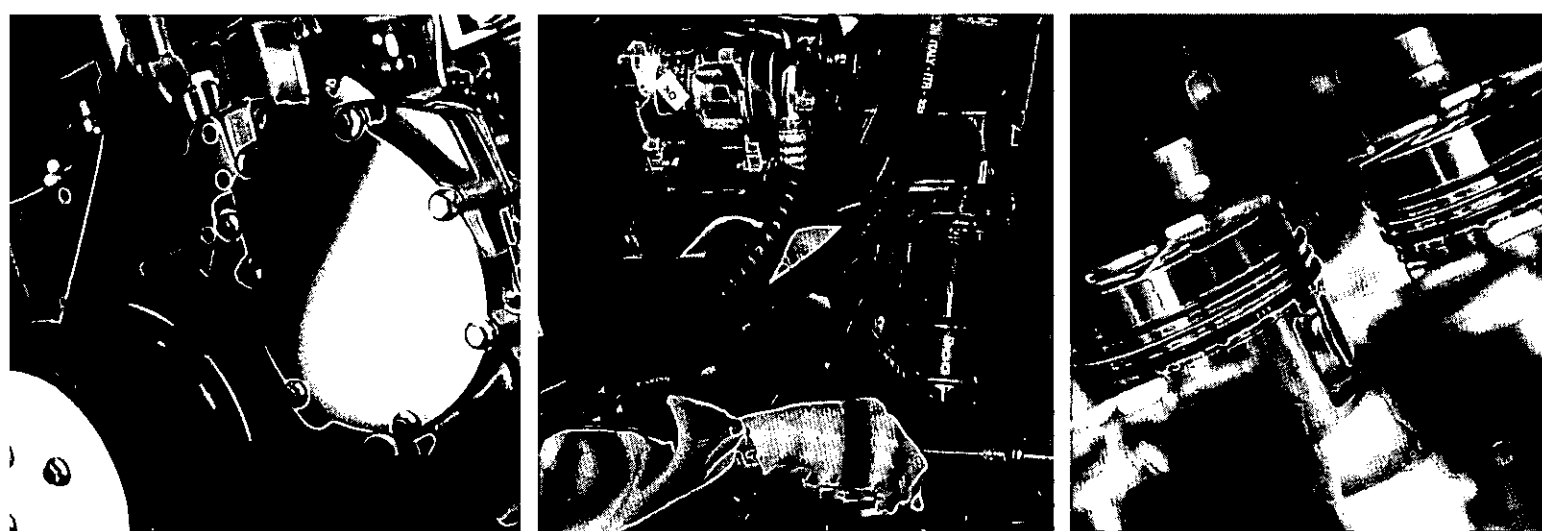




User' Handbook

Eagle Tx2000



Models 340Tx, 380Tx and 410Tx

TSD3429



EAGLE Tx2000

340Tx, 380Tx and 410Tx

6 cylinder diesel engines for trucks

USER'S HANDBOOK

Publication TSD 3429 (issue 3)

©Proprietary information of Perkins Engines Company Limited 1998,
all rights reserved

Published in May 1998 by Technical Publications Department.
Perkins Engines Company Limited,
Lancaster Road, Shrewsbury,
Shropshire SY1 3NX, England.

Contents

General information	1
Engine views	2
Operation instructions	3
Preventive maintenance	4
Engine fluids	5
Fault diagnosis	6
Engine preservation	7
Parts and service	8
Engine data	9

General Information

1

Introduction	...	...	...	...	...	...	1.02
How to care for your engine		...	...	...	...	...	1.02
Safety precautions	...	...	...	...	...	...	1.03
Engine identification	...	...	...	...	...	...	1.04
Perkins companies	...	...	...	...	...	...	1.05

1 GENERAL INFORMATION

Introduction

The new range of Eagle truck engines is the latest development from Perkins Engines Company Limited, a world leader in the design and manufacture of high performance diesel engines.

More than fifty years of diesel production experience, together with the use of the latest technology, have been used in the manufacture of your engine to give you reliable and economic power.

The exhaust gas emissions from this range of engines are well within the limits specified in EC Regulations 24.03 and 49.02, Directives 88/77/EEC and 91/542/EEC Stage 2.

To ensure that you use the correct information for your specific engine type, refer to 'Engine identification' on page 1.04.

Danger is indicated by two methods:

Warning! *This indicates that there is a possible danger to the person.*

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.

How to care for your engine

This handbook has been written to assist you to maintain and operate your engine correctly.

To obtain the best performance and the longest life from your engine, you must ensure that the maintenance operations are done at the intervals shown in 'Preventive maintenance'. If the engine is operated in a very dusty environment or other adverse conditions, certain maintenance intervals will have to be reduced. Renew the filter elements and the lubricating oil regularly to ensure that the inside of your engine remains clean.

Ensure that all adjustments and repairs are done by personnel who have had the correct training. Perkins distributors have this type of personnel available. You can also obtain parts and service from your Perkins distributor. If you do not know the address of your nearest distributor, enquire at one of the Perkins companies listed on page 1.05.

The left and right sides of the engine are as seen from the rear (flywheel) end.

Read the 'Safety precautions' and remember them. They are given for your protection and must be applied at all times.

Safety precautions

These safety precautions are important.



Reference must also be made to the local regulations in the country of operation.

- Only use these engines in the type of application for which they have been designed.
- Do not change the specification of the engine.
- Do not smoke when you put fuel in the tank.
- Clean away fuel which has been spilt. Material which has been contaminated by fuel must be moved to a safe place.
- Do not put fuel in the tank while the engine runs (unless it is absolutely necessary).
- Do not clean, add lubricating oil, or adjust the engine while it runs (unless you have had the correct training; even then extreme caution must be used to prevent injury).
- Do not make adjustments that you do not understand.
- Ensure that the engine does not run in a location where it can cause a concentration of toxic emissions.
- Other persons must be kept at a safe distance while the engine or equipment is in operation.
- Do not permit loose clothing or long hair near moving parts.
- Keep away from moving parts during engine operation. **Caution:** *Some moving parts cannot be seen clearly while the engine runs.*
- Do not operate the engine if a safety guard has been removed.
- Do not remove the filler cap of the cooling system while the engine is hot and while the coolant is under pressure, because dangerous hot coolant can be discharged.
- Do not use salt water or any other coolant which can cause corrosion in the closed coolant circuit.
- Do not allow sparks or fire near the batteries (especially when the batteries are on charge) because the gases from the electrolyte are highly flammable. The battery fluid is dangerous to the skin and especially to the eyes.
- Disconnect the battery terminals before a repair is made to the electrical system.
- Only one person must control the engine.
- If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.
- Diesel fuel and lubricating oil (especially used lubricating oil) can damage the skin of certain persons. Protect your hands with gloves or a special solution to protect the skin.
- Do not wear clothing which is contaminated by lubricating oil. Do not put material which is contaminated with oil into the pockets.
- Discard used lubricating oil in a safe place to prevent contamination.
- Ensure that the control lever of the transmission drive is in the 'out-of-drive' position before the engine is started.
- The combustible material of some components of the engine (for example certain seals) can become extremely dangerous if it is burned. Never allow this burnt material to come into contact with the skin or with the eyes.
- Fuel and oil pipes **MUST** be inspected for cracks or damage before they are fitted to the engine.
- Fit only genuine Perkins parts.

1 GENERAL INFORMATION

Engine Identification

The engine is a six cylinder in-line unit, turbocharged and intercooled.

Three engine ratings are available, 340Tx, 380Tx and 410Tx. Details can be obtained from Perkins Shrewsbury, or from the nearest Perkins distributor.

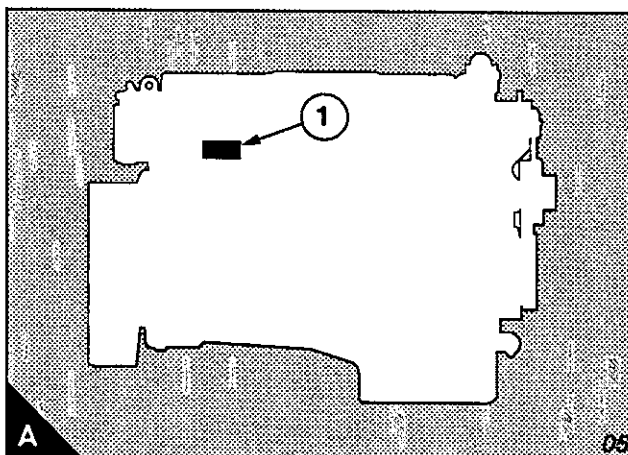
The engine number is stamped on the data plate which is fastened to the right side of the crankcase (A1).

A typical engine number is SAL O6 0161 U 3757 A which consists of these codes:

SA	=	Identifies the engine application
L	=	Identifies the engine type
06	=	The number of cylinders
0161	=	The engine specification number
U	=	Country of manufacture
3757	=	Build line number
A	=	Year of manufacture

Units such as the fuel injection pump and turbochargers have their own data plates.

If you need parts, service or information for your engine, you must give the complete engine number to your Perkins distributor.



Engine views						2
Location of major items	...	...	...	...	...	2.02
Views of engine	...	...	...	...	...	2.02

2 ENGINE VIEWS

Introduction

Perkins engines are built to suit specific installations and the views which follow do not necessarily match your engine in every detail.

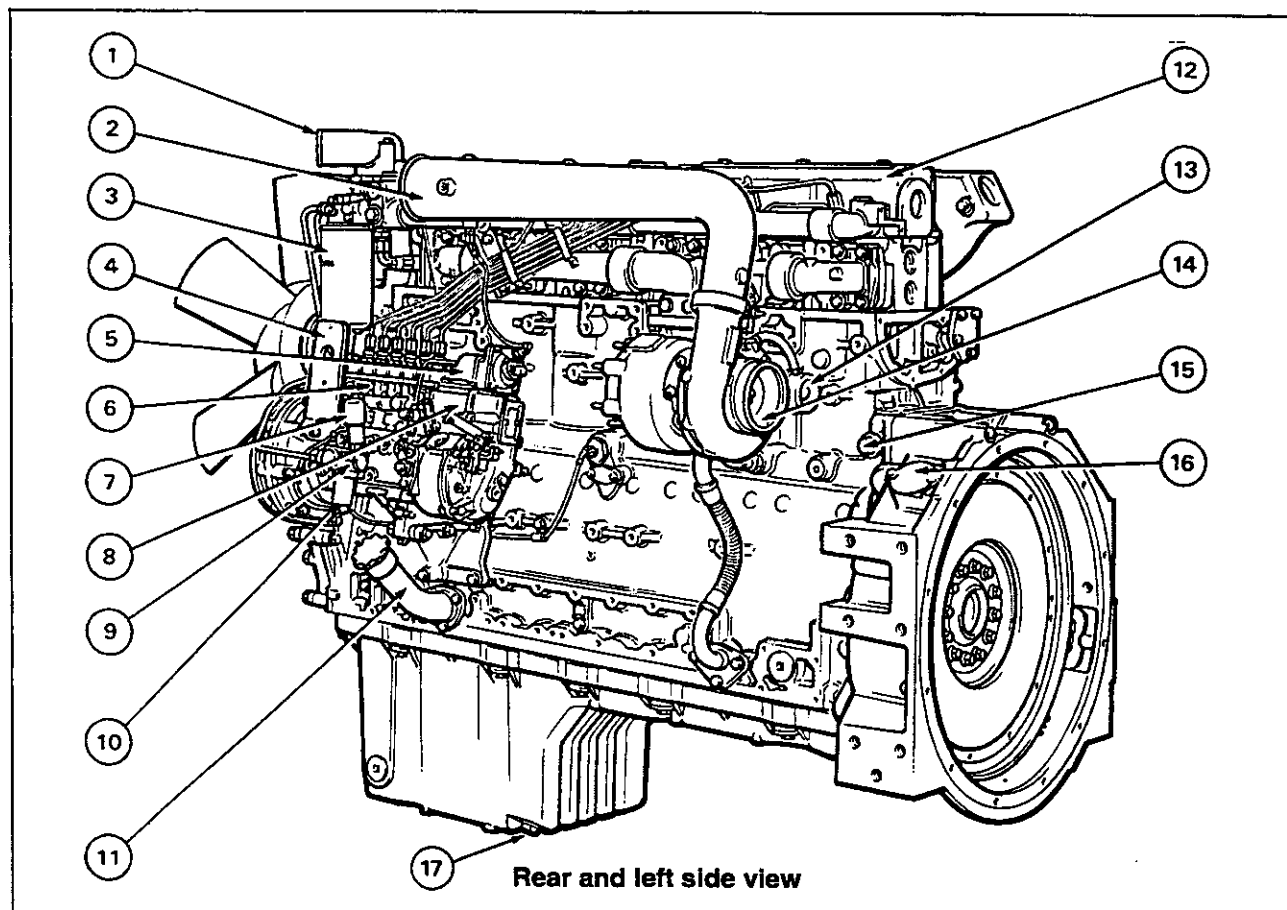
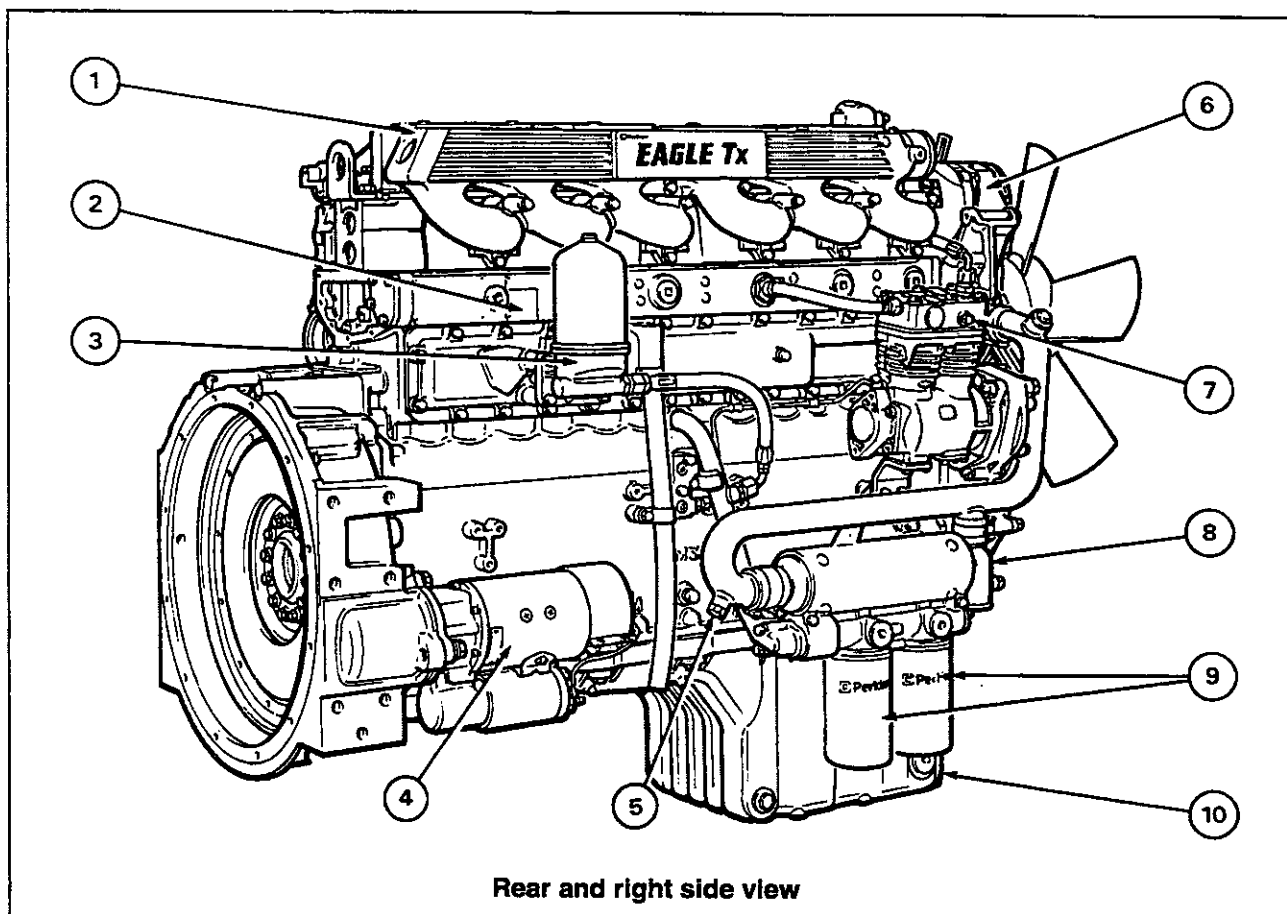
Location of engine parts

