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## 0.01 Technical Data (container)

			100%	75%	50%
Power input	[2]	kW	2,622	2,015	1,421
Gas volume	*)	Nm <sup>3</sup> /h	583	448	316
Mechanical output	[1]	kW	1,095	821	548
Electrical output	[4]	kW el.	1,067	798	529
<b>Heat to be dissipated (calculated with Glykol 37%)</b>					
~ Intercooler 1st stage (Engine jacket water cooling circuit)	[9]	kW	187	84	19
~ Intercooler 2nd stage (Low temperature circuit)		kW	81	54	32
~ Lube oil (Engine jacket water cooling circuit)		kW	126	99	86
~ Jacket water		kW	345	310	263
~ Surface heat	ca. [7]	kW	85	~	~
<b>Spec. fuel consumption of engine electric</b>					
Spec. fuel consumption of engine electric	[2]	kWh/kWel. h	2.46	2.53	2.69
Spec. fuel consumption of engine	[2]	kWh/kWh	2.40	2.45	2.59
Lube oil consumption	ca. [3]	kg/h	0.33	~	~
Electrical efficiency			40.7%	39.6%	37.2%
<b>Fuel gas LHV</b>					
Fuel gas LHV		kWh/Nm <sup>3</sup>	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 (container)

Length	mm	~ 12,200
Width	mm	2500-3000
Height	mm	~ 2,600
Weight empty	kg	~ 29,400
Weight filled	kg	~ 30,900

## Connections

Jacket water inlet and outlet	DN/PN	80/10
Exhaust gas outlet [C]	DN/PN	250/10
Fuel gas connection (container) [D]	DN/PN	100/16
Fresh oil connection	G	28x2"
Waste oil connection	G	28x2"
Cable outlet	mm	800x400
Condensate drain	mm	~

## Output / fuel consumption

ISO standard fuel stop power ICFN	kW	1,095
Mean effe. press. at stand. power and nom. speed	bar	18.00
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	50
Spec. fuel consumption of engine	kWh/kWh	2.40
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	~ 342

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 320 GS-D25
Working principle		4-Stroke
Configuration		V 70°
No. of cylinders		20
Bore	mm	135
Stroke	mm	170
Piston displacement	lit	48.67
Nominal speed	rpm	1,500
Mean piston speed	m/s	8.50
Length	mm	3,320
Width	mm	1,358
Height	mm	2,065
Weight dry	kg	5,200
Weight filled	kg	5,700
Moment of inertia	kgm <sup>2</sup>	8.61
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	2,622
Intercooler	kW	268
Lube oil	kW	126
Jacket water	kW	345
Exhaust gas cooled to 180 °C	kW	506
Exhaust gas cooled to 100 °C	kW	642
Surface heat	kW	48

### Exhaust gas data

Exhaust gas temperature at full load	[8]	°C	465
Exhaust gas temperature at bmep= 13.5 [bar]		°C	~ 494
Exhaust gas temperature at bmep= 9 [bar]		°C	~ 512
Exhaust gas mass flow rate, wet		kg/h	5,657
Exhaust gas mass flow rate, dry		kg/h	5,250
Exhaust gas volume, wet		Nm <sup>3</sup> /h	4,420
Exhaust gas volume, dry		Nm <sup>3</sup> /h	3,913
Max.admissible exhaust back pressure after engine		mbar	60

### Combustion air data

Combustion air mass flow rate		kg/h	5,208
Combustion air volume		Nm <sup>3</sup> /h	4,030
Max. admissible pressure drop at air-intake filter		mbar	10

**basis for exhaust gas data: natural gas: 100% CH<sub>4</sub>; biogas 65% CH<sub>4</sub>, 35% CO<sub>2</sub>**

## Sound pressure level

Aggregate a)		dB(A) re 20 $\mu$ Pa	96
31,5	Hz	dB	78
63	Hz	dB	90
125	Hz	dB	92
250	Hz	dB	89
500	Hz	dB	92
1000	Hz	dB	90
2000	Hz	dB	89
4000	Hz	dB	87
8000	Hz	dB	90
Exhaust gas b)		dB(A) re 20 $\mu$ Pa	122
31,5	Hz	dB	97
63	Hz	dB	108
125	Hz	dB	118
250	Hz	dB	110
500	Hz	dB	113
1000	Hz	dB	114
2000	Hz	dB	117
4000	Hz	dB	115
8000	Hz	dB	114

## Sound power level

Aggregate	dB(A) re 1pW	117
Measurement surface	m <sup>2</sup>	120
Exhaust gas	dB(A) re 1pW	130
Measurement surface	m <sup>2</sup>	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  $\pm$  3 dB

