

2003-05 ENGINES**Range Rover - 4.4L V8****ADJUSTMENTS****ENGINE OIL PRESSURE CHECK**

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT** .

Check

1. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
2. Remove oil pressure switch. See **SWITCH - OIL PRESSURE**.
3. Fit LRT-12-052/10 to oil filter housing and fit LRT-12-052C to LRT-12-052/10, tighten unions. See **Fig. 1**.
4. Check engine oil level, top-up if necessary.
5. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
6. Start and run engine until normal operating temperature is reached.
7. Note oil pressure readings with the engine running at idle and at 3500 rev/min.
8. Switch off engine.
9. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
10. Remove LRT-12-052C.
11. Remove LRT-12-052/10.
12. Clean oil spillage.
13. Fit oil pressure switch. See **SWITCH - OIL PRESSURE**.
14. Check engine oil level, top-up if necessary.
15. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .

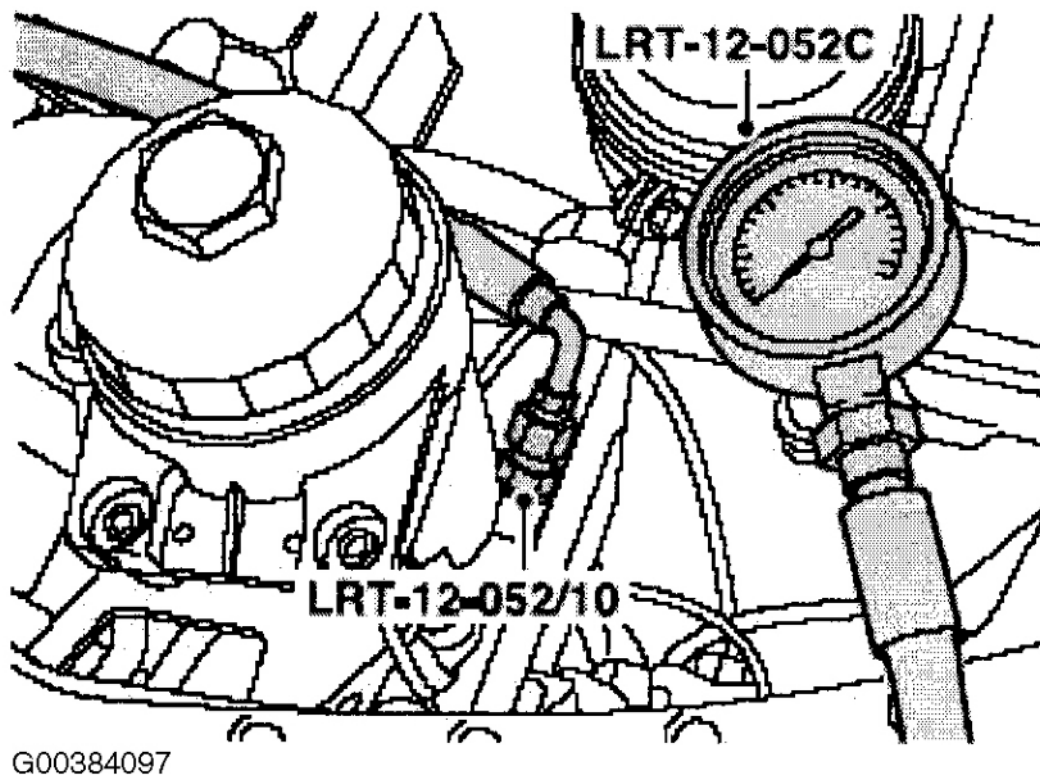


Fig. 1: Installing LRT-12-052/10 To Oil Filter Housing & LRT-12-052C To LRT-12-052/10 To Gauge Oil Pressure

Courtesy of LAND ROVER NORTH AMERICA, INC.

REPAIRS

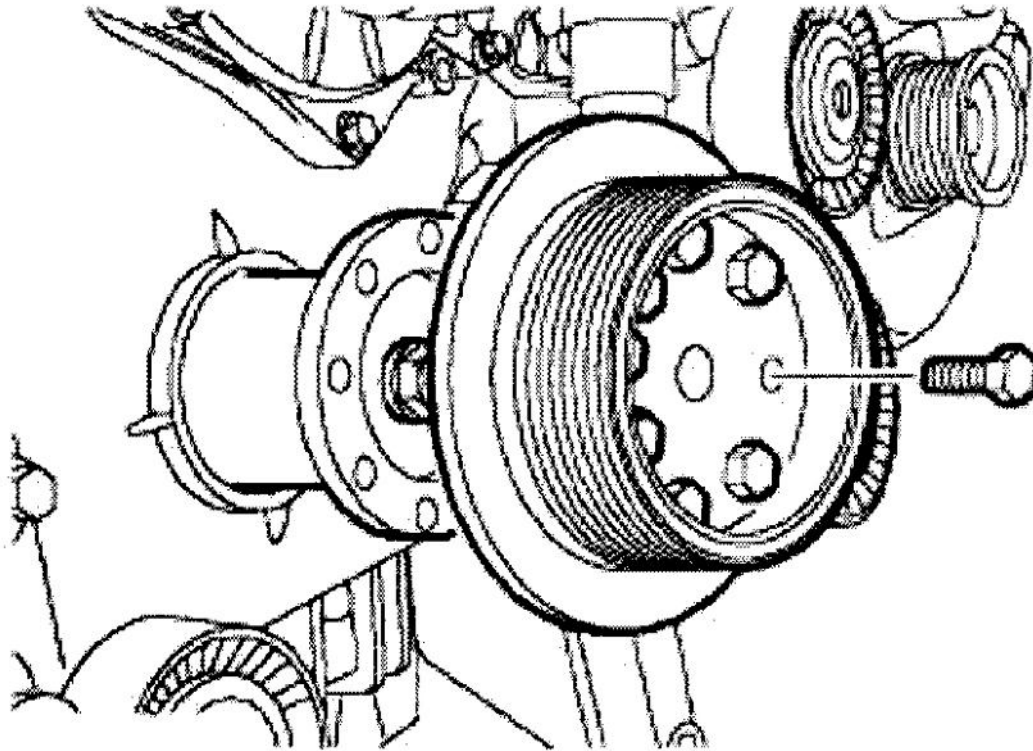
PULLEY - CRANKSHAFT

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT** .

Removal

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Remove ancillary drive belt. See **ANCILLARY DRIVE BELT** .
4. Remove viscous fan. See **VISCOUS FAN** .
5. Remove compressor drive belt. See **SPECIFICATIONS & DRIVE BELT ROUTING** .
6. Remove 8 bolts securing crankshaft pulley to hub assembly. See **Fig. 2** .

7. Remove crankshaft pulley.



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Fig. 2: Removing Crankshaft Pulley-To-Hub Assembly Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Position crankshaft pulley to hub assembly, fit to locating dowel.
2. Fit 8 new bolts securing crankshaft pulley to hub assembly and tighten to 22 Nm (16 ft. lbs).
3. Fit compressor drive belt. See **SPECIFICATIONS & DRIVE BELT ROUTING** .
4. Fit viscous fan. See **VISCOUS FAN** .
5. Fit ancillary drive belt. See **ANCILLARY DRIVE BELT** .
6. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .

OIL SEAL - CRANKSHAFT - FRONT

Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed.

See **BATTERY DISCONNECT & RECONNECT** .

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Remove crankshaft pulley. See **PULLEY - CRANKSHAFT**.
4. Fit LRT-12-229 to crankshaft pulley hub. See **Fig. 3**.
5. Position LRT-12-229 to rest on sub frame and remove crankshaft pulley bolt. See **Fig. 4**.
6. Remove LRT-12-229 from crankshaft pulley hub.
7. Remove crankshaft pulley hub.
8. Fit LRT-12-230/1 and LRT-12-230/2 to crankshaft seal and remove crankshaft oil seal. See **Fig. 5**.
9. Discard oil seal.

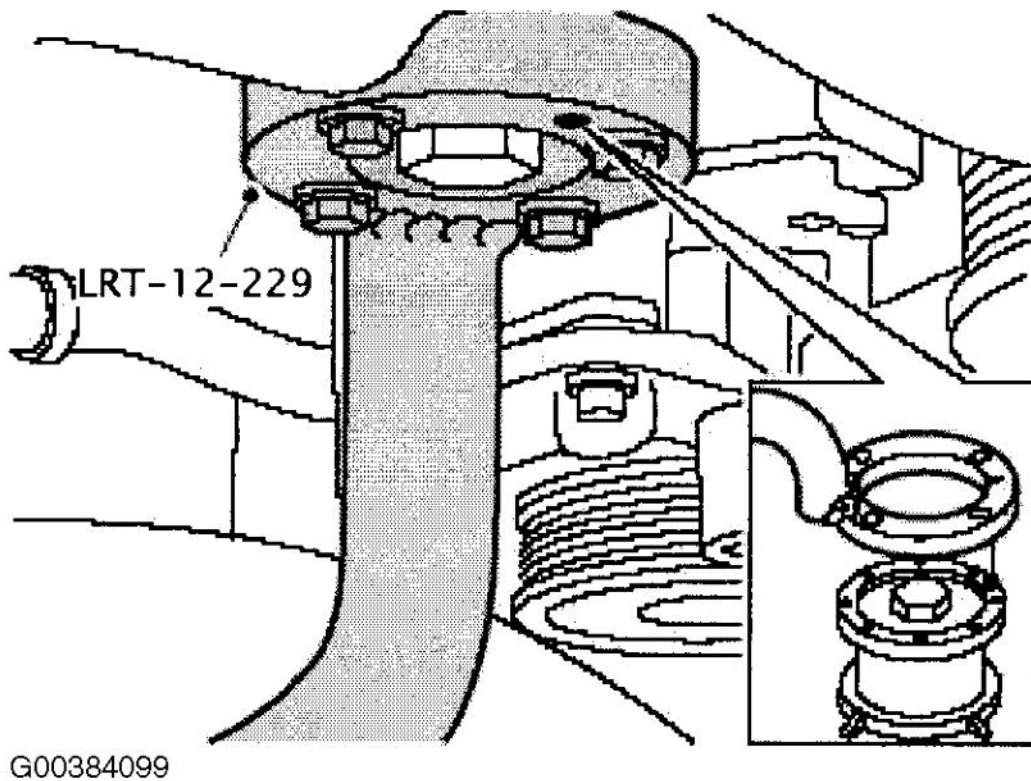
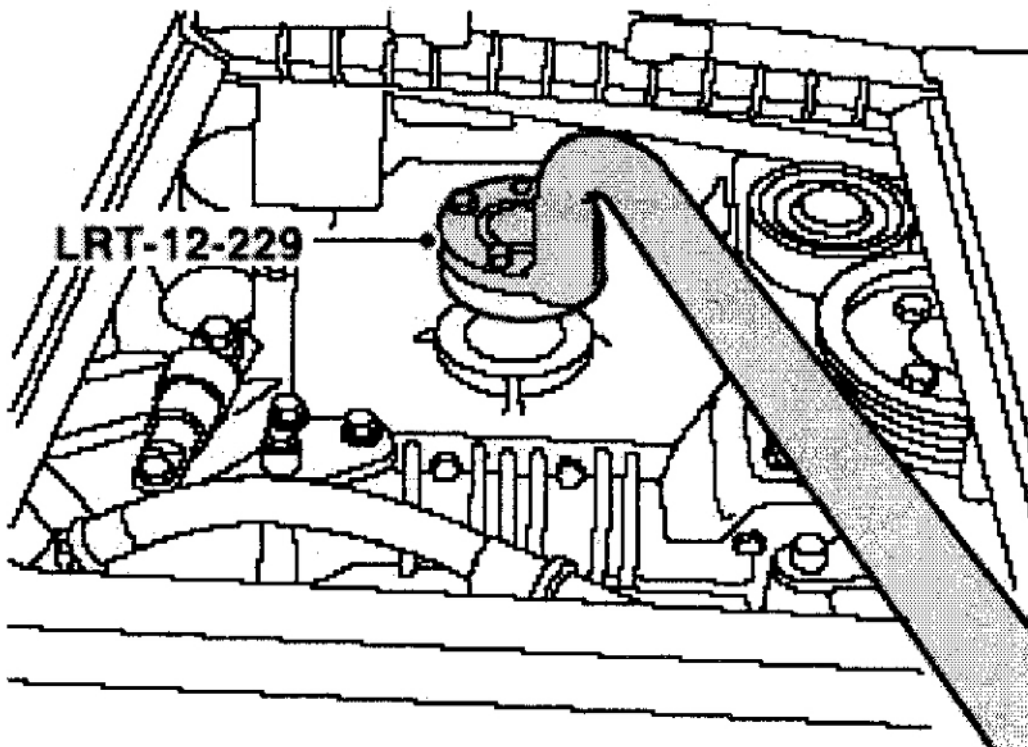


Fig. 3: Installing LRT-12-229 To Crankshaft Pulley Hub
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 4: Removing Crankshaft Pulley Bolt With LRT-12-229
Courtesy of LAND ROVER NORTH AMERICA, INC.

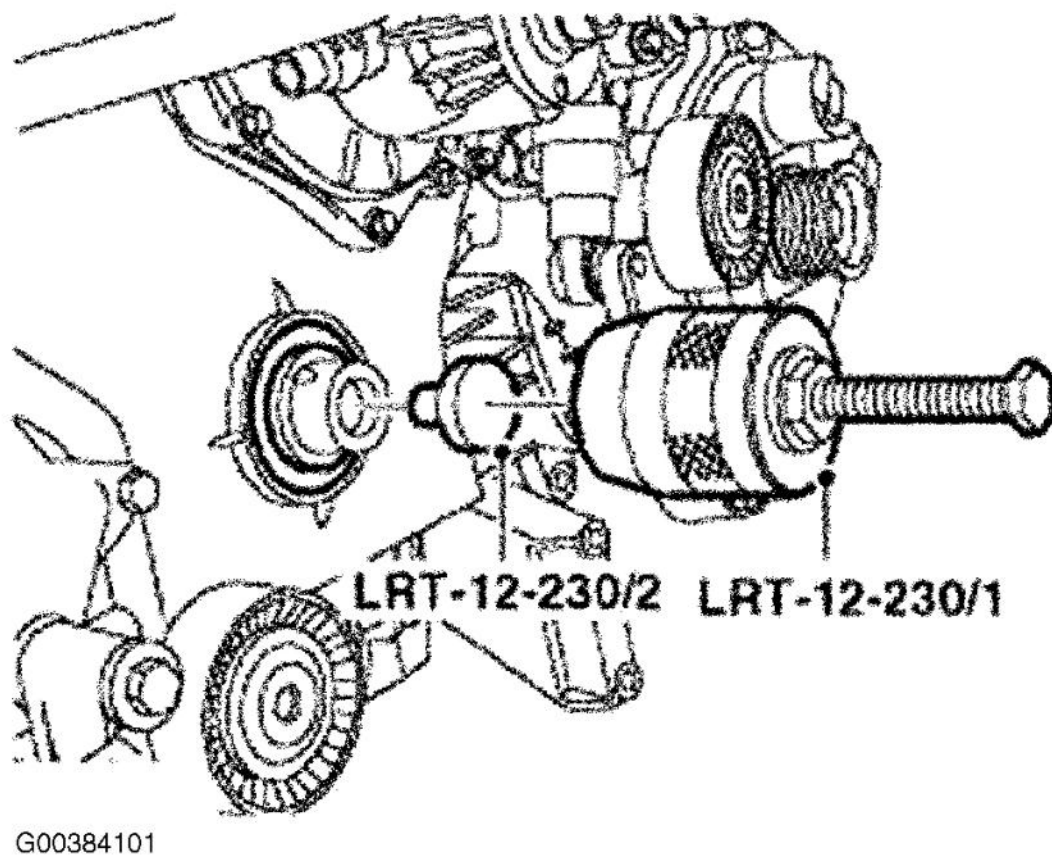


Fig. 5: Removing Crankshaft Oil Seal With LRT-12-230/1 & LRT-12-230/2
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Clean seal mating faces.
2. Fit new crankshaft oil seal to front cover using LRT-12-231. See **Fig. 6**.

NOTE: Front crankshaft oil seal should be fitted flush to front timing cover.

3. Remove LRT-12-231.
4. Clean crankshaft pulley hub and mating faces, fit crankshaft pulley hub to crankshaft.
5. Fit new bolt to crankshaft, lock crankshaft using LRT-12-229 and initially tighten crankshaft bolt to 100 Nm (74 ft. lbs). Using an angle torque gauge tighten in the following sequence:

Stage 1

60°

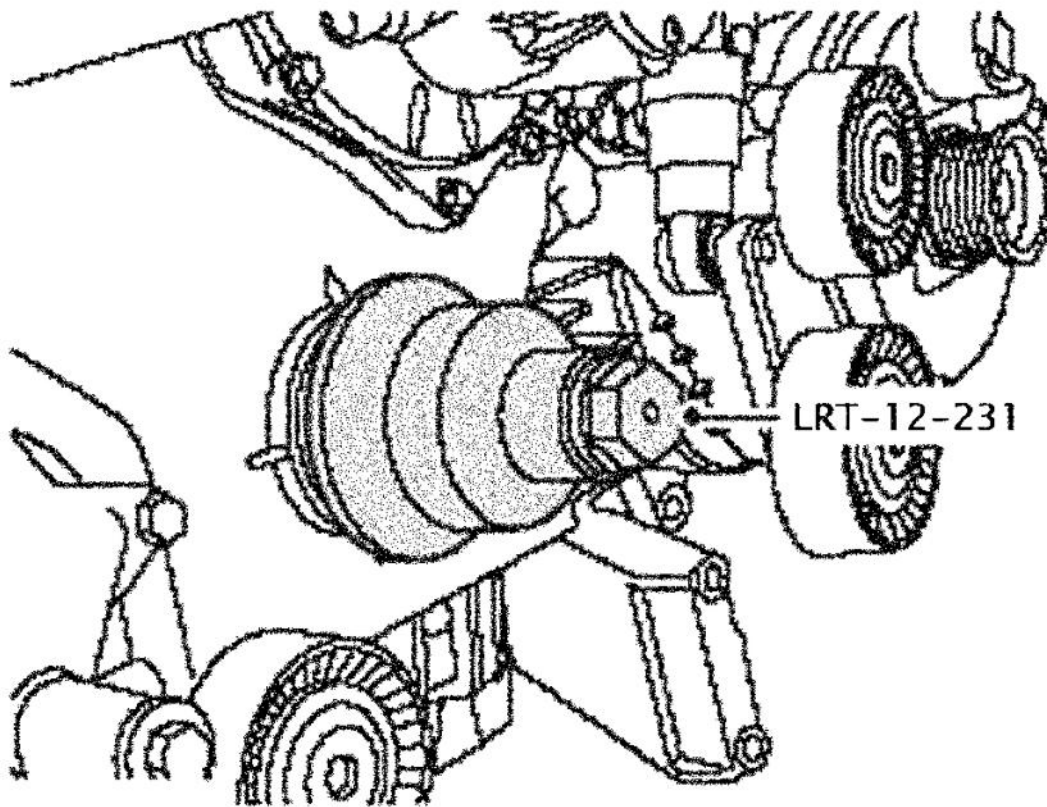
Stage 2

60°

Stage 3

30°

6. Remove LRT-12-229 from crankshaft pulley hub.
7. Fit crankshaft pulley. See **PULLEY - CRANKSHAFT**.
8. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.



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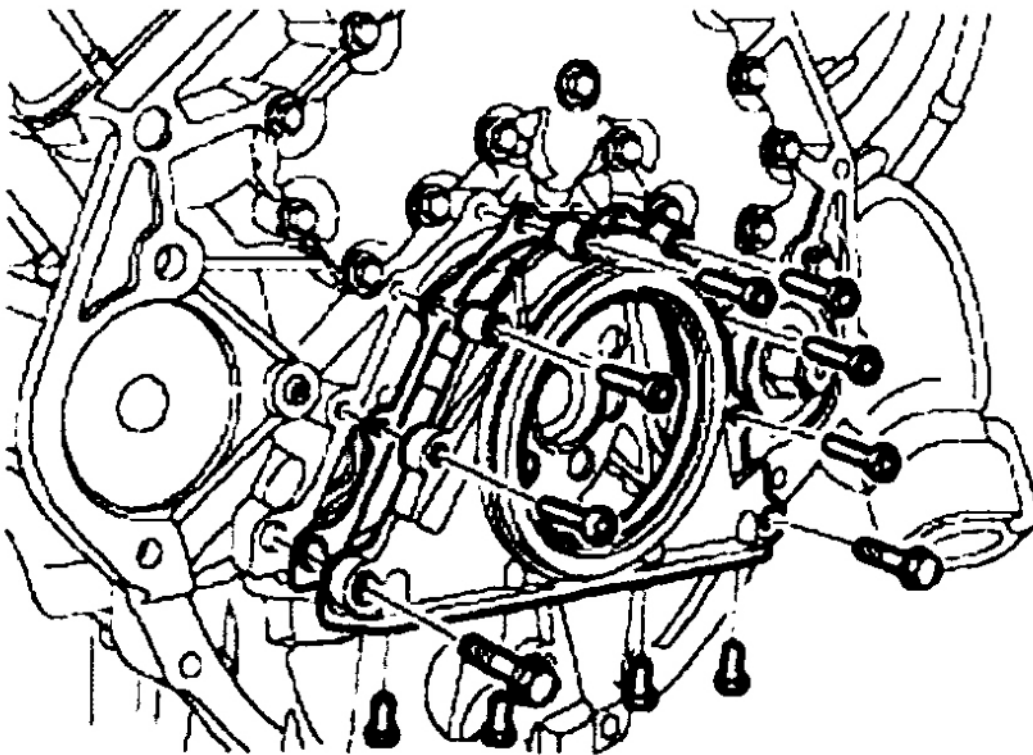
Fig. 6: Installing NEW Crankshaft Oil Seal-To-Front Cover With LRT-12-231
Courtesy of LAND ROVER NORTH AMERICA, INC.

OIL SEAL - CRANKSHAFT - REAR**Removal**

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed.

See **BATTERY DISCONNECT & RECONNECT** .

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Drain engine oil. See **FILTER - ENGINE OIL**.
4. Remove torque converter drive plate. See **TORQUE CONVERTER DRIVE PLATE**.
5. Remove 6 Torx bolts and 6 bolts securing crankshaft rear oil seal housing to cylinder block. See **Fig. 7**.
6. Remove crankshaft rear oil seal housing.
7. Discard gasket from crankshaft rear oil seal housing.
8. Remove crankshaft rear oil seal from housing.



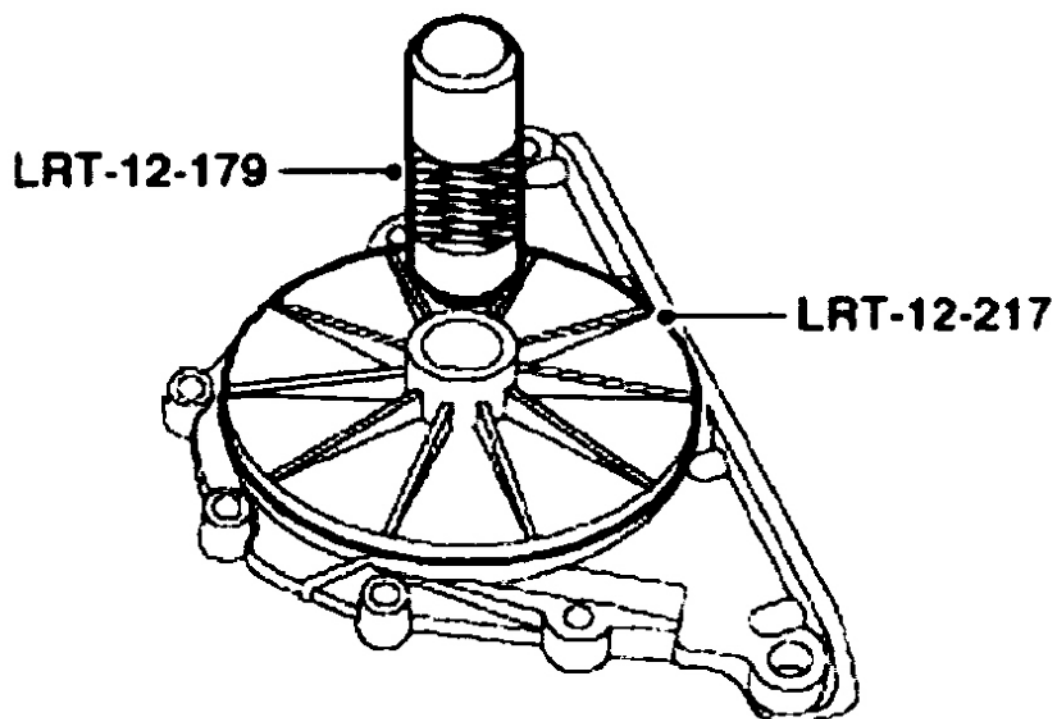
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Fig. 7: Removing Crankshaft Rear Oil Seal Housing-To-Cylinder Block
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

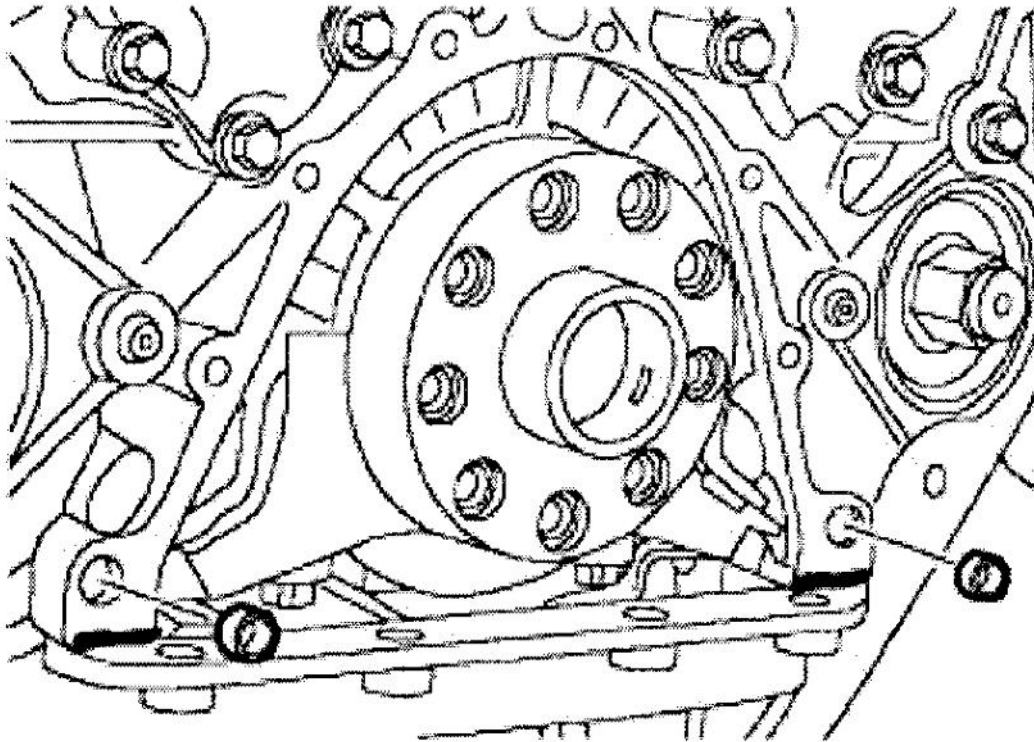
1. Clean crankshaft rear oil seal housing, locating dowels and mating faces on cylinder block and crankshaft oil seal running surface.

2. Fit LRT-12-217 and LRT-12-179 to new crankshaft rear oil seal and fit new seal to housing. See **Fig. 8**.
3. Check for correct fitment of dowels in cylinder block. See **Fig. 9**.
4. Fit new gasket to crankshaft rear oil seal housing.
5. Apply sealant , Part No. STC 50550 to upper oil sump gasket contact point. See **Fig. 10**.
6. Fit LRT-12-218 to crankshaft. Apply a thin coat of oil to inner lip of crankshaft rear oil seal, fit seal and housing over LRT-12-218, fit onto dowels and remove tool. See **Fig. 11**.
7. Fit new washers to 6 Torx bolts, fit 6 Torx bolts and 6 bolts securing crankshaft oil seal housing to cylinder block and tighten to 12 Nm (9 ft. lbs).
8. Fit torque converter drive plate. See **TORQUE CONVERTER DRIVE PLATE**.
9. Fill engine with oil. See **FILTER - ENGINE OIL**.
10. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.



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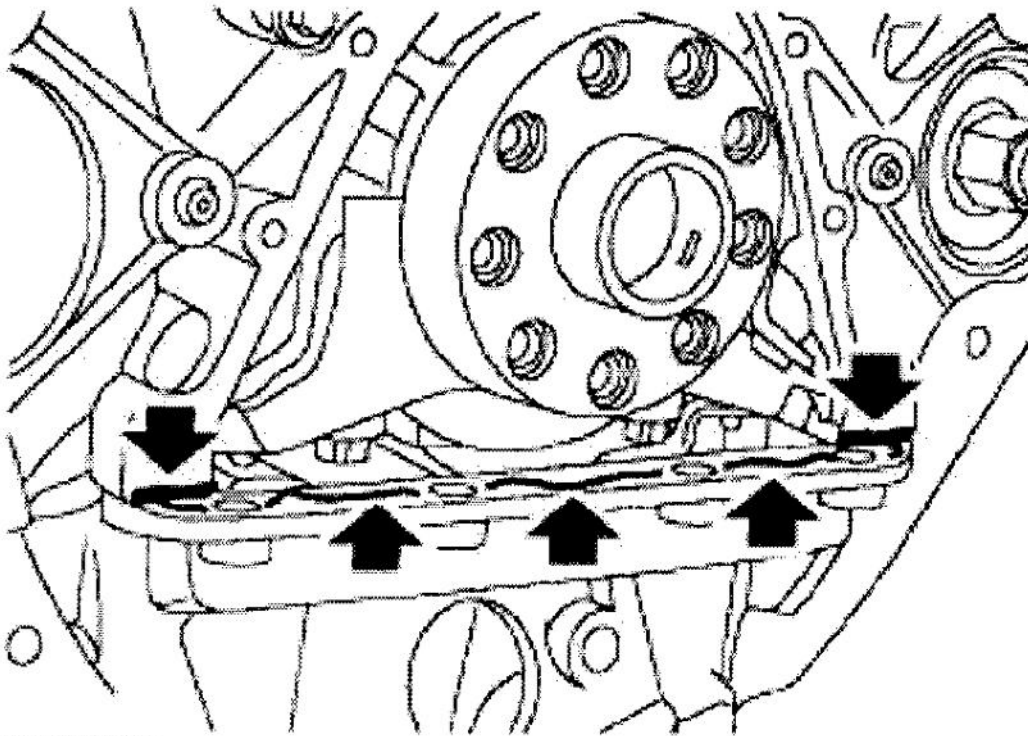
Fig. 8: Installing NEW Crankshaft Rear Oil Seal With LRT-12-217 & LRT-12-179
Courtesy of LAND ROVER NORTH AMERICA, INC.



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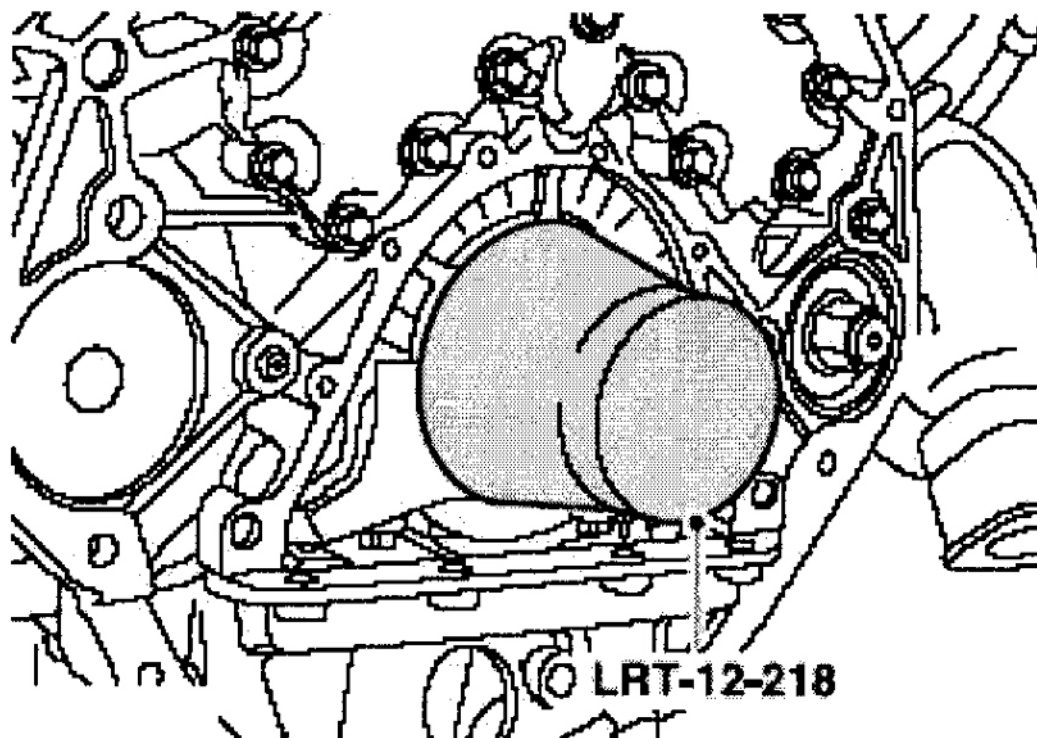
Fig. 9: Checking Dowels

Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 10: Applying Sealant-To-Upper Oil Sump Gasket
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 11: Installing LRT-12-218 To Crankshaft To Fit Seal & Housing
Courtesy of LAND ROVER NORTH AMERICA, INC.

GASKET - CYLINDER HEAD - LEFT

Removal

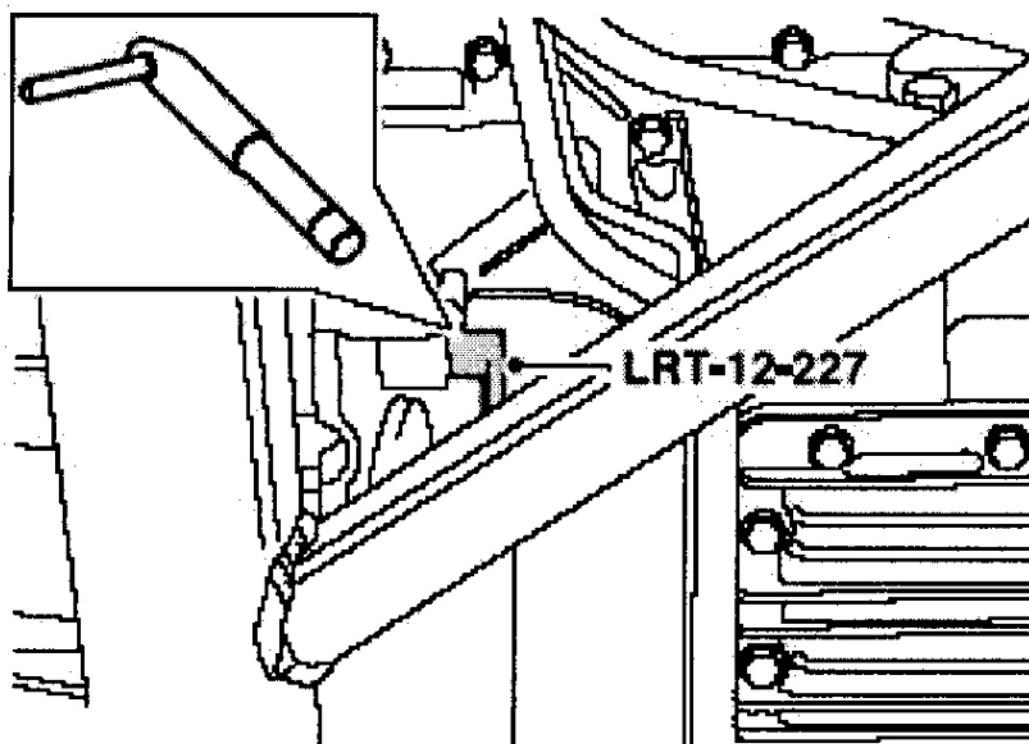
Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT** .

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Drain cooling system. See **DRAINING & REFILLING COOLING SYSTEM** .
4. Drain engine oil and remove oil filter. See **FILTER - ENGINE OIL**.
5. Remove left exhaust manifold. See **GASKET(S) -- EXHAUST MANIFOLD -- LH** .
6. Remove coolant pump to coolant manifold pipes. See **PIPE(S) -- COOLANT PUMP TO COOLANT MANIFOLD** .
7. Remove left Variable Camshaft Control (VCC) unit. See **VARIABLE CAMSHAFT UNIT - VARIABLE CAMSHAFT CONTROL (VCC) - LEFT**.

8. Remove LRT-12-227 from timing tool access hole. See **Fig. 12**.
9. Rotate engine crankshaft pulley anti-clockwise to align the 45° mark before TDC timing mark. See **Fig. 13**.

NOTE: Raise timing chain and hold under tension while turning crankshaft pulley.

10. Remove LRT-12-223/6, LRT-12-223/5, LRT-12-223/3 and LRT-12-223/4 from left cylinder head camshafts.
11. Remove bolt securing left timing chain guide rail to left cylinder head. See **Fig. 14**.
12. Working in the sequence shown, progressively loosen 10 cylinder head bolts. See **Fig. 15**.
13. Discard 10 cylinder head bolts and remove 10 cylinder head bolt washers.
14. With assistance, remove cylinder head assembly. See **Fig. 16**.
15. Discard cylinder head gasket.
16. Discard "O" ring from cylinder block. See **Fig. 17**.



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Fig. 12: Removing LRT-12-227 From Timing Tool Access Hole
Courtesy of LAND ROVER NORTH AMERICA, INC.

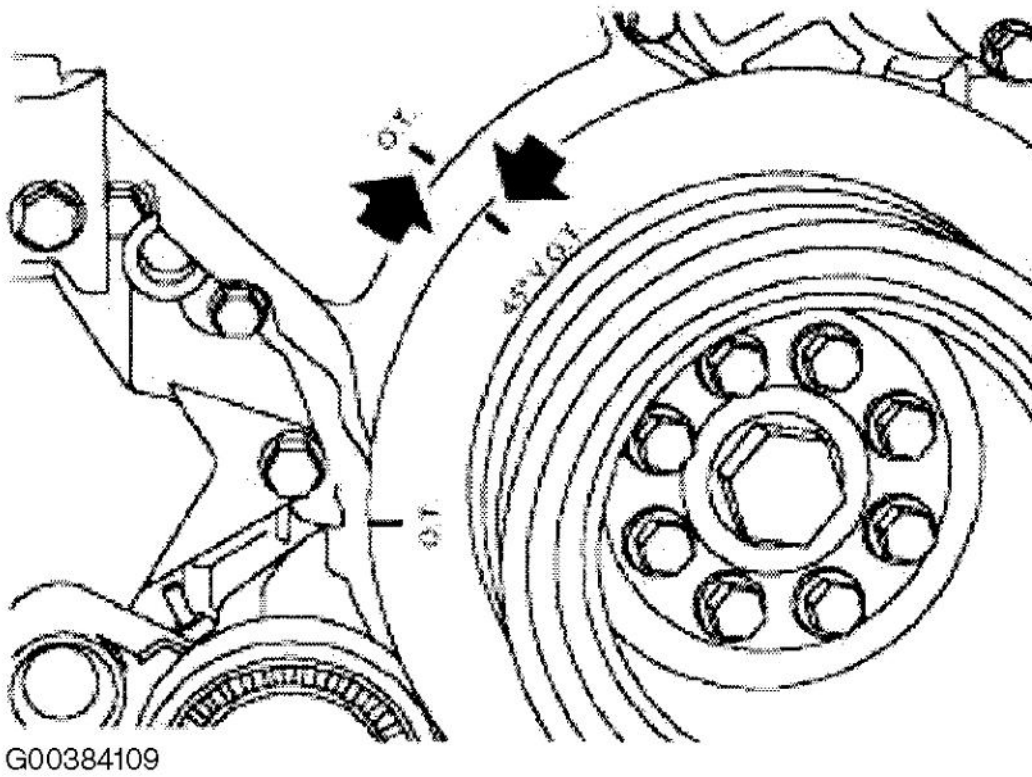
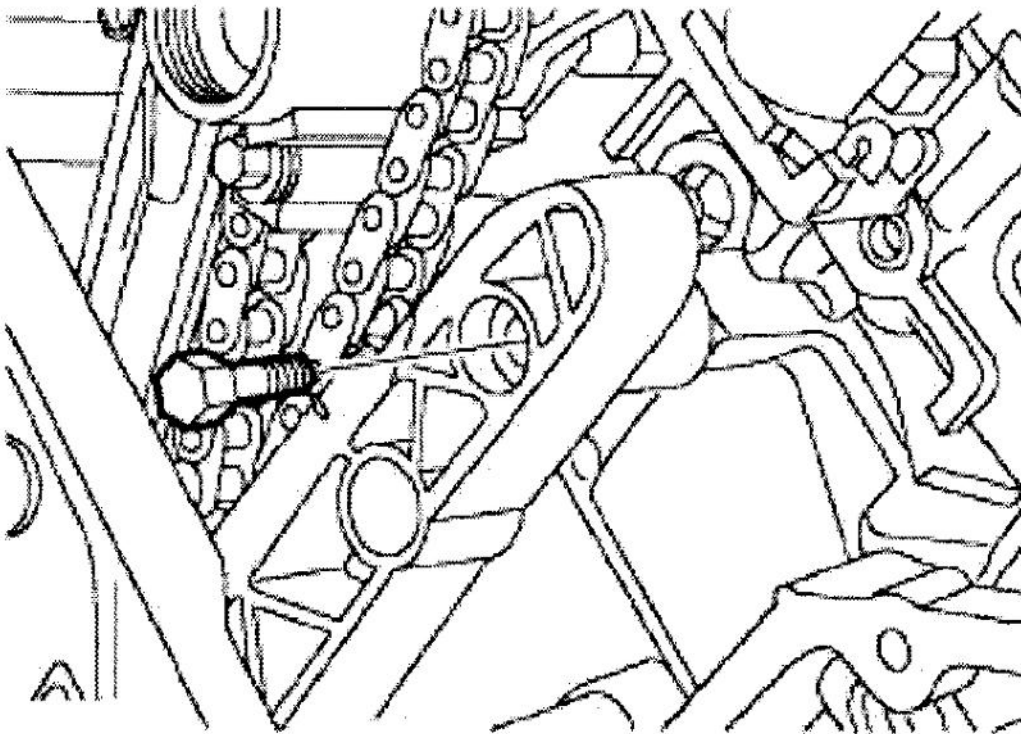
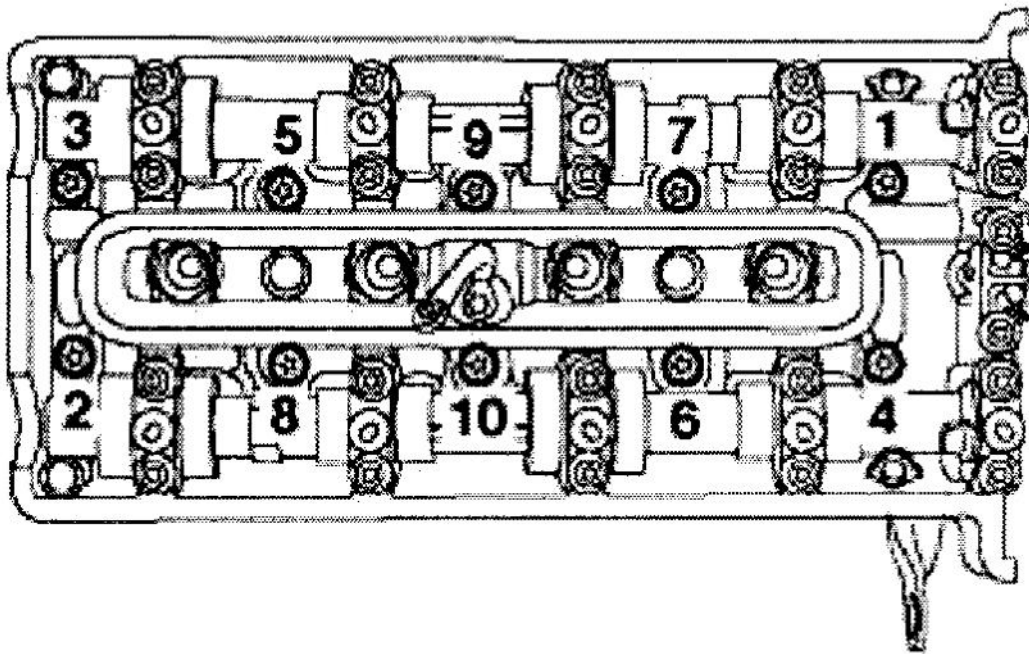


Fig. 13: Rotating Engine Crankshaft Pulley Anti-Clockwise
Courtesy of LAND ROVER NORTH AMERICA, INC.



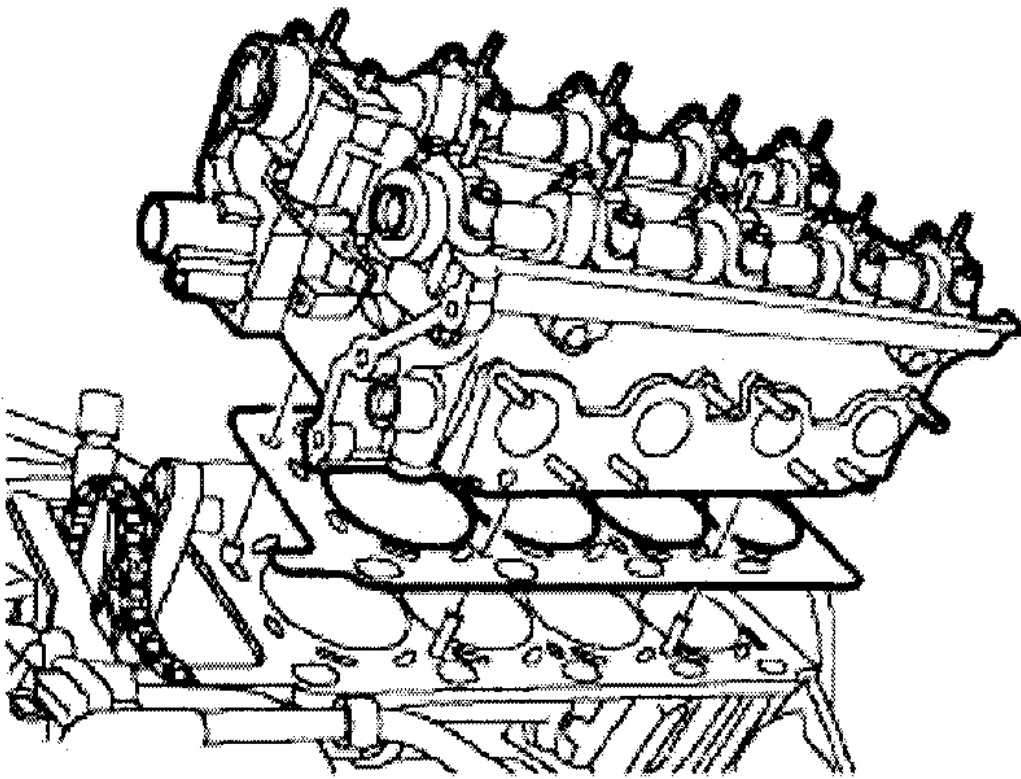
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Fig. 14: Removing Left Timing Chain Guide Rail-To-Cylinder Head Bolt
Courtesy of LAND ROVER NORTH AMERICA, INC.



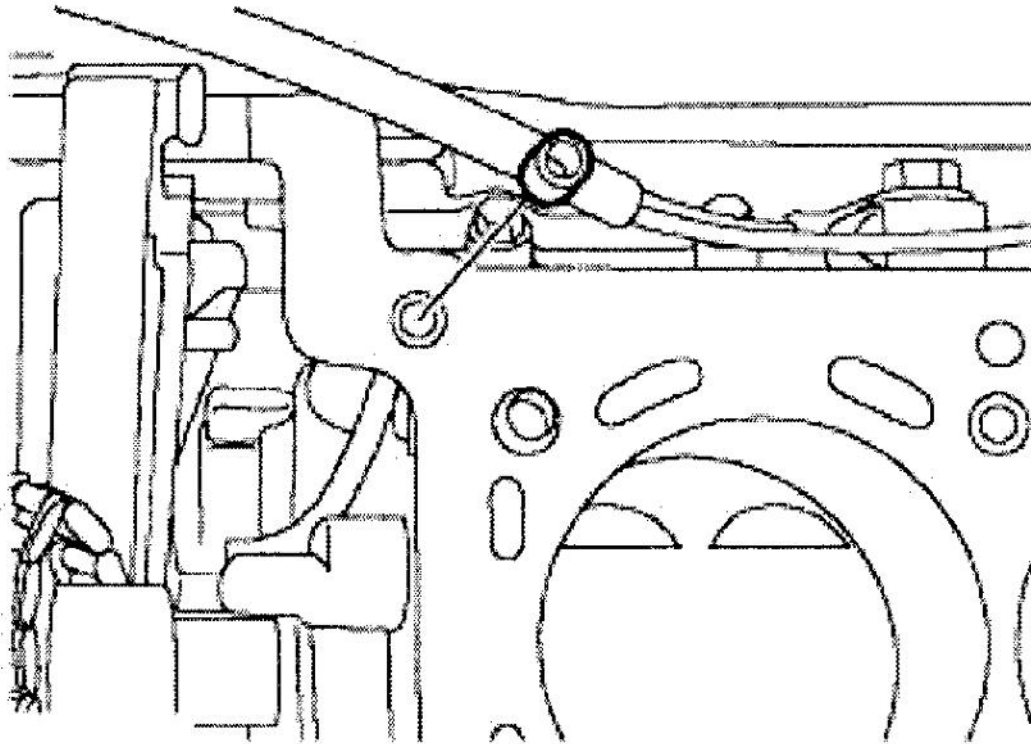
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Fig. 15: Loosening Cylinder Head Bolts In Sequence
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 16: Removing Cylinder Head Assembly
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 17: Discarding "O" Ring From Cylinder Block
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Clean mating faces of cylinder head and cylinder block, dowels and dowel holes. If necessary remove all traces of sealing compound with hard wood scraper. Ensure remnants do not remain in oil ways cooling ducts or bolt holes.

CAUTION: Make sure no oil or coolant is left in the cylinder head bolt holes as damage to the cylinder block may occur when tightening the cylinder head bolts.

2. Using a straight edge and feeler gauges, check cylinder head for distortion along lines in illustration. See **Fig. 18**.
3. Fit new "O" ring to cylinder block.
4. Apply sealant, Part No. STC 50550 to areas illustrated. See **Fig. 19**.
5. Fit new cylinder head gasket to locating dowels on cylinder block.
6. With assistance, fit cylinder head and carefully position cylinder head onto dowels.

7. Fit cylinder head bolt washers and new cylinder head bolts. Tighten cylinder head bolts in sequence shown to 30 Nm (22 ft. lbs). Using an angle torque gauge tighten all bolts in sequence by a further 80°, and then a final 80°. See **Fig. 20**.

NOTE: **DO NOT remove special coating from new cylinder head bolts.**

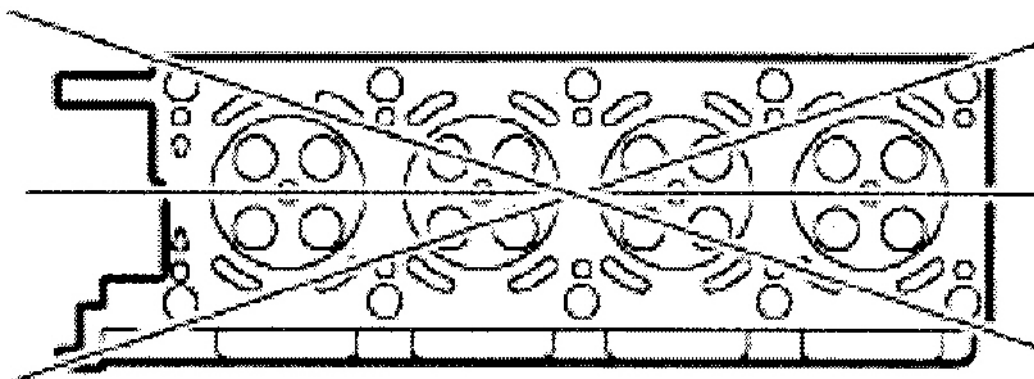
8. Fit bolt securing left timing chain guide rail to left cylinder head and tighten.
9. Carefully rotate camshafts until letter and cylinder number markings located on rear of camshafts are in an upright position. See **Fig. 21**.

NOTE: **The twisting and apparent misalignment of the camshafts does not indicate incorrect engine timing.**

10. Loosen bolt securing LRT-12-223/4 to LRT-12-223/3.
11. Fit LRT-12-223/4 and LRT-12-223/3 to rear of left camshafts and tighten bolt securing tools. See **Fig. 22**.
12. Fit LRT-12-223/5, LRT-12-223/6 to left cylinder head and tighten LRT-12-223/6 into spark plug thread. See **Fig. 23**.
13. Rotate engine crankshaft pulley clockwise to align TDC timing mark. See **Fig. 24**.

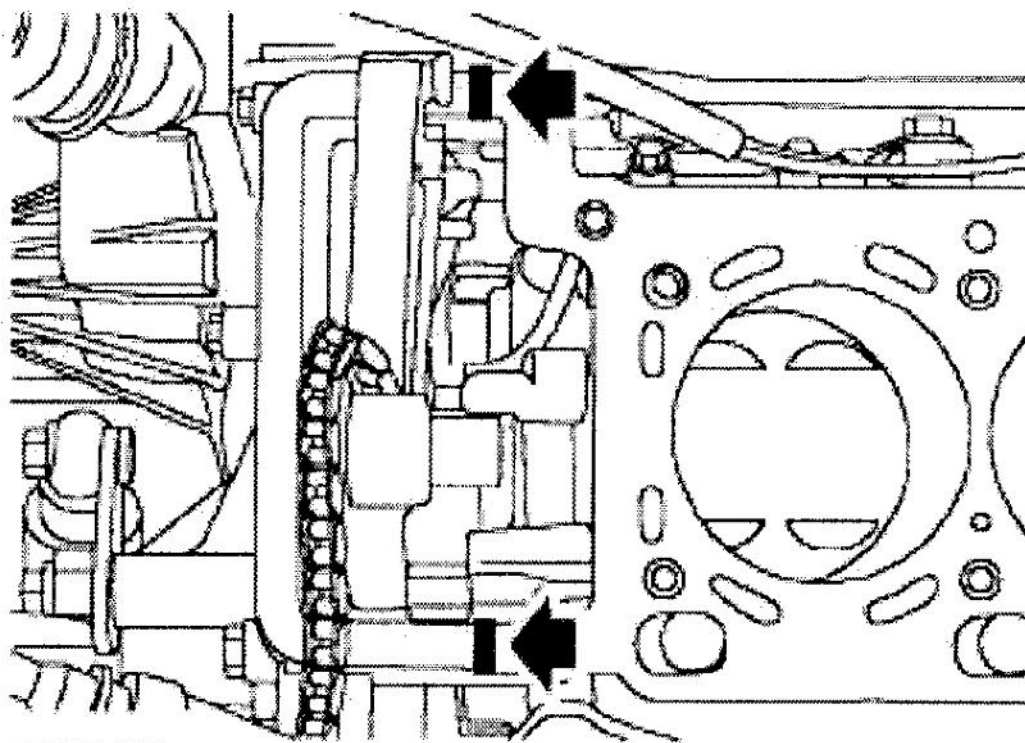
NOTE: **Raise timing chain and hold under tension while turning crankshaft pulley.**

14. Position LRT-12-227 through timing tool access hole and secure flywheel in TDC position. See **Fig. 12**.
15. Fit left Variable Camshaft Control (VCC) unit. See **VARIABLE CAMSHAFT UNIT - VARIABLE CAMSHAFT CONTROL (VCC) - LEFT**.
16. Fit coolant pump to coolant manifold pipes. See **PIPE(S) -- COOLANT PUMP TO COOLANT MANIFOLD**.
17. Fit left exhaust manifold. See **GASKET(S) -- EXHAUST MANIFOLD -- LH**.
18. Fit new oil filter and fill engine with oil. See **FILTER - ENGINE OIL**.
19. Fill cooling system. See **DRAINING & REFILLING COOLING SYSTEM**.
20. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.



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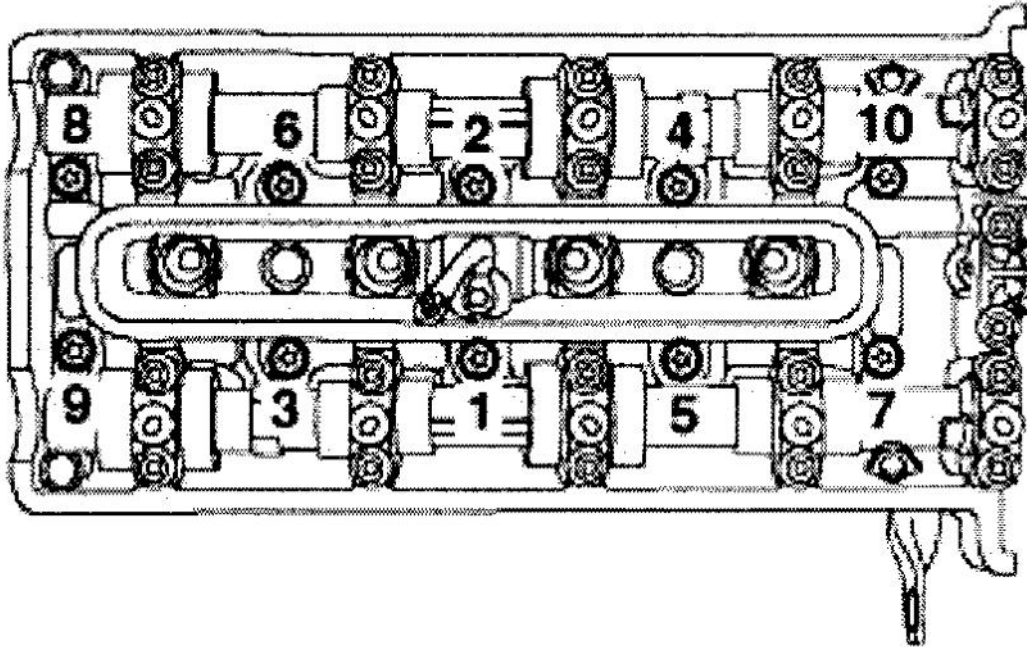
Fig. 18: Checking Cylinder Head For Distortion
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 19: Applying Sealant To Left Cylinder Head

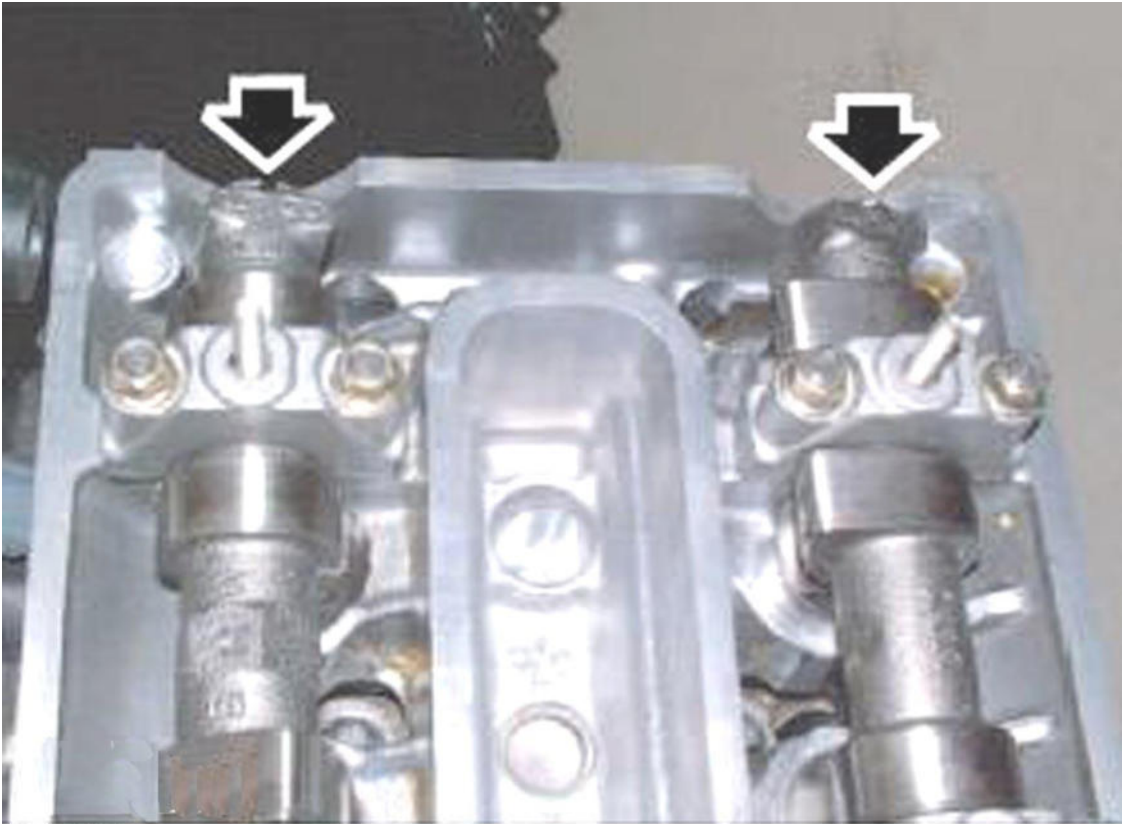
Courtesy of LAND ROVER NORTH AMERICA, INC.



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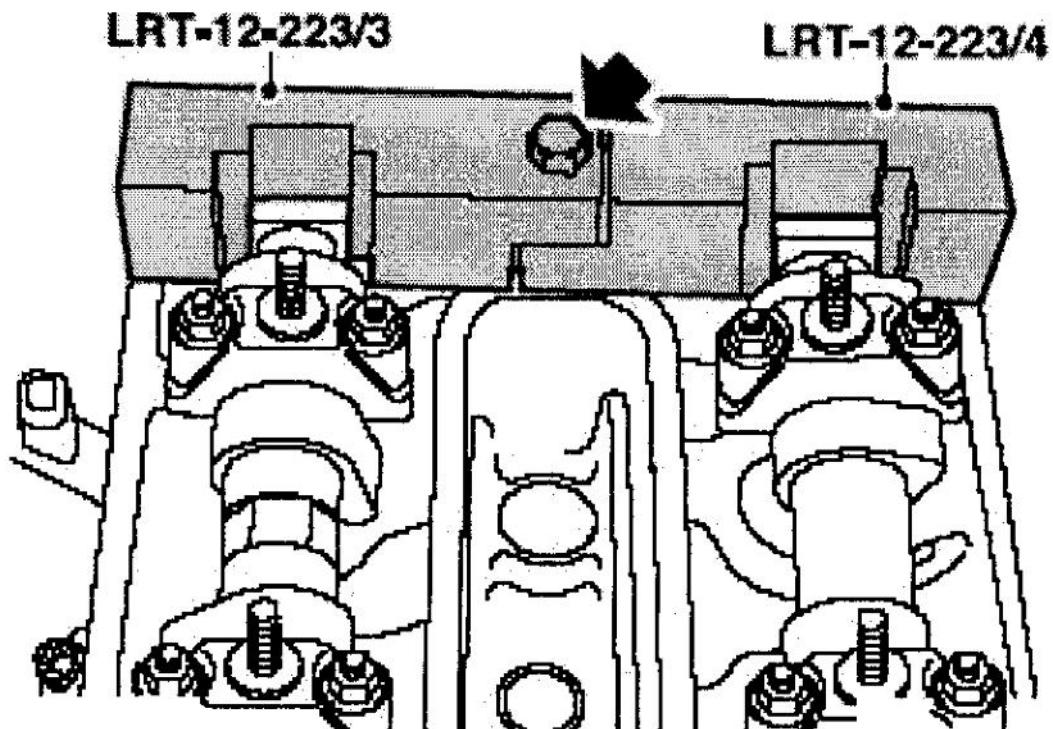
Fig. 20: Installing Cylinder Head

Courtesy of LAND ROVER NORTH AMERICA, INC.



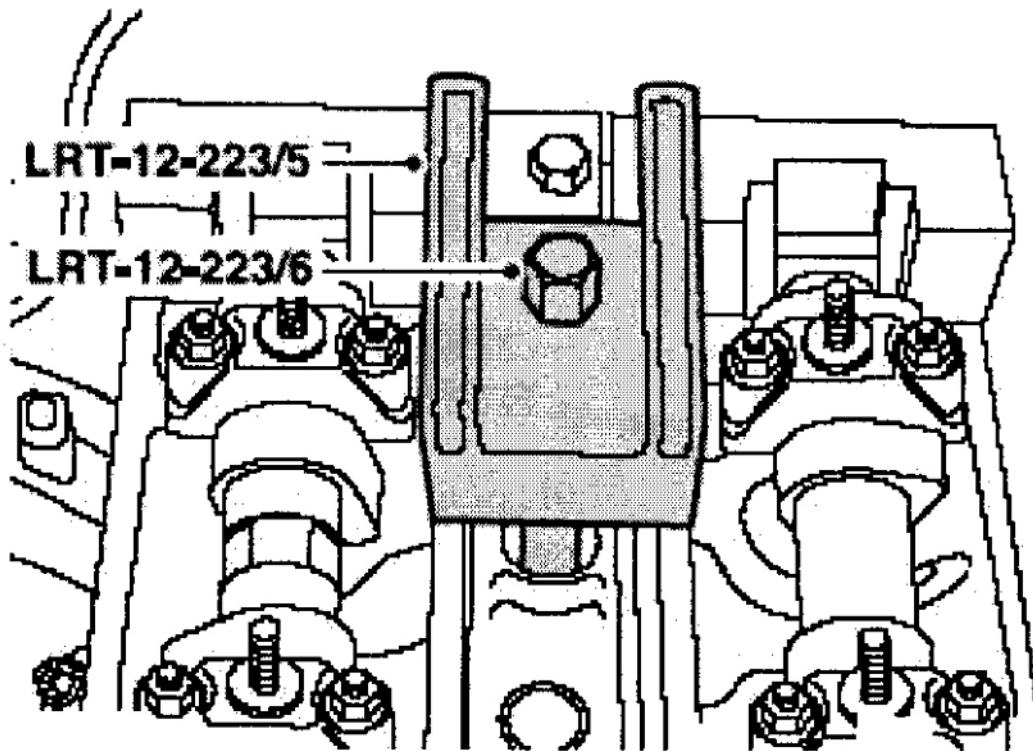
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Fig. 21: Rotating Camshafts To Upright Position
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 22: Installing LRT-12-223/4 & LRT-12-223/3 To Rear Of Left Camshafts
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 23: Installing LRT-12-223/5 & LRT-12-223/6 To Left Cylinder Head
Courtesy of LAND ROVER NORTH AMERICA, INC.

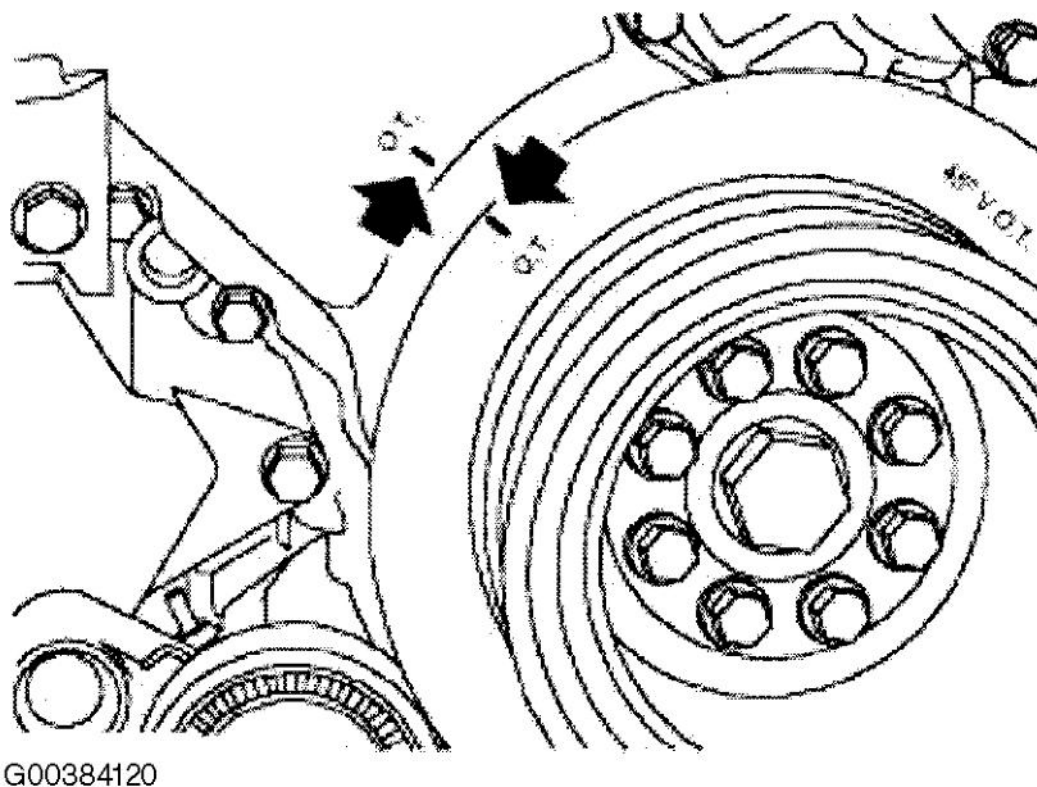


Fig. 24: Rotating Engine Crankshaft Pulley Clockwise
 Courtesy of LAND ROVER NORTH AMERICA, INC.

GASKET - CYLINDER HEAD - RIGHT

Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT** .

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Drain cooling system. See **DRAINING & REFILLING COOLING SYSTEM** .
4. Drain engine oil and remove oil filter. See **FILTER - ENGINE OIL**.
5. Remove right exhaust manifold. See **GASKET(S) -- EXHAUST MANIFOLD -- RH** .
6. Remove coolant pump to coolant manifold pipes. See **PIPE(S) -- COOLANT PUMP TO COOLANT MANIFOLD** .
7. Remove right Variable Camshaft Control (VCC) unit. See **VARIABLE CAMSHAFT UNIT - VARIABLE CAMSHAFT CONTROL (VCC) - RIGHT**.

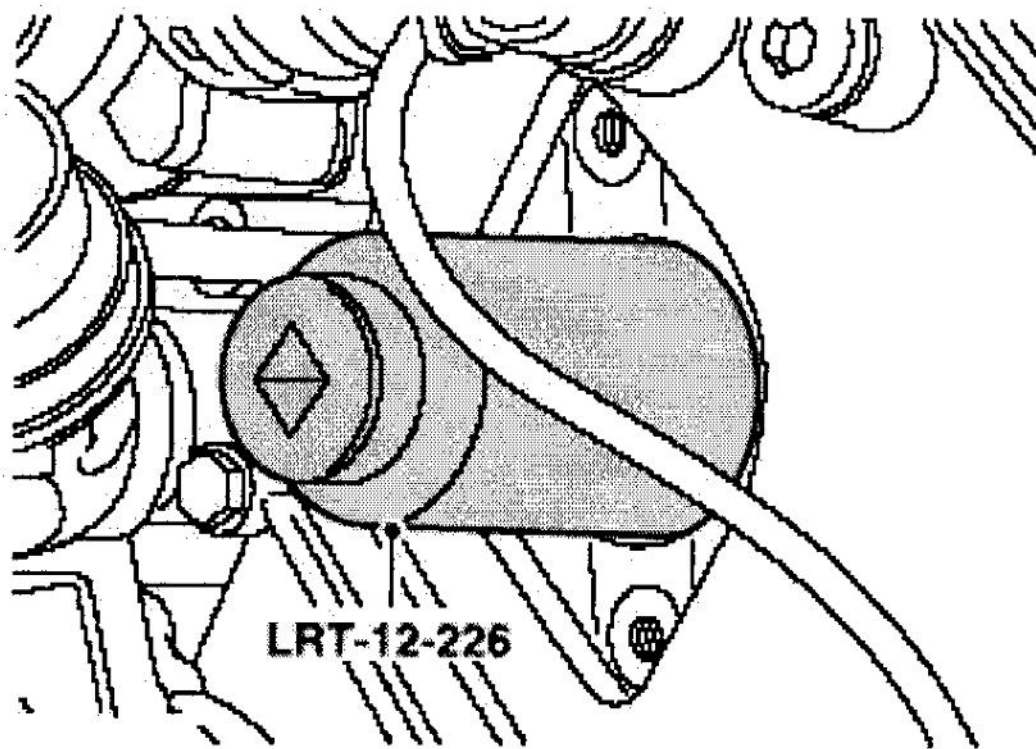
8. Fit LRT-12-226 to VCC solenoid and remove solenoid. See **Fig. 25**.

CAUTION: DO NOT allow oil to come into contact with the drive belts while removing the solenoid.

9. Remove LRT-12-227 from timing tool access hole. See **Fig. 12**.
10. Rotate engine crankshaft pulley anti-clockwise to align the 45° mark before TDC timing mark. See **Fig. 13**.

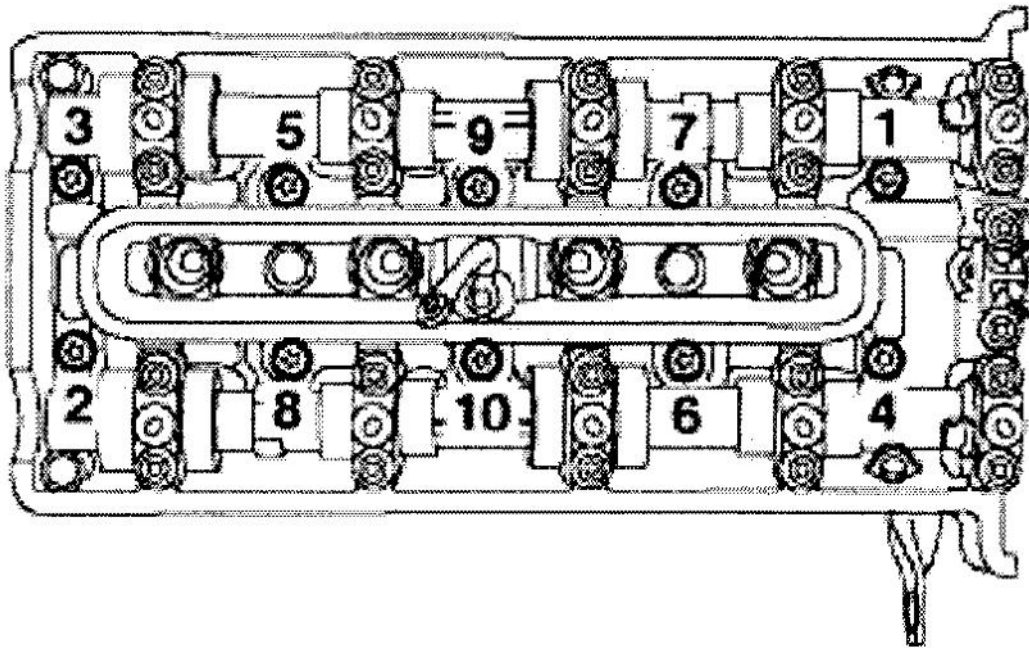
NOTE: Raise timing chain and hold under tension while turning crankshaft pulley.

11. Remove LRT-12-223/5, LRT-12-223/6, LRT-12-223/2 and LRT-12-223/1 from right cylinder head camshafts.
12. Working in the sequence shown, progressively loosen 10 cylinder head bolts. See **Fig. 26**.
13. Discard 10 cylinder head bolts and remove 10 cylinder head bolt washers.
14. With assistance, remove cylinder head assembly. See **Fig. 27**.
15. Discard cylinder head gasket.
16. Discard "O" ring from cylinder block. See **Fig. 28**.



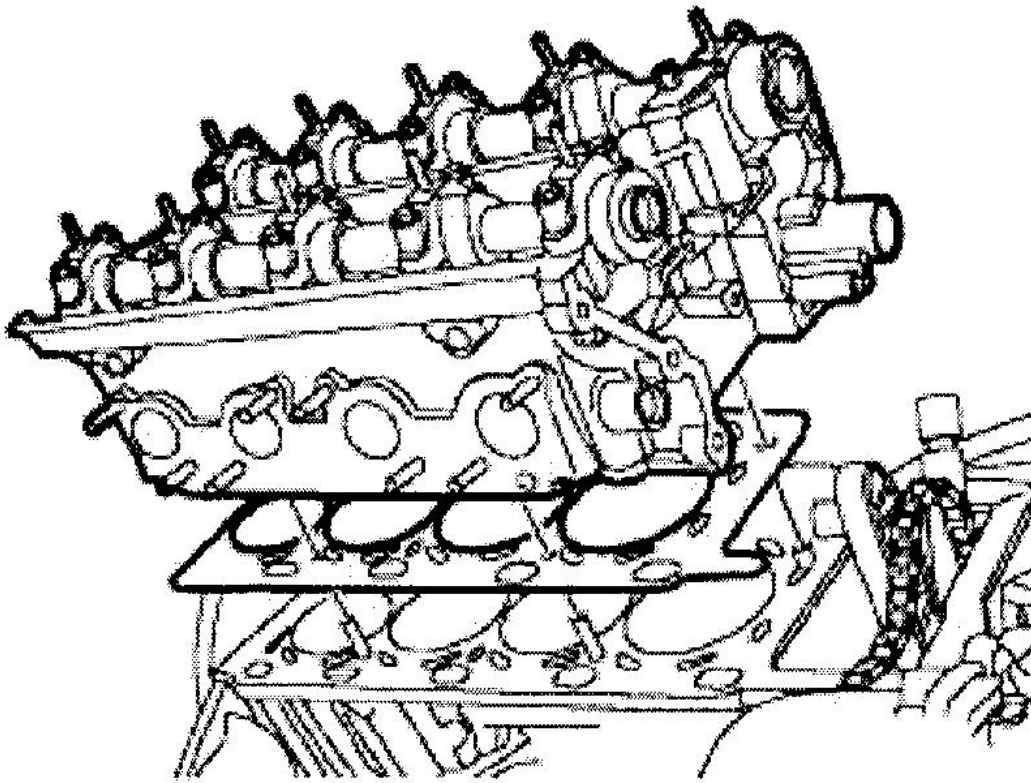
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Fig. 25: Installing LRT-12-226 To VCC Solenoid
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 26: Loosening Right Cylinder Head Bolts In Sequence
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 27: Removing Right Cylinder Head Assembly
Courtesy of LAND ROVER NORTH AMERICA, INC.

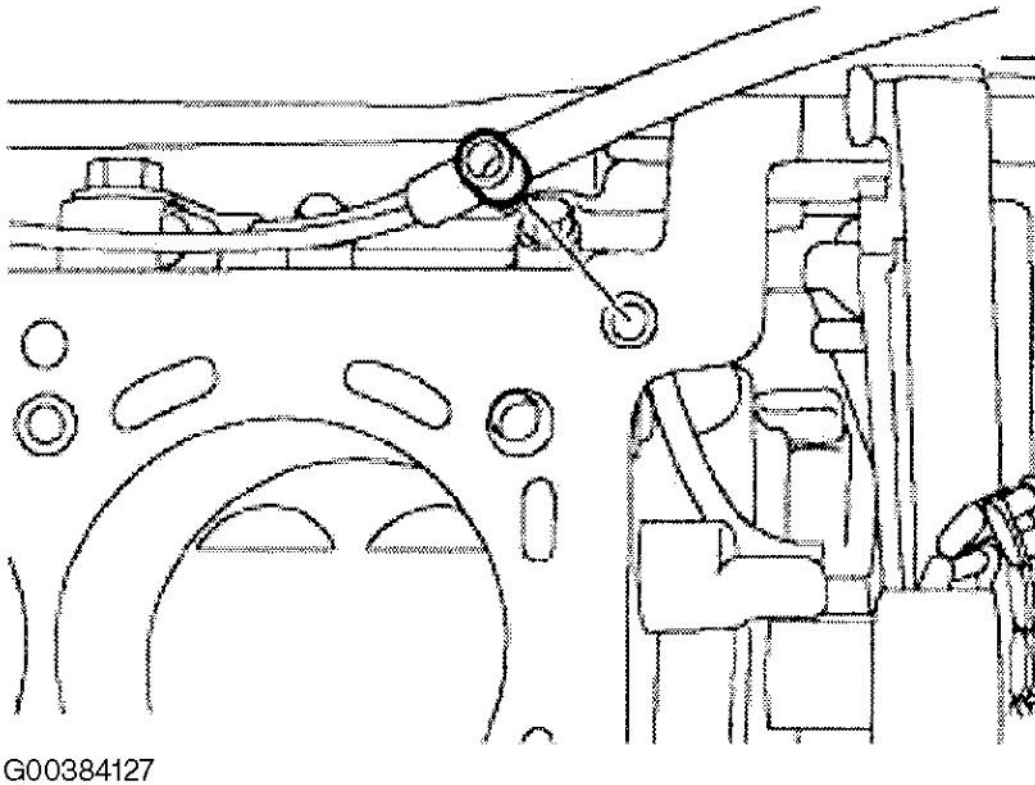


Fig. 28: Discarding "O" Ring From Right Cylinder Block
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Clean mating faces of cylinder head and cylinder block, dowels and dowel holes. If necessary remove all traces of sealing compound with hard wood scraper. Ensure remnants do not remain in oil ways cooling ducts or bolt holes.

CAUTION: Make sure no oil or coolant is left in the cylinder head bolt holes as damage to the cylinder block may occur when tightening the cylinder head bolts.

2. Using a straight edge and feeler gauges, check cylinder head for distortion along lines in illustration. See **Fig. 18**.
3. Fit new "O" ring to cylinder block.
4. Apply sealant, Part No. STC 50550 to areas illustrated. See **Fig. 29**.
5. Fit new cylinder head gasket to locating dowels on cylinder block.
6. With assistance, fit cylinder head and carefully position cylinder head onto dowels.

7. Fit cylinder head bolt washers and new cylinder head bolts. Tighten cylinder head bolts in sequence shown to 30 Nm (22 ft. lbs). Using an angle torque gauge tighten all bolts in sequence by a further 80° and then a final 80°. See **Fig. 30**.

NOTE: **DO NOT remove special coating from new cylinder head bolts.**

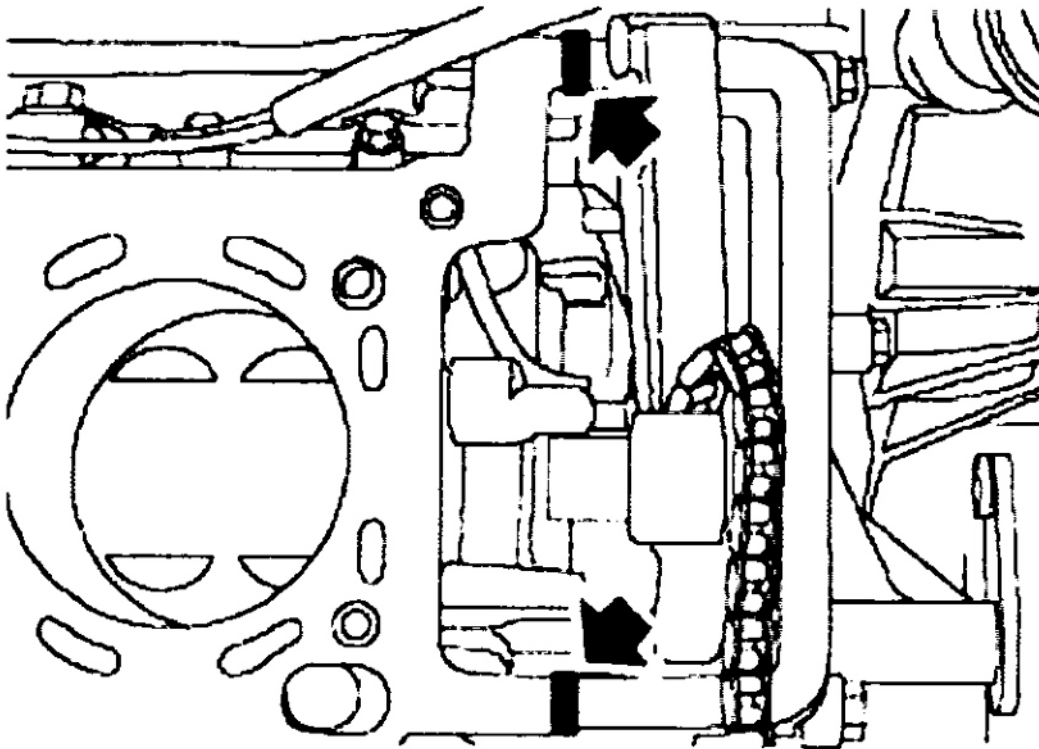
8. Carefully rotate camshafts until letter and cylinder number markings located on rear of camshafts are in an upright position. See **Fig. 21**.

NOTE: **The twisting and apparent misalignment of the camshafts does not indicate incorrect engine timing.**

9. Loosen bolt securing LRT-12-223/2 to LRT-12-223/1.
10. Fit LRT-12-223/2 and LRT-12-223/1 to rear of right camshafts and tighten bolt securing tools. See **Fig. 22**.
11. Fit LRT-12-223/5, LRT-12-223/6 to right cylinder head and tighten LRT-12-223/6 into spark plug thread. See **Fig. 23**.
12. Rotate engine crankshaft pulley clockwise to align TDC timing mark. See **Fig. 24**.

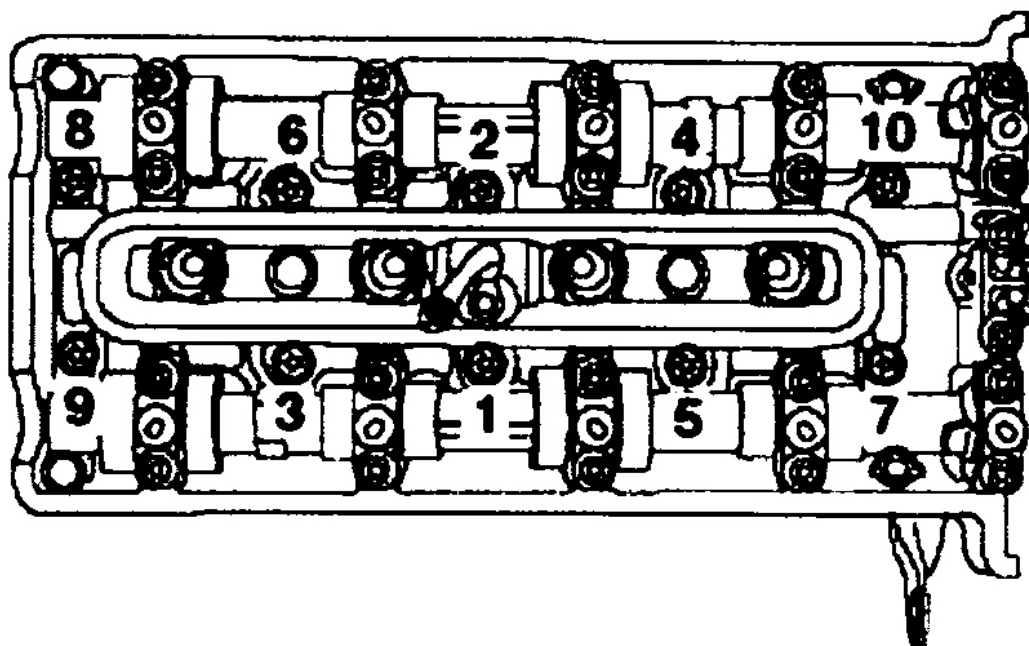
NOTE: **Raise timing chain and hold under tension while turning crankshaft pulley.**

13. Position LRT-12-227 through timing tool access hole and secure flywheel in TDC position.
14. Fit LRT-12-226 to Variable Camshaft Control (VCC) solenoid and fit solenoid. See **Fig. 25**.
15. Fit right VCC unit. See **VARIABLE CAMSHAFT UNIT - VARIABLE CAMSHAFT CONTROL (VCC) - RIGHT**.
16. Fit coolant pump to coolant manifold pipes. See **PIPE(S) -- COOLANT PUMP TO COOLANT MANIFOLD**.
17. Fit right exhaust manifold. See **GASKET(S) -- EXHAUST MANIFOLD -- RH**.
18. Fit new oil filter and fill engine with oil. See **FILTER - ENGINE OIL**.
19. Fill cooling system. See **DRAINING & REFILLING COOLING SYSTEM**.
20. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.



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Fig. 29: Applying Sealant STC 50550 Cylinder Head - Right
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 30: Installing Cylinder Head - Right Bolts In Sequence
 Courtesy of LAND ROVER NORTH AMERICA, INC.

GASKET - CAMSHAFT COVER - LEFT

Removal

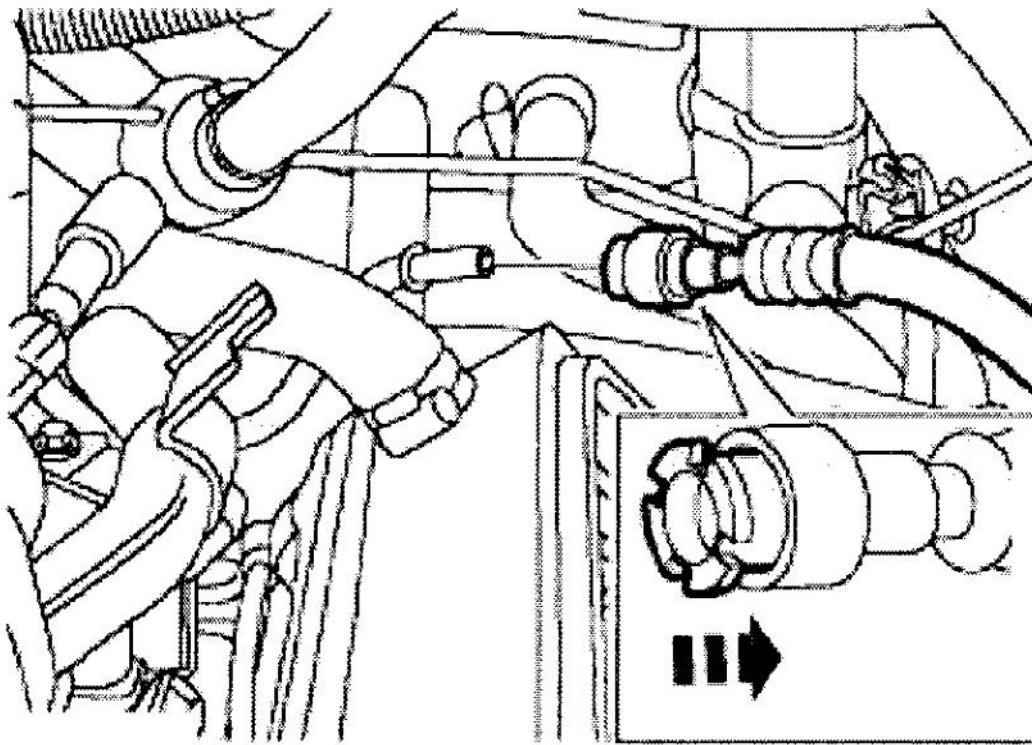
Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT**.

1. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.
2. Remove engine acoustic cover. See **ACOUSTIC COVER - ENGINE**.
3. Remove air intake plenum. See **80.15.62 PLENUM -- AIR INTAKE**.
4. Depressurize fuel system. See **FUEL SYSTEM -- DEPRESSURIZE**.

CAUTION: Always fit plugs to open connections to prevent contamination.

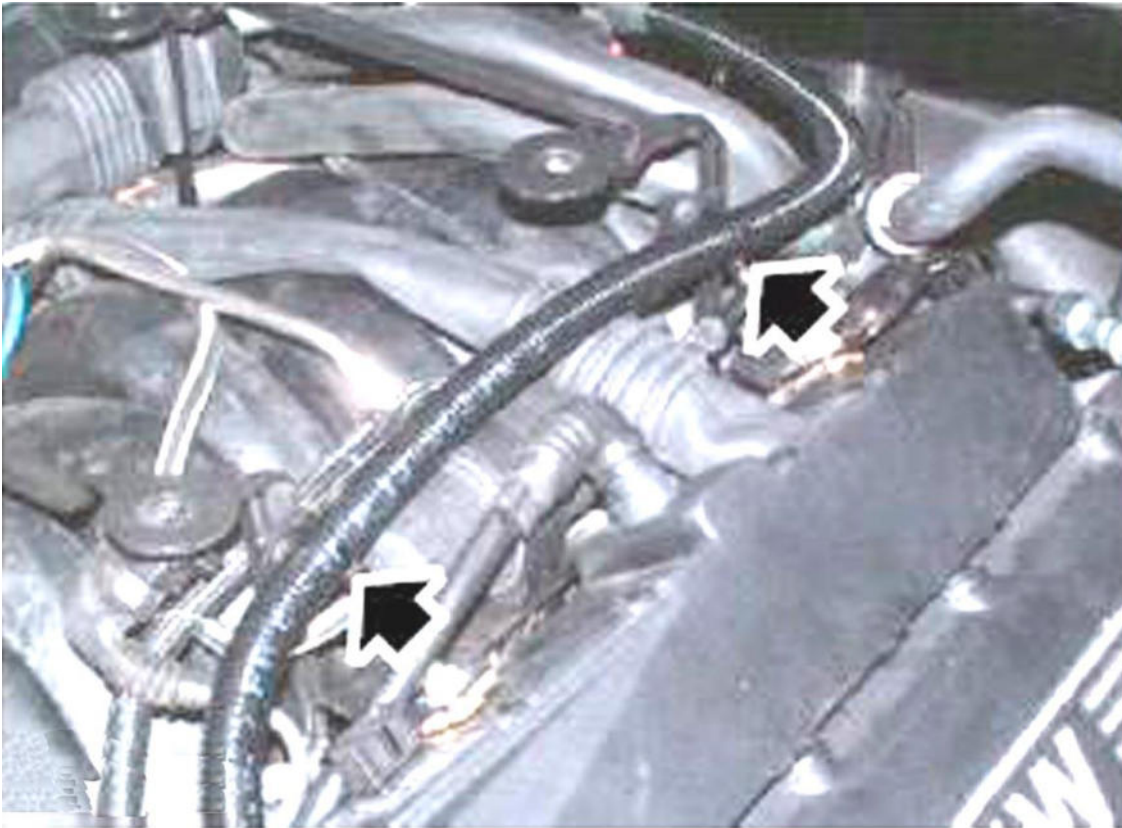
5. Disconnect fuel feed hose from fuel rail. See **Fig. 31**.
6. Release 2 clips securing battery cable to engine acoustic cover brackets. See **Fig. 32**.
7. Release heater pump from mounting rubbers and move aside. See **Fig. 33**.

8. Release clip and disconnect breather hose from camshaft cover.
9. Remove left ignition coil cover. See **COVER -- IGNITION COILS -- LH**.
10. Remove nut and disconnect earth lead from camshaft cover. See **Fig. 34**.
11. Disconnect multiplugs from ignition coils. See **Fig. 35**.
12. Remove 7 nuts securing ignition coils to camshaft cover. Remove 4 ignition coils. See **Fig. 36**.
13. Discard ignition coil cover gasket.
14. Remove 8 nuts and 3 bolts securing camshaft cover to cylinder head. Remove camshaft cover, discard 2 gaskets and 11 sealing washers. See **Fig. 37**.



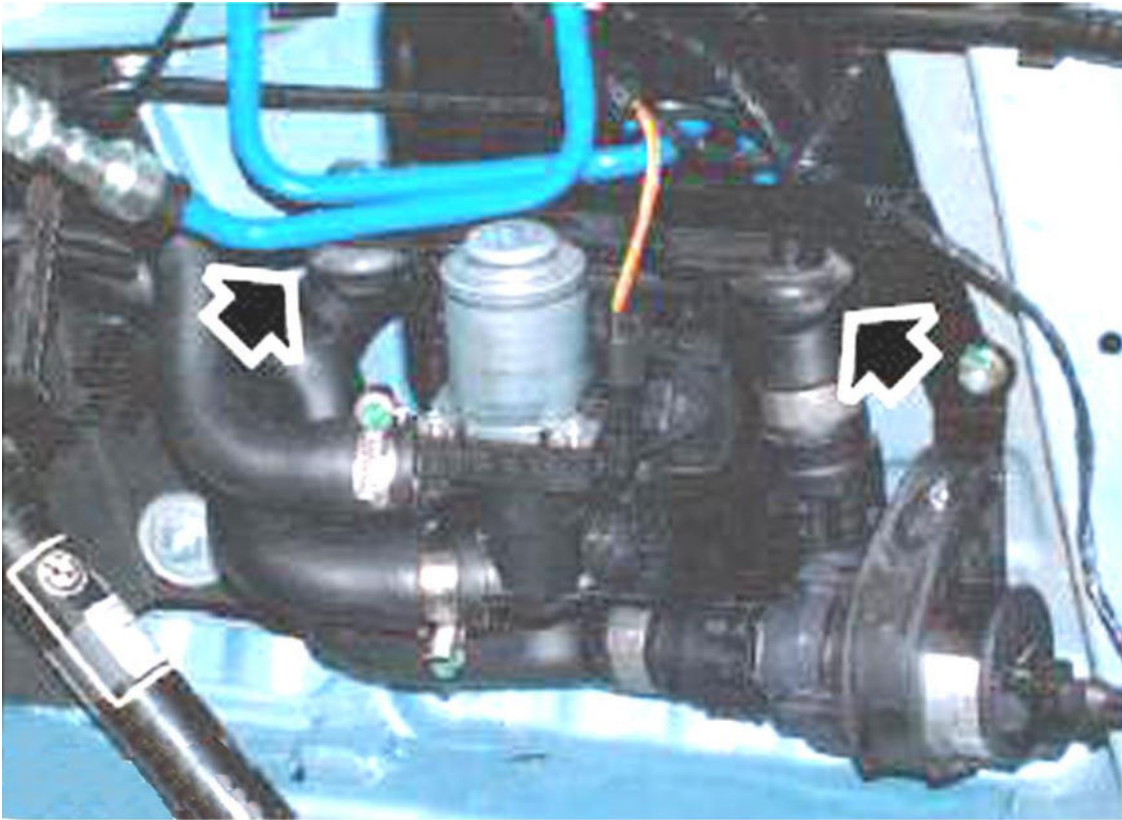
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Fig. 31: Disconnecting Fuel Feed Hose From Fuel Rail
Courtesy of LAND ROVER NORTH AMERICA, INC.



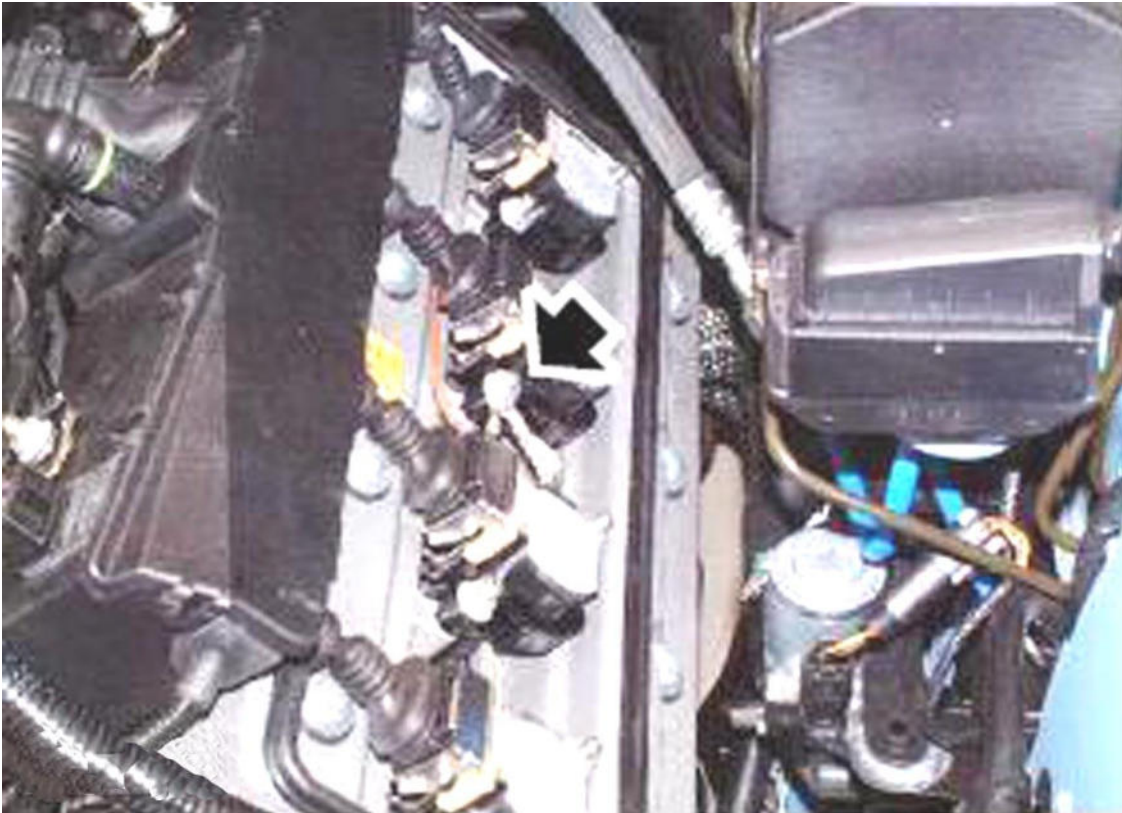
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Fig. 32: Releasing Clips From Battery Cable To Engine Acoustic Cover Brackets
Courtesy of LAND ROVER NORTH AMERICA, INC.



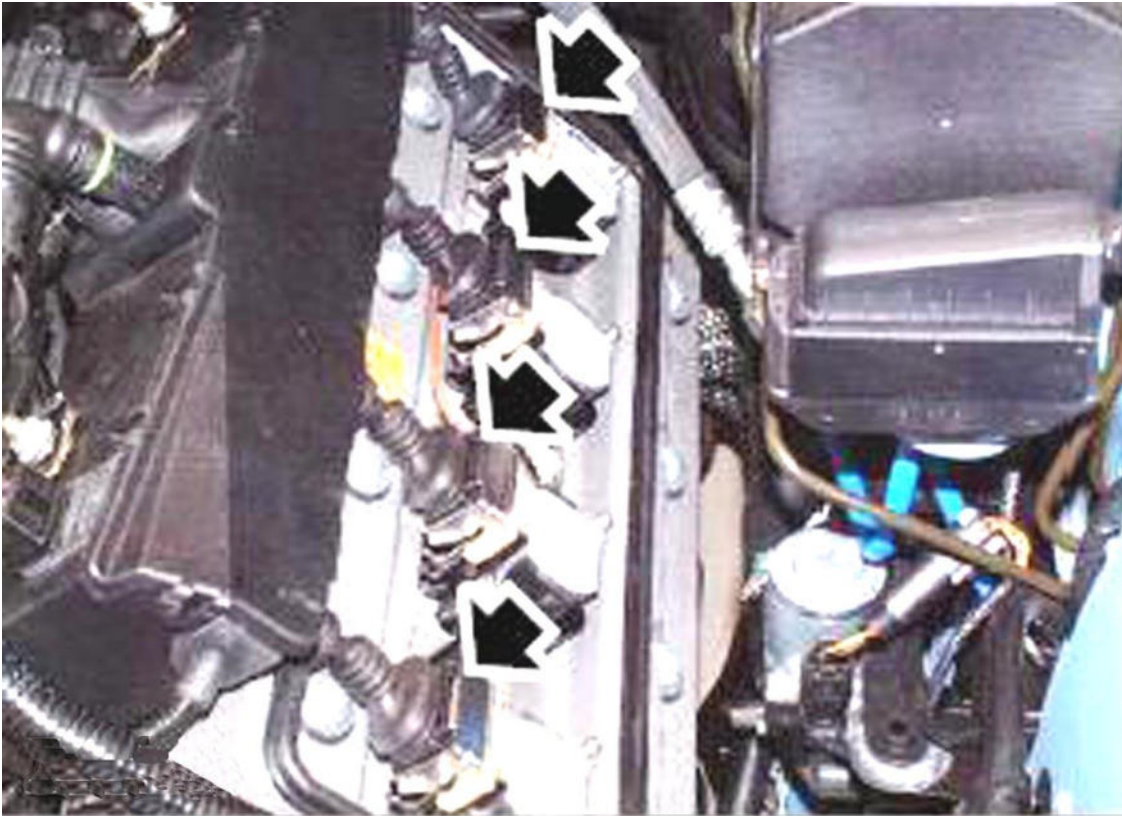
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Fig. 33: Releasing Heater Pump From Mounting Rubbers
Courtesy of LAND ROVER NORTH AMERICA, INC.



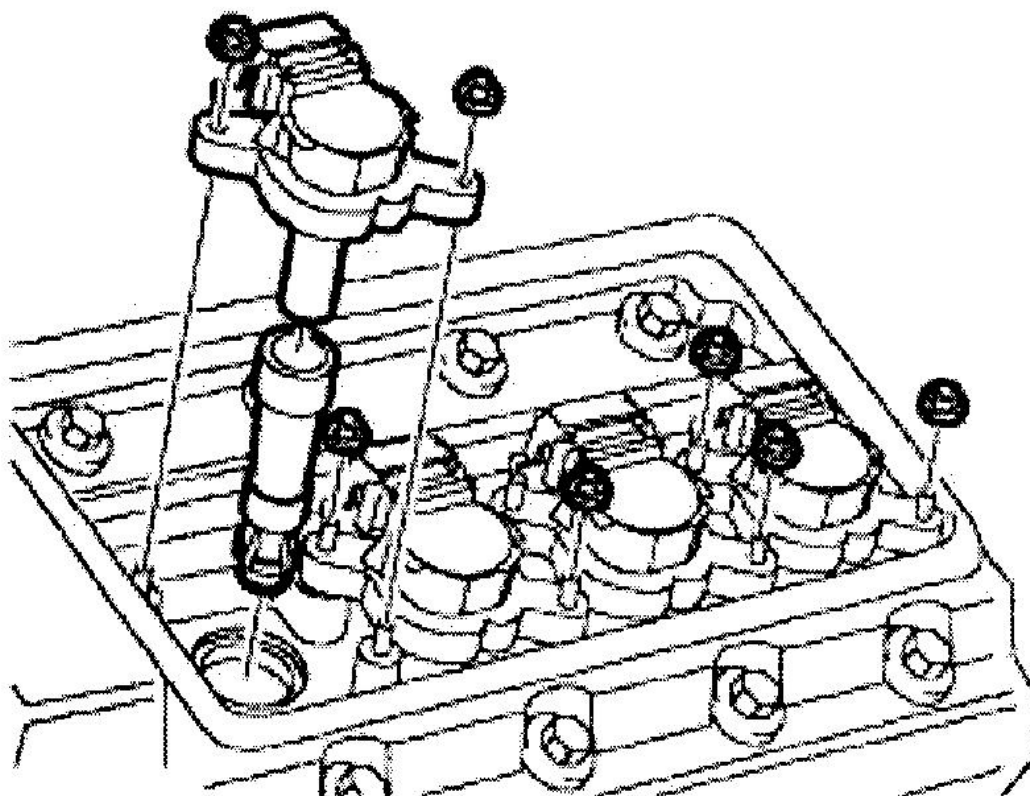
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Fig. 34: Removing Nut & Disconnecting Earth Lead From Camshaft Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.



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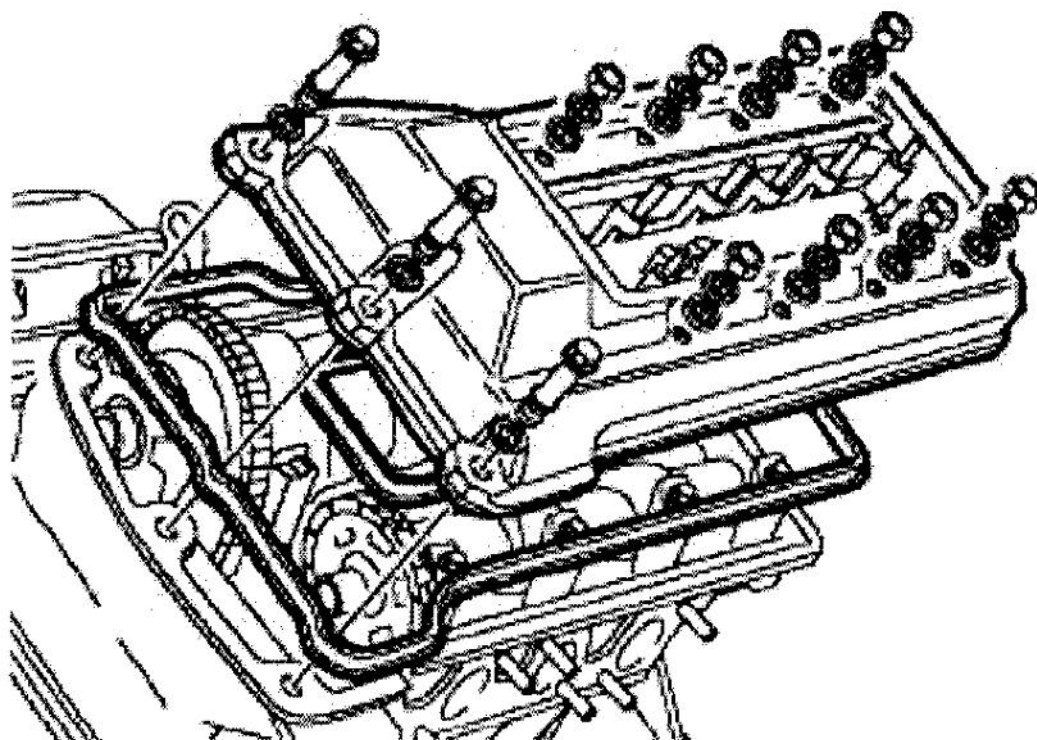
Fig. 35: Disconnecting Multiplugs From Ignition Coils
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 36: Removing Ignition Coil Nuts

Courtesy of LAND ROVER NORTH AMERICA, INC.



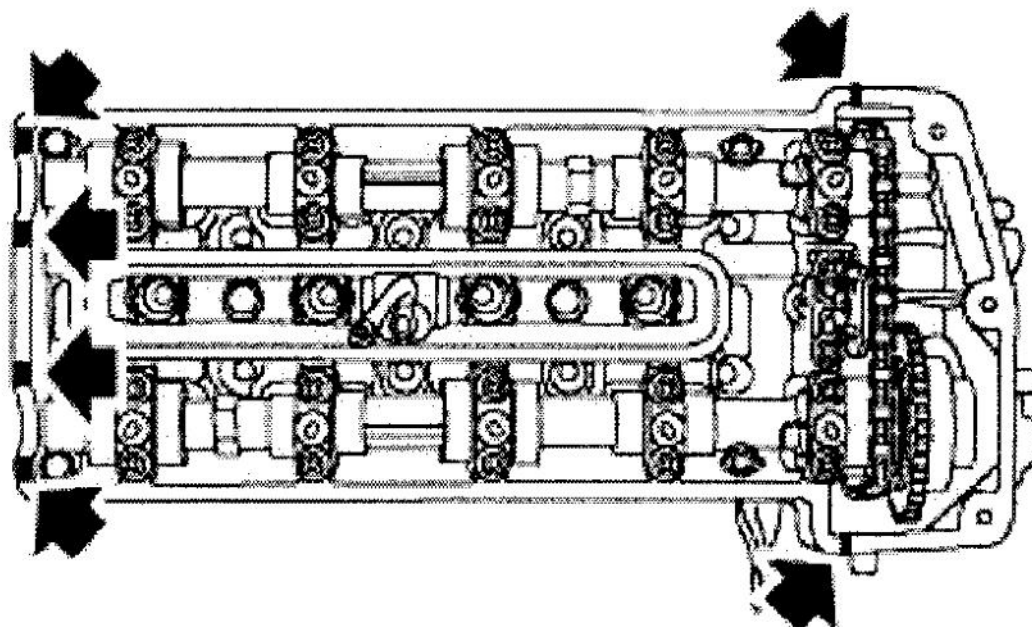
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Fig. 37: Removing Camshaft Cover-To-Cylinder Head Nuts
 Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Clean camshaft cover and mating face of cylinder head.
2. Apply sealant, Part No. STC 50550 to areas illustrated. See **Fig. 38**.
3. Fit 2 new gaskets and 11 new sealing washers to camshaft cover and fit to cylinder head.
4. Fit 8 nuts and 3 bolts securing camshaft cover and progressively tighten in sequence shown to 10 Nm (7 ft. lbs). See **Fig. 287**.
5. Fit 4 ignition coils.
6. Fit 7 nuts securing ignition coils to camshaft cover and tighten to 4 Nm (3 ft. lbs).
7. Connect multiplugs to ignition coils.
8. Connect earth lead to camshaft cover and tighten nut to 4 Nm (3 ft. lbs).
9. Fit new ignition coil cover gasket.
10. Fit left ignition coil cover. See **COVER -- IGNITION COILS -- LH**.
11. Connect breather hose to camshaft cover and secure with clip.
12. Secure heater pump to mounting rubbers.

