

## 2.3L 5-CYL VIN [57]

1995 Volvo 850

1995-96 ENGINES  
Volvo - 2.3L 5-Cylinder

850

### \* PLEASE READ THIS FIRST \*

NOTE: For repair procedures not covered in this article, see ENGINE OVERHAUL - GENERAL INFORMATION article in GENERAL INFORMATION section. Repair information for this engine is not available at time of publication.

### ENGINE IDENTIFICATION

Engine may be identified by using Vehicle Identification Number (VIN) stamped on a metal pad, located near lower left corner of windshield. The sixth and seventh character identifies engine model.

Engine identification number, located on left side of cylinder block below cylinder head, may be required when ordering replacement parts.

#### ENGINE IDENTIFICATION CODES TABLE

Engine	Code
2.3L (Turbo) .....	57

### ADJUSTMENTS

#### VALVE CLEARANCE ADJUSTMENT

Engine is equipped with hydraulic lifters. No valve adjustment is necessary.

### REMOVAL & INSTALLATION

NOTE: For reassembly reference, label all electrical connectors, vacuum hoses and fuel lines before removal. Also place mating marks on other major assemblies before removal. Hood removal is not necessary, as hood opens to horizontal position. Removal and installation information for turbocharger is not available at time of publication.

#### FUEL PRESSURE RELEASE

Fuel Pump Pressure Release

Before disconnecting any lines, cover fuel line connector with shop towel to absorb any fuel left in line. With ignition key removed from ignition switch, reconnect relay.

### ENGINE

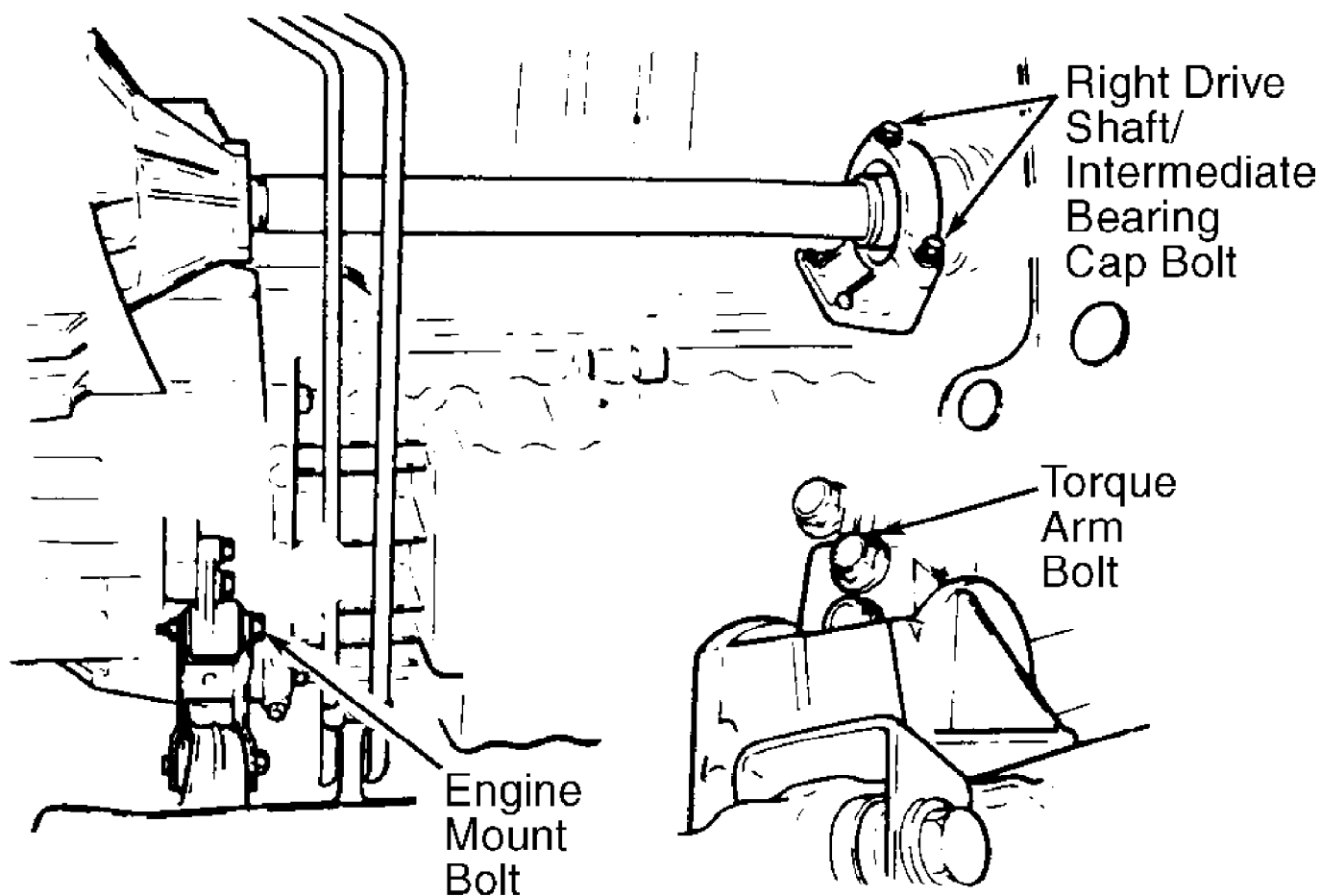
Removal

1) Remove expansion tank cap. Raise and support vehicle. Remove splash guard and air baffle under engine. Drain all coolant by

opening drain cocks on cylinder block and radiator. Remove front wheels, steering arm/wheel spindle joints, and nuts securing ball joints to support arms.

2) Remove ABS wire and brake line retaining bracket bolt located on inner fender panel, close to bottom of strut. Remove left drive axle shaft. See AXLE SHAFTS - FWD article in DRIVE AXLES section. Disconnect 2 thin Black hoses from evaporative fuel canister. Remove White vacuum hose from vacuum reservoir.

3) Remove right drive shaft and intermediate bearing cap. Carefully place components on steering servo pipes. Remove 2 right engine mounting bolts. Loosen wheel arch liner to allow access to mounting. Remove torque arm in gearbox. See Fig. 1. Install Sealing Plugs (5488) in drive shaft holes.



93G83408

Fig. 1: Removing Drive Shaft, Engine Mount Bolt & Torque Arm Bolt  
Courtesy of Volvo Cars of North America.

4) Remove front exhaust pipe nuts and springs. Remove front exhaust pipe bolts. Disconnect speedometer. Remove engine mounting shield bolt. Lower vehicle.

5) Remove battery, battery self, and fresh air hose between air intake and air cleaner housing. Disconnect MAF sensor connector and primary lead between distributor and coil. Remove throttle pulley cover. If equipped with cruise control, disconnect all necessary electrical wiring and vacuum hose.

6) Disconnect intake hose at throttle body and idle air control valve hose. Disconnect vacuum hose and crankcase ventilation

hose from intake hose. Disconnect vacuum hoses and connector from solenoid valve. Disconnect heater hose. Remove air cleaner housing. Disconnect throttle cable from throttle pulley. Remove torque arm.

7) Disconnect 2 heater hoses at firewall, brake servo hose, and 2 HO2S connectors. Remove upper nut on rear engine mount. Disconnect gear selector cables from mounting bracket on transmission. Disconnect rubber-mounted section of cable bracket. On automatic transmission equipped vehicles, disconnect 2 oil cooler hoses. On manual transmission equipped vehicles, remove clutch slave cylinder retaining ring. Remove slave cylinder from transmission.

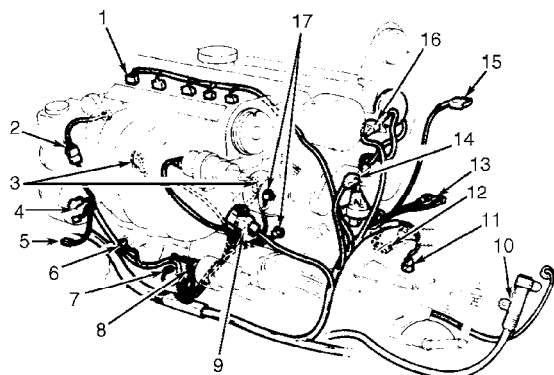
8) On all vehicles, disconnect negative battery cable. Disconnect lower radiator hose at radiator. Loosen and move air cleaner mounting bracket aside. Remove rubber mount from air cleaner bracket. On manual transmission equipped vehicles, remove clutch slave cylinder through front hole in air cleaner bracket and place aside. On all vehicles, place air cleaner bracket aside.

9) Remove electric cooling fan relays from fan shroud. Disconnect connectors and place wiring aside. Remove 2 control module box cooling air ducts. Remove 4 fan shroud screws from radiator. Use a piece of plywood to protect radiator and slide fan housing back slightly and remove air intakes. Remove fan.

10) Remove 2 long mounting bolts in A/C compressor. Leave compressor in position until removing engine. Remove front engine mounting pad nut and cable duct bracket mounting bolts. Remove intake manifold and starter support brackets.

11) Disconnect upper radiator hose from thermostat housing. Remove coolant hose between expansion tank and thermostat housing. Remove expansion tank lower hose from fitting on engine. Remove drive belt. Disconnect temperature sensor wiring from bracket on servo pump. Remove 6 servo pump bolts. Leave servo pump in position at this time.

12) Remove protective cover over fuel distribution manifold. Remove upper and lower fuel pipe clips. Remove fuel distribution manifold bolts. Disconnect braided ground lead from engine. Secure injectors with 5 Holders (5465). Lift and place fuel distribution manifold (including injectors) aside. Remove engine wiring harness. See Fig. 2.



- |                             |                              |
|-----------------------------|------------------------------|
| 1. Injectors                | 10. Lead To Auto. Trans.     |
| 2. Coolant Temp. Sensor     | 11. Back-Up Lights           |
| 3. Knock Sensor             | 12. Speed Sensor             |
| 4. Alternator               | 13. HO2S Connector           |
| 5. A/C Compressor           | 14. Camshaft Position Sensor |
| 6. Cooling Fan              | 15. Mass Airflow Sensor      |
| 7. Starter Motor            | 16. RPM Sensor               |
| 8. Oil Pressure Switch      | 17. Ground Terminals         |
| 9. Throttle Position Sensor |                              |

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Fig. 2: Removing Engine Wiring Harness  
Courtesy of Volvo Cars of North America.

13) Remove spark plug cover and attach Lifting Lugs (5459 and 5464) to engine. Lift servo pump and place aside. Remove A/C

compressor and place on sub-frame. Lift out engine and transmission using Lifting Yokes (2810 and 5428).

