G3520C

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1200	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	11.3	APPLICATION:	GENSET
AFTERCOOLER TYPE:	SCAC	RATING LEVEL:	CONTINUOUS
AFTERCOOLER - STAGE 2 INLET (°C):	54	FUEL:	LOW ENERGY
AFTERCOOLER - STAGE 1 INLET (°C):	103	FUEL SYSTEM:	CAT LOW PRESSURE
JACKET WATER OUTLET (°C):	110		WITH AIR FUEL RATIO CONTROL
ASPIRATION:	TA	FUEL PRESSURE RANGE(kPag):	10-35
COOLING SYSTEM:	JW+1AC, OC+2AC	FUEL METHANE NUMBER:	140
CONTROL SYSTEM:	ADEM3	FUEL LHV (MJ/Nm3):	19.68
EXHAUST MANIFOLD:	DRY	ALTITUDE CAPABILITY AT 25°C INLET AIR TEMP. (m):	880
COMBUSTION:	LOW EMISSION	POWER FACTOR:	0.8
NOx EMISSION LEVEL (g/bhp-hr NOx):	1.0	VOLTAGE(V):	480-4160

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)	bkW	1672	1255	841
GENERATOR EFFICIENCY		(1)	%	95.7	95.6	95.1
GENSET EFFICIENCY(@ 1.0 Power Factor)	(ISO 3046/1)	(3)	%	39.8	38.0	36.9
THERMAL EFFICIENCY		(4)	%	38.1	39.6	38.2
TOTAL EFFICIENCY (@ 1.0 Power Factor)		(5)	%	77.9	77.6	75.1

ENGINE DATA						
GENSET FUEL CONSUMPTION	(ISO 3046/1)	(6)	MJ/ekW-hr	9.17	9.60	9.83
GENSET FUEL CONSUMPTION	(NOMINAL)	(6)	MJ/ekW-hr	9.40	9.83	10.07
ENGINE FUEL CONSUMPTION	(NOMINAL)	(6)	MJ/bkW-hr	8.99	9.40	9.58
AIR FLOW (0°C, 101.3 kPa)	(WET)	(7)	Nm3/bkW-hr	3.95	4.00	4.15
AIR FLOW	(WET)	(7)	kg/bkW-hr	5.11	5.16	5.36
FUEL FLOW (0ºC, 101.3 kPa)			Nm3/hr	764	600	409
COMPRESSOR OUT PRESSURE			kPa(abs)	352	263	181
COMPRESSOR OUT TEMPERATURE			°C	187	146	100
AFTERCOOLER AIR OUT TEMPERATURE			°C	60	58	58
INLET MAN. PRESSURE		(8)	kPa(abs)	303	231	163
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	(9)	°C	60	58	58
TIMING		(10)	°BTDC	28	28	28
EXHAUST TEMPERATURE - ENGINE OUTLET		(11)	°C	491	515	528
EXHAUST GAS FLOW (0 °C, 101.3 kPa)	(WET)	(12)	Nm3/bkW-hr	4.41	4.48	4.64
EXHAUST GAS MASS FLOW	(WET)	(12)	kg/bkW-hr	5.68	5.76	5.97
MAX INLET RESTRICTION		(13)	kPa	2.50	2.50	2.50
MAX EXHAUST RESTRICTION		(13)	kPa	5.00	5.00	5.00

EMISSIONS DATA - ENGINE OUT						
NOx (as NO2)	(corr. to 5% O2)	(14)(15)	mg/Nm3 DRY	439	425	406
CO	(corr. to 5% O2)	(14)(16)	mg/Nm3 DRY	2098	2071	2018
THC (mol. wt. of 15.84)	(corr. to 5% O2)	(14)(16)	mg/Nm3 DRY	2355	2577	2978
NMHC (mol. wt. of 15.84)	(corr. to 5% O2)	(14)(16)	mg/Nm3 DRY	353	387	447
NMNEHC (VOCs) (mol. wt. of 15.84)	(corr. to 5% O2)	(14)(16)(17)	mg/Nm3 DRY	236	258	298
HCHO (Formaldehyde)	(corr. to 5% O2)	(14)(16)	mg/Nm3 DRY	193	187	198
CO2	(corr. to 5% O2)	(14)(16)	g/Nm3 DRY	323	325	327
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)	kW	4178	3278	2238
HEAT REJECTION TO JACKET WATER (JW)	(20)(28)	kW	517	455	379
HEAT REJECTION TO ATMOSPHERE	(21)	kW	127	106	85
HEAT REJECTION TO LUBE OIL (OC)	(22)(29)	kW	137	123	109
HEAT REJECTION TO EXHAUST (LHV TO 25°C)	(23)(24)	kW	1333	1118	728
HEAT REJECTION TO EXHAUST (LHV TO 177°C)	(23)	kW	798	701	428
HEAT REJECTION TO A/C - STAGE 1 (1AC)	(25)(28)	kW	212	83	-4
HEAT REJECTION TO A/C - STAGE 2 (2AC)	(26)(29)	kW	145	104	66
PUMP POWER	(27)	kW	35	35	35

