Technical Data

4000 Series

4016TAG1A
4016TAG2A

Diesel Engine - Electrounit

Basic technical data

Number of cylinders 16
Cylinder arrangement ... ... 60° Vee
Cycle . ...4 stroke, compression ignition
Induction system ... ...Turbocharged
Compression ratio . ...13,6:1 nominal
Bore... ... ... 160 mm
Stroke ... ... 190 mm
Cubic capacity... ... ...61,123 litres
Direction of rotation... ... ... Anti-clockwise 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
Cylinders designated 'A' are on the left side of the engine when viewed from the front (opposite end to flywheel)
Total weight Electrounit (engine only)... ... ... (dry) 5570 kg
.. .. (wet) 5847 kg
Overall dimensions ... ...Height 2128 mm
.. ..Length 3302 mm
.. .. Width 1723 mm
Moment of inertia .. ..Engine 11,15 kgm^2
.. ..Flywheel 9,57 kgm^2
Cyclic irregularity for engine/flywheel (Prime power):
4016TAG1A ... 1500 rev/min 1,300
4016TAG2A ... 1500 rev/min 1,277

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 rev/min
Static injection timing.. ... ... see engine number plate
Cooling water exit temperature .. ..<98 °C

Fuel data

To conform to BS2869 class A1, A2.

Performance

Estimated sound pressure level 1500 rev/min 106/112dBA
Note: All data based on operation to ISO 3046/1, BS 5514 and DIN 6271 standard reference conditions.

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 (nominal)... ... ... 3,0 kPa

General installation 4016TAG1A

Designation	Units	50Hz 1500 rev/min			60Hz 1800 rev/min		
		Continuous Baseload	Prime Power	Standby Maximum	Continuous Baseload	Prime Power	Standby Maximum
Gross engine power	kWb	1270	1588	1741	-	-	-
Fan power	kWm	51			-	-	-
Net engine power	kWm	1219	1537	1690	-	-	-
BMEP gross	bar	16,6	20,8	22,8	-	-	-
Combustion air flow	m^3/min	107	132	140	-	-	-
Exhaust gas temperature max (after turbo)	°C	400	439		-	-	-
Exhaust gas flow max (after turbo)	m^3/min	252	343		-	-	-
Boost pressure ratio max (after turbo)	-	3,0	3,30	3,50	-	-	-
Mechanical efficiency	%	88	91	92	-	-	-
Overall thermal efficiency	%	41	41	41	-	-	-
Friction power and pumping losses	kWm	160			-	-	-
Mean piston speed	m/s	9,5			-	-	-
Engine coolant flow (min)	l/s	19			-	-	-
Typical Genset Electrical Output 0,8 pf 25 °C (100 kPa)	kVA	1463	1844	2028	-	-	-
	kWe	1170	1476	1622	-	-	-
Assumed alternator efficiency	%	96			-	-	-

General installation 4016TAG2A

Designation	Units	50Hz 1500 rev/min			60Hz 1800 rev/min		
		Continuous Baseload	Prime Power	Standby Maximum	Continuous Baseload	Prime Power	Standby Maximum
Gross engine power	kWb	1413	1766	1937	-	-	-
Fan power	kWm	51			-	-	-
Net engine power	kWm	1362	1715	1886	-	-	-
BMEP gross	bar	18,5	23,1	25,4	-	-	-
Combustion air flow	m^3/min	117	137	145	-	-	-
Exhaust gas temperature max (after turbo)	°C	450	493		-	-	-
Exhaust gas flow (max)	m^3/min	275	387		-	-	
Boost pressure ratio	-	3,0	3,49	3,80	-	-	-
Mechanical efficiency	%	88	92	92	-	-	-
Overall electrical efficiency	%	41	40	40	-	-	-
Friction power and pumping losses	kWm	-	160		-	-	-
Mean piston speed	m/s	9,5			-	-	
Engine coolant flow (min)	l/s	19			-	-	
Typical Genset Electrical Output 0,8 pf 25 °C (100 kPa)	kVA	1634	2058	2263	-	-	-
	kWe	1307	1646	1811	-	-	-
Assumed alternator efficiency	%	96			-	-	-

Note: Not to be used for CHP design purposes. (Indicative figures only). Consult Perkins Engines Co. Ltd. Assumes complete combustion.

