FUEL INJECTORS

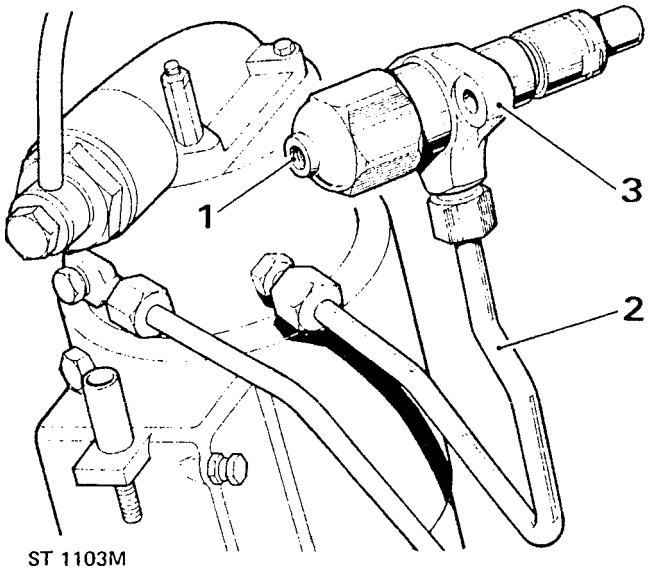
CHECKING NOZZLE ASSEMBLIES

WARNING: Do not allow the fuel spray to contact the person otherwise injury may result from skin penetration.

When an injection nozzle is considcrcd to be the cause of irregular running and loss of power, a quick check may be made by loosening the fuel feed pipe union nut on each nozzle in turn, whilst the engine is idling at approximately 1,000rev/min.
If the injection nozzle assembly being checked has been operating properly, there will be a distinct reduction in engine speed accompanied by obvious roughness, but a faulty injection nozzle may make little or no difference to the engine note when its fuel feed pipe is loosened.

Spray check

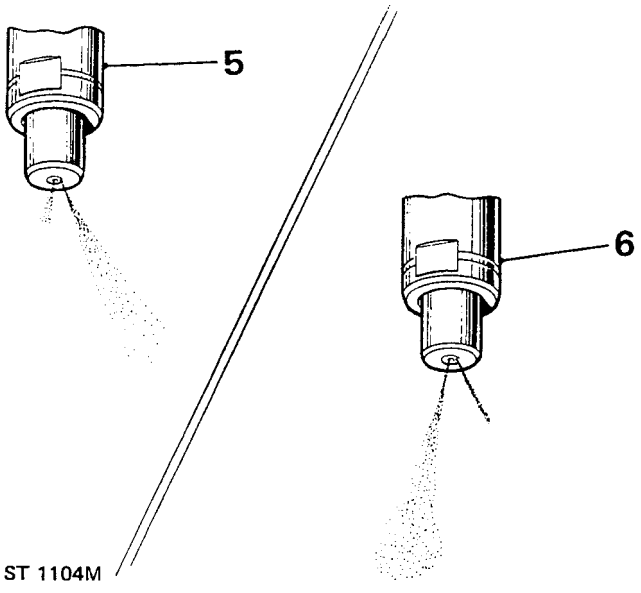
1. Remove the fuel spill gallery pipe complete from the injection nozzles.
2. Disconnect the fuel feed pipe (injection pump to nozzle) from the nozzle to bc tested and from the injection pump.
3. Rcleasc the fixings and withdraw the suspected injection nozzle assembly; reconnect the pipe and nozzle assembly to the injection pump in a position whereby fuel ejection may be observed.



ST 1103M

NOTE: The above illustration shows the D.P.A. pump fitted *to* the 3.25 iitre diesei engine.

4. Loosen the union nuts securing the remaining fuel pipes to injection nozzles.
5. Whilst the starter turns the engine over, observe the manner in which fuel issues from the nozzle and compare the spray form with the correct form as illustrated.
   Very little fuel should issue from the main spray hole with the engine turning over at starter speed but a fine spray comparable to that illustrated should be ejected from the auxiliary spray hole.
6. If the ejected fuel is more in the form of a liquid jet or issues from the main pintle hole, then the nozzle and holder assembly should be removed for overhaul and a replacement unit fitted.
7. Refit the injectors and tighten the union nuts.
8. Connect the spill gallery pipe with the bolt and two washers.



ST 1104M

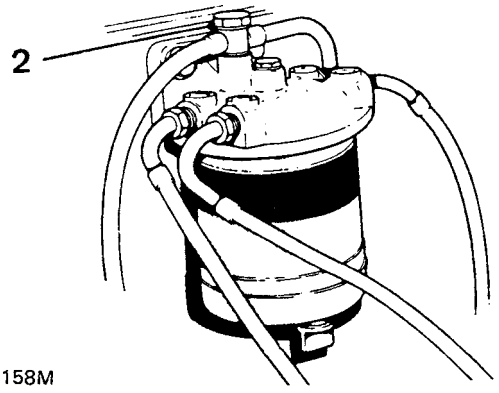
PRIME FUEL SYSTEM

Procedure following fuel filter or sedimentor service

When models fitted with a sedimentor have had thc water drained only from the sedimentor bowl, no priming is necessary as the water is replaced by fuel automatically syphoned from thc tank. However, if the sedimcntor has been dismantled and air has entered the body, or where the fuel filter element has been replaced and the filter bowl cleaned, then the system must be primed as follows:

continued

1. Do not attempt to start the engine hoping to draw the fuel through in this way, othcrwisc the **full** priming procedure will be necessary.
2. Slacken the bleed pipe banjo bolt on the top of the main fuel filter.



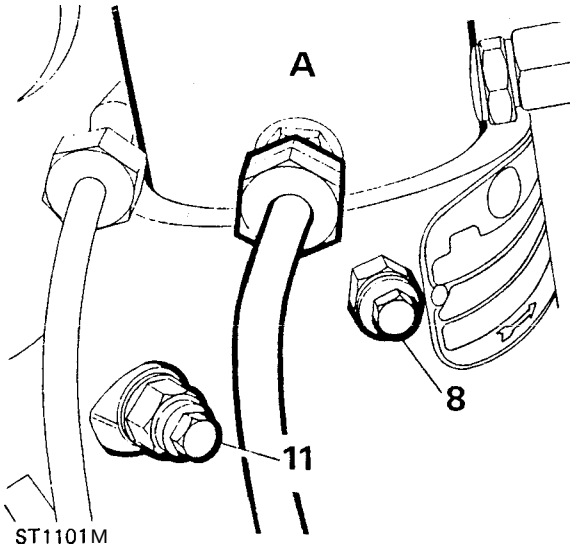
ST 1158M

3. Operate the hand priming lever on the mechanical pump, until fuel free from bubbles emerges.
   Always ensure that fuel pump lever is on the bottom of the operating cam when priming the fuel system, otherwise maximum movement of the priming lever cannot be achieved.
4. Tighten the bleed pipe banjo bolt whilst the fuel is still emerging.
5. Operate the hand priming lever once or twice to clear the last bubbles of air into the filter bleed pipe.
6. Start engine in normal way and check for leaks.

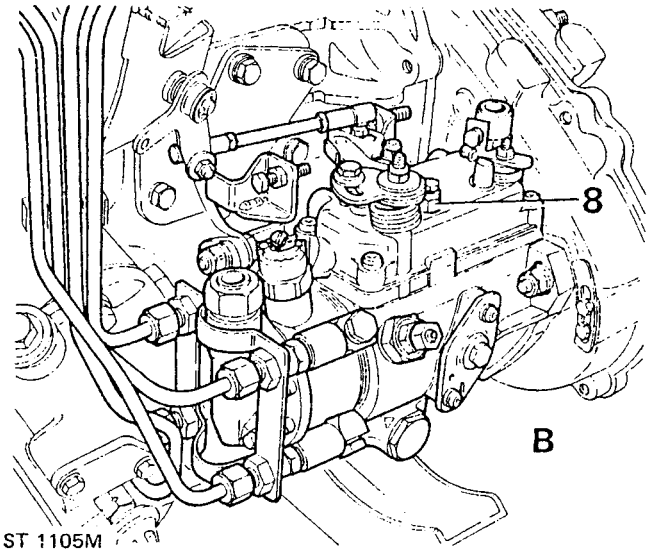
Procedure when fuel system has been drained

7. Carry out instructions 1 to 5 inclusive.
8. Release air vent screw on distributor body.

Illustration A — *2.25* litre D.P.A. pump
Illustration B — *2.5* litre D.P.S. pump



ST1101M



ST 1105M

9. Operate the fuel pump hand priming lever until fuel free of air emerges.
10. Rctighten the air vent screw.
11. To ensure that all air is exhausted from the pump it may also be necessary to slacken air vent screw in the distributor control cover and repeat instructions 9 and 10. 2.25 litre engine D.P.A. pump only.
12. Start the engine in the normal way and check for leaks.

Procedure when distributor pump has been drained

13. Carry out instructions 8 to 12 inclusive.

FUEL INJECTION PUMP — Altitude compensation

When Diesel engines are operated at high altitude it is recognised that the reduced air density causes a reduction in the weight of air drawn into the engine cylinders, which results in incomplete combustion of the injected fuel at full throttle, unless this is reduced in proportion to the reduction in air density.
To compensate for these variations and to avoid excessive fuel consumption, accompanied by excessive exhaust smoke, the amount of fuel delivered to the cylinders must be reduced to suit the conditions under which the engine is required to operate. For every 330 metres (1000 feet) above 990 metres (3000 feet) the fuel delivery must be reduced by 3%.
Adjustments to the D.P.S. pump, however, must only be carried-out by an authorised C.A.V. Dealer.

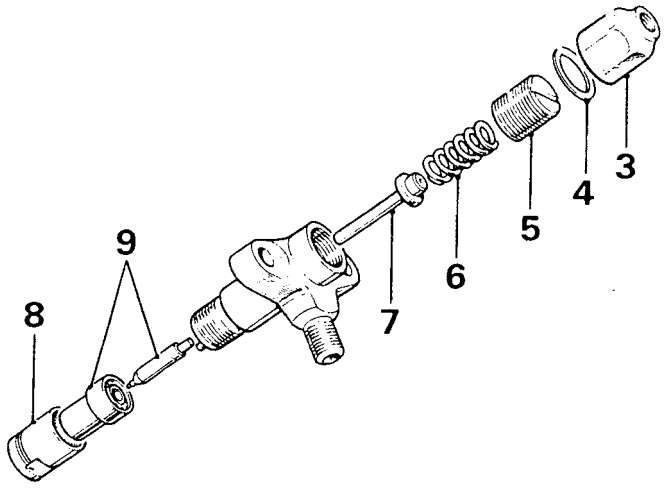
OVERHAUL FUEL INJECTORS

Service tools:

271483 or 18G109 or Diesel tune III	Injector nozzle testing and setting kit
278182 or 18G109B or Diesel tune 102	Adaptor Pintaux Injector
278181 or 18G109E	Injector nozzle flushing tool
605002 or 18G1487 or FT9101	Injector nozzle cleaning kit

DISMANTLE

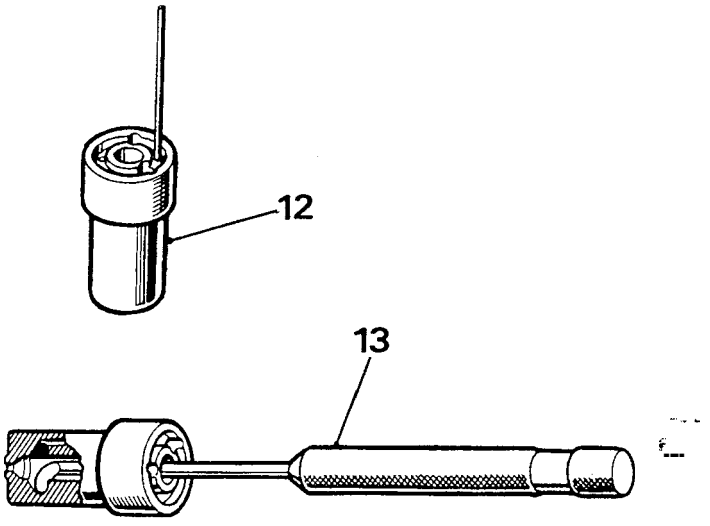
1. Remove the injectors from the engine.
2. Disconnect the injectors from the fuel spill rail.
3. Remove the combined locknut and end cap.
4. Withdraw the sealing washer.
5. Unscrew the pressure adjusting screw.
6. Withdraw the pressure spring.
7. Withdraw the valve spindle.
8. Unscrew the cap nut.
9. Withdraw the nozzle valve and body.