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1. (Standard reference conditions of 25°C, 100 kPa barometric pressure.) No overload permitted at rating shown. Consult the altitude deration factor chart for applications that exceed the rated altitude 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 and corrected to 5 % exhaust oxygen. 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 °C	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1	1	0.97	0.94	0.91	0.88	0.85	0.83	0.80	0.77	0.75	0.73	0.70
45	1	1	0.98	0.95	0.92	0.90	0.87	0.84	0.81	0.79	0.76	0.74	0.71
40	1	1	1	0.97	0.94	0.91	0.88	0.85	0.83	0.80	0.77	0.75	0.72
35	1	1	1	0.98	0.95	0.92	0.90	0.87	0.84	0.81	0.79	0.76	0.74
30	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.83	0.80	0.77	0.75
25	1	1	1	1	0.99	0.95	0.92	0.90	0.87	0.84	0.81	0.79	0.76
20	1	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.83	0.80	0.77
15	1	1	1	1	1	0.99	0.96	0.93	0.90	0.87	0.84	0.81	0.79
10	1	1	1	1	1	1	0.97	0.94	0.91	0.88	0.86	0.83	0.80

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS (ACHRF)

INLET AIR TEMP °C	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.28	1.32	1.36	1.40	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42
45	1.22	1.26	1.29	1.33	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
40	1.16	1.20	1.23	1.27	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
35	1.10	1.14	1.17	1.21	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23
30	1.04	1.07	1.11	1.15	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17
25	1	1.01	1.05	1.09	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
20	1	1	1	1.03	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
15	1	1	1	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1	1	1	1

ALTITUDE (METERS ABOVE SEA LEVEL)

FUEL USAGE GUIDE:

This table shows the derate factor and full load set point timing required for a given fuel. Note that deration and set point timing adjustment may be required 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.

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):

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 28 and 29 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.

INLET AND EXHAUST RESTRICTIONS FOR ALTITUDE CAPABILITY:

The altitude derate chart is based on the maximum inlet and exhaust restrictions provided on page 1. Contact factory for restrictions over the specified values. Heavy Derates for higher restrictions will apply.

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. Genset Efficiency published in accordance with ISO 3046/1, based on a 1.0 power factor.
4. Thermal Efficiency is calculated based on energy recovery from the jacket water, 1st stage aftercooler, and exhaust to 177ºC with engine operation at ISO 3046/1 Genset Efficiency, and assumes unburned fuel is converted in an oxidation catalyst.
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% at the specified power factor. Nominal genset and engine fuel consumption tolerance is ± 2.5% of full load data at the specified power factor.
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 ± 5°C.
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 (+)35°C, (-)30°C.
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 exhaust (LHV to 25°C) value shown includes unburned fuel and is not intended to be used for sizing or recovery calculations.
25. Heat rejection to A/C - Stage 1 based on treated water. Tolerance is ±5% of full load data.
26. Heat rejection to A/C - Stage 2 based on treated water. Tolerance is ±5% of full load data.
27. Pump power includes engine driven jacket water and aftercooler water pumps. Engine brake power includes effects of pump power.
28. 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.
29. 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	%	bkW	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
1600	100	1672	116.6	77.2	87.0	87.7	90.3	96.5	98.1	98.9	101.2	93.8	102.6
1200	75	1255	115.5	76.3	84.2	84.9	88.9	93.3	97.2	94.3	99.0	92.5	100.8
800	50	841	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	%	bkW	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
1600	100	1672	107.9	105.6	108.6	105.5	103.2	102.6	101.3	101.0	101.1	106.1	109.8
1200	75	1255	107.9	103.4	105.7	104.3	101.2	101.1	100.1	100.1	100.7	110.6	99.2
800	50	841	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	%	bkW	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
1600	100	1672	117.6	107.2	98.1	98.0	88.1	106.8	97.7	106.0	100.2	94.2	102.5
1200	75	1255	117.1	106.8	96.7	96.0	92.9	110.8	99.0	105.5	97.8	95.8	102.1
800	50	841	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	%	bkW	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
1600	100	1672	100.4	102.1	101.7	101.9	104.9	106.9	107.2	107.4	105.8	104.7	107.9
1200	75	1255	97.9	100.9	101.6	98.9	103.0	105.2	105.9	106.6	105.3	101.0	105.8
800	50	841	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 - DM8702-03

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 3747. The data is recorded with the exhaust sound source isolated.

Exhaust: Sound power level data is calculated in accordance with ISO 6798 Annex A. Exhaust data is post-catalyst on gas engine ratings labeled as "Integrated Catalyst".

Measurements made in accordance with ISO 3747 and ISO 6798 for mechanical and exhaust sound level only. Frequency bands outside the displayed ranges are not measured, due to physical test, and environmental conditions that affect the accuracy of the measurement. 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.