13. Secure 2 clips on battery cable to engine acoustic cover brackets.
14. Connect quick release fuel hose to fuel rail.
15. Fit air intake plenum. See **80.15.62 PLENUM -- AIR INTAKE** .
16. Fit engine acoustic cover. See **ACOUSTIC COVER - ENGINE**.
17. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .



G00384144

Fig. 38: Applying Sealant To Left Camshaft Cover Gasket
Courtesy of LAND ROVER NORTH AMERICA, INC.

GASKET - CAMSHAFT COVER - RIGHT

Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT** .

1. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
2. Remove engine acoustic cover. See **ACOUSTIC COVER - ENGINE**.
3. Remove air intake plenum. See **80.15.62 PLENUM -- AIR INTAKE** .
4. Remove right ignition coil cover. See **COVER -- IGNITION COILS -- RH** .
5. Remove nut and disconnect earth lead from camshaft cover. See **Fig. 34**.

6. Disconnect multiplugs from ignition coils. See **Fig. 35**.
7. Remove 7 nuts securing ignition coils to camshaft cover. Remove 4 ignition coils. See **Fig. 36**.
8. Discard ignition coil cover gasket.
9. Remove dipstick tube. See **TUBE - DIPSTICK**.
10. Remove 6 nuts and 3 bolts securing camshaft cover to cylinder head. Remove camshaft cover, discard 2 gaskets and 11 sealing washers. See **Fig. 37**.

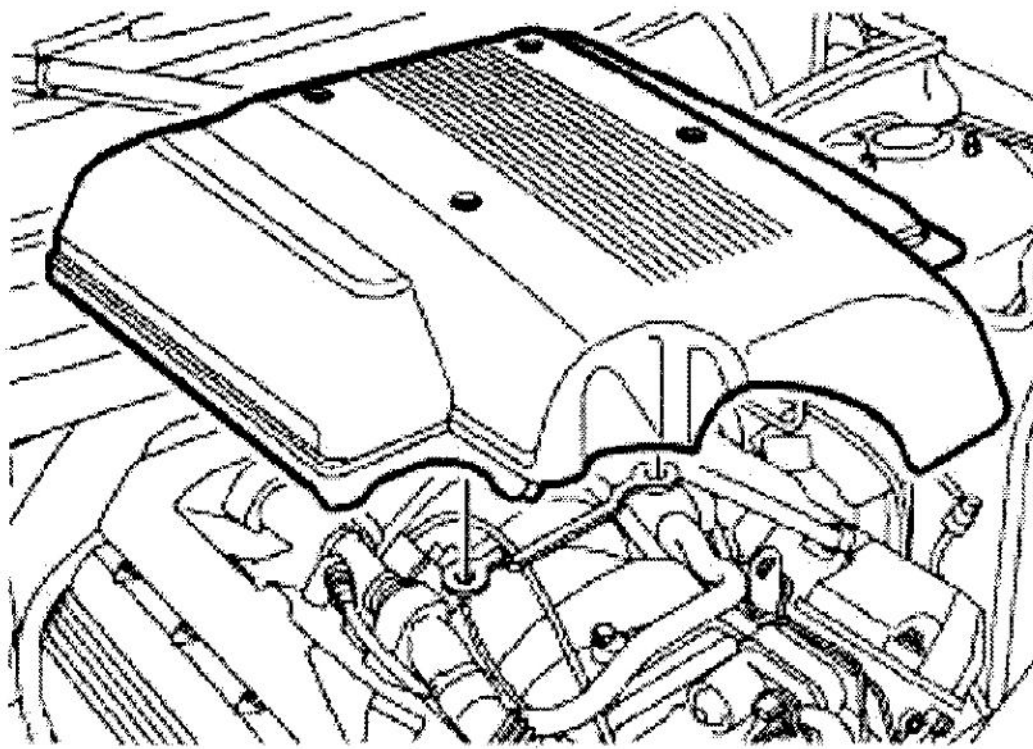
Installation

1. Clean camshaft cover and mating face of cylinder head.
2. Apply sealant , Part No. STC 50550 to areas illustrated. See **Fig. 38**.
3. Fit 2 new gaskets and 11 new sealing washers to camshaft cover and fit to cylinder head.
4. Fit dipstick tube. See **TUBE - DIPSTICK**.
5. Fit 6 nuts and 3 bolts securing camshaft cover and progressively tighten in sequence shown to 10 Nm (7 ft. lbs). See **Fig. 287**.
6. Fit 4 ignition coils.
7. Fit 7 nuts securing ignition coils to camshaft cover and tighten to 4 Nm (3 ft. lbs).
8. Fit new ignition coil cover gasket.
9. Connect multiplugs to ignition coils.
10. Connect earth lead to camshaft cover and tighten nut to 4 Nm (3 ft. lbs).
11. Fit right ignition coil cover. See **COVER -- IGNITION COILS -- RH** .
12. Fit air intake plenum. See **80.15.62 PLENUM -- AIR INTAKE** .
13. Fit engine acoustic cover. See **ACOUSTIC COVER - ENGINE**.
14. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .

ACOUSTIC COVER - ENGINE**Removal**

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT** .

1. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
2. Release 4 Allen head turnbuckles and remove acoustic cover. See **Fig. 39**.



G00384152

Fig. 39: Removing Engine Acoustic Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Fit and secure engine acoustic cover.
2. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .

CONTROL SOLENOID - VARIABLE CAMSHAFT CONTROL (VCC) - LEFT

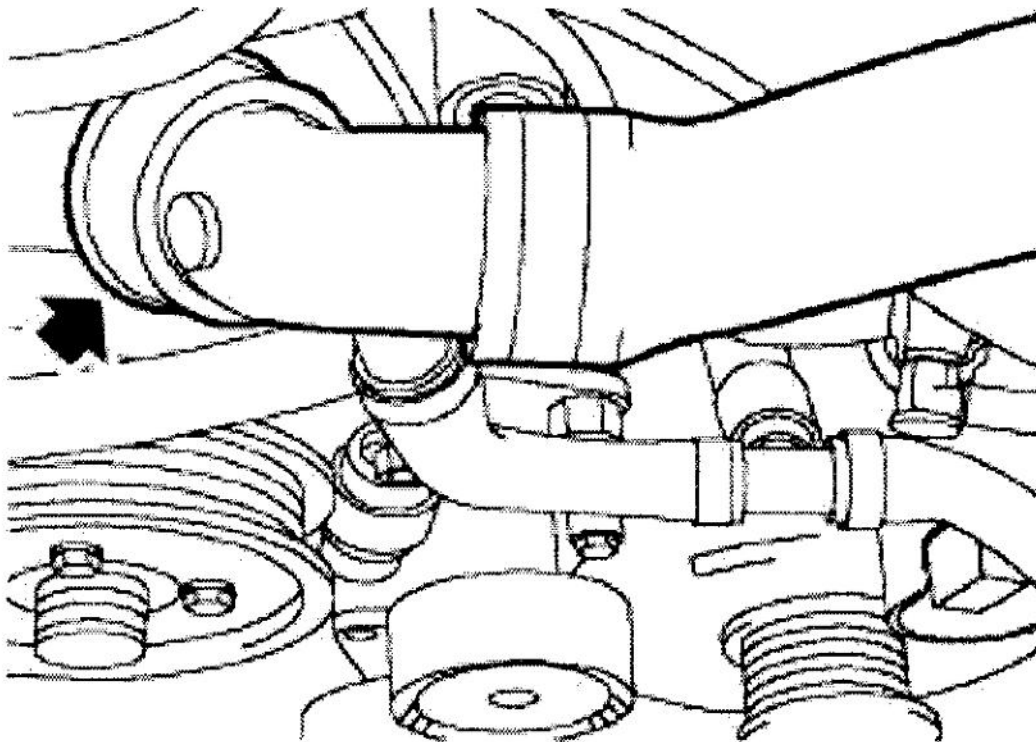
Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed.
See **BATTERY DISCONNECT & RECONNECT** .

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Drain cooling system. See **DRAINING & REFILLING COOLING SYSTEM** .
4. Release clip and disconnect coolant hose from coolant pump.
5. Disconnect multiplug from Variable Camshaft Control (VCC) solenoid.

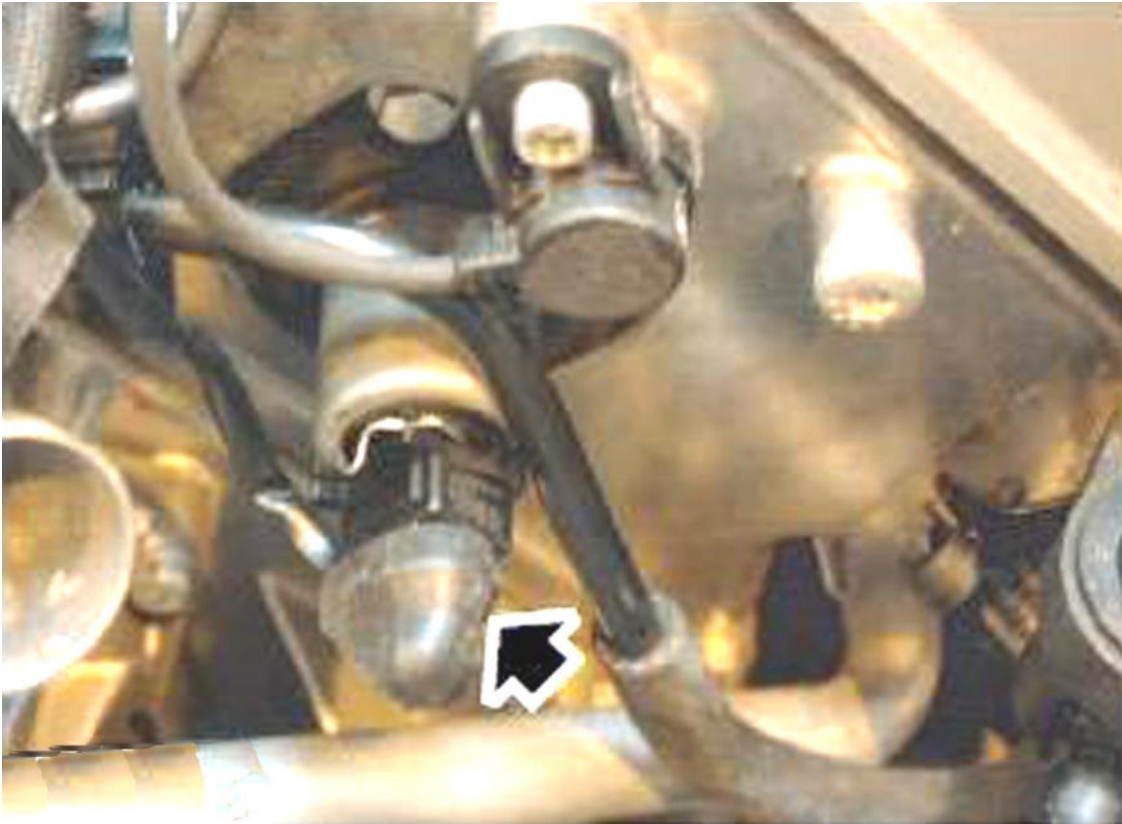
6. Remove 2 bolts securing VCC solenoid seal and remove seal. See **Fig. 42**.
7. Fit LRT-12-226 to VCC solenoid and remove solenoid. See **Fig. 43**.

CAUTION: DO NOT allow oil to come into contact with the drive belts while removing the solenoid.



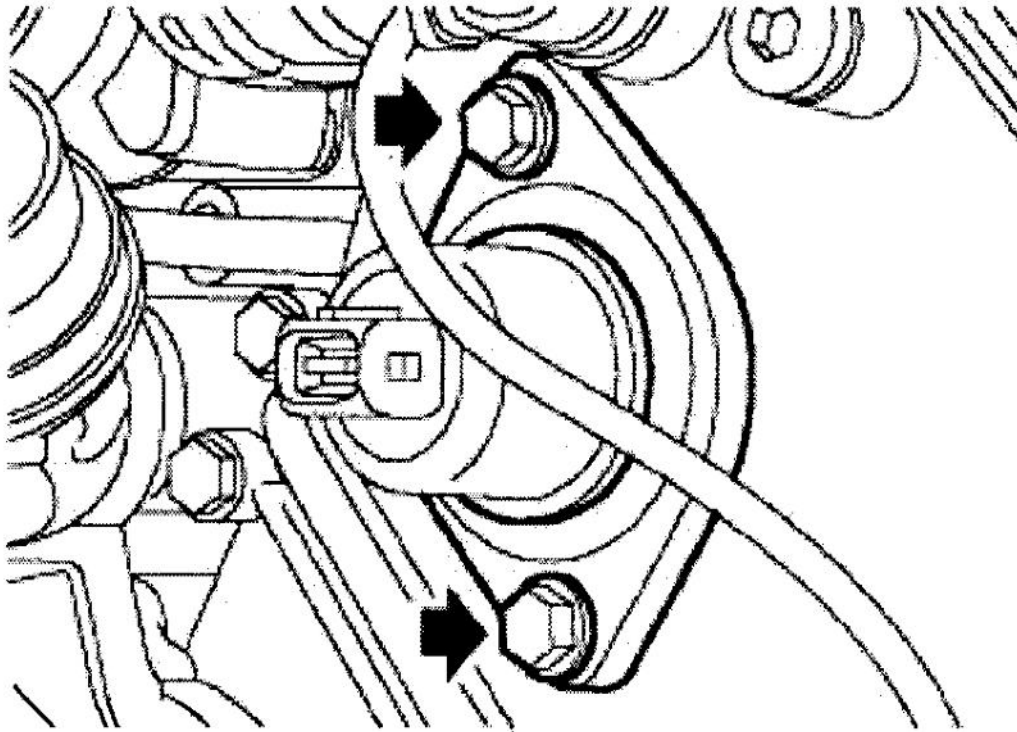
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Fig. 40: Releasing Clip & Disconnecting Coolant Hose From Coolant Pump
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00384154

Fig. 41: Disconnecting Multiplug From Variable Camshaft Control Solenoid - Left
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 42: Removing Variable Camshaft Control Solenoid Seal - Left
Courtesy of LAND ROVER NORTH AMERICA, INC.

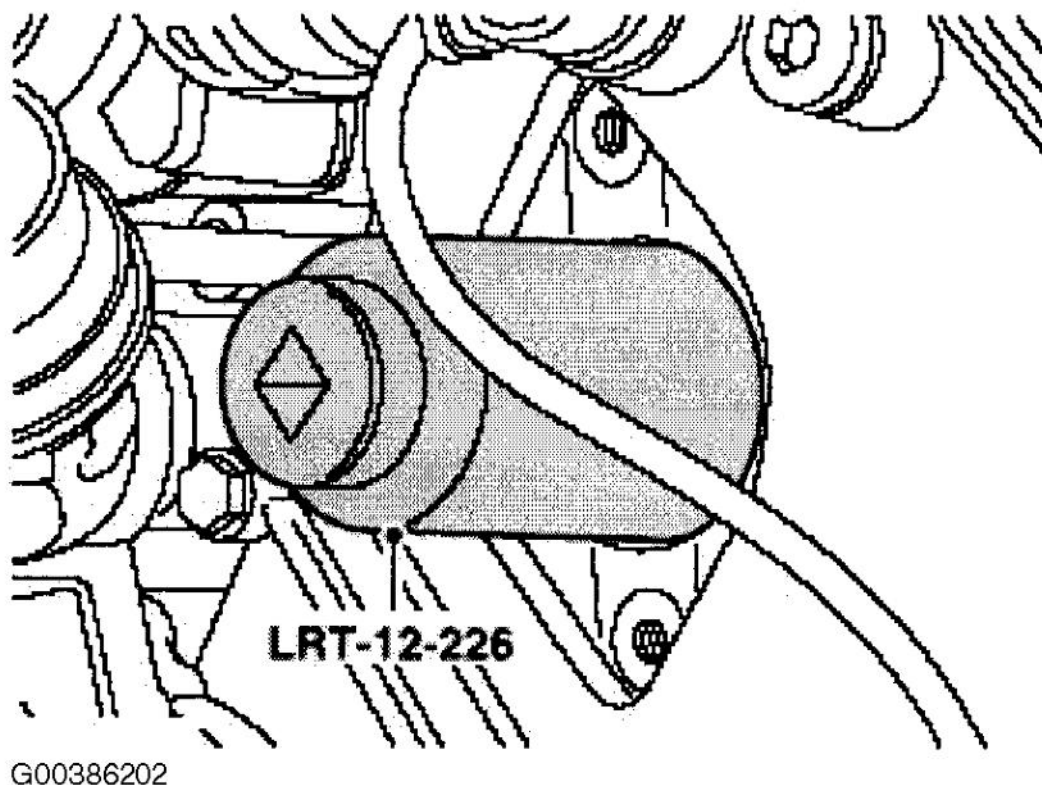


Fig. 43: Removing Variable Camshaft Control Solenoid - Left With LRT-12-226
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Fit LRT-12-226 to Variable Camshaft Control (VCC) solenoid and fit solenoid.
2. Tighten VCC solenoid to 25 Nm (18 ft. lbs) and remove LRT-12-226.
3. Clean VCC solenoid, VCC solenoid seal and mating faces.
4. Lubricate inner mating face of VCC solenoid seal.
5. Fit VCC solenoid seal, fit bolts and tighten.
6. Connect multiplug to VCC solenoid.
7. Connect coolant hose to coolant pump and secure with clip.
8. Fill cooling system. See **DRAINING & REFILLING COOLING SYSTEM**.
9. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.

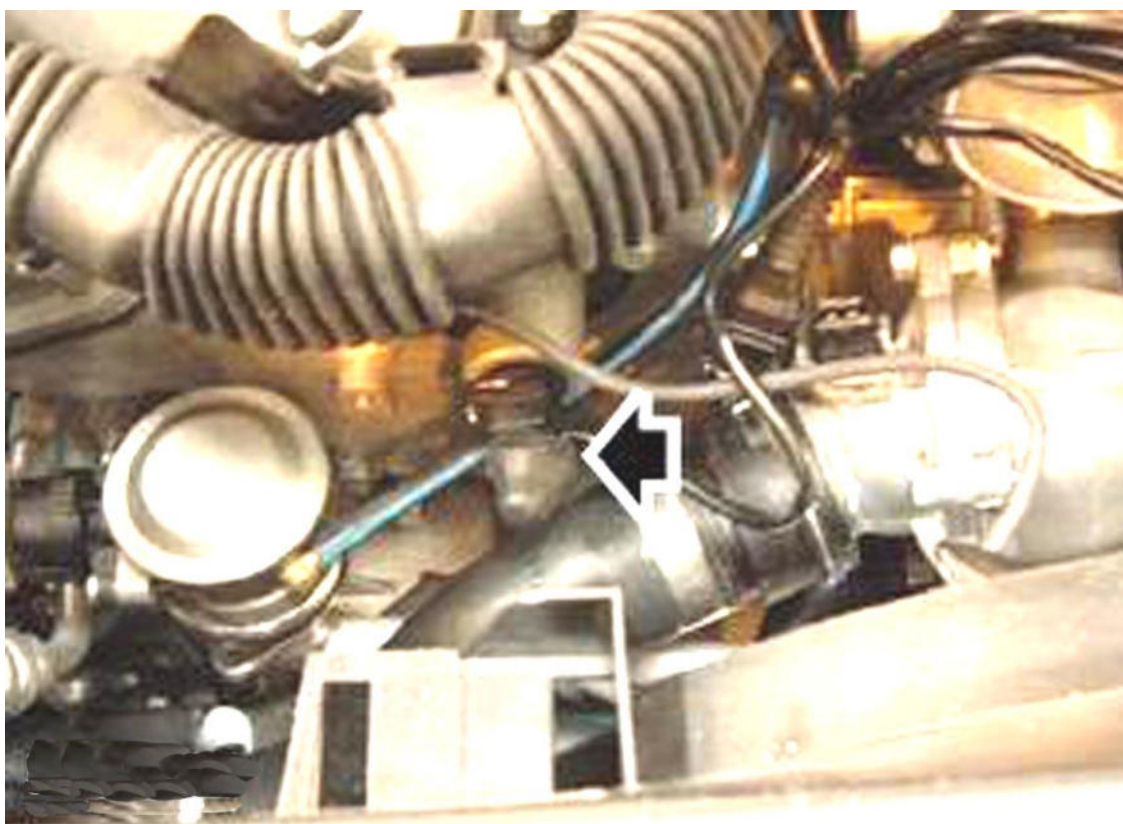
CONTROL SOLENOID - VARIABLE CAMSHAFT CONTROL (VCC) - RIGHT

Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT** .

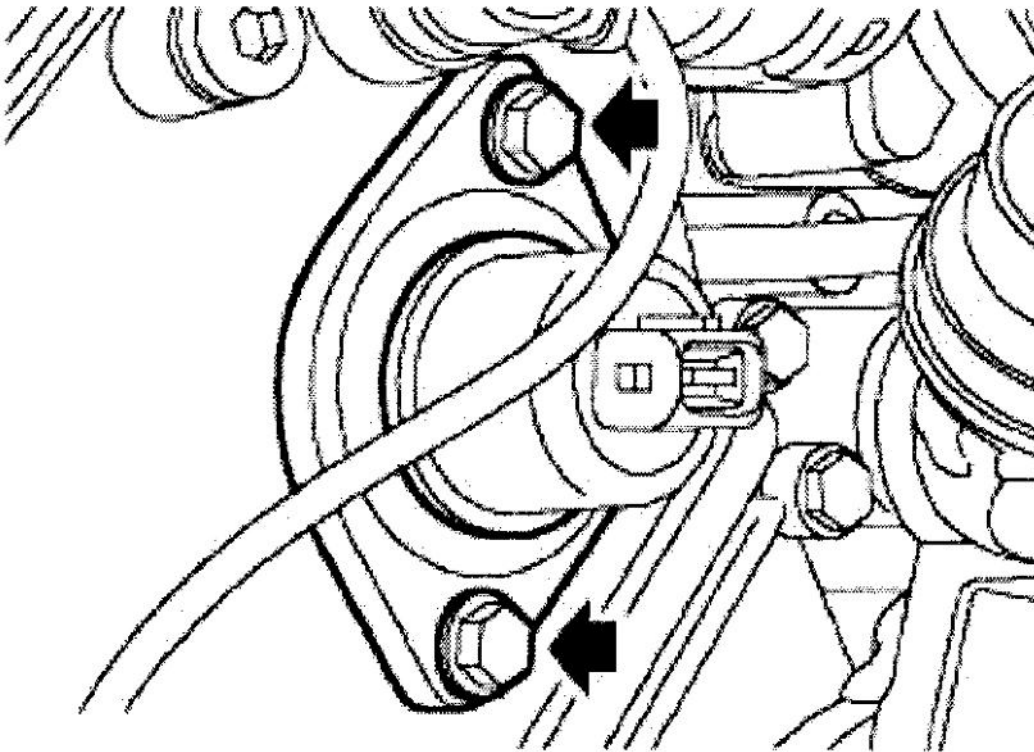
1. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
2. Remove air intake hose. See **HOSE -- AIR FLOW METER TO THROTTLE BODY** .
3. Disconnect multiplug from Variable Camshaft Control (VCC) solenoid. See **Fig. 44** .
4. Remove 2 bolts securing VCC solenoid seal and remove seal. See **Fig. 45** .
5. Fit LRT-12-226 to VCC solenoid and remove solenoid. See **Fig. 46** .

CAUTION: DO NOT allow oil to come into contact with the drive belts while removing the solenoid.



G00386203

Fig. 44: Disconnecting Multiplug From Variable Camshaft Control Solenoid
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386204

Fig. 45: Removing Variable Camshaft Control Solenoid - Right
Courtesy of LAND ROVER NORTH AMERICA, INC.

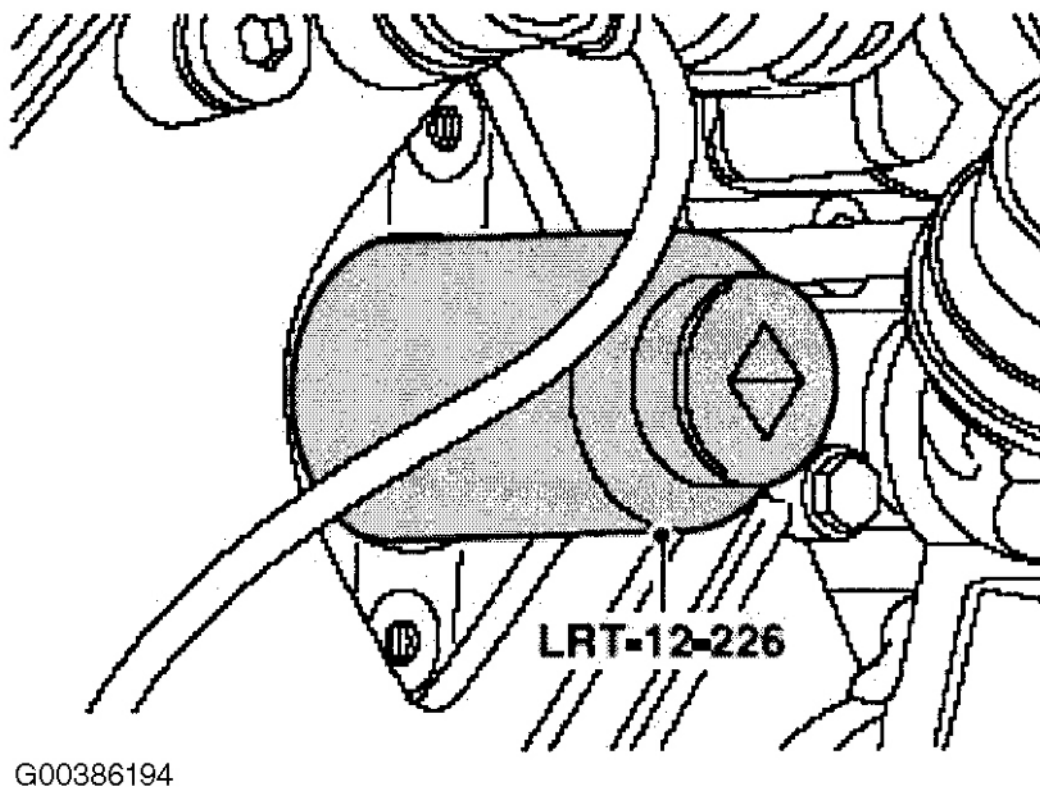


Fig. 46: Removing Variable Camshaft Control Solenoid With LRT-12-226
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Fit LRT-12-226 to Variable Camshaft Control (VCC) solenoid and fit solenoid.
2. Tighten VCC solenoid to 25 Nm (18 ft. lbs) and remove LRT-12-226.
3. Clean VCC solenoid, VCC solenoid seal and mating faces.
4. Lubricate inner mating face of VCC solenoid seal.
5. Fit VCC solenoid seal, fit bolts and tighten.
6. Connect multiplug to VCC solenoid.
7. Connect air intake hose. See **HOSE -- AIR FLOW METER TO THROTTLE BODY**.
8. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.

VARIABLE CAMSHAFT UNIT - VARIABLE CAMSHAFT CONTROL (VCC) - LEFT

Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed.

See **BATTERY DISCONNECT & RECONNECT** .

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Drain cooling system. See **DRAINING & REFILLING COOLING SYSTEM** .
4. Remove fan cowl. See **VISCOUS FAN** .
5. Remove left camshaft cover. See **GASKET - CAMSHAFT COVER - LEFT**.
6. Remove right camshaft cover. See **GASKET - CAMSHAFT COVER - RIGHT**.
7. Remove 8 spark plugs.
8. Remove 2 bolts securing engine lifting eye to rear of right cylinder head and remove engine lifting eye. See **Fig. 47**.
9. Remove 20 nuts securing 4 camshaft oil lines to left and right cylinder heads and remove camshaft oil lines. See **Fig. 48**.
10. Rotate engine crankshaft pulley until cylinder one camshaft lobes are at TDC firing position. See **Fig. 49**.
11. The rear of the camshafts may appear twisted and out of alignment when cylinder one is in the TDC firing position. See **Fig. 50**.

NOTE: **The twisting and apparent misalignment of the camshafts does not indicate incorrect engine timing.**

12. Position LRT-12-227 through timing tool access hole and secure flywheel in TDC position. See **Fig. 51**.
13. Remove left upper timing gear cover. See **COVER - TIMING GEAR - UPPER - LEFT**.
14. Remove right upper timing gear cover. See **COVER - TIMING GEAR - UPPER - RIGHT**.
15. Remove nut securing left CMP sensor ring and remove CMP sensor ring. See **Fig. 52**.

NOTE: **Thread is left handed.**

16. Remove nut securing right CMP sensor ring and remove CMP sensor ring. See **Fig. 53**.

NOTE: **Thread is left handed.**

17. Loosen 2 Torx bolts securing left VCC unit and left exhaust camshaft sprocket 1/2 a turn. See **Fig. 54**.

NOTE: **Thread is left handed.**

18. Loosen 2 Torx bolts securing right VCC unit and right exhaust camshaft sprocket 1/2 a turn. See **Fig. 55**.

NOTE: **Thread is left handed.**

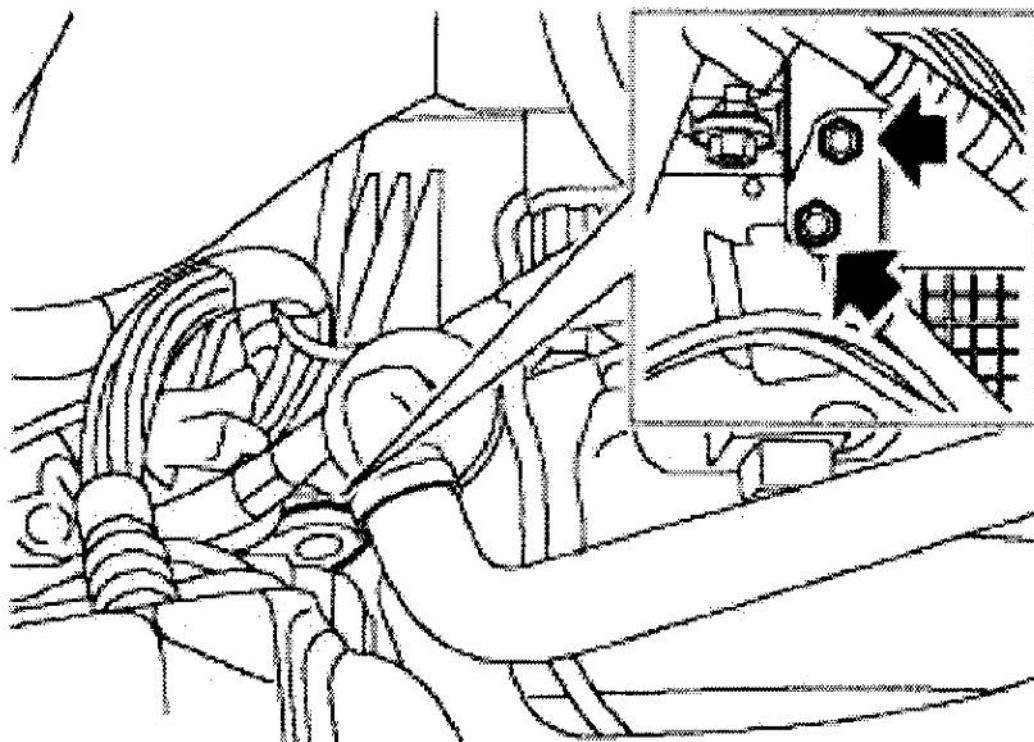
19. Loosen bolt securing LRT-12-223/2 to LRT-12-223/1.
20. Fit LRT-12-223/2 and LRT-12-223/1 to rear of right camshafts and tighten bolt securing tools. See **Fig. 56**.

21. Fit LRT-12-223/5, LRT-12-223/6 to right cylinder head and tighten LRT-12-223/6 into spark plug thread. See **Fig. 57**.
22. Loosen bolt securing LRT-12-223/4 to LRT-12-223/3.
23. Fit LRT-12-223/4 and LRT-12-223/3 to rear of left camshafts and tighten bolt securing tools. See **Fig. 58**.
24. Fit LRT-12-223/5, LRT-12-223/6 to left cylinder head and tighten LRT-12-223/6 into spark plug thread. See **Fig. 59**.
25. Compress left exhaust timing chain tensioner, fit LRT-12-220 to chain tensioner and remove 2 Torx bolts securing left VCC unit and left exhaust camshaft sprocket. See **Fig. 60**.

NOTE: Thread is left handed.

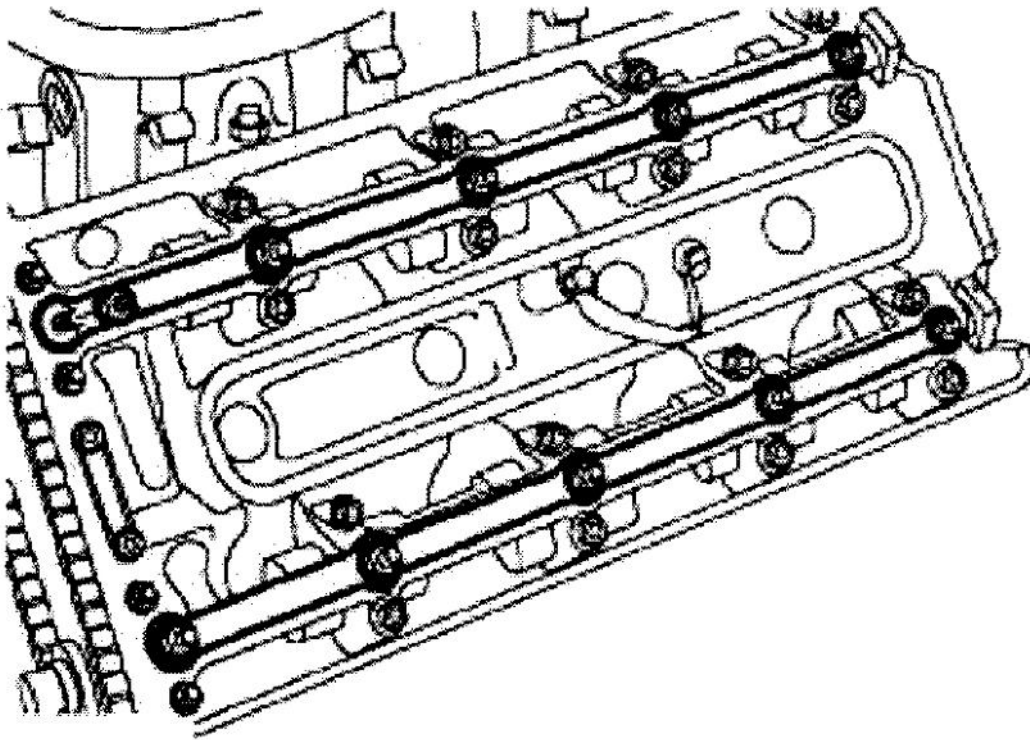
26. Remove left exhaust camshaft sprocket, left exhaust camshaft chain and left VCC unit.

NOTE: Secure chain to cylinder head to prevent chain falling into lower timing gear cover.



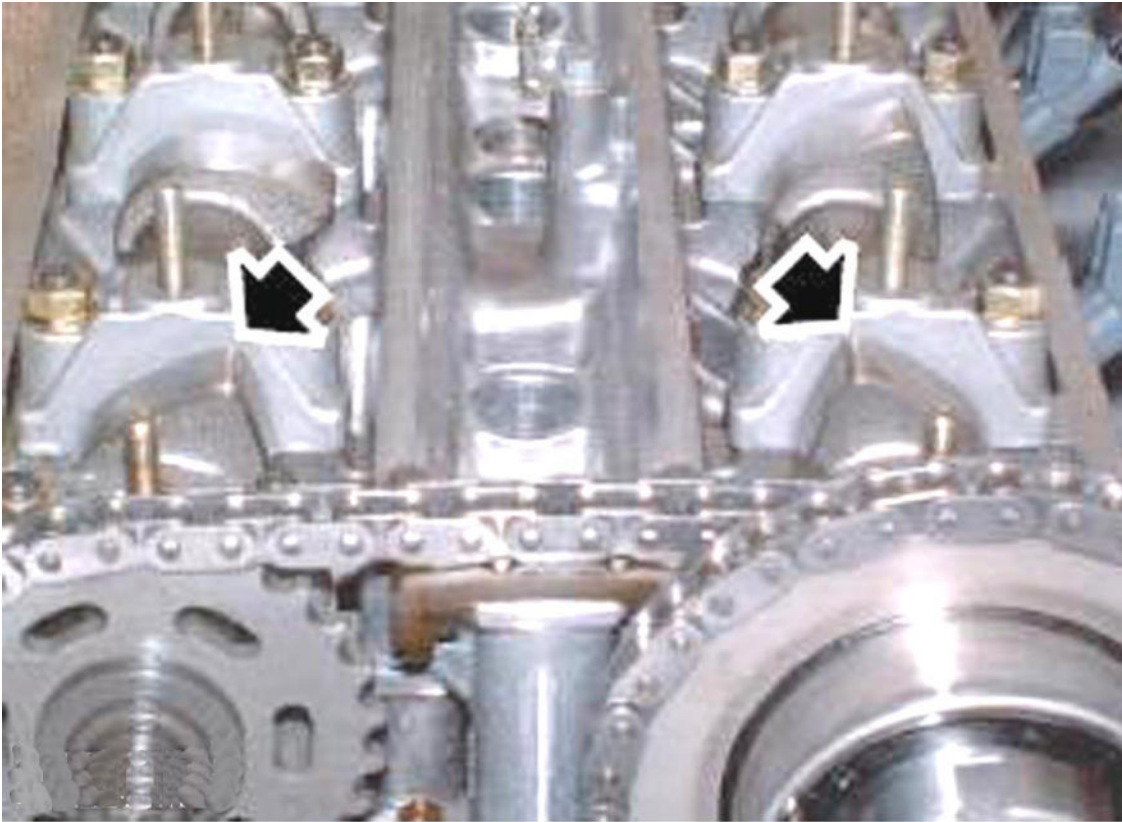
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Fig. 47: Removing Engine Lifting Eye From Right Cylinder Head
Courtesy of LAND ROVER NORTH AMERICA, INC.



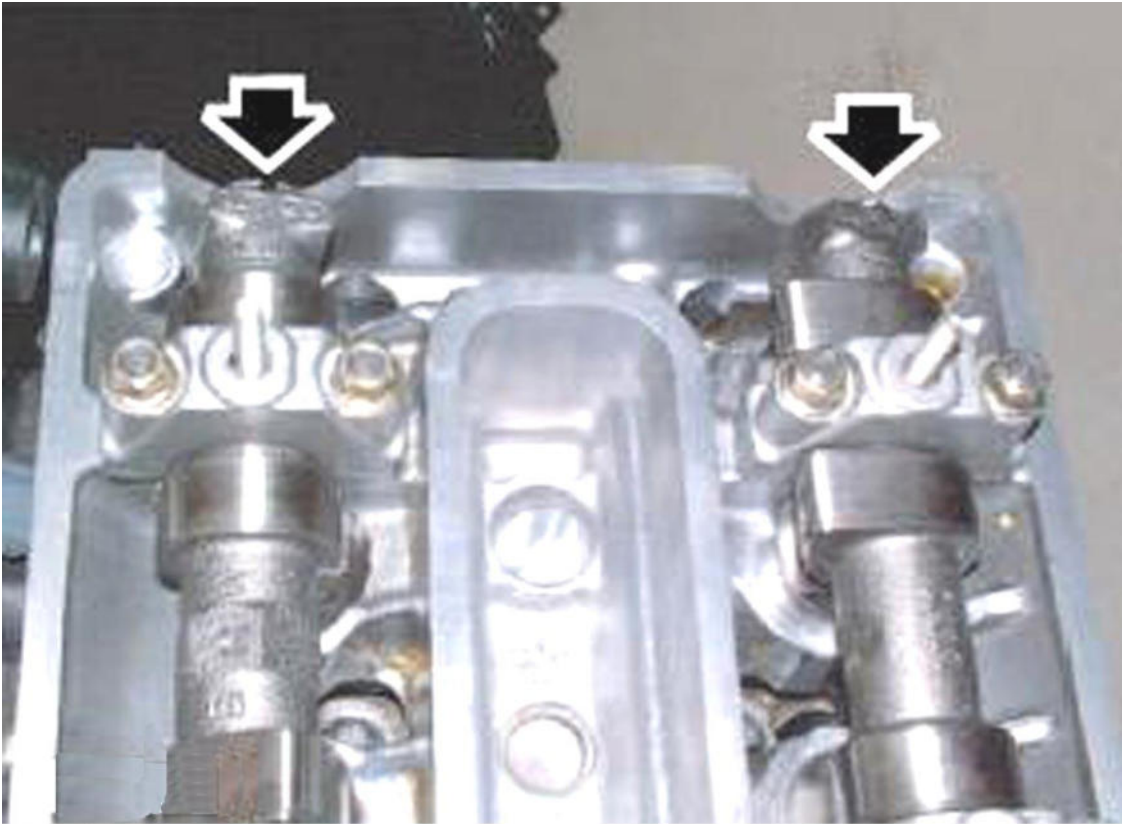
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Fig. 48: Removing Camshaft Oil Lines From Left & Right Cylinder Heads
Courtesy of LAND ROVER NORTH AMERICA, INC.



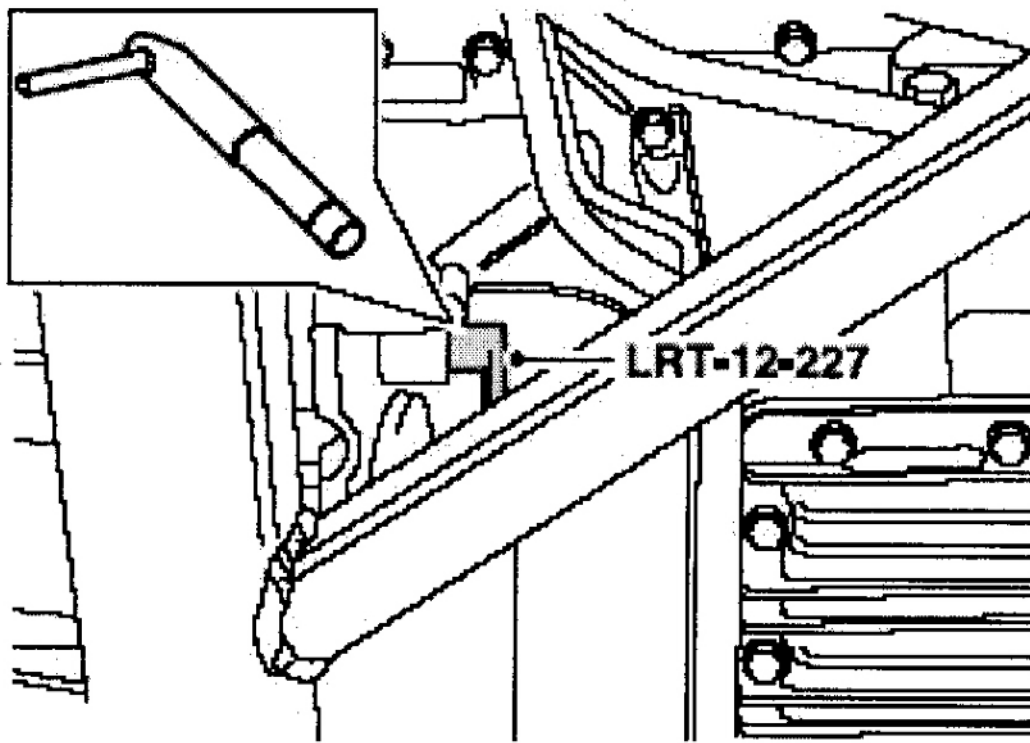
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Fig. 49: Rotating Engine Crankshaft Pulley Cylinder One TDC
Courtesy of LAND ROVER NORTH AMERICA, INC.



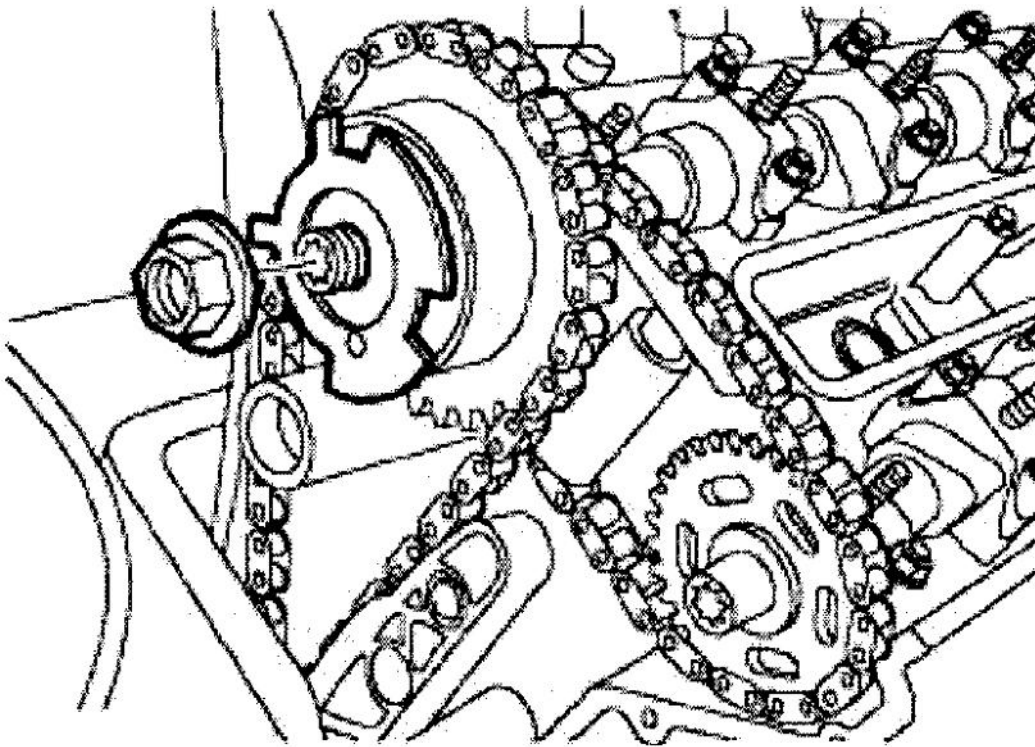
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Fig. 50: Rear Camshafts May Appear Twisted
Courtesy of LAND ROVER NORTH AMERICA, INC.



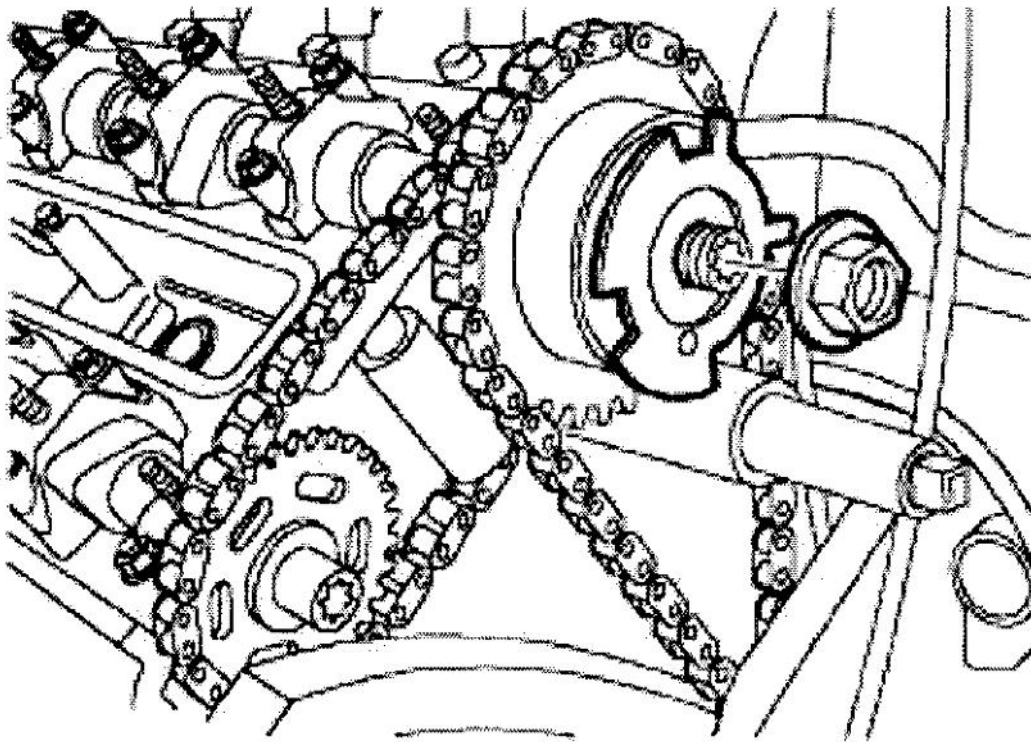
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Fig. 51: Securing Flywheel In TDC With LRT-12-227
Courtesy of LAND ROVER NORTH AMERICA, INC.



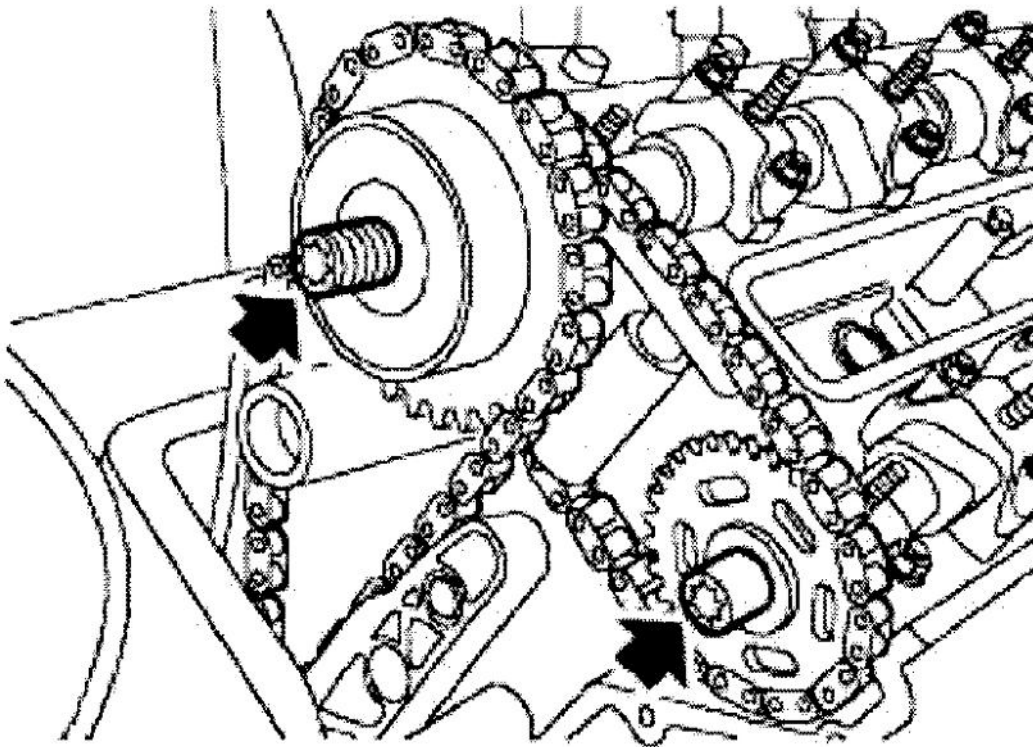
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Fig. 52: Removing Camshaft Sensor Ring
Courtesy of LAND ROVER NORTH AMERICA, INC.



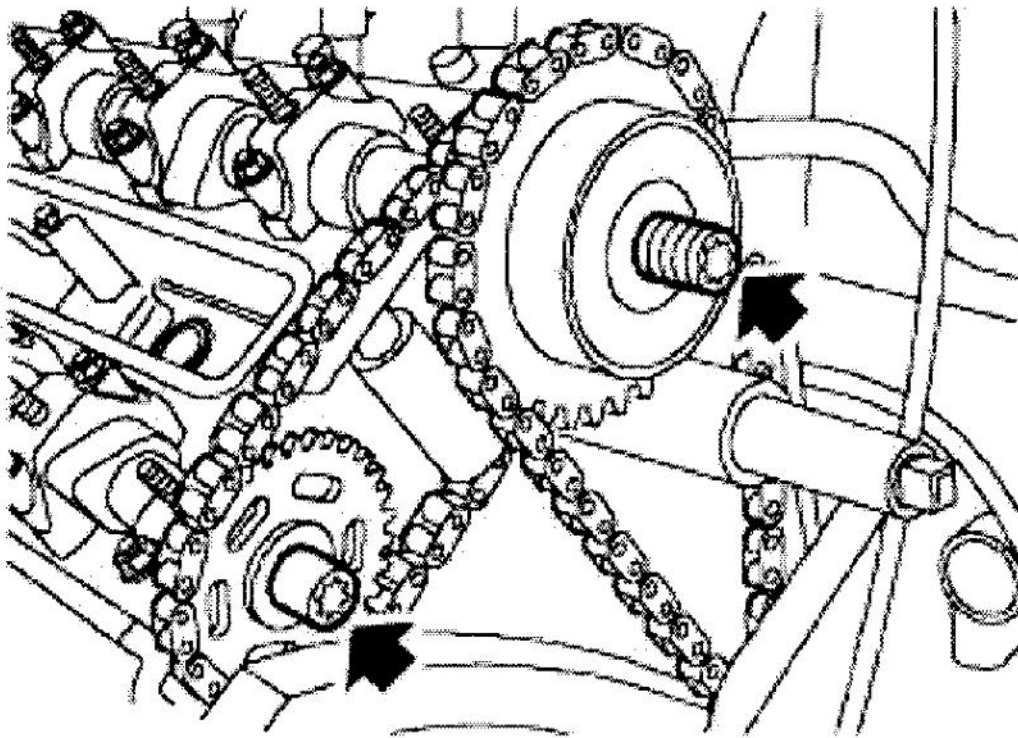
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Fig. 53: Removing Right Camshaft Sensor Ring
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386211

Fig. 54: Loosening Left Variable Camshaft Control Unit Torx Bolts & Left Exhaust Camshaft sprocket
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386212

Fig. 55: Loosening Right Variable Camshaft Control Unit Torx Bolts & Right Exhaust Camshaft Sprocket

Courtesy of LAND ROVER NORTH AMERICA, INC.

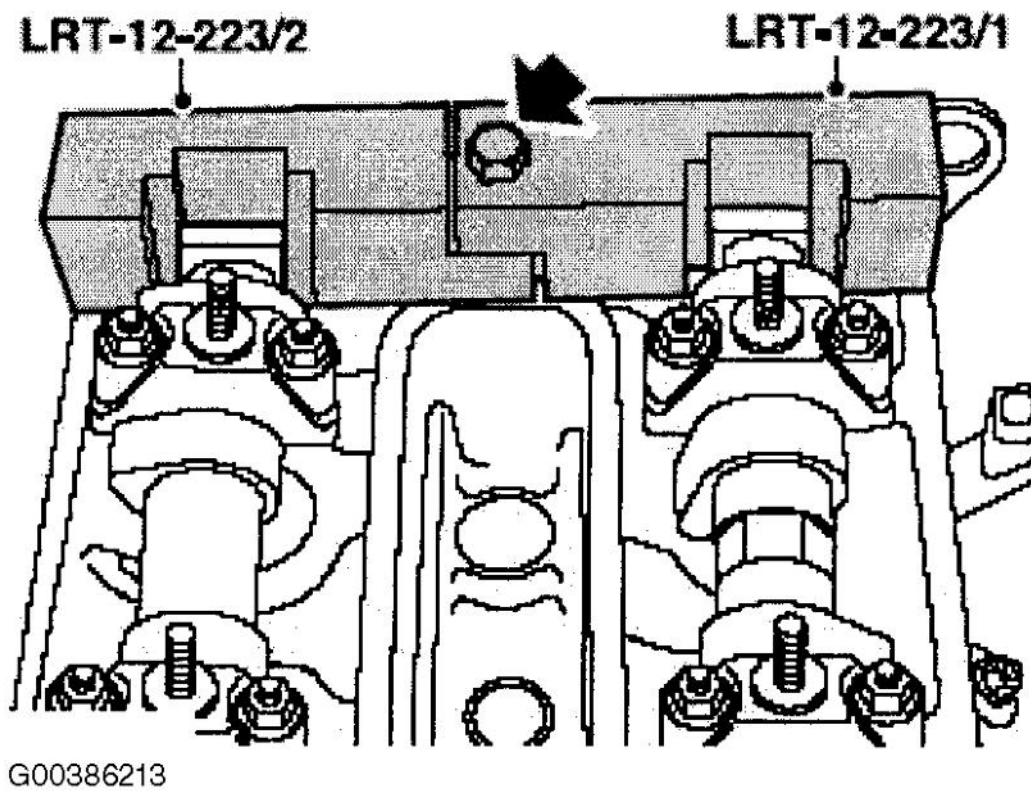


Fig. 56: Locating Bolt Securing LRT-12-223/2 To LRT-12-223
Courtesy of LAND ROVER NORTH AMERICA, INC.

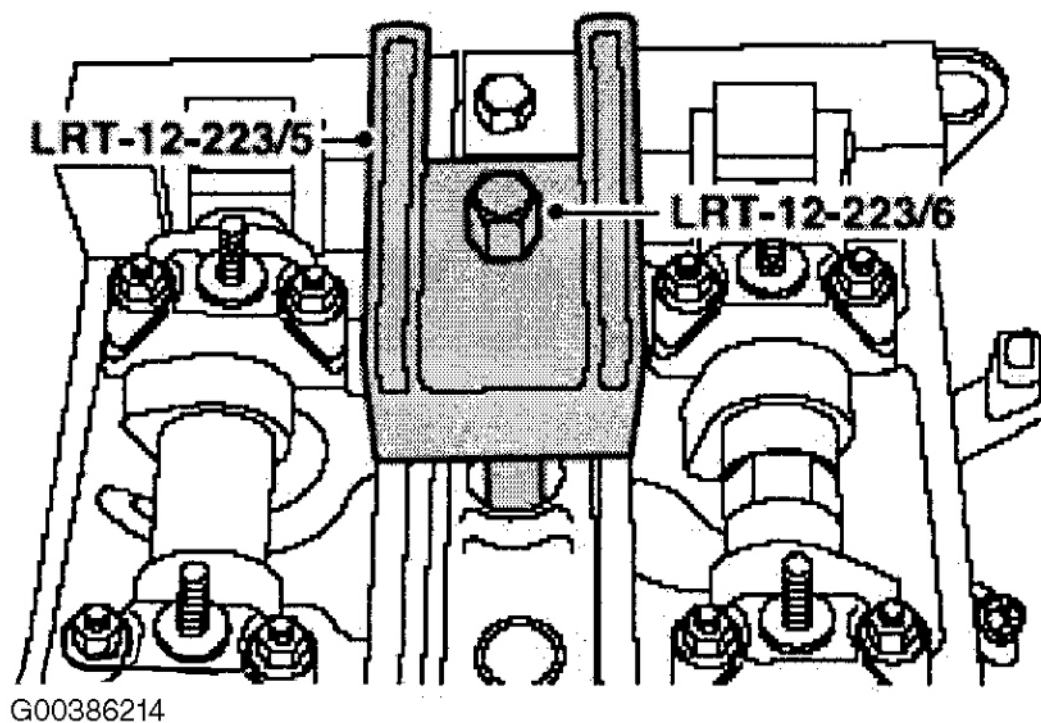
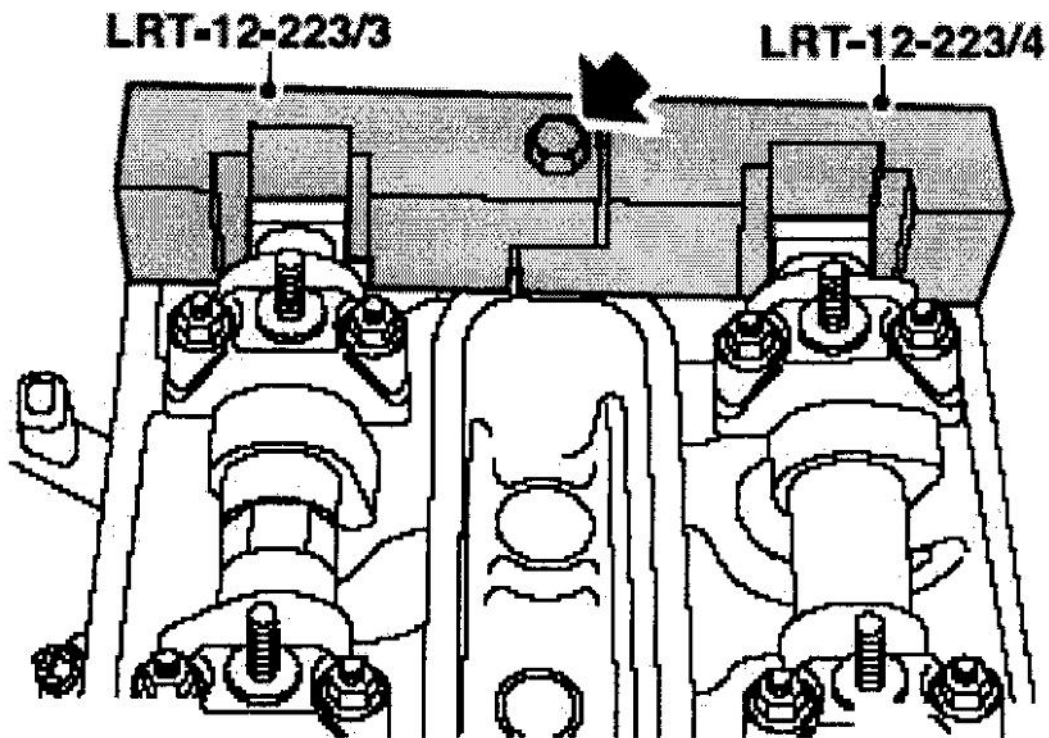
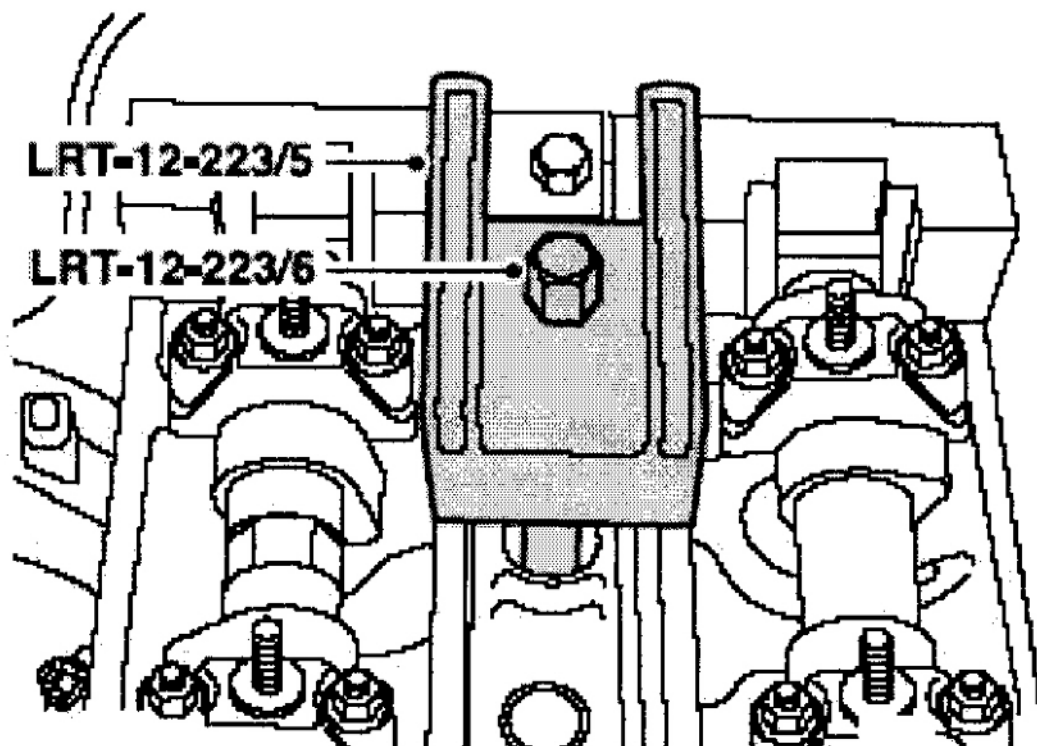


Fig. 57: Installing LRT-12-223/5 & LRT-12-223/6 To Right Cylinder Head
Courtesy of LAND ROVER NORTH AMERICA, INC.



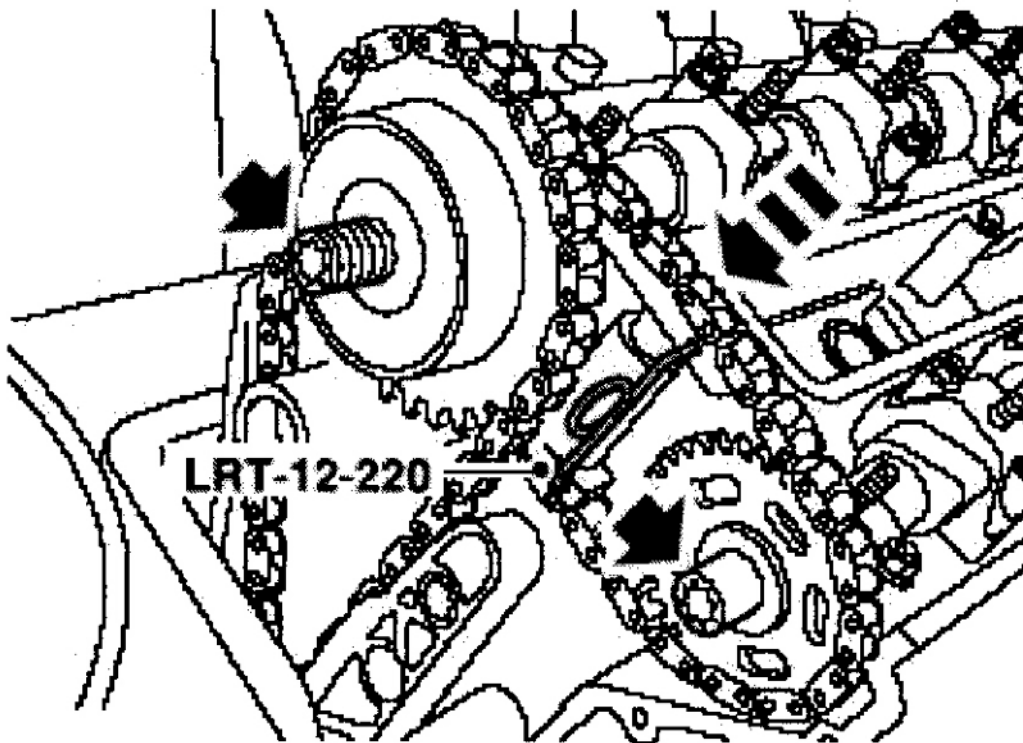
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Fig. 58: Installing LRT-12-223/3 & LRT-12-223/4 To Rear Of Left Camshafts
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386216

Fig. 59: Installing LRT-12-223/5 & LRT-12-223/6 To Left Cylinder Head
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386217

Fig. 60: Removing Left Variable Camshaft Control Unit Torx Bolts & Left Exhaust Camshaft Sprocket
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Position left exhaust camshaft chain to left VCC unit and position left exhaust camshaft sprocket to left exhaust camshaft chain.

NOTE: The Variable Camshaft Control (VCC) unit, exhaust camshaft chain and exhaust camshaft sprocket do not have timing marks on them. These parts may be freely fitted to the timing gear chain and camshafts in any position.

2. Secure chain to cylinder head to prevent chain falling into lower timing gear cover.
3. Compress left exhaust timing chain tensioner and remove LRT-12-220.
4. Fit LRT-12-221 to right cylinder head, fit LRT-12-222 to LRT-12-221 and hand tighten. See **Fig. 61**.

NOTE: Only screw in adjustment bolt until slight resistance is present.

5. Fit LRT-12-224 to left VCC unit, connect multimeter between pin on left VCC unit and stud on left oil

line. See **Fig. 62**.

6. Rotate left VCC unit using LRT-12-224 to 40 Nm (30 ft. lbs) and using the multimeter, check continuity is present.

NOTE: Rotating the VCC unit using LRT-12-224 will remove the oil cushion and make sure the VCC unit is at the full left stop position. Continuity should be present when the VCC unit reaches this position.

7. Tighten Torx bolts securing left VCC unit and exhaust camshaft sprocket to 15 Nm (11 ft. lbs) and loosen one quarter of a turn.

NOTE: Thread is left handed.

8. Fit LRT-12-224 to right VCC unit, connect multimeter between pin on right VCC unit and stud on right oil line. See **Fig. 63**.
9. Rotate right VCC unit using LRT-12-224 to 40 Nm (30 ft. lbs) and using the multimeter, check continuity is present.

NOTE: Rotating the VCC unit using LRT-12-224 will remove the oil cushion and make sure the VCC unit is at the full left stop position. Continuity should be present when the VCC unit reaches this position.

10. Tighten Torx bolts securing right VCC unit and exhaust camshaft sprocket to 15 Nm (11 ft. lbs) and loosen one quarter of a turn.

NOTE: Thread is left handed.

11. Adjust chain tension by tightening LRT-12-222 to 0.7 Nm (6.3 INCH lbs).
12. Fit LRT-12-224 to left VCC unit, connect multimeter between pin on left VCC unit and stud on left oil line. See **Fig. 62**.

NOTE: When the chain tension is adjusted the VCC unit will move and require adjusting to the left stop.

13. Rotate left VCC unit using LRT-12-224 to 40 Nm (30 ft. lbs) and using the multimeter, check continuity is present.

NOTE: Rotating the VCC unit using LRT-12-224 will remove the oil cushion and make sure the VCC unit is at the full left stop position. Continuity should be present when the VCC unit reaches this position.

14. Tighten left VCC unit Torx bolt to 110 Nm (81 ft. lbs) and left exhaust camshaft sprocket Torx bolt to 125 Nm (92 ft. lbs).

NOTE: Thread is left handed.

15. Fit LRT-12-224 to right VCC unit, connect multimeter between pin on right VCC unit and stud on right oil line. See **Fig. 63**.

NOTE: When the chain tension is adjusted the VCC unit will move and require adjusting to the left stop.

16. Rotate right VCC unit using LRT-12-224 to 40 Nm (30 ft. lbs) and using the multimeter, check continuity is present.

NOTE: Rotating the VCC unit using LRT-12-224 will remove the oil cushion and make sure the VCC unit is at the full left stop position. Continuity should be present when the VCC unit reaches this position.

17. Tighten right VCC unit Torx bolt to 110 Nm (81 ft. lbs) and right exhaust camshaft sprocket Torx bolt to 125 Nm (92 ft. lbs).

NOTE: Thread is left handed.

18. Fit right Camshaft (CMP) sensor ring, fit and hand tighten securing nut.

NOTE: Thread is left handed.

19. Position LRT-12-228/1 locating dowel to right CMP sensor ring, fit 2 bolts securing tool to right cylinder head and tighten. See **Fig. 64**.

NOTE: To ensure correct CMP sensor ring adjustment, make sure the tool is aligned flush with the cylinder head and lower timing gear cover before tightening the tool securing bolts.

20. Tighten nut securing CMP sensor ring to 40 Nm (30 ft. lbs) and remove LRT-12-228/1 from right cylinder head.

NOTE: Thread is left handed.

21. Fit left CMP sensor ring, fit and hand tighten securing nut.

NOTE: Thread is left handed.

22. Position LRT-12-228/2 locating dowel to left CMP sensor ring, fit 2 bolts securing tool to right cylinder head and tighten. See **Fig. 65**.

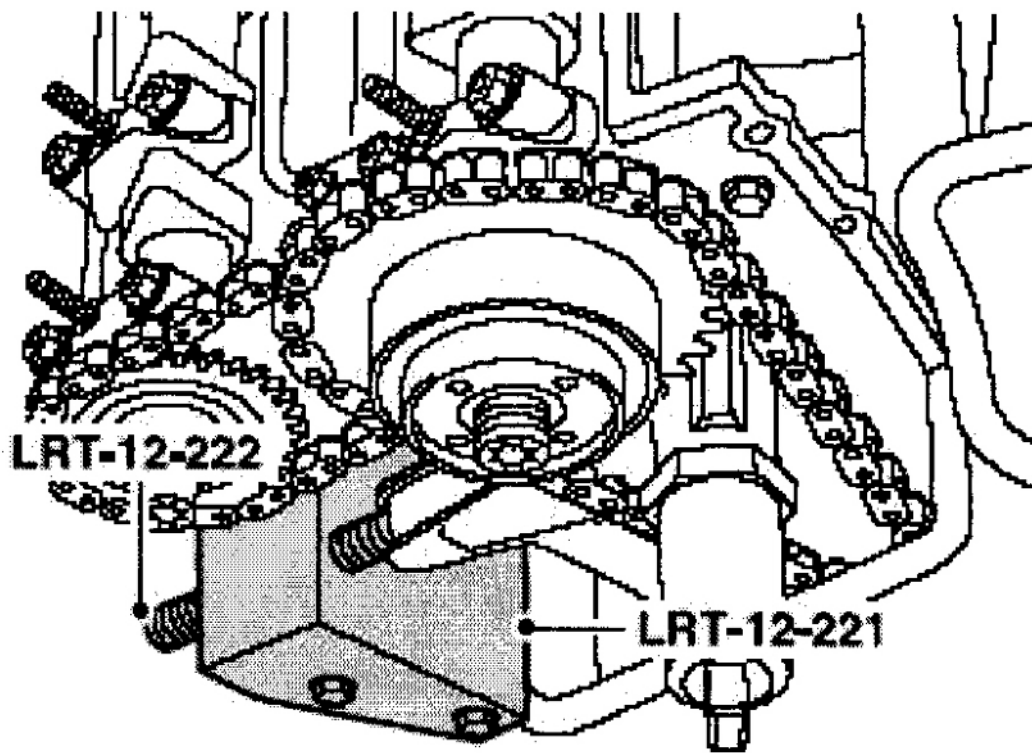
NOTE: To ensure correct CMP sensor ring adjustment, make sure the tool is

aligned flush with the cylinder head and lower timing gear cover before tightening the tool securing bolts.

23. Tighten nut securing CMP sensor ring to 40 Nm (30 ft. lbs) and remove LRT-12-228/2 from left cylinder head.

NOTE: Thread is left handed.

24. Remove LRT-12-223/5, LRT-12-223/6, LRT-12-223/2 and LRT-12-223/1 from right cylinder head camshafts.
25. Remove LRT-12-223/6, LRT-12-223/5, LRT-12-223/3 and LRT-12-223/4 from left cylinder head camshafts.
26. Loosen LRT-12-222, remove 2 bolts securing LRT-12-221 to right cylinder head and remove LRT-12-221.
27. Fit right upper timing gear cover. See **COVER - TIMING GEAR - UPPER - RIGHT**.
28. Fit left upper timing gear cover. See **COVER - TIMING GEAR - UPPER - LEFT**.
29. Remove LRT-12-227 from timing tool access hole.
30. Fit 4 camshaft oil lines to left and right cylinder heads, fit and tighten 20 securing bolts.
31. Fit engine lifting eye to rear of right cylinder head and fit 2 bolts securing engine lifting eye and tighten.
32. Fit and tighten 8 spark plugs to 31 Nm (23 ft. lbs).
33. Fit right camshaft cover. See **GASKET - CAMSHAFT COVER - RIGHT**.
34. Fit left camshaft cover. See **GASKET - CAMSHAFT COVER - LEFT**.
35. Fit fan cowl. See **VISCOUS FAN**.
36. Fill cooling system. See **DRAINING & REFILLING COOLING SYSTEM**.
37. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.



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Fig. 61: Installing LRT-12-222 To LRT-12-221 & Hand Tighten
Courtesy of LAND ROVER NORTH AMERICA, INC.

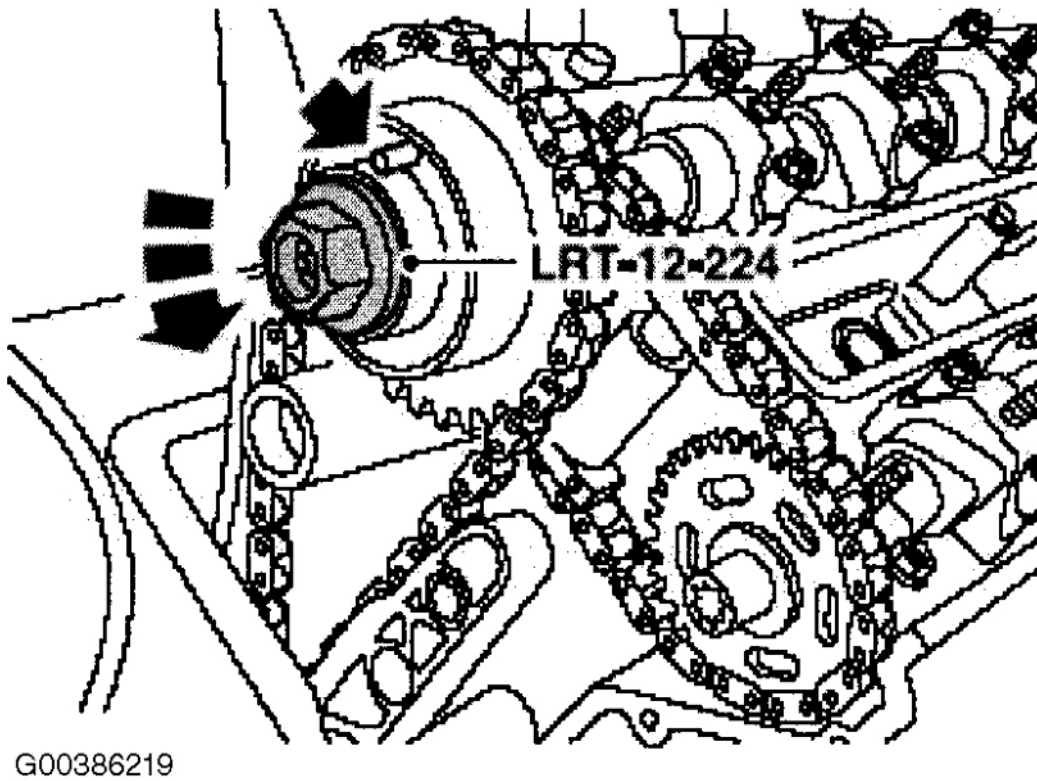
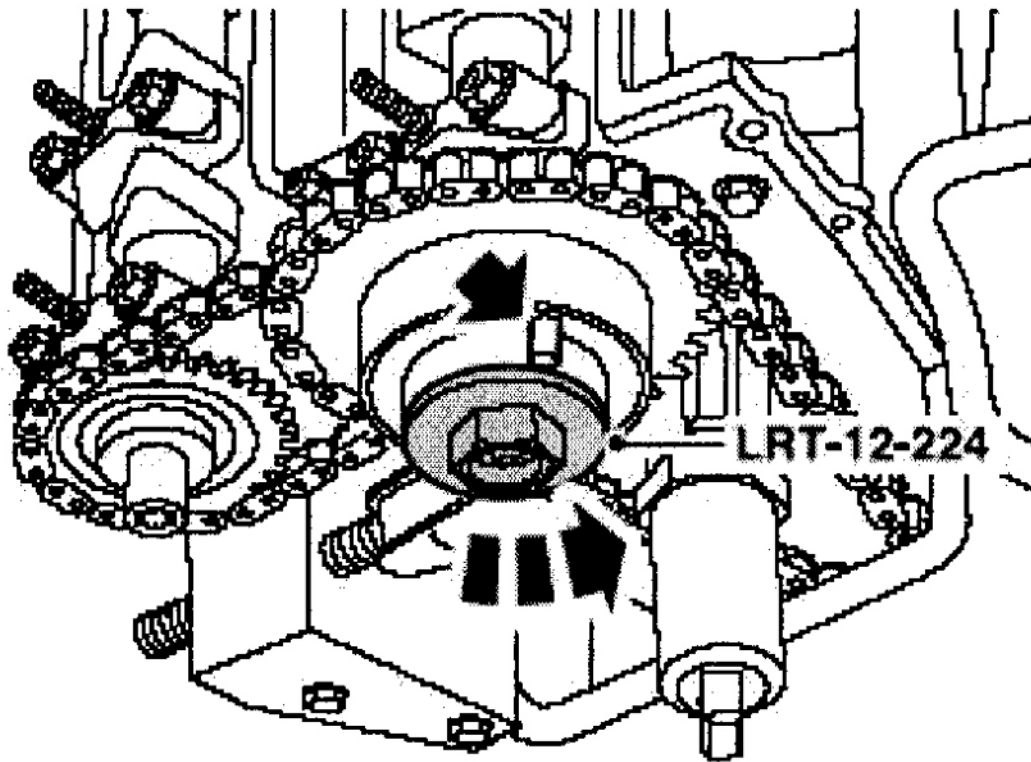
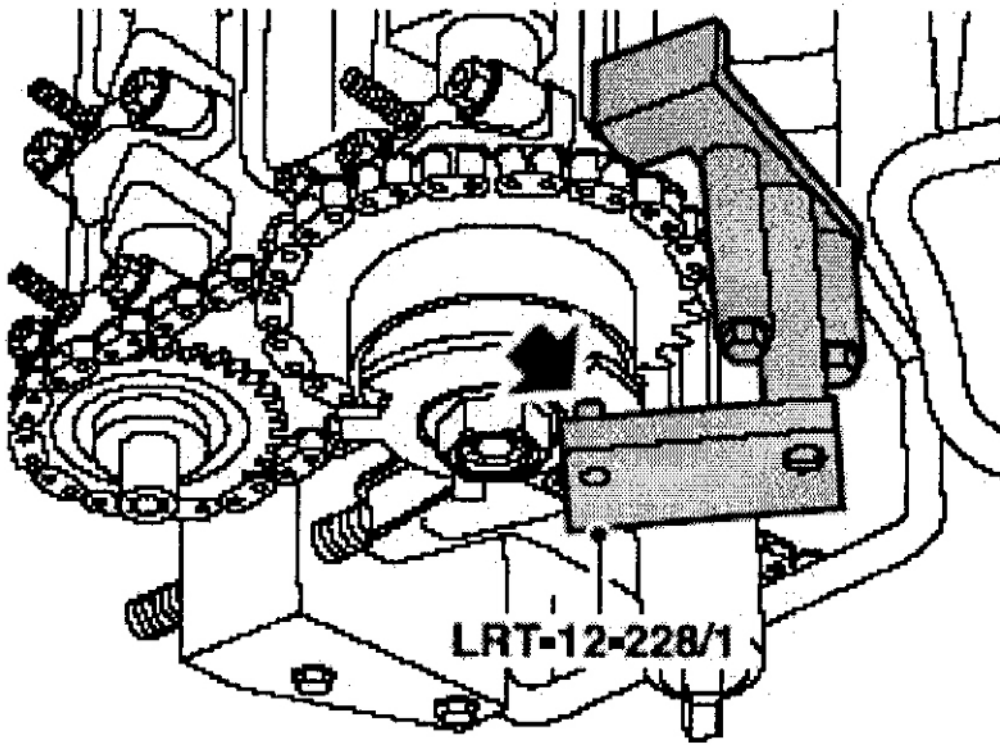


Fig. 62: Installing LRT-12-224 To Left VCC Unit
Courtesy of LAND ROVER NORTH AMERICA, INC.



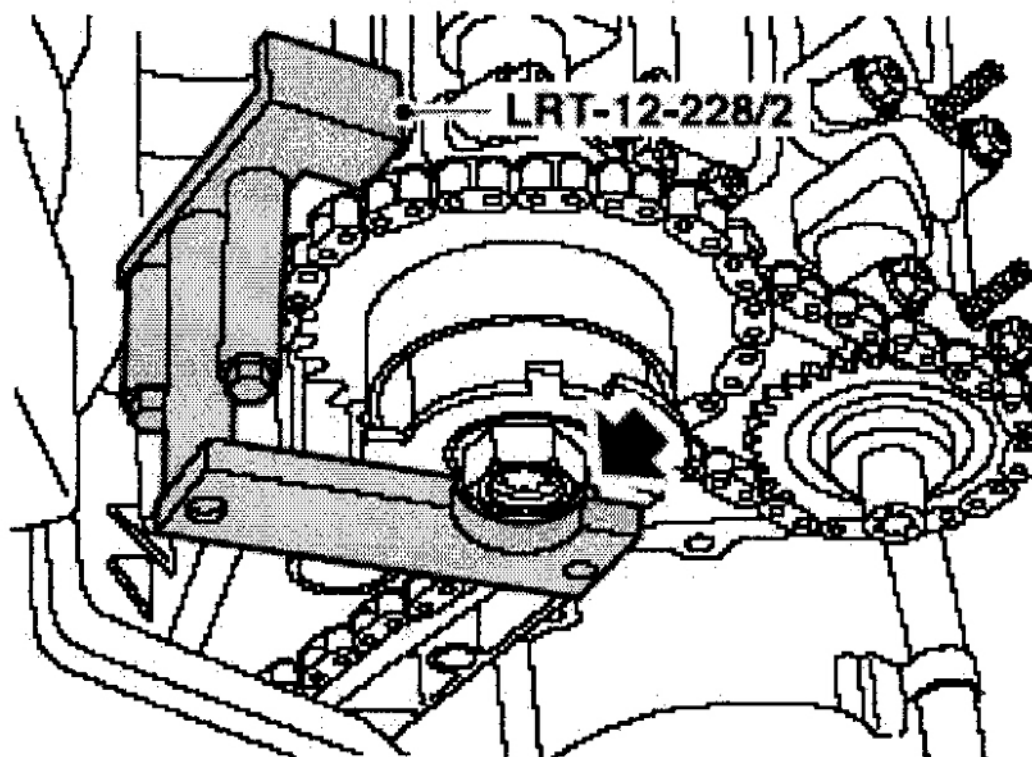
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Fig. 63: Installing LRT-12-224 To Right VCC Unit
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386221

Fig. 64: Installing LRT-12-228/1 To Right Cylinder Head
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386222

Fig. 65: Installing LRT-12-228/2 To Left Cylinder Head
Courtesy of LAND ROVER NORTH AMERICA, INC.

VARIABLE CAMSHAFT UNIT - VARIABLE CAMSHAFT CONTROL (VCC) - RIGHT

Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed.
See **BATTERY DISCONNECT & RECONNECT**.

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.
3. Drain cooling system. See **DRAINING & REFILLING COOLING SYSTEM**.
4. Remove fan cowl. See **VISCOUS FAN**.
5. Remove left camshaft cover. See **GASKET - CAMSHAFT COVER - LEFT**.
6. Remove right camshaft cover. See **GASKET - CAMSHAFT COVER - RIGHT**.
7. Remove 8 spark plugs.
8. Remove 2 bolts securing engine lifting eye to rear of right cylinder head and remove engine lifting eye.

See **Fig. 66**.

9. Remove 20 nuts securing 4 camshaft oil lines to left and right cylinder heads and remove camshaft oil lines. See **Fig. 48**.
10. Rotate engine crankshaft pulley until cylinder one camshaft lobes are at TDC firing position. See **Fig. 49**.
11. The rear of the camshafts may appear twisted and out of alignment when cylinder one is in the TDC firing position. See **Fig. 50**.

NOTE: **The twisting and apparent misalignment of the camshafts does not indicate incorrect engine timing.**

12. Position LRT-12-227 through timing tool access hole and secure flywheel in TDC position. See **Fig. 67**.
13. Remove left upper timing gear cover. See **COVER - TIMING GEAR - UPPER - LEFT**.
14. Remove right upper timing gear cover. See **COVER - TIMING GEAR - UPPER - RIGHT**.
15. Remove nut securing right CMP sensor ring and remove CMP sensor ring. See **Fig. 68**.

NOTE: **Thread is left handed.**

16. Remove nut securing left Camshaft (CMP) sensor ring and remove CMP sensor ring.

NOTE: **Thread is left handed.**

17. Loosen 2 Torx bolts securing right Variable Camshaft Control (VCC) unit and right exhaust camshaft sprocket 1/2 a turn. See **Fig. 55**.

NOTE: **Thread is left handed.**

18. Loosen 2 Torx bolts securing left VCC unit and left exhaust camshaft sprocket 1/2 a turn. See **Fig. 54**.

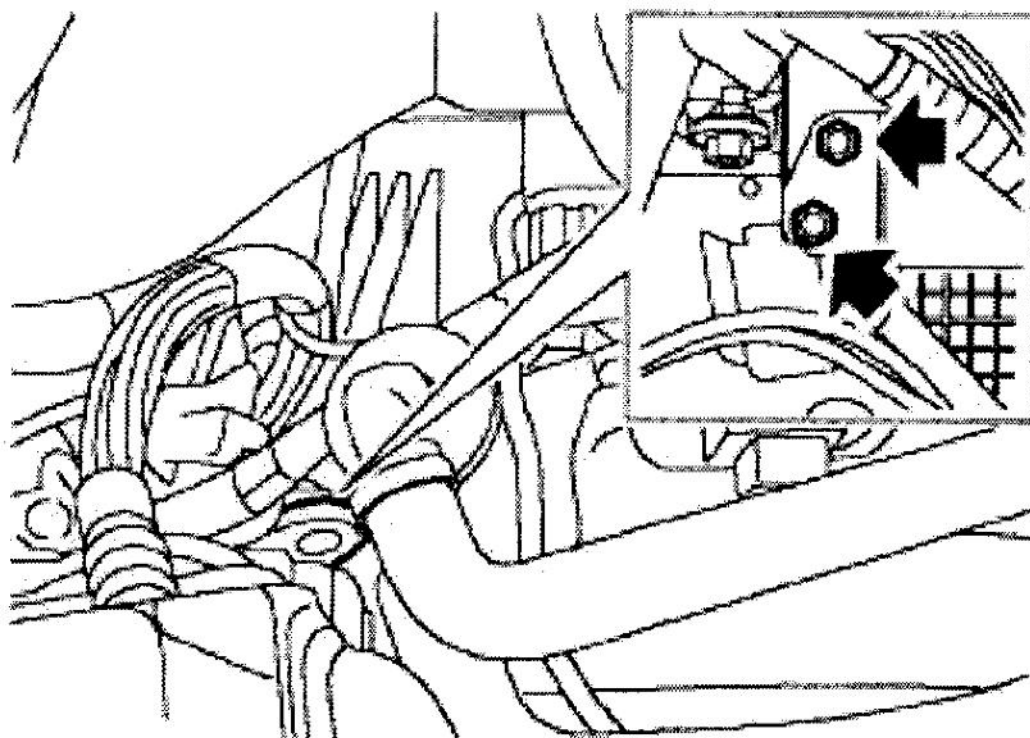
NOTE: **Thread is left handed.**

19. Loosen bolt securing LRT-12-223/2 to LRT-12-223/1.
20. Fit LRT-12-223/2 and LRT-12-223/1 to rear of right camshafts and tighten bolt securing tools. See **Fig. 56**.
21. Fit LRT-12-223/5, LRT-12-223/6 to right cylinder head and tighten LRT-12-223/6 into spark plug thread. See **Fig. 57**.
22. Loosen bolt securing LRT-12-223/4 to LRT-12-223/3.
23. Fit LRT-12-223/4 and LRT-12-223/3 to rear of left camshafts and tighten bolt securing tools. See **Fig. 58**.
24. Fit LRT-12-223/5, LRT-12-223/6 to left cylinder head and tighten LRT-12-223/6 into spark plug thread. See **Fig. 59**.
25. Compress right exhaust timing chain tensioner, fit LRT-12-220 to chain tensioner and remove 2 Torx bolts securing right VCC unit and right exhaust camshaft sprocket. See **Fig. 69**.

NOTE: Thread is left handed.

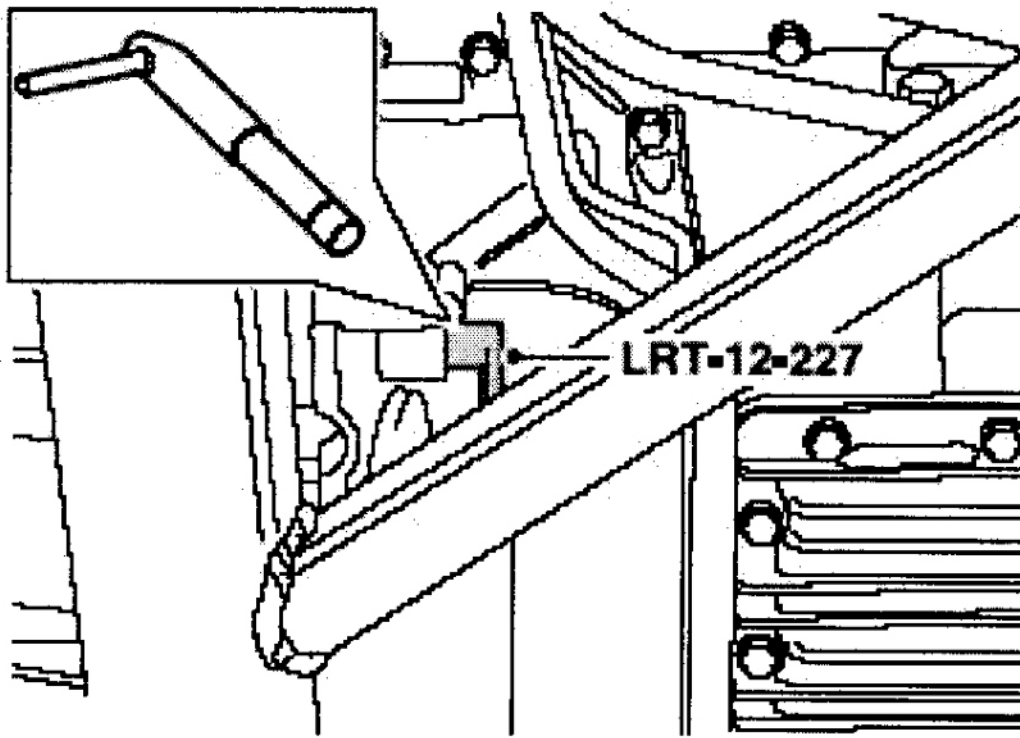
26. Remove right exhaust camshaft sprocket, right exhaust camshaft chain and right VCC unit.

NOTE: Secure chain to cylinder head to prevent chain falling into lower timing gear cover.



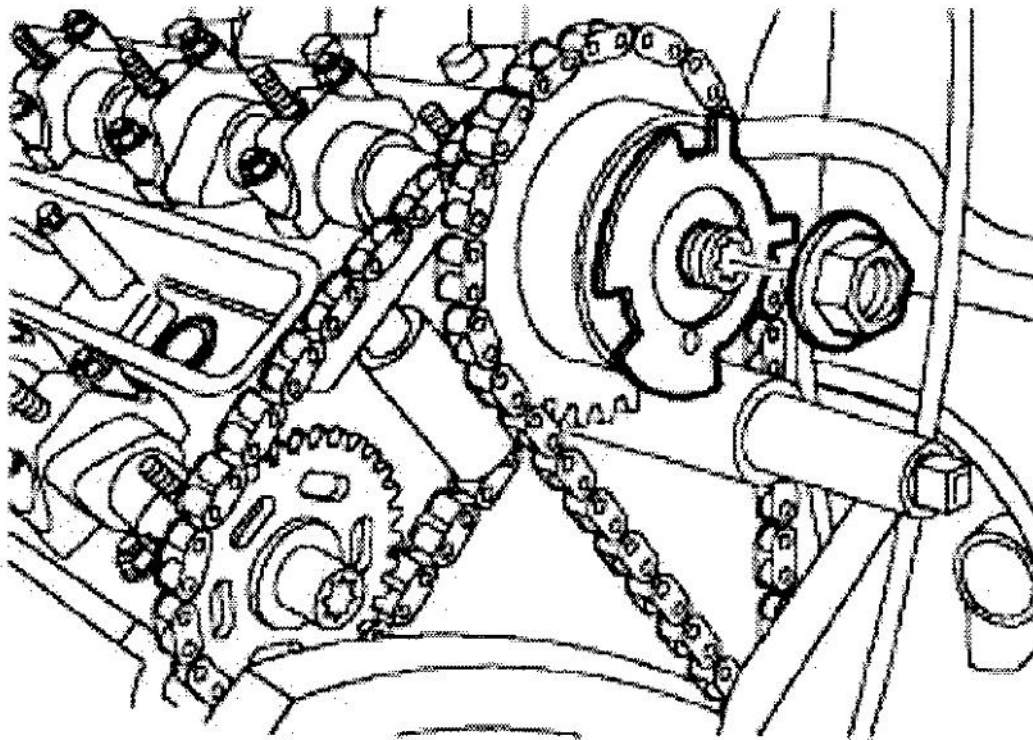
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Fig. 66: Removing Engine Lifting Eye From Right Cylinder Head
Courtesy of LAND ROVER NORTH AMERICA, INC.



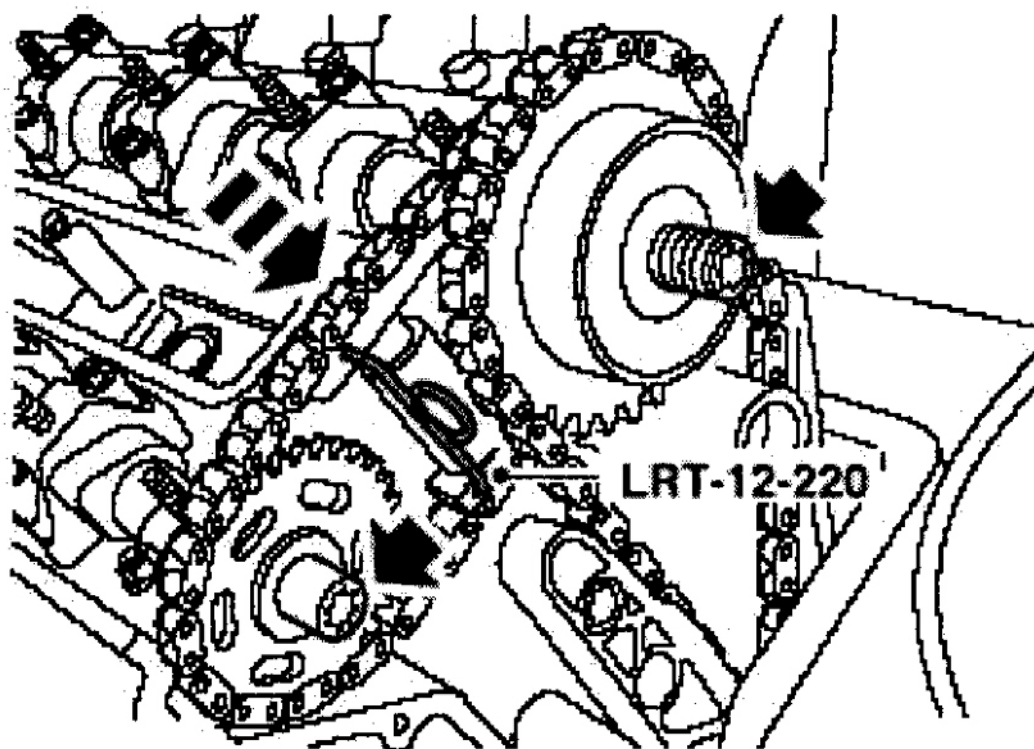
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Fig. 67: Securing Flywheel In TDC With LRT-12-227
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 68: Removing Right Camshaft Sensor Ring
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386227

Fig. 69: Removing Right VCC Unit Torx Bolts & Right Exhaust Camshaft Sprocket
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Position right exhaust camshaft chain to right VCC unit and position right exhaust camshaft sprocket to right exhaust camshaft chain.

NOTE: The Variable Crankshaft Control (VCC) unit, exhaust camshaft chain and exhaust camshaft sprocket do not have timing marks on them. These parts may be freely fitted to the timing gear chain and camshafts in any position.

2. Position right VCC unit to timing gear chain, fit VCC and exhaust camshaft sprocket to camshafts, fit and hand tighten 2 Torx bolts to eliminate play.

NOTE: Thread is left handed.

3. Compress right exhaust timing chain tensioner and remove LRT-12-220. See **Fig. 61**.

NOTE: Only screw in adjustment bolt until slight resistance is present.

4. Fit LRT-12-221 to right cylinder head, fit LRT-12-222 to LRT-12-221 and hand tighten.
5. Fit LRT-12-224 to left VCC unit, connect multimeter between pin on left VCC unit and stud on left oil line. See **Fig. 62**.
6. Rotate left VCC unit using LRT-12-224 to 40 Nm (30 ft. lbs) and using the multimeter, check continuity is present.

NOTE: Rotating the VCC unit using LRT-12-224 will remove the oil cushion and make sure the VCC unit is at the full left stop position. Continuity should be present when the VCC unit reaches this position.

7. Tighten Torx bolts securing left VCC unit and exhaust camshaft sprocket to 15 Nm (11 ft. lbs) and loosen one quarter of a turn.

NOTE: Thread is left handed.

8. Fit LRT-12-224 to right VCC unit, connect multimeter between pin on right VCC unit and stud on right oil line. See **Fig. 63**.
9. Rotate right VCC unit using LRT-12-224 to 40 Nm (30 ft. lbs) and using the multimeter, check continuity is present.

NOTE: Rotating the VCC unit using LRT-12-224 will remove the oil cushion and make sure the VCC unit is at the full left stop position. Continuity should be present when the VCC unit reaches this position.

10. Tighten Torx bolts securing right VCC unit and exhaust camshaft sprocket to 15 Nm (11 ft. lbs) and loosen one quarter of a turn.

NOTE: Thread is left handed.

11. Adjust chain tension by tightening LRT-12-222 to 0.7 Nm (6.3 INCH lbs).
12. Fit LRT-12-224 to left VCC unit, connect multimeter between pin on left VCC unit and stud on left oil line. See **Fig. 62**.

NOTE: When the chain tension is adjusted the VCC unit will move and require adjusting to the left stop.

13. Rotate left VCC unit using LRT-12-224 to 40 Nm (30 ft. lbs) and using the multimeter, check continuity is present.

NOTE: Rotating the VCC unit using LRT-12-224 will remove the oil cushion and make sure the VCC unit is at the full left stop position. Continuity should be present when the VCC unit reaches this position.

14. Tighten left VCC unit Torx bolt to 110 Nm (81 ft. lbs) and left exhaust camshaft sprocket Torx bolt to 125 Nm (92 ft. lbs).

NOTE: Thread is left handed.

15. Fit LRT-12-224 to right VCC unit, connect multimeter between pin on right VCC unit and stud on right oil line. See **Fig. 63**.

NOTE: When the chain tension is adjusted the VCC unit will move and require adjusting to the left stop.

16. Rotate right VCC unit using LRT-12-224 to 40 Nm (30 ft. lbs) and using the multimeter, check continuity is present.

NOTE: Rotating the VCC unit using LRT-12-224 will remove the oil cushion and make sure the VCC unit is at the full left stop position. Continuity should be present when the VCC unit reaches this position.

17. Tighten right VCC unit Torx bolt to 110 Nm (81 ft. lbs) and right exhaust camshaft sprocket Torx bolt to 125 Nm (92 ft. lbs).

NOTE: Thread is left handed.

18. Fit right CMP sensor ring, fit and hand tighten securing nut.

NOTE: Thread is left handed.

19. Position LRT-12-228/1 locating dowel to right CMP sensor ring, fit 2 bolts securing tool to right cylinder head and tighten. See **Fig. 64**.

NOTE: To ensure correct CMP sensor ring adjustment, make sure the tool is aligned flush with the cylinder head and lower timing gear cover before tightening the tool securing bolts.

20. Tighten nut securing CMP sensor ring to 40 Nm (30 ft. lbs) and remove LRT-12-228/1 from right cylinder head.

NOTE: Thread is left handed.

21. Fit left CMP sensor ring, fit and hand tighten securing nut.

NOTE: Thread is left handed.

22. Position LRT-12-228/2 locating dowel to left CMP sensor ring, fit 2 bolts securing tool to right cylinder

head and tighten. See **Fig. 65**.

NOTE: To ensure correct CMP sensor ring adjustment, make sure the tool is aligned flush with the cylinder head and lower timing gear cover before tightening the tool securing bolts.

23. Tighten nut securing CMP sensor ring to 40 Nm (30 ft. lbs) and remove LRT-12-228/2 from left cylinder head.

NOTE: Thread is left handed.

24. Remove LRT-12-223/5, LRT-12-223/6, LRT-12-223/2 and LRT-12-223/1 from right cylinder head camshafts.
25. Remove LRT-12-223/6, LRT-12-223/5, LRT-12-223/3 and LRT-12-223/4 from left cylinder head camshafts.
26. Loosen LRT-12-222, remove 2 bolts securing LRT-12-221 to right cylinder head and remove LRT-12-221.
27. Fit right upper timing gear cover. See **COVER - TIMING GEAR - UPPER - RIGHT**.
28. Fit left upper timing gear cover. See **COVER - TIMING GEAR - UPPER - LEFT**.
29. Remove LRT-12-227 from timing tool access hole.
30. Fit 4 camshaft oil lines to left and right cylinder heads, fit and tighten 20 securing bolts.
31. Fit engine lifting eye to rear of right cylinder head and fit 2 bolts securing engine lifting eye and tighten.
32. Fit and tighten 8 spark plugs to 31 Nm (23 ft. lbs).
33. Fit right camshaft cover. See **GASKET - CAMSHAFT COVER - RIGHT**.
34. Fit left camshaft cover. See **GASKET - CAMSHAFT COVER - LEFT**.
35. Fit fan cowl. See **VISCOUS FAN**.
36. Fill cooling system. See **DRAINING & REFILLING COOLING SYSTEM**.
37. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.

ENGINE & ANCILLARIES - REMOVE FOR ACCESS & REFIT

Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT**. If fitting a replacement engine, a new dowel must be fitted, in the correct position, into the crankshaft boss. The procedure for this is detailed at the start of the installation section.

1. Release bonnet support stays, raise and secure bonnet in upright position.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.
3. Remove air intake plenum. See **80.15.62 PLENUM -- AIR INTAKE**.
4. Depressurize fuel system. See **FUEL SYSTEM -- DEPRESSURIZE**.

5. Recover refrigerant from A/C system. See **82.30.02 REFRIGERANT RECOVERY-RECYCLING AND RECHARGE** .
6. Remove Mass Air Flow (MAF)/Intake Air Temperature (IAT) sensor. See **SENSOR -- COMBINED MASS AIR FLOW (MAFS) & INTAKE AIR TEMPERATURE (IAT)** .
7. Raise front of vehicle and support on stands.

WARNING: DO NOT work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

8. Drain cooling system. See **DRAINING & REFILLING COOLING SYSTEM** .
9. Remove viscous coupling. See **VISCOUS FAN** .
10. Release cover, remove nut and disconnect battery positive lead from stud. See **Fig. 70**.
11. Remove right ignition coil cover. See **COVER -- IGNITION COILS -- LH** .
12. Remove left ignition coil cover. See **COVER -- IGNITION COILS -- LH** .
13. Position differential breather pipe clear of engine. See **Fig. 71**.
14. Remove nut and disconnect earth lead from left camshaft cover. See **Fig. 72**.
15. Remove nut and disconnect earth lead from right camshaft cover. See **GASKET - CAMSHAFT COVER - RIGHT**.
16. Disconnect multiplugs from ignition coils. See **Fig. 73**.
17. Disconnect multiplugs from throttle body, thermostat heater, CMP sensor and ECT sensor. See **Fig. 74**.
18. Cut 2 cable ties securing engine harness at throttle body and release harness.
19. Disconnect multiplug from right Variable Camshaft Control (VCC) solenoid. See **Fig. 75**.
20. Release VCC multiplug harness from clip.
21. Disconnect multiplug from left VCC solenoid. See **Fig. 76**.
22. Disconnect multiplug from alternator. See **Fig. 77**.
23. Release alternator harness from 4 clips.
24. Disconnect multiplugs from left Camshaft (CMP) sensor and left knock sensor. See **Fig. 78**.
25. Remove 2 nuts securing left fuel injector harness to fuel rail, release vacuum reservoir and mounting bracket from stud and position aside. See **Fig. 79**.
26. Release alternator harness from 2 clips on engine cover mounting brackets. See **Fig. 80**.
27. Disconnect multiplugs from left fuel injectors. See **Fig. 81**.
28. Release engine harness from clips and move clear of camshaft cover. See **Fig. 82**.
29. If fitted: Disconnect multiplug from Secondary Air Injection (SAI) control valve. See **Fig. 83**.
30. Remove 2 nuts securing engine harness to induction manifold and, remove washer. See **Fig. 84**.
31. If fitted: SAI control valve from securing stud. Position valve aside.
32. Disconnect multiplug from right Knock Sensor (KS). See **Fig. 85**.
33. Disconnect multiplugs from right fuel injectors. See **Fig. 86**.
34. Disconnect multiplug from charcoal canister purge control valve. See **Fig. 87**.
35. Position engine harness to right bulkhead.

36. Disconnect pipe from charcoal canister purge control valve. See **Fig. 88**.

CAUTION: Always fit plugs to open connections to prevent contamination.

37. Remove charcoal canister purge valve pipe. See **Fig. 89**.
38. Release transmission breather pipes from clips at coolant manifold and position aside.
39. Release clips and disconnect heater hoses from coolant manifold.
40. Undo bolt securing gearbox multiplug bracket to gearbox bell housing and position aside. See **Fig. 90**.
41. Disconnect multiplug from starter motor lead. See **Fig. 91**.
42. Position absorbent cloth around fuel feed pipe connection to collect spillage.
43. Disconnect fuel feed hose from fuel rail. See **Fig. 92**.

CAUTION: Always fit plugs to open connections to prevent contamination.

44. Remove absorbent cloth.
45. Release hose clip and disconnect brake servo vacuum hose from one way valve. See **Fig. 93**.

CAUTION: Always fit plugs to open connections to prevent contamination.

46. Disconnect vacuum pipe from induction manifold. See **Fig. 94**.
47. Disconnect multiplug from radiator bottom hose. See **Fig. 95**.
48. Remove bolt securing radiator bottom hose to bracket, release clips and remove radiator bottom hose. See **Fig. 96**.
49. Release clip and disconnect radiator top hose from radiator.
50. Release clips and disconnect radiator top hose from coolant pump and alternator. See **Fig. 97**.
51. Release clip securing radiator top hose to coolant "T" junction and remove radiator top hose. See **Fig. 98**.
52. Release clip and disconnect coolant hose from "T" junction. See **Fig. 99**.
53. Disconnect multiplug from A/C compressor. See **Fig. 100**.
54. Remove Allen bolt securing A/C pipe to A/C compressor and disconnect A/C pipe. Discard "O" ring. See **Fig. 101**.

CAUTION: Immediately cap all A/C pipes to prevent ingress of dirt and moisture into the system.

55. Remove Allen bolt securing A/C pipe to condenser and disconnect A/C pipe. Discard "O" ring. See **Fig. 102**.

CAUTION: Immediately cap all A/C pipes to prevent ingress of dirt and moisture into the system.

56. If fitted: Disconnect 2 hoses from the SAI control valve. See **Fig. 103**.

CAUTION: Always fit plugs to open connections to prevent contamination.

57. Disconnect multiplug from oil pressure switch. See **Fig. 104**.
58. Remove 2 nuts securing oil filter housing and release oil filter housing from mounting bracket. See **Fig. 105**.
59. Position oil filter housing and hoses aside and secure to engine with cable ties.
60. Position container to collect Power Assisted Steering (PAS) fluid spillage.
61. Release clip and disconnect fluid inlet hose from PAS pump. Undo union nut and disconnect PAS outlet hose from PAS pump. Discard "O" ring. See **Fig. 106**.