Rear (flywheel end) and right side view of engine

- 1 Inlet manifold
- 2 Data plate
- 3 By-pass oil filter
- 4 Starter motor
- 5 Coolant drain plug
- 6 Alternator
- 7 Air compressor
- 8 Oil cooler
- 9 Canisters of the lubricating oil filter (2)
- 10 Sump

Rear (flywheel end) and left side view of engine

- 1 Thermostat
 - 2 Air delivery to intercooler
 - 3 Canister of the fuel filter
 - 4 Bracket for 'Econocruise' control unit
 - 5 Boost control unit
 - 6 Fuel injection pump
 - 7 Hand primer (fuel lift pump)
 - 8 Governor
 - 9 Fuel lift pump
 - 10 Preliminary fuel filter
 - 11 Filler, lubricating oil
 - 12 Rocker cover
 - 13 Waste-gate (380Tx and 410Tx engines only)
 - 14 Turbocharger
 - 15 Coolant drain
 - 16 Cover plate, engine timing pointer
- Note:** On present production engines the cover plate is at the bottom of the flywheel housing
- 17 Drain plug, lubricating oil



Operation instructions**3**

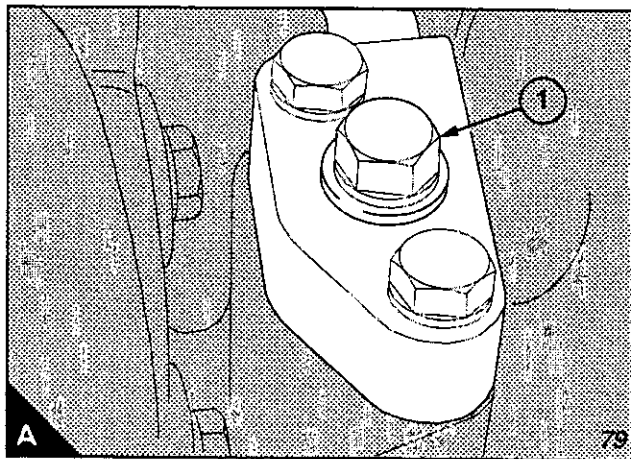
How to prepare a new or an overhauled engine	...	...	...	3.02
Normal start procedures	...	...	...	3.02
Service checks before a new or an overhauled engine, or an engine which has been in storage, is started		...	...	3.02
Service checks each day before the first engine start		...	...	3.02
How to start the engine	...	...	...	3.03
How to start the engine in low ambient temperatures		...	...	3.03
How to run the engine	...	...	...	3.03
How to stop the engine	...	...	...	3.03
Running-in after a repair	...	...	...	3.03

3 OPERATION INSTRUCTIONS

How to prepare a new or an overhauled engine

Every new engine supplied by Perkins Shrewsbury is run-in before it leaves the factory.

- 1 Check that all protection covers and blanking plugs have been removed.
- 2 Fit all components that were removed for storage or for transport.
- 3 Ensure that the drain plugs for the coolant and for the lubricating oil are securely fitted.
- 4 Where necessary, connect the remote control linkages, the pressure gauge pipes, the air inlet pipes and the wiring loom.
- 5 Connect the fuel pipes.
- 6 Connect the exhaust pipes.
- 7 Fill the fuel tank/s with the correct grade of fuel (see page 5.02).
- 8 Fill the cooling system with the approved coolant mixture (see page 5.02).
- 9 Fill the sump to the 'H' or 'Top' mark on the dipstick with the correct grade of lubricating oil (see page 5.02).
- 10 Remove the plug from the right side of the fuel injection pump and fill the fuel injection pump and governor with clean engine lubricating oil, of the correct grade, until the level of the oil reaches the hole for the plug. Fit the plug and tighten securely.
- 11 Add oil to the turbocharger. Clean the area around the blanking plug and inlet pipe at the top of the turbocharger bearing housing (A). Remove the plug (A1) and insert 0,2 litre (1/3 pint) of engine lubricating oil of the correct grade and specification as that already in the system. Refit the plug.
- 12 Eliminate air from the fuel system (see page 4.13).
- 13 Lubricate all of the control linkages and check the linkages for free movement.
- 14 Ensure that the stop control is in the STOP position and that the accelerator is in the IDLE position. Press the start button for 10 seconds and wait for 10 seconds, then press it for 20 seconds and wait for 20 seconds. Oil pressure MUST be indicated on the gauge.



Normal start procedures

Service checks before a new or an overhauled engine, or an engine which has been in storage, is started

If an engine has been in storage for a period of more than one month or if the fuel injection pump or turbocharger has been removed, lubricating oil must be added to the fuel injection pump, to the governor of the fuel injection pump and to the turbocharger. The procedure is given on this page, paragraphs 10 and 11. Use clean engine oil of the same grade and specification as that already in the system.

Service checks each day before the first engine start

- 1 Check that the level of the coolant is as specified in the vehicle manual. Fill, if necessary, to the required level with the approved coolant mixture. Find the reason for any suspected loss of coolant.
- 2 Check the engine oil level. With the engine stopped the oil level must be at the 'H' or 'Top' mark on the dipstick. If necessary, add oil of the same grade and specification as that already in the system. Do NOT add more oil than is necessary.
- 3 Check the level in the fuel tank. Open the valve for the fuel, if one is fitted.

How to start the engine

Perform the daily service checks then proceed as follows:

If fitted, move the stop control lever to the RUN position.

- 1 Move the accelerator to the maximum speed position.
- 2 Press the start switch and release it when the engine reaches self sustaining speed.
- 3 When the engine speed reaches 1000 rev/min, return the accelerator to the idle position.

How to start the engine in low ambient temperatures

Where consistently low temperatures are likely to be encountered the points which follow are important:

- The correct grade of oil should be used.
- The specified coolant mixture should be used.
- The batteries should be in good condition and fully charged.

If a cold engine is started as described above (1 and 2) in a temperature of more than 10°C, its speed will increase immediately.

In ambient temperatures of below 10°C the engine should be kept at idle speed for 20 seconds.

The engine will start at -15°C without the need for start aids, although a slight delay may be experienced until the engine becomes self-sustained.

The fuel injection pump fitted to the EURO 2 engine incorporates an excess fuel device which operates when the lever of the speed control is moved to the position for maximum speed. This excess fuel device works as a starting aid when ambient temperatures are below 0°C.

How to run the engine

The precautions that follow will help to ensure a long and fault-free life for the engine:

- 1 Do not operate the engine at high speeds and loads until the coolant has reached a minimum temperature of 78°C (172°F).
- 2 Do not allow the engine to run at idle speed, or without load, for prolonged periods.
- 3 Where possible operate the engine in the speed range of 1200 to 1700 rev/min. Do not exceed the maximum rated speed of the engine.

- 4 Never allow an engine to continue to run if the oil pressure is below 1 bar (14.75 lbf/in²) at the rated speed.

- 5 Where it is possible, fill the fuel tank/s at the end of each day to prevent condensation and to allow sediment to fall to the bottom of the tank.

How to stop the engine

- 1 Operate the engine for 3 minutes at idle speed with no load to allow the turbocharger to reduce speed and temperature.
- 2 If vehicle protection or safety devices are fitted ensure that they are set correctly.
- 3 Move the stop control or switch to the STOP position and release it after the engine is stopped.

Running-in after a repair

Every new or reconditioned engine which is supplied by Perkins Engines has been given a period of running-in before it leaves the Factory and it requires no special process when it is put into service.

When a 'Short engine' or a 'Long engine' has been installed, or when a partial overhaul has needed new cylinder liners and new piston rings, the Operator is advised that the procedure, given below, should be applied before the engine is run at full load.

- 1 Run the engine at or below 1500 rev/min, without a load until the normal temperature is reached.
- 2 During the initial three to four hours of engine running, operate the vehicle carefully; where possible, increase **gradually** the load on the engine until full load conditions are reached.

Make frequent checks of:

- Oil pressure.
- Coolant temperature.
- Pipework and connections for leaks.

Preventive maintenance

4

Preventive maintenance periods	...	...	...	...	4.02
Schedule	...	...	...	...	4.03
How to check the coolant level	...	...	...	...	4.04
How to check the lubricating oil level	...	...	...	...	4.04
How to check the drive belts	...	...	...	...	4.05
How to adjust the drive belts	...	...	...	...	4.05
How to renew the engine lubricating oil	...	...	...	...	4.06
How to renew the canisters of the oil filter	...	...	...	...	4.07
How to renew the rotor of the by-pass filter for the lubricating oil	...	...	...	...	4.07
How to renew the canister of the main fuel filter	...	...	...	...	4.08
How to clean the preliminary fuel filter	...	...	...	...	4.08
How to check the specific gravity of the coolant	...	...	...	...	4.09
How to check the pH value of the coolant	...	...	...	...	4.09
Fuel injector fault	...	...	...	...	4.10
How to remove a fuel injector	...	...	...	...	4.10
Fuel injector sleeves	...	...	...	...	4.11
How to correct a fuel injector sleeve	...	...	...	...	4.11
How to fit a fuel injector	...	...	...	...	4.12
How to eliminate air from the fuel system	...	...	...	...	4.13
How to check the tappet clearances	...	...	...	...	4.14
Alternator	...	...	...	...	4.15
How to maintain the alternator	...	...	...	...	4.15
Starter motor	...	...	...	...	4.16
How to maintain the starter motor	...	...	...	...	4.16
How to drain the coolant system	...	...	...	...	4.17
How to clean the coolant system	...	...	...	...	4.17
How to fill the coolant system	...	...	...	...	4.17
How to check the turbocharger	...	...	...	...	4.18
Coolant pump	...	...	...	...	4.18
Tensioner pulley for fan belts	...	...	...	...	4.18
Engine damper	...	...	...	...	4.18
Air compressor	...	...	...	...	4.18
Cylinder head bolts	...	...	...	...	4.18

4 PREVENTIVE MAINTENANCE

Preventive maintenance periods

These preventive maintenance periods apply to average conditions of operation. Check the periods given by the manufacturer of the vehicle in which the engine is installed. If necessary, use the shorter periods. When the operation of the engine must conform to the local regulations, these periods and procedures may need to be adapted to ensure correct operation of the engine.

The service intervals can be reduced for operation in adverse conditions. The intervals must not be extended unless Perkins Shrewsbury have approved the changes as indicated in the Perkins Warranty.

Note: When the engine is used for short distance operation with frequent starts and stops, the hours of operation are more important than the distance.

It is good preventive maintenance to check for leakage and loose fasteners at each service. These maintenance periods apply only to engines that are operated with fuel and lubricating oil which conform to the specifications given in this handbook.

Eagle Tx2000, 340Tx, 380Tx and 410Tx engines

The standard maintenance schedule, detailed on page 4.03 applies to vehicles completing less than 80,000 km/50,000 miles per year, or where the preferred oils are not available.

1 NORMAL OPERATION - Vehicles which operate for less than 80 000 km/50 000 miles per year and/or where an oil NOT shown in the Preferred list is being used (ie. oils from the "Acceptable" list).

Service period - 20 000 km/12 500 miles. The "Preferred" and "Acceptable" oils listed on pages 5.03 and 5.04 are recommended.

Note: Vehicles which operate for less than 80 000 km / 50 000 miles, **MUST** have their lubricating oil and filters changed at least twice each year.

