

**Genset without heat recovery system**

**AoE 16V400L62**

**1 Ratings and Emissions**

|  |   |                 |                                |
|--|---|-----------------|--------------------------------|
| For operation on   | <b>NATURAL GAS</b>                      |                 |                                |
| Methane number   |   |                 |                                |
| Low heat value (LHV)                                     | <b>Hu = 8,0-11,5 kWh/m<sup>3</sup>n</b> |                 |                                |
| Cooling water temperature                                | <b>90 / 78 °C</b>                       |                 |                                |
| Genset with synchronous generator for generating         | <b>3Ph, 50Hz</b>                        |                 |                                |
| Gas mixture cooler, intern<br>(1 <sup>st</sup> stage HT) | <b>integrated</b>                       |                 |                                |
| Gas mixture cooler, extern<br>(2 <sup>nd</sup> stage LT) | <b>40 °C</b>                            |                 |                                |
| No <sub>x</sub>  | <b>&lt; 500</b>                         | <b>&lt; 250</b> | mg/m <sub>n</sub> <sup>3</sup> |

**1.1 Continuous Operating Data in Grid Parallel Mode**

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.

|   | GB 1562 N5  | 415         | GB 1549 N5  | GB 1546 N5  | GB 1554 N5  | V                |
|---|-------------|-------------|-------------|-------------|-------------|------------------|
| Generator voltage   | 400         | 415         | 6300        | 10500       | 11000       | V                |
| Electrical output of generator (no overload capacity)                                   | <b>1562</b> |             | <b>1549</b> | <b>1546</b> | <b>1554</b> | kW <sub>el</sub> |
| Thermal output<br>(Engine cooling / lube oil / 1 <sup>st</sup> stage HT mixture cooler) |             | <b>872</b>  |             | <b>909</b>  |             | kW <sub>th</sub> |
| Thermal output<br>(2 <sup>nd</sup> stage LT mixture cooling)                            |             | <b>101</b>  |             | <b>107</b>  |             | kW <sub>th</sub> |
| Total energy input  |             | <b>3765</b> |             | <b>3884</b> |             | kW               |

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

|   | 400         | 415         | 6300        | 10500       | 11000       | V                |
|---|-------------|-------------|-------------|-------------|-------------|------------------|
| Generator voltage   | 400         | 415         | 6300        | 10500       | 11000       | V                |
| Electrical output of generator  | <b>1171</b> |             | <b>1160</b> | <b>1157</b> | <b>1168</b> | kW <sub>el</sub> |
| Thermal output<br>(Engine cooling / lube oil / 1 <sup>st</sup> stage HT mixture cooler) |             | <b>647</b>  |             | <b>671</b>  |             | kW <sub>th</sub> |
| Thermal output<br>(2 <sup>nd</sup> stage LT mixture cooling)                            |             | <b>78</b>   |             | <b>82</b>   |             | kW <sub>th</sub> |
| Total energy input  |             | <b>2902</b> |             | <b>2983</b> |             | kW               |

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

|   | 400        | 415         | 6300       | 10500       | 11000      | V                |
|---|------------|-------------|------------|-------------|------------|------------------|
| Generator voltage   | 400        | 415         | 6300       | 10500       | 11000      | V                |
| Electrical output of generator  | <b>778</b> |             | <b>767</b> | <b>766</b>  | <b>772</b> | kW <sub>el</sub> |
| Thermal output<br>(Engine cooling / lube oil / 1 <sup>st</sup> stage HT mixture cooler) |            | <b>457</b>  |            | <b>463</b>  |            | kW <sub>th</sub> |
| Thermal output<br>(2 <sup>nd</sup> stage LT mixture cooling)                            |            | <b>54</b>   |            | <b>58</b>   |            | kW <sub>th</sub> |
| Total energy input  |            | <b>2050</b> |            | <b>2093</b> |            | kW               |

**1.4 Continuous Operating Data Insolated Mode**

|                                | 400         | 415 | 6300        | 10500       | 11000       | V                |
|--------------------------------|-------------|-----|-------------|-------------|-------------|------------------|
| Generator voltage              | 400         | 415 | 6300        | 10500       | 11000       | V                |
| Electrical output of generator | <b>1420</b> |     | <b>1408</b> | <b>1405</b> | <b>1413</b> | kW <sub>el</sub> |

**1.5 Pollutant Emissions**

Emission values related to dry exhaust gas with 5% O<sub>2</sub>. (For exhaust gas volume flow see 3.5)

|   |                  |                 |                                |
|---|------------------|-----------------|--------------------------------|
| No <sub>x</sub> , stated as NO <sub>2</sub>   | <b>&lt; 500</b>  | <b>&lt; 250</b> | mg/m <sub>n</sub> <sup>3</sup> |
| CO, without catalyst                          | <b>&lt; 1000</b> |                 | mg/m <sub>n</sub> <sup>3</sup> |
| CO, with catalyst (optional, delivered loose) | <b>&lt; 300</b>  |                 | mg/m <sub>n</sub> <sup>3</sup> |

