

Genset with heat recovery system

(Engine cooling water/heating water, 2nd stage LT mixture cooling water, without exhaust gas exchanger)

AE 12V4000L62

1 Ratings and Emissions

For operation on Methane number	NATURAL GAS		
Low heat value (LHV)	MZ ≥ 70		
Heating water temperature	Hu = 8,0-11,5 kWh/m_n³		
Genset with synchronous generator for generating	80 / 70 °C		
Gas mixture cooler, intern (1 st stage HT)	3Ph, 50Hz		
Gas mixture cooler, extern (2 nd stage LT)	integrated		
No _x	< 500	< 250	mg/m _n ³
			40 °C

1.1 Continuous Operating Data in Grid Parallel Mode

Generator voltage	400	415	6300	10500	11000	V
Electrical output of generator (no overload capacity)	1166	1165	1160	1157		kW _{el}
Thermal output (Engine cooling / lube oil / 1 st stage HT mixture cooler)		610		649		kW _{th}
Thermal output (2 nd stage LT mixture cooling)		71		74		kW _{th}
Total energy input		2821		2912		kW

1.2 Part Load Data in Grid Parallel Mode (75%)

Generator voltage	400	415	6300	10500	11000	V
Electrical output of generator	875	874	867	864		kW _{el}
Thermal output (Engine cooling / lube oil / 1 st stage HT mixture cooler)		458		481		kW _{th}
Thermal output (2 nd stage LT mixture cooling)		55		62		kW _{th}
Total energy input		2177		2229		kW

1.3 Part Load Data in Grid Parallel Mode (50%)

Generator voltage	400	415	6300	10500	11000	V
Electrical output of generator	581	582	572	571		kW _{el}
Thermal output (Engine cooling / lube oil / 1 st stage HT mixture cooler)		321		320		kW _{th}
Thermal output (2 nd stage LT mixture cooling)		40		41		kW _{th}
Total energy input		1536		1545		kW

1.4 Continuous Operating Data Insolated Mode

Generator voltage	400	415	6300	10500	11000	V
Electrical output of generator (is only valid for MZ ≥ 90)	1050	1049	1044	1041		kW _{el}

8% tolerance for thermal outputs and 5% for total energy input listed. Performance data in accordance with ISO 3046. All data apply to grid parallel operation. Data for site operating conditions other than those mentioned, available on demand. Max. reactive power in kVA, resp. nominal current acc. to nominal output of the generator.

1.5 Pollutant Emissions

Emission values related to dry exhaust gas with 5% O₂. (For exhaust gas volume flow see 3.5)

NO _x , stated as NO ₂	< 500		< 250	mg/m _n ³
CO, without catalyst		< 1000		mg/m _n ³
CO, with catalyst (optional, delivered loose)		< 300		mg/m _n ³

2 Design Principles / Scope of Supply

- ◆ Engine and flange-mounted alternator (SAE 00 housing) are connected via a torsionally resilient coupling and resiliently mounted to a rigid, welded steel base frame.
- ◆ Standby heater
- ◆ Lube oil pump for draining the oil sump (incl. two solenoid valves).
- ◆ The base frame is installed on vibration dampers

2.1 Engine plus Accessories

	MTU 12V4000L62		
Otto-Gas-Engine	V 12		
Cyl. arrangement, no. of cyl.	170 / 210		mm
Bore / stroke	57,20		Litre
Volume	1500		1/min
Speed	10,5		m/s
Mean piston speed	12,9:1		
Compression ratio	16,8		bar
Mean effective pressure			
Standard power acc. to ISO 3046, (no overload capacity)*	1200		kW _{mech}
Specific full-load consumption (tolerance 5%)	2,35	2,43	kWh/kWh _{mech}
Gas consumption (based on LHV=10kWh/m ³)	282,1	291,2	m ³ /h
Lube oil consumption (not guaranteed, at rated load and after 1000Oh)	0,3		g/kWh _{mech}

* Overload must reliably be avoided by means of suitable external control systems (e.g. electronic output power control).

