

4016-61TRG3

4000

1600 - 2183 kWm (Gross) @ 1500 rpm

Electropak

Series

Basic technical data

| | |
|-----------------------|---|
| Number of cylinders | 16 |
| Cylinder arrangement | 60° Vee |
| Cycle | 4 stroke |
| Induction system | Turbocharged |
| Combustion system | Direct injection |
| Compression ratio | 13:1 nominal |
| Bore | 160 mm |
| Stroke | 190 mm |
| Cubic capacity | 61.123 litres |
| Direction of rotation | Anticlockwise viewed on flywheel |
| Firing order | 1 ^A , 1 ^B , 3 ^A , 3 ^B , 7 ^A , 7 ^B , 5 ^A , 5 ^B , 8 ^A , 8 ^B , 6 ^A , 6 ^B , 2 ^A , 2 ^B , 4 ^A , 4 ^B |
| Cylinder 1 | Furthest from flywheel |

Note: Cylinders designated 'A' are on the right hand side of the engine when viewed from the flywheel end

Weight of Electropak

Temperate

| | |
|-----|---------|
| Dry | 7783 kg |
| Wet | 8381 kg |

Tropical

| | |
|-----|---------|
| Dry | 8203 kg |
| Wet | 8861 kg |

Overall dimensions of Electropak

Temperate

| | |
|--------|---------|
| Length | 4542 mm |
| Width | 2185 mm |
| Height | 3175 mm |

Tropical

| | |
|--------|---------|
| Length | 4562 mm |
| Width | 2185 mm |
| Height | 3736 mm |

Moment of inertia

| | |
|----------|------------------------|
| Engine | 10.89 kgm ² |
| Flywheel | 9.55 kgm ² |

Total engine inertia

| | |
|---------------------|------------------------|
| Engine and flywheel | 20.44 kgm ² |
|---------------------|------------------------|

Cyclic irregularity, engine/flywheel Prime power

| | |
|----------|-------|
| 1500 rpm | 1.204 |
|----------|-------|

Ratings

Steady state speed stability at constant load ... $\pm 0.25\%$
Electrical ratings are based on average alternator efficiency and are for guidance only (0.8 power factor being used).

Operating point

| | |
|--------------------------------|-------------------------|
| Engine speed | 1500 rpm |
| Static injection timing | See engine number plate |
| Cooling water exit temperature | < 98°C |

Fuel data

To conform to BS2869 class A2 or BS EN590.

Performance

| | |
|-------------------------------|-----------|
| Sound pressure level 1500 rpm | 119 dB(A) |
|-------------------------------|-----------|

Note: All data based on operation to ISO 3046/1, BS 5514 and DIN 6271 standard reference conditions.

Note: For engines operating in ambient conditions other than the standard reference conditions stated below a suitable de-rate must be applied.

Note: De-rate tables for increased ambient temperature and/or altitude are available, please contact Perkins Applications Department.

Test conditions

| | |
|--|--------------|
| Air temperature | 25°C |
| Barometric pressure | 100 kPa |
| Relative humidity | 30% |
| Air inlet restriction at maximum power (nominal) | 2.5 kPa |
| Exhaust back pressure at maximum power (nominal) | 3 kPa |
| Fuel temperature (inlet pump) | 58°C maximum |

General installation

4016-61TRG3

| Designation | Units | Type of operation and application | | |
|---|----------|-----------------------------------|-------------|---------------|
| | | Baseload power | Prime power | Standby power |
| | | 50 Hz @ 1500 rpm | | |
| Gross engine power | kWb | 1600 | 1975 | 2183 |
| Fan power | kWm | 100 | | |
| ElectropaK nett engine power | kWm | 1500 | 1875 | 2083 |
| Gross BMEP | kPa | 2094 | 2585 | 2857 |
| Combustion air flow | m³/min | 135 | 160 | 175 |
| Exhaust gas temperature after turbo (maximum) | °C | 460 | 475 | 560 |
| Exhaust gas flow (maximum) at atmospheric pressure | m³/min | 525 | | |
| Boost pressure ratio | - | 4 | | |
| Mechanical efficiency | % | 94 | | |
| Overall thermal efficiency (nett) | % | 40 | | |
| Friction power and pumping losses | kWm | 160 | | |
| Mean piston speed | m/s | 9.5 | | |
| Engine coolant flow (minimum) | litres/s | 21 | | |
| Typical GenSet electrical output 0.8pf 25°C (100 kPa) | kWe | 1440 | 1800 | 2000 |
| | kVA | 1800 | 2250 | 2500 |
| Assumed alternator efficiency | % | 96 | | |

