

1993-95 ENGINES**3.9L & 4.2L V8****ENGINE IDENTIFICATION****ENGINE IDENTIFICATION CODES**

Engine	(1) Engine Code
3.9L	2
4.2L	3
(1) Engine code and compression ratio is stamped on a cast pad on the cylinder block, between numbers 3 and 5 cylinders. Compression ratio is located above serial number.	

BLEEDING COOLING SYSTEM**DRAINING & REFILLING COOLING SYSTEM**

WARNING: DO NOT remove expansion tank filler cap when engine is hot. The cooling system is pressurized and scalding could result.

1. Remove expansion tank filler cap by slowly turning it counterclockwise, pause to allow pressure to escape. Continue turning in same direction and remove. See **Fig. 1**.
2. Remove radiator filler plug and "O" ring. See **Fig. 2**.
3. Disconnect bottom hose from radiator. Drain coolant into a clean container. Reconnect bottom hose, retighten hose clamp. See **Fig. 3**.
4. Remove engine drain plugs, one each side of cylinder block, beneath exhaust manifolds. Drain coolant, install and tighten plugs. See **Fig. 4**.
5. Pour correct solution of water and anti-freeze into expansion tank until radiator is full.
6. Start engine, run it until normal operating temperature is attained, topping off as necessary.
7. Install radiator filler plug and "O" ring, with NEW "O" ring if required. Tighten to 53 INCH lbs. (6 Nm). See **Fig. 2**.
8. Install expansion tank filler cap.
9. Allow engine to cool, check coolant level. Top off expansion tank until level reaches seam of expansion tank.

CAUTION: The following fill procedure must be followed whenever heater pipes mounted on top of rocker cover have been removed.

10. Remove the fill tower plug. See **Fig. 5**.
11. Pour correct solution of water and anti-freeze into fill tower until radiator is full. See **Fig. 5**.
12. Start engine, run until normal operating temperature is attained, topping off as necessary.

13. Install radiator fill plug and fill tower plug, with NEW "O" ring if required. Tighten to 53 INCH lbs. (6 N.m).
14. Fit expansion tank filler cap.
15. Allow engine to cool, check coolant level in expansion tank. Top off until reaches seam of expansion tank.

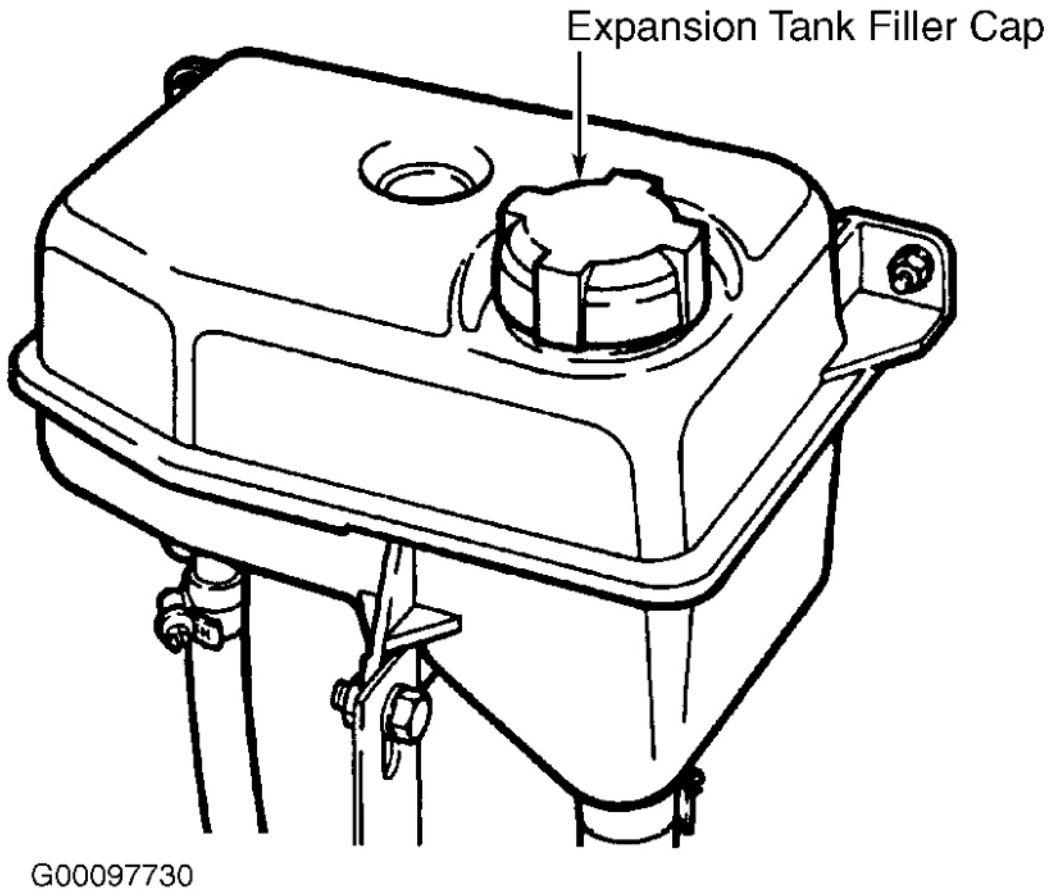
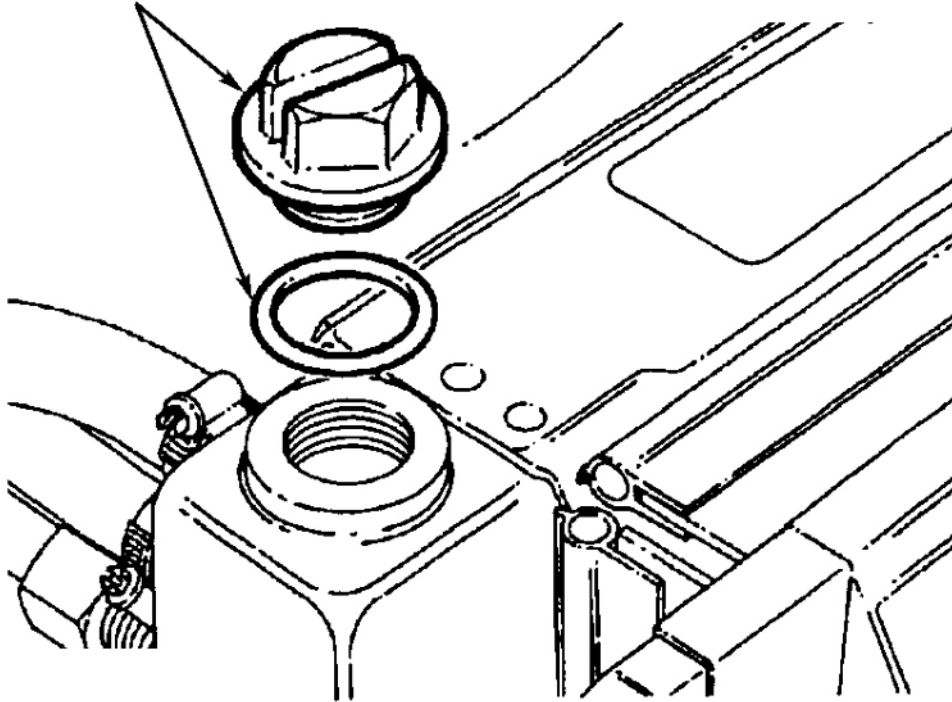


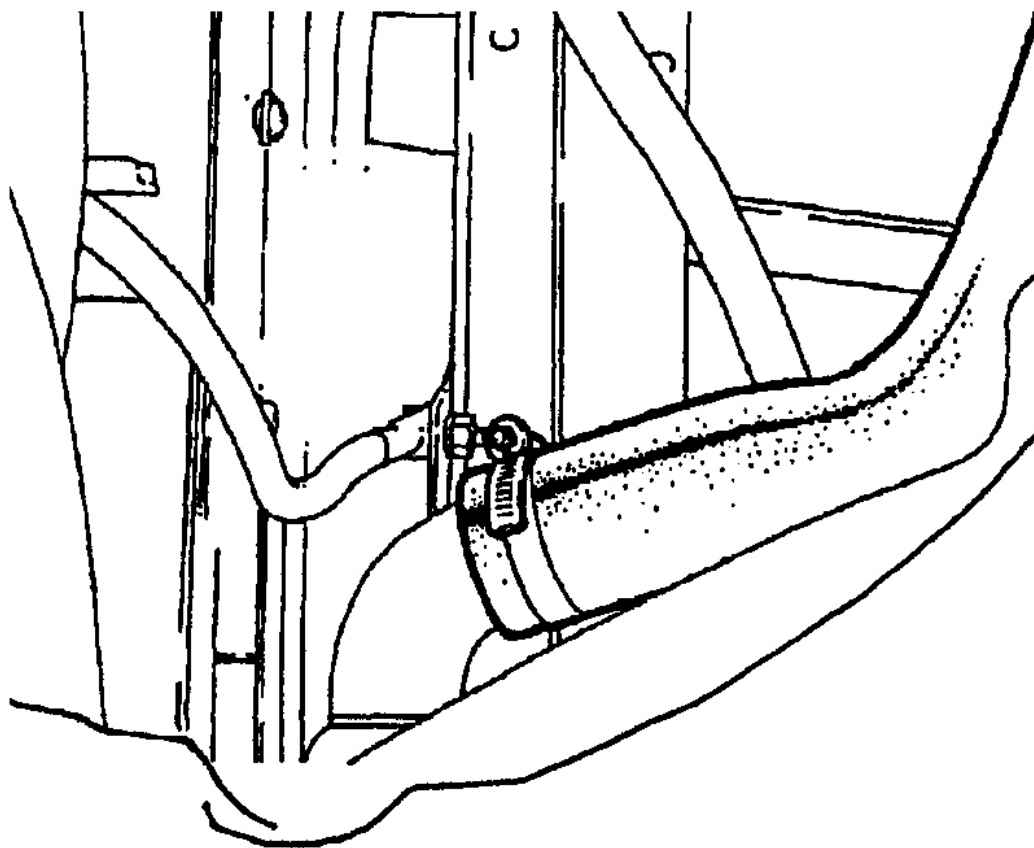
Fig. 1: Removing Expansion Tank Filler Cap
Courtesy of LAND ROVER NORTH AMERICA, INC.

Radiator Filter Plug & "O" Rings



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Fig. 2: Removing Radiator Filler Plug & "O" Ring
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 3: Disconnecting Bottom Radiator Hose
Courtesy of LAND ROVER NORTH AMERICA, INC.

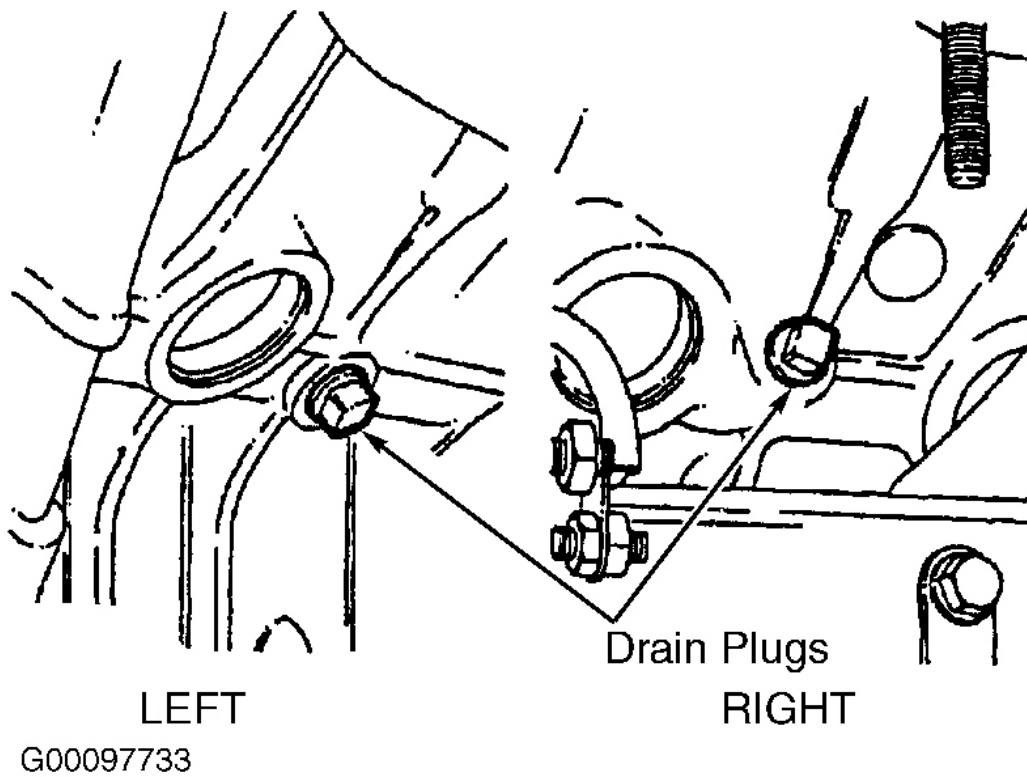
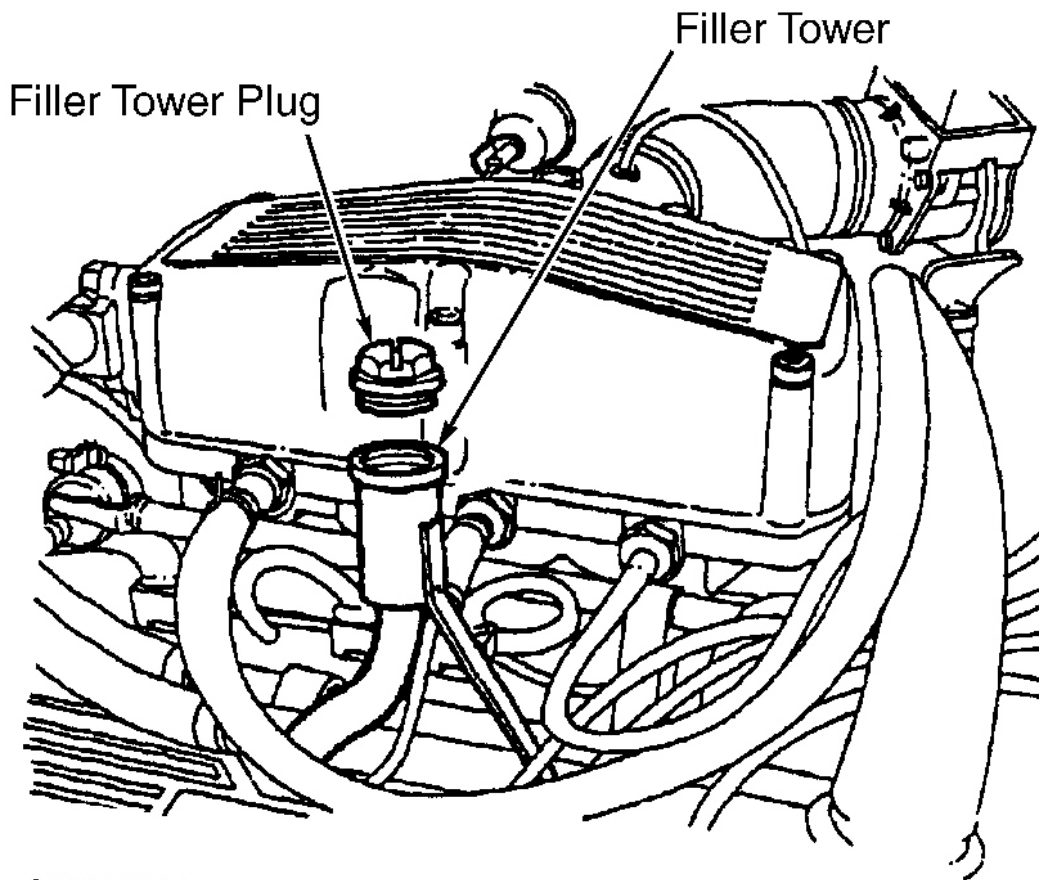


Fig. 4: Removing Engine Drain Plugs

Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 5: Identifying Fill Tower & Plug

Courtesy of LAND ROVER NORTH AMERICA, INC.

OIL SERVICE

Change engine oil every 7500 miles using appropriate engine oil. See **ENGINE OIL VISCOSITY** table. With oil pan and oil filter dry add 7 quarts of engine oil.

ENGINE OIL VISCOSITY

Ambient Temperature °F (°C)	⁽¹⁾ Oil Viscosity
-22 - 14 (-30 - -10)	5W/20, 5W/30 Or 5W/40
-4 - 50 (-20 - 10)	10W/30
-4 - 122 (-20 - 50)	10W/40 Or 10W/50
14 - 122 (10 - 50)	15W/40 Or 15W/50
32 - 122 (0 - 50)	20W/40 Or 20W/50

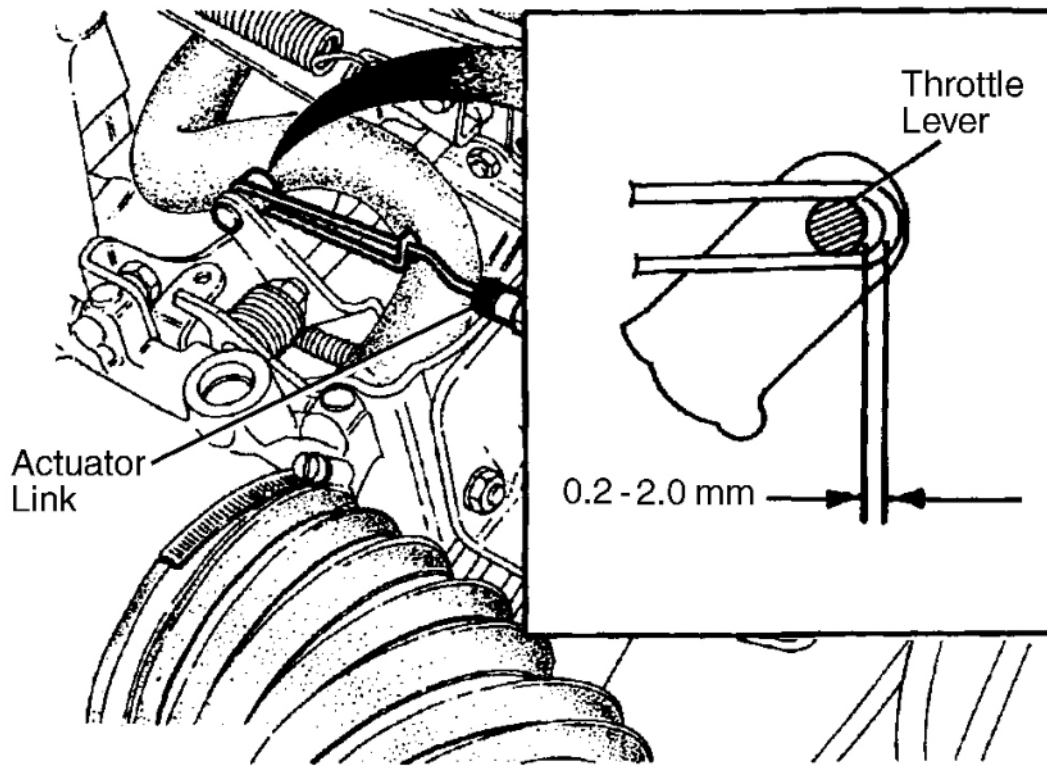
(1) Use oils to API service levels SG or SH.

ADJUSTMENTS

CRUISE CONTROL ACTUATOR LINK

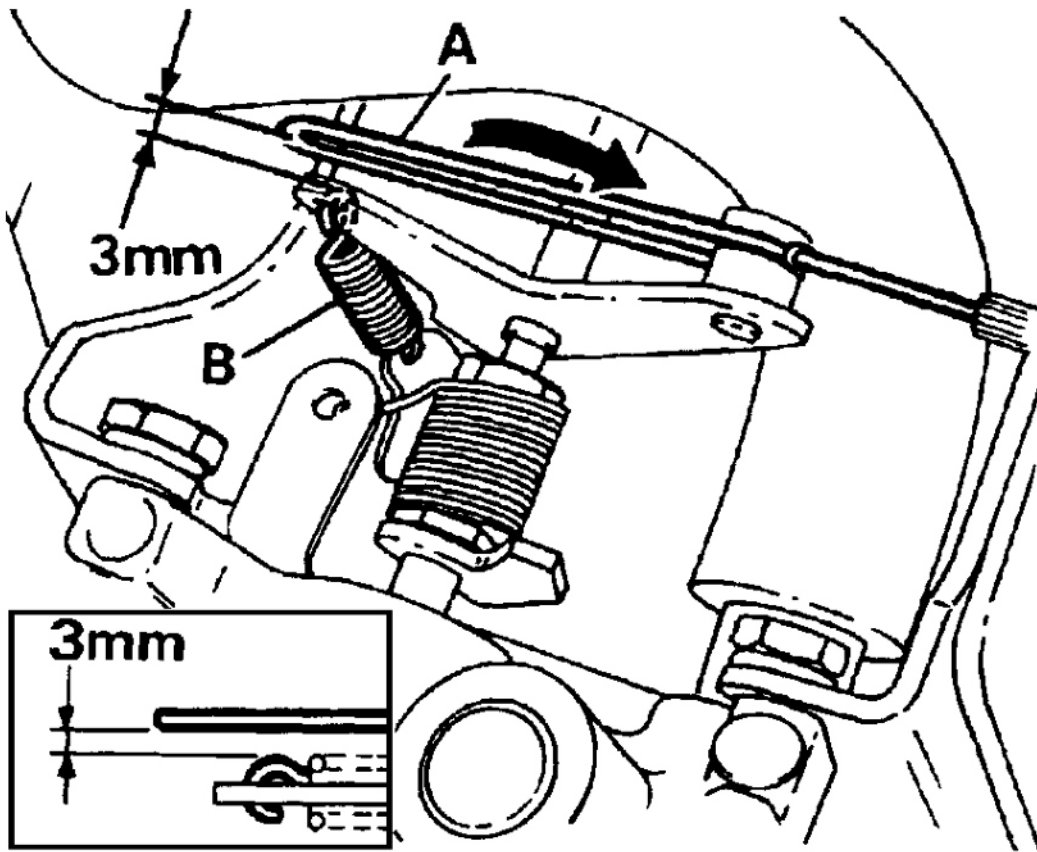
NOTE: **Setting procedure is carried out at minimum throttle condition only.**

1. Ensure ignition is switched OFF.
2. Check clearance between inside edge of cruise control actuator link and recessed diameter of throttle lever. Clearance should be 0.008-.079" (0.20-2.00 mm). See **Fig. 6**.
3. Remove link from actuator. See **Fig. 6**.
4. Rotate socket joint adjuster as necessary. See **Fig. 6**.
5. Refit link to actuator and recheck clearance between link and lever.
6. With throttle fully open, check a gap of at least 0.1" (3 mm) exists between side of link ("A" in illustration) and side of small spring ("B" in illustration). See **Fig. 7**. Realign link by bending to achieve correct gap. Recheck clearance at closed throttle/open throttle. Check link slides smoothly in groove of throttle lever.



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Fig. 6: Adjusting Cruise Control Actuator Link (1 Of 2)
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 7: Adjusting Cruise Control Actuator Link (2 Of 2)
Courtesy of LAND ROVER NORTH AMERICA, INC.

TROUBLE SHOOTING

NOTE: To trouble shoot engine mechanical components, see appropriate table in TROUBLE SHOOTING article in GENERAL INFORMATION.

OIL PRESSURE TEST

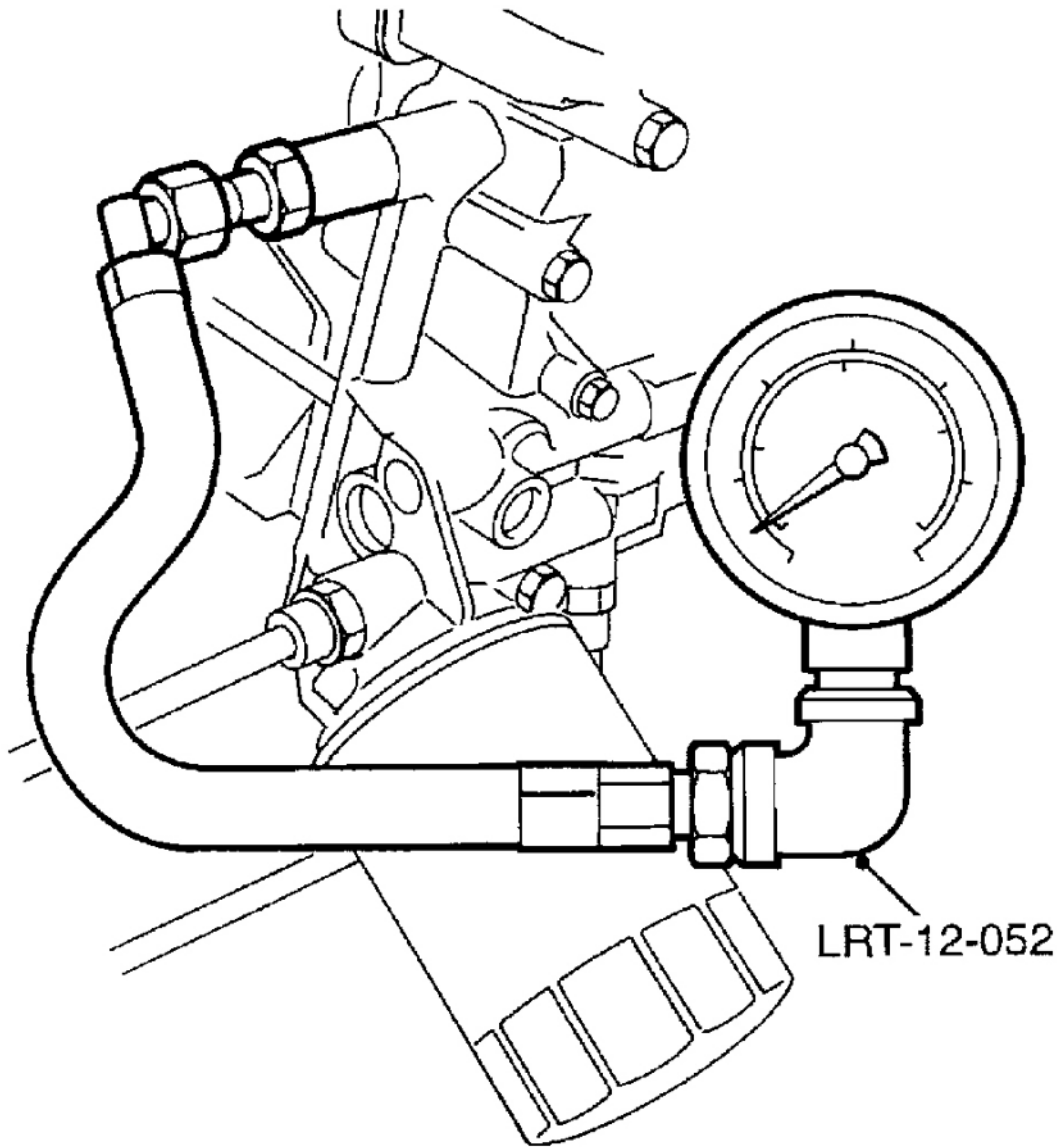
WARNING: Suitable extraction equipment must be fitted to exhaust system of vehicle, if test is being carried out in workshop.

WARNING: If vehicle has been running, engine oil will be hot. Care must be taken when fitting equipment to prevent possibility of personal injury due to scalding.

1. Check oil level.
2. Place vehicle on a suitable hoist.
3. Disconnect negative battery terminal and remove oil pressure switch.
4. Install test gauge. See **Fig. 8**.
5. Connect negative battery terminal.
6. Start and run engine to normal operating temperature (thermostat open).
7. With engine speed maintained at 2400 RPM engine oil pressure should be 1.76 kg/cm² (25 psi).

NOTE: **Excessive lubrication pressure can effect engine performance by overpressurizing the hydraulic tappets causing the valves to be held open.**

8. If there is no oil pressure check for air lock in system. Repair as necessary. If air lock is not present go to next step.
9. If oil pressure is low. Repair or replace oil pump as necessary.



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Fig. 8: Checking Oil Pressure

Courtesy of LAND ROVER NORTH AMERICA, INC.

REMOVAL & INSTALLATION (WITH ENGINE IN VEHICLE)

WARNING: During battery removal or before carrying out any repairs or maintenance to electrical components always disconnect battery negative lead first. If positive lead is disconnected with negative lead in place, accidental contact of wrench to any grounded metal part could cause a severe spark,

possibly resulting in personal injury. Upon installation of battery connect positive lead first.

DEPRESSURIZING FUEL SYSTEM

WARNING: Under normal operating conditions the fuel injection system is pressurized by a high pressure fuel pump, operating at up to 34-37 psi (2.3-2.5 kg/cm²). When the engine is stationary this pressure is maintained within the system. To prevent pressurized fuel escaping and to avoid personal injury it is necessary to depressurize the fuel injection system before any service operations are carried out.

WARNING: The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

NOTE: If the vehicle has not been run there will still be a small amount of residual pressure in the fuel line. The depressurizing procedure must still be carried out before disconnecting the component within the fuel system.

1. Pull the fuel pump relay off its multi-plug. Fuel pump relay is located under front right seat, adjacent to ECU, and is mounted on a Blue terminal block.
2. Start and run the engine.
3. When sufficient fuel has been used up causing the fuel line pressure to drop, the injectors will become inoperative, resulting in engine stall. Switch the ignition off.
4. Disconnect the battery negative terminal.

NOTE: Fuel at low pressure will remain in the system. To remove this low pressure fuel, place an absorbent cloth around the fuel feed hose at the fuel rail and release the fuel feed hose at the appropriate end.

5. Disconnect either the nut and ferrule at the fuel rail or the hose at the inlet end of the fuel filter.
6. To restart engine, refit the fuel feed hose.
7. Refit the fuel pump relay, reconnect the battery.
8. Crank the engine (engine will fire within approximately 6 to 8 seconds).

ENGINE

Removal

1. Park vehicle on level ground and apply park brake.
2. Depressurize fuel system. See **DEPRESSURIZING FUEL SYSTEM**.
3. Remove hood. See **HOOD**.
4. Remove battery. See **BATTERY**.

5. Remove radiator/oil coolers. See **RADIATOR/OIL COOLERS**.
6. Place an absorbent cloth around fuel feed hose at fuel rail and release compression nut. Remove feed hose from rail, seal end of pipes with masking tape to prevent ingress of dirt.
7. Release fuel return hose clamp and remove hose from pressure regulator, seal both openings with masking tape to prevent ingress of dirt.
8. Remove vacuum hose from rear of regulator.
9. Detach throttle bracket from plenum chamber and lay assembly to one side. See **PLENUM CHAMBER**. DO NOT disturb kick down cable setting.
10. Remove ram housing. See **RAM HOUSING**.
11. Remove mass air flow sensor. See **MASS AIR FLOW SENSOR**.
12. Remove air cleaner assembly. See **AIR CLEANER**.
13. Remove generator. See **GENERATOR**.
14. Release air conditioning compressor from its mounting and lay to one side. DO NOT discharge air conditioning system.

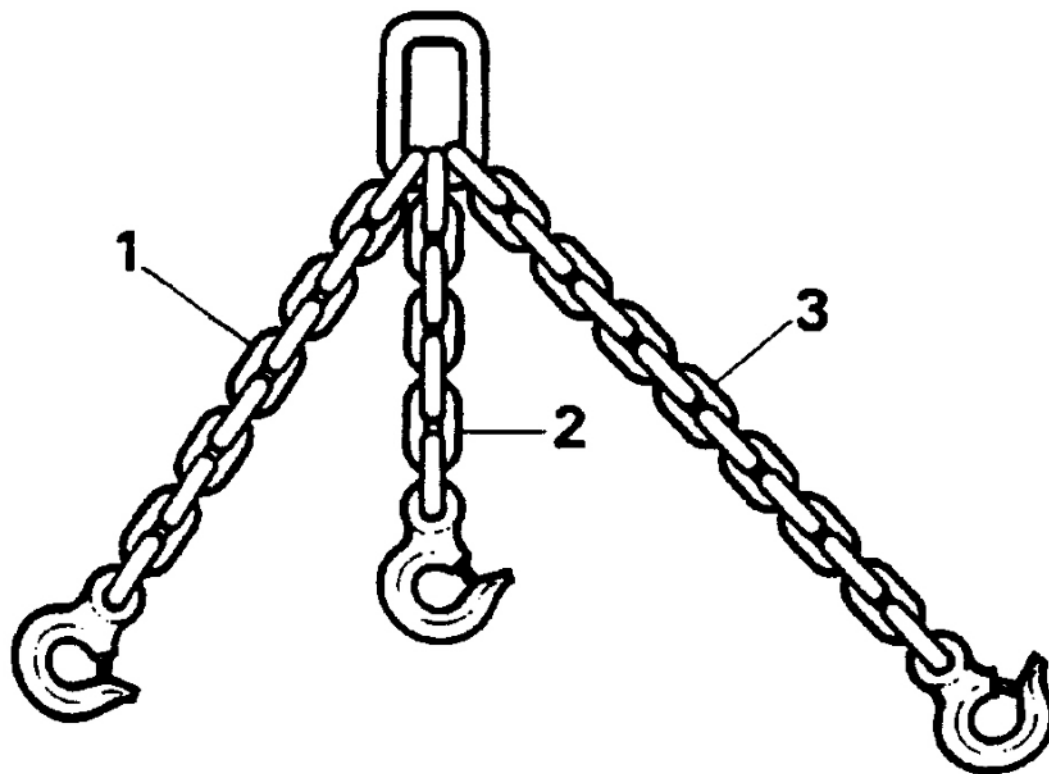
NOTE: Release bolts securing compressor mounting bracket to engine and remove bracket to enable temporary lifting eye ETC 5964 to be fitted. Secure lifting eye to mounting bracket fixing points with suitable bolts of equivalent size, pitch and thread. Leave lifting eye attached until engine is reinstalled in vehicle.

15. Place drain tray underneath vehicle.
16. Disconnect hose from reservoir to power steering pump. Secure hose end above level of fluid reservoir to avoid unnecessary loss of fluid.
17. Disconnect power steering pump to power steering box hose. Seal hose and pump openings with masking tape to prevent ingress of dirt. Wipe away any fluid spillage from chassis or steering box.
18. Disconnect fuel temperature and coolant temperature sensor multi-plugs.
19. Disconnect leads from coil.
20. Identify each injector multi-plug for reassembly and disconnect plugs from injectors.
21. Maneuver harness from behind fuel rails and place to one side clear of engine assembly.
22. Remove 2 clamps securing gearbox oil cooler pipes to engine block.
23. Remove engine mounting fixings on both sides of cylinder block.
24. Fit lifting chains to engine lifting eyes as shown. See **Fig. 9**.

NOTE: All chain dimensions are measured from end of lifting hook to end of last link in chain.

25. Fit chain lifting eye to a suitable engine hoist. Raise hoist high enough to enable engine mountings to be removed, and withdraw rubber mountings.
26. Lower hoist until engine rests securely on engine mounting brackets. Remove lifting chains and hoist.
27. Disconnect 2 heater hoses located on top of right hand rocker cover.

28. Remove ground strap from rear of left hand cylinder head. DO NOT remove from retaining clip.
29. Remove all electrical harnesses from retaining clips at rear of engine.
30. Remove transmission breather pipes from retaining clip on rear lifting eye.
31. Remove top 2 bolts securing bell housing to cylinder block.
32. Raise front of vehicle, lower vehicle on to axle stands.
33. Remove bell housing bottom cover. Remove gasket from bell housing face.
34. Remove nuts securing exhaust downpipes to manifolds, remove heat shield from right hand side downpipe.
35. Remove electrical leads from starter motor solenoid. Disconnect multi-plug from oil level sensor on side of oil pan, if fitted.
36. With assistance rotate engine at crankshaft pulley until 2 access holes in drive plate/ring gear assembly are visible. See **Fig. 10**.
37. Remove 2 bolts visible through access holes. Mark one access hole and one bolt hole to ensure unit is reassembled in its original position
38. Rotate crankshaft 180° until 2 remaining access holes are visible, remove 2 bolts.
39. Remove remaining bell housing to cylinder block bolts.
40. Remove starter motor ground strap from chassis.
41. Remove stands and lower vehicle.
42. Position hydraulic trolley jack under bell housing to support gearbox when engine and gearbox are separated.
43. Fit lifting chains to engine. Carefully raise hoist a little, ease engine and gearbox apart, steady engine on hoist.
44. Ensure no components remain that will prevent engine being removed.
45. Slowly raise engine clear of engine compartment. Move engine away from vehicle and place on a suitable engine stand.

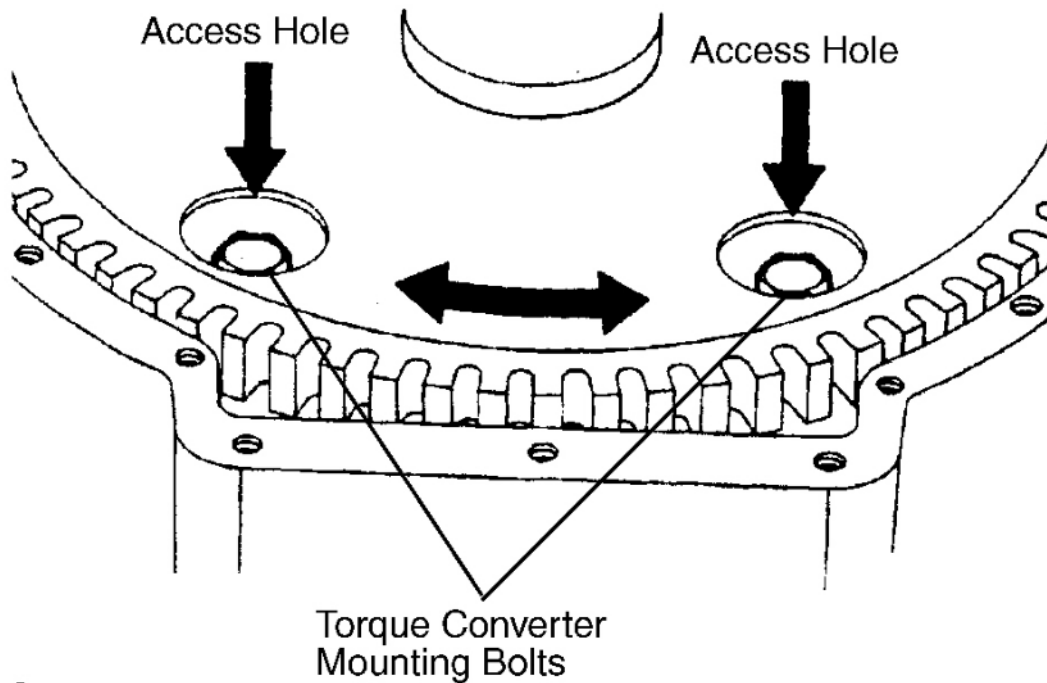


KEY TO CHAIN LENGTHS

1. L/H Front chain 356mm
(14 in.) total overall length.
2. R/H Front chain 330mm
(13 in.) total overall length.
3. R/H Rear chain 457mm
(18 in.) total overall length.

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Fig. 9: Identifying Lifting Chain Lengths
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 10: Removing Torque Converter Bolts
 Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Fit lifting chains to engine. Raise engine using hoist.
2. Lower engine into engine compartment. Ensure all components are clear of engine assembly.
3. With assistance, maneuver engine until bottom 2 engine and bellhousing bolt holes align. Ensure that 2 cylinder block dowels locate in bell housing.
4. Fit 2 bolts and partially tighten.
5. Remove jack and lower hoist until engine rests securely on engine mounting brackets.
6. Fit top 2 bell housing securing bolts. Tighten to 40 Nm.
7. Fit remaining bell housing to cylinder block bolts, and tighten to 40 Nm.
8. With assistance, rotate crankshaft pulley, line up marked holes in drive plate and torque converter. Fit 2 bolts and tighten to 40 Nm.
9. Rotate crankshaft 180° and fit remaining 2 bolts tighten to correct torque, 40 Nm.
10. Fit NEW gasket and refit bottom cover, tighten bolts to 9 Nm.
11. Fit NEW exhaust flange gaskets, fit exhaust to manifold.
12. Refit all harnesses, ground straps breather pipes and hoses at rear of engine.
13. Raise engine and refit engine mounting rubbers, tighten nuts to 20 Nm.

14. Remove temporary lifting eye ETC 5964 and reverse instructions 1 to 23, ensuring that all electrical plugs and harnesses are fitted in correct locations.

INTAKE MANIFOLD

Removal

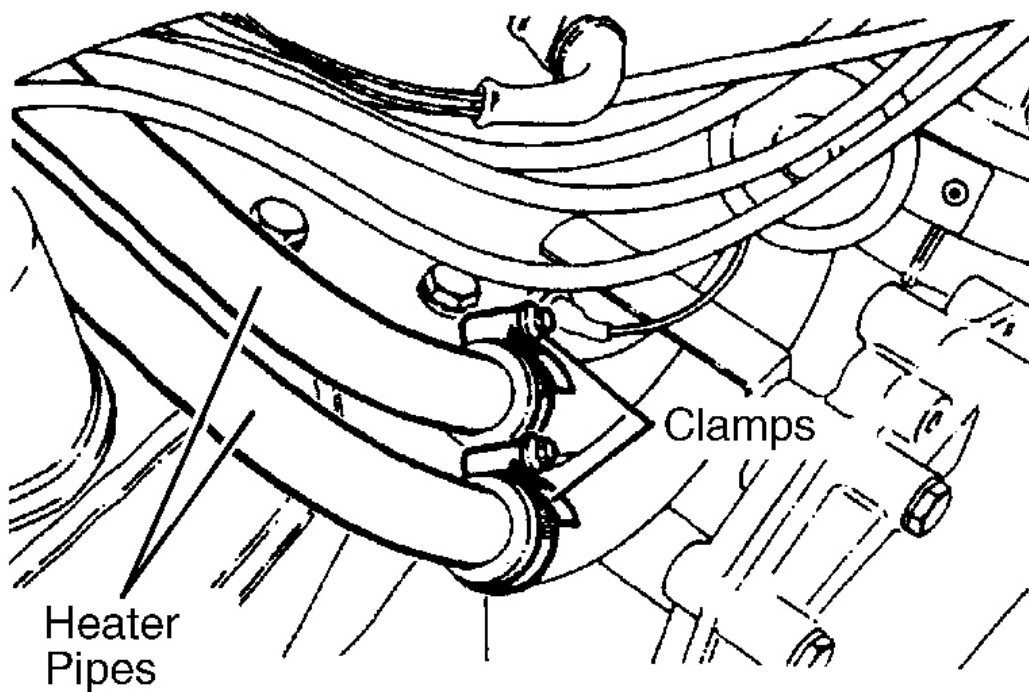
1. Depressurize fuel system. See **DEPRESSURIZING FUEL SYSTEM**.
2. Disconnect the battery negative lead.
3. Remove radiator bottom hose, drain coolant until level is below thermostat housing. Refit hose, tighten clamp.
4. Remove plenum chamber. See **PLENUM CHAMBER**.
5. Remove ram housing. See **RAM HOUSING**.

CAUTION: Place a protective cover over intake manifold openings to prevent ingress of dirt.

6. Disconnect electrical multi-plugs to fuel temperature sensor and injectors.
7. Remove 2 nuts and bolts securing pressure regulator to fuel rail, ease regulator out of rail. Seal end of fuel rail with plastic plugs to prevent ingress of dirt.

NOTE: Intake manifold can be removed from cylinder block without removing fuel rail and injectors.

