PROJECT REPORT

Sabey Data Center Properties > Quincy, WA

SABEY Data Centers

Intergate Quincy Notice of Construction

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1. EXECUTIVE SUMMARY

Sabey Data Center Properties (Sabey) is proposing to construct two new data center buildings at Intergate Quincy (IGQ) data center campus in Quincy, Washington. The IGQ campus currently consists of three buildings (Building A, Building B [under construction], and Building C) operated by Sabey with multiple tenants.

As part of the IGQ project, two new data center buildings (Building D and Building E) will be constructed, with a total of 30 diesel-fired main generator sets (gensets) of up to 2,500 kW each. The main gensets will be used to provide standby electrical power to the data center during periods of interrupted power supply. There will also be 1 – 300 kW support genset per building for emergency lighting in the event of a complete power outage. In addition, each data center main genset will have a 2,000-gallon diesel belly tank, and there will be a total of 20 – 15,000-gallon stand-alone fuel storage tanks for the two buildings. Lastly, Sabey will install a total of 120 indirect evaporative cooling (IDEC) units for the new data center buildings.

In addition to the new proposed buildings, Sabey is submitting as-built information for existing buildings A, B, and C permitted under Approval Order 16AQ-E011[1]. Overall, Sabey is reducing the number of permitted gensets from Buildings A, B, and C from 44 to 37.

This 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. 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.

[1] A construction extension was granted by Ecology on September 7, 2018 to allow installation of the remaining gensets through July 1, 2020.

Sabey's IGQ facility proposed 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. The following equipment will be installed for the operation of the proposed data center buildings.

- 30 – 2,500 kW diesel-fired main gensets (permit applicable) with attached 2,000-gallon belly diesel fuel tanks (de minimis unit[2]);
- 20 – 15,000-gallon diesel storage tanks (de minimis unit[2]);
- 2 – 300 kW support gensets; and
- 120 indirect evaporative cooling units

A site plan is included in Appendix B.

2.1. NEW STANDBY GENSETS

Buildings D and E will have a total of 30 diesel-fired main gensets of up to 2,500 kW and 2 – 300 kW support gensets. The site plan (Appendix B) shows the locations of the proposed gensets. The main gensets will provide electrical power to the data center during periods of interrupted power supply. The support gensets will provide power for each building for emergency lighting in the event of a complete power outage. All the generators will be operated in accordance to the following:

- Maximum of fifty-five (55) 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.

Sabey has evaluated five models for the proposed main gensets, including:

- Caterpillar 3516C, 2500 kW Standby Generator Set;
- Kohler KD2250, 2250 kW Standby Generator Set;
- Kohler KD2500, 2500 kW Standby Generator Set;
- Cummins DQKAF, 2250 kW Standby Generator Set; and
- Cummins DQKAN, 2500 kW Standby Generator Set.

Sabey has evaluated two models for the proposed support gensets, including:

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

Sabey has not determined the model for the main gensets or support gensets to be installed at IGQ. Therefore, all models are considered in this NOC application. The specifications from the vendors are included in Appendix C. Table 2-1 below summarizes the operation scenarios for all 32 gensets.

[2] As discussed in Section 3, the VOC emissions from the diesel storage tanks are expected to be below the de minimis level of 2 tons per year.

Table 2-1. Operation Scenarios Summary

Operation Scenario	Operations for Each Genset [a] (hr/day/genset)	(hr/yr/genset)	Total Operations for All Gensets [b] (engine-hr/hr)	(engine-hr/day)	(engine-hr/yr)
Main Genset Running at Any Load	24	55	30	720	1,650
Support Genset Running at Any Load	24	55	2	48	110

[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 6 days in any given year while keeping the total number of hours per engine per year equal to or below 55.

[b] All 30 main gensets will be operated up to 24 hr/day/genset which corresponds to maximum of 720 engine-hrs in any single day.

2.2. EXISTING STANDBY GENSETS

Approval Order (AO) 16AQ-E011 for the IGQ facility permitted the installation of 44 – 2 MWe generators at Buildings A, B, and C. To provide maximum flexibility, emission calculations for the installation of these engines were based on the worst-case emission rates across all loads for each model for the following engine models:

- Caterpillar Model 3516C, 2.0 MWe;
- Caterpillar Model 3512C, 1.5 MWe;
- Cummins QSK60-G14 NR2 2.0 MWe;
- Cummins QSK50-G5 NR2 1.5 MWe;
- MTU 16V4000G43 2.0 MWe; and
- MTU 12V4000G43 1.5 MWe

Only 37 gensets have actually been built or are planned, and each engine is 2 MWe or smaller. Sabey will not be installing the remaining 7 permitted 2 MWe gensets and requests that the facility remain permitted for a total of 37 gensets for Buildings A, B, and C.

The actual models and quantities of as-built and planned engines are as follows:

- 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 MWe in size

The 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 of the as-built generators operate in accordance with AO 16AQ-E011 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.

Genset locations are consistent with the original modeling, so ambient concentrations of all pollutants are expected to be as modeled or lower since there are fewer and smaller engines. The existing gensets are not considered part of the project and are evaluated in the analysis via the local and regional background concentration value provided by Ecology for NAAQS analyses.

2.3. FUEL STORAGE TANKS

Each genset will be equipped with a 2,000-gallon belly tank. Sabey also proposes to install a total of 20 stand-alone diesel fuel storage tanks with two tanks per utility yard. The stand-alone tanks are sized at 15,000 gallons each. The diesel stored in these tanks will be used as fuel for the standby generators. The site plan (Appendix B) shows the locations of the stand-alone tanks. As discussed in Section 4.1, Sabey expects these fuel storage tanks will be exempt from NOC permitting.

2.4. COOLING SYSTEM

Sabey has selected an IDEC system for the IGQ campus cooling needs. 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 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 new 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.

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 New 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[3] standby engines. 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 - 2500 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. Two Cummins models are assessed, DQKAF - 2250 kW and DQKAN - 2500 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, KD2250 – 2250 kW and KD2500 – 2500 kW.

An hourly emission rate is calculated based on the provided g/hp-hr or g/kWh emission data for each vendor, except for Caterpillar, which provides lb/hr data. Vendor performance emission data is provided in 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 and Table 3.3-1, AP-42 are used to calculate emissions of SO_2 from the main gensets and support gensets, respectively. The maximum engine power at 100% load is used.

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

- 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 New 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. The CAT C9 genset at 300 kW is assessed and included.
- 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. The Cummins DQDAC genset at 300 kW is assessed and included.
- 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 3.3-1, AP-42 for engines smaller 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 3.3-2, AP-42 for engines smaller than 600 hp. The maximum hourly fuel consumption rate across all loads are 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 As-Built Gensets

Facility-wide potential to emit calculations are performed based on the engines that have actually been installed or are planned to be installed under AO 16AQ-E011, as discussed in Section 2.2. Vendor supplied emissions data was reviewed to determine the maximum emission rates of PM, SO_2, CO, NO_X, and VOC across all loads for each engine model. For engines that have multiple versions of specification sheets issued over the span of the installation phases, the worst-case emission factors are used. Specification sheets are provided in Appendix C.

An hourly emission rate is calculated based on the provided g/hp-hr or g/kWh emission data for each vendor, except for Caterpillar, which provides lb/hr data. For each main genset and each support genset, the maximum hourly emissions are calculated based on the following conservative approaches:

- Emissions for the installed units are based on the highest emission factor across all loads for the engine model. Emissions for the planned engines are calculated based on the most conservative emission rates, fuel usage rates, and exhaust flow rates between the two main engines models that have been installed to date.
- Maximum emission rates account for cold-start emissions during the first minute of engine start-up, as described in Section 3.1.1.
- PM_{10} and $PM_{2.5}$ emissions are the sum of PM and CPM emissions.
- 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 and Table 3.3-1, AP-42 are used to calculate emissions of SO_2 from the main gensets and support gensets, respectively. The maximum engine power at 100% load is used.
- HAP and TAP emission factors from Tables 3.4-3 and 3.4-4, AP-42 are used to calculate emissions from the main gensets. HAP and TAP emissions are estimated based on factors from Table 3.3-2, AP-42 for the support gensets. The maximum hourly fuel consumption rate across all loads and all models are used for each HAP/TAP, except for DPM and other criteria pollutants that are also TAPs (i.e., SO_2, CO and NO_2).

3.1.4. Calculation Methodologies for Diesel Storage Tanks

Minimal VOC emissions are expected from the working losses and standing losses of the diesel storage tanks. Due to the low vapor pressure of diesel (<0.01 psia) and the maximum operation of the gensets being at or below 55 hours per year per genset, the VOC emissions from the diesel storage tanks are 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.

3.1.5. 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.

Table 3-1. Project Emission Summary

Pollutant	Maximum Emissions for All Proposed Engines [a]			Diesel Storage Tanks	Cooling Systems	Project Total	Facility-Wide PTE
	(lb/hr)	(lb/day)	(tpy)	(tpy)	(tpy)	(tpy)	(tpy)
PM_{10} [b]	102.41	2457.86	2.20	--	1.27E-01	2.33	5.92
$PM_{2.5}$ [b]	102.41	2457.86	2.20	--	1.27E-01	2.33	5.92
SO2 [c]	3.29	79.04	0.09	--	--	0.09	0.20
CO [d]	538.50	12924.04	13.95	--	--	13.95	18.13
NO_X [d]	2013.87	48332.85	55.35	--	--	55.35	94.88
VOC	38.58	925.86	1.03	<1	--	2.03	4.12
HAPs	1.15	27.52	0.03	<0.01	--	0.04	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.

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). The proposed project involves construction of 30 main emergency gensets, 2 support emergency gensets, and 120 cooling units. These emission units do not meet any of the exemption criteria under WAC 173-460-110; therefore, the construction of the units requires NOC approval.

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 3.2, 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

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 well 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.

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 newly constructed facilities. 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 certified Tier 3 engines for the support gensets. 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, and the detailed calculations are included in Appendix C.

Table 4-1. Project TAP Emission Summary

Pollutant	Averaging Period	De Minimis	SQER	Project Total [a]	Modeling Required?
		(lbs/averaging period)			
Acetaldehyde	year	3.00E+00	6.00E+01	1.25E+00	De Minimis
Acrolein	24-hr	1.30E-03	2.60E-02	1.49E-01	Yes
Benzene	year	1.00E+00	2.10E+01	3.08E+01	Yes
Benzo(a)anthracene	year	4.50E-02	8.90E-01	2.50E-02	De Minimis
Benzo(a)pyrene	year	8.20E-03	1.60E-01	1.01E-02	No
Benzo(b)fluoranthene	year	4.50E-02	8.90E-01	4.36E-02	De Minimis
Benzo(k)fluoranthene	year	4.50E-02	8.90E-01	8.60E-03	De Minimis
1,3-Butadiene	year	2.70E-01	5.40E+00	1.36E-02	De Minimis
Chrysene	year	4.50E-01	8.90E+00	6.01E-02	De Minimis
Dibenz(a,h)anthracene	year	4.10E-03	8.20E-02	1.38E-02	No
Formaldehyde	year	1.40E+00	2.70E+01	3.50E+00	No
Indeno(1,2,3-cd)pyrene	year	4.50E-02	8.90E-01	1.64E-02	De Minimis
Naphthalene	year	2.40E-01	4.80E+00	5.13E+00	Yes
Propylene	24-hr	1.10E+01	2.20E+02	5.17E+00	De Minimis
Toluene	24-hr	1.90E+01	3.70E+02	4.87E+00	De Minimis
Xylenes	year	8.20E-01	29	7.67E+00	No
Diesel Engine Exhaust, Particulate	year	0.032	0.639	3.42E+03	Yes
SO_2	1-hr	4.6E-01	1.20E+00	3.29E+00	Yes
CO	1-hr	1.10E+00	4.30E+01	5.39E+02	Yes
NO_2 [b]	1-hr	4.60E-01	8.70E-01	2.01E+02	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 Section 0 demonstrate that the ASILs are met for acrolein, naphthalene, benzene, SO_2 and CO. Sabey will perform a Second Tier Review in accordance to 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 Emission Rate [c] (gr/dscf)	PM Combustion Limit (gr/dscf)	In Compliance?
Main Genset	2.12	1,801	0.04	0.1	Yes
Support Genset	0.19	333	0.03	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 main genset and 50% load for 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 genset.

[c] Maximum grain loading rate for the main genset is for the 10% load, which has an emission rate of 0.63 lb/hr/engine and a flow rate of 1,801 scfm. Maximum grain loading rate for the support engines is for the 25% load, which has an emission rate of 0.13 lb/hr/engine and a flow rate of 510 scfm.

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.[4] 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.[5]

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 EPA's *Control*

[4] U.S. EPA, Office of Air and Radiation. Memorandum from J.C. Potter to the Regional Administrators. Washington, D.C. December 1, 1987.
[5] U.S. EPA. *Draft New Source Review Workshop Manual*, Chapter B. Research Triangle Park, North Carolina. October 1990.

Cost Manual (CCM)[6] 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 (Vantage Data Center, CyrusOne with permits issued in 2017 and 2019, respectively) [7], 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 main gensets and Tier 3 emission standards for the smaller support 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 to 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 2,250 kWe genset from the CyrusOne application. Costs for the support gensets are estimated using the 0.6 power rule.

[6] 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
[7] Vantage Data Center, Approval Order No. 16AQ-E026; CyrusOne Data Center, Approval Order 19AQ-E052

- 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.[8]

The calculated cost to control per ton of NO_X is $19,002 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 $22,227. Tier 4 Integrated Control is cost prohibitive for the project.[9] Sabey proposes meeting EPA Tier 2 standards as BACT for NO_X 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.
- 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.[9]

[8] Consistent with Vantage and CyrusOne applications' assessment of acceptable unit costs.
[9] Consistent with Vantage and CyrusOne BACT cost effectiveness assessments.

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	$431,940	$280,676	$38,677	$595,270	$83,015	No
DOC	$96,387	$225,477	$8,631	$132,834	$69,677	No
Tier 4	$1,107,454	$735,982	$99,163	$1,526,218	$680,492	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.[9] Therefore, Sabey proposes meeting EPA Tier 2 emission standards for the main engines and EPA Tier 3 for the support engines, 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 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[10]. 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]	$946,762	$92,023	No
DPF	$431,940	$120,776	No
DOC	$96,387	$40,055	No
Tier 4	$1,107,454	$210,315	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 TAP is meeting EPA Tier 2 emission standards for main gensets and EPA Tier 3 emission standards for support gensets as well as the operating and maintenance requirements under 40 CFR Part 60 Subpart IIII.

[10] 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

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.

Note that after the modeling was completed and previous NOC application submitted, it was determined by Sabey that the final design of Building D and the associated equipment will require Building D to be shifted 20 feet to the West. Since shifting the building will move the building more to the interior of the property, and it is a very small shift (less than the resolution of current receptor grid at the fenceline) it is expected that modeled impacts will be largely unimpacted, and the current modeling analysis is expected to be a conservative demonstration. Revised modeling has not been conducted. Ecology provided concurrence that no re-modeling was required for this change on April 3, 2020[11]. Coordinates and figures presented in this section reflect the modeled locations and not the new proposed locations.

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 19191 with Plume Rise Model Enhancements (PRIME) advanced downwash algorithms, is used as the dispersion model in the air quality analysis.

6.2. METEOROLOGICAL DATA

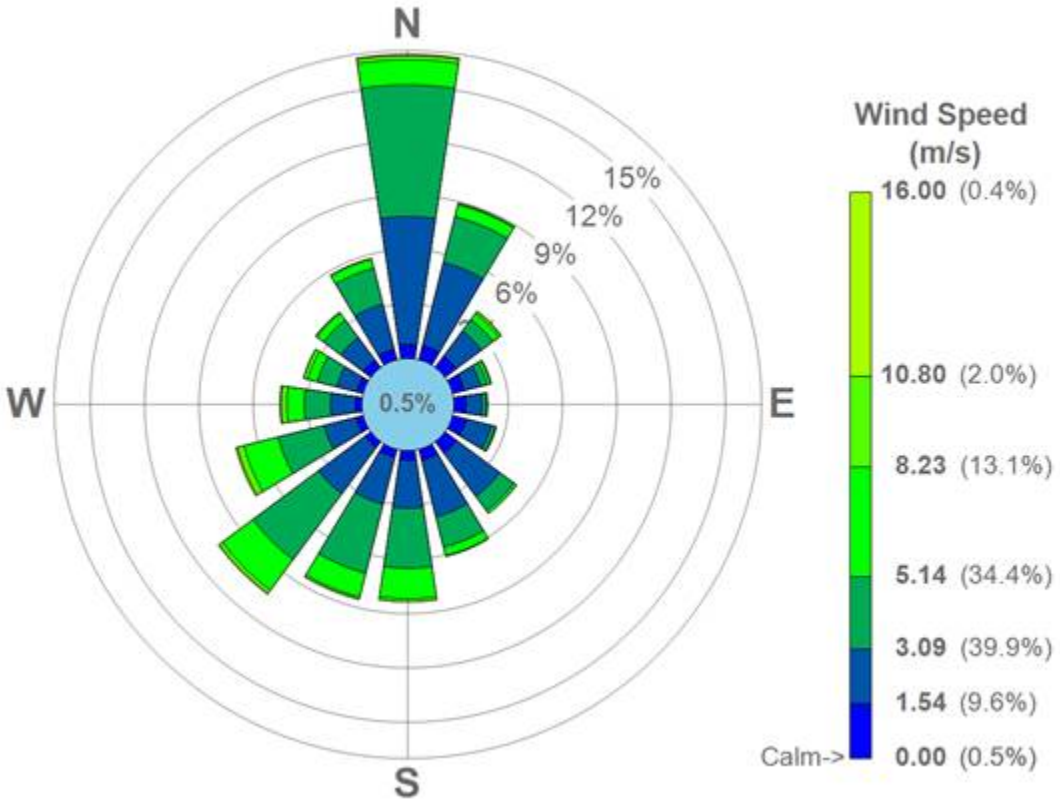
Five years of surface meteorological data are taken from the nearest airport, Grant County International Airport (Station ID: KMWH; WBAN ID: 24110) using 1-min ASOS data. The data from the five most recent years (2014 through 2018) is used. The meteorological data is processed using AERMET version 18081. The 1-min wind data was processed using the latest version of AERMINUTE pre-processing tool (version 15272). Quality of the 1-minute data was verified by comparison to the hourly ISHD data from KMWH, which showed only small differences typical of 1-minute and hourly wind data comparisons. The "Ice-Free Winds Group" AERMINUTE option was selected due to the fact that a sonic anemometer was used at KMWH for the entire 2014-2018 period. Additionally, the 1-min wind speed threshold of 0.5 meter per second (m/s) is applied for the 1-min ASOS data according to EPA guidance.[12] The wind rose for the modeled period (2014-2018) is provided in Figure 6-1.

Trinity also reviewed the percentage of calm and missing data for the modeled period. Before applying the 0.5 m/s threshold for the 1-min ASOS data, the total percentage of calm wind data is 0.48%. The AERMOD-ready data shows 0.50% of calm wind data and 0.80% 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.

[11] Tesfamichael Ghidey (Ecology Modeling Group) provided email concurrence to Ashley Jones (Trinity Consultants) on April 3, 2020 that no re-modeling is required.
[12] EPA Memo *Use of ASOS meteorological data in AERMOD dispersion modeling*, March 8, 2013.

Figure 6-1. 2014-2018 Wind Rose at Grant County International Airport (KMWH)



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 is approximately 5,236,150 meters Northing and 286,986 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).[13] 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

[13] 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.

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.

- Two grids containing 12.5-meter spaced receptors and extending roughly 250 meters from the center of each of the new proposed buildings.
- A grid containing 25-meter spaced receptors extending from 250 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 4,400 meters from the center of the project location.
- A grid containing 600-meter spaced receptors extending from 4,400 meters to 10,000 meters from the center project location.

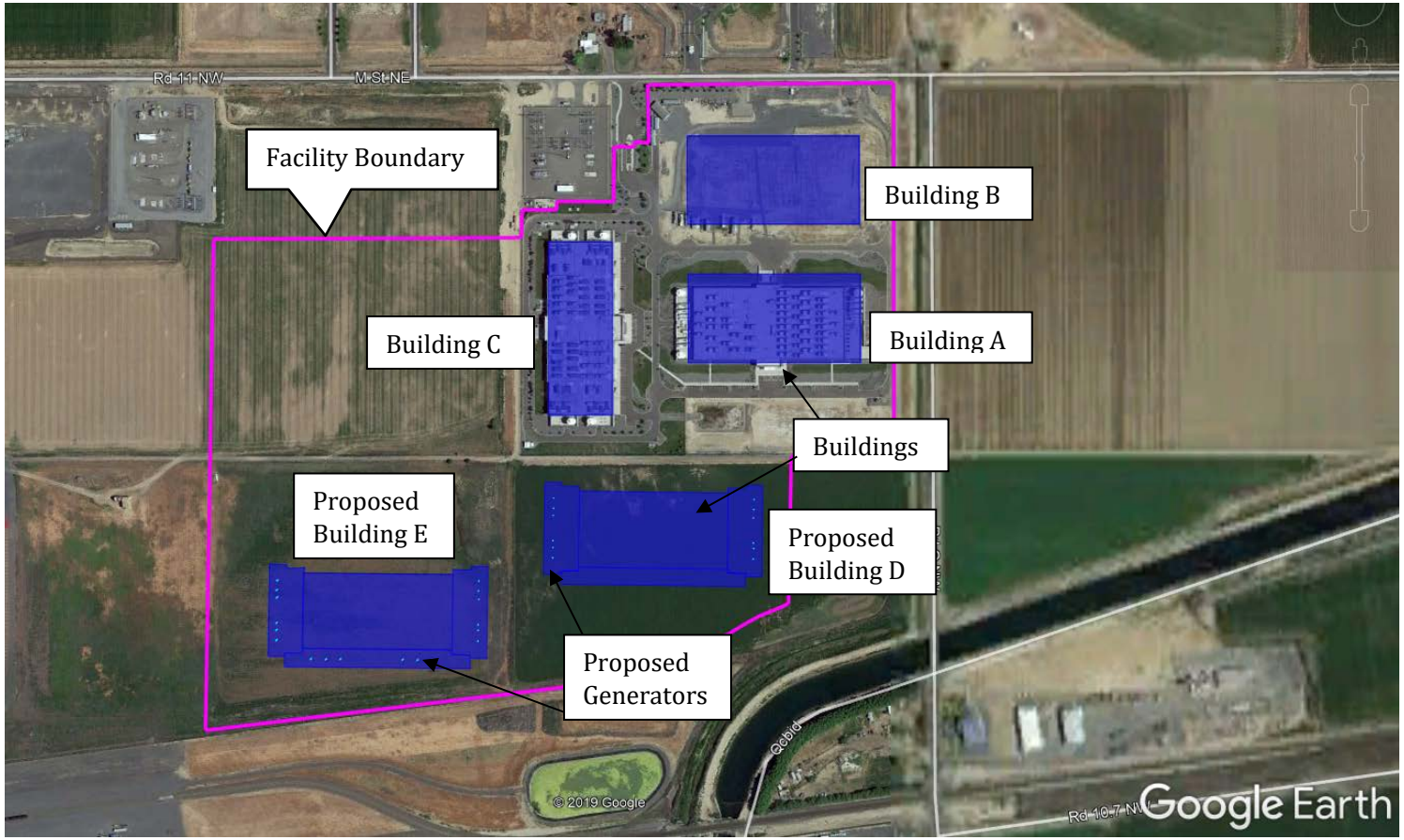
In addition, 10-meter spaced receptors are included along the property fenceline. All receptors are placed at the ground level for the NAAQS analysis. The receptors are placed at 1.5 m flagpole height, as requested by Ecology, for the TAP analysis.

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.

Figure 6-2. Modeled Buildings and Fenceline



6.7. EMISSION SOURCE PARAMETERS

The sources included for TAP modeling are the 32 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 each building. One building will have 12 gensets and one building will have 18 gensets. The two support gensets will be located near the loading docks on the south side of each 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. Note than in addition to the load analysis, a sensitivity analysis to which building configuration having more gensets was also completed, and the "worst case" configuration was determined for each pollutant and averaging period. The table below shows all possible genset locations regardless of configuration.

Table 6-1. Modeled Sources

Model Unit ID [1]	Description	UTM Easting (m)	UTM Northing (m)	Elevation (m)
D1	D1 - Building D	286,886.1	5,236,186.2	396.24
D2	D2 - Building D	286,885.8	5,236,175.6	396.15
D3	D3 - Building D	286,885.2	5,236,167.8	396.09
D4	D4 - Building D	286,883.9	5,236,141.4	395.9
D5	D5 - Building D	286,883.6	5,236,133.9	395.85
D6	D6 - Building D	286,883.0	5,236,123.0	395.76
D7	D7 - Building D	287,099.4	5,236,176.8	395.35
D8	D8 - Building D	287,098.7	5,236,166.2	395.25
D9	D9 - Building D	287,098.1	5,236,157.4	395.16
D10	D10 - Building D	287,096.9	5,236,130.8	394.87
D11	D11 - Building D	287,097.2	5,236,124.9	394.8
D12	D12 - Building D	287,095.9	5,236,113.9	394.7
D13*	D13 - Building D	286,919.3	5,236,101.7	395.37
D14*	D14 - Building D	286,934.9	5,236,101.4	395.28
D15*	D15 - Building D	286,950.6	5,236,101.0	395.22
D16*	D16 - Building D	287,016.4	5,236,097.6	394.89
D17*	D17 - Building D	287,032.0	5,236,096.4	394.83
D18*	D18 - Building D	287,047.7	5,236,095.4	394.74
E1	E1 - Building E	286,589.8	5,236,110.0	395.87
E2	E2 - Building E	286,589.0	5,236,099.8	395.78
E3	E3 - Building E	286,589.0	5,236,092.0	395.65
E4	E4 - Building E	286,587.8	5,236,065.3	395.33
E5	E5 - Building E	286,587.4	5,236,057.8	395.25
E6	E6 - Building E	286,587.0	5,236,046.9	395.14
E7	E7 - Building E	286,803.5	5,236,101.4	395.83
E8	E8 - Building E	286,803.1	5,236,090.8	395.73
E9	E9 - Building E	286,803.1	5,236,082.2	395.62
E10	E10 - Building E	286,801.5	5,236,055.5	395.32
E11	E11 - Building E	286,801.1	5,236,049.6	395.25
E12	E12 - Building E	286,800.7	5,236,038.2	395.08

Model Unit ID [1]	Description	UTM Easting (m)	UTM Northing (m)	Elevation (m)
E13*	E13 - Building E	286,622.9	5,236,025.8	394.83
E14*	E14 - Building E	286,638.7	5,236,024.9	394.82
E15*	E15 - Building E	286,654.1	5,236,024.5	394.81
E16*	E16 - Building E	286,720.1	5,236,021.5	394.88
E17*	E17 - Building E	286,735.9	5,236,020.7	394.88
E18*	E18 - Building E	286,751.3	5,236,019.8	394.87
S1	Support Generator 1	286,991.0	5,236,103.4	395.07
S2	Support Generator 2	286,693.3	5,236,028.0	394.94

[1] Note that Model IDs identified with an "*" are only included in a model scenario if the worst-case configuration for a pollutant and averaging period identifies its building (Building D or Building E) as worst case for the 18 genset configuration. Only one building will have 18 main gensets and the other building 12 main gensets for a total of 30 gensets.

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, and SO_2, highest hourly emissions across all vendors are included for each generator at each of 10%, 25%, 50%, 75% and 100% loads. For each load, the worst-case (i.e., lowest) flow rate and temperature from vendor provided information is applied for all genset modeled at the specified load.
- For filterable PM/DPM, the load analysis was performed for CAT, Cummins, and Kohler 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 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, which mimics the main 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 NO_X 1-hour, 100% load results in the maximum offsite concentration across all loads on 1-hour basis. For the 1-hour standard the configuration with 12 main gensets at Building D and 18 gensets at Building E

resulted in the maximum offsite concentration. Out of all gensets, three engines located at Building E (model IDs E15, E16, E17) 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 NO_X annual, 100% load results in the maximum offsite concentration across all loads on annual basis. For the annual standard the configuration with 18 main gensets at Building D and 12 gensets at Building E resulted in maximum offsite concentration.
- For $PM_{2.5}$ 24-hour, 100% load results in maximum offsite 24-hour averaged concentration across all loads with the configuration with 12 main gensets at Building D and 18 gensets at Building E. Out of all gensets, three engine scenarios located at Building E are the highest impacting units that result in maximum offsite 1-hour concentrations. These are genset E15 at 10% load, E16 at 75% load, and E16 at 100% load.
- For $PM_{2.5}$ annual, 10% load results in the maximum offsite annual averaged concentration across all loads with the configuration with 12 main gensets at Building D and 18 gensets at Building E.
- For DPM, Cummins DQKAN 100% load results in the maximum annual averaged offsite concentration across all loads and vendors. This maximum occurs in the configuration with 18 main gensets at Building D and 12 main gensets at Building E.
- For CO, 25% load results in maximum offsite concentration across all loads on 1-hour and 8-hour basis. This maximum occurs in the configuration with 12 main gensets at Building D and 18 main gensets at Building E.
- For SO_2, 100% load results in maximum offsite concentration across all loads on 1-hour and 3-hour basis. This maximum occurs in the configuration with 12 main gensets at Building D and 18 main gensets at Building E.
- For TAPs that are not criteria pollutants, 100% load results in maximum offsite 24-hour averaged concentration across all loads, occurring in the configuration with 12 main gensets at Building D and 18 main gensets at Building E.
- For TAPs that are not criteria pollutants, 100% load results in maximum offsite annual averaged concentration across all loads, occurring in the configuration with 18 main gensets at Building D and 12 main gensets at Building E.

Table 6-2. Load Analysis Results

Pollutant	Averaging Period	Worst-Case Load [1]		Worst-Case Configuration
NO_X	1-hr	Main Support	100% 100%	D12/E18
NO_X	Annual	Main Support	100% 100%	D18/E12
$PM_{2.5}$	24-hr	Main Support	100% 10%	D12/E18
$PM_{2.5}$	Annual	Main Support	10% 10%	D12/E18
PM_{10}	24-hr	Main Support	100% 10%	D12/E18
CO	1-hr and 8-hr	Main Support	25% 50%	D12/E18
SO_2	1-hr and 3-hr	Main Support	100% 100%	D12/E18
Acrolein	24-hr	Main Support	100% 100%	D12/E18
Benzene	year	Main Support	100% 100%	D18/E12
Naphthalene	year	Main Support	100% 100%	D18/E12
Diesel Engine Exhaust, Particulate	year	Main Support	100% - Cummins DQKAN 50% Cummins	D18/E12
[1] 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[14]:

- 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[15].
- Ozone background concentration of 52 ppb, based on NW-AIRQUEST at the site location.[16]

[14] Initial approval from Ecology through email on February 21, 2018.
[15] Filtered available entries in Excel file "NO_2_ISR_database.xlsx", EPA NO_2/NO_X in-stack ratio database, available at https://www3.epa.gov/scram001/no2_isr_database.htm, accessed January 27, 2020. The average ISR for RICE firing diesel or kerosene is 0.07.
[16] Northwest Airquest data hosted by Idaho Department of Environmental Quality, available at https://idahodeq.maps.arcgis.com/apps/MapSeries/index.html?appid=0c8a006e11fe4ec5939804b873098dfe and provided by Ranil Dhammapala (Ecology) on January 3, 2020.

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 Ecology to represent both a local and regional concentration to be added to the project modeling analysis.

Table 6-3. Background Concentrations for NAAQS Analysis

Pollutant	Averaging Period	Background Concentration [a]				NAAQS (µg/m³)
PM_{10}	24-hour	NA		77.6	µg/m³	150
$PM_{2.5}$	24-hour	NA		18.9	µg/m³	35
$PM_{2.5}$	Annual	NA		5.8	µg/m³	12
NO_2 [b]	1-hour	NA		68	µg/m³	188
NO_2	Annual	3.5	ppb	6.6	µg/m³	100
SO_2	1-hour	2.9	ppb	7.6	µg/m³	196
SO_2	3-hour	5.4	ppb	14.1	µg/m³	1,300
CO	1-hour	1,150	ppb	1,316.5	µg/m³	40,000
CO	8-hour	810	ppb	927.3	µg/m³	10,000

[a] 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).

[b] NO_2 1-hr value was provided by Ecology (January 3rd) and represents a local and regional combined impact to be added to the project modeled concentration.

6.10.2. Monte Carlo

The 1-hour NO_2 and 24-hour $PM_{2.5}$ NAAQS is 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. The operating scenarios and arrangement of the generators in operation will vary as well as the meteorological conditions that affect the dispersion of the pollutants. Since it is difficult to rank the emissions from various arrangement and operating scenarios of the generators by emissions, the ambient impact analysis was performed using the statistical approach with the Monte Carlo script developed by Ecology, which is run by the software "R".[17] This script takes account for the low probability of all intermittent emission sources occurring on days with poor dispersion meteorological conditions within a year. It processes the post files that AERMOD generates for the intermittent sources, randomly selects the concentrations from the intermittent sources for each receptor for multiple iterations, and then calculates the median 98th percentile 1-hour concentration from all the iterations for all the receptors that is comparable to the 1-hour NO_2 NAAQS and 24-hour $PM_{2.5}$ NAAQS.

[17] The Monte Carlo script is provided by Ranil Dhammapala (Ecology) on January 2, 2020.

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

- 32 generators (30 main gensets and 2 support gensets) operating simultaneously for emergency, maintenance, or testing operations, for up to 6 calendar days per year.
- Each engine may be tested monthly for 11 months per year. In order to test all 32 generators in a given month, the testing may take up to 3 calendar days per month. The three generators that result in the highest offsite concentrations on hourly basis (model IDs E14, E15, and E16 for NO_X and E15 [10% load] and E16 [75% load and 100% load] for $PM_{2.5}$) based on the NO_X and $PM_{2.5}$ 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., 192 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 E16, 100% load for both pollutants) based on the NO_X and $PM_{2.5}$ load analysis is modeled for 24 days per year. Based on a conservative 8-hour operating day for maintenance and testing.

Note that on an annual basis each engine is still limited to 55 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. In order to account for the background concentration presented in Table 6-3, the threshold for the Monte Carlo analysis is determined as the difference of 1-hour NO_2 NAAQS and the background concentration, which is 120 µg/m^3. The source parameters for all generators modeled for the NO_2 NAAQS demonstration are summarized in Table 6-4.

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

Pollutant	Averaging Period	Load Scenario [1]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Modeled Emission Rate [2] (g/s/genset)
NO_2	1-hour	100% Main Genset	18.29	724.15	47.56	0.46	8.401
		100% Support Genset	3.66	770.48	58.97	0.15	8.632E-01

[1] Based on load analysis results as discussed in Section 6.7.
[2] Maximum hourly emission rate at 100% load across all vendors is used here for the main genset, which is 66.67 lb/hr/main genset.

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 Result

Pollutant	Averaging Period	Maximum Median Concentration [1] (µg/m³)	UTM Easting (m)	UTM Northing (m)	Background (µg/m³)	Total Modeled Concentration (µg/m³)	1-hr NO_2 NAAQS (µg/m³)
NO_2	1-hour	118.12	286,675.1	5,235,967.1	68.0	186.12	188

[1] The maximum median concentration from Monte Carlo output is listed here.

6.10.3.2. Annual NO_2 NAAQS Compliance Demonstration

Sabey proposes 55 hrs/yr limit on all of the 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 [1]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Modeled Emission Rate [2] (g/s/genset)
NO_2	Annual	100% Main Genset	18.29	724.15	47.56	0.46	5.271E-02
		100% Support Genset	3.66	770.48	58.97	0.15	5.417E-03

[1] Based on load analysis results as discussed in Section 6.7.
[2] Annual emissions are scaled to 55 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	Averaging Period	Maximum Modeled Concentration [1] (µg/m³)	UTM Easting (m)	UTM Northing (m)	Background (µg/m³)	Total Modeled Concentration (µg/m³)	Annual NO_2 NAAQS (µg/m³)
NO_2	Annual	1.7	287,141	5,236,212	6.6	8.3	100

[1] The corresponding year with the maximum modeled concentration is 2014.

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 100% load are used for $PM_{2.5}$ 24-hour modeling and those corresponding to 10% load are used for $PM_{2.5}$ annual modeling.

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. In order to conservatively estimate the impact from such scenario, the main generator with the maximum 24-hour offsite impact based on the load analysis results (see Appendix F), model ID E16 operating at 100% load, is modeled assuming 24 hours of operation per day. The source parameters are summarized in Table 6-8.

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

Pollutant	Averaging Period	Load Scenario [1]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Modeled Emission Rate [2] (g/s/genset)
$PM_{2.5}$	24-hour	100% Main Genset	18.29	724.15	47.56	0.46	3.412E-01
		10% Support Genset	3.66	540.93	15.91	0.15	4.891E-02

[1] Based on load analysis results as discussed in Section 6.7. Only the engine results in maximum offsite concentration, model ID E16, is modeled in this case.
[2] Maximum hourly emission rate at 100% load across all vendors is used, which is 2.71 lb/hr.

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-hour $PM_{2.5}$ NAAQS Model Result

Pollutant	Averaging Period	Maximum Median Concentration [1] ($\mu g/m^3$)	UTM Easting (m)	UTM Northing (m)	Background ($\mu g/m^3$)	Total Modeled Concentration ($\mu g/m^3$)	24-hour $PM_{2.5}$ NAAQS ($\mu g/m^3$)
$PM_{2.5}$	24-hour	5.71	286,685.1	5,235,968	18.9	24.61	35

[1] The maximum median concentration from Monte Carlo output is listed here.

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 and 10% load for the support gensets are the worst-case loads on annual basis for $PM_{2.5}$. Therefore, modeling parameters, including emission rates, corresponding to the 10% load for the main gensets and those corresponding to 10% load for the support gensets are used for annual $PM_{2.5}$ modeling, which are summarized in Table 6-10. The emission rates for all units are scaled to 55 hrs/yr for each generator.

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

Pollutant	Averaging Period	Load Scenario [1]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Modeled Emission Rate [2] (g/s/genset)
$PM_{2.5}$	Annual	10% Main Genset	18.29	587.04	11.50	0.46	1.033E-03
		10% Support Genset	3.66	540.93	15.91	0.15	2.993E-04

[1] Based on load analysis results as discussed in Section 6.7.
[2] Annual emissions are scaled to 55 hrs/yr based on the maximum hourly emission rate at 10% load across all vendors for the main gensets.

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	Averaging Period	Maximum Modeled Concentration [1] ($\mu g/m^3$)	UTM Easting (m)	UTM Northing (m)	Background ($\mu g/m^3$)	Total Modeled Concentration ($\mu g/m^3$)	Annual $PM_{2.5}$ NAAQS ($\mu g/m^3$)
$PM_{2.5}$	Annual	0.1	286,698.5	5,235,962.5	5.8	5.9	12

[1] 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 discussed in Section 6.7, 100% load model parameters for the main gensets and 50% load parameters for the house gensets are used for PM_{10} 24-hr NAAQS modeling. All generators are modeled. 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 [1]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Modeled Emission Rate [2] (g/s/genset)
PM_{10}	24-hour	100% Main Genset	18.29	724.15	47.56	0.46	3.412E-01
		10% House Genset	3.66	540.93	15.91	0.15	4.891E-02

[1] Based on load analysis results as discussed in Section 6.7.
[2] Maximum hourly emission rate at 100% load across all vendors for the main gensets is used, which is 2.71 lb/hr/main genset.

The 6th highest model results, plus the background concentration, are summarized in Table 6-13, which demonstrated compliance with PM_{10} NAAQS.

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

Pollutant	Averaging Period	H6H Modeled Concentration [1] (µg/m³)	UTM Easting (m)	UTM Northing (m)	Background (µg/m³)	Total Modeled Concentration (µg/m³)	24-hour PM_{10} NAAQS (µg/m³)
PM_{10}	24-hour	69.3	286,673.5	5,235,962.5	77.6	146.9	150

[1] The PM_{10} 24-hr NAAQS shall not be exceeded more than once per year. Therefore, the highest 6th high concentration across all receptors over the 5 modeled years are listed here.

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, 25% load model parameters for the main gensets and 50% load model parameters for the support gensets 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 [1]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Modeled Emission Rate [2] (g/s/genset)
CO	1-hour 8-hour	25% Main Genset	18.29	659.26	18.63	0.46	1.593
		50% Support Genset	3.66	691.21	44.37	0.15	4.541E-01

[1] Based on load analysis results as discussed in Section 6.7.
[2] Hourly emission rate for the main genset is based on Tier 2 emission standard under 40 CFR 89.112(a) and the maximum engine horsepower of all vendors, which is 12.04 lb/hr.

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	Averaging Period	H2H Modeled Concentration [1] (µg/m³)	UTM Easting (m)	UTM Northing (m)	Background (µg/m³)	Total Modeled Concentration (µg/m³)	CO NAAQS (µg/m³)
CO	1-hour	1,426.2	286,645.2	5,235964.6	1,316.5	2,742.7	40,000
	8-hour	997.2	286,655.2	5,235,965.5	927.3	1,924.5	10,000

[1] 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 are listed here. The listed 1-hr concentration and the listed 8-hr concentration both occur in modeled year 2014.

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 5-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 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 [1]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Modeled Emission Rate [2] (g/s/genset)
SO_2	1-hour 3-hour	100% Main Genset	18.29	724.15	47.56	0.46	5.566E-03
		100% Support Genset	3.66	770.48	58.97	0.15	1.240E-01

[1] Based on load analysis results as discussed in Section 6.7.
[2] 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	Averaging Period	Modeled Concentration [1] (µg/m³)	UTM Easting (m)	UTM Northing (m)	Background (µg/m³)	Total Modeled Concentration (µg/m³)	SO_2 NAAQS (µg/m³)
SO_2	1-hour	94.5	286,754.9	5,235,973.7	7.6	102.1	196
	3-hour	75.6	286,736.0	5,235,962.5	14.1	89.7	1,300

[1] The highest 4th high result over the modeled 5-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 2018) 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 with following approaches:

- The load analysis performed for TAPs for which emissions are 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 the main gensets, the 100% load source parameters, including corresponding emission rates, are used for modeling acrolein, benzene, and naphthalene. 100% load is the worst-case load for both 24-hour and annual averaging periods for the support gensets, and the corresponding emission rates and parameters are used for modeling acrolein, benzene, and naphthalene emissions for support gensets. In the case of acrolein, the configuration with 12 main gensets located at Building D and 18 main gensets located at Building E resulted in the highest concentrations; however, for both benzene and naphthalene, the configuration with 18 main gensets at Building D and 12 main gensets at Building E is used.
- 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 Cummins' DQKAN 100% load emission profile. Therefore, the DPM models are set

up using Cummins' DQKAN 100% load emission profile and source parameters for the main gensets. 50% load with the Cummins' DQDAC support genset represents the worst-case load for the support gensets, and 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 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
2014	Acrolein	24-hr	1.41E-2	286,635.3	5,235,963.8	0.35	4.0%
2014	Benzene	year	5.10E-04	287,141	5,236,212	0.13	0.4%
2014	Naphthalene	year	9.00E-5	287,141	5,236,212	0.029	0.3%
2014	DPM	year	5.39E-2	287,141	5,236,212	0.0033	1,633.3%
2015	SO_2	1-hr	123.67	286,744.9	5,235,972.9	660	18.7%
2014	CO	1-hr	1,541.59	286,645.2	5,235,964.6	23,000	6.7%
2014	NO_2	1-hr	1,212.59	281,386	5,244,350	470	258.0%

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

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.

DEPARTMENT OF ECOLOGY
State of Washington

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 Intergate Quincy 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
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) John Sasser - Senior Vice President, Data Center Operations	
16. Responsible Official Phone 206-277-5302	17. Responsible Official E-mail johnsas@sabey.com
18. Responsible Official Certification and Signature I certify that the information on this application is accurate and complete. Signature [signature] Date 2/4/20	

Part 2: Technical Information

Notice of Construction Application

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

DEPARTMENT OF ECOLOGY
State of Washington

Notice of Construction Application

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.

WAC 197-11-970 Determination of nonsignificance (DNS).

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

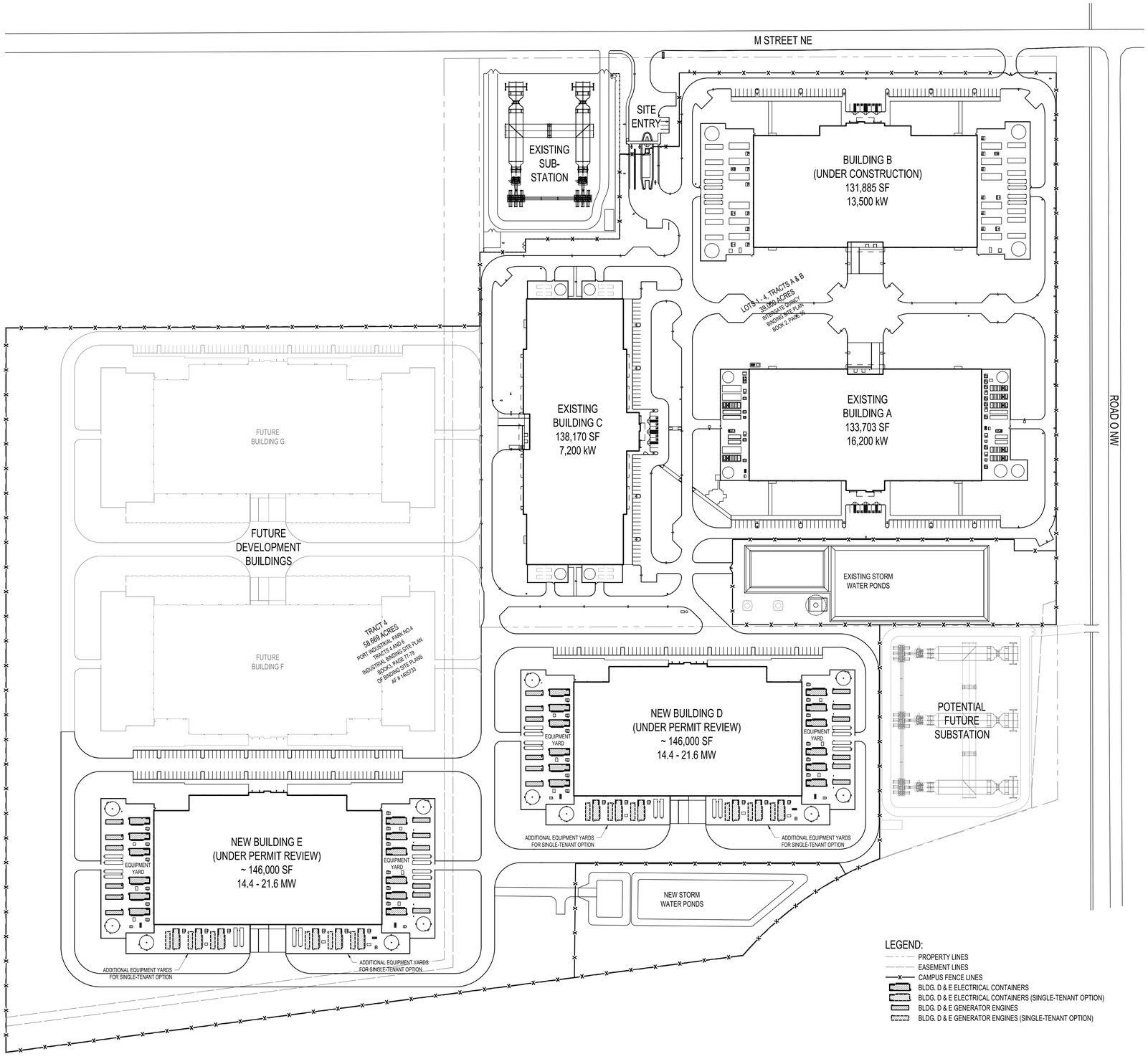
(OPTIONAL)

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



1 IGQ CAMPUS SITE PLAN
SCALE: 1" = 100'-0"

0 25' 50' 100' 200'

SABEY

SABEY ARCHITECTURE
seattle, washington
206.281.8700
sabey.com

SABEY DATA CENTER PROPERTIES:

INTERGATE.QUINCY BUILDINGS D, E, AND FUTURE DEVELOPMENT

2200 M STREET NE
QUINCY, WA
98848

MARK	DATE	DESCRIPTION
ISSUE: FOR REFERENCE ONLY		

PROGRESS DATE: 01/29/20
DRAWN BY: BH
CHECKED BY:
APPROVED BY:

PROJECT NO:
FILE: IGQ_SitePlan - Ecology_01-29-20.dwg

INTERGATE.QUINCY
CAMPUS SITE PLAN

SP-1

APPENDIX C: EMISSION CALCULATIONS AND SUPPORTING DOCUMENTATION

1. Emission Calculation Summary
2. Engine Specifications - Project
   - Caterpillar 3516C 2500 kW Specifications
   - Cummins DQKAF 2250 kW Specifications
   - Cummins DQKAN 2500 kW Specifications
   - Kohler KD2250 2250 kW Specifications
   - Kohler KD2500 2500 kW Specifications
   - Caterpillar C9 300 kW Specifications
   - Cummins DQDAC 300 kW Specifications
3. Engine Specifications – As-Built
   - Caterpillar 3516C 2000 kW Specifications
   - Caterpillar 3512C 1500 kW Specifications
   - Caterpillar C9 300 kW Specifications
   - Caterpillar C9 250 kW Specification
4. Cooling Unit Specifications

1. EMISSION CALCULATION SUMMARY

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[1]	2.50	3.59	3.59	0.11	39.52	1.09	4.18	0.03
Existing Diesel Storage Tanks	--	--	--	--	--	1.00	--	1.00E-02
New Main Gensets	1.70	2.18	2.18	0.04	54.98	1.02	13.77	0.03
New Support Genset	9.92E-03	0.02	0.02	0.05	0.38	0.02	0.19	6.73E-04
New Diesel Storage Tanks	--	--	--	--	--	1.00	--	1.00E-02
New Cooling Units	1.27E-01	1.27E-01	1.27E-01	--	--	--	--	--
Project Emissions	**1.84**	**2.33**	**2.33**	**0.09**	**55.35**	**2.03**	**13.95**	**0.04**
WAC Exemption Levels	1.25	0.75	0.50	2.00	2.00	2.00	5.00	N/A
NSR Required?	Yes	Yes	Yes	No	Yes	Yes	Yes	N/A
Facility-Wide Potential Emissions	**4.34**	**5.92**	**5.92**	**0.20**	**94.88**	**4.12**	**18.13**	**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

[1] PTE from existing engines and cooling units are calculated based on the quantity and type of units actually installed and planned. HAP emissions are the sum of PTE for the TAPs that are HAPs too, assuming the unlisted HAPs are emitted in negligible amount.

[2] WAC exemption levels are listed in WAC 173-400-110 Table 110(5).

Table C-2. Project TAP Emissions

Pollutant	Project Emission Rate	Existing Equipment PTE[1]	Total
	(tpy)		
Acenaphthene	9.20E-05	8.31E-05	1.75E-04
Acenaphthylene	1.82E-04	1.65E-04	3.46E-04
Acetaldehyde	6.27E-04	6.32E-04	1.26E-03
Acrolein	1.71E-04	1.62E-04	3.32E-04
Anthracene	2.44E-05	2.22E-05	4.67E-05
Benzene	0.02	1.40E-02	0.03
Benzo(a)anthracene	1.25E-05	1.14E-05	2.39E-05
Benzo(a)pyrene	5.07E-06	4.59E-06	9.66E-06
Benzo(b)fluoranthene	2.18E-05	1.97E-05	4.14E-05
Benzo(g,h,l)perylene	1.10E-05	9.95E-06	2.09E-05
Benzo(k)fluoranthene	4.30E-06	3.89E-06	8.20E-06
1,3-Butadiene	6.80E-06	9.47E-06	1.63E-05
Chrysene	3.01E-05	2.72E-05	5.72E-05
Dibenz(a,h)anthracene	6.89E-06	6.26E-06	1.31E-05
Fluoranthene	8.04E-05	7.31E-05	1.53E-04
Fluorene	2.56E-04	2.34E-04	4.90E-04
Formaldehyde	1.75E-03	1.68E-03	3.43E-03
Indeno(1,2,3-cd)pyrene	8.18E-06	7.42E-06	1.56E-05
Naphthalene	2.56E-03	2.32E-03	4.88E-03
Phenanthrene	8.05E-04	7.29E-04	1.53E-03
Propylene	5.92E-03	5.56E-03	1.15E-02
Pyrene	7.36E-05	6.68E-05	1.40E-04
Toluene	5.58E-03	5.07E-03	1.07E-02
Xylenes	3.83E-03	3.48E-03	7.32E-03
Diesel engine exhaust, particulate	1.71	0.55	2.26
SO_2	0.09	0.11	0.20
CO	13.95	4.18	18.13
NO_2	5.54	3.95	9.49

Table C-3a. Operation Scenario Summary

Operation Scenario	Maximum Operations for Each Engine (hr/day/engine)	(hr/yr/engine)	Maximum Operations for All Engines [2] (engine-hr/hr)	(engine-hr/day)	(engine-hr/yr)
Main Genset Running at Any Load [1]	24	55	30	720	1650
Support Genset Running at Any Load	24	55	2	48	110

[1] 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 6 days in any given year while keeping the total number of hours per engine per calendar year equal to or below 55. Maintenance and testing runs outside of these 6 days will be operated for a single engine at any hour, up to 24 engine-hours in any day.

[2] The project includes 30 main gensets and 2 support genset.

Table C-3b. Criteria Pollutants Emission Estimate - Main Gensets

Pollutant	Emission Factor	Maximum Engine Emission Rate Across Any Load/Vendor [1] Warm Engine (lb/hr/engine)	Cold-Start (lb/hr/engine)	(tpy/engine) [5]	Annual Total for All Engines (tpy)
Particulate Matter (PM) [2]	Maximum Vendor Hourly Emission Rate	2.01	2.12	0.06	1.70
Condensable PM [2]	Maximum Vendor Hourly Emission Rate for Total Hydrocarbon	1.20	1.27	0.03	1.02
Particulate Matter <10 microns (PM_{10}) [2]	Maximum Vendor Hourly Emission Rate	2.57	2.71	0.07	2.18
Particulate Matter < 2.5 microns ($PM_{2.5}$) [2]	Maximum Vendor Hourly Emission Rate	2.57	2.71	0.07	2.18
Sulfur Dioxide (SO_2) [3]	1.21E-05 lb/hp-hr per AP-42	0.04	0.04	1.21E-03	0.04
Carbon Monoxide (CO) [4]	Maximum Vendor Hourly Emission Rate	15.63	17.71	0.46	13.77
Nitrogen Oxides (NO_X) [4]	Maximum Vendor Hourly Emission Rate	66.67	66.60	1.83	54.98
Volatile Organic Compounds (VOC)	Maximum Vendor Hourly Emission Rate	1.20	1.27	0.03	1.02

[1] 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 6 days in any given year while keeping the total number of hours per engine per calendar year equal to or below 55. Maintenance and testing runs outside of these 6 days will be operated for a single engine at any hour, up to 24 engine-hours in any day.

[2] Diesel PM hourly emissions are the maximum based on engine specifications across all loads and vendors (see Load Emissions tables) for conservatism. PM_{10} and $PM_{2.5}$ emissions are the diesel PM emission rates plus the condensable PM emission rate. Condensable PM emissions are conservatively assumed to be the same as hydrocarbon emissions from vendor data, which is also conservatively assumed to be the maximum hourly emission rate across all loads and vendors.

[3] SO_2 emissions are calculated conservatively assuming constant operation at 100% load (i.e., maximum engine power). SO_2 emissions are 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.

[4] NO_X and CO hourly emissions are the maximum based on engine specifications across all loads and vendors (see Load Emissions tables) for conservatism.

[5] Emission calculations conservatively assumes 28 1-hour cold-start periods per year.

Table C-3c. Criteria Pollutants Emission Estimate - Support Genset

Pollutant	Emission Factor	Maximum Engine Emission Rate Across Any Load/Vendor[1]			Annual Total for All Engines
		Warm Engine (lb/hr/engine)	Cold-Start (lb/hr/engine)	(tpy/engine)[5]	(tpy)
Particulate Matter (PM) [2]	Maximum Vendor Hourly Emission Rate	0.18	0.19	4.96E-03	9.92E-03
Condensable PM [2]	Maximum Vendor Hourly Emission Rate for Total Hydrocarbon	0.29	0.31	8.28E-03	1.66E-02
Particulate Matter <10 microns (PM_{10}) [2]	Maximum Vendor Hourly Emission Rate	0.37	0.39	1.04E-02	2.08E-02
Particulate Matter < 2.5 microns ($PM_{2.5}$) [2]	Maximum Vendor Hourly Emission Rate	0.37	0.39	1.04E-02	2.08E-02
Sulfur Dioxide (SO_2) [3]	2.05E-03 lb/hp-hr per AP-42	0.98	0.98	2.71E-02	5.41E-02
Carbon Monoxide (CO) [4]	Maximum Vendor Hourly Emission Rate	3.18	3.60	0.09	0.19
Nitrogen Oxides (NO_X) [4]	Maximum Vendor Hourly Emission Rate	6.85	6.84	0.19	0.38
Volatile Organic Compounds (VOC)	Maximum Vendor Hourly Emission Rate	0.29	0.31	8.28E-03	1.66E-02

[1] 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 6 days in any given year while keeping the total number of hours per engine per calendar year equal to or below 55. Maintenance and testing runs outside of these 6 days will be operated for a single engine at any hour, up to 24 engine-hours in any day.

[2] Diesel PM hourly emissions are the maximum based on engine specifications across all loads and vendors (see Load Emissions tables) for conservatism. PM_{10} and $PM_{2.5}$ emissions are the diesel PM emission rates plus the condensable PM emission rate. Condensable PM emissions are conservatively assumed to be the same as hydrocarbon emissions from vendor data, which is also conservatively assumed to be the maximum hourly emission rate across all loads and vendors.

