
Perkins 4000 Series 4016-E61TRS

16 cylinder, turbocharged,
gas engines

WORKSHOP MANUAL

Publication TSL4235, Issue 1.

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The information is correct at the time of print.

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General information

Introduction

The 4016-E61TRS Series engine is a 16 cylinder turbocharged gas engine designed by Perkins Engines Company Limited, a world leader in the design and manufacture of high-performance gas engines.

Perkins approved assembly and quality standards, together with the latest technology, have been applied to the manufacture of the engine to give reliable and economic power.

The general information included in the User's Handbook Publication TSL4230 (Sections 1 to 9) has not been repeated in this Workshop Manual, the two publications should be used together as specific references to the User's Handbook are made for certain operations.

For information and maintenance procedures on the engines electronic management system refer to the EMS Diagnostic Manual Publication TSL4233.

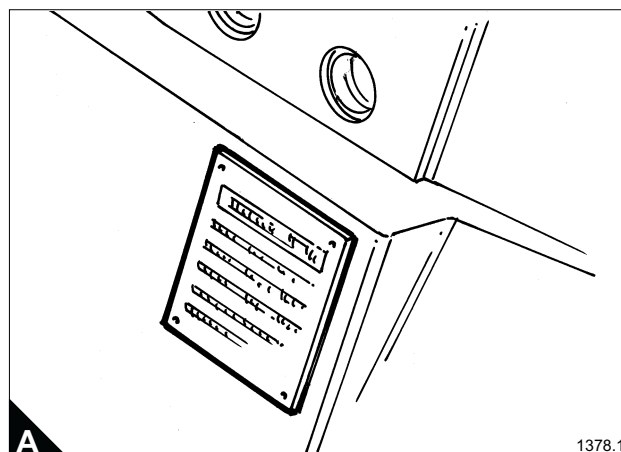
The manuals enable the operator to carry out routine servicing of the engine. Before undertaking any service work the appropriate section should be read in full and completely understood.

Users are respectfully advised that, in the interests of safety, it is their responsibility to employ competent persons to operate, maintain and service the engine.

Special tools are required to perform certain overhaul operations and a list is given on page 113, Section 23.

Reference to the relevant special tools is also made at the beginning of each operation. Operators who are not equipped to undertake major repairs are urged to consult their Perkins distributor.

Torque settings on page 29 and Wear and renewal limits on page 30, Section 11 for specific components are also provided. Reference should be made to these where indicated in the manual.



In addition to the general safety precautions, danger to both operator and engine are highlighted in the engine manuals with the caption.

Warning! This indicates that there is a possible danger to the person (or the person and engine).

Caution: This indicates that there is a possible danger to the engine.

Note: Is used where the information is important, but there is not a danger.

The information contained in this manual is based on that available at time of going to print. In line with Perkins Engines Company Limited policy of continual development and improvement that information may change at any time without notice. The engine user should ensure that he has the latest information before starting work.

The engine type and serial number must be given when requesting information from Perkins Engines Company Limited or a Perkins Distributor.

Note: The plate carrying the engine type and serial number is fixed to the crankcase above the flywheel housing on cylinder no. 8 'A' Bank (A).

Engine description

4016-E61TRS Engine specification

16 Cylinder, 60° 'V' form, 4-stroke gas engine, water cooled, displacing 61.1 litres.

Dry exhaust manifolds with single turbocharger, and a water-cooled two-stage charge air cooler with separate water cooling circuits.

Electronic management system of ignition timing and knock-detection, closed-loop control of lean burn combustion with NO_x emissions maintained to 250mg/Nm³, 500mg/Nm³ or other setting as desired.

Safety precautions

General

For safe and reliable operation of the engine it is essential that these safety precautions, and those Warnings and Cautions given throughout the handbook, are observed, and where necessary the special tools indicated are used.

All safety precautions should be read and understood before operating or servicing the engine.

Improper operation or maintenance procedures are dangerous and could result in accidents, injury or death.