8. Disconnect electrical leads from air-conditioning engine coolant sensor.
9. Disconnect electrical leads to coolant temperature transmitter located at front of intake manifold.
10. Remove injector harnesses from behind fuel rail, lay to one side. See **Fig. 11**.
11. Release hose clamps securing 2 heater hoses behind water pump. See **Fig. 11**.
12. Remove 2 bolts securing rigid heater pipes to intake manifold and ease pipes out of hoses.
13. Lay heater pipe assembly to one side.
14. Release twelve bolts securing intake manifold.
15. Remove intake manifold.
16. Remove 2 gasket clamps from cylinder block.
17. Lift off gasket, remove gasket seals.
18. Remove sealing compound from around water passage openings of cylinder heads.

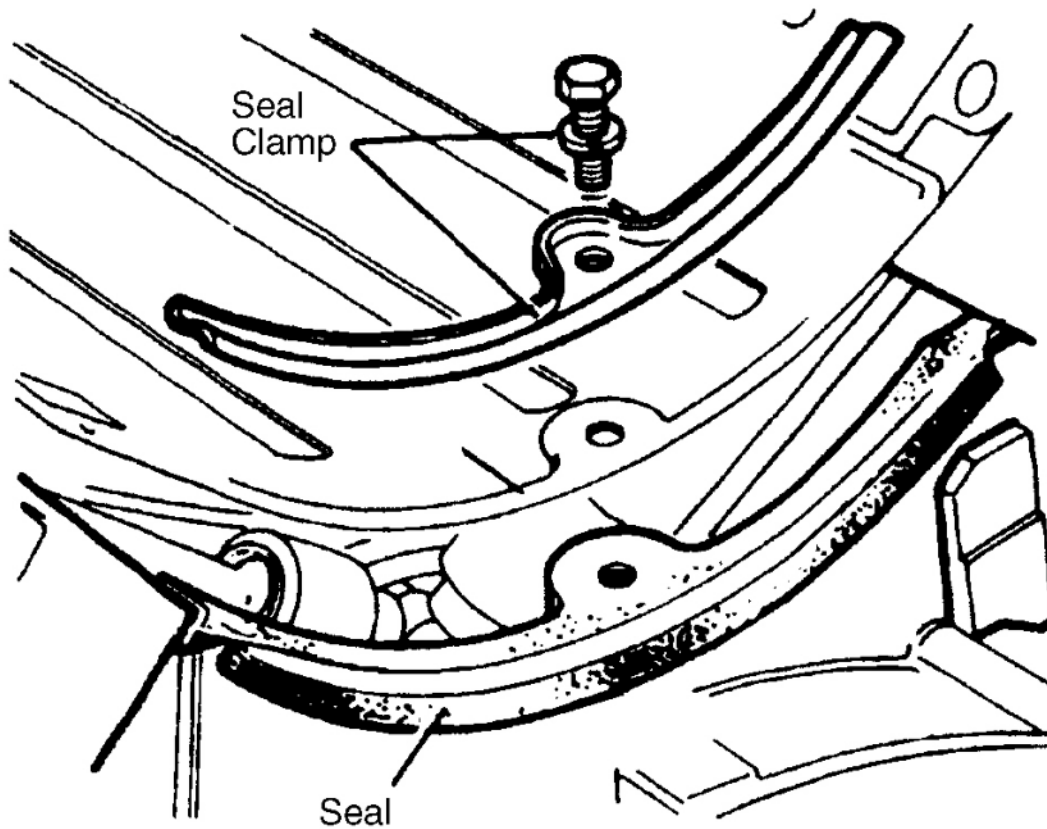


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Fig. 11: Removing Intake Manifolds Heater Hoses
Courtesy of LAND ROVER NORTH AMERICA, INC.

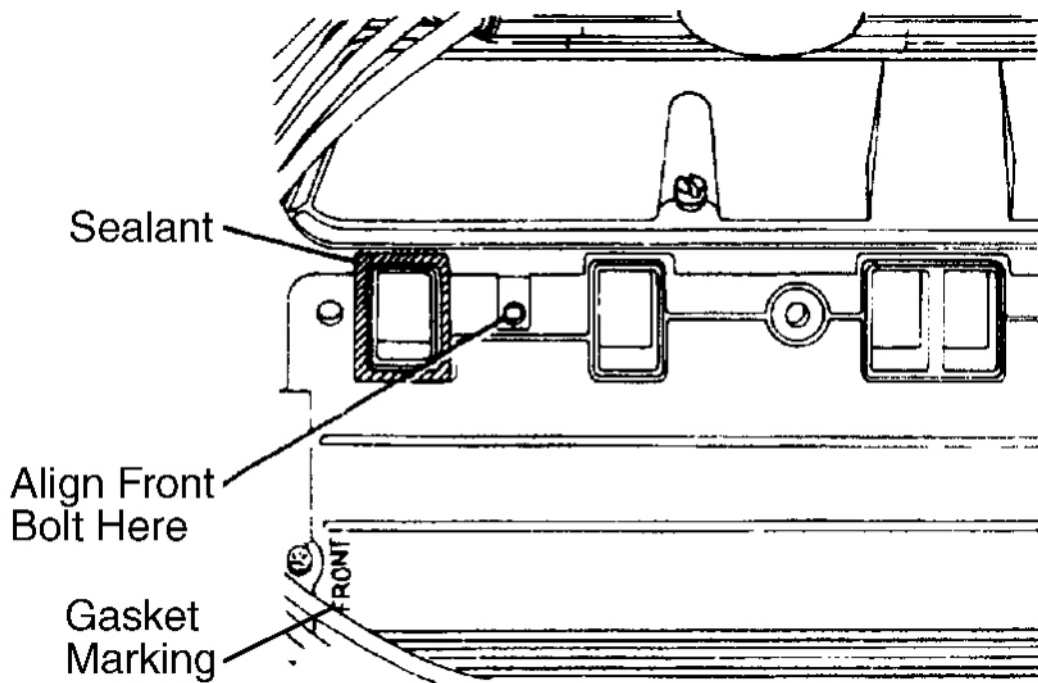
Installation

1. Locate NEW seals in position with ends engaged in notches formed between cylinder heads and block. See **Fig. 12**.
2. Lightly apply "Hylomar" sealant around outside of water passage openings on cylinder heads, manifold gasket and intake manifold. See **Fig. 13**.
3. Fit manifold gasket with word "FRONT" to front and open bolt hole to front right hand side. See **Fig. 13**.
4. Fit gasket clamps, DO NOT fully tighten bolts. See **Fig. 12**.
5. Locate intake manifold onto cylinder heads, clean threads of manifold securing bolts.
6. Fit manifold bolts. Evenly tighten a little at a time, alternating sides, working from center outwards.
7. Tighten to 28 ft lbs. (38 Nm).
8. Tighten gasket clamps to 13 ft lbs. (18 Nm).
9. Reverse remaining removal instructions.
10. Replenish cooling system.
11. Start engine, check for water and fuel leaks.



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Fig. 12: Identifying New Intake Manifold Seals
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 13: Identifying Cylinder Heads, Manifold Gasket & Courtesy of LAND ROVER NORTH AMERICA, INC.

EXHAUST MANIFOLD

Removal

1. Disconnect front exhaust pipes from manifolds.
2. Tap back bolt locking tabs and remove 8 bolts, lock tabs and washers.
3. Remove manifolds and old gaskets.

Installation

1. Ensure that mating surface of cylinder head and exhaust manifold are clean and smooth.
2. Coat threads of each bolt with anti-seize compound.
3. Place manifold and NEW gaskets in position on cylinder head and fit securing bolts, NEW lockplates and plain washers. Plain washers are fitted between manifold and lockplates.
4. Evenly tighten manifold bolts to 15 ft lbs. (20 Nm) and bend over lockplate tabs.
5. Reconnect front exhaust pipe, using NEW exhaust flange gaskets.

CYLINDER HEADS & GASKETS

Removal

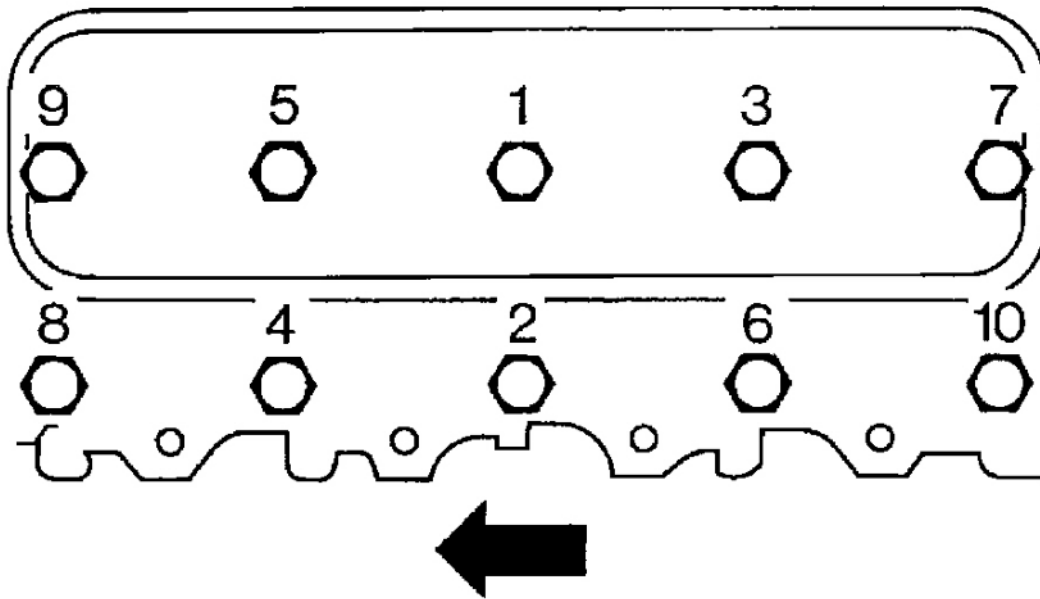
1. Drain cooling system. See **BLEEDING**.
2. Remove intake manifold. See **INTAKE MANIFOLD**.
3. Remove generator. See **GENERATOR**.
4. Remove A/C compressor, if equipped. See **A/C COMPRESSOR**.
5. Remove rocker shafts. See **ROCKER SHAFTS**.
6. Remove push rods.
7. Remove both exhaust manifolds. See **EXHAUST MANIFOLD**.
8. Remove air cleaner assembly. See **AIR CLEANER ASSEMBLY**.
9. Remove mass air flow sensor. See **MASS AIR FLOW SENSOR**.
10. Remove ground leads from rear of left hand cylinder head
11. On right hand cylinder head, remove breather pipe from lifting bracket.
12. On either cylinder head, loosen cylinder head bolts, reversing tightening sequence.
13. Remove cylinder heads.
14. Remove cylinder head gaskets.
15. Clean exhaust mating surfaces.
16. Clean head and block faces.

Installation

1. Fit NEW cylinder head gaskets with word TOP uppermost. DO NOT use sealant.
2. Oil cylinder bores.
3. Clean threads of head bolts and coat with Loctite 572.
4. Locate cylinder heads on block.

NOTE: **There are no bolts fitted in the 4 lower holes in each cylinder head.**

5. Locate cylinder head bolts in position as illustrated. See **Fig. 14**.
 - Long bolts (96 mm) - 2, 4, 6, 7, 8, 9 and 10.
 - Short bolts (66 mm) - 1, 3 and 5.
6. Tighten bolts progressively in sequence, shown to 15 ft lbs. (20 Nm) then a further $180^\circ \pm 5^\circ$. See **Fig. 14**.
7. Reverse removal procedures, steps 1 to 11.



**Left hand cylinder head illustrated,
arrow points to front of vehicle.**

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Fig. 14: Cylinder Head Bolt Tightening Sequence
Courtesy of LAND ROVER NORTH AMERICA, INC.

ROCKER COVER

Removal (Right)

1. Disconnect the battery negative lead.
2. Disconnect purge pipe from charcoal canister at plenum.
3. Remove breather pipe from rocker cover.
4. Remove coolant pipes from intake manifold.
5. Remove spark plug leads from plugs and retaining clips.
6. Remove 4 rocker cover bolts. Moving fuel pipes aside, remove rocker cover.
7. Discard rocker cover gasket.

Removal (Left)

1. Remove mass air flow sensor. See **MASS AIR FLOW SENSOR**.

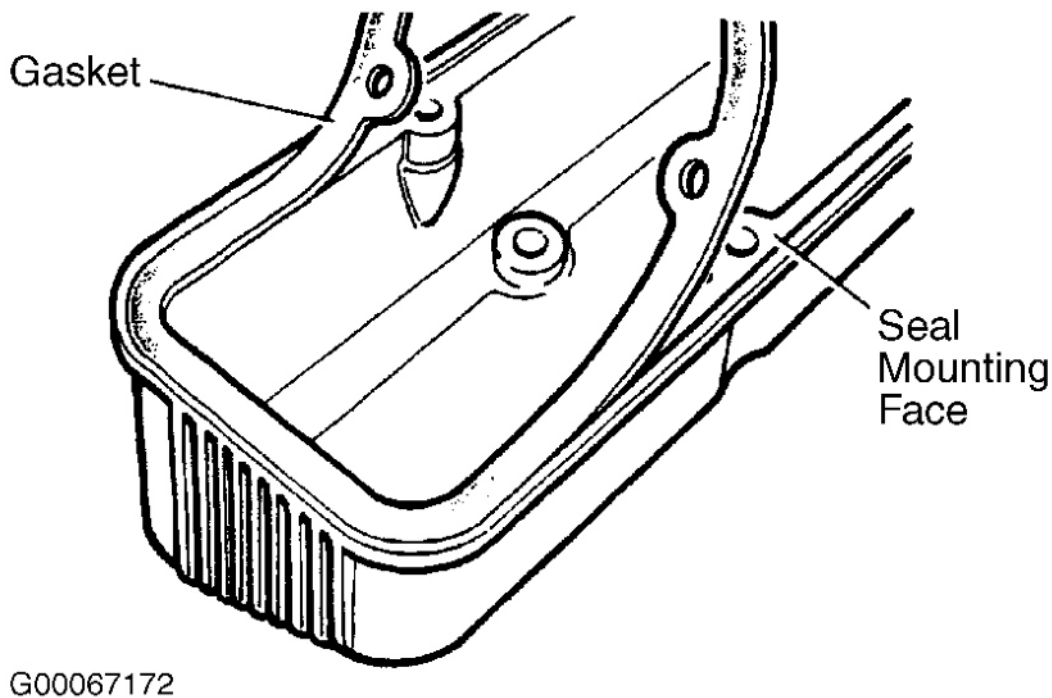
2. Remove plenum chamber. See **PLENUM CHAMBER**.
3. Remove dipstick.
4. Remove spark plug leads from plugs and retaining clips.
5. Disconnect high tension lead from coil.
6. Remove generator heat shield from rocker cover.
7. Remove mass air flow sensor harness clip.
8. Remove dipstick tube clip.
9. Remove 4 rocker cover bolts, remove rocker cover.
10. Discard gasket

Installation (Right)

1. Remove plug lead retaining clips from rocker cover, fit to new rocker cover.
2. Clean and dry rocker cover and cylinder head mating faces, using Bostik cleaner 6001.
3. Apply Bostik 1775 impact adhesive to rocker cover seal face and gasket, using a brush to ensure an even film. See **Fig. 15**. Allow adhesive to become touch dry, approximately 15 minutes.

NOTE: **Gasket fits one way round only. It must be fitted accurately, first time. Subsequent movement will destroy bonding.**

4. Place one end of gasket into cover recess with edge firmly against recess wall, holding remainder of gasket clear. See **Fig. 15**. Work around cover, pressing gasket into place ensuring edge firmly contacts recess wall.
5. Allow cover to stand for 30 minutes before fitting.
6. Fit rocker cover to cylinder head with 4 screws (short screws inboard), tighten to 6 ft lbs. (8 Nm).
7. Position fuel pipes.
8. Fit breather pipe to rocker cover, tighten clip.
9. Fit coolant pipes to intake manifold, tighten bolts.
10. Fit spark plug leads to plugs and retaining clips.
11. Connect purge pipe from charcoal canister at plenum, tighten clip.

**Fig. 15: Fitting Rocker Covers**

Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation (Left)

1. Remove plug lead retaining clips from rocker cover, fit to new rocker cover, if installing new rocker cover.
2. Clean and dry rocker cover and cylinder head mating faces, using Bostik cleaner 6001.
3. Apply Bostik 1775 impact adhesive to rocker cover seal face and gasket, using a brush to ensure an even film. See **Fig. 15**. Allow adhesive to become touch dry, approximately 15 minutes.

NOTE: Gasket fits only one way. It must be fitted accurately, first time. Subsequent movement will destroy bonding.

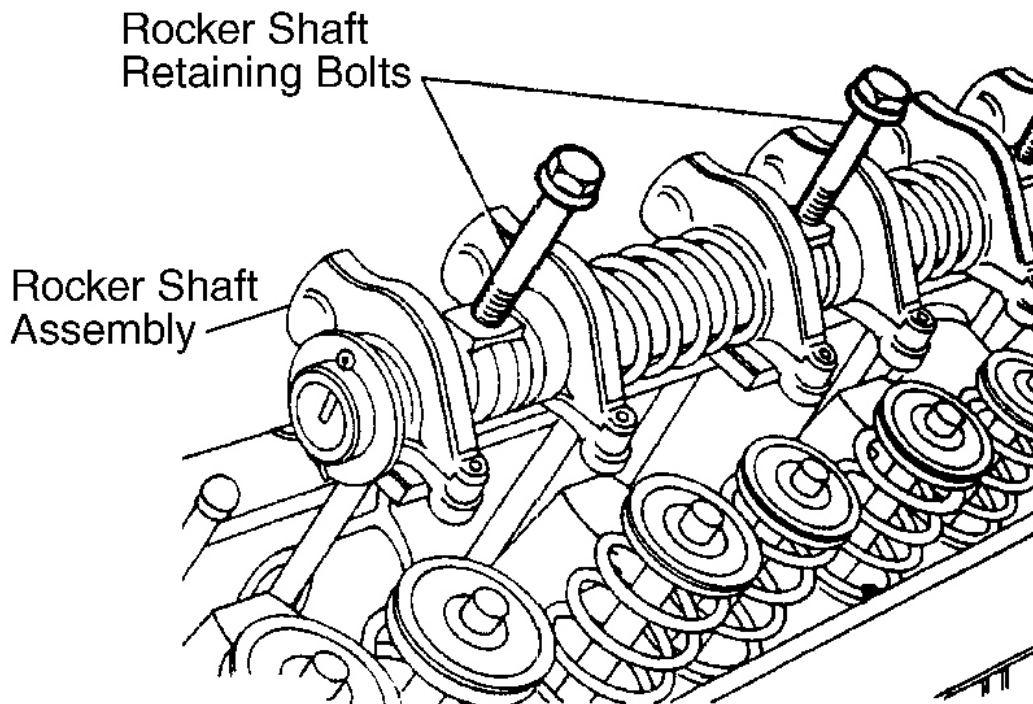
4. Place one end of gasket into cover recess with edge firmly against recess wall, holding remainder of gasket clear. See **Fig. 15**. Work around cover, pressing gasket into place ensuring edge firmly contacts recess wall.
5. Allow cover to stand for 30 minutes before fitting.
6. Fit rocker cover to cylinder head with 4 screws (short screws inboard), tighten to 80 INCH lbs. (9 Nm).
7. Locate and tighten dipstick tube clip.
8. Fit and tighten mass air flow sensor harness clip.

9. Fit generator heat shield to rocker cover.
10. Connect high tension lead to coil.
11. Connect spark plug leads to plugs and retaining clips.
12. Fit dipstick.

ROCKER SHAFTS

Removal

1. Remove rocker covers as required. See **ROCKER COVER**.
2. Remove 4 rocker shaft retaining bolts.
3. Remove rocker shaft assembly. See **Fig. 16**.



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Fig. 16: Removing Rocker Shafts

Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

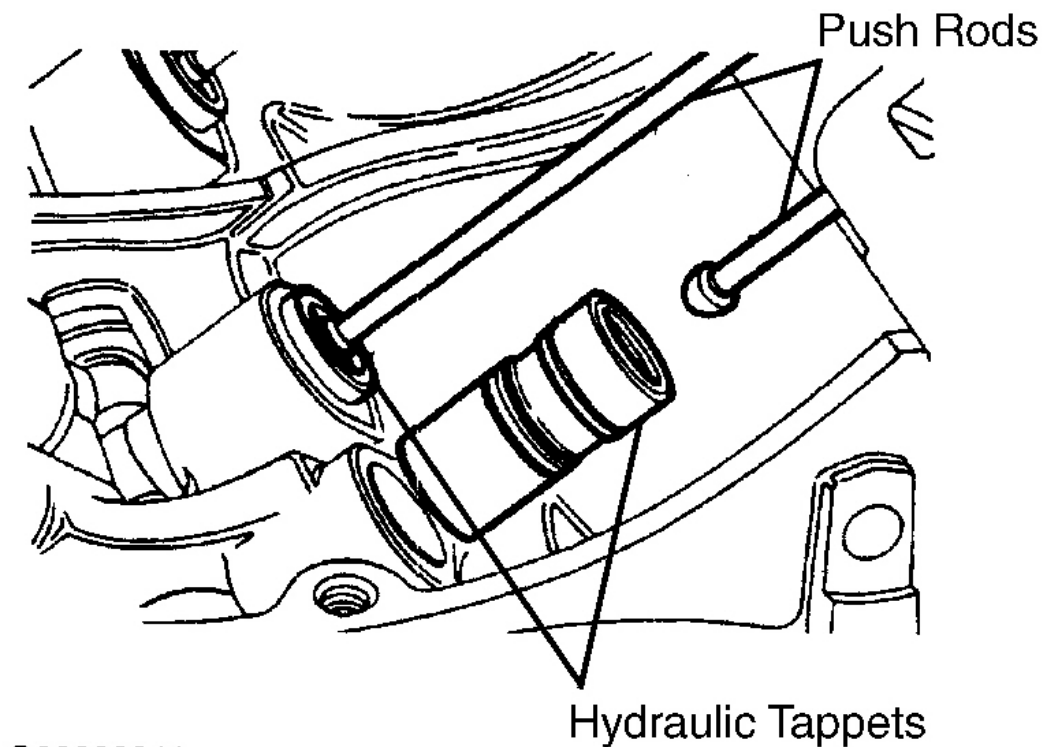
NOTE: Each rocker shaft is notched at one end. Notch must be uppermost and towards front of engine on right hand side, towards rear on left hand side.

1. Clean rocker pedestal locations on cylinder head.
2. Fit rocker shaft assembly locating push rods to rockers.
3. Tighten rocker shaft retaining bolts to 28 ft lbs. (38 Nm).
4. Fit rocker covers.

HYDRAULIC TAPPETS

Removal

1. Remove rocker shafts. See **ROCKER SHAFTS**.
2. Remove intake manifold. See **INTAKE MANIFOLD**.
3. Withdraw pushrods and retain in sequence removed. See **Fig. 17**.
4. Remove hydraulic tappets.



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Fig. 17: Removing Hydraulic Tappets
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

NOTE: Before fitting, immerse tappets in clean engine oil and pump inner sleeve of tapped several times using a pushrod, to reduce tappet noise when engine is stated.

1. Lubricate tappet bores. Fit tappets and push rods to their original locations. See **Fig. 17**. Ensure that tappets move freely in their respective bores. Before fitting tappets, immerse them in clean engine oil to reduce tappet noise when engine is first started after overhaul.

NOTE: Tappet noise can be expected on initial starting up after an overhaul due to oil drainage from tappet assemblies or if vehicle has been standing over a very long period. If excessive noise is apparent after an overhaul, engine should be run at approximately 2,500 RPM for a few minutes (subject to the following caution), when noise should be eliminated.

CAUTION: DO NOT exceed 1000 RPM for 15 seconds when first starting engine, otherwise crankshaft rear oil seal will be damaged.

- 2.
3. Inspect push rod seats in rocker arms.
4. Check push rods for straightness and inspect ball ends for damage. Replace as necessary.
5. Lubricate push rods with engine oil.
6. To complete installation, reverse removal procedure.

CRANKSHAFT PULLEY ASSEMBLY

Removal

1. Remove viscous coupling. See **VISCOUS COUPLING**.
2. Remove drive belt. See **DRIVE BELT**.
3. Raise vehicle on lift.
4. Remove bell housing bottom cover.
5. Remove engine undertray. See **ENGINE UNDERTRAY**.
6. With assistance to stop flex-plate rotation, remove crankshaft pulley assembly retaining bolt.
7. Remove crankshaft pulley assembly.

Installation

1. If required, place assembly in vice and remove pulley.
2. Fit pulleys to torsional vibration damper.
3. Lubricate seal face of assembly.
4. Fit pulley assembly.
5. With assistance to stop flex-plate rotation, fit retaining bolt, tighten to 207 ft lbs. (280 Nm).

6. To complete installation, reverse instructions 1 to 5.

TIMING GEAR COVER OIL SEAL

Removal

1. Remove crankshaft pulley. See **CRANKSHAFT PULLEY ASSEMBLY**. DO NOT disassemble pulley.
2. Remove 8 screws and remove mud shield.
3. Fit bottom of Seal Extractor (18G1328) to crankshaft, fit extractor to seal. See **SPECIAL TOOLS**.
4. Turn center bolt of extractor to remove seal.
5. Remove seal from extractor.

Installation

1. Clean seal seating.
2. Lubricate outside diameter of seal.
3. Locate seal in timing gear cover.
4. Fit Seal Installation Adaptor (18G1291/5 to 18G1291/4). See **SPECIAL TOOLS**.
5. Fit tool to seal.
6. Fit and tighten center bolt to crankshaft, tighten center locknut to seat seal.
7. Loosen locknut and remove tool.
8. Lubricate seal lip.
9. Fit mud excluder and tighten screws.
10. Fit crankshaft pulley assembly.

CRANKSHAFT REAR OIL SEAL

Removal

1. Remove engine. See **ENGINE**.
2. Remove flex-plate. See **FLEX-PLATE & RING GEAR**.
3. Remove dipstick.
4. With assistance, invert engine, support on blocks.
5. Remove oil pan. See **OIL PAN** under ENGINE OILING SYSTEM.
6. Remove rear main bearing cap.
7. Remove cross seals from cap.
8. Remove crankshaft rear oil seal.

Installation

1. Clean main bearing cap and oil seal area of block.
2. Fit NEW cross seals to bearing cap. See **Fig. 85**.

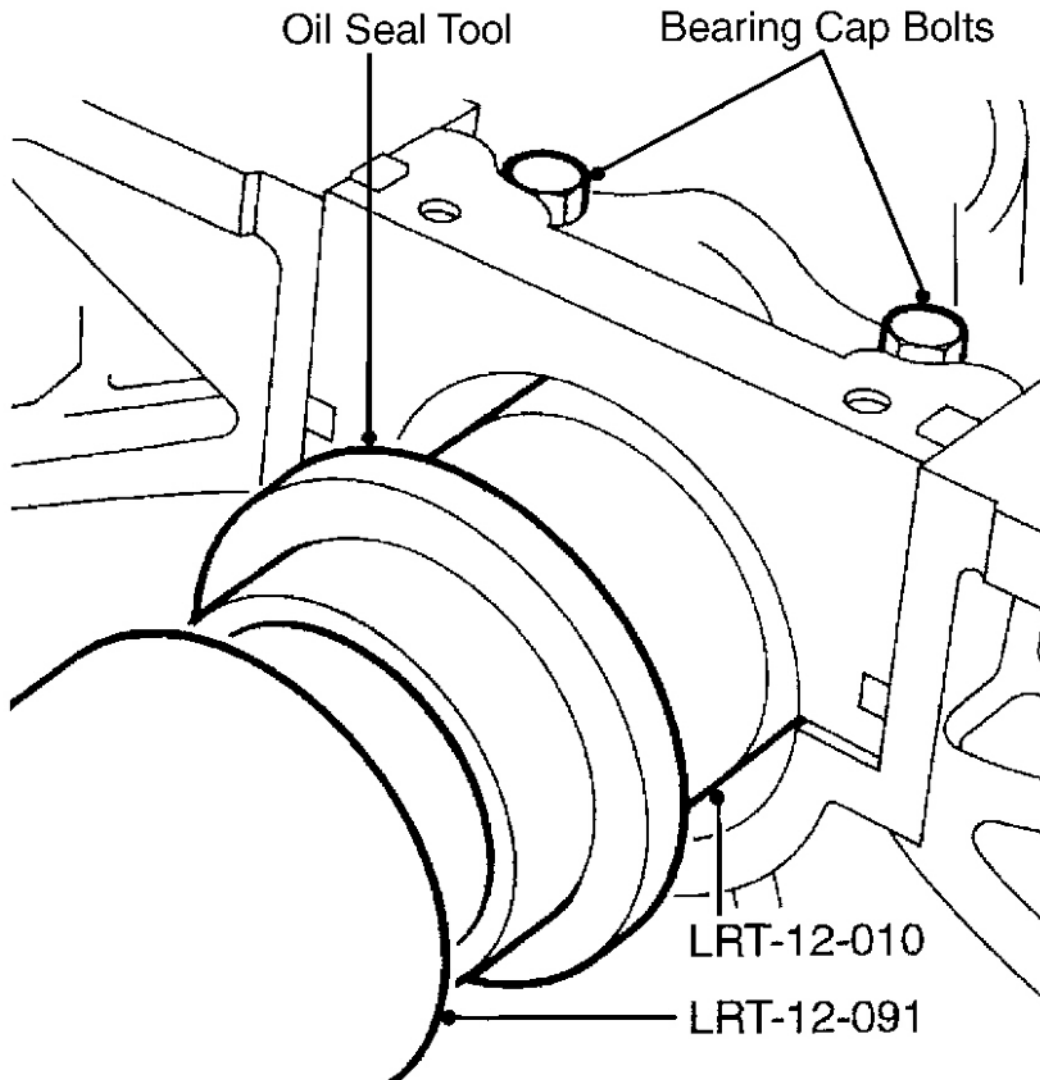
3. Apply Hylomar (SQ32M) to block as illustrated. See **Fig. 85**.
4. Lubricate bearing shell and cross seals using clean engine oil.
5. Fit bearing cap, do not tighten bolts. See **Fig. 85**.
6. Ensure cap is fully home and seated squarely on the block.
7. Ensure Oil Seal Guide (LRT-12-010) and crank journal are scrupulously clean. Coat seal guide and oil seal journal with clean engine oil.

CAUTION: DO NOT handle oil seal lip, check it is not damaged. Ensure outside diameter remains clean and dry.

8. Position Oil Seal Guide (R01014) on crankshaft flange.

NOTE: Lubricant coating must cover seal guide outer surface completely to ensure that oil seal lip is not turned back during assembly. Position oil seal, lipped side towards engine, on seal guide. Seal outside diameter **MUST** be clean and dry.

9. Push oil seal fully and squarely by hand into recess in cap and block until it contacts machined step in recess. Remove seal guide. See **Fig. 18**.
10. Tighten rear main bearing cap to 66 ft lbs. (90 Nm). See **Fig. 18**.
11. Fit oil pan. See **OIL PAN** under ENGINE OILING SYSTEM.
12. Reposition engine, fit dipstick.
13. Fit flex-plate.
14. Fit engine to vehicle.



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Fig. 18: Installing Crankshaft Rear Oil Seal
Courtesy of LAND ROVER NORTH AMERICA, INC.

TIMING GEAR COVER GASKET

Removal

1. Remove crankshaft pulley. See **CRANKSHAFT PULLEY ASSEMBLY**. DO NOT remove pulleys.
2. Remove water pump pulley.
3. Release distributor cap clips.
4. Release plug leads from plugs and clips.

5. Place cap and leads to one side.
6. Turn engine until No. 1 piston is at Top Dead Center (TDC)
7. Check position of rotor arm.
8. Remove fixings securing power steering pump bracket to water pump bracket.
9. Remove power steering pump bracket from water pump.
10. Remove clips securing wiring to generator tensioner.
11. Disconnect distributor feed wire.
12. Pivot power steering pump away from timing gear cover, tighten pivot to retain in position.
13. Disconnect vacuum pipe from distributor.
14. Remove water pump bottom hose.
15. Disconnect oil pressure switch.
16. Disconnect heater hose at water pump.
17. Remove generator tensioner from water pump, move tensioner aside.
18. Mark distributor position to timing gear cover.
19. Remove distributor clamp, remove distributor.
20. Remove fixings oil pan to timing gear cover.
21. Loosen 4 adjacent oil pan fixings.
22. Remove generator support strut from timing gear cover, move strut aside.
23. Loosen remaining timing gear cover fixings and remove timing gear cover.
24. Remove timing gear cover gasket.

Installation

1. Clean timing gear cover, clean block face.
2. Lightly grease gasket faces.
3. Fit NEW gasket to block face.
4. Apply "Hylosil" to oil pan gasket.
5. Clean threads of cover fixing bolts, apply Loctite 372 to threads.
6. Fit timing gear cover, fit fixing bolts, tighten to 21 ft lbs. (28 Nm).
7. Fit generator support strut to timing gear cover.
8. Tighten oil pan to timing gear cover fixings to 89 INCH lbs. (10 Nm).
9. Tighten oil pan fixings to 89 INCH lbs. (10 Nm).
10. Lubricate distributor "O" ring.
11. Fit distributor in position marked.
12. Align oil pump drive, if distributor does not seat correctly.
13. Fit distributor clamp, tighten to 15 ft lbs. (20 Nm).
14. Locate generator tensioner on water pump bracket.
15. Connect heater hose, tighten clip.

16. Connect oil pressure switch.
17. Connect bottom hose, tighten clip.
18. Connect vacuum pipe to distributor.
19. Loosen power steering pump pivot, lower pump.
20. Connect distributor feed wire.
21. Connect wire ties to generator tensioner.
22. Fit power steering pump bracket to water pump, tighten to 21 ft lbs (28 Nm).
23. Fit power steering pump to bracket.
24. Position distributor cap. Fit plug leads to plugs and clips.
25. Clip distributor cap in position.
26. Fit water pump pulley, tighten to 89 INCH lbs. (10 Nm).
27. Fit crankshaft pulley. See **CRANKSHAFT PULLEY ASSEMBLY**.
28. Tension drive belts correctly.
29. Check ignition timing.
30. Refill cooling system.

TIMING CHAIN & CHAINWHEELS

Removal

1. Remove timing gear cover. See **TIMING GEAR COVER GASKET**.
2. Remove retaining bolt and washer, remove distributor drive gear and spacer.
3. Ensure number one piston is at Top Dead Center (TDC).
4. Remove chainwheels and chain as an assembly.

Installation

1. Clean chainwheels and chain.
2. Fit chainwheels to chain, aligning timing marks.
3. Ensure camshaft key is fitted parallel to shaft axis to ensure adequate lubrication to distributor drive gear.
4. Engage chainwheel assembly on camshaft and crankshaft keys, ensure chainwheels are fully located.
5. Check alignment of timing marks with straight edge.
6. Fit spacer with flange to front.
7. Fit distributor drive gear with groove towards spacer.
8. Fit retaining bolt and washer, tighten to 43 ft lbs. (58 Nm).
9. Fit timing gear cover. See **TIMING GEAR COVER GASKET**.

FLEX-PLATE & RING GEAR

Removal & Installation

1. Remove transmission. See appropriate AUTOMATIC TRANSMISSION article.
2. Remove flex-plate and ring gear assembly. See **FLEX-PLATE & RING GEAR** under REMOVAL & INSTALLATION (WITH ENGINE REMOVED).
3. Clean all components for reassembly.
4. Fit ring gear and flex-plate assembly. See **FLEX-PLATE & RING GEAR** under REMOVAL & INSTALLATION (WITH ENGINE REMOVED).
5. Fit transmission.

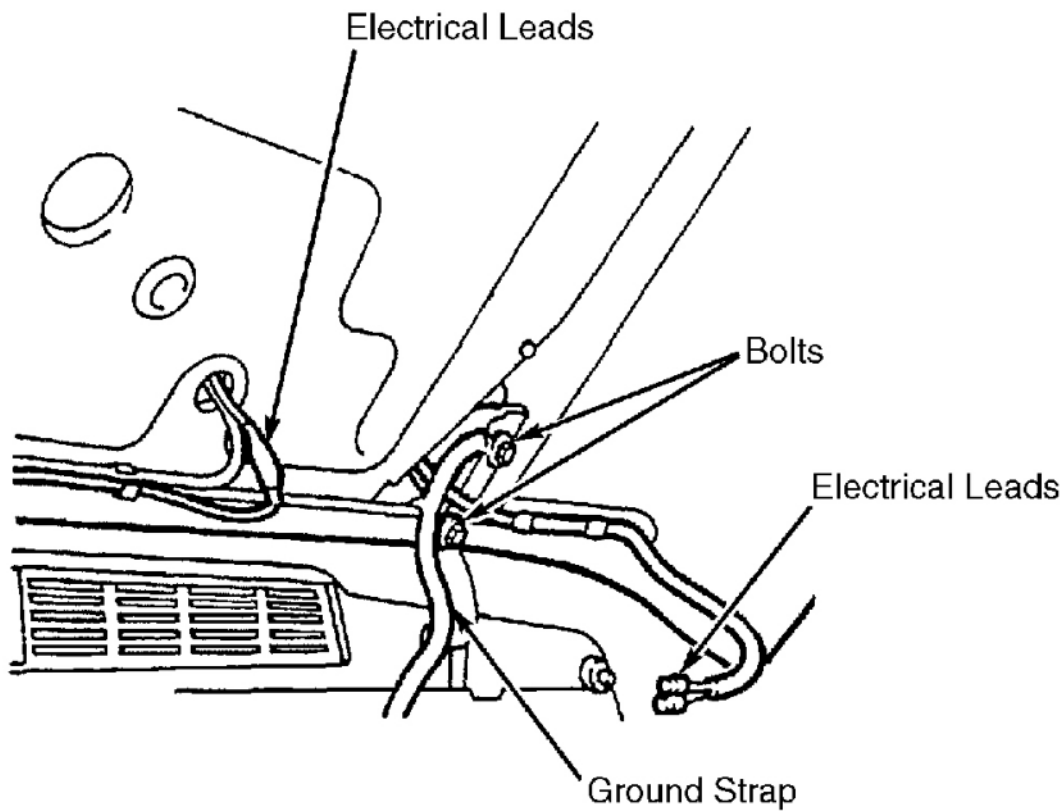
HOOD

Removal

1. Disconnect the battery negative lead.
2. Disconnect electrical leads to under hood lamp and heated washer jets. See **Fig. 19**.
3. Disconnect windshield washer tube at "T" joint.
4. With assistance release 4 bolts securing hood to hinges. Note ground strap located onto left hinge for reassembly. Lift hood clear of vehicle. See **Fig. 19**.

Installation

1. Install hood, ensure ground strap is refitted. Before final tightening of bolts, align hood with decker panel, fender and front grille. See **Fig. 19**.
2. To complete installation, reverse removal procedure.



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Fig. 19: Removing Hood

Courtesy of LAND ROVER NORTH AMERICA, INC.

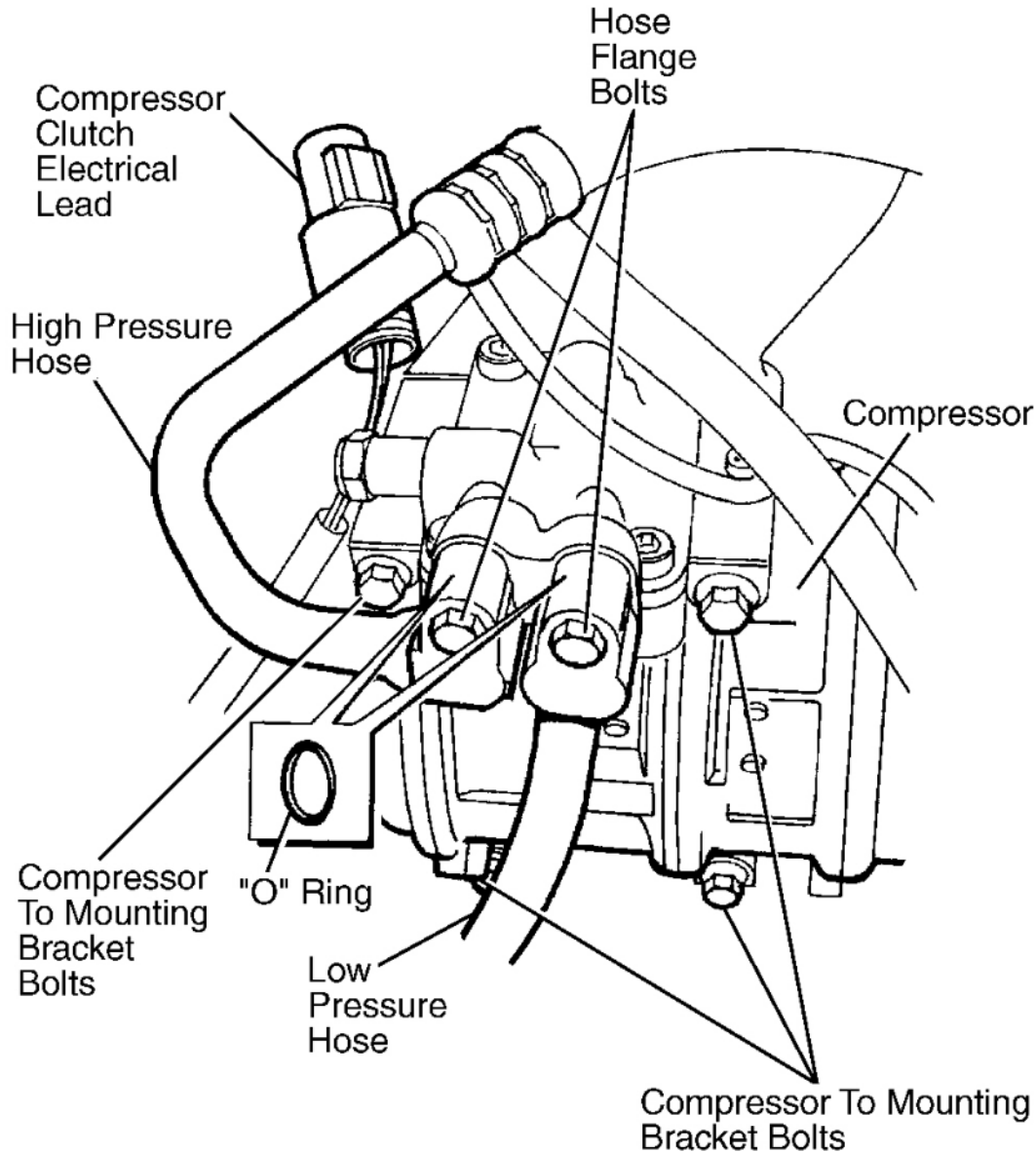
A/C COMPRESSOR**Removal**

1. Disconnect the battery negative lead.
2. Using approved equipment, recover refrigerant from air conditioning system.
3. Remove screws retaining center panel to fan cowl
4. Remove center panel.

WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

5. Remove 2 bolts securing hose flanges to compressor. See **Fig. 20**.
6. Disconnect high pressure hose from compressor. See **Fig. 20**.
7. Disconnect low pressure hose from compressor. See **Fig. 20**.

8. Remove "O" ring from each flange.
9. Disconnect electrical lead from compressor clutch. See **Fig. 20**.
10. Release drive belt from compressor pulley. See **DRIVE BELT**.
11. Remove 4 bolts securing compressor to mounting bracket. See **Fig. 20**.
12. Remove compressor from mounting bracket. See **Fig. 20**.



