G3412C

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1800	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	11.4	PACKAGE TYPE:	WITH RADIATOR
AFTERCOOLER TYPE:	SCAC	RATING LEVEL:	STANDBY
AFTERCOOLER WATER INLET (°F):	130	FUEL:	NATURAL GAS
JACKET WATER OUTLET (°F):	210	FUEL SYSTEM:	LPG IMPCO WITH AIR FUEL RATIO CONTROL
ASPIRATION:	TA		
COOLING SYSTEM:	JW+OC, AC	FUEL PRESSURE RANGE(psig): (See note 1)	1.5-5.0
CONTROL SYSTEM:	EIS	FUEL METHANE NUMBER:	80
EXHAUST MANIFOLD:	WC	FUEL LHV (Btu/scf):	905
COMBUSTION:	LOW EMISSION	ALTITUDE CAPABILITY AT 77°F INLET AIR TEMP. (ft):	2000
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0	POWER FACTOR:	0.8
FAN POWER (bhp):	46	VOLTAGE(V):	480-600

RATING		NOTES	LOAD	100%	75%	50%
PACKAGE POWER	(WITH FAN)	2,3	ekW	500	375	250
PACKAGE POWER	(WITH FAN)	2,3	kVA	625	469	312
ENGINE POWER	(WITHOUT FAN)	3	bhp	755	577	400
GENERATOR EFFICIENCY		2	%	94.6	94.8	94.7
PACKAGE EFFICIENCY(@ 1.0 Power Factor)	(ISO 3046/1)	4	%	32.4	30.7	27.7
THERMAL EFFICIENCY		5	%	43.5	46.7	51.6
TOTAL EFFICIENCY (@ 1.0 Power Factor)		6	%	75.9	77.4	79.3

ENGINE DATA						
PACKAGE FUEL CONSUMPTION	(ISO 3046/1)	7	Btu/ekW-hr	10694	11285	12434
PACKAGE FUEL CONSUMPTION	(NOMINAL)	7	Btu/ekW-hr	10901	11504	12675
ENGINE FUEL CONSUMPTION	(NOMINAL)	7	Btu/bhp-hr	7216	7477	7911
AIR FLOW (77°F, 14.7 psia)	(WET)	8, 9	ft3/min	1575	1193	809
AIR FLOW	(WET)	8, 9	lb/hr	6985	5292	3587
FUEL FLOW (60ºF, 14.7 psia)			scfm	100	79	58
COMPRESSOR OUT PRESSURE			in Hg(abs)	78.7	74.2	57.0
COMPRESSOR OUT TEMPERATURE			°F	354	311	242
AFTERCOOLER AIR OUT TEMPERATURE			°F	141	139	137
INLET MAN. PRESSURE		10	in Hg(abs)	69.7	54.1	39.1
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	11	°F	150	148	144
TIMING		12	°BTDC	22	22	22
EXHAUST TEMPERATURE - ENGINE OUTLET		13	°F	769	738	715
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	14, 9	ft3/min	3904	2892	1933
EXHAUST GAS MASS FLOW	(WET)	14, 9	lb/hr	7259	5509	3747

EMISSIONS DATA - ENGINE OUT					
NOx (as NO2)	15,16	g/bhp-hr	2.00	2.00	2.00
CO	15,17	g/bhp-hr	1.76	1.92	1.85
THC (mol. wt. of 15.84)	15,17	g/bhp-hr	5.23	5.43	5.49
NMHC (mol. wt. of 15.84)	15,17	g/bhp-hr	0.79	0.81	0.82
NMNEHC (VOCs) (mol. wt. of 15.84)	15,17,18	g/bhp-hr	0.52	0.54	0.55
HCHO (Formaldehyde)	15,17	g/bhp-hr	0.27	0.27	0.27
CO2	15,17	g/bhp-hr	474	469	459
EXHAUST OXYGEN	15,19	% DRY	8.6	8.4	8.1
LAMBDA	15,19		1.59	1.52	1.41

ENERGY BALANCE DATA						
LHV INPUT		20	Btu/min	90807	71870	52793
HEAT REJECTION TO JACKET WATER (JW)		21,27	Btu/min	20861	19531	17397
HEAT REJECTION TO ATMOSPHERE	(INCLUDES GENERATOR)	22	Btu/min	5255	4044	2907
HEAT REJECTION TO LUBE OIL (OC)		23,27	Btu/min	3299	3088	2751
HEAT REJECTION TO EXHAUST (LHV TO 77°F)		24,25	Btu/min	24444	17901	11874
HEAT REJECTION TO EXHAUST (LHV TO 350°F)		24	Btu/min	13561	9547	6129
HEAT REJECTION TO AFTERCOOLER (AC)		26,28	Btu/min	6554	4016	1680