ST 1106M

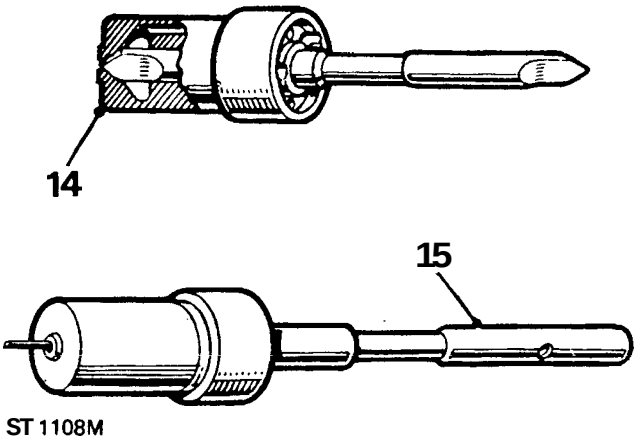
Cleaning and inspecting

10. Soak the component parts of the assembly in Shell Calibration Fluid to loosen carbon deposits, but do not allow parts of any one assembly to be interchanged with those of another.
11. Brush away all external carbon deposits from component parts with a brass wire brush and return them to the fluid bath. Particular care must be exercised when cleaning the pintle and seat of nozzle valve to avoid scratching or scoring, which could result in spray distortion.
12. Clean the three oil feed passages in the nozzle body with a wire or drill of 1,5 mm (0.062 in) diameter.
13. Remove the carbon from the annular recess with the tool illustrated.



ST 1107M

14. Remove the carbon from the valve seat, using the appropriate tool with a rotary motion.
15. Select the appropriate size probe from the pocket of cleaning kit and secure it in the pintle hole cleaner.
    Insert the probe into the bore of nozzle valve body and allow the end to extend through the main fuel outlet, then turn in a rotary manner to remove carbon.

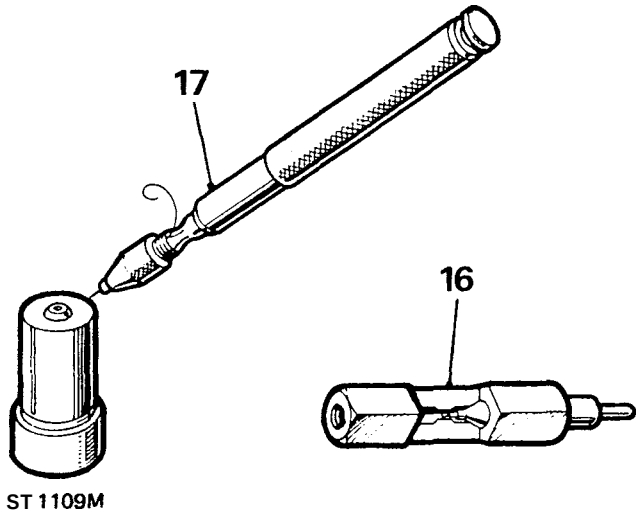


ST 1108M

continued

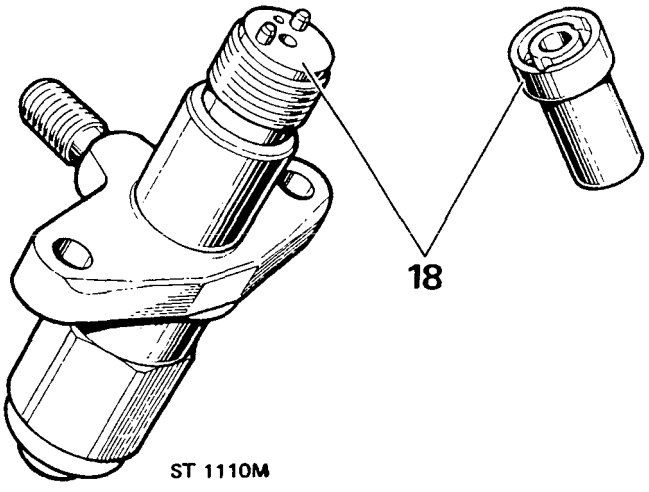
16. Carbon may be removed from the nozzle valve cone by inserting the valve into the tool illustrated and then rotating it alternately in a clockwise then anti-clockwise manner whilst pressing the valve inward. If the nozzle is blued or the seating has a dull circumferential ring indicating pitting or wear, the nozzle body and valve should be returned to a CAV Service Agent and replacement parts fitted. Do not attempt to lap the nozzle valve to body. This process requires special equipment and training.
17. Clean the auxiliary spray hole using the special tool fitted with probing wire 0,20 mm (0.008 in) diameter.

NOTE: Allow 1,5 mm (0.062 in) only to extend from the chuck and thus minimise the possibility of the wire bending or breaking while probing. Great care must be taken to prevent breakage of the wire inthehole.



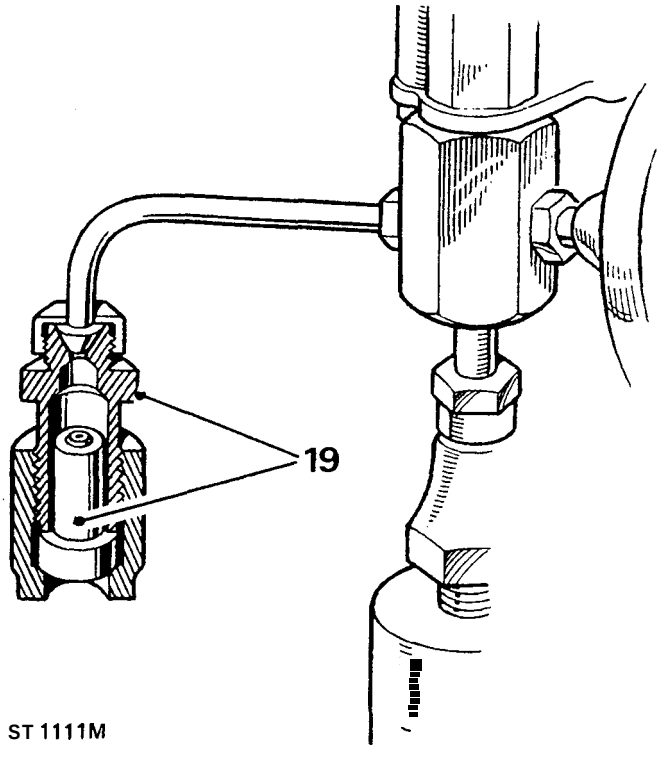
ST 1109M

18. Examine the pressure faces of nozzle body and nozzle holder to ascertain their freedom from scoring and scratches. These surfaces must be perfectly smooth.



ST 1110M

19. With the flushing tool secured to the nozzle testing outfit, fit the nozzle body (spray holes uppermost) to the flushing tool and pump test oil through vigorously. This flushing process is necessary for the removal of any tiny carbon particles which may have become lodged in the body after scraping and probing.



ST 1111M

Assemble

20. Fit the nozzle valve to nozzle and check for freedom of movement.
21. Immerse the nozzle body and valve in the fluid bath and assemble whilst submerged.
22. Wash the remaining components and assemble the injector in the sequence illustrated during the dismantling.
23. Set the injection nozzle assembly in accordance with the following test procedure.

Bench test injector nozzle and holder assembly

24. To check a nozzle assembly and to ensure that it is functioning correctly, a setting outfit, as illustrated, is essential. **A** bench covered with linoleum or non-ferrous sheet metal is most suitable for mounting the outfit; such a surface facilitates the cleanliness essential when checking nozzle parts. Between the bench and setting outfit, a tray, also of non-ferrous metal, should **be** positioned to prevent spilt fuel spreading. Small containers may be attached to the bench to isolate the component parts of each assembly. These parts are carefully mated by the manufacturers and must **not** be interchanged. Lastly, a small bath with a cover, containing Shell Calibration Fluid for washing components, should be kept conveniently near.

25. The efficient operation of the injection nozzle assembly is dependent on four main conditions, as follows:
    The nozzle valve must open at 135 Ats.
    The rate of back leakage must be within 150 to 100 Ats.
    Seat tightness must be sufficient to prevent leakage.
    Spray form must compare favourably with the illustrations.
26. Pressure setting, back leakage and seat tightness tests may be made by coupling the injection nozzle and holder assembly direct to the pressure feed pipe on the setting outfit, but an adaptor must be fitted between the pipe and injection nozzle and holder assembly when testing spray form. This adaptor, see instruction 38, increases the pressure of fuel to the injection nozzle and holder assembly sufficiently for the main and auxiliary spray form to 6e determined.

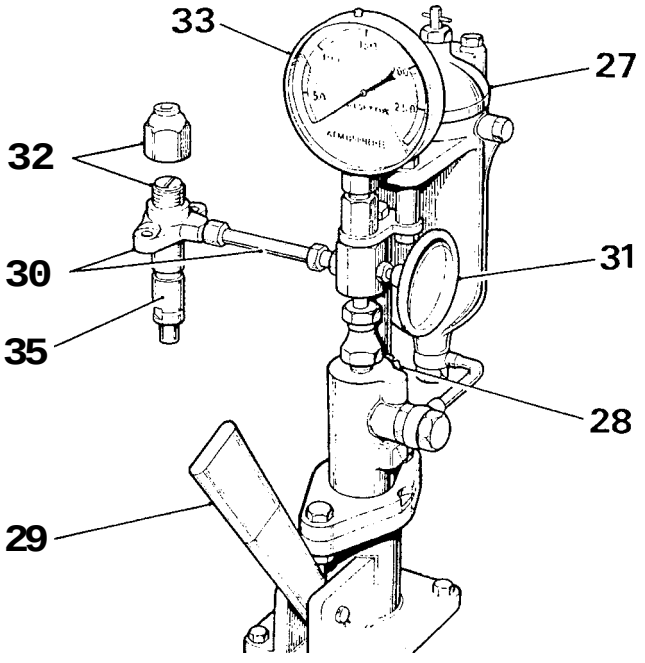
Test procedure

WARNING: The injection nozzle must not be allowed to point towards the operator when spraying and the hands must never be allowed to contact the spray which has a force that can penetrate the flesh.