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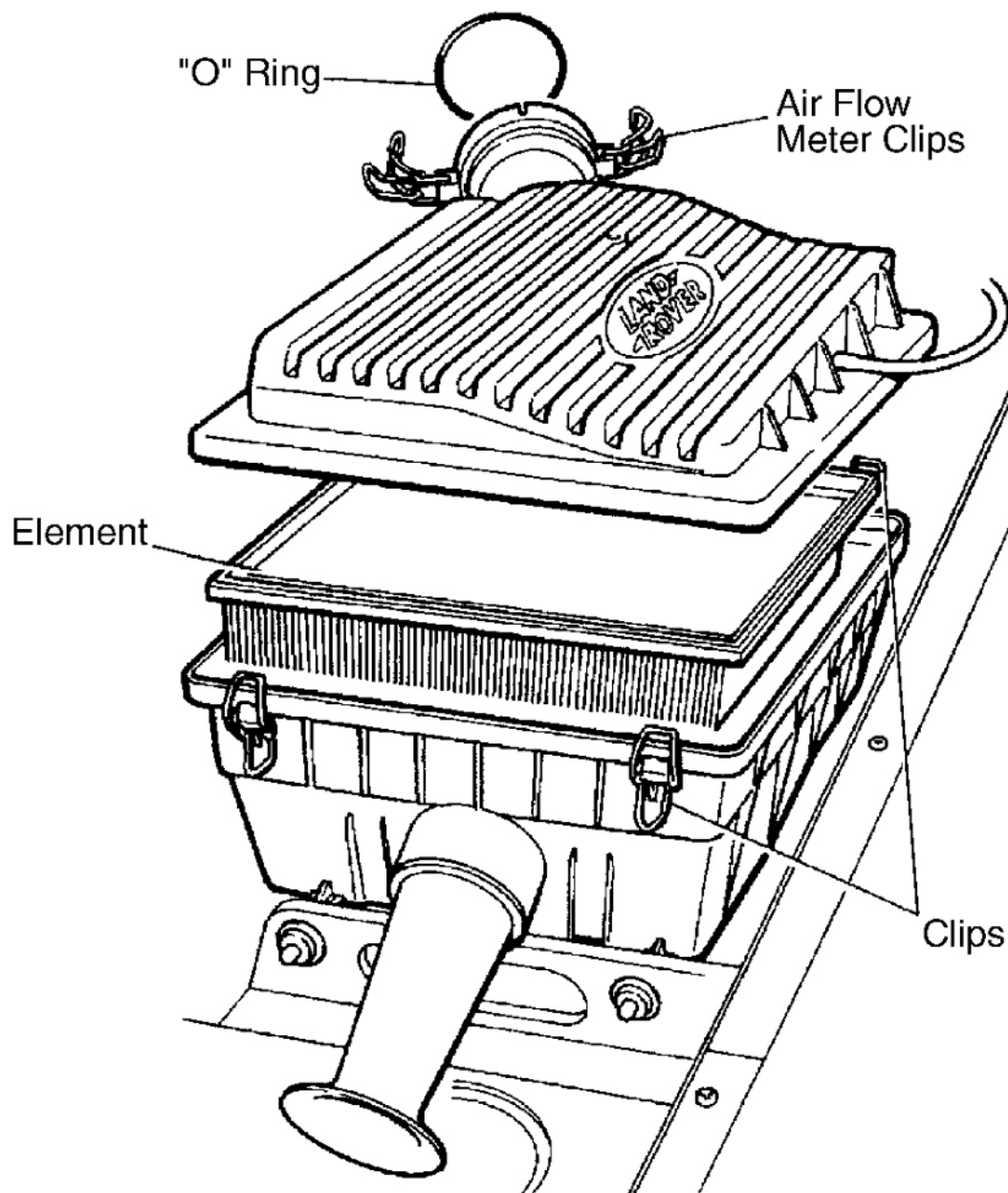
Fig. 20: Removing A/C Compressor
 Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Locate compressor in mounting bracket, fit bolts. Tighten to 18 ft lbs. (25 Nm).
2. Connect electrical lead to compressor clutch.
3. Fit new "O" rings to high and low pressure hose flanges, lubricate with refrigerant oil.
4. Engage hose flanges, fit bolts. Tighten to 89 INCH lbs. (10 Nm).
5. Fit compressor drive belt. See **DRIVE BELT**.
6. Fit center panel to fan cowl.
7. Using approved equipment, evacuate and recharge air conditioning system.
8. Perform a leak test on disturbed joints.

AIR CLEANER ELEMENT**Removal**

1. Release 4 clips retaining air cleaner cover. See **Fig. 21**.
2. Release 2 clips to air flow meter. See **Fig. 21**.
3. Remove air cleaner cover, retain air flow meter "O" ring. See **Fig. 21**.
4. Remove element. See **Fig. 21**.



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Fig. 21: Removing Air Cleaner Element
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

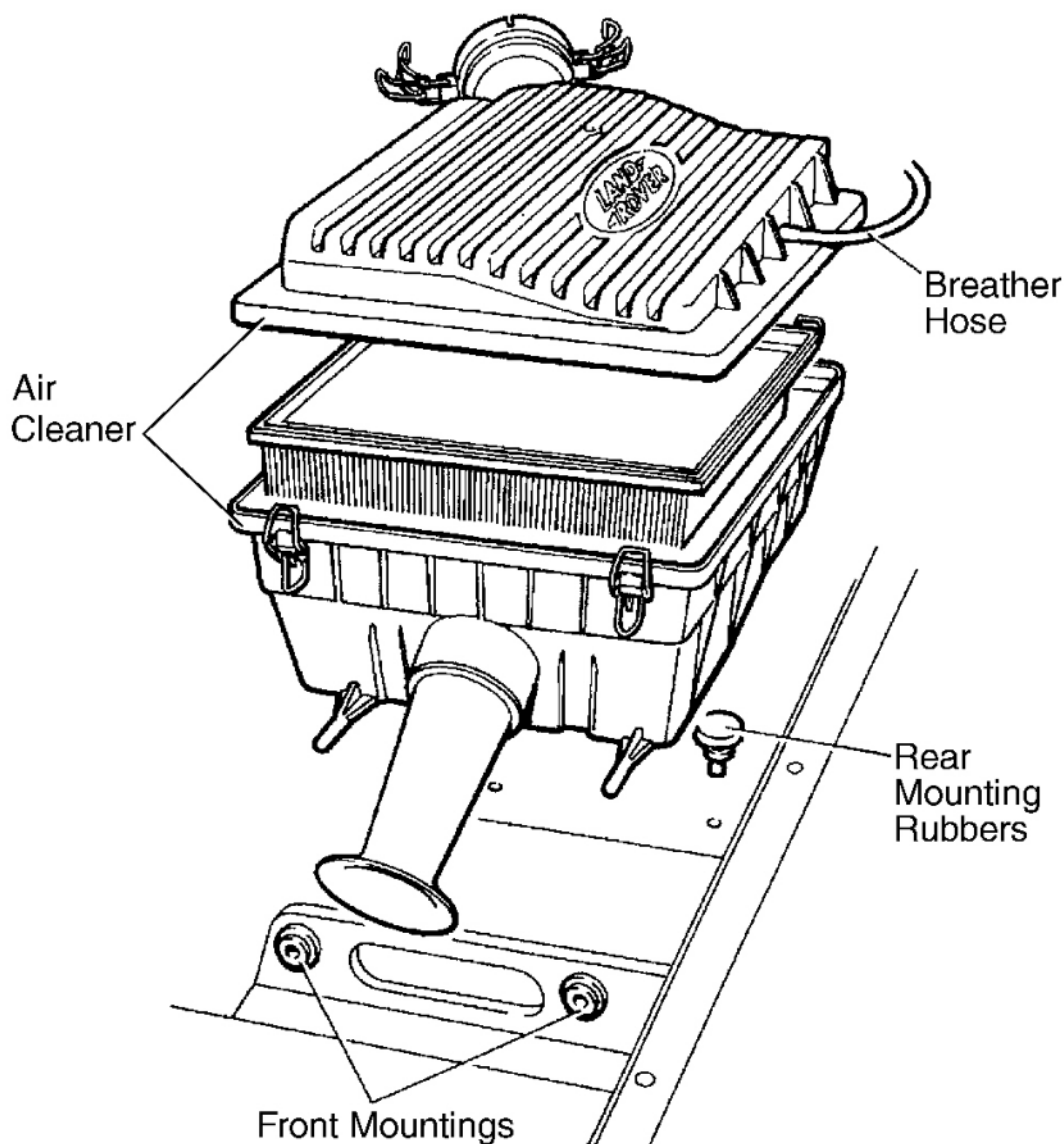
1. Fit new element.
2. Fit "O" ring.

3. Position air cleaner cover, secure 2 clips to air flow meter.
4. Secure 4 air cleaner cover clips.

AIR CLEANER ASSEMBLY

Removal

1. Remove air cleaner element. See **AIR CLEANER ELEMENT**.
2. Detach breather hose from air cleaner cover, if required. See **Fig. 22**.
3. Lift rear of air cleaner from rear mounting rubbers. See **Fig. 22**.
4. Remove air cleaner from front mountings. See **Fig. 22**.
5. Remove air cleaner from vehicle. See **Fig. 22**.



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Fig. 22: Removing Air Cleaner Assembly
 Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Fit rear mounting rubbers to air cleaner body.
2. Locate air cleaner body in front mounting bushings.
3. Position rear mounting rubbers in locating holes.
4. Pull rubbers through body to locate correctly.

5. Fit air filter element.

DRIVE BELT

Removal

1. Remove fan cowl upper.
2. Release drive belt tension by turning tensioner clockwise.
3. With tension released, remove belt from generator pulley.
4. Release tensioner pulley.
5. Remove drive belt. Mark direction of rotation on belt if refitting.

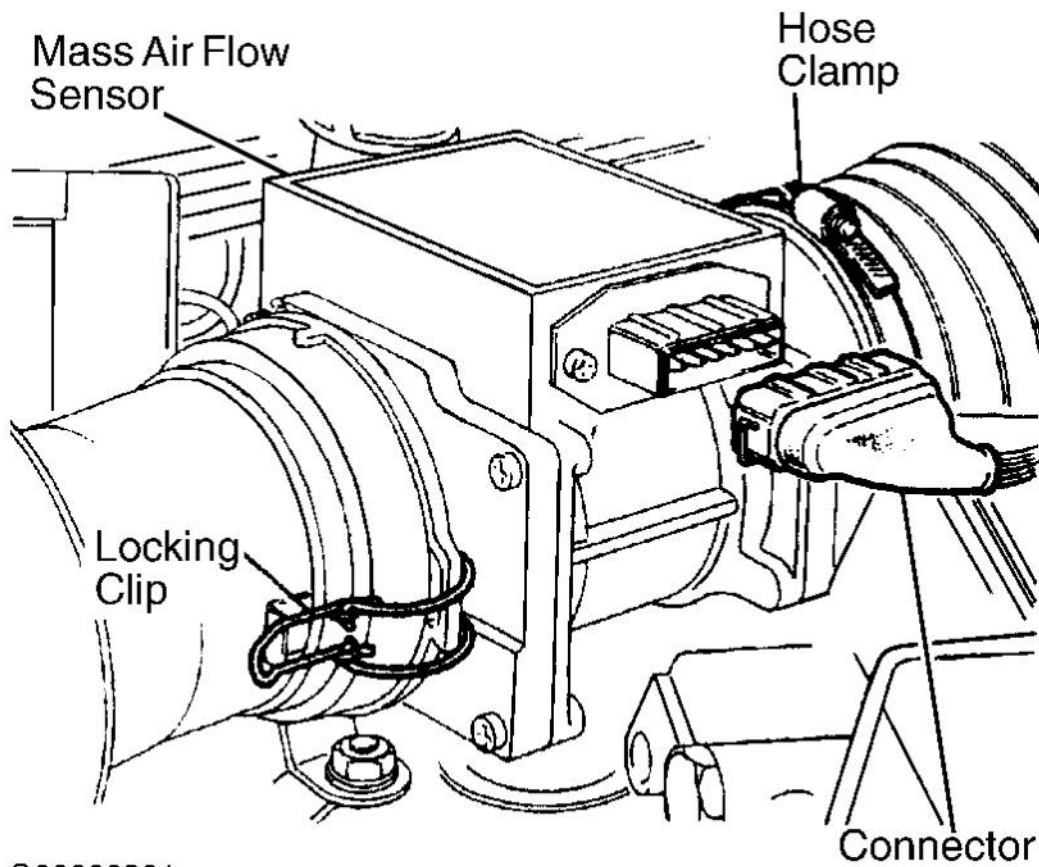
Installation

1. Clean drive belt pulley grooves and ensure grooves are not damaged.
2. Position belt correctly around all pulleys except generator. See appropriate COOLING SYSTEM & DRIVE BELT ROUTING article.
3. Turn drive belt tensioner clockwise.
4. Locate drive belt on generator pulley.
5. Ensure drive belt is squarely located on pulleys with all grooves engaged.
6. Release tensioner to tension drive belt.
7. Fit upper fan cowl section.

MASS AIR FLOW SENSOR

Removal & Installation

1. Disconnect the battery negative lead.
2. Release intake hose clamp and disconnect it from sensor. See **Fig. 23**.
3. Disconnect multi-plug. See **Fig. 23**
4. Release 2 clips securing air cleaner case to mass air flow sensor. Remove sensor from engine compartment. See **Fig. 23**
5. To install, reverse removal procedure. Ensure multi-plug is firmly reconnected. Ensure hose clamp at the rear of sensor is securely tightened to prevent unmetered air entering engine.



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Fig. 23: Identifying Mass Air Flow Sensor Components
 Courtesy of LAND ROVER NORTH AMERICA, INC.

BATTERY

Removal & Installation

NOTE: Coat battery clamps and terminals with petroleum jelly before refitting.

1. Disconnect the battery negative lead and positive lead.
2. Release 4 nuts securing battery bracket in position.
3. Remove bracket.
4. Remove battery.
5. To install, reverse removal procedure.

DISTRIBUTOR

Removal

1. Release single nut securing distributor clamp.
2. Remove clamp and withdraw distributor.

Installation

1. To install, turn crankshaft to bring number one piston to 6° Before Top Dead Center (BTDC) on compression stroke (both valves closed No. 1 cylinder).
2. Turn distributor drive until rotor arm is approximately 30° counterclockwise from No. 1 spark plug lead position on cap.
3. Turn oil pump and distributor common drive shaft so that tongue is in approximate position as illustrated. See **Fig. 24**.
4. Fit distributor to engine and check that center line of rotor arm is now in line with No. 1 spark plug lead position in distributor cap. Reposition distributor if necessary. The vacuum capsule should be approximately 90° to camshaft. See **Fig. 25**.
5. If distributor does not seat correctly in timing gear cover, oil pump drive is not engaged. In this event, remove distributor, reset oil pump drive tongue as necessary, and repeat operation.
6. Fit clamp and nut leaving both loose at this stage. See **Fig. 25**.
7. Rotate distributor until peak on pick-up lines up with peak on reluctor ring. The rotor arm may be removed for a better view.

CAUTION: DO NOT start engine before this operation is carried out.

8. Secure distributor in this position by tightening clamp nut. See **Fig. 25**.
9. Fit distributor cap and spark plugs and connect high tension leads in accordance with **Fig. 26**.

NOTE: **The above distributor setting is to enable engine to be run so that correct setting can be achieved once engine is refitted to vehicle.**

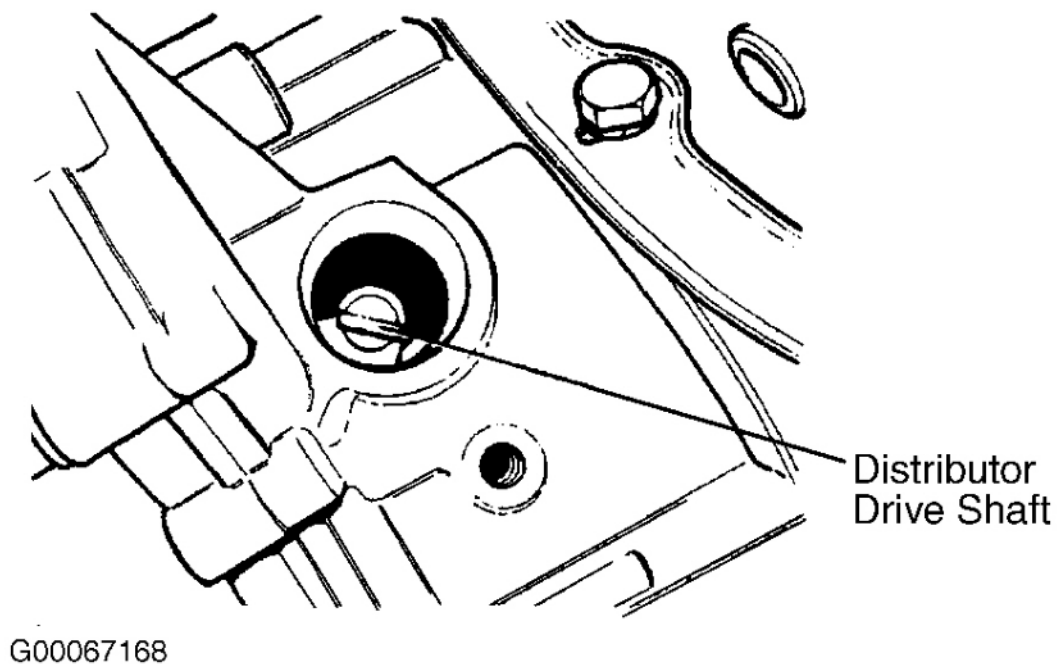
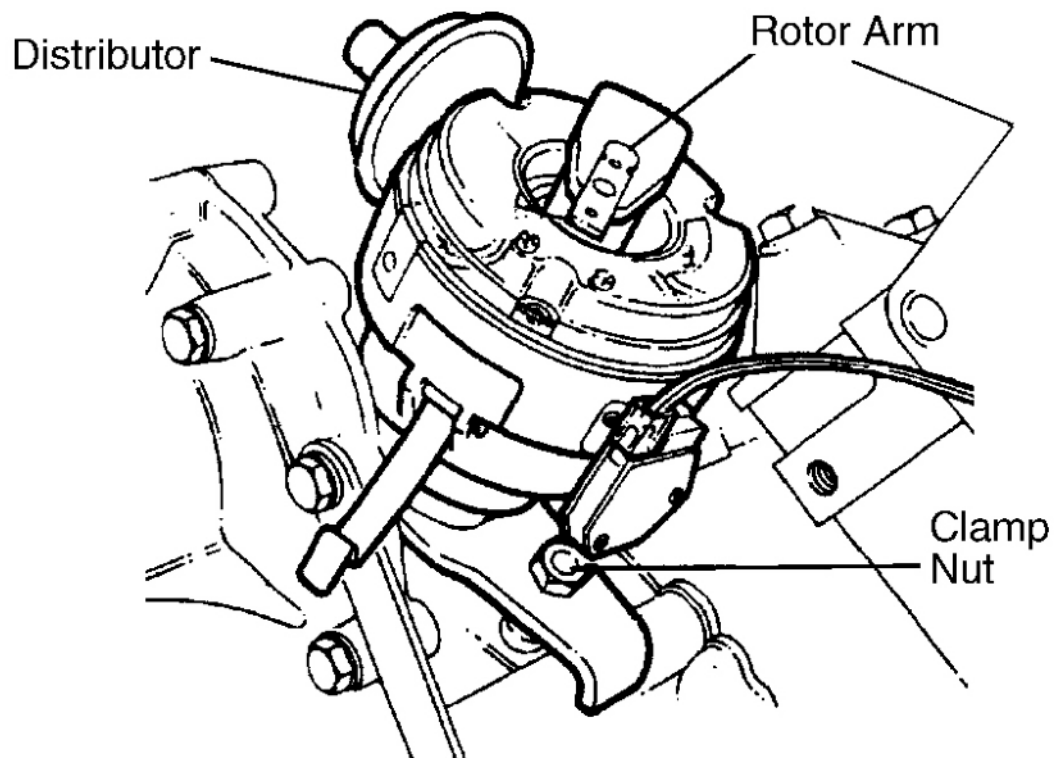


Fig. 24: Installing Distributor (1 Of 2)

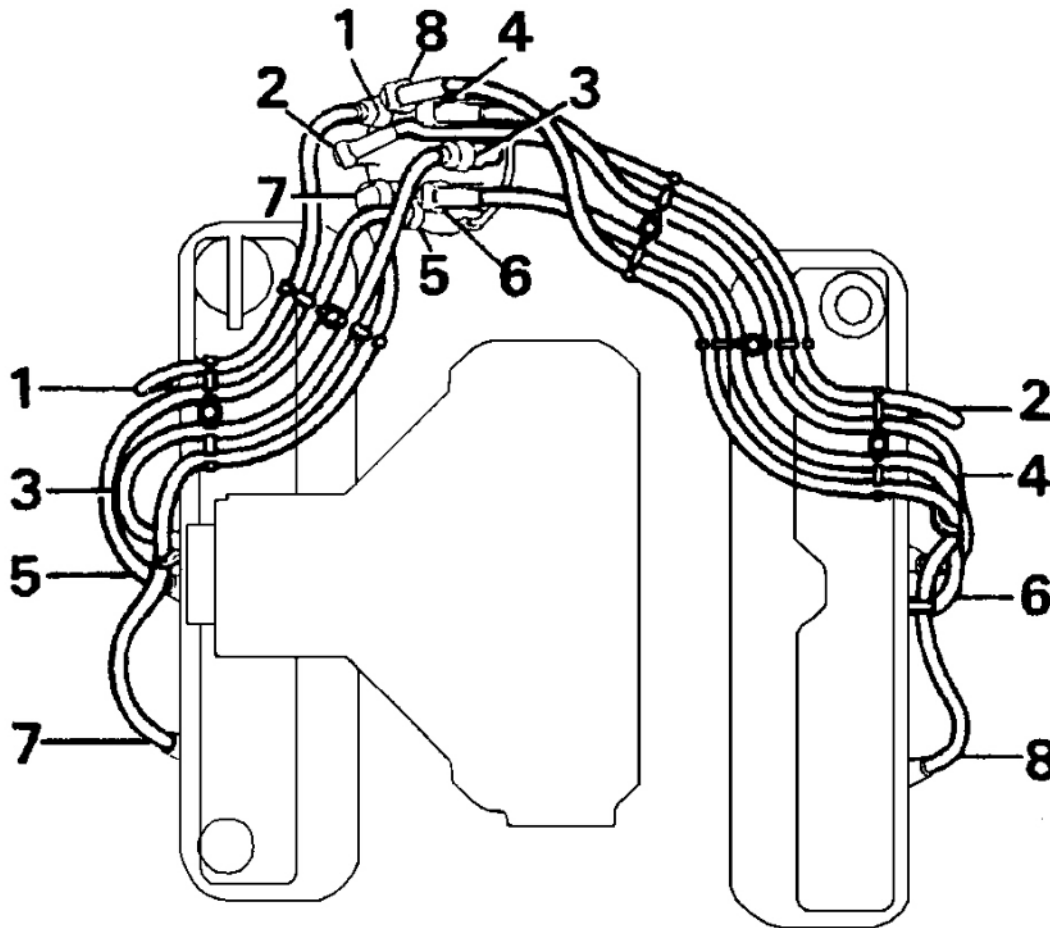
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 25: Installing Distributor (2 Of 2)

Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 26: Identifying Ignition Wire Routing
Courtesy of LAND ROVER NORTH AMERICA, INC.

ENGINE UNDERTRAY

Removal & Installation

1. Disconnect the battery negative lead.
2. Remove 3 screws, securing undertray to spoiler.
3. Remove 2 screws, one each side, securing rear of undertray to chassis mounting brackets.
4. Remove undertray by flexing to clear rear mountings.
5. Removal of one or both rear mounting brackets may be necessary. For example when removing steering box. Remove nut and washer from chassis bolt.
6. Withdraw under-tray mounting bracket.

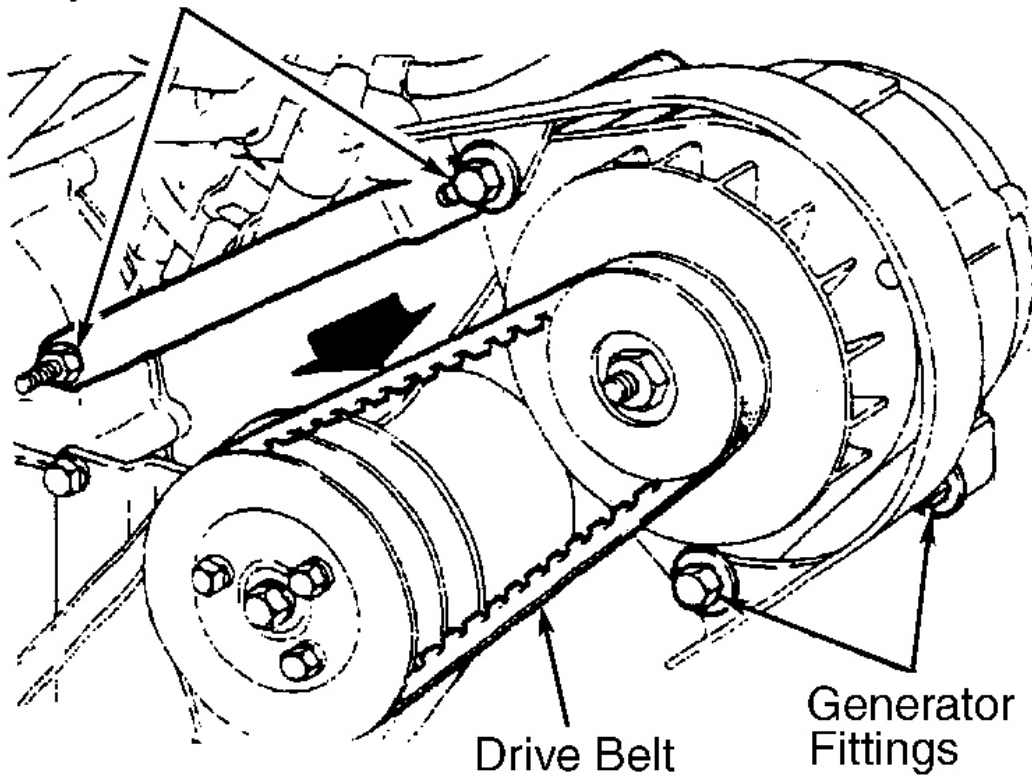
7. To install, reverse removal procedure.

GENERATOR

Removal

1. Disconnect battery negative lead.
2. Disconnect leads from generator.
3. Loosen generator fittings, pivot generator inwards and remove drive belt. See **Fig. 27**.
4. Remove 3 mounting bolts and lift the generator clear of the engine.

Generator Fittings & Adjustment Link



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Fig. 27: Removing Generator

Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

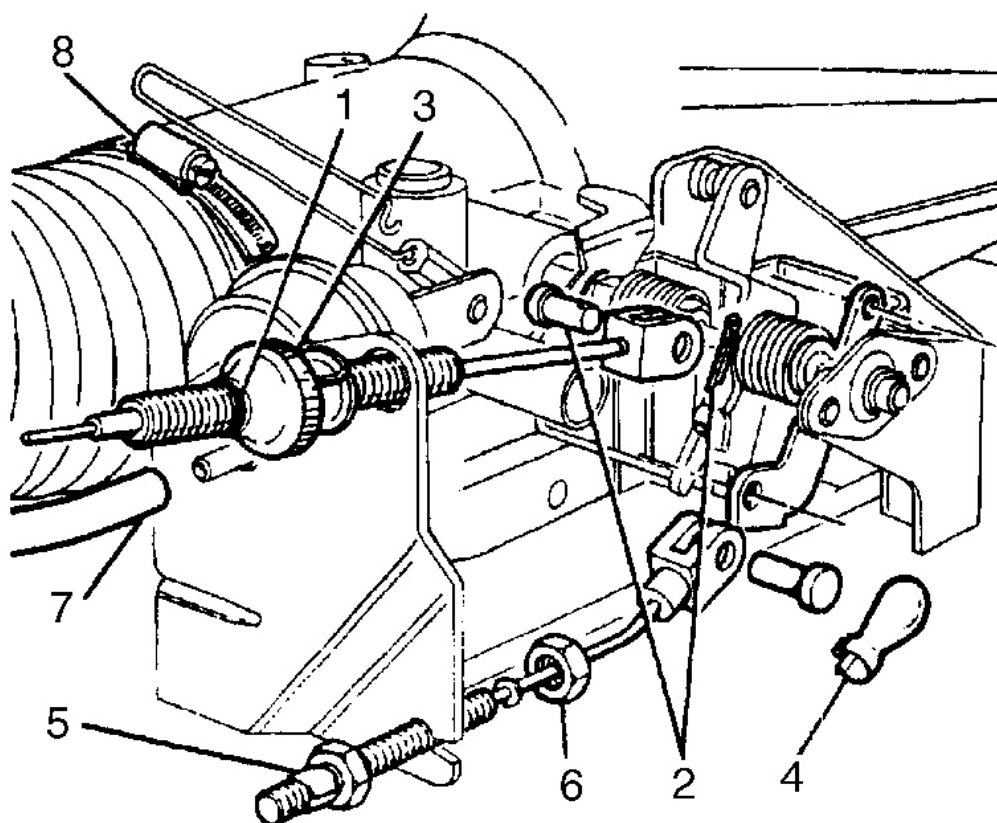
NOTE: **The fan guard is attached to the front fitting and the adjustment bracket bolt.**

1. Install the generator and the mounting bolts.
2. Install the drive belt and adjust the belt tension. See **Fig. 27**.
3. Tighten the mounting bolts and the adjustment bracket and securing nut to specifications. See **Fig. 27**. See **TORQUE SPECIFICATIONS**.
4. Connect the wiring leads to the generator.
5. Connect the battery. Restore radio/cassette and CD code. See appropriate ENTERTAINMENT SYSTEMS article.

PLENUM CHAMBER

Removal

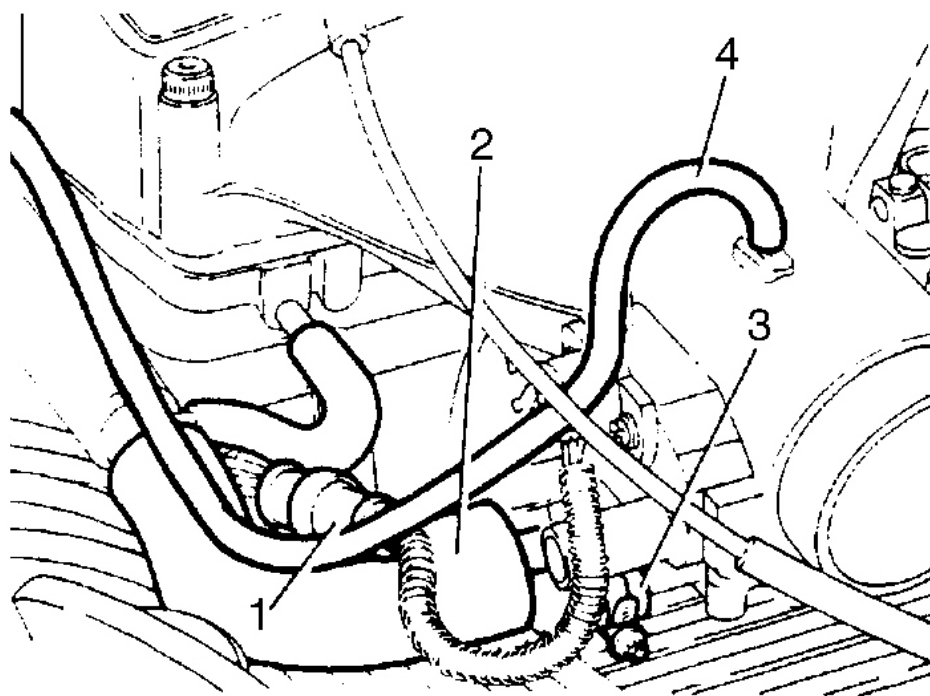
1. Disconnect the battery negative lead.
2. Disconnect electrical multi-plug from bypass air valve.
3. Disconnect vacuum hose adjacent to bypass air valve.
4. Mark an identification line on throttle cable outer to assist reassembly. See **Fig. 28**.
5. Remove clevis pin from throttle cable. See **Fig. 28**.
6. Pry adjustment thumb wheel from throttle bracket. Lay cable aside. See **Fig. 28**.
7. Remove retaining clip and clevis pin from kick down cable. See **Fig. 28**.
8. Apply adhesive tape behind rear adjustment nut on kick down cable to prevent nut moving. See **Fig. 28**.
9. Remove front lock nut. Remove cable and lay aside. See **Fig. 28**.
10. Remove cruise control vacuum hose. See **Fig. 28**.
11. Remove intake hose from neck of plenum chamber. See **Fig. 28**.
12. Disconnect throttle position sensor multi-plug. See **Fig. 29**.
13. Remove PCV breather hose. See **Fig. 29**.
14. Disconnect 2 coolant hoses and plug each hose to prevent excessive loss of coolant. Identify each hose for reassembly. See **Fig. 29**.
15. Remove distributor vacuum hose. See **Fig. 29**.
16. Release 2 screws and remove throttle position sensor.
17. Remove 6 screws securing plenum chamber. Remove plenum chamber.
18. Remove idle air control valve hose.
19. If fitted, unclip cruise control actuator link. Hold throttle fully open, release link from countershaft assembly. Carefully return lever assembly to close throttle.
20. Release tension on inboard throttle spring. See **Fig. 30**.
21. Bend back lock washer tabs. See **Fig. 30**.
22. Hold throttle stop lever in closed position, release nut from throttle shaft. See **Fig. 30**.
23. Release tension on outboard throttle spring. See **Fig. 30**.
24. Remove overtravel spring. See **Fig. 30**.



- | | |
|----------------------------|------------------------|
| 1. Throttle Cable | 5. Rear Adjustment Nut |
| 2. Cotter Pin & Clevis Pin | 6. Front Lock Nut |
| 3. Thumb Wheel | 7. Vacuum Hose |
| 4. Retaining Clip | 8. Large Hose |

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Fig. 28: Disconnecting Throttle Levers & Valves
 Courtesy of LAND ROVER NORTH AMERICA, INC.



1. Connector

2. PCV Breather Hose

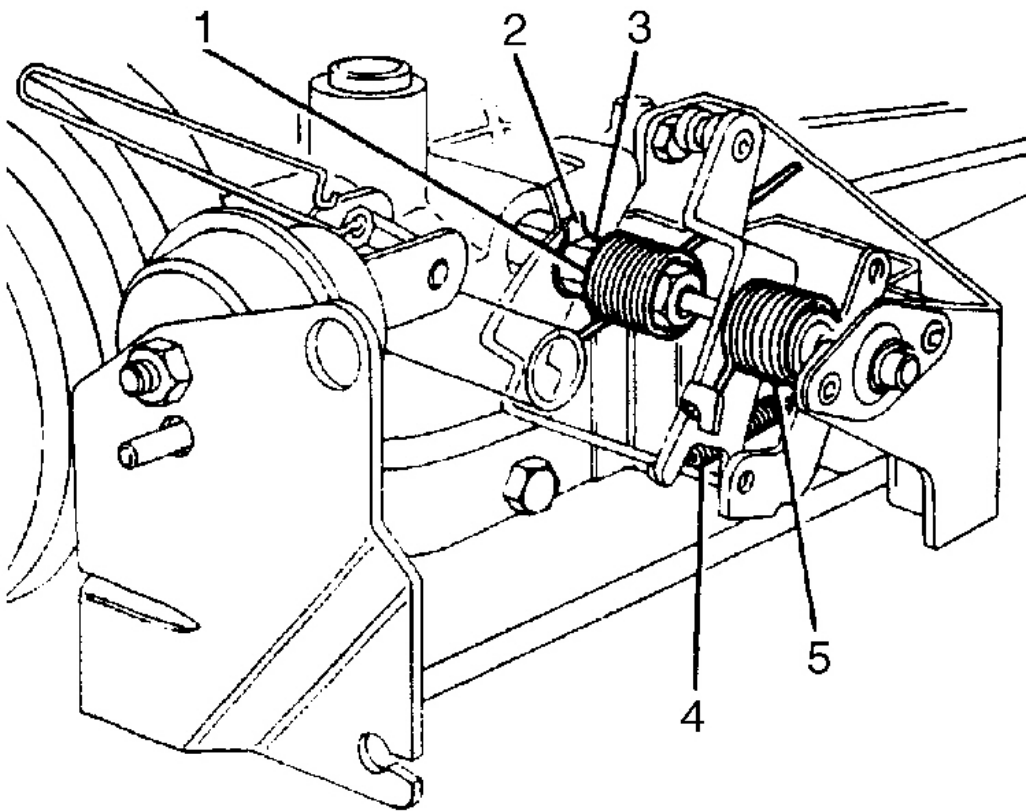
3. Coolant Hoses

4. Distributor Vacuum Hose

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Fig. 29: Removing Throttle Hoses

Courtesy of LAND ROVER NORTH AMERICA, INC.



1. Inboard Throttle Return Spring
2. Tab Washer
3. Throttle Shaft Nut
4. Overtravel Spring
5. Outboard Throttle Return Spring

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Fig. 30: Removing Throttle Lever Assembly
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Fit stop lever to throttle shaft and a new tab washer, and secure with throttle shaft nut.
2. Holding stop lever on stop, tighten throttle shaft nut securely, bend over tabs to lock nut in position.
3. Fit inboard throttle return spring noting that small hooked end of spring is nearest plenum.
4. Locate hooked end of inboard spring on stop lever. Wind up straight end one full turn and locate in appropriate slot.

5. Fit countershaft to interconnecting nut of throttle valve shaft.
6. Secure throttle bracket assembly to plenum. Secure with 3 retaining bolts.
7. Ensure hooked end of outboard spring is retained by lever, wind spring up one full turn and locate free end in appropriate slot.
8. Fit overtravel spring. Lightly grease throttle return and overtravel springs with Admax (L3) or Energrease (LS3).
9. Using a depth vernier or depth micrometer, check dimension from mouth of bore to top and bottom of valve disc. Dimension must be within 0.019" (0.50 mm) total indicator reading across diameter of disc.
10. If dimension is out of limits, adjust small set screw below stop lever.
11. Reconnect and adjust cruise control actuator link. See **CRUISE CONTROL ACTUATOR LINK** under ADJUSTMENTS.
12. Clean joint faces of plenum and ram housing. Apply "Hylomar" sealant, refit plenum chamber. Tighten bolts to 19 ft lbs. (26 Nm).
13. To complete installation, reverse removal procedure.

RADIATOR/OIL COOLERS

Removal

1. Drain cooling system.
2. Remove fan blade assembly.
3. Remove fan cowl.
4. Disconnect radiator top hoses.

NOTE: **Note oil spillage will occur when connections are loosened. Blank off exposed oil connections.**

5. Disconnect 4 transmission and engine oil cooler connections to radiator end tanks.
6. Disconnect transmission oil temperature sensor plug.
7. Remove radiator securing brackets from each side.
8. Remove radiator unit by lifting from its location. Check condition of rubber mounting pads.

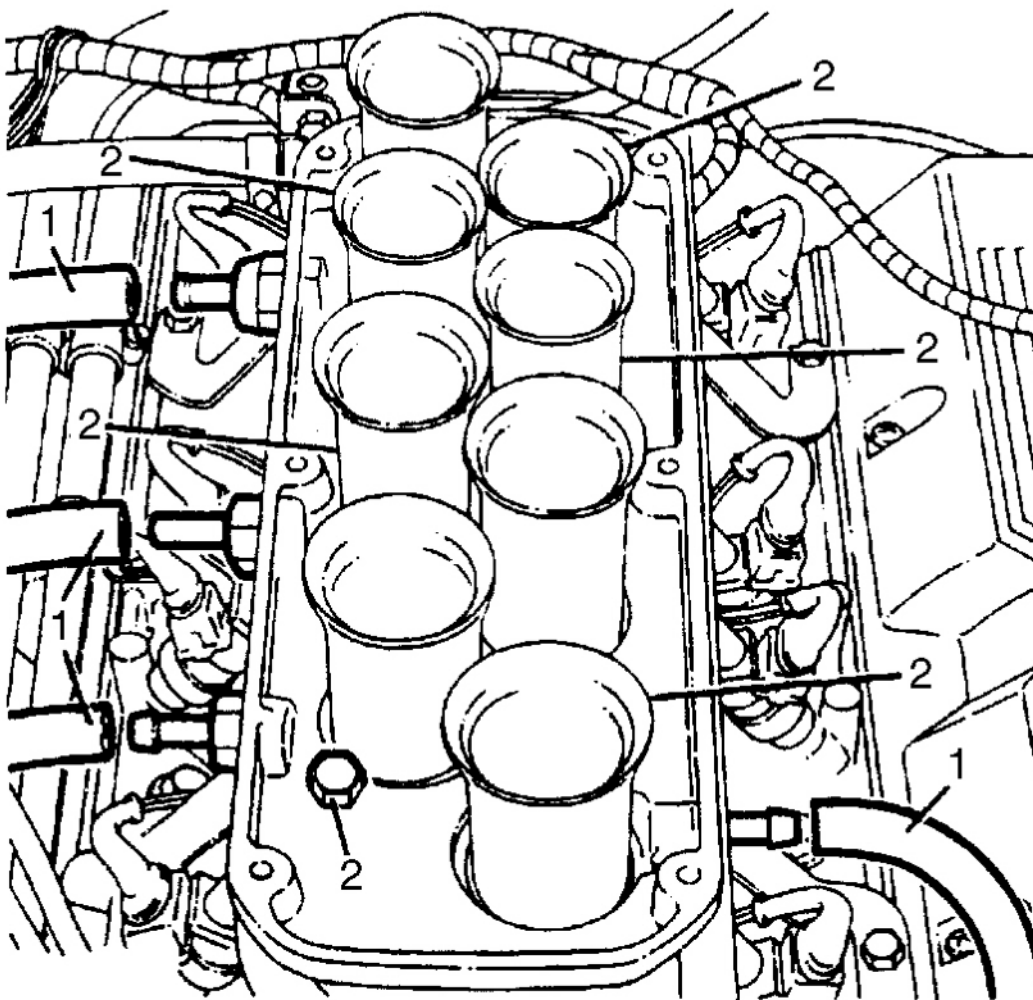
Installation

1. To install, check radiator sealing strips are securely located.
2. Transfer oil cooler adaptors if fitting new radiator.
3. Reverse removal procedure. Ensure that oil cooler connections are tightened to 22 ft lbs. (30 Nm) before fitting fan blades and cowl.
4. Clean coolant/oil spillage from vehicle.
5. Check all connections for coolant/oil leaks.

RAM HOUSING

Removal

1. Disconnect the battery negative lead.
2. Remove plenum chamber. See **PLENUM CHAMBER**.
3. Release hoses from ram housing. See **Fig. 31**.
4. Remove 6 through bolts (with plain washers) securing ram housing to intake manifold. See **Fig. 31**.
5. Remove ram housing from intake manifold.
6. Place a protective cover over inlet bores to prevent ingress of dirt.



1. Ram Housing Hoses
2. Through Bolt Locations

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Fig. 31: Removing Ram Housing Hoses & Through Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. To install, clean all mating faces.
2. Apply "Hylomar" sealant to intake manifold face.
3. Fit ram housing. Tighten bolts, working from 2 center bolts, diagonally towards outer 4 bolts.
4. Tighten to 19 ft lbs. (26 Nm).

VISCOUS COUPLING

WARNING: Disconnect battery negative terminal to prevent engine being started before removing or adjusting drive belts.

Removal & Installation

NOTE: Nut securing viscous unit to water pump has a left hand thread. Release by turning clockwise when viewed from front of viscous unit.

1. Loosen nut securing viscous coupling/fan blade assembly to water pump.
2. Remove 4 fan cowl fixings, lift cowl out of lower mountings.
3. Remove viscous coupling securing nut, withdraw assembly.
4. Remove fan cowl, if necessary.
5. Remove fan blades from viscous coupling, if necessary.
6. To install, reverse removal procedure.

