

Parkland 3 - Arc Resources

VGF - L36GL

Custom Power Generation

Abby Novlesky

Current / Typical Run Mode

Power Generation

ENGINE SPEED (rpm):	1800	COOLING SYSTEM:	JW, IC + OC
DISPLACEMENT (in3):	2193	INTERCOOLER WATER INLET (°F):	130
COMPRESSION RATIO:	11:1	JACKET WATER OUTLET (°F):	180
IGNITION SYSTEM:	CEC	JACKET WATER CAPACITY (gal):	44
EXHAUST MANIFOLD:	Water Cooled	AUXILIARY WATER CAPACITY (gal):	14
COMBUSTION:	Lean Burn, Open Chamber	LUBE OIL CAPACITY (gal):	86
ENGINE DRY WEIGHT (lbs):	11200	MAX. EXHAUST BACKPRESSURE (in. H2O):	15
AIR/FUEL RATIO SETTING:	7.8% O2	MAX. AIR INLET RESTRICTION (in. H2O):	15
ENGINE SOUND LEVEL (dBA)	99	EXHAUST SOUND LEVEL (dBA)	111
IGNITION TIMING:	8° BTDC	PHASE:	3
FREQUENCY (Hz):	60	PHASE ROTATION:	T1-T2-T3
GENERATOR TYPE:	Synchronous		

SITE CONDITIONS:

FUEL:	Natural Gas	ALTITUDE (ft):	2180
FUEL PRESSURE RANGE (psig):	26 - 50	MAXIMUM INLET AIR TEMPERATURE (°F):	95
FUEL HHV (BTU/ft3):	1,156.4	FUEL WKI:	72.3
FUEL LHV (BTU/ft3):	1,045.4		

SITE SPECIFIC TECHNICAL DATA

POWER RATING	UNITS		MAX RATING AT 100 °F AIR TEMP	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE OF 95 °F		
				100%	80%	51%
CONTINUOUS ENGINE POWER	BHP		868	869	695	439
OVERLOAD	% 2/24 hr		0	0	-	-
ELECTRICAL EFFICIENCY (LHV)	%		31.5	31.5	30.5	27.9
GENERATOR OUTPUT	kWe		614	614	491	310
GENERATOR kVA	kVA		768	768	614	388
based on 94.8% generator efficiency at 0.8 PF, no auxiliary engine driven equipment						

FUEL CONSUMPTION

FUEL CONSUMPTION (LHV)	BTU/BHP-hr		7665	7663	7911	8639
FUEL CONSUMPTION (HHV)	BTU/BHP-hr		8478	8477	8751	9556
FUEL FLOW	SCFM		106	106	88	60
based on fuel analysis LHV						

HEAT REJECTION

JACKET WATER (JW)	BTU/hr x 1000		1753	1750	1512	1157
LUBE OIL (OC)	BTU/hr x 1000		218	218	205	185
INTERCOOLER (IC)	BTU/hr x 1000		485	475	338	169
EXHAUST	BTU/hr x 1000		2010	2023	1672	1128
RADIATION	BTU/hr x 1000		106	111	110	108

EMISSIONS (ENGINE OUT):

NOx (NO + NO2)	g/bhp-hr		2.0	2.0	2.0	2.0
CO	g/bhp-hr		1.3	1.3	1.3	1.6
THC	g/bhp-hr		1.6	1.6	1.6	1.6
NMHC	g/bhp-hr		0.47	0.47	0.54	0.63
NM,NEHC (VOC)	g/bhp-hr		0.11	0.11	0.13	0.15
CO2	g/bhp-hr		478	478	494	539
CO2e	g/bhp-hr		507	507	526	577
CH2O	g/bhp-hr		0.19	0.19	0.19	0.19
CH4	g/bhp-hr		1.14	1.14	1.31	1.51

AIR INTAKE / EXHAUST GAS

INDUCTION AIR FLOW	SCFM		2004	2006	1657	1141
EXHAUST GAS MASS FLOW	lb/hr		8730	8738	7217	4972
EXHAUST GAS FLOW	ACFM		5256	5261	4322	2950
EXHAUST TEMPERATURE	°F		910	910	902	890
at exhaust temp, 14.5 psia						