CAUTION: Always fit plugs to open connections to prevent contamination.

62. Remove container from below PAS pump.
63. Remove 4 bolts securing differential air flow panel to sub-frame and remove panel.
64. Remove 4 nuts securing front pipe flanges to exhaust manifolds and discard nuts. See **Fig. 107**.
65. Release exhaust front pipes from exhaust manifolds.
66. Remove front road wheels.
67. Remove right front drive shaft. See **FRONT DRIVE SHAFT** .
68. Remove differential breather hose. Remove 4 differential securing bolts and release differential from engine sump. See **Fig. 108**.

NOTE: Securing bolt above pinion remains captive to differential.

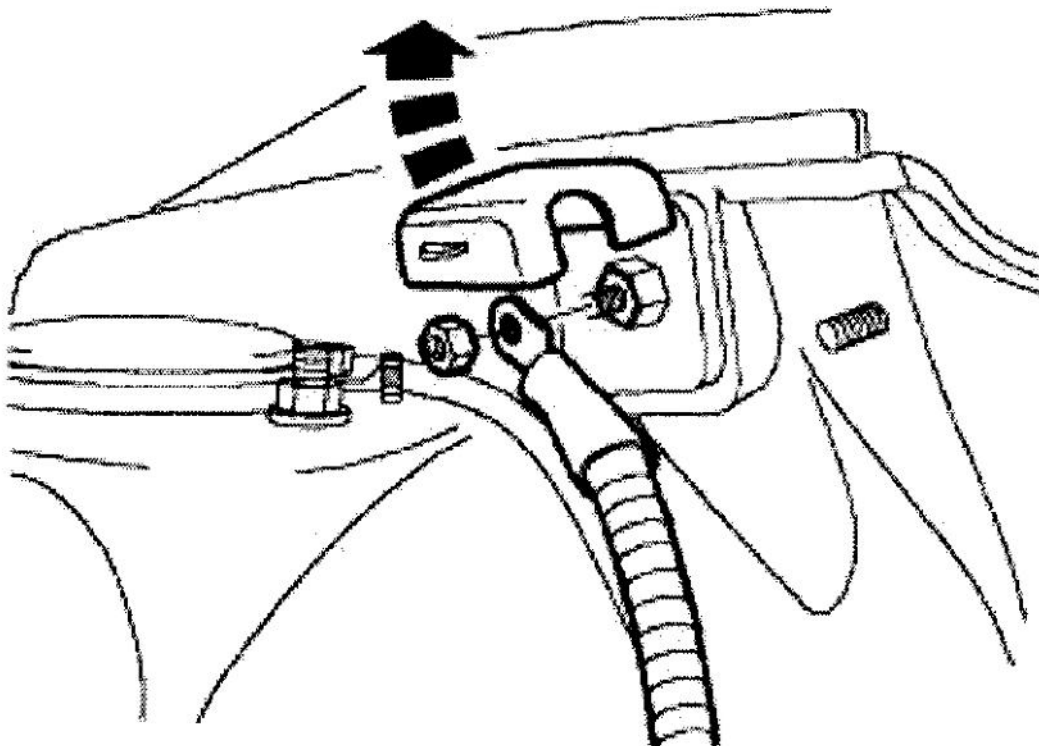
69. Disconnect engine earth lead. See **Fig. 109**.
70. Remove Crankshaft (CKP) sensor. See **SENSOR -- CRANKSHAFT POSITION (CKP)** .
71. Remove bolt securing transmission cooler pipes and release cooler pipes from bracket. See **Fig. 110**.
72. Remove grommet from bottom of bell housing to gain access to torque converter. See **Fig. 111**.
73. Remove grommet from bell housing to gain access to torque converter securing bolts. See **Fig. 112**.
74. Rotate crankshaft for access and remove 4 bolts securing torque converter to drive plate.
75. Position torque converter clear of drive plate.
76. Remove 2 bolts securing starter motor and release starter motor. See **Fig. 113**.

NOTE: Starter motor remains captive to engine.

77. Support gearbox.
78. Remove 8 Torx bolts securing gearbox to engine. See **Fig. 114**.
79. Fit LRT-12-216 to engine lifting eyes. See **Fig. 115**.
80. Remove nut securing right engine mounting to engine mounting bracket. See **Fig. 116**.
81. Remove nut securing left engine mounting to engine mounting bracket. See **Fig. 117**.
82. Connect chain to lifting bracket and take weight of engine.
83. Raise engine clear of mountings.
84. Remove 2 Torx bolts from top of bell housing. See **Fig. 118**.
85. Release engine from dowels, carefully raise and guide engine clear of vehicle.

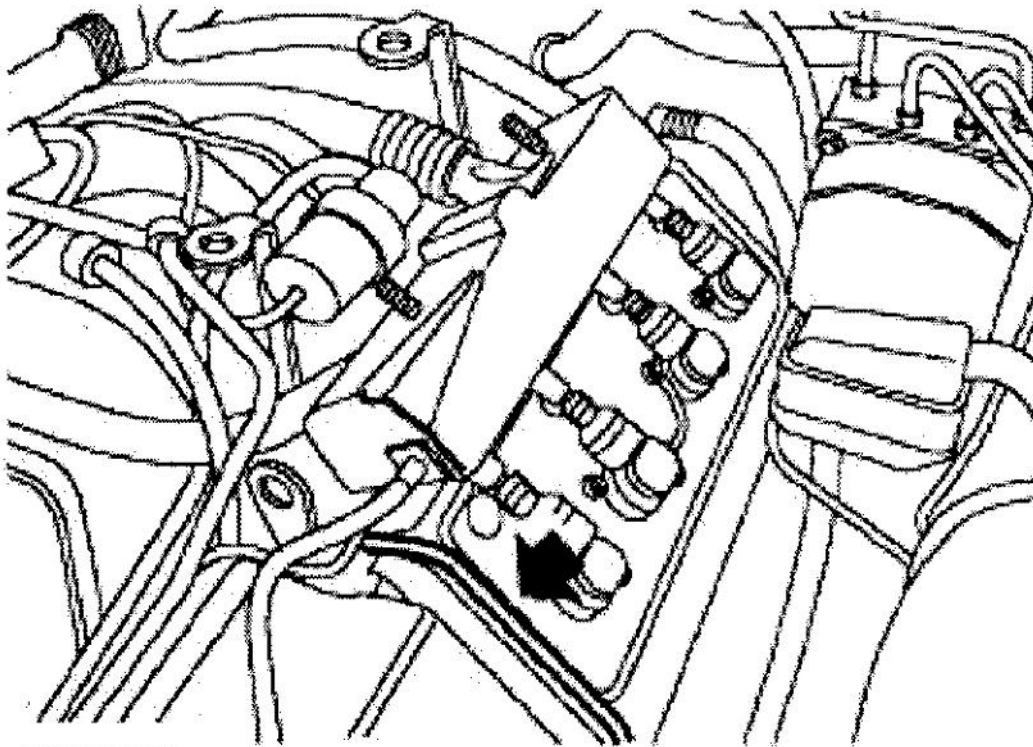
CAUTION: To prevent damage to the radiator, DO NOT allow engine to contact the radiator.

86. Discard differential "O" ring. See **Fig. 119**.



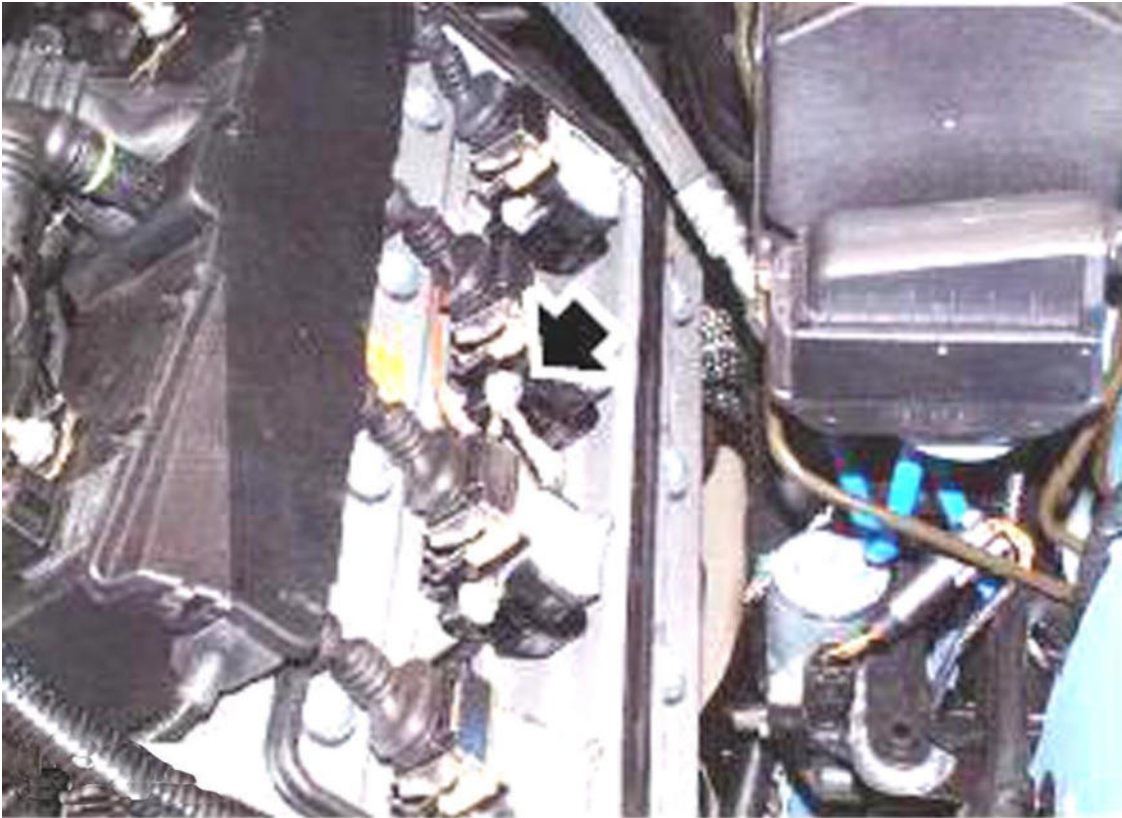
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Fig. 70: Disconnecting Battery Positive Lead From Stud
Courtesy of LAND ROVER NORTH AMERICA, INC.



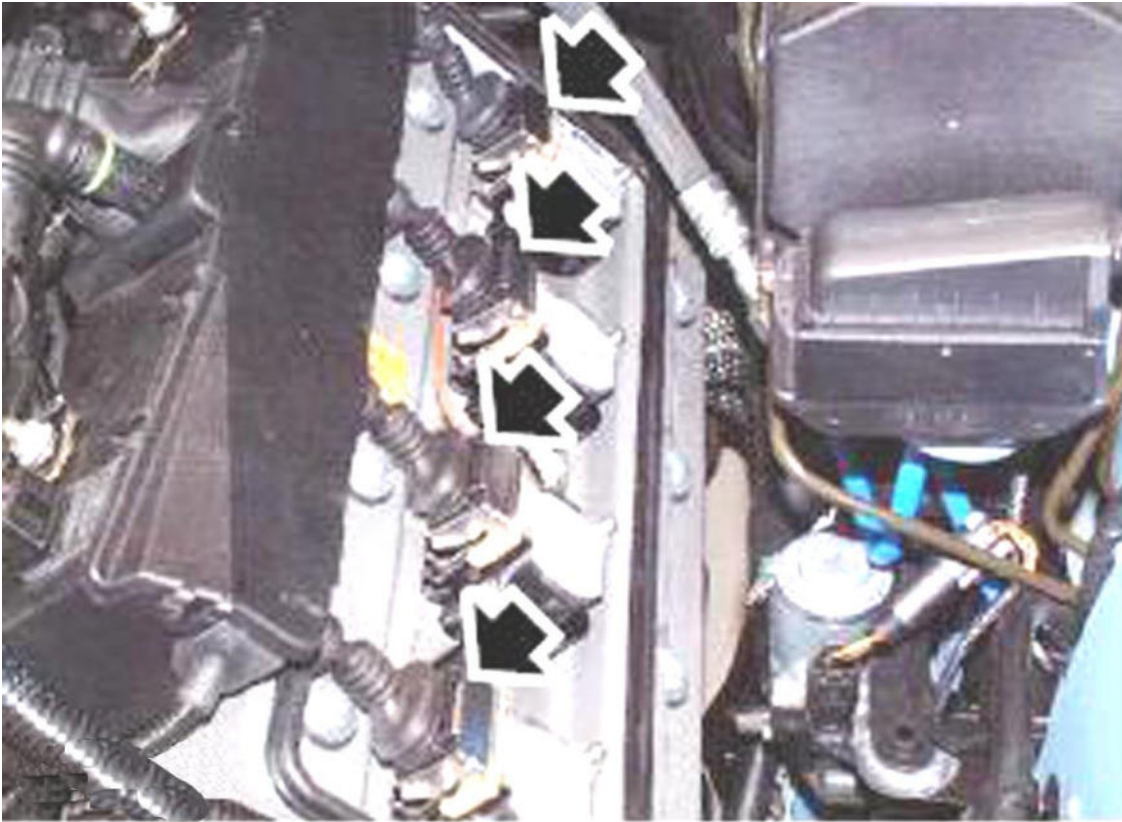
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Fig. 71: Positioning Breather Pipe Clear Of Engine
Courtesy of LAND ROVER NORTH AMERICA, INC.



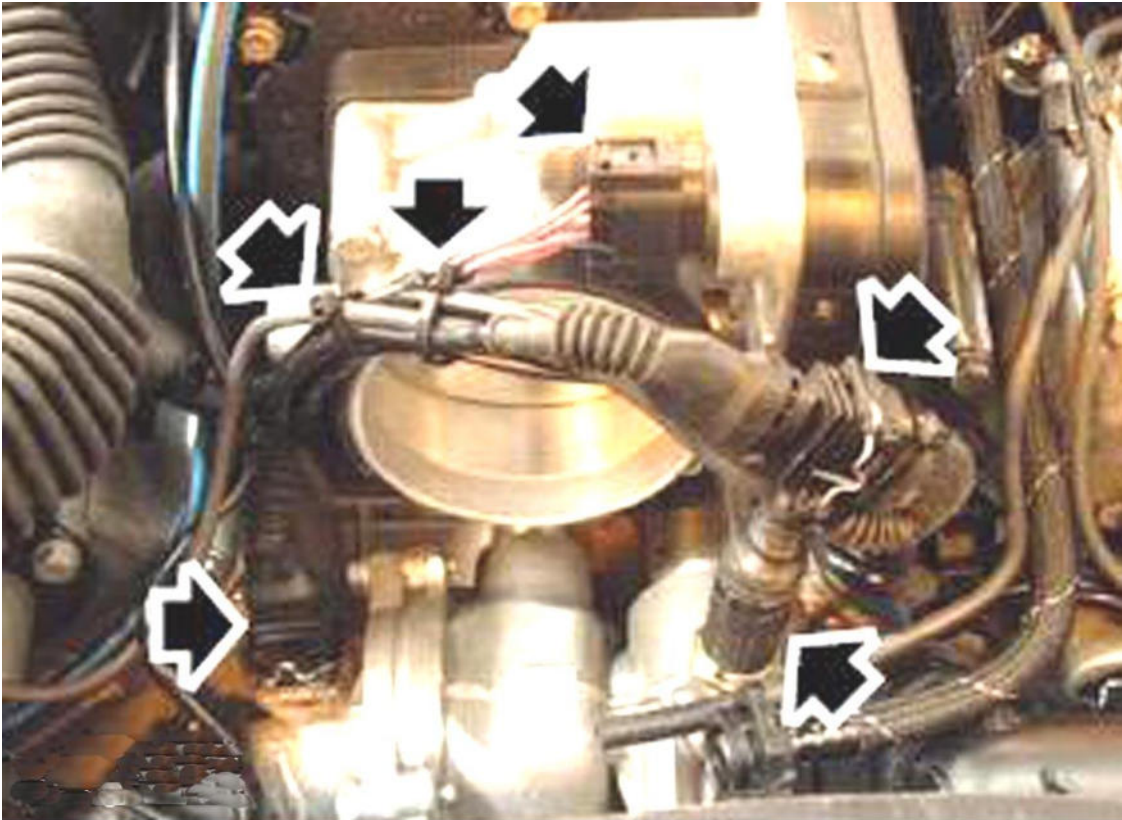
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Fig. 72: Disconnecting Earth Lead From Left Camshaft Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.



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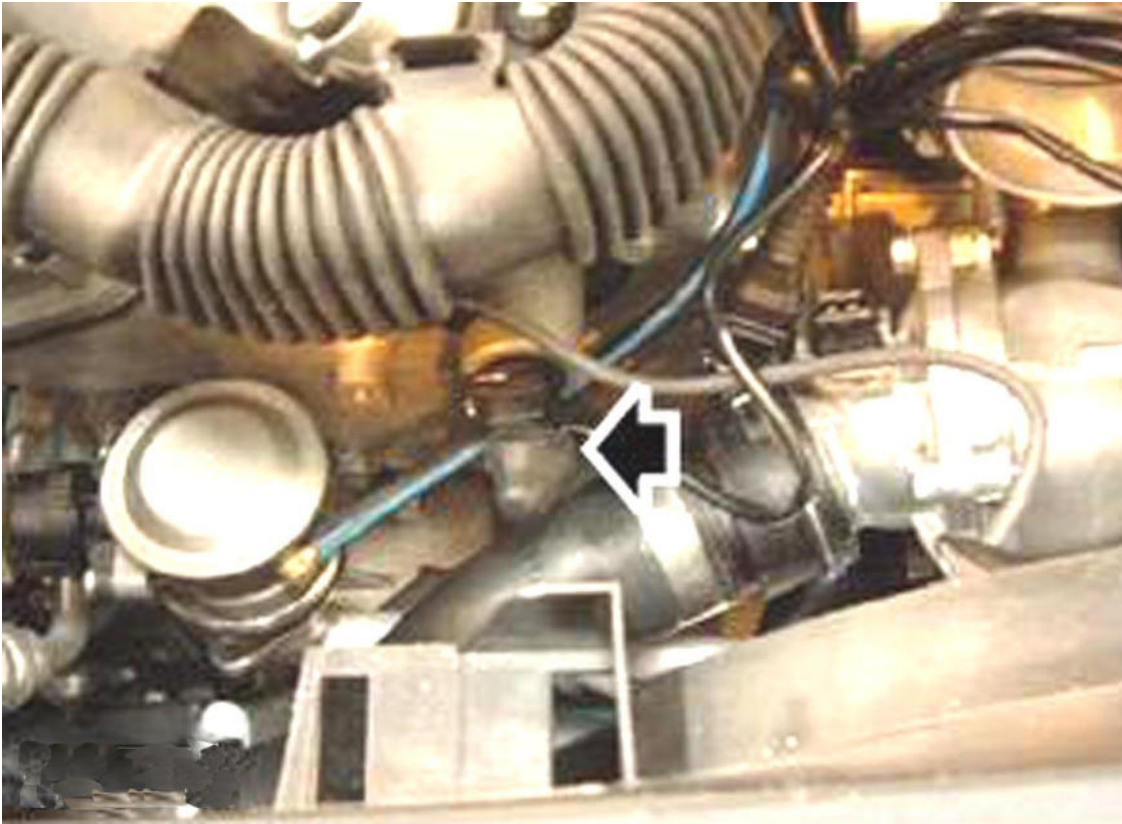
Fig. 73: Disconnecting Multiplugs From Ignition Coils
Courtesy of LAND ROVER NORTH AMERICA, INC.



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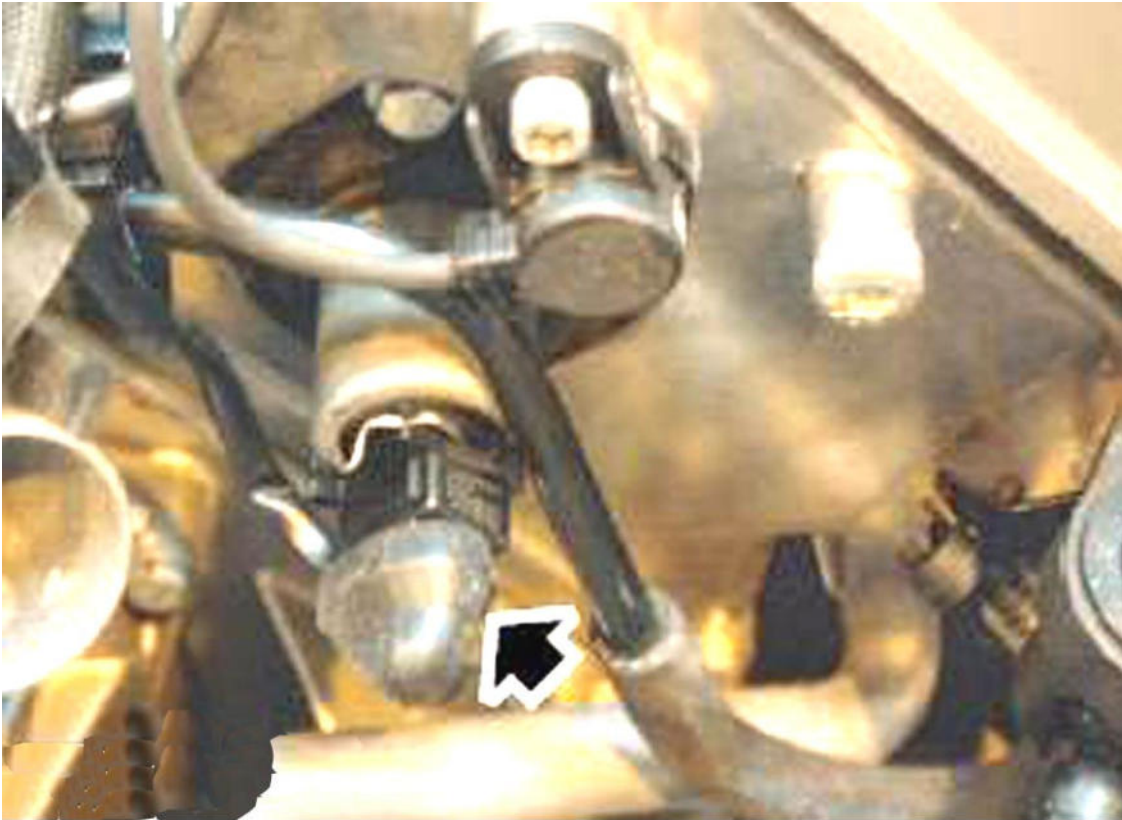
Fig. 74: Disconnecting Multiplugs From Throttle body, Thermostat Heater, Camshaft Sensor & ECT Sensor

Courtesy of LAND ROVER NORTH AMERICA, INC.



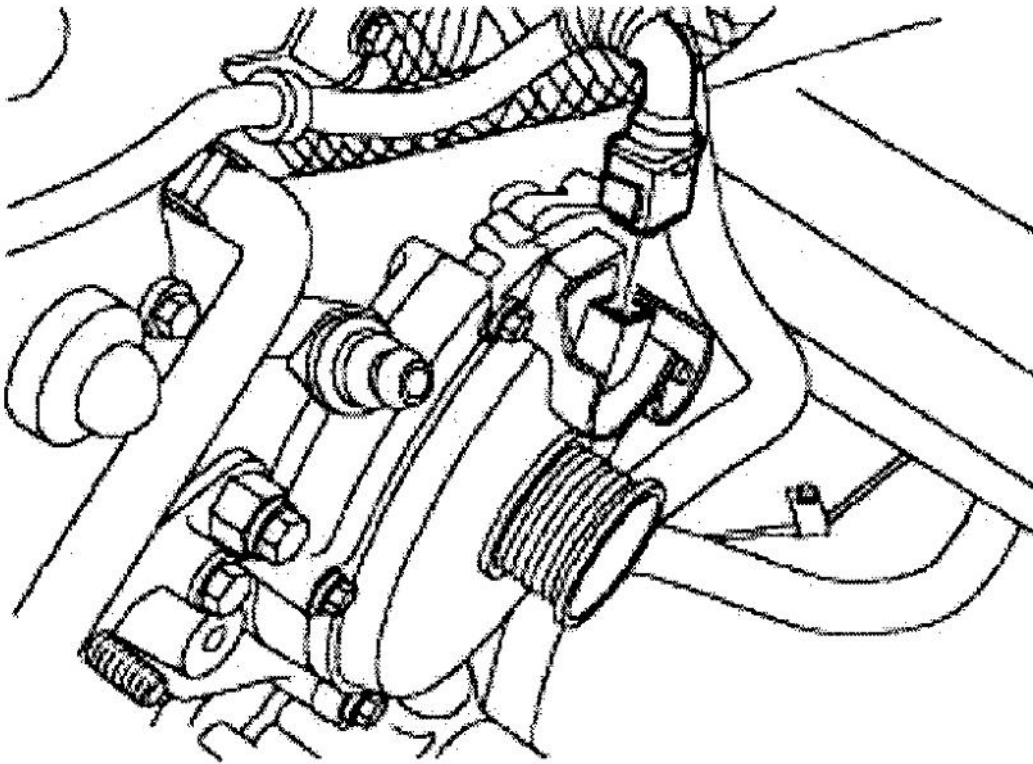
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Fig. 75: Disconnecting Right Variable Camshaft Control Solenoid Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



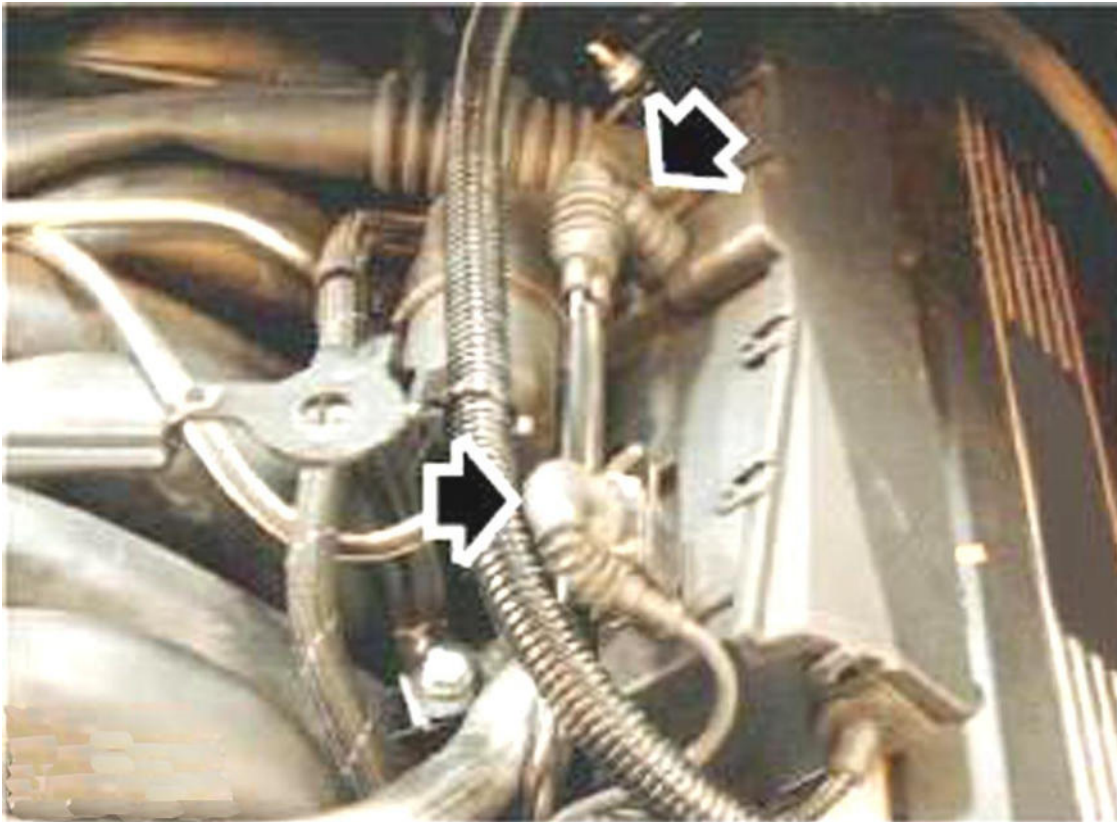
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Fig. 76: Disconnecting Left Variable Camshaft Control Solenoid Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



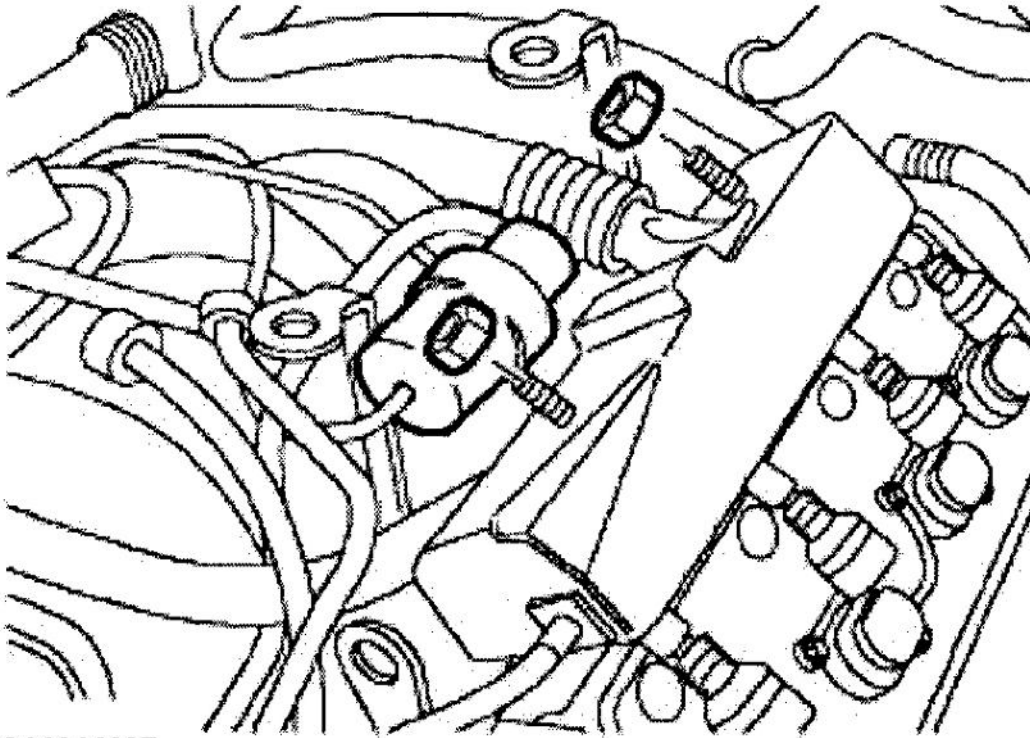
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Fig. 77: Disconnecting Alternator Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



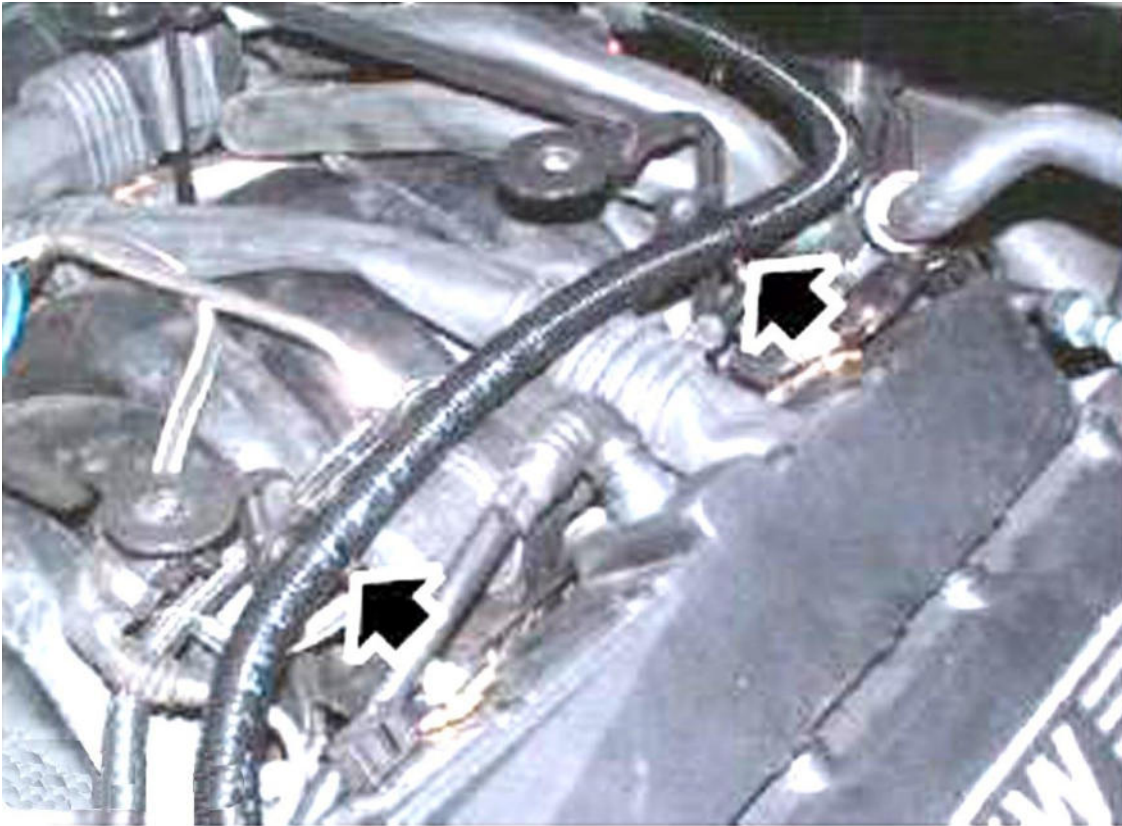
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Fig. 78: Disconnecting Left Camshaft Sensor Multiplug & Left Knock Sensor Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



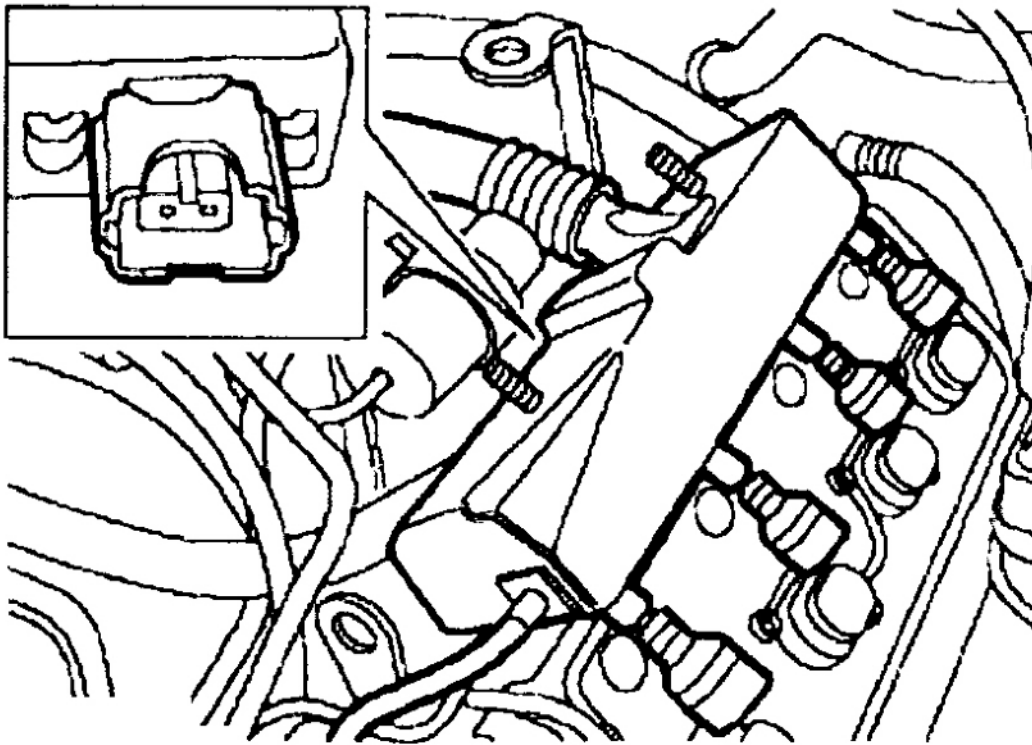
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Fig. 79: Removing Left Fuel Injector Harness-To-Fuel Rail Nuts
Courtesy of LAND ROVER NORTH AMERICA, INC.



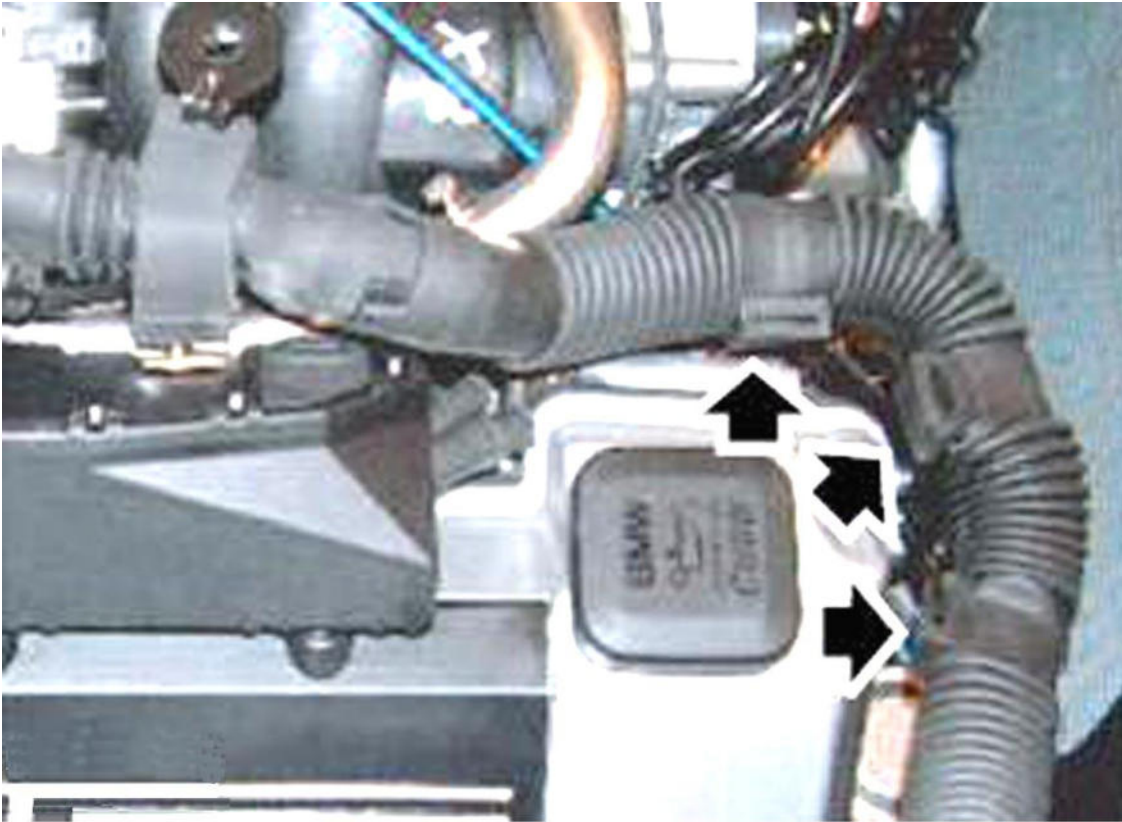
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Fig. 80: Releasing Alternator Harness Clips From Engine Mounting Brackets
Courtesy of LAND ROVER NORTH AMERICA, INC.



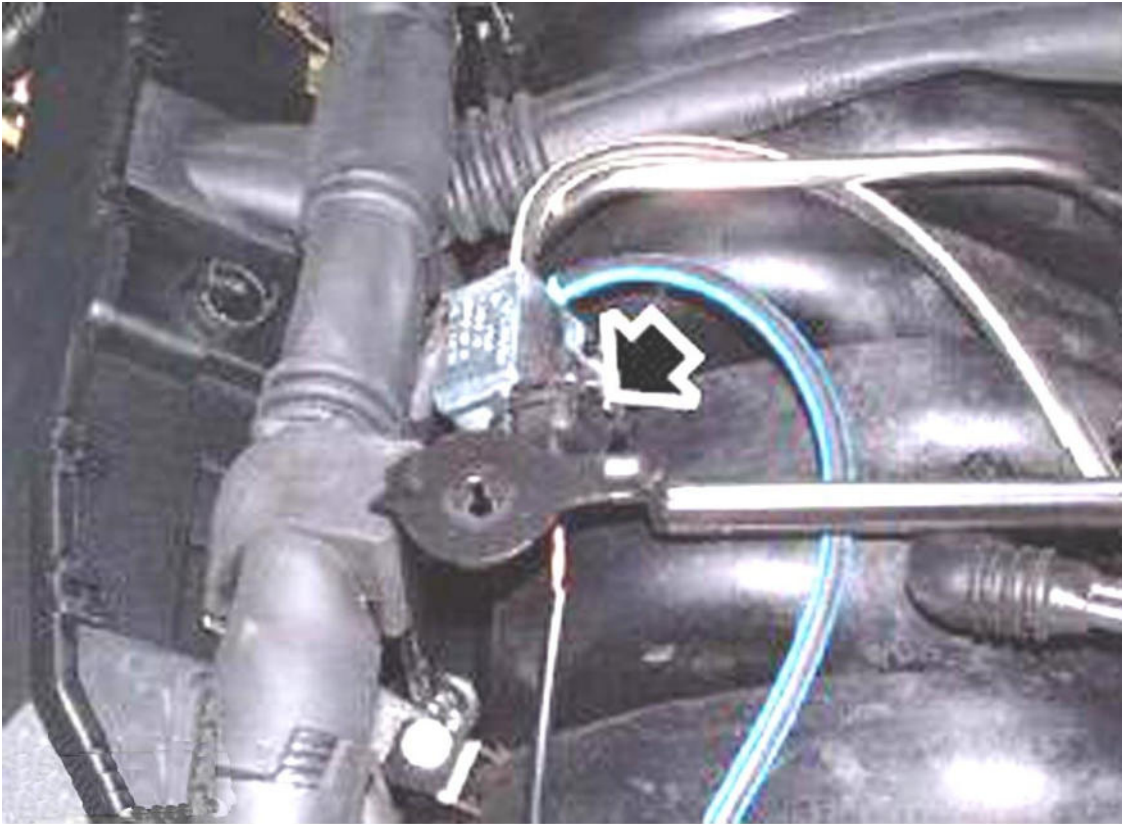
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Fig. 81: Disconnecting Left Fuel Injectors Multiplugs
Courtesy of LAND ROVER NORTH AMERICA, INC.



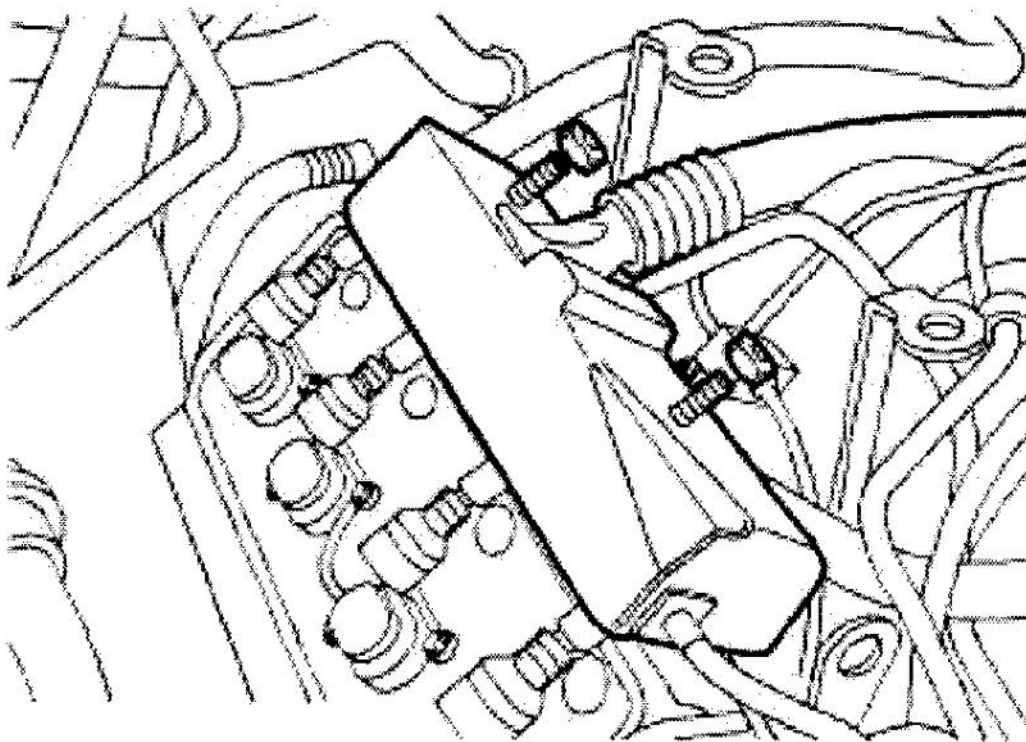
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Fig. 82: Releasing Engine Harness Clips & Moving Clear Of Camshaft Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.



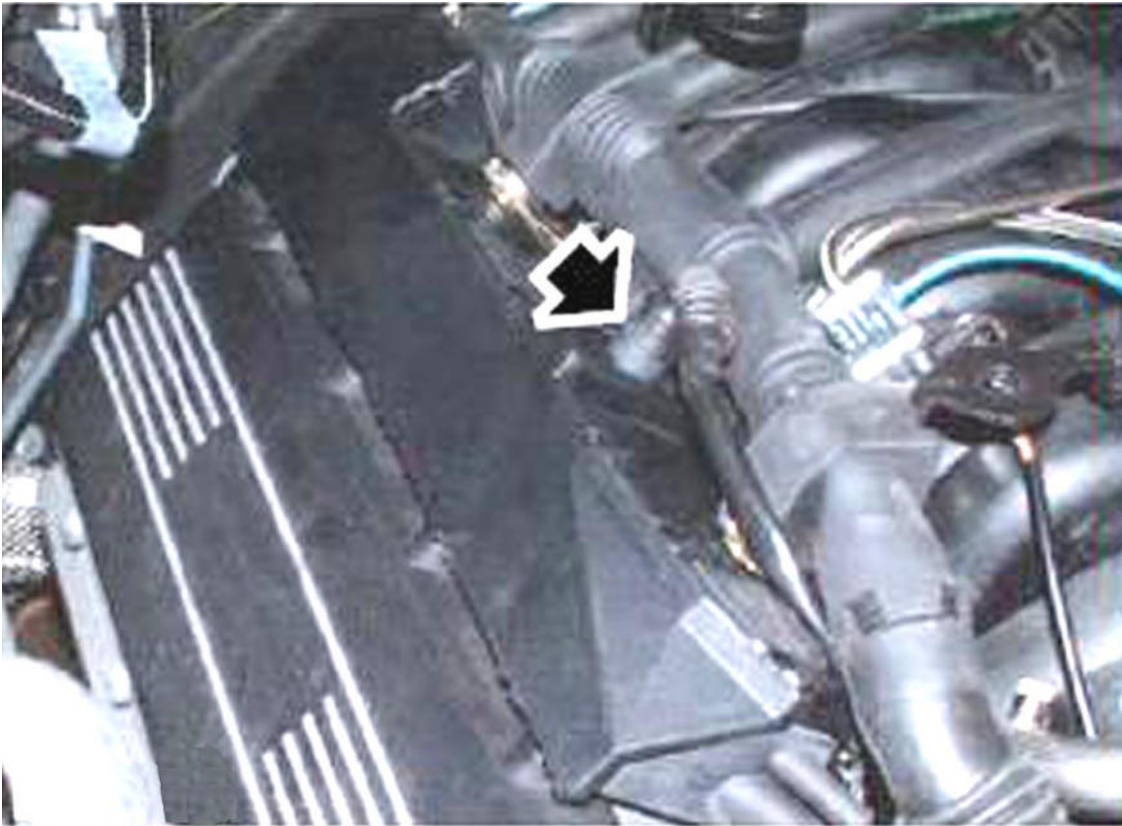
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Fig. 83: Disconnecting Secondary Air Injection Control Valve Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



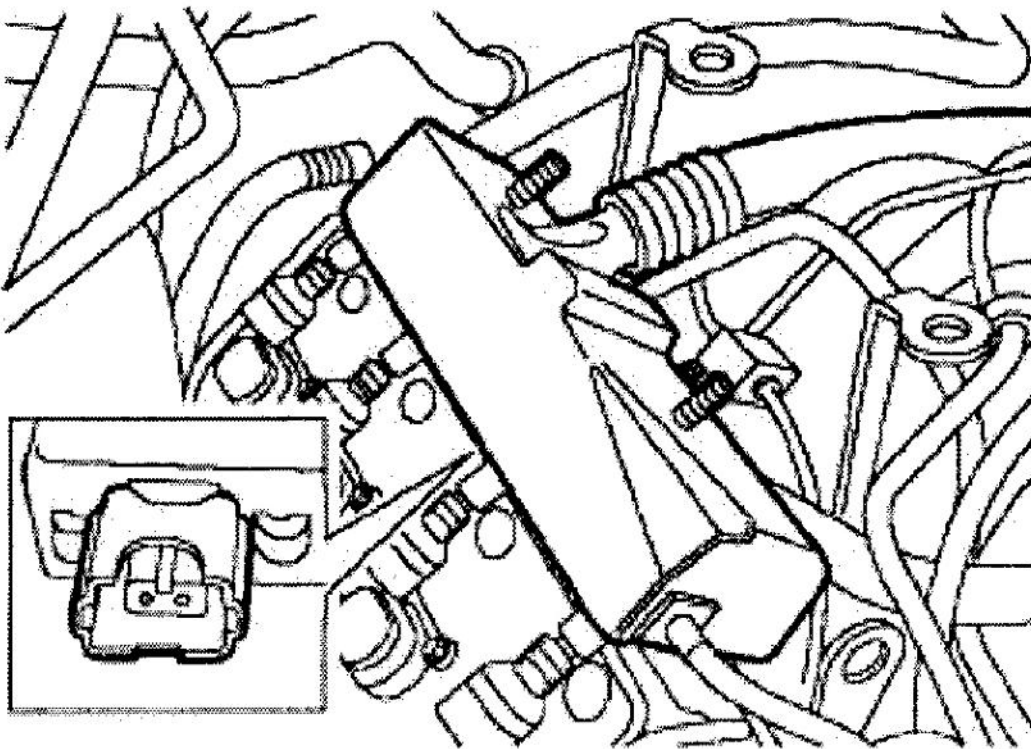
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Fig. 84: Removing Engine Harness Nuts-To-Induction Manifold
Courtesy of LAND ROVER NORTH AMERICA, INC.



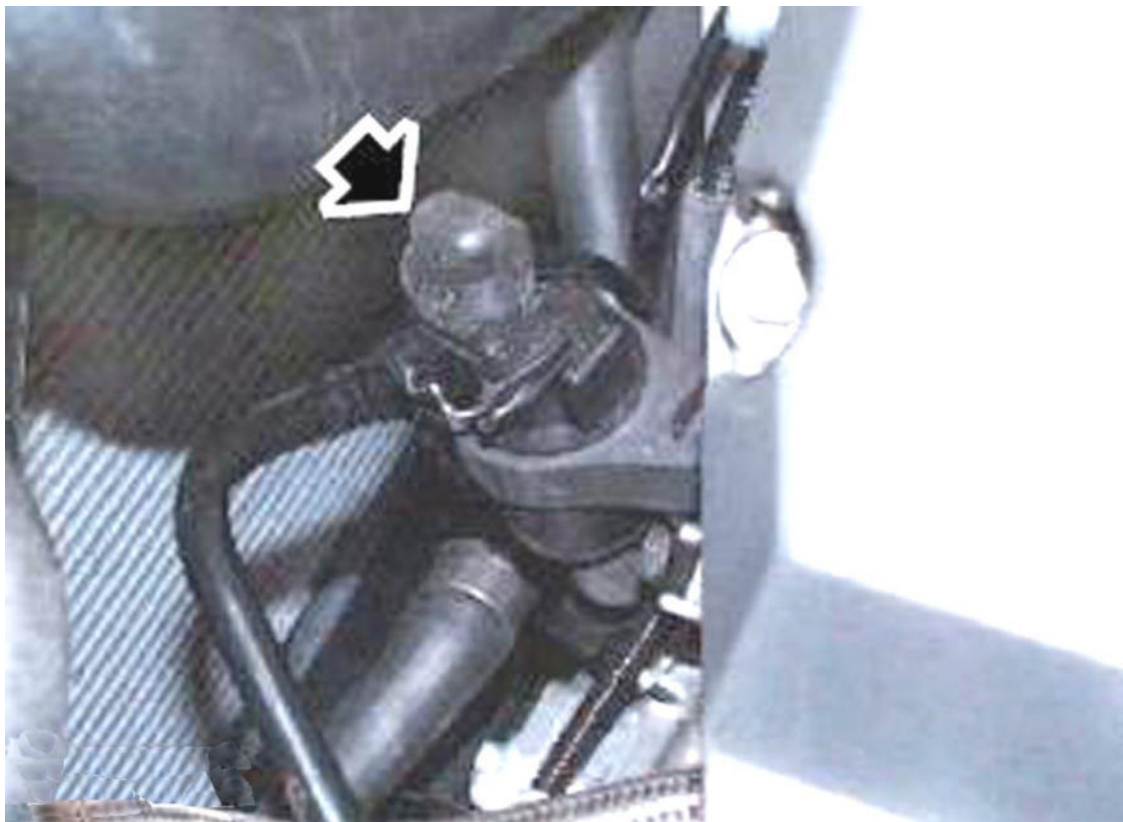
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Fig. 85: Disconnecting Right Knock Sensor Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



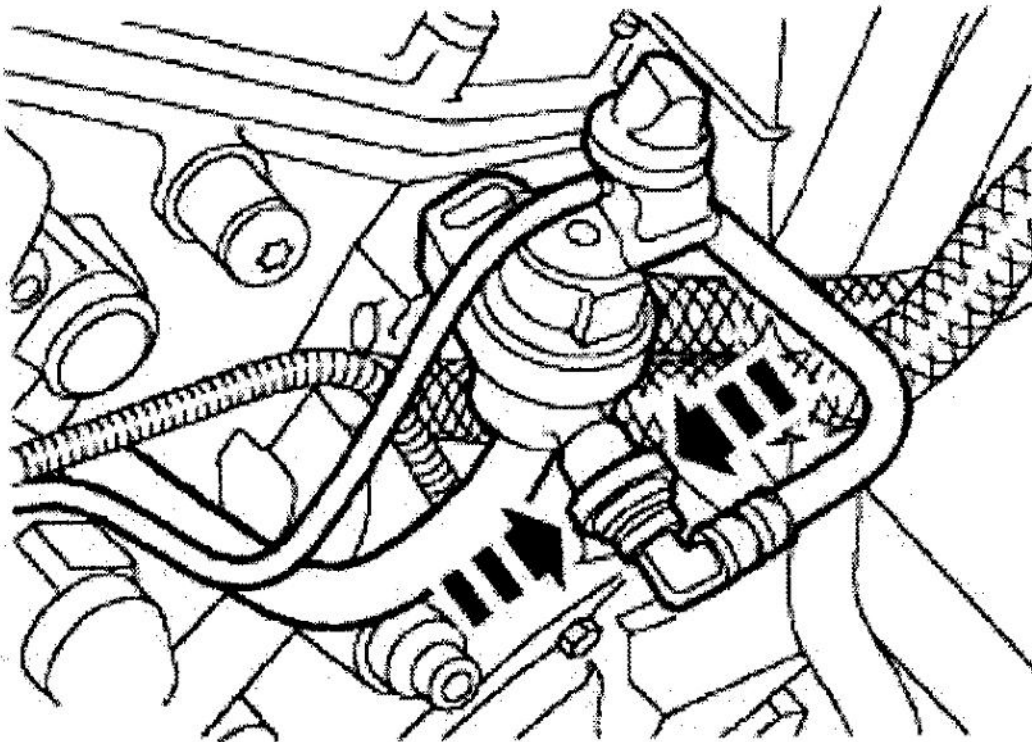
G00386244

Fig. 86: Disconnecting Right Fuel Injectors Multiplugs
Courtesy of LAND ROVER NORTH AMERICA, INC.



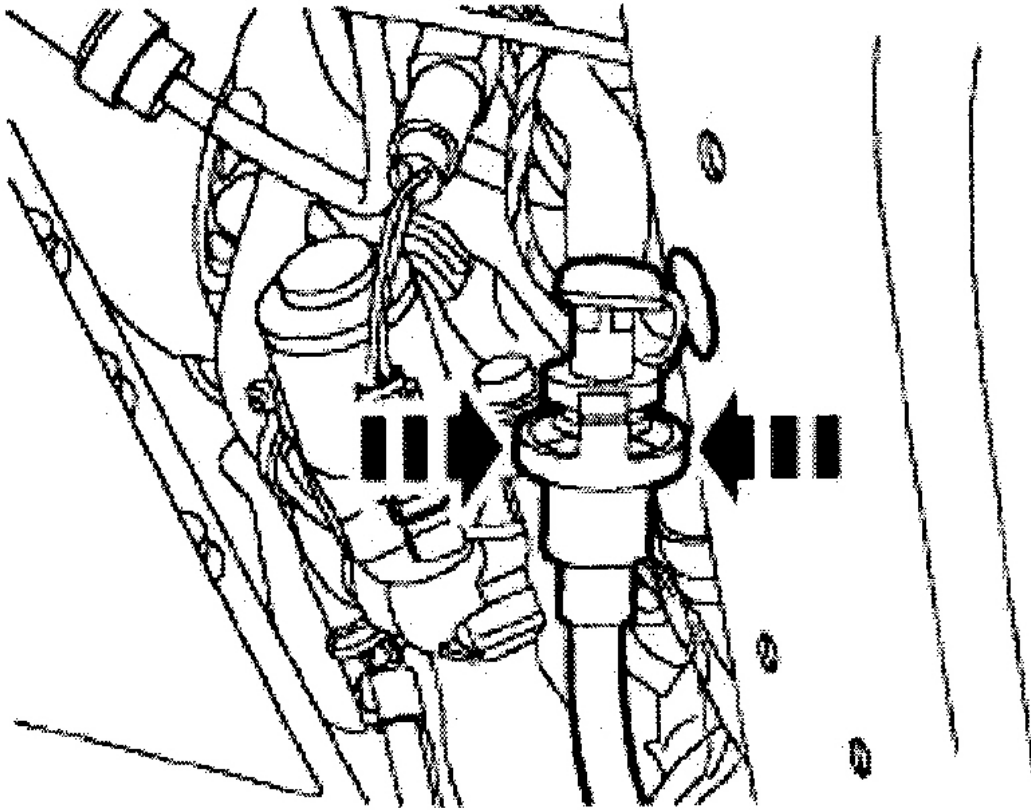
G00386245

Fig. 87: Disconnecting Charcoal Canister Purge Control Valve Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



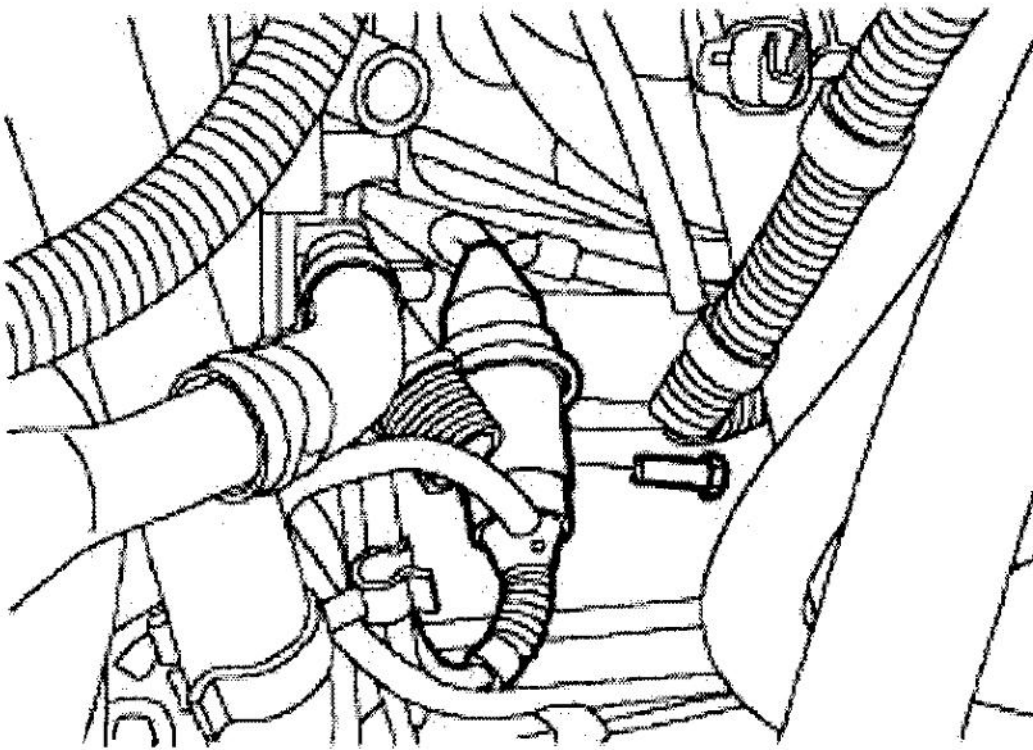
G00386246

Fig. 88: Disconnecting Charcoal Canister Purge Control
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386247

Fig. 89: Removing Charcoal Canister Purge Valve Pipe
Courtesy of LAND ROVER NORTH AMERICA, INC.



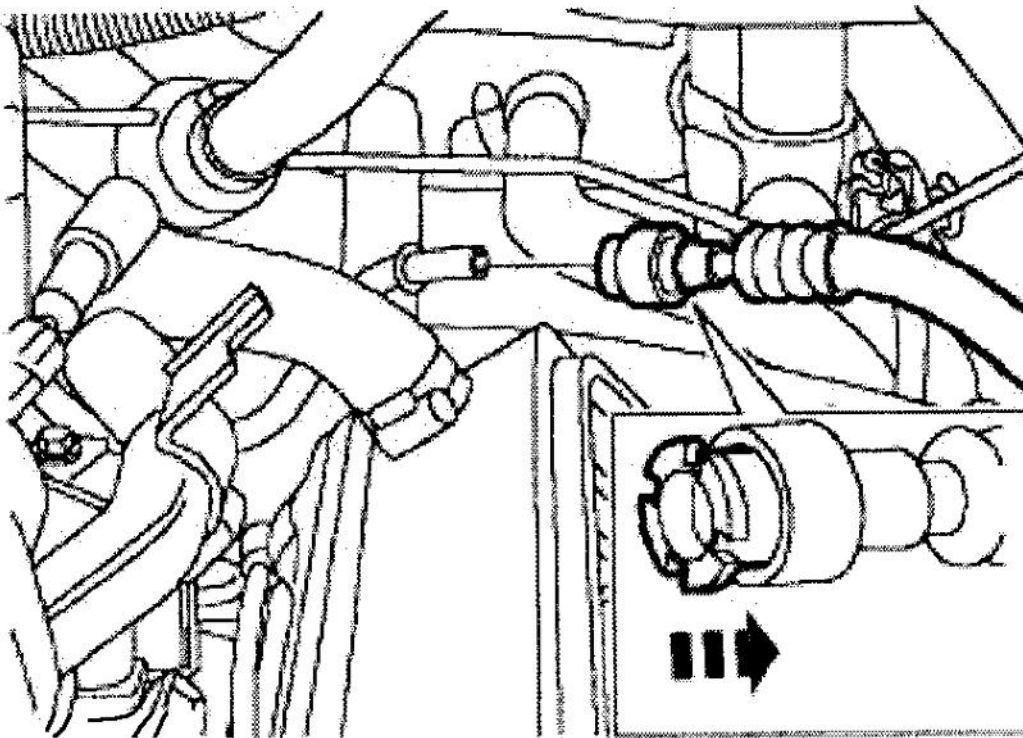
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Fig. 90: Removing Gearbox Multiplug Bracket-To-Gearbox
Courtesy of LAND ROVER NORTH AMERICA, INC.



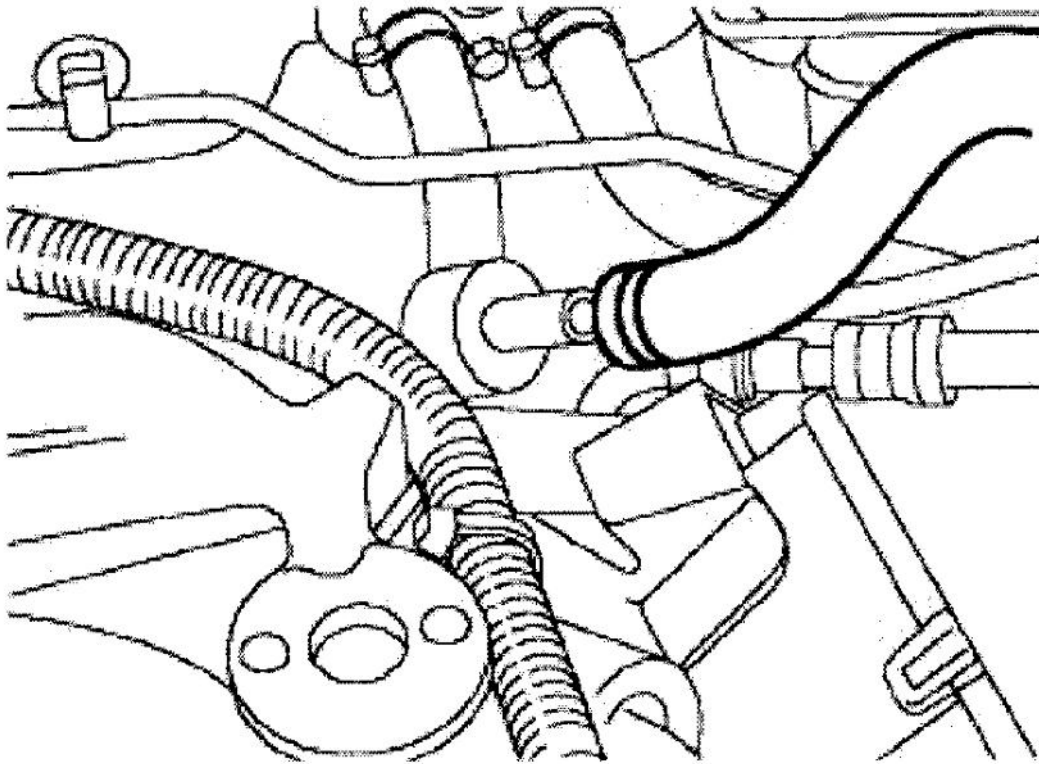
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Fig. 91: Disconnecting Starter Motor Lead Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



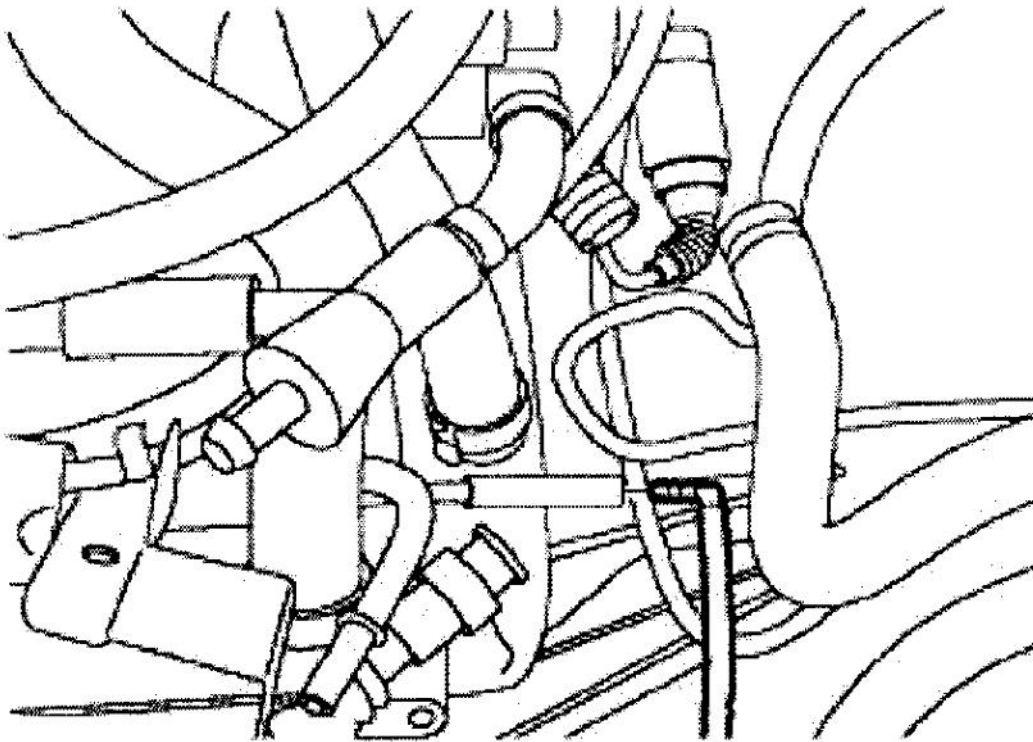
G00386250

Fig. 92: Disconnecting Fuel Feed Hose From Fuel Rail
Courtesy of LAND ROVER NORTH AMERICA, INC.



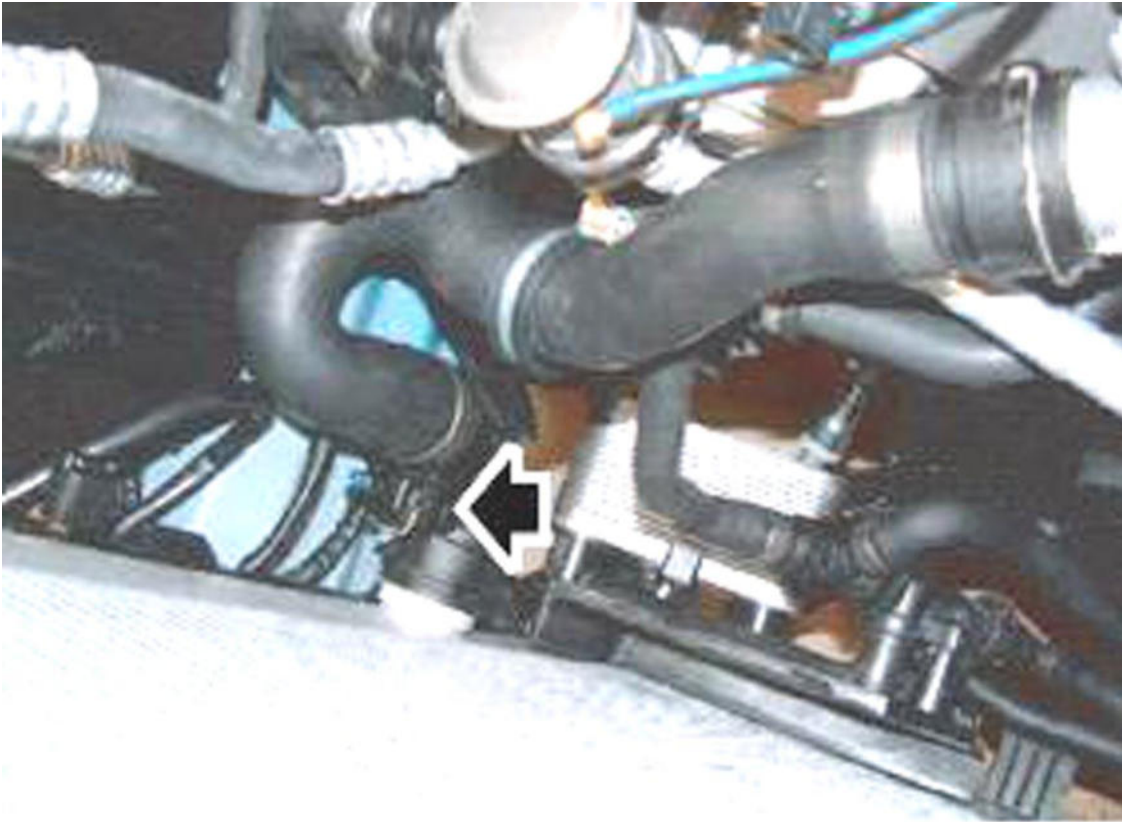
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Fig. 93: Disconnecting Brake Servo Vacuum Hose From One Way Valve
Courtesy of LAND ROVER NORTH AMERICA, INC.



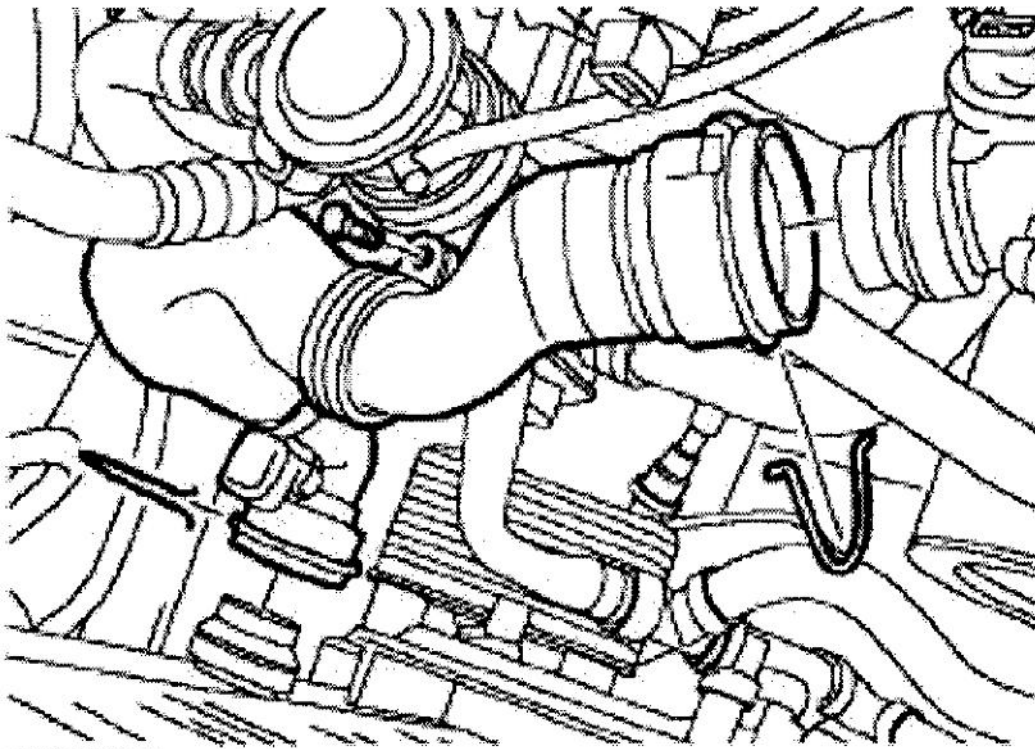
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Fig. 94: Disconnecting Vacuum Pipe From Induction Manifold
Courtesy of LAND ROVER NORTH AMERICA, INC.



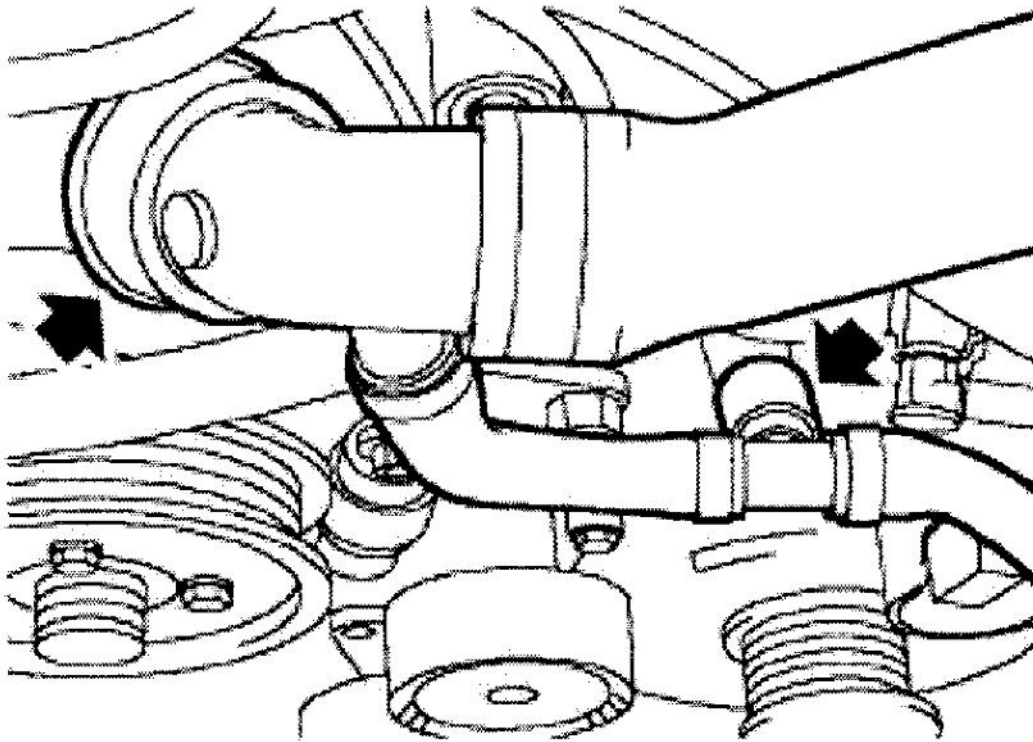
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Fig. 95: Disconnecting Radiator Bottom Hose Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



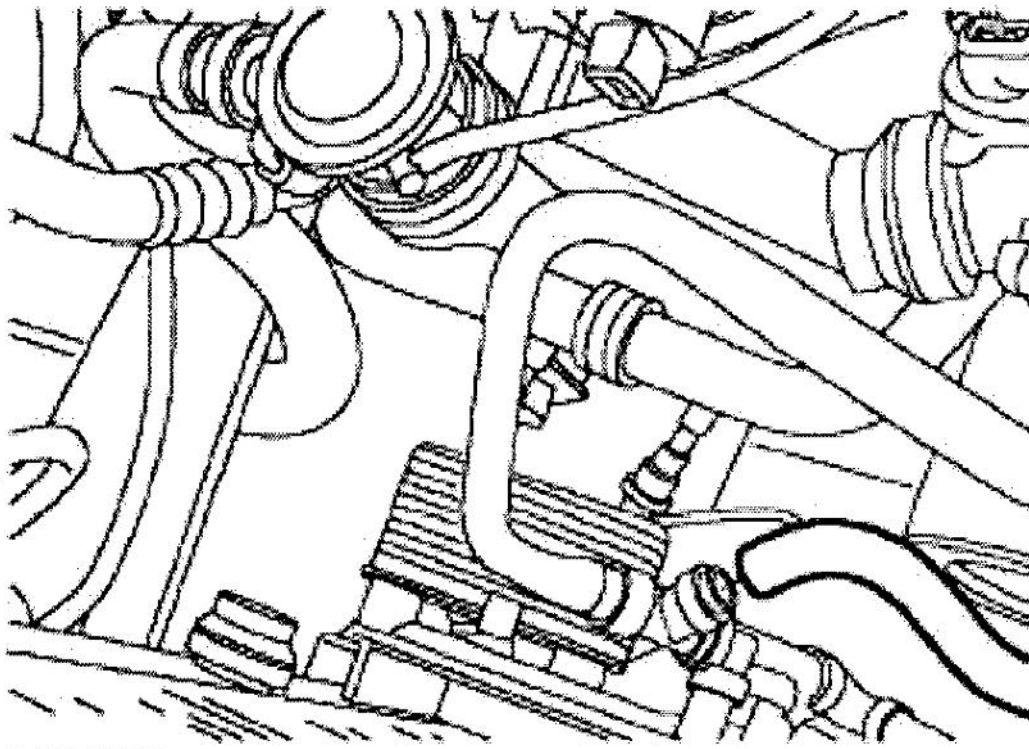
G00386254

Fig. 96: Removing Radiator Bottom Hose
Courtesy of LAND ROVER NORTH AMERICA, INC.



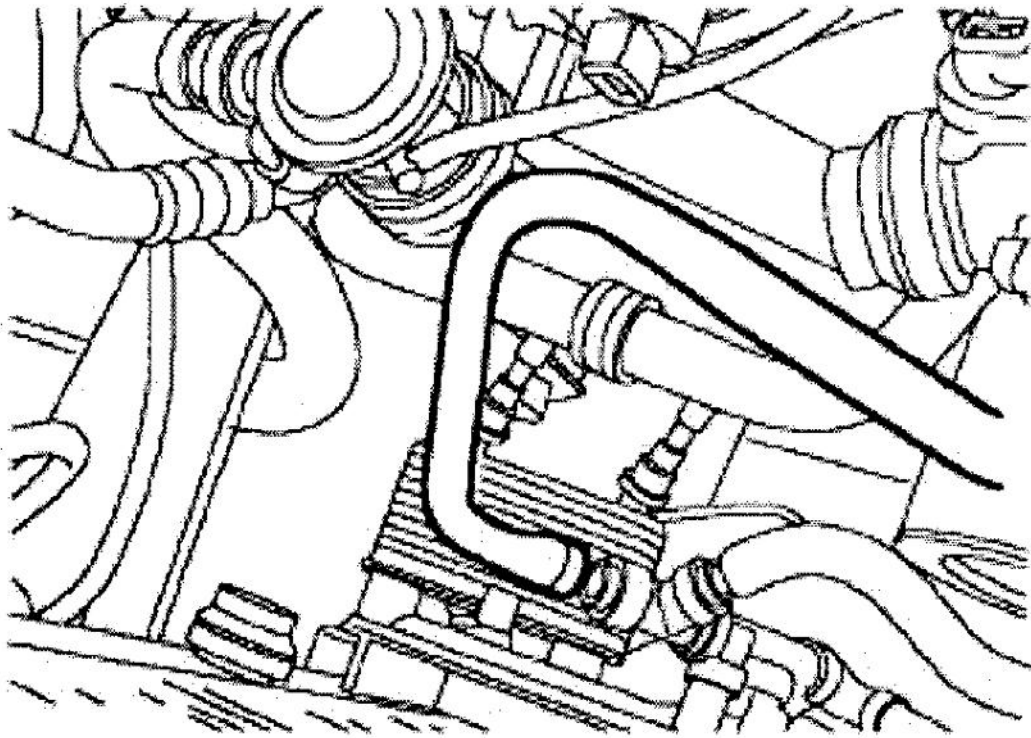
G00386255

Fig. 97: Disconnecting Radiator Top Hose From Coolant
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386256

Fig. 98: Removing Radiator Top Hose
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386257

Fig. 99: Disconnecting Coolant Hose From "T" Junction
Courtesy of LAND ROVER NORTH AMERICA, INC.

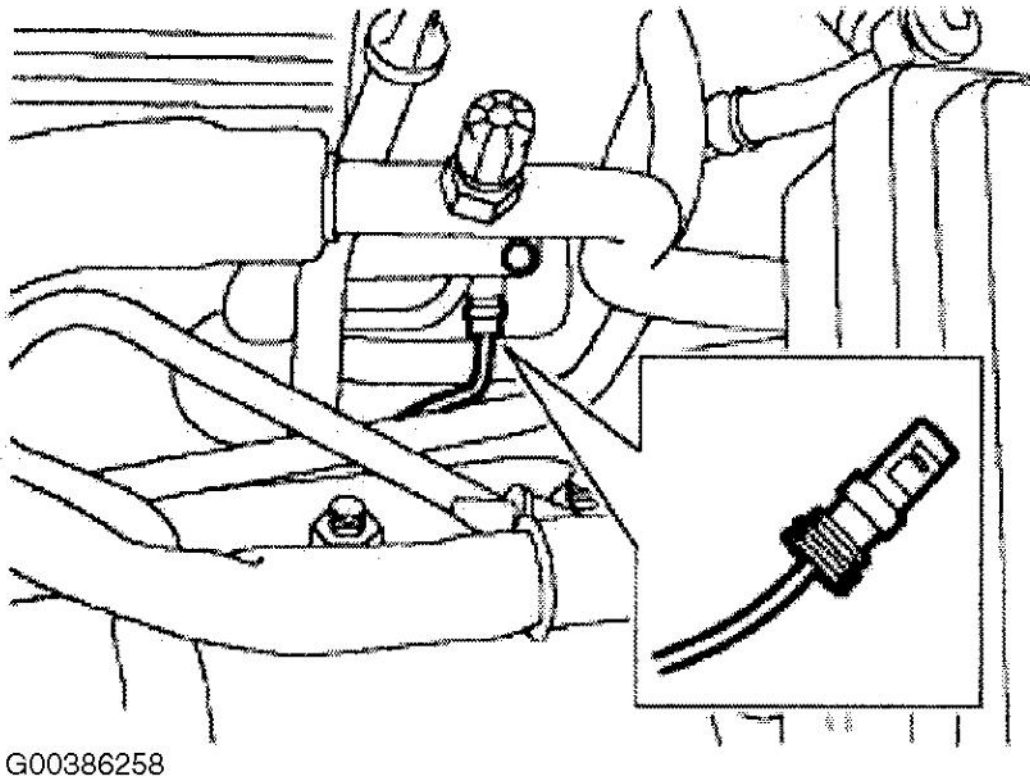
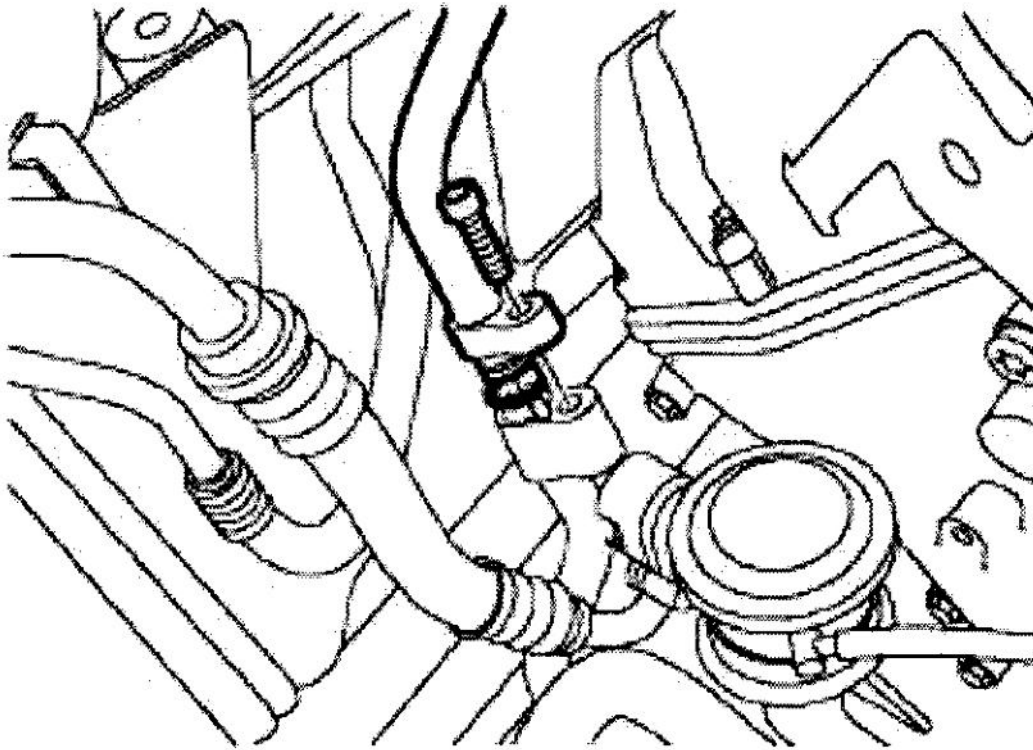
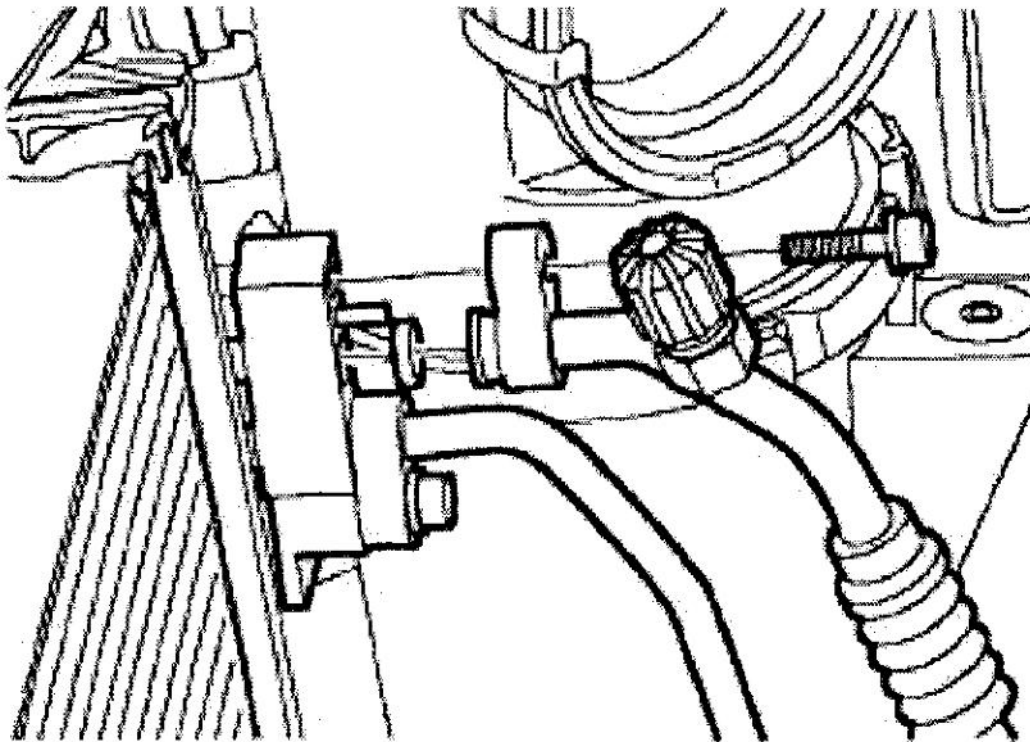


Fig. 100: Disconnecting A/C Compressor Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



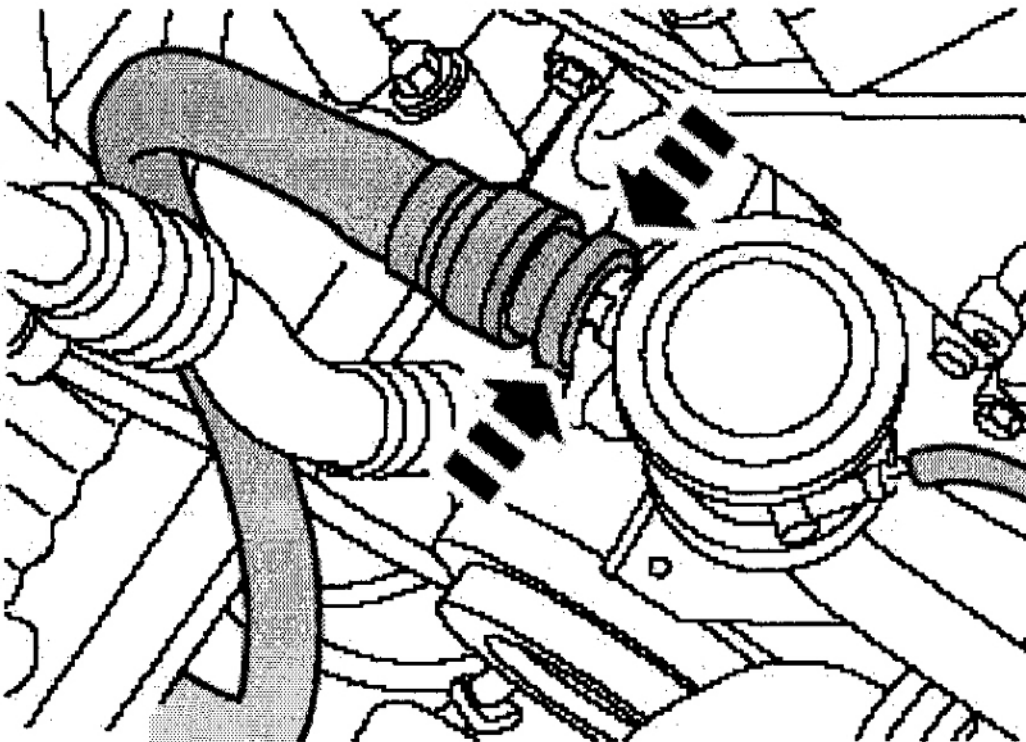
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Fig. 101: Disconnecting A/C Pipe From A/C Compressor
Courtesy of LAND ROVER NORTH AMERICA, INC.



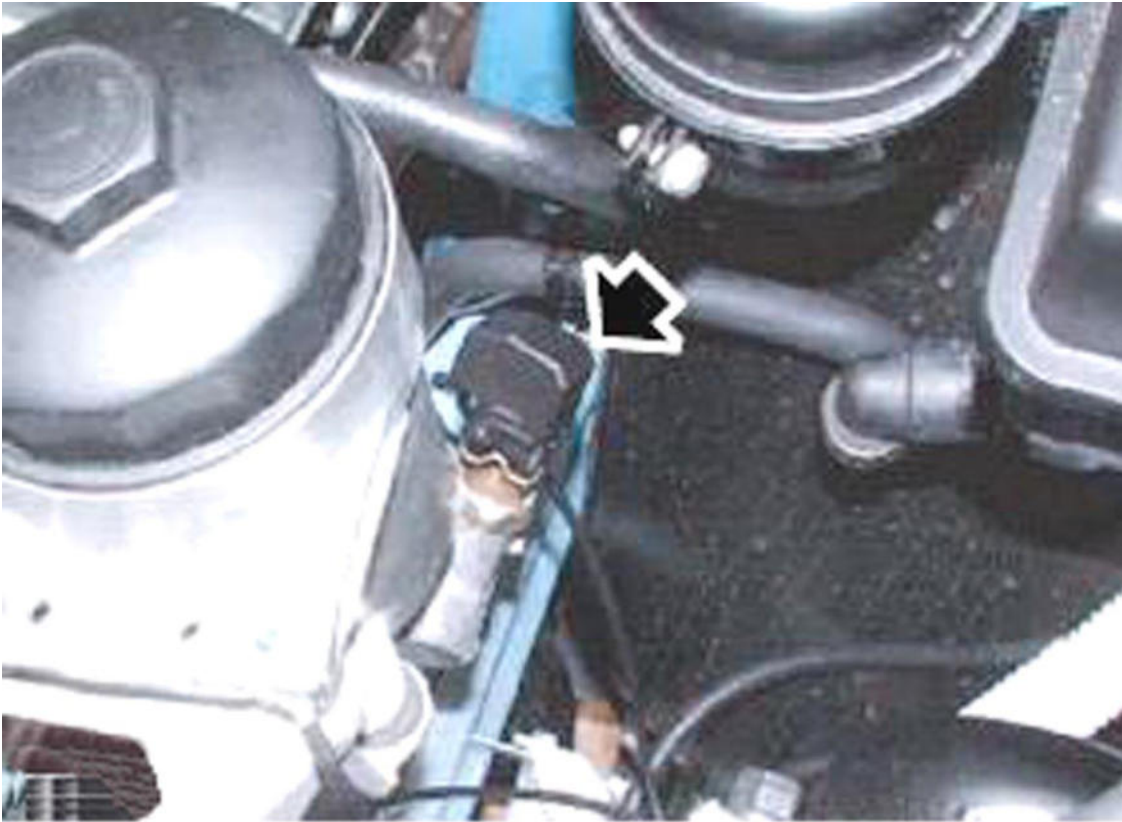
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Fig. 102: Disconnecting A/C Pipe From Condenser
Courtesy of LAND ROVER NORTH AMERICA, INC.



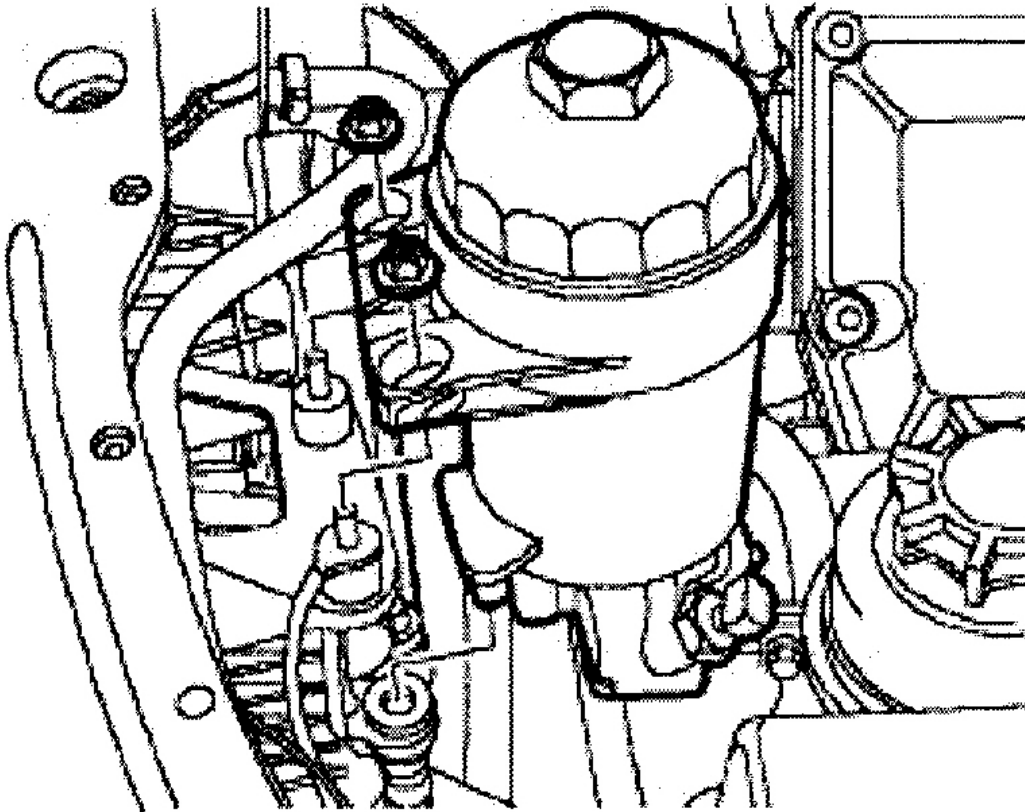
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Fig. 103: Disconnecting Secondary Air Injection Control Valve Hoses
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386262

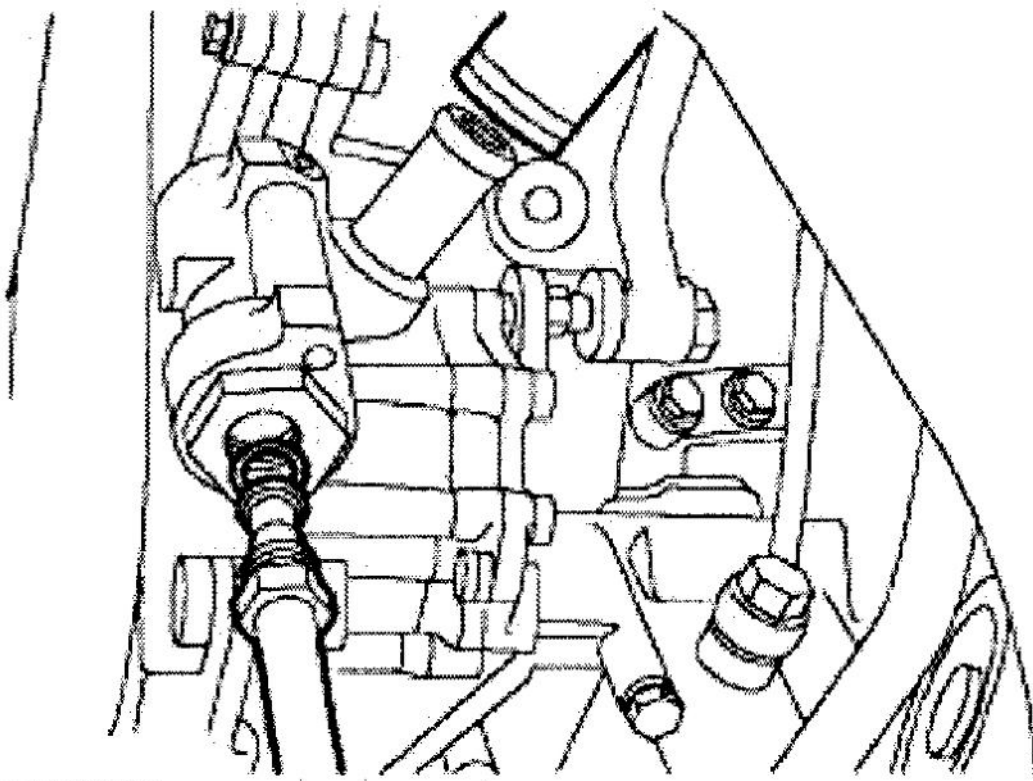
Fig. 104: Disconnecting Oil Pressure Switch Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386263

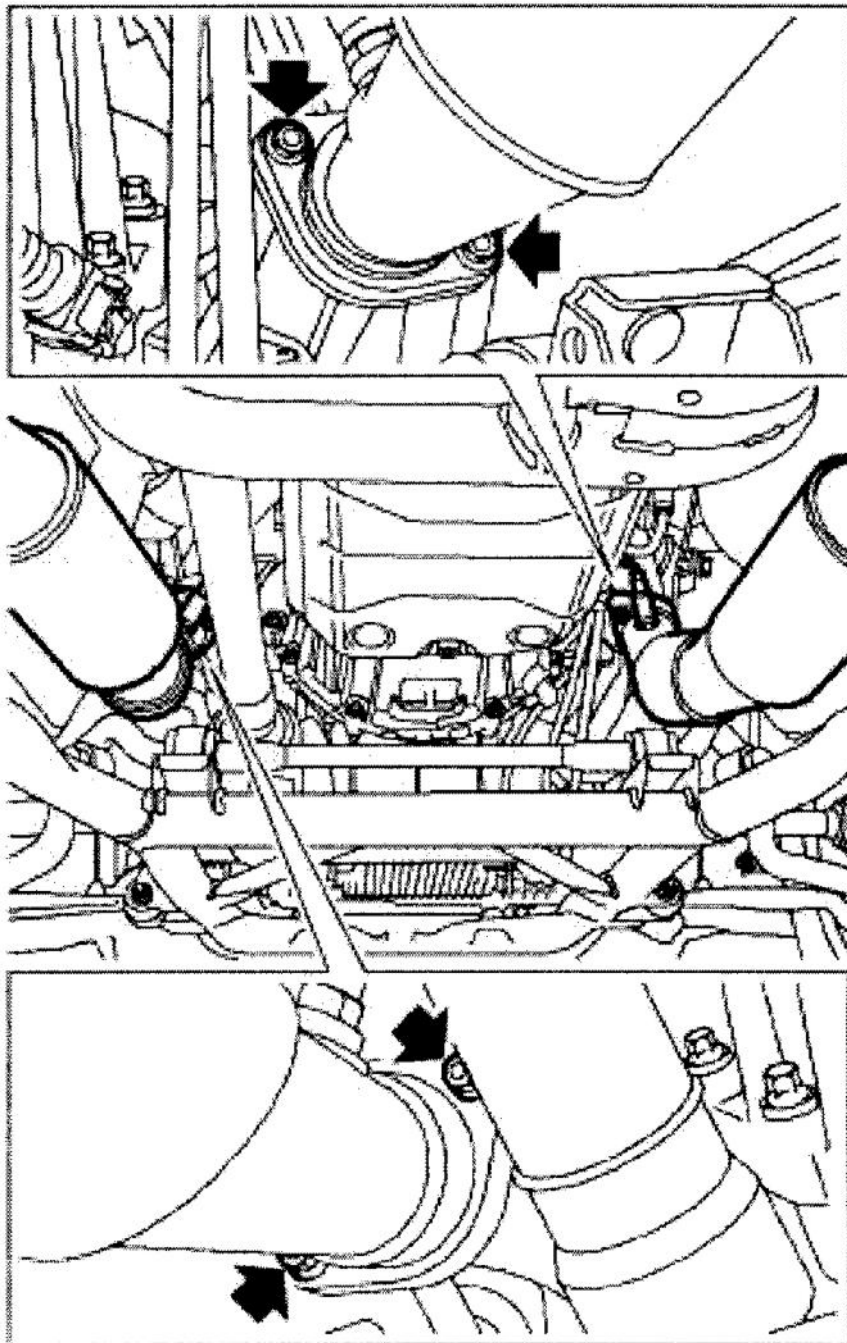
Fig. 105: Removing Oil Filter Housing

Courtesy of LAND ROVER NORTH AMERICA, INC.



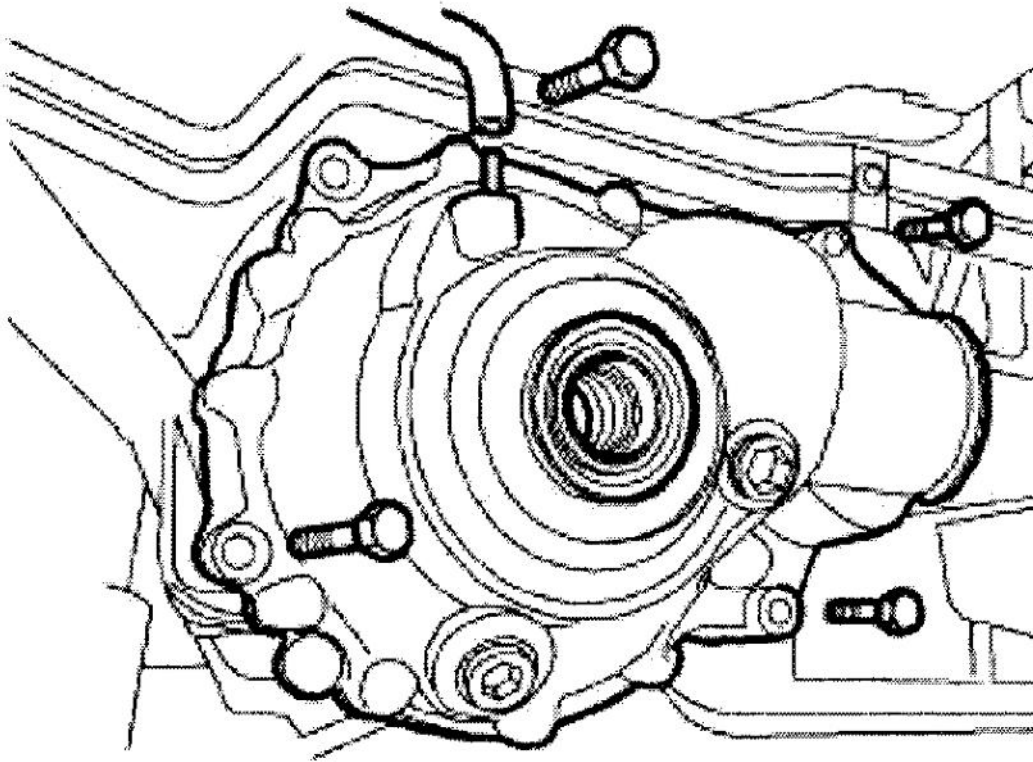
G00386264

Fig. 106: Removing Hoses From Power Assisted Steering Pump
Courtesy of LAND ROVER NORTH AMERICA, INC.



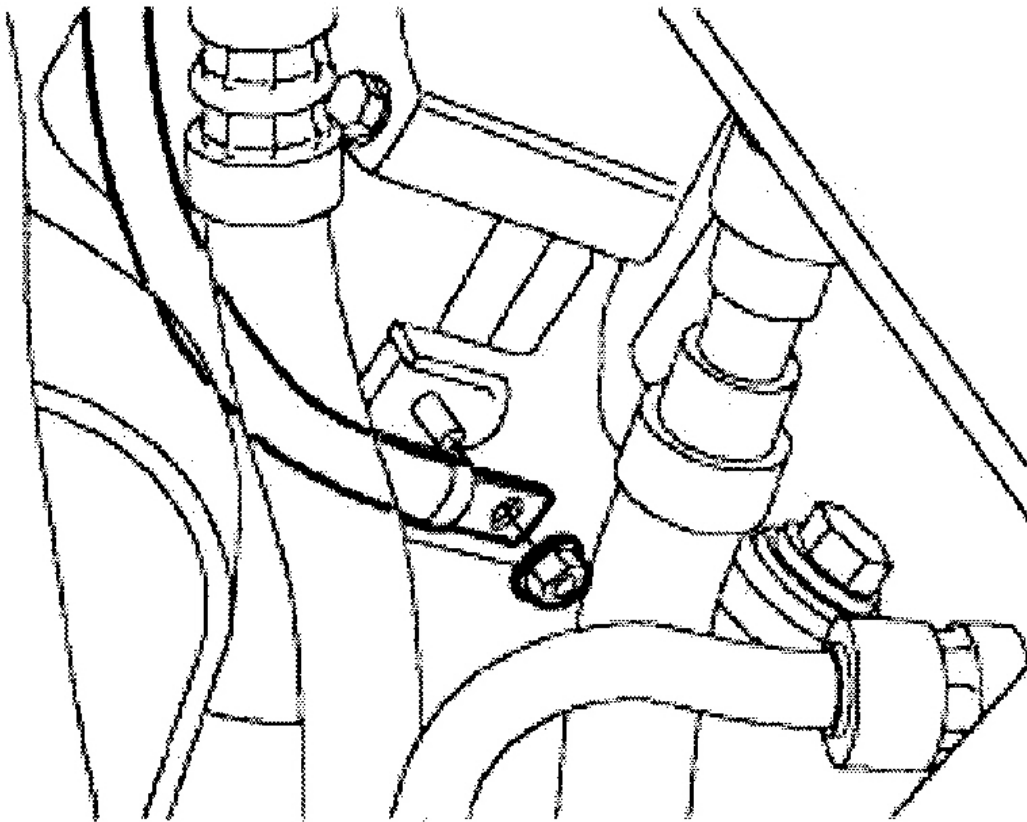
G00386265

Fig. 107: Removing Front Pipe Flanges Nuts-To-Exhaust Manifold
Courtesy of LAND ROVER NORTH AMERICA, INC.



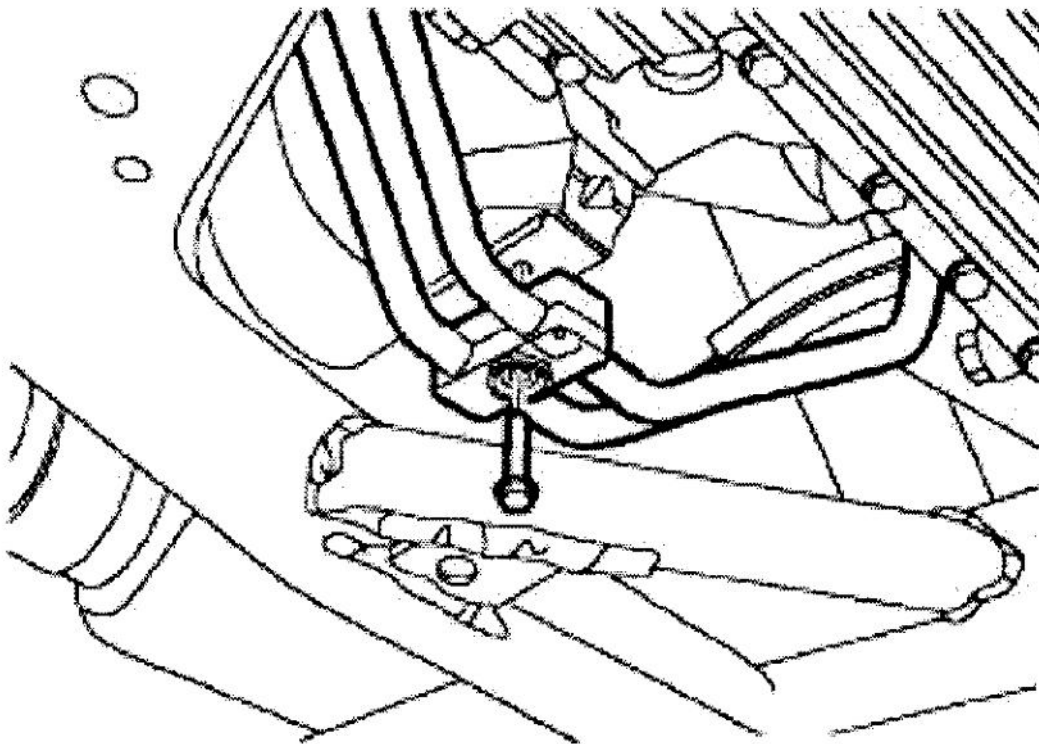
G00386266

Fig. 108: Removing Differential From Engine Sump
Courtesy of LAND ROVER NORTH AMERICA, INC.