Prime Power rating is available for unlimited hours per year with a variable load of which the average engine load factor is 80% of the published prime power rating. **Standby Power rating** is for the supply of emergency power at variable load for the duration of the non-availability of the mains power supply. NO OVERLOAD capacity is available at this rating. Engines must not be allowed to have facilities for parallel operation with the mains supply. This rating should be applied only when reliable mains power is available. Should this not be the case then refer to Prime Power rating. A standby rated engine should be sized for an average load factor of 80% based on published standby rating for 500 operating hours per year. Standby ratings should never be applied except in true emergency power failure conditions.

On 16 cylinder engines used for baseload operation, the following items must be incorporated:
1. Auto lubricating oil pump (extra price, see options).
2. Centrifugal by-pass filter to be baseframe mounted (extra price, see options).
3. Electrically driven radiators on separate baseframe (customer supply).
4. Start/stop sequence as follows:

START - 4 minutes priming.
2 minutes start and no load 1500 rev/min.
Synchronise and ramp to full load over 3 minutes.

STOP - Ramp down to no load 1500 rev/min.
5 minutes no load and running.
Stop engine and run oil priming pump for 4 minutes.

Energy balance

Note: Not to be used for CHP design purposes. (Indicative figures only). Consult Perkins Engines Co Ltd. Assumes complete combustion.

4016TAG1A

	Units	1500 rev/min			1800 rev/min		
		Continuous Baseload	Prime Power	Standby Maximum	Continuous Baseload	Prime Power	Standby Maximum
Energy in fuel	kWt	3106	3846	4297	-	-	-
Energy in power output (gross)	kWb	1270	1588	1741	-	-	-
Energy to cooling fan	kWm	51	51	51	-	-	-
Energy in power output (net)	kWm	1219	1537	1690	-	-	-
Energy to exhaust	kWt	947	1079	1276	-	-	-
Energy to coolant and oil	kWt	480	586	629	-	-	-
Energy to radiation	kWt	58	103	107	-	-	-
Energy to charge coolers	kWt	363	490	544	-	-	-

4016TAG2A

	Units	1500 rev/min			1800 rev/min		
		Continuous Baseload	Prime Power	Standby Maximum	Continuous Baseload	Prime Power	Standby Maximum
Energy in fuel	kWt	3466	4361	4908	-	-	-
Energy in power output (gross)	kWb	1413	1766	1937	-	-	-
Energy to cooling fan	kWm	51	51	51	-	-	-
Energy in power output (net)	kWm	1362	1716	1886	-	-	-
Energy to exhaust	kWt	1048	1245	1490	-	-	-
Energy to coolant and oil	kWt	517	660	721	-	-	-
Energy to radiation	kWt	68	130	150	-	-	-
Energy to charge coolers	kWt	420	560	610	-	-	-

Cooling system

Recommended coolant: 50% inhibited ethylene glycol or 50% inhibited propylene glycol and 50% clean fresh water. For combined heat and power systems and where there is no likelihood of ambient temperatures below 10 °C then clean 'soft' water may be used, treated with 1% by volume of Perkins inhibitor in the cooling system. The inhibitor is available in bottles under Perkins Part No. 21825 735.

Maximum jacket water pressure in crankcase ... ... 1,7 bar

The following is a guide based on ambient air conditions of 52 °C on a Perkins supplied radiator.

Total coolant capacity:

Electrounit (engine only) ... ... 95 litres

ElectropaK (engine/radiator) .. ..316 litres

Pressure cap setting .. .. 0,69 bar

Fan . ... Incorporated in radiator

Diameter ... ...1905 mm (pusher)

Ambient cooling clearance (open ElectropaK Prime power) based on air temperature at fan 3 °C above ambient.