#### Installation

1) Attach Lifting Lug (5429) to rear of engine. Using Lifting Yoke (5428) and Lifting Tool (2810), lower engine and transmission into position. Guide engine mountings into position and tighten top nuts to 37 ft. lbs. (50 N.m).

2) Support transmission with jack and remove lifting yoke from engine. Using 2 Support Rails (5033), Lifting Beam (5006) and Lifting Hook (5115), support rear of engine. Remove jack under transmission. Using Transmission Lifting Fixture (5972), raise transmission. Install transmission support member. Tighten bolted joints between support member and side members. Tighten transmission bump stop nut to 37 ft. lbs. (50 N.m).

3) Install control rod and reaction arm to lever mounting. Install locking clip. Install oxygen sensor and reconnect electrical connector. Using Socket (5244), tighten front and rear couplings. Ensure "O" ring is okay and install air preheater pipe to exhaust pipe.

4) Install air conditioning compressor to mounting. Reconnect oil cooler lines. Tighten fittings to 26 ft. lbs. (35 N.m). Remove lifting tools.

5) Reinstall coolant hoses to firewall. Install timing pick-up and camshaft sensor connectors. Reconnect engine connector to wiring harness connector on left wheel housing. Reconnect relay and install wiring duct mounting nuts. Install harness connector cover.

6) Install fuel hoses, cruise control vacuum hose, ECC vacuum hoses, brake servo vacuum hose, throttle cable and throttle pulley cover. Install air mass meter and intake hose. Reconnect idling valve hose and connector. Reconnect oil trap hoses. Reconnect 2 EVAP vacuum hoses.

7) Install servo pump and drive belt. Install radiator and radiator hoses, expansion tank hoses, and transmission oil cooler lines. Tighten cooling line fittings to 26 ft. lbs. (35 N.m). Install cooling fan. Install battery and reconnect positive cable.

8) Jack up vehicle and reconnect cooling lines to transmission. Tighten fittings to 26 ft. lbs. (35 N.m). Install exhaust pipe and heat shield. Install radiator mounting bolts, air baffle under radiator, and splash guard under engine. Fill engine with oil and cooling system. Connect negative battery cable. Start engine and check for leaks.

## INTAKE MANIFOLD

#### Removal & Installation

For intake manifold removal and installation, see CYLINDER HEAD under REMOVAL & INSTALLATION.

## EXHAUST MANIFOLD

#### Removal

Remove exhaust manifold-to-cylinder head nuts. Disconnect front exhaust pipe. Remove 2 heat shields from exhaust manifold. Lift manifold off studs, turn it 90 degrees, and lift out of engine compartment. On vehicles with A/C, use care to avoid damage to switch on A/C pipe.

#### Installation

Install manifold with NEW gaskets. Install front exhaust pipe to manifold. Tighten manifold-to-cylinder head nuts to 18 ft. lbs. (25 N.m). Install heat shields. Using Loctite on bolts, and ensuring springs and washers are under exhaust pipe nuts, tighten front exhaust

pipe-to-manifold nuts to end of threads. Do not tighten to more than 84 INCH lbs. (10 N.m).

## CYLINDER HEAD

### Removal

1) Disconnect negative battery cable. Remove expansion tank cap. Remove splash guard under engine. Open drain cocks on cylinder block and radiator and drain coolant. Remove exhaust manifold-to-front exhaust pipe nuts. Remove exhaust manifold. See EXHAUST MANIFOLD under REMOVAL & INSTALLATION. Remove timing belt. See TIMING BELT under REMOVAL & INSTALLATION.

2) Lift and place fuel distribution manifold and injectors aside. Install Holders (5465) to injectors. Disconnect 2 braided ground leads from engine. Remove 4 fan shroud retaining screws. Remove control module box cooling air ducts. Bend shroud aside slightly, lift relay holder, and disconnect electric cooling fan connectors. Remove control module box and air cleaner intakes. Lift out electric cooling fan assembly.

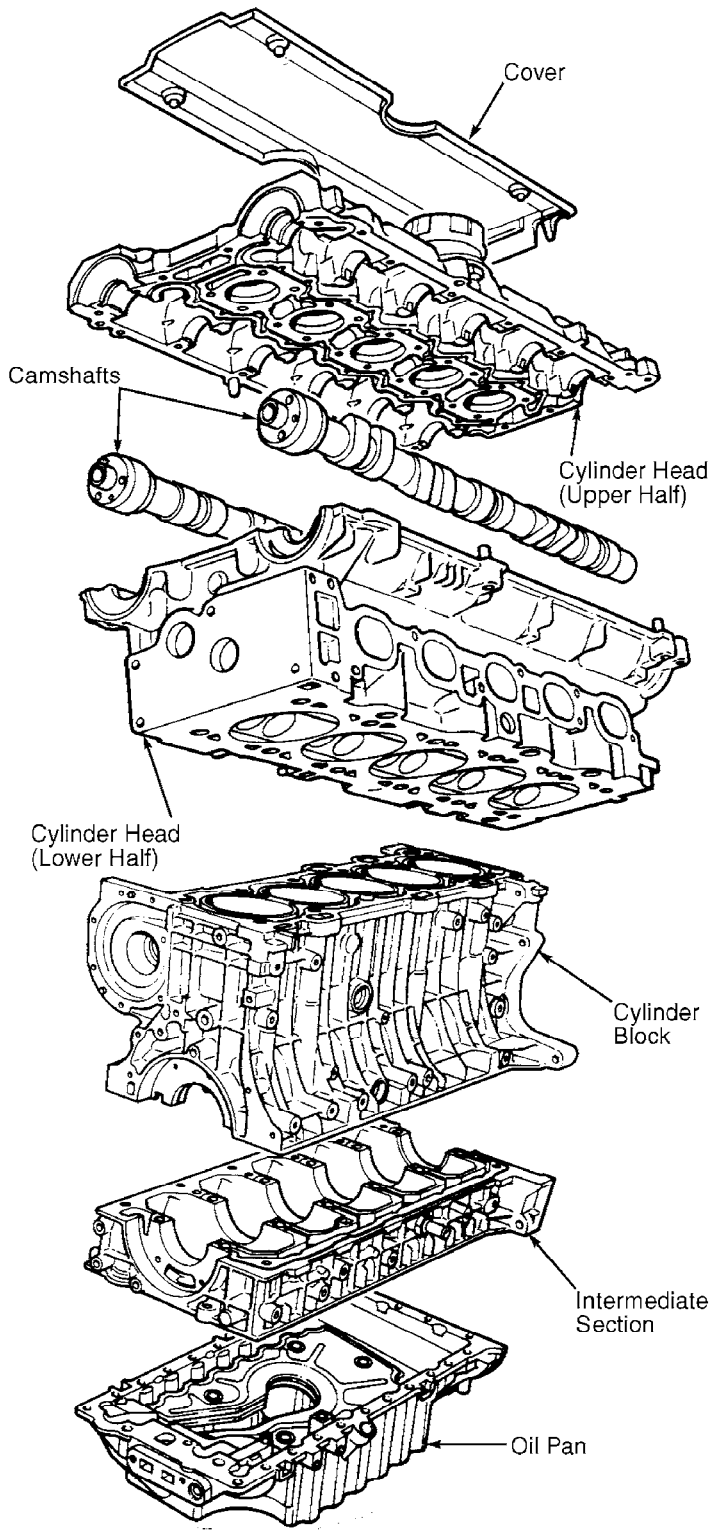
NOTE: Avoid damage to injector nozzles and needles.

3) Disconnect Idle Air Control (IAC) valve and Throttle Position (TP) potentiometer connectors. Disconnect crankcase ventilation and EVAP canister hoses. Disconnect servo (vacuum) reservoir and intake manifold vacuum servo hoses. Remove intake hose.

4) Remove 3 intake manifold upper mounting bolts. Remove oil dip-stick and bracket from intake manifold. Loosen manifold lower mounting bolts a few turns. Remove manifold bracket bolt. Remove intake manifold.

5) Disconnect upper radiator hose from thermostat housing. Mark camshaft pulleys for reassembly reference and remove camshaft pulleys. Remove timing belt cover inner bolt. Remove air cleaner housing and hoses. Remove Camshaft Position (CMP) sensor and shutter. Remove distributor cover, rotor and ignition lead clip. Remove torque arm and brackets. Starting at outer edge and working inward, remove bolts in upper half of cylinder head. Remove upper cylinder head by very carefully tapping upward with a copper mallet at parting lugs and camshaft pulley end. Mark camshafts for reassembly reference and remove camshafts.

6) Remove 2 coolant pipe bolts. Starting at outer edge and working inward, remove cylinder head bolts. Remove cylinder head. See Fig. 3. Remove cylinder head gasket.



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Fig. 3: Exploded View Of Engine Assembly  
Courtesy of Volvo Cars of North America.

