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Technical Description

Cogeneration Unit

JMS 312 GS-B.LC

dyn. GC Profile 1 (150ms/30%)

2G 2022 JMS 312 D225

Electrical output	548	kW el.
Thermal output	552	kW

Emission values

NOx	< 0,50 g/Nm³ (5% O2)
CO	< 0,50 g/Nm³ (5% O2)
CH2O	< 20 mg/Nm³ (5% O2)

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0.01 Technical Data (at module)

			100%	75%	50%
Power input	[2]	kW	1.315	1.017	719
Gas volume	*)	Nm³/h	292	226	160
Mechanical output	[1]	kW	567	425	283
Electrical output	[4]	kW el.	548	411	272
Recoverable thermal output (calculated with Glykol 37%)					
~ Intercooler 1st stage	[9]	kW	64	32	13
~ Lube oil		kW	58	46	33
~ Jacket water		kW	182	164	129
~ Exhaust gas cooled to 180 °C		kW	248	202	154
Total recoverable thermal output	[5]	kW	552	444	329
Total output generated		kW total	1.100	855	601
Heat to be dissipated (calculated with Glykol 37%)					
~ Intercooler 2nd stage		kW	42	21	5
~ Lube oil		kW	---	---	---
~ Surface heat	ca. [7]	kW	54	~	~
Spec. fuel consumption of engine electric	[2]	kWh/kWel.h	2,40	2,48	2,64
Spec. fuel consumption of engine	[2]	kWh/kWh	2,32	2,39	2,54
Lube oil consumption	ca. [3]	kg/h	0,17	~	~
Electrical efficiency			41,7%	40,4%	37,8%
Thermal efficiency			42,0%	43,7%	45,7%
Total efficiency	[6]		83,6%	84,0%	83,6%
Hot water circuit:					
Forward temperature		°C	95,0	91,1	86,9
Return temperature		°C	75,0	75,0	75,0
Hot water flow rate		m³/h	26,6	26,6	26,6
Fuel gas LHV		kWh/Nm³	4,5		

*) 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)

Length	mm	~ 4.700
Width	mm	~ 2.300
Height	mm	~ 2.300
Weight empty	kg	~ 9.400
Weight filled	kg	~ 9.900

Connections

Hot water inlet and outlet [A/B]	DN/PN	80/10
Exhaust gas outlet [C]	DN/PN	250/10
Fuel Gas (at module) [D]	DN/PN	80/16
Water drain ISO 228	G	½"
Condensate drain	DN/PN	50/10
Safety valve - jacket water ISO 228 [G]	DN/PN	1½"/2,5
Safety valve - hot water	DN/PN	50/16
Lube oil replenishing (pipe) [I]	mm	28
Lube oil drain (pipe) [J]	mm	28
Jacket water - filling (flex pipe) [L]	mm	13
Intercooler water-Inlet/Outlet 1st stage	DN/PN	80/10
Intercooler water-Inlet/Outlet 2nd stage [M/N]	DN/PN	65/10

Output / fuel consumption

ISO standard fuel stop power ICFN	kW	567
Mean effe. press. at stand. power and nom. speed	bar	15,53
Fuel gas type		Biogas
Based on methane number | Min. methane number	MZ	135 | 117 d)
Compression ratio	Epsilon	16
Min./Max. fuel gas pressure at inlet to gas train	mbar	80 - 200 c)
Max. rate of gas pressure fluctuation	mbar/sec	10
Maximum Intercooler 2nd stage inlet water temperature	°C	42
Spec. fuel consumption of engine	kWh/kWh	2,32
Specific lube oil consumption	g/kWh	0,30
Max. Oil temperature	°C	~ 90
Jacket-water temperature max.	°C	~ 95
Filling capacity lube oil (refill)	lit	~ 216

c) Lower gas pressures upon inquiry
d) based on methane number calculation software AVL 3.2

0.02 Technical data of engine

Manufacturer		JENBACHER
Engine type		J 312 GS-D225
Working principle		4-Stroke
Configuration		V 70°
No. of cylinders		12
Bore	mm	135
Stroke	mm	170
Piston displacement	lit	29,20
Nominal speed	rpm	1.500
Mean piston speed	m/s	8,50
Length	mm	2.400
Width	mm	1.457
Height	mm	2.065
Weight dry	kg	3.200
Weight filled	kg	3.530
Moment of inertia	kgm²	7,77
Direction of rotation (from flywheel view)		left
Radio interference level to VDE 0875		N
Starter motor output	kW	7
Starter motor voltage	V	24

Thermal energy balance

Power input	kW	1.315
Intercooler	kW	106
Lube oil	kW	58
Jacket water	kW	182
Exhaust gas cooled to 180 °C	kW	248
Exhaust gas cooled to 100 °C	kW	318
Surface heat	kW	29

