Ring Power CAT
Power Systems Division

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Submittal Data

Prepared For:
Harvest Power
221 Crescent Street
Waltham, MA 02453

ORLANDO DIGESTER
Caterpillar G3520
Generator Set

PRELIMINARY SUBMITTALS, REV. A

Ring Power Project Number:	11-748
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Date:
12/21/2011

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- DC Options

4. MISCELLANEOUS INFORMATION

Caterpillar Limited Warranty Statement
Torsional Vibration Analysis

(*) INDICATES ITEMS SHIPPED LOOSE. INSTALLATION / ASSEMBLY IS THE RESPONSIBILITY OF THE CUSTOMER / CONTRACTOR.

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GENERATOR SET

ENGINE DIVISION
ENGINE DATA SHEET

SUBJECT: GENERATOR SET PROTOTYPE TESTING

This document serves to certify the prototype testing that Caterpillar performs on its generator sets. The Caterpillar reputation for quality is well founded -- that's by design. Tens of thousands of Caterpillar Generator Sets are in use worldwide. Quality design, manufacture, and testing of performance-matched components makes them dependable power sources.

Caterpillar does extensive testing of its generator sets to ensure quality and long-lasting reliability for power requirements throughout the world. Prototype testing is an integral part of generator set evaluation and is performed on the engine; generator; and finally, the entire generator set. Prototype test data is used as the basis for performance guidelines for production generator sets, as well as the basis for the information in the Technical Information File (TIF) published by Caterpillar. Prototype testing will be outlined in three sections: Engine Prototype Testing, Generator Prototype Testing, and Generator Set Prototype Testing.

Engine Prototype Testing

Caterpillar's commitment to a reliable quality product starts with the design and development of engine systems in the Caterpillar Technical Center at Mossville, Illinois, U.S.A. The most modern instrumentation and lab testing procedures are employed to evaluate engine and component performance. Instrument labs throughout the Technical Center are used to determine the performance of new engine designs and modifications. New and modified engine designs are tested for performance and durability in thousands of hours of simulated operation in Caterpillar research test cells. The major test work performed on an engine under development in the prototype stages includes but is not limited to:

- Engine Performance
  - Partial Loads
  - Full Load
  - Lug
- Oil Consumption
- Fuel Consumption
- Exhaust Emissions
- Noise Levels
- Statability -- Cold Weather and Hot Weather
- Piston, Ring, and Liner Wear for Life Projections
- Piston Structure Test
- Lube System Evaluation
- Cooling System Performance and Heat Rejection
- Valve Train Overspeed Qualification
- Deep Thermal Cycle Endurance
- Cycle Endurance in the Lab
- Field Endurance

Printed in U.S.A.

There are many more tests which include engine component testing such as:

- Governors
- Injectors
- Bearings
- Turbos
- Valves
- Lifters
- Water Pumps
- Oil Pumps
- Fuel Lines

Engine prototype testing is an integral part of the development of all Caterpillar Engines and is" performed before any-power generation test "is attempted. This test is to assist in quality control of the final product and provide a record of the test results for future reference. Whenever the output requirement of the generator set engine is increased beyond that of the original basic dynamometer test, or when major components are changed, Caterpillar Generator Set Engines are submitted for test to verify performance to Caterpillar standards.

Generator Prototype Testing

Generator concept is designed and approved before any manufacture of test generators. Sufficient design data for analysis includes, but is not limited to, layout drawings, computer design sheets, torsional and linear vibration analysis data requirements, and mechanical assembly details. Caterpillar designs structural and electrical generator characteristics to match specific Caterpillar Engine performance. Generator-design meets or exceeds the quality standards commensurate with the quality expected of machines operating in prime power applications for similar output range. Generators are designed and tested in such a manner to achieve factory works approval by all recognized marine agencies, including the American Bureau of Shipping, Lloyd's Register of Shipping, Bureau Veritas, and Det norske Veritas. Verification of design and assurance of compliance with design quality standards is performed by a test development program performed on prototype generators manufactured to the concept design approved by Caterpillar. For verification of design and assurance of compliance to Caterpillar standards, the performance test work includes but is not limited to the following tests:

- Standard Production Tests
- Temperature Rise Heat Runs at Both 50 and 60 Hz and at Continuous and Standby Ratings
- Motor Starting at 50 and 60 Hz at 1.0 and 0.8 Power Factor
- Wave Form Harmonic Analysis
- Wave Form Pictures
- Saturation Curves
    - No Load
    - Short Circuit
    - Rated Load
- Direct Axis Synchronous Reactance
- Negative Sequence Reactance
- Zero Sequence Reactance
- Direct Axis Transient Reactance
- Voltage Dip and Rise (Application and Rejection)
- Voltage Wave Form Deviation

- Voltage Unbalance
- Part Load Readings
- Motorized for no Load Losses
- Exciter Open and Short Circuit Saturation Curve
- Efficiency/Loss Test
- Verification of Compliance
    - Overload Capability
    - Short Circuit Capability
    - 150% Overspeed Capability
- EMI Test
- Telephone Influencer Factor and Telephone Harmonic Factor

These tests are to be conducted in accordance with MIL Std-705B and additional test procedures approved by Caterpillar. Applicable standards include MG1-22 NEMA, CSA Std. C22.2-100, C50 (A.N.S.I.), IEC Pub. 34-1, BS 4999, and BS 5000.

Generator Set Prototype Testing

Caterpillar performs electrical tests and mechanical tests on prototype generator sets to assure that the engine-generator combination will perform adequately and reliably. Electric AC power generator tests incorporate a group of 15 tests in the procedure to evaluate the engine-generator combination. Although the entire series of tests may not be required in each situation, the proper selection of tests will provide an adequate evaluation. The following 15 tests provide a comprehensive evaluation of Caterpillar AC power generator sets.

- Waveform Analysis
- Voltage Adjustment
- Voltage Frequency Curve
- Voltage Drift
- Voltage Spike Check
- Voltage Sensing Loss
- Diode Stress
- Short Circuit Tests
- Harmonic Analysis
- Heat Runs
- Motor Starting
- Transient Response
- Excitation Requirements
- Saturation Curves
- Voltage Overshoot During Start

In addition to the rigorous electrical tests performed on Caterpillar Generator Sets, complete system testing and evaluation is performed on prototype generator sets. Prototype generator sets are subjected to extensive testing and endurance runs, including teardown after testing and complete inspection for stress or worn parts for signs of fatigue. Prototype generator sets must pass this stringent testing before production models are released for sale. Complete system testing for generator sets includes but is not limited to:

- Mounting Evaluation
- Wiring Compatibility
- Control Panel Functions
- Linear Vibration

- Torsional Analysis
- Radiator and Cooling Performance
- Fuel Consumption
- Oil Consumption
- Noise Levels
- Governor Response
- Heat Rejection Data
- Full Load Performance Checks
- Safety Shutdowns
    - High Water Temperature
    - Overspeed
    - Low Oil Pressure
    - Overcranking
- Auto Start and Shutdown Capabilities

In conclusion, Caterpillars generator sets undergo extensive prototype testing procedures. However, the Caterpillar commitment to quality does not stop at prototype testing. Production testing is just as important, if not more important, than Caterpillar's extensive prototype testing. Caterpillar sets the industry standard for production generator set testing. All engines are 100% dynamometer tested, all generators are fully loaded with motor drive, and all generator sets are assembled and tested again at partial and full loads with full electrical and mechanical tests to ensure the customer receives a quality product.