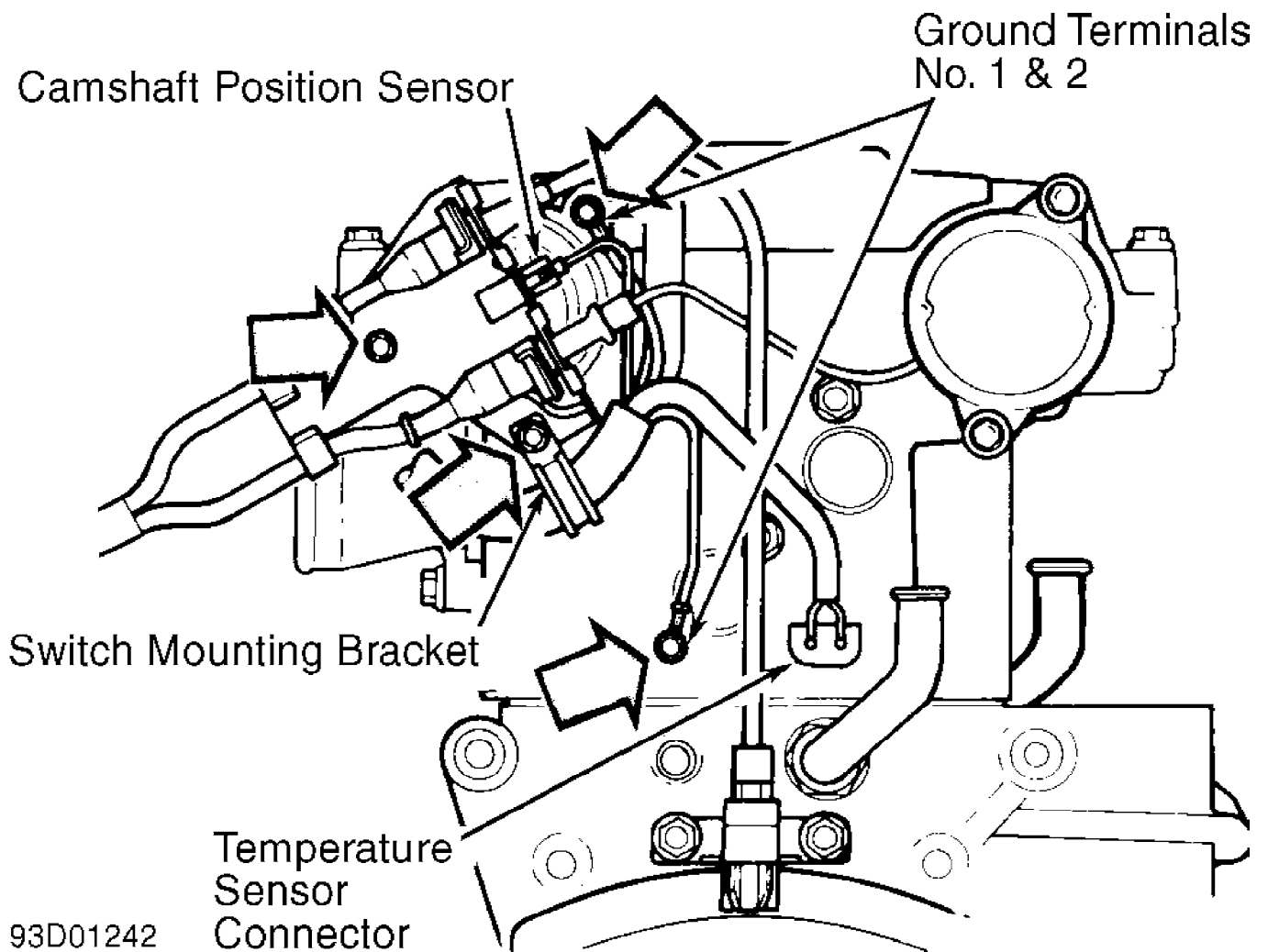


Fig. 4: Removing Components From Rear Of Engine  
 Courtesy of Volvo Cars of North America.

Installation

1) Remove starter and protective plug. Install Crankshaft Locking Tool (5451). See Fig. 5. Turn crankshaft counterclockwise until stopped by tool. Using NEW gasket, install bottom half of cylinder head. Oil bolts and tighten, in sequence, in 3 steps. See Fig. 6. See TORQUE SPECIFICATIONS. Install coolant pipe with NEW gasket.

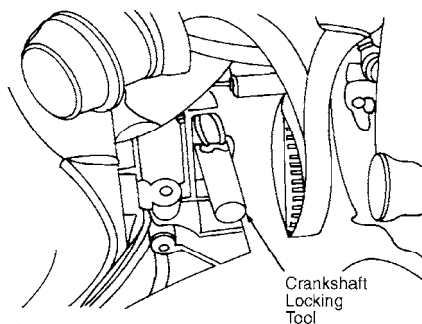
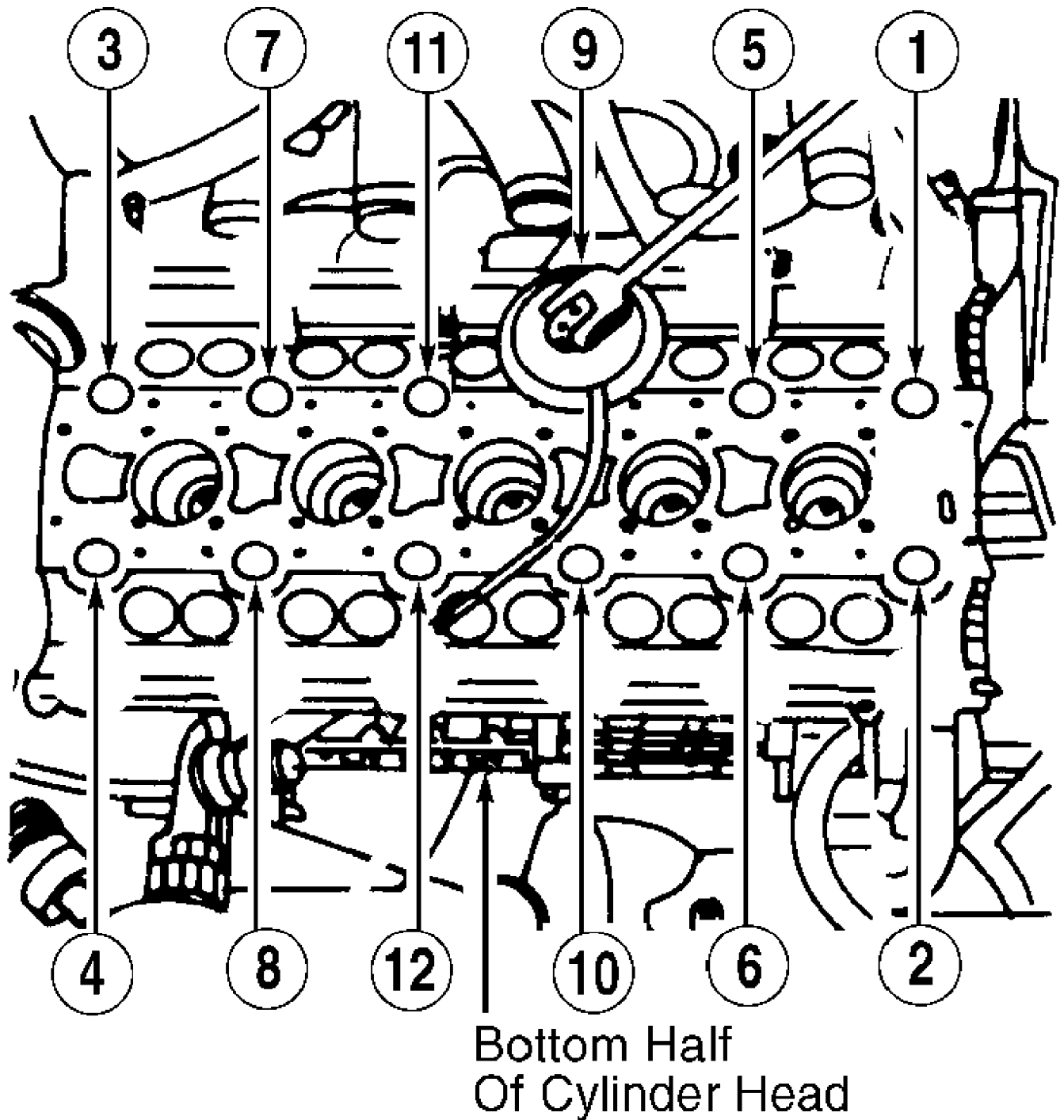


Fig. 5: Attaching Crankshaft Locking Tool (5451)  
 Courtesy of Volvo Cars of North America.



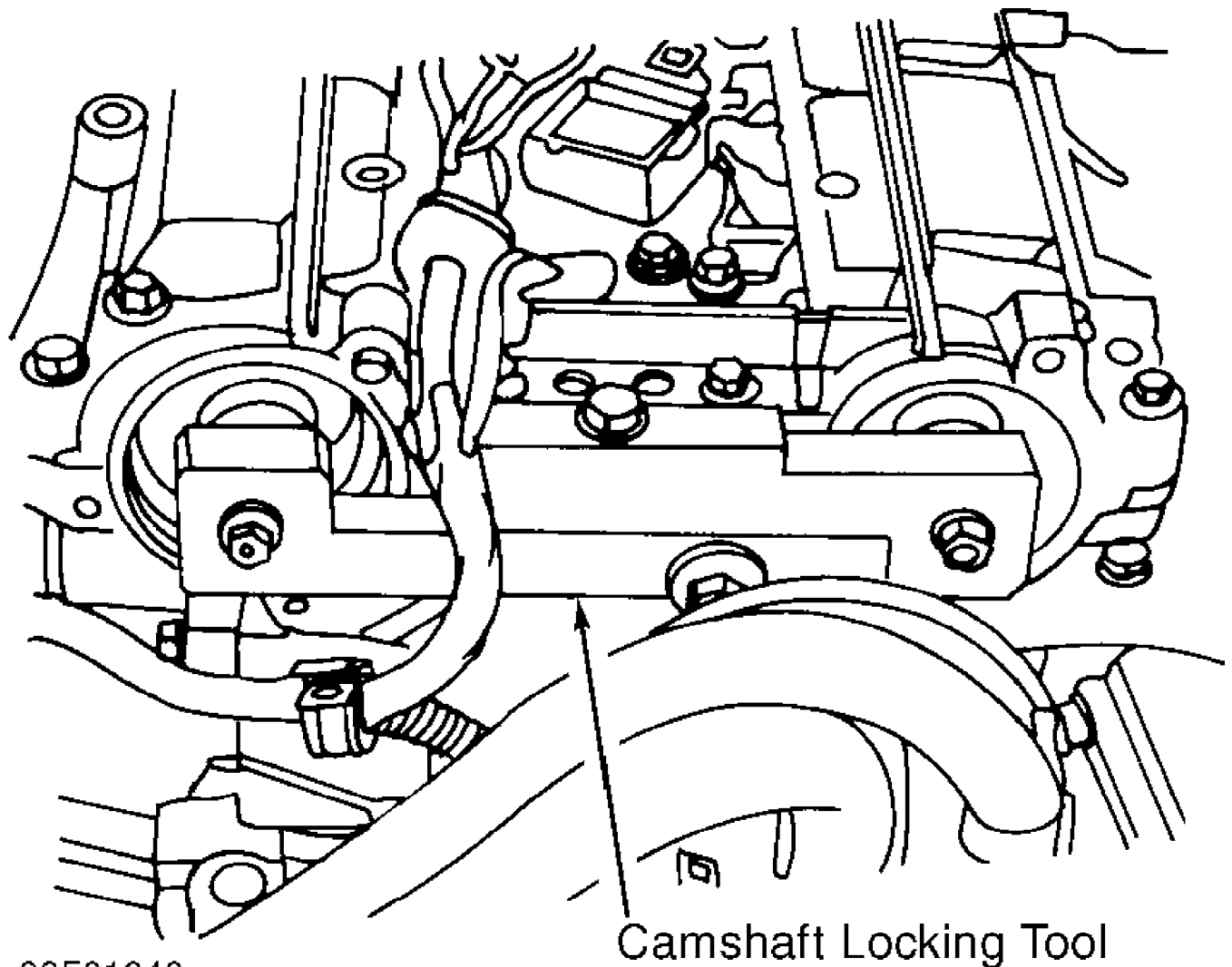
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Fig. 6: Cylinder Head Bolt Tightening Sequence  
Courtesy of Volvo Cars of North America.