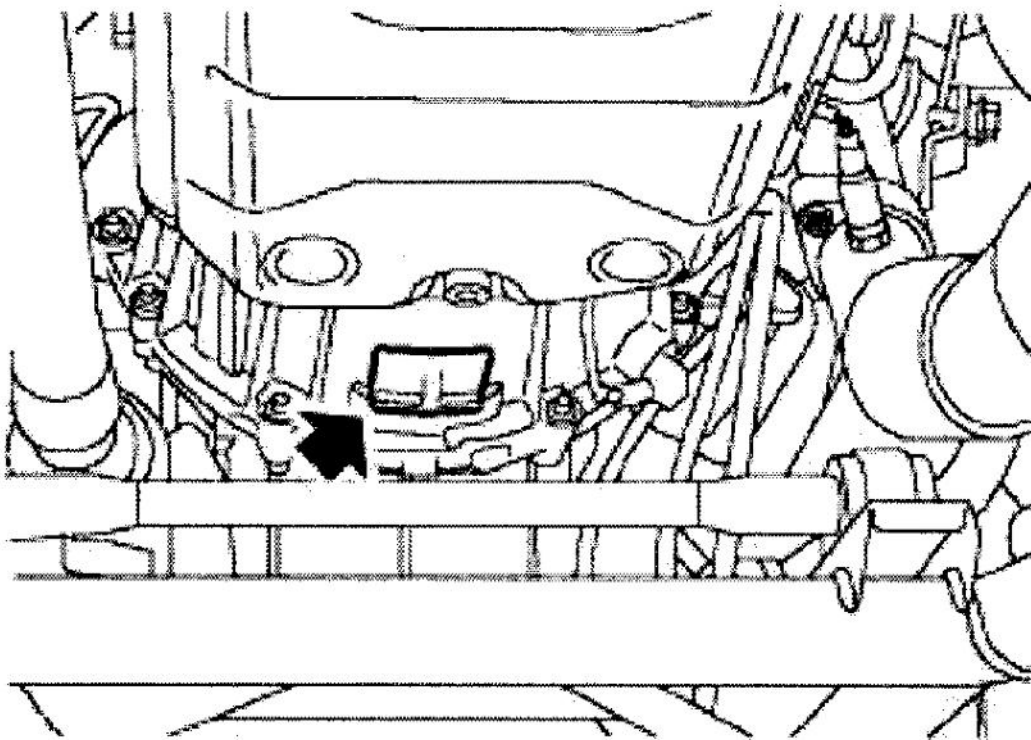
G00386267

Fig. 109: Disconnecting Engine Earth Lead
Courtesy of LAND ROVER NORTH AMERICA, INC.



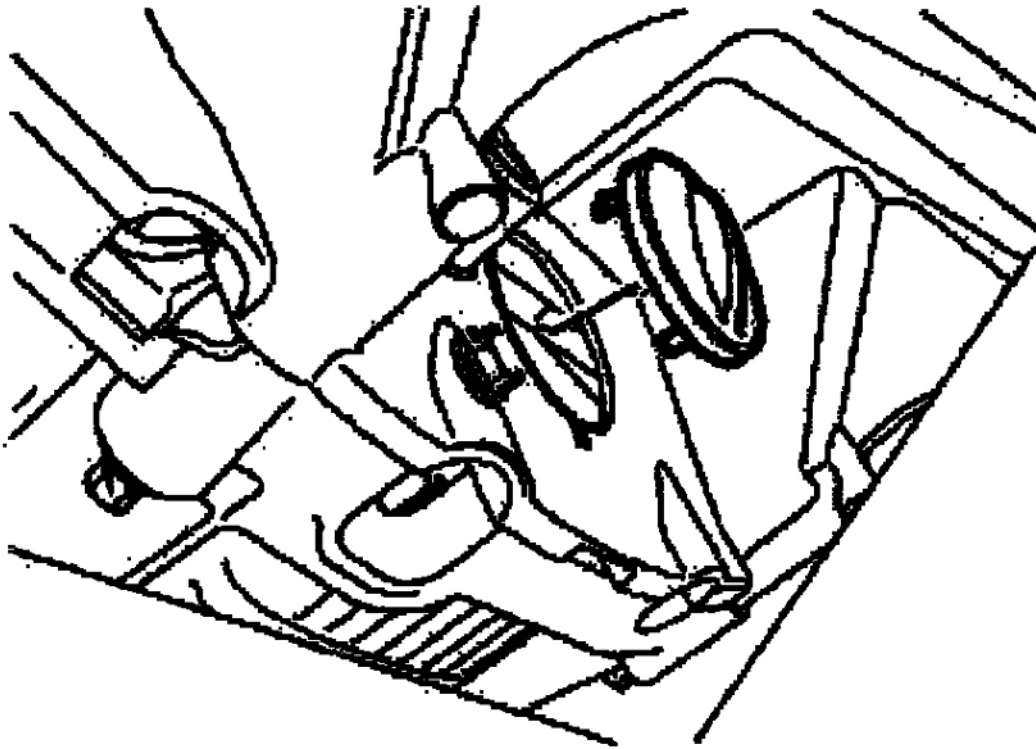
G00386268

Fig. 110: Releasing Transmission Cooler Pipes
Courtesy of LAND ROVER NORTH AMERICA, INC.



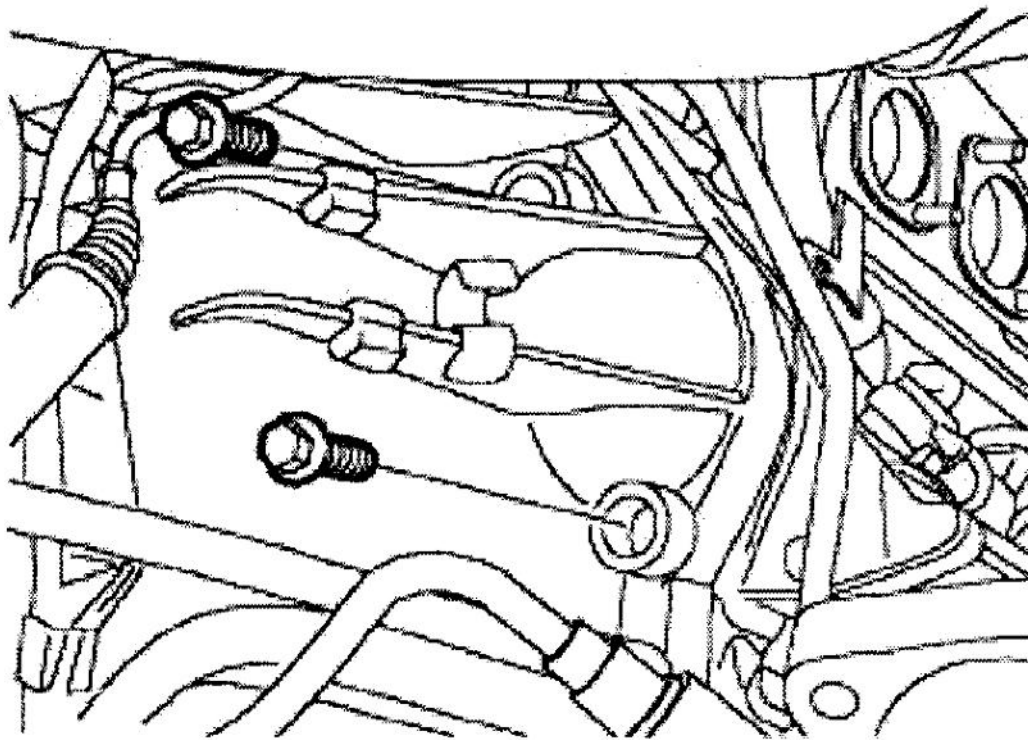
G00386269

Fig. 111: Removing Grommet From Bottom Of Bell Housing
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386270

Fig. 112: Removing Grommet From Bell Housing To Gain Access To Torque Converter Securing Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386271

Fig. 113: Removing Starter Motor

Courtesy of LAND ROVER NORTH AMERICA, INC.

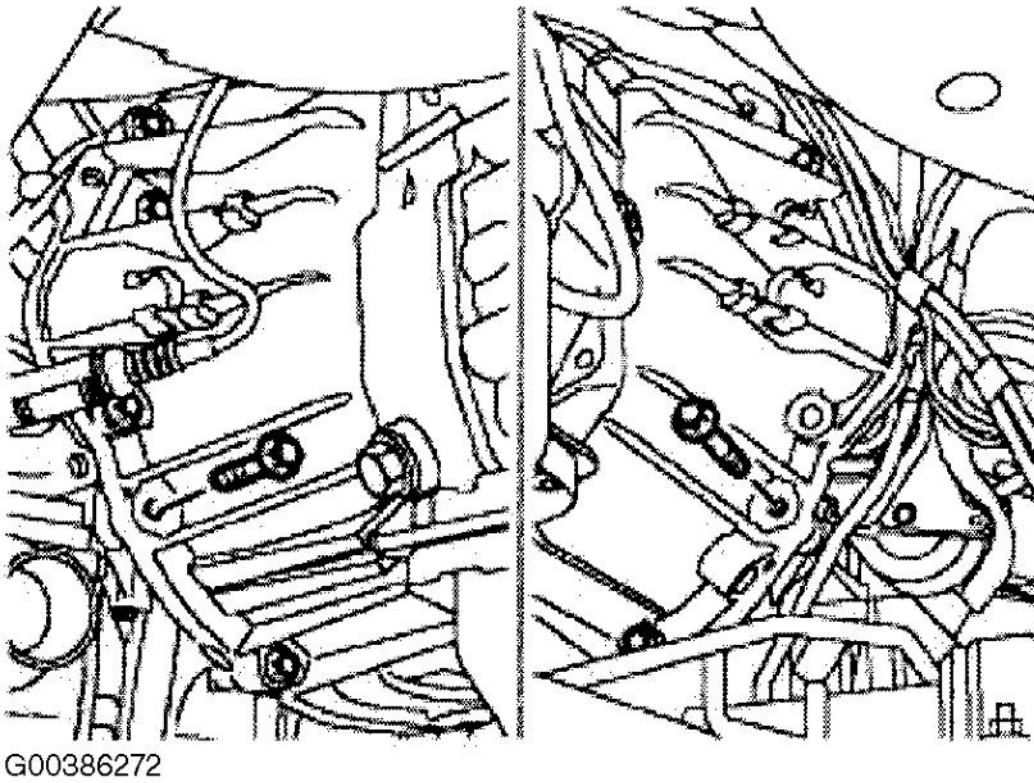
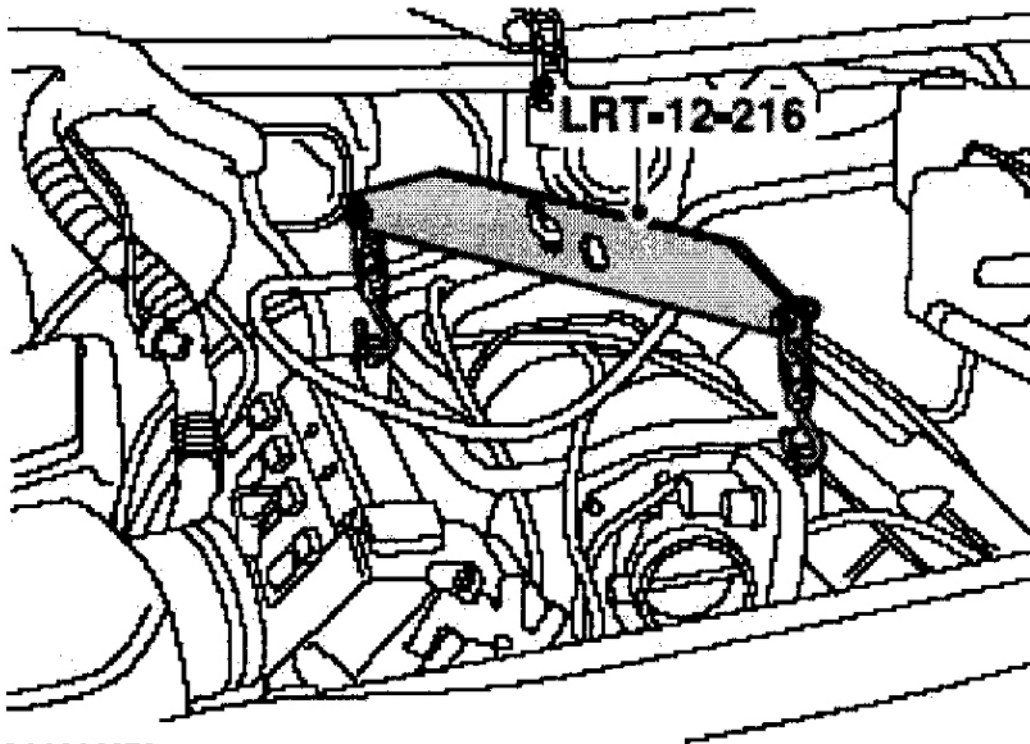
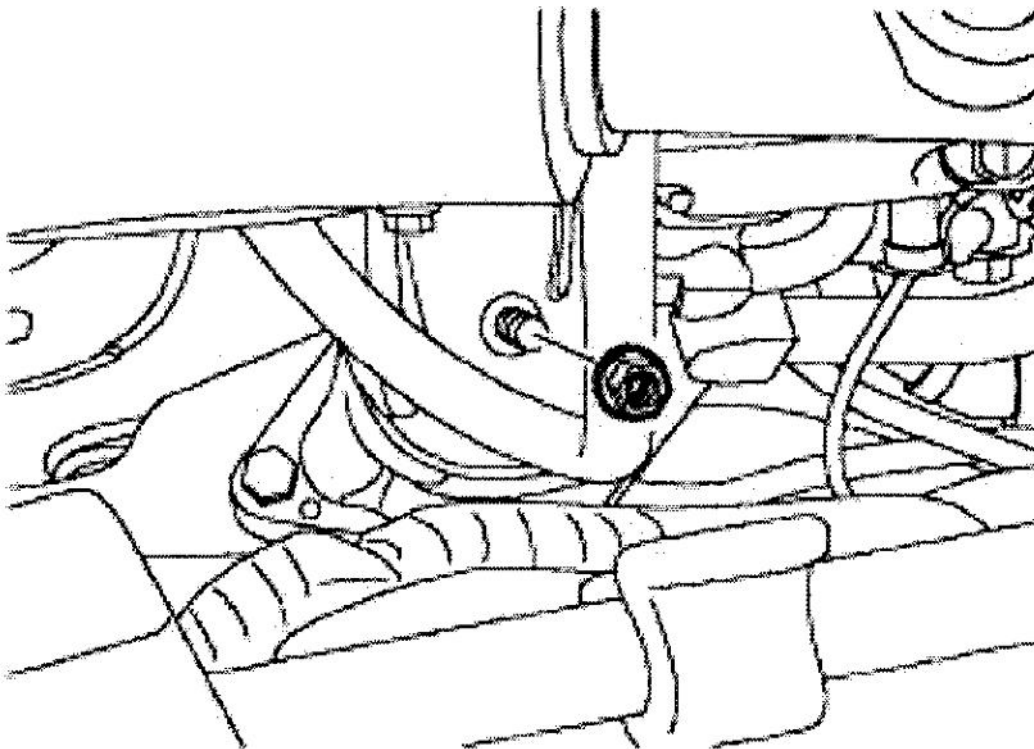


Fig. 114: Removing Gearbox-To-Engine Torx Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.



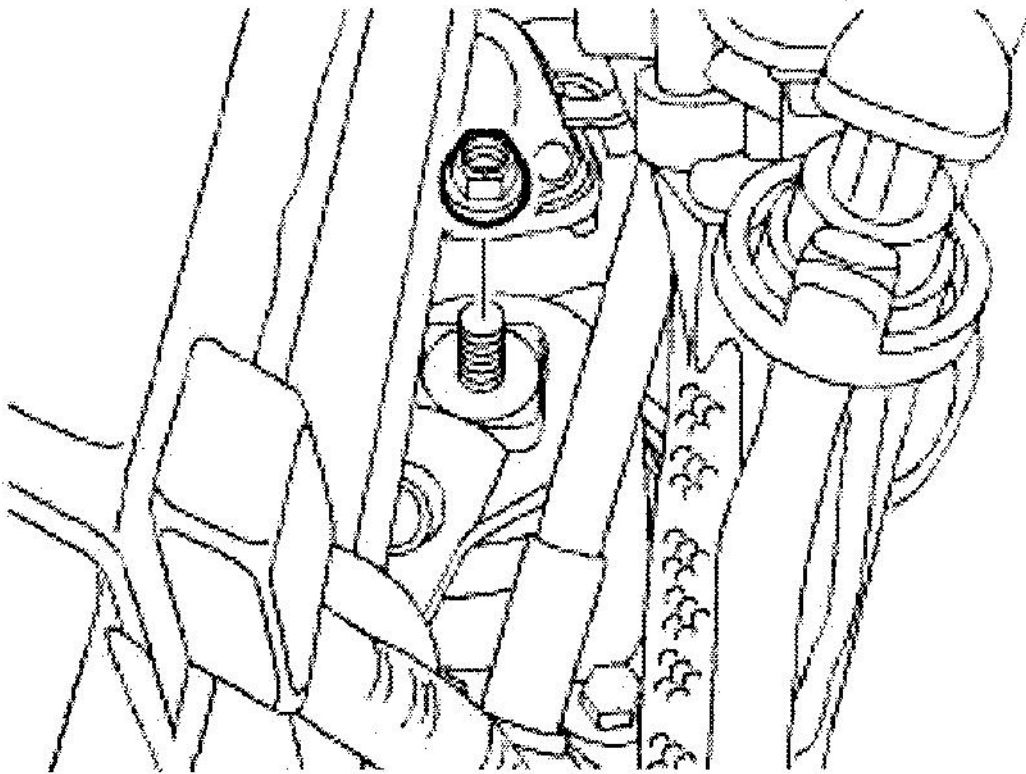
G00386273

Fig. 115: Installing LRT-12-216-To-Engine Lifting Eyes
Courtesy of LAND ROVER NORTH AMERICA, INC.



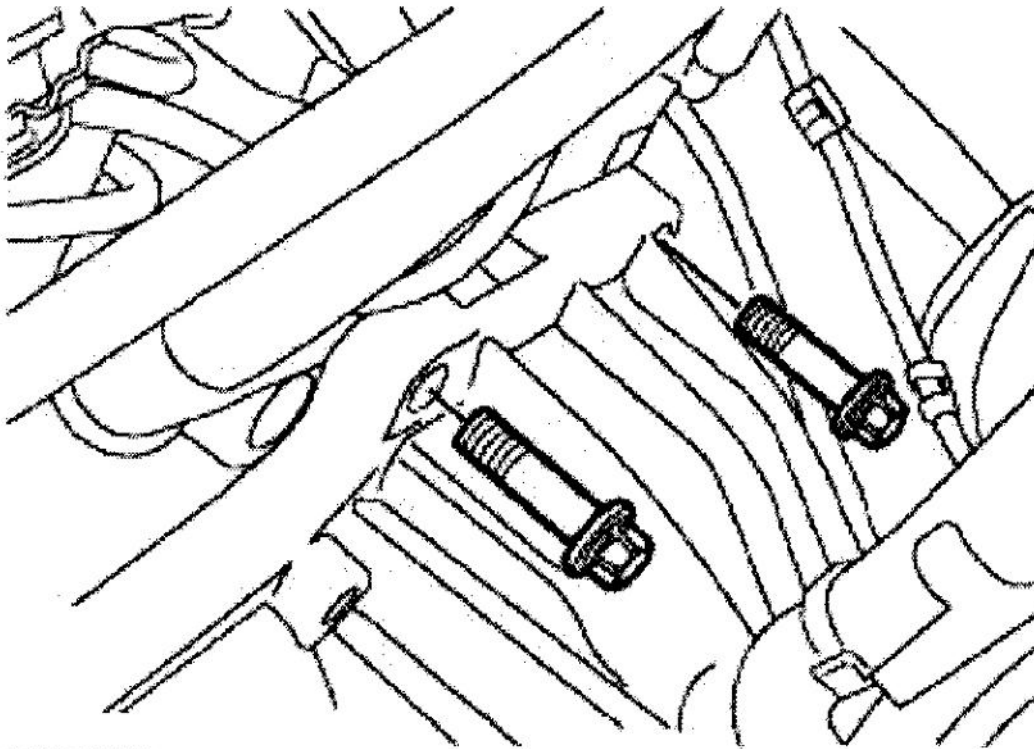
G00388121

Fig. 116: Removing Right Engine Mounting Nut-To-Engine Mounting Bracket
Courtesy of LAND ROVER NORTH AMERICA, INC.



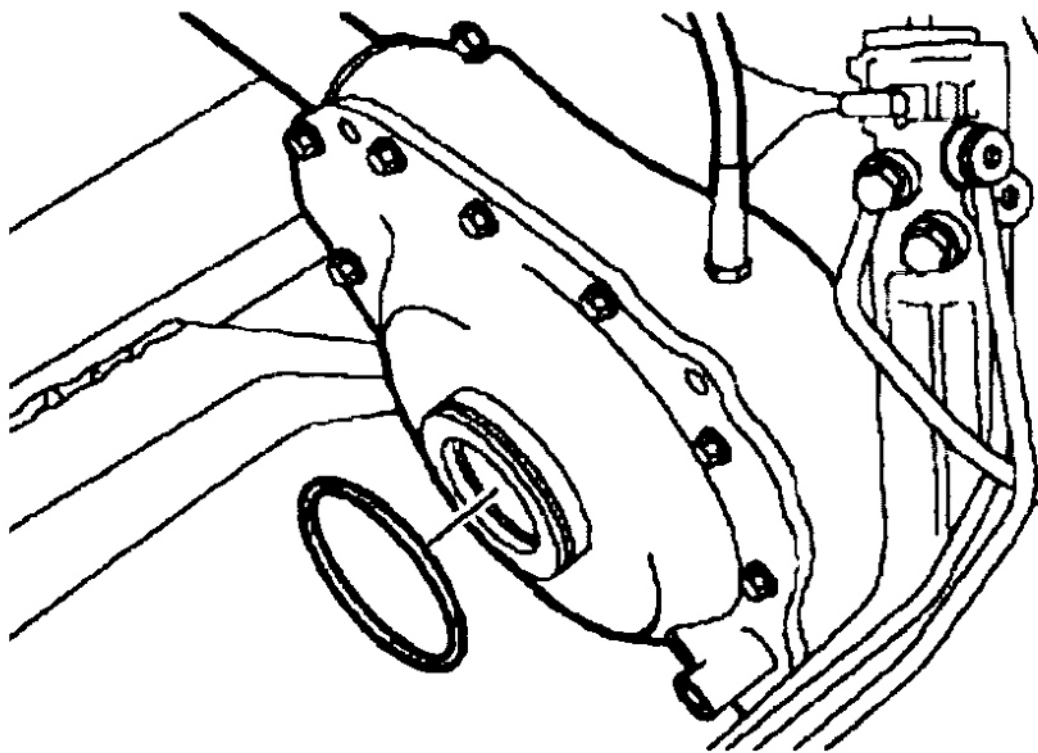
G00388122

Fig. 117: Removing Left Engine Mounting Nut-To-Engine Mounting Bracket
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388123

Fig. 118: Removing Top Of Bell Housing Torx Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388124

Fig. 119: Discarding Differential "O" Ring
 Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

Procedure for fitting crankshaft dowel to a replacement engine, steps 1 - 10 only:

1. Remove right camshaft cover gasket. See **GASKET - CAMSHAFT COVER - RIGHT**.
2. Rotate engine crankshaft pulley clockwise until letter and cylinder number stampings, located on rear of camshafts, are in upright position. See **Fig. 50**.
3. If necessary, continue to rotate crankshaft slightly to align TDC timing marks. See **Fig. 24**.
4. Temporarily fit drive plate ensuring that hollow bush in drive plate securing bolt hole, is aligned with bolt hole "A" in crankshaft boss. See **Fig. 120**.
5. Fit and lightly tighten 8 drive plate securing bolts. Do not fit a bolt in drive plate hole with hollow bush.
6. Fit timing pin LRT-12-227, ensuring that it is inserted in hole in drive plate. If necessary, rotate crankshaft slightly to enable timing pin to be inserted. See **Fig. 121**.
7. Check that TDC timing marks are still aligned and that hole with hollow bush is still in position "A".
8. Remove timing pin LRT-12-227, and remove drive plate.
9. Fit crankshaft dowel into securing bolt hole at position "A".

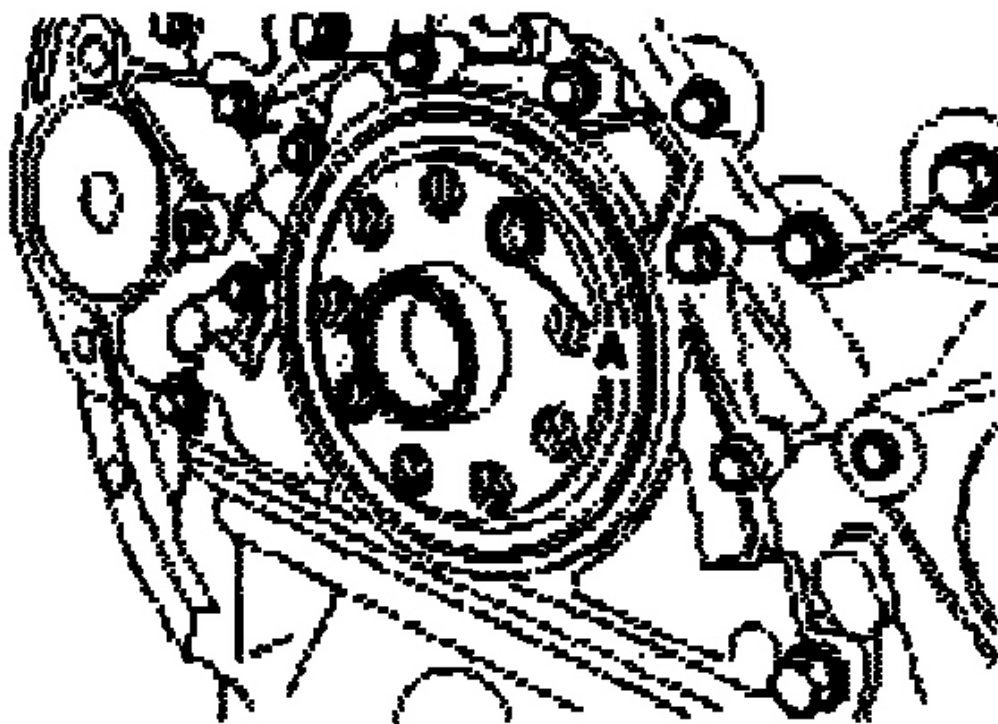
10. Fit right camshaft cover gasket.
11. All engines: Clean torque converter and drive plate mating faces.
12. Clean gearbox to engine mating faces, dowels and dowel holes.
13. Clean differential and engine sump mating faces.
14. Fit new "O" ring to differential and lubricate with clean oil.
15. With assistance, carefully fit engine to gearbox. Ensure engagement of torque converter spigot and location onto dowels.

NOTE: When fitting engine, guide the engine past differential mating face.

16. Ensure torque converter is fully engaged with gearbox.
17. Fit 8 Torx bolts securing automatic gearbox to engine, tighten to 45 Nm (33 ft. lbs)
18. Align starter motor to engine and tighten securing bolts to 45 Nm (33 ft. lbs).
19. Fit 2 top bell housing Torx bolts and tighten to 25 Nm (18 ft. lbs).
20. Remove support from gearbox.
21. Lower engine onto mountings.
22. Disconnect lifting chains.
23. Fit 2 nuts securing engine mountings to engine mounting brackets and tighten to 100 Nm (74 ft. lbs).
24. Remove engine lifting bracket.
25. Fit bolts securing drive plate to torque converter and tighten to 45 Nm (33 ft. lbs)
26. Fit grommets to bell housing.
27. Clean mating faces of exhaust front pipes and exhaust manifolds.
28. Align exhaust front pipes to exhaust manifolds.
29. Fit 4 new nuts securing exhaust front pipes to exhaust manifolds and tighten to 45 Nm (33 ft. lbs).
30. Carefully align differential to sump. Fit bolts, but DO NOT tighten at this stage.
31. Align differential to transfer box front output flange. See **FRONT DIFFERENTIAL ASSEMBLY ALIGNMENT**.
32. Tighten differential to engine sump securing bolts to 110 Nm (81 ft. lbs).
33. Connect breather hose to differential.
34. Connect engine earth lead to engine and tighten securing nut and bolt.
35. Fit differential air flow panel to sub-frame and tighten bolts to 45 Nm (33 ft. lbs).
36. Fit right front drive shaft. See **FRONT DRIVE SHAFT**.
37. Fit new "O" ring to Power Assisted Steering (PAS) hose union, connect hose to pump and tighten nut to 25 Nm (18 ft. lbs).
38. Connect supply hose to PAS pump and secure using new clip.
39. Fit oil filter housing to bracket and tighten securing nuts.
40. Connect multiplug to oil pressure switch.
41. If fitted: Connect Secondary Air Injection (SAI) control valve hoses.
42. Fit new "O" rings to A/C pipes and lubricate with clean refrigerant oil.

43. Align A/C pipes to condenser and compressor. Fit Allen bolts securing A/C pipes to condenser and compressor and tighten to 25 Nm (18 ft. lbs).
44. Connect multiplug to A/C compressor.
45. Connect coolant hose to "T" junction and secure clip.
46. Fit radiator top hose and secure with clips.
47. Fit radiator bottom hose, secure with clips and tighten "P" clip securing bolt.
48. Connect multiplug to radiator bottom hose.
49. Connect vacuum pipe to inlet manifold.
50. Connect brake vacuum servo hose to one way valve and secure using new clip.
51. Clean fuel hose connections.
52. Connect fuel feed hose to fuel rail.
53. Connect multiplug to starter motor lead.
54. Position gearbox multiplug and bracket to bell housing and tighten securing bolt.
55. Connect heater hoses to coolant manifold and secure with clips.
56. Fit transmission breather pipes into clips.
57. Fit charcoal canister purge valve pipe.
58. Position engine harness to engine.
59. Connect multiplug to charcoal canister purge control valve.
60. Fit washer to fuel injector harness securing stud.
61. Position and secure engine harness to brackets with clips.
62. Connect multiplugs to right fuel injectors.
63. Connect multiplugs to left fuel injectors.
64. Connect alternator harness to 2 clips on engine cover mounting brackets.
65. Fit fuel hose and mounting bracket to left fuel injector harness securing stud.
66. Fit vacuum reservoir and mounting bracket to left fuel injector harness securing stud.
67. Fit 2 nuts securing fuel injector harness to induction manifold and tighten nuts.
68. Connect multiplugs to knock sensors.
69. Connect multiplugs to Camshaft (CMP) sensors.
70. Secure alternator harness into 4 securing clips.
71. Connect multiplug to alternator.
72. If fitted: Connect multiplug to Secondary Air Injection (SAI) control valve.
73. Connect multiplugs to Variable Camshaft Control solenoids.
74. Connect multiplugs to throttle body, thermostat heater, Electronic Coolant Temperature (ECT) sensor, and right CMP sensor.
75. Align engine harness to throttle body and secure using new cable ties.
76. Connect multiplugs to ignition coils.
77. Connect engine harness earth leads to left and right camshaft covers and tighten nuts.
78. Position differential breather pipe to left engine camshaft cover.

79. Fit left ignition coil cover. See COVER -- IGNITION COILS -- LH .
80. Fit right ignition coil cover. See COVER -- IGNITION COILS -- RH .
81. Fit viscous coupling. See VISCOUS FAN .
82. Fit front road wheels and tighten nuts to 140 Nm (103 ft. lbs).
83. Remove stands and lower front end of vehicle.
84. Fit MAF/IAT sensor. See SENSOR -- COMBINED MASS AIR FLOW (MAFS) & INTAKE AIR TEMPERATURE (IAT) .
85. Recharge A/C system. See 82.30.02 REFRIGERANT RECOVERY-RECYCLING AND RECHARGE .
86. Fit air intake plenum. See 80.15.62 PLENUM -- AIR INTAKE .
87. Fit battery positive lead to stud, tighten nut to 18 Nm (13 ft. lbs) and close cover.
88. Connect battery earth lead. See BATTERY DISCONNECT & RECONNECT .
89. Fill cooling system. See DRAINING & REFILLING COOLING SYSTEM .
90. Bleed PAS system. See POWER ASSISTED STEERING (PAS) SYSTEM - BLEED .
91. Connect support stays and close bonnet.



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Fig. 120: Aligning Hollow Bush In Drive Plate Securing Bolt Hole with Bolt Hole "A" In Crankshaft Boss
Courtesy of LAND ROVER NORTH AMERICA, INC.

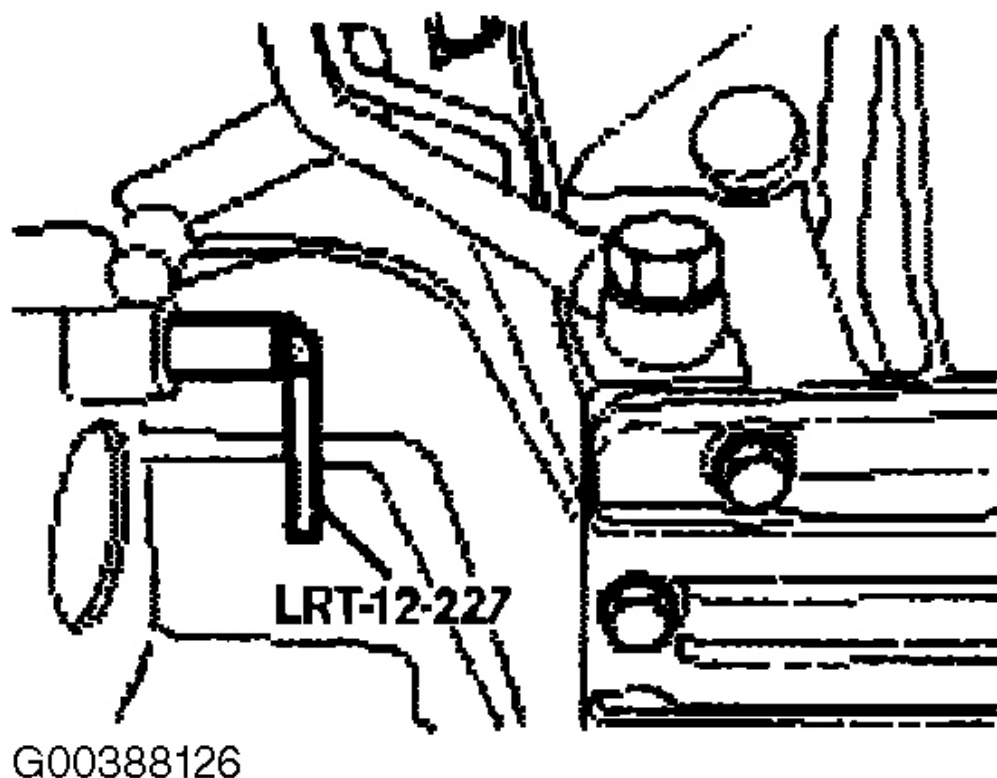


Fig. 121: Installing Timing Pin LRT-12-227 In Hole In Drive Plate
Courtesy of LAND ROVER NORTH AMERICA, INC.

MOUNTING - REAR

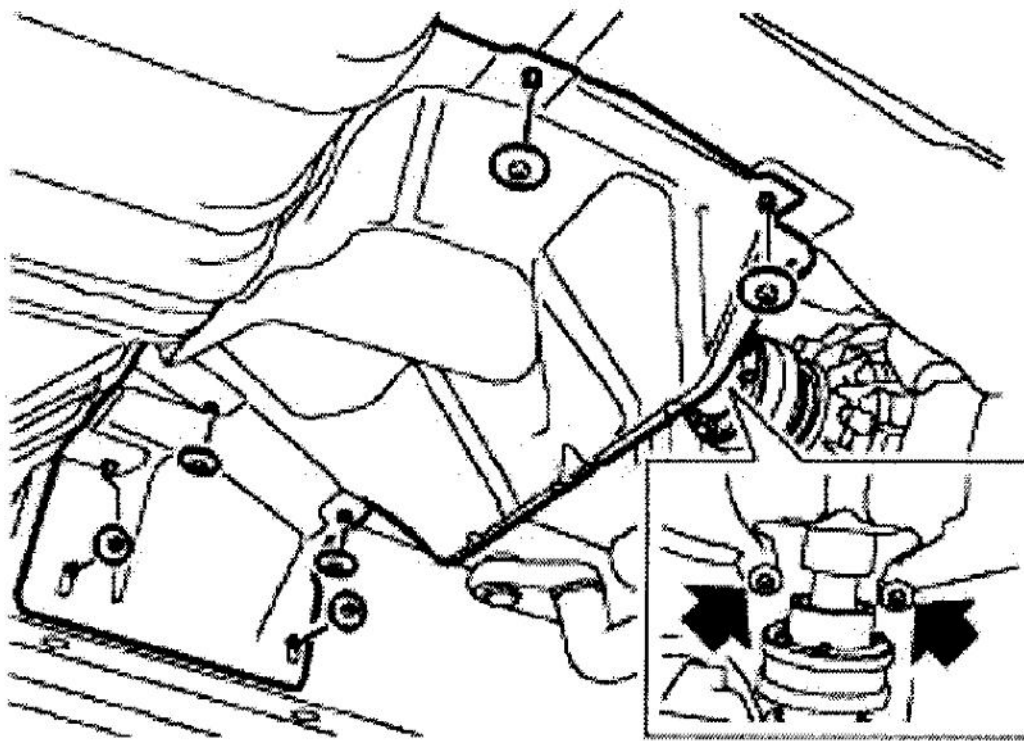
Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed.
See **BATTERY DISCONNECT & RECONNECT**.

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.
3. Raise vehicle on lift.
4. Remove exhaust system. See **EXHAUST SYSTEM & MOUNTINGS**.
5. Remove 8 nuts securing center heat shield and remove shield. See **Fig. 122**.

6. Remove 5 nuts, release and remove right heat shield. See **Fig. 123**.
7. Remove 5 nuts, release and remove left heat shield. See **Fig. 124**.
8. Support gearbox on a jack.
9. Remove nut and bolt securing mounting to cross member.
10. Remove 6 bolts securing cross member and remove cross member. See **Fig. 125**.
11. Remove snubbers from mounting. See **Fig. 126**.
12. Lubricate center screw LRT-41-018/4 with Molybdenum Disulphide grease and assemble tool as shown to remove mounting from transfer gearbox. See **Fig. 127**.

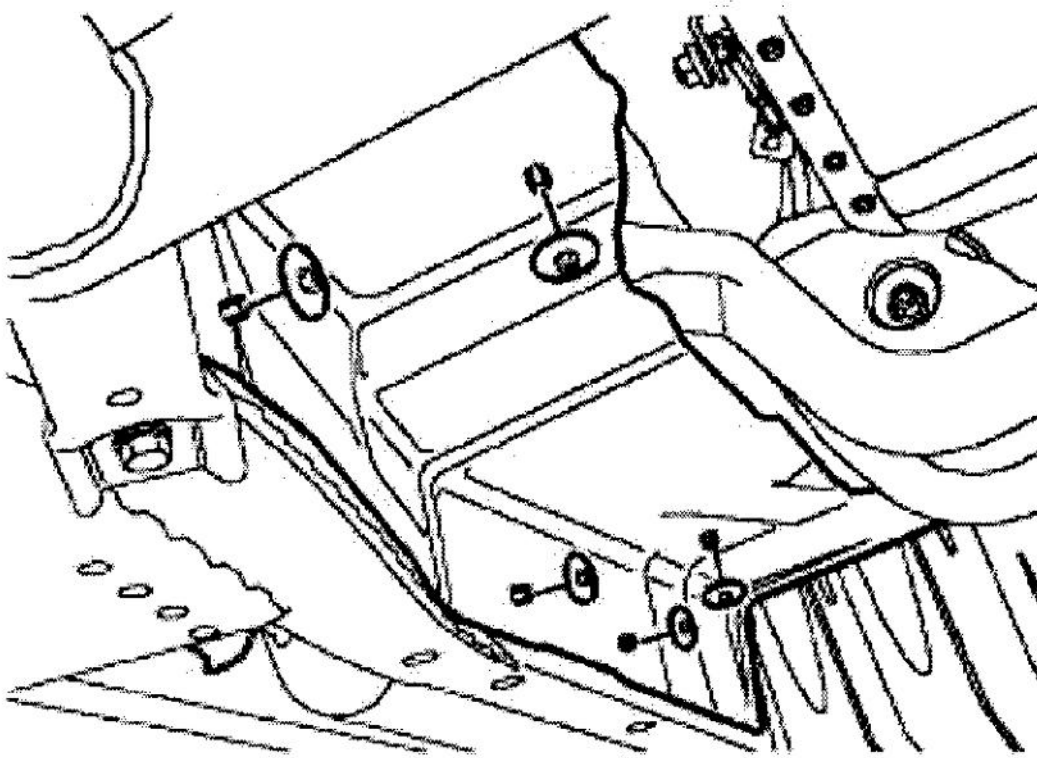
CAUTION: Ensure tool alignment indicator is at the 6 o'clock position. The tool alignment indicator is a machined flat, on LRT-41-018/1 and LRT-41-018/2.



G00388127

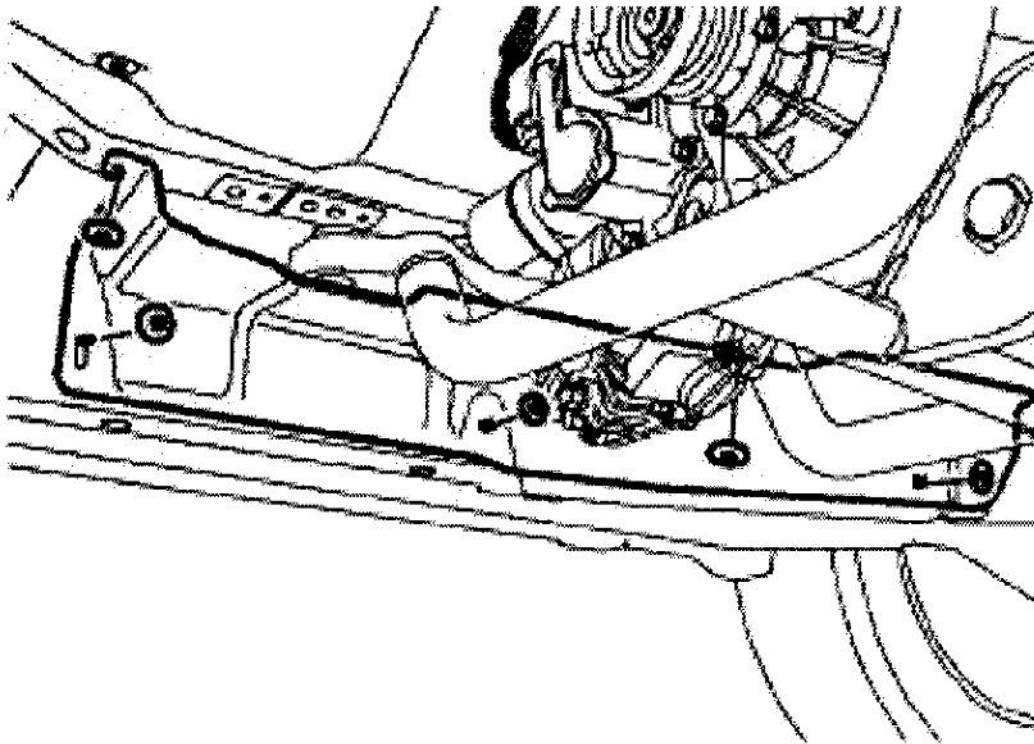
Fig. 122: Removing Center Heat Shield

Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388128

Fig. 123: Removing Right Heat Shield
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 124: Removing Left Heat Shield
Courtesy of LAND ROVER NORTH AMERICA, INC.

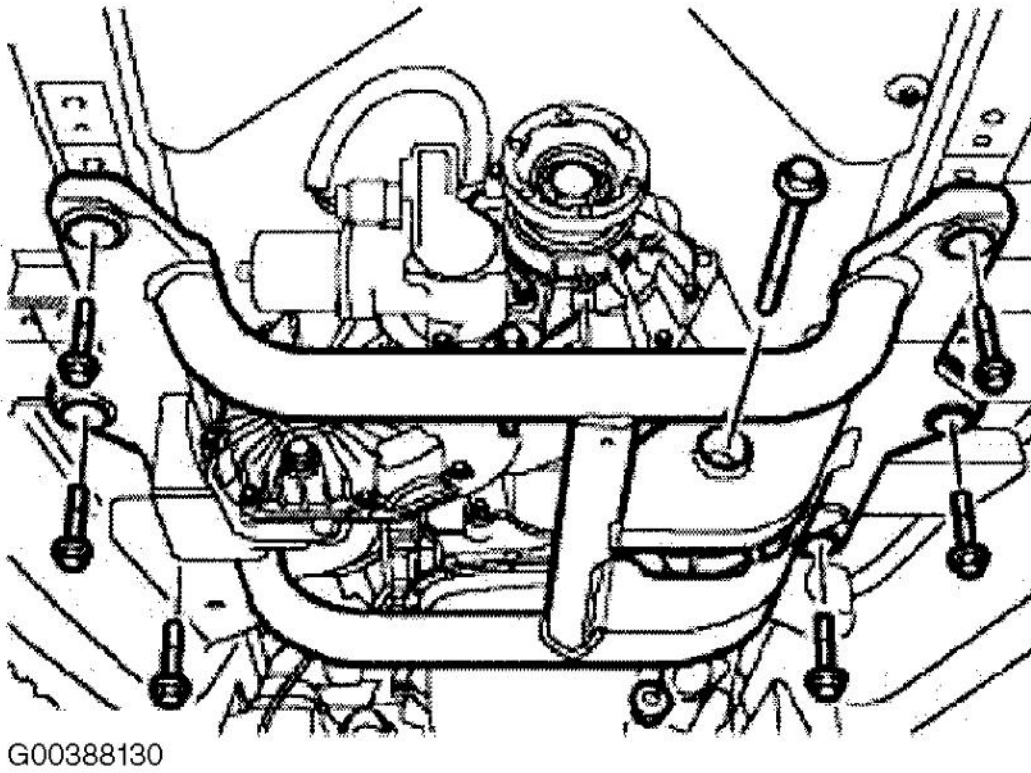


Fig. 125: Removing Cross Member
Courtesy of LAND ROVER NORTH AMERICA, INC.

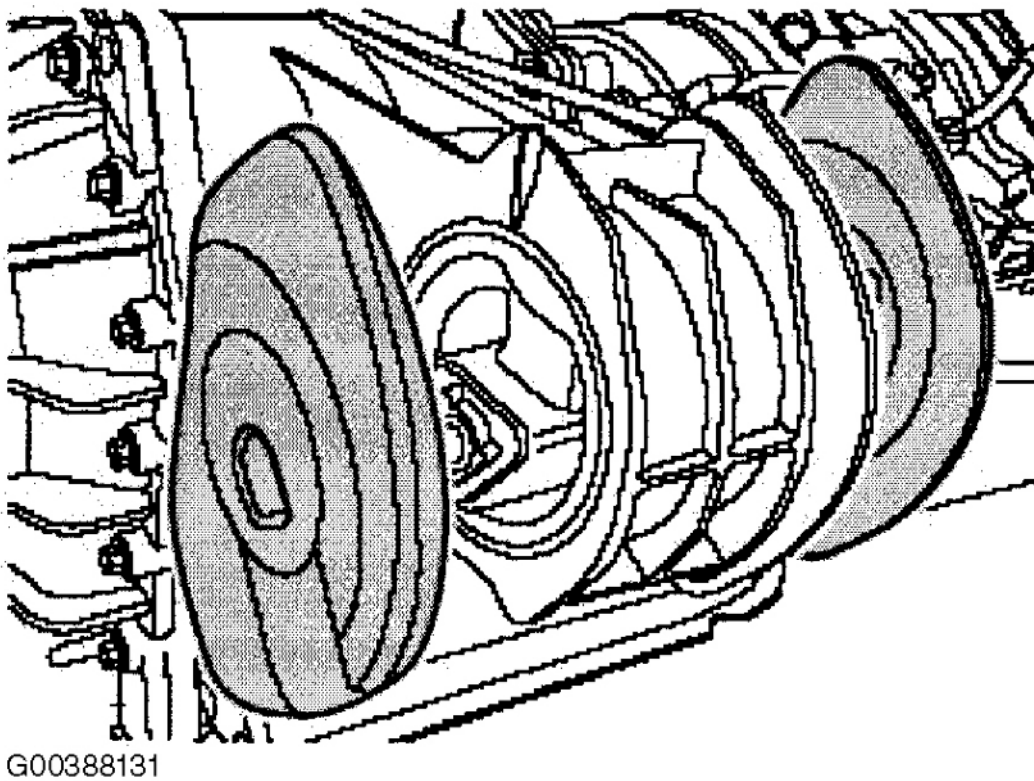


Fig. 126: Removing Snubbers
Courtesy of LAND ROVER NORTH AMERICA, INC.

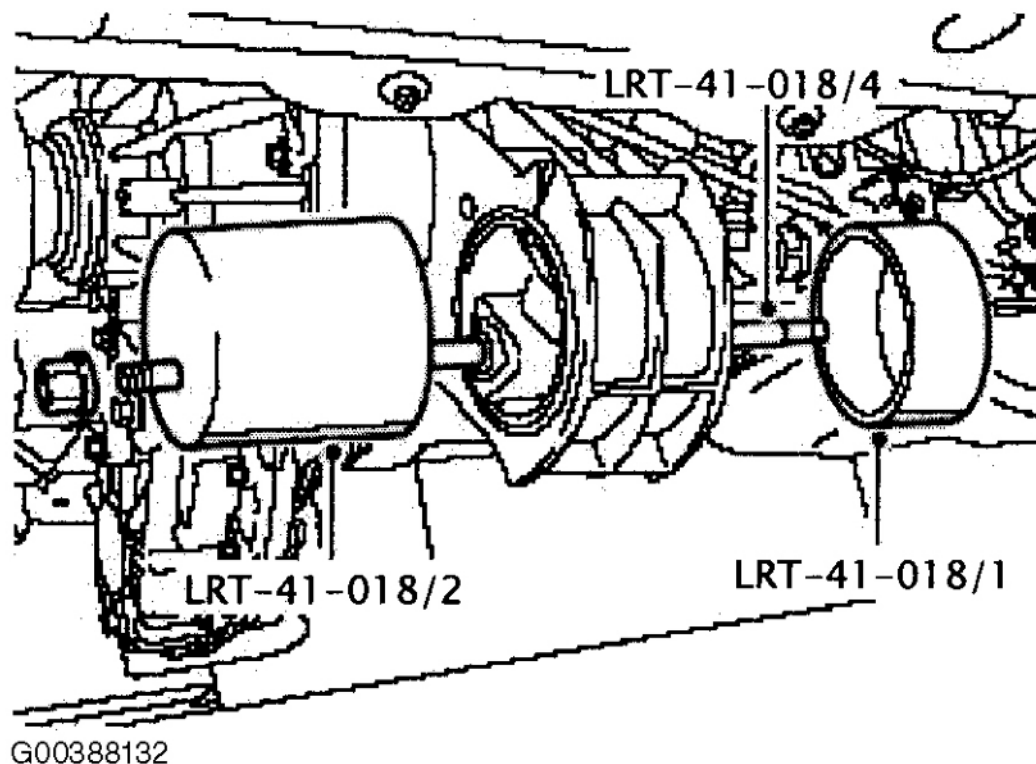


Fig. 127: Assembling LRT-41-018/4 To Remove Mounting From Transfer Gearbox
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

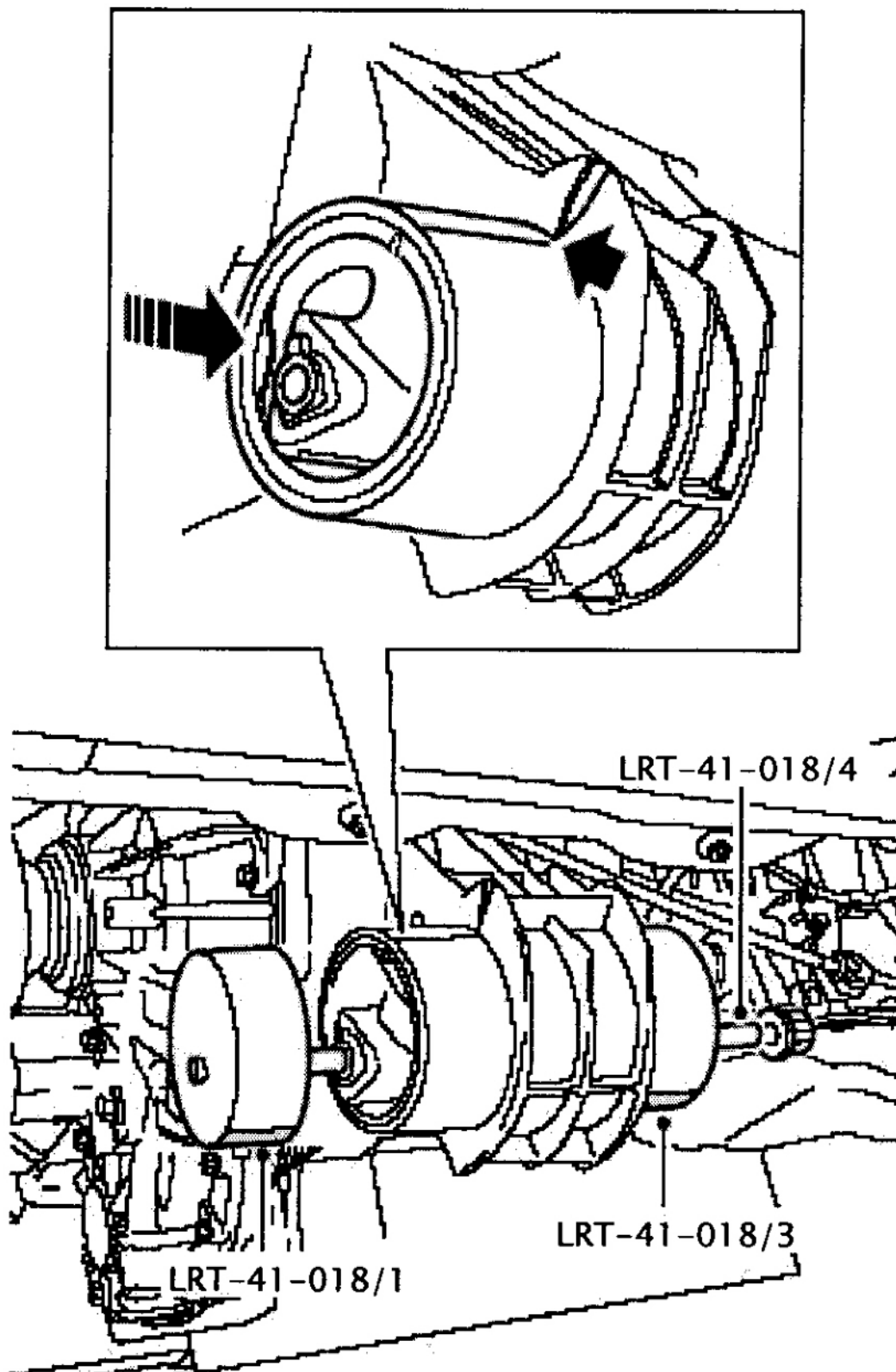
1. Clean mounting and mating faces.
2. Lubricate new mounting and bore in transfer gearbox casing to aid assembly.
3. Position new mounting to rear face of transfer gearbox, and start entry. Mounting to be parallel, with timing marks aligned. See **Fig. 128**.

NOTE: Transfer timing mark to side of mounting to assist with alignment.

4. Lubricate center screw LRT-41-018/4 with Molybdenum Disulphide grease and assemble tool as shown to fit mounting to transfer gearbox. Start with the center screw at full length and when the mounting is approximately 75 percent fitted, reduce the length of the center screw by screwing it fully into the base plate LRT-41-018/1. This will ensure the center screw LRT-41-018/4, does not foul on the gearbox fluid pan.

CAUTION: Ensure tool alignment indicator is at the 6 o'clock position.

5. Ensure the mounting is fitted parallel. If necessary, use a mallet and tap the base plate to maintain a parallel fit.
6. Fit snubbers.
7. Fit cross member to mounting, fit nut and bolt but DO NOT tighten at this stage.
8. Raise gearbox on jack.
9. Align cross member, fit bolts and tighten to 68 Nm (50 ft. lbs).
10. Remove support from gearbox.
11. Tighten nut and bolt securing mounting to cross member to 100 Nm (74 ft. lbs).
12. Fit left heat shield and secure with nuts.
13. Fit right heat shield and secure with nuts.
14. Fit center heat shield and secure with nuts.
15. Fit exhaust system. See **EXHAUST SYSTEM & MOUNTINGS** .
16. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .



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Fig. 128: Positioning New Mounting To Rear Face of Transfer Gearbox
Courtesy of LAND ROVER NORTH AMERICA, INC.

ENGINE MOUNTING - LEFT

Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed.
See **BATTERY DISCONNECT & RECONNECT**.

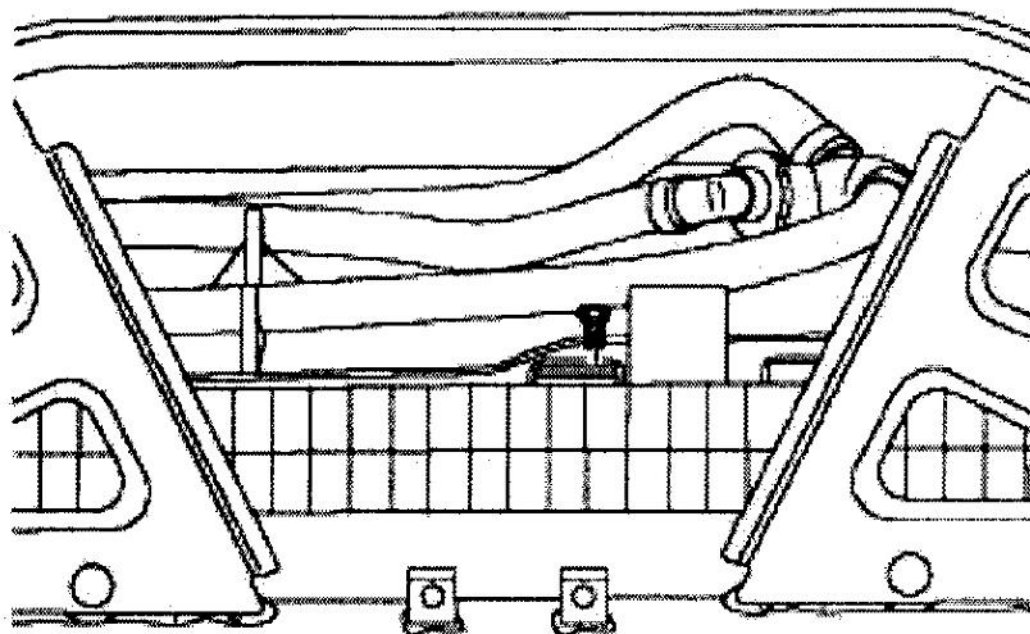
1. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.
2. Raise front of vehicle and support on stands.
3. Remove air intake plenum. See **80.15.62 PLENUM -- AIR INTAKE**.
4. Remove air intake hose. See **HOSE -- AIR FLOW METER TO THROTTLE BODY**.
5. Remove undertray. See **76.11.81 UNDERTRAY -- FRONT**.
6. Remove 4 bolts securing differential air flow panel and remove panel.
7. Remove screw securing fan cowl to radiator. See **Fig. 129**.
8. Release auxiliary cooling fan multiplug from fan cowl. See **Fig. 130**.
9. Remove scriveners securing fan cowl. See **Fig. 131**.
10. Release fan cowl from radiator. See **Fig. 132**.
11. Fit LRT-12-216 to engine lifting eyes. See **Fig. 115**.
12. Remove nut securing right engine mounting to engine mounting bracket. See **Fig. 116**.
13. Remove nut securing left engine mounting to engine mounting bracket. See **Fig. 117**.
14. Remove front road wheels.
15. Remove nut and disconnect link from left front suspension height sensor. See **Fig. 133**.
16. Remove nuts securing right and left track rod end ball joints to steering arms. Discard nuts. See **Fig. 134**.
17. Using LRT-57-036 release track rod ends from steering arms.
18. Disconnect multiplug from Power Assisted Steering (PAS) rack pinion sensor. See **Fig. 135**.
19. Note fitted position of intermediate steering column. Remove Torx bolt from intermediate steering column clamp and disconnect column from PAS rack. See **Fig. 136**.
20. Remove 2 Torx bolts and 2 nuts securing PAS rack, discard nuts and bolts. See **Fig. 137**.
21. Release PAS rack from front sub-frame and position rack forward for access.
22. Connect chain to engine lifting bracket and raise engine sufficiently only to clear mounting.

CAUTION: To prevent damage to the radiator, guide the fan cowl clear of the radiator as it is raised with the engine.

23. Remove 2 bolts securing left engine mounting to sub-frame and remove engine mounting, discard bolts. See **Fig. 138**.

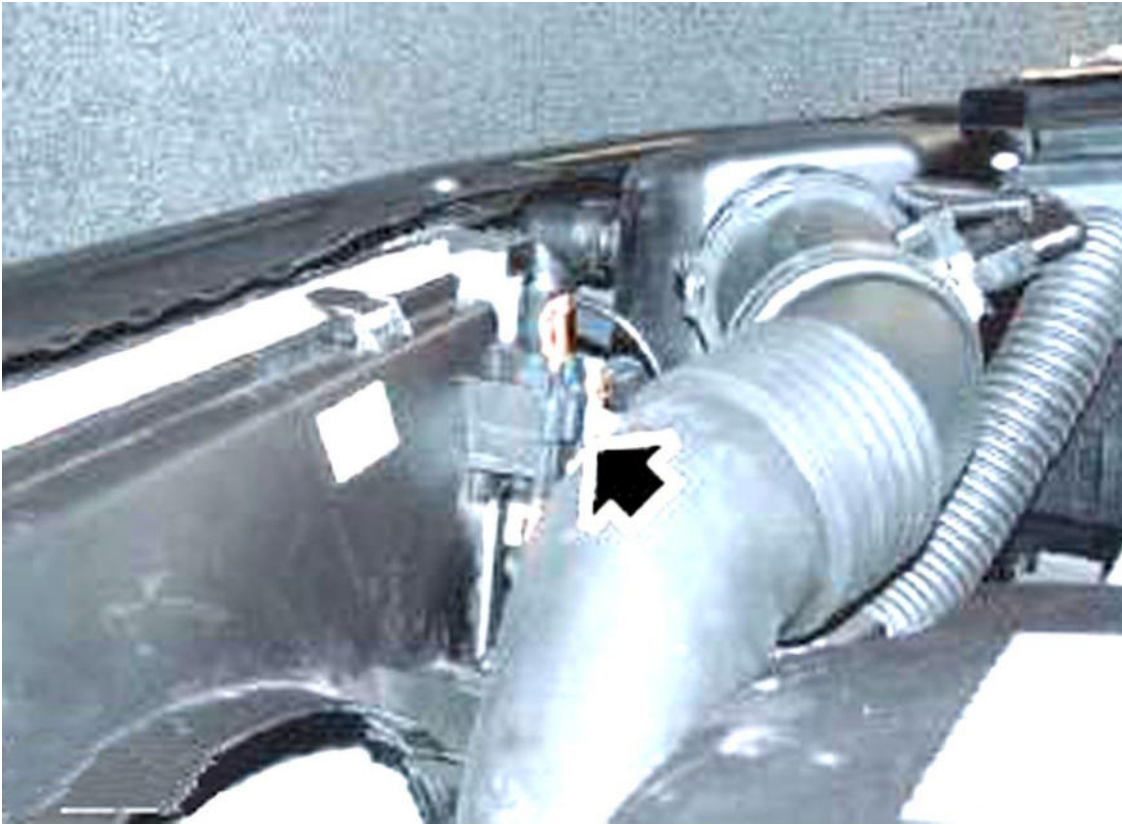
NOTE: The left engine mounting is removed from under the left front wheel arch

through the opening of the front sub-frame.



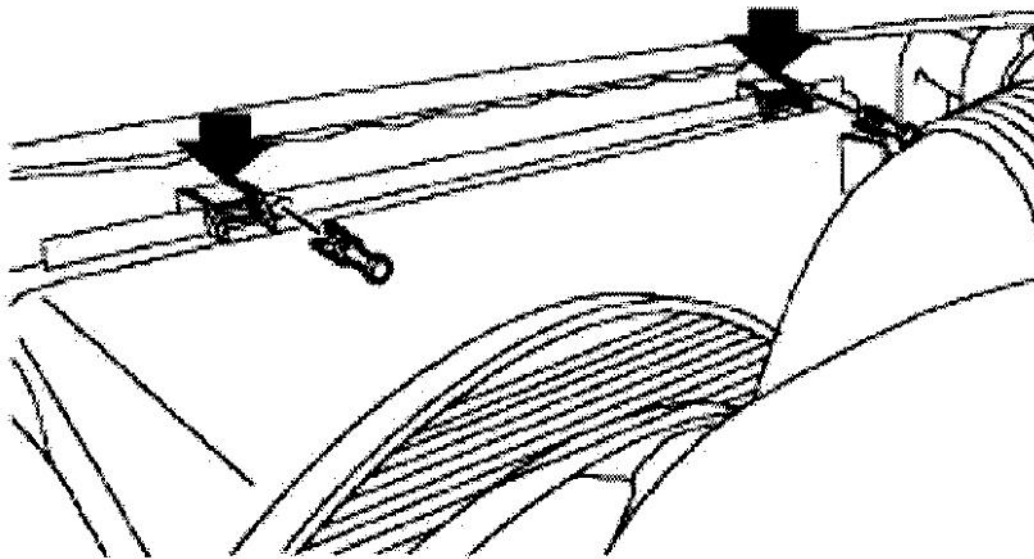
G00388134

Fig. 129: Removing Fan Cowl-To-Radiator Screw
Courtesy of LAND ROVER NORTH AMERICA, INC.



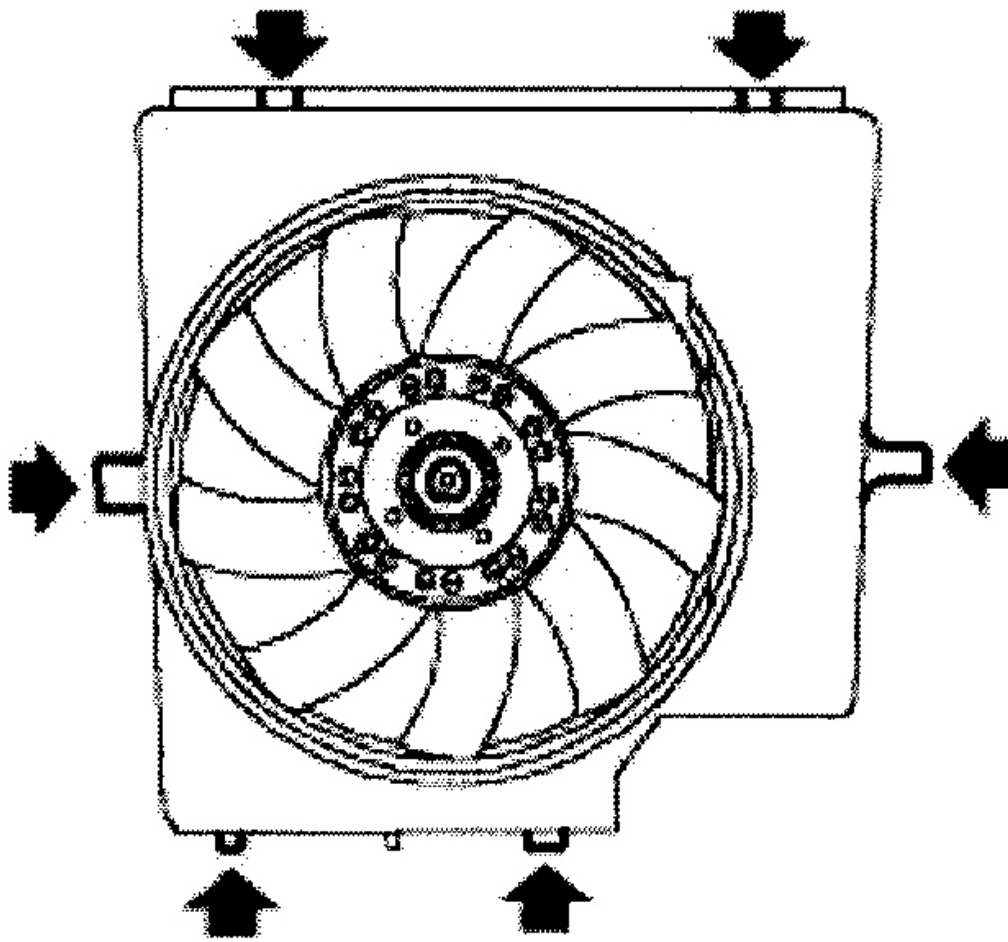
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Fig. 130: Releasing Auxiliary Cooling Fan Multiplug From Fan Cowl
Courtesy of LAND ROVER NORTH AMERICA, INC.



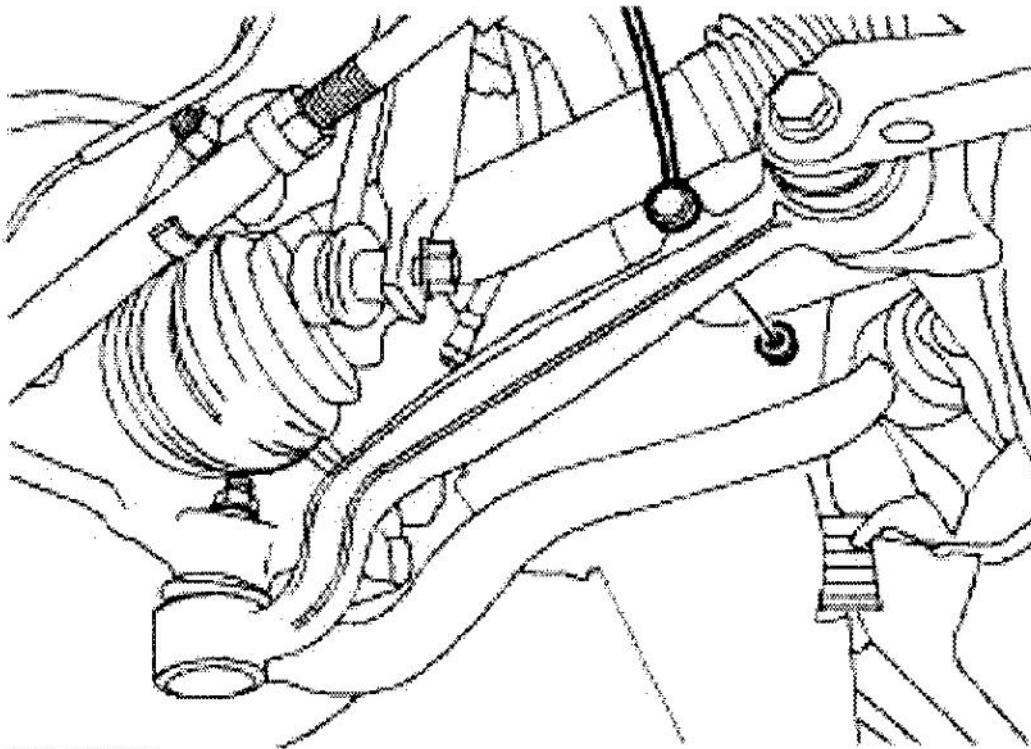
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Fig. 131: Removing Scrivets Securing Fan Cowl
Courtesy of LAND ROVER NORTH AMERICA, INC.



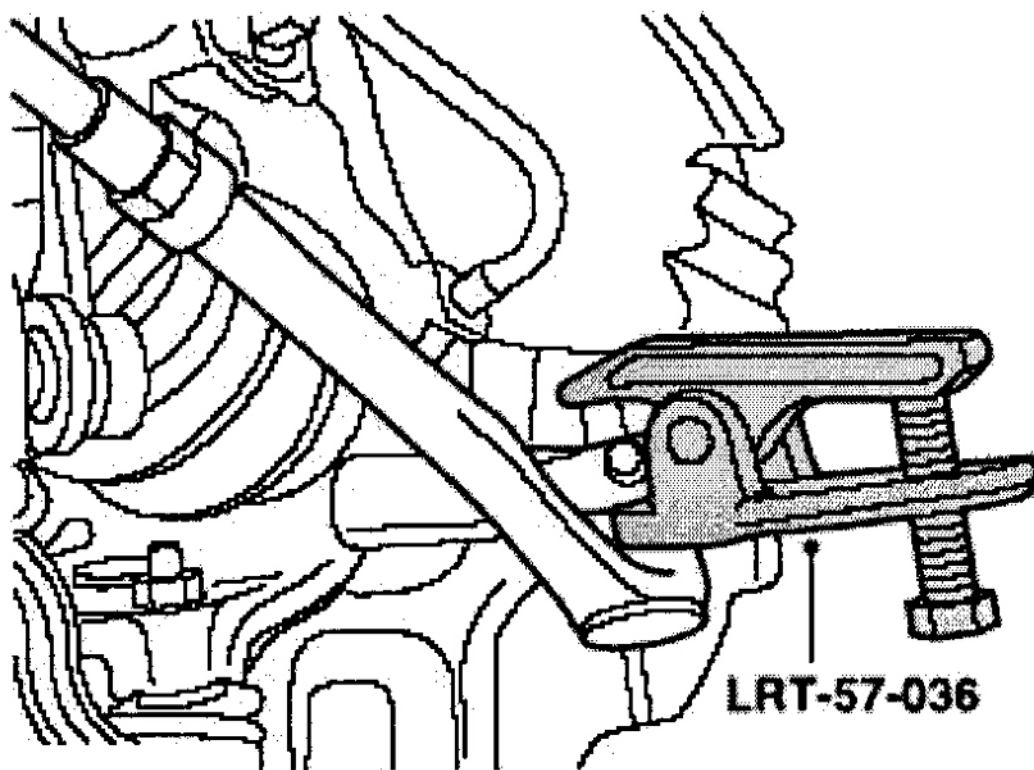
G00388137

Fig. 132: Releasing Fan Cowl From Radiator
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388138

Fig. 133: Disconnecting Link From Left Front Suspension
Courtesy of LAND ROVER NORTH AMERICA, INC.



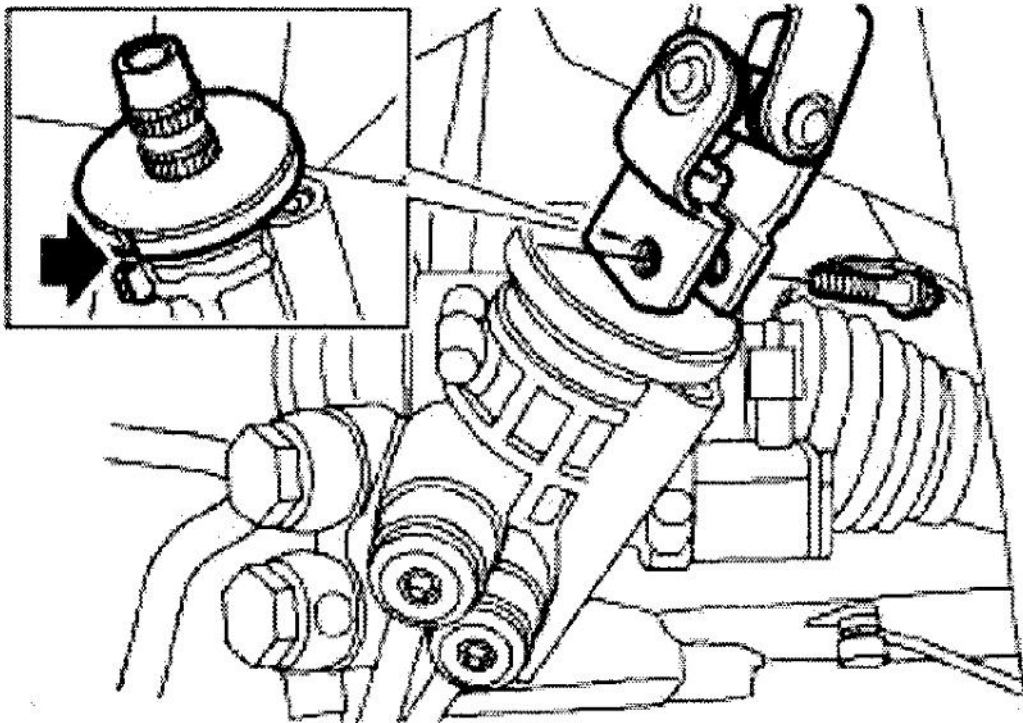
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Fig. 134: Removing Nuts Securing Right & Left Track Rod End Ball Joints-To-Steering Arms
Courtesy of LAND ROVER NORTH AMERICA, INC.



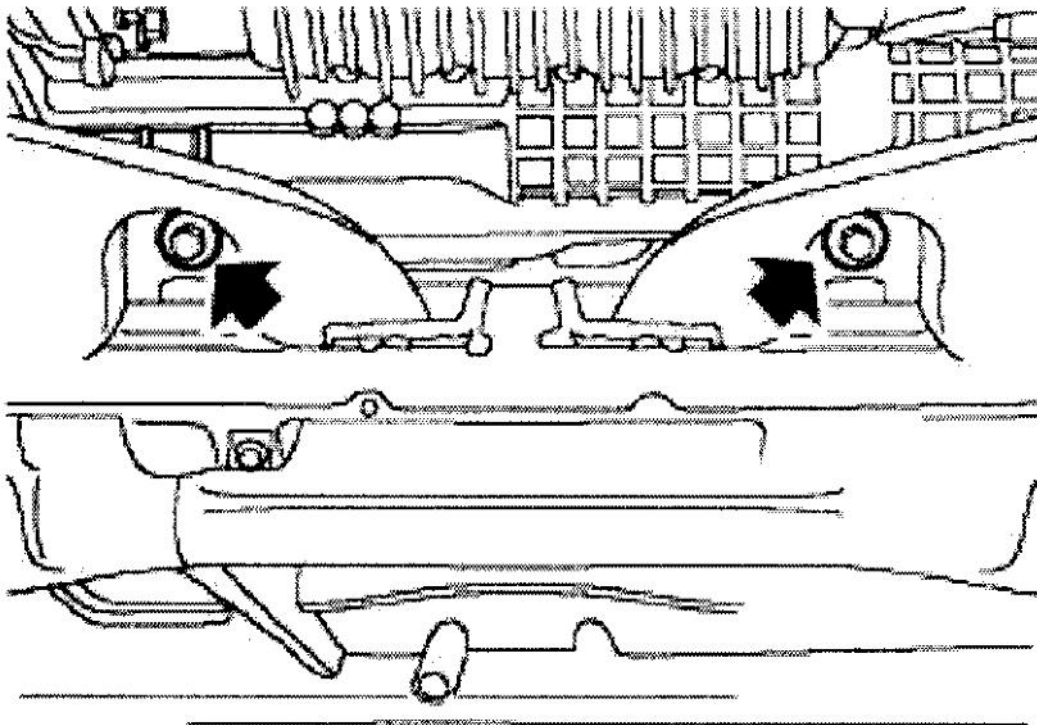
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Fig. 135: Disconnecting Multiplug From Power Assisted Steering Rack Pinion Sensor
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388141

Fig. 136: Disconnecting Column From Power Assisted Steering Rack
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388142

Fig. 137: Removing & Discarding Power Assisted Steering Torx Bolts & Nuts
Courtesy of LAND ROVER NORTH AMERICA, INC.

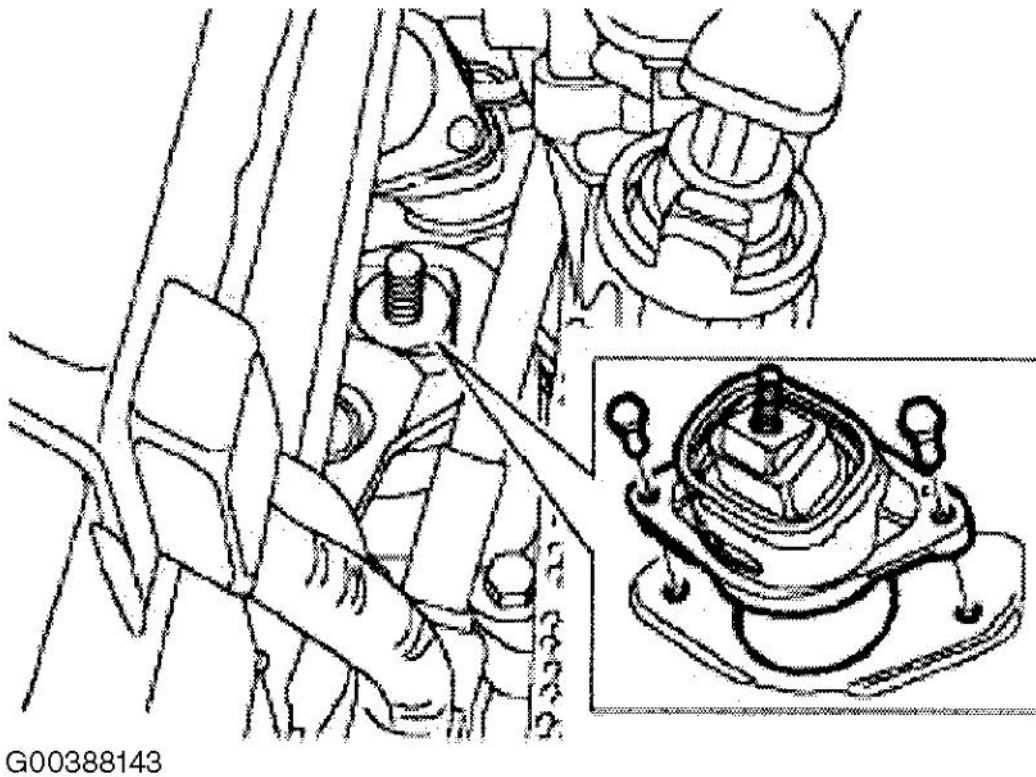


Fig. 138: Removing Left Engine Mounting Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Clean engine mountings and mating faces.
2. Fit left engine mounting to sub-frame and tighten new bolts to 56 Nm (41 ft. lbs).
3. Lower engine onto engine mountings.

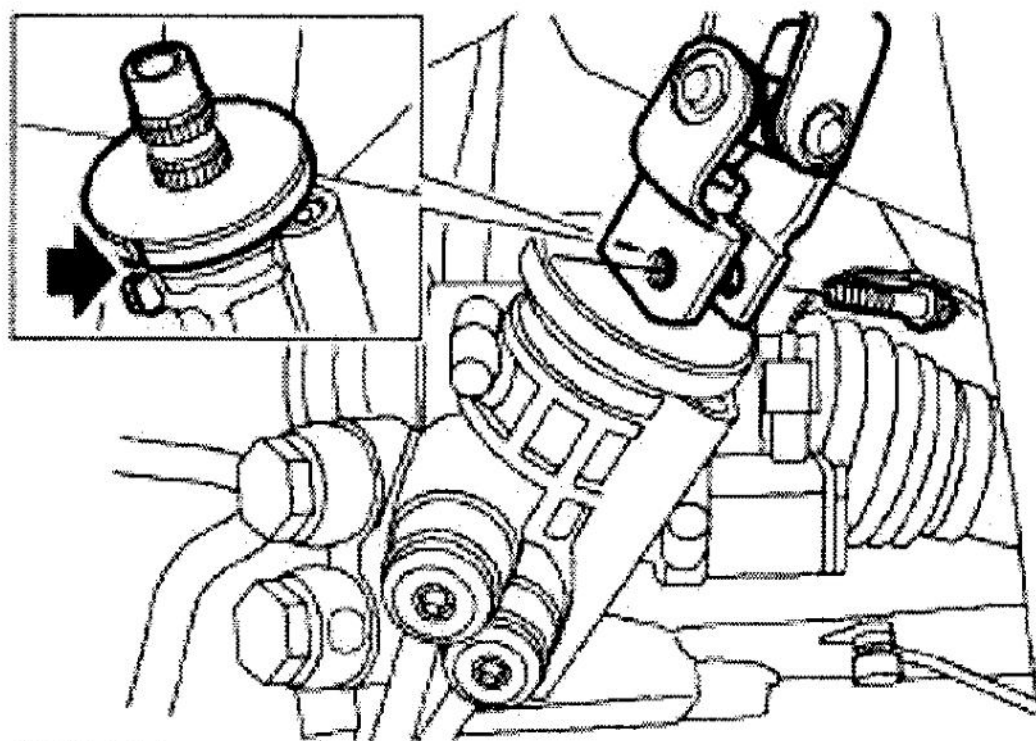
NOTE: Guide the fan cowl into position as the engine is lowered.

4. Position PAS rack into front sub-frame and using new Torx bolts and nuts tighten to 100 Nm (74 ft. lbs), then tighten a further 90°.
5. Connect intermediate steering column to PAS rack and tighten securing clamp Torx bolt to 24 Nm (18 ft. lbs). See **Fig. 139**.

NOTE: Make sure that intermediate steering column is correctly aligned to PAS rack.

6. Connect multiplug to PAS rack pinion sensor.

7. Connect track rod ends to steering arms, using new nuts tighten to 55 Nm (41 ft. lbs).
8. Connect link to suspension height sensor and tighten nut.
9. Fit front road wheels and tighten nuts to 140 Nm (103 ft. lbs).
10. Fit 2 nuts securing engine mountings to engine mounting brackets and tighten to 100 Nm (74 ft. lbs).
11. Remove engine lifting chains.
12. Remove engine lifting bracket.
13. Fit fan cowl to radiator and fit securing scrivenets.
14. Fit auxiliary cooling fan multiplug to fan cowl.
15. Fit screw securing fan cowl to radiator.
16. Fit undertray. See **76.11.81 UNDERTRAY -- FRONT** .
17. Fit differential air flow panel and tighten bolts to 45 Nm (33 ft. lbs).
18. Remove stands and lower front end of vehicle.
19. Connect air intake hose. See **HOSE -- AIR FLOW METER TO THROTTLE BODY** .
20. Fit air intake plenum. See **80.15.62 PLENUM -- AIR INTAKE** .
21. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .



G00388144

Fig. 139: Connecting Intermediate Steering Column-To-Power Assisted Steering Rack

Courtesy of LAND ROVER NORTH AMERICA, INC.

ENGINE MOUNTING - RIGHT

Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT** .

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Remove air intake plenum. See **80.15.62 PLENUM -- AIR INTAKE** .
4. Remove air intake hose. See **HOSE -- AIR FLOW METER TO THROTTLE BODY** .
5. Remove undertray. See **76.11.81 UNDERTRAY -- FRONT** .
6. Remove screw securing fan cowl to radiator. See **Fig. 129**.
7. Release auxiliary cooling fan multiplug from fan cowl. See **Fig. 130**.
8. Remove scrivenets securing fan cowl. See **Fig. 131**.
9. Release fan cowl from radiator. See **Fig. 132**.
10. Fit LRT-12-216 to engine lifting eyes. See **Fig. 133**.
11. Remove nut securing right engine mounting to engine mounting bracket. See **Fig. 116**.
12. Remove nut securing left engine mounting to engine mounting bracket. See **Fig. 117**.
13. Connect chain to engine lifting bracket and raise engine sufficiently only to clear mounting.

CAUTION: To prevent damage to the radiator, guide the fan cowl clear of the radiator as it is raised with the engine.

14. Remove 2 bolts securing right engine mounting to sub-frame, discard bolts.
15. Remove right engine mounting.

NOTE: The right engine mounting is removed from underneath the vehicle between the gearbox bell housing and the sub-frame.

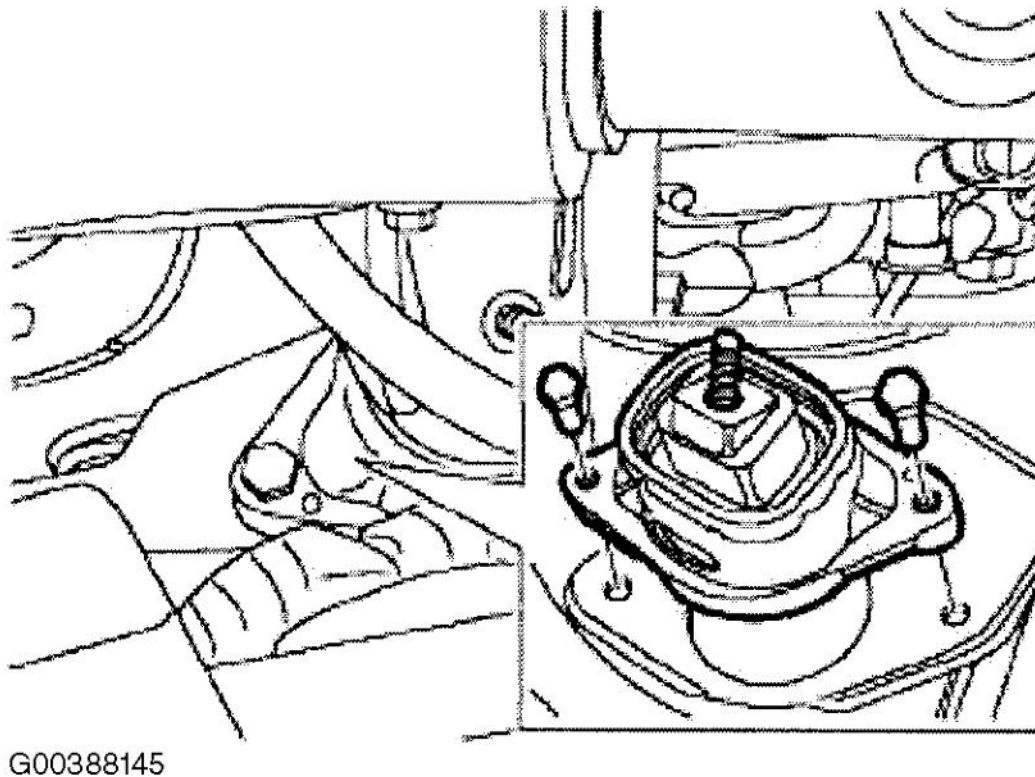


Fig. 140: Removing & Discarding Right Engine Mounting
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Clean engine mountings and mating faces.
2. Fit right engine mounting to sub-frame and tighten new bolts to 56 Nm (41 ft. lbs).
3. Lower engine onto engine mountings.

NOTE: Guide the fan cowl into position as the engine is lowered.

4. Remove engine lifting chains.
5. Fit 2 nuts securing engine mountings to engine mounting brackets and tighten to 100 Nm (74 ft. lbs).
6. Remove engine lifting bracket.
7. Fit fan cowl to radiator and fit securing scrivenets.
8. Fit auxiliary cooling fan multiplug to fan cowl.
9. Fit screw securing fan cowl to radiator.
10. Fit undertray. See **76.11.81 UNDERTRAY -- FRONT** .

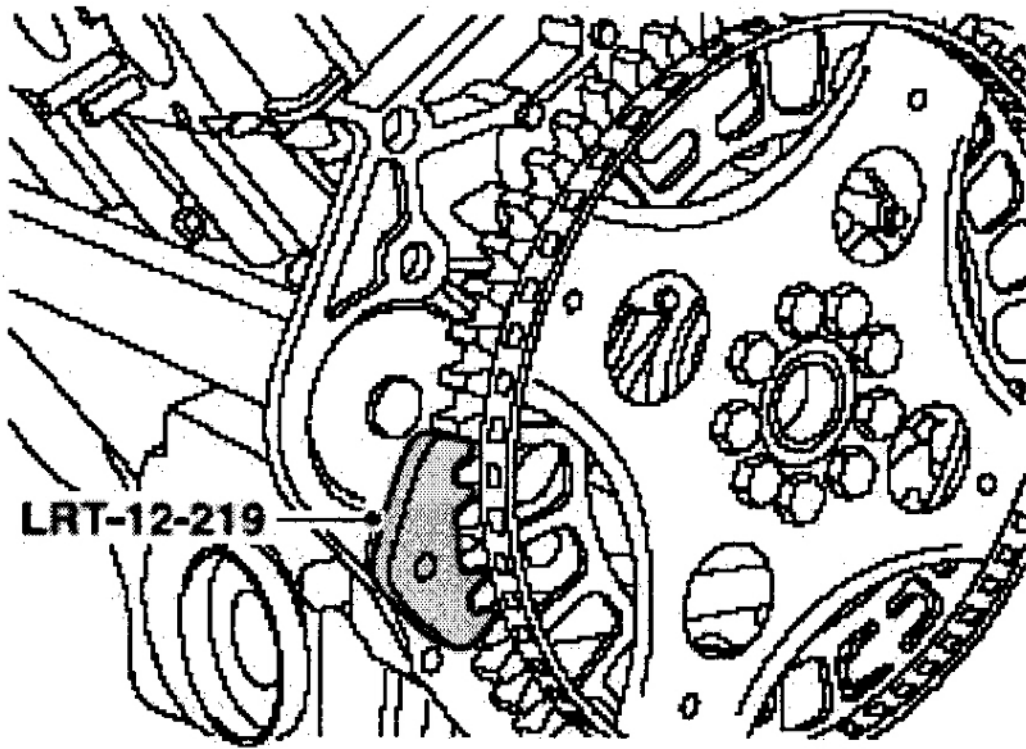
11. Connect air intake hose. See **HOSE -- AIR FLOW METER TO THROTTLE BODY** .
12. Fit air intake plenum. See **80.15.62 PLENUM -- AIR INTAKE** .
13. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .

TORQUE CONVERTER DRIVE PLATE

Removal

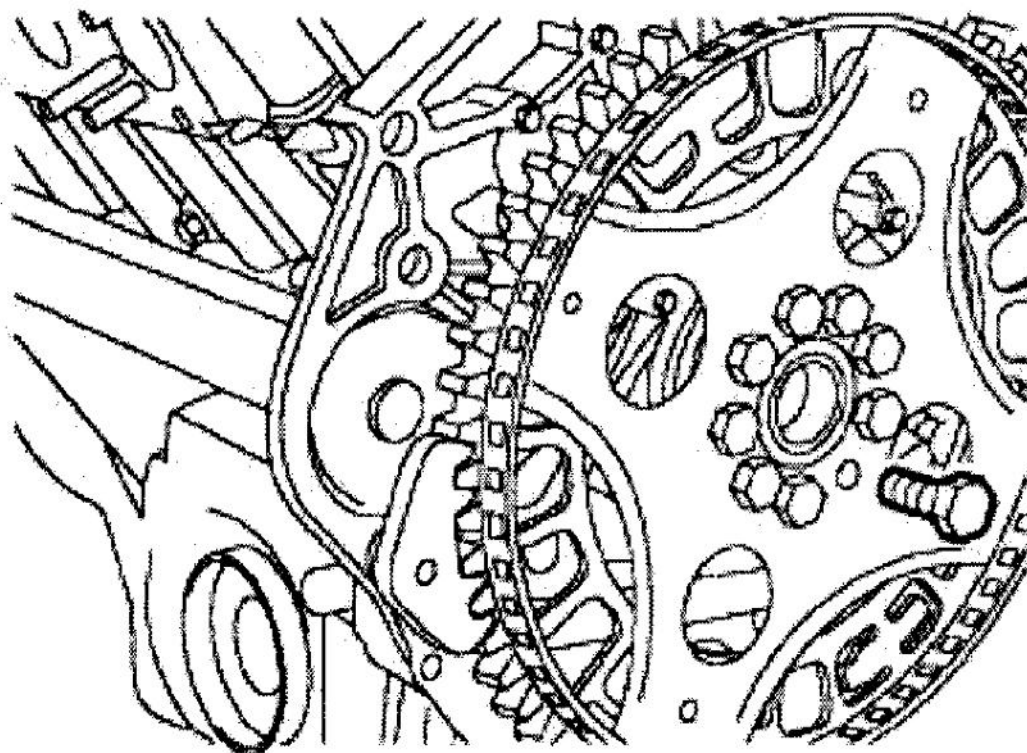
Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT** . New drive plates do not have the hollow bush fitted. It is supplied with a new drive plate separately.

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Remove gearbox and transfer gearbox assembly. See **TRANSFER BOX** .
4. Position LRT-12-219 to lock flywheel. See **Fig. 141**.
5. Reference mark the torque converter drive plate and crankshaft boss to aid fitment. One of the drive plate fixing holes has a hollow bush fitted.
6. Remove 9 bolts securing torque converter drive plate to crankshaft, discard the bolts. Note the fitted position of the hollow bush.
7. Remove torque converter drive plate and LRT-12-219.



G00388146

Fig. 141: Position LRT-12-219 To Lock Flywheel
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388147

Fig. 142: Marking Torque Converter Hollow Bush & Removing Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.

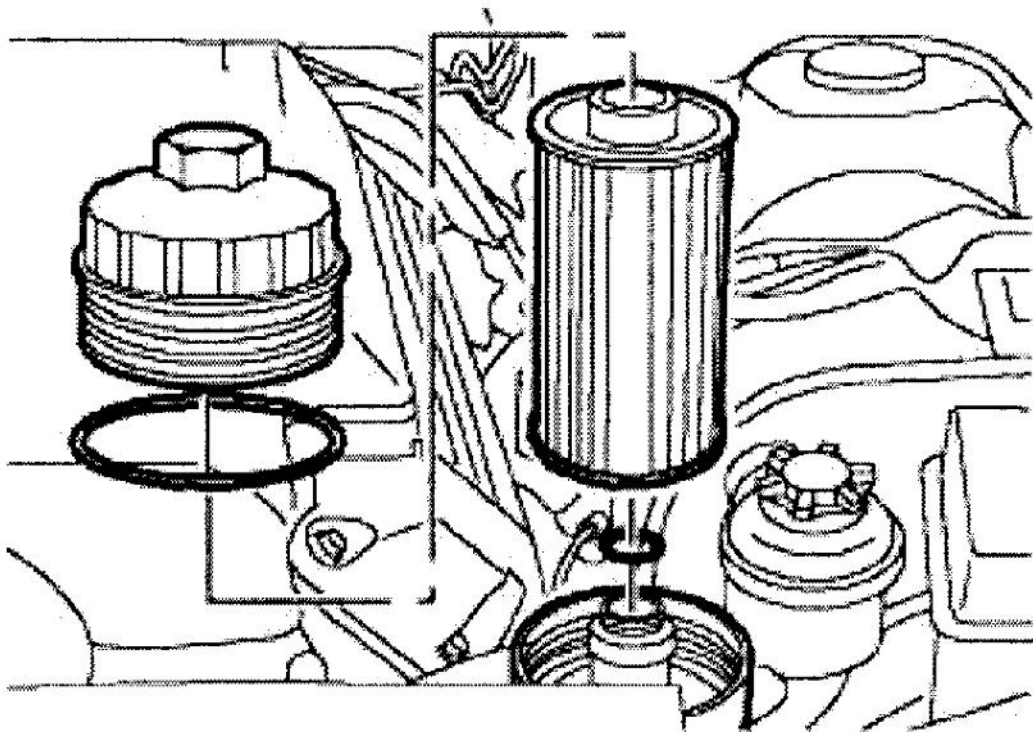
Installation

1. If drive plate is to be replaced, ensure that the hollow bush, supplied with the replacement drive plate, is fitted into the same hole as on the original drive plate.
2. Clean crankshaft bolt holes and torque converter drive plate dowel.
3. Clean torque converter drive plate and mating face of crankshaft.
4. Align reference marks, position torque converter drive plate to crankshaft and LRT-12-219 to lock flywheel. Ensure that the bushed hole in the drive plate is located onto the dowel.
5. Fit new bolts securing torque converter drive plate to crankshaft and tighten progressively to 120 Nm (89 ft. lbs).
6. Remove LRT-12-219 from flywheel.
7. Refit gearbox and transfer gearbox assembly. See **TRANSFER BOX**.
8. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.

FILTER - ENGINE OIL

Removal

1. Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT**.
2. Position absorbent cloth beneath oil filter housing to collect spillage.
3. Remove oil filter cap and filter element from oil filter housing. Remove oil filter element from oil filter cap. Discard filter element and 2 "O" rings. See **Fig. 143**.



G00388148

Fig. 143: Removing Oil Filter
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Clean oil filter cap and housing.
2. Fit 2 new oil filter "O" rings and lubricate with clean engine oil.
3. Fit new oil filter element into oil filter cap.
4. Fit oil filter cap and tighten to 25 Nm (18 ft. lbs).
5. Remove absorbent cloth.
6. Clean oil filter cap and housing.

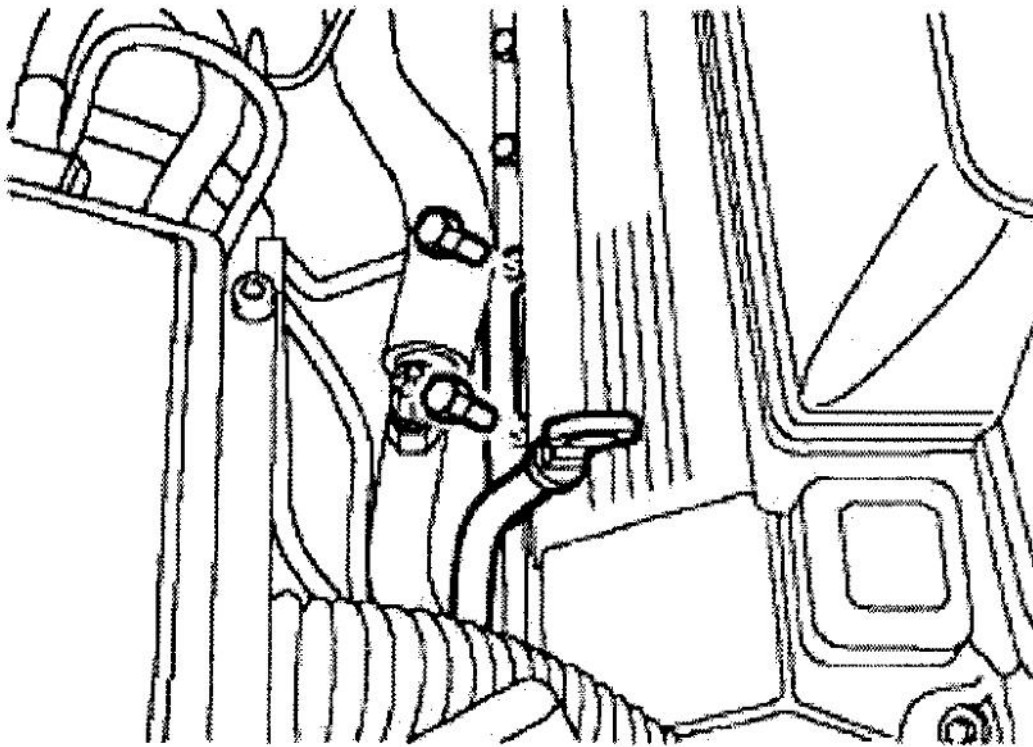
7. Remove engine oil dipstick.
8. Remove engine oil filler cap and fill engine to correct level.
9. Clean engine oil filler cap and mating face.
10. Fit engine oil filler cap.
11. Fit engine oil dipstick.
12. Start engine and run at idle speed until oil pressure warning light extinguishes.
13. Visually check oil filter cap for signs of leakage.
14. Stop engine, wait a few minutes, then check oil level. Top up if necessary.

TUBE - DIPSTICK

Removal

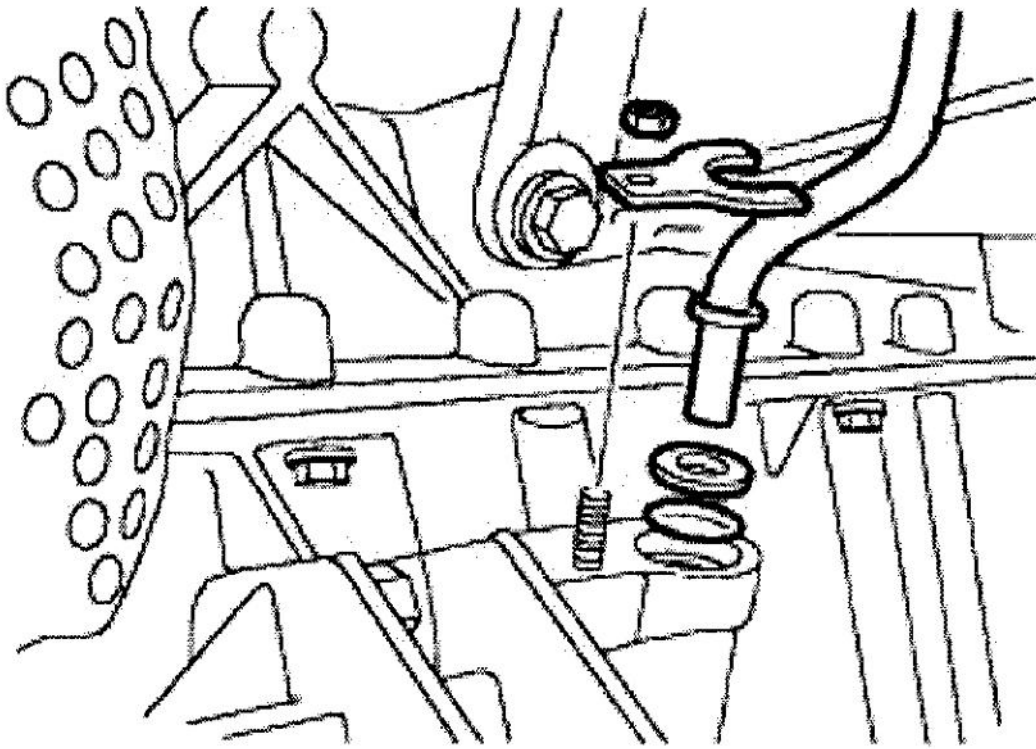
Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT** .

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Remove dipstick.
4. Remove 2 nuts securing dipstick tube bracket to camshaft cover. See **Fig. 144**.
5. Remove nut and clamp securing dipstick tube to oil sump.
6. Remove dipstick tube, washer and "O" ring, discard "O" ring. See **Fig. 145**.



G00388149

Fig. 144: Removing Dipstick Tube Bracket Nuts
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388150

Fig. 145: Removing Dipstick Tube Nut & Clamp From Oil Sump
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

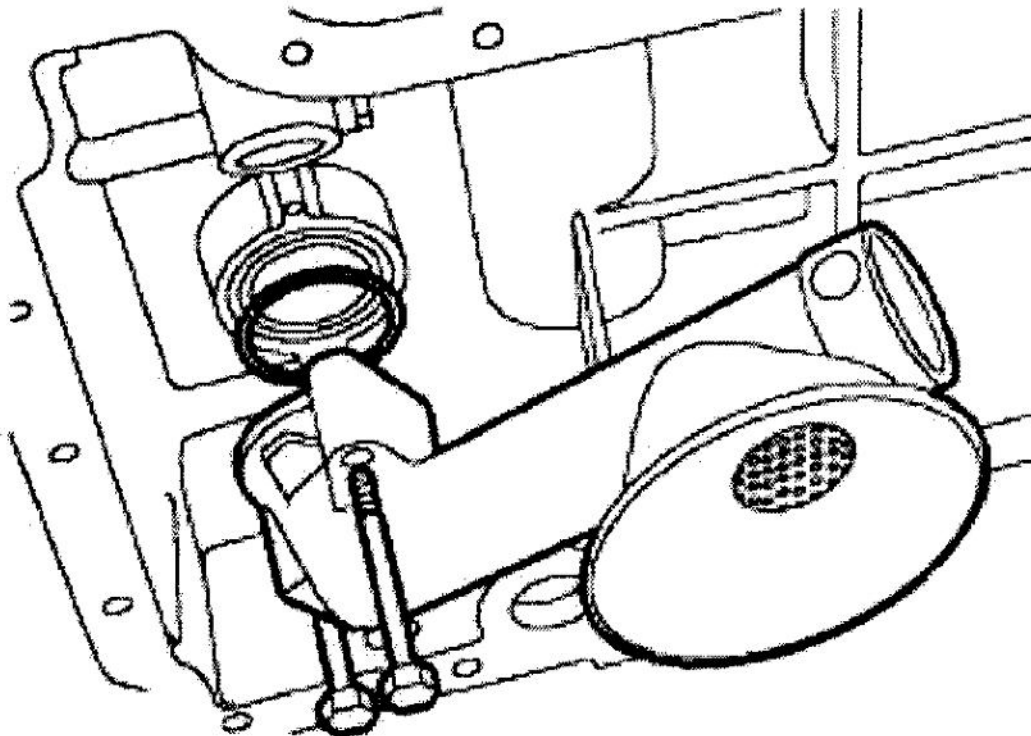
1. Clean dipstick tube and mating faces in engine oil sump.
2. Fit new "O" ring to oil sump and position dipstick tube and washer to oil sump.
3. Fit clamp securing dipstick tube to oil sump and tighten nut.
4. Fit and tighten 2 nuts securing dipstick tube bracket to camshaft cover.
5. Fit dipstick.
6. Check engine oil level, top-up if necessary.
7. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .

STRAINER - OIL PICK UP

Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed.
See **BATTERY DISCONNECT & RECONNECT** .

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Remove lower oil sump. See **GASKET - LOWER OIL SUMP**.
4. Remove 2 bolts securing oil pick-up strainer to oil pump, remove strainer and discard "O" ring. See **Fig. 146**.



G00388151

Fig. 146: Removing Oil Pick-Up Strainer-To-Oil Pump Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

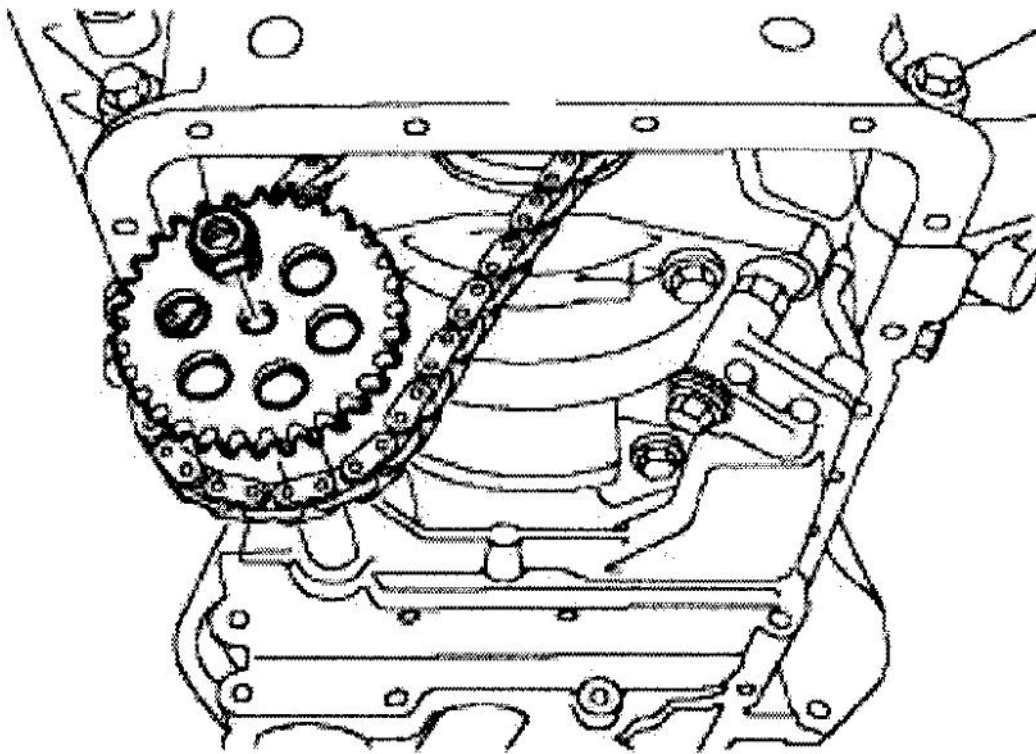
1. Clean oil pick up strainer and mating faces.
2. Fit new "O" ring to oil pump groove location, position oil pick-up strainer to oil pump.
3. Fit and tighten 2 bolts securing oil pick-up strainer to oil pump.
4. Fit lower oil sump. See **GASKET - LOWER OIL SUMP**.
5. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .

