

REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Avoiding Trouble

Many procedures in this guide require you to "label and disconnect ... " a group of lines, hoses or wires. Don't be lulled into thinking you can remember where everything goes—you won't. If you hook up vacuum or fuel lines incorrectly, the vehicle may run poorly, if at all. If you hook up electrical wiring incorrectly, you may instantly learn a very expensive lesson.

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You don't need to know the official or engineering name for each hose or line. A piece of masking tape on the hose and a piece on its fitting will allow you to assign your own label such as the letter A or a short name. As long as you remember your own code, the lines can be reconnected by matching similar letters or names. Do remember that tape will dissolve in gasoline or other fluids; if a component is to be washed or cleaned, use another method of identification. A permanent felt-tipped marker or a metal scribe can be very handy for marking metal parts. Remove any tape or paper labels after assembly.

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Avoiding the Most Common Mistakes

Pay attention to the instructions provided. There are 3 common mistakes in mechanical work:

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1. Incorrect order of assembly, disassembly or adjustment. When taking something apart or putting it together, performing steps in the wrong order usually just costs you extra time; however, it CAN break something. Read the entire procedure before beginning disassembly. Perform everything in the order in which the instructions say you should, even if you can't immediately see a reason for it. When you're taking apart something that is very intricate, you might want to draw a picture of how it looks when assembled at one point in order to make sure you get everything back in its proper position. We will supply exploded views whenever possible. When making adjustments, perform them in the proper order. One adjustment possibly will affect another.
2. Overtorquing (or undertorquing). While it is more common for overtorquing to cause damage, undertorquing may allow a fastener to vibrate loose causing serious damage. Especially when dealing with aluminum parts, pay attention to torque specifications and utilize a torque wrench in assembly. If a torque figure is not available, remember that if you are using the right tool to perform the job, you will probably not have to strain yourself to get a fastener tight enough. The pitch of most threads is so slight that the tension you put on the wrench will be multiplied many times in actual force on what you are tightening. A good example of how critical torque is can be seen in the case of spark plug installation, especially where you are putting the plug into an aluminum cylinder head. Too little torque can fail to crush the gasket, causing leakage of combustion gases and consequent overheating of the plug and engine parts. Too much torque can damage the threads or distort the plug, changing the spark gap.

There are many commercial products available for ensuring that fasteners won't come loose, even if they are not torqued just right (a very common brand is Loctite®). If you're worried about getting something together tight enough to hold, but loose enough to avoid mechanical damage during assembly, one of these products might offer substantial insurance. Before choosing a threadlocking compound, read the label on the package and make sure the product is compatible with the materials, fluids, etc. involved.

3. Crossthreading. This occurs when a part such as a bolt is screwed into a nut or casting at the wrong angle and forced. Crossthreading is more likely to occur if access is difficult. It helps to clean and lubricate fasteners, then to start threading the bolt, spark plug, etc. with your fingers. If you encounter resistance, unscrew the part and start over again at a different angle until it can be inserted and turned several times without much effort. Keep in mind that many parts, especially spark plugs, have tapered threads, so that gentle turning will automatically bring the part you're threading to the proper angle. Don't put a wrench on the part until it's been tightened a couple of turns by hand. If you suddenly encounter resistance, and the part has not seated fully, don't force it. Pull it back out to make sure it's clean and threading properly.

Be sure to take your time and be patient, and always plan ahead. Allow yourself ample time to perform repairs and maintenance. You may find maintaining your car a satisfying and enjoyable experience.

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HOW TO USE THIS GUIDE

Repair guide for 1990-98 Volvo cars is intended to help you learn more about the inner workings of your vehicle while saving you money on its upkeep and operation.

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The beginning of the guide will likely be referred to the most, since that is where you will find information for maintenance and tune-up. The other sections deal with the more complex systems of your vehicle. Operating systems from engine through brakes are covered to the extent that the average do-it-yourselfer becomes mechanically involved. This guide will not explain such things as rebuilding a differential for the simple reason that the expertise required and the investment in special tools make this task uneconomical. It will, however, give you detailed instructions to help you change your own brake pads and shoes, replace spark plugs, and perform many more jobs that can save you money, give you personal satisfaction and help you avoid expensive problems.

A secondary purpose of this guide is a reference for owners who want to understand their vehicle and/or their mechanics better. In this case, no tools at all are required.

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Maintenance or Repair-

It's necessary to mention the difference between maintenance and repair. Maintenance includes routine inspections, adjustments, and replacement of parts which show signs of normal wear. Maintenance compensates for wear or deterioration. Repair implies that something has broken or is not working. A need for repair is often caused by lack of maintenance. Example: draining and refilling the automatic transmission fluid is maintenance recommended by the manufacturer at specific mileage intervals. Failure to do this can shorten the life of the transmission/transaxle, requiring very expensive repairs. While no maintenance program can prevent items from breaking or wearing out, a general rule can be stated: MAINTENANCE IS CHEAPER THAN REPAIR.

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Two basic mechanic's rules should be mentioned here. First, whenever the left side of the vehicle or engine is referred to, it is meant to specify the driver's side. Conversely, the right side of the vehicle means the passenger's side. Second, screws and bolts are removed by turning counterclockwise, and tightened by turning clockwise unless specifically noted.

Safety is always the most important rule. Constantly be aware of the dangers involved in working on an automobile and take the proper precautions. See the information in this section regarding SERVICING YOUR VEHICLE SAFELY and the SAFETY NOTICE on the acknowledgment page.

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Where to Begin

Before removing any bolts, read through the entire procedure. This will give you the overall view of what tools and supplies will be required. There is nothing more frustrating than having to walk to the bus stop on Monday morning because you were short one bolt on Sunday afternoon. So read ahead and plan ahead. Each operation should be approached logically and all procedures thoroughly understood before attempting any work.

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All sections contain adjustments, maintenance, removal and installation procedures, and in some cases, repair or overhaul procedures. When repair is not considered practical, we tell you how to remove the part and then how to install the new or rebuilt replacement. In this way, you at least save labor costs. "Backyard" repair of some components is just not practical.

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Adjustments

Ignition system functions are controlled by the ECM, so no adjustment is necessary. To check or adjust the ignition timing, refer to [General Information & Maintenance](#) of this repair guide.

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Camshaft Position Sensor

The Camshaft position sensor is covered in [Driveability & Emissions Controls](#), under Electronic Engine Controls.

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Crankshaft Position Sensor

The Crankshaft position sensor is covered in [Driveability & Emissions Controls](#), under Electronic Engine Controls.

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Diagnosis and Testing

SERVICE PRECAUTIONS

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- The ignition system operates with a very high output and there are hazardous voltages in the low and high voltage circuits.
- Always turn the ignition *OFF*, before separating connectors.
- Never disconnect the battery while the engine is running.
- Always disconnect the battery when quick charging the battery.
- Never use a boost charger or voltage higher than 16 volts to start the engine.
- Always remove the control unit if the vehicle is to be stove or if welding is to be carried out. The control unit must not be exposed to temperatures above 176°F (80°C).
- Do not replace a control unit without first correcting the original fault, or the same fault may damage the new control unit.
- Do not be hasty in condemning the ECM. This system uses voltages and resistances that are very small. Examine the sensors, wiring and connectors carefully. The sensors operate in more harsh conditions than the ECM which is generally in a more protected location.
- Check all ground connections before condemning the ECM.
- Use care when working around vehicles equipped with Supplementary Restraint System (SRS), often known as "air bags." Vehicles equipped with SRS are generally recognized by the letters *SRS* molded into the steering wheel cover. Follow all precautions to avoid personal injury.

Before performing any component testing, check for and, if necessary, repair the following:

- Damaged, corroded, contaminated, carbon tracked or worn distributor cap and rotor
- Damaged, fouled, improperly seated or gapped spark plug(s)
- Damaged or improperly engaged electrical connections, spark plug wires, etc.
- Discharged battery
- Blown fuses

SECONDARY SPARK TEST

The best way to perform this procedure is to use a spark tester (available at most automotive parts stores). Two types of spark testers are commonly available. The Neon Bulb type is connected to the spark plug wire and flashes with each ignition pulse. The Air Gap type must be adjusted to the individual spark plug gap specified for the engine. This type of tester allows the user to not only detect the presence of spark, but also the intensity (orange/yellow is weak, blue is strong).

1. Disconnect a spark plug wire at the spark plug end.
2. Connect the plug wire to the spark tester and ground the tester to an appropriate location on the engine.
3. Crank the engine and check for spark at the tester.
4. If spark exists at the tester, the ignition system is functioning properly.
5. If spark does not exist at the spark plug wire, remove the distributor cap and ensure that the rotor is turning when the engine is cranked.
6. If the rotor is turning, perform the spark test again using the ignition coil wire.
7. If spark does not exist at the ignition coil wire, test the ignition coil, and other distributor related components or wiring. Repair or replace components as necessary.

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Distributor

On these Motronic systems, the distributor is essentially a rotor bolted onto the end of the intake camshaft. There is no distributor housing to remove. Once the distributor cap is removed, the rotor can be removed from the camshaft. See [General Information & Maintenance](#) for Distributor Cap and Rotor removal and installation.

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General Information

See Figure 1

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The Motronic 4.3 and 4.4 system on 850/C70/S70/V70 models is a total control system. Both engine and ignition controls are incorporated into one system with one control module. The control module receives the inputs from various sensors and controls all the outputs together.

The inputs that directly affect ignition include the RPM sensor (crankshaft position sensor), Camshaft Position (CMP) sensor, knock sensors, Engine Coolant Temperature (ECT) sensor, Mass Air Flow (MAF) sensor, acceleration sensor, Throttle Position (TP) sensor and, on vehicles equipped with an automatic transaxle, a Transmission Control Module (TCM). The RPM and CMP sensors determine engine speed and directly affect ignition timing control. The TP and MAF sensors, as well as the TCM, determine engine load. The knock sensor determines if the ignition timing is correct by detecting engine knocks or pre-ignition, and the acceleration sensor determines if the vehicle is being driven on a bumpy or uneven surface, possibly causing faulty knock sensor readings.

The system has a fail safe or limp home mode where it defaults to a predetermined timing and voltage level if an input device fails. The Malfunction Indicator Lamp (MIL) will illuminate and the vehicle may exhibit more driveability problems; it should be diagnosed as soon as possible.

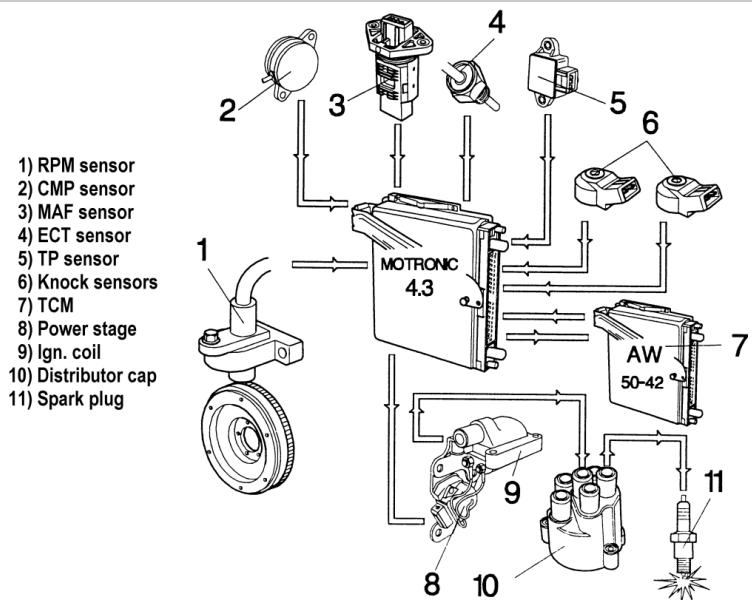


Fig. Fig. 1: Motronic 4.3 distributor ignition system

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Ignition Coil

TESTING

Primary Winding Test

See Figures 1, 2 and 3

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1. Disconnect the negative battery cable.
2. Remove the air cleaner assembly.
3. Remove the coil primary leads.
4. Connect an ohmmeter between the primary windings connectors on the outside of the coil.
5. Resistance should be 0.5-1.5 ohms.



Fig. Fig. 1: Remove the coil primary leads

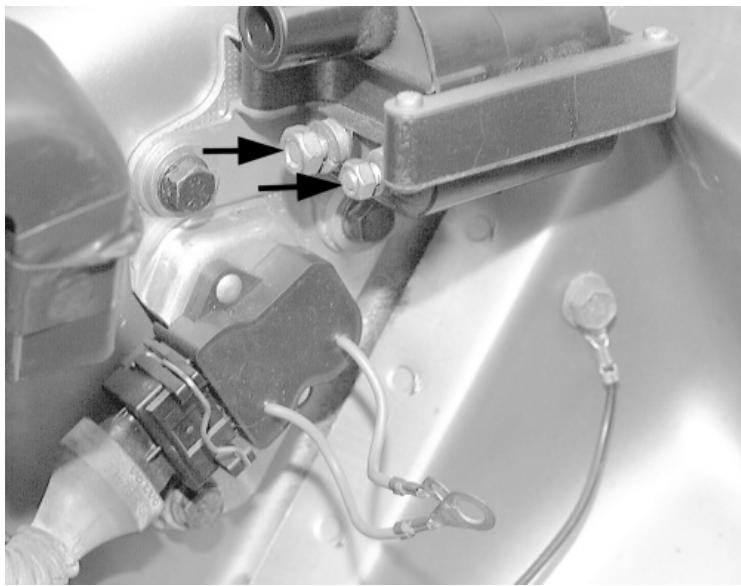


Fig. Fig. 2: Attach the ohmmeter probes to the studs after removing the primary leads

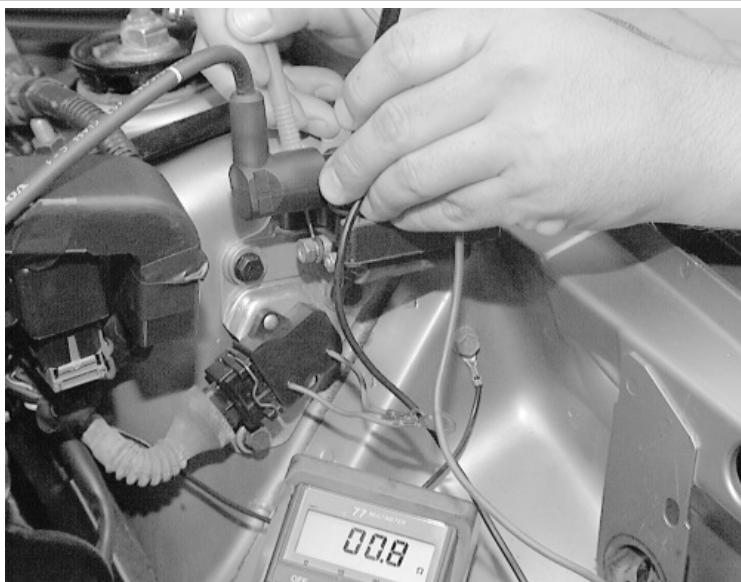


Fig. Fig. 3: Testing the primary windings of the ignition coil

Secondary Winding Test

See Figure 4

1. Disconnect the negative battery cable.
2. Remove the air cleaner assembly.
3. Remove the coil wire from the coil.
4. Connect an ohmmeter between one of the primary winding connectors on the outside of the coil and the coil wire tower on the coil.
5. Resistance should be 8-9 kilohms.

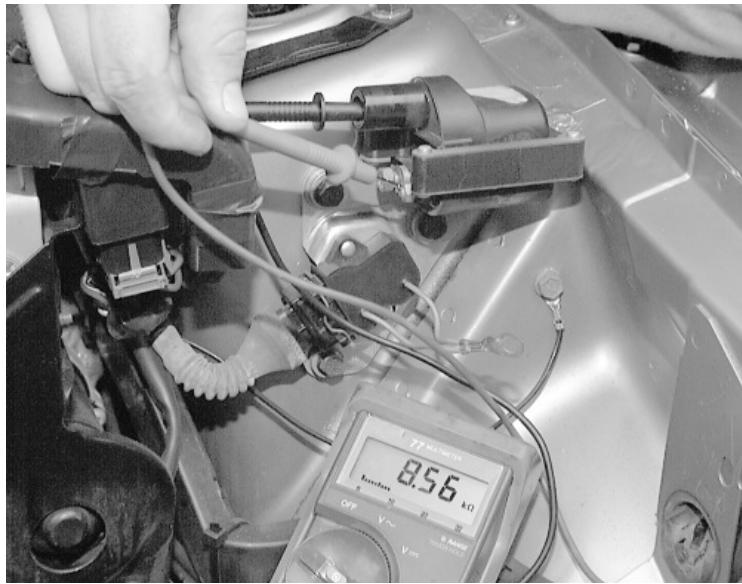


Fig. Fig. 4: Testing the secondary windings of the ignition coil

REMOVAL & INSTALLATION

See Figures 5, 6, 7 and 8

The ignition coil and power stage are an assembly.

1. Disconnect the negative battery cable.
2. Remove the air cleaner assembly.
3. Carefully remove the coil wire from the coil tower.
4. Remove the mounting bolt(s) from the retaining bracket and remove the ignition coil and power stage.
5. Unplug the power stage connector.

To install:

6. Install the coil and power stage and tighten the retaining bolts.
7. Plug the power stage connector in.
8. Install the coil wire on the coil tower.
9. Install the air cleaner assembly.
10. Connect the negative battery cable.

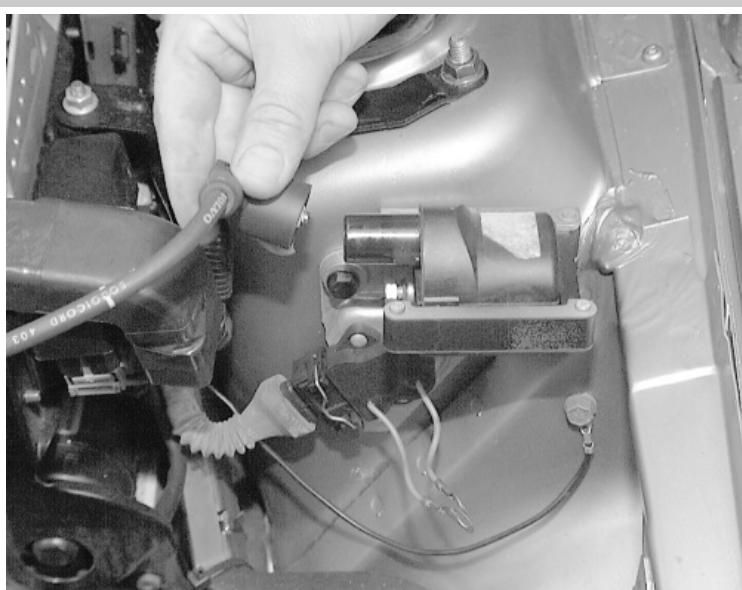


Fig. Fig. 5: Remove the coil wire from the coil

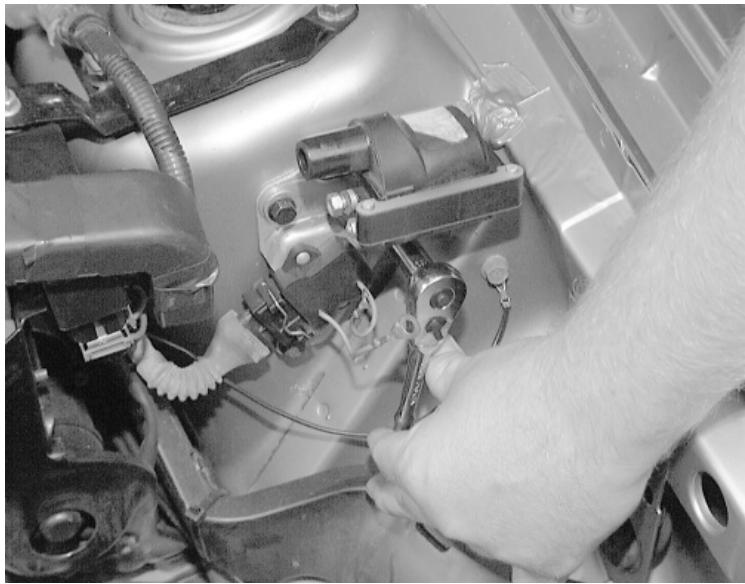


Fig. Fig. 6: Unfasten the mounting bolts ...

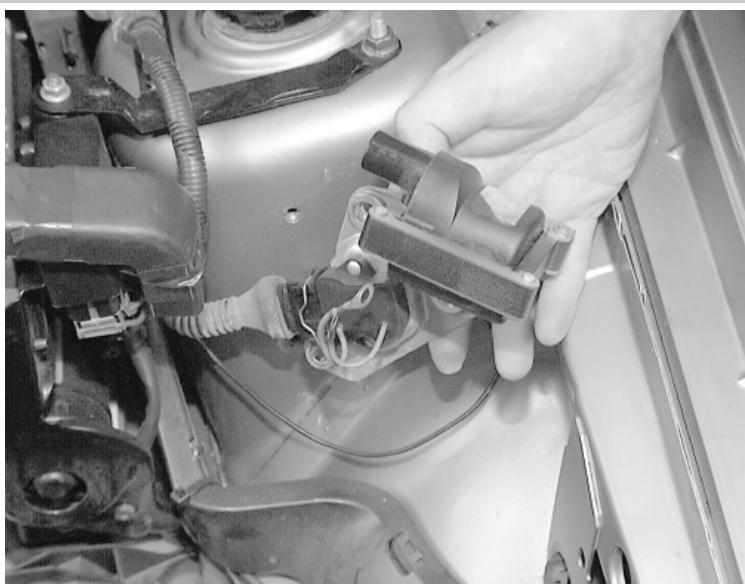


Fig. Fig. 7: ... then remove the assembly from the strut tower



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Power Stage (Ignition Module)

REMOVAL & INSTALLATION

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The ignition coil and power stage are an assembly. Refer to the Ignition Coil removal and installation procedure in this section.

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Balance Shafts

REMOVAL & INSTALLATION

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B234 Engine

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.

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.

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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Camshaft, Bearings and Lifters

REMOVAL & INSTALLATION

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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/Shft removal/installation for their removal.

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.

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.

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

See Figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11

- 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.

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.

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. Fig. 1: Remove the camshaft pulley cover



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

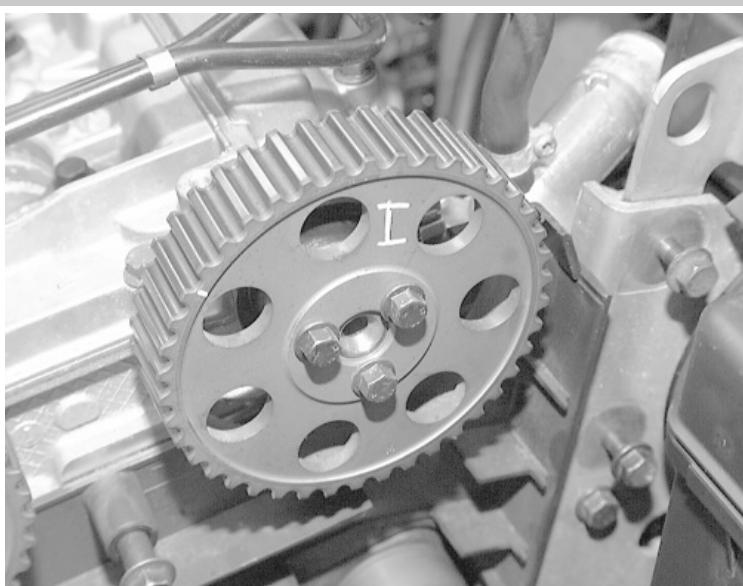


Fig. Fig. 3: ... and the intake camshaft pulley

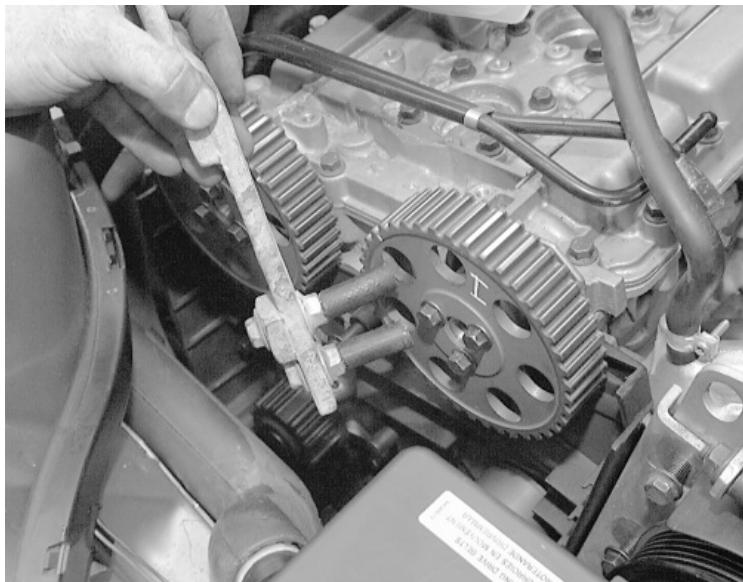


Fig. Fig. 4: Install the pulley holding tool ...

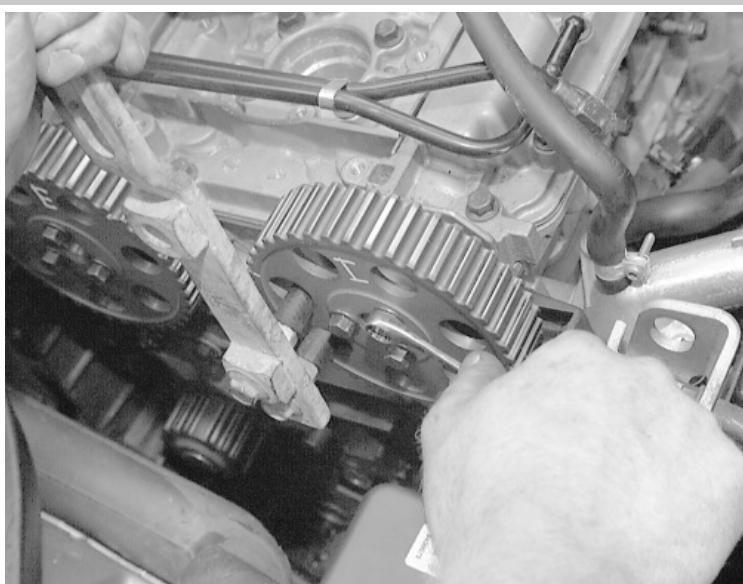


Fig. Fig. 5: ... and remove the pulley retaining bolts

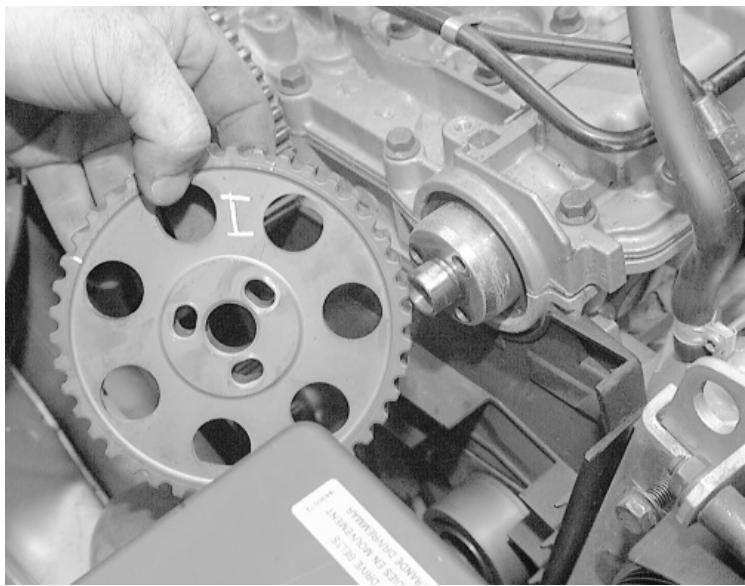


Fig. Fig. 6: Remove the pulley from the camshaft

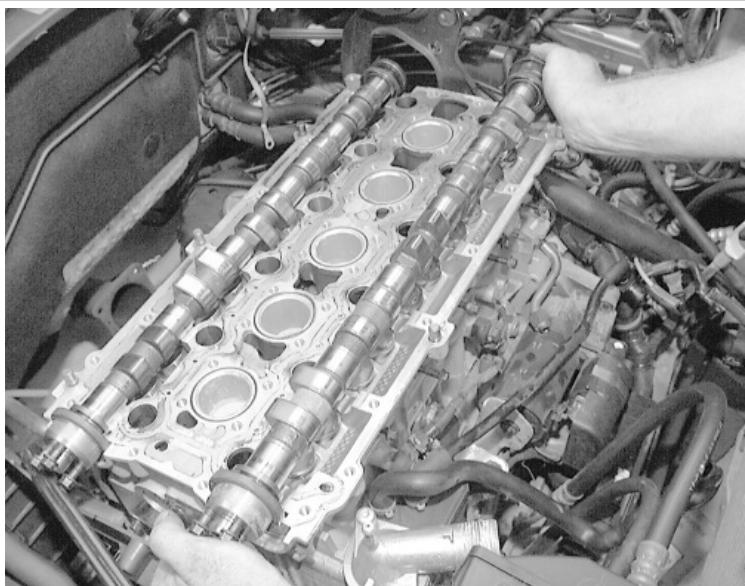


Fig. Fig. 7: Carefully lift the intake camshaft from the cylinder head

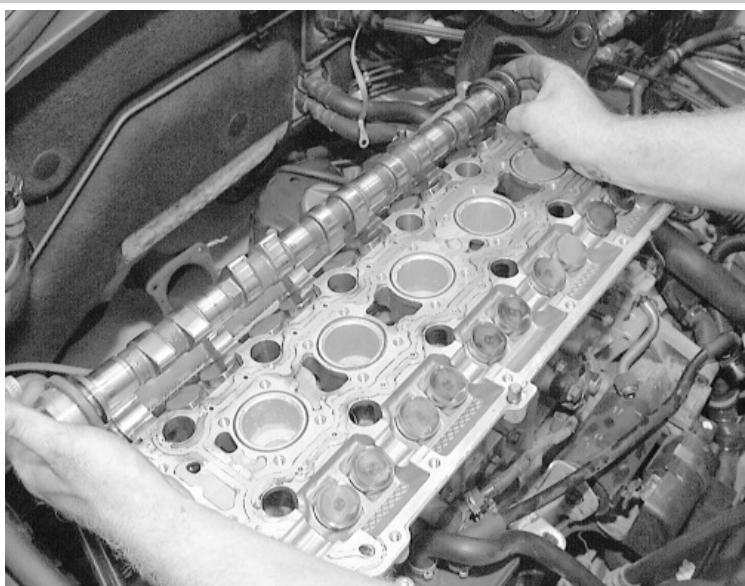


Fig. Fig. 8: Remove the exhaust camshaft

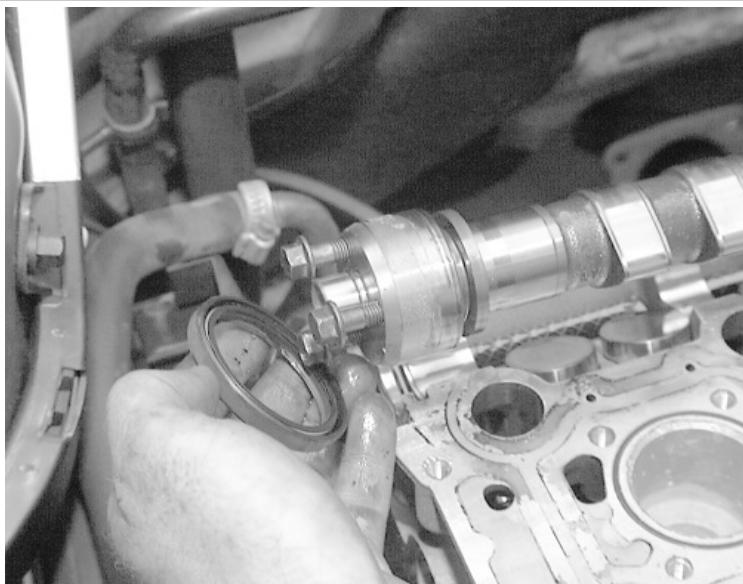


Fig. Fig. 9: Remove the camshaft seals



Fig. Fig. 10: Inspect the camshaft lobes for wear

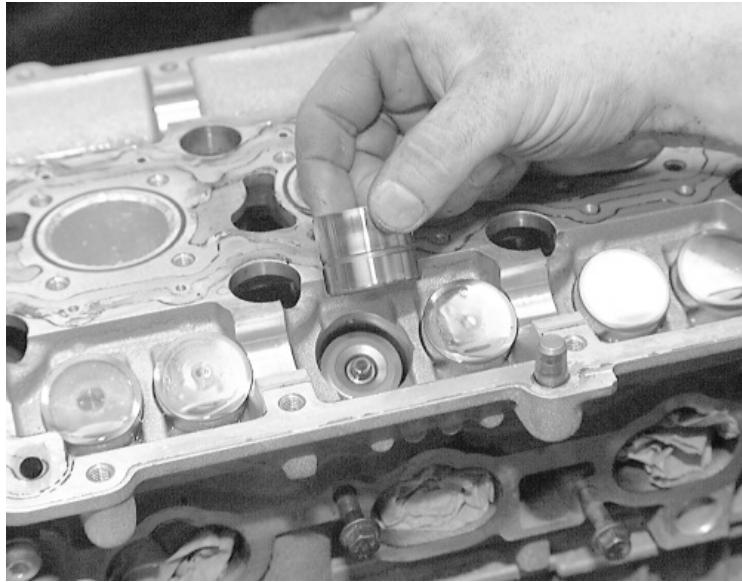


Fig. Fig. 11: Remove the camshaft followers, noting their position

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Crankshaft Damper

REMOVAL & INSTALLATION

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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.

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

See Figures 1, 2, 3, 4 and 5

- 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.

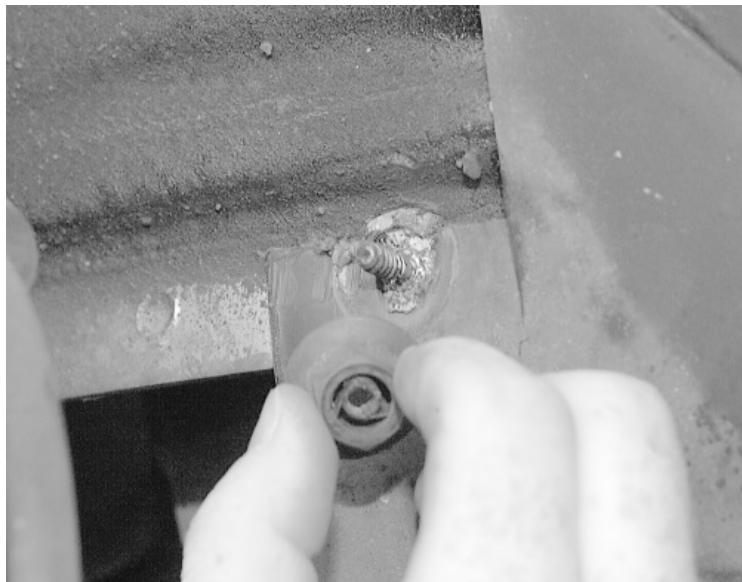


Fig. Fig. 1: Remove the nut in the upper left corner of the fenderwell trim ...



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



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

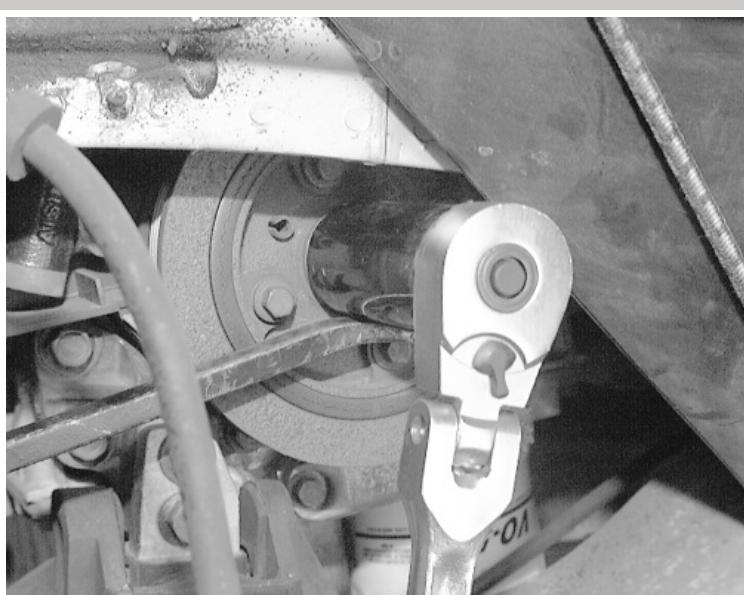


Fig. Fig. 4: Keep the damper from turning while you remove the center nut

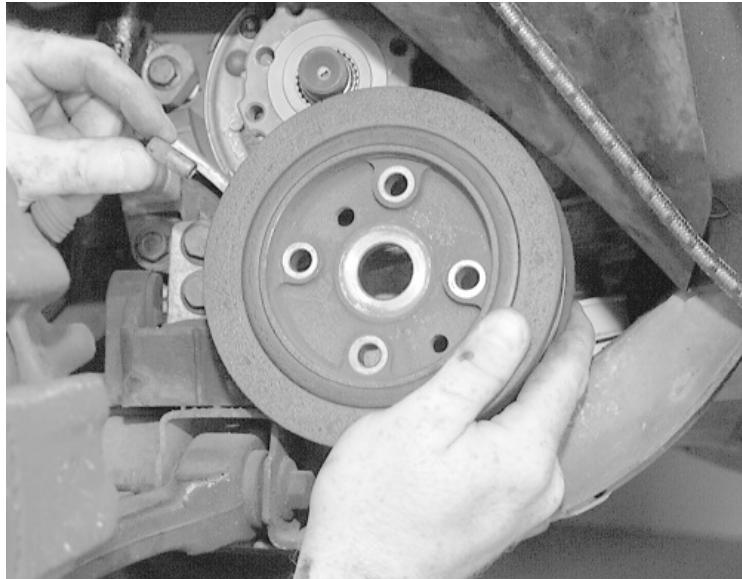


Fig. Fig. 5: Remove the damper from the crankshaft

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Cylinder Head

REMOVAL & INSTALLATION

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2.3L 4-Cylinder Engine

See Figures 1 and 2

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.

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.

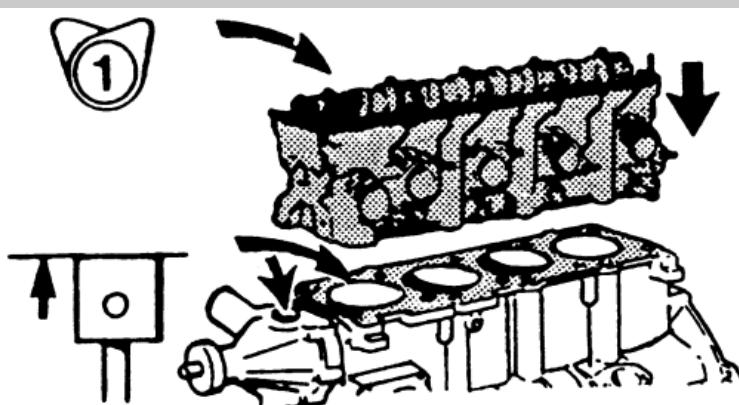


Fig. Fig. 1: Positioning the cylinder head and gasket on the engine block. Check that the water pump O-ring sits correctly in the groove

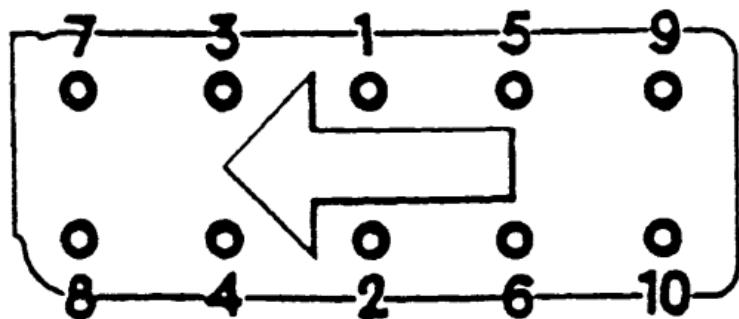


Fig. Fig. 2: Cylinder head bolt torque sequence for the 2.3L 4-cylinder engines

2.8L 6-Cylinder Engine

See Figures 3, 4 and 5

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.

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.

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.

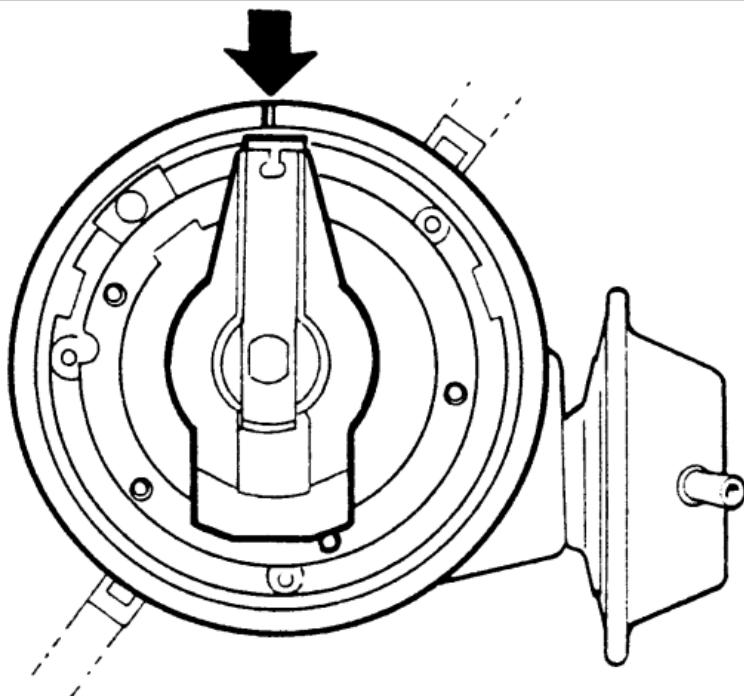


Fig. Fig. 3: The engine is at TDC of the No. 1 cylinder when the notch on the distributor aligns with the rotor

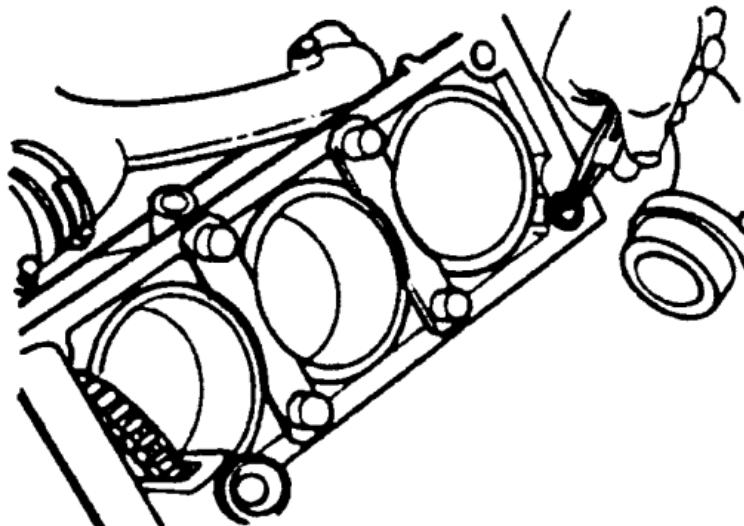


Fig. Fig. 4: The cylinder liners must be installed before the cylinder head

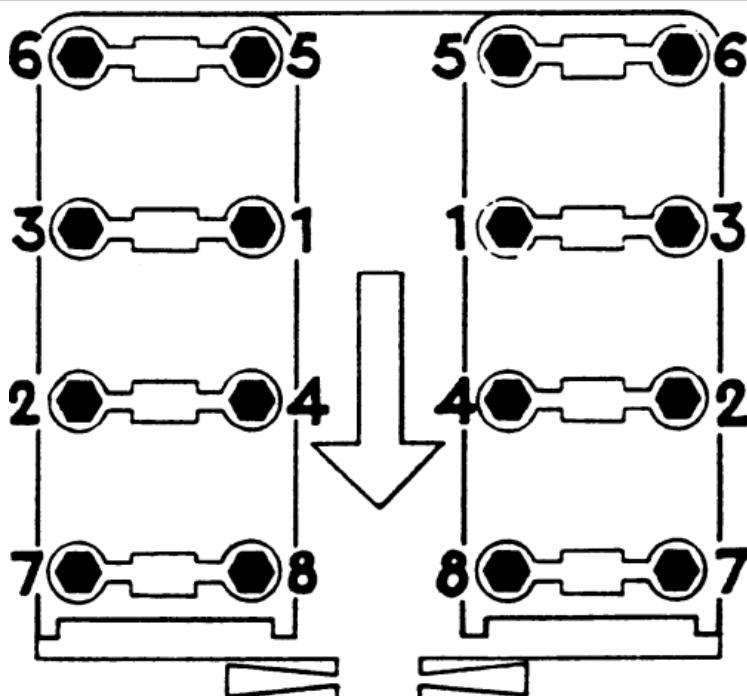


Fig. Fig. 5: 2.8L 6-cylinder engine cylinder head bolt tightening sequence

2.9L 6-Cylinder Engine

See Figure 6

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.

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.

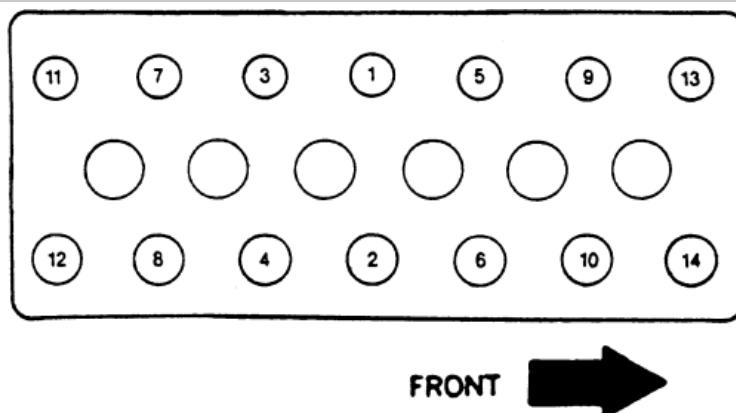


Fig. Fig. 6: 2.9L 6-cylinder engine cylinder head bolt tightening sequence

2.3L and 2.4L 5-Cylinder Engines

See Figures 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19

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.

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.

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.