GAS GENERATOR SET

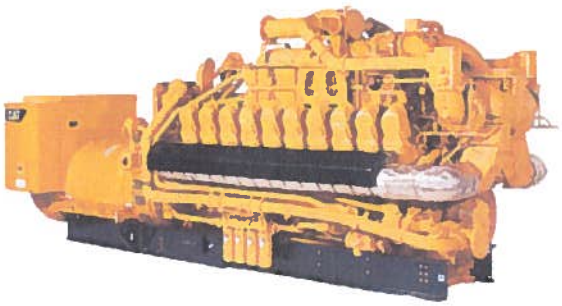

Image shown may not reflect actual package

LOW ENERGY FUEL
CONTINUOUS
1600 ekW / 2000 kVA
60 HZ 1200 RPM 480 VOLTS

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

BENEFITS

EMISSIONS
- Meets most worldwide emissions requirements down to .5 g/bhp-hr NO_x level without aftertreatment

FULL RANGE OF ATTACHMENTS
- Wide range of bolt-on system expansion attachments, factory designed and tested
- Flexible packaging options for easy and cost effective installation

PROVEN SYSTEM
- Fully protype tested
- Field proven in a wide range of applications worldwide
- Certified torsional vibration analysis available

WORLDWIDE PRODUCT SUPPORT
- Cat® dealers provide extensive post sales support including maintenance and repair agreement
- Cat dealers have over 1,600 dealer branch stores operating in 200 countries
- Cat® S•O•S SM program cost effectively detects internal engine component condition, even the presence of unwanted fluids and combustion by-products

CAT G3520C GAS ENGINE
- Robust high speed diesel block design provides prolonged life and lower owning operating costs
- Designed for maximum performance on low pressure gaseous fuel supply
- Simple open chamber combustion system for reliability and fuel flexibility
- Leading edge technology in ignition system and air/fuel ratio control for lower emission and engine efficiency
- One electronic control module handles all engine functions: ignition, governing, air/fuel ratio control and engine protection

CAT SR4B GENERATOR
- Designed to match performance and output characteristics of Cat gas engines
- Industry leading mechanical and electrical design
- High efficiency

CAT EMCP II+ CONTROL PANEL
- Simple user friendly interface and navigation
- Digital monitoring, metering and protection setting
- Fully-featured power metering and protective relaying
- UL 508A Listed
- Remote control and monitor capability options

CONTINUOUS 1600 ekW 2000 kVA

60 Hz 1200 RPM 480V

FACTORY INSTALLED STANDARD & OPTIONAL EQUIPMENT

System	Standard	Optional
Gas Engine Control Module (GECM)	Fuel/air ratio control; Start/stop logic: gas purge cycle, staged shutdown; Engine Protection System: detonation sensitive timing, high exhaust temperature shutdown; Governor: Transient richening and turbo bypass control; Ignition.	
Air Inlet	Two element, single-stage air cleaner with enclosure and service indicator	Air cleaner with precleaner; Mounting stand
Control Panel	EMCP II+	Local alarm module; Remote annuciator; Communications Module (PL1000T, PL1000E) Synchronizing module; Engine failure relay
Cooling	Engine driven water pumps for jacket water and aftercooler; Jacket water and SCAC thermostats; ANSI/DN customer flange connections for JW inlet and outlet Cat flanges on SCAC circuit	Coolant level drain line with valves, fan with guard; Inlet/Outlet connections.
Exhaust	Dry exhaust manifolds, insulated and shielded; Center section cooled turbocharger with Cat flanged outlet; Individual exhaust port and turbocharger outlet wired to Integrated Temperature Sensing Module (ITSM) with GECM providing alarms and shutdowns.	Flange; Exhaust expander; Elbow; Flexible fitting; Muffler and spark-arresting muffler with companion flanges.
Fuel	Electronic fuel metering valve; Throttle plate, 24V DC actuator, controlled by GECM; Fuel system is sized for 10.8 to 25.6 MJ/Nm^3 (275 to 650 Btu/cu ft) dry pipeline natural gas with pressure of 10.0 to 34.5 kPa (1.5 to 5 psi) to the engine fuel control valve.	Fuel filter; Gas pressure regulator; Gas shutoff valve, 24V, ETR (Energized-To-Run)
Generator	SR4B generator, includes: Cat Digital Voltage Regulator (Cat DVR) with 3-phase sensing and KVAR/PF control; Reactive droop; Bus bar connections; Winding temperature detectors; Anti-condensation space heater.	Medium and high voltage generators and attachments; Low voltage extension box; Cable access box; Air filter for generator; Bearing temperature detectors; Manual voltage control; European bus bar.
Governing	Electronic speed governor as part of GECM; Electronically-controlled 24V DC actuator connected to throttle shaft.	Woodward load sharing module
Ignition	Electronic Ignition System controlled by GECM; Individual cylinder Detonation Sensitive Timing (DST)	
Lubrication	Lubricating oil; Gear type lube oil pump; Oil filter, filler and dipstick; Integral lube oil cooler; Oil drain valve; Crankcase breather.	Oil level regualtor; Prelube pump; Positive crankcase ventilation system
Mounting	330 mm structural steel base (for low and medium voltage units); Spring-type anti-vibration mounts (shipped loose)	
Starting / Charging	24V starting motors; Battery with cables and rack (shipped loose); Battery disconnect switch; 60A, 24V charging alternator (standard on 60Hz 1800rpm only)	Charging alternator; Battery charger; Oversized battery; Jacket water heater;
General	Paint -- Caterpillar Yellow except rails & radiators; Damper guard. Operation and Maintenance Manuals; Parts Book.	Crankcase explosion relief valve; Engine barring group; EEC D.O.I and other certifications

CONTINUOUS 1600 ekW 2000 kVA

60 Hz 1200 RPM 480V

SPECIFICATIONS

CAT GAS ENGINE

G3520C SCAC 4-stroke-cycle watercooled gas engine

Number of Cylinders	V20
Bore --- mm (in)	170 (6.7)
Stroke --- mm (in)	190 (7.5)
Displacement --- L (cu in)	86.3 (5266)
Compression Ratio	11.3:1
Aspiration	Turbocharged Separate Circuit Aftercooled
Cooling Type	Two stage aftercooler, JW + O/C + A/C 1 combined
Fuel System	Low Pressure
Governor Type	Electronic (ADEM ™ III)

CAT SR4B GENERATOR

Frame size	868
Excitation	Permanent Magnet
Pitch	0.75
Number of poles	6
Number of bearings	2
Number of leads	6
Insulation	Class H
IP rating	Drip proof IP22
Alignment	Pilot shaft
Overspeed capability -- % of rated	125%
Waveform deviation line to line, no load	less than 3.0%
Paralleling kit droop transformer	Standard
Voltage regulator	Cat DVR
Voltage level adjustment	+/- 5.0%
Voltage regulation, steady state	+/- 0.5%
Voltage regulation with 3% speed change	+/- 0.5%
Telephone Influence Factor (TIF)	less than 50