HEAT EXCHANGER SIZING¹²

TOTAL JACKET WATER CIRCUIT (JW)	BTU/hr x 1000		1988
TOTAL AUXILIARY WATER CIRCUIT (IC + OC)	BTU/hr x 1000		797

COOLING SYSTEM WITH ENGINE MOUNTED WATER PUMPS

JACKET WATER PUMP MIN. DESIGN FLOW	GPM	218
JACKET WATER PUMP MAX. EXTERNAL RESTRICTION	psig	33
AUX WATER PUMP MIN. DESIGN FLOW	GPM	62
AUX WATER PUMP MAX. EXTERNAL RESTRICTION	psig	16

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FUEL COMPOSITION

HYDROCARBONS:			Mole or Volume %	FUEL:	Natural Gas
Methane	CH4		82.41	FUEL PRESSURE RANGE (psig):	26 - 50
Ethane	C2H6		13.899	FUEL WKI:	72.3
Propane	C3H8		2.44		
Iso-Butane	I-C4H10		0.121	FUEL SLHV (BTU/ft3):	1027.18
Normal Butane	N-C4H10		0.209	FUEL SLHV (MJ/Nm3):	40.39
Iso-Pentane	I-C5H12		0.018		
Normal Pentane	N-C5H12		0.021	FUEL LHV (BTU/ft3):	1045.37
Hexane	C6H14		0.002	FUEL LHV (MJ/Nm3):	41.11
Heptane	C7H16		0		
Ethene	C2H4		0	FUEL HHV (BTU/ft3):	1156.38
Propene	C3H6		0	FUEL HHV (MJ/Nm3):	45.47
	SUM HYDROCARBONS		99.12	FUEL DENSITY (SG):	0.66
NON-HYDROCARBONS:					
Nitrogen	N2		0.633	Standard Conditions per ASTM D3588-91 [60°F and 14.696psia] and ISO 6976:1996-02-01[25, V(0;101.325)]. Based on the fuel composition, supply pressure and temperature, liquid hydrocarbons may be present in the fuel. No liquid hydrocarbons are allowed in the fuel. The fuel must not contain any liquid water. Waukesha recommends both of the following: 1) Dew point of the fuel gas to be at least 20°F (11°C) below the measured temperature of the gas at the inlet of the engine fuel regulator. 2) A fuel filter separator to be used on all fuels except commercial quality natural gas. Refer to the 'Fuel and Lubrication' section of 'Technical Data' or contact the Waukesha Application Engineering Department for additional information on fuels, or LHV and WKI* calculations. * Trademark of General Electric Company	
Oxygen	O2		0		
Helium	He		0.014		
Carbon Dioxide	CO2		0.228		
Carbon Monoxide	CO		0		
Hydrogen	H2		0.005		
Water Vapor	H2O		0		
	TOTAL FUEL		100		

FUEL CONTAMINANTS

Total Sulfur Compounds	0	% volume	Total Sulfur Compounds	0	µg/BTU
Total Halogen as Chloride	0	% volume	Total Halogen as Chloride	0	µg/BTU
Total Ammonia	0	% volume	Total Ammonia	0	µg/BTU
<u>Siloxanes</u>			Total Siloxanes (as Si)	0	µg/BTU
Tetramethyl silane	0	% volume			
Trimethyl silanol	0	% volume			
Hexamethyldisiloxane (L2)	0	% volume			
Hexamethylcyclotrisiloxane (D3)	0	% volume			
Octamethyltrisiloxane (L3)	0	% volume			
Octamethylcyclotetrasiloxane (D4)	0	% volume			
Decamethyltetrasiloxane (L4)	0	% volume			
Decamethylcyclopentasiloxane (D5)	0	% volume			
Dodecamethylpentasiloxane (L5)	0	% volume			
Dodecamethylcyclohexasiloxane (D6)	0	% volume			
Others	0	% volume			

Calculated fuel contaminant analysis will depend on the entered fuel composition and selected engine model.

No water or hydrocarbon condensates are allowed in the engine. Requires liquids removal.

