

1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3

Fuel Delivery: FI | **Fuel:** GAS

B234 Engine

NOTE: The use of the correct special tools or their equivalent is required for this procedure.

LEFT SHAFT AND HOUSING

1. Disconnect the negative battery cable.
2. Set the engine to TDC of the No. 1 cylinder.
3. Remove the timing and balance shaft belts.
4. Use a counterhold tool 5362 and remove the left side balance shaft pulley.
5. Remove the air mass meter and inlet hose.
6. Unfasten the bracket under the intake manifold and remove the bracket holding the alternator and power steering pump. These may be swung aside and tied with wire to the left shock tower.
7. Remove the bolts securing the balance shaft housing to the block. Using an extractor tool 5376 or similar, carefully separate the housing from the block. The housing must be removed evenly from both its front and rear mounts.

To install:

8. Clean the joint faces on the cylinder block. Coat new O-rings with engine oil and place them in the grooves around the oil passages on the housing. The rings can be held in place with a light coating of grease.
9. Coat the balance shafts and bearings with cam lube or moly grease.
10. Install the balance shaft housing. Make absolutely sure the housing is evenly mounted on the front and rear mountings. Tighten the bolts alternately in a diagonal pattern. Tighten each bolt $\frac{1}{2}$ turn at a time; tighten them to 15 ft. lbs. (20 Nm). When all the bolts are at 15 ft. lbs. (20 Nm), loosen them individually and tighten each one to 90 inch lbs. (10 Nm) plus 90 degrees of rotation.

NOTE: Make certain the shaft does not seize within the housing during installation.

11. If the halves of the housing were split apart during the repair, tighten the joint bolts to 72 inch lbs. (8 Nm).
12. Install the drive pulley. Use a counterholding tool. Note that the pulley has a slot which will align with the guide on the shaft. The shallow side of the pulley faces inward, toward the engine. Tighten the center bolt for the pulley to 37 ft. lbs. (50 Nm).
13. Install the bracket for the alternator and power steering pump. Double check their connections and hoses.
14. Attach the support under the intake manifold and don't forget the wire clamp on the bottom bolt.
15. Install the air mass meter and its intake hose.
16. Install the balance shaft belt and camshaft belt.
17. Connect the negative battery cable.

RIGHT SHAFT AND HOUSING

1. Disconnect the negative battery cable.
2. Set the engine to TDC of the No. 1 cylinder.
3. Remove the timing and balance shaft belts.
4. Use a counterhold tool 5362 and remove the left side balance shaft pulley.
5. Remove the balance shaft belt tensioner and remove the bolt running through the backing plate to the balance shaft housing.
6. Remove the air mass meter and its air inlet hose.
7. Remove the air preheat hose from the bottom heat shield at the exhaust manifold.
8. Remove the nuts holding the right engine mount to the crossmember.
9. Connect a hoist or engine lift apparatus to the top of the engine.
10. Lift the engine at the right side, being careful to maintain clearance between the brake master cylinder and the intake manifold.
11. Remove the complete motor mount from the block, including the pad and lower mounting plate.
12. Remove the bolts securing the balance shaft housing to the block.
13. Using an extractor tool 5376 or similar, carefully separate the housing from the block. The housing must be removed evenly from both its front and rear mounts.

To install:

14. Clean the joint faces on the cylinder block.
15. Coat new O-rings with engine oil and place them in the grooves around the oil passages on the housing. The rings can be held in place with a light coating of grease.
16. Install the balance shaft housing. Make absolutely sure the housing is evenly mounted on the front and rear mountings. Tighten the bolts alternately in a diagonal pattern. Tighten each bolt $\frac{1}{2}$ turn at a time; tighten them to 15 ft. lbs. (20 Nm). When all the bolts are at 15 ft. lbs. (20 Nm), loosen them individually and tighten each one to 7.5 ft. lbs. (10 Nm) plus 90 degrees of rotation.

NOTE: Make certain the shaft does not seize within the housing during installation.

17. If the halves of the housing were split apart during the repair, tighten the joint bolts to 72 inch lbs. (8 Nm).
18. Install the drive pulley. Use a counterholding tool. Note that the pulley has a slot which will align with the guide on the shaft. The shallow side of the pulley faces inward, toward the engine. Tighten the center bolt for the pulley to 37 ft. lbs. (50 Nm).
19. Install the engine mount onto the block.
20. Using the studs on the crossmember as a guide, lower the engine into place on the front crossmember. When the engine is correctly seated, the lifting apparatus may be removed.
21. Reinstall the air mass meter and its air intake hose.
22. Reinstall the motor mount bolts and the air preheat tube at the lower part of the exhaust manifold.
23. Install the bolt through the backing plate and into the balance shaft housing.
24. Reinstall the belt tensioner, tightening the bolt so the pulley is movable when the belt is in position.
25. Reinstall the balance shaft and camshaft belts.
26. Connect the negative battery cable.

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The 2.3L 4-cylinder, 2.9L 6-cylinder, and 2.3 and 2.4L 5-cylinder engines all use camshafts that ride directly over the followers (lifters). After camshaft removal, they can be lifted out of their bores and inspected. If removal is necessary, mark the followers to assure their placement in the correct bore.

The 2.8L 6-cylinder engine uses rocker shaft mounted followers. Please refer to Rocker Arm/Shaft removal/installation for their removal.

NOTE: When installing a camshaft, always lubricate the camshaft, seats, and lifters with the proper camshaft lube or moly grease.

2.3L 4-Cylinder Engines

1. Disconnect the negative battery cable.
2. Remove the drive belts.
3. Set the engine to TDC of the No. 1 cylinder.
4. Remove the timing belt.
5. Remove the valve cover.
6. Remove the camshaft center bearing cap. Install camshaft press tool 5021 or equivalent over the center bearing journal to hold the camshaft in place while removing the other bearing caps.
7. Remove the 4 remaining bearing caps.
8. Remove the seal from the forward edge of the camshaft.
9. Release camshaft press tool and lift out the camshaft.

WARNING

Do not rotate the crankshaft while the camshaft is removed from the cylinder head.

To install:

10. Apply sealant to the outer sealing surfaces of the front and rear caps.
11. Lubricate the camshaft with cam lube or moly grease, and place into position. The guide pin for the timing gear should face up.
12. Install the rear bearing cap.
13. Slide the camshaft back and forth to check the camshaft end-play. End-play should be 0.004–0.016 in. (0.1–0.4mm).
14. Install the camshaft press tool.
15. Install the camshaft seal.
16. Lubricate and install the remaining caps starting in the center and working out.
17. Tighten the bolts to 14 ft. lbs. (20 Nm).
18. Lubricate the front seal and install, using tool 5025 or equivalent.
19. Install the camshaft gear and spacer washer.
20. Remove the tools.
21. Install the timing belt.
22. Install the remaining components.
23. Connect the negative battery cable.

2.8L 6-Cylinder Engine

1. Disconnect the negative battery cable.
2. Set the engine to TDC of the No. 1 cylinder.
3. Remove the cylinder head.
4. Remove the camshaft rear cover plate.
5. Remove the camshaft retaining fork at the front of the cylinder head.
6. Pull the camshaft out the rear of the head.

NOTE: The camshaft does not have bearings, the journals in the head are machined to fit the camshaft. The retaining fork is used to adjust end-play to position the camshaft in the correct position.

To install:

7. Oil the camshaft and followers and install.
8. Tighten the camshaft retaining bolt to 7–11 ft. lbs. (10–15 Nm).
9. Install the camshaft retaining fork.
10. Install the rear cover plate.
11. Install the cylinder head.
12. Connect the negative battery cable.

2.9L 6-Cylinder Engine

1. Disconnect the negative battery cable.
2. Remove the drive belts.
3. Set the engine to TDC of the No. 1 cylinder.
4. Remove the timing belt.

NOTE: Do not turn the crankshaft while the belt is removed.

5. Remove the camshaft pulleys, using the holding tool 5199 or equivalent.
6. Remove the top half of the cylinder head.
7. Tap the joint lugs and camshaft front ends lightly.
8. Remove the camshafts.

To install:

9. Lubricate the camshafts and bearing seats with cam lube or moly grease.
10. Place the camshafts into position.
11. Install the holding tool 5453 or equivalent to the front end and the locking tool 5452 or equivalent to the rear end of the cylinder head upper section.

12. Install the upper cylinder head section and tighten against the lower section, using the press tools 5454 or equivalent.
13. Install and tighten the retaining bolts to 13 ft. lbs. (17 Nm), starting from the inside and working outwards.
14. Remove the tools.
15. Lubricate the camshaft front seals and tap into place.
16. Install the camshaft pulleys.
17. Tighten the camshaft pulley bolts alternately to 15 ft. lbs. (20 Nm).
18. Install the timing belt.
19. Install the tensioner and tighten the bolts to 18 ft. lbs. (25 Nm). Check that the timing marks on the crankshaft and camshaft pulleys are correctly aligned.
20. Install the remaining components.
21. Install the drive belts.
22. Connect the negative battery cable.

2.3L and 2.4L 5-Cylinder Engines

1. Disconnect the negative battery cable.
 2. Remove the drive belt.
 3. Set the engine to TDC of the No. 1 cylinder.
 4. Remove the timing belt.
 5. Remove the ignition coils cover.
- NOTE: Do not turn the crankshaft while the belt is removed.**
6. Remove the camshaft position sensor and shutter at the right rear of camshaft assembly.
 7. Remove the switch holder and shield at the left rear of assembly.
 8. Remove the ignition coils. Mark their locations.
 9. Mark the pulleys for reference so they can be returned to their original sides, then remove the camshaft pulleys, using holding tool 5199 or equivalent.
 10. Remove the top half of the cylinder head.
 11. Tap the joint lugs and camshaft front ends lightly.
 12. Remove the camshafts.
 13. Thoroughly clean the mating surfaces between the upper and lower halves of the cylinder head.

WARNING

Do not use a metal scraper. Use a soft putty knife and gasket solvent cleaner with an exhaust fan. The surfaces must be totally clean to assure a tight seal.

To install:

14. Lubricate the camshafts and bearing seats.
 15. Place the camshafts into position.
 16. Install the holding tool 5453 or equivalent to the front end and the locking tool 5452 or equivalent to the rear end of the cylinder head upper section.
 17. Remove No. 1 and No. 5 spark plugs
 18. Using a roller, apply liquid gasket 161 059-9 or equivalent to the upper half of the cylinder head.
- NOTE: Make sure that no liquid gasket gets into the oil passages. Only a thin coating is required.**
19. Install the upper cylinder head section and tighten against the lower section, using the press tools 5454 or equivalent.
 20. Install and tighten the retaining bolts to 13 ft. lbs. (17 Nm), starting from the inside and working outwards.
 21. Remove the tools.
 22. Lubricate the camshaft front seals and tap into place.
 23. Mount the upper timing cover.
 24. Install the camshaft sprockets and line up the camshaft timing marks.
 25. Install two camshaft sprocket bolts furthest from the timing mark and tighten until they are just touching the sprocket.
 26. Remove the upper timing cover.
 27. Make sure that the remaining camshaft sprocket bolt hole is centered.
 28. Turn all the idler pulleys listening for bearing noise.
 29. Check to see that the contact surfaces are clean and smooth.
 30. Remove the tensioner pulley lever and idler pulley, lubricate the contact surfaces and bearing with grease. If the tensioner pulley lever or idler is seized, replace it.
 31. Install the tensioner pulley lever and tighten to 18 ft. lbs. (25 Nm).
 32. Install the idler pulley and tighten to 18 ft. lbs. (25 Nm).
 33. Compress the tensioner fully with tool 999 5456 or equivalent.
 34. Install the timing belt.
 35. Install the rear camshaft seal using drift 999 5450 or equivalent and press it carefully into position flush with the inner chamfer edge.
 36. Install the remaining components
 37. Connect the negative battery cable.
 38. Start the engine and run it until the thermostat opens.
 39. Check the engine for leaks.

Fig. 1: Remove the camshaft pulley cover



Fig. 2: Prior to removal, mark the exhaust camshaft pulley . .



Fig. 3: . . . and the intake camshaft pulley

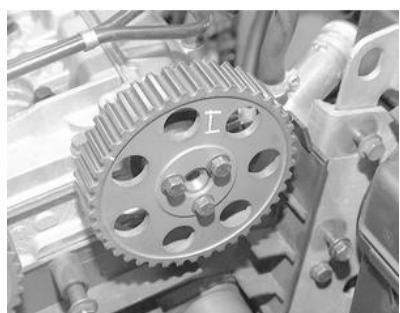


Fig. 4: Install the pulley holding tool . . .



Fig. 5: . . . and remove the pulley retaining bolts



Fig. 6: Remove the pulley from the camshaft

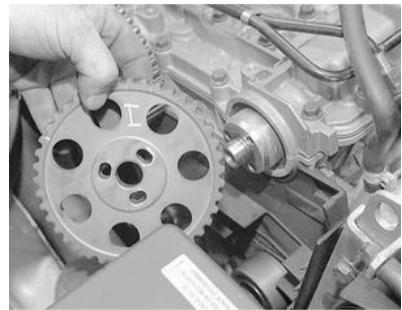


Fig. 7: Carefully lift the intake camshaft from the cylinder head



Fig. 8: Remove the exhaust camshaft

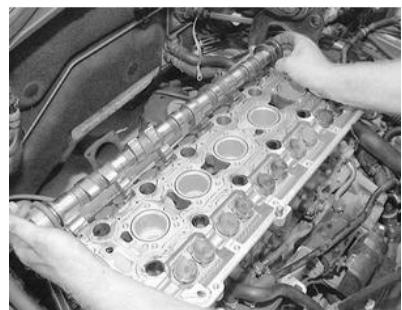


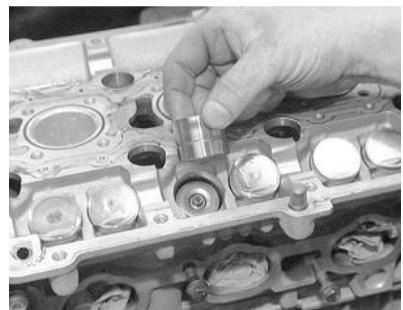
Fig. 9: Remove the camshaft seals



Fig. 10: Inspect the camshaft lobes for wear



Fig. 11: Remove the camshaft followers, noting their position



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[2.3L 4-Cylinder Engine](#)

1. Disconnect the negative battery cable.
2. Remove the drive belts and cooling fan.
3. Remove the cooling fan shroud.
4. Remove the center nut on the damper.
5. Remove the damper from the crankshaft.

To install:

6. Install the damper on the crankshaft.
7. Tighten the center nut to 44 ft. lbs. (60 Nm) and then an additional 60°.
8. Install the cooling fan shroud.
9. Install the drive belts and cooling fan.
10. Connect the negative battery cable.

[2.8L 6-Cylinder Engine](#)

1. Disconnect the negative battery cable.
2. Remove the drive belt(s) and cooling fan.
3. Raise and safely support the vehicle on jackstands.
4. Remove the splashguard from the underside of the vehicle.
5. Remove the starter and install Volvo tool number 5112 or equivalent to keep the crankshaft from turning.
6. Remove the center nut on the crankshaft pulley.

NOTE: Be careful when removing the pulley, the aligning key on the crankshaft can fall out and get lost.

7. Remove the pulley from the crankshaft.

To install:

8. Install the pulley onto the crankshaft. Align the key onto the slot on the crankshaft.
9. Tighten the center nut on the pulley to 177–207 ft. lbs. (240–280 Nm).
10. Remove the special tool and install the starter.
11. Install the splashguard.
12. Lower the vehicle.
13. Install the cooling fan and drive belts.
14. Connect the negative battery cable.

[2.9L 6-Cylinder Engine](#)

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle on jackstands.
3. Remove the splashguard from the underside of the vehicle.
4. Remove the drive belt(s) and cooling fan.
5. Remove the four vibration damper bolts.
6. Attach Volvo tool number 5433 or equivalent to hold damper. Remove the center nut on damper.
7. Remove the damper from the crankshaft.

To install:

8. Install damper onto crankshaft.
9. Attach tool number 5433 or equivalent and tighten center nut to 221 ft. lbs. (300 Nm).
10. Install the four damper bolts and tighten to 26 ft. lbs. (35 Nm).
11. Install the cooling fan and drive belts.
12. Install the splashguard.
13. Lower the vehicle.
14. Connect the negative battery cable.

[2.3L and 2.4L 5-Cylinder Engines](#)

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle on jackstands.
3. Remove the nut retaining the fenderwell trim in the uppermost corner and bend the trim back to gain access to the front of the engine.
4. Remove the drive belt.
5. Remove the four vibration damper bolts.
6. Attach Volvo tool number 5433 or equivalent to hold the damper stationary.
7. Remove the center nut from the damper.
8. Remove the damper from the crankshaft.

To install:

9. Install the damper onto the crankshaft.
10. Attach tool number 5433 or equivalent to hold the damper stationary, and tighten the center nut to 133 ft. lbs. (180 Nm).
11. Install the four damper bolts and tighten to 18 ft. lbs. (25 Nm).
12. Install the drive belt.

13. Install the fenderwell trim.
14. Lower the vehicle.
15. Connect the negative battery cable.

Fig. 1: Remove the nut in the upper left corner of the fenderwell trim . . .

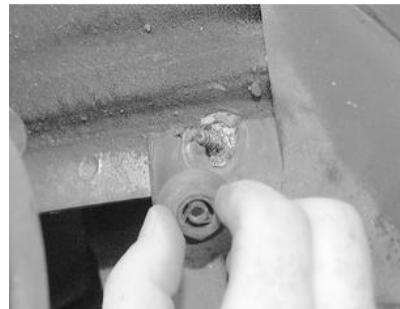


Fig. 2: . . . and bend the trim up to access the crankshaft damper



Fig. 3: While using a suitable tool to keep the crankshaft from rotating, remove the damper retaining bolts

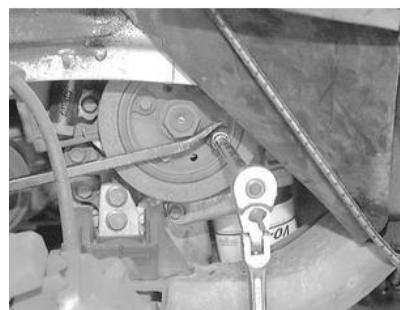


Fig. 4: Keep the damper from turning while you remove the center nut

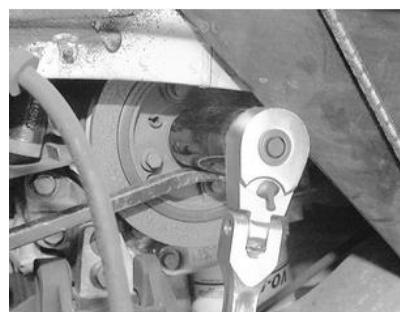
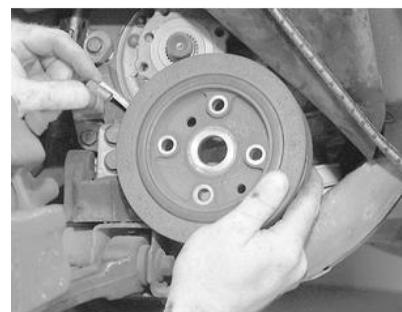


Fig. 5: Remove the damper from the crankshaft



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2.3L 4-Cylinder Engine

1. Disconnect the negative battery cable.
2. Drain the engine oil.
3. Remove the overflow tank cap and drain the coolant.
4. Disconnect the upper radiator hose.
5. Remove the distributor cap and wires.
6. Remove the PCV hoses.
7. Remove the EGR valve and vacuum pump.
8. Remove the air pump, if equipped, and air injection manifold.
9. Disconnect and remove all hoses to the turbocharger, if equipped. Plug all open hoses and holes immediately.
10. Remove the exhaust manifold and header pipe bracket.
11. Remove the intake manifold.
12. Remove the fuel injectors.
13. Remove the valve cover.
14. Remove the fan and shroud.
15. Set the engine to TDC of the No. 1 cylinder.
16. Remove the timing belt.
17. Loosen the cylinder head bolts by reversing the torque sequence.
18. Remove the cylinder head.

NOTE: The cylinder head should be cleaned and inspected prior to installation. For general cylinder head inspection and overhaul procedures, refer to Engine Reconditioning later in this section.

To install:

19. Check the position of the crankshaft. No. 1 piston should be at TDC. Check the position of the camshaft for cylinder No. 1. Both lobes should be in such a position that if the head were installed, the valves would be closed.
20. Install the cylinder head gasket and the cylinder head.
21. Coat a new O-ring for the water pump with coolant and install it in place.
22. Apply a light coat of oil to the head bolts and install.
23. Tighten the head bolts in three steps using the proper sequence.
 - A. Step 1 — Tighten all bolts to 14 ft. lbs. (20 Nm).
 - B. Step 2 — Tighten all bolts to 43 ft. lbs. (60 Nm).
 - C. Step 3 — Angle tighten all bolts an additional 90 degrees.
24. Install the timing belt.
25. Install the shroud and fan.
26. Install the drive belts and pulleys.
27. Install the intake manifold, fuel injection system, throttle cable and valve covers.
28. Install the exhaust manifold and header pipe.
29. Install the air pump assembly.
30. If equipped with a turbocharger, install the turbocharger and related parts.
31. Install the EGR valve, vacuum pump, PCV hoses, distributor cap and wires, and the overflow tank.
32. Connect the negative battery cable.
33. Fill the radiator with coolant, check the engine oil and transmission fluid.
34. Start the engine and allow it to reach operating temperature.
35. Check the timing.

Fig. 1: Positioning the cylinder head and gasket on the engine block. Check that the water pump O-ring sits correctly in the groove

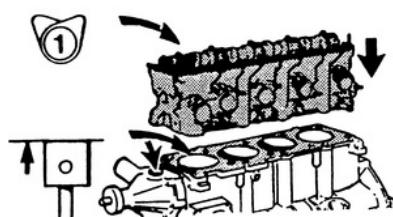
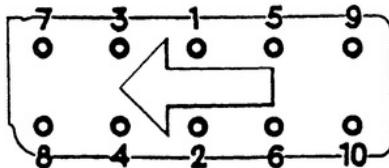


Fig. 2: Cylinder head bolt torque sequence for the 2.3L 4-cylinder engines



2.8L 6-Cylinder Engine

1. Disconnect the negative battery cable.
 2. Drain the engine oil.
 3. Drain the coolant.
 4. Remove the air cleaner assembly and all attaching hoses.
 5. Disconnect the throttle cable. On automatic transmission equipped vehicles, disconnect the kickdown cable.
 6. Disconnect the EGR vacuum hose and remove the pipe between the EGR valve and manifold.
 7. Remove the oil filler cap and cover the hole with a rag.
 8. Disconnect the PCV pipe(s) from the intake manifold.
 9. Remove the front section of the intake manifold.
 10. Unplug the electrical connector and fuel line at the cold start injector.
 11. Remove the vacuum hose, both fuel lines, and the electrical connector from the control pressure regulator.
 12. Remove the hose, pipe and electrical connector from the auxiliary air valve.
 13. Remove the auxiliary air valve.
 14. Remove the electrical connector from the fuel distributor.
 15. Remove the wire loom from the intake manifolds.
 16. Remove the spark plug wires.
 17. Turn the engine to TDC of the No. 1 cylinder by aligning the notch on the distributor with the rotor.
 18. Disconnect the fuel injectors from their holders.
 19. Disconnect the distributor vacuum hose, carbon filter hose and diverter valve hose from the intake manifold.
 20. Disconnect the power brake hose and heater hose at the intake manifold.
 21. Disconnect the throttle control link from its pulley.
 22. If equipped with an EGR vacuum amplifier, disconnect the wires from the throttle micro-switch and solenoid valve.
 23. At the firewall, disconnect the fuel lines from the fuel filter and return line.
 24. Remove the 2 attaching screws and lift out the fuel distributor and throttle housing assembly.
 25. If not equipped with an EGR vacuum amplifier, disconnect the EGR valve hose from under the throttle housing.
 26. Remove the cold start injector, rubber ring and pipe.
 27. Remove the 4 retaining bolts and lift off the intake manifold.
 28. Remove the rubber rings.
 29. Remove the splash guard under the engine.
 30. If removing the left cylinder head, remove the air pump from its bracket.
 31. If removing the right cylinder head, disconnect the upper radiator hose.
 32. On air conditioned vehicles, remove the air conditioning compressor and secure it aside. Do not disconnect the refrigerant lines.
 33. Disconnect the distributor leads and remove the distributor.
 34. Remove the EGR valve, bracket and pipe.
 35. At the firewall, Remove the electrical connectors at the relays.
 36. On air conditioned vehicles, remove the rear compressor bracket.
 37. Disconnect the coolant hose(s) from the water pump to the cylinder head(s). If removing the left cylinder head disconnect the lower radiator hose at the water pump.
 38. Disconnect the air injection system supply hose from the applicable cylinder head. Separate the air manifold at the rear of the engine. If removing the left cylinder head, remove the backfire valve and air hose.
 39. Remove the valve cover(s).
 40. On the left cylinder head, remove the Allen head screw and 4 upper bolts to the timing gear cover.
 41. On the right cylinder head, remove the 4 upper bolts to the timing gear cover and the front cover plate.
 42. From under the vehicle, remove the exhaust pipe clamps for both header pipes.
 43. If removing the right cylinder head, remove the retainer bracket bolts and pull the dipstick tube out of the crankcase.
 44. Remove the applicable exhaust manifold(s).
 45. Remove the cover plate at the rear of the cylinder head.
 46. Rotate the camshaft sprocket, for the applicable cylinder head, into position so the large sprocket hole aligns with the rocker arm shaft. With the camshaft in this position, loosen the cylinder head bolts, in sequence, same sequence as tightening, and remove the rocker arm and shaft assembly.
 47. Loosen the camshaft retaining fork bolt, directly in back of sprocket, and slide the fork away from the camshaft.
 48. Next, it is necessary to hold the cam chain stretched during camshaft removal. Otherwise, the chain tensioner will automatically take up the slack, making it impossible to reinstall the sprocket on the cam without removing the timing chain cover to loosen the tensioner device. To accomplish this, a sprocket retainer tool 999 5104 or equivalent is installed over the sprocket with 2 bolts in the top of the timing chain cover. A bolt is then screwed into the sprocket to hold it in place.
 49. Remove the camshaft sprocket center bolt and push the camshaft to the rear, so it clears the sprocket.
 50. Remove the cylinder head.
- NOTE: Do not remove the cylinder head by pulling straight up. Instead, lever the head off by inserting 2 spare head bolts into the front and rear inboard cylinder head bolt holes and pulling toward the applicable wheel housing. Otherwise, the cylinder liners may be pulled up, breaking the lower liner seal and leaking coolant into the crankcase. If any do pull up, new liner seals must be used and the crankcase completely drained. If the head(s) seem stuck, gently tap around the edges of the head(s) with a rubber mallet, to break the joint.**
51. Remove the head gasket.
 52. Clean the contact surfaces with a plastic scraper and lacquer thinner.
 53. If the head is going to be off for any length of time, install liner holders tool 999 5093 or 2 strips of thick stock steel with holes for the head bolts, so the liners stay pressed down

against their seals. Install the holders width-wise between the middle 4 head bolt holes.