The operator should check before beginning an operation that all the basic safety precautions have been carried out to avoid accidents occurring.

You must also refer to the local regulations in the country of use. Some items only apply to specific applications.

Ensure that guards are fitted

- over exposed rotating parts.
- over exposed hot surfaces.
- over exposed air intakes.
- over exposed belts.
- over live electrical terminals (high and low tension).

Ensure that appropriate protection equipment is worn at all times

- always wear protective gloves when:
 - using inhibitors.
 - using anti-freeze.
 - removing the pressure cap from the cooling system.
 - when changing the lubricating oil/filter.
 - when changing the electrolyte in the battery.
- always wear ear protection when working in an enclosed engine room.
- always wear goggles when using an air pressure line.
- always wear protective boots when working on the engine.
- always wear protective headgear when working on or underneath the engine.

Ensure that no smoking or naked flames are lit

- when checking battery electrolyte.
- when working in the engine room.
- when operating or servicing the engine.

Oil pipes

- ensure that all pipes are regularly checked for leaks.
- always apply suitable barrier cream to hands before any work is carried out.

Gas/air pipes

- always check for gas/air mixture leaks.

Electrical equipment

- always check that electrical equipment is earthed to local safety standards.
- always disconnect the electrical supply to the jacket water heater (if fitted) before working on the engine.
- take care to avoid any risk of electric shock.
- never re-adjust the settings of electronic equipment without reference to the appropriate Manual.

Freezing or heating components

always use protective gloves and use the correct handling equipment.

10

Exhaust system

- check the system for leaks.
- ensure that the engine room is correctly ventilated.
- check that all the guards are fitted.
- check that the pipework allows the exhaust gas to escape upwards.
- check that the pipework is supported.

Stopping the engine

- Ensure that the engine is stopped before performing any of the following operations:
 - changing the lubricating oil.
 - filling or topping up cooling system.
 - beginning any repair work on the engine.
 - adjusting belts (where fitted).
 - adjusting bridge pieces / valve clearance.
 - changing spark plugs.
 - changing air, or oil filters.
 - tightening any fixing bolts.

Flammable fluids

- ensure that these are never stored near the engine.
- ensure that they are never used near a naked light.

Clothing

- do not wear loose clothing, ties, jewellery, etc.
- always wear steel toe cap shoes/boots.
- always wear appropriate head, eye and ear protection.
- always wear suitable overalls.
- always replace a spillage contaminated overall immediately.

Lifting heavy components

- always use the correct lifting equipment.
- never work alone.
- always wear a helmet, if the weight is above head height.

De-scaling solution

- always wear both hand and eye protection when handling.
- always wear overalls and appropriate footwear.

Waste disposal

- do not leave oil covered cloths on or near the engine.
- do not leave loose items on or near the engine.
- always provide a fireproof container for oil contaminated cloths.

Note: Most accidents are caused by failure to observe basic safety precautions and can be avoided by recognising potentially dangerous situations before an accident occurs. Whilst there are many potential hazards that can occur during the operation of the engine which cannot be always be anticipated, and thus a warning cannot be included to cover every possible circumstance that might involve a potential hazard, by following these basic principles the risk can be minimised.

Dangers from used engine oils

Prolonged and repeated contact with mineral oil will result in the removal of natural oils from the skin, leading to dryness, irritation and dermatitis. The oil also contains potentially harmful contaminants which may result in skin cancer.

Adequate means of skin protection and washing facilities should be readily available.

The following is a list of 'Health Protection Precautions', suggested to minimise the risk of contamination.

