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0.01 Technical Data (at module)

			100%	75%	50%
Power input	[2]	kW	2 834	2 183	1 533
Gas volume	*)	Nm³/h	630	485	341
Mechanical output	[1]	kW	1 234	925	617
Electrical output	[4]	kW el.	1 197	895	593
Recoverable thermal output					
~ Intercooler 1st stage	[9]	kW	266	151	28
~ Lube oil		kW	169	151	132
~ Jacket water		kW	326	271	228
~ Exhaust gas cooled to 180 °C		kW	464	387	296
Total recoverable thermal output	[5]	kW	1 225	960	684
Total output generated		kW total	2 422	1 856	1 277
Heat to be dissipated (calculated with Glykol 37%)					
~ Intercooler 2nd stage		kW	35	26	17
~ Lube oil		kW	~	~	~
~ Surface heat	ca. [7]	kW	108	~	~
Spec. fuel consumption of engine electric	[2]	kWh/kWel.h	2,37	2,44	2,59
Spec. fuel consumption of engine	[2]	kWh/kWh	2,30	2,36	2,49
Lube oil consumption	ca. [3]	kg/h	0,25	~	~
Electrical efficiency			42,2%	41,0%	38,7%
Thermal efficiency			43,2%	44,0%	44,6%
Total efficiency	[6]		85,5%	85,0%	83,3%
Hot water circuit:					
Forward temperature		°C	77,0	74,4	71,7
Return temperature		°C	65,0	65,0	65,0
Hot water flow rate		m³/h	87,7	87,7	87,7
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; ...). In the specifications in addition to the general tolerance of ±8 % on the thermal output a further reserve of +5 % is recommended for the dimensioning of the cooling requirements.

Main dimensions and weights (at module)

Length	mm	~ 6 700
Width	mm	~ 1 800
Height	mm	~ 2 200
Weight empty	kg	~ 15 000
Weight filled	kg	~ 15 700

Connections

Hot water inlet and outlet [A/B]	DN/PN	100/10
Exhaust gas outlet [C]	DN/PN	300/10
Fuel Gas (at module) [D]	DN/PN	125/16
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	100/10
Intercooler water-Inlet/Outlet 2nd stage [M/N]	DN/PN	65/10

Output / fuel consumption

ISO standard fuel stop power ICFN	kW	1 234
Mean effe. press. at stand. power and nom. speed	bar	20,20
Fuel gas type		Biogas
Based on methane number | Min. methane number	MZ	135 | 117 d)
Compression ratio	Epsilon	12,5
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	55
Spec. fuel consumption of engine	kWh/kWh	2,30
Specific lube oil consumption	g/kWh	0,20
Max. Oil temperature	°C	85
Jacket-water temperature max.	°C	95
Filling capacity lube oil (refill)	lit	~ 360

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

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0.02 Technical data of engine

Manufacturer		JENBACHER
Engine type		J 416 GS-B25
Working principle		4-Stroke
Configuration		V 70°
No. of cylinders		16
Bore	mm	145
Stroke	mm	185
Piston displacement	lit	48,88
Nominal speed	rpm	1 500
Mean piston speed	m/s	9,25
Length	mm	3 660
Width	mm	1 495
Height	mm	2 085
Weight dry	kg	6 800
Weight filled	kg	7 435
Moment of inertia	kgm²	13,50
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	2 834
Intercooler	kW	301
Lube oil	kW	169
Jacket water	kW	326
Exhaust gas cooled to 180 °C	kW	464
Exhaust gas cooled to 100 °C	kW	616
Surface heat	kW	59

Exhaust gas data

Exhaust gas temperature at full load	[8]	°C	414
Exhaust gas temperature at bmep= 15,2 [bar]		°C	~ 436
Exhaust gas temperature at bmep= 10,1 [bar]		°C	~ 463
Exhaust gas mass flow rate, wet		kg/h	6 363
Exhaust gas mass flow rate, dry		kg/h	5 921
Exhaust gas volume, wet		Nm³/h	4 970
Exhaust gas volume, dry		Nm³/h	4 419
Max.admissible exhaust back pressure after engine		mbar	60

