	3.66	633.15	30.99	0.30	0.40	5.054E-02	0.42	5.329E-02	12.64	1.819E-04
50%	7,286	1.00	747	12.0	3.66	670.15	47.13	0.30	0.36	4.594E-02	0.38	4.844E-02	11.49	1.653E-04
75%	9,461	1.00	891	12.0	3.66	750.15	61.19	0.30	0.22	2.757E-02	0.23	2.907E-02	6.90	9.920E-05
100%	10,820	1.00	892	12.0	3.66	751.15	69.98	0.30	0.11	1.378E-02	0.12	1.453E-02	3.45	4.960E-05
CAT 3516C - Tier 2, 2,500 kW														
10%	4,800	1.50	647	60.0	18.29	614.98	13.80	0.46	0.31	3.906E-02	0.33	4.119E-02	9.77	1.406E-04
25%	7,845	1.50	831	60.0	18.29	717.09	22.55	0.46	0.31	3.906E-02	0.33	4.119E-02	9.77	1.406E-04
50%	12,413	1.50	851	60.0	18.29	727.98	35.68	0.46	0.29	3.654E-02	0.31	3.853E-02	9.14	1.315E-04
75%	15,893	1.50	859	60.0	18.29	732.32	45.69	0.46	0.27	3.402E-02	0.28	3.587E-02	8.51	1.224E-04
100%	19,579	1.50	915	60.0	18.29	763.82	56.28	0.46	0.41	5.166E-02	0.43	5.447E-02	12.93	1.859E-04
Cummins DQKAF - Tier 2, 2,250 kW														
10%	4,403	1.50	611	60.0	18.29	594.82	12.66	0.46	0.41	5.218E-02	0.44	5.503E-02	13.06	1.878E-04
25%	6,770	1.50	731	60.0	18.29	661.48	19.46	0.46	0.54	6.748E-02	0.56	7.115E-02	16.88	2.428E-04
50%	11,174	1.50	821	60.0	18.29	711.48	32.12	0.46	0.50	6.298E-02	0.53	6.641E-02	15.76	2.266E-04
75%	14,037	1.50	853	60.0	18.29	729.26	40.35	0.46	0.32	4.049E-02	0.34	4.269E-02	10.13	1.457E-04
100%	16,429	1.50	893	60.0	18.29	751.48	47.23	0.46	0.57	7.198E-02	0.60	7.590E-02	18.01	2.590E-04
Cummins DQKAF with Diesel Oxidation Trapping Catalyst - Tier 2, 2,250 kW														
10%	4,403	1.50	631	60.0	18.29	605.93	12.66	0.46	0.24	3.024E-02	0.25	3.189E-02	7.57	1.088E-04
25%	6,770	1.50	751	60.0	18.29	672.59	19.46	0.46	0.28	3.528E-02	0.30	3.720E-02	8.83	1.270E-04
50%	11,174	1.50	841	60.0	18.29	722.59	32.12	0.46	0.25	3.150E-02	0.26	3.321E-02	7.88	1.134E-04
75%	14,037	1.50	873	60.0	18.29	740.37	40.35	0.46	0.16	2.016E-02	0.17	2.126E-02	5.04	7.255E-05
100%	16,429	1.50	913	60.0	18.29	762.59	47.23	0.46	0.29	3.654E-02	0.31	3.853E-02	9.14	1.315E-04
Kohler KD2250 with Oxidizing Catalyst and Diesel Particulate Filter - Tier 2, 2,500 kW														
10%	4,469	1.50	734	60.0	18.29	663.15	12.85	0.46	0.02	2.778E-03	0.02	2.929E-03	0.69	9.996E-06
25%	7,148	1.50	847	60.0	18.29	726.15	20.55	0.46	0.13	1.667E-02	0.14	1.757E-02	4.17	5.998E-05
50%	12,031	1.50	842	60.0	18.29	723.15	34.59	0.46	0.07	8.333E-03	0.07	8.787E-03	2.08	2.999E-05
75%	17,296	1.50	837	60.0	18.29	720.15	49.72	0.46	0.15	1.944E-02	0.16	2.050E-02	4.86	6.997E-05
100%	18,132	1.50	844	60.0	18.29	724.15	52.12	0.46	0.09	1.111E-02	0.09	1.172E-02	2.78	3.999E-05

a. Flow rate, temperature and corresponding hourly emission rate are summarized for each vendor and load where data is available.