PUMP - OIL

Removal

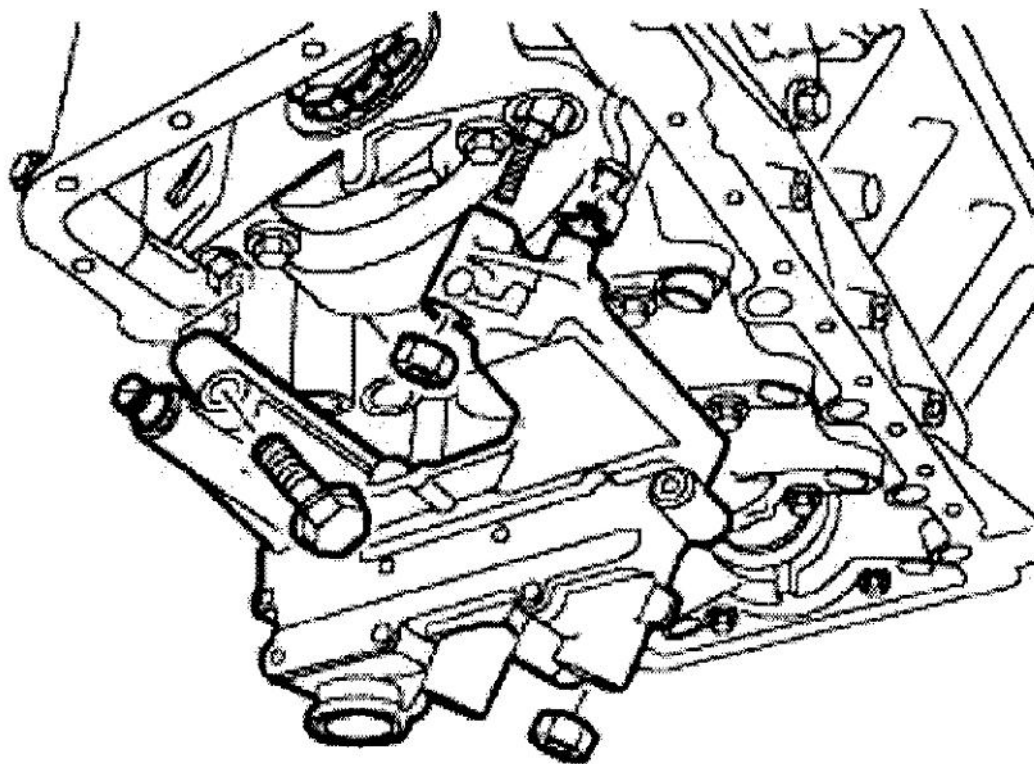
Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT**.

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.
3. Remove engine upper oil sump. See **GASKET - OIL SUMP**.
4. Remove nut securing sprocket to oil pump and remove sprocket. See **Fig. 147**.
5. Remove 2 nuts and 1 bolt securing oil pump to engine and remove oil pump. See **Fig. 148**.
6. Discard "O" rings from oil pump and oil pipe.



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Fig. 147: Removing Sprocket-To-Oil Pump
Courtesy of LAND ROVER NORTH AMERICA, INC.



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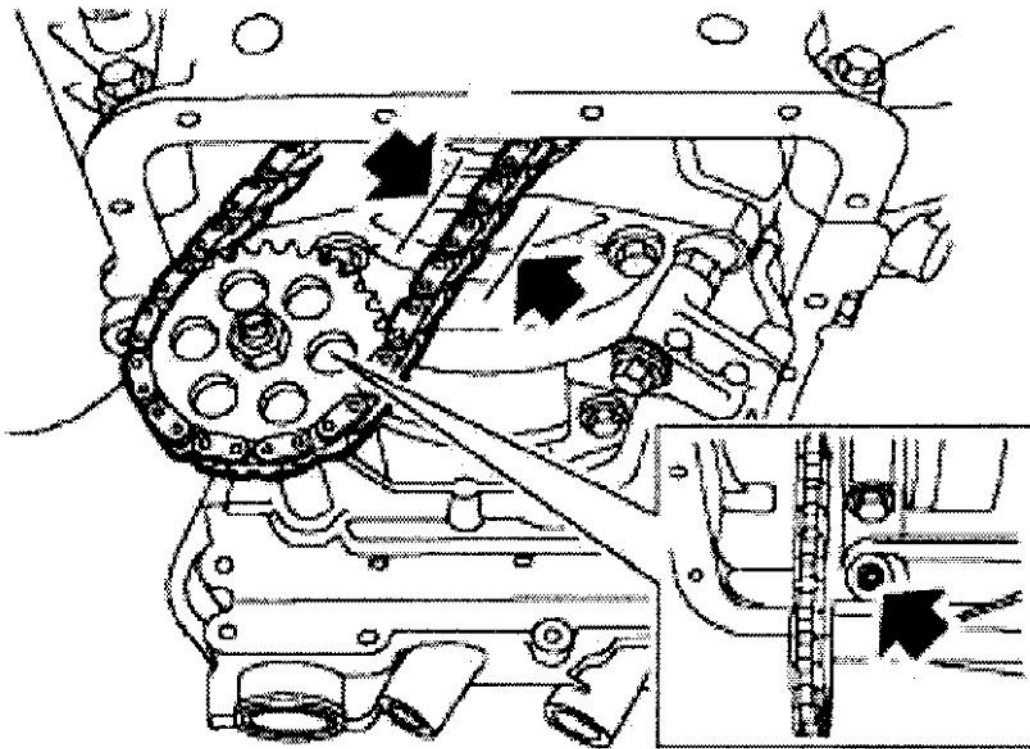
Fig. 148: Removing Oil Pump-To-Engine Nuts & Bolt
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Clean oil pipes to oil pump mating faces, fit new "O" ring seals and lubricate with clean engine oil.
2. Position oil pump to 2 oil pipes and engine, fit and tighten 2 nuts securing oil pump to engine.
3. Position sprocket to oil pump chain and fit sprocket to oil pump.
4. Fit and tighten nut securing sprocket to oil pump.
5. Adjust Allen bolt spacer to adjust oil pump chain deflection to between 8 mm (0.314 in) and 12 mm (0.470 in). See **Fig. 149**.

NOTE: The oil pump chain is adjusted by turning the Allen bolt spacer which is accessed through the oil pump securing bolt hole.

6. Fit and tighten bolt securing oil pump to engine.
7. Fit engine upper oil sump. See **GASKET - OIL SUMP**.
8. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.



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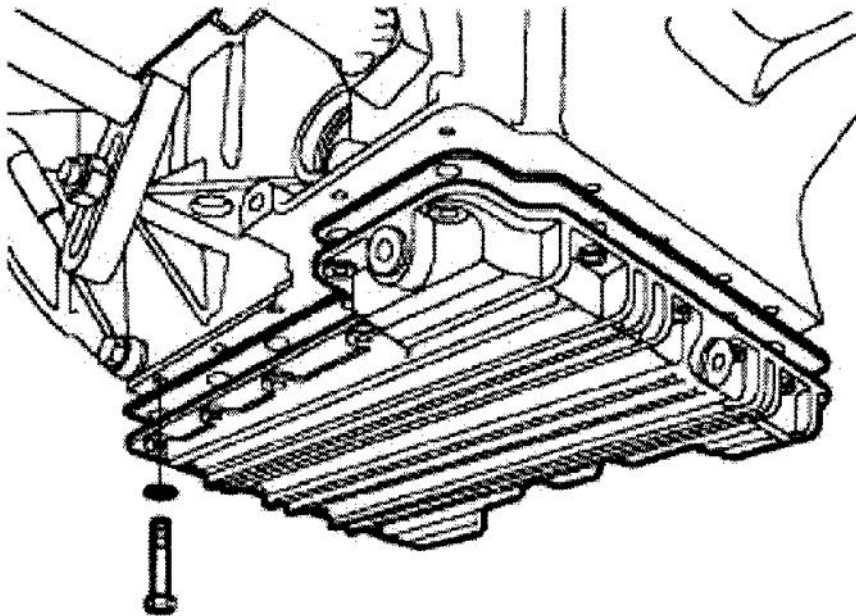
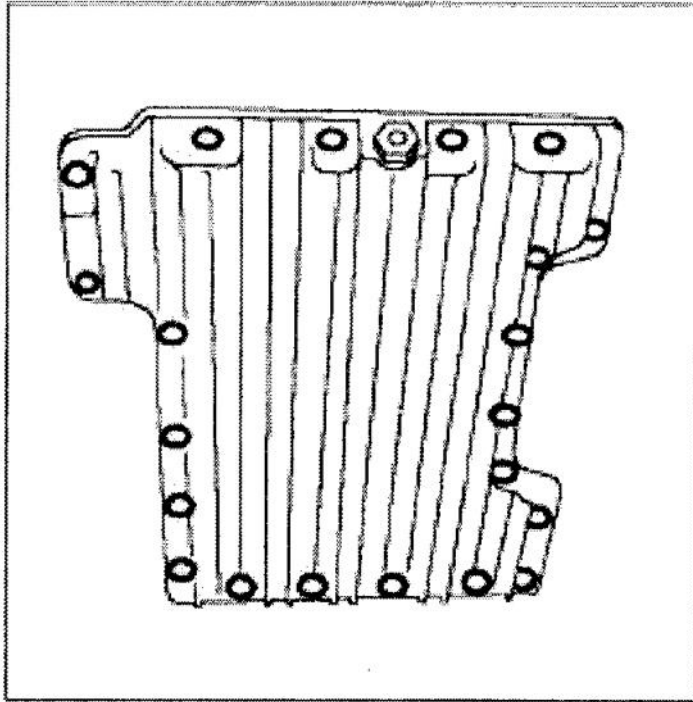
Fig. 149: Adjusting Oil Pump Chain Deflection
Courtesy of LAND ROVER NORTH AMERICA, INC.

GASKET - LOWER OIL SUMP

Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT** .

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Drain engine oil. See **FILTER - ENGINE OIL**.
4. Remove 21 bolts securing lower oil sump to upper oil sump. Remove lower oil sump and discard gasket. See **Fig. 150**.



G00388155

Fig. 150: Removing Lower Oil Sump-To-Upper Oil Sump Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

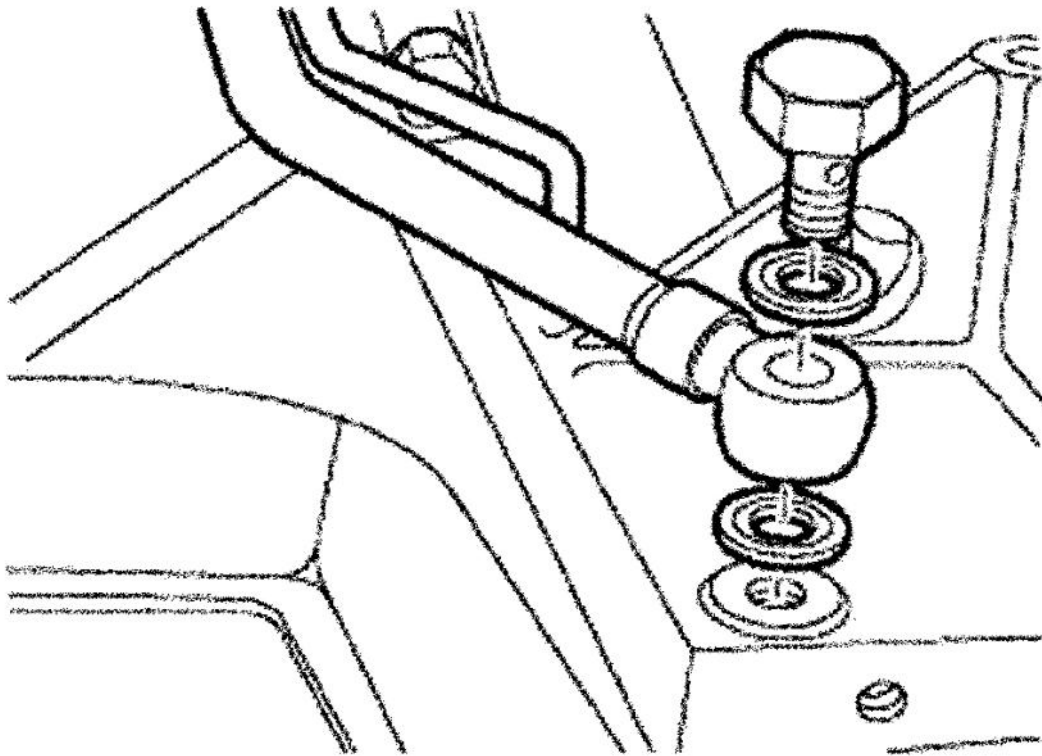
1. Clean lower oil sump mating faces.
2. Fit new gasket to lower oil sump mating face.
3. Fit lower oil sump.
4. Fit 21 bolts securing lower oil sump and tighten to 10 Nm (7 ft. lbs).
5. Fill engine with oil. See **FILTER - ENGINE OIL**.
6. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.

GASKET - OIL SUMP

Removal

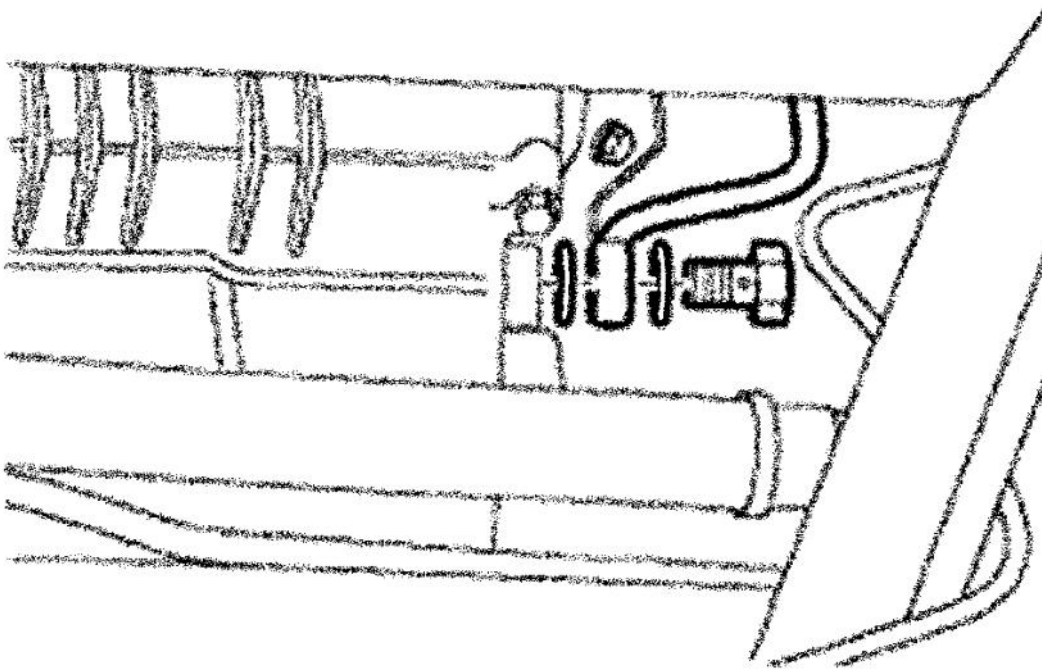
Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT**.

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.
3. Remove dipstick tube. See **TUBE - DIPSTICK**.
4. Remove Power Assisted Steering (PAS) pump. See **PUMP - POWER STEERING**.
5. Remove differential. See **FRONT DIFFERENTIAL ASSEMBLY**.
6. Remove oil pick-up strainer. See **STRAINER - OIL PICK UP**.
7. Remove banjo bolt securing engine oil return pipe to oil sump and discard 2 sealing washers. See **Fig. 151**.
8. Remove banjo bolt securing engine oil filter return pipe to oil sump and discard 2 sealing washers. See **Fig. 152**.
9. Remove 4 Torx bolts securing oil sump to bell housing. See **Fig. 153**.
10. Remove 31 bolts securing oil sump to engine cylinder block, note position of bolts as lengths vary. See **Fig. 154**.
 - A = M8 x 60 mm
 - B = M6 x 80 mm
 - C = M6 x 40 mm
 - All remaining bolts are M6 x 20 mm
11. Remove oil sump and discard gasket.



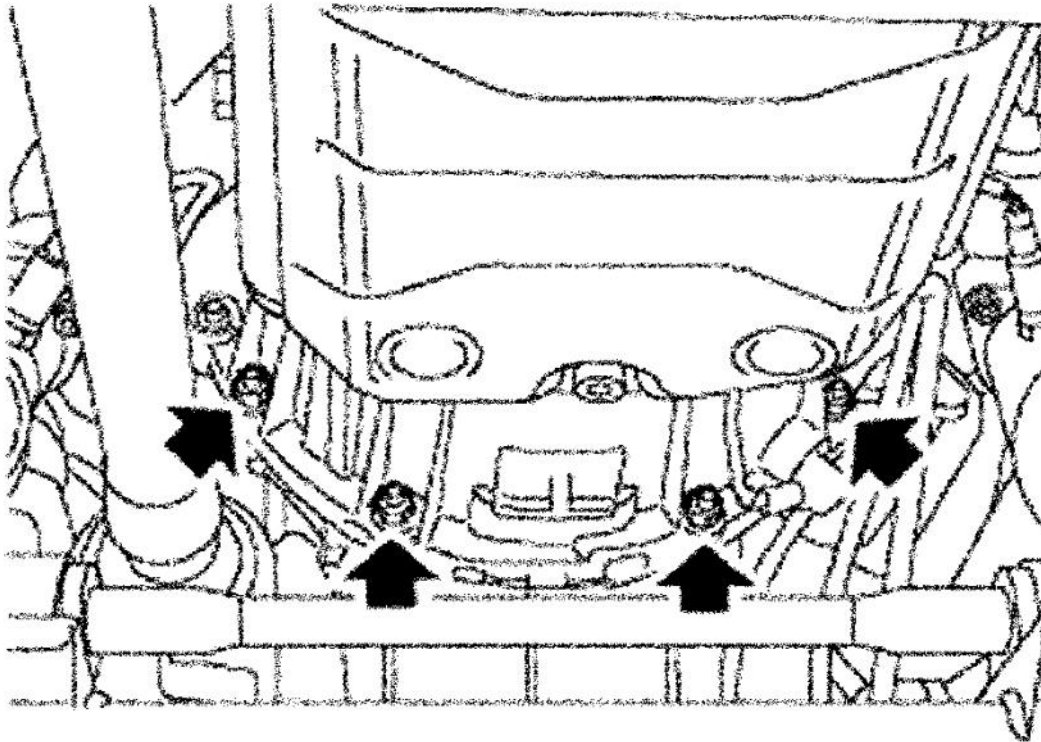
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Fig. 151: Removing Engine Oil Return Pipe-To-Oil Sump Banjo Bolt
Courtesy of LAND ROVER NORTH AMERICA, INC.



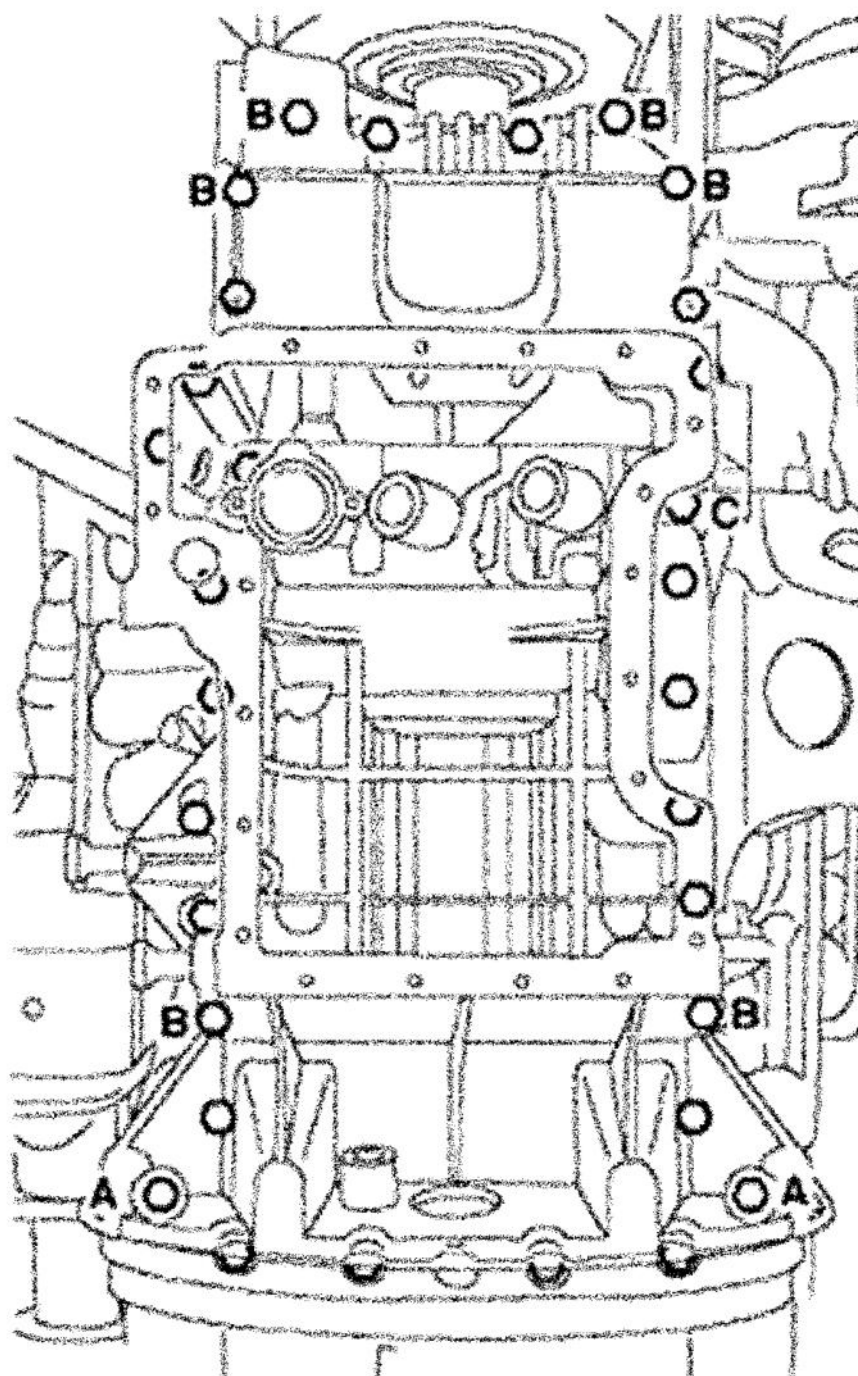
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Fig. 152: Removing Engine Oil Filter Return Pipe-To-Oil Sump Banjo Bolt
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388158

Fig. 153: Removing Oil Sump-To-Bell Housing Torx Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388159

Fig. 154: Removing Oil Sump-To-Engine Cylinder Block Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Clean oil sump and gasket mating faces.
2. Fit new gasket to sump, position sump to cylinder block, fit bolts but DO NOT tighten at this stage.
3. Tighten 31 bolts securing upper oil sump to cylinder block, M6 x 8.8 mm to 10 Nm (7 ft. lbs), M6 x 10.9 mm to 12 Nm (9 ft. lbs) and M8 x 8.8 mm to 22 Nm (16 ft. lbs).

NOTE: **Note position of 6 mm bolts as they are two different lengths.**

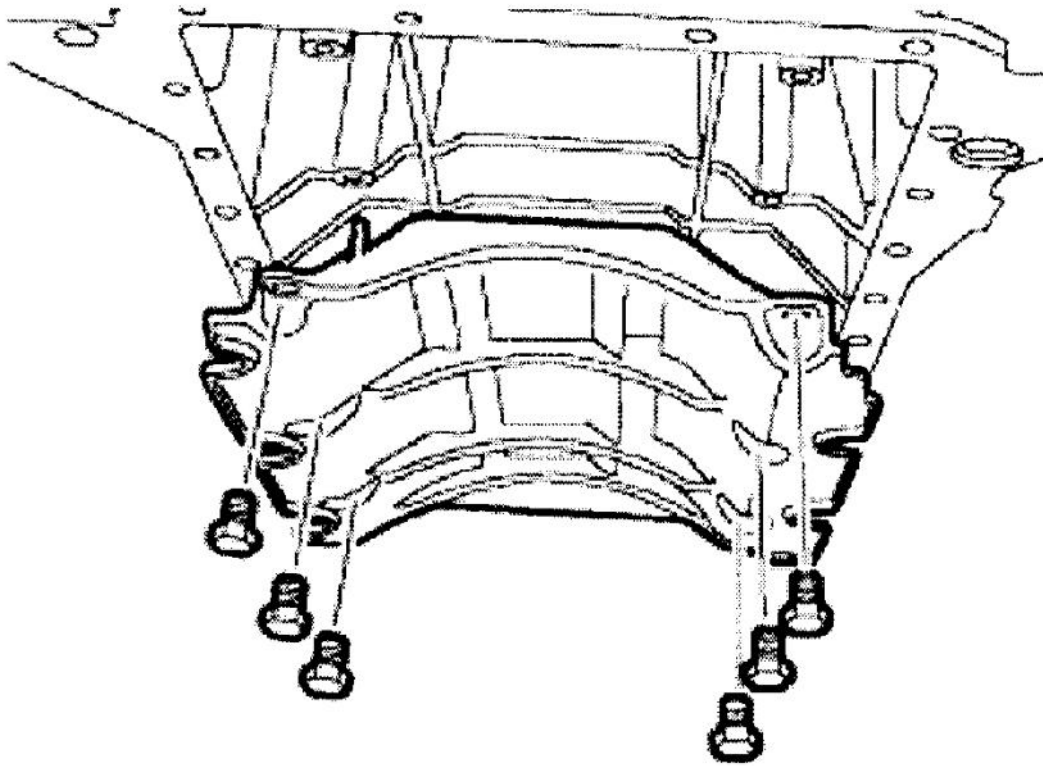
4. Fit 4 Torx bolts securing oil sump to bell housing and tighten to 53 Nm (39 ft. lbs)
5. Fit 2 new sealing washers, fit banjo bolt securing engine oil filter return pipe to oil sump and tighten to 30 Nm (22 ft. lbs).
6. Fit differential. See **FRONT DIFFERENTIAL ASSEMBLY** .
7. Fit oil pick-up strainer. See **STRAINER - OIL PICK UP**.
8. Fit Power Assisted Steering (PAS) pump. See **PUMP - POWER STEERING** .
9. Fit dipstick tube. See **TUBE - DIPSTICK**.
10. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .

BAFFLE PLATE

Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT** .

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Remove engine oil sump. See **GASKET - OIL SUMP**.
4. Remove 6 bolts securing baffle plate and remove plate. See **Fig. 155**.



G00388160

Fig. 155: Removing Baffle Plate

Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

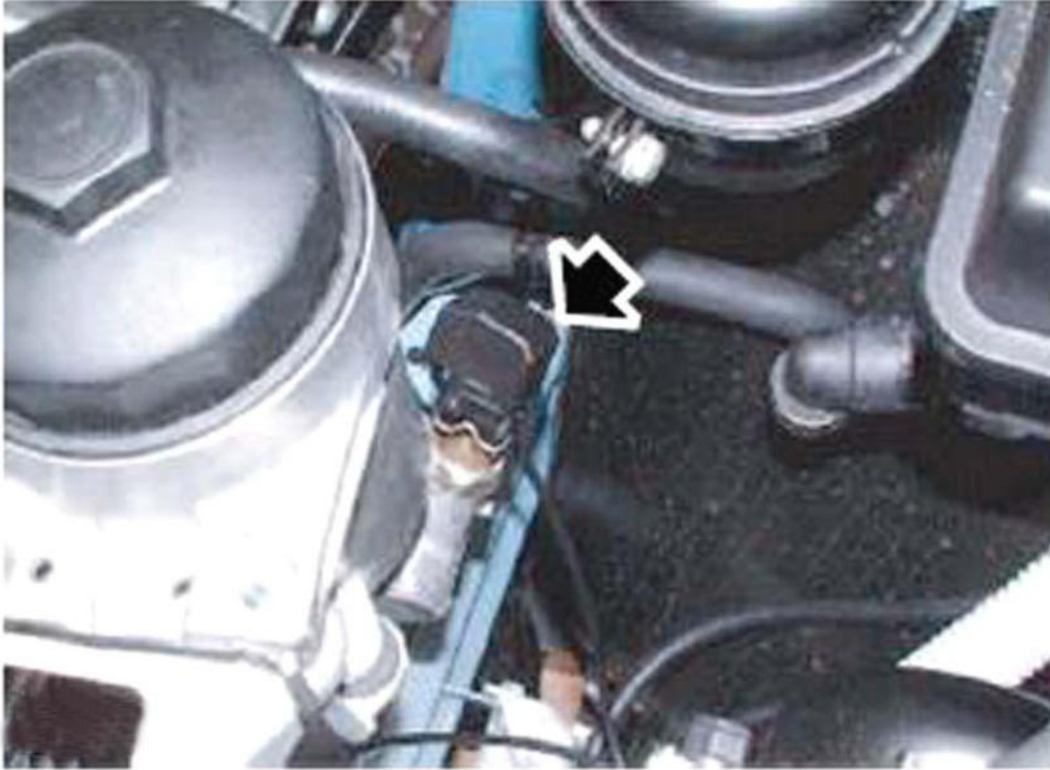
1. Fit baffle plate and tighten bolts to 10 Nm (7 ft. lbs).
2. Fit engine oil sump. See **GASKET - OIL SUMP**.
3. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .

SWITCH - OIL PRESSURE**Removal**

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT** .

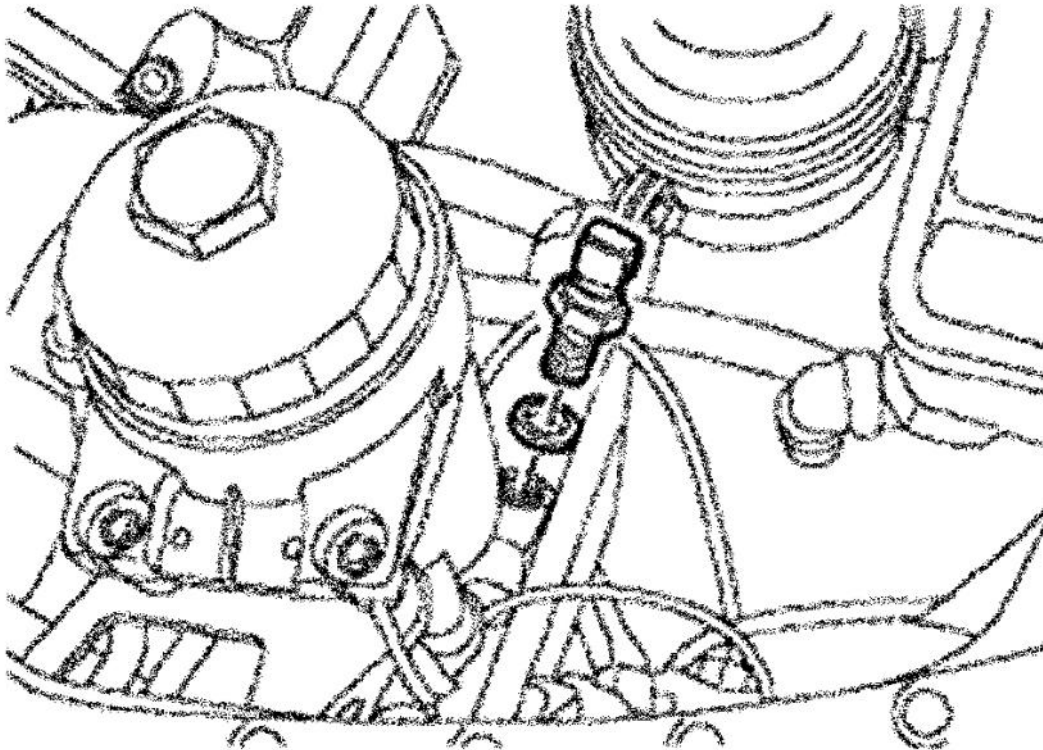
1. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
2. Disconnect multiplug from oil pressure switch. See **Fig. 156**.
3. Position absorbent cloth beneath oil filter housing to collect spillage.

4. Remove oil pressure switch from oil filter housing and discard sealing washer. See **Fig. 157**.



G00388161

Fig. 156: Removing Oil Pressure Switch
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388162

Fig. 157: Removing Oil Pressure Switch From Oil Filter Housing
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Clean oil pressure switch and oil filter housing mating faces.
2. Fit new sealing washer to oil pressure switch.
3. Fit oil pressure switch and tighten to 27 Nm (20 ft. lbs).
4. Connect multiplug to oil pressure switch.
5. Remove absorbent cloth.
6. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
7. Connect exhaust extractor to tail pipes.
8. Start engine and run at idle speed until oil pressure warning light extinguishes.
9. Check for leaks from oil pressure switch.
10. Stop engine, wait a few minutes, then check oil level. Top up if necessary.
11. Disconnect exhaust extractor from tail pipes.

TIMING CHAIN - INCLUDES ALIGN GEARS

Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT**.

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.
3. Drain cooling system. See **DRAINING & REFILLING COOLING SYSTEM**.
4. Remove left Variable Camshaft Control (VCC) unit. See **VARIABLE CAMSHAFT UNIT - VARIABLE CAMSHAFT CONTROL (VCC) - LEFT**.
5. Remove lower timing gear cover. See **COVER - TIMING GEAR - LOWER**.
6. Remove timing chain.

Installation

1. Clean timing chain guides and sprockets.
2. Check timing chain guides and sprockets for excessive wear.
3. Lubricate timing chain with clean engine oil.
4. Fit timing chain to crankshaft sprocket and right VCC unit.

NOTE: The timing chain may be fitted in any position to the crankshaft sprocket and right Variable Camshaft Control (VCC) unit sprocket.

5. Secure timing chain to left cylinder head until left VCC unit is fitted.
6. Fit lower timing gear cover. See **COVER - TIMING GEAR - LOWER**.
7. Fit left VCC unit. See **VARIABLE CAMSHAFT UNIT - VARIABLE CAMSHAFT CONTROL (VCC) - LEFT**.
8. Fill cooling system. See **DRAINING & REFILLING COOLING SYSTEM**.
9. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.

COVER - TIMING GEAR - UPPER - RIGHT

Removal

Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT**.

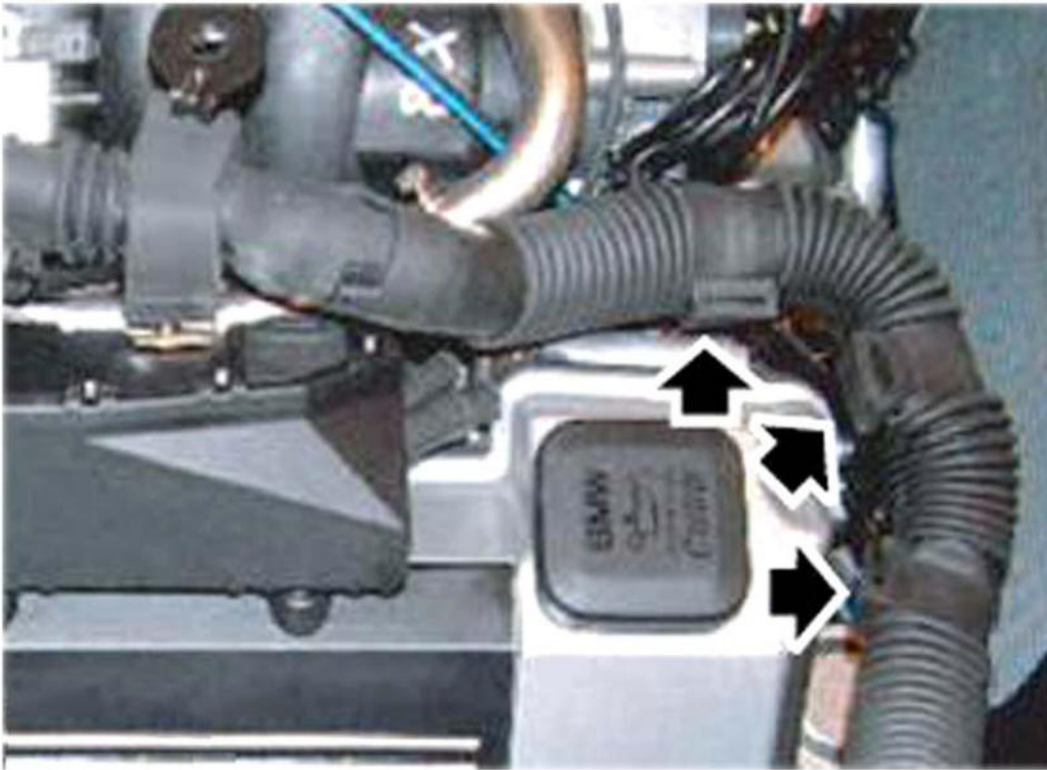
1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.
3. Drain cooling system. See **DRAINING & REFILLING COOLING SYSTEM**.
4. Remove fan cowl. See **VISCOUS FAN**.
5. Release engine harness from bracket on right upper timing gear cover. See **Fig. 158**.
6. Remove 2 bolts securing engine harness bracket to right timing gear cover and remove bracket. See **Fig.**

159.

7. Cut 3 cable ties to release CMP sensor harness. See **Fig. 160**.
8. Disconnect multiplug from CMP sensor. See **Fig. 161**.
9. Disconnect multiplug from VCC solenoid. See **Fig. 162**.
10. Remove right camshaft cover. See **GASKET - CAMSHAFT COVER - RIGHT**.
11. Release clip and disconnect coolant hose from coolant pump. See **Fig. 163**.
12. Release clip, disconnect radiator bottom hose from thermostat housing and remove bolt securing "P" clip. See **Fig. 164**.
13. If fitted: Remove bolt securing Secondary Air Injection (SAI) pipe to left cylinder head. See **Fig. 165**.
14. If fitted: Remove bolt securing SAI pipe to right cylinder head. See **Fig. 166**.
15. If fitted: Remove Allen bolt securing SAI pipe clip to coolant pump. See **Fig. 167**.
16. If fitted: Release SAI pipe from cylinder heads and position aside. Discard "O" rings.
17. Remove 2 bolts securing VCC solenoid seal and remove seal. See **Fig. 168**.
18. Remove chain tensioner from timing gear cover and discard sealing washer. Separate oil tensioner body and allow oil to drain. See **Fig. 169**.
19. Remove 6 bolts securing timing gear cover to cylinder head and remove timing gear cover. See **Fig. 170**.
20. Discard timing gear cover gasket.
21. Discard timing chain tensioner "O" ring. See **Fig. 171**.

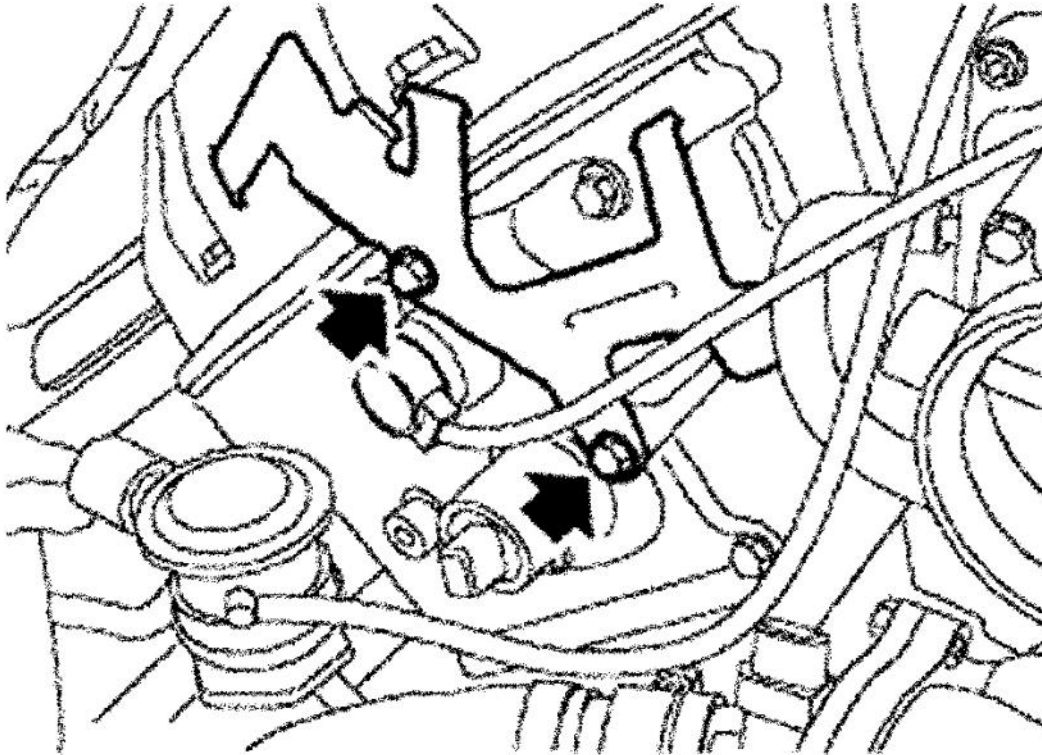
NOTE: **DO NOT** carry out further dismantling if component is removed for access only.

22. Remove bolt securing CMP sensor and remove sensor.
23. Discard "O" ring.



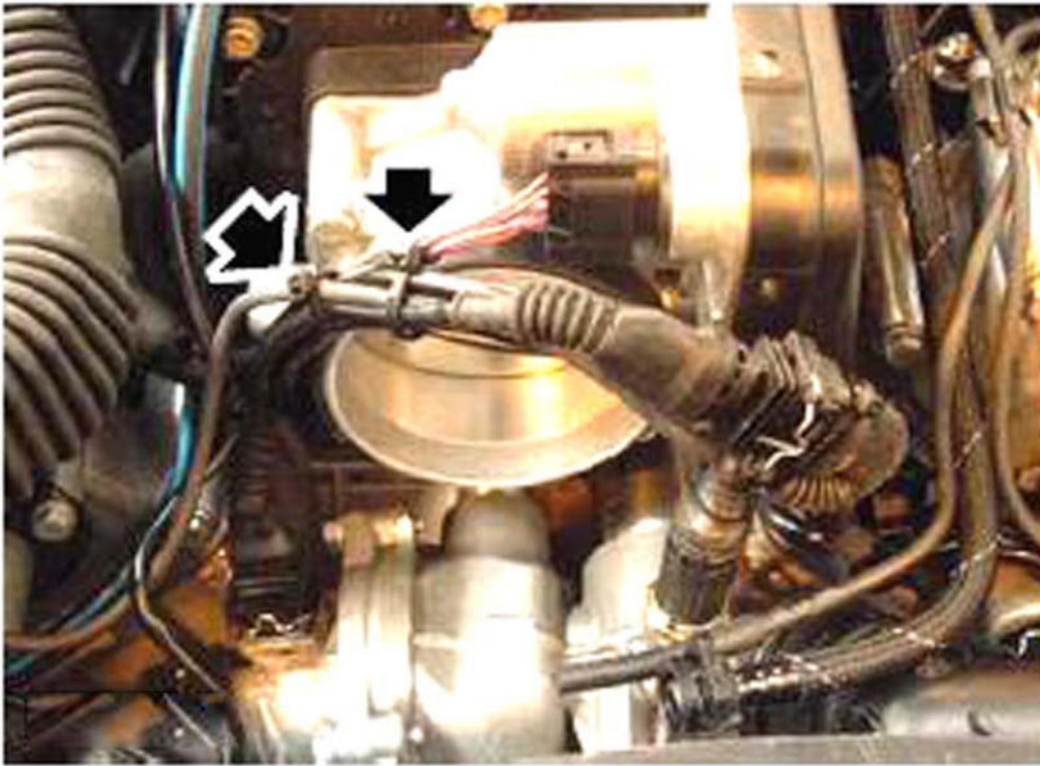
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Fig. 158: Releasing Engine Harness From Bracket On Right Upper Timing Gear Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.



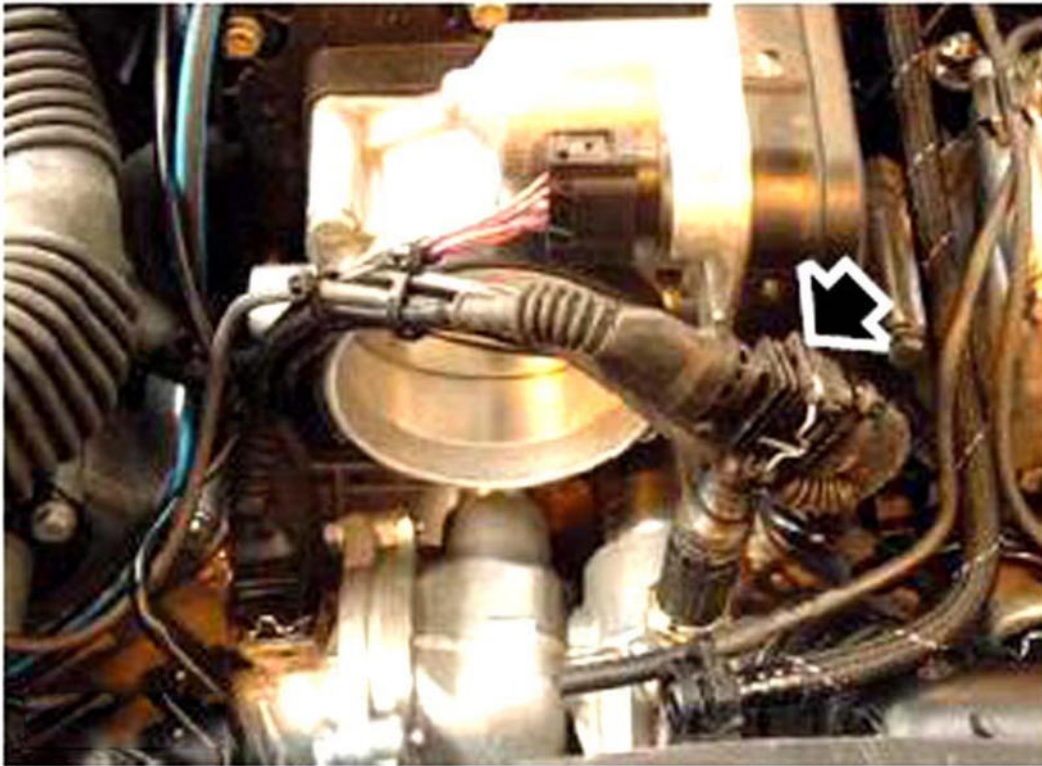
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Fig. 159: Removing Engine Harness-To-Right Timing Gear Cover Bracket
Courtesy of LAND ROVER NORTH AMERICA, INC.



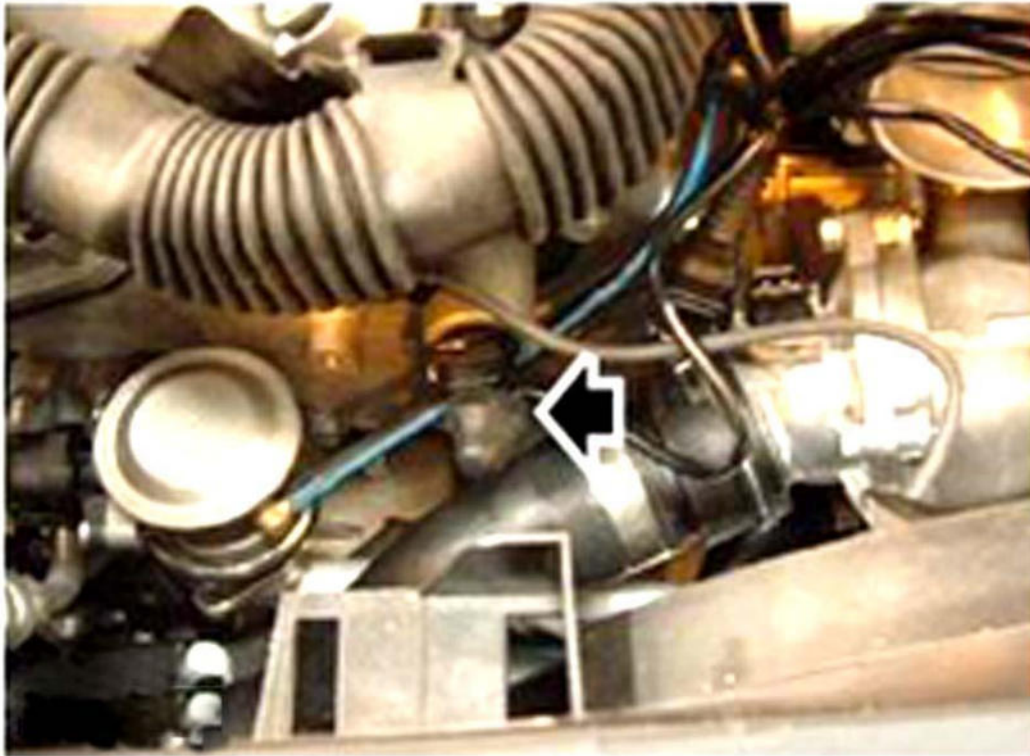
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Fig. 160: Releasing Camshaft Sensor Harness Cable Ties
Courtesy of LAND ROVER NORTH AMERICA, INC.



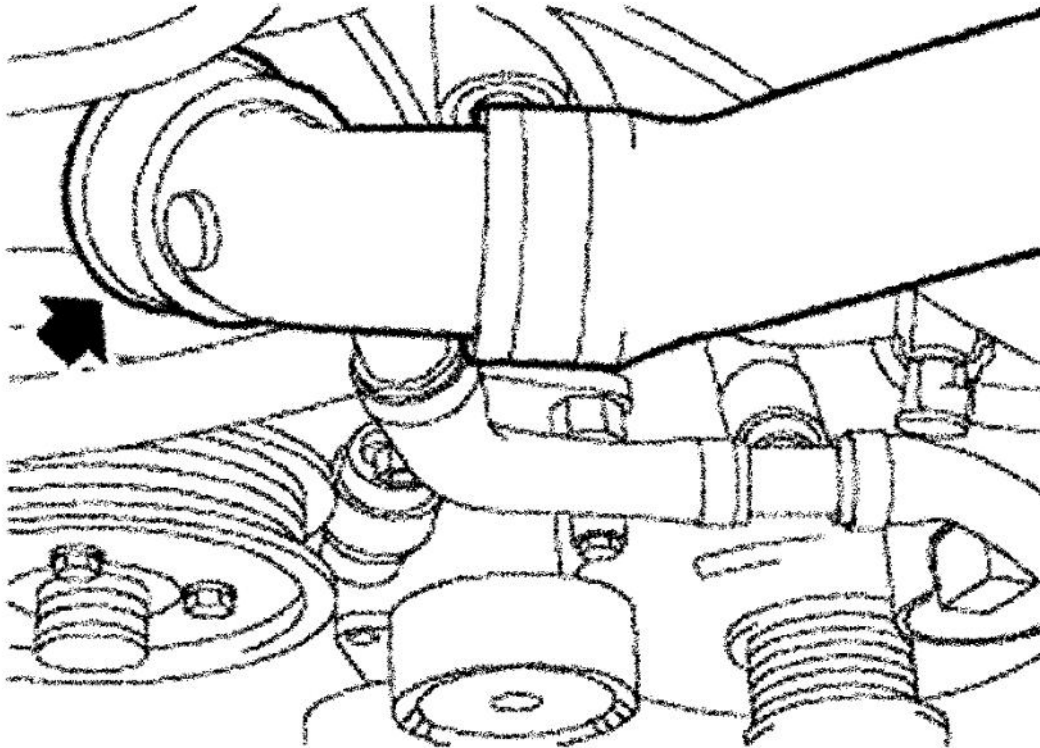
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Fig. 161: Disconnecting Camshaft Sensor Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



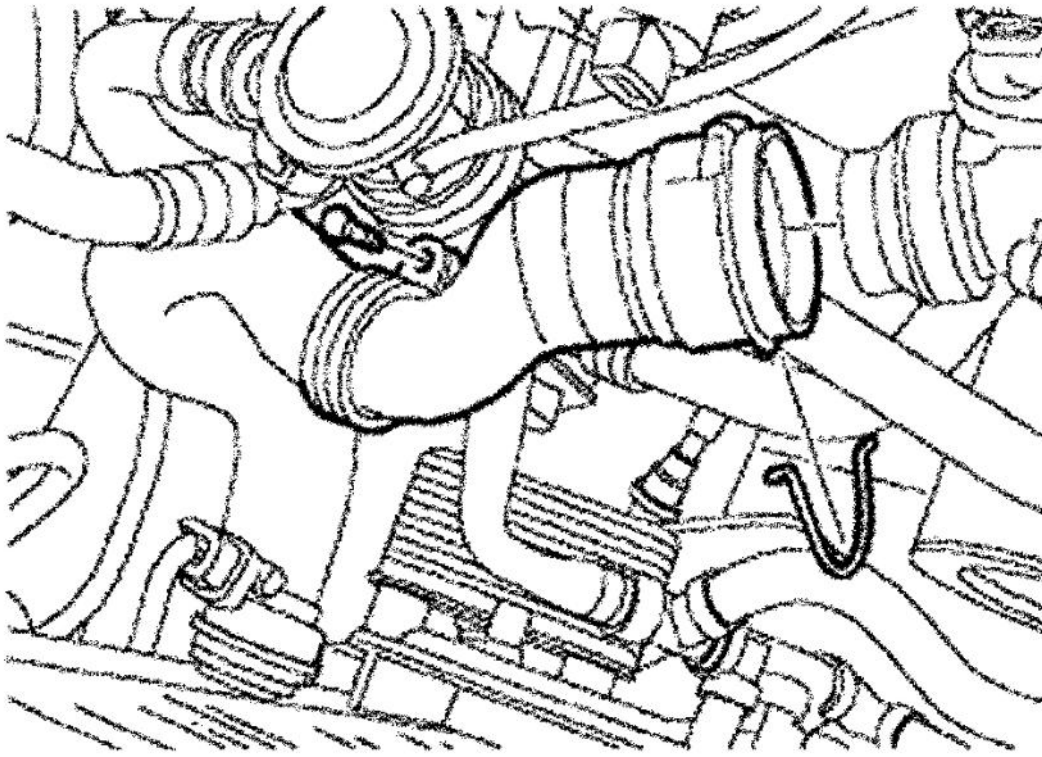
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Fig. 162: Disconnecting Variable Camshaft Control (VCC) Solenoid Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



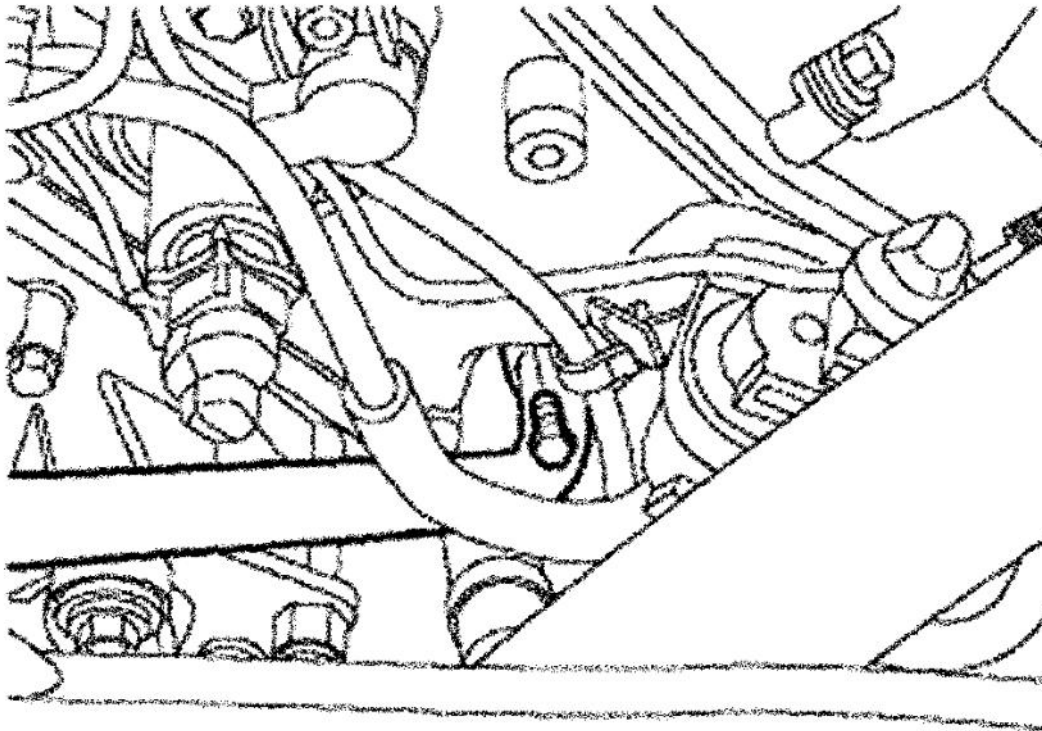
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Fig. 163: Disconnecting Coolant Hose From Coolant Pump
Courtesy of LAND ROVER NORTH AMERICA, INC.



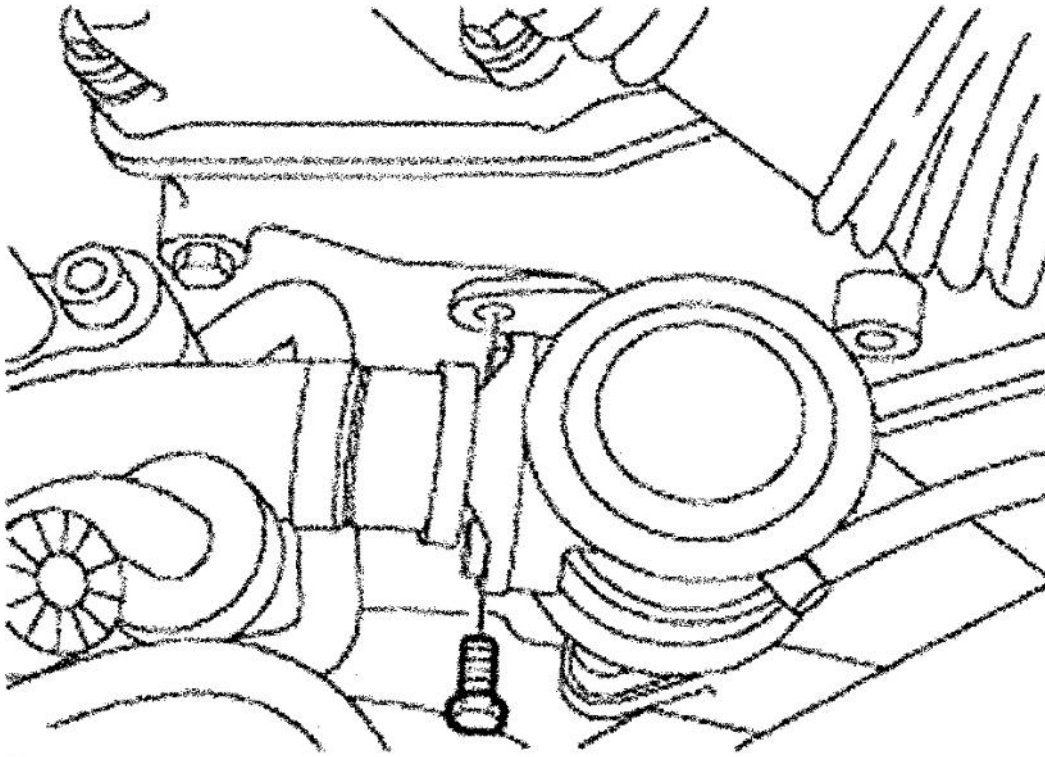
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Fig. 164: Disconnecting Radiator Bottom Hose From Thermostat Housing
Courtesy of LAND ROVER NORTH AMERICA, INC.



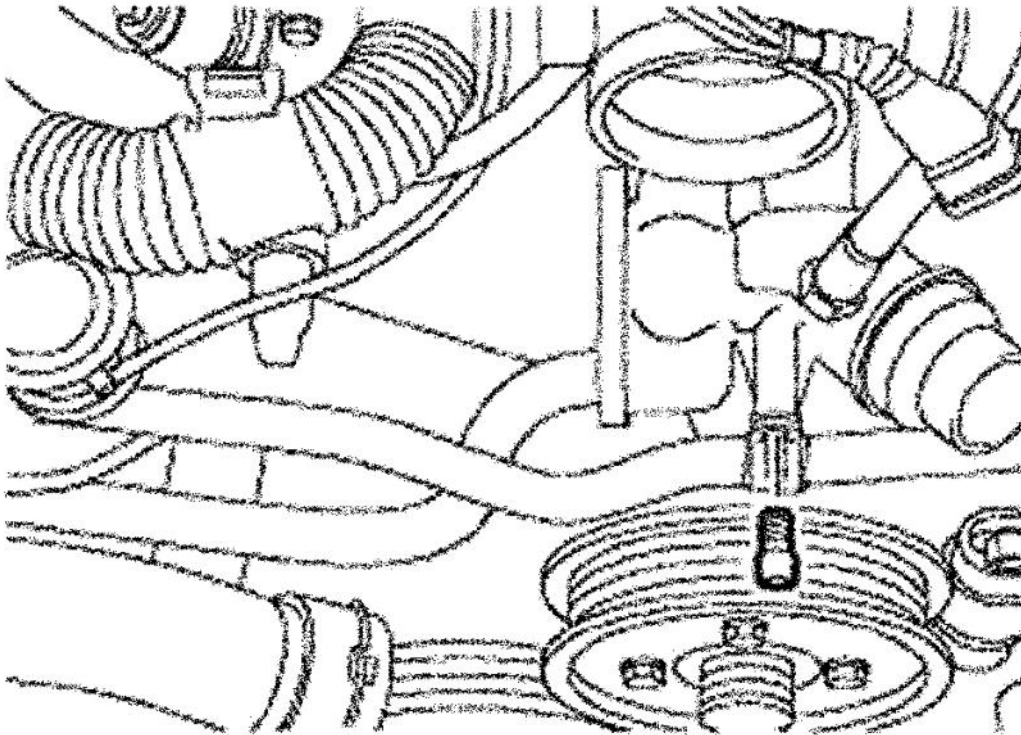
G00388170

Fig. 165: Removing Secondary Air Injection Pipe-To-Left Cylinder Head Bolt
Courtesy of LAND ROVER NORTH AMERICA, INC.



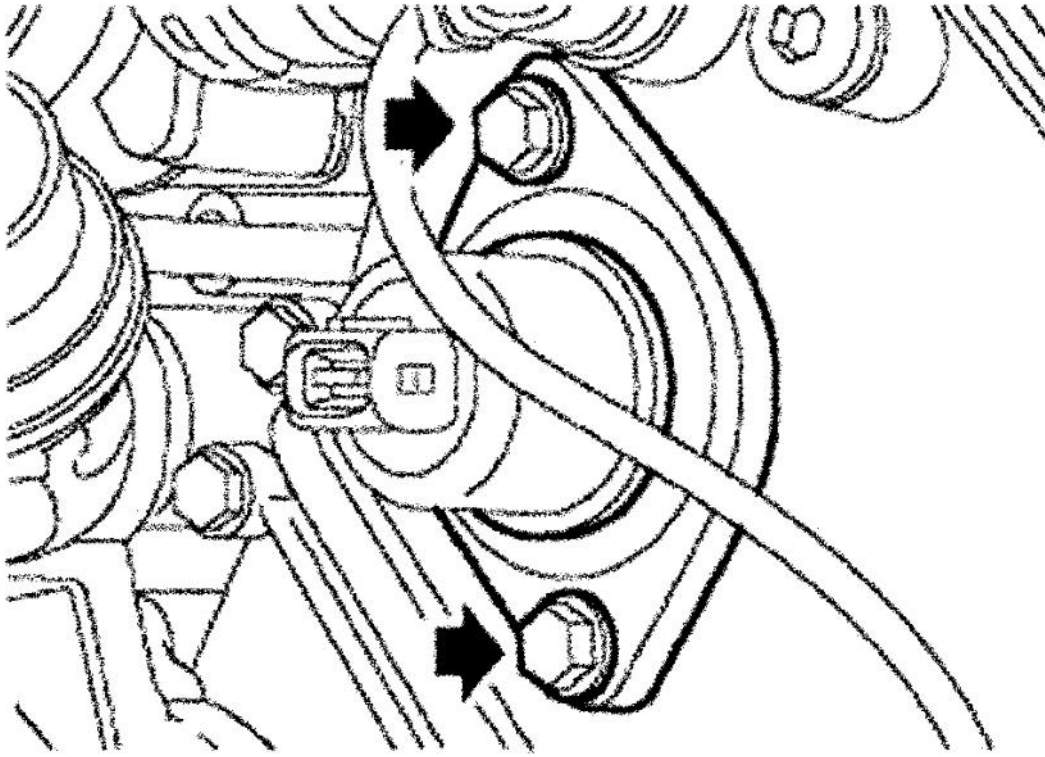
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Fig. 166: Removing Secondary Air Injection Pipe-To-Right Cylinder Head Bolt
Courtesy of LAND ROVER NORTH AMERICA, INC.



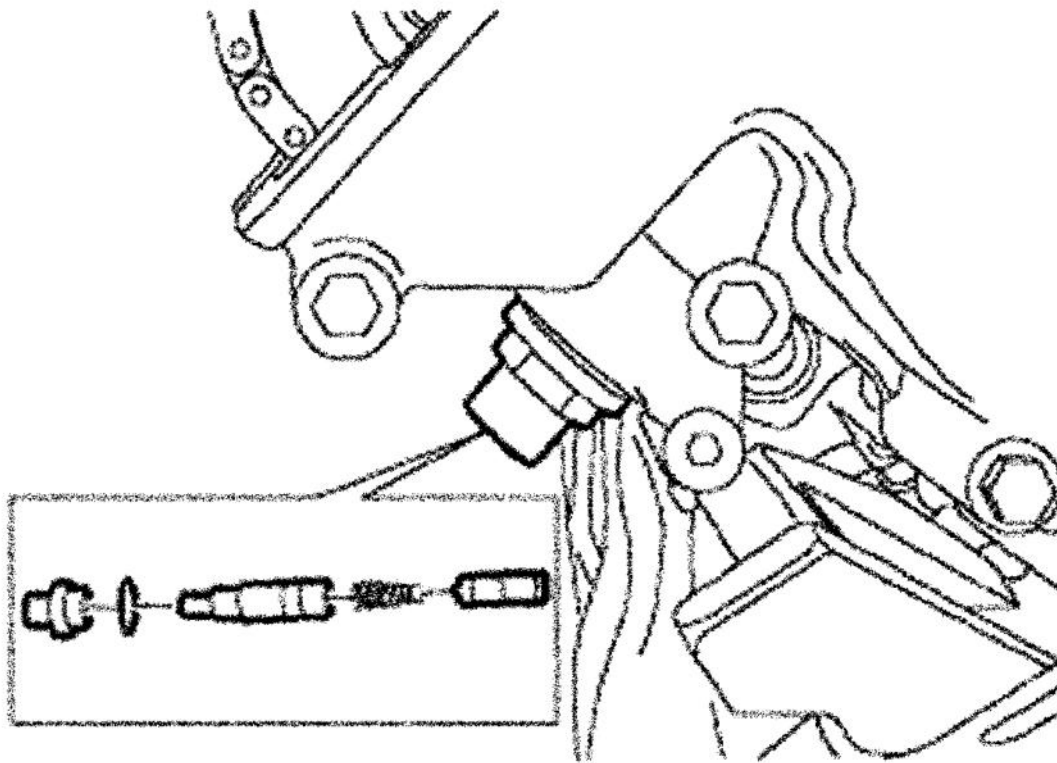
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Fig. 167: Removing Secondary Air Injection Pipe Clip-To-Coolant Pump Allen Bolt
Courtesy of LAND ROVER NORTH AMERICA, INC.



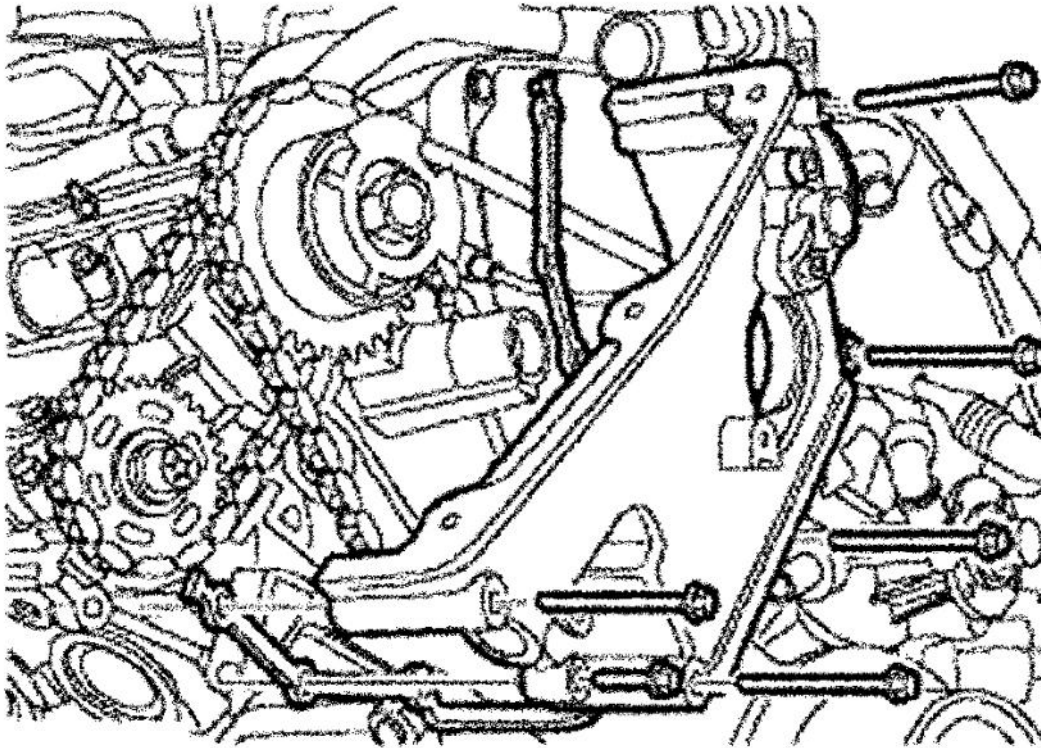
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Fig. 168: Removing Variable Camshaft Control Solenoid Seal Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.



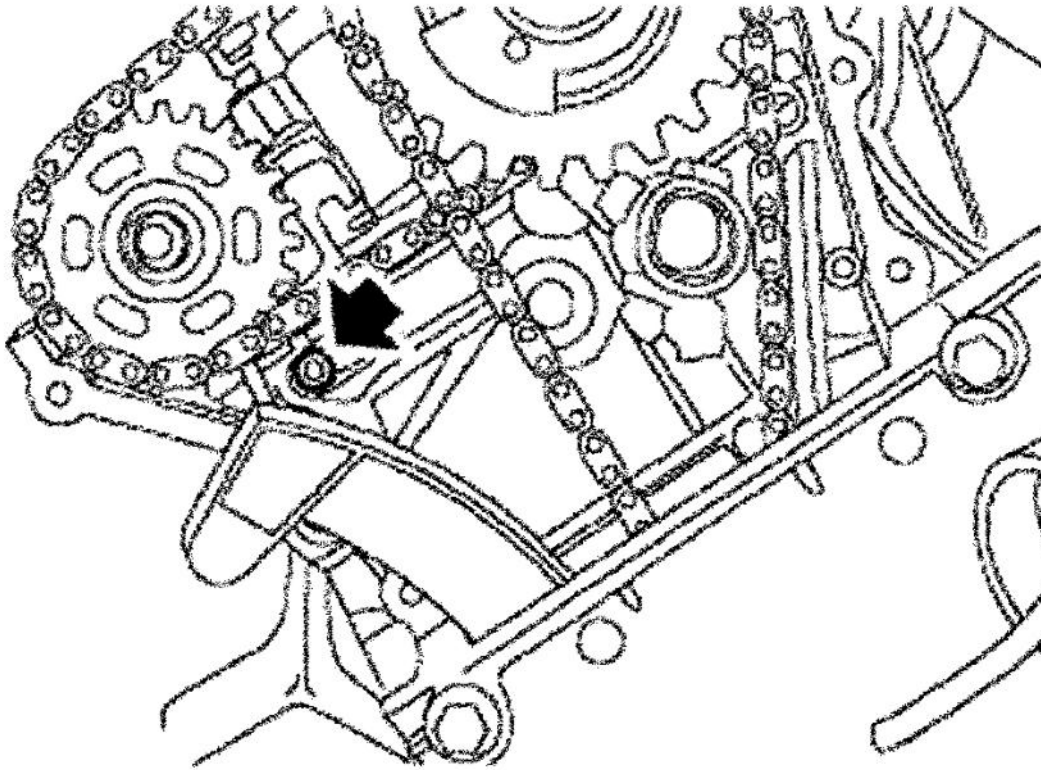
G00388174

Fig. 169: Removing Chain Tensioner & Separating Oil Tensioner Body
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388175

Fig. 170: Removing Timing Gear Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.



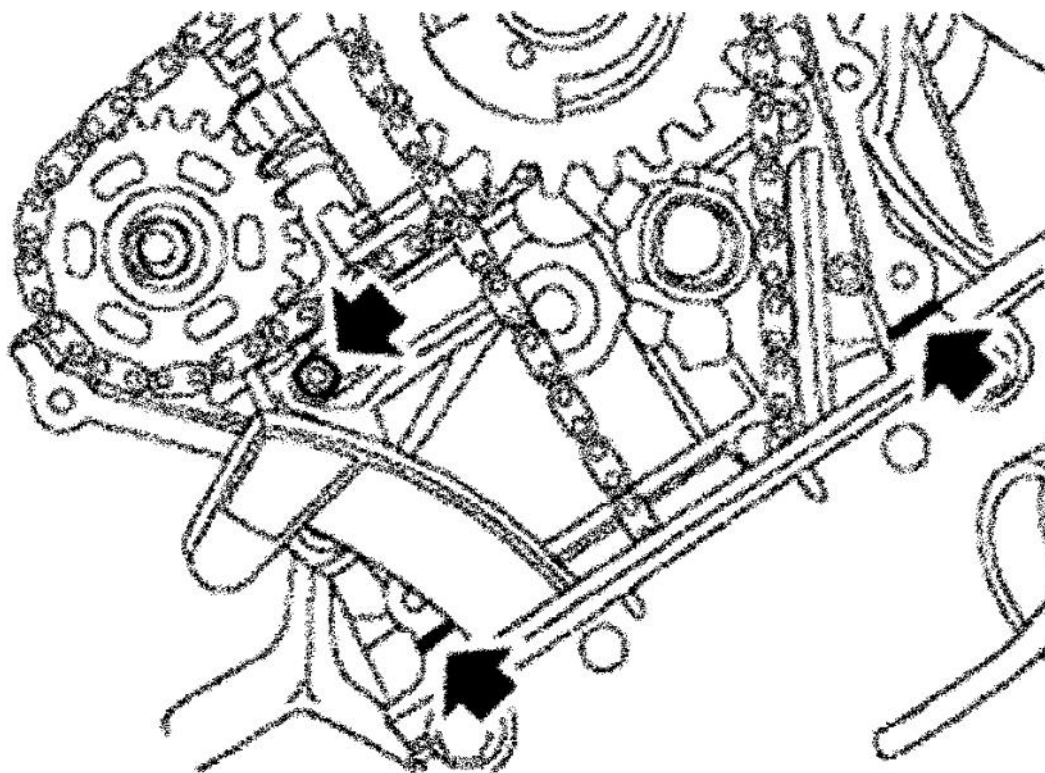
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Fig. 171: Discarding Timing Chain Tensioner "O" Ring
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

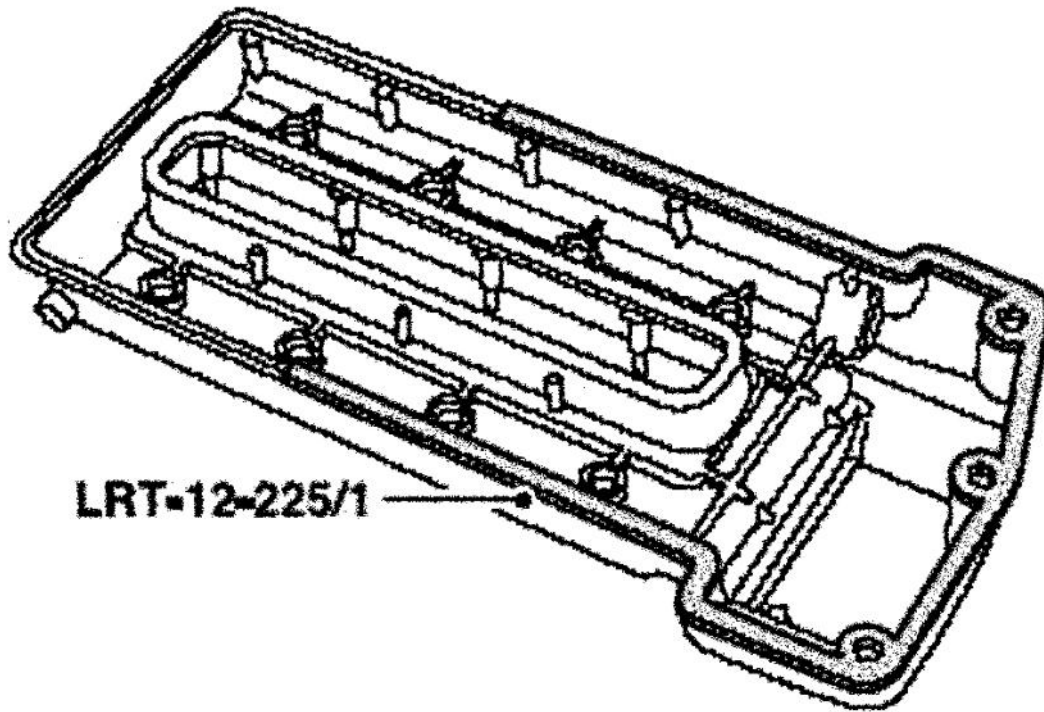
1. Clean Camshaft (CMP) sensor and mating face.
2. Fit new "O" ring to CMP sensor.
3. Fit CMP sensor, fit bolt and tighten to 10 Nm (7 ft. lbs).
4. Clean timing gear cover and mating face, clean dowels and dowel holes.
5. Fit new timing gear cover gasket.
6. Fit new chain tensioner "O" ring and apply sealant, Part No. STC 50550 to areas illustrated. See **Fig. 172**.
7. Fit timing cover, fit and hand tighten 6 bolts.
8. Fit LRT-12-225/1 to right camshaft cover. See **Fig. 173**.
9. Fit camshaft cover and tool, fit 4 bolts and tighten to 10 Nm (7 ft. lbs). See **Fig. 174**.
10. Tighten bolts securing timing gear cover to 15 Nm (11 ft. lbs).
11. Remove 4 bolts securing camshaft cover, remove camshaft cover and LRT-12-225/1.
12. Fit new sealing washer, fit timing chain tensioner and tighten plug securing chain tensioner to 40 Nm (30 ft. lbs).

13. Clean Variable Camshaft Control (VCC) solenoid, seal and mating faces.
14. Lubricate inner mating face of VCC solenoid seal.
15. Fit VCC solenoid seal, fit bolts and tighten.
16. If fitted: Fit 2 new "O" rings to Secondary Air Injection (SAI) pipe and position SAI pipe to engine. Fit and tighten 3 bolts securing SAI pipe to engine.
17. Connect 2 coolant hoses to coolant pump and secure with clips.
18. Fit right camshaft cover. See **GASKET - CAMSHAFT COVER - RIGHT**.
19. Connect multiplug to VCC solenoid.
20. Connect multiplug to Camshaft (CMP) sensor.
21. Secure CMP sensor harness with 3 cable ties.
22. Fit engine harness bracket to engine harness, fit and tighten 2 bolts.
23. Fit fan cowl. See **VISCOUS FAN**.
24. Fill cooling system. See **DRAINING & REFILLING COOLING SYSTEM**.
25. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.



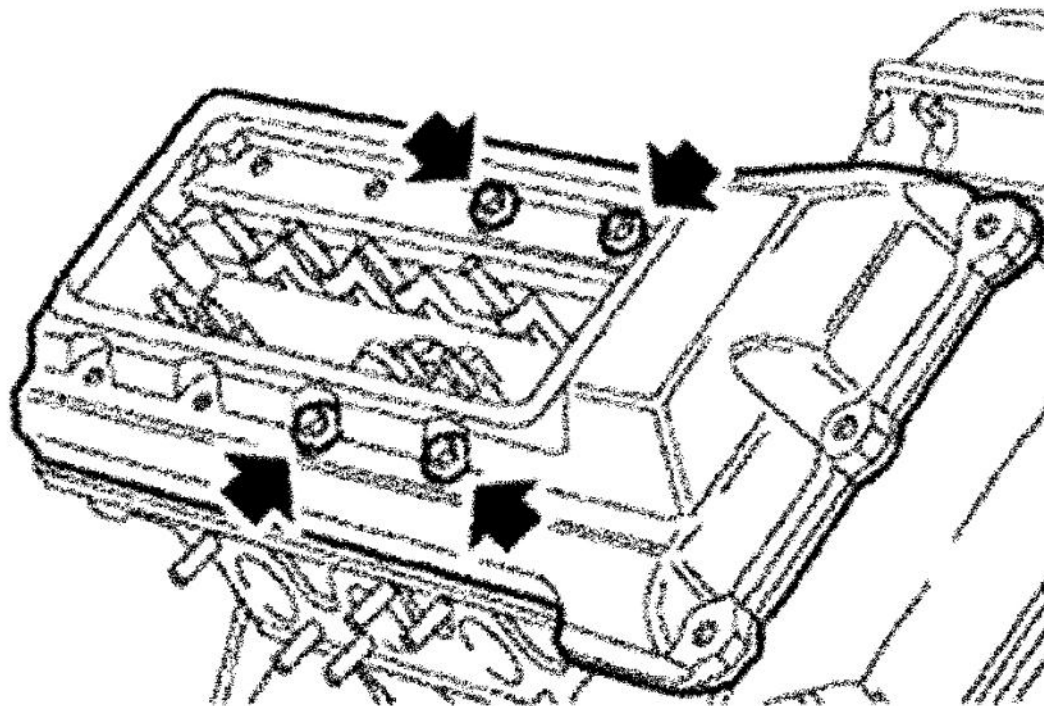
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Fig. 172: Installing NEW Chain Tensioner "O" Ring & Apply Sealant
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388178

Fig. 173: Installing LRT-12-225/1 To Right Camshaft Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388179

Fig. 174: Installing Camshaft Cover

Courtesy of LAND ROVER NORTH AMERICA, INC.

COVER - TIMING GEAR - UPPER - LEFT**Removal**

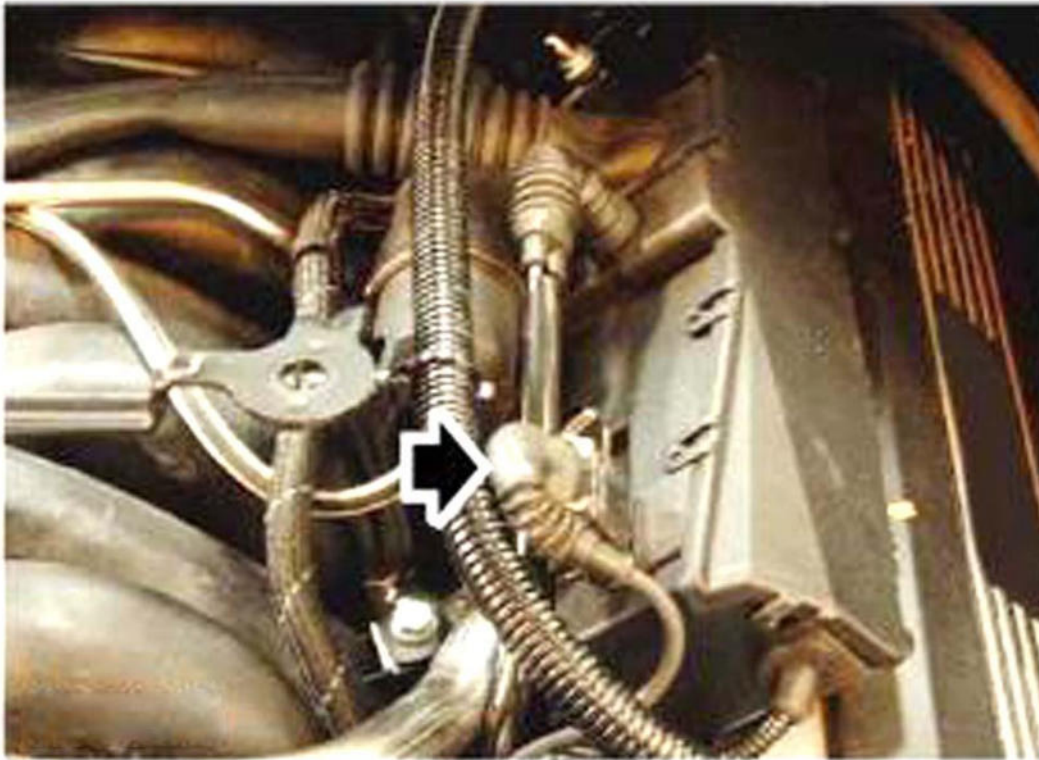
Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed. See **BATTERY DISCONNECT & RECONNECT** .

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Drain cooling system. See **DRAINING & REFILLING COOLING SYSTEM** .
4. Remove fan cowl. See **VISCOUS FAN** .
5. Remove charcoal canister purge solenoid valve. See **SOLENOID -- CANISTER PURGE** .
6. Release Camshaft (CMP) sensor harness from clip and release clip from timing gear cover.
7. Disconnect multiplug from CMP sensor. See **Fig. 175**.
8. Release fuel vapor pipe from bracket on timing gear cover.
9. Disconnect multiplug from alternator. See **Fig. 176**.
10. Release alternator harness from 3 clips.

11. Remove left camshaft cover. See **GASKET - CAMSHAFT COVER - LEFT**.
12. Remove left Variable Camshaft Control (VCC) solenoid valve. See **CONTROL SOLENOID - VARIABLE CAMSHAFT CONTROL (VCC) - LEFT**.
13. Release clip and disconnect coolant hose from alternator.
14. Release clip, disconnect radiator bottom hose from thermostat housing and remove bolt securing "P" clip. See **Fig. 164**.
15. If fitted: Remove bolt securing Secondary Air Injection (SAI) pipe to left cylinder head. See **Fig. 165**.
16. If fitted: Remove bolt securing SAI pipe to right cylinder head. See **Fig. 166**.
17. If fitted: Remove Allen bolt securing SAI pipe clip to coolant pump. See **Fig. 167**.
18. If fitted: Release SAI pipe from cylinder heads and position aside. Discard "O" rings.
19. Remove 6 bolts securing timing gear cover to cylinder head and remove timing gear cover. See **Fig. 177**.
20. Discard timing gear cover gasket.

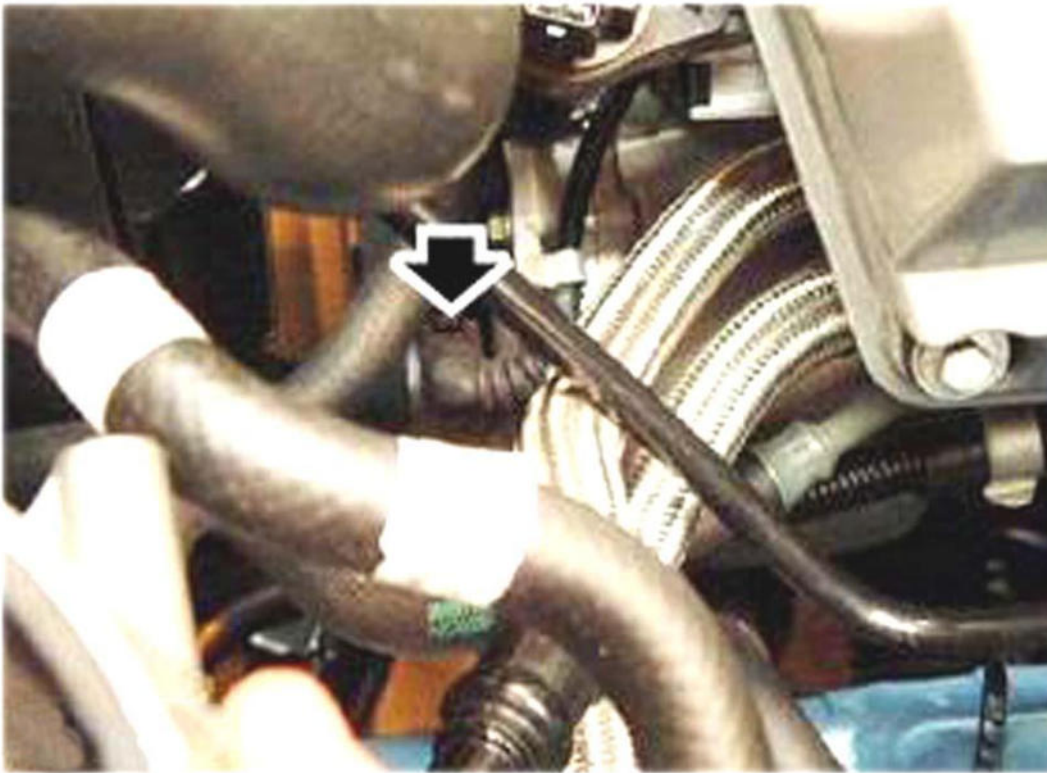
NOTE: **DO NOT carry out further dismantling if component is removed for access only**

21. Remove 2 bolts securing 2 brackets to upper timing gear cover and remove brackets.
22. Remove bolt securing CMP sensor and remove sensor.
23. Discard "O" ring.



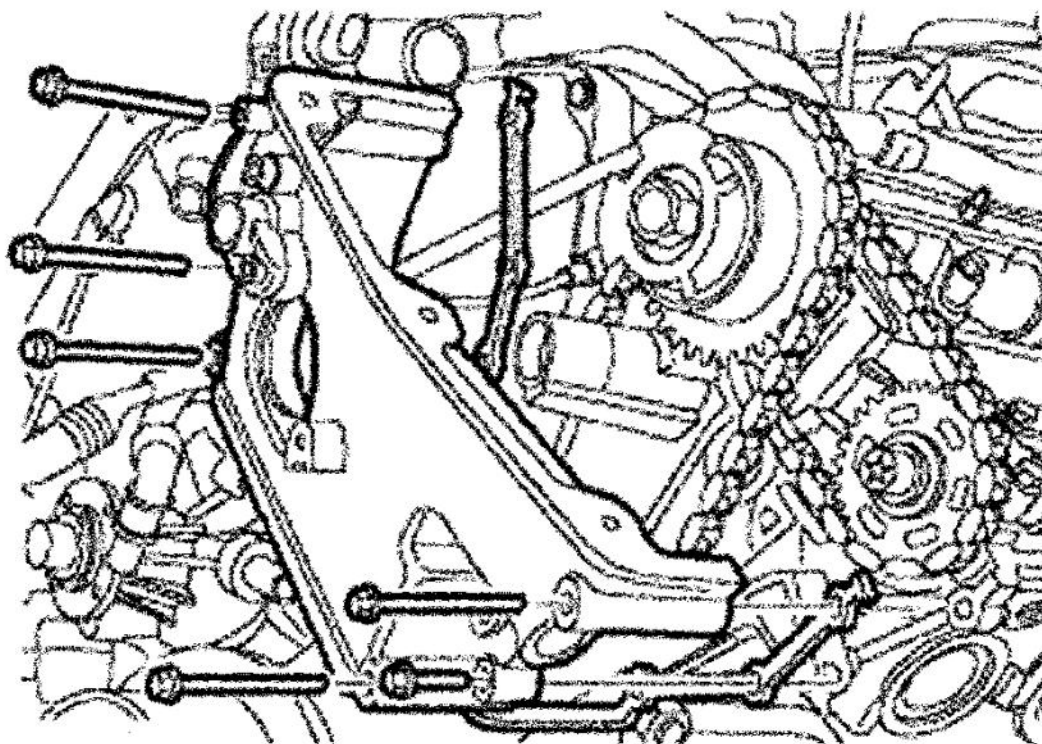
G00388180

Fig. 175: Disconnecting Camshaft Sensor Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388181

Fig. 176: Disconnecting Alternator Multiplug
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388182

Fig. 177: Removing Timing Gear Cover

Courtesy of LAND ROVER NORTH AMERICA, INC.

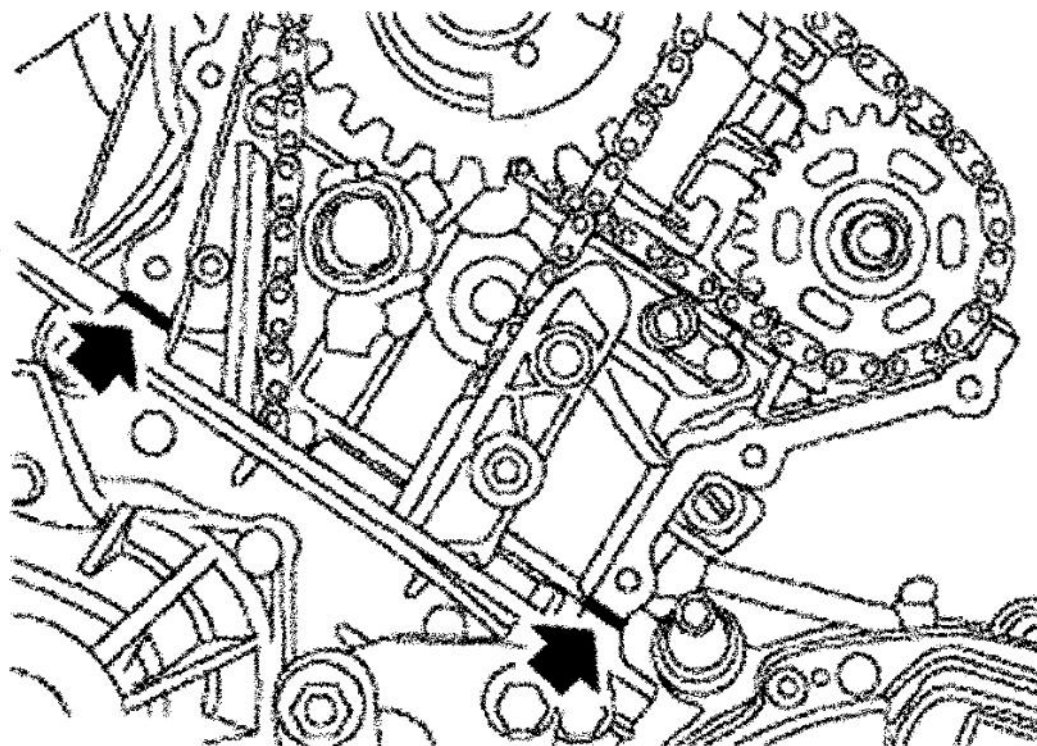
Installation

1. Clean Camshaft (CMP) sensor and mating face.
2. Fit new "O" ring to CMP sensor.
3. Fit CMP sensor, fit bolt and tighten to 10 Nm (7 ft. lbs).
4. Position 2 brackets to timing gear cover, fit bolts and tighten.
5. Clean timing gear cover and mating face, clean dowels and dowel holes.
6. Fit new timing gear cover gasket.
7. Apply sealant, Part No. STC 50550 to areas illustrated.
8. Fit right lower bolt to timing gear cover and position cover to cylinder head.

NOTE: It is not possible to fit the right lower bolt after fitting the left upper timing gear cover.

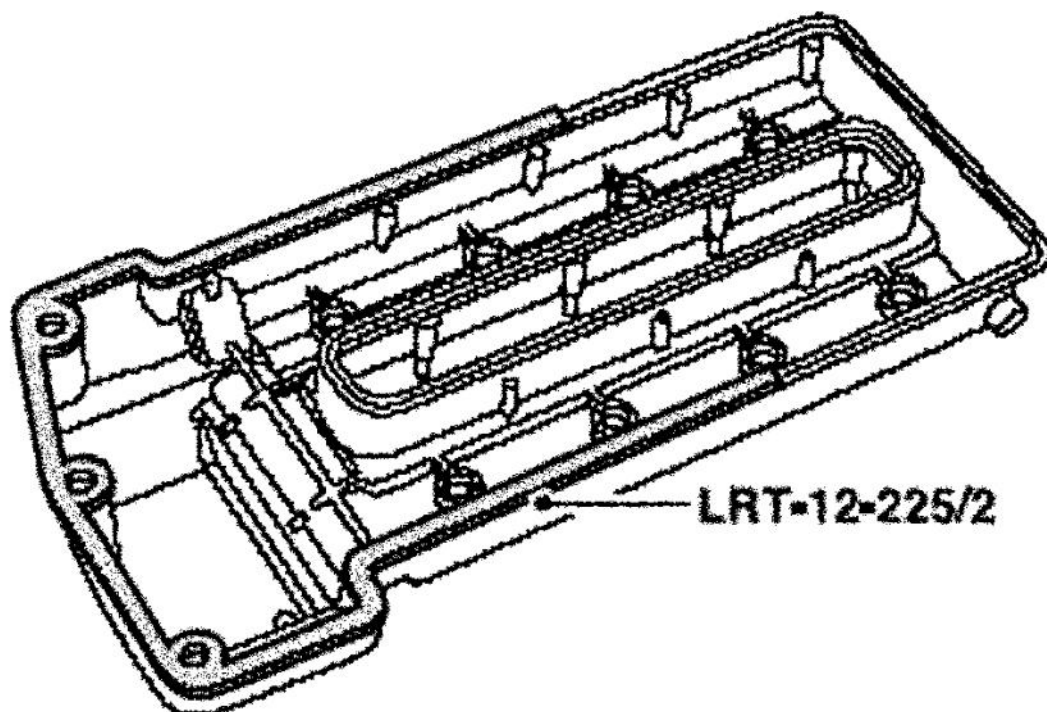
9. Fit remaining 5 bolts and hand tighten 6 bolts securing timing cover.
10. Fit LRT-12-225/2 to left camshaft cover.

11. Fit camshaft cover and tool, fit 4 bolts and tighten to 10 Nm (7 ft. lbs).
12. Tighten bolts securing timing gear cover to 15 Nm (11 ft. lbs).
13. Remove 4 bolts securing camshaft cover, remove camshaft cover and LRT-12-225/2.
14. If fitted: Fit 2 new "O" rings to Secondary Air Injection (SAI) pipe and position SAI pipe to engine. Fit and tighten 3 bolts securing SAI pipe to engine.
15. Fit bolt securing radiator lower coolant hose "P" clip to bracket and tighten.
16. Connect coolant hose to alternator and secure with clip.
17. Fit left Variable Camshaft Control (VCC) solenoid valve. See **CONTROL SOLENOID - VARIABLE CAMSHAFT CONTROL (VCC) - LEFT**.
18. Fit left camshaft cover. See **GASKET - CAMSHAFT COVER - LEFT**.
19. Connect multiplug to alternator and secure alternator harness to 3 clips.
20. Secure fuel vapor pipe to bracket on timing gear cover.
21. Connect multiplug to Camshaft (CMP) sensor.
22. Secure CMP sensor harness to clip and secure clip to timing gear cover.
23. Fit fan cowl. See **VISCOUS FAN**.
24. Fill cooling system. See **DRAINING & REFILLING COOLING SYSTEM**.
25. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.



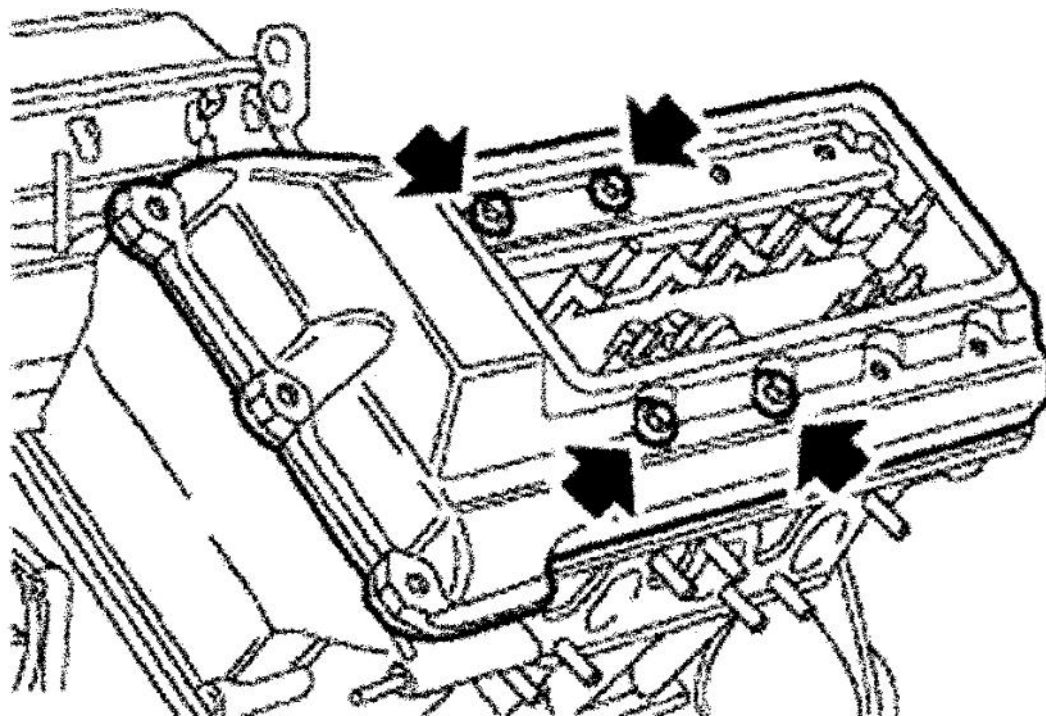
G00388183

Fig. 178: Applying Sealant To Cover - Timing Gear - Upper - Left
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388184

Fig. 179: Installing LRT-12-225/2 To Left Camshaft Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388185

Fig. 180: Installing Camshaft Cover

Courtesy of LAND ROVER NORTH AMERICA, INC.

COVER - TIMING GEAR - LOWER**Removal**

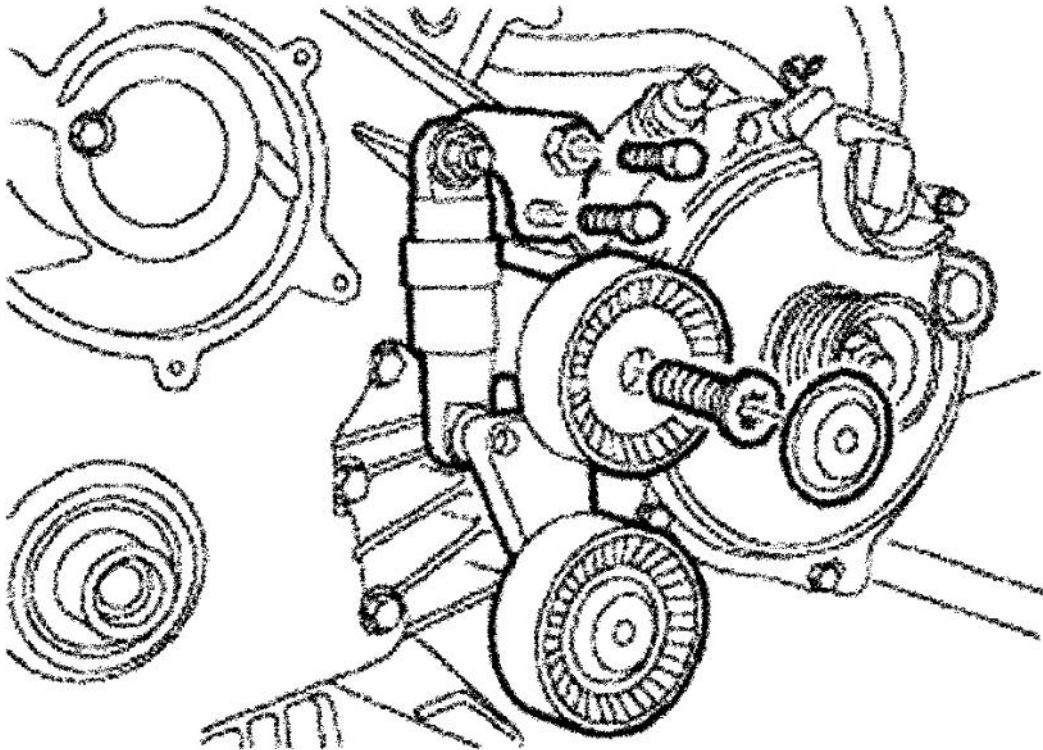
Before disconnecting the battery, ensure all text and cautions in the battery disconnection section are observed.
See **BATTERY DISCONNECT & RECONNECT** .

1. Position vehicle on lift.
2. Disconnect battery earth lead. See **BATTERY DISCONNECT & RECONNECT** .
3. Remove coolant pump. See **GASKET -- COOLANT PUMP** .
4. Remove left upper timing gear cover. See **COVER - TIMING GEAR - UPPER - LEFT** .
5. Remove right upper timing gear cover. See **COVER - TIMING GEAR - UPPER - RIGHT** .
6. Remove crankshaft front oil seal. See **OIL SEAL - CRANKSHAFT - FRONT** .
7. Remove 2 bolts securing ancillary drive belt tensioner to lower timing gear cover. See **Fig. 181** .
8. Remove dust cap from ancillary drive belt tensioner idler pulley and remove Torx bolt securing ancillary drive belt tensioner idler pulley.
9. Remove ancillary drive belt tensioner assembly.

10. Remove nut and disconnect battery cable from alternator. See **Fig. 182**.
11. Release battery cable from lower timing gear cover.
12. Remove 6 alternator securing bolts and alternator harness securing clip. See **Fig. 183**.
13. Release and remove alternator from engine timing cover.
14. Discard alternator "O" ring.
15. Remove 2 Allen bolts and 1 nut securing Power Assisted Steering (PAS) pump and move aside. See **Fig. 184**.
16. Remove 6 bolts securing lower timing gear cover to upper sump. See **Fig. 185**.
17. Remove 15 bolts securing lower timing gear cover to cylinder block. See **Fig. 186**.
 - A = M8 X 75 mm
 - B = M6 X 40 mm
 - C = M6 X 85 mm
 - D = M6 X 80 mm
 - E = M8 X 90 mm
 - F = M6 X 60 mm

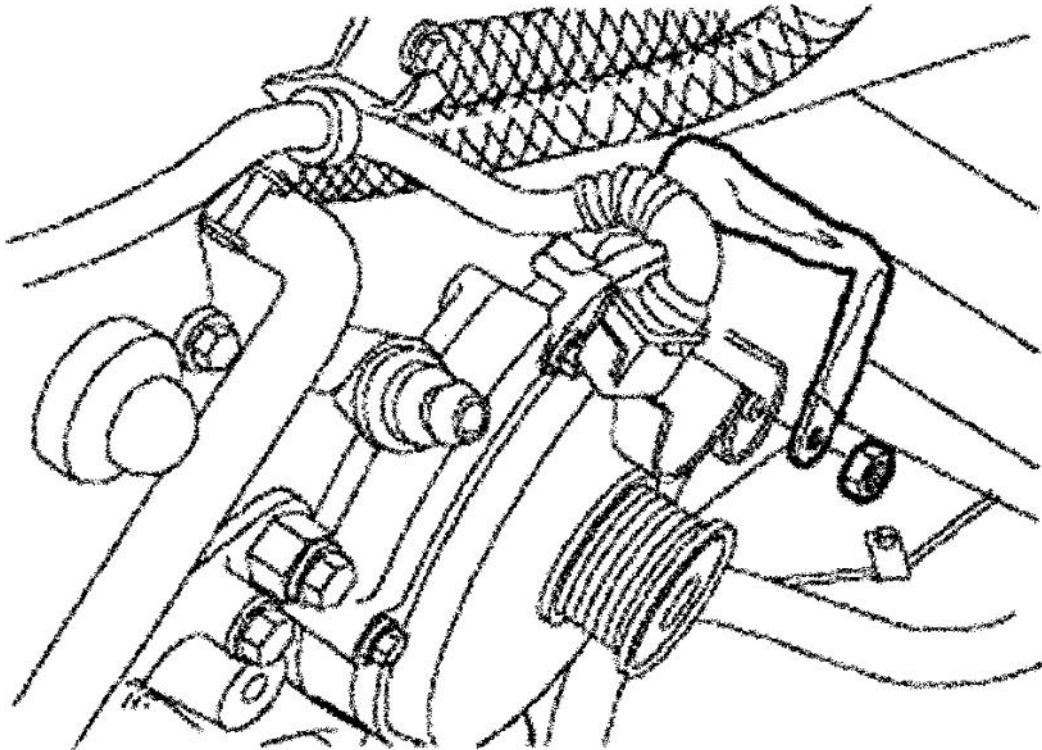
NOTE: **Note position of all securing bolts.**

18. Remove lower timing gear cover.
19. Discard 3 lower timing gear cover gaskets.



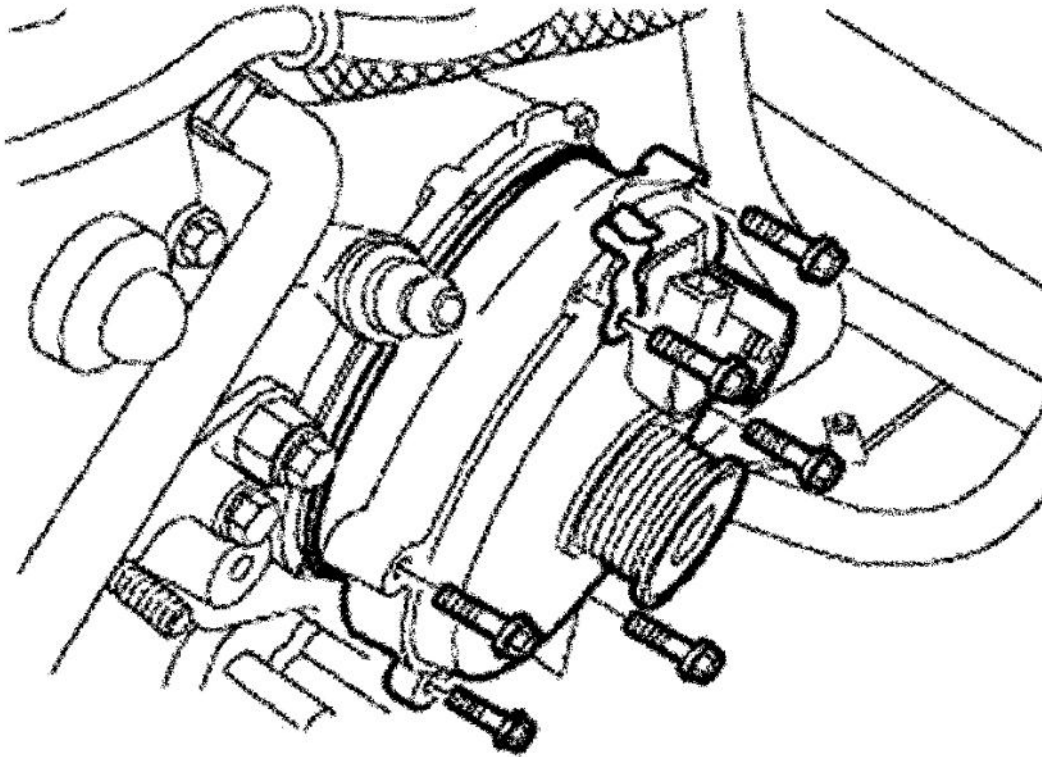
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Fig. 181: Removing Ancillary Drive Belt Tensioner Assembly
Courtesy of LAND ROVER NORTH AMERICA, INC.



