

Safety precautions

These safety precautions are important. You must refer also to the local regulations in the country of use. Some items only apply to specific applications.

- 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. Attention: 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.
- Ensure that the engine is operated only from the control panel or from the operator's position.
- 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.
- Do not move mobile equipment if the brakes are not in good condition.
- Ensure that the control lever of the transmission drive is in the "out-of-drive" position before the engine is started.
- Use extreme care if emergency repairs must be made at sea or in adverse conditions.
- 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.
- Read and use the instructions relevant to asbestos joints.
- Fit only genuine Perkins parts.



Basic engine data

Number of cylinders	...	...	...	...	...	...	...	...	...	...	4
Cylinder arrangement	...	...	...	...	...	...	...	...	...	...	In-line
Cycle	...	...	...	...	...	...	...	...	...	...	Four stroke
Induction system	...	...	...	...	...	...	...	...	...	...	Naturally aspirated or turbocharged
Combustion system	...	...	...	...	...	...	...	...	...	...	Direct injection
Nominal bore	...	...	...	...	...	...	...	...	...	...	84,5 mm (3.33 in)
Stroke	...	...	...	...	...	...	...	...	...	...	88,9 mm (3.50 in)
Compression ratio:											
- Naturally aspirated vehicle and M60 engines	...	...	...	...	...	...	...	...	...	...	18.1:1
- Turbocharged vehicle and M80T engines	...	...	...	...	...	...	...	...	...	...	17.2:1
- 500 and M50 engines	...	...	...	...	...	...	...	...	...	...	17.0:1
Cubic capacity	...	...	...	...	...	...	...	...	...	...	1,994 litres (122 in ³)
Firing order	...	...	...	...	...	...	...	...	...	...	1, 3, 4, 2
Tappet clearances (cold):*											
I - Inlet (cylinder head fitted to block)	...	...	...	...	...	...	...	...	...	...	0.25/0.35 mm (0.010/0.014 in)
(cylinder head not fitted to block)	...	...	...	...	...	...	...	...	...	...	0.30/0.40 mm (0.012/0.016 in)
I - Exhaust (cylinder head fitted to block)	...	...	...	...	...	...	...	...	...	...	0.35/0.45 mm (0.014/0.018 in)
(cylinder head not fitted to block)	...	...	...	...	...	...	...	...	...	...	0.40/0.50 mm (0.016/0.020 in)
I * Adjust only if clearances are outside limits of:											
1 - Inlet (cylinder head fitted to block)	...	...	...	...	...	...	...	...	...	...	0.20/0.40 mm (0.008/0.016 in)
(cylinder head not fitted to block)	...	...	...	...	...	...	...	...	...	...	0.25/0.45 mm (0.010/0.018 in)
I - Exhaust (cylinder head fitted to block)	...	...	...	...	...	...	...	...	...	...	0.30/0.50 mm (0.012/0.028 in)
(cylinder head not fitted to block)	...	...	...	...	...	...	...	...	...	...	0.35/0.55 mm (0.014/0.022 in)
Lubricating oil pressure (minimum at maximum engine speed and normal engine temperature)	...	...	...	...	...	...	...	...	...	...	250 kN/m ² (36 lbf/in ²) 2,5 kgf/cm ²
Direction of rotation	...	...	...	...	...	...	...	...	...	...	Clockwise from the front

11B RECOMMENDED TORQUE TENSIONS

Recommended torque tensions

The torque tensions below apply to components lubricated lightly with clean engine oil before they are fitted.

Description	Thread size	Torque		
		Nm	lbf ft	kgf m
Cylinder head assembly				
Setscrews, cylinder head	M12	See section 12		
Setscrews, camshaft cover	M8	22	16	2,2
Piston and connecting rod assemblies				
Nuts, connecting rod big ends	11/32 UNF	47	35	4,8
Banjo bolts, piston cooling jets	MS	11	6	1,1
Crankshaft assembly				
Setscrews, main bearings	M12	112	83	11,4
Setscrew (gold colour), crankshaft pulleys	M14	180	133	18,4
Setscrew (black colour), crankshaft pulleys	M14	200	148	20,4
Cap screws, crankshaft pulley	M6	12	9	1,2
	M8	27	20	2,7
Setscrews, rear oil seal housing	M8	22	16	2,2
	M10	43	32	4,4
Timing case and drive assembly				
Setscrews, timing case	M5	3	2	0,3
	MS	6	4	0,6
	M8	10	7	1,0
Setscrew, hub of camshaft pulley	M12	85	63	8,7
Setscrew, camshaft pulley to hub	M8	22	16	2,2
Cap screw, tensioner pulley	M10	43	32	4,4
Setscrew, idler pulley	M10	43	32	4,4
Aspiration system				
Nuts, turbocharger to manifold	M8	22	16	2,2
Nuts, exhaust outlet to turbocharger or to heat exchanger	M8	22	16	2,2
Setscrews, inlet and exhaust manifolds	M8	22	16	2,2
Lubrication system				
Plug, lubricating oil sump	1/4 BSP	43	32	4,4
Setscrews, lubricating oil pump	M6	9	7	0,9
	M10	43	32	4,4
Screws, backplate to oil pump	M4	4	3	0,4
Setscrews, filter head to oil pump	MS	22	16	2,2
Setscrews, lubricating oil sump	M6	12	9	1,2
Fuel system				
Nuts, high-pressure fuel pipes	M12	18	13	1,8
Setscrews, atomiser clamps	M10	43	32	4,4
Setscrews, fuel lift pump	M8	22	16	2,2
Setscrews, mounting bracket for fuel injection pump	M10	43	32	4,4
Nut, pulley to fuel injection pump	M14	60	44	6,1
Nuts for flange of fuel injection pump	M8	22	16	2,2