Table E-6a. Modeled Rectangular Buildings

Model ID	Description	UTM X (m)	UTM Y (m)	Elevation (m)	Height (m)	X Length (m)	Y Length (m)	Angle (Degrees)
BUILD_D	New Building D	286910.1	5236112.2	395.5	8.08	158.2	80.60	2.9

Table E-6b. Polygon Buildings

Model ID	Description	UTM X (m)	UTM Y (m)	Elevation (m)	Height (m)
BUILD_C	Existing Building	286884	5236274	397.0	8.53
BUILD_B	Existing Building	287223	5236464.95	397.3	8.53
BUILD_A	Existing Building	287218.45	5236317.87	396.1	8.53
DWALLE	Genset Enclosure - Building D, East Side	287072.7	5236189.7	395.6	3.66
DWALLW	Genset Enclosure - Building D, West Side	286877.6	5236202.8	396.4	3.66
DWALLSW	Genset Enclosure - Building D, Southwest Side	286911	5236112.6	395.5	3.66
DWALLSE	Genset Enclosure - Building D, Southeast Side	287001.7	5236106.9	395.0	3.66
BUILD_E	New Building E	286579.4	5236372.6	398.1	6.10
EWALL_NW	Genset Enclosure - Building E, Northwest Side	286576.9	5236380	398.2	3.05
EWALL_NE	Genset Enclosure - Building E, Northeast Side	286808	5236273.7	397.1	3.05
EWALL_SW	Genset Enclosure - Building E, Southwest Side	286569.1	5236188.1	396.6	3.05
EWALL_SE	Genset Enclosure - Building E, Southeast Side	286804.3	5236178.5	396.4	3.05

Table E-7. Model Background Concentrations

Pollutant	Averaging Period	Background Concentration/ Use [a]	Units	Background Concentration (µg/m³)
NO_2	1-hr	55.6	µg/m³	56
	Annual	3.0	ppb	5.6
PM_{10}	24-hr	77.85	µg/m³	77.85
$PM_{2.5}$	24-hr	18.5	µg/m³	18.49
	Annual	5.7	µg/m³	5.7
CO	1-hr	1.130	ppm	1293.6
	8-hr	0.790	ppm	904.4
O3	PVMRM	52	ppb	102.0
	8-hr	58	ppb	112.9
SO_2	1-hr	3.05	ppb	8.0
	3-hr	5.6	ppb	14.7
	24-hr	0.95	ppb	2.5
	Annual	0.2	ppb	0.5
DPM	Annual	0.14	µg/m³	0.14

a. Background concentrations for models are determined using the NW-AIRQUEST database tool.
https://idahodeq.maps.arcgis.com/apps/MapSeries/index.html?appid=0c8a006e11fe4ec5939804b873098dfe

b. NO_2 1-hr and DPM annual background concentrations are based on the results of Ecology's background model and study. The average concentration of the receptors immediately surrounding the fenceline are used to determine the background concentration based on guidance from Ranil at Ecology in a phone call on June 10, 2021.
https://waecy.maps.arcgis.com/apps/MapSeries/index.html?appid=12d296d4ce9c41ffba73175b76ad8716

APPENDIX F. AERMOD LOAD ANALYSIS RESULTS

Table F-1. Maximum Modeled Concentrations - Main Generator Sets

Pollutant	Averaging Period	Maximum Modeled Concentration (µg/m³)				
		MAIN10	**MAIN25**	**MAIN50**	**MAIN75**	**MAIN100**
CO	8-HR	1,339.16	**2,339.87**	711.28	1,152.73	694.72
CO	1-HR	2,467.29	**4,516.67**	1,691.54	2,631.99	1,566.58
NO_X	ANNUAL	234.75	228.60	262.06	430.13	**738.81**
NO_X	1-HR	3,251.84	3,220.20	3,906.82	6,788.60	**11,427.56**
PM_{10}	24-HR	**112.29**	83.42	82.72	66.00	64.83
$PM_{2.5}$	ANNUAL	**44.77**	31.26	25.35	19.50	18.89
$PM_{2.5}$	24-HR	**112.29**	83.42	82.72	66.00	64.83
SO_2	3-HR	1.74	3.01	3.88	5.17	**5.94**
SO_2	1-HR	2.07	3.91	5.37	7.12	**8.21**
TAPs	ANNUAL	8,201.02	11,118.96	12,430.66	14,666.36	**16,130.25**
TAPs	24-HR	38,567.77	42,165.82	53,710.41	63,930.22	**74,327.98**
TAPs	1-HR	115,619.89	163,345.15	190,637.98	236,261.85	**264,320.17**