To install:

54. If the dowels at the outboard corners of the block have slipped down, use a pair of needle-nose pliers to retrieve them. Prop them up with an $\frac{1}{8}$ inch (3mm). Remember to keep the timing chain taut during cylinder head installation.
55. Remove the liner holders and install the head gaskets. The left and right head gaskets are different, ensure the correct one is installed.
56. Install the cylinder head.
57. Install the camshaft and remove the timing chain retainer tool.
58. Install the head bolts finger-tight after lubricating with oil.
59. On 1990 asbestos-free gasket, with fixed-washer bolts, tighten all bolts in stages as follows:
 - A. Tighten the bolts to 44 ft. lbs. (60 Nm).
 - B. Loosen bolts, tighten it to 30 ft. lbs. (40 Nm).
 - C. Angle-tighten to 160–180 degrees.
60. Except 1990 asbestos-free gasket, with fixed-washer bolts, tighten all bolts in stages as follows:
 - A. Tighten bolts to 43 ft. lbs. (60 Nm).
 - B. Loosen bolt 1, then tighten it to 15 ft. lbs. (20 Nm).
 - C. Angle-tighten to 106 degrees, using special tool 5098 or equivalent.
 - D. Repeat this for remaining bolts in sequence shown. Loosen and tighten each bolt in turn.

NOTE: After the engine has been warmed-up, angle-tighten each bolt a further 45 degrees.

61. Install the camshaft center bolt and tighten to 52–66 ft. lbs. (70–89 Nm).
62. Install the timing gear case and rear cylinder head covers.
63. Check and adjust the valve lash.
64. After adjusting valve lash, turn the engine to TDC on No. 1 piston.
65. Install the valve covers, air injection system, exhaust pipes and manifolds.
66. Install all coolant hoses, install the air conditioner compressor brackets, distributor, EGR valve, cold start injector using a new gasket, and intake manifold.
67. Install the vacuum pump and lower splash shield.
68. Fasten all electrical connections previously removed.
69. Install the throttle linkage, fuel injectors and all fuel injection system hoses, lines and electrical connections.
70. Connect the negative battery cable.
71. Fill the radiator with coolant, check the engine and transmission oil.
72. Start the engine and allow it to reach operating temperature.
73. Adjust the timing and check for leaks.

Fig. 3: The engine is at TDC of the No. 1 cylinder when the notch on the distributor aligns with the rotor

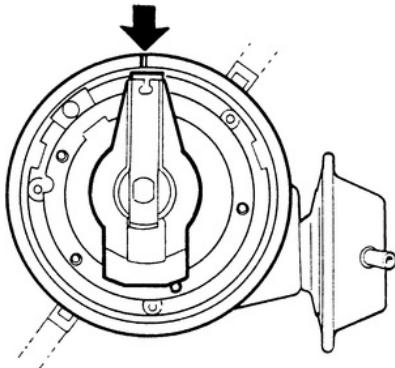


Fig. 4: The cylinder liners must be installed before the cylinder head

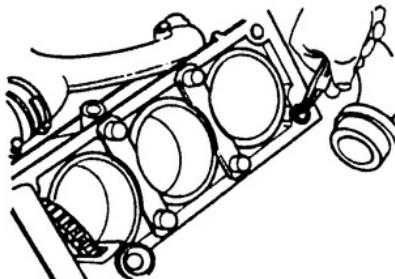
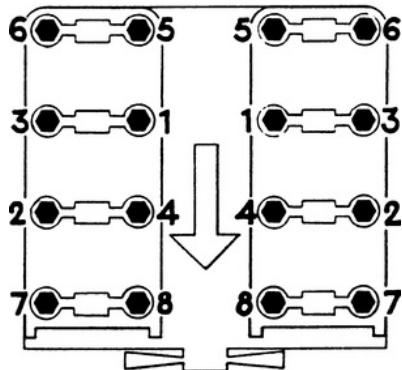


Fig. 5: 2.8L 6-cylinder engine cylinder head bolt tightening sequence



2.9L 6-Cylinder Engine

1. Disconnect the negative battery cable.
2. Drain the engine oil.
3. Drain the cooling system.
4. Remove the front exhaust pipe, heat shield and exhaust manifold(s).
5. Remove the coolant pipe bolts.
6. Set the engine to TDC of the No. 1 cylinder.
7. Remove the timing belt.
8. Remove the transmission mounting plate bolt.
9. Remove the air mass meter and intake hose.
10. Remove the throttle pulley cover, throttle cable and cable bracket.
11. Disconnect the throttle switch lead and vacuum hoses at throttle housing and cruise control servo.
12. Remove the intake manifold outer section.
13. Mark the positions and remove the ignition coils.
14. Mark the camshaft pulleys (intake and exhaust sides) and remove the pulleys, using holding tool 5199 or equivalent.
15. Remove the camshaft sensor, ground terminals and temperature sensor connector.
16. Remove the coolant hose at rear.
17. Carefully tap the top half of the cylinder head upwards, using a soft mallet.
18. Tap the joint lugs and camshaft front ends.
19. Remove the camshafts.
20. Remove the cylinder head bolts, starting at the outside and working inwards.
21. Lift the cylinder head from the engine.
22. Remove the gasket.
23. Clean and inspect the cylinder head and block mating surface.

To install:

24. Align the crankshaft timing mark by removing the starter motor and installing the crankshaft locking tool 5451 or equivalent. Turn the crankshaft until it is stopped by the tool.
25. Fit a new cylinder head gasket and install the bottom half of the cylinder head.
26. Oil the cylinder head bolts; install and tighten in sequence as follows:

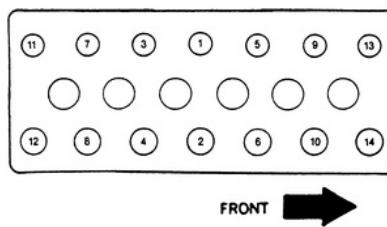
- A. Stage 1 — 15 ft. lbs. (20 Nm)
- B. Stage 2 — 44 ft. lbs. (60 Nm)
- C. Stage 3 — angle tighten 130 degrees

27. Install new O-rings in the spark plug wells and oil the camshaft bearing seats.
28. Apply sealing compound (Part No. 1161059-9 or equivalent) to the upper section of the cylinder head.

NOTE: Do not allow any compound to penetrate the coolant or oil passages.

29. Install the camshaft.
30. Place the upper section of the cylinder head into position.
31. Install the press tools (5454 or equivalent) and tighten against the lower section.
32. Install the bolts, working from the inside outwards. Tighten to 13 ft. lbs. (17 Nm).
33. Remove the tools.
34. Grease the camshaft front seal and tap the seal into place.
35. Place the upper timing cover into position.
36. Install the camshaft pulleys while aligning the timing marks.
37. Temporarily install and tighten the pulley mounting bolts.
38. Remove the timing cover and install the mounting plate bolt.
39. Install the timing belt.
40. Loosen the camshaft pulley bolts and withdraw the tensioner locking pin.
41. Insert the remaining camshaft pulley bolt.
42. Hold the pulley using the counterhold tool 5199 or equivalent and tighten all bolts alternately to 15 ft. lbs. (20 Nm).
43. Remove the crankshaft locking tool.
44. Install the protective plug and install the starter motor.
45. Install the upper timing cover.
46. Check that the timing marks on the crankshaft and camshaft pulleys are correctly aligned.
47. Install the camshaft sensor, ground terminals and temperature sensor connector.
48. Install the coolant hose at rear.
49. Install the remaining components.
50. Change the engine oil.
51. Fill the cooling system.
52. Connect the negative battery cable.
53. Start the engine and check for leaks.
54. Recheck the cooling system level.

Fig. 6: 2.9L 6-cylinder engine cylinder head bolt tightening sequence



2.3L and 2.4L 5-Cylinder Engines

1. Disconnect the negative battery cable.
2. Raise and safely support vehicle.
3. Remove the splash guard below the engine.
4. Drain the coolant into a suitable container.
5. Disconnect the exhaust pipe from the manifold.
6. Remove the exhaust manifold.
7. Set the engine to TDC of the No. 1 cylinder.
8. Remove the timing belt.
9. Disconnect the fuel distribution manifold and lift it and the injectors off to one side. Use 999-5533 holders or equivalent to separate them.
10. Disconnect the two ground straps from the engine.

NOTE: Make sure that the injectors and needles are not damaged.

11. Remove the engine cooling fan.
12. Remove the intake manifold.
13. Remove the upper radiator hose from thermostat housing.
14. Remove the camshaft sprockets. Mark them intake or exhaust.
15. Remove the inner timing cover bolt.
16. Remove the air cleaner and hoses.
17. Remove the camshaft position sensor and damper.
18. Remove the distributor cap, wiring and rotor.
19. Remove the extension arm and brackets.
20. Working inwards from each end, loosen the bolts on the upper half of the cylinder head.
21. Gently tap the upper half with a soft mallet on the edges and front of the camshafts.
22. Remove the bolts and upper half of the cylinder head.
23. Mark the camshafts and remove.
24. Remove the coolant pipe bolts.
25. Remove the cylinder head bolts working outward.
26. Remove the lower portion of the cylinder head and head gasket.
27. Clean all mating surfaces thoroughly.

WARNING

Do not use a metal scraper. Use a soft putty knife and gasket solvent cleaner with an exhaust fan. The surfaces must be totally clean to assure a tight seal.

To install:

28. Align the crankshaft timing marks.
29. Install crankshaft locking tool 999-5451 or equivalent and turn the crankshaft counterclockwise until it stops.
30. Install a new cylinder head gasket and the lower cylinder head.
31. Apply a small amount of oil to the bolts.
32. Tighten the lower cylinder head in three stages, starting on the inside and working outward as follows:

- A. 15 ft. lbs. (20 Nm)
- B. 44 ft. lbs. (60 Nm)
- C. Angle tighten an additional 130° using an angle gauge

33. Install the coolant pipe using a new gasket.
34. Replace the O-rings in the spark plug wells.
35. Remove No. 1 and No. 5 spark plugs.
36. Using a roller, apply liquid gasket 161-059-9 or equivalent to the upper cylinder head.

NOTE: Make sure that no liquid gasket gets into the oil passages. Only a thin coating is required.

37. Install the camshafts and lock them in place using tools 999-5453 (front) and 999-5452 (rear) or equivalents.
38. Install the upper cylinder head.
39. Pull the head down using press tools 999-5453 or 5454 (2) or equivalents.
40. Tighten the upper half working from the inside outward. Tighten to 13 ft. lbs. (17 Nm).
41. Remove tools 999-5453 and 999-5454 or equivalents.
42. Install the camshaft seals using an appropriate seal driver.
43. Mount the upper timing cover.
44. Install the camshaft sprockets and line up the camshaft timing marks.
45. Install two camshaft sprocket bolts furthest from the timing mark and tighten until they are just touching the sprocket.
46. Remove the upper timing cover.
47. Make sure that the remaining camshaft sprocket bolt hole is centered.

48. Install the tensioner pulley lever and tighten to 18 ft. lbs. (25 Nm).
49. Install the idler pulley and tighten to 18 ft. lbs. (25 Nm).
50. Compress the tensioner by placing in a suitable vise. Tighten the vise slowly and in small increments, stopping every $\frac{1}{4}$ turn. Install a lock pin 2mm in diameter (a 2mm Allen wrench also will work) in the piston. If the tensioner leaks, has no resistance or will not compress, replace it.
51. Install the timing belt.
52. Install the third camshaft sprocket bolt and tighten the bolts to 15 ft. lbs. (20 Nm).
53. Remove the tensioner lock pin.
54. Remove the crankshaft locking tool from the flywheel end of the block and install the plug in the hole.
55. Install the starter motor.
56. Remove the camshaft locking tool 999-5452 or its equivalent.
57. Turn the crankshaft two complete revolutions and check that the timing marks are lined up.
58. Install the rear camshaft seal using driver 999-5450 or equivalent.
59. Install the upper timing cover.
60. Install the remaining engine components
61. Connect the negative battery cable.
62. Change the engine oil.
63. Fill the cooling system.
64. Start the engine and run it until the thermostat opens.
65. Bleed the cooling system.
66. Check the engine for leaks.

Fig. 7: Remove camshafts to access the cylinder head bolts

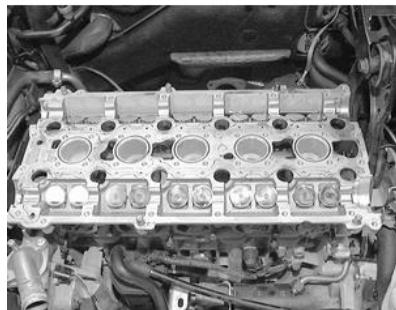


Fig. 8: Loosen the cylinder head bolts starting from the inside and working outward

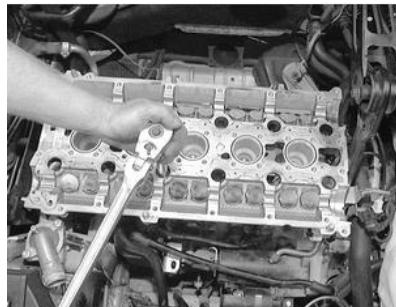


Fig. 9: Remove the bolts from the cylinder head; if necessary, use a magnet to extract them

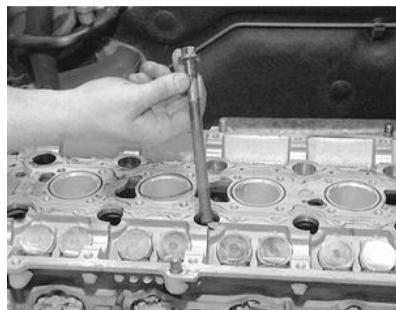


Fig. 10: Carefully lift the cylinder head off of the engine block

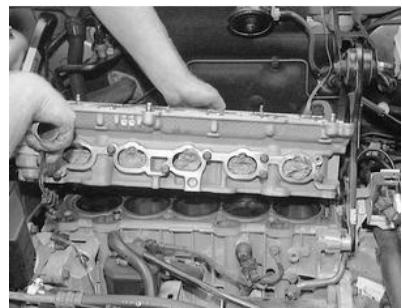


Fig. 11: After the head is removed, inspect the block for damage, cracks, and obvious wear



Fig. 12: Remove and replace the O-rings around the spark plug holes



Fig. 13: Remove the head gasket . . .

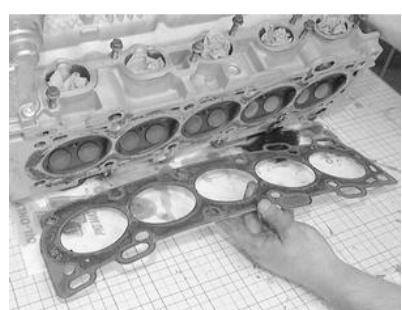


Fig. 14: . . . and thoroughly clean the cylinder head

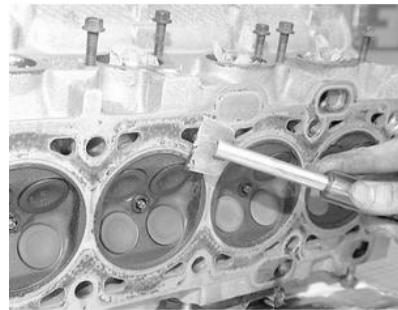


Fig. 15: View of the combustion chamber, including the intake (larger) valves, exhaust (smaller) valves, and spark plug electrodes

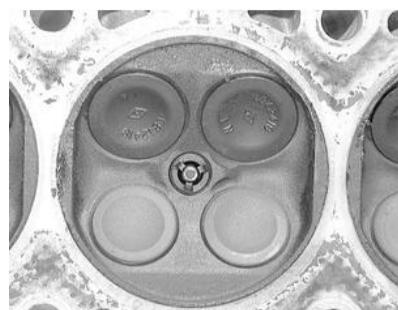


Fig. 16: Carefully place the cylinder head onto the engine block

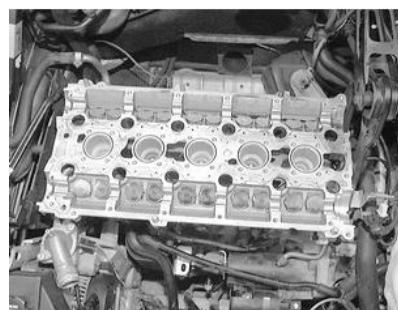


Fig. 17: Tighten the cylinder head bolts in proper sequence to specification using a torque wrench

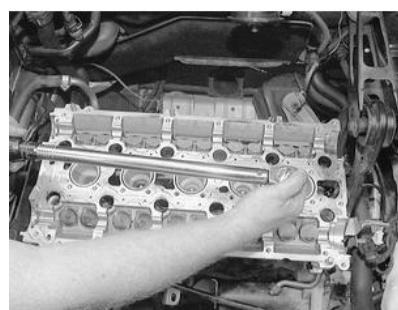


Fig. 18: A torque angle gauge can be helpful when angle-tightening the head bolts

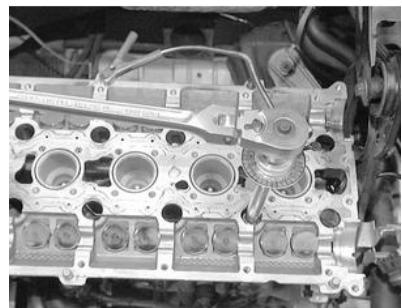
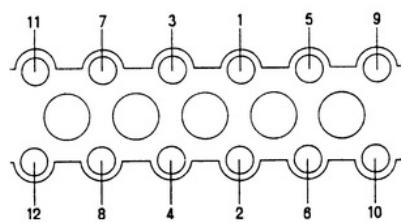


Fig. 19: 2.3L and 2.4L 5-cylinder engine head bolt tightening sequence



ENGINE MECHANICAL SPECIFICATIONS

	English Specifications	Metric Specifications
Intake Lift		
B230F and FT		
Intake	0.374 in.	9.499 mm
Exhaust	0.414 in.	10.515 mm
B234F		
Intake	0.370 in.	9.398 mm
Exhaust	0.370 in.	9.398 mm
B280F		
Intake	0.235 in.	5.969 mm
Exhaust	0.214 in.	5.436 mm
B5254S, T, and FT		
Intake	0.333 in.	8.470 mm
Exhaust	0.333 in.	8.470 mm
B5234T and T3		
Intake	0.313 in.	7.961 mm
Exhaust	0.313 in.	7.961 mm
B6304		
Intake	0.354 in.	9.004 mm
Exhaust	0.354 in.	9.004 mm
Clearance		
B230F and FT	0.0012 - 0.0028 in.	0.0304 - 0.0711 mm
B234F	0.0012 - 0.0028 in.	0.0304 - 0.0711 mm
B280F	0.0014 - 0.0034 in.	0.0356 - 0.0864 mm
B5254S, T, and FT	0.0012 - 0.0028 in.	0.0304 - 0.0711 mm
B5234T and T3	0.0012 - 0.0028 in.	0.0304 - 0.0711 mm
B6304	0.0012 - 0.0028 in.	0.0304 - 0.0711 mm
Lead		
B230F and FT	0.004 - 0.0016 in.	0.102 - 0.406 mm
B234F	0.004 - 0.0016 in.	0.102 - 0.406 mm
B280F	N/A	N/A
B5254S, T, and FT	0.002 - 0.008 in.	0.05 - 0.20 mm
B5234T and T3	0.002 - 0.008 in.	0.05 - 0.20 mm
B6304	0.002 - 0.008 in.	0.05 - 0.20 mm
Outer Diameter		
B230F and FT	1.4557 - 1.4565 in.	36.975 - 36.995 mm
B234F	1.4557 - 1.4565 in.	36.975 - 36.995 mm
B280F	1.4557 - 1.4565 in.	36.975 - 36.995 mm
B5254S, T, and FT	1.3750 - 1.3780 in.	34.950 - 35.020 mm
B5234T and T3	1.3750 - 1.3780 in.	34.950 - 35.020 mm
B6304	1.3750 - 1.3780 in.	34.950 - 35.020 mm
Outer Height		
B230F and FT	1.180 - 1.220 in.	29.97 - 30.99 mm
B234F	1.180 - 1.220 in.	29.97 - 30.99 mm
B280F	N/A	N/A
B5254S, T, and FT	N/A	N/A
B5234T and T3	N/A	N/A
B6304	N/A	N/A
Clearance		
B230F and FT	0.0012 - 0.0030 in.	0.030 - 0.076 mm
B234F	0.0012 - 0.0030 in.	0.030 - 0.076 mm
B280F	0.0012 - 0.0030 in.	0.030 - 0.076 mm
B5254S, T, and FT	N/A	N/A
B5234T and T3	N/A	N/A
B6304	N/A	N/A
Cylinder Head		
Cylinder Head Height		
B230F and FT	5.752 in.	146.1 mm
B234F	5.752 in.	146.1 mm
B280F	N/A	N/A
B5254S, T, and FT	5.076 - 5.080 in.	128.95 - 129.05 mm