Consult your Cat dealer for available voltage

CAT EMCPII+ CONTROL PANEL

- Power by 24 volts DC
- NEMA 12, IP44 dust-proof enclosure
- Lockable hinged door
- Single-location customer connection
- Auto start/stop control switch
- Voltage adjustment potentiomenter
- True RMS AC metering, 3 phase
- Purge cycle and staged shutdown logic
- Digital indication for:
  - RPM
  - Operating hours
  - Oil pressure
  - Coolant temperature
  - DC voltage
  - L-L volts, L-N volts, phase amps, Hz, ekW, kVA, kVAR, kWhr, %kW, pf
  - System diagnostic codes
- Shutdown with indicating lights;
  - Low oil pressure
  - High coolant temperature
  - High oil temperature
  - Overspeed
  - Overcrank
  - Emergency stop
  - High inlet air temperature (for TA engine only)
  - Detonation sensitive timing (for LE engine only)
- Programmable protective relaying functions:
  - Under / Over voltage
  - Under / Over frequency
  - Overcurrent
  - Reverse power
- Spare indicator LEDs
- Spare alarm/shutdown inputs

CONTINUOUS 1600 ekW 2000 kVA

60 Hz 1200 RPM 480V

TECHNICAL DATA

G3520C Gas Generator Set (1)			DM 5859		DM 5860	
Emission level (NO_x)	mg/Nm^3	g/bhp-hr	440	1.0	220	0.5
Aftercooler SCAC (Stage 2)	Deg C	Deg F	54	130	54	130
Package Performance						
Power Rating @ 0.8 pf (w/ 2 water pumps and w/o fan)	ekW	Continuous	1600		1600	
Power Rating @ 0.8 pf (w/ 2 water pumps and w/o fan)	kVA	Continuous	2000		2000	
Power Rating @ 1.0 pf (w/ 2 water pumps and w/o fan)	ekW	Continuous	1613		1613	
Electric Efficiency @ 1.0 pf (ISO 3046/1) **(2)**	%		39.7%		38.9%	
Mechanical Power (w/ 2 water pumps and w/o fan)	bkW	bhp	1665	2233	1665	2233
Fuel Consumption (3)						
100% load w/o fan	Nm^3/hr	scf/hr	812	30 390	832	31 115
75% load w/o fan	Nm^3/hr	scf/hr	639	23 898	647	24 214
50% load w/o fan	Nm^3/hr	scf/hr	435	16 236	461	17 247
Altitude Capability (4)						
At 25 Deg C (77 Deg F) ambient, above sea level	M	ft	880	2888	420	1378
Cooling System						
Ambient air temperature	Deg C	Deg F	25	77	25	77
Jacket water temperature (Maximum outlet)	Deg C	Deg F	110	230	110	230
Exhaust System						
Combustion air inlet flow rate	Nm^3/min	SCFM	112	4317	117	4512
Exhaust stack gas temperature	Deg C	Deg F	488	910	481	898
Exhaust gas flow rate	Nm^3/min	CFM	121	12 063	127	12 476
Exhaust flange size (internal diameter)	mm	in	360	14	360	14
Heat Rejection (5)						
Heat rejection to jacket water & oil cooler & AC-Stage 1	kW	Btu/min	907	51 594	926	52 669
Heat rejection to AC - Stage 2	kW	Btu/min	153	8675	156	8895
Heat rejection to exhaust (LHV to 350 Deg F)	kW	Btu/min	994	56 564	1011	57 574
Heat rejection to exhaust (LHV to 120 Deg C)	kW	Btu/min	1176	66 938	1201	68 360
Heat rejection to atmosphere from engine	kW	Btu/min	127	7210	127	7210
Heat rejection to atmosphere from generator	kW	Btu/min	66.7	3797	66.7	3797
Generator						
Frame			868		868	
Temperature rise	Deg C	Deg F	105	221	105	221
Motor starting capability @ 30% voltage dip **(6)**	skVA		4079		4079	
Lubrication System						
Standard sump refill with filter change	L	gal	541	143	541	143
Emissions (7)						
NO_x @ 5% O_2 (dry)	mg/Nm^3	g/bhp-hr	440	1.0	220	0.5
CO @ 5% O_2 (dry)	mg/Nm^3	g/bhp-hr	1100	2.5	1100	2.5
THC @ 5% O_2 (dry)	mg/Nm^3	g/bhp-hr	2522	5.56	2601	5.84
NMHC @ 5% O_2 (dry)	mg/Nm^3	g/bhp-hr	379	0.84	391	0.88
Exhaust O_2 (dry)	%		8.7		9	

CONTINUOUS 1600 ekW 2000 kVA

60 Hz 1200 RPM 480V

DEFINITIONS AND CONDITIONS

(1) **Continuous** --- Maximum output available for an unlimited time

Data is based on low energy gas having a Low Heat Value (LHV) of 18 MJ/Nm^3 (456 Btu/ft^3) and 135 Cat Methane Number. For values in excess of altitude, ambient temperature, inlet/exhaust restriction, or different from the conditions listed, contact your Cat dealer.

(2) **Efficiency** of standard generator is used. For higher efficiency generators, contact your local Cat dealer.

(3) **Ratings and fuel consumption** are based on ISO3046/1 standard reference conditions of 25° C (77° F) of ambient temperature and 100 kPa (29.61 in Hg) of total barometic pressure, 30% relative humidity with 0, +5% fuel tolerance.

(4) **Altitude** capability is based on 2.5 kPa air filter and 5.0 kPa exhaust stack restrictions.

(5) **Heat Rejection** --- Values based on nominal data with fuel tolerence of +/-2.5% and 2.5 kPa inlet and 5.0 kPa exhaust restrictions.

(6) Assume synchronous driver

(7) **Emissions data** measurements are consistent with those described in EPA CFR 40 Part 89 Subpart D & E and ISO8178-1 for measuring HC, CO, PM, NO_x.

Data shown is based on steady state engine operating conditions of 25° C (77 ° F), 96.28 kPa (28.43 in Hg) and having a LHV of 456 Btu/cu and 135 Cat Methane number at 101.6 kPa (30.00 in Hg) absolute and 0°C (32°F).
Emission data shown is subject to instrumentation, measurement, facility, and engine fuel system adjustment.
CO value is nominal and representative of a new engine with < or equal to 100 hours.
For not-to-exceed or site specific emissions, contact your Cat Dealer.