Viscosity of the selected oil must be based on these operating temperatures:

-15°C (5°F) and above	SAE 15W/40
-20°C to 30°C (-4°F to 86°F)	SAE 10W/30
-15°C to 30°C (5°F to 86°F)	SAE 15W/30

2 EXTENDED MAINTENANCE / LONG DRAIN

An extended maintenance schedule can be applied to those vehicles which operate for more than 80 000 km/50 000 miles per year. This "LONG DRAIN" schedule is applicable only to those vehicles which exceed the quoted mileage and providing that:

- The Service period is up to 50 000 km/31 250 miles.
- The correct lubricating oil is used. The oil used at this service period must be equal to or exceed CCMC-D5/API-CE, ACEA-3 or Merc 228.3 specifications. Refer to section 5 for recommended lubricants.
- The lubricating oil filters and the rotor of the by-pass filter are correctly serviced at the time of changing the lubricating oil.

Viscosity of the selected oil must be based on the operating temperatures as shown below:

-15°C (5°F) and above
SAE 15W/40 is recommended
-15°C to -25°C (5°F to -13°F)
SAE 10W/30 is recommended

For advice on engines which operate in arctic conditions, below -15°C (-13°F), contact the Service Department at Perkins Engines Company Limited.

Engine test requirements

The oil selected from the above specifications must have a maximum bore polish rating from a recent Ford Tornado test run to CEC L-27-T-79 procedure which does not exceed the reference oil RL47.

Schedule

The preventive maintenance operations must be applied at the interval (kilometres, miles, days, weeks or months) which occurs first.

A - Every 500 km/300 miles or daily

B - Every 20 000 km/12 500 miles (see page 4.02 paragraph 1 for details)

C - Every 50 000 km/31 250 miles (see page 4.02 paragraph 2 for details)

D - Every 160 000 km/100 000 miles or every 12 months

E - Every 400 000 km/250 000 miles

F - Every 800 000 km/500 000 miles

A	B	C	D	E	F	Operation
●						Check the pressure of the lubricating oil at the gauge, if fitted
●						Check the level of the lubricating oil
●						Check the amount of coolant
	●					Check the condition and the tension of all drive belts
	●					Renew the canister of the main fuel filter
	●					Renew the lubricating oil (see page 4.02 paragraph 1)
	●					Renew the canisters of the lubricating oil filter and renew the rotor of the by-pass filter (see page 4.02 paragraph 1)
	●					Renew the canister of the main fuel filter
		●				Renew the lubricating oil (see page 4.02 paragraph 2)
		●				Renew the canisters of the lubricating oil filter and renew the rotor of the by-pass filter (see page 4.02 paragraph 2)
			●			Check the specific gravity and the pH value of the coolant. Drain, flush and refill the coolant system every 2 years.
			●			Renew the compressor air filter, if fitted
			●			Ensure that the fuel injectors are checked and corrected, or renewed if necessary*
			●			Ensure that the tappet clearances are checked, and adjusted if necessary*
				●		Ensure that the alternator, turbocharger, starter motor and the coolant pump are checked*
				●		Ensure that the belt tensioner pulley, the engine damper and the air compressor are checked*
					●	Engine overhaul, if required.

- Weekly. Inspect and clean as necessary, the preliminary fuel filter bowl at the base of the fuel lift pump. Refer to page 4.08.
- Ensure that the air cleaner is maintained at the periods recommended by the vehicle manufacturer.

Note: Vehicles which operate for less than 80 000 km/50 000 miles per year, MUST have their lubricating oil and filters changed at least twice each year.

* By a person who has had the correct training.

4 PREVENTIVE MAINTENANCE

How to check the coolant level

Remove the filler cap from the radiator or header tank and ensure that the level of the coolant mixture is correct as specified by the vehicle manufacturer in the manual. If necessary, add coolant. Fit the filler cap.

Caution: *If coolant is added to the system during the service, it must consist of the same original mixture as used to fill the system.*

Warning! *On a hot engine release the filler cap carefully as the system will be under pressure.*

How to check the lubricating oil level

Check the amount of lubricating oil in the sump by the use of the dipstick, at the periods given in the service schedule.

Stop the engine and, if possible, allow it to stand for a few minutes before checking the engine oil level. Add oil as necessary, ensuring that the added oil is the same grade and specification as the oil already in the system.

Do NOT overfill.

How to check the drive belts

Check all drive belts and renew a belt if it is worn or damaged. Where more than one belt is used between two pulleys, all of the belts must be renewed together.

Check the belt tension at the centre of the longest free length, for example, position (A1) to check the alternator drive belt.

Use a 'Gates "Krikit" V-belt tension gauge' or similar tool to check the tension of the belts.

The correct tension for all belts is **90 to 100 lbf** (400 to 489 N).

Note: When new belts are fitted they must be checked again after the engine has been run for 15 minutes and, if necessary, adjusted to the correct tension.

How to adjust the tension of the fan belts

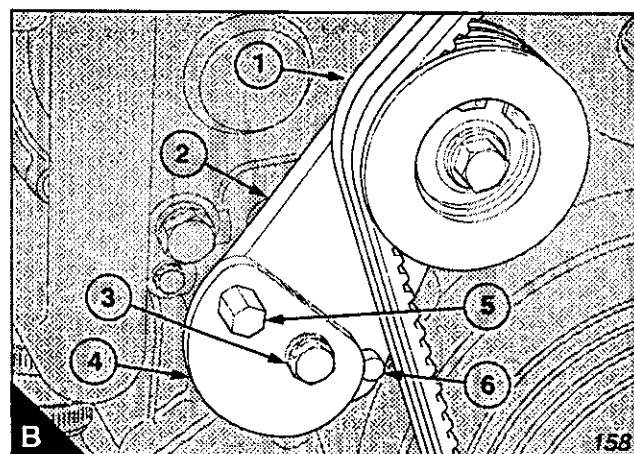
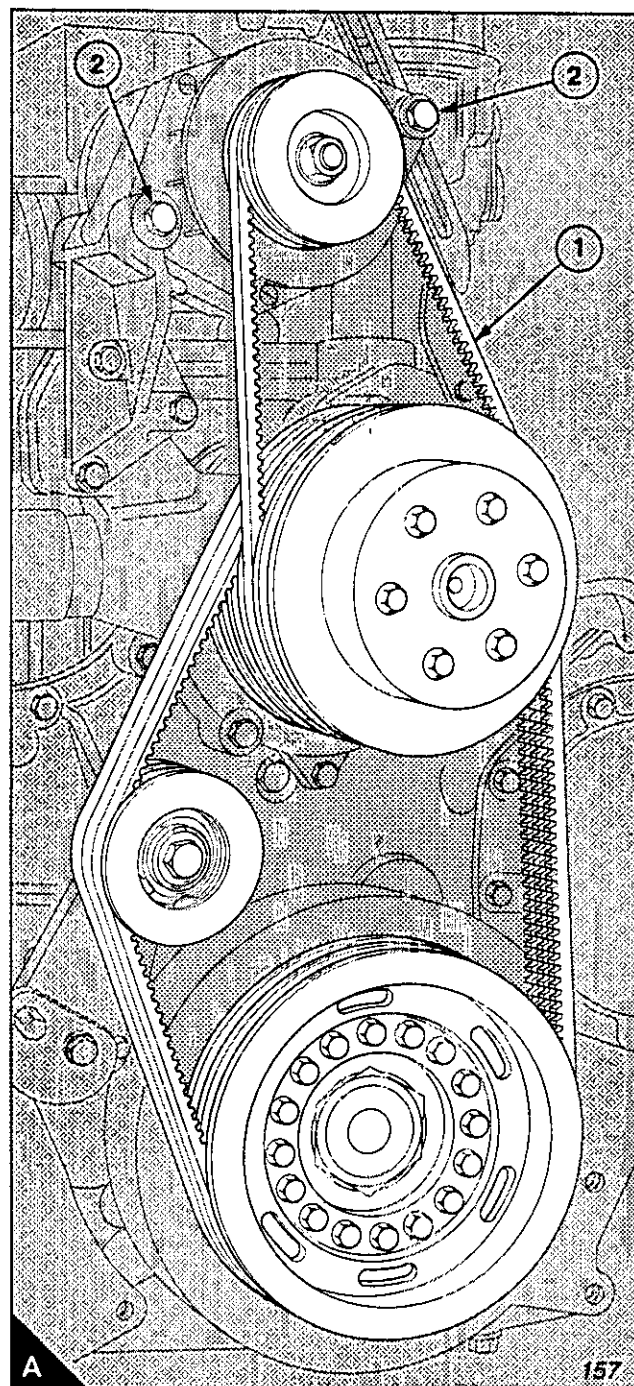
Loosen the bolt (B1) which is covered by the triple fan belts. The plate (B2), which holds the tensioner pulley, pivots about this bolt. Loosen the bolt (B3) which locks the cam plate (B4) and also clamps the plate (B2). Use a spanner on the hexagon (B5) and rotate the cam plate until the correct tension is obtained (as given above). Then tighten the bolts (B3 and B1).

How to adjust the tension of the alternator belt

Loosen the two bolts (A2) and rotate the alternator on the pivot bolt to tighten the belt to the correct tension. Tighten the two bolts.

Check again the belts to ensure that the tensions are still correct. Maximum belt life will be obtained only if the belts are kept at the correct tensions.

Where more than one belt is used between two pulleys, check/adjust the tension on the tightest belt.



4 PREVENTIVE MAINTENANCE

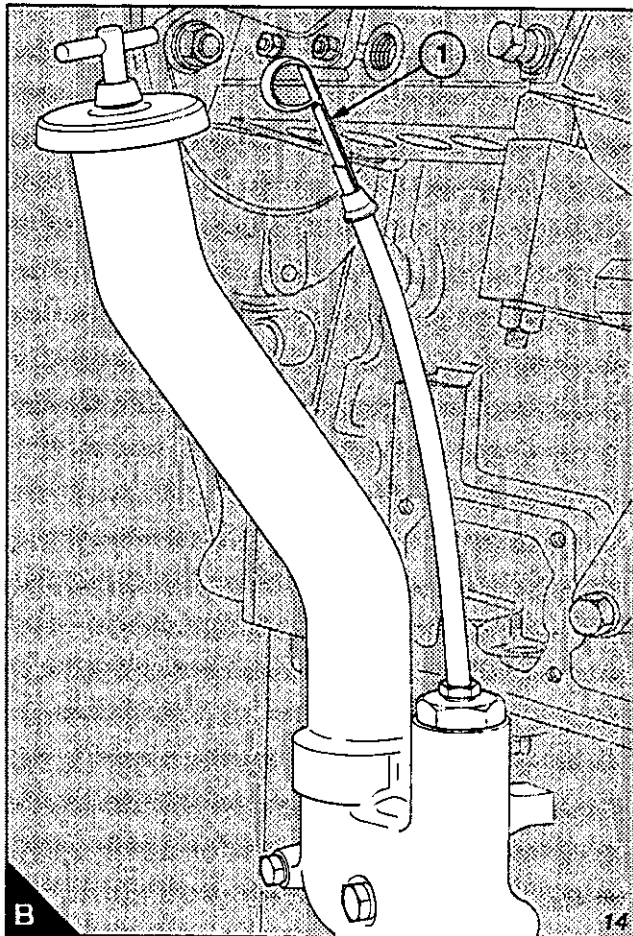
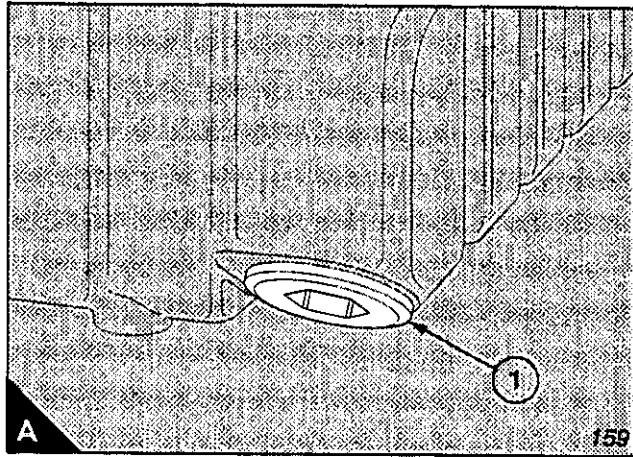
How to renew the engine lubricating oil

Ensure that the engine is on level ground.

- 1 Operate the engine until it is warm.
- 2 Stop the engine, remove the sump drain plug (A1) and drain the lubricating oil into a suitable container. The sump plug is a brass socket plug with $\frac{3}{4}$ inch BSP thread.
- 3 Fit the drain plug and a new sealing washer (ST49856); tighten to a torque of 45 lbf ft.
- 4 Renew both of the oil filter canisters (see page 4.07).
- 5 Clean the area around the oil filler cap and remove the cap. Fill the sump to the 'H' or 'Top' mark on the dipstick (B1) with clean new lubricating oil of an approved grade as given on pages 5.03 and 5.04. Do NOT overfill.

The illustration (B) shows a typical arrangement of lubricating oil filler and dipstick, but these may vary to suit the vehicle manufacturer's installation requirements.

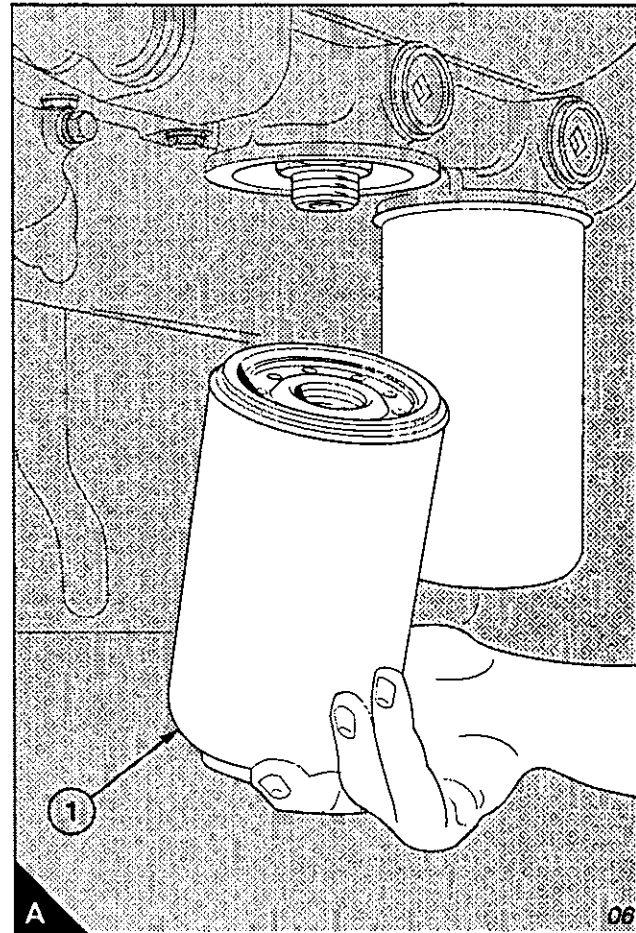
- 6 Operate the engine and check for leakage from the filter canisters. When the engine has cooled, check the oil level on the dipstick and put more oil into the sump, if necessary.