27. Remove the cap from the setting outfit container and fill with 0,8 litre (1.5 pints) of Shell Calibration Fluid.
28. Air vent the system by removing the vent screw, allow oil to flow freely for a few seconds and replace the screw whilst the flow continues.
29. Operate the pump handle until fluid flows from pipe.
30. Connect the injector and holder assembly to the pressure feed pipe with the nozzle pointing downwards. The length and bore of this pipe is important and replacement pipes must be approximately 75 mm (2.8 in) between the union nuts and of 3 mm (0.118 in) bore.
31. Close the check valve to keep the pressure gauge out of circuit and smartly operate the hand lever several times to expel all air from the system.

Leak-back test

32. Adjustment is made by removing the combined end cap and locknut from the nozzle holder, and turning the adjusting screw clockwise to increase and anti-clockwise to decrease the opening pressure.
33. Fit assembled injector to nozzle setting outfit and adjust to open at 160 to 170 atmospheres then pump up to just below this figure, release handle to allow the needle of gauge to fall naturally. Time the pressure drop from 150 atmospheres down to 100 atmospheres.
34. This should be not less than 5 seconds for the original nozzle and not less than 7 seconds if a new one is to be fitted, and not more than 36 seconds for either with oil temperature 10° to 21°C (50" to 70°F).
35. Check externally the top and bottom of nozzle cap nut and pressure pipe union nuts for signs of oil leakage. If leakage occurs at the nozzle cap nut, remove the nut and examine the pressure faces of nozzle holders and nozzle body (see item 18) for presence of foreign matter or surface scoring, before tightening further.
    A leak-proof nozzle assembly with an excessive rate of pressure drop indicates a worn nozzle valve; the nozzle valve and nozzle body should be renewed.



ST 11127M

Pressure setting

36. The selected operational opening pressure of the nozzle valve is 135 atmosphcrcs. Readjust to this setting in the manner described in item 32.

Seat tightness

37. Wipe the bottom face of the injection nozzle dry and raise the pressure in the system to 125 atmospheres. A slight dampness on the bottom face is permissible, but blob formation or dripping indicates a badly seating valve in which case the assembly should be dismantled for further examination.

Spray form

38. Fuel delivery to the injection nozzle assembly when testing spray form must be characteristically similar to fuel delivery under normal operating conditions and to effect these conditions an adaptor (CAV Y7044872) must be fitted between the injection nozzle assembly and the pressure pipe.

continued

39. The adaptor differs mainly in the cap nut and nozzle valve from the ordinary type of injection nozzle and holder assembly as fitted to the engine; the nozzle valve has no pintle.

40. The cap nut is extended, bored and threaded to receive nozzles for testing.

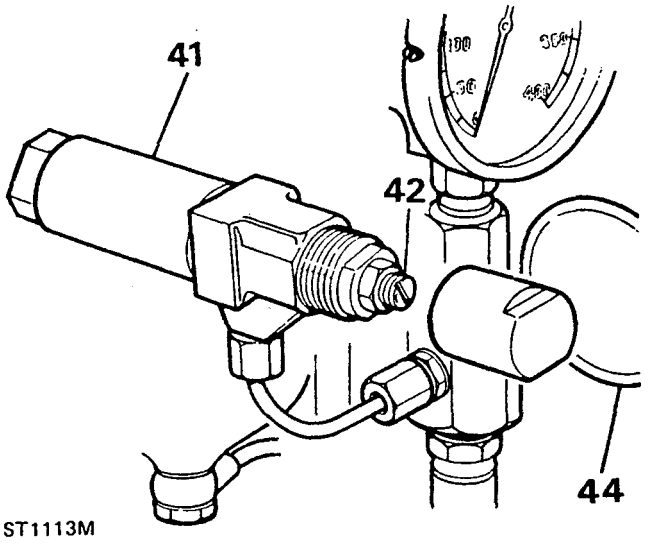
41. Connect the adaptor assembly to the pressure pipe.

42. Remove the end cap and adjust the opening pressure of the nozzle valve to 220 atmospheres.

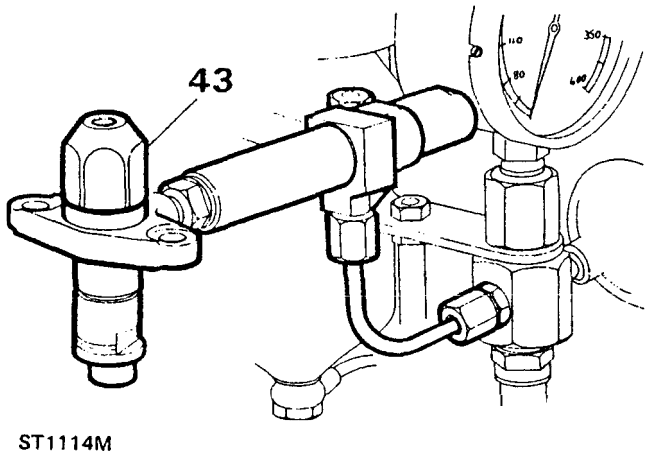
43. Screw the injection nozzle and holder assembly to be tested, into the adaptor.

44. With the check valve closed, operate the handle smartly to expel air from the system. The auxiliary spray form may be tested at **60** strokes per minute and the main spray at **140.** Spray development from starting to running speeds is illustrated, this illustration should be referred to and compared with the spray form of nozzles under test.

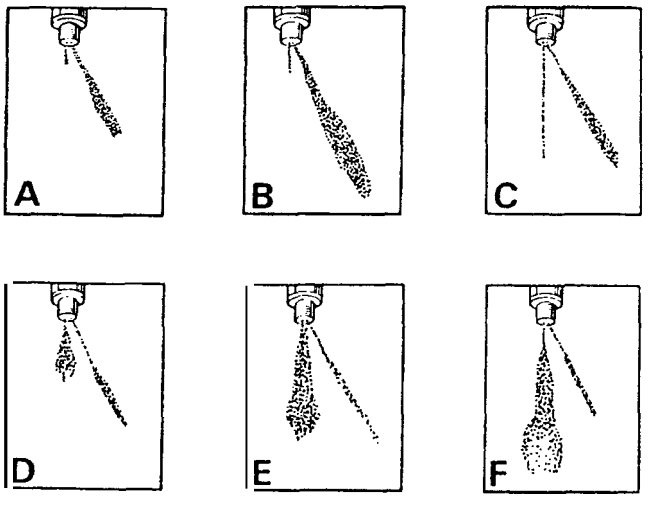
Spray formation should be well formed and free from splits or distortion. **A** slight centre 'core' can be disregarded. Observe the main spray through **360** degrees to ensure a uniform spray.



ST1113M



ST1114M



ST1115M

45. When satisfactory, fit the combined locknut and end cap, connect the injectors to the fuel spill rail and fit them to the engine.

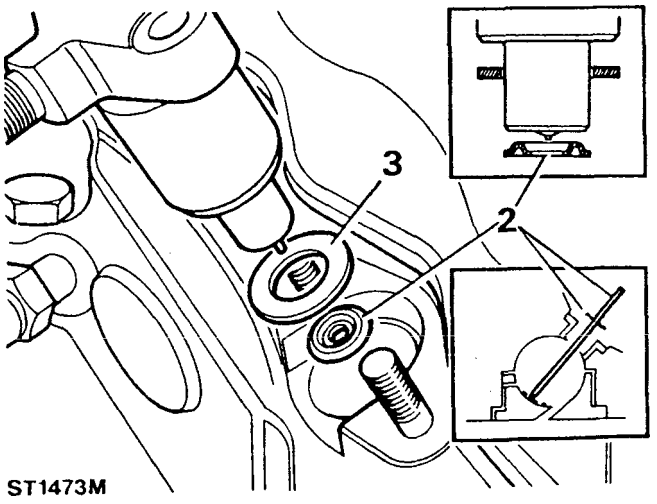
FITTING FUEL INJECTORS

The steel sealing washer fitted below the injector nozzle is to ensure that combustion does not take place around the nozzle body and cause it to overheat. **A** washer which has been used more than once, or an incorrectly fitted washer may cause the nozzle to overheat and result in that cylinder misfiring.

1. Ensure that the new washers are separated from each other and are clean.

2. Use **a** length of thin welding wire to guide one washer only into each port with the domed side toward the injector as illustrated. Ensure that only one washer is fitted to each port.

continued



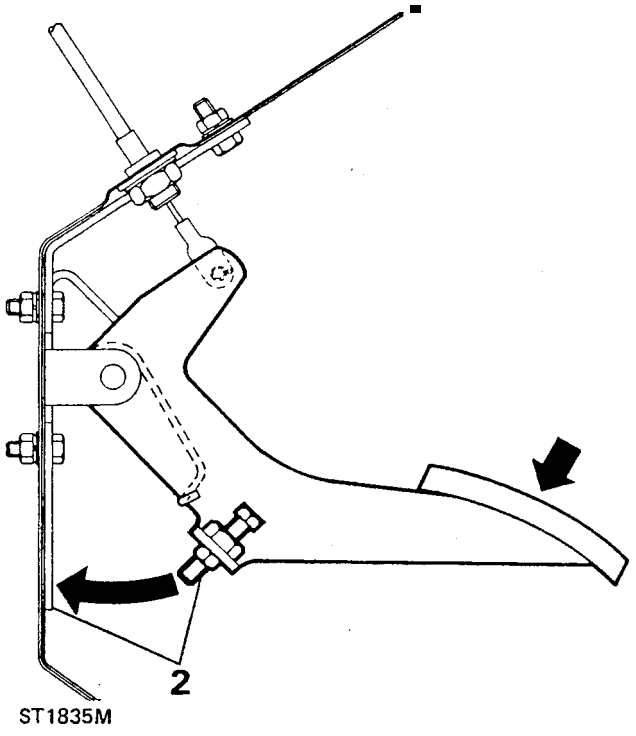
ST1473M

3. Lightly grease the copper washer into position on each injector before fitting to the cylinder head.
4. Fit the injector and evenly tighten the retaining nuts to the correct torque **6** to 8 Nm (4 to **6** Ibs ft). Uneven or overtightening of the injector nuts could distort the nozzle and cause misfiring when normal running temperature is reached.
5. Reconnect the injector pipes but do not overtighten the union nuts.

THROTTLE PEDAL ADJUSTMENT —

Petrol and Diesel four cylinder engines

1. After renewing the throttle cable, remove any slack in the cable by adjustment of the cable adjuster at the engine end.
2. Depress the throttle pedal, by hand, to the full extent of the carburetter, DPA or DPS pump linkage, and adjust the pedal stop screw to take up all clearance between the screw and scuttle panel. Make sure that no strain is placed upon the carburetter or pump linkage.