REMOVAL & INSTALLATION (WITH ENGINE REMOVED)

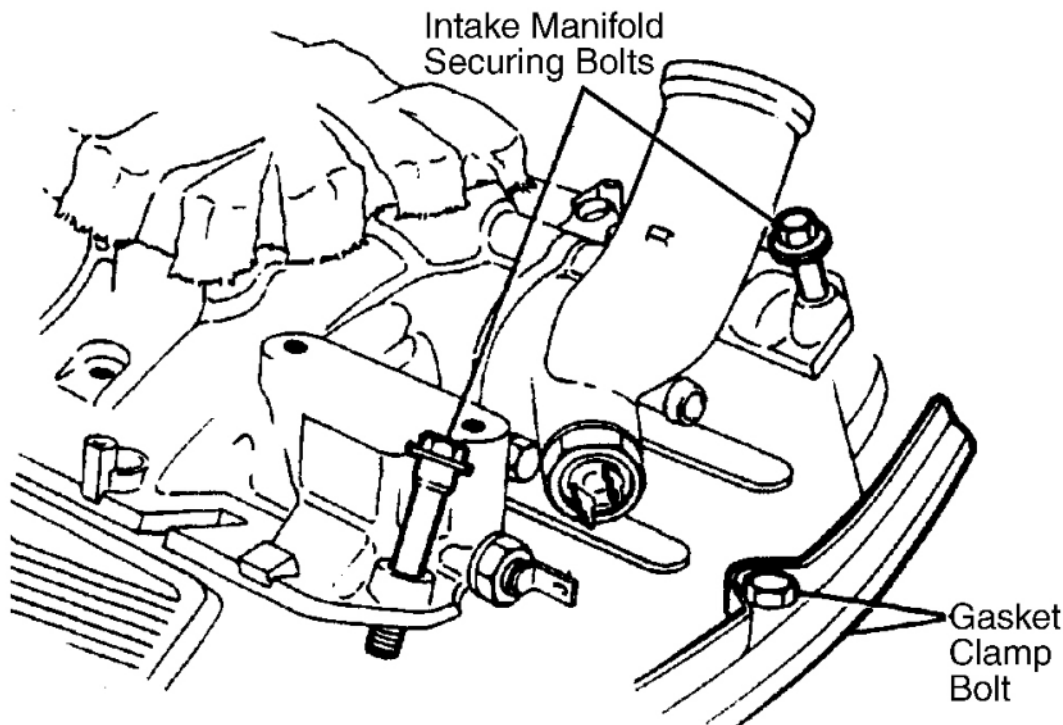
WARNING: During battery removal or before carrying out any repairs or maintenance to electrical components always disconnect battery negative lead first. If positive lead is disconnected with negative lead in place, accidental contact of wrench to any grounded metal part could cause a severe spark, possibly resulting in personal injury. Upon installation of battery connect positive lead first.

NOTE: Removal and installation procedures of individual engine components, are performed with engine removed from vehicle, oil drained into a suitable container, exterior of engine cleaned and engine secured on an approved engine stand.

INTAKE MANIFOLD

Removal

1. Release hose clamp securing hose to rear of water pump.
2. Detach retaining clips from top of injectors.
3. Remove 4 bolts securing fuel rail to manifold.
4. Withdraw fuel rail and injectors.
5. Evenly loosen and remove 12 bolts securing intake manifold to cylinder heads.
6. Lift intake manifold from cylinder heads.
7. Wipe away any excess coolant lying on manifold gasket and remove gasket clamp bolts and remove clamps. See **Fig. 32**.
8. Lift off gasket and seals.



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Fig. 32: Removing Intake Manifold

Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Apply Hylomar (SQ32M) sealing compound to notches formed between cylinder head and block. See **Fig. 12**.
2. Locate NEW seals in position with their ends engaged in notches formed between cylinder heads and block. See **Fig. 12**.

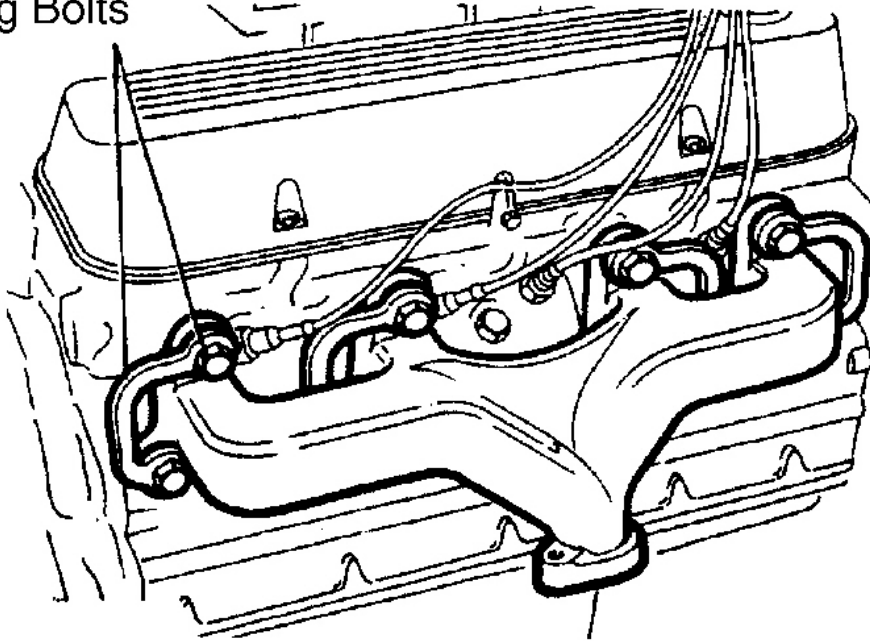
3. Apply Hylomar (SQ32M) sealing compound on corners of cylinder head, manifold gasket and manifold, around water passage joints. See **Fig. 13**.
4. Fit manifold gasket with FRONT to front and open bolt hole at right front side. See **Fig. 13**.
5. Fit gasket clamps but do not fully tighten bolts at this stage.
6. Locate manifold on to cylinder head.
7. Clean threads of manifold securing bolts.
8. Fit all manifold bolts and tighten them a little at a time, evenly, alternate sides working from center to each end and finally tighten to 30 ft lbs. (40 Nm). See **Fig. 32**.
9. Tighten gasket clamp bolts to 13 ft lbs. (18 Nm). See **Fig. 32**.

EXHAUST MANIFOLDS

Removal & Installation

1. Bend back lock tabs and remove 8 bolts securing each manifold. Withdraw manifolds and gaskets. See **Fig. 33**.
2. To install, ensure that mating surfaces of cylinder head and exhaust manifold are clean, fit NEW gaskets to exhaust manifold and coat threads of each bolt with anti-seize compound.
3. Place manifold in position on cylinder head and fit NEW lockplates, securing bolts and plain washers. See **Fig. 33**. The plain washers are fitted between manifold and lockplates. Evenly tighten manifold bolts to 15 ft lbs. (20 Nm) and bend over lock tabs.

Exhaust Manifold
Securing Bolts



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Fig. 33: Removal & Installation Of Exhaust Manifold
Courtesy of LAND ROVER NORTH AMERICA, INC.

ROCKER SHAFTS & VALVE GEAR

Removal & Disassembly Of Rocker Shafts

1. Remove rocker covers. See **ROCKER COVERS**.
2. Remove 4 rocker shaft retaining bolts and lift off assembly. See **Fig. 16**.
3. Withdraw pushrods and retain in sequence removed. See **Fig. 17**.
4. Remove hydraulic tappets. Retain with their respective pushrods. If a tappet cannot be removed leave in position until camshaft is removed. See **Fig. 17**.
5. Remove cotter pin from one end of rocker shaft.
6. Withdraw the following components and retain them in correct sequence for reassembly: Plain washer, wave washer, rocker arms, brackets and springs. See **Fig. 36**.
7. Examine each component for wear in particular rockers and shafts. Discard weak or broken springs.

Inspection Of Tappets & Pushrods

1. Hydraulic Tappet: inspect inner and outer surfaces of body for damage or scoring. Replace hydraulic

tappet if body is roughly scored or grooved, or has a hole extending through wall in a position to permit oil leakage from lower chamber.

2. The prominent wear pattern just above lower end of body should not be considered a defect unless it is definitely grooved or scored. It is caused by side thrust of cam against body while tappet is moving vertically in its bore.
3. Inspect cam contact surface of tappets. Fit NEW tappets if surface is excessively worn or damaged. See **Fig. 34**.
4. A hydraulic tappet body that has been rotating will have a round wear pattern and a non-rotating tappet body will have a square wear pattern with a very slight depression near center.
5. Tappets MUST rotate and a circular wear condition is normal. Tappets with this wear pattern can be refitted provided there are no other defects. See **Fig. 34**.
6. In case of a non-rotating tappet, fit a NEW replacement and check camshaft lobes for wear; also ensure new tappet rotates freely in cylinder block. See **Fig. 34**.
7. Fit a NEW hydraulic tappet if area where pushrod contacts is rough or otherwise damaged.
8. Fit a NEW pushrod if it is bent or has a rough or damaged ball end or seat.

Assembly Of Rocker Shafts

CAUTION: If shafts and rockers are incorrectly assembled and fitted to engine, oil supply to rocker shafts will be restricted.

1. Both shafts must be assembled so that identification groove is at one o'clock position with push rod end of rockers to right. See **Fig. 35**.
2. Fit a cotter pin to one end of rocker shaft. See **Fig. 36**.
3. Slide a plain washer over long end of shaft to contact cotter pin. See **Fig. 36**.
4. Fit a wave washer to contact plain washer. See **Fig. 36**.
5. Early type rocker arms are angled. They must be fitted so that valve end of rocker arms angle away from each other. See **Fig. 37**.
6. On later type rocker arms valve end is offset and must be fitted as shown. See **Fig. 37**.
7. Early and late types of rocker arms are interchangeable provided complete set is changed.
8. Assemble rocker arms, brackets and springs to rocker shaft. See **Fig. 36**.
9. Compress springs, brackets and rockers, and fit a wave washer, plain washer and cotter pin to end of rocker shaft.
10. Fit locating bolts through brackets and place assemblies to one side.

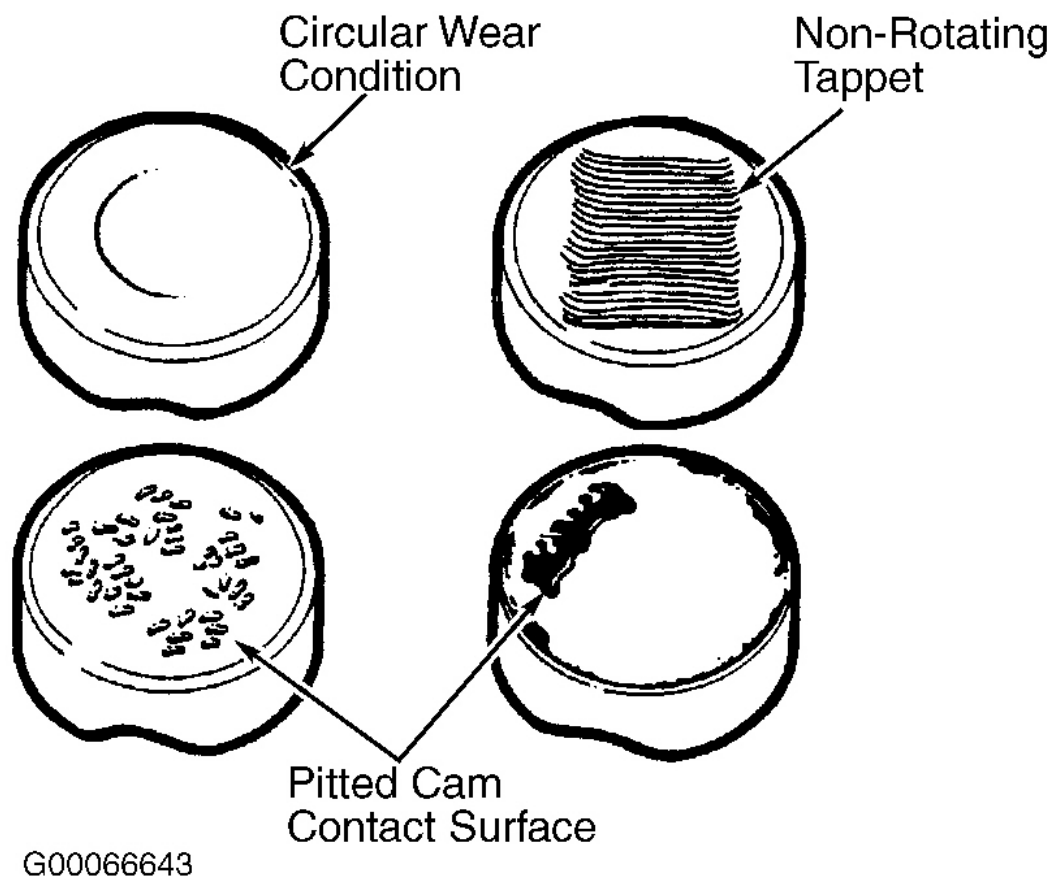


Fig. 34: Inspecting Tappets & Pushrods
Courtesy of LAND ROVER NORTH AMERICA, INC.

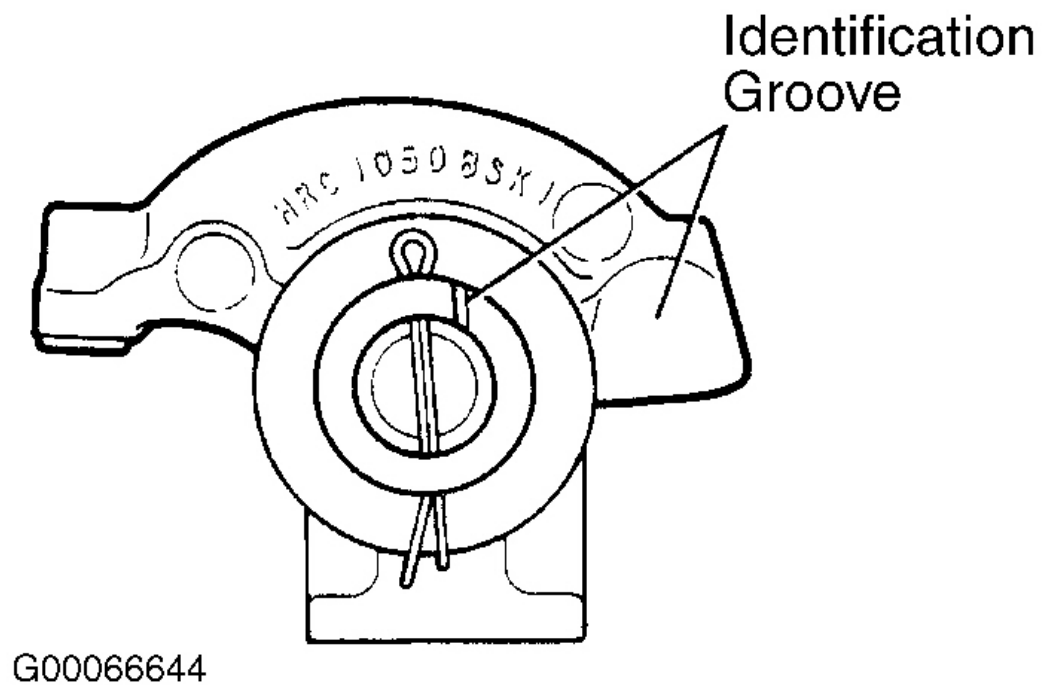
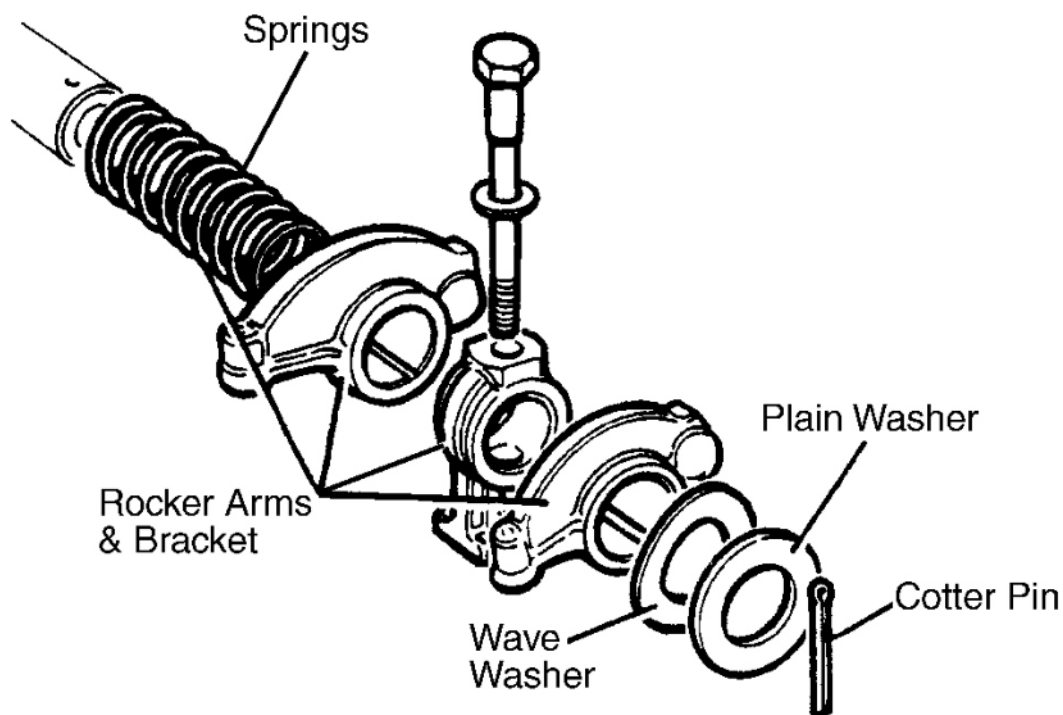


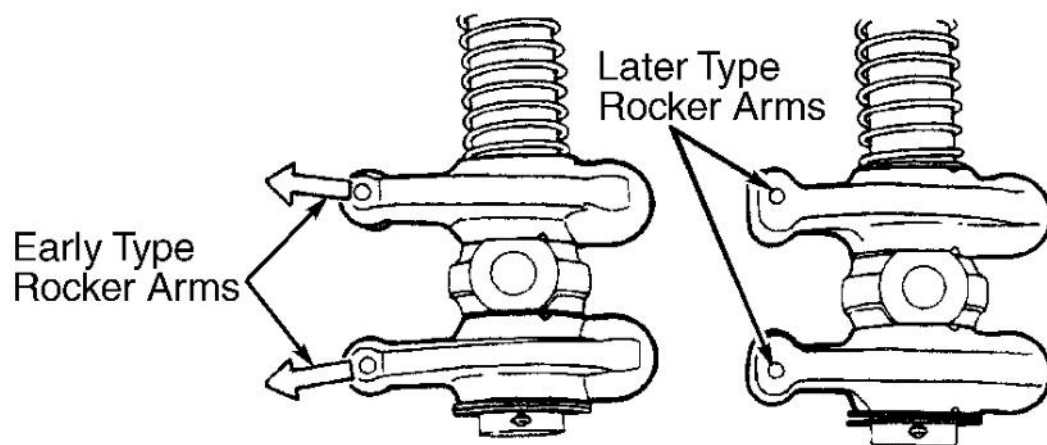
Fig. 35: Assembling Rocker Shafts (1 Of 3)
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 36: Assembling Rocker Shafts (2 Of 3)

Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 37: Assembling Rocker Shafts (3 Of 3)

Courtesy of LAND ROVER NORTH AMERICA, INC.

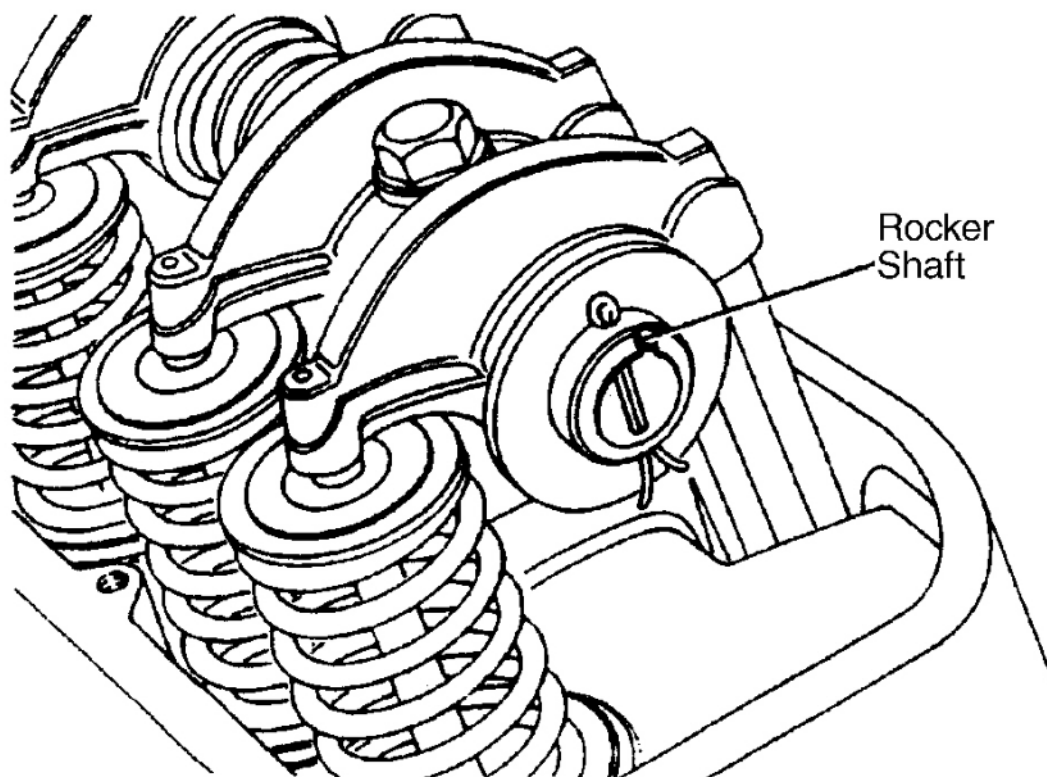
Installation

NOTE: Before fitting, immerse tappets in clean engine oil and pump inner sleeve of tapped several times using a pushrod, to reduce tappet noise when engine is stated.

1. Fit tappets and push rods to their original locations. See **Fig. 17**. Ensure that tappets move freely in their respective bores. Before fitting tappets, immerse them in clean engine oil to reduce tappet noise when engine is first started after overhaul.
2. The rocker shafts are handed and must be fitted correctly to align oilways.
3. Each rocker shaft is notched at one end and on one side only. The notch must be highest and toward front of engine on right-hand side, and toward rear on left-hand side. See **Fig. 38**.
4. Fit rocker shaft assemblies. Ensure that pushrods engage rocker cups. See **Fig. 16**. Tighten bolts to 28 ft lbs. (38 Nm).

NOTE: Tappet noise can be expected on initial starting up after an overhaul due to oil drainage from tappet assemblies or if vehicle has been standing over a very long period. If excessive noise is apparent after an overhaul, engine should be run at approximately 2,500 RPM for a few minutes (subject to the following caution), when noise should be eliminated.

CAUTION: DO NOT exceed 1000 RPM for 15 seconds when first starting engine, otherwise crankshaft rear oil seal will be damaged.



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Fig. 38: Fitting Rocker Assemblies

Courtesy of LAND ROVER NORTH AMERICA, INC.

ROCKER COVERS

Removal & Installation

1. Remove spark plug leads from spark plugs and retaining clips. Release 4 screws and lift off rocker covers.
2. An oil baffle is fitted inside each rocker cover. Remove 2 screws to remove baffle for cleaning.
3. Remove old gasket and sealant from covers and cylinder heads. Clean and dry gasket mounting face using Bostik cleaner 6001. Apply Bostik 1775 to seal face and gasket, use a brush to ensure an even film. Allow adhesive to become touch-dry, approximately 15 minutes.

NOTE: The gasket fits one way only and must be fitted accurately first time. Any subsequent movement would destroy bond.

4. Fit pilot studs in rocker cover fixing holes to guide gasket onto cover and into recess. Press gasket into place ensuring that outer edge firmly contacts recess wall.

5. Allow covers to stand for 30 minutes before fitting.
6. Secure rocker covers to cylinder heads with short screws inboard, long screws outboard. Tighten to 80 INCH lbs. (9 Nm).

FLEX-PLATE & RING GEAR

Removal

NOTE: To ensure the following components are reassembled in their correct radial positions, mark each component with an identification line to enable each part to be reassembled in correct relationship to one another.

1. Remove 4 retaining bolts. See [Fig. 39](#).
2. Withdraw clamp ring, flex-plate, hub aligner and ring gear assembly. See [Fig. 39](#).
3. Remove 6 socket head bolts securing crankshaft adaptor plate and shim to crankshaft flange. See [Fig. 39](#).
4. Withdraw crankshaft adaptor plate and shim. See [Fig. 39](#).
5. Inspect ring gear assembly for distortion, cracks, chipped or badly worn teeth. If ring gear is in poor condition fit a complete NEW assembly. See [Fig. 39](#).

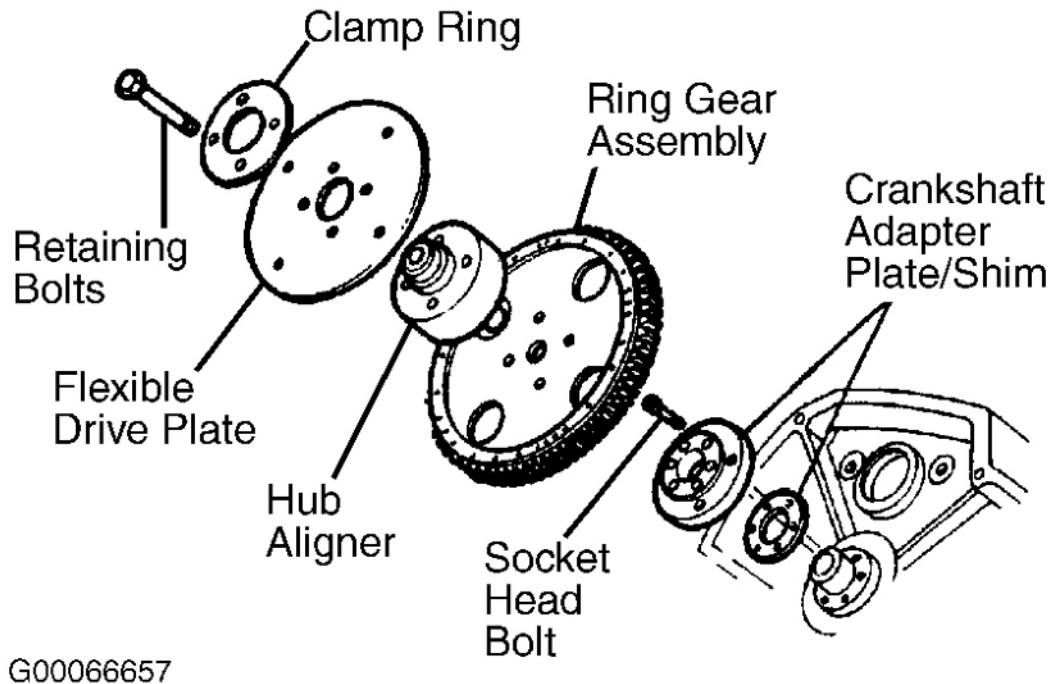


Fig. 39: Flex-Plate & Ring Gear Assembly
Courtesy of LAND ROVER NORTH AMERICA, INC.

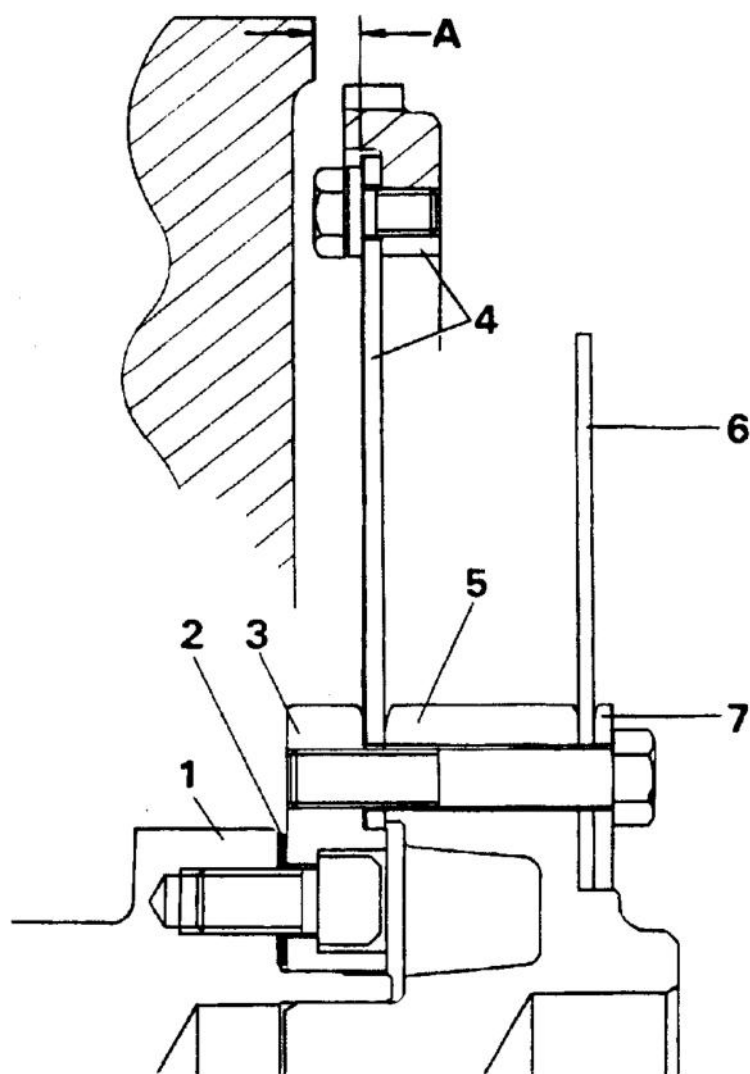
Installation

1. Fit shim and crankshaft adaptor plate to crankshaft flange noting previously marked identification lines and secure in position with 6 socket head bolts. See **Fig. 39**. DO NOT fully tighten bolts at this stage.
2. Fit ring gear assembly, hub aligner, flex-plate noting previously marked identification lines and secure in position with 4 bolts and clamping ring. See **Fig. 39**. DO NOT fully tighten bolts at this stage.
3. To ensure that there is no distortion to flex-plate when bolted to torque converter, check setting height of drive plate as follows.
4. To prevent excessive clearance, a shim is fitted between crankshaft drive flange and crankshaft adaptor plate. See **Fig. 40**. The setting height, dimension "A", is measured between front face of ring gear drive plate and engine cylinder block to gearbox mating face, a dimension of 0.318-0.323" (8.08-8.20 mm) is to be maintained. Should this dimension not be achieved a selection of shims in progressive thicknesses are available. Select appropriate shim to maintain dimension. See **FLEX PLATE SHIM THICKNESS** table.

FLEX PLATE SHIM THICKNESS

Part No.	Dimension (mm)
FRC 7084	1.20-1.25
FRC 7085	1.30-1.35
FRC 7086	1.40-1.45
FRC 7087	1.50-1.55
FRC 7088	1.60-1.65
FRC 7089	1.70-1.75
FRC 7090	1.80-1.85
FRC 7091	1.90-1.95
FRC 7092	2.00-2.05
FRC 7093	2.10-2.15

5. Remove 4 bolts, clamp ring, flex-plate, hub aligner and ring gear assembly.
6. Remove 6 socket head bolts and crankshaft adaptor.
7. Fit appropriate shim, refit adaptor and 6 socket head bolts, tighten to 62 ft lbs. (84 Nm). See **Fig. 40**.
8. Fit ring gear assembly, hub aligner, flex-plate and clamp ring.
9. Coat threads of 4 securing bolts with Loctite 270 prior to assembly, fit bolts and tighten to 30 ft lbs. (40 Nm).

**KEY:**

- A. Setting Height
8.08-8.20 mm (.318-.323")
- 1. Crankshaft Flange
- 2. Shim
- 3. Crankshaft Adapter Flange
- 4. Drive Plate & Ring Gear Assembly
- 5. Hub Aligner
- 6. Flexible Drive Plate
- 7. Clamp Ring

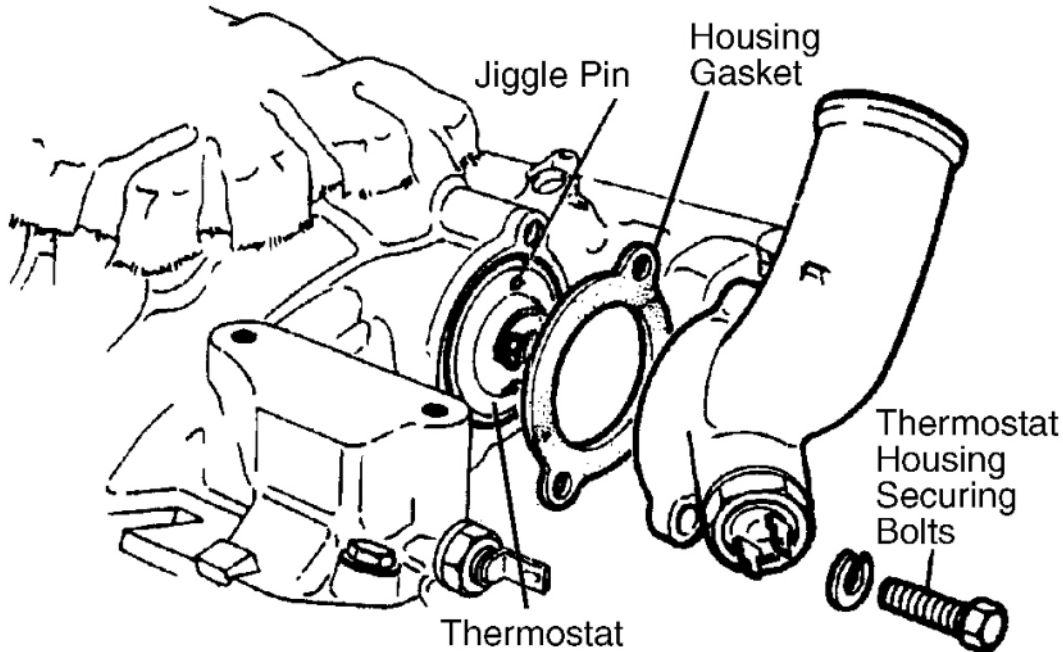
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Fig. 40: Installing Ring Gear & Flex Plate Assembly
Courtesy of LAND ROVER NORTH AMERICA, INC.

THERMOSTAT

Removal

1. Remove 2 bolts securing thermostat housing to intake manifold. See **Fig. 41**.
2. Remove housing gasket. See **Fig. 41**.
3. Remove thermostat.

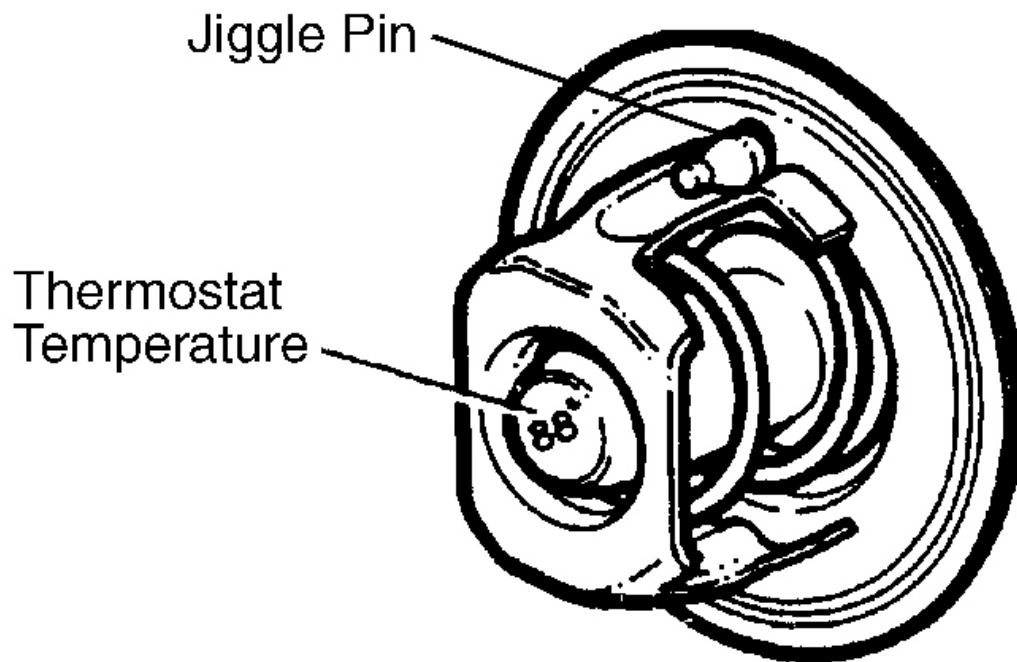


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Fig. 41: Removal & Installation Of Thermostat
Courtesy of LAND ROVER NORTH AMERICA, INC.

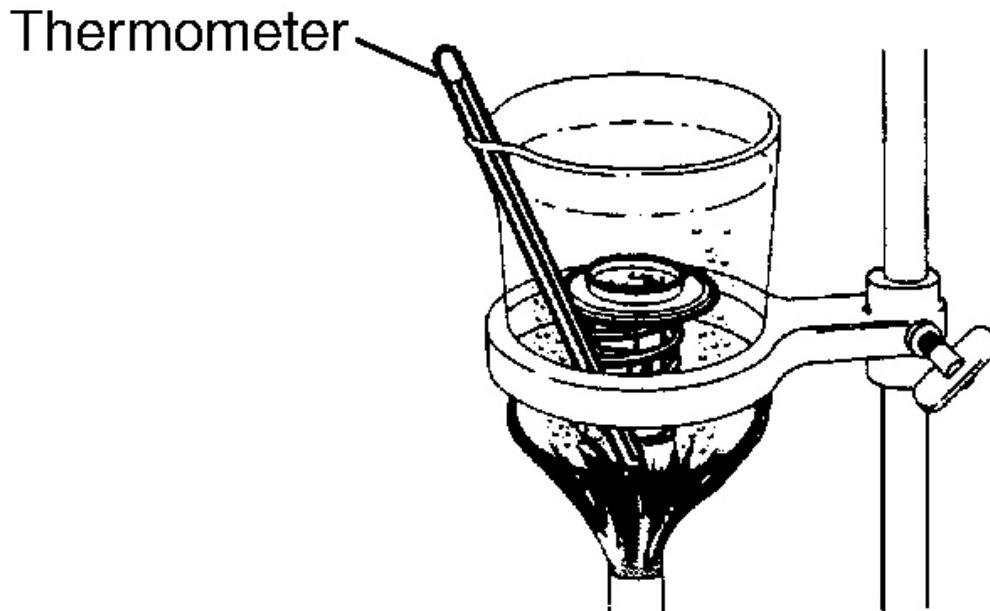
Testing

1. Note temperature stamped on thermostat at which it should be fully open should be 88°C (190°F). See **Fig. 42**.
2. Place thermostat and thermometer in container of water. See **Fig. 43**.
3. Heat water and observe temperature at which thermostat opens.
4. If faulty, discard thermostat.



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Fig. 42: Identifying Thermostat Temperature Rating Location
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 43: Testing Thermostat

Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

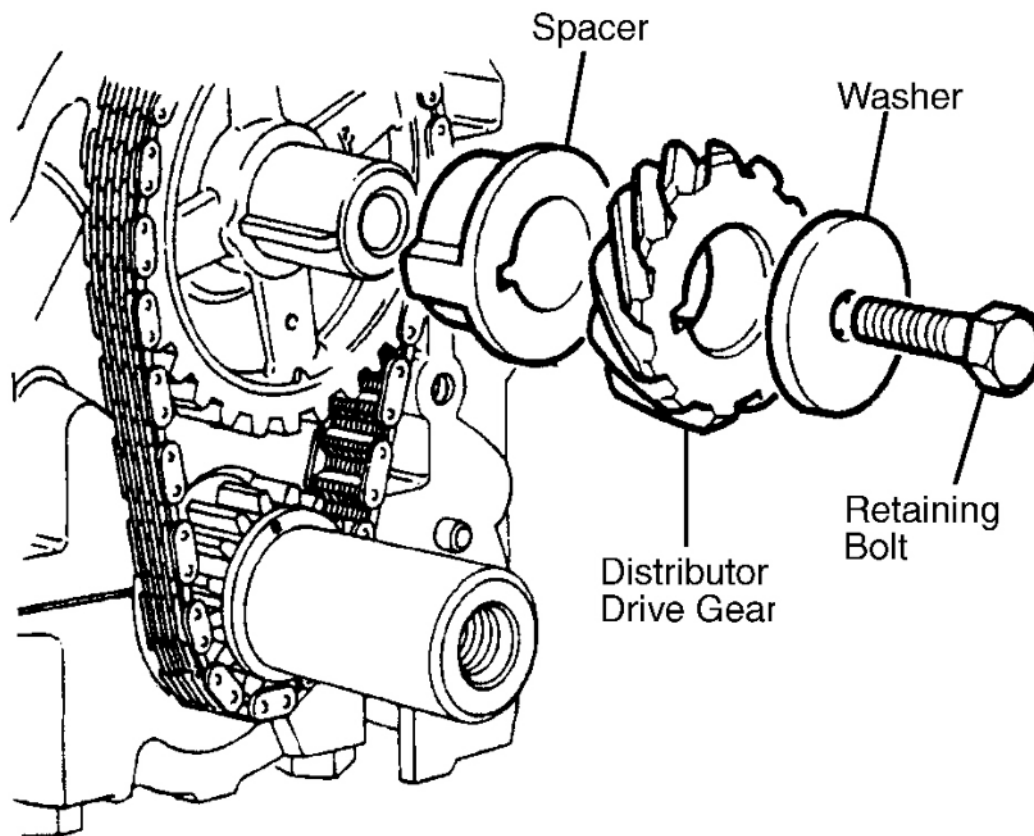
1. Clean intake manifold and thermostat housing mating faces.

NOTE: Airlocks may develop in cooling system if thermostat is incorrectly positioned, with consequent loss of coolant and possible overheating.

2. Fit thermostat with jiggle pin uppermost at 12 o'clock position. See **Fig. 41**.
3. Fit housing using a NEW gasket, and tighten 2 bolts to 21 ft lbs. (28 Nm).

TIMING CHAIN SPROCKET & CAMSHAFT**Removal**

1. Remove retaining bolt and washer and withdraw distributor drive gear and spacer. See **Fig. 44**.
2. Withdraw sprocket complete with timing chain. See **Fig. 45**.
3. Withdraw camshaft while taking particular care not to damage bearings in cylinder block. See **Fig. 46**.



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Fig. 44: Removing Distributor Drive Gear & Spacer
Courtesy of LAND ROVER NORTH AMERICA, INC.