Basic Engine

- ◆ Monobloc grey cast crankcase with inspection ports, flywheel housing SAE 00, flywheel 21" cast iron oil pan
- ◆ Forged crankshaft
- ◆ Forged connecting rods
- ◆ Four-valve, individual cylinder heads with central pre-chamber armoured valves with „Rotocap“ rotators
- ◆ Light-metal solid-skirt pistons with oil cooling duct, piston cooling via oil spray nozzles

Mixture Formation

- ◆ Air intake via dry-type engine-mounted air filters
- ◆ Venturi type air-gas mixer with gas supply via electronically controlled gas metering valve

Turbocharging

- ◆ Turbocharger for gas-air mixture compression
- ◆ Two-stage mixture cooling
- ◆ Throttles between mixture coolers and intake manifold

Exhaust System

- ◆ Dry-type, insulated exhaust manifolds in the engine Vee

Lube Oil System

- ◆ Lube oil circulation pump with safety valve for forced-feed lubrication and piston cooling
- ◆ Engine mounted heat exchanger
- ◆ Lube oil filters with replaceable filter elements
- ◆ Engine-mounted device for automatic oil level control
- ◆ Oil dipstick
- ◆ Closed crankcase venting system with oil separator connected to mixture piping before turbo charger
- ◆ Connections for oil refill and oil draining

Cooling System (2-circuit)

- ◆ High temperature circuit for lube oil cooling, 1st stage of mixture cooling and engine jacket
- ◆ Connections with counter-flanges for external cooling- or heat recovery system
- ◆ Integrated cooling preheating unit

Starting System

- ◆ Electric starter (9 kW, 24 VDC)

Ignition System

- ◆ Microprocessor-controlled high-voltage spark-ignition system with low voltage distribution, no moving parts, no wear
- ◆ Automatic control for ignition energy adjustment
- ◆ Variable timing control
- ◆ Timing sensors at camshaft and crankshaft
- ◆ One ignition coil per cylinder
- ◆ Industrial spark plugs

2.2 Generator

Self-regulating, brushless revolving-field synchronous generator with built-in exciter, voltage and cos φ regulator, designed to VDE 0530, radio interference class N, low-harmonic design.

Generator voltage	400	415	6300	10500	11000	V
Rating (F)	1445	1439	2148	2167		kVA
Insulation class	H	H	F	F		
Temperature-rise rating	F	F	B	B		
Cos φ *	1,0 -0,8	1,0 -0,8	1,0 -0,8	1,0 -0,8		
Frequency			50			Hz
Speed			1500			1/min
Efficiency (100% load) at cos φ 1	97,2	97,1	96,7	96,4		%
Stator connection			Star			
Max. ambient temperature.			40			°C
Type of protection			IP 23			

*) Cos-phi must be over the whole power range in the defined range. Only inductive reactive power admissible (over-erected).

In case of nominal mains voltage variations by ± 2%, an automatic voltage adjustment must be used.

2.3 Heat Exchanger System

heat recovery system (to extract heat from cooling water circuit and 2nd stage LT of mixture cooler)

Engine cooling circuit (HT)

- ◆ Plate heat exchanger engine cooling-/heating water
- ◆ Cooling water pump
- ◆ Thermostat controlled mixture valve
- ◆ Expansion vessel
- ◆ Pressure and level monitoring cooling water
- ◆ Overpressure valve

Mixture cooling water circuit (2nd stage, LT)

- ◆ Pump for 2nd stage mixture cooler
- ◆ Control valve
- ◆ Expansion vessel (max. water volume note) with pressure and level monitoring
- ◆ max. Δp for re cooler and pipes notes
- ◆ Overpressure valve

Values for cooling / heating water are based on water without antifrost and corrossions additives.

Admissible antifrost and corrossions additives see operating media. Values in brackets []* refer to 35% Glycol.