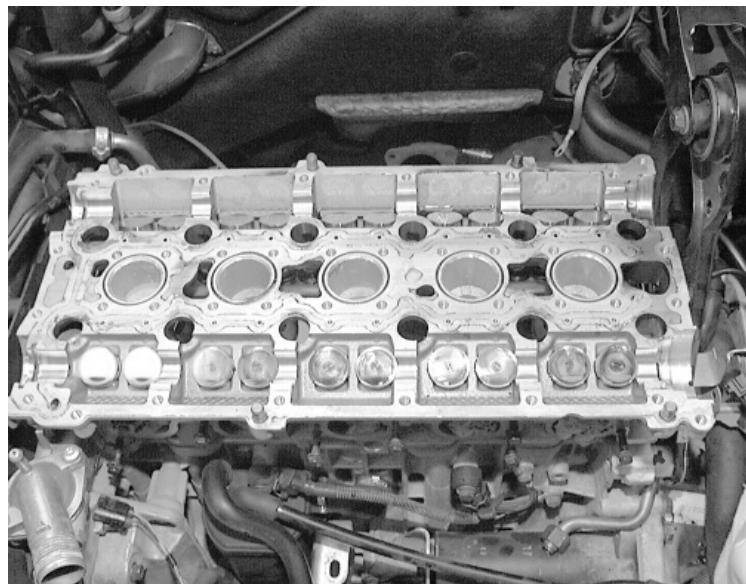


Fig. Fig. 7: Remove camshafts to access the cylinder head bolts

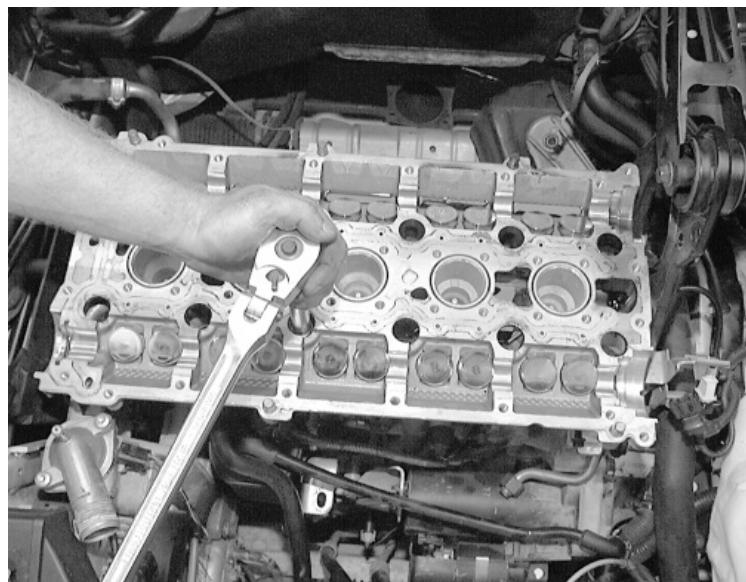


Fig. Fig. 8: Loosen the cylinder head bolts starting from the inside and working outward

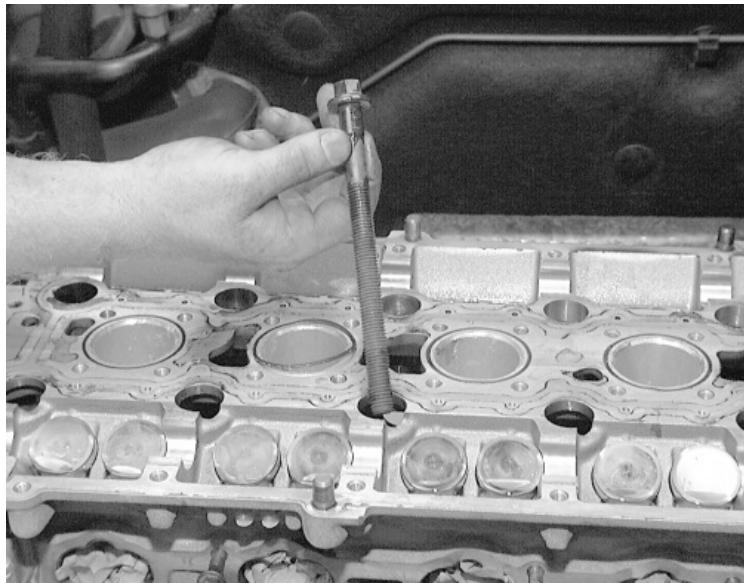


Fig. Fig. 9: Remove the bolts from the cylinder head; if necessary, use a magnet to extract them

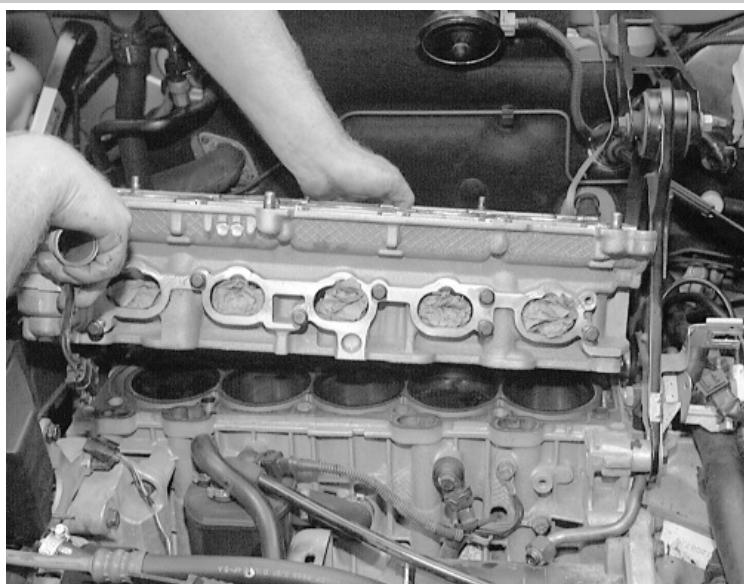


Fig. Fig. 10: Carefully lift the cylinder head off of the engine block

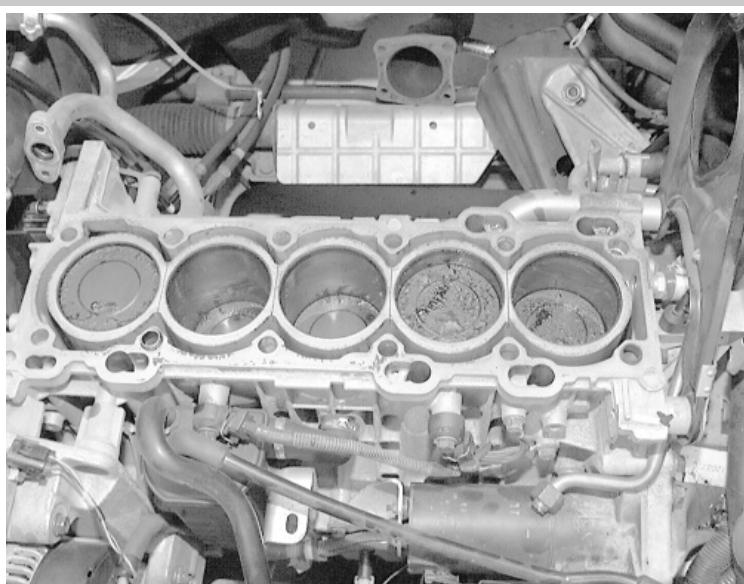


Fig. Fig. 11: After the head is removed, inspect the block for damage, cracks, and obvious wear

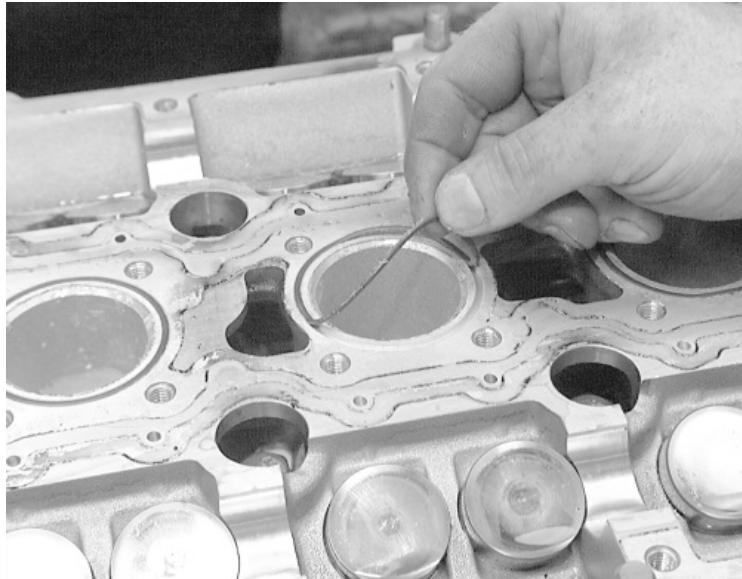


Fig. Fig. 12: Remove and replace the O-rings around the spark plug holes

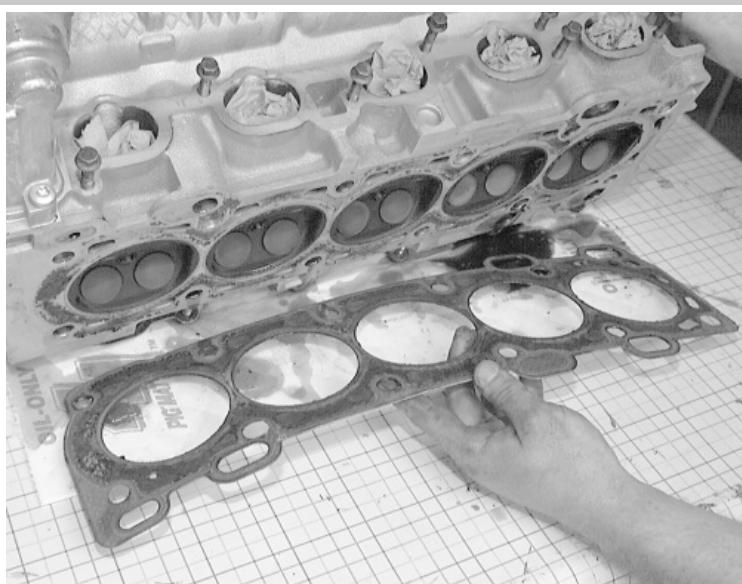


Fig. Fig. 13: Remove the head gasket ...

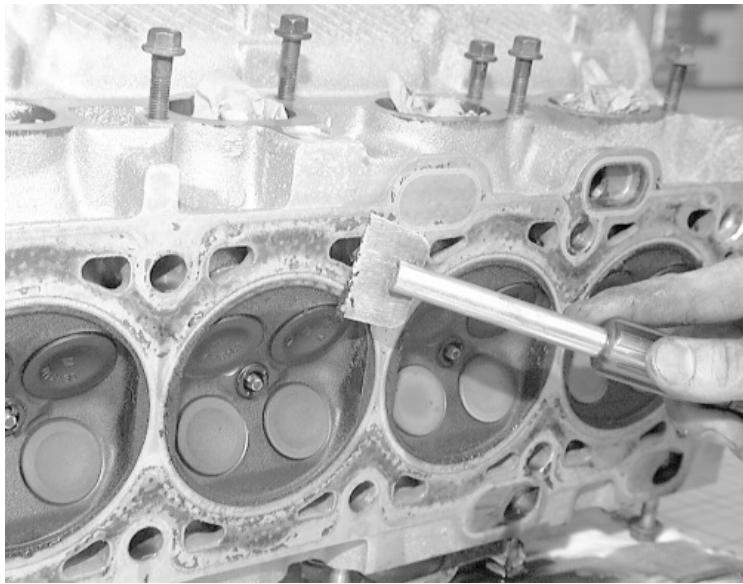


Fig. Fig. 14: ... and thoroughly clean the cylinder head

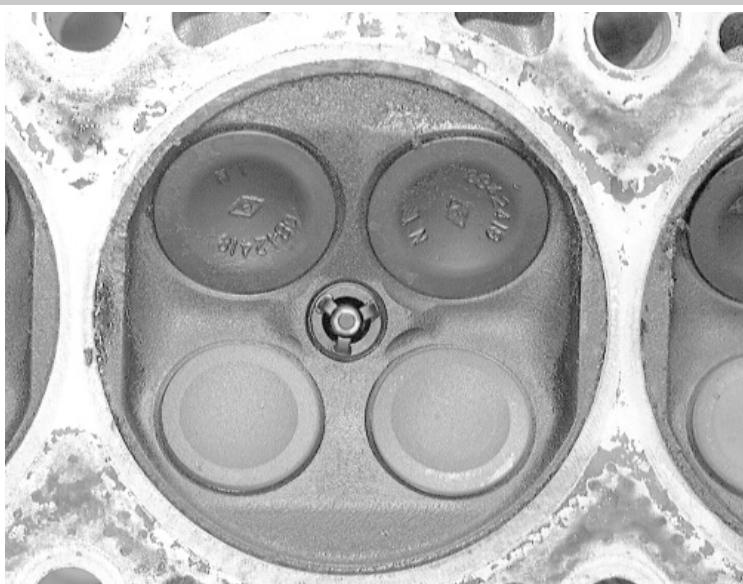


Fig. Fig. 15: View of the combustion chamber, including the intake (larger) valves, exhaust (smaller) valves, and spark plug electrodes

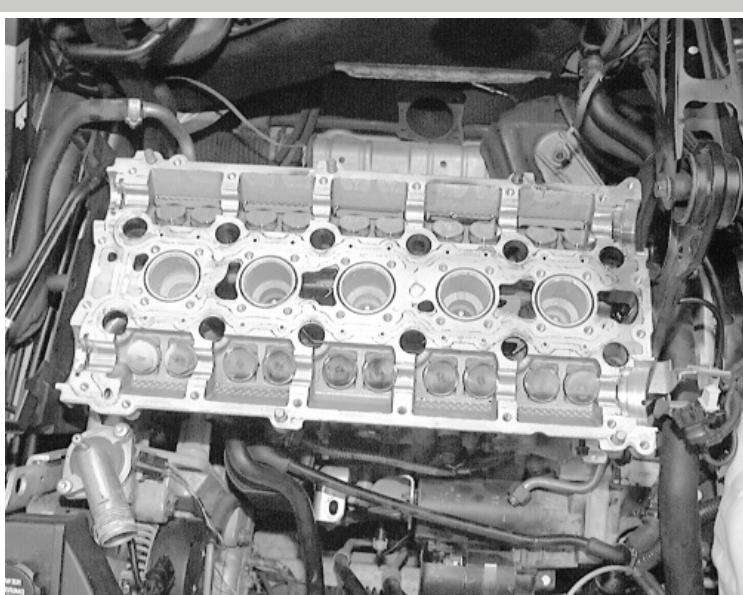


Fig. Fig. 16: Carefully place the cylinder head onto the engine block

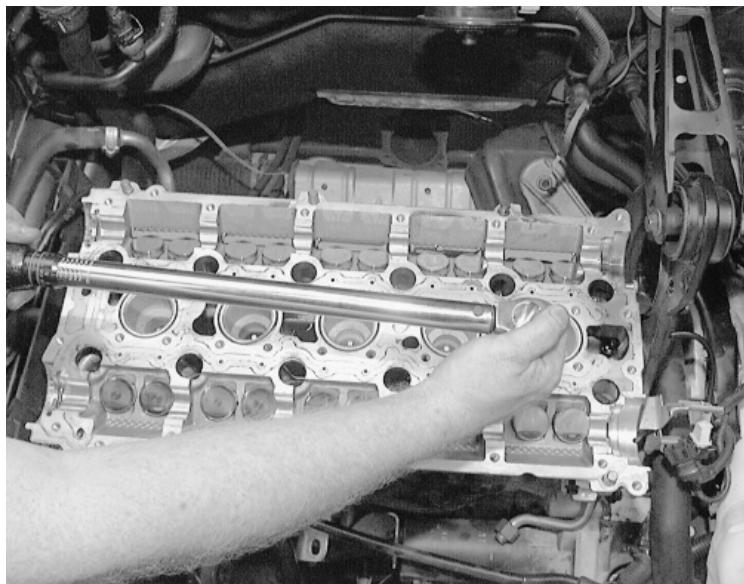


Fig. Fig. 17: Tighten the cylinder head bolts in proper sequence to specification using a torque wrench

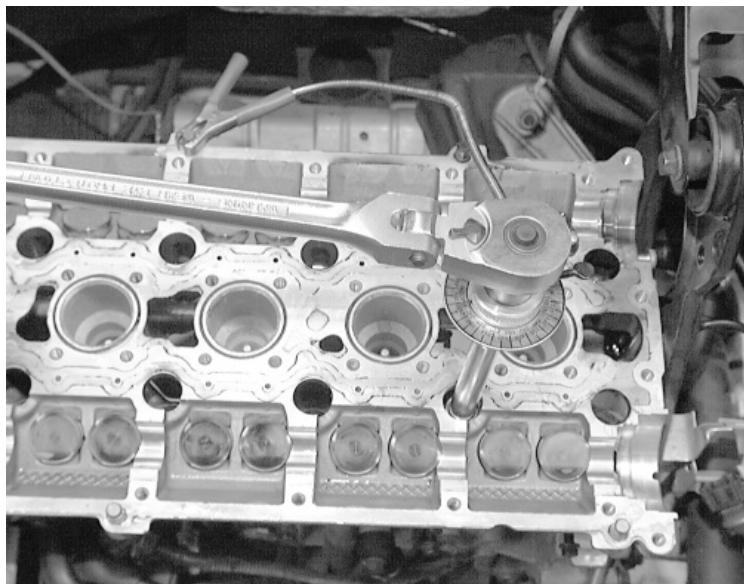


Fig. Fig. 18: A torque angle gauge can be helpful when angle-tightening the head bolts

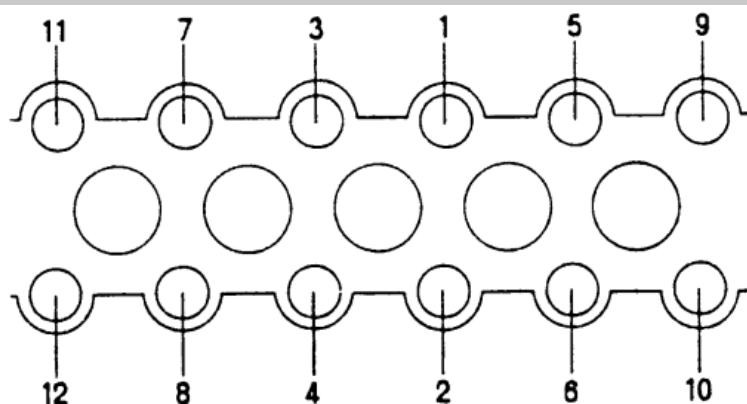


Fig. Fig. 19: 2.3L and 2.4L 5-cylinder engine head bolt tightening sequence



Engine

REMOVAL & INSTALLATION

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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 guide.

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 guide.

Although Volvo recommends removing the engine and transmission as an assembly, transmissions 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.

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.

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.

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

See Figure 1

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.

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.

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.

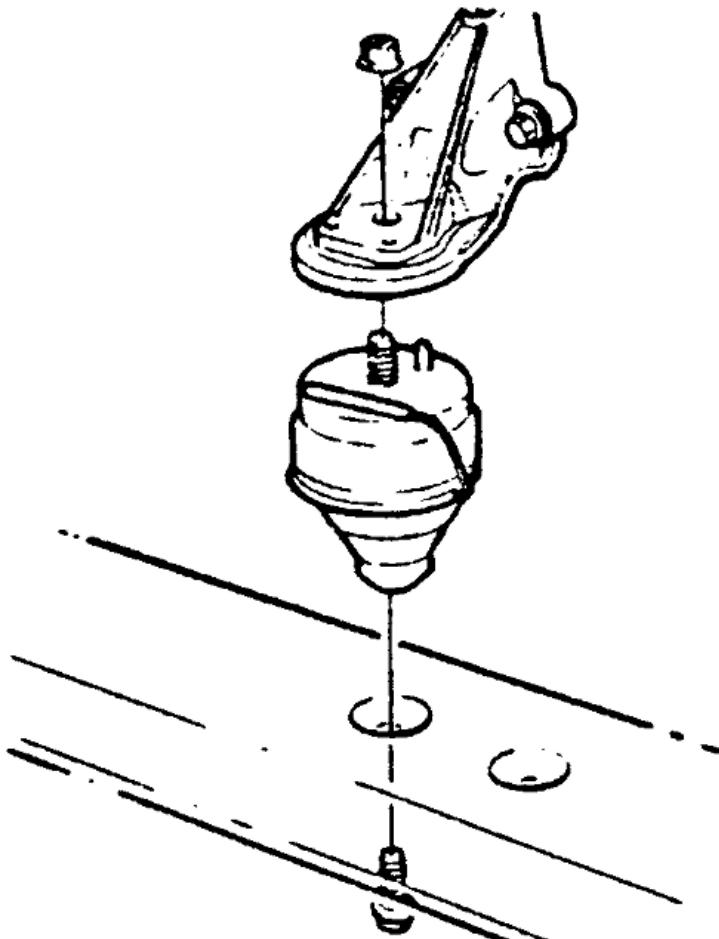


Fig. Fig. 1: Typical engine mount on the 2.3L and 2.4L 5-cylinder engine

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Engine Fan

REMOVAL & INSTALLATION

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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

See Figures 1, 2, 3, 4, 5, 6 and 7

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. Fig. 1: Remove the retaining bolts on the drivers side ...

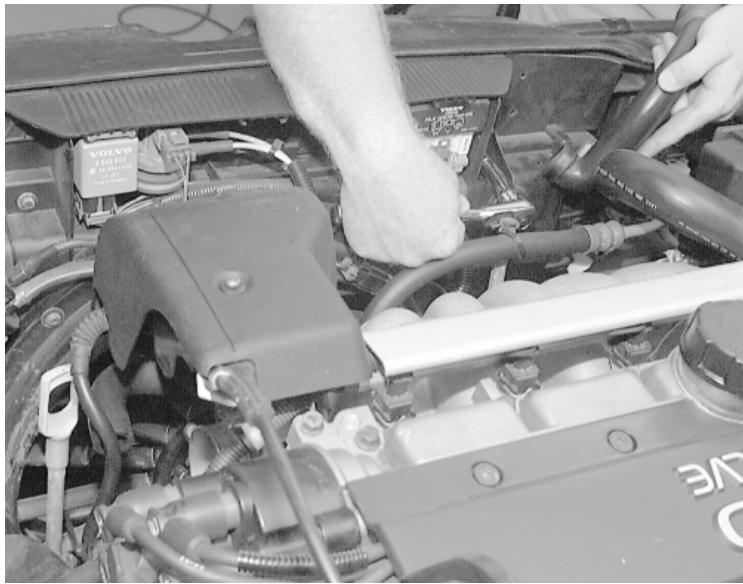


Fig. Fig. 2: ... and passenger side of the radiator



Fig. Fig. 3: Slide the relay holder toward the engine

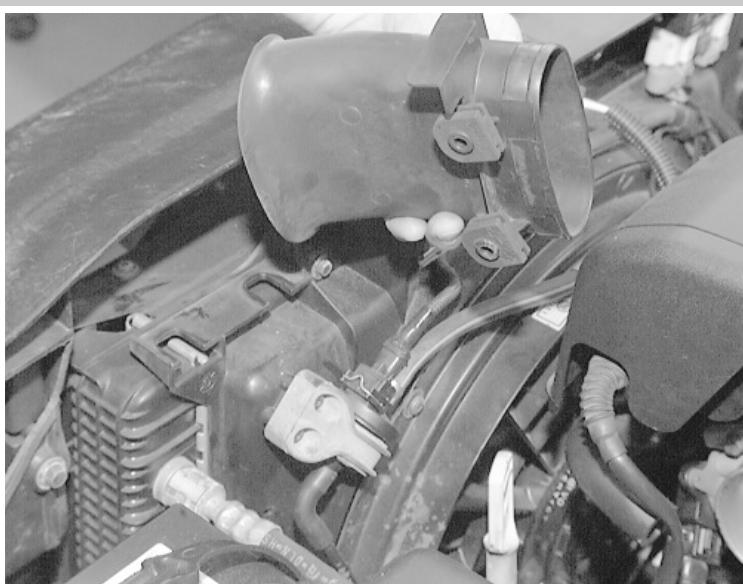


Fig. Fig. 4: Remove the air hoses from the control module box and the air cleaner

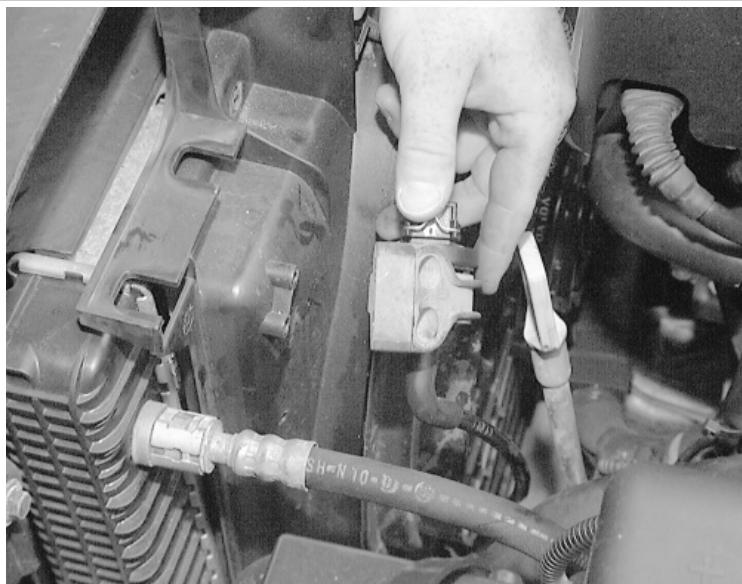


Fig. Fig. 5: Remove the connectors from the fan assembly

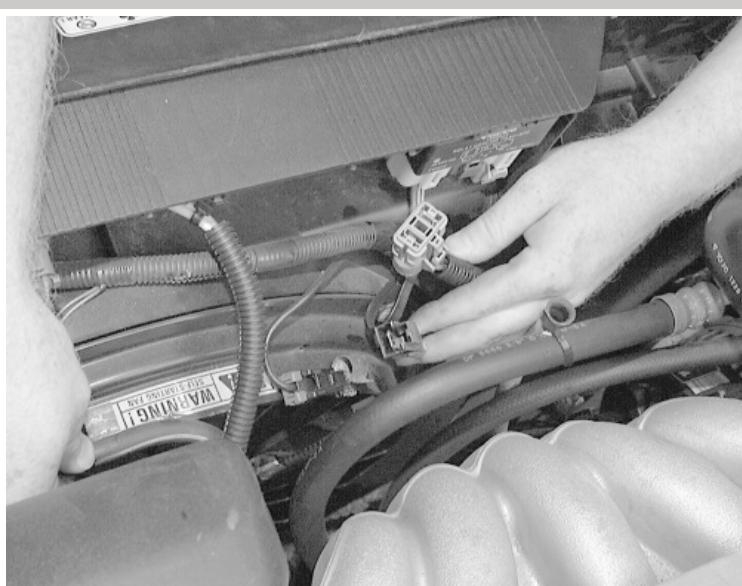


Fig. Fig. 6: After the retaining bolts are removed, carefully maneuver the fan up ...

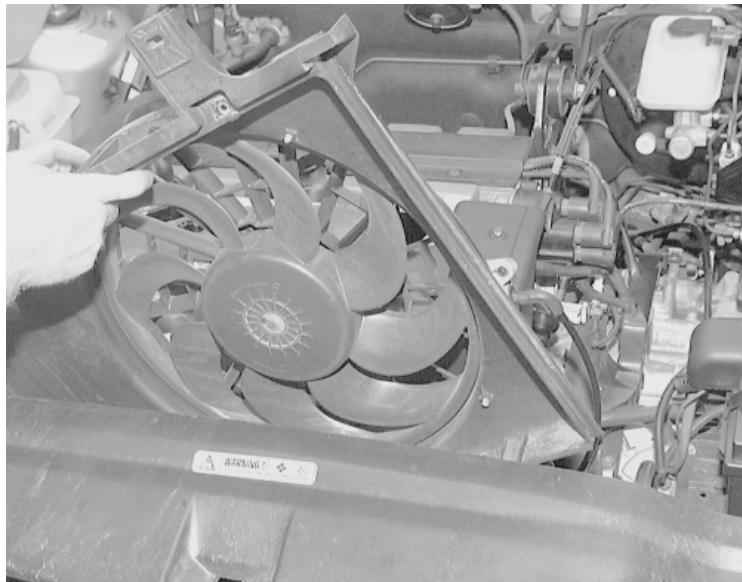


Fig. Fig. 7: ... and out of the engine compartment

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Exhaust Manifold

REMOVAL & INSTALLATION

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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

See Figure 1

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.

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).

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.

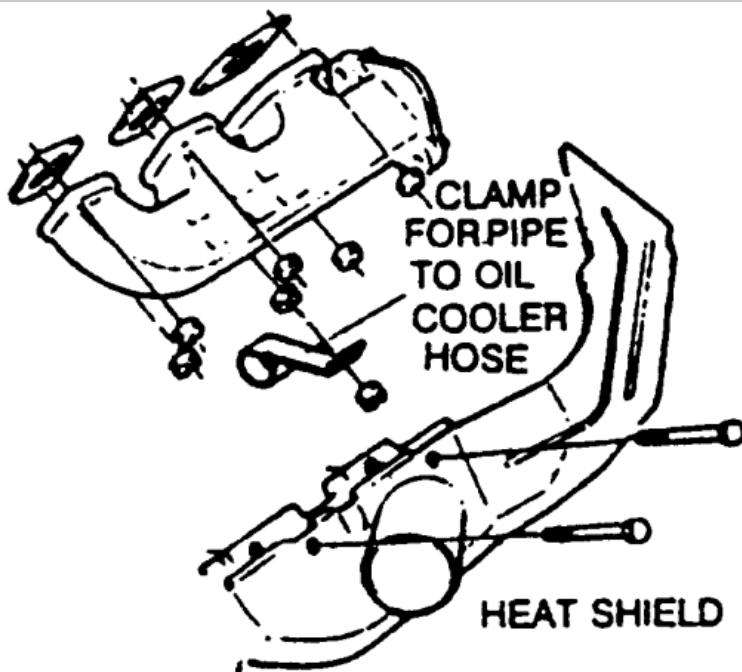


Fig. Fig. 1: Exploded view of the exhaust manifold assembly-2.8L 6-cylinder engine

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).

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

See Figures 2, 3, 4, 5, 6, 7, 8, 9 and 10

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.

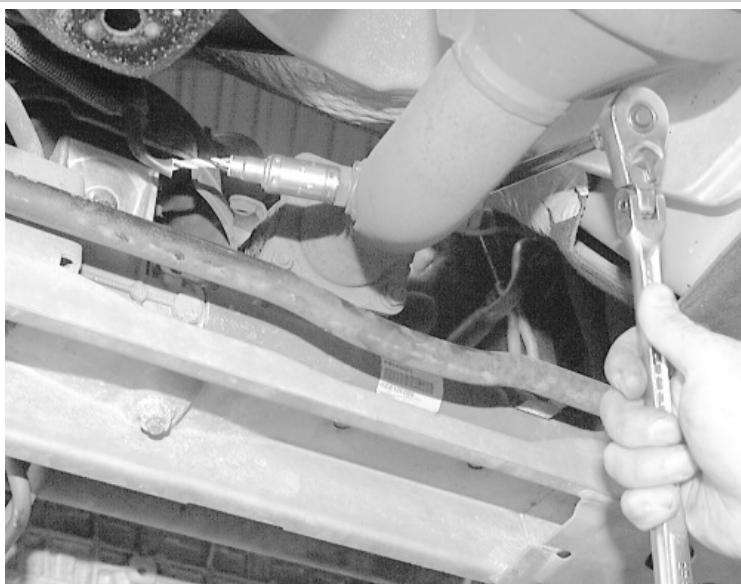


Fig. Fig. 2: Remove the exhaust pipe-to-manifold flange retaining hardware ...

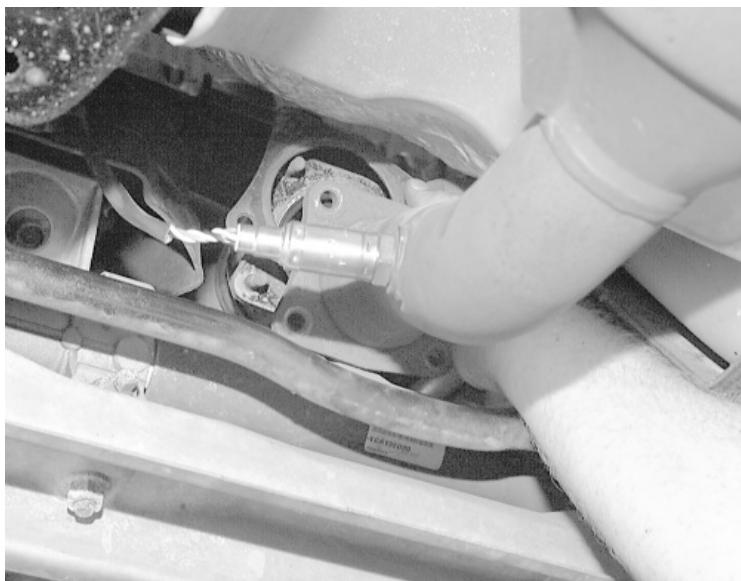


Fig. Fig. 3: ... and disconnect the flange



Fig. Fig. 4: Remove the manifold heat shield

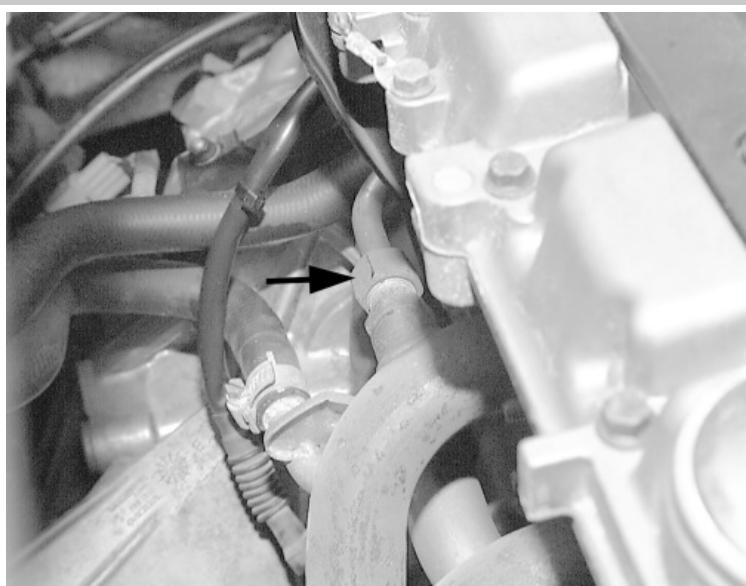


Fig. Fig. 5: The EGR tube is connected on the drivers side of the manifold



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



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

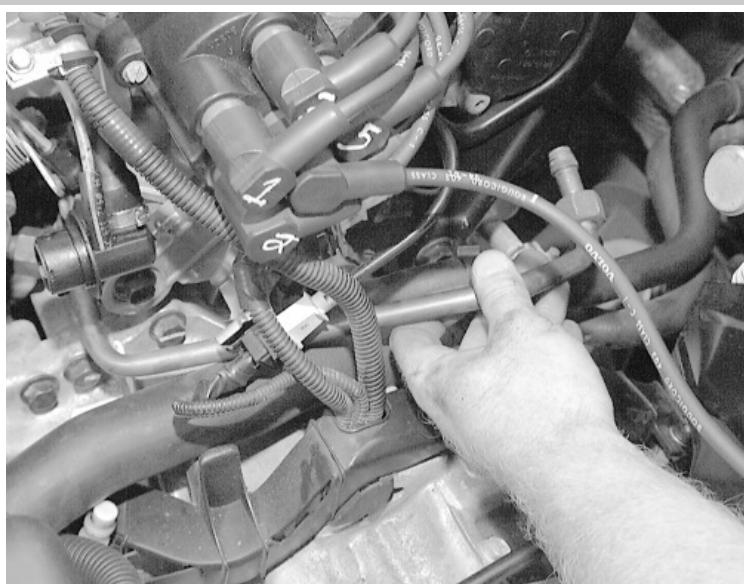


Fig. Fig. 8: Unfasten the fitting on the EGR valve and remove the tube from the vehicle



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

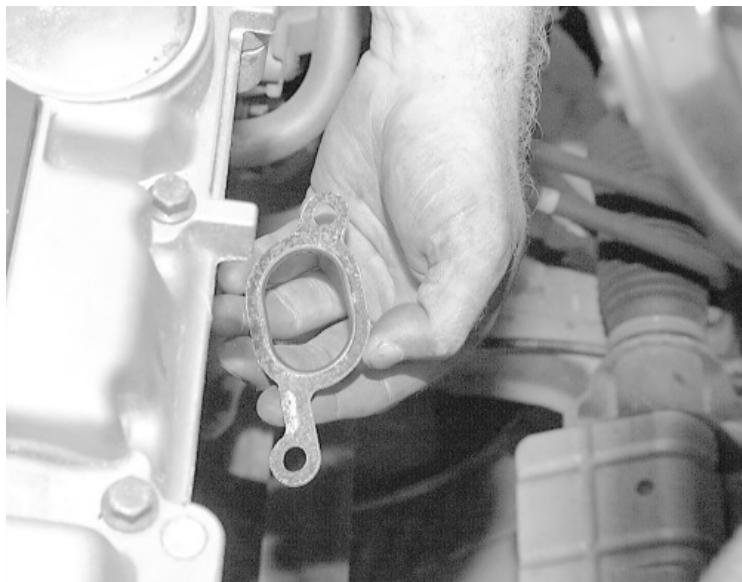


Fig. Fig. 10: The exhaust manifold uses individual gaskets around each port in the head; replace them before manifold installation

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Flywheel/Flexplate

REMOVAL & INSTALLATION

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See Figures 1 and 2

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 [Drive Train](#).
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 [Drive Train](#).
14. Lower the vehicle.
15. Connect the negative battery cable.

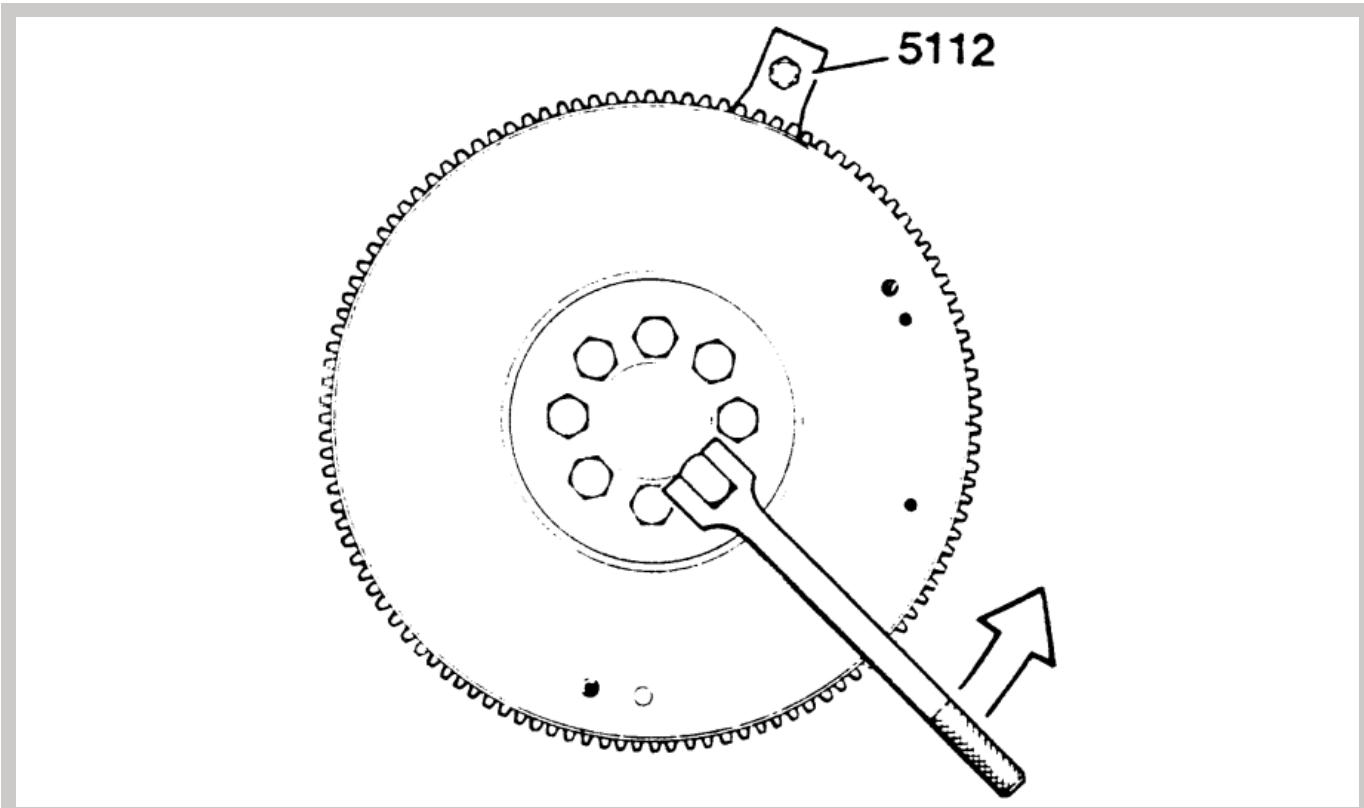


Fig. Fig. 1: The flywheel must be immobilized so that the retaining bolts can be removed; tool 5112 is being used here to hold the flywheel

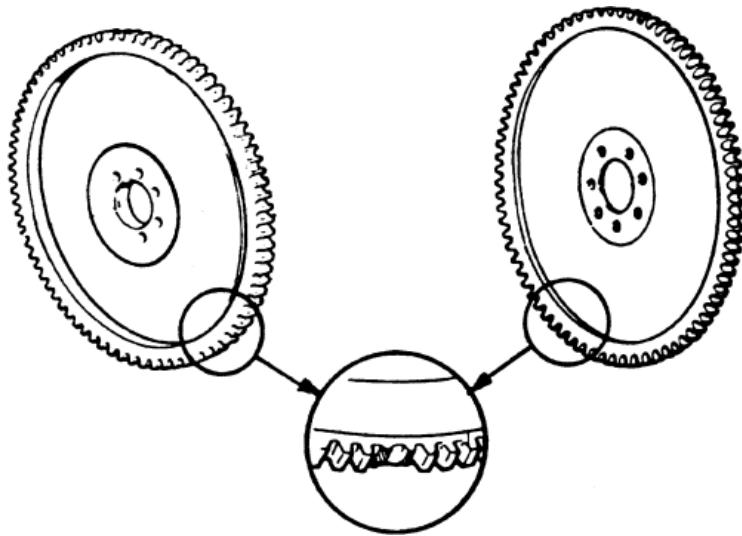


Fig. Fig. 2: Check the ring gears teeth for damage; if damage is noted, replace the ring gear

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Front Crankshaft Seal

REMOVAL & INSTALLATION

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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.

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.

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.

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REMOVAL & INSTALLATION

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

See Figure 1

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.

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.

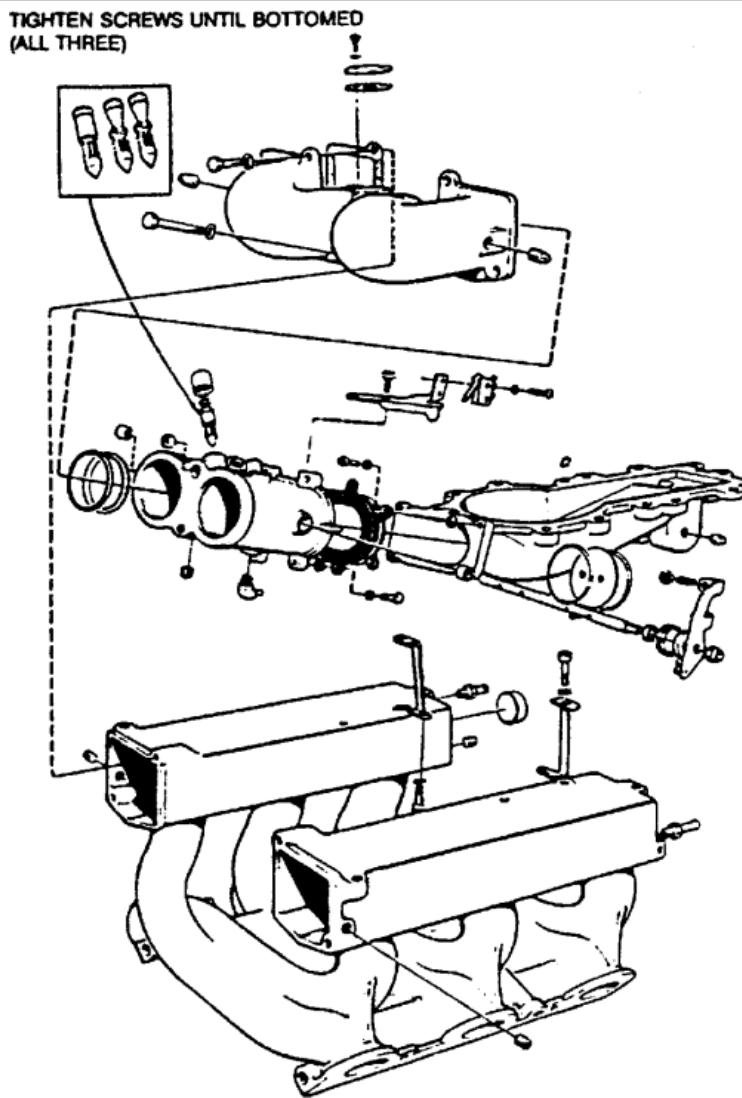


Fig. Fig. 1: Intake manifold assembly-2.8L 6-cylinder

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

See Figures 2, 3, 4, 5, 6 and 7

- 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.

If additional room is necessary, you may remove the electric cooling fan.

- 19.** Loosen the lower intake manifold bolts several turns.

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.