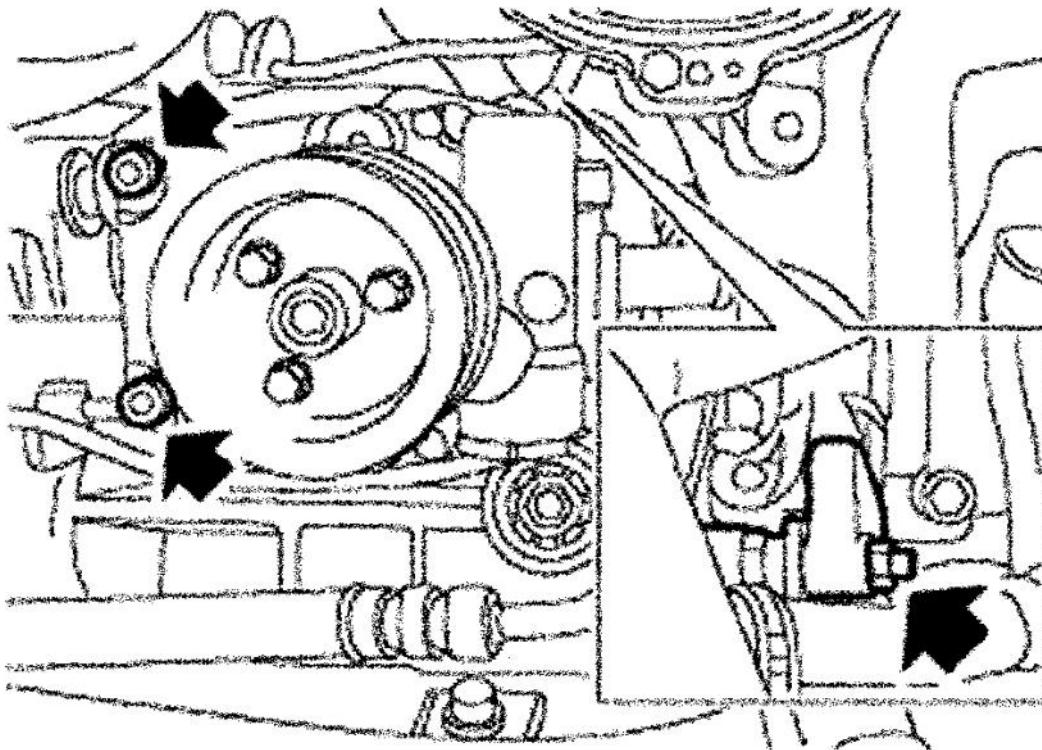
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Fig. 182: Disconnecting Battery Cable From Alternator
Courtesy of LAND ROVER NORTH AMERICA, INC.



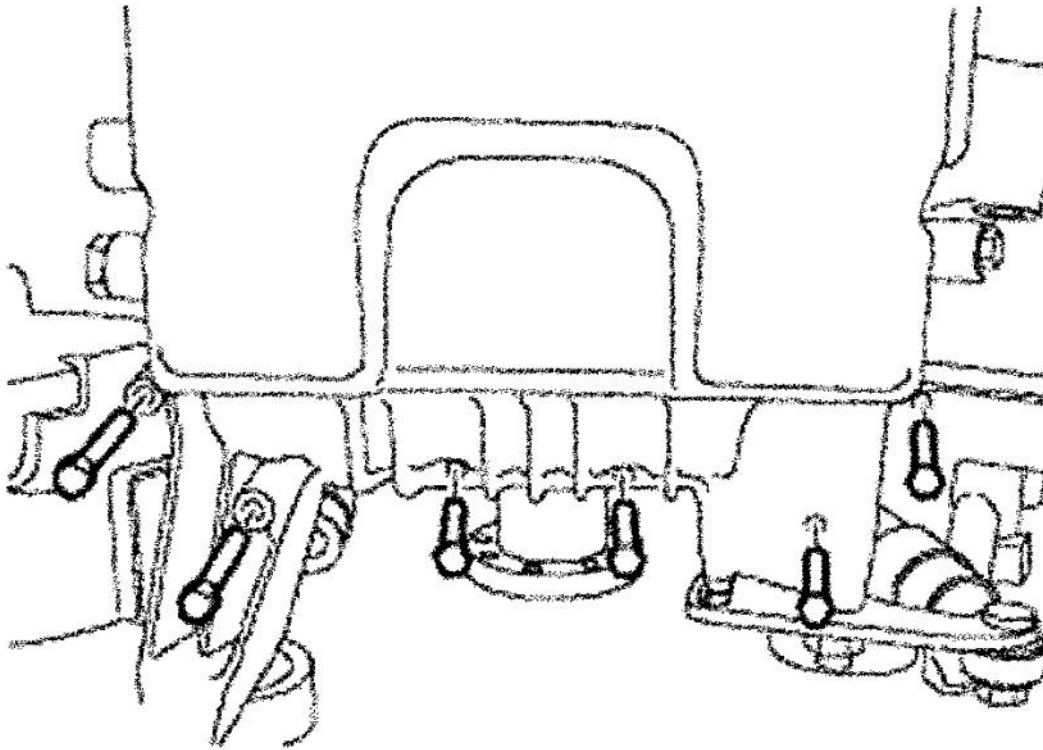
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Fig. 183: Removing Alternator Clip & Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388189

Fig. 184: Moving Power Assisted Steering Pump Aside
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388190

Fig. 185: Removing Lower Timing Gear Cover-To-Upper Sump
Courtesy of LAND ROVER NORTH AMERICA, INC.

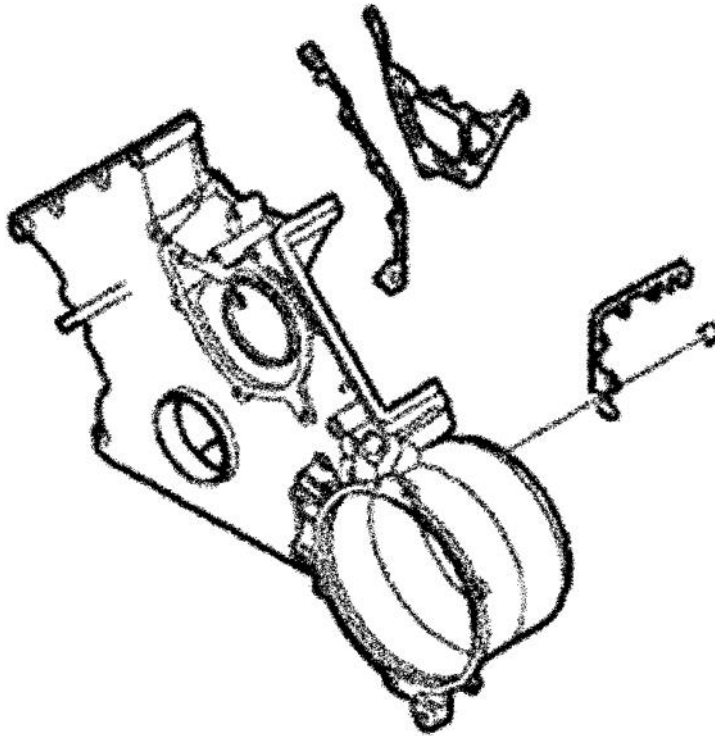
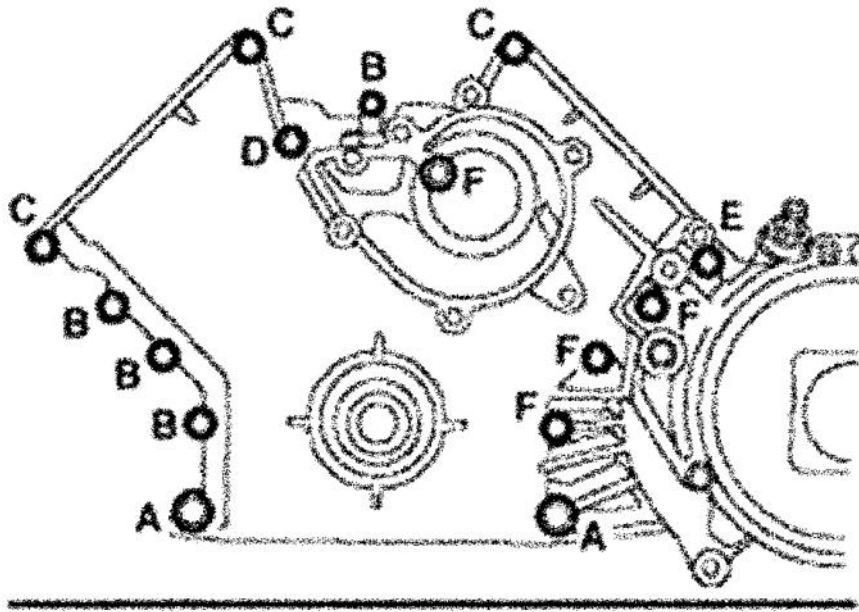


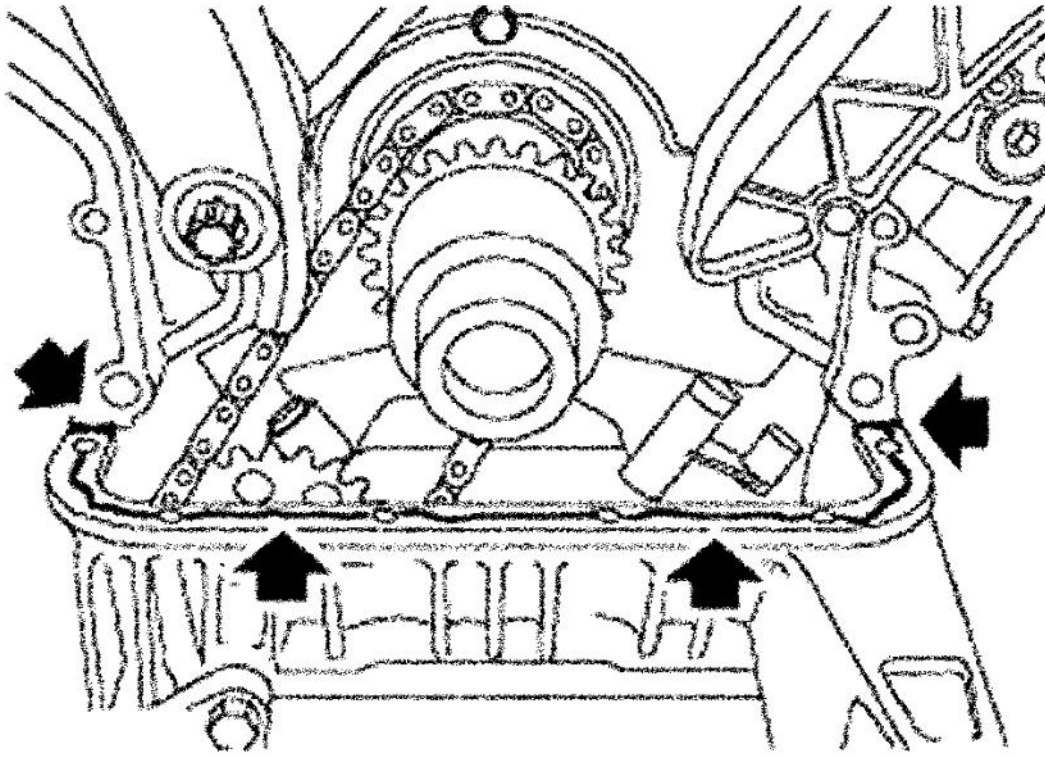
Fig. 186: Removing Lower Timing Gear Cover-To-Cylinder
Courtesy of LAND ROVER NORTH AMERICA, INC.

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1. Clean timing gear cover and mating faces, clean dowels and dowel holes.
2. Apply sealant, Part No. STC 50550 to areas illustrated.
3. Fit 3 new lower timing gear cover gaskets.
4. Fit lower timing gear cover.
5. Fit 15 bolts securing lower timing gear cover to cylinder block and initially tighten to 5 Nm (4 ft. lbs).
6. Tighten 6 mm bolts securing lower timing gear cover to 10 Nm (7 ft. lbs) and 8 mm bolts securing lower timing gear cover to 22 Nm (16 ft. lbs).

CAUTION: Check torque of all bolts once they have been tightened down.

7. Fit 6 bolts securing lower timing gear cover to upper oil sump and tighten to 12 Nm (9 ft. lbs).
8. Position Power Assisted Steering (PAS) pump to mounting and fit Allen bolts and securing nut. Tighten Allen bolts to 10 Nm (7 ft. lbs) and securing nut to 25 Nm (18 ft. lbs).
9. Clean alternator and engine timing gear cover mating face.
10. Lubricate and fit new "O" ring to alternator.
11. Fit alternator and tighten securing bolts.
12. Secure battery cable to lower timing gear cover.
13. Connect battery lead to alternator and tighten nut securing battery lead to alternator to 13 Nm (10 ft. lbs).
14. Fit ancillary drive belt tensioner assembly, fit Torx bolt securing ancillary drive belt tensioner idler pulley and tighten Torx bolt.
15. Fit dust cap to ancillary drive belt tensioner idler pulley.
16. Fit 2 bolts securing ancillary drive belt tensioner to timing gear cover but DO NOT tighten at this stage.
17. Fit crankshaft front oil seal. See **OIL SEAL - CRANKSHAFT - FRONT**.
18. Fit right upper timing gear cover. See **COVER - TIMING GEAR - UPPER - RIGHT**.
19. Fit left upper timing gear cover. See **COVER - TIMING GEAR - UPPER - LEFT**.
20. Fit coolant pump. See **GASKET -- COOLANT PUMP**.
21. Connect battery earth lead. See **BATTERY DISCONNECT & RECONNECT**.



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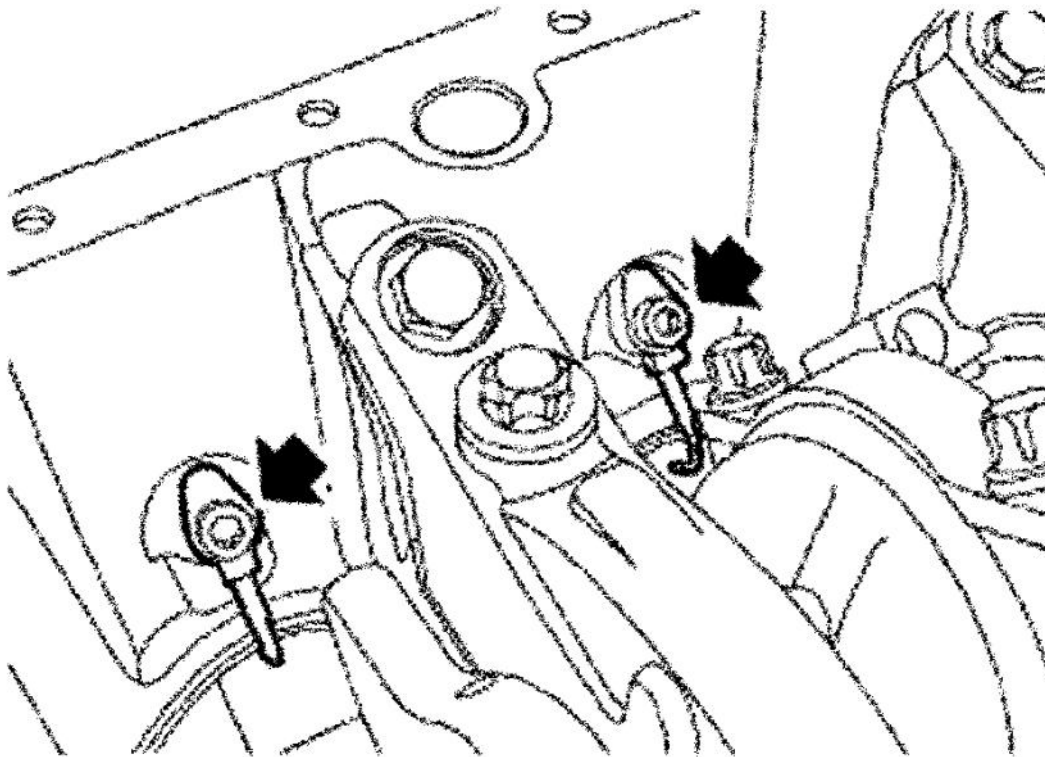
Fig. 187: Applying Sealant Cover - Timing Gear - Lower
Courtesy of LAND ROVER NORTH AMERICA, INC.

OVERHAUL

PISTON ASSEMBLIES - ENGINE SET

Removal

1. Remove cylinder head gaskets.
2. Remove connecting rod bearings. See **BEARINGS - CONNECTING RODS - ENGINE SET**.
3. With a socket and bar fitted to crankshaft pulley bolt, rotate crankshaft for access to the lubrication jets. See **Fig. 188**.
4. Remove Allen screws securing lubrication jets and remove the jets.

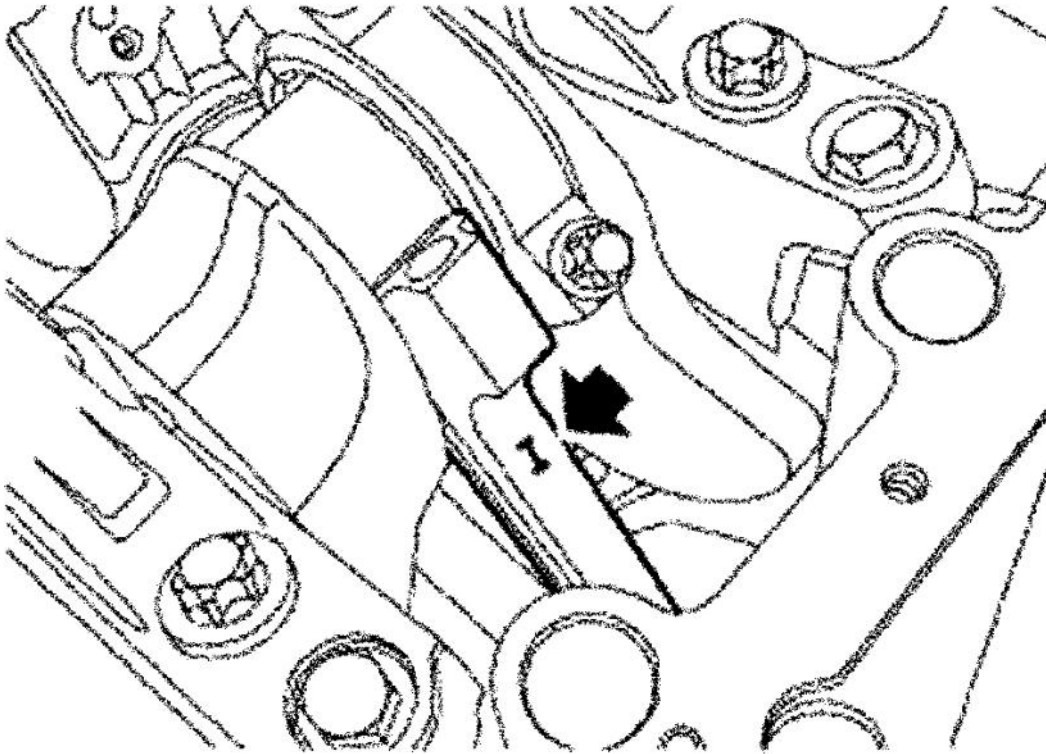


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Fig. 188: Rotating Crankshaft For Access To Lubrication Jets
Courtesy of LAND ROVER NORTH AMERICA, INC.

Disassembly

1. Mark connecting rod relative to its fitted position to aid reassembly. See **Fig. 189**.
2. Mark piston relative to its fitted position to aid reassembly. See **Fig. 190**.
3. Fit guides LRT-12-176 to connecting rod to protect cylinder bore and crankshaft journals. See **Fig. 191**.
4. Remove ridge of carbon from top of cylinder bore.
5. Carefully push piston assembly from cylinder bore.
6. Remove guides LRT-12-176 from connecting rod.
7. Hold connecting rods in a soft jawed vice.
8. Carefully remove and discard 2 retaining rings securing the gudgeon pin in the piston. See **Fig. 192**.
9. Push the gudgeon pin out of the piston and connecting rod, remove the piston.
10. Repeat for the 7 remaining pistons.



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Fig. 189: Marking Connecting Rod Relative To Its Installation
Courtesy of LAND ROVER NORTH AMERICA, INC.

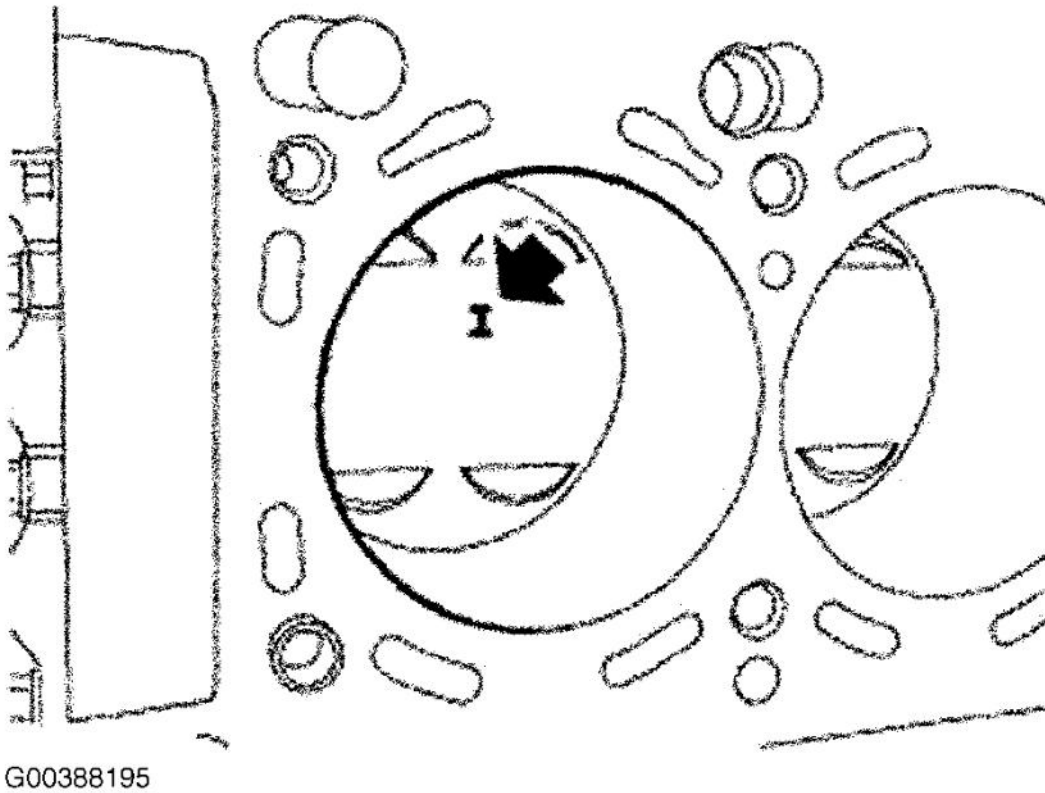


Fig. 190: Marking Piston Relative To Its Installation Position
Courtesy of LAND ROVER NORTH AMERICA, INC.

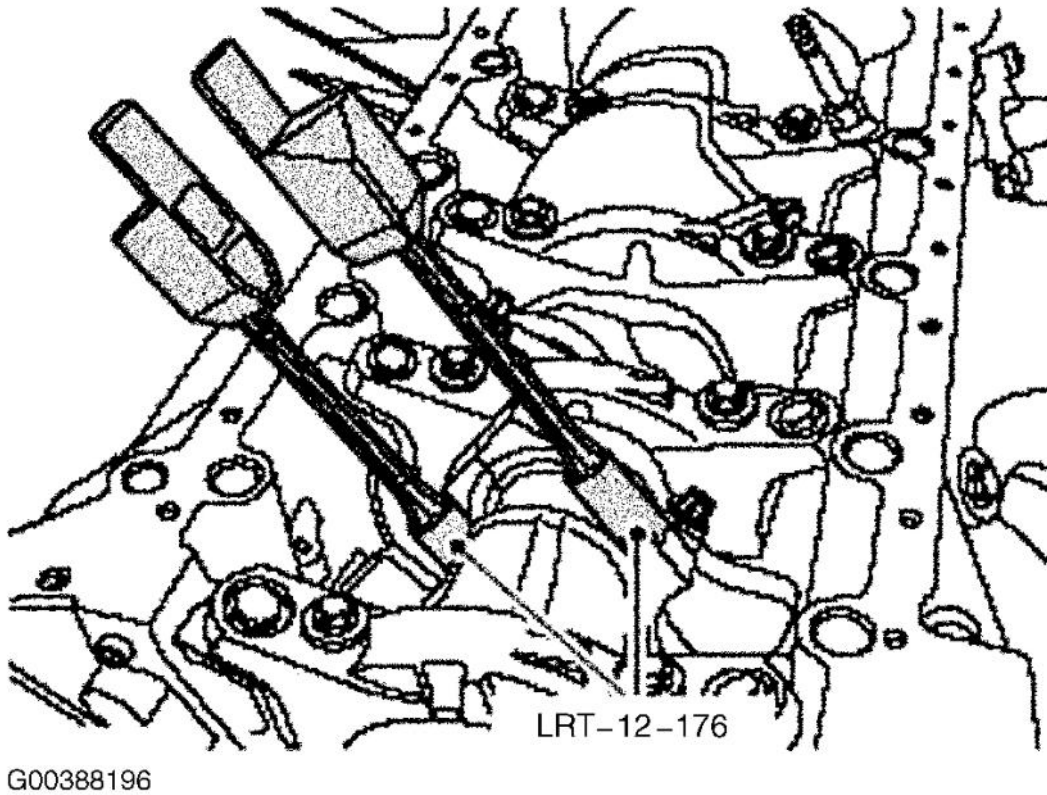
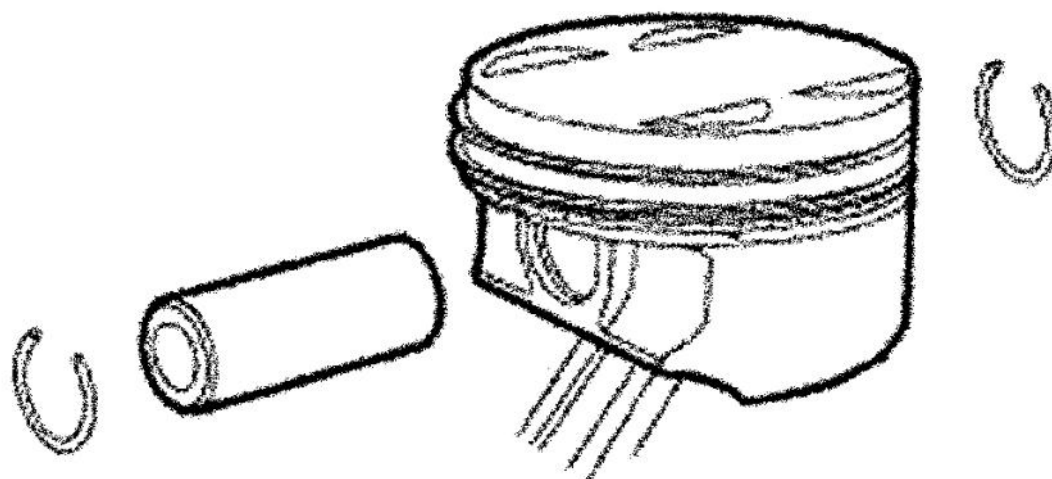


Fig. 191: Installing Guides LRT-12-176 To Connecting Rod
Courtesy of LAND ROVER NORTH AMERICA, INC.



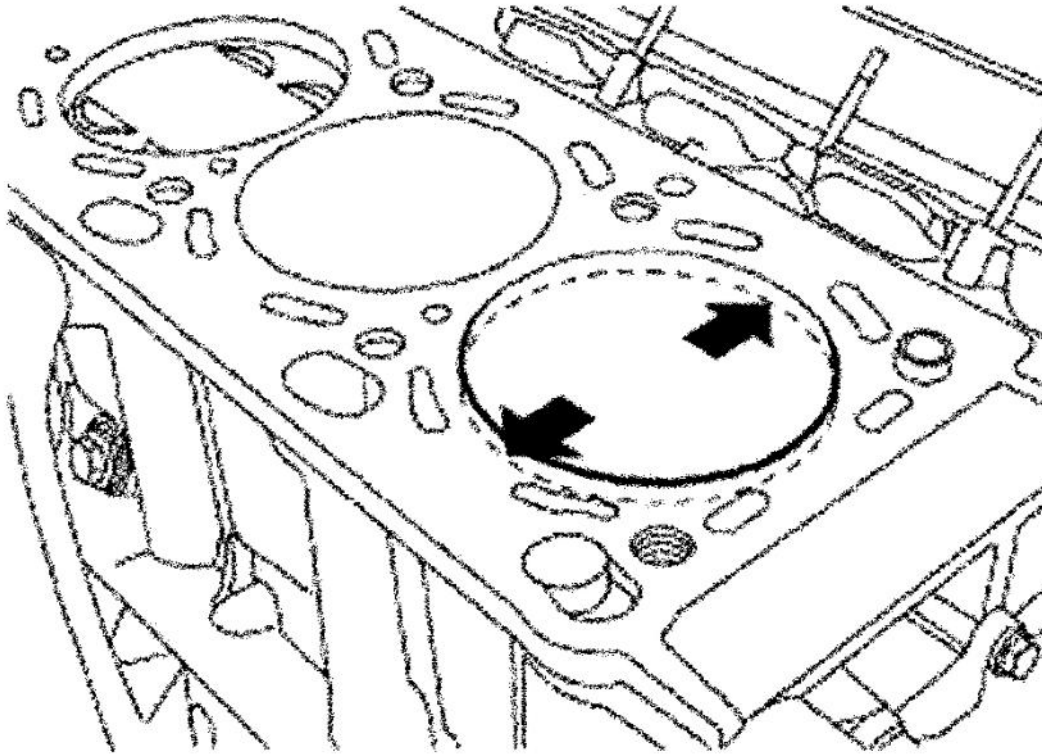
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Fig. 192: Removing & Discarding Retaining Rings-To-Gudgeon Pin
 Courtesy of LAND ROVER NORTH AMERICA, INC.

Inspect

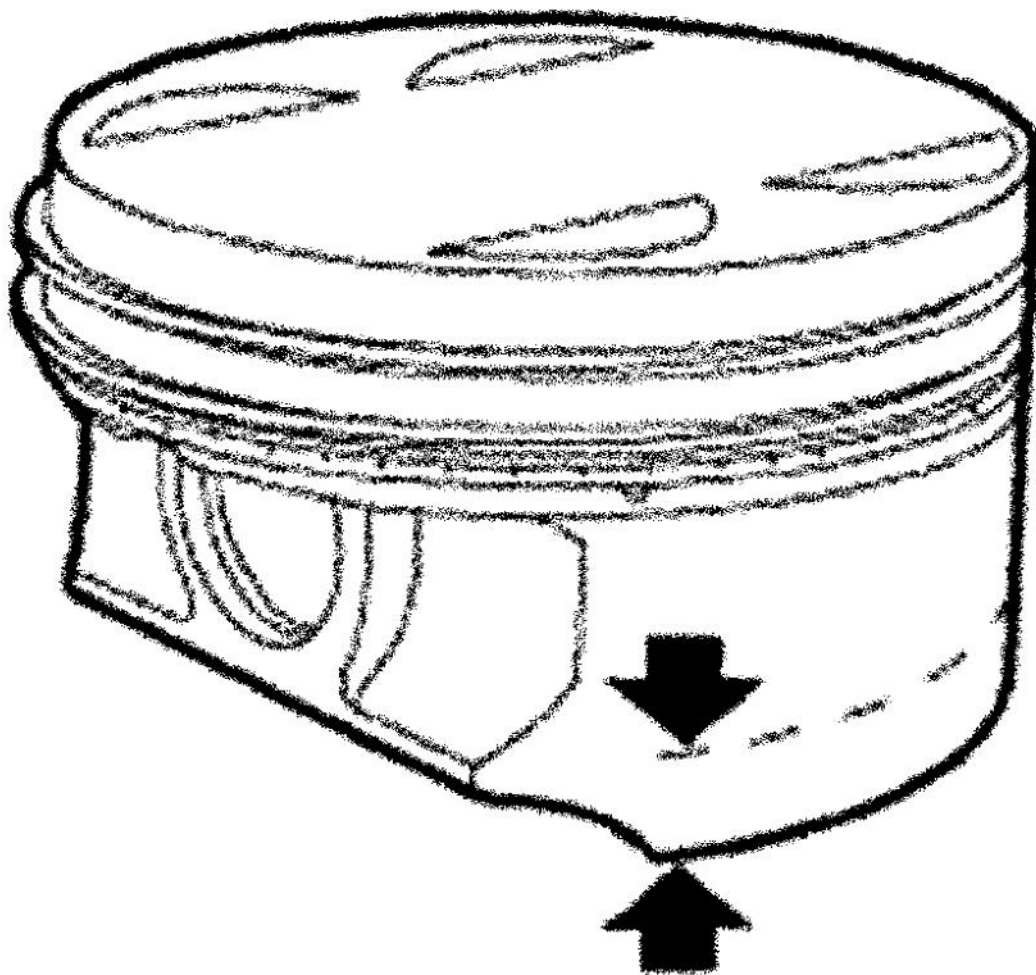
1. Clean cylinder bores, pistons, piston rings connecting rods and gudgeon pins.
2. Pistons and cylinder bores: check and record cylinder bore diameters at bottom, center and top of bore ensuring that measurements are taken at the angle shown. See **Fig. 193**.
3. Repeat procedure at angle shown and from the 2 sets of measurements obtained, calculate cylinder bore ovality and taper.
4. Starting with No 1 piston, measure and record piston diameter at right angles to gudgeon pin holes, and 12 mm from bottom of piston skirt. See **Fig. 194**.
5. Compare piston diameter with cylinder bore size and determine piston to bore clearance.
6. Using an expander, remove piston rings from piston.
7. Check new ring fitted gap 30 mm from top of bore. Ensure rings are fitted square to bore when checking gap. See **Fig. 195**.
8. Fit oil control ring rails and expander, ensuring ends butt and do not overlap. See **Fig. 196**.
9. Fit 2nd compression ring with TOP marking upwards.
10. Check piston to groove clearance. See **Fig. 197**.
11. Fit 1st compression ring with TOP marking upwards.
12. Check fit of gudgeon pin in piston, pin must be a tight, sliding fit with no perceptible side play.
13. Check small-end bushes for wear, check that gudgeon pin is a sliding fit in the bush with no perceptible side play. Small end bushes cannot be replaced, a NEW connecting rod must be fitted.
14. Check parallelism of connecting rods on both sides taking the measurement approximately 150 mm from the center line of the connecting rod. See **Fig. 198**.

15. Check for distortion on both sides of connecting rod.



G00388198

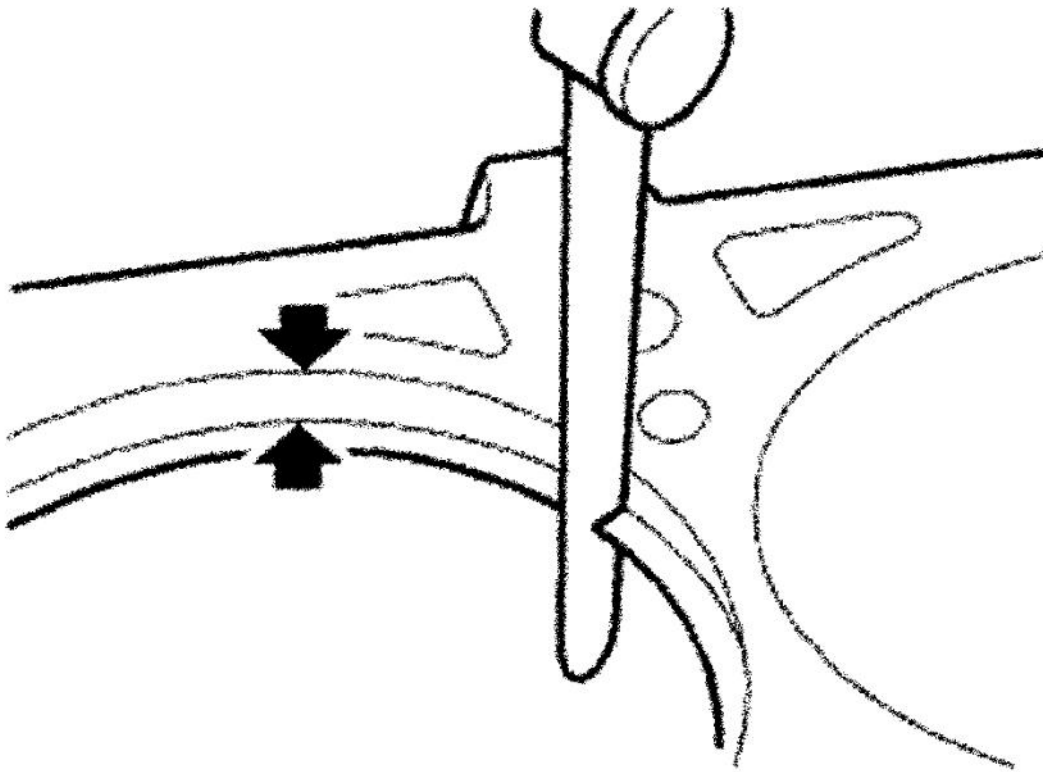
Fig. 193: Checking Cylinder Bore Diameters
Courtesy of LAND ROVER NORTH AMERICA, INC.



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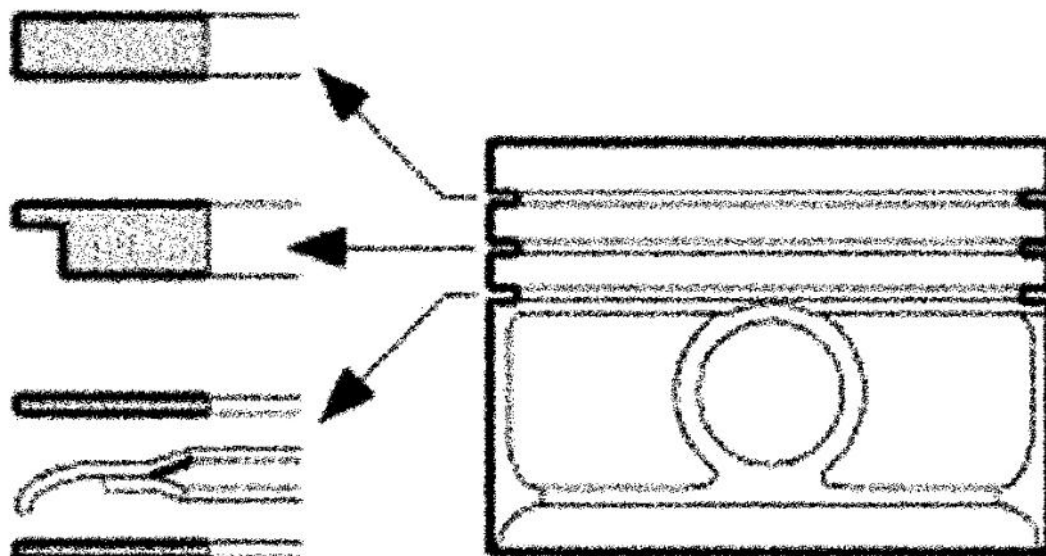
Fig. 194: Measuring Piston Diameter

Courtesy of LAND ROVER NORTH AMERICA, INC.



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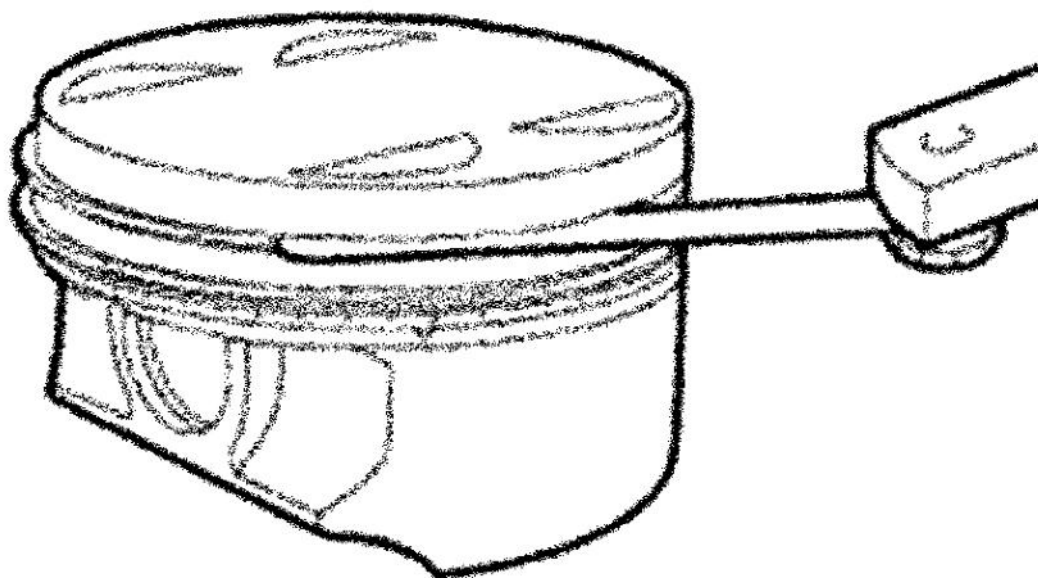
Fig. 195: Checking NEW Ring Installed Gap
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 196: Installing Oil Control Ring Rails

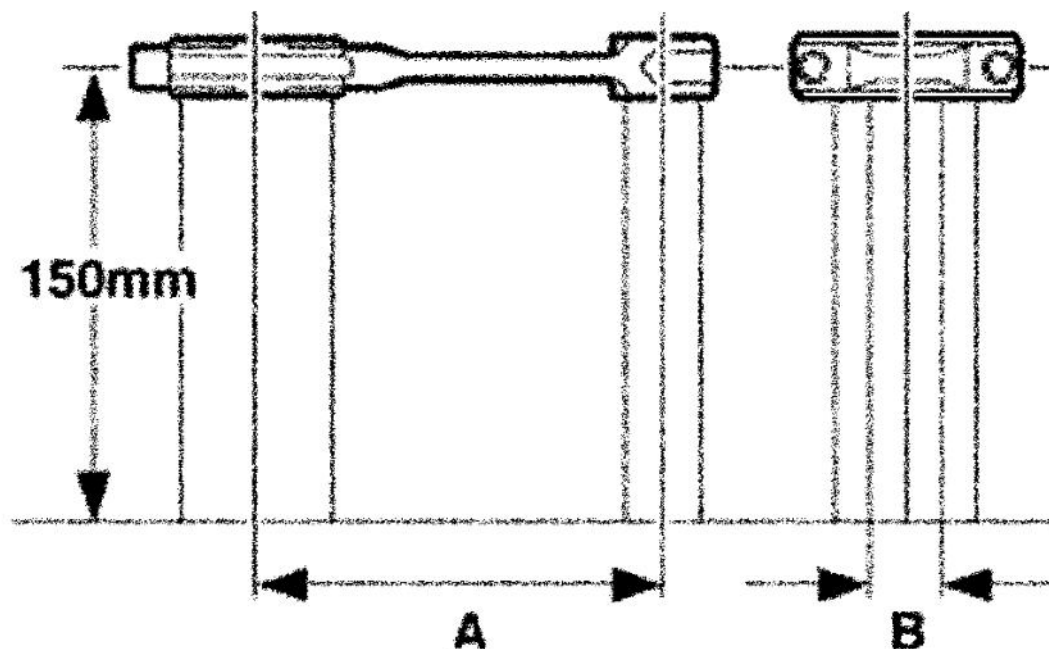
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 197: Checking Piston Ring-To-Groove Clearance

Courtesy of LAND ROVER NORTH AMERICA, INC.

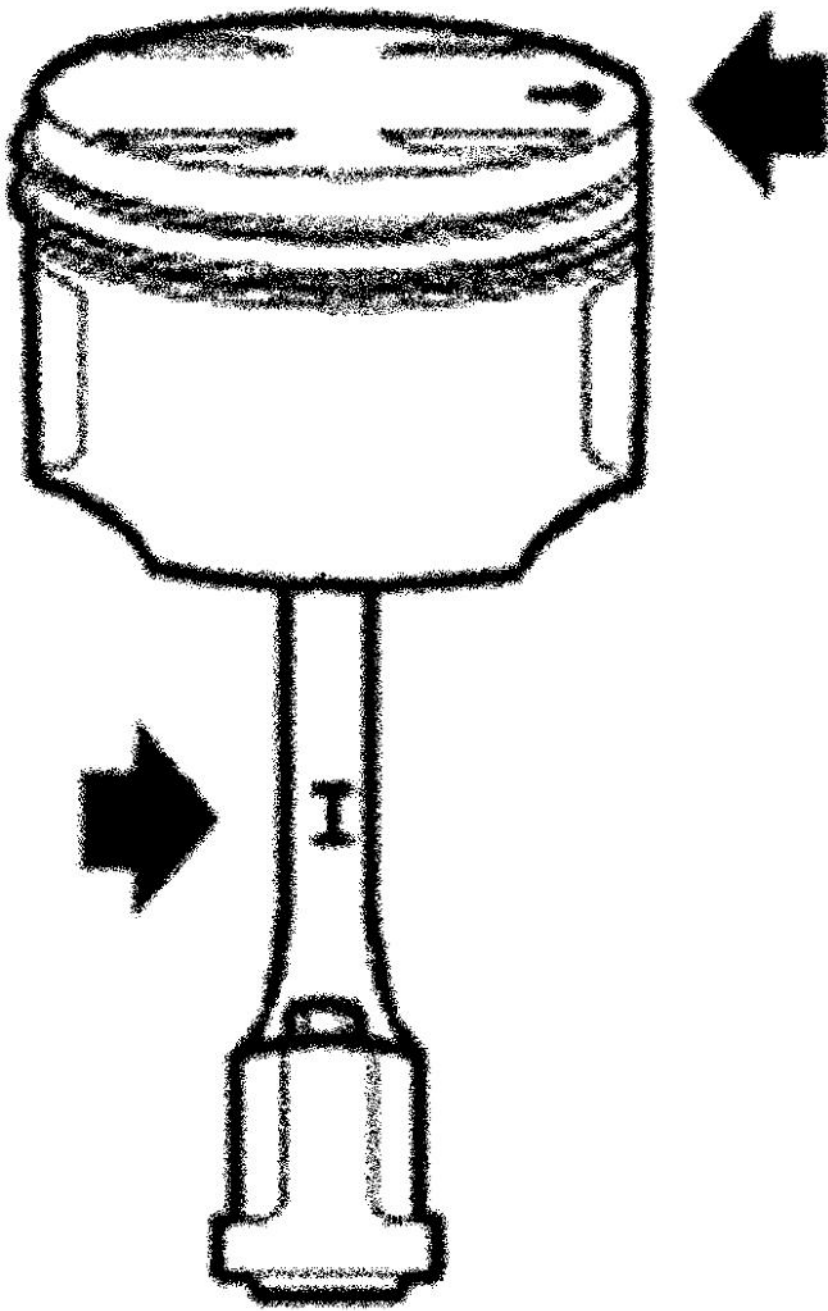


G00388203

Fig. 198: Checking Parallelism Of Connecting Rods
 Courtesy of LAND ROVER NORTH AMERICA, INC.

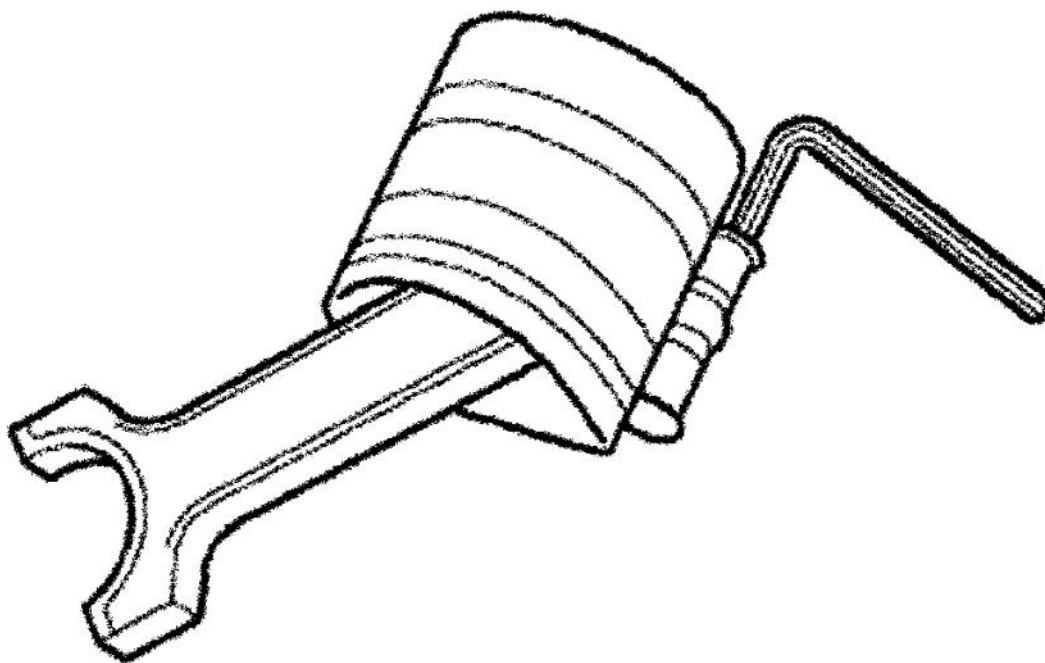
Reassembly

1. Clean cylinder bores, pistons, piston rings and connecting rods.
2. Fit each piston to its connecting rod ensuring that the arrow on the piston which points to the front of the engine is relative to the mark made on the connecting rod during disassembly. See **Fig. 199**.
3. Lubricate gudgeon pins and bushes with engine oil, fit gudgeon pins and secure with new retaining rings ensuring that they are fully seated in their grooves.
4. Lubricate pistons, piston rings and cylinder bores with clean engine oil.
5. Check that piston rings are free to rotate, position ring gaps at 120° to each other and away from the thrust side - left side of piston - viewed from front of piston.
6. Using a piston ring clamp, compress piston rings. See **Fig. 200**.
7. Fit guides LRT-12-176 to connecting rod to protect cylinder bore and crankshaft journals. See **Fig. 201**.
8. Fit connecting rod and piston into cylinder bore. Ensure arrow on piston is facing towards the front of the cylinder block and dimples on connecting rods that share a journal face each other as shown.
9. Remove guides LRT-12-176 from connecting rod.



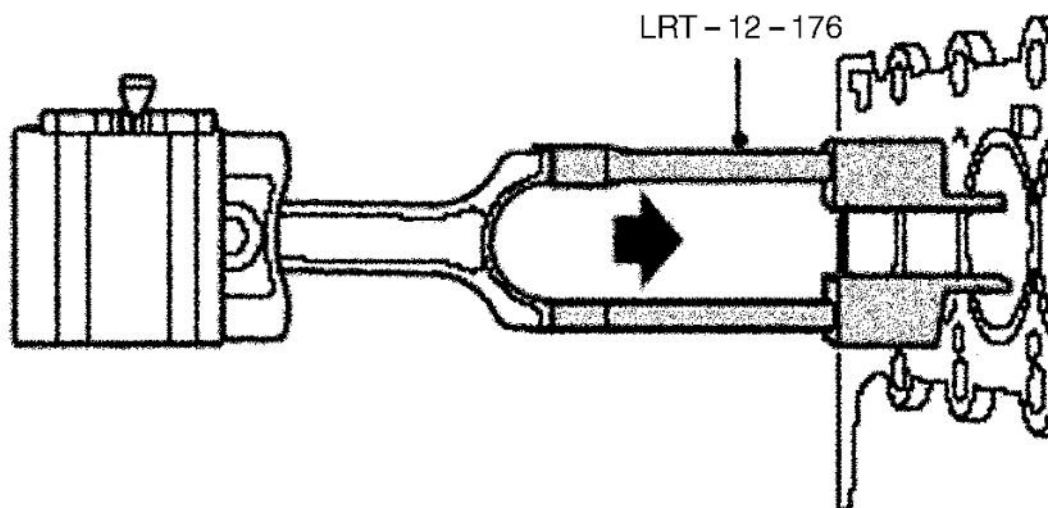
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Fig. 199: Installing Each Piston To Its Connecting Rod
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388205

Fig. 200: Using A Piston Ring Clamp
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388206

Fig. 201: Installing Guides LRT-12-176 To Connecting Rods

Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Clean lubricating jet and mating face.
2. Fit lubrication jets and tighten Allen screws to 10 Nm (7 ft. lbs.).
3. Fit connecting rod bearings. See **BEARINGS - CONNECTING RODS - ENGINE SET**.
4. Fit cylinder head gaskets. See **GASKET - CYLINDER HEAD - LEFT** and **GASKET - CYLINDER HEAD - RIGHT**.

BEARINGS - CONNECTING RODS - ENGINE SET

Removal

1. Remove oil pump. See **PUMP - OIL**.

Disassembly

1. With a socket and bar fitted to crankshaft pulley bolt, rotate crankshaft in direction of rotation to gain access to connecting rod bearing cap bolts. See **Fig. 202**.
2. Mark connecting rod and bearing cap in relation to cylinder number. See **Fig. 203**.

NOTE: **Connecting rods and caps have reference marks which align for assembly.**

3. Loosen and remove big-end bearing cap bolts, do not discard bolts at this stage.
4. Remove big-end bearing cap, remove and discard bearing shell.
5. Move connecting rod clear of crankshaft journal.
6. Remove bearing shell from connecting rod, discard the bearing shell. See **Fig. 204**.

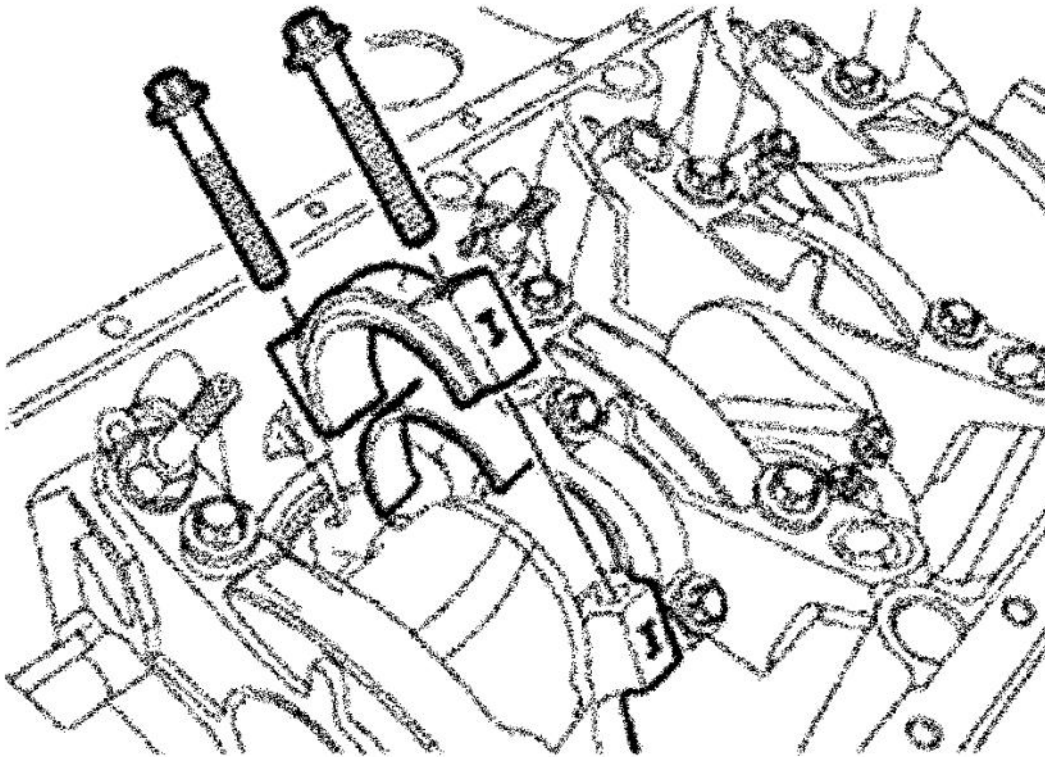
NOTE: **Blue color coded big-end bearing shells are fitted to the connecting rods and Red color coded big end bearing shells are fitted to the bearing caps.**

7. Repeat above procedure for remaining connecting rod bearings. Keep big-end bearing caps in fitted order.



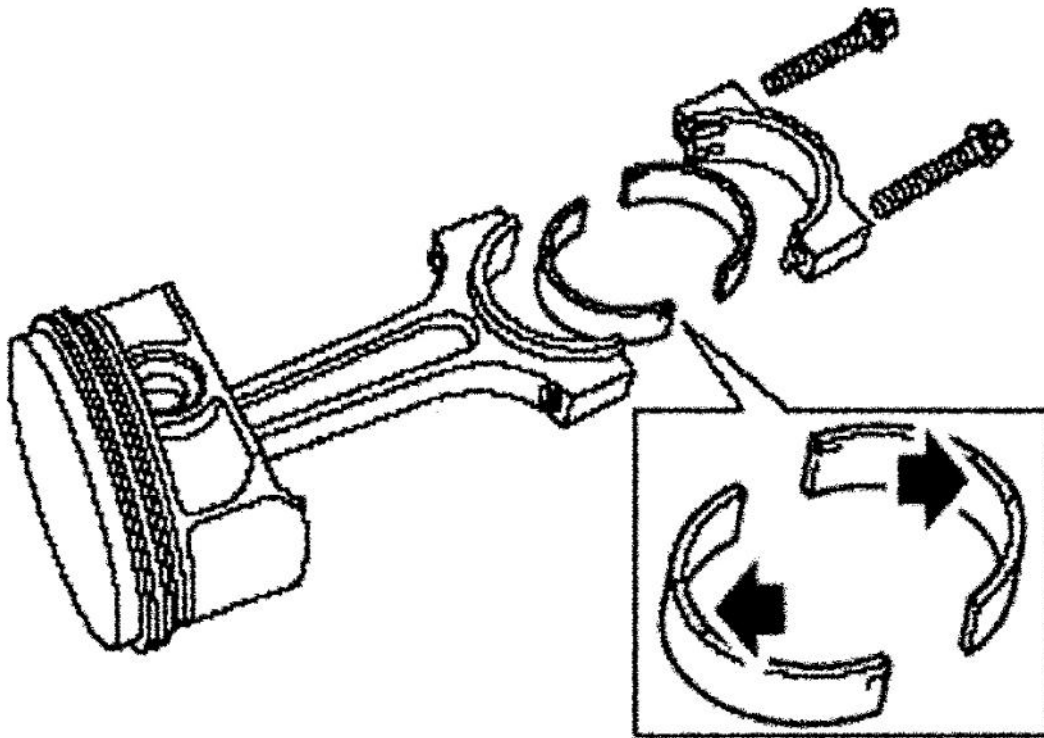
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Fig. 202: Rotating Crankshaft Pulley Shaft
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388208

Fig. 203: Marking Connecting Rod & Bearing Cap By Cylinder Number
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388209

Fig. 204: Removing Bearing Shell From Connecting Rod
Courtesy of LAND ROVER NORTH AMERICA, INC.

Inspection

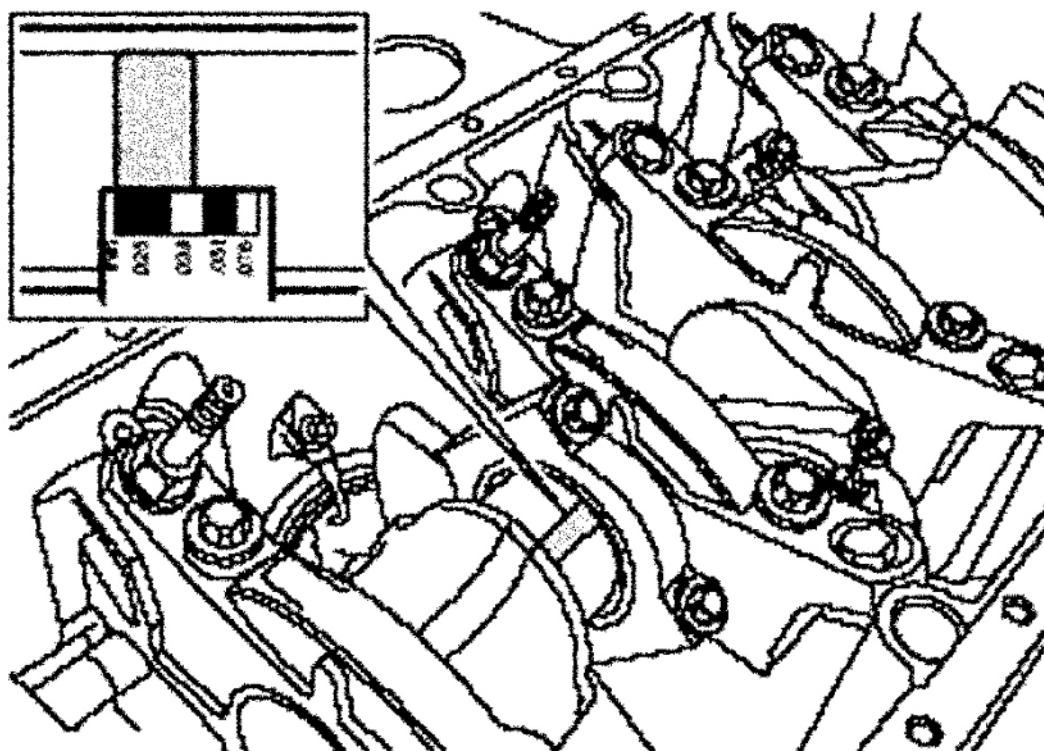
1. Wipe big-end journals, new bearing shells, connecting rods and bearing caps.
2. Measure and record each crankshaft big-end journal diameter, taking 4 measurements at 90° intervals on each journal.
3. Clean and lubricate the original big end bearing cap bolts.
4. Position crankshaft with journal at BDC.
5. Fit a new BLUE color coded big-end bearing shell to the connecting rod.
6. Fit a new RED color coded big-end bearing shell to the bearing cap.
7. Pull connecting rod onto big-end journal.
8. Place a strip of Plastigage across the big-end journal.
9. Fit big-end bearing cap, ensure reference marks on connecting rod and the cap are aligned.

CAUTION: DO NOT rotate the crankshaft when plastigage is being used.

10. Fit the original big end bearing cap bolts and tighten to 5 Nm (3.7 ft. lbs), then tighten to 20 Nm (15 ft. lbs) and finally, using an angle gauge, tighten a further 80°.

CAUTION: DO NOT rotate the crankshaft when plastigage is being used.

11. Remove bolts securing cap to connecting rod and remove the bearing cap.
12. Using the scale provided, measure the width of plastigage on journal and compare with bearing clearance. See **Fig. 205**.
13. If correct bearing clearance cannot be obtained with the available bearing shells, the crankshaft must be replaced.
14. Retain selected bearing shells with connecting rod and bearing cap.
15. Remove all traces of Plastigage using clean engine oil and a cloth.
16. Repeat the above procedure for the remaining big-end bearings.
17. After completion of big-end bearing clearance checks, discard original bearing cap bolts.



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Fig. 205: Measuring Width Of Plastigage
Courtesy of LAND ROVER NORTH AMERICA, INC.

Reassembly

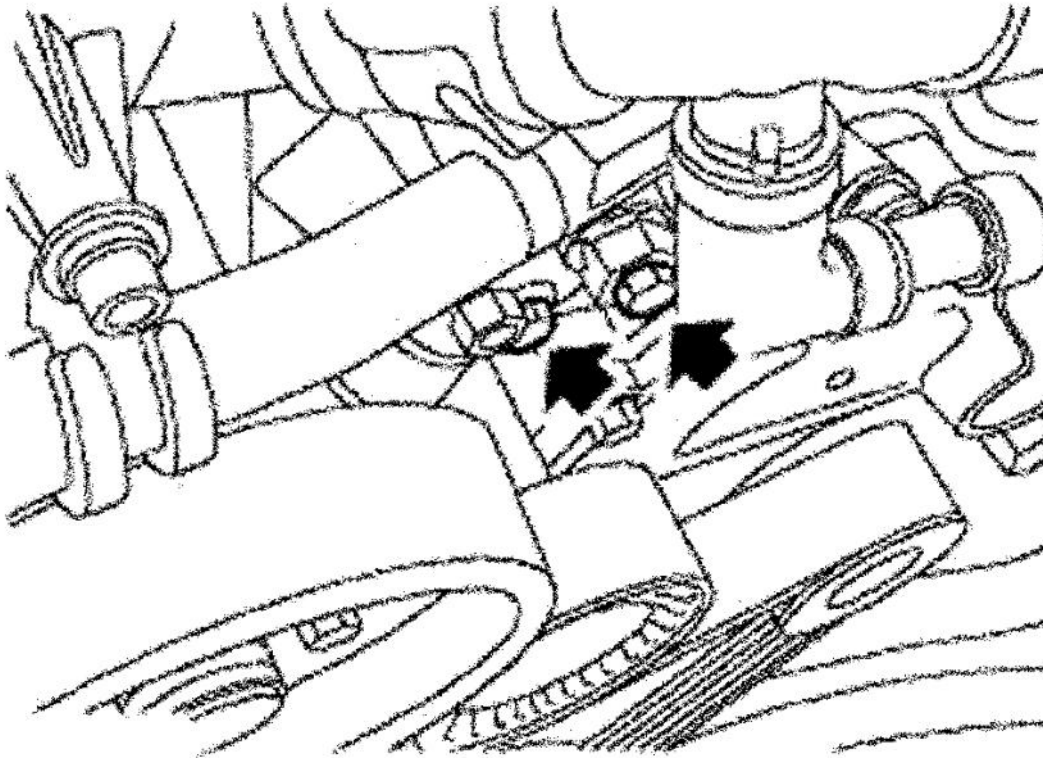
1. Lubricate crankshaft journals and selected bearing shells with clean engine oil.
2. Pull connecting rod onto its journal making sure the bearing shell is located correctly.
3. Fit big-end bearing cap, ensure reference marks on connecting rod and the cap are aligned.
4. Clean and lubricate new big-end bearing cap bolts.
5. Fit the new big end bearing cap bolts and tighten to 5 Nm (3.7 ft. lbs), then tighten to 20 Nm (15 ft. lbs) and finally, using an angle gauge, tighten a further 80°.

Installation

Fit oil pump. See **PUMP - OIL**.

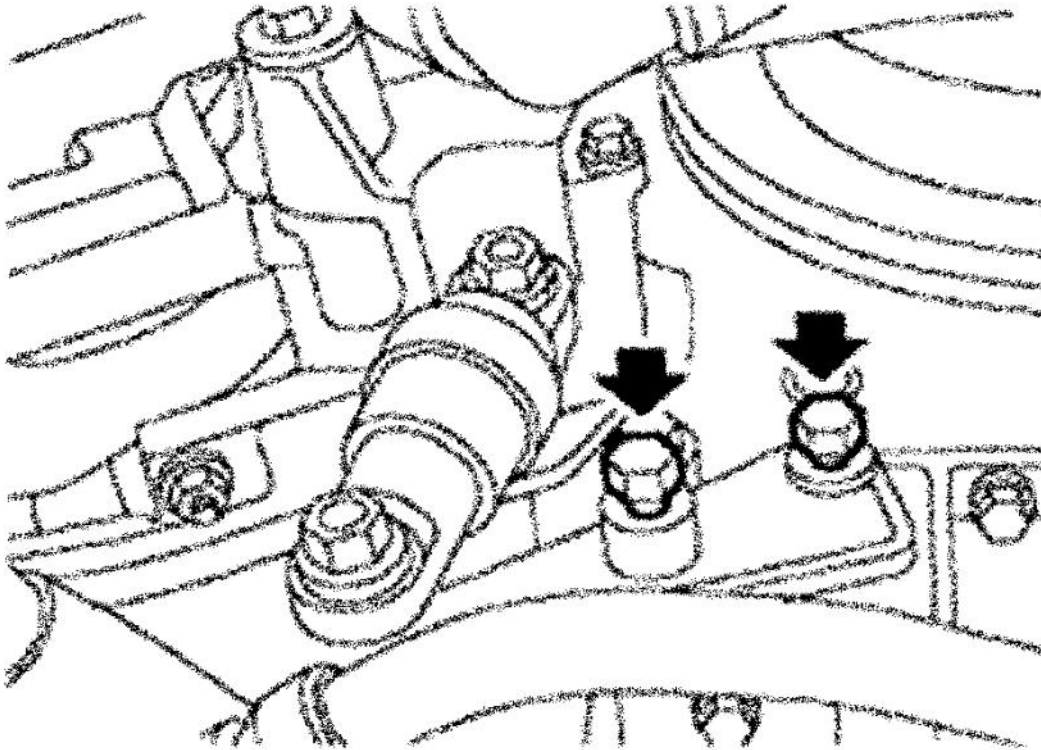
PULLEY CRANKSHAFT**Disassembly**

1. Loosen 2 bolts securing ancillary drive belt tensioner and release tension from the belt.
2. Remove ancillary drive belt. See **ANCILLARY DRIVE BELT** .
3. Loosen 2 bolts securing A/C compressor drive belt tensioner and release tension from the belt.
4. Remove compressor drive belt.
5. Remove 8 bolts securing crankshaft pulley to hub assembly.
6. Remove crankshaft pulley.



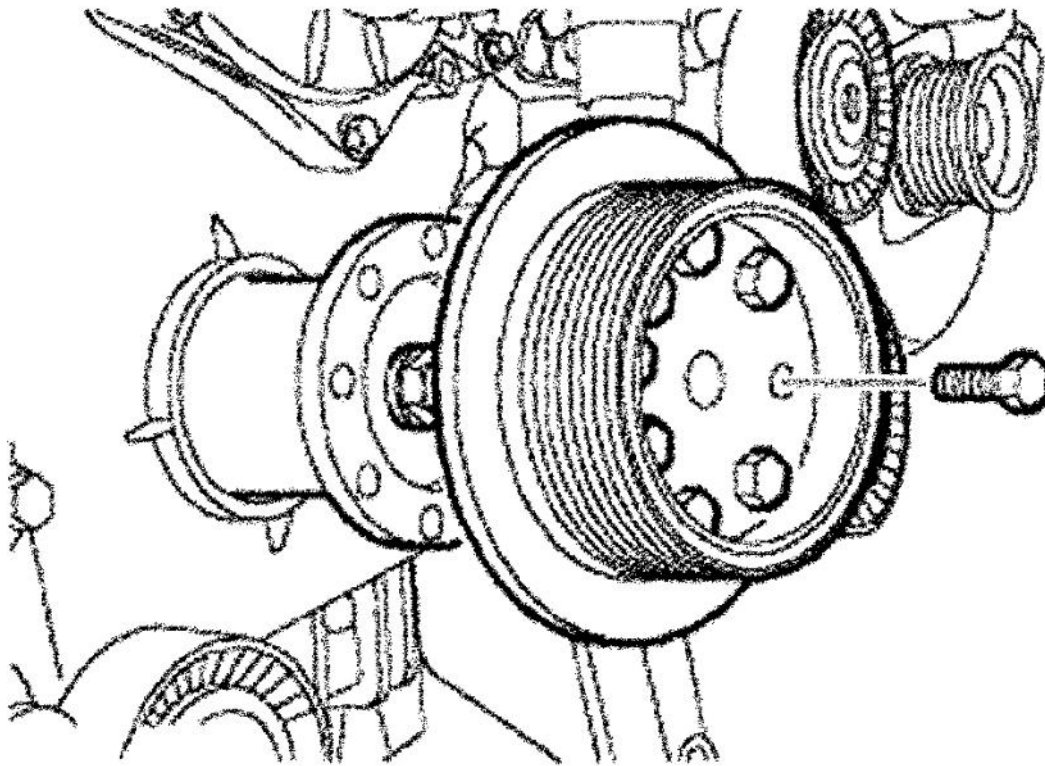
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Fig. 206: Removing Ancillary Drive Belt Tensioner Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 207: Removing A/C Compressor Drive Belt Tensioner Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.

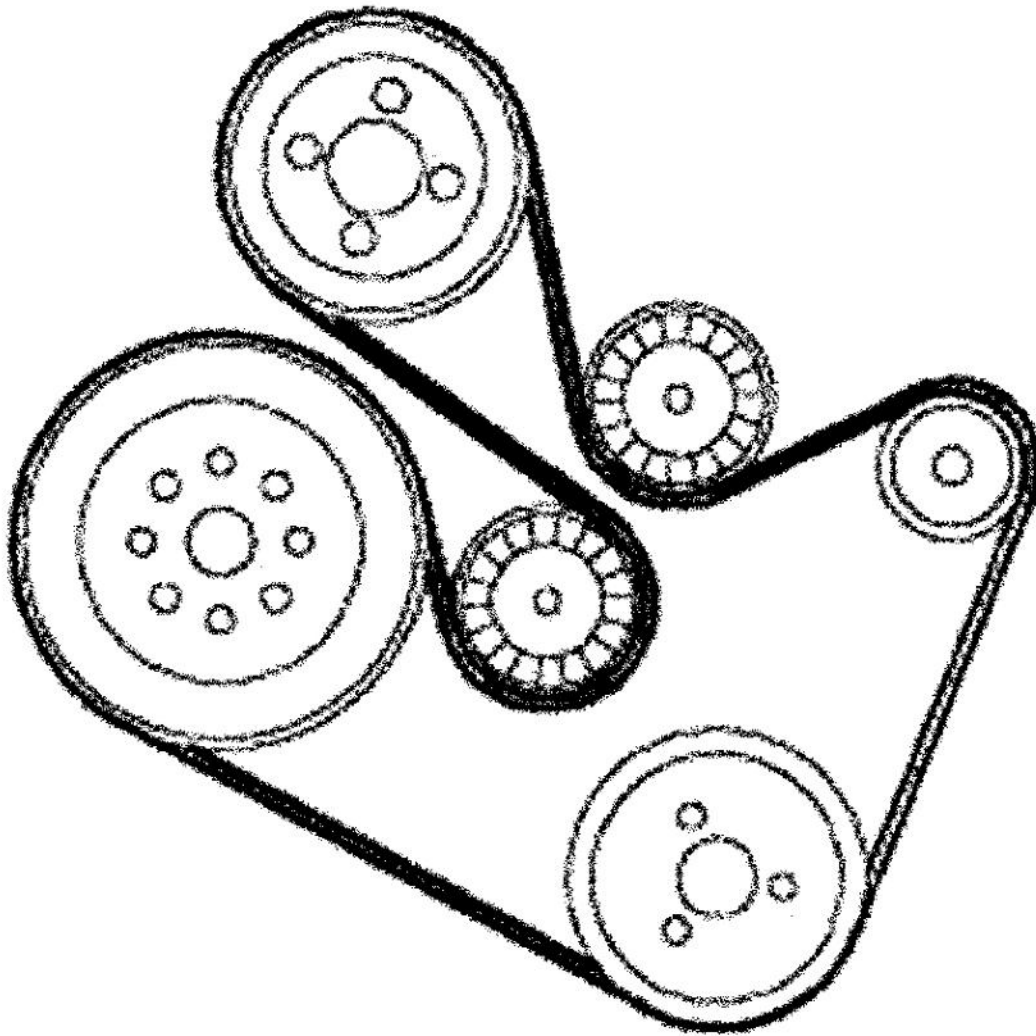


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Fig. 208: Removing Crankshaft Pulley Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.

Reassembly

1. Clean crankshaft pulley and mating face.
2. Position crankshaft pulley to hub assembly, fit to locating dowel.
3. Fit 8 new bolts securing crankshaft pulley to hub assembly and tighten to 22 Nm (16 ft. lbs).
4. Clean A/C compressor drive belt pulleys.
5. Fit A/C compressor drive belt, rotate tensioner fully clockwise and tighten the tensioner bolts to 22 Nm (16 ft. lbs).
6. Clean ancillary drive belt pulleys.
7. Fit ancillary drive belt, rotate tensioner fully clockwise and tighten tensioner bolts to 22 Nm (16 ft. lbs).
See **Fig. 209**.



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Fig. 209: Installing Ancillary Drive Belt
Courtesy of LAND ROVER NORTH AMERICA, INC.

OIL SEAL - CRANKSHAFT - REAR

Disassembly

1. Remove crankshaft pulley. See **PULLEY CRANKSHAFT**.
2. Fit LRT-12-229 to crankshaft pulley hub. See **Fig. 210**.
3. With assistance, remove crankshaft pulley bolt.
4. Remove LRT-12-229 from crankshaft pulley hub.
5. Remove crankshaft pulley hub.

6. Fit LRT-12-230/1 and LRT-12-230/2 to crankshaft seal and remove crankshaft oil seal. See **Fig. 211**.
7. Discard oil seal.

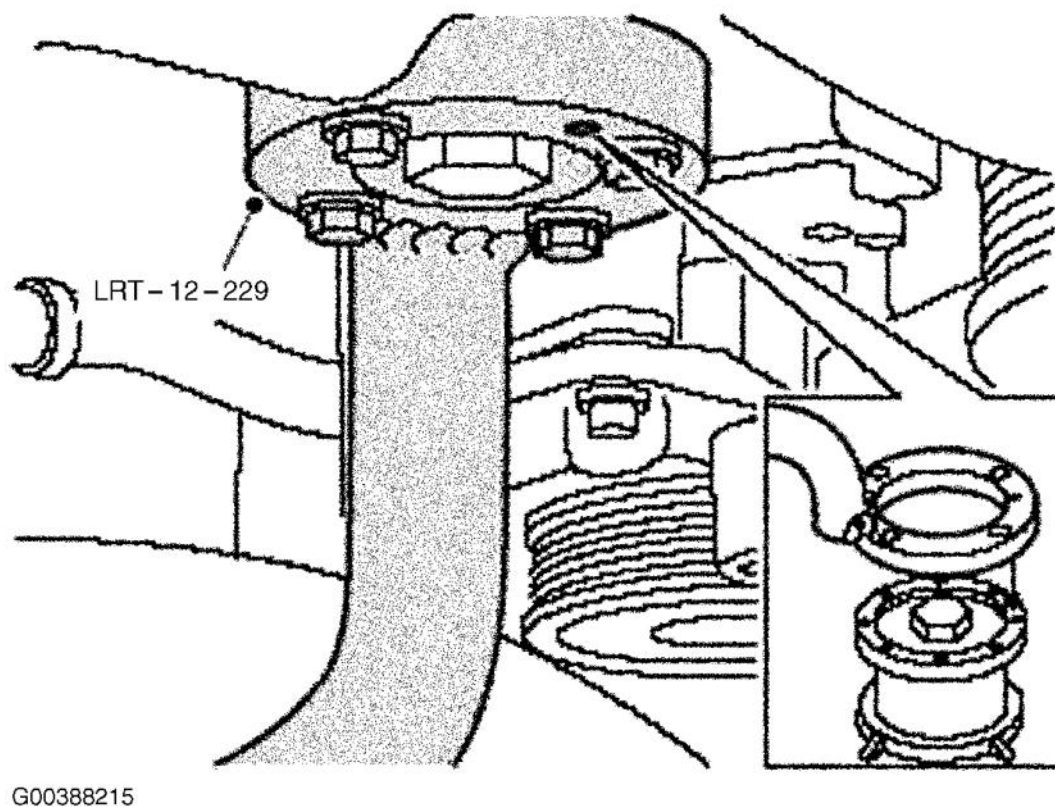


Fig. 210: Installing LRT-12-229 To Crankshaft Pulley Hub
Courtesy of LAND ROVER NORTH AMERICA, INC.

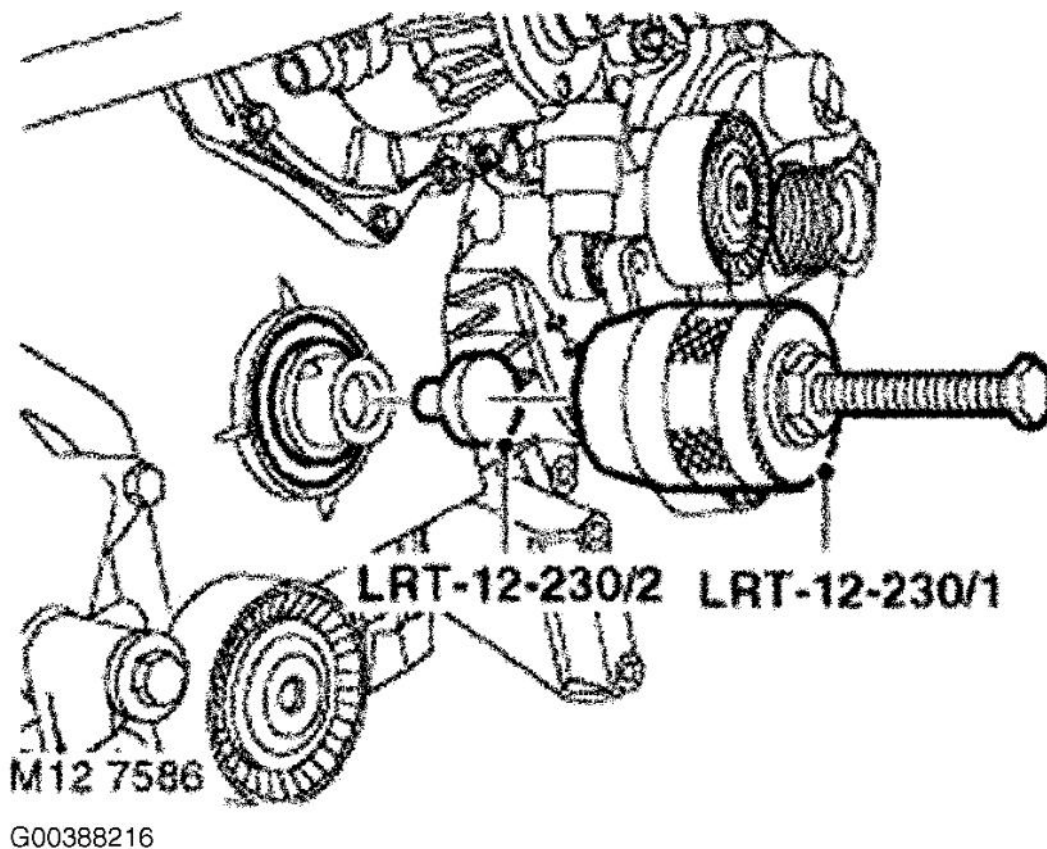


Fig. 211: Removing Crankshaft Oil Seal with LRT-12-230/1 & LRT-12-230/2
Courtesy of LAND ROVER NORTH AMERICA, INC.

Reassembly

1. Clean seal mating faces.
2. Fit new crankshaft oil seal to front cover using LRT-12-231. See **Fig. 212**.

NOTE: Front crankshaft oil seal should be fitted flush to front timing cover.

3. Remove LRT-12-231.
4. Clean crankshaft pulley hub and mating faces, fit crankshaft pulley hub to crankshaft.
5. Fit new bolt to crankshaft, lock crankshaft using LRT-12-229 and initially tighten crankshaft bolt to 100 Nm (74 ft. lbs). Using an angle torque gauge tighten in the following sequence:

Stage 1

60°

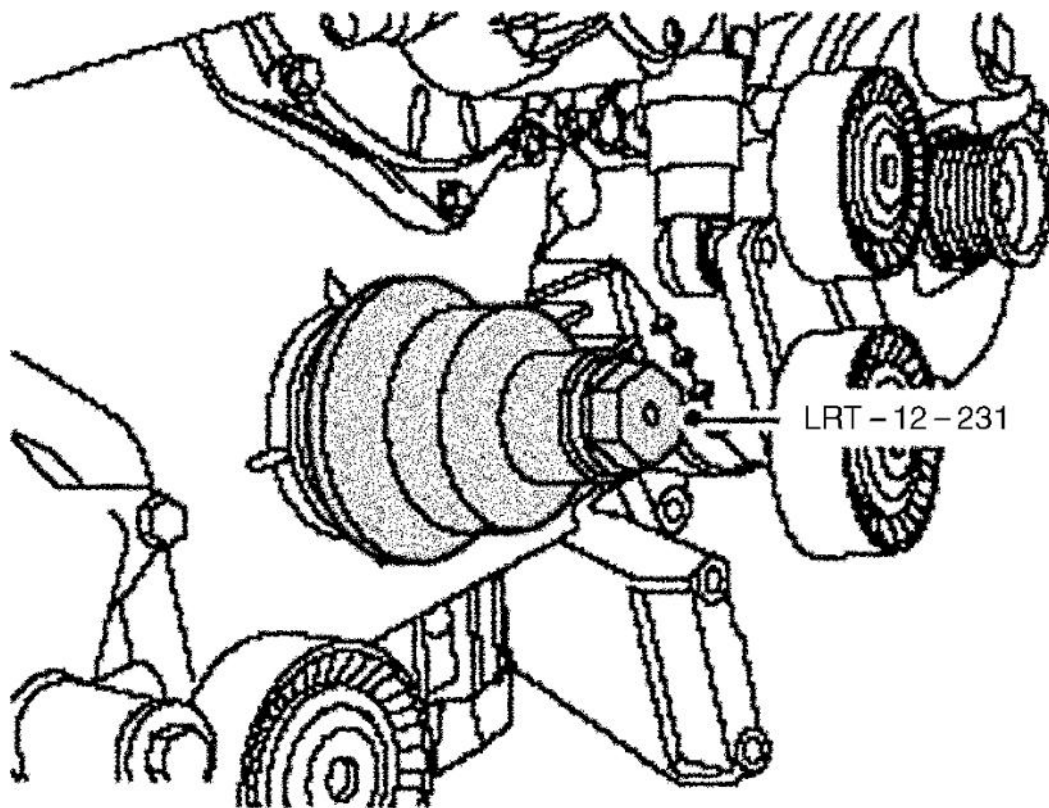
Stage 2

60°

Stage 3

30°

6. Remove LRT-12-229 from crankshaft pulley hub.
7. Fit crankshaft pulley. See **PULLEY CRANKSHAFT**.



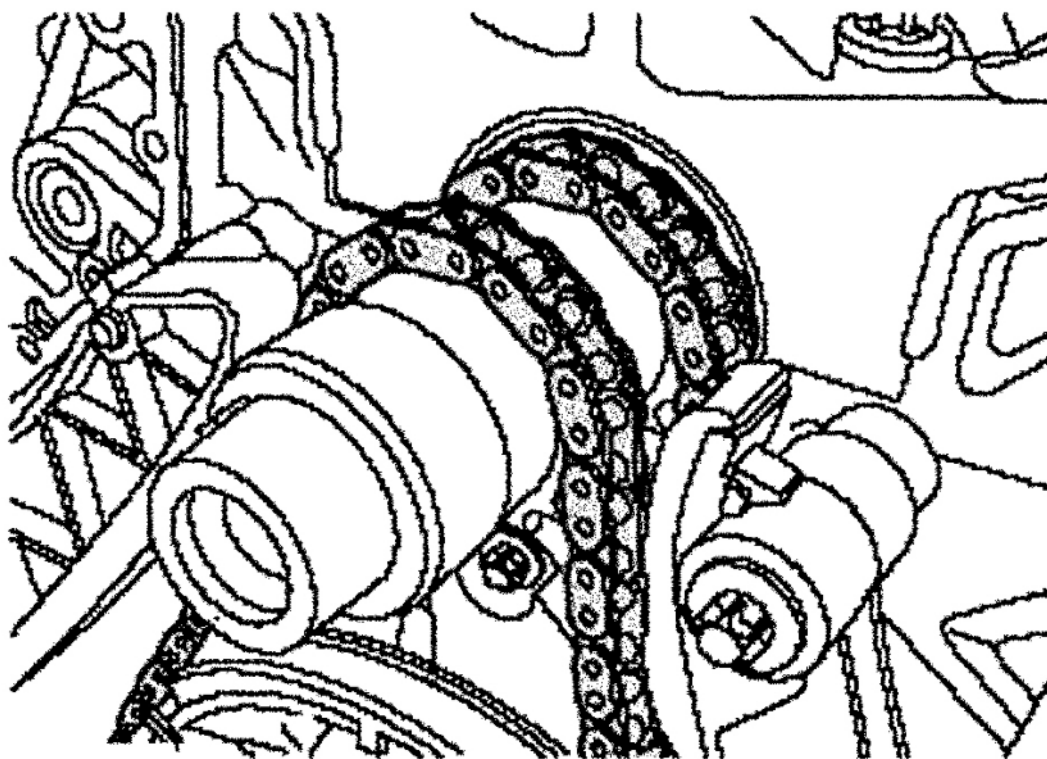
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Fig. 212: Installing NEW Crankshaft Oil Seal With LRT-12-231
Courtesy of LAND ROVER NORTH AMERICA, INC.

CRANKSHAFT & MAIN BEARINGS**Removal**

If, after inspection, the crankshaft has to be replaced, it will be necessary to fit a new dowel into the crankshaft rear boss. Before discarding the original crankshaft, note the fitted position of the dowel.

1. Remove cylinder head gaskets. See GASKET - CYLINDER HEAD - LEFT and GASKET - CYLINDER HEAD - RIGHT.
2. Remove crankshaft rear oil seal. See OIL SEAL - CRANKSHAFT - REAR.
3. Remove timing gear lower cover. See COVER - TIMING GEAR - LOWER.
4. Remove connecting rod bearings. See BEARINGS - CONNECTING RODS - ENGINE SET.
5. Release timing chain from crankshaft gear. See Fig. 213.
6. Remove oil pump drive chain from crankshaft gear.
7. Remove Allen screws securing lubrication jets and remove the jets. See Fig. 188.
8. Push connecting rods away from crankshaft until the pistons crowns are flush with the top of the cylinder bores.



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Fig. 213: Releasing Timing Chain From Crankshaft Gear
Courtesy of LAND ROVER NORTH AMERICA, INC.

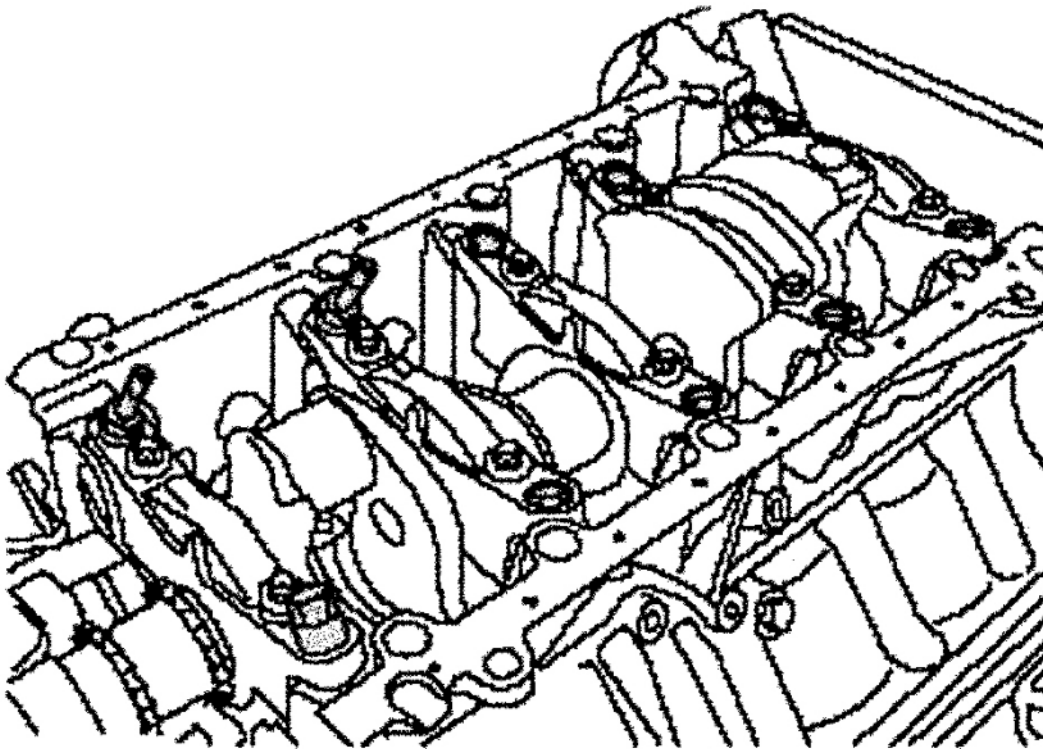
Disassembly

1. Remove 10 bolts securing main bearing cap and adjustable spacers. Discard bolts. See Fig. 214.
2. Remove 10 bolts securing main bearing caps to cylinder block, do not discard bolts at this stage.

3. Using the adjustable spacers, carefully release and remove the 5 main bearing caps. See [Fig. 215](#).

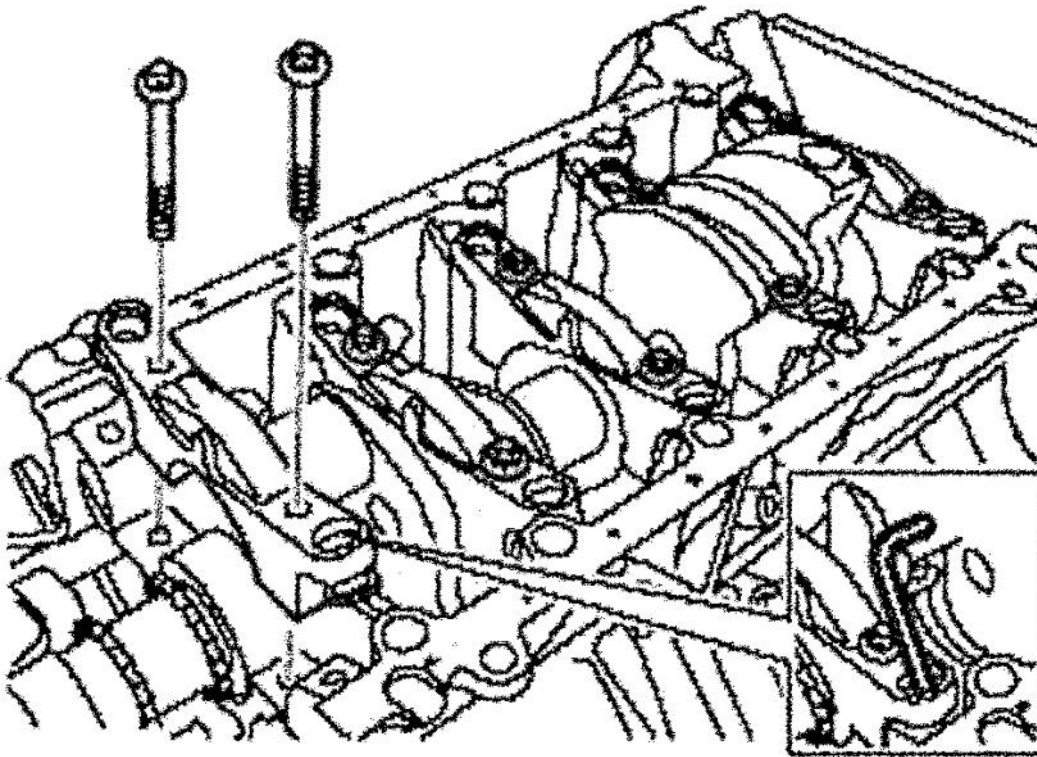
NOTE: All main bearing shell locating keys must align. Bearing caps 1 to 3 are marked and number 5 main bearing cap carries the crankshaft thrust bearings. Number 4 main bearing cap is not marked.

4. Remove crankshaft from cylinder block.
5. Remove and discard bearing shells from cylinder block and main bearing caps. See [Fig. 216](#).
6. Remove crankshaft thrust washers.
7. Use a puller and remove the crankshaft gear. See [Fig. 217](#).
8. Remove key from crankshaft.



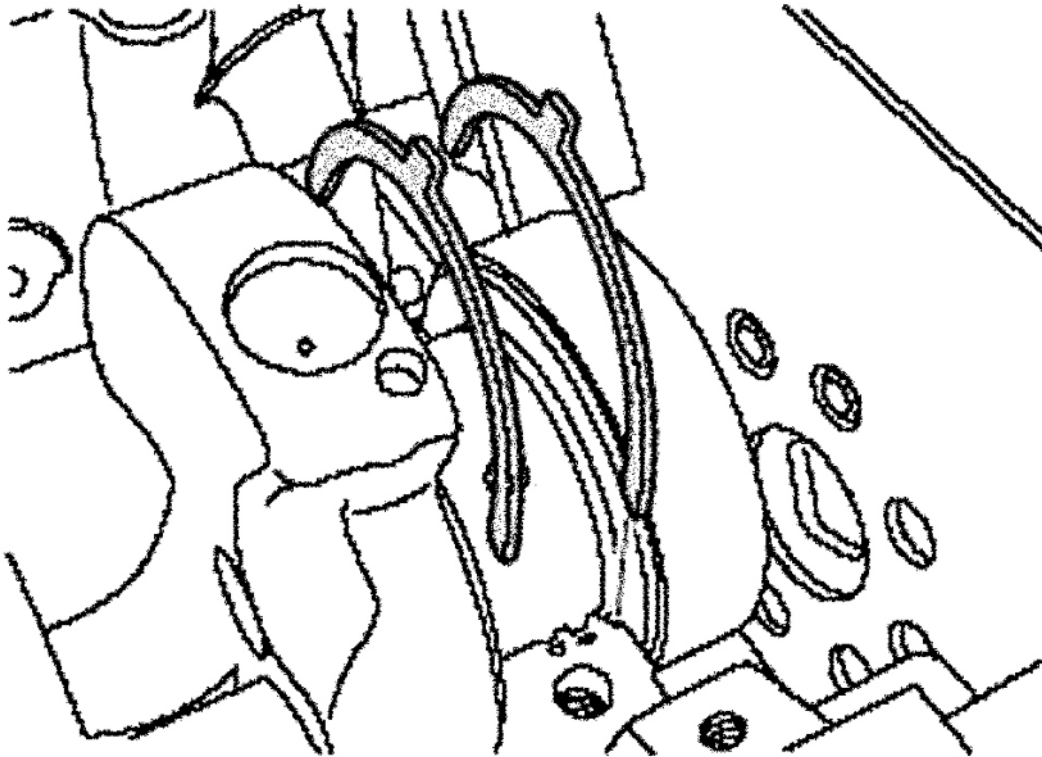
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Fig. 214: Removing Main Bearing Cap Bolts & Adjustable Spacers
Courtesy of LAND ROVER NORTH AMERICA, INC.



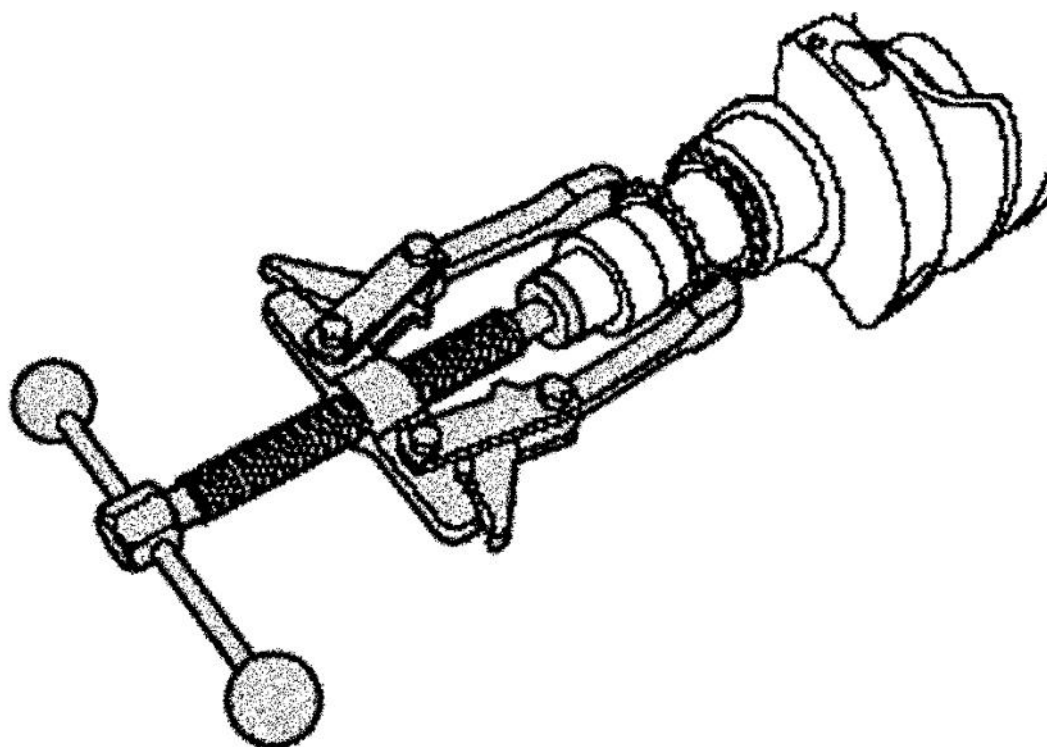
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Fig. 215: Removing Main Bearing Caps With Adjustable Spacers
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 216: Removing & Discarding Bearing Shells From Cylinder Block & Main Bearing Caps
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388222

Fig. 217: Removing Crankshaft Gear

Courtesy of LAND ROVER NORTH AMERICA, INC.

Inspection

1. Check paint mark on crankshaft front web to determine if main bearing journals have been ground undersize. See **Fig. 218**.
2. Measure and record each main journal diameter. Take 4 measurements at 90° intervals on each journal to check size and ovality. See **Fig. 219**.
3. If crankshaft journals are worn, oval, or scored, then the crankshaft must be replaced.
4. Clean crankshaft, ensure oil ways are clear of obstructions.
5. Clean main bearing caps and bearing shell locations in cylinder block; ensure bearing cap bolt holes are clean and dry.
6. Clean original main bearing cap bolts and lightly oil bolt threads.
7. If crankshaft or main bearing shells are being replaced, ignore previous color code selection and fit only yellow coded bearing shells of appropriate size to the cylinder block.
8. Lubricate bearing shells with engine oil.
9. Carefully fit crankshaft to cylinder block.
10. Fit adjustable spacers fully into main bearing caps.

11. Fit new appropriate size main bearing shells of the correct color code to the main bearing caps.
12. Place a strip of Plastigage across each main bearing journal. See **Fig. 205**.
13. Fit main bearing caps and fit original bolts. Tighten bolts evenly and progressively to 20 Nm (15 ft. lbs) then, using an angle torque gauge, tighten a further 100°.

CAUTION: DO NOT rotate the crankshaft when plastigage is being used.

14. Progressively loosen and remove main bearing bolts, bearing caps and shells.
15. Using the scale provided, measure the width of Plastigage on each main bearing journal and compare with specified bearing clearances.
16. If clearances are incorrect, select alternative main bearing cap shell(s) from the range available and repeat check.
17. Lift out crankshaft, remove all traces of Plastigage from main bearing journals using clean engine oil and a cloth.
18. Fit selected bearing shells to main bearing caps.
19. Lubricate bearing journals and main bearing shells with clean engine oil.
20. Fit crankshaft and fit the main bearing caps numbers 1 to 4.
21. Clean crankshaft thrust washers.
22. Lubricate crankshaft thrust washers with clean engine oil.
23. Fit selected crankshaft thrust washers to cylinder block.

CAUTION: Crankshaft thrust washers must be fitted with the oil grooves facing the crankshaft.

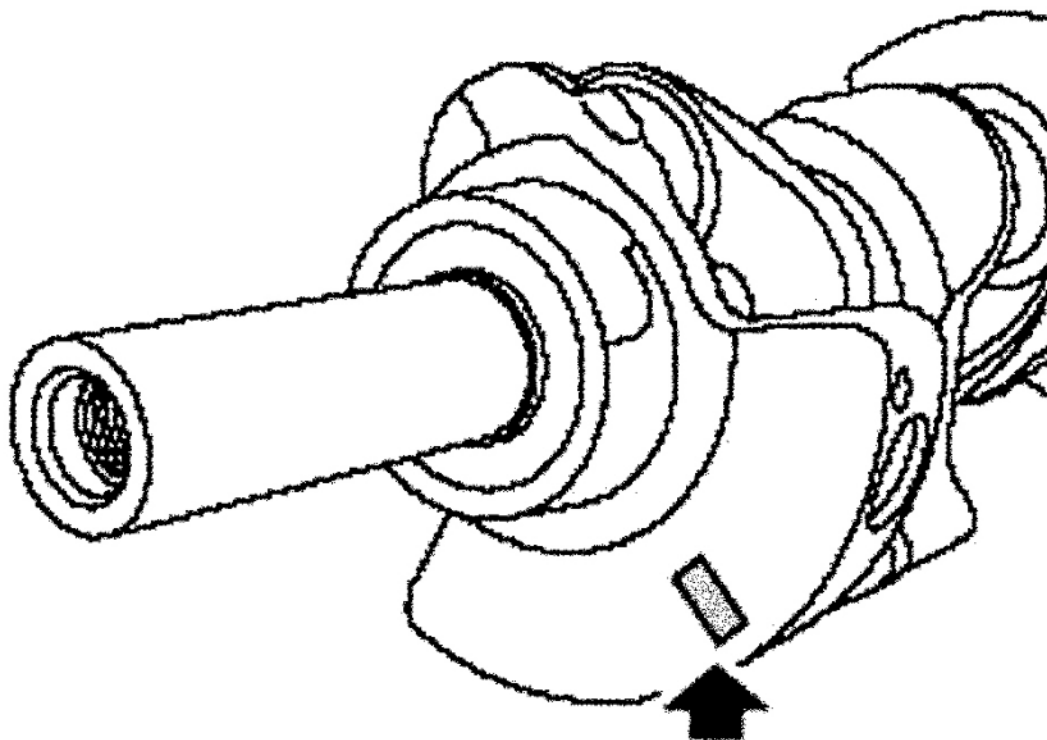
24. Fit selected crankshaft thrust washers to number 5 main bearing cap and fit main bearing cap.

CAUTION: Crankshaft thrust washers must be fitted with the oil grooves facing the crankshaft.

25. Fit original main bearing cap bolts, tighten bolts evenly and progressively to 20 Nm (15 ft. lbs) then, using an angle torque gauge, tighten bolts a further 100°.
26. Fit Dial Test Indicator (DTI) as shown to check crankshaft end float. If end float is incorrect, remove bolts securing number 5 main bearing cap and remove thrust washers. See **Fig. 220**.
27. If crankshaft end float is incorrect, measure and select thrust washers to give correct end float.
28. Lubricate selected crankshaft thrust washers.
29. Fit selected crankshaft thrust washers to cylinder block.

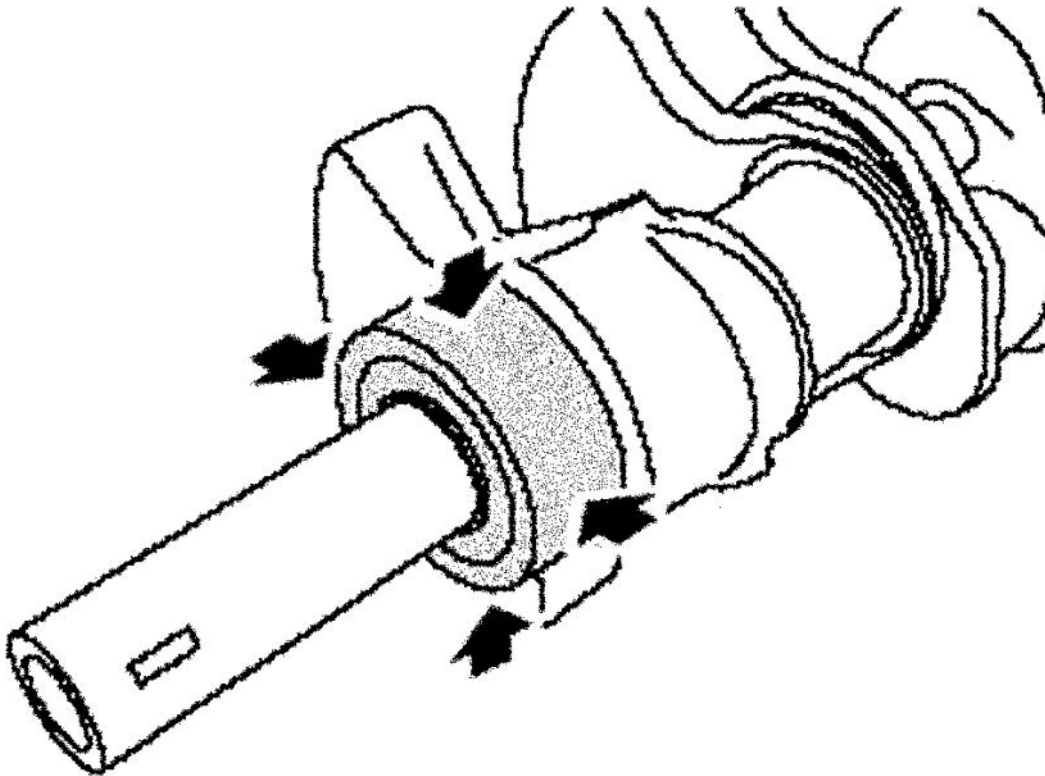
CAUTION: Crankshaft thrust washers must be fitted with the oil grooves facing the crankshaft.

30. Fit selected crankshaft thrust washers to number 5 main bearing cap and fit main bearing cap.
31. Remove and discard original bolts securing main bearing caps numbered 1 to 4.



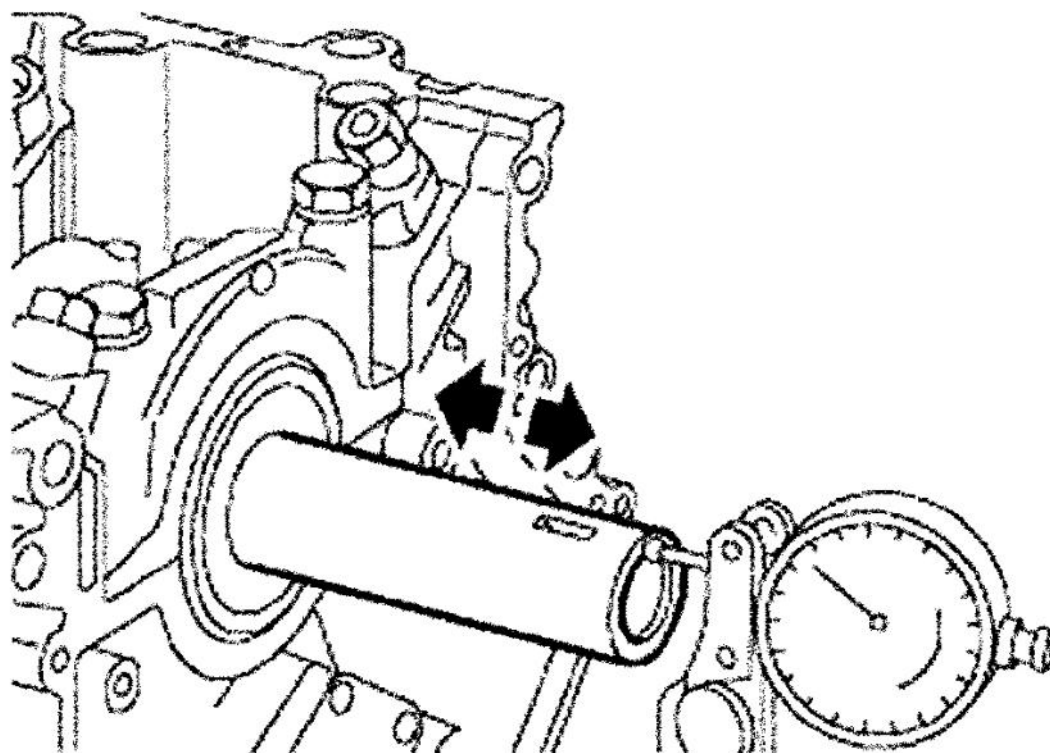
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Fig. 218: Checking Paint Mark On Crankshaft Front Web
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388224

Fig. 219: Measuring Each Main Journal
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388225

Fig. 220: Installing Dial Test Indicator To Check Crankshaft End Float
Courtesy of LAND ROVER NORTH AMERICA, INC.

Reassembly

1. Fit new main bearing cap bolts. Tighten bolts to 20 Nm (15 ft. lbs) then, tighten bolts a further 100°.

CAUTION: DO NOT remove special coating from main bearing cap bolts.

2. Tighten main bearing cap adjustable spacers to 10 Nm (7 ft. lbs).
3. Fit new bolts securing main bearing caps through adjustable spacers and tighten to 20 Nm (15 ft. lbs) then, tighten bolts a further 45°.
4. Clean crankshaft gear and mating face on crankshaft.
5. Clean keys and key ways.
6. Fit key to crankshaft.
7. Heat crankshaft gear to a maximum of 150° Centigrade and fit gear to crankshaft.