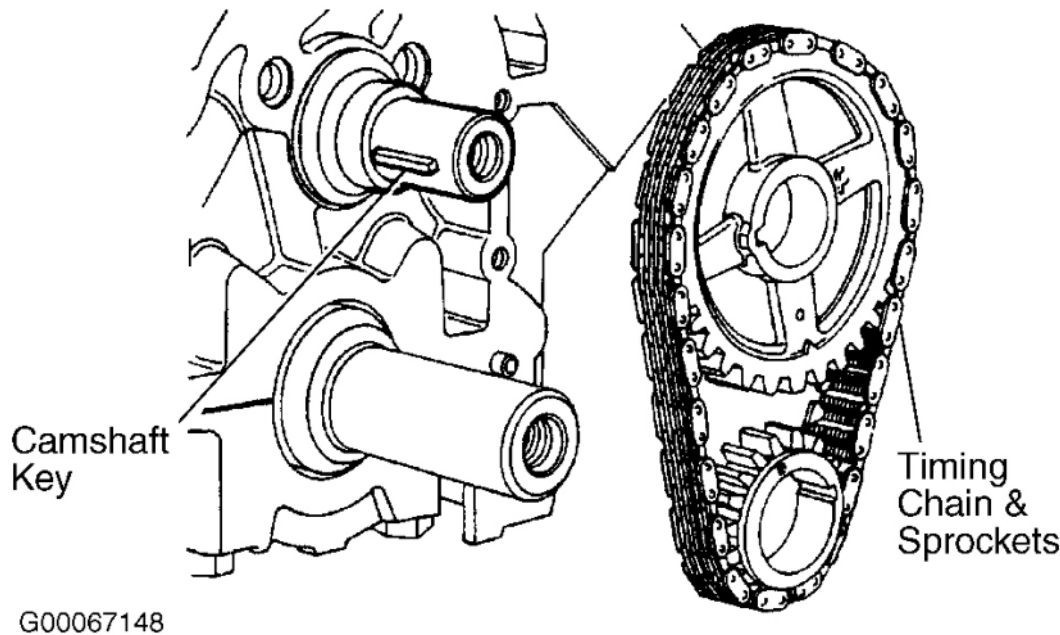


Fig. 45: Removal & Installation Of Timing Chain & Sprockets
 Courtesy of LAND ROVER NORTH AMERICA, INC.

Inspection

1. Visually examine all parts for wear. Check camshaft bearing journals and cams for wear, pits, scores and overheating. Should any of these conditions be present, fit a NEW camshaft.
2. Examine links and pins of timing chain for wear and compare its condition with that of a new chain. Similarly, teeth of sprockets should be inspected and, if necessary, fit a NEW sprocket.
3. Measure camshaft journals for overall wear, out of roundness and taper. The diameters of 5 journals are as follows starting from front of shaft:
 - No. 1 Journal 1.786-1.785" (45.40-45.30 mm)
 - No. 2 Journal 1.756-1.755" (44.60-44.50 mm)
 - No. 3 Journal 1.726-1.725" (43.84-43.81 mm)
 - No. 4 Journal 1.696-1.695" (43.07-43.05 mm)
 - No. 5 Journal 1.666-1.665" (42.31-42.29 mm)
4. To check camshaft for straightness rest 2 end journals, i.e. No. 1 and No. 5, on "V" blocks and mount a dial gauge on center journal. Rotate shaft and note reading. If run out is more than 0.002" (0.05 mm), fit a NEW camshaft.

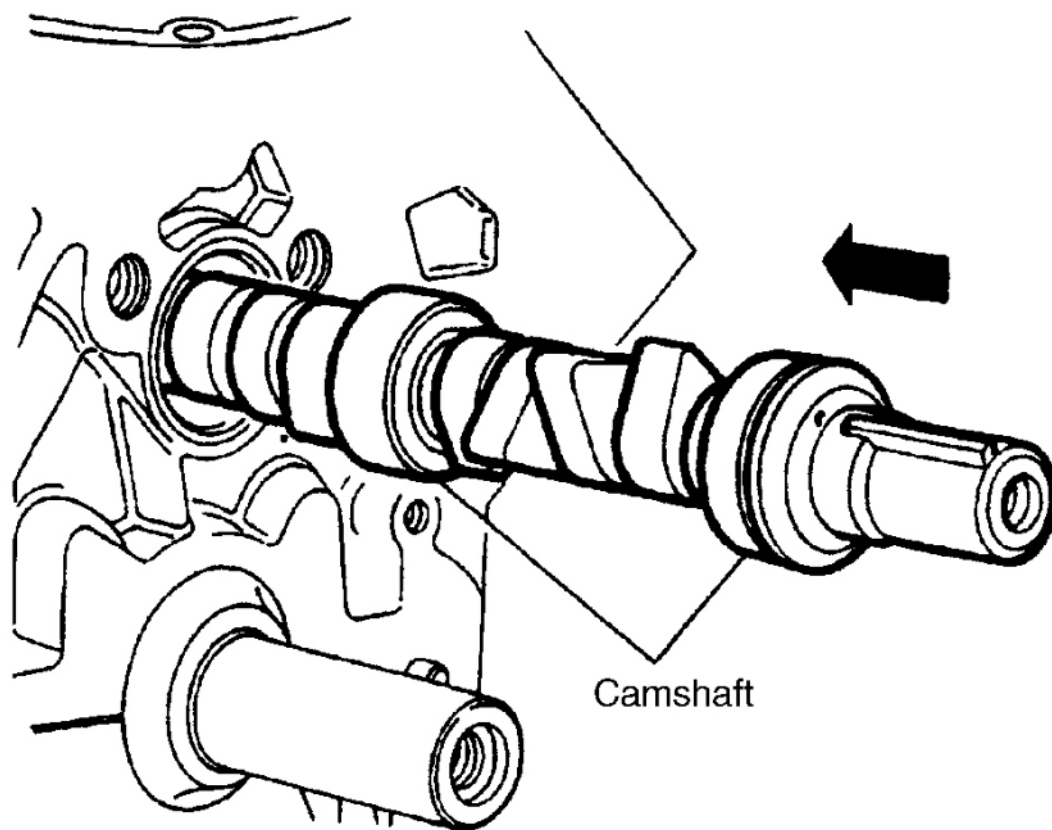
Installation

1. Lubricate camshaft journals and carefully insert camshaft into cylinder block. See **Fig. 46**.

2. Turn crankshaft to bring number one piston to Top Dead Center (TDC).
3. Temporarily fit camshaft sprocket with marking "F" or FRONT outward. See **Fig. 47**.
4. Turn camshaft until mark on camshaft sprocket is at 6 o'clock position, then remove sprocket without disturbing camshaft. See **Fig. 47**.
5. Encircle sprockets with chain keeping timing marks aligned. See **Fig. 47**.

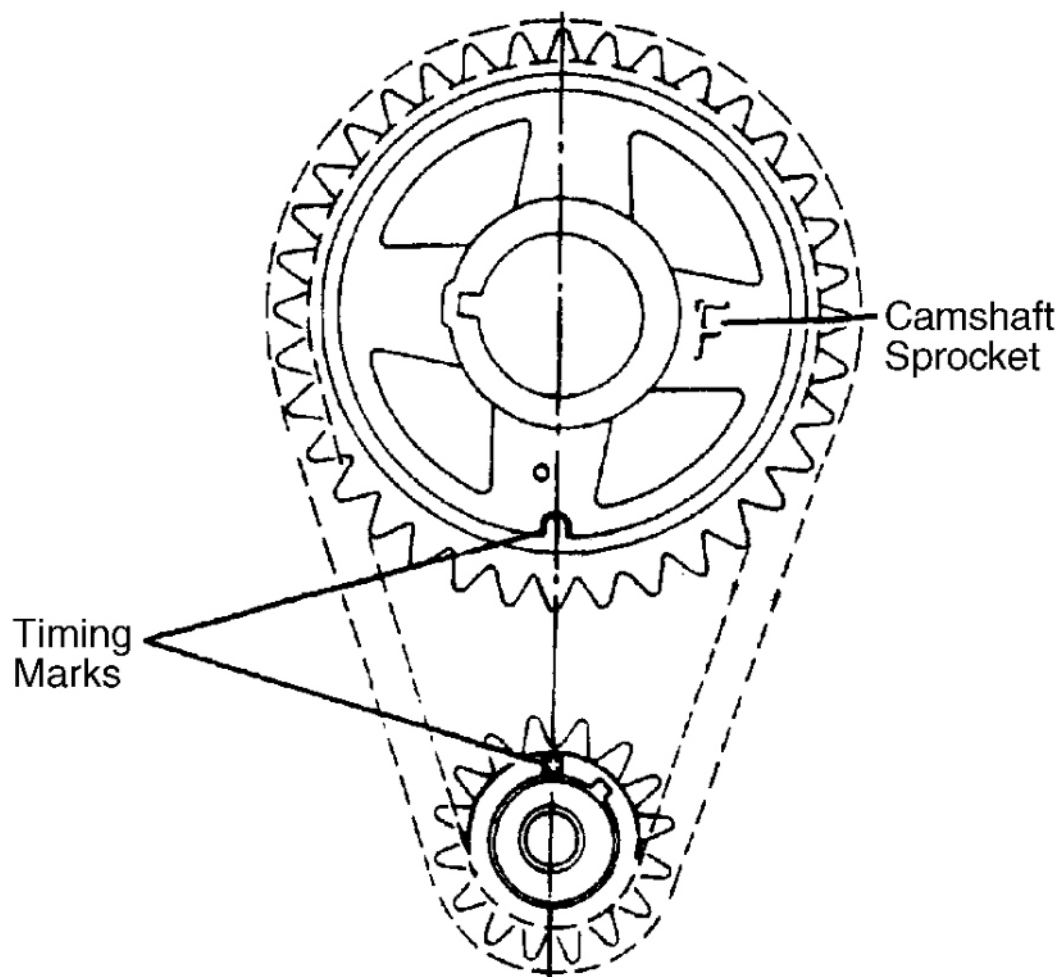
CAUTION: The space between key and keyway acts as an oilway for lubrication of drive gear. Ensure that key is seated to full depth of keyway. The overall dimension of shaft and key must not exceed 1.187" (30.15 mm). Dimension "A". See **Fig. 48.**

6. Engage sprocket assembly on camshaft and crankshaft key locations and check that camshaft key is parallel to shaft axis to ensure adequate lubrication of distributor drive gear. See **Fig. 45**.
7. Check that timing marks line up and fit spacer with flange to front. See **Fig. 49**.
8. Fit distributor drive gear ensuring that annular grooved side is fitted to rear, that is towards spacer. See **Fig. 49**.
9. Secure drive gear and camshaft sprocket assembly with bolt and washer and tighten to 44 ft lbs. (60 Nm). See **Fig. 49**.



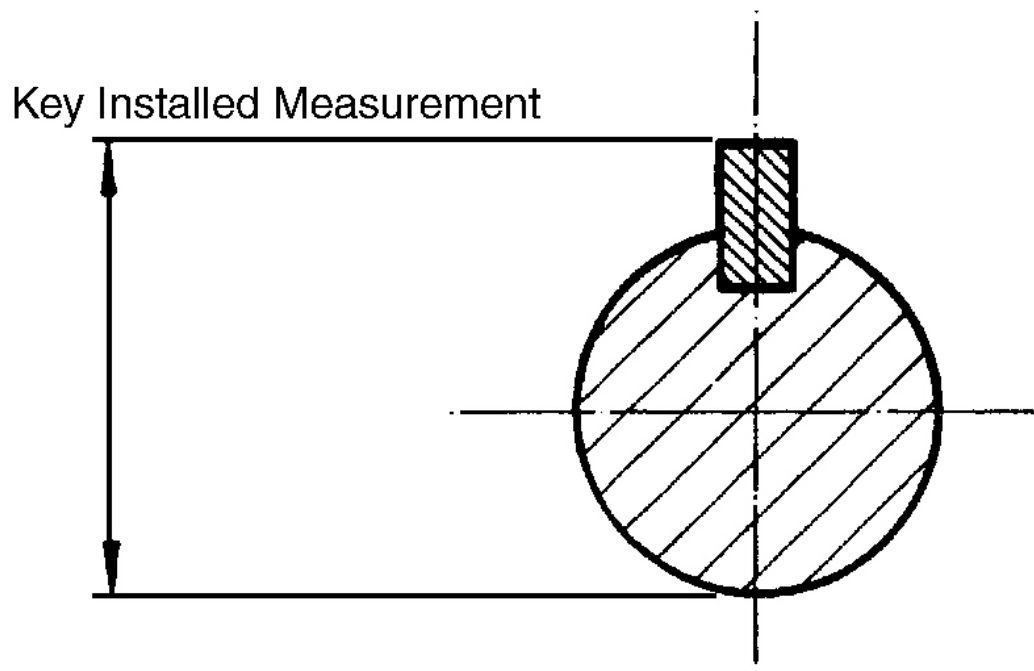
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Fig. 46: Removal & Installation Of Camshaft
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 47: Identifying Camshaft Timing Marks
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 48: Measuring Key Installed Height
Courtesy of LAND ROVER NORTH AMERICA, INC.

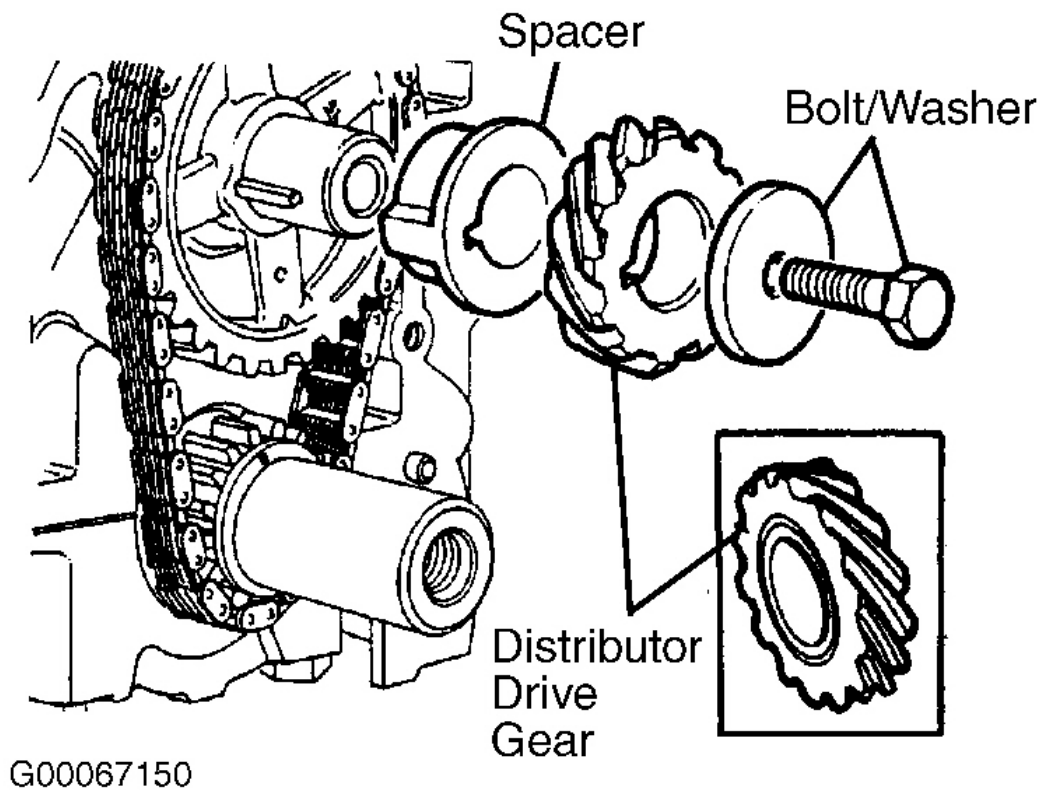


Fig. 49: Installing Distributor Drive Gear
Courtesy of LAND ROVER NORTH AMERICA, INC.

TIMING GEAR COVER & WATER PUMP

Removal

1. Place an oil drip-tray beneath timing gear cover and remove oil filter element.
2. Remove crankshaft pulley bolt and special washer and withdraw pulley.
3. Remove 2 bolts securing oil pan to bottom of timing gear cover. See **Fig. 50**.
4. Remove remaining timing gear cover retaining bolts and remove cover complete with oil pump. See **Fig. 51**.

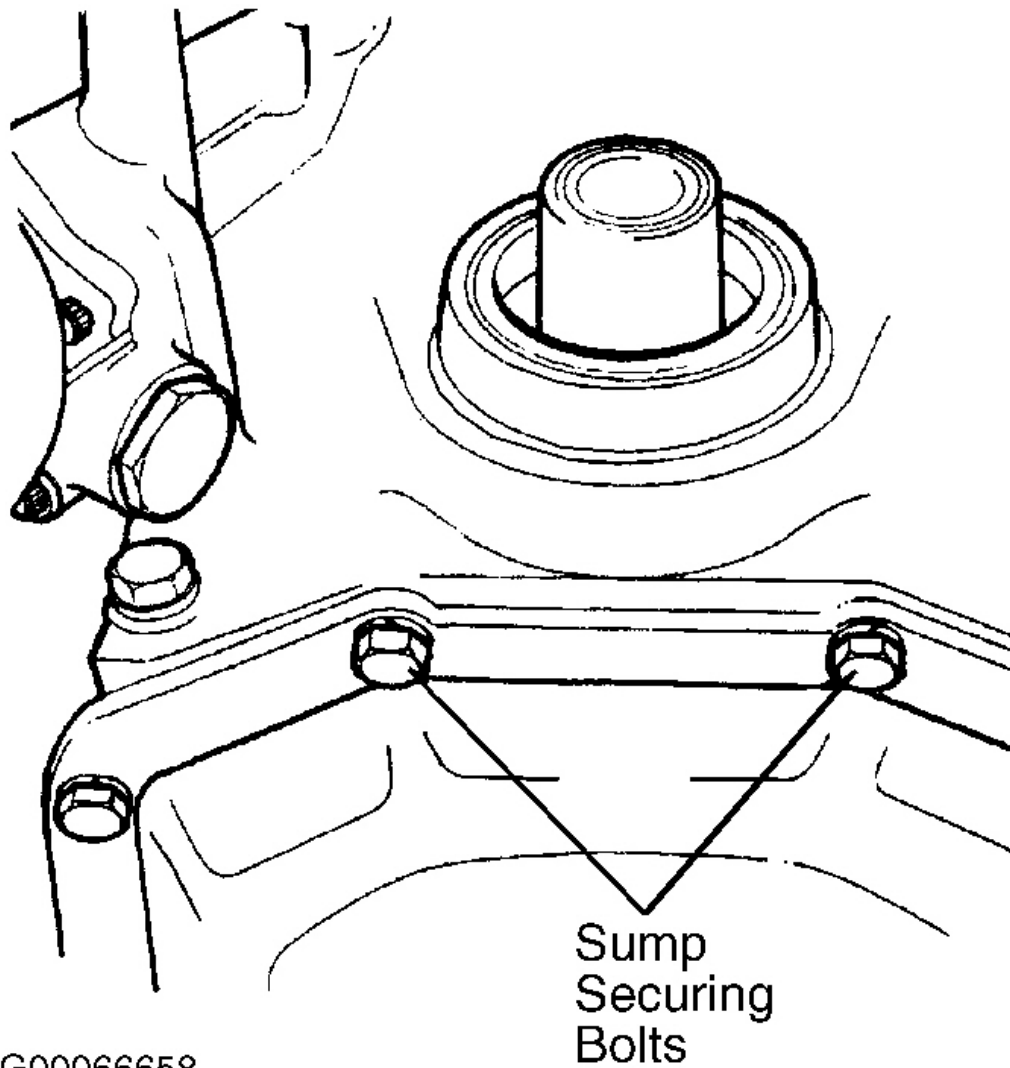
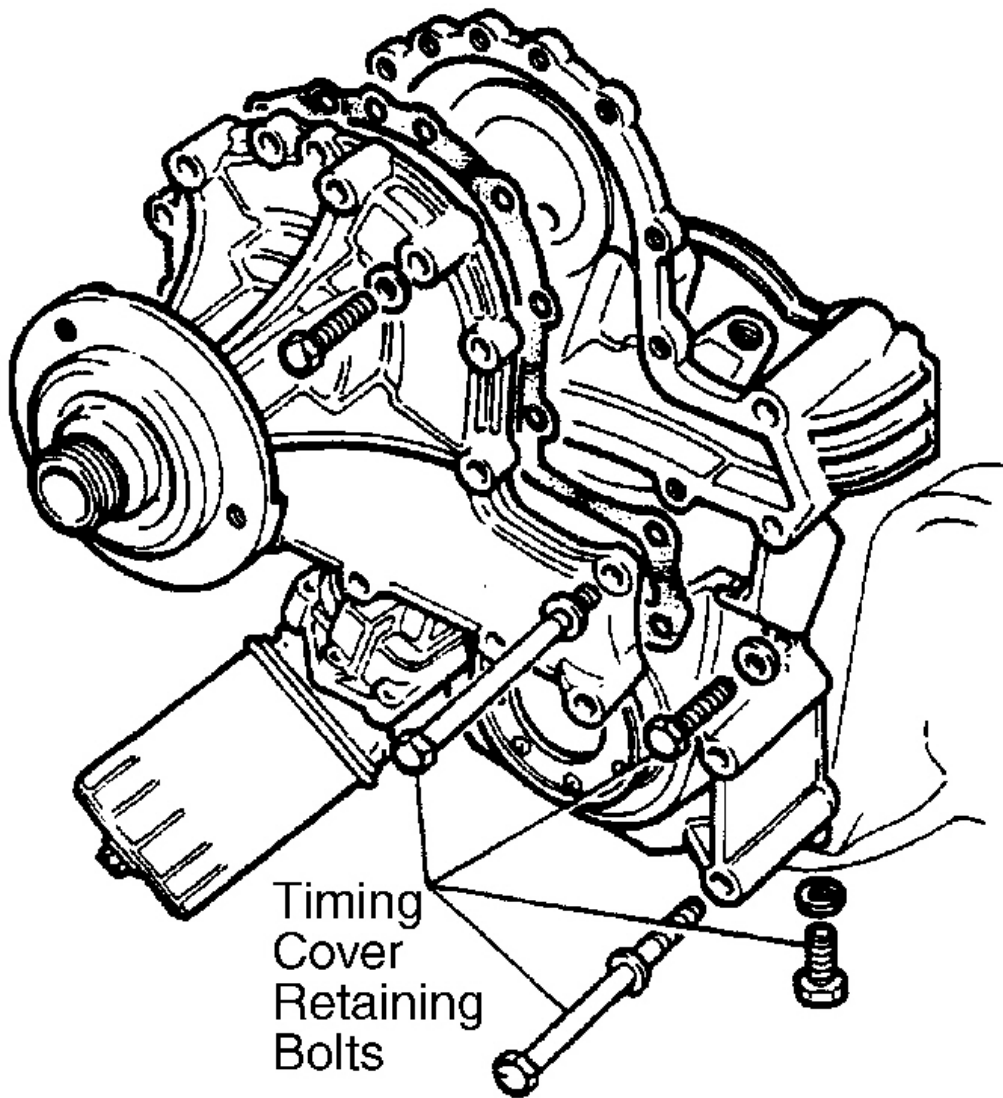


Fig. 50: Removing Timing Gear Cover & Water Pump (1 Of 2)
Courtesy of LAND ROVER NORTH AMERICA, INC.



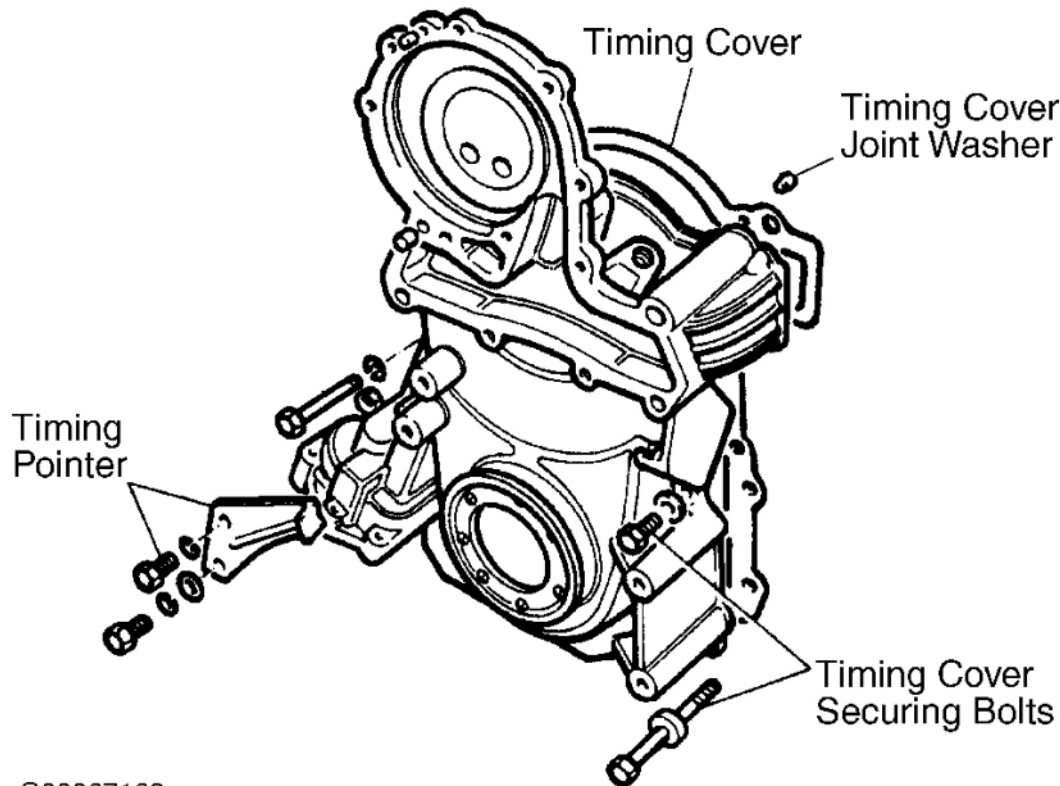
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Fig. 51: Removing Timing Gear Cover & Water Pump (2 Of 2)
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Place a new timing gear cover joint washer in position and fit timing gear cover locating it on 2 dowels. See **Fig. 52**.
2. Clean threads of timing gear cover securing bolts, then coat them with Loctite 572. See **Fig. 52**.
3. Fit and evenly tighten timing gear cover bolts to 21 ft lbs. (28 Nm).

4. Fit crankshaft pulley and tighten retaining bolt to 199 ft lbs. (270 Nm).
5. Fit timing pointer. See **Fig. 52**.



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Fig. 52: Fitting Timing Gear Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.

TIMING GEAR COVER OIL SEAL

Removal & Installation

1. Remove timing gear cover and water pump. See **TIMING GEAR COVER & WATER PUMP**.
2. Remove 7 drive screws, mud shield and oil seal. See **Fig. 53**.
3. To install, position gear cover with top of front face and bottom supported across oil seal housing bore on a suitable wooden block. See **Fig. 53**.
4. Enter oil seal, lip side leading, into housing bore. See **Fig. 53**.
5. Press in oil seal until plain face is approximately 0.059" (1.50 mm) below gear cover face. See **Fig. 53**.
6. Fit mud shield and secure with screws.
7. To complete installation, reverse removal procedure.

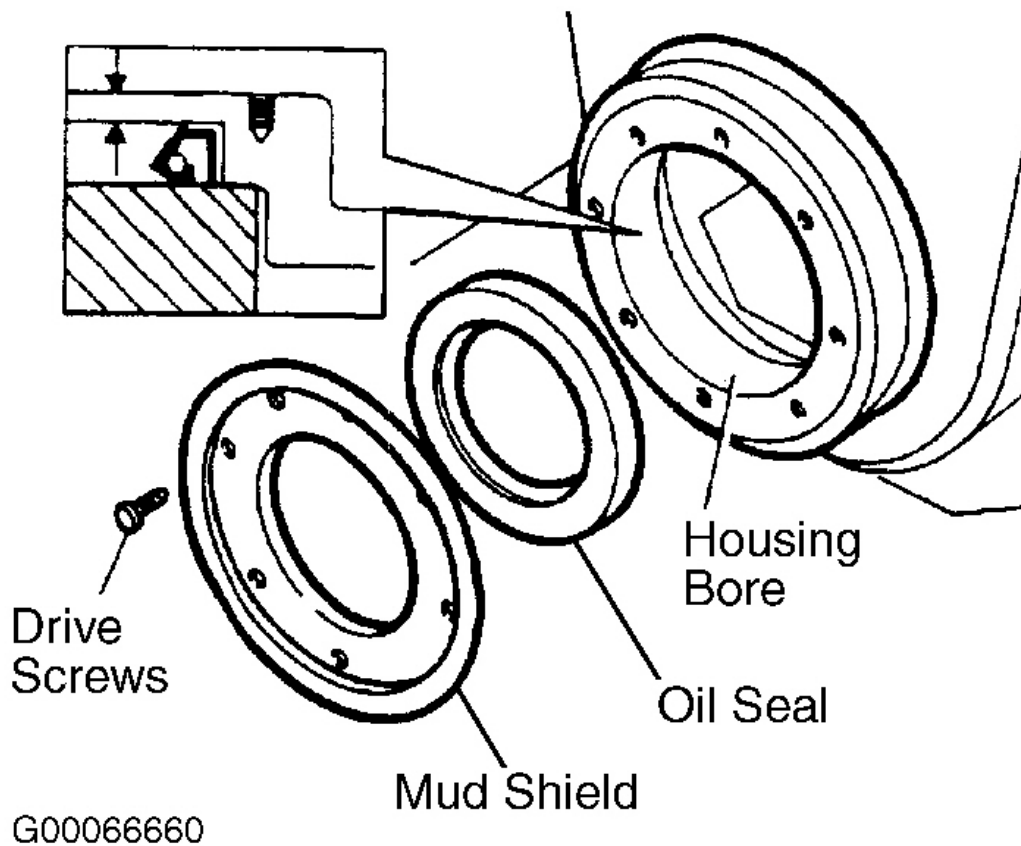


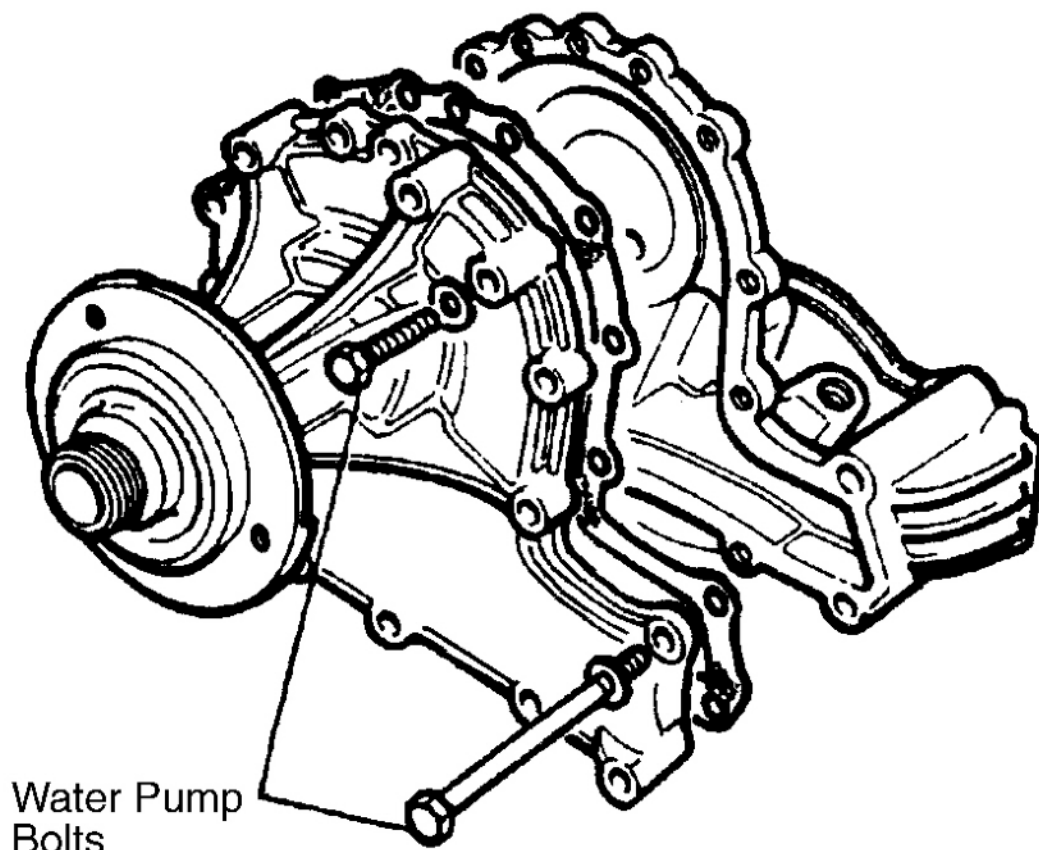
Fig. 53: Fitting New Timing Gear Cover Oil Seal
Courtesy of LAND ROVER NORTH AMERICA, INC.

WATER PUMP

Removal & Installation

NOTE: The water pump is not a serviceable item, in event of bearing failure or severe corrosion to pump impeller vanes, fit a NEW water pump assembly.

1. Remove 15 bolts and withdraw water pump and joint washer. See **Fig. 54**.
2. To install, lightly grease a NEW joint washer and place it in position on timing gear cover. See **Fig. 54**.
3. Clean threads of 4 long bolts and coat them with Loctite 572 thread lubricant sealant. Locate water pump in position. See **Fig. 54**.
4. Locate generator adjusting link on water pump.
5. Leave generator adjusting link loose and tighten remaining water pump housing bolts evenly and to 21 ft lbs. (28 Nm).



Water Pump
Bolts

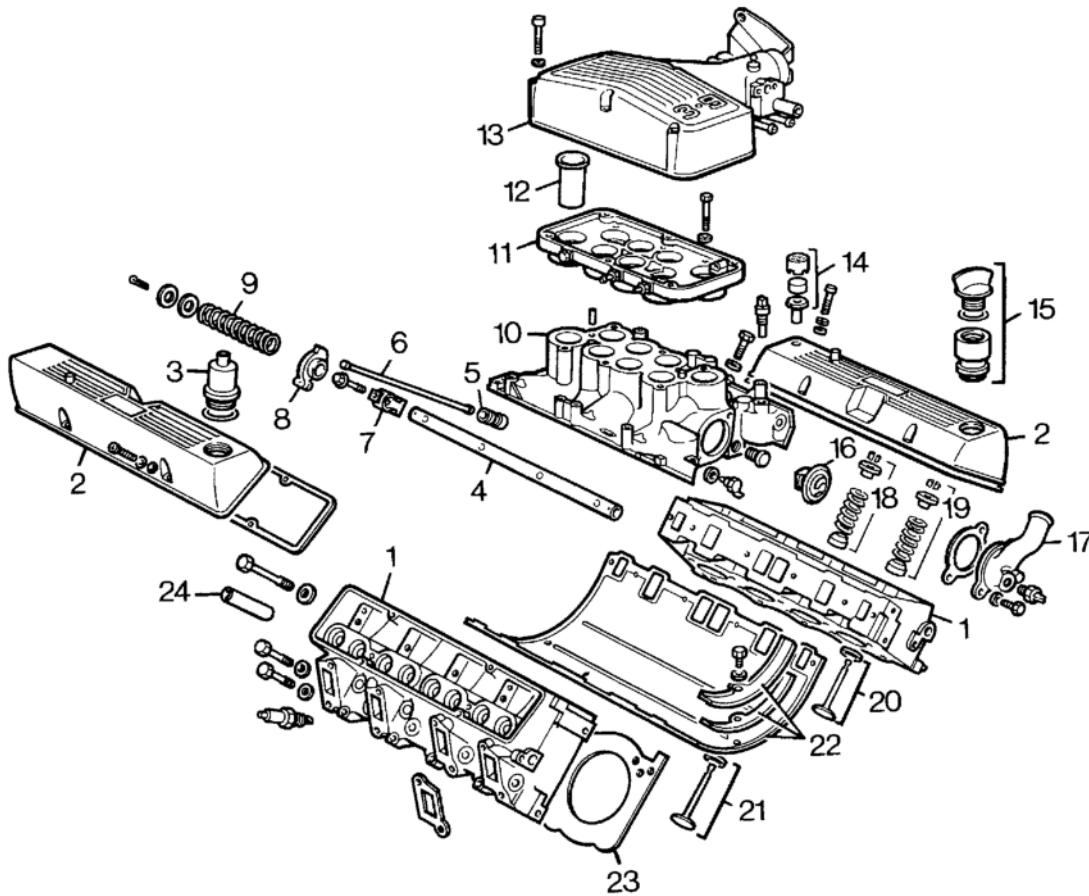
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Fig. 54: Removal & Installation Of Water Pump
Courtesy of LAND ROVER NORTH AMERICA, INC.

OVERHAUL

1995 Land Rover Defender 90

1993-95 ENGINES 3.9L & 4.2L V8



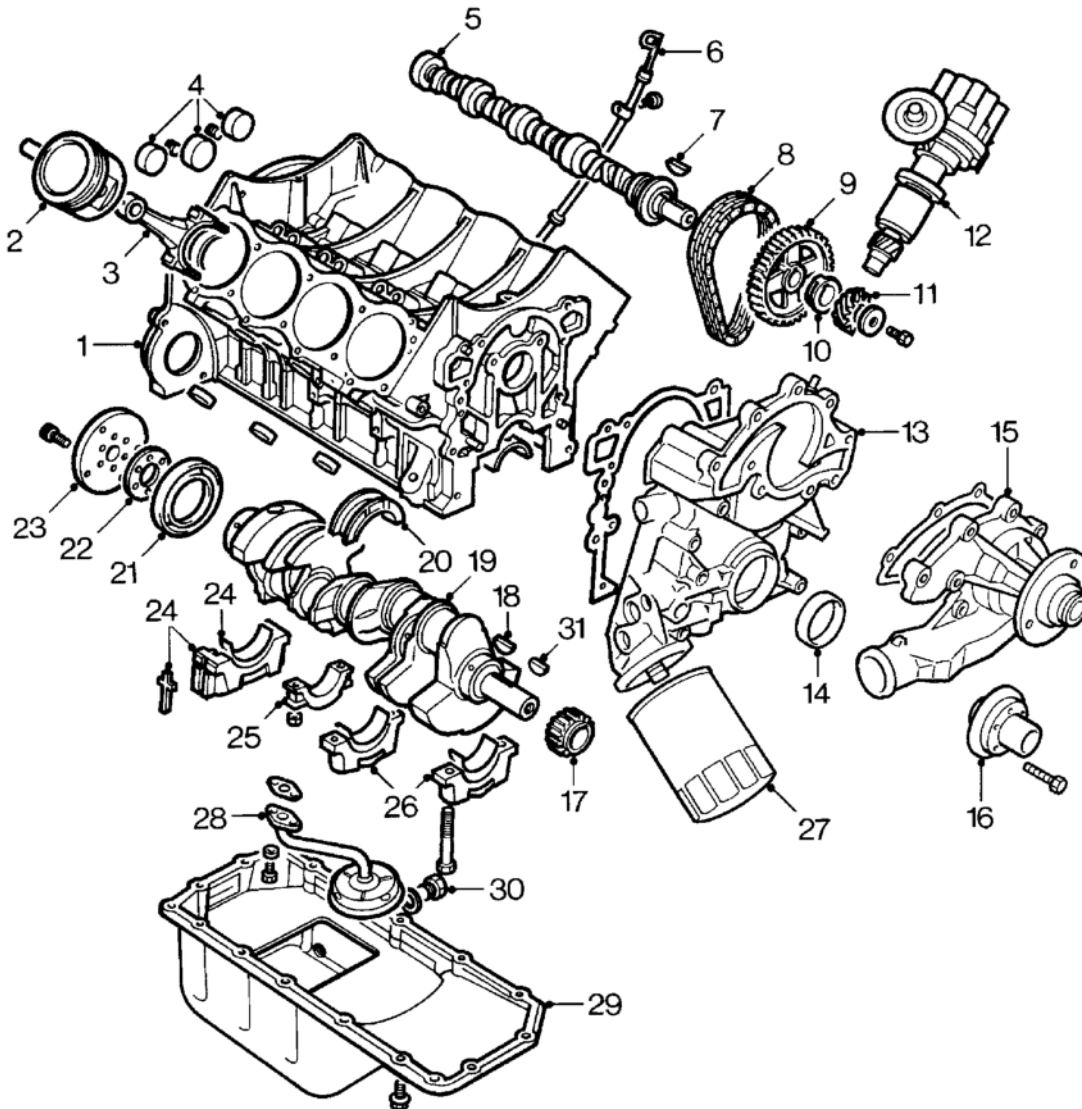
- | | |
|---------------------------------------|---|
| 1. Cylinder heads (2) | 13. Plenum chamber upper |
| 2. Rocker covers (2) | 14. PCV air intake filter |
| 3. PCV filter | 15. Oil filler |
| 4. Rocker shafts (2) | 16. Thermostat |
| 5. Hydraulic tappets (8) | 17. Thermostat cover |
| 6. Pushrods (8) | 18. Inlet valve seal, spring, cap and collets (8) |
| 7. Rocker brackets (8) | 19. Exhaust valve seal, spring, cap and collets (8) |
| 8. Rocker arms (4) left and (4) right | 20. Inlet valve and seat (8) |
| 9. Rocker shaft springs (6) | 21. Exhaust valve and seat (8) |
| 10. Inlet manifold | 22. Inlet manifold gasket and seals |
| 11. Plenum chamber lower | 23. Cylinder head gaskets (2) |
| 12. Ram pipes (8) | 24. Valve guides (16) |

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Fig. 55: Exploded View Of Engine (1 Of 2)
Courtesy of LAND ROVER NORTH AMERICA, INC.

1995 Land Rover Defender 90

1993-95 ENGINES 3.9L & 4.2L V8



- | | |
|---------------------------------|---|
| 1. Cylinder block | 17. Crankshaft sprocket |
| 2. Pistons and gudgeon pins (8) | 18. Crankshaft sprocket key |
| 3. Connecting rods (8) | 19. Crankshaft |
| 4. Core plugs | 20. Centre main bearing shells (2) |
| 5. Camshaft | 21. Crankshaft rear oil seal |
| 6. Dipstick | 22. Spacer |
| 7. Camshaft key | 23. Adaptor plate |
| 8. Timing chain | 24. Rear main bearing cap, shell and side seals |
| 9. Camshaft sprocket | 25. Connecting rod caps |
| 10. Distance piece | 26. Main bearing caps and shell bearings |
| 11. Distributor drive gear | 27. Oil filter |
| 12. Distributor | 28. Oil pump suction pipe/strainer |
| 13. Front cover | 29. Oil sump |
| 14. Front cover oil seal | 30. Oil sump drain plug |
| 15. Coolant pump | 31. Oil pump drive key |
| 16. Crankshaft damper / pulley | |

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Fig. 56: Exploded View Of Engine (2 Of 2)

Courtesy of LAND ROVER NORTH AMERICA, INC.

CYLINDER HEADS

CAUTION: Keep components in fitted order.

Cylinder Head

1. Remove cylinder heads and gaskets.
2. Ensure spark plugs are removed.
3. Using Valve Spring Compressor (LRT-12-034), remove valves, springs and umbrella seals, and retain them in sequence for refitting. See **Fig. 57**.
4. From left hand cylinder head, remove earth lead studs.
5. Remove 3 bolts securing power steering pump mounting bracket to cylinder head.
6. Remove 4 bolts securing generator mounting bracket to cylinder head.
7. Right hand cylinder head, remove rear lifting bracket.
8. Fit lifting bracket to new right hand cylinder head.
9. Fit mounting brackets and earth lead studs to new cylinder head. Tighten bolts to 22 ft lbs. (30 Nm).
10. Regrind valves. See **VALVES**.
11. Lubricate valve stems, fit valves, springs, and caps. Fit NEW inlet and exhaust valve stem seals.
12. Using Spring Compressor (LRT-12-034), compress springs, fit collets. Tap valve to check correct collet seating.
13. Fit spark plugs.
14. Fit cylinder heads with NEW gaskets.