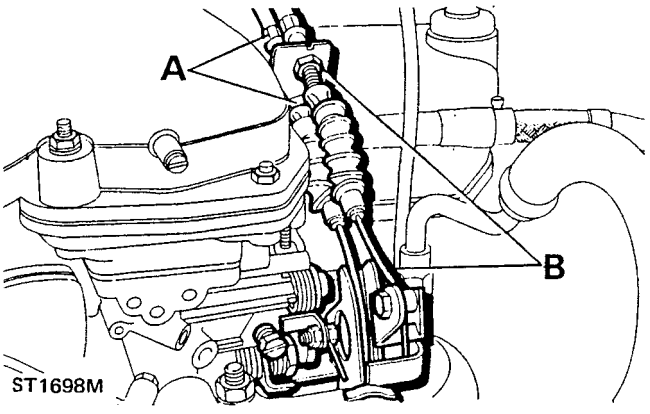
ST1835M

HAND THROTTLE — where fitted

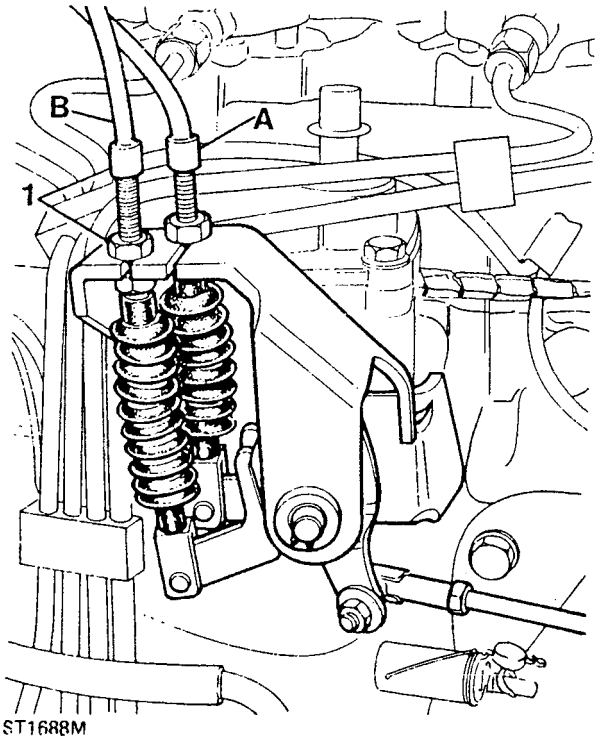
Petrol and Diesel four cylinder engines

Adjust

1. Slacken the lock nut on the cable adjuster and turn the adjuster to remove all slack from the cable and tighten the locknut.
   NOTE: The first illustration petrol engine and second illustration Diesel engine.
   A.) Foot pedal cable adjuster
   B.) Hand throttle cable adjuster



ST1698M



ST1688M

GENERAL SPECIFICATIONDATA
2.5 Litre Turbo Charged Diesel Engine — Supplement

Number of cylinders	4
Bore	90, 47 mm (3.562 ins)
Stroke	97,00 mm (3.822 ins)
Capacity	2495 cc
Compression ratio	21:1
Valve charger	O.h.v. pushrod operated
Turbo charger	Garrett T2

Crankshaft

Main bearing journal diameter	63,487-63,500 mm (2.4995-2.500 in)
Regrind dimensions:	
63,246-63,2333 mm (2.490-2.4895 in)	Use 0.010 in U/S bearings
Crankpin journal diameter	58,725-58,744 mm (2.312-2.31275 in)
Regrind dimensions:	
58,48985-58,4708 mm (2.30275-2.30200 in)	Use 0.010 in U/S bearings
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05-0,15 mm (0.002-0.006 in)

Main bearings

Number and type	5 halved shells without oil grooves
Diametrical clearance	0,018-0,061 mm (0.0007-0.0024 in)

Connecting rods

Length between centres	175,38-175,43 mm (6.905-6.907 in)
Diametrical clearance (big-end bearings)	0,025-0,075 mm (0.001-0.003 in)
End-float on crankpin	0,15-0,356 mm (0.006-0.014 in)

Pistons

Type	Aluminium alloy 'V' shaped valve recess in crown
Skirt diametrical clearance (at right angle to gudgeon pin)	0,025-0,05 mm (0.001-0.002 in)

Gudgeon pins

Type	Floating
Fit in piston	Hand push fit
Diameter	30,1564-30,1625 mm (1.18726-1.18750 in)
Clearance in connecting rod	0,0196-0,0036 mm (0.00077-0.00014 in)

Piston rings

Type:	
Top	Chamfered friction edge, chrome plated
Second	Taper faced
Oil control	Expander and rails
Gap in bore:	
Top	0,30 to 0,50 mm (0.011-0.019 in)
Second	0,25 to 0,45 mm (0.009-0.017 in)
Oil control	0,3 to 0,6 mm (0.011-0.023 inj
Clearance in piston grooves:	
Top	0,140 to 0,180 mm (0.002to0.007 in)
Second	0,040 to 0,080 mm (0.001 to 0.003 in)
Oil control	0,04 to 0,080 mm (0.001 to 0.003 in)

continued

Camshaft

Drive	25,4 mm (0.1 in) wide dry toothed belt
Location	Right-hand side (thrust side)
End-float	0,1-0,2 mm (0.004-0.008 in)
Number of bearings	4
Material	Steel shell, white metal lined

Valves

Seat angle:	
Inlet	45"
Exhaust	45"
Head diameter:	
Inlet	39,12-39,37 mm (1.540-1.550 in)
Exhaust	33,25-33,50 mm (1.309-1.319 in)
Stem diameter:	
Inlet	7,912-7,899 mm (0.3114-0.3109 in)
Exhaust	8,682-8,694 mm (0.3418-0.3422 in)
Valve lift:	
Inlet	9,85 mm (0.388 in)
Exhaust	10,26 mm (0.404 in)
Cam lift:	
Inlet	6,81 mm (0.268 in)
Exhaust	7,06 mm (0.278 in)

Valve springs

Type	Duplex Interference double coil
Inner:	
Length, free	42,67 mm (1.680 in)
Length, under 8.0 kg (17.7 lb) load	40,30 mm (1.587 in)
Outer:	
Length, free	46,28 mm (1.822 in)
Length, under 21 kg (46 lb) load	40,30 mm (1.587 in)

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2000 rpm	2,5-4,57 kgf cm^2 (35-65 lbf in^2)
Oil pump:	
Type	Double gear 10 teeth, sintered iron gears
Drive	Splined shaft from camshaft skew gear
End-float of both gears	0,026-0,135 mm (0.0009-0.0045 in)
Radial clearance of gears	0,025-0,075 mm (0.0008-0.0025 in)
Backlash of gears	0,1-0,2 mm (0.0034-0.0067 in)
Oil pressure relief valve:	
Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm (2.670 in)
Compressed length at 2.58 kg (5.7 lb) load	61,23 mm (2.450 in)
Oil filter:	
Type	Screw-on disposable canister

FUEL SYSTEM

Inspection pump	See **'ENGINE TUNING DATA'**
Fuel lift pump type	Mechanical with hand primer
Pressure range	0,35-0,56 kgf cm^2 (5-8 lbf in^2)
Fuel filter	Paper element
Air cleaner	Paper element type

continued

COOLING SYSTEM

Type	Pressurized spill return system with thermostat control, pump and fan assisted
Thermostat opening temperature	82°C
Pressure cap	1,0 kgf cm² (15 lbf in²)
Water pump type	Centrifugal
Fan type	7 blade with viscous coupling
Radiator	Combined engine coolant and oil cooler

CLUTCH

Type	Verto diaphragm spring
Centre plate diameter (friction plate)	235 mm (9.25 in)
Facing material	Verto 791
Number of damper springs	8
Damper spring colour	2 off white/green -Suffix 'C' 2 off pigeon blue - Suffix **'A'** 4 off ruby red - Suffix 'B'
Clutch release bearing	Ball journal

TRANSMISSION

Type	LT230T. Two-speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential
Ratios Ninety and One Ten	High 1.4109:1 Low 3.3198:1

Rear axle

Type-Ninety models	Spiral bevel
Type-One Ten models	Hypoid; full floating shafts, Salisbury 8HA
Ratio-All models	3.54:1

Front axle

Type-Ninety models	Spiral bevel
Front wheel drive	Enclosed constant velocity joint
Ratio	3.54:1

Overall ratio (including final drive) Ninety and One Ten models

	In high transfer	In low transfer
Fifth (Cruising gear)	4.15:1	9.76:1
Fourth	4.99:1	11.75:1
Third	7.53:1	17.71:1
Second	11.49:1	27.03:1
First	17.90:1	42.11:1
Reverse	18.48:1	43.47:1

ELECTRICAL

Starter motor	Paris Rhone type D9R91 12 volt, with reduction gear

ENGINE TUNING DATA

ENGINE

Firing order	1-3-4-2
Injection timing	13" B.T.D.C.

Timing marks:

Valve timing	Slot for peg in flywheel and TDC mark on front pulley
Injection timing	Special tool 18G 1458 inserted in D.P.S. pump
Tappet clearances inlet and exhaust	0,25 mm (0.010 in)

Valve timing

Inlet opens	16° B.T.D.C.
Inlet closes	42" A.B.D.C.
Inlet peak	103" A.T.D.C.
Exhaust opens	51" B.B.D.C.
Exhaust closes	13" A.T.D.C.
Exhaust peak	109" R.T.D.C.

Valve lift

Inlet	9,85 mm (0,388 ins)
Exhaust	10,26 mm (0.404 ins)

Maximum governed speeds

Full load	4000 r.p.m.
No load (flight speed)	4400 ± 80 r.p.m.
Idle speed	670 ± 20 r.p.m.
Dic-down time	4 seconds

DISTRIBUTOR PUMP

Make/type	CAV DPS type with boost control and two speed mechanical governor with auto advance and solenoid electrical shut-off. Tamper proof sealing on flight speed and fuel adjustment screws.
Direction of rotation	Clockwise, viewed from drive end
Advance box (two stage)	7" advance with 3" start retard
Back leakage rate 150-100 Atm:	
New nozzle	7 seconds
Original nozzle	5 seconds
Despatch nozzle	8520A290A

INJECTORS

Make/type	CAV Pintaux DES5385001
Nozzle size	BDNO/SPC 6209
Opening pressure (working pressure)	135 to 140 Atmospheres
Injector pipe type	High pressure multi-bundy
size	1,94 to 2,06 mm
length	457,2 mm (18 ins)

HEATER PLUGS

Make/type	Probe type, Champion CH63 i i volts 90 watts nominal
Time to reach operating temperature of 850°C	8 seconds

TURBO-CHARGER

Make/type	Garrett T2
Maximum boost pressure	48 cm HG (9.3 P.S.I.G.) measured at wastegate actuator "T" piece

TORQUE WRENCH SETTINGS

TURBO-CHARGER FIXINGS	Nm	lbf.ft
Stud-Turbo charger to exhaust manifold	22-28	16-21
Nut-Turbo charger to exhaust manifold	21-26	15-19
Adaptor-Oil feed to cylinder block	22-28	16-21
Adaptor-Oil drain to cylinder block	22-28	16-21
Pipc-Oil feed to turbo charger	15-22	11-16
Pipe-Oil drain	32-48	23-35
Stud-Outlet elbow to turbo charger	22-28	16-21
Nut-Outlet elbow to turbo charger	21-26	15-19
Heat shield support to inlet manifold	22-28	16-21
Stud-Exhaust manifold to cylinder head	30-40	22-30
Nut-Exhaust manifold to cylinder head	28-36	21-26
Screw-inlet and exhaust manifold to cylinder head	30-40	22-30

RECOMMENDED ENGINE OILS

The following list of recommended engine oils for temperate climates - ambient temperature range - 10°C to 35°C should be used for oil changes and topping up. They are SHPD (Super High Performance Diesel) oils that allow a maximum of 10,000 km (6,000 miles) between oil and filter changes.