CONTINUOUS 1600 ekW 2000 kVA

60 Hz 1200 RPM 480V

Performance Number:	DM5859, DM5860
Feature Code:	520GE38
Generator Argmt:	158-6422
Source:	U.S. Sourced

www.Cat-ElectricPower.com

GENERATOR DATA

Selected Model

Engine: 3520	**Generator Frame:** 868	**Genset Rating (kW):** 1600.0	**Line Voltage:** 480
Fuel: Gas	**Generator Arrangement:** 1586422	**Genset Rating (kVA):** 2000.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2405.6
Duty: CONTINUOUS	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 40400 /40310 /38180 /9778

Spec Information

Generator Specification

Frame: 868 **Type:** SR4B	**No. of Bearings:** 2
Winding Type: FORM WOUND	**Flywheel:** 21.0
Connection: SERIES STAR	**Housing:** 00
Phases: 3	**No. of Leads:** 6
Poles: 6	**Wires per Lead:** 6
Sync Speed: 1200	**Generator Pitch:** 0.75

Generator Efficiency

Per Unit Load	kW	Efficiency %
0.25	400.0	92.7
0.5	800.0	95.4
0.75	1200.0	96.1
1.0	1600.0	96.2
1.1	1760.0	96.2

Reactances	Per Unit	Ohms
SUBTRANSIENT - DIRECT AXIS X''_d	0.1563	0.0180
SUBTRANSIENT - QUADRATURE AXIS X''_q	0.1571	0.0181
TRANSIENT - SATURATED X'_d	0.2500	0.0288
SYNCHRONOUS - DIRECT AXIS X_d	1.9149	0.2206
SYNCHRONOUS - QUADRATURE AXIS X_q	1.0486	0.1208
NEGATIVE SEQUENCE X_2	0.1571	0.0181
ZERO SEQUENCE X_0	0.0538	0.0062

Time Constants	Seconds
OPEN CIRCUIT TRANSIENT - DIRECT AXIS T'_{d0}	3.6300
SHORT CIRCUIT TRANSIENT - DIRECT AXIS T'_d	0.4741
OPEN CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_{d0}	0.0167
SHORT CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_d	0.0122
OPEN CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_{q0}	0.0113
SHORT CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_q	0.0091
EXCITER TIME CONSTANT T_e	0.1889
ARMATURE SHORT CIRCUIT T_a	0.0459

Short Circuit Ratio: 0.63	Stator Resistance = 0.0019 Ohms	Field Resistance = 1.522 Ohms

Voltage Regulation

Voltage level adustment: +/-	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:	10.24 Volts	40.03 Volts	Volts
Excitation current	3.2 Amps	10.29 Amps	Amps

Selected Model

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Frequency: 60 **Excitation Type:** Permanent Magnet **Pwr. Factor:** 0.8 **Rated Current:** 2405.6
Duty: CONTINUOUS **Connection:** SERIES STAR **Application:** EPG **Status:** Current
Version: 40400 /40310 /38180 /9778

Generator Mechanical Information

Center of Gravity

Dimension X	-1132.0 mm	-44.6 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 = 5413 kg * Rotor WT = 2156 kg * Stator WT = 3257 kg
11,934 LB 4,753 LB 7,180 LB

Rotor Balance = 0.0508 mm deflection PTP
Overspeed Capacity = 150% 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
62.0 LB IN. s^2	54.9 MLB IN./rad	5.0 IN.	924.6 LB IN. s^2	53.1 MLB IN./rad	3.8 IN.	3.9 LB IN. s^2
7.0 N m s^2	6.2 MN m/rad	127.0 mm	104.462 N m s^2	6.0 MN m/rad	96.5 mm	0.443 N m s^2

Total J
990.4 LB IN. s^2
111.905 N m s^2

Selected Model

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

Version: 40400 /40310 /38180 /9778

Generator Cooling Requirements - Temperature - Insulation Data

Cooling Requirements:		**Temperature Data: (Ambient 40 ^{0}C)**	
Heat Dissipated:	63.2 kW	**Stator Rise:**	105.0 ^{0}C
Air Flow:	0.0 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	1660.0 kVA
F BR -105/40	2000.0 kVA
H BR - 125/40	2200.0 kVA
F PR - 130/40	2200.0 kVA

Selected Model

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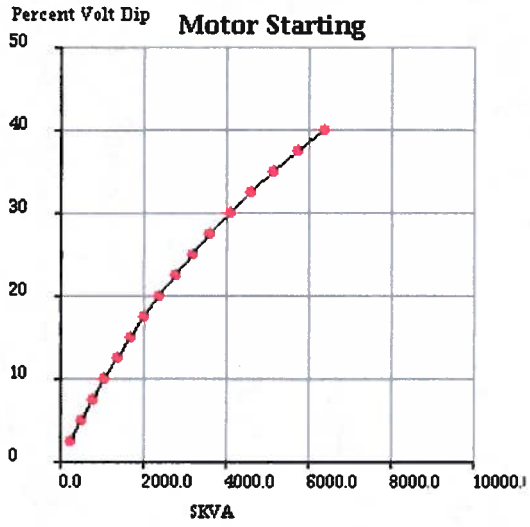
Starting Capability & Current Decrement

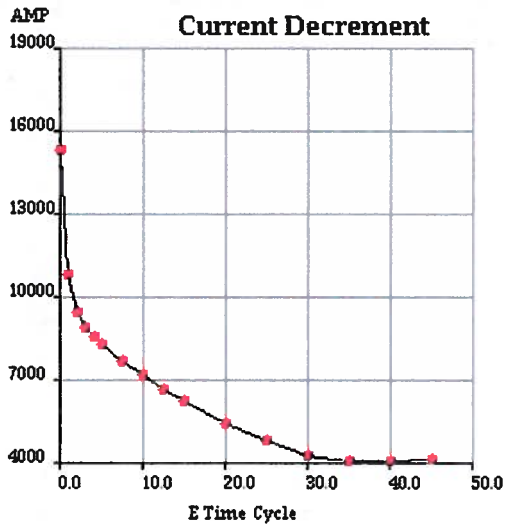
Motor Starting Capability (0.4 pf)

SKVA	Percent Volt Dip
244	2.5
501	5.0
772	7.5
1,057	10.0
1,360	12.5
1,680	15.0
2,019	17.5
2,379	20.0
2,763	22.5
3,172	25.0
3,610	27.5
4,079	30.0
4,582	32.5
5,125	35.0
5,710	37.5
6,345	40.0



Current Decrement Data

E Time Cycle	AMP
0.0	15,305
1.0	10,805
2.0	9,434
3.0	8,888
4.0	8,561
5.0	8,295
7.5	7,707
10.0	7,173
12.5	6,685
15.0	6,238
20.0	5,453
25.0	4,794
30.0	4,276
35.0	4,081
40.0	4,067
45.0	4,156



Instantaneous 3 Phase Fault Current: 15305 Amps **Instantaneous Line - Line Fault Current:** 13232 Amps
Instantaneous Line - Neutral Fault Current: 19568 Amps

Selected Model

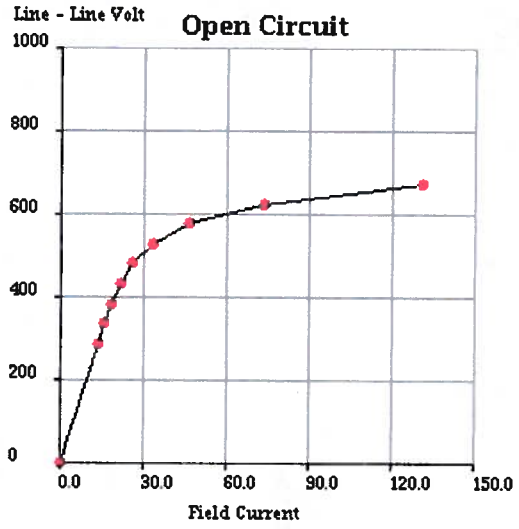
Engine: 3520	**Generator Frame:** 868	**Genset Rating (kW):** 1600.0	**Line Voltage:** 480
Fuel: Gas	**Generator Arrangement:** 1586422	**Genset Rating (kVA):** 2000.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2405.6
Duty: CONTINUOUS	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 40400 /40310 /38180 /9778

