

# 4016-61TRG1

1269 - 1774 kWm (Gross) @ 1500 rpm

# 4000

## Series

## Electropak

### 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 <sup>A</sup> , 1 <sup>B</sup> , 3 <sup>A</sup> , 3 <sup>B</sup> , 7 <sup>A</sup> , 7 <sup>B</sup> , 5 <sup>A</sup> , 5 <sup>B</sup> , 8 <sup>A</sup> , 8 <sup>B</sup> , 6 <sup>A</sup> , 6 <sup>B</sup> , 2 <sup>A</sup> , 2 <sup>B</sup> , 4 <sup>A</sup> , 4 <sup>B</sup>
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 .....	5570 kg
Wet .....	5847 kg

#### Tropical

Dry .....	5570 kg
Wet .....	5847 kg

### Overall dimensions of Electropak

#### Temperate

Length .....	3302 mm
Width .....	1723 mm
Height .....	2128 mm

#### Tropical

Length .....	3302 mm
Width .....	1723 mm
Height .....	2128 mm

### Moments of inertia

Engine .....	10.89 kgm <sup>2</sup>
Flywheel .....	9.55 kgm <sup>2</sup>
Total engine inertia (engine + flywheel) .....	20.44 kgm <sup>2</sup>

### Cyclic irregularity, engine/flywheel standby power

1500 rpm .....	1:24
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### Ratings

Steady state speed stability at constant load ..... ± 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 .....	117 dB(A)
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**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 derate must be applied.

**Note:** Derate 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

### 4016-61TRG1

Designation	Units	Type of operation and application		
		Baseload power	Prime power	Standby power
		50 Hz @ 1500 rpm		
Gross engine power	kWb	1269	1648	1774
Fan power	kWm	90		
ElectropaK nett engine power	kWm	1179	1558	1684
Gross BMEP	kPa	1661	2157	2322
Combustion air flow	m <sup>3</sup> /min	122	155	165
Exhaust gas temperature after turbo (maximum)	°C	375	400	425
Exhaust gas flow (maximum) at atmospheric pressure	m <sup>3</sup> /min	400		
Boost pressure ratio	-	3.62		
Mechanical efficiency	%	94		
Overall thermal efficiency (nett)	%	40.3	40.7	40.2
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	1120	1480	1600
	kVA	1400	1850	2000
Assumed alternator efficiency	%	95		

**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

Designation	Units	1500 rpm		
		Baseload power	Prime power	Standby power
Energy in fuel	kWt	2926	3824	4190
Energy in power output (gross)	kWb	1269	1648	1774
Energy to cooling fan	kWm	90		
Energy in power output (nett)	kWm	1179	1558	1684
Energy to exhaust	kWt	990	1293	1419
Energy to coolant and oil	kWt	392	459	471
Energy to radiation	kWt	62	56	91
Energy to charge coolers	kWt	213	369	435

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

## Cooling system

### Coolant system - both circuits

Recommended coolant: 50% inhibited ethylene glycol or 50% inhibited propylene glycol and 50% clean fresh water.

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

Electronit (engine only) .....	95 litres
ElectropaK - Temperate cooling (engine and radiator) .....	210 litres
ElectropaK - Tropical cooling (engine and radiator) .....	215 litres

### Total coolant capacity: secondary water

ElectropaK - Temperate cooling (charge coolers, pipework and radiator) .....	150 litres
ElectropaK - Tropical cooling (charge coolers, pipework and radiator).....	170 litres

### Radiator: jacket water (temperate and tropical)

Radiator face area .....	4.7 m <sup>2</sup>
Number of rows and material .....	copper, 4 rows
Fins per inch and material.....	brass, 14 rows
Width of matrix.....	2180 mm
Height of matrix.....	2158 mm
Weight of radiator (dry) .....	kg
Pressure cap setting (minimum) .....	70 kPa

### Radiator: secondary water (temperate and tropical)

Radiator face area .....	4.7 m <sup>2</sup>
Number of rows and material .....	copper, 4 rows
Fins per inch and material.....	brass, 11 rows
Width of matrix.....	2180 mm
Height of matrix.....	2158 mm
Weight of radiator (dry) .....	kg
Pressure cap setting (minimum) .....	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 .....	1524 mm
Number of blades.....	8
Material .....	Aluminium
Drive ratio.....	0:84
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 .....	21 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)

### Chargecooling or secondary circuit (temperate)

Maximum pressure in secondary cooling circuit.....	100 kPa
Maximum return temperature.....	63°C
Maximum static pressure head on pump.....	70 kPa
Maximum permissible restriction to coolant pump flow .....	46 kPa
Coolant flow (minimum).....	720 litres/min
Maximum temperature rise across the chargecooling circuit .....	13°C