Note: All quoted gross engine powers include an allowance of 1.5% for installation variances.

Note: Not to be used for CHP design purposes (indicative figures only). Consult Perkins Engines Company Limited. Assumes complete combustion.

Rating definitions

Baseload power

Unlimited hours usage with an average load factor of 100% of the published baseload power rating.

Prime power

Variable load. Unlimited hours usage with an average load factor of 80% of the published prime power over each 24 hour period. A 10% overload is available for 1 hour in every 12 hour operation.

Standby power

Limited to 500 hours annual usage with an average load factor of 80% of the published standby power rating over each 24 hour period. Up to 300 hours of annual usage may be run continuously. No overload is permitted on standby power.

Emissions capability

All 4016-61TRG ratings are optimised to the 'best fuel consumption' and do not comply to Harmonised International Regulation Emission Limits. More information on these statements can be obtained by contacting the Applications Department at Perkins Engines Company Limited.

Energy balance

4016-61TRG3

| Designation | Units | 1500 rpm | | |
|--------------------------------|-------|----------------|-------------|---------------|
| | | Baseload power | Prime power | Standby power |
| Energy in fuel | kWt | 4022 | 4951 | 5458 |
| Energy in power output (gross) | kWb | 1600 | 1975 | 2183 |
| Energy to cooling fan | kWm | 100 | | |
| Energy in power output (nett) | kWm | 1500 | 1875 | 2083 |
| Energy to exhaust | kWt | 1136 | 1400 | 1535 |
| Energy to coolant and oil | kWt | 614 | 757 | 830 |
| Energy to radiation | kWt | 117 | 135 | 160 |
| Energy to charge coolers | kWt | 555 | 684 | 750 |

Note: Not to be used for combined heat and power (CHP) purposes (indicative figures only). If necessary, consult Perkins Engines Company Ltd.

Cooling system

Coolant system - both circuits

Recommended coolant: 50% inhibited ethylene glycol or 50% inhibited propylene glycol and 50% clean fresh water (except charged/cooled circuit which is 30% dilution).

Where there is no likelihood of ambient temperature below 10°C, then clean soft water may be used, treated with 1% by volume of Perkins inhibitor.

Total coolant capacity: Jacket Water

| | |
|--|------------|
| Electrounit (engine only) | 95 litres |
| ElectropaK - Temperate cooling (engine and radiator) | 260 litres |
| ElectropaK - Tropical cooling (engine and radiator) | 270 litres |

Total coolant capacity: Secondary Water

| | |
|---|------------|
| ElectropaK - Temperate cooling (charge coolers, pipework and radiator) | 200 litres |
| ElectropaK - Tropical cooling (charge coolers, pipework and radiator) | 230 litres |

Radiator: Jacket Water/Secondary Water (Temperate)

| | |
|--------------------------------------|---|
| Radiator face area | 6.4 m ² |
| Number of rows and material | copper, 5 rows |
| Fins per inch and material | brass, 11 rows/14 rows (jacket/secondary) |
| Width of matrix | 2180 mm |
| Height of matrix | 2930 mm |
| Weight of radiator (dry) | __kg |
| Pressure cap setting (minimum) | 70 kPa |