ENGINE MECHANICAL SPECIFICATIONS

	English Specifications	Metric Specification
ance and FT	0.006 - 0.0014 in. 0.006 - 0.0018 in. 0.0079 - 0.0150 in.	0.1524 - 0.3556 mm 0.1524 - 0.4572 mm 0.2007 - 0.3810 mm
S, T, and FT T and T3	0.006 - 0.0018 in. 0.006 - 0.0018 in. 0.006 - 0.0018 in.	0.1524 - 0.4572 mm 0.1524 - 0.4572 mm 0.1524 - 0.4572 mm
ck		
ore Diameter and FT and B234F		
andard "C"	3.7795 - 3.7799 in.	96.00 - 96.01 mm
andard "D"	3.7799 - 3.7803 in.	96.01 - 96.02 mm
andard "E"	3.7803 - 3.7807 in.	96.02 - 96.03 mm
andard "G"	3.7811 - 3.7815 in.	96.04 - 96.05 mm
rsize 1	3.7913 in.	96.3 mm
rsize 2	3.8031 in.	96.6 mm
	3.5827 - 3.5839	91.13 - 91.16 mm
S, T, and FT		
andard "C"	3.2677 - 3.2681 in.	83.00 - 83.01 mm
andard "D"	3.2681 - 3.2685 in.	83.01 - 83.02 mm
andard "E"	3.2685 - 3.2689 in.	83.02 - 83.03 mm
andard "G"	3.2692 - 3.2696 in.	83.04 - 83.05 mm
rsize 1	3.2755 - 3.2759 in.	83.20 - 83.21 mm
rsize 2	3.2834 - 3.2838 in.	83.40 - 83.41 mm
T and T3		
andard "C"	3.1889 - 3.1893 in.	81.00 - 81.01 mm
andard "D"	3.1893 - 3.1897 in.	81.01 - 81.02 mm
andard "E"	3.1897 - 3.1901 in.	81.02 - 81.03 mm
andard "G"	3.1905 - 3.1909 in.	81.04 - 81.05 mm
rsize 1	3.1968 - 3.1972 in.	81.20 - 81.21 mm
rsize 2	3.2047 - 3.2051 in.	81.40 - 81.41 mm
andard "C"	3.2677 - 3.2681 in.	83.00 - 83.01 mm
andard "D"	3.2681 - 3.2685 in.	83.01 - 83.02 mm
andard "E"	3.2685 - 3.2689 in.	83.02 - 83.03 mm
andard "G"	3.2692 - 3.2696 in.	83.04 - 83.05 mm
rsize 1	3.2755 - 3.2759 in.	83.20 - 83.21 mm
rsize 2	3.2834 - 3.2838 in.	83.40 - 83.41 mm
Taper		
nes	0.004 in.	0.10 mm
Out-of Round		
nes	0.004 in.	0.10 mm
ht		
and FT	5.73 in. 5.73 in. N/A	145.6 mm 145.6 mm N/A
S, T, and FT T and T3	5.20 in. 5.20 in. 5.20 in.	132.1 mm 132.1 mm 132.1 mm
Deck Warpage		
ngines	.020 in	.50 mm
ngines	.008 in.	.20 mm

ENGINE MECHANICAL SPECIFICATIONS

	English Specifications	Metric Specifications
Journal Diameter		
B230F and FT	2.1255 - 2.1260 in.	53.9877 - 54.0004 mm
B234F	2.0472 - 2.0476 in.	51.9989 - 52.0090 mm
B280F	2.3611 - 2.3618 in.	59.9719 - 59.9897 mm
B5254S, T, and FT	1.96 in.	50.0 mm
B5234T and T3	1.96 in.	50.0 mm
B6304	1.96 in.	50.0 mm
Out-of-Round		
B230F and FT	0.00016 in.	0.004 mm
B234F	0.00016 in.	0.004 mm
B280F	0.0002 in.	0.004 mm
B5254S, T, and FT	0.0002 in.	0.004 mm
B5234T and T3	0.0002 in.	0.004 mm
B6304	0.0002 in.	0.004 mm
Aper		
B230F and FT	0.00016 in.	0.004 mm
B234F	0.00016 in.	0.004 mm
B280F	0.0002 in.	0.004 mm
B5254S, T, and FT	0.0002 in.	0.004 mm
B5234T and T3	0.0002 in.	0.004 mm
B6304	0.0002 in.	0.004 mm
Bearing Journal Diameter		
B230F and FT	2.4981 - 2.4986 in.	63.4517 - 63.4644 mm
B234F	2.4803 in.	63.0 mm
B280F	2.7576 - 2.7583 in.	70.0434 - 70.0608 mm
B5254S, T, and FT	2.5 in.	65.0 mm
B5234T and T3	2.5 in.	65.0 mm
B6304	2.5 in.	65.0 mm
Out-of-Round		
B230F and FT	0.00016 in.	0.004 mm
B234F	0.00016 in.	0.004 mm
B280F	0.0002 in.	0.004 mm
B5254S, T, and FT	0.0002 in.	0.004 mm
B5234T and T3	0.0002 in.	0.004 mm
B6304	0.0002 in.	0.004 mm
Aper		
B230F and FT	0.00016 in.	0.004 mm
B234F	0.00016 in.	0.004 mm
B280F	0.0002 in.	0.004 mm
B5254S, T, and FT	0.0002 in.	0.004 mm
B5234T and T3	0.0002 in.	0.004 mm
B6304	0.0002 in.	0.004 mm
Bearing Clearance		
B230F and FT	.0011 - 0.0033 in.	0.0279 - 0.0838 mm
B234F	.0011 - 0.0033 in.	0.0279 - 0.0838 mm
B280F	0.0035 in.	0.0889 mm
B5254S, T, and FT	.001 - .002 in.	.02 - .04 mm
B5234T and T3	.001 - .002 in.	.02 - .04 mm
B6304	.001 - .002 in.	.02 - .04 mm
Piston Rod Clearance		
B230F and FT	0.0009 - 0.0026 in.	0.23 - 0.26 mm
B234F	0.0009 - 0.0026 in.	0.23 - 0.26 mm
B280F	0.0079 - 0.0150 in.	0.2007 - 0.3810 mm
B5254S, T, and FT	N/A	N/A
B5234T and T3	N/A	N/A
B6304	N/A	N/A

ENGINE MECHANICAL SPECIFICATIONS

	English Specifications	Metric Specifications
34T and T3	5.076 - 5.080 in.	128.95 - 129.05 mm
04	5.076 - 5.080 in.	128.95 - 129.05 mm
um Warpage		
th		
All Engines	0.020 in.	0.50 mm
Length		
All Engines	0.008 in.	0.20 mm
Seat Width		
OF and FT		
Intake	0.049 - 0.075 in.	1.27 - 1.91 mm
Exhaust	0.066 - 0.066 in.	1.68 - 2.31 mm
4F		
Intake	0.049 - 0.075 in.	1.27 - 1.91 mm
Exhaust	0.066 - 0.066 in.	1.68 - 2.31 mm
OF		
Intake	0.049 - 0.075 in.	1.27 - 1.91 mm
Exhaust	0.066 - 0.066 in.	1.68 - 2.31 mm
54S, T, and FT		
Intake	0.055 - 0.070 in.	1.40 - 1.80 mm
Exhaust	0.070 - 0.086 in.	1.80 - 2.20 mm
34T and T3		
Intake	0.055 - 0.070 in.	1.40 - 1.80 mm
Exhaust	0.070 - 0.086 in.	1.80 - 2.20 mm
04		
Intake	0.055 - 0.070 in.	1.40 - 1.80 mm
Exhaust	0.070 - 0.086 in.	1.80 - 2.20 mm
Seat Angle		
Engines		45 degrees
Intake		45 degrees
Exhaust		
Guide Diameter		
OF and FT		
Intake	0.3150 - 0.3158 in.	8.00 - 8.02 mm
Exhaust	0.3150 - 0.3158 in.	8.00 - 8.02 mm
4F		
Intake	0.3150 - 0.3158 in.	8.00 - 8.02 mm
Exhaust	0.3150 - 0.3158 in.	8.00 - 8.02 mm
OF		
Intake	0.3150 - 0.3158 in.	8.00 - 8.02 mm
Exhaust	0.3150 - 0.3158 in.	8.00 - 8.02 mm
54S, T, and FT		
Standard	0.472 in.	12.0 mm
Oversize 1	0.476 in.	12.1 mm
Oversize 2	0.480 in.	12.2 mm
34T and T3		
Standard	0.472 in.	12.0 mm
Oversize 1	0.476 in.	12.1 mm
Oversize 2	0.480 in.	12.2 mm
04		
Standard	0.472 in.	12.0 mm
Oversize 1	0.476 in.	12.1 mm
Oversize 2	0.480 in.	12.2 mm
Stem-to-guide Clearance		
Engines	0.0012 - 0.0024 in.	0.030 - 0.060 mm
End Springs		
Face Angle		
Engines	44.5 degrees	

ENGINE MECHANICAL SPECIFICATIONS

	English Specifications	Metric Specification
Type		
F and FT	OHC In-line 4-cylinder	
F	OHC In-line 4-cylinder	
F	OHC 90 degree V-6	
4S, T, and FT	OHC In-line 5-cylinder	
4T and T3	OHC In-line 5-cylinder	
4	OHC In-line 6-cylinder	
stroke		
F and FT	3.78 x 3.15 in	96.0 x 80.0 mm
F	3.78 x 3.15 in	96.0 x 80.0 mm
F	3.58 x 2.87 in.	90.9 x 72.9 mm
4S, T, and FT	3.27 x 3.54 in.	83.0 x 89.9 mm
4T and T3	3.19 x 3.54 in.	81.0 x 89.9 mm
4	3.27 x 3.54 in.	83.0 x 89.9 mm
displacement		
F and FT	144 c.i.	2.3L
F	144 c.i.	2.3L
F	175 c.i.	2.8L
4S, T, and FT	151 c.i.	2.4L
4T and T3	144 c.i.	2.3L
4	181 c.i.	2.9L
compression Ratio		
F	9.8:1	
FT	8.7:1	
F	10.0:1	
F	9.5:1	
4S, T, and FT	10.5:1	
4FT	8.5:1	
4T and T3	8.5:1	
	10.7:1	
order		
F and FT	1 - 3 - 4 - 2	
F	1 - 3 - 4 - 2	
F	1 - 6 - 3 - 5 - 2 - 4	
4S, T, and FT	1 - 2 - 4 - 5 - 3	
4T and T3	1 - 2 - 4 - 5 - 3	
	1 - 5 - 3 - 6 - 2 - 4	
cooling system	Pressure Feed - Full Flow Filtration	
	Liquid Cooled - Forced Circulation	

and FT	0.004 - 0.016 in.	0.102 - 0.406 mm
	0.004 - 0.016 in.	0.102 - 0.406 mm
	0.0028 - 0.0106 in.	0.0711 - 0.2692 mm
S, T, and FT	0.003-0.007 in.	0.08 - 0.19 mm
T and T3	0.003-0.007 in.	0.08 - 0.19 mm
	0.003-0.007 in.	0.08 - 0.19 mm
and FT	0.013 in.	0.032 mm
	0.013 in.	0.032 mm
	0.013 in.	0.032 mm
S, T, and FT	0.013 in.	0.032 mm
T and T3	0.013 in.	0.032 mm
	0.013 in.	0.032 mm

ENGINE MECHANICAL SPECIFICATIONS

Section	English Specifications	Metric Specifications
Pins, and Rings		
Pin-to-Cylinder Clearance		
30F and FT	0.0004 - 0.0012 in.	0.0101 - 0.0305 mm
34F	0.0004 - 0.0012 in.	0.0101 - 0.0305 mm
80F	0.0007 - 0.0015 in.	0.0177 - 0.0381 mm
254S, T, and FT	0.0003 - 0.0011 in.	0.010 - 0.030 mm
234T and T3	0.0003 - 0.0011 in.	0.010 - 0.030 mm
304	0.0003 - 0.0011 in.	0.010 - 0.030 mm
Pin Diameter		
30F and FT and B234F		
Standard "C"	3.7787 - 3.7791 in.	95.978 - 95.989 mm
Standard "D"	3.7791 - 3.7795 in.	95.989 - 95.999 mm
Standard "E"	3.7795 - 3.7799 in.	95.999 - 96.009 mm
Standard "G"	3.7811 - 3.7815 in.	96.039 - 96.050 mm
Oversize 1	3.7905 - 3.7909 in.	96.278 - 96.288 mm
Oversize 2	3.8024 - 3.8028 in.	96.581 - 96.591 mm
80F	3.5796 - 3.5807 in.	91.051 - 91.083 mm
254S, T, and FT		
Standard "C"	3.2669 - 3.2673 in.	82.980 - 82.990 mm
Standard "D"	3.2673 - 3.2677 in.	82.990 - 83.000 mm
Standard "E"	3.2677 - 3.2681 in.	83.000 - 83.010 mm
Standard "G"	3.2683 - 3.2689 in.	83.017 - 83.032 mm
Oversize 1	3.2746 - 3.2752 in.	83.177 - 83.192 mm
Oversize 2	3.2825 - 3.2831 in.	83.377 - 83.392 mm
234T and T3		
Standard "C"	3.1881 - 3.1885 in.	80.980 - 80.990 mm
Standard "D"	3.1885 - 3.1889 in.	80.990 - 81.000 mm
Standard "E"	3.1889 - 3.1893 in.	81.000 - 81.010 mm
Standard "G"	3.1896 - 3.1902 in.	81.017 - 81.032 mm
Oversize 1	3.1959 - 3.1965 in.	81.177 - 81.192 mm
Oversize 2	3.2038 - 3.2044 in.	81.377 - 81.392 mm
304		
Standard "C"	3.2669 - 3.2673 in.	82.980 - 82.990 mm
Standard "D"	3.2673 - 3.2677 in.	82.990 - 83.000 mm
Standard "E"	3.2677 - 3.2681 in.	83.000 - 83.010 mm
Standard "G"	3.2683 - 3.2689 in.	83.017 - 83.032 mm
Oversize 1	3.2746 - 3.2752 in.	83.177 - 83.192 mm
Oversize 2	3.2825 - 3.2831 in.	83.377 - 83.392 mm
Pin Diameter		
30F and FT	.9055 in.	23.0 mm
34F	.9055 in.	23.0 mm
80F	.9055 in.	23.0 mm
254S, T, and FT	0.9 in.	23.0 mm
234T and T3	0.9 in.	23.0 mm
304	0.9 in.	23.0 mm
Ring End Gap		
30F and FT		
No. 1 Compression	0.0118 - 0.0217 in.	0.2997 - 0.5512 mm
No. 2 Compression	0.0118 - 0.0217 in.	0.2997 - 0.5512 mm
Oil Control	0.0118 - 0.0256 in.	0.2997 - 0.5512 mm
34F		
No. 1 Compression	0.0118 - 0.0217 in.	0.2997 - 0.5512 mm
No. 2 Compression	0.0118 - 0.0217 in.	0.2997 - 0.5512 mm
Oil Control	0.0118 - 0.0256 in.	0.2997 - 0.5512 mm
80F		
No. 1 Compression	0.0158 - 0.0236 in.	0.4013 - 0.5994 mm
No. 2 Compression	0.0158 - 0.0236 in.	0.4013 - 0.5994 mm
Oil Control	0.0158 - 0.0571 in.	0.4013 - 1.4503 mm

ENGINE MECHANICAL SPECIFICATIONS

	English Specifications	Metric Specifications
54S, T, and FT		
No. 1 Compression	0.012 - 0.022 in.	0.30 - 0.55 mm
No. 2 Compression	0.012 - 0.022 in.	0.30 - 0.55 mm
Oil Control	0.012 - 0.024 in.	0.30 - 0.60 mm
34T and T3		
No. 1 Compression	0.012 - 0.022 in.	0.30 - 0.55 mm
No. 2 Compression	0.012 - 0.022 in.	0.30 - 0.55 mm
Oil Control	0.012 - 0.024 in.	0.30 - 0.60 mm
04		
No. 1 Compression	0.012 - 0.022 in.	0.30 - 0.55 mm
No. 2 Compression	0.012 - 0.022 in.	0.30 - 0.55 mm
Oil Control	0.012 - 0.024 in.	0.30 - 0.60 mm
Ring Side Clearance		
0F and FT		
No. 1 Compression	0.0024 - 0.0036 in.	0.060 - 0.092 mm
No. 2 Compression	0.0016 - 0.0028 in.	0.040 - 0.072 mm
Oil Control	0.0012 - 0.0025 in.	0.030 - 0.063 mm
4F		
No. 1 Compression	0.0024 - 0.0036 in.	0.060 - 0.092 mm
No. 2 Compression	0.0016 - 0.0028 in.	0.040 - 0.072 mm
Oil Control	0.0012 - 0.0025 in.	0.030 - 0.063 mm
OF		
No. 1 Compression	0.0021 - 0.0029 in.	0.053 - 0.074 mm
No. 2 Compression	0.0010 - 0.0021 in.	0.025 - 0.053 mm
Oil Control	0.0004 - 0.0009 in.	0.010 - 0.023 mm
54S, T, and FT		
No. 1 Compression	0.0024 - 0.0036 in.	0.060 - 0.092 mm
No. 2 Compression	0.0016 - 0.0028 in.	0.040 - 0.072 mm
Oil Control	0.0012 - 0.0025 in.	0.030 - 0.063 mm
34T and T3		
No. 1 Compression	0.0024 - 0.0036 in.	0.060 - 0.092 mm
No. 2 Compression	0.0016 - 0.0028 in.	0.040 - 0.072 mm
Oil Control	0.0012 - 0.0025 in.	0.030 - 0.063 mm
04		
No. 1 Compression	0.0024 - 0.0036 in.	0.060 - 0.092 mm
No. 2 Compression	0.0016 - 0.0028 in.	0.040 - 0.072 mm
Oil Control	0.0012 - 0.0025 in.	0.030 - 0.063 mm
Shaft (B234F only)		
Bearing Inside Diameter	1.8512 - 1.8523 in.	47.020 - 47.050 mm
Journal Outside Diameter	1.8494 - 1.8504 in.	46.975 - 47.000 mm
Bearing Inside Diameter	1.6957 - 1.6969 in.	43.070 - 43.100 mm
Journal Outside Diameter	1.6939 - 1.6949 in.	43.025 - 43.050 mm
Bearing Inside Diameter	1.6917 - 1.6929 in.	43.970 - 43.000 mm
Journal Outside Diameter	1.6900 - 1.6909 in.	42.925 - 42.950 mm
Bearings Oil Clearance	0.0008 - 0.0030 in.	.020 - 0.075 mm
Push Rods and Lifters		
Diameter		
0F and FT	1.179 - 1.180 in.	29.950 - 29.972 mm
4F	1.179 - 1.180 in.	29.950 - 29.972 mm
OF		
No. 1	1.592 - 1.593 in.	40.436 - 40.462 mm
No. 2	1.616 - 1.617 in.	41.046 - 41.071 mm
No. 3	1.639 - 1.640 in.	41.630 - 41.656 mm
No. 4	1.663 - 1.664 in.	42.240 - 42.265 mm
54S, T, and FT	N/A	N/A
34T and T3	N/A	N/A
04	N/A	N/A

ENGINE MECHANICAL SPECIFICATIONS

	English Specifications	Metric Specifications
Intake Head Diameter		
30F and FT		
Intake	1.73 in.	44 mm
Exhaust	1.38 in.	35 mm
34F		
Intake	1.73 in.	44 mm
Exhaust	1.38 in.	35 mm
80F		
Intake	1.81 - 1.85 in.	46.04 - 47.05 mm
Exhaust	1.45 - 1.49 in.	36.88 - 37.90 mm
254S, T, and FT		
Intake	1.568 - 1.580 in.	39.85 - 40.15 mm
Exhaust	1.568 - 1.580 in.	39.85 - 40.15 mm
234T and T3		
Intake	1.568 - 1.580 in.	39.85 - 40.15 mm
Exhaust	1.568 - 1.580 in.	39.85 - 40.15 mm
304		
Intake	1.568 - 1.580 in.	39.85 - 40.15 mm
Exhaust	1.568 - 1.580 in.	39.85 - 40.15 mm
Stem Diameter		
30F and FT		
Intake	0.3132 - 0.3138 in.	7.955 - 7.970 mm
Exhaust	0.3128 - 0.3134 in.	7.945 - 7.960 mm
34F		
Intake	0.3132 - 0.3138 in.	7.955 - 7.970 mm
Exhaust	0.3128 - 0.3134 in.	7.945 - 7.960 mm
80F		
Intake		Tapered
Exhaust		Tapered
254S, T, and FT		
Intake	0.273 - 0.274 in.	6.95 - 6.97 mm
Exhaust	0.274 - 0.275 in.	6.97 - 6.99 mm
234T and T3		
Intake	0.273 - 0.274 in.	6.95 - 6.97 mm
Exhaust	0.274 - 0.275 in.	6.97 - 6.99 mm
304		
Intake	0.273 - 0.274 in.	6.95 - 6.97 mm
Exhaust	0.274 - 0.275 in.	6.97 - 6.99 mm
Spring Height		
30F and FT	1.79 in.	45.5 mm
34F	1.79 in.	45.5 mm
80F	1.85 in.	47.1 mm
254S, T, and FT	1.70 in.	43.2 mm
234T and T3	1.70 in.	43.2 mm
304	1.70 in.	43.2 mm
Spring Test Pressure		
30F and FT	158 lbs. @ 1.08 in.	703 N @ 27.5 mm
34F	158 lbs. @ 1.08 in.	703 N @ 27.5 mm
80F	165 lbs. @ 1.08 in.	734 N @ 27.5 mm
254S, T, and FT		
Intake	150 lbs. @ 1.00 in.	667 N @ 25.4 mm
Exhaust	61 lbs. @ 1.34 in.	271 N @ 34.1 mm
234T and T3		
Intake	150 @ 1.00 in.	667 N @ 25.4 mm
Exhaust	61 lbs. @ 1.34 in.	271 N @ 34.1 mm
304		
Intake	150 @ 1.00 in.	667 N @ 25.4 mm
Exhaust	61 lbs. @ 1.34 in.	271 N @ 34.1 mm

1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3

Fuel Delivery: FI | **Fuel:** GAS

Belt Driven Type

1. Disconnect the negative battery cable.
2. If equipped with a two-piece shroud, remove the top section of the fan shroud.
3. Loosen the adjusting bolts and slacken the drive belts.
4. Remove the fan mounting bolts.
5. Remove the fan assembly.

To install:

6. Install the engine fan.
7. Tighten the fan mounting bolts.
8. Adjust the drive belt(s) to the specified tension.
9. If removed, install the top half of the fan shroud.
10. Connect the negative battery cable.

Electric Cooling Fan

Some models are equipped with electric cooling fans. The fan function is controlled by a thermocontact placed in the upper right corner of the radiator. Some vehicles may be equipped with a thermal switch in the radiator end tank or lower radiator hose. The fan, on most models, will generally switch ON when coolant temperatures are 190–212°F (88–100°C).

B6304F engines are fitted with a fully electric radiator fan. The 2-speed fan is mounted behind the radiator. The fan is controlled by a relay, in response to either temperature signal sent to the Motronic control unit or directly by the pressure switches mounted in the A/C high-pressure circuit. The relay is mounted on a bracket in front of the battery.

Except 850/C70/S70/V70

1. Disconnect the negative and positive battery cables.
2. Remove the battery holder, as required.
3. Remove the harness connector on the crossmember.
4. Undo the relay and remove the ground lead from the terminal on the right-hand wheel housing in the engine compartment.
5. Remove the fan shroud, if required.
6. Remove the cooling fan mounting bolts.
7. Remove the fan assembly from the vehicle.

To install:

8. Install the fan assembly in the vehicle.
9. Tighten the mounting bolts.
10. Install the fan shroud and tighten the bolts.
11. Connect the ground lead, and attach the relay connector.
12. Attach the connector on the crossmember.
13. Install the battery holder as required.
14. Connect the battery cables.
15. Start the engine and check cooling fan operation.

850/C70/S70/V70

1. Disconnect the negative battery cable.
2. Remove the two retaining bolts on relay holder from the top of the radiator.
3. Remove the control module and air intake hoses.
4. Remove the four fan mounting bolts.
5. Pull the fan up and unplug the relay and fan connectors.
6. Remove the fan from the vehicle.

To install:

7. Place the fan into the engine compartment and attach the relay and connectors.
8. Tighten the four fan retaining bolts.
9. Install the air hoses.
10. Tighten the relay holder retaining bolts.
11. Connect the negative battery cable.

Fig. 1: Remove the retaining bolts on the driver's side . . .



Fig. 2: . . . and passenger side of the radiator



Fig. 3: Slide the relay holder toward the engine



Fig. 4: Remove the air hoses from the control module box and the air cleaner



Fig. 5: Remove the connectors from the fan assembly

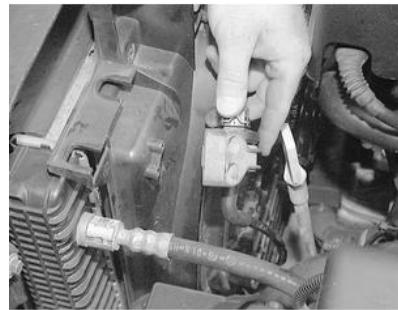


Fig. 6: After the retaining bolts are removed, carefully maneuver the fan up . . .