How to renew the canisters of the oil filter

Two screw-on type canisters are fitted to the filter head, which is integral with the casing of the heat exchanger and is fitted to the right side of the engine at the front.

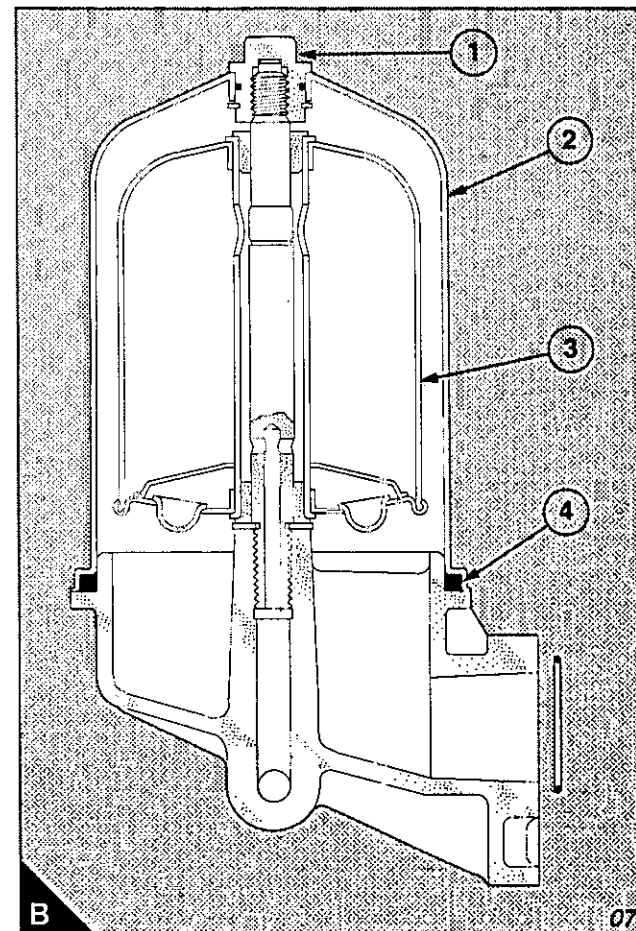
- 1 Put a tray under the canisters and use a strap wrench 21825 825 to remove each canister (A1).
- 2 Check that the sealing rings are correctly fitted to the new canisters and clean the contact faces of the filter head.
- 3 Fill the two new canisters with new engine lubricating oil of the correct grade and lubricate the top of each canister seal with the same oil.
- 4 To install the new canisters use this procedure: Tighten the canisters, on their adaptors, until the sealing rings are in contact with the face of the filter head, then turn the canisters a further $1\frac{1}{4}$ turns, by hand. Do NOT overtighten. Run engine and check for leaks.



How to renew the rotor of the by-pass filter for the lubricating oil

Mounted on the rear tappet cover is a by-pass filter for the lubricating oil. The rotor of the by-pass filter must be renewed at the periods given in the relevant schedule.

- 1 Clean the area around the by-pass filter. Remove the filter bowl (B2), remove and discard the rotor (B3).
- 2 Remove the seal (B4) from the filter bowl and clean all the components, especially the recess for the seal in the filter bowl and the contact face for the seal on the housing.
- 3 Fit a new seal to the recess in the filter bowl and lubricate the face of the seal with clean engine lubricating oil.
- 4 Fit a new rotor to the spindle and ensure that it can rotate freely. Fit the filter bowl and tighten the nut (B1) to a torque of 20 Nm (15 lbf ft).
- 5 When the engine is operated, check for leakage from the by-pass filter.



4 PREVENTIVE MAINTENANCE

How to renew the canister of the main fuel filter

The main fuel filter (A) is at the front of the engine on the left hand side and is a unit with a single canister.

1 Clean the area around the filter and remove the fuel filter canister (A2). If necessary, use a strap wrench 21825 825. Discard the canister.

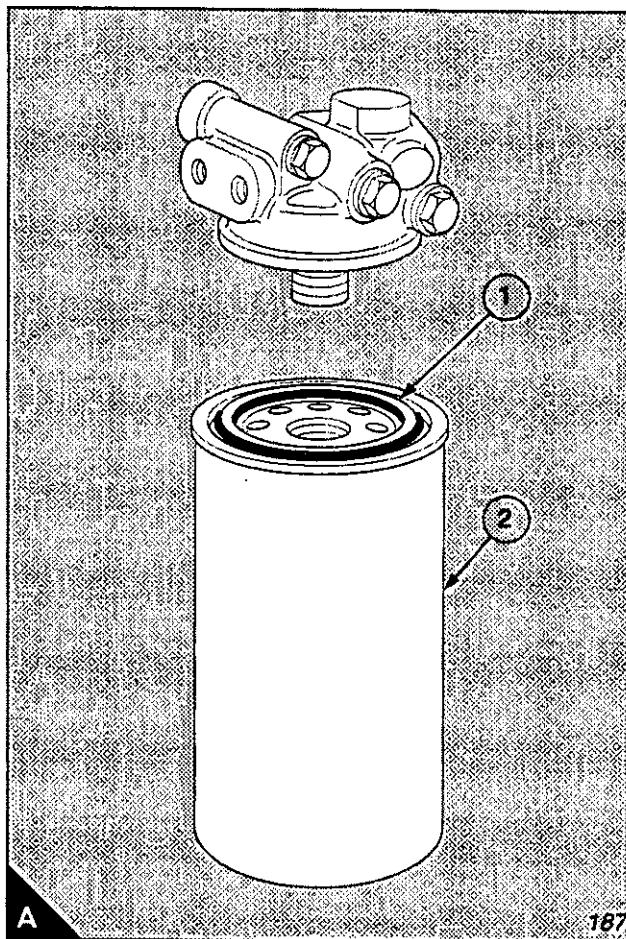
2 Check that the sealing ring (A1) is fitted correctly to the new canister and clean the contact face of the filter head.

3 Fill the canister with clean fuel oil of the correct specification, lubricate the top of the canister seal with clean fuel oil and renew the sealing ring on the adaptor.

4 To install the new canister use this procedure: Tighten the canister on its adaptor, until the sealing ring is in contact with the face of the filter head, then turn the canister a further $1\frac{1}{4}$ turns, by hand, or to a torque of 20 Nm (15 lbf ft). Do NOT overtighten.

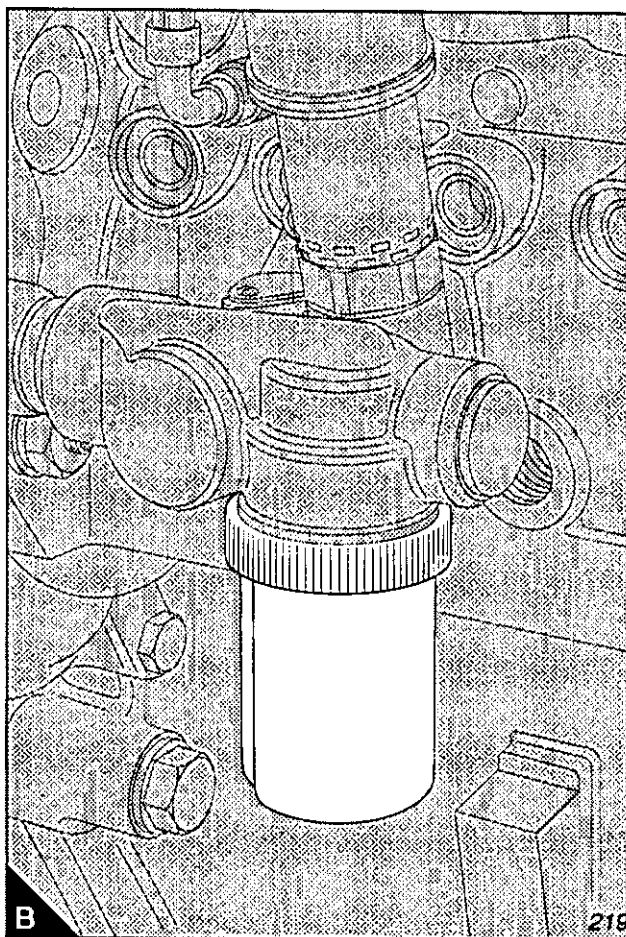
After the fuel filter canister has been renewed, turn on the fuel supply. Eliminate air from the low pressure fuel system as given on page 4.13.

Run the engine and check for leaks.



How to clean the preliminary fuel filter

The fuel lift pump incorporates a small inverted bowl filter (B) sited immediately beneath the hand priming pump. For maintenance purposes the bowl should be unscrewed and the element cleaned with paraffin and then dried with compressed air. Fill with clean diesel fuel before re-fitting.



How to check the specific gravity of the coolant

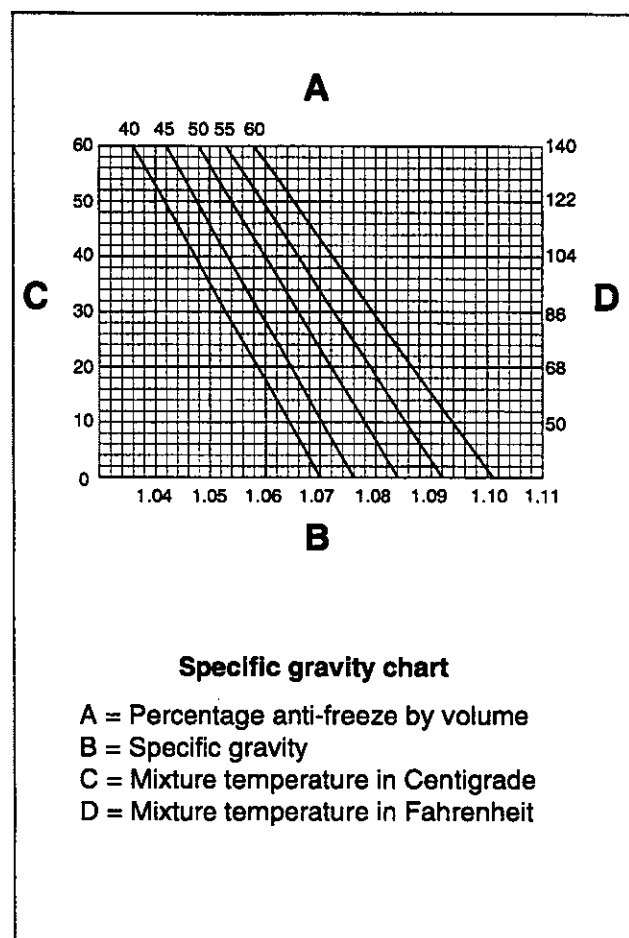
Drain some coolant from the cooling system after the engine has been stopped and before the formation of sediment. Proceed as follows:

- 1 For mixtures which contain inhibited ethylene glycol:
 - (a) Put a hydrometer, and a reliable thermometer, into the antifreeze mixture and check the readings on both instruments.
 - (b) Compare the readings obtained with the chart and adjust the strength of the mixture as necessary.
- 2 For mixtures which contain inhibited propylene glycol:
 - (a) Open the cover of the refractometer, check that the clear panel is clean and use a small syringe to apply a few drops of the coolant mixture to the clear panel.
 - (b) Spread the coolant over the full area of the clear panel and close the cover. Hold the refractometer horizontally with the clear panel at the top and inspect the sample through the viewer.
 - (c) Compare the reading with the chart in the instructions; adjust the strength of the mixture as necessary.

Caution: The clear panel must be cleaned thoroughly before use. If some of the fluid which was tested earlier remains on the clear panel, the reading of the sample will be affected.

Protection against frost is as follows:

Antifreeze/water (% by volume)	Protection down to (°C)
50/50	-35
60/40	-40



How to check the pH value of the coolant

The pH value of the coolant must not be less than pH7 or more than pH9.5. The pH value can be found by the use of a pH meter or test papers, which are available from pharmaceutical manufacturers.

If these limits are exceeded the pH value may be adjusted by the addition of a corrosion inhibitor to the same specification as that already in use. If this is not possible, the system must be drained, flushed and filled with new coolant.

4 PREVENTIVE MAINTENANCE

Fuel injector fault

A fuel injector fault can cause an engine misfire.

To find which injector is defective, operate the engine at a fast idle speed. Loosen and tighten the union nut of each of the high-pressure fuel pipes at the fuel injection pump. When the union nut of the defective injector pipe is loosened, it has little or no effect on the engine speed.

Warning!

- Ensure that the fuel does not spray onto your skin.
- Ensure that the fan guards are fitted.