- 1 Avoid prolonged and repeated contact with used engine oils.
- 2 Wear protective clothing, including impervious gloves where applicable.
- 3 Do not put oily rags into pockets.
- 4 Avoid contaminating clothes, particularly underwear, with oil.
- 5 Overalls must be cleaned regularly. Discard unwashable clothing and oil impregnated footwear.
- 6 First aid treatment should be obtained immediately for open cuts and wounds.
- 7 Apply barrier creams before each period of work to aid the removal of mineral oil from the skin.
- 8 Wash with soap and hot water, or alternatively use a skin cleanser and a nail brush, to ensure that all oil is removed from the skin. Preparations containing lanolin will help replace the natural skin oils which have been removed.
- 9 Do NOT use petrol, kerosene, diesel fuel, thinners or solvents for washing the skin.
- 10 If skin disorder appears, medical advice must be taken.
- 11 Degrease components before handling if practicable.
- 12 Where there is the possibility of a risk to the eyes, goggles or a face shield should be worn. An eye wash facility should be readily available.

Environmental protection

There is legislation to protect the environment from the incorrect disposal of used lubricating oil. To ensure that the environment is protected, consult your Local Authority who can give advice.

Danger from 'fluorosilicone' (trade name Viton) 'O' ring seals

All of the engines 'O' ring seals are made from fluorosilicone material

It is a safe material under normal conditions of operation, but if it is burned the extremely dangerous hydrofluoric acid is produced.

If it is necessary to come into contact with the components which have been burnt, follow the precautions below:

- Allow the components to cool.
- Use Neoprene gloves and a face mask.
- Wash the contaminated area with a calcium hydroxide solution and then with clean water.
- Disposal of gloves and components which are contaminated, must be in accordance with local regulations.

If there is contamination of the skin or eyes, wash the affected area with a continuous supply of clean water.

Obtain immediate medical attention.

Practical information for cleaning components

Use suitable gloves for protection when components are degreased.

It is important that the work area is kept clean and that the components are protected from dirt and debris. Ensure that dirt does not contaminate the fuel system.

Before a component is removed from the engine, clean around the component and ensure that all openings, disconnected hoses and pipes are sealed.

Remove, clean and inspect each component carefully. If it useable, put it in a clean dry place until needed. Ball and roller bearings must be cleaned thoroughly and inspected. If the bearings are usable, they must be flushed in low viscosity oil and protected with clean paper until needed.

Before the components are assembled, ensure that the area is free from dust and dirt as possible. Inspect each component immediately before it is fitted, wash all pipes and ports, and pass dry compressed air through them before connections are made.

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Lubricating oil recommendations

Only one oil is recommended for the 4016-E61TRS engine, that is MOBIL PEGASUS 805.

Quantity of oil

Sump capacity on the dipstick

- Maximum257 litres
- Minimum 147 litres
- Total system286 litres

Oil change period

For normal operation change the oil after the first 500 hours, then sample the oil every 250 hours to establish a contamination trend. This should give an oil change period of 2,000 hours.

Oil samples should be taken from the mean level in the engine sump never from the sump drain plug. Should there be a lubricating oil supply problem or a high sulphur content in the gas, Perkins Engines Company Ltd should be contacted.

Oil contamination to be regarded as critical parameters

Viscosity at 100°C	16.5 cSt maximum
Insolubles	1.5 maximum
Total Acid Number (TAN)	less than 4 times the TAN value for new oil.
Total Base Number (TBN)	50% less than new oil value.
Total Base Number (TBN) and Total Acid Number (TAN) must not cross over.	
Nitration	25 maximum
Oxidation	25 maximum
Water	0.2% maximum
Iron	Less than 20 ppm*
Copper	Less than 40 ppm*

Coolant specification

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 temperature below 10°, 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. OE 45350 (1 litre).

Maintenance of coolant

Warning! *Always stop the engine and allow the pressurised system to cool before removing the filler cap. Avoid skin contact with the coolant mixture.*

The coolant mixture should be changed at 8,000 hours or 12 months and checked at 2,000 hour intervals for the correct alkalinity level, the pH should not be above 7.5.

Note: A hydrometer only shows the proportion of ethylene glycol. This is not a measure of protection against corrosion.