Generator Output Characteristic Curves

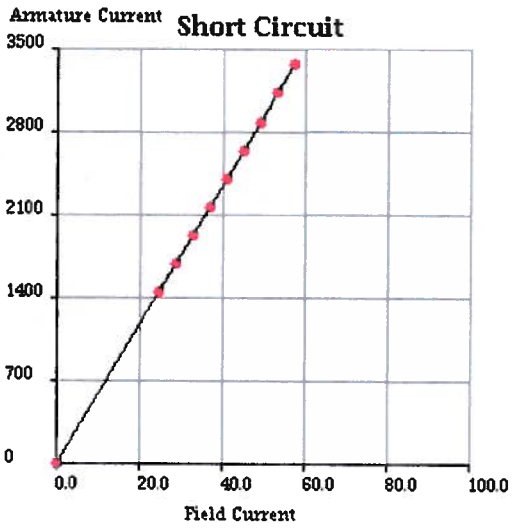
Open Circuit Curve

Field Current	Line - Line Volt
0.0	0
13.5	288
15.9	336
18.5	384
21.7	432
26.1	480
33.2	528
46.4	576
73.3	624
130.9	672



Short Circuit Curve

Field Current	Armature Current
0.0	0
24.6	1,443
28.7	1,684
32.8	1,925
36.9	2,165
41.0	2,406
45.1	2,646
49.2	2,887
53.3	3,127
57.4	3,368



Selected Model

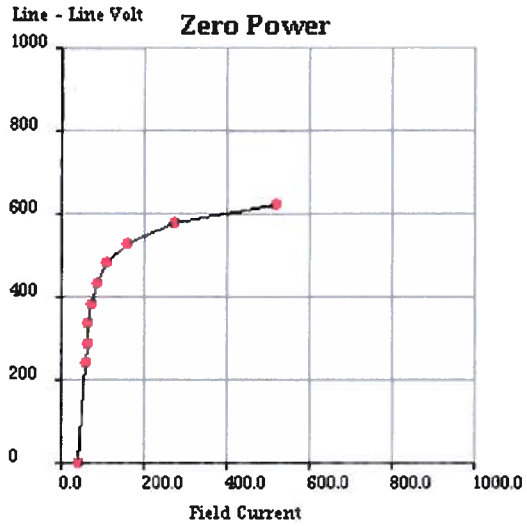
Engine: 3520	**Generator Frame:** 868	**Genset Rating (kW):** 1600.0	**Line Voltage:** 480
Fuel: Gas	**Generator Arrangement:** 1586422	**Genset Rating (kVA):** 2000.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2405.6
Duty: CONTINUOUS	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 40400 /40310 /38180 /9778

Generator Output Characteristic Curves

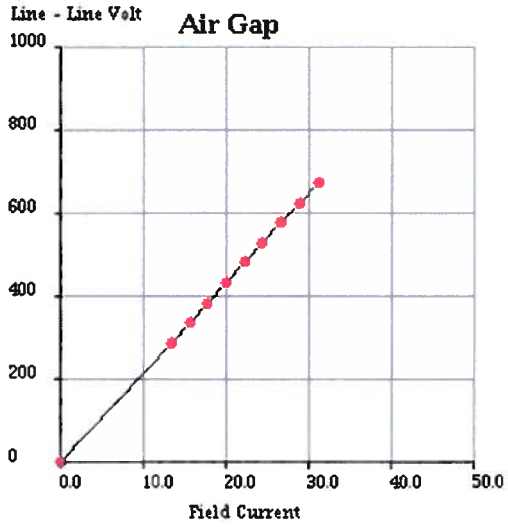
Zero Power Factor Curve

Field Current	Line - Line Volt
41.0	0
58.3	240
61.5	288
65.7	336
72.2	384
84.1	432
108.0	480
159.0	528
270.8	576
519.5	624



Air Gap Curve

Field Current	Line - Line Volt
0.0	0
13.3	288
15.6	336
17.8	384
20.0	432
22.2	480
24.4	528
26.7	576
28.9	624
31.1	672

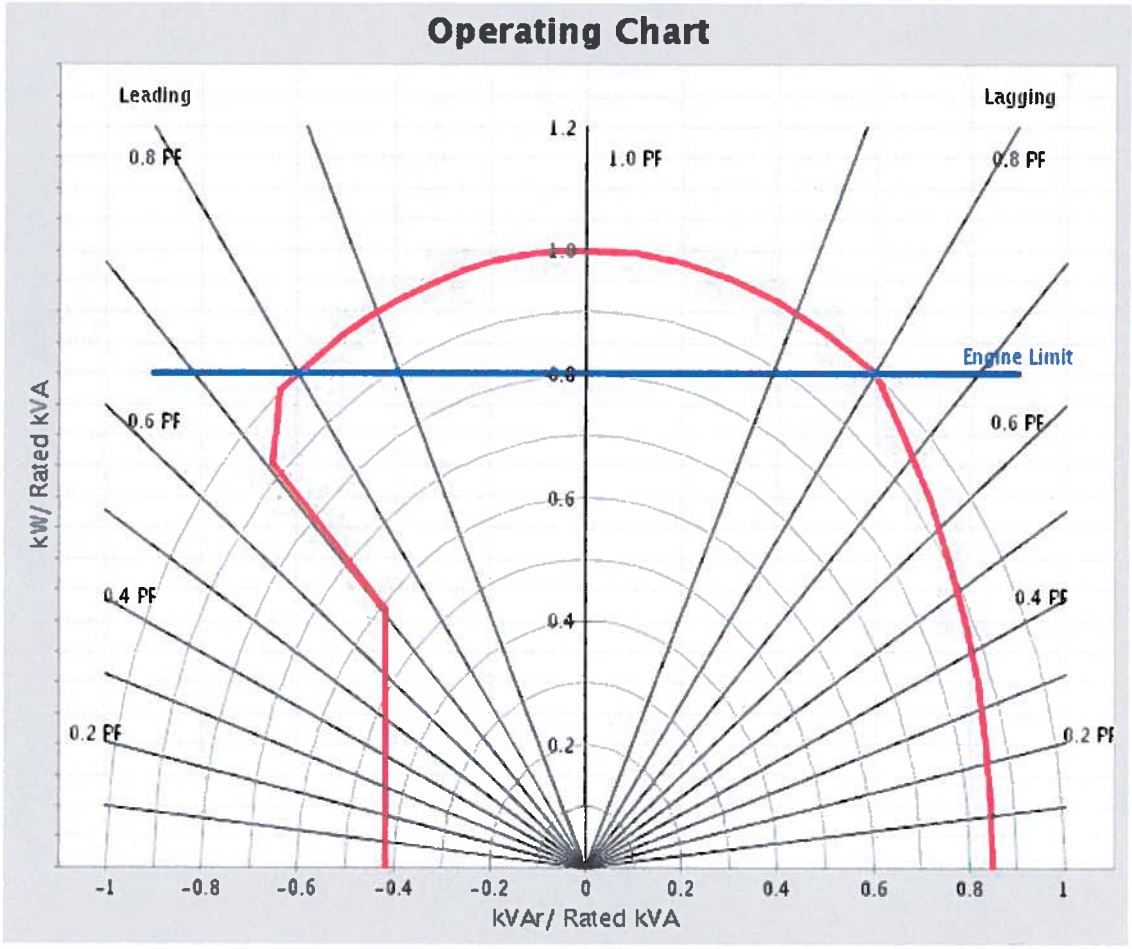


Selected Model

Engine: 3520	**Generator Frame:** 868	**Genset Rating (kW):** 1600.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 1586422	**Genset Rating (kVA):** 2000.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2405.6
Duty: CONTINUOUS	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 40400 /40310 /38180 /9778