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	70	75	80	100
SET POINT TIMING	18	20	22	22
DERATION FACTOR	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	0.98	0.95	0.91	0.88	0.84	0.81	0.78	0.75	0.72	0.69	0.66	0.64	0.61
120	1	0.96	0.93	0.89	0.86	0.82	0.79	0.76	0.73	0.70	0.68	0.65	0.62
110	1	0.98	0.94	0.91	0.87	0.84	0.81	0.78	0.75	0.72	0.69	0.66	0.63
100	1	1	0.96	0.92	0.89	0.85	0.82	0.79	0.76	0.73	0.70	0.67	0.64
90	1	1	0.98	0.94	0.90	0.87	0.84	0.80	0.77	0.74	0.71	0.68	0.66
80	1	1	0.99	0.96	0.92	0.89	0.85	0.82	0.79	0.76	0.73	0.70	0.67
70	1	1	1	0.98	0.94	0.90	0.87	0.83	0.80	0.77	0.74	0.71	0.68
60	1	1	1	0.99	0.96	0.92	0.88	0.85	0.82	0.78	0.75	0.72	0.69
50	1	1	1	1	0.98	0.94	0.90	0.87	0.83	0.80	0.77	0.74	0.71

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	1.35	1.41	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47
120	1.28	1.34	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
110	1.20	1.26	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32
100	1.13	1.19	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
90	1.06	1.12	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18
80	1	1.05	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
70	1	1	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
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 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 assume a specific air-to-core temperature rise and zero additional air flow restriction on the standard packaged radiator. Refer to TMI Systems Data for fan air flow and air-to-core temperature rise values. Increased fan airflow restriction or a different air-to-core rise value requires a Special Rating Request to determine actual engine power at your site. Additional rating may be available with a larger, custom radiator.

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 28 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. Fuel pressure range specified is to the engine fuel pressure regulator. Additional fuel train components should be considered in pressure and flow calculations.
2. Generator efficiencies, power factor, and voltage are based on standard generator. [Package Power (ekW) is calculated as: (Engine Power (bkW) - Fan Power (bkW)) x Generator Efficiency], [Package Power (kVA) is calculated as: (Engine Power (bkW) - Fan Power (bkw)) x Generator Efficiency / Power Factor]
3. Rating is with two engine driven water pumps. Tolerance is (+)3, (-)0% of full load.
4. Package Efficiency published in accordance with ISO 3046/1, based on a 1.0 power factor.
5. Thermal Efficiency is calculated based on energy recovery from the jacket water, lube oil, and exhaust to 350ºF with engine operation at ISO 3046/1 Package Efficiency, and assumes unburned fuel is converted in an oxidation catalyst.
6. Total efficiency is calculated as: Package Efficiency + Thermal Efficiency. Tolerance is ±10% of full load data.
7. ISO 3046/1 Package fuel consumption tolerance is (+)5, (-)0% at the specified power factor. Nominal package and engine fuel consumption tolerance is ± 3.0% of full load data at the specified power factor.
8. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.
9. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.
10. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.
11. Inlet manifold temperature is a nominal value with a tolerance of ± 9°F.
12. Timing indicated is for use with the minimum fuel methane number specified. Consult the appropriate fuel usage guide for timing at other methane numbers.
13. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.
14. Exhaust flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 6 %.
15. Emissions data is at engine exhaust flange prior to any after treatment.
16. NOx tolerances are ± 18% of specified value.
17. CO, CO2, THC, NMHC, NMNEHC, and HCHO are the maximum values expected under steady state conditions. THC, NMHC, and NMNEHC do not include aldehydes. An oxidation catalyst may be required to meet Federal, State or local CO or HC requirements.
18. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ
19. 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.
20. LHV rate tolerance is ± 3.0%.
21. 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.
22. Heat rejection to atmosphere based on treated water. Tolerance is ± 50% of full load data.
23. Lube oil heat rate based on treated water. Tolerance is ± 20% of full load data.
24. Exhaust heat rate based on treated water. Tolerance is ± 10% of full load data.
25. 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.
26. Heat rejection to aftercooler based on treated water. Tolerance is ±5% of full load data.
27. 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.
28. 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.