Warning! *Failure to follow the above recommendations may result in engine damage and will invalidate the engine warranty.*

10

Gas specification

A new engine will be set to operate on clean natural gas conforming to the British natural gas specifications having a lower calorific value of 34.71 MJ/Sm³ (930 BTU/Sft³).

The difference between high calorific value (HCV) and low calorific (LCV) is that (HCV) is the total amount of heat given off by the gas during combustion and the (LCV) is the high calorific value less the amount of heat used to vaporize the water content of the gas. Since the amount of heat lost in vaporizing the water is different for different gases, the lower calorific value of the gas is chosen as the basis for fuel consumption data. There must be no liquid hydrocarbon fractions in the gas.

Limiting values for British Gas	
Methane number must exceed	75
Combustible constituents must exceed	95%
Calorific value (LCV) to exceed	34 MJ/Nm ³ (912 BTU/Sft ³)
Ethane	4.5%
Hydrogen content not to exceed	0.1%
Propane must not exceed	1.0%
Isobutane content not to exceed	0.2%
Normal butane not to exceed	0.2%
Normal pentane and higher fractions (hexane, heptane, etc). The summation must not exceed:	0.02%
Gas pressure at inlet to regulators	15 mbar (1.5 kPa)
Gas pressure not to exceed without additional pressure regulators	50 mbar (5 kPa)
Hydrogen sulphide not to exceed	0.01% or 100 ppm

Note: The rating may be reduced if lower calorific value of the fuel is lower than 34.71 MJ/Nm³ (930 BTU/Sft³). Also pressure must be constant to maintain emissions and stability. If any of the above parameters are not met, Perkins Engines Company Ltd should be consulted for advice.

Gas safety regulations

There are legal requirements that within the U.K. gas fittings and equipment must be installed only by competent persons and in accordance with the Institution of Gas Engineers Procedures IGE UP2. Outside the U.K. anyone undertaking work on the engine or associated with the engine and its gas equipment in particular should check with local and national regulations to ensure compliance.

Preventive maintenance

Maintenance checks

The maintenance procedures are suitable for an engine working under average conditions. If your engine is working under particularly dirty or dusty conditions, more frequent servicing will be necessary particularly in respect of the lubricating oil and air cleaners. Correct and regular maintenance will help prolong engine life.

Warning! *Make quite certain that the engine cannot be started before undertaking any maintenance.*

10

Maintenance procedures

Using Manuals

User's Handbook (Publication TSL4230).....	UH
Diagnostic Manual (Publication TSL4233).....	DM
Workshop Manual (Publication TSL4235)	WM

Also refer to Maintenance Schedule on page 22.

First 500 hour – A service

Description	Manual
Check EMS logged events and record	DM
Check EMS logged diagnostic codes, record and rectify	
Oil & filter change. Clean piston cooling jet oil strainer plug	UH
Equalise bridge pieces and set valve clearance	UH
Spark plugs clean and re-gap	UH

B service – 2,000, 6,000, 18,000 and 22,000 hours

Description	Manual
Check EMS logged events and record	DM
Check EMS logged diagnostic codes, record and rectify	
Oil & filter change. Recommend oil sampling required Clean piston cooling jet oil strainer plug	UH
Equalise bridge pieces and set valve clearance	UH
Spark plugs check, clean and re-gap	UH
Breather element – replace	UH
Air filter – replace (Subject to environmental conditions)	UH
Calibrate oxygen sensor, - Replace oxygen sensor	UH - DM

C service – 4,000 and 20,000 hours

Description	Manual
Check EMS logged events and record	DM
Check EMS logged diagnostic codes, record and rectify	
Oil & filter change. Recommend oil sampling required Clean piston cooling jet oil strainer plug	UH
Equalise bridge pieces and set valve clearance	UH
Spark plugs check, clean and re-gap	UH
Breather element – replace	UH
Air filter – replace (Subject to environmental conditions)	UH
Calibrate oxygen sensor, - Replace oxygen sensor	UH - DM
Check emissions. (Adjust if required)	DM

Using Manuals

User's Handbook (Publication TSL4230)	UH
Diagnostic Manual (Publication TSL4233)	DM
Workshop Manual (Publication TSL4235)	WM

Also refer to Maintenance Schedule on page 22.

