# 0.01 Technical Data (at module)

| Data at: | | | | Full load | Part Load | | Propane |
|---|---|---|---|---|---|---|---|
| Fuel gas LHV | | BTU/scft | | 8684 | | | 2500 |
| | | | | 100% | 75% | 50% | 100% |
| | | | | | | | |
| Energy input | | MBTU/hr | [2] | 14.734 | 11.383 | 8.036 | 6.703 |
| Gas volume | | scfhr | *) | 1.697 | 1.311 | 925 | 2.681 |
| Mechanical output | | bhp | [1] | 2.509 | 1.881 | 1.255 | 1004 |
| Electrical output | | kW el. | [4] | 1.790 | 1.326 | 880 | 713 |
| Recoverable thermal output | | | | | | | |
| ~ Intercooler 1st stage | | MBTU/hr | | 1.339 | 754 | 218 | 65 |
| ~ Lube oil (with gearbox) | | MBTU/hr | | 710 | 632 | 550 | 471 |
| ~ Jacket water | | MBTU/hr | | 1.061 | 901 | 778 | 717 |
| ~ Exhaust gas cooled to 248 °F | | MBTU/hr | | 3.488 | 2.958 | 2.283 | 1.962 |
| Total recoverable thermal output | | MBTU/hr | [5] | 6.598 | 5.245 | 3.829 | 3.215 |
| | | | | | | | |
| | | | | | | | |
| Heat to be dissipated | | | | | | | |
| ~ Intercooler 2nd stage | | MBTU/hr | | 340 | 266 | 198 | 171 |
| ~ Lube oil (with gearbox) | | MBTU/hr | | ~ | ~ | ~ | ~ |
| ~ Surface heat | ca. | MBTU/hr | [7] | 655 | 565 | 493 | 320 |
| ~ Balance heat | | MBTU/hr | | 147 | 113 | 82 | 68 |
| | | | | | | | |
| Spec. fuel consumption of engine | | BTU/bhp.hr | [2] | 5.872 | 6.050 | 6.402 | 6.676 |
| Lube oil consumption | ca. | gal/hr | [3] | 0,17 | ~ | ~ | ~ |
| Electrical efficiency | | % | | 41,5% | 39,8% | 37,3% | 36.3% |
| Thermal efficiency | | % | | 44,8% | 46,1% | 47,7% | 47.9% |
| Total efficiency | | % | [6] | 86,2% | 85,8% | 85,0% | 84.2% |
| | | | | | | | |
| Hot water circuit: | | | | | | | |
| Forward temperature | | °F | | 194,0 | 170,3 | 167,0 | |
| Return temperature | | °F | | 158,0 | 158,0 | 158,0 | |
| Hot water flow rate | | GPM | | 366,5 | 366,5 | 366,5 | |

*) approximate value for pipework dimensioning
[_] Explanations: see 0.10 - Technical parameters

All heat data is based on standard conditions according to attachment 0.10. Deviations from the standard conditions can result in a change of values within the heat balance, and must be taken into consideration in the layout of the cooling circuit/equipment (intercooler; emergency cooling; ...).

## Main dimensions and weights (at module)(with gearbox)

| | | |
|---|---|---|
| Length | in | ~ 360 |
| Width | in | ~ 90 |
| Height | in | ~ 110 |
| Weight empty | lbs | ~ 46.030 |
| Weight filled | lbs | ~ 48.240 |

## Connections

| | | |
|---|---|---|
| Hot water inlet and outlet | in/lbs | 4"/145 |
| Exhaust gas outlet | in/lbs | 20"/145 |
| Fuel gas (at gas train) | in/lbs | 4"/232 |
| Fuel Gas (at module) | in/lbs | 4"/145 |
| Water drain ISO 228 | G | ½" |
| Condensate drain | in/lbs | 2"/145 |
| Safety valve - jacket water ISO 228 | in/lbs | 2x1½"/2.5 |
| Safety valve - hot water | in/lbs | 2½"/232 |
| Lube oil replenishing (pipe) | in | 1,1 |
| Lube oil drain (pipe) | in | 1,1 |
| Jacket water - filling (flex pipe) | in | 0,5 |
| Intercooler water-Inlet/Outlet 1st stage | in/lbs | 4"/145 |
| Intercooler water-Inlet/Outlet 2nd stage | in/lbs | 2½"/145 |