2) Install NEW cylinder head gasket and "O" rings in spark plug wells. Remove No. 1 and No. 5 spark plugs. Oil lower camshaft bearing seats. Using a roller, apply Sealing Compound (1 161 059-9) to upper section of cylinder head. Ensure sealer does not penetrate oil passages. Oil upper camshaft bearing seats. Install camshafts in upper



cylinder head section, using Holder (5453) at front and Locking Tool (5452) at rear to secure camshafts. See Fig. 7.

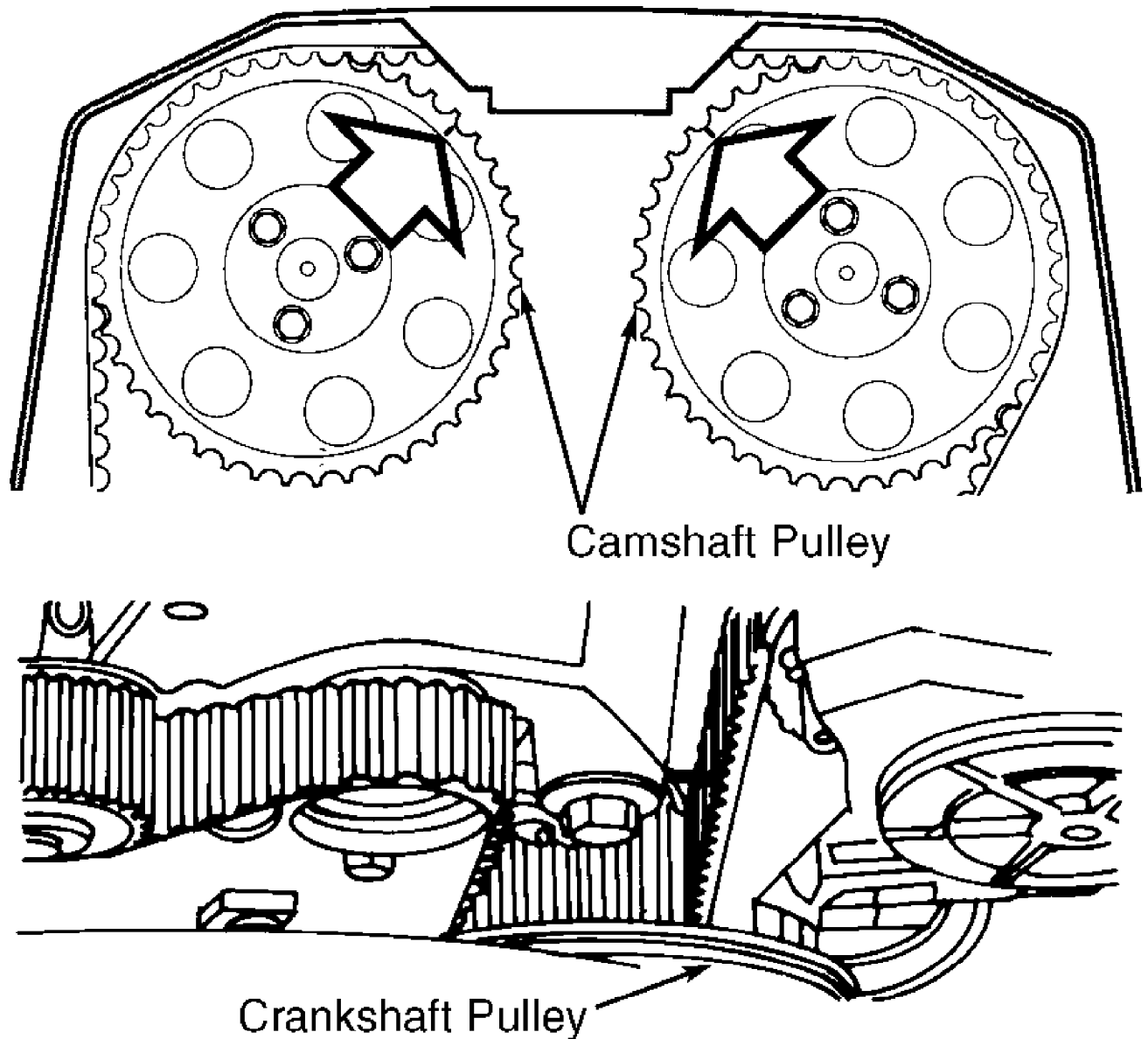


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Fig. 7: Using Locking Tool (5452) To Secure Camshafts  
Courtesy of Volvo Cars of North America.

3) Install upper cylinder head. Tighten against lower section using 2 Press Tools (5454). Tighten retaining bolts to 13 ft. lbs. (17 N.m), starting from inside and working outward. Remove 2 press tools.

4) Using Drift (5449), install camshaft front seals. Install camshaft pulleys and align timing marks. See Fig. 8. Tighten each pulley with 2 bolts, just until bolts are in contact with pulleys.



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Fig. 8: Aligning Camshaft & Crankshaft Timing Marks  
 Courtesy of Volvo Cars of North America.

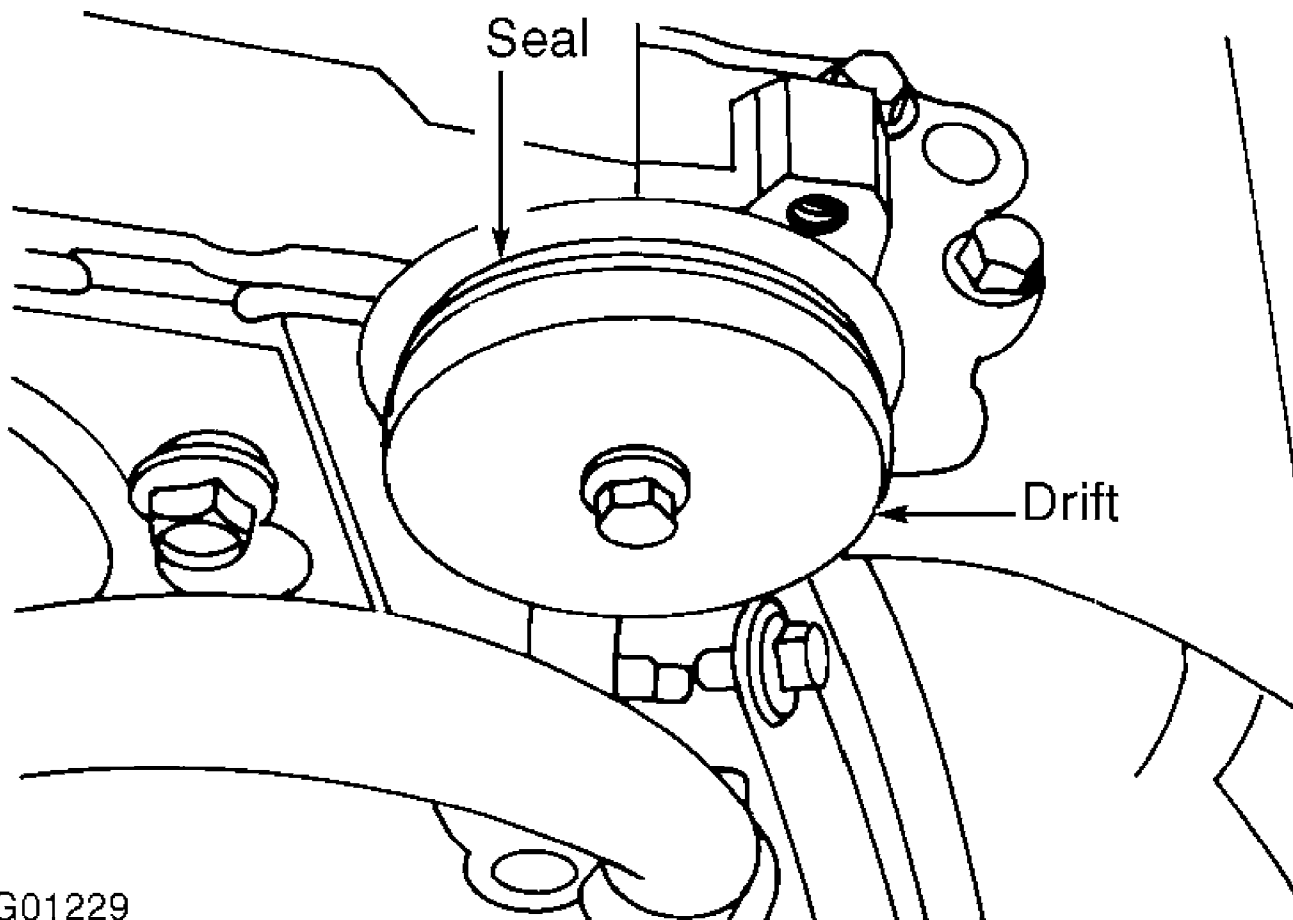
5) Remove upper timing belt cover. Install belt tensioner and tighten bolts to 18 ft. lbs. (25 N.m). Place timing belt over camshaft pulleys, around coolant pump, and press over tensioner pulley. Loosen camshaft pulley bolts and remove tensioner locking pin.

6) Install third camshaft pulley bolt. Hold camshaft pulleys still and tighten bolts alternately to 15 ft. lbs. (20 N.m). Install inner timing belt cover bolt. Install upper timing belt cover. On both engines, remove crankshaft locking tool and install protective plug. Install starter. Remove camshaft locking tool. Install upper transmission cover.

7) Turn crankshaft through 2 revolutions. Ensure timing marks on crankshaft and camshaft pulleys are correctly aligned. See Fig. 8. Install outer timing belt cover. On both engines, use D rift (5450), and install right rear camshaft seal. See Fig. 9. Install torque arm

and switch brackets, distributor rotor and ignition lead clip. Install camshaft position sensor and shutter, spark plugs, distributor cap and wires, and air cleaner housing with hoses and connectors. Install exhaust manifold. See EXHAUST MANIFOLD under REMOVAL & INSTALLATION.

8) Install intake pipe and cooling fan. Install fuel distribution manifold. Install 2 engine ground leads. Install exhaust pipe and splash guard under engine. Fill engine with oil and coolant. Start and run engine until it reaches normal operating temperature. Check for leaks.



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Fig. 9: Installing Seal Using Drift (5450)  
Courtesy of Volvo Cars of North America.

