G3516

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1400	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8	APPLICATION:	GAS COMPRESSION
AFTERCOOLER TYPE:	SCAC	RATING LEVEL:	CONTINUOUS
AFTERCOOLER WATER INLET (°F):	90	FUEL:	NAT GAS
JACKET WATER OUTLET (°F):	210	FUEL SYSTEM:	HPG IMPCO
ASPIRATION:	TA	FUEL PRESSURE RANGE(psig): (See note 1)	35.0-40.0
COOLING SYSTEM:	JW+OC, AC	FUEL METHANE NUMBER:	80
CONTROL SYSTEM:	EIS	FUEL LHV (Btu/scf):	905
EXHAUST MANIFOLD:	ASWC	ALTITUDE CAPABILITY AT 77°F INLET AIR TEMP. (ft):	5000
COMBUSTION:	LOW EMISSION		
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0		

RATING		NOTES	LOAD	100%	75%	50%
ENGINE POWER	(WITHOUT FAN)	(2)	bhp	1340	1005	670
ENGINE EFFICIENCY	(ISO 3046/1)	(3)	%	34.5	33.7	31.8
ENGINE EFFICIENCY	(NOMINAL)	(3)	%	33.8	33.0	31.2
ENGINE DATA						
FUEL CONSUMPTION	(ISO 3046/1)	(4)	Btu/bhp-hr	7377	7558	7989
FUEL CONSUMPTION	(NOMINAL)	(4)	Btu/bhp-hr	7520	7705	8144
AIR FLOW (77°F, 14.7 psia)	(WET)	(5) (6)	ft3/min	2799	3083	2092
AIR FLOW	(WET)	(5) (6)	lb/hr	12409	13670	9274
FUEL FLOW (60ºF, 14.7 psia)			scfm	186	143	101
COMPRESSOR OUT PRESSURE			in Hg(abs)	79.2	71.5	52.4
COMPRESSOR OUT TEMPERATURE			°F	330	293	212
AFTERCOOLER AIR OUT TEMPERATURE			°F	95	92	90
INLET MAN. PRESSURE		(7)	in Hg(abs)	67.7	50.6	34.6
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	(8)	°F	105	105	109
TIMING		(9)	°BTDC	35	35	35
EXHAUST TEMPERATURE - ENGINE OUTLET		(10)	°F	852	845	852
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(11) (6)	ft3/min	7417	7968	5445
EXHAUST GAS MASS FLOW	(WET)	(11) (6)	lb/hr	12918	14061	9550
EMISSIONS DATA - ENGINE OUT						
NOx (as NO2)		(12)(13)	g/bhp-hr	2.00	4.25	4.62
CO		(12)(14)	g/bhp-hr	1.83	3.08	3.59
THC (mol. wt. of 15.84)		(12)(14)	g/bhp-hr	2.95	4.33	4.47
NMHC (mol. wt. of 15.84)		(12)(14)	g/bhp-hr	0.44	0.65	0.67
NMNEHC (VOCs) (mol. wt. of 15.84)		(12)(14)(15)	g/bhp-hr	0.30	0.43	0.45
HCHO (Formaldehyde)		(12)(14)	g/bhp-hr	0.25	0.27	0.30
CO2		(12)(14)	g/bhp-hr	488	500	529
EXHAUST OXYGEN		(12)(16)	% DRY	8.4	8.0	7.0
LAMBDA		(12)(16)		1.54	2.21	2.12
ENERGY BALANCE DATA						
LHV INPUT		(17)	Btu/min	167913	129025	90948
HEAT REJECTION TO JACKET WATER (JW)		(18)(25)	Btu/min	40862	18468	17627
HEAT REJECTION TO ATMOSPHERE		(19)	Btu/min	5313	4428	3543
HEAT REJECTION TO LUBE OIL (OC)		(20)(25)	Btu/min	6461	2920	2787
HEAT REJECTION TO EXHAUST (LHV TO 77°F)		(21)(22)	Btu/min	45875	48681	33180
HEAT REJECTION TO EXHAUST (LHV TO 350°F)		(21)	Btu/min	29117	30667	21172
HEAT REJECTION TO AFTERCOOLER (AC)		(23)(26)	Btu/min	11752	11081	4560
PUMP POWER		(24)	Btu/min	838	838	838

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. Part load data may require engine adjustment.

For notes information consult page three.

FUEL USAGE GUIDE

CAT METHANE NUMBER	14	20	25	30	35	40	45	50	55	60	65	70	75	80	100
SET POINT TIMING	20	20	20	21	23	24	25	26	28	29	30	32	33	35	35
DERATION FACTOR	0.50	0.65	0.78	0.90	0.90	0.90	1	1	1	1	1	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	1	1	0.98	0.95	0.91	0.88	0.84	0.81	0.78	0.75	0.72	0.69
120	1	1	1	1	0.96	0.93	0.89	0.86	0.82	0.79	0.76	0.73	0.70
110	1	1	1	1	0.98	0.94	0.91	0.87	0.84	0.80	0.77	0.74	0.71
100	1	1	1	1	1	0.96	0.92	0.89	0.85	0.82	0.79	0.75	0.72
90	1	1	1	1	1	0.98	0.94	0.90	0.87	0.83	0.80	0.77	0.74
80	1	1	1	1	1	0.99	0.96	0.92	0.88	0.85	0.81	0.78	0.75
70	1	1	1	1	1	1	0.97	0.94	0.90	0.86	0.83	0.80	0.76
60	1	1	1	1	1	1	0.99	0.95	0.92	0.88	0.85	0.81	0.78
50	1	1	1	1	1	1	1	0.97	0.94	0.90	0.86	0.83	0.79