Camshaft cover

To remove and to fit

12A-01**To remove**

1 Remove the setscrew which fastens the front flange of the camshaft cover to the timing case (A1).

Some vehicle engines have a setscrew, fitted inside the timing case, which also fastens the timing case to the camshaft cover (A2). For these engines the timing case cover will have to be removed and the setscrew released.

Marine engines: Remove the setscrew which is fitted through the drive housing of the raw water pump into the rear flange of the cover (A3). If the cover is too tight for removal, loosen the mounting bracket for the raw water pump.

2 Remove the setscrew from the timing hole in the top front of the camshaft cover (A4). Turn the crankshaft until the timing hole in the front journal of the camshaft aligns with the hole in the cover. This will ensure easier removal of the fuel lift pump and the camshaft cover.

3 Remove the engine lift brackets, if fitted. If nothing is driven from the rear of the camshaft, remove the rear cover and fit the camshaft retainer PD.181 (B1). This will ensure that the camshaft will not tilt when the camshaft cover is removed.

4 Remove the fuel lift pump, operation 20A-03 and the exhaustor, operation 24A-01, if fitted.

5 Loosen evenly the setscrews of the camshaft cover in the reverse sequence to that given in figure D. Remove the setscrews and the cover (B). Ensure that the thrust washer (B2) remains in position in the cover.

To fit

1 Check the cover and the thrust washer for the camshaft for wear and for other damage. If the cover is worn or damaged, a new cylinder head assembly will be needed as the bores for the camshaft journals are machined with the cover and the head fastened together.

2 Check that the location thimbles (B3) and the thrust washer (B2) are correctly fitted. Ensure that the front and the rear seals of the camshaft are still in their correct positions against the shoulders in the cylinder head and that they are not tilted.

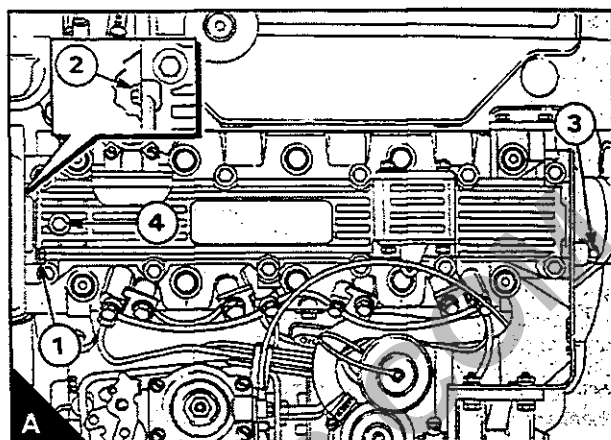
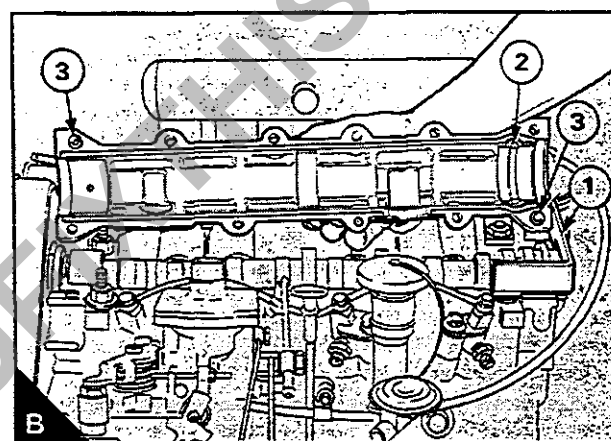
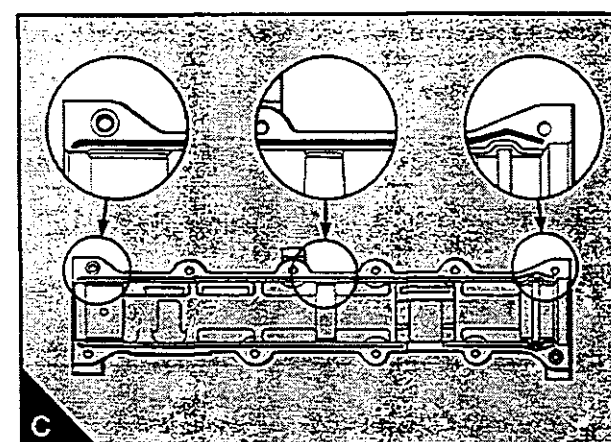
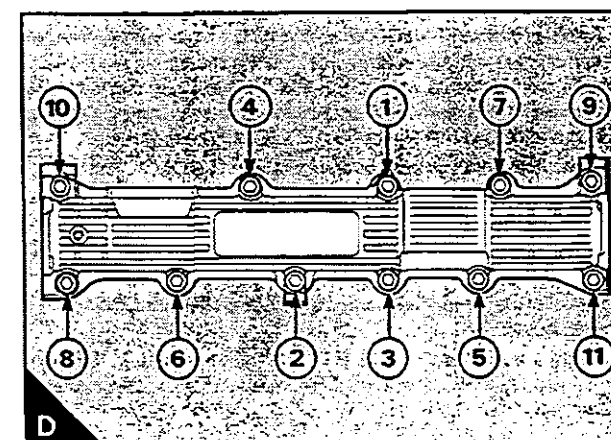
3 Ensure that the grooves in the camshaft cover and the contact faces of the cylinder head and the cover are clean. Apply a 2 mm (0.08 in) diameter bead of POWERPART Hylosil to the outer grooves of the cover but leave the inner grooves empty, as shown in figure (C). As soon as the sealant has been applied, fit the cover. Fit the cover setscrews with the longer setscrews at each end of the cover. Gradually tighten the setscrews to keep the cover parallel to the cylinder head as it is pulled down. Finally tighten the cover setscrews to 22 Nm (16 lbf ft) 2,2 kgf m in the sequence shown in figure (D).