### CRANKSHAFT FRONT SEAL

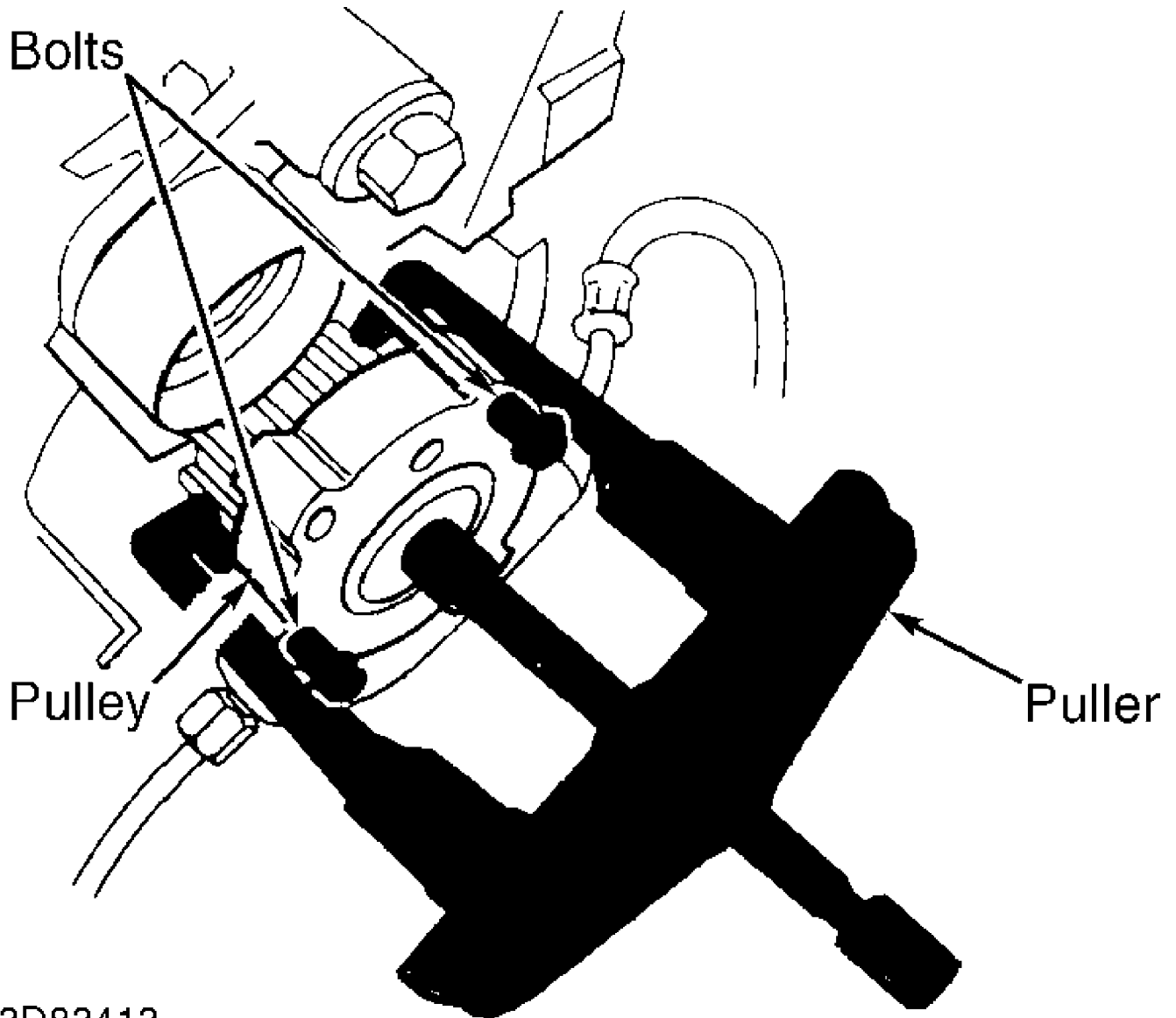
#### Removal

1) Remove spark plug cover and 2 fuel line clips. Remove expansion tank and place it on top of engine. Remove front timing belt cover and auxiliary drive belt. Remove right front wheel and release wheel arch liner to gain access to vibration damper. Remove vibration damper guard. Turn crankshaft clockwise until all timing marks are aligned. See Fig. 8.

2) Remove tensioner upper mounting bolt and loosen tensioner lower bolt. Twist tensioner to free pulley. Remove lower bolt, tensioner, upper timing belt cover and belt. Remove vibration damper. Attach Counterhold (5433) to damper to prevent it from turning.

3) Finger tighten 2 vibration damper bolts in crankshaft belt pulley threads as far as possible. Attach puller to crankshaft belt pulley to puller arms act on bolts, not on pulley. See Fig. 10. Remove

crankshaft belt pulley. Remove oil seal with a screwdriver.



### 93D83413

Fig. 10: Removing Crankshaft Belt Pulley  
Courtesy of Volvo Cars of North America.

#### Installation

1) Clean seat and install new greased seal. Press in seal using Drift (5455) and crankshaft center nut. Install timing belt tensioner and tighten bolts to 18 ft. lbs. (25 N.m), plus an additional 30 degrees. Install timing belt tensioner locking pin. Place timing belt around crankshaft pulley and right idler pulley, over camshaft pulleys, around coolant pump, and press over tensioner pulley.

2) Remove timing belt tensioner locking pin. Install vibration damper. Using counterhold to keep it from turning, tighten vibration damper center nut to 133 ft. lbs. (180 N.m). Remove counterhold and tighten remaining bolts to 18 ft. lbs. (25 N.m). Install upper timing belt cover. Turn crankshaft 2 revolutions clockwise to ensure timing marks on crankshaft and camshaft pulleys

are aligned. Install spark plug cover.

3) Install vibration damper guard, front timing belt cover, auxiliary drive belt, 2 fuel pipe clips, expansion tank, wheel arch liner and wheel. Fill cooling system with coolant. Check oil level. Start engine and check for leaks.

## TIMING BELT

### Removal

1) Remove spark plug cover and 2 fuel line clips. Lift out expansion tank and place on top of engine. Remove front timing belt cover. Remove auxiliary drive belt. Remove right front wheel and release wheel arch liner to gain access to vibration damper. Remove vibration damper guard. Turn crankshaft clockwise until all timing marks are aligned. See Fig. 8.

2) Remove tensioner upper mounting bolt and loosen tensioner lower bolt. Twist tensioner to free pulley. Remove lower bolt, tensioner, upper timing belt cover and belt.

3) Remove tensioner upper mounting bolt and loosen lower mounting bolt. Twist tensioner to free plunger/pulley. Remove lower bolt, tensioner and belt.

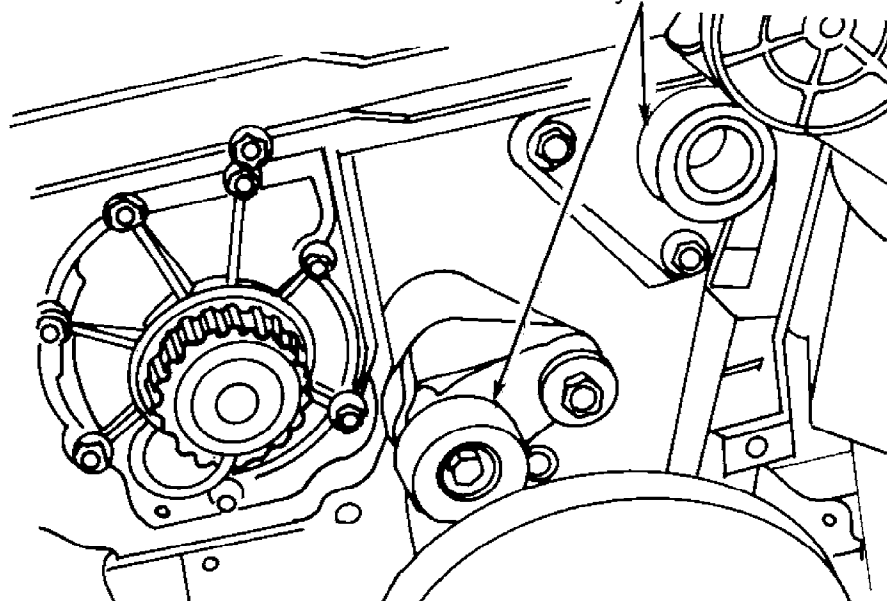
CAUTION: DO NOT turn crankshaft or camshafts while belt is removed.

### Inspection

1) Spin tensioner and idler pulleys and listen for bearing noise. See Fig. 11.

2) Ensure pulley surfaces in contact with belt are clean and smooth. Check tensioner pulley arm and idler pulley mountings, and tighten bolts as necessary. See TORQUE SPECIFICATIONS. Check tensioner for signs of leakage, no resistance when depressed, or a plunger that cannot be depressed.

## Tensioner & Idler Pulleys



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Fig. 11: Checking Tensioner & Idler Pulleys  
Courtesy of Volvo Cars of North America.

### Installation

1) Compress tensioner and tighten center nut. Wait until

compression has taken place and insert a 2 mm locking pin in plunger. Install tensioner and tighten mounting bolts to 18 ft. lbs. (25 N.m). Place timing belt around crankshaft pulley and right idler. Place belt over camshaft pulleys. Position belt around water pump and press over tensioner pulley.

2) Remove tensioner locking pin. To complete installation, reverse removal procedure. Turn crankshaft 2 revolutions to ensure timing marks on crankshaft and camshaft pulleys are aligned. See Fig. 8.

## CAMSHAFTS

### Removal

For camshaft removal and installation, see CYLINDER HEAD under REMOVAL & INSTALLATION.

## FRONT & REAR CAMSHAFT OIL SEALS

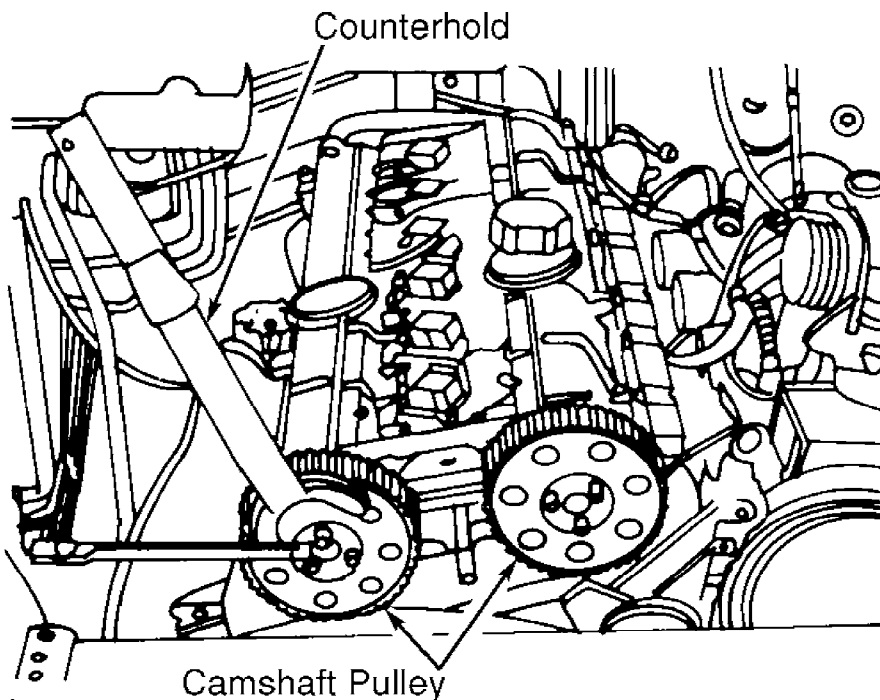
### Removal

1) Disconnect negative battery cable. Remove spark plug cover and 2 fuel line clips. Lift expansion tank and place on top of engine. Remove front timing belt cover and right front wheel. Loosen right wheel arch lining to access vibration damper.