Combustion air data

Combustion air mass flow rate	kg/h	5 875
Combustion air volume	Nm³/h	4 546
Max. admissible pressure drop at air-intake filter	mbar	10

Sound pressure level

Aggregate a)		dB(A) re 20µPa	97
31,5	Hz	dB	84
63	Hz	dB	88
125	Hz	dB	97
250	Hz	dB	95
500	Hz	dB	93
1000	Hz	dB	88
2000	Hz	dB	87
4000	Hz	dB	90
8000	Hz	dB	88
Exhaust gas b)		dB(A) re 20µPa	113
31,5	Hz	dB	101
63	Hz	dB	111
125	Hz	dB	116
250	Hz	dB	105
500	Hz	dB	102
1000	Hz	dB	96
2000	Hz	dB	108
4000	Hz	dB	107
8000	Hz	dB	104

Sound power level

Aggregate	dB(A) re 1pW	117
Measurement surface	m²	105
Exhaust gas	dB(A) re 1pW	121
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, precision class 3.
b) average sound pressure level on measurement surface in a distance of 1m according to DIN 45635, precision class 2.
The spectra are valid for aggregates up to bmep=20 bar. (for higher bmep add safety margin of 1dB to all values per increase of 1 bar pressure).
Engine tolerance ± 3 dB

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0.03 Technical data of generator

Manufacturer		Leroy-Somer e)
Type		LSA 52.2 SL80 e)
Type rating	kVA	1 540
Driving power	kW	1 234
Ratings at p.f. = 1,0	kW	1 197
Ratings at p.f. = 0,8	kW	1 185
Rated output at p.f. = 0,8	kVA	1 481
Rated reactive power at p.f. = 0,8	kVar	889
Rated current at p.f. = 0,8	A	78
Frequency	Hz	50
Voltage	kV	11
Speed	rpm	1 500
Permissible overspeed	rpm	1 800
Power factor (lagging - leading)		0,8 - 0,95
Efficiency at p.f. = 1,0		97,0%
Efficiency at p.f. = 0,8		96,0%
Moment of inertia	kgm²	59,00
Mass	kg	5 175
Radio interference level to EN 55011 Class A (EN 61000-6-4)		N
Cable outlet		left
Ik" Initial symmetrical short-circuit current	kA	0,70
Is Peak current	kA	1,78
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.	2,11
xd' direct axis transient reactance	p.u.	0,20
xd" direct axis sub transient reactance	p.u.	0,11
x2 negative sequence reactance	p.u.	0,11
Td" sub transient reactance time constant	ms	8
Ta Time constant direct-current	ms	22
Tdo' open circuit field time constant	s	1,20

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.

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0.04 Technical data of heat recovery

General data - Hot water circuit		
Total recoverable thermal output	kW	1 225
Return temperature	°C	65,0
Forward temperature	°C	77,0
Hot water flow rate	m³/h	87,7
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	1,20
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	35
Return temperature	°C	55
Cooling water flow rate	m³/h	20
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	300/10
SECONDARY:		
Pressure drop hot water circuit	bar	0,20
Hot water connection	DN/PN	100/10

