

SLW_VHP_G1600_C10 catalyst out - S&L Standard Lambda-1
VHP - P9394GSI S5

S&L Energie-Projekte GmbH BH

Power Generation

ENGINE SPEED (rpm):	1000	NOx SELECTION (mg/Nm3):	61
DISPLACEMENT (L):	154	COOLING SYSTEM:	JW, IC + OC
COMPRESSION RATIO:	9.7:1	INTERCOOLER WATER INLET (°C):	60
IGNITION SYSTEM:	ESM2	JACKET WATER OUTLET (°C):	82.2
EXHAUST MANIFOLD:	Water Cooled	JACKET WATER CAPACITY (L):	560
COMBUSTION:	Rich Burn, Turbocharged	AUXILIARY WATER CAPACITY (L):	61
ENGINE DRY WEIGHT (kg):	15377	LUBE OIL CAPACITY (L):	980
AIR/FUEL RATIO SETTING:	ESM2	MAX. EXHAUST BACKPRESSURE (mm H2O):	470
ENGINE SOUND LEVEL (dBA)	101	MAX. AIR INLET RESTRICTION (mm H2O):	381
IGNITION TIMING:	ESM2 Controlled	EXHAUST SOUND LEVEL (dBA)	106
FREQUENCY (Hz):	50	PHASE:	3
GENERATOR TYPE:	Synchronous	PHASE ROTATION:	T1-T2-T3
VOLTAGE:	10000	GEN. ROTATING MASS MOMENT OF INERTIA (kg m2):	86,3

SITE CONDITIONS:

FUEL:	Erdgas H (Hamburg)	ALTITUDE (m):	75
FUEL PRESSURE RANGE (barG):	2.76 - 4.14	MAXIMUM INLET AIR TEMPERATURE (°C):	35
FUEL HHV (MJ/Nm3):	40.42	FUEL WKI:	93.3
FUEL LHV (MJ/Nm3):	36.54		

SITE SPECIFIC TECHNICAL DATA

POWER RATING	UNITS	MAX RATING AT 38 °C AIR TEMP	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE OF 35 °C		
			99%	95%	75%
CONTINUOUS ENGINE POWER	kWb	1679	1664	1259	1259
OVERLOAD	% 2/24 hr	0	0	-	-
ELECTRICAL EFFICIENCY (LHV)	%	35.3	35.3	35.3	35.3
GENERATOR OUTPUT	kWe	1615	1600	1211	1211
GENERATOR kVA	kVA	2019	2000	1514	1514
GENERATOR CURRENT	Amps	117	116	88	88

based on 96.15% generator efficiency at 0.8 PF, no auxiliary engine driven equipment

FUEL CONSUMPTION

FUEL CONSUMPTION (LHV)	kJ/kWe-hr		10191	10198	10205	10205
FUEL CONSUMPTION (HHV)	kJ/kWe-hr		11273	11281	11289	11289
FUEL FLOW	Nm3/hr	<i>based on fuel analysis LHV</i>	450	447	338	338

HEAT REJECTION

JACKET WATER (JW)	kW		1320	1306	1033	1033
LUBE OIL (OC)	kW		156	154	132	132
INTERCOOLER (IC)	kW		180	170	81	81
EXHAUST	kW		1169	1165	845	845
RADIATION	kW		157	161	150	150

EMISSIONS (CATALYST OUT):

NOx (NO + NO2)	mg/Nm3	<i>corr. To 5% O2</i>	63	63	63	63
CO	mg/Nm3	<i>corr. To 5% O2</i>	126	126	126	126
THC	mg/Nm3	<i>corr. To 5% O2</i>	144	144	181	181
NMHC	mg/Nm3	<i>corr. To 5% O2</i>	2	2	3	3
NM,NEHC (VOC)	mg/Nm3	<i>corr. To 5% O2</i>	1	1	1	1
CO2	g/Nm3	<i>corr. To 5% O2</i>	182	182	182	182
CO2e	g/Nm3	<i>corr. To 5% O2</i>	185	185	186	186
CH2O	mg/Nm3	<i>corr. To 5% O2</i>	0.42	0.42	0.42	0.42
CH4	mg/Nm3	<i>corr. To 5% O2</i>	141	142	178	178

AIR INTAKE / EXHAUST GAS

INDUCTION AIR FLOW	Nm3/hr		4398	4358	3303	3303
EXHAUST GAS MASS FLOW	kg/hr		6158	6103	4625	4625
EXHAUST GAS FLOW	m3/hr	<i>at exhaust temp, 100 kPa</i>	15739	15617	11515	11515
EXHAUST TEMPERATURE	°C		578	579	556	556

HEAT EXCHANGER SIZING¹²

TOTAL JACKET WATER CIRCUIT (JW)	kW	1497
TOTAL AUXILIARY WATER CIRCUIT (IC + OC)	kW	381

COOLING SYSTEM WITH ENGINE MOUNTED WATER PUMPS

JACKET WATER PUMP MIN. DESIGN FLOW	L/min	2687
JACKET WATER PUMP MAX. EXTERNAL RESTRICTION	barG	0.89
AUX WATER PUMP MIN. DESIGN FLOW	L/min	318
AUX WATER PUMP MAX. EXTERNAL RESTRICTION	barG	1.94

FUEL COMPOSITION
HYDROCARBONS:

		<u>Mole or Volume %</u>
Methane	CH4	94.46
Ethane	C2H6	3.447
Propane	C3H8	0.349
Iso-Butane	I-C4H10	0.064
Normal Butane	N-C4H10	0.049
Iso-Pentane	I-C5H12	0.013
Normal Pentane	N-C5H12	0.01
Hexane	C6H14	0
Heptane	C7H16	0
Ethene	C2H4	0
Propene	C3H6	0

FUEL: Erdgas H (Hamburg)
 FUEL PRESSURE RANGE (barG): 2.76 - 4.14
 FUEL WKI: 93.3

FUEL SLHV (BTU/ft3): 912.99
 FUEL SLHV (MJ/Nm3): 35.90

FUEL LHV (BTU/ft3): 929.16
 FUEL LHV (MJ/Nm3): 36.54

FUEL HHV (BTU/ft3): 1027.83
 FUEL HHV (MJ/Nm3): 40.42

SUM HYDROCARBONS 98.392

FUEL DENSITY (SG): 0.59

NON-HYDROCARBONS:

Nitrogen	N2	0.8
Oxygen	O2	0
Helium	He	0
Carbon Dioxide	CO2	0.804
Carbon Monoxide	CO	0
Hydrogen	H2	0
Water Vapor	H2O	0

TOTAL FUEL 99.996

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 INNIO Waukesha Gas Engines Inc.

FUEL CONTAMINANTS

Total Sulfur Compounds	0	% volume
Total Halogen as Chloride	0	% volume
Total Ammonia	0	% volume

Total Sulfur Compound: 0 µg/BTU
 Total Halogen as Chlorid: 0 µg/BTU
 Total Ammonia: 0 µg/BTU

Siloxanes

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

Total Siloxanes (as Si) 0 µg/BTU

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.

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 Waukesha 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. NO_x, 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
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 175.76 PSI BMEP and 1000 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.
21. Available Turndown Speed Range refers to the constant torque speed range available. Reduced power may be available at speeds outside of this range. Contact application engineering.

SPECIAL REQUIREMENTS

Requires option code 1005A for 0.15g/bhp-hr catalyst.