2) On both engines, remove timing belt. See TIMING BELT. Use Counterhold (5199) to hold camshaft stationary. See Fig. 12. Remove camshaft pulleys. Using a screwdriver, carefully pry out front seals. Clean seats and check shafts for wear.

### Installation

Using Drift (5449), install new front seal.



93A01231

Fig. 12: Using Counterhold (5199) To Hold Camshaft Stationary  
Courtesy of Volvo Cars of North America.

### Removal

Remove air cleaner housing with hoses and connectors. Remove

distributor cover, rotor and ignition lead clip. Remove camshaft position sensor housing and shutter.

#### Installation

Using Drift (5450), install new greased rear seal. See Fig. 9 . Seal is located on same plane as edge of inside shoulder. To complete installation, reverse removal procedure.

### REAR CRANKSHAFT OIL SEAL

**NOTE:** For manual transmission removal procedures, see TRANSMISSION REMOVAL & INSTALLATION - M/T article in MANUAL TRANS SERVICE section . Automatic transmission removal information is not available at time of publication.

#### Removal & Installation

Install Gear Sector (5112) to keep crankshaft from turning. Remove flywheel. Pry out seal with screwdriver. Tap in new greased seal using Drift (5430) and Installer (1801). Install flywheel. Apply Loctite to new bolts and tighten to 33 ft. lbs. (45 N.m), plus an additional 50 degrees.

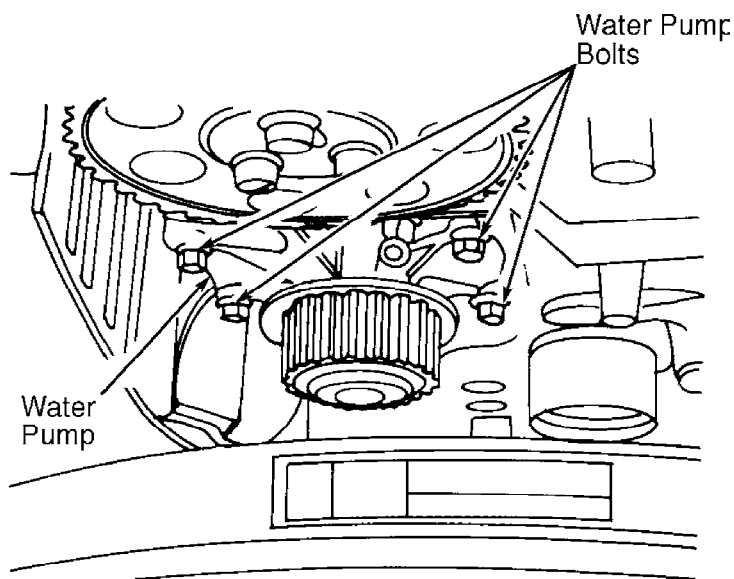
### WATER PUMP

#### Removal

Remove expansion tank cap and drain coolant. Remove timing belt. See TIMING BELT. Remove bolts holding water pump to engine block. See Fig. 13. Remove water pump.

#### Installation

Remove old gasket from cylinder block. Install water pump. Tighten mounting bolts alternately to 15 ft. lbs. (20 N.m). Install timing belt. See TIMING BELT. Fill engine with coolant. Start engine and check for leaks.



93C01232

Fig. 13: Removing Water Pump  
Courtesy of Volvo Cars of North America.

### OIL PUMP

### Removal

1) Remove spark plug cover and 2 fuel line clips. Remove expansion tank and place it on top of engine. Remove front timing belt cover and auxiliary drive belt. Remove right front wheel and release wheel arch liner to gain access to vibration damper. Remove vibration damper guard. Turn crankshaft clockwise until all timing marks are aligned. See Fig. 8.

2) Remove tensioner upper mounting bolt and loosen tensioner lower bolt. Twist tensioner to free pulley. Remove lower bolt, tensioner, upper timing belt cover and belt. Remove vibration damper. Attach Counterhold (5433) to damper to prevent it from turning.

3) Finger tighten 2 vibration damper bolts in crankshaft belt pulley threads as far as possible. Attach a puller to crankshaft belt pulley to puller arms act on bolts, not on pulley. Remove crankshaft belt pulley. Remove 4 oil pump mounting bolts. See Fig. 14. Pry off oil pump with a screwdriver inserted behind lugs.

### Inspection

1) Check all oil pump components for damage and wear. Closely inspect crescent between suction and delivery sides. If any defective components are found, replace entire pump assembly.

2) Ensure relief valve spring length is within specification. See OIL PUMP SPECIFICATIONS table. Using a feeler gauge, check outer rotor-to-housing clearance. If clearance is not within specification, replace oil pump assembly.

### OIL PUMP SPECIFICATIONS TABLE

Component	Clearance
Outer Rotor-To-Housing .....	.014" (.35 mm)
Relief Valve Spring	
Free Length .....	3.233" (82.13 mm)
	Lbs. @ In. (N @ mm)
Pressure	
Valve Closed .....	12 @ 2.21 (52 @ 56.1)
Valve Open .....	19 @ 1.57 (85 @ 39.9)

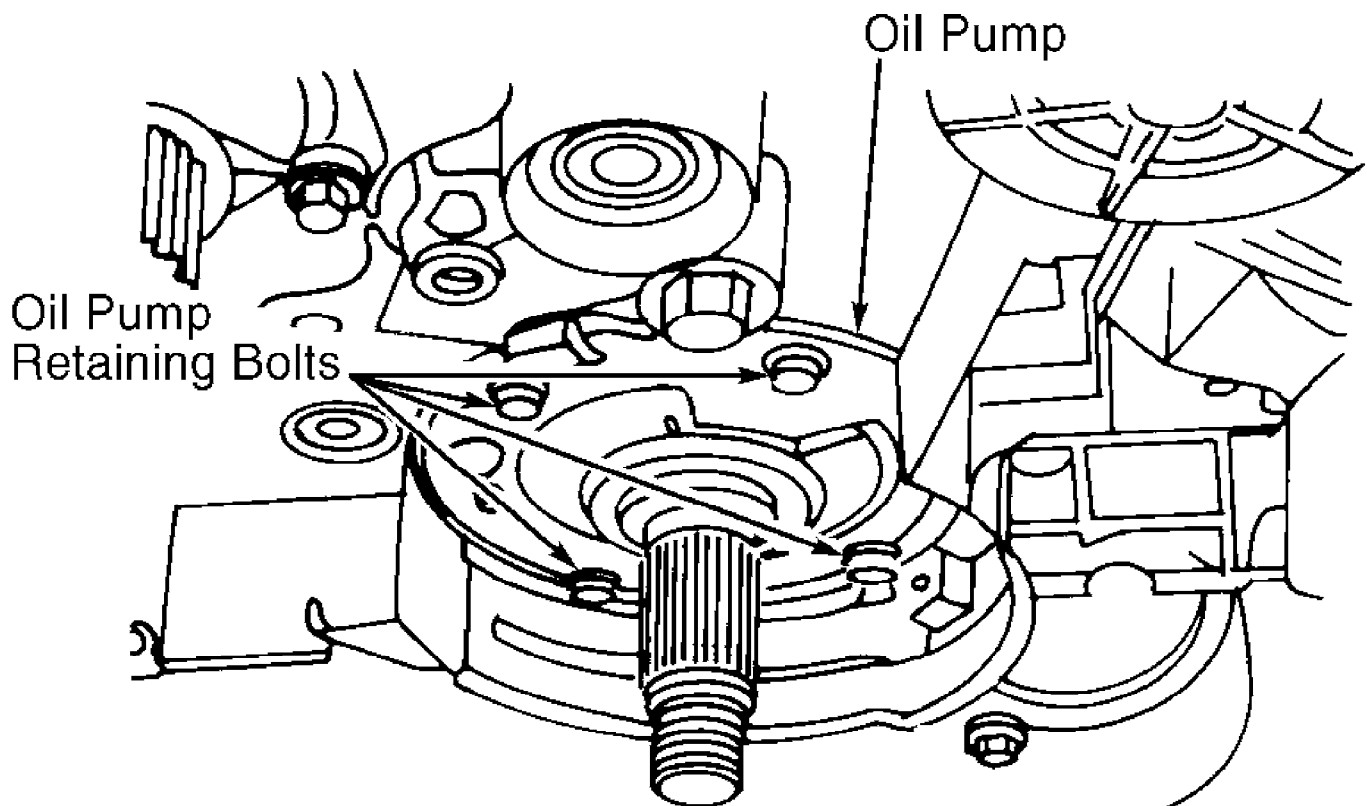
### Installation

1) Using NEW gasket and Drift (5455), install oil pump. Pull in pump using crankshaft center nut. Tighten oil pump bolts alternately to 84 INCH lbs. (10 N.m). Install timing belt tensioner and tighten bolts to 18 ft. lbs. (25 N.m). Install timing belt tensioner locking pin. Place timing belt around crankshaft pulley and right idler pulley, over camshaft pulleys, around coolant pump, and press over tensioner pulley.

2) Remove timing belt tensioner locking pin. Install vibration damper. Using counterhold to keep it from turning, tighten vibration damper center nut to 133 ft. lbs. (180 N.m). Remove counterhold and tighten bolts to 18 ft. lbs. (25 N.m). Install upper timing belt cover. Turn crankshaft 2 revolutions clockwise to ensure timing marks on crankshaft and camshaft pulleys are aligned. Install spark plug cover.

3) Install vibration damper guard, front timing belt cover, auxiliary drive belt, 2 fuel pipe clips, expansion tank, wheel arch liner and wheel. Fill cooling system with coolant. Check oil level. Start engine and check for leaks.





93E01233

Fig. 14: Removing Oil Pump Retaining Bolts  
 Courtesy of Volvo Cars of North America.

## OVERHAUL

### CYLINDER HEAD

#### Cylinder Head

Ensure all mating surfaces are clean. Measure cylinder head warpage. If longitudinal warpage is less than .020" (.50 mm), or lateral warpage is less than .008" (.20 mm), resurfacing is not required. If warpage is greater than specifications, resurface cylinder head. Maximum resurface limit is .011" (.30 mm).