[3] SO_2 emissions are calculated conservatively assuming constant operation at 100% load (i.e., maximum engine power). SO_2 emissions are calculated according to methodology presented in AP-42, Chapter 3.3, Table 3.3-1.

[4] NO_X and CO hourly emissions are the maximum based on engine specifications across all loads and vendors (see Load Emissions tables) for conservatism.

[5] Emission calculations conservatively assumes 28 1-minute cold-start periods per year.

Table C-3d. Fuel Consumption Summary

Operation Mode [1]	Hourly Fuel Consumption Rate [2] (gal/hr)	Maximum Hourly Scenario		Maximum Daily Scenario		Annual Scenario	
		Maximum Number of Engines Running in Any Single Hour	Subtotal (gal/hr)	Maximum Number of Engines-Hours in Any Single Day	Subtotal (gal/day)	Number of Engines-Hours in a Year	Subtotal (gal/yr)
Main Genset Maximum Load	173.50	30	5,205	720	124,920	1650	286,275
Support Genset Maximum Load	23.07	2	46	48	1,107	110	2,538
Total	196.57		5,251		126,027		288,813

[1] 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 6 days in any given year while keeping the total number of hours per engine per calendar year equal to or below 55. Maintenance and testing runs outside of these 6 days will be operated for a single engine at any hour, up to 24 engine-hours in any day.

[2] The maximum hourly fuel consumption rate among all vendors at 100% load is used to determine the daily and annual fuel consumptions for conservatism.

Table C-3e. Maximum 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)	63.83	1532.00	1.71
Condensable PM	38.58	925.86	1.03
Particulate Matter <10 microns (PM_{10})	82.01	1968.22	2.20
Particulate Matter < 2.5 microns ($PM_{2.5}$)	82.01	1968.22	2.20
Sulfur Dioxide (SO_2)	3.29	79.04	0.09
Carbon Monoxide (CO)	538.50	12924.04	13.95
Nitrogen Oxides (NO_X)	2013.87	48332.85	55.35
Volatile Organic Compounds (VOC)	38.58	925.86	1.03
Hazardous Air Pollutants (HAPs)	1.15	27.52	0.03

Table C-4. 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

[1] Factors, hourly emission rates, and exhaust flow characteristics are obtained from the Performance Data section in "CAT C9 300kW Technical Data.pdf".

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

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)	173.5	134.9	98.4	57.9	31.3

[1] Exhaust flow characteristics are obtained from Tier 2 Performance Data sheet for CAT 3516C.

Cummins DQKAF **GenSet Power (kW):** **2250**
Engine size (hp): **3,280** **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	8.88	6.03	4.55	5.25	8.70	64.21	32.70	16.45	9.49	6.29
CO	0.74	0.40	0.56	1.42	4.66	5.35	2.17	2.02	2.57	3.37
HC	0.07	0.03	0.12	0.26	0.66	0.51	0.16	0.43	0.47	0.48
PM	0.10	0.08	0.18	0.40	0.83	0.72	0.43	0.65	0.72	**0.60**
					Exhaust Flow Rate (acfm)	**16,546**	**14,174**	11,190	6,594	4,150
					Exhaust Flow Rate (scfm)	6,445.0	5,689.0	4,610.6	2,932.1	2,072.4
					Exhaust Temperature (°F)	895	855	**821**	**727**	**597**
					Fuel Combustion Rate (gal/hr)	154	121	88	48	26.80

Cummins DQKAN **GenSet Power (kW):** **2500**
Engine size (hp): **3,640** **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	7.96	5.76	5.07	4.89	6.03	63.88	34.67	20.34	9.81	4.84
CO	1.50	1.26	1.04	1.62	3.26	12.04	7.58	4.17	3.25	2.62
HC	0.07	0.09	0.14	0.26	0.60	0.56	0.54	0.56	0.52	0.48
PM	0.25	0.25	0.23	0.43	0.70	**2.01**	**1.50**	**0.92**	**0.86**	0.56
					Exhaust Flow Rate (acfm)	18,269	15,122	**10,902**	**6,482**	**4002**
					Exhaust Flow Rate (scfm)	6,506.2	5,538.7	4,112.9	2,613.6	1,800.8
					Exhaust Temperature (°F)	1022	981	939	849	713
					Fuel Combustion Rate (gal/hr)	173.1	133.6	91.1	50.6	26.8

Kohler KD2250 **GenSet Power (kW):** **2250**
Engine size (hp): **3,352** **Tier:** **2**
Engine size (kW): **2,500**

	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	9.0	5.6	5.8	6.1	9.7	49.60	23.14	15.98	8.40	5.35
CO	1.3	2.6	2.2	8.1	10.9	7.16	10.75	6.06	11.16	6.01
HC	0.14	0.15	0.22	0.35	0.89	0.77	0.62	0.61	0.48	0.49
PM	0.07	0.18	0.13	0.47	0.28	0.39	0.74	0.36	0.65	0.15
					Exhaust Flow Rate (kg/hr)	15017	14404	9978	5904	4042
					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)	**843.8**	**836.6**	842.0	847.4	734.0
					Fuel Combustion Rate (gal/hr)	167.10	136.90	95.20	55.40	--

[1] 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 KD2500 **GenSet Power (kW):** **2500**
Engine size (hp): **3,621** **Tier:** **2**
Engine size (kW): **2,700**

	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	11.2	5.3	5.7	5.9	7.8	66.67	23.66	16.97	8.78	4.64
CO	1.0	3.5	1.9	7.4	8.3	5.95	15.63	5.66	11.01	4.94
HC	0.14	0.12	0.21	0.34	0.84	0.83	0.54	0.63	0.51	0.50
PM	0.10	0.20	0.15	0.40	0.45	0.60	0.89	0.45	0.60	0.27
					Exhaust Flow Rate (kg/hr)	15085	15390	10714	6183	4140
					Exhaust Flow Rate (acfm)	18,340	18,916	12,865	7,599	4,674
					Exhaust Flow Rate (scfm)	7,373.3	7,522.4	5,236.8	3,022.2	2,023.6
					Exhaust Temperature (°F)	852.80	867.20	836.60	867.20	759.20
					Fuel Combustion Rate (gal/hr)	172.00	151.00	102.80	58.70	--

[2] 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-5a. Cold Start Scaling Factors

Pollutant	Spike Duration (seconds)[1]	Cold-Start Emission Spike[1] (ppm)	Steady-State (Warm) Emissions[1] (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

[1] 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-5b. Cold Start Emission Rates

	Worst-case Emission Rate (lb/hr/engine)					
	Main Genset			Support Genset		
Pollutant	Warm	Cold-Start	Startup Emission Rate [1]	Warm	Cold-Start	Startup Emission Rate [1]
HC	1.20	5.12	1.27	0.29	1.25	0.31
NO_X	66.67	62.46	66.60	6.85	6.42	6.84
CO	15.63	140.64	17.71	3.18	28.62	3.60
DEEP/PM	2.01	8.56	2.12	0.18	0.75	0.19
$PM_{10}/PM_{2.5}$	2.57	10.96	2.71	0.37	1.57	0.39

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

Table C-5c. Cold Start Emissions

Pollutant	Annual Emissions from Cold Start Hours - Main Gensets (tpy)	Annual Emissions from Cold Start Hours - Support Gensets (tpy)
HC	0.53	8.65E-03
NO_X	27.97	1.92E-01
CO	7.44	1.01E-01
DEEP	0.89	5.18E-03
$PM_{10}/PM_{2.5}$	1.14	1.09E-02

[1] Calculations conservatively assume 28 cold starts per engine, per year.

Table C-6. Project Cooling Unit Emissions

Value	PM	PM_{10}	$PM_{2.5}$
Hours of Operation (hr/yr)	8,760	8,760	8,760
Cooling Units	120	120	120
Total Water Consumption Flowrate (gal/hr)	241	241	241
Recirculation Flowrate (gal/min-unit)	84	84	84
Total Annual Throughput [1] (tpy water recirculated)	23,149,285	23,149,285	23,149,285
Total Dissolved Solids (TDS) [2] (ppm)	550	550	550
Drift Loss [2] (wt%)	0.001%	0.001%	0.001%
Total Emissions (tpy)	1.27E-01	1.27E-01	1.27E-01

[1] Recirculation flowrate was provided by Munters Corporation on March 17, 2020.

[2] 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.

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

Table C-7. HAP and TAP Emissions

Pollutant	CAS Number	HAP?	TAP?	Diesel Fired Industrial Engines for Main Gensets [1]	Main Genset Emissions [2]			Diesel Fired Industrial Engines for Support Gensets [1]	Support Genset Emissions [2]			Averaging Period	De Minimis	SQER	Project Emissions	Modeling Required? [3]
				(lb/MMBtu)	(lb/hr)	(lb/day)	(tpy)	(lb/MMBtu)	(lb/hr)	(lb/day)	(tpy)			(lb/avg period)		
Acenaphthene [4]	83-32-9	Yes	No	4.68E-06	3.34E-03	0.08	9.18E-05	1.42E-06	8.98E-06	2.15E-04	2.47E-07	-	-	-	-	--
Acenaphthylene [4]	208-96-8	Yes	No	9.23E-06	6.58E-03	0.16	1.81E-04	5.06E-06	3.20E-05	7.68E-04	8.80E-07	-	-	-	-	--
Acetaldehyde [4]	75-07-0	Yes	Yes	2.52E-05	0.02	0.43	4.94E-04	7.67E-04	4.85E-03	0.12	1.33E-04	year	3.00E+00	6.00E+01	1.25	De Minimis
Acrolein	107-02-8	Yes	Yes	7.88E-06	5.62E-03	0.13	1.55E-04	9.25E-05	5.85E-04	1.40E-02	1.61E-05	24-hr	1.30E-03	2.60E-02	0.15	Yes
Anthracene [4]	120-12-7	Yes	No	1.23E-06	8.77E-04	0.02	2.41E-05	1.87E-06	1.18E-05	2.84E-04	3.25E-07	-	-	-	-	--
Benzene	71-43-2	Yes	Yes	7.76E-04	0.55	13.28	0.02	9.33E-04	5.90E-03	0.14	1.62E-04	year	1.00E+00	2.10E+01	30.76	Yes
Benzo(a)anthracene [4]	56-55-3	Yes	Yes	6.22E-07	4.44E-04	1.06E-02	1.22E-05	1.68E-06	1.06E-05	2.55E-04	2.92E-07	year	4.50E-02	8.90E-01	0.02	De Minimis
Benzo(a)pyrene [4]	50-32-8	Yes	Yes	2.57E-07	1.83E-04	4.40E-03	5.04E-06	1.88E-07	1.19E-06	2.85E-05	3.27E-08	year	8.20E-03	1.60E-01	1.01E-02	No
Benzo(b)fluoranthene [4]	205-99-2	Yes	Yes	1.11E-06	7.92E-04	0.02	2.18E-05	9.91E-08	6.26E-07	1.50E-05	1.72E-08	year	4.50E-02	8.90E-01	0.04	De Minimis
Benzo(g,h,l)perylene [4]	--	Yes	No	5.56E-07	3.96E-04	9.52E-03	1.09E-05	4.89E-07	3.09E-06	7.42E-05	8.50E-08	-	-	-	-	--
Benzo(k)fluoranthene [4]	207-08-9	Yes	Yes	2.18E-07	1.55E-04	3.73E-03	4.27E-06	1.55E-07	9.80E-07	2.35E-05	2.69E-08	year	4.50E-02	8.90E-01	8.60E-03	De Minimis
1,3-Butadiene	106-99-0	Yes	Yes	--	--	--	--	3.91E-05	2.47E-04	5.93E-03	6.80E-06	year	2.70E-01	5.40E+00	1.36E-02	De Minimis
Chrysene	218-01-9	Yes	Yes	1.53E-06	1.09E-03	0.03	3.00E-05	3.53E-07	2.23E-06	5.36E-05	6.14E-08	year	4.50E-01	8.90E+00	0.06	De Minimis
Dibenz(a,h)anthracene [4]	53-70-3	Yes	Yes	3.46E-07	2.47E-04	5.92E-03	6.79E-06	5.83E-07	3.69E-06	8.84E-05	1.01E-07	year	4.10E-03	8.20E-02	1.38E-02	No
Fluoranthene [4]	206-44-0	Yes	No	4.03E-06	2.87E-03	0.07	7.90E-05	7.61E-06	4.81E-05	1.15E-03	1.32E-06	-	-	-	-	--
Fluorene [4]	86-73-7	Yes	No	1.28E-05	9.13E-03	0.22	2.51E-04	2.92E-05	1.85E-04	4.43E-03	5.08E-06	-	-	-	-	--
Formaldehyde [4]	50-00-0	Yes	Yes	7.89E-05	0.06	1.35	1.55E-03	1.18E-03	7.46E-03	0.18	2.05E-04	year	1.40E+00	2.70E+01	3.50	No
Indeno(1,2,3-cd)pyrene	193-39-5	Yes	Yes	4.14E-07	2.95E-04	7.09E-03	8.12E-06	3.75E-07	2.37E-06	5.69E-05	6.52E-08	year	4.50E-02	8.90E-01	0.02	De Minimis
Naphthalene [4]	91-20-3	Yes	Yes	1.30E-04	0.09	2.22	2.55E-03	8.48E-05	5.36E-04	1.29E-02	1.47E-05	year	2.40E-01	4.80E+00	5.13	Yes
Phenanthrene	85-01-8	Yes	No	4.08E-05	0.03	0.70	8.00E-04	2.94E-05	1.86E-04	4.46E-03	5.11E-06	-	-	-	-	--
Propylene [4]	115-07-1	No	Yes	2.79E-04	0.20	4.77	5.47E-03	2.58E-03	0.02	0.39	4.48E-04	24-hr	1.10E+01	2.20E+02	5.17	De Minimis
Pyrene [4]	129-00-0	Yes	No	3.71E-06	2.65E-03	0.06	7.28E-05	4.78E-06	3.02E-05	7.25E-04	8.31E-07	-	-	-	-	--
Toluene	108-88-3	Yes	Yes	2.81E-04	0.20	4.81	5.51E-03	4.09E-04	2.59E-03	0.06	7.11E-05	24-hr	1.90E+01	3.70E+02	4.87	De Minimis
Xylenes	1330-20-7	Yes	Yes	1.93E-04	0.14	3.30	3.78E-03	2.85E-04	1.80E-03	0.04	4.95E-05	24-hr	8.20E-01	1.60E+01	3.35	No
Diesel engine exhaust, particulate [5]	--	No	Yes	See Table C-3b.	63.46	109.61	1.70	See Table C-3c.	0.37	4.41	9.92E-03	year	2.70E-02	5.40E-01	3,421.84	Yes
SO_2 [6]	7446-09-05	No	Yes	See Table C-3b.	1.33	2.34	0.04	See Table C-3c.	1.97	24.60	0.05	1-hr	4.60E-01	1.20E+00	3.29	Yes
CO [6]	630-08-0	No	Yes	See Table C-3b.	531.29	890.70	13.77	See Table C-3c.	7.21	80.34	0.19	1-hr	1.10E+00	4.30E+01	538.50	Yes
NO_2 [6]	10102-44-0	No	Yes	See Table C-3b.	200.02	4,800.40	5.50	See Table C-3c.	1.37	32.89	0.04	1-hr	4.60E-01	8.70E-01	201.39	Yes
Total HAP Emissions:					1.12	26.93	0.03		0.02	0.59	6.73E-04					
Total TAP Emissions:					797.37	5,833.43	21.04		10.96	143.20	0.29					

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-8a. Existing Gensets Operation Scenario Summary

Operation Scenario	Maximum Operations for Each Engine (hr/day/engine)	(hr/yr/engine)	Maximum Operations for All Engines [2] (engine-hr/hr)	(engine-hr/day)	(engine-hr/yr)
Main Genset Running at Any Load [1]	24	57.5	34	816	1955
Support Genset Running at Any Load	24	57.5	3	72	173

[1] 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).

[2] The project includes 34 main gensets and 3 support genset.

Table C-8b. Existing Gensets Criteria Pollutants Emission Estimate - Main Gensets

Pollutant	Emission Factor	Total Maximum Emission Rate for Main Gensets[1] Warm Engine (Total lb/hr)	Cold-Start (Total lb/hr)	Annual Total for All Engines (tpy)[4]
Particulate Matter (PM) [2]	Vendor Hourly Emission Rate	18.18	19.17	0.54
Condensable PM [2]	Vendor Hourly Emission Rate for Total Hydrocarbon	36.32	38.30	1.07
Particulate Matter <10 microns (PM_{10}) [2]	Vendor Hourly Emission Rate	54.50	57.47	1.61
Particulate Matter < 2.5 microns ($PM_{2.5}$) [2]	Vendor Hourly Emission Rate	54.50	57.47	1.61
Sulfur Dioxide (SO_2) [3]	1.21E-05 lb/hp-hr per AP-42	1.16	1.16	3.33E-02
Carbon Monoxide (CO)	Vendor Hourly Emission Rate	134.63	152.58	4.12
Nitrogen Oxides (NO_X)	Vendor Hourly Emission Rate	1364.70	1363.26	39.22
Volatile Organic Compounds (VOC)	Vendor Hourly Emission Rate	36.32	38.30	1.07

[1] 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).

[2] PM_{10} and $PM_{2.5}$ emissions are the diesel PM emission rates plus the condensable PM emission rate. Condensable PM emissions are conservatively assumed to be the same as hydrocarbon emissions from vendor data.

[3] SO_2 emissions are calculated conservatively assuming constant operation at 100% load (i.e., maximum engine power). SO_2 emissions are 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.

[4] Emission calculations conservatively assumes 28 1-hour cold-start periods per year.

Table C-8c. Existing Gensets Criteria Pollutants Emission Estimate - Support Genset

Pollutant	Emission Factor	Total Maximum Engine Emission Rate for Support Gensets[1] Warm Engine (Total lb/hr)	Cold-Start (Total lb/hr)	Annual Total for All Engines (tpy)[4]
Particulate Matter (PM) [2]	Maximum Vendor Hourly Emission Rate	0.45	0.47	1.33E-02
Condensable PM [2]	Maximum Vendor Hourly Emission Rate for Total Hydrocarbon	0.64	0.67	1.89E-02
Particulate Matter <10 microns (PM_{10}) [2]	Maximum Vendor Hourly Emission Rate	1.09	1.15	3.22E-02
Particulate Matter < 2.5 microns ($PM_{2.5}$) [2]	Maximum Vendor Hourly Emission Rate	1.09	1.15	3.22E-02
Sulfur Dioxide (SO_2) [3]	2.05E-03 lb/hp-hr per AP-42	2.62	2.62	7.52E-02
Carbon Monoxide (CO)	Maximum Vendor Hourly Emission Rate	1.79	2.03	0.05
Nitrogen Oxides (NO_X)	Maximum Vendor Hourly Emission Rate	10.78	10.77	0.31
Volatile Organic Compounds (VOC)	Maximum Vendor Hourly Emission Rate	0.64	0.67	1.89E-02

[1] 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).

[2] PM_{10} and $PM_{2.5}$ emissions are the diesel PM emission rates plus the condensable PM emission rate. Condensable PM emissions are conservatively assumed to be the same as hydrocarbon emissions from vendor data.

[3] SO_2 emissions are calculated conservatively assuming constant operation at 100% load (i.e., maximum engine power). SO_2 emissions are calculated according to methodology presented in AP-42, Chapter 3.3, Table 3.3-1.

[4] Emission calculations conservatively assumes 28 1-minute cold-start periods per year.

Table C-8d. Existing Gensets Fuel Consumption Summary

Genset Type [1]	Maximum Total Hourly Fuel Consumption Rate (gal/hr)	Maximum Total Daily Fuel Consumption Rate (gal/day)	Maximum Total Annual Fuel Consumption Rate (gal/yr)
Main Genset	4491.60	107,798	258,267
Support Genset	61.50	1,476	3,536
Total	4553.10	109,274	261,803

[1] 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).

Table C-9. Existing Gensets Load Emission Tables

CAT C9 **GenSet Power (kW):** **300** **Quantity:** **1**

Engine size (hp): **480**

	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 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

[1] Factors, hourly emission rates, and exhaust flow characteristics are obtained from the Performance Data section in "CAT C9 300kW Technical Data.pdf".

CAT C9 **GenSet Power (kW):** **250** **Quantity:** **2**

Engine size (hp): **398** **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	3.14	2.38	2.16	2.27	3.22	3.15	1.78	1.11	0.70	0.55
CO	0.68	0.90	1.01	2.30	3.89	0.59	0.60	0.47	0.63	0.60
HC	0.17	0.29	0.44	0.57	1.03	0.17	0.22	0.23	0.19	0.18
PM	0.16	0.22	0.23	0.40	0.49	0.14	0.15	0.11	0.11	0.08
					Exhaust Flow Rate (acfm)	2,245.6	1977	1616	1077	721
					Exhaust Temperature (°F)	852	791	756	721	612
					Fuel Combustion Rate (gal/hr)	19.40	15.50	11.60	7.30	4.40

Two different years of CAT C9 engines are present on site. This data represents a worst case across both data sheets.

CAT 3516C **GenSet Power (kW):** **2000** **Quantity:** **23**

Engine size (hp): **2,937**

	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	6.56	4.67	3.82	5.04	7.13	42.45	22.75	12.81	9.31	6.47
CO	0.54	0.39	0.60	2.12	4.36	3.48	1.88	2.00	3.91	3.95
HC	0.15	0.23	0.34	0.49	1.08	0.93	1.13	1.13	0.90	0.98
PM	0.04	0.05	0.08	0.31	0.49	0.23	0.22	0.27	0.57	0.45
					Exhaust Flow Rate (acfm)	15,292.8	12,897.9	10,138.7	6,328.1	4,478.2
					Exhaust Temperature (°F)	752.10	684.60	654.00	641.70	552.80
					Fuel Combustion Rate (gal/hr)	138.0	107.5	77.5	44.8	26.4

[1] Exhaust flow characteristics are obtained from Performance Data sheet for 2000 kW CAT 3516C.

CAT 3512C **GenSet Power (kW):** **1500** **Quantity:** **6**

Engine size (hp): **2,206** **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	6.09	4.09	3.95	5.33	8.34	29.35	14.84	9.89	7.39	5.70
CO	0.80	0.66	1.36	2.88	5.59	3.85	2.41	3.40	3.98	3.82
HC	0.15	0.22	0.29	0.42	0.97	0.72	0.78	0.73	0.58	0.66
PM	0.04	0.06	0.12	0.27	0.33	0.20	0.20	0.31	0.37	**0.23**
					Exhaust Flow Rate (acfm)	10,909.2	9,156.1	6,856.9	4,354.9	3,012.8
					Exhaust Temperature (°F)	759.0	700.6	686.4	648.1	526.2
					Fuel Combustion Rate (gal/hr)	104.6	82.0	58.1	33.9	19.7

Table C-10a. Existing Genset Cold Start Scaling Factors

Pollutant	Spike Duration (seconds)[1]	Cold-Start Emission Spike[1] (ppm)	Steady-State (Warm) Emissions[1] (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

[1] 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-10b. Existing Genset Cold Start Emission Rates

	Worst-case Emission Rate (lb/hr)					
	Main Genset			Support Genset		
Pollutant	Warm	Cold-Start	Startup Emission Rate [1]	Warm	Cold-Start	Startup Emission Rate [1]
HC	36.32	154.97	38.30	0.64	2.73	0.67
NO_X	1364.70	1278.51	1363.26	10.78	10.10	10.77
CO	134.63	1211.67	152.58	1.79	16.11	2.03
DEEP/PM	18.18	77.57	19.17	0.45	1.92	0.47
$PM_{10}/PM_{2.5}$	54.50	232.53	57.47	1.09	4.65	1.15

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

Table C-10c. Existing Genset Cold Start Emissions

Pollutant	Annual Emissions from Cold Start Hours - Main Gensets (tpy)	Annual Emissions from Cold Start Hours - Support Gensets (tpy)
HC	0.54	9.45E-03
NO_X	19.09	1.51E-01
CO	2.14	2.84E-02
DEEP	0.27	6.64E-03
$PM_{10}/PM_{2.5}$	0.80	1.61E-02

[1] Calculations conservatively assume 28 cold starts per engine, per year.

Table C-11. Existing Cooling Unit Emissions

Emission Point	Quantity	Annual Emission Rate (tpy)		
		PM	PM_{10}	$PM_{2.5}$
Permitted Cooling Units	176	2.32	2.32	2.32
Existing Cooling Units	148	1.95	1.95	1.95

[1] 176 cooling units were permitted for the site, but only 148 have actually been constructed to date. PTE for exisiting cooling units is therefore calculated for units that have actually been installed.

Table C-12. Existing HAP and TAP Emissions

Pollutant	CAS Number	HAP?	TAP?	Diesel Fired Industrial Engines for Main Gensets [1] (lb/MMBtu)	Main Genset Emissions [2] (lb/hr)	(lb/day)	(tpy)	Diesel Fired Industrial Engines for Support Gensets [1] (lb/MMBtu)	Support Genset Emissions [2] (lb/hr)	(lb/day)	(tpy)	Averaging Period
Acenaphthene [4]	83-32-9	Yes	No	4.68E-06	2.88E-03	0.07	8.28E-05	1.42E-06	1.20E-05	2.87E-04	3.44E-07	-
Acenaphthylene [4]	208-96-8	Yes	No	9.23E-06	5.68E-03	0.14	1.63E-04	5.06E-06	4.26E-05	1.02E-03	1.23E-06	-
Acetaldehyde [4]	75-07-0	Yes	Yes	2.52E-05	0.02	0.37	4.46E-04	7.67E-04	6.46E-03	0.16	1.86E-04	year
Acrolein	107-02-8	Yes	Yes	7.88E-06	4.85E-03	0.12	1.39E-04	9.25E-05	7.79E-04	0.02	2.24E-05	24-hr
Anthracene [4]	120-12-7	Yes	No	1.23E-06	7.57E-04	0.02	2.18E-05	1.87E-06	1.58E-05	3.78E-04	4.53E-07	-
Benzene	71-43-2	Yes	Yes	7.76E-04	0.48	11.46	1.37E-02	9.33E-04	7.86E-03	0.19	2.26E-04	year
Benzo(a)anthracene [4]	56-55-3	Yes	Yes	6.22E-07	3.83E-04	9.19E-03	1.10E-05	1.68E-06	1.42E-05	3.40E-04	4.07E-07	year
Benzo(a)pyrene [4]	50-32-8	Yes	Yes	2.57E-07	1.58E-04	3.80E-03	4.55E-06	1.88E-07	1.58E-06	3.80E-05	4.55E-08	year
Benzo(b)fluoranthene [4]	205-99-2	Yes	Yes	1.11E-06	6.83E-04	0.02	1.96E-05	9.91E-08	8.35E-07	2.00E-05	2.40E-08	year
Benzo(g,h,l)perylene [4]	--	Yes	No	5.56E-07	3.42E-04	8.21E-03	9.84E-06	4.89E-07	4.12E-06	9.89E-05	1.18E-07	-
Benzo(k)fluoranthene [4]	207-08-9	Yes	Yes	2.18E-07	1.34E-04	3.22E-03	3.86E-06	1.55E-07	1.31E-06	3.13E-05	3.75E-08	year
1,3-Butadiene	106-99-0	Yes	Yes	--	--	--	--	3.91E-05	3.29E-04	7.91E-03	9.47E-06	year
Chrysene	218-01-9	Yes	Yes	1.53E-06	9.41E-04	0.02	2.71E-05	3.53E-07	2.97E-06	7.14E-05	8.55E-08	year
Dibenz(a,h)anthracene [4]	53-70-3	Yes	Yes	3.46E-07	2.13E-04	5.11E-03	6.12E-06	5.83E-07	4.91E-06	1.18E-04	1.41E-07	year
Fluoranthene [4]	206-44-0	Yes	No	4.03E-06	2.48E-03	0.06	7.13E-05	7.61E-06	6.41E-05	1.54E-03	1.84E-06	-
Fluorene [4]	86-73-7	Yes	No	1.28E-05	7.88E-03	0.19	2.26E-04	2.92E-05	2.46E-04	5.90E-03	7.07E-06	-
Formaldehyde [4]	50-00-0	Yes	Yes	7.89E-05	0.05	1.17	1.40E-03	1.18E-03	9.94E-03	0.24	2.86E-04	year
Indeno(1,2,3-cd)pyrene	193-39-5	Yes	Yes	4.14E-07	2.55E-04	6.11E-03	7.32E-06	3.75E-07	3.16E-06	7.58E-05	9.08E-08	year
Naphthalene [4]	91-20-3	Yes	Yes	1.30E-04	0.08	1.92	2.30E-03	8.48E-05	7.14E-04	0.02	2.05E-05	year
Phenanthrene	85-01-8	Yes	No	4.08E-05	0.03	0.60	7.22E-04	2.94E-05	2.48E-04	5.95E-03	7.12E-06	-
Propylene [4]	115-07-1	No	Yes	2.79E-04	0.17	4.12	4.94E-03	2.58E-03	0.02	0.52	6.25E-04	24-hr
Pyrene [4]	129-00-0	Yes	No	3.71E-06	2.28E-03	0.05	6.56E-05	4.78E-06	4.03E-05	9.67E-04	1.16E-06	-
Toluene	108-88-3	Yes	Yes	2.81E-04	0.17	4.15	4.97E-03	4.09E-04	3.45E-03	0.08	9.91E-05	24-hr
Xylenes	1330-20-7	Yes	Yes	1.93E-04	0.12	2.85	3.41E-03	2.85E-04	2.40E-03	0.06	6.90E-05	year
Diesel engine exhaust, particulate [5]	--	No	Yes	See Table C-8b.	19.17	437.31	0.54	See Table C-8c	0.47	10.82	1.33E-02	year
SO_2 [6]	7446-09-05	No	Yes	See Table C-8b.	1.16	27.81	0.03	See Table C-8c	2.62	62.78	0.08	1-hr
CO [6]	630-08-0	No	Yes	See Table C-8b.	152.58	3,249.07	4.12	See Table C-8c	2.03	43.20	0.05	1-hr
NO_2 [6]	10102-44-0	No	Yes	See Table C-8b.	136.47	3,275.28	3.92	See Table C-8c	1.08	25.87	0.03	1-hr
Total HAP Emissions:					0.97	23.24	0.03		0.03	0.78	9.38E-04	
Total TAP Emissions:					310.47	7,015.69	8.64		6.25	143.96	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.

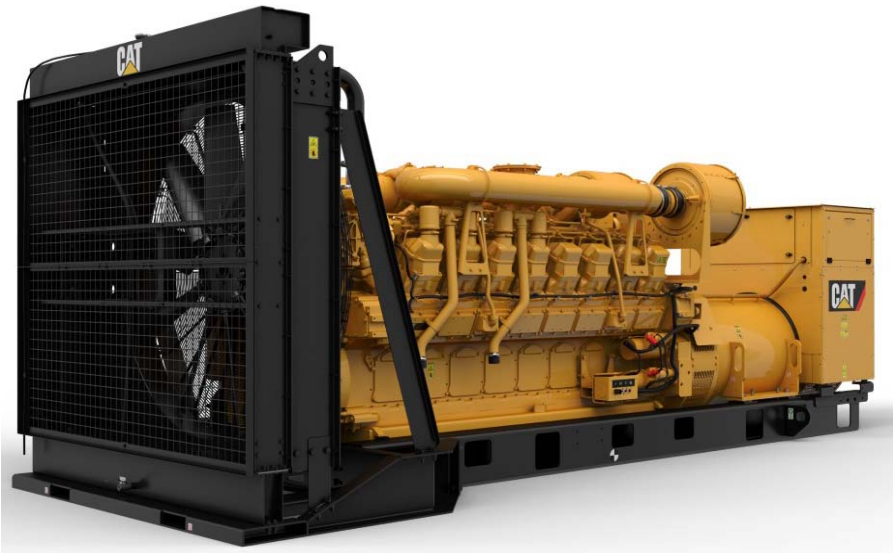
4. These are categorized as polycyclic organic matter (POM), which is a HAP.

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.

2.ENGINE SPECIFICATIONS - PROJECT

NC POWER SYSTEMS



TECHNICAL DATA

CATERPILLAR 3516C PACKAGED GENERATOR SET

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

PREPARED FOR:

SABEY CORPORATION

JOB:

SABEY IGQ – DOE PERMIT GENERATOR

Michael Va
Project Engineer
October 2019
Rev. 1

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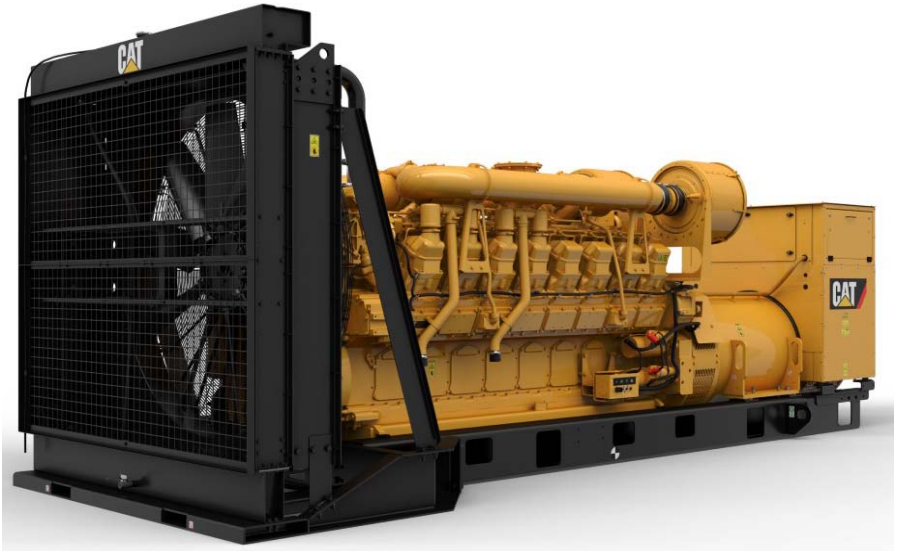
NC POWER SYSTEMS



CAT Cut/Data Sheets

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Cat® 3516C
Diesel Generator Sets

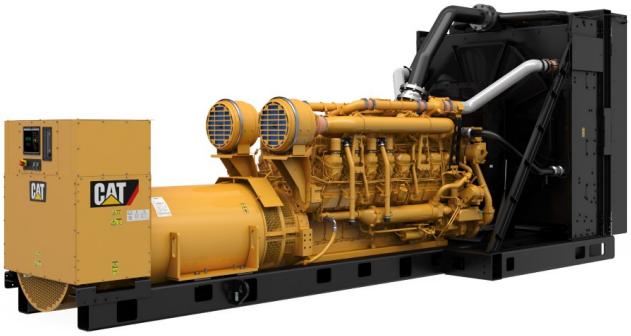


Image shown may not reflect actual configuration

Bore – mm (in)	170 (6.69)
Stroke – mm (in)	215 (8.46)
Displacement – L (in^3)	78 (4764.73)
Compression Ratio	14.7:1
Aspiration	TA
Fuel System	EUI
Governor Type	ADEM™ A3

Mission Critical 60 Hz ekW (kVA)
2500 (3125)

Emissions Performance
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

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
- ❑ 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
- ■ UL2200
- ❑ 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.*

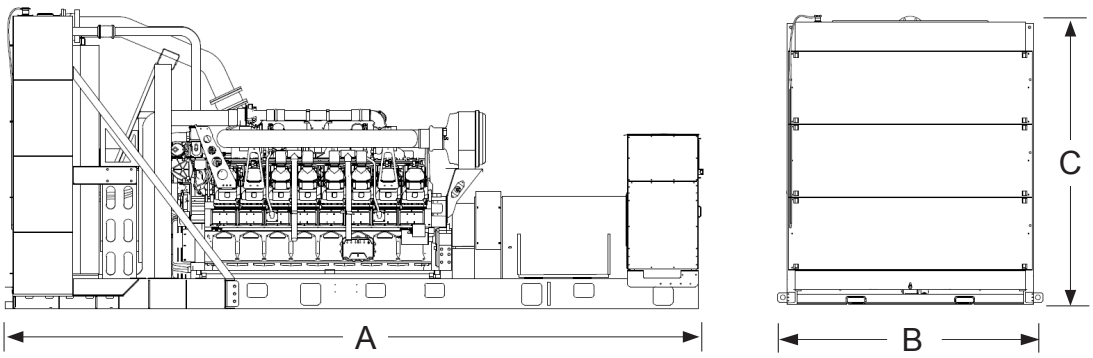
Package Performance

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)		2800.0	(98881)
Engine coolant capacity – L (gal)		233.0	(61.6)
Radiator coolant capacity – L (gal)		268.8	(71.0)
Total coolant capacity – L (gal)		501.8	(132.6)
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.*

3516C Diesel Generator Sets
Electric Power

Weights and Dimensions



Dim "A" mm (in)	Dim "B" mm (in)	Dim "C" mm (in)	Dry Weight kg (lb)
7033 (276.9)	2766 (108.9)	3018 (118.8)	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
AS1359, CSA C22.2 No100-04, UL142, UL489, UL869, UL2200, NFPA37, NFPA70, NFPA99, NFPA110, IBC, IEC60034-1, ISO3046, ISO8528, NEMA MG1-22, NEMA MG1-33, 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
Tier III/Tier IV compliant per Uptime Institute requirements. ANSI/TIA-942 compliant for Rated-1 through Rated-4 data centers.

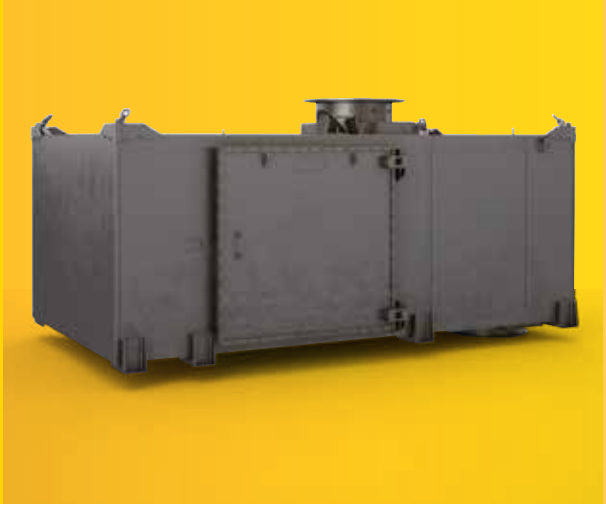
Fuel Rates
Fuel rates are based on fuel oil of 35º API [16°C (60ºF)] gravity having an LHV of 42,780 kJ/kg (18,390 Btu/lb) when used at 29ºC (85ºF) and weighing 838.9 g/liter (7.001 lbs/U.S. gal.)

www.cat.com/electricpower

3516 PGFL
LEHE1377-01 (04/19)

CAT® RETROFIT SELECTIVE CATALYTIC REDUCTION (SCR) SYSTEM

Horizontal Design



Serviceability

- SCR catalyst hatch is hinged for ease of service during checks and fully removable for access during SCR catalyst removal and replacement.
- DOC/DPF hatch can be lifted by one technician without the need for cranes.
- Nut strips provide ease in securing of hatches after service.
- Catalysts are packaged in lightweight, easy-to-handle modules.

Performance

- Dual wall reactor housing with standard insulation blanket provides superior heat retention for maximum emissions reduction.
- Closed loop dosing control system ensures highest levels of emissions reductions at lowest cost.
- Integral silencer design provides high levels of sound reduction.

Flexibility

- Addition of DOC or DPF catalysts can be performed at a later date with no changes to unit.

Support

- One source for warranty on complete package that includes worldwide Cat® dealer coverage on engine and aftertreatment.

Durability

- Reactor housing is constructed of stainless steel for superior life in indoor and outdoor installations.
- Standard powder-coated steel dosing cabinet provides protection in indoor environments while an optional stainless steel cabinet provides additional durability in corrosive indoor environments.
- Specialized mounting feet allow natural thermal expansion during operation, reducing the potential for stress cracking.

Ease of Installation

- Mounting bosses provide easy installation of harnesses on site as well as a durable method of retention during operation.
- Integral lifting eyes reduce guesswork and potential safety issues involved with moving the unit by providing attachment points that promote stability.
- Integrated mixing tube and silencing provide easy installation.

Safety

- Standard insulation blanket reduces surface temperature for additional safety.
- E-stop on dosing cabinet enhances safety by providing the ability to completely shut down the SCR system in an emergency situation.

CAT®

CAT® RETROFIT SELECTIVE CATALYTIC REDUCTION (SCR) SYSTEM

Horizontal Design

Housing	
Construction	409 Stainless Steel
Configuration	Bottom-in, Top-out
Inlet / Outlet Type	Flange
Lifting Lugs	Qty. 4 at Corners
Access Hatch (SCR)	Side Mounted, Hinged
Access Hatch (DOC / DPF)	Top Mounted, Liftable

Catalysts (SCR)	
Construction	Ceramic
Catalysts Serviceable	Yes
Sulfur Tolerance (Diesel)	ULSD (<15 PPM)
Biodesel	Up to B20
Fuel Quality (Gas)	Pipeline Quality Natural Gas

Catalysts (Optional DOC/DPF)	
Construction	Ceramic
Catalysts Serviceable	Yes
Sulfur Tolerance (Diesel)	ULSD (<15 PPM)
Biodesel	Up to B20
Fuel Quality (Gas)	Pipeline Quality Natural Gas

Dosing Cabinet	
Construction (Standard)	Powder-coated Steel
Construction (Optional)	Stainless Steel

Performance	
Max. NOx Reduction	Up to 95%
Max. CO Reduction	Up to 95%
Max. HC Reduction	Up to 90%
Max. PM Reduction	Over 85%
Silencing Capability	Up to 45 dB(A)

Weights (Est.) (SCR Housing with SCR Catalysts)		
3x3x3	2600 kg	5732 lbs
4x3x3	3200 kg	7055 lbs
4x4x3	3450 kg	7607 lbs
5x4x3	4000 kg	8819 lbs

Weights (Est.) (SCR Housing with SCR and DOC Catalysts)		
3x3x3	2763 kg	6092 lbs
4x3x3	3400 kg	7496 lbs
4x4x3	3687 kg	8129 lbs
5x4x3	4300 kg	9481 lbs

Weights (Est.) (SCR Housing with SCR Catalysts and DPF Filters)		
3x3x3	2800 kg	6173 lbs
4x3x3	3500 kg	7717 lbs
4x4x3	3800 kg	8378 lbs
5x4x3	4400 kg	9701 lbs

Inlet/Outlet (Number/Size)					
Inlet			**Outlet**		
3x3x3	1 x	305 mm/12.0 in	3x3x3	1 x	508 mm/20.0 in
4x3x3	2 x	406 mm/16.0 in	4x3x3	1 x	508 mm/20.0 in
4x4x3	2 x	508 mm/20.0 in	4x4x3	1 x	610 mm/24.0 in
5x4x3	2 x	508 mm/20.0 in	5x4x3	1 x	610 mm/24.0 in

	Dimensions		
	Length	Width	Height
3x3x3	4024 mm/158.4 in	1935 mm/76.2 in	1819 mm/71.6 in
4x3x3	4024 mm/158.4 in	2390 mm/94.1 in	1948 mm/76.7 in
4x4x3	4024 mm/158.4 in	2390 mm/94.1 in	1948 mm/76.7 in
5x4x3	4024 mm/158.4 in	2868 mm/112.9 in	1948 mm/76.7 in

Contact your Cat dealer in situations where standard features listed above do not meet required project specifications.

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PEHJ0461-00

Pi cture shown may not reflect actual configuration

EMCP 4.2B GENERATOR SET CONTROLLER

The Cat® EMCP 4.2B offers fully featured power metering, protective relaying and engine and generator control and monitoring. Engine and generator controls, diagnostics, and operating information are accessible via the control panel keypads; diagnostics from the EMCP 4 optional modules can be viewed and reset through the EMCP 4.2B.

Full range of attachments

- Wide range of system expansion attachments, designed specifically to work with the EMCP 4
- Flexible packaging options for easy and cost effective installation

World wide product support

- Cat dealers provide extensive pre and post sale support
- Cat dealers have over 1,600 dealer branch stores operating in 200 countries

Features

- A 33 x 132 pixel, 3.8 inch, white backlit graphical display denotes text alarm/event descriptions, set points, engine and generator monitoring, and is visible in all lighting conditions.
- Textual display with support for 26 languages
- Advanced engine monitoring is available on systems with an ADEM™ controller.
- Integration with the CDVR and IVR provides enhanced system performance
- Fully featured power metering, protective relaying, engine and generator parameter viewing, and expanded AC metering are all integrated into this controller.
- Real-time clock allows for date and time stamping of diagnostics and events in the control's logs as well as service maintenance reminders based on engine operating hours or calendar days. Up to 40 diagnostic events are stored in the non-volatile memory

Features

- Ability to view and reset diagnostics on EMCP 4 optional modules via the control panel removes the need for a separate service tool for troubleshooting
- Set points and software stored in non-volatile memory, preventing loss during a power outage
- Five levels of security allow for configurable operator privileges
- Programmable security levels for groups of setpoints.
- Programmable kW Relays (3)
- Programmable weekly exerciser timer
- Dealer configurable resistive maps
- Default overview screen
- Real (kW) Load histogram
- Auto mains failure
- Programmable logic functionality
- Selectable units
    - Temperature: °C or °F
    - Pressure: psi, kPa, bar
    - Fuel Consumption: Liter/hr or Gal/hr (U.S. or U.K.)

Standard Features

- Voltage (L-L, L-N)
- Current (Phase)
- Average Volt, Amp, Frequency
- kW, kVAr, kVA (Average, Phase, %)
- Power Factor (Average, Phase)
- kW-hr, kVAr-hr (total)
- Excitation voltage and current (with CDVR)
- Desired Voltage, Excitation Command, Operating Mode (with IVR)
- Generator stator and bearing temp (with optional module)
- kW load histogram

Generator Protection

- Generator phase sequence
- Over/Under voltage (27/59)
- Over/Under frequency (81 O/U)
- Reverse Power (kW) (32)
- Reverse Reactive Power (kVAr) (32RV)
- Overcurrent (50/51)
- Thermal Damage Curve

Engine Monitoring

- Coolant temperature
- Oil pressure
- Engine speed (RPM)
- Battery voltage
- Run hours
- Crank attempt and successful start counter
- Enhanced engine monitoring (with electronic engines)

Engine Protection

- Control switch not in auto (alarm)
- High coolant temp (alarm and shutdown)
- Low coolant temp (alarm)
- Low coolant level (alarm)
- High engine oil temp (alarm and shutdown)
- Low, high, and weak battery voltage
- Overspeed
- Overcrank
- Low Oil Pressure

Control

- Run / Auto / Stop control
- Speed and voltage adjust
- Local and remote emergency stop
- Remote start/stop
- Cycle crank

Inputs & Outputs

- Two dedicated digital inputs
- Three analog inputs
- Six programmable digital inputs
- Eight relay out
- Two programmable digital outputs

Communications

- Primary and accessory CAN data links
- RS-485 annunciator data link
- Modbus RTU (RS-485 Half duplex)

Language Support

Arabic, Bulgarian, Czech, Chinese, Danish, Dutch, English, Estonian, Finnish, French, German, Greek, Hungarian, Italian, Icelandic, Japanese, Latvian, Lithuanian, Norwegian, Polish, Portuguese, Romanian, Russian, Spanish, Swedish, Turkish

Environmental

- Control module operating temperature: -40°C to 70°C
- Display operating temperature: -20°C to 70°C
- Humidity: 100% condensing 30°C to 60°C
- Storage temperature: -40°C to 85°C
- Vibration: Random profile, 24-1000 Hz, 4.3G rms

Standards

- UL Recognized
- CSA C22.2 No.100,14, 94
- Complies with all necessary standards for CE Certification
  - 98/37/EC Machinery Directive
  - BS EN 60204-1 Safety of Machinery 89/336/EEC EMC Directive
  - BS EN 50081-1 Emissions Standard
  - BS EN 50082-2 Immunity Standard 73/23/EEC Low Voltage Directive
  - EN 50178 LVD Standard
- IEC529, IEC60034-5, IEC61131-3
- MIL STND 461

Optional Modules

RS-485 annunciator

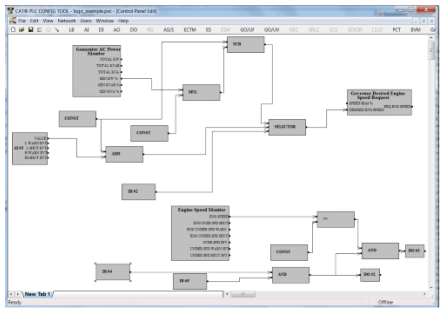
The EMCP 4 RS-485 Annunciator serves to display generator set system alarm conditions and status indications. The annunciator has been designed for use on the long distance annunciator datalink and is used for remote (up to 4000 feet) application.

The remote monitoring software allows the user to configure data monitoring and data acquisition processes for monitoring, graphing, and logging of generator set data.

Remote monitoring software

The EMCP remote monitoring software package is a PC based program which allows the user to monitor and control a generator set, and is capable of running on a Windows based operating system. The remote monitoring software allows the user to configure data monitoring and data acquisition processes for monitoring, graphing, and logging of generator set data.

Programmable logic software



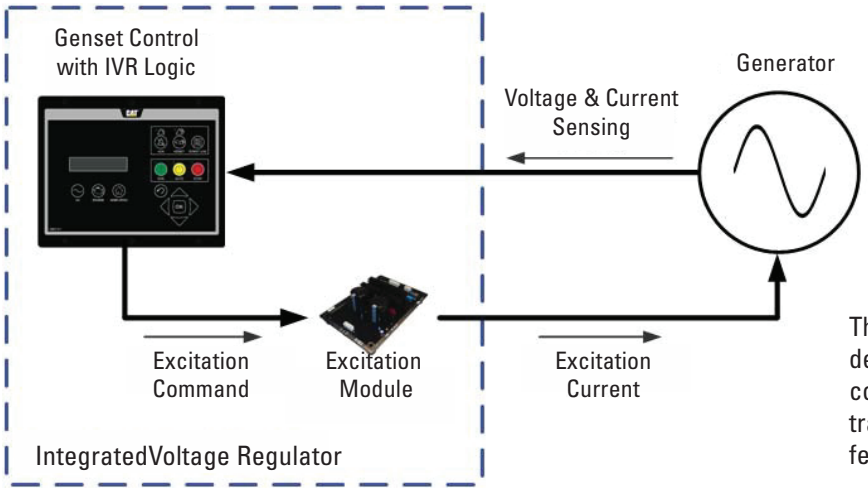
The EMCP programmable logic software package is a PC based program which allows the configuration of the programmable logic blocks, and is capable of running on a Windows based operating system. The programmable logic software allows the user to configure logic to change the operation of the EMCP control and interfaces within a limited scope.

Optional Modules (Continued)

Digital input/output module

The Digital Input/Output (DI/O) module serves to provide expandable Input and Output event capability of the EMCP 4 and is capable of reading 12 digital inputs and setting 8 relay outputs.
The DI/O module has been designed for use on the accessory Communication Network and may be used in either local (package mounted) or remote (up to 800 feet) application.

INTEGRATED VOLTAGE REGULATOR



INTEGRATED VOLTAGE REGULATOR

The Integrated Voltage Regulator (IVR) is designed to provide robust, precise closed-loop control of the generator voltage, optimized transient performance and industry leading feature specification.

Caterpillar is leading the power generation marketplace with power solutions engineered to deliver unmatched flexibility, expandability, reliability and cost-effectiveness.

FEATURES

When used with an Excitation Module, EMCP 4.3/4.4 and IVR-compatible EMCP 4.1/4.2 (B) controllers offers:

- Automatic Voltage Regulation (AVR)
- Programmable stability settings
- Soft start control with an adjustable time setting in AVR control mode
- Dual Slope, Configurable Under Frequency (Volts/Hz) regulation
- Three-phase or single-phase generator voltage (RMS) sensing/regulation in AVR mode
- Setpoint adjustment from the EMCP display or Cat ET ServiceTool
- IVR Operating Status and Voltage Bias Overview screens to provide an enhanced level of user interface
- Integrated Voltage Regulator event monitoring

EMCP 4.3/4.4 and IVR-compatible EMCP 4.2 (B) controllers also offer:

- Power Factor Regulation (PF)
- Reactive Droop compensation
- Line drop compensation

WORLDWIDE PRODUCT SUPPORT

- Worldwide parts availability through the Cat dealer network
- Over 1,800 dealer branch stores operating in 200 countries
- The best product support record in the industry
- Cat dealers provide extensive post sale support including maintenance and repair agreements

COMPLETE SYSTEM INTEGRATION

Fully designed and factory tested to work seamlessly with Cat generators using Self Excitation (SE), Internal Excitation (IE) or Permanent Magnet (PMG) excitation systems and EMCP controls.

INTEGRATED VOLTAGE REGULATOR

INTEGRATED VOLTAGE REGULATOR FEATURE SPECIFICATION

		EMCP 4.2(B) 		
SPECIFICATIONS				
No Load to Full Load Regulation	±0.5%	±0.25%	±0.25%	±0.25%
Configurable Volts / Hz Characteristic	•	•	•	•
Configurable Knee Frequency	•	•	•	•
Regulator ResponseTime	10 ms	10 ms	5 ms	5 ms
Single and Three Phase Sensing	•	•	•	•
Voltage Adjustment Range	± 30%	± 30%	± 30%	± 30%
CONTROL				
Characteristic	•	•	•	•
Excitation Enable I Disable Selection	•	•	•	•
Line Loss (1^2R) Compensation	–	•	•	•
Reactive Droop Compensation	–	•	•	•
Power Factor Control Mode	–	•	•	•
PROTECTION I ALARMS				
Generator Overvoltage	•	•	•	•
Generator Under voltage	•	•	•	•
Over Excitation	•	•	•	•
Loss of Sensing	•	•	•	•
Generator Reverse VARs	–	•	•	•
Event Log	•	•	•	•
METERING				
EMCP AC Metering	•	•	•	•
EMCP Power Metering	–	•	•	•
Excitation Command Percentage	•	•	•	•
Operating Mode Status 1ndication	•	•	•	•
VOLTAGE ADJUSTMENT				
EMCP 4 Display Voltage Bias	•	•	•	•
Digital Input (Raise I Lower) Voltage Bias[1]	•	•	•	•
Potentiometer Voltage Bias[1]	•	•	•	•
Analog Voltage Bias -Voltage Range[1]	0V to SV	0V to SV	-10V to +10V	-10V to +10V
Analog Voltage Bias - Current Range[1]	-	-	0mA to 20mA	0mA to 20mA
Analog Voltage Bias - PWM Range[1]	-	-	0% to 100%	0% to 100%
SCADA (Modbus) Voltage Bias	-	•	•	•

[1]Requires an available input on the EMCP 4.

EXCITATION MODULE SPECIFICATION

The Integrated Voltage Regulator consists of an EMCP 4 interfacing with an Excitation Module. There are a range of Excitation Modules available to match Cat generator sets.

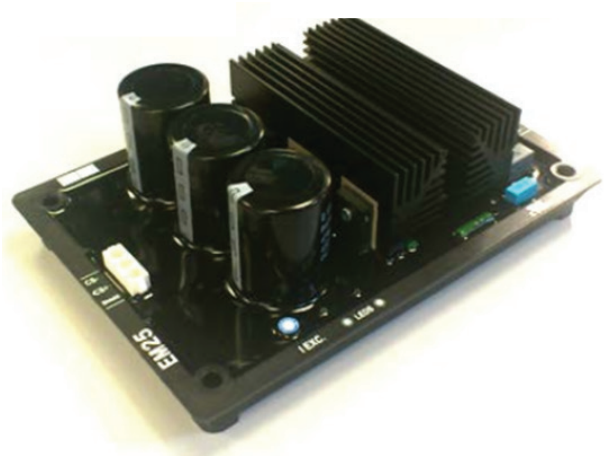


Figure 3: EM25 Excitation Module

EXCITATION MODULE TECHNICAL SPECIFICATION

	EM10	EM15	EM25
Compatible Generator Excitation Types	Self Excitation (SE) Internal Excitation (IE) Permanent Magnet (PMG)		
Nominal Field Current Output	6 Amps	7 Amps	13 AMPS
Maximum (forcing) Field Current Output	10 Amps	15 Amps	25 AMPS
Maximum AC Voltage Input	180Vrms	240Vrms	270 Vrms

For more information on the Excitation Module refer to the component spec sheet.