4016TAG1A

Maximum additional restriction (duct allowance) to cooling airflow (Prime power) and resultant minimum airflow					
Ambient clearance 50% glycol		**Duct allowance mm H_20**		**Min airflow m^3/min**	
rev/min		**rev/min**		**rev/min**	
1500	**1800**	**1500**	**1800**	**1500**	**1800**
52 °C	**-**	17	-	2394	-

4016TAG2A

Maximum additional restriction (duct allowance) to cooling airflow (Prime power) and resultant minimum airflow					
Ambient clearance 50% glycol		**Duct allowance mm H_20**		**Min airflow m^3/min**	
rev/min		**rev/min**		**rev/min**	
1500	**1800**	**1500**	**1800**	**1500**	**1800**
52 °C	**-**	15	-	2430	-

Coolant pump speed and
method of drive .. .. 1,4 x e rev/min gear driven

Maximum static pressure head on pump
above engine crank centre line .. .. 7 m

Maximum external permissible restriction
to coolant pump flow .. .. 20 kPa

Thermostat operating range... ... ...71-85 °C

Shutdown switch setting ... ... 101 °C rising

Coolant immersion heater capacity ... ... 4 kW x 2

Jacket cooling water data	Units	1500 rev/min	1800 rev/min
Coolant flow	l/s	19	-
Coolant exit temperature (max)	°C	98	-
Coolant entry temperature (min)	°C	70	-
Coolant entry temperature (max)	°C	80	-

Lubrication system

Recommended lubricating oil to conform with the specification of API CG4 15W/40.

Lubricating oil capacity:

Sump maximum .. .. 214 litres

Sump minimum ... ... 147 litres

Lubricating oil temperature maximum to bearings .. .. 105 °C

Lubricating oil pressure
at 80 °C temperature to bearing gallery (minimum) ... ... 0,34 MPa

Oil consumption	Units	1500 rev/min 4016TAG1A	1500 rev/min 4016TAG2A
After running-in*	g/kWhr	0,50	0,52
Oil flow rate from pump	l/s	6,70	6,70

*Typical after 250 hours

Sump drain plug tapping size G1

Oil pump speed and method of drive .. 1,4 x e rev/min, gear driven

Oil pump flow 1500 rev/min . ... .6,70 litres/sec

Shutdown switch setting .. .. 1,93 bar falling

Normal operating angles

Fore and aft . ... 5°

Side tilt ... ... 10°

Fuel system

Recommended fuel . ... To conform to BS2869 1998 Class A1, A2

Type of injection system .. .. Direct injection

Fuel injection pump . ... Combined unit injector

Fuel injector . ... Combined unit injector

Fuel injector opening pressure ... ...234 bar

Fuel lift pump ... ... Tuthill TCH 5

Delivery/hour at 1500 rev/min . ... 1380 litres

Delivery/hour at 1800 rev/min . ... N/A

Heat retained in fuel to tank ... ...12,0 kW

Temperature of fuel at lift pump to be less than .. .. 58 °C

Fuel lift pump pressure ... ... 3,0 bar

Fuel lift pump maximum suction head . ...2,5 m

Fuel lift pump maximum pressure head (see Installation Manual)

Fuel filter spacing ... ... 10 microns

Governor type .. .. Electronic

Torque at the governor output shaft ... ... 1,631 kgm

Static injection timing .. ..See engine number plate

Tolerance on fuel consumption ... ... To ISO 8528-1 1993

4016TAG1A

Fuel consumption (gross)				
Designation	**g/kWh**		**Litres/hr**	
rev/min	**1500**	**1800**	**1500**	**1800**
At Standby Max power rating	207	-	424	-
At Prime Power rating	205	-	383	-
At Continuous Baseload rating	199	-	297	-
At 75% of Prime Power rating	198	-	277	-
At 50% of Prime Power rating	198	-	185	-
At 25% of Prime Power rating	218	-	102	-

4016TAG2A

Fuel consumption (gross)				
Designation	**g/kWh**		**Litres/hr**	
rev/min	**1500**	**1800**	**1500**	**1800**
At Standby Max power rating	212	-	483	-
At Prime Power rating	209	-	434	-
At Continuous Baseload rating	205	-	341	-
At 75% of Prime Power rating	203	-	316	-
At 50% of Prime Power rating	202	-	210	-
At 25% of Prime Power rating	212	-	110	-

Induction system

Maximum air intake restriction of engine:
Clean filter . ... 127 mm H_20
Dirty filter ... ... 380 mm H_20
Air filter type .. .. MF&T 5000-00-00

Exhaust system

Maximum back pressure for total system.