#### Valve Springs

Measure valve spring free length. Replace any spring shorter than minimum free length specification. See VALVE SPRING FREE LENGTH in VALVES & VALVE SPRINGS table under ENGINE SPECIFICATIONS.

#### Valve Stem Oil Seals

Place new seal on valve stem. Remove protective sleeve. Using Drift (5379), push seal onto stem by hand only as far as possible. Do not use a hammer to install valve stem seals.

#### Valve Guides

Three replacement valve guides are available. Standard valve guide has no grooves at top and is .472" (12 mm) in diameter. First oversize valve guide has one groove at top and is .476" (12.1 mm) in diameter. Second oversize valve guide has 2 grooves at top and is .480" (12.2 mm) in diameter.

#### Valve Seat

Replacement procedure is not available at time of publication.

#### Valves

Check valve for wear or burning. Measure valve dimensions after refacing. Replace any valve that does not meet specification. See VALVES & VALVE SPRINGS table under ENGINE SPECIFICATIONS. Measure valve stem installed height after refinishing valve or seat. See CYLINDER HEAD table under ENGINE SPECIFICATIONS.

#### Valve Seat Correction Angles

Ensure valve seat angles are within specification. For face angle, see VALVES & VALVE SPRINGS table under ENGINE SPECIFICATIONS. Upper relief angle is 15 degrees. Lower relief angle is 70 degrees.

### CYLINDER BLOCK ASSEMBLY

#### Piston & Rod Assembly

1) Carefully press out pistons and connecting rods by hand. Mark pistons and connecting rods for reassembly reference. Carefully pry out piston pin locking circlip with a screwdriver. Clean and inspect all components for damage. Check connecting rod cap bolt length. Maximum length is 2.16" (55 mm).

2) Check piston pin fit in connecting rod. No play should be present as pin should slide through hole with gentle thumb pressure. Replace piston as necessary. Check piston pin fit in connecting rod in same manner. If pin fails to slide through hole without play when pressed with thumb, install NEW connecting rod bushing. Ensure numerical designation on connecting rod faces toward starter motor side of block.

#### Fitting Pistons

Install pistons using Piston Ring Compressor (115 8281). Ensure arrow on top of piston faces toward timing belt end of engine.

#### Piston Rings

1) Using Piston Ring Pliers (998 5424), remove piston rings. Remove carbon deposits. Scrape ring grooves clean. Check pistons for damage and repair as necessary. Check piston ring side play and piston diameter. See PISTONS, PINS & RINGS under ENGINE SPECIFICATIONS.

2) Using Piston Ring Pliers (998 5424), install piston rings so gaps are 120 degrees apart. Install upper compression and oil scraper rings with text facing upward. Install lower compression ring with groove facing downward.

#### Crankshaft & Main Bearings

1) Remove engine from vehicle. See ENGINE under REMOVAL & INSTALLATION. Remove cylinder head. See CYLINDER HEAD under REMOVAL & INSTALLATION. Place engine upside down. Remove oil filter. Disconnect flame trap return line. Remove oil pan. Remove all oil passage "O" rings. Remove oil pump suction pipe and "O" ring.

2) Rotate crankshaft so all piston connecting rod bolts are accessible for removal without rotating crankshaft again. Starting at sides and working toward center, remove intermediate section bolts. Loosen intermediate section by carefully tapping with a plastic mallet. Remove crankshaft rear seal.

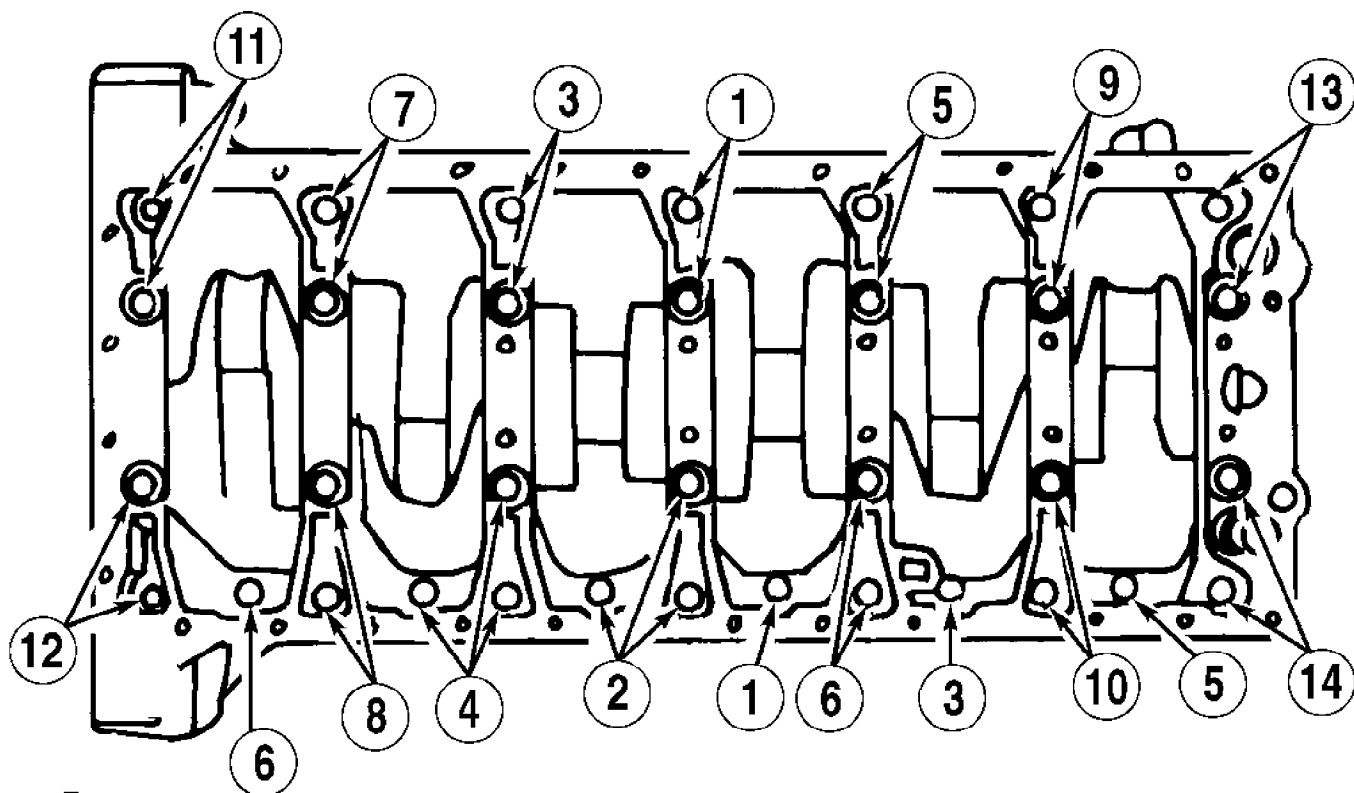
CAUTION: DO NOT not allow crankshaft to rotate.

3) Check identification markings on connecting rods and connecting rod caps. Mark components for reassembly reference as necessary. Remove connecting rod caps. Lift crankshaft out of block

and support on "V" blocks on 2 outermost main journals. Remove main bearings from block. Mark position of thrust bearing for reassembly reference.

4) Use micrometer and measure crankshaft out-of-round and taper. Ensure to measure at several points around circumference and along length. Use Dial Gauge (9684) and Magnetic Stand (9696) to check straightness of crankshaft. See ENGINE SPECIFICATIONS.

5) Check classification markings on cylinder block and crankshaft before installing crankshaft main bearings. Main bearings are color-coded Yellow, Blue and Red. Torque intermediate section bolts in 5 stages. Each stage should be completely torqued before beginning another stage. See Fig. 15. See TORQUE SPECIFICATIONS. After main bearings are installed and intermediate section is tightened, check crankshaft end play.



93E83414

Fig. 15: Intermediate Section Tightening Sequence (Typical)  
Courtesy of Volvo Cars of North America.

#### Thrust Bearing

Ensure thrust bearing is marked for reassembly reference.

#### Cylinder Block

1) Wipe bores clean and visually check. Measure bores using Dial Gauge (9639), Micrometer (9704), and micrometer stand. Use dial gauge and check for maximum wear at right angles to center line of engine immediately below top dead center. Check for minimum wear in direction of center line at bottom dead center.

2) Each cylinder is identified by a classification mark (C, D, E, or G) punched in rear of block. Oversize bores can be indicated by OS1 or OS2. See CYLINDER BLOCK under ENGINE SPECIFICATIONS.