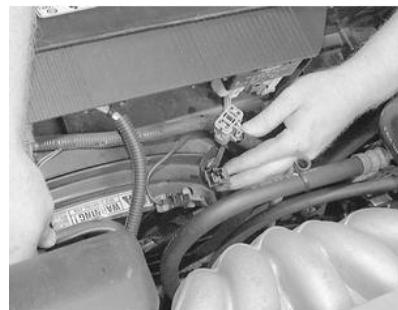
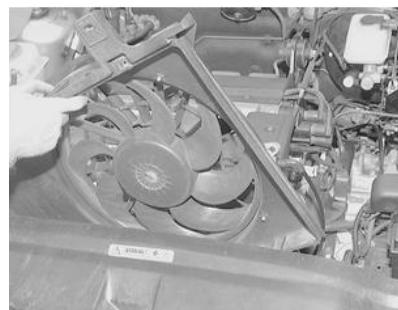


Fig. 7: . . . and out of the engine compartment



1992 Volvo 940

Submodel: | Engine Type: L4 | Liters: 2.3

Fuel Delivery: FI | Fuel: GAS

[ENGINE MECHANICAL SPECIFICATIONS \(GENERAL INFORMATION AND CRANKSHAFT\)](#)

[ENGINE MECHANICAL SPECIFICATIONS \(CRANKSHAFT AND CONNECTING ROD\)](#)

[ENGINE MECHANICAL SPECIFICATIONS \(CONNECTING ROD AND CYLINDER BLOCK\)](#)

[ENGINE MECHANICAL SPECIFICATIONS \(PISTON, PINS AND RINGS\)](#)

[ENGINE MECHANICAL SPECIFICATIONS \(PISTON, PINS AND RINGS, BALANCE SHAFT AND CAMSHAFT\)](#)

[ENGINE MECHANICAL SPECIFICATIONS \(BALANCE SHAFT AND CYLINDER HEAD\)](#)

[ENGINE MECHANICAL SPECIFICATIONS \(CYLINDER HEADS, VALVES AND SPRINGS\)](#)

[ENGINE MECHANICAL SPECIFICATIONS \(VALVES AND SPRINGS\)](#)

1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3

Fuel Delivery: FI | **Fuel:** GAS

In the process of removing the engine, you will come across a number of steps which call for the removal of a separate component or system, such as "disconnect the exhaust system" or "remove the radiator." In most instances, a detailed removal procedure can be found elsewhere in this manual.

It is virtually impossible to list each individual wire and hose which must be disconnected, simply because so many different model and engine combinations have been manufactured. Careful observation and common sense are the best possible approaches to any repair procedure.

Removal and installation of the engine can be made easier if you follow these basic points:

- If you have to drain any of the fluids, use a suitable container.
- Always tag any wires or hoses and, if possible, the components they came from before disconnecting them.
- Because there are so many bolts and fasteners involved, store and label the retainers from components separately in muffin pans, jars or coffee cans. This will prevent confusion during installation.
- After unbolting the transmission or transaxle, always make sure it is properly supported.
- If it is necessary to disconnect the air conditioning system, have this service performed by a qualified technician using a recovery/recycling station. If the system does not have to be disconnected, unbolt the compressor and set it aside.
- When unbolting the engine mounts, always make sure the engine is properly supported. When removing the engine, make sure that any lifting devices are properly attached to the engine. It is recommended that if your engine is supplied with lifting hooks, your lifting apparatus be attached to them.
- Lift the engine from its compartment slowly, checking that no hoses, wires or other components are still connected.
- After the engine is clear of the compartment, place it on an engine stand or workbench.
- After the engine has been removed, you can perform a partial or full teardown of the engine using the procedures outlined in this manual.

NOTE: Although Volvo recommends removing the engine and transmission as an assembly, we have found the transmission can be left in the vehicle if desired. If choosing to remove the engine only and leave the transmission in the vehicle, disregard the transmission, shifter, cables, driveshaft, and mount removal procedures. In place of these procedures, the bell housing bolts must be removed, as well as the torque converter bolts, if equipped with an automatic transmission. Also, a floorjack or other suitable support must be placed under the transmission.

2.3L 4-Cylinder Engine

1. Properly relieve the fuel system pressure.
2. Disconnect the battery cables, negative lead first.
3. Remove the battery.
4. If equipped with a manual transmission, remove the shifter.
5. Disconnect the windshield washer hose and engine compartment light wire.
6. Scribe marks around the hood mount brackets on the underside of the hood for later alignment.
7. Remove the hood.
8. Remove the overflow tank cap.
9. Remove the gravel shield from the underside of the radiator.
10. Drain the cooling system.
11. Remove the upper and lower radiator hoses.
12. Disconnect the overflow hoses at the radiator.
13. Disconnect the PCV hose at the cylinder head.
14. If equipped with an automatic transmission, disconnect the oil cooler lines at the radiator.
15. Remove the fan assembly.
16. Remove the radiator and fan shroud.
17. Remove the air cleaner.
18. If equipped, disconnect the hoses at the air pump.
19. Remove the air pump and drive belt.
20. Remove the vacuum pump and hoses.
21. Disconnect the power brake booster vacuum hose.
22. Remove the power steering pump, drive belt and bracket. Position aside without disconnecting the hydraulic lines.
23. If equipped with A/C, remove the crankshaft pulley and compressor drive belt. Then install the pulley again for reference.
24. Disconnect the air conditioning wiring and remove the compressor from the bracket. Position the compressor aside without disconnecting the hoses.
25. Remove the bracket.
26. Disconnect the vacuum hoses from the engine.
27. Disconnect the carbon canister hoses.
28. Remove the distributor wire connector, high tension lead, starter cables and the clutch cable clamp.
29. Disconnect the wiring harness at the voltage regulator.
30. Disconnect the throttle cable at the pulley and the wire for the A/C at the manifold solenoid.
31. Remove the gas cap.
32. Disconnect the fuel lines at the filter and return pipe.
33. At the firewall, remove the electrical connectors for the ballast resistor and relays.
34. Disconnect the heater hoses.
35. Unplug the micro-switch connectors at the intake manifold and all remaining harness connectors to the engine.
36. If equipped, disconnect the cruise control cables and hoses.
37. Drain the engine oil.
38. Remove the exhaust manifold flange retaining nuts. Loosen the exhaust pipe clamp bolts and remove the bracket for the front exhaust pipe mount.
39. Remove the exhaust manifolds from the cylinder head.
40. Raise and safely support the vehicle.
41. From underneath, remove the front motor mount bolts.
42. If equipped with an automatic transmission, place the gear selector lever in **PARK** and disconnect the gear shift control rod from the transmission.
43. On manual transmission vehicles, disconnect the clutch controls.
44. Disconnect the speedometer cable and mark and remove the driveshaft from the transmission.
45. On overdrive equipped vehicles, disconnect the control wire from the shifter.
46. Use a floor jack and a wooden block and support the weight of the engine beneath the transmission.
47. Remove the bolts for the rear transmission mount.

48. Remove the transmission support crossmember.
49. Lift out the engine using the proper lifting equipment.

NOTE: When removing the engine and transmission as an assembly, they must be removed at slightly an angle to clear the engine compartment.

50. Separate the engine from the transmission.

To install:

51. If the engine was rebuilt, install any components removed such as engine mounts, lifting eyelets, etc.
52. Install the engine to the transmission.
53. Attach the engine and transmission to the hoist, and carefully raise the engine.
54. Place the engine into the engine compartment carefully, and guide into the mounting position.
55. Install and tighten the engine mounts to 37 ft. lbs. (50 Nm).
56. Install the transmission crossmember.
57. Install the rear transmission mount.
58. Remove the hoist.
59. Installation of the remaining components is the reverse of removal.

2.8L 6-Cylinder Engine

1. Properly relieve the fuel system pressure.
2. Disconnect the negative battery cable.
3. If equipped with manual transmission, remove the shifter assembly.
4. Remove the battery.
5. Disconnect the windshield washer hose and engine compartment light wire.
6. Scribe marks around the hood mount brackets on the underside of the hood for later hood alignment.
7. Remove the hood.
8. Remove the air cleaner assembly.
9. Remove the splash guard under the engine.
10. Remove the overflow tank cap.
11. Drain the cooling system.
12. Remove the upper and lower radiator hoses and disconnect the overflow hoses at the radiator.
13. If equipped with automatic transmission, disconnect the transmission cooler lines at the radiator.
14. Remove the fan assembly.
15. Remove the radiator and fan shroud.
16. Disconnect the heater hoses, power brake hose at the intake manifold and the vacuum pump hose at the pump.
17. Remove the vacuum pump and O-ring in the valve cover.
18. Remove the gas cap.
19. Properly relieve the fuel system pressure.
20. At the firewall remove the fuel lines at the filter and return pipe, remove the relay connectors and all other wire connectors.
21. Disconnect the distributor wires.
22. Disconnect the evaporative control carbon canister hoses and the vacuum hose at the EGR valve.
23. Remove the voltage regulator wire connector.
24. Disconnect the throttle cable and kickdown cable, on automatic transmission vehicles, the vacuum amplifier hose at the T-pipe and the hoses at the thermostat.
25. If equipped, disconnect the cruise control cables and hoses.
26. Disconnect the air pump hose at the backfire valve, the solenoid valve wire and the micro-switch wire.
27. Remove the exhaust manifold flange retaining nuts (both sides).
28. If equipped with air conditioning, remove the compressor and drive belt and place it aside. Do not disconnect the refrigerant hoses.
29. Drain the crankcase.
30. Remove the power steering pump, drive belt and bracket. Position aside.
31. From underneath, remove the retaining nuts for the front motor mounts.
32. Remove, as required, the front exhaust pipe.
33. On 49 states vehicles, remove the front exhaust pipe hangers and clamps and allow the system to hang.
34. If equipped with automatic transmission, place the shift lever in **P**.
35. Disconnect the shift control lever at the transmission.
36. On manual transmission vehicles, disconnect the clutch cylinder from the bell housing. Leave the cylinder connected; secure it to the vehicle.
37. Disconnect the shifter linkage.
38. Disconnect the speedometer cable and mark and remove the driveshaft.
39. Raise and safely support the vehicle. Place jackstands under the reinforced box member area to the rear of each front jacking attachment. Then, using a floor jack and a thick, wide wooden block, support the weight of the engine under the oil pan.
40. Remove the bolts for the rear transmission mount.
41. Remove the transmission support crossmember.
42. Lift out the engine and transmission as a unit.

NOTE: When removing the engine and transmission as an assembly, they must be removed at slightly an angle to clear the engine compartment.

43. Separate the engine from the transmission.

To install:

44. If the engine was rebuilt, install any components removed such as engine mounts, lifting eyelets, etc.
45. Install the engine to the transmission.
46. Attach the engine and transmission to the hoist, and carefully raise the engine.
47. Place the engine into the engine compartment carefully, and guide into the mounting position.
48. Install and tighten the engine mounts to 37 ft. lbs. (50 Nm).
49. Install the transmission crossmember.
50. Install the rear transmission mount.
51. Remove the hoist.
52. Installation of the remaining components is the reverse of removal.

2.9L 6-Cylinder Engine

1. Properly relieve the fuel system pressure.
2. Disconnect the negative battery cable.

3. Remove the battery.
4. Remove the ground lead connection to the body at the top of side member.
5. Remove the drive belt.
6. Remove the cooling fan.
7. Release the upper bolts and unfasten the connector at the relay in front of the battery.
8. Disconnect the ground lead at the right-hand ground terminal.
9. Remove the splash shield from the underside of the radiator.
10. Drain the cooling system.
11. Remove the upper and lower radiator hoses from the engine.
12. Remove the radiator overflow hose.
13. Remove the transmission cooler lines from the radiator.
14. Remove the top nut on both left and right side engine mounts.
15. Remove and remove the large and small crankcase ventilation hoses and the idle air hose.
16. Disconnect the idle air valve wiring.
17. Disconnect and remove the two EVAP valve hoses at the intake manifold.
18. Unplug the air mass meter connector, air preheater hose and throttle pulley cover.
19. Remove the air intake hose from the throttle body.
20. Remove the servo pump mounting bolts.
21. Disconnect and remove the fuel return line at the regulator and fuel line at the firewall.
22. Remove the throttle cable, cruise control vacuum hose and fuel line snap catches.
23. Remove the engine wiring harness cover and disconnect the harness. Remove the relay connector. Remove the harness duct retaining nuts.
24. Disconnect the heater hoses at the firewall, ECC hoses at the intake manifold and brake servo vacuum hose.
25. Remove the timing pick up and camshaft sensor connectors.
26. Support the engine at the rear using engine removal tool assembly 5033, 5006, 5115, 5428 and 5429, or equivalent that will support the engine from above.
27. Remove the radiator.
28. Drain the engine oil.
29. Disconnect the hose at the oil thermostat in the cylinder block.
30. Disconnect the A/C compressor wiring. Remove the compressor from the mount and set it aside without disconnecting the hoses.
31. Remove the exhaust pipe flanges at the manifold. Remove the lower section of the air preheater pipe and remove the exhaust pipe shield.
32. Remove the oil pipe connections at the gearbox. Plug the openings.
33. Remove the clips between the gear selector lever and control rod/reaction arm. Withdraw the rods from their mounting.

NOTE: Before separating the driveshaft, mark the coupling halves for reassembly.

34. Disconnect the driveshaft and transmission support member.
35. Install engine lifting tool (2810 or equivalent) and adjust the lifting yoke to ensure the engine is balanced. Position the wiring harnesses so as to avoid damage when lifting.
36. Remove the engine and transmission assembly from the vehicle.
37. Separate the engine from the transmission.

To install:

38. If the engine was rebuilt, install any components removed such as engine mounts, lifting eyelets, etc.
39. Install the engine to the transmission.
40. Attach the engine and transmission to the hoist, and carefully raise the engine.
41. Place the engine into the engine compartment carefully, and guide into the mounting position.
42. Install and tighten the engine mounts to 37 ft. lbs. (50 Nm).
43. Install the transmission crossmember.
44. Install the rear transmission mount.
45. Remove the hoist.
46. Installation of the remaining components is the reverse of removal.

2.3L and 2.4L 5-Cylinder Engines

WARNING

After the engine is removed, do not move the vehicle or the wheel bearings will be damaged.

1. Properly relieve the fuel system pressure.
2. Disconnect the negative battery cable.
3. Remove the battery and tray.
4. Raise and safely support vehicle.
5. On vehicles with automatic transaxles, remove the air baffle from below the engine.
6. Remove the radiator expansion cap.
7. Drain the coolant into a suitable container.
8. Remove the front wheels and disconnect both track rods from the axle.
9. Remove both ball joints from the control arm.
10. Remove the ABS/brake hose bracket bolt.
11. Remove both halfshafts.
12. Remove the right side engine mount retainer bolts.
13. Remove the torque rod bolt in the gearbox.

NOTE: Install plugs in the axle shaft holes to prevent fluid leakage.

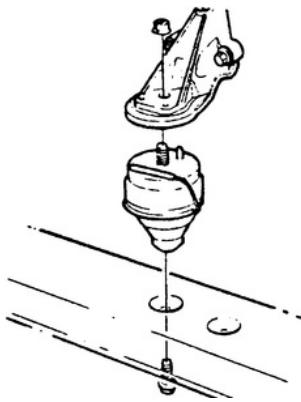
14. Remove the front exhaust pipe lower nut and bolt from the bracket.
15. Remove the two carriage bolts and skid plate.
16. Remove the speedometer connection and remove the front and rear lower engine mount bolts.
17. Lower the vehicle.
18. Remove the fresh air intake to the air cleaner, coil wires, throttle pulley cover and throttle cable from the pulley.
19. Tag and remove the throttle body inlet hose, idle air control valve, crankcase ventilation, preheat hoses and mass air flow sensor connector.
20. Disconnect the torque rod from the bracket and firewall.
21. Disconnect the ground strap from the firewall.
22. Unfasten the heated oxygen sensors and clips.
23. Remove the brake booster hose from the engine.
24. Remove the upper air charge pipe and fresh air intake from the radiator then disconnect the vacuum hoses to the turbocharger and EGR regulator.
25. Remove the radiator and coolant hoses.
26. Remove the clutch slave cylinder retaining ring, if equipped. Make sure that the piston does not slip out.

27. Remove the gear cable selector, after marking the position.
 28. On automatic transaxle, mark the position and then remove the gear selector cable.
 29. Remove the accessory drive belt
 30. Remove the A/C compressor without disconnecting the lines and set it aside
 31. Properly relieve the fuel system pressure.
 32. Remove the fuel distribution manifold cover, injector covers, upper and lower fuel line clips and engine ground strap.
 33. Install holders 999-5533 or equivalent on the injectors.
 34. Disconnect the fuel pressure regulator vacuum hose. Lift the fuel distribution manifold off and lay it aside.
- NOTE: Make sure that the injectors and needles are not damaged.**
35. Disconnect and remove the wiring harness from the engine.
 36. Lift up the air pump and lay it to one side.
 37. Install engine lifting yoke 999-2810 and arm 999-5428, or equivalents, and connect to hoist.
 38. Remove the front engine mount when the engine/transaxle is secured.
 39. Lift the engine out of the vehicle.
 40. On vehicles with automatic transaxles remove the turbo oil cooler lines and valve (if equipped) from the right side of the oil sump.
 41. Separate the engine from the transaxle.

To install:

42. If the engine was rebuilt, install any components removed such as engine mounts, lifting eyelets, etc.
43. Install the engine to the transaxle.
44. Install the valve and turbo oil cooler lines to the oil sump.
45. Attach the engine and transaxle to the hoist, and carefully raise the engine.
46. Place the engine into the engine compartment carefully, and guide into the mounting position.
47. Install and tighten the engine mounts to 37 ft. lbs. (50 Nm).
48. Installation of the remaining components is the reverse of removal.

Fig. 1: Typical engine mount on the 2.3L and 2.4L 5-cylinder engine



1992 Volvo 940

Submodel: | Engine Type: L4 | Liters: 2.3

Fuel Delivery: FI | Fuel: GAS

NOTE: Before working on the exhaust system, it is a good idea to soak the retaining hardware with a quality rust penetrant prior to attempting to remove them. After the penetrant is applied, wait at least 10–15 minutes to let the penetrant begin to work.

2.3L 4-Cylinder Engine

1. Disconnect the negative battery cable.
2. Remove the air cleaner and all necessary hoses.
3. Remove the EGR valve pipe from the manifold.
4. Remove the exhaust pipe from the exhaust manifold.
5. Remove the turbo, turbo pipes, and attaching hardware.
6. Remove the manifold nuts and manifold.

To install:

7. Position and install the manifold using a new gasket.
8. Tighten the manifold bolts to 10–20 ft. lbs. (14–27 Nm).
9. Install the turbo, turbo pipes, and attaching hardware.
10. Install the EGR valve pipe.
11. Install the air cleaner and any necessary hoses.
12. Connect the negative battery cable.
13. Start the vehicle and check for leaks.

2.8L 6-Cylinder Engine

1. Disconnect the negative battery cable.
2. Raise and support the vehicle safely.
3. Unbolt the crossover pipe from the left and right side of the exhaust manifolds, if equipped.

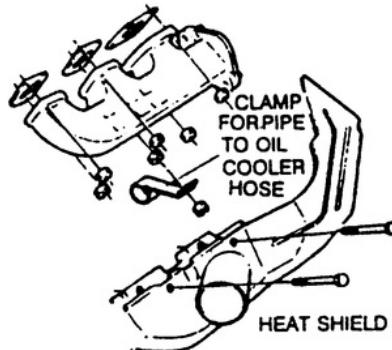
NOTE: If the vehicle has the Y-type exhaust pipe disconnect this pipe at the left and right manifolds.

4. Remove any other necessary hardware.
5. Remove the manifold nuts.
6. Remove the manifold(s) from the cylinder head(s).

To install:

7. Install the manifold(s) on the cylinder head(s).
- NOTE:** Always use new gaskets when reinstalling the manifolds.
8. Tighten the manifold bolts to 7–11 ft. lbs. (10–15 Nm).
 9. Connect the Y or crossover pipe.
 10. Install any removed hardware.
 11. Lower the vehicle.
 12. Connect the negative battery cable.
 13. Start the vehicle and check for leaks.

Fig. 1: Exploded view of the exhaust manifold assembly — 2.8L 6-cylinder engine



2.9L 6-Cylinder Engine

1. Disconnect the negative battery lead.
2. Remove the exhaust pipe mounting nuts at the manifold joints.
3. Remove the heat shield retaining bolts and heat shield.
4. Remove the exhaust manifold mounting nuts.
5. Remove the exhaust manifold and gasket.

To install:

6. Before installation, clean the manifold and cylinder head mating surfaces.
7. Fit a new gasket and place the exhaust manifold into position.

8. Install the mount lifting lug on the studs between the 3rd and 4th exhaust branches.
 9. Tighten the mounting nuts to 18 ft. lbs. (25 Nm).
 10. Install the heat shield to the rear manifold. Tighten to 11 ft. lbs. (15 Nm).
 11. Install the front exhaust pipe to manifold. Using threadlocking compound, tighten to 44 ft. lbs. (60 Nm).
- NOTE: Loosen the joint at the catalytic converter and re-tighten to 18 ft. lbs. (25 Nm). This is necessary to prevent stress on the system.**
12. Connect the negative battery lead.
 13. Start the engine and check for leaks.

2.3L and 2.4L 5-Cylinder Engines

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.
3. Disconnect the exhaust pipe from the manifold by removing the nuts on the flanged joint.
4. If equipped, remove the turbo, turbo pipes, and attaching components.
5. Remove the carriage bolts from the manifold.
6. Remove the two heat shields from the exhaust manifold.
7. Remove the exhaust manifold bolts.
8. Push the manifold toward the firewall and lift it out from the top.

WARNING

When removing or installing the exhaust manifold, be careful not to damage the air conditioning pressure switch, if so equipped.

To install:

9. Check the gasket surface of the cylinder head, clean if necessary.
10. Install the exhaust manifold using new gaskets.
11. Line up the exhaust manifold with the pipe using the carriage bolts.
12. Install the exhaust manifold bolts using a locking compound on the threads.
13. Tighten the bolts to 18 ft. lbs. (25 Nm).
14. Install the turbo, turbo pipes, and attaching components.
15. Install the heat shields.
16. Tighten the carriage bolts using thread sealing compound.
17. Tighten the nuts to no more than 86 inch lbs. (10 Nm). Remember to install the springs and washers with the nuts.
18. Connect the negative battery cable.
19. Run the engine and check for leaks.

Fig. 2: Remove the exhaust pipe-to-manifold flange retaining hardware . . .



Fig. 3: . . . and disconnect the flange

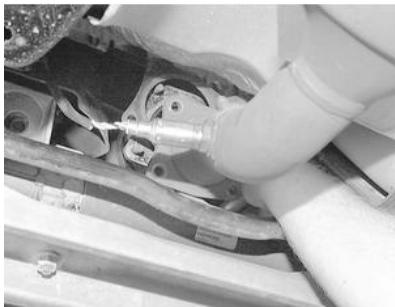


Fig. 4: Remove the manifold heat shield



Fig. 5: The EGR tube is connected on the driver's side of the manifold

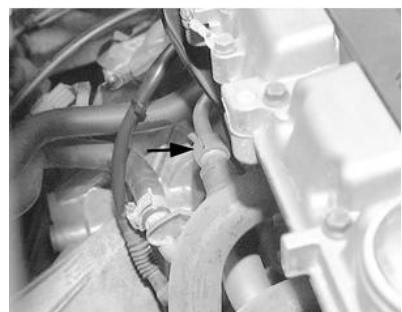


Fig. 6: Use two wrenches to remove the EGR tube fitting



Fig. 7: The EGR valve and tube are located beneath the throttle body



Fig. 8: Unfasten the fitting on the EGR valve and remove the tube from the vehicle

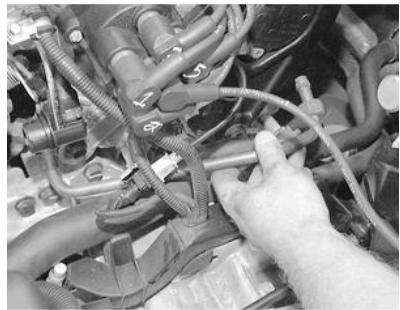


Fig. 9: Unfasten the retaining bolts and remove the manifold from the engine



Fig. 10: The exhaust manifold uses individual gaskets around each port in the head; replace them before manifold installation



1992 Volvo 940

Submodel: | Engine Type: L4 | Liters: 2.3

Fuel Delivery: FI | Fuel: GAS

The ring gear is contacted by the starter gear during engine start up. If any damage is found on the ring gear (broken or chipped teeth, cracks, etc.) the cause of the failure should be identified and repaired. The starter should be checked as a possible cause.