4 Where necessary, remove the camshaft retainer and fit the rear end cover.

Marine engines: Fit and tighten the setscrew which fastens the drive housing of the raw water pump to the camshaft cover. If the mounting bracket for the raw water pump has been loosened, align the bracket before it is fastened, see operation 21A-08.

5 Fit and tighten the setscrew(s) which fasten(s) the timing case to the camshaft cover. If necessary, fit the timing case cover.

6 Ensure that the timing hole in the front journal of the camshaft aligns with the timing hole in the camshaft cover. Fit the fuel lift pump, operation 20A-03 and if necessary, the exhaustor, operation 24A-01. Fit the setscrew in the timing hole in the camshaft cover. If necessary, fit the engine lift brackets.



12 CYLINDER HEAD ASSEMBLY

Cylinder head assembly

To remove and to fit

12A-07

To remove

- 1 Disconnect the battery.
- 2 Drain the cooling system.

Marine engines: See operations 21A-01 and 21A-03.

3 Disconnect the coolant hose from the thermostat housing. If necessary, disconnect the by-pass hose at the bottom of the thermostat housing. If necessary, disconnect the heater hoses.

4 Disconnect all electrical connections at the cylinder head and the thermostat housing.

5 Disconnect the air inlet pipe and the exhaust pipe.

6 If the cylinder head is to be dismantled, remove the inlet and the exhaust manifolds.

Marine engines: Remove the inlet manifold, the turbocharger (if fitted) and the heat exchanger/manifold/header tank assembly, operation 21A-12.

7 Disconnect the fuel lift pump and the exhaust, if fitted.

8 Disconnect the fuel filter and remove it from its bracket.

9 Remove the high-pressure pipes from the atomisers and from the fuel injection pump - do not bend the pipes. When a pipe nut is loosened at the pump, hold the outlet connection of the pump with a spanner to prevent movement of the connection. Fit covers to the open connections of the atomisers and of the pump.

10 Remove the atomisers, operation 20A-02, and the glow plugs, operation 23C-01, to prevent possible damage to their tips.

11 Remove the setscrew from the timing hole in the top front of the camshaft cover 12A-03/A4. Turn the crankshaft until the timing hole in the front journal of the camshaft aligns with the hole in the cover.

12 Remove the starter motor, operation 23B-01 and fit the anti-rotation tool PD.203 to the flywheel.

13 Remove the timing case cover, operation 15A-01 and remove the camshaft pulley, operation 15A-06.

14 Remove the setscrew which is fitted through the camshaft cover into the timing case (A1).

Vehicle engines: Remove the setscrew which is fitted through the timing case into the camshaft cover. Later engines: Remove the setscrew which fastens the timing case to the cylinder head (A3).