## 0.03 Technical data of generator

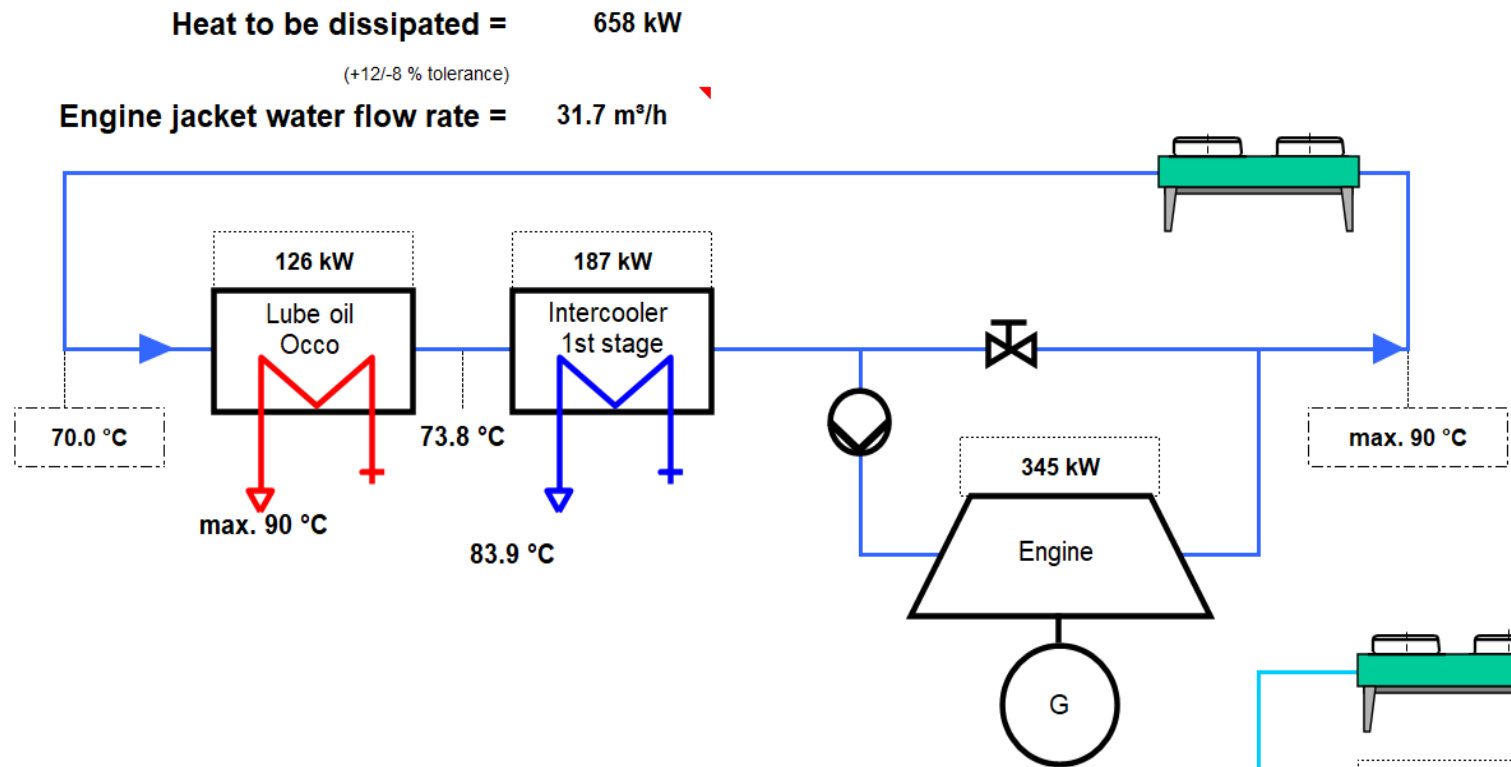
Manufacturer		STAMFORD e)
Type		PE 734 E e)
Type rating	kVA	1,625
Driving power	kW	1,095
Ratings at p.f. = 1,0	kW	1,067
Ratings at p.f. = 0.8	kW	1,058
Rated output at p.f. = 0.8	kVA	1,322
Rated reactive power at p.f. = 0.8	kVar	793
Rated current at p.f. = 0.8	A	1,909
Frequency	Hz	50
Voltage	V	400
Speed	rpm	1,500
Permissible overspeed	rpm	1,800
Power factor (lagging - leading) (UN)		0,8 - 0,95
Efficiency at p.f. = 1,0		97.4%
Efficiency at p.f. = 0.8		96.6%
Moment of inertia	kgm <sup>2</sup>	44.49
Mass	kg	3,506
Radio interference level to EN 55011 Class A (EN 61000-6-4)		N
Cable outlet		~
I <sub>k</sub> " Initial symmetrical short-circuit current	kA	20.97
I <sub>s</sub> Peak current	kA	53.39
Insulation class		H
Temperature (rise at driving power)		F
Maximum ambient temperature	°C	40

### Reactance and time constants (saturated) at rated output

x <sub>d</sub> direct axis synchronous reactance	p.u.	2.060
x <sub>d</sub> ' direct axis transient reactance	p.u.	0.125
x <sub>d</sub> " direct axis sub transient reactance	p.u.	0.090
x <sub>2</sub> negative sequence reactance	p.u.	0.132
T <sub>d</sub> " sub transient reactance time constant	ms	20
T <sub>a</sub> Time constant direct-current	ms	20
T <sub>do</sub> ' open circuit field time constant	s	2.46

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.

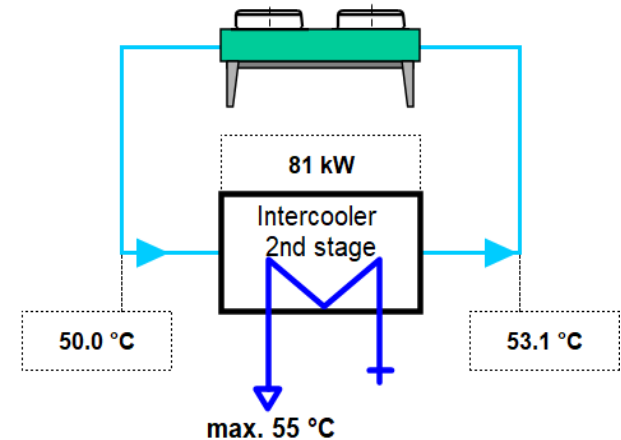
## Engine jacket water cooling circuit (calculated with Glykol 37%)



## Low temperature circuit (calculated with Glykol 37%)

Heat to be dissipated = 81 kW  
(+12/-8 % tolerance)

Cooling water flow rate = 25.0 m³/h



## 0.05 Cooling water circuit

### Oil - heat (Engine jacket water cooling circuit)

Nominal output	kW	126
Max. Oil temperature	°C	90
Loss of nominal pressure of engine jacket water	bar	0.20
Safety valve - max press. set point	bar	2.50

### Engine jacket water - heat (Engine jacket water cooling circuit)

Nominal output	kW	345
Max. engine jacket water temperature (outlet engine)	°C	90
Engine jacket water flow rate	m <sup>3</sup> /h	31.7
Safety valve - max press. set point	bar	2.50

### Mixture Intercooler (1st stage) (Engine jacket water cooling circuit)

Nominal output	kW	187
Max. inlet cooling water temp. (intercooler)	°C	73.8
Nominal pressure of cooling water / (max. operating pressure)	PN	10
Loss of nominal pressure of engine jacket water	bar	0.40
Safety valve - max press. set point	bar	2.50

### Mixture Intercooler (2nd stage) (Low temperature circuit)

Nominal output	kW	81
Max. inlet cooling water temp. (intercooler)	°C	50
Aftercooler water flow rate	m <sup>3</sup> /h	25.0
Nominal pressure of cooling water / (max. operating pressure)	PN	10
Intercooler water pressure drop	bar	0.20
Safety valve - max press. set point	bar	2.50

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

## 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.

H<sub>2</sub> 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-H<sub>2</sub> mixture according to the specification. For reliable compliance with required NO<sub>x</sub> emissions, the JENBACHER LEANOX<sup>plus</sup> control is recommended (measurement of NO<sub>x</sub> emissions and correction of the LEANOX controller). Higher H<sub>2</sub> addition rates into the natural gas network must be assessed on a project-specific basis.