EMCP 4 DISPLAY

EXAMPLE SCREENS - EMCP 4.1/4.2

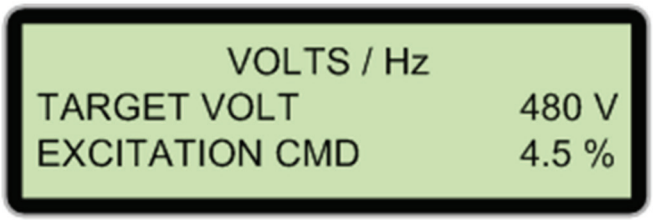


Figure 3: IVR Overview Screen

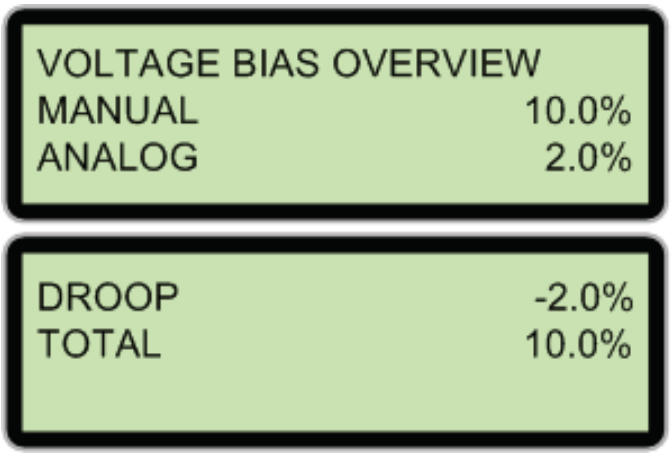


Figure 4: Voltage Bias Overview Screens

EXAMPLE SCREENS - EMCP 4.3/4.4

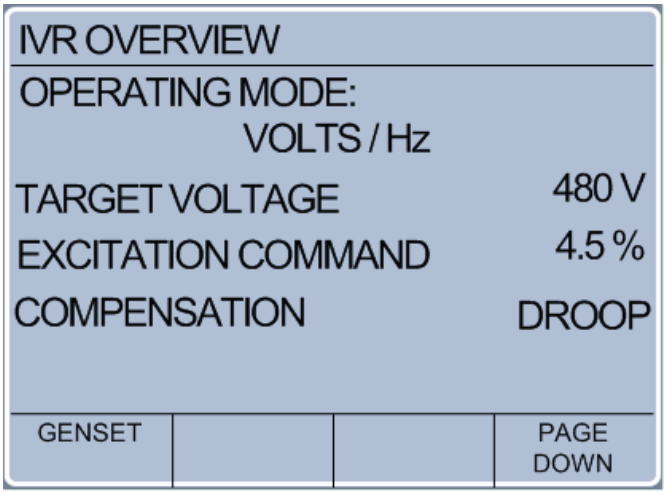


Figure 5: IVR Overview Screen

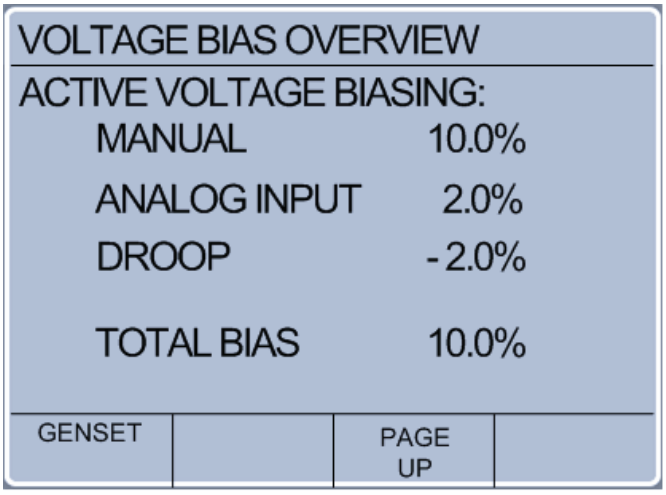


Figure 6: Voltage Bias Overview Screen

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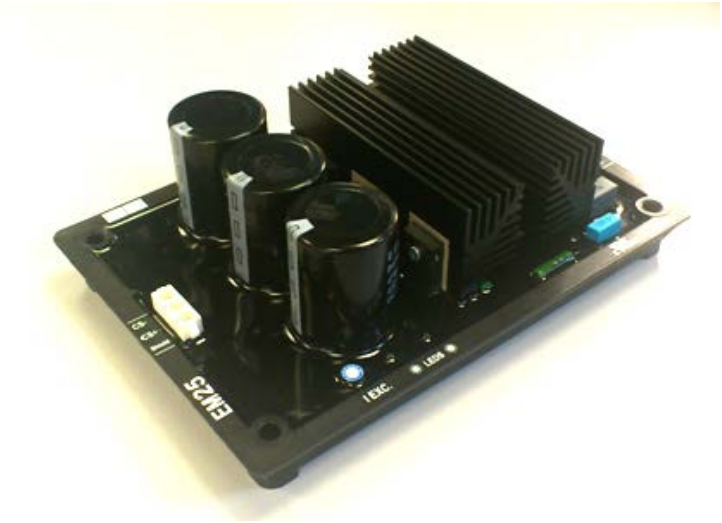


Picture shown may not reflect actual configuration

Excitation Module EM25

The EM25 Excitation Module is a power electronics component designed to provide excitation current to the generator that is controlled by the Integrated Voltage Regulator (IVR) feature in the EMCP 4 controls.

Features

- Over-excitation protection - limit can be adjusted via a potentiometer (IEXC.)
- Green status LED indicating unit is powered on
- Red status LED indicating excitation current limiting (flashing) or shutdown (solid)

When used with EMCP 4.2B/4.3/4.4 and IVR-compatible EMCP 4.1/4.2 controllers, the Integrated Voltage Regulator system offers:

- Automatic Voltage Regulation (AVR)
- Programmable stability settings
- Soft start control with an adjustable time setting in AVR control mode
- Dual Slope Under Frequency (Volts / Hz) regulation
- Three-phase or single-phase generator voltage (RSM) sensing/regulation in AVR mode

EMCP 4.2B/4.3/4.4 and IVR-compatible EMCP 4.1/4.2 controllers also offer:

- Power Factor Regulation (PF)
- Generator paralleling with reactive droop compensation.
- Line drop compensation.

Complete System Integration

Fully designed and factory tested to work seamlessly with Cat generators using Self Excitation (SE), Internal Excitation (IE) or Permanent Magnet (PMG) excitation systems and EMCP controls.

Worldwide Product Support

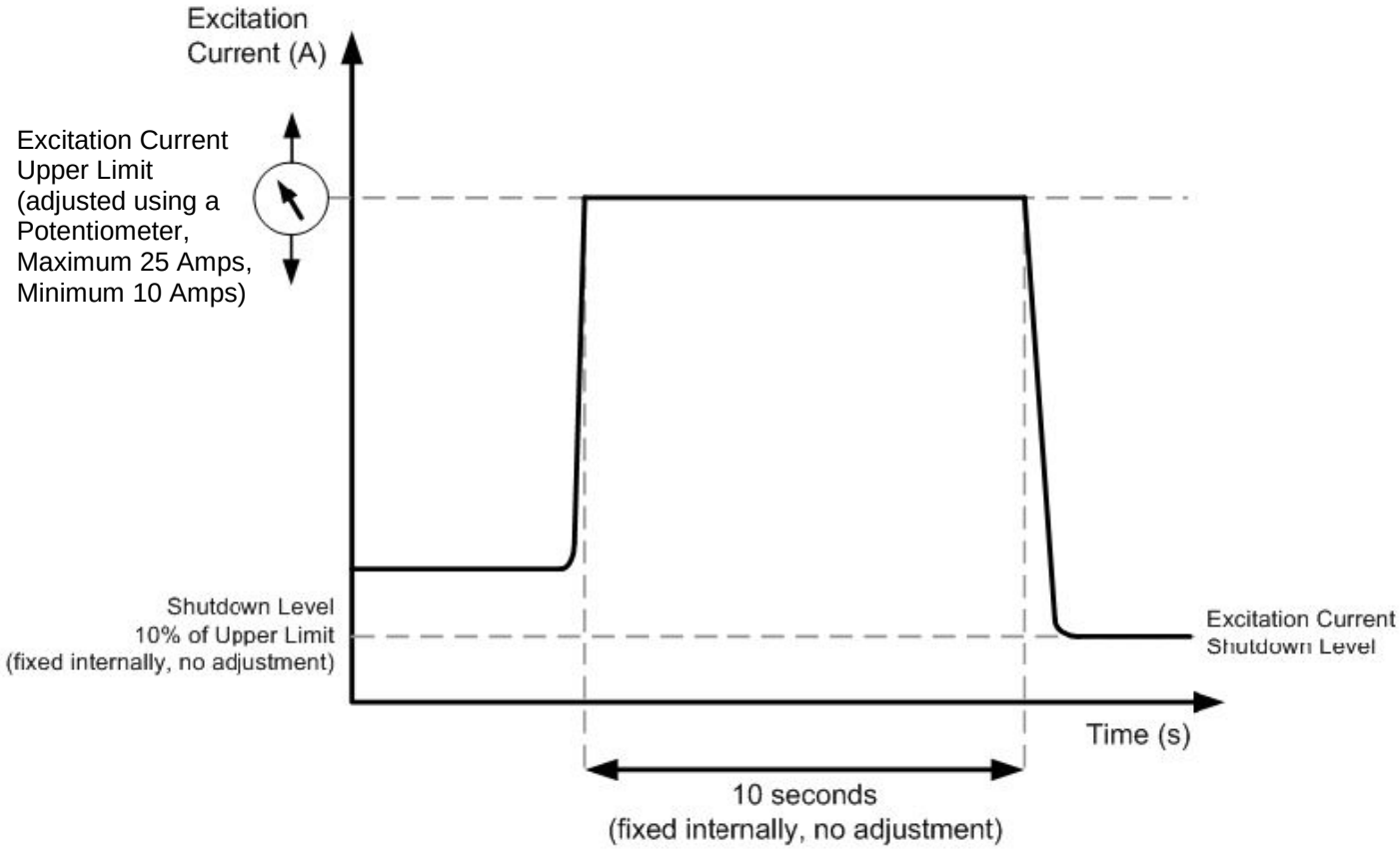
- Worldwide parts availability
- Over 1,800 dealer branch stores operating in 200 countries
- The best product support record in the industry
- Cat dealers provide extensive post sale support including maintenance and repair agreements.

Specifications

Electrical	
Generator Excitation Types	Self Excitation / Internal Excitation / Permanent Magnet (PMG)
Max. Continuous Field Current Output	13 Amps
Max. Forcing Field Current Output	25 Amps
Max. AC Voltage Input (X1:X2, Z1:Z2)	270 Vrms
Environmental	
Operating Temperature Range	−40 °C (−40 °F) to +70 °C (+158 °F)
Storage Temperature Range	−40 °C (−40 °F) to +85 °C (+185 °F)
Relative Humidity Tolerance	95% non-condensing humidity
Salt Spray	5% salt (NaCl) solution for 120 hrs
Vibration	4.5 G-rms, 24-2000 Hz in 3 orthogonal planes
Electromagnetic Compatibility	RF Immunity (Radiated & Conducted) RF Emissions (Radiated & Conducted) Electrical Transients
Weight	900 g ± 100 g
Power Consumption (at Max. Continuous Rating)	<900 VA
Conformity	
UL	UL Recognized (U.S. and Canada) File No. E334232
CE Integration Certificate	In conformity with the applicable requirements of the following Standards: EN 50178 EN 60204-1 EN 61000-6-2 EN 61000-6-4

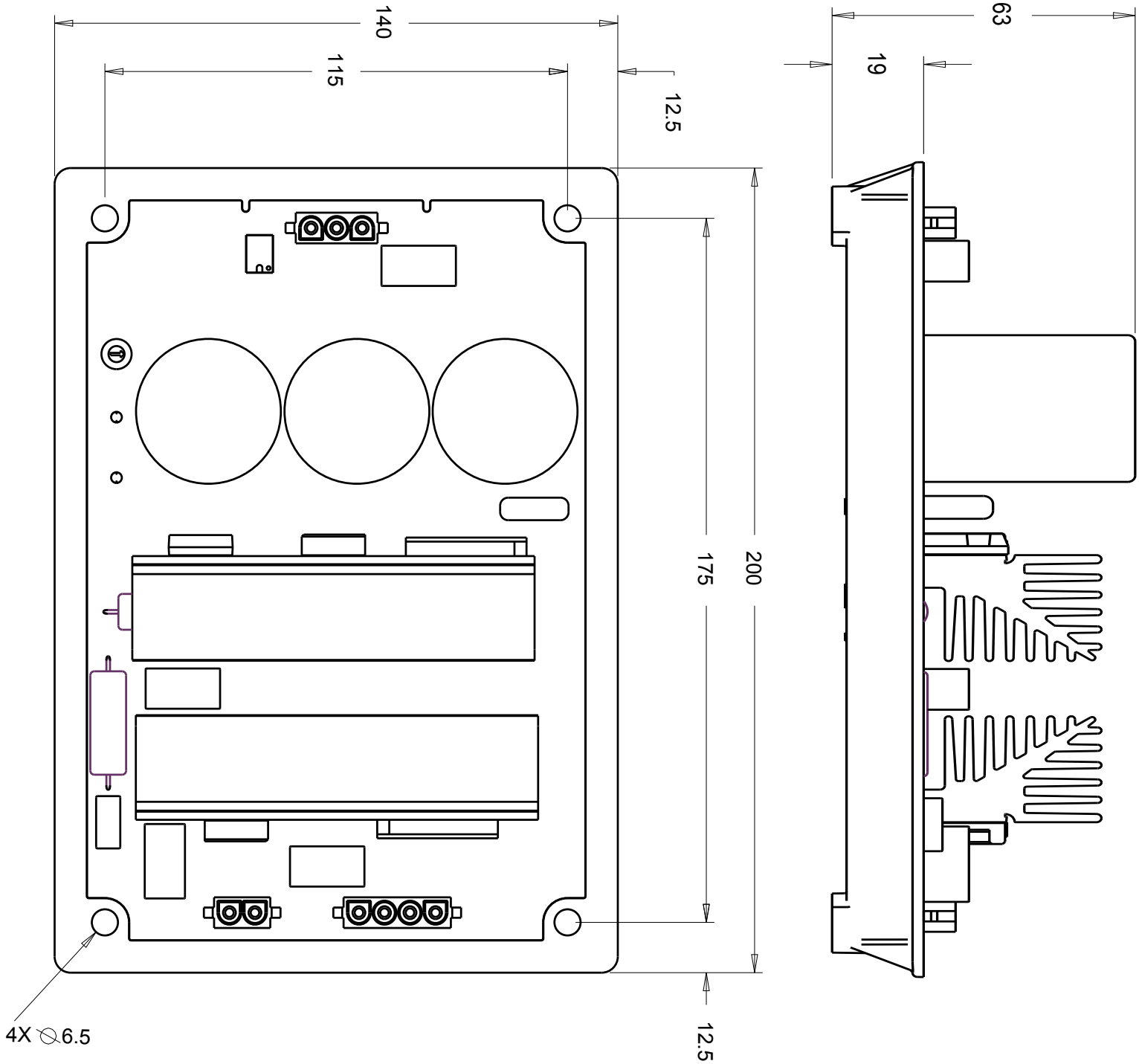
Over- Excitation Protection

- If a short-circuit fault occurs at the generator terminals, the EM25 will allow the excitation current to rise to the upper limit value set by the adjustment potentiometer (max. 25 Amps.)
- The excitation current will be clamped at the upper limit value for 10 seconds (fixed internally).
- After 10 seconds, the excitation current is reduced to a value of 10% of the potentiometer setting.

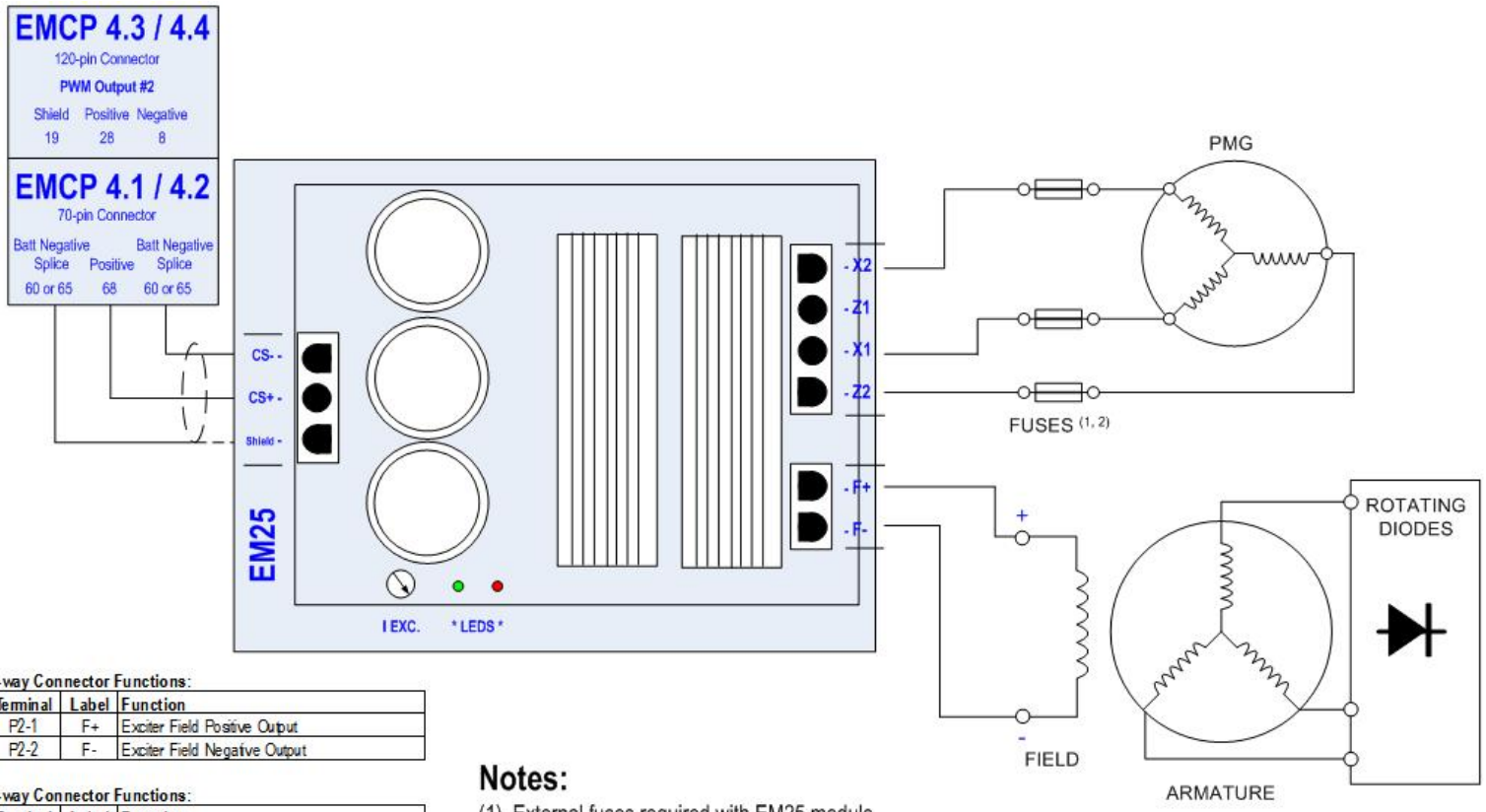


Outline Drawing

(Dimensions in mm)



Example Connection Diagram (Permanent Magnet Excitation)



2-way Connector Functions:

Terminal	Label	Function
P2-1	F+	Exciter Field Positive Output
P2-2	F-	Exciter Field Negative Output

3-way Connector Functions:

Terminal	Label	Function
P3-1	Shield	Excitation Command Shield
P3-2	CS+	Excitation Command Positive Input
P3-3	CS-	Excitation Command Negative Input

Notes:

(1) External fuses required with EM25 module
(2) Recommend 600V, 15A fast acting fuses (KTK-15)

4-way Connector Functions (PMG Excitation):

Terminal	Label	Function
P4-1	X2	Excitation Power Supply Input (PMG Phase B)
P4-2	Z1	Not Connected
P4-3	X1	Excitation Power Supply Input (PMG Phase A)
P4-4	Z2	Excitation Power Supply Input (PMG Phase C)

4-way Connector Functions (Self-Excitation):

Terminal	Label	Function
P4-1	X2	Excitation Power Supply Input (single-phase)
P4-2	Z1	Not Connected
P4-3	X1	Excitation Power Supply Input (single-phase)
P4-4	Z2	Not Connected

4-way Connector Functions (Internal Excitation):

Terminal	Label	Function
P4-1	X2	Excitation Power Supply Input (Aux Winding 1 - Positive)
P4-2	Z1	Excitation Power Supply Input (Aux Winding 2 - Positive)
P4-3	X1	Excitation Power Supply Input (Aux Winding 1 - Negative)
P4-4	Z2	Excitation Power Supply Input (Aux Winding 2 - Negative)

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Picture shown may not reflect actual configuration

Molded Case and Insulated Case Circuit Breakers:

C27-C175 North America built packages (50/60Hz)

NW-Frame
1200-5000A (UL),

Features

- Moisture and fungus protection
- Clear indication of breaker status
- Reinforced insulation
- Shunt trip
- Auxiliary contacts
- Load side extension bars
- Maintenance-free operation
- Exceptional characteristics under short-circuit conditions
- Adjustable trip settings

Conformity with International Standards

Circuit Breakers have been designed to comply with the international standard IEC 60947-2 as well as these other major standards:

NW-Frame
UL 489
NEMA AB1
CSA 22.2 No. 5096
NMX J-266-ANCE
ANSI C37.13, C37.16, C37.17, C37.50
UL 1066 (cULus Listed)
NEMA SG3

Standard Features

Standards

- UL-CSA
  - L-Frame
  - P-Frame
  - R-Frame
  - NW-Frame
- IEC
  - NS-Frame

Shunt trip

- The shunt trip provides a means of tripping the circuit breaker electronically
- Shunt trip ratings
- Voltage: 24VDC
- Coil Burden (Holding/Inrush): 4.5/200 VA
- Power Consumption: 4.5 VA

Auxiliary contacts

The auxiliary contacts provide a means of remote circuit breaker position indication and consists of (1) Form C Contact (1 Normally open and 1 Normally closed contact) with the following current ratings:
6A @ 240-480 VAC, 50/60Hz

Trip units

All circuit breakers come equipped with True RMS Current Sensing.
The trip units for each of the circuit breaker ratings sample the current waveform to provide true RMS protection through the 15th harmonic. This true RMS sensing gives accurate values for the magnitude of a nonsinusoidal waveform. Therefore, the heating effects of harmonically distorted waveforms are accurately evaluated.
The trip system comes equipped with a set of current transformers (CT's) to sense current, a trip unit to evaluate the current, and a tripping solenoid to trip the circuit breaker.
Additionally, each trip unit comes equipped with Active Thermal Imaging which is active 20 minutes before and after tripping.

Customer cable connections

Connections include bus for installation flexibility.

Optional Features

Electrically-operated Circuit Breakers

Circuit breakers that are electrically-operated come with a two-step stored energy mechanism and come standard with a motor assembly. Motor assemblies provide on and off control from remote locations.
These assemblies contain a spring-charging motor, a shunt trip, and shunt close.
Motor Assembly Voltage Rating: 24-30VDC

Undervoltage trip

Undervoltage trip option trips the circuit breaker when the voltage drops to a value between 35% and 70% of the control voltage.
An attempt to close the circuit breaker when the UV is not energized produces no movement in the main contacts.
Closing is allowed when the supply voltage of the UV trip reaches 85% of the rated voltage.

- Voltage Rating: 24-30VAC/VDC
- Operating Threshold:
  - Opening: 0.35 to 0.7Vn
  - Closing: 0.85 Vn
- Power Consumption: 4.5VA
- Circuit Breaker Response Time at Vn: 50ms +/- 10

Circuit Breakers Table (Continued)

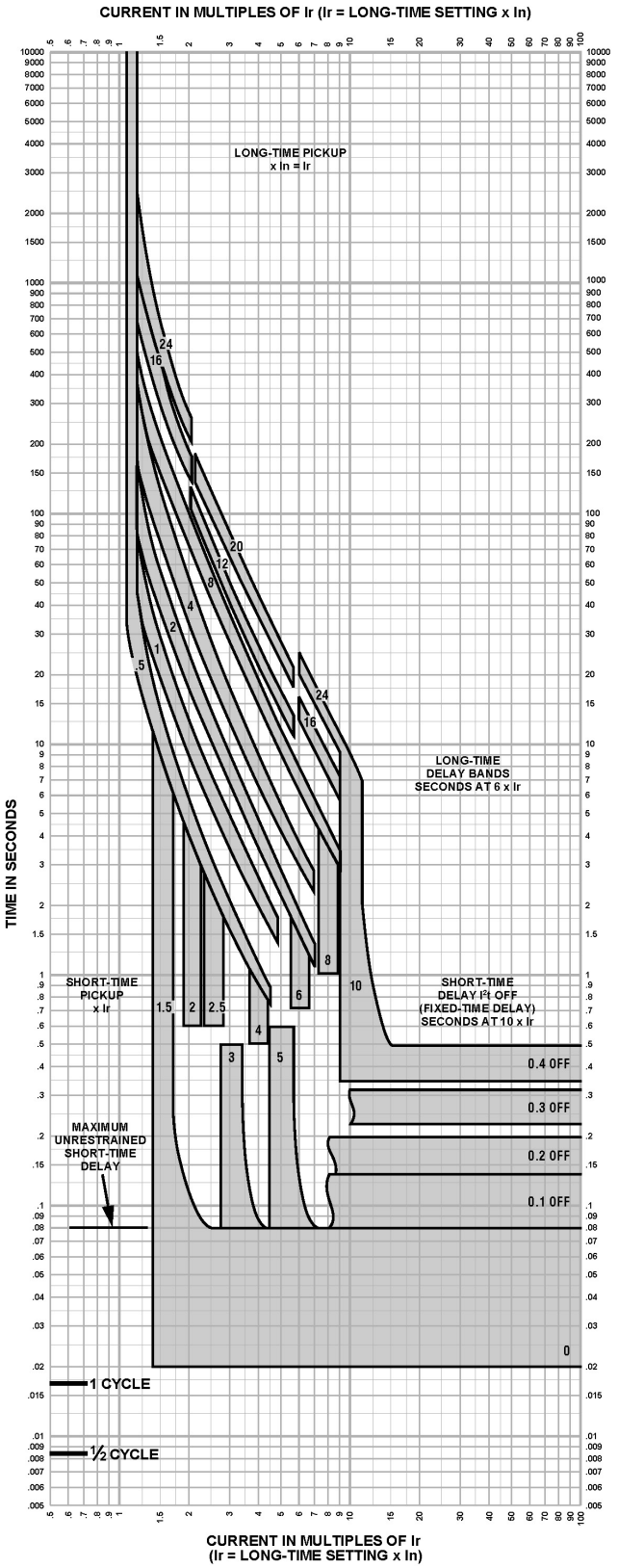
Cat Part Number	Frame and Rating (Amps)	IEC/UL	No. Poles	Operation	Trip Unit	Circuit Breaker Characteristics	Options	Instantaneous Override (kA RMS) +/- 10%
2449913	4000A NW-Frame ICCB	UL	6P	EO	6.0P LSIG-P	Table 8	4 Aux Contact, Shunt Trip, Modbus	170

Circuit Breakers Characteristics (Continued)

Model		NW-Frame
Number of Poles		3 & 4
Rated Current (Amps)		2500-5000A (UL)
Voltage Rating (VAC)		600UL
Interrupt Rating (UL/CSA) (60Hz) - kA RMS	**240V**	100
	480V	100
	600V	85

Table 8

P, R, NS-Frame Long-Short Trip Curve and NW-Frame Long-Short Trip Curve



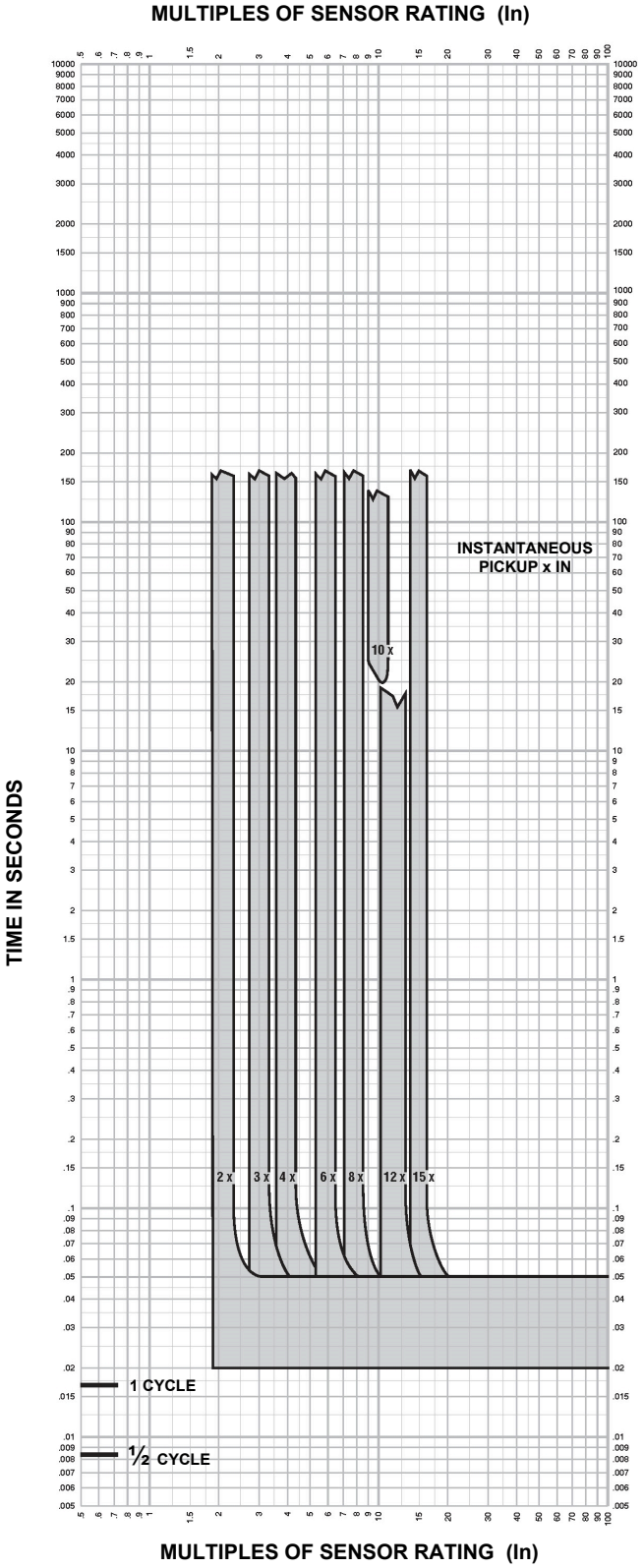
Long-time Pickup and Delay Short-time Pickup and I²t OFF Delay

The time-current curve information is to be used for application and coordination purposes only. Curves apply from -30°C to +60°C ambient temperature.

Notes:

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermalimaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately 20 minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the interrupting rating of the circuit breaker.
3. With zone-selective interlocking on, short-time delay utilized and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
4. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.
5. For a withstand circuit breaker, instantaneous can be turned OFF. See Page 22 for instantaneous trip curve. See tables on pages 03-18 for instantaneous override values..
6. Overload indicator illuminates at 100%.

P, R, NS-Frame Instant Curve and NW-Frame Instant Trip Curve



Instantaneous Pickup 2x–15x and OFF

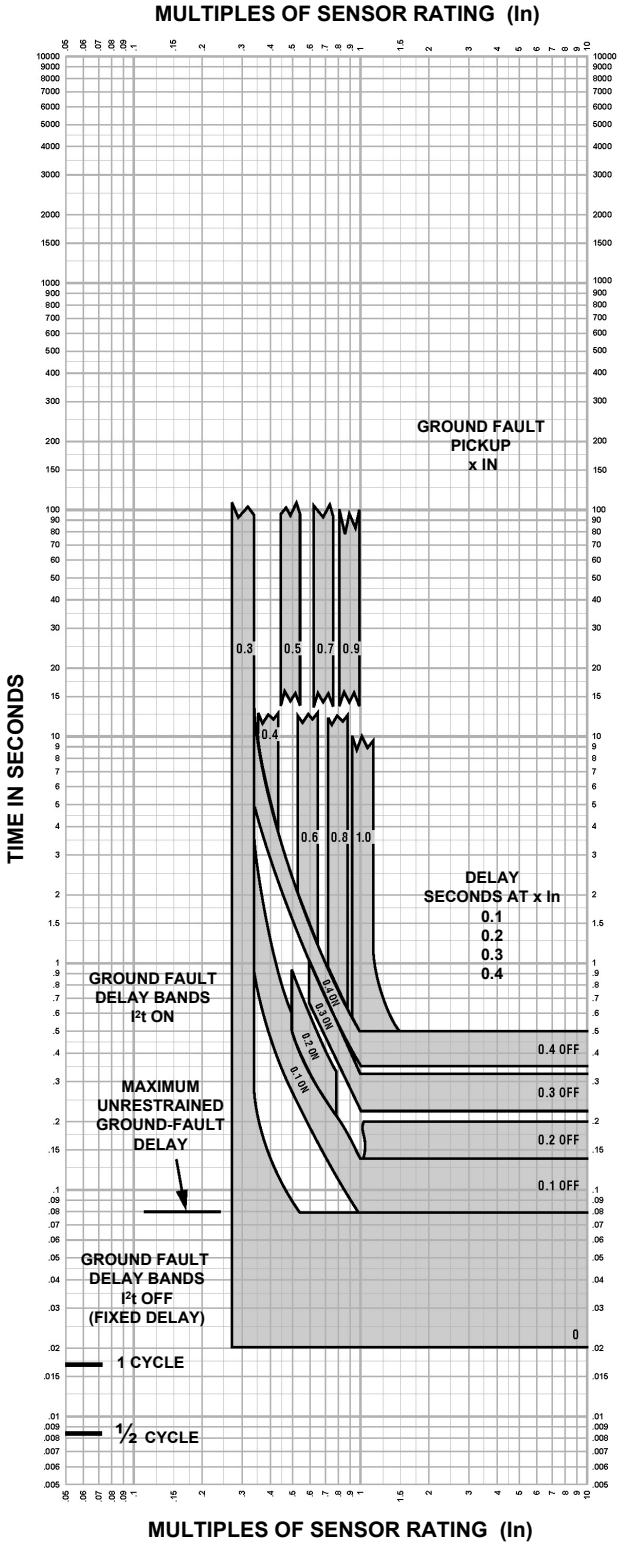
The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30° to +60°C ambient temperature.

Notes:

1. The end of the curve is determined by the interrupting rating of the circuit breaker.
2. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.
3. The instantaneous region of the trip curve shows maximum total clearing times. Actual clearing times in this region can vary depending on the circuit breaker mechanism design and other factors. The actual clearing time can be considerably faster than indicated. Contact your local Sales Office for additional information.
4. For a withstand circuit breaker, instantaneous can be turned OFF. See tables on pages 03-18 for instantaneous override values.
5. See page 22 for long-time pickup, long-time delay, short-time pickup, and short time delay trip curves.

P, R, NS-Frame Gound Curve and NW-Frame Ground Fault Trip Curve



Ground-fault I^2t OFF and ON In ≤ 400 A

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C ambient temperature.

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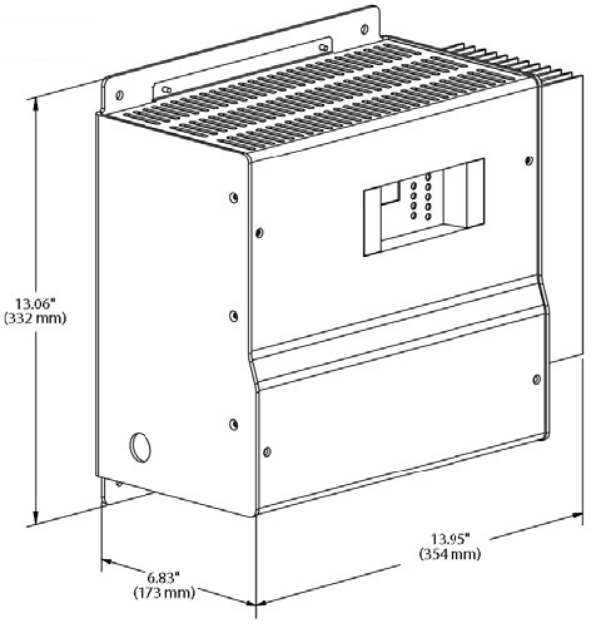
Battery Charger



UL 20 Amp Battery Charger

This battery charger offers accurate, automatic charging of lead-acid and nickel cadmium batteries. The output voltage automatically adjusts to changing input, load, battery and ambient conditions. This prevents battery over-charging and consequent loss of battery electrolyte.

Standard features include AC line compensation, precision voltage regulation, current limiting, automatic 2-rate charging, voltmeter and ammeter, temperature compensation and UL Listing.

The user interface is easy to understand with digital metering, NFPA 110 alarms and a battery fault alarm.

Features

- Electronically current limited at 105% of rated output
- Alarm system
- Digital Display
- Lightning and voltage transient protection
- Protection of connected equipment against load dump
- Constant voltage, current limited, 4-rate automatic equalization
- IP 20 housing
- Temperature Compensation
  - On board temperature sensor with remote port
- AC isolated from DC
- Auto AC line compensation
- Output regulated by sensed battery voltage

Dimensions			
Width	**Depth**	**Height**	**Weight**
354 mm (13.93 in)	173 mm (6.83 in)	332 mm (13.06 in)	19.1 kg (42 lb)

Feature code: BTC 20A2

Specification

Input supply	110 – 120 V 208 – 240V
AC and DC fuses	(2 input and 2 output)
Output voltage	24V
Output amps	20A
Input Frequency	50 / 60 Hz
Operating temperature	–20°C (–4°F) to +60°C (140°F)

Housing constructed of rustproof anodized aluminum.

Standards

- C-UL listed to UL 1236
- NFPA 70, NFPA 110
- CSA 22.2 No 107 certified
- UL 1564
- CE DOC to EN 60335
- IBC Seismic Certification

Battery Charger

NFPA 110 alarm package as follows:

- AC on — Green led (indication)
- AC fail — Red led and form C contact (2A)
- Float mode — LED
- Fast charge — LED
- Temp comp active — LED
- Low battery volts — Red LED and Form C contact
- High battery volts — Red LED and Form C contact
- Charger fail — Red LED and Form C contact
- Battery fault — Red LED and Form C contact
  - Battery disconnected
  - Battery polarity reversed
  - Mismatched charger battery voltage
  - Open or high resistance charger to battery connection
  - Open battery cell or excessive internal resistance

LEHE0140-01 (02/19)

Picture shown may not reflect actual configuration

Electric Starting Motor

for C27, C32, 3512, 3516, C175-16 and C175-20

U.S. Sourced

Electric Starting Motors are used for improved engine start capability.
Battery-powered electric motors utilize low voltage direct current and provide fast, convenient, pushbutton starting with lightweight, compact, engine-mounted components.

Design

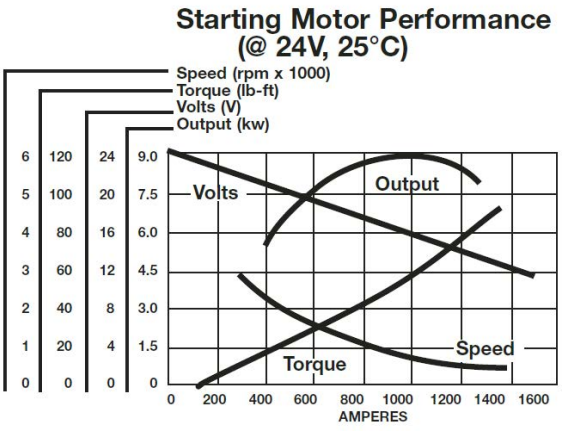
- Splash-proof and environmentally protected.
- Seamless one-piece solenoid case is sealed for corrosion protection.
- Positive-engagement shift mechanism assures pinion–to-ring gear engagement prior to cranking, minimizing milled ring gears and pinions.
- Epoxy impregnation and glass banding give starter armature exceptional rotation strength.
- Positive spring retention in the six wide, one-piece brushes gives uniform pressure and brush wear for extended service life.
- Extra-large brush leads are used to handle the high current experienced during the cranking of high-power diesel engines.
- Rotatable drive housing, with 12 positions, allows easy repositioning of the solenoid switch.
- Totally Enclosed Shift mechanism.
- Bearing Lubrication and Sealing: Three sintered-bronze bearing extra-large oil reservoirs.

Specifications

- System Voltage: 24 V
- Rotation: Clockwise
- Polarity: Insulated
- Mounting: SAE #3
- Pinion Data:
  - No Teeth/Pinion Blank: 11/12
  - Pitch: 6/8
- Output: 24V: 9.0 kW
- Weight: 34 kg (75 lbs)
- Operation temperature range
  - - 25°C to +121°C
- Pressure Angle: 20°
- Oil Sealed: ± 6 PSI
- Water Sealed: ± 6 PSI and 3500 PSI Pressure Wash

Option

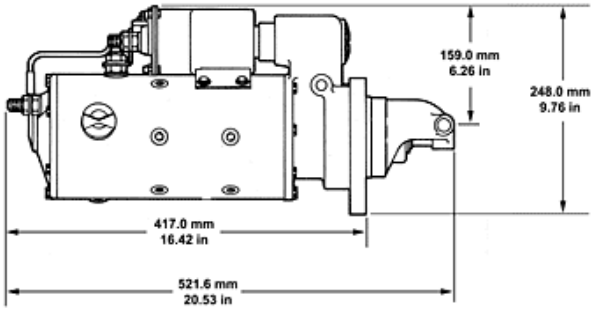
- Heavy-Duty Applications: Two or more units can be tandem-mounted for starting large engines.

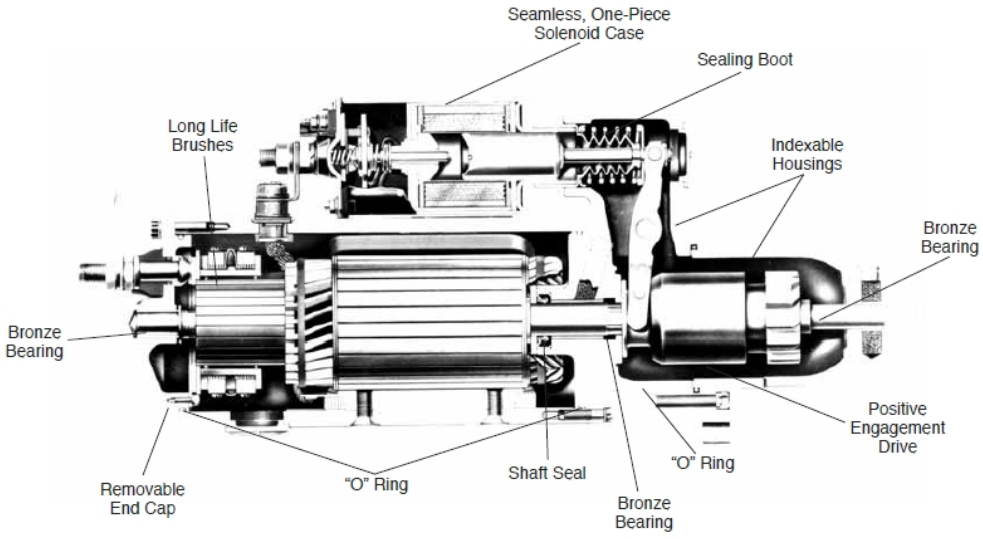


Available Options

Model	Single	Dual	Quadruple
C27		+	
C32		+	
3512	+	+	
3512B	+	+	
3512C	+	+	
3516		+	
3516B		+	
3516C		+	
C175-16		+	+
C175-20		+	+

Dimensions Drawing





Picture shown may not reflect actual configuration

JACKET WATER HEATER With Pump

3516

Caterpillar offers a factory-installed jacket water heater for improved cold-starting capability.

The Jacket Water Heater with the pump is a complete coolant preheater with thermostat, pump and all required controls.
Forced circulation of the coolant delivers uniform heating throughout the entire engine, extends element life and offers a significant reduction in electrical consumption.

The Jacket Water Heater operates automatically when provided contacts are supplied with a 24 Volt DC signal from the engine.

FEATURES

- Factory Installed
- Complete with hoses, thermostat and pump
- Base frame mounting minimizes engine induced vibration
- Automatically disconnected when engine is running via the generator space heater relay
- Supplied with UL recognized components
- Thermostat is factory pre-set to 54°C (130°F)

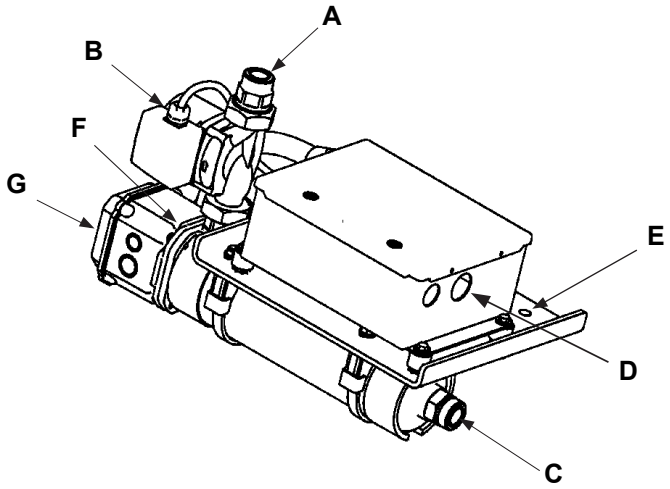
HEATER DESIGN DESCRIPTION

The jacket water heater package is designed to efficiently pre-heat the engine by heating and circulating the engine's coolant.
This design results in the following benefits

- Increase life of heater hoses, engine seals, and heating elements.
- Improve heat transfer efficiency from elements to engine coolant.
- More uniform engine temperature distribution.
- Application of a thermostat with a reduced thermal differential.
- Lower customer utility costs and increased heater reliability.
- Heater thermostat's setpoint is preset from the factory.

HEATER OPERATION/WIRING

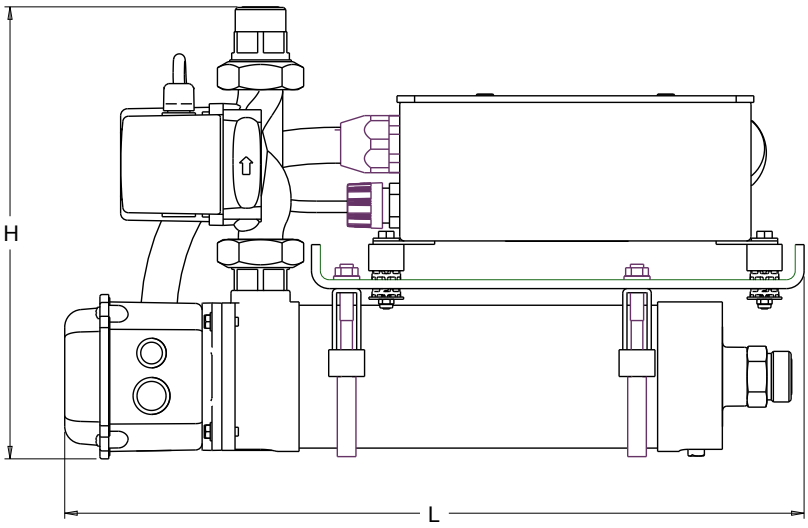
A 38 L/pm (10 gpm) pump is located at the heater outlet to pull the coolant through the heater.
A fixed thermostat is located inside Element enclosure box, near the outlet of Heater and responds to the temperature of the coolant inside the tank. The figure below shows the general design.

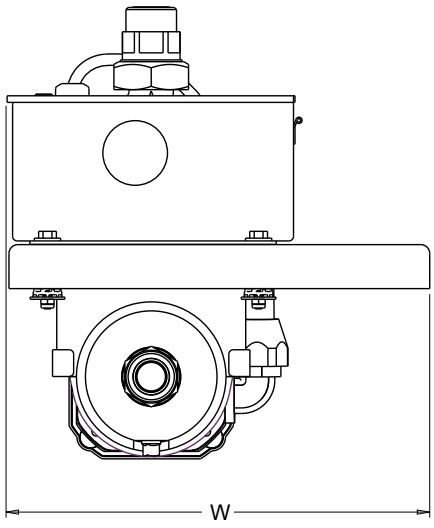


A. Discharge port
B. Pump/motor
C. Suction (behind unit)
D. Power and control wiring entrance
E. Mounting base
F. Element assembly
G. Thermostat

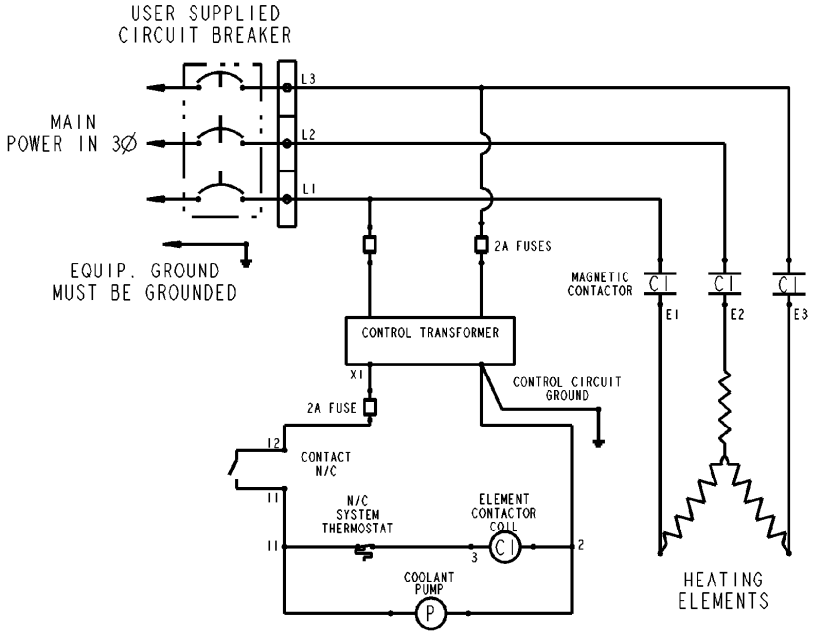
SPECIFICATIONS

Voltage		
	480	
Rating	9 kW	
Frequency	60	
Phase	Three phase	
Amps	11	
Flow Rate	38 L/pm (10 gmp)	
Pump Rating	97W	
Fixed Thermostat	38°C - 54°C (100°F - 130°F)	
Length	533.7 mm (21")	
Width	307.56 mm (12.1")	
Height	325.8 mm (12.8")	
Weight	25.76 kg (56.8 lbs)	





Wiring Diagram - 480 V JWH



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Primary Fuel Filter with water separator

3516C*

* excluding 3516C EPA Tier 2 (2750 ekW)

Picture shown may not reflect actual configuration

General Description

Fuel contamination, either in the form of dirt or water, will find its way into your fuel system no matter how careful you are. Even a small amount of dirt or water corrosion can start problems. Water or particulates can cause microscopic surface damage that is then focused on by the high-pressure fuel flow, which causes wear that will eventually lead to reduced efficiency and complete breakdown.

Using fuel filter with water separator you will achieve system cleanliness for reliable engine operation.

Features

- The high-grade aluminum components and powdercoat paints mean that corrosion is never a worry.
- A durable single bolt mounting bracket doubles resistance to vibration fatigue.
- Sheds water and keeps engines waterproof, rustproof and dirtproof.
- Polymer bowl withstands impact and temperature extremes.
- Self-venting drain. A single twist makes draining clean, fast and easy.
- Unique media to increase dirt holding capacity and extend filter life
- Treated media that separates and coalesces water from fuel

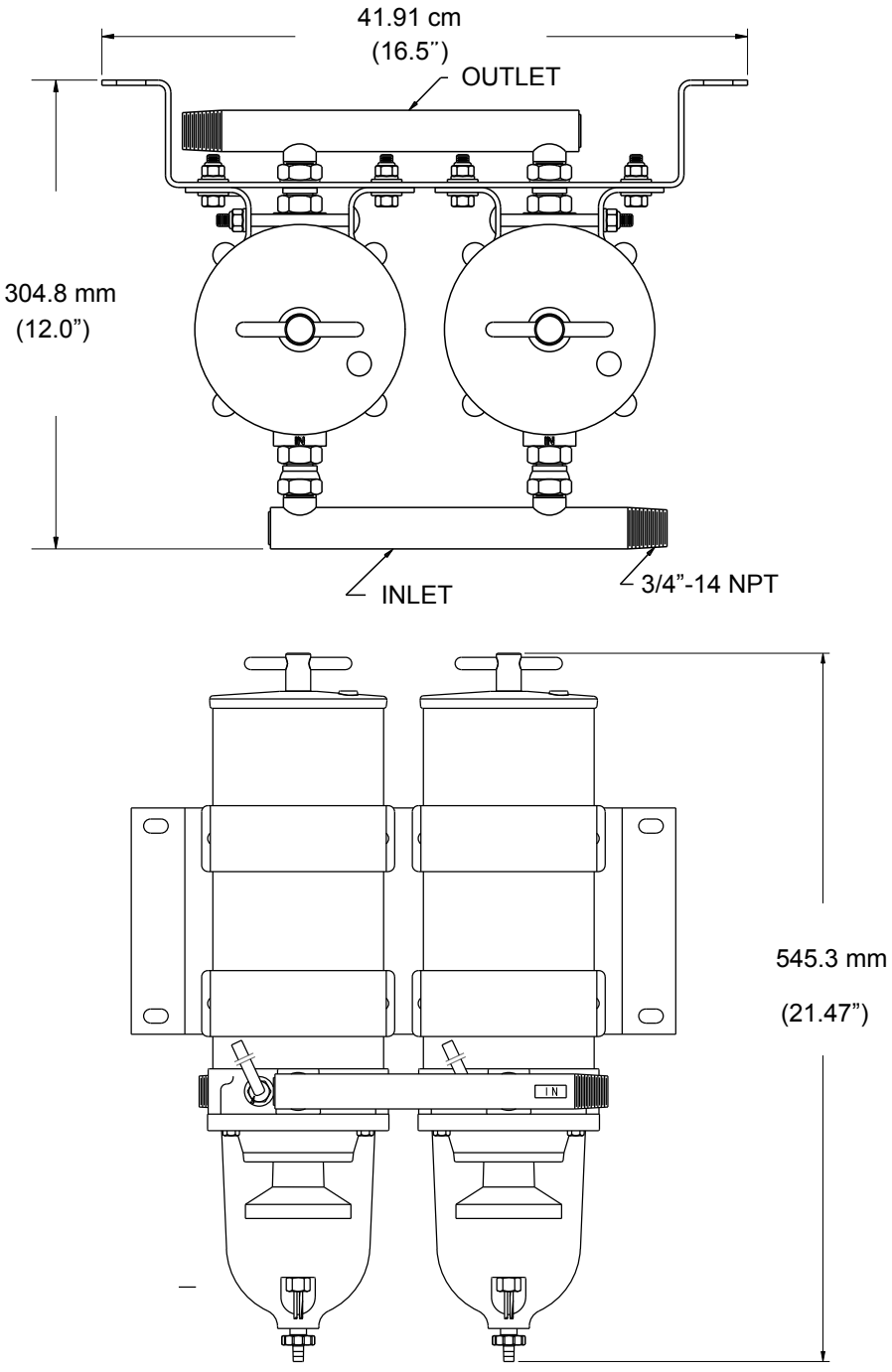
Specifications

- Filtration Rating: 30 micron
- Two filters on-line
- Ports: 3/4”-14 NPT
- Maximum Pressure: 1.03 bar (15 psi)
- Max Flow Rate: 1362 lph (360 gph)
- Height: 545.3 mm (21.47”)
- Width: 419.1 mm (16.5”) with Bracket
- Depth: 304.8 mm (12.0”) with Bracket
- Weight: 11.8 kg (26.0 lbs)

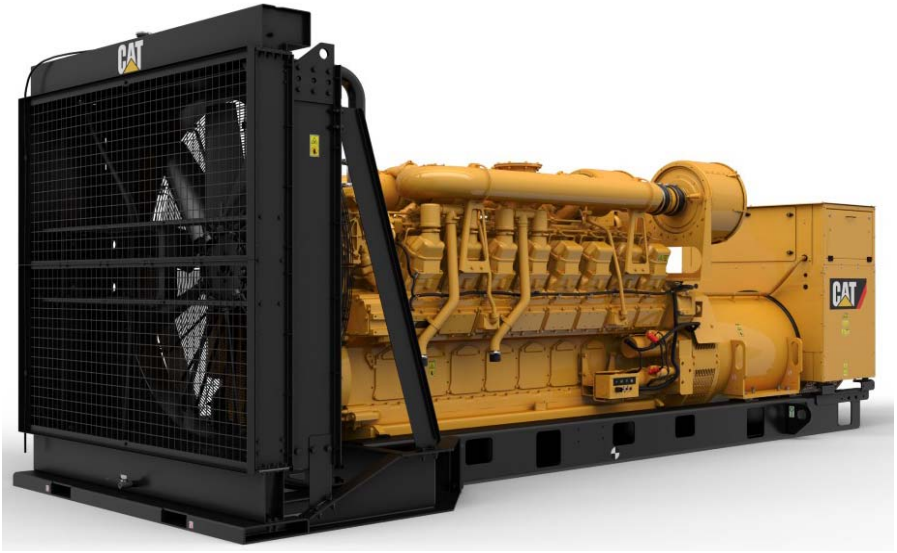
Filter Element Specifications

- Effective media area: 9980 cm^2
- Weight: 0.59 kg (1.3 Lbs.)
- Length: 213 mm (8.38”)
- Diameter 109 mm (4.29”)

General Dimensions Drawing



NC POWER SYSTEMS



Technical Data

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2019 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

OFFICE OF TRANSPORTATION AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: **Caterpillar Inc.**
(U.S. Manufacturer or Importer)

Certificate Number: KCPXL78.1NZS-014

Effective Date: 07/24/2018

Expiration Date: 12/31/2019

Byron J. Bunker, Division Director
Compliance Division

Issue Date: 07/24/2018

Revision Date: N/A

Model Year: 2019
Manufacturer Type: Original Engine Manufacturer
Engine Family: KCPXL78.1NZS

Mobile/Stationary Indicator: Stationary
Emissions Power Category: kW>560
Fuel Type: Diesel
After Treatment Devices: No After Treatment Devices Installed
Non-after Treatment Devices: Electronic Control, Engine Design Modification

Pursuant to Section 111 and Section 213 of the Clean Air Act (42 U.S.C. sections 7411 and 7547) and 40 CFR Part 60, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following engines, by engine family, more fully described in the documentation required by 40 CFR Part 60 and produced in the stated model year.

This certificate of conformity covers only those new compression-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 60 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 60.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 60. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 60.

This certificate does not cover engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.