Table F-2. Maximum Modeled Concentrations - Support Engines

Pollutant	Averaging Period	Maximum Modeled Concentration (µg/m³)					Maximum Modeled Concentration (µg/m³)				
		S1_10	**S1_25**	**S1_50**	**S1_75**	**S1_100**	**S2_10**	**S2_25**	**S2_50**	**S2_75**	**S2_100**
CO	8-HR	44.41	93.34	**156.11**	49.92	26.08	198.96	275.45	221.37	192.87	**388.19**
CO	1-HR	92.31	197.72	**338.06**	108.35	57.12	470.58	623.63	534.67	464.10	**900.77**
NO_X	ANNUAL	5.51	6.22	10.09	20.61	**52.45**	**5.89**	2.72	3.54	3.79	5.02
NO_X	1-HR	58.20	65.21	106.16	216.49	**550.47**	**205.62**	91.23	111.13	120.64	163.23
PM_{10}	24-HR	**11.68**	7.20	7.55	4.05	3.70	1.60	1.38	1.37	2.08	**3.50**
$PM_{2.5}$	ANNUAL	**4.45**	2.77	2.95	1.59	1.45	0.24	0.22	0.23	0.34	**0.57**
$PM_{2.5}$	24-HR	**11.68**	7.20	7.55	4.05	3.70	1.60	1.38	1.37	2.08	**3.50**
SO_2	3-HR	9.91	20.08	33.98	47.30	**60.35**	0.24	0.51	0.87	1.14	**1.26**
SO_2	1-HR	12.31	26.15	45.26	63.08	**81.03**	0.40	0.81	1.31	1.68	**2.07**
TAPs	ANNUAL	473.36	670.86	915.53	1,112.39	**1,401.67**	609.24	908.04	1,373.81	1,708.83	**1,997.38**
TAPs	24-HR	1,781.44	2,463.51	3,332.97	4,013.35	**5,044.09**	5,993.08	8,732.37	13,249.25	16,046.90	**19,581.77**
TAPs	1-HR	5,621.37	7,979.36	10,797.70	13,067.79	**16,371.94**	22,838.47	32,577.19	47,916.16	57,031.14	**67,207.31**

Table F-3. Individual Engine Load Analysis Results for $PM_{2.5}$, PM_{10}, and NO_X