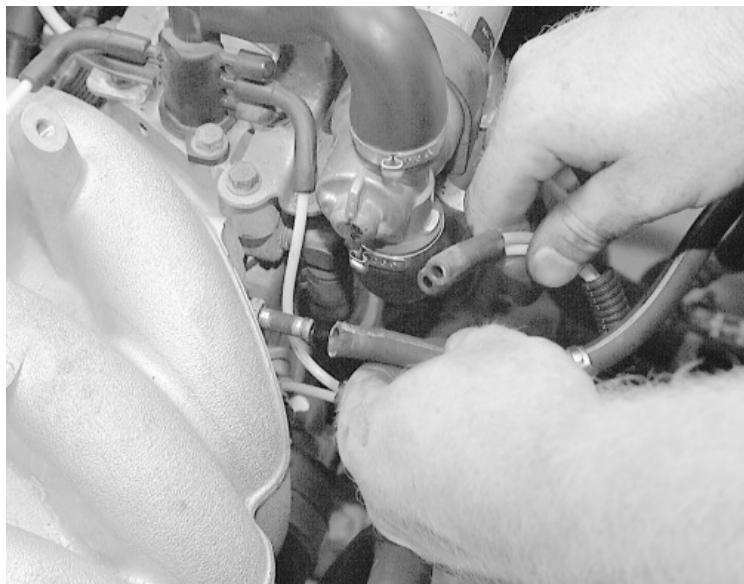


Fig. Fig. 2: Label and remove the various vacuum lines from the intake manifold

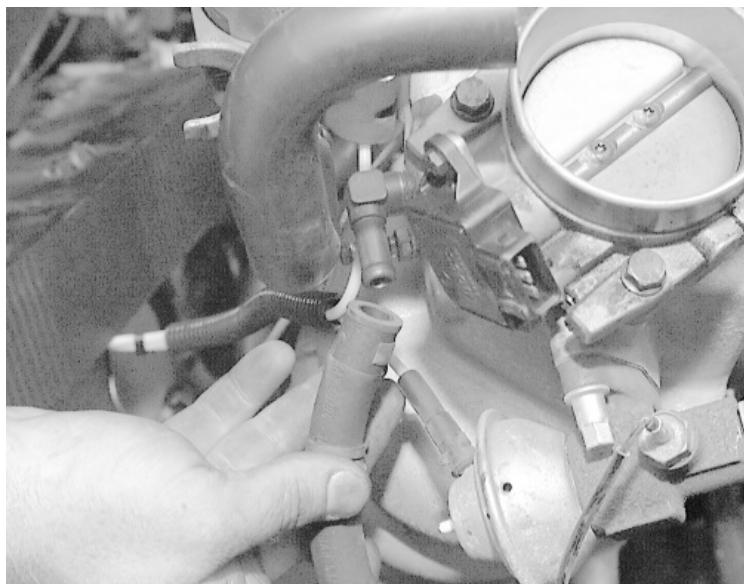


Fig. Fig. 3: Some hoses are more easily removed from their sources than at the intake manifold

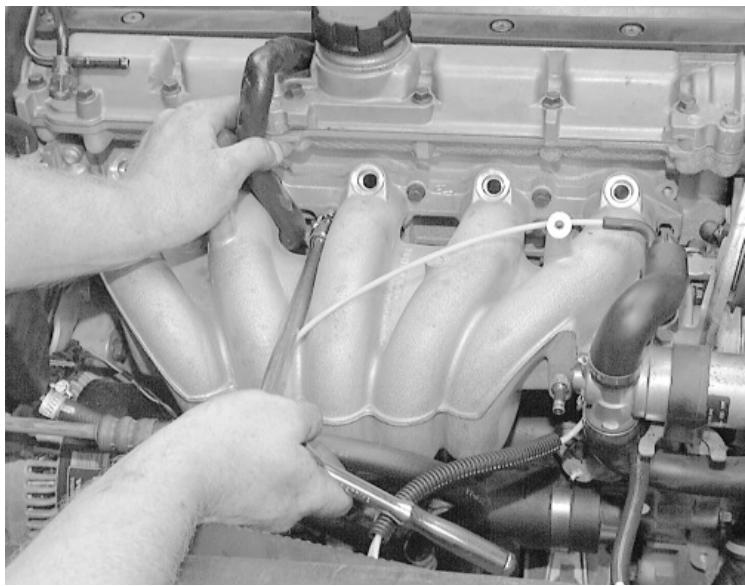


Fig. Fig. 4: Remove the retaining bolts ...

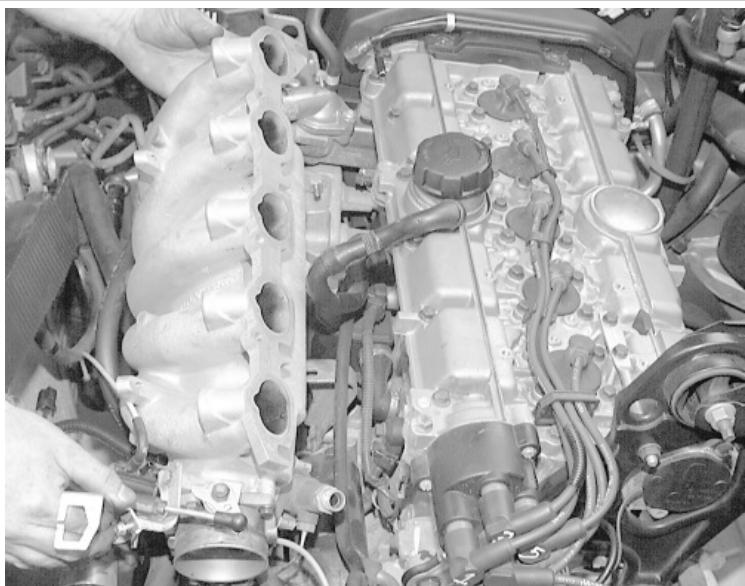


Fig. Fig. 5: ... and carefully lift the intake manifold from the cylinder head

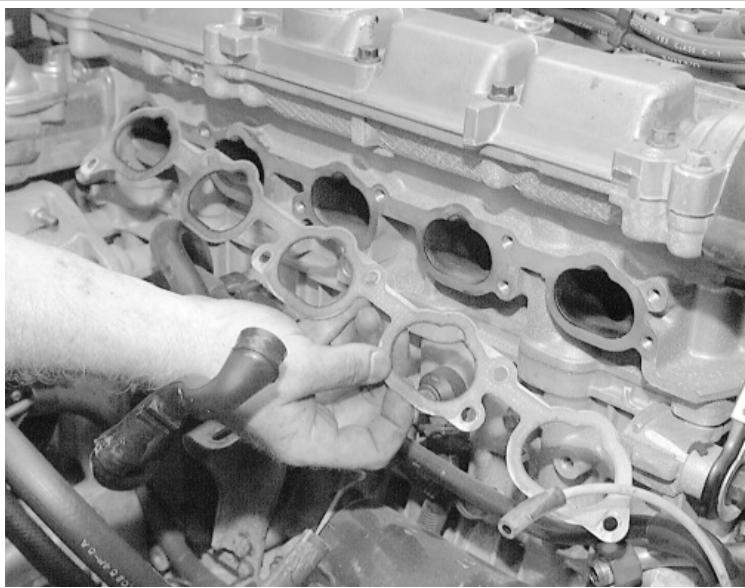


Fig. Fig. 6: Remove the old intake gasket from the cylinder head and thoroughly clean the mating surfaces

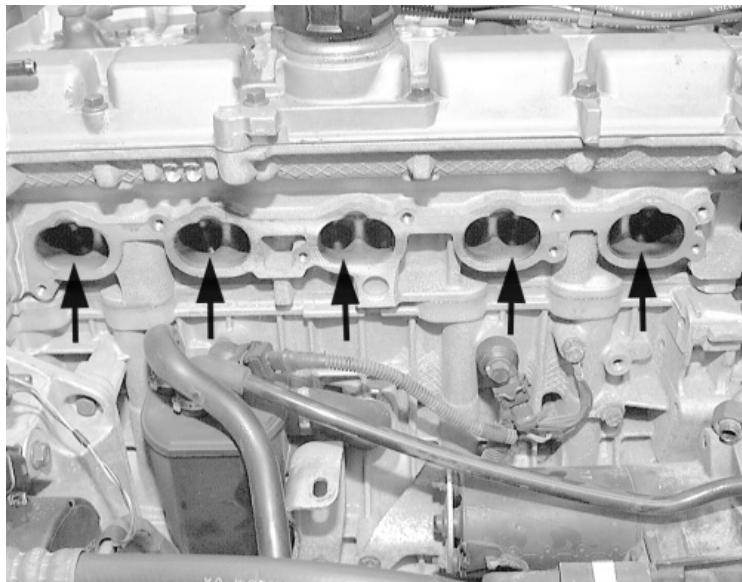


Fig. Fig. 7: You can see the valves through the intake ports. Inspect the valves for carbon build-up while the intake manifold is off

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Oil Pan

REMOVAL & INSTALLATION

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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

See Figure 1

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.

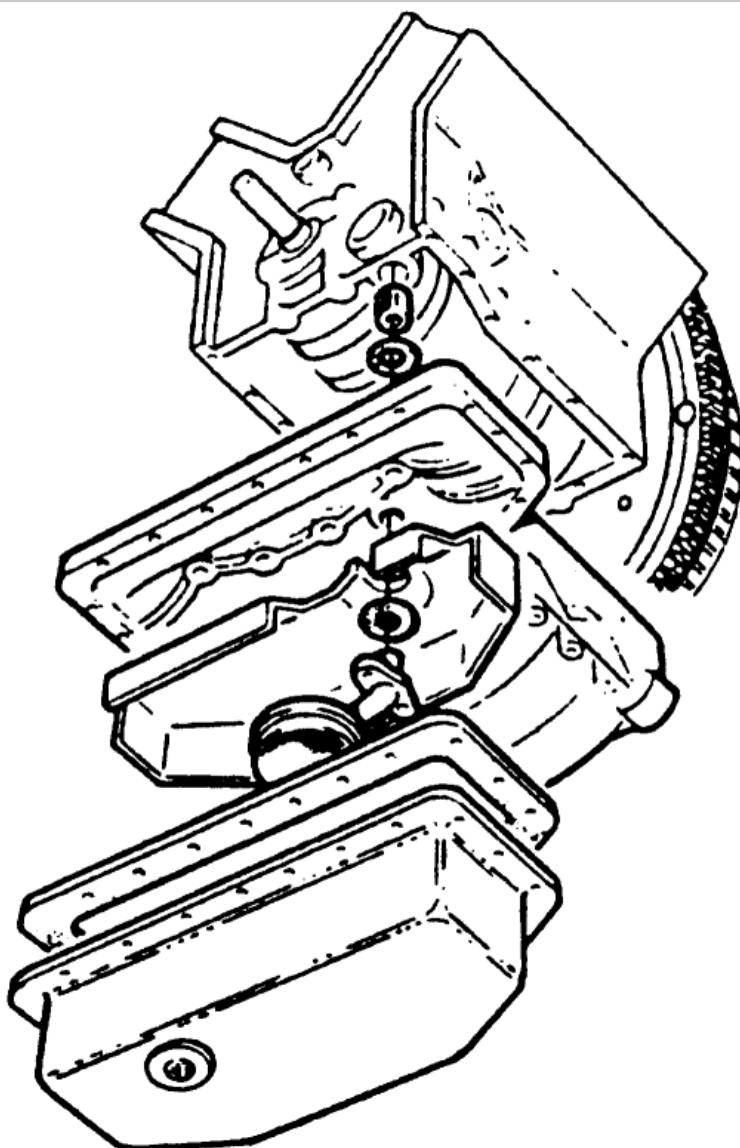


Fig. Fig. 1: Oil pan and lower crankcase components-2.8L 6-cylinder engine

2.3L and 2.4L 5-Cylinder Engines

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.

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REPAIR GUIDE

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Oil Pump

REMOVAL & INSTALLATION

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2.3L (B230F and B230FT) 4-Cylinder Engine

See Figure 1

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.

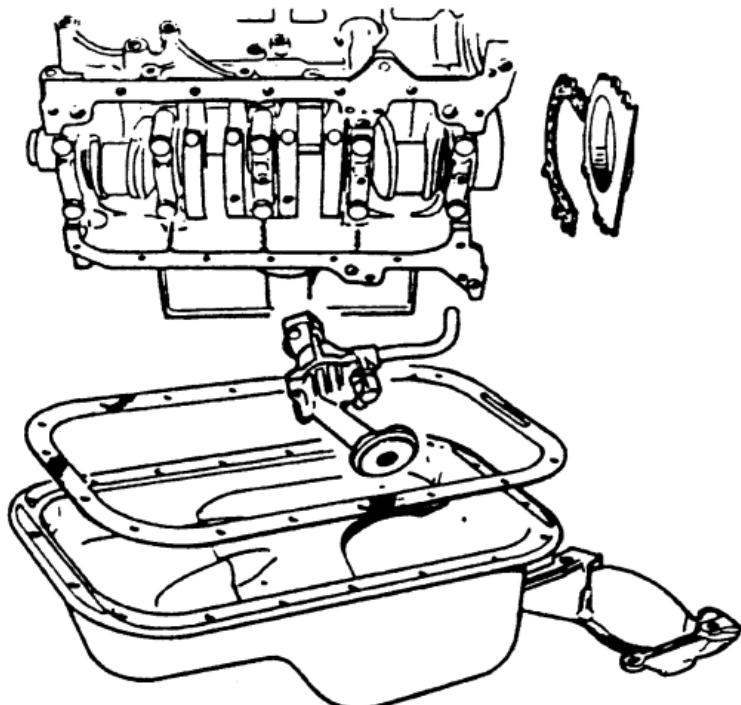


Fig. Fig. 1: Exploded view of the oil pan, rear seal flange, oil pump, and delivery tube on B230F and B230FT engines

2.3L (B234F) 4-Cylinder Engine

See Figures 2 and 3

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) plus 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.

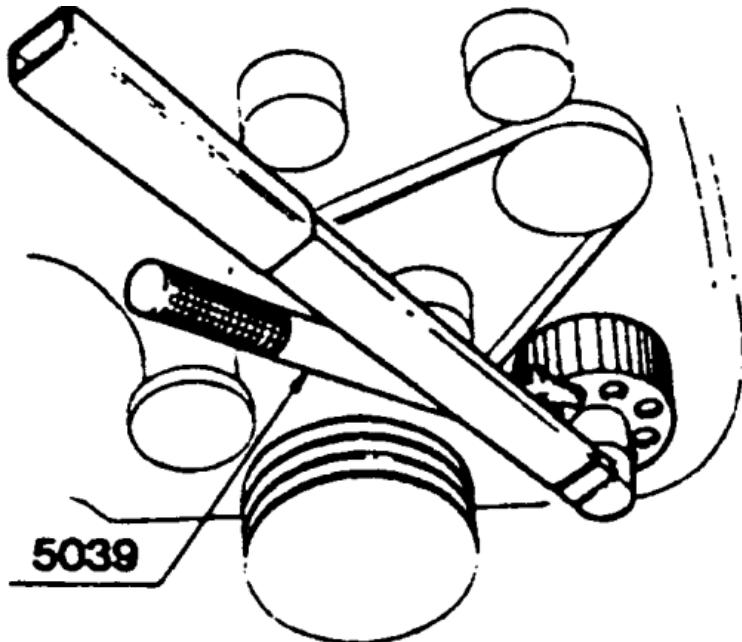


Fig. Fig. 2: Use counterhold tool 5039 or equivalent to remove the pump pulley

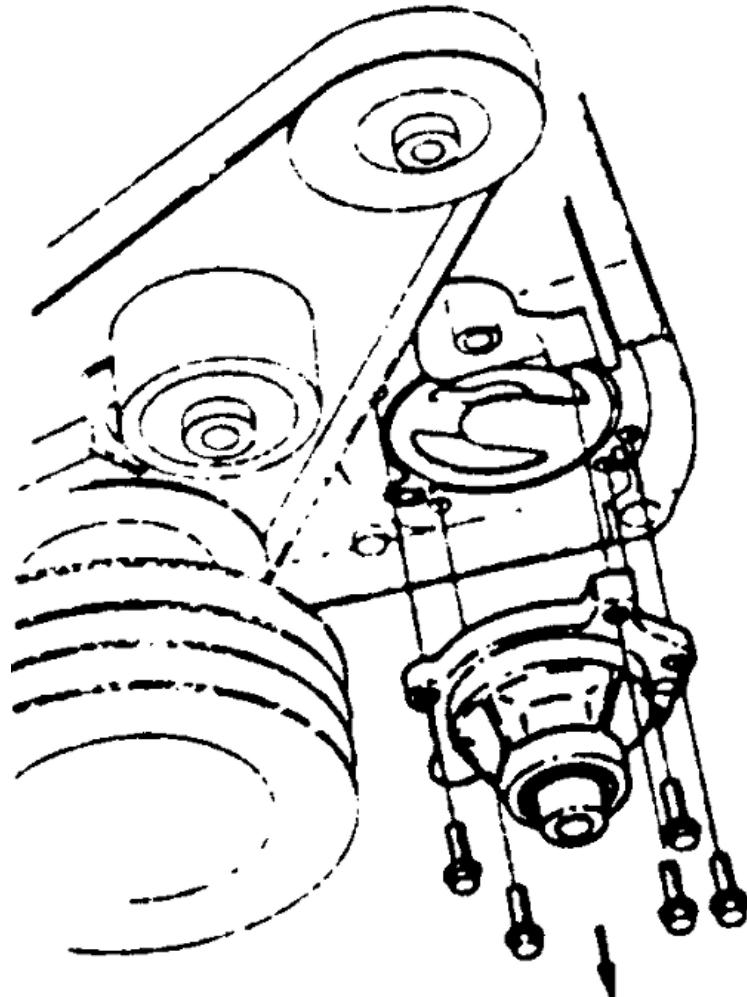


Fig. Fig. 3: Removing the oil pump-B234F engine

2.8L 6-Cylinder Engine

See Figure 4

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.

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.

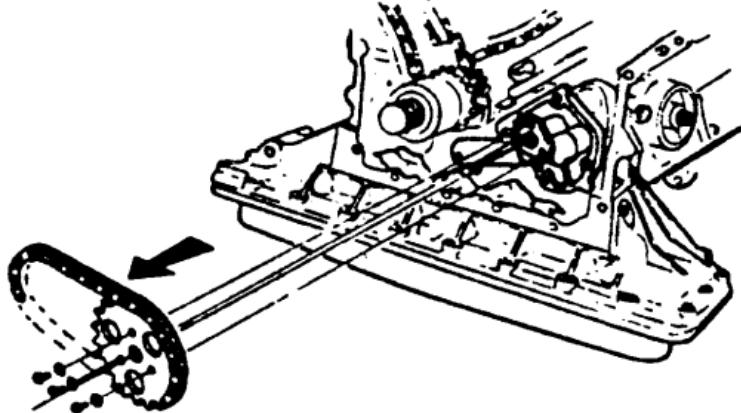


Fig. Fig. 4: Removing the oil pump drive sprocket and chain

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.

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.

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Radiator

REMOVAL & INSTALLATION

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See Figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11

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 drivers 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.

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.

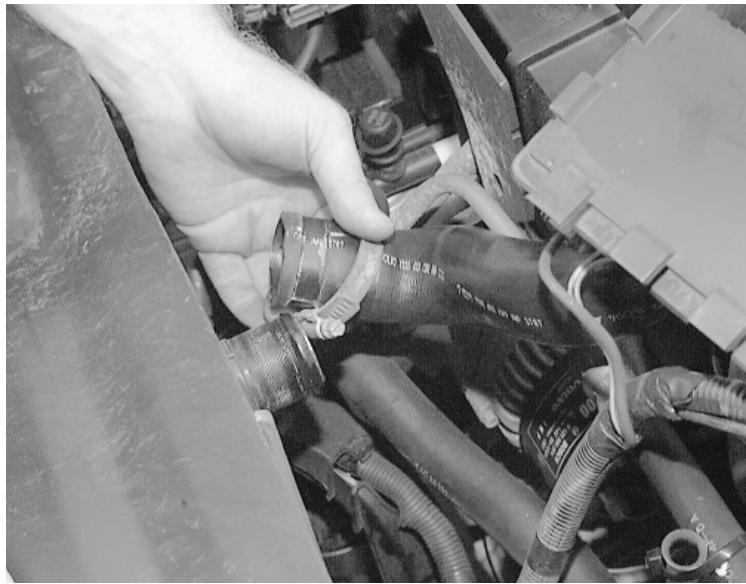


Fig. Fig. 1: Undo the clamps and remove the radiator hoses

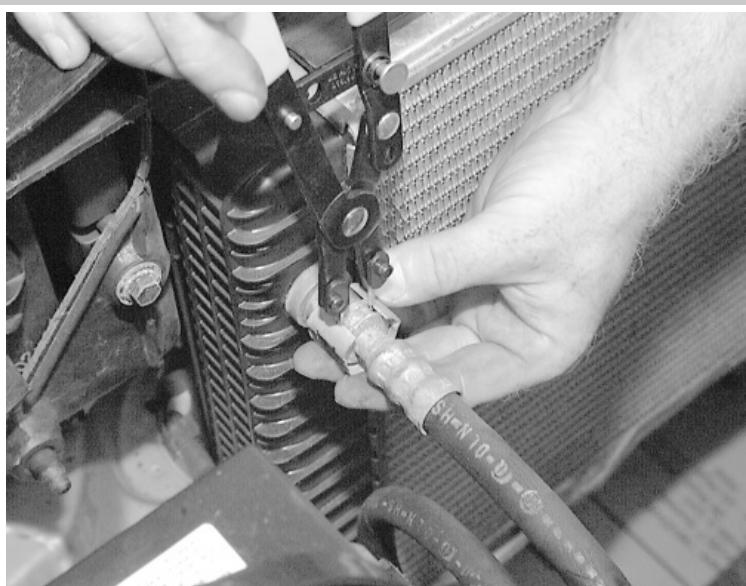


Fig. Fig. 2: A pair of retaining ring pliers can be used to release the quick-connect fittings on the transmission cooler lines



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

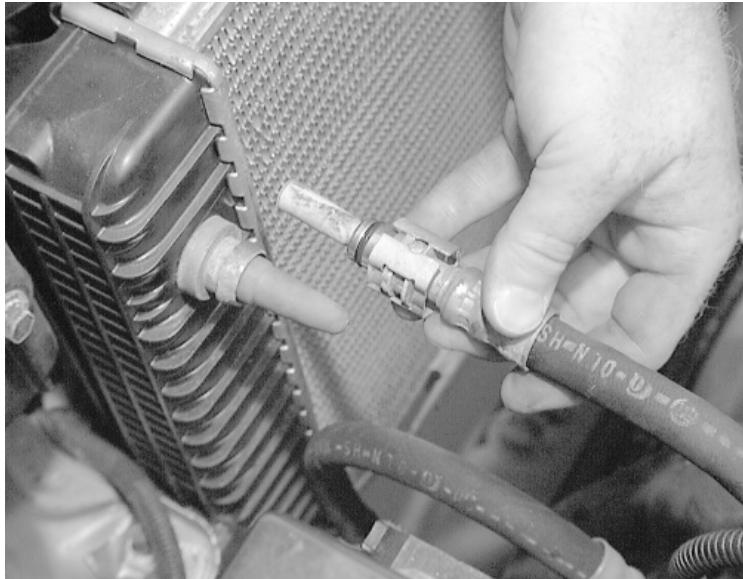


Fig. Fig. 4: Plug the cooler line ...

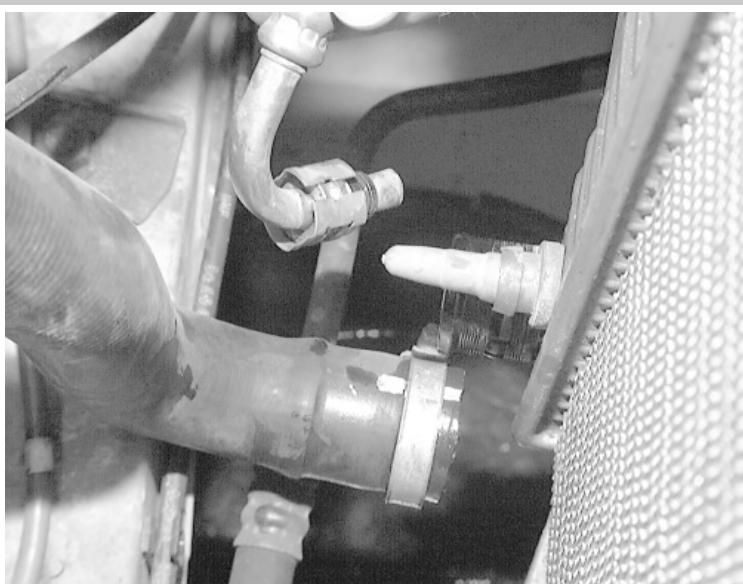


Fig. Fig. 5: ... and the cooler fitting on the radiator to prevent contamination

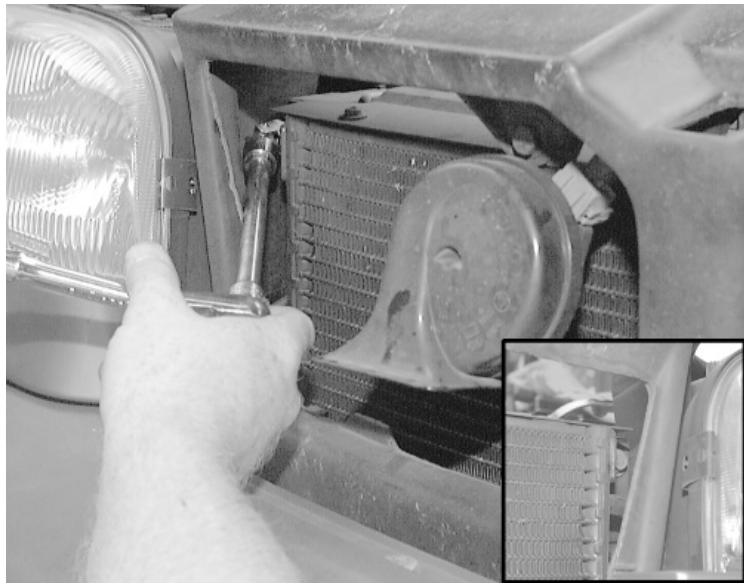


Fig. Fig. 6: Remove the condenser and radiator upper mounting bolts



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



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



Fig. Fig. 9: ... as well as that on the drivers side of the radiator



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

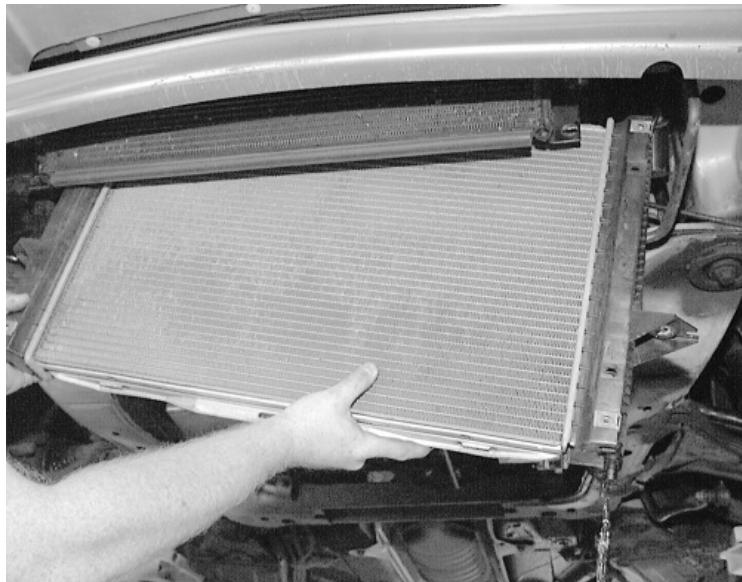


Fig. Fig. 11: ... the radiator can be removed. (On some models such as this 850, you remove it from below)

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REPAIR GUIDE

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Rear Main Seal

REMOVAL & INSTALLATION

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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.

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.

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.

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.

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 [Drive Train](#).
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 [Drive Train](#).
11. Lower the vehicle.
12. Connect the negative battery cable.

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Rocker Arm (Valve) Cover

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2.3L 4-Cylinder Engines

See Figure 1

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.

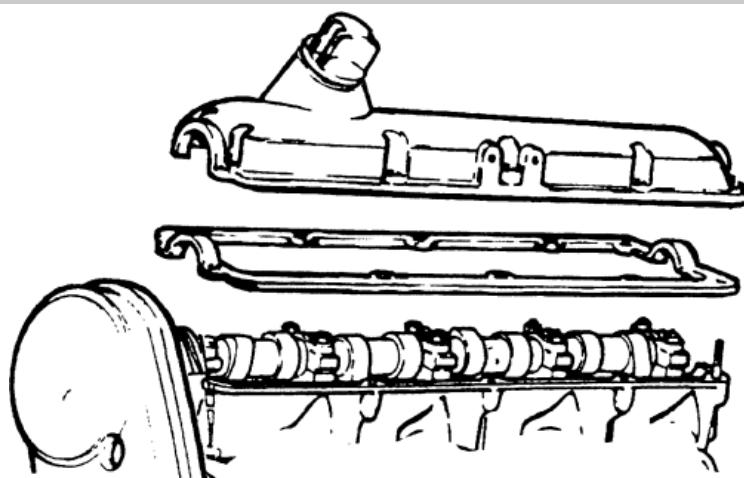


Fig. Fig. 1: Valve cover and gasket assembly

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

See Figures 2, 3, 4, 5 and 6

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

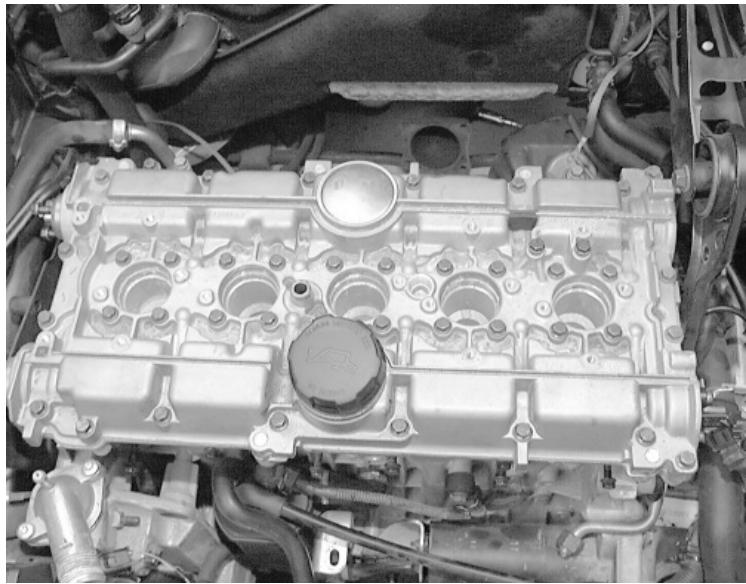


Fig. Fig. 3: Remove the spark plug cover and the plug wires or ignition coils to access the retaining bolts



Fig. Fig. 4: Remove the retaining bolts



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

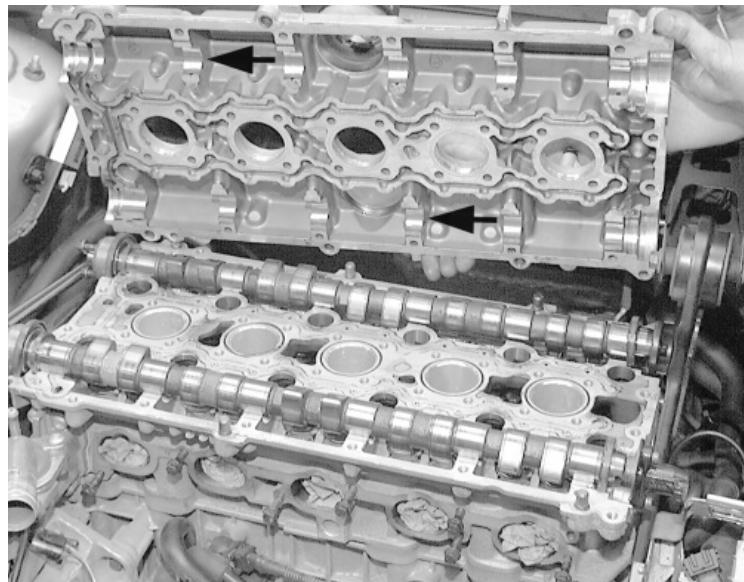


Fig. Fig. 6: Carefully lift the upper cylinder head up and off the lower section. Note the integral camshaft bearing caps in the casting

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Rocker Arm/Shafts

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

2.8L 6-Cylinder Engine

See Figure 1

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 drivers side valve cover (if removing the drivers 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.

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.

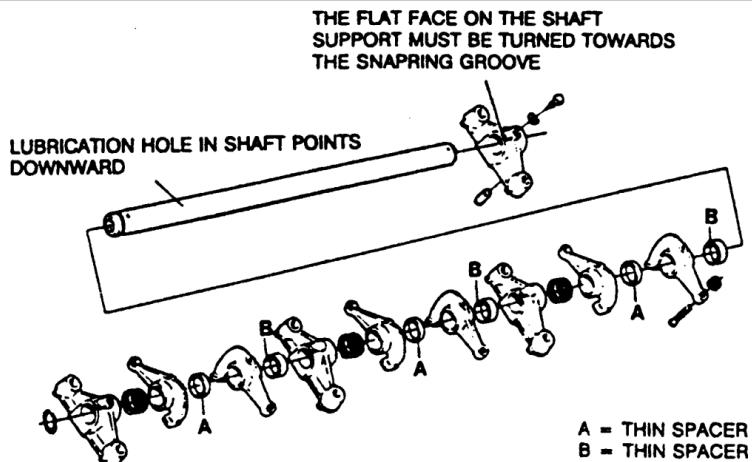


Fig. Fig. 1: Rocker arm shaft assembly-2.8L 6-cylinder engine

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Thermostat

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See Figures 1, 2 and 3

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:

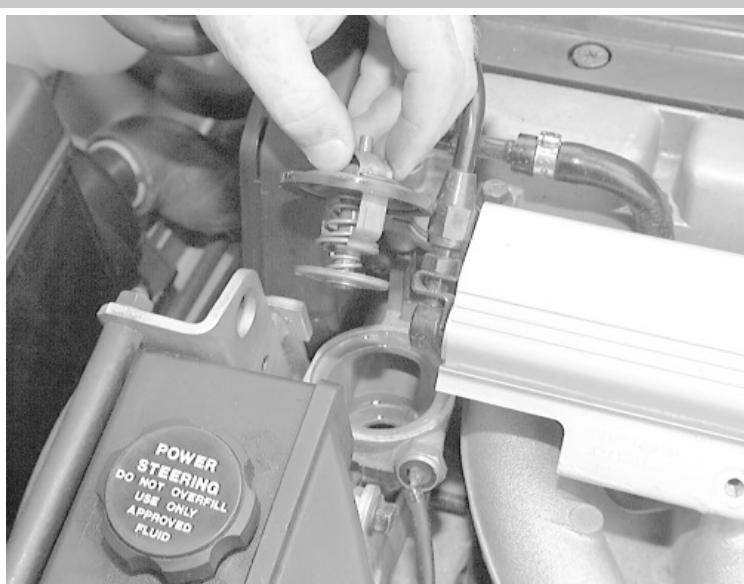
6. Before installing the thermostat, thoroughly clean the mating surfaces.
7. Fit a new gasket and place the thermostat into position.
8. Install the thermostat housing and tighten bolts to proper torque (refer to torque specifications in the back of this section).
9. Fill the cooling system through 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. Fig. 1: Remove the radiator hose



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



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Timing Belt Cover

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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

See Figure 1

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.

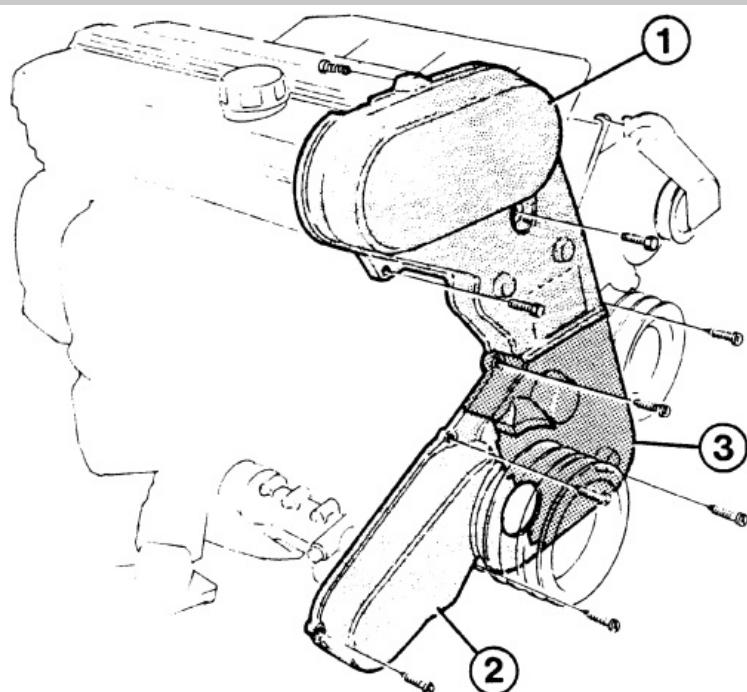


Fig. Fig. 1: The B234F engine has a three-piece timing cover

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

See Figures 2, 3, 4, 5, 6, 7, 8 and 9

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.

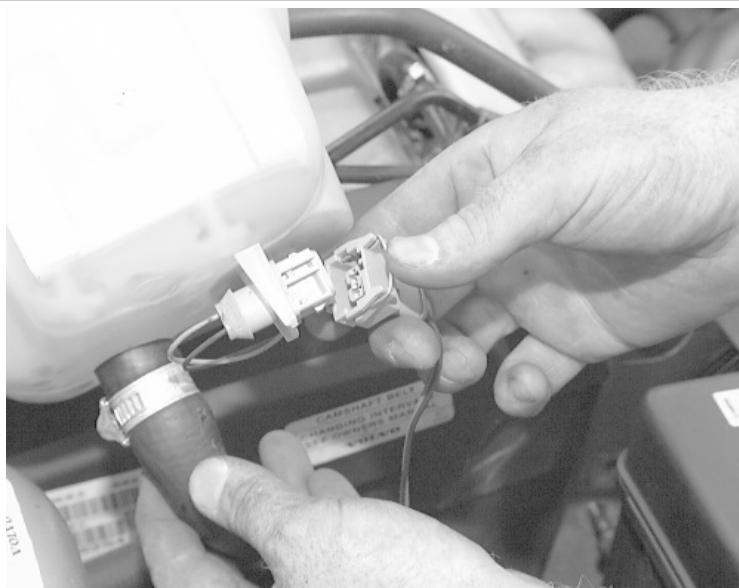


Fig. Fig. 2: Unplug the connector, disconnect the hose and remove the expansion tank



Fig. Fig. 3: Remove the belt and the tensioner



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



Fig. Fig. 5: ... access the fuel line clips



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



Fig. Fig. 7: Remove the fenderwell trim



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



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

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Timing Belt and Sprockets

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Although not necessary, 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

See Figures 1, 2, 3, 4, 5, 6, 7 and 8

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 belts rotation if you are reinstalling the same belt.

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 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.

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.

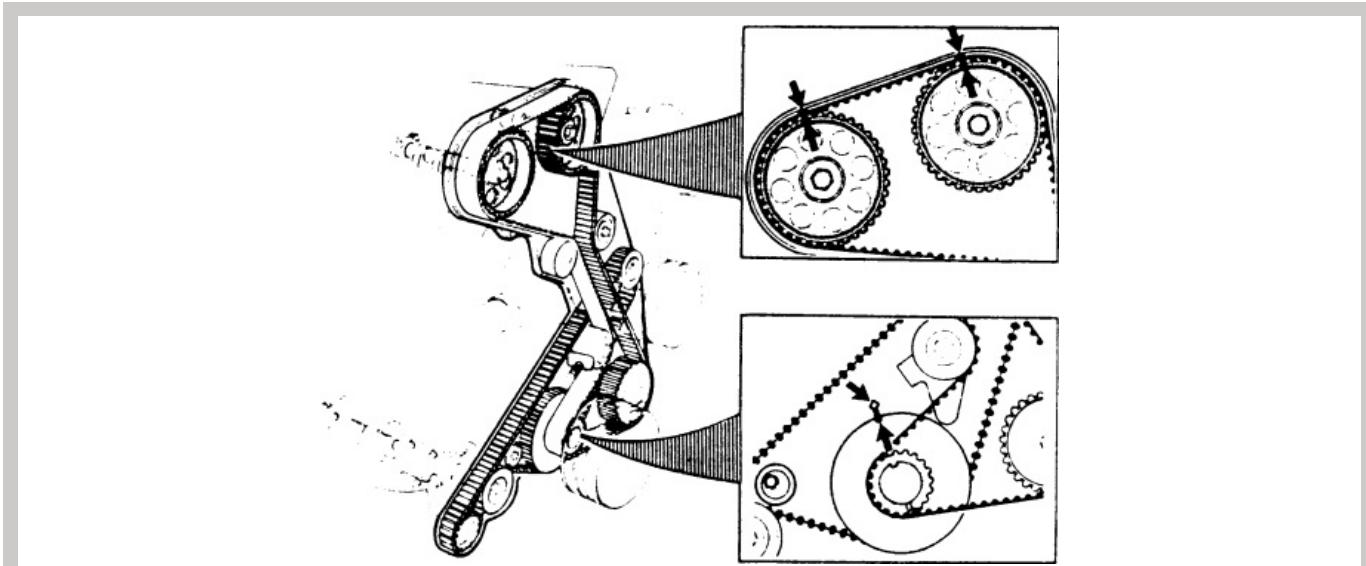


Fig. Fig. 1: Align the marks on the timing gears before removing the belt

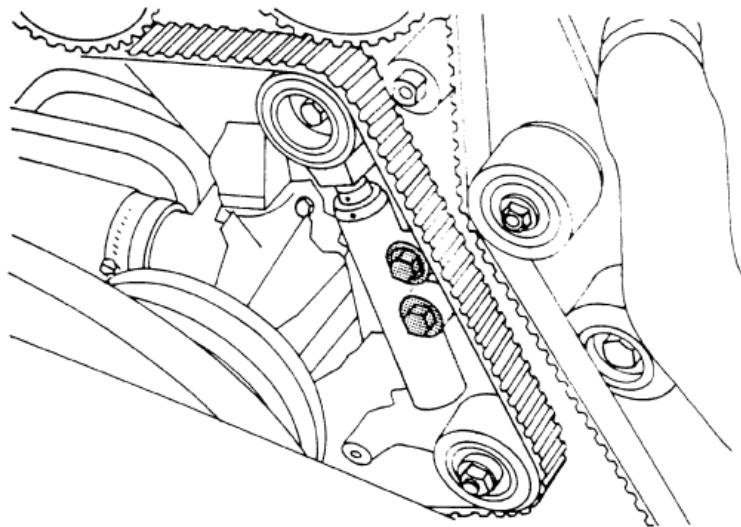


Fig. Fig. 2: Remove the tensioner bolts in order to remove the timing belt

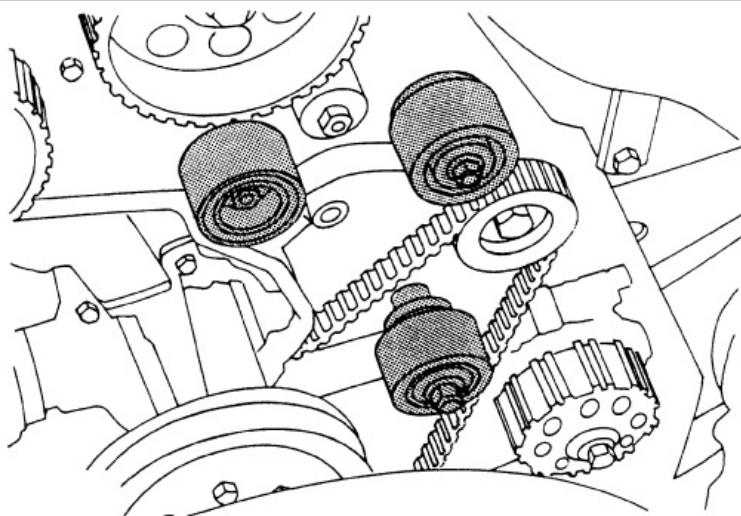


Fig. Fig. 3: Check the timing belt idler pulleys for wear or bearing noise; replace if necessary