FREE FIELD MECHANICAL & EXHAUST NOISE

MECHANICAL: Sound Power (1/3 Octave Frequencies)

Gen Power With 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)
500	755	100	118.7	106.3	112.0	105.0	104.5	107.1	103.8	104.1	106.2	104.2	104.5
375	577	75	117.9	105.7	111.0	104.2	105.2	107.9	103.9	105.2	107.3	104.6	104.2
250	400	50	117.4	105.6	110.7	103.9	105.1	107.3	104.1	105.3	107.4	103.9	103.8

MECHANICAL: Sound Power (1/3 Octave Frequencies)

Gen Power With 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)
500	755	100	104.3	104.1	103.7	102.8	101.2	102.2	102.5	101.5	99.6	113.0	104.7
375	577	75	103.7	102.8	102.9	101.7	100.1	100.7	100.3	99.5	102.2	100.8	96.8
250	400	50	103.3	103.1	102.7	101.1	99.6	100.3	99.6	98.4	98.5	96.5	92.6

EXHAUST: Sound Power (1/3 Octave Frequencies)

Gen Power With 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)
500	755	100	129.1	119.7	117.4	119.7	115.4	119.7	117.0	118.5	116.4	113.9	119.2
375	577	75	128.1	113.5	116.3	120.7	114.5	118.3	116.7	119.3	115.8	112.9	117.1
250	400	50	127.0	109.8	116.0	116.6	116.6	119.5	116.0	118.8	115.0	111.7	115.6

EXHAUST: Sound Power (1/3 Octave Frequencies)

Gen Power With 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)
500	755	100	114.8	118.2	114.9	114.6	113.0	110.5	107.0	103.9	98.1	91.9	84.0
375	577	75	113.4	115.1	114.8	113.2	110.8	109.5	105.8	102.6	97.7	90.0	80.1
250	400	50	111.6	112.8	112.8	110.3	107.8	106.8	103.5	100.5	96.0	87.7	76.9

SOUND PARAMETER DEFINITION:
Sound Power Level Data - DM8702-03

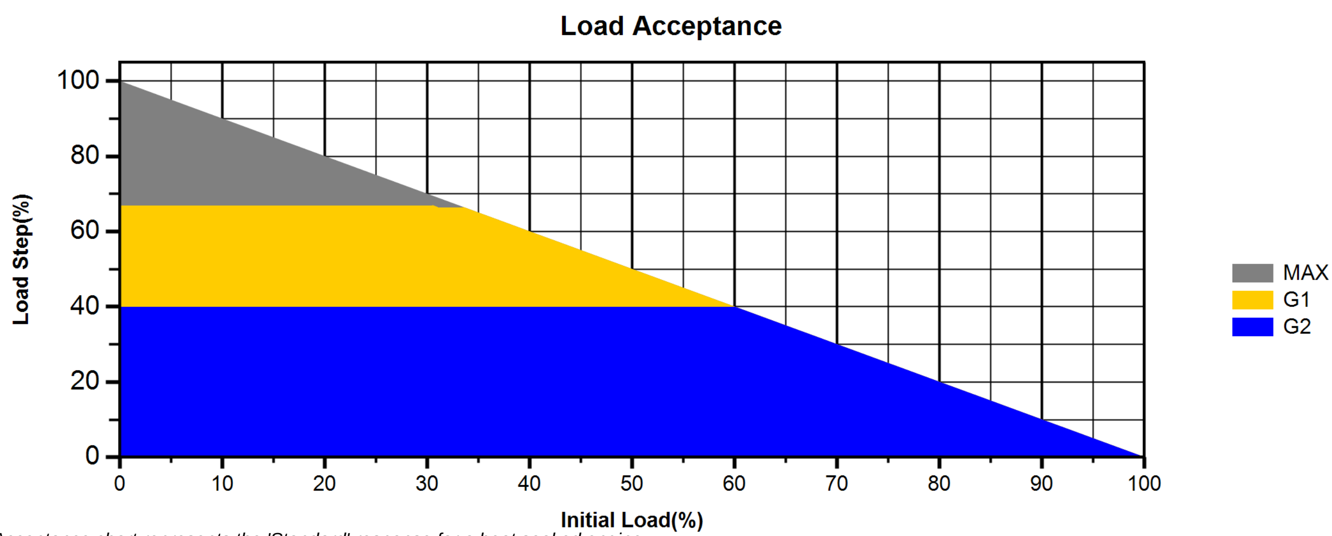
Sound power is defined as the total sound energy emanating from a source irrespective of direction or distance. Sound power level data is presented under two index headings:
Sound power level -- Mechanical
Sound power level -- Exhaust

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.