Engine ID	$PM_{2.5}/PM_{10}$ Modeled Maximum Concentration										NO_X Modeled Maximum Concentration									
	Annual					24-hr					Annual					1-hr				
	10	25	50	75	100	10	25	50	75	100	10	25	50	75	100	10	25	50	75	100
D1	0.64	0.34	0.22	0.15	0.14	2.55	1.98	1.76	1.24	1.14	3.36	2.48	2.30	3.38	5.46	57.20	51.97	68.93	120.31	212.60
D2	1.92	1.05	0.58	0.37	0.31	6.06	4.58	3.88	3.03	2.78	10.08	7.64	5.94	8.20	12.31	104.67	87.74	109.92	191.11	341.42
D3	1.93	1.07	0.61	0.40	0.34	6.14	4.73	3.98	3.17	2.89	10.09	7.81	6.31	8.81	13.29	104.99	91.36	115.24	200.49	358.51
D4	2.07	1.20	0.76	0.51	0.44	6.30	5.06	4.65	3.76	3.76	10.83	8.75	7.82	11.27	17.26	93.30	92.44	117.37	206.45	369.39
D5	1.95	1.15	0.74	0.50	0.44	6.12	4.93	4.60	3.77	3.71	10.22	8.43	7.64	11.04	17.03	90.51	90.53	115.74	201.01	363.36
D6	0.80	0.45	0.28	0.20	0.18	3.11	2.35	1.87	1.50	1.34	4.17	3.33	2.91	4.38	7.11	69.10	67.25	87.31	150.33	268.71
D7	0.47	0.29	0.22	0.16	0.16	1.76	1.20	1.09	0.89	0.91	2.46	2.14	2.27	3.62	6.19	59.67	48.06	59.31	106.43	186.17
D8	0.90	0.58	0.41	0.30	0.29	3.24	2.16	1.69	1.33	1.29	4.74	4.21	4.22	6.71	11.19	59.08	57.01	70.37	125.20	221.23
D9	0.95	0.60	0.42	0.32	0.30	3.30	2.17	1.82	1.44	1.42	5.00	4.40	4.39	6.99	11.68	69.65	66.24	83.93	146.53	258.83
D10	0.63	0.37	0.26	0.19	0.17	2.34	1.47	1.16	0.90	0.92	3.28	2.74	2.65	4.09	6.81	74.71	71.38	86.65	142.36	258.78
D11	0.58	0.34	0.24	0.18	0.17	2.24	1.40	1.12	0.91	0.92	3.02	2.52	2.47	3.87	6.51	74.48	72.27	86.48	145.28	255.18
D12	0.52	0.31	0.22	0.17	0.16	3.20	1.88	1.10	0.89	0.91	2.70	2.28	2.32	3.69	6.22	58.79	54.27	54.41	79.40	132.62
D13	1.73	1.24	1.10	0.87	0.86	5.33	4.37	4.40	3.72	3.87	9.09	9.10	11.41	19.24	33.73	101.60	97.85	131.83	216.85	389.12
D14	**2.98**	2.22	2.06	1.64	1.63	7.95	6.51	7.03	6.05	6.35	15.60	16.21	21.26	36.21	**63.79**	129.34	131.57	170.72	295.74	531.43
D15	**3.43**	**2.58**	**2.40**	1.94	1.92	8.93	7.39	8.12	7.02	7.33	17.98	18.89	24.86	42.73	**75.20**	155.97	159.84	195.56	337.13	613.76
D16	**2.80**	2.00	1.73	1.35	1.32	8.59	6.70	6.56	5.39	5.46	14.65	14.65	17.87	29.81	**51.78**	164.07	171.23	215.12	375.15	663.24
D17	1.86	1.26	1.03	0.79	0.76	6.53	4.88	4.36	3.44	3.37	9.77	9.23	10.64	17.40	29.64	135.94	142.39	181.13	313.52	563.86
D18	1.11	0.70	0.50	0.38	0.35	4.30	3.44	3.16	2.48	2.49	5.80	5.15	5.17	8.28	13.76	117.28	125.53	168.39	293.06	517.57
E1	0.67	0.47	0.32	0.24	0.23	3.42	2.61	2.53	2.10	2.14	3.53	3.46	3.34	5.33	8.82	82.79	87.48	114.58	200.22	360.88
E2	0.73	0.51	0.32	0.24	0.23	3.44	2.97	2.93	2.40	2.51	3.84	3.75	3.31	5.36	8.80	85.03	89.68	118.16	207.46	369.55
E3	0.82	0.57	0.32	0.24	0.23	3.74	3.16	3.22	2.65	2.82	4.29	4.16	3.30	5.30	8.98	121.15	108.90	124.77	220.12	392.82
E4	1.03	0.67	0.47	0.34	0.31	4.58	3.38	3.34	2.93	3.13	5.40	4.92	4.81	7.40	12.06	129.64	129.35	163.55	277.81	494.01
E6	1.12	0.79	0.64	0.48	0.45	5.24	3.67	3.61	2.80	2.86	5.88	5.77	6.63	10.61	17.66	201.52	209.26	271.46	428.63	697.06
E7	1.19	0.84	0.69	0.52	0.50	5.67	4.04	3.81	3.08	3.18	6.25	6.16	7.17	11.58	19.36	235.96	249.54	323.67	556.47	941.85
E8	1.17	0.83	0.69	0.53	0.50	6.54	5.01	4.45	3.51	3.67	6.14	6.08	7.15	11.69	19.58	256.01	278.40	362.01	627.33	1,120.97
E9	1.19	0.84	0.70	0.53	0.53	8.00	6.33	5.63	4.42	4.59	6.25	6.12	7.28	11.77	20.53	286.53	309.19	412.59	716.13	1,269.34
E10	1.48	1.05	0.87	0.66	0.64	**9.68**	7.66	6.81	5.58	5.73	7.74	7.66	9.04	14.58	24.88	319.20	345.48	473.09	822.96	**1,446.46**
E11	1.06	0.76	0.64	0.49	0.48	5.56	4.16	3.72	3.07	3.10	5.55	5.56	6.61	10.75	18.76	253.20	262.90	340.09	538.30	893.02