15 Release evenly the setscrews of the cylinder head in the reverse sequence to that shown in figure 12A-09/A. Remove the setscrews and remove the head (B) - ensure that the camshaft does not hit the timing case. Put the head on a flat surface which will not damage the bottom face.

16 Check the top face of each cylinder head setscrew for centre punch marks. If there are four centre punch marks on the setscrew head, it has been tightened four times in service and it cannot be used again. Also check the setscrews for distortion with a straight edge held along the setscrew. If there is a visual reduction in the diameter of the stem or of the thread that has not been in engagement with the cylinder head, the setscrew must be discarded.

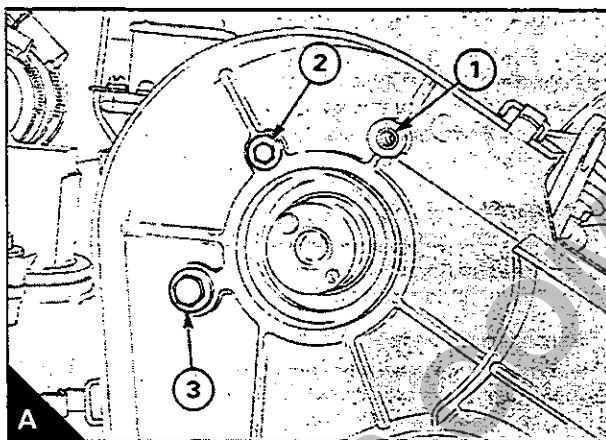
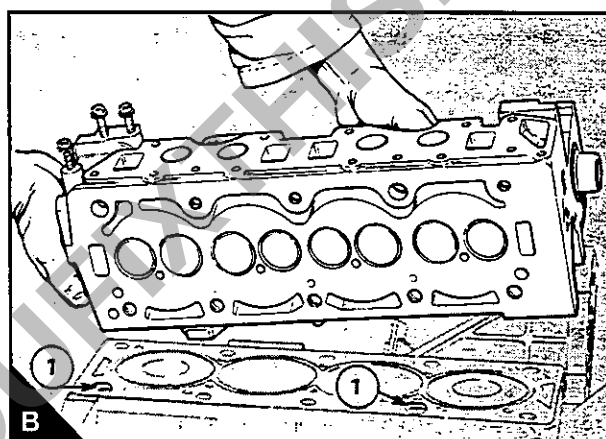
17 Remove the cylinder head gasket.

To fit

Special tools:

Angle gauge, to tighten cylinder head setscrews, MS.1531

1 Clean the bottom face of the cylinder head and the top face of the cylinder block. Ensure that there is no debris in the cylinder bores.



15

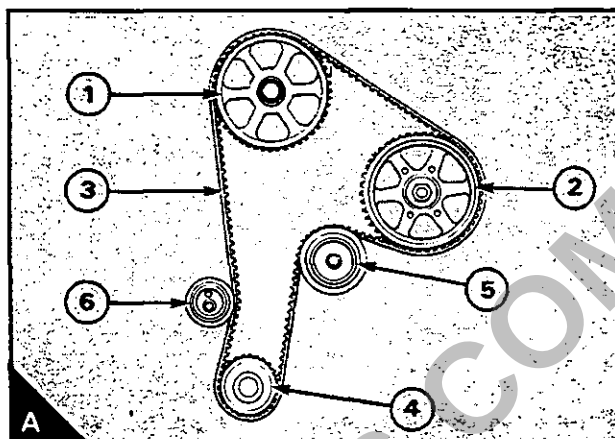
TIMING CASE AND DRIVE ASSEMBLY

General description

Toothed pulleys are fitted to the camshaft (A1) and to the fuel injection pump (A2). These pulleys are driven through a toothed belt (A3) by a similar pulley fitted to the crankshaft (A4). The pulleys are made of sintered 2% copper iron and the belt is made of glass fibre and neoprene. A plain idler pulley (A5) ensures the correct belt engagement and an adjustable tensioner pulley (A6) controls the belt tension.

Currently, the camshaft pulley has a separate hub but, on some early engines, the pulley has an integral hub. The pulley of the fuel injection pump has two keyways, one for turbocharged engines and the other for naturally aspirated engines.

The timing pulleys and belt are contained in a timing case and cover which are made of glass filled polypropylene. A brush type of dust seal is fitted to the cover for certain industrial applications.



Alternator

To remove and to fit

23A-04

To remove

- 1 Disconnect the electrical connections at the alternator.
- 2 Loosen the pivot fasteners of the alternator and the adjustment link fasteners.
- 3 Release all the belt tension and remove the belt.
- 4 Remove the adjustment link from the alternator and remove the pivot bolt. Make a note of the position of the washer to ensure that it is fitted correctly. Remove the alternator (A).