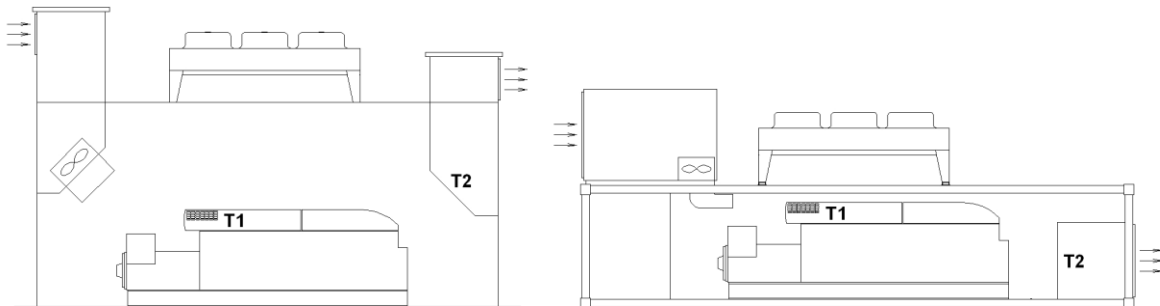
### b) Performance reduction due to voltage and frequency limits

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 (T<sub>1</sub>)

Engine room outlet temperature: 50°C (T<sub>2</sub>) -> 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 (CH<sub>4</sub>) 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.

## 1.00 Scope of supply - module

### Design:

The module is built as a compact package. Engine and generator are connected through a coupling and are mounted to the base frame. To provide the best possible isolation from the transmission of vibrations the engine is mounted to the frame by means of anti-vibrational mounts. The remaining vibrations are eliminated by mounting the module on isolating pads (e.g. Sylomer). This, in principle, allows the module to be placed directly on any floor capable of carrying the static load.

## 1.01 Spark ignited gas engine

Four-stroke, air/gas mixture turbocharged, aftercooled, with high performance ignition system and electronically controlled air/gas mixture system.

The engine is equipped with the most advanced

LEANOX® LEAN-BURN COMBUSTION SYSTEM

developed by JENBACHER.

### 1.01.01 Engine design

## **Engine block**

Single-piece crankcase and cylinder block made of special casting; crank case covers for engine inspection, welded steel oil pan.

## **Crankshaft and main bearings**

Drop-forged, precision ground, surface hardened, statically and dynamically balanced; main bearings (upper bearing shell: 3-material bearing / lower bearing shell: sputter bearing) arranged between crank pins, drilled oil passages for forced-feed lubrication of connecting rods.

## **Vibration damper**

Maintenance free viscous damper

## **Flywheel**

With ring gear for starter motor

## **Pistons**

Single-piece made of light metal alloy, with piston ring carrier and oil passages for cooling; piston rings made of high quality material, main combustion chamber specially designed for lean burn operation.

## **Connecting rods**

Drop-forged, heat-treated, big end diagonally split and toothed. Big end bearings (upper bearing shell: sputter bearing / lower bearing shell: grooved bearing) and connecting rod bushing for piston pin.

## **Cylinder liner**

Chromium alloy gray cast iron, wet, individually replaceable.

## **Cylinder head**

Specially designed and developed for JENBACHER-lean burn engines with optimized fuel consumption and emissions; water cooled, made of special casting, individually replaceable; Valve seats, valve guides and spark plug sleeves individually replaceable; exhaust and inlet valves made of high quality material.

## **Crankcase breather**

Connected to combustion air intake system.

## **Valve train**

Camshaft, with replaceable bushings, driven by crankshaft through intermediate gears, valve lubrication by splash oil through rocker arms.

## **Combustion air/fuel gas system**

Motorized carburetor for automatic adjustment according to fuel gas characteristic. Exhaust driven turbocharger, mixture manifold with bellows, water-cooled intercooler, throttle valve and distribution manifolds to cylinders.

## **Ignition system**

Most advanced, fully electronic high performance ignition system, external ignition control.

## **Lubricating system**

Gear-type lube oil pump to supply all moving parts with filtered lube oil, pressure control valve, pressure relief valve and full-flow filter cartridges. Cooling of the lube oil is arranged by a heat exchanger.

## **Engine cooling system**

Jacket water pump complete with distribution pipework and manifolds.

## **Exhaust system**

Turbocharger and exhaust manifold

## **Exhaust gas temperature measuring**

Thermocouple for each cylinder

## **Electric actuator**

For electronic speed and output control

## **Electronic speed monitoring for speed and output control**

By magnetic inductive pick up over ring gear on flywheel

## **Starter motor**

Engine mounted electric starter motor

## **1.01.03 Engine accessories**

### **Insulation of exhaust manifold:**

Insulation of exhaust manifold is easily installed and removed

### **Sensors at the engine:**

- Jacket water temperature sensor
- Jacket water pressure sensor
- Lube oil temperature sensor
- Lube oil pressure sensor
- Mixture temperature sensor
- Charge pressure sensor
- Minimum and maximum lube oil level switch
- Exhaust gas thermocouple for each cylinder
- Knock sensors
- Gas mixer / gas dosing valve position reporting.

### **Actuator at the engine:**

- Actuator - throttle valve
- Bypass-valve for turbocharger
- Control of the gas mixer / gas dosing valve

## **1.01.04 Standard tools (per installation)**

The tools required for carrying out the most important maintenance work are included in the scope of supply and delivered in a toolbox.

## **1.03 Module accessories**

### **Base frame**

Welded structural steel to accommodate engine, generator and heat exchangers.

### **Flexible coupling**

With torque limiter to couple engine with generator. The coupling isolates the major subharmonics of engine firing impulses from the generator.

## **Bell housing**

To connect engine with generator housing. With two ventilation and control windows.

## **Anti-vibration mounts**

Arranged between engine/generator assembly and base frame. Isolating pads (SYLOMER) for placement between base frame and foundation, delivered loose.

## **Exhaust gas connection**

Connection of exhaust gas turbocharger; including flexible connection to compensate for expansions and vibrations.

## **Combustion air filter**

Dry type air filter with replaceable filter cartridges, including flexible connection to carburetor and service indicator.

## **Interface panel**

Totally enclosed sheet steel cubicle with front door, wired to terminals, ready to operate. Cable entry at bottom.

Painting: RAL 7035

Protection: IP 54 external, IP 20 internal (protection against direct contact with live parts)

Design according to IEC 439-1 (EN 60 439-1/1990) and DIN VDE 0660 part 500, respectively.