# 0.02 Technical data of engine

| | | |
|---|---|---|
| Manufacturer | | GE Jenbacher |
| Engine type | | J 612 GS-E12 |
| Working principle | | 4-Stroke |
| Configuration | | V 60° |
| No. of cylinders | | 12 |
| Bore | in | 7,48 |
| Stroke | in | 8,66 |
| Piston displacement | cu.in | 4.568 |
| Nominal speed | rpm | 1.500 |
| Mean piston speed | in/s | 433 |
| Filling capacity lube oil | gal | 106 |
| Filling capacity water | gal | 53 |
| Length | in | 167 |
| Width | in | 74 |
| Height | in | 99 |
| Weight dry | lbs | 17.196 |
| Weight filled | lbs | 18.960 |
| Moment of inertia | lbs-ft² | 1345,01 |
| Direction of rotation (from flywheel view) | | left |
| Flywheel connection | | SAE 21" |
| Radio interference level to VDE 0875 | | N |
| Starter motor output | kW | 15 |
| Starter motor voltage | V | 24 |

## Thermal energy balance

| | | |
|---|---|---|
| Energy input | MBTU/hr | 14.734 |
| Intercooler | MBTU/hr | 1.679 |
| Lube oil (with gearbox) | MBTU/hr | 710 |
| Jacket water | MBTU/hr | 1.061 |
| Exhaust gas total | MBTU/hr | 4.449 |
| Exhaust gas cooled to 356 °F | MBTU/hr | 2.876 |
| Exhaust gas cooled to 212 °F | MBTU/hr | 3.692 |
| Surface heat | MBTU/hr | 379 |
| Balance heat | MBTU/hr | 147 |

## Exhaust gas data

| | | |
|---|---|---|
| Exhaust gas temperature at full load | °F [8] | 804 |
| Exhaust gas mass flow rate, wet | lbs/hr | 23.296 |
| Exhaust gas mass flow rate, dry | lbs/hr | 21.819 |
| Exhaust gas volume, wet | scfhr | 310.401 |
| Exhaust gas volume, dry | scfhr | 280.354 |
| Max.admissible exhaust back pressure after engine | psi | 0,870 |

## Combustion air data

| | | |
|---|---|---|
| Combustion air mass flow rate | lbs/hr | 22.582 |
| Combustion air volume | SCFM | 4.929 |
| Max. admissible pressure drop in front of intake-air filter | psi | 0,145 |

**base for exhaust gas data: natural gas: 100% CH4; biogas 65% CH4, 35% CO2**

## Output / fuel consumption

| | | |
|---|---|---|
| ISO standard fuel stop power ICFN | bhp | 2.509 |
| Mean effe. press. at stand. power and nom. speed | psi | 290 |
| Fuel gas type | | Natural gas |
| Based on methane number | MN d) | 70 |
| Compression ratio | Epsilon | 11,00 |
| Min. fuel gas pressure for the pre chamber | psi | 43.5 - 58.0 |
| Min./Max. fuel gas pressure at inlet to gas train | psi | 1.2 - 2.9 c) |
| Allowed Fluctuation of fuel gas pressure | % | ± 10 |
| Max. rate of gas pressure fluctuation | psi/sec | 0,145 |
| Maximum Intercooler 2nd stage inlet water temperature | °F | 104 |
| Spec. fuel consumption of engine | BTU/bhp.hr | 5.872 |
| Specific lube oil consumption | g/bhp.hr | 0,22 |
| Max. Oil temperature | °F | 176 |
| Jacket-water temperature max. | °F | 203 |

c) Lower gas pressures upon inquiry
d) based on methane number calculation software AVL 3.1