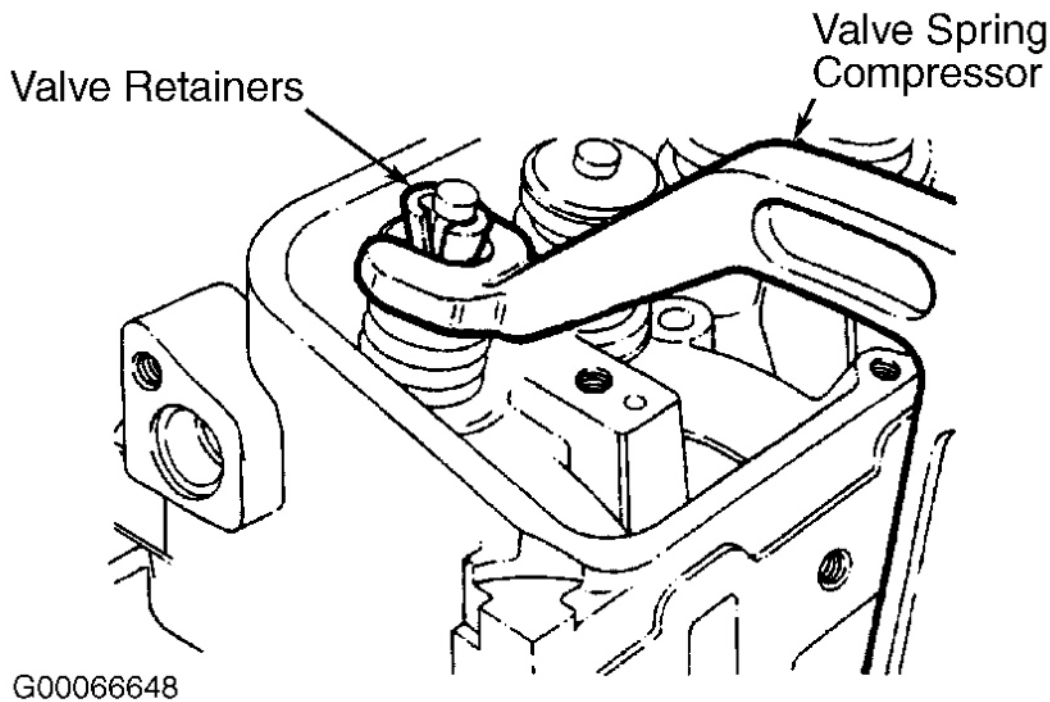


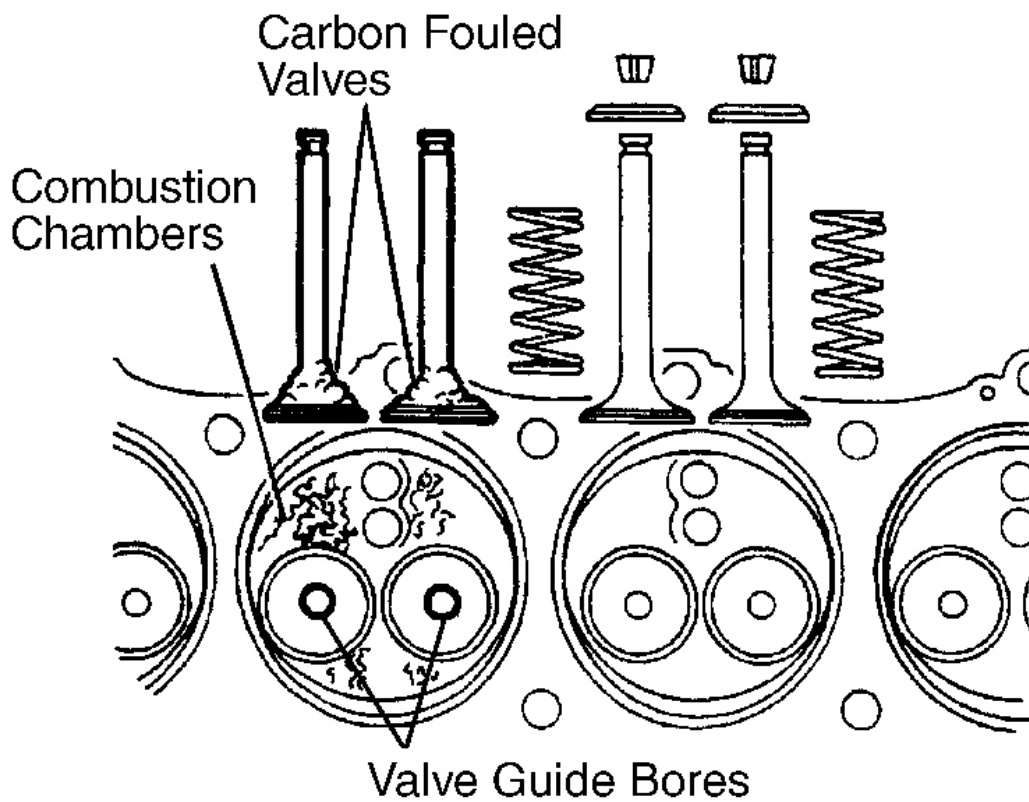
Fig. 57: Removing Valves

Courtesy of LAND ROVER NORTH AMERICA, INC.

Valves & Valve Seats

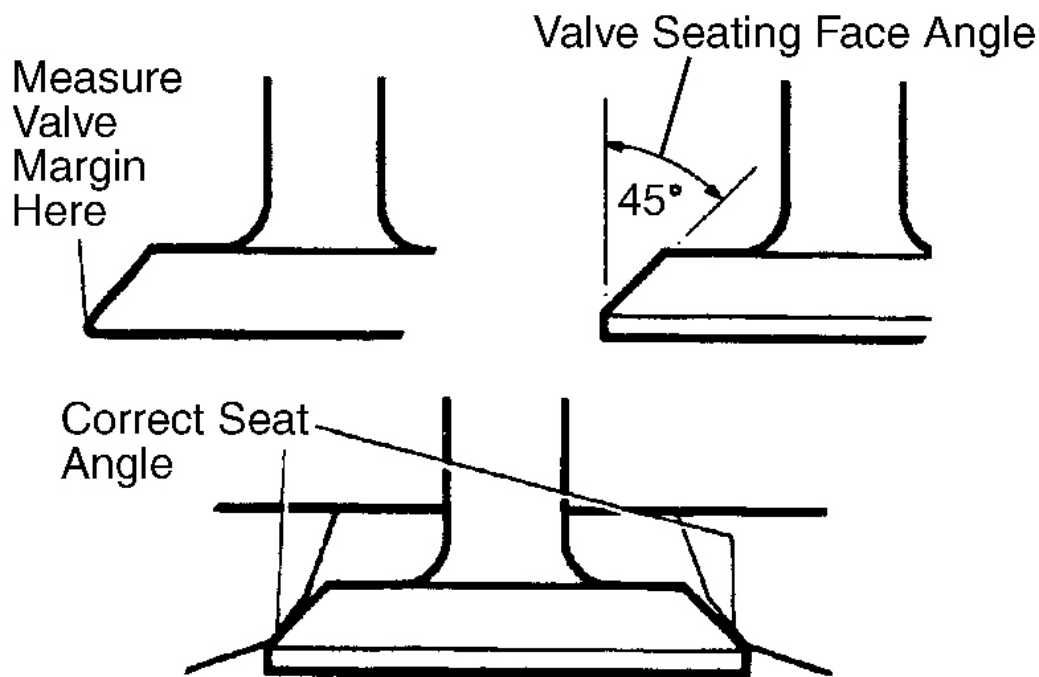
CAUTION: Renew worn valve guides and seat inserts before refacing valve seats.

1. Check condition of valve seats and valves that are to be reused.
2. Clean combustion chambers with a soft wire brush. See **Fig. 58**.
3. Clean carbon from valve seats. See **Fig. 58**.
4. Clean valve guide bores. See **Fig. 58**.
5. Regrind or fit NEW valves as necessary.
6. If a valve must be ground to a knife-edge to obtain a true seat, fit a NEW valve. See **Fig. 59**.
7. The correct angle for valve seating face is 45 degrees + 1/4. See **Fig. 59**.
8. The correct angle for seat is 46 degrees + 1/4 and seat witness should be towards outer edge. See **Fig. 59**.



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Fig. 58: Cleaning & Inspecting Valve Assemblies
Courtesy of LAND ROVER NORTH AMERICA, INC.



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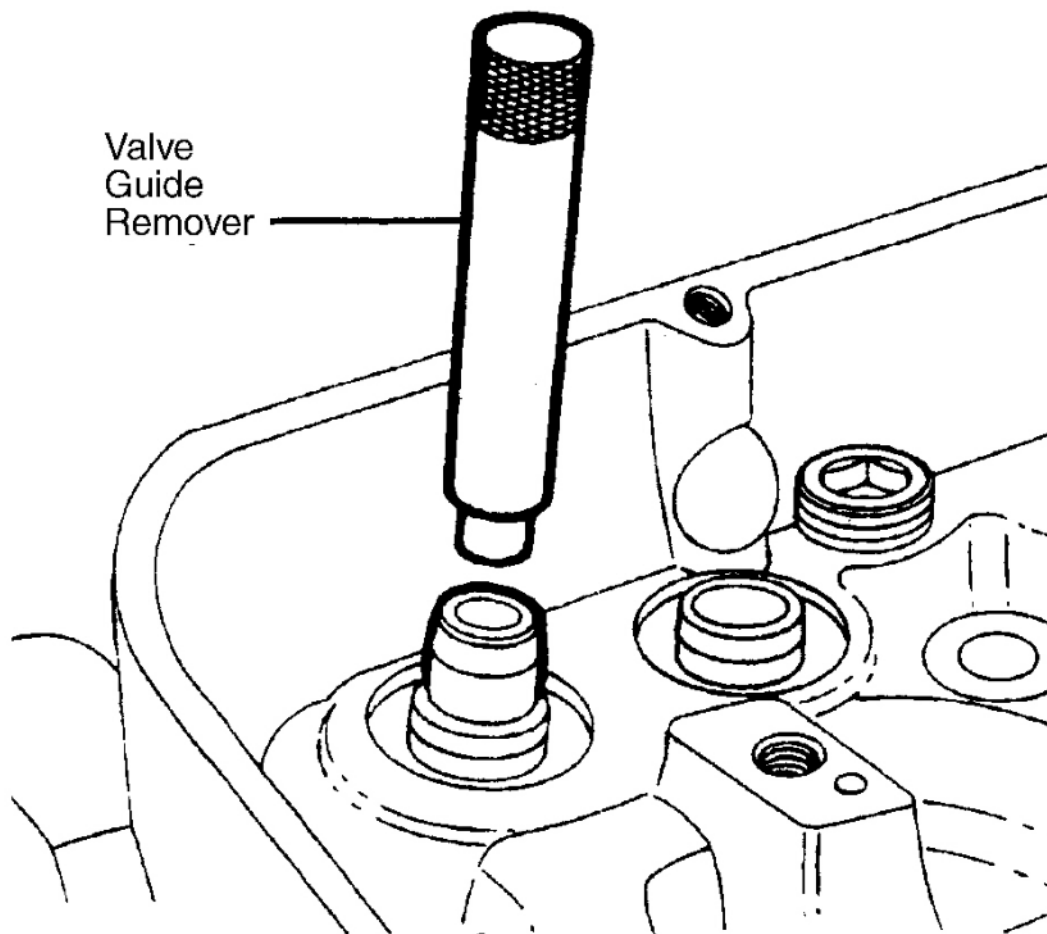
Fig. 59: Identifying Correct Valve Seat & Face Angles
 Courtesy of LAND ROVER NORTH AMERICA, INC.

Valve Guides

1. Check valve guides and fit replacements as necessary. Using Valve Guide Remover (274401), drive out old guides from valve spring seat face of cylinder head. See **Fig. 60**.

NOTE: Service valve guides are 0.0010" (0.025 mm) larger on outside diameter than original equipment to ensure interference fit.

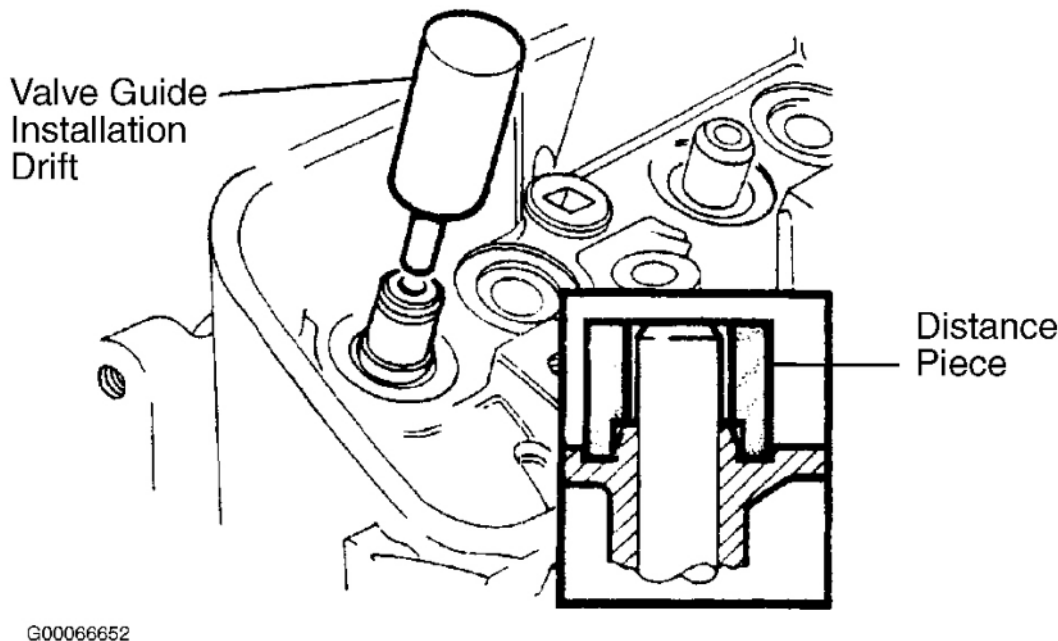
2. Lubricate NEW valve guide and place in position.
3. Using Guide Drift (RO600959) partially drive guide into cylinder head. See **Fig. 61**.
4. Remove Guide Drift (RO600959) and place Distance Piece (RO605774A) over valve guide, continue to drift guide into cylinder until drift contacts distance piece.
5. Alternatively drift guide into cylinder head until it protrudes 0.7" (19 mm) above valve spring recess in head.



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Fig. 60: Removing Valve Guides

Courtesy of LAND ROVER NORTH AMERICA, INC.



G00066652

Fig. 61: Fitting New Valve Guides

Courtesy of LAND ROVER NORTH AMERICA, INC.

Valve Seats

1. Check valve seats for wear, pits and burning and fit NEW inserts if necessary.
2. Remove old seat inserts by grinding them away until they are thin enough to be cracked and pried out. See **Fig. 62**.
3. Heat cylinder head evenly to approximately 65°C (150°F).
4. Press NEW insert into recess in cylinder head. See **Fig. 62**.

NOTE: Service valve seat inserts are available in 2 over-sizes 0.010 and 0.020" (0.25 and 0.50 mm) larger on outside diameter to ensure interference fit.

5. Using Service Tool (MS621) if necessary, cut valve seats to 46 degrees + 1/4.
6. The nominal seat width is 0.059" (1.50 mm). See **Fig. 62**. If seat exceeds 0.078" (2.00 mm) it should be reduced to specified width by use of 20 and 70 degree cutters. See **Fig. 63**.
7. The inlet valve seat diameter, "A" is 1.458" (37.03 mm) and exhaust valve seat is 1.240" (31.50 mm).
8. Ensure that cutter blades are correctly fitted to cutter head with angled end of blade downward facing work. Check that cutter blades are adjusted so that middle of blade contacts area of material to be cut. Use key provided in Hand Set (MS76). Use light pressure and remove only minimum material necessary.
9. Coat valve seat with a small quantity of Blueing, revolve a properly ground valve against seat. A

continuous fine line should appear around valve. If there is a gap of not more than 0.5" (12 mm) it can be corrected by lapping.

10. Alternatively, insert a strip of cellophane between valve and seat, hold valve down by stem and slowly pull out cellophane. If there is a drag, seal is satisfactory in that spot. Repeat this in at least 8 places. Lapping-in will correct a small open spot.

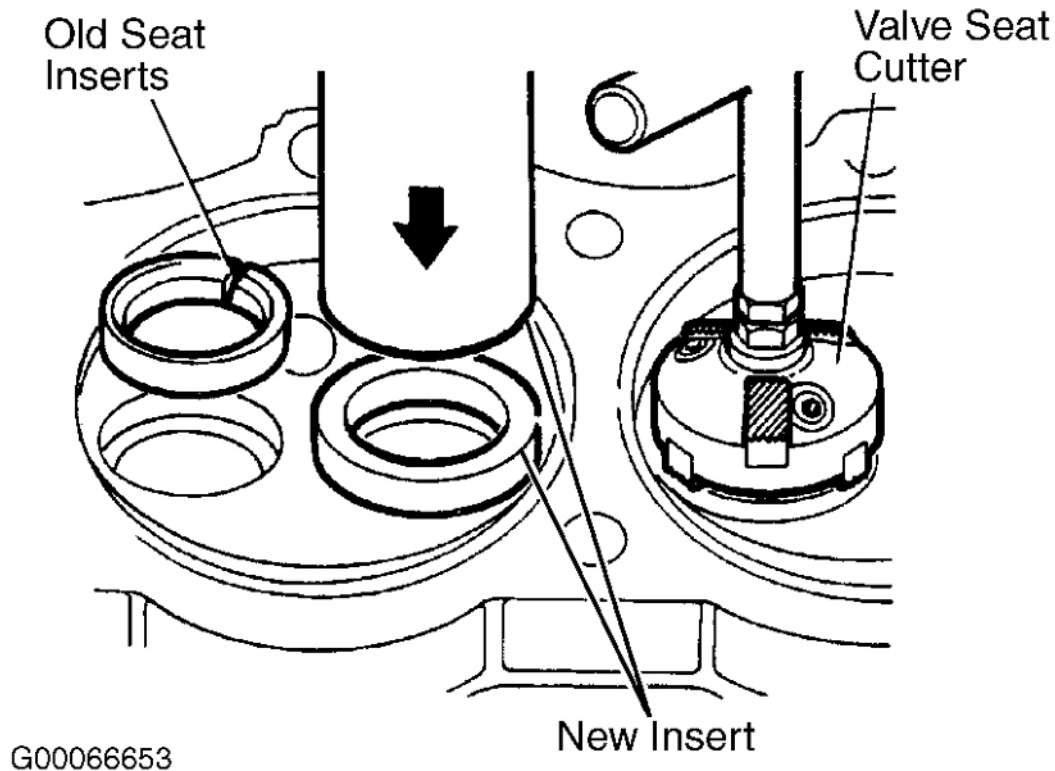
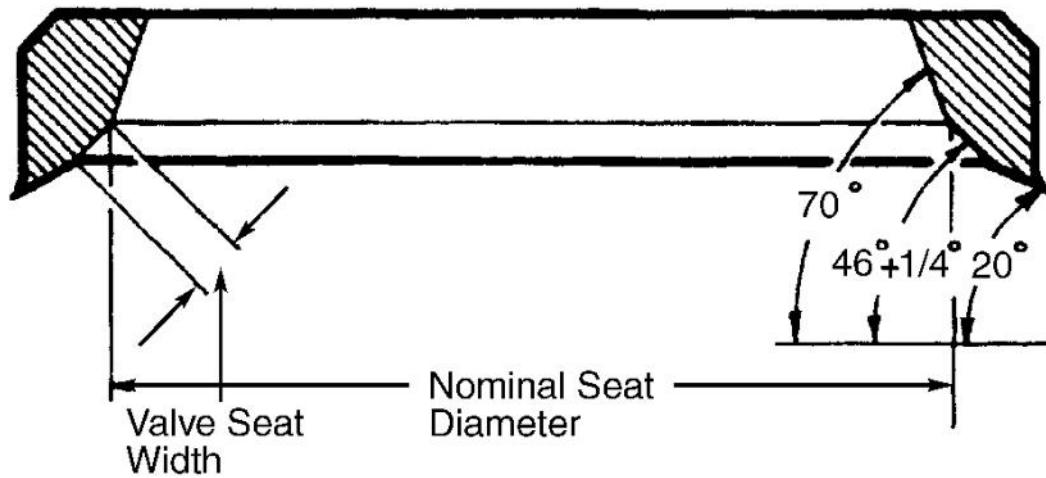


Fig. 62: Fitting New Valve Seats (1 Of 2)

Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 63: Fitting New Valve Seats (2 Of 2)
Courtesy of LAND ROVER NORTH AMERICA, INC.

Valves

1. Before fitting valves and springs, height of each valve above head must be checked. Insert each valve in its guide, and while holding head firmly against seat, measure height of stem above valve spring seat surface. This dimension must not exceed 1.875" (47.63 mm). If necessary fit a NEW valve or grind end of valve stem. See **Fig. 64**.
2. Lubricate valve stems and assemble valves, fit NEW umbrella seals and springs, fit caps, compress springs and caps using Spring Compressor (18G 106A) and secure springs in place. Note that umbrella seals are only fitted to inlet valves. See **Fig. 64**.

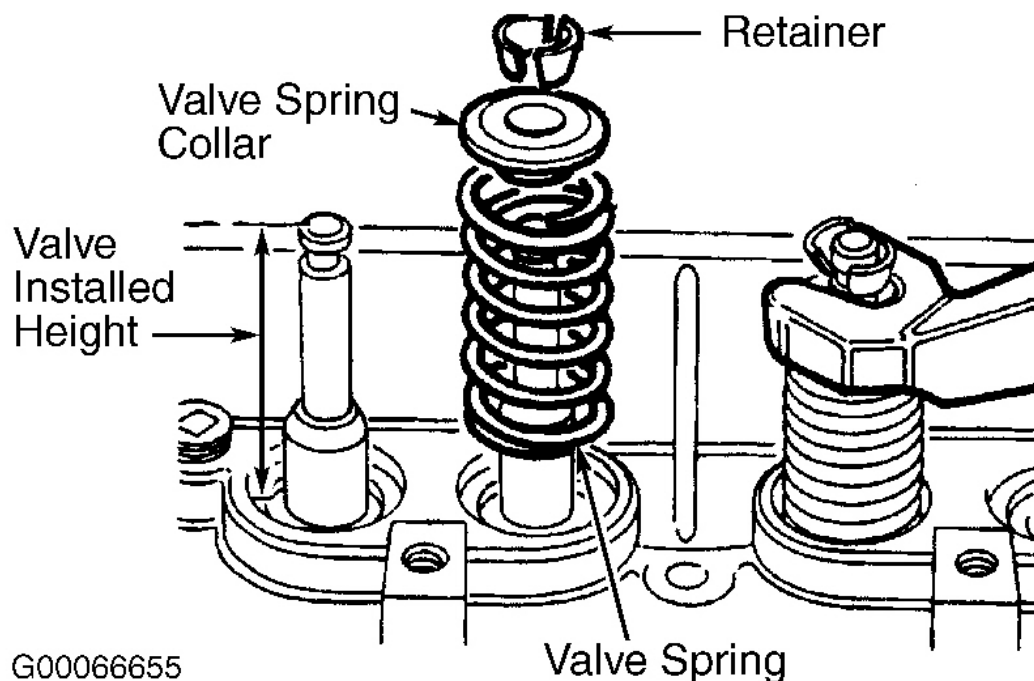
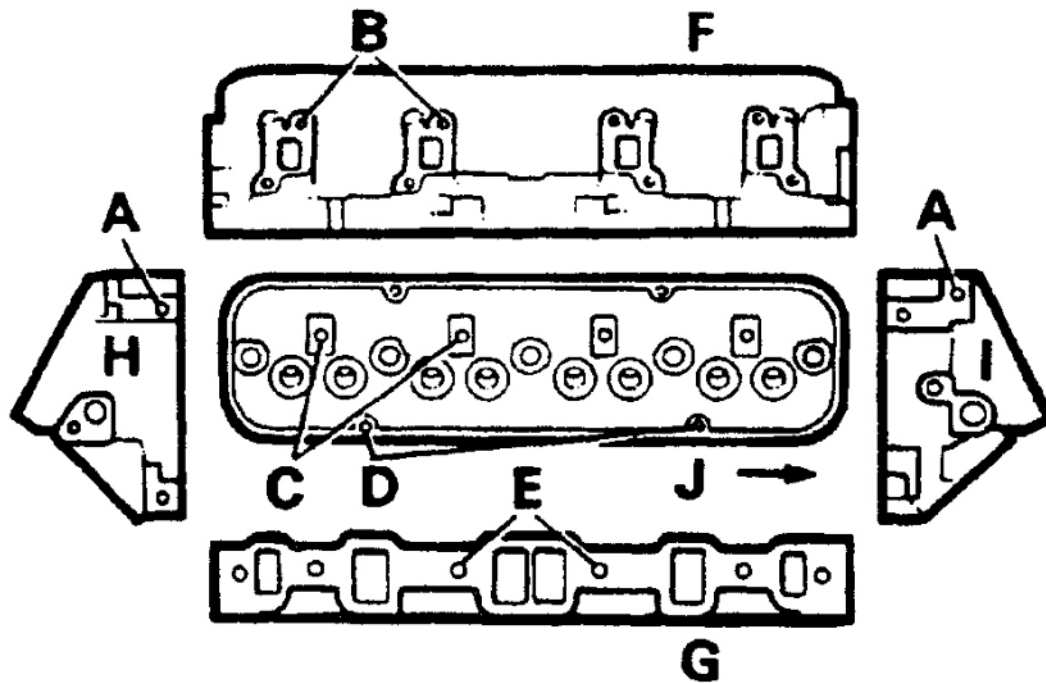


Fig. 64: Reassembling Valves To Cylinder Head
 Courtesy of LAND ROVER NORTH AMERICA, INC.

Repairing Cylinder Head Threads

Damaged or stripped threads in cylinder head can be salvaged by fitting Helicoils as follows. To identify holes, see **Fig. 65**:

- Holes A - These 3 holes may be drilled 0.03906" dia. x $0.0937 + 0.0040$ " deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.0875" (min) deep (3/8 UNC 1.5D insert). See **Fig. 65**.
- Holes B - These 8 holes may be drilled 0.03906" dia. x $0.0812 + 0.0040$ " deep. Tapped with Helicoil Tap No. 6 CBB 0.0749" (min) deep (3/8 UNC 1.5D insert). See **Fig. 65**.
- Holes C - These 4 holes may be drilled 0.03906" dia x $0.0937 + 0.0040$ " deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.0875" (min) deep (3/8 UNC 1.5D insert). See **Fig. 65**.
- Holes D - These 4 holes may be drilled 0.0261" dia x $0.0675 + 0.0040$ " deep. Tapped with Helicoil Tap No. 4 CPB or 4CS x 0.0625" (min) deep (1/4 UNC 1.5D insert). See **Fig. 65**.
- Holes E - These 6 holes may be drilled 0.03906" dia x $0.0937 + 0.0040$ " deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.0875" (min) deep (3/8 UNC 1.5D insert). See **Fig. 65**.



A - E. Thread Sizes (See Text)
 F. Exhaust Manifold Face
 G. Intake Manifold Face

H. Front Face
 I. Rear Face
 J. Front Of Engine

NOTE: Right-Hand Cylinder Head Illustrated.

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Fig. 65: Repairing Cylinder Head Threads

Courtesy of LAND ROVER NORTH AMERICA, INC.

CYLINDER BLOCK ASSEMBLY

Removing Piston & Rod Assembly

1. Withdraw retaining bolts and remove oil pan.
2. Remove oil pan strainer.
3. Remove connecting rod caps and retain them in sequence for reassembly.
4. Screw guide bolts (605351) onto connecting rods. See **Fig. 66**.
5. Push connecting rod and piston assembly up cylinder bore and withdraw it from top. See **Fig. 67**. Retain connecting rod and piston assemblies in sequence with their respective caps.
6. Remove guide bolts (605351) from connecting rod.

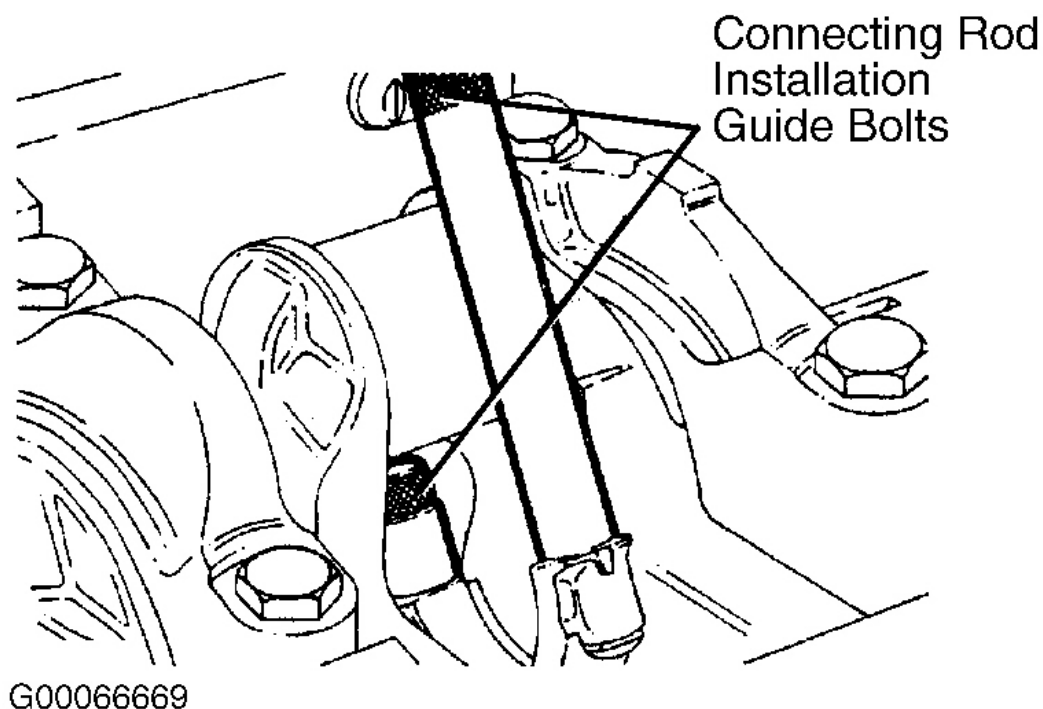


Fig. 66: Removing Connecting Rods & Pistons (1 Of 2)
Courtesy of LAND ROVER NORTH AMERICA, INC.

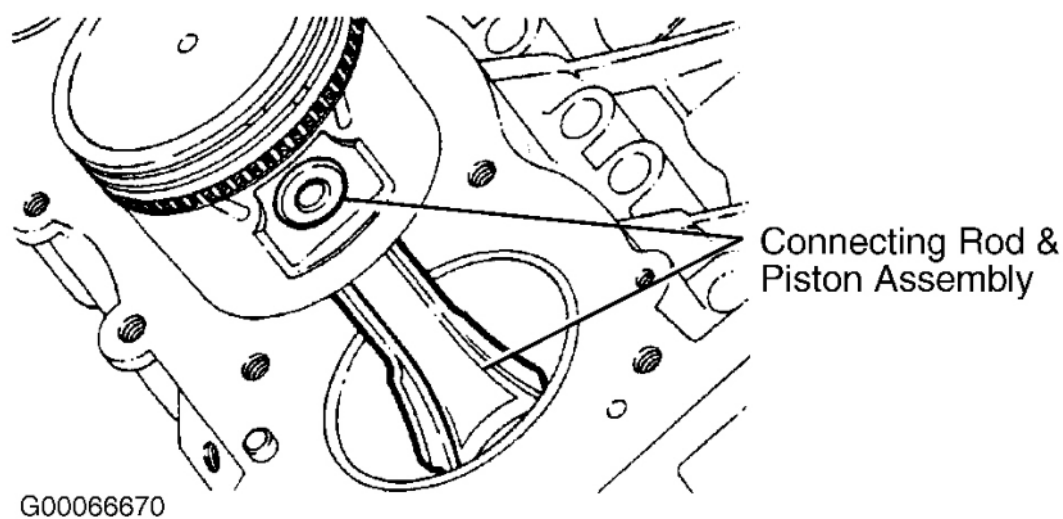


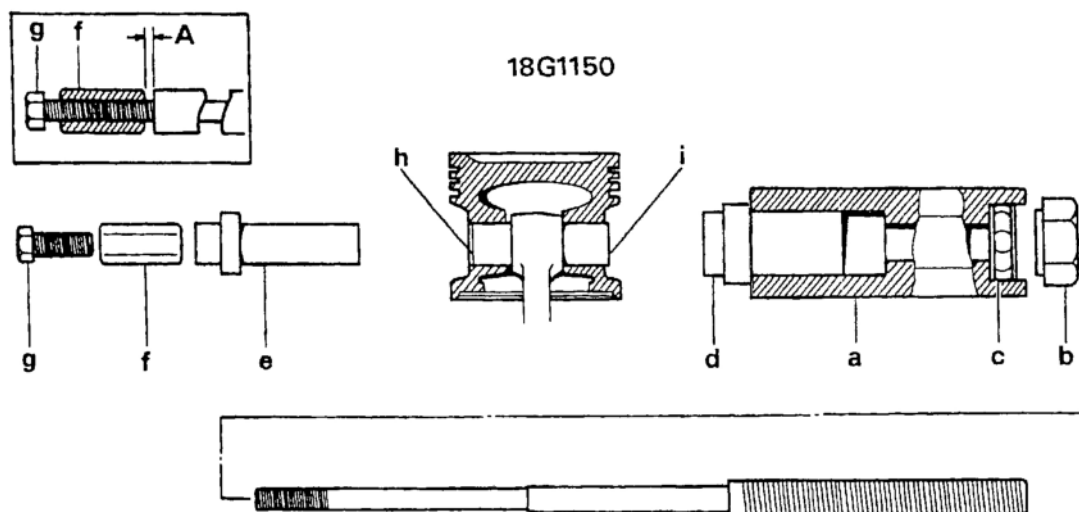
Fig. 67: Removing Connecting Rods & Pistons (2 Of 2)

Courtesy of LAND ROVER NORTH AMERICA, INC.

Disassembly Of Piston & Rod Assembly

NOTE: The connecting rods, caps and bearing shells must be retained in sets, and in correct sequence. Remove piston rings over crown of piston. If same piston is to be refitted, mark it relative to its connecting rod to ensure that original assembly is maintained.

1. Remove piston pin using Special Tool (18G 1150) in the following order:
 - a. Clamp hexagon body of Special Tool (18G 1150) in a vice. See **Fig. 68**.
 - b. Position large nut flush with end of center screw. See **Fig. 68**.
 - c. Push screw forward until nut contacts thrust race. See **Fig. 68**.
 - d. Locate Piston Adaptor (18G 1150E) with its long spigot inside bore of hexagon body. See **Fig. 68**.
 - e. Fit Remover/Replacer Bushing (18G 1150) on center screw with flanged end away from piston pin. See **Fig. 68**.
 - f. Screw stop-nut about half way onto smaller threaded end of center screw, leaving a gap "A" of 0.1" (3 mm) between this nut and the Remover/Replacer Bushing. See **Fig. 68**.
 - g. Lock stop-nut securely with lock screw. See **Fig. 68**.
 - h. Check that Remover/Replacer Bushing is correctly positioned in bore of piston. See **Fig. 68**.
 - i. Push connecting-rod to right to expose end of piston pin, which must be located in end of adaptor "D". See **Fig. 68**.
 - j. Screw large nut up to thrust race.
 - k. Hold lock screw and turn large nut until piston pin has been withdrawn from piston. Dismantle tool.
2. Check alignment of connecting rods.
3. Check connecting rod small ends, pistons pins must be press fit.



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Fig. 68: Removing Piston Pin

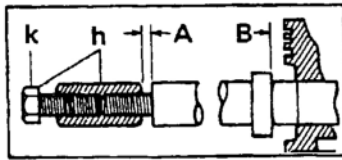
Courtesy of LAND ROVER NORTH AMERICA, INC.

Reassembly Of Piston & Rod Assembly

1. Using Special Tool (18G 1150) refit each piston to its connecting rod in following order:
 - a. Clamp the hexagon body of Special Tool (18G 1150) in a vice, with the Adaptor (18G 1150 E) positioned as in step d of DISASSEMBLY OF PISTON & ROD ASSEMBLY. See **Fig. 69**.
 - b. Remove the large nut of Special Tool (18G 1150) and push the center screw approximately 2" (50 mm) into the body until the shoulder is exposed.
 - c. Slide the parallel guide sleeve, grooved end last, onto the center screw and up to the shoulder. See **Fig. 69**.
 - d. Lubricate the piston pin and bores of the connecting rod and piston with oil containing graphite (Molykore 2). Also lubricate the ball race and center screw of Special Tool (18G 1150).
 - e. Fit the connecting rod and the piston together onto the tool with the markings aligned if the original pair are being used and with the connecting rod around the sleeve up to the groove. See **Fig. 69**.
 - f. Fit the piston pin into the piston bore, up to the connecting rod. See **Fig. 69**.
 - g. Fit the Remover/Replacer Bushing (18G 115013) with its flanged end towards the piston pin. See **Fig. 69**.
 - h. Screw the stop nut onto the center screw and adjust this nut to obtain an 0.031" (0.80 mm) end float "A" on the whole assembly, and lock the nut securely with the screw. See **Fig. 69**.
 - i. Slide the assembly back into the hexagon body and screw on the large nut up to the thrust race.
 - j. Set the Torque Wrench (18G 537) to 12 ft lbs. (16 Nm). This represents the minimum load for an acceptable interference fit of the piston pin in the connecting rod. See **Fig. 69**.
 - k. Using the torque wrench and Socket (18G 587) on the large nut, and holding the lock screw, pull the piston pin in until the flange of the remover/replacer bush is 0.157" (4.00 mm) "B" from the face of the piston. Under no circumstances must this flange be allowed to contact the piston. See **Fig. 69**.

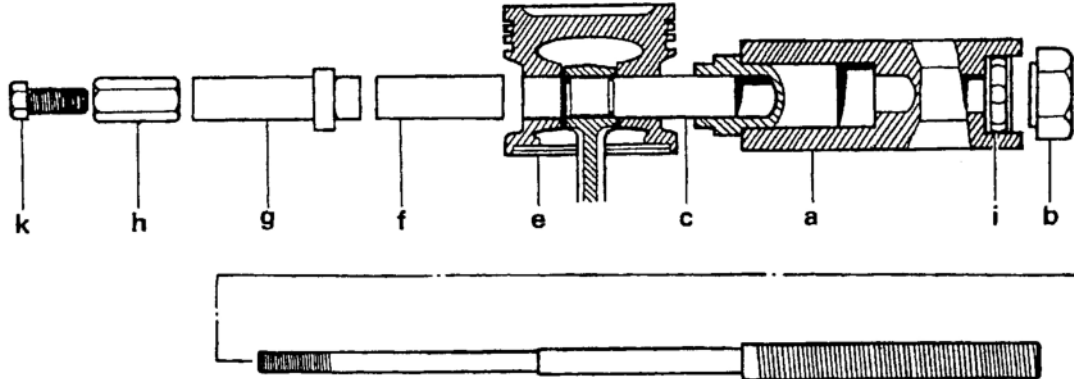
CAUTION: If torque wrench has not reached at least 12 ft lbs. (16 Nm) throughout pull, fit of piston pin to connecting rod is not acceptable and necessitates fitting NEW components. The large nut and center screw of tool must be kept well oiled.

2. Remove tool and check that piston moves freely on piston pin and that no damage has occurred during pressing.



CAUTION: If the torque wrench has not reached at least 12 ft.lbs throughout the pull, the fit of the piston pin to the connecting rod is not acceptable and necessitates the fitting of new components. The large nut and centre screw of the tool must be kept well oiled.

18G.1150



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Fig. 69: Installing Piston Pin

Courtesy of LAND ROVER NORTH AMERICA, INC.

Fitting Piston

1. If replacing the original pistons, remove carbon deposits, particularly from ring grooves. Examine pistons for signs of damage or excessive wear. Go to next step for method of checking running clearance. Fit NEW pistons if necessary.

NOTE: Pistons are available in service standard size and in oversizes of 0.010" (0.25 mm) and 0.020" (0.50 mm). Service standard size pistons are supplied 0.00100" (0.0254 mm) oversize. When fitting NEW service standard size pistons to a cylinder block, check for correct piston to bore clearance, honing bore if necessary. Bottom of piston skirt/bore clearance should be 0.0007-.0013" (0.018-.033 mm).

NOTE: The temperature of piston and cylinder block must be same to ensure accurate measurement. When reboring cylinder block, crankshaft main bearing caps must be fitted and tightened to 52 ft lbs. (70 Nm).

2. If installing NEW pistons, check cylinder bore dimension at right angles to piston pin 1.5-2.0" (40-50 mm) from top. See **Fig. 70**.
3. Check piston dimension at right angles to piston pin. On 3.9L check piston dimension 2.4" (62 mm) from top of piston, and on 4.2L engine check piston dimension 2.3" (58 mm) from top of piston. See **Fig. 71**.
4. The piston dimension must be 0.0007-0.0013" (0.018-0.033 mm) smaller than cylinder.
5. If new piston rings are to be fitted without reboring, deglaze cylinder walls with a hone, without increasing bore diameter, to provide a cross-hatch finish. After honing, thoroughly clean piston bores to

remove all traces of foreign matter.

NOTE: Gapping does not apply to oil control rings.

6. Check compression ring in applicable cylinder, held square to bore with piston. Gap limits are 0.017-0.022" (0.44-0.56 mm). Use a fine-cut flat file to increase gap if required. Select a new piston ring if gap exceeds limit. See **Fig. 72**.
7. Temporarily fit compression rings to piston.
8. The ring marked TOP must be fitted with marking on top and into second groove. The chrome ring is for top groove and can be fitted either way round.
9. Check compression ring clearance in piston groove. Clearance limits are 0.002-0.004" (0.05-0.10 mm). See **Fig. 73**.