BP	Vanellus C3 Extra 15/40
CASTROL	Deusol Turbomax 15/40
MOBIL	Delvac 1400 Super 15/40
SHELL	Myrina 15/40

The following list of oils is for emergency use only if the above oils arc not available. Thcy can be used for topping-up without detriment, but if used for engine oil changing, they are limited to a maximum of 5,000 km (3,000 miles) between oil and filter changes.

BP	Vanellus C3 Multigrade 15/40
CASTROL	Dcusol RX Super 15/40
DUCKHAMS	Hypergrade 15/50
ESSO	Essolube XD-3 15/40
MOBIL	Delvac Super 15/40
PETROFINA	Fina Dilano HPD 15/40
SHELL	Rimula X 15/40
TEXACO	URSA Super Plus 15/40

Use only oils to MIL-L-2104C/D or API Service levels CD or SE/CD-15W/40 SECTION 10

MAINTENANCE SCHEDULE

The following additional maintenance is required for the turbo charged engine to that contained in thc main schedulc for the non-Turbo Charged 2.5 Litre Diesel cngine.

Every 500 km (250 miles)
- Check engine oil level

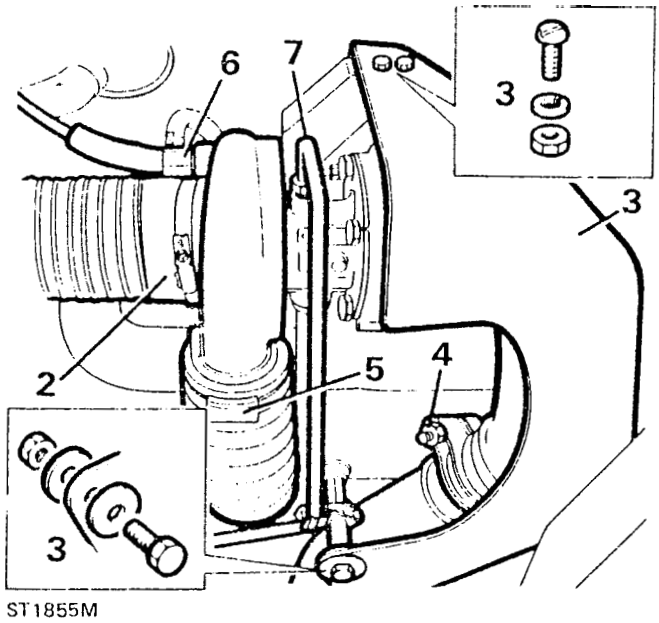
At 1,600 km (1,000 miles), 10,000 km (6,000 miles) and 20.000 km (12,000 miles) then every 20,000 km (12,000 miles)
- Check tappets, and adjust if necessary

Every 80.000 km (48,000 miles)
- Check maximum turbo-charge boost pressure.

TURBO-CHARGER

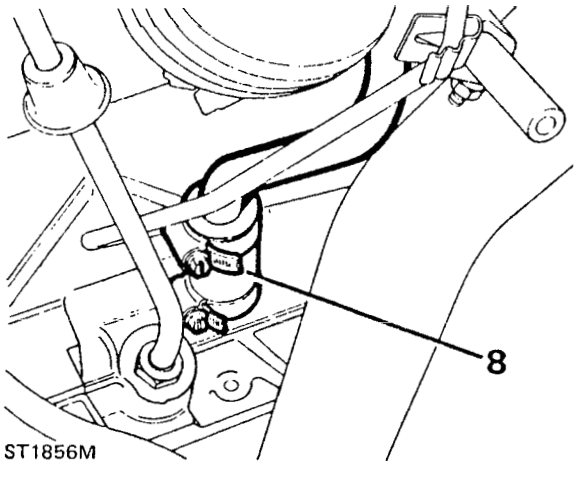
Removing

1. Remove the bonnet.
2. Remove the hose connecting the air cleaner to the turbo-charger.
3. Remove the turbo-charger heat shield fixings and remove the heat shield.
4. Release the clamp securing the turbo-charger elbow to the exhaust downpipe.
5. Remove the inlet manifold to the turbo-charger hose.
6. Disconnect the boost control hose from the turbo-charger.
7. Disconnect from the turbo-charger the lubrication inlet pipe.



ST1855M

8. Disconnect, at the flexible hose, the lubrication drain pipe from the turbo-charger.



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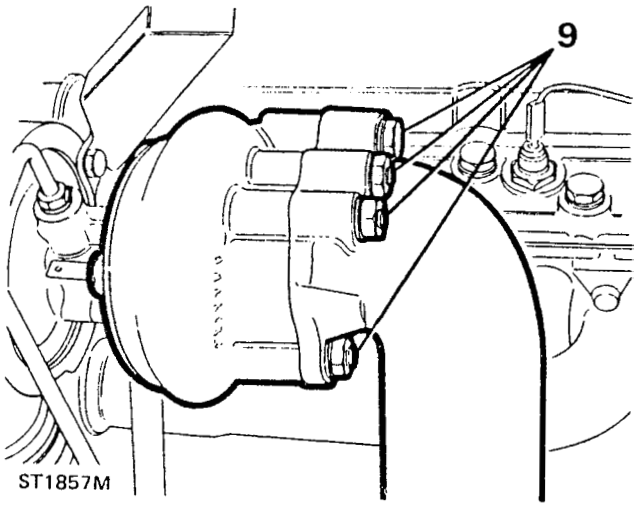
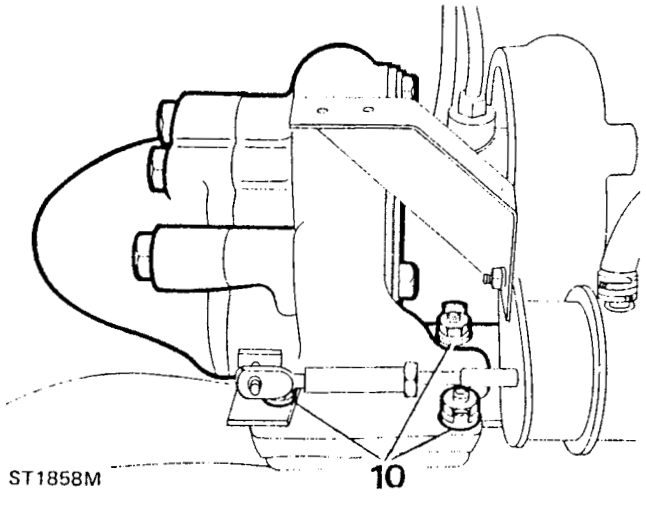
9. Remove the five nuts to release the exhaust elbow and gasket from the turbo-charger.



ST1857M

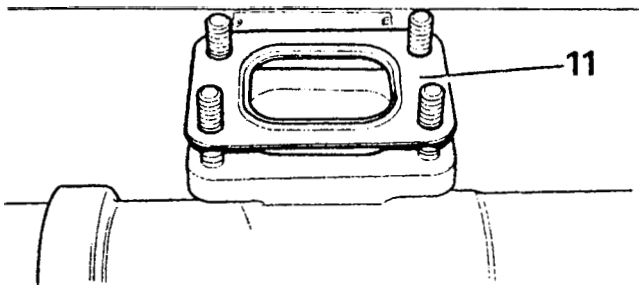
10. Release the lock tabs and remove the four nuts securing the turbo-charger to the exhaust manifold and remove the turbo-charger and gasket.



ST1858M

Fitting

11. Fit the raised bead side of a new gasket uppermost to the exhaust manifold and fit and secure the turbo-charger with the four nuts, tightening evenly to the correct torque and secure with lock tabs.
12. Fit the exhaust elbow, using a new gasket, to the turbo-charger and retain with the five nuts tightening evenly to the correct torque.

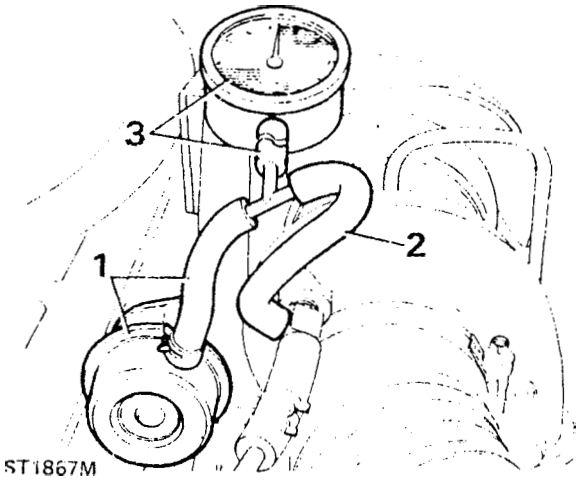


ST1863M

13. Fit the exhaust downpipe to the turbo-charger elbow and tighten the clamp bolt.
14. Connect the lubrication inlet pipe to the turbo-charger.
15. Fit the oil drain pipe to the flexible connection.
16. Connect the boost control pipe to the turbo-charger.
17. Fit the hose connecting the inlet manifold to turbo-charger.
18. Fit the heat shield.
19. Fit the air cleaner to turbo-charger hose.
20. Immediately prior to starting the engine release the oil inlet pipe to the turbo-charger and fill the centre housing with a recommended make and grade of engine oil and re-fit the pipe.

CHECKING TURBO-CHARGER BOOST PRESSURE

1. Disconnect, from the turbo-charger, the hose to the actuator and insert, into the free end a suitable 'T'piece.
2. Connect a short length of slave hose to the turbo-charger and connect the other end to the 'T' piece.
3. Connect a further slave hose to the third leg of the 'T' piece and the other end to a pressure gauge capable of reading in excess of *50* cm of Mercury. The pressure gauge hose must be long enough to reach into the cab of the vehicle so that the gauge can be observed by the driver or passenger.
4. Drive the vehicle in the normal manner (2,500-*3,000* r.p.m. full load) and observe the maximum pressure obtained and compare with the figure in Data Section 05.



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RENEW TURBO-CHARGER ACTUATOR

1. Remove the two screws securing actuator bracket to the turbo-charger.
2. Remove the nut and bolt securing actuator to the heat shield bracket and disconnect the hose.
3. Remove clip retaining actuator arm to the wastegate lever pin and withdraw the actuator from the engine.
4. Fit the replacement actuator with the two bolts and single nut and bolt. Tighten bolts to 12.5 to 14.0 Nm (111 to 124 in lbs).
5. Push the wastegate lever as far as possible towards the actuator and apply pressure to keep lever in this position.
6. Pressurize the replacement actuator to *57-62* cm HgG (11-12 p.s.i.g) and hold this pressure.

CAUTION: Use only the threaded rod-end to make adjustments. Forcing the entire rod in or out will change the calibration with the possibility of damaging engine over-boost.