On vehicles with automatic transmission, the ring gear is an integral part of the flexplate and cannot be replaced. On vehicles with manual gearboxes, the ring gear on the flywheel can be removed and replaced. This replacement involves heating the ring to 450°F, and handling the heated ring. It is usually found to be easier to buy a complete flywheel and ring gear assembly than to attempt the replacement. If you possess the proper equipment for heating and handling the ring gear, the procedure is as follows:

1. Disconnect the negative battery cable.
2. Raise and support the vehicle.
3. Remove the transmission, as described in Section 7.
4. If equipped with a manual transmission/transaxle, remove the clutch plate and disc.
5. Remove the bolts attaching the flywheel or ring gear to the crankshaft flange.
6. Remove the flywheel or ring gear.
7. Inspect the flywheel for cracks, grooves, or bluing and inspect the ring gear for burrs or worn teeth.
8. Replace the flywheel or ring gear if any damage is apparent.
9. Remove burrs with a mill file.
10. To replace a ring gear, use the following steps.
 - A. Use a 10mm bit and drill a hole between two cogs (teeth) on the ring gear, being careful not to drill into the flywheel.
 - B. Mount the flywheel in a vise protected by soft jaws and split the ring gear at the hole with a chisel.
 - C. Heat the new ring gear to approximately 450°F (232°C). When handling the heated ring, wear heavy gloves and use tongs.
 - D. Position the ring gear with the beveled side facing the flywheel.
 - E. Use a brass drift and tap the ring gear until flush. Allow to air cool before installation; do not attempt to cool the metal with water, oil or other fluids.
11. Install the flywheel.
12. Install the bolts and torque to specification in a crisscross pattern.
13. Install the transmission, as described in Section 7.
14. Lower the vehicle.
15. Connect the negative battery cable.

Fig. 1: The flywheel must be immobilized so that the retaining bolts can be removed; tool 5112 is being used here to hold the flywheel

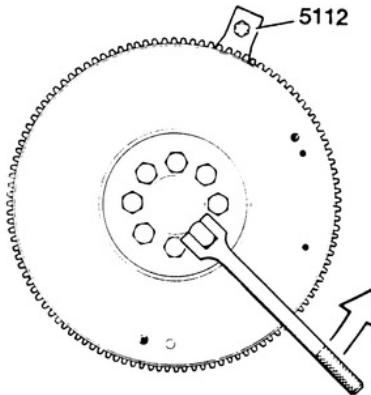
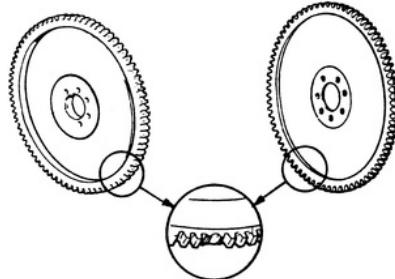


Fig. 2: Check the ring gear's teeth for damage; if damage is noted, replace the ring gear



1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3

Fuel Delivery: FI | **Fuel:** GAS

[2.3L \(B230 and B230FT\) 4-Cylinder Engine](#)

1. Disconnect the negative battery cable.
2. Remove the cooling fan and shroud.
3. Remove the drive belts and water pump pulley.
4. Remove upper timing belt cover.
5. Set the crankshaft to TDC and remove the timing belt.

NOTE: Do not turn the crankshaft or camshaft. Pistons may strike valves.

6. Carefully pry loose the seal to be replaced. Do not damage the contact face.

To install:

7. Clean the contact faces. Lubricate the seal and seat, then press the seal into position.
8. Install the timing belt. Make sure the timing belt is correctly positioned.
9. Install the timing belt cover and vibration damper.
10. Tighten the crankshaft center bolt to 45 ft. lbs. (60 Nm) plus an additional 60 degrees.
11. Install the drive belts and water pump pulley.
12. Install the cooling fan and shroud.
13. Connect the negative battery cable.
14. Start the engine.
15. Check for leaks and proper operation.

[2.3L \(B234F\) 4-Cylinder Engine](#)

1. Disconnect the negative battery cable.
2. Remove the timing/balance shaft belts as described in this section.
3. Remove the timing belt right-side idler.
4. Remove the crankshaft pulley, using a counterhold and guide (Tools 5284 and 5872 or equivalent) between the cylinder head, in the right-hand idler bolt hole.
5. Carefully pry out the seal. Avoid damaging the sealing faces on the shaft and in seating flange.

To install:

6. Before installing the new seal, thoroughly clean the crankshaft end and seating flange.
7. Lubricate the new seal and tap the seal into the seating flange.
- NOTE:** Face of seal should normally be flush with the chamfered edge in the housing; however, if the shaft end shows sign of wear, seal may be located approximately 3mm further in.
8. Install the balance shaft drive pulley. Guide must face outwards.
9. Install the timing belt pulley and guides.
10. Install the crankshaft damper/pulley.
11. Tighten the crankshaft bolt in 2-stages. First tighten to 44 ft. lbs. (60 Nm); then tighten an additional 60 degrees.
12. Turn the crankshaft to TDC on No. 1 cylinder.
13. Install the right-hand idler. Tighten to 18.5 ft. lbs. (25 Nm).
14. Install the timing/balance shaft belts as described in this section.
15. Connect the negative battery cable.

[2.9L 6-Cylinder Engine](#)

1. Disconnect the negative battery cable.
2. Remove the timing belt.
3. Remove the crankshaft pulley, using a suitable puller.
4. Carefully pry out the old seal.

To install:

5. Before installing the new seal, thoroughly clean the crankshaft face.
6. Lubricate the new seal and tap the seal into place, using tool 5455 or equivalent.
7. Install the timing belt.
8. Connect the negative battery cable.

[2.3L and 2.4L 5-Cylinder Engines](#)

1. Disconnect the negative battery cable.
2. Remove the fuel line clips.
3. Lift the coolant expansion tank and place it on top of the engine.
4. Remove the drive belts.
5. Remove the front timing cover.
6. Raise and safely support the vehicle.
7. Remove the right front wheel and loosen the inner fender liner.
8. Remove the vibration damper guard and turn crankshaft pulley until all timing marks align.
9. Remove the timing belt.

WARNING

Do not turn the crankshaft or camshafts once the timing belt has been removed.

10. Install a universal puller so the claws pull against the bolts and not the sprocket. Pull the sprocket off.

WARNING

Make sure that the puller does not damage the sprocket teeth.

11. Remove the front seal using a groove cut chisel.
12. Clean the mating surface.

To install:

13. Install the new seal into place.
14. Install the crankshaft timing belt sprocket using the nut and a spacer.
15. Install the timing belt.
16. Turn the crankshaft two complete revolutions and make sure the timing marks on the crankshaft and camshaft pulleys align properly.
17. Install the two fuel line clips.
18. Install the remaining components.
19. Install the wheel.
20. Connect the negative battery cable.
21. Test run the engine.

1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3

Fuel Delivery: FI | **Fuel:** GAS

2.3L 4-Cylinder Engine

1. Properly relieve the fuel system pressure.
2. Disconnect the negative battery cable.
3. Remove the air cleaner-to-throttle body hose.
4. If equipped, disconnect the cruise control cables and hoses.
5. Remove the PCV valve.
6. Disconnect the wiring and the fuel hose from the cold start injector. If necessary, remove the cold start injector.
7. Disconnect the wiring and the hoses at the auxiliary valve. If necessary, remove the auxiliary valve.
8. Remove the intake manifold brace.
9. Label and disconnect the vacuum hoses at the intake manifold.
10. Loosen the clamp for the rubber connecting pipe on the air-fuel control unit and remove the boot from the manifold.
11. Remove the manifold bolts and manifold.

To install:

12. Clean the gasket mating surfaces thoroughly.
13. Install the intake manifold, using new gaskets, and tighten the bolts to 15 ft. lbs. (20 Nm).
14. Install the intake manifold brace and the air-fuel control unit connecting pipe.
15. Install and connect the auxiliary valve, cold start injector using a new gasket, and the PCV valve.
16. Connect all vacuum hoses and electrical connectors.
17. Connect the negative battery cable.
18. Start the engine and bring it to normal operating temperature.

2.8L 6-Cylinder Engine

1. Properly relieve the fuel system pressure.
2. Disconnect the negative battery cable.
3. Remove the air cleaner-to-throttle body hose.
4. Drain the radiator coolant.
5. Remove the throttle cable from the pulley and bracket.
6. If equipped, disconnect the cruise control cables and hoses.
7. On automatic transmission vehicles, remove the throttle cable that is connected to the transmission.
8. Remove the EGR pipe from the EGR valve to the manifold.
9. Disconnect the EGR vacuum line.
10. Remove the PCV valve.

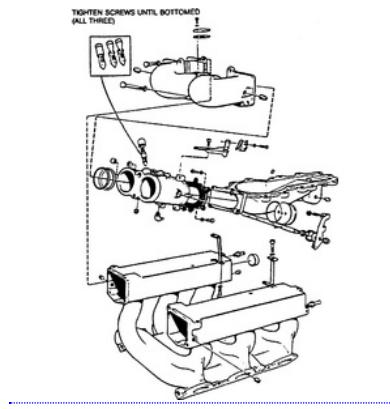
NOTE: Cover the oil cap opening with a rag to keep dirt out.

11. Remove the front manifold bolts and remove the front section of the manifold.
12. Unplug the cold start connector, fuel line and injector.
13. Remove the pressure control regulator vacuum lines, fuel lines and the connector.
14. Remove the auxiliary valve and its necessary piping.
15. Unplug the electrical connections at the air fuel control unit.
16. Remove all 6 spark plug wires.
17. Remove all 6 injectors.
18. Move the wiring harness to the outside of the manifold.
19. Disconnect the vacuum hose at the distributor and the intake manifold.
20. Disconnect the heater hose at the intake manifold.
21. Disconnect the hose to the diverter valve.
22. Disconnect the vacuum hose to the power brake booster.
23. Disconnect the throttle cable link.
24. Disconnect the wires to the micro-switch.
25. Pull the wires away from the intake manifold.
26. Remove the fuel filter line and the return line.
27. Remove the air control unit.
28. Disconnect the vacuum hose from the throttle valve housing.
29. Remove the pipe and cold start injector assembly.
30. Remove the intake manifold from the vehicle.

To install:

31. Clean all gasket mating surfaces thoroughly.
32. Install the intake manifold using new gaskets and tighten the bolts to 7–11 ft. lbs. (10–15 Nm).
33. Install the cold start injector assembly using a new gasket, air control unit, fuel filter and return line, throttle cable, EGR valve, diverter valve, heater hose, injectors and spark plug wires.
34. Install all vacuum, fuel and coolant hoses previously removed.
35. Attach all electrical connections previously removed.
36. Fill the radiator with coolant and check the engine and transmission oil.
37. Connect the negative battery cable.
38. Start the engine and bring to operating temperature.
39. Bleed the cooling system.
40. Check for leaks.

Fig. 1: Intake manifold assembly — 2.8L 6-cylinder



2.9L 6-Cylinder Engine

1. Properly relieve the fuel system pressure.
2. Disconnect the negative battery lead.
3. Remove the air cleaner-to-throttle body hose.
4. Remove the throttle pulley cover.
5. Disconnect and remove the throttle switch wiring, throttle cable and bracket, cruise control vacuum servo and vacuum hoses at throttle the housing.
6. Remove the injector cover plate and distribution manifold retaining bolts (3).
7. Disconnect the pressure regulator vacuum hose and fuel line bracket.
8. Carefully lift out the injector and distribution manifold assembly.
9. Remove the air preheater hose.
10. Remove the left and right side power stage connectors on the bottom of the manifold.
11. Remove the manifold bottom mounting.
12. Disconnect the brake servo hose and vacuum hoses under the manifold.
13. Cut away the clamps securing the rubber sleeves between the manifold sections, and lift out the outer manifold section.
14. Remove the upper bolts and loosen the lower bolts.
15. Remove the inner section of the manifold.

To install:

16. Install the inner section of the manifold, using a new gasket.
17. Install the rubber sleeves on the inner section and lubricate the free ends with petroleum jelly.
18. Install the mounting bolts and torque to 15 ft. lbs. (20 Nm).
19. Route the wiring between the second and third branches of the outer manifold section.
20. Place the manifold against the lower section and connect the crankcase ventilation hoses.
21. Insert the manifold branches in the rubber sleeves. Secure with new Oetiker clamps.
22. Tighten the manifold lower mounting.
23. Reconnect the vacuum hoses, brake servo hose, power stage connectors and air preheater hose.
24. Inspect the injector O-rings. Lubricate with petroleum jelly.
25. Reconnect the fuel pressure regulator vacuum hose.
26. Press the fuel distribution manifold into position.
27. Tighten the manifold retaining bolts to 15 ft. lbs. (20 Nm).
28. Reconnect the injector harnesses and EGR vacuum hoses.
29. Install the injector cover.
30. Install the throttle cable, throttle pulley cover and vacuum hoses (cruise control and throttle housing).
31. Install the cable bracket at the throttle pulley.
32. Reconnect the PCV, idling valve wiring, air hose, air mass meter and throttle housing connector.
33. Connect the negative battery lead.
34. Start the engine and check operation.

2.3L and 2.4L 5-Cylinder Engines

1. Properly relieve the fuel system pressure.
2. Disconnect the negative battery cable.
3. Remove the injector cover.
4. Unfasten the connectors and clips from the injectors.
5. Remove the two clips holding the fuel line.
6. Remove the distribution manifold mounting bolts.
7. Carefully remove the fuel rail with the fuel injectors by pulling upward evenly over the entire rail assembly to unseat the injector O-rings.
8. Disconnect the hose to the purge valve.
9. Carefully lay the distribution manifold and injectors on the engine.

WARNING

Make sure that the injectors and needles are not damaged.

10. Remove the throttle pulley cover.
11. Disconnect the throttle linkage from the pulley.
12. Disconnect the intake air hose to the throttle body.
13. Remove the multi-nipple.
14. Remove the EGR hose clamp on turbo models.
15. Remove the pressure line to turbo instrumentation/EGR valve control.
16. Disconnect the vacuum hose.
17. Disconnect the brake booster hose.
18. Loosen the dipstick bracket and intake manifold lower bracket bolt.

- NOTE: If additional room is necessary, you may remove the electric cooling fan.**
19. Loosen the lower intake manifold bolts several turns.
NOTE: The lower intake manifold bolts are not through-bolts.
 20. Remove the upper intake manifold bolts.
 21. Remove the intake manifold.
 22. Make sure the mating surfaces of the cylinder head and intake manifold is clean.

To install:

23. If removed, install the throttle body with a new gasket.
24. Install a new intake gasket.
25. Install the intake manifold and upper bolts. Tighten all bolts from inside to outside to 15 ft. lbs. (20 Nm).
26. Install the EGR valve (if equipped) with a new gasket.
27. Install the throttle body with a new gasket.
28. Install the multi-nipple and connect the hoses.
29. Install the fuel distribution manifold.
30. Install the wiring and injector cover.
31. Install the remaining components.
32. Connect the negative battery cable.
33. Test run engine and check for leaks.

Fig. 2: Label and remove the various vacuum lines from the intake manifold



Fig. 3: Some hoses are more easily removed from their sources than at the intake manifold

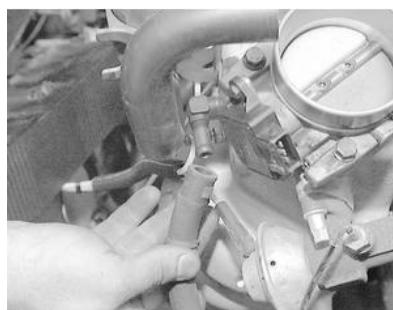


Fig. 4: Remove the retaining bolts . . .

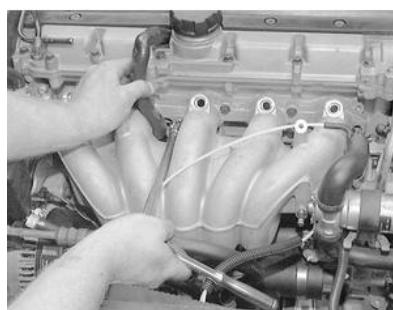


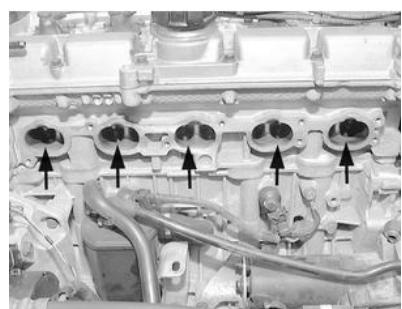
Fig. 5: . . . and carefully lift the intake manifold from the cylinder head



Fig. 6: Remove the old intake gasket from the cylinder head
and thoroughly clean the mating surfaces



Fig. 7: You can see the valves through the intake ports.
Inspect the valves for carbon build-up while the intake
manifold is off



1992 Volvo 940

Submodel: | Engine Type: L4 | Liters: 2.3

Fuel Delivery: FI | Fuel: GAS

2.3L 4-Cylinder and 2.9L 6-Cylinder Engines

1. Disconnect the negative battery cable.
2. Raise and support the vehicle safely.
3. Drain the engine oil.
4. Remove the splash guard, if equipped.
5. On 2.3L engines, perform the following steps:
 - A. Remove the engine mount retaining nuts.
 - B. Remove the lower bolt and loosen the top bolt on the steering column yoke.
 - C. Slide the yoke assembly up on the steering shaft.
6. Raise and safely support the front of the engine.
7. Remove the retaining bolts for the front axle crossmember.
8. Remove the crossmember.
9. Remove the left engine mount.
10. Remove the pan support bracket.
11. Remove the pan bolts and remove the pan.

To install:

12. Clean the gasket mating surfaces thoroughly.
13. Install the oil pan and using new gaskets, tighten the bolts in a crisscross pattern to 8 ft. lbs. (11 Nm).
14. Lower the engine and install all engine mounts.
15. Install the front crossmember and install the bolts.
16. On 2.3L engines, install the yoke assembly on the steering shaft and tighten the bolts to 18 ft. lbs. (24 Nm).
17. Install the splash guard, if equipped.
18. Lower the vehicle.
19. Connect the negative battery cable.
20. Fill the engine with oil.
21. Start the engine and allow it to reach operating temperature.
22. Check for leaks.

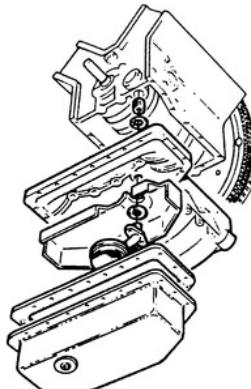
2.8L 6-Cylinder Engine

1. Disconnect the negative battery cable.
2. Raise and support the vehicle safely.
3. Remove the splash guard.
4. Drain the crankcase.
5. Remove the oil pan retaining bolts.
6. Swivel the pan past the stabilizer bar and remove.

To install:

7. Clean the gasket mating surfaces thoroughly.
8. Install the oil pan, using a new gasket, and tighten the bolts in a crisscross pattern to 6–8 ft. lbs. (8–11 Nm).
9. Install the splash guard, lower the vehicle and fill the crankcase with oil.
10. Connect the negative battery cable.
11. Start the engine and allow it to reach operating temperature.
12. Check for leaks.

Fig. 1: Oil pan and lower crankcase components — 2.8L 6-cylinder engine



2.3L and 2.4L 5-Cylinder Engines

NOTE: This procedure is performed with the engine removed from the car.

1. Remove the oil filter.
2. Remove the oil pan bolts.
3. Carefully tap the oil pan to break the seal and remove the oil pan.
4. Remove the oil passage O-rings.

To install:

5. Thoroughly clean the mating surfaces of the cylinder block and oil pan.
6. Coat new oil passage O-rings with engine oil and install them in the block.
7. Apply a thin layer of gasket sealant to the engine block.
8. Install the oil pan and pan bolts.
9. Tighten the pan bolts in a crisscross pattern to 12 ft. lbs. (17 Nm).
10. Install the oil filter.

1992 Volvo 940

Submodel: | Engine Type: L4 | Liters: 2.3

Fuel Delivery: FI | Fuel: GAS

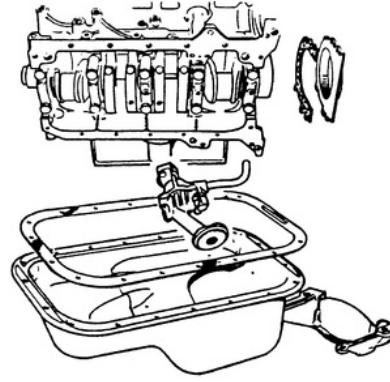
2.3L (B230F and B230FT) 4-Cylinder Engine

1. Disconnect the negative battery cable.
2. Drain and recycle the engine oil.
3. Remove the oil pan.
4. Remove the 2 oil pump retaining bolts.
5. Remove the oil pump and pull the delivery tube from the engine block.

To install:

6. Coat new sealing rings with engine oil and install them at either end of the delivery tube.
7. Install the pump with the delivery tube attached.
8. Align the pipe to the engine block, so that the seal does not become damaged.
9. Tighten the two oil pump retaining bolts.
10. Attach the clamp for the oil trap drain hose to the oil pump bolts. Make sure the hose is securely clamped behind the oil pump shoulder. Do not shorten the hose.
11. Install the oil pan.
12. Fill the engine with oil.
13. Connect the negative battery cable.
14. Start the vehicle and check the oil level.

Fig. 1: Exploded view of the oil pan, rear seal flange, oil pump, and delivery tube on B230F and B230FT engines



2.3L (B234F) 4-Cylinder Engine

1. Disconnect the negative battery cable.
2. Drain and recycle the engine coolant.
3. Drain and recycle the engine oil.
4. Remove the timing belt.
5. Using a counterholding tool 5039 or similar, remove the oil pump drive pulley.
6. Thoroughly clean the area around the oil pump.
7. Place sheets of newspaper or a container on the splash guard to contain any spillage and remove the oil pump mounting bolts.
8. Remove the pump from the engine.
9. Remove the seal from the groove in the block.
10. Clean the area with solvent, making certain there are no particles of dirt trapped in the pump area.

To install:

11. Install the new seal in the groove and install the new oil pump.
12. Lubricate the pump with clean engine oil before installation.
13. Tighten the mounting bolts to 8 ft. lbs. (11 Nm).
14. Using the counterhold, install the drive pulley and tighten the center bolt to 15 ft. lbs. (20 Nm) plug 60 degrees of rotation.
15. Clean the area of any oil spillage; remove the paper or container from the splash guard.
16. Install the timing belt.
17. Fill the engine with coolant.
18. Fill the engine with oil.
19. Connect the negative battery cable.

Fig. 2: Use counterhold tool 5039 or equivalent to remove the pump pulley

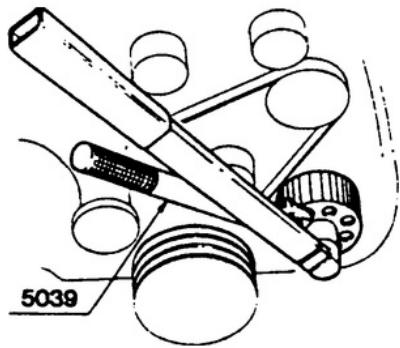
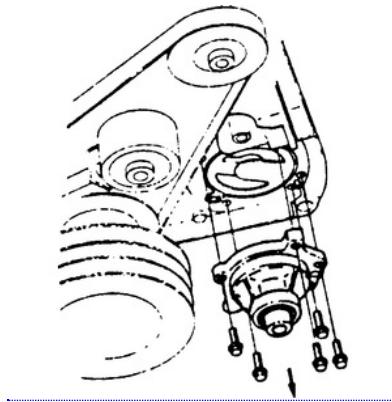


Fig. 3: Removing the oil pump — B234F engine



2.8L 6-Cylinder Engine

The oil pump body is cast integrally with the cylinder block. It is chain driven by a separate sprocket on the crankshaft and is located behind the timing chain cover. The pick-up screen and tube are serviced by removing the oil pan. To check the pump gears or remove the oil pump cover:

1. Disconnect the negative battery cable.
2. Drain and recycle the engine oil.
3. Remove the air cleaner and valve covers.
4. Loosen the fan shroud and remove the fan.
5. Remove the shroud.
6. Loosen the alternator, air pump, power steering pump, air conditioning compressor, if equipped, and remove their drive belts.
7. Block the flywheel from turning and remove the 36mm bolt and the crankshaft pulley.

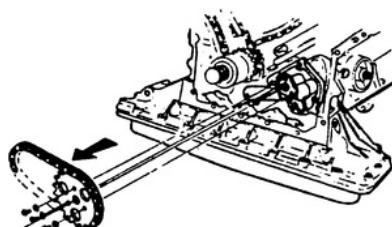
NOTE: Be careful not to drop key into crankcase.

8. Remove the timing gear cover (25 bolts).
9. Remove the oil pump drive sprocket and chain.
10. Remove the oil pump cover and gears.

To install:

11. Prime the pump, remove all air by filling it with clean engine oil and operating the pump by hands, before installation.
12. Install the oil pump gears and cover.
13. Install the oil pump drive sprocket and chain.
14. Install the timing gear cover, crankshaft pulley, alternator, air pump, power steering pump, air conditioning compressor and all accessory drive belts.
15. Remove the flywheel block and install the valve covers.
16. Fill the engine with oil.
17. Connect the negative battery cable.