Ambient temperature: 5 - 40 °C (41 - 104 °F), Relative humidity:70 %

Dimensions:

- Height: 1000 mm (39 in)
- Width: 1000 mm (39 in)
- Depth: 300 mm (12 in)

Power supply from the starter battery charger.

Power distribution to the engine mounted auxiliaries (power input from the supplier of the auxiliaries power supply):

3 x 400/230 V, 50 Hz, 16 A

## **Essential components installed in interface panel:**

- Terminal strip
- Decentralised input and output cards, connected by a data bus interface to the central engine control of the module control panel.
- Speed monitoring
- Relays, contacts, fuses, engine contact switch to control valves and auxiliaries
- Measuring transducer for excitation voltage
- Air conditioning system (**option**)

## **1.03.01 Engine jacket water system**

Closed cooling circuit, consisting of:

- Expansion tank
- Filling device (check and pressure reducing valves, pressure gauge)
- Safety valve(s)
- Thermostatic valve
- Required pipework on module
- Vents and drains
- Jacket water pump, including check valve
- Jacket water preheat device

## 1.03.02 Automatic lube oil replenishing system incl. extension tank

### Automatic lube oil replenishing system:

Includes float valve in lube oil feed line, including inspection glass. Electric monitoring system will be provided for engine shut-down at lube oil levels "MINIMUM" and "MAXIMUM". Solenoid valve in oil feed line is only activated during engine operation. Manual override of the solenoid valve, for filling procedure during oil changes is included.

### Oil drain

By set mounted cock

### Oil sump extension tank 300 l

To increase the time between oil changes

### Aftercooling oil pump:

Mounted on the module base frame; it is used for the aftercooling of the turbocharger; period of operation of the pump is 15 minutes from engine stop.

Consisting of:

- Oil pump 250 W, 400/230 V
- Oil filter
- Necessary pipework

## 1.07 Painting

- Quality: Oil resistant prime layer  
Synthetic resin varnish finishing coat
- Colour:

Engine:	RAL 6018 (green)
Base frame:	RAL 6018 (green)
Generator:	RAL 6018 (green)
Module interface panel:	RAL 7035 (light grey)
Control panel:	RAL 7035 (light grey)

## 1.11 Engine generator control panel per module- DIA.NE XT4 incl. Single synchronization of the generator breaker

### Dimensions:

- Height: 2310 mm (including 200 mm (8 in) pedestal \*)
- Width: 800 -1200mm \*)
- Depth: 600 mm \*)

Protection class:

- external IP42
- Internal IP 20 (protection against direct contact with live parts)

\*) Control panels will be dimensioned on a project specific basis. Actual dimensions will be provided in the preliminary documentation for the project.

Control supply voltage from starter and control panel batteries: 24V DC

Auxiliary equipment supply (by the supplier of the auxiliary equipment supply system)

The following network forms are possible for the supply of the auxiliary equipment. Depending on these, appropriate protective measures are provided:

**Standard: TN- S (L1/2/3, N, PE)**

- Power supply via the module control cabinet via connection terminals or directly at the 3-pole mains disconnection unit. Protection against electric shock by automatic disconnection with miniature circuit breaker or fuse.
- Additional protection for sockets with fault current breaker (RCD) type A, 30 mA
- Option:
  - According to national requirements or customer wishes, a 4-pole mains disconnecting device can also be used. Especially if the neutral conductor is not considered to be reliably earthed.
  - Downstream outputs for auxiliary equipment with neutral conductors are fused using 2 or 4 poles.

**Option: TN-C (L1/2/3, PEN)**

- Power supply via the module control cabinet via connection terminals or directly at the 3-pole mains disconnection unit. Protection against electric shock by automatic disconnection with miniature circuit breaker or fuse.
- Additional protection for sockets with fault current breaker (RCD) type A, 30 mA

**Option: TT (L1/2/3, N)**

- Power supply via the module control cabinet via connection terminals or directly at the 4-pole mains disconnection unit. Protection against electric shock by automatic disconnection through integrated differential current monitoring (RCD) type A.
- Downstream outputs for auxiliary equipment with neutral conductors are fused using 2 or 4 poles.
- Additional protection for sockets with fault current breaker (RCD) type A, 30 mA
- Option:
  - When using frequency converters, an additional differential current monitoring device (RCD) type B is mounted.

**Option: IT (L1/2/3, N, PE)**

- Power supply via the module control cabinet via connection terminals or directly at the 4-pole mains disconnection unit. Protection against electric shock by automatic disconnection through integrated differential current monitoring (RCD) type A. Insulation monitoring is part of customer's scope of supply. Preparations have already been made for the transfer of error messages to the module control cabinet and alarm signaling via DIA.NE.
- Downstream outputs for auxiliary equipment with neutral conductors are fused using 2 or 4 poles.
- Additional protection for sockets with fault current breaker (RCD) type A, 30 mA
- Option:
  - When using frequency converters, an additional differential current monitoring device (RCD) type B is mounted.
- Option:

- An insulation monitoring device connected to the auxiliary power supply with automatic disconnection in case of insulation faults. Alarm signaling via DIA.NE.
- Option:
  - Overvoltage protection for auxiliary equipment, protection module with integrated remote signaling.
  - SPD in conformity with EN 61643-11 type 2
  - Nominal voltage  $U_n$  230/400V