## ENGINE OILING

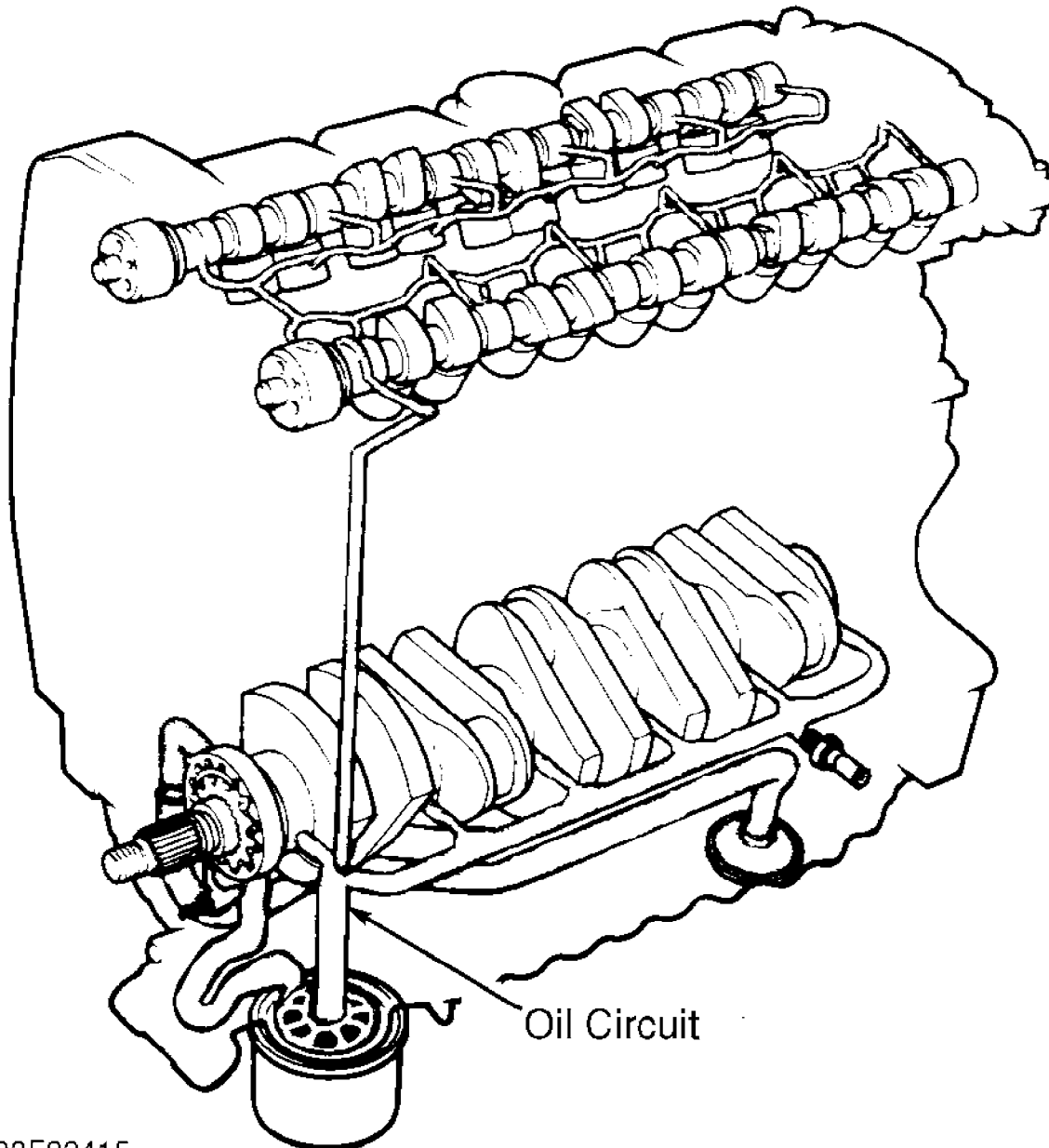
## ENGINE LUBRICATION SYSTEM

### Crankcase Capacity

Oil capacity is 4.4 qts. (5.3L) with filter. On turbocharged engines, add .95 qt. (.9L) if turbo oil cooler is drained.

### Oil Pressure

Oil pressure is 14 psi (.10 bar) at idle and 43 psi (.30 bar) at 3000 RPM. See Fig. 16.



93F83415

Fig. 16: Engine Oil Schematic  
Courtesy of Volvo Cars of North America.

## TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS TABLE

Application	Ft. Lbs. (N.m)
Bump Stop-To-Support Member Bolt	37 (50)
Camshaft Cover Bolt	13 (17)
Camshaft Pulley Bolt	15 (20)
Connecting Rod Bearing Cap Bolt	(1) 15 (20)
Cylinder Block (Intermediate Section)	
Stage No. 1 (M10 Bolt)	15 (20)
Stage No. 2 (M10 Bolt)	33 (45)
Stage No. 3 (M8 Bolt)	18 (25)
Stage No. 4 (M7 Bolt)	13 (17)
Stage No. 5 (M10 Bolt)	(1)
Cylinder Head Bolt	
Stage No. 1	15 (20)
Stage No. 2	44 (60)
Stage No. 3	(2)
Drain Plug	35 (26)
Engine Mount Top Nut	37 (50)
Exhaust Manifold-To-Cylinder Head Nut	18 (25)
Exhaust System Bolt Behind Catalytic Converter	18 (25)
Flywheel-To-Crankshaft Bolt	(3) 33 (45)
Gearbox-To-Engine Bolt	37 (50)
Heat Shield Bolt	11 (15)
Intake Manifold Bolt	15 (20)
Knock Sensor Bolt	15 (20)
Oil Pan Bolts	20 (15)
Oil Pick-Up Tube	13 (17)
Spark Plug	18 (25)
Timing Belt Pulley Bolt	30 (40)
Timing Belt Tensioner Bolt	18 (25)
Torque Converter-To-Flywheel Bolt	30 (40)
Transmission Bump Stop Nut	37 (50)
Transmission Oil Cooler Fittings	22 (30)
Transmission Support Member Bolt	37 (50)
Upper Cylinder Head Retaining Bolt	13 (17)
Vibration Damper Bolt	(4) 18 (25)
Vibration Damper Center Nut	133 (180)
Water Pump Bolt	15 (20)

INCH Lbs. (N.m)

Front Exhaust Pipe-To-Manifold Nut	84 (10)
Oil Pump Bolt	84 (10)

- (1) - Tighten an additional 90 degrees.
- (2) - Tighten an additional 130 degrees.
- (3) - Tighten an additional 50 degrees.
- (4) - Tighten an additional 30 degrees.
- (5) - Tighten an additional 60 degrees.

**ENGINE SPECIFICATIONS**

**GENERAL ENGINE SPECIFICATIONS**

GENERAL ENGINE SPECIFICATIONS TABLE

Application	Specification
-------------	---------------

Displacement	
Turbo	2.3L
Bore	
Turbo	3.18" (81 mm)
Stroke	3.54" (90 mm)
Compression Ratio	
Turbo	8.5:1
Fuel System	
Turbo	MFI
Horsepower @ RPM	
Turbo	222 @ 5280
Torque Ft. Lbs. @ RPM	
Turbo	221 @ 2000-5280

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## CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS SPECIFICATIONS

### CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS TABLE

Application	In. (mm)
Crankshaft	
End Play	.003-.007 (.08-.19)
Runout	.0013 (.032)
Main Bearings	
Journal Diameter	2.559 (65.00)
Journal Out-Of-Round	.0002 (.004)
Journal Taper	.0002 (.004)
Oil Clearance	.0010-.0018 (.025-.045)
Connecting Rod Bearings	
Journal Diameter	1.969 (50.00)
Journal Out-Of-Round	.0002 (.004)
Journal Taper	.0002 (.004)

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## CONNECTING RODS SPECIFICATIONS

### CONNECTING RODS TABLE

Application	In. (mm)
Bore Diameter	
Crankpin Bore	2.08 (53)
Out-Of-Round Maximum	.0002 (.004)
Side Play	.006-.018 (.15-.45)

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## PISTONS, PINS & RINGS SPECIFICATIONS

### PISTONS, PINS & RINGS TABLE

Application	In. (mm)
Pistons	
Clearance	.0003-.0011 (.010-.030)
Diameter	
Size C	3.1881-3.1885 (80.980-80.990)
Size D	3.1885-3.1889 (80.990-81.000)
Size E	3.1889-3.1893 (81.000-81.010)
Size G	3.1896-3.1902 (81.017-81.032)
Oversize 1	3.1959-3.1965 (81.177-81.192)
Oversize 2	3.2038-3.2044 (81.377-81.392)

Pins	
Diameter	.905 (23.00)
Rings	
No. 1	
End Gap	.008-.016 (.20-.40)
Side Clearance	.0019-.0030 (.050-.085)
No. 2	
End Gap	.008-.016 (.20-.40)
Side Clearance	.0012-.0026 (.030-.065)
No. 3 (Oil)	
End Gap	.009-.020 (.25-.50)
Side Clearance	.0008-.0022 (.020-.055)

## CYLINDER BLOCK SPECIFICATIONS

### CYLINDER BLOCK TABLE

Application	In. (mm)
Cylinder Bore	
Size C	3.1889-3.1893 (81.000-81.010)
Size D	3.1893-3.1897 (81.010-81.020)
Size E	3.1897-3.1901 (81.020-81.030)
Size G	3.1905-3.1909 (81.040-81.050)
Oversize 1	3.1968-3.1972 (81.200-81.210)
Oversize 2	3.2047-3.2051 (81.400-81.410)
Maximum Taper	.004 (.10)
Maximum Out-Of-Round	.004 (.10)
Deck Height	5.20 (132.1)
Maximum Machining	.012 (.30)
Maximum Deck Warpage	
Length	.020 (.50)
Width	.008 (.20)

## VALVES & VALVE SPRINGS SPECIFICATIONS

### VALVES & VALVE SPRINGS TABLE

Application	Specification
Intake Valves	
Face Angle	45.5°
Head Diameter	1.215-1.226" (30.85-31.15 mm)
Minimum Margin	.047" (1.2 mm)
Length	4.09-4.10" (103.9-104.2 mm)
Stem Diameter	.273-.274" (6.95-6.97 mm)
Valve Tip Maximum Refinish	.015" (.40 mm)
Exhaust Valves	
Face Angle	44.5°
Head Diameter	1.057-1.069" (26.85-27.15 mm)
Minimum Margin	.047" (1.2 mm)
Length	4.06-4.07" (103.1-103.5 mm)
Stem Diameter	.273-.274" (6.95-6.97 mm)
Valve Tip Maximum Refinish	.015" (.40 mm)
Valve Springs	
Free Length	1.69" (43.0 mm)
	Lbs. @ In. (N @ mm)
Pressure	
Valve Closed	61 @ 1.3 (270 @ 34)

Valve Open ..... 151 @ .9 (670 @ 24.5)

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## CYLINDER HEAD SPECIFICATIONS

### CYLINDER HEAD TABLE

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Application	Specification
Cylinder Head Height	..... 5.076-5.080" (128.95-129.05 mm)
Maximum Warp	
Length	..... .020" (.50 mm)
Width	..... .008" (.20 mm)
Maximum Machining	..... .012 (.30)
Valve Seats	
Intake Valve	
Seat Angle	..... 45°
Seat Width	..... .055-.070" (1.4-1.8 mm)
Maximum Seat Runout	..... .003-.004" (.07-.11mm)
Seat Bore Diameter	..... 1.28" (32.6 mm)
Exhaust Valve	
Seat Angle	..... 45°
Seat Width	..... .070-.086" (1.8-2.2 mm)
Maximum Seat Runout	..... .003-.004" (.07-.11 mm)
Seat Bore Diameter	..... 1.13" (28.6 mm)
Valve Guides	
Valve Guide Diameter	
Standard	..... .472" (12.0 mm)
Oversize 1	..... .476" (12.1 mm)
Oversize 2	..... .480" (12.2 mm)
Valve Stem-To-Guide Oil Clearance	
Minimum	
Exhaust	..... .002-.003" (.04-.07 mm)
Intake	..... .001-.002" (.03-.06 mm)
Maximum	..... .006" (.15 mm)

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## CAMSHAFT SPECIFICATIONS

### CAMSHAFT TABLE

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Application	In. (mm)
End Play	..... .002-.008 (.05-.20)
Lobe Lift	..... .333 (8.45)
Oil Clearance	
Minimum	..... .0012 (.030)
Maximum	..... .0027 (.071)

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## VALVE LIFTERS SPECIFICATIONS

### VALVE LIFTERS TABLE

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Application	In. (mm)
Lifter Diameter	..... 1.260 (32.00)
Lifter Height	
External	..... 1.022-1.043 (25.95-26.05)
Internal	
Compressed	..... .636 (16.15)
Unloaded	..... .724 (18.40)

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