D service – 8,000 and 24,000 hours

Description	Manual
Check EMS logged events and record	DM
Check EMS logged diagnostic codes, record and rectify	
Oil & filter change. Recommend oil sampling required Clean piston cooling jet oil strainer plug	UH
Equalise bridge pieces and set valve clearance	UH
Spark plugs check, clean and re-gap	UH
Breather element – replace	UH
Air filter – replace (Subject to environmental conditions)	UH
Cylinder head – Check valve recession using tool	UH
Charge cooler – Clean & regasket	WM
Test sensors & protection systems yearly	DM
Check coolant antifreeze/inhibitor strength yearly	UH
Calibrate oxygen sensor, - Replace oxygen sensor	UH - DM
Calibrate turbine inlet temperature interface module	DM
Check emissions. (Adjust if required)	DM
Magnetic pick ups – clean & adjust	WM
Check & calibrate ignition timing	DM

E service – 10,000, 14,000, 26,000 and 30,000 hours

Description	Manual
Check EMS logged events and record	DM
Check EMS logged diagnostic codes, record and rectify	
Oil & filter change. Recommend oil sampling required Clean piston cooling jet oil strainer plug	UH
Equalise bridge pieces and set valve clearance	UH
Spark plugs check, clean and re-gap	UH
Breather element – replace	UH
Air filter – replace (Subject to environmental conditions)	UH
Cylinder head – Check valve recession using tool	UH
Calibrate oxygen sensor, - Replace oxygen sensor	UH - DM

10

Using Manuals

User's Handbook (Publication TSL4230).....	UH
Diagnostic Manual (Publication TSL4233).....	DM
Workshop Manual (Publication TSL4235)	WM

Also refer to Maintenance Schedule on page 22.

F service – 12,000 and 28,000 hours

Description	Manual
Check EMS logged events and record	DM
Check EMS logged diagnostic codes, record and rectify	
Oil & filter change. Recommend oil sampling required Clean piston cooling jet oil strainer plug	UH
Equalise bridge pieces and set valve clearance	UH
Spark plugs check, clean and re-gap	UH
Breather element – replace	UH
Air filter – replace (Subject to environmental conditions)	UH
Cylinder head – Check valve recession using tool	UH
Calibrate oxygen sensor, - Replace oxygen sensor	UH - DM
Check emissions. (Adjust if necessary)	DM

G service – 16,000 hours

Description	Manual
Check EMS logged events and record	DM
Check EMS logged diagnostic codes, record and rectify	
Oil & filter change. Recommend oil sampling required Clean piston cooling jet oil strainer plug	UH
Equalise bridge pieces and set valve clearance	UH
Spark plugs check, clean and re-gap	WM
Breather element – replace	WM
Air filter – replace (Subject to environmental conditions)	WM
Change cylinder heads	WM
Charge cooler - clean and regasket	WM
Test sensors and protection systems yearly	DM
Check coolant antifreeze/inhibitor strength yearly	UH
Calibrate oxygen sensor, - Replace oxygen sensor	UH - DM
Calibrate turbine inlet temperature interface module	DM
Check emissions. (Adjust if required)	DM
Oil cooler assembly - overhaul	WM
Turbocharger - replace	WM
Clean gas mixer (see air filter change)	UH
Magnetic pick ups – clean & adjust	WM
Check & calibrate ignition timing	DM
Inspect ignition coils	UH
TV dampers - replace	WM

Using Manuals

User's Handbook (Publication TSL4230)	UH
Diagnostic Manual (Publication TSL4233)	DM
Workshop Manual (Publication TSL4235)	WM

Also refer to Maintenance Schedule on page 22.