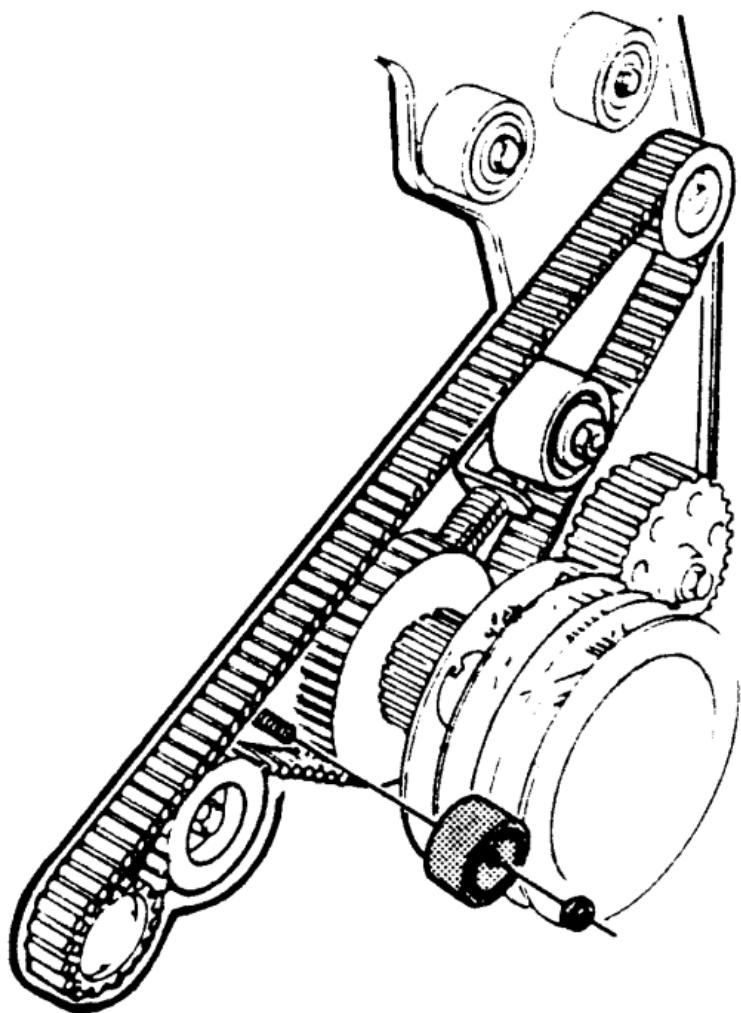


Fig. Fig. 4: Remove the idler pulley for the balance shaft

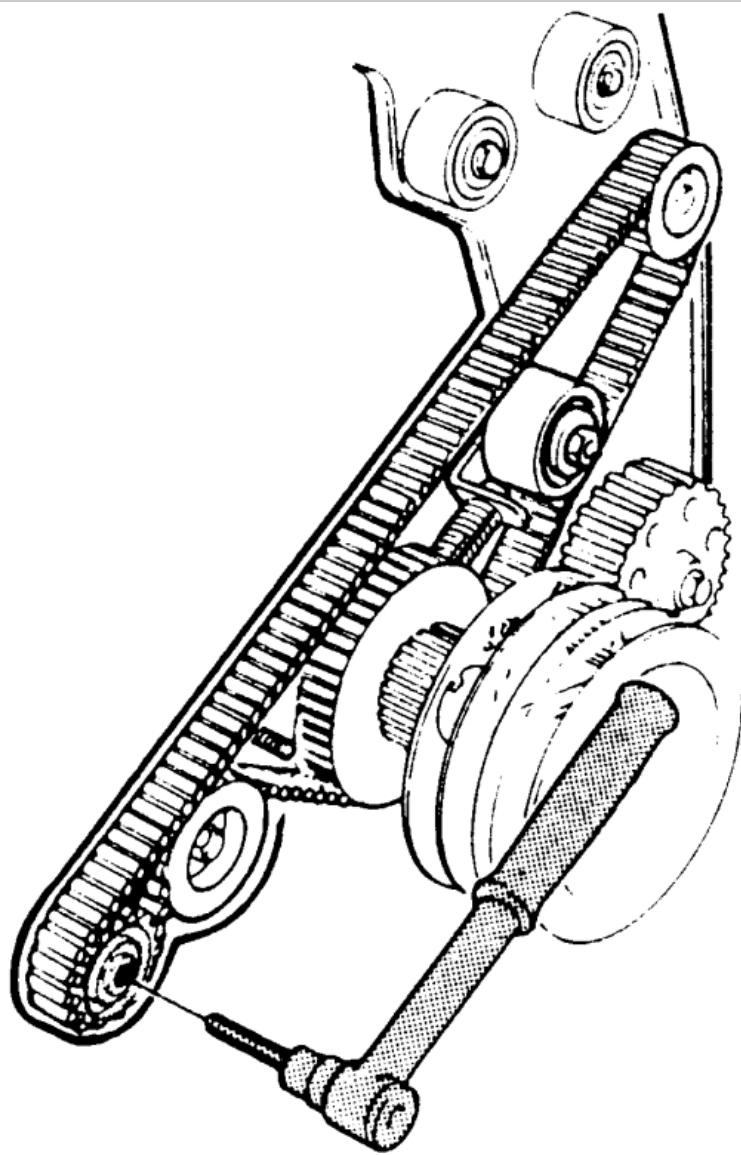


Fig. Fig. 5: Remove the tensioner pulley to remove the balance shaft

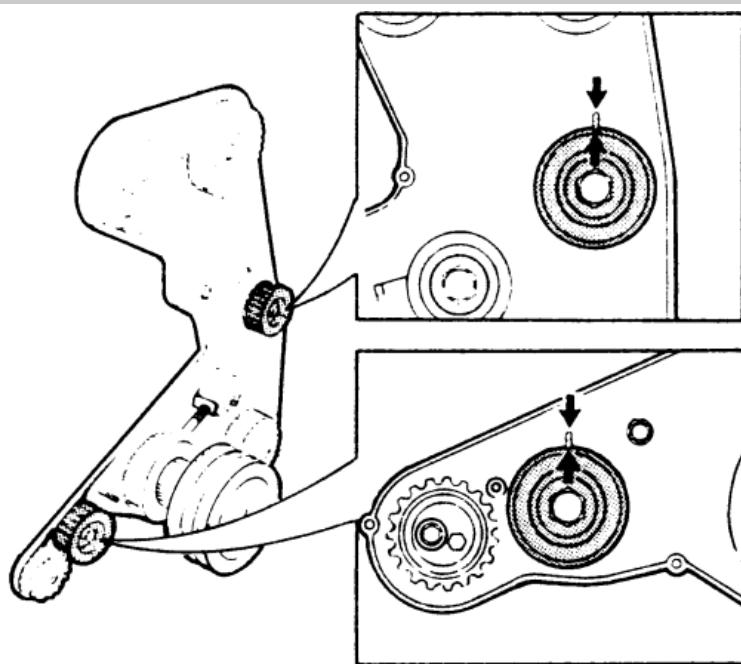


Fig. Fig. 6: Line up the balance shafts before installing the belt

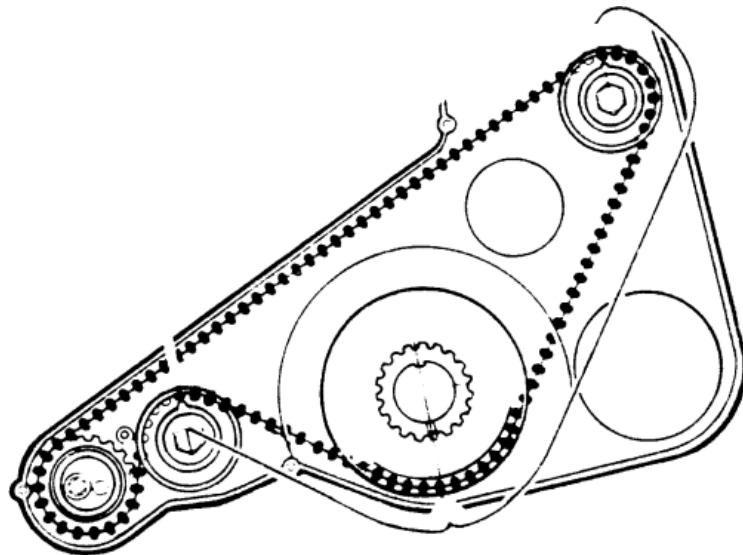


Fig. Fig. 7: Check the alignment of the balance shafts and crankshaft before tightening the tensioner

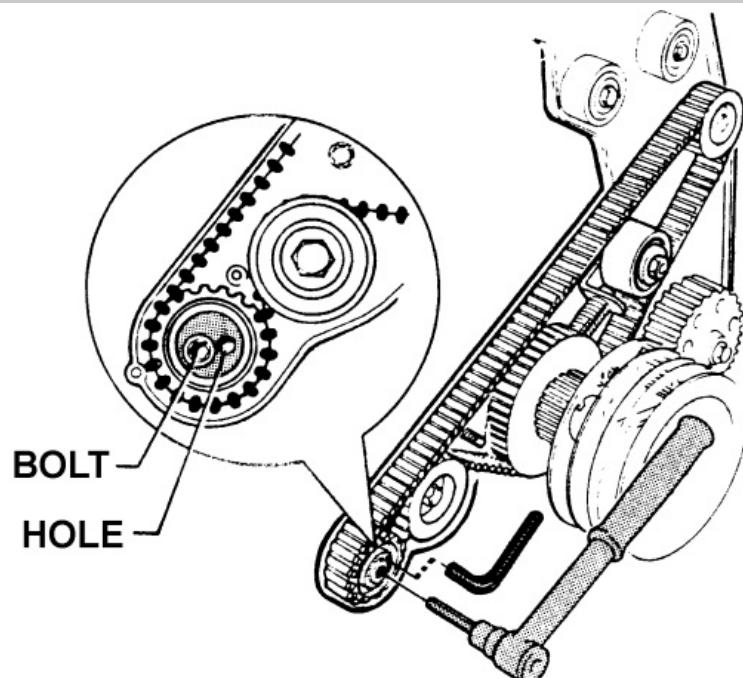


Fig. Fig. 8: Use an Allen wrench as a counterhold when tightening the tensioner pulley

2.9L 6-Cylinder Engine

See Figure 9

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.

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.

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:

- 1.** Remove the lever mounting bolt, tensioner pulley and sleeve behind the bolt.
- 2.** Grease the surfaces of the bushing, bolt and sleeve, using high temp grease.
- 3.** Install the sleeve, tensioner pulley and lever mounting bolt.
- 4.** 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.

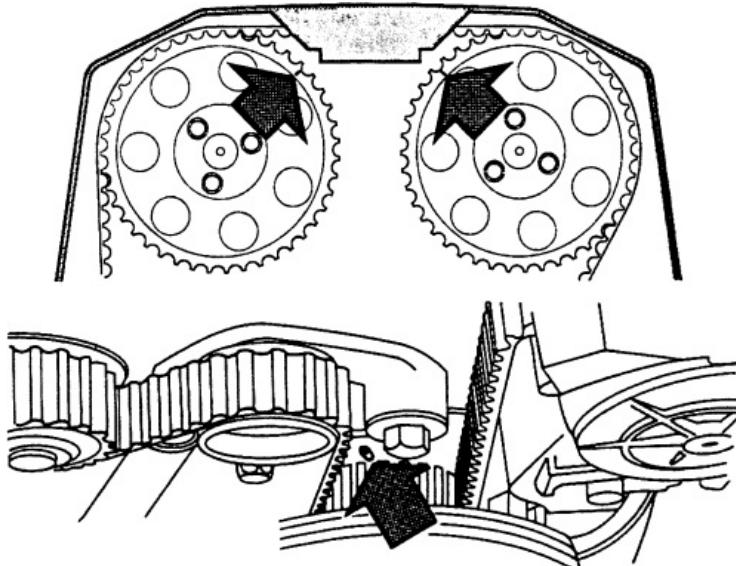


Fig. 9: Pulley alignment marks for timing belt replacement

2.3L and 2.4L 5-Cylinder Engines

See Figures 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 and 21

- 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.

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.

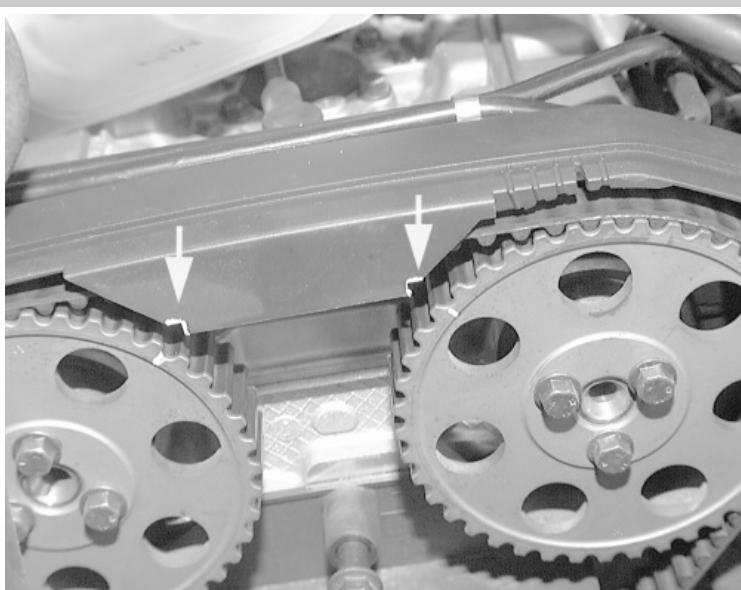


Fig. Fig. 10: Line up the camshaft pulleys with the marks on the engine mounting plate



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

installation



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



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

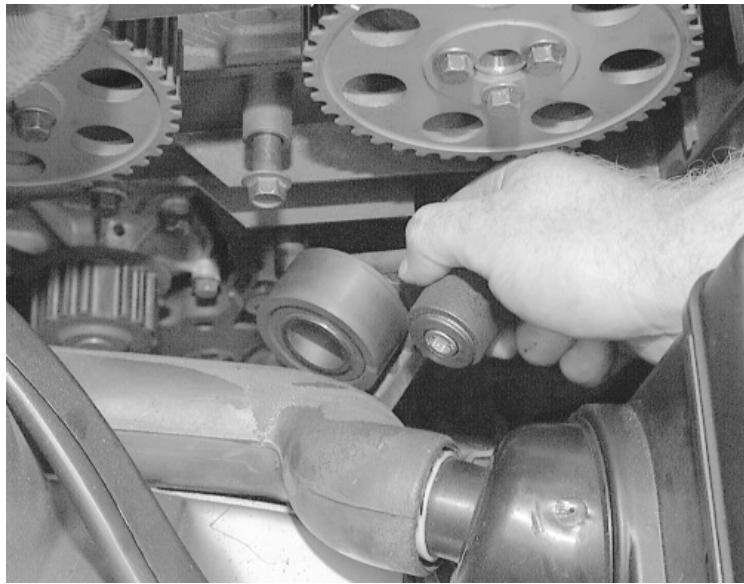


Fig. Fig. 14: Remove the tensioner pulley from the engine

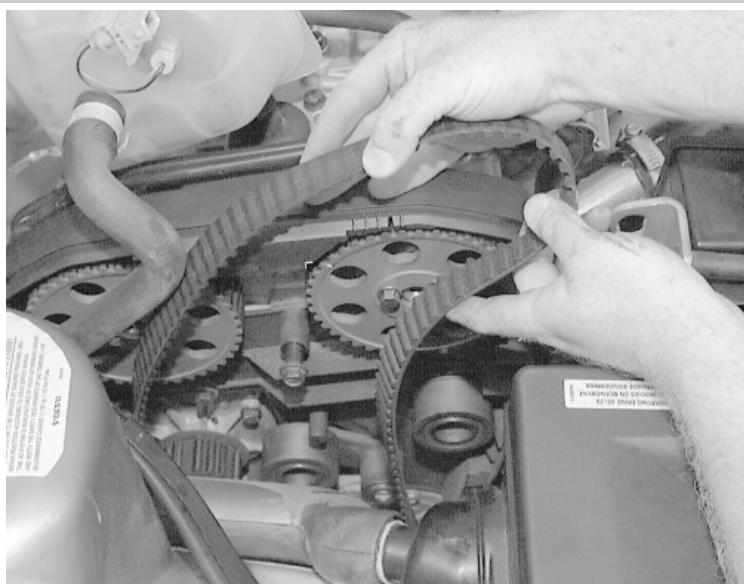


Fig. Fig. 15: Slide the timing belt off the camshaft pulleys and remove it from the engine



Fig. Fig. 16: Remove the tensioner from the engine

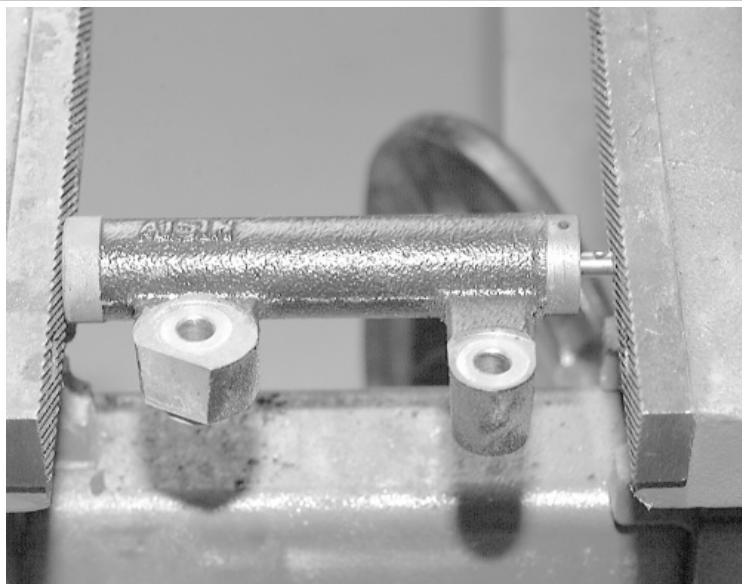


Fig. Fig. 17: Install the tensioner in a vise ...

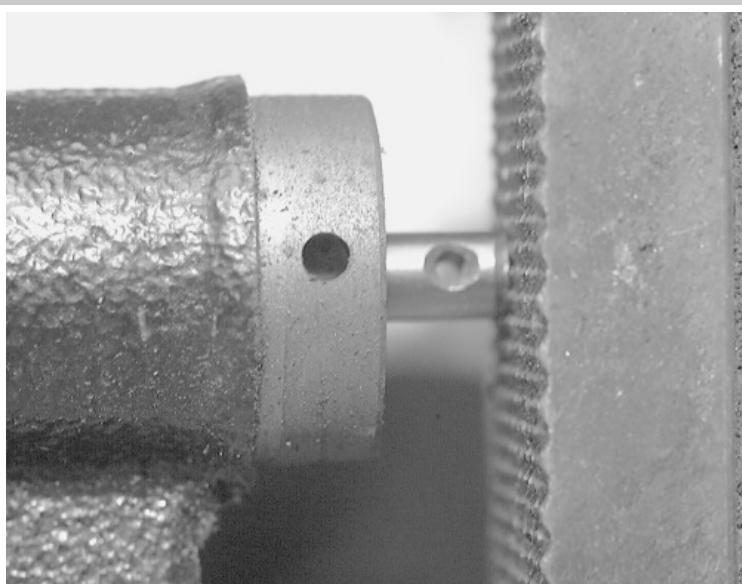


Fig. Fig. 18: ... and compress the tensioner piston until ...

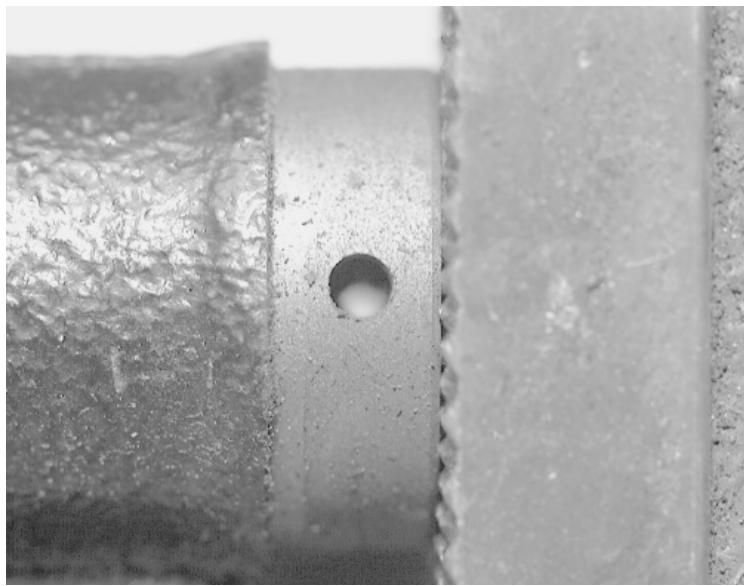


Fig. Fig. 19: ... the holes align ...

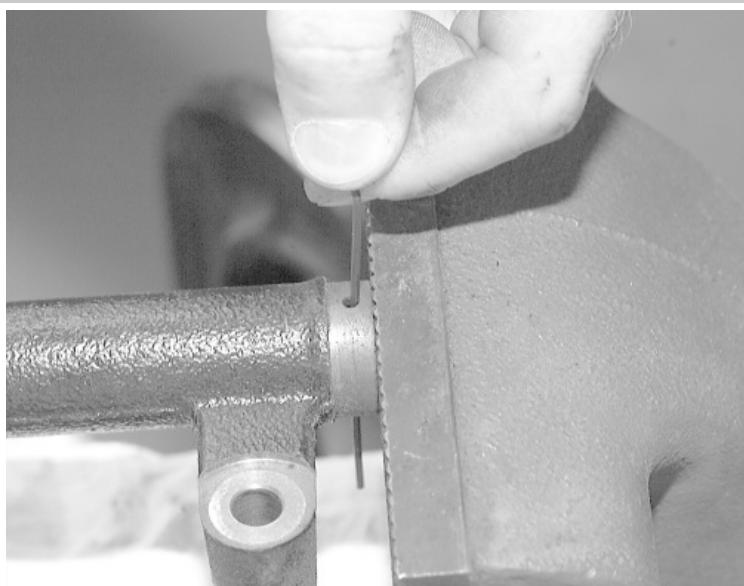


Fig. Fig. 20: ... then install a 2mm lock pin (or 2mm Allen wrench, as used here)

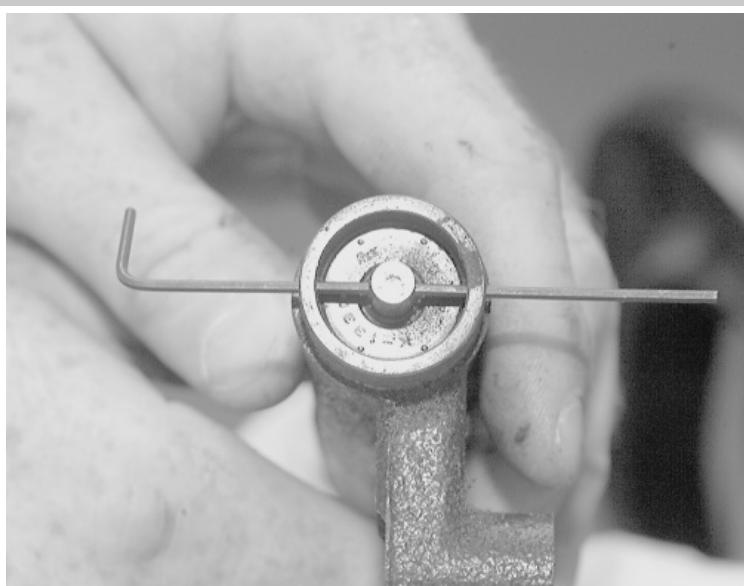


Fig. Fig. 21: Remove the tensioner from the vise, leaving the pin or Allen wrench in the piston

ADJUSTMENT

B234F Engine

See Figure 22

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.

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.

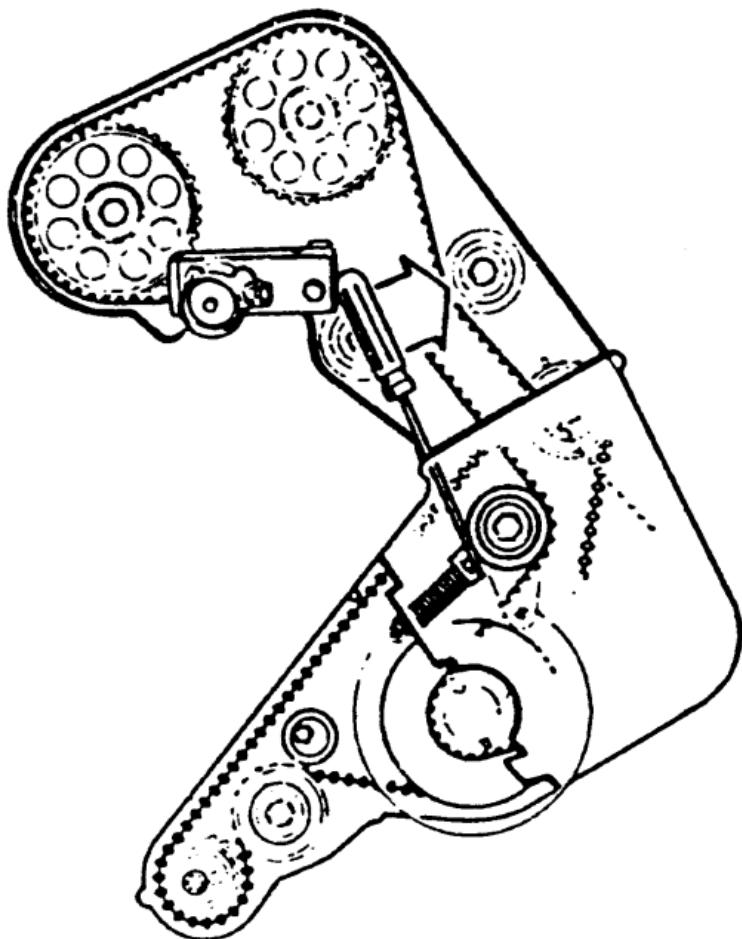


Fig. Fig. 22: Adjusting the timing belt-B234F engine

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.

INSPECTION

See Figures 23, 24, 25, 26, 27, 28, 29 and 30

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 manufacturers 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 [General Information & Maintenance](#).

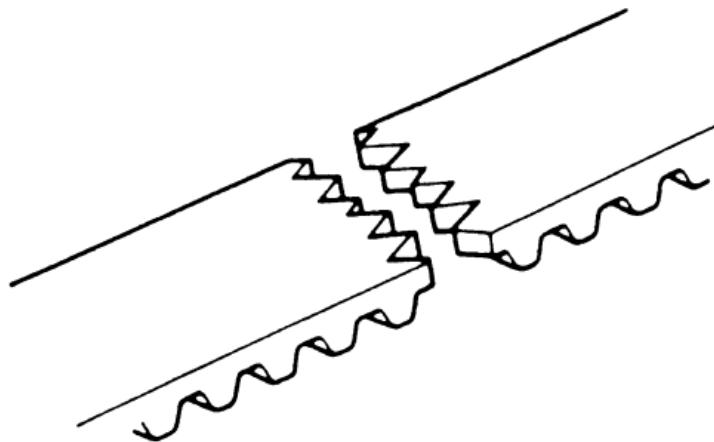


Fig. Fig. 23: Check for premature parting of the belt

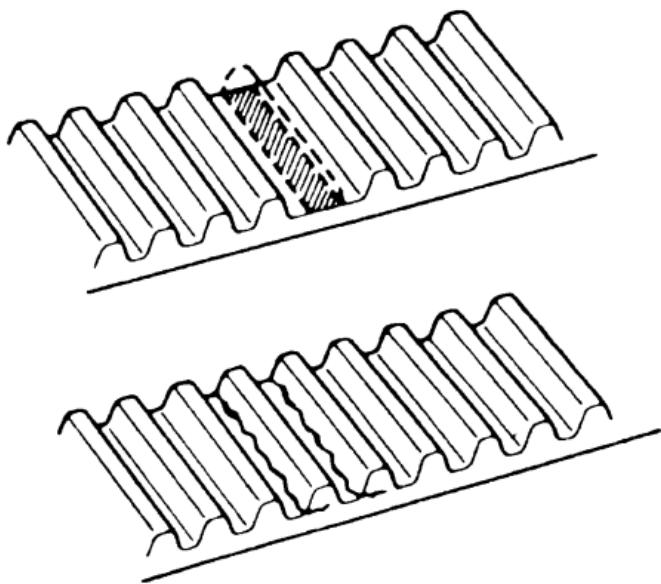


Fig. Fig. 24: Check if the teeth are cracked or damaged

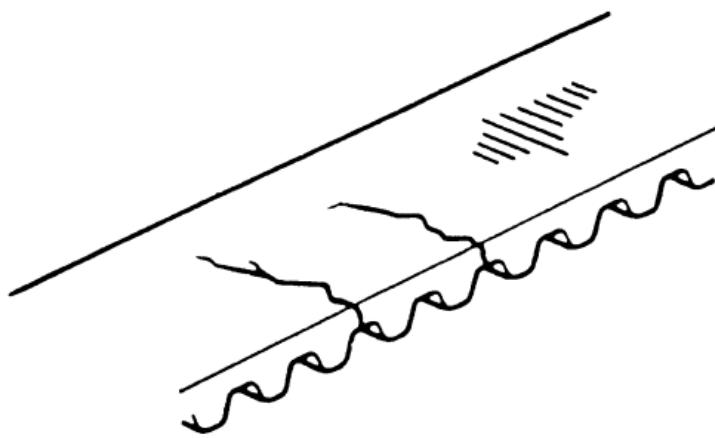


Fig. Fig. 25: Look for noticeable cracks or wear on the belt face

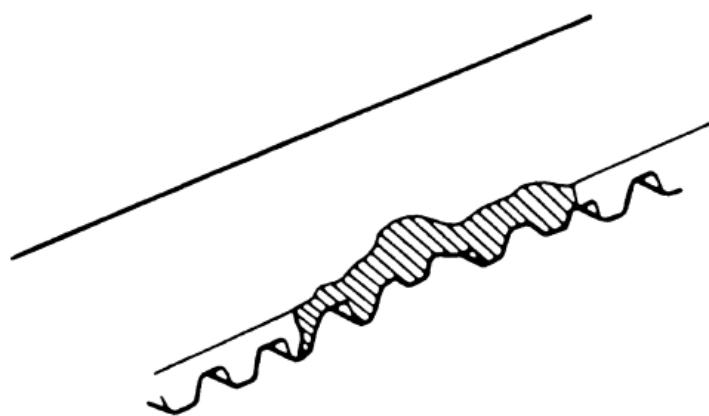


Fig. Fig. 26: You may only have damage on one side of the belt; if so, the guide could be the culprit

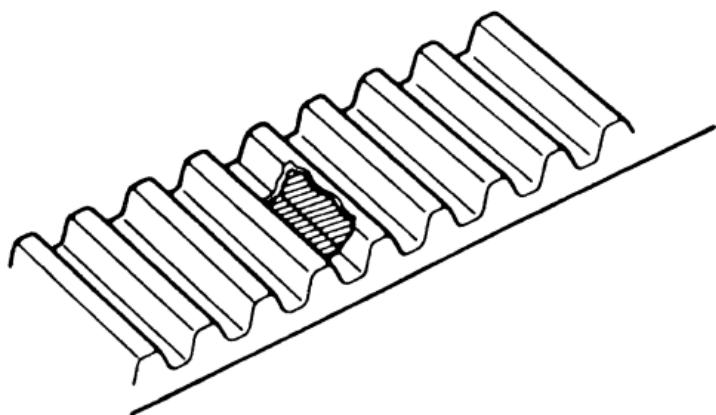


Fig. Fig. 27: Foreign materials can get in between the teeth and cause damage

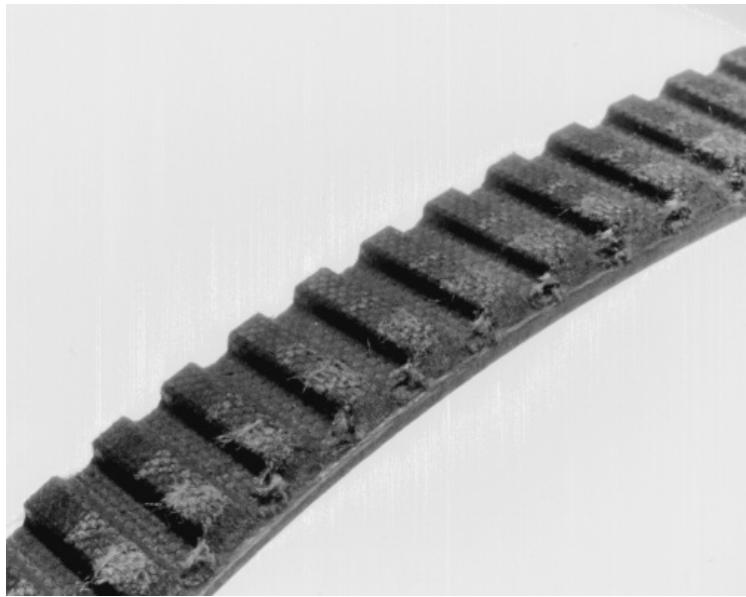


Fig. Fig. 28: Inspect the timing belt for cracks, fraying, glazing or damage of any kind



Fig. Fig. 29: Damage on only one side of the timing belt may indicate a faulty guide

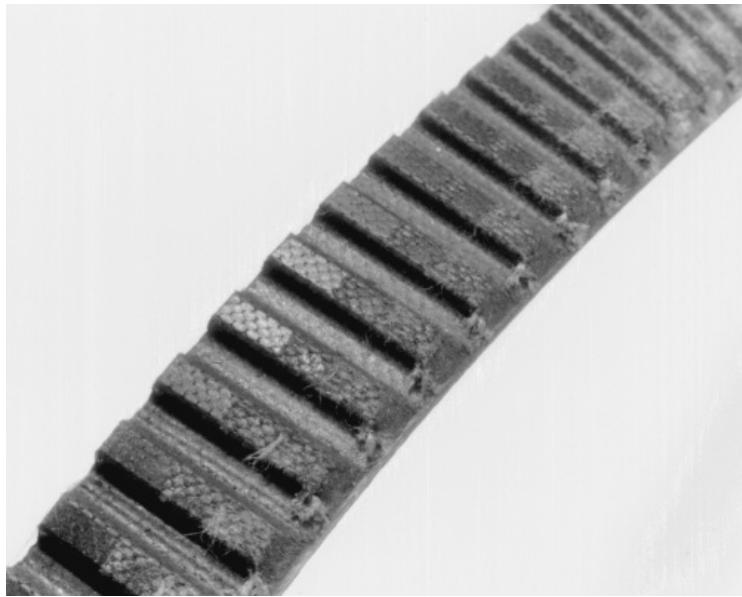


Fig. Fig. 30: ALWAYS replace the timing belt at the interval specified by the manufacturer

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Timing Chain Cover and Seal

REMOVAL & INSTALLATION

2.8L 6-Cylinder Engine

[Print](#)

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.

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.

Do not drop the pulley key into the crankcase.

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

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.

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Timing Chain and Gears

REMOVAL & INSTALLATION

[Print](#)

See Figures 1, 2, 3 and 4

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 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 drivers side camshaft sprocket and chain:
 - A. Rotate the crankshaft, using crankshaft nut, if necessary, until the crankshaft key is pointing directly to the drivers side camshaft and the drivers side camshaft key groove is pointing straight-up (12 o'clock).
 - B. Place the chain on the drivers 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 drivers side chain and sprockets in this position, install the sprocket and chain on the drivers 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 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.

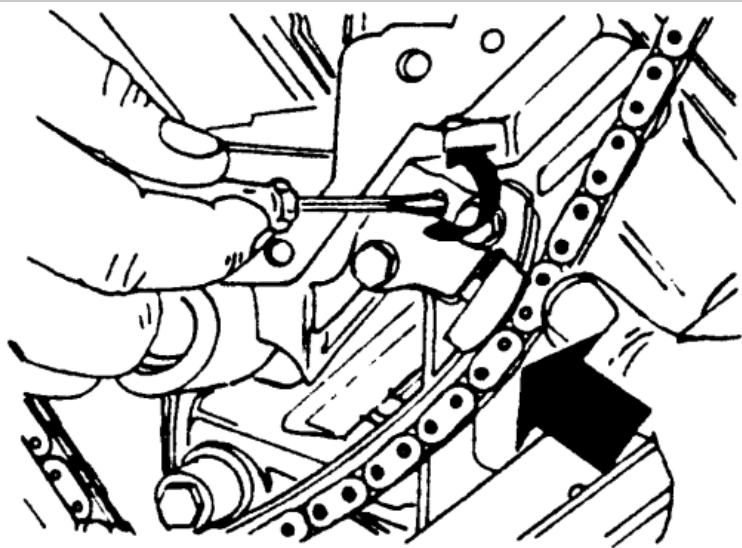


Fig. Fig. 1: Relieving the chain tension

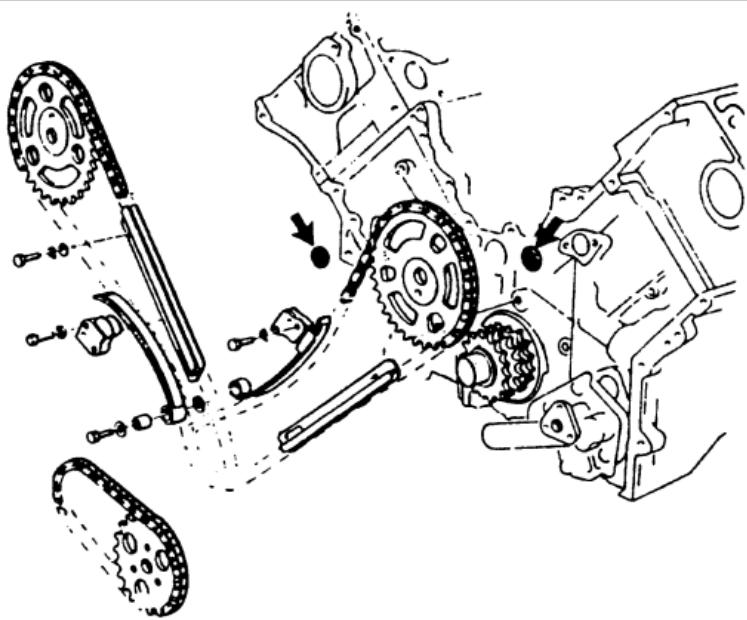
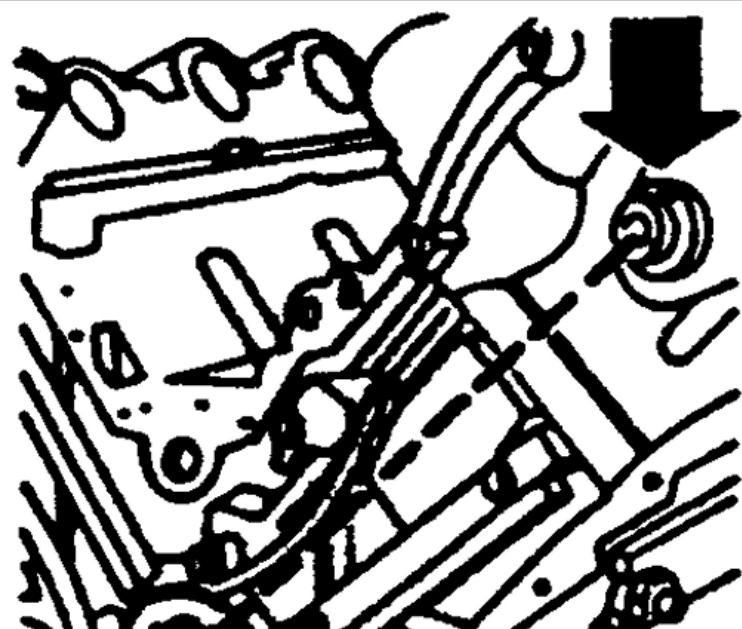
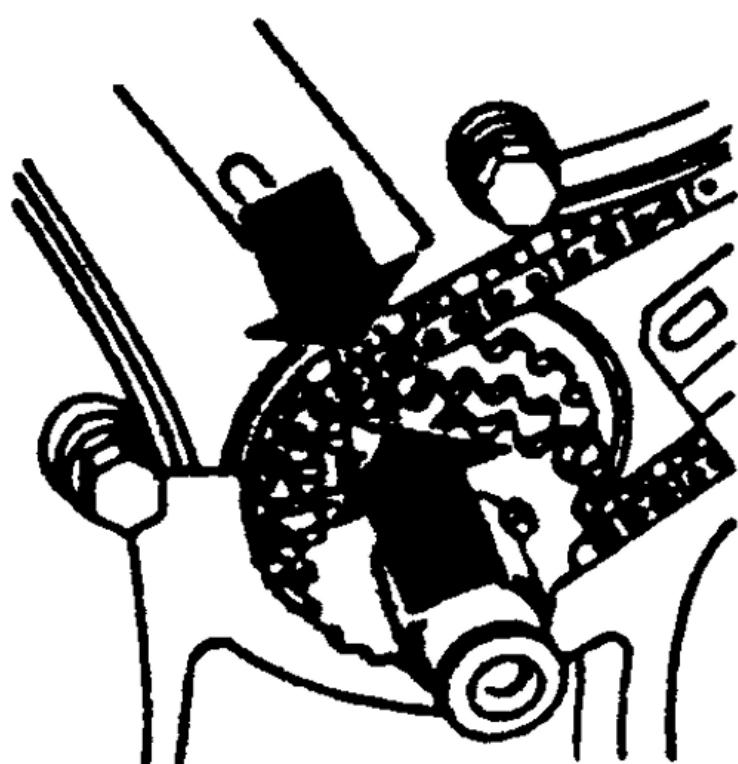
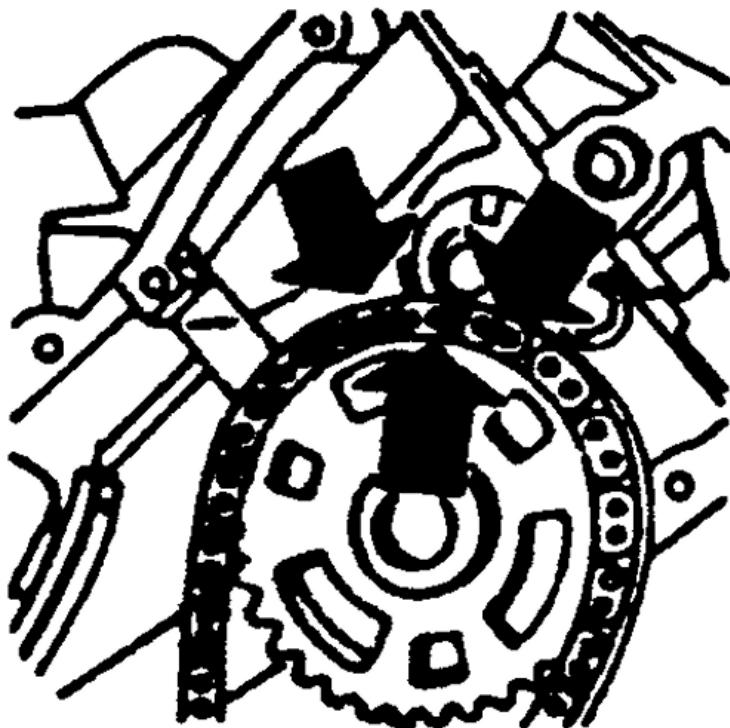


Fig. Fig. 2: Exploded view of timing chain, tensioner and sprocket assembly





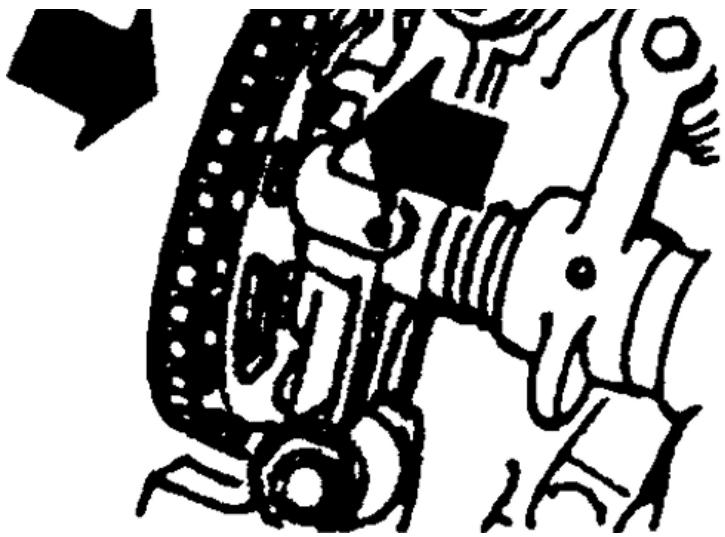


Fig. Fig. 3: Drivers side timing chain installation sequence

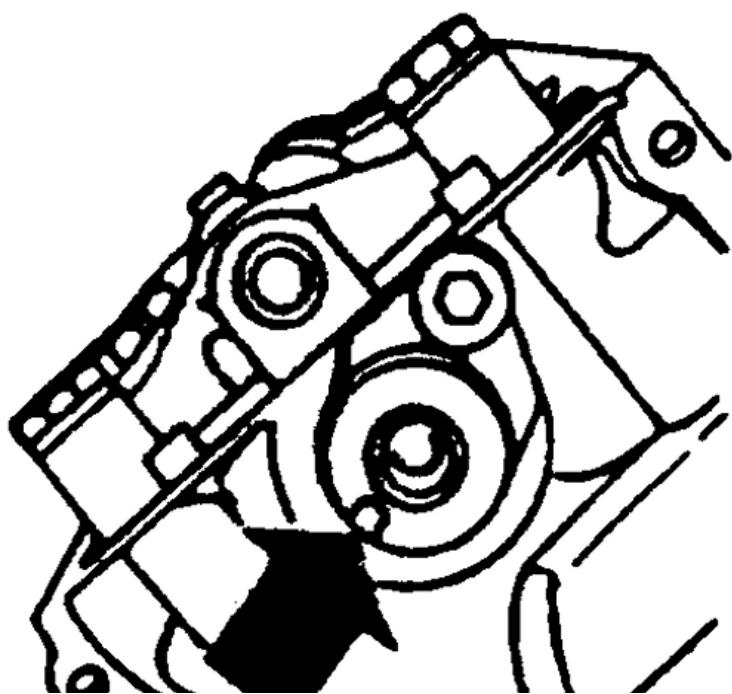
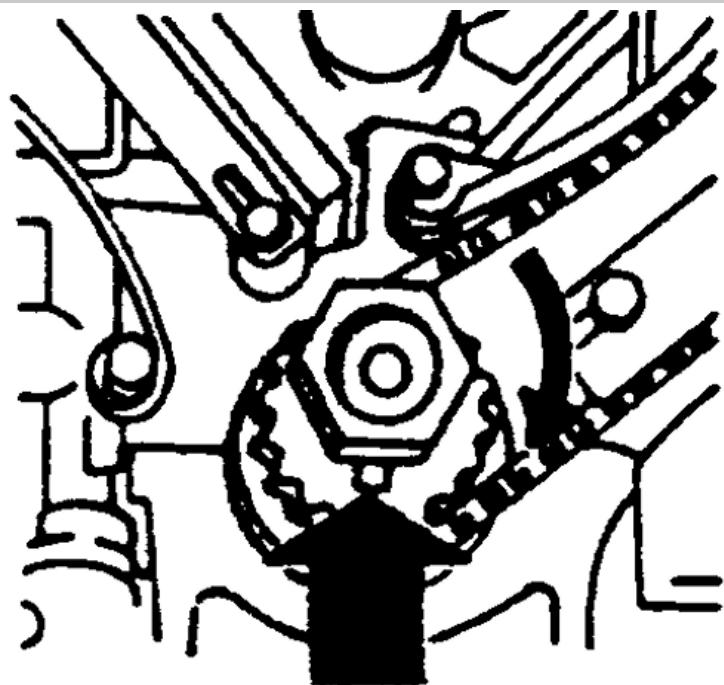




Fig. Fig. 4: Passenger side timing chain installation sequence

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Turbocharger

REMOVAL & INSTALLATION

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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

See Figures 1, 2 and 3

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.

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:

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.