E12	1.11	0.80	0.68	0.52	0.49	6.56	4.51	4.03	3.33	3.37	5.84	5.82	6.98	11.39	19.26	276.78	293.56	390.78	673.57	1,103.06
E13	1.11	0.79	0.67	0.52	0.52	7.17	5.70	4.89	3.97	3.84	5.84	5.79	6.91	11.51	20.34	314.25	337.60	449.86	776.84	**1,337.48**
E14	1.19	0.82	0.70	0.57	0.57	**8.96**	7.15	6.00	4.83	4.73	6.25	6.00	7.23	12.53	22.13	336.13	368.47	494.25	848.38	**1,486.14**
E15	1.33	0.93	0.77	0.62	0.61	**10.14**	8.13	6.82	5.55	5.58	6.98	6.80	7.94	13.57	24.01	361.33	395.86	533.37	934.29	**1,643.01**
E16	1.05	0.84	0.81	0.66	0.66	3.53	2.49	2.40	2.06	2.16	5.53	6.15	8.39	14.53	25.78	167.89	155.58	116.43	197.03	350.75
E17	1.04	0.84	0.80	0.65	0.65	4.00	2.65	2.37	2.03	2.11	5.47	6.11	8.27	14.29	25.36	180.91	184.76	113.05	198.24	352.26
E18	1.03	0.83	0.79	0.64	0.64	4.31	2.81	2.32	1.99	2.06	5.42	6.05	8.19	14.18	25.14	180.26	182.89	134.28	201.84	355.86
E19	1.02	0.82	0.79	0.63	0.63	4.84	2.96	2.29	1.96	2.05	5.36	5.97	8.12	14.01	24.81	238.46	203.30	200.01	314.54	443.14
E20	1.02	0.81	0.77	0.63	0.62	5.23	3.52	2.28	1.96	2.05	5.33	5.96	7.99	13.79	24.42	282.55	254.14	250.28	399.79	717.35
E21	1.36	1.01	0.92	0.73	0.73	6.59	5.06	4.99	4.22	4.36	7.13	7.41	9.50	16.06	28.46	175.35	179.80	243.26	428.71	766.43
E22	1.48	1.11	1.02	0.81	0.81	5.82	4.48	3.92	3.15	3.24	7.75	8.10	10.51	17.86	31.51	155.26	161.15	213.75	372.98	662.32
E23	1.58	1.19	1.10	0.88	0.87	4.34	3.69	3.85	3.32	3.45	8.29	8.70	11.39	19.45	34.08	128.58	117.90	131.94	212.90	379.42
E24	1.70	1.29	1.19	0.96	0.95	4.59	3.88	4.07	3.49	3.64	8.89	9.42	12.35	21.13	37.25	96.68	86.65	116.15	203.75	365.07
E25	1.84	1.41	1.30	1.05	1.05	4.95	4.17	4.30	3.69	3.88	9.66	10.34	13.45	23.20	41.01	91.96	88.95	119.42	209.06	374.19
E26	1.75	1.25	1.14	0.93	0.93	**11.01**	8.45	7.88	6.29	6.35	9.17	9.12	11.75	20.43	36.19	295.27	312.99	412.90	720.00	**1,287.52**
E27	1.62	1.27	1.21	0.99	0.99	**8.97**	6.87	6.45	5.12	4.99	8.47	9.30	12.52	21.78	38.58	211.71	221.56	293.61	507.69	914.10
E28	1.71	1.35	1.28	1.04	1.04	6.86	5.26	5.14	4.08	4.02	8.94	9.84	13.19	22.90	40.60	173.69	190.87	242.64	419.70	737.75
E29	1.80	1.42	1.35	1.09	1.10	5.75	4.22	4.26	3.59	3.74	9.46	10.39	13.92	24.13	42.95	156.18	171.09	210.90	373.05	652.96
E30	1.92	1.51	1.43	1.16	1.17	5.10	3.94	4.21	3.60	3.79	10.08	11.08	14.74	25.65	**45.71**	139.27	147.02	189.68	319.88	534.84
E31	1.11	1.07	0.77	0.43	0.70	6.25	5.42	3.95	2.08	3.51	7.25	9.45	12.74	21.93	38.62	193.80	243.71	318.88	554.62	993.02
E32	1.19	1.14	0.82	0.45	0.74	4.92	4.54	3.24	1.66	2.84	7.76	10.10	13.58	23.20	40.89	168.40	209.76	282.93	486.93	866.64
E33	1.26	1.21	0.86	0.48	0.79	3.90	3.66	2.79	1.63	2.77	8.23	10.70	14.28	24.50	43.40	164.52	202.34	255.24	430.87	763.41
E34	1.33	1.26	0.89	0.50	0.82	3.40	3.34	2.65	1.55	2.67	8.67	11.16	14.84	25.50	45.03	151.48	183.80	216.67	376.83	613.69
E35	1.40	1.32	0.93	0.52	0.85	3.45	3.45	2.69	1.59	2.73	9.14	11.73	15.48	26.57	**46.99**	134.97	159.82	182.84	294.87	471.39
E36	1.26	0.95	0.84	0.65	0.63	3.99	3.35	3.47	3.00	3.16	6.63	6.98	8.68	14.39	24.61	157.46	163.43	193.81	272.11	484.80
E37	1.26	0.92	0.76	0.58	0.56	4.21	3.46	3.68	3.07	3.22	6.60	6.70	7.89	12.80	22.04	147.51	151.51	166.99	267.68	437.69
E38	1.12	0.76	0.58	0.43	0.41	4.47	3.58	3.63	3.09	3.19	5.86	5.54	5.97	9.55	16.08	151.40	147.83	132.98	233.49	391.25
E39	0.81	0.56	0.46	0.35	0.34	4.34	3.38	3.55	3.03	3.15	4.27	4.10	4.71	7.72	13.21	113.49	92.69	116.70	204.35	366.24
E40	0.60	0.42	0.35	0.27	0.25	4.29	3.43	3.49	2.89	2.89	3.17	3.08	3.62	5.86	9.89	108.04	90.05	114.84	199.68	359.95