Load Acceptance chart represents the 'Standard' response for a heat soaked engine

Transient Load Acceptance

Load Step	Frequency Deviation +/- (%)	Voltage Deviation +/- (%)	Recovery Time (sec)	Classification as Defined by ISO 8528 - 5	Notes
100	+4/-32	+3/-46	5.5		
75	+6/-20	+3/-30	5.3		
50	+6/-12	+3/-17	5	G1	(2)
25	+2/-5	+3/-7	4	G2	(3)
20	+2/-4	+3/-6	3.8	G2	(3)
15	+2/-4	+3/-5	3.8	G2	(3)
10	+2/-3	+3/-5	3.8	G2	(3)
5	+2/-2	+3/-4	3.8	G2	(3)
-25	+4/-2	+5/-3	4		
-50	+5/-2	+9/-3	5		
Breaker Open	+10/-2	+20/-3	5.5		(1)
Recovery Specification	+3.5/-3.5	+5/-5			
Steady State Specification	+2.5/-2.5	+5/-5			

Transient Information

The transient load steps listed above are stated as a percentage of the engine's full rated load as indicated in the appropriate performance technical data sheet. Site ambient conditions, fuel quality, inlet/exhaust restriction and emissions settings will all affect engine response to load change. Engines that are not operating at the standard conditions stated in the Technical data sheet should be set up according to the guidelines included in the technical data; applying timing changes and/or engine derates as needed. Adherence to the engine settings guidelines will allow the engines to retain the transient performance stated in the tables above as a percentage of the site derated power (where appropriate).Fuel supply pressure and stability is critical to transient performance. Proper installation requires that all fuel train components (including filters, shut off valves, and regulators) be sized to ensure adequate fuel be delivered to the engine. The following are fuel pressure requirements to be measured at the engine mounted fuel control valve.

a. Steady State Fuel Pressure Stability +/- .15 psi/sec
b. Transient fuel Pressure Stability +/- .15 psi/sec

Inlet water temperature to the SCAC must be maintained at specified value for all engines. It is important that the external cooling system design is able to maintain the Inlet water temp to the SCAC to within +/- 1 °C during all engine-operating cycles. The SCAC inlet temperature stability criterion is to maintain stable inlet manifold air temperature. The Air Fuel Ratio control system requires up to 180 seconds to converge after a load step has been performed for NOx to return to nominal setting. If the stabilization time is not met between load steps the transient performance listed in the document may not be met. Differences in generator inertia may change the transient response of engine. Engine Governor gains and Voltage regulator settings may need to be tuned for site conditions. Engines must be maintained in accordance to guidelines specified in the Caterpillar Service Manuals applicable to each engine. Wear of components outside of the specified tolerances will affect the transient capability of the engine.

NOTES:

1. For unloading the engine to 0% load from a loaded condition no external input is needed. The engine control algorithm employs a load sensing strategy to determine a load drop. In the event that the local generator breaker opens the strategy provides control to the engine that resets all control inputs to the rated idle condition. This prevents engine over speeding and will allow the engine to remain running unloaded at the rated synchronous speed.
2. The engines specified above have been tested against the voltage deviation, frequency deviation, and recovery time requirements defined in ISO 8528 - 5. At this time the engines stated above will meet class G1 transient performance as defined by ISO 8528 - 5 with exceptions.
3. The engines specified above have been tested against the voltage deviation, frequency deviation, and recovery time requirements defined in ISO 8528 - 5. At this time the engines stated above will meet class G2 transient performance as defined by ISO 8528 - 5 with exceptions.
4. Air flow is critical for turbocharged engines during transients. As the exhaust temperature increases, the air flow or turbo response increases to enhance the genset transient response. Therefore, the recovery time for an engine's "First" load step after start up may differ from the "Standard" response for a heat soaked engine. If different, the load step recovery times are illustrated as Standard/First .
5. Steady state voltage and frequency stability specified at +/-2 sigma or better.