Designation	Units	1500 rev/min	1800 rev/min
4016TAG1A	mm H_20	949	-
4016TAG2A	mm H_20	673	-

Exhaust outlet flange size . ... 2 x 254 mm (table 'D')
For recommended pipe sizes, refer to the Installation Manual.

Electrical system

Type .. .. Insulated return
Alternator ... ... 24 volts with integral regulator
Alternator output ... ... 40 amps at a stabilised output 28 volts at 20 °C ambient
Starter motor . ... 24 volts
Starter motor power .. .. 16,4 kW
Number of teeth on flywheel 156
Number of teeth on starter motor 12
Minimum cranking speed at (0 °C) ... ... 120 rev/min
Pull-in current of each starter motor solenoid
.. .. 30 amps at 24 volts
Hold-in current of each starter motor solenoid each
.. .. 9 amps at 24 volts
Engine stop solenoid . ... 24 volts
Pull-in current of stop solenoid .. .. 60 amps at 24 volts
Hold-in current of stop solenoid ... ... 1,1 amps at 24 volts

Engine mounting

Position of centre of gravity (wet engine) forward from rear face of crankcase . ... 1117 mm
Engine vertical centre line above crankshaft centre line ... .. 50 mm
Maximum additional load applied to flywheel due to all rotating components ... ... 850 kg

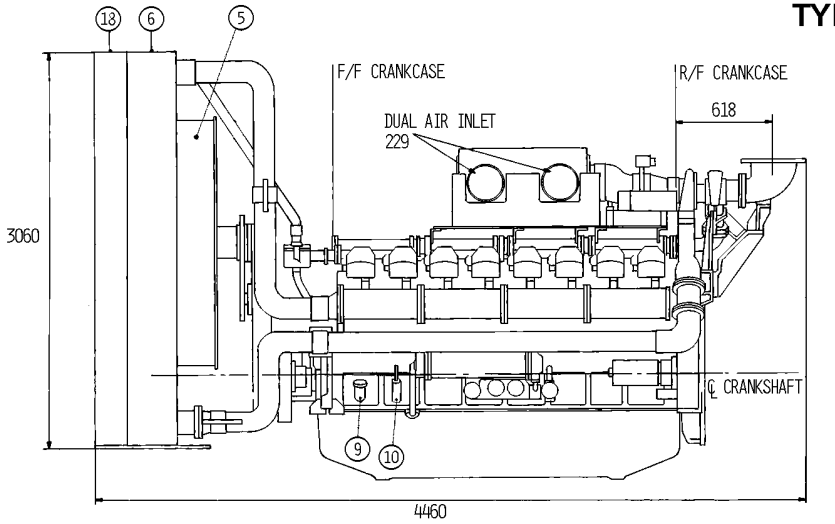
Starting requirements

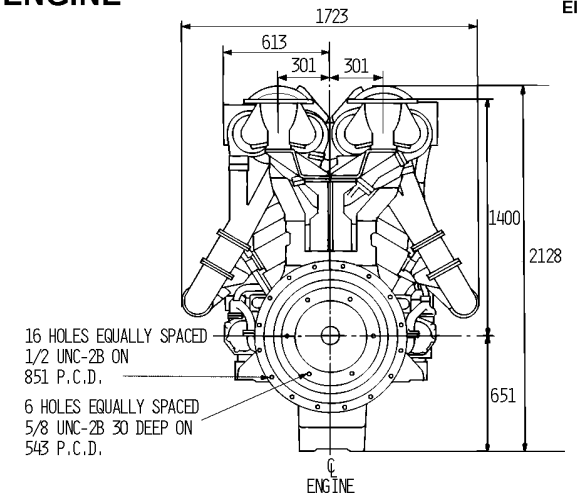
Temperature range		
Range Down to 0 °C (32 °F)	Oil:	API CG4 15W/40
	Starter:	2 x 24V
	Battery:	4 x 12 volts x 286 Ah
	Max breakaway current:	2000 amps
	Cranking current:	957 amps
	Aids:	Not necessary
	Starter cable size:	120 mm^2
	Maximum length:	6 m