Table F-4. Summary of DPM Load Analysis Results

Engine Model	Maximum Concentration	Worst-Case Operating Load
Cummins DQKAF	0.10521	10%
CAT 3516C	0.04969	10%
Cummins DQKAF with DOTC	0.02397	10%
Kohler KD2250 with Ox Cat and DPF	0.01227	25%

Table F-5. Representative Engine Model and Operating Load for Modeling

Generator ID	Engine Model	Operating Load
D1	CAT 3516C	10%
D2	CAT 3516C	10%
D3	CAT 3516C	10%
D4	CAT 3516C	10%
D5	CAT 3516C	10%
D6	CAT 3516C	10%
D7	CAT 3516C	10%
D8	CAT 3516C	10%
D9	CAT 3516C	10%
D10	CAT 3516C	10%
D11	CAT 3516C	10%
D12	CAT 3516C	10%
D13	CAT 3516C	10%
D14	CAT 3516C	10%
D15	CAT 3516C	10%
D16	CAT 3516C	10%
D17	CAT 3516C	10%
D18	CAT 3516C	10%
E1	CAT 3516C	10%
E2	CAT 3516C	10%
E3	CAT 3516C	10%
E4	CAT 3516C	10%
E6	CAT 3516C	10%
E7	CAT 3516C	10%
E8	CAT 3516C	10%
E9	CAT 3516C	10%
E10	CAT 3516C	10%
E11	CAT 3516C	10%
E12	CAT 3516C	10%
E13	CAT 3516C	10%
E14	CAT 3516C	10%
E15	CAT 3516C	10%
E16	CAT 3516C	10%
E17	CAT 3516C	10%
E18	CAT 3516C	10%
E19	CAT 3516C	10%
E20	CAT 3516C	10%
E21	CAT 3516C	10%
E22	CAT 3516C	10%
E23	CAT 3516C	10%
E24	CAT 3516C	10%
E25	CAT 3516C	10%
E26	CAT 3516C	10%
E27	CAT 3516C	10%
E28	CAT 3516C	10%
E29	CAT 3516C	10%
E30	CAT 3516C	10%
E31	Cummins DQKAF	10%
E32	Cummins DQKAF	10%
E33	Cummins DQKAF	10%
E34	Cummins DQKAF	10%
E35	Cummins DQKAF	10%
E36	CAT 3516C	10%
E37	CAT 3516C	10%
E38	CAT 3516C	10%
E39	CAT 3516C	10%
E40	CAT 3516C	10%