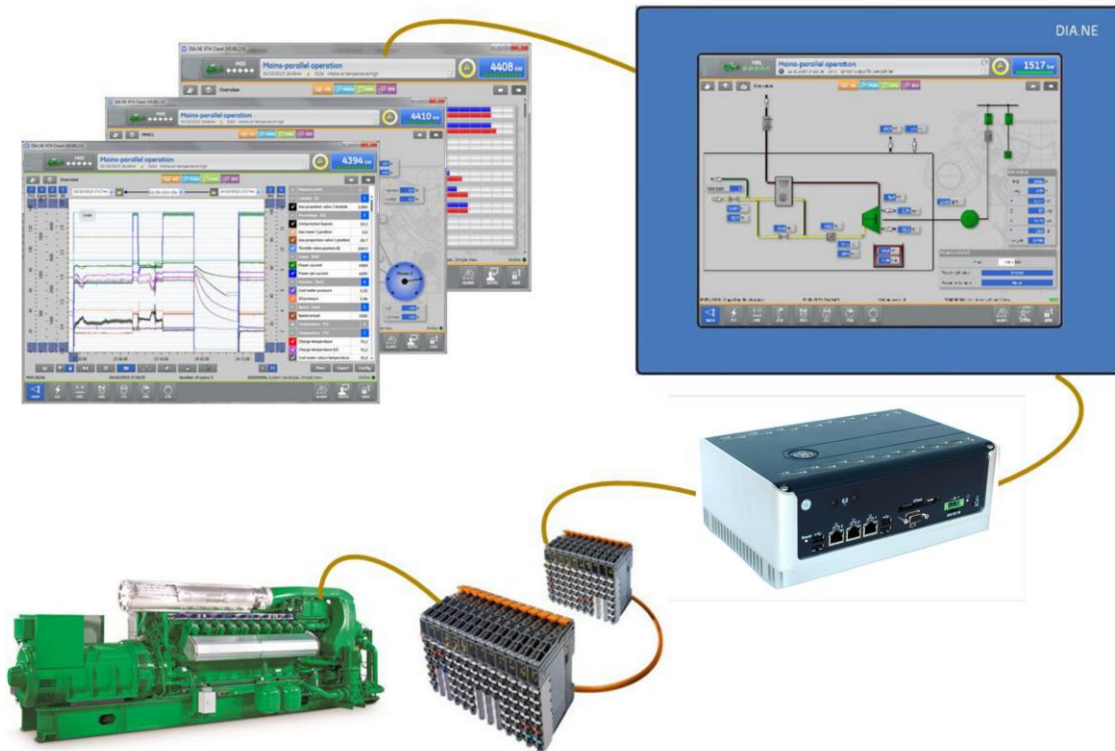
3 x 400/230 V, 50 Hz

## Consisting of:

Motor - Management - System DIA.NE

## Setup:

- a) Touch display visualization
- b) Central engine and unit control



## Touch Display Screen:

15" Industrial color graphic display with resistive touch.

Protection class of DIA.NE XT panel front: IP 65

The screen shows a clear and functional summary of the measurement values and simultaneously shows a graphical summary.

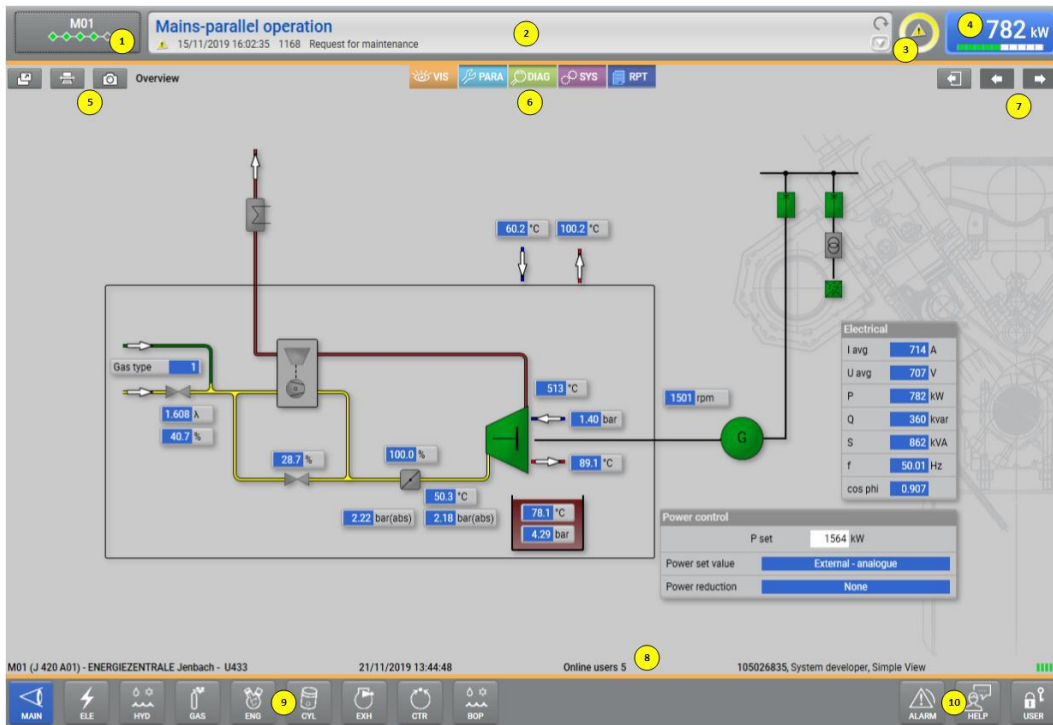
Operation is via the screen buttons on the touch screen

Numeric entries (set point values, parameters...) are entered on the touch numeric pad or via a scroll bar.

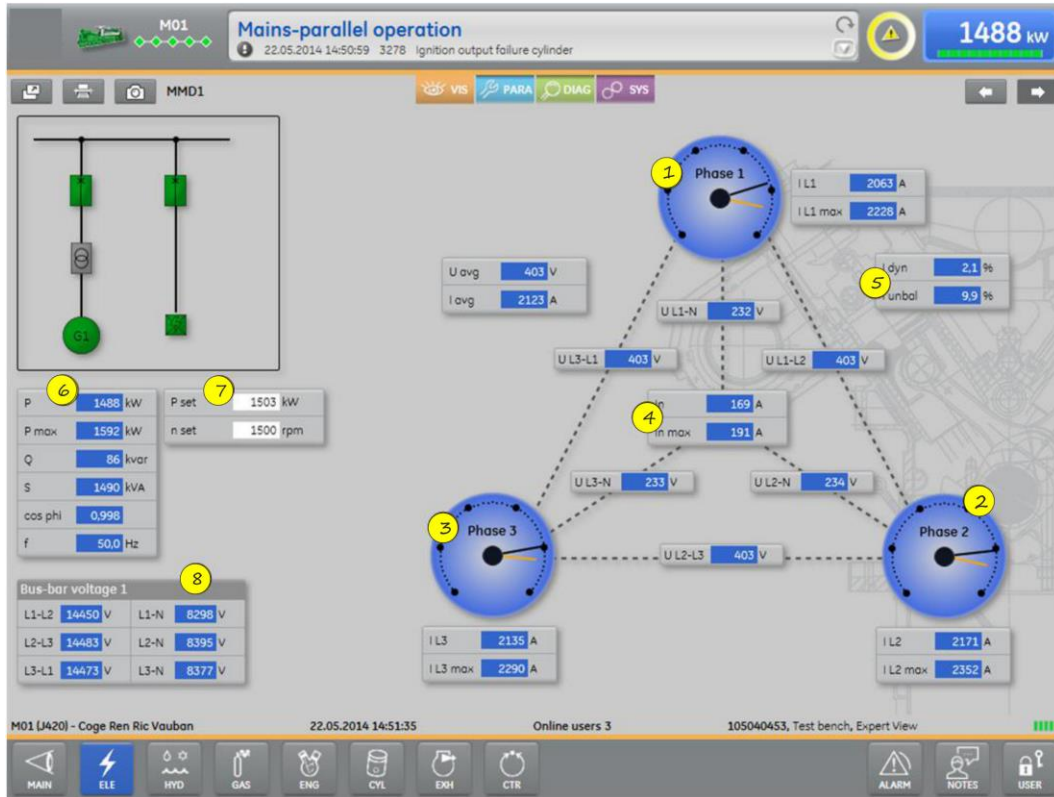
Determination of the operation mode and the method of synchronization via a permanently displayed button panel on the touch screen.