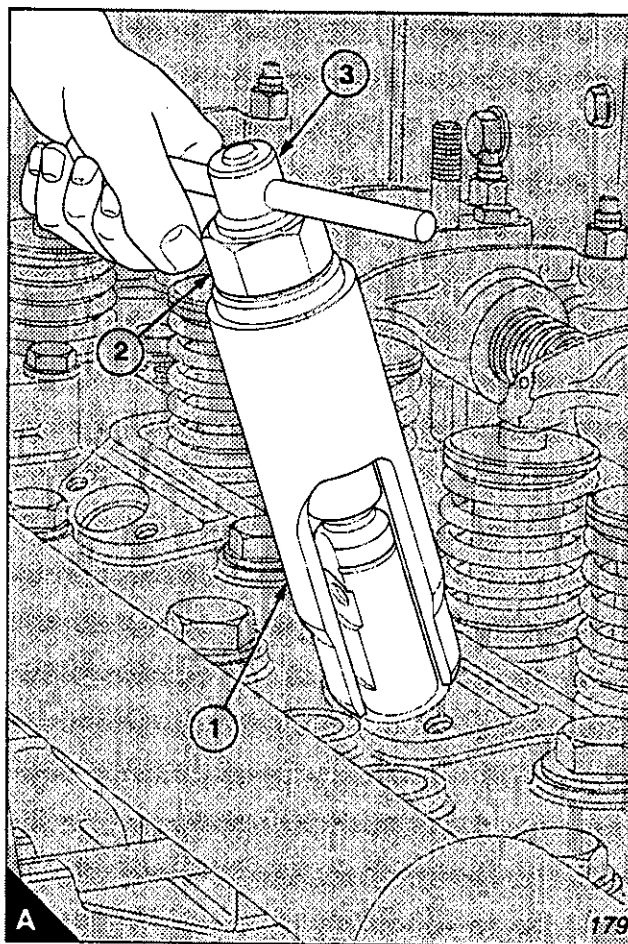
How to remove a fuel injector

- 1 Clean the area around the fuel injector and around its connections.
- 2 Disconnect and remove the leak-off pipe assembly from the fuel injectors.
- 3 Disconnect and remove the assembly of the high pressure fuel pipes. Do NOT bend the pipes.

Caution: Ensure that dirt does not enter the fuel injector.

4 Remove the nuts and the clamp which retain the fuel injector to be removed and withdraw the fuel injector. Fit plastic protection caps to the open apertures on the fuel injector to protect it from dirt. Remove and discard the copper sealing washer and the rubber seal, and temporarily seal the top of the fuel injector sleeve to prevent the entry of contamination.

5 To remove a tight fuel injector, use the removal tool supplied in the kit 21825 914; remove all pipes from the fuel injector, place the cylindrical portion of the tool (A1) over the fuel injector to be removed. Unscrew the nut (A2). Rotate the central part of the tool (A3) until the thread fully engages with the thread on the injector. Turn the hexagon nut (A2) with a suitable spanner; this action will lift the injector from its sleeve, without damaging the sleeve. Other, harsher methods, may damage the sleeve or the cylinder head.



Fuel injector sleeves

Steel fuel injector sleeves are fitted through the coolant galleries of each cylinder head and retained by a thread at the bottom of the sleeve. The thread is sealed with 'Loctite 575 or 620' sealing compound.

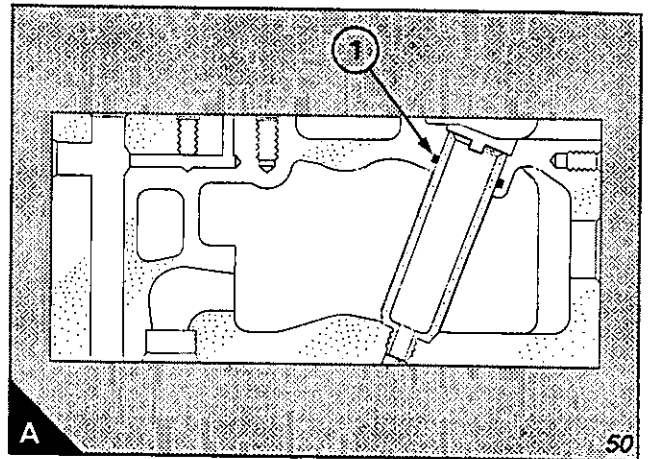
The top of the fuel injector sleeve is sealed by an 'O' ring (A1), which is fitted to a groove in the cylinder head.

How to correct a fuel injector sleeve

Before the fuel injectors are removed, the faces of the seats in the fuel injector sleeves should be cleaned by the method given below

1 To retain carbon and metal particles, grease must be applied to both of the cutters of the tool, 21825909, before it is used. Insert the tool into the fuel injector sleeve and remove the carbon deposits from the faces of the seats. **DO NOT REMOVE METAL FROM THE FACES OF THE SEATS.**

2 When a fuel injector is removed, if the copper sealing washer remains in the fuel injector sleeve, it can be removed with the tool which is used to clean the fuel injector sleeve.



4 PREVENTIVE MAINTENANCE

How to fit a fuel injector

The seal between the nozzle of the fuel injector and the fuel injector sleeve is made by a copper sealing washer which must be renewed at the recommended intervals given in the schedules for the preventive maintenance of the fuel injectors.

To prevent the entry of dirt between the fuel injector and the fuel injector sleeve, a rubber seal is fitted onto the body of the fuel injector over a counterbore in the cylinder head. An aluminium distance piece is then fitted above the rubber seal. When the clamp for the fuel injector is tightened, the rubber seal is pressed into the counterbore. The rubber seal should be renewed at the recommended intervals given in the schedules for the preventive maintenance of the fuel injectors.

1 Ensure that the fuel injector sleeve is clean and is free from carbon deposits.

2 Fit a new rubber seal (A1) onto the body of the fuel injector and a new copper sealing washer (A2) to the nozzle. Fit the aluminium distance piece above the rubber seal.

3 Apply evenly anti-seize compound ('Morris K72', 'Copaslip' or equivalent) to the body of the fuel injector between the arrows (B1). Do NOT allow the anti-seize compound to contaminate the copper washer or the nozzle of the fuel injector (B2).

Caution: Ensure that dirt does not enter the fuel injector.

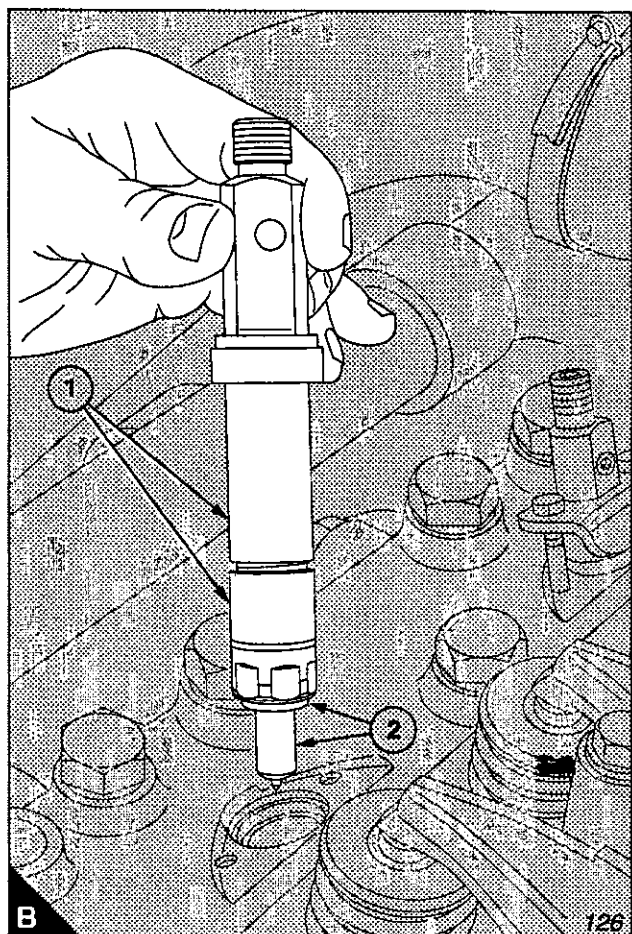
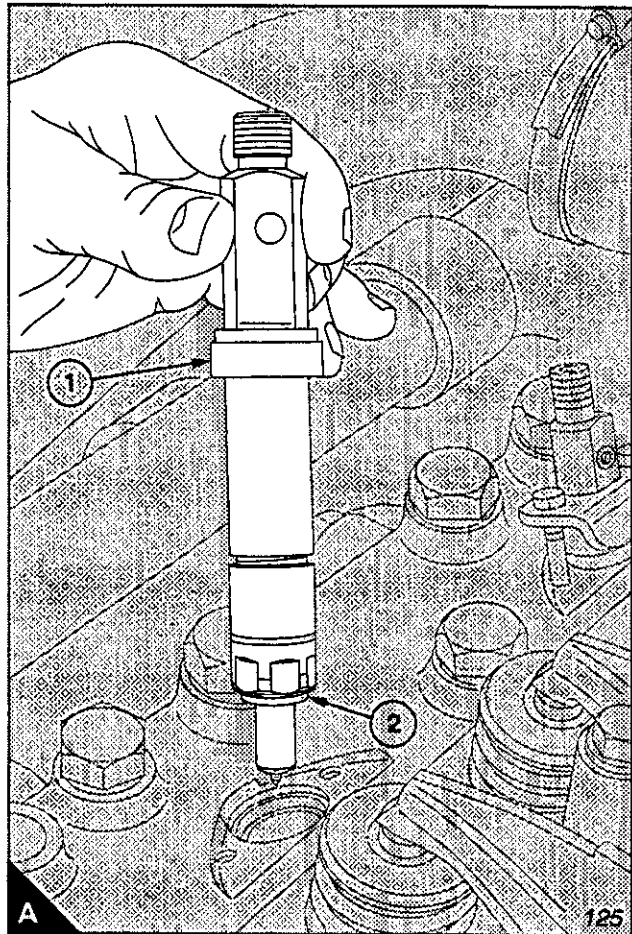
4 If fitted, remove the plastic protection caps from the fuel injector. Fit the fuel injector into the fuel injector sleeve. Apply an even layer of anti-seize compound of 1 mm thickness to the threads of the retaining studs. Retain the fuel injector with the clamp and the nuts. Tighten evenly the nuts to a torque of 11 Nm (8 lbf ft). If the injector studs have been removed these should be refitted and tightened to a torque of 11 Nm (8 lbf ft).

5 Fit the set of the high-pressure fuel pipes. Ensure that there is no tension on the connections and that the connections do not turn when the nuts are tightened.

6 Fit and tighten all clamps which may have been removed.

7 Fit the leak-off pipe, complete with new washers, and eliminate air from the fuel system as given on page 4.13.

8 Run the engine and check for leakage.



How to eliminate air from the fuel system

Air in the fuel system can cause:

- Engine misfire
- Uneven running
- Poor engine performance
- Engine stopping
- Difficulty or failure to start

If air has entered the fuel system, the source of the problem must be traced and the fault eliminated.

Air can enter the system if:

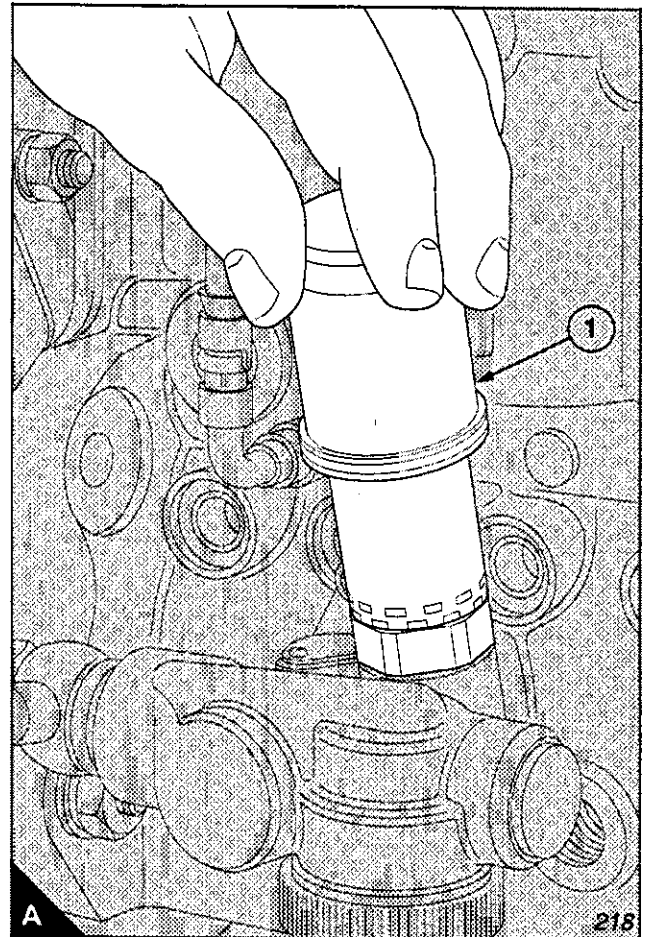
- The fuel tank is drained during normal operation.
- The low-pressure fuel pipes are disconnected.
- There is a leak from the fuel system during the operation of the engine.
- The fuel filter canister has been removed.
- There is a leak from the bowl of the preliminary filter.

To eliminate air from the system, use the procedure which follows:

- 1** Ensure that there is fuel in the operating tank and that all leakages have been eliminated.
- 2** Loosen the union at the outlet pipe from the lift pump; operate the hand priming pump and allow fuel to flow and then retighten the union.
- 3** Continue to operate the hand priming pump and loosen the union on the outlet side of the fuel filter; allow fuel to flow before tightening the union.
- 4** Continue to operate the hand priming pump and loosen in turn, each union where the high pressure fuel injection pipe joins its fuel injector. Tighten the unions once air has been eliminated.
- 5** With all unions tightened, continue to hand prime (A1) until the relief valve is heard to open.

Warning! Ensure that:

- a) Pipes have not been strained or distorted.
- b) Unions and clamps have been correctly tightened.
- c) Fuel does not spray onto your skin.
- d) Spilt fuel has been thoroughly dispersed.



4 PREVENTIVE MAINTENANCE

To check and adjust the tappet clearances

Check and adjust the tappet clearances in the sequence which follows, while the injectors are removed for service.

The tappet clearances are measured between the rocker levers and the tips of the valves (A).