Notes:

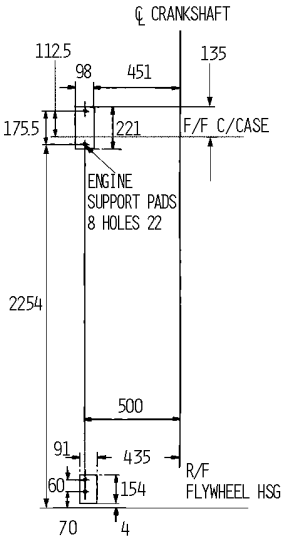
- Battery capacity is defined by the 20 hour rate at 0 °C.
- The oil specification should be for the minimum ambient temperature as the oil will not be warmed by the immersion heater.
- Breakaway current is dependent on battery capacity available. Cables should be capable of handling the transient current which may be up to double the steady cranking current.

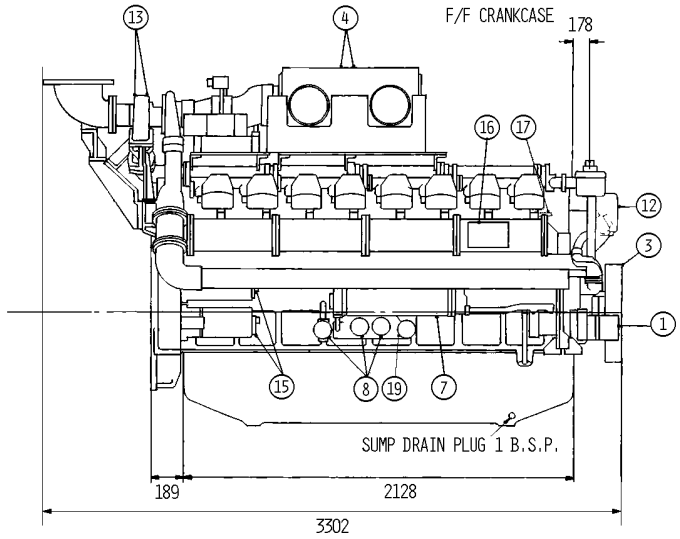
TYPICAL ENGINE

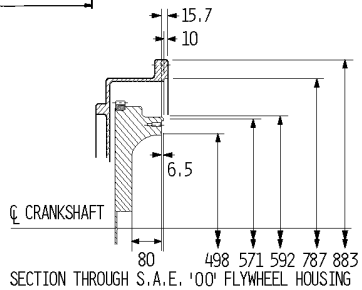




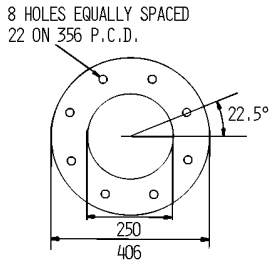
Electrounit Support and Pad Dimensions



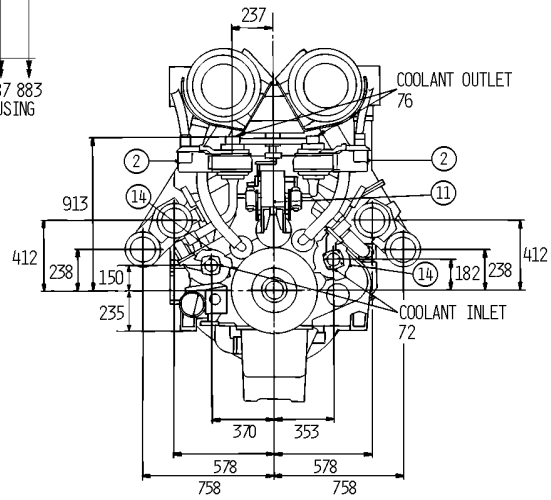




SECTION THROUGH S.A.E. '00' FLYWHEEL HOUSING
& S.A.E. 518 FLYWHEEL



EXHAUST FLANGE 10" TABLE 'D'