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TIER 2 PERFORMANCE DATA

PERFORMANCE DATA[EM1895]

September 18, 2019

Performance Number: EM1895 **Change Level: 04**

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):**	210.2
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):**	16.2
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	173.5	78.1	121.9	1,235.6	67.6	915.2
2,250.0	90	3,283	303	0.335	157.1	71.3	119.4	1,190.0	61.3	881.2
2,000.0	80	2,935	271	0.339	142.3	64.3	116.9	1,158.9	55.3	864.0
1,875.0	75	2,760	255	0.342	134.9	60.7	115.8	1,145.6	52.3	858.5
1,750.0	70	2,586	239	0.346	127.6	57.0	114.7	1,133.3	49.3	854.6
1,500.0	60	2,237	207	0.354	113.0	49.5	112.7	1,112.4	43.2	851.2
1,250.0	50	1,889	174	0.365	98.4	41.3	111.0	1,091.8	36.8	850.7
1,000.0	40	1,547	143	0.373	82.5	31.4	109.4	1,061.5	29.3	856.6
750.0	30	1,203	111	0.385	66.2	21.7	107.9	1,010.3	22.1	848.2
625.0	25	1,029	95	0.394	57.9	17.2	107.2	968.3	18.7	831.1
500.0	20	854	79	0.403	49.2	12.7	106.4	902.0	15.5	796.1
250.0	10	497	46	0.441	31.3	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]

September 18, 2019

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
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

PERFORMANCE DATA[EM1895]

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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	2.5	3.8
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

PERFORMANCE DATA[EM1895]

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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.

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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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3516C (EM1895)

TIER 4 COMPLIANCE EMISSION DATA

Rated speed PSV: 1800 rpm

Genset Power (w/ fan)	ekW	2500	1875	1250	625	250
Engine Power	bhp	3633	2760	1889	1029	497
% Load	%	100	75	50	25	10
Volumetric Fuel Consumption	gal/hr	173.5	135	98	58	31
Wet Exhaust Mass Flow	lb/hr	33260	28202	22133	14172	10137
Volumetric Exhaust Flow (Wet)	cfm	19579	15893	12413	7845	4800
Exhaust Temperature	deg F	915	859	851	831	647
Total NOx (as NO2)	lb/hr	50.59	31.09	15.44	7.87	7.02
% Reduction	%	90	90	90	90	90
Post Catalyst NOx (as NO2)	lb/hr	5.06	3.11	1.54	0.79	0.70
Total CO	lb/hr	6.01	2.88	2.41	3.3	4.62
% Reduction	%	80	80	80	80	80
Post Catalyst CO	lb/hr	1.20	0.58	0.48	0.66	0.92
Total HC	lb/hr	1.1	1.1	1.2	0.9	0.96
% Reduction	%	80	80	80	80	80
Post Catalyst HC	lb/hr	0.22	0.22	0.24	0.18	0.19
Total PM	lb/hr	0.41	0.27	0.29	0.31	0.31
% Reduction	%	85	85	85	85	85
Post Catalyst PM	lb/hr	0.06	0.04	0.04	0.05	0.05

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Systems Data
Reference Number: EM1895

CATERPILLAR®

September 18, 2019
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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)	5.9	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	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	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

TEST SPEC [LF3210]

SEPTEMBER 18, 2019

For Help Desk Phone Numbers Click here

Reference Number: 4581567

Effective Serial Number: LYM00128

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			
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
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			
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		
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 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			

Application/Performance Data

Description	Measure	Data
Application Identification		297 GS MISSION CRI
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
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	
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

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RADIATOR PERFORMANCE DATA [LF3756]

SEPTEMBER 18, 2019

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Component Performance Number: EM2773

Radiator Data	Engine Data	Combination Data
Radiator Part Number: 5258746	**Performance Number:** EM1895	**Pully Ratio:** 0.39
Radiator Type: ASF56.0CV	**Sales Model:** 3516	**Fan Power:** 130.07893 hp
Front Area: 55.97 ft2	**EKW:** 2500	
Radiator Dry Weight: 6,686.6 lbs	**Rating:** MCSTNDBY	
Radiator Wet Weight: 7,319.3 lbs	**Speed:** 1800	
Radiator Water Capacity High Temp Circuit: 71.0 gal	**Settings:** NA	
Radiator Water Capacity Low Temp Circuit: NA gal	**IM ATAAC Temp Deg F:** 122	

Center of Gravity (X): 25.28 in (Distance from front face of core)
Center of Gravity (Y): 58.94 in (Distance from bottom of radiator support)
Center of Gravity (Z): 0.78 in (Distance from center line of core)

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 ---------					
113	107	98	107	104	95

Air Flow Restrictions (1/2 inH2O)	Air Flow Restrictions (3/4 inH2O)
--------- scfm ---------	
101000	96303

No Graph data available...

Reference Number: EM2773

No notes found...

Parameters Reference: TM6016

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. NON-TIER 4 AMBIENT CAPABILITY CALCULATIONS ARE BASED ON A 50/50 GLYCOL COOLANT MIX AND 4°C (7°F) AIR TO CORE RISE.
TIER 4 AMBIENT CAPABILITY CALCULATIONS ARE BASED ON A 50/50 GLYCOL COOLANT MIX AND 6°C (9°F) AIR TO CORE RISE. ASSUME 3°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.

LAST UPDATED : 05/13/2010

GENERATOR DATA

SEPTEMBER 18, 2019

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

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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.

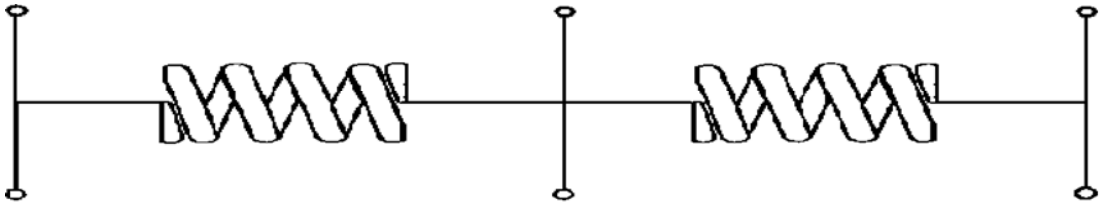
- "X" is measured from driven end of generator and parallel to rotor. Towards engine fan is positive. See General Information for details
- "Y" is measured vertically from rotor center line. Up is positive.
- "Z" is measured to left and right of rotor center line. To the right is positive.

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** | **J3 = Exciter End**

TOTAL J = J1 + J2 + J3

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

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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

Generator Cooling Requirements - Temperature - Insulation Data

Cooling Requirements:		**Temperature Data: (Ambient 40 ^{0}C)**	
Heat Dissipated:	112.3 kW	**Stator Rise:**	125.0 ^{0}C
Air Flow:	199.2 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	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
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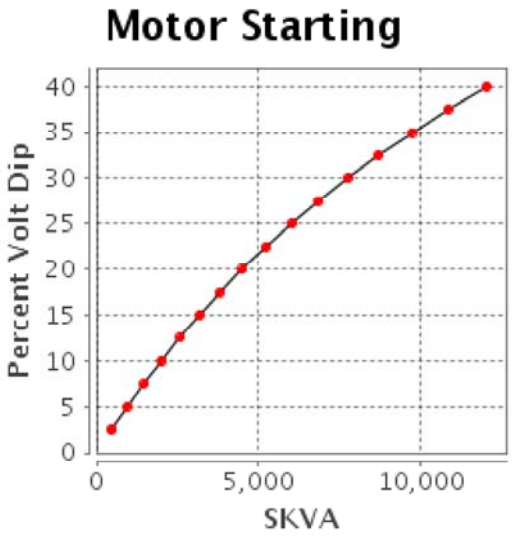
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version:
41205 /40749 /40681 /9309

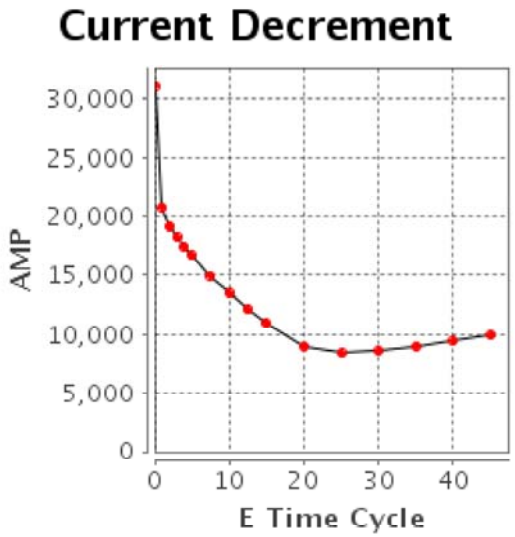
Starting Capability & Current Decrement
Motor Starting Capability (0.4 pf)

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

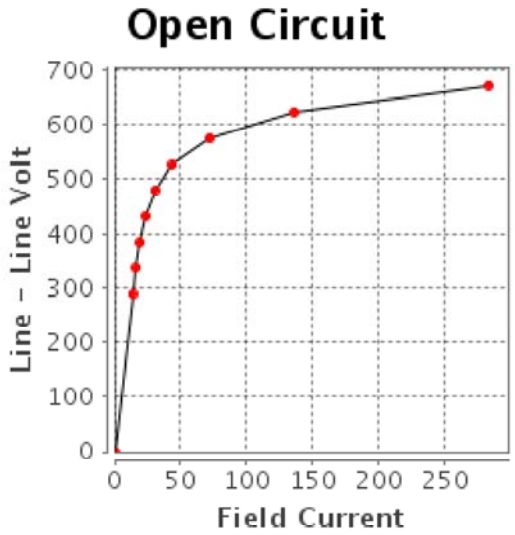
Selected Model

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

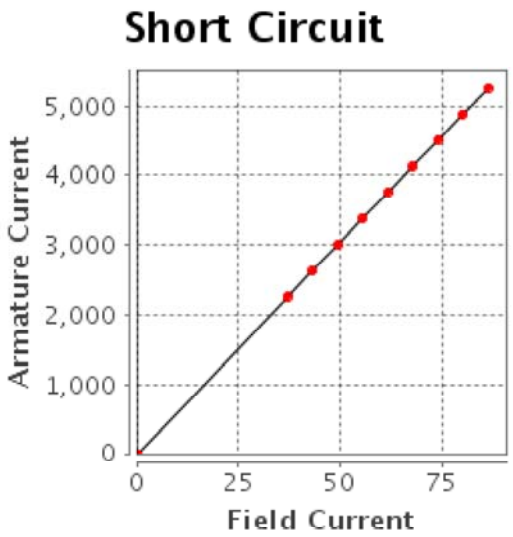
Generator Output Characteristic Curves
Open Circuit Curve

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

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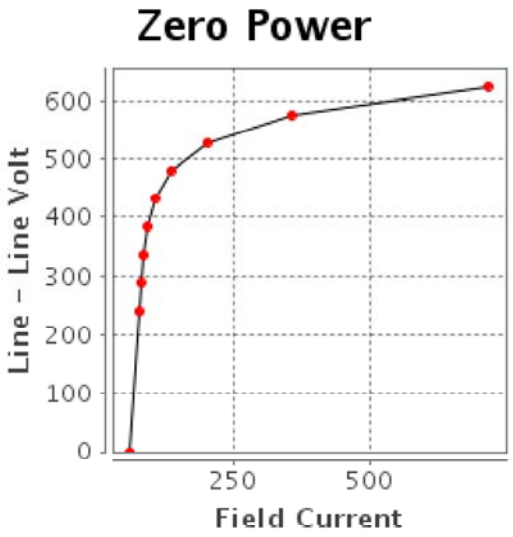
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 3758.8
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version:
41205 /40749 /40681 /9309

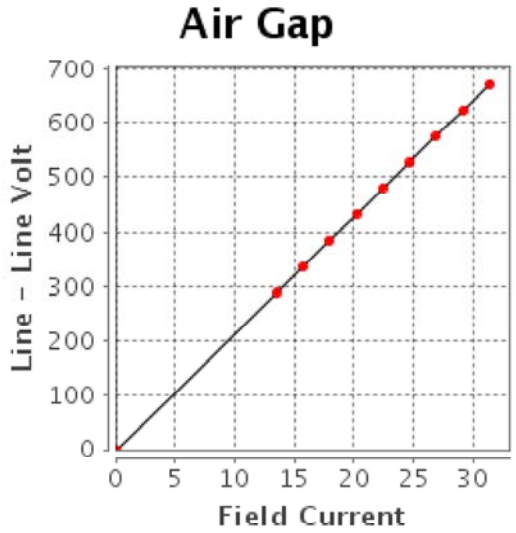
Generator Output Characteristic Curves
Zero Power Factor Curve

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



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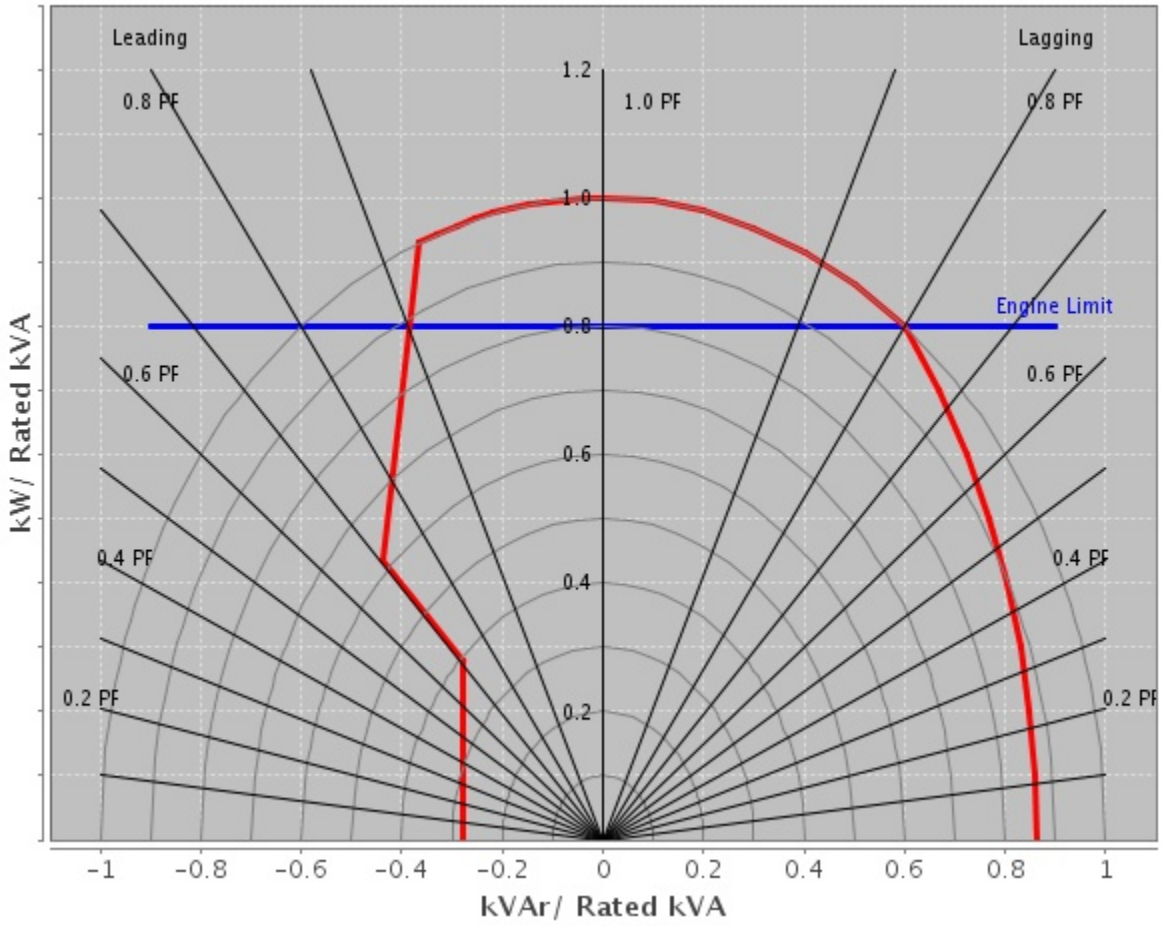
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 3758.8
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version:
41205 /40749 /40681 /9309

Reactive Capability Curve

Operating Chart



Selected Model

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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

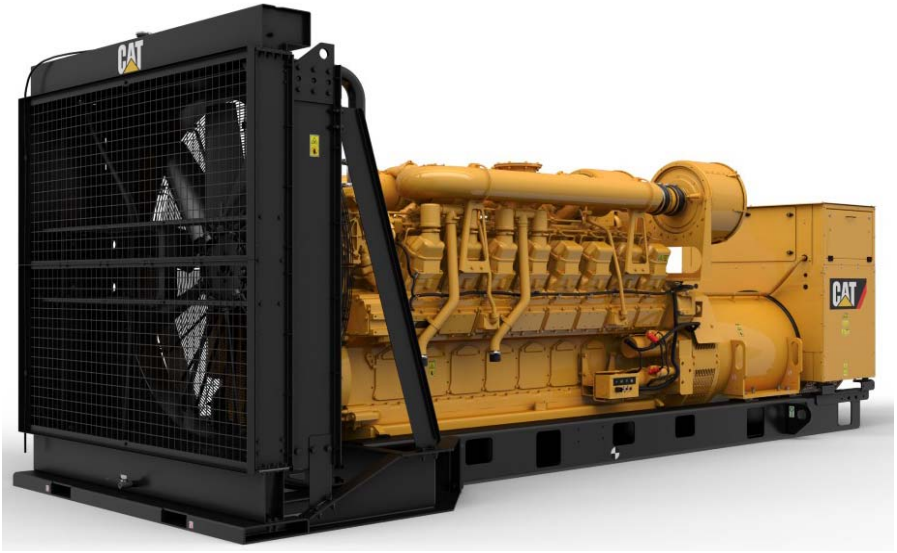
DM7825 Caterpillar SR5 Generators (50 Hz, 60 Hz)
Data for 1400, 1600, 1700, 1800 and 1900 frames Caterpillar SR5 generators built by Leroy Somer - USA and Leroy Somer France.

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



Engineering Drawings

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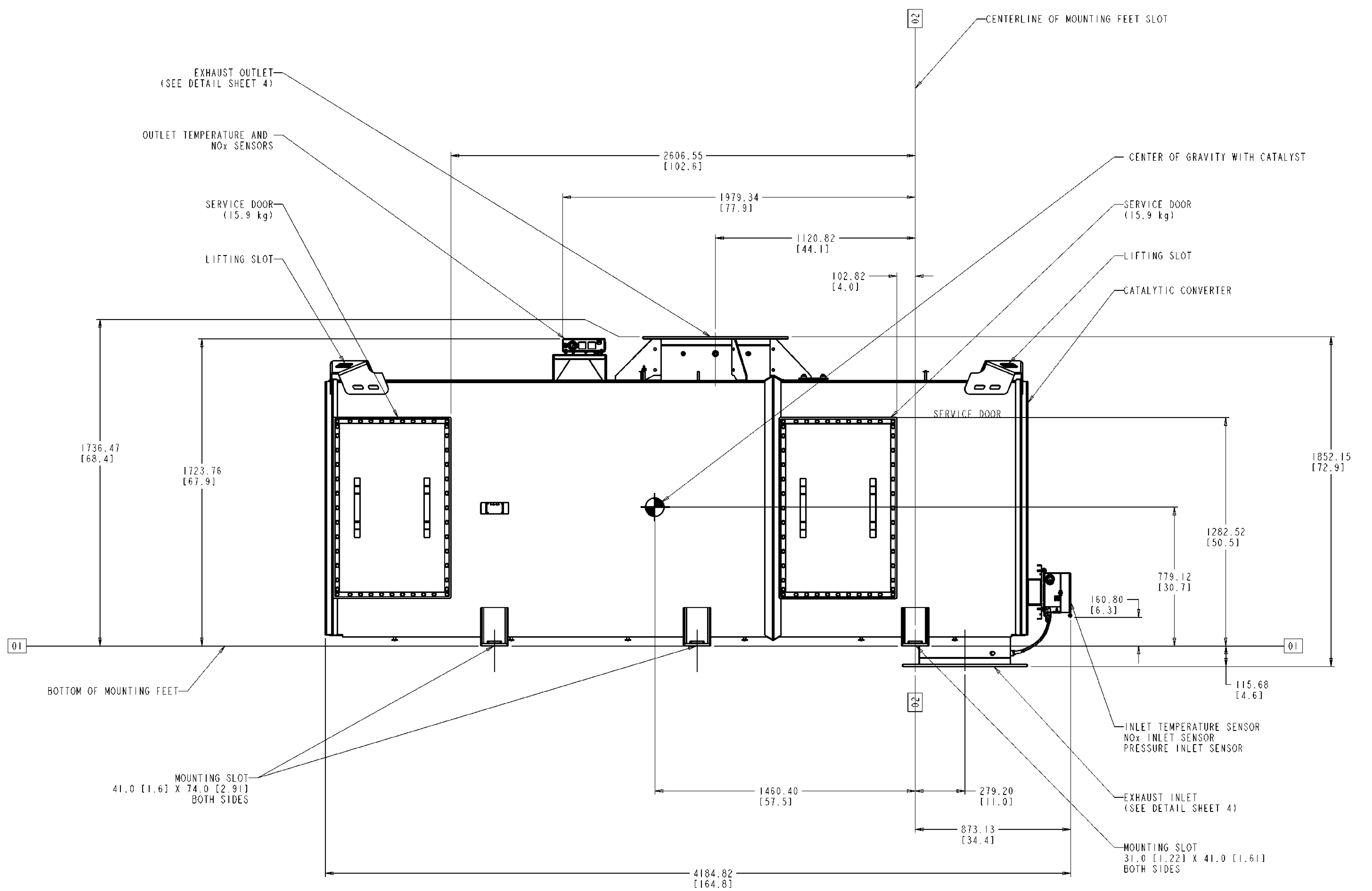
METRIC 559-1243



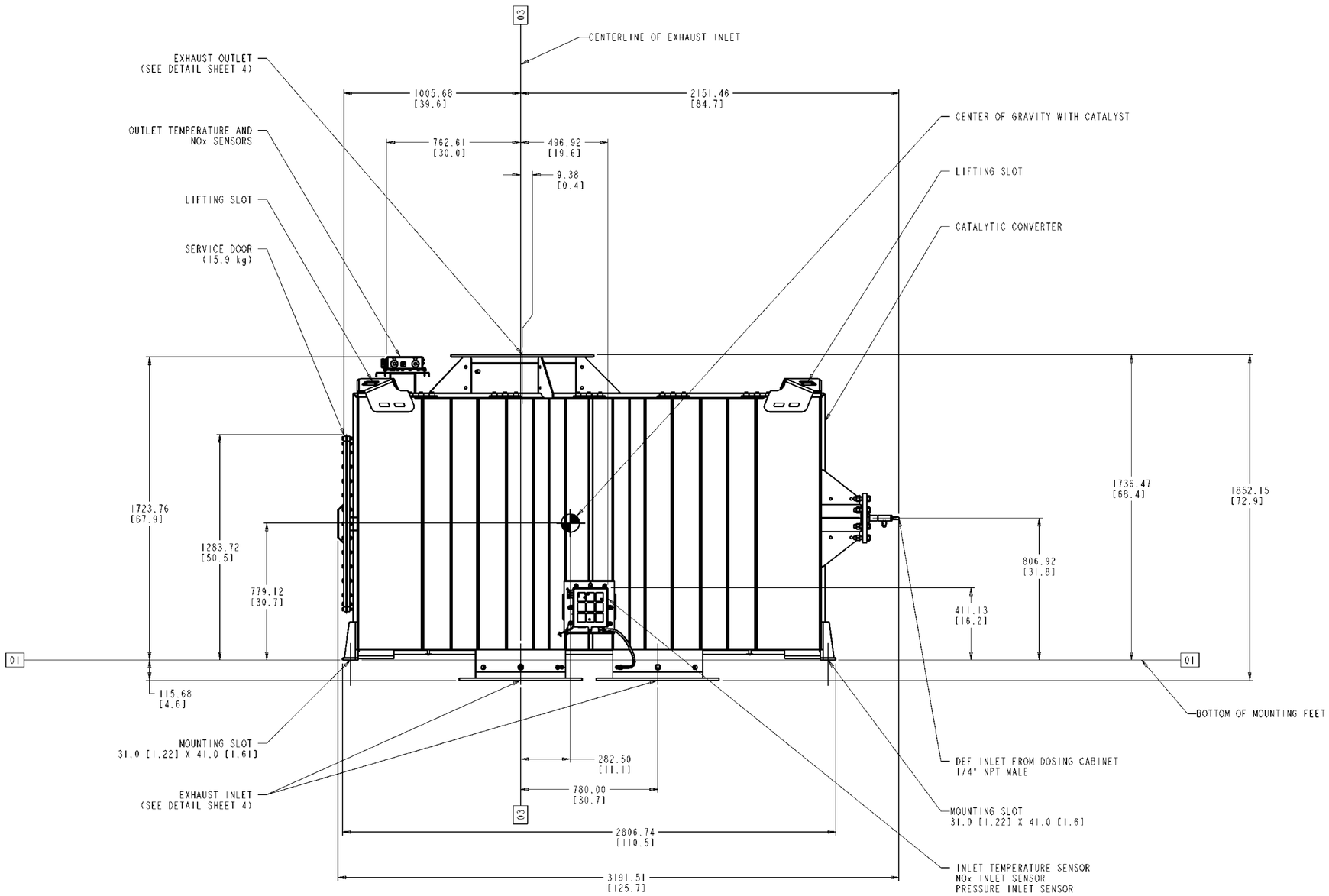
PRELIMINARY

CONVERTER GP-CATALYTIC
DWG# 559-1243 CHG 01
METRIC [INCH]
FRONT VIEW
BOTTOM IN
535-6800 CHG 01 SHOWN
SCALE 1:10

PRICING AR	FLOW TYPE	CATALYTIC TYPE
547-2600 CHG 00	SIDE IN	5X4X3 (EH9)
547-2590 CHG 00		
547-2580 CHG 00		

1E5167A	INT-PROP
1E2966B	IDENT
1E2722E	DRAWING
1E0198W	BRAND MARKINGS
1E0013G	CONFIDENTIALITY
1E0012A	INTERPRETATION
1E0011	INTPR & TOL

Caterpillar: Confidential Green
PROD OTHER RECORDS
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN mm DIMENSIONS W/O TOL ARE BASIC
VERSION TYPE PRIMARY X SECONDARY
THIRD ANGLE PROJECTION
SHEET 1 OF 4
DWG CONTROL PS111
CATERPILLAR
INSTL-ATTACHMENT (AFTERTREATMENT MODULES)
559-1243 VER - CHG 01 E



CONVERTER GP-CATALYTIC
DWG# 559-1243 CHG 01
METRIC [INCH]
RIGHT SIDE VIEW
BOTTOM IN
535-6800 CHG 01 SHOWN
SCALE 1:10

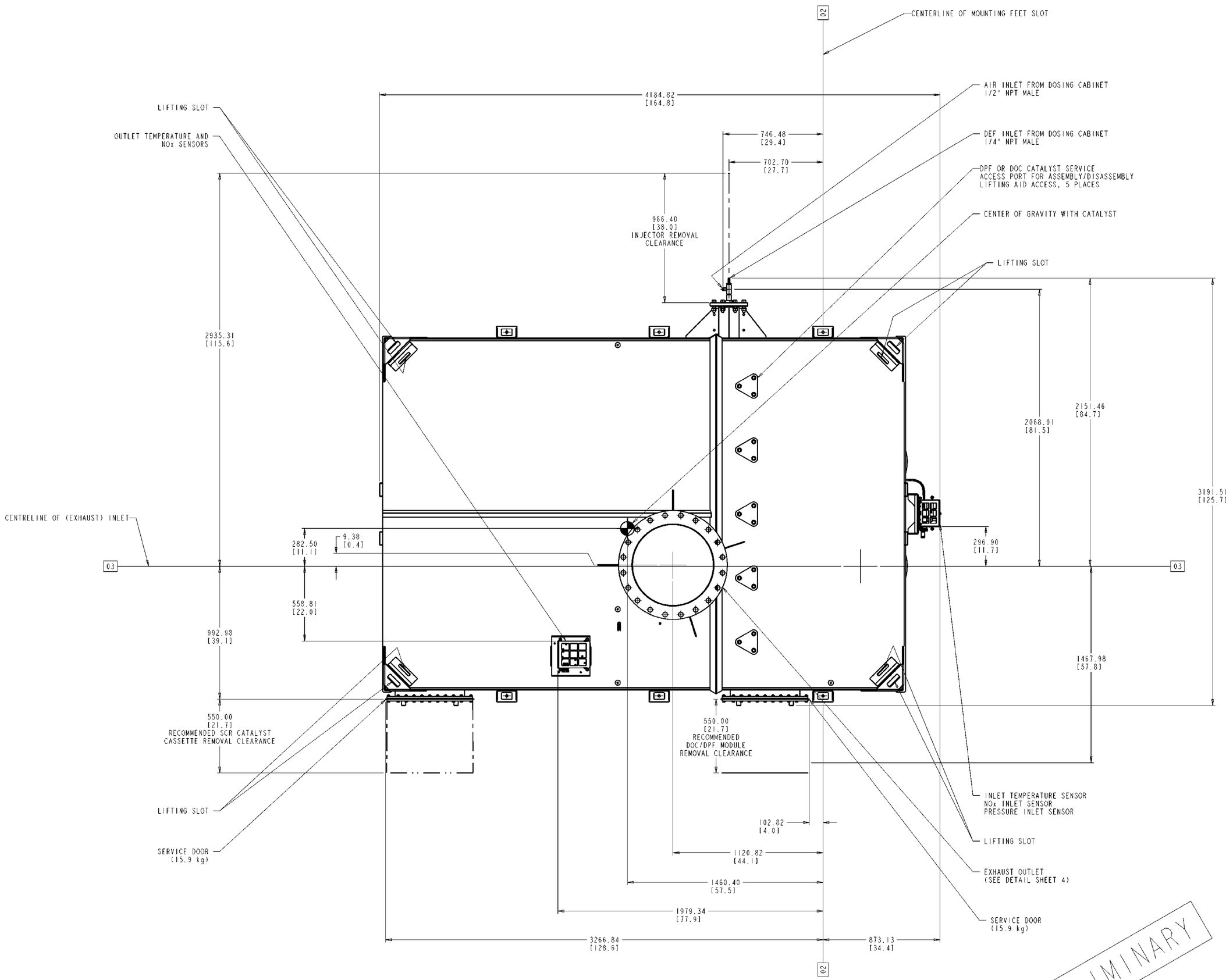
PRELIMINARY

	IE5167A	INT-PROP
	IE2966B	IDENT
	IE2722E	DRAWING
	IE0198W	BRAND MARKINGS
	IE0013G	CONFIDENTIALITY
	IE0012A	INTERPRETATION
	IE0011	INTPR & TOL
NOTE	Caterpillar: Confidential Green	
	PROD. / OTHER	RECORDS

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN mm DIMENSIONS W/O TOL ARE BASIC
VERSION TYPE: PRIMARY X / SECONDARY
THIRD ANGLE PROJECTION
SHEET 2 OF 4
DWG CONTROL PS111

CATERPILLAR

INSTL-ATTACHMENT
(AFTERTREATMENT MODULES)
559-1243 VER - CHG 01 E



CONVERTER GP-CATALYTIC
DWG# 559-1243 CHG 01
METRIC [INCH]
TOP VIEW
BOTTOM IN
535-6800 CHG 01 SHOWN
SCALE 1:10

PRELIMINARY

	IE5167A	INT-PROP
	IE2966B	IDENT
	IE2722E	DRAWING
	IE0198W	BRAND MARKINGS
	IE0013G	CONFIDENTIALITY
	IE0012A	INTERPRETATION
NOTE	IE0011	INTPR & TOL

Caterpillar: Confidential Green

PROD. | OTHER | RECORDS

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN mm DIMENSIONS W/O TOL ARE BASIC

VERSION TYPE: PRIMARY X, SECONDARY

THIRD ANGLE PROJECTION

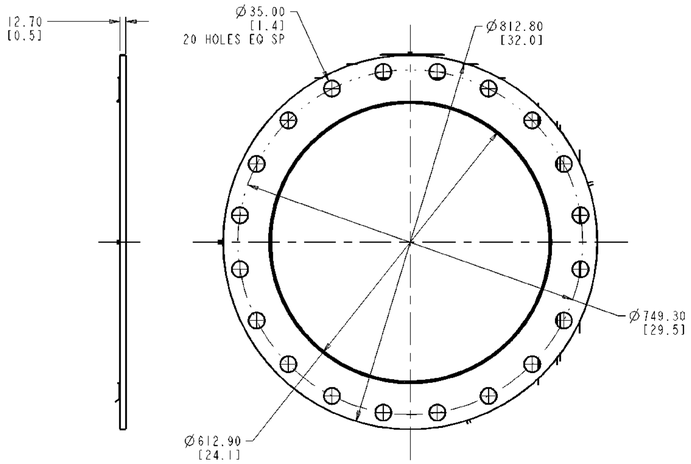
SHEET 3 OF 4

DWG CONTROL PS111

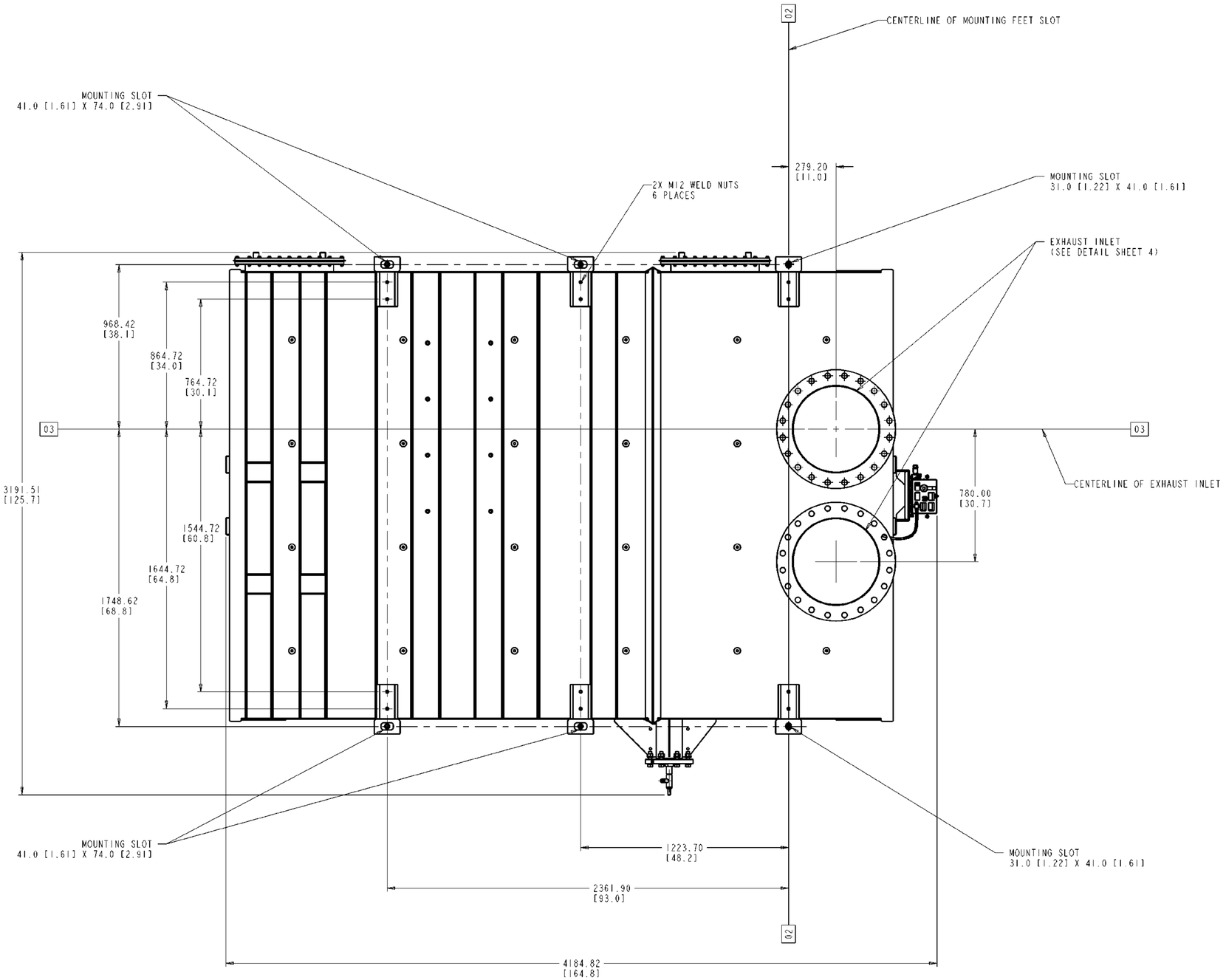
CATERPILLAR

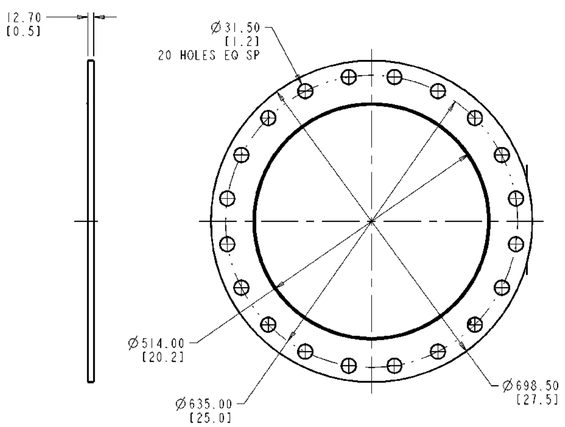
INSTL-ATTACHMENT
(AFTERTREATMENT MODULES)

559-1243 | VER - | CHG 01 | E



DETAIL OF EXHAUST OUTLET
SCALE 1:5





DETAIL OF EXHAUST INLET
SCALE 1:5

CONVERTER GP-CATALYTIC
DWG# 559-1243 CHG 01
METRIC [INCH]
BOTTOM VIEW
BOTTOM IN
535-6800 CHG 01 SHOWN
SCALE 1:10

PRELIMINARY

MAIL		
RETN		
	IE5167A	INT-PROP
	IE2966B	IDENT
	IE2722E	DRAWING
	IE0198W	BRAND MARKINGS
	IE0013G	CONFIDENTIALITY
	IE0012A	INTERPRETATION
	IE0011	INTPR & TOL
NOTE	Caterpillar: Confidential Green	
	PROD. / OTHER	RECORDS

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN mm DIMENSIONS W/O TOL ARE BASIC
VERSION TYPE: PRIMARY X / SECONDARY
THIRD ANGLE PROJECTION
SHEET 4 OF 4
DWG CONTROL PS111

CATERPILLAR

INSTL-ATTACHMENT
(AFTERTREATMENT MODULES)

559-1243 | VER - | CHG 01 | E

Generator set data sheet

Model: DQKAF
Frequency: 60 Hz
Fuel type: Diesel
kW rating: 2250 Standby
1825 Prime
Emissions level: EPA NSPS Stationary Emergency Tier 2

Exhaust emission data sheet:	**EDS-1120**
Exhaust emission compliance sheet:	**EPA-1166**
Sound performance data sheet:	**MSP-1132**
Cooling performance data sheet:	**MCP-208**
Prototype test summary data sheet:	**PTS-308**
Standard set-mounted radiator cooling outline:	**A034T734**
Optional set-mounted radiator cooling outline:	**A034H896**
Optional heat exchanger cooling outline:	**A034H896**
Optional remote radiator cooling outline:	**A034U921**

Fuel consumption

	Standby				Prime				Continuous
	kW (kVA)				kW (kVA)				kW (kVA)
Ratings	2250 (2812)				1825 (2281)				
Load	**1/4**	**1/2**	**3/4**	**Full**	**1/4**	**1/2**	**3/4**	**Full**	**Full**
US gph	50.6	85.6	119.3	151.8	43.9	72.6	100.4	127.4	
L/hr	191.7	324.1	451.7	574.6	166.2	274.6	380.0	482.2	

Engine

	Standby rating	Prime rating	Continuous rating
Engine manufacturer	Cummins Inc.		
Engine model	QSK60-G14 NR2		
Configuration	Cast iron, V 16 cylinder		
Aspiration	Turbocharged and low temperature after-cooled		
Gross engine power output, kWm (bhp)	2446 (3280)	1980 (2655)	
BMEP at set rated load, kPa (psi)	2710 (393)	2193 (318)	
Bore, mm (in.)	159 (6.25)		
Stroke, mm (in.)	190 (7.48)		
Rated speed, rpm	1800		
Piston speed, m/s (ft/min)	11.4 (2243)		
Compression ratio	14.5:1		
Lube oil capacity, L (qt)	261 (276)	378 (400)	
Overspeed limit, rpm	2070		
Regenerative power, kW	277		

Fuel flow

Maximum fuel flow, L/hr (US gph)	1033 (273)	
Maximum fuel inlet restriction, kPa (in Hg)	16.9 (5)	
Maximum fuel inlet temperature, ℃ (℉)	71 (160)	

Air	Standby rating	Prime rating	Continuous rating
Combustion air, m^3/min (scfm)	195 (6900)	167 (5910)	
Maximum air cleaner restriction, kPa (in H_2O)	3.7 (15)		
Alternator cooling air, m^3/min (cfm)	222 (7840)		

Exhaust			
Exhaust flow at set rated load, m^3/min (cfm)	473 (16700)	402 (14205)	
Exhaust temperature, °C (°F)	474 (885)	457 (855)	
Maximum back pressure, kPa (in H_2O)	6.7 (27)		

Standard set-mounted radiator cooling			
Ambient design, °C (°F)	40 (104)		
Fan load, kW_m (HP)	46 (61)		
Coolant capacity (with radiator), L (US gal)	537 (142)		
Cooling system air flow, m^3/min (scfm)	2094 (73937)		
Total heat rejection, MJ/min (Btu/min)	121.3 (114968)	98.5 (93385)	
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 set-mounted radiator cooling			
Ambient design, °C (°F)	50 (122)		
Fan load, kW_m (HP)	66 (88)		
Coolant capacity (with radiator), L (US gal)	606 (160)		
Cooling system air flow, m^3/min (scfm)	2347 (82891)		
Total heat rejection, MJ/min (Btu/min)	121.3 (114968)	98.5 (93385)	
Maximum cooling air flow static restriction, kPa (in H_2O)	0.12 (0.5)		
Maximum fuel return line restriction kPa (in Hg)			

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]	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)	1900 (502)		
Max flow rate at max friction head, aftercooler circuit, L/min (US gal/min)	606 (160)		
Heat rejected, jacket water circuit, MJ/min (Btu/min)	56.6 (53645)	50.2 (47575)	
Heat rejected, aftercooler circuit, MJ/min (Btu/min)	43.9 (41605)	31.5 (29820)	
Heat rejected, fuel circuit, MJ/min (Btu/min)			
Total heat radiated to room, MJ/min (Btu/min)	19.4 (18406)	16 (15183.1)	
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)	18 (60)		
Maximum static head, aftercooler circuit, m (ft)	18 (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)			
Maximum fuel return line restriction, kPa (in Hg)			

Weights[2]

Unit dry weight kgs (lbs)	16182 (35675)
Unit wet weight kgs (lbs)	16882 (37218)

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	Standard cooling system**:** Full rated power available up to 578.6 m (1898 ft) elevation at ambient temperatures up to 40 °C (104 °F). Above these conditions derate by 6.4% per 305 m (1000 ft), and derate by an additional 8.5% per 10 °C (18 °F). Enhanced cooling system**:** Full rated power available up to 588.6 m (1930.5 ft) elevation at ambient temperatures up to 40 °C (104 °F). Above these conditions derate by 6.4% per 305 m (1000 ft). Full rated power available up to 32.9 m (107.8 ft) elevation at ambient temperatures up to 50 °C (122 °F). Above these conditions derate by 4% per 305 m (1000 ft). At higher ambient temperatures, derate by additional 12% per 10 °C (18 °F).
Prime	Full rated power available up to 64.1 m (210.3 ft) elevation at ambient temperature up to 40 °C (104 °F). Above these elevations, at 40 °C (104 °F), derate by 5.1% per 305 m (1000 ft). Derate by 17% at sea level at ambient temperatures up to 50 °C (122 °F). Above these elevations, at 50 °C (122 °F), derate by an additional 5.1% per 305 m (1000 ft). At higher ambient temperatures, derate by an additional 16% 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.

Alternator data

Voltage	Connection[1]	Temp rise degrees C	Duty[2]	Single phase factor[3]	Max surge kVA[4]	Winding No.	Alternator data sheet	Frame size	Feature code
380	Wye, 3-phase	105/80	S/P		7994	13	ADS-516	LVSI804S	B599-2
380	Wye, 3-phase	125/105	S/P		7333	13	ADS-515	LVSI804R	B737-2
380	Wye, 3-phase	150/125	S/P		7333	13	ADS-515	LVSI804R	B799-2
416	Wye, 3-phase	105/80	S/P		9719	13	ADS-517	LVSI804T	B715-2
440	Wye, 3-phase	125	S		8412	12	ADS-516	LVSI804S	B535-2
440	Wye, 3-phase	105/80	S/P		8412	12	ADS-516	LVSI804S	B664-2
440	Wye, 3-phase	150	S		7267	12	ADS-515	LVSI804R	B701-2
480	Wye, 3-phase	105/80	S/P		8412	12	ADS-516	LVSI804S	B600-2
480	Wye, 3-phase	80	S		9719	12	ADS-517	LVSI804T	B601-2
480	Wye, 3-phase	125	S		7267	12	ADS-515	LVSI804R	B738-2
480	Wye, 3-phase	150	S		7267	12	ADS-515	LVSI804R	B816-2
600	Wye, 3-phase	125/105	S/P		7233	7	ADS-515	LVSI804R	B300-2
600	Wye, 3-phase	105/80	S/P		8189	7	ADS-516	LVSI804S	B603-2
600	Wye, 3-phase	80	S		12426	7	ADS-531	LVSI804W	B604-2
600	Wye, 3-phase	150	S		7695	7	ADS-335	P734G	B817-2
4160	Wye, 3-phase	105/80	S/P		6335	51	ADS-518	MVSI804R	B313-2
4160	Wye, 3-phase	80	S		7295	51	ADS-519	MVSI804S	B605-2
4160	Wye, 3-phase	80	S/P		7295	51	ADS-519	MVSI804S	B905-2
4160	Wye, 3-phase	125/105	S/P		6335	51	ADS-518	MVSI804R	B930-2
12470	Wye, 3-phase	105/80	S/P		7993	87	ADS-522	HVSI804S	B567-2
12470	Wye, 3-phase	125/105	S/P		6800	91	ADS-522	HVSI804S	B810-2
12470	Wye, 3-phase	105/80	S/P		7993	91	ADS-523	HVSI804T	B928-2
13200	Wye, 3-phase	105/80	S/P		6800	91	ADS-522	HVSI804S	B806-2
13200	Wye, 3-phase	125/105	S/P		6800	91	ADS-522	HVSI804S	B819-2
13200	Wye, 3-phase	105/80	S/P		6800	91	ADS-522	HVSI804S	B929-2
13800	Wye, 3-phase	125	S		5948	91	ADS-521	HVSI804R	B820-2
13800	Wye, 3-phase	105	S		6800	91	ADS-522	HVSI804S	B908-2
13800	Wye, 3-phase	80	S/P		7993	91	ADS-523	HVSI804T	B909-2

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.

[5] Derate may be applicable. Please consult the factory for details.

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.™

D-3511 (03/18)

Exhaust emission data sheet 2250DQKAF

60 Hz Diesel generator set
EPA NSPS stationary emergency

Engine information:

Model:	Cummins Inc. QSK60-G14 NR2	Bore:	6.25 in. (159 mm)
Type:	4 Cycle, 60° V, 16 cylinder diesel	Stroke:	7.48 in. (190 mm)
Aspiration:	Turbocharged and low temperature after-cooled (2 pump/2 loop)	Displacement:	3673 cu. in. (60.2 liters)
Compression ratio:	14.5:1		
Emission control device:	Turbocharged with low temperature after-cooler		

Performance data	1/4 Standby	1/2 Standby	3/4 Standby	Full Standby	Full Prime
BHP @ 1800 RPM (60 Hz)	820	1640	2459	3280	2655
Fuel consumption (Gal/Hr)	48	88	121	154	129
Exhaust gas flow (CFM)	6594	11190	14174	16546	14760
Exhaust gas temperature (°F)	727	821	855	895	864
Exhaust emission data					
HC (Total unburned hydrocarbons)	0.15	0.07	0.02	0.04	0.02
NOx (Oxides of nitrogen as NO2)	4.04	3.5	4.64	6.83	5.03
CO (Carbon monoxide)	0.71	0.28	0.2	0.37	0.2
PM (Particular matter)	0.16	0.07	0.03	0.04	0.03
SO2 (Sulfur dioxide)	0.005	0.005	0.005	0.004	0.005
Smoke (Bosch)	0.55	0.31	0.17	0.25	0.17

All values are Grams per HP-Hour

Test conditions

Data is representative of steady-state engine speed (± 25 RPM) at designated genset loads. 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:	NOx measurement corrected to 75 grains H2O/lb dry air
Reference standard:	ISO 8178

The NOx, 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.

2019 EPA Tier 2 Exhaust Emission Compliance Statement 2250DQKAF Stationary Emergency

60 Hz Diesel generator set

Compliance Information:

The engine used in this generator set complies with Tier 2 emissions limit of U.S. EPA New Source Performance Standards for stationary emergency engines under the provisions of 40 CFR 60 Subpart IIII when tested per ISO8178 D2.

Engine Manufacturer:	Cummins Inc.
EPA Certificate Number:	KCEXL060.AAD-021
Effective Date:	10/01/2018
Date Issued:	10/01/2018
EPA Engine Family (Cummins Emissions Family):	KCEXL060.AAD

Engine information:

Model:	QSK60-G14 NR2	Bore:	6.25 in. (159 mm)
Engine Nameplate HP:	3280	Stroke:	7.48 in. (190 mm)
Type:	4 cycle, 60°V, 16 Cylinder Diesel	Displacement:	3673 cu. in. (60.2 liters)
Aspiration:	Turbocharged and Low Temperature Aftercooled	Compression Ratio:	14.5:1
Emission control device:	Electronic Control		

Diesel Fuel Emissions Limits

D2 Cycle Exhaust Emissions

	Grams per BHP-hr			Grams per kW_m-hr		
	NO_X + NMHC	CO	PM	NO_X + NMHC	CO	PM
Test Results	4.2	0.75	0.10	5.6	1.0	0.14
EPA Emissions Limit	4.8	2.6	0.15	6.4	3.5	0.20

Test methods: EPA nonroad emissions recorded per 40CFR89 (ref. ISO8178-1) and weighted at load points prescribed in Subpart E, Appendix A for constant speed engines (ref. ISO8178-4, D2)

Diesel fuel specifications: Cetane number: 40-48. Reference: ASTM D975 No. 2-D, 300-500 ppm Sulfur.

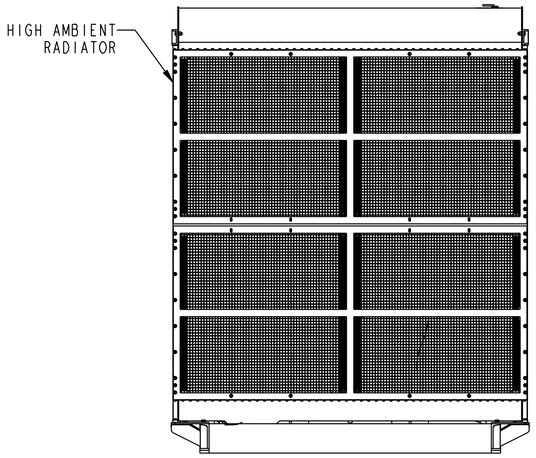
Reference conditions: Air inlet temperature: 25°C (77°F), Fuel inlet temperature: 40°C (104°F). Barometric pressure: 100 kPa (29.53 in Hg), Humidity: 10.7 g/kg (75 grains H2O/lb) of dry air; required for NOx correction, Restrictions: Intake restriction set to a maximum allowable limit for clean filter; Exhaust back pressure set to a maximum allowable limit.

Tests conducted using alternate test methods, instrumentation, fuel or reference conditions can yield different results.

Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may result in elevated emission levels.

PTC® Creo® Parametric

REL NO	REV	NO	REVISION	DWN	CKD	APVD	DATE
ECO-156406	A	1	PRODUCTION RELEASE	SLO	LDE	A.BORROTO	22FEB15



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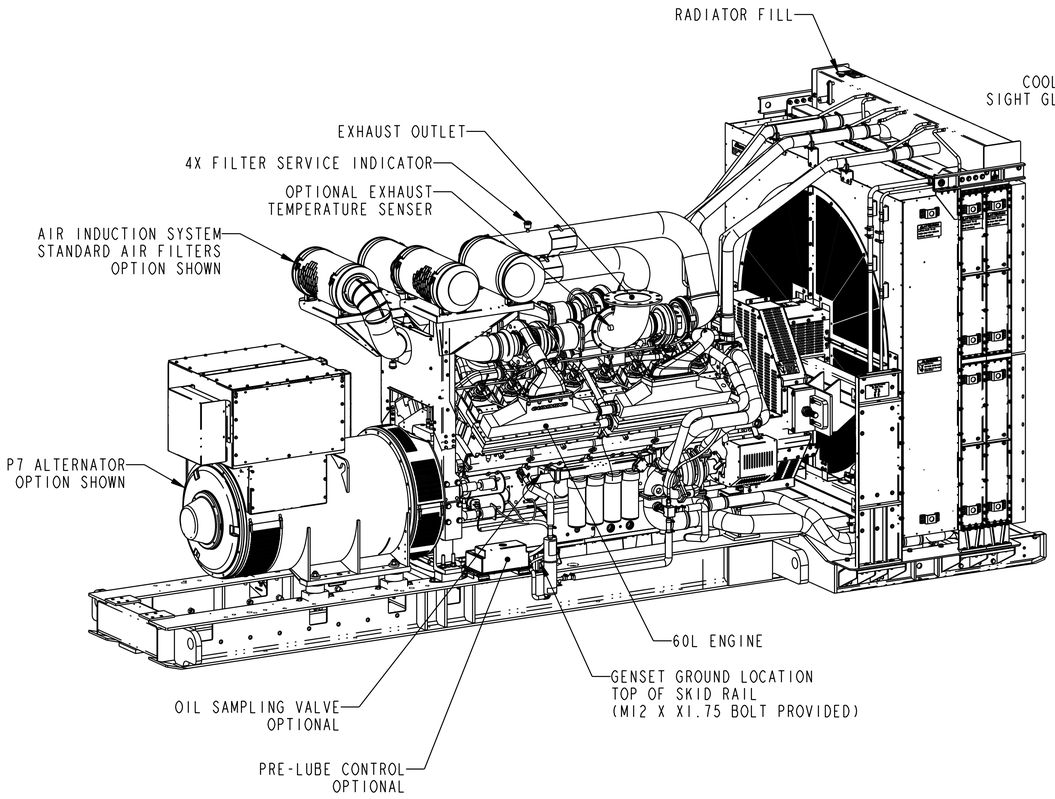

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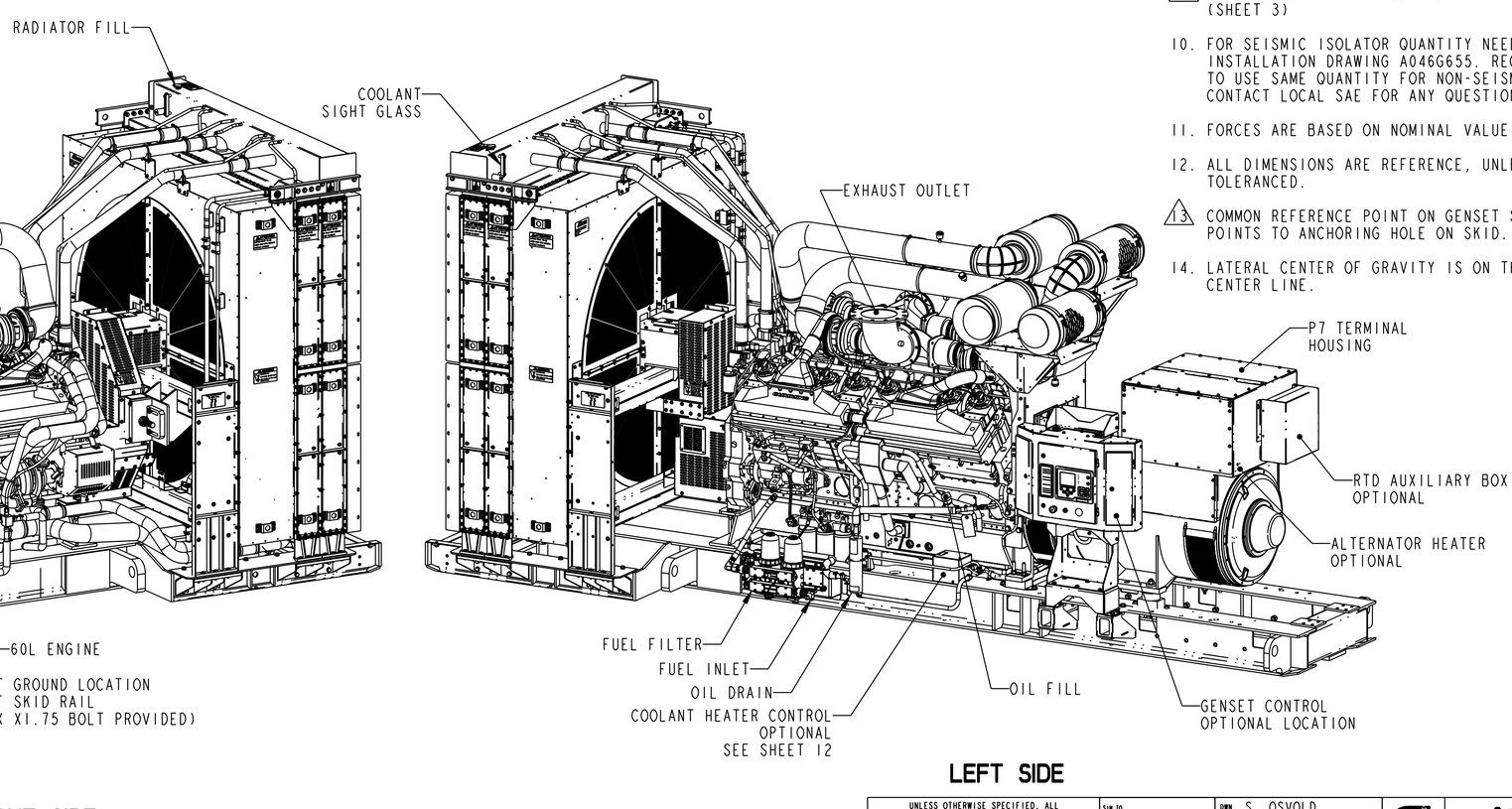

LEFT SIDE

NOTES:

1. ALL DIMENSIONS SHOWN IN [ ] ARE INCHES.
2. PROVIDE FLEXIBLE CONDUIT TO CONTROL BOX.
3. GENSET SHIPPED FILLED WITH ENGINE OIL.
4. SUPPLIED FUEL HOSE:
   - 4.1. FUEL INLET HOSE: Ø22.2 [Ø0.88] X 1270 [50.0] LONG WITH 1-11 1/2 NPT EXTERNAL FITTING.
   - 4.2. FUEL OUTLET HOSE: Ø16 [Ø0.64] X 1270 [50.0] LONG WITH 3/4-14 NPT EXTERNAL FITTING.
5. IN-SKID ANTI VIBRATION MOUNTS ARE STANDARD ON THESE GENSETS.