Exhaust gas data

Exhaust gas temperature at full load	[8]	°C	450
Exhaust gas temperature at bmep= 11,7 [bar]		°C	~ 471
Exhaust gas temperature at bmep= 7,8 [bar]		°C	~ 500
Exhaust gas mass flow rate, wet		kg/h	2.935
Exhaust gas mass flow rate, dry		kg/h	2.730
Exhaust gas volume, wet		Nm³/h	2.292
Exhaust gas volume, dry		Nm³/h	2.038
Max.admissible exhaust back pressure after engine		mbar	60

Combustion air data

Combustion air mass flow rate	kg/h	2.709
Combustion air volume	Nm³/h	2.097
Max. admissible pressure drop at air-intake filter	mbar	10

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

Sound pressure level

Aggregate a)			dB(A) re 20µPa		95		
31,5	Hz		dB		80		
63	Hz		dB		87		
125	Hz		dB		91		
250	Hz		dB		91		
500	Hz		dB		90		
1000	Hz		dB		89		
2000	Hz		dB		86		
4000	Hz		dB		86		
8000	Hz		dB		89		
Exhaust gas b)			dB(A) re 20µPa		115		
31,5	Hz		dB		108		
63	Hz		dB		119		
125	Hz		dB		113		
250	Hz		dB		117		
500	Hz		dB		112		
1000	Hz		dB		111		
2000	Hz		dB		103		
4000	Hz		dB		101		
8000	Hz		dB		98		

Sound power level

Aggregate	dB(A) re 1pW	115
Measurement surface	m²	97
Exhaust gas	dB(A) re 1pW	123
Measurement surface	m²	6,28

a) average sound pressure level on measurement surface in a distance of 1m (converted to free field) according to DIN 45635 and ISO 3744, precision class 3.
b) average sound pressure level on measurement surface in a distance of 1m according to DIN 45635 and ISO 3744, precision class 2.

The spectra are valid for aggregates up to bmep=18 bar. (for higher bmep add safety margin of 1dB to all values per increase of 1 bar pressure).
Engine tolerance ± 3 dB

0.03 Technical data of generator

Manufacturer		STAMFORD e)
Type		CG 634 H e)
Type rating	kVA	731
Driving power	kW	567
Ratings at p.f. = 1,0	kW	548
Ratings at p.f. = 0,8	kW	542
Rated output at p.f. = 0,8	kVA	678
Rated reactive power at p.f. = 0,8	kVar	407
Rated current at p.f. = 0,8	A	979
Frequency	Hz	50
Voltage	V	400
Speed	rpm	1.500
Permissible overspeed	rpm	1.800
Power factor (lagging - leading) (UN)		0,8 - 0,95
Efficiency at p.f. = 1,0		96,6%
Efficiency at p.f. = 0,8		95,7%
Moment of inertia	kgm²	19,50
Mass	kg	2.145
Radio interference level to EN 55011 Class A (EN 61000-6-4)		N
Cable outlet		left
Ik" Initial symmetrical short-circuit current	kA	8,13
Is Peak current	kA	20,70
Insulation class		H
Temperature (rise at driving power)		F
Maximum ambient temperature	°C	40

Reactance and time constants (saturated) at rated output

xd direct axis synchronous reactance	p.u.	2,012
xd' direct axis transient reactance	p.u.	0,171
xd" direct axis sub transient reactance	p.u.	0,119
x2 negative sequence reactance	p.u.	0,134
Td" sub transient reactance time constant	ms	30
Ta Time constant direct-current	ms	40
Tdo' open circuit field time constant	s	2,44

e) JENBACHER reserves the right to change the generator supplier and the generator type. The contractual data of the generator may thereby change slightly. The contractual produced electrical power will not change.

0.04 Technical data of heat recovery

General data - Hot water circuit

Total recoverable thermal output	kW	552
Return temperature	°C	75,0
Forward temperature	°C	95,0
Hot water flow rate	m³/h	26,6
Nominal pressure of hot water	PN	10
min. operating pressure	bar	3,5
max. operating pressure	bar	9,0
Pressure drop hot water circuit	bar	0,80
Maximum Variation in return temperature	°C	+0/-5
Max. rate of return temperature fluctuation	°C/min	10

General data - Cooling water circuit

Heat to be dissipated (calculated with Glykol 37%)	kW	42
Return temperature	°C	42
Cooling water flow rate	m³/h	15
Nominal pressure of cooling water	PN	10
min. operating pressure	bar	0,5
max. operating pressure	bar	5,0
Loss of nominal pressure of cooling water	bar	~
Maximum Variation in return temperature	°C	+0/-5
Max. rate of return temperature fluctuation	°C/min	10

Exhaust gas heat exchanger

Type	shell-and-tube	

PRIMARY:

Exhaust gas pressure drop approx	bar	0,02
Exhaust gas connection	DN/PN	250/10

SECONDARY:

Pressure drop hot water circuit	bar	0,20
Hot water connection	DN/PN	80/10

The final pressure drop will be given after final order clarification and must be taken from the P&ID order documentation.

