

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
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Cyclic irregularity, engine/flywheel Prime power

1500 rpm	1.204
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Ratings

Steady state speed stability at constant load

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)
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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 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	m ³ /min	135	160	175
Exhaust gas temperature after turbo (maximum)	°C	460	475	560
Exhaust gas flow (maximum) at atmospheric pressure	m ³ /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 Tropical 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

Electronit (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 m²
 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 m²
 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

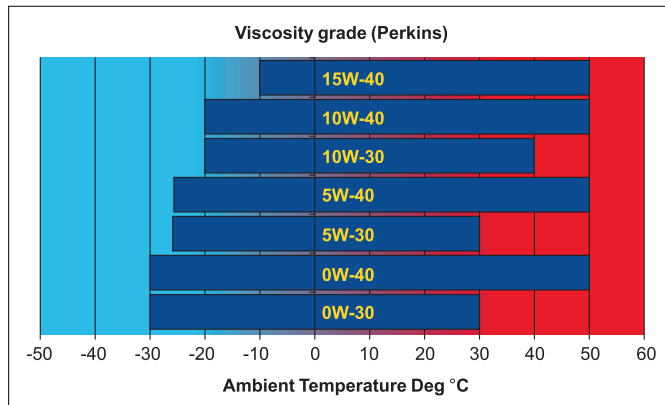
At rated speed	400 kPa
Minimum @ 80°C	340 kPa
Oil filter screen spacing	40 microns
Sump drain plug tapping size	G1
Oil Pump speed and method of drive	1.4 x e rpm, engine driven
Shutdown switch - pressure setting	193 kPa (falling)

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
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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 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.

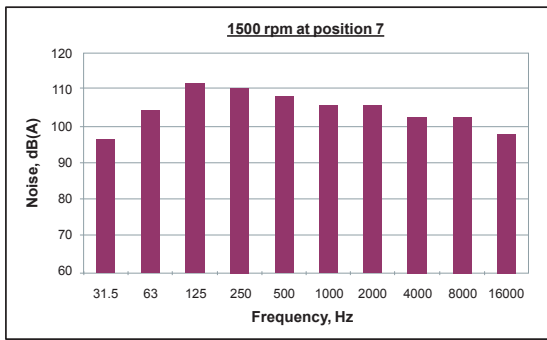
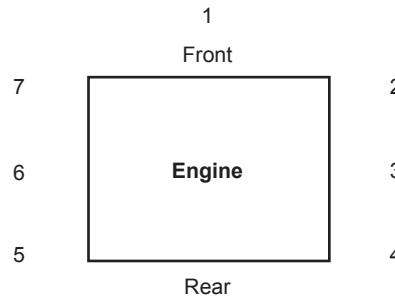
Octave analysis

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.