Fig. 4: Removing the oil pump drive sprocket and chain



2.9L 6-Cylinder Engine

1. Disconnect the negative battery cable.
2. Drain the cooling system.
3. Drain the engine oil.
4. Remove the drive belts, front timing belt cover, cooling fan and splashguard.
5. Remove the radiator.
6. Remove the timing belt.
7. Remove the crankshaft pulley, using a suitable puller.
8. Remove the oil pump mounting bolts and remove the oil pump.

To install:

9. Before installing the oil pump, thoroughly clean the mating surfaces.
10. Transfer the snow shield.
11. Place a new gasket into position, then install the oil pump using tool 5455 or equivalent. Use the mounting bolts as a guide.
12. Pull in the pump using the crankshaft center nut.
13. Apply threadlocking compound to the pump mounting bolts and install the bolts. Tighten alternately to 84 inch lbs. (10 Nm).
14. Install the crankshaft pulley, using the center bolt and spacer.
15. Install the timing belt.
16. Install the tensioner.
17. Align the timing marks and install the ignition coil cover.
18. Install the radiator.
19. Install the remaining components.
20. Fill the engine with oil.
21. Fill the engine with coolant.
22. Connect the negative battery cable.

2.3L and 2.4L 5-Cylinder Engines

The oil pump is on the front of the crankshaft.

1. Disconnect the negative battery cable.
2. Drain and recycle the engine oil.
3. Remove spark plug cover.
4. Remove the drive belts.
5. Remove the front timing cover and timing belt.
6. Raise and safely support the vehicle.

WARNING

Do not turn the crankshaft or camshafts once the timing belt has been removed.

7. Remove the crankshaft damper, using tool 999 5433 or equivalent to counterhold it from moving.
8. Remove the crankshaft sprocket.

WARNING

Make sure the puller does not damage the sprocket teeth.

9. Remove the old front seal using a groove cut chisel.
10. Clean the mating surface where the seal lies.
11. Remove the four bolts retaining the oil pump.

NOTE: There are tabs on the oil pump housing located at the 6 o'clock and 11 o'clock positions.

12. Carefully pry out the oil pump using a groove cut chisel.
13. Clean the surfaces where the pump mates to the engine.

To install:

14. Install the new oil pump using tool 999-5455 or equivalent using the bolts to guide it in. Use the crankshaft nut to press it in. Tighten the bolts alternately to 84 inch lbs. (10 Nm).
15. Install the crankshaft timing belt sprocket using the nut and a spacer.
16. Install the timing belt and cover.
17. Install the drive belts.
18. Fill the engine with clean engine oil.
19. Connect the negative battery cable.
20. Start the engine and check for leaks.

1992 Volvo 940

Submodel: | Engine Type: L4 | Liters: 2.3

Fuel Delivery: FI | Fuel: GAS

NOTE: Perform this work only on a cold engine.

1. Disconnect the negative battery cable.
2. Set the heater control to MAX heat.
3. Remove the expansion tank cap.
4. Place a suitable drain pan into position. Open the cock on the right-hand side of the engine block. Fit a hose to the cock to collect the coolant. Open the radiator draincock.
5. Close the drain cocks when the coolant is completely drained.
6. Remove the cooling fan.
7. Remove the cooling fan shroud.
8. Disconnect the upper and lower radiator hoses
9. On vehicles equipped with automatic transmissions, disconnect the transmission oil cooler lines at the radiator. Plug the lines immediately. Catch the spillage from the radiator in a separate pan.
10. Some vehicles are equipped with a temp sensor on the driver's side top of the radiator, if equipped remove the connector.
11. Remove the radiator retaining bolts and brackets.
12. Remove the radiator assembly from the vehicle.

NOTE: On 850/C70/S70/V70 models, the radiator comes out the bottom of the vehicle.

To install:

13. Place the radiator into position and install the retaining bolts.
14. On automatic transmission vehicles, connect the oil cooler lines.
15. Install the fan and shroud.
16. Install the lower and upper radiator hoses.
17. Connect the expansion tank hose. Make sure that the overflow hose is clear of the fan and is free of any sharp bends.
18. Fill the cooling system through the expansion tank, with a 50 percent antifreeze, 50 percent water solution.
19. Connect the negative battery cable.
20. Run the engine until normal operating temperature is reached.
21. Bleed the cooling system.
22. Check for leaks.
23. Top up the cooling system, as required.
24. Replace the cap.
25. Check and top up the automatic transmission fluid level.

Fig. 1: Undo the clamps and remove the radiator hoses



Fig. 2: A pair of retaining ring pliers can be used to release the quick-connect fittings on the transmission cooler lines



Fig. 3: Remove the line from the radiator; fluid will most likely spill, so placing a pan underneath is advised



Fig. 4: Plug the cooler line . . .



Fig. 5: . . . and the cooler fitting on the radiator to prevent contamination



Fig. 6: Remove the condenser and radiator upper mounting bolts

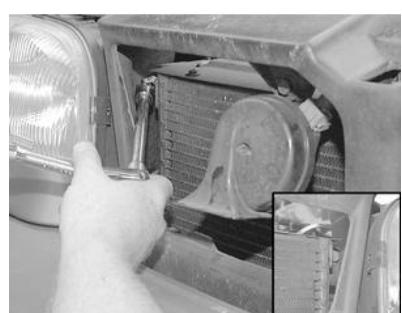


Fig. 7: The condenser must be supported after the upper mounting bolts are removed (two pieces of rope or tiestraps are helpful)



Fig. 8: Remove the lower mounting bolt on the passenger side . . .



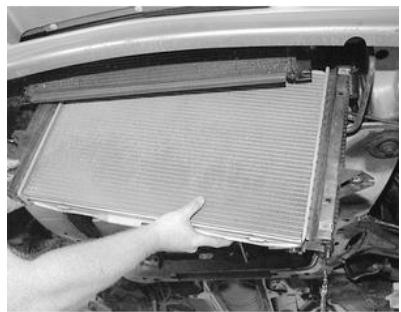
Fig. 9: . . . as well as that on the driver's side of the radiator



Fig. 10: After the radiator support brackets are removed . . .



Fig. 11: . . . the radiator can be removed. (On some models such as this 850, you remove it from below)



1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3

Fuel Delivery: FI | **Fuel:** GAS

2.3L 4-Cylinder Engines

1. Disconnect the negative battery cable.
2. Remove the transmission.
3. Remove the clutch and pressure plate, if equipped.
4. Remove the pilot bearing snapring and remove the bearing.
5. Remove the flywheel or driveplate, as equipped.

NOTE: Be careful not to press in the activator pins for the timing device.

6. Remove the rear oil pan brace.
7. Remove the 2 center bolts from the pan that bolt into the seal housing.
8. Loosen 2 bolts on either side of the 2 in the seal housing.
9. Remove the 6 seal housing bolts and remove the seal housing.

NOTE: Be careful not to damage the oil pan gasket when removing the seal housing.

10. Remove the seal using special tool 2817 or a suitable replacement.

To install:

11. Use a new gasket on the seal housing and coat the seal with oil prior to installation. Install the seal.
12. Install the seal housing and tighten the bolts in a crisscross pattern.
13. Install the rear oil pan brace and flywheel. Tighten the flywheel bolts to 47–54 ft. lbs. (64–73 Nm) in a crisscross pattern. When installing the flywheel turn the crankshaft to bring the No. 1 piston to TDC. The lower flywheel pin should be installed approximately 15 degrees from the horizontal and opposite the starter.
14. Coat the outside of the pilot bearing and install it on the flywheel.
15. Install the clutch assembly and transmission, as required.
16. Connect the negative battery cable.
17. Fill the transmission with fluid.
18. Start the engine and allow it to reach operating temperature.
19. Check for leaks.

2.8L 6-Cylinder Engine

1. Disconnect the negative battery cable.
2. Remove the transmission.
3. Remove the clutch and pressure plate, if equipped.
4. Remove the flywheel or driveplate, on automatic transmissions.

NOTE: On automatic transmissions remove the crankshaft spacer.

5. Remove the 2 rear pan bolts.
6. Remove the bolts in the seal housing and then the housing.

NOTE: Carefully remove the housing so as not to damage the oil pan gasket.

7. Using tool 5107, remove the old seal.

To install:

8. Coat the new seal with engine oil and using the seal tool, install the new seal.
9. Install the seal housing and tighten the seal housing bolts in a crisscross pattern to 7–11 ft. lbs. (10–15 Nm).
10. Install the rear oil pan bolts.
11. Install the flywheel and clutch assembly, as required.
12. Tighten the flywheel bolts to 33–37 ft. lbs. (45–50 Nm).
13. Install the transmission.
14. Connect the negative battery cable.
15. Fill the transmission with oil.
16. Start the engine and allow it to reach operating temperature.
17. Check for leaks.

2.9L 6-Cylinder Engine

1. Disconnect the negative battery cable.
2. Remove the transmission from the vehicle.
3. Remove the flexplate.
4. Carefully pry out the seal, taking care not to damage the sealing faces on the shaft and in seat.

To install:

5. Before installing the seal, thoroughly clean the seat and inspect for signs of wear.
6. Lubricate the mating surface between the seat and seal. Oil the seal lips and press the new seal into place, using a suitable seal installer tool 5430 and 1801 or equivalent.
7. Install the flexplate. Use new bolts and threadlocking compound. Tighten the bolts in 2 stages: first to 33 ft. lbs. (45 Nm); then tighten an additional 50 degree turn.
8. Install the transmission.
9. Connect the negative battery cable.

2.3L and 2.4L 5-Cylinder Engines

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.

3. Remove the transmission as described in Section 7.
4. Remove the flywheel if equipped with manual transaxle, or the flexplate if equipped with automatic transmission.
5. Using a seal puller or other suitable tool, remove the old seal. Take care not to damage the block surface during removal or new seal could leak.

To install:

6. Thoroughly clean sealing surface on the block.
7. Using special tools 999-5430 and 999-1801 or equivalent, install the new seal into the engine block.
8. Install the flywheel/flexplate, using threadlocking compound on the bolts.
9. Tighten all the bolts in two stages:
 - A. Tighten to 33 ft. lbs. (45 Nm).
 - B. Angle tighten 50°.
10. Install the transmission as described in Section 7.
11. Lower the vehicle.
12. Connect the negative battery cable.

1992 Volvo 940

Submodel: | Engine Type: L4 | Liters: 2.3

Fuel Delivery: FI | Fuel: GAS

The 2.8L V6 engine (B280F) is the only engine that contains rocker arms and/or shafts.

2.8L 6-Cylinder Engine

1. Properly relieve the fuel system pressure.
2. Disconnect the negative battery cable.
3. Remove the air cleaner-to-throttle body hose.
4. Disconnect the air pump bracket
5. Remove the driver's side valve cover (if removing the driver's side rocker shaft assembly).
6. Tie the upper radiator hose aside and remove the oil filler cap and carbon canister hose.
7. The following steps are necessary if your car has A/C and if you are removing the passenger side valve cover. If you do not need to remove the passenger side valve cover, skip them.
 - A. Remove the A/C compressor belt and the compressor from the mounting bracket located on the passenger side of the engine. Do not remove the lines from the compressor.
 - B. Place the compressor with the lines attached on the passenger side front shock tower and secure.
 - C. Remove the compressor bracket.
8. Remove the EGR valve.
9. Remove the control pressure regulator.
10. Disconnect any hoses or wires in the way. Remove the right valve cover, if necessary.

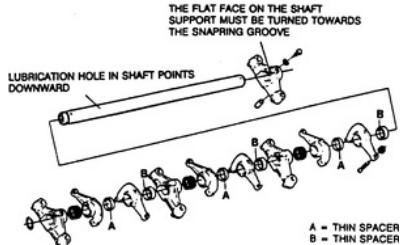
NOTE: Do not jar the head while the rocker and bolts are loose, as the cylinder liner O-ring seals may break, requiring engine disassembly.

11. The rocker arm bolts double as cylinder head bolts. Loosen the head bolts by reversing the torque sequence. If removing both rocker shafts, mark them left and right.

To install:

12. Install the rocker shafts. Follow cylinder head installation procedure for proper torque specification and sequence.
13. Adjust the valve lash.
14. Install the valve covers, EGR valve, control pressure regulator, air conditioning compressor and bracket and air pump.
15. Attach all fuel, coolant and vacuum lines previously disconnected.
16. Attach all electrical connections previously removed.
17. Connect the negative battery cable.
18. Start the engine and allow it to reach operating temperature.
19. Adjust the timing and check for leaks.

Fig. 1: Rocker arm shaft assembly — 2.8L 6-cylinder engine



1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3

Fuel Delivery: FI | **Fuel:** GAS

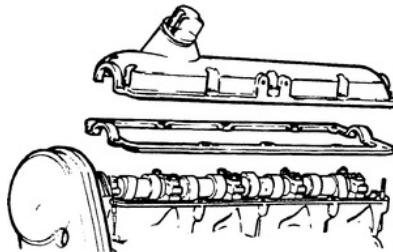
2.3L 4-Cylinder Engines

1. Disconnect the negative battery cable.
2. Label and remove the spark plug wires.
3. Remove the attaching bolts for the valve cover.
4. Remove the valve cover from the cylinder head. If necessary, lightly tap the valve cover with a soft hammer to aid in removal.

To install:

5. Thoroughly clean the valve cover and cylinder head gasket mating surfaces.
6. Install the valve cover on the cylinder head using a new gasket.
7. Tighten the valve cover bolts to 14 ft. lbs. (20 Nm) in a crisscross pattern.
8. Install the spark plug wires.
9. Connect the negative battery cable.
10. Start the engine and check for leaks.

Fig. 1: Valve cover and gasket assembly



2.8L 6-Cylinder Engine

1. Disconnect the negative battery cable.
2. The following steps are necessary if your car has A/C and if you are removing the passenger side valve cover; if you do not need to remove the passenger side valve cover, skip them.
 - A. Remove the A/C compressor belt and the compressor from the mounting bracket located on the passenger side of the engine. Do not remove the lines from the compressor.
 - B. Place the compressor with the lines attached on the passenger side front shock tower and secure.
 - C. Remove the compressor bracket.
3. Remove the air cleaner-to-throttle body hose.
4. Label and remove all necessary electrical and vacuum connections.
5. Remove the attaching bolts for the valve cover(s).
6. Remove the valve cover(s) from the cylinder head(s). If necessary, lightly tap the valve cover with a soft hammer to aid in removal.

To install:

7. Thoroughly clean the valve cover(s) and cylinder head gasket mating surfaces.
8. Install the valve cover(s) on the cylinder head(s) using new gaskets.
9. Tighten the valve cover bolts to 11 ft. lbs. (15 Nm) in a crisscross pattern.
10. Install all necessary electrical and vacuum connections.
11. Install the air cleaner assembly.
12. Install the A/C bracket (if removed).
13. Install the A/C compressor and belt (if removed).
14. Connect the negative battery cable.
15. Start the engine and check for leaks.

2.3L and 2.4L 5-Cylinder, and 2.9L 6-Cylinder Engines

The 2.3L and 2.4L 5-cylinder, and 2.9L 6-cylinder engines have a two-piece cylinder head, the upper half and the lower half. The upper half is basically the same as a valve cover, except that it incorporates the bearing caps for the camshafts into the underside.

1. Disconnect the negative battery cable.
2. Remove the spark plug access cover.
3. Label and remove the ignition coils and vent hoses or the distributor cap and wires if equipped.
4. Check the cam alignment before removing the cylinder head.
5. Remove the bolts attaching the upper cylinder head.
6. Remove the upper cylinder head, lightly tap with a soft hammer if necessary.

To install:

7. Thoroughly clean the upper and lower cylinder head gasket mating surfaces.
8. Apply liquid sealing compound to the upper cylinder head mating surface.

WARNING

Use a roller or your finger to spread sealant, do not use an excessive amount of sealant, or the oil passages could become clogged.

9. Place the upper cylinder head onto the lower cylinder head.
10. Check the cam alignment before tightening the cylinder head.
11. Install Volvo tool number 5454 or equivalent to the upper cylinder head.
12. Tighten the nut on the tools to seat the upper cylinder head.
13. Tighten the upper cylinder head bolts, beginning from the center out to 13 ft. lbs. (17 Nm).
14. Install the ignition coils and hoses or the distributor cap and wires.
15. Install the spark plug access cover.
16. Connect the negative battery cable.
17. Start the vehicle and check for leaks.

Fig. 2: Remove the clamp and detach the vent hose



Fig. 3: Remove the spark plug cover and the plug wires or ignition coils to access the retaining bolts



Fig. 4: Remove the retaining bolts

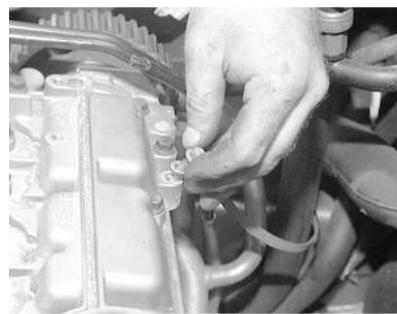


Fig. 5: A light tap with a soft-faced hammer is usually required to loosen the valve cover

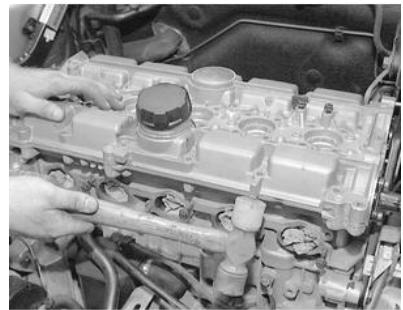
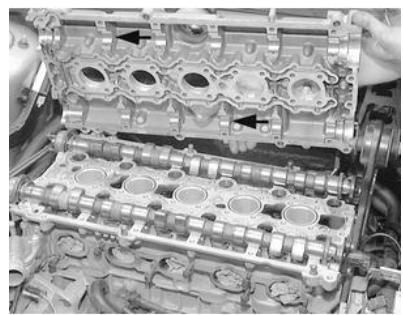


Fig. 6: Carefully lift the upper cylinder head up and off the lower section. Note the integral camshaft bearing caps in the casting



1992 Volvo 940

Submodel: | Engine Type: L4 | Liters: 2.3

Fuel Delivery: FI | Fuel: GAS

1. Disconnect the negative battery cable.
2. Drain the cooling system into a suitable container.
3. Disconnect the coolant hose attached to the thermostat housing.
4. Remove the thermostat housing retaining bolts.
5. Remove the thermostat housing, thermostat and gasket. Some thermostats require alignment with certain marks or are "clocked" (only fit in the housing a certain way), so be sure to pay close attention while removing.

To install:

6. Before installing the thermostat, thoroughly clean the mating surfaces.
7. Fit a new gasket and place the thermostat into position.
8. Install the thermostat housing and tighten bolts to proper torque (refer to torque specifications in the back of this section).
9. Fill the cooling system through the expansion tank.
10. Connect the negative battery cable.
11. Start the engine and allow to reach normal operating temperature.
12. Bleed the cooling system.
13. Top up with coolant and check for leaks.

Fig. 1: Remove the radiator hose



Fig. 2: Unfasten the retaining bolts and remove the thermostat housing

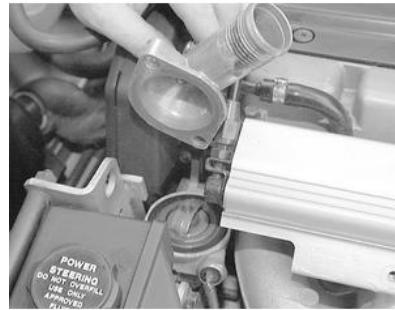


Fig. 3: Remove the thermostat from the engine



1992 Volvo 940

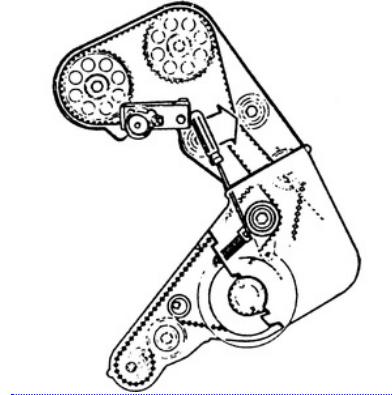
Submodel: | Engine Type: L4 | Liters: 2.3

Fuel Delivery: FI | Fuel: GAS

B234F Engine

1. Place a tension gauge (9988500 or equivalent) between the exhaust camshaft drive pulley and tensioner.
2. Read the gauge. If the belt tension is correct, the gauge should read between 3.2 and 4.2 units.
3. If the reading is incorrect, remove the protective rubber cap in the timing belt cover. Slacken the locknut.
4. Turn the crankshaft clockwise through one revolution. Camshaft pulley markings should again coincide with the markings on the timing belt mounting plate.
NOTE: Do not turn the engine counterclockwise during belt tensioning procedure.
5. Turn the engine further clockwise until the camshaft pulley markings are $1 \frac{1}{2}$ teeth past the markings on the timing belt mounting plate. Tighten the tensioner locknut.
6. Turn the crankshaft clockwise to complete one revolution (TDC).
7. Check that all markings coincide.
8. Recheck the belt tension.
9. If the reading is still not correct, proceed as follows:
 - A. Slacken the tensioner locknut.
 - B. Install the measuring gauge.
 - C. Insert a screwdriver between the tensioner pulley and the end of the spring carrier pin.
 - D. Re-adjust the belt to obtain the specified tension. Tighten the tensioner locknut to 37 ft. lbs. (50 Nm).
10. Install the protective rubber cap over the tensioner locknut.
11. Install the upper timing belt cover.

Fig. 1: Adjusting the timing belt — B234F engine



2.9L 6-Cylinder Engine

1. Place a tension gauge (9988500 or equivalent) between the exhaust camshaft drive pulley and water pump.
2. Read the gauge. If the belt tension is correct, the gauge should read between 3.5 and 4.6 units.
3. If the reading is incorrect, replace the tensioner.

1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3

Fuel Delivery: FI | **Fuel:** GAS

The timing belt should be periodically inspected for wear. Removal of the timing cover is necessary to visually check the belt for signs of wear or contamination. The belt should show no signs of wear such as cracked teeth, wear on the belt face, wear on one or both sides of the belt, and there should be no foreign materials on the belt or between the teeth. If there is oil, coolant, lubricant, or any other foreign material on the belt, it is a good idea to replace the belt due to the fact that rapid wear can result from this contamination. Usually sticking to the manufacturer's guide for timing belt replacement interval will ensure little problems but it is still a good idea to periodically inspect your belt. If the belt breaks the engine will shut down and serious engine damage can occur. The proper manufacturer recommended timing belt replacement interval can be found in Section 1.

Fig. 1: Check for premature parting of the belt

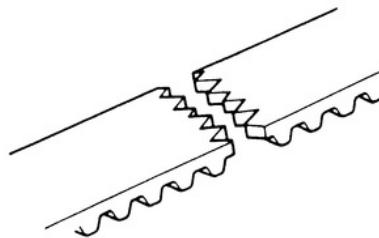


Fig. 2: Check if the teeth are cracked or damaged

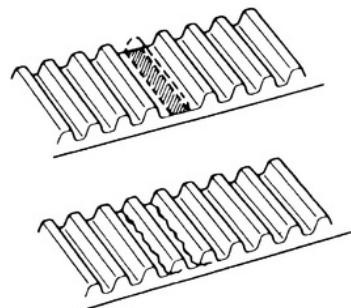


Fig. 3: Look for noticeable cracks or wear on the belt face

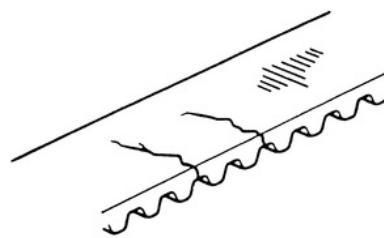


Fig. 4: You may only have damage on one side of the belt; if so, the guide could be the culprit

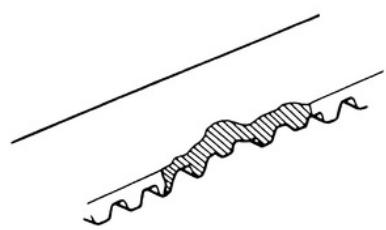


Fig. 5: Foreign materials can get in between the teeth and cause damage

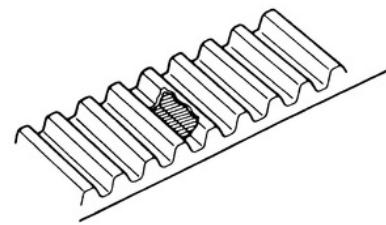


Fig. 6: Inspect the timing belt for cracks, fraying, glazing or damage of any kind



Fig. 7: Damage on only one side of the timing belt may indicate a faulty guide



Fig. 8: ALWAYS replace the timing belt at the interval specified by the manufacturer



1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3

Fuel Delivery: FI | **Fuel:** GAS

NOTE: Although not necessary, we recommend that you replace the timing belt tensioner when replacing the belt. The tensioner can (and often does) leak hydraulic fluid, and can seize, causing the belt to break.