Valves 'rocking' on cylinder No	Check tappets on cylinder No
6	1
3	4
5	2
1	6
4	3
2	5

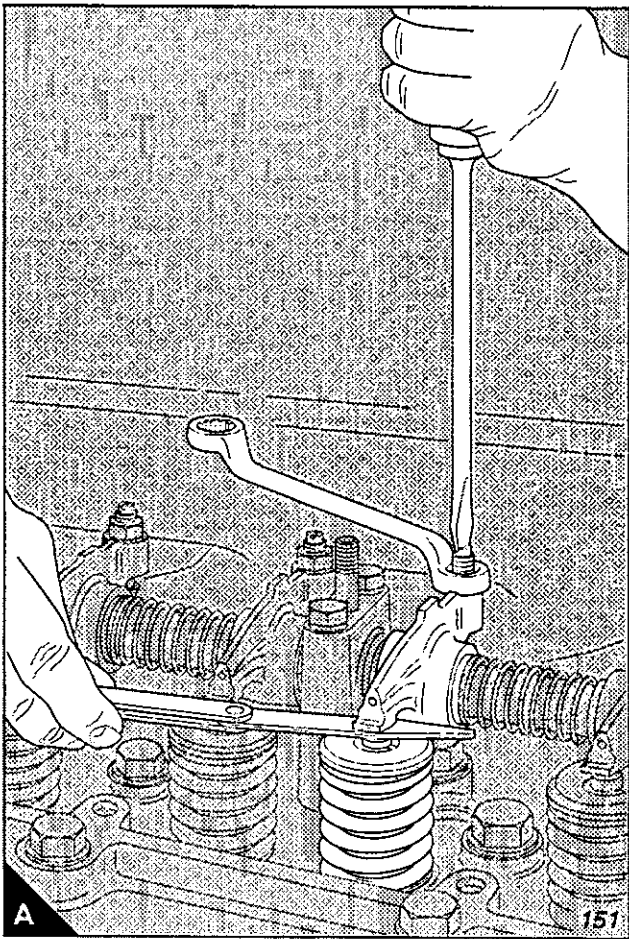
Valves 'rocking' means: inlet valve just opening and exhaust valve just closing.

- 1 Remove the rocker covers.
- 2 Turn the crankshaft in the normal direction of rotation, anti-clockwise when viewed on the flywheel, until the inlet valves of number 6 cylinder are 'rocking'. Check the clearances of the valves of number 1 cylinder and, if necessary, adjust to the correct clearances as shown (A).

When the clearance has been set, tighten the lock nut.

Tappet clearances (cold):

- | | |
|---------|--------------------|
| Inlet | 0,25 mm (0.010 in) |
| Exhaust | 0,50 mm (0.020 in) |
- 3 Continue to turn the engine and adjust the remainder of the tappet clearances in the sequence given above.
 - 4 Fit the rocker covers.



Alternator

The alternator which is fitted on the Tx Series engine is either a CAV or a Prestolite. These have integral regulators and are belt driven.

A typical alternator is the three phase type with rotating field and stationary armature. The rectifier consists of six silicon diodes. These are retained by the two heat sinks in the assembly of the rectifier, which is in the housing at the slip ring end.

Excitation of the field is done by three auxiliary diodes which are assembled in the centre of the rectifier.

The output is controlled by an integral regulator and the maximum rated output (hot) is 55 amps at 28 volts.

A centrifugal fan causes a flow of cool air through the alternator and the fins of the heat sinks.

How to maintain the alternator

Clean the outside of the alternator and ensure that the ventilation holes are clean, at the periods given in the service schedule. Contamination near to the diodes can cause sparks and must be removed with an approved cleaning fluid. A recommended fluid is Electronic Cleaning Fluid, Grade 8-23, available in aerosol containers or in larger quantities from Applied Chemicals Limited, Uxbridge, Middlesex.

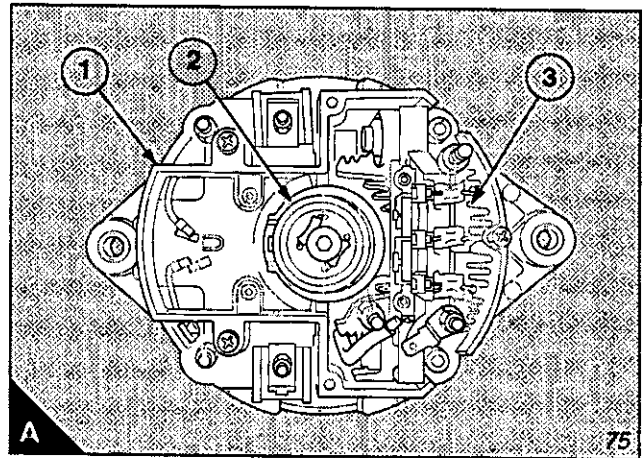
The alternator must be checked and corrected, if necessary, by a person who has had the correct training, at the recommended intervals given in the schedules for the preventive maintenance of the alternator. Proceed as follows:

1 Check the condition and the tension of the drive belt, and adjust or renew as necessary.

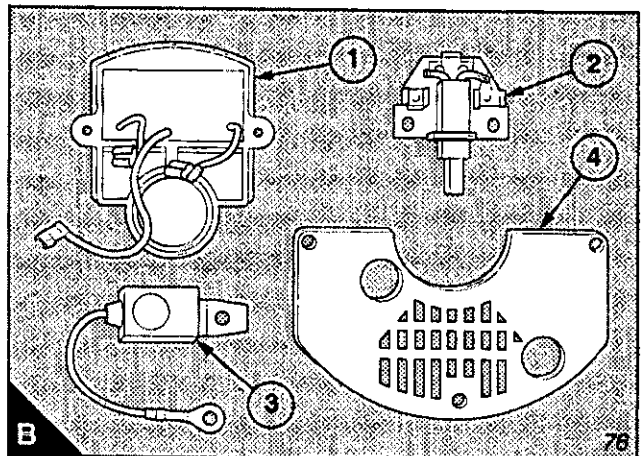
2 Disconnect the two wires of the regulator (B1) from the terminals on the holder (B2) of the carbon brushes. Make a note of the correct position of each wire for their subsequent assembly. Remove the two screws which retain the regulator and lift away the regulator.

3 Remove the screws which retain the holder of the carbon brushes, disconnect the wires and lift out the assembly of the holder.

4 Check the carbon brushes for damage and ensure that they are suitable for use. The minimum possible protrusion of the carbon brushes from the holder must be 10,0 mm (0.394 in). Renew the carbon brushes if the protrusion is less than 10 mm.



- A
- 1 Carbon brush housing
 - 2 Slip ring assembly
 - 3 Rectifier assembly



- B
- 1 Regulator
 - 2 Carbon brush holder
 - 3 Capacitor
 - 4 Plastic cover

5 Remove the four screws which retain the housing of the carbon brushes, withdraw the housing and inspect the assembly of the slip rings.

6 Clean the components and remove all of the dirt. Use a soft clean rag which is damp with gasoline or white spirit. Slip rings which are worn or rough must be renewed.

7 It is recommended that the Manufacturer's Instruction Publication is used as a reference when new components are to be fitted.

4 PREVENTIVE MAINTENANCE

Starter motor

The Prestolite MS1A starter motor is an electrically operated 24 volt unit with a solenoid switch fitted on the outside of the yoke. The drive gear engages with a starter ring which is a component of the flywheel assembly.

How to maintain the starter motor

Caution: Before the starter motor is removed from the engine or other work is done to it, disconnect the cables from the battery terminals.

At intervals, inspect the starter cables for damage and ensure that the nuts of the terminals and the bolts which hold the starter motor are tight.

The starter motor must be checked and corrected, if necessary, by a person who has had the correct training, at the recommended intervals given in the schedules for the preventive maintenance of the starter motor. Remove the starter motor and proceed as follows:

1 Clean the outside of the starter motor and remove the commutator cover. Use dry compressed air to remove dust from the area of the carbon brushes.

2 Inspect the commutator for wear and damage. A polished dark copper finish indicates that the condition is acceptable. Signs of wear or damage indicate that a new or reconditioned commutator is necessary.

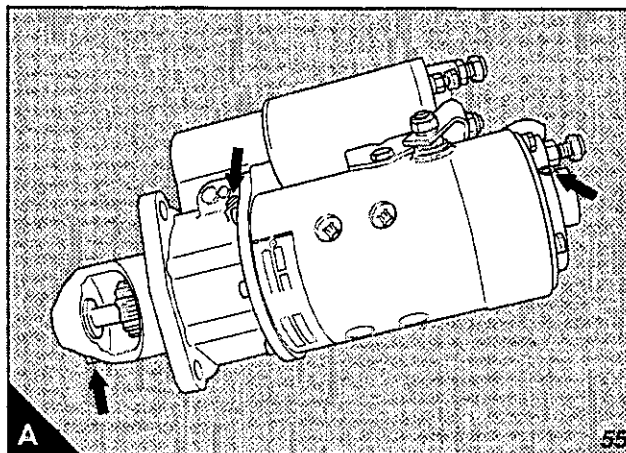
3 Ensure that the carbon brushes slide freely in their holder and check that the load of the springs is 1,42 to 1,68 kgf (50 to 59 ozf). An excessively lower load indicates that the carbon brushes are worn. The minimum acceptable length is 15,9 mm (0.625 in).

4 If new carbon brushes are necessary, the shape of the contact faces must conform to the radius of the commutator. Keep away the wires of the carbon brushes from other components.

5 Spread a thin application of glycerine on the gasket of the cover for the carbon brushes, and fit the ends of the cover across one of the ribbed sections of the yoke. Tighten the two screws which retain the cover to 1,13 to 1,70 Nm (10 to 15 lbf in).

6 Remove the screws from the three points shown by arrows (A) and put three or four drops of SAE 5W/40 engine lubricating oil on the lubricator wicks. Fit the screws to the three points.

A new unit, or an exchange unit, should also be lubricated by the same procedure before it is fitted.



7 Clean the splines of the pinion assembly and lubricate them with a thin application of graphite grease. Check that the pinion moves freely.

8 Ensure that the starter motor is assembled correctly to the engine and retain it securely with the three bolts. Check that the terminals are clean.

9 Fit the lugs of the relevant cables to the two terminals. Ensure that the polarity of the cables is correct and fit the locking washers and the lock nuts, or the self-locking nuts if relevant.

10 Hold a 19 mm (0.75 in) A/F spanner on the inner lock nuts to ensure that they do not move while the outer nuts are tightened to 25 to 30 lbf ft (34 Nm to 41 Nm) with a suitable torque wrench.

How to drain the coolant system

Drain and flush the coolant system every 2 years or less. It is recommended that the coolant system is drained as soon as possible after the engine has been stopped and before the formation of sediment. Proceed as follows:

- 1 Ensure that the engine is level.
- 2 Refer to the manufacturer's instruction publication and remove carefully the filler cap of the radiator or header tank, especially if the engine is hot.
- Warning!** Use care during the removal of the filler cap as the coolant system will be under pressure.
- 3 Remove the coolant drain plugs from:
 - a) the rear of the left side of the engine (A1)
 - b) the pipe between the oil cooler and coolant pump.

Ensure that the drain holes are not restricted.

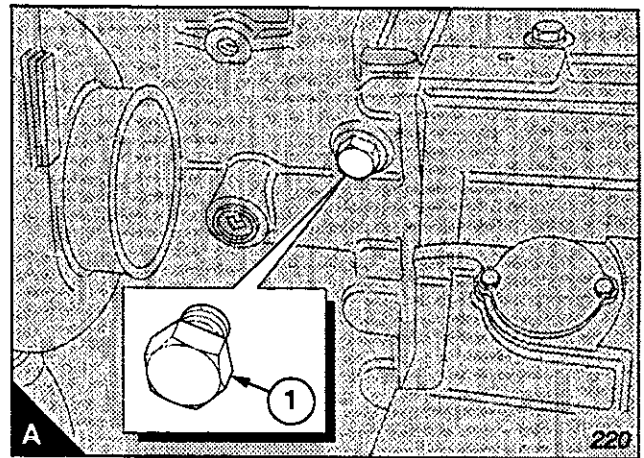
- 4 To drain the radiator, refer to the Manufacturer's Instruction Publication.
- 5 Flush the system with clean water.
- 6 Fit the engine drain plug and all items which were removed in accordance with the Manufacturer's Instruction Publication.
- 7 Fit a 'coolant drained' label if the coolant system is not to be filled immediately.

How to clean the coolant system

The coolant system must be drained and flushed through with clean water until it flows clear from all of the drain outlets.

If the system has become contaminated, it must be cleaned. Use clean water with 1% of Symperonic 'N'. This is equivalent to 10 ml/litre or 45 ml/UK gallon.

- 1 Fill the system with clean water, at the same time add the necessary amount of Symperonic 'N' at the filler cap.
- 2 Operate the engine until the coolant reaches the normal temperature of operation, then operate the engine at maximum rated speed for 10 minutes. See 'Warning' at the end of this section.
- 3 Stop the engine and drain immediately the coolant from all of the drain outlets.



- 4 Allow the engine to cool, then fill the system with clean water. Allow a minimum of 5 litres (1 UK gallon) to drain from the system before the drain outlets are closed.
- 5 Operate the engine as in operation 2, but maintain maximum speed for 5 minutes only.
- 6 Repeat operations 3, 4 and 5.
- 7 Drain the system completely and close the drain outlets. Fill the system with the correct coolant mixture.

Note: In very cold ambient conditions, the thermostat may not open to allow full circulation of the cleaning fluid. If this occurs the engine must be operated on load. The thermostat is open when the pipe between the thermostat housing and the radiator is hot. If the pipe is cool, the thermostat valve is closed.

How to fill the coolant system

Fill the system slowly, with the approved coolant mixture, until the coolant is just in contact with the bottom of the filler tube inside the radiator or as specified in the vehicle manual. For radiators which have a short filler tube: check that the level of the coolant mixture is 76 mm (3 in) below the top of the filler tube of the radiator. Operate the engine until the coolant reaches the normal temperature of operation. Stop the engine, check the coolant level and, if necessary, add extra coolant. Fit the filler cap.

Warning! Use care during the removal of the filler cap as the coolant system will be under pressure.

4 PREVENTIVE MAINTENANCE

How to check the turbocharger

Disconnect and remove the pipes from between the air filters and the turbocharger, at the periods given in the service schedule.

1 Turn, rapidly, the rotor assembly, check for freedom of movement and for sounds of interference. If necessary, overhaul or renew the turbocharger.

2 Check for signs of severe oil leakage into the compressor housing. If necessary, overhaul or renew the turbocharger.

Deposits must not be removed from the turbine wheel nor the compressor wheel, or the balance of the assembly will be adversely affected.