APPENDIX G. ELECTRONIC MODEL FILES

Files are attached electronically. A directory of files is provided below.

Appendix Table G-1. Modeling Files Directory

Folder	File Name	Description
\BPIP	Bpip input file Bpip output file Bpip summary file	Files for BPIP inputs and outputs.
\Load Analysis\CO	CLC1820.ami CLC1820.aml	AERMOD input and output files for the CO load analysis.
\Load Analysis\DPM\Main Gensets	*Make_Model*.ami *Make_Model*.out	AERMOD input and output files for the DPM load analysis for each of the 2 main gensets being considered. File names are specified using the make and model of the given modeled engine.
\Load Analysis\DPM\Support Gensets	*Make_Model*.ami *Make_Model*.out	AERMOD input and output files for the DPM load analysis for the support gensets being considered. File names are specified using the make and model of the given modeled engine.
\Load Analysis\NOx	NLC1820.ami NLC1820.aml	AERMOD input and output files for the NO_2 load analysis.
\Load Analysis\PM	PLC1820.ami PLC1820.aml	AERMOD input and output files for the $PM_{2.5}$/PM_{10} load analysis.
\Load Analysis\SO2	SLC1820.ami SLC1820.aml	AERMOD input and output files for the SO_2 load analysis.
\Load Analysis\TAP	TLC1820.ami TLC1820.aml	AERMOD input and output files for the TAP load analysis.
\MET Data	20XX_sub_KMWH.PFL 20XX_sub_KMWH.SFC Quincy_KMWH1820.PFL Quincy_KMWH1820.SFC	Meteorological files as inputs to AERMOD, including the surface file and upper air file. "*xx*" indicates the year among 2018-2020. The surface file and upper air file containing 2018-2020 data are also included in this folder.
\Monte Carlo Script	MonteCarlo_script_parallel_processing_Jun2021.R Modified PM_{10} Monte Carlo Script.R	A copy of the Monte Carlo script provided by Ecology, which is used to execute the Monte Carlo analysis for both NO_2 and $PM_{2.5}$. A modified copy of the Monte Carlo script for PM_{10} is also included.
\NAAQS Models\CO	CNC*xx*.ami CNC*xx*.aml	AERMOD input and output files for the CO NAAQS models. Model years are indicated by "*xx*" among -2018-2020.
\NAAQS Models\NO2	NNC*xx*.ami NNC*xx*.aml	AERMOD input and output files for the NO_2 NAAQS models. Model years are indicated by "*xx*" among 2018-2020. The model file that uses the concatenated 3-year meteorological data set is also included in this folder.
	MC_NO2_output.csv	Output file from the Monte Carlo Analysis