To fit

- 1 Put the alternator in position and assemble loosely the pivot fasteners and the adjustment link and its fasteners. Ensure that the washer is fitted in its correct position and that the alternator pulley is aligned to the crankshaft pulley.
- 2 Fit the drive belt and adjust the drive belt tension, operation 23A-02. Tighten the adjustment link fasteners and then the pivot fasteners and check the tension again.
- 3 Connect the electrical connections at the alternator.

To maintain

- 1 Ensure that the drive belt is not worn and that the belt tension is correct.
- 2 Keep the alternator clean. To clean the alternator, use a material which is damp with kerosene or a special fluid used for this purpose. Ensure that the fluid does not enter the alternator.
- 3 Ensure that air can pass easily over the casing to keep it cool.

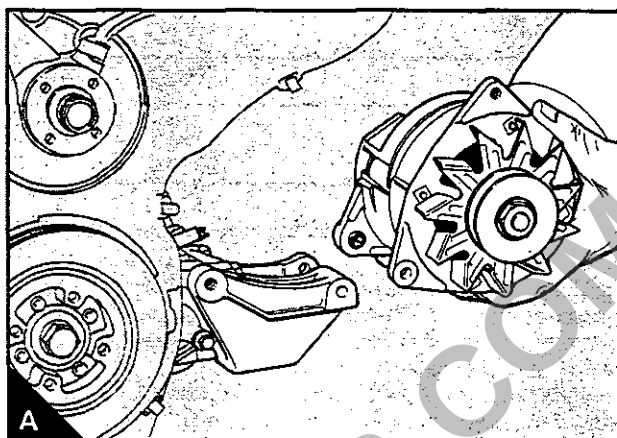
Fault diagnosis

The alternator is designed so that a flow of current (indicated by no light at the warning light or by a reading shown on an ammeter) shows that the system is in correct operation. If the system is in correct operation, no open circuit, voltage or current output checks need to be done on the installation unless:

- The warning light does not show when the alternator is stationary and the switch is in the "on" position or it shows a light when the alternator is in operation.
- No charge current is shown on the ammeter.
- The battery is discharged.
- The battery is hotter than normal which is an indication of loss of voltage control.

If one or more of the above symptoms occur, the procedure indicated below should be applied.

- 1 Ensure that the battery is in a fully charged condition.
- 2 Connect a moving-coil voltmeter of good quality, with a range of 0-50 volts, across the alternator positive and negative terminals. If an ammeter is not fitted in the electrical circuit: Fit a moving-coil ammeter of good quality, with a range of 0-100 ampere, in the wire between the alternator and the positive terminal of the battery.
- 3 Turn the warning light switch to the "on" position (main switch on instrument panel) when the warning light should be illuminated.
- 4 Switch on a 10-15 ampere load, for example, lights, fans, etc..



- 5 Start the engine and operate it at a fast idle speed when either: the warning light should be extinguished or the ammeter indicates a small current charge in relationship to the engine speed.

- 6 Increase the engine speed for a moment to near maximum speed; the charge current should be approximately 55 amperes for A127-55 alternators or 70 amperes for A127-70MT alternators.

- 7 Operate the engine at approximately half speed and remove the electrical load. The voltage should go up to 14 volts for a 12 volt system and then remain constant. At the same time the current reading should show a reduction.

Any change in the above data can indicate a fault and the alternator should be removed for test by a specialist.

The regulator is a sealed unit and a repair is not possible. If there is a regulator fault, the regulator must be renewed.

Wiring diagrams for marine engines

These wiring diagrams apply only to wiring looms and instrument panels which have been supplied by Perkins.

Notes for wiring diagrams of instrument panel (23D.03/A) and engine (23D.03/B)

! * Not used on later engines

-  Starter motor 12 V
-  Alternator
-  Glow plugs
-  Glow plug relay (33RA)
-  Negative earth relay (33RA)
-  Three/two 1 amp diodes '1', '2' & '3'
-  Start relay (33RA)
-  Coolant temperature switch for start advance solenoid (open on increase in temperature)*
-  Start advance solenoid (KSB)*
-  Engine stop solenoid (energise to stop)
-  Oil pressure switch
-  Coolant temperature switch
-  Coolant temperature sender
-  Six way connector - to be sealed with tape to prevent entry of water
-  Eight way connector - to be sealed with tape to prevent entry of water
-  Two fast fuses
-  Water warning device option (includes warning lamp 12V/1.2W bulb)
-  Connector - optional illumination switch (customer supply)
-  Spare cables
-  Fit insulation to all spare cables and fasten to wiring loom with tape

-  Battery (customer supply)
-  Connect earth cable to starter motor fastener
-   indicates engine earth
-  Security key switch
-  Heat switch (push button)
-  Start switch (illuminated push button - 24V/1.2W bulb)
-  Stop switch (illuminated push button - 24V/1.2W bulb)
-  Warning lamp for coolant temperature - 12V/1.2W bulb)
-  Four/two amp diodes '4', '5', '6' and '7'