B230F and B230FT Engines

1. Disconnect the negative battery cable.
2. Remove the timing belt cover as described in this section.
3. Set the engine to TDC of the No. 1 cylinder.
4. To remove the tension from the belt, loosen the nut for the tensioner and press the idler roller back. The tension spring can be locked in this position by inserting the shank end of a 3mm drill through the pusher rod.
5. Remove the 6 retaining bolts and the crankshaft pulley.
6. Remove the belt, taking care not to bend it at any sharp angles. The belt should be replaced at 45,000 mile (72,500 km) intervals, if it becomes oil soaked or frayed or if it is on a vehicle that has been sitting idle for any length of time.

To install:

7. If the crankshaft, idler shaft or camshaft were disturbed while the belt was out, align each shaft with its corresponding index mark to assure proper valve timing and ignition timing, as follows:
 - A. Rotate the crankshaft so the notch in the convex crankshaft gear belt guide aligns with the embossed mark on the front cover (12 o'clock position).
 - B. Rotate the idler shaft so the dot on the idler shaft drive sprocket aligns with the notch on the timing belt rear cover (4 o'clock position).
 - C. Rotate the camshaft so the notch in the camshaft sprocket inner belt guide aligns with the notch in the forward edge of the valve cover (12 o'clock position).
8. Install the timing belt (don't use any sharp tools) over the sprockets and then over the tensioner roller. Some new belts have yellow marks. The 2 lines on the drive belt should fit toward the crankshaft marks. The next mark should then fit toward the intermediate shaft marks, etc.
9. Loosen the tensioner nut and let the spring tension automatically take up the slack. Tighten the tensioner nut to 37 ft. lbs. (51 Nm).
10. Rotate the crankshaft one full revolution clockwise and make sure the timing marks still align.
11. Install the drive belts, radiator fan and shroud.
12. Connect the negative battery cable.

B234F Engine

NOTE: The B234F engine has 2 timing belts, one driving the camshafts and one driving the balance shafts. The camshaft belt may be removed separately; the balance shaft belt requires removal of the camshaft belt. During reassembly, the exact placement of the belts and pulleys must be observed.

1. Remove the negative battery cable.
2. Remove the timing belt covers.
3. Turn the engine to TDC, of the compression stroke, on cylinder No. 1. Make sure the marks on the cam pulleys align with the marks on the backing plate and that the marking on the belt guide plate (on the crankshaft) is opposite the TDC mark on the engine block.
4. Remove the protective cap over the timing belt tensioner locknut. Loosen the locknut, compress the tensioner, to release tension on the belts, and re-tighten the locknut, holding the tensioner in place.
5. Remove the timing belt from the camshafts. Do not crease or fold the belt. Place a mark noting the direction of the belt's rotation if you are reinstalling the same belt.

NOTE: The camshafts and the crankshaft must not be moved when the belt is removed.

6. Check the tensioner by spinning it counterclockwise and listening for any bearing noise within. Check also that the belt contact surface is clean and smooth. In the same fashion, check the timing belt idler pulleys. Make sure the bolts are tightened to 18.5 ft. lbs. (25 Nm).
7. If the balance shaft belt is to be removed:

- A. Remove the balance shaft belt idler pulley from the engine.
- B. Loosen the locknut on the tensioner and remove the belt. Slide the belt under the crankshaft pulley assembly. Check the tensioner and idler wheels carefully for any sign of contamination; check the ends of the shafts for any sign of oil leakage.
- C. Check the position of the balance shafts and the crankshaft after belt removal. The balance shaft markings on the pulleys should align with the markings on the backing plate and the crankshaft marking should still be aligned with the TDC mark on the engine block.
- D. When refitting the balance shaft belt, observe that the belt has colored dots on it. These marks assist in the critical placement of the belt. The yellow dot will align with the right lower shaft, the blue dot will align on the crank and the other yellow dot will match to the upper left balance shaft.
- E. Carefully work the belt in under the crankshaft pulley. Make sure the blue dot is opposite the bottom (TDC) marking on the belt guide plate at the bottom of the crankshaft. Fit the belt around the left upper balance shaft pulley, making sure the yellow mark is opposite the mark on the pulley. Install the belt around the right lower balance shaft pulley and again check that the mark on the belt aligns with the mark on the pulley.
- F. Work the belt around the tensioner. Double check that all the markings are still aligned.
- G. Set the belt tension by inserting an Allen key into the adjusting hole in the tensioner. Turn the crankshaft carefully through a few degrees on either side of TDC to check that the belt has properly engaged the pulleys. Return the crank to the TDC position and set the adjusting hole just below the 3 o'clock position when tightening the adjusting bolt. Use the Allen wrench, in the adjusting hole, as a counter hold and tighten the locking bolt to 29.5 ft. lbs. (40 Nm).
- H. Check the tension of the belt. If the belt is out of specification, the belt must be readjusted.

To install:

8. Reinstall the camshaft belt by aligning the double line marking on the belt with the top marking on the belt guide plate at the top of the crankshaft. Stretch the belt around the crank pulley and place it over the tensioner and the right side idler. Place the belt on the camshaft pulleys. The single line marks on the belt should align exactly with the pulley markings. Route the belt around the oil pump drive pulley and press the belt onto the left side idler.
9. Check that all the markings align and that the engine is still positioned at TDC, of the compression stroke, for cylinder No. 1.
10. Loosen the tensioner locknut.
11. Turn the crankshaft clockwise. The cam pulleys should rotate 1 full turn until the marks again align with the marks on the backing plate.

NOTE: The engine must not be rotated counterclockwise during this procedure.

12. Smoothly rotate the crankshaft further clockwise until the cam pulley markings are $1 \frac{1}{2}$ teeth beyond the marks on the backing plate.
13. Tighten the tensioner locknut.
14. Check the tension on the balance shaft belt; it should now be 3.8 units. If the tension is too low, adjust the tensioner clockwise. If the tension is too high, repeat Step 7g.
15. Check the belt guide for the balance shaft belt and make sure it is properly seated.
16. Install the center timing belt cover, the one that covers the tensioner, the fan shroud, fan pulley and fan.
17. Install all the drive belts and connect the battery cable.
18. Double check all installation items, paying particular attention to loose hoses or hanging wires, untightened nuts, poor routing of hoses and wires (too tight or rubbing) and tools left in the engine area.

19. Connect the negative battery cable.
 20. Start the engine and allow it to run until the thermostat opens.
- CAUTION**
The upper and lower timing belt covers are still removed. The belt and pulleys are exposed and moving at high speed.
21. Turn the engine **OFF** and bring the engine to TDC, of the compression stroke, on cylinder No. 1.
 22. Disconnect the negative battery cable.
 23. Check the tension of the camshaft belt. Position the gauge between the right (exhaust) cam pulley and the idler. Belt tension must be 5.5 plus or minus 0.2 units. If the belt needs adjustment, remove the rubber cap over the tensioner locknut, cap is located on the timing belt cover, and loosen the locknut.
 24. Insert a suitable tool between the tensioner wheel and the spring carrier pin to hold the tensioner. If the belt needs to be tightened, move the roller to adjust the tension to 6.0 units. If the belt is too tight, adjust to obtain a reading of 5.0 units on the gauge. Tighten the tensioner locknut.
 25. Rotate the crankshaft so the cam pulleys move through 1 full revolution and recheck the tension on the camshaft belt. It should now be 5.5 plus or minus 0.2 units. Install the plastic plug over the tensioner bolt.
 26. Final check the tension on the balance shaft belt by fitting the gauge and turning the tensioner clockwise. Only small movements are needed. After any needed readjustments, rotate the crankshaft clockwise through 1 full revolution and recheck the balance shaft belt. The tension should now be on the final specification of 4.9 plus or minus 0.2 units.
 27. Install the idler pulley for the balance shaft belt.
 28. Reinstall the upper and lower timing belt covers.
 29. Connect the negative battery cable.
 30. Start the engine and final check performance.

Fig. 1: Align the marks on the timing gears before removing the belt

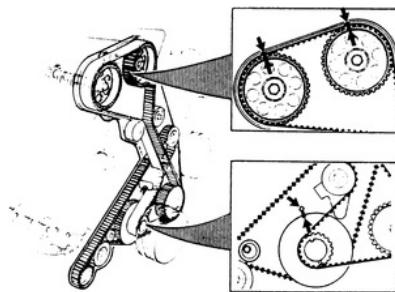


Fig. 2: Remove the tensioner bolts in order to remove the timing belt

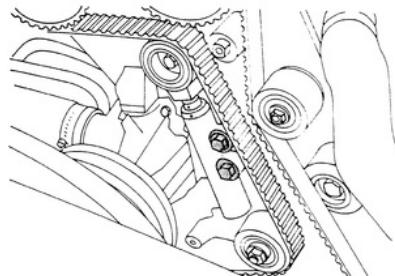


Fig. 3: Check the timing belt idler pulleys for wear or bearing noise; replace if necessary

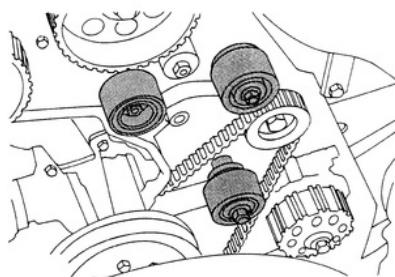


Fig. 4: Remove the idler pulley for the balance shaft

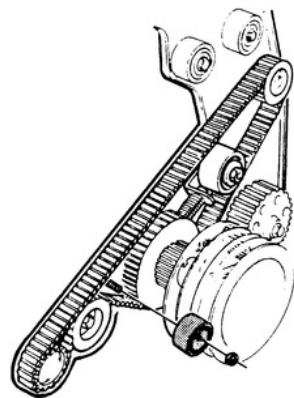


Fig. 5: Remove the tensioner pulley to remove the balance shaft

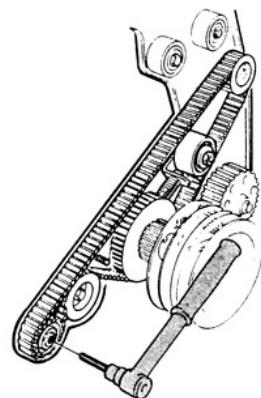


Fig. 6: Line up the balance shafts before installing the belt

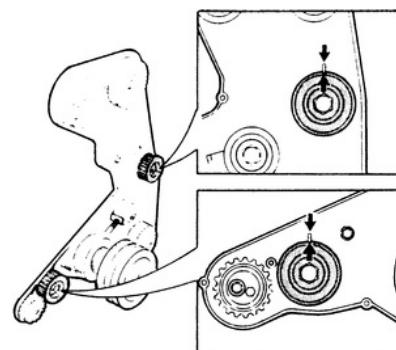


Fig. 7: Check the alignment of the balance shafts and crankshaft before tightening the tensioner

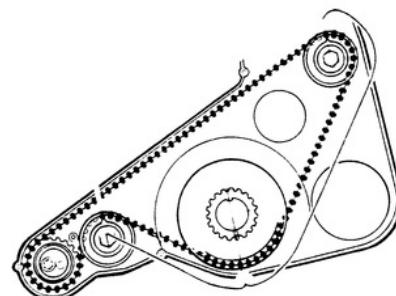
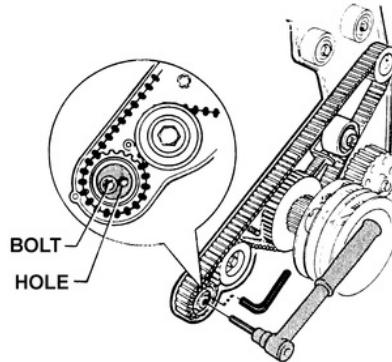


Fig. 8: Use an Allen wrench as a counterhold when tightening the tensioner pulley



2.9L 6-Cylinder Engine

1. Disconnect the negative battery cable.
2. Remove the splashguard, vibration damper guard and ignition coil cover.
3. Remove the auxiliary drive belts.
4. Remove the front timing belt cover.
5. Rotate the crankshaft clockwise, until the timing marks on the camshaft pulleys/timing belt mounting plate and crankshaft pulley/oil pump housing are aligned.
6. Remove the upper timing belt cover.
7. Check the belt tensioner, as outlined in this section. Replace the tensioner, if required.
8. Remove the tensioner upper mounting bolts. Loosen the tensioner lower mounting bolt and twist the tensioner to free the plunger. Remove the lower mounting bolt and remove the tensioner.
9. Remove the timing belt.

NOTE: Do not rotate the crankshaft while the timing belt is removed.

10. Check the tensioner and idler pulleys, as follows:

- A. Spin the pulleys and listen for bearing noise.
- B. Check that the pulley surfaces in contact with the belt are clean and smooth.
- C. Check the tensioner pulley arm and idler pulley mountings.
- D. Tighten the tensioner pulley arm to 30 ft. lbs. (40 Nm) and the idler pulley to 18 ft. lbs. (25 Nm).

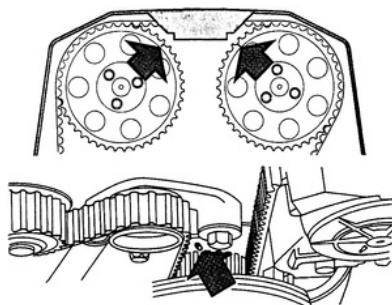
To install:

11. Place the belt around the crankshaft pulley and right-side idler. Place the belt over the camshaft pulleys.
12. Position the belt around the water pump and press over tensioner pulley.

NOTE: The timing belt lever bushing must be greased every time the belt is replaced or the tensioner pulley removed. This is necessary to help prevent seizure of the bushing, with the possible risk of incorrect belt tension. Service the bushing, using the following procedure:

- A. Remove the lever mounting bolt, tensioner pulley and sleeve behind the bolt.
- B. Grease the surfaces of the bushing, bolt and sleeve, using high temp grease.
- C. Install the sleeve, tensioner pulley and lever mounting bolt.
- D. Tighten the bolt to 30 ft. lbs. (40 Nm).
13. Insert the tensioner mounting bolts. Tighten to 18 ft. lbs. (25 Nm).
14. Remove the locking pin.
15. Install the front timing belt cover.
16. Turn the crankshaft through 2 revolutions and check that the timing marks on the crankshaft and camshaft pulleys are correctly aligned.
17. Install the ignition coil, front timing belt cover, auxiliaries drive belts, vibration damper guard and splashguard.
18. Connect the negative battery cable.
19. Start and check the engine operation.

Fig. 9: Pulley alignment marks for timing belt replacement



2.3L and 2.4L 5-Cylinder Engines

1. Disconnect the negative battery cable.
2. Remove the coolant expansion tank and place it on top of the engine.
3. Remove the spark plug cover and drive belts.

4. Remove the timing belt cover.
5. Align the pulley marks with the marks on the engine mounting plate.
6. Wait five minutes after lining up marks, then install gauge 998 8500 or equivalent between the exhaust camshaft and water pump. Read the gauge using a mirror, while still installed. For 23mm belts, the tension should be 2.7–4.0 units.

NOTE: If the belt tension is incorrect, the tensioner must be replaced.

7. Remove the upper tensioner bolt and loosen the lower bolt, turning the tensioner to free up the pulley.
8. Remove the lower bolt and the tensioner.
9. Remove the timing belt.

To install:

10. Turn all the pulleys listening for bearing noise. Check to see that the contact surfaces are clean and smooth.
11. Remove the tensioner pulley lever and idler pulley, lubricate the contact surfaces and bearing with grease. If the tensioner pulley lever or idler is seized replace it.
12. Install the tensioner pulley lever and idler pulley and tighten to 18 ft. lbs. (25 Nm).
13. Compress the tensioner with tool 999 5456 or equivalent and insert a 0.079 in. (2.0mm) lock pin in the piston. If the tensioner leaks, has no resistance, or will not compress, replace it.
14. Install the tensioner and tighten the bolts to 18 ft. lbs. (25 Nm).
15. Install the timing belt in order:
 - A. Around the crankshaft sprocket.
 - B. Around the right idler pulley
 - C. Around the camshaft sprockets
 - D. Around the water pump
 - E. Onto the tensioner pulley
16. Pull the lock pin out from the tensioner and install the upper timing cover. Turn the crankshaft two complete revolutions and check to see that the timing marks on the crankshaft and camshaft pulleys are lined up.
17. Install the timing belt covers and the fuel line clips.
18. Install the accessory belts.
19. Install the vibration damper guard and the inner fenderwell.
20. Install the spark plug cover.
21. Install the coolant reservoir tank.
22. Connect the negative battery cable.

Fig. 10: Line up the camshaft pulleys with the marks on the engine mounting plate

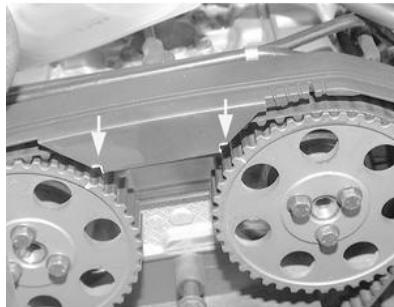


Fig. 11: If you are not replacing the timing belt, make sure you mark the rotational direction for proper indexing upon installation



Fig. 12: To ease installation, note the belt routing before removal

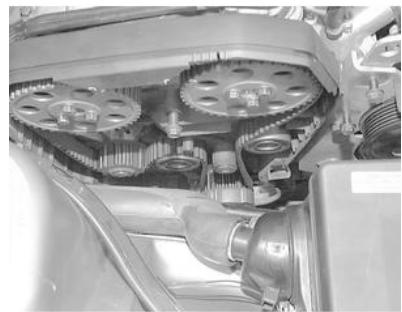


Fig. 13: The tensioner as mounted on the engine block



Fig. 14: Remove the tensioner pulley from the engine



Fig. 15: Slide the timing belt off the camshaft pulleys and remove it from the engine



Fig. 16: Remove the tensioner from the engine

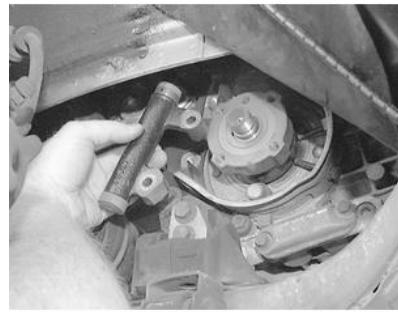


Fig. 17: Install the tensioner in a vise . . .

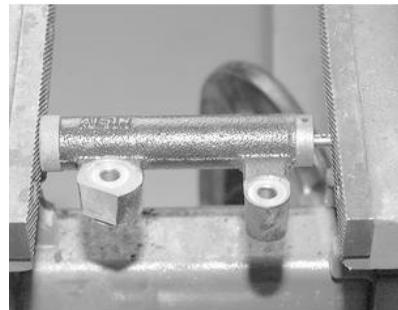


Fig. 18: . . . and compress the tensioner piston until . . .

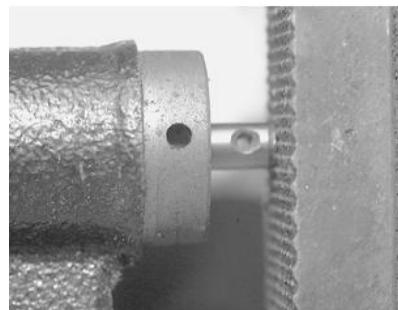


Fig. 19: . . . the holes align . . .

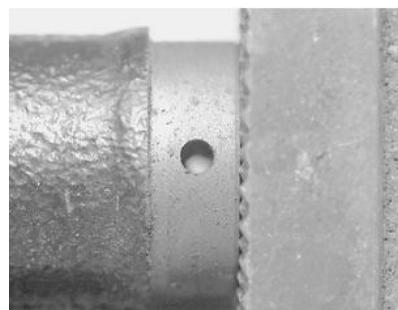


Fig. 20: . . . then install a 2mm lock pin (or 2mm Allen wrench, as used here)

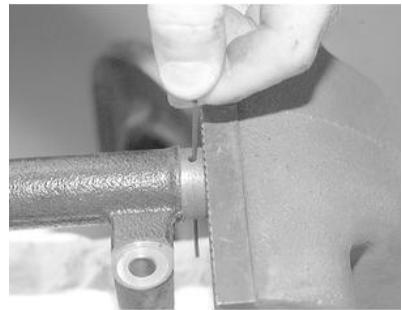
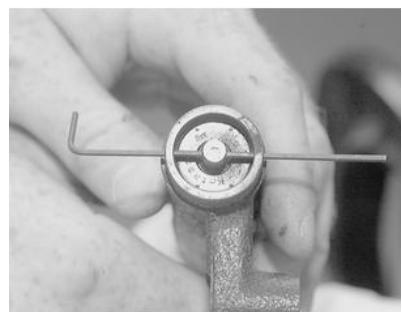


Fig. 21: Remove the tensioner from the vise, leaving the pin or Allen wrench in the piston



1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3

Fuel Delivery: FI | **Fuel:** GAS

2.3L 4-Cylinder Engine

1. Disconnect the negative battery cable.
2. Remove the cooling fan and shroud.
3. Remove the drive belts.
4. Remove the water pump pulley.
5. Remove the 4 retaining bolts and lift off the timing belt cover.

To install:

6. Clean all gasket mating surfaces thoroughly.
7. Install the timing belt cover using a new gasket.
8. Install the water pump pulley, and all drive belts.
9. Install the fan and shroud.
10. Connect the negative battery cable.
11. Start the engine and check for leaks.

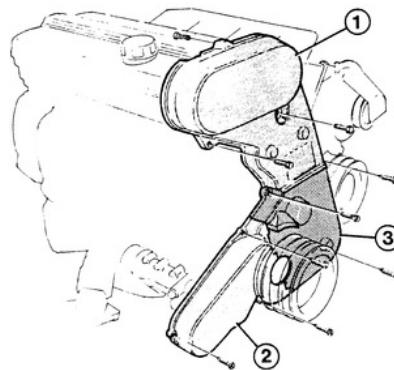
B234F 4-Cylinder Engine

1. Remove the negative battery cable.
2. Remove the drive belts.
3. Remove the radiator fan, its pulley and the fan shroud.
4. Remove the drive belts for the power steering belts and the air conditioning compressor.
5. Beginning with the top cover, remove the retaining bolts and remove the timing belt covers.

To install:

6. Clean all gasket mating surfaces thoroughly.
7. Install the timing belt covers using new gaskets.
8. Install the water pump pulley, and all drive belts.
9. Install the fan and shroud.
10. Connect the negative battery cable.
11. Start the engine and check for leaks.

Fig. 1: The B234F engine has a three-piece timing cover



2.9L 6-Cylinder Engine

1. Disconnect the negative battery lead.
2. Remove the drive belt.
3. Remove the lower timing belt cover, splash guard and vibration damper guard.
4. Remove the ignition coil cover.
5. Remove the upper timing cover.

To install:

6. Install the upper timing belt cover.
7. Install the ignition coil cover.
8. Install the lower timing belt cover, splash guard and vibration damper guard.
9. Install the drive belt.
10. Connect the negative battery cable.

2.3L and 2.4L 5-Cylinder Engines

1. Disconnect the negative battery cable.
2. Remove the coolant expansion tank and place it on top of the engine.

3. Remove the spark plug cover.
4. Remove the drive belts.
5. Remove the fuel line clips.
6. Remove the right front wheel and loosen the inner fenderwell.
7. Remove the vibration damper guard and turn crankshaft pulley until the marks are lined up.
8. Remove the water pump pulley.
9. Remove the retaining bolts and lift off the timing belt cover.

To install:

10. Position the timing belt cover in place and secure with the retainer bolts.
11. Install the water pump pulley, followed by the drive belts.
12. Install the remaining components.
13. Connect the negative battery cable.

Fig. 2: Unplug the connector, disconnect the hose and remove the expansion tank



Fig. 3: Remove the belt and the tensioner



Fig. 4: Remove the spark plug cover to . . .