7. Screw the rod-end in either direction until the rod end eye will locate easily over the wastegate pin and secure with retaining clip.
8. Release the calibration pressure and tighten the rod end locknut. Reconnect the hose.
9. Check the boost pressure, on the road, as described earlier. The pressure should not fall below 44 or exceed *50* cm HgG *(8.5* —9.7 p.s.i.g.)

TURBO-CHARGER FAULT TRACING

It is important to be aware that when tracing a suspected fault in a turbo-charger that a turbo-charger cannot compensate for incorrect engine operation deficiencies in the air, or fuel intake systems, exhaust emission components or for damaged and worn engine internal parts such as valves and pistons. Before suspecting the turbo-charger, the engine should be checked against the tuning data in Section 05. Replacing a sound turbo-charger with another will not correct engine deficiencies.

Systematic fault tracing of a suspected turbo-charger failure is important for two reasons. First, it must be found what, if anything, is wrong with the turbo-charger so that it can be exchanged. Second, it must be decided what action is necessary to prevent a repeat failure.

In many cases, evidence pointing to the cause of a failure is destroyed while removing the turbo-charger from the engine. For example, if a turbo-charger failed because of a faulty installation, such as loose connections that allowed dirt to enter the compressor, this would not be evident once the turbo-charger was removed from the engine. Failure to correct the installation, such as reinstalling defective manifold flange Connections, could cause an identical failure of the replacement unit. The hose connecting the air cleaner to the compressor, which could contain dirt or harmful particles, should be cleaned or renewed if necessary.

In general, the fault tracing procedures that can be done with the least effort and in the least amount of time should be done first. Do not remove and renew the turbo-charger until the following visual checks and repairs that can be made with the turbo-charger installed, have been done. **DO NOT, UNDER ANY CIRCUMSTANCES, DISMANTLE THE TUKBO-CHARGER.**

VISUAL INSPECTION

1. Inspect all connections within the intake system. Tighten loose connections as required.
2. Replace damaged air intake components.
3. Check the connection between the compressor and the engine intake manifold.
   Tighten loose bolts as required.
4. Check exhaust system connections at turbine housing inlet and outlet flanges for oil leakage and loose connections. Tighten loose connections as required. If oil leakage exists, check the general condition of the engine.
5. Check the oil line connections at the centre housing oil inlet and outlet ports for leakage.
   Tighten loose connections as required. Start engine and recheck connections.

ENGINE PROTECTION

To prevent corrosion of the aluminium alloy engine parts it is imperative that the cooling system is filled with a solution of clean water and the correct type of anti-freeze, winter and summer, or water and inhibitor if frost precautions are not required. Never fill or top-up with water only, always add an inhibitor (Marstons SQ36) if anti-freeze is not used. NEVER use salt water with an inhibitor otherwise corrosion will occur. In certain territories where the only available water supply may have some salt content, use only clean rainwater or distilled water.

Recommended solutions

Anti-freeze Unipart Universal Anti-freeze or permanent type ethylene base, without methanol, with a suitable inhibitor for aluminium engines and engine parts.

Use one part of anti-freeze to one part water.

Inhibitor Marston Lubricants SQ36 inhibitor concentrate.

Use 100 cc of inhibitor per litre of water.

Anti-freeze can remain in the cooling system and will provide adequate protection for two years provided that the specific gravity of the coolant is checked before the onset of the second winter and topped-up with new anti-freeze as required.

Land Rovers leaving the factory have the cooling system filled with 50% of anti-freeze mixture. This gives protection against frost down to minus **47°C** (minus 53°F). Vehicles so filled can be identified by a label affixed to the windscreen and radiator.

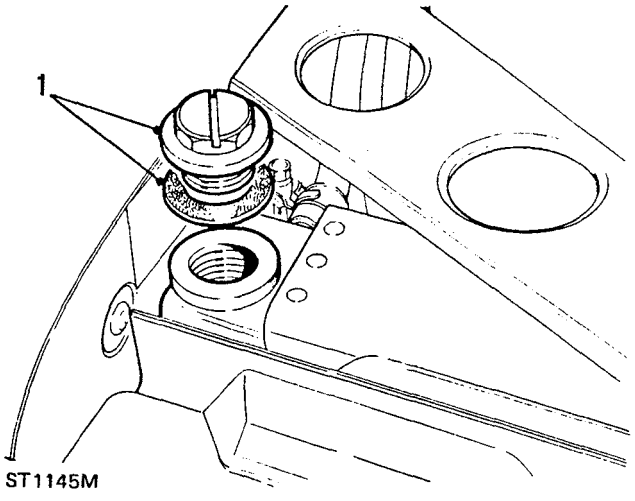
After the second winter the system should be drained and thoroughly flushed. Before adding new anti-freeze examine all joints and renew defective hoses to make sure that the system is leakproof. Inhibitor solution should be drained and flushed out and new inhibitor solution introduced every two years, or sooner where the purity of the water is questionable.

See the 'General specification data' section for protection quantities.

DRAIN AND FILL V8 ENGINE COOLING SYSTEM

WARNING: Do not remove the radiator filler cap when the engine is hot because the cooling system is pressurized and personal scalding could result.

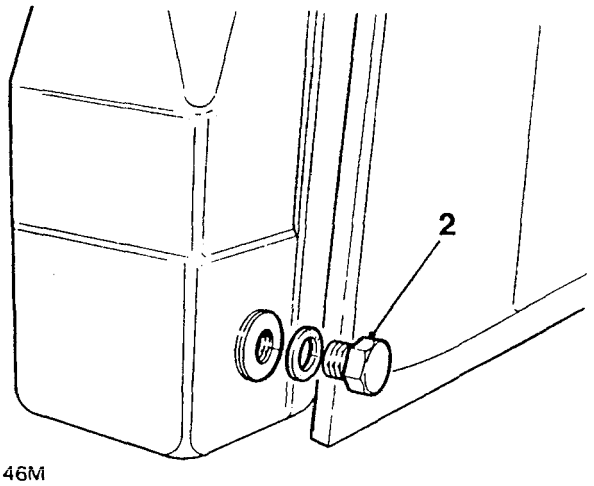
1. Remove the radiator filler plug.



ST1145M

2. Remove the radiator drain plug and allow the coolant to drain, if neccssary, into a suitable container. Refit the drain plug and new washer. The drain plug is situated on the left-hand side of the radiator towards the bottom facing the engine compartment.

NOTE: Disconnect bottom hose to drain on radiators without a drain plug. Connect hose after draining.



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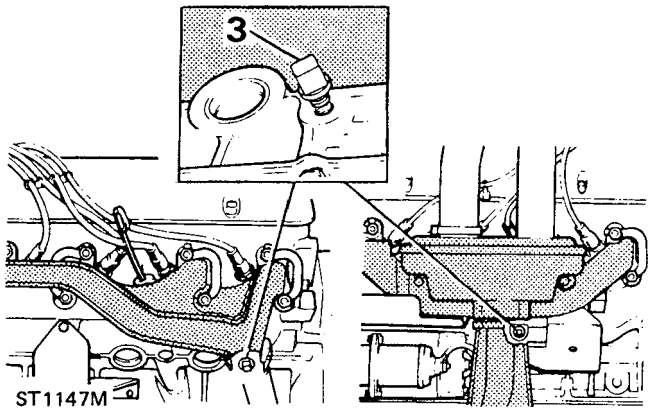
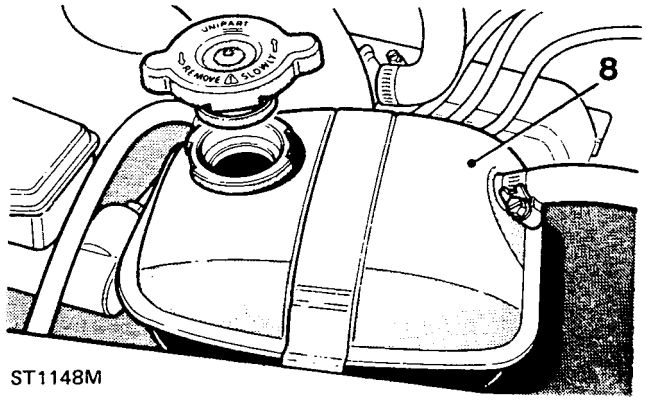
3. Remove the engine drain plugs, one each side of the cylinder block, beneath the exhaust manifolds. Allow the coolant to drain and refit plugs and washers.



4. To drain the expansion tank remove it from the vehicle, empty, flush-out and refit. If necessary renew the expansion tank hose.
5. Make up a solution of anti-freeze and water in a scparatc container in the concentration required. The cooling system capacity is quoted in the data section. Therefore to allow for topping up and the expansion tank make up a quantity in excess of this quantity.
6. If anti-freeze is not required use Marstons SQ36 in the concentration recommended as described under 'Engine protection'. Make **up** a quantity in excess of capacity for topping up and expansion tank.
7. Make surc all drain plugs are tight and fill the system through the radiator filler **plug** until the coolant is just below the filler neck. Fit the plug but do not over tighten.
8. Half fill the expansion tank with coolant and secure the cap correctly.

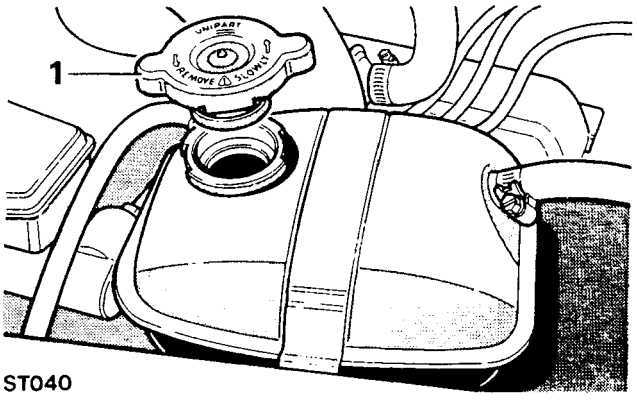


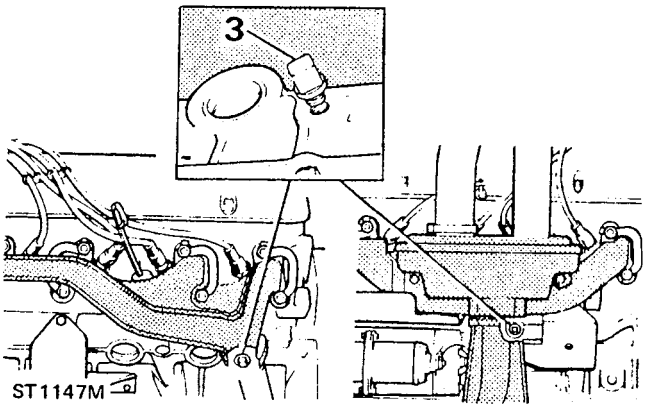
9. Start and run the engine until normal operating temperature is reached. Allow the engine to cool and check the levels in the radiator and expansion tank and top up if necessary. Finally check all hose connections for leaks.