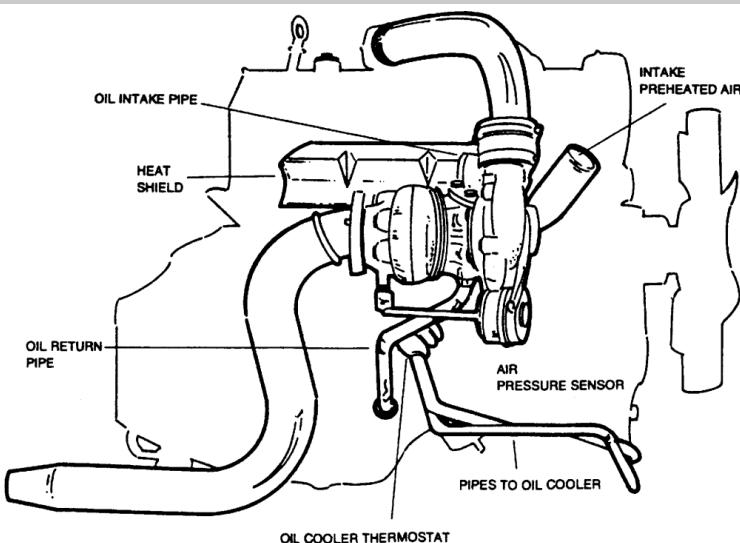


Fig. Fig. 1: Turbocharger system component locations-B230FT engine

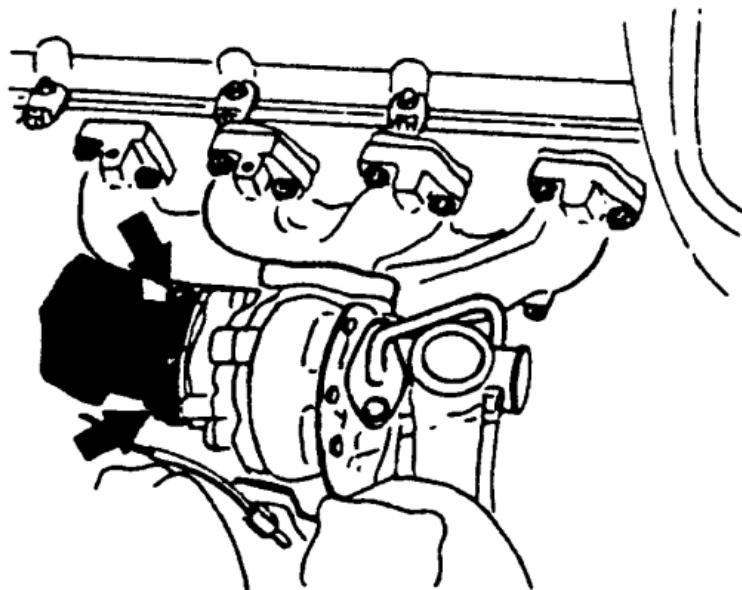


Fig. Fig. 2: Disconnect the turbo unit from the exhaust manifold

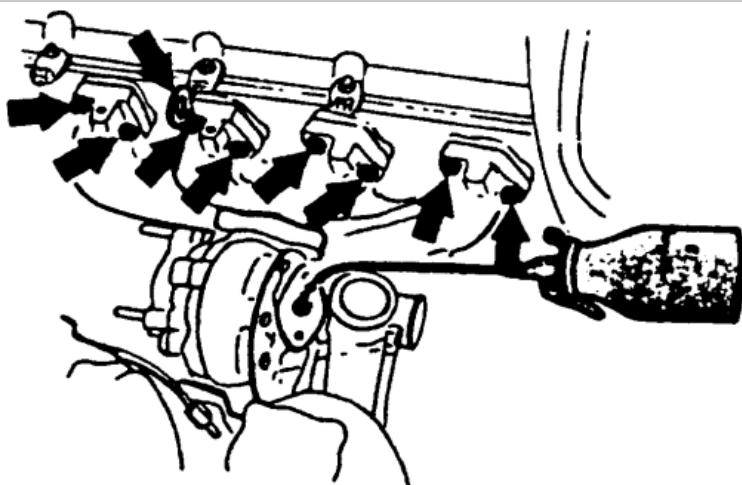


Fig. Fig. 3: Lubricating the exhaust manifold bolts with a proper rust penetrant or lubricant aids their installation into the cylinder head. Note the manifold bolt locations

2.3L and 2.4L 5-Cylinder Engines

See Figure 4

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

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.

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

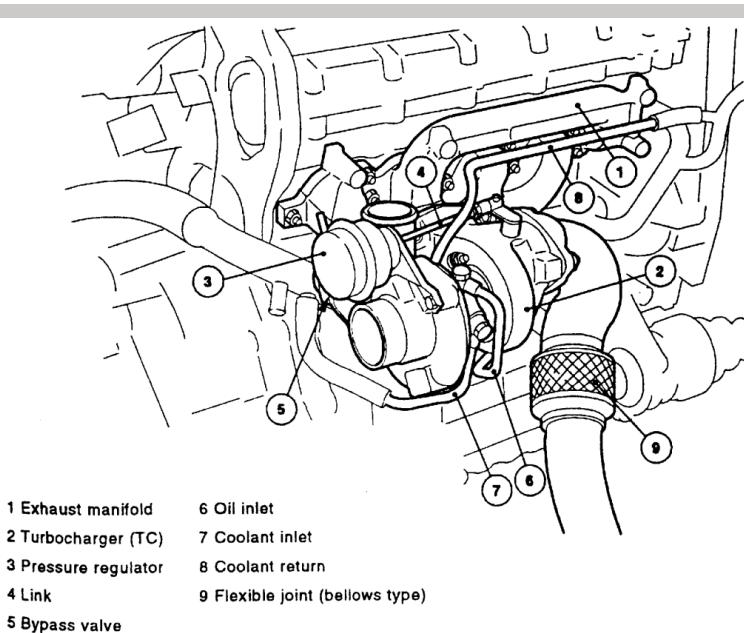


Fig. Fig. 4: Turbocharger assembly and related components-2.3L and 2.4L 5-cylinder engines

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Water Pump

REMOVAL & INSTALLATION

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See Figure 1

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.

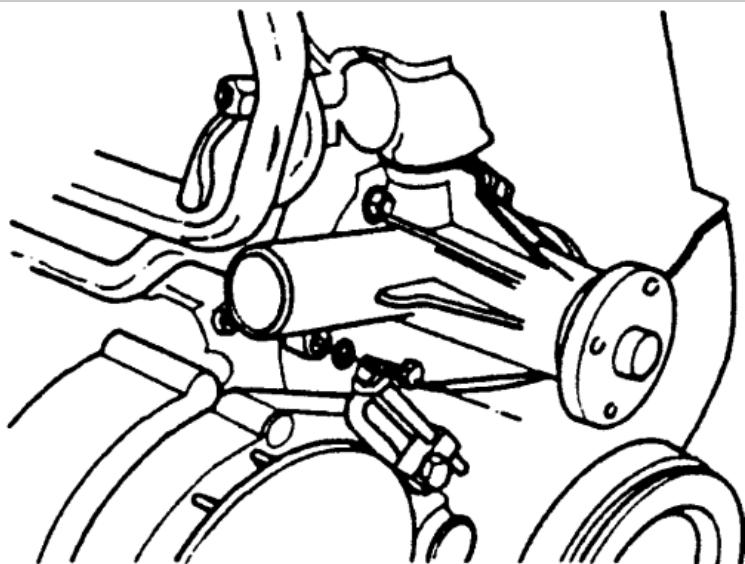


Fig. Fig. 1: Water pump installation on the 2.3L 4-cylinder

2.8L 6-Cylinder Engine

See Figure 2

1. Disconnect the negative battery cable.

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.

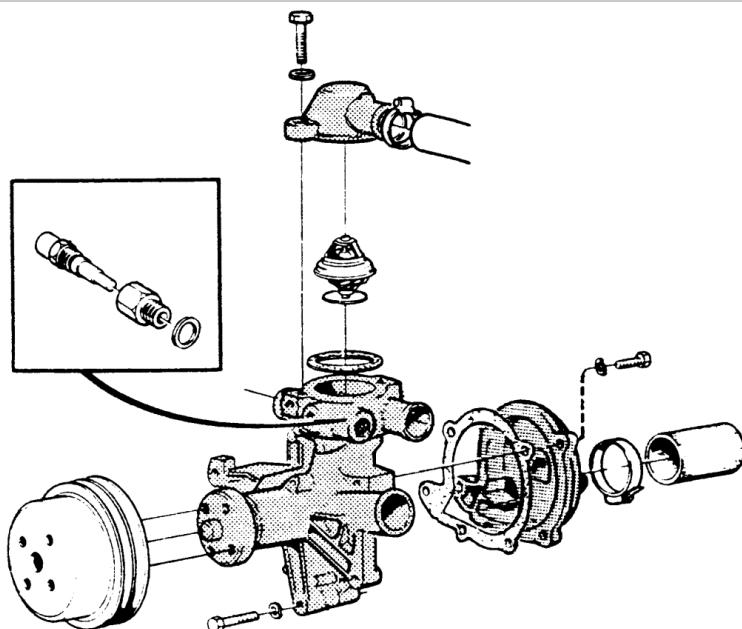


Fig. Fig. 2: Exploded view of the water pump assembly on the 2.8L 6-cylinder engine

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

See Figures 3, 4 and 5

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:

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.

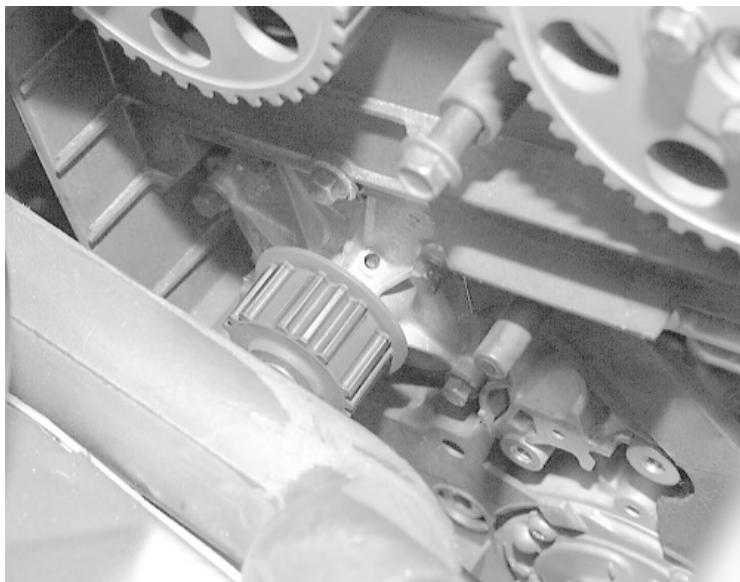


Fig. Fig. 3: The water pump is retained by eight bolts (some are hidden in photo)

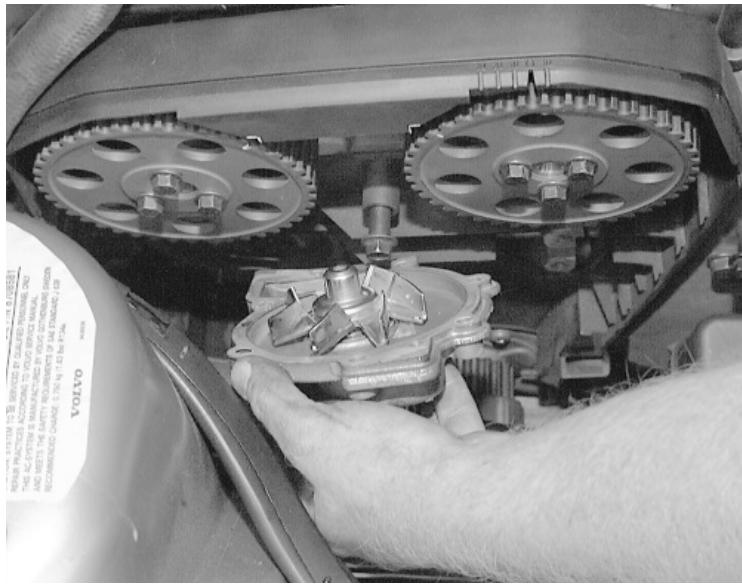


Fig. Fig. 4: Unfasten the retaining bolts and carefully remove the water pump from the engine

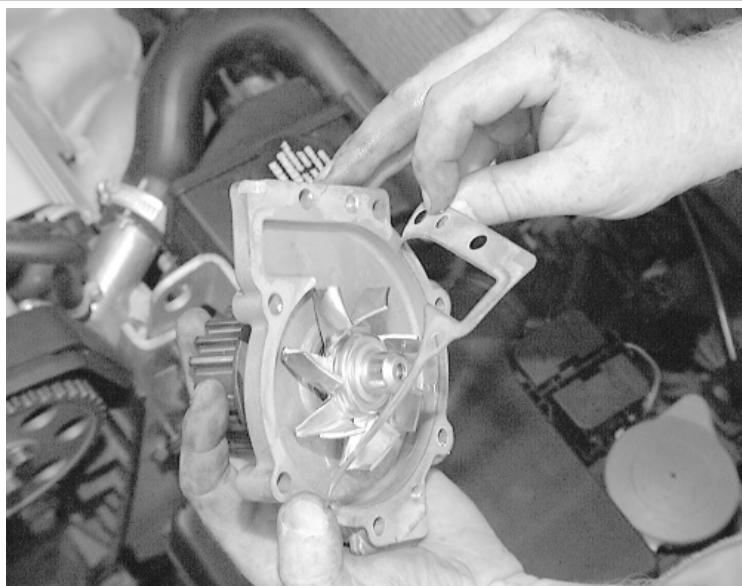


Fig. Fig. 5: Position a new gasket on the pump before installing it

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AIR POLLUTION

The earth's atmosphere, at or near sea level, consists approximately of 78 percent nitrogen, 21 percent oxygen and 1 percent other gases. If it were possible to remain in this state, 100 percent clean air would result. However, many varied sources allow other gases and particulates to mix with the clean air, causing our atmosphere to become unclean or polluted.

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Some of these pollutants are visible while others are invisible, with each having the capability of causing distress to the eyes, ears, throat, skin and respiratory system. Should these pollutants become concentrated in a specific area and under certain conditions, death could result due to the displacement or chemical change of the oxygen content in the air. These pollutants can also cause great damage to the environment and to the many man made objects that are exposed to the elements.

To better understand the causes of air pollution, the pollutants can be categorized into 3 separate types, natural, industrial and automotive.

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Automotive Pollutants

The third major source of air pollution is automotive emissions. The emissions from the internal combustion engines were not an appreciable problem years ago because of the small number of registered vehicles and the nation's small highway system. However, during the early 1950's, the trend of the American people was to move from the cities to the surrounding suburbs. This caused an immediate problem in transportation because the majority of suburbs were not afforded mass transit conveniences. This lack of transportation created an attractive market for the automobile manufacturers, which resulted in a dramatic increase in the number of vehicles produced and sold, along with a marked increase in highway construction between cities and the suburbs. Multi-vehicle families emerged with a growing emphasis placed on an individual vehicle per family member. As the increase in vehicle ownership and usage occurred, so did pollutant levels in and around the cities, as suburbanites drove daily to their businesses and employment, returning at the end of the day to their homes in the suburbs.

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It was noted that a smoke and fog type haze was being formed and at times, remained in suspension over the cities, taking time to dissipate. At first this "smog," derived from the words "smoke" and "fog," was thought to result from industrial pollution but it was determined that automobile emissions shared the blame. It was discovered that when normal automobile emissions were exposed to sunlight for a period of time, complex chemical reactions would take place.

It is now known that smog is a photo chemical layer which develops when certain oxides of nitrogen (NO_x) and unburned hydrocarbons (HC) from automobile emissions are exposed to sunlight. Pollution was more severe when smog would become stagnant over an area in which a warm layer of air settled over the top of the cooler air mass, trapping and holding the cooler mass at ground level. The trapped cooler air would keep the emissions from being dispersed and diluted through normal air flows. This type of air stagnation was given the name "Temperature Inversion."

TEMPERATURE INVERSION

In normal weather situations, surface air is warmed by heat radiating from the earth's surface and the sun's rays. This causes it to rise upward, into the atmosphere. Upon rising it will cool through a convection type heat exchange with the cooler upper air. As warm air rises, the surface pollutants are carried upward and dissipated into the atmosphere.

When a temperature inversion occurs, we find the higher air is no longer cooler, but is warmer than the surface air, causing the cooler surface air to become trapped. This warm air blanket can extend from above ground level to a few hundred or even a few thousand feet into the air. As the surface air is trapped, so are the pollutants, causing a severe smog condition. Should this stagnant air mass extend to a few thousand feet high, enough air movement with the inversion takes place to allow the smog layer to rise above ground level but the pollutants still cannot dissipate. This inversion can remain for days over an area, with the smog level only rising or lowering from ground level to a few hundred feet high. Meanwhile, the pollutant levels increase, causing eye irritation, respiratory problems, reduced visibility, plant damage and in some cases, even disease.

This inversion phenomenon was first noted in the Los Angeles, California area. The city lies in terrain resembling a basin and with certain weather conditions, a cold air mass is held in the basin while a warmer air mass covers it like a lid.

Because this type of condition was first documented as prevalent in the Los Angeles area, this type of trapped pollution was named Los Angeles Smog, although it occurs in other areas where a large concentration of automobiles are used and the air remains stagnant for any length of time.

HEAT TRANSFER

Consider the internal combustion engine as a machine in which raw materials must be placed so a finished product comes out. As in any machine operation, a certain amount of wasted material is formed. When we relate this to the internal combustion engine, we find that through the input of air and fuel, we obtain power during the combustion process to drive the vehicle. The by-product or waste of this power is, in part, heat and exhaust gases with which we must dispose.

The heat from the combustion process can rise to over 4000°F (2204°C). The dissipation of this heat is controlled by a ram air effect, the use of cooling fans to cause air flow and a liquid coolant solution surrounding the combustion area to transfer the heat of combustion through the cylinder walls and into the coolant. The coolant is then directed to a thin-finned, multi-tubed radiator, from which the excess heat is transferred to the atmosphere by 1 of the 3 heat transfer methods, conduction, convection or radiation.

The cooling of the combustion area is an important part in the control of exhaust emissions. To understand the behavior of the combustion and transfer of its heat, consider the air/fuel charge. It is ignited and the flame front burns progressively across the combustion chamber until the burning charge reaches the cylinder walls. Some of the fuel in contact with the walls is not hot enough to burn, thereby snuffing out or quenching the combustion process. This leaves unburned fuel in the combustion chamber. This unburned fuel is then forced out of the cylinder and into the exhaust system, along with the exhaust gases.

Many attempts have been made to minimize the amount of unburned fuel in the combustion chambers due to quenching, by increasing the coolant temperature and lessening the contact area of the coolant around the combustion area. However, design limitations within the combustion chambers prevent the complete burning of the air/fuel charge, so a certain amount of the unburned fuel is still expelled into the exhaust system, regardless of modifications to the engine.

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Industrial Pollutants

Industrial pollution is caused primarily by industrial processes, the burning of coal, oil and natural gas, which in turn produce smoke and fumes. Because the burning fuels contain large amounts of sulfur, the principal ingredients of smoke and fumes are sulfur dioxide and particulate matter. This type of pollutant occurs most severely during still, damp and cool weather, such as at night. Even in its less severe form, this pollutant is not confined to just cities. Because of air movements, the pollutants move for miles over the surrounding countryside, leaving in its path a barren and unhealthy environment for all living things.

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Working with Federal, State and Local mandated regulations and by carefully monitoring emissions, big business has greatly reduced the amount of pollutant introduced from its industrial sources, striving to obtain an acceptable level. Because of the mandated industrial emission clean up, many land areas and streams in and around the cities that were formerly barren of vegetation and life, have now begun to move back in the direction of nature's intended balance.

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Natural Pollutants

Natural pollution has been present on earth since before man appeared and continues to be a factor when discussing air pollution, although it causes only a small percentage of the overall pollution problem. It is the direct result of decaying organic matter, wind born smoke and particulates from such natural events as plain and forest fires (ignited by heat or lightning), volcanic ash, sand and dust which can spread over a large area of the countryside.

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Such a phenomenon of natural pollution has been seen in the form of volcanic eruptions, with the resulting plume of smoke, steam and volcanic ash blotting out the sun's rays as it spreads and rises higher into the atmosphere. As it travels into the atmosphere the upper air currents catch and carry the smoke and ash, while condensing the steam back into water vapor. As the water vapor, smoke and ash travel on their journey, the smoke dissipates into the atmosphere while the ash and moisture settle back to earth in a trail hundreds of miles long. In some cases, lives are lost and millions of dollars of property damage result.

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BASIC FUEL SYSTEM DIAGNOSIS

When there is a problem starting or driving a vehicle, two of the most important checks involve the ignition and the fuel systems. The questions most mechanics attempt to answer first, "is there spark?" and "is there fuel?" will often lead to solving most basic problems. For ignition system diagnosis and testing, please refer to the information on engine electrical components and ignition systems found earlier in this guide. If the ignition system checks out (there is spark), then you must determine if the fuel system is operating properly (is there fuel?).

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Air Bag Module

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In addition to a driver side air bag module, some models contain a passenger side air bag module, located above the glove box.

Driver Side

See Figures 1, 2 and 3

WARNING

Before working near the steering wheel, read the SRS service precautions earlier in this section.

1. Place the front wheels in a straight-ahead position.
2. Disconnect the negative battery cable AND TAPE the cable end away from the battery.
3. Turn the ignition key to position / so that the steering lock is OFF.
4. On some models, remove the sound insulation knee guard and the side panel from the center console.
5. Turn the steering wheel slightly in order to reach the 2 Torx® bolts in back of the steering wheel.
6. Remove the two attaching bolts.
7. Disconnect the connector and remove the air bag module.

CAUTION

Be sure to carry the air bag module with the pad facing away from you, and place it on a workbench or other flat surface with the pad facing upward. This will reduce the chance of injury in the event of accidental deployment.

Do not turn the ignition switch

ON while the air bag assembly is removed, as this will register a fault code.

To install:

8. Rest the bottom of the air bag assembly on the steering wheel and reattach the connector.
9. Place the air bag module in position, being careful not to get the leads caught.
10. Install and tighten the retaining bolts to 53 inch lbs. (6 Nm).

When tightening the air bag assembly retaining bolts, tighten the right side bolt first.

11. Install the knee guard (if removed).

CAUTION

When connecting the battery, make sure that no one is in the vehicle, in case of an SRS malfunction causing accidental air bag deployment.

- 12.** Connect the negative battery cable.
- 13.** Turn the ignition on and check the SRS system for codes.



Fig. Fig. 1: Remove the driver side air bag modules retaining bolts ...



Fig. Fig. 2: ... and carefully pull the module from the steering wheel

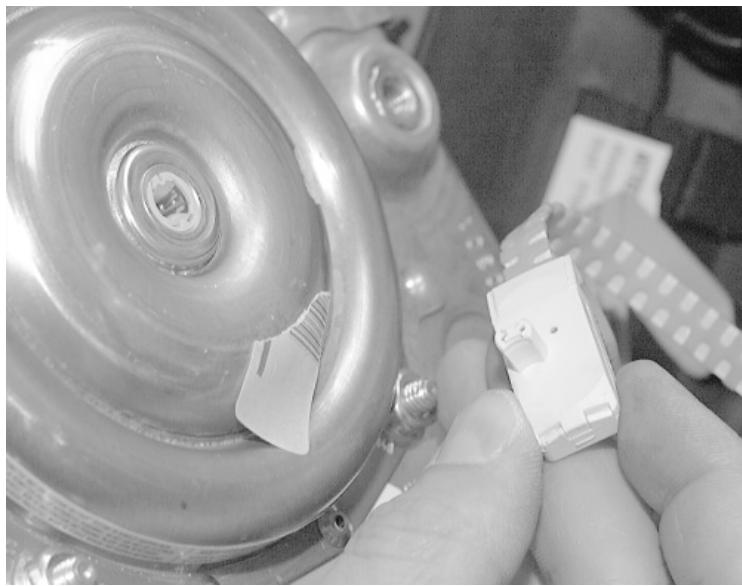


Fig. Fig. 3: Unplug the connector from the air bag and remove the module from the car. Handle and store the module safely, as described

Passenger Side

The passenger side air bag is removed when the instrument panel cover is removed. See the Instrument Cluster Removal and Installation procedure, later in this section, for removal of the cover. After the cover is removed, the air bag module is simply unbolted from the cover. To install, tighten the module retaining bolts and install the cover back onto the instrument panel.

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Contact Reel

REMOVAL & INSTALLATION

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WARNING

Before working near the steering wheel, read the SRS service precautions earlier in this section.

1. Place the front wheels in a straight-ahead position.
2. Disconnect the negative battery cable AND TAPE the cable end away from the battery.
3. Remove the air bag assembly.

Do not turn the ignition switch ON while the air bag assembly is removed, as this will register a fault code.

4. Unfasten the retaining bolt and remove the steering wheel. On some models, it may be necessary to use a puller; if so, follow the tool manufacturers instructions.
5. Detach the connector and remove the contact reel.

To install:

6. Set the contact reel to the zero position. If the contact reel must be "zeroed," turn the reel to the far right end and then back 3 revolutions to the left. Lock the contact reel with the screw in the plastic strip.
7. Install the steering wheel.
8. Install the air bag assembly.

CAUTION

When connecting the battery, make sure that no one is in the vehicle, in case of an SRS malfunction causing accidental air bag deployment.

9. Reconnect the negative battery cable.
10. Check the vehicle operation and SRS system for fault codes.

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General Information

See Figures 1 and 2

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The air bag system used on Volvo vehicles is referred to as Supplemental Restraint System (SRS). The SRS system provides additional protection for the driver, if a forward collision of sufficient force is encountered. The SRS assists the normal seat belt restraining system by deploying an air bag, via the steering wheel and, on some models, the passenger side of the dashboard.

The system also includes a knee bolster at the lower steering column area. It is used to absorb energy and control the driver's forward movement during an accident by limiting leg movement.

The system also includes a battery voltage check. The SRS warning lamp will illuminate, if the voltage falls below 9 volts. When the voltage rises above 9 volts again, the lamp will go out after approximately 10 seconds.

The SRS system is monitored continuously by a microprocessor in the crash sensor. Any fault which is detected is stored in the memory and the SRS warning lamp will turn ON.

Some later Volvo models are equipped with a Side Impact Protection System (SIPS). Vehicles equipped with SIPS will contain a decal possibly located on the front windshield, drivers side of the instrument panel, below the seat pocket, or on the drivers side B-pillar.

The object of the SIPS system is to protect the occupants in the event of certain side-impact accidents. An air bag is deployed to cushion the impact against the outer side of the vehicle. This system uses sensor mounted in the seat bottom, just outside the seat track. If an accident occurs, the bag could deploy, triggered based upon information gathered by the crash sensor measuring the violence of the collision. This sophisticated process occurs in milliseconds.

The SIPS system is not part of the SRS system and has its own function, in fact unlike the SRS system, the SIPS system can deploy one side without deploying the other, depending on which side the impact occurs.

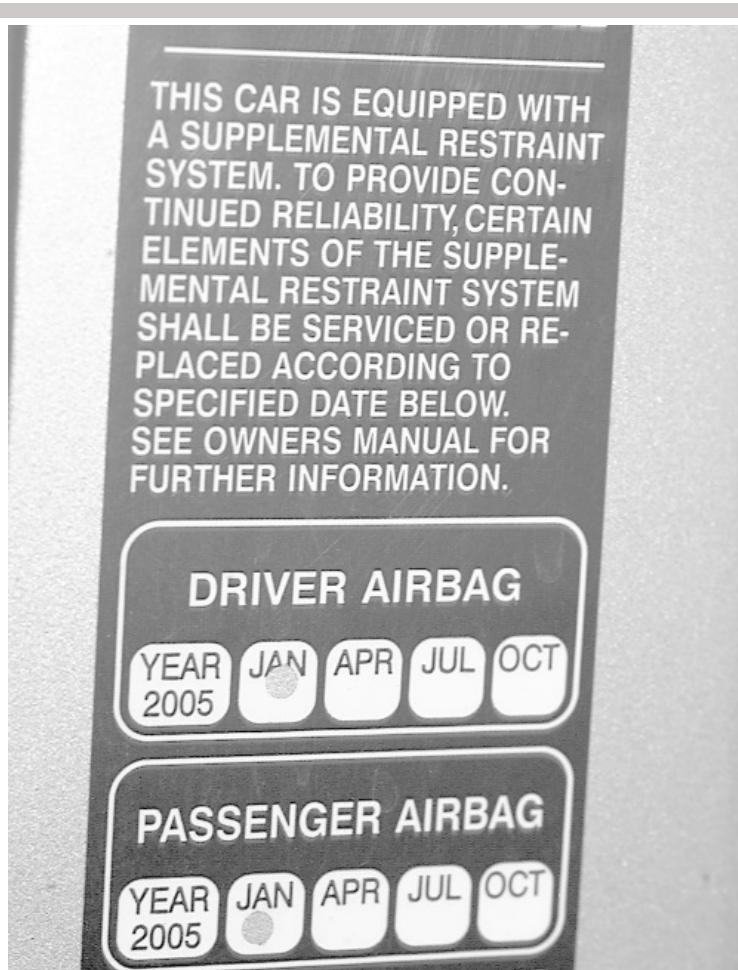


Fig. Fig. 1: This label is a reminder of the presence of a Supplemental Restraint System (SRS); be sure to heed the information

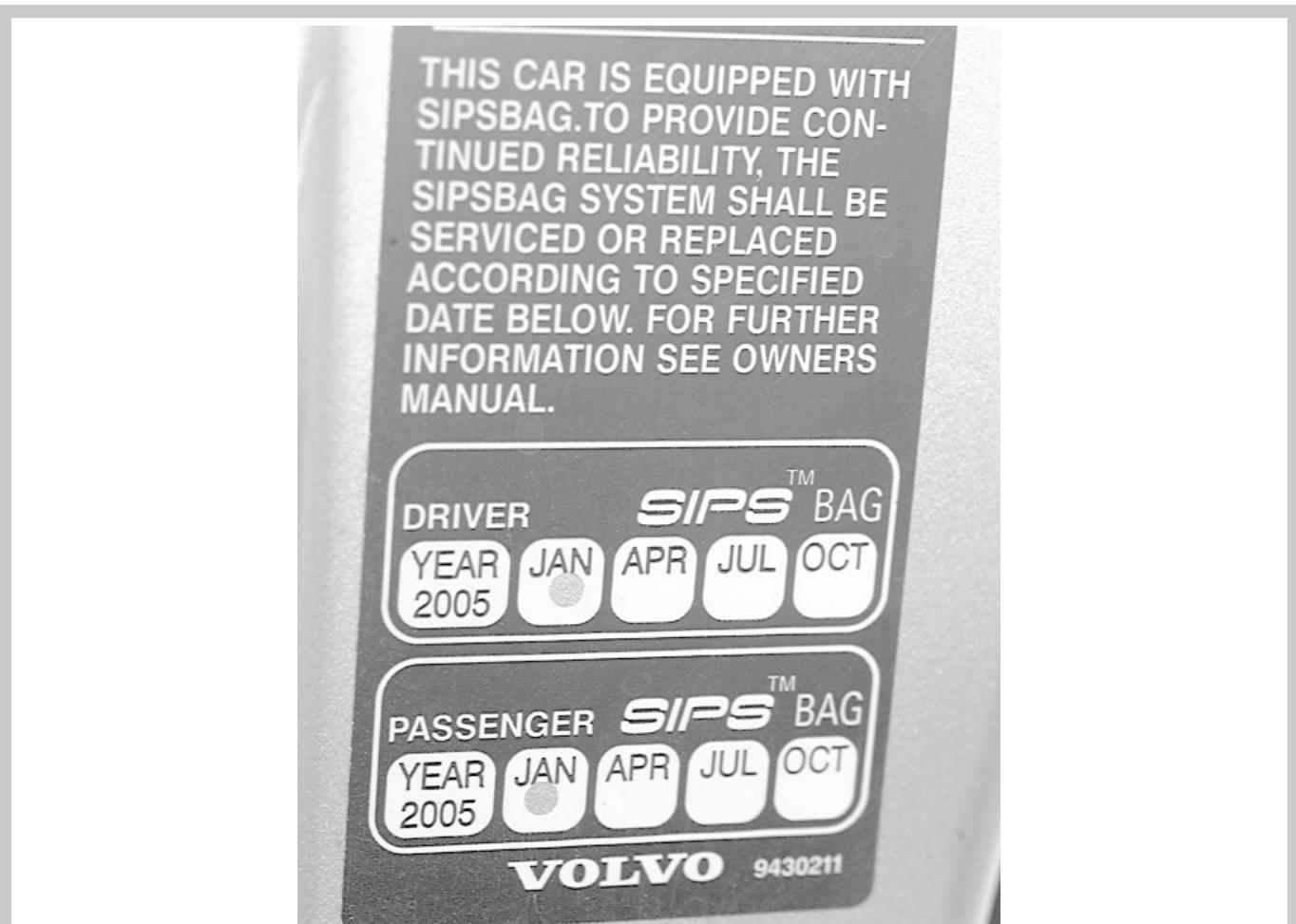


Fig. Fig. 2: This label is a notification of the presence of a Side Impact Protection System (SIPS); again, note the service requirements

SYSTEM OPERATION

Under normal conditions, the SRS warning lamp will come ON when the ignition switch is turned to the *ON* position. If the engine is not started, the lamp will be extinguished after approximately 10 seconds. Failure of the warning lamp to go OFF, while driving, indicates a fault in the SRS system. The warning lamp will remain lit until the fault is corrected and the memory cleared.

The crash sensor records a combination of G-force and prolong deceleration. When a sufficiently high G-force and prolong deceleration are simultaneously recorded, the power unit will deliver a current which will trigger the gas generator of the inflatable bag. The bag will be filled in a few hundredths of a second with non-toxic nitrogen. Immediately after the collision, the gas is released through a ventilation hole and the air bag slowly collapses. The entire sequence of inflation and collapse takes approximately 0.2 milliseconds.

The SIPS system works very similar to the SRS, however the SIPS is completely mechanical. Only three components per side of the vehicle are used. The crash sensor operates very similar to the SRS and activates when an impact of the deformed door hits the sensor at a speed greater than 2 milliseconds or 6.6 ft. per second. No electricity is used, the crash sensor deploys an igniter that uses a charge very similar to the way a shotgun is fired to fill the bag.

The SIPS bag deploys and breaks through the seat cushion SIPS module cover. A stitch seam in the seat is strategically placed to aid in this process. The bag deploys toward the door to help protect the driver/passenger's rib cage during a side-impact collision. There is a vent on the underside of the bag which will allow the bag to deflate slowly, acting as a brake on the driver/passenger.

SERVICE PRECAUTIONS

Since the Supplemental Restraint System (SRS) is such a complex and critical safety system (which requires special precautions when repairs are being made), Volvo recommends that all repairs to the SRS system be performed by Volvo SRS-trained technicians.

CAUTION

To avoid deployment when servicing the SRS system or components in the immediate area, do not use electrical test equipment such as battery or AC powered voltmeter, ohmmeter, etc. or any type of tester other than specified. Do not use a non-powered probe tester. To avoid personal injury all precautions must be strictly adhered to.

- ❑ All work which includes removing or replacing the air bag assembly must be carried out with the battery disconnected and with the ignition turned *OFF* for the duration of work. This is to ensure that the air bag does not accidentally inflate during service repairs and that no faults codes will register, requiring subsequent cancellation.
- ❑ When working around the instrument panel or steering column, take special care to ensure that the SRS wiring are not pinched, chafed or penetrated by bolts/screws, etc. This is most likely to happen when installing the sound insulation, knee bolsters, ignition lock or steering column cover.
- ❑ For air bag fault tracing purposes and/or to check the system, use multimeter 999 6525 and test resistor 998 86595 or their equivalents.
- ❑ Do not disassemble or tamper with the air bag assembly.
- ❑ Always store a removed air bag assembly with the pad surface upwards.
- ❑ Never install used SRS parts from another vehicle.
- ❑ Never replace the original steering wheel with any other design, since it will make it impossible to properly install the air bag.

- Always detach the yellow SRS connector when performing any diagnostic troubleshooting or service procedure associated with the SRS system.
- When repairs are made to the front suspension and steering, be aware that the contact reel can only withstand being turned 3 turns in either direction.
- Never install an air bag assembly that shows signs of being dropped or improperly handled, such as dents, cracks or deformation.
- When replacing a sensor, the replacement unit should be installed with the directional arrow oriented.
- Do not energize the system until all components are connected. A failure code may appear.
- Always wear gloves and safety glasses when handling the air bag assembly. Wash hands with mild soap and water afterwards.
- Always store the air bag assembly on a secure flat surface, away from high heat source and free of oil, grease, detergent or water.
- Never disconnect any electrical connection with the ignition switch *ON* unless instructed to do so in a test.
- Before disconnecting the negative battery cable, make a record of the contents memorized by each memory system (audio, seats, etc.). Then when service or repairs are completed, make certain to reset these memory systems.

DISARMING THE SYSTEM

1. Turn the ignition switch to the *OFF* position.
2. Disconnect the negative battery cable AND TAPE the cable end away from the battery.

ARMING THE SYSTEM

Assuming that the system components (air bag control module, sensors, air bag, etc.) are installed correctly and are in good working order, the system is armed whenever the battery's positive and negative battery cables are connected.

WARNING

If you have disarmed the air bag system for any reason, and are re-arming the system, make sure no one is in the vehicle (as an added safety measure), then connect the negative battery cable.

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Back-up Light Switch

REMOVAL & INSTALLATION

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1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.
3. Unplug the back-up light switch connector.
4. Unscrew the back-up light switch connector from the transaxle and remove it.

To install:

5. Thread the switch into the transaxle and tighten.
6. Plug the electrical connector in.
7. Lower the vehicle.
8. Connect the negative battery cable.

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REPAIR GUIDE

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Halfshafts

REMOVAL & INSTALLATION

[Print](#)

850, C70, S70 and V70 Models

See Figures 1, 2, 3, 4, 5, 6 and 7

1. With the vehicle sitting on all four wheels, loosen the axle shaft nut.
2. Raise and safely support the vehicle.
3. Remove the wheels.
4. Disconnect the ABS sensor from the halfshaft, but do not disconnect the harness.
5. Disconnect all brackets for brake lines and ABS wiring on both sides and let them hang.
6. Remove the axle nut.
7. Push the end of the halfshaft from hub using a soft drift and a mallet.
8. Disconnect the sway bar from the link.
9. Remove all splash guards.
10. Separate the ball joint from control arm, being careful not to damage the boots.
11. For the right side halfshaft, remove the bearing cap and pull the shaft out of the transmission while holding the strut out of the way.

- 12.** Install a plug in the transmission.

Be careful not to damage the transmission seal.

- 13.** For left side, remove the halfshaft by carefully prying between the transmission and the halfshaft.
- 14.** Hold the strut assembly out of the way.
- 15.** Install a plug in the transmission.

To install:

- 16.** Install the right halfshaft and tighten the bearing cap to 19 ft. lbs. (25 Nm).
- 17.** Install the splashguard.

Make sure that the transmission axle seal and axle boot are not damaged.

- 18.** Clean the ABS wheel if necessary.
- 19.** Apply metal adhesive to the halfshaft splines. Carefully press shaft in so that the lock ring engages with the differential gear. Check it by carefully pulling on the shaft joint housing.
- 20.** Install the axle nut and hand-tighten.
- 21.** Connect the ball joints using new nuts.
- 22.** Install the sway bar link using new nuts.
- 23.** Connect the brake line and ABS cable bracket on both sides.
- 24.** Install the ABS sensor on the halfshaft and clean it with a soft brush.
- 25.** Install the wheels.
- 26.** With all four wheels on the ground, tighten the axle nut to 89 ft. lbs. (120 Nm) plus an additional 60°. Lock the nut by staking its flange into the driveshaft groove.



Fig. Fig. 1: Loosening the axle nut will be tough; it is sometimes easier to do with the wheels on the ground



Fig. Fig. 2: After loosening, remove the axle nut



Fig. Fig. 3: Remove the nut retaining the lower ball joint to the spindle

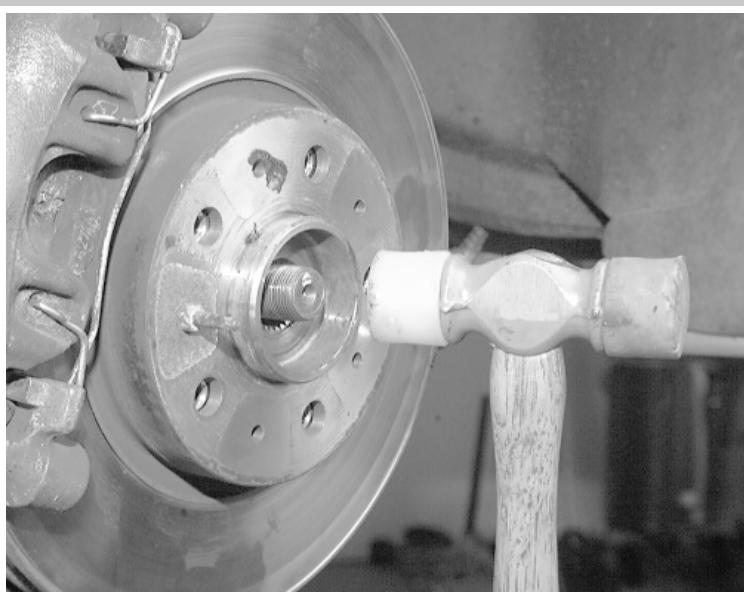


Fig. Fig. 4: After the lower control arm is separated from the spindle, tap the halfshaft out of the hub

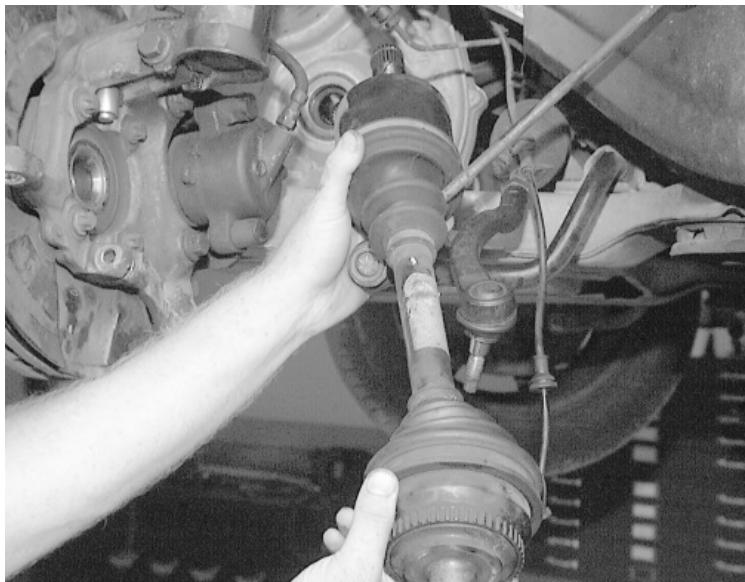


Fig. Fig. 5: The halfshaft will need to be removed from the transaxle with a prybar or suitable tool



Fig. Fig. 6: After the halfshaft is removed, inspect the axle seal and ...

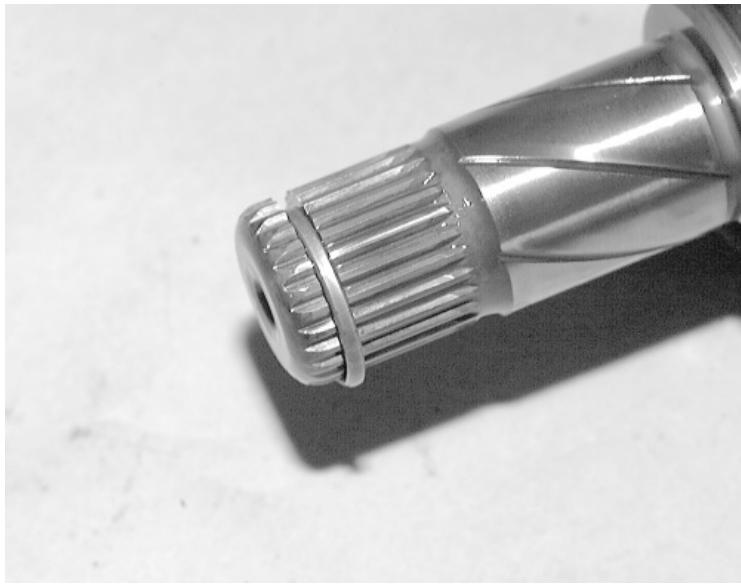


Fig. Fig. 7: ... the halfshaft retaining ring on the spline shaft

CV-JOINTS OVERHAUL

See Figures 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 and 21

These vehicles use several different types of joints. Engine size, transaxle type, whether the joint is an inboard or outboard joint, even which side of the vehicle is being serviced could make a difference in joint type. Be sure to properly identify the joint before attempting joint or boot replacement. Look for identification numbers at the large end of the boots and/or on the end of the metal retainer bands.

The 3 types of joints used are the Birfield Joint, (B.J.), the Tripod Joint (T.J.) and the Double Offset Joint (D.O.J.).

Do not disassemble a Birfield joint. Service with a new joint or clean and repack using a new boot kit.

The distance between the large and small boot bands is important and should be checked prior to and after boot service. This is so the boot will not be installed either too loose or too tight, which could cause early wear and cracking, allowing the grease to get out and water and dirt in, leading to early joint failure.

The driveshaft joints use special grease; do not add any grease other than that supplied with the kit.

Double Offset Joint

The Double Offset Joint (D.O.J.) is bigger than other joints and, in these applications, is normally used as an inboard joint.

1. Remove the halfshaft from the vehicle.
2. Side cutter pliers can be used to cut the metal retaining bands. Remove the boot from the joint outer race.
3. Locate and remove the large circlip at the base of the joint. Remove the outer race (the body of the joint).
4. Remove the small snapring and take off the inner race, cage and balls as an assembly. Clean the inner race, cage and balls without disassembling.
5. If the boot is to be reused, wipe the grease from the splines and wrap the splines in vinyl tape before sliding the boot from the shaft.
6. Remove the inner (D.O.J.) boot from the shaft. If the outer (B.J.) boot is to be replaced, remove the boot retainer rings and slide the boot down and off of the shaft at this time.

To install:

7. Be sure to tape the shaft splines before installing the boots. Fill the inside of the boot with the specified grease. Often the grease supplied in the replacement parts kit is meant to be divided in half, with half being used to lubricate the joint and half being used inside the boot.
8. Install the cage onto the halfshaft so the small diameter side of the cage is installed first. With a brass drift pin, tap lightly and evenly around the inner race to install the race until it comes into contact with the rib of the shaft. Apply the specified grease to the inner race and cage and fit them together. Insert the balls into the cage.
9. Install the outer race (the body of the joint) after filling with the specified grease. The outer race should be filled with this grease.
10. Tighten the boot bands securely. Make sure the distance between the boot bands is correct.
11. Install the halfshaft to the vehicle.