Radiator: Jacket Water/Secondary Water (Tropical)

| | |
|-----------------------------------|---|
| Radiator face area | 7.7 m ² |
| Number of rows and material | copper, 5 rows/6 rows (jacket/secondary) |
| Fins per inch and material | brass, 13 rows/14 rows (jacket/secondary) |
| Width of matrix | 2200/2180 mm (jacket/secondary) |
| Height of matrix | 3500 mm |
| Weight of radiator (dry) | __kg |
| Pressure cap setting (min) | 70 kPa |

Water jacket cooling data

| Coolant jacket data | Units | 1500 rpm |
|-------------------------------------|----------|----------|
| Coolant flow | litres/s | 21 |
| Coolant exit temperature (maximum) | °C | 98 |
| Coolant inlet temperature (minimum) | °C | 70 |
| Coolant inlet temperature (maximum) | °C | 80 |

Water Jacket coolant pump

| | |
|-----------------------|---------------|
| Speed | 1.4 x e rpm |
| Method of drive | Engine driven |

Secondary water circuit

| Coolant jacket data | Units | 1500 rpm |
|--|----------|------------------------|
| Coolant flow | litres/s | 12 |
| Maximum permissible restriction to coolant pump flow | kPa | see later |
| Coolant exit temperature (maximum) | °C | dependent on ambient |
| Coolant inlet temperature (minimum) | °C | 10 |
| Coolant inlet temperature (maximum) | °C | refer to derate charts |

Secondary water coolant pump

| | |
|-----------------------|---------------|
| Speed | 1.4 x e rpm |
| Method of drive | Engine driven |

Fan (Temperate and Tropical)

| | |
|------------------------|----------------------------|
| Type | Temperate/Tropical Cooling |
| Diameter | 1905 mm |
| Number of blades | 13 |
| Material | Aluminium |
| Drive ratio | 0:6 |
| Pusher/Puller | Pusher |

Jacket water system

| | |
|--|-----------------|
| Maximum pressure in engine cooling circuit | 170 kPa |
| Maximum top tank temperature | 98°C |
| Maximum static pressure head on pump | 70 kPa |
| Maximum permissible restriction to coolant pump flow | 30 kPa |
| Thermostat operating range | 71 - 85°C |
| Coolant flow (minimum) | 1260 litres/min |
| Maximum temperature rise across the engine | 9°C |
| Shutdown switch setting | 101°C (rising) |
| Coolant immersion heater capacity (2 off) | 4 kWe (each) |

Charge cooling or secondary circuit (Temperate)

| | |
|---|----------------|
| Maximum pressure in secondary cooling circuit | 100 kPa |
| Maximum return temperature | 65°C |
| Maximum static pressure head on pump | 7 kPa |
| Maximum permissible restriction to coolant pump flow | 48 kPa |
| Coolant flow (minimum) | 720 litres/min |
| Maximum temperature rise across the charged cooling circuit | 17°C |

Charge cooling or secondary circuit (Tropical)

| | |
|---|----------------|
| Maximum pressure in secondary cooling circuit | 100 kPa |
| Maximum return temperature | 66°C |
| Maximum static pressure head on pump | 7 kPa |
| Maximum permissible restriction to coolant pump flow | 60 kPa |
| Coolant flow (minimum) | 720 litres/min |
| Maximum temperature rise across the charged cooling circuit | 16°C |

| Duct Allowance - Temperate cooling (Maximum additional restriction to cooling airflow and resultant minimum airflow) | | | | | |
|--|------|----------|----|-----|---------------------|
| Description | rpm | Standard | °C | Pa | m ³ /min |
| Ambient clearance: Inhibited coolant | 1500 | Low BSFC | 43 | | |
| Duct allowance | 1500 | Low BSFC | | 250 | |
| Minimum airflow | 1500 | Low BSFC | | | 2630 |

| Duct Allowance - Tropical cooling (Maximum additional restriction to cooling airflow and resultant minimum airflow) | | | | | |
|---|------|----------|----|-----|---------------------|
| Description | rpm | Standard | °C | Pa | m ³ /min |
| Ambient clearance: Inhibited coolant | 1500 | Low BSFC | 50 | | |
| Duct allowance | 1500 | Low BSFC | | 125 | |
| Minimum airflow | 1500 | Low BSFC | | | 3320 |