DRAIN AND FILL 2.25 LITRE PETROL AND DIESEL AND 2.5 DIESEL SYSTEMS

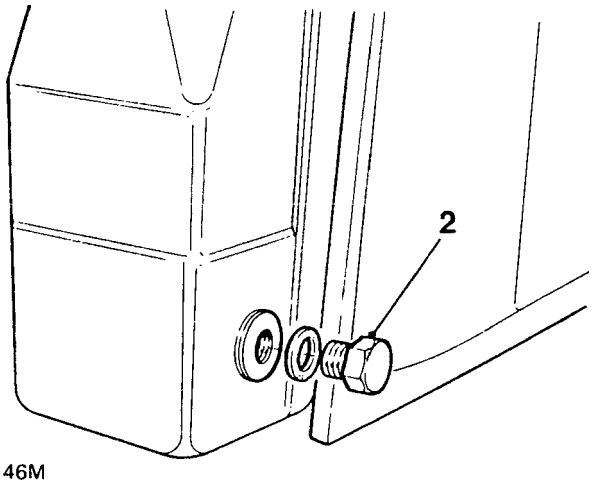
WARNING: Do not remove the radiator or expansion tank filler caps when the engine is hot because the cooling system is pressurized and personal scalding could result.

1. Remove the expansion tanks and radiator filler plug.



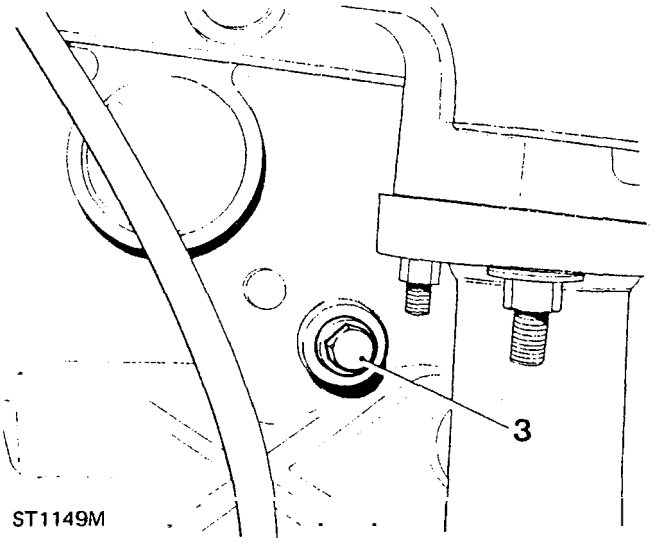


2. Remove the radiator drain plug and allow the coolant to drain, if necessary into a suitable container. Refit the drain plug with a new washer. The plug is located on the left-hand side of the radiator facing the engine compartment.



NOTE: Radiator without a drain plug, disconnected the bottom hose to drain. Reconnect after draining.

3. Remove the cylinder block drain plug, on the left-hand side of the engine, and allow coolant to drain completely before refitting the plug.



4. To drain the expansion tank, disconnect the hose from the tank to the water pump. Drain and flush and reconnect the hose.
5. Make up a solution of anti-freeze and water in a separate container in the concentration required. The cooling system capacity can vary so refer to 'Capacities' under 'General specification data'. To allow for topping up and the expansion tank prepare a quantity in excess of the capacity of the system concerned.
6. If anti-freeze is not required, use Marstons inhibitor SQ36 in the recommended concentration, see under 'Engine protection'. Prepare a quantity in excess of the capacity for topping up and the expansion tank.
7. Check all hoses and drain plugs for security and fill the system through the expansion tank until approximately three quarters full.
8. Fit the expansion tank cap and radiator filler plug and run the engine until normal operating temperature is reached. Allow the engine to cool completely. Remove the expansion tank cap and if necessary top up to half full. Remove the radiator filler plug and check that the coolant level is just below the filler neck. Finally examine the cooling system for leaks. Tighten the radiator filler plug to 40—50 lbs. in.

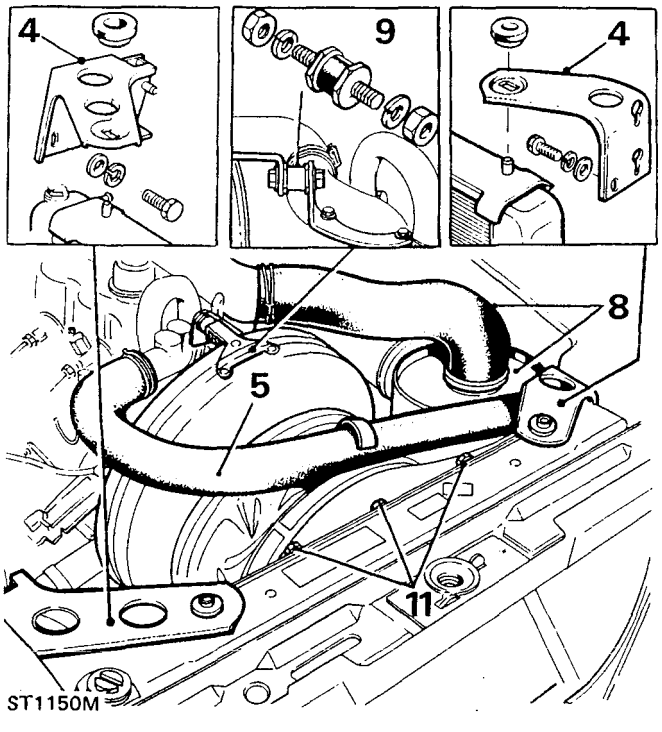
REMOVING THE RADIATOR (2.25 litre petrol and 2.25 and 2.50 diesel)

1. Disconnect the battery.
2. Drain the radiator by removing the drain plug at the bottom left-hand side of the radiator and releasing the expansion tank filler cap. See drain and fill cooling system.
3. Disconnect the overflow hose from the radiator.
4. The radiator is held in position by two brackets each secured by three screws. Remove the screws and brackets.
5. Disconnect the top and bottom hoses from the radiator.
6. **Diesel engine**
7. Disconnect the vacuum pump hose from the pump and release it from the clips on the radiator cowling.

Petrol engine

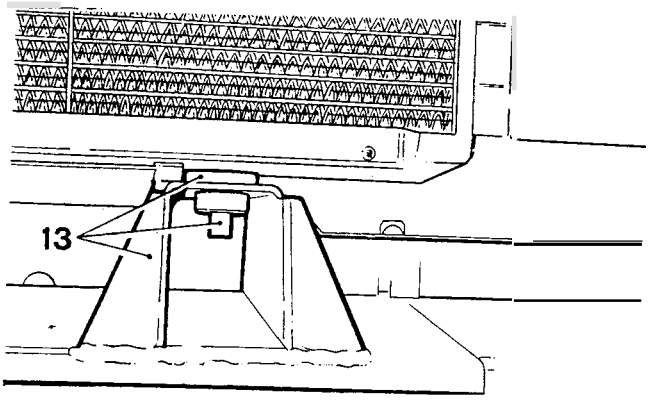
8. Disconnect the air cleaner hose from the carburetter and remove the air cleaner.
9. Release the three fixings securing cowling to the engine.
10. Pull back the cowling towards the radiator and lift radiator and cowl.
11. Remove the five screws securing the cowling to the radiator and separate the two units noting that the cowling is held to the bottom of the radiator by two clips.

continued



FITTING THE RADIATOR

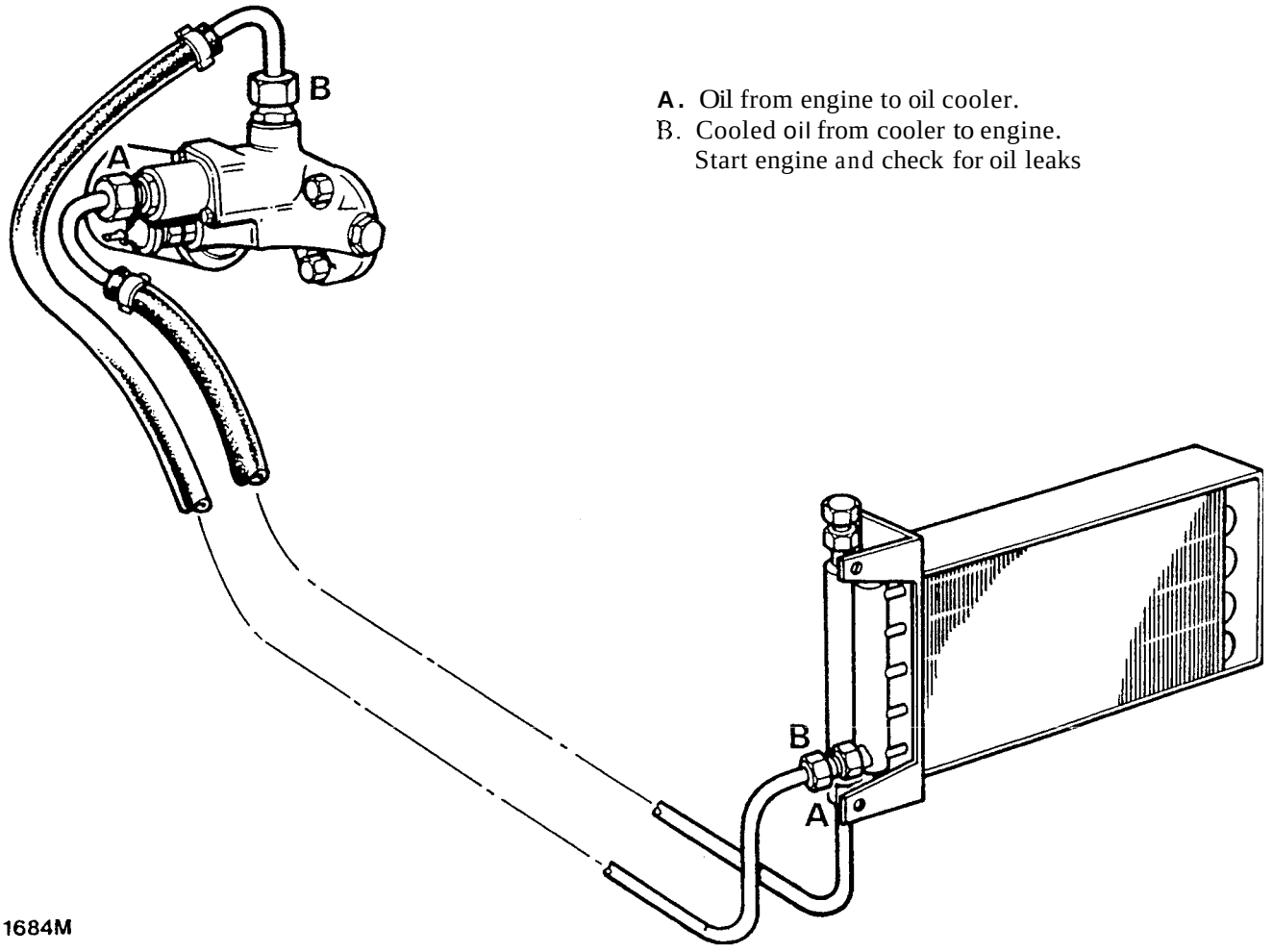
12. Locate the cowling into the clip at the bottom of the radiator and secure it at the top with the five screws.
13. Lower the radiator and cowl assembly into position in the vehicle ensuring that the two pegs at the bottom of the radiator locate in the corresponding rubber pads in the crossmember brackets.