Except Double Offset Joint

1. Disconnect the negative battery cable. Remove the halfshaft.
2. Use side cutter pliers to remove the metal retaining bands from the boot(s) that will be removed. Slide the boot from the T.J. case.
3. Remove the snapring and the tripod joint spider assembly from the halfshaft. Do not disassemble the spider and use care in handling.
4. If the boot is to be reused, wrap vinyl tape around the spline part of the shaft so the boot(s) will not be damaged when removed. Remove the dynamic damper, if used, and the boots from the shaft.

To install:

5. Double check that the correct replacement parts are being installed. Wrap vinyl tape around the splines to protect the boot and install the boots and damper, if used, in the correct order.
6. Install the joint spider assembly to the shaft and install the snapring.
7. Fill the inside of the boot with the specified grease. Often the grease supplied in the replacement parts kit is meant to be divided in half, with half

being used to lubricate the joint and half being used inside the boot. Keep grease off the rubber part of the dynamic damper (if used).

8. Secure the boot bands with the halfshaft in a horizontal position. Make sure distance between boot bands is correct.

9. Install the halfshaft to the vehicle and reconnect the negative battery cable.



Fig. Fig. 8: Check the CV-boot for wear

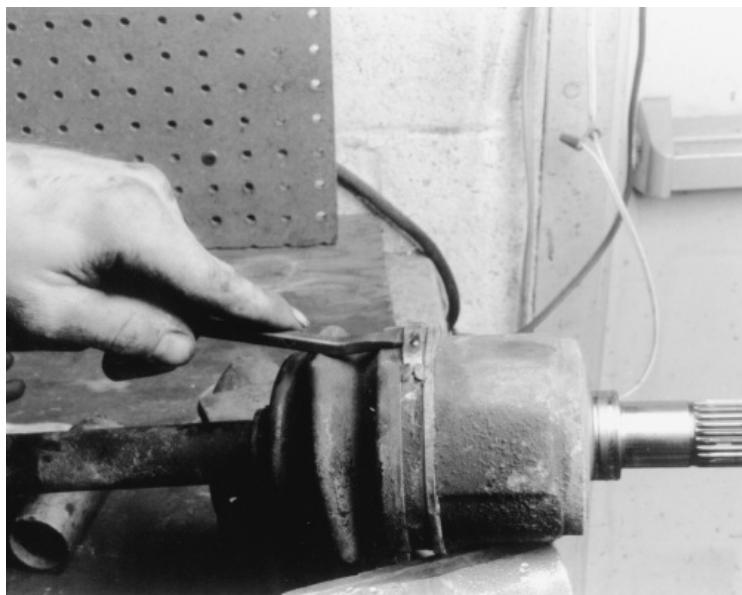


Fig. Fig. 9: Removing the outer band from the CV-boot



Fig. Fig. 10: Removing the inner band from the CV-boot



Fig. Fig. 11: Removing the CV-boot from the joint housing



Fig. Fig. 12: Clean the CV-joint housing prior to removing boot



Fig. Fig. 13: Removing the CV-joint housing assembly



Fig. Fig. 14: Removing the CV-joint



Fig. Fig. 15: Inspecting the CV-joint housing

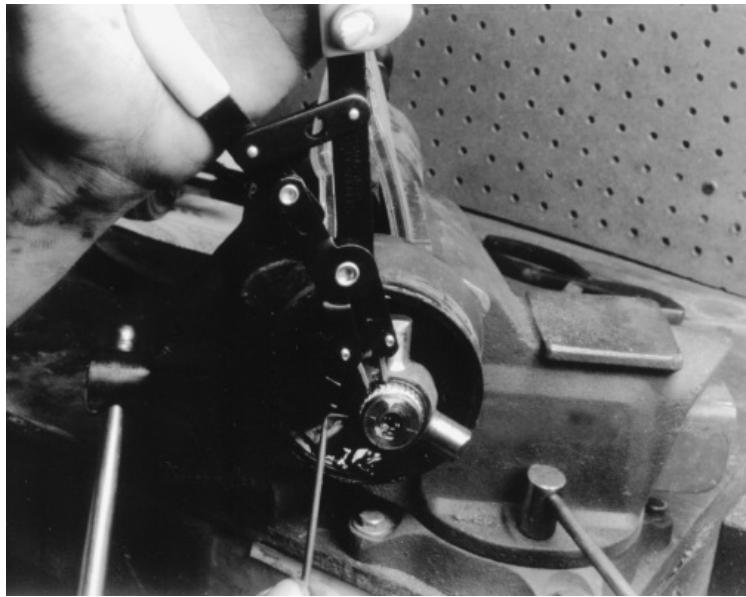


Fig. Fig. 16: Removing the CV-joint outer snapring

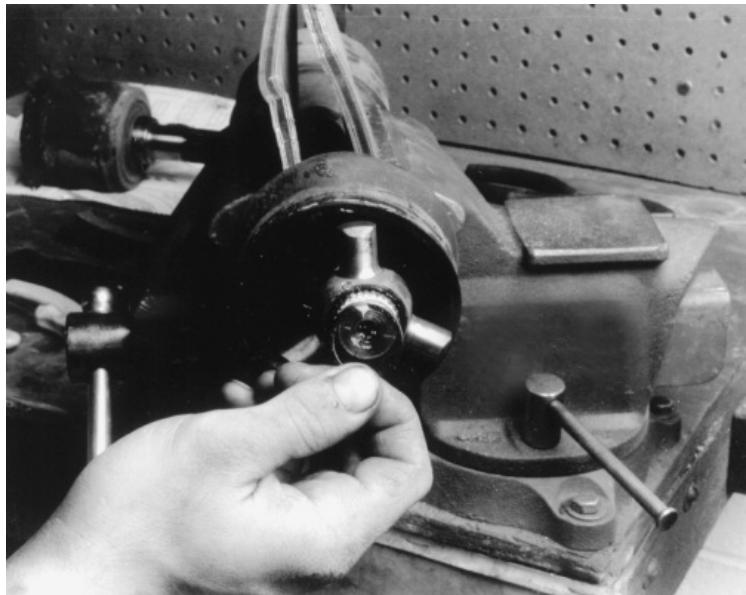


Fig. Fig. 17: Checking the CV-joint snapring for wear



Fig. Fig. 18: CV-joint snapping (typical)

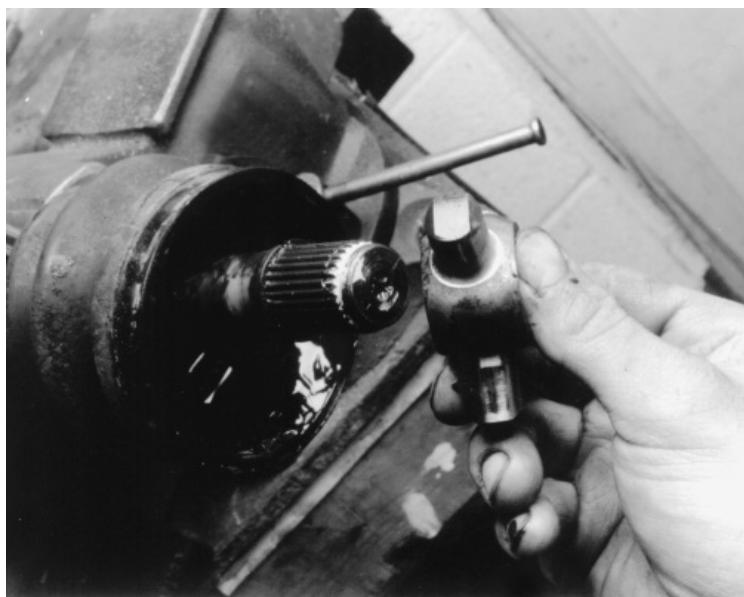


Fig. Fig. 19: Removing the CV-joint assembly



Fig. Fig. 20: Removing the CV-joint inner snapring



Fig. Fig. 21: Installing the CV-joint assembly (typical)

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Manual Transaxle Assembly

REMOVAL & INSTALLATION

850

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1. With all four wheels on the ground, loosen the front axle shaft locknuts.
2. Place the transaxle in *N* and set the parking brake.
3. Disconnect and remove the battery, air cleaner air intake ducts.
4. Remove the battery tray.
5. On turbocharged models, disconnect the timing valve from air cleaner and the turbocharger air duct clamp and hose.
6. Disconnect the gear selector cables from the brackets and lever.
7. Remove the selector link plate after tapping out the lock pin.
8. Detach the back-up light switch connector.
9. On turbocharged models remove the control pulley cover.
10. Disconnect the turbocharger inlet pipe and tie it back out of the way.
11. Disconnect the upper coolant hose to the engine oil cooler.

- 12.** Disconnect the clutch slave cylinder and remove the clip.
- 13.** Remove the ground strap from the transaxle.
- 14.** Loosen the rear engine mount and splash guard nut.
- 15.** Remove the bolts connecting the engine, transaxle and starter.
- 16.** Disconnect the transaxle ground strap.
- 17.** Disconnect the ground strap from the firewall.
- 18.** Remove the torque arm bolt.
- 19.** Secure the engine from above with an engine support that rests on the inner edges of the engine compartment.
- 20.** Lift the engine up slightly to take weight off the engine mounts.
- 21.** Raise and safely support the vehicle and remove the wheels.
- 22.** Disconnect the ABS sensor from the left side axle shaft, but do not unfasten the connector.
- 23.** Drain the gear oil from the transaxle.
- 24.** Disconnect all brackets for the front brake lines and ABS wiring for both sides of the vehicle.
- 25.** Remove the plastic inner fender liners on both sides.
- 26.** Remove and discard the axle shaft locknuts.
- 27.** Separate the ball joint from control arm, being careful not to damage the boots.
- 28.** Disconnect the sway bar links on both sides.
- 29.** Remove the mounting screws holding the cable to the front of the subframe and disconnect the cable from the subframe.
- 30.** Disconnect the carbon canister hoses.
- 31.** Disconnect the exhaust pipe clamp behind the catalytic converter.
- 32.** Remove the left and right halfshafts.

Be careful not to damage the transaxle seal.

- 33.** Install seal plugs in the transaxle.
- 34.** Loosen the two right side subframe-to-body bolts approximately $\frac{1}{2}$ in. (15mm).
- 35.** Remove the subframe-to-body bolts on the left side.

Make sure the steering gear bolts come out of the subframe and the control arm is free of the axle shaft boot on the right side.

- 36.** Remove the jack and let the frame hang down from the right side bolts.
- 37.** Tie the left side of the steering gear to the left side frame rail for support.
- 38.** Remove the steering gear engine mount bolt and nut at the top of the mount and remove.

Make sure the steering gear is properly secured so the lower steering shaft does not slide out of the steering column.

- 39.** Disconnect the oxygen sensor wiring clamps from the cover, as well as the connector and wiring to the vehicle speed sensor.
- 40.** Remove the cover at the back of the engine and the mount from the transaxle.
- 41.** Lower the engine and transaxle with the lifting hook.

WARNING

If the engine is lowered too far, the exhaust pipe will be crushed against the steering rack. Be careful not to pinch any wiring or hoses and be sure that the engine dipstick tube is free of the fan.

- 42.** Remove the seven remaining transaxle-to-engine bolts. Pull the gearbox away from the engine. Lower the jack and move the transaxle away.

To install:

- 43.** Secure the throwout bearing fork to the transaxle.
- 44.** Make sure the mating surfaces on the transaxle and engine are clean and that the dowel pins are in place on the engine.

Do not grease the primary shaft or throwout bearing sleeve. Make sure there are no breaks in the clutch plate.

- 45.** Lift the transaxle into place and mate to the engine.
- 46.** Install the seven bolts securing the engine and transaxle and tighten them a little at a time to draw the transaxle into place. Tighten the bolts to 37 ft. lbs. (50 Nm) and remove the transaxle jack.
- 47.** Lift the engine and transaxle up until the distance between the engine support beam and spark plug cover is 0.20 in. (5mm).
- 48.** Install the rear transaxle mount and bolts.
- 49.** Tighten the rear two bolts to 37 ft. lbs. (50 Nm), then remove the front bolt.
- 50.** Install the cover.
- 51.** Install the engine mount by fitting its guide pin into the cover.
- 52.** Install a new nut and hand-tighten.
- 53.** Install the steering rack engine mount bolt, but do not tighten.
- 54.** Remove the support for the steering gear.
- 55.** Reconnect the oxygen sensor wiring and clamps on the cover.
- 56.** Install the vehicle speed sensor connector and wiring and connect the transaxle ground strap.
- 57.** Install the subframe using new 4 x M14 bolts and apply grease to the threads.
- 58.** Starting on the left side, lift the frame with a jack.
- 59.** Mount the support brackets on both sides.

60. Tighten the frame bolts to 78 ft. lbs. (105 Nm), then tighten an additional 120°.
61. Tighten the bracket bolts to 37 ft. lbs. (50 Nm).
62. Remove the jack and repeat the procedure for the right side.
63. Remove the engine support tool and lifting eyelet from engine.
64. Tighten the engine mount nut to 37 ft. lbs. (50 Nm).
65. Install five new nuts on the steering rack and tighten them to 37 ft. lbs. (50 Nm).
66. Install the front engine mount nut, then tighten the front and rear bolts to 37 ft. lbs. (50 Nm).
67. Install the torque rod mount on the transaxle using new bolts. On earlier vehicles equipped with M18 bolts, tighten the bolts to 13 ft. lbs. (18 Nm) and then an additional 90 degrees. On later models with M10 bolts, tighten to 26 ft. lbs. (35 Nm) and then an additional 40 degrees.
68. Install the oil line bracket bolts and tighten to 19 ft. lbs. (25 Nm).
69. Tighten the exhaust pipe clamp while rocking the pipe back and forth to seat it properly.
70. Install the right and left halfshafts.

Make sure the transaxle axle seal and axle boot are not damaged.

71. Connect the control arms to the ball joints using new nuts.
72. Connect the brake line and ABS cable bracket on both sides.
73. Install the ABS sensor on the axle shaft and clean if needed.
74. Tighten the sensor to 7.4 ft. lbs. (10 Nm).
75. Attach the cable pipe and carbon canister to the subframe.
76. Install the front splash guard.
77. Install the wheels.
78. Install the starter and tighten the bolts to 30 ft. lbs. (40 Nm).
79. Connect the cable conduit and oxygen sensor connectors.
80. Install the dipstick tube with a new O-ring and tighten the bolt to 19 ft. lbs. (25 Nm).
81. Connect the slave cylinder and clips.
82. Fasten the back-up light switch connector.
83. Position the shift lever plate and secure with the lock pin.
84. Install the cables and lubricate the levers, cables, washers and clips with grease.
85. Connect ground strip to the firewall.
86. Install a new bolt and nut for the extension arm and torque rod.
87. Connect the oil cooler hose to the cooler, if equipped.
88. Lower the vehicle.
89. Install the throttle body and cover over control pulley.
90. Connect the intake manifold to the turbocharger.
91. Install the coolant expansion tank, battery tray, air cleaner and connectors.
92. Connect the control valve to air cleaner on turbocharged models.
93. Install the battery and attach leads.
94. Tighten the axle shaft nut to 89 ft. lbs. (120 Nm), then tighten an additional 60 degrees. Lock the axle shaft nut by notching its flange into the axle shaft groove.
95. Fill the transaxle with the specified amount of oil.
96. Reinstall the plug.
97. Check the function of the clutch before driving.

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REPAIR GUIDE

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Understanding the Manual Transaxle

Because of the way an internal combustion engine breathes, it can produce torque, or twisting force, only within a narrow speed range. Most modern, overhead valve pushrod engines must turn at about 2500 rpm to produce their peak torque. By 4500 rpm they are producing so little torque that continued increases in engine speed produce no power increases. The torque peak on overhead camshaft engines is generally much higher, but much narrower.

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The manual transaxle and clutch are employed to vary the relationship between engine speed and the speed of the wheels so that adequate engine power can be produced under all circumstances. The clutch allows engine torque to be applied to the transaxle input shaft gradually, due to mechanical slippage. Consequently, the vehicle may be started smoothly from a full stop. The transaxle changes the ratio between the rotating speeds of the engine and the wheels by the use of gears. The gear ratios allow full engine power to be applied to the wheels during acceleration at low speeds and at highway/passing speeds.

In a front wheel drive transaxle, power is usually transmitted from the input shaft to a mainshaft or output shaft located slightly beneath and to the side of the input shaft. The gears of the mainshaft mesh with gears on the input shaft, allowing power to be carried from one to the other. All forward gears are in constant mesh and are free from rotating with the shaft unless the synchronizer and clutch is engaged. Shifting from one gear to the next causes one of the gears to be freed from rotating with the shaft and locks another to it. Gears are locked and unlocked by internal dog clutches which slide between the center of the gear and the shaft. The forward gears employ synchronizers; friction members which smoothly bring gear and shaft to the same speed before the toothed dog clutches are engaged.

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Coil Springs

REMOVAL & INSTALLATION

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The coil springs are integrated into the strut assembly. See the MacPherson Strut removal and installation and overhaul procedures which follow.

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Control Arm Strut

The control arm strut, also called the radius rod or strut rod, serve to locate the lower control arm and prevent fore-and-aft movement. Except for impact damage, the rods rarely fail. The rubber bushings on each end are prone to fatigue and wear, and may need to be replaced after a few years. This part is found on all 960/S90/V90 models.

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REMOVAL & INSTALLATION

See Figure 1

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle on jackstands.
3. Loosen the rod-to-bracket bolt but don't remove it.
4. Remove the nut at the control arm. This is sometimes easier said than done; the control arm bolt can be very tight.
5. Once the front nut is loosened, the back mount may be removed and the rod placed on a workbench.

To install:

6. If the bushings are to be replaced, press them free of their mounts and install the new ones.
7. Reinstall the rod, attaching the bracket bolt first.
8. Make sure the front bushings seat properly in the control arm and that the front nut draws tight against its washer.
9. Tighten the bracket bolt to 63 ft. lbs. (85 Nm).
10. Tighten the control arm nut to 70 ft. lbs. (95 Nm).
11. Lower the vehicle.
12. Connect the negative battery cable.

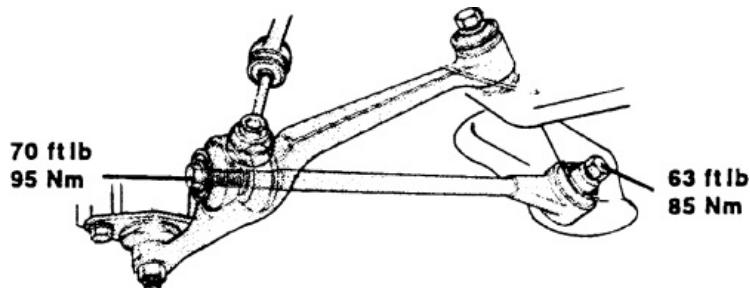


Fig. Fig. 1: Strut rod-900 series vehicles

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FRONT SUSPENSION

See Figures 1 and 2

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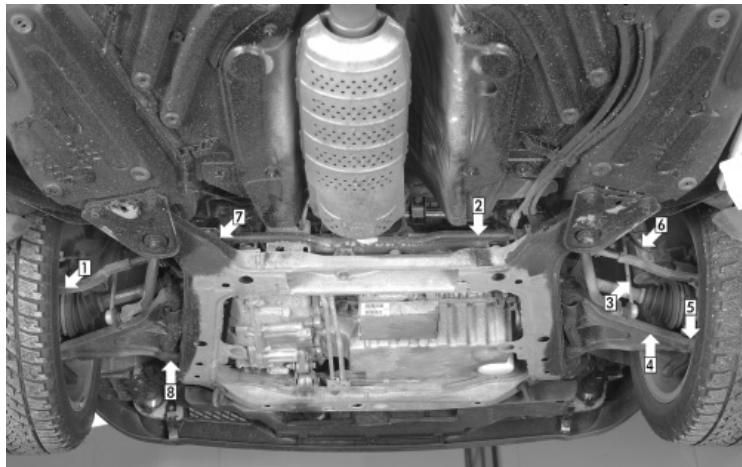


Fig. Fig. 1: V70R AWD Front Suspension and Steering Components

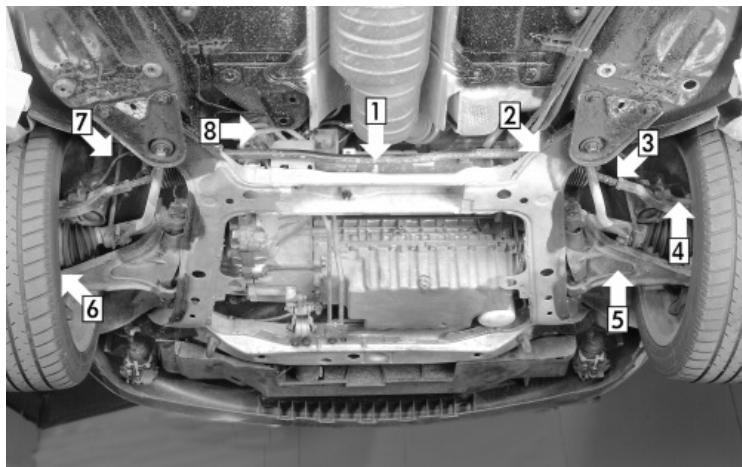


Fig. Fig. 2: 850 Front Suspension and Steering Components

The front suspension is the MacPherson type, which means that the wheels are independently sprung. The spring is located around the strut assembly, the lower end of which is affixed to the wheel spindle. The strut assembly is retained by a threaded screw in an upper mount, which is fixed to the wheel housing, and by its seating at the bottom. The upper end of the spring is fixed to the wheel arch and rests on the upper mount, through the upper mount seat. The seating for the lower end of the spring is a welded perch on the bottom of the strut tube.

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Front Hub and Bearing

ADJUSTMENT

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850, S70, C70 and V70 Models

The front wheel bearings are not adjustable on front drive vehicles. If the lateral run-out on the hub with the disc removed exceeds 0.0007 inch (0.020mm), the hub must be replaced.

REMOVAL & INSTALLATION

850, S70, C70 and V70 Models

See Figures 1 and 2

1. Raise and safely support vehicle.
2. Remove the wheel.
3. Disconnect the ABS sensor from the axle shaft, but do not detach the sensor connector. Hang the sensor out of the way.
4. Remove the caliper, carrier and rotor. Hang the caliper safely out of the way.
5. Remove the halfshaft.
6. Separate the ball joint from the control arm.
7. Disconnect the sway bar link.
8. Remove the four bolts retaining the hub.
9. Remove the hub.

To install:

10. Clean the axle shaft and hub mating surfaces.
11. Clean the ABS sensor with a soft brush.
12. Install the new hub and tighten the bolts alternately to 33 ft. lbs. (45 Nm) plus an additional 60 degrees.
13. Insert the axle shaft into the hub and fit the splines.
14. Tighten the new axle shaft nut by hand.
15. Connect the ball joint to the control arm using new nuts.
16. Connect the sway bar link.
17. Install the brake rotor, carrier and caliper.
18. Tighten the axle nut to 89 ft. lbs. (120 Nm), plus an additional 60 degrees, using tool 5461 or equivalent to counterhold. Lock the axle shaft nut using a chisel to tap the flange into the groove.
19. Clean the ABS sensor and its seat with a soft brush. Tighten the sensor to 84 inch lbs. (10 Nm).
20. Install the wheels.
21. Lower the vehicle.

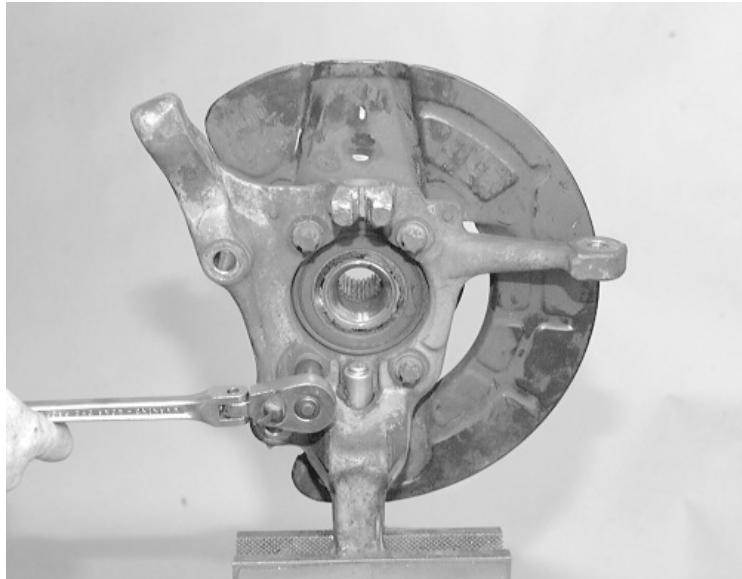


Fig. Fig. 1: Remove the four hub retaining bolts-although shown removed from the spindle, this can be done on the car

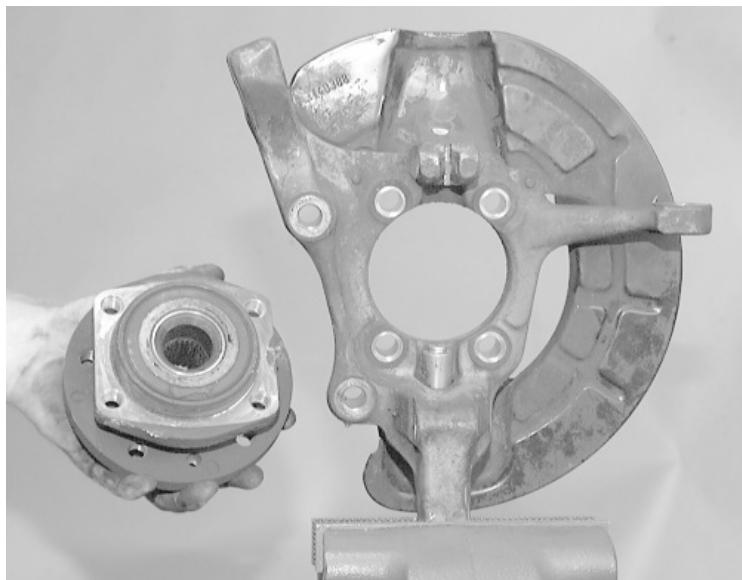


Fig. Fig. 2: Separate the hub from the spindle after the retaining bolts are removed



Front Wheel Bearings

[Print](#)

INSPECTION

To check wheel bearing play, raise the vehicle and support it safely. Rock the wheel at 12 and 6 o'clock position. If there is movement, the wheel bearing should be serviced.

To check wheel bearing noise, raise the wheel off the ground, then spin the wheel by hand and let it rotate freely after spinning. Check for wheel bearing noise. If the wheel bearing remains noisy after proper adjustment, replace the wheel bearing.

ADJUSTMENT

Except 850, C70, S70 and V70

The front wheel bearings are not adjustable on the rear drive vehicles. If the lateral run-out on the hub with the disc removed exceeds 0.0012 inch (0.030mm), the hub must be replaced.

REMOVAL & INSTALLATION

Except 850, C70, S70 and V70

See Figures 1, 2 and 3

1. Raise and support the vehicle safely.
2. Remove the wheel(s).
3. Remove the brake caliper. Hang the caliper out of the way with a piece of stiff wire. Do not let the caliper hang by the brake hose.
4. Pry off the grease cap.
5. Remove the cotter pin and castle nut.
6. Remove the hub and brake disc assembly. Use a bearing puller to remove the inner bearing if it stays on the spindle.

If the vehicle is equipped with separate brake disc and hub, the guide pin and brake disc must be removed from the hub prior to bearing replacement.

7. Use a brass drift and carefully tap out the grease seal and inner bearing race.
8. Remove the outer bearing race, using a suitable handle and drift.

To install:

9. Press in a new inner bearing race, using a suitable handle and drift.
10. Press in a new outer bearing race, using a suitable handle and drift.
11. Pack the wheel bearing between the cage and inner race with as much grease as possible. Also smear grease on the outer side of the bearing and bearing races inside the hub. Fill the space in the hub with grease to a diameter of the smallest ball races.
12. On hubs with integrated brake disc, position the inner bearing seal in the hub and press the seal in so the edge lies in the same plane as the hub.
13. On hub with separate hub and brake disc:
 - A. Press the sealing ring onto the spindle, making sure that the seal ring is square. The sealing ring lip should face outwards.
 - B. Install the inner bearing in the hub. Press in the sealing washer.

14. Install the hub, outer race and castle nut.

On vehicles with separate hub and brake disc, install the brake disc and guide pin.

15. To adjust the bearing pre-load:
 - A. Spin the hub and simultaneously tighten the center nut to 42 ft. lbs. (57 Nm).
 - B. Loosen the nut $\frac{1}{2}$ turn, then tighten the nut by hand, approximately 12 inch lbs. (1.4 Nm).
 - C. Install the cotter pin. If the pin hole in the spindle does not align with the pin hole in the nut, unscrew the nut slightly to the nearest pin hole.
 - D. Install the protective cap.
16. Install the brake caliper.
17. Install the wheel.
18. Lower the vehicle.

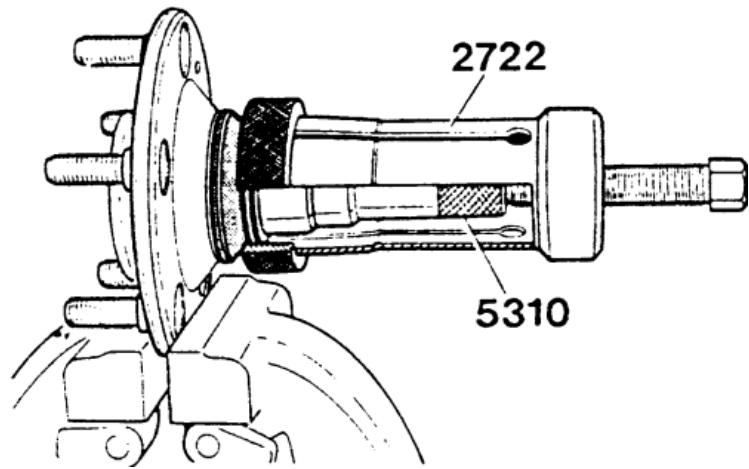


Fig. Fig. 1: Removing the inner ring using puller 2722 or equivalent

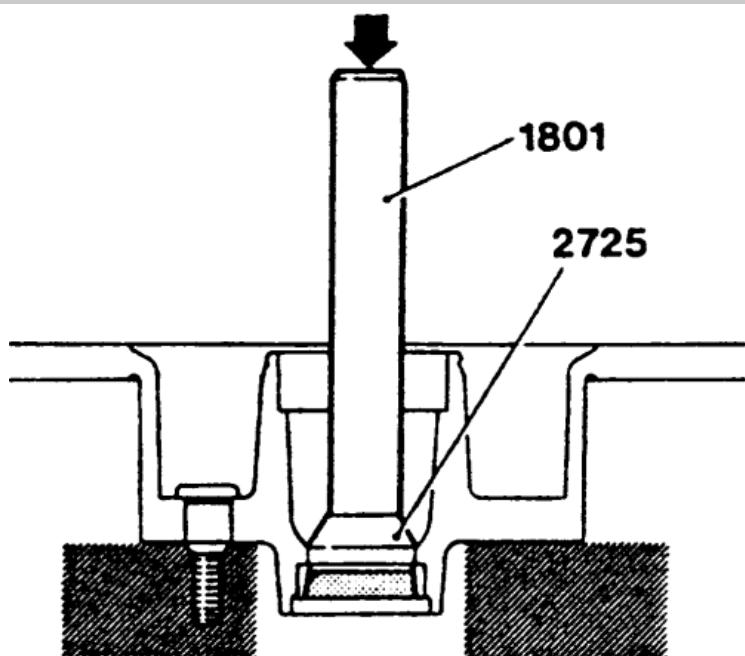


Fig. Fig. 2: Removing the outer bearing race from the hub using drift 2725 or equivalent

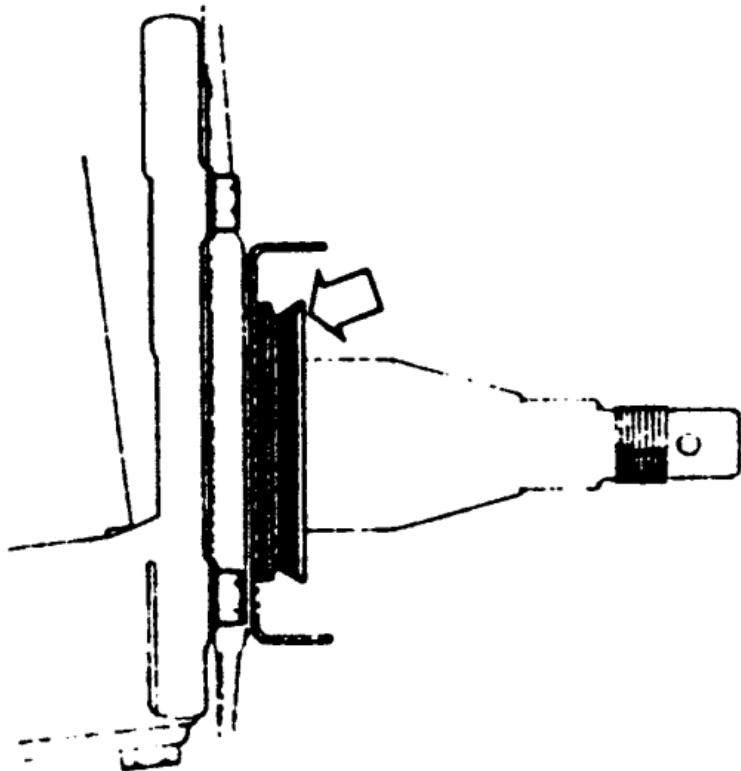


Fig. Fig. 3: Press the sealing ring onto the spindle before installing the hub assembly

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Knuckle and Spindle

REMOVAL & INSTALLATION

[Print](#)

1. Raise the vehicle and support it safely.
2. Remove the wheel(s).
3. Remove the caliper, and support it out of the way using a piece of wire.
4. Remove the brake rotor.
5. Remove the axle nut (if applicable).
6. Remove any harnesses, lines, etc. that facilitate removal of the spindle.
7. Disconnect the tie rod end from the spindle.
8. Disconnect the lower ball joint from the bottom of the spindle.
9. Disconnect the strut tube from the top of the spindle.
10. Remove the spindle from the vehicle.

To install:

If replacing the spindle with a new one, make sure to transfer the backing plate, hub or any part not attached to the new spindle assembly.

11. Install the spindle on the vehicle.
12. Connect the strut tube to the spindle and tighten to specification.
13. Connect the lower ball joint to the spindle and tighten to specification.
14. Connect the tie rod end to the spindle and tighten to specification.
15. Reconnect any harnesses, lines, etc. removed.
16. Install the axle nut and tighten to specification.
17. Install the brake rotor.
18. Install the brake caliper.
19. Install the wheel(s).
20. Lower the vehicle.

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Lower Ball Joint

INSPECTION

[Print](#)

Check the ball joint axial play. Maximum axial play permitted is 0.12 inch (3mm). Check the radial play. Maximum radial play permitted is 0.02 inch (0.5mm).

REMOVAL & INSTALLATION

240 Series

1. Raise the vehicle and support it safely.
2. Mark the position of the wheel stud nearest to the valve. Wheel is marked to facilitate installation and to avoid the need for rebalancing.
3. Remove the wheel and tire assembly.
4. Remove the ball joint nut from the knuckle.
5. Remove the 4 bolts which retains the ball joint and remove the ball joint from the control arm.
6. Remove the ball joint retaining nut and press the ball joint out of attachment.

To install:

Ball joints are different for right and left sides. It is therefore important that the correct ball joint is installed on the correct side.

7. Press the ball joint to the attachment, and install the ball joint on the control arm and tighten the bolts to 44 ft. lbs. (60 Nm).
8. Install the ball joint to the knuckle and tighten to 85 ft. lbs. (115 Nm).
9. Install the wheel on the hub assembly, while aligning the marking made earlier. Alternately tighten the nuts to specifications.
10. Lower the vehicle.

700, 900, S90 and V90 Series

See Figure 1

1. Raise the vehicle and support it safely.
2. Mark the position of the wheel stud nearest to the valve. Wheel is marked to facilitate installation and to avoid the need for rebalancing.
3. Remove the wheel and tire assembly.
4. Remove the bolt which holds the anti-roll bar link to the control arm.
5. Remove the cotter pin, nut and washer for the ball joint stud.
6. Pull the control arm from the ball joint using a suitable puller (5259 or equivalent).
7. Remove the bolts holding the ball joint to the spring strut.
8. Press the control arm downwards and remove the ball joint.

To install:

9. Install the new ball joint.
10. Use new bolts and apply sealing fluid to the threads. Check that the bolt heads sit flat on the ball joint. Tighten the bolts to 22 ft. lbs. (30 Nm) PLUS angle tighten 90 degrees.
11. Install the control arm to ball joint.
12. Install the washer and nut.
13. Tighten ball joint stud (nut) to 44 ft. lbs. (60 Nm).
14. Install the cotter pin.
15. Install the anti-roll bar.
16. Install the wheel.
17. Lower the vehicle.

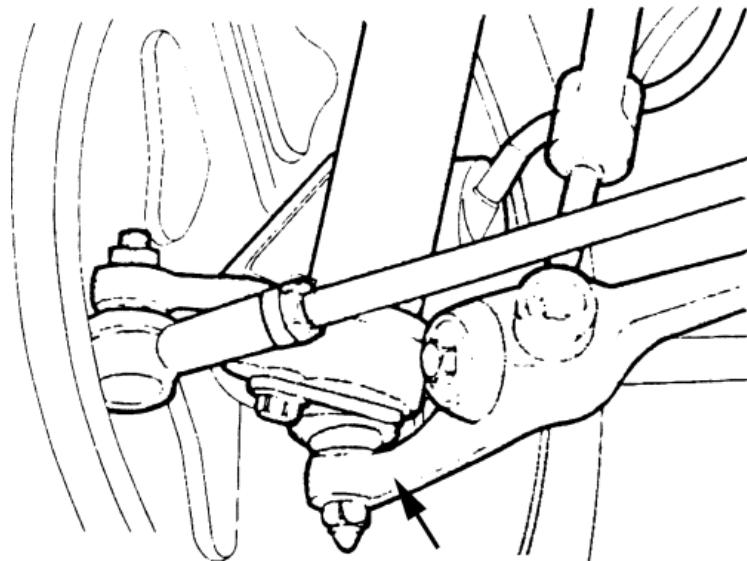


Fig. Fig. 1: Ball joint assembly -900 series vehicles

850, C70, S70 and V70 Series

1. Raise and safely support the vehicle.
2. Remove the wheel.
3. Remove the three nuts holding the ball joint to the lower control arm.
4. Remove the clamping bolt and nut from the steering knuckle where the ball joint is mounted.
5. Spread the ball joint apart and remove it from the hub housing.

To install:

6. Clean the control arm and steering knuckle where the new ball joint is fitted.
7. Install the new ball joint with the clamping bolt and nut. Tighten the bolt to 37 ft. lbs. (50 Nm).
8. Connect the ball joint to the lower control arm and fasten it with new nuts. Apply rustproofing compound to the nuts. Starting from inside, working outward, tighten the nuts to 13 ft. lbs. (18 Nm) and then angle tighten 120°.
9. Install the wheel.
10. Lower the car.

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Lower Control Arm

On all models, fully install the control arm, bounce the suspension several times, and THEN tighten the control arm-to-crossmember mounting nuts or bolts.

[Print](#)

240 Series

See Figure 1

1. Raise the vehicle and support it safely.
2. Remove the wheel(s).
3. Disconnect the stabilizer (sway bar) link at the control arm.
4. Remove the control arm from the ball joint. Refer to the Lower Ball Joint removal and installation procedure.
5. Remove the control arm rear attachment plate.
6. Remove the control arm front retaining bolt.
7. Remove the control arm.

To install:

8. If bushings are to be replaced, note that the right and left bushings are not interchangeable. The right side bushing should be turned so that the small slots point horizontally when installed.
9. Install the bracket onto the control arm. The nut should be tightened only enough to hold securely. The washer should be able to be turned with your fingers after the nut is on.
10. Attach the control arm. Install the front retaining bolt and nut; tighten the nut only a few turns onto the bolt.
11. Guide the stabilizer link into position. Attach it loosely with its nut and bolt.
12. Install the ball joint and its mount. Tighten the 3 mounting bolts to specification.
13. Install the rear bracket to the vehicle. Tighten the three bolts to 25-35 ft. lbs. (34-48 Nm).
14. Tighten the stabilizer link.

- 15.** Install the wheel(s).
- 16.** Lower the vehicle.
- 17.** Jounce the front of the vehicle up and down. This normalizes the front suspension and allows the control arm to seek its final position.
- 18.** Tighten the rear mount nut to 38-44 ft. lbs. (52-60 Nm).
- 19.** Tighten the front mount to 55 ft. lbs. (75 Nm).

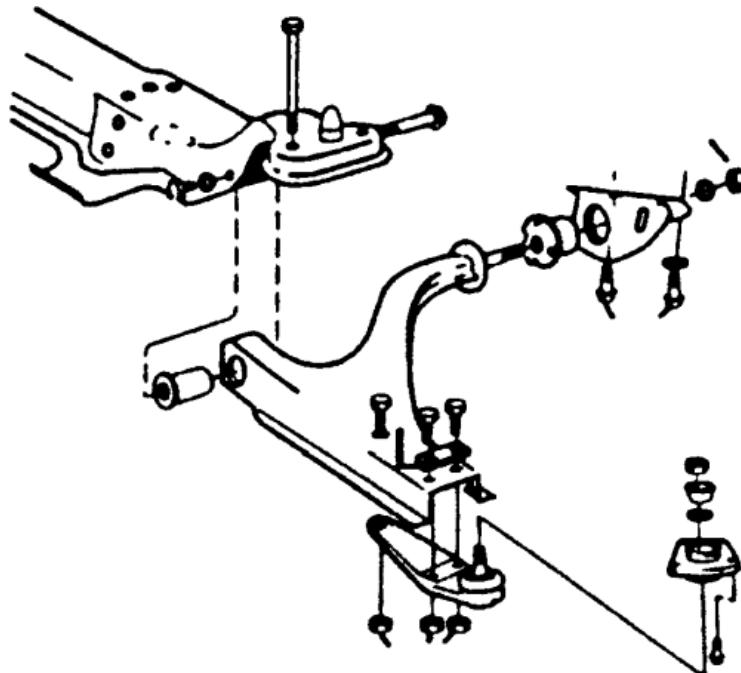


Fig. Fig. 1: Lower control arm-240 series vehicles

700, 900, S90 and V90 Series

- 1.** Raise the vehicle and support it safely.
- 2.** Remove the wheel(s).
- 3.** Remove the cotter pin from the ball joint and remove the ball joint nut.
- 4.** Disconnect the stabilizer (sway bar) link at the control arm.
- 5.** Disconnect the strut bolt and remove the front bushing.
- 6.** Use a ball joint puller and separate the ball joint from the control arm. Make sure the puller is properly located and that the rubber boot is not damaged during removal.
- 7.** Unbolt the control arm at the crossmember and remove the arm.
- 8.** If the bushings are to be replaced, use a press and support the arm from below. The new bushings should always be pressed in from the front side of the arm.

To install:

- 9.** Fit the control arm over the end of the strut rod.
- 10.** Install the arm in the crossmember but do not fully tighten the nut.
- 11.** Install the ball joint in the control arm.
- 12.** Tighten the nut to 44 ft. lbs. (60 Nm), then install a new cotter pin.
- 13.** Install the bushing, washer and bolt for the strut rod. Tighten the bolt to 70 ft. lbs.(95 Nm).
- 14.** Attach the stabilizer link to the control arm and tighten it to 63 ft. lbs. (86 Nm).
- 15.** Install the wheel(s).
- 16.** Lower the vehicle. Jounce the front of the vehicle up and down. This normalizes the front suspension and allows the control arm to seek its final position.
- 17.** Tighten the control arm-to-crossmember bolt to 63 ft. lbs.(86 Nm).

850, C70, S70 and V70 Series

See Figures 2, 3, 4, 5, 6 and 7

- 1.** Raise and safely support vehicle.
- 2.** Remove the through-bolt securing the ball joint to the spindle.
- 3.** Remove the ball joint from the spindle, an appropriate puller may be necessary.
- 4.** Remove the bolts and nuts holding the lower control arm to the frame.
- 5.** Remove the lower control arm.

To install:

- 6.** Clean the ball joint and subframe where the lower control arm mates.
- 7.** Install the lower control arm in the frame and attach with new bolts and nuts. Tighten the lower control arm subframe bolts to 48 ft. lbs. (65 Nm) and then angle tighten 120°.
- 8.** Apply rustproofing compound to the lower control arm nuts.
- 9.** Connect the ball joint to the spindle and tighten the bolt to 13 ft. lbs. (18 Nm).
- 10.** Lower the vehicle.