Code	Colour	Code	Colour	Code	Colour
N	Brown	G	Green	W	White
B	Black	P	Purple	U	Blue
Y	Yellow	R	Red	LG	Light Green

-  Warning lamp for oil pressure - 12V/1.2W bulb
-  Warning lamp for alternator - 12V/2W bulb
-  Tachometer - illuminated - 12V/2W bulb
-  Temperature gauge - illuminated - 12V/2W bulb
-  Audible alarm
-  Diode panel
-  Connectors 'D', 'W', 'X', 'Y' and 'Z'

!  For earlier Prima M80T only
WARNING - On all other engine models cables must be fitted with insulation and fastened to wiring loom with tape



Resistance of battery cables 1 and 2 not to be more than 0.0017 ohms								
Maximum total length		Cable size	Nominal cross section area		Nominal resistance in ohms		Approx. equivalent sizes	
m	ft	Metric	mm ²	in ²	per m	per ft	English imperial	American B & S SAE
2.2	7.3	37/0.9	23.54	0.0365	0.000762	0.0002323	37/0.36	3
3.7	12.0	61/0.9	38.30	0.0601	0.000462	0.0001408	61/0.36	1
5.6	19.0	61/1.3	61.175	0.0948	0.000293	0.0000890	61/0.44	00
9.0	28.3	19/2.52	95.00	0.1470	0.000189	0.0000600	513/0.18	000

It is recommended that an isolation switch is fitted in the positive battery cable

General information

10

Introduction	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10.02
Engine identification	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10.03
Safety precautions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10.04
Asbestos joints	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10.05

2 Ensure that numbers 1 and 4 pistons are at TDC and that the timing pin is fitted through the backplate or through the flywheel housing into the timing hole in the flywheel.

3 Ensure that the two location thimbles (12A.08/B1) are in position in the top face of the cylinder block and fit the cylinder head gasket without jointing compound. The gasket will only fit in one position over the thimbles.

4 Ensure that the timing pin is fitted through the camshaft cover into the timing hole in the camshaft. Put the cylinder head in position over the thimbles. Engage the cylinder head setscrews with the longer setscrews fitted at the ends of the head. Tighten evenly all the setscrews in the sequence shown in figure (A) to a torque of 50 Nm (37 lbf ft) 5,1 kgf m. Tighten all the setscrews again, in the same sequence, to a torque of 100 Nm (74 lbf ft) 10,2 kgf m. Finally tighten the setscrews, in the same sequence, another quarter of a turn (90°). Tool MS.1531 can be used for this operation (B). Fit the tool between the socket and the handle. Put the stop (B1) against a suitable protrusion on the cylinder head to prevent movement of the degree dial in a clockwise direction. Turn the pointer to align with the 90° mark on the degree dial. Tighten the setscrew until the pointer aligns with the zero position.

If no tool is available, make a suitable mark on the flange of each setscrew (C1). Make other marks on the cylinder head (C2) at 90° clockwise to the marks on the setscrews. Tighten each setscrew in the correct sequence until the marks on the flange are next to, and in line with, the marks on the cylinder head (C3). The setscrews do not need to be tightened again with the engine hot or after a period in service.

If the original setscrews have been fitted again, mark the top of each setscrew with a centre punch to indicate that it has been tightened in service. A maximum of four centre punch marks is permissible.

5 If necessary, fit the inlet and the exhaust manifolds, section 18. Marine engines: Fit the heat exchanger/manifold/header tank assembly, operation 21A-12 and fit the inlet manifold.

6 Connect the air filter and the exhaust pipe.

7 Fit the setscrews which fasten the timing case to the cylinder head (12A.08/A1) and to the camshaft cover 12A.03/A1 (and 12A.03/A2 on some vehicle engines).

8 Fit the camshaft pulley, fit the timing belt and check the belt tension, see section 15.

9 Check the timing of the fuel injection pump, operation 17A-03 and remove the timing pins. Remove the anti-rotation tool and turn the crankshaft through two revolutions to ensure that there is no restriction to movement.

10 Fit the starter motor, operation 23B-01.

11 Fit the glow plugs, operation 23C-01.

12 Fit the atomisers, operation 20A-02.

13 Fit the high-pressure fuel pipes and tighten the pipe nuts to 18 Nm (13 lbf ft) 1,8 kgf m. Ensure that a separate spanner is used to prevent movement of the outlets of the fuel injection pump.

14 Fit the fuel filter and the low-pressure fuel pipes between the fuel injection pump and the fuel filter.

15 If necessary, fit the fuel lift pump, operation 20A-03 and the exhaustor, operation 24A-01. Connect the pipes to the fuel lift pump and the exhaustor.