Reactive Capability Curve



Selected Model

Engine: 3520	**Generator Frame:** 868	**Genset Rating (kW):** 1600.0	**Line Voltage:** 480
Fuel: Gas	**Generator Arrangement:** 1586422	**Genset Rating (kVA):** 2000.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 2405.6
Duty: CONTINUOUS	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 40400 /40310 /38180 /9778

General Information

DM7824 Caterpillar SR4B Generators (50 Hz, 60 Hz)
Data for 360s, 440s, 450s, 490, 590, 660, 690, 820 and 860 frames.
Caterpillar SR4B generators built by Leroy Somer-USA(& predecessors).

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.

G3520C

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1200	FUEL:	Low Energy
COMPRESSION RATIO:	11.3	FUEL SYSTEM:	CAT LOW PRESSURE WITH AIR FUEL RATIO CONTROL
AFTERCOOLER - STAGE 2 INLET (°F):	130		
AFTERCOOLER - STAGE 1 INLET (°F):	217	FUEL PRESSURE RANGE(psig):	1.5-5.0
JACKET WATER OUTLET (°F):	230	FUEL METHANE NUMBER:	140
ASPIRATION:	TA	FUEL LHV (Btu/scf):	500
COOLING SYSTEM:	JW+1AC, OC+2AC	ALTITUDE CAPABILITY AT 77°F INLET AIR TEMP. (ft):	2887
IGNITION SYSTEM:	ADEM3	APPLICATION:	Genset
EXHAUST MANIFOLD:	DRY	POWER FACTOR:	0.8
COMBUSTION:	Low Emission	VOLTAGE(V):	480-4160
NOx EMISSION LEVEL (g/bhp-hr NOx):	1.0		

RATING		NOTES	LOAD	100%	75%	50%
GENSET POWER	(WITHOUT FAN)	(1)(2)	ekW	1600	1200	800
GENSET POWER	(WITHOUT FAN)	(1)(2)	KVA	2000	1500	1000
ENGINE POWER	(WITHOUT FAN)	(2)	bhp	2242	1683	1128
GENERATOR EFFICIENCY		(1)	%	95.7	95.6	95.1
GENSET EFFECIENCY	(ISO 3046/1)	(3)	%	39.2	37.5	36.6
GENSET EFFECIENCY	(NOMINAL)	(3)	%	38.3	36.6	35.7
ENGINE EFFICIENCY	(NOMINAL)	(3)	%	40.0	38.3	37.6
THERMAL EFFICIENCY	(NOMINAL)	(4)	%	39.9	39.9	41.6
TOTAL EFFICIENCY	(NOMINAL)	(5)	%	78.2	76.5	77.3
ENGINE DATA						
GENSET FUEL CONSUMPTION	(ISO 3046/1)	(6)	Btu/ekW-hr	8697	9100	9320
GENSET FUEL CONSUMPTION	(NOMINAL)	(6)	Btu/ekW-hr	8910	9322	9547
ENGINE FUEL CONSUMPTION	NOMINAL	(6)	Btu/bhp-hr	6358	6646	6771
AIR FLOW (77°F, 14.7 psia)	(WET)	(7)	scfm	4248	3222	2242
AIR FLOW	(WET)	(7)	lb/hr	18836	14288	9940
COMPRESSOR OUT PRESSURE			in Hg(abs)	104.1	77.8	53.5
COMPRESSOR OUT TEMPERATURE			°F	369	295	212
AFTERCOOLER AIR OUT TEMPERATURE			°F	140	137	136
INLET MAN. PRESSURE		(8)	in Hg(abs)	89.7	68.3	48.4
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	(9)	°F	140	137	136
TIMING		(10)	°BTDC	28	28	28
EXHAUST TEMPERATURE - ENGINE OUTLET		(11)	°F	915	958	982
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(12)	ft3/min	12309	9663	6823
EXHAUST GAS MASS FLOW	(WET)	(12)	lb/hr	20951	15948	11073
MAX INLET RESTRICTION		(13)	in H2O	10.04	10.04	10.04
MAX EXHAUST RESTRICTION		(13)	in H2O	20.07	20.07	20.07
EMISSIONS DATA - ENGINE OUT						
NOx (as NO2)		(14)(15)	g/bhp-hr	1.00	1.00	1.00
CO		(14)(16)	g/bhp-hr	4.78	4.88	4.97
THC (mol. wt. of 15.84)		(14)(16)	g/bhp-hr	5.36	6.07	7.34
NMHC (mol. wt. of 15.84)		(14)(16)	g/bhp-hr	0.80	0.91	1.10
NMNEHC (VOCs) (mol. wt. of 15.84)		(14)(16)(17)	g/bhp-hr	0.54	0.61	0.73
HCHO (Formaldehyde)		(14)(16)	g/bhp-hr	0.44	0.44	0.49
CO2		(14)(16)	g/bhp-hr	736	765	806
EXHAUST OXYGEN		(14)(18)	% DRY	8.4	8.1	8.0
LAMBDA		(14)(18)		1.64	1.58	1.61
ENERGY BALANCE DATA						
LHV INPUT		(19)	Btu/min	237589	186442	127298
HEAT REJECTION TO JACKET WATER (JW)		(20)(27)	Btu/min	29397	25887	21531
HEAT REJECTION TO ATMOSPHERE		(21)	Btu/min	7210	6013	4823
HEAT REJECTION TO LUBE OIL (OC)		(22)(28)	Btu/min	7791	6995	6197
HEAT REJECTION TO EXHAUST (LHV TO 77°F)		(23)	Btu/min	75835	63569	41405
HEAT REJECTION TO EXHAUST (LHV TO 350°F)		(23)	Btu/min	53213	43777	31605
HEAT REJECTION TO A/C - STAGE 1 (1AC)		(24)(27)	Btu/min	12077	4700	-241
HEAT REJECTION TO A/C - STAGE 2 (2AC)		(25)(28)	Btu/min	8222	5917	3767
PUMP POWER		(26)	Btu/min	1977	1977	1977

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1. (Standard reference conditions of 77°F, 29.60 in Hg barometric pressure, 500 ft. altitude.) No overload permitted at rating shown. Consult altitude curves for applications above maximum rated altitude and/or temperature.

Emission levels are at engine exhaust flange prior to any after treatment. Values are based on engine operating at steady state conditions, adjusted to the specified NOx level at 100% load. Tolerances specified are dependent upon fuel quality. Fuel methane number cannot vary more than ± 3.

For notes information consult page three.