Fig. Fig. 2: You must use two wrenches or ratchets to remove the ball joint through-bolt



Fig. Fig. 3: Once the bolt is removed, the ball joint is pulled downward from the spindle; however, a puller may be necessary

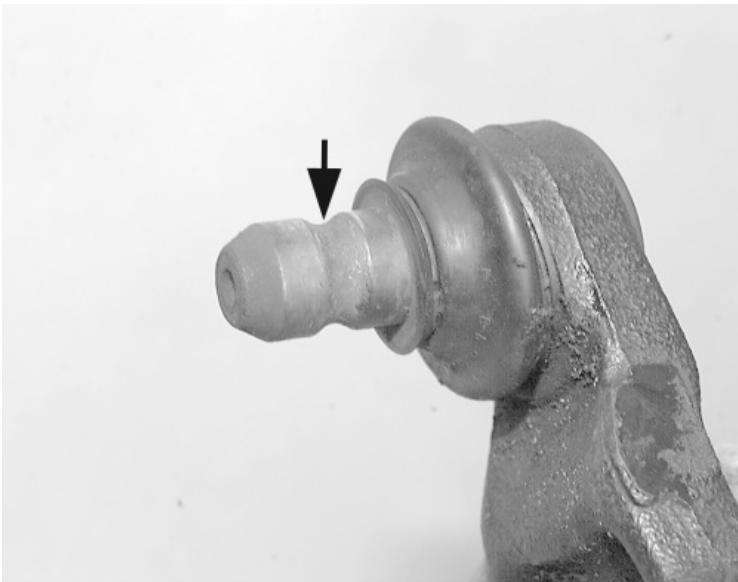


Fig. Fig. 4: This groove is where the through-bolt passes and retains the ball joint to the spindle



Fig. Fig. 5: Remove the control arm-to-subframe bolts and nuts



Fig. Fig. 6: Threading the nut onto the bolt reduces the chance of losing them or getting the bolts mixed up

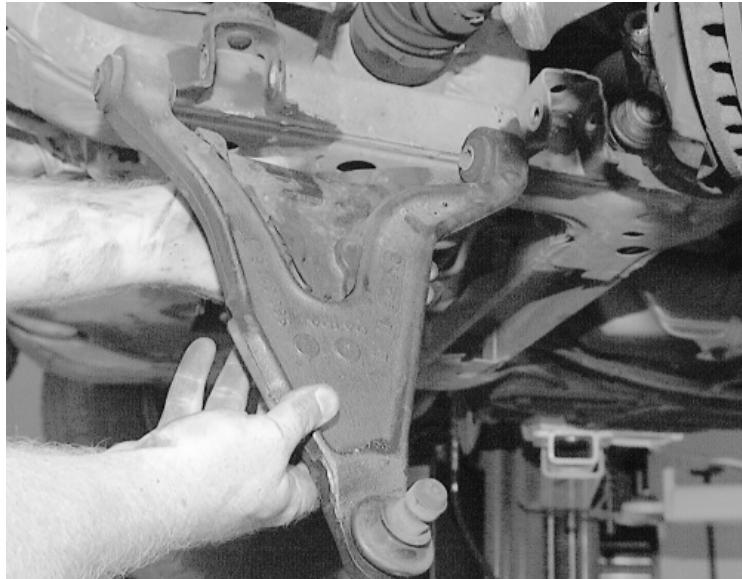


Fig. Fig. 7: Pull the control arm from the subframe to remove it

CONTROL ARM BUSHING REPLACEMENT

240 Series

1. Raise the vehicle and support it safely.
2. Mark the position of the wheel stud nearest to the valve. This is done to facilitate installation and to avoid the need for rebalancing.
3. Disconnect the stabilizer (sway bar) link at the control arm.
4. Remove the lower control arm.
5. Remove the rear bracket from the control arm.
6. Drive out the old bushings.

To install:

7. When replacing the bushings, note that the right and left bushings are not interchangeable. The right side bushing should be turned so that the small slots point horizontally when installed.
8. Install the new bushings onto the control arm.
9. Install the bracket onto the control arm. The nut should be tightened only enough to hold securely. The washer should be able to be turned with your fingers after the nut is on.
10. Install the control arm.
11. Install the stabilizer (sway bar) link at the control arm.
12. Install the wheel.
13. Lower the vehicle.

700, 900, S90 and V90 Models

The control arm assembly on these models is connected to the spindle through a ball joint and has one connection to the crossmember.

1. Raise and safely support the vehicle securely on jackstands.
2. Mark the position of the wheel stud nearest to the valve. Wheel is marked to facilitate installation and to avoid the need for rebalancing.
3. Remove the lower control arm.
4. Press out the bushing with a suitable drift.

To install:

5. Press in the new bushing with a suitable drift. Use disc 5240 or equivalent as a support. The disc recess should face upwards.

Press the bushing in from the front side of the control arm.

6. Install the control arm.
7. Install the wheel.
8. Lower the vehicle.

850, C70, S70 and V70 Series

1. Raise and safely support the vehicle.
2. Remove the wheel(s).
3. Remove the control arm.

- 4.** Clean the bushing outer sleeves.
- 5.** Press out the bushings using tool 5481 and 5482 or equivalent.

To install:

- 6.** Press in the bushings using tool 5481 and 5482 or equivalent.
- 7.** Install the control arm.
- 8.** Install the wheel(s).
- 9.** Lower the vehicle.

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



MacPherson Struts

REMOVAL & INSTALLATION

[Print](#)

240, 700, 900, S90 and V90 Series

See Figure 1

- 1.** Raise and safely support vehicle.
- 2.** Remove the wheel.
- 3.** Disconnect the tie rod end.
- 4.** Place a floor jack under the control arm.
- 5.** Disconnect the sway bar link.
- 6.** Unbolt the brake lines from the bracket and detach them from the clips.
- 7.** Remove the cover over the strut nut.
- 8.** Disconnect the coil wire and place it out of the way.
- 9.** Hold the strut shaft with tool 5037 or equivalent and loosen the nut a few turns with tool 5036 or equivalent.
- 10.** Mark the position of the upper mount in the housing, then remove the nuts and washers.
- 11.** Carefully lower the jack and pull the strut and spring out of the housing.

WARNING

Be careful not to damage the fender when removing the strut assembly. Use retaining hook 5045 or equivalent attached to the anti-sway bar to prevent it from falling.

To install:

- 12.** Guide the strut assembly into the body.
- 13.** Install the upper mount according to the earlier marking and tighten to 30 ft. lbs. (40 Nm).
- 14.** Tighten the strut nut to 111 ft. lbs. (150 Nm) using socket 5036 and holder 5037 or equivalents.
- 15.** Press nut cover back on and connect the coil wire.
- 16.** Install the sway bar link and tighten it until the distance between the washers is 1.65 in. (42mm).
- 17.** Install the brake line bracket and clips. Make sure that the brake lines are sitting correctly in the wheelwell.
- 18.** Install the tie rod end.
- 19.** Install the wheel.
- 20.** Lower the vehicle and test.

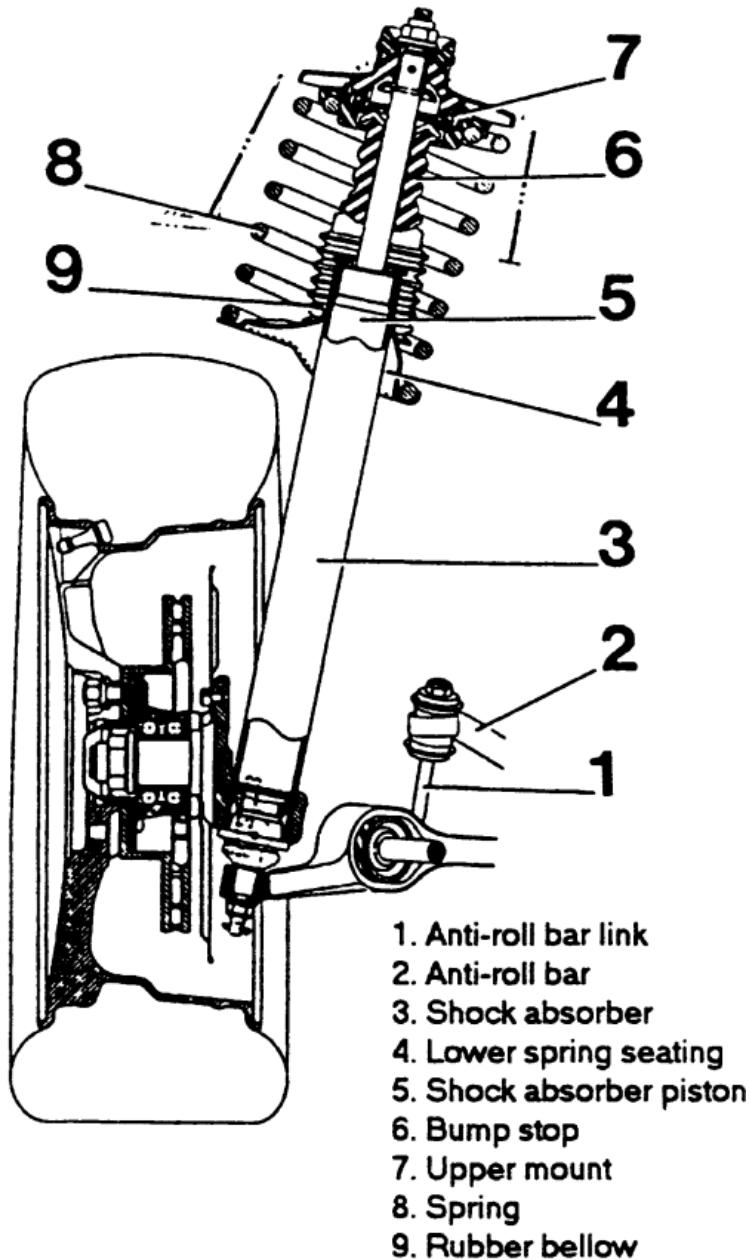


Fig. Fig. 1: Typical MacPherson strut assembly

850, C70, S70 and V70 Series

See Figures 2, 3, 4, 5, 6, 7 and 8

1. Raise and safely support vehicle.
2. Remove the wheel.
3. Disconnect the sway bar link from the strut.
4. Remove the ABS sensor lead from the strut and brake bracket, but do not disconnect.
5. Install support tool 5466 or equivalent under the control arm.

WARNING

If this tool is not installed, the axle joint may be damaged from excessive downward pressure.

6. Remove the two nuts and bolts holding the strut to the steering knuckle.
7. Remove the upper nuts attaching the strut attachment to the body.
8. Remove the spring and strut assembly.

To install:

9. Install the spring and strut assembly in the spring housing and fasten it using new nuts; tighten them to 18 ft. lbs. (25 Nm).
10. Connect the strut to the steering knuckle using new bolts and nuts.
11. Tighten them to 48 ft. lbs. (65 Nm) and angle tighten 90°.
12. Connect the sway bar to the strut using new nuts.
13. Install the ABS sensor lead to the strut and brake pipe bracket.
14. Remove the support tool.

15. Install the wheel.

16. Lower the vehicle.

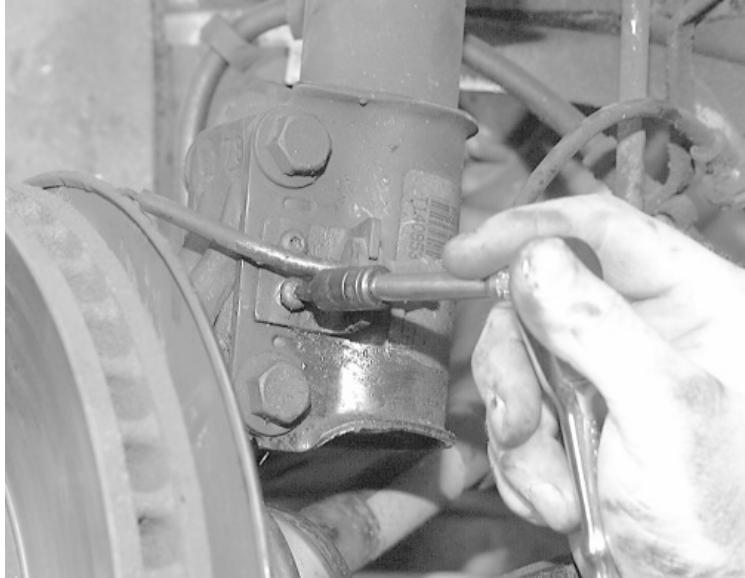


Fig. Fig. 2: Remove the ABS sensor lead from the strut

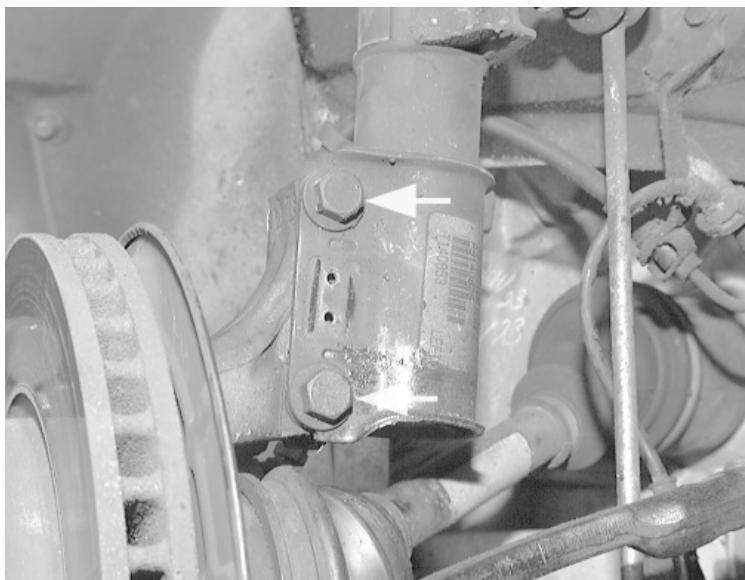


Fig. Fig. 3: The strut is attached to the knuckle by two bolts (and nuts)

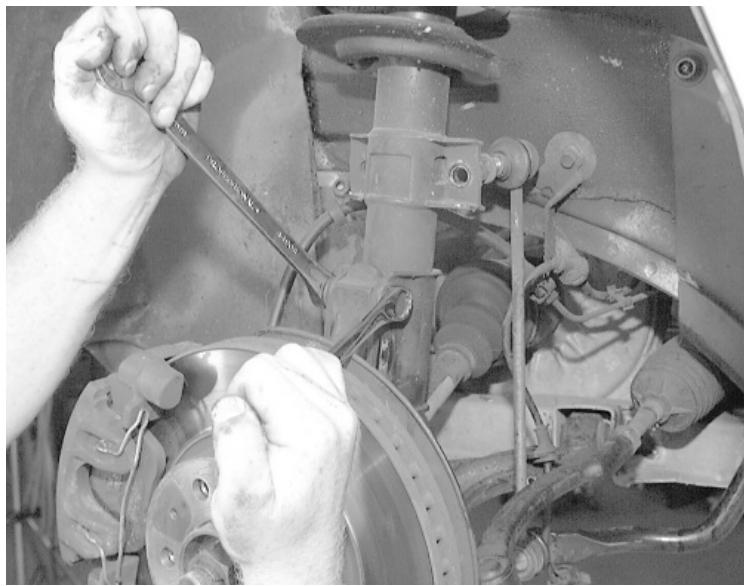


Fig. Fig. 4: Remove the two strut-to-knuckle bolts and nuts

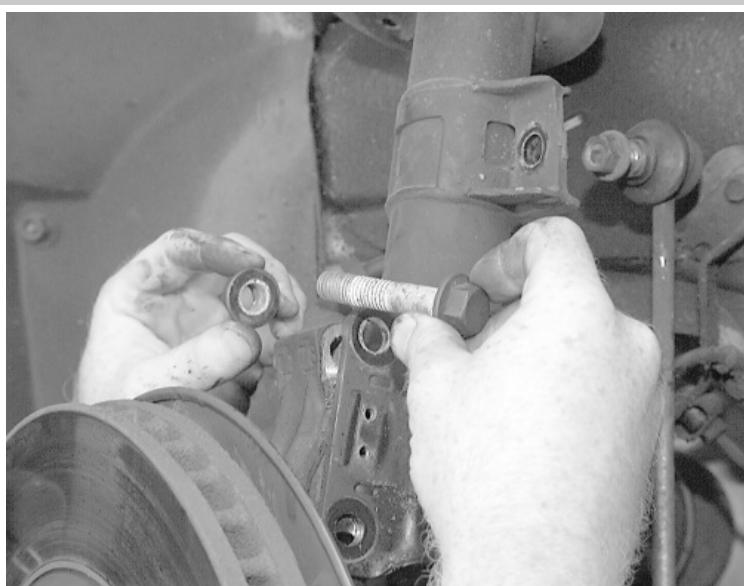


Fig. Fig. 5: Threading the nut onto the bolt after removal is an easy way to keep track of them

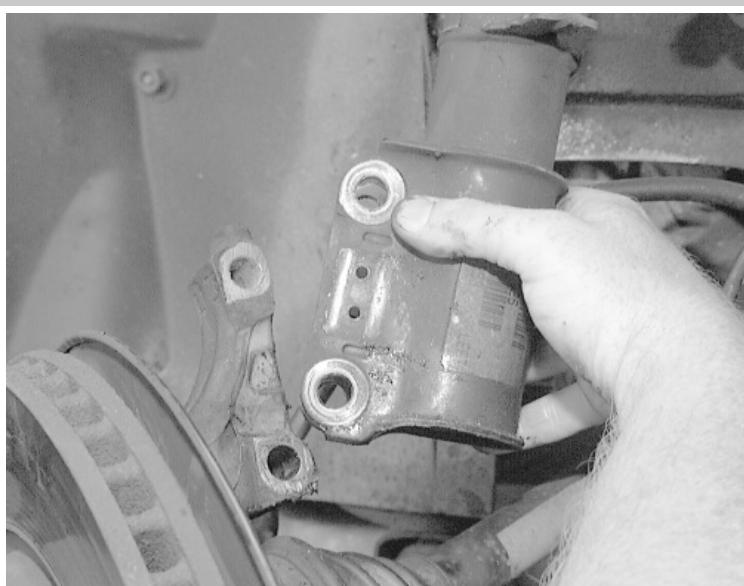


Fig. Fig. 6: Separate the strut from the spindle



Fig. Fig. 7: Remove the three bolts holding the strut to the body, but never remove the large nut in the center while still in the vehicle

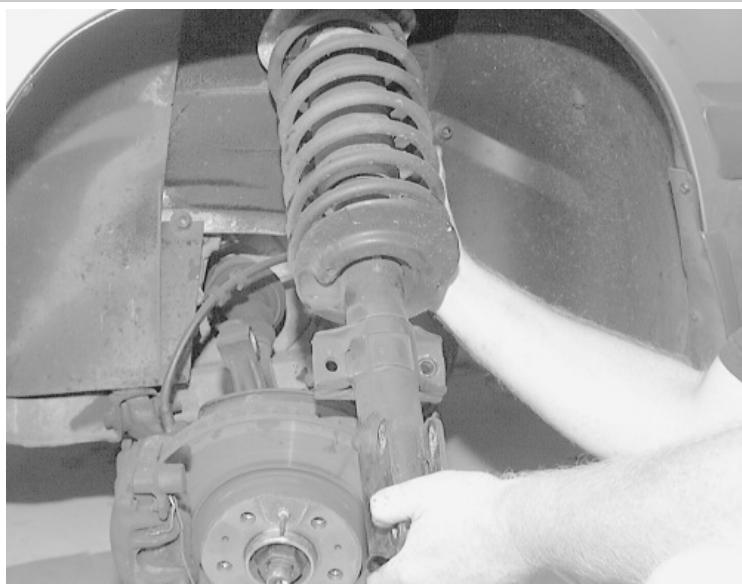


Fig. Fig. 8: Carefully remove the strut from the vehicle

OVERHAUL

CAUTION

A coil spring compressor is required to remove the spring. Improper removal procedures may cause serious injury.

240, 700, 900, S90 and V90 Series

1. Remove the strut from the vehicle.
2. To remove the spring:
 - A. Attach spring compressor tool 5040 or equivalent to the spring. The two parts of the tool should be opposite each other and have three coils between the claws.
 - B. Compress each side alternately until the strut is loose inside the spring.
 - C. Hold the strut shaft with tool 5037 or equivalent and remove the nut with tool 5036 or equivalent and lift off the upper mount, spring retainer, spring and rubber bumper.

On vehicles equipped with gas pressure struts, the bumper has been replaced by a rubber bellow and disc.

3. To remove the strut, unscrew the retaining nut and pull the shock insert out of the casing, using tool 5039 or equivalent for standard struts, or tool

5173 or equivalent for gas struts.

To install:

4. Insert the strut insert into the housing and tighten the retaining nut to 111 ft. lbs. (150 Nm).
5. Install the bumper or bellows and disc on the strut, making sure that the top of the bumper is lower than the top of the strut shaft
6. Install the spring so the compressor tool bolt holes face upwards.
7. Install the upper mount, washer and nut but do not tighten fully.
8. Remove the compressor loosening the bolts alternately and make sure that the ends of the spring fit correctly into the upper and lower plates.
9. Install the strut in the vehicle.

850, C70, S70 and V70 Series

See Figures 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18

1. Remove the strut from the vehicle.
2. Mount the spring and strut assembly in a vise and secure it.
3. Install spring compressing tool 5407 or equivalent and alternately compress the spring.
4. Remove the bolt and washer from the strut attachment using socket 5467 and counterhold 5468 or equivalents.
5. Remove the strut nut using socket 5469 and counterhold 5468 or equivalents.
6. Remove the bearing dustcap and remove the bearing locknut.
7. Remove the spring seat and bearing, rubber stopper, boot, and check them for damage.
8. Remove the compressed spring from the strut.

To install:

9. Compress the spring to about 12 in. (30.5cm) in length.
10. Install the rubber stopper.
11. Install the washer.
12. Install the compressed spring.
13. Install the spring seat and bearing.

Make sure that the spring ends are properly seated.

14. Install the spring attachment, washer, and nut and tighten it to 52 ft. lbs. (70 Nm) using socket 5467 and counterhold 5468, or their equivalents.
15. Slowly and alternately remove the spring compressor.
16. Install the strut in the vehicle.

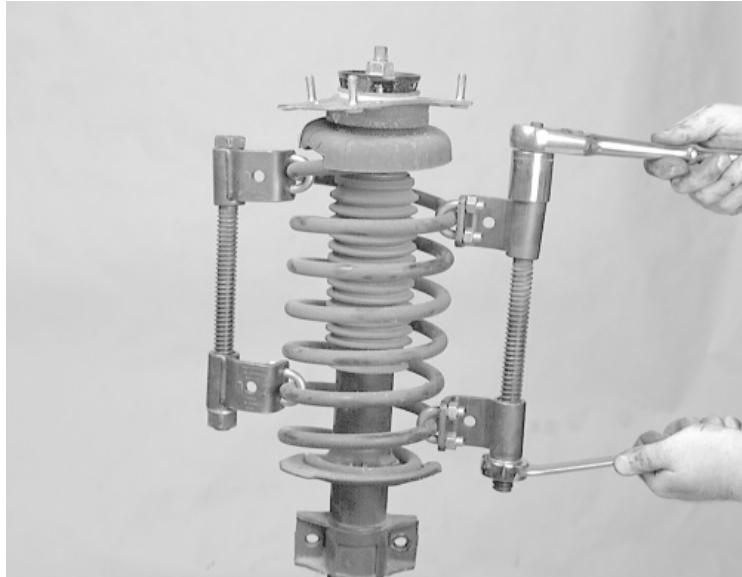


Fig. Fig. 9: Install the strut spring compressor tool onto the spring



Fig. Fig. 10: A tool set, such as this one from Lisle®, is available to aid in the removal of the strut bearing



Fig. Fig. 11: One tool fits over the nut, and the other is used to hold the shaft while the retaining nut is removed



Fig. Fig. 12: Remove the nut ...



Fig. Fig. 13: ... followed by the bearing dust cap



Fig. Fig. 14: Use the shaft tool to aid in the removal of the bearing locknut

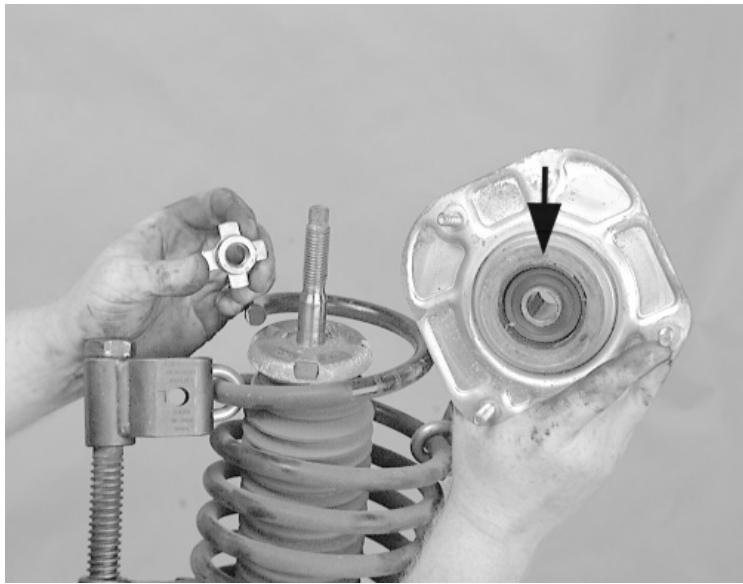


Fig. Fig. 15: Remove the bearing and upper spring seat ...

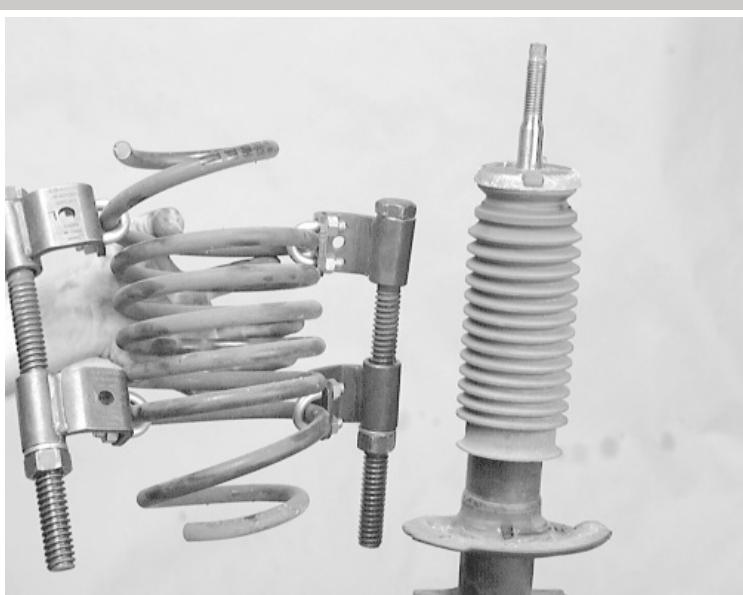


Fig. Fig. 16: ... then remove the compressed spring

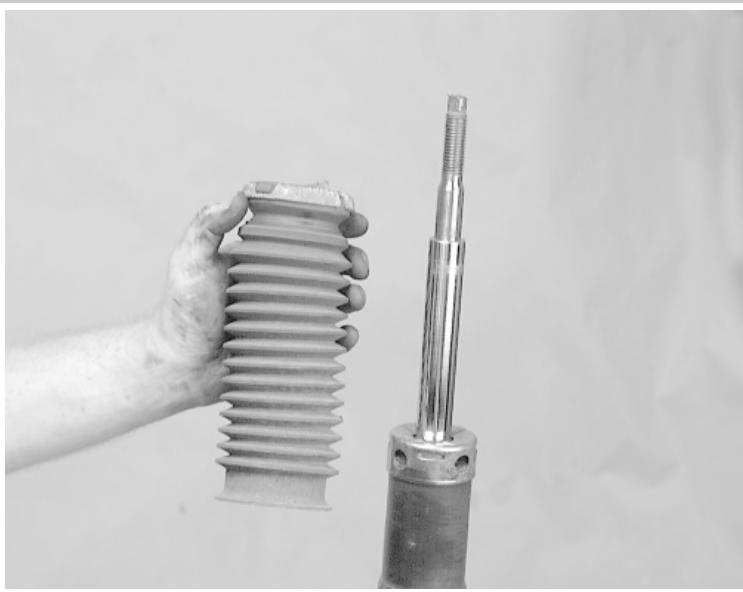


Fig. Fig. 17: Dont forget to remove the strut boot if replacing the strut

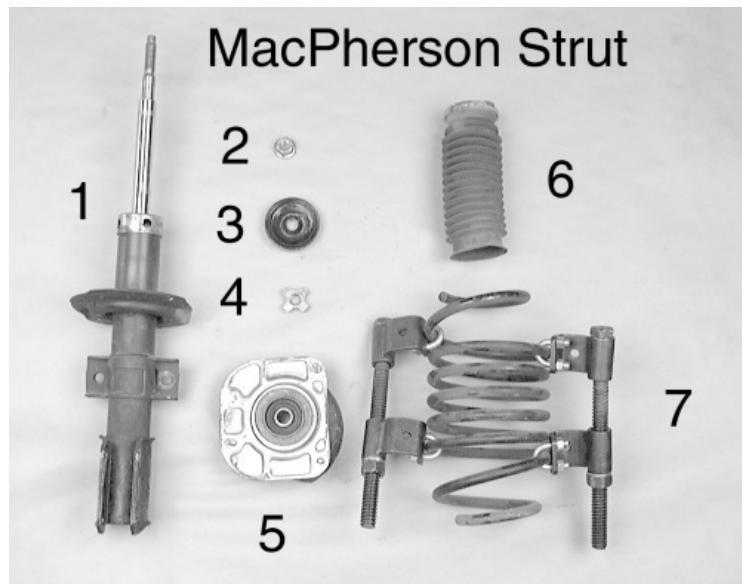


Fig. Fig. 18: Disassembled strut components include a strut tube (1), retaining nut (2), bearing dust cap (3) and locknut (4), bearing and upper spring seat (5), boot (6) and compressed spring (7)

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



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Sway Bar

The sway bar, variously called the anti-roll bar or stabilizer bar, serves to control the sideways roll of the body during cornering. While the bar itself rarely fails, the links and bushings around it are prone to wear. If the bar is not rigidly mounted to the vehicle, it cannot do its job properly.

Sway bars of different diameters (thickness) can stiffen or soften the roll characteristics of a vehicle. Bushings are easily replaced and well worth the effort in terms of restoring proper cornering manners to your vehicle.

REMOVAL & INSTALLATION

240 Series

1. Raise the vehicle and support it safely.
2. Remove the wheels.
3. Remove the underside splash guard panel, if equipped.
4. Remove the upper nut securing the anti-roll bar to the struts.
5. Remove the upper link nut on the opposite side.
6. Remove the bolts for the two retaining brackets and remove the bar.
7. If the link bushings are worn, remove the lower link bolts and remove the entire link.
8. Inspect all the bushings for compression or elongation. Replace as required. The two U-shaped bushings from the front brackets are particularly prone to deforming.

To install:

9. Reconnect the lower link to the arms, if removed.
10. Hold the bar in position and install the front brackets with bushings. Make sure the slot in the bushing faces forward.
11. Install the bar to the link on one side of the vehicle but do not tighten more than a few turns.
12. Connect the bar to the link on the opposite side and install the bushings and nut.
13. Tighten each upper link nut until 1.65 inches (42mm) can be measured between the outer surfaces of the upper and lower washers.
14. Reinstall the underside splash panel, if required.
15. Install the wheel.
16. Lower the vehicle.

700 Series, 940 and 1992-94 960 Models

See Figure 1

1. Raise and safely support vehicle.
2. Remove the wheels.
3. Remove the splashguard from under the engine.
4. Disconnect the anti-sway bar from upper link mounts on both sides.

5. Remove the sway bar clamps on both sides and take the bar off.

To install:

6. Install new rubber bushings on sway bar and attach to subframe with clamps.
7. Connect sway bar to upper link mounts and tighten the nut until the distance between bushing washers is 1.65 in. (42mm).
8. Install the splashguard under the engine.
9. Install the wheels.
10. Lower the vehicle.

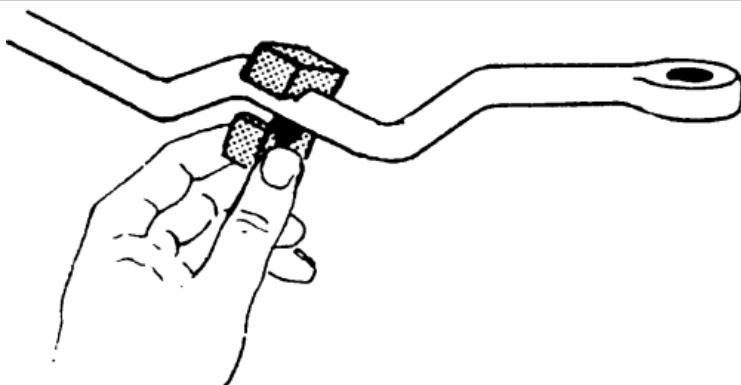


Fig. Fig. 1: The bushing opening should face towards the front of the vehicle when installed

1995-98 960/S90/V90 Models

1. Raise and safely support the vehicle.
2. Remove the wheels.
3. Remove the nuts connecting the sway bar to the axle beam.
4. Remove the bolts connecting the sway bar to the support arms.
5. Remove the sway bar.

To install:

6. Attach the sway bar to the axle beam using new nuts. Tighten the nuts to 15 ft. lbs. (20 Nm).
7. Connect the sway bar to the support arms using new bolts. Do not tighten the bolts.
8. Tighten the support arm bolts to 63 ft. lbs. (80 Nm).
9. Install the wheels.
10. Lower the vehicle.

850, C70, S70 and V70 Series

See Figures 2, 3, 4 and 5

1. Install support rails 5033, bracket 5006 and lifting hook 5115, or suitable equivalents. These make it possible to raise the engine in the vehicle.
2. Raise the engine slightly.
3. Raise and safely support the vehicle.
4. Remove the underengine splashguard.
5. Remove the five nuts holding steering gear to the subframe.
6. Disconnect the power steering line brackets from the subframe at the front and rear edges.
7. Position a suitable jack under the rear crossmember.
8. Remove the bolts holding the subframe brackets to the body on both sides.
9. Remove the two subframe bolts, brackets and washers.
10. Lower the subframe at the rear edge approximately 0.59-0.79 in. (15-20mm). Make sure that the steering gear bolts come away from the frame.
11. Remove the sway bar links and subframe brackets.
12. Remove the sway bar.

To install:

13. Install the sway bar and subframe brackets.
14. Install the sway bar links using new nuts and tighten them to 37 ft. lbs. (50 Nm).
15. Raise the subframe up with the jack and push the steering gear mount bolts into the frame.
16. Install the subframe brackets and new M14 bolts, but do not tighten fully.
17. Move the jack to the front edge of the frame and replace the bolts. Do not tighten fully.
18. First tighten the bolts on the left side on the frame to 77 ft. lbs. (105 Nm) and angle tighten 120°. Then do the same to the right side.
19. Tighten the bracket bolts to 37 ft. lbs. (50 Nm).
20. Install new attaching nuts to the steering gear and tighten them to 37 ft. lbs. (50 Nm).
21. Tighten the power steering line brackets on the front and rear edges of the subframe.

- 22.** Install the underengine splashguard.
- 23.** Lower the vehicle.
- 24.** Remove the support rails, bracket and lifting hook.

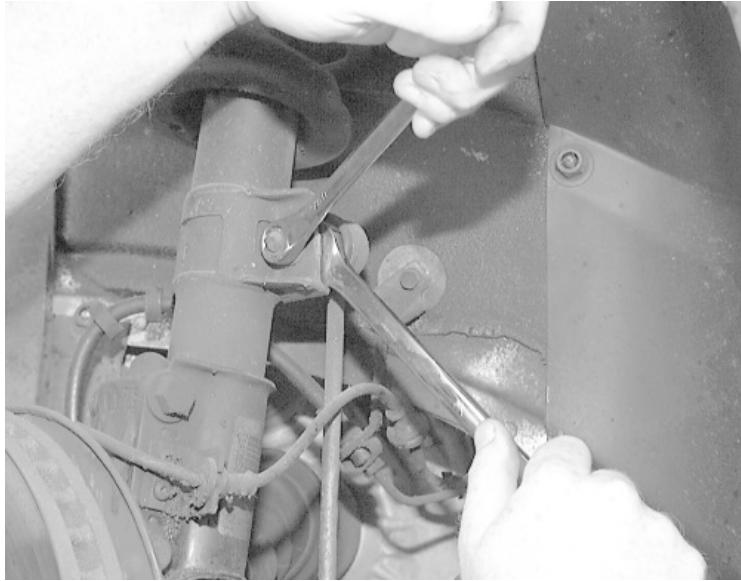


Fig. Fig. 2: Hold the hex head on the ball end of the link with an appropriate size wrench, or the nut cannot be removed



Fig. Fig. 3: If replacing the link, use a new nut; the old nut can be discarded

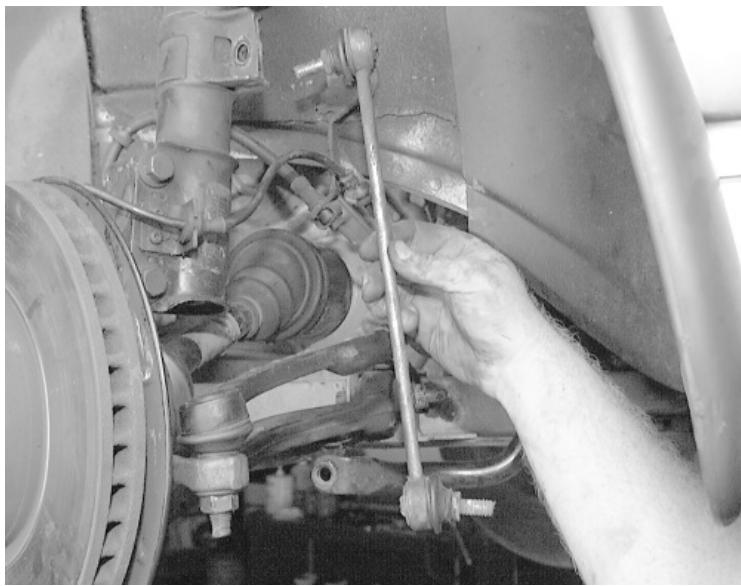


Fig. Fig. 4: After both nuts are unfastened, remove the link from the vehicle



Fig. Fig. 5: The sway bar bushings are located on the subframe

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Wheel Alignment

If the tires are worn unevenly, if the vehicle is not stable on the highway or if the handling seems uneven in spirited driving, the wheel alignment should be checked. If an alignment problem is suspected, first check for improper tire inflation and other possible causes. These can be worn suspension or steering components, accident damage or even unmatched tires. If any worn or damaged components are found, they must be replaced before the wheels can be properly aligned. Wheel alignment requires very expensive equipment and involves minute adjustments which must be accurate; it should only be performed by a trained technician. Take your vehicle to a properly equipped shop.

[Print](#)

Following is a description of the alignment angles which are adjustable on most vehicles and how they affect vehicle handling. Although these angles can apply to both the front and rear wheels, usually only the front suspension is adjustable.

CASTER

See Figure 1

Looking at a vehicle from the side, caster angle describes the steering axis rather than a wheel angle. The steering knuckle is attached to a control arm or strut at the top and a control arm at the bottom. The wheel pivots around the line between these points to steer the vehicle. When the upper point is tilted back, this is described as positive caster. Having a positive caster tends to make the wheels self-centering, increasing directional stability. Excessive positive caster makes the wheels hard to steer, while an uneven caster will cause a pull to one side. Overloading the vehicle or sagging rear springs will affect caster, as will raising the rear of the vehicle. If the rear of the vehicle is lower than normal, the caster becomes more positive.

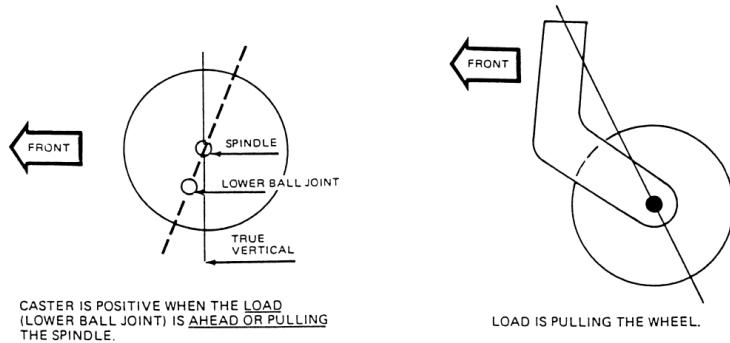


Fig. Fig. 1: Caster affects straight-line stability. Caster wheels used on shopping carts, for example, employ positive caster

CAMBER

See Figure 2

Looking from the front of the vehicle, camber is the inward or outward tilt of the top of wheels. When the tops of the wheels are tilted in, this is negative camber; if they are tilted out, it is positive. In a turn, a slight amount of negative camber helps maximize contact of the tire with the road. However, too much negative camber compromises straight-line stability, increases bump steer and torque steer.

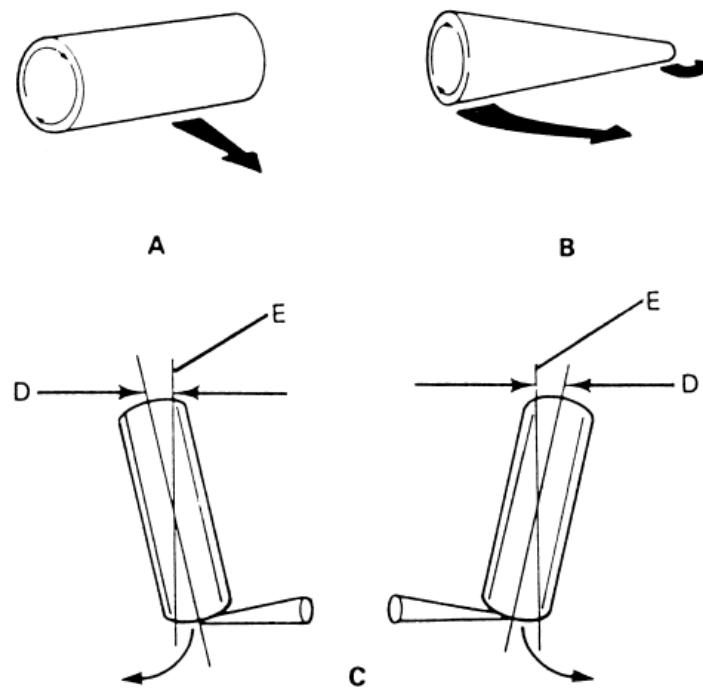


Fig. Fig. 2: Camber influences tire contact with the road

TOE

See Figure 3

Looking down at the wheels from above the vehicle, toe angle is the distance between the front of the wheels, relative to the distance between the back of the wheels. If the wheels are closer at the front, they are said to be toed-in or to have negative toe. A small amount of negative toe enhances directional stability and provides a smoother ride on the highway.

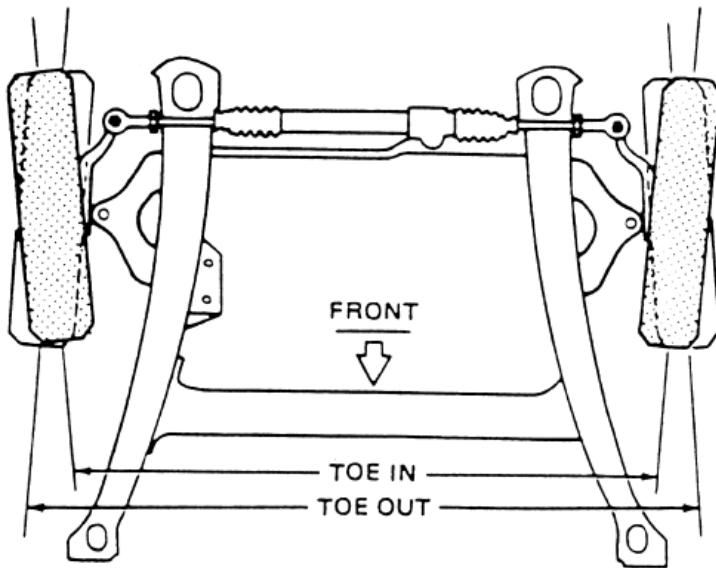


Fig. Fig. 3: With toe-in, the distance between the wheels is closer at the front than at the rear

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Brake Caliper

REMOVAL & INSTALLATION

[Print](#)

240 Series

1. Raise and safely support the vehicle.
2. Remove the front wheel(s).
3. Disconnect any ABS wires, if equipped.
4. Clean the caliper to ensure that no dirt gets into the brake line.
5. Disconnect the brake lines, and remove the two caliper mounting bolts.

If the brake line is seized to the caliper, it should be replaced.

To install:

6. Install the caliper using new mounting bolts.
7. Check the location of the caliper in relation to the disc.
 - A. Use feeler gauges to check the distance between the disc and the caliper support stubs on both sides.
 - B. The difference between the two measurements must not exceed 0.001 in. (0.25mm).
 - C. Repeat the measurements using the upper and lower support stubs to check if the caliper is mounted parallel to the disc.
 - D. If the caliper is not correctly aligned, shims can be used to adjust its position.
8. Install the brake pads and make sure that the disc can rotate freely between the pads.
9. Connect any ABS wires unfasten during removal.
10. Bleed the brake system.
11. Install the wheels.
12. Lower the vehicle.
13. Check the brake pedal function before driving vehicle.

700 Series, 900 Series, S90 and V90 Models

1. Raise and safely support the vehicle.
2. Remove the wheels.
3. Disconnect the ABS lead and brake hose from their clips.
4. Clean the brake hose and line connection.
5. Disconnect the hose from the line.
6. Disconnect the hose from the caliper.
7. Remove the lower caliper guide pin bolt, swing the caliper up and remove the brake pads.
8. Remove the caliper mounting bolts and lift the caliper off.
9. Remove the upper caliper guide pin bolt to separate the caliper from the mounting bracket.

10. Clean the guide pins and inspect for wear or damage. Replace as necessary.

To install:

11. Lubricate the guide pins with silicone grease.
12. Reassemble the caliper and mounting bracket using one guide pin bolt, but do not tighten.
13. Install the bleed nipple and brake hose.
14. Mount the caliper with new bolts and tighten to 74 ft. lbs. (100 Nm).
15. Install the brake pads and guide pin bolt.
16. Tighten the guide pin bolts to 20 ft. lbs. (27 Nm).
17. Reconnect brake hose to line and ABS lead to the hose.

Make sure that the brake hoses are not twisted.

18. Bleed the brake system.
19. Install the wheels.
20. Lower the vehicle.
21. Check brake pedal function before driving vehicle.

850, S70, C70 and V70 Series

See Figures 1 and 2

1. Turn the ignition switch *OFF* and, if equipped with ABS, remove the key to prevent accidental pump activation.
2. Raise and safely support the vehicle.
3. Remove the wheel(s).
4. Disconnect any ABS wires, if equipped.
5. Loosen the brake hose a half turn.
6. Remove the caliper bolts, lift the caliper off and unscrew the caliper from the hose.
7. Drain the remaining brake fluid from the caliper.
8. Remove the brake pads.

To install:

9. Grease the caliper bolts with lithium grease and insert them into the sleeves.
10. Screw the caliper onto the brake hose.
11. Install the brake pads and mount the caliper.
12. Tighten the caliper bolts to 22 ft. lbs. (30 Nm) and install the dust caps.
13. Install the retaining clip.
14. Tighten the brake hose to 13 ft. lbs. (18 Nm).

Make sure that the brakes hose is not twisted.

15. Fill the master cylinder and bleed the brake system. Check the system for leaks and proper function.
16. Connect any ABS wires which were previously removed.
17. Install the wheels.
18. Lower the vehicle.
19. Check the brake function before driving the car.



Fig. Fig. 1: Loosen and remove the caliper carrier retaining bolts, usually using a 17mm socket or wrench ...



Fig. Fig. 2: ... and remove the caliper carrier

OVERHAUL

See Figures 3, 4, 5, 6, 7, 8, 9 and 10

Some vehicles may be equipped dual piston calipers. The procedure to overhaul the caliper is essentially the same with the exception of multiple pistons, O-rings and dust boots.