## Sound pressure level

| | | |
|---|---|---|
| Aggregate b) | dB(A) re 20µPa | 100 |
| 31,5 Hz | dB | 90 |
| 63 Hz | dB | 88 |
| 125 Hz | dB | 100 |
| 250 Hz | dB | 95 |
| 500 Hz | dB | 94 |
| 1000 Hz | dB | 93 |
| 2000 Hz | dB | 91 |
| 4000 Hz | dB | 91 |
| 8000 Hz | dB | 94 |
| Exhaust gas a) | dB(A) re 20µPa | 116 |
| 31,5 Hz | dB | 104 |
| 63 Hz | dB | 121 |
| 125 Hz | dB | 124 |
| 250 Hz | dB | 116 |
| 500 Hz | dB | 111 |
| 1000 Hz | dB | 110 |
| 2000 Hz | dB | 108 |
| 4000 Hz | dB | 104 |
| 8000 Hz | dB | 86 |

## Sound power level

| | | |
|---|---|---|
| Aggregate | dB(A) re 1pW | 121 |
| Measurement surface | ft² | 1.324 |
| Exhaust gas | dB(A) re 1pW | 124 |
| Measurement surface | ft² | 67,60 |

a) average sound pressure level on measurement surface in a distance of 3.28ft according to DIN 45635, precision class 2.
b) average sound pressure level on measurement surface in a distance of 3.28ft (converted to free field) according to DIN 45635, precision class 3.
Operation with 1200 rpm see upper values, operation with 1800 rpm add 3 dB to upper values.
Engine tolerance ± 3 dB

## 0.03 Technical data of generator

| | | |
|---|---|---|
| Manufacturer | | STAMFORD |
| Type | | LVSI 804 R2 |
| Type rating | kVA | 2.750 |
| Driving power | bhp | 2.477 |
| Ratings at p.f.= 1.0 | kW | 1.790 |
| Ratings at p.f. = 0,8 | kW | 1.772 |
| Rated output at p.f. = 0,8 | kVA | 2.214 |
| Rated current at p.f. = 0,8 | A | 2.663 |
| Frequency | Hz | 60 |
| Voltage | V | 480 |
| Speed | rpm | 1.800 |
| Permissible overspeed | rpm | 2.160 |
| Power factor lagging | | 0,8 - 1,0 |
| Efficiency at p.f.= 1.0 | % | 96,9% |
| Efficiency at p.f. = 0,8 | % | 95,9% |
| Moment of inertia | lbs-ft² | 1774,12 |
| Mass | lbs | 11.449 |
| Radio interference level to VDE 0875 | | N |
| Construction | | B3/B14 |
| Protection Class | | IP 23 |
| Insulation class | | H |
| Temperature rise (at driving power) | | F |
| Maximum ambient temperature | °F | 104 |
| Total harmonic distortion | % | 1,5 |

### Reactance and time constants

| | | |
|---|---|---|
| xd direct axis synchronous reactance | p.u. | 2,13 |
| xd' direct axis transient reactance | p.u. | 0,19 |
| xd" direct axis sub transient reactance | p.u. | 0,14 |
| Td" sub transient reactance time constant | ms | 15 |
| Ta Time constant direct-current | ms | 66 |
| Tdo' open circuit field time constant | s | 3,95 |

## 0.03.01 Technical data of gearbox

| | | |
|---|---|---|
| Manufacturer | | EICKHOFF |
| Type | | ANO - 090 |
| Gearbox ratio | | 1:1.2 |
| Efficiency | % | 98,73 |
| Mass | lbs | 2.282 |

# 0.04 Technical data of heat recovery

## General data - Hot water circuit

| | | |
|---|---|---|
| Total recoverable thermal output | MBTU/hr | 6.598 |
| Return temperature | °F | 158,0 |
| Forward temperature | °F | 194,0 |
| Hot water flow rate | GPM | 366,5 |
| Design pressure of hot water | psi | 145 |
| Pressure drop hot water circuit | psi | 18,13 |
| Maximum Variation in return temperature | °F | +5/-36 |
| Max. rate of return temperature fluctuation | °F/min | 18 |

## Mixture Intercooler (1st stage)

| | | |
|---|---|---|
| Type | | gilled pipes |
| Design pressure of hot water | psi | 145 |
| Pressure drop hot water circuit | psi | 3,63 |
| Hot water connection | in/lbs | 4"/145 |