FUEL USAGE GUIDE

CAT METHANE NUMBER	110	120	130	140	150
SET POINT TIMING	-	24	26	28	30
DERATION FACTOR	0	1	1	1	1

ALTITUDE DERATION FACTORS AT RATED SPEED

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1	0.98	0.94	0.91	0.87	0.84	0.81	0.78	0.74	0.72	0.69	0.66	0.63
120	1	1	0.96	0.92	0.89	0.85	0.82	0.79	0.76	0.73	0.70	0.67	0.64
110	1	1	0.98	0.94	0.90	0.87	0.84	0.80	0.77	0.74	0.71	0.68	0.66
100	1	1	0.99	0.96	0.92	0.88	0.85	0.82	0.79	0.75	0.72	0.70	0.67
90	1	1	1	0.97	0.94	0.90	0.87	0.83	0.80	0.77	0.74	0.71	0.68
80	1	1	1	0.99	0.95	0.92	0.88	0.85	0.81	0.78	0.75	0.72	0.69
70	1	1	1	1	0.97	0.93	0.90	0.86	0.83	0.80	0.77	0.73	0.70
60	1	1	1	1	0.99	0.95	0.92	0.88	0.85	0.81	0.78	0.75	0.72
50	1	1	1	1	1	0.97	0.93	0.90	0.86	0.83	0.80	0.76	0.73

ALTITUDE (FEET ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS (ACHRF)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1.33	1.38	1.43	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47
120	1.26	1.31	1.36	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
110	1.20	1.24	1.29	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
100	1.13	1.18	1.22	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
90	1.06	1.11	1.16	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
80	1	1.04	1.09	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
70	1	1	1.02	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
60	1	1	1	1	1	1	1	1	1	1	1	1	1
50	1	1	1	1	1	1	1	1	1	1	1	1	1

ALTITUDE (FEET ABOVE SEA LEVEL)

FUEL USAGE GUIDE:

This table shows the derate factor required for a given fuel. Note that deration occurs as the methane number decreases. Methane number is a scale to measure detonation characteristics of various fuels. The methane number of a fuel is determined by using the Caterpillar Methane Number Calculation program.

ALTITUDE DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information along with the fuel usage guide chart to help determine actual engine power for your site.

ACTUAL ENGINE RATING:

To determine the actual rating of the engine at site conditions, one must consider separately, limitations due to fuel characteristics and air system limitations. The Fuel Usage Guide deration establishes fuel limitations. The Altitude/Temperature deration factors and RPC (reference the Caterpillar Methane Program) establish air system limitations. RPC comes into play when the Altitude/Temperature deration is less than 1.0 (100%). Under this condition, add the two factors together. When the site conditions do not require an Altitude/Temperature derate (factor is 1.0), it is assumed the turbocharger has sufficient capability to overcome the low fuel relative power, and RPC is ignored. To determine the actual power available, take the lowest rating between 1) and 2).

1) Fuel Usage Guide Deration
2) 1-((1-Altitude/Temperature Deration) + (1-RPC))

AFTERCOOLER HEAT REJECTION FACTORS(ACHRF):

Aftercooler heat rejection is given for standard conditions of 77°F and 500 ft. altitude. To maintain a constant air inlet manifold temperature, as the inlet air temperature goes up, so must the heat rejection. As altitude increases, the turbocharger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor (ACHRF) to adjust for inlet air temp and altitude conditions. See Notes 27 and 28 below for application of this factor in calculating the heat exchanger sizing criteria. Failure to properly account for these factors could result in detonation and cause the engine to shutdown or fail.

NOTES:

1. Generator efficiencies, power factor, and voltage are based on standard generator. [Genset Power (ekW) is calculated as: Engine Power (bkW) x Generator Efficiency], [Genset Power (kVA) is calculated as: Engine Power (bkW) x Generator Efficiency / Power Factor]
2. Rating is with two engine driven water pumps. Tolerance is (+)3, (-)0% of full load.
3. ISO 3046/1 Genset efficiency tolerance is (+)0, (-)5% of full load % efficiency value. Nominal genset and engine efficiency tolerance is ± 2.5% of full load % efficiency value.
4. Thermal Efficiency is calculated as: (Heat rejection to jacket water + Heat Rejection to A/C Stage 1 + Heat rejection to exhaust to 350°F) / LHV Input
5. Total efficiency is calculated as: Genset Efficiency + Thermal Efficiency. Tolerance is ±10% of full load data.
6. ISO 3046/1 Genset fuel consumption tolerance is (+)5, (-)0% of full load data. Nominal genset and engine fuel consumption tolerance is ± 2.5% of full load data.
7. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.
8. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.
9. Inlet manifold temperature is a nominal value with a tolerance of ± 9°F.
10. Timing indicated is for use with the minimum fuel methane number specified. Consult the appropriate fuel usage guide for timing at other methane numbers.
11. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.
12. Exhaust flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 6 %.
13. Inlet and Exhaust Restrictions are maximum allowed values at the corresponding loads. Increasing restrictions beyond what is specified will result in a significant engine derate.
14. Emissions data is at engine exhaust flange prior to any after treatment.
15. NOx tolerances are ± 18% of specified value.
16. CO, CO2, THC, NMHC, NMNEHC, and HCHO values are "Not to Exceed" levels. THC, NMHC, and NMNEHC do not include aldehydes.
17. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ
18. Exhaust Oxygen tolerance is ± 0.5; Lambda tolerance is ± 0.05. Lambda and Exhaust Oxygen level are the result of adjusting the engine to operate at the specified NOx level.
19. LHV rate tolerance is ± 2.5%.
20. Heat rejection to jacket water value displayed includes heat to jacket water alone. Value is based on treated water. Tolerance is ± 10% of full load data.
21. Heat rejection to atmosphere based on treated water. Tolerance is ± 50% of full load data.
22. Lube oil heat rate based on treated water. Tolerance is ± 20% of full load data.
23. Exhaust heat rate based on treated water. Tolerance is ± 10% of full load data.
24. Heat rejection to A/C - Stage 1 based on treated water. Tolerance is ±5% of full load data.
25. Heat rejection to A/C - Stage 2 based on treated water. Tolerance is ±5% of full load data.
26. Pump power includes engine driven jacket water and aftercooler water pumps. Engine brake power includes effects of pump power.
27. Total Jacket Water Circuit heat rejection is calculated as: (JW x 1.1) + (1AC x 1.05) + [0.9 x (1AC + 2AC) x (ACHRF - 1) x 1.05]. Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.
28. Total Second Stage Aftercooler Circuit heat rejection is calculated as: (OC x 1.2) + (2AC x 1.05) + [(1AC + 2AC) x 0.1 x (ACHRF - 1) x 1.05]. Heat exchanger sizing criterion is maximum circuit heat rejection at site conditions, with applied tolerances. A cooling system safety factor may be multiplied by the total circuit heat rejection to provide additional margin.