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connection variant F

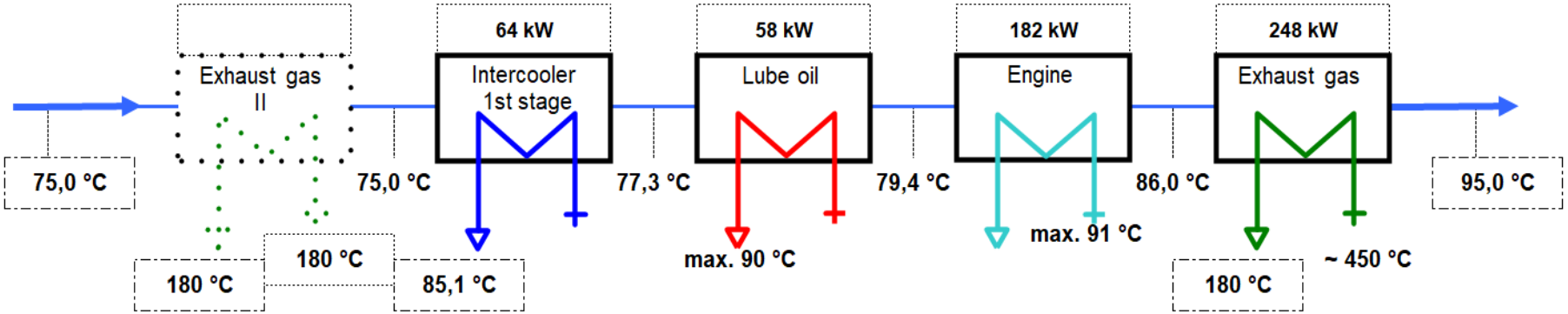
J 312 GS-D225

Hot water circuit (calculated with Glykol 37%)

Recoverable thermal output = 552 kW

(+12/-8 % tolerance)

Hot water flow rate = 26,6 m³/h

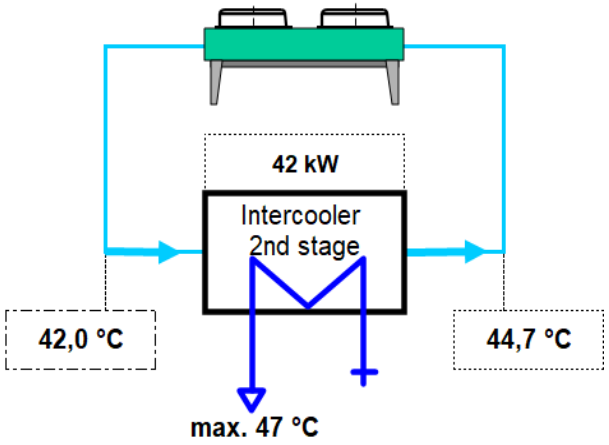


Low temperature circuit (calculated with Glykol 37%)

Heat to be dissipated = 42 kW

(+12/-8 % tolerance)

Cooling water flow rate = 15,0 m³/h



0.10 Technical parameters

All data in the technical specification are based on engine full load (unless stated otherwise) at specified temperatures and the methane number and subject to technical development and modifications.

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 ISO 3046-1, respectively
[2] According to ISO 3046-1, respectively, with a tolerance of +**5** %.
Efficiency performance is based on a new unit (immediately upon commissioning).Effects of degradation during normal operation can be mitigated through regular service and maintenance work.
reference value --> 65%CH4 / 35%CO2
[3] Average value between oil change intervals according to maintenance schedule, without oil change amount
[4] At p. f. = 1.0 according to IEC 60034-1:2017 with relative tolerances, all direct driven pumps are included
[5] Total output with a tolerance of +12/-8 %
[6] According to above parameters [1] through [5]
[7] As a guiding value at p.f. 0.8 and only valid for (engine, generator, TCM). Other peripheral equipment is not considered.
[8] Exhaust temperature with a tolerance of ±8 %
Note: an optimised operating mode to minimise methane slip can result in changed exhaust gas data (exhaust gas temperature, NOx emissions, etc.) and must be taken into account in the design of the exhaust gas aftertreatment
[9] Intercooler heat on:
*** standard conditions** - If the turbocharger design is done for air intake temperature > 30°C w/o de-rating, the intercooler heat of the 1st stage need to be increased by 2%/°C starting from 25°C. Deviations between 25 – 30°C will be covered with the standard tolerance.
*** Hot Country application (V1xx)** - If the turbocharger design is done for air intake temperature > 40°C w/o de-rating, the intercooler heat of the 1st stage need to be increased by 2%/°C starting from 35°C. Deviations between 35 – 40°C will be covered with the standard tolerance.