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

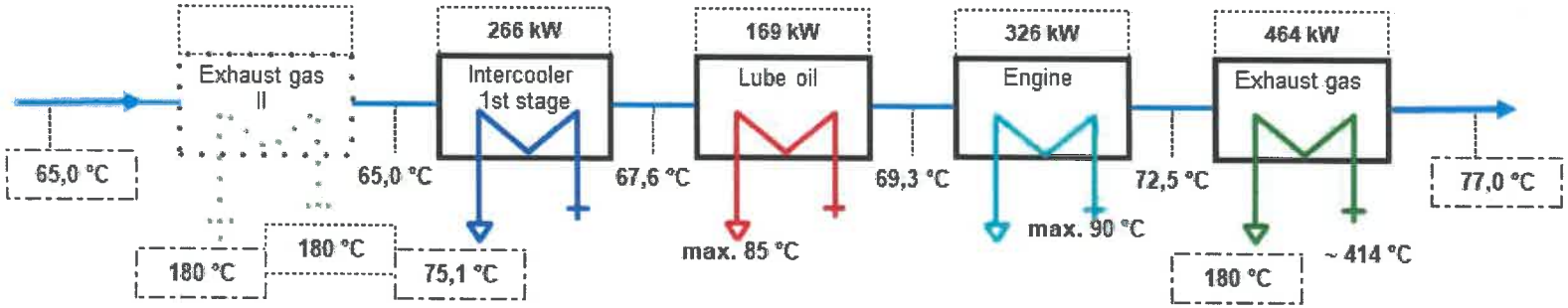
Hot water circuit

Murphy Process Engineering **J 416 GS-B25**

Recoverable thermal output = 1 225 kW

(±8 % tolerance +5 % reserve for cooling requirements)

Hot water flow rate = 87,7 m³/h

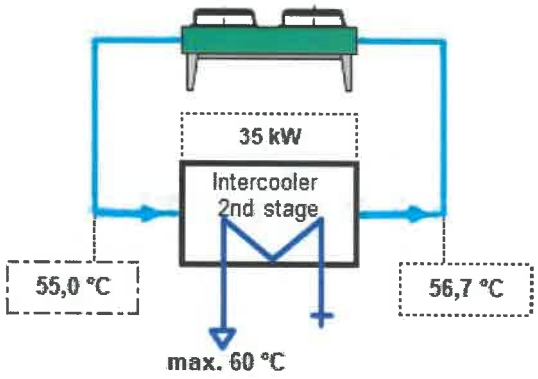


Low temperature circuit (calculated with Glykol 37%)

Heat to be dissipated = 35 kW

(±8 % tolerance +5 % reserve for cooling requirements)

Cooling water flow rate = 20,0 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 DIN-ISO 3046 and DIN 6271, respectively
(2) According to DIN-ISO 3046 and DIN 6271, 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 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 (at p. f. = 0,8) ,(guiding value)
(8) Exhaust temperature with a tolerance of ±8 %
(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:

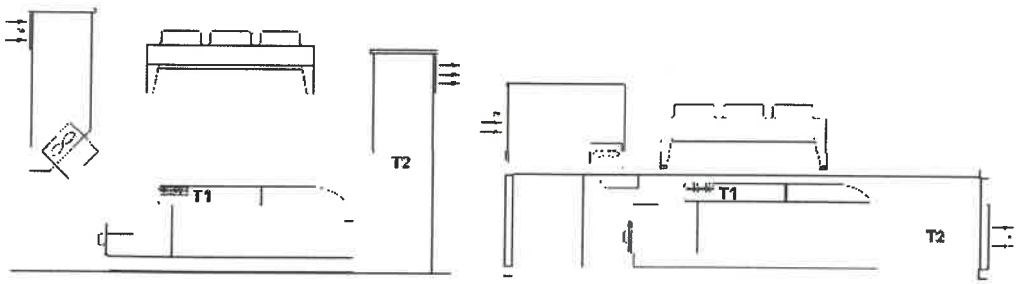
Barometric pressure:	1000 mbar (14.5 psi) or 100 m (328 ft) above sea level
Air temperature:	25°C (77°F) or 298 K
Relative humidity:	30 %

- 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

Output adjustment for turbo charged engines
Standard rating of the engines is for an installation at an altitude ≤ **500 m** and an air intake temperature ≤ **30 °C** (T1)

Maximum room temperature: **50°C** (T2) -> engine stop



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 carried out by the engine management system.
Exceedance of the voltage and frequency limits for generators according to IEC 60034-1 Zone A will lead to a derate in output.

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 TI 1000-0300)
- Gas humidity (limiting value according to TI 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