Lubrication system

Total system capacity

Maximum sump capacity 213 litres
Minimum sump capacity 157 litres
Oil temperature at normal operating conditions... 95°C
Oil temperature (in rail) - Maximum continuous operations 105°C

Lubricating oil pressure

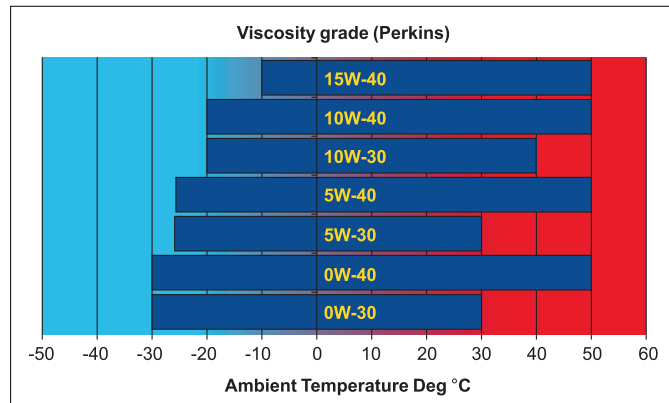
At rated speed 400 kPa
Minimum @ 80°C 340 kPa
Oil filter screen spacing 40 microns
Sump drain plug tapping size G1
Oil Pump speed and method of drive 1.4 x e rpm, engine driven
Shutdown switch - pressure setting..... 193 kPa (falling)

Oil consumption

| Prime power | Units | 1500 rpm |
|--|------------|----------|
| After running in (typically after 250 hours) | g/kWhr | 0.52 |
| Oil flow rate from pump | litres/sec | 6.7 |

Recommended SAE viscosity

Multigrade oil conforming to the following must be used API CG 15W/40.



Note: For additional notes on lubricating oil specifications, refer to the OMM manual

Induction system

Maximum air intake restriction of engine

Clean filter. 1.24 kPa
Dirty filter..... 3.71 kPa
Air filter type..... Medium duty axial flow

Fuel system

Recommended fuel to conform to: BS2869 Class A2 or BS EN590
Injection system..... Direct
Fuel injection pump and injector type..... Unit injector
Nozzle opening pressure 23 MPa
Lift pump type Tuthill TCH 5
Fuel delivery 1380 litres/hour
Heat retained in fuel to tank. 14 kW
Fuel inlet temperature to be less than 58°C
Maximum suction head at pump inlet 2.5 metres
Maximum static pressure head see manual
Fuel filter spacing 10 microns
Governor type..... electronic
Governing to ISO 8528-5 2004
Torque at the governor output shaft..... 1.631 kgm
Tolerance on fuel consumption ± 5%

Fuel consumption

| 4016-41TRG3, Temperate and Tropical | | |
|-------------------------------------|-------|-----------|
| Rating | g/kWh | litres/hr |
| Standby | 209 | 529 |
| Prime | 205 | 470 |
| Baseload | 200 | 371 |
| 75% prime | 200 | 344 |
| 50% prime | 204 | 234 |
| 25% prime | 220 | 126 |

Note: All based on assumed density of 0.862

Note: All figures in the tables above are based on gross mechanical output, for fuel consumption based on electrical output of the generating set contact your OEM

Exhaust system

Exhaust outlet size (internal). 2 x 254 mm
Exhaust outlet flange size 10 inch table D
Back pressure for total system 4 kPa

Electrical system

Alternator type..... Insulated return
Alternator voltage..... 24 volts
Alternator output 55 amps
Starter motor type 2 x 24 Volt Electric
Starter motor power 16.4 kW
Number of teeth on flywheel 156
Number of teeth on starter pinion..... 12
Minimum cranking speed (0°C) 120 rpm
Starter solenoid pull-in current @ -25°C maximum 30 amps
Starter solenoid hold-in current @ -25°C maximum 9 amps
Engine stop solenoid. 24 volts
Hold-in current of stop solenoid 1.1 amps