. . . access the fuel line clips



Fig. 6: Unfasten the retaining bolts and remove the fuel line clips



Fig. 7: Remove the fenderwell trim



Fig. 8: Remove the water pump pulley; it is retained by a "shoulder" bolt (shown)



Fig. 9: Remove the retaining bolts and carefully remove the timing belt cover



1992 Volvo 940

Submodel: | Engine Type: L4 | Liters: 2.3

Fuel Delivery: FI | Fuel: GAS

2.8L 6-Cylinder Engine

1. Remove the timing chain cover.
2. Set the engine to TDC of the No. 1 cylinder.
3. Remove the oil pump sprocket and drive chain.
4. Slacken the tension in both camshaft timing chains by rotating each tensioner lock $\frac{1}{4}$ turn counterclockwise and pushing the rubbing block piston.
5. Remove both chain tensioners.
6. Remove the 2 curved and the 2 straight chain damper/runners.
7. Remove the camshaft sprocket retaining bolt, 10mm Allen head, and the sprocket and chain assembly. Repeat for the other side.

To install:

8. Install the chain tensioners and tighten to 60 inch lbs. (7 Nm).
9. Install the curved chain damper/runners and tighten to 7–11 ft. lbs. (10–15 Nm).
10. Install the straight chain damper/runners and tighten to 60 inch lbs. (7 Nm).
11. First install the driver's side camshaft sprocket and chain:
 - A. Rotate the crankshaft, using crankshaft nut, if necessary, until the crankshaft key is pointing directly to the driver's side camshaft and the driver's side camshaft key groove is pointing straight-up (12 o'clock).
 - B. Place the chain on the driver's side sprocket so the sprocket notchmark is centered precisely between the 2 white lines on the chain.
 - C. Position the chain on the crankshaft sprocket (inner), making sure the other white line on the chain aligns with the crankshaft sprocket notch.
 - D. While holding the driver's side chain and sprockets in this position, install the sprocket and chain on the driver's side camshaft, chain stretched on tension side, so the sprocket pin fits into the camshaft recess.
 - E. Tighten the sprocket center bolt to 51–59 ft. lbs. (69–80 Nm); use a suitable tool to keep the cam from turning.
12. To install the passenger side camshaft sprocket and chain:
 - A. Rotate the crankshaft clockwise until the crankshaft key points straight down (6 o'clock).
 - B. Align the camshaft key groove so it is pointing halfway between the 8 and 9 o'clock positions; at this position, the No. 6 cylinder rocker arms will rock.
 - C. Place the chain on the passenger side sprocket so the sprocket notchmark is centered precisely between the 2 white lines on the chain.
 - D. Then, position the chain on the middle crankshaft sprocket, making sure the other white line aligns with the crankshaft sprocket notch.
 - E. Install the sprocket and chain on the camshaft so the sprocket notch fits into the camshaft recess.
 - F. Tighten the sprocket nut to 51–59 ft. lbs. (69–80 Nm).
13. Rotate the chain tensioners $\frac{1}{4}$ turn clockwise each. The chains are tensioned by rotating the crankshaft 2 full turns clockwise. Recheck to make sure the alignment marks coincide.
14. Install the oil pump sprocket and chain.
15. Install the timing chain cover.

Fig. 1: Relieving the chain tension

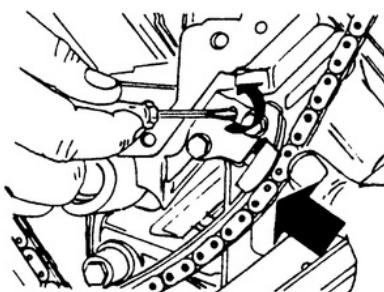


Fig. 2: Exploded view of timing chain, tensioner and sprocket assembly

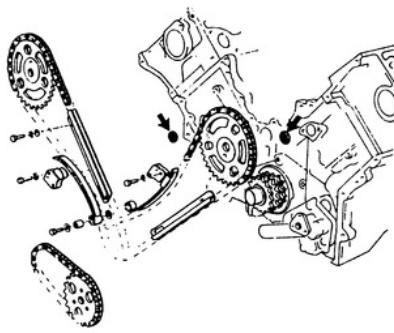


Fig. 3: Driver's side timing chain installation sequence

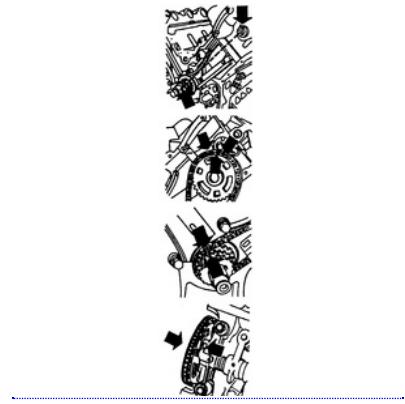
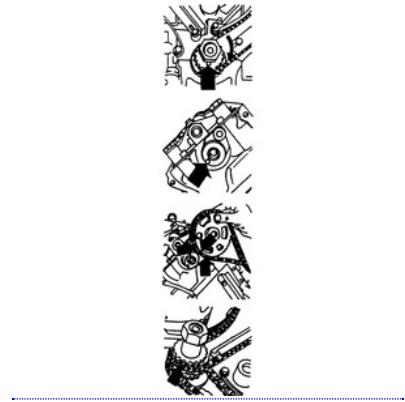


Fig. 4: Passenger side timing chain installation sequence



1992 Volvo 940

Submodel: | **Engine Type:** L4 | **Liters:** 2.3

Fuel Delivery: FI | **Fuel:** GAS

[2.8L 6-Cylinder Engine](#)

[COVER AND SEAL](#)

1. Disconnect the negative battery cable.
2. Remove the air cleaner and valve covers.
3. Loosen the fan shroud and remove the fan.
4. Remove the shroud.
5. Loosen the alternator, air pump, power steering pump, air conditioning compressor, if equipped, and remove their drive belts.
6. Block the flywheel from turning, remove the crankshaft pulley nut (36mm) and the pulley.

NOTE: Do not drop the pulley key into the crankcase.

7. Remove the power steering pump and place aside.
8. Remove the pump bracket.
9. Remove the 25 timing chain cover 11mm hex retaining bolts, then tap and remove the cover.

To install:

10. Clean the gasket contact surfaces.
11. Place the upper gasket on the cover and the lower gasket on the block.
12. Install the cover and tighten to 7–11 ft. lbs. (10–15 Nm).
13. Trim the gaskets flush with the valve cover.
14. Install a new crankshaft seal.
15. Block the flywheel, install the pulley, key and tighten the 36mm nut to 118–132 ft. lbs. (160–180 Nm).
16. Install the power steering pump, pump bracket, alternator, air pump, power steering pump and air conditioning compressor.
17. Install the fan and shroud.
18. Install the accessory drive belts.
19. Connect the negative battery cable.
20. Start the engine and check for leaks.

[SEAL ONLY](#)

1. Disconnect the negative battery cable.
2. Remove the air cleaner and valve covers.
3. Loosen the fan shroud and remove the fan.
4. Remove the shroud.
5. Loosen the alternator, air pump, power steering pump, air conditioning compressor, if equipped, and remove their drive belts.
6. Block the flywheel from turning, remove the crankshaft pulley nut (36mm) and the pulley.

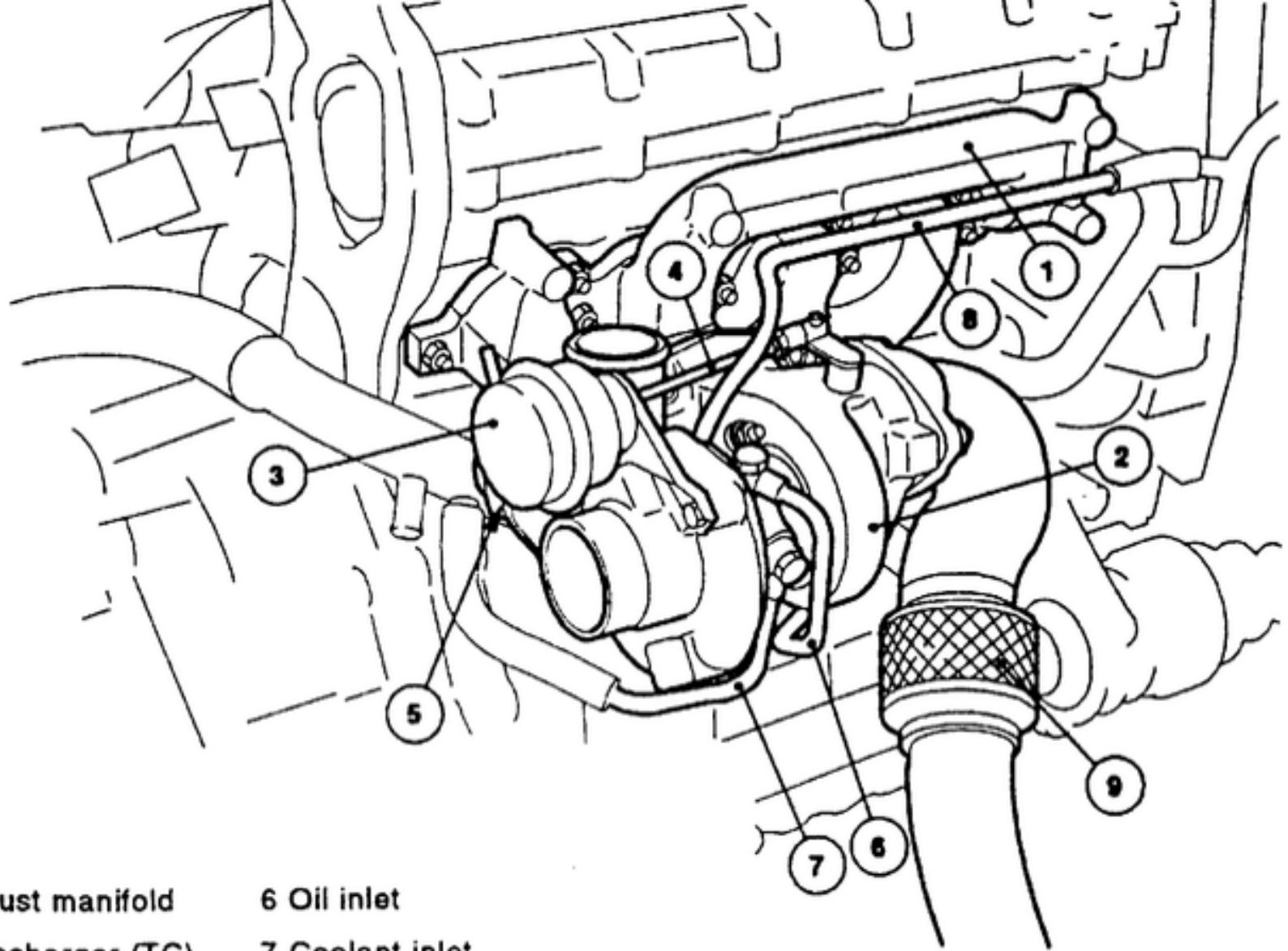
NOTE: Do not drop the pulley key into the crankcase.

7. Remove the seal, using a suitable puller (Tool 9 995 069-3 or equivalent).

NOTE: Be careful not to damage the timing chain cover contact surface.

To install:

8. Fill the space between the seal lips with grease and install the new seal, using tool 5103 or equivalent.
9. Block the flywheel, install the pulley, key and tighten the 36mm nut to 118–132 ft. lbs. (160–180 Nm).
10. Install the power steering pump, pump bracket, alternator, air pump, power steering pump and air conditioning compressor.
11. Install the fan and shroud.
12. Install the accessory drive belts.
13. Connect the negative battery cable.
14. Start the engine and check for leaks.



1 Exhaust manifold

2 Turbocharger (TC)

3 Pressure regulator

4 Link

5 Bypass valve

6 Oil inlet

7 Coolant inlet

8 Coolant return

9 Flexible joint (bellows type)

1992 Volvo 940

Submodel: | Engine Type: L4 | Liters: 2.3

Fuel Delivery: FI | Fuel: GAS

NOTE: Before working on the exhaust system, it is a good idea to soak the retaining hardware with a quality rust penetrant prior to attempting to remove them. After the penetrant is applied, wait at least 10–15 minutes to let the penetrant begin to work.

2.3L 4-Cylinder Engine

1. Disconnect the negative battery cable.
2. Remove preheater hose to the air cleaner.
3. Remove the pipe and rubber bellows between the air/fuel control unit and the turbocharger unit.
4. Pull out the crankcase ventilation hose from the pipe.
5. Remove the pipe and pipe connector between the turbocharger unit and the intake manifold.

NOTE: Cover the turbocharger intake and outlet ports to keep dirt out of the system.

6. Disconnect the exhaust pipe and place aside.
7. Remove the upper heat shield.
8. Remove the brace between the turbocharger unit and the manifold.
9. Remove the lower heat shield by removing the retaining screw under the manifold.
10. Remove the oil pipe clamp, retaining screws on the turbo unit and the pipe connection screw in the cylinder block under the manifold. Do not allow any dirt to enter the oil passages.
11. Remove the manifold retaining nuts and washers. Leave one nut in place to keep the manifold in position.
12. Remove the oil delivery pipe. Cover the opening on the turbo unit.
13. Disconnect the air/fuel control unit by loosening the clamps.
14. Move the unit with the lower section of the air cleaner up to the right side wheel housing. Place a cover over the wheel housing as protection.
15. Remove the remaining nut and washer on the manifold.
16. Lift the assembly forward and up.
17. Remove the manifold gaskets.
18. Disconnect the return oil pipe O-ring from the cylinder block.
19. Disconnect the turbocharger unit from the manifold.

To install:

NOTE: Be sure to use a new gasket for the exhaust manifold and a new O-ring to the return oil pipe. Coat the O-ring with oil prior to installing. Keep everything clean during assembly and use extreme care to keep dirt out of the various turbo inlet and outlet pipes and hoses.

20. Install the turbocharger on the exhaust manifold and tighten the bolts as follows:
 - A. Step 1 — 7 ft. lbs. (10 Nm)
 - B. Step 2 — 30 ft. lbs. (40 Nm)
 - C. Step 3 — Tighten all bolts an additional 120 degrees ($\frac{1}{3}$ turn).
21. Install the exhaust manifold and turbocharger assembly on the engine.
22. Connect all oil pipes from and to the turbocharger using new O-rings.
23. Install the air/fuel control unit and air cleaner.
24. Install the heat shields, spark plug wires, exhaust pipes, preheater assembly and expansion tank.
25. Connect the negative battery cable.
26. Disconnect the wire at terminal 15 (brown) of the ignition coil. Use the ignition key to crank the engine for about 30 seconds. This circulates oil to the turbocharger, providing proper start-up lubrication.
27. Turn the ignition **OFF**, reconnect the coil wire, start the engine and allow it to idle for a few minutes prior to test driving.

Fig. 1: Turbocharger system component locations — B230FT engine

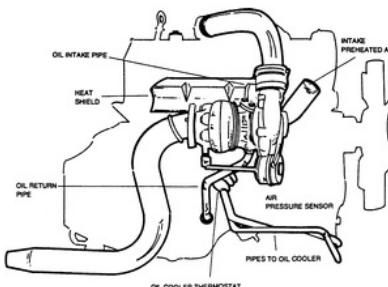


Fig. 2: Disconnect the turbo unit from the exhaust manifold

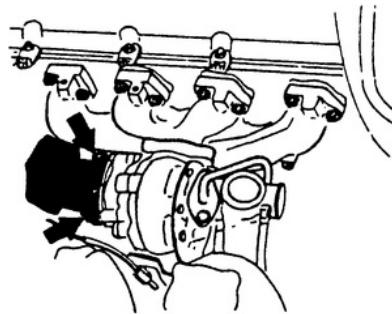
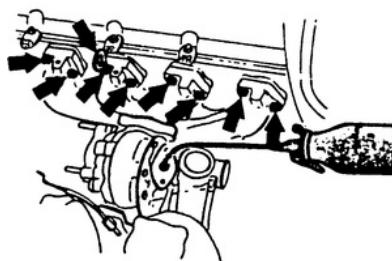


Fig. 3: Lubricating the exhaust manifold bolts with a proper rust penetrant or lubricant aids their installation into the cylinder head. Note the manifold bolt locations



2.3L and 2.4L 5-Cylinder Engines

1. Disconnect the negative battery cable.
 2. Drain and recycle the engine coolant.
 3. Drain the engine oil.
 4. Remove the heat shield from over the exhaust manifold.
 5. Remove the upper air charge pipe and rubber hose from the turbo and move it to one side.
 6. Remove the fresh air intake hose and inner heat shield.
 7. Disconnect the upper turbo coolant return pipe and clamp off the hose, move it to the side.
 8. Disconnect the oil inlet pipe nipple.
 9. Raise and safely support the vehicle.
 10. Remove or disconnect the following from under side:
 - clamp between the pipes
 - oil return pipe
 - exhaust pipe bracket and bolt
 - exhaust pipe to turbo nut
 - exhaust manifold to turbo nuts
 11. From the top side remove the exhaust pipe to turbo nuts.
 12. Disconnect the coolant inlet pipe to the turbo.
 13. Remove the turbo/exhaust manifold nuts.
 14. Disconnect the following hoses from the turbo:
 - red boost pressure
 - white bypass valve
 - yellow pressure regulator
 15. Remove the turbo and the old pin bolts from the exhaust manifold.
 16. Coat new O-rings with oil, and install them in the pipes.
- To install:**
17. Remove the old O-rings from the pipes.
 18. Install new pin bolts with threadlocking compound and tighten to 15 ft. lbs. (20 Nm).
 19. Install the turbo and connect the red, white, and yellow hoses to it.
 20. Install the upper exhaust manifold nuts and tighten them lightly.
 21. Working from under the vehicle, install the lower exhaust manifold nuts and tighten them to 18 ft. lbs. (25 Nm).
 22. On the top side, tighten the upper exhaust manifold nuts to 18 ft. lbs. (25 Nm).
 23. Tighten the exhaust manifold/turbo nuts to 22 ft. lbs. (30 Nm) and check that they are mated properly.
 24. Under the vehicle install the oil pipe, grease the O-ring.
 25. Install the exhaust pipe bracket bolt.
 26. Lower the vehicle and install or connect the following:
 - oil inlet pipe
 - inlet and outlet coolant pipes (make sure the clamps are removed)
 - fresh air intake hose

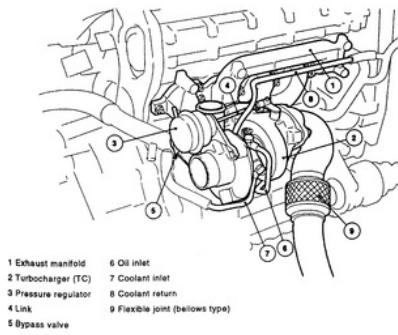
- inner heat shield
- upper air charge pipe
- outer heat shield

NOTE: Replace the copper coolant pipe and upper oil pipe washers.

27. Raise the vehicle and remove the clamp from coolant return hose.
28. Connect the negative battery cable.
29. Run the engine to check the boost pressure.
30. Check oil and coolant levels.

NOTE: It may be necessary to reset a fault code after replacing the turbocharger.

Fig. 4: Turbocharger assembly and related components — 2.3L and 2.4L 5-cylinder engines



1992 Volvo 940

Submodel: | Engine Type: L4 | Liters: 2.3

Fuel Delivery: FI | Fuel: GAS

2.3L 4-Cylinder Engine

1. Disconnect the negative battery cable.
2. Set the heater control to MAX heat.
3. Remove the expansion tank cap.
4. Open the draincocks on the right-hand side of the engine block and on the radiator, and drain the coolant into a suitable container.
5. Close the draincocks when the coolant is completely drained.
6. Remove the radiator shroud and fan.
7. Remove the lower radiator hose at the water pump.
8. If required, remove the retaining bolt for the coolant pipe beneath the exhaust manifold and pull the pipe rearward.
9. Remove the drive belts and water pump pulleys.
10. Remove the water pump bolts, washers and nuts.
11. Remove the water pump assembly.

To install:

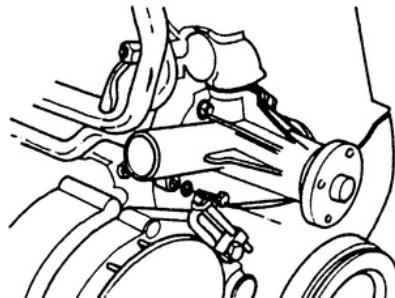
12. Clean the gasket contact surfaces thoroughly and use a new gasket and O-rings. Coat the O-rings with coolant prior to installing them. Install a thin layer of gasket sealer on the water pump to help the gasket stay in place during installation.

CAUTION

Make sure that the water pump is aligned before tightening the retaining bolts, it is extremely easy to misalign the pump and break it.

13. Install the water pump and tighten the bolts to 11–15 ft. lbs. (15–20 Nm) in a crisscross pattern.
14. Install the coolant pipe and lower radiator hose.
15. Install the accessory drive belts and water pump pulley.
16. Install the fan and shroud.
17. Connect the negative battery cable.
18. Fill the cooling system with coolant.
19. Start the engine and allow it to reach normal operating temperature.
20. Check for leaks.
21. Add coolant as necessary.

Fig. 1: Water pump installation on the 2.3L 4-cylinder



2.8L 6-Cylinder Engine

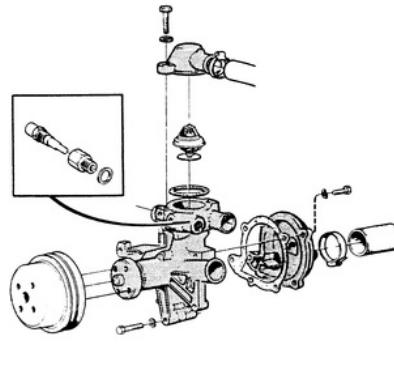
1. Disconnect the negative battery cable.
- NOTE: On some variants of this engine, it may be necessary to remove the front and main sections of the intake manifold.**
2. Remove the overflow tank cap and drain the cooling system.
 3. Disconnect both radiator hoses.
 4. On automatic transmission vehicles, disconnect the transmission cooler lines at the radiator.
 5. Disconnect the fan shroud.
 6. Remove the radiator and fan shroud.
 7. Remove the fan.
 8. Remove the hoses from the water pump to each cylinder head.
 9. Remove the fan belts.
 10. Remove the water pump pulley.
 11. Loosen the hose clamps at the rear of the water pump.
 12. Remove the water pump from the block (3 bolts).

To install:

13. Transfer the thermal sender and temperature sensor to the new water pump.
14. Transfer the thermostat cover, thermostat and rear pump cover to the new pump.
15. Install the new pump and tighten the bolts to 11–15 ft. lbs. (15–20 Nm).
16. Install the clamps, water pump pulley and fan belts.
17. Install the hoses that reach to each cylinder head.
18. Install the fan, shroud and radiator.
19. If equipped with an automatic transmission, connect the transmission cooler lines.

20. Install the intake manifold, as necessary.
21. Connect the negative battery cable.
22. Fill the radiator with coolant if necessary.
23. Start the engine and allow it to reach operating temperature.
24. Check for leaks.

Fig. 2: Exploded view of the water pump assembly on the 2.8L 6-cylinder engine



2.9L 6-Cylinder Engine

1. Disconnect the negative battery cable.
2. Drain the cooling system by opening the draincock on the right side of the cylinder block.
3. Remove the timing belt.
4. Remove the water pump retaining bolts (7) and remove the water pump.

To install:

5. Before installing the water pump, clean the mating surfaces.
6. Install the water pump, using a new gasket.
7. Tighten the mounting bolts to 15 ft. lbs. (20 Nm).
8. Install the timing belt.
9. Fill the cooling system.
10. Connect the negative battery cable.
11. Start the engine and check for leaks.

2.3L and 2.4L 5-Cylinder Engines

1. Properly relieve the fuel system pressure.
2. Disconnect the negative battery cable.
3. Raise and safely support vehicle.
4. Remove the splashguard from below the engine.
5. Drain the cooling system.
6. Remove the following:
 - Fuel line clips
 - Expansion tank
 - Front timing cover
 - Accessory belts
7. Remove the timing belt.
8. Remove the water pump retaining bolts and remove the water pump from the block.
9. Clean the cylinder block where the two mate.

To install:

NOTE: The replacement pump may look different than your original, this is normal as Volvo redesigned the pump on later models and the replacement pump is the new design.

10. Install the new water pump and gasket, and tighten the bolts to 15 ft. lbs. (20 Nm).
11. Install the timing belt.
12. Install the following:
 - The two fuel line clips
 - Front timing cover
 - Accessory belts
 - Spark plug cover
 - Vibration damper guard
 - Wheel well panel
 - Wheel
13. Connect the negative battery cable.
14. Fill the cooling system.
15. Run the engine to normal operating temperature.
16. Top off as necessary and check for leaks.

Fig. 3: The water pump is retained by eight bolts (some are hidden in photo)



Fig. 4: Unfasten the retaining bolts and carefully remove the water pump from the engine



Fig. 5: Position a new gasket on the pump before installing it