△6 GENSET LIFTING SHACKLES TO BE USED PER DIMENSIONS SHOWN. (SHEETS 2 AND 3)

△7 MINIMUM AIR FILTER REMOVAL DISTANCE:
HEAVY DUTY AIR FILTER = 700 [28] (SHEET 3)
STANDARD DUTY AIR FILTER = 610 [24] (SHEET 2)

8. GENSET WEIGHTS ARE WITH STANDARD DUTY AIR CLEANERS. ADD 59 Kg (130 LBS) WITH HEAVY DUTY AIR CLEANER.

△9 ISOLATOR LOCATION USED ONLY FOR ROOFTOP INSTALLATIONS. (SHEET 3)

10. FOR SEISMIC ISOLATOR QUANTITY NEEDED, USE GENSET INSTALLATION DRAWING A046G655. RECOMMENDATION TO USE SAME QUANTITY FOR NON-SEISMIC ISOLATORS AS WELL. CONTACT LOCAL SAE FOR ANY QUESTIONS.
11. FORCES ARE BASED ON NOMINAL VALUE.
12. ALL DIMENSIONS ARE REFERENCE, UNLESS SPECIFICALLY TOLERANCED.

△13 COMMON REFERENCE POINT ON GENSET SKID (——►) POINTS TO ANCHORING HOLE ON SKID. SEE SHEET 3.

14. LATERAL CENTER OF GRAVITY IS ON THE CRANK SHAFT CENTER LINE.

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS	SIM TO	DWN S. OSVOLD	Cummins®	CUMMINS POWER GENERATION	
DIM: X ± - / .X ± - / .XX ± - ; HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13	DO NOT SCALE PRINT	CKD L. ERNST	SITE CODE	OUTLINE, GENSET HIGH AMBIENT	
		APVD A. BORROTO			
		DATE 13FEB16			
ANG TOL ± -	SCALE 1:20	FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5-2009	FIRST USED ON GENSET-QSK60	PGF	DWG SIZE D: A054M306 — CAD SHEET 1 of 13

PTC® Creo® Parametric

REL NO	REV	NO	REVISION	DWN	CKD	APVD	DATE
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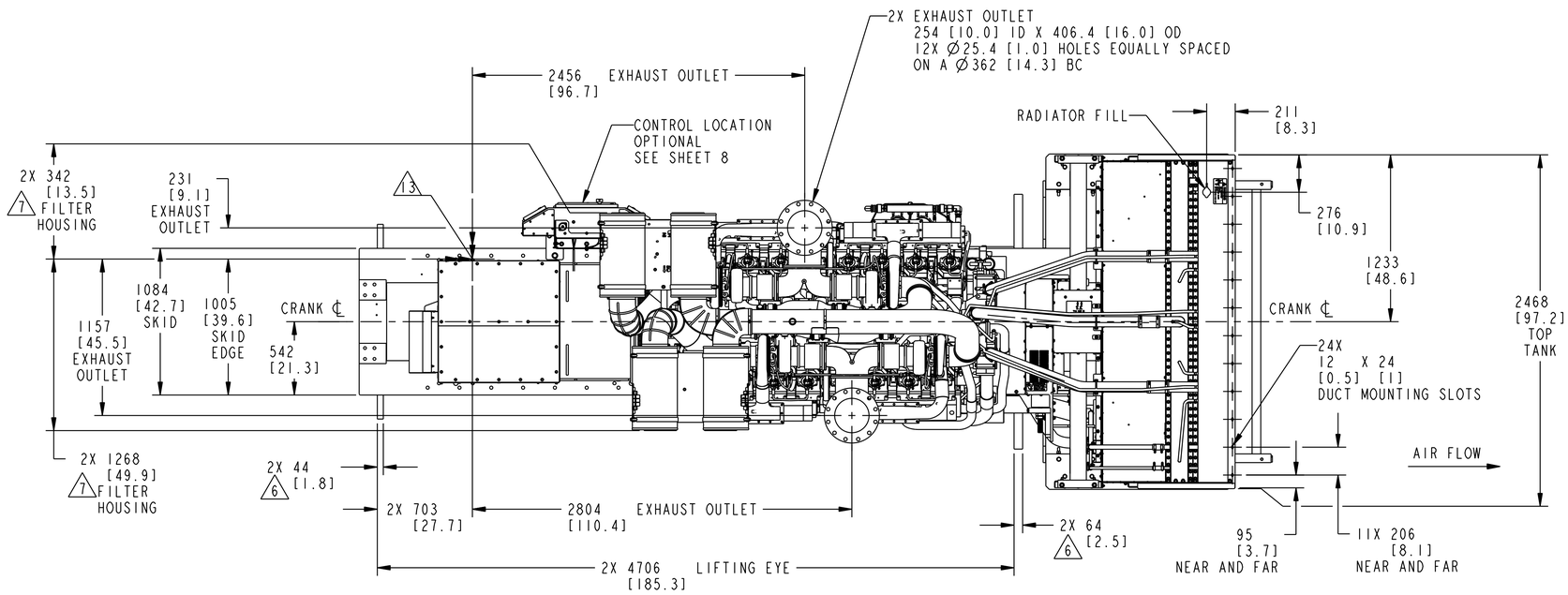
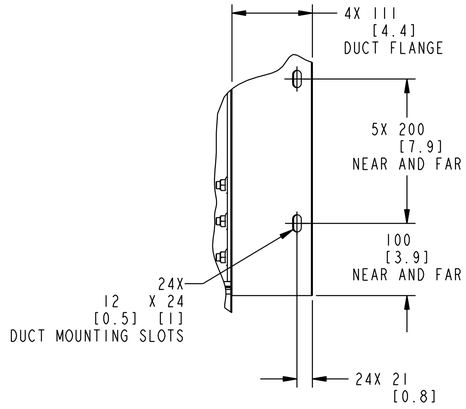
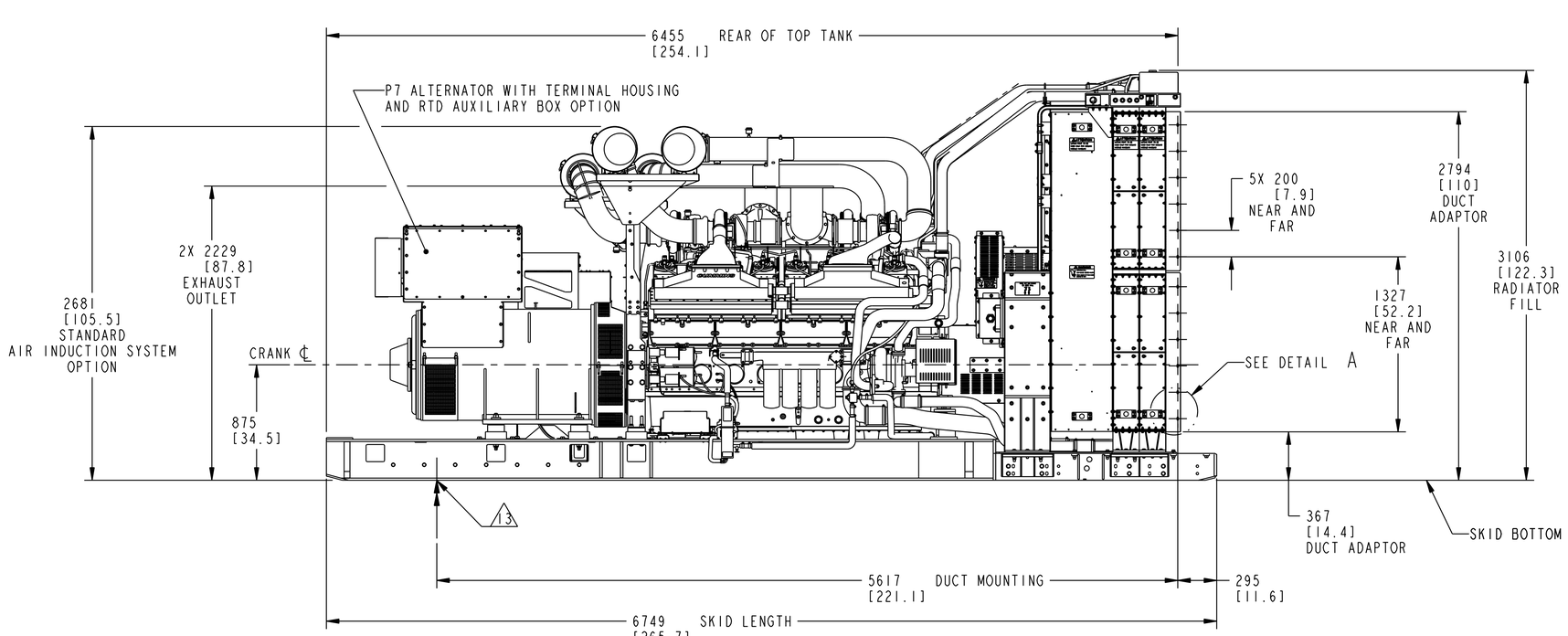
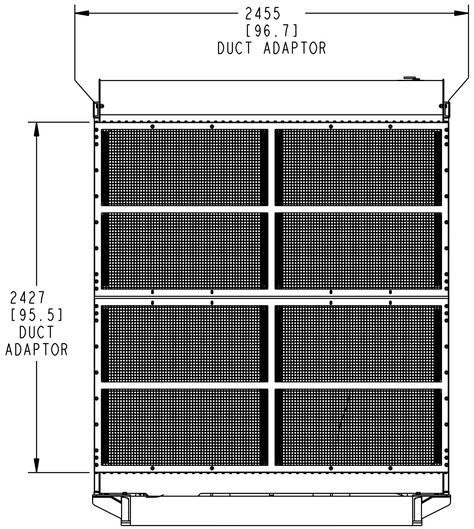




DETAIL A
SCALE 1:4





INFORMATION ON THIS SHEET IS TYPICAL FOR ALL CONFIGURATIONS

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS			SIM TO	DWN S. OSVOLD	Cummins®	CUMMINS POWER GENERATION	
DIM X ± - / .X ± - / .XX± -	HOLE 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13		DO NOT SCALE PRINT	CKD L. ERNST		OUTLINE, GENSET HIGH AMBIENT	
				APVD A. BORROTO			
				DATE 13FEB16	SITE CODE		
ANG TOL ± -	SCALE 1:20	THIS DOCUMENT (AND THE INFORMATION SHOWN THEREON) IS CONFIDENTIAL AND PROPRIETARY AND SHALL NOT BE DISCLOSED TO OTHERS IN HARD COPY OR ELECTRONIC FORM, REPRODUCED BY ANY MEANS, OR USED FOR ANY PURPOSE WITHOUT WRITTEN CONSENT OF CUMMINS INC.	FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5-2009	FIRST USED ON GENSET-QSK60	PGF	DWG SIZE D A054M306	CAD SHEET 2 of 13

Potential Site Variation Values

Generator Set Model	DQKAF
Engine Model	QSK60-G14
Fuel Rating	6816
Emissions Level	Tier 2

			ISO Standby				
Generator Set Load		%	10	25	50	75	100
		kWe	225	563	1125	1688	2250
Engine Load		hp	328	820	1640	2459	3280
Fuel Consumption		gal/hr	26.8	48	88	121	154
Nominal	HC	g/bhp·hr	0.39	0.15	0.07	0.02	0.04
	NOx	g/bhp·hr	6.69	4.04	3.50	4.64	6.83
	CO	g/bhp·hr	2.33	0.71	0.28	0.20	0.37
	PM	g/bhp·hr	0 .33	0.16	0.07	0.03	0.04
Potential Site Variation	HC	g/bhp·hr	0.66	0.26	0.12	0.03	0.07
	NOx	g/bhp·hr	8.70	5.25	4.55	6.03	8.88
	CO	g/bhp·hr	4.66	1.42	0.56	0.40	0.74
	PM	g/bhp·hr	0.83	0.40	0.18	0.08	0.10

Potential Site Variation Values

Generator Set Model	DQKAF
Engine Model	QSK60-G14
Fuel Rating	6816
Emissions Level	Tier 2

			ISO Standby				
Generator Set Load		%	10	25	50	75	100
		kWe	225	563	1125	1688	2250
Engine Load		hp	328	820	1640	2459	3280
Fuel Consumption		gal/hr	26.8	48	88	121	154
Nominal	HC	g/bhp·hr	0.39	0.15	0.07	0.02	0.04
	NOx	g/bhp·hr	6.69	4.04	3.50	4.64	6.83
	CO	g/bhp·hr	2.33	0.71	0.28	0.20	0.37
	PM	g/bhp·hr	0 .33	0.16	0.07	0.03	0.04
Potential Site Variation	HC	g/bhp·hr	0.66	0.26	0.12	0.03	0.07
	NOx	g/bhp·hr	8.70	5.25	4.55	6.03	8.88
	CO	g/bhp·hr	4.66	1.42	0.56	0.40	0.74
	PM	g/bhp·hr	0.83	0.40	0.18	0.08	0.10

18" exhaust outlet
188" exhaust height

Exhaust emission data sheet 2250DQKAF

60 Hz Diesel generator set
EPA NSPS stationary emergency

Engine information:

Model:	Cummins Inc. QSK60-G14 NR2	Bore:	6.25 in. (159 mm)
Type:	4 Cycle, 60° V, 16 cylinder diesel	Stroke:	7.48 in. (190 mm)
Aspiration:	Turbocharged and low temperature after-cooled (2 pump/2 loop)	Displacement:	3673 cu. in. (60.2 liters)
Compression ratio:	14.5:1		
Emission control device:	Turbocharged with low temperature after-cooler		

Performance data	1/4 Standby	1/2 Standby	3/4 Standby	Full Standby	Full Prime
BHP @ 1800 RPM (60 Hz)	820	1640	2459	3280	2655
Fuel consumption (Gal/Hr)	48	88	121	154	129
Exhaust gas flow (CFM)	6594	11190	14174	16546	14760
Exhaust gas temperature (°F)	727	821	855	895	864
Exhaust emission data					
HC (Total unburned hydrocarbons)	0.15	0.07	0.02	0.04	0.02
NOx (Oxides of nitrogen as NO2)	4.04	3.5	4.64	6.83	5.03
CO (Carbon monoxide)	0.71	0.28	0.2	0.37	0.2
PM (Particular matter)	0.16	0.07	0.03	0.04	0.03
SO2 (Sulfur dioxide)	0.005	0.005	0.005	0.004	0.005
Smoke (Bosch)	0.55	0.31	0.17	0.25	0.17

All values are Grams per HP-Hour

Test conditions

Data is representative of steady-state engine speed (± 25 RPM) at designated genset loads. 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:	NOx measurement corrected to 75 grains H2O/lb dry air
Reference standard:	ISO 8178

The NOx, 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 Data Sheet

Model: DQKAN
Frequency: 60 Hz
Fuel Type: Diesel
kW Rating: 2500 Standby
Emissions Level: EPA NSPS Stationary Emergency Tier 2

Exhaust emission data sheet:	**EDS-1153**
Exhaust emission compliance sheet:	**EPA-1223**
Sound performance data sheet:	**MSP-1189**
Cooling performance data sheet:	**MCP-269**
Prototype test summary data sheet:	**PTS-315**
Standard set-mounted radiator cooling outline:	**A054H274**

Fuel Consumption

	kW (kVA)			
Ratings	2500 (3125)			
Load	**1/4**	**1/2**	**3/4**	**Full**
US gph	50.6	91.1	133.6	173.1
L/hr	191.5	344.9	505.7	655.3

Engine

Engine manufacturer	Cummins Inc.
Engine model	QSK60-G19 NR2
Configuration	Cast iron, V 16 cylinder
Aspiration	Turbocharged and low temperature after-cooled
Gross engine power output, kWm (bhp)	2715 (3640)
BMEP at set rated load, kPa (psi)	3007 (436)
Bore, mm (in.)	159 (6.25)
Stroke, mm (in.)	190 (7.48)
Rated speed, rpm	1800
Piston speed, m/s (ft/min)	11.4 (2243)
Compression ratio	14.5:1
Lube oil capacity, L (qt)	378 (400)
Overspeed limit, rpm	2070
Regenerative power, kW	207

Fuel Flow

Maximum fuel flow, L/hr (US gph)	1105 (292)
Maximum fuel inlet restriction, clean/dirty, kPa (in Hg)	16.9 (5) / 30 (9)
Maximum fuel inlet temperature, °C (°F)	71 (160)

Air

Combustion air, m^3/min (scfm)	193 (6829)
Maximum air cleaner restriction, clean/dirty, kPa (in H_2O)	1.3 (7) / 5.3 (20.6)
Alternator cooling air, m^3/min (cfm)	222 (7840)

Exhaust

Exhaust flow at set rated load, m^3/min (cfm)	517 (18269)
Exhaust temperature, °C (°F)	551 (1022)
Maximum back pressure, kPa (in H_2O)	7.4 (30)

Standard Set-Mounted Radiator Cooling

Ambient design, °C (°F)	48 (118)
Fan load, kW_m (HP)	54 (72)
Coolant capacity (with radiator), L (US gal)	681.4 (180)
Cooling system air flow, m^3/min (scfm)	2649 (93550)
Total heat rejection, MJ/min (Btu/min)	88.4 (83894)
Maximum cooling air flow static restriction, kPa (in H_2O)	0.12 (0.5)

Weights[1]

Unit dry weight kgs (lbs)	22887 (50457)
Unit wet weight kgs (lbs)	23299 (51366)

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

Derating Factors

Full rated power available up to 300 m (1000 ft.) at ambient temperature up to 43 °C (110 °F). Above these elevations, derate at 5% per 300 m (1000 ft.) and 12% per 10 °C (18 °F).

Ratings Definitions

Emergency Standby Power (ESP): 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.

Alternator Data

Voltage	Connection[1]	Temp rise degree C[2]	Duty	Max surge kVA[4]	Winding No.	Alternator data sheet	Feature code
380	Wye, 3-phase	105	S	13024	13	ADS-531	B408-2
416	Wye, 3-phase	80	S	28176	12	ADS-532	B734-2
416	Wye, 3-phase	80	P	13283	12	ADS-531	B715-2
416	Wye, 3-phase	105	S	13283	12	ADS-531	B715-2
440	Wye, 3-phase	80	S	14781	12	ADS-532	B688-2
440	Wye, 3-phase	80	P	13204	12	ADS-531	B664-2
440	Wye, 3-phase	105	S	13204	12	ADS-531	B664-2
480	Wye, 3-phase	80	S	13204	12	ADS-531	B601-2
480	Wye, 3-phase	80	S/P	14781	12	ADS-532	B903-2
600	Wye, 3-phase	80	S	12426	7	ADS-531	B604-2
600	Wye, 3-phase	80	S/P	14781	7	ADS-532	B904-2
4160	Wye, 3-phase	80	S	11185	51	ADS-545	B605-2
4160	Wye, 3-phase	80	S/P	15662	51	ADS-587	B905-2
12470	Wye, 3-phase	80	S	13438	91	ADS-534	B607-2
12470	Wye, 3-phase	105	S	11213	91	ADS-533	B568-2
13200	Wye, 3-phase	80	S	13438	91	ADS-534	B807-2
13200	Wye, 3-phase	105	S	11213	91	ADS-533	B501-2
13800	Wye, 3-phase	80	S	11213	91	ADS-533	B610-2
13800	Wye, 3-phase	80	S/P	13438	91	ADS-534	B909-2

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[2]. All single phase ratings are at unity power factor.

[2] Also capable of 105/125/150 °C temp rise.

[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.™

NAD-5919-EN PD00000134 (8/19)

Exhaust emission data sheet 2500DQKAN

60 Hz Diesel generator set
EPA NSPS stationary emergency

Engine information:

Model:	Cummins Inc. QSK60-G19 NR2	Bore:	6.25 in. (159 mm)
Type:	4 Cycle, 60° V, 16 cylinder diesel	Stroke:	7.48 in. (189 mm)
Aspiration:	Turbocharged and low temperature after-cooled (2 pump/2 loop)	Displacement:	3673 cu. in. (60.1 liters)
Compression ratio:	14:5:1		
Emission control device:	Turbocharged with low temperature after-cooler		

Performance data	1/4 Standby	1/2 Standby	3/4 Standby	Full Standby
BHP @ 1800 RPM (60 Hz)	910	1820	2730	3640
Fuel consumption (Gal/Hr)	50.6	91.1	133.6	173.1
Exhaust gas flow (CFM)	6482.0	10902.0	15122.0	18269.0
Exhaust gas temperature (°F)	849.0	939.0	981.0	1022.0
Exhaust emission data				
HC (Total unburned hydrocarbons)	0.15	0.08	0.05	0.04
NOx (Oxides of nitrogen as NO2)	3.76	3.90	4.43	6.12
CO (Carbon monoxide)	0.81	0.52	0.63	0.75
PM (Particular matter)	0.17	0.09	0.10	0.10
SO2 (Sulfur dioxide)	0.005	0.005	0.005	0.004
Smoke (Bosch)	0.70	0.50	0.57	0.60

All values are Grams per HP-Hour

Test conditions

Data is representative of steady-state engine speed (± 25 RPM) at designated genset loads. 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:	NOx measurement corrected to 75 grains H2O/lb dry air
Reference standard:	ISO 8178

The NOx, 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.

2019 EPA Tier 2 Exhaust Emission Compliance Statement 2500DQKAN Stationary Emergency

60 Hz Diesel generator set

Compliance Information:

The engine used in this generator set complies with Tier 2 emissions limit of U.S. EPA New Source Performance Standards for stationary emergency engines under the provisions of 40 CFR 60 Subpart IIII when tested per ISO8178 D2.

Engine Manufacturer:	Cummins Inc.
EPA Certificate Number:	KCEXL060.AAD-021
Effective Date:	10/01/2018
Date Issued:	10/01/2018
EPA Engine Family (Cummins Emissions Family):	KCEXL060.AAD

Engine information:

Model:	QSK60-G19 NR2	Bore:	6.25 in. (159 mm)
Engine Nameplate HP:	3640	Stroke:	7.48 in. (190 mm)
Type:	4 cycle, 60°V, 16 Cylinder Diesel	Displacement:	3673 cu. in. (60.2 liters)
Aspiration:	Turbocharged and Low Temperature Aftercooled (2P/2L)	Compression Ratio:	14.5:1
Emission control device:	Electronic Control		

Diesel Fuel Emissions Limits

D2 Cycle Exhaust Emissions

	Grams per BHP-hr			Grams per kW_m-hr		
	NO_X + NMHC	CO	PM	NO_X + NMHC	CO	PM
Test Results	4.2	0.75	0.10	5.6	1.0	0.14
EPA Emissions Limit	4.8	2.6	0.15	6.4	3.5	0.20

Test methods: EPA nonroad emissions recorded per 40CFR89 (ref. ISO8178-1) and weighted at load points prescribed in Subpart E, Appendix A for constant speed engines (ref. ISO8178-4, D2)

Diesel fuel specifications: Cetane number: 40-48. Reference: ASTM D975 No. 2-D, 300-500 ppm Sulfur.

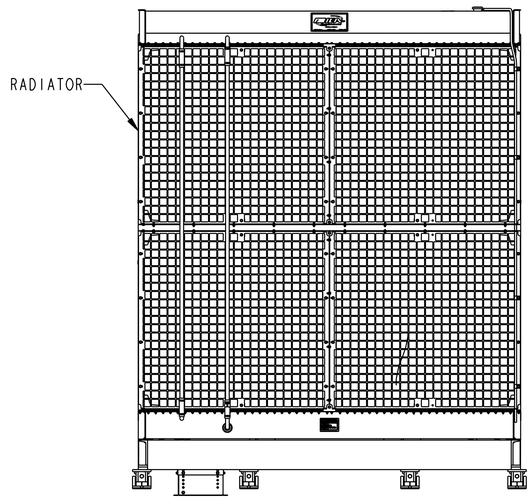
Reference conditions: Air inlet temperature: 25°C (77°F), Fuel inlet temperature: 40°C (104°F). Barometric pressure: 100 kPa (29.53 in Hg), Humidity: 10.7 g/kg (75 grains H2O/lb) of dry air; required for NOx correction, Restrictions: Intake restriction set to a maximum allowable limit for clean filter; Exhaust back pressure set to a maximum allowable limit.

Tests conducted using alternate test methods, instrumentation, fuel or reference conditions can yield different results.

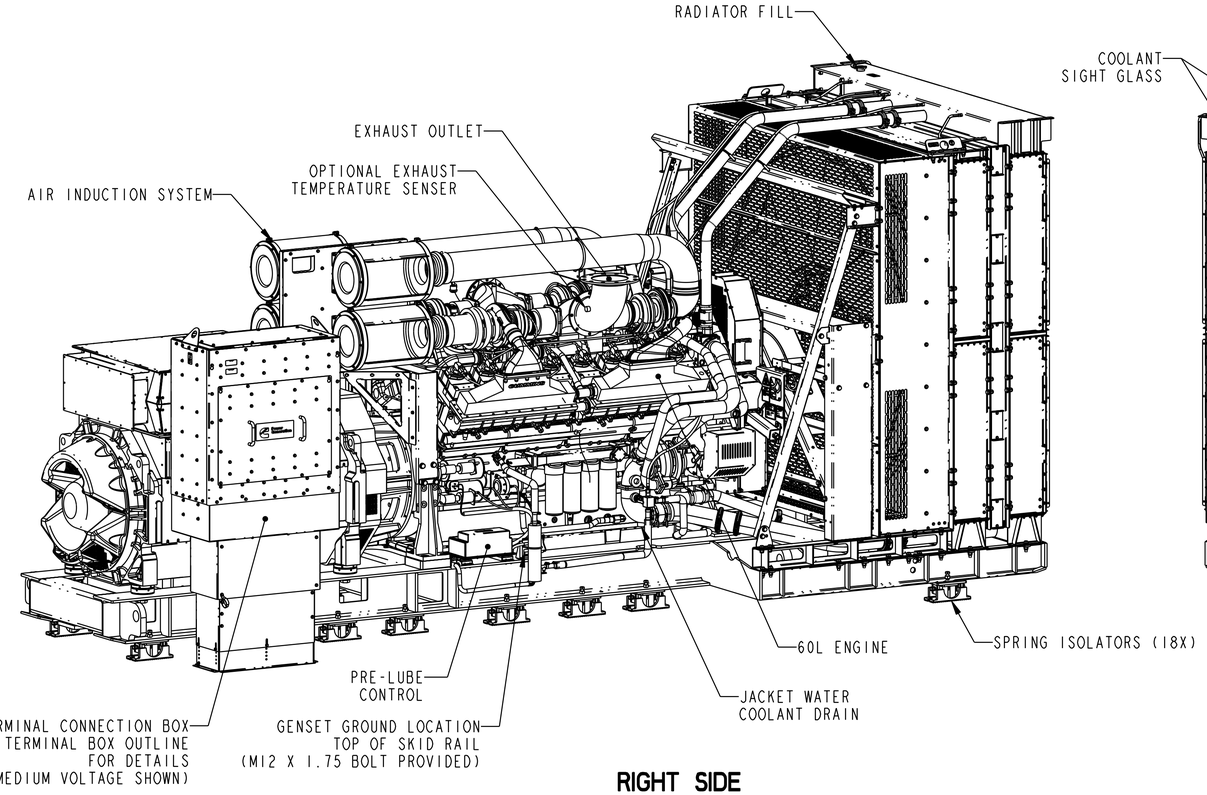
Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may result in elevated emission levels.

PTC® Creo® Parametric

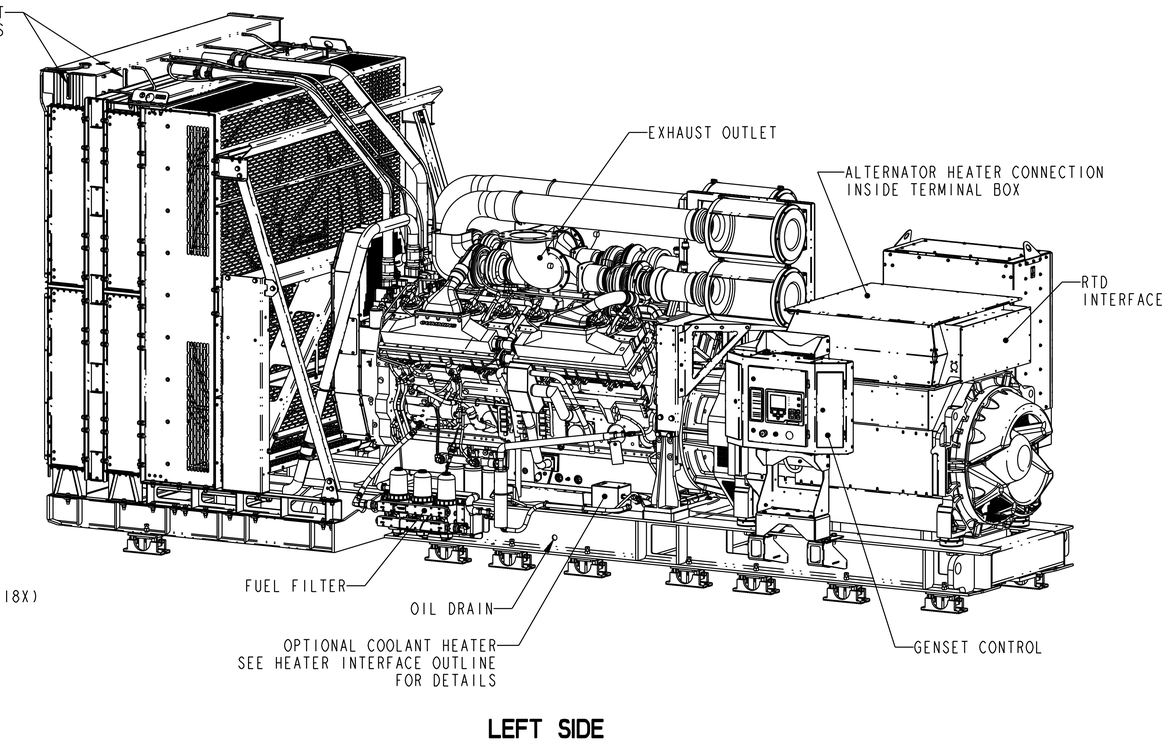
REL NO	REV	NO	REVISION	DWN	CKD	APVD	DATE
ECO-156405	A	1	PRODUCTION RELEASE	SLO	DEM	D.MALONE	10DEC15



REAR



RIGHT SIDE



LEFT SIDE

NOTES:

1. DIMENSIONS SHOWN IN [ ] ARE IN INCHES.
2. ALL DIMENSIONS ARE REFERENCE BASED ON CAD DATA.
3. PROVIDE FLEXIBLE CONDUIT TO CONTROL BOX.
4. GENSET SHIPPED FILLED WITH OIL.
5. SUPPLIED FUEL HOSE:
   - 5.1. FUEL INLET HOSE 25 [1] X 1270 [50] LONG WITH 1-11 1/2 NPT EXTERNAL FITTING.
   - 5.2. FUEL OUTLET HOSE 16 [.6] X 1270 [50] LONG WITH 3/4-14 NPT EXTERNAL FITTING.
6. COMMON REFERENCE POINT ON GENSET SKID (⟶►) POINTS TO ANCHORING HOLE ON SKID. (SHEET 3)
7. FOR C OF G VALUE SEE SHEET 2.

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM: X ± - | .X ± - | .XX± -

HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13

ANG TOL ± -

SCALE 1:20

SIM TO

DO NOT SCALE PRINT

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5-2009

FIRST USED ON DQKAN

DWN S. OSVOLD

CKD D. MALONE

APVD D. MALONE

DATE 03DEC15

SITE CODE PGF

CUMMINS POWER GENERATION

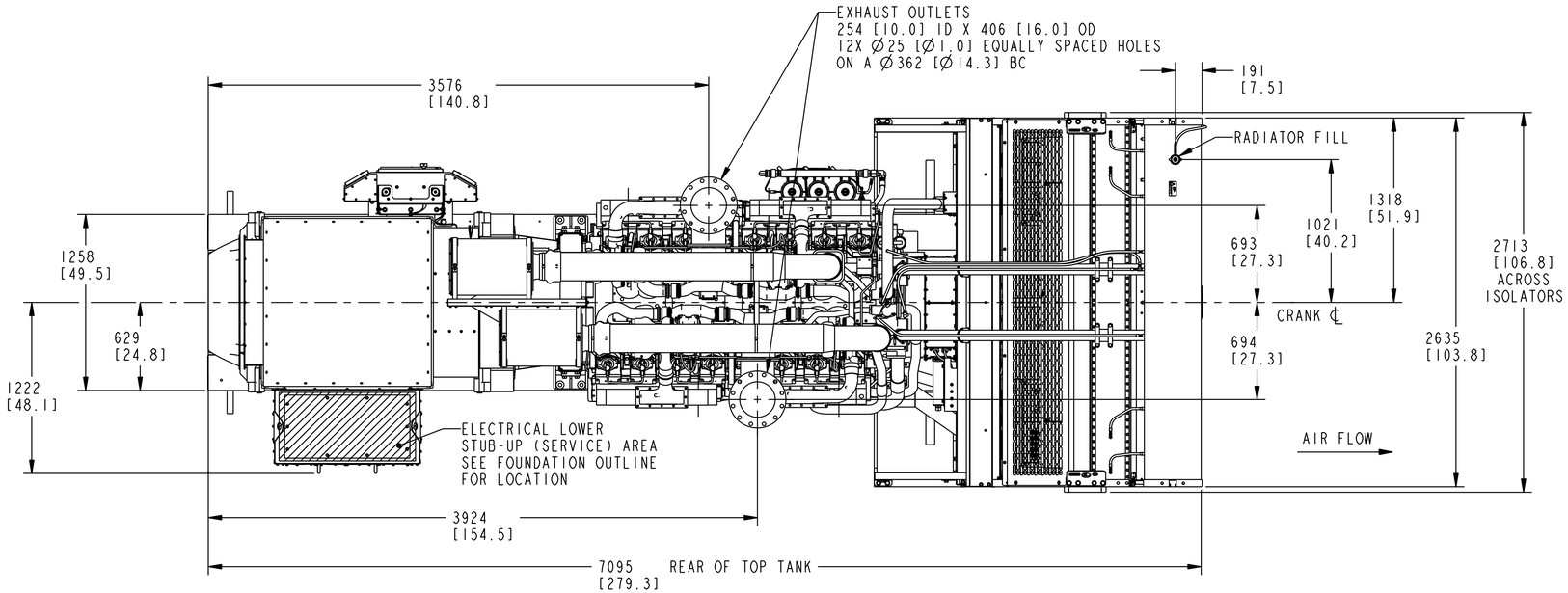
OUTLINE, GENSET

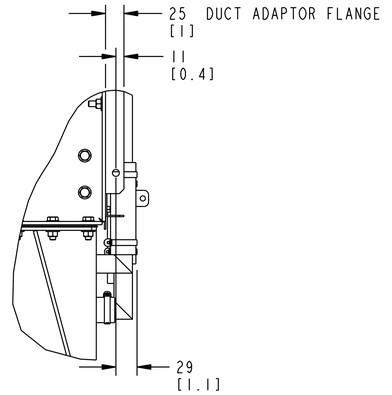
DWG SIZE D | A054H274 | CAD SHEET 1 of 5

Drawing Name: A054H275 Revision: A
Part Name: A054H274 Revision: A
Sheet 1 of 6

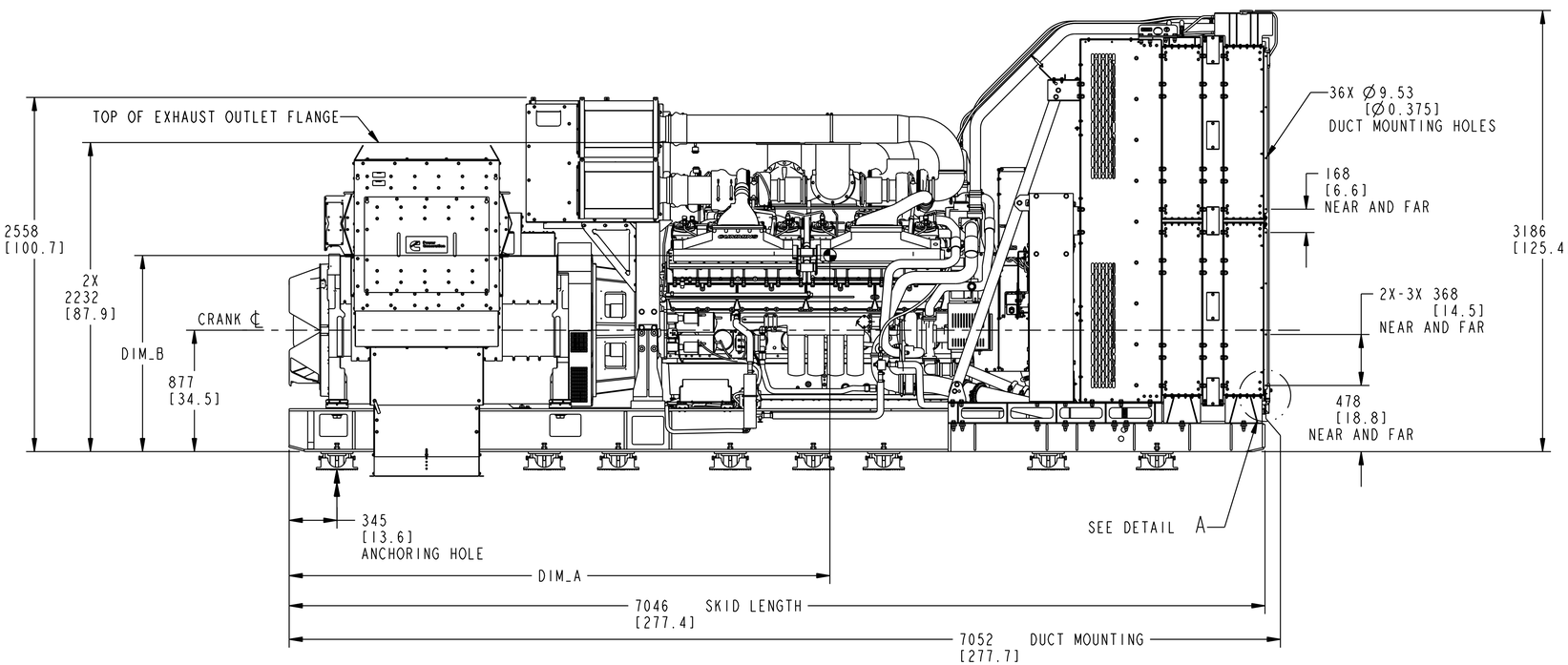
PTC® Creo® Parametric

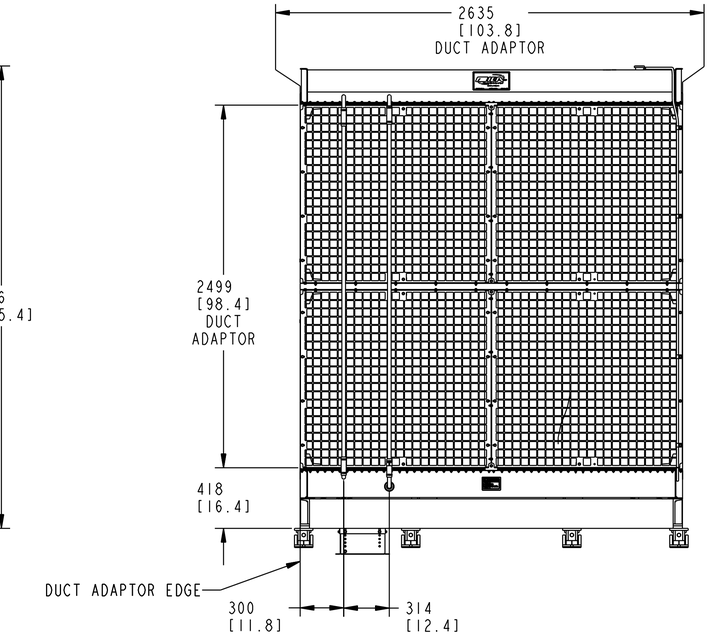
REL NO	REV	NO	REVISION	DWN	CKD	APVD	DATE
ECO-156405	A	1	PRODUCTION RELEASE	SLO	DEM	D.MALONE	10DEC15





DETAIL A
2 PLACES
SCALE 1:4





TABULATION						
ALTERNATOR FRAME SIZE	DIM_A C.G.	DIM_B C.G.	GENSET WEIGHT			
			DRY KGS	DRY LBS	WET KGS	WET LBS
P80X	3239	937.25	22887	50457	23299	51366

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM		HOLE
X	± -	0.00- 4.99 +0.15/-0.08
.X	± -	5.00- 9.99 +0.20/-0.10
		10.00-17.49 +0.25/-0.13
.XX	± -	17.50-24.99 +0.30/-0.13

ANG TOL ± -

SCALE 1:20

SIM TO
DO NOT SCALE PRINT

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5-2009

FIRST USED ON DQKAN

DWN	S. OSVOLD
CKD	D. MALONE
APVD	D. MALONE
DATE	03DEC15

SITE CODE PGF

CUMMINS POWER GENERATION

OUTLINE, GENSET

DWG SIZE D | A054H274 | CAD SHEET 2 OF 5

Potential Site Variation Values

Generator Set Model	DQKAN
Engine Model	QSK60-G19
Fuel Rating	FR60448
Emissions Level	Tier 2

			ISO Standby				
Generator Set Load		%	10	25	50	75	100
		kWe	250	625	1250	1875	2500
Engine Load		hp	364	910	1820	2730	3640
Fuel Consumption		gal/hr	26.8	50.6	91.1	133.6	173.1
Nominal	HC	g/bhp·hr	0.35	0.15	0.08	0.05	0.04
	NOx	g/bhp·hr	4.64	3.76	3.90	4.43	6.12
	CO	g/bhp·hr	1.63	0.81	0.52	0.63	0.75
	PM	g/bhp·hr	0.28	0.17	0.09	0.10	0.10

Potential Site Variation	HC	g/bhp·hr	0.60	0.26	0.14	0.09	0.07
	NOx	g/bhp·hr	6.03	4.89	5.07	5.76	7.96
	CO	g/bhp·hr	3.26	1.62	1.04	1.26	1.50
	PM	g/bhp·hr	0.70	0.43	0.23	0.25	0.25

Potential Site Variation Values

Generator Set Model	DQKAN
Engine Model	QSK60-G19
Fuel Rating	FR60448
Emissions Level	Tier 2

			ISO Standby				
Generator Set Load		%	10	25	50	75	100
		kWe	250	625	1250	1875	2500
Engine Load		hp	364	910	1820	2730	3640
Fuel Consumption		gal/hr	26.8	50.6	91.1	133.6	173.1
Nominal	HC	g/bhp·hr	0.35	0.15	0.08	0.05	0.04
	NOx	g/bhp·hr	4.64	3.76	3.90	4.43	6.12
	CO	g/bhp·hr	1.63	0.81	0.52	0.63	0.75
	PM	g/bhp·hr	0.28	0.17	0.09	0.10	0.10
Potential Site Variation	HC	g/bhp·hr	0.60	0.26	0.14	0.09	0.07
	NOx	g/bhp·hr	6.03	4.89	5.07	5.76	7.96
	CO	g/bhp·hr	3.26	1.62	1.04	1.26	1.50
	PM	g/bhp·hr	0.70	0.43	0.23	0.25	0.25

Exhaust height
188"

18" outlet

Exhaust emission data sheet 2500DQKAN

60 Hz Diesel generator set
EPA NSPS stationary emergency

Engine information:

Model:	Cummins Inc. QSK60-G19 NR2	Bore:	6.25 in. (159 mm)
Type:	4 Cycle, 60° V, 16 cylinder diesel	Stroke:	7.48 in. (189 mm)
Aspiration:	Turbocharged and low temperature after-cooled (2 pump/2 loop)	Displacement:	3673 cu. in. (60.1 liters)
Compression ratio:	14:5:1		
Emission control device:	Turbocharged with low temperature after-cooler		

Performance data	1/4 Standby	1/2 Standby	3/4 Standby	Full Standby
BHP @ 1800 RPM (60 Hz)	910	1820	2730	3640
Fuel consumption (Gal/Hr)	50.6	91.1	133.6	173.1
Exhaust gas flow (CFM)	6482.0	10902.0	15122.0	18269.0
Exhaust gas temperature (°F)	849.0	939.0	981.0	1022.0
Exhaust emission data				
HC (Total unburned hydrocarbons)	0.15	0.08	0.05	0.04
NOx (Oxides of nitrogen as NO2)	3.76	3.90	4.43	6.12
CO (Carbon monoxide)	0.81	0.52	0.63	0.75
PM (Particular matter)	0.17	0.09	0.10	0.10
SO2 (Sulfur dioxide)	0.005	0.005	0.005	0.004
Smoke (Bosch)	0.70	0.50	0.57	0.60

All values are Grams per HP-Hour

Test conditions

Data is representative of steady-state engine speed (± 25 RPM) at designated genset loads. Pressures, temperatures, and emission rates were stabilized.

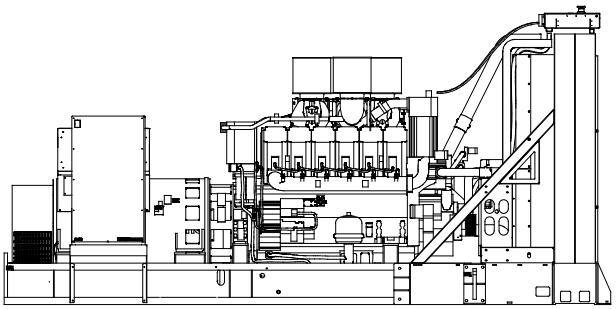
Fuel specification:	ASTM D975 No. 2-D diesel fuel with ULSD, and 40-48 cetane number.
Fuel temperature	99 ± 9 °F (at fuel pump inlet)
Intake air temperature:	77 ± 9 °F
Barometric pressure:	29.6 ± 1 in. Hg
Humidity:	NOx measurement corrected to 75 grains H2O/lb dry air
Reference standard:	ISO 8178

The NOx, 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.

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 Controller 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	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 Prime 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.

KOHLER®

Industrial Diesel Generator Set - KD2250

Tier 2 EPA-Certified for Stationary Emergency Applications

Alternator	Voltage	Ph	Hz	130°C Rise Standby Rating kW/kVA	130°C Rise Standby Rating Amps	105°C Rise Prime Rating kW/kVA	105°C Rise Prime Rating 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)
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)
Engine jacket water capacity, L (gal.)	356 (94)
Radiator system capacity, including engine, L (gal.)	643 (170)
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.)	2434 (96)
Fan, kWm (HP)	90 (120.7)
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
Battery, recommended cold cranking amps (CCA):	
Quantity, CCA rating each, type (with standard starters)	4, 1110, AGM
Battery voltage (DC)	12

Air Requirements	60 Hz
Radiator-cooled cooling air, m^3/min. (scfm)‡	2549 (90000)
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.

Controller

APM802 Controller
Provides advanced control, system monitoring, and system diagnostics for optimum performance and compatibility.

- Graphic display with touch screen and menu control provide easy local data access
- Measurements are selectable in metric or English units
- User language is selectable
- Two USB ports allow connection of a flash drive, mouse, or keypad
- Electrical data, mechanical data, and system settings can be saved to a flash drive
- Ethernet port allows connection to a PC type computer or Ethernet switch
- The controller supports Modbus® RTU and TCP protocols
- NFPA 110 Level 1 capability

Refer to G6-152 for additional controller features and accessories.

Modbus® is a registered trademark of Schneider Electric.

Codes and Standards

- Engine- generator set is designed and manufactured in facilities certified to ISO 9001.
- Generator set meets NEMA MG1, BS5000, ISO, DIN EN, and IEC standards, NFPA 110.
- Engine generator set is tested to ISO 8528-5 for transient response.
- The generator set and its components are prototype-tested, factory-built, and production-tested.

Third-Party Compliance

- Tier 2 EPA-Certified for Stationary Emergency Applications

Available Approvals and Listings

- ❑ California OSHPD Approval
- ❑ CSA Certified
- ❑ IBC Seismic Certification
- ❑ UL 2200 Listing
- ❑ cUL Listing (fuel tanks only)
- ❑ Florida Dept. of Environmental Protection (FDEP) Compliance (fuel tanks only)

Warranty Information

- 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.

Available Warranties for Standby Applications

- ❑ 5-Year Basic Limited Warranty
- ❑ 5-Year Comprehensive Limited Warranty
- ❑ 10-Year Major Components Limited Warranty

KOHLER®

Industrial Diesel Generator Set - KD2250

Tier 2 EPA-Certified for Stationary Emergency Applications

Standard Features

- Closed Crankcase Ventilation (CCV) Filters
- Customer Connection
- Fan Bearing Grease Extension
- Fuel/Water Separator
- Generator Heater
- Local Emergency Stop Switch
- Oil Drain and Coolant Drain Extension
- Operation and Installation Literature
- Spring Isolation Under the Skid

Available Options

Engine Type

- ❑ KDxxxx Tier 2 EPA-Certified Engine
- ❑ KDxxxx-F Fuel Optimized Engine

Approvals and Listings

- ❑ California OSHPD Approval
- ❑ CSA Certified
- ❑ IBC Seismic Certification
- ❑ UL 2200 Listing
- ❑ cUL Listing (fuel tanks only)
- ❑ Florida Dept. of Environmental Protection (FDEP) Compliance (fuel tanks only)

Enclosed Unit

- ❑ Sound Level 1 Enclosure/Fuel Tank Package
- ❑ Sound Level 2 Enclosure/Fuel Tank Package

Open Unit

- ❑ Exhaust Silencer, Critical (kits: PA-354880 qty. 3)
- ❑ Exhaust Silencer, Hospital (kits: PA-354900 qty. 3)
- ❑ Flexible Exhaust Connector, Stainless Steel

Controller

- ❑ Input/Output, Analog
- ❑ Input/Output, Digital
- ❑ Input/Output, Harness
- ❑ Input/Output, Thermocouple (standard on 4160 V and above)
- ❑ Load Shed
- ❑ Manual Key Switch
- ❑ Remote Emergency Stop
- ❑ Remote Serial Annunciator Panel

Cooling System

- ❑ Block Heater; 9000 W, 208 V, (Select 1 Ph or 3 Ph) *
- ❑ Block Heater; 9000 W, 240 V, (Select 1 Ph or 3 Ph) *
- ❑ Block Heater; 9000 W, 380 V, 3 Ph *
- ❑ Block Heater; 9000 W, 480 V, (Select 1 Ph or 3 Ph) *

* Required for Ambient Temperatures Below 10°C (50°F) and block heater kit includes air intake manifold grid heater

Electrical System

- ❑ Battery, AGM (kit with qty. 4)
- ❑ Battery Charger
- ❑ Battery Heater; 100 W, 120 V, 1Ph
- ❑ Battery Rack and Cables
- ❑ Bus Bar
- ❑ Line Circuit Breaker (select right or left side mounting)
- ❑ Line Circuit Breaker with Shunt Trip (select right or left side mtg)

Fuel System

- ❑ Flexible Fuel Lines
- ❑ Restriction Gauge (for fuel/water separator)

Literature

- ❑ General Maintenance
- ❑ NFPA 110
- ❑ Overhaul
- ❑ Production

Miscellaneous

- ❑ Air Cleaner, Heavy Duty
- ❑ Air Cleaner Restriction Indicator
- ❑ Automatic Oil Replenishment System
- ❑ Engine Fluids (oil and coolant) Added
- ❑ Rated Power Factor Testing

Electrical Package (Requires Enclosure selection)

- ❑ Basic Electrical Package (select 1 Ph or 3 Ph)
- ❑ Wire Battery Charger (1 Ph)
- ❑ Wire Block Heater (select 1 Ph or 3 Ph)
- ❑ Wire Controller Heater (1 Ph)
- ❑ Wire Generator Heater (1 Ph)

Warranty (Standby Applications only)

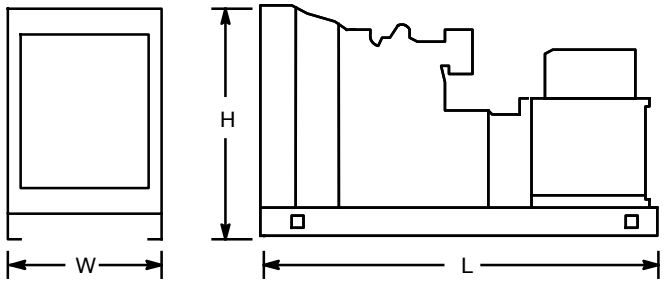
- ❑ 5-Year Basic Limited Warranty
- ❑ 5-Year Comprehensive Limited Warranty
- ❑ 10-Year Major Components Limited Warranty

Other

- ❑
- ❑

Dimensions and Weights

Overall Size, max., L x W x H, mm (in.):	6957 x 2852 x 3307 (273.9 x 112.3 x 130.2)
Weight, radiator model, max. wet, kg (lb.):	27033 (59598)



NOTE: This drawing is provided for reference only and should not be used for planning installation. Contact your local distributor for more detailed information.

KOHLER

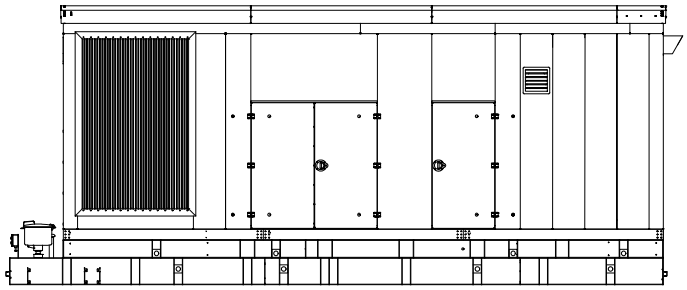
Industrial Diesel Generator Set - KD2250
Tier 2 EPA-Certified for Stationary Emergency Applications

KOHLER CO., Kohler, Wisconsin 53044 USA
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales and service outlet in the US and Canada, phone 1-800-544-2444
KOHLERPower.com

Sound Enclosures and Subbase Fuel Tank

Sound Level 1 Enclosure Standard Features

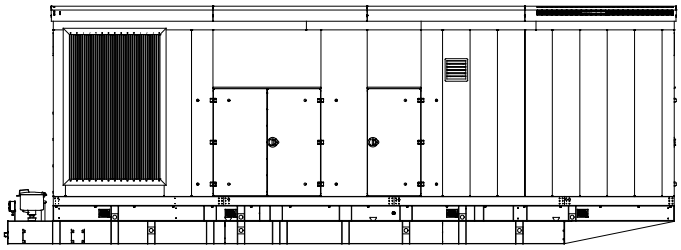
- Lift base or tank-mounted, aluminum construction enclosure with internal-mounted, exhaust silencers.
- Every enclosure has a sloped roof to reduce the buildup of moisture and debris.
- Sound attenuated enclosure that offers noise reduction using acoustic insulation, acoustic-lined air inlets and an acoustic-lined air discharge.
- Fade-, scratch-, and corrosion-resistant Kohler® Power Armor™ automotive-grade textured finish.
- Acoustic insulation that meets UL 94 HF1 flammability classification.
- Enclosure has large access doors that are hinged and removable which allow for easy maintenance.
- Lockable, flush-mounted door latches.
- Air inlet louvers reduce rain and snow entry.
- High wind bracing, 241 kph (150 mph).



Sound Level 1 Enclosure
(Shown with available spill containment)

Sound Level 2 Enclosure Standard Features

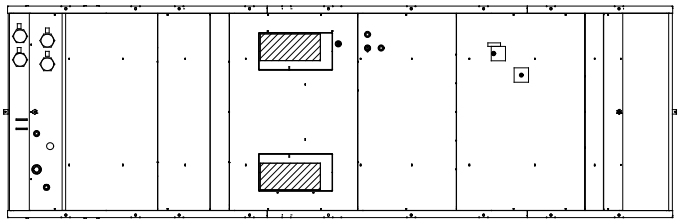
- Includes all of the sound level 1 enclosure features with the addition of up to 51 mm (2 in.) acoustic insulation material, intake sound baffles, vertical air discharge, and secondary silencers.
- Louvered air inlet and vertical outlet hood with 90 degree angles to redirect air and reduce noise.