**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**

|   | <b>MTU 16V4000L62</b> |       |                       |
|---|-----------------------|-------|-----------------------|
| Otto-Gas-Engine   | V 16                  |       |                       |
| Cyl. arrangement, no. of cyl.   | 170 / 210             |       | mm                    |
| Bore / stroke   | 76,27                 |       | Litre                 |
| Volume  | 1500                  |       | 1/min                 |
| Speed   | 10,5                  |       | m/s                   |
| Mean piston speed   | 12,9:1                |       |                       |
| Compression ratio   | 16,8                  |       | bar                   |
| Mean effective pressure   | <b>1600</b>           |       | kW <sub>mech</sub>    |
| Standard power acc. to ISO 3046, (no overload capacity)*              |                       |       |                       |
| Specific full-load consumption (tolerance 5%)                         | 2,35                  | 2,43  | g/kWh <sub>mech</sub> |
| Gas consumption (based on LHV=10kWh/m <sup>3</sup> n)                 | 376,5                 | 388,4 | m <sup>3</sup> /h     |
| Lube oil consumption (not guaranteed, at rated load and after 1000Oh) | 0,3                   |       | g/kWh <sub>mech</sub> |

\* 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, 1<sup>st</sup> 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 (2x 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.

|                                   |          |     |          |          |          |       |
|-----------------------------------|----------|-----|----------|----------|----------|-------|
| Generatorspannung                 | 400      | 415 | 6300     | 10500    | 11000    | V     |
| Rating (F)                        | 1935     |     | 2148     | 2168     | 1920     | kVA   |
| Insulation class                  | H        |     | F        | F        | F        |       |
| Temperature-rise rating           | F        |     | B        | B        | B        |       |
| Cos φ *                           | 1,0 -0,8 |     | 1,0 -0,9 | 1,0 -0,9 | 1,0 -0,8 |       |
| Frequency                         |          |     | 50       |          |          | Hz    |
| Speed                             |          |     | 1500     |          |          | 1/min |
| Efficiency (100% load) at cos φ 1 | 97,6     |     | 96,8     | 96,6     | 97,1     | %     |
| 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 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

**2.4 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.

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

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

**3.2 Filling Quantities**

|  |     |       |
|--|-----|-------|
| Lube oil – quantity (first filling)                        | 285 | Liter |
| Lube oil – quantity (consecutive oil changes)              | 250 | Liter |
| Engine cooling water, HT                                   | 270 | Liter |
| Mixture cooling water, LT<br>(without re cooler and pipes) | 22  | Liter |

**3.3 Heat Generation**

**Engine Cooling** (engine block with lube oil and 1<sup>st</sup> stage HT mixture cooling)

|   | 872     |        | 909 |        |                   |
|---|---------|--------|-----|--------|-------------------|
| Thermal output (8% tolerance)           |         |        |     |        | kW                |
| Cooling water temperature, in- / outlet | 78 / 90 |        |     |        | °C                |
| Cooling water volume flow               | 65      | [70 ]  | 66  | [71 ]  | m <sup>3</sup> /h |
| Pressure loss                           | 2,0     | [2,3 ] | 2,1 | [2,4 ] | bar               |
| System pressure permitted max.          | 6,0     |        |     |        | bar               |
| Cooling water temperature, min.         | 40      |        |     |        | °C                |

**Mixture Cooling** (2<sup>nd</sup> stage LT)

|  | 101 |  | 107 |  |                   |
|--|-----|--|-----|--|-------------------|
| Thermal output (8% tolerance)                    |     |  |     |  | kW                |
| Mixture cooling water volume flow (8% tolerance) | 23  |  | 22  |  | m <sup>3</sup> /h |
| Inlet temperature mixture cooling water max.     | 40  |  |     |  | °C                |
| Outlet temperature mixture cooling water max.    | 44  |  | 45  |  | °C                |
| Pressure loss                                    | 0,4 |  |     |  | bar               |
| System pressure permitted max.                   | 6,0 |  |     |  | bar               |
| Note information pressure control valve.         |     |  |     |  |                   |

**3.4 Combustion Air / Ventilation**

|   | 107   |  | 107   |  |                                |
|---|-------|--|-------|--|--------------------------------|
| Heat radiated from the genset<br>(engine and generator without adjoining pipes)<br>Engine room ventilation  |       |  |       |  | kW                             |
| Minimum intake air volume flow for engine room cooling.<br>(The engine room ventilation has to be calculated and adjusted according to the requirements for gaseous fuels valid at the installation site) | 23712 |  | 24076 |  | m <sup>3</sup> /h              |
| Ventilation air volume flow   | 16810 |  | 16810 |  | m <sup>3</sup> /h              |
| Combustion air volume flow  | 6332  |  | 6666  |  | m <sub>n</sub> <sup>3</sup> /h |
| Intake air temperature min.<br>(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                           |