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

- Volume values at standard conditions (fuel gas, combustion air, exhaust gas)
  Pressure: 1013 mbar (14.7 psi)
  Temperature: 0°C (32°F) or 273 K

Loss of engine performance

a) Performance reduction due to gas quality

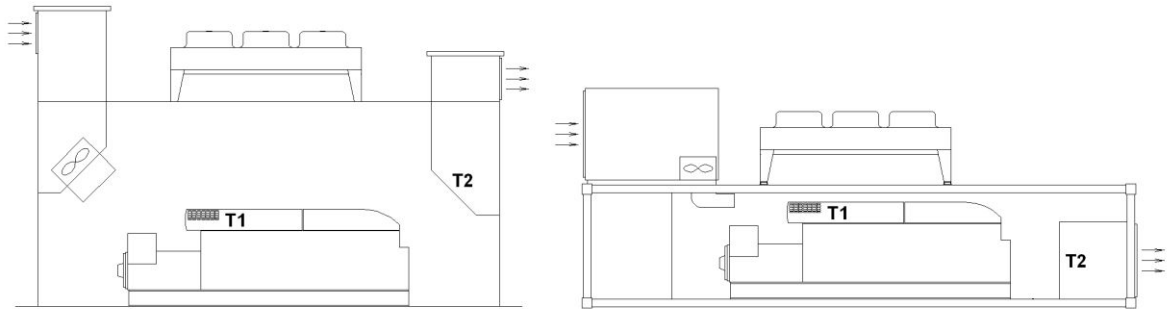
If the reference methane number is not reached and the knock control responds, the ignition timing at full performance is adjusted in conjunction with the engine management system; only then is performance reduced.
H2 admixtures in the range of 3–5 Vol% into the natural gas network are generally regarded as non-critical. Prerequisites for this are rates of change according to TA 1000-0300, as well as the knock resistance (minimum methane number) of the natural gas-H2 mixture according to the specification. For reliable compliance with required NOx emissions, the JENBACHER LEANOX^{plus} control is recommended (measurement of NOx emissions and correction of the LEANOX controller). Higher H2 addition rates into the natural gas network must be assessed on a project-specific basis.

b) Performance reduction due to voltage and frequency limits

If the voltage and frequency limits for generators specified in IEC 60034-1 Zone A are exceeded, performance is reduced.

c) Performance reduction due to environmental conditions

Standard rating of the engines is for an installation at an altitude ≤ **500 m** and combustion air temperature ≤ **30 °C** (T1)
Engine room outlet temperature: **50°C** (T2) -> engine stop



The minimum recommended air change ratio (C) must be observed to maintain the required air quality and prevent unwanted gas accumulations (refer to Section ⇨ Potentially explosive Atmospheres as per TA1100-0110). The calculation is based on TA 1100-0110 and is C_{min}= 50h^{-1} for JENBACHER modules.

Parameters for the operation of JENBACHER gas engines

The genset fulfils the limits for mechanical vibrations according to ISO 8528-9.
The following forms an integral part of a contract and must be strictly observed: **TA 1000-0004, TA 1100 0110, TA 1100-0111**, and **TA 1100-0112.**
Transport by rail should be avoided. See **TA 1000-0046** for further details

Failure to adhere to the requirements of the above-mentioned TA documents can lead to engine damage and may result in loss of warranty coverage.

Parameters for the operation of control unit and the electrical equipment

Relative humidity 50% by maximum temperature of 40°C.
Altitude up to 2000m above the sea level.

Parameters for using a gas compressor
The gas quantity indicated under the technical data refers to standard conditions with the given calorific value. The actual volume flow (under operating conditions) has to be considered for dimensioning the gas compressor and each gas feeding component – it will be affected by:

- Actual gas temperature (limiting temperature according to **TA 1000-0300**)
- Gas humidity (limiting value according to **TA 1000-0300**)
- Gas Pressure
- Calorific value variations (can be equated with methane (CH4) variations in the case of biogas)
- The gas compressor is designed for a max. relative under pressure of 15 mbar(g) (0.22 psi) and a inlet temperature of 40°C (104°F) , if within scope of supply JENBACHER.

0.20 Mode of Operation

Grid Parallel Mode
The genset is running in parallel to the utility. The unit load can be adjusted via its power control set point or designated option.
Procedure in the event of mains failure:
When the mains monitor relay (protective relay ANSI No. 27, 59, 81, 78- provided either by JENBACHER or the customer) is activated due to a mains failure, the engine is isolated from the mains by opening the generator breaker. The module is shut down without any cool-down run.
Island operation is not available in this case!
The module can be restarted following the restoration of mains power after a 5-minute mains stabilization period.