The turbochargers fitted to the 380Tx and 410Tx range of engines incorporate waste-gates; these monitor the boost delivery pressure in the turbocharger compressor and once this reaches a pre-set figure a valve opens and allows the excess pressure to escape. The operation of the waste-gate should be checked as follows:

1 Apply air pressure upto a maximum of 207 kN/m² (30 lbf/in²) and feel for movement of the end of the control rod. This should be about 1,15 mm (0.045 in).

2 If the rod fails to move, disconnect the rod from its lever and try to move the lever by hand. If the lever is stiff, that part of the turbocharger must be dismantled and cleaned.

3 With the rod still disconnected, test the assembly again with air pressure upto 207 kN/m² (30 lbf/in²). If the rod fails to move, the diaphragm and rod assembly must be renewed.

Coolant pump

Examine the exterior of the coolant pump. Check for signs of leakage. Overhaul or renew as necessary.

Tensioner pulley for fan belts

At the periods given in the service schedule the tensioner pulley must be inspected. Proceed as follows:

1 Remove the fan belts as given on page 4.05.

2 Check that the pulley assembly is retained securely.

3 Check the condition of the bearings and renew if necessary.

4 Fit the fan belts and alternator belt as given on page 4.05.

Engine damper

At the periods given in the service schedule, examine the engine damper. Check for damage and signs of leakage. Renew if necessary.

Air compressor

At the periods given in the service schedule, check the performance of the air compressor. Examine the exterior for damage or signs of oil or air leaks. Overhaul or renew as necessary.

Cylinder head bolts

The cylinder head bolts of all Eagle Tx2000 engines are correctly tightened before they leave the factory and require no further tightening in service.

In an emergency, should it be necessary to remove and fit a cylinder head, detailed instructions are given in the workshop manual. Advice or assistance may be obtained from your nearest distributor or from the Service Department at Perkins Shrewsbury.

Engine fluids**5**

Diesel fuel	...	...	...	...	...	...	5.02
Coolant							
Coolant mixture	...	...	...	...	...	...	5.02
Corrosion Inhibitor	...	...	...	...	...	...	5.02
Water quality	...	...	...	...	...	...	5.02
Lubricating oil	...	...	...	...	...	...	5.02
Engine oils							
Europe	...	...	...	...	...	...	5.03
Remainder of the world	...	...	...	...	...	...	5.04

5 ENGINE FLUIDS

Diesel fuel

Diesel fuel must conform to the specifications below:

BS EN 590:1993 - (0.2% sulphur maximum - 49 minimum cetane number). Fuel oils for automotive use, or

BS 2869: Part 2 1988 Class 2 - 0.5% sulphur maximum - 45 minimum cetane number). Fuel oils for non-marine use.

ASTM Diesel Fuel Classification: D.975 No.1-D or

ASTM Diesel Fuel Classification: D.975 No.2-D.

The use of fuels that do not conform to the above standards can cause damage and/or reduced engine life and could affect the warranty. Further details can be obtained from Perkins Shrewsbury.

Coolant

Coolant mixture

The coolant approved for use in all diesel engines manufactured by Perkins Shrewsbury is a mixture of 50% inhibited ethylene glycol, or inhibited propylene glycol, and 50% clean soft water.

Mixtures which contain methanol are **NOT** approved.

The corrosion inhibitor in the anti-freeze or coolant concentrate, must be based on sodium nitrite, sodium benzoate, sodium borate, sodium metasilicate and benzotriazole.

Neither amines nor phosphates to be used. If operators are in doubt, they should consult their source of supply.

In addition, all products which are used should conform to BS 6580-1992.

Corrosion Inhibitor

If anti-freeze is not available and is not required then clean soft water, with 1% of Perkins Shrewsbury corrosion inhibitor, may be used. This ratio is equivalent to 0.5 litres of corrosion inhibitor to 50 litres (11 UK gallons) of water.

The corrosion inhibitor is available from Perkins Shrewsbury, part number OE 45350 (1 litre).

The use of this product should be controlled in accordance with the manufacturer's instructions.

Water quality

Soft water means de-ionised water, distilled water, rain water, or water from a mains supply which has a maximum combined chloride and sulphate level of

150 mg/litre and a maximum total hardness of 250 mg/litre.

i) If soft water is not used, the cooling system may be affected by the formation of hard deposits which can cause the engine to overheat. This is especially important for engines which are topped up frequently.

ii) The use of products which are not approved for the cooling system may cause serious problems. Coolant mixtures with insufficient corrosion inhibitor can cause erosion and/or corrosion of the cooling system components.

Lubricating oil

1 Viscosity - The lubricating oil recommendations are given on page 4.02.

For engines which are scheduled to operate in arctic conditions, below -25°C (-13°F), contact the Service Department, Perkins Shrewsbury.

2 Performance specification - For heavy duty operation, or extended drain (Eagle Tx only), the lubricating oils equal to, or exceeding the requirements of CCMC-D5 and API-CE or Merc 228.3 must be used and these are listed in the 'preferred' columns of the tables section 5.03.

For normal operation, oils which exceed the requirements of CCMC-D4 and API-CE may be used. These oils are listed in the 'acceptable' columns of the tables section 5.03.

In countries where oils which conform to API-CE or Merc, are not yet available, an oil which conforms to API-CD/MIL-L-2104D may be used, as given on page 5.04.

It is strongly recommended that the operator uses oils shown in the 'preferred' columns as these give the greatest protection.

Below is a list of oils which comply with the Perkins recommendations. The operator must ensure that the oil used conforms to the above requirements.

Europe

Manufacturer lubricating oil	Preferred multi-grade oils which conform to CCMC D5, API-CE or Merc 228.3	Acceptable multi-grade oils which conform to CCMC D4, API-CE-4
AGIP	Sigma Turbo 15W/40	Super Diesel 15W/40
BP	Vanellus C3 Extra 15W/40 Vanellus FE 10W/30 Vanellus HT 10W/40	Vanellus C3 15W/40 Vanellus C3 10W/30
CALTEX	ONLY MARKETING IN MIDDLE EAST, SOUTH AND EAST AFRICA AND AUSTRALASIA	ONLY MARKETING IN MIDDLE EAST, SOUTH AND EAST AFRICA AND AUSTRALASIA
CASTROL	Turbomax 15W/40	RX Super Plus 15W/40
CENTURY	Centurion 15W/40	Hypafleet 15W/40
CHEVRON	Delo SHP 15W/40	
DALTONS	Turbolene D Plus 15W/40	Turbolene D 15W/40 Ashford 15W/40
ELF	Performance Trophy 15W/40	Performance Super 15W/40
ESSO	Essolube TDX 10W/40 Super Diesel Oil TD 15W/40	Essolube XD-3+ 15W/40
GULF	Superfleet Special 15W/40	Superfleet 15W/40 Super Diesel Multi-grade 15W/40
KUWAIT	Q8T 700 15W/40	Q8T 800 Q8T 400
MILLERS	Truckmaster XHPD 15W/40 Magna fleet SHPD 15W/40 Truckmaster XFE 10W/30	Maxifleet MP 15W/40 Multifleet 15W/40 Suprex 15W/40
MOBIL	Delvac XHP 15W/40	Delvac Super 15W/40 Delvac 1300 Super 15W/40
MORRIS	XHD Plus 15W/40 XHD FE 10W/30 XHD 15W/40	Duplex CDX 15W/40
NICKERSON	Caroylak SHPD 15W/40	Caroylak HDC/X 15W/40
PETROFINA	Fina Kappa LDO 15W/40	Fina Kappa TD 15W/40
SHELL	Myrina TX 10W/30 Myrina M 15W/40	Rimula X 15W/40
SUN	Sunoco Super HPD 15W/40	
TEXACO	URSA Super TD 15W/40	URSA Super LA 15W/40 URSA Super LA 10W/30 URSA Super FE 15W/40
VEEDOL	Turbostar 15W/40 NOT AVAILABLE IN THE UK	Dieselstar Plus 15W/40 NOT AVAILABLE IN THE UK

5 ENGINE FLUIDS

Remainder of the world

Manufacturer lubricating oil	Preferred multi-grade oils which conform to CCMC D5, API-CE-4 or Merc 228.3	Acceptable multi-grade oils which conform to API-CE/CD, MIL-L-2104D
AGIP	Sigma Turbo 15W/40	Super Diesel 15W/40
BP	Vanellus C3 Extra 15W/40 Vanellus FE 10W/30	Vanellus C3 15W/40
CALTEX	RPM Delo 450 15W/40	RPM Delo 400 15W/40 (Advanced)
CASTROL	Turbomax 15W/40	RX Super Plus 15W/40
CENTURY	Centurion 15W/40 Superby 15W/40 MIDDLE EAST, FAR EAST AND AUSTRALIA	Hypafleet 15W/40 MIDDLE EAST, FAR EAST AND AUSTRALIA
CHEVRON	Delo SHP 15W/40	
DALTONS	Turbolene D Plus 15W/40 AVAILABLE MIDDLE EAST ONLY	Ashford 15W/40 AVAILABLE MIDDLE EAST ONLY
ELF	Disola W 15W/40	
ESSO	Super Diesel Oil TD 15W/40	Essolube XD-3+ 15W/40 Essolube XD-3 15W/40
KUWAIT	Q8T 700	Q8T 800 Q8T 400
MILLERS	AVAILABLE ONLY BY SPECIAL ORDER	AVAILABLE ONLY BY SPECIAL ORDER
MOBIL	Delvac XHP 15W/40	Delvac Super 15W/40 Delvac 1300 Super 15W/40
MORRIS	XHD Plus 15W/40 XHD 15W/40 XHD FE 10W/30	Duplex CDX 15W40
PETROFINA	Fina Kappa LDO 15W/40	Fina Kappa TD 15W/40
SHELL	Myrina M 15W/40	Rimula X 15W/40 Rotella T 15W/40
TEXACO		URSA Premium 15W/40 URSA Super Plus 15W/40
VEEDOL	Turbostar 15W/40	Dieselstar Plus 15W/40 Dieselstar 15W/40 Ultistar 25W/40

Warranty

The engine must be operated with the approved fuel, lubricant and coolant, and maintained in accordance with the service schedule or the warranty can become invalid.

Fault diagnosis					6
Problems and possible causes	...	...	...	...	6.02
Code list of possible causes	...	...	...	...	6.03

6 FAULT DIAGNOSIS

Problems and possible causes

Problem	Possible causes	
	Checks by the user	Checks by service personnel
The starter motor turns the engine too slowly	1, 2, 3, 4	
The engine will not start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 17	34, 35, 36, 37, 38, 42, 43, 44
The engine is difficult to start	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19	34, 36, 37, 38, 40, 42, 43, 44, 64
Not enough power	8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20, 21	34, 36, 37, 38, 39, 42, 43, 44, 61, 63, 64
Misfire	8, 9, 10, 12, 13, 15, 20, 22	34, 36, 37, 38, 39, 40, 41, 43
High fuel consumption	11, 13, 15, 17, 18, 19, 21, 22	34, 36, 37, 38, 39, 40, 42, 43, 44, 63, 64
Black exhaust smoke	11, 13, 15, 17, 19, 21, 22	34, 36, 37, 38, 39, 40, 42, 43, 44, 61, 63, 64
Blue or white exhaust smoke	4, 15, 21, 23	36, 37, 38, 39, 42, 44, 45, 52, 58, 62
The pressure of the lubricating oil is too low	4, 24, 25, 26	46, 47, 48, 50, 51, 59
The engine knocks	9, 13, 15, 17, 20, 22, 23	36, 37, 40, 42, 44, 46, 52, 53, 60
The engine runs erratically	7, 8, 9, 10, 11, 12, 13, 15, 16, 18, 20, 22, 23	34, 38, 40, 41, 44, 52, 60
Vibration	13, 18, 20, 27, 28	34, 38, 39, 40, 41, 44, 52, 54
The pressure of the lubricating oil is too high	4, 25	49
The engine temperature is too high	11, 13, 15, 19, 27, 29, 30, 32	34, 36, 37, 39, 52, 55, 56, 57
Crankcase pressure	31, 33	39, 42, 44, 45, 52
Bad compression	11, 22	37, 39, 40, 42, 43, 44, 45, 53, 60
The engine starts and stops	10, 11, 12	6, 7, 8, 9, 10, 12, 16, 34, 35

Code list of possible causes

- | | | | |
|----|--|----|---|
| 1 | The battery capacity is low. | 34 | A fault in the fuel injection pump. |
| 2 | A bad electrical connection. | 35 | A broken drive on the fuel injection pump. |
| 3 | A fault in the starter motor. | 36 | The timing of the fuel injection pump is incorrect. |
| 4 | The wrong grade of lubricating oil. | 37 | The valve timing is incorrect. |
| 5 | The starter motor turns the engine too slowly. | 38 | There is bad compression. |
| 6 | The fuel tank is empty. | 39 | The cylinder head gasket leaks. |
| 7 | A fault in the stop control. | 40 | The valves are not free. |
| 8 | A restriction in a fuel pipe. | 41 | Wrong high-pressure pipes. |
| 9 | A fault in the fuel lift pump. | 42 | The cylinder bores are worn. |
| 10 | A dirty element of the fuel filter. | 43 | A leakage between the valves and the seats. |
| 11 | A restriction in the air filter or the induction system. | 44 | The piston rings are not free, or they are worn or damaged. |
| 12 | There is air in the fuel system. | 45 | The valve stems and/or the guides are worn. |
| 13 | A fault in the fuel injectors, or the fuel injectors are of the wrong type. | 46 | The crankshaft bearings are worn or damaged. |
| 14 | The cold start system is not used correctly. | 47 | The lubricating oil pump is worn. |
| 15 | A fault in the cold start system. | 48 | The relief valve does not close. |
| 16 | A restriction in the vent of the fuel tank. | 49 | The relief valve does not open. |
| 17 | The wrong type or grade of fuel has been used. | 50 | The spring of the relief valve is broken. |
| 18 | A restriction in the movement of the engine speed control. | 51 | A fault in the suction pipe of the lubricating oil pump. |
| 19 | A restriction in the exhaust pipe. | 52 | A piston is damaged. |
| 20 | The engine temperature is too high. | 53 | The piston height is incorrect. |
| 21 | The engine temperature is too low. | 54 | The flywheel housing, or the flywheel, is not aligned correctly. |
| 22 | The tappet clearances are incorrect. | 55 | A fault in the thermostat or the thermostat is of a wrong type. |
| 23 | Too much oil, or oil of a wrong specification is used in a wet type air cleaner. | 56 | A restriction in the coolant passages. |
| 24 | Not enough lubricating oil in the sump. | 57 | A fault in the water pump. |
| 25 | A defective gauge. | 58 | There is damage to the oil seals (if they are fitted) of the valve stems. |
| 26 | A dirty element of the lubricating oil filter. | 59 | A restriction in the sump strainer. |
| 27 | The fan is damaged. | 60 | A valve spring is broken. |
| 28 | A fault in the mountings of the engine or the flywheel housing. | 61 | The impeller of the turbocharger is damaged or is dirty. |
| 29 | Too much lubricating oil in the sump. | 62 | Leakage of lubricating oil from the oil seal of the turbocharger. |
| 30 | A restriction in the air passages or in the water passages of the radiator. | 63 | The induction system leaks (turbocharged engines). |
| 31 | A restriction in the breather. | 64 | Damaged or defective waste-gate. |
| 32 | There is insufficient coolant in the system. | | |
| 33 | A fault in the exhaust, or there is a leakage in the vacuum pipe. | | |

Engine preservation**7**

Storage	...	...	...	...	...	...	7.02
Short period storage	...	...	...	...	...	...	7.02
Long period storage	...	...	...	...	...	...	7.02
Removal from storage	...	...	...	...	...	...	7.03
Approved products for engine preservation	...	...	...	...	...	...	7.04

7 ENGINE PRESERVATION

Storage

When the engine is not in use, temporarily or for a longer period, it must be protected from corrosion. The amount and the type of treatment to prevent corrosion during storage is according to the length of the period of storage. When necessary, there must also be protection from frost.