## Main screens (examples):

Main: Display of the overview, auxiliary's status, engine start and operating data.

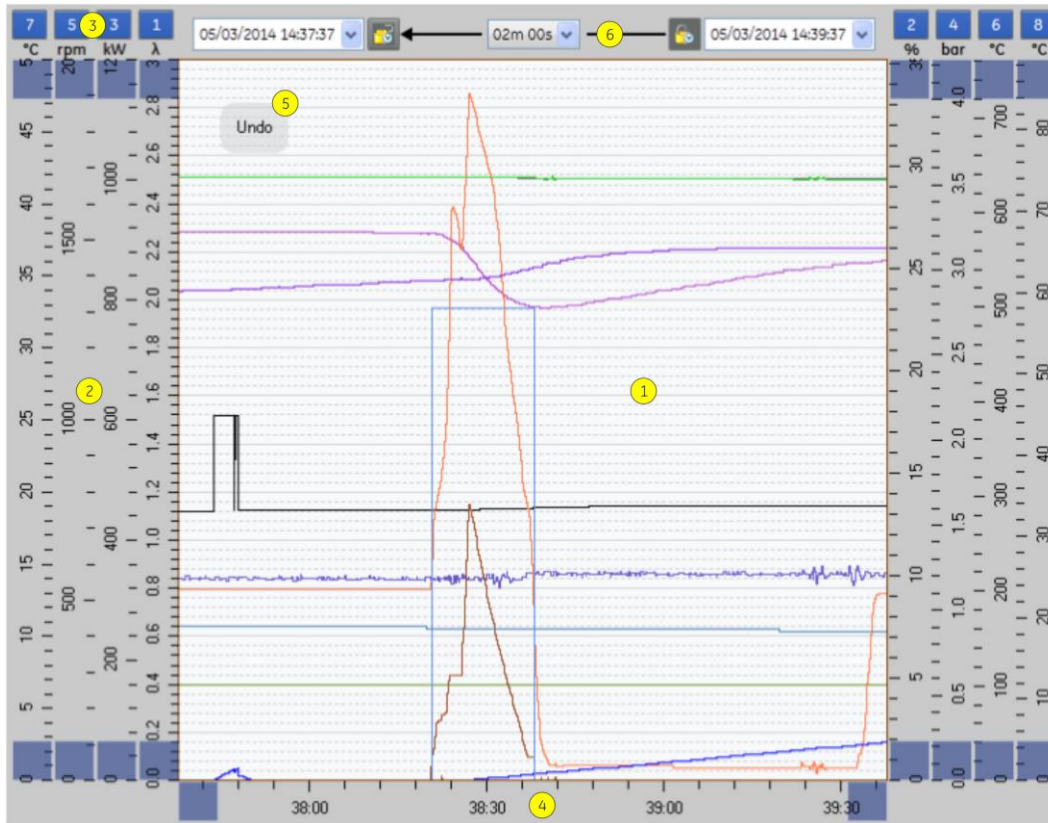


ELE: Display of the generator connection with electrical measurement values and synchronization status



## Trending

Trend with 100ms resolution



### Measurement values:

- 500 data points are stored
- Measurement interval = 100ms
- Raw data availability with 100ms resolution: 24 hours + max. 50.000.000 changes in value at shut down (60 mins per shut down)
- Compression level 1: min, max, and average values with 1000ms resolution: 1 day
- Compression level 2: min, max, and average values with 30s resolution: 1 month
- Compression level 3: min, max, and average values with 10min resolution: 10 years

### Messages:

1.000.000 message events

### Actions (operator control actions):

100.000 Actions

### System messages:

100.000 system messages

## Central engine and module control:

An industrial PC- based modular industrial control system for module and engine sequencing control (start preparation, start, stop, aftercooling and control of auxiliaries) as well as all control functions.

## Interfaces:

- Ethernet (twisted pair) for remote monitoring access
- Ethernet (twisted pair) for connection between engines
- Ethernet (twisted pair) for the Powerlink connection to the control input and output modules.

## Connection to the local building management system according to the JENBACHER option list (OPTION)

- MODBUS-RTU Slave
- MODBUS-TCP Slave,
- PROFIBUS-DP Slave (120 words),
- PROFIBUS-DP Slave (190 words),
- ProfiNet Slave
- OPC DA Server

## Control functions:

- Speed control in idle and in island mode
- Power output control in grid parallel operation, or according to an internal or external set point value on a case by case basis
- LEANOX control system which controls boost pressure according to the power at the generator terminals, and controls the mixture temperature according to the engine driven air-gas mixer
- Knocking control: in the event of knocking detection, ignition timing adjustment, power reduction and mixture temperature reduction (if this feature is installed)
- Load sharing between engines in island mode operation (option)
- Linear power reduction in the event of excessive mixture temperature and misfiring
- Linear power reduction according to CH<sub>4</sub> signal (if available)
- Linear power reduction according to gas pressure (option)
- Linear power reduction according to air intake temperature (option)

Multi-transducer to record the following alternator electrical values:

- Phase current (with slave pointer)
- Neutral conductor current
- Voltages Ph/Ph and Ph/N
- Active power (with slave pointer)
- Reactive power
- Apparent power
- Power factor
- Frequency
- Active and reactive energy counter

Additional 0 (4) - 20 mA interface for active power as well as a pulse signal for active energy

The following alternator monitoring functions are integrated in the multi-measuring device:

- Overload/short-circuit [51], [50]
- Over voltage [59]
- Under voltage [27]
- Asymmetric voltage [64], [59N]
- Unbalance current [46]
- Excitation failure [40]
- Over frequency [81>]
- Under frequency [81<]