H service – 32,000 hours

Description	Manual
Check EMS logged events and record	DM
Check EMS logged diagnostic codes, record and rectify	
Oil & filter change. Recommend oil sampling required Clean piston cooling jet oil strainer plug	UH
Equalise bridge pieces and set valve clearance	UH
Spark plugs check, clean and re-gap	UH
Breather element – replace	UH
Air filter – replace (Subject to environmental conditions)	UH
Change cylinder heads	WM
Change cylinder head bolts - replace after 2 uses or 32,000 hrs	WM
Charge cooler - clean and regasket	WM
Test sensors and protection systems yearly	DM
Check coolant antifreeze/inhibitor strength yearly	WM
Calibrate oxygen sensor, - Replace oxygen sensor	UH - DM
Calibrate turbine inlet temperature interface module	WM - DM
Check emissions. (Adjust if required)	DM
Oil cooler assembly - overhaul	WM
Turbocharger - replace	WM
Clean gas mixer (see air filter change)	UH
Magnetic pick ups – clean & adjust	WM
Check & calibrate ignition timing	DM
Governor actuator – change throttle valve	WM
Fuel valve / tecjet - replace	WM
Butterfly valve – overhaul	WM
Inspect ignition coils	UH
Pistons, rings and liners – replace	WM
Big end bearings & bolts – replace	WM
Small end bearings – inspect & replace if necessary	WM
Camshaft, camshaft bushes & cam-follower assembly – replace	WM
Starter motors - replace	WM
Front and rear crankshaft oil seals – inspect & replace if necessary	WM
Pushrods – check for wear & straightness	WM
Valve train gear – clean & inspect	WM
TV dampers - replace	WM

Activity	Engine running hours																	
	A	B	C	B	D	E	F	E	G	B	C	B	D	E	F	E	H	
	500	2000	4000	6000	8000	10000	12000	14000	16000	18000	20000	22000	24000	26000	28000	30000	32000	
Check EMS logged events and record	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Check EMS logged diagnostic codes, record and rectify	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Oil & filter change. Recommend oil sampling required at every 250 hrs initially to establish trends	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Rocker box cover joints - replace	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Check, log & adjust tappets/bridge pieces	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Spark plugs - clean, re-gap & new washer, Change = O	X	X	O	X	O	X	O	X	O	X	O	X	O	X	O	X	O	
Breather element - replace		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Air filter - replace (Subject to environmental conditions)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Cylinder head - check using valve recession tool					X	X	X	X					X	X	X	X		
Cylinder head - change (Life = 14,000--16,000)									X								X	
Cylinder head bolts - replace after 2 uses or 32,000 hrs Whichever occurs first																	X	
Charge cooler - clean & regasket					X				X				X				X	
Test sensors & protection systems yearly or 8000 hrs					X				X				X				X	
Check coolant antifreeze/inhibitor strength yearly or 8000 hrs					X				X				X				X	
Calibrate oxygen sensor = X, replace oxygen sensor = O		X	X	X	O	X	X	X	O	X	X	X	O	X	X	X	O	
Calibrate turbine inlet temperature interface module					X				X				X				X	
Check emissions - adjust if necessary			X		X		X		X		X		X		X		X	
Oil cooler assy - overhaul									X								X	
Turbocharger - replace									X								X	
Clean and inspect gas mixer									X								X	
Magnetic pick ups - clean & adjust					X				X				X				X	
Check & calibrate ignition timing					X				X				X				X	
Governor actuator - change throttle valve																	X	
Fuel valve / Tecjet - replace																	X	
Butterfly valve - overhaul																	X	
Inspect ignition coils									X								X	
Pistons, rings and liners - replace																	X	
Big end bearings & bolts - replace																	X	
Small end bearings - inspect & replace if necessary																	X	
Camshaft, camshaft bushes & camfollower assy - replace																	X	
Starter motors - replace																	X	
Front & rear oil seals - inspect & replace if necessary																	X	
Pushrods - check for wear & straightness																	X	
Valve train gear - clean & inspect																	X	
TV Dampers - replace									X								X	
Exhaust manifold - replace																	X	

Notes:

- All sensors should last the life of the engine.
- Maintenance schedule from 32,000 hrs to 64,000 hrs same as 2,000 to 32,000.
- At 64,000 hrs operation consult Perkins Engine Company Limited reference major overhaul - swing engine / service exchange engine components such as oil pump, main bearings, knock sensors, EMS, ignition coils will require overhauling / replacing.