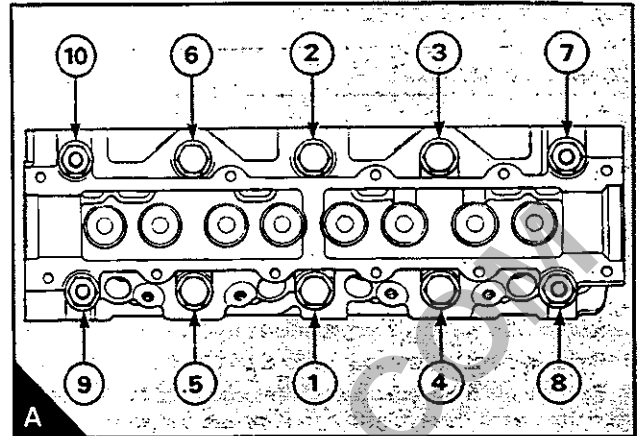
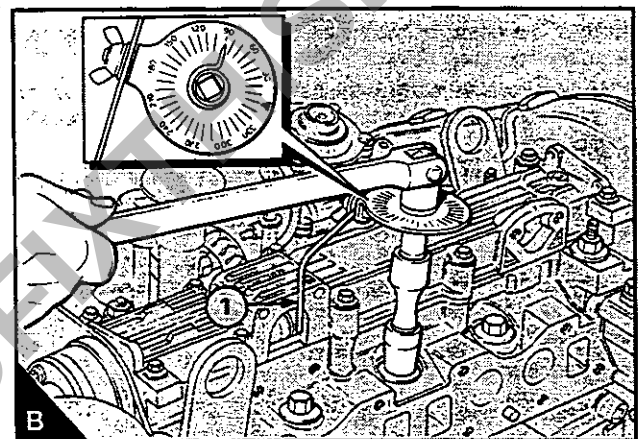
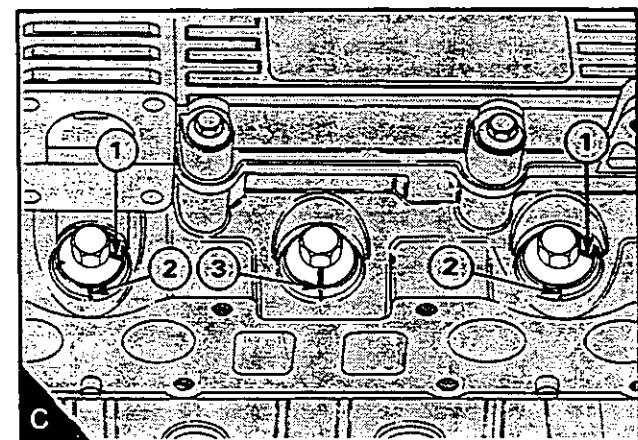
16 Fit the timing case cover, operation 15A-01.

17 If necessary, fit the turbocharger, operation 18A-02.

18 Connect the coolant by-pass and the coolant outlet pipe.

Marine engines: Connect the raw water pipes to the heat exchanger and to the raw water pump. If necessary, connect the heater hoses.

19 Connect the electrical connections to the cylinder head and to the thermostat housing.



20 Fill the cooling system.

For marine engines: see operation 21A-02.

21 Connect the battery.

22 Eliminate air from the fuel system, operation 20A-10.

23 Start the engine and check for leaks.

15 TIMING CASE AND DRIVE ASSEMBLY

Toothed pulley for crankshaft

To remove and to fit

15A-07

Special tools:

Timing pins, PD.182

Location pins for fuel pump pulley, PD.190

Pulley remover, PD.195

Adaptors for use with PD.195, PD.195-1

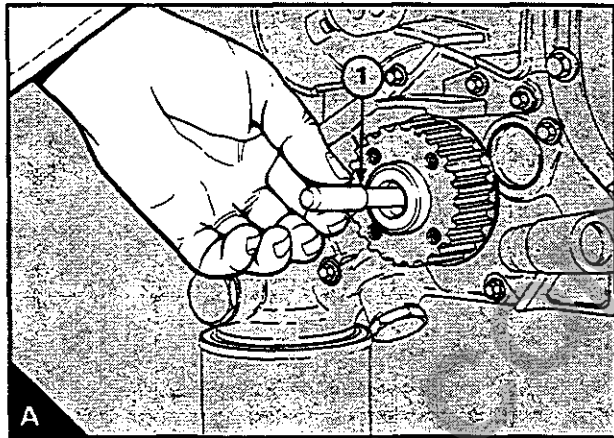
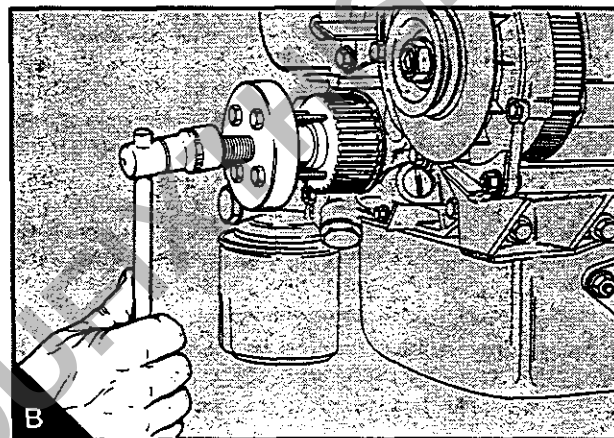
Anti-rotation tool, PD.203

