G3520C

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1200	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	11.3:1	FUEL:	Low Energy
AFTERCOOLER TYPE:	SCAC	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):	1378
CONTROL 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):	0.5		

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 EFFICIENCY(@ 1.0 Power Factor)	(ISO 3046/1)	(3)	%	38.8	37.5	34.8
THERMAL EFFICIENCY		(4)	%	39.1	39.9	41.5
TOTAL EFFICIENCY (@ 1.0 Power Factor)		(5)	%	77.9	77.4	76.3

ENGINE DATA						
GENSET FUEL CONSUMPTION	(ISO 3046/1)	(6)	Btu/ekW-hr	8907	9221	9895
GENSET FUEL CONSUMPTION	(NOMINAL)	(6)	Btu/ekW-hr	9124	9446	10137
ENGINE FUEL CONSUMPTION	(NOMINAL)	(6)	Btu/bhp-hr	6511	6734	7189
AIR FLOW (77°F, 14.7 psia)	(WET)	(7)	ft3/min	4441	3372	2285
AIR FLOW	(WET)	(7)	lb/hr	19691	14952	10130
FUEL FLOW (60ºF, 14.7 psia)			scfm	487	378	271
COMPRESSOR OUT PRESSURE			in Hg(abs)	107.2	80.7	54.8
COMPRESSOR OUT TEMPERATURE			°F	378	304	218
AFTERCOOLER AIR OUT TEMPERATURE			°F	142	138	136
INLET MAN. PRESSURE		(8)	in Hg(abs)	93.5	71.0	49.1
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	(9)	°F	142	138	136
TIMING		(10)	°BTDC	28	28	28
EXHAUST TEMPERATURE - ENGINE OUTLET		(11)	°F	903	949	986
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(12)	ft3/min	12723	10008	7001
EXHAUST GAS MASS FLOW	(WET)	(12)	lb/hr	21863	16639	11336
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	0.50	0.50	0.50
CO	(14)(16)	g/bhp-hr	4.22	4.35	4.49
THC (mol. wt. of 15.84)	(14)(16)	g/bhp-hr	5.63	6.37	7.49
NMHC (mol. wt. of 15.84)	(14)(16)	g/bhp-hr	0.85	0.96	1.12
NMNEHC (VOCs) (mol. wt. of 15.84)	(14)(16)(17)	g/bhp-hr	0.56	0.64	0.75
HCHO (Formaldehyde)	(14)(16)	g/bhp-hr	0.42	0.43	0.43
CO2	(14)(16)	g/bhp-hr	747	773	794
EXHAUST OXYGEN	(14)(18)	% DRY	8.8	8.5	8.4
LAMBDA	(14)(18)		1.68	1.64	1.55

ENERGY BALANCE DATA					
LHV INPUT	(19)	Btu/min	243312	188925	135157
HEAT REJECTION TO JACKET WATER (JW)	(20)(28)	Btu/min	29209	23554	22109
HEAT REJECTION TO ATMOSPHERE	(21)	Btu/min	7210	6013	4823
HEAT REJECTION TO LUBE OIL (OC)	(22)(29)	Btu/min	7791	6995	6197
HEAT REJECTION TO EXHAUST (LHV TO 77°F)	(23)(24)	Btu/min	80268	67379	48302
HEAT REJECTION TO EXHAUST (LHV TO 350°F)	(23)	Btu/min	48523	42685	30884
HEAT REJECTION TO A/C - STAGE 1 (1AC)	(25)(28)	Btu/min	13344	5446	7
HEAT REJECTION TO A/C - STAGE 2 (2AC)	(26)(29)	Btu/min	8435	6176	3904
PUMP POWER	(27)	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.) 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. 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	0.96	0.93	0.89	0.86	0.83	0.79	0.76	0.73	0.70	0.68	0.65	0.62	0.60
120	0.98	0.94	0.91	0.87	0.84	0.81	0.78	0.75	0.72	0.69	0.66	0.64	0.61
110	1	0.96	0.92	0.89	0.85	0.82	0.79	0.76	0.73	0.70	0.67	0.65	0.62
100	1	0.98	0.94	0.90	0.87	0.84	0.80	0.77	0.74	0.71	0.69	0.66	0.63
90	1	0.99	0.96	0.92	0.89	0.85	0.82	0.79	0.76	0.73	0.70	0.67	0.64
80	1	1	0.97	0.94	0.90	0.87	0.83	0.80	0.77	0.74	0.71	0.68	0.65
70	1	1	0.99	0.96	0.92	0.88	0.85	0.82	0.79	0.75	0.72	0.69	0.67
60	1	1	1	0.97	0.94	0.90	0.87	0.83	0.80	0.77	0.74	0.71	0.68
50	1	1	1	0.99	0.96	0.92	0.88	0.85	0.82	0.78	0.75	0.72	0.69

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	1.37	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39
120	1.26	1.31	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
110	1.19	1.24	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26
100	1.13	1.17	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19
90	1.06	1.11	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
80	1	1.04	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
70	1	1	1	1	1	1	1	1	1	1	1	1	1
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 and full load set point timing required for a given fuel. Note that deration and set point timing reduction 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 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):

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. ISO 3046/1 Genset efficiency tolerance is (+)0, (-)5% of full load % efficiency value 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 350ºF 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% 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 exhaust (LHV to 77°F) 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	%	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.