Engine Cooling (engine block with lube oil and 1st stage HT mixture cooling)

Thermal output (8% tolerance)	610		649		kW
Cooling water temperature, in- / outlet	78 / 90				°C
Cooling water volume flow	45 [48]		48 [52]		m³/h
Pressure loss	1,4 [1,6]		1,6 [1,9]		bar
System pressure permitted max.	6,0				bar
Standby heater, min.	40				°C

Mixture Cooling (2nd stage LT)

Data see 3.3

Plate Heat Exchanger

Thermal output (8% tolerance)	610		649		kW
Cooling water temperature, in- / outlet	90 / 78				°C
Heating water temperature, in- / outlet	70 / 80				°C

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2.4 Gas Supply

Gas regulation lines delivered loose, components approved per Directive for Gas Components 90/356/EWG

Gas Regulation Line

- ◆ Gas filter
- ◆ two solenoid valves (or double solenoid valve)
- ◆ Low pressure regulator
- ◆ valve leakage monitor
- ◆ flexible stainless steel hose

2.5 Engine Management (MIS)

General

- ◆ Control cabinet is mounted directly to the genset
 - ◆ Connection to control cabinet (e.g. MMC-4000) with CanOpen and discrete signals (digital and analog) via a multipolar engine cable (max. 25 m). There is an assignment diagram for the engine cable and a signal list specifically for the CanOpen interface.
- The engine is controlled by discrete signals. The engine management requests various auxiliary drives (e.g. pumps, gas valves, etc.) and expects corresponding feedback within certain timeframes. The CanOpen interface serves solely for the exchange of information. No specifications can be issued via the interface (read only!).
- ◆ Internal bus communication via CAN.

ECU7

- ◆ Speed governing
- ◆ Air / Fuel ratio control via engine characteristic map
- ◆ Engine start / stop sequence
- ◆ Emergency stop sequence
- ◆ Engine monitoring (temperatures, pressures, speed, etc.)

EMU7

- ◆ Single exhaust temperature monitoring (cylinderhead)

SAM

- ◆ Providing CANopen interface
- ◆ Lube oil make up
- ◆ Monitoring of minimum load

Ignition

- ◆ Electronic ignition system
- ◆ Ignition time setting
- ◆ Speed monitoring

Knocking monitoring AKR

- ◆ Acoustic knocking monitoring system
- ◆ Individual ignition timing adjustment per cylinder

3 Technical Data Design / Operation

3.1 Operating Media

The binding specifications for cooling water, fuel, lube oil, exhaust condensate and heating water are stipulated in the relevant MTU operating media regulations.

3.2 Filling Quantities

Lube oil – quantity (first filling)	260	Liter
Lube oil – quantity (consecutive oil changes)	220	Liter
Engine cooling water, HT (engine and heat recovery)	250	Liter
Heating water	30	Liter
Mixture cooling water, LT (without re cooler and pipes)	30	Liter

3.3 Heat Generation

Heating water return temperature upstream of genset, min / max		60 / 70	°C
Heating water volume flow, standard	55	59	m ³ /h
Max. permissible working pressure (cooling water heat exchanger)		16	bar
Pressure loss at standard flow rate (between the connecting flanges)		0,5	bar

Mixture Cooling (2nd stage LT)

Thermal output (8% tolerance)	71	74	kW
Mixture cooling water volume flow (8% tolerance)	22	22	m ³ /h
Inlet temperature mixture cooling water max.		40	°C
Max. permissible pressure loss outside the heat recovery system		0,5	bar
System pressure permitted max.		6,0	bar
Information for dimensioning of expansion vessel for max. water siphon		300	Liter
Note information pressure control valve.			

3.4 Combustion Air / Ventilation

Heat radiated from the genset (engine and generator without adjoining pipes)	114	114	kW
Engine room ventilation			
Minimum intake air volume flow for engine room cooling. (The engine room ventilation has to be calculated and adjusted according to the requirements for gaseous fuels valid at the installation site)	22957	23162	m ³ /h
Ventilation air volume flow	17781	17781	m ³ /h
Combustion air volume flow	4749	4937	m _n ³ /h
Intake air temperature min. / max. (for other temperatures the limit values must be adapted after consultation)		15	°C
Temperature difference intake / ventilation max.		< 20	K
max. permissible intake negative pressure at inlet air filter		3	mbar

3.5 Exhaust Gas (Exhaust gas heat exchanger not included in scope of supply, optional)

Thermal output by 120°C (8% tolerance)	662	692	kW
Exhaust temperature (turbocharger outlet)	454	456	°C
Exhaust gas mass flow, dry	5931	6169	kg/h
Exhaust gas mass flow, moist	6371	6622	kg/h
Exhaust gas volume flow, dry (0 °C, 1013 mbar)	4483	4663	m _n ³ /h
Exhaust gas volume flow, moist (0 °C, 1013 mbar)	5001	5197	m _n ³ /h
Permissible back-pressure downstream of engine min. / max.		30 / 50	mbar

In multi-genset systems, separate exhaust piping for each genset is recommended.