1. Remove the caliper from the vehicle and place on a clean workbench.

CAUTION

NEVER place your fingers in front of the pistons in an attempt to catch or protect the pistons when applying compressed air. This could result in personal injury!

Depending upon the vehicle, there are two different ways to remove the piston from the caliper. Refer to the brake pad replacement procedure to make sure you have the correct procedure for your vehicle.

2. The first method is as follows:

- A. Stuff a shop towel or a block of wood into the caliper to catch the piston.
- B. Remove the caliper piston using compressed air applied into the caliper inlet hole. Inspect the piston for scoring, nicks, corrosion and/or worn or damaged chrome plating. The piston must be replaced if any of these conditions are found.



Fig. Fig. 3: For some types of calipers, use compressed air to drive the piston out of the caliper, but be sure to keep your fingers clear

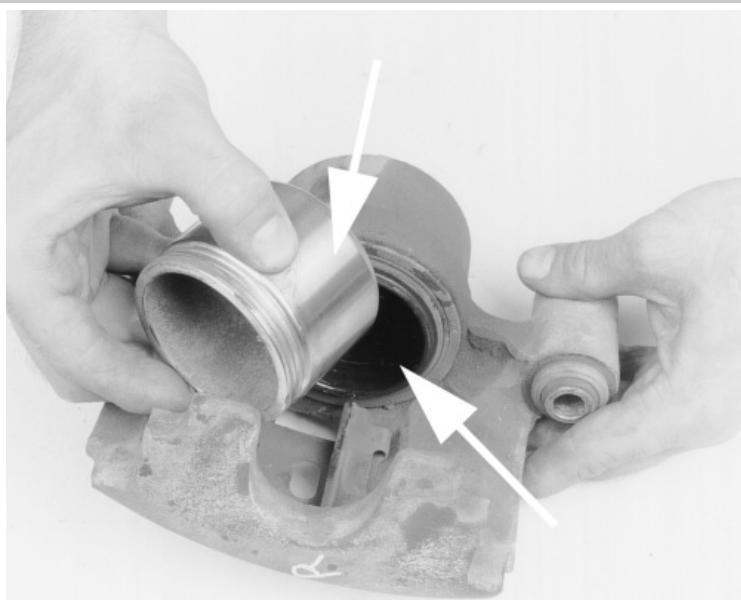


Fig. Fig. 4: Withdraw the piston from the caliper bore

3. For the second method, you must rotate the piston to retract it from the caliper.
4. If equipped, remove the anti-rattle clip.



Fig. Fig. 5: On some vehicles, you must remove the anti-rattle clip

5. Use a prytool to remove the caliper boot, being careful not to scratch the housing bore.

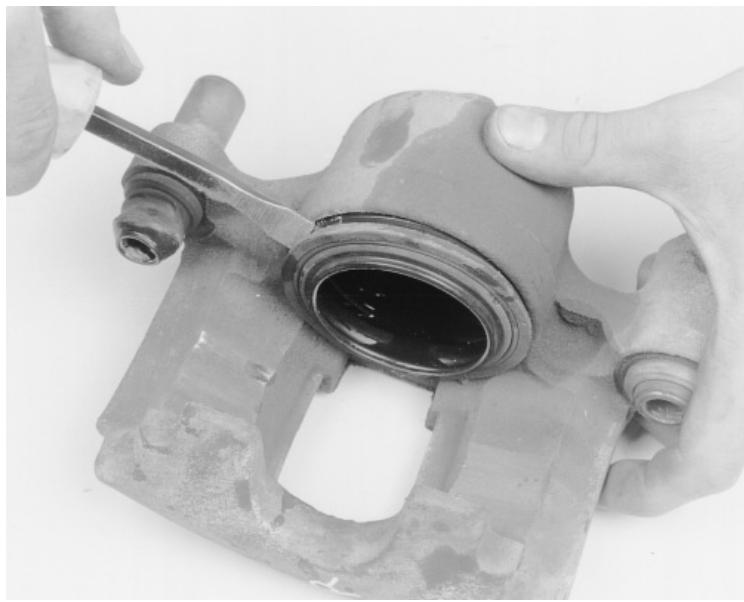


Fig. Fig. 6: Use a prytool to carefully pry around the edge of the boot ...



Fig. Fig. 7: ... then remove the boot from the caliper housing, taking care not to score or damage the bore

6. Remove the piston seals from the groove in the caliper bore.



Fig. Fig. 8: Use extreme caution when removing the piston seal; DO NOT scratch the caliper bore

7. Carefully loosen the brake bleeder valve cap and valve from the caliper housing.
8. Inspect the caliper bores, pistons and mounting threads for scoring or excessive wear.
9. Use crocus cloth to polish out light corrosion from the piston and bore.
10. Clean all parts with denatured alcohol and dry with compressed air.

To assemble:

11. Lubricate and install the bleeder valve and cap.
12. Install the new seals into the caliper bore grooves, making sure they are not twisted.
13. Lubricate the piston bore.
14. Install the pistons and boots into the bores of the calipers and push to the bottom of the bores.
15. Use a suitable driving tool to seat the boots in the housing.



Fig. Fig. 9: Use the proper size driving tool and a mallet to properly seal the boots in the caliper housing

16. Install the caliper in the vehicle.
17. Install the wheel and tire assembly, then carefully lower the vehicle.
18. Properly bleed the brake system.

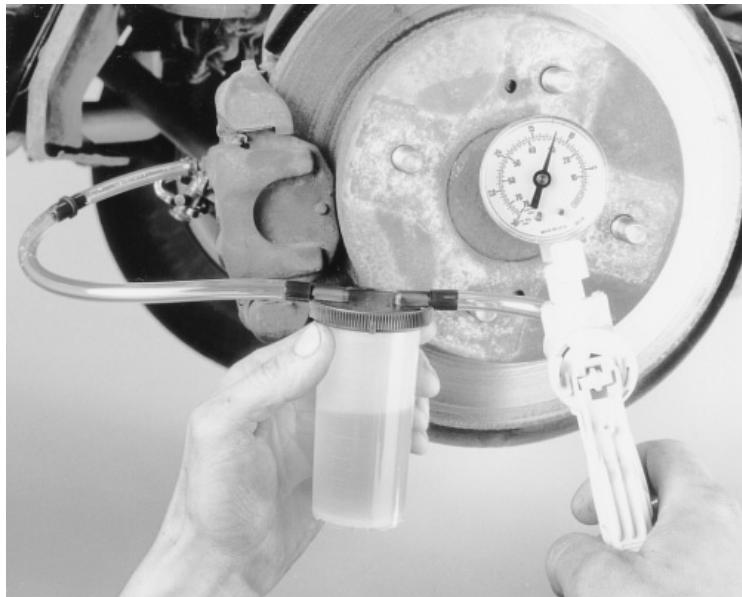


Fig. Fig. 10: There are tools, such as this Mighty-Vac, available to assist in proper brake system bleeding

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Brake Disc (Rotor)

REMOVAL & INSTALLATION

240 Series

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1. Raise and safely support vehicle.
2. remove the front wheel(s).
3. Remove the brake caliper and hang it from the spring with a piece of wire.
4. Remove the two screws securing the disc.
5. Lift the disc off, it may be necessary to tap on the disc with a soft headed hammer.

To install:

6. Install the new disc, make sure the mating surfaces of the disc and hub are clean and dry.
7. Install the caliper using new mounting bolts.
8. Check the location of the caliper in relation to the disc. Use feeler gauges to check the distance between the disc and the caliper support stubs on both sides. The difference between the two measurements must not exceed 0.001 in. (0.0013mm). Repeat the measurements using the upper and lower support stubs to check if the caliper is mounted parallel to the disc. If the caliper is not correctly aligned, shims can be used to adjust the caliper's position.
9. Install the brake pads and make sure that the disc can rotate freely between the pads.
10. Install the disc securing screws.
11. Install the wheels.
12. Check brake pedal function before driving vehicle.

700 Series, 900 Series, S90 and V90 Models

1. Raise and safely support the vehicle.
2. Remove the wheels.
3. Remove the caliper and brake pads.
4. Hang the caliper from the spring, to avoid damaging the brake hose.
5. Remove the wheel pin guide and brake disc.
6. Clean the hub flange, remove the corrosion with a scraper and or wire brush.
7. Clean the ABS pick-up and toothed wheel using a soft brush.

To install:

8. Ensure that the mating surfaces on the hub and disc are clean.
9. Insert guide pin and tighten to 6 ft. lbs. (8 Nm). Reinstall the ring gauge and cross tighten the lug nuts to 63 ft. lbs. (85 Nm).
10. Measure disc run-out. Measure on the disc surface 0.60 in. (15mm) in from the edge. Maximum run-out is 0.0023 in. (0.060mm). Remove the measuring equipment.
11. Install the caliper carrier using new mounting bolts, then install the caliper and brake pads.

- 12.** Operate the brake pedal several times and check the fluid level.
- 13.** Install the wheels.
- 14.** Check brake function before driving vehicle. Limit hard braking whenever possible during the 500 miles (800 km) after pad replacement.

850, S70, C70 and V70 Series

See Figures 1 and 2

- 1.** Raise and safely support the vehicle.
- 2.** Remove the wheels.
- 3.** Remove the brake caliper and brake pads.
- 4.** Remove the carrier.
- 5.** Remove the guide pin bolt.
- 6.** Remove the rotor and clean the hub flange of all corrosion and dirt.
- 7.** Check the hub run-out by mounting gauge ring (Volvo tool 5419 from tool kit 5418) or equivalent.
- 8.** Install the dial indicator on the spindle (using the caliper bracket bolt holes). Place the probe end to the gauge ring.
- 9.** Turn hub slowly and identify the highest point. If the run-out exceeds 0.0007 in. (0.020mm), the hub must be replaced.
- 10.** Remove the measuring equipment.

To install:

- 11.** Install the brake rotor.
- 12.** Tighten the guide pin bolt to 72 inch lbs. (8 Nm).
- 13.** Install the caliper carrier using new bolts.
- 14.** Install the brake caliper and brake pads.
- 15.** Depress the brake pedal several times and check the brake fluid reservoir.
- 16.** Install the wheels.
- 17.** Check the brake function before driving vehicle.



Fig. Fig. 1: Remove the wheel guide pin bolt ...

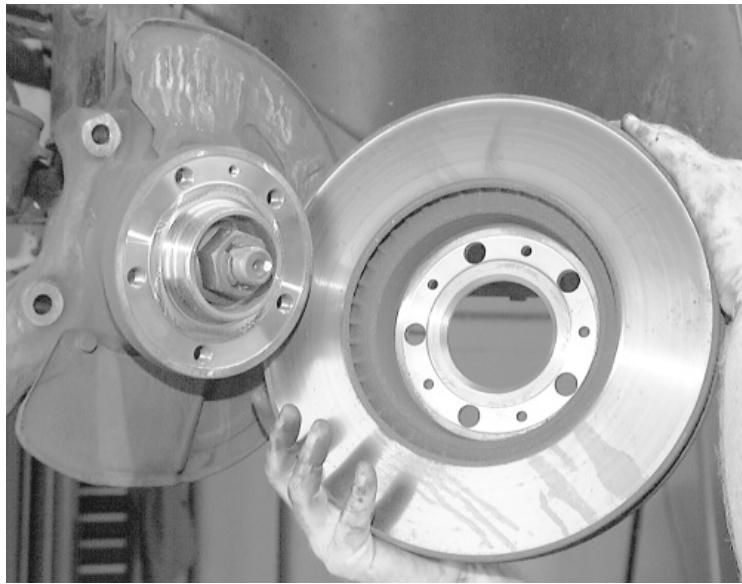


Fig. Fig. 2: ... and remove the brake disc from the hub

INSPECTION

Inspect the brake rotor for scoring and wear; minor scoring or disc pad lining build-up does not require rotor machining or replacement. If heavy scoring, cracks or other damage is evident, replace or have the rotor machined, as necessary.

Glaze on the rotor can be removed by hand-sanding it with medium grit garnet paper or aluminum oxide sandpaper.

The minimum thickness of each brake rotor is indicated on the rotor itself. Do not utilize a rotor which is worn below the minimum allowable thickness. If rotor damage cannot be corrected by grinding to these minimums, the rotor must be replaced.

Rotor lateral run-out must not be more than 0.001 in. (0.035mm).

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998



Brake Pads

REMOVAL & INSTALLATION

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CAUTION

Older brake pads or shoes may contain asbestos, which has been determined to be cancer causing agent. Never clean the brake surfaces with compressed air! Avoid inhaling any dust from any brake surface! When cleaning brake surfaces, use a commercially available brake cleaning fluid.

240 Series

1. Raise and safely support the vehicle.
2. Remove the front wheels.
3. Remove the spring clips and retaining pins. Remove the retaining springs and brake pads.

If the brake pads are difficult to remove, tool 2917 or equivalent can be used to collapse the caliper pistons to ease removal.

4. Clean the caliper where the brake pads sit and inspect the dust caps for damage, and replace if necessary.
5. Check the brake rotor surface for signs of wear, warping or variations in thickness.
6. Compress the caliper pistons using a large pair of pliers or a C-clamp.

It may be necessary to remove some brake fluid from the reservoir when depressing the piston.

To install:

7. Before replacing the pads:
 - A. Check the rubber dust caps for the brake pistons, replace if defective. If dirt has penetrated into the cylinders, due to a defective dust cap, recondition the caliper.
 - B. Check the friction surface of the disc, if required, replace or machine the rotor surface.
 - C. Check the rubber seals on the guide pins, replace them if they are defective.
8. Install the brake pads, retaining springs, retaining pins, and spring clips.
9. Check the brake fluid level and pump the brake pedal several times. It may be necessary to bleed the brake system.
10. Install the wheels.
11. Check the brake pedal operation before driving the vehicle.

700 Series, 900 Series, S90 and V90 Models

1. Raise and safely support the vehicle.
2. Remove the wheels.
3. Remove the lower caliper guide pin bolt and swing the caliper upwards.
4. Remove the brake pads.

Do not depress the brake pedal while pads are removed.

To install:

The fluid level can rise in the reservoir when the piston is compressed.

5. Remove some brake fluid to prevent spillage. Air may be trapped in the dust seal of the piston. To avoid damage to the boot, it may be necessary to release the trapped air.
6. Press the piston back into the caliper.
7. Inspect the piston dust cap, if it is damaged, the caliper must be overhauled or replaced.
8. Check the disc brake surface for distortion or variation in thickness. Replace if not within specification.
9. Check to see that the metal guide plates are in position and install the pads. Check the guide pin boots for damage and replace them if necessary.
10. Swing the caliper down into position, being careful not to damage the guide pin boots. Tighten the guide pin bolt to 20 ft. lbs. (27 Nm).
11. Check the reservoir fluid level and add as necessary.
12. Operate the brake pedal repeatedly.
13. Install the wheels.

850, S70, C70 and V70 Series

See Figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11

1. Raise and safely support the vehicle.
2. Remove the front wheels.
3. Carefully remove retaining spring, without bending.
4. Remove the protective caps from the guide pin bolts.
5. Use an appropriate size Allen wrench (typically 7mm) to remove the guide pins.
6. Remove caliper from the carrier.
7. Remove the brake pads. Hang the caliper from the spring so that the hose is not damaged.

WARNING

Do not depress the brake pedal while the pads are removed.

8. Clean the caliper carrier where the brake pads sit.
9. Check the piston dust boot for damage or dirt. If the boot is damaged, the caliper should be overhauled or replaced.
10. Check the brake rotor for signs of wear or damage.
11. Check the guide pin bolt rubber sleeves for damage and replace if necessary.

To install:

12. Press the piston back into the caliper cylinder using a suitable tool.
13. Lubricate the caliper guide pins with silicone grease.
14. Insert the brake pads and slide the caliper on over them.
15. Tighten the guide pins to 22 ft. lbs. (30 Nm) and replace the dust caps.
16. Install the retaining spring.
17. Install the wheels.
18. Lower the vehicle.
19. Depress the brake pedal several times and check the brake fluid reservoir level.
20. Check brake pedal function before driving vehicle.

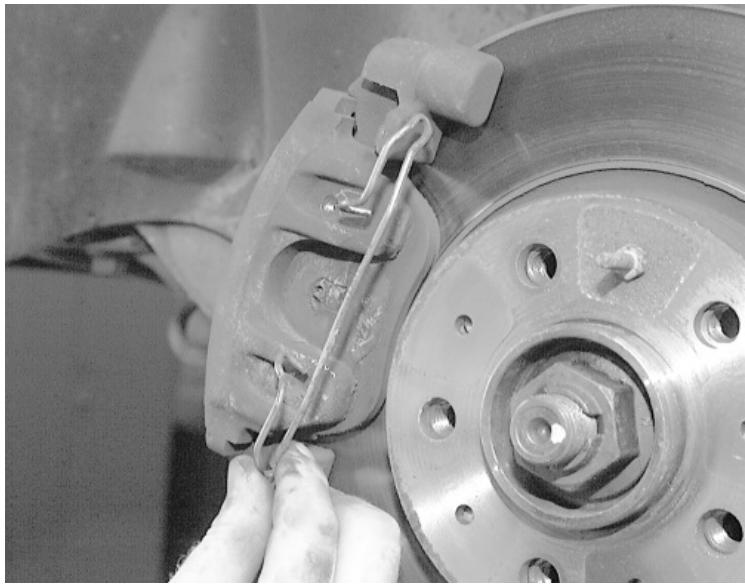


Fig. Fig. 1: Remove the retaining spring



Fig. Fig. 2: Remove the protective caps over the caliper guide pins ...



Fig. Fig. 3: ... and use an appropriate size Allen wrench (typically 7mm) ...



Fig. Fig. 4: ... to loosen and remove the caliper guide pins

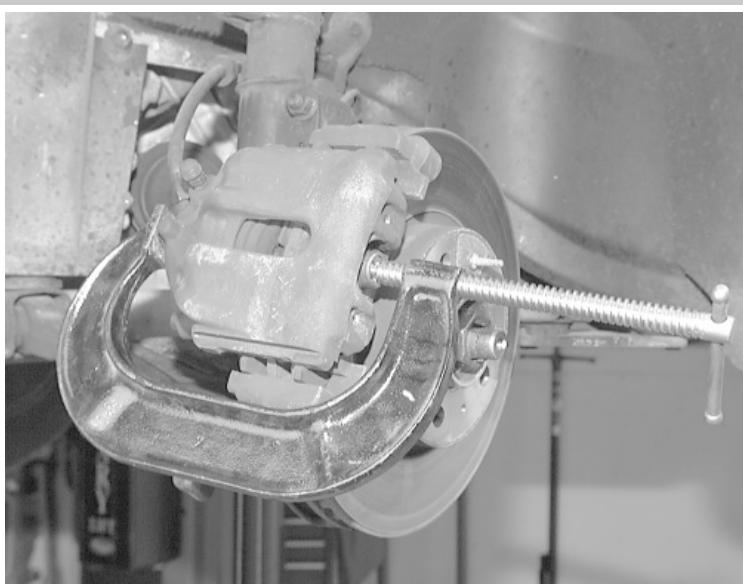


Fig. Fig. 5: A large C-clamp is a useful tool to compress the piston

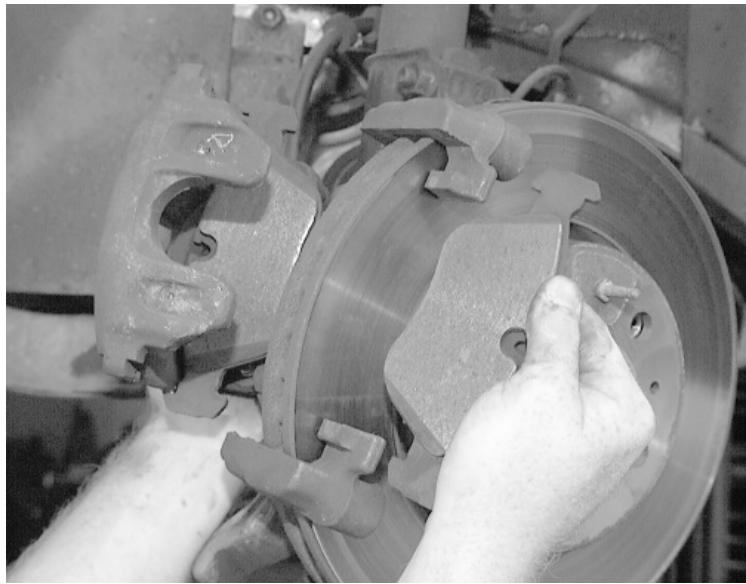


Fig. Fig. 6: Pull the caliper off and remove the brake pads

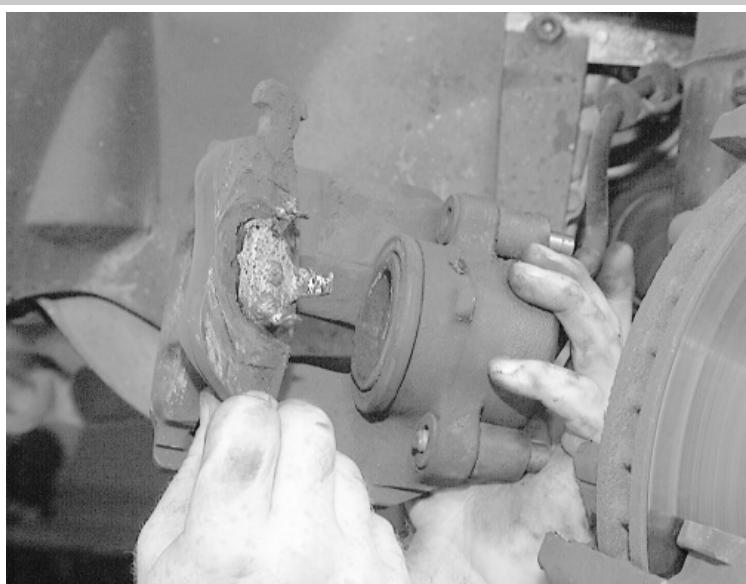


Fig. Fig. 7: The inboard pad is held into the caliper by metal tabs



Fig. Fig. 8: Thoroughly brush and clean the caliper carrier before replacing the pads



Fig. Fig. 9: Volvo recommends that a high temperature grease be applied to the pad contact points on the caliper carrier ...



Fig. Fig. 10: ... and caliper pins prior to pad installation



Fig. Fig. 11: Inspect the rubber sleeves for damage and cracking

INSPECTION

See Figure 12

CAUTION

Older brake pads or shoes may contain asbestos, which has been determined to be cancer causing agent. Never clean the brake surfaces with compressed air! Avoid inhaling any dust from any brake surface! When cleaning brake surfaces, use a commercially available brake cleaning fluid.

Check the width of the brake pads using a thickness gauge, available at most auto parts stores. Minimum brake pad thickness is 0.08 inch (2mm).

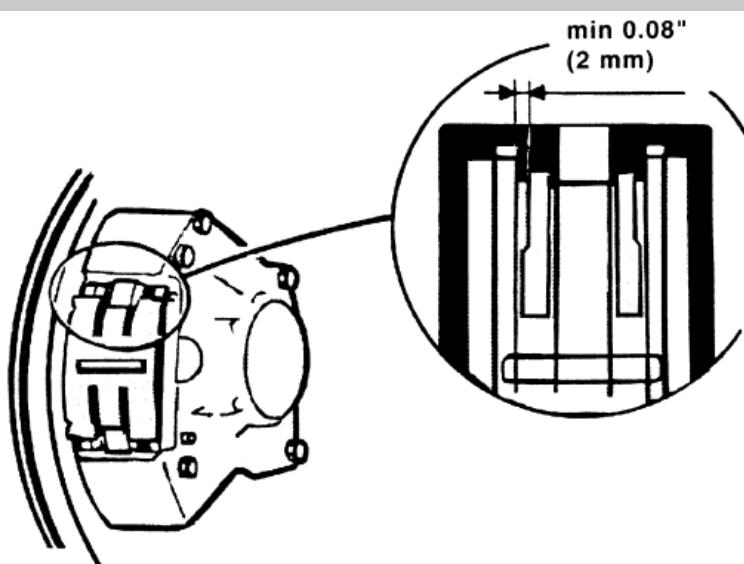


Fig. Fig. 12: Pad thickness is measured from the disc to the edge of the pad

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REPAIR GUIDE

Volvo 240/740/760/780/940/960 1990-1998

Doors

REMOVAL & INSTALLATION

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The doors are heavy! Provide proper support for the door when removing. Do not allow the door to sag while partially attached and do not subject the door to impact or twisting movements.

1. Disconnect the negative battery cable.
2. Disconnect any wiring harnesses running into the door. This may be done either inside the door (remove the door panel) or under the dashboard,

inside the pillar. Make sure the wiring harness will not catch or bind as the door is removed from the vehicle.

3. Scribe marks around the hinges to facilitate door installation.
4. Support the door with a jack. Place a piece of wood on the jack to protect the paintwork.
5. Have a helper support the door, then loosen and remove the hinge mounting bolts and remove the door from the vehicle.

To install:

6. With an assistant, position the door and install the hinge bolts. Do not fully tighten the hinge mounting bolts at this time.
7. Check the door for proper alignment. If required, loosen the mounting bolts just enough to allow the door to be moved into position.
8. Tighten all the hinge bolts and check the final fit.
9. If the door stop bracket was removed, reinstall it.
10. Connect the wiring harness and check the function of electrical components in the door. Install the door panel if removed.
11. Connect the negative battery cable.

ADJUSTMENT

See Figure 1

The primary door adjustments are carried out at the hinge bolts at the forward end of each door. Further adjustment for the closed position and for latching smoothness may be made at the latch plate or striker. This piece is located at the rear edge of the door and is attached to the bodywork of the vehicle; it is the piece which the door engages when closed.

Although the striker or latchplate is different on various models, the adjustment procedure is the same:

1. Adjust the position of the door by moving the striker plate sideways.
2. If further adjustments are necessary, first slacken the upper door hinge bolts, then, if necessary, the lower 2 bolts. Push the door toward the body.

Never loosen more than 3 bolts at a time or the door may drop. Do not attempt to correct height variations (sag) by adjusting the striker.

3. After the striker bolts have been tightened, open and close the door several times. Observe the motion of the door as it engages the striker; it should continue its straight-in motion and not deflect up or down as it hits the striker.
4. Check the feel of the latch during opening and closing. It must be smooth and linear, without any trace of grinding or binding during engagement and release.

It may be necessary to repeat the striker adjustment procedure several times (and possibly adjust the hinges) before the proper door-to-body alignment is corrected.

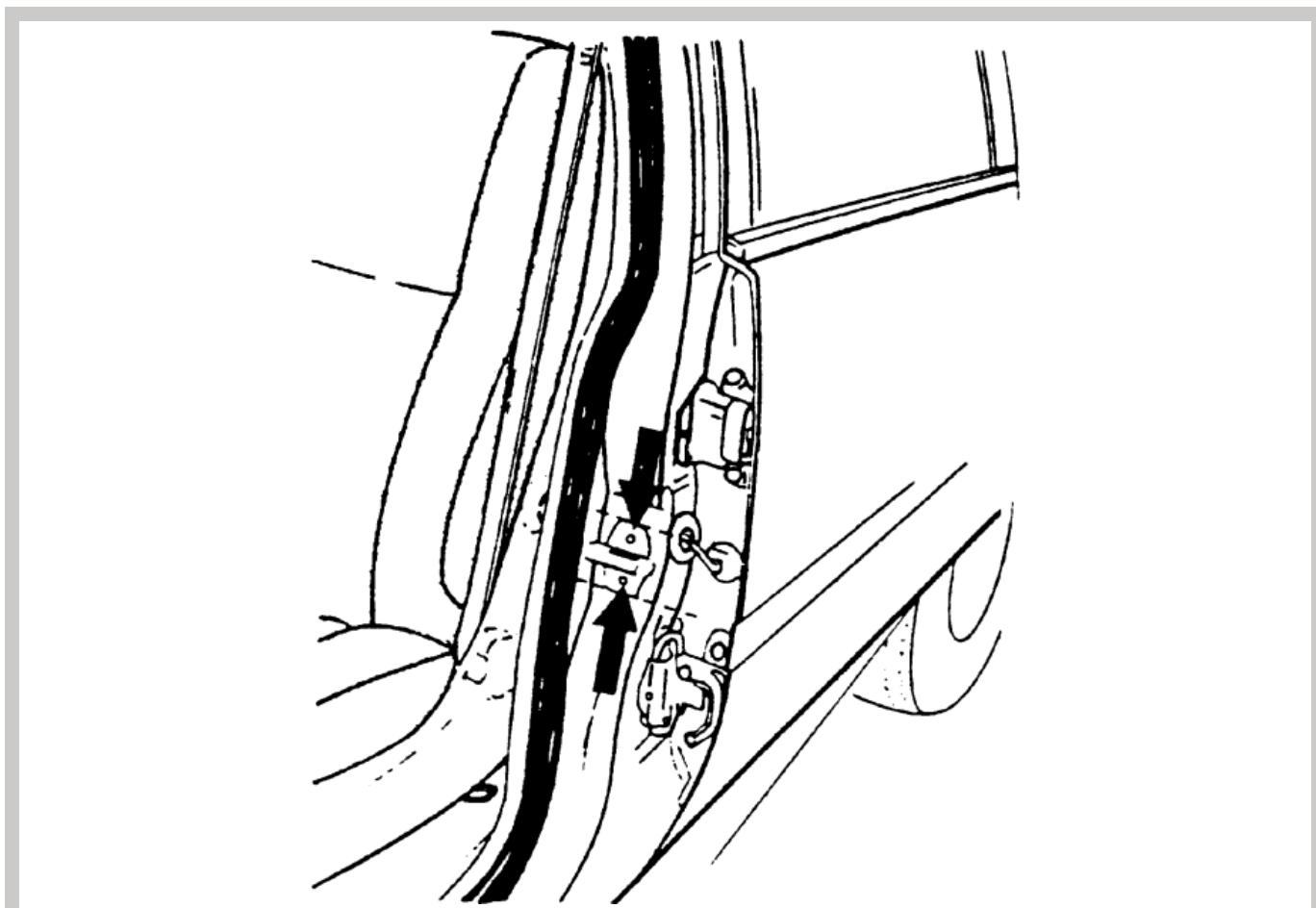


Fig. Fig. 1: Door adjustment points on the front door-700 series models shown, others similar

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EXTERIOR

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WARNING

To avoid damage to the Electronic Control Module (ECM) and/or other electronic components, always disconnect the negative battery cable before using any electric welding equipment on the vehicle.

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Fenders

REMOVAL & INSTALLATION

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1. Remove the windshield wiper arms.
2. Remove the cowl trim.
3. Unfasten the air inlet grille bolts and remove the grille.
4. Remove the bumper end-piece, headlight and turn signal lens assemblies.
5. Remove the wheel well trim.
6. Remove the fender retaining bolts and carefully remove the fender from the vehicle.

To install:

Before installing the retaining bolts at the wheel arch joint, apply sealer (P/N 591278-7 or equivalent).

7. Install the fender into place and tighten the retaining bolts.
8. Install the wheel well trim.
9. Install the headlight and turn signal lens assemblies, and the bumper end-piece.
10. Install the air inlet grille and tighten the retaining bolts.
11. Install the cowl trim.
12. Install the windshield wiper arms.

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Grille

REMOVAL & INSTALLATION

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The plastic grilles on these vehicles are retained by a variety of plastic clips and screws. With the hood raised, remove all the retaining hardware and lift the grille clear of the vehicle. Be careful of any wires and/or tubing running between the grille and the radiator. Do not force the grille into position or it will crack; work carefully and make sure everything lines up before tightening the mounting hardware.

On some models, the grille is an integral part of the hood and removal of the hood also removes the grille. This can be verified when the hood is opened; if the grille is attached, it will raise with the hood.

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Hood

REMOVAL & INSTALLATION

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See Figures 1, 2, 3, 4 and 5

1. Raise the hood.
2. Disconnect any electrical or fluid lines between the hood and the body.
3. Scribe marks around the hinges to facilitate hood installation. Have a helper support the hood so it doesn't damage the body during removal.
4. Remove the hinge-to-hood bolts on each side and lift the hood clear of the vehicle.

The hood can be easily damaged; take great care not to bend or dimple the hood. Store it on pads and cover it to protect it while off the vehicle.

To install:

5. Position the hood and install the bolts just tight enough to hold it in position.
6. Lower the hood and check the alignment; the gap should be even all around.
7. Tighten the bolts.
8. Attach any electrical connections or fluid lines which were removed.

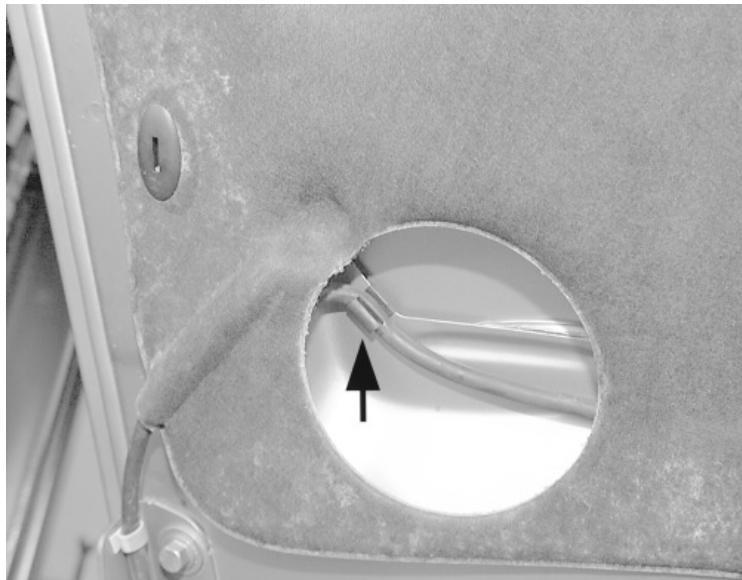


Fig. Fig. 1: Locate the washer jet hoses ...



Fig. Fig. 2: ... and disconnect them



Fig. Fig. 3: Remove the clips retaining the hose



Fig. Fig. 4: Matchmark the hood and hinges to ease installation



Fig. Fig. 5: Remove the two retaining bolts from each side and, with the help of an assistant, remove the hood

ALIGNMENT

Hoods can be easily damaged; take great care not to bend or dimple the hood.

1. Front height adjustment: adjust the guide pins or rubber bump stops on the front panel.
2. Left and right adjustment: loosen the hood and move the hood in the desired direction.
3. Hood length: loosen the hood hinges and move the hood in the desired direction. (The hinges are provided with oval holes.)
4. Rear height adjustment: adjust the hinge mountings near the wheel arch.

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Outside Mirrors

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Mirror Assembly

See Figures 1, 2, 3 and 4

1. Remove the door panel, as described later in this section.
2. Unplug the mirror electrical connector.
3. Remove the trim panel and rubber cover (if equipped).
4. Remove the screws and clips.
5. Remove the mirror assembly.

To install:

6. Position the mirror assembly.
7. Tighten the screws and attach the clips.
8. Install the rubber cover.
9. Plug in the electrical connector.
10. Install the door panel.



Fig. Fig. 1: Unplug the electrical connector



Fig. Fig. 2: Remove the trim cover ...



... to access the retaining screws



Fig. Fig. 4: Remove the mirror assembly

Mirror Glass

See Figure 5

1. Press on the lower edge of the mirror so that the gear is revealed in the slot in the bottom of the mirror.
2. Move the cogs to the right with a small screwdriver and remove the mirror glass.

To install:

3. Align the assembly lugs on the rear of the mirror glass.
4. Depress the lower edge of the glass and move the cogs to the left.
5. Check to ensure that the new glass is firmly installed.

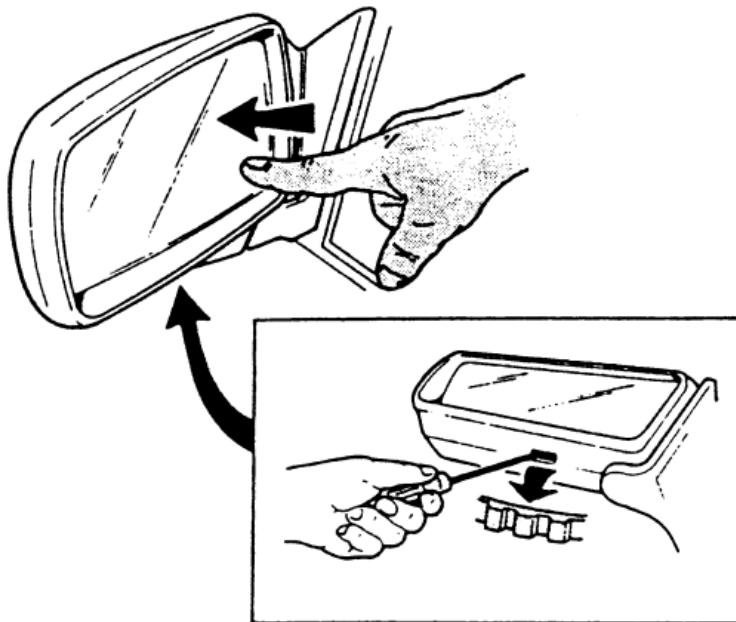


Fig. Fig. 5: Mirror glass removal

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Power Antenna

The power antenna extends when the radio is turned *ON*. The mast will retract when the radio is turned *OFF*. The 700 and 900 Series vehicles have a switch that allows the antenna to be retracted with the radio *ON*. The switch will also prevent the mast from extending when the radio is first turned *ON*. There are 3 leads to the power antenna unit. There is a ground lead that is electrically connected to the chassis and a green or green and red power lead connected to the fuse box to provide operating voltage. The third lead is connected to the radio (through a switch for the 700 and 900 series vehicles) to provide the signal for antenna operation. When there is power on this lead, the antenna extends; when the power is removed, by turning *OFF* the radio or turning *OFF* the antenna switch on 700 and 900 series vehicles, the antenna retracts.

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable.
2. Remove the trim panel covering the antenna assembly.
3. Disconnect the electrical leads and ground strap, if used.
4. Unscrew the upper antenna retaining nut around the base on the body.
5. Unbolt the antenna assembly securing fasteners.
6. Remove the antenna assembly from the underside.

To install:

7. Install the antenna from the underside and tighten the retaining bolts.
8. Install the upper antenna retaining nut.
9. Connect the electrical leads and the ground strap.
10. Install the trim panel.
11. Connect the negative battery cable.

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Power Mirror Motor

REMOVAL & INSTALLATION

[Print](#)[See Figure 1](#)

1. Remove the mirror glass, as described in the previous procedure.
2. Remove the retaining screws and lift out the motor.
3. Unplug the electrical connector.
4. Remove the motor from the vehicle.

To install:

5. Plug in the electrical connector.
6. Position the motor and tighten its retaining screws.
7. Install the mirror glass.

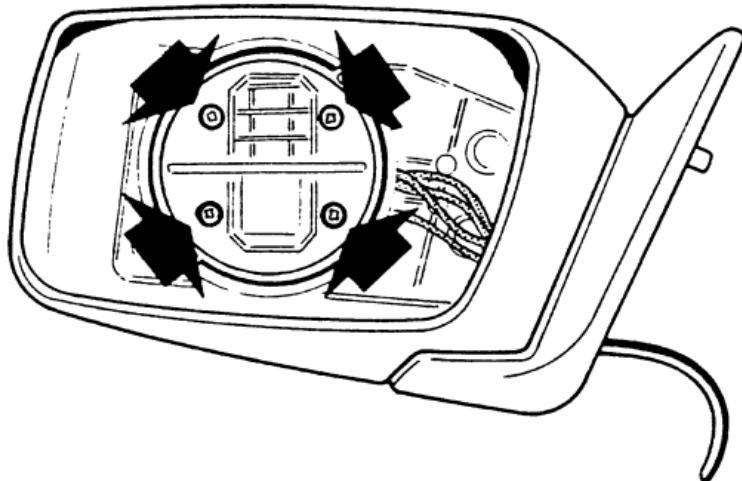


Fig. Fig. 1: Location of the power mirror motor retaining bolts

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Power Sunroof

The power sunroof is controlled by a switch that selects the direction of travel of the sunroof. The switch changes the polarity of the voltage going to the sunroof motor. This changes the rotation of the motor, thereby changing the direction of sunroof travel.

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REMOVAL & INSTALLATION

[See Figure 1](#)

1. Open the sunroof to the ventilation position.
2. Disconnect the battery ground cable.
3. Push down the sunroof headlining with a finger. Unhook the retaining springs with a bent piece of wire.
4. Pull down on the headlining sufficiently to pass beneath the gutter rail. At the same time, slide the sunroof to the rear to release the catches at the front.

Do not pull the sunroof too far to the rear; otherwise, it will be difficult to remove again.

5. Unhook the spring retaining brackets.
6. Remove the retaining screws from the sides and front.
7. Remove the sunroof.

To install:

8. Fit the sunroof into position and install the retaining screws.
9. Install the spring retaining brackets.

- 10.** Slide the sunroof forward to engage the catches in the front.
- 11.** Install or reposition any trim moved for access.
- 12.** Connect the negative battery cable.

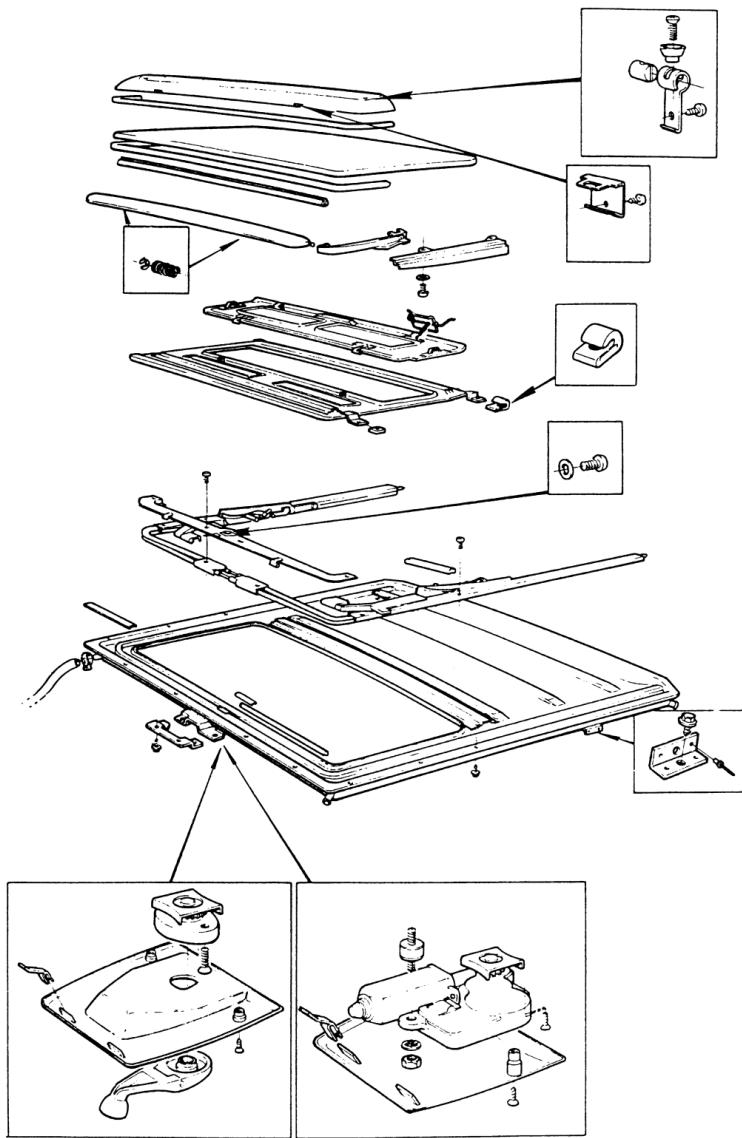


Fig. Fig. 1: Exploded view of the sunroof assembly

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Trunk Lid or Liftgate

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2 and 4-Door Models

- 1.** Open the trunk lid. Have a helper support the lid; remove the retaining clip for the gas shock (which holds the lid open) and disconnect it from the lid.
- 2.** Detach any wiring to the trunk lid at the nearest connector. Make sure the wiring will not bind when the lid is removed.
- 3.** Scribe marks around the hinges to facilitate trunk lid installation.
- 4.** Remove the bolts which hold the hinges to the trunk lid and lift the lid clear of the vehicle.

Trunk lids can be easily damaged; take great care not to bend or dimple the trunk lid. Store it on pads and cover it to protect it while off the vehicle.

To install:

- 5.** Place the lid into position and lightly tighten the bolts until snug.
- 6.** Check the lid-to-body alignment and adjust the trunk lid as necessary.
- 7.** Final-tighten the bolts.

8. Reattach the gas shock to the trunk lid and reconnect the wiring, if any.

Wagon (5-Door Model)

Because of the size and weight of the liftgate, this procedure requires 2 people during removal and installation.

1. Remove the inner cover panel on the liftgate.
2. Detach any electrical connectors within the liftgate. Tag or identify the connectors for ease of reassembly.
3. Pull the harness through the hole in the top of the liftgate.
4. While your helper supports the liftgate, disconnect the gas shock(s).
5. With the liftgate safely supported, remove the liftgate-to-hinge bolts on each side at the top. On the 740, one of the bolts is beneath a rubber plug which must be removed.
6. Remove the liftgate from the vehicle and store it on pads.

To install:

7. Place the liftgate into position and loosely tighten the bolts until snug.
8. Check the alignment of the liftgate in relation to the body, and adjust it as necessary.
9. When the alignment is correct, final-tighten the hinge bolts. Left-right alignment is critical. Take your time and work for an even fit.
10. Connect the gas shock(s) to the liftgate.
11. Feed the wire harness through the hole at the top of the liftgate and into position.
12. Connect the wires to the proper points.

ALIGNMENT

All Models

Both trunk lids and wagon liftgates are adjustable on their hinges due to slotted holes. The trunk lids are also adjustable by loosening the hinge-to-body bolts and repositioning the hinge vertically.

Wagon liftgates have additional adjusters on the sides. Loosen their screws a few turns and close the liftgate. The adjuster should seek the correct position for smooth operation. Because of the curve of the body and roofline, the wagon liftgate needs to be checked carefully for alignment to the body. Seams should be straight and even, and panels should be flush with no obvious high or low points.

Final adjustments are made at the latch (on the lid) and the striker (on the body). Each can be loosened and moved on its mounts to control tightness and ease of operation. It is recommended to start by loosening the striker only; close the lid or liftgate and let the striker seek its position. Continue adjusting until the latch has no binding in its operation, the key turns freely and the weatherstrip is evenly compressed around the lid/liftgate.

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