ST1151M

14. Secure the top of the radiator with the two brackets and bolts.
15. Secure the cowling to the engine.
16. Connect the top, bottom and overflow hoses.
17. **Diesel engine**
    Fit the hose to the vacuum pump and secure it with the clips on the cowling.
    Fit the air cleaner and connect the hose to the air intake manifold.
18. **All engines**

    Check that the radiator drain plug (where fitted) is tight and fill the cooling system.



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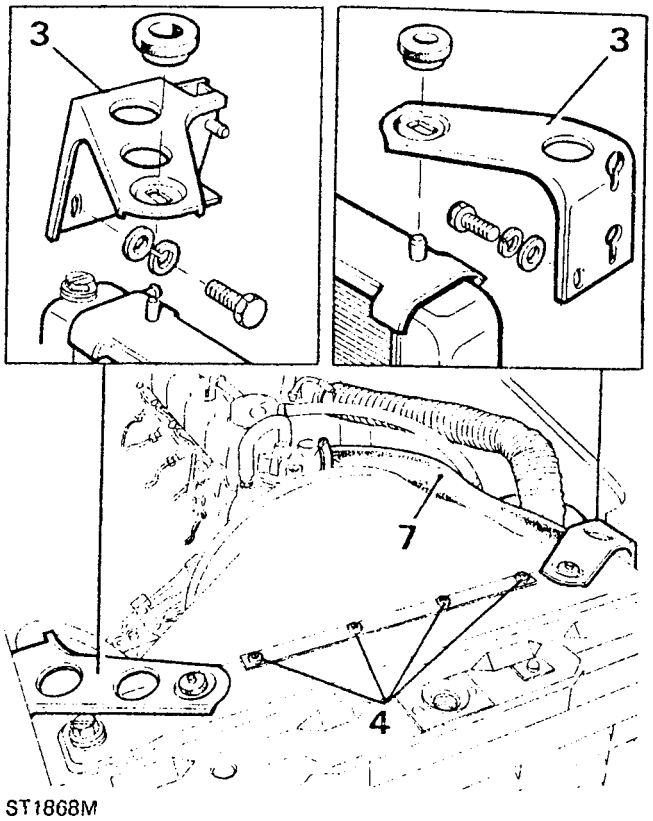
A. Oil from engine to oil cooler.
B. Cooled oil from cooler to engine.
Start engine and check for oil leaks

RADIATOR ASSEMBLY —TURBO-CHARGED VEHICLES.

Removing

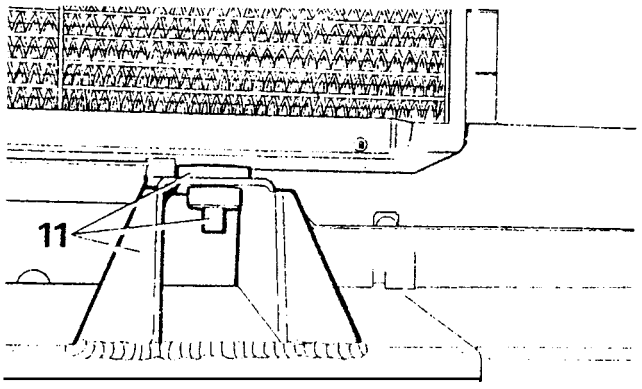
1. Disconnect the battery.
2. Remove the split pin and clevis pin securing the lower end of the bonnet stay and lift-off the bonnet.
3. Remove the three screws each side securing the radiator left-hand and right-hand retaining brackets and remove the brackets.
4. Remove the four screws and withdraw the radiator cooling fan cowl.
5. Disconnect the bottom hose from the radiator and drain the coolant.
6. Disconnect the oil cooler inlet and outlet pipes from the radiator and blank-off the pipes and radiator apertures to prevent ingress of dirt.
7. Disconnect the radiator top hose from the radiator and thermostat housing.
8. Disconnect expansion tank hose from radiator.
9. Lift the radiator from the engine compartment.
10. If the radiator is to be renewed, remove the oil cooler unions from the radiator and fit to the replacement radiator.



ST1868M

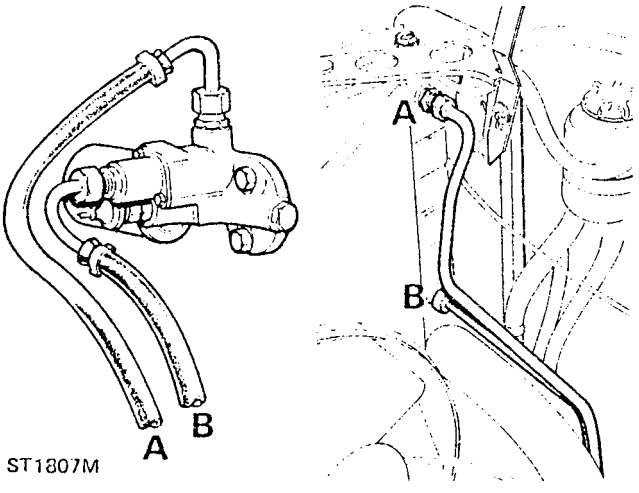
Fitting

11. Fit the radiator into position ensuring that the two pegs at the bottom of the radiator locate in the corresponding rubber pads in the cross member brackets.



ST1869M

12. Fit the radiator top hose to the radiator and thermostat housing.
13. Connect the radiator bottom hose.
14. Fit the expansion tank hose to radiator.
15. Fit the fan cowl and secure with the four screws.
16. Fit the radiator left-hand and right-hand retaining brackets.
17. Fit the oil cooler inlet and outlet hoses to the radiator.
    Hose **A** to top of radiator.
    Hose B to bottom of radiator.

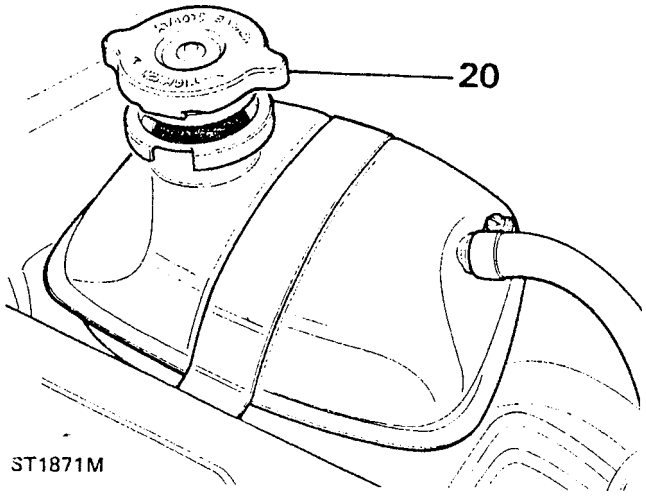


ST1807M

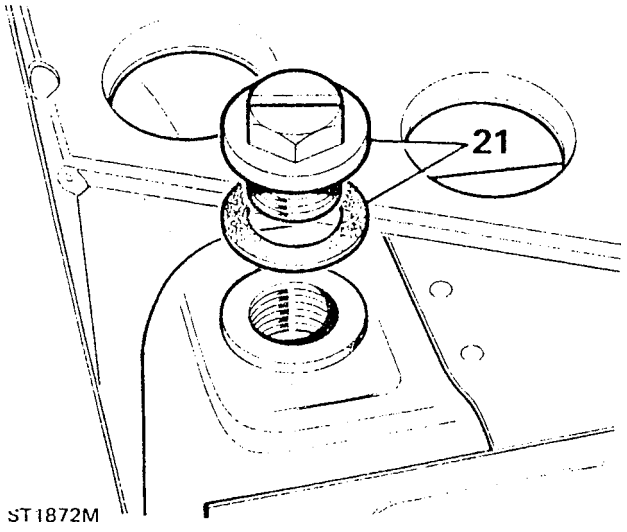
18. Fit the bonnet and stay securing with the clevis pin and new split pin.

Filling radiator

19. Check that all hose clips are tight.
20. Remove the expansion tank cap.



21. Remove the radiator plug.



22. Fill the system with coolant using a mixture of water and anti-freeze or anti-corrosion inhibitor, through the expansion tank untill the coolant is just below the level of the radiator plug hole. Continue filling until the expansion tank is half-full.
23. Fit the expansion tank cap and radiator plug. Tighten the plug to 40—50 Ibs. in.
24. Check the engine oil level in sump and top-up.
25. Connect the battery and run the engine until normal running temperature is attained whilst checking for coolant leaks.
26. Stop the engine and allow it to cool completely.
27. Remove the radiator plug and check the level and fit and tighten plug.
28. Top-up level of expansion tank and fit the cap.

COOLING SYSTEM FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
A — EXTERNAL LEAKAGE	1. Loose hose clips 2. Defective rubber hose 3. Damaged radiator seams 4. Excessive wear in the water pump 5. Loose core plugs 6. Damaged gaskets 7. Leaks at the heater connections or plugs 8. Leak at the water temperature gauge plug	1. Tighten 2. Renew 3. Rectify 4. Renew 5. Renew 6. Renew 7. Rectify 8. Tighten
B — INTERNAL LEAKAGE	1. Defective cylinder head gasket 2. Cracked cylinder wall 3. Loose cylinder head bolts	1. Renew. Check engine oil for contamination and refill as necessary 2. Renew cylinder block 3. Tighten. Check engine for oil contamination and refill as necessary
C — WATER LOSS	1. Boiling 2. Internal or external leakage 3. Restricted radiator or inoperative thermostat	1. Ascertain the cause of engine overheating and correct as necessary 2. See items A and B 3. Flush radiator or renew the thermostat as necessary
D — POOR CIRCULATION	1. Restriction in system 2. Insufficient coolant 3. Inoperative water pump 4. Loose fan belt 5. Inoperative thermostat	1. Check hoses for crimps, reverse-flush the radiator, and clear the system of rust and sludge 2. Replenish 3. Renew 4. Adjust 5. Renew
	2. Infrequent flushing and draining of system 3. Incorrect anti-freeze mixtures	1. Use only soft, clean water together with correct anti-freeze or inhibitor mixture 2. The cooling system should be drained and flushed thoroughly at least once a year 3. Certain anti-freeze solutions have a corrosive effect on parts of the cooling system. Only recommended solutions should be used.
F — OVERHEATING	1. Poor circulation 2. Dirty oil and sludge in engine 3. Radiator fins choked with chaff, mud. etc. 4. Incorrect ignition timing 5. Insufficient coolant 6. Low oil level 7. Tight engine 8. Choked or damaged exhaust pipe or silencer 9. Dragging brakes 10. Overloading vehicle 11. Driving in heavy sand or mud 12. Engine labouring on gradients 13. Low gear work 14. Excessive engine idling 15. Inaccurate temperature gauge 16. Defective thermostat	1. See item D 2. Refill 3. Use air pressure from the engine side of the radiator and clean out passages thoroughly 4. Check using electronic equipment 5. See item D 6. Replenish 7. New engines are very tight during the 'running-in' period and moderate speeds should be maintained for the first 1,000 miles (1500 km) 8. Rectify or renew 9. Adjust brakes 10. In the hands of the operator 11. In the hands of the operator 12. In the hands of the operator 13. In the hands of the operator 14. In the hands of the operator 15. Renew 16. Renew
G — OVERCOOLING	1. Defective thermostat 2. Inaccurate temperature gauge	1. Renew 2. Renew