Sound Level 2 Enclosure
(Shown with available spill containment)

Subbase Fuel Tank Features

- The fuel tank has a Power Armor Plus™ textured epoxy-based rubberized coating.
- The above-ground rectangular secondary containment tank mounts directly to the generator set, below the generator set skid (subbase).
- Both the inner and outer tanks have UL-listed emergency relief vents.
- Flexible fuel lines are provided with subbase fuel tank selection.
- The containment tank's construction protects against fuel leaks or ruptures. The inner (primary) tank is sealed inside the outer (secondary) tank. The outer tank contains the fuel if the inner tank leaks or ruptures.
- The above ground secondary containment subbase fuel tank meets UL 142 requirements.
- Features include:
  - Additional fittings for optional accessories (qty. 3)
  - Electrical stub-up area open to bottom
  - Emergency inner and outer tank relief vents
  - Fuel fill with lockable cap and 51 mm (2 in.) riser
  - Fuel leak detection switch
  - Fuel level mechanical gauge
  - Fuel level sender
  - Normal vent
  - Removable engine supply and return diptubes



Subbase Fuel Tank (Top View)

DISTRIBUTED BY:

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	10% ESP
Power [kW]	2500	1875	1250	625	250
Speed [rpm]	1800	1800	1800	1800	1800
Exhaust Gas Flow [kg/h]	15017	14404	9978	5904	4042
Exhaust Gas Temperature [C]	451	447	450	453	390
NO_X [g/kWh]	7.6	4.7	4.9	5.1	8.2
CO [g/kWh]	0.4	0.8	0.7	2.5	5.3
HC [g/kWh]	0.12	0.13	0.19	0.30	0.70
PM [g/kWh]	0.05	0.12	0.09	0.32	0.19

NOT TO EXCEED EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP	10% ESP
NO_X [g/kWh]	9.0	5.6	5.8	6.1	9.7
CO [g/kWh]	1.3	2.6	2.2	8.1	10.9
HC [g/kWh]	0.14	0.15	0.22	0.35	0.89
PM [g/kWh]	0.07	0.18	0.13	0.47	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.

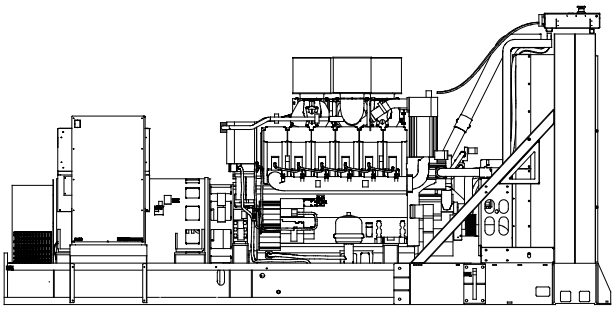
Data was taken from a single engine test according to the test methods, fuel specification and reference conditions stated above and is subjected to instrumentation and engine-to-engine variability. Tests conducted with alternate test methods, instrumentation, fuel or reference conditions can yield different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

Data and specifications subject to change without notice.

KOHLER®

Industrial Diesel Generator Set - KD2500

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**	2250- 2500
	kVA	2812- 3125
Prime:	**kW**	2050- 2270
	kVA	2562- 2838

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 Controller on page 4.
  - The low coolant level shutdown prevents overheating (standard on radiator models only).

General Specifications

Orderable Generator Model Number	GMKD2500
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	APM802
Fuel Tank Capacity, L (gal.)	8577- 16383 (2266- 4328)
Fuel Consumption, L/hr (gal./hr) 100% at Standby	651 (172.0)
Fuel Consumption, L/hr (gal./hr) 100% at Prime Power	626 (165.3)
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 Prime 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**
KH06930TO4D	277/480	3	60	2500/3125	3759	2500/3125	3759	2270/2838	3414	2190/2738	3294
KH07000TO4D	347/600	3	60	2500/3125	3008	2500/3125	3008	2270/2838	2731	2250/2812	2706
	2400/4160	3	60	2500/3125	434	2500/3125	434	2270/2838	394	2250/2812	391
KH07770TO4D	277/480	3	60	2500/3125	3759	2500/3125	3759	2270/2838	3414	2270/2838	3414
	347/600	3	60	2500/3125	3008	2500/3125	3008	2270/2838	2731	2270/2838	2731
	2400/4160	3	60	2500/3125	434	2500/3125	434	2270/2838	394	2270/2838	394
KH08430TO4D	240/416	3	60	2500/3125	4338	2500/3125	4338	2270/2838	3939	2270/2838	3939
	277/480	3	60	2500/3125	3759	2500/3125	3759	2270/2838	3414	2270/2838	3414
	347/600	3	60	2500/3125	3008	2500/3125	3008	2270/2838	2731	2270/2838	2731
	2400/4160	3	60	2500/3125	434	2500/3125	434	2270/2838	394	2270/2838	394

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

Tier 2 EPA-Certified for Stationary Emergency Applications

				130°C Rise Standby Rating		105°C Rise Prime Rating	
Alternator	**Voltage**	**Ph**	**Hz**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**
KH08100TO4D	3810/6600	3	60	2500/3125	274	2270/2838	249
	7200/12470	3	60	2250/2812	131	2050/2562	119
	7620/13200	3	60	2380/2975	131	2180/2725	120
	7970/13800	3	60	2500/3125	131	2270/2838	119
KH09270TO4D	3810/6600	3	60	2500/3125	274	2270/2838	249
	7200/12470	3	60	2500/3125	145	2270/2838	132
	7620/13200	3	60	2500/3125	137	2270/2838	125
	7970/13800	3	60	2500/3125	131	2270/2838	119

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)	-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%	651 (172.0)
75%	572 (151.0)
50%	389 (102.8)
25%	222 (58.7)
Diesel, Lph (gph) at % load	**Prime Rating**
100%	626 (165.3)
75%	492 (130.0)
50%	358 (94.7)
25%	204 (53.8)

Radiator System	**60 Hz**
Ambient temperature, °C (°F)*	50 (122)
Engine jacket water capacity, L (gal.)	356 (94)
Radiator system capacity, including engine, L (gal.)	643 (170)
Engine jacket water flow, Lpm (gpm)	2082 (550)
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	870 (49476)
Charge cooler water flow, Lpm (gpm)	662 (174)
Heat rejected to charge cooling water at rated kW, dry exhaust, kW (Btu/min.)	760 (43220)
Water pump type	Centrifugal
Fan diameter, including blades, mm (in.)	2434 (96)
Fan, kWm (HP)	90 (120.7)
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)	579 (20447)
Exhaust temperature at rated kW at 25°C (77°F) ambient, dry exhaust, °C (°F)	500 (932)
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
Battery, recommended cold cranking amps (CCA):	
Quantity, CCA rating each, type (with standard starters)	4, 1110, AGM
Battery voltage (DC)	12

Air Requirements	60 Hz
Radiator-cooled cooling air, m^3/min. (scfm)‡	2549 (90000)
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)	208 (7345)
Heat rejected to ambient air:	
Engine, kW (Btu/min.)	150 (8530)
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.

Controller

APM802 Controller
Provides advanced control, system monitoring, and system diagnostics for optimum performance and compatibility.

- Graphic display with touch screen and menu control provide easy local data access
- Measurements are selectable in metric or English units
- User language is selectable
- Two USB ports allow connection of a flash drive, mouse, or keypad
- Electrical data, mechanical data, and system settings can be saved to a flash drive
- Ethernet port allows connection to a PC type computer or Ethernet switch
- The controller supports Modbus® RTU and TCP protocols
- NFPA 110 Level 1 capability

Refer to G6-152 for additional controller features and accessories.

Modbus® is a registered trademark of Schneider Electric.

Codes and Standards

- Engine- generator set is designed and manufactured in facilities certified to ISO 9001.
- Generator set meets NEMA MG1, BS5000, ISO, DIN EN, and IEC standards, NFPA 110.
- Engine generator set is tested to ISO 8528-5 for transient response.
- The generator set and its components are prototype-tested, factory-built, and production-tested.

Third-Party Compliance

- Tier 2 EPA-Certified for Stationary Emergency Applications

Available Approvals and Listings

- ❑ California OSHPD Approval
- ❑ CSA Certified
- ❑ IBC Seismic Certification
- ❑ UL 2200 Listing
- ❑ cUL Listing (fuel tanks only)
- ❑ Florida Dept. of Environmental Protection (FDEP) Compliance (fuel tanks only)

Warranty Information

- 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.

Available Warranties for Standby Applications

- ❑ 5-Year Basic Limited Warranty
- ❑ 5-Year Comprehensive Limited Warranty
- ❑ 10-Year Major Components Limited Warranty

KOHLER®

Industrial Diesel Generator Set - KD2500

Tier 2 EPA-Certified for Stationary Emergency Applications

Standard Features

- Closed Crankcase Ventilation (CCV) Filters
- Customer Connection
- Fan Bearing Grease Extension
- Fuel/Water Separator
- Generator Heater
- Local Emergency Stop Switch
- Oil Drain and Coolant Drain Extension
- Operation and Installation Literature
- Spring Isolation Under the Skid

Available Options

Engine Type

- ❑ KDxxxx Tier 2 EPA-Certified Engine
- ❑ KDxxxx-F Fuel Optimized Engine

Approvals and Listings

- ❑ California OSHPD Approval
- ❑ CSA Certified
- ❑ IBC Seismic Certification
- ❑ UL 2200 Listing
- ❑ cUL Listing (fuel tanks only)
- ❑ Florida Dept. of Environmental Protection (FDEP) Compliance (fuel tanks only)

Enclosed Unit

- ❑ Sound Level 1 Enclosure/Fuel Tank Package
- ❑ Sound Level 2 Enclosure/Fuel Tank Package

Open Unit

- ❑ Exhaust Silencer, Critical (kits: PA-354880 qty. 3)
- ❑ Exhaust Silencer, Hospital (kits: PA-354900 qty. 3)
- ❑ Flexible Exhaust Connector, Stainless Steel

Controller

- ❑ Input/Output, Analog
- ❑ Input/Output, Digital
- ❑ Input/Output, Harness
- ❑ Input/Output, Thermocouple (standard on 4160 V and above)
- ❑ Load Shed
- ❑ Manual Key Switch
- ❑ Remote Emergency Stop
- ❑ Remote Serial Annunciator Panel

Cooling System

- ❑ Block Heater; 9000 W, 208 V, (Select 1 Ph or 3 Ph) *
- ❑ Block Heater; 9000 W, 240 V, (Select 1 Ph or 3 Ph) *
- ❑ Block Heater; 9000 W, 380 V, 3 Ph *
- ❑ Block Heater; 9000 W, 480 V, (Select 1 Ph or 3 Ph) *

* Required for Ambient Temperatures Below 10°C (50°F) and block heater kit includes air intake manifold grid heater

Electrical System

- ❑ Battery, AGM (kit with qty. 4)
- ❑ Battery Charger
- ❑ Battery Heater; 100 W, 120 V, 1Ph
- ❑ Battery Rack and Cables
- ❑ Bus Bar
- ❑ Line Circuit Breaker (select right or left side mounting)
- ❑ Line Circuit Breaker with Shunt Trip (select right or left side mtg)

Fuel System

- ❑ Flexible Fuel Lines
- ❑ Restriction Gauge (for fuel/water separator)

Literature

- ❑ General Maintenance
- ❑ NFPA 110
- ❑ Overhaul
- ❑ Production

Miscellaneous

- ❑ Air Cleaner, Heavy Duty
- ❑ Air Cleaner Restriction Indicator
- ❑ Automatic Oil Replenishment System
- ❑ Engine Fluids (oil and coolant) Added
- ❑ Rated Power Factor Testing

Electrical Package (Requires Enclosure selection)

- ❑ Basic Electrical Package (select 1 Ph or 3 Ph)
- ❑ Wire Battery Charger (1 Ph)
- ❑ Wire Block Heater (select 1 Ph or 3 Ph)
- ❑ Wire Controller Heater (1 Ph)
- ❑ Wire Generator Heater (1 Ph)

Warranty (Standby Applications only)

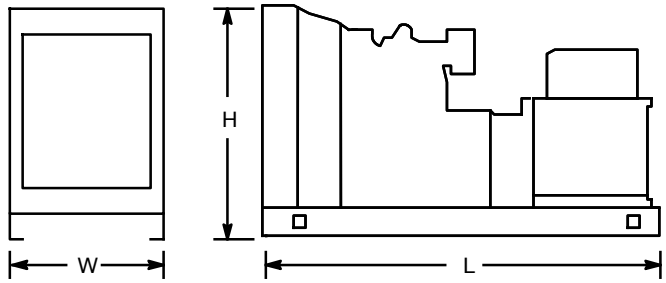
- ❑ 5-Year Basic Limited Warranty
- ❑ 5-Year Comprehensive Limited Warranty
- ❑ 10-Year Major Components Limited Warranty

Other

- ❑
- ❑

Dimensions and Weights

Overall Size, max., L x W x H, mm (in.):	6957 x 2852 x 3307 (273.9 x 112.3 x 130.2)
Weight, radiator model, max. wet, kg (lb.):	27033 (59598)



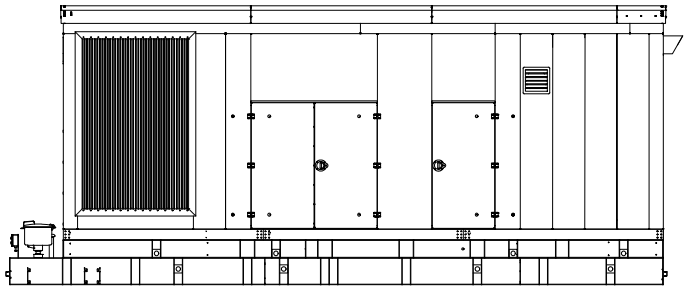
NOTE: This drawing is provided for reference only and should not be used for planning installation. Contact your local distributor for more detailed information.

KOHLER CO., Kohler, Wisconsin 53044 USA
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales and service outlet in the US and Canada, phone 1-800-544-2444
KOHLERPower.com

Sound Enclosures and Subbase Fuel Tank

Sound Level 1 Enclosure Standard Features

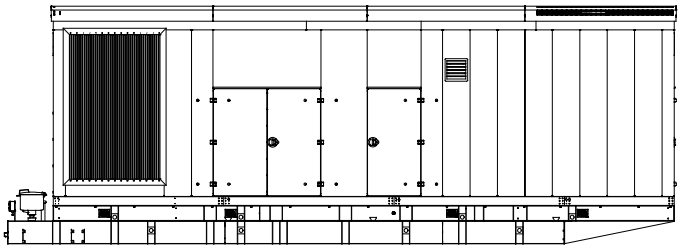
- Lift base or tank-mounted, aluminum construction enclosure with internal-mounted, exhaust silencers.
- Every enclosure has a sloped roof to reduce the buildup of moisture and debris.
- Sound attenuated enclosure that offers noise reduction using acoustic insulation, acoustic-lined air inlets and an acoustic-lined air discharge.
- Fade-, scratch-, and corrosion-resistant Kohler® Power Armor™ automotive-grade textured finish.
- Acoustic insulation that meets UL 94 HF1 flammability classification.
- Enclosure has large access doors that are hinged and removable which allow for easy maintenance.
- Lockable, flush-mounted door latches.
- Air inlet louvers reduce rain and snow entry.
- High wind bracing, 241 kph (150 mph).



Sound Level 1 Enclosure
(Shown with available spill containment)

Sound Level 2 Enclosure Standard Features

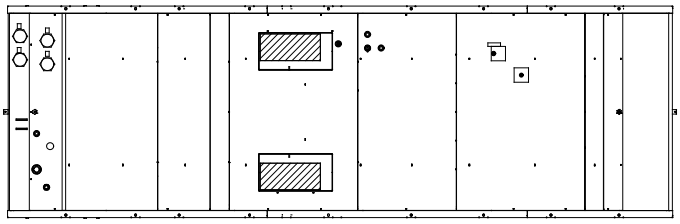
- Includes all of the sound level 1 enclosure features with the addition of up to 51 mm (2 in.) acoustic insulation material, intake sound baffles, vertical air discharge, and secondary silencers.
- Louvered air inlet and vertical outlet hood with 90 degree angles to redirect air and reduce noise.



Sound Level 2 Enclosure
(Shown with available spill containment)

Subbase Fuel Tank Features

- The fuel tank has a Power Armor Plus™ textured epoxy-based rubberized coating.
- The above-ground rectangular secondary containment tank mounts directly to the generator set, below the generator set skid (subbase).
- Both the inner and outer tanks have UL-listed emergency relief vents.
- Flexible fuel lines are provided with subbase fuel tank selection.
- The containment tank's construction protects against fuel leaks or ruptures. The inner (primary) tank is sealed inside the outer (secondary) tank. The outer tank contains the fuel if the inner tank leaks or ruptures.
- The above ground secondary containment subbase fuel tank meets UL 142 requirements.
- Features include:
  - Additional fittings for optional accessories (qty. 3)
  - Electrical stub-up area open to bottom
  - Emergency inner and outer tank relief vents
  - Fuel fill with lockable cap and 51 mm (2 in.) riser
  - Fuel leak detection switch
  - Fuel level mechanical gauge
  - Fuel level sender
  - Normal vent
  - Removable engine supply and return diptubes



Subbase Fuel Tank (Top View)

DISTRIBUTED BY:

KOHLER®

KD2500

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	10% ESP
Power [kW]	2700	2025	1350	675	270
Speed [rpm]	1800	1800	1800	1800	1800
Exhaust Gas Flow [kg/h]	15085	15390	10714	6183	4140
Exhaust Gas Temperature [C]	456	464	447	464	404
NO_X [g/kWh]	9.5	4.5	4.9	5.0	6.6
CO [g/kWh]	0.3	1.2	0.7	2.6	4.1
HC [g/kWh]	0.12	0.10	0.18	0.29	0.70
PM [g/kWh]	0.06	0.16	0.12	0.34	0.38

NOT TO EXCEED EMISSION DATA

Cycle point	100% ESP	75% ESP	50% ESP	25% ESP	10% ESP
NO_X [g/kWh]	11.2	5.3	5.7	5.9	7.8
CO [g/kWh]	1.0	3.5	1.9	7.4	8.3
HC [g/kWh]	0.14	0.12	0.21	0.34	0.84
PM [g/kWh]	0.10	0.20	0.15	0.40	0.45

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.

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]

October 14, 2019

Performance Number: DM8168 **Change Level: 04**

SALES MODEL:	C9	**COMBUSTION:**	DIRECT INJECTION
BRAND:	CAT	**ENGINE SPEED (RPM):**	1,800
ENGINE POWER (BHP):	480	**HERTZ:**	60
GEN POWER W/O FAN (EKW):	319.0	**FAN POWER (HP):**	36.5
GEN POWER WITH FAN (EKW):	300.0	**ASPIRATION:**	TA
COMPRESSION RATIO:	16.1	**AFTERCOOLER TYPE:**	ATAAC
RATING LEVEL:	STANDBY	**AFTERCOOLER CIRCUIT TYPE:**	JW+OC, ATAAC
PUMP QUANTITY:	1	**INLET MANIFOLD AIR TEMP (F):**	120
FUEL TYPE:	DIESEL	**JACKET WATER TEMP (F):**	192.2
MANIFOLD TYPE:	DRY	**TURBO CONFIGURATION:**	SINGLE
GOVERNOR TYPE:	ELEC	**TURBO QUANTITY:**	1
CAMSHAFT TYPE:	STANDARD	**TURBOCHARGER MODEL:**	S310-1.25
IGNITION TYPE:	CI	**CERTIFICATION YEAR:**	2005
INJECTOR TYPE:	EUI	**PISTON SPD @ RATED ENG SPD (FT/MIN):**	1,759.8
REF EXH STACK DIAMETER (IN):	4		
MAX OPERATING ALTITUDE (FT):	3,281		

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

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

PERFORMANCE DATA[DM8168]

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
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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		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

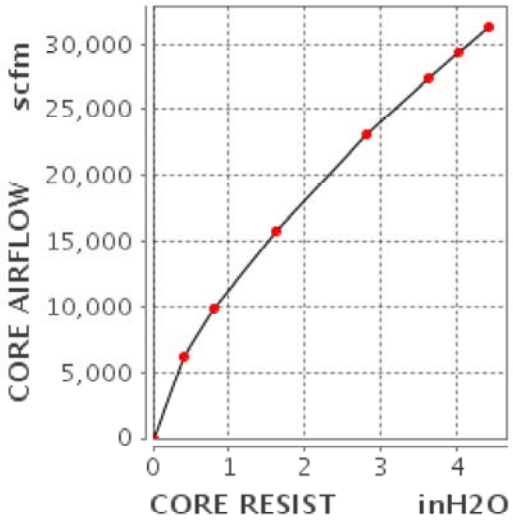
Radiator Data	Engine Data	Combination Data
Radiator Part Number: 4490660	**Performance Number:** DM8168	**Pully Ratio:** 0.76
Radiator Type: AS13.3CTS	**Sales Model:** C9	**Fan Power:** 22.79734 hp
Front Area: 13.24 ft2	**EKW:** 300	
Radiator Dry Weight: 269.0 lbs	**Rating:** STANDBY	
Radiator Wet Weight: NA lbs	**Speed:** 1800	
Radiator Water Capacity High Temp Circuit: 6.0 gal	**Settings:** NA	
Radiator Water Capacity Low Temp Circuit: NA gal	**IM ATAAC Temp Deg F:** 120	

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)

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

No notes found...

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

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

Version:
41764 /40476 /41800 /10592

Generator Mechanical Information

Center of Gravity

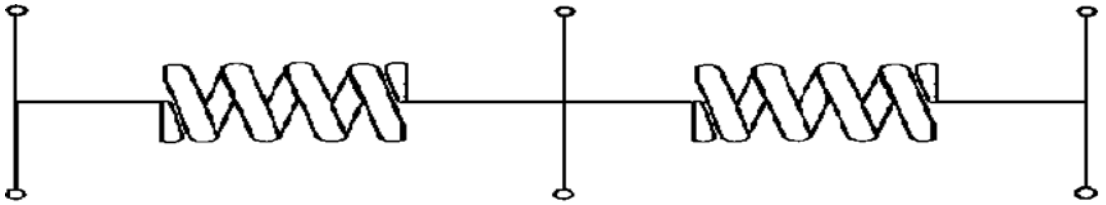
Dimension X	-431.0 mm	-17.0 IN.
Dimension Y	0.0 mm	0.0 IN.
Dimension Z	0.0 mm	0.0 IN.

- "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** | **J3 = Exciter End**

TOTAL J = J1 + J2 + J3

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

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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

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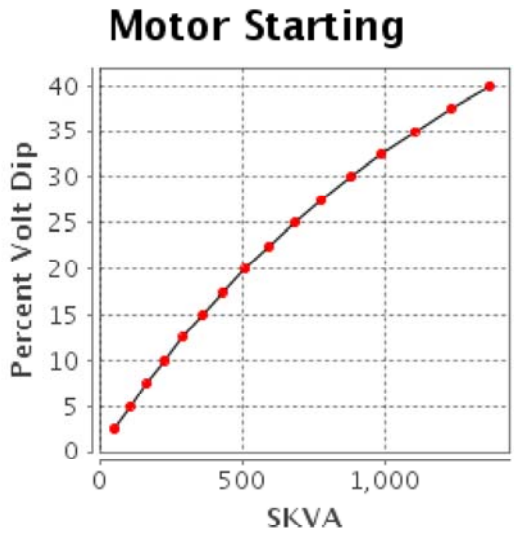
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 41764 /40476 /41800 /10592

Starting Capability & Current Decrement

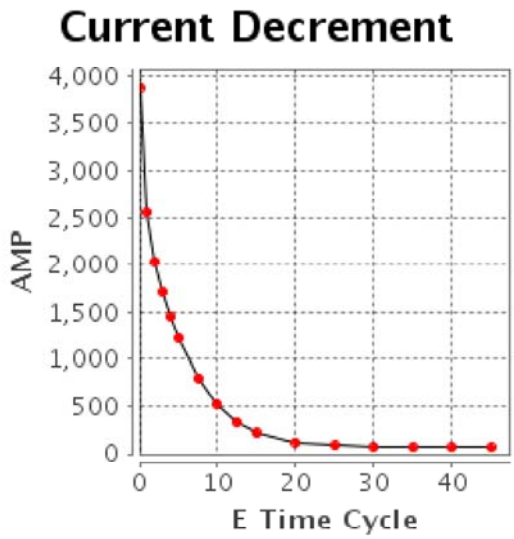
Motor Starting Capability (0.6 pf)

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

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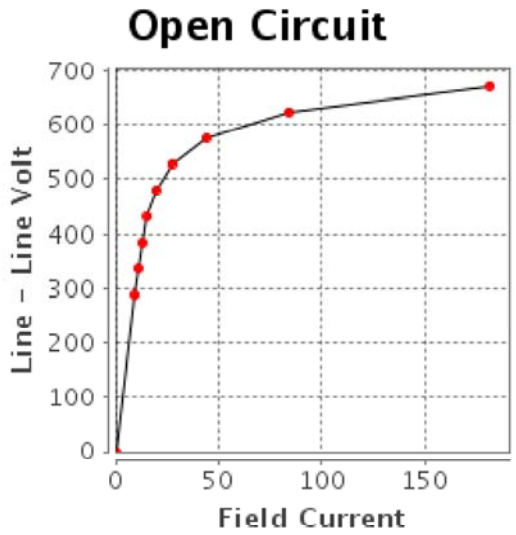
Fuel: Diesel	**Generator Arrangement:** 4183863	**Genset Rating (kVA):** 375.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Self Excited	**Pwr. Factor:** 0.8	**Rated Current:** 451.1
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version:
41764 /40476 /41800 /10592

Generator Output Characteristic Curves

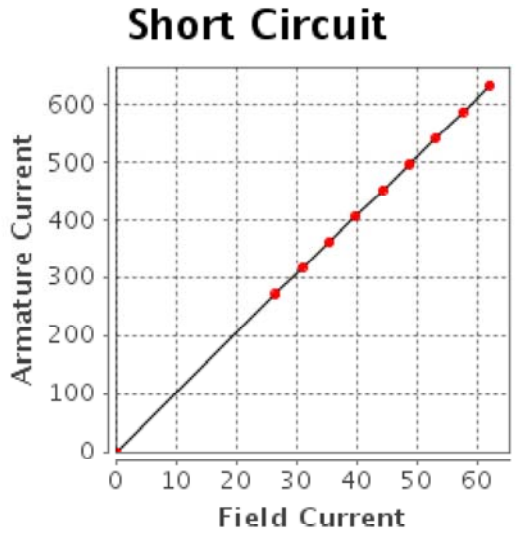
Open Circuit Curve

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



Top...

Selected Model

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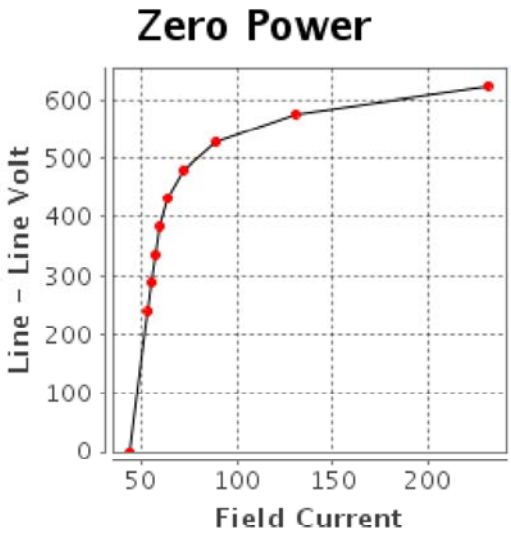
Fuel: Diesel	**Generator Arrangement:** 4183863	**Genset Rating (kVA):** 375.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Self Excited	**Pwr. Factor:** 0.8	**Rated Current:** 451.1
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version:
41764 /40476 /41800 /10592

Generator Output Characteristic Curves

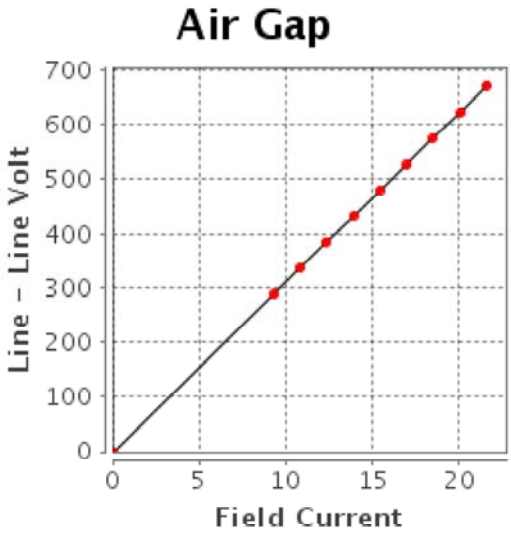
Zero Power Factor Curve

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

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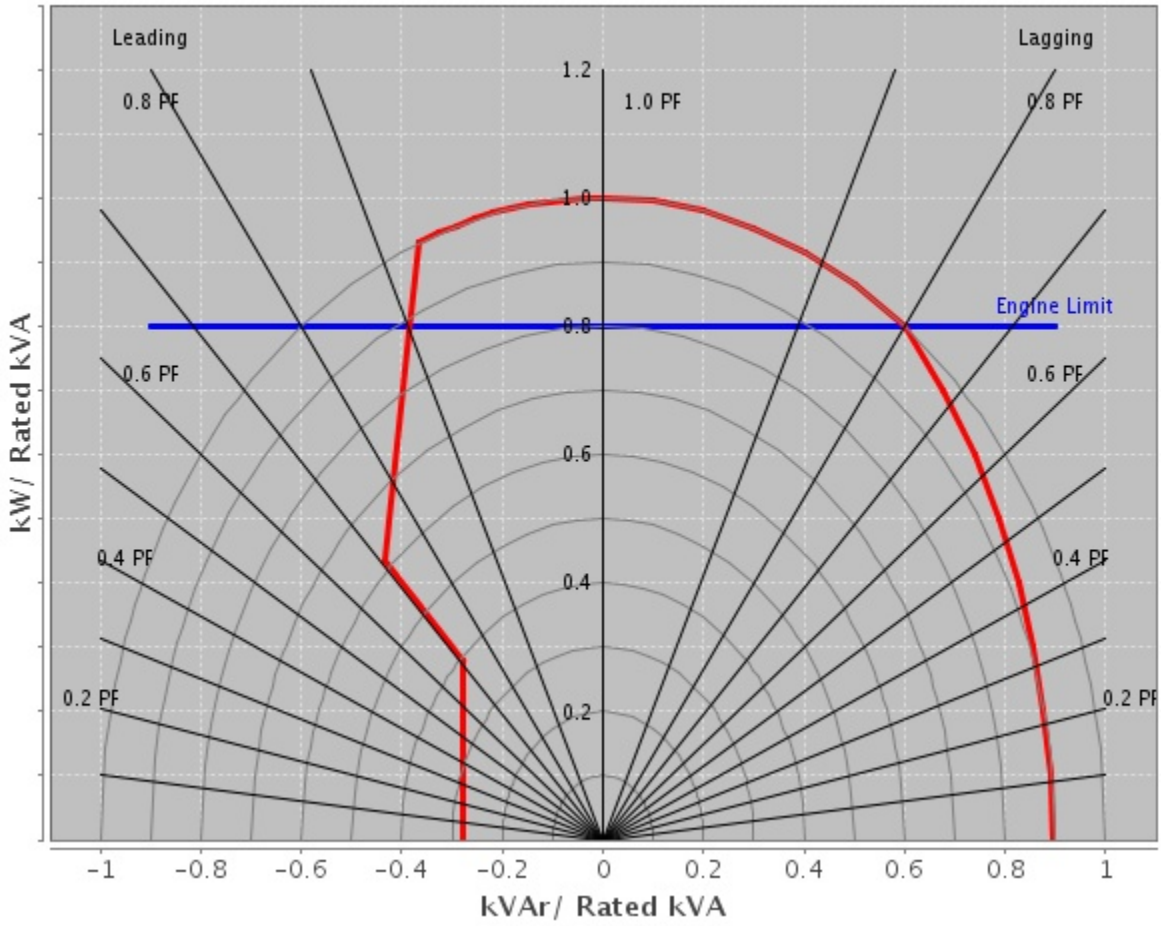
Fuel: Diesel	**Generator Arrangement:** 4183863	**Genset Rating (kVA):** 375.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Self Excited	**Pwr. Factor:** 0.8	**Rated Current:** 451.1
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version:
41764 /40476 /41800 /10592

Reactive Capability Curve

Operating Chart



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Selected Model

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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)

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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.

Current Date: 10/14/2019 9:39:16 AM

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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

PTC® Creo® Parametric

REL NO	LTR	NO	REVISION	DRN	CKD	APVD	DATE
ECO-145369	A	1	PRODUCTION_RELEASE	AM	KK	K_KISHORE	05AUG14

TABULATION											
TANK/LIFT BASE FEATURE CODE	TANK CAPACITY	TANK WEIGHT DRY KG (LBS)	DIM_D	DIM_E	DIM_F	DIM_G DFEJ, DFEK	DIM_G DQHAB	DIM_G DQDAA, DQDAB, DQDAC	DIM_H	DIM_J	DIM_K	DIM_L
C242	270	939 (2071)	2643 (104)	183 (7.2)	305 (12)	1625.6 (64.0)	1447.6 (57.0)	1371.8 (54.0)	526 (20.7)	1126 (44.3)	1122 (44.2)	614.7 (24.2)
C201	300	954 (2103)	2643 (104)	183 (7.2)	305 (12)	1625.6 (64.0)	1447.6 (57.0)	1371.8 (54.0)	526 (20.7)	1126 (44.3)	1122 (44.2)	614.7 (24.2)
C202	400	1019 (2246)	2694 (106)	234 (9.2)	356 (14)	1676.6 (66.0)	1498.6 (59.0)	1422.8 (56.0)	577 (22.7)	1177 (46.3)	1173 (46.2)	665 (26.2)
C203	500	1097 (2419)	2749.6 (108.2)	291 (11.5)	413 (16.2)	1733.2 (68.2)	1555.2 (61.2)	1479.4 (58.2)	633.6 (24.9)	1234.6 (48.5)	1230.6 (48.4)	722.9 (28.4)
C204	600	1161 (2559)	2819 (111)	361 (14.2)	483 (19)	1803.6 (71.0)	1625.6 (64.0)	1549.8 (61.0)	704 (27.7)	1304 (51.3)	1300 (51.2)	792.5 (31.2)
C205	660	1198 (2641)	2864.3 (112.7)	405 (15.9)	527 (20.7)	1847.9 (72.7)	1669.9 (65.7)	1594.1 (62.7)	748.3 (29.4)	1349.3 (53.0)	1345.3 (52.9)	836.9 (32.9)
C206	720	1243 (2741)	2908.2 (114.5)	450 (17.7)	572 (22.5)	NA	NA	1639 (64.2)	793.2 (31.2)	1394.2 (54.8)	1390.2 (54.7)	881.9 (34.7)
C207	850	1332 (2936)	2997 (118)	538 (21.2)	660 (26)	1980.6 (78.0)	1802.6 (71.0)	NA	881 (34.7)	1481 (58.3)	1478 (58.2)	970.3 (38.2)
F214	NA	NA	2540 (100)	81 (3.2)	203 (8)	1523.6 (60.0)	1345.6 (53.0)	1371.8 (50.0)	424 (16.7)	1024 (40.3)	1021 (40.2)	513.1 (20.2)

NOTES:

1. DIMENSIONS SHOWN IN [ ] ARE INCHES.
2. FOUNDATION REFERENCE POINT (⌐◇¬). SEE FOUNDATION DRAWING FOR DETAILS.
3. FOR FEATURE CODE L116 (FLORIDA TANKS) AND L120 (MICHIGAN TANKS) ADD 162MM [6.4"] TO DIMS D-L
4. SEE SHEET 2 FOR TANK VENT LOCATIONS.
5. EXCESSIVE TWISTING OF THE FUEL TANK, WHEN FASTENING IT TO A FOUNDATION, MAY RESULT IN STRUCTURAL FAILURE OF THE TANK. TO INSURE THE INSTALLATION DOES NOT EXCESSIVELY TWIST THE FUEL TANK, THE FOLLOWING PROCEDURE MUST BE OBSERVED:
   - 5.1 REFER TO CUMMINS APPLICATION MANUAL T030 FOR GENERAL GENSET/TANK MOUNTING GUIDELINES.
   - 5.2 TIGHTEN TANK HOLD DOWN MOUNTING FASTENERS.

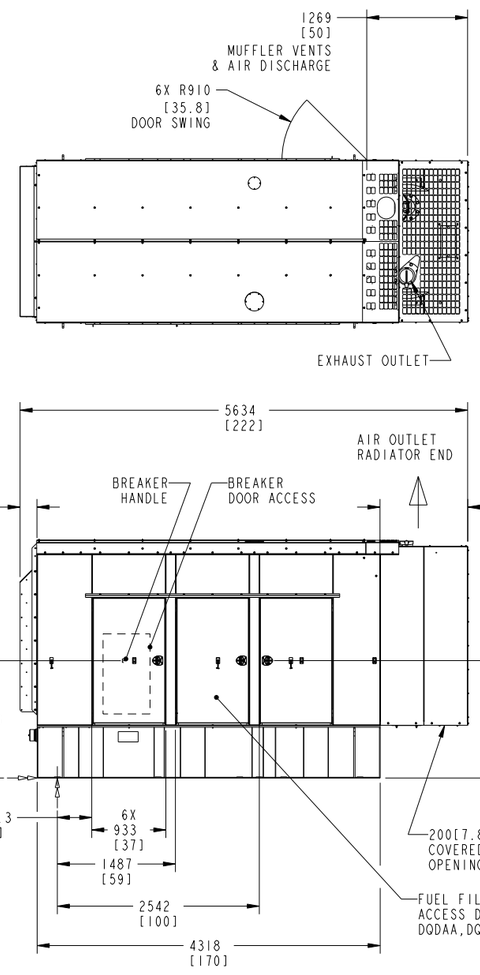
⚠6 ALL DIMENSIONS NOT SHOWN ARE IDENTICAL TO THOSE SHOWN ON SHEET 1.

⚠7 THE ENCLOSURE IS ENGINEERED TO MAINTAIN IT'S INTEGRITY WITH A 150 MPH WIND LOAD CONDITION.

OPTIONAL FEATURE
F202,F205

TABULATION						
MODEL	KW	CG_DIM "A"	CG_DIM "B"	CG_DIM "C"	STEEL ENCLOSURE WEIGHT KG (LBS)	ALUMINUM ENCLOSURE WEIGHT KG (LBS)
DFEJ	450	1956 [77.0]	1041 [41]	737 [29.0]	8026 (17696)	7536 (16606)
DFEK	500	1933 [76.1]			8162 (17996)	7672 (16906)
DQDAA	250	1927 [75.9]		723 [28.5]	5957 (13088)	5467 (11998)
DQDAB	275					
DQDAC	300	1945 [76.6]		724 [28.5]	6057 (13388)	5567 (12298)
DQHAB	300	2085 [82.1]		871 [34.3]	6384 (14076)	5894 (12986)

***WEIGHT & CG'S ARE SHOWN WITH HIGHEST GALLON FUEL TANK, ENCLOSURE, AND STANDARD WET GENSET. ADDITION OF OTHER FEATURES MAY CHANGE THE WEIGHT.



UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS	SIM TO A034J589	DRN A_MARBHAL	CUMMINS POWER GENERATION
DIM: X ±1, .X ±0.8, .XX± 0.38 — HOLE: 0.00-4.99 +0.15/-0.08; 5.00-9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13	DO NOT SCALE PRINT	CKD K_KISHORE	OUTLINE,ENCLOSURE (LEVEL 2)
ANG TOL: ± 1.0° — SCALE: 1/32	- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP	APVD K_KISHORE	SITE CODE PGF
		DATE 05AUG14	SIZE D — A050L370 — SHEET 1 OF 4 — REV A
		FIRST USED ON DFEJ,K	FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994

Drawing Name: A050L371 Revision: A
Part Name: A050L370 Revision: A
Sheet 1 of 5

3. ENGINE SPECIFICATIONS – AS-BUILT

PERFORMANCE DATA[DM9168]

October 4, 2016

Performance Number: DM9168 **Change Level: 02**

SALES MODEL:	3516C	**COMBUSTION:**	DI
BRAND:	CAT	**ENGINE SPEED (RPM):**	1,800
ENGINE POWER (BHP):	2,937	**HERTZ:**	60
GEN POWER WITH FAN (EKW):	2,000.0	**FAN POWER (HP):**	114.0
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):**	210.2
GOVERNOR TYPE:	ADEM3	**TURBO CONFIGURATION:**	PARALLEL
ELECTRONICS TYPE:	ADEM3	**TURBO QUANTITY:**	4
CAMSHAFT TYPE:	STANDARD	**TURBOCHARGER MODEL:**	GTA5518BN-56T-1.12
IGNITION TYPE:	CI	**CERTIFICATION YEAR:**	2010
INJECTOR TYPE:	EUI	**CRANKCASE BLOWBY RATE (FT3/HR):**	2,937.9
FUEL INJECTOR:	3920220	**FUEL RATE (RATED RPM) NO LOAD (GAL/HR):**	13.7
UNIT INJECTOR TIMING (IN):	64.34	**PISTON SPD @ RATED ENG SPD (FT/MIN):**	2,244.1
REF EXH STACK DIAMETER (IN):	12		
MAX OPERATING ALTITUDE (FT):	3,117		

	INDUSTRY	SUBINDUSTRY	APPLICATION
	OIL AND GAS	LAND PRODUCTION	PACKAGED GENSET
	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
2,000.0	100	2,937	307	0.329	138.0	78.3	121.2	1,118.5	71.5	752.1
1,800.0	90	2,641	276	0.331	124.9	73.1	119.6	1,067.5	65.7	716.0
1,600.0	80	2,353	246	0.337	113.1	68.0	118.2	1,027.0	60.0	693.3
1,500.0	75	2,212	231	0.340	107.5	65.2	117.5	1,008.1	57.2	684.6
1,400.0	70	2,071	216	0.344	101.8	62.3	116.8	989.4	54.4	676.9
1,200.0	60	1,795	188	0.352	90.1	55.5	115.4	952.0	48.0	662.8
1,000.0	50	1,521	159	0.357	77.5	46.5	113.7	913.4	40.1	654.0
800.0	40	1,250	131	0.357	63.8	34.8	111.8	863.8	30.3	655.0
600.0	30	977	102	0.365	50.9	24.2	110.6	803.8	22.0	650.0
500.0	25	839	88	0.374	44.8	19.7	110.2	767.0	18.7	641.7
400.0	20	699	73	0.388	38.8	15.7	109.8	724.6	15.7	629.0
200.0	10	411	43	0.450	26.4	9.0	109.1	596.9	10.9	552.8

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
2,000.0	100	2,937	83	454.3	6,548.9	15,292.8	28,512.8	29,478.4	6,205.0	5,738.7
1,800.0	90	2,641	77	428.8	6,318.7	14,243.0	27,390.5	28,264.7	5,956.5	5,533.7
1,600.0	80	2,353	72	404.5	6,073.3	13,331.0	26,220.6	27,012.9	5,685.0	5,301.6
1,500.0	75	2,212	69	392.7	5,932.2	12,897.9	25,568.0	26,319.7	5,542.0	5,176.6
1,400.0	70	2,071	66	380.9	5,777.2	12,448.0	24,862.1	25,573.8	5,384.8	5,037.5
1,200.0	60	1,795	59	353.9	5,397.2	11,422.5	23,141.0	23,771.1	5,003.4	4,694.0
1,000.0	50	1,521	50	318.8	4,857.3	10,138.7	20,731.5	21,274.5	4,476.2	4,208.4
800.0	40	1,250	38	271.1	4,090.0	8,488.8	17,357.1	17,803.6	3,744.5	3,524.2
600.0	30	977	27	225.0	3,394.1	6,989.6	14,328.5	14,684.4	3,097.0	2,920.6
500.0	25	839	22	204.1	3,103.5	6,328.1	13,075.2	13,388.4	2,825.1	2,668.8
400.0	20	699	18	184.1	2,840.4	5,696.0	11,947.2	12,218.4	2,572.5	2,435.7
200.0	10	411	11	148.5	2,409.4	4,478.2	10,105.7	10,290.7	2,174.6	2,076.8

PERFORMANCE DATA[DM9168]

October 4, 2016

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
EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
2,000.0	100	2,937	43,150	7,564	101,696	49,615	15,778	38,240	124,558	296,234	315,563
1,800.0	90	2,641	40,179	7,175	92,069	43,106	14,280	34,105	111,977	268,102	285,596
1,600.0	80	2,353	37,427	6,907	84,225	38,510	12,931	30,201	99,774	242,774	258,615
1,500.0	75	2,212	36,092	6,791	80,632	36,523	12,286	28,303	93,784	230,664	245,715
1,400.0	70	2,071	34,737	6,671	77,064	34,629	11,640	26,432	87,835	218,548	232,809
1,200.0	60	1,795	31,877	6,341	69,432	30,722	10,302	22,179	76,103	193,426	206,048
1,000.0	50	1,521	28,631	6,026	60,835	26,675	8,865	17,129	64,508	166,434	177,294
800.0	40	1,250	24,910	5,810	50,784	22,387	7,288	11,280	53,005	136,837	145,766
600.0	30	977	21,252	5,496	41,420	18,139	5,820	6,677	41,431	109,268	116,397
500.0	25	839	19,405	5,303	37,082	16,055	5,124	4,986	35,574	96,210	102,488
400.0	20	699	17,492	5,098	32,738	13,986	4,431	3,593	29,634	83,193	88,622
200.0	10	411	13,286	4,670	23,481	8,473	3,022	1,516	17,448	56,745	60,447

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	2,000.0	1,500.0	1,000.0	500.0	200.0
PERCENT LOAD		%	100	75	50	25	10
ENGINE POWER		BHP	2,937	2,212	1,521	839	411
TOTAL NOX (AS NO2)		G/HR	19,256	10,318	5,811	4,222	2,933
TOTAL CO		G/HR	1,581	854	894	1,773	1,794
TOTAL HC		G/HR	422	514	512	410	442
PART MATTER		G/HR	105.4	99.5	122.5	256.7	203.2
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	3,305.2	2,333.8	1,849.4	2,378.8	2,855.1
TOTAL CO	(CORR 5% O2)	MG/NM3	258.0	181.8	272.6	895.6	1,714.4
TOTAL HC	(CORR 5% O2)	MG/NM3	59.5	93.5	131.7	194.1	379.0
PART MATTER	(CORR 5% O2)	MG/NM3	14.6	18.4	34.4	119.9	161.2
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,610	1,137	901	1,159	1,391
TOTAL CO	(CORR 5% O2)	PPM	206	145	218	716	1,371
TOTAL HC	(CORR 5% O2)	PPM	111	175	246	362	708
TOTAL NOX (AS NO2)		G/HP-HR	6.56	4.67	3.82	5.03	7.13
TOTAL CO		G/HP-HR	0.54	0.39	0.59	2.11	4.36
TOTAL HC		G/HP-HR	0.14	0.23	0.34	0.49	1.08
PART MATTER		G/HP-HR	0.04	0.04	0.08	0.31	0.49
TOTAL NOX (AS NO2)		LB/HR	42.45	22.75	12.81	9.31	6.47
TOTAL CO		LB/HR	3.48	1.88	1.97	3.91	3.95
TOTAL HC		LB/HR	0.93	1.13	1.13	0.90	0.98
PART MATTER		LB/HR	0.23	0.22	0.27	0.57	0.45

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN		EKW	2,000.0	1,500.0	1,000.0	500.0	200.0
PERCENT LOAD		%	100	75	50	25	10
ENGINE POWER		BHP	2,937	2,212	1,521	839	411
TOTAL NOX (AS NO2)		G/HR	16,047	8,598	4,842	3,518	2,444
TOTAL CO		G/HR	878	474	497	985	996
TOTAL HC		G/HR	317	386	385	308	333
TOTAL CO2		KG/HR	1,393	1,073	765	430	250
PART MATTER		G/HR	75.3	71.0	87.5	183.4	145.2
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,754.3	1,944.8	1,541.2	1,982.3	2,379.2
TOTAL CO	(CORR 5% O2)	MG/NM3	143.3	101.0	151.4	497.5	952.4
TOTAL HC	(CORR 5% O2)	MG/NM3	44.7	70.3	99.0	145.9	285.0

PERFORMANCE DATA[DM9168]

October 4, 2016

PART MATTER	(CORR 5% O2)	MG/NM3	10.4	13.1	24.6	85.6	115.2
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,342	947	751	966	1,159
TOTAL CO	(CORR 5% O2)	PPM	115	81	121	398	762
TOTAL HC	(CORR 5% O2)	PPM	83	131	185	272	532
TOTAL NOX (AS NO2)		G/HP-HR	5.46	3.89	3.18	4.19	5.94
TOTAL CO		G/HP-HR	0.30	0.21	0.33	1.17	2.42
TOTAL HC		G/HP-HR	0.11	0.17	0.25	0.37	0.81
PART MATTER		G/HP-HR	0.03	0.03	0.06	0.22	0.35
TOTAL NOX (AS NO2)		LB/HR	35.38	18.96	10.68	7.76	5.39
TOTAL CO		LB/HR	1.94	1.05	1.09	2.17	2.20
TOTAL HC		LB/HR	0.70	0.85	0.85	0.68	0.73
TOTAL CO2		LB/HR	3,070	2,365	1,687	949	552
PART MATTER		LB/HR	0.17	0.16	0.19	0.40	0.32
OXYGEN IN EXH		%	10.8	12.3	13.3	14.2	15.8
DRY SMOKE OPACITY		%	0.3	0.5	1.2	3.7	3.0
BOSCH SMOKE NUMBER			0.15	0.21	0.42	1.25	1.12

PERFORMANCE DATA[DM9168]

October 4, 2016

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	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,849	2,731	2,937
1,000	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,931	2,820	2,702	2,937
2,000	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,927	2,876	2,826	2,761	2,614	2,937
3,000	2,937	2,937	2,937	2,937	2,937	2,926	2,873	2,822	2,772	2,724	2,673	2,526	2,937
4,000	2,849	2,849	2,849	2,849	2,849	2,820	2,768	2,719	2,671	2,625	2,581	2,438	2,849
5,000	2,752	2,752	2,752	2,752	2,752	2,716	2,667	2,619	2,573	2,529	2,486	2,350	2,752
6,000	2,659	2,659	2,659	2,659	2,659	2,616	2,569	2,523	2,478	2,436	2,379	2,261	2,659
7,000	2,570	2,570	2,570	2,570	2,567	2,519	2,473	2,429	2,386	2,345	2,261	2,144	2,570
8,000	2,484	2,484	2,484	2,484	2,471	2,425	2,381	2,338	2,297	2,257	2,144	2,027	2,484
9,000	2,401	2,401	2,401	2,401	2,377	2,333	2,291	2,250	2,211	2,144	2,027	1,909	2,401
10,000	2,321	2,321	2,321	2,321	2,287	2,245	2,204	2,165	2,127	2,027	1,909	1,792	2,321
11,000	2,244	2,244	2,244	2,242	2,200	2,159	2,120	2,082	2,027	1,909	1,792	1,703	2,244
12,000	2,171	2,171	2,171	2,156	2,115	2,076	2,038	1,997	1,880	1,792	1,674	1,586	2,171
13,000	2,100	2,100	2,100	2,072	2,033	1,995	1,959	1,850	1,762	1,674	1,586	1,498	2,100
14,000	2,027	2,027	2,027	1,991	1,954	1,917	1,821	1,733	1,645	1,557	1,439	1,351	2,027
15,000	1,938	1,938	1,938	1,913	1,877	1,792	1,703	1,615	1,498	1,410	1,292	1,204	1,938

Cross Reference

Test Spec	Setting	Engine Arrangement	Engineering Model	Engineering Model Version	Start Effective Serial Number	End Effective Serial Number
3496500	LL6305	2666137	GS334	-	SBJ00001	
3704962	GG0605	3994236	GS717	-	DD600001	
3704962	GG0605	5063102	GS334	-	SBJ02000	

Supplementary Data

Type	Classification	Performance Number
SOUND	SOUND PRESSURE	DM8779

Performance Parameter Reference

Parameters Reference:DM9600-08

PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600

PERFORMANCE DATA[DM9168]

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 (84.2), 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.