## Lockable operation modes selectable via touch screen:

- "OFF" operation is not possible, running units will shut down immediately;
- "MANUAL" manual operation (start, stop) possible, unit is not available for fully automatic operation.
- "AUTOMATIC" fully automatic operation according to external demand signal:

## Demand modes selectable via touch screen:

- external demand off („OFF“)
- external demand on („REMOTE“)
- override external demand („ON“)

## Malfunction Notice list:

### Shut down functions e.g.:

- Low lube oil pressure
- Low lube oil level
- High lube oil level
- High lube oil temperature
- Low jacket water pressure
- High jacket water pressure
- High jacket water temperature
- Overspeed
- Emergency stop/safety loop
- Gas train failure
- Start failure
- Stop failure
- Engine start blocked
- Engine operation blocked
- Misfiring
- High mixture temperature
- Measuring signal failure
- Overload/output signal failure
- Generator overload/short circuit
- Generator over/undervoltage
- Generator over/underfrequency
- Generator asymmetric voltage
- Generator unbalanced load
- Generator reverse power
- High generator winding temperature
- Synchronizing failure
- Knocking failure

### Warning functions e.g.:

- Cooling water temperature min.
- Cooling water pressure min.
- Generator winding temperature max.

### Remote signals:

(volt free contacts)

1NO = 1 normally open

1NC = 1 normally closed

1COC = 1 change over contact

- Ready for automatic start (to Master control) 1NO
- Operation (engine running) 1NO
- Demand auxiliaries 1NO
- Collective signal "shut down" 1NC
- Collective signal "warning" 1NC

#### External (by others) provided command/status signals:

- Engine demand (from Master control) 1S
- Auxiliaries demanded and released 1S

#### Single synchronizing Automatic

For automatic synchronizing of the module with the generator circuit breaker to the grid by PLC-technology, integrated within the module control panel.

#### Consisting of:

- Hardware extension of the programmable control for fully automatic synchronization selection and synchronization of the module and for monitoring of the generator circuit breaker closed signal.
- Lockable synchronization selection via touch screen with the following selection modes:
  - "MANUAL" Manual initiation of synchronization via touch screen button followed by fully automatic synchronization of the module
  - "AUTOMATIC" Automatic module synchronization, after synchronizing release from the module control
  - "OFF" Selection and synchronization disabled
- Control of the generator circuit breaker according to the synchronization mode selected via touch screen.
- "Generator circuit breaker CLOSED/ Select" Touch-button on DIA.NE XT
- "Generator circuit breaker OPEN" Touch-button on DIA.NE XT

#### Status signals:

Generator circuit breaker closed

Generator circuit breaker open

#### Remote signals:

(volt free contacts)

Generator circuit breaker closed 1 NO

#### The following reference and status signals must be provided by the switchgear supplier:

- Generator circuit breaker CLOSED 1 NO
- Generator circuit breaker OPEN 1 NO
- Generator circuit breaker READY TO CLOSE 1 NO
- Mains circuit breaker CLOSED 1 NO
- Mains circuit breaker OPEN 1 NO

Mains voltage 3 x **400/230V** or 3x 110V/v3 other measurement voltages available on request

Bus bar voltage 3 x **400/230 V** or 3x 110V/v3 – other measurement voltages available on request

Generator voltage 3 x **400 V** or 3x 110V/ $\sqrt{3}$  – other measurement voltages available on request

Voltage transformer in the star/star connection with minimum 50VA and Class 0,5

**The following volt free interface-signals will be provided by JENBACHER to be incorporated in switchgear:**

- CLOSING/OPENING command for generator circuit breaker  
(permanent contact) 1 NO + 1 NC
- Signal for circuit breaker undervoltage trip 1 NO

Maximum distance between module control panel and engine/interface panel: 30m  
Maximum distance between module control panel and power panel: 50m  
Maximum distance between module control panel and master control panel: 50m  
Maximum distance between alternator and generator circuit breaker: 30m

## 1.20.03 Starting system

### **Starter battery:**

2 piece 12 V AGM battery, 125 Ah (according to DIN 72311).

### **Battery voltage monitoring:**

Monitoring by PLC.

### **Battery charging equipment:**

Capable for charging the starter battery with I/U characteristic and for the supply of all connected D.C. consumers.

Charging device is mounted inside of the module interface panel or module control panel.

### **• General data:**

- Power supply **3 x 320 - 575 V, 47 - 63 Hz**
- max. power consumption 1040 W / 1550 W (5 sec)
- Nominal D.C. voltage 24 V(+/-1%)
- Voltage setting range 24V to 28V ( adjustable)
- Nominal current (max.) 40 A
- Degree of protection IP20 to IEC 60529
- Operating temperature 0 °C - 70 °C
- Protection class 1
- Humidity class 3K3, no condensation.
- Natural air convection
- Standards EN60950,EN50178  
UL/cUL (UL508 / UL 60950-1)

### **Signalling:**

Green Led: Output voltage > 21,6V

## Control accumulator:

- Pb battery 24 VDC/18 Ah

## 1.20.05 Electric jacket water preheating

Installed in the jacket water cooling circuit, consisting of:

- Heating elements
- Water circulating pump

The jacket water temperature of a stopped engine is maintained between 56°C (133 °F) and 60°C (140°F), to allow for immediate loading after engine start.

## 1.20.08 Flexible connections

Following flexible connections per module are included in the JENBACHER -scope of supply:

<u>No. Connection</u>	<u>Unit</u>	<u>Dimension</u>	<u>Material</u>
2 Warm water in-/outlet	<b>DN/PN</b>	<b>80/10</b>	Stainless steel
1 Exhaust gas outlet	<b>DN/PN</b>	<b>250/10</b>	Stainless steel
1 Fuel gas inlet	<b>DN/PN</b>	<b>80/16</b>	Stainless steel
2 Intercooler in-/outlet	<b>DN/PN</b>	<b>65/10</b>	Stainless steel
2 Lube oil connection	<b>MM</b>	<b>28</b>	Hose

Seals and flanges for all flexible connections are included.

## 2.00 Electrical Equipment

Totally enclosed floor mounted sheet steel cubicle with front door wired to terminals. Ready to operate, with cable entry at bottom. Naturally ventilated or with forced ventilation.

Protection: IP 42 external  
IP 20 internal (protection against direct contact with live parts)

Design according to EN 61439-2 / IEC 61439-2 and ISO 8528-4.  
Ambient temperature 5 - 40 °C (41 - 104 °F), 70 % Relative humidity

Standard painting: Panel: RAL 7035  
Pedestal: RAL 7020 (Rittal TS8)  
RAL 9005 (Rittal VX25)

## 4.00 Delivery, installation and commissioning

### 4.01 Carriage

According to contract.