FREE FIELD MECHANICAL & EXHAUST NOISE

MECHANICAL: Sound Power (1/3 Octave Frequencies)

Gen Power Without Fan	Percent Load	Engine Power	Overall	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz
ekW	%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
1600	100	2242	116.6	77.2	87.0	87.7	90.3	96.5	98.1	98.9	101.2	93.8	102.6
1200	75	1683	115.5	76.3	84.2	84.9	88.9	93.3	97.2	94.3	99.0	92.5	100.8
800	50	1128	113.7	73.8	81.0	80.4	87.2	90.5	93.2	92.4	98.1	90.5	99.6

MECHANICAL: Sound Power (1/3 Octave Frequencies)

Gen Power Without Fan	Percent Load	Engine Power	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz
ekW	%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
1600	100	2242	107.9	105.6	108.6	105.5	103.2	102.6	101.3	101.0	101.1	106.1	109.8
1200	75	1683	107.9	103.4	105.7	104.3	101.2	101.1	100.1	100.1	100.7	110.6	99.2
800	50	1128	108.2	101.3	104.2	105.6	99.7	100.1	98.8	98.9	102.7	98.0	95.2

EXHAUST: Sound Power (1/3 Octave Frequencies)

Gen Power Without Fan	Percent Load	Engine Power	Overall	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz
ekW	%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
1600	100	2242	117.6	107.2	98.1	98.0	88.1	106.8	97.7	106.0	100.2	94.2	102.5
1200	75	1683	117.1	106.8	96.7	96.0	92.9	110.8	99.0	105.5	97.8	95.8	102.1
800	50	1128	114.8	106.3	95.0	93.9	89.4	108.0	96.1	101.8	94.2	94.8	98.8

EXHAUST: Sound Power (1/3 Octave Frequencies)

Gen Power Without Fan	Percent Load	Engine Power	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz
ekW	%	bhp	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
1600	100	2242	100.4	102.1	101.7	101.9	104.9	106.9	107.2	107.4	105.8	104.7	107.9
1200	75	1683	97.9	100.9	101.6	98.9	103.0	105.2	105.9	106.6	105.3	101.0	105.8
800	50	1128	94.7	97.6	98.5	95.1	101.0	103.9	103.9	103.9	101.3	101.5	100.8

SOUND PARAMETER DEFINITION:

Sound Power Level Data - DM8702-01

Sound power is defined as the total sound energy emanating from a source irrespective of direction or distance. Sound power level data is presented under two index headings:
Sound power level -- Mechanical
Sound power level -- Exhaust

Mechanical: Sound power level data is calculated in accordance with ISO 6798. The data is recorded with the exhaust sound source isolated.

Exhaust: Sound power level data is calculated in accordance with ISO 6798 Annex A.

Measurements made in accordance with ISO 6798 for engine and exhaust sound level only. No cooling system noise is included unless specifically indicated. Sound level data is indicative of noise levels recorded on one engine sample in a survey grade 3 environment.

How an engine is packaged, installed and the site acoustical environment will affect the site specific sound levels. For site specific sound level guarantees, sound data collection needs to be done on-site or under similar conditions.

SYSTEMS DATA [LA4310]

Reference Number: 2603697 **Version Symbol:** - **Change Level:** 00

Sales Model: G3520C SI TA SCAC **Eff. Serial Number Prefix:** GZJ **Engr. Model:** GS299

Description	Answer	Unit
Air Intake System		
The installed system must comply with the system limits below for all emissions certified engines to assure regulatory compliance.		
MAX ALLOW RESTR-TURBO OR MANF IN-CLN FIL	5.2	IN WTR
MAX ALLOW RESTR-TURBO OR MANF IN-DIR FIL	14.9	IN WTR
Cooling System		
ENGINE COOLANT CAPACITY	92.4	GAL
MAX ALLOW CO GEN COOLANT OUTLET TEMP	230	DEG F
MAX ALLOW STD COOLANT OUTLET TEMP	230	DEG F
REGULATOR OUTLET START OPEN TEMP	189	DEG F
REGULATOR OUTLET FULL OPEN TEMP	208	DEG F
MAX RECOMMENDED SYS PRESS CAP PRESSURE	55.0	PSI
MAX ALLOW UNINTERRUPTED FILL RATE	5	GPM
MAX PUMP RISE LOSS - PERCENT OF TOTAL	110	
MINIMUM ALLOWABLE PUMP CAVITION TEMP	105	
Engine Spec System		
CYLINDER ARRANGEMENT	60V	
CYLINDER QUANTITY	20	
CYLINDER BORE DIAMETER	6.6929	IN
PISTON STROKE	7.4803	IN
TOTAL CYLINDER DISPLACEMENT	5,266	CU IN
COMPRESSION RATIO (TO ONE)	11.3	
ENGINE CRANKSHAFT ROTATION	STD	
CYLINDER FIRING ORDER	1-2-11-12-	
CYLINDER FIRING ORDER - CONTINUED	3-4-15-16-	
CYLINDER FIRING ORDER - CONTINUED	7-8-19-20-	
CYLINDER FIRING ORDER - CONTINUED	9-10-17-18	
CYLINDER FIRING ORDER - CONTINUED	-5-6-13-14	
NUMBER 1 CYLINDER LOCATION	R FRONT	
Exhaust System		
The installed system must comply with the system limits below for all emissions certified engines to assure regulatory compliance.		
MAX ALLOW EXH PRES-TURBO ELB OR NA MANF	20.1	IN WTR
MANIFOLD TYPE	DRY	
MAX STATIC VERT WT ON CL CUST EXH CONN	NAV	LB
MAX STATIC OFFSET FORCE AT CUST EXH CONN	NAV	FT LB
Fuel System		
MIN ALLOW INLET FUEL PRESS AT CUST CONN	1.7	PSI
MAX ALLOW INLET FUEL PRESS AT CUST CONN	5.0	PSI
MIN ALLOW FUEL INLET TEMP AT CUST CONN	32	DEG F
MAX ALLOW FUEL INLET TEMP AT CUST CONN	140	DEG F
FUEL SYSTEM TYPE	CAT LOW	
FUEL SYSTEM TYPE (CONTD)	PRESSURE	
FUEL SYSTEM TYPE (CONTD)	W /AFRC	

Lube System		
OIL MANF PRES-MAX AT RATED COND	45.0	PSI
OIL MANF PRES-MIN AT RATED COND	14.9	PSI
RECOMMENDED OIL TYPE - API	CAT NGEO	
LOW OP SETTING AT LOW IDLE FOR WARN CONT	20.0	PSI
LUBE SYSTEM OIL COOLER TYPE	SHELL TUBE	
FUL LD OIL CON-GRAM/KW-HR OIL	0.426	
MAX OIL TEMP-COOLER OUT-FOR ALRM/SHUTDN	219	DEG F
MAX OIL TEMP-COOLER OUT-FOR PREALARM	216	DEG F
Mounting System		
MAX ENGINE DRY WEIGHT	23,951	LB
CENTER OF GRAVITY PERFORMANCE PARAMETER	TM7077	
CENTER OF GRAVITY LOCATION X DIMENSION	59.1731	IN
CENTER OF GRAVITY LOCATION Y DIMENSION	13.7795	IN
CENTER OF GRAVITY LOCATION Z DIMENSION	4.7244	IN
OVERALL ENGINE LENGTH	164.9603	IN
OVERALL ENGINE HEIGHT	95.3148	IN
OVERALL ENGINE WIDTH	70.9841	IN
FLYWHEEL HOUSING SIZE SAE NUMBER	00	
GENERAL DIMENSION DRG REF NUMBER	2506874	
MASS MOMENT OF INERTIA - X AXIS	NAV	LB IN SEC2
MASS MOMENT OF INERTIA - Y AXIS	NAV	LB IN SEC2
MASS MOMENT OF INERTIA - Z AXIS	NAV	LB IN SEC2
Starting System		
MINIMUM REQUIRED CRANKING SPEED	120	RPM