EMISSIONS DEFINITIONS:
Emissions : DM1176

PERFORMANCE DATA[DM9168]

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 : 7/7/15

PERFORMANCE DATA[DM9168]

April 23, 2014

Performance Number: DM9168 **Change Level: 01**

SALES MODEL:	3516C	**COMBUSTION:**	DI
ENGINE POWER (BHP):	2,937	**ENGINE SPEED (RPM):**	1,800
GEN POWER WITH FAN (EKW):	2,000.0	**HERTZ:**	60
COMPRESSION RATIO:	14.7	**FAN POWER (HP):**	114.0
APPLICATION:	PACKAGED GENSET	**ASPIRATION:**	TA
RATING LEVEL:	MISSION CRITICAL STANDBY	**AFTERCOOLER TYPE:**	ATAAC
SUB APPLICATION:	STANDARD	**AFTERCOOLER CIRCUIT TYPE:**	JW+OC, ATAAC
PUMP QUANTITY:	2	**INLET MANIFOLD AIR TEMP (F):**	122
FUEL TYPE:	DIESEL	**JACKET WATER TEMP (F):**	210.2
MANIFOLD TYPE:	DRY	**TURBO CONFIGURATION:**	PARALLEL
GOVERNOR TYPE:	ADEM3	**TURBO QUANTITY:**	4
ELECTRONICS TYPE:	ADEM3	**TURBOCHARGER MODEL:**	GTA5518BN-56T-1.12
CAMSHAFT TYPE:	STANDARD	**CERTIFICATION YEAR:**	2010
IGNITION TYPE:	CI	**CRANKCASE BLOWBY RATE (FT3/HR):**	2,937.9
INJECTOR TYPE:	EUI	**FUEL RATE (RATED RPM) NO LOAD (GAL/HR):**	13.7
FUEL INJECTOR:	2664387	**PISTON SPD @ RATED ENG SPD (FT/MIN):**	2,244.1
REF EXH STACK DIAMETER (IN):	12		
MAX OPERATING ALTITUDE (FT):	3,117		

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
2,000.0	100	2,937	307	0.329	138.0	78.3	121.2	1,118.5	71.5	752.1
1,800.0	90	2,641	276	0.331	124.9	73.1	119.6	1,067.5	65.7	716.0
1,600.0	80	2,353	246	0.337	113.1	68.0	118.2	1,027.0	60.0	693.3
1,500.0	75	2,212	231	0.340	107.5	65.2	117.5	1,008.1	57.2	684.6
1,400.0	70	2,071	216	0.344	101.8	62.3	116.8	989.4	54.4	676.9
1,200.0	60	1,795	188	0.352	90.1	55.5	115.4	952.0	48.0	662.8
1,000.0	50	1,521	159	0.357	77.5	46.5	113.7	913.4	40.1	654.0
800.0	40	1,250	131	0.357	63.8	34.8	111.8	863.8	30.3	655.0
600.0	30	977	102	0.365	50.9	24.2	110.6	803.8	22.0	650.0
500.0	25	839	88	0.374	44.8	19.7	110.2	767.0	18.7	641.7
400.0	20	699	73	0.388	38.8	15.7	109.8	724.6	15.7	629.0
200.0	10	411	43	0.450	26.4	9.0	109.1	596.9	10.9	552.8

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
2,000.0	100	2,937	83	454.3	6,548.9	15,292.8	28,512.8	29,478.4	6,205.0	5,738.7
1,800.0	90	2,641	77	428.8	6,318.7	14,243.0	27,390.5	28,264.7	5,956.5	5,533.7
1,600.0	80	2,353	72	404.5	6,073.3	13,331.0	26,220.6	27,012.9	5,685.0	5,301.6
1,500.0	75	2,212	69	392.7	5,932.2	12,897.9	25,568.0	26,319.7	5,542.0	5,176.6
1,400.0	70	2,071	66	380.9	5,777.2	12,448.0	24,862.1	25,573.8	5,384.8	5,037.5
1,200.0	60	1,795	59	353.9	5,397.2	11,422.5	23,141.0	23,771.1	5,003.4	4,694.0
1,000.0	50	1,521	50	318.8	4,857.3	10,138.7	20,731.5	21,274.5	4,476.2	4,208.4
800.0	40	1,250	38	271.1	4,090.0	8,488.8	17,357.1	17,803.6	3,744.5	3,524.2
600.0	30	977	27	225.0	3,394.1	6,989.6	14,328.5	14,684.4	3,097.0	2,920.6
500.0	25	839	22	204.1	3,103.5	6,328.1	13,075.2	13,388.4	2,825.1	2,668.8
400.0	20	699	18	184.1	2,840.4	5,696.0	11,947.2	12,218.4	2,572.5	2,435.7
200.0	10	411	11	148.5	2,409.4	4,478.2	10,105.7	10,290.7	2,174.6	2,076.8

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
EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
2,000.0	100	2,937	43,150	7,564	101,696	49,615	15,778	38,240	124,558	296,234	315,563
1,800.0	90	2,641	40,179	7,175	92,069	43,106	14,280	34,105	111,977	268,102	285,596
1,600.0	80	2,353	37,427	6,907	84,225	38,510	12,931	30,201	99,774	242,774	258,615
1,500.0	75	2,212	36,092	6,791	80,632	36,523	12,286	28,303	93,784	230,664	245,715
1,400.0	70	2,071	34,737	6,671	77,064	34,629	11,640	26,432	87,835	218,548	232,809
1,200.0	60	1,795	31,877	6,341	69,432	30,722	10,302	22,179	76,103	193,426	206,048
1,000.0	50	1,521	28,631	6,026	60,835	26,675	8,865	17,129	64,508	166,434	177,294
800.0	40	1,250	24,910	5,810	50,784	22,387	7,288	11,280	53,005	136,837	145,766
600.0	30	977	21,252	5,496	41,420	18,139	5,820	6,677	41,431	109,268	116,397
500.0	25	839	19,405	5,303	37,082	16,055	5,124	4,986	35,574	96,210	102,488
400.0	20	699	17,492	5,098	32,738	13,986	4,431	3,593	29,634	83,193	88,622
200.0	10	411	13,286	4,670	23,481	8,473	3,022	1,516	17,448	56,745	60,447

Emissions Data

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN		EKW	2,000.0	1,500.0	1,000.0	500.0	200.0
PERCENT LOAD		%	100	75	50	25	10
ENGINE POWER		BHP	2,937	2,212	1,521	839	411
TOTAL NOX (AS NO2)		G/HR	19,098	10,213	5,798	4,218	2,932
TOTAL CO		G/HR	1,564	847	905	1,772	1,794
TOTAL HC		G/HR	423	513	512	409	443
PART MATTER		G/HR	103.2	99.5	123.9	256.7	203.1
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	3,299.4	2,320.1	1,852.8	2,379.4	2,855.8
TOTAL CO	(CORR 5% O2)	MG/NM3	257.0	181.1	277.5	896.4	1,715.8
TOTAL HC	(CORR 5% O2)	MG/NM3	60.1	93.7	132.1	194.2	379.5
PART MATTER	(CORR 5% O2)	MG/NM3	14.4	18.5	35.1	120.0	161.3
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,607	1,130	902	1,159	1,391
TOTAL CO	(CORR 5% O2)	PPM	206	145	222	717	1,373
TOTAL HC	(CORR 5% O2)	PPM	112	175	247	363	708
TOTAL NOX (AS NO2)		G/HP-HR	6.54	4.64	3.82	5.04	7.13
TOTAL CO		G/HP-HR	0.54	0.38	0.60	2.12	4.36
TOTAL HC		G/HP-HR	0.15	0.23	0.34	0.49	1.08
PART MATTER		G/HP-HR	0.04	0.05	0.08	0.31	0.49
TOTAL NOX (AS NO2)		LB/HR	42.10	22.52	12.78	9.30	6.46
TOTAL CO		LB/HR	3.45	1.87	2.00	3.91	3.95
TOTAL HC		LB/HR	0.93	1.13	1.13	0.90	0.98
PART MATTER		LB/HR	0.23	0.22	0.27	0.57	0.45

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN		EKW	2,000.0	1,500.0	1,000.0	500.0	200.0
PERCENT LOAD		%	100	75	50	25	10
ENGINE POWER		BHP	2,937	2,212	1,521	839	411
TOTAL NOX (AS NO2)		G/HR	15,915	8,511	4,832	3,515	2,443
TOTAL CO		G/HR	869	471	503	984	997
TOTAL HC		G/HR	318	385	385	308	333
TOTAL CO2		KG/HR	1,383	1,068	762	430	250
PART MATTER		G/HR	73.7	71.1	88.5	183.4	145.1
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,749.5	1,933.4	1,544.0	1,982.8	2,379.8
TOTAL CO	(CORR 5% O2)	MG/NM3	142.8	100.6	154.2	498.0	953.2
TOTAL HC	(CORR 5% O2)	MG/NM3	45.2	70.4	99.3	146.0	285.3
PART MATTER	(CORR 5% O2)	MG/NM3	10.3	13.2	25.1	85.7	115.2
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,339	942	752	966	1,159
TOTAL CO	(CORR 5% O2)	PPM	114	80	123	398	763
TOTAL HC	(CORR 5% O2)	PPM	84	131	185	273	533
TOTAL NOX (AS NO2)		G/HP-HR	5.45	3.87	3.19	4.20	5.94
TOTAL CO		G/HP-HR	0.30	0.21	0.33	1.18	2.42
TOTAL HC		G/HP-HR	0.11	0.18	0.25	0.37	0.81
PART MATTER		G/HP-HR	0.03	0.03	0.06	0.22	0.35
TOTAL NOX (AS NO2)		LB/HR	35.09	18.76	10.65	7.75	5.39
TOTAL CO		LB/HR	1.92	1.04	1.11	2.17	2.20
TOTAL HC		LB/HR	0.70	0.85	0.85	0.68	0.73
TOTAL CO2		LB/HR	3,049	2,356	1,681	947	551
PART MATTER		LB/HR	0.16	0.16	0.20	0.40	0.32
OXYGEN IN EXH		%	10.8	12.3	13.3	14.2	15.8
DRY SMOKE OPACITY		%	0.3	0.5	1.2	3.7	3.0
BOSCH SMOKE NUMBER			0.15	0.21	0.43	1.25	1.12

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)	50	60	70	80	90	100	110	120	130	NORMAL
ALTITUDE (FT)										
0	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937
1,000	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937
2,000	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937
3,000	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,896	2,847	2,937
4,000	2,937	2,937	2,937	2,937	2,937	2,886	2,835	2,786	2,739	2,937
5,000	2,937	2,937	2,933	2,879	2,826	2,776	2,727	2,680	2,634	2,937
6,000	2,930	2,874	2,820	2,767	2,717	2,669	2,622	2,576	2,533	2,890
7,000	2,816	2,762	2,710	2,660	2,611	2,565	2,520	2,476	2,434	2,796
8,000	2,706	2,654	2,604	2,555	2,509	2,464	2,421	2,379	2,339	2,705
9,000	2,598	2,548	2,500	2,454	2,409	2,366	2,325	2,285	2,246	2,616
10,000	2,495	2,447	2,400	2,356	2,313	2,272	2,232	2,193	2,156	2,530
11,000	2,394	2,348	2,303	2,261	2,220	2,180	2,142	2,105	2,069	2,445
12,000	2,296	2,252	2,210	2,169	2,129	2,091	2,054	2,019	1,985	2,362
13,000	2,202	2,159	2,119	2,079	2,042	2,005	1,970	1,936	1,903	2,281
14,000	2,110	2,070	2,031	1,993	1,957	1,922	1,888	1,855	1,824	2,202
15,000	2,022	1,983	1,945	1,909	1,875	1,841	1,809	1,778	1,747	2,125

Cross Reference

Engine Arrangement			
Arrangement Number	**Effective Serial Number**	**Engineering Model**	**Engineering Model Version**
2666137	SBJ00001	GS334	-
3994236	DD600001	GS717	-

Test Specification Data						
Test Spec	**Setting**	**Effective Serial Number**	**Engine Arrangement**	**Governor Type**	**Default Low Idle Speed**	**Default High Idle Speed**
3496500	LL6305	SBJ00001	2666137	ADEM3		
3704962	GG0605	DD600001	3994236	ADEM3		

Supplementary Data

Type	Classification	Performance Number
SOUND	SOUND PRESSURE	DM8779

General Notes

General Notes DM9168 - 01
SOUND PRESSURE DATA FOR THIS RATING CAN BE FOUND IN PERFORMANCE NUMBER - DM8779

Performance Parameter Reference

Parameters Reference:DM9600-05

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%
Heat rejection	+/- 5%
Heat rejection exhaust only	+/- 10%

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 reference atmospheric pressure is 100 KPA (29.61 in hg) and standard temperature is 25 (77) at 60% relative humidity.

FOR 3600 ENGINES
Engine rating obtained and presented in accordance with ISO 3046/1 and SAE J1995 JAN90 standard reference conditions of 25, 100 KPA 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.

PERFORMANCE DATA[DM9168]

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 (84.2), 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.

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.

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. Log on to the Technology and Solutions Divisions (T&SD) web page (https://pdgt.cat.com/cda/layout) for information including federal regulation applicability and time lines for implementation. Information for labeling and tagging requirements is also provided.

NOTES:
Regulation watch covers regulations in effect and future regulation changes for world, federal, state and local. This page includes items on the watch list where a regulation change or product change might be pending and may need attention of the engine product group. For additional emissions information log on to the TMI web page.

Additional product information for specific market application is available.
Customer's may have special emission site requirements that need to be verified by the Caterpillar Product Group engineer.

HEAT REJECTION DEFINITIONS:
Diesel Circuit Type and HHV Balance : DM9500

EMISSIONS DEFINITIONS:
Emissions : DM1176

PERFORMANCE DATA[DM9168]

SOUND DEFINITIONS:
Sound Power : DM8702

Sound Pressure : TM7080

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

Date Released : 11/23/11

1,500 kWe Caterpillar

PERFORMANCE DATA[DM8260]

February 11, 2011

Performance Number: DM8260 **Change Level: 02**

SALES MODEL:	3512C	COMBUSTION:	DI
ENGINE POWER (BHP):	2,206	ENGINE SPEED (RPM):	1,800
GEN POWER WITH FAN (EKW):	1,500.0	HERTZ:	60
COMPRESSION RATIO:	14.7	FAN POWER (HP):	88.5
APPLICATION:	PACKAGED GENSET	ASPIRATION:	TA
RATING LEVEL:	STANDBY	AFTERCOOLER TYPE:	ATAAC
PUMP QUANTITY:	2	AFTERCOOLER CIRCUIT TYPE:	JW+OC, ATAAC
FUEL TYPE:	DIESEL	INLET MANIFOLD AIR TEMP (F):	122
MANIFOLD TYPE:	DRY	JACKET WATER TEMP (F):	210.2
GOVERNOR TYPE:	ADEM3	TURBO CONFIGURATION:	PARALLEL
ELECTRONICS TYPE:	ADEM3	TURBO QUANTITY:	4
CAMSHAFT TYPE:	STANDARD	TURBOCHARGER MODEL:	GTB4708BN-52T-0.96
IGNITION TYPE:	CI	CERTIFICATION YEAR:	2006
INJECTOR TYPE:	EUI	CRANKCASE BLOWBY RATE (FT3/HR):	2,203.4
FUEL INJECTOR:	2664387	FUEL RATE (RATED RPM) NO LOAD (GAL/HR):	9.9
REF EXH STACK DIAMETER (IN):	10	PISTON SPD @ RATED ENG SPD (FT/MIN):	2,244.1
MAX OPERATING ALTITUDE (FT):	3,937		

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
1,500.0	100	2,206	307	0.332	104.6	77.5	120.9	1,145.6	74.6	759.0
1,350.0	90	1,983	276	0.336	95.2	72.2	116.1	1,102.7	68.8	726.8
1,200.0	80	1,768	246	0.343	86.6	66.9	113.2	1,069.1	63.1	708.7
1,125.0	75	1,662	232	0.346	82.0	63.4	111.5	1,052.3	59.5	700.6
1,050.0	70	1,556	217	0.348	77.4	59.7	109.8	1,035.3	55.8	693.6
900.0	60	1,349	188	0.352	67.9	51.1	107.1	1,000.5	47.6	682.5
750.0	50	1,144	159	0.355	58.1	40.6	107.5	963.7	38.4	686.4
600.0	40	940	131	0.359	48.2	30.0	108.4	921.9	29.4	686.0
450.0	30	736	103	0.368	38.6	20.9	107.1	856.1	21.9	667.6
375.0	25	632	88	0.376	33.9	16.9	106.2	809.6	18.8	648.1
300.0	20	527	73	0.388	29.2	13.3	105.2	754.6	16.0	621.1
150.0	10	312	43	0.443	19.7	7.3	103.2	609.7	11.4	526.2

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	4,570.7	10,909.2	20,179.4	20,912.0	4,401.2	3,984.7
1,350.0	90	1,983	77	428.8	4,387.3	10,167.0	19,354.1	20,020.6	4,213.1	3,825.4
1,200.0	80	1,768	71	409.0	4,190.2	9,533.7	18,456.0	19,062.3	4,012.0	3,655.5
1,125.0	75	1,662	68	396.6	4,062.8	9,156.1	17,861.1	18,435.5	3,879.9	3,539.6
1,050.0	70	1,556	64	382.7	3,917.6	8,750.8	17,185.6	17,727.5	3,730.8	3,407.5
900.0	60	1,349	55	350.3	3,576.3	7,863.4	15,607.1	16,082.3	3,384.9	3,097.2
750.0	50	1,144	44	309.9	3,132.5	6,856.9	13,608.7	14,015.1	2,941.7	2,693.8
600.0	40	940	33	266.6	2,669.6	5,821.5	11,547.1	11,884.6	2,498.4	2,290.8
450.0	30	736	23	224.6	2,255.4	4,830.1	9,719.1	9,989.4	2,106.6	1,937.5
375.0	25	632	19	204.3	2,072.0	4,354.9	8,915.9	9,153.2	1,932.9	1,782.3
300.0	20	527	15	184.3	1,901.9	3,888.6	8,175.8	8,380.0	1,769.0	1,636.5
150.0	10	312	9	148.8	1,629.0	3,012.8	6,991.2	7,129.2	1,502.5	1,404.3

1500 KWe

PERFORMANCE DATA[DM8260]

February 11, 2011

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
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	35,045	7,072	75,190	35,916	11,958	27,337	93,547	224,502	239,151
1,350.0	90	1,983	32,811	6,707	68,272	31,548	10,884	24,908	84,110	204,338	217,671
1,200.0	80	1,768	30,708	6,394	62,804	28,510	9,899	22,371	74,958	185,849	197,976
1,125.0	75	1,662	29,571	6,250	59,771	26,919	9,378	20,805	70,466	176,063	187,551
1,050.0	70	1,556	28,384	6,110	56,659	25,337	8,847	19,142	66,004	166,092	176,930
900.0	60	1,349	25,881	5,841	50,233	22,204	7,761	15,544	57,205	145,705	155,213
750.0	50	1,144	23,184	5,565	43,580	19,571	6,637	11,412	48,509	124,605	132,736
600.0	40	940	20,363	5,287	36,864	16,564	5,513	7,503	39,882	103,503	110,257
450.0	30	736	17,435	4,840	29,997	13,124	4,417	4,600	31,201	82,927	88,339
375.0	25	632	15,907	4,570	26,510	11,255	3,877	3,492	26,809	72,781	77,530
300.0	20	527	14,318	4,299	22,979	9,339	3,336	2,570	22,353	62,636	66,723
150.0	10	312	10,869	3,818	15,812	5,101	2,253	1,253	13,214	42,305	45,066

1500 Kwe

PERFORMANCE DATA[DM8260]

February 11, 2011

Emissions Data

RATED SPEED NOT TO EXCEED DATA: 1800 RPM

GENSET POWER WITH FAN		**EKW**	**1,500.0**	**1,125.0**	**750.0**	**375.0**	**150.0**
ENGINE POWER		**BHP**	**2,206**	**1,662**	**1,144**	**632**	**312**
PERCENT LOAD		**%**	**100**	**75**	**50**	**25**	**10**
TOTAL NOX (AS NO2)		G/HR	13,311	6,733	4,486	3,351	2,583
TOTAL CO		G/HR	1,745	1,092	1,544	1,806	1,733
TOTAL HC		G/HR	326	354	333	263	302
PART MATTER		G/HR	90.5	92.4	140.5	169.6	102.7
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,631.0	1,672.1	1,552.2	2,038.1	2,711.4
TOTAL CO	(CORR 5% O2)	MG/NM3	394.6	312.6	662.4	1,129.4	2,176.8
TOTAL HC	(CORR 5% O2)	MG/NM3	63.8	89.0	114.9	162.2	330.4
PART MATTER	(CORR 5% O2)	MG/NM3	16.8	22.3	50.7	100.7	105.3
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,282	814	756	993	1,321
TOTAL CO	(CORR 5% O2)	PPM	316	250	530	903	1,741
TOTAL HC	(CORR 5% O2)	PPM	119	166	215	303	617
TOTAL NOX (AS NO2)		G/HP-HR	6.09	4.09	3.95	5.33	8.34
TOTAL CO		G/HP-HR	0.80	0.66	1.36	2.88	5.59
TOTAL HC		G/HP-HR	0.15	0.22	0.29	0.42	0.97
PART MATTER		G/HP-HR	0.04	0.06	0.12	0.27	0.33
TOTAL NOX (AS NO2)		LB/HR	29.35	14.84	9.89	7.39	5.70
TOTAL CO		LB/HR	3.85	2.41	3.40	3.98	3.82
TOTAL HC		LB/HR	0.72	0.78	0.73	0.58	0.66
PART MATTER		LB/HR	0.20	0.20	0.31	0.37	0.23

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN		**EKW**	**1,500.0**	**1,125.0**	**750.0**	**375.0**	**150.0**
ENGINE POWER		**BHP**	**2,206**	**1,662**	**1,144**	**632**	**312**
PERCENT LOAD		**%**	**100**	**75**	**50**	**25**	**10**
TOTAL NOX (AS NO2)		G/HR	11,092	5,610	3,738	2,793	2,153
TOTAL CO		G/HR	969	607	858	1,003	963
TOTAL HC		G/HR	245	267	251	197	227
TOTAL CO2		KG/HR	1,012	791	557	324	186
PART MATTER		G/HR	64.7	66.0	100.4	121.1	73.3
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,192.5	1,393.4	1,293.5	1,698.4	2,259.5
TOTAL CO	(CORR 5% O2)	MG/NM3	219.2	173.7	368.0	627.4	1,209.3
TOTAL HC	(CORR 5% O2)	MG/NM3	48.0	66.9	86.4	121.9	248.4
PART MATTER	(CORR 5% O2)	MG/NM3	12.0	15.9	36.2	72.0	75.2
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,068	679	630	827	1,101
TOTAL CO	(CORR 5% O2)	PPM	175	139	294	502	967
TOTAL HC	(CORR 5% O2)	PPM	90	125	161	228	464
TOTAL NOX (AS NO2)		G/HP-HR	5.08	3.41	3.29	4.45	6.95
TOTAL CO		G/HP-HR	0.44	0.37	0.76	1.60	3.11
TOTAL HC		G/HP-HR	0.11	0.16	0.22	0.31	0.73
PART MATTER		G/HP-HR	0.03	0.04	0.09	0.19	0.24
TOTAL NOX (AS NO2)		LB/HR	24.45	12.37	8.24	6.16	4.75
TOTAL CO		LB/HR	2.14	1.34	1.89	2.21	2.12
TOTAL HC		LB/HR	0.54	0.59	0.55	0.44	0.50
TOTAL CO2		LB/HR	2,230	1,743	1,228	714	409
PART MATTER		LB/HR	0.14	0.15	0.22	0.27	0.16
OXYGEN IN EXH		%	10.4	11.6	12.3	13.3	15.3
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 TIER 2		2006 - 2010		
GASEOUS EMISSIONS DATA MEASUREMENTS ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 89 SUBPART D AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. GASEOUS EMISSIONS VALUES 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 ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 60 SUBPART IIII AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. GASEOUS EMISSIONS VALUES 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	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)	50	60	70	80	90	100	110	120	130	NORMAL
ALTITUDE (FT)										
0	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206
1,000	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206
2,000	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,200	2,163	2,206
3,000	2,206	2,206	2,206	2,206	2,206	2,193	2,155	2,118	2,082	2,206
4,000	2,206	2,206	2,206	2,188	2,149	2,110	2,073	2,037	2,003	2,206
5,000	2,206	2,186	2,144	2,105	2,066	2,029	1,994	1,959	1,926	2,183
6,000	2,143	2,101	2,062	2,023	1,987	1,951	1,917	1,884	1,852	2,113
7,000	2,059	2,020	1,981	1,945	1,909	1,875	1,842	1,811	1,780	2,045
8,000	1,978	1,940	1,904	1,868	1,834	1,802	1,770	1,739	1,710	1,978
9,000	1,900	1,863	1,828	1,794	1,762	1,730	1,700	1,670	1,642	1,913
10,000	1,824	1,789	1,755	1,723	1,691	1,661	1,632	1,604	1,576	1,850
11,000	1,750	1,717	1,684	1,653	1,623	1,594	1,566	1,539	1,513	1,788
12,000	1,679	1,647	1,616	1,586	1,557	1,529	1,502	1,476	1,451	1,727
13,000	1,610	1,579	1,549	1,520	1,493	1,466	1,440	1,415	1,391	1,668
14,000	1,543	1,513	1,485	1,457	1,431	1,405	1,380	1,357	1,334	1,610
15,000	1,478	1,450	1,422	1,396	1,371	1,346	1,322	1,300	1,278	1,554

Cross Reference

Engine Arrangement			
Arrangement Number	Effective Serial Number	Engineering Model	Engineering Model Version
2673949	EBG00001	GS335	-

Test Specification Data						
Test Spec	Setting	Effective Serial Number	Engine Arrangement	Governor Type	Default Low Idle Speed	Default High Idle Speed
0K7015	GG0288	EBG00001	2673949	ADEM3		

General Notes

General Notes DM8260 - 02
SOUND PRESSURE DATA FOR THIS RATING CAN BE FOUND IN PERFORMANCE NUMBER - DM8779

Performance Parameter Reference

Parameters Reference:DM9600-02
PERFORMANCE DEFINITIONS

<h2><u>PERFORMANCE DEFINITIONS DM9600</u></h2>

<B>APPLICATION:</B>
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%
Heat rejection	+/- 5%
Heat rejection exhaust only	+/- 10%

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%

*Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications.

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 reference atmospheric pressure is 100 KPA (29.61 in hg) and standard temperature is 25°C (77°F) at 60% relative humidity.

FOR 3600 ENGINES
Engine rating obtained and presented in accordance with ISO 3046/1 and SAE J1995 JAN90 standard reference conditions of 25°C, 100 KPA 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.

1500 kwe

PERFORMANCE DATA[DM8260]

February 11, 2011

REFERENCE FUEL

DIESEL
Reference fuel is #2 distillate diesel with a 35° API gravity;
A lower heating value is 42,780 KJ/KG (18,390 BTU/LB) when used at
29°C (84.2°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.

ALTITUDE CAPABILITY
Altitude capability is the maximum altitude above sea level at standar
d 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.

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 'not to
exceed' 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. Log on to the
Technology and Solutions Divisions (T&SD) web page
(http://tsd.cat.com/etsd/index.cfm?tech_id=2635ICAL) for information
including federal regulation applicability and time lines for
implementation. Information for labeling and tagging requirements is
also provided.

 NOTES:
Regulation watch covers regulations in effect and future regulation ch
anges for world, federal, state and loca. This page includes items
on the watch list where a regulation change or product change might
be pending and may need attention of the engine product group.
For additional emissions information log on to the TMI web page.

Additional product information for specific market application is
available.
Customer's may have special emission site requirements that need to be
verified by the Caterpillar Product Group engineer.

<h5><u>HEAT REJECTION DEFINITIONS:</u></h4>
Diesel Circuit Type and HHV Balance : <a href="http://tmiweb.cat.com/t
mi/servlet/TMIDirector?Action=buildtab&tab=DDDefinitionsDisplay&log=ge
nData&jsp=PerfDetail&perfNo=DM9500">DM9500

<h5><u>SOUND DEFINITIONS:</u></h4>
Sound Power : <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector?A
ction=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&per
fNo=DM8702">DM8702

Sound Pressure : <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirecto
r?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&
perfNo=TM7080">TM7080

PERFORMANCE DATA[DM8260]

<h5><u>RATING DEFINITIONS:</u></h5>
Agriculture <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector?Act
ion=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&perfN
o=TM6008">TM6008

Fire Pump <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector?Actio
n=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&perfNo=
TM6009">TM6009

Generator Set <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector?A
ction=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&per
fNo=TM6035">TM6035

Generator (Gas) <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector
?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&p
erfNo=TM6041">TM6041

Industrial Diesel <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirect
or?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail
&perfNo=TM6010">TM6010

Industrial (Gas) <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirecto
r?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&
perfNo=TM6040">TM6040

Irrigation <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector?Acti
on=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&perfNo
=TM5749">TM5749

Locomotive <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector?Acti
on=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&perfNo
=TM6037">TM6037

Marine Auxiliary <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirecto
r?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&
perfNo=TM6036">TM6036

Marine Prop (Except 3600) <a href="http://tmiweb.cat.com/tmi/servlet/T
MIDirector?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=Pe
rfDetail&perfNo=TM5747">TM5747

Marine Prop (3600 only) <a href="http://tmiweb.cat.com/tmi/servlet/TMI
Director?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=Perf
Detail&perfNo=TM5748">TM5748

MSHA <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirector?Action=bui
ldtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&perfNo=TM604
2">TM6042

Oil Field (Petroleum) <a href="http://tmiweb.cat.com/tmi/servlet/TMID
irector?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfD
etail&perfNo=TM6011">TM6011

Off-Highway Truck <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirect
or?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail
&perfNo=TM6039">TM6039

On-Highway Truck <a href="http://tmiweb.cat.com/tmi/servlet/TMIDirecto
r?Action=buildtab&tab=DDDefinitionsDisplay&log=genData&jsp=PerfDetail&
perfNo=TM6038">TM6038

<h6 align="right">Date Released : 12/06/10</h6>

GEN SET PACKAGE PERFORMANCE DATA [C09DE02]

APRIL 19, 2011

For Help Desk Phone Numbers Click here

Performance Number: DM8501

Change Level: 02

Sales Model: C9 DITA **Combustion:** DI **Aspr:** TA

Engine Power:
250 W/F EKW 265 W/O F EKW
398 HP

Speed: 1,800 RPM **After Cooler:** ATAAC

Manifold Type: DRY **Governor Type:** ELEC **After Cooler Temp(F):** 120

Turbo Quantity: 1 **Engine App:** GP **Turbo Arrangement:**

Hertz: 60 **Application Type:** PACKAGE-DIE **Engine Rating:** PGS **Strategy:**

Rating Type: STANDBY **Certification:** EPA TIER-3 2005 - ----
EPA STAT EMERC 2011 - ----

General Performance Data 1

GEN W/F EKW	PERCENT LOAD	ENGINE POWER BHP	ENGINE BMEP PSI	FUEL BSFC LB/BHP-HR	FUEL RATE GPH	INTAKE MFLD TEMP DEG F	INTAKE MFLD P IN-HG	INTAKE AIR FLOW CFM	EXH MFLD TEMP DEG F	EXH STACK TEMP DEG F	EXH GAS FLOW CFM
250	100	398	326.05	0.34	19.36	122.36	77.94	882.87	1,145.48	853.88	2,242.48
225	90	359	294.14	0.35	17.73	121.64	74.33	858.15	1,096.88	824.9	2,129.48
200	80	321	262.96	0.35	16.25	122.18	70.86	833.43	1,052.06	801.32	2,023.53
187.5	75	302	247.58	0.36	15.53	122.54	69.15	819.3	1,031	791.42	1,974.09
175	70	284	232.21	0.36	14.77	122.36	66.75	801.64	1,012.1	784.22	1,914.06
150	60	247	202.04	0.37	13.18	122.18	60.77	752.2	974.84	770.18	1,776.33
125	50	211	172.45	0.38	11.57	121.82	53.36	692.17	938.48	756.5	1,613.88
100	40	177	144.6	0.39	9.93	121.28	43.5	610.94	902.66	743.18	1,412.59
75	30	142	116.03	0.4	8.16	120.92	32.6	519.13	861.08	728.78	1,190.11
62.5	25	124	101.38	0.41	7.26	120.56	27.04	473.22	837.86	720.86	1,077.1
50	20	106	86.44	0.42	6.31	120.38	21.38	427.31	813.02	712.76	957.03
25	10	69	56.13	0.45	4.36	120.38	11.99	346.08	669.2	610.52	716.89

General Performance Data 2

GEN W/F EKW	PERCENT LOAD	ENGINE POWER BHP	COMPRESS OUT PRESS IN-HG	COMPRESS OUT TEMP DEG F
250	100	398	78.8	426.2
225	90	359	75.25	408.92
200	80	321	71.78	390.74
187.5	75	302	70.09	381.2
175	70	284	67.67	370.94
150	60	247	61.68	347.36
125	50	211	54.19	319.28
100	40	177	44.27	280.4
75	30	142	33.29	236.66

62.5	25	124	27.66	214.16
50	20	106	21.97	191.3
25	10	69	12.53	149.72

Engine Heat Rejection Data

GEN W/F EKW	PERCENT LOAD	REJ TO JW BTU/MN	REJ TO ATMOS BTU/MN	REJ TO EXHAUST BTU/MN	EXH RCOV TO 350F BTU/MN	FROM OIL CLR BTU/MN	FROM AFT CLR BTU/MN	WORK ENERGY BTU/MN	LHV ENERGY BTU/MN	HHV ENERGY BTU/MN
250	100	5,971.3	1,188.6	15,753.0	10,293.5	2,223.6	4,731.6	16,890.4	41,799.4	44,529.1
225	90	5,516.4	1,057.8	14,615.6	9,383.5	2,035.9	4,344.9	15,241.1	38,273.4	40,775.7
200	80	5,175.2	1,006.6	13,591.9	8,587.3	1,865.3	3,941.1	13,591.9	35,031.9	37,363.5
187.5	75	5,004.5	955.4	13,136.9	8,189.3	1,780.0	3,736.4	12,795.7	33,439.5	35,657.4
175	70	4,833.9	881.5	12,625.1	7,848.0	1,694.7	3,508.9	12,056.4	31,790.3	33,894.4
150	60	4,492.7	767.7	11,544.6	7,108.7	1,512.7	2,985.7	10,464.1	28,434.9	30,254.8
125	50	4,151.5	682.4	10,350.3	6,255.7	1,325.1	2,411.3	8,928.6	24,909.0	26,558.2
100	40	3,867.1	796.2	8,871.7	5,288.9	1,137.4	1,711.8	7,506.8	21,383.1	22,747.9
75	30	3,412.2	847.4	7,393.1	4,322.1	932.7	1,057.8	6,028.2	17,572.8	18,710.2
62.5	25	3,184.7	779.1	6,596.9	3,867.1	830.3	779.1	5,232.0	15,582.3	16,606.0
50	20	2,900.4	648.3	5,857.6	3,355.3	722.2	534.6	4,492.7	13,535.0	14,445.0
25	10	2,388.5	563.0	3,924.0	1,933.6	500.5	176.3	2,900.4	9,383.5	9,952.2

EMISSIONS DATA

EPA TIER-3 2005 - ---- ********** G5
Gaseous emissions data measurement are consistent with those described in in 40 CFR, EU 97/68/EC, ECE Regulation No. 96 and ISO 8178 for measuring HC, CO, PM and NOx.

Gaseous emissions values are WEIGHTED CYCLE AVERAGES and are in compliance with the following non-road regulations:

LOCALITY	AGENCY/LEVEL	MAX LIMITS - g/kw-hr		
U. S. (incl Calif)	EPA/Tier 3	CO:3.5	NOx + HC:4.0	PM:0.2
Europe	EU/Stage-IIIA	CO:3.5	NOx + HC:4.0	PM:0.2

EPA STAT EMERC 2011 - ---- ********** P4
EPA EMERGENCY STATIONARY
GASEOUS EMISSIONS DATA MEASUREMENTS ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 60 SUBPART IIII AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX.

GASEOUS EMISSIONS VALUES ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE NON-ROAD REGULATIONS.

LOCALITY	AGENCY/LEVEL	MAX LIMITS - g/kW-hr
U.S. (INCL CALIF)	EPA/STAT EMERGENCY	CO:3.5 NOx + HC:4.0 PM:0.20

REFERENCE EXHAUST STACK DIAMETER	--
WET EXHAUST MASS	4,012.4 LB/HR
WET EXHAUST FLOW (852.80 F STACK TEMP)	2,245.31 CFM
WET EXHAUST FLOW RATE (32 DEG F AND 29.98 IN HG)	841.00 STD CFM
DRY EXHAUST FLOW RATE (32 DEG F AND 29.98 IN HG)	770.92 STD CFM
FUEL FLOW RATE	19 GAL/HR

RATED SPEED "Not to exceed data"

GEN PWR EKW	PERCENT LOAD	ENGINE POWER BHP	TOTAL NOX (AS NO2) LB/HR	TOTAL CO LB/HR	TOTAL HC LB/HR	PART MATTER LB/HR	OXYGEN IN EXHAUST PERCENT
250	100	398	3.1500	.5900	.1700	.1400	10.1000
187.5	75	302	1.7800	.6000	.2200	.1400	11.4000
125	50	211	1.1100	.4700	.2300	.1100	12.6000
62.5	25	124	.7000	.6100	.1900	.1000	13.8000
25	10	69	.5500	.6000	.1800	.0800	15.2000

RATED SPEED "Nominal Data"

GEN PWR EKW	PERCENT LOAD	ENGINE POWER BHP	TOTAL NOX (AS NO2) LB/HR	TOTAL CO LB/HR	TOTAL HC LB/HR	TOTAL CO2 LB/HR	PART MATTER LB/HR	OXYGEN IN EXHAUST PERCENT
250	100	398	2.6000	.3200	.0900	424.2	.0700	10.1000
187.5	75	302	1.4700	.3200	.1200	339.6	.0700	11.4000
125	50	211	.9200	.2500	.1200	252.9	.0600	12.6000
62.5	25	124	.5800	.3300	.1000	157.9	.0500	13.8000
25	10	69	.4500	.3200	.1000	94.8	.0400	15.2000

Altitude Capability Data(Corrected Power Altitude Capability)

Ambient Operating Temp. / Altitude	50 F	68 F	86 F	104 F	122 F	NORMAL
0 F	398.28 hp	398.28 hp	398.28 hp	398.28 hp	398.28 hp	398.28 hp
984.25 F	398.28 hp	398.28 hp	398.28 hp	398.28 hp	398.28 hp	398.28 hp
1,640.42 F	398.28 hp	398.28 hp	398.28 hp	398.28 hp	388.9 hp	398.28 hp
3,280.84 F	398.28 hp	398.28 hp	390.24 hp	378.17 hp	366.1 hp	398.28 hp
4,921.26 F	392.92 hp	379.51 hp	367.44 hp	355.37 hp	344.64 hp	379.51 hp
6,561.68 F	370.12 hp	356.71 hp	344.64 hp	333.91 hp	323.19 hp	360.73 hp
8,202.1 F	347.32 hp	335.26 hp	324.53 hp	313.8 hp	304.41 hp	341.96 hp
9,842.52 F	325.87 hp	315.14 hp	304.41 hp	295.02 hp	285.64 hp	324.53 hp
11,482.94 F	305.75 hp	295.02 hp	285.64 hp	276.25 hp	268.2 hp	308.43 hp
13,123.36 F	286.98 hp	276.25 hp	268.2 hp	258.82 hp	250.77 hp	292.34 hp
14,763.78 F	268.2 hp	258.82 hp	250.77 hp	242.72 hp	234.68 hp	277.59 hp

The powers listed above and all the Powers displayed are Corrected Powers

Identification Reference and Notes

Engine Arrangement:	2575707	**Lube Oil Press @ Rated Spd(PSI):**	49.5
Effective Serial No:	S9L00001	**Piston Speed @ Rated Eng SPD (FT/Min):**	1,752.0
Primary Engine Test Spec:	0K6612	**Max Operating Altitude(FT):**	3,280.8
Performance Parm Ref:	TM5739	**PEEC Elect Control Module Ref**	
Performance Data Ref:	DM8501	**PEEC Personality Cont Mod Ref**	
Aux Coolant Pump Perf Ref:			
Cooling System Perf Ref:		**Turbocharger Model**	S310-1.25 VTF
Certification Ref:	EPA TIER 3	**Fuel Injector**	
Certification Year:	2005	**Timing-Static (DEG):**	--
Compression Ratio:	16.1	**Timing-Static Advance (DEG):**	--
Combustion System:	DI	**Timing-Static (MM):**	--
Aftercooler Temperature (F):	120	**Unit Injector Timing (MM):**	--
Crankcase Blowby Rate(CFH):	--	**Torque Rise (percent)**	--
Fuel Rate (Rated RPM) No Load (Gal/HR):	--	**Peak Torque Speed RPM**	--
Lube Oil Press @ Low Idle Spd(PSI):	42.5	**Peak Torque (LB/FT):**	--

Reference Number: DM8501

EPA TIER-3 2005----G5EPA STAT EMERC 2011----P4

Parameters Reference: TM5739

GEN SET - PACKAGED - DIESEL
TOLERANCES:
AMBIENT AIR CONDITIONS AND FUEL USED WILL AFFECT THESE VALUES. EACH OF THE VALUES MAY VARY IN ACCORDANCE WITH THE FOLLOWING TOLERANCES.

ENGINE POWER	+/- 3%
EXHAUST STACK TEMPERATURE	+/- 8%
GENERATOR POWER	+/- 5%
INLET AIR FLOW	+/- 5%
INTAKE MANIFOLD PRESSURE - GAGE	+/- 10%
EXHAUST FLOW	+/- 6%
SPECIFIC FUEL CONSUMPTION	+/- 3%
FUEL RATE	+/- 5%
HEAT REJECTION	+/- 5%
HEAT REJECTION EXHAUST ONLY	+/- 10%

CONDITIONS:
ENGINE PERFORMANCE IS CORRECTED TO INLET AIR STANDARD CONDITIONS OF 99 KPA (29.31 IN HG) AND 25 DEG C (77 DEG F).

THESE VALUES CORRESPOND TO THE STANDARD ATMOSPHERIC PRESSURE AND TEMPERATURE IN ACCORDANCE WITH SAE J1349. ALSO INCLUDED IS A CORRECTION TO STANDARD FUEL GRAVITY OF 35 DEGREES API HAVING A LOWER HEATING VALUE OF 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/L (7.002 LB/GAL).

THE CORRECTED PERFORMANCE VALUES SHOWN FOR CATERPILLAR ENGINES WILL APPROXIMATE THE VALUES OBTAINED WHEN THE OBSERVED PERFORMANCE DATA IS CORRECTED TO SAE J1349, ISO 3046-2 & 8665 & 2288 & 9249 & 1585, EEC 80/1269 AND DIN70020 STANDARD REFERENCE CONDITIONS.

ENGINES ARE EQUIPPED WITH STANDARD ACCESSORIES; LUBE OIL, FUEL PUMP AND JACKET WATER PUMP. THE POWER REQUIRED TO DRIVE AUXILIARIES MUST BE DEDUCTED FROM THE GROSS OUTPUT TO ARRIVE AT THE NET POWER AVAILABLE FOR THE EXTERNAL (FLYWHEEL) LOAD. TYPICAL AUXILIARIES INCLUDE COOLING FANS, AIR COMPRESSORS, AND CHARGING ALTERNATORS.

RATINGS MUST BE REDUCED TO COMPENSATE FOR ALTITUDE AND/OR AMBIENT TEMPERATURE CONDITIONS ACCORDING TO THE APPLICABLE DATA SHOWN ON THE PERFORMANCE DATA SET.

GEN SET - PACKAGED - DIESEL
ALTITUDE:
ALTITUDE CAPABILITY - THE RECOMMENDED REDUCED POWER VALUES FOR SUSTAINED ENGINE OPERATION AT SPECIFIC ALTITUDE LEVELS AND AMBIENT TEMPERATURES.

COLUMN "N" DATA - THE FLYWHEEL POWER OUTPUT AT NORMAL AMBIENT TEMPERATURE.

AMBIENT TEMPERATURE - TO BE MEASURED AT THE AIR CLEANER AIR INLET DURING NORMAL ENGINE OPERATION.
NORMAL TEMPERATURE - THE NORMAL TEMPERATURE AT VARIOUS SPECIFIC ALTITUDE LEVELS IS FOUND ON TM2001.

THE GENERATOR POWER CURVE TABULAR DATA REPRESENTS THE NET ELECTRICAL POWER OUTPUT OF THE GENERATOR.

GENERATOR SET RATINGS
EMERGENCY STANDBY POWER (ESP)

OUTPUT AVAILABLE WITH VARYING LOAD FOR THE DURATION OF AN EMERGENCY OUTAGE. AVERAGE POWER OUTPUT IS 70% OF THE ESP RATING. TYPICAL OPERATION IS 50 HOURS PER YEAR, WITH MAXIMUM EXPECTED USAGE OF 200 HOURS PER YEAR.

STANDBY POWER RATING

OUTPUT AVAILABLE WITH VARYING LOAD FOR THE DURATION OF AN EMERGENCY OUTAGE. AVERAGE POWER OUTPUT IS 70% OF THE STANDBY POWER RATING. TYPICAL OPERATION IS 200 HOURS PER YEAR, WITH MAXIMUM EXPECTED USAGE OF 500 HOURS PER YEAR.

PRIME POWER RATING

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 POWER RATING

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 EKW FOR 100% OF OPERATING HOURS.

PERFORMANCE DATA[DM8501]

February 23, 2015

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

SALES MODEL:	C9	**COMBUSTION:**	DI
ENGINE POWER (BHP):	398	**ENGINE SPEED (RPM):**	1,800
GEN POWER W/O FAN (EKW):	265.0	**HERTZ:**	60
GEN POWER WITH FAN (EKW):	250.0	**FAN POWER (HP):**	30.2
COMPRESSION RATIO:	16.1	**ASPIRATION:**	TA
RATING LEVEL:	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):**	192.2
GOVERNOR TYPE:	ELEC	**TURBO CONFIGURATION:**	SINGLE
CAMSHAFT TYPE:	STANDARD	**TURBO QUANTITY:**	1
IGNITION TYPE:	CI	**TURBOCHARGER MODEL:**	S310-1.25
INJECTOR TYPE:	EUI	**CERTIFICATION YEAR:**	2005
REF EXH STACK DIAMETER (IN):	4	**PISTON SPD @ RATED ENG SPD (FT/MIN):**	1,759.8
MAX OPERATING ALTITUDE (FT):	3,281		

INDUSTRY	SUBINDUSTRY	APPLICATION
OIL AND GAS	LAND PRODUCTION	PACKAGED GENSET
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
250.0	100	398	326	0.341	19.4	77.7	122.3	1,142.4	55.4	852.0
225.0	90	359	294	0.346	17.7	74.1	121.6	1,094.4	51.6	823.5
200.0	80	321	263	0.355	16.3	70.7	122.1	1,050.1	48.2	800.5
187.5	75	302	247	0.360	15.5	69.0	122.5	1,029.4	46.4	790.7
175.0	70	284	232	0.364	14.8	66.6	122.4	1,010.3	44.2	782.4
150.0	60	247	202	0.374	13.2	60.6	122.2	973.8	39.4	768.3
125.0	50	211	172	0.385	11.6	53.2	121.8	937.9	33.9	755.8
100.0	40	176	144	0.394	9.9	43.3	121.2	899.4	27.4	742.4
75.0	30	141	116	0.404	8.1	32.2	120.7	857.9	20.5	727.9
62.5	25	124	101	0.410	7.3	26.7	120.5	835.9	17.2	720.5
50.0	20	106	87	0.418	6.3	21.3	120.3	812.9	14.1	712.7
25.0	10	68.9	56	0.445	4.4	12.1	120.5	671.3	9.1	612.1

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
250.0	100	398	79	425.2	889.8	2,245.6	3,863.5	3,999.1	841.8	776.8
225.0	90	359	75	407.9	866.1	2,131.2	3,753.5	3,877.8	816.6	756.7
200.0	80	321	72	390.0	845.5	2,029.1	3,641.7	3,755.4	791.7	736.4
187.5	75	302	70	380.5	833.2	1,976.5	3,583.9	3,692.5	777.2	724.2
175.0	70	284	67	370.2	815.6	1,915.7	3,500.2	3,603.4	758.3	707.7
150.0	60	247	61	346.6	770.3	1,777.1	3,290.5	3,382.8	711.5	666.0
125.0	50	211	54	318.8	711.6	1,616.1	3,025.9	3,107.0	653.7	613.6
100.0	40	176	44	280.7	631.2	1,409.7	2,668.7	2,738.1	576.6	542.5
75.0	30	141	33	236.6	539.6	1,189.0	2,266.0	2,323.1	492.3	464.1
62.5	25	124	27	214.1	493.0	1,076.6	2,063.6	2,114.4	448.5	423.3
50.0	20	106	22	191.5	447.1	961.4	1,865.3	1,909.6	403.2	380.9
25.0	10	68.9	13	150.2	365.7	720.7	1,521.7	1,552.4	330.6	314.7

Heat Rejection Data

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

PERFORMANCE DATA[DM8501]

Emissions Data

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

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

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN		EKW	250.0	187.5	125.0	62.5	25.0
PERCENT LOAD		%	100	75	50	25	10
ENGINE POWER		BHP	398	302	211	124	68.9
TOTAL NOX (AS NO2)		G/HR	1,150	661	419	260	205
TOTAL CO		G/HR	144	145	113	152	144
TOTAL HC		G/HR	36	47	48	37	38
TOTAL CO2		KG/HR	193	155	115	71	43
PART MATTER		G/HR	32.1	33.9	25.1	25.1	17.5
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	1,516.2	1,083.8	918.3	939.9	1,312.7
TOTAL CO	(CORR 5% O2)	MG/NM3	172.8	215.5	229.8	496.4	785.9
TOTAL HC	(CORR 5% O2)	MG/NM3	37.7	59.9	83.6	111.9	195.8
PART MATTER	(CORR 5% O2)	MG/NM3	32.6	43.3	43.2	76.0	79.5
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	739	528	447	458	639
TOTAL CO	(CORR 5% O2)	PPM	138	172	184	397	629
TOTAL HC	(CORR 5% O2)	PPM	70	112	156	209	365
TOTAL NOX (AS NO2)		G/HP-HR	2.91	2.20	2.00	2.11	2.98
TOTAL CO		G/HP-HR	0.36	0.48	0.54	1.23	2.08
TOTAL HC		G/HP-HR	0.09	0.15	0.23	0.30	0.55
PART MATTER		G/HP-HR	0.08	0.11	0.12	0.20	0.25
TOTAL NOX (AS NO2)		LB/HR	2.54	1.46	0.92	0.57	0.45
TOTAL CO		LB/HR	0.32	0.32	0.25	0.34	0.32
TOTAL HC		LB/HR	0.08	0.10	0.11	0.08	0.08
TOTAL CO2		LB/HR	425	342	255	156	94
PART MATTER		LB/HR	0.07	0.07	0.06	0.06	0.04
OXYGEN IN EXH		%	10.2	11.6	12.7	13.7	15.0
DRY SMOKE OPACITY		%	0.5	0.8	0.8	1.4	0.9
BOSCH SMOKE NUMBER			0.39	0.67	0.66	1.21	0.84

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	398	398	398	398	398	398	398	398	398	398	398	398	398
1,000	398	398	398	398	398	398	398	398	398	398	395	389	398
2,000	398	398	398	398	398	398	398	398	394	387	380	374	398
3,000	398	398	398	398	398	398	393	386	379	372	366	360	398
4,000	398	398	398	398	392	385	378	371	365	358	352	346	396
5,000	398	398	392	384	377	370	363	357	351	345	339	333	384
6,000	392	384	377	370	363	356	349	343	337	331	326	320	372
7,000	377	369	362	355	349	342	336	330	324	318	313	308	360
8,000	362	355	348	341	335	329	323	317	311	306	301	296	348
9,000	348	341	334	328	322	316	310	304	299	294	289	284	337
10,000	334	327	321	315	309	303	297	292	287	282	277	273	325
11,000	320	314	308	302	296	291	285	280	275	271	266	262	314
12,000	307	301	295	290	284	279	274	269	264	260	255	251	304
13,000	295	289	283	278	272	267	263	258	253	249	245	241	293
14,000	282	277	271	266	261	256	252	247	243	239	235	231	283
15,000	271	265	260	255	250	246	241	237	233	229	225	221	273

Cross Reference

Engine Arrangement			
Arrangement Number	**Effective Serial Number**	**Engineering Model**	**Engineering Model Version**
2575707	S9L00001	GS279	-
3950368	S9P00001	GS279	-
4529865	S9P00001	GS857	LS

Test Specification Data						
Test Spec	**Setting**	**Effective Serial Number**	**Engine Arrangement**	**Governor Type**	**Default Low Idle Speed**	**Default High Idle Speed**
0K6612		S9L00001	2575707	ELEC		
0K6612		S9P00001	3950368	ELEC		
4150078	PP5548	S9P00001	3950368	ELEC		
4150078	PP5548	S9P00001	4529865	ELEC		

Performance Parameter Reference

Parameters Reference:DM9600-06

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 (84.2), 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. Log on to the Technology and Solutions Divisions (T&SD) web page (https://pdgt.cat.com/cda/layout) for information including federal regulation applicability and time lines for implementation. Information for labeling and tagging requirements is also provided.

NOTES:
Regulation watch covers regulations in effect and future regulation changes for world, federal, state and local. This page includes

items on the watch list where a regulation change or product change might be pending and may need attention of the engine product group. For additional emissions information log on to the TMI web page.

Additional product information for specific market application is available.
Customer's may have special emission site requirements that need to be verified by the Caterpillar Product Group engineer.

HEAT REJECTION DEFINITIONS:
Diesel Circuit Type and HHV Balance : DM9500

EMISSIONS DEFINITIONS:
Emissions : DM1176

SOUND DEFINITIONS:
Sound Power : DM8702

Sound Pressure : TM7080

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

Date Released : 5/12/14

4. COOLING UNIT SPECIFICATIONS

Munters Data Center Cooling Systems

Completed By: BP

Date: 8/12/2019

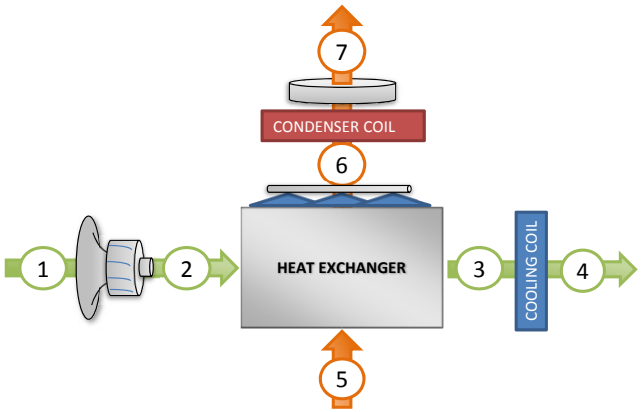
Inputs: SI / IP

Outputs: SI / IP

Individual Unit Design Performance (Based on N Units)

System Design Inputs

Project location	Quincy, WA		
Project elevation	1,229		ft
Total power consumed by servers	13,704		kW
Target supply air temperature (Dry | IEC)	72.0	72.0	Deg F
Max supply air temp (DX Target | DX Peak)	72.0	76.0	Deg F
Design temperature rise through IT eqmt.	20.0		Deg F
Room air dew point	55.0		Deg F
Total Duct ESP (Process | Scavenger)	0.50	0.00	IN-WC
Unit size	PV-W60-PVT		
Number of units (N)	36		
Supply Air Isolation Damper	☐ Include		
Return Air Isolation Damper	☐ Include		
Scavenger Air Control Damper	☑ Include		
Mechanical Cooling type	Direct Expansion (DX)		
Condenser coil location	Scavenger Exhaust		
Cycles of Concentration	5.0		
	Critical	Operating	
Ambient DB	109.0	109.0	Deg F
Ambient WB	75.0	75.0	Deg F
% Design load		100.0%	13,704.0 kW
Rate performance for N+(__) units operating		8	
ESP Adjustment (Supply) Min ax		80%	%



Estimated Unit Operating Performance (per unit)

	Critical	Operating	
ITE load rejected	380.7	311.5	kW
Total heat rejected (ITE load + fan heat)	120	95	Refrigeration Tons
Heat rejected by IEC/HX	81.1	66.6	Refrigeration Tons
Mech. cooling required	39.0	28.9	Refrigeration Tons
Supply fan air volume	65,910	53,926	CFM
Supply fan calculated TSP	3.1	2.2	IN-WC
Scavenger fan air volume	43,450	35,484	CFM
Scavenger fan calculated TSP	1.3	0.9	IN-WC

Estimated Unit Electrical Performance (per unit)

	Critical	Operating	
Unit operating power (+/- 5%)	84	55	kW
Unit coefficient of performance	5.05	6.06	
Unit partial PUE	1.220	1.178	

Estimated Unit Water Performance (per unit)

	Critical	Operating	
Water evaporation rate	235.7	193.1	Gal/hr
Water bleed rate	58.9	48.3	Gal/hr
Total water consumption	294.6	241.4	Gal/hr
Unit WUE	2.93	2.93	L / kWh

*Estimated value. Accurate value to be determined from customer-supplied water analysis.