If a common exhaust header system is installed, exhaust flow back into any non-operating gensets must be avoided by use of a 100% gas-tight exhaust shut-off flap.

In the range of partial load the exhaustive temperature rises up to 550°C. In case of use of catalyzers, due to the exothermic reaction the exhaustive temperature may increase up to 600°C.

3.6 Sound Levels

Engine surface noise emitted by the genset

(distance 1 m, free field measurement, Tolerance +5 dB for single 1/3-octave band, +2 db(A) for total A-weighted level)

Frequency (Hz)	Sound pressure levels (dB)			
	Lin dB	dB (A)	Lin dB	dB (A)
12,5				
16				
20				
25		73,3		73,8
31,5		63,5		64,0
40		67,7		68,2
50		68,7		69,2
63		71,6		72,1
80		82,3		82,8
100		79,6		80,1
125		82,4		82,9
160		82,4		82,9
200		80,0		80,5
250		82,0		82,5
315		84,9		85,4
400		89,0		89,5
500		86,0		86,5
630		86,3		86,8
800		85,7		86,2
1000		85,0		85,5
1250		85,5		86,0
1600		84,8		85,3
2000		85,6		86,1
2500		83,8		84,3
3150		82,7		83,6
4000		83,1		83,6
5000		86,8		84,3
6300		96,5		97,3
8000		82,1		82,6
10k		80,5		81,0
Sum of sound pressure levels (dB)	100,2	99,4	100,7	99,9
Sound power levels dB (A)		118,4		118,9

undampened Exhaust noise

(distance of 1 m from outlet, Tolerance +5 dB for single 1/3-octave band, +3 db(A) for total A-weighted level)

Frequency (Hz)	Sound pressure levels (dB)			
	Lin dB	dB (A)	Lin dB	dB (A)
12,5				
16				
20				
25		78,5		79,0
31,5		76,6		77,1
40		83,9		84,4
50		94,7		95,2
63		101,1		101,6
80		113,5		114,0
100		107,1		107,6
125		110,0		110,5
160		111,9		112,4
200		111,6		112,1
250		100,4		100,9
315		101,6		102,1
400		99,4		99,9
500		97,5		98,0
630		93,7		94,2
800		89,6		90,1
1000		84,5		85,0
1250		87,9		88,4
1600		87,8		88,3
2000		86,6		87,1
2500		85,0		85,5
3150		83,4		83,9
4000		80,0		80,5
5000		85,6		86,1
6300		82,9		83,4
8000		64,0		64,5
10k		51,1		51,6
Sum of sound pressure levels (dB)	118,7	106	119,2	106,5
Sound power levels dB (A)		118,6		119,1

3.7 Connections

Unless stated otherwise, the connecting flanges are to DIN 2501.

Nominal diameters and pressures are as follows:

Safety gas line *	DN80 / PN16	
Exhaust gas outlet (expansion joint)	DN250 / PN6	
Heating water in- / outlet	DN100 / PN16	
Mixture cooling water in- / outlet	DN50 / PN16	
Safety pressure valve outlet (CWsystem HT)	Socket R 2 1/2"	
Safety pressure valve outlet (MCWsystem LT)	Socket R 1 1/2"	
Lube oil flow and return: Tube connection to DIN 3861	d = 22	

*) Dimension depending on gas pressure and gas quality

3.8 Paints, Dimensions and Weights of the Genset

Engine, Generator and Frame	RAL 9006	
Length	6000	mm
Width	1800	mm
Height	2400	mm
Genset (dry weight)	10000	kg
Genset (service weight)	10500	kg
Heat recovery system (dry weight)	1250	kg
Heat recovery system (service weight)	1400	kg
For binding dimensions please refer to drawing.		

Data are subject to change without notice in the interest of further development.