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NOTES

1. All data is based on engines with standard configurations unless noted otherwise.
2. Power rating is adjusted for fuel, site altitude, and site air inlet temperature, in accordance with ISO 3046/1 with tolerance of $\pm 3\%$.
3. Fuel consumption is presented in accordance with ISO 3046/1 with a tolerance of $-0 / +5\%$ at maximum rating. Fuel flow calculation based on fuel LHV and fuel consumption with a tolerance of $-0/+5\%$. For sizing piping and fuel equipment, it is recommended to include the 5% tolerance.
4. Heat rejection tolerances are $\pm 30\%$ for radiation, and $\pm 8\%$ for jacket water, lube oil, intercooler, and exhaust energy.
5. Emission levels for engines with GE supplied 3-way catalyst are given at catalyst outlet flange. For all other engine models, emission levels are given at engine exhaust outlet flange prior to any after treatment. Values are based on a new engine operating at indicated site conditions, and adjusted to the specified timing and air/fuel ratio at rated load. Catalyst out emission levels represent emission levels the catalyst is sized to achieve. Manual adjustment may be necessary to achieve compliance as catalyst/engine age. Catalyst-out emission levels are valid for the duration of the engine warranty. Emissions are at an absolute humidity of 75 grains H₂O/lb (10.71 g H₂O/kg) of dry air. Emission levels may vary subject to instrumentation, measurement, ambient conditions, fuel quality, and engine variation. Engine may require adjustment on-site to meet emission values, which may affect engine performance and heat output. NOx, CO, THC, and NMHC emission levels are listed as a not to exceed limit, all other emission levels are estimated. CO₂ emissions based on EPA Federal Register/Vol. 74, No. 209/Friday, October 30, 2009 Rules and Regulations 56398, 56399 (3) Tier 3 Calculation Methodology, Equation C-5.
6. Air flow is based on undried air with a tolerance of $\pm 7\%$.
7. Exhaust temperature given at engine exhaust outlet flange with a tolerance of $\pm 50^{\circ}\text{F}$ (28°C).
8. Exhaust gas mass flow value is based on a "wet basis" with a tolerance of $\pm 7\%$.
9. Inlet air restrictions based on full rated engine load. Exhaust backpressure based on 176 PSI BMEP and 1800 RPM. Refer to the engine specification section of Waukesha's standard technical data for more information.
10. Cooling circuit capacity, lube oil capacity, and engine dry weight values are typical.
11. Fuel must conform to Waukesha's "Gaseous Fuel Specification" S7884-7 or most current version. Fuel may require treatment to meet current fuel specification.
12. Heat exchanger sizing values given as the maximum heat rejection of the circuit, with applied tolerances and an additional 5% reserve factor.
13. Fuel volume flow calculation in english units is based on 100% relative humidity of the fuel gas at standard conditions of 60°F and 14.696 psia (29.92 inches of mercury; 101.325 kPa).
14. Fuel volume flow calculation in metric units is based on 100% relative humidity of the fuel gas at a combustion temperature of 25°C and metering conditions of 0°C and 101.325 kPa (14.696 psia; 29.92 inches of mercury). This is expressed as $[25, V(0;101.325)]$.
15. Engine sound data taken with the microphone at 1 m (3.3 ft) from the side of the engine at the approximate front-to-back centerline. Microphone height was at intake manifold level. Engine sound pressure data may be different at front, back and opposite side locations. Exhaust sound data taken with microphone 1 meter (3.3 ft) away and 1 meter (3.3 ft) to the side of the exhaust outlet.
16. Due to variation between test conditions and final site conditions, such as exhaust configuration and background sound level, sound pressure levels under site conditions may be different than those tabulated above.
17. Cooling system design flow is based on minimum allowable cooling system flow. Cooling system maximum external restriction is defined as the allowable restriction at the minimum cooling system flow.
18. Continuous Power Rating: The highest load and speed that can be applied 24 hours per day, seven days per week, 365 days per year except for normal maintenance at indicated ambient reference conditions and fuel. No engine overload power rating is available.
19. emPact emission compliance available for entire range of operable fuels; however, fuel system and/or O₂ set point may need to be adjusted in order to maintain compliance.
20. In cold ambient temperatures, heating of the engine jacket water, lube oil and combustion air may be required. See Waukesha Technical Data.

SPECIAL REQUIREMENTS

Requires option code 1100 for continuous operation up to 176 psi (12.1 bar) BMEP.
 Site conditions over 100°F or 1500 ft may require a special generator or radiator. Contact Application Engineering.