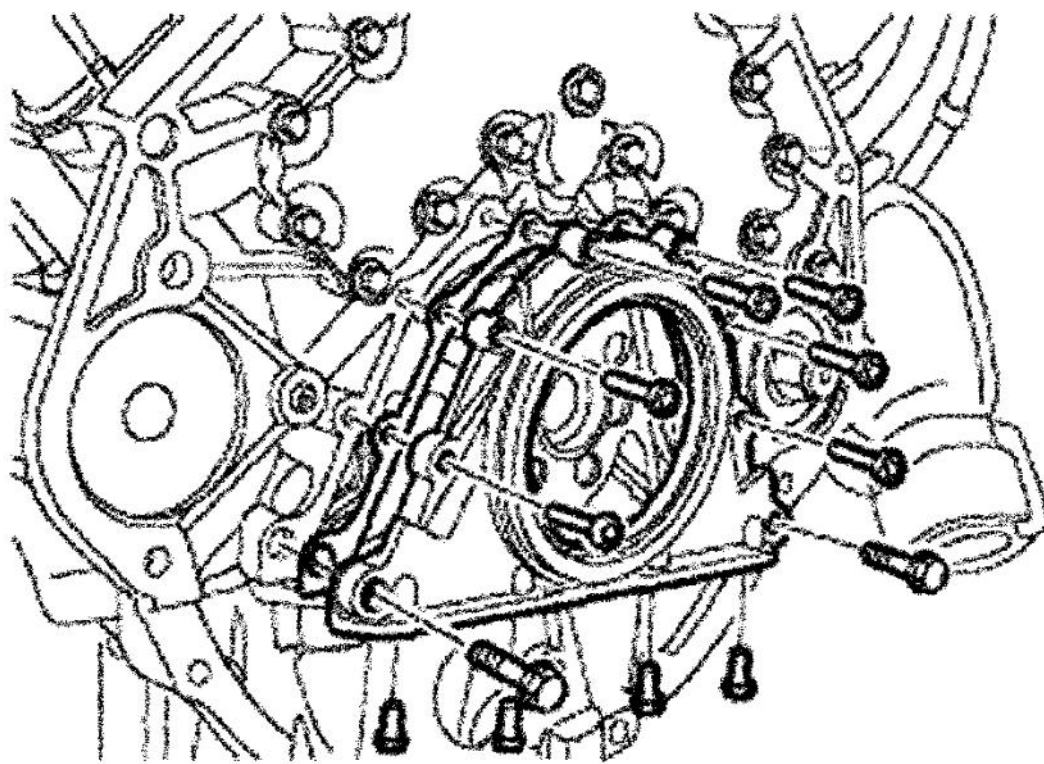
Installation

1. Clean lubricating jets and mating faces.
2. Fit lubrication jets and tighten Allen screws to 10 Nm (7 ft. lbs).
3. Fit connecting rod bearings. See **BEARINGS - CONNECTING RODS - ENGINE SET**.
4. Clean oil pump drive chain.
5. Lubricate oil pump drive chain with engine oil.
6. Fit oil pump drive chain to crankshaft gear.
7. Connect timing chain to crankshaft gear.
8. Fit timing gear lower cover. See **COVER - TIMING GEAR - LOWER**.
9. Fit crankshaft rear oil seal. See **OIL SEAL - CRANKSHAFT - REAR**.
10. Fit cylinder head gaskets. See **GASKET - CYLINDER HEAD - LEFT** and **GASKET - CYLINDER HEAD - RIGHT**.

OIL SEAL - CRANKSHAFT - FRONT

Disassembly

1. Remove torque converter drive plate. See **TORQUE CONVERTER DRIVE PLATE**.
2. Remove 6 Torx bolts securing crankshaft rear oil seal housing and discard sealing washers. See **Fig. 221**.
3. Remove 6 bolts securing crankshaft rear oil seal housing.
4. Carefully release and remove crankshaft rear oil seal housing.
5. Discard gasket from crankshaft rear oil seal housing.
6. Remove crankshaft rear oil seal from housing.

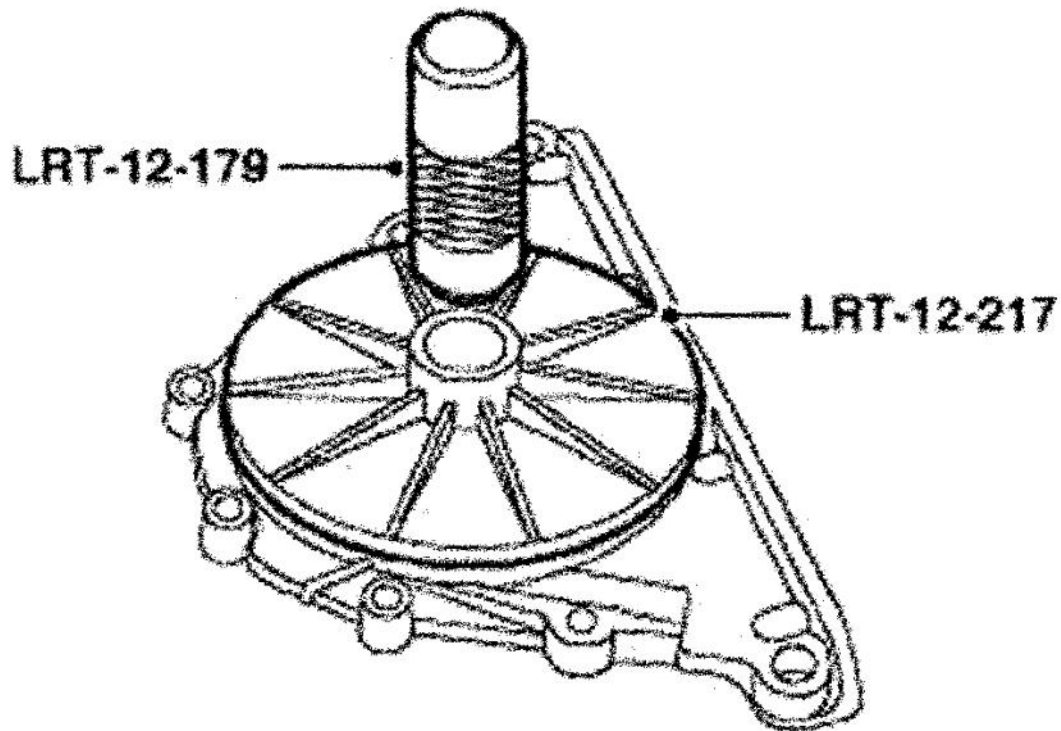


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Fig. 221: Removing Crankshaft Rear Oil Seal Housing Torx Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.

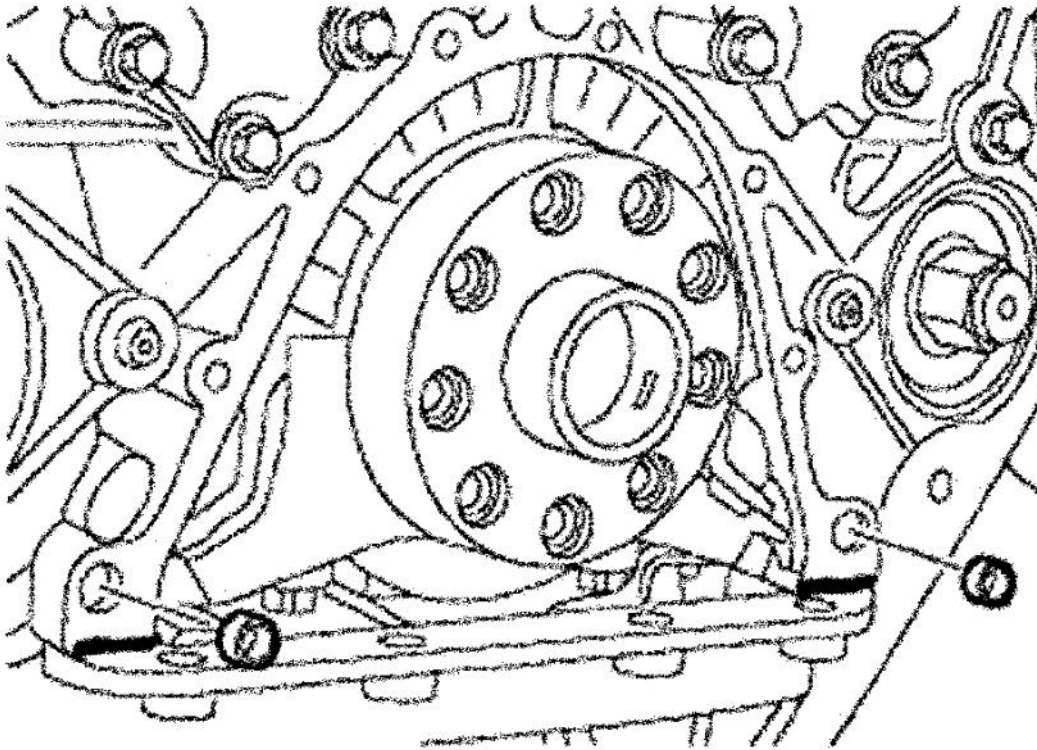
Reassembly

1. Clean oil seal housing, dowel and dowel holes.
2. Clean oil seal recess in housing and running surface on crankshaft.
3. Clean oil seal housing mating face on cylinder block and remove old sealant from sump gasket.
4. Fit LRT-12-217 and LRT-12-179 to new crankshaft rear oil seal and fit new seal to housing. See **Fig. 222**.
5. Check for correct fitment of dowels in cylinder block. See **Fig. 223**.
6. Fit new gasket to crankshaft rear oil seal housing.
7. Apply sealant to oil seal housing contact points as shown. See **Fig. 224**.
8. Fit LRT-12-218 to crankshaft, apply a thin coat of oil to inner lip of crankshaft rear oil seal, fit seal housing over LRT-12-218 onto dowels and remove LRT-12-218. See **Fig. 225**.
9. Fit new sealing washers to 6 Torx bolts, fit 6 Torx bolts and 6 bolts securing crankshaft oil seal housing to cylinder block and tighten to 12 Nm (9 ft. lbs).
10. Fit torque converter drive plate. See **TORQUE CONVERTER DRIVE PLATE**.



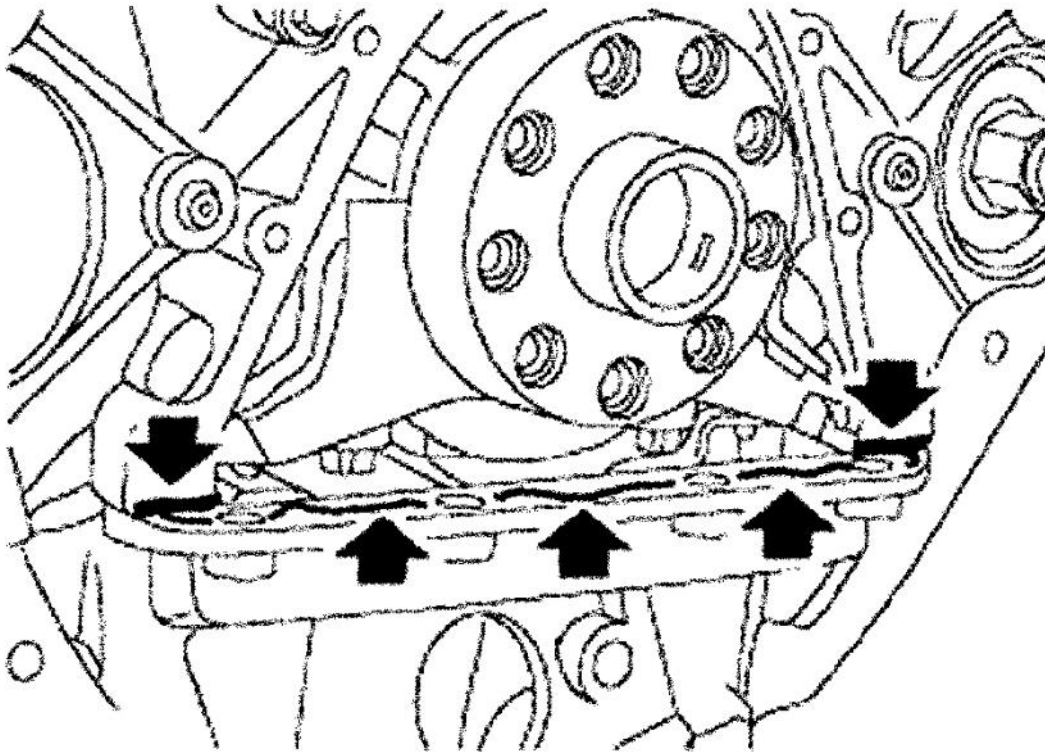
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Fig. 222: Installing NEW Crankshaft Rear Oil Seal With LRT-12-217 & LRT-12-179
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388228

Fig. 223: Checking Installation Of Dowels In Cylinder Block
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 224: Applying Sealant To Oil Seal Housing
Courtesy of LAND ROVER NORTH AMERICA, INC.

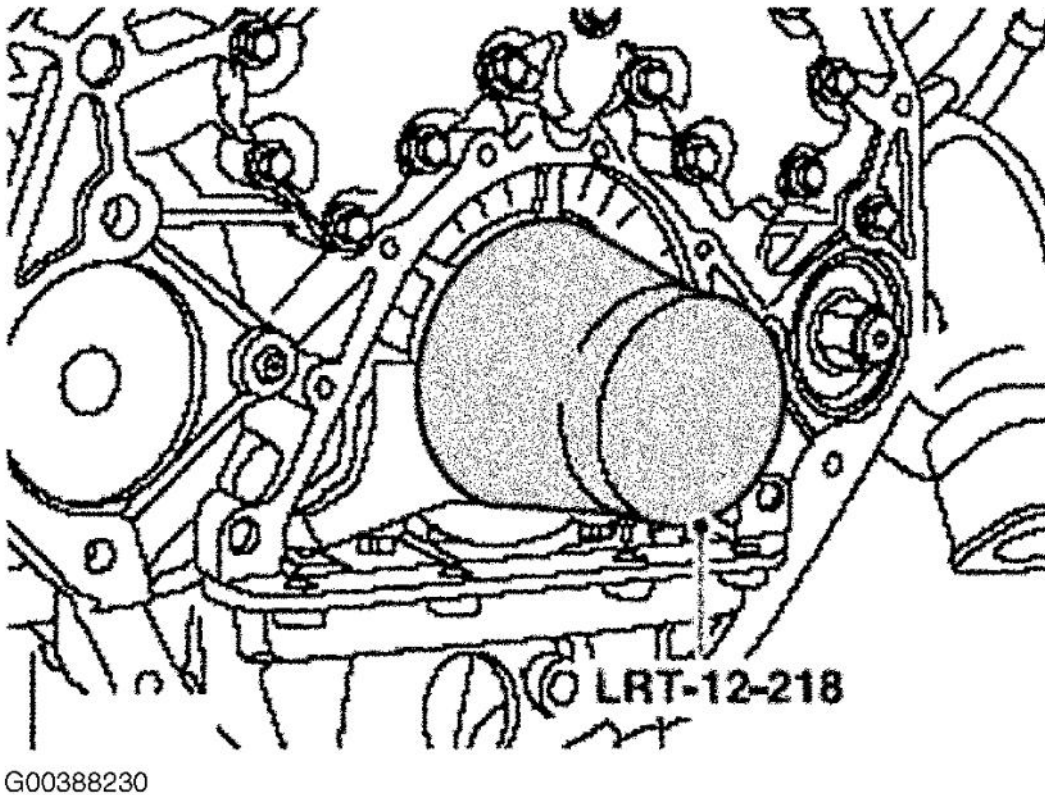


Fig. 225: Installing Crankshaft Rear Oil Seal With LRT-12-218
Courtesy of LAND ROVER NORTH AMERICA, INC.

GASKET - CYLINDER HEAD

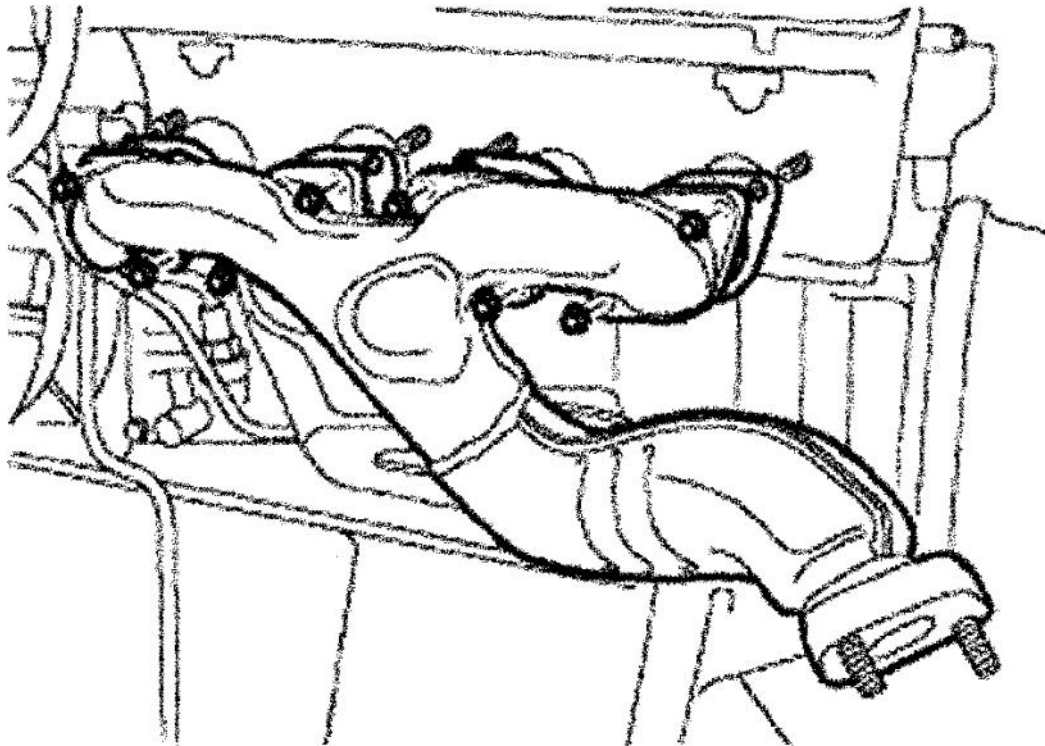
Removal

1. Remove 8 nuts securing exhaust manifold, remove exhaust manifold and discard nuts and 2 gaskets. See **Fig. 226**.
2. Remove coolant pump to coolant manifold pipes. See **PIPES - WATER PUMP TO COOLANT MANIFOLD**.
3. Remove left Variable Camshaft Control (VCC) unit. See **VARIABLE CAMSHAFT UNIT - VARIABLE CAMSHAFT CONTROL (VCC) - LEFT**.
4. Remove LRT-12-227 from timing tool access hole. See **Fig. 227**.
5. Rotate engine crankshaft pulley anti-clockwise to align the 45° before TDC timing mark. See **Fig. 13**.

NOTE: Raise timing chain and hold under tension while turning crankshaft pulley.

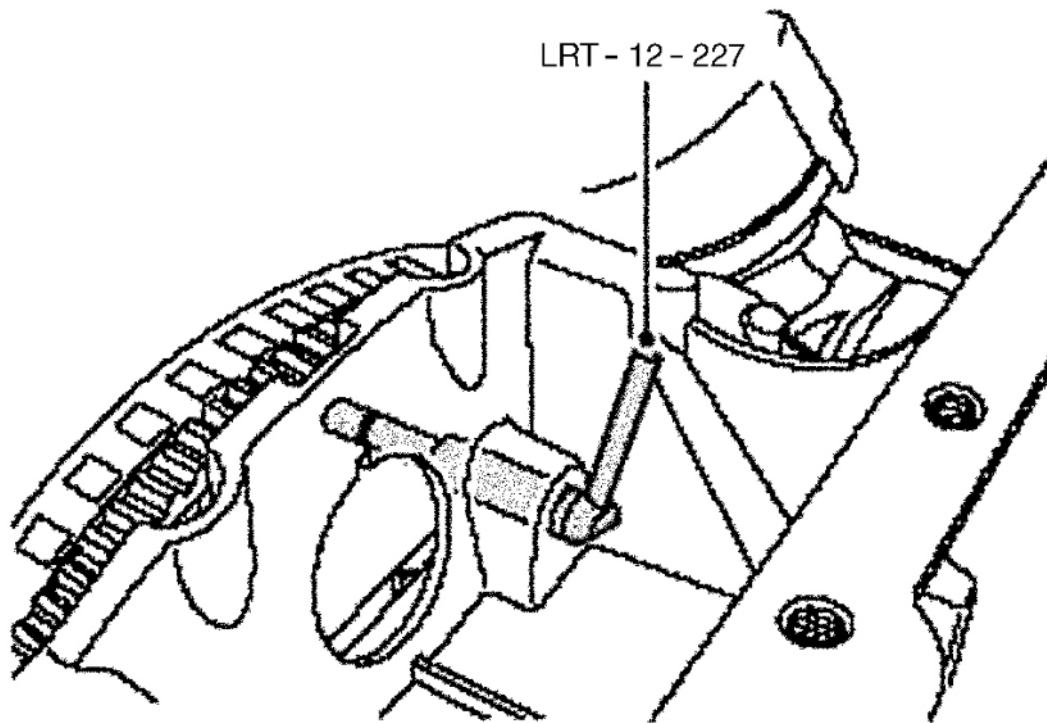
6. Remove LRT-12-223/6, LRT-12-223/5, LRT-12-223/3 and LRT-12-223/4 from left cylinder head camshafts.

7. Remove bolt securing left timing chain guide rail to left cylinder head. See **Fig. 228**.



G00388231

Fig. 226: Removing Exhaust Manifold
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 227: Removing Timing Tool LRT-12-227
Courtesy of LAND ROVER NORTH AMERICA, INC.

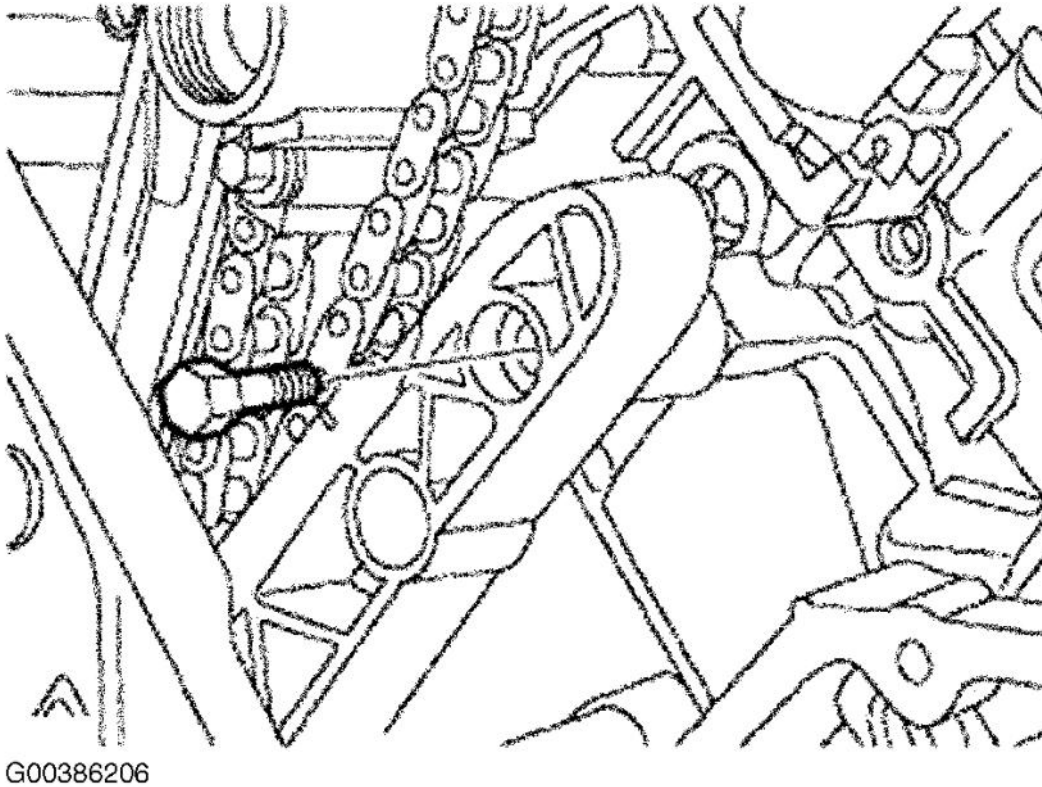
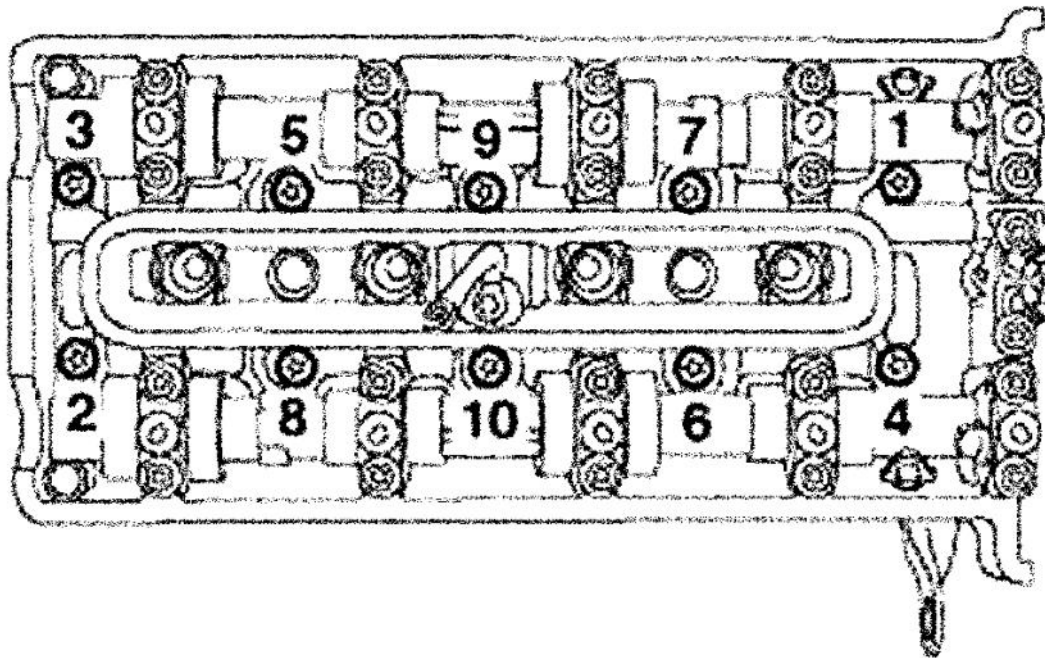


Fig. 228: Removing Left Timing Chain Guide Rail Bolt From Left Cylinder Head
Courtesy of LAND ROVER NORTH AMERICA, INC.

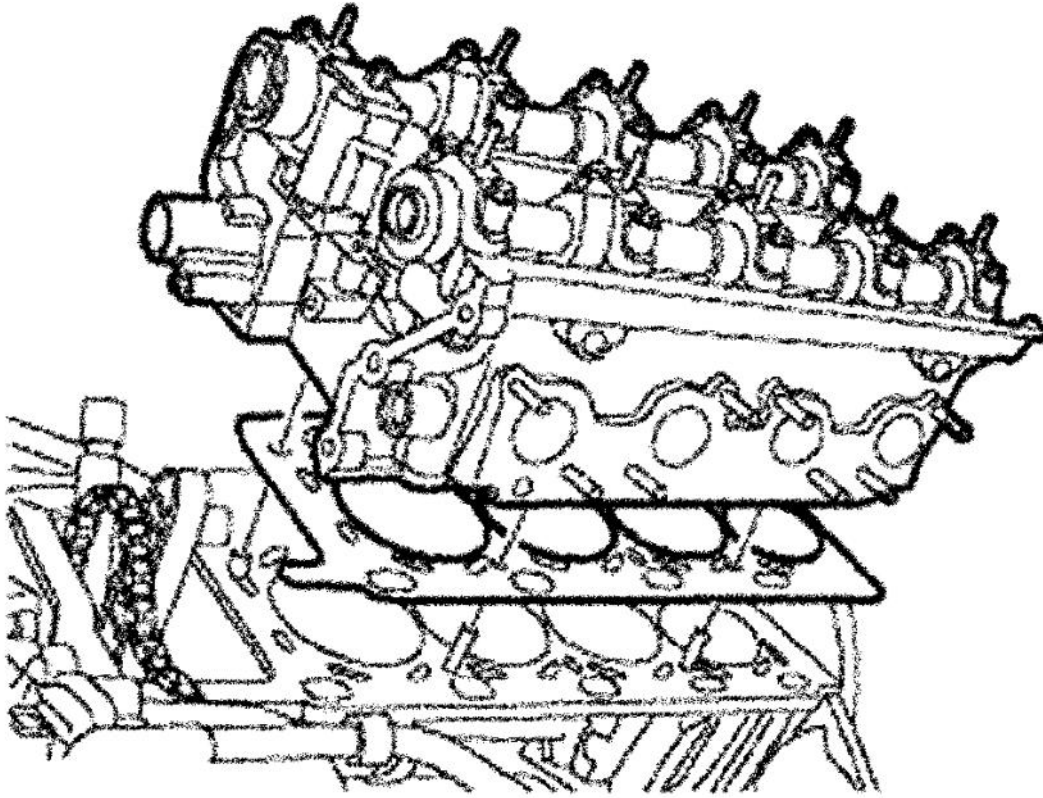
Disassembly

1. Working in the sequence shown, progressively loosen 10 cylinder head bolts. See **Fig. 229**.
2. Discard 10 cylinder head bolts and remove 10 cylinder head bolt washers.
3. With assistance, remove cylinder head assembly.
4. Discard cylinder head gasket. See **Fig. 230**.
5. Discard "O" ring from cylinder block to left cylinder head mating face. See **Fig. 231**.



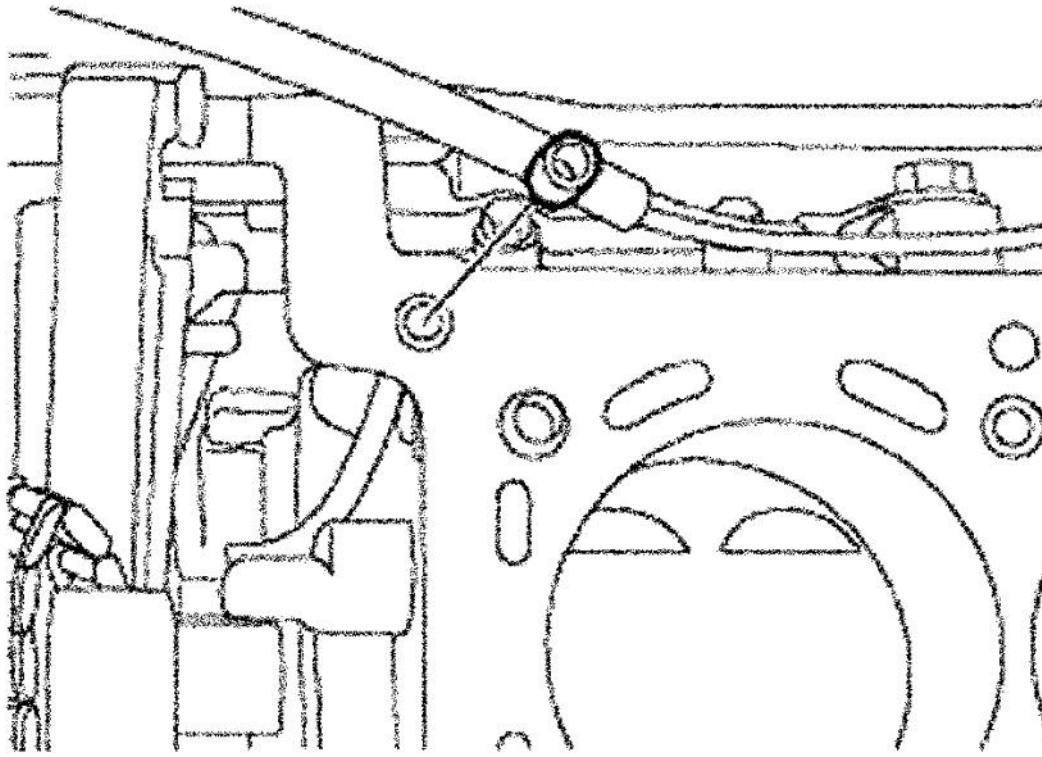
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Fig. 229: Removing Cylinder Head Bolts In Sequence
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386208

Fig. 230: Removing Cylinder Head Assembly
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00386209

Fig. 231: Discarding "O" Ring From Cylinder Block
Courtesy of LAND ROVER NORTH AMERICA, INC.

Inspection

1. Clean mating faces of cylinder head and cylinder block, dowels and dowel holes. If necessary remove all traces of sealing compound with hard wood scraper. Ensure remnants do not remain in oil ways cooling ducts or bolt holes.

CAUTION: Make sure no oil or coolant is left in the cylinder head bolt holes as damage to the cylinder block may occur when tightening the cylinder head bolts.

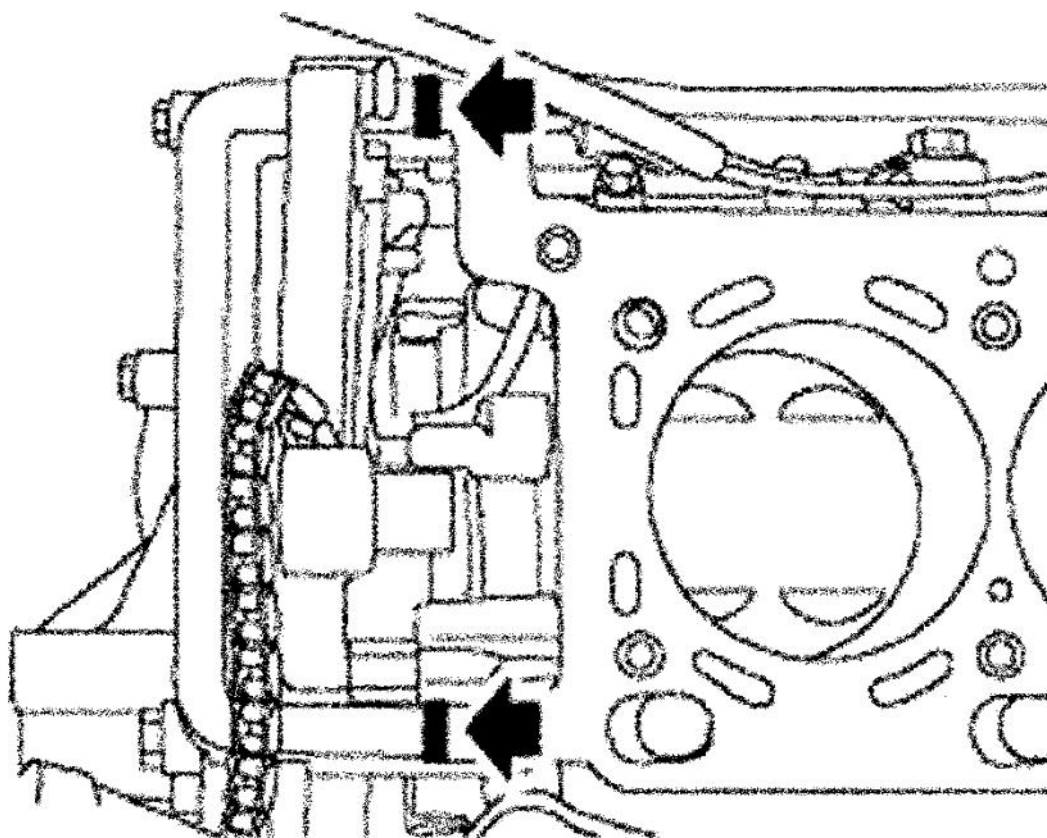
2. Using a straight edge and feeler gauges, check cylinder head for distortion along lines shown in illustration. See **Fig. 18**.

Reassembly

1. Fit new "O" ring to cylinder block.
2. Apply sealant STC 50550 to areas illustrated. See **Fig. 232**.

3. Fit new cylinder head gasket to locating dowels on cylinder block.
4. With assistance, fit cylinder head and carefully position cylinder head onto dowels.
5. Fit cylinder head bolt washers and new cylinder head bolts. Tighten cylinder head bolts in sequence shown to 30 Nm (22 ft. lbs). Using an angle torque gauge tighten all bolts in sequence by 80° and then a final 80°. See **Fig. 30**.

NOTE: DO NOT remove special coating from new cylinder head bolts.



G00388233

Fig. 232: Applying Sealant To Cylinder Head
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Fit bolt securing left timing chain guide and tighten to 10 Nm (7 ft. lbs).
2. Carefully rotate camshafts until letter and cylinder number markings located on rear of camshafts are in an upright position. See **Fig. 21**.
3. Loosen bolt securing LRT-12-223/4 to LRT-12-223/3.

4. Fit LRT-12-223/4 and LRT-12-223/3 to rear of left camshafts and tighten bolt securing tools. See **Fig. 22**.
5. Fit LRT-12-223/5, LRT-12-223/6 to left cylinder head and tighten LRT-12-223/6 into spark plug thread. See **Fig. 23**.
6. Rotate engine crankshaft pulley clockwise to align TDC timing mark. See **Fig. 24**.

NOTE: **Raise timing chain and hold under tension while turning crankshaft pulley.**

7. Position LRT-12-227 through timing tool access hole and secure flywheel in TDC position. See **Fig. 12**.
8. Fit left Variable Camshaft Control (VCC) unit. See **VARIABLE CAMSHAFT UNIT - VARIABLE CAMSHAFT CONTROL (VCC) - LEFT**.
9. Fit coolant pump to coolant manifold pipes. See **PIPES - WATER PUMP TO COOLANT MANIFOLD**.
10. Clean exhaust manifold mating faces and fit new gaskets.
11. Apply copper grease to exhaust manifold studs, fit exhaust manifold, fit 8 new nuts securing exhaust manifold and tighten to 23 Nm (17 ft. lbs).

CYLINDER HEAD - OVERHAUL

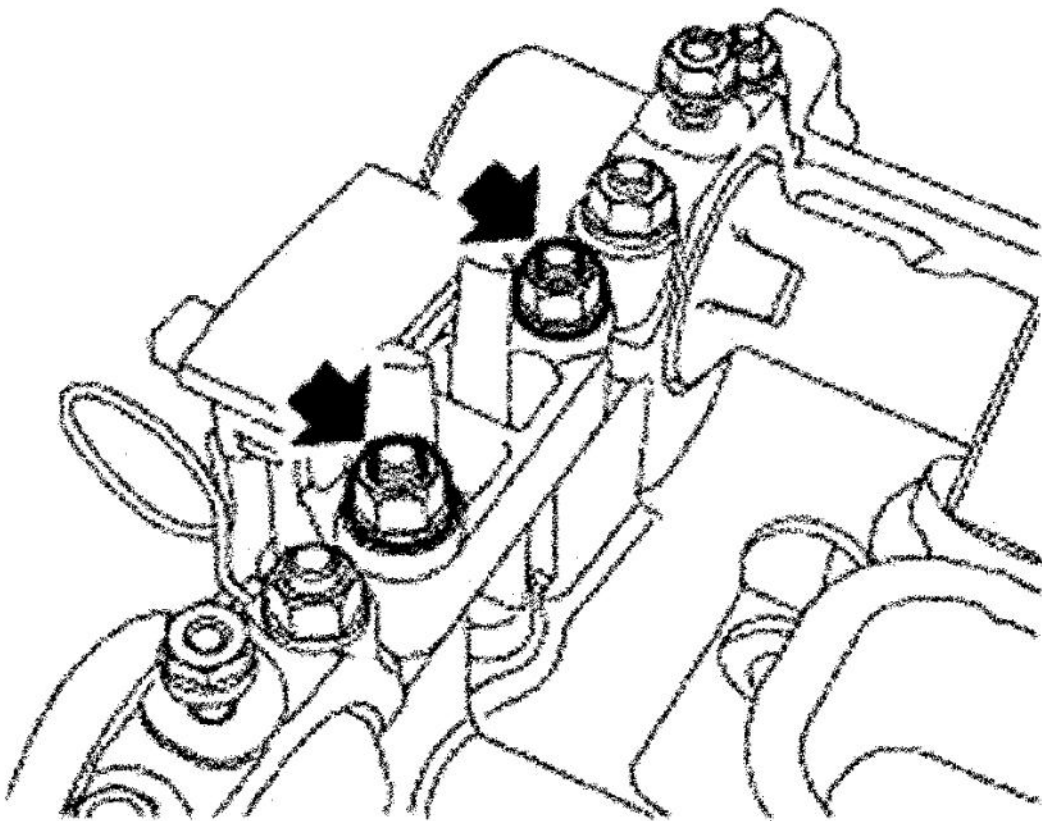
Removal

1. Remove 2 nuts securing exhaust camshaft drive chain tensioner, remove tensioner and discard "O" ring. See **Fig. 233**.
2. Remove 5 bolts securing Variable Camshaft Control (VCC) oil distribution housing. Remove sealing washer from long bolt and discard washer. See **Fig. 234**.
3. Remove VCC oil distribution housing, remove and discard gasket.

NOTE: **If distribution unit is worn, move unit backwards and forwards to release from sealing rings.**

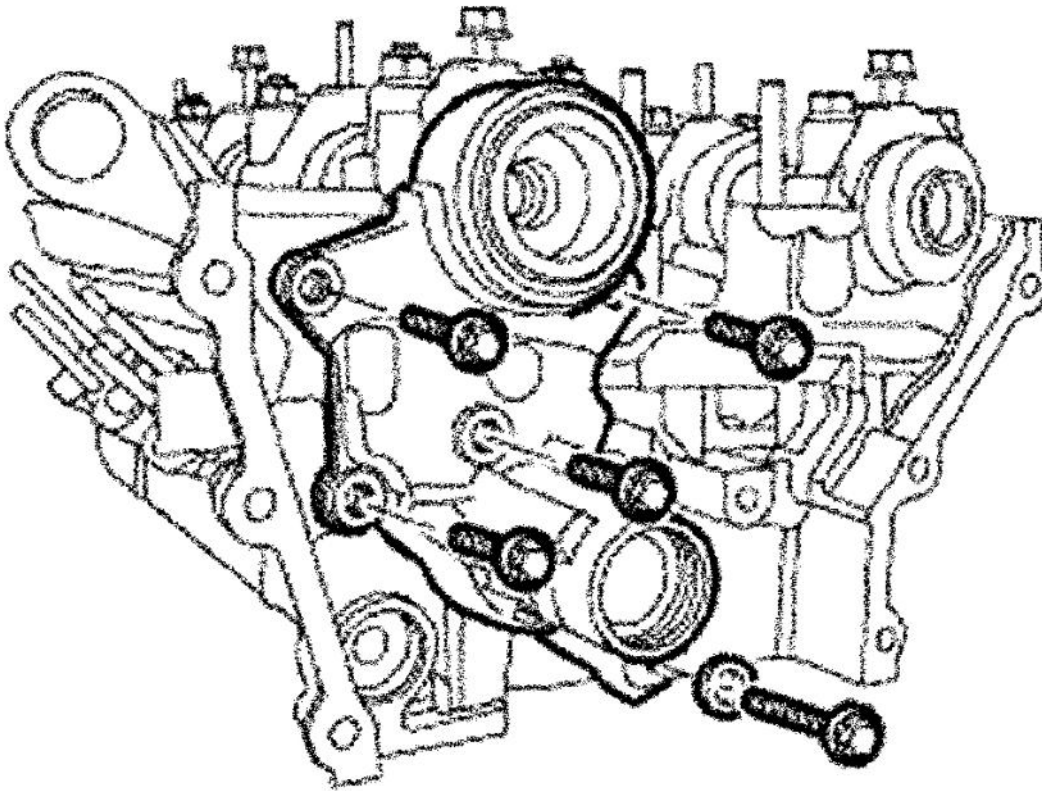
4. Carefully release and remove 3 Variable Camshaft Control (VCC) oil distribution sealing rings from the inlet camshaft. See **Fig. 235**.
5. Fit an M10 bolt into the VCC non-return valve and by hand, remove the valve from the cylinder head. Discard "O" ring. See **Fig. 236**.
6. Check camshaft end-float using a DTI.
7. Using a spanner on the hexagon, rotate inlet camshaft until lobes of cylinder 8 face upwards. See **Fig. 237**.
8. Using a spanner on the hexagon, rotate exhaust camshaft until lobes of cylinder 6 face upwards.
9. Identify camshaft bearing caps for refitting. Inlet camshaft is marked "E" with caps marked from E1 to E5 from driven end of camshaft when viewed from inlet side of cylinder head. Exhaust camshaft is marked "A" with caps marked A1 to A5 from driven end of camshaft when viewed from inlet side of cylinder head.
10. Evenly and progressively loosen and remove 10 nuts securing inlet camshaft bearing caps. See **Fig. 238**.
11. Remove camshaft bearing caps.

12. Remove inlet camshaft.
13. Evenly and progressively loosen and remove 10 nuts securing exhaust camshaft bearing caps. See **Fig. 239**.
14. Remove camshaft bearing caps.
15. Remove exhaust camshaft.
16. Remove tappets. Retain in fitted order if to be refitted.
17. Position LRT-12-034 to spring cap and compress valve spring. See **Fig. 240**.
18. Remove 2 collets and release valve spring compressor.
19. Remove valve stem oil seal using LRT-12-071. Discard stem seal. See **Fig. 241**.
20. Repeat procedure for remaining valves, keeping components in their fitted order.



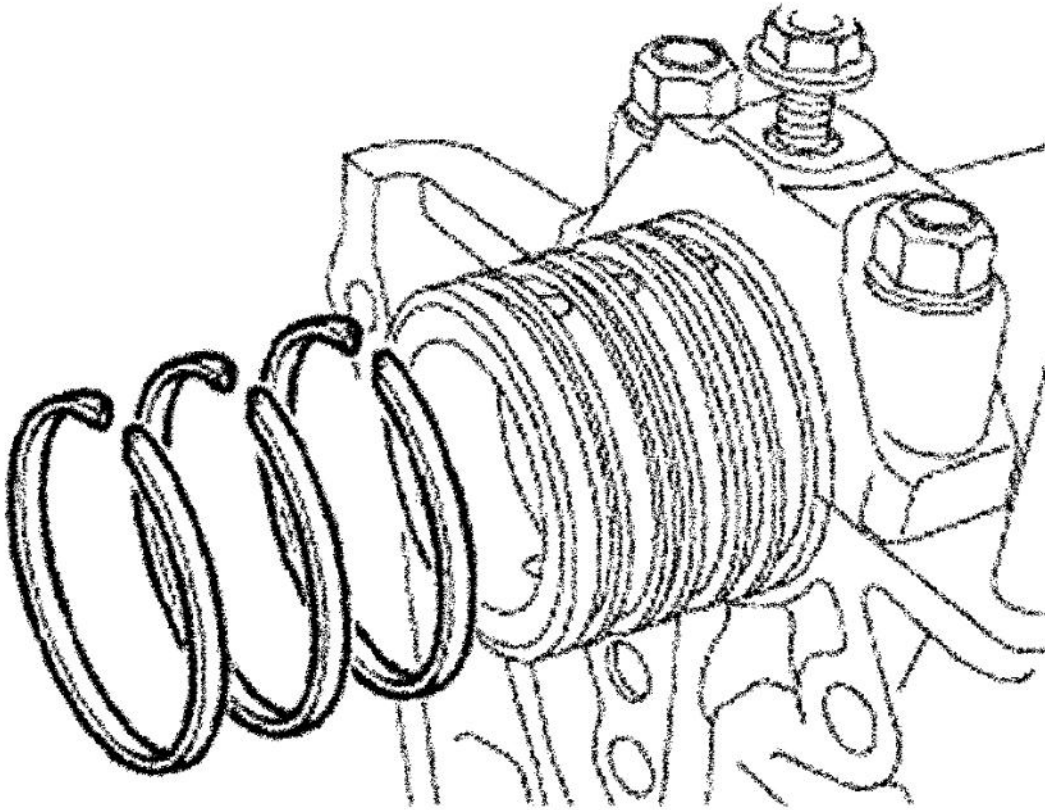
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Fig. 233: Removing Exhaust Camshaft Drive Chain Tensioner Nuts
Courtesy of LAND ROVER NORTH AMERICA, INC.



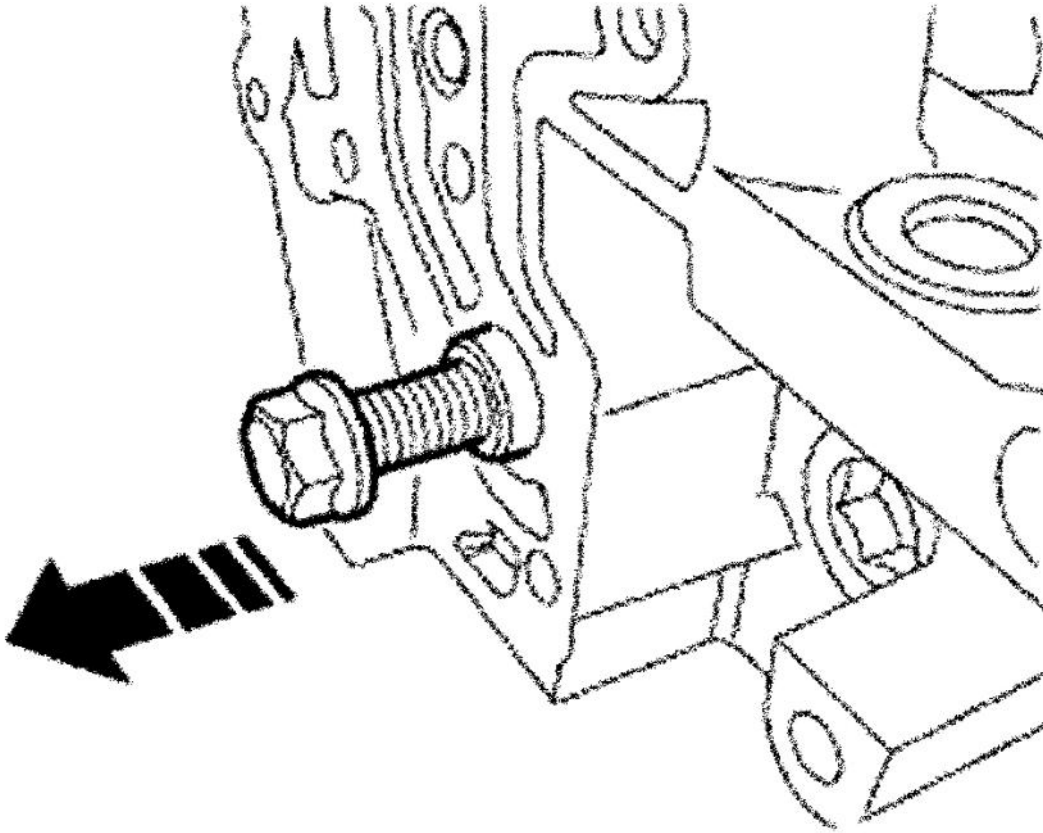
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Fig. 234: Removing Oil Distribution Housing Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.



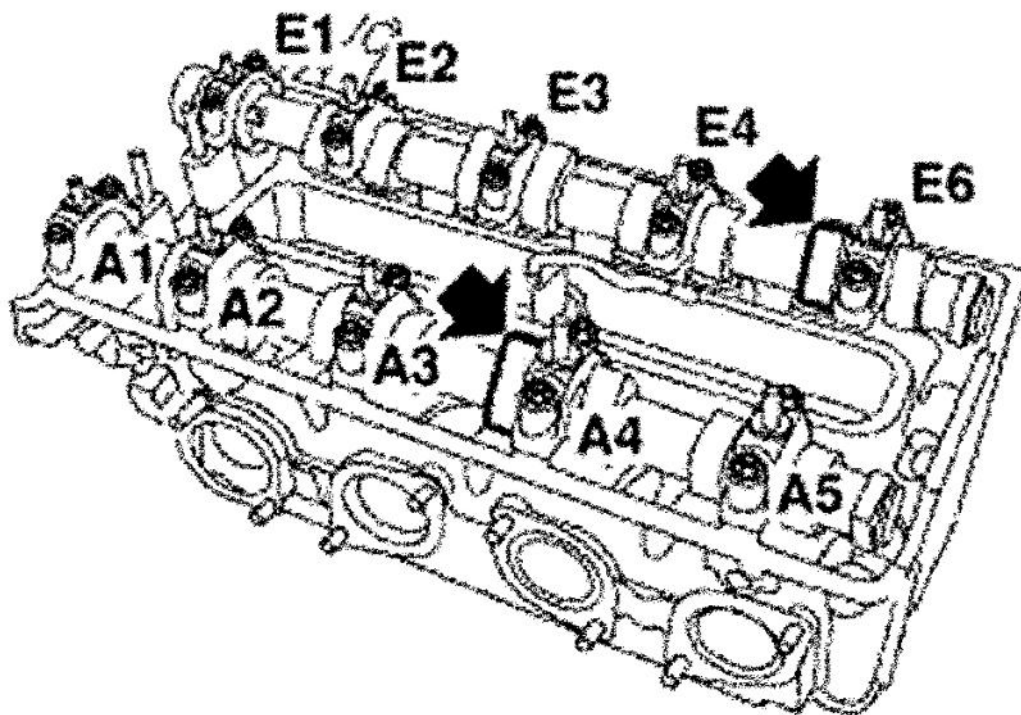
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Fig. 235: Removing Variable Camshaft Control Oil Distribution Sealing Rings
Courtesy of LAND ROVER NORTH AMERICA, INC.



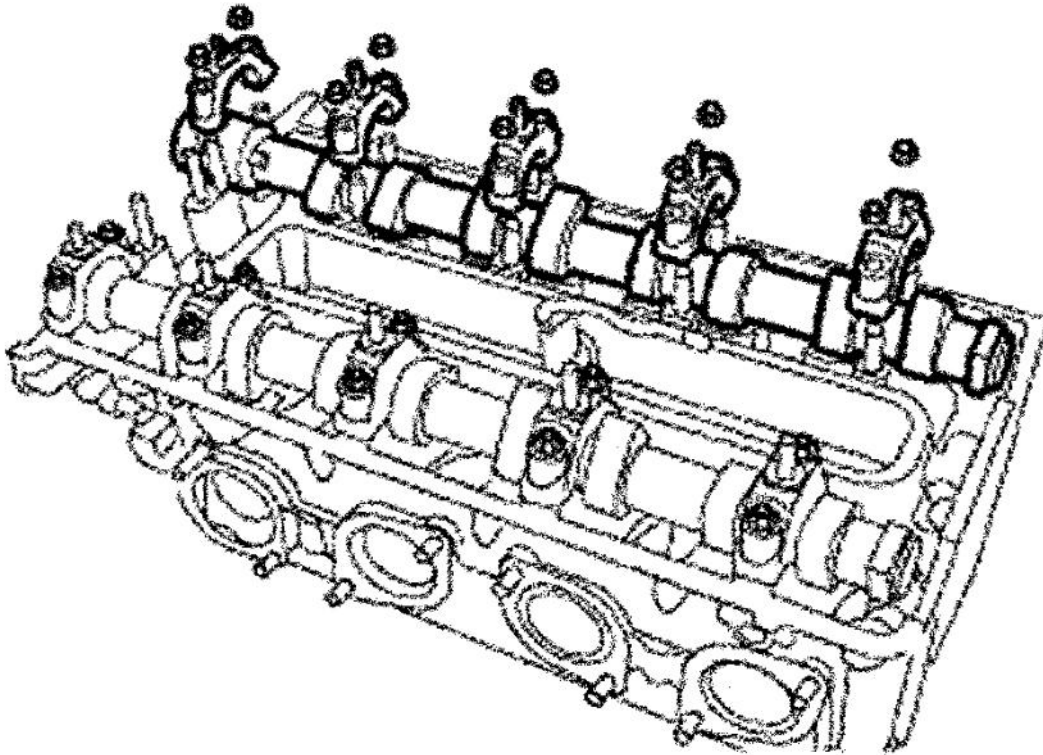
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Fig. 236: Installing An M10 Bolt Into Variable Camshaft Control Non-Return Valve
Courtesy of LAND ROVER NORTH AMERICA, INC.



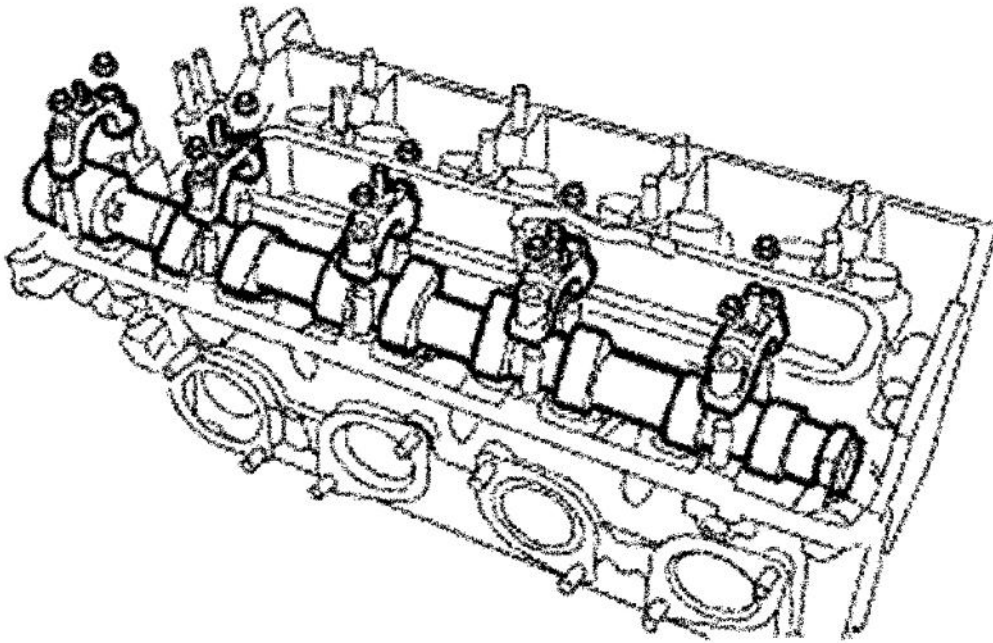
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Fig. 237: Rotating Inlet Camshaft Until Lobes Of Cylinder 8 Face Upwards
Courtesy of LAND ROVER NORTH AMERICA, INC.



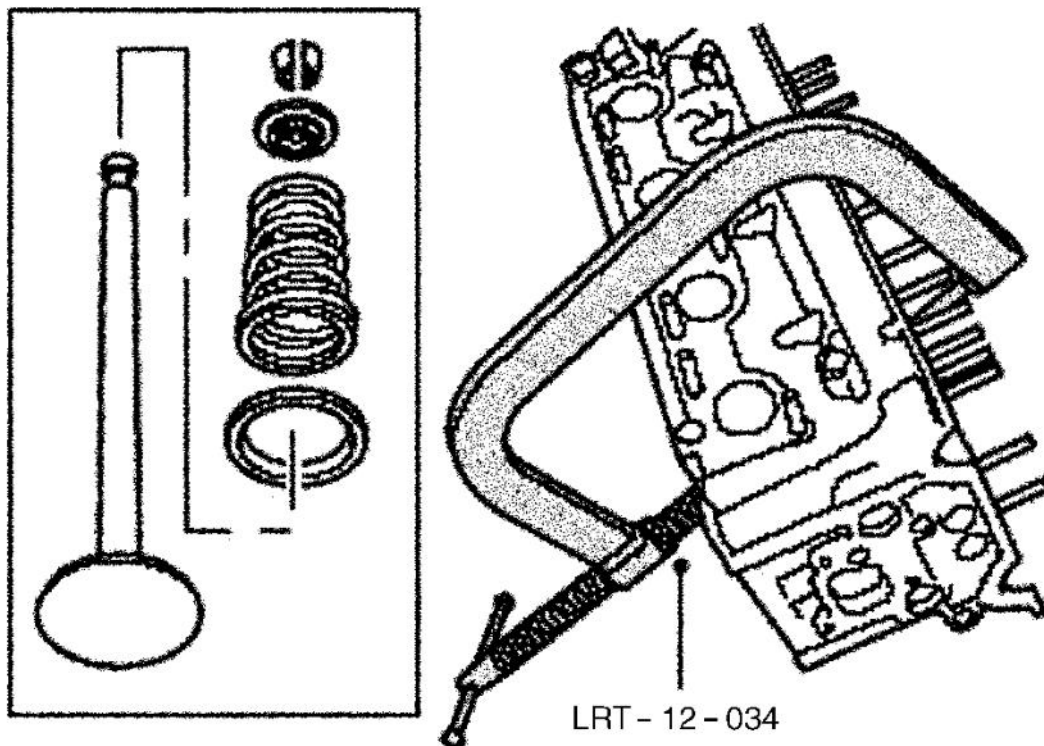
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Fig. 238: Removing Inlet Camshaft Bearing Caps Nuts
Courtesy of LAND ROVER NORTH AMERICA, INC.



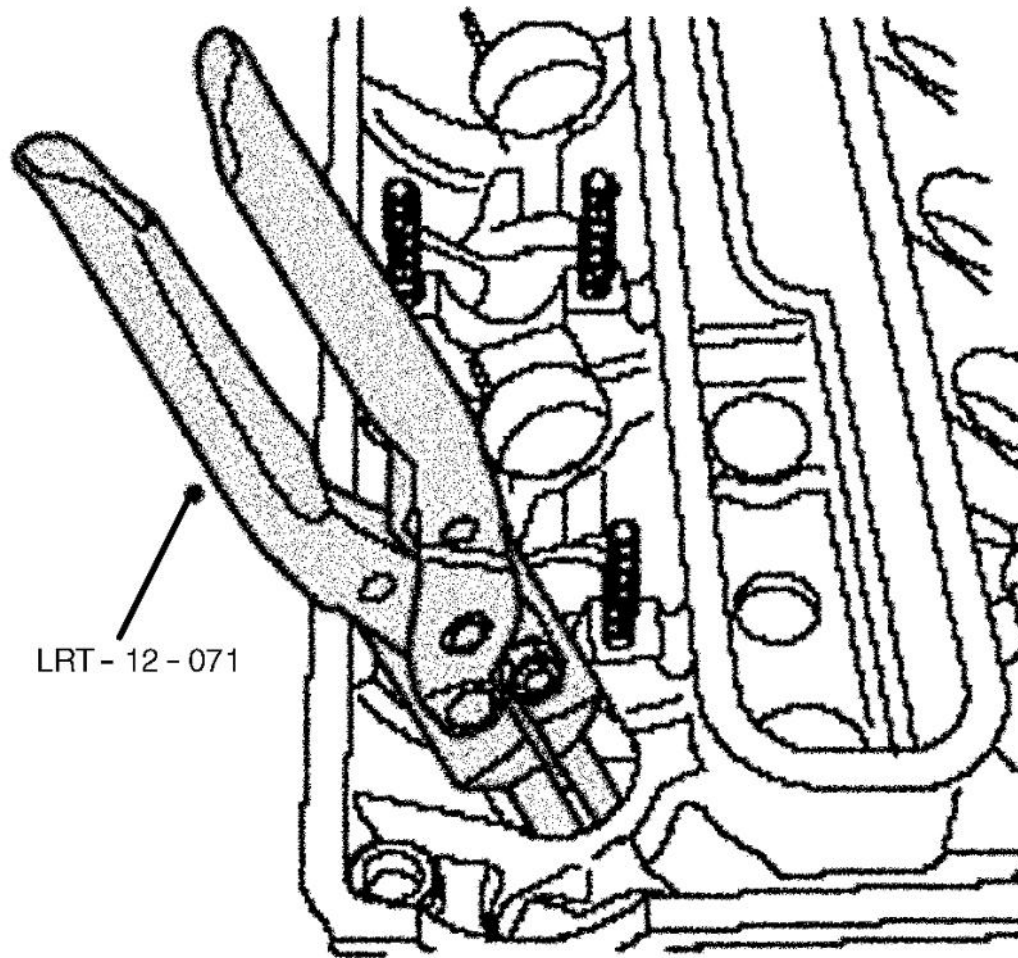
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Fig. 239: Removing Exhaust Camshaft Bearing Cap Nuts
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 240: Positioning LRT-12-034 To Spring Cap & Compressing Valve Spring
Courtesy of LAND ROVER NORTH AMERICA, INC.



LRT - 12 - 071

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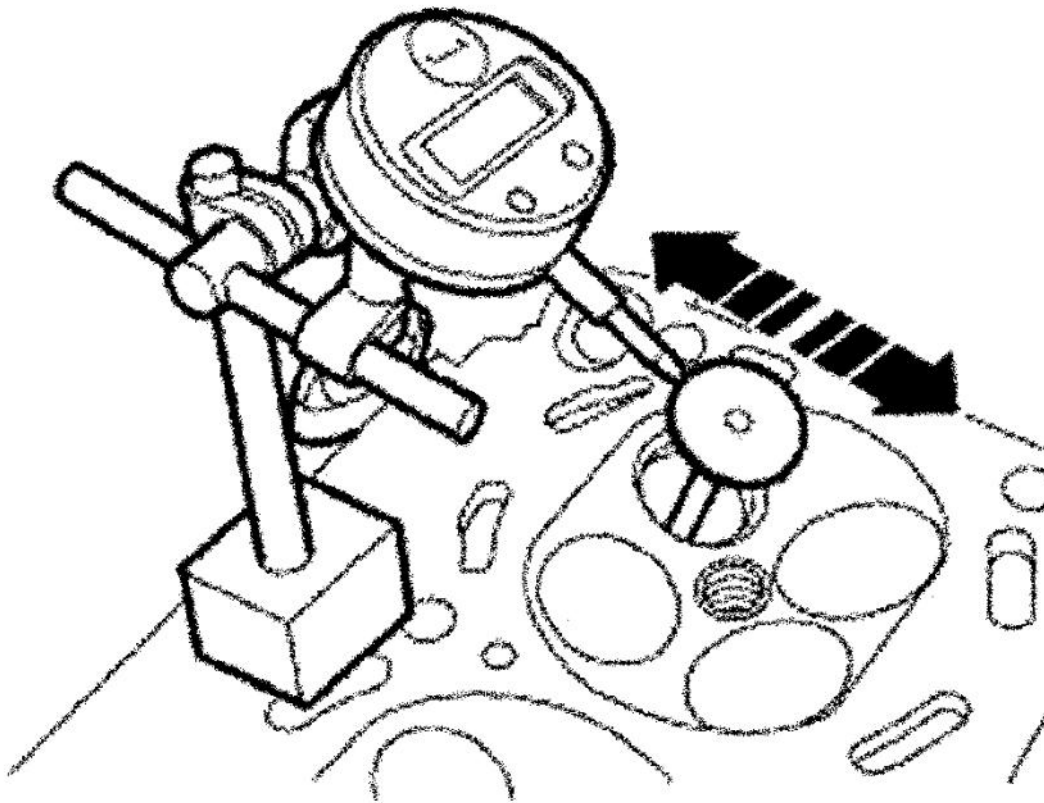
Fig. 241: Removing Valve Stem Oil Seal with LRT-12-071
Courtesy of LAND ROVER NORTH AMERICA, INC.

Inspection

1. Inspect camshafts and replace camshafts if scored, pitted or excessively worn.
2. Check camshaft, camshaft bearings in cylinder head and bearing caps for wear.
3. Using a straight edge and feeler gauges, check cylinder head for distortion along lines shown in illustration. See **Fig. 18**.
4. Clean valve seat, inspect for pitting, burning, cracks and wear. See **Fig. 242**.
5. Fit new valve to valve guide, with end of valve stem level with valve guide.
6. Mount dial gauge onto cylinder head and zero gauge on valve head. Move valve from side to side to measure valve guide wear.
7. If valve movement is excessive, the guides can be reamed to accept valves with a larger stem diameter.

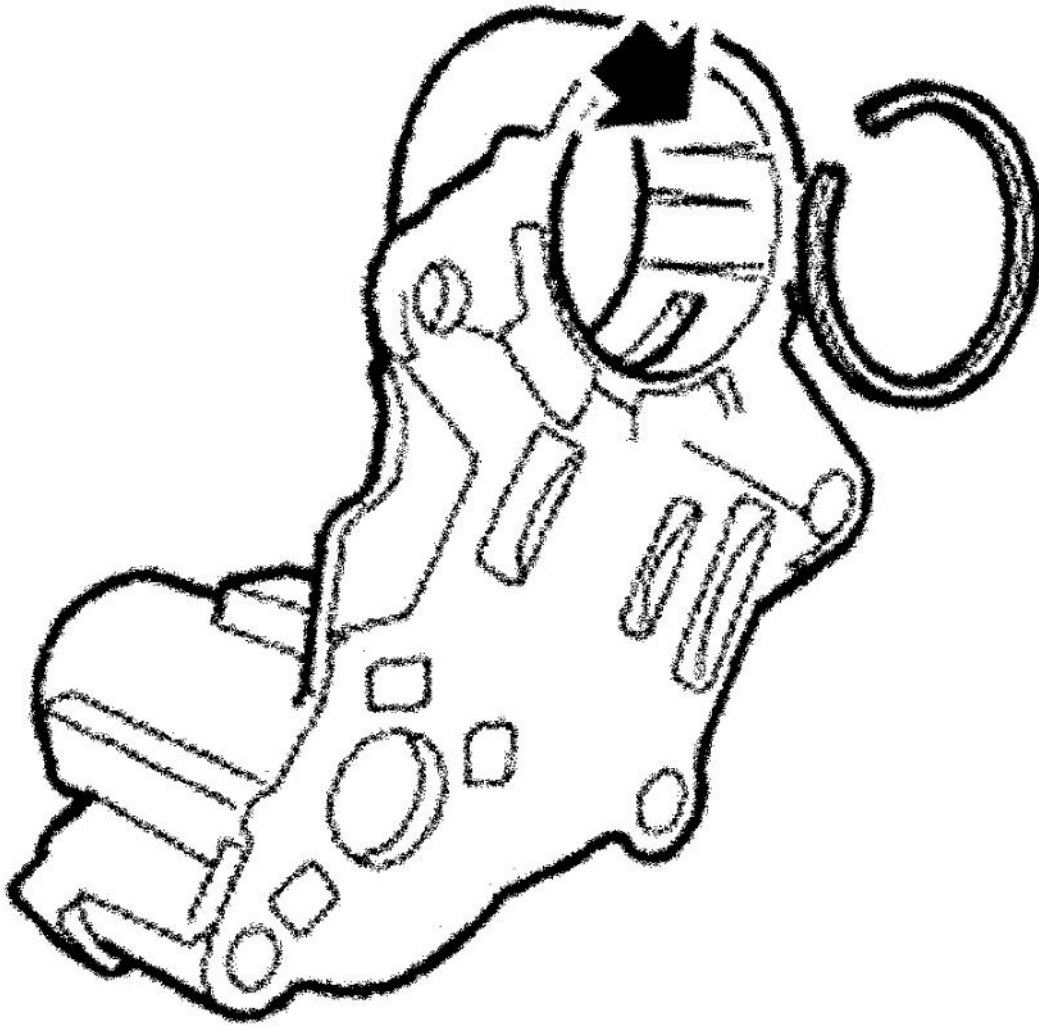
8. If valve guides have been reamed to fit valves with a larger stem diameter then the valve seats must be cut as shown using LRT-12-501, LRT-12-503 and LRT-12-517.
9. Ensure cutter blades are fitted correctly to cutter head. Adjust blades so that middle of the blade contacts the area to be cut. Use light pressure and remove the minimum of material.
10. Repeat as necessary for all valves, valve guides and valve seats.
11. Inspect the Variable Camshaft Control (VCC) oil distribution housing and sealing rings for signs of wear.

CAUTION: Replace distribution housing and sealing rings if pitting or scoring is evident in a longitudinal direction.



G00388243

Fig. 242: Mounting Dial Gauge Onto Cylinder Head
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388244

Fig. 243: Inspecting Variable Camshaft Control (VCC) Oil Distribution Housing & Sealing Rings For Signs Of Wear

Courtesy of LAND ROVER NORTH AMERICA, INC.

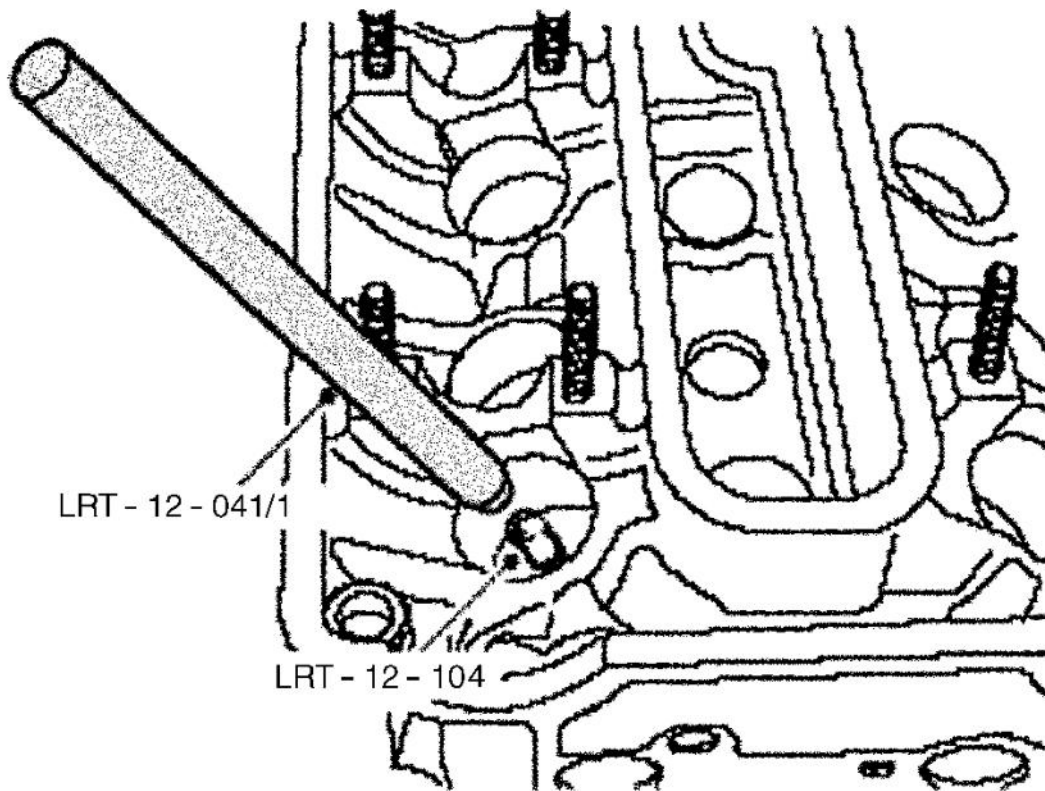
Reassembly

1. Clean combustion space valve guide and manifold ports, blow out with air line.
2. Clean valve, valve spring, spring seat, cap and collets.
3. Lubricate valve with clean engine oil and fit valve.
4. Fit LRT-12-104 over valve stem, fit new seal to valve stem, and remove LRT-12-104. Press valve seal onto valve guide using LRT-12-041/1. See **Fig. 244**.
5. Fit valve spring seat, valve spring and spring cap. See **Fig. 245**.

6. Use LRT-12-034 to compress valve spring. Fit collets and carefully release spring.
7. Repeat above for remaining valves.
8. Clean tappets, tappet bores and ensure oil ways are clear.
9. Lubricate tappets and tappet bores, fit the tappets in original positions.
10. Clean camshafts.
11. Clean camshaft bearings and caps. Ensure oil ways are clear.
12. Lubricate camshaft and camshaft bearings.
13. Fit exhaust camshaft with lobes of cylinder 6 facing upwards. Fit bearing caps marked "A" in correct order and tighten the nuts evenly and progressively to 14 Nm (10 ft. lbs). See **Fig. 246**.
14. Fit inlet camshaft with lobes of cylinder 8 facing upwards. Fit bearing caps marked "E" in the correct order and tighten the nuts evenly and progressively to 14 Nm (10 ft. lbs).
15. Clean Variable Camshaft Control (VCC) oil non-return valve and ensure oil ways are clear.
16. Using a new "O" ring, fit the VCC oil non return valve to the cylinder head.

CAUTION: VCC non-return valve to be fitted with M10 thread visible.

17. Clean VCC unit oil distribution rings and grooves in inlet camshaft.
18. Lubricate VCC oil distribution rings and carefully fit rings to grooves in inlet camshaft.
19. Clean VCC oil distribution housing and mating face on cylinder head. Ensure oil ways are clear.
20. Fit VCC oil distribution housing gasket to cylinder head.
21. With all VCC ring gaps facing upwards, fit housing squarely over rings and align to cylinder head. See **Fig. 247**.
22. Fit a new sealing washer to the long bolt and tighten all bolts securing VCC housing to 10 Nm (7 ft. lbs).
23. Clean exhaust camshaft timing chain tensioner and mating face. Ensure oil way is clear.
24. Lubricate exhaust camshaft drive chain tensioner.
25. Using a new "O" ring, fit exhaust camshaft drive chain tensioner and tighten bolts to 10 Nm (7 ft. lbs).
26. Clean exhaust manifold and cylinder head mating face.
27. Use new gaskets and fit exhaust manifold to cylinder head.
28. Fit nuts securing exhaust manifold and tighten to 24 Nm (18 ft. lbs).



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Fig. 244: Installing NEW Seal To Valve Stem With LRT-12-104
Courtesy of LAND ROVER NORTH AMERICA, INC.

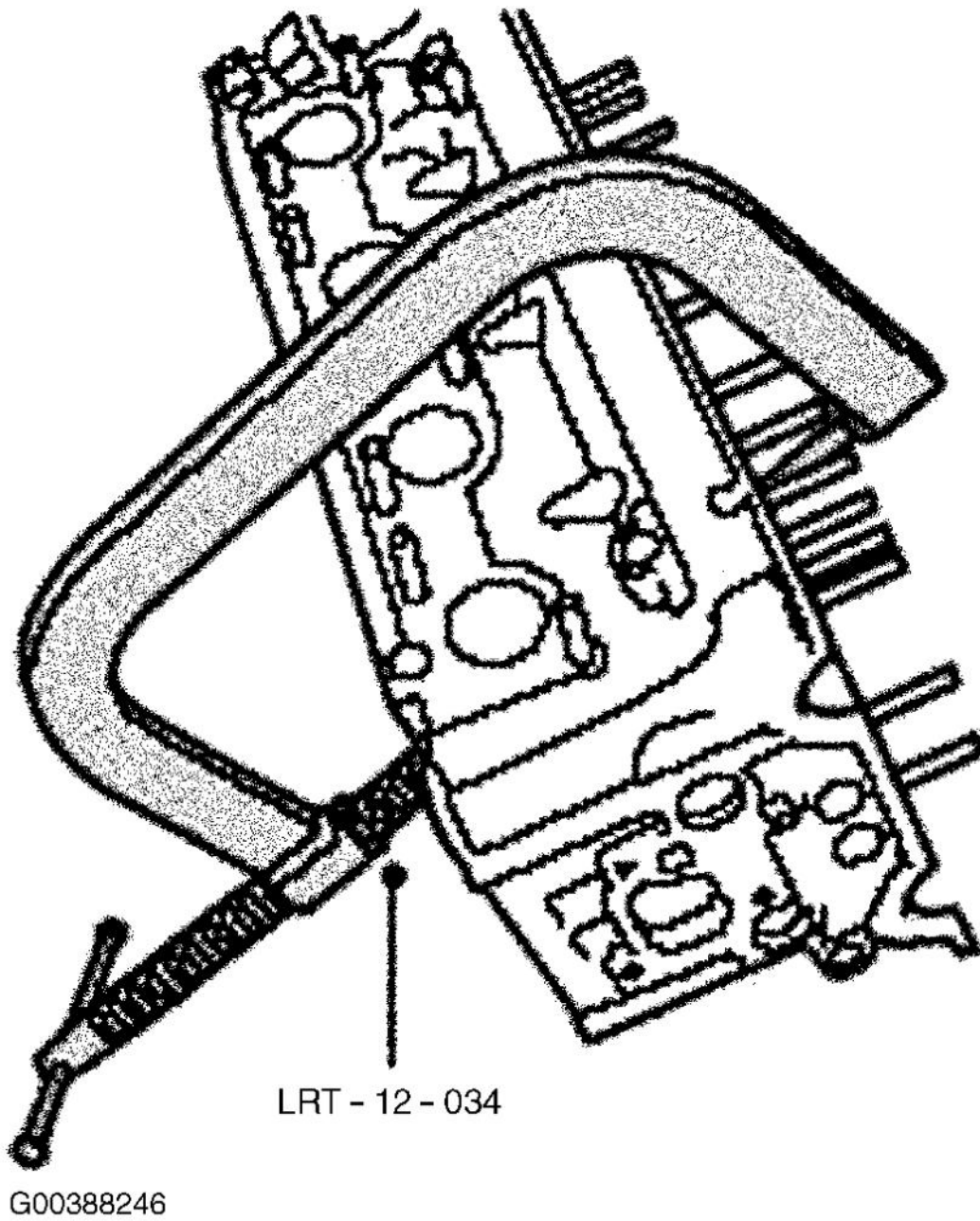
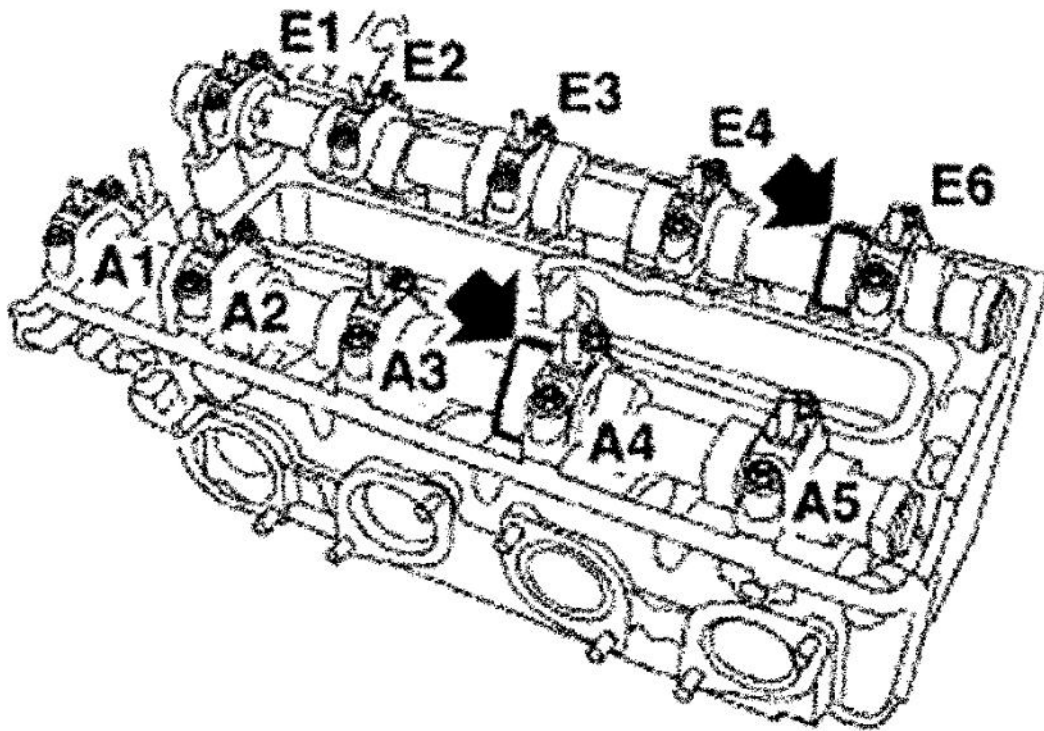
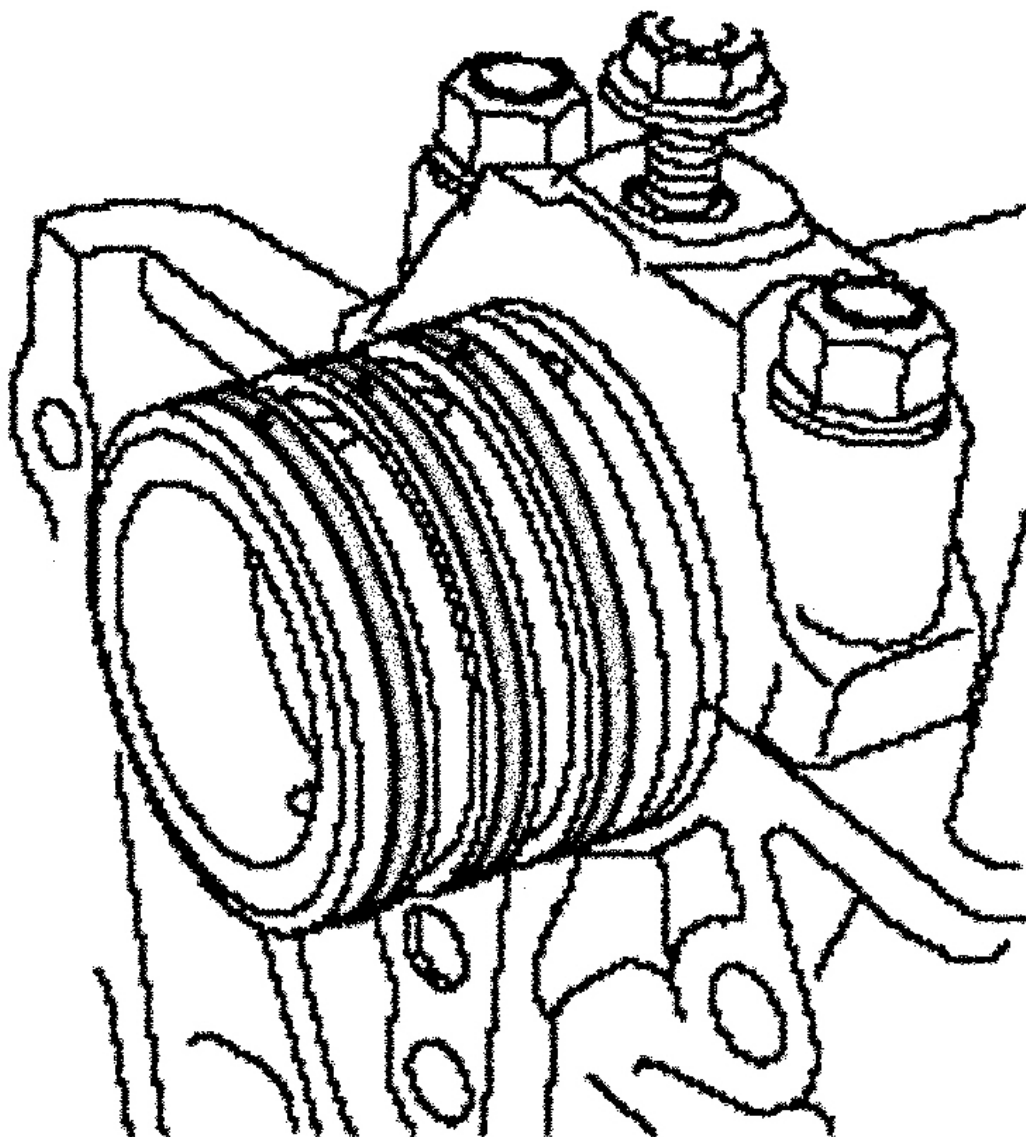


Fig. 245: Installing Collets With LRT-12-034
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 246: Installing Exhaust Camshaft With Lobes Of Cylinder 6 Facing Upwards
Courtesy of LAND ROVER NORTH AMERICA, INC.



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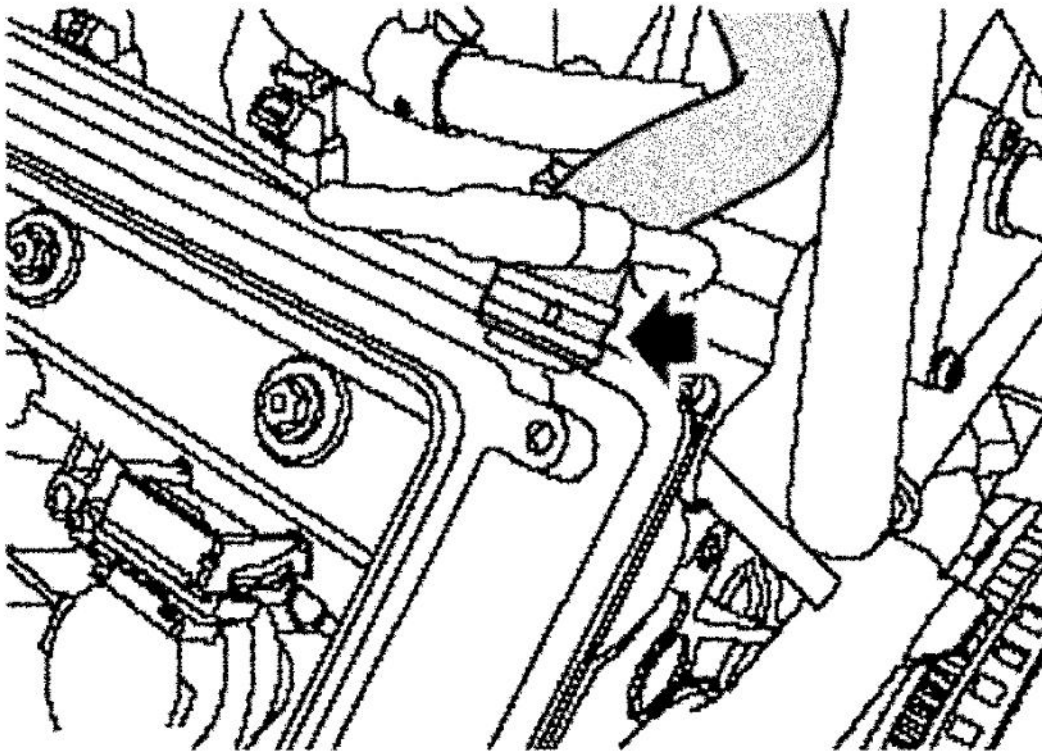
Fig. 247: Installing Housing Squarely Over Rings & Align Cylinder Head
Courtesy of LAND ROVER NORTH AMERICA, INC.

GASKET - COVERS - CAMSHAFT

Disassembly

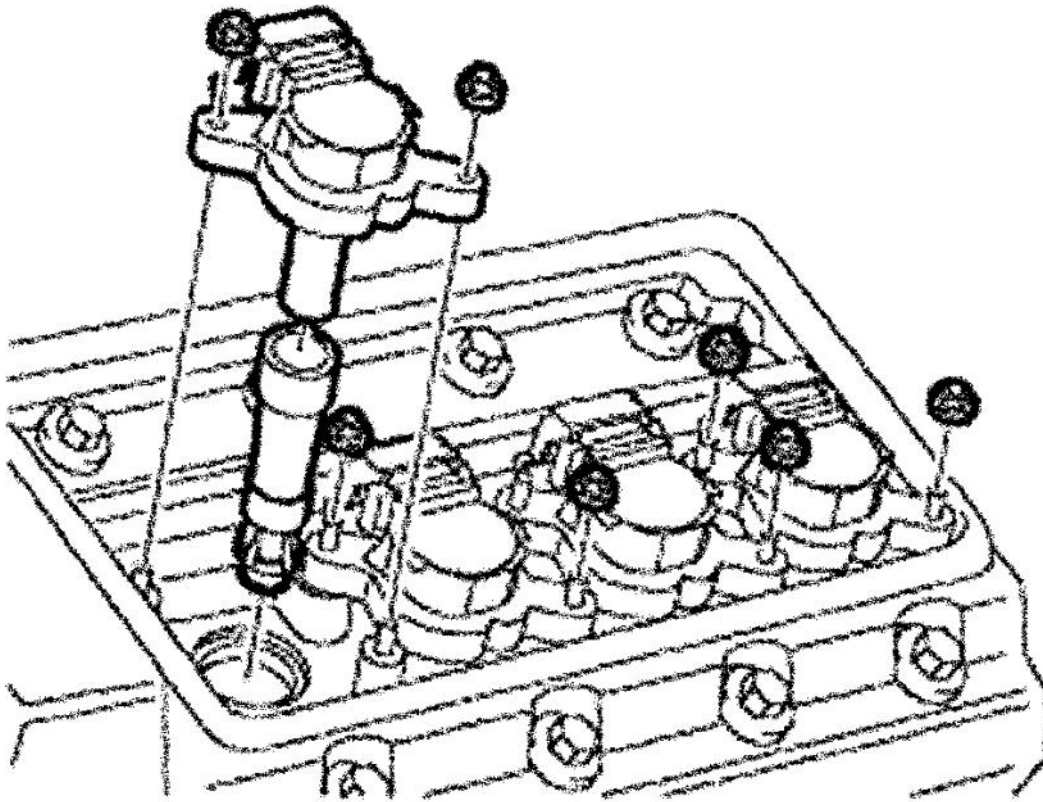
1. Left camshaft cover: Release clip and disconnect breather hose from camshaft cover. See **Fig. 248**.

2. Remove 7 nuts securing ignition coils to camshaft cover. Remove 4 ignition coils. See **Fig. 249**.
3. Right camshaft cover: Remove 2 nuts securing dipstick tube. See **Fig. 250**.
4. Right camshaft cover: Remove nut and clamp securing dipstick tube to oil sump.
5. Right camshaft cover: Remove dipstick tube and sealing washer, discard "O" ring.
6. Remove 8 nuts and 3 bolts securing camshaft cover to cylinder head. Remove camshaft cover, discard 2 gaskets and 11 sealing washers. See **Fig. 251**.



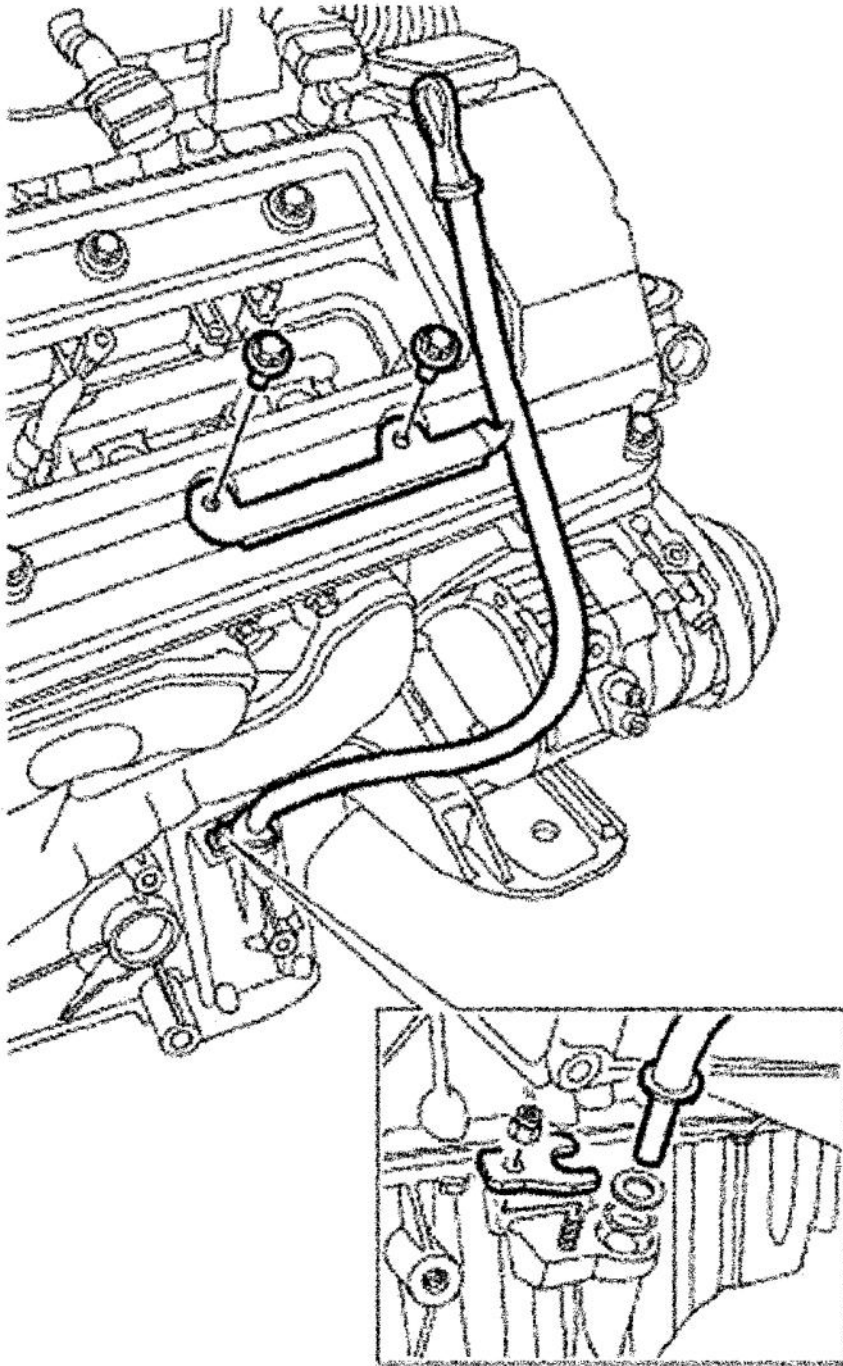
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Fig. 248: Disconnecting Breather Hose From Camshaft Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.



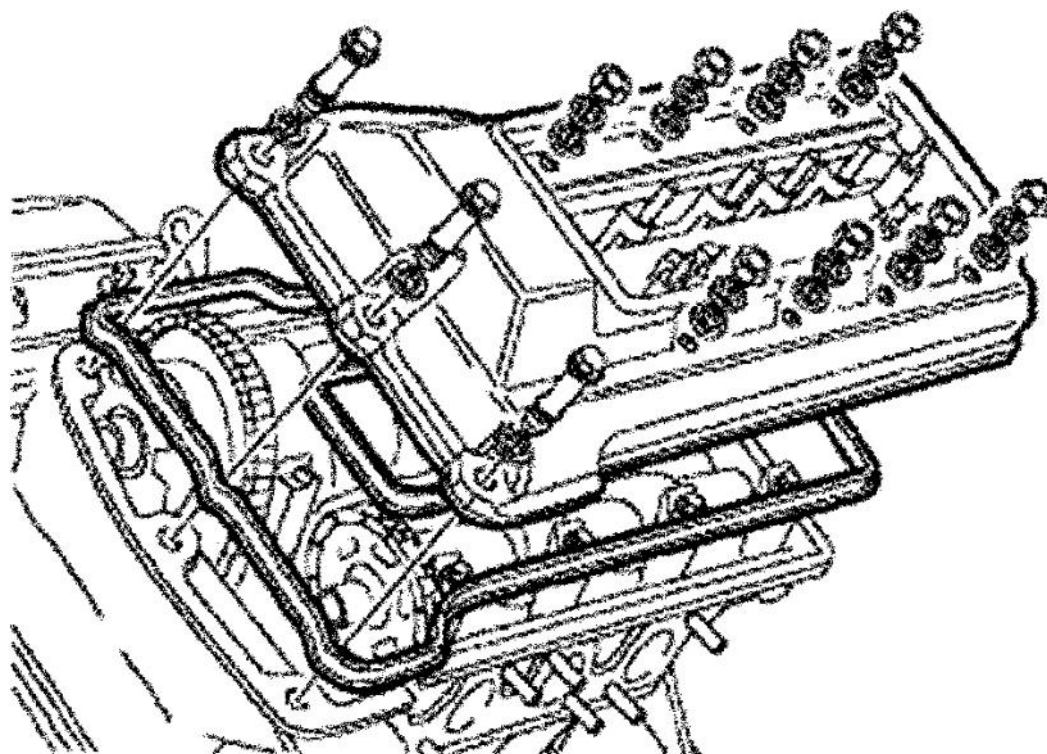
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Fig. 249: Removing Ignition Coils To Camshaft Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 250: Removing Dipstick Tube
Courtesy of LAND ROVER NORTH AMERICA, INC.



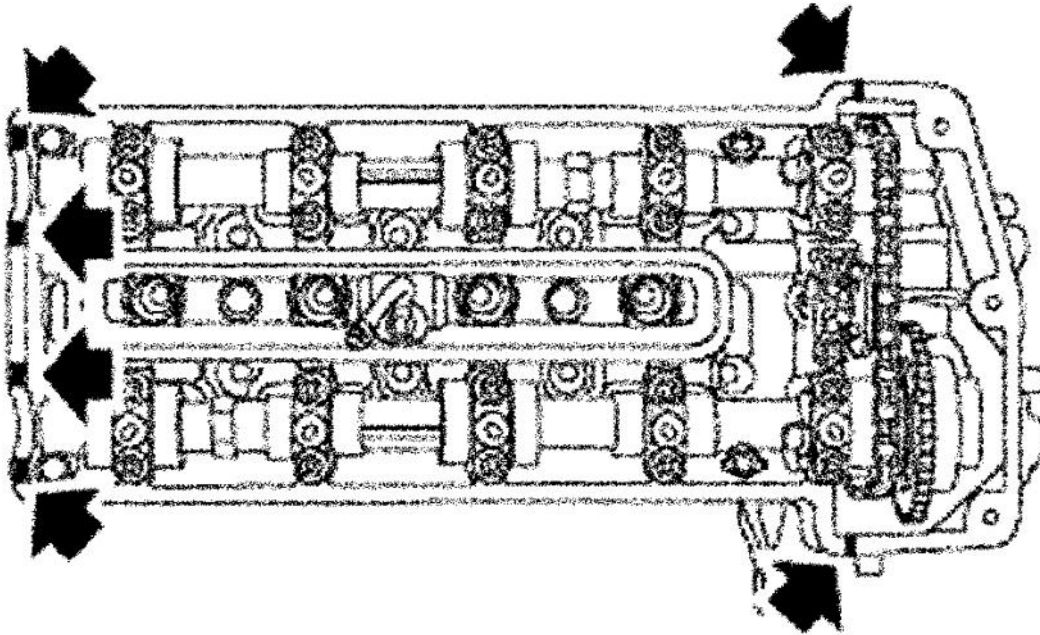
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Fig. 251: Removing Camshaft Cover

Courtesy of LAND ROVER NORTH AMERICA, INC.

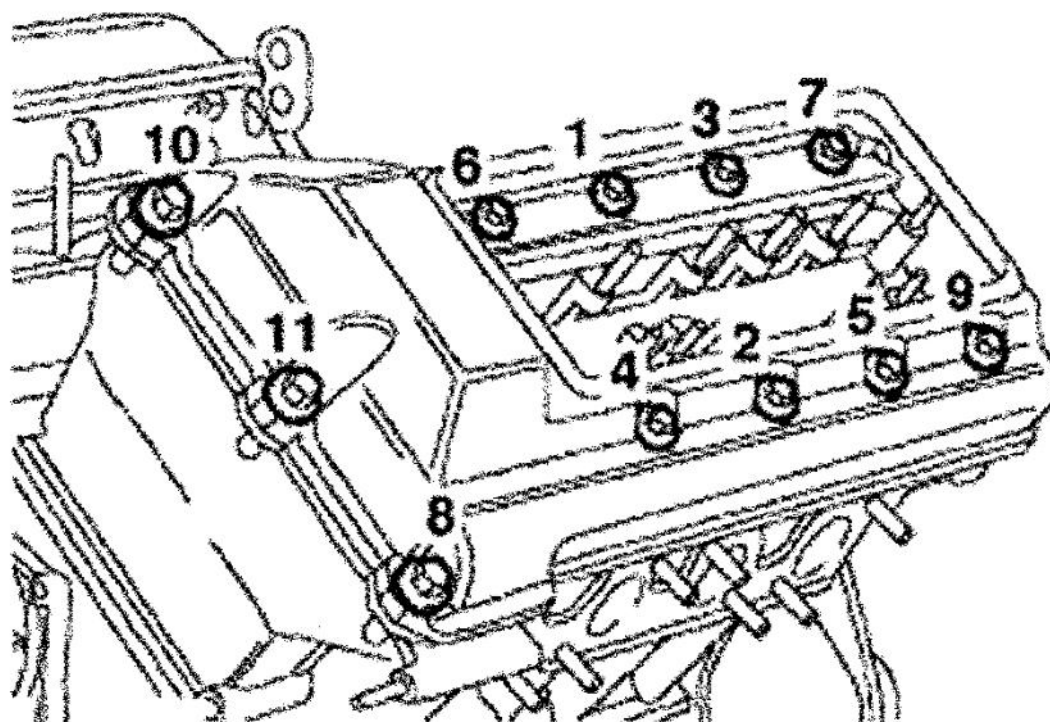
Reassembly

1. Clean camshaft cover and mating face of cylinder head.
2. Apply sealant STC 50550 to areas illustrated. See **Fig. 252**.
3. Fit 2 new gaskets and 11 new sealing washers to camshaft cover and fit to cylinder head.
4. Fit 8 nuts and 3 bolts securing camshaft cover and progressively tighten in sequence shown to 10 Nm (7 ft. lbs). See **Fig. 253**.
5. Fit 4 ignition coils.
6. Fit 7 nuts securing ignition coils to camshaft cover and tighten to 4 Nm (3 ft. lbs).
7. Right camshaft cover: Clean dipstick tube and mating face.
8. Right camshaft cover: Fit new "O" ring and sealing washer to oil sump and position dipstick tube to oil sump.
9. Right camshaft cover: Fit and tighten nuts securing dipstick tube to 10 Nm (7 ft. lbs).
10. Right camshaft cover: Fit clamp securing dipstick tube to oil sump and tighten nut to 10 Nm (7 ft. lbs).
11. Connect breather hose to camshaft cover and secure with clip.



G00388253

Fig. 252: Applying Sealant To Camshaft Gasket
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388254

Fig. 253: Installing Camshaft Cover Nuts & Bolts In Sequence
 Courtesy of LAND ROVER NORTH AMERICA, INC.

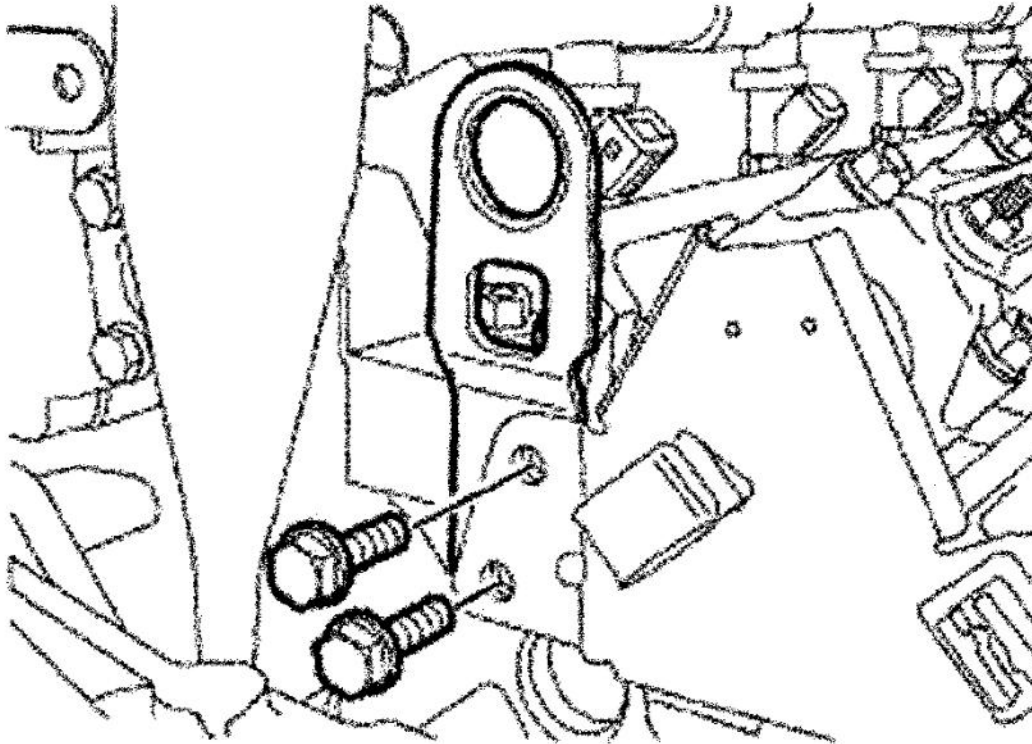
VARIABLE CAMSHAFT UNIT - VARIABLE CAMSHAFT CONTROL (VCC)

Removal

1. Remove camshaft covers. See GASKET - CAMSHAFT COVER - LEFT and GASKET - CAMSHAFT COVER - RIGHT.
2. Remove 8 spark plugs.
3. Remove 2 bolts securing engine lifting eye to rear of right cylinder head and remove lifting eye. See Fig. 254.
4. Remove 20 nuts securing 4 camshaft oil lines to left and right cylinder heads and remove camshaft oil lines. See Fig. 48.
5. Rotate engine crankshaft pulley until cylinder one camshaft lobes are at TDC firing position. See Fig. 49.
6. The rear of the camshafts may appear twisted and out of alignment when cylinder one is in the TDC firing position. See Fig. 50.

NOTE: The twisting and apparent misalignment of the camshafts does not indicate incorrect engine timing.

7. Position LRT-12-227 through timing tool access hole and secure flywheel in TDC position. See **Fig. 67**.
8. Remove timing gear upper covers. See **COVER - TIMING GEAR - UPPER - LEFT** and **COVER - TIMING GEAR - UPPER - RIGHT**.



G00388255

Fig. 254: Removing Engine Lifting Eye From Right Cylinder Head
Courtesy of LAND ROVER NORTH AMERICA, INC.

Disassembly

1. Remove nut securing left Camshaft (CMP) sensor ring and remove CMP sensor ring. See **Fig. 52**.

NOTE: Thread is left handed.

2. Remove nut securing right CMP sensor ring and remove CMP sensor ring. See **Fig. 53**.

NOTE: Thread is left handed.

3. Loosen 2 Torx bolts securing left Variable Camshaft Control (VCC) unit and left exhaust camshaft sprocket 1/2 a turn. See **Fig. 54**.

NOTE: Thread is left handed.

- Loosen 2 Torx bolts securing right VCC unit and right exhaust camshaft sprocket 1/2 a turn. See **Fig. 55**.

NOTE: Thread is left handed.

- Loosen bolt securing LRT-12-223/2 to LRT-12-223/1.
- Fit LRT-12-223/2 and LRT-12-223/1 to rear of right camshafts and tighten bolt securing tools. See **Fig. 56**.
- Fit LRT-12-223/5, LRT-12-223/6 to right cylinder head and tighten LRT-12-223/6 into spark plug thread. See **Fig. 57**.
- Loosen bolt securing LRT-12-223/4 to LRT-12-223/3. See **Fig. 58**.
- Fit LRT-12-223/4 and LRT-12-223/3 to rear of left camshafts and tighten bolt securing tools.
- Fit LRT-12-223/5, LRT-12-223/6 to left cylinder head and tighten LRT-12-223/6 into spark plug thread. See **Fig. 59**.
- Compress left exhaust timing chain tensioner, fit LRT-12-220 to chain tensioner and remove 2 Torx bolts securing left VCC unit and left exhaust camshaft sprocket. See **Fig. 60**.

NOTE: Thread is left handed.

- Remove left exhaust camshaft gear, left exhaust camshaft chain and left VCC unit.

NOTE: Secure chain to cylinder head to prevent chain falling into lower timing gear cover.

Reassembly

- Position left Variable Camshaft Control (VCC) unit to timing gear chain, fit VCC unit and exhaust camshaft sprocket to camshafts, fit and hand tighten 2 Torx bolts to eliminate excess play.

NOTE: Thread is left handed.

- Compress left exhaust timing chain tensioner and remove LRT-12-220.
- Fit LRT-12-221 to right cylinder head, fit LRT-12-222 to LRT-12-221 and hand tighten. See **Fig. 61**.

NOTE: Only screw in adjustment bolt until slight resistance is present.

- Fit LRT-12-224 to left VCC unit, connect multimeter between pin on left VCC unit and stud on left oil line. See **Fig. 62**.
- Rotate left VCC unit anti-clockwise using LRT-12-224 to 40 Nm (30 ft. lbs) and using the multimeter, check continuity is present.

NOTE: Rotating the VCC unit using LRT-12-224 will remove the oil cushion and

make sure the VCC unit is at the full left stop position. Continuity should be present when the VCC unit reaches this position.

6. Tighten Torx bolts securing left VCC unit and exhaust camshaft sprocket to 15 Nm (11 ft. lbs) and loosen one quarter of a turn.

NOTE: Thread is left handed.

7. Fit LRT-12-224 to right VCC unit, connect multimeter between pin on right VCC unit and stud on right oil line. See **Fig. 63**.
8. Rotate right VCC unit anti-clockwise using LRT-12-224 to 40 Nm (30 ft. lbs) and using the multimeter, check continuity is present.