State Points at Critical Design Conditions (Water Sprays on)

	DB (°F)	WB (°F)	ACFM
1 (R/A)	96.0	68.9	65,910
2	98.2	69.6	66,171
3	83.2	65.0	64,393
4 (S/A)	76.0	62.6	63,063
5 (O/A)	109.0	75.0	43,859
6	81.0	78.5	42,448
7 (E/A)	93.7	81.5	43,450

State Points at Operating Rating Point Conditions (Water Sprays on)

	DB (°F)	WB (°F)	ACFM
1 (R/A)	96.0	68.9	53,926
2	97.6	69.4	54,077
3	82.5	64.8	52,618
4 (S/A)	76.0	62.6	51,597
5 (O/A)	109.0	75.0	35,885
6	81.0	78.5	34,732
7 (E/A)	92.7	81.2	35,484

Note: Performance values includes estimated supply fan heat

MADE IN THE USA

All Values are Preliminary

Munters Data Center Cooling Systems

Bin Analysis

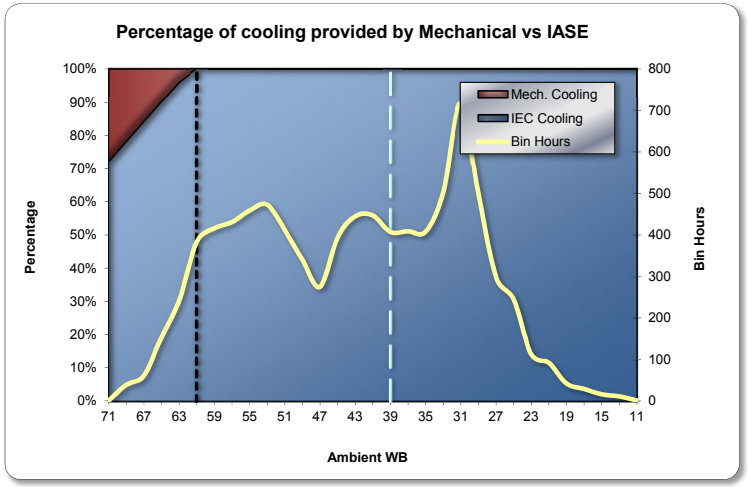
% Design load	75.4%	10,328.0 kW
Redundancy Required, N+(_)	8	
Approximate percentage of units with filters	100%	
Number of Operating Units (N+8)	44	
Units With Filters	44	
Units Without Filters	0	

ESP Adj (Supply) Min / Max	80%	%
Supply ESP (all units operating)	0.21	IN-WC
Electricity Rate	$0.000	$/kWh
Water	$0.000	$/100 ft^3
Sewer	$0.000	$/100 ft^3

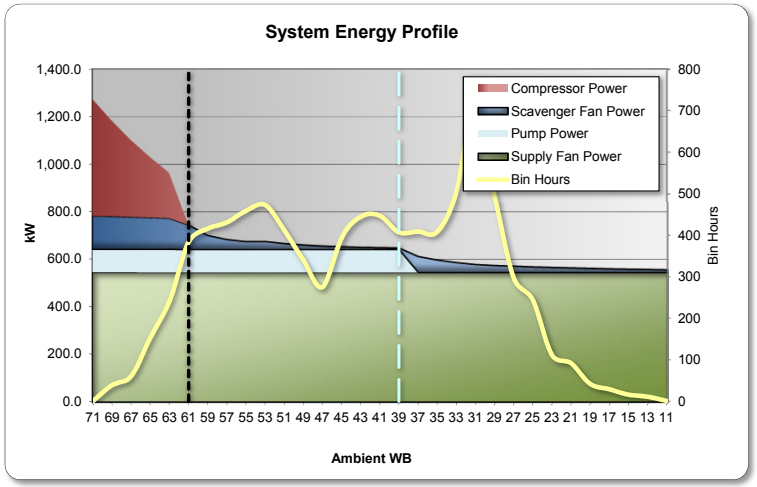
Annual Performance Summary

	Total	Per Unit				
Predicted Annual Power Use	6,138,392	139,509	kWh	Predicted Annual Ton-Hours of Mechanical Cooling:	135,289	0.50%
Predicted Annual Water Evaporated	19,343.4	439.6	1,000 gal	Predicted Annual Ton-Hours of Dry HX Cooling:	10,452,021	38.58%
Predicted Annual Water Drained	5,273.0	119.8	1,000 gal	Predicted Annual Ton-Hours of IEC Cooling:	16,501,401	60.92%
Predicted Annual Total Water Consumed	24,616.4	559.5	1,000 gal			

Estimated system annualized COP	15.8		Predicted Cost of Electricity Used	$0
Estimated System annualized partial PUE	1.068		Predicted Cost of Water Evaporated	$0
Estimated System annualized WUE	0.76	L / kWh	Predicted Cost of Water Drained	$0
			Predicted Cost of Water	$0
Predicted Annual Hrs Mech. Cooling Active	497		Predicted Total Annual Operating Cost	$0
% Annual Hrs IASE Rejects 100% of load	94.3%			



Mechanical Cooling Off
Water Sprays Off



Mechanical Cooling Off
Water Sprays Off

O/A dry bulb temperature to enable IEC	44.6	Deg F
O/A dry bulb temp where dry HX rejects total load	47.0	Deg F

Binned Weather Data			SYSTEM TOTALS (Based on N+8 units operating)														
BIN HOURS	O/A MCDB (°F)	O/A WB (°F)	S/A Temp (°F)	R/A Temp (°F)	SUPPLY AIRFLOW PER UNIT (ACFM)	SCAVENGER AIRFLOW PER UNIT (ACFM)	IASE COOLING (% OF TOTAL)	PUMP POWER (kW)	COMPRESSOR POWER (kW)	SUPPLY FAN POWER (kW)	SCAVENGER FAN POWER (kW)	TOTAL SYSTEM POWER (kW)	SYSTEM pPUE (AT BIN CONDITION)	KW / TON	SYSTEM COP (AT BIN CONDITION)	TOTAL SYSTEM ENERGY (kWh)
1	91.0	71.0	72.0	92.0	38,886	26,424	72%	96.8	492.1	545.5	139.4	1,317.9	1.128	0.4	8.3	1,318
39	93.7	69.0	72.0	92.0	38,886	26,219	78%	96.8	402.8	545.3	138.9	1,227.7	1.119	0.4	8.9	47,882
61	90.7	67.0	72.0	92.0	38,886	26,025	84%	96.8	324.0	545.1	136.5	1,146.4	1.111	0.4	9.5	69,930
154	86.4	65.0	72.0	92.0	38,886	25,838	90%	96.8	254.1	544.9	133.8	1,073.6	1.104	0.3	10.1	165,342
242	82.2	63.0	72.0	92.0	38,886	25,657	96%	96.8	191.9	544.7	131.2	1,008.7	1.098	0.3	10.8	244,095
384	78.5	61.0	72.0	92.0	38,886	23,450	100%	96.8	0.0	544.6	103.6	789.0	1.076	0.3	13.8	302,971
416	74.3	59.0	72.0	92.0	38,886	18,984	100%	96.8	0.0	544.6	59.3	744.7	1.072	0.2	14.6	309,797
431	70.8	57.0	72.0	92.0	38,886	16,531	100%	96.8	0.0	544.6	41.3	726.7	1.070	0.2	15.0	313,204
459	67.5	55.0	72.0	92.0	38,886	15,074	100%	96.8	0.0	544.6	32.5	717.9	1.070	0.2	15.1	329,516
473	64.7	53.0	72.0	92.0	38,886	15,230	100%	96.8	0.0	544.6	33.2	718.6	1.070	0.2	15.1	339,919
412	60.8	51.0	72.0	92.0	38,886	13,610	100%	96.8	0.0	544.6	24.7	710.1	1.069	0.2	15.3	292,573
340	59.2	49.0	72.0	92.0	38,886	12,308	100%	96.8	0.0	544.6	18.8	704.2	1.068	0.2	15.4	239,422
275	56.6	47.0	72.0	92.0	38,886	11,247	100%	96.8	0.0	544.6	14.2	699.6	1.068	0.2	15.5	192,378
394	53.8	45.0	72.0	92.0	38,886	10,371	100%	96.8	0.0	544.6	11.0	696.4	1.067	0.2	15.6	274,366
445	50.7	43.0	72.0	92.0	38,886	9,640	100%	96.8	0.0	544.6	8.7	694.1	1.067	0.2	15.7	308,867
447	47.7	41.0	72.0	92.0	38,886	9,023	100%	96.8	0.0	544.6	7.0	692.4	1.067	0.2	15.7	309,515
407	45.3	39.0	72.0	92.0	38,886	8,498	100%	96.8	0.0	544.6	5.8	691.2	1.067	0.2	15.7	281,320
409	41.8	37.0	72.0	92.0	38,886	20,756	100%	0.0	0.0	544.6	66.8	655.4	1.063	0.2	16.6	268,070
408	38.9	35.0	72.0	92.0	38,886	18,937	100%	0.0	0.0	544.6	52.3	640.9	1.062	0.2	17.0	261,486
503	35.7	33.0	72.0	92.0	38,886	17,302	100%	0.0	0.0	544.6	41.0	629.6	1.061	0.2	17.3	316,675
716	32.4	31.0	72.0	92.0	38,886	15,933	100%	0.0	0.0	544.6	33.0	621.6	1.060	0.2	17.5	445,056
498	30.5	29.0	72.0	92.0	38,886	15,241	100%	0.0	0.0	544.6	29.3	617.9	1.060	0.2	17.6	307,725
298	28.7	27.0	72.0	92.0	38,886	14,647	100%	0.0	0.0	544.6	26.4	615.0	1.060	0.2	17.7	183,257
245	26.1	25.0	72.0	92.0	38,886	13,884	100%	0.0	0.0	544.6	22.8	611.4	1.059	0.2	17.8	149,797
112	24.5	23.0	72.0	92.0	38,886	13,449	100%	0.0	0.0	544.6	20.9	609.5	1.059	0.2	17.8	68,268
92	22.3	21.0	72.0	92.0	38,886	12,907	100%	0.0	0.0	544.6	18.7	607.3	1.059	0.2	17.9	55,874
42	20.4	19.0	72.0	92.0	38,886	12,474	100%	0.0	0.0	544.6	16.9	605.5	1.059	0.2	18.0	25,432
29	18.1	17.0	72.0	92.0	38,886	11,993	100%	0.0	0.0	544.6	14.9	603.5	1.058	0.2	18.0	17,502
16	15.8	15.0	72.0	92.0	38,886	11,560	100%	0.0	0.0	544.6	13.2	601.8	1.058	0.2	18.1	9,629
11	13.7	13.0	72.0	92.0	38,886	11,189	100%	0.0	0.0	544.6	11.9	600.5	1.058	0.2	18.1	6,605
1	12.0	11.0	72.0	92.0	38,886	10,909	100%	0.0	0.0	544.6	11.0	599.5	1.058	0.2	18.1	600

All Values are Preliminary

All Values are Preliminary

SYSTEM TOTALS (Based on N+8 units operating)				
H_2O EVAPORATED (1,000 GAL/HR)	H_2O BLEED (1,000 GAL/HR)	TOTAL H_2O USAGE RATE (1,000 GAL/HR)	SYSTEM WUE (AT BIN CONDITION)	TOTAL H_2O CONSUMED (1,000 GAL)
4.56	1.14	5.70	1.58	5.7
5.31	1.33	6.63	1.83	258.7
5.33	1.33	6.66	1.84	406.2
5.18	1.29	6.47	1.79	996.9
5.04	1.26	6.30	1.74	1,523.4
4.74	1.18	5.92	1.64	2,274.1
4.15	1.04	5.19	1.43	2,157.7
3.83	0.96	4.79	1.32	2,065.0
3.62	0.90	4.52	1.25	2,076.3
3.52	0.88	4.41	1.22	2,083.6
3.29	0.82	4.11	1.14	1,695.1
3.24	0.81	4.05	1.12	1,377.2
3.14	0.79	3.93	1.08	1,079.8
3.05	0.76	3.81	1.05	1,500.4
2.95	0.74	3.69	1.02	1,640.8
2.87	0.72	3.59	0.99	1,603.0
2.82	0.71	3.53	0.97	1,435.3
0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.0
0.00	0.00	0.00	0.00	0.0

APPENDIX D: BACT COST CALCULATIONS

Table D-1. General Cost Calculation Inputs

Number of Main Engines	30
Number of Support Engines	2
Bank Prime Rate (Dec. 2019)[1]	4.75%
Lifespan of SCR (yrs.)[2]	25
Lifespan of DPF (yrs.)[2]	25
Lifespan of DOC (yrs.)[2]	25
Lifespan of Tier 4 Integrated Control System (yrs.)	25
CECPI 2016 ($)	541.7
CECPI 2018 ($)	603.1

[1] Capital recovery is calculated using a 4.75% annual interest rate, which is the bank prime rate as of December 2019.

[2] 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[1]

Pollutant	Main tpy	Support tpy	SCR Removal %	DPF Removal %	DOC Removal %	Tier 4 Removal %
Particulate Matter (PM)	1.70	0.01	0%	90%	25%	88%
Carbon Monoxide (CO)	13.77	0.19	0%	80%	80%	80%
Volatile Organic Compounds (VOC)	1.02	0.02	0%	70%	70%	70%
Nitrogen Oxides (NO_X)	54.98	0.38	90%	0%	0%	90%

[1] Control technology removal efficiencies are consistent with calculations from recent Vantage and CyrusOne applications.

Table D-3. Toxic Air Pollutant Emission Rates and Control Efficiencies[1]

Pollutant	Main tpy	Support tpy	SCR Removal %	DPF Removal %	DOC Removal %	Tier 4 Removal %
Acrolein	1.55E-04	1.61E-05	0%	70%	70%	70%
Benzene	1.52E-02	1.62E-04	0%	70%	70%	70%
Benzo(a)pyrene	5.04E-06	3.27E-08	0%	70%	70%	70%
Dibenz(a,h)anthracene	6.79E-06	1.01E-07	0%	70%	70%	70%
Formaldehyde	1.55E-03	2.05E-04	0%	70%	70%	70%
Naphthalene	2.55E-03	1.47E-05	0%	70%	70%	70%
Xylenes	3.78E-03	4.95E-05	0%	70%	70%	70%
Diesel engine exhaust, particulate	1.70E+00	9.92E-03	0%	90%	25%	88%
Sulfur Dioxide (SO_2)	3.64E-02	5.41E-02	0%	0%	0%	0%
Carbon Monoxide (CO)	1.38E+01	1.87E-01	0%	80%	80%	80%
Nitrogen Dioxide (NO_2)	5.50E+00	3.77E-02	90%	0%	0%	90%

[1] Control technology removal efficiencies are consistent with calculations from recent Vantage and CyrusOne applications.

Table D-4. SCR Cost Calculation Inputs

MW of NH3 (g/mol)	17.03
MW of NOX (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[1]	0.9
Water density (lb/gal)	8.35
Size of main engines (MW)	2.25
NRF[2]	1.125
$CC_{replace}$ ($/ft^3)[3]	227
Size of support engines (MW)	0.3

[1] 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)

[2] NRF is the NO_X removal, as defined in the EPA Control Cost Manual, 7th Edition, Equation 2.41.

[3] $CC_{replace}$ is the cost of catalyst replacement. The value used is the catalyst replacement cost used in EPA Control Cost Manual, 7th Edition, Section 2.5, Example Problem #1.

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 30 Main Engines	$ 5,082,765	[a]	A
	Emission Control Package for 2 Support Engines	$ 101,151	[i]	B
	Sales Tax	$ 336,955	[b]	C = WA State Tax of 6.5% x (A + B)
	Shipping	$ 259,196	[b]	D = 5% of package price x (A + B)
	Installation for 30 Main Engines	$ 390,000	[c]	E
	Installation for 2 Support Engines	$ 26,000	[c]	F
Total Direct Cost		*$ 6,196,067*		TDC = A + B + C + D + E + F
Indirect Cost				
	Engineering	$ 96,000	[d]	G
	Construction and Field Expenses	$ 96,000	[d]	H
	Contractor Fees	$ 421,333	[d]	I = 6.8% x (A + B + C + D + E + F)
	Startup	$ 96,000	[d]	J
	Performance Test	$ 61,960.67	[d]	K = 1% x (A + B + C + D + E + F)
	Contingencies	$ 185,882.00	[d]	L = 3% x (A + B + C + D + E + F)
Total Indirect Cost		*$ 957,175*		TIC = G + H + I + J + K + L
Total Capital Investment		**$ 7,153,242**		TCI = TDC + TIC

Table D-5b. Operating Costs

Operating Cost				Reference
Direct Annual Cost				
	Maintenance	$ 35,766	[e]	M = 0.5% x TCI
	Catalyst Cost	$ 264,214	[e]	N = {Cost of replacement catalyst}
	Reagent Consumption	$ 5,222	[f]	O = {NO_X removal, cost of ammonia}
Total Direct Annual Costs		*$ 305,202*		DAC = M + N + O
Indirect Annual Costs				
	Administrative Charges	$ 3,597	[b]	P = 3% x ((Op. Labor Cost) + 40% x K)
	Property Tax	$ 71,532.42	[b]	Q = 1% x TCI
	Insurance	$ 71,532.42	[b]	R = 1% x TCI
	Capital Recovery	$ 494,897.95	[g]	CRC_S = TCI x CRF
Total Indirect Annual Costs		*$ 641,560*		IDAC = P + Q + R + CRC
Total Annual Cost [h]		**$ 946,762**		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) multiplied by 30 engines.

[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 price from Vantage (for the 3 MWe unit) and CyrusOne (for the 2250 unit) multiplied by 30 engines.

[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 4.75% annual interest rate, which is the bank prime rate as of December 2019, 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		$ 946,762		
	Ecology Acceptable Unit Cost ($/ton)	**Total Removal (tpy)**		**Reasonable Annual Cost ($/yr)**
Removal efficiency of 90% for NOx	$12,000	49.82	[a,c]	$ 597,888.00
		Total Reasonable Annual Cost for Combined Pollutants	[a,b]	$ 597,888.00
		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	4.98E+00	$ 92,022.57
				Total Reasonable Annual Cost for Combined Pollutants	$ 92,022.57
				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 application

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 30 Main Engines	$ 3,023,685	[a]	A
	Emission Control Package for 2 Support Engine	$ 60,174	[g]	B
	Sales Tax	$ 200,451	[b]	C = WA State Tax of 6.5% x (A + B)
	Shipping	$ 154,192.95	[b]	D = 5% x (A + B)
	Instrumentation	$ 30,838.59	[b]	E = 1% x (A + B)
Total Direct Cost		*$ 3,469,341*		TDC = A + B + C + D + E
Indirect Cost				
	Engineering	$ 64,000	[c]	F
	Construction and Field Expenses	$ -	[c]	G
	Contractor Fees	$ 235,915	[c]	H = 6.8% x (A + B + C + D + E)
	Startup	$ 48,000.00	[c]	I
	Performance Test	$ 34,693.41	[c]	J = 1% x (A + B + C + D + E)
	Contingencies	$ 104,080.24	[c]	K = 3% x (A + B + C + D + E)
Total Indirect Cost		*$ 486,689*		TIC = F + G + H + I + J + K
Total Capital Investment		**$ 3,956,030**		TCI = TDC + TIC

Table D-6b. Operating Costs

Operating Cost			Reference
Indirect Annual Costs[e]			
	Administrative Charges	$ 79,121 [b]	L = 2% × TCI
	Property Tax	$ 39,560 [b]	M = 1% × TCI
	Insurance	$ 39,560 [b]	N = 1% × TCI
	Capital Recovery	$ 273,698.45 [d]	CRC_S = TCI x CRF
Total Indirect Annual Costs		*$ 431,940*	IDAC = L + M + N + CRC
Total Annual Cost[f]		**$ 431,940** [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 4.75% annual interest rate, which is the bank prime rate as of December 2019, 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		**$ 431,940**		
	Ecology Acceptable Unit Cost ($/ton)	**Total Removal (tpy)**		**Cost Effectiveness ($/ton)**
Removal efficiency of 90% for PM	$12,000	1.54	[a,c]	$ 18,467.14
Removal efficiency of 80% for CO	$5,000	11.17	[a,c]	$ 55,840.00
Removal efficiency of 70% for VOC	$12,000	0.73	[a,c]	$ 8,707.44
		Total Reasonable Annual Cost for Combined Pollutants	[a,b]	$ 83,014.58
		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	1.19E-04	$ 6.13
Removal efficiency of 70% for Benzene	1.30E-01	5.3	$ 55,833	1.08E-02	$ 601.07
Removal efficiency of 70% for Benzo(a)pyrene	1.00E-03	7.4	$ 78,029	3.55E-06	$ 0.28
Removal efficiency of 70% for Dibenz(a,h)anthracene	5.00E-04	7.7	$ 81,190	4.82E-06	$ 0.39
Removal efficiency of 70% for Formaldehyde	1.70E-01	5.2	$ 54,610	1.23E-03	$ 66.99
Removal efficiency of 70% for Naphthalene	2.90E-02	6.0	$ 62,674	1.79E-03	$ 112.49
Removal efficiency of 70% for Xylenes	2.20E+02	2.1	$ 21,934	2.68E-03	$ 58.87
Removal efficiency of 90% for Diesel engine exhaust, particulate	3.30E-03	6.9	$ 72,585	1.54E+00	$ 111,768.18
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	1.12E+01	$ 8,162.00
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	$ 120,776.40
				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 = $\text{Log}_{10}(27{,}000 / \text{ASIL})$

[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 consisten 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 30 Main Engines	$ 667,290	[a]	A
	Emission Control Package for 2 Support Engines	$ 13,280	[g]	B
	Sales Tax	$ 44,237	[b]	C = WA State Tax of 6.5% x (A + B)
	Shipping	$ 34,028.48	[b]	D = 5% x (A +B)
	Instrumentation	$ 6,805.70	[b]	E = 1% x (A + B)
Total Direct Cost		*$ 765,641*		TDC = A + B + C + D + E
Indirect Cost				
	Engineering	$ 19,141	[c]	F = 2.5% x (A + B + C + D + E)
	Construction and Field Expenses	$ -	[c]	G
	Contractor Fees	$ 52,064	[c]	H = 6.8% x (A + B + C + D + E)
	Startup	$ 15,312.82	[c]	I = 2% x (A + B + C + D + E)
	Performance Test	$ 7,656.41	[c]	J = 1% x (A + B + C + D + E)
	Other instrumentation	$ 22,969.23	[c]	K = 3% x (A + B + C + D + E)
Total Indirect Cost		*$ 117,143*		TIC = F + G + H + I + J + K
Total Capital Investment		**$ 882,784**		TCI = TDC + TIC

Table D-7b. Operating Costs

Operating Cost			Reference
Indirect Annual Costs [e]			
	Administrative Charges	$ 17,656 [b]	L = 2% × TCI
	Property Tax	$ 8,828 [b]	M = 1% × TCI
	Insurance	$ 8,828 [b]	N = 1% × TCI
	Capital Recovery	$ 61,075.52 [d]	CRC_S = TCI x CRF
Total Indirect Annual Costs		*$ 96,387*	IDAC = L + M + N + CRC
Total Annual Cost [f]		**$ 96,387** [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 4.75% annual interest rate, which is the bank prime rate as of December 2019, and a 25-yr life span for the DOC, following the precedence 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		**$ 96,387**	
	Ecology Acceptable Unit Cost ($/ton)	**Total Removal (tpy)**	**Reasonable Annual Cost ($/yr)**
Removal efficiency of 25% for PM	$12,000	0.43 [a,c]	$ 5,129.76
Removal efficiency of 80% for CO	$5,000	11.17 [a,c]	$ 55,840.00
Removal efficiency of 70% for VOC	$12,000	0.73 [a,c]	$ 8,707.44
		Total Reasonable Annual Cost for Combined Pollutants [a,b]	$ 69,677.20
		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 ($\mu g/m^3$)	ASIL Based Cost Factor [b]	Ecology Acceptable Unit Cost ($/ton)[c]	Total Removal (tpy)	Reasonable Annual Cost ($/yr)[d]
Removal efficiency of 70% for Acrolein	3.50E-01	4.89	$ 51,317	1.19E-04	$ 6.13
Removal efficiency of 70% for Benzene	1.30E-01	5.32	$ 55,833	1.08E-02	$ 601.07
Removal efficiency of 70% for Benzo(a)pyrene	1.00E-03	7.43	$ 78,029	3.55E-06	$ 0.28
Removal efficiency of 70% for Dibenz(a,h)anthracene	5.00E-04	7.73	$ 81,190	4.82E-06	$ 0.39
Removal efficiency of 70% for Formaldehyde	1.70E-01	5.20	$ 54,610	1.23E-03	$ 66.99
Removal efficiency of 70% for Naphthalene	2.90E-02	5.97	$ 62,674	1.79E-03	$ 112.49
Removal efficiency of 70% for Xylenes	2.20E+02	2.09	$ 21,934	2.68E-03	$ 58.87
Removal efficiency of 25% for Diesel engine exhaust, particulate	3.30E-03	6.91	$ 72,585	4.28E-01	$ 31,046.72
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	1.12E+01	$ 8,162.00
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	$ 40,054.94
				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 30 Main Engines	$ 7,701,450	[a]	A
	Emission Control Package for 2 Support Engin	$ 153,266	[f]	B
	Sales Tax	$ 510,557	[b]	C = WA State Tax of 6.5% x (A + B)
	Shipping	$ 392,735.78	[b]	D = 5% x (A + B)
	Instrumentation	$ 78,547.16	[b]	E = 1% x (A + B)
Total Direct Cost		*$ 8,836,555*		TDC = A + B + C + D + E
Indirect Cost				
	Engineering	$ 160,000	[c]	F
	Construction and Field Expenses	$ 96,000	[c]	G
	Contractor Fees	$ 600,886	[c]	H = 6.8% x (A + B + C + D + E)
	Startup	$ 96,000.00	[c]	I
	Performance Test	$ 88,365.55	[c]	J = 1% x (A + B + C + D + E)
	Contingencies	$ 265,096.65	[c]	K = 3% x (A + B + C + D + E)
Total Indirect Cost		*$ 1,306,348*		TIC = F + G + H + I + J + K
Total Capital Investment		**$ 10,142,903**		TCI = TDC + TIC

Table D-8b. Operating Costs

Operating Cost			Reference
Indirect Annual Costs			
	Administrative Charges	$ 202,858 [b]	L = 2% × TCI
	Property Tax	$ 101,429 [b]	M = 1% × TCI
	Insurance	$ 101,429 [b]	N = 1% × TCI
	Capital Recovery	$ 701,738.01 [d]	CRC_S = TCI x CRF
Total Indirect Annual Costs		*$ 1,107,454*	IDAC = L + M + N + CRC
Total Annual Cost [e]		**$ 1,107,454** [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 4.75% annual interest rate, which is the bank prime rate as of December 2019, and a 25-yr life span for the DOC, following the precedence 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		**$ 1,107,454**	
	Ecology Acceptable Unit Cost ($/ton)	**Total Removal (tpy)**	**Reasonable Annual Cost ($/yr)**
Removal efficiency of 88% for PM	$12,000	1.50 [a,c]	$ 18,056.76
Removal efficiency of 80% for CO	$5,000	11.17 [a,c]	$ 55,840.00
Removal efficiency of 70% for VOC	$12,000	0.73 [a,c]	$ 8,707.44
Removal efficiency of 90% for NOx	$12,000	49.82 [a,c]	$ 597,888.00
		Total Reasonable Annual Cost for Combined Pollutants [a,b]	$ 680,492.20
		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	1.19E-04	$ 6.13
Removal efficiency of 70% for Benzene	1.30E-01	5.32	$ 55,833	1.08E-02	$ 601.07
Removal efficiency of 70% for Benzo(a)pyrene	1.00E-03	7.43	$ 78,029	3.55E-06	$ 0.28
Removal efficiency of 70% for Dibenz(a,h)anthracene	5.00E-04	7.73	$ 81,190	4.82E-06	$ 0.39
Removal efficiency of 70% for Formaldehyde	1.70E-01	5.20	$ 54,610	1.23E-03	$ 66.99
Removal efficiency of 70% for Naphthalene	2.90E-02	5.97	$ 62,674	1.79E-03	$ 112.49
Removal efficiency of 70% for Xylenes	2.20E+02	2.09	$ 21,934	2.68E-03	$ 58.87
Removal efficiency of 88% for Diesel engine exhaust, particulate	3.30E-03	6.91	$ 72,585	1.51E+00	$ 109,284.44
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	1.12E+01	$ 8,162.00
Removal efficiency of 90% for Nitrogen Dioxide (NO2)	4.70E+02	1.76	$ 18,472	4.98E+00	$ 92,022.57
				Total Reasonable Annual Cost for Combined Pollutants	$ 210,315.23
				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 = $\text{Log}_{10}(27{,}000 / \text{ASIL})$

[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 Configuration	Modeled Load Scenario [1]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Emission Rate [2] (g/s/engine)
NO_X	1-hr	D12	100%	18.29	724.15	47.56	0.46	8.401E+00
NO_X	Annual	D18	100%	18.29	724.15	47.56	0.46	5.271E-02
$PM_{10}/PM_{2.5}$	24-hr	D12	100%	18.29	724.15	47.56	0.46	3.412E-01
$PM_{2.5}$	Annual	D12	10%	18.29	587.04	11.50	0.46	1.033E-03
CO	1-hr	D12	25%	18.29	659.26	18.63	0.46	1.593E+00
CO	8-hr	D12	25%	18.29	659.26	18.63	0.46	1.593E+00
SO_2	1-hr	D12	100%	18.29	724.15	47.56	0.46	5.566E-03
SO_2	3-hr	D12	100%	18.29	724.15	47.56	0.46	5.566E-03

[1] 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.

[2] 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: 55

Table E-1b. For Each Support Genset - Criteria Pollutant Model Parameters

Pollutant	Averaging Period	Modeled Configuration	Modeled Load Scenario [1]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Emission Rate [2] (g/s/engine)
NO_X	1-hr	N/A	100%	3.66	770.48	58.97	0.15	8.632E-01
NO_X	Annual	N/A	100%	3.66	770.48	58.97	0.15	5.417E-03
$PM_{10}/PM_{2.5}$	24-hr	N/A	10%	3.66	540.93	15.91	0.15	4.891E-02
$PM_{2.5}$	Annual	N/A	10%	3.66	540.93	15.91	0.15	2.993E-04
CO	1-hr	N/A	50%	3.66	691.21	44.37	0.15	4.541E-01
CO	8-hr	N/A	50%	3.66	691.21	44.37	0.15	4.541E-01
SO_2	1-hr	N/A	100%	3.66	770.48	58.97	0.15	1.240E-01
SO_2	3-hr	N/A	100%	3.66	770.48	58.97	0.15	1.240E-01

[1] 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.

[2] 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: 55

Table E-2a. For Each Main Genset - TAP Model Parameters

Pollutant	Averaging Period	Modeled Configuration	Modeled Load Scenario [1]	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Emission Rate [2,3] (g/s/engine)
Acrolein	24-hr	D12	100%	18.29	724.15	47.56	0.46	2.360E-05
Naphthalene	year	D18	100%	18.29	724.15	47.56	0.46	2.444E-06
Benzene	year	D18	100%	18.29	724.15	47.56	0.46	1.459E-05
Diesel Engine Exhaust, Particulate	year	D18	100% - Cummins DQKAN [1]	18.29	823.15	52.52	0.46	1.631E-03
CO	1-hr	D12	25%	18.29	659.26	18.63	0.46	1.593E+00
SO_2	1-hr	D12	100%	18.29	724.15	47.56	0.46	5.566E-03
NO_2	1-hr	D12	100%	18.29	724.15	47.56	0.46	8.401E+00

[1] 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.

[2] 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: 55

[3] 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-2b. For Each Support Genset - TAP Model Parameters

Pollutant	Averaging Period	Modeled Configuration	Modeled Load Scenario [1]	Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Emission Rate [2,3] (g/s/engine)
Acrolein	24-hr	N/A	100%	3.66	770.48	58.97	0.15	3.684E-05
Naphthalene	year	N/A	100%	3.66	770.48	58.97	0.15	2.120E-07
Benzene	year	N/A	100%	3.66	770.48	58.97	0.15	1.555E-07
Diesel Engine Exhaust, Particulate	year	N/A	50% - Cummins	3.66	691.48	44.37	0.15	1.427E-04
CO	1-hr	N/A	50%	3.66	691.21	44.37	0.15	4.541E-01
SO_2	1-hr	N/A	100%	3.66	770.48	58.97	0.15	1.240E-01
NO_2	1-hr	N/A	100%	3.66	770.48	58.97	0.15	8.632E-01

[1] 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.

[2] 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: 55

[3] 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
E1	E1 - Building E	286,589.80	5,236,110.00	395.87
E2	E2 - Building E	286,589.00	5,236,099.80	395.78
E3	E3 - Building E	286,589.00	5,236,092.00	395.65
E4	E4 - Building E	286,587.80	5,236,065.30	395.33
E5	E5 - Building E	286,587.40	5,236,057.80	395.25
E6	E6 - Building E	286,587.00	5,236,046.90	395.14
E7	E7 - Building E	286,803.50	5,236,101.40	395.83
E8	E8 - Building E	286,803.10	5,236,090.80	395.73
E9	E9 - Building E	286,803.10	5,236,082.20	395.62
E10	E10 - Building E	286,801.50	5,236,055.50	395.32
E11	E11 - Building E	286,801.10	5,236,049.60	395.25
E12	E12 - Building E	286,800.70	5,236,038.20	395.08
E13	E13 - Building E	286,622.90	5,236,025.80	394.83
E14	E14 - Building E	286,638.70	5,236,024.90	394.82
E15	E15 - Building E	286,654.10	5,236,024.50	394.81
E16	E16 - Building E	286,720.10	5,236,021.50	394.88
E17	E17 - Building E	286,735.90	5,236,020.70	394.88
E18	E18 - Building E	286,751.30	5,236,019.80	394.87
S1	Support Genset	286,991.00	5,236,103.40	395.07
S2	Support Genset	286,693.30	5,236,028.00	394.94

Table E-4a. For Each Main Genset - Load Analysis Parameters

Operation Load	Flow Rate [1] (acfm)	Diameter (ft)	Temp [1] (°F)	Stack Height (ft)	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Maximum Hourly Emission Rate, Warm Engine [2] (lb/hr/engine)			Maximum Hourly Emission Rate, Cold Start (lb/hr/engine)			Annual Emission Rate (tpy/engine)			Maximum Hourly Modeled Emission Rate (g/s/engine)			Annual Modeled Emission Rate (g/s/engine)			Modeled Emission Rate for TAPs [3] (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	NO_X	$PM_{10}/PM_{2.5}$	CO	
10%	4,002	1.50	597.0	60.0	18.29	587.04	11.50	0.46	7.02	1.27	6.01	7.01	1.34	6.81	0.19	0.04	0.18	8.845E-01	1.687E-01	8.577E-01	5.550E-03	1.033E-03	5.074E-03	31.30
25%	6,482	1.50	727.0	60.0	18.29	659.26	18.63	0.46	9.81	1.38	11.16	9.80	1.46	12.65	0.27	0.04	0.33	1.236E+00	1.839E-01	1.593E+00	7.757E-03	1.125E-03	9.427E-03	58.70
50%	10,902	1.50	821.0	60.0	18.29	711.48	31.34	0.46	20.34	1.49	6.06	20.32	1.57	6.87	0.56	0.04	0.18	2.563E+00	1.980E-01	8.656E-01	1.608E-02	1.211E-03	5.121E-03	102.80
75%	14,174	1.50	836.6	60.0	18.29	720.15	40.75	0.46	34.67	2.05	15.63	34.63	2.16	17.71	0.95	0.06	0.46	4.368E+00	2.719E-01	2.231E+00	2.741E-02	1.664E-03	1.320E-02	151.00
100%	16,546	1.50	843.8	60.0	18.29	724.15	47.56	0.46	66.67	2.57	12.04	66.60	2.71	13.64	1.83	0.07	0.35	8.401E+00	3.412E-01	1.719E+00	5.271E-02	2.088E-03	1.017E-02	173.50

[1] Flow rate and temperature are the lowest (i.e., most conservative) parameters across all vendors (see Load Emissions tables) for each load.
[2] Maximum hourly emission rate across all vendors (see Load Emissions tables) for each load. The maximum emission rates are for Tier 2 engines.
[3] 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-4b. For Each Support Genset - Load Analysis Parameters

Operation Load	Flow Rate [1] (acfm)	Diameter (ft)	Temp [1] (°F)	Stack Height (ft)	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	Maximum Hourly Emission Rate, Warm Engine [2] (lb/hr/engine)			Maximum Hourly Emission Rate, Cold Start (lb/hr/engine)			Annual Emission Rate (tpy/engine)			Maximum Hourly Modeled Emission Rate (g/s/engine)			Annual Modeled Emission Rate (g/s/engine)			Modeled Emission Rate for TAPs [3] (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	NO_X	$PM_{10}/PM_{2.5}$	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	0.02	0.0604790	0.0489101	0.0896687	3.795E-04	2.993E-04	5.305E-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	0.02	0.01	0.05	0.0806386	0.0358716	0.2291852	5.060E-04	2.195E-04	1.356E-03	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	0.03	0.01	0.09	0.1499375	0.0438431	0.4540731	9.409E-04	2.683E-04	2.686E-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	0.07	0.01	0.03	0.3270313	0.0252430	0.1568486	2.052E-03	1.545E-04	9.279E-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	0.19	0.01	0.02	0.8632361	0.0239144	0.0859444	5.417E-03	1.463E-04	5.084E-04	23.07

[1] Flow rate and temperature are the lowest (i.e., most conservative) parameters across both vendors.
[2] Maximum hourly emission rate across both vendors (see Load Emissions tables) for each load.
[3] 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-5. For Each Engine - DPM Load Analysis

Operation Load	Flow Rate [1] (acfm)	Diameter (ft)	Temp [1] (°F)	Stack Height (ft)	Stack Height (m)	Temp (K)	Exit Velocity (m/s)	Diameter (m)	DPM Maximum Hourly Emission Rate [1] (lb/hr/engine)	(g/s/engine)	DPM Maximum Hourly Emission Rate, Cold Start [1] (lb/hr/engine)	(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	3.39	4.878E-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	5.65	8.130E-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	8.48	1.220E-04
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	3.96	5.691E-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	3.96	5.691E-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	4.25	6.116E-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	7.09	1.019E-04
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	9.92	1.427E-04
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	4.25	6.116E-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	4.54	6.524E-05
CAT 3516C - Tier 2, 2500 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	17.52	2.520E-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	17.52	2.520E-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	16.39	2.358E-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	15.26	2.195E-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	23.18	3.333E-04
Cummins DQKAF - Tier 2, 2250 kW														
10%	4,150	1.50	597.0	60.0	18.29	587.04	11.93	0.46	0.60	7.562E-02	0.63	7.974E-02	33.93	4.880E-04
25%	6,594	1.50	727.0	60.0	18.29	659.26	18.96	0.46	0.72	9.111E-02	0.76	9.607E-02	40.87	5.879E-04
50%	11,190	1.50	821.0	60.0	18.29	711.48	32.17	0.46	0.65	8.200E-02	0.69	8.646E-02	36.79	5.291E-04
75%	14,174	1.50	855.0	60.0	18.29	730.37	40.75	0.46	0.43	5.467E-02	0.46	5.764E-02	24.52	3.527E-04
100%	16,546	1.50	895.0	60.0	18.29	752.59	47.56	0.46	0.72	9.111E-02	0.76	9.607E-02	40.87	5.879E-04
Cummins DQKAN - Tier 2, 2500 kW														
10%	4,002	1.50	713.0	60.0	18.29	651.48	11.50	0.46	0.56	7.078E-02	0.59	7.463E-02	31.75	4.567E-04
25%	6,482	1.50	849.0	60.0	18.29	727.04	18.63	0.46	0.86	1.087E-01	0.91	1.146E-01	48.76	7.014E-04
50%	10,902	1.50	939.0	60.0	18.29	777.04	31.34	0.46	0.92	1.163E-01	0.97	1.226E-01	52.16	7.503E-04
75%	15,122	1.50	981.0	60.0	18.29	800.37	43.47	0.46	1.50	1.896E-01	1.59	1.999E-01	85.05	1.223E-03
100%	18,269	1.50	1022.0	60.0	18.29	823.15	52.52	0.46	2.01	2.528E-01	2.12	2.665E-01	113.40	1.631E-03
Kohler KD2250 - Tier 2, 2250 kW														
10%	4,469	1.50	734.0	60.0	18.29	663.15	12.85	0.46	0.15	1.944E-02	0.16	2.050E-02	8.72	1.254E-04
25%	7,148	1.50	847.4	60.0	18.29	726.15	20.55	0.46	0.65	8.158E-02	0.68	8.603E-02	36.60	5.264E-04
50%	12,031	1.50	842.0	60.0	18.29	723.15	34.59	0.46	0.36	4.513E-02	0.38	4.759E-02	20.25	2.912E-04
75%	17,296	1.50	836.6	60.0	18.29	720.15	49.72	0.46	0.74	9.373E-02	0.78	9.884E-02	42.05	6.048E-04
100%	18,132	1.50	843.8	60.0	18.29	724.15	52.12	0.46	0.39	4.860E-02	0.41	5.125E-02	21.80	3.136E-04
Kohler KD2500 - Tier 2, 2500 kW														
10%	4,674	1.50	759.2	60.0	18.29	677.15	13.44	0.46	0.27	3.375E-02	0.28	3.559E-02	15.14	2.178E-04
25%	7,599	1.50	867.2	60.0	18.29	737.15	21.85	0.46	0.60	7.500E-02	0.63	7.909E-02	33.65	4.840E-04
50%	12,865	1.50	836.6	60.0	18.29	720.15	36.98	0.46	0.45	5.625E-02	0.47	5.932E-02	25.24	3.630E-04
75%	18,916	1.50	867.2	60.0	18.29	737.15	54.38	0.46	0.89	1.125E-01	0.94	1.186E-01	50.47	7.260E-04
100%	18,340	1.50	852.8	60.0	18.29	729.15	52.72	0.46	0.60	7.500E-02	0.63	7.909E-02	33.65	4.840E-04

[1] 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
BUILD_E	New Building E	286617.9	5236116.7	395.9	8.08	79.6	158.90	92.7

Table E-6b. Polygon Buildings

Model ID	Description	UTM X (m)	UTM Y (m)	Elevation (m)	Height (m)
BLD_2	Existing Building	286582.87	5237178.33	407.7	9.14
BLD_5	Existing Building	285839.12	5236347.36	399.8	6.10
BLD_6	Existing Building	285885.78	5236347.4	399.6	6.10
BLD_8	Existing Building	285960.91	5236347.1	399.5	6.10
BLD_108	Existing Building	286007.3	5236347.36	399.5	6.10
BLD_109	Existing Building	285839.13	5236511.03	401.5	6.10
BLD_111	Existing Building	286884	5236274	397.0	8.53
BLD_116	Existing Building	287223	5236464.95	397.3	8.53
BLD_117	Existing Building	287218.45	5236317.87	396.1	8.53
BLD_1	Existing Building	287053.86	5236717.27	400.4	9.45
BLD_10	Existing Building	286957.5	5236983.37	403.8	9.45
BLD_21	Existing Building	287249.32	5237234.12	407.0	9.45
BLD_25	Existing Building	287036.46	5237231.36	407.3	9.45
BLD_22	Existing Building	287234.01	5237005.54	403.4	9.45
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
EWALLE	Genset Enclosure - Building E, East Side	286776.4	5236114.3	396.0	3.66
EWALLW	Genset Enclosure - Building E, West Side	286618.4	5236121.8	396.0	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
EWALLSW	Genset Enclosure - Building E, Southwest Side	286614.1	5236036.9	395.0	3.66
EWALLSE	Genset Enclosure - Building E, Southeast Side	286705.3	5236032.6	395.0	3.66

Table E-7. Model Background Concentrations

Pollutant	Averaging Period	Background Concentration/ Use [a]	Units	Background Concentration ($\mu g/m^3$)
NO_2	1-hr	68	$\mu g/m^3$	68
	Annual	3.5	ppb	6.6
PM_{10}	24-hr	77.6	$\mu g/m^3$	77.6
$PM_{2.5}$	24-hr	18.9	$\mu g/m^3$	18.9
	Annual	5.8	$\mu g/m^3$	5.8
CO	1-hr	1.15	ppm	1316.5
	8-hr	0.81	ppm	927.3
O3	PVMRM	52	ppb	102.0
	8-hr	57	ppb	111.8
SO2	1-hr	2.9	ppb	7.6
	3-hr	5.4	ppb	14.1
	24-hr	0.9	ppb	2.4
	Annual	0.2	ppb	0.5
DPM	Annual	0.19	$\mu g/m^3$	0.19

[a] Background concentrations for models provided by Ecology in email from Ranil Dhammapala, dated 1/3/20.

APPENDIX F: AERMOD LOAD ANALYSIS RESULTS

Table F-1. Maximum Modeled Concentrations - Main Generator Sets

Pollutant	Averaging Period	Maximum Modeled Concentration (µg/m^3)									
		D12_10	D12_25	D12_50	D12_75	D12_100	D18_10	D18_25	D18_50	D18_75	D18_100
CO	8-HR	661.05	**995.68**	417.36	965.29	689.48	435.18	671.48	286.27	681.79	498.47
CO	1-HR	1031.75	**1277.35**	518.82	1168.32	840.83	780.99	957.90	403.83	922.48	637.97
NO_X	ANNUAL	70.01	66.80	89.93	122.29	204.18	59.92	66.80	101.91	147.12	**254.25**
NO_X	1-HR	1063.99	991.09	1536.19	2287.42	**4109.24**	805.39	743.23	1195.72	1806.08	3117.85
PM_{10}	24-HR	109.58	111.79	117.06	132.22	**148.79**	80.41	80.65	82.49	91.78	102.16
$PM_{2.5}$	ANNUAL	**16.41**	12.66	9.90	9.69	10.03	14.04	12.66	11.21	11.65	12.49
$PM_{2.5}$	24-HR	109.58	111.79	117.06	132.22	**148.79**	80.41	80.65	82.49	91.78	102.16
SO_2	3-HR	96.09	182.91	279.58	346.40	**432.91**	71.78	123.56	197.17	264.50	330.50
SO_2	1-HR	120.29	200.46	299.69	392.76	**489.14**	91.06	150.33	233.27	310.11	371.13
TAPs	ANNUAL	2477.30	3172.53	3607.16	4227.60	4216.82	2120.38	3172.51	4087.40	5085.98	**5250.91**
TAPs	24-HR	16544.69	28019.14	42671.53	57701.62	**62552.17**	12140.56	20215.02	30071.32	40054.85	42946.71
TAPs	1-HR	37651.73	47068.59	61615.60	79075.07	**84865.29**	28500.68	35297.32	47959.56	62435.58	64390.80

Table F-2a. Maximum Modeled Concentrations - Support Engine S1

Pollutant	Averaging Period	Maximum Modeled Concentration (µg/m^3)				
		S1_10	S1_25	S1_50	S1_75	S1_100
CO	8-HR	34.39	75.57	**130.87**	42.35	22.31
CO	1-HR	90.91	182.54	**298.73**	95.31	50.11
NO_X	ANNUAL	2.98	3.14	4.72	9.19	**22.77**
NO_X	1-HR	61.31	64.22	98.61	198.76	**503.30**
PM_{10}	24-HR	**10.66**	7.04	7.20	3.63	3.37
$PM_{2.5}$	ANNUAL	**2.41**	1.53	1.49	0.73	0.67
$PM_{2.5}$	24-HR	**10.66**	7.04	7.20	3.63	3.37
SO_2	3-HR	68.41	143.63	246.82	345.19	**442.56**
SO_2	1-HR	101.38	199.11	328.92	455.87	**583.07**
TAPs	ANNUAL	256.27	338.87	428.20	496.27	**608.48**
TAPs	24-HR	1133.82	1561.07	2073.96	2471.44	**3075.58**
TAPs	1-HR	5271.76	6928.88	8946.66	10728.03	**13451.35**

Table F-2b. Maximum Modeled Concentrations - Support Engine S2

Pollutant	Averaging Period	Maximum Modeled Concentration (µg/m^3)				
		S2_10	S2_25	S2_50	S2_75	S2_100
CO	8-HR	63.31	123.24	**207.13**	65.94	34.80
CO	1-HR	178.78	339.82	**527.85**	166.50	85.68
NO_X	ANNUAL	4.68	4.48	6.36	12.36	**30.74**
NO_X	1-HR	120.58	119.56	174.24	347.22	**860.54**
PM_{10}	24-HR	**25.71**	15.51	14.87	7.54	6.98
$PM_{2.5}$	ANNUAL	**3.79**	2.18	2.00	0.98	0.90
$PM_{2.5}$	24-HR	**25.71**	15.51	14.87	7.54	6.98
SO_2	3-HR	134.39	258.40	416.95	560.85	**704.17**
SO_2	1-HR	199.37	370.66	581.20	796.39	**996.92**
TAPs	ANNUAL	402.52	483.06	576.72	667.18	**821.49**
TAPs	24-HR	2733.75	3438.48	4279.89	5130.04	**6368.42**
TAPs	1-HR	10367.47	12899.10	15808.73	18741.60	**22998.94**

Table F-3. Individual Engine Load Analysis Results for $PM_{2.5}$ and NO_X

	$PM_{2.5}$ Modeled Maximum Concentration										NO_X Modeled Maximum Concentration									
	Annual					24-hr					Annual					1-hr				
Engine ID	10	25	50	75	100	10	25	50	75	100	10	25	50	75	100	10	25	50	75	100
D1	0.52694	0.37307	0.25318	0.24881	0.25933	7.1951	6.22609	4.28764	4.04238	4.48338	2.24832	1.9689	2.3011	3.14108	5.27895	62.31442	56.61259	86.31647	129.4088	229.4031
D2	0.58758	0.43452	0.30946	0.30584	0.31747	8.42763	7.67488	7.42579	7.5769	8.41736	2.50706	2.29319	2.81259	3.86104	6.46252	122.0735	98.85003	147.8565	218.3037	383.4654
D3	0.54261	0.42618	0.34256	0.34162	0.35374	7.91374	7.94647	7.77161	7.97376	8.68837	2.31519	2.24921	3.11339	4.31268	7.2009	121.256	101.3218	152.2051	226.1652	395.9836
D4	0.50494	0.43174	0.33919	0.3363	0.34756	8.1565	8.22193	8.39278	8.97588	9.66586	2.15448	2.27855	3.0828	4.24554	7.07504	99.26105	97.26093	146.3092	217.3586	384.5288
D5	0.45951	0.36185	0.30976	0.30451	0.31209	8.01081	8.08377	8.33279	9.03719	9.76467	1.96063	1.90968	2.81533	3.84428	6.35297	90.06616	92.29634	138.1908	205.7201	364.4504
D6	0.53779	0.30263	0.25826	0.25461	0.26265	5.2437	3.78168	2.89591	3.20791	3.58536	2.29463	1.59714	2.34728	3.21422	5.34663	75.03457	70.52239	107.8063	159.5077	284.0907
D7	0.48688	0.3756	0.28957	0.28189	0.29286	4.58435	4.22011	4.6151	5.29773	5.94803	2.0774	1.98224	2.63182	3.55868	5.96146	66.06387	63.37239	98.68692	147.5158	260.4482
D8	0.53506	0.41595	0.31925	0.30678	0.31743	5.40825	4.70111	5.10841	5.89449	6.72357	2.28296	2.1952	2.90153	3.87285	6.46165	71.01636	73.23169	115.2736	171.3091	303.3443
D9	0.59356	0.46814	0.36194	0.34651	0.35745	6.04775	5.18224	5.64871	6.53765	7.5139	2.53257	2.47062	3.28957	4.37438	7.27633	80.90656	83.6614	129.9141	193.1151	341.7785
D10	0.63171	0.49786	0.37521	0.37429	0.39234	5.74282	6.06828	6.51012	7.41416	8.44506	2.69535	2.62748	3.41015	4.72514	7.98652	81.19071	83.8572	121.3855	181.5275	321.6698
D11	0.65117	0.52039	0.40328	0.4056	0.42776	5.83691	6.17415	6.62663	7.5485	8.6102	2.7784	2.74639	3.66531	5.12046	8.70761	80.07499	82.03807	121.0216	178.7273	323.4268
D12	0.57642	0.2921	0.24206	0.24911	0.26654	8.23067	4.99896	3.53819	3.052	3.46778	2.45946	1.54157	2.20004	3.14488	5.42577	65.86217	63.54443	82.24613	118.2268	208.6203
D13	1.27068	1.01715	0.88548	0.9178	0.98201	10.9556	10.26041	10.02404	10.94575	12.14101	5.42167	5.36805	8.04778	11.58658	19.98992	98.97245	109.0085	162.2428	237.7506	420.1863
D14	1.24861	1.01061	0.8498	0.87663	0.93807	11.2452	10.3595	10.10677	11.64432	13.33579	5.32752	5.33356	7.72352	11.06676	19.09557	135.3281	136.8625	209.505	304.5843	543.3727
D15	1.23089	1.14976	1.05773	1.11095	1.20217	11.38439	10.48745	11.31246	13.0085	14.8873	5.25193	6.06793	9.61332	14.0249	24.47154	156.0583	156.7788	243.1862	357.8239	634.5597
D16	1.90432	1.82482	1.83068	2.01735	**2.23384**	10.63498	10.49971	11.15728	12.7596	14.55631	8.1253	9.63054	16.63846	25.4676	**45.4725**	144.8737	157.6384	240.7055	353.8154	627.6327
D17	1.90355	1.82046	1.81537	1.99587	**2.20767**	9.88443	9.97241	10.6156	12.11662	13.79601	8.122	9.60757	16.4993	25.19641	**44.9397**	129.059	140.5698	213.317	316.2005	560.982
D18	1.93329	1.84402	1.8144	1.9792	**2.18289**	11.75399	11.8627	12.28297	13.83602	15.6211	8.24889	9.7319	16.49041	24.98597	**44.4353**	149.5235	167.9295	263.5286	386.5572	676.6625
E1	0.78546	0.51593	0.30501	0.25527	0.23896	10.86856	8.97058	6.26204	5.94368	6.50503	3.35137	2.72286	2.77217	3.22265	4.86423	124.8004	112.1653	170.6784	252.7002	447.5384
E2	0.80969	0.56386	0.36649	0.30815	0.28941	10.89599	9.51389	6.77122	7.19239	8.19966	3.45476	2.9758	3.33091	3.89021	5.8913	142.2527	121.7337	184.3712	273.6115	483.6516
E3	0.82325	0.5785	0.3717	0.32419	0.31387	12.99581	12.88598	12.18153	12.22885	13.31387	3.51261	3.05308	3.37825	4.09264	6.38923	153.7884	129.8446	195.2961	290.8944	510.6281
E4	0.65661	0.49107	0.34396	0.31908	0.31364	10.52321	10.66148	11.0437	11.64994	12.37407	2.80161	2.59162	3.1261	4.02812	6.38456	109.8805	106.3506	159.5447	237.4719	419.1335
E5	0.55728	0.42331	0.29845	0.28029	0.28006	9.35501	9.41453	9.89095	10.6072	11.46114	2.37778	2.23403	2.7125	3.53851	5.70105	103.0513	98.8971	147.4145	219.6381	389.1109
E6	0.59902	0.25536	0.21411	0.21433	0.22432	6.61107	4.65041	3.44353	3.85203	4.32087	2.55586	1.34765	1.94599	2.70581	4.56624	85.67394	80.47026	123.3095	182.0868	321.5348
E7	0.77594	0.42101	0.25533	0.23422	0.23101	8.56948	9.06968	9.88629	11.32682	12.66	3.31076	2.22188	2.32063	2.95687	4.70245	139.9459	117.1887	178.4162	263.2952	467.4727
E8	0.79393	0.45885	0.28487	0.25959	0.2582	10.59591	10.96427	11.56188	13.08562	14.65891	3.38752	2.42163	2.58912	3.27718	5.25595	143.9231	116.4866	179.5071	262.4376	466.3402
E9	0.78014	0.48679	0.31316	0.28117	0.2787	10.75927	11.17881	11.85331	13.50692	15.24867	3.32867	2.56908	2.84616	3.54959	5.67332	134.2154	114.0698	176.0332	260.0762	457.3523
E10	0.46416	0.29181	0.21841	0.2214	0.23356	9.5841	10.016	10.76814	12.4179	14.23028	1.98044	1.54005	1.98505	2.79503	4.75432	103.413	104.7656	158.5629	234.5233	415.8326
E11	0.43771	0.2878	0.23172	0.23553	0.24889	8.82365	9.24606	9.99328	11.54402	13.19584	1.86761	1.51887	2.10598	2.97334	5.06645	97.11844	98.25182	156.8021	234.3337	404.4234
E12	0.58255	0.27837	0.17618	0.18132	0.1945	8.16045	5.15712	3.49265	2.63174	2.85465	2.48559	1.46913	1.60124	2.289	3.95925	77.87179	76.93586	119.97	177.2268	316.2415
E13	1.29819	1.03445	0.90549	0.93629	1.00264	13.26377	11.9965	11.07594	11.82784	12.99168	5.53907	5.45938	8.22969	11.82002	20.40991	112.6473	118.9623	176.9793	262.3916	467.1152
E14	1.47572	1.22734	1.04526	1.0945	1.18095	18.2524	15.89329	14.04304	14.7629	16.8874	6.29654	6.47736	9.49997	13.81725	24.03964	147.8541	151.3822	230.8656	341.9445	607.8807
E15	1.85039	1.51492	1.29829	1.34476	1.43671	**24.7413**	20.80459	17.56473	18.75075	21.39607	7.89516	7.99505	11.79974	16.97659	29.24593	178.933	185.2768	291.3752	436.8641	**774.262**
E16	2.04848	1.64261	1.33982	1.33195	1.39126	24.71502	23.40242	22.57058	**24.9463**	**28.2056**	8.74038	8.66892	12.17714	16.81487	28.3208	202.3917	221.8189	349.0549	516.9724	**915.654**
E17	1.75145	1.43238	1.18664	1.18713	1.24071	14.78948	15.01853	15.78623	17.81829	20.24489	7.47304	7.55945	10.785	14.98667	25.25613	172.7991	179.5544	270.3015	404.8348	**720.129**
E18	1.39776	1.16773	0.99349	1.00899	1.0592	11.60307	11.18633	12.33723	14.32135	16.45671	5.9639	6.16274	9.02945	12.73781	21.56118	138.5338	143.5136	216.7276	318.2801	568.7221

Table F-4. Main Genset DPM Load Analysis Results

Make/Model	D12					D18				
	10%	25%	50%	75%	100%	10%	25%	50%	75%	100%
Cummins_DQKAN	0.03451	0.03631	0.02543	0.03107	0.03453	0.03018	0.03683	0.02914	0.03848	**0.04464**
Cummins_DQKAF	0.03782	0.03137	0.01818	0.00982	0.01408	0.03266	0.0315	0.02072	0.01184	0.01763
CAT_3516C	0.01745	0.01138	0.00737	0.00551	0.00677	0.01582	0.01202	0.00861	0.00681	0.00879
Kohler_KD2250	0.00878	0.02537	0.00936	0.01413	0.00699	0.00793	0.02628	0.01086	0.01775	0.00887
Kohler_KD2500	0.01467	0.02214	0.01105	0.01543	0.01064	0.01348	0.0233	0.01301	0.0198	0.01355

Table F-5. Support Genset DPM Load Analysis Results

Make/Model	S1					S2				
	10%	25%	50%	75%	100%	10%	25%	50%	75%	100%
Cummins_DQDAC	0.00301	0.00397	**0.00449**	0.00168	0.0017	0.00473	0.00566	**0.00605**	0.00226	0.0023
CAT_C9	0.0021	0.00292	0.00374	0.0016	0.00144	0.0031	0.00404	0.00503	0.00215	0.00195

Files are attached electronically. A directory of files is provided below.

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	CLC1418.ami CLC1418.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 5 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 both of the support gensets being considered. File names are specified using the make and model of the given modeled engine.
\Load Analysis\NOx	NLC1418.ami NLC1418.aml	AERMOD input and output files for the NO_2 load analysis.
\Load Analysis\PM	PLC1418.ami PLC1418.aml	AERMOD input and output files for the $PM_{2.5}$/PM_{10} load analysis.
\Load Analysis\SO2	SLC1418.ami SLC1418.aml	AERMOD input and output files for the SO_2 load analysis.
\Load Analysis\TAP	TLC1418.ami TLC1418.aml	AERMOD input and output files for the TAP load analysis.
\MET Data	MWHxx.PFL MWHxx.SFC	Meteorological files as inputs to AERMOD, including the surface file and upper air file. "*xx*" indicates the year among 2014-2018. The surface file and upper air file containing 2014-2018 data are also included in this folder.
\Monte Carlo Script	MonteCarlo_script_parallel_processing_Jan2019.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 $PM_{2.5}$
\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 2014-2018.
\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 2014-2018. The model file that uses the concatenated 5-year meteorological data set is also included in this folder.

Folder	File Name	Description
\NAAQS Models\NO2\R	20200207_0055_MC_NO2_output.csv	Output file from the Monte Carlo Analysis
	No2_e*yy*_month.mxd	Max daily output file from AERMOD for each of the 3 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_e16.mxd	Max daily output file from AERMOD for the highest-contributing genset (model ID E16, 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_NC1418.ami PM2.5_24HR_NC1418.out PM2.5_Annual_NC1418.ami PM2.5_Annual_NC1418.out	AERMOD input and output files for the PM2.5 NAAQS models.

Folder	File Name	Description
\NAAQS Models\PM2.5\R	20200211_MC_PM25_output.csv	Output file from the Monte Carlo Analysis
	Pm25_e*yy*_*zz*_month.mxd	Max daily output file from AERMOD for each of the 3 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 and "*zz*" indicates the engine load of the particular genset.
	Pm25_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.
	Pm25_e16_100.mxd	Max daily output file from AERMOD for the highest-contributing genset (model ID E16, 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_PM25.R	R script containing the command lines for executing the Monte Carlo script provided by Ecology.
\NAAQS Models\PM10	PM10_24HR_NC1418.ami PM10_24HR_NC1418.out	AERMOD input and output files for the PM_{10} NAAQS model.
\NAAQS Models\SO2	SO2_1HR_NC1418.ami SO2_1HR_NC1418.out SO2_3HR_NC1418.ami SO2_3HR_NC1418.out	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	ATC1418.ami ATC1418.out	AERMOD input and output files for the Acrolein TAP model.
\TAP Models\Benzene	BTC*xx*.ami BTC*xx*.out	AERMOD input and output files for the Benzene TAP models. Model years are indicated by "*xx*" among 2014-2018.
\TAP Models\CO	CTC1418.ami CTC1418.out	AERMOD input and output files for the CO TAP model.
\TAP Models\DPM	DTC*xx*.ami DTC*xx*.out	AERMOD input and output files for the DPM TAP models. Model years are indicated by "*xx*" among 2014-2018.
\TAP Models\Naphthalene	NaTC*xx*.ami NaTC*xx*.out	AERMOD input and output files for the Naphthalene TAP models. Model years are indicated by "*xx*" among 2014-2018.
\TAP Models\NO2	NTC*xx*.ami NTC*xx*.out	AERMOD input and output files for the NO2 TAP models. Model years are indicated by "*xx*" among 2014-2018.

Folder	File Name	Description
\TAP Models\SO2	STC*xx*.ami STC*xx*.out	AERMOD input and output files for the SO_2 TAP models. Model years are indicated by "*xx*" among 2014-2018.