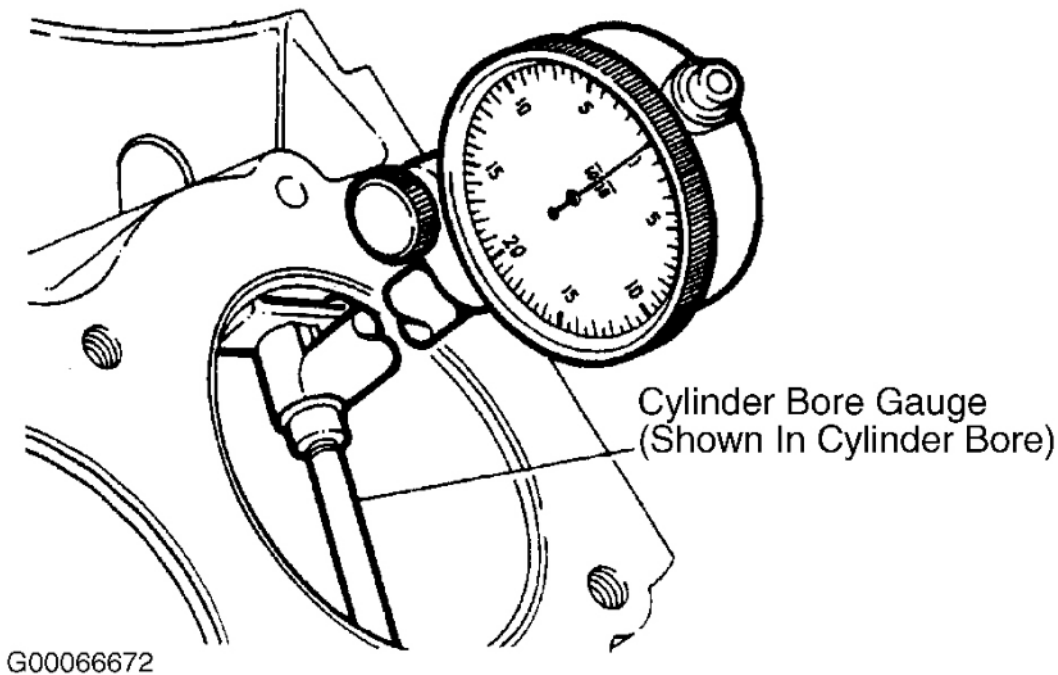
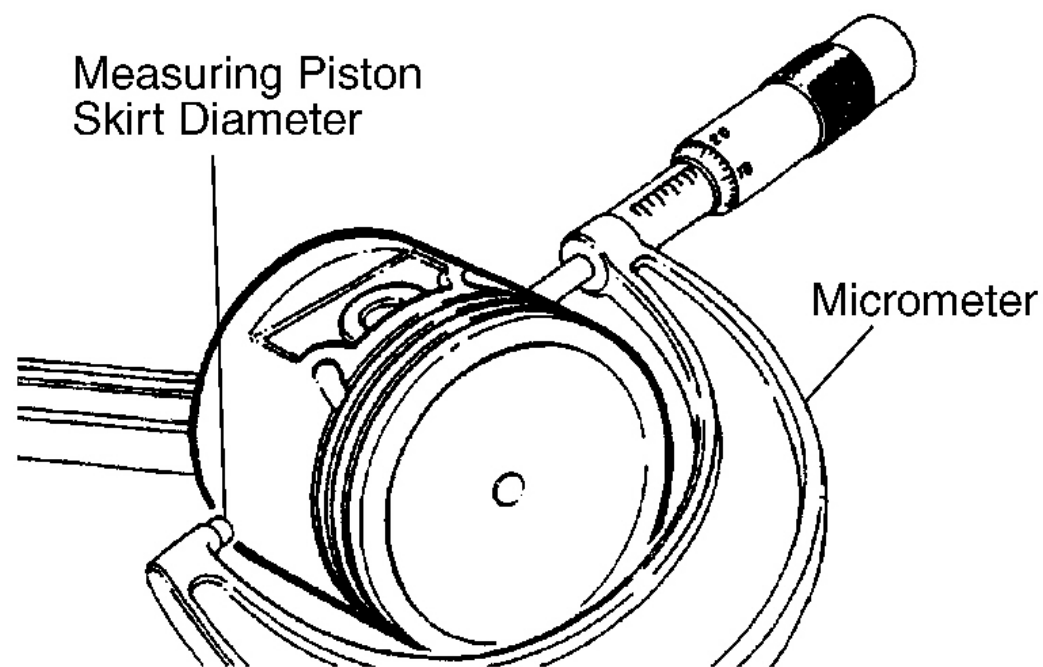


Fig. 70: Measuring Cylinder Diameter
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 71: Measuring Piston Diameter

Courtesy of LAND ROVER NORTH AMERICA, INC.

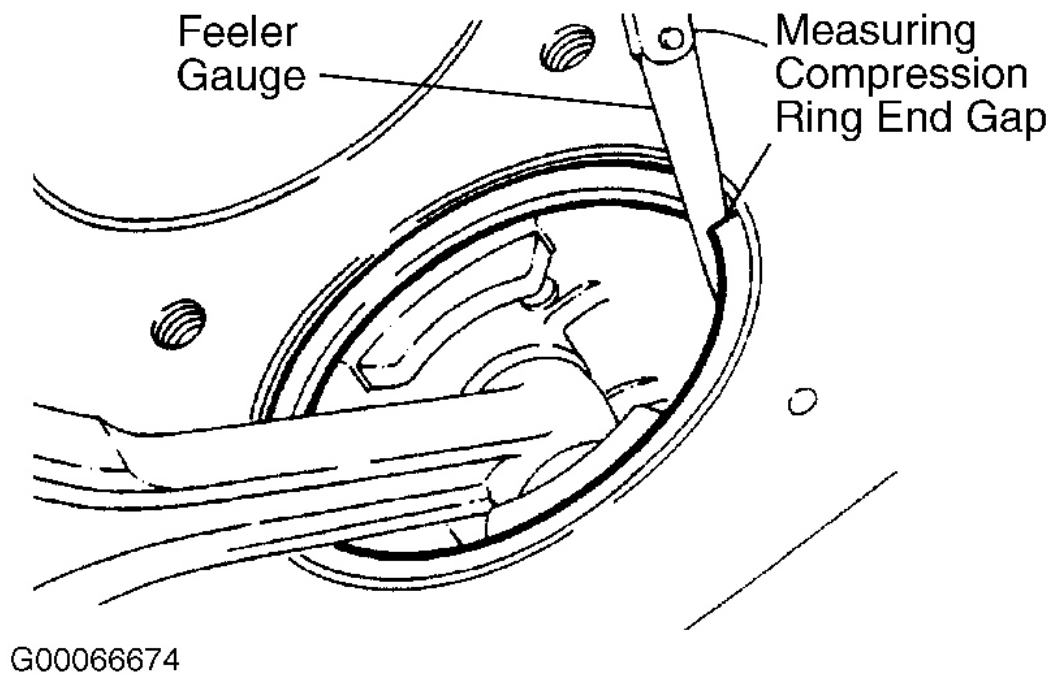
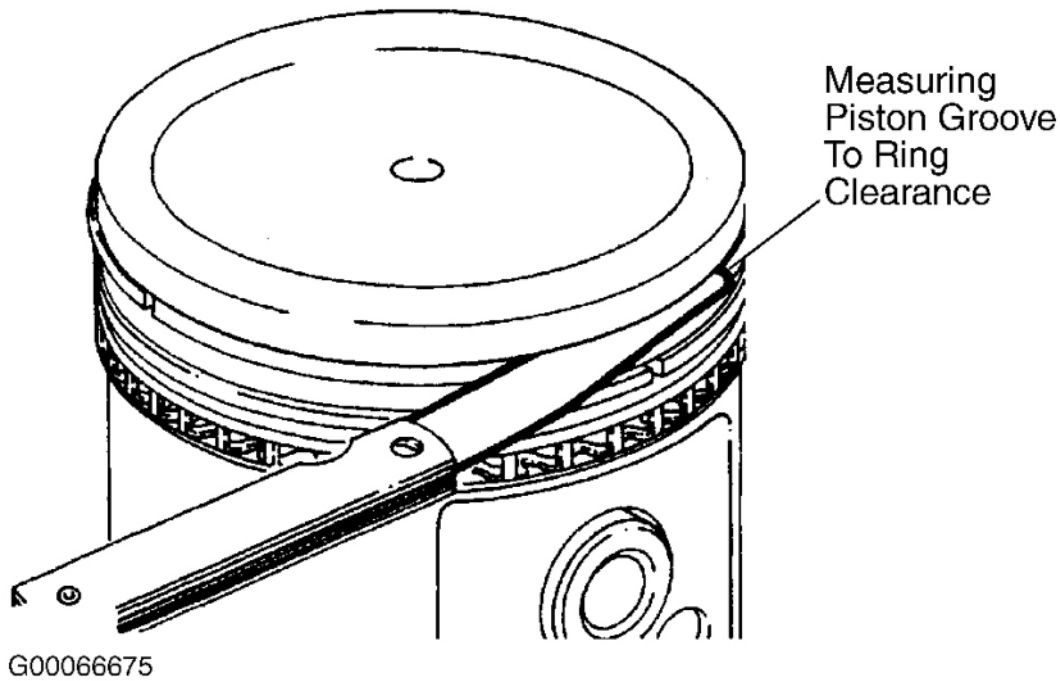


Fig. 72: Measuring Piston Ring Gap

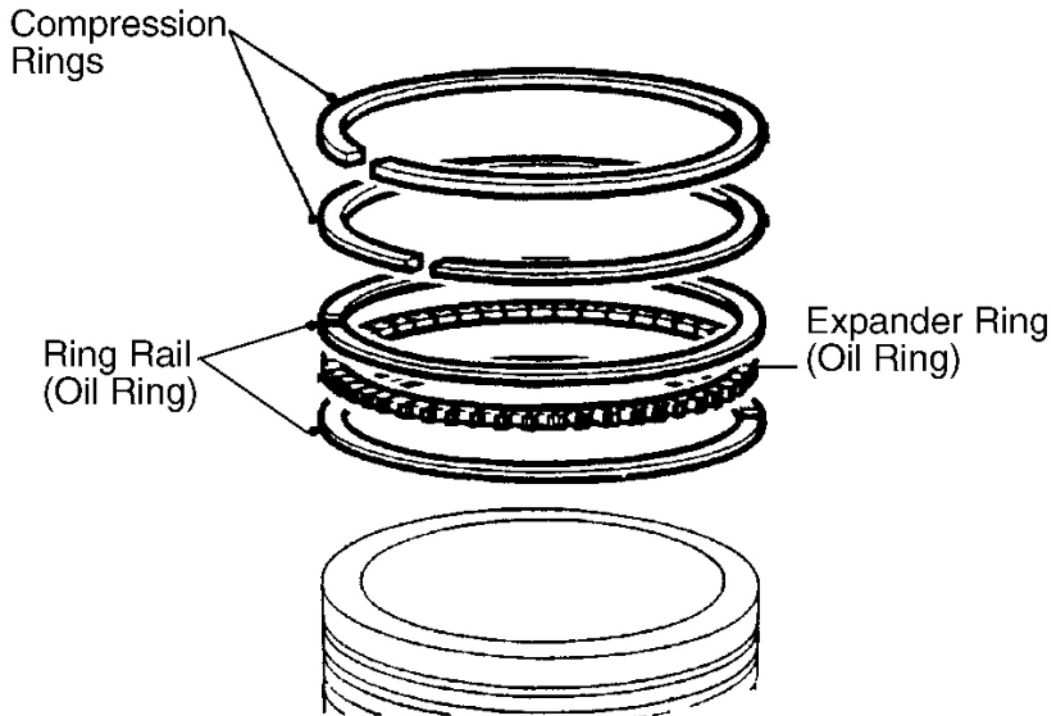
Courtesy of LAND ROVER NORTH AMERICA, INC.

**Fig. 73: Measuring Ring Clearance**

Courtesy of LAND ROVER NORTH AMERICA, INC.

Piston Rings

1. Fit expander ring into bottom groove making sure that ends butt and do not overlap. See **Fig. 74**.
2. Fit 2 ring rails to bottom groove, one above and one below expander ring. See **Fig. 74**.
3. Fit second compression ring with marking TOP uppermost. See **Fig. 74**. Fit chrome ring into top groove, either way round.



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Fig. 74: Identifying Piston Ring Position

Courtesy of LAND ROVER NORTH AMERICA, INC.

Rod Bearings

1. Locate bearing upper shell into connecting rod. See [Fig. 75](#).
2. Locate connecting rod and bearing onto applicable crankshaft journal, noting that domed shape boss on connecting rod must face towards front of engine on right-hand bank of cylinders and towards rear on left-hand bank. See [Fig. 75](#).
3. When both connecting rods are fitted, bosses will face inwards towards each other.
4. Place a piece of Plastigauge (P61) across center of lower half of crankshaft journal. See [Fig. 76](#).
5. Fit bearing lower shell into connecting rod cap.

NOTE: Rib on edge of cap must be on same side as domed shape boss on connecting rod. See [Fig. 75](#).

6. Fit cap and shell onto connecting rod.
7. Secure connecting rod cap. See [Fig. 75](#). Tighten to 37 ft lbs. (50 Nm).
8. DO NOT rotate crankshaft or connecting rod while Plastigauge is in use.
9. Remove connecting rod cap and shell.

10. Using scale printed on Plastigauge packet, measure flattened Plastigauge at its widest point. See **Fig. 76**.
11. The graduation that most closely corresponds to width of Plastigauge indicates bearing clearance.
12. The correct bearing clearance with new or overhauled components is 0.0006-0.0022" (0.015-0.055 mm).
13. If a bearing has been in service, it is advisable to fit a NEW bearing if clearance exceeds 0.003" (0.08 mm).
14. If a NEW bearing is being fitted, use selective assembly to obtain correct clearance.

NOTE: It is important that connecting rods, caps and bearing shells be retained in sets, and in correct sequence.

15. Wipe off Plastigauge with an oily rag. DO NOT scrape it off.

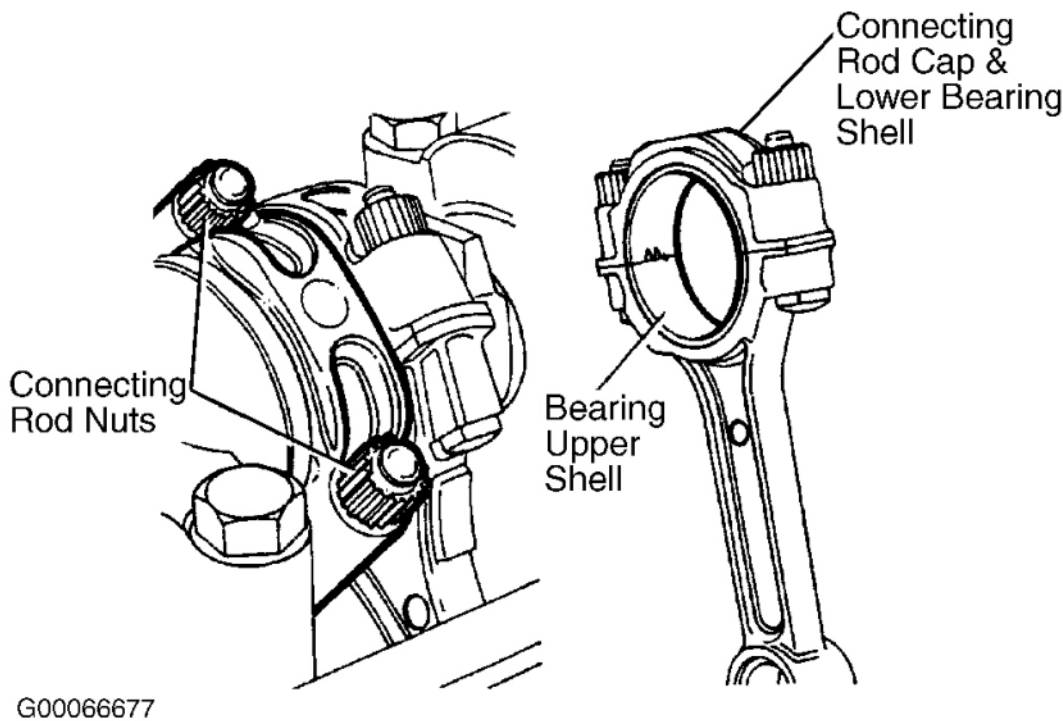
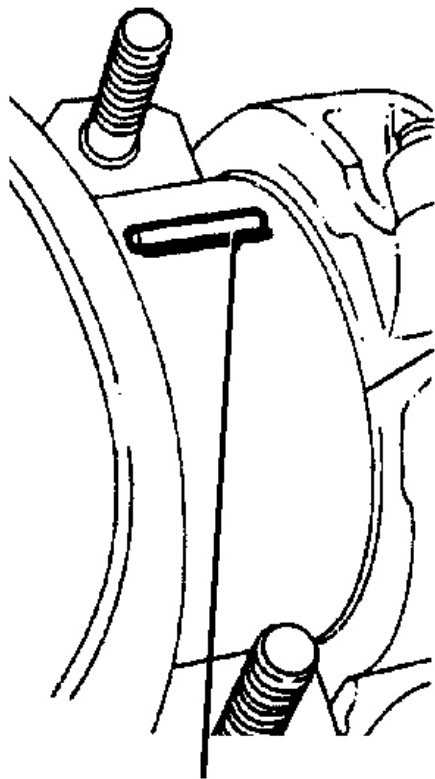


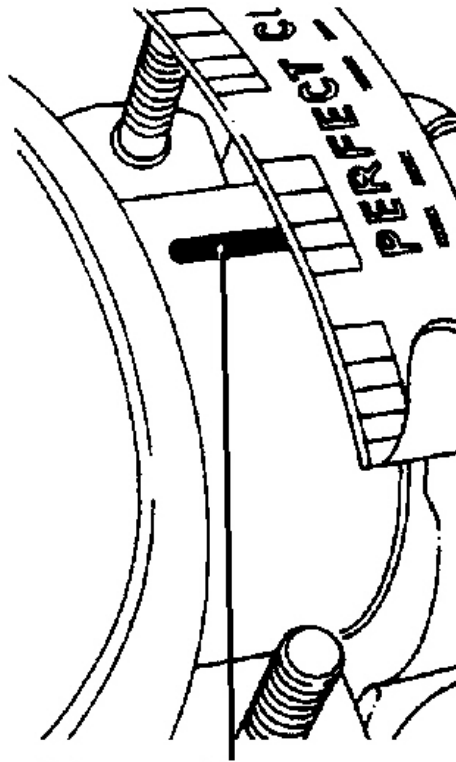
Fig. 75: Checking Rod Bearings (1 Of 2)

Courtesy of LAND ROVER NORTH AMERICA, INC.



Plastigauge

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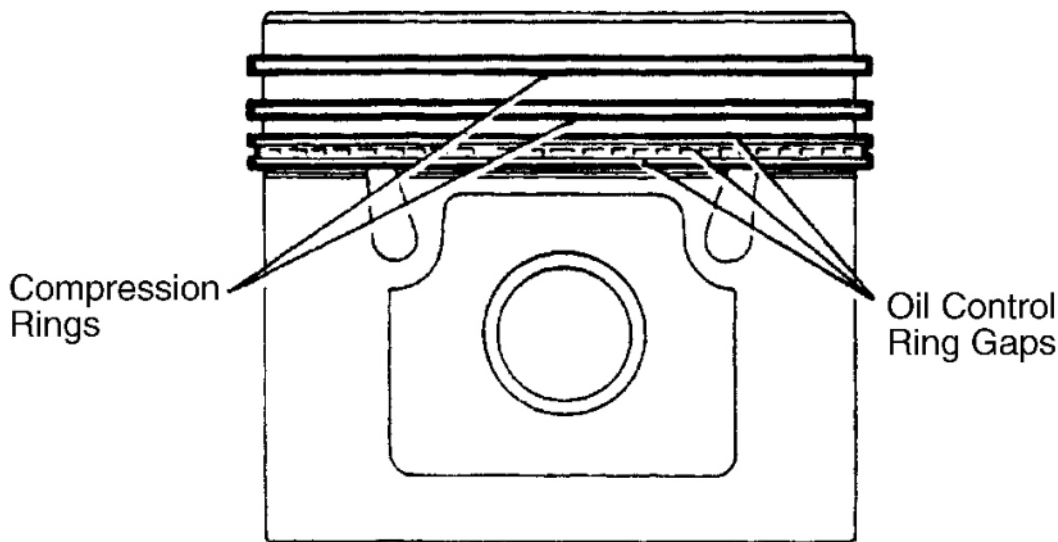
Measuring
Plastigauge
W/Plastigauge
Scale**Fig. 76: Checking Rod Bearings (2 Of 2)**

Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation Of Piston & Rod Assembly

1. Locate applicable crankshaft journal at Bottom Dead Center (BDC).
2. Place bearing upper shell in connecting rod. See **Fig. 75**.
3. Retain upper shell by screwing guide bolts (605351) onto connecting rods.
4. Insert connecting rod and piston assembly into its respective bore, noting that domed shape boss on connecting rod must face toward front of engine on right-hand bank of cylinders and toward rear on left-hand bank. When both connecting rods are fitted, bosses will face inward toward each other. See **Fig. 75**.
5. Position oil control piston rings so that ring gaps are all at one side, between piston pin and piston thrust face. Space gaps in ring rails approximately 1" (25 mm) each side of expander ring joint. See **Fig. 77**.

6. Position compression rings so that their gaps are on opposite sides of piston between piston pin and piston thrust face. See **Fig. 77**.
7. Using a piston ring compressor, fit piston into cylinder bore, until piston crown is just below cylinder block top face. See **Fig. 78**.
8. Pull connecting rods onto crankshaft journals using guide rods. Use extreme care when pulling pistons down their respective bores to prevent scratching crank pins. See **Fig. 66**.
9. Place bearing lower shell in connecting rod cap.
10. Fit cap and shell onto connecting rod, noting that rib on edge of cap must be toward front of engine on right-hand bank of cylinders and toward rear on left-hand bank.
11. Check that connecting rods move freely sideways on crankshaft. Tightness indicates insufficient bearing clearance or a misaligned connecting rod.
12. Check end-float between connecting rods on each crankshaft journal. Clearance limits should be 0.006-0.015" (0.15-0.37 mm). See **Fig. 79**.
13. Tighten connecting rod nuts to 37 ft lbs. (50 Nm). Fit oil strainer and joint washer.



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Fig. 77: Fitting Connecting Rods & Pistons (1 Of 3)
Courtesy of LAND ROVER NORTH AMERICA, INC.

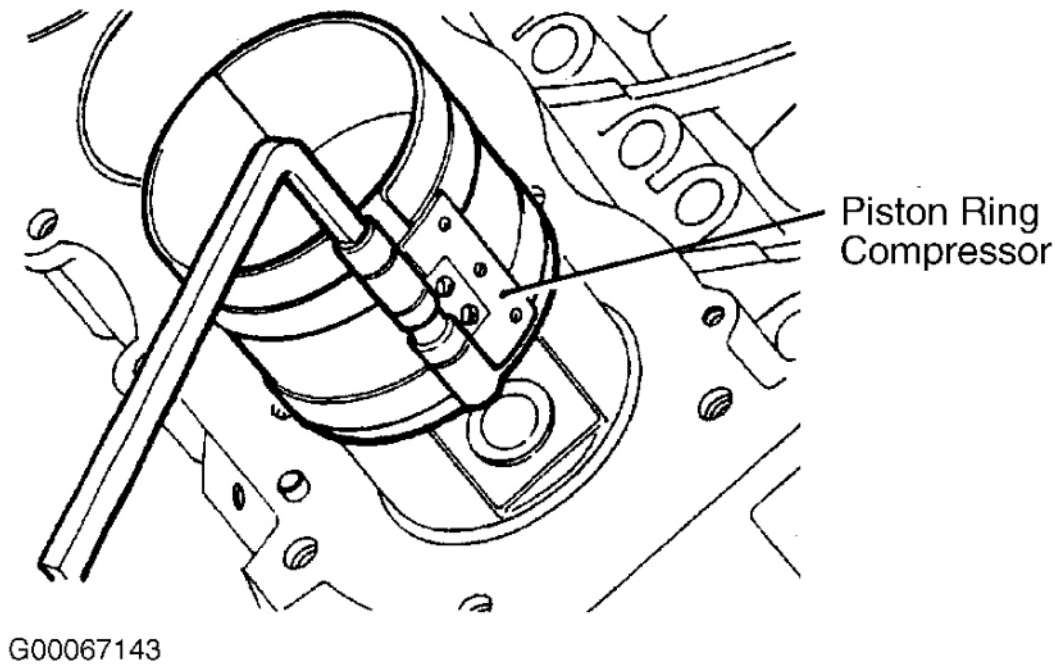
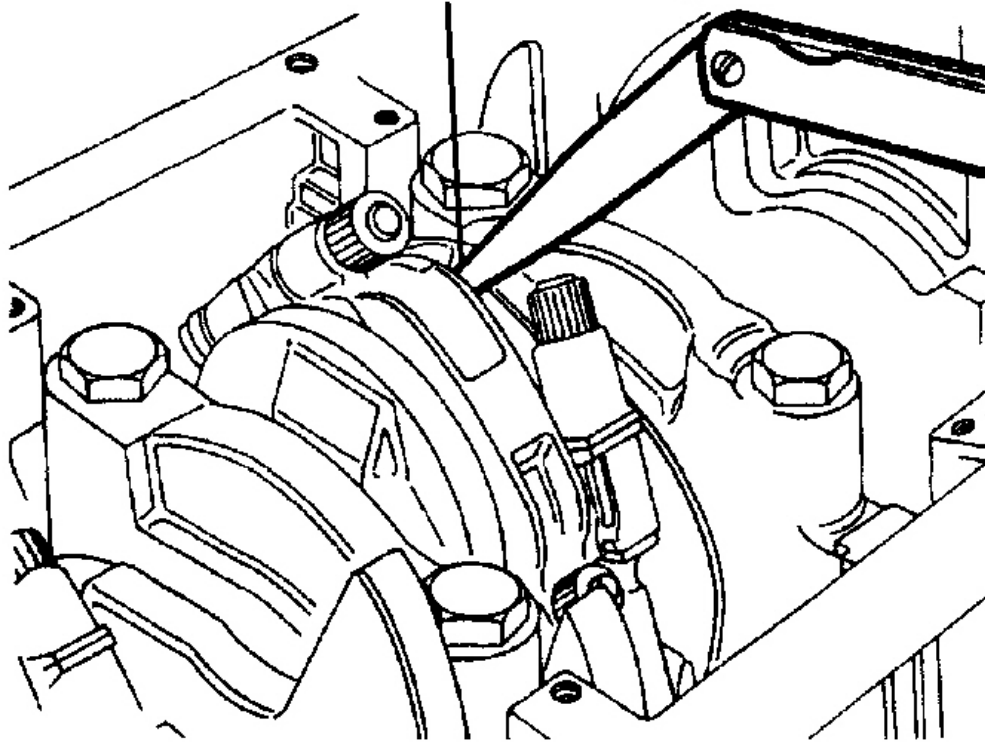


Fig. 78: Fitting Connecting Rods & Pistons (2 Of 3)
Courtesy of LAND ROVER NORTH AMERICA, INC.

Measuring End Float W/Feeler Gauge



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Fig. 79: Fitting Connecting Rods & Pistons (3 Of 3)
Courtesy of LAND ROVER NORTH AMERICA, INC.

Removal & Inspection Of Crankshaft, Main & Thrust Bearings

1. Remove main bearing caps and lower bearing shells and retain in sequence. It is important to keep them in pairs and mark them with number of respective journal until it is decided if bearing shells are to be refitted. See [Fig. 80](#).
2. Lift out crankshaft and rear oil seal. See [Fig. 80](#).
3. To inspect and overhaul crankshaft, rest crankshaft on "V"-blocks at No. 1 and No. 5 main bearing journals. See [Fig. 81](#).
4. Using a dial indicator, check run-out at No. 2, 3 and 4 main bearing journals. See [Fig. 81](#).
5. The total indicator readings at each journal should not exceed 0.003" (0.08 mm).
6. If crankshaft is bent it is not suitable for regrinding and should be renewed.
7. Check each crankshaft journal for out of round. If out of round exceeds 0.0016" (0.040 mm) around

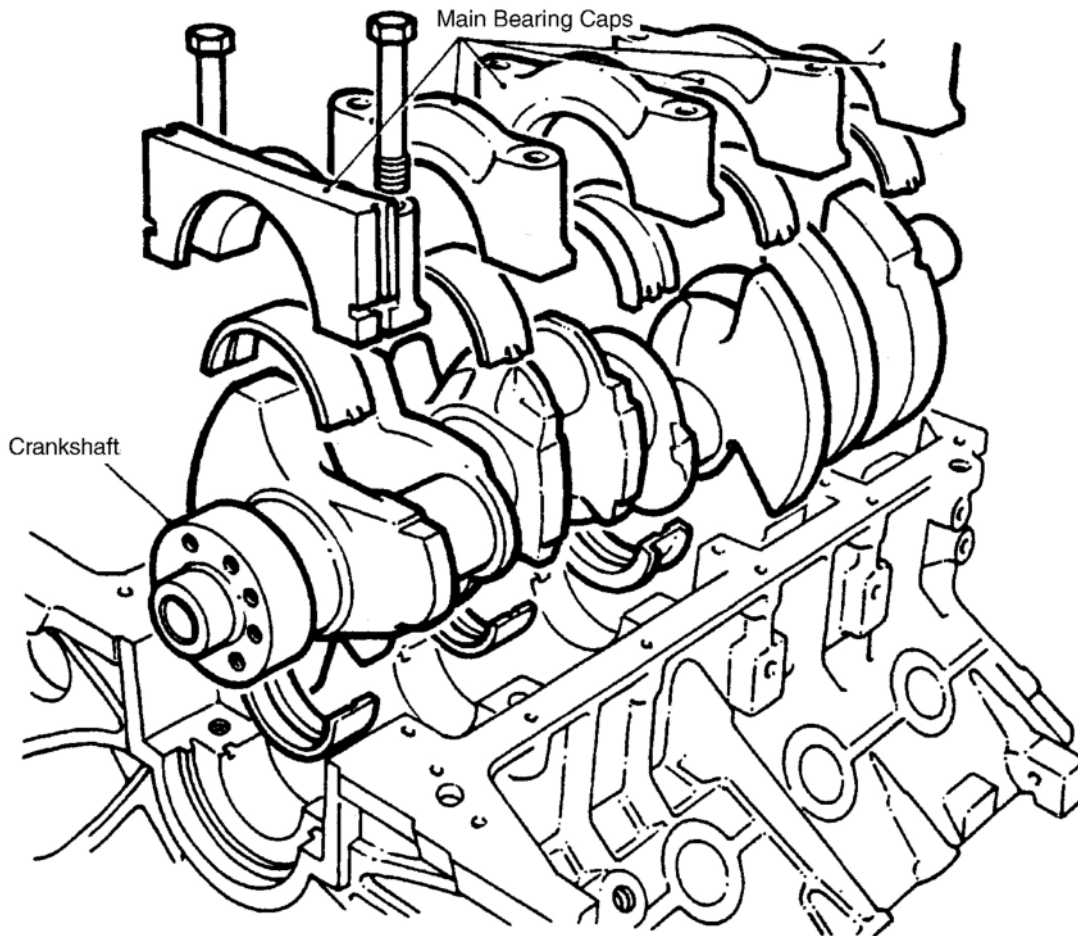
crankshaft journal, regrind or fit new crankshaft.

8. Bearings for crankshaft main journals and connecting rod journals are available in the following undersizes: See **Fig. 82**.
 - 0.010" (0.25 mm)
 - 0.020" (0.50 mm)
9. The center main bearing shell, which controls crankshaft thrust, has thrust faces increased in thickness when more than 0.010" (0.25 mm) undersize, as shown in table. See **CRANKSHAFT THRUST BEARING SELECTION** table. See **Fig. 82**.

CRANKSHAFT THRUST BEARING SELECTION

Main Bearing Journal Size	Thrust Face Width
Standard	Standard
.25 mm (.010") Undersize	Standard
.50 mm (.020") Undersize	.25 mm (.010") Oversize

10. When a crankshaft is to be reground, thrust faces on either side of center main journal must be machined in accordance with dimensions in table. See **CRANKSHAFT THRUST BEARING SELECTION** table. See **Fig. 83**.
11. For example, if a 0.020" (0.50 mm) undersize bearing is to be fitted, then 0.0049" (0.125 mm) must be machined off each thrust face of center journal, maintaining correct radius. See **Fig. 83**.
12. When checking crankshaft dimensions, the radius for all journals except rear main bearing is 0.075-.090" (1.90-2.28 mm). See **Fig. 83** and **Fig. 84**.
13. The radius for rear main bearing journal is 0.120" (3.04 mm). See **Fig. 83** and **Fig. 84**.
14. For main bearing journal diameter, see **Fig. 83** and **Fig. 84**.
15. For thrust face width, and connecting rod journal diameter, see **Fig. 83** and **Fig. 84**.
16. To check main bearing clearance, remove oil seals from cylinder block and rear main bearing cap.
17. Fit upper main bearing shells into cylinder block. These must be shells with oil holes and oil grooves.
18. Locate flanged upper main bearing shell in center position.
19. Place crankshaft in position on bearings.
20. Place a piece of Plastigauge across center of crankshaft main bearing journals. See **Fig. 76**.
21. Fit bearing lower shell into main bearing cap.
22. Fit No. 1-4 main bearing caps and shells, tighten to 52 ft lbs. (70 Nm).
23. Fit rear main bearing cap and shell and tighten to 66 ft lbs. (90 Nm). DO NOT allow crankshaft to be rotated while Plastigauge is in use.
24. Remove main bearing caps and shells.
25. Using scale printed on Plastigauge packet, measure flattened Plastigauge at its widest point. See **Fig. 76**.
26. The graduation that most closely corresponds to width of Plastigauge indicates bearing clearance.
27. The correct bearing clearance with new or overhauled components is 0.0009-0.0026" (0.023-.065 mm).
28. If correct clearance is not obtained initially, select a suitable bearing to give required clearance.
29. Wipe off Plastigauge with an oily rag. DO NOT scrape it off.
30. Maintain bearing shells and caps in sets and in correct sequence.



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Fig. 80: Installation Of Crankshaft & Bearings
Courtesy of LAND ROVER NORTH AMERICA, INC.

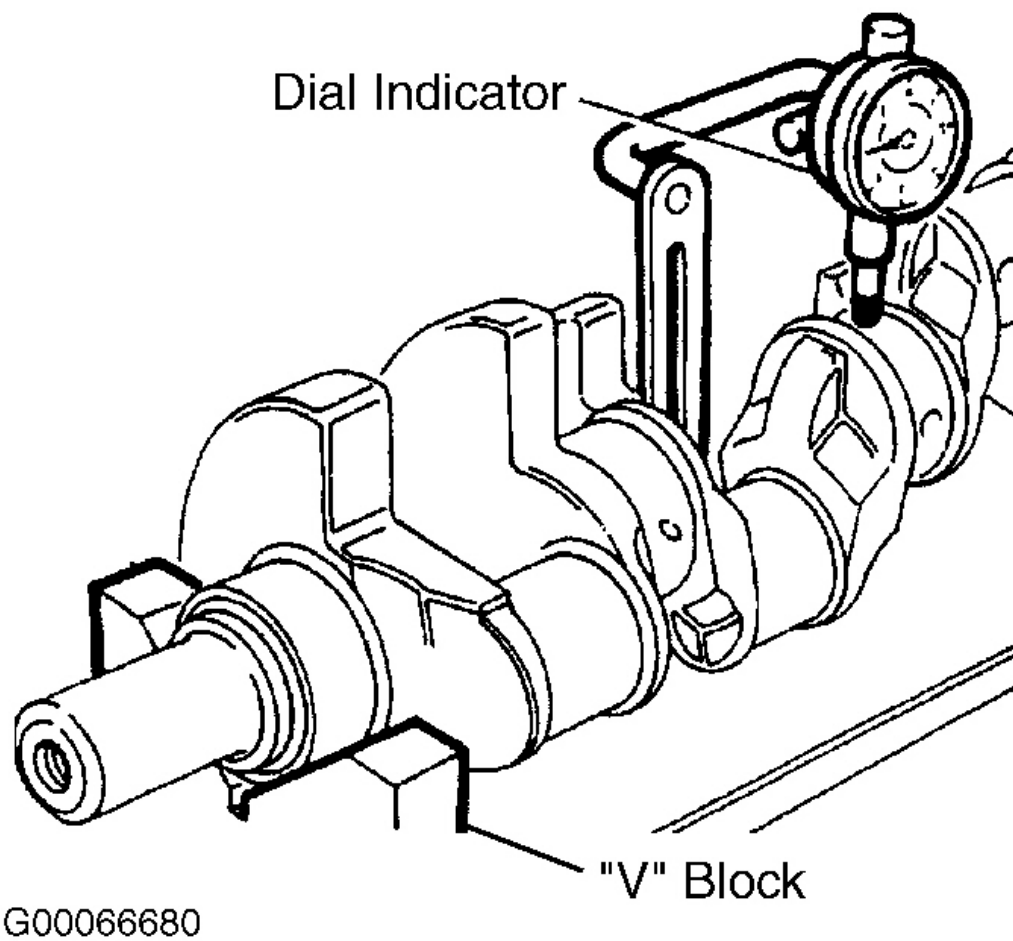
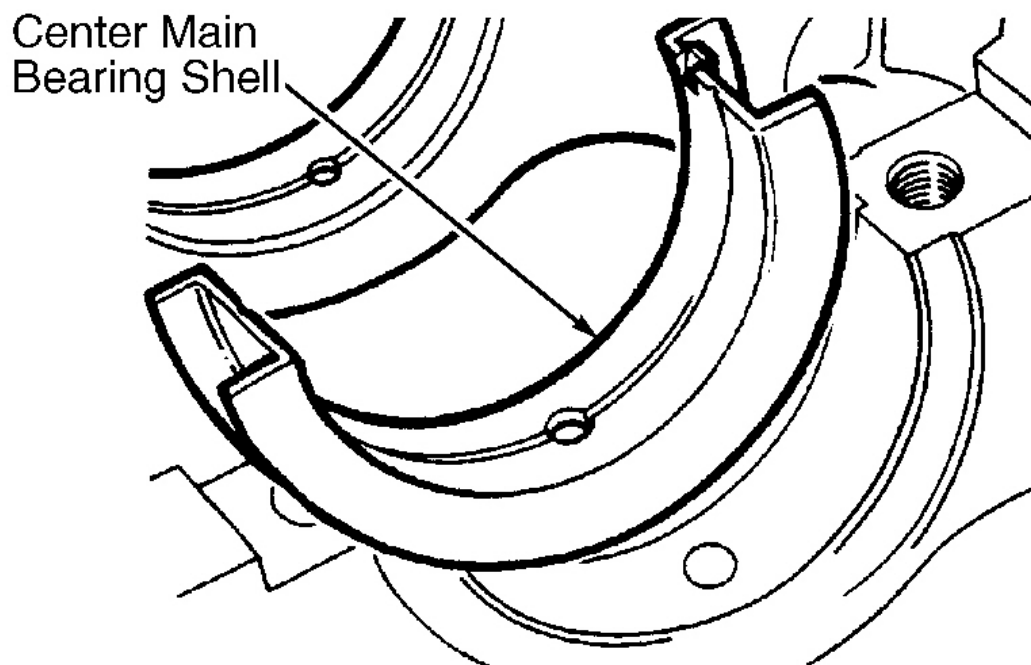
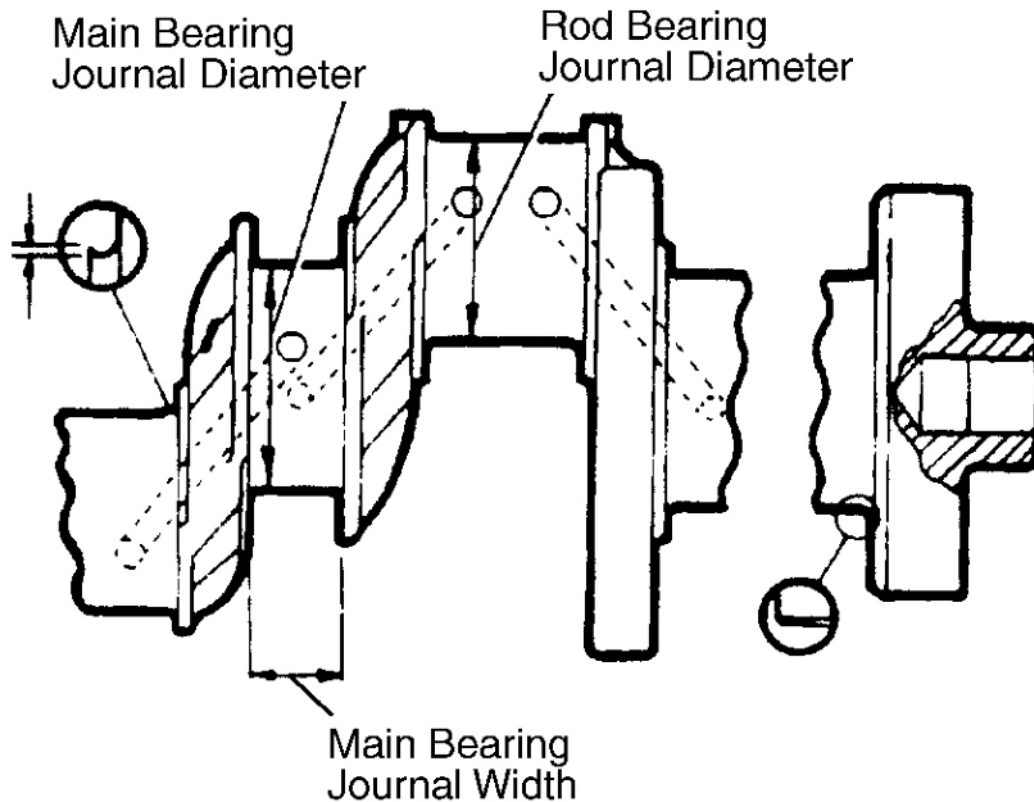


Fig. 81: Inspection Of Crankshaft (1 Of 2)
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00066681

Fig. 82: Inspection Of Crankshaft (2 Of 2)
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00067133

Fig. 83: Identifying Crankshaft Dimensions (1 Of 2)
 Courtesy of LAND ROVER NORTH AMERICA, INC.

Crankshaft dimensions-millimetre

Crankshaft Grade	Diameter '12'	Width '13'	Diameter '14'
Standard	58.400-58.412	26.975-27.026	50.800-50.812
0.254 U/S	58.146-58.158	26.975-27.026	50.546-50.558
0.508 U/S	57.892-57.904	27.229-27.280	50.292-50.304

Crankshaft dimensions - inches

Crankshaft Grade	Diameter '12'	Width '13'	Diameter '14'
Standard	2.2992-2.2997	1.062-1.064	2.0000-2.0005
0.010 U/S	2.2892-2.2897	1.062-1.064	1.9900-1.9905
0.020 U/S	2.2792-2.2797	1.072-1.074	1.9800-1.9805

G00067134

Fig. 84: Identifying Crankshaft Dimensions (2 Of 2)

Courtesy of LAND ROVER NORTH AMERICA, INC.

Reassembly Of Crankshaft & Main Bearings

1. Fit upper main bearing shells into cylinder block; these must be shells with oil holes and oil grooves. See **Fig. 82**.
2. Place flanged upper main bearing shell in center position. See **Fig. 82**.
3. Lubricate crankshaft main bearing journals and bearing shells with clean engine oil and lower crankshaft into position.
4. Lubricate lower main bearing shells and fit No. 1-4 main bearing caps and shells only, leaving fixing bolts finger-tight at this stage.
5. Fit cross shaped side seals to grooves on each side of rear main bearing cap. DO NOT cut side seals to length, they must protrude approximately 0.059" (1.50 mm) above bearing cap parting face. See **Fig. 85**.
6. Apply Hylomar (SQ32M) jointing compound to back half of rear main bearing cap parting face or, if preferred, to equivalent area on cylinder block. See **Fig. 85**.
7. Lubricate bearing half and bearing cap side seals with clean engine oil. See **Fig. 85**.
8. Fit bearing cap assembly to engine.
9. DO NOT tighten cap bolts at this stage but ensure that cap is fully home and squarely seated on cylinder block.

CAUTION: DO NOT handle oil seal lip, visually check that it is not damaged and ensure outside diameter remains clean and dry.