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	1.31	1.36	1.41	1.46	1.51	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57
120	1.24	1.29	1.34	1.40	1.45	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
110	1.18	1.23	1.28	1.33	1.38	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43
100	1.12	1.17	1.22	1.27	1.32	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37
90	1.06	1.10	1.15	1.20	1.25	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
80	1	1.04	1.09	1.14	1.18	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23
70	1	1	1.02	1.07	1.12	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17
60	1	1	1	1.01	1.05	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
50	1	1	1	1	1	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03

ALTITUDE (FEET ABOVE SEA LEVEL)

MINIMUM SPEED CAPABILITY AT THE RATED SPEED'S SITE TORQUE (RPM)

INLET AIR TEMP °F	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1080	1130	1190	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300
120	1060	1110	1160	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300
110	1030	1080	1140	1190	1300	1300	1300	1300	1300	1300	1300	1300	1300
100	1010	1060	1110	1170	1300	1300	1300	1300	1300	1300	1300	1300	1300
90	1000	1040	1090	1140	1190	1300	1300	1300	1300	1300	1300	1300	1300
80	1000	1010	1060	1110	1170	1300	1300	1300	1300	1300	1300	1300	1300
70	1000	1000	1040	1090	1140	1200	1300	1300	1300	1300	1300	1300	1300
60	1000	1000	1010	1060	1110	1170	1300	1300	1300	1300	1300	1300	1300
50	1000	1000	1000	1040	1090	1140	1200	1300	1300	1300	1300	1300	1300

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 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. The derate factors shown do not take into account external cooling system capacity. The derate factors provided assume the external cooling system can maintain the specified cooling water temperatures, at site conditions.

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 note 26 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.

MINIMUM SPEED CAPABILITY AT THE RATED SPEED'S SITE TORQUE (RPM):

This table shows the minimum allowable engine turndown speed where the engine will maintain the Rated Speed’s Torque for the given ambient conditions.

NOTES:

1. Fuel pressure range specified is to the engine fuel pressure regulator. Additional fuel train components should be considered in pressure and flow calculations.
2. Engine rating is with two engine driven water pumps. Tolerance is ± 3% of full load.
3. ISO 3046/1 engine efficiency tolerance is (+)0, (-)5% of full load % efficiency value. Nominal engine efficiency tolerance is ± 3.0% of full load % efficiency value.
4. ISO 3046/1 fuel consumption tolerance is (+)5, (-)0% of full load data. Nominal fuel consumption tolerance is ± 3.0% of full load data.
5. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.
6. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.
7. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.
8. Inlet manifold temperature is a nominal value with a tolerance of ± 9°F.
9. Timing indicated is for use with the minimum fuel methane number specified. Consult the appropriate fuel usage guide for timing at other methane numbers.
10. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.
11. Exhaust flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 6 %.
12. Emissions data is at engine exhaust flange prior to any after treatment.
13. NOx values are set points and will vary with operating conditions.
14. CO, CO2, THC, NMHC, NMNEHC, and HCHO values are "Not to Exceed" levels. THC, NMHC, and NMNEHC do not include aldehydes.
15. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ
16. 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.
17. LHV rate tolerance is ± 3.0%.
18. 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.
19. Heat rejection to atmosphere based on treated water. Tolerance is ± 50% of full load data.
20. Lube oil heat rate based on treated water. Tolerance is ± 20% of full load data.
21. Exhaust heat rate based on treated water. Tolerance is ± 10% of full load data.
22. 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.
23. Heat rejection to aftercooler based on treated water. Tolerance is ±5% of full load data.
24. Pump power includes engine driven jacket water and aftercooler water pumps. Engine brake power includes effects of pump power.
25. Total Jacket Water Circuit heat rejection is calculated as: (JW x 1.1) + (OC x 1.2). 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.
26. Total Aftercooler Circuit heat rejection is calculated as: AC x ACHRF 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.

ENGINE POWER (bhp):	1340	COOLING SYSTEM:	JW+OC, AC
ENGINE SPEED (rpm):	1400	AFTERCOOLER WATER INLET (°F):	90
EXHAUST MANIFOLD:	ASWC	JACKET WATER OUTLET (°F):	210

Free Field Mechanical and Exhaust Noise

SOUND PRESSURE LEVEL (dB)										
			Octave Band Center Frequency (OBCF)							
100% Load Data			dB(A)	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Mechanical Sound	Distance from the Engine (ft)	3.3	98.1	93.8	95.3	91.5	90	93.1	92.8	88.8	83.2
		23.0	88.5	84.2	85.7	81.9	80.4	83.5	83.2	79.2	73.6
		49.2	83.2	78.9	80.4	76.6	75.1	78.2	77.9	73.9	68.3
Exhaust Sound	Distance from the Engine (ft)	3.3	113.5	102.9	105.5	109.5	105.6	106.9	106.6	107.1	104
		23.0	100.1	88.1	94.6	94.9	91.6	94.3	93.2	93.8	89.1
		49.2	93.5	81.5	87.9	88.2	84.9	87.6	86.6	87.2	82.5

SOUND PARAMETER DEFINITION:

Data Variability Statement:
Sound data presented by Caterpillar has been measured in accordance with ISO 6798 in a Grade 3 test environment. Measurements made in accordance with ISO 6798 will result in some amount of uncertainty. The uncertainties depend not only on the accuracies with which sound pressure levels and measurement surface areas are determined, but also on the 'near-field error' which increases for smaller measurement distances and lower frequencies. The uncertainty for a Grade 3 test environment, that has a source that produces sounds that are uniformly distributed in frequency over the frequency range of interest, is equal to 4 dB (A-weighted). This uncertainty is expressed as the largest value of the standard deviation.