This schedule is for guidance purposes only and is to assist in calculating whole life cost, figures based on project objectives, parts consumption's are not warranted.

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Moteurs Perkins S.A.,
Paris Nord II - Parc des reflets,
165 Avenue du Bois de la Pie, BP 40064,
F-95913 Roissy - CDG Cedex, France.
Telephone: 0033 (01) 49-90-7168
Fax: 0033 (01) 49-90-7190

Germany

Perkins Motoren GmbH,
Saalaeckerstrasse 4,
D-63801 Kleinostheim,
Germany.
Telephone: 0049 6027 5010
Fax: 0049 6027 501130

Italy

Motori Perkins S.p.A.,
Via Socrate 8,
22070 Casnate con Bernate (Como), Italy.
Telephone: 0039 (0) 31 564633/564625
Fax: 0039 (0) 31 565480/564145/396001

Singapore

Perkins Engines (Far East) Pte Ltd,
39 Tuas Avenue 13,
Singapore 638999.
Telephone: (65) 861 1318
Fax: (65) 861 6252

United Kingdom

Perkins Engines Company Ltd,
Eastfield, Peterborough, PE1 5NA,
England.
Telephone: 0044 (0) 1733 583000
Telex: 32501 Perken G
Fax: 0044 (0) 1733 582240

Perkins Engines Company Limited,
Tixall Road, Stafford, ST16 3UB,
England.
Telephone: 0044 (0) 1785 223141
Fax: 0044 (0) 1785 215110

Perkins Engines Company Limited,
Lancaster Road, Shrewsbury, SY1 3NX,
England.
Telephone: 0044 (0) 1743 212000
Fax: 0044 (0) 1743 212700

United States of America

Perkins Engines Inc,
26200 Town Centre Drive,
Suite 280, Novi,
Michigan 48375,
USA
Telephone: 001 248 374 3100
Fax: 001 248 374 3100

Perkins Engines Latin America Inc,
999 Ponce de Leon Boulevard, Suite 710,
Coral Gables, Florida 33134,
U.S.A.
Telephone: 001 305 442 7413
Telex: 32501 Perken G
Fax: 001 305 442 7419

In addition to the above companies, there are Perkins distributors in most countries. Perkins Engines Company Limited, Peterborough or one of the above companies can provide details.

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Specifications

Basic technical data

Number of cylinders.....	16
Cylinder arrangement	60° Vee
Cycle.....	4 stroke, spark ignition
Induction system.....	Turbocharged
Compression ratio	12:1
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
Estimated total weight (dry)	5500 kg

Ratings

Electrical ratings are based on average alternator efficiency and are for guidance only (1.0 power factor being used).

Operating point

Engine speed.....	1500 rpm
Ignition timing	24° BTDC
Mixture cooler water temp	40 °C
Cooling water exit temp	<98 °C
Exhaust emissions:.....	1/2 TA-Luft (NOx)
.....	TA-Luft (NOx)

Fuel data

Fuel type.....	Natural Gas (UK)
Lower calorific value	34,710 kJ/Sm ³ (45,671 kJ/kg)
Density.....	0.76 kg/Sm ³
Stoich. air requirement	16 kg/kg
Minimum methane number.....	75