### 4.02 Unloading

Unloading, moving of equipment to point of installation, mounting and adjustment of delivered equipment on intended foundations is not included in JENBACHER scope of supply.

### **4.03 Assembly and installation**

Assembly and installation of all JENBACHER -components is not included in JENBACHER scope of supply.

### **4.04 Storage**

The customer is responsible for secure and appropriate storage of all delivered equipment.

### **4.05 Start-up and commissioning**

Start-up and commissioning with the JENBACHER start-up and commissioning checklist is not included. Plants with island operation require internet connection.

### **4.06 Trial run**

After start-up and commissioning, the plant will be tested in an 8-hour trial run. The operating personnel will be introduced simultaneously to basic operating procedures.  
Is not included in JENBACHER scope of supply.

### **4.07 Emission measurement with exhaust gas analyser**

Emission measurement by JENBACHER personnel, to verify that the guaranteed toxic agent emissions have been achieved (costs for measurement by an independent agency will be an extra charge).

## **5.01 Limits of delivery - Container**

### **Electrical**

- Module:  
At terminals of generator circuit breaker

### **Warm water**

At inlet and outlet flanges on container

### **Exhaust gas**

At exhaust gas outlet flange on top of the container; special stack provided locally

### **Combustion air**

The air filters are set mounted, no external ductwork is necessary

### **Fuel gas**

At inlet flange of the container

### **Lube oil**

At lube oil connections on container

### **Condensate**

At condensate drain on container.

### **Insulation**

Insulation of heat exchangers, pipework and exhaust gas silencer is not included in our scope of supply and must be provided locally.

## First filling

The first filling of module, (lube oil, engine jacket water, anti freeze-, anti corrosive agent) is not included in our scope of supply.

The composition and quality of the used consumables are to be strictly monitored in accordance with the "Technical Instructions" of JENBACHER.

Suitable bellows and flexible connections **must be provided locally** for all connections.  
Cables from the module must be flexible.

## 5.02 Factory tests and inspections

The individual module components shall undergo the following tests and inspections:

### 5.02.01 Engine tests

Carried out as combined Engine- and Module test according to DIN ISO 3046 at JENBACHER test bench. The following tests are made at 100%, 75% and 50% load, and the results are reported in a test certificate:

- Engine output
- Fuel consumption
- Jacket water temperatures
- Lube oil pressure
- Lube oil temperatures
- Boost pressure
- Exhaust gas temperatures, for each cylinder

### 5.02.02 Generator tests

Carried out on test bench of the generator supplier.

### 5.02.03 Module tests

The engine will be tested with natural gas (methane number 94). The performance data achieved at the test bench may therefore vary from the data as defined in the technical specification due to differences in fuel gas quality.

Carried out as combined Engine- and Module test commonly with module control panel at JENBACHER test bench, according to ISO 8528, DIN 6280. The following tests are made and the results are reported in a test certificate:

Visual inspection of scope of supply per specifications.

- Functional tests per technical specification of control system.
  - Starting in manual and automatic mode of operation
  - Power control in manual and automatic mode of operation
  - Function of all safety systems on module
- Measurements at 100%, 75% and 50% load:
  - Frequency
  - Voltage
  - Current
  - Generator output
  - Power factor
  - Fuel consumption
  - Lube oil pressure
  - Jacket water temperature
  - Boost pressure

- Mixture temperature
- Exhaust emission (NOx)

The module test will be carried out with the original generator, except if it is not possible because of the delivery date. Then a test generator will be used for the module test.

To prove characteristics of the above components, which are not tested on the test bench by JENBACHER, the manufacturers' certificate will be provided.

In the case of a container unit the above mentioned test procedure for the module is performed in Jenbach. JENBACHER reserves the right to perform the functional test of the container in a facility elsewhere.

## 5.03 Documentation

**List of standard pre-documentation provided based on the technical status at the time of order receipt:**

- Module drawing **1)**
- Technical diagram **1)**
- Drawings of the cabinet views **3)**
- Electrical interface list **2)**
- Technical specification of the control system **2)**

**Before delivery** (depending on progress in ordering the components, on request)

- Technical drawings for BoP components/accessories supplied separately (if included in scope of supply of INNIO Jenbacher GmbH & Co OG) **1)**

**Upon delivery**

- Circuit diagrams **3)**
- Cable list **3)**

**Delivered with the engine**

- Brief instructions (transport, erection, moving) **1)**

**For commissioning**

- Operation and maintenance instructions **4)**
- Spare parts catalogue **4)**
- Original supplier operation and maintenance instructions for any BoP components (installed in the INNIO Jenbacher GmbH & Co OG scope of supply) as Appendix **1)**

All the components found in the INNIO Jenbacher GmbH & Co OG scope of supply are described in the operation and maintenance instructions, and in the spare parts catalogue.

In addition, the manufacturer's original operation and maintenance instructions will be provided for every BoP component, in German and English as standard, as an Appendix for the operation and maintenance manual provided.

Additional costs of producing or providing the required documents using the KKS (power station coding system) and/or integration in subcontractors' documentation, or additional approval, design and proof of testing documentation must be negotiated or ordered separately.

**This standard offer does not include:**

- Approval documentation
- Design documentation
- Proof of testing documentation
- Printed copies and digital off-line versions (e.g. printed versions, CD, pdf, etc.) must be negotiated separately and ordered accordingly.

**Available languages (language codes as per ISO 639-1):**

<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>de</b>	German
				<b>en</b>	English
				<b>fr</b>	French
				<b>it</b>	Italian
				<b>es</b>	Spanish
				<b>nl</b>	Dutch
				<b>hu</b>	Hungarian
				<b>ru</b>	Russian
				<b>pl</b>	Polish
				<b>tr</b>	Turkish
				<b>cs</b>	Czech
				<b>pt</b>	Portuguese
				<b>da</b>	Danish
				<b>sk</b>	Slovakian
				<b>sl</b>	Slovenian
				<b>sr</b>	Serbian
				<b>lv</b>	Latvian
				<b>et</b>	Estonian
				<b>ro</b>	Rumanian
				<b>no</b>	Norwegian
				<b>hr</b>	Croatian
				<b>fi</b>	Finnish
				<b>zh</b>	Chinese
				<b>el</b>	Greek
				<b>bg</b>	Bulgarian
				<b>lt</b>	Lithuanian
				<b>sv</b>	Swedish