ITEM	
1	ALTERNATOR
2	BREATHER
3	DAMPERS
4	AIR CLEANERS
5	FAN
6	RADIATOR (COVRAD)
7	OIL COOLER
8	LUBRICATING OIL FILTERS
9	OIL FILLER
10	DIPSTICK
11	STOP SOLENOID
12	GOVERNOR ACTUATOR
13	TURBOCHARGERS
14	COOLANT PUMP
15	24V STARTER
16	GOVERNOR CONTROL BOX
17	FUEL LEAK OFF
18	CHARGE COOLER
19	FUEL FILTER

DIM 021

THIS DRAWING SHOWS APPROX DIMENSIONS ONLY. FOR INSTALLATION DETAILS,
G.A. DRAWINGS MUST BE OBTAINED FROM PERKINS ENGINES COMPANY STAFFORD LTD
A 52°C AIR AMBIENT RADIATOR CAN BE SUPPLIED AS AN OPTION.

4016TAG1A/4016TAG2A DIESEL ENGINES

Load acceptance (cold)

4016TAG1A
1500 rev/min

Initial load application when engine reaches rated speed (15 seconds max 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/kWe	Transient frequency deviation %	Frequency recovery time seconds	Prime power %	Load kWm/kWe	Transient frequency deviation %	Frequency recovery time seconds
67	1031/990	≤ -10	5	33	506/486	≤ -10	5

4016TAG2A
1500 rev/min

Initial load application when engine reaches rated speed (15 seconds max 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/kWe	Transient frequency deviation %	Frequency recovery time seconds	Prime power %	Load kWm/kWe	Transient frequency deviation %	Frequency recovery time seconds
57	977/938	≤ -10	5	43	738/708	≤ -10	5

Above complies with requirements of Classifications 3 & 4 of ISO 8528-12 and G2 operating limits stated in ISO 8528-5.
The above figures were obtained under test conditions as follows:
Engine block temperature . ... 45 °C
Alternator efficiency... ... ... 96%
Minimum ambient temperature . ... 10 °C
Isochronous Governing
Under Frequency Roll Off (UFRO) set to 1 Hz below rated frequency
Typical alternator inertia ... ... 50 Kgm^2

All tests were conducted using an engine which was installed and serviced to Perkins Engines Company Limited recommendations.

Noise level

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 level

Sound pressure level re: -20 x 10^{-6} pa
Speed 1500 r/min.....Ambient noise level 75 dBA.
Octave analysis performed at the position of maximum noise.

POSITION 1
TAG1A - 106 dBA
TAG2A - 107 dBA

POSITION 7
TAG1A - 111 dBA
TAG2A - 112 dBA

POSITION 2
TAG1A - 112 dBA
TAG2A - 111 dBA

F

POSITION 6
TAG1A - 111 dBA
TAG2A - 111 dBA

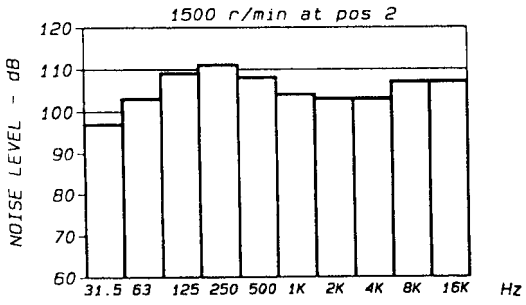
POSITION 3
TAG1A - 111 dBA
TAG2A - 111 dBA

POSITION 5
TAG1A - 111 dBA
TAG2A - 111 dBA

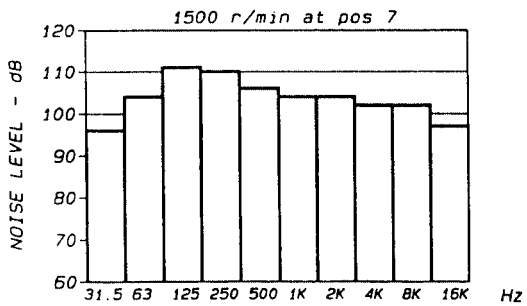
POSITION 4
TAG1A - 110 dBA
TAG2A - 111 dBA

R

4016TAG1A



4016TAG2A



The information given on technical data sheets are for standard ratings only. For ratings other than shown contact Perkins Engines Company Limited, Stafford.

Notes

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