Folder	File Name	Description
\NAAQS Models\NO2\R	NO2_EYY_month.mxd	Max daily output file from AERMOD for each of the 5 highest-contributing gensets, determined using the NO_2 load analysis. These engines are used to represent the monthly testing of all gensets, per the model procedures outlined in Section 6 of this report. “YY” indicates the model ID of the particular genset.
	NO2_ALL_power.mxd	Max daily output file from AERMOD for the operating scenario where all gensets operate simultaneously for emergency operations, per the model procedures outlined in Section 6 of this report.
	NO2_E15.mxd	Max daily output file from AERMOD for the highest-contributing genset (model ID E15, 100% load). This file represents the operating scenario for maintenance and load testing for each genset, per the model procedures outlined in Section 6 of this report.
	postfile_days_array.csv	File containing the index of Monte Carlo input files for use in the R script.
	r_sabey_NO2.R	R script containing the command lines for executing the Monte Carlo script provided by Ecology.
\NAAQS Models\PM2.5	PM2.5_24HR_NC1820.ami PM2.5_24HR_NC1820.aml PM2.5_Annual_NC1820.ami PM2.5_Annual_NC1820.aml	AERMOD input and output files for the PM2.5 NAAQS models.
\NAAQS Models\PM2.5\R	MC_PM25_output.csv	Output file from the Monte Carlo Analysis
	PM2.5_EYY_month.bin	Binary post output file from AERMOD for each of the 5 highest-contributing gensets, determined using the $PM_{2.5}$ load analysis. These engines are used to represent the monthly testing of all gensets, per the model procedures outlined in Section 6 of this report. “YY” indicates the model ID.
	PM2.5_ALL_power.bin	Binary post output file from AERMOD for the operating scenario where all gensets operate simultaneously for emergency operations, per the model procedures outlined in Section 6 of this report.
	PM2.5_E26.bin	Binary post output file from AERMOD for the highest-contributing genset (model ID E26, 10% load). This file represents the operating scenario for maintenance and load testing for each genset, per the model procedures outlined in Section 6 of this report.
	Sabey_Receptors.txt	Text file containing receptors for use with binary output files in the Monte Carlo R script.
	postfile_days_array.csv	File containing the index of Monte Carlo input files for use in the R script.
	r_sabey_PM25.R	R script containing the command lines for executing the Monte Carlo script provided by Ecology.
\NAAQS Models\PM10	PM10_24HR_NB1820.ami PM10_24HR_NB1820.out	AERMOD input and output files for the PM_{10} NAAQS model.

Folder	File Name	Description
\NAAQS Models\PM2.5\R	MC_PM10_output.csv	Output file from the Monte Carlo Analysis
	PM10_EYY_month.bin	Binary post output file from AERMOD for each of the 5 highest-contributing gensets, determined using the PM_{10} load analysis. These engines are used to represent the monthly testing of all gensets, per the model procedures outlined in Section 6 of this report. "YY" indicates the model ID.
	PM10_ALL_power.bin	Binary post output file from AERMOD for the operating scenario where all gensets operate simultaneously for emergency operations, per the model procedures outlined in Section 6 of this report.
	PM10_E26.bin	Binary post output file from AERMOD for the highest-contributing genset (model ID E26, 10% load). This file represents the operating scenario for maintenance and load testing for each genset, per the model procedures outlined in Section 6 of this report.
	Sabey_Receptors.txt	Text file containing receptors for use with binary output files in the Monte Carlo R script.
	postfile_days_array.csv	File containing the index of Monte Carlo input files for use in the R script.
	r_sabey_PM10.R	R script containing the command lines for executing the Monte Carlo script provided by Ecology.
\NAAQS Models\SO2	SO2_1HR_NC1820.ami SO2_1HR_NC1820.aml SO2_3HR_ NC1820.ami SO2_3HR_ NC1820.aml	AERMOD input and output files for the SO_2 NAAQS models (with the file name indicating the averaging period of the given model).
\TAP Models\Acrolein	ATB1C20.ami ATB1C20.aml	AERMOD input and output files for the Acrolein TAP model.
\TAP Models\Benzene	BTC*xx*.ami BTC*xx*.aml	AERMOD input and output files for the Benzene TAP models. Model years are indicated by "*xx*" among 2018-2020.
\TAP Models\CO	CTC1820.ami CTC1820.aml	AERMOD input and output files for the CO TAP model.
\TAP Models\DPM	DTC*xx*.ami DTC*xx*.aml	AERMOD input and output files for the DPM TAP models. Model years are indicated by "*xx*" among 2018-2020.
\TAP Models\Naphthalene	NaTC*xx*.ami NaTC*xx*.aml	AERMOD input and output files for the Naphthalene TAP models. Model years are indicated by "*xx*" among 2018-2020.
\TAP Models\NO2	NTC*xx*.ami NTC*xx*.aml	AERMOD input and output files for the NO_2 TAP models. Model years are indicated by "*xx*" among 2018-2020.
\TAP Models\SO2	STC*xx*.ami STC*xx*.aml	AERMOD input and output files for the SO_2 TAP models. Model years are indicated by "*xx*" among 2018-2020.