Performance

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

Test conditions

Air temperature.....	25°C
Barometric pressure	100 kPa
Relative humidity	30%

General installation

Designation	Units	Continuous baseload rating	
		50 Hz; 1500 rpm	
		¹ / ₂ TA-Luft (NOx)	TA-Luft (NOx)
Gross engine power	KW	1042	1042
BMEP gross	Bar	13.7	13.7
Combustion air flow	m ³ /min	82.7	79.8
Exhaust gas temperature max (after turbo)	°C	496	495
Exhaust gas flow (max)	m ³ /min	220	212
Overall electrical efficiency	%	38.2	39.2
Mean piston speed	m/s	9.5	9.5
Charge coolant flow	l/s	10	10
Nominal excess air factor (Lambda)	λ	1.80	1.75
Typical Gen Set 25°C (100 kPa) Electrical Output (unit 1.0pf)	kW	1008	1008
Assumed alternator efficiency	%	96.8	96.8

Energy balance

Continuous baseload rating	Units	1500 rpm ¹ / ₂ TA-Luft NOx	%	1500 rpm TA-Luft NOx	%
Energy in fuel (Fuel heat of combustion)	kW	2638	100	2574	100
Energy in power output (Net) (Engine shaft power)	kW	1042	39.5	1042	40.5
Energy to exhaust cooled to 120°C	kW	693	26.3	665	25.8
Energy to coolant (jacket, oil and 1st circuit of c/c)	kW	577	21.9	584	22.7
Sum of useable heat	kW	1270	48.1	1249	48.5
Sum of useable energy	kW	2312	87.6	2291	89.0
Energy to radiation (surface radiation and other losses)	kW	83	3.1	46	1.8
Energy to charge cooler 2nd circuit	kW	71	2.7	68	2.6
Waste energy from exhaust gas	kW	172	6.5	169	6.6

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

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 temperature below 10°, 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. OE 45350 (1 litre)

Maximum jacket water pressure in crankcase 1.7 bar

Jacket water data	Units	1500 rpm
Coolant flow	m ³ /h	54
Coolant exit temperature (max)	°C	98
Coolant entry temperature	°C	84

Charge cooling water data (2nd circuit)	Units	1500 rpm
Coolant flow	m ³ /h	36
Coolant entry temperature (max)	°C	40

Charge cooler Plate and fin on engine

Coolant pump..... not fitted

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

Coolant immersion heater capacity..... 4 kW (2 off)

Lubrication system

Recommended lubricating oil:
For Natural Gas fuel applications Mobil Pegasus 805

Lubricating oil capacity:

Total system 286 litres

Sump maximum 257 litres

Sump minimum 147 litres

Lubricating oil temperature maximum to bearings 105°

Lubricating oil pressure:

at 85°C temperature to bearing gallery 4.5 bar

Oil consumption	Units	1500 rpm
After RUNNING-IN *	g/kW.hr	0.3
Oil flow rate from pump	l/s	7.8

* Typical after 250 hours

Sump drain plug tapping size G1

Oil pump gear driven

Normal operating angles:

Fore and aft 5°

Side tilt 22°

Fuel system

Recommended fuel Natural Gas LHV at 34.71 MJ/m³

Gas supplies must be filtered to the same standard as the engine intake air, i.e. Maximum particle size not to exceed 5 microns.

Gas supply pressure 5 kPa to 10 kPa at full rated flow conditions

Carburettor type Woodward Tecjet 50

Installation of gas supply and shut off valves to be in accordance with local regulations.

Fuel consumption gross	kJ/kWs	
Designation	¹ / ₂ TA-Luft	TA-Luft
	1500 rpm	1500 rpm
Continuous baseload rating	2.53	2.47

Designation		¹ / ₂ TA-Luft	TA-Luft
Mass flow data	Units	1500 rpm	1500 rpm
Fuel	kg/h	201	198

Designation		¹ / ₂ TA-Luft	TA-Luft
Volume flow data (100kPa)	Units	1500 rpm	1500 rpm
Fuel (15°C)	m ³ /h	265	261



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