### Chargecooling or secondary circuit (tropical)

Maximum pressure in secondary cooling circuit.....	100 kPa
Maximum return temperature.....	70°C
Maximum static pressure head on pump.....	70 kPa
Maximum permissible restriction to coolant pump flow .....	46 kPa
Coolant flow (minimum).....	720 litres/min
Maximum temperature rise across the chargecooling circuit .....	13°C

Duct allowance - Temperate cooling (maximum additional restriction to cooling airflow and resultant minimum airflow)					
Description	rpm	Standard	°C	Pa	m <sup>3</sup> /min
Ambient clearance: Inhibited coolant	1500	Low BSFC	35		
Duct allowance	1500	Low BSFC		250	
Minimum airflow	1500	Low BSFC			2082

Duct allowance - Tropical cooling (maximum additional restriction to cooling airflow and resultant minimum airflow)					
Description	rpm	Standard	°C	Pa	m <sup>3</sup> /min
Ambient clearance: Inhibited coolant	1500	Low BSFC	50		
Duct allowance	1500	Low BSFC		125	
Minimum airflow	1500	Low BSFC			2160

## 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

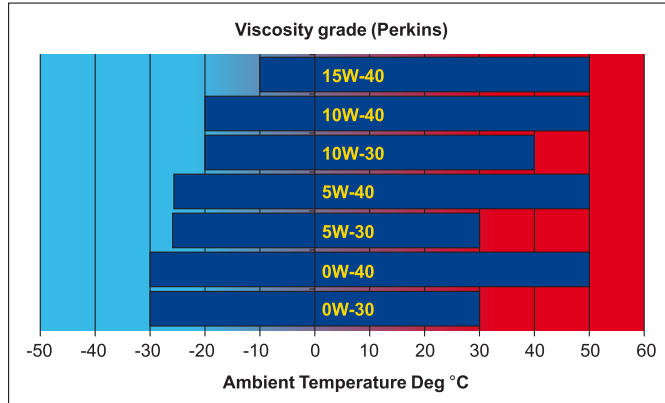
At rated speed	400 kPa
Minimum @ 80°C	340 kPa
Oil filter screen spacing	40 microns
Sump drain plug tapping size	G1
Oil pump speed and method of drive	1.4 x e rpm, engine driven
Shutdown switch - pressure setting	193 kPa (falling)

### 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

4016-41TRG1, temperate and tropical		
Rating	g/kWh	litres/hr
Standby	195	401
Prime	194	371
Baseload	192	283
75% Prime	192	280
50% Prime	192	193
25% Prime	186	103

**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 152.4 mm
Exhaust outlet flange size	10 inch table D
Back pressure for total system	3.91 - 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
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## 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 24 volts
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.

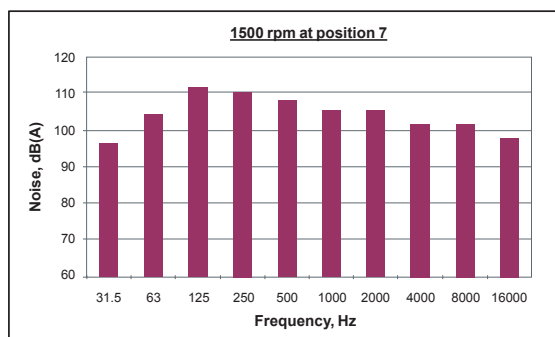
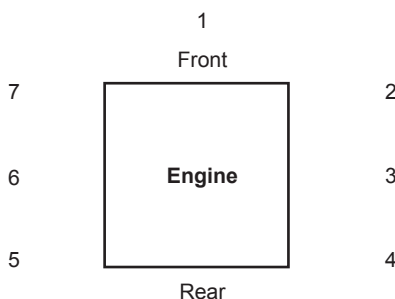
### Octave analysis

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

#### Total noise levels

Sound pressure level ..... -20 x 10<sup>-6</sup> pa  
 Speed 1500 rpm ..... Ambient noise level 79 dB(A)

Position	Noise, dB(A)
1	107
2	110
3	110
4	109
5	109
6	109
7	110



### Load acceptance (cold)

Initial load acceptance when engine reaches rated speed (15 seconds maximum after engine starts to crank)				Second 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
63	985/936	≤ 10	5	37	573/544	≤ 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 kgm<sup>2</sup>  
 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 Engines 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.