NOTE: Rotating the VCC unit using LRT-12-224 will remove the oil cushion and make sure the VCC unit is at the full left stop position. Continuity should be present when the VCC unit reaches this position.

9. Tighten Torx bolts securing right VCC unit and exhaust camshaft sprocket to 15 Nm (11 ft. lbs) and loosen one quarter of a turn.

NOTE: Thread is left handed.

10. Adjust chain tension by tightening LRT-12-222 to 0.7 Nm (6.3 INCH lbs). See **Fig. 62**.
11. Fit LRT-12-224 to left VCC unit, connect multimeter between pin on left VCC unit and stud on left oil line.

NOTE: When the chain tension is adjusted the VCC unit will move and require adjusting to the left stop.

12. Rotate left VCC unit anti-clockwise using LRT-12-224 to 40 Nm (30 ft. lbs) and using the multimeter, check continuity is present.

NOTE: Rotating the VCC unit using LRT-12-224 will remove the oil cushion and make sure the VCC unit is at the full left stop position. Continuity should be present when the VCC unit reaches this position.

13. Tighten left VCC unit Torx bolt to 110 Nm (81 ft. lbs) and left exhaust camshaft sprocket Torx bolt to 125 Nm (92 ft. lbs).

NOTE: Thread is left handed.

14. Fit LRT-12-224 to right VCC unit, connect multimeter between pin on right VCC unit and stud on right oil line. See **Fig. 63**.

NOTE: When the chain tension is adjusted the VCC unit will move and require adjusting to the left stop.

15. Rotate right VCC unit anti-clockwise using LRT-12-224 to 40 Nm (30 ft. lbs) and using the multimeter, check continuity is present.

NOTE: Rotating the VCC unit using LRT-12-224 will remove the oil cushion and make sure the VCC unit is at the full left stop position. Continuity should be present when the VCC unit reaches this position.

16. Tighten right VCC unit Torx bolt to 110 Nm (81 ft. lbs) and right exhaust camshaft sprocket Torx bolt to 125 Nm (92 ft. lbs).

NOTE: Thread is left handed.

17. Fit right Camshaft (CMP) sensor ring, fit and hand tighten securing nut.

NOTE: Thread is left handed.

18. Position LRT-12-228/1 locating dowel to right CMP sensor ring, fit 2 bolts securing tool to right cylinder head and tighten. See Fig. 64.

NOTE: To ensure correct CMP sensor ring adjustment, make sure the tool is aligned flush with the cylinder head and lower timing gear cover before tightening the tool securing bolts.

19. Tighten nut securing CMP sensor ring to 40 Nm (30 ft. lbs) and remove LRT-12-228/1 from right cylinder head.

NOTE: Thread is left handed.

20. Fit left CMP sensor ring, fit and hand tighten securing nut.

NOTE: Thread is left handed.

21. Position LRT-12-228/2 locating dowel to left CMP sensor ring, fit 2 bolts securing tool to left cylinder head and tighten. See Fig. 65.

NOTE: To ensure correct CMP sensor ring adjustment, make sure the tool is aligned flush with the cylinder head and lower timing gear cover before tightening the tool securing bolts.

22. Tighten nut securing CMP sensor ring to 40 Nm (30 ft. lbs) and remove LRT-12-228/2 from left cylinder head.

NOTE: Thread is left handed.

23. Remove LRT-12-223/5, LRT-12-223/6, LRT-12-223/2 and LRT-12-223/1 from right cylinder head camshafts.
24. Remove LRT-12-223/6, LRT-12-223/5, LRT-12-223/3 and LRT-12-223/4 from left cylinder head camshafts.
25. Loosen LRT-12-222, remove 2 bolts securing LRT-12-221 to right cylinder head and remove LRT-12-221

Installation

1. Fit timing gear upper covers. See **COVER - TIMING GEAR - UPPER - LEFT** and **COVER - TIMING GEAR - UPPER - RIGHT**.
2. Remove LRT-12-227 from timing tool access hole.
3. Fit 4 camshaft oil lines to left and right cylinder heads, fit and tighten 20 securing bolts.
4. Fit engine lifting eye to rear of right cylinder head, fit and tighten 2 bolts securing engine lifting eye.
5. Fit and tighten 8 spark plugs to 23 Nm (17 ft. lbs).
6. Fit camshaft cover gaskets. See **GASKET - CAMSHAFT COVER - LEFT** and **GASKET - CAMSHAFT COVER - RIGHT**.

STRAINER - OIL PICK UP

Removal

Remove lower sump gasket. See **GASKET - LOWER OIL SUMP**.

Disassembly

Remove 2 bolts securing oil pick-up strainer to oil pump, remove strainer and discard "O" ring. See **Fig. 146**.

Inspection

Clean oil pick up strainer and mating faces.

Reassembly

1. Fit new "O" ring to oil pump groove location, position oil pick-up strainer to oil pump.
2. Fit 2 bolts securing oil pick-up strainer to oil pump and tighten bolts to 10 Nm (7 ft. lbs).

Installation

Fit lower sump gasket. See **GASKET - LOWER OIL SUMP**.

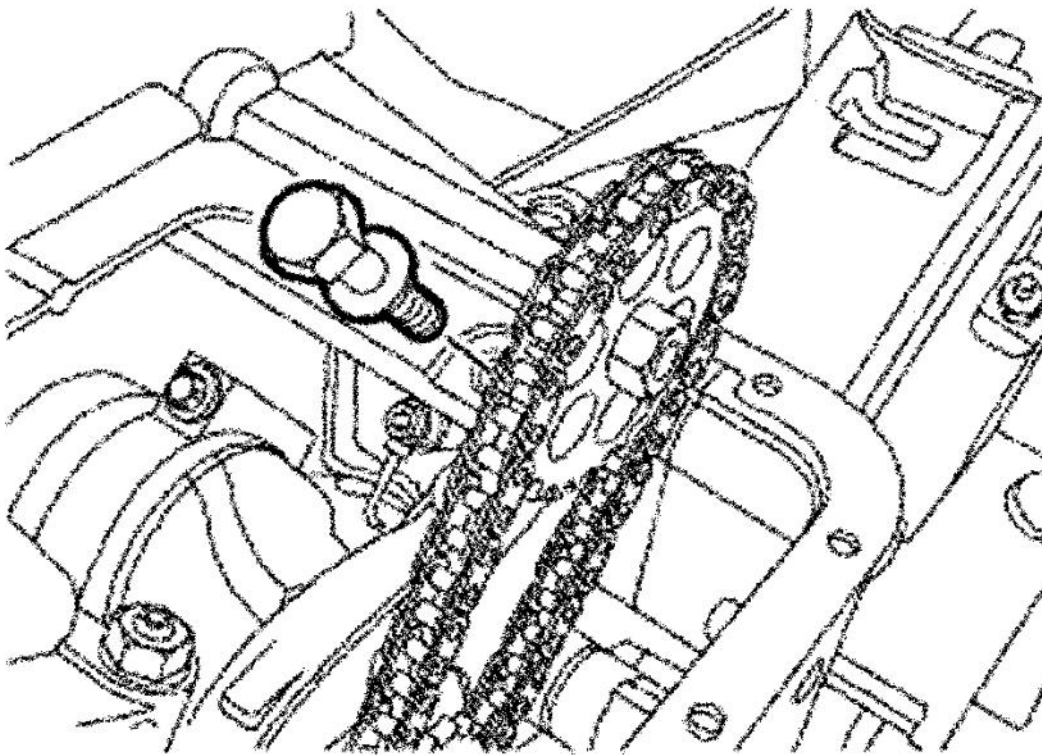
PUMP - ENGINE OIL

Removal

1. Remove sump gasket. See **GASKET - OIL SUMP**.

Disassembly

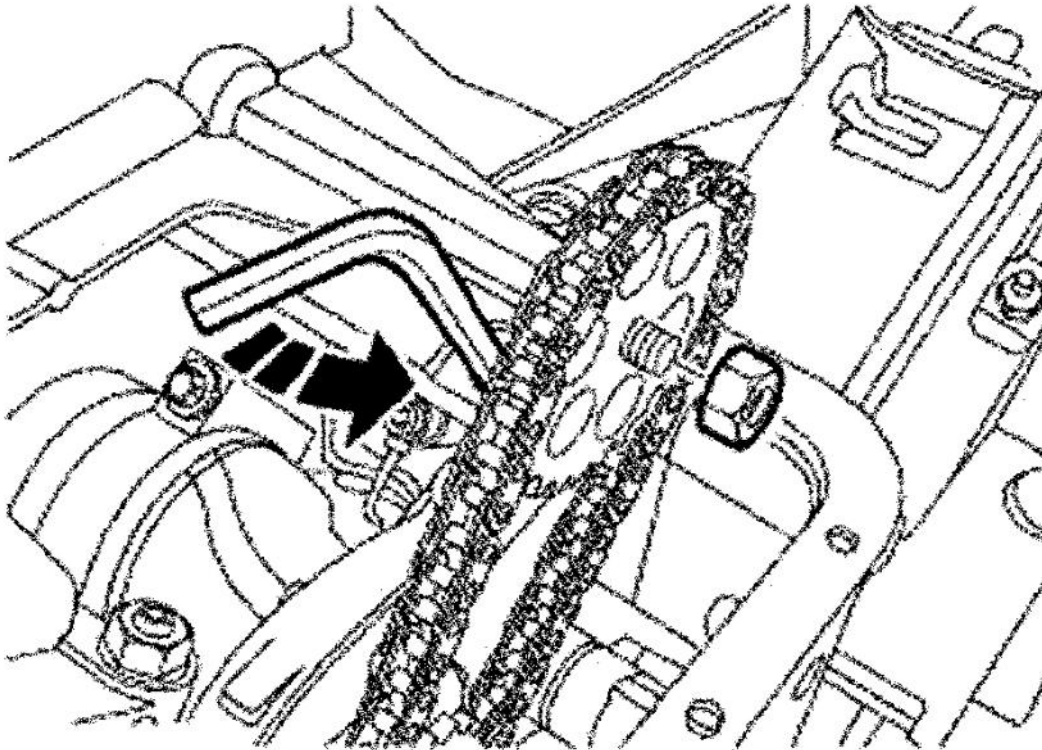
1. Remove bolt securing oil pump. See **Fig. 255**.
2. Rotate oil pump drive chain tensioning nut anti-clockwise to release the tension. See **Fig. 256**.
3. Remove nut securing gear to oil pump and remove the gear.
4. Remove 2 nuts securing oil pump and remove the oil pump. See **Fig. 257**.
5. Remove oil feed and governing pipes from cylinder block, remove and discard 3 "O" rings. See **Fig. 258**.
6. Remove adjusting nut from oil pump.



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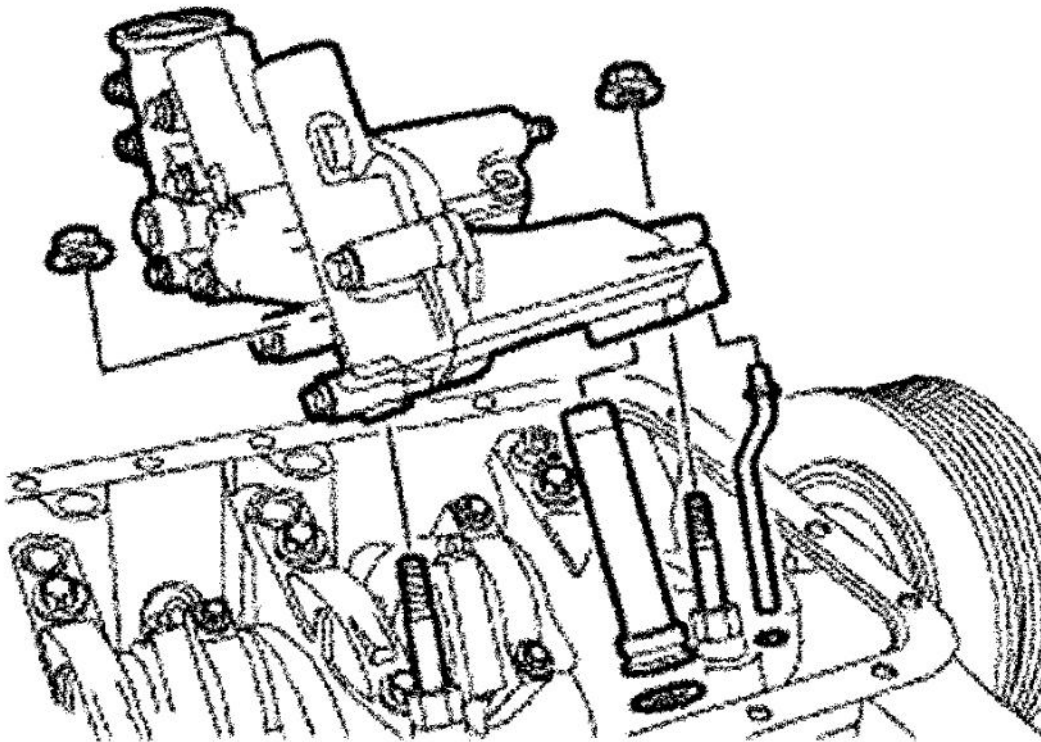
Fig. 255: Removing Oil Pump Bolt

Courtesy of LAND ROVER NORTH AMERICA, INC.



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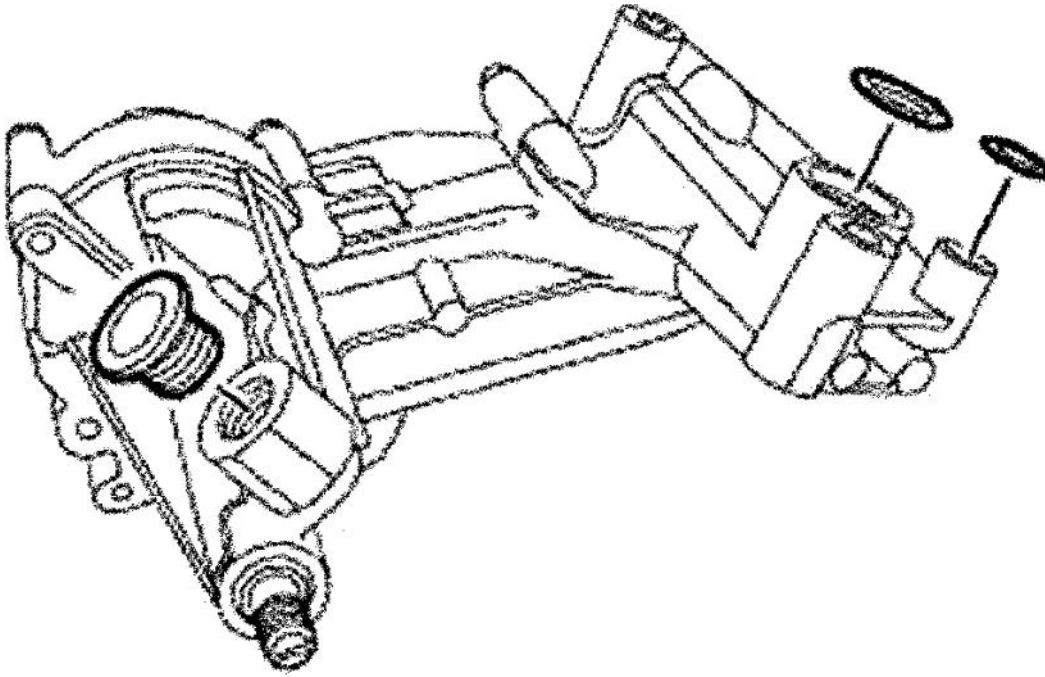
Fig. 256: Rotating Oil Pump drive Chain Tensioning Nut
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388260

Fig. 257: Removing Oil Pump

Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388261

Fig. 258: Removing Oil Feed & Governing Pipes From Cylinder Blocks
Courtesy of LAND ROVER NORTH AMERICA, INC.

Inspect

Clean oil pipes, oil pump and mating faces.

Reassembly

1. Lubricate new "O" rings. Fit oil feed pipe "O" rings to groove in pump and pipe and fit governing pipe "O" ring to pipe.
2. Fit oil pipes to cylinder block.
3. Fit adjusting nut fully into the oil pump.
4. Lubricate the oil pump.
5. Fit oil pump, engage oil pipes and tighten 2 nuts securing the oil pump to 23 Nm (17 ft. lbs).
6. Clean the oil pump gear.
7. Fit oil pump gear to chain and oil pump. If necessary, rotate pump spindle to align the drive flats.
8. Fit nut securing gear to oil pump and tighten to 47 Nm (34 ft. lbs).
9. Rotate oil pump drive chain adjuster to give a deflection of 8 mm (0.314 in) to 12 mm (0.470) midway between sprockets.

NOTE: The oil pump chain is adjusted by turning the Allen bolt spacer which is accessed through the oil pump securing bolt hole.

10. Fit bolt securing oil pump and tighten to 23 Nm (17 ft. lbs).

Installation

1. Fit sump gasket. See **GASKET - OIL SUMP.**

GASKET - SUMP BOTTOM PLATE

Removal

1. Position container below engine sump drain plug, remove plug and discard sealing washer. Allow oil to drain.
2. Remove 21 bolts securing lower oil sump to upper oil sump. Remove lower oil sump and discard gasket.

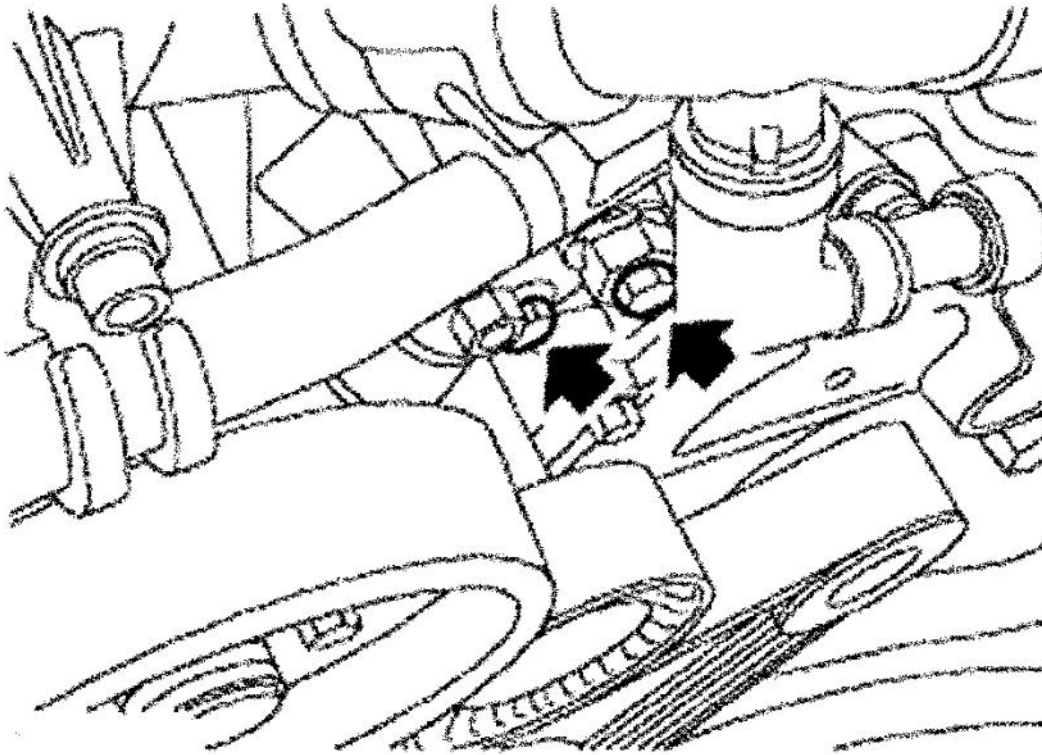
Installation

1. Clean lower oil sump mating faces.
2. Fit new gasket to lower oil sump mating face.
3. Fit lower oil sump.
4. Fit 21 bolts securing lower oil sump and tighten to 10 Nm (7 ft. lbs).
5. Clean sump drain plug, fit new sealing washer and tighten to 25 Nm (18 ft. lbs).
6. Fill engine with oil.

GASKET - OIL SUMP

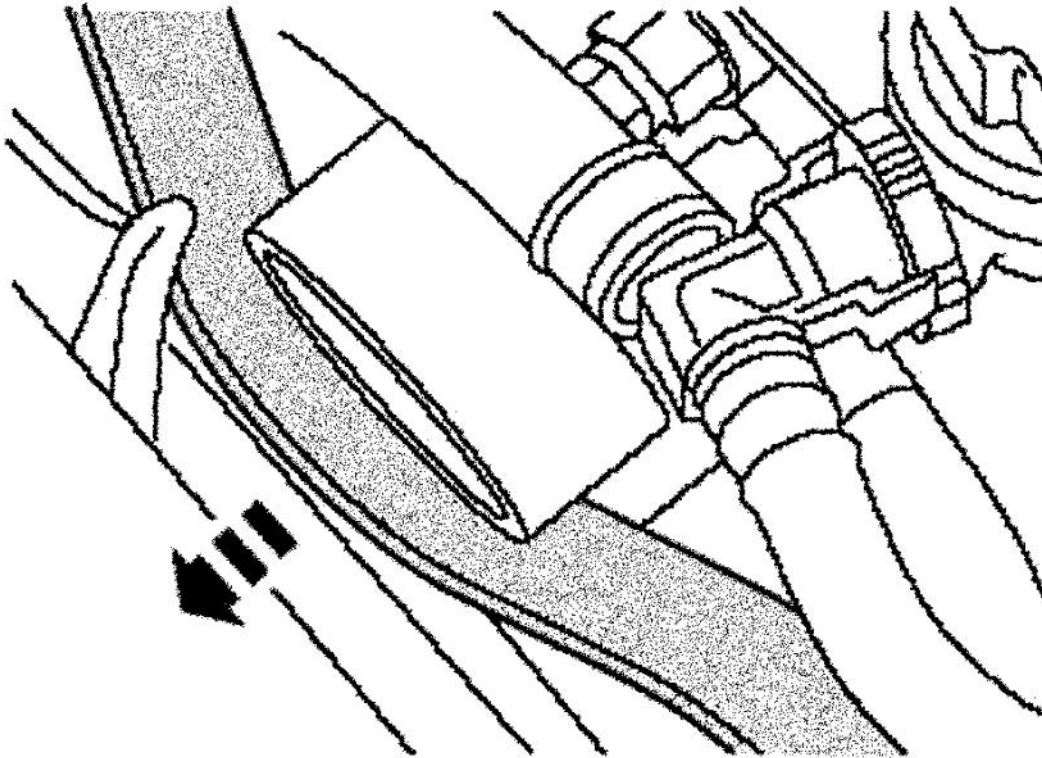
Removal

1. Remove dipstick.
2. Remove 2 nuts securing dipstick tube bracket to camshaft cover. See **Fig. 144.**
3. Remove nut and clamp securing dipstick tube to oil sump. Remove dipstick tube and sealing washer. Discard "O" ring. See **Fig. 145.**
4. Loosen 2 bolts securing ancillary drive belt tensioner and release tension from the belt. See **Fig. 259.**
5. Remove ancillary drive belt. See **ANCILLARY DRIVE BELT** . See **Fig. 260.**
6. Remove 2 Allen bolts and one nut securing Power Assisted Steering (PAS) pump, remove pump. See **Fig. 261.**
7. Remove oil pick-up strainer. See **STRAINER - OIL PICK UP.**



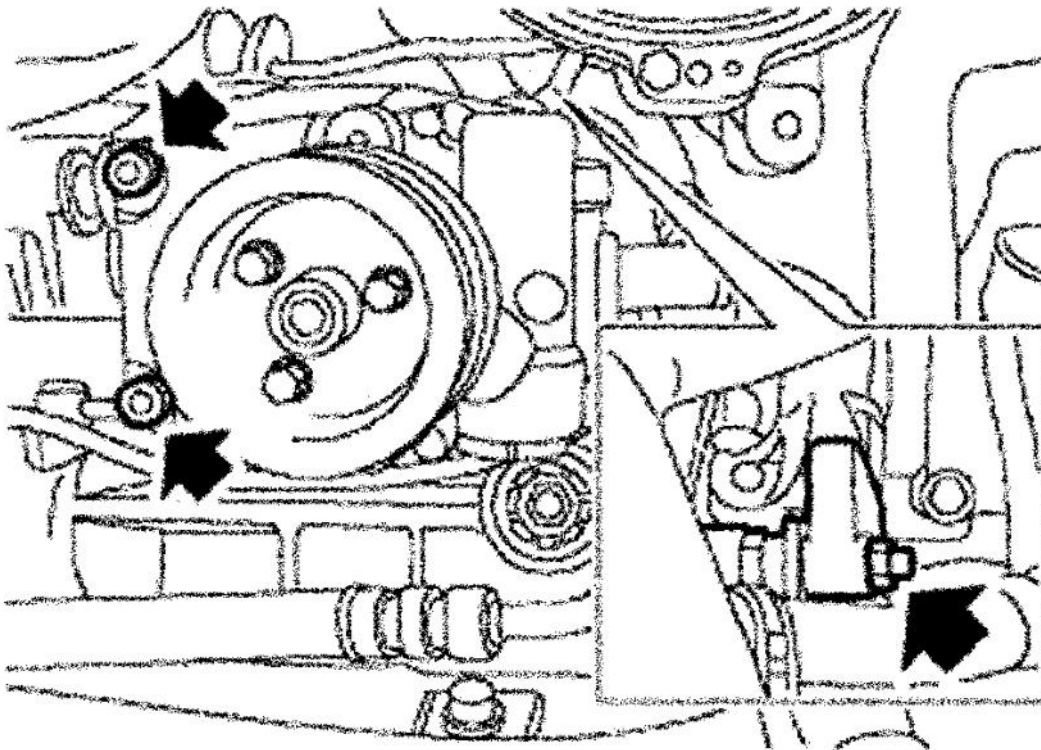
G00388262

Fig. 259: Removing Ancillary Drive Belt Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388263

Fig. 260: Removing Ancillary Drive Belt
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388264

Fig. 261: Removing Power Assisted Steering Pump
Courtesy of LAND ROVER NORTH AMERICA, INC.

Disassembly

1. Remove banjo bolt securing engine oil return pipe to oil sump and discard 2 sealing washers. See **Fig. 151**.
2. Remove banjo bolt securing engine oil filter return pipe to oil sump and discard 2 sealing washers. See **Fig. 152**.
3. Remove 31 bolts securing oil sump to engine cylinder block. See **Fig. 154**:
 - A = M8 x 60 mm
 - B = M6 x 80 mm
 - C = M6 x 40 mm
 - All remaining bolts are M6 x 20 mm

NOTE: Note position of all bolts as they are different lengths.

4. Remove oil sump and discard gasket.

Inspection

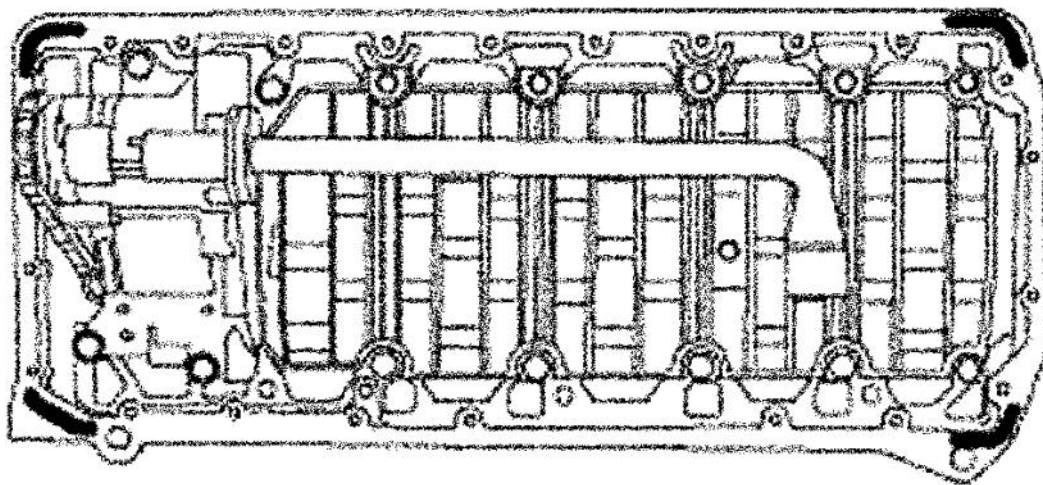
Clean oil sump and gasket mating faces.

Reassembly

1. Apply a 2 mm bead of sealant to areas illustrated. See **Fig. 262**.
2. Fit new gasket, position oil sump to cylinder block, fit bolts but DO NOT tighten at this stage.

NOTE: Note position of 6 mm bolts as they are two different lengths.

3. Tighten 31 bolts securing upper oil sump to cylinder block
 - M6 x 8.8 mm to 10 Nm (7 ft. lbs)
 - M6 x 10.9 mm to 12 Nm (9 ft. lbs)
 - M8 x 8.8 mm to 22 Nm (16 ft. lbs)
4. Clean engine oil filter and return pipe mating faces.
5. Fit 2 new sealing washers, fit banjo bolt securing engine oil filter return pipe to oil sump and tighten to 30 Nm (22 ft. lbs).



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Fig. 262: Applying Sealant To Oil Sump Gasket
Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

1. Fit oil pick-up strainer. See **STRAINER - OIL PICK UP**.
2. Clean Power Assisted Steering (PAS) pump and mating faces.

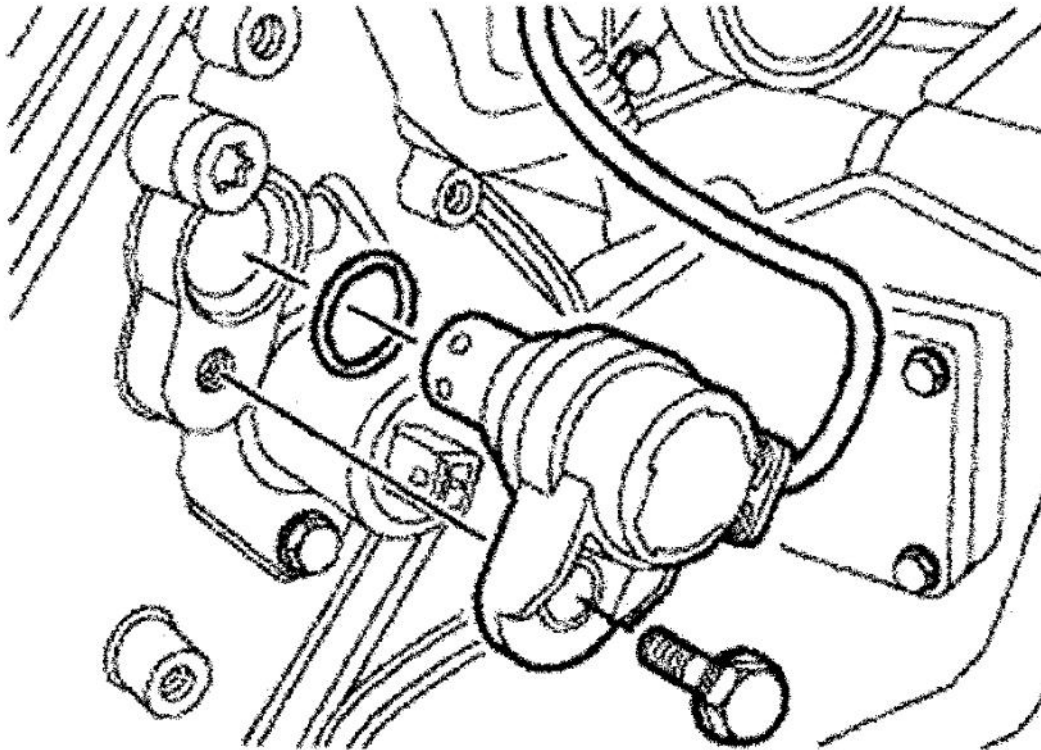
3. Position PAS pump to mounting, fit Allen bolts and securing nut. Tighten Allen bolts to 10 Nm (7 ft. lbs) and securing nut to 25 Nm (18 ft. lbs).
4. Clean ancillary drive belt pulleys.
5. Fit ancillary drive belt, rotate tensioner fully clockwise and tighten tensioner bolts to 22 Nm (16 ft. lbs).
6. Clean dipstick tube and mating face.
7. Fit new "O" ring and sealing washer to oil sump and position dipstick tube to oil sump.
8. Fit nuts securing dipstick tube to camshaft cover and tighten to 10 Nm (7 ft. lbs).
9. Fit clamp securing dipstick tube and tighten nut to 10 Nm (7 ft. lbs).
10. Fit dipstick.

COVER - TIMING GEAR - UPPER

Removal

This procedure covers both left and right timing gear upper covers.

1. Remove camshaft cover. See **GASKET - COVERS - CAMSHAFT.**
2. Remove Variable Camshaft Control (VCC) solenoid valve. See **VARIABLE CAMSHAFT UNIT - VARIABLE CAMSHAFT CONTROL (VCC).**
3. Remove bolt securing Camshaft (CMP) sensor and remove sensor. Discard "O" ring. See **Fig. 263.**
4. If fitted: Remove bolt securing Secondary Air Injection (SAI) pipe to right cylinder head. See **Fig. 264.**
5. If fitted: Remove bolt securing SAI pipe to left cylinder head. See **Fig. 265.**
6. If fitted: Remove Allen bolt securing SAI pipe clip to coolant pump. See **Fig. 266.**
7. If fitted: Release SAI pipe from cylinder heads and position aside, discard "O" rings.



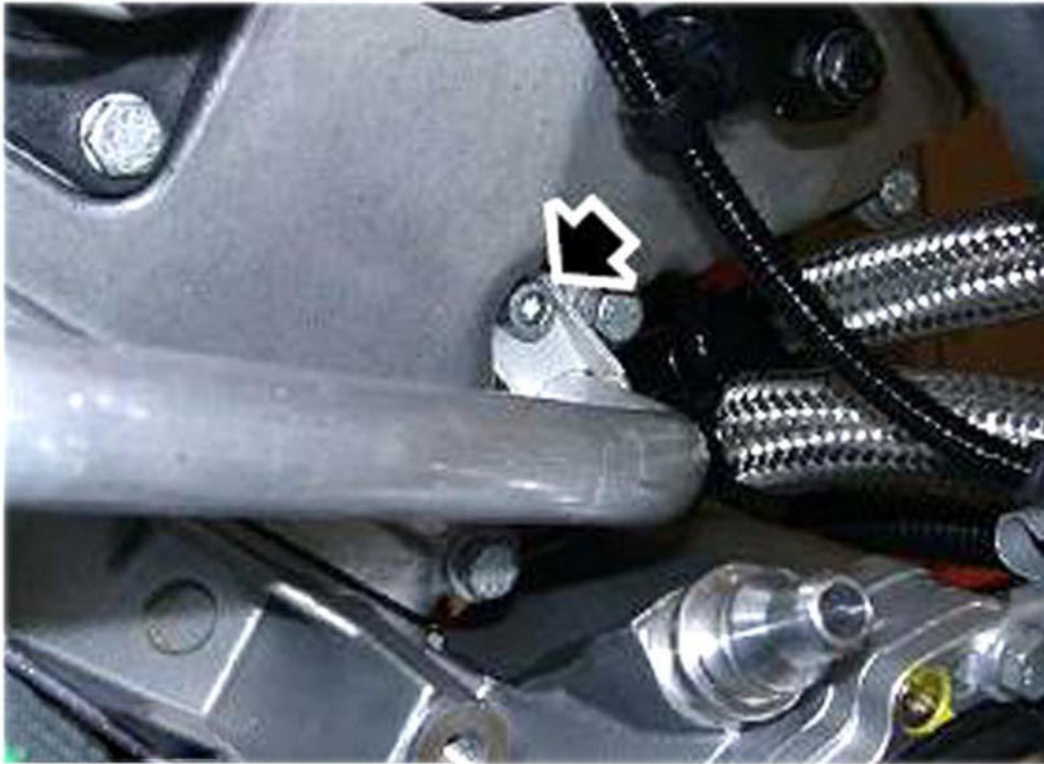
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Fig. 263: Removing Camshaft Sensor
Courtesy of LAND ROVER NORTH AMERICA, INC.



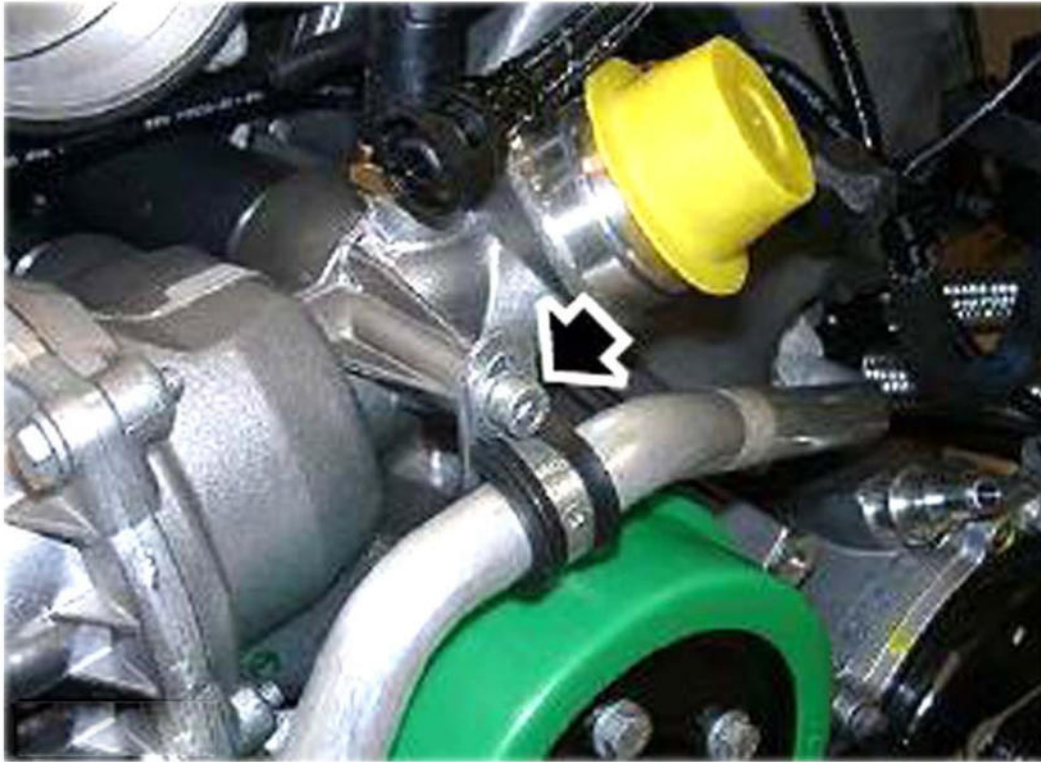
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Fig. 264: Removing Secondary Air Injection Pipe To Right Cylinder Head
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 265: Removing Secondary Air Injection Pipe-To-Left Cylinder Head Bolt
Courtesy of LAND ROVER NORTH AMERICA, INC.



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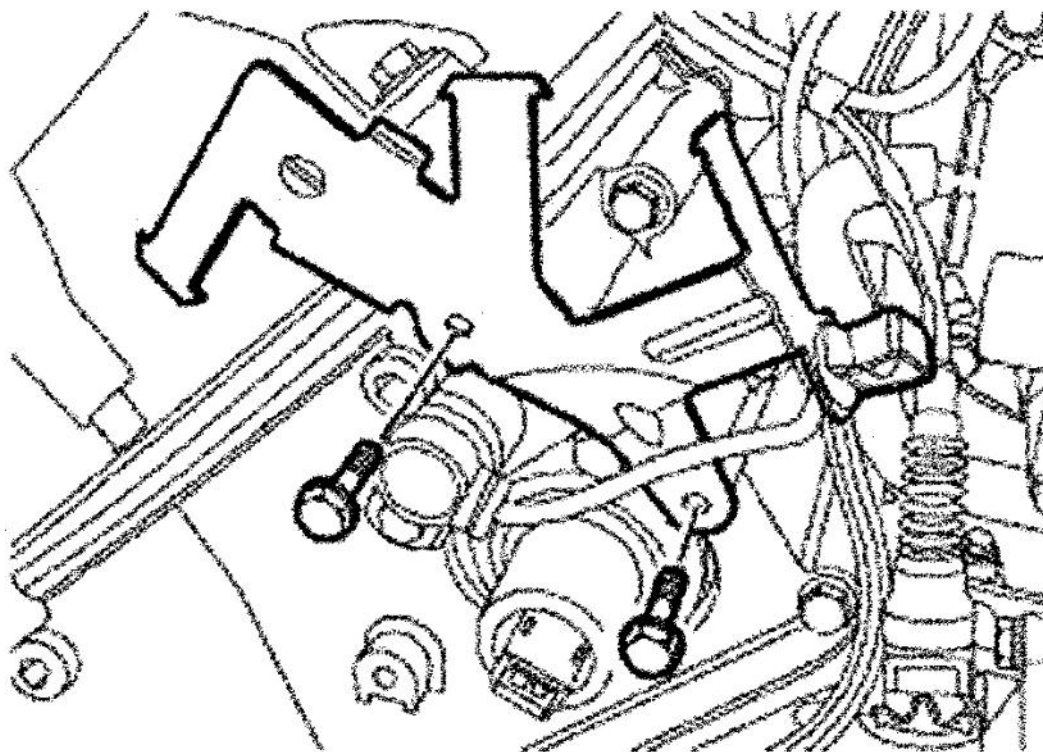
Fig. 266: Removing Secondary Air Injection Pipe Clip-To-Coolant Pump Bolt
Courtesy of LAND ROVER NORTH AMERICA, INC.

Disassembly

1. Right upper timing gear cover: Remove 2 bolts securing VCC solenoid seal and remove seal. See **Fig. 168**.
2. Right upper timing gear cover: Remove chain tensioner from timing gear cover and discard sealing washer. See **Fig. 169**.
3. Right upper timing gear cover: Separate chain tensioner body and allow oil to drain.
4. Right upper timing gear cover: Remove 2 bolts securing engine harness bracket to right timing gear cover and remove bracket. See **Fig. 267**.
5. Remove 2 bolts securing 2 brackets to upper timing gear cover and remove brackets. See **Fig. 268**.
6. Remove 6 bolts securing timing gear cover to cylinder head and remove timing gear cover. See **Fig. 177**.
7. Discard timing gear cover gasket.

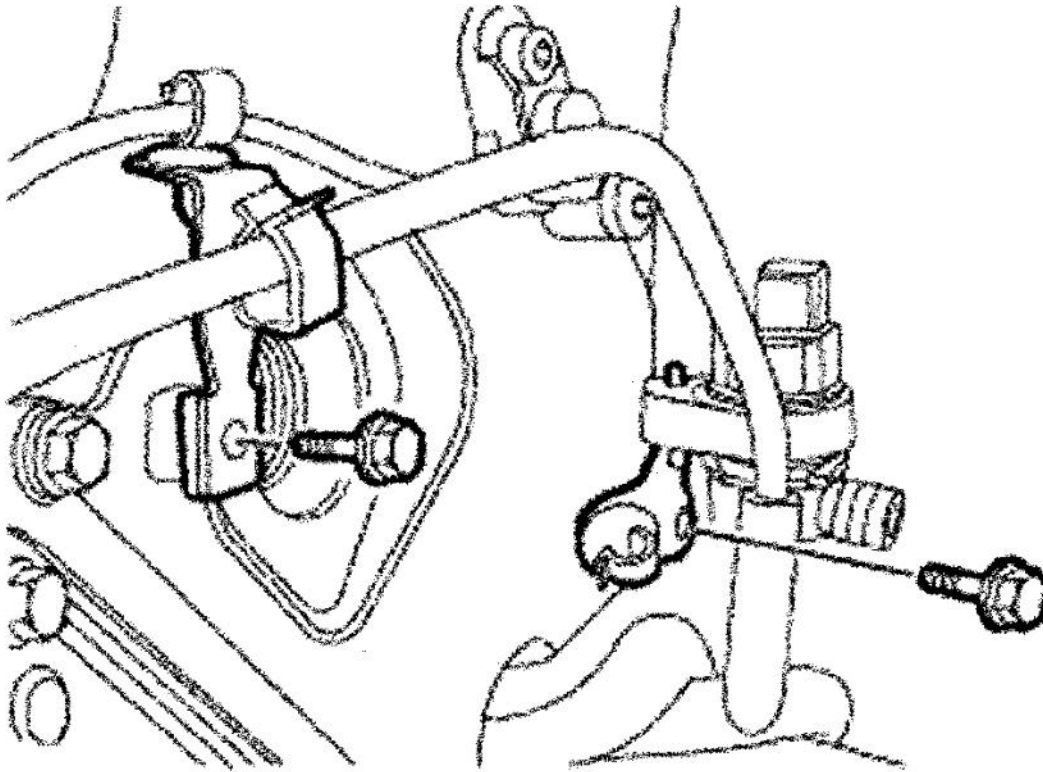
NOTE: **DO NOT** carry out further dismantling if component is removed for access only.

8. Remove bolt securing Camshaft (CMP) sensor and remove sensor. See **Fig. 269**.
9. Discard "O" ring.



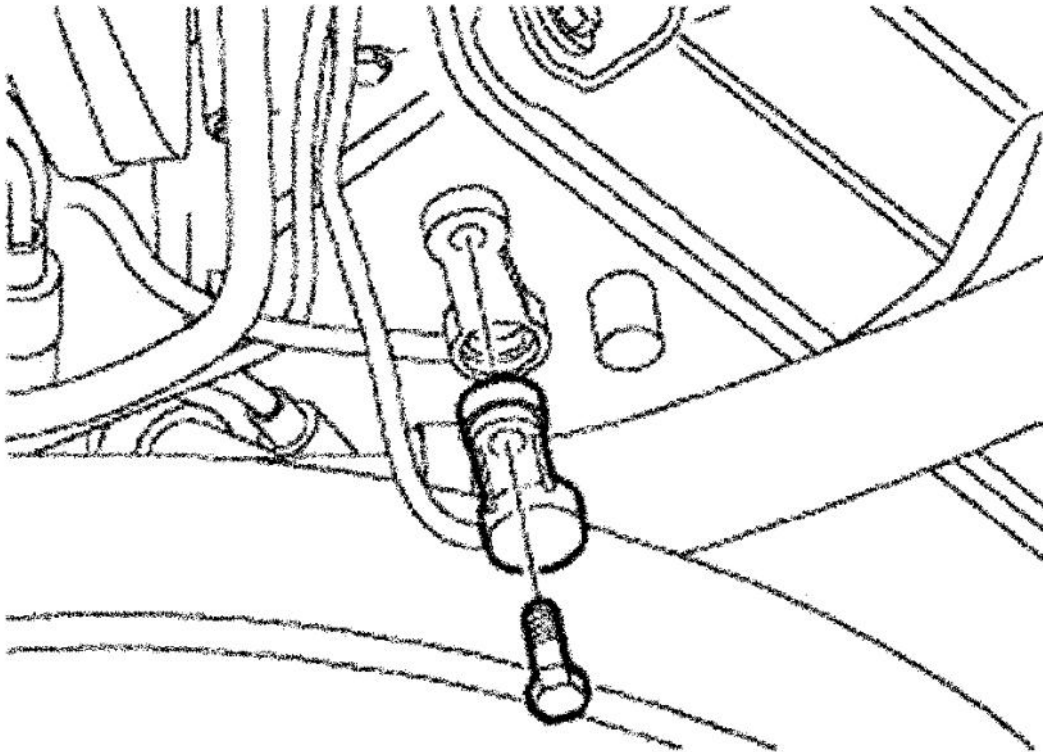
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Fig. 267: Removing Engine Harness Bracket Bolts From Right Timing Gear Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388271

Fig. 268: Removing Brackets To Upper Timing Gear Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388272

Fig. 269: Removing Camshaft Sensor

Courtesy of LAND ROVER NORTH AMERICA, INC.

Inspection

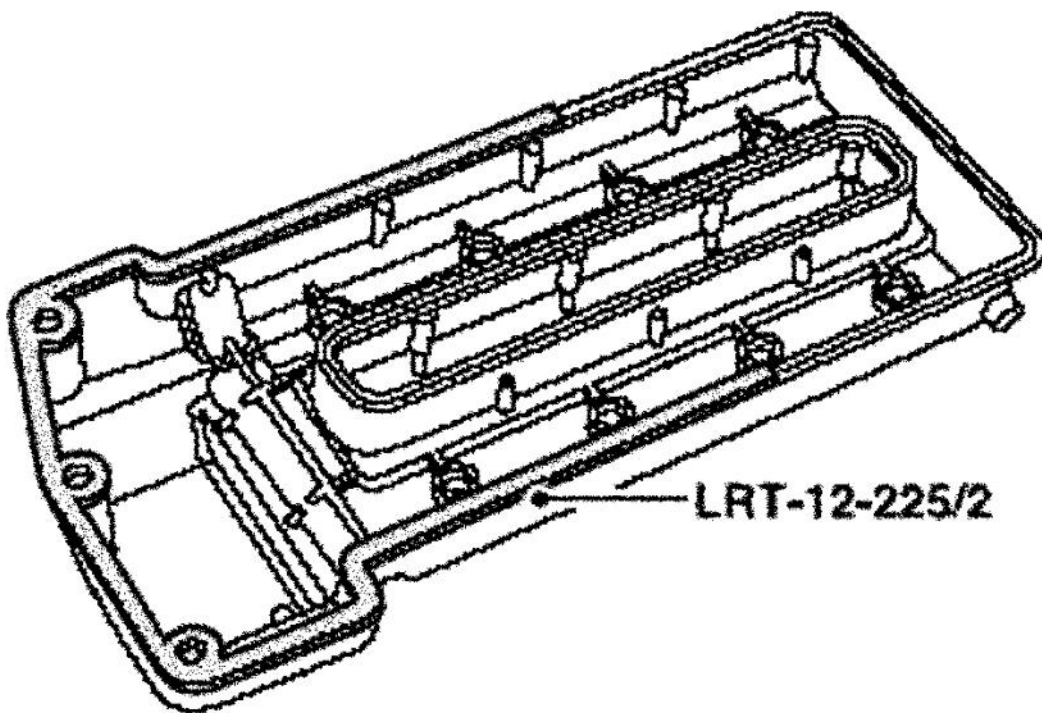
Clean Camshaft (CMP) sensor and mating face.

Reassembly

1. Fit new "O" ring to Camshaft (CMP) sensor.
2. Fit CMP sensor, fit bolt and tighten to 10 Nm (7 ft. lbs).
3. Clean timing gear cover and mating face, clean dowels and dowel holes.
4. Remove bolt securing CMP sensor and remove sensor.
5. Apply sealant STC 50550 to areas illustrated. See **Fig. 178**.
6. Fit right lower bolt to timing gear cover and position cover to cylinder head.

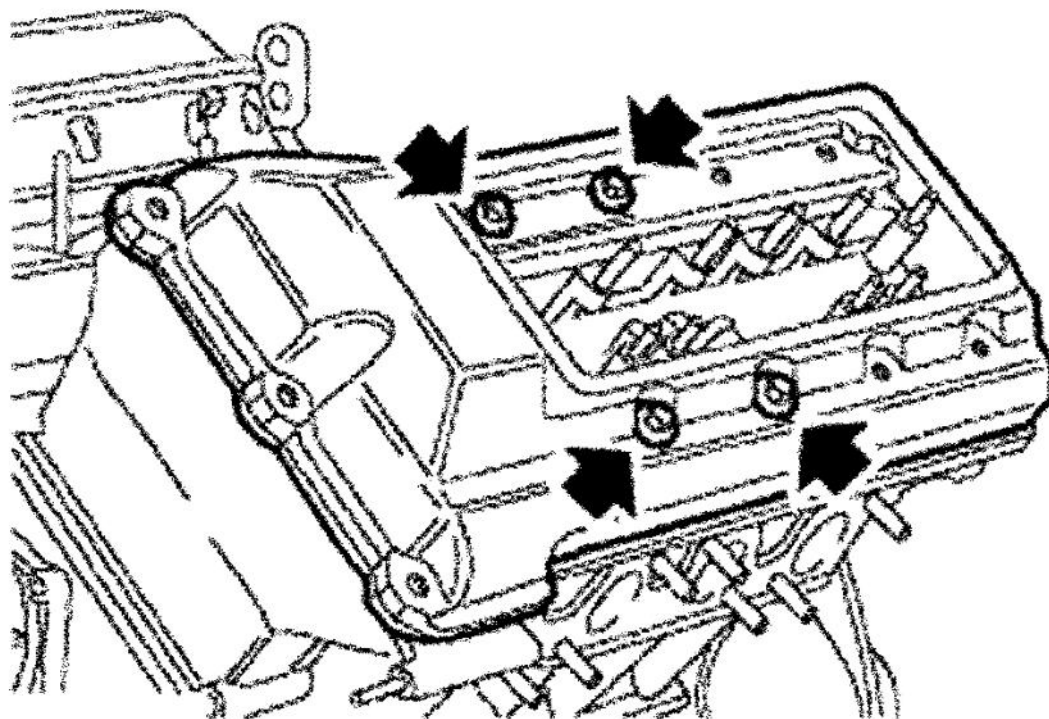
NOTE: It is not possible to fit the right lower bolt after fitting the left upper timing gear cover.

7. Fit remaining 5 bolts and hand tighten 6 bolts securing timing cover.
8. Fit LRT-12-225/2 to left camshaft cover. See **Fig. 270**.
9. Fit camshaft cover and tool, fit 4 bolts and tighten to 10 Nm (7 ft. lbs) See **Fig. 271**.
10. Tighten bolts securing timing gear cover to 15 Nm (11 ft. lbs).
11. Position 2 brackets to timing gear cover, fit bolts and tighten.
12. Remove 4 bolts securing camshaft cover, remove camshaft cover and LRT-12-225/2.
13. Right upper timing gear cover: Fit new sealing washer, fit timing chain tensioner and tighten plug securing chain tensioner to 40 Nm (30 ft. lbs).
14. Right upper timing gear cover: Clean right Variable Camshaft Control (VCC) solenoid seal and mating faces.
15. Right upper timing gear cover: Lubricate inner mating face of VCC solenoid seal.
16. Right upper timing gear cover: Fit VCC solenoid seal, fit bolts and tighten.



G00388273

Fig. 270: Installing Left Camshaft Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 271: Installing Camshaft Cover & Tool LRT-12-225/2
 Courtesy of LAND ROVER NORTH AMERICA, INC.

Installation

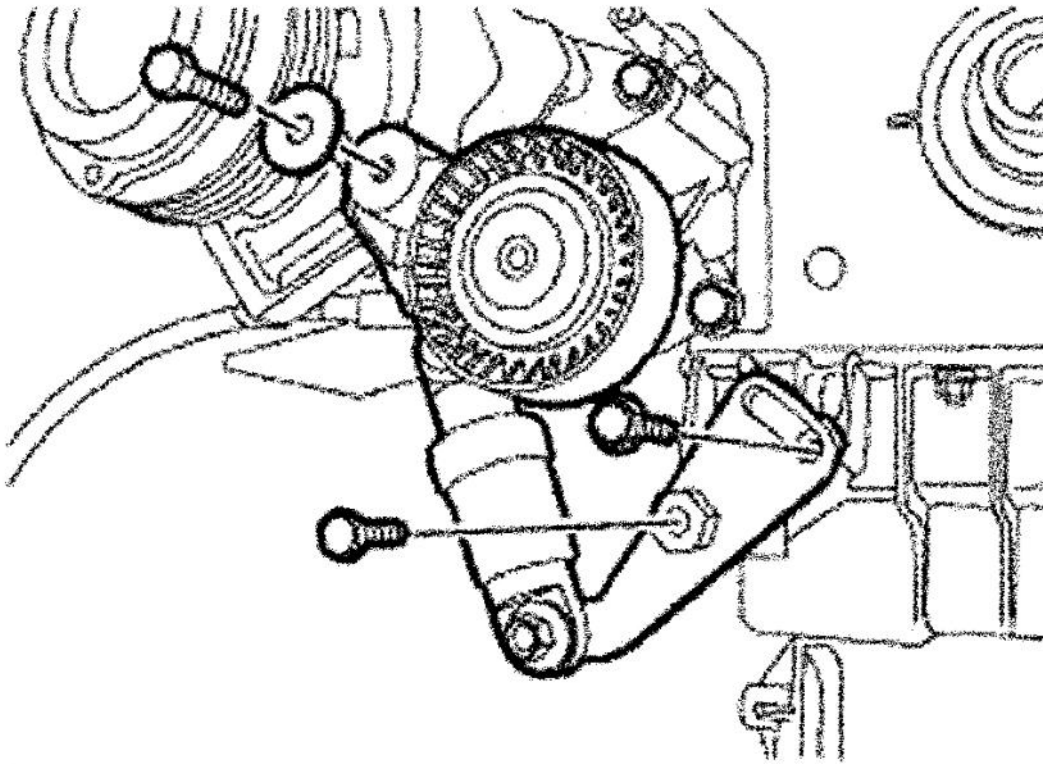
1. If fitted: Fit 2 new "O" rings to Secondary Air Injection (SAI) pipe and position SAI pipe to engine. Fit 3 bolts and tighten 3 bolts securing SAI pipe to 10 Nm 7 (ft. lbs).
2. Fit left Variable Camshaft Control (VCC) solenoid valve. See **CONTROL SOLENOID - VARIABLE CAMSHAFT CONTROL (VCC) - LEFT**.
3. Fit left camshaft cover. See **GASKET - CAMSHAFT COVER - LEFT**.

COVER - TIMING GEAR - LOWER

Removal

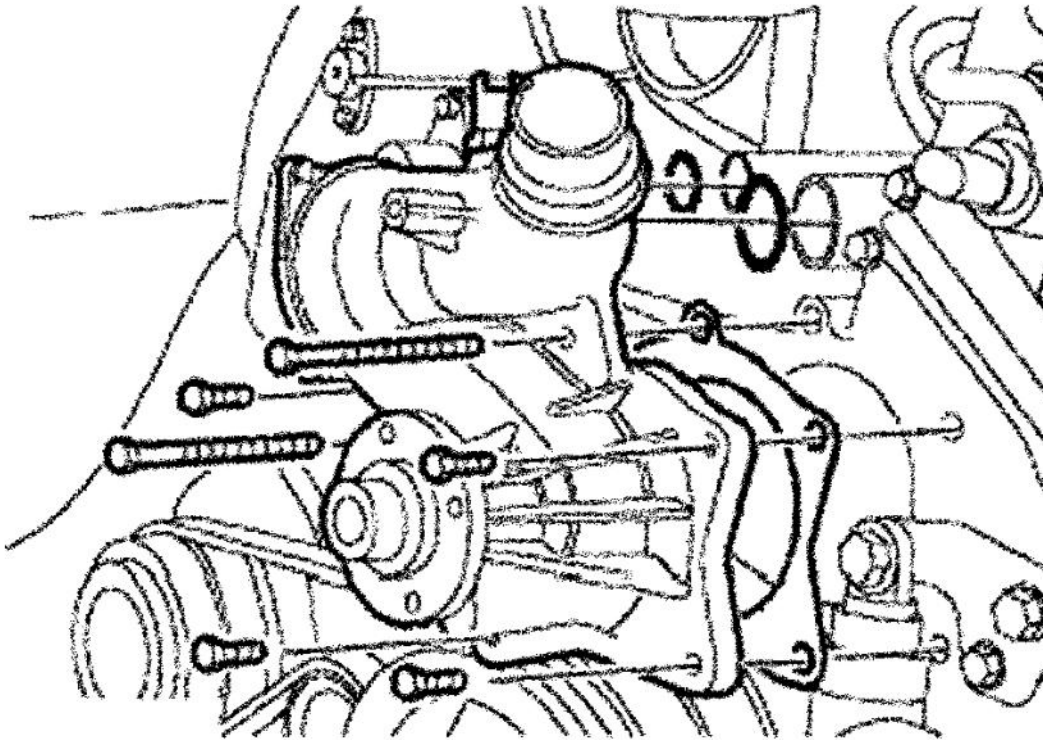
1. Remove timing gear upper covers. See **COVER - TIMING GEAR - UPPER**.
2. Remove crankshaft front oil seal. See **OIL SEAL - CRANKSHAFT - FRONT**.
3. Remove 2 bolts securing ancillary drive belt tensioner to lower timing gear cover. See **Fig. 181**.
4. Remove dust cap from ancillary drive belt tensioner idler pulley and remove Torx bolt securing ancillary drive belt tensioner idler pulley.
5. Remove ancillary drive belt tensioner assembly.

6. Remove 2 bolts securing A/C compressor drive belt tensioner. See **Fig. 272**.
7. Remove remaining bolt securing A/C compressor drive belt tensioner and remove tensioner.
8. Remove nut and disconnect battery cable from alternator. See **Fig. 182**.
9. Release battery cable from lower timing gear cover.
10. Remove 6 alternator securing bolts and alternator harness securing clip. See **Fig. 183**.
11. Release and remove alternator from engine timing cover.
12. Discard alternator "O" ring.
13. Remove 2 Allen bolts and 1 nut securing Power Assisted Steering (PAS) pump and move aside. See **Fig. 184**.
14. Remove 6 bolts securing coolant pump. See **Fig. 273**.
15. Support coolant rail pipes and remove coolant pump, remove and discard coolant pump "O" rings.



G00388275

Fig. 272: Removing A/C Compressor Drive Belt Tensioner
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388276

Fig. 273: Removing Coolant Pump

Courtesy of LAND ROVER NORTH AMERICA, INC.

Disassembly

1. Remove 6 bolts securing lower timing gear cover to upper sump. See **Fig. 185**.
2. Remove 15 bolts securing lower timing gear cover to cylinder block.

NOTE: Note position of all bolts as they are different lengths. See **Fig. 186**:

- A = M8 x 75 mm
- B = M6 x 40 mm
- C = M6 x 85 mm
- D = M6 x 80 mm
- E = M8 x 90 mm
- F = M6 x 60 mm

3. Remove lower timing gear cover.
4. Discard 3 lower timing gear cover gaskets.

Inspection

Clean timing gear cover and mating faces, clean dowels and dowel holes.

Reassembly

1. Apply sealant STC 50550 to areas illustrated. See **Fig. 187**.
2. Fit 3 new lower timing gear cover gaskets.
3. Fit lower timing gear cover.
4. Fit 15 bolts securing lower timing gear cover to cylinder block and initially tighten to 5 Nm (4 ft. lbs).
5. Tighten 6 mm bolts securing lower timing gear cover to 10 Nm (7 ft. lbs) and 8 mm bolts securing lower timing gear cover to 22 Nm (16 ft. lbs).

CAUTION: Check torque of all bolts once they have been tightened down.

6. Fit 6 bolts securing lower timing gear cover to upper oil sump and tighten to 12 Nm (9 ft. lbs).

Installation

1. Lubricate new "O" rings and fit to sealing grooves in coolant pump.
2. Clean coolant pump housing and mating faces.
3. Fit new gasket to coolant pump, fit pump to engine and secure with bolts tighten bolts to 10 Nm (7 ft. lbs).
4. Position Power Assisted Steering (PAS) pump to mounting, fit Allen bolts and securing nut. Tighten Allen bolts to 10 Nm (7 ft. lbs) and securing nut to 25 Nm (18 ft. lbs).
5. Clean alternator and engine timing gear cover mating face.
6. Lubricate and fit new "O" ring to alternator.
7. Fit alternator and tighten securing bolts.
8. Secure battery cable to lower timing gear cover.
9. Connect battery lead to alternator and tighten nut securing battery lead to alternator to 13 Nm (10 ft. lbs).
10. Position A/C compressor drive belt tensioner and secure with bolt but DO NOT tighten at this stage.
11. Fit 2 bolts securing A/C compressor drive belt tensioner to upper sump but DO NOT tighten at this stage.
12. Fit ancillary drive belt tensioner assembly, fit Torx bolt securing ancillary drive belt tensioner idler pulley and tighten Torx bolt.
13. Fit dust cap to ancillary drive belt tensioner idler pulley.
14. Fit 2 bolts securing ancillary drive belt tensioner to timing gear cover but DO NOT tighten at this stage.
15. Fit crankshaft front oil seal. See **OIL SEAL - CRANKSHAFT - FRONT**.
16. Fit timing gear upper covers. See **COVER - TIMING GEAR - UPPER**.

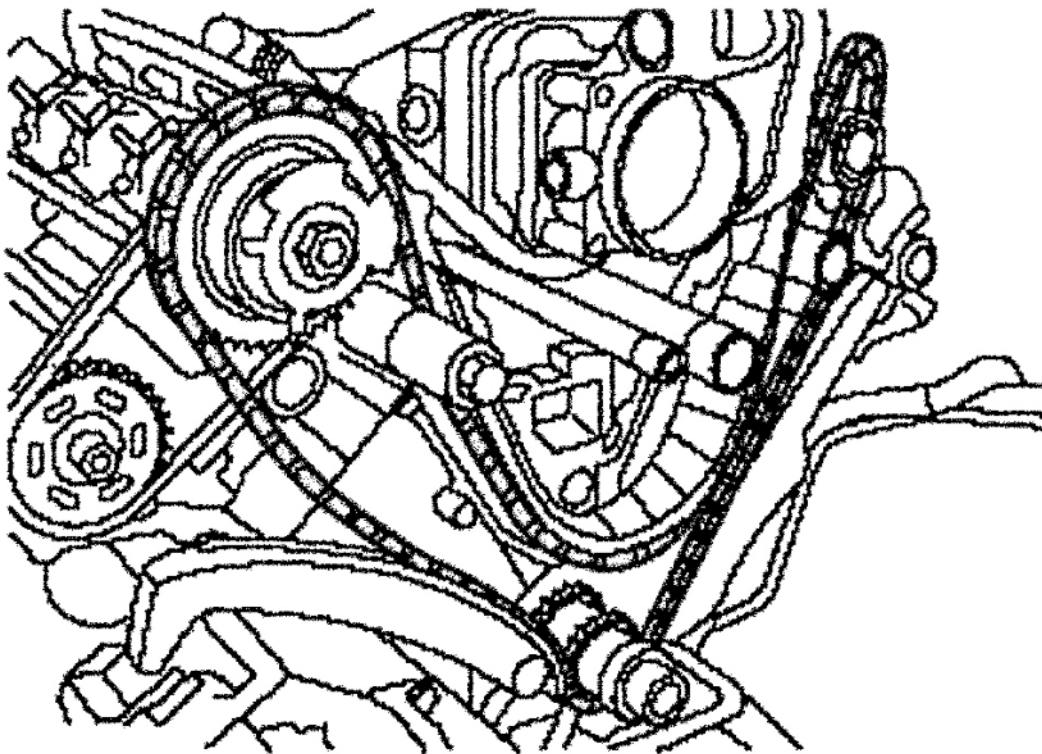
TIMING CHAIN & GUIDES

Removal

1. Remove left Variable Camshaft Control (VCC) unit. See VARIABLE CAMSHAFT UNIT - VARIABLE CAMSHAFT CONTROL (VCC).
2. Remove lower timing gear cover. See COVER - TIMING GEAR - LOWER.

Disassembly

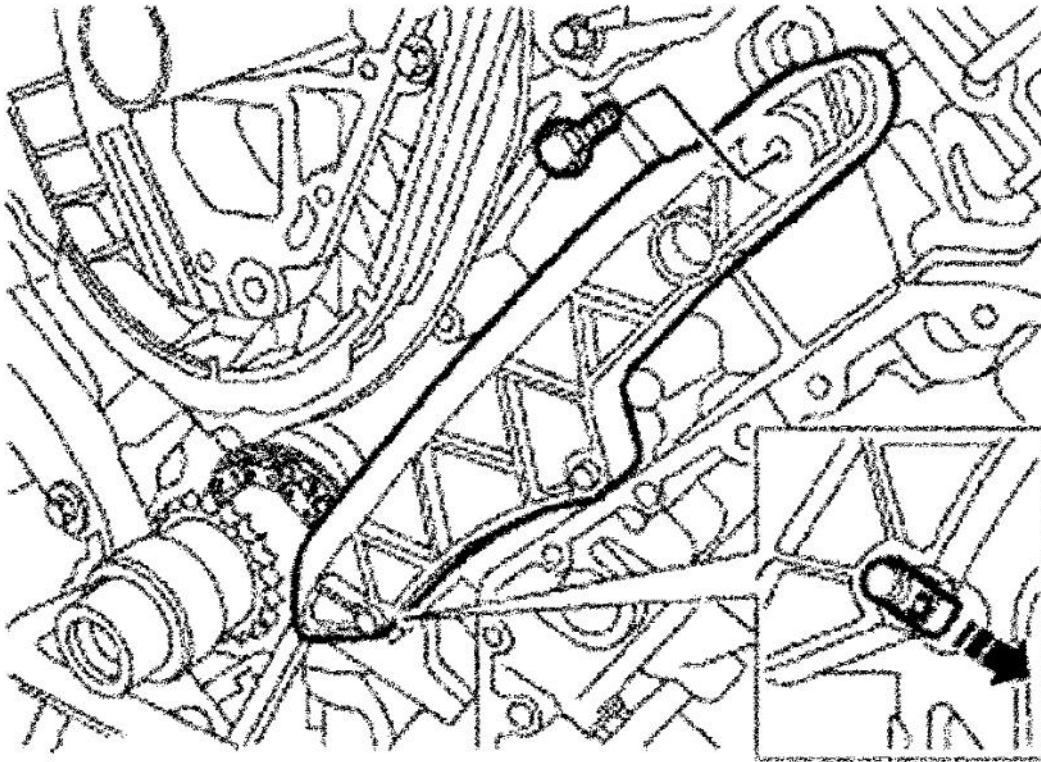
1. Remove timing chain. See Fig. 274.
2. Remove bolt securing left timing chain guide. See Fig. 275.
3. Release clip securing left timing chain guide and remove guide.
4. Remove Torx bolt securing right timing chain tensioner guide. See Fig. 276.
5. Remove tensioner guide and discard "O" ring.
6. Remove 5 Torx bolts securing timing chain center guide. See Fig. 277.
7. Remove center guide and discard "O" ring, seal and restrictor.



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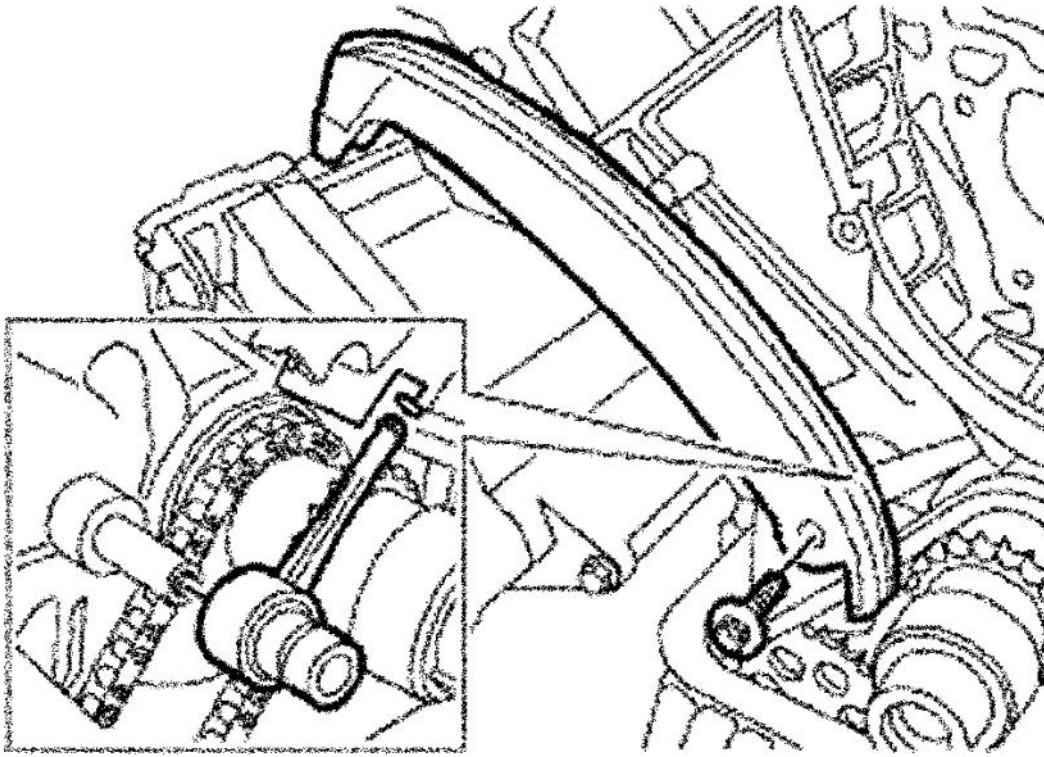
Fig. 274: Removing Timing Chain

Courtesy of LAND ROVER NORTH AMERICA, INC.



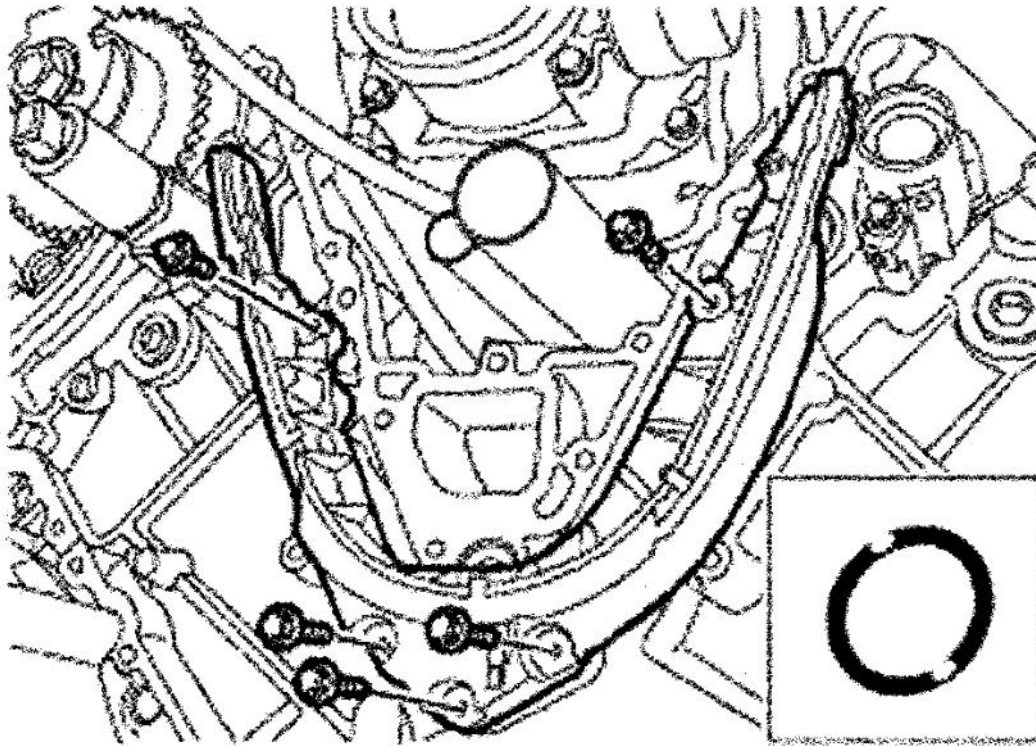
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Fig. 275: Removing Left Timing Chain Guide Bolt
Courtesy of LAND ROVER NORTH AMERICA, INC.



G00388279

Fig. 276: Removing Right Timing Chain Tensioner Guide
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 277: Removing Timing Chain Center Guide & Discard "O" Ring Seal & Restrictor
Courtesy of LAND ROVER NORTH AMERICA, INC.

Inspection

1. Clean timing chain gears.
2. Check timing chain gears for excessive wear.

Reassembly

1. Fit and lubricate new restrictor, seal and "O" ring to center timing chain guide.
2. Position center timing chain guide and secure with Torx bolts, tighten to 10 Nm (7 ft. lbs).
3. Fit and lubricate "O" ring to right timing chain tensioner guide.
4. Fit right timing chain tensioner guide and secure with Torx bolt tighten to 45 Nm (33 ft. lbs).
5. Fit left timing chain guide and secure retaining clip.
6. Fit bolt to secure left timing chain guide and tighten to 10 Nm (7 ft. lbs).
7. Lubricate timing chain with clean engine oil.
8. Fit timing chain to crankshaft sprocket and right VCC unit.

NOTE: The timing chain may be fitted in any position to the crankshaft sprocket and right Variable Camshaft Control (VCC) unit sprocket.

9. Secure timing chain to left cylinder head until left VCC unit is fitted.

Installation

1. Fit lower timing gear cover. See **COVER - TIMING GEAR - LOWER.**
2. Fit left Variable Camshaft Control (VCC) unit. See **VARIABLE CAMSHAFT UNIT - VARIABLE CAMSHAFT CONTROL (VCC) - LEFT.**

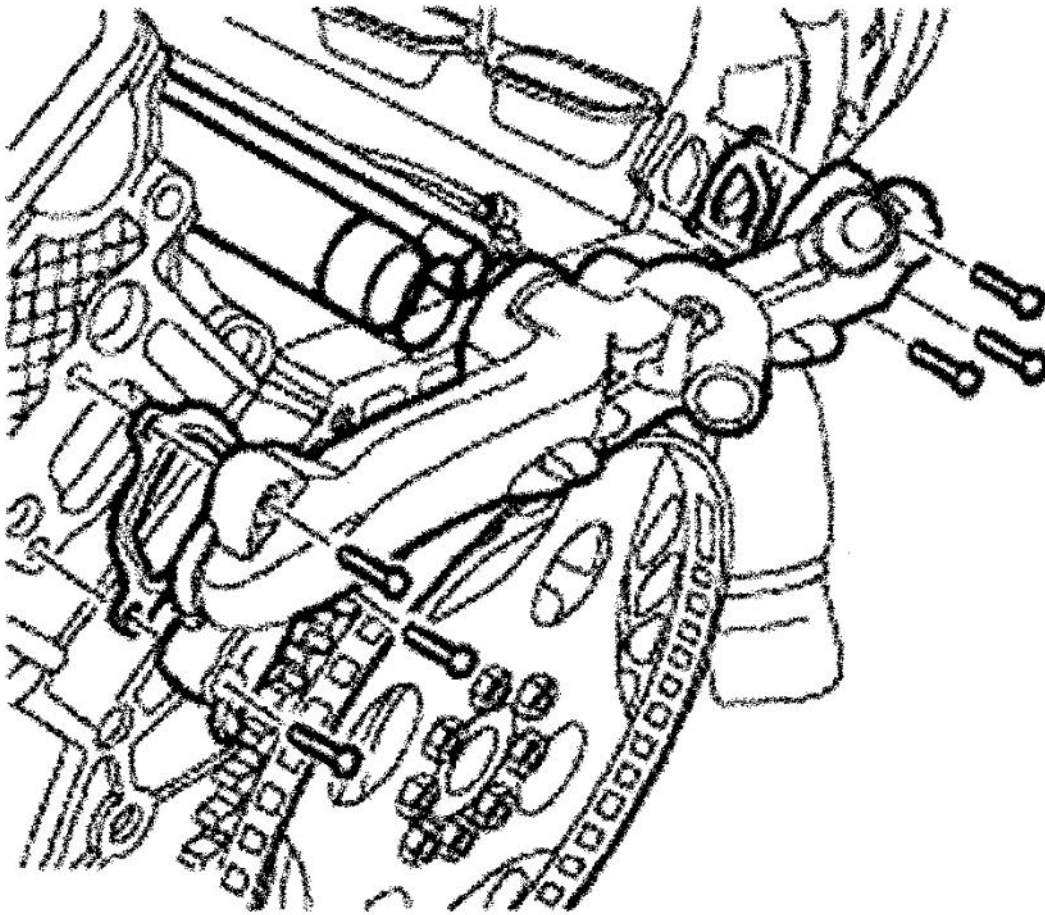
PIPES - WATER PUMP TO COOLANT MANIFOLD

Removal

Remove induction manifold. See **GASKET - INDUCTION MANIFOLD.**

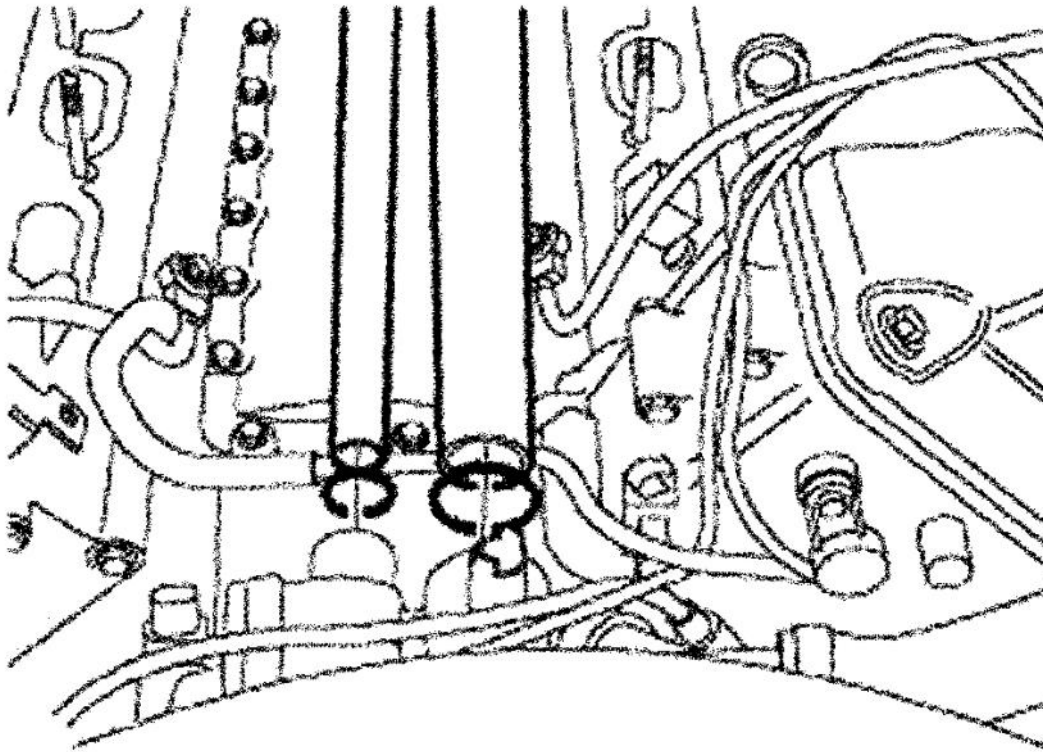
Disassembly

1. Remove 6 bolts securing coolant manifold to cylinder heads. See **Fig. 278.**
2. Remove coolant manifold.
3. Remove and discard coolant manifold gaskets.
4. Remove 2 coolant pipes from coolant pump. See **Fig. 279.**
5. Discard "O" rings.



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Fig. 278: Removing Coolant Manifold-To-Cylinder Head Bolts
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 279: Removing Coolant Pipes From Coolant Pump
Courtesy of LAND ROVER NORTH AMERICA, INC.

Inspection

1. Clean gasket mating faces.
2. Clean "O" ring grooves and ends of coolant pipes.

Reassembly

1. Lubricate new "O" rings with rubber grease and fit to grooves in coolant pump and coolant manifold.
2. Fit coolant pipes to the coolant pump.
3. Position new gaskets and coolant manifold to cylinder heads, fit bolts and tighten to 10 Nm (7 ft. lbs).

Installation

1. Fit induction manifold. See **GASKET - INDUCTION MANIFOLD**.

GASKET - INDUCTION MANIFOLD

Disassembly

1. Remove nut securing positive terminal to bracket on inlet manifold and release terminal from bracket. See **Fig. 280**.
2. If fitted: Disconnect vacuum hose from Secondary Air Injection (SAI) control valve. See **Fig. 281**.

CAUTION: Always fit plugs to open connections to prevent contamination.

3. If fitted: Disconnect SAI vacuum hose from inlet manifold end cover, note fitted position and remove reservoir and vacuum switch from inlet manifold. See **Fig. 282**.

CAUTION: Always fit plugs to open connections to prevent contamination.

4. Remove 2 bolts securing engine breather separator to bracket on inlet manifold and move the separator aside.
5. Loosen clip and disconnect engine breather hose from inlet manifold end cover. See **Fig. 283**.

CAUTION: Always fit plugs to open connections to prevent contamination.

6. Loosen clip and disconnect engine breather hose from left camshaft cover.

CAUTION: Always fit plugs to open connections to prevent contamination.

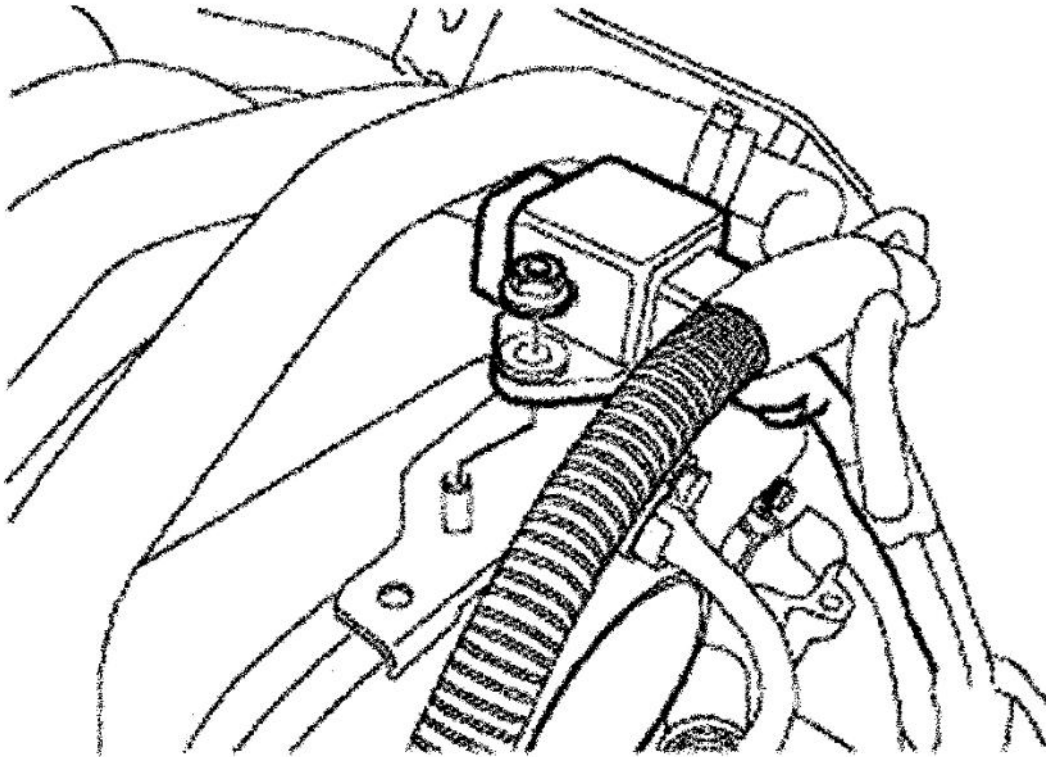
7. Disconnect purge control valve hose from inlet manifold. See **Fig. 284**.

CAUTION: Always fit plugs to open connections to prevent contamination.

8. Remove 10 nuts securing induction manifold to cylinder heads and remove 10 spacers. See **Fig. 285**.
9. Raise inlet manifold for access to manifold drain hose.
10. Release clip and disconnect drain hose from inlet manifold. Discard clip.

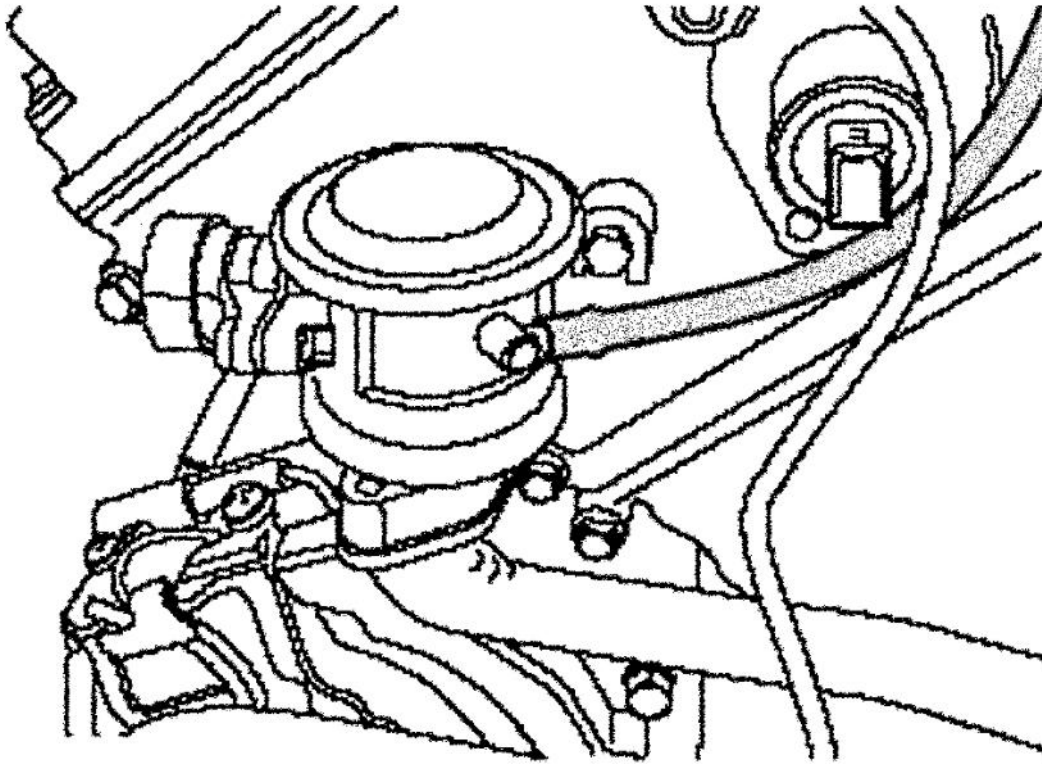
CAUTION: Always fit plugs to open connections to prevent contamination.

11. Remove induction manifold and discard 4 gaskets.



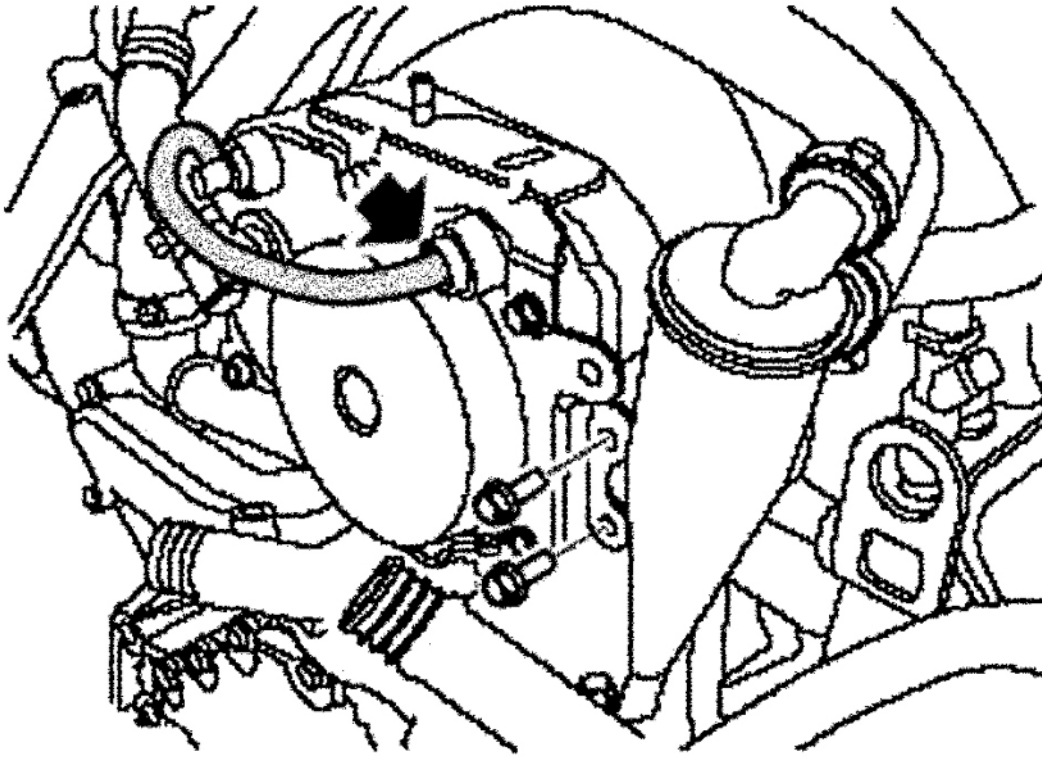
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Fig. 280: Removing Positive Terminal From Bracket On Inlet Manifold
Courtesy of LAND ROVER NORTH AMERICA, INC.



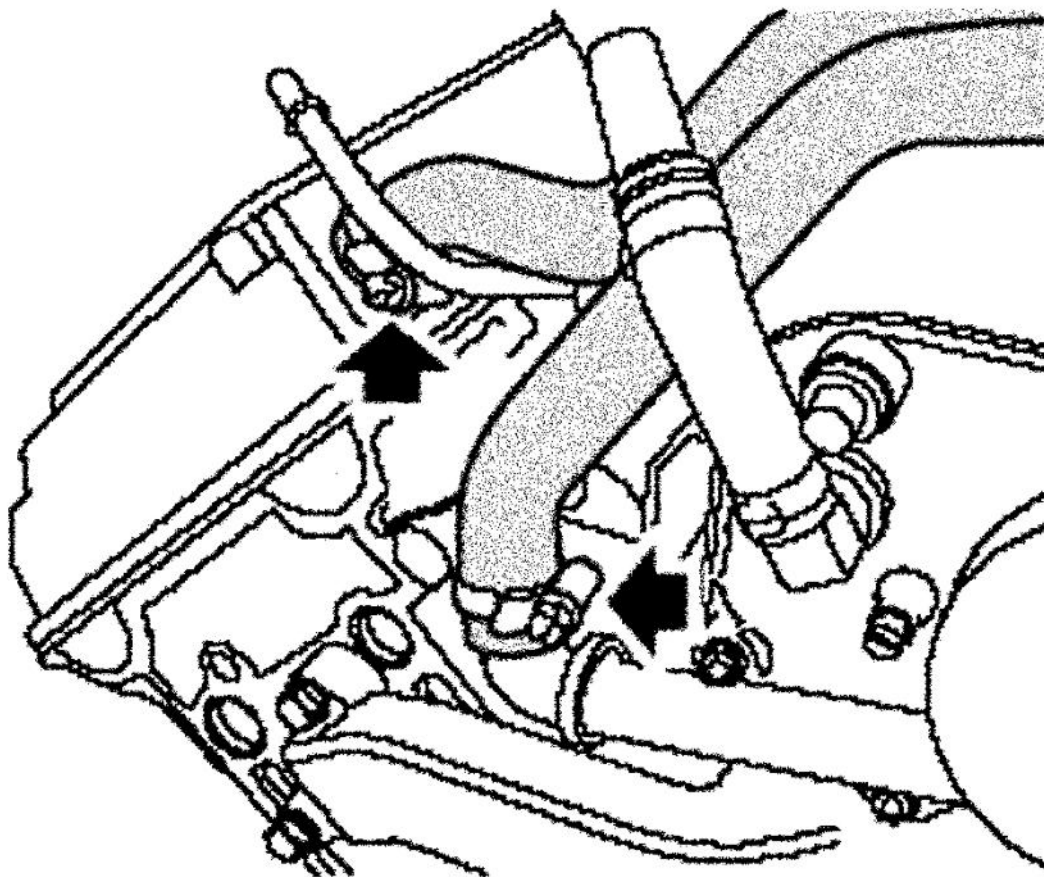
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Fig. 281: Disconnecting Vacuum Hose From Secondary Air Injection Control Valve
Courtesy of LAND ROVER NORTH AMERICA, INC.



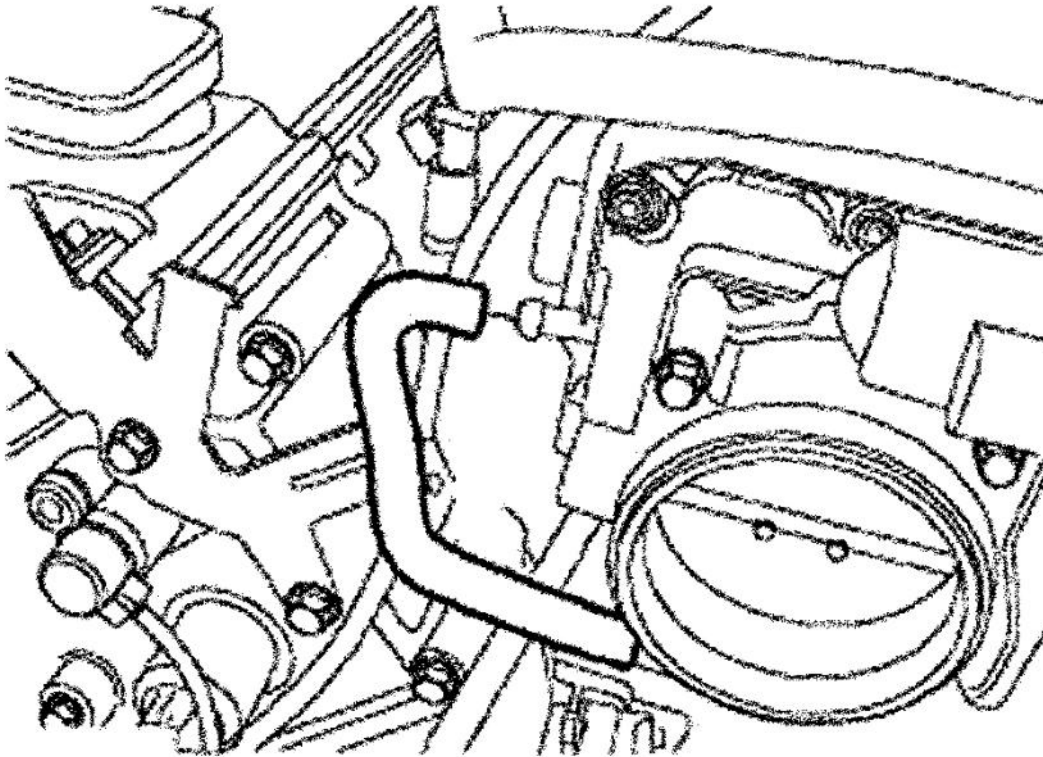
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Fig. 282: Disconnecting Secondary Air Injection Vacuum Hose From Inlet Manifold
Courtesy of LAND ROVER NORTH AMERICA, INC.



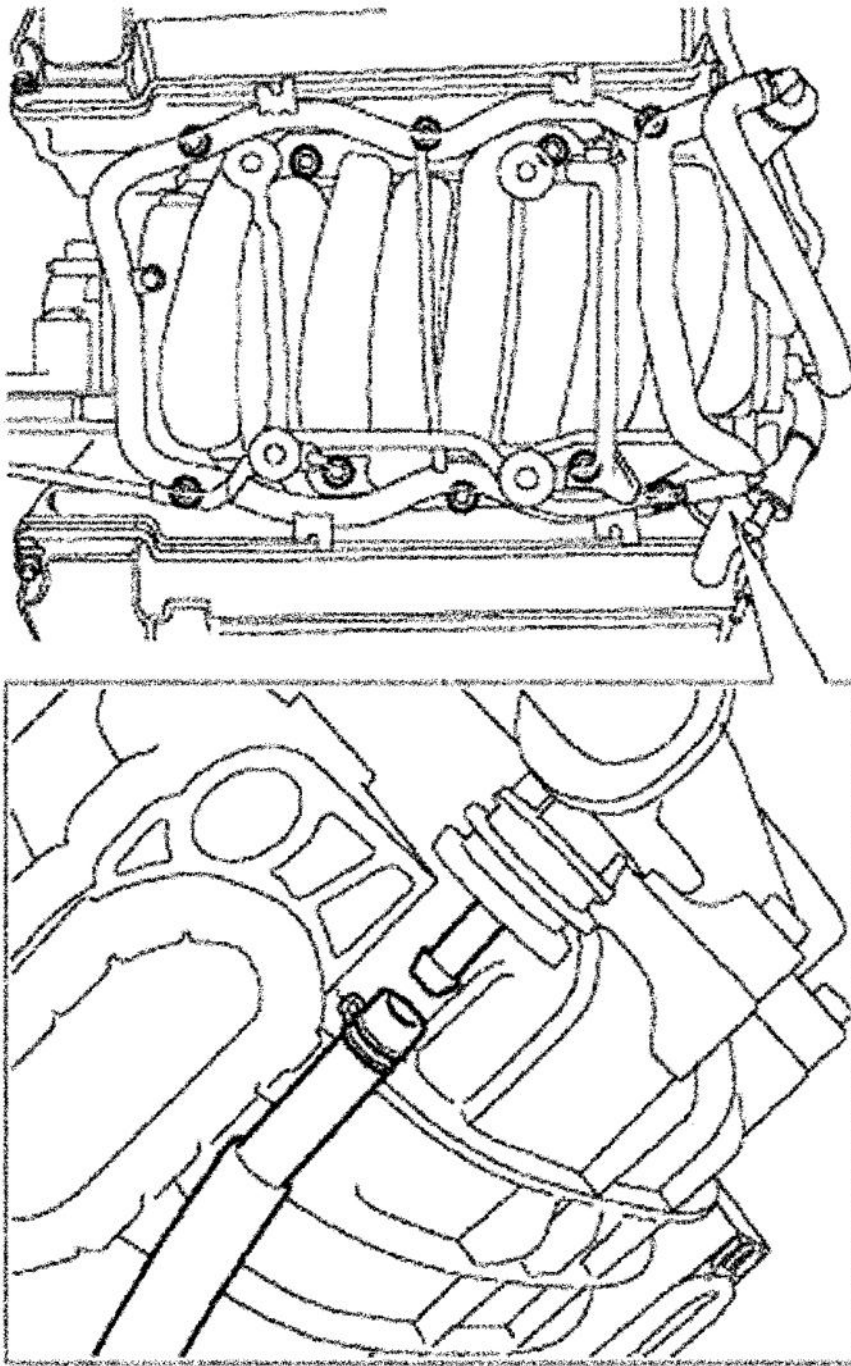
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Fig. 283: Disconnecting Engine Breather Hose From Inlet Manifold End Cover
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 284: Disconnecting Purge Control Valve Hose From Inlet Manifold
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 285: Removing Induction Manifold To Cylinder Head
Courtesy of LAND ROVER NORTH AMERICA, INC.

Reassembly

1. Fit new gaskets to inlet manifold.
2. Position inlet manifold, connect drain hose and secure the hose with a new clip.
3. Fit inlet manifold to studs, fit spacers and tighten nuts evenly and progressively to 15 Nm (11 ft. lbs).
4. Connect purge control valve hose to inlet manifold.
5. Connect engine breather hoses and tighten hose clips.
6. Position engine breather separator to bracket and tighten bolts to 6 Nm (4.4 ft. lbs).
7. Position Secondary Air Injection (SAI) vacuum switch and reservoir to inlet manifold, connect hose to inlet manifold end cover.
8. Connect vacuum hose to SAI control valve.
9. Fit positive terminal to bracket on inlet manifold and tighten nut to 10 Nm (7 ft. lbs).

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Battery Positive Cable-To-Stud Nut	13 (18)
Bell Housing Top Torx Bolts	18 (25)
Connecting Rod Bolts ⁽¹⁾	
Step 1	(2)
Step 2	15 (20)
Step 3	Tighten An Additional 80 Degrees
Crankshaft Pulley Bolt	
Step 1	74 (100)
Step 2	Tighten An Additional 60 Degrees
Step 3	Tighten An Additional 60 Degrees
Step 4	Tighten An Additional 30 Degrees
Crankshaft Pulley-To-Hub Bolts	16 (22)
Crankshaft Rear Oil Seal Housing Bolts	9 (12)
Crossmember Bolts	50 (68)
Cylinder Block Drain Plug	18 (25)
Cylinder Head Bolts ^{(1) (3)}	
Step 1	22 (30)
Step 2	Tighten An Additional 80 Degrees
Step 3	Tighten An Additional 80 Degrees
Differential-To-Engine Oil Pan Bolts	81 (110)

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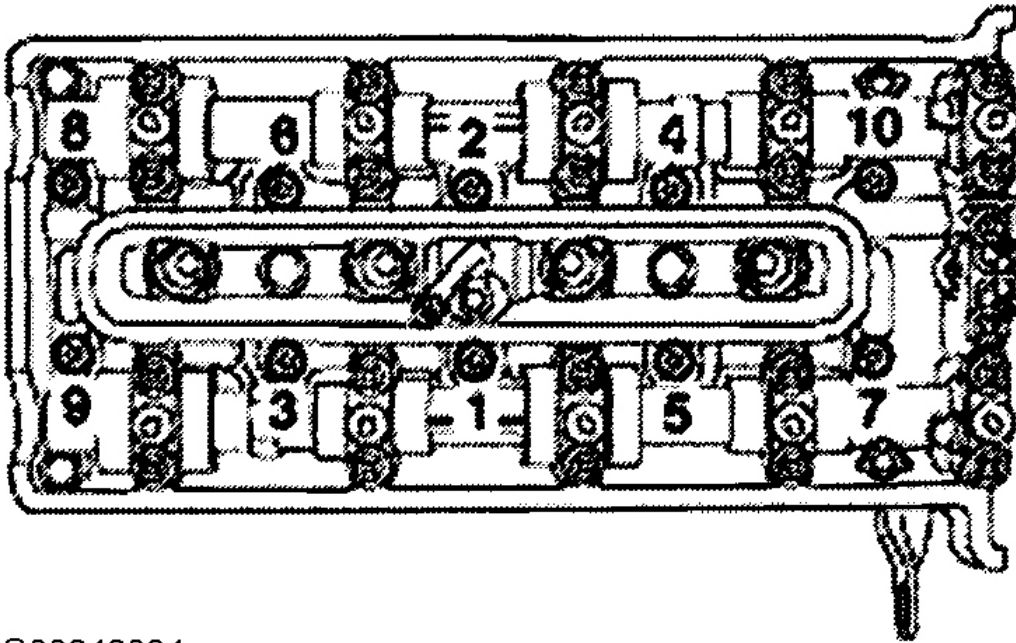
2003-05 ENGINES Range Rover - 4.4L V8

Drive Plate-To-Crankshaft Bolts	89 (120)
Drive Plate-To-Torque Converter Bolts	33 (45)
Engine Coolant Temperature Sensor	11 (15)
Engine Left/Right Mount-To-Sub-Frame Bolt ⁽¹⁾	41 (56)
Engine Mount-To-Mounting Bracket Nuts	74 (100)
Engine Rear Mount-To-Crossmember Bolts	74 (100)
Exhaust Camshaft Sprocket Torx Bolt	
Initial Torque	11 (15)
Checking Continuity Torque	30 (40)
Final Torque	92 (125)
Exhaust Manifold Nuts	17 (23)
Intake Manifold Nuts	11 (15)
Knock Sensor Bolts	15 (20)
Lower Timing Gear Cover-To-Upper Oil Pan Bolts	9 (12)
Oil Filter Cap	18 (25)
Oil Filter Return Pipe-To-Oil Pan	22 (30)
Oil Pan-To-Bell Housing Torx Bolts	39 (53)
Oil Pressure Switch	20 (27)
Oxygen Sensor ⁽⁴⁾	37 (50)
Main Bearing Caps	
Main Bearing Cap Adjustable Spacers	(5)
Main Bearing Cap Adjustable Spacer Bolts ⁽¹⁾	
Step 1	15 (20)
Step 2	Tighten An Additional 45 Degrees
Main Bearing Cap Bolts ⁽¹⁾	
Step 1	15 (20)
Step 2	Tighten An Additional 100 Degrees
Spark Plugs	23 (31)
Timing Chain Tensioner Plug	30 (40)
Timing Cover Bolts	11 (15)
Transmission-To-Engine Torx Bolts	33 (45)
Variable Camshaft Control Solenoid	18 (25)
Variable Camshaft Control Unit Torx Bolt	
Initial Torque	11 (15)
Checking Continuity Torque	30 (40)
Final Torque	81 (110)
Viscous Fan Coupling Nut	33 (45)

2003 Land Rover Range Rover HSE

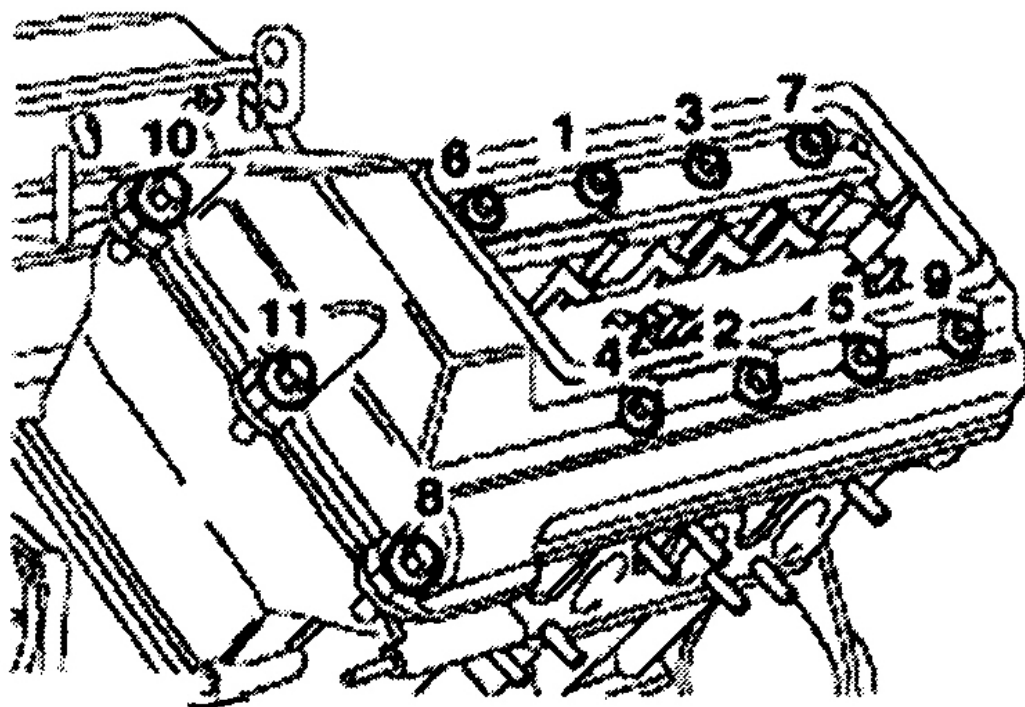
2003-05 ENGINES Range Rover - 4.4L V8

	INCH Lbs. (N.m)
Camshaft Cover Bolts & Nuts ⁽⁶⁾	89 (10)
Camshaft Position Sensor Bolt	89 (10)
Coolant Gallery Sealing Plate-To-Cylinder Block Bolts	89 (10)
Coolant Manifold-To-Cylinder Head Bolts	89 (10)
Crankshaft Position Sensor Bolt	89 (10)
Engine Harness-To-Coolant Manifold Bolt	89 (10)
Ground Strap-To-Camshaft Cover Nut	35 (4)
Ignition Coil Nuts	35 (4)
Intake Manifold Bracket Bolts	89 (10)
Lower Oil Pan Bolts	89 (10)
Lower Timing Cover Bolts	
Step 1 - All Bolts	44 (5)
Step 2	
6-mm Bolts	89 (10)
8-mm Bolts	(7)
Oil Baffle Plate Bolts	89 (10)
Secondary Air Injection Pipe Bolts	89 (10)
Thermostat Housing Bolts	89 (10)
Upper Oil Pan-To-Block Bolts	
M6 x 8.8-mm	89 (10)
M6 x 10.9-mm	106 (12)
M8 x 8.8-mm	(7)
Viscous Coupling-To-Fan Bolts	89 (10)
Water Pump Bolts	89 (10)
(1) Use NEW bolts/nuts only. (2) Tighten to 44 INCH lbs. (5 N.m). (3) Tighten cylinder head bolts in sequence. See Fig. 286. (4) Apply anti-seize compound to threads. (5) Tighten to 89 INCH lbs. (10 N.m). (6) Tighten camshaft cover bolts and nuts in sequence. See Fig. 287. (7) Tighten to 16 ft. lbs. (22 N.m).	



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Fig. 286: Cylinder Head Bolt Tightening Sequence
Courtesy of LAND ROVER NORTH AMERICA, INC.



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Fig. 287: Camshaft Cover Bolt & Nut Tightening Sequence
Courtesy of LAND ROVER NORTH AMERICA, INC.