The engine is fitted with a composite sump and to avoid possible damage, the engine must not be allowed to rest on its sump.

All new and reconditioned engines which leave the Factory have been inhibited to Perkins Engines' standards. An engine may be in storage, under a cover and in dry conditions, for a maximum period of 12 months from the date it left the Factory, without the need for it to be inhibited again.

After a period of 12 months of storage, the engine must be inspected thoroughly and must be again inhibited.

Short period storage

Up to seven days:

No treatment is necessary.

Up to three months:

Each week, operate the engine until the normal temperature of operation is reached. If the engine cannot be operated, turn the crankshaft by hand, in the normal direction of rotation (anti-clockwise as seen on the flywheel), a minimum of three revolutions.

Long period storage

If it is necessary to put an engine into storage for a period of between three and twelve months, use this procedure:

1 Remove the thermostat from its housing and carefully clean it. Apply a silicone grease, such as MS4, to the valve stems of the thermostat and operate the valves by hand to ensure that the grease enters the glands. Fit the thermostat to its housing.

2 Operate the engine until the normal temperature of operation is reached. Stop the engine and drain immediately the lubricating oil from the sump and from the canisters of the oil filter (see 'Caution' on this page).

3 Fill the canisters of the oil filter with PX4 corrosion inhibitor and fit the canisters to the filter head (see 4.07).

4 Fill the sump, to the normal oil level, with PX4 corrosion inhibitor and, once again, run the engine until the normal temperature of operation is reached.

5 Stop the engine, disconnect the fuel supply pipe and connect the pipe to a supply of PX4 corrosion inhibitor. Start the engine, while it is still hot, and operate the engine, with no load, for ten minutes. Stop the engine.

6 Disconnect the supply of PX4 corrosion inhibitor from the fuel system and seal the end of the pipe. Drain the fuel filters.

Note: The canisters of the oil filters and the fuel filters are designed so that when fitted upside down, the lubricating oil or fuel does not drain from the canister, when the engine is stopped.

To drain a canister, hold the canister over a suitable container, insert a small tool into one of the inlet openings and carefully press open the rubber, non-return seal. During this operation, do not damage the rubber seal or the element of the filter.

Fasten a label, at a position where it will be seen, to indicate that the fuel system has been disconnected.

7 Remove the fuel injectors and put them in a container of PX4 corrosion inhibitor.

8 Set the fuel control lever to the **NO FUEL** position, remove the rocker covers and disconnect the air filter(s).

9 Turn the engine by the use of the starter and, at the same time, spray PX4 corrosion inhibitor into the manifolds until an emission of vapour is seen from each opening for the fuel injectors. Connect the air inlet pipes. Connect the air filter(s).

10 Spray 40 cc of PX4 corrosion inhibitor into each cylinder, through the openings for the fuel injectors. Fit the fuel injectors.

Caution: The engine must NOT be turned after this operation and a label must be fitted to this effect.

11 Spray PX4 corrosion inhibitor around the valves and around the rocker assemblies. Refit the rocker covers.

12 Drain the PX4 corrosion inhibitor from the sump of the engine and from the oil filter canisters. Fit a **NO OIL** label to the oil filler cap.

13 Drain the cooling system and fill with the recommended coolant mixture (see page 5.02).

Caution: The mixture must NOT contain less than 50% inhibited ethylene glycol or propylene glycol, and may contain up to 90% by volume.

14 Wait for 15 minutes, then drain completely the coolant mixture. Fit a **NO COOLANT** label to the filler cap of the radiator.

15 Disconnect the exhaust pipe at the turbocharger outlet, or at the junction of the manifolds if the engine has a normal aspiration system. Inject two grammes of VPI 260 powder and fit a blanking plug. Do NOT connect the exhaust pipe.

16 Inject two grammes of VPI 260 powder into the turbocharger, if relevant.

17 Disconnect the air ducts between the air filter(s) and the turbocharger and inject two grammes of VPI 260 powder into the air ducts.

18 Inject two grammes of VPI 260 powder into each paper element type air filter. Other types of air cleaners may be sprayed inside with PX4 corrosion inhibitor. Fit the air ducts.

19 Spray Crodafluid PM47 onto areas of the engine and auxiliary equipment which are not protected by paint. Ensure that the fuel control linkage is sprayed with Crodafluid PM47.

Caution: Do NOT spray PM47 into the vent holes of the alternator.

20 Cover, completely, the alternator and the starter motor in mouldable wax wrapping, and seal with adhesive tape.

21 Seal the air filter inlets, the crankcase breather and all other openings with mouldable wax wrapping and adhesive tape.

22 Remove all drive belts, apply French chalk to the belts and put them in a sealed plastic bag. Fasten the bag to the engine.

23 Fasten to the engine a label which indicates:

- (a) That the exhaust system has been sealed.
- (b) The dates when the corrosion inhibitors were applied to the engine and when the corrosion inhibitors must be applied again.

If the engine is to remain in storage for more than one year, the above procedure must be repeated at the end of each period of twelve months.

Removal from storage

To prepare the engine for use, after it has been in storage, refer to section 3 - Operation instructions. The information given applies to new engines and to those engines which have been removed from storage.

7 ENGINE PRESERVATION

Approved products for engine preservation

Component	Product	Manufacturer
Thermostat	MS4 silicone grease	Ambersil Limited Whitney Road Basingstoke Hampshire
Lubrication system	PX4 corrosion inhibitor	Croda Chemicals Limited Churchill Road Doncaster Yorkshire
Fuel system	PX4 corrosion inhibitor	Croda Chemicals Limited
Valves and rocker assemblies	PX4 corrosion inhibitor	Croda Chemicals Limited
Cooling system	Inhibited ethylene glycol or inhibited propylene glycol	Various
Induction/exhaust systems	PX4 corrosion inhibitor VPI 260 powder	Croda Chemicals Limited Shell Chemicals Limited Stanlow Terminal Ellesmere Port Cheshire
Engine and auxiliaries - outer casing	Crodafluid PM47 Mouldable wax wrapping	Croda Chemicals Limited Carrs Paper Limited Shirley Solihull West Midlands

Parts and service**8**

Introduction	...	...	...	...	...	...	8.02
Service literature	...	...	...	...	...	...	8.02
Training	...	...	...	...	...	...	8.02
Service Bulletins	...	...	...	...	...	...	8.02

8 PARTS AND SERVICE

Introduction

If problems occur with your engine or with the components fitted to it, your Perkins distributor can make the necessary repairs. Your Perkins distributor will ensure that only the correct parts are fitted and that the work is done correctly.

Certain components can be supplied by your Perkins distributor through the Perkins POWER EXCHANGE System. These will enable you to reduce the cost of certain repairs.

Service literature

Workshop manuals and other service publications are available from your Perkins distributor at a nominal cost.

Training

A four day course on the service and the overhaul of the Eagle range of engines is available at the Factory. For details, apply to: The Customer Training Centre, Perkins Engines Company Limited, Shrewsbury, Shropshire.

Service Bulletins

Service procedures and engine design are checked continuously at Perkins Engines. As a result of this development work, it may become necessary to alter the information in manuals and other service publications. Between revisions of the literature, all relevant personnel are provided with full details of changes as they occur. The information is produced as a Service Bulletin; these are supplied to distributors for distribution as necessary.

Changes to engine design and service procedures are published as Service Bulletins for addition to any relevant Manuals.

Engine data**9**

General	...	...	...	...	...	...	9.02
Cooling system	...	...	...	...	...	...	9.02
Fuel system	...	...	...	...	...	...	9.03
Lubrication system	...	...	...	...	...	...	9.03
Induction/exhaust system	...	...	...	...	...	...	9.03
Electrical equipment	...	...	...	...	...	...	9.03
Auxiliary equipment	...	...	...	...	...	...	9.03
Optional equipment	...	...	...	...	...	...	9.03

9 ENGINE DATA

Eagle Tx2000

340Tx, 380Tx and 410Tx

General

Number of cylinders	6
Cylinder arrangement	In-line
Cycle	Four stroke
Induction system	
340Tx (all versions)	Turbocharged
380Tx and 410Tx	Turbocharged with waste-gate
Combustion system	Direct injection
Nominal bore	130,17 mm (5.125 in)
Stroke	152,4 mm (6.000 in)
Compression ratio	17.8:1
Cubic capacity	12,17 litres (742.64 in ³)
Firing order	1, 4, 2, 6, 3, 5
No. 1 cylinder is at front (fan end)	
Tappet clearances (cold)	
Inlet	0,25 mm (0.010 in)
Exhaust	0,50 mm (0.020 in)
Direction of rotation	Counter-clockwise: view on flywheel
Injection timing	As stamped on engine data plate
Dry weight of engine (approximate)	
340Tx, 380Tx and 410Tx	1050 kg
Cooling system	
Capacity of coolant system	
(engine only)	18 litres
Coolant system pressure	Maximum 70 kN/m ² (10 lbf/in ²) to suit installation
Temperature (normal)	
At sea level	82 to 103°C (180 to 217°F)
Thermostat	Triple-element wax capsule type with radiator by-pass

Fuel system**Type**

Low-pressure supply to fuel injection pump with through flow return to tank

Fuel injection pump

340Tx

Inline P7100 with boost control device fitted. Automatic selection of excess fuel and retarded timing for starting.

380Tx and 410Tx

Inline P8500 with boost control device fitted. Automatic selection of excess fuel and retarded timing for starting.

Governor

340Tx

Variable speed 'K' Cam type RQV250-900 PA1224K

380Tx and 410Tx

Variable speed 'K' Cam type RQV250-900 PA1223K

Lift pump

Single acting, with integral preliminary fuel filter

Fuel supply pressure

159 to 255 kN/m² (23 to 37 lbf/in²)

Fuel injectors

Low spring type, 8 hole; opening pressure 250 bar

Main fuel filter

Single screw-on type canister

Lubrication system**Type**

Wet sump

Lubricating oil pressure

Normal load conditions

350 to 480 kN/m² (50 to 70 lbf/in²)

Minimum at rated speed

*207 kN/m² (30 lbf/in²)

Capacity of lubricating oil

41 litres to maximum mark on dipstick

Pressure relief valve

Spring loaded plunger in body of oil pump

Oil-to-coolant heat exchanger

Single unit, tube stack type with partial by-pass for coolant

Filters

Two screw-on type canisters with integral by-pass valves and lubricating oil by-pass filter

Induction/exhaust system**Aspiration**

340Tx

Pressure charged by turbocharger OE52534

380Tx and 410Tx

Pressure charged by turbocharger OE52535, incorporating waste-gate control

Electrical equipment**Alternator**

Belt driven unit, output 24 volts, option of 55 or 70 amps

Starter motor

Single flange-mounted 24 volt

Auxiliary equipment**Air compressor**

Twin cylinder, flange mounted and gear driven at 1.212 x engine speed. Fitted with an air intake filter

* Important for the protection of turbocharger bearings

Perkins Engines Company Limited
Lancaster Road
Shrewsbury, Shropshire SY1 3NX
Telephone: (01743) 212000 Telex: 35171/2

Copyright Perkins Engines Company Limited 1998

Subject to any existing rights of third parties, the information given in this document is the property of Perkins Engines Company Limited and should not be copied (in whole or in part) or used for the manufacture or otherwise disclosed without the written consent of the Company. This does not preclude use by engine and equipment operators for normal instructional maintenance or overhaul purposes.

TSD Publication 3429 (Issue 3)

Issued by Technical Publications Department
Perkins Engines Company Limited
Shrewsbury

CALIFORNIA
Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Asia

Perkins Engines (Asia Pacific) Pte Ltd
7 Tractor Road
Singapore 627968
Telephone +65 6828 7469
Fax +65 6828 7414

Europe, Middle East and Africa

Perkins Engines Company Limited
Peterborough PE1 5NA
United Kingdom
Telephone +44 (0)1733 583000
Fax +44 (0)1733 582240

North America

Perkins Engines Inc
N4 AC 6160
PO Box 610
Mossville, IL 61552-0610, USA
1-888-PERK-ENG
Telephone +1 309 578 7364
Fax +1 309 578 7329

Latin America

Perkins Motores do Brasil Ltda
Rua Alexandre Dumas, 1711 Ed. Birman 11, 9º andar
Chácara Santo Antonio
São Paulo / SP - Brasil
Cep: 04717-004
Telephone +55 11 2109 2038
Fax +55 11 2109 2089



 **Perkins®**

www.perkins.com