Engine mounting

Maximum static bending moment at rear face of block. 1356 Nm

Centre of gravity

ElectropaK, wet

Refer to the GA drawing for Temperate and Tropical cooling groups

Cold start recommendations

Temperature range down to -10°C (14°F)

Oil..... API CG 15W/40
Starter 2 x 24V
Battery..... 4 x 12 volts x 286 Ah
Maximum breakaway current. 2000 amps
Cranking current 957 amps
Aids..... Block heaters
Minimum mean cranking speed. 120 rpm

Note: Battery capacity is defined by the 20 hour rate

Note: The oil specification should be for the minimum ambient temperature as the oil will not be warmed by the immersion heater

Note: Breakaway current is dependant on battery capacity available. Cables should be capable of handling transient current which may be up to double the steady cranking current.

Noise data

Noise levels

The figures for total noise levels are typical for an engine running at Prime Power rating in a semi-reverberant environment and measured at a distance of one metre from the periphery of the engine.

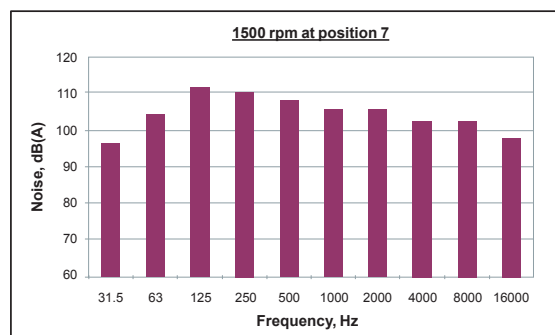
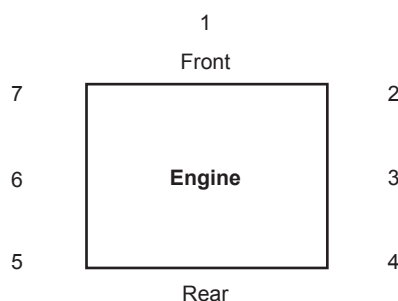
Octave analysis

The following histograms show an octave band analysis at the position of the maximum noise level.

Total noise levels

Sound pressure level -20×10^{-6} pa
Speed 1500 rpm Ambient noise level 75 dB(A)

| Position | Noise, dB(A) |
|----------|--------------|
| 1 | 107 |
| 2 | 111 |
| 3 | 111 |
| 4 | 111 |
| 5 | 111 |
| 6 | 111 |
| 7 | 112 |



Load acceptance (cold)

| Initial load acceptance when engine reaches rated speed (15 seconds maximum after engine starts to crank) | | | | 2nd load application immediately after engine has recovered to rated speed (5 seconds after initial load application) | | | |
|--|-----------------------|---------------------------------------|---------------------------------------|--|-----------------------|---------------------------------------|---------------------------------------|
| Prime power % | Load kWm nett/ kWe | Transient frequency deviation % | Frequency recovery time seconds | Prime power % | Load kWm nett/ kWe | Transient frequency deviation % | Frequency recovery time seconds |
| 52 | 975/936 | ≤ 10 | 5 | 48 | 900/864 | ≤ 10 | 5 |

The figure shown in the tables above were obtained under the following test conditions:

Engine block temperature (cold) 45°C
Ambient temperature 25°C
Governing mode Isochronous
Alternator inertia 55 kgm²
Under frequency roll off (UFRO) point set to 49.5 Hz
UFRO rate set to 16 v/Hz
LAM on/off on

All tests were conducted using an engine installed and serviced to Perkins Engine Company limited recommendations.

Applied load is a percentage of generator electrical output efficiency as published in the general installation section of this data sheet.

The information given on this Technical Data Sheet is for guidance only. For ratings other than those shown, please contact Perkins Engines Company Limited.