**TB 46206 d 50**

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

|  |         |      |                                |
|--|---------|------|--------------------------------|
| Thermal output by 120°C (8% tolerance)                     | 847     | 889  | kW                             |
| Exhaust temperature (turbocharger outlet)                  | 442     | 441  | °C                             |
| Exhaust gas mass flow, dry                                 | 7826    | 8182 | kg/h                           |
| Exhaust gas mass flow, moist                               | 8463    | 8904 | kg/h                           |
| Exhaust gas volume flow, dry (0 °C, 1013 mbar)             | 5916    | 6188 | m <sub>n</sub> <sup>3</sup> /h |
| Exhaust gas volume flow, moist (0 °C, 1013 mbar)           | 6603    | 6896 | m <sub>n</sub> <sup>3</sup> /h |
| Permissible back-pressure downstream of engine min. / max. | 30 / 60 |      | 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                                |                            | 68,3   |        | 68,1   |
| 31,5                              |                            | 68,8   |        | 68,6   |
| 40                                |                            | 72,1   |        | 72,4   |
| 50                                |                            | 66,8   |        | 67,2   |
| 63                                |                            | 73,6   |        | 74,1   |
| 80                                |                            | 74,1   |        | 74,5   |
| 100                               |                            | 84,0   |        | 83,7   |
| 125                               |                            | 80,6   |        | 80,4   |
| 160                               |                            | 81,3   |        | 81,3   |
| 200                               |                            | 81,6   |        | 81,5   |
| 250                               |                            | 81,8   |        | 81,9   |
| 315                               |                            | 85,0   |        | 84,2   |
| 400                               |                            | 91,5   |        | 91,7   |
| 500                               |                            | 85,8   |        | 85,7   |
| 630                               |                            | 84,8   |        | 85,0   |
| 800                               |                            | 84,6   |        | 84,7   |
| 1000                              |                            | 83,5   |        | 83,4   |
| 1250                              |                            | 82,3   |        | 82,2   |
| 1600                              |                            | 81,0   |        | 80,6   |
| 2000                              |                            | 81,4   |        | 81,1   |
| 2500                              |                            | 82,2   |        | 82,0   |
| 3150                              |                            | 82,0   |        | 82,0   |
| 4000                              |                            | 82,8   |        | 82,8   |
| 5000                              |                            | 84,3   |        | 83,9   |
| 6300                              |                            | 94,8   |        | 96,3   |
| 8000                              |                            | 85,6   |        | 88,3   |
| 10k                               |                            | 82,5   |        | 82,7   |
| Sum of sound pressure levels (dB) | 99,3                       | 98     | 100,1  | 98,9   |
| Sound power levels dB (A)         |                            | 117,4  |        | 118,3  |

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                                |                            | 90,8   |        | 90,0   |
| 31,5                              |                            | 85,9   |        | 86,4   |
| 40                                |                            | 98,3   |        | 98,7   |
| 50                                |                            | 89,7   |        | 91,1   |
| 63                                |                            | 107,2  |        | 107,1  |
| 80                                |                            | 116,4  |        | 116,4  |
| 100                               |                            | 117,2  |        | 117,6  |
| 125                               |                            | 110,5  |        | 110,5  |
| 160                               |                            | 107,1  |        | 107,3  |
| 200                               |                            | 105,2  |        | 105,6  |
| 250                               |                            | 103,6  |        | 104,1  |
| 315                               |                            | 102,2  |        | 102,6  |
| 400                               |                            | 100,7  |        | 100,7  |
| 500                               |                            | 96,9   |        | 97,7   |
| 630                               |                            | 94,7   |        | 95,5   |
| 800                               |                            | 93,0   |        | 94,3   |
| 1000                              |                            | 92,5   |        | 94,0   |
| 1250                              |                            | 91,9   |        | 93,2   |
| 1600                              |                            | 91,2   |        | 91,9   |
| 2000                              |                            | 91,3   |        | 91,7   |
| 2500                              |                            | 91,5   |        | 92,1   |
| 3150                              |                            | 89,2   |        | 89,9   |
| 4000                              |                            | 87,9   |        | 90,4   |
| 5000                              |                            | 79,7   |        | 81,5   |
| 6300                              |                            | 75,1   |        | 75,4   |
| 8000                              |                            | 67,9   |        | 66,3   |
| 10k                               |                            | 62,9   |        | 61,3   |
| Sum of sound pressure levels (dB) | 121,1                      | 106,5  | 121,3  | 107    |
| Sound power levels dB (A)         |                            | 118,7  |        | 119,2  |

### 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)                  | DN300 / PN6  |  |
| Cooling water in- / outlet                            | DN100 / PN16 |  |
| Mixture cooling water in- / outlet                    | DN50 / PN16  |  |
| 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

|                         |          |    |
|-------------------------|----------|----|
| Engine and Generator    | RAL 9006 |    |
| Frame                   | RAL 5002 |    |
| Length                  | 5300     | mm |
| Width                   | 1700     | mm |
| Height                  | 2600     | mm |
| Genset (dry weight)     | 13200    | kg |
| Genset (service weight) | 13800    | kg |

For binding dimensions please refer to drawing.

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