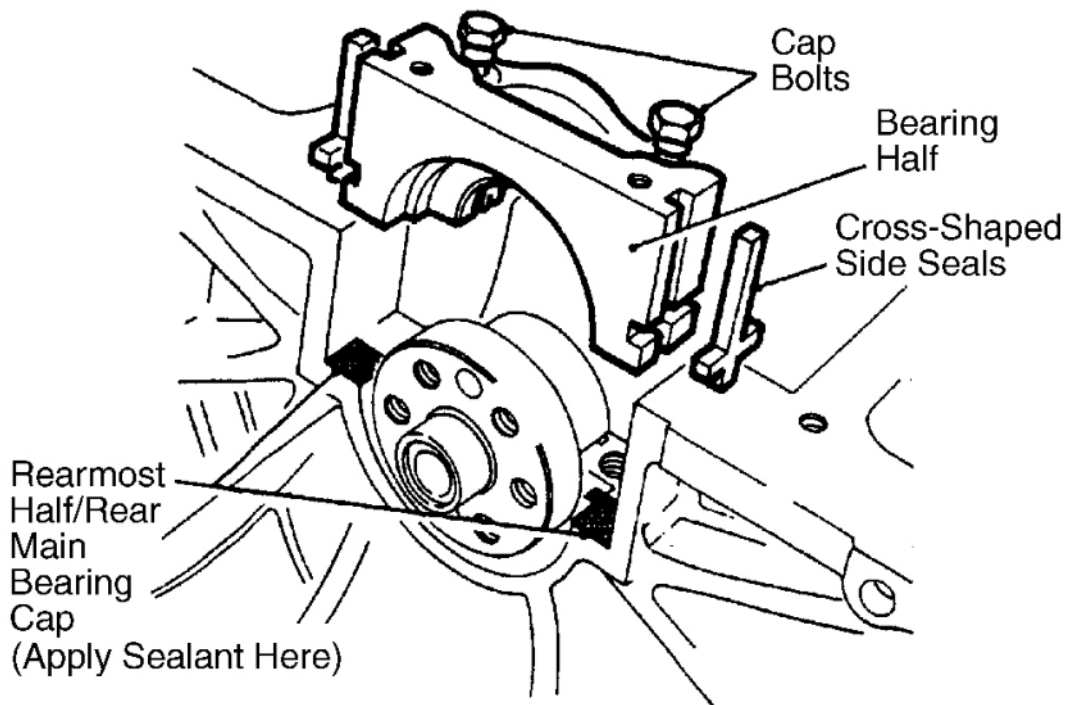
10. Position Seal Guide (RO 1014) on crankshaft flange. See **Fig. 86**.

NOTE: The lubricant coating must cover seal guide outer surface completely to ensure oil seal lip is not turned back during assembly.

Position oil seal, lipped side towards engine, on to seal guide. The seal outside diameter must be clean and dry. See Fig. 86.

11. Ensure that oil seal guide and crankshaft journal are scrupulously clean, then coat seal guide and oil seal journal with clean engine oil. See **Fig. 86**.
12. Push home oil seal fully and squarely by hand into recess formed in cap and block until it contacts machined step in recess. Withdraw seal guide. See **Fig. 86**.
13. Tighten main bearing cap bolts to correct torque, main bearings 1-4 to 52 ft lbs. (70 Nm), rear main bearing to 66 ft lbs. (90 Nm).
14. Using a feeler gauge or a dial indicator, check crankshaft end-float. Crankshaft end-float should be, 0.004-0.008" (0.10-.20 mm). See **Fig. 87**.

CAUTION: DO NOT exceed 1000 RPM for 15 seconds when first starting engine, otherwise crankshaft rear oil seal will be damaged.



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Fig. 85: Installing Crankshaft & Main Bearings (1 Of 3)
Courtesy of LAND ROVER NORTH AMERICA, INC.

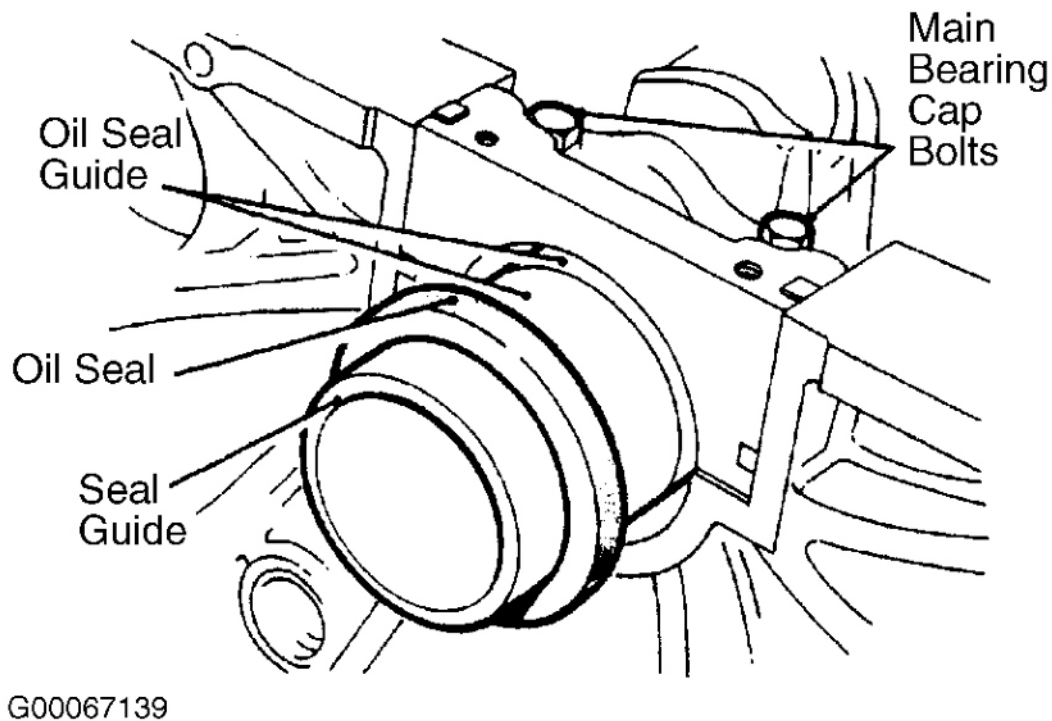


Fig. 86: Installing Crankshaft & Main Bearings (2 Of 3)
Courtesy of LAND ROVER NORTH AMERICA, INC.

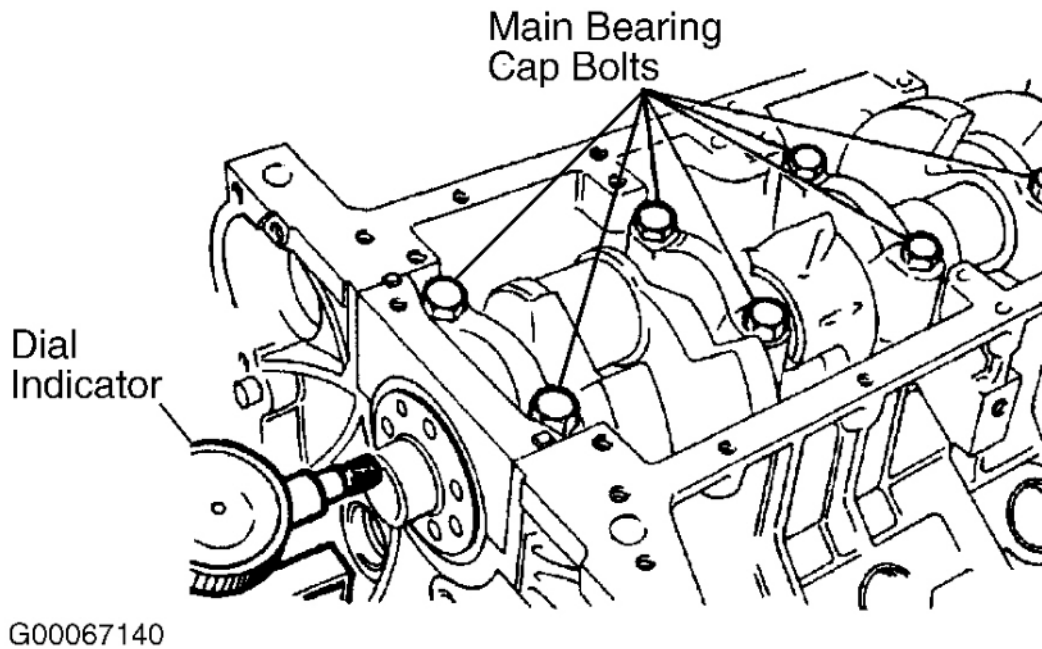
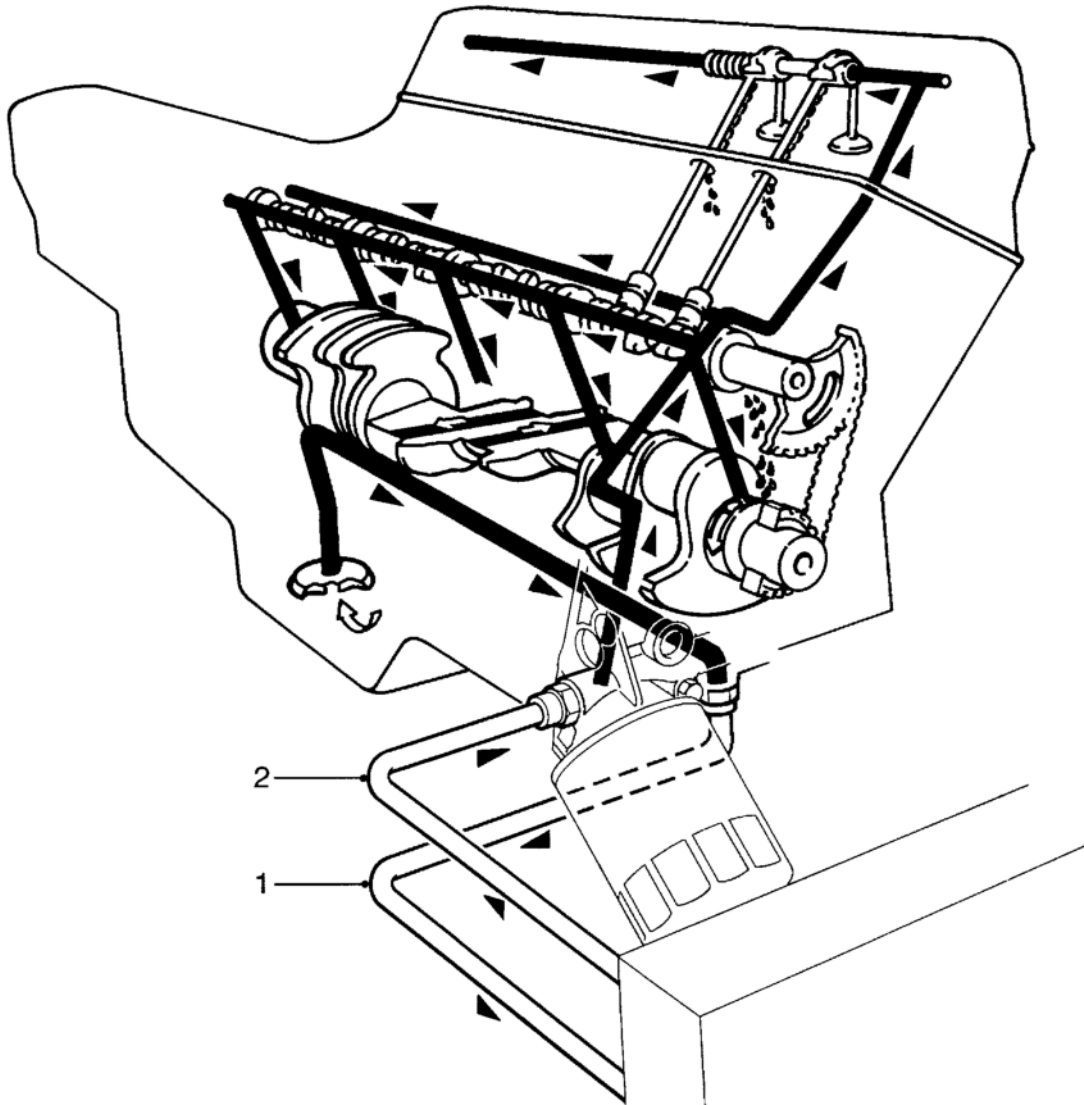


Fig. 87: Installing Crankshaft & Main Bearings (3 Of 3)
Courtesy of LAND ROVER NORTH AMERICA, INC.

ENGINE OILING SYSTEM



Lubrication system

1. Oil to cooler
2. Oil from cooler

G00109112

Fig. 88: Engine Oil Flow Diagram

Courtesy of LAND ROVER NORTH AMERICA, INC.

OIL COOLER ADAPTER

Removal

1. Remove both oil cooler pipes. See **Fig. 89**.
2. Mark position of adaptor plate relative to oil pump cover.
3. Remove center fixing and withdraw adaptor plate. See **Fig. 89**.

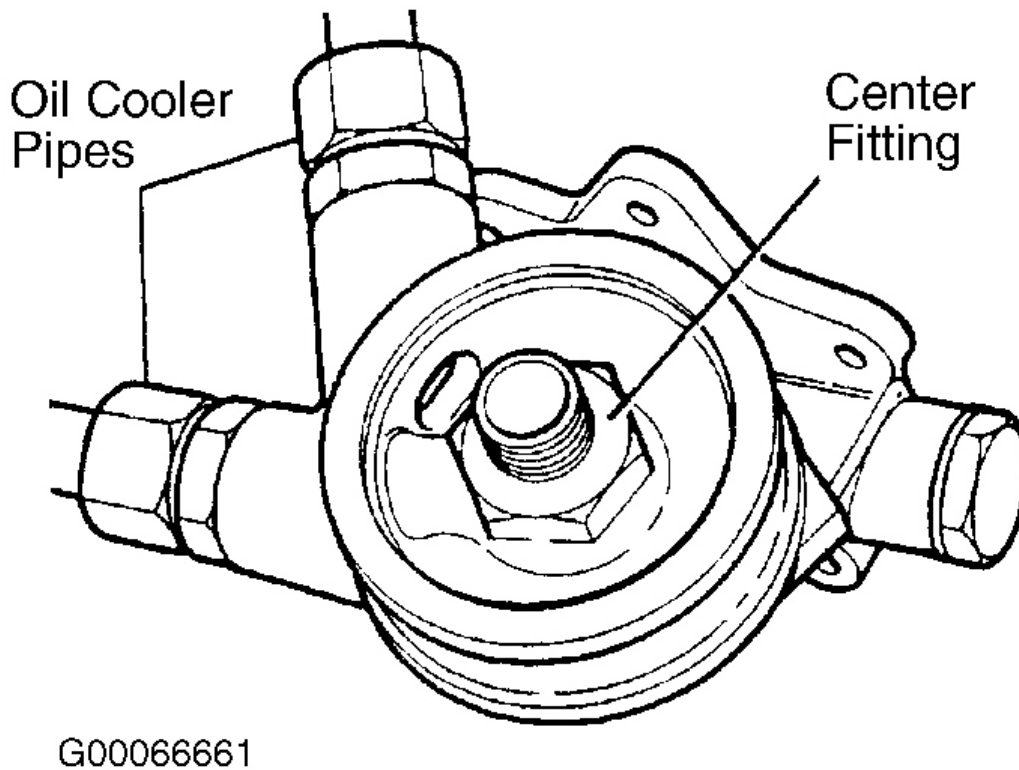


Fig. 89: Removing Oil Cooler Adaptor Plate
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. To install, reverse removal procedure, lining up location marks to ensure pipe runs are correct. Ensure pipes and center fixing are tightened to specified torque. See **TORQUE SPECIFICATIONS**.

OIL PAN

Removal

1. Drain engine oil.
2. Fit drain plug. Tighten to 30 ft lbs. (40 Nm).
3. If fitted, disconnect low oil level sensor multi-plug.
4. Remove bolt securing dipstick tube to rocker cover.
5. Working from the center outwards, progressively slacken and remove 17 bolts securing oil pan. Remove oil pan.
6. Remove all traces of sealant from mating surfaces of oil pan, cylinder block and front cover, using a

suitable solvent or plastic scraper.

7. Clean mating surfaces of oil pan, cylinder block and front cover.

Installation

1. Apply RTV Hylosil White sealant to mating surface of oil pan.
2. Position oil pan, tighten bolts finger tight.
3. Tighten bolts progressively in sequence shown. See **Fig. 90**. Tighten to 13 ft lbs. (18 Nm).
4. Fit bolt securing dipstick tube to rocker cover.
5. If fitted, connect low oil level sensor multi-plug.

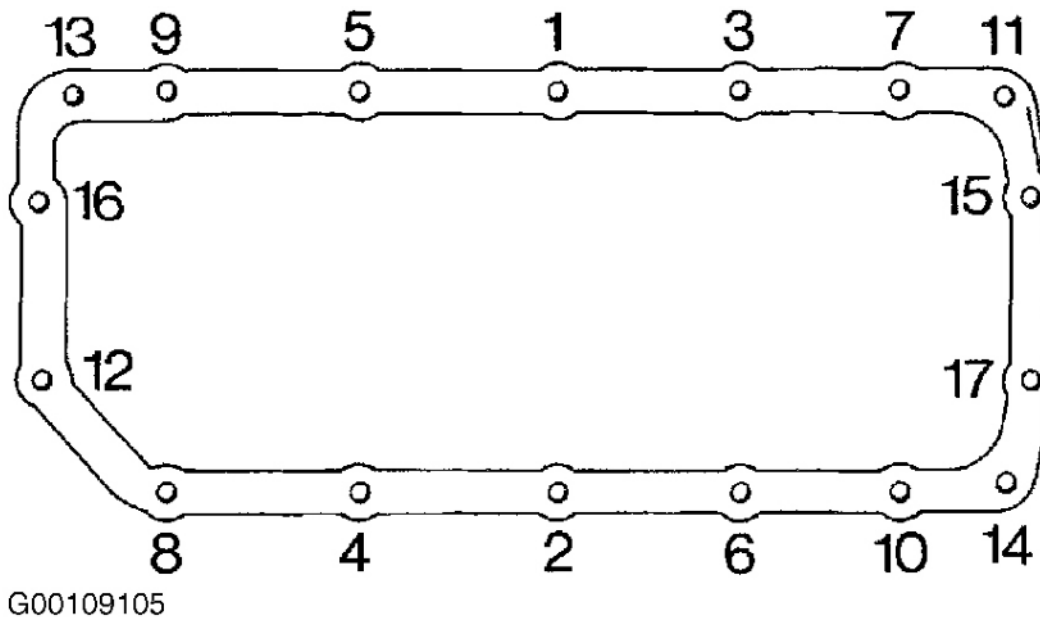


Fig. 90: Oil Pan Bolt Tightening Sequence
 Courtesy of LAND ROVER NORTH AMERICA, INC.

OIL PUMP

Removal

1. Remove bolts from oil pump cover. See **Fig. 91**.
2. Withdraw oil pump cover. See **Fig. 91**.
3. Lift off cover and remove gasket. See **Fig. 91**.
4. Withdraw oil pump gears. See **Fig. 91**.

Disassembly

1. Unscrew plug from pressure relief valve. See **Fig. 92**.
2. Lift sealing washer from plug. See **Fig. 92**.
3. Withdraw spring from relief valve. See **Fig. 92**.
4. Withdraw pressure relief valve. See **Fig. 92**.

Inspection

1. Check oil pump gears for wear or scores.
2. Fit oil pump gears and shaft into timing gear cover. See **Fig. 93**.
3. Place a straight edge across gears. See **Fig. 93**.
4. Check clearance between straight edge and timing gear cover. If less than 0.002" (0.05 mm), check timing gear cover gear recess for wear. See **Fig. 93**.
5. Check oil pressure relief valve for wear or scores.
6. Check sides of relief valve spring for wear or signs of collapse.
7. Clean wire screen filter for relief valve.
8. Check fit of relief valve in its bore. The valve must be an easy slide fit with no perceptible side movement.

LUBRICATION SYSTEM SPECIFICATIONS

Application	Specification
Lubrication System Type	Wet Sump Pressure Fed
Oil Pump Type	Eccentric Rotor
Oil Pressure	42 psi (2.95 Kg/cm ²) @ 2500 RPM With Engine Hot
Internal Oil Filter	Wire Screen, Pump Intake Filter In Sump
External Oil Filter	Full Flow, Self-Contained Cartridge

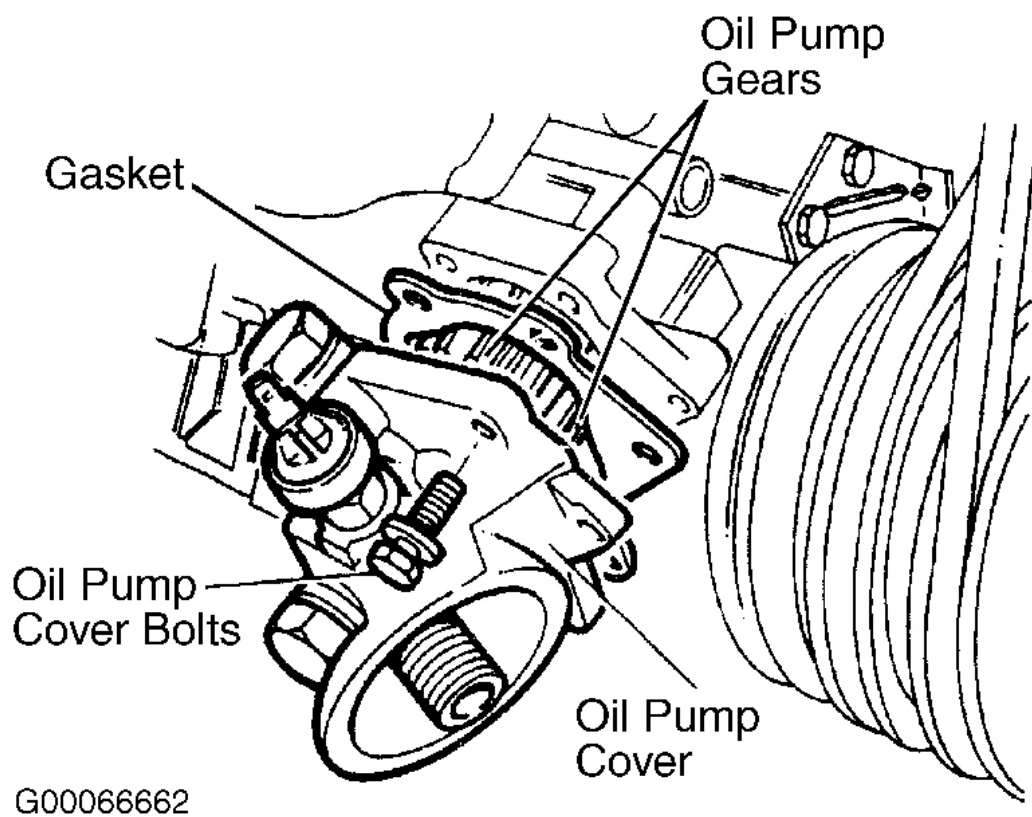
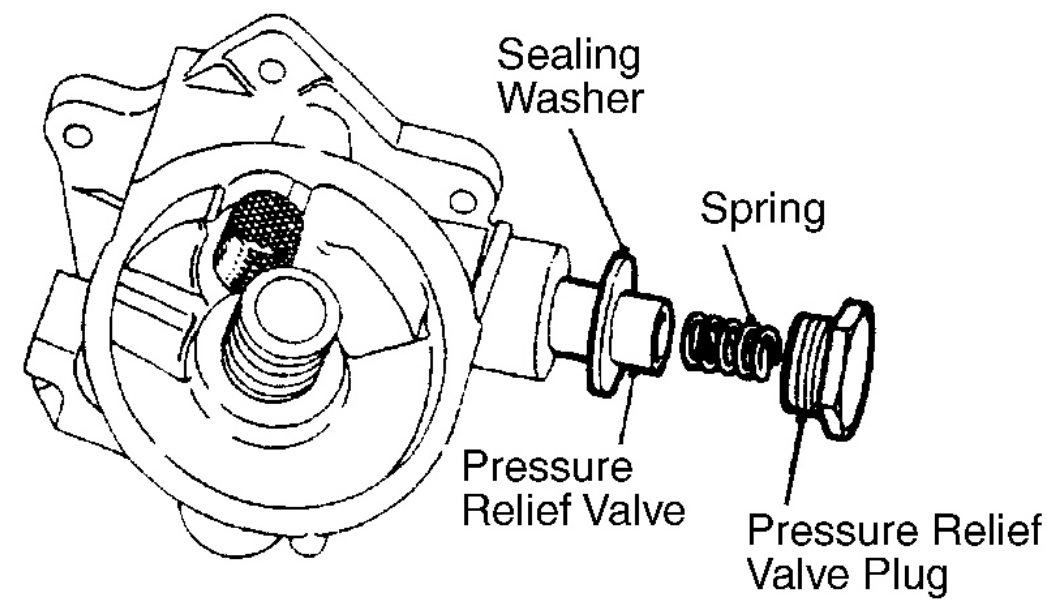


Fig. 91: Removing Oil Pump

Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 92: Dismantling Oil Pressure Relief Valve
Courtesy of LAND ROVER NORTH AMERICA, INC.

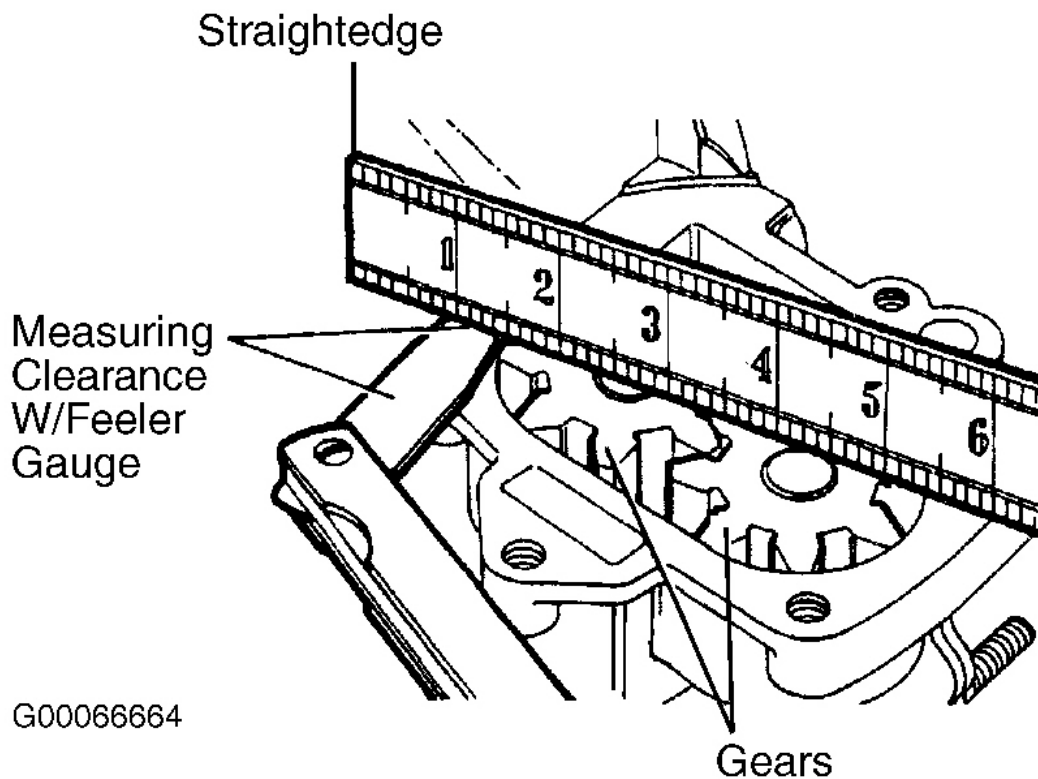


Fig. 93: Checking Oil Pump Clearance
Courtesy of LAND ROVER NORTH AMERICA, INC.

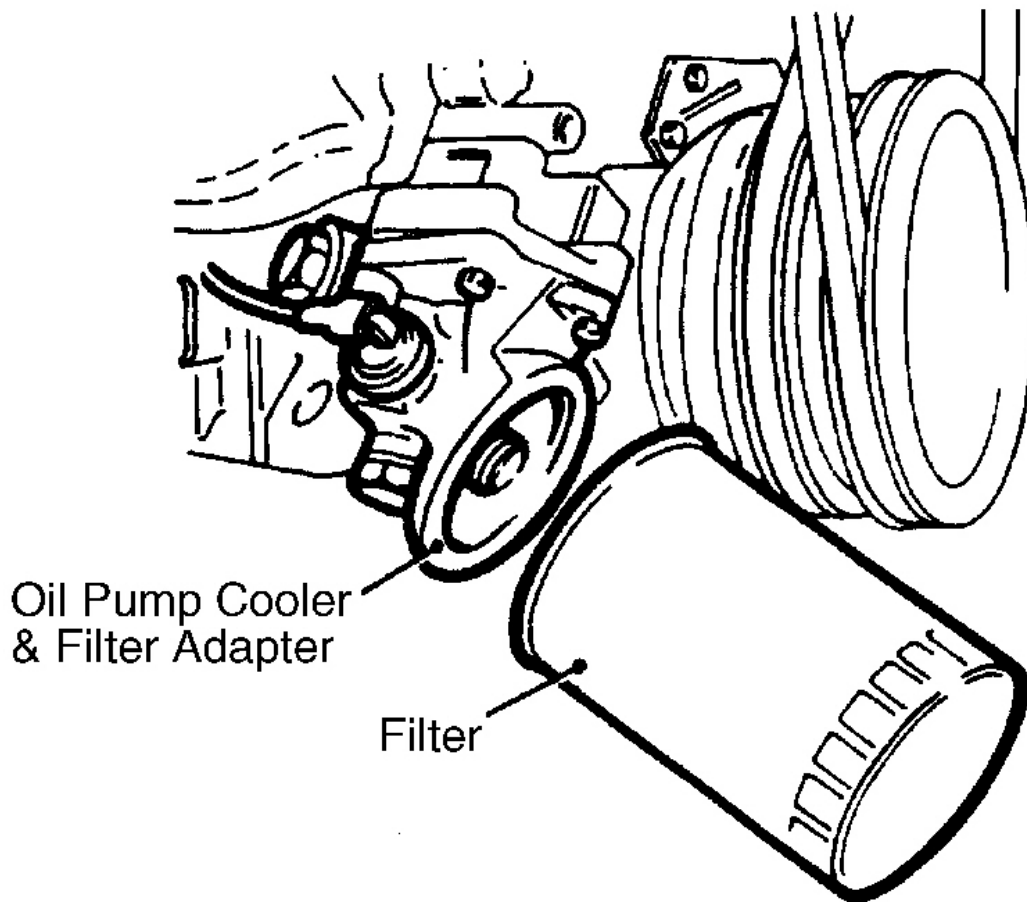
Reassembly & Installation

NOTE: Unless pump is fully packed with Petroleum Jelly, it may not prime itself when engine is started.

1. Insert relief valve spring.
2. Locate sealing washer on to relief valve plug.
3. Fit relief valve plug and tighten to 30-35 ft lbs. (40-47 Nm).
4. Fully pack oil pump gear housing with Petroleum Jelly. Use only Petroleum Jelly, no other grease is suitable.
5. Fit oil pump gears so that Petroleum Jelly is forced into every cavity between teeth of gears.
6. Place a new gasket on oil pump cover.
7. Locate oil pump cover in position.
8. Fit special fixing bolts and gradually tighten to 10 ft lbs. (13 Nm).

OIL FILTER

1. Clean oil pump/oil cooler adaptor mating face. See **Fig. 94**.
2. Coat sealing ring of new filter with clean engine oil.
3. Fill filter with new oil as far as possible, noting angle at which filter is to be fitted.
4. Screw on filter until sealing ring touches oil pump/oil cooler mating face, then tighten it another half turn by hand only. DO NOT overtighten. See **Fig. 94**.
5. Refill engine with specified grade and quantity of oil.



G00067175

Fig. 94: Oil Filter

Courtesy of LAND ROVER NORTH AMERICA, INC.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS (BY APPLICATION)

Application	Ft. Lbs. (N.m)
-------------	----------------

1995 Land Rover Defender 90

1993-95 ENGINES 3.9L & 4.2L V8

Adaptor Plate-To-Crankshaft	62 (84)
Generator & Power Steering Mounting Bracket-To-Cylinder Head	22 (30)
Generator-To-Mounting Bracket	18 (25)
Generator-To-Adjusting Link	18 (25)
Chainwheel-To-Camshaft	43 (58)
Connecting Rod Bolt	38 (51)
Cylinder Head Bolts	
Step 1	14 (20)
Step 2	(1)
Damper-To-Crankshaft	200 (271)
Distributor Clamp Nut	15 (21)
Drive Plate-To-Converter	29 (39)
Engine Mountings-To-Engine & Chassis	41 (55)
Engine Mounting Rubbers-To-Brackets	22 (30)
Exhaust Manifold-To-Cylinder Heads	15 (21)
Fan-To-Viscous Unit	21 (29)
Flex-Plate-To-Crankshaft Adaptor Plate	(2) 30 (41)
Intake Manifold-To-Cylinder Heads	28 (38)
Lifting Eye-To-Cylinder Heads	29 (39)
Main Bearing Cap Bolts	(3) 53 (72)
Main Bearing Cap Rear Bolts	(3) 68 (92)
Oil Plug	20 (27)
Oil Relief Valve Plug	32 (44)
Oil Pan Drain Plug	30 (40)
Oil Pan-To-Cylinder Block	13 (18)
Oil Pan Rear-To-Cylinder Block	13 (18)
Plenum Chamber-To-Ram Housing	18 (25)
Ram Housing-To-Intake Manifold	17 (24)
Rocker Shaft Bracket-To-Cylinder Head	28 (38)
Spark Plug	15 (21)
Starter Motor Attachment	32 (44)
Thermostat Housing-To-Intake Manifold	20 (27)
Timing Cover-To-Cylinder Block	(4) 20 (27)
Viscous Unit-To-Water Pump Hub	33 (45)
Water Pump Timing Cover-To-Cylinder Block	20 (27)
INCH Lbs. (N.m)	
Manifold Gasket Clamp Bolt	150 (17)
Oil Pump Cover-To-Timing Cover	115 (13)
Rocker Cover-To-Cylinder Head	80 (9)
Water Pump Pulley-To-Water Pump Hub	(4) 89 (10)

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1993-95 ENGINES 3.9L & 4.2L V8

Water Jacket-To-Plenum Chamber

(4) 115 (13)

- (1) A further 175-185 degrees.
- (2) These bolts must have threads coated in sealant Loctite 270 prior to assembly.
- (3) These bolts must have threads coated in lubricant EXP16A (Marston Lubricants) prior to assembly.
- (4) These bolts must have threads coated with Loctite 572 prior to assembly. For this purpose it is necessary to use an approved dispenser to apply sealant/lubricant to first 3 threads of bolts.

TORQUE SPECIFICATIONS (BY BOLT SIZE - EXCEPT LISTED BY APPLICATION)

Application	Ft. Lbs. (N.m)
Metric Fasteners	
M5	4 (6)
M6	7 (9)
M8	18 (25)
M10	33 (45)
M12	66 (90)
M14	77 (105)
M16	133 (180)
SAE Corse & Fine Thread Fasteners	
1/4	7 (9)
5/16	17 (24)
3/8	29 (39)
7/16	58 (78)
1/2	66 (90)
5/8	100 (136)

ENGINE SPECIFICATIONS**GENERAL SPECIFICATIONS****GENERAL SPECIFICATIONS**

Application	Specification
3.9L V8 Engine	
Number Of Cylinders	8, 2 Banks of 4
Bore	3.7 in (94 mm)
Stroke	2.8 in (71.12 mm)
Capacity	241.07 in ³ (3950 cm ³)
Valve Operation	Overhead By Push-Rod
Compression Ratio	8.13:1 Or 9.35:1
Maximum Power	
With 8.13:1 Compression	(170 hp @ 4550 RPM)

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1993-95 ENGINES 3.9L & 4.2L V8

With 9.35:1 Compression	(180 hp @ 4750 RPM)
4.2L V8 Engine	
Number Of Cylinders	8, 2 Banks Of 4
Bore	3.7 in (94 mm)
Stroke	3.03 in (77 mm)
Capacity	261 in ³ (4275 cm ³)
Valve Operation	Overhead By Push-Rod
Compression Ratio	8.94:1
Maximum Power	200 hp @ 4850 RPM

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS**CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS**

Application	In. (mm)
Crankshaft End Play	(1) .0039-.0078 (.099-.198)
Main Bearings (2)	
Journal Diameter	2.2996-2.3001 (58.409-58.422)
Minimum Regrind Diameter	2.2990-2.2601 (58.393-57.406)
Undersize Bearing Shells	.0100-.0200 (.254-.508)
Oil Clearance	.0004-.0019 (.010-.048)
Connecting Rod Bearings (3)	
Journal Diameter	2.0000-2.0005 (50.800-50.812)
Minimum Regrind Diameter	1.9600-1.9605 (49.784-49.797)
Undersize Bearing Shells	.0100-.0200 (.254-.508)
Oil Clearance	.0006-.0022 (.015-.055)
(1) Taken on thrust washers of center main bearing.	
(2) Main bearings are No. 5 Vandervell, made of Lead-Indium.	
(3) Connecting rod bearings are Vandervell VP, made of Lead-Indium.	

CONNECTING RODS**CONNECTING RODS (1)**

Application	In. (mm)
Center-To-Center Length	5.658-5.662 (143.71-143.81)
Side Play	.006-.014 (.15-.36)
(1) Horizontally split big-end, plain small-end.	

ENGINE PISTONS, PINS & PISTON RINGS**PISTONS, PINS & RINGS**

1995 Land Rover Defender 90

1993-95 ENGINES 3.9L & 4.2L V8

Application	In. (mm)
Piston Clearance ⁽¹⁾	.0007-.0016 (.018-.041)
Pins	
Length	2.861-2.866 (72.67-72.79)
Diameter	.8746-.8748 (22.215-22.220)
Piston Fit	.0001-.0003 (.002-.007)
Rod Fit	(2)
Rings	
No. 1 ⁽³⁾	
Width	.0582-.0587 (1.478-1.490)
End Gap	.016-.026 (.40-.65)
No. 2 ⁽⁴⁾	
Width	.0582-.0587 (1.478-1.490)
End Gap	.016-.026 (.40-.65)
No. 3 (Oil) ⁽⁵⁾	
Width	.118 (3.00)
End Gap	.015-.055 (.38-1.40)
(1) Measured at bottom of skirt at right angles to piston pin.	
(2) Press fit.	
(3) Molybdenum Barrel faced.	
(4) Tapered and marked "T" or "Top".	
(5) Hepworth & Grandage.	

CAMSHAFT BEARINGS**CAMSHAFT BEARINGS**

Application	In. (mm)
Camshaft Bearings	(1)
(1) 5 non-serviceable bearings.	

ENGINE VALVES & VALVE SPRINGS**VALVES & VALVE SPRINGS**

Application	Specification
Intake Valves	
Length	4.590-4.620" (116.59-117.35 mm)
Lift	.374" (9.49 mm)
Head Diameter	1.565-1.575" (39.75-40.00 mm)

1995 Land Rover Defender 90

1993-95 ENGINES 3.9L & 4.2L V8

Stem Diameter	.3411-.3417" (8.664-8.679 mm)
Exhaust Valves	
Length	4.590-4.620" (116.59-117.35 mm)
Lift	.374" (9.49 mm)
Head Diameter	1.347-1.357" (34.23-34.48 mm)
Stem Diameter	.3406-.3412" (8.651-8.666 mm)
Valve Springs	
Installed Height	(1) 1.59" (40.4 mm)
(1) At pressure of 65 Lbs. (29.5 Kg).	

VALVE SEATS & VALVE GUIDES**VALVE SEATS & GUIDES**

Application	Specification
Valve Seat Angle	
Intake Valve	45-45.5°
Exhaust Valve	45-45.5°
Valve Stem-To-Guide Clearance	
Intake Valve	.0010-.0026" (.025-.066 mm)
Exhaust Valve	.0015-.0031" (.038-.078 mm)

CAMSHAFT DRIVE**CAMSHAFT DRIVE**

Application	In. (mm)
Drive Chain	(1)
(1) Consists of .375" (9.52 mm) pitch x 54 pitches.	

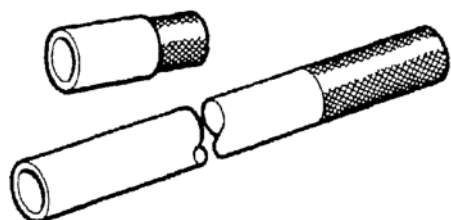
VALVE LIFTERS**VALVE LIFTERS**

Application	Specification
Type	Self-Adjusting Hydraulic

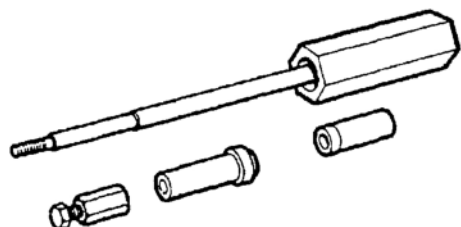
SPECIAL TOOLS

1995 Land Rover Defender 90

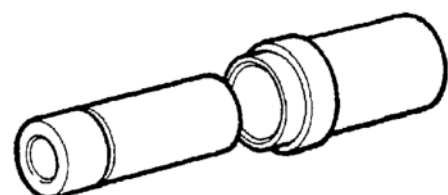
1993-95 ENGINES 3.9L & 4.2L V8



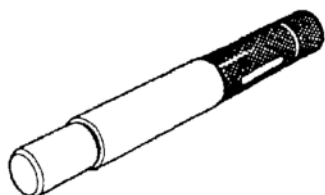
LRT-12-041 Guide bolts
RO605351



LRT-12-013 Piston pin remover/replacer - Basic tool
18G1150



LRT-12-014 Adaptor remover/replacer - piston pin
18G1150E



LRT-12-001 Clutch centralizing tool
18G79

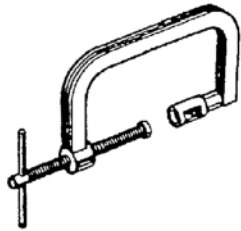
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Fig. 95: Special Tools (1 Of 3)

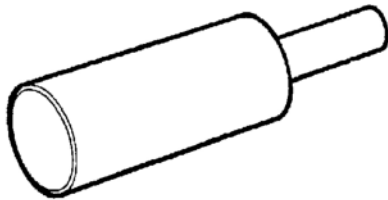
Courtesy of LAND ROVER NORTH AMERICA, INC.

1995 Land Rover Defender 90

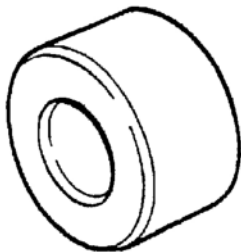
1993-95 ENGINES 3.9L & 4.2L V8



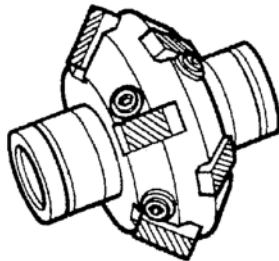
LRT-12-034 Spring compressor
MS1519A



LRT-12-038 Drift - Valve guide replacement - intake and exhaust
RO600959



LRT-12-515 Distance piece for valve guide
RO605774A



LRT-12-504 Valve seat cutter
MS621

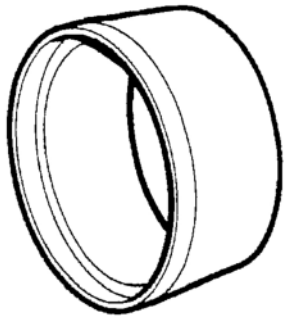
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Fig. 96: Special Tools (2 Of 3)

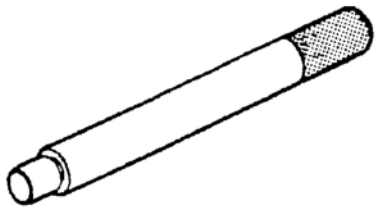
Courtesy of LAND ROVER NORTH AMERICA, INC.

1995 Land Rover Defender 90

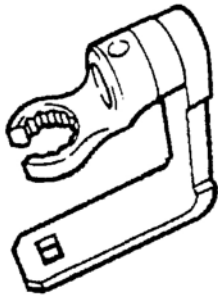
1993-95 ENGINES 3.9L & 4.2L V8



LRT-12-010 Crankshaft rear seal sleeve
RO1014



LRT-12-037 Drift for valve guide removal - intake and
RO274401A exhaust



LRT-12-047 Torque adaptor heated oxygen sensor
LST 134

G00109102

Fig. 97: Special Tools (3 Of 3)

Courtesy of LAND ROVER NORTH AMERICA, INC.