## Mixture Intercooler (2nd stage) (Intercooler separate)

| | | |
|---|---|---|
| Type | | gilled pipes |
| Design pressure of hot water | psi | 145 |
| Pressure drop hot water circuit | psi | 3,63 |
| Hot water connection | in/lbs | 2½"/145 |

## Heat exchanger lube oil

| | | |
|---|---|---|
| Type | | plate heat exchanger |
| Design pressure of hot water | psi | 145 |
| Pressure drop hot water circuit | psi | 5,80 |
| Hot water connection | in/lbs | 4"/145 |

## Heat exchanger engine jacket water

| | | |
|---|---|---|
| Type | | plate heat exchanger |
| Design pressure of hot water | psi | 145 |
| Pressure drop hot water circuit | psi | 5,80 |
| Hot water connection | in/lbs | 4"/145 |

## Exhaust gas heat exchanger

| | | |
|---|---|---|
| Type | | shell-and-tube |
| | | |
| PRIMARY: | | |
| Exhaust gas pressure drop approx | psi | 0,22 |
| Exhaust gas connection | in/lbs | 20"/145 |
| | | |
| SECONDARY: | | |
| Design pressure of hot water | psi | 87 |
| Pressure drop hot water circuit | psi | 2,90 |
| Hot water connection | in/lbs | 4"/145 |

## 0.10 Technical parameters

All data in the technical specification are based on engine full load (unless stated otherwise) at specified temperatures as well as the methane number and subject to technical development and modifications. For isolated operation an output reduction may apply according to the block load diagram. Before being able to provide exact output numbers, a detailed site load profile needs to be provided (motor starting curves, etc.).

All pressure indications are to be measured and read with pressure gauges (psi.g.).

(1) At nominal speed and standard reference conditions ICFN according to DIN-ISO 3046 and DIN 6271, respectively
(2) According to DIN-ISO 3046 and DIN 6271, respectively, with a tolerance of + 5 %
(3) Average value between oil change intervals according to maintenance schedule, without oil change amount
(4) At p. f. = 1.0 according to VDE 0530 REM / IEC 34.1 with relative tolerances
(5) Total output with a tolerance of +/- 8 %
(6) According to above parameters (1) through (5)
(7) Only valid for engine and generator; module and peripheral equipment not considered
(8) Exhaust temperature with a tolerance of +/- 5 %

**Radio interference level**
The ignition system of the gas engines complies the radio interference levels of CISPR 12 and EN 55011 class B, (30-75 MHz, 75-400 MHz, 400-1000 MHz) and (30-230 MHz, 230-1000 MHz), respectively.

**Definition of output**
- ISO-ICFN continuous rated power:
  Net break power that the engine manufacturer declares an engine is capable of delivering continuously, at stated speed, between the normal maintenance intervals and overhauls as required by the manufacturer. Power determined under the operating conditions of the manufacturer's test bench and adjusted to the standard reference conditions.
- Standard reference conditions:

| | |
|---|---|
| Barometric pressure: | 14.5 psi (1000 mbar) or 328 ft (100 m) above sea level |
| Air temperature: | 77°F (25°C) or 298 K |
| Relative humidity: | 30 % |

- Volume values at standard conditions (fuel gas, combustion air, exhaust gas)

| | |
|---|---|
| Pressure: | 1 atmosphere (1013.25 mbar) |
| Temperature: | 60°F (15.56°C) |

**Output adjustment for turbo charged engines**
For plants installed at >1640.5 ft (500 m) above see level and/or intake temperature > 86 °F (30 °C) the reduction of engine power is determined for each project.

If the actual methane number is lower than the specified, the knock control responds. First the ignition timing is changed at full rated power. Secondly the rated power is reduced. These functions are done by the engine management.

**Parameters for the operation of GE Jenbacher gas engines**

The following "Technical Instruction of GE JENBACHER" forms an integral part of a contract and must be strictly observed: **TI 1100-0110 – TI 1100-0112**