To remove

- 1 Disconnect the battery.
- 2 Remove the setscrew from the timing hole in the camshaft cover. Turn the crankshaft until the timing hole in the camshaft aligns with the hole in the cover. Fit the timing pins PD.182 into the camshaft and into the flywheel.
- 3 Remove the starter motor and fit the anti-rotation tool PD.203 to the flywheel.
- 4 Remove the crankshaft pulley, operation 14A-01A or 14A-01B.
- 5 Remove the timing case cover, operation 15A-01.
- 6 Fit the location pins PD.190 through the plain holes in the pulley of the fuel injection pump and into the pump support bracket.
- 7 Remove the timing belt, operation 15A-04.
- 8 Remove the toothed pulley from the crankshaft. If it is tight, use remover tool PD.195 and adaptors PD.195-1. Fit the narrow end of the distance piece (A1) into the crankshaft. Fasten the main tool (B) to the pulley with the setscrews and tighten the centre screw onto the distance piece to remove the pulley.
- 9 Check the pulley for wear, cracks and other damage. Renew it if necessary.

To fit

- 1 Ensure that the key is fitted correctly to the crankshaft. Put the toothed pulley in position on the crankshaft with the tapped holes towards the front. If a brush type of dust seal is not fitted to the timing case cover, fit the crankshaft pulley, operation 14A-01A or 14A-01B.
- 2 Fit the timing belt, operation 15A-04. Remove the location pins from the pulley of the injection pump and adjust the belt tension, operation 15A-03. Remove the anti-rotation tool.
- 3 Remove the timing pins from the camshaft and from the flywheel.
- 4 Check the timing of the fuel injection pump, operation 17A-03.
- 5 Turn the crankshaft through two revolutions to check that there is no restriction to movement.
- 6 Fit the timing case cover, operation 15A-01 and fit the access panel. If a brush type of dust seal is fitted to the cover, fit the crankshaft pulley, operation 14A-01A or 14A-01B.
- 7 Fit the setscrew in the timing hole in the camshaft cover.
- 8 Fit the starter motor, operation 23B-01.
- 9 Connect the battery.



General description

Non-marine engines:

Coolant from the bottom of the radiator passes through the centrifugal water pump which is fitted on the front of the cylinder block. The pump is belt driven from the crankshaft pulley and assists the flow of the coolant through the system. From the pump, the coolant passes directly into the front of the cylinder block.

The coolant then circulates around the cylinder block and cools the cylinders. From the cylinder block, the coolant passes to the cylinder head. Restriction holes in the cylinder head gasket ensure that the block and head are cooled evenly. The coolant passes out of the front right side of the head and into the thermostat housing. If the coolant is cold, it will pass through the by-pass in the thermostat housing and go directly into the inlet pipe of the water pump. As the temperature of the coolant increases, the thermostat valve will open, the by-pass will close and the coolant will pass to the radiator to be cooled.

Marine engines:

These engines have two cooling circuits. The closed circuit is filled with coolant which is used to cool the cylinder block and the cylinder head as for the non-marine engines above. This coolant is used also to cool the exhaust manifold. The raw water circuit uses raw water from outside the boat to cool the coolant of the closed circuit and to cool also the lubricating oil of M60 and M80T engines.

The heat exchanger, the exhaust manifold and the header tank for the closed circuit coolant are all together in one assembly. This is fitted to the right side of the engine.

The coolant in the closed circuit passes from the header tank to the inlet of the water pump. From the pump the coolant passes through the cylinder block and the cylinder head to the thermostat housing. If the coolant is cold, it passes through the by-pass, directly to the inlet of the water pump. As the temperature of the coolant increases, the thermostat valve will open, the by-pass will close and the coolant will pass to the heat exchanger. In the heat exchanger, the coolant passes around the tubes and is cooled by the raw water in the tubes. The coolant leaves the exchanger tubestack and enters the tank assembly where it cools the exhaust manifold which is an integral part of the assembly. The coolant then passes to the inlet of the water pump. For M60 and M80T engines, some coolant passes through an outlet at the rear of the assembly to an oil cooler and then to the pump inlet.

The raw water is circulated by the raw water pump which is fitted at the rear of the cylinder head and is driven from the rear end of the camshaft. From the pump, the raw water passes through the tubes of the heat exchanger and is then discharged into the exhaust.

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