2A

4.3L V6 ENGINE

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1 General information

This Part of Chapter 2 is devoted to in-vehicle repair procedures for the 4.3L V6 engine. These engines utilize cast-iron blocks with six cylinders arranged in a "V" shape at a 90-degree angle between the two banks. The overhead valve cast iron cylinder heads are equipped with integral valve guides and seats. Hydraulic roller lifters actuate the valves through tubular pushrods and rocker arms. A balance shaft has been incorporated into this engine to smooth power pulsations. The balance shaft is located directly above the camshaft in the engine block and is driven off the camshaft. The oil pump is mounted to the rear main cap and is driven by the distributor and the oil pump driveshaft.

To positively identify this engine, locate the Vehicle Identification Number (VIN) on the left front corner of the instrument panel. The VIN is visible from the outside of the vehicle through the windshield. The eighth character in the sequence is the engine designation:

W = 4.3 liter V6 engine (L35)

X = 4.3 liter V6 engine (LU3)

All information concerning engine removal and installation and engine block and cylinder head overhaul can be found in Part C of this Chapter. The following repair procedures are based on the assumption that the engine is installed in the vehicle. If the engine has been removed from the vehicle and mounted on a stand, many of the steps outlined in this Part of Chapter 2 will not apply.

The Specifications included in this Part of Chapter 2 apply only to the procedures contained in this Part. Part C of Chapter 2 contains the Specifications necessary for cylinder head and engine block rebuilding.

2 Repair operations possible with the engine in the vehicle

Many major repair operations can be accomplished without removing the engine from the vehicle.

Clean the engine compartment and the exterior of the engine with some type of pressure washer before any work is done. It will make the job easier and help keep dirt out of the internal areas of the engine.

Remove the hood, if necessary, to improve access to the engine as repairs are performed (see Chapter 11 if necessary).

If vacuum, exhaust, oil or coolant leaks develop, indicating a need for gasket or seal replacement, the repairs can generally be made with the engine in the vehicle. The intake and exhaust manifold gaskets, timing chain cover gasket, oil pan gasket, crankshaft oil seals and cylinder head gaskets are all accessible with the engine in place.

Exterior engine components, such as the intake and exhaust manifolds, the oil pan and oil pump, the water pump, the starter motor, the alternator, the distributor and the fuel system components can be removed for repair with the engine in place.

Since the cylinder heads can be removed without pulling the engine, valve component servicing can also be accomplished with the engine in the vehicle. Replacement of the timing chain and sprockets is also possible with the engine in the vehicle.

3 Top Dead Center (TDC) - locating

Refer to illustration 3.7

1 Top Dead Center (TDC) is the highest point in the cylinder that each piston reaches as it travels up the cylinder bore. Each piston reaches TDC on the compression stroke and again on the exhaust stroke, but TDC generally refers to piston position on the compression stroke.

2 Positioning the piston(s) at TDC is an essential part of many procedures such as distributor and timing chain/sprocket removal.

3 Before beginning this procedure, be sure to place the transmission in Neutral and apply the parking brake or block the rear wheels. Also, disable the ignition system by disconnecting the coil wire from the distributor and grounding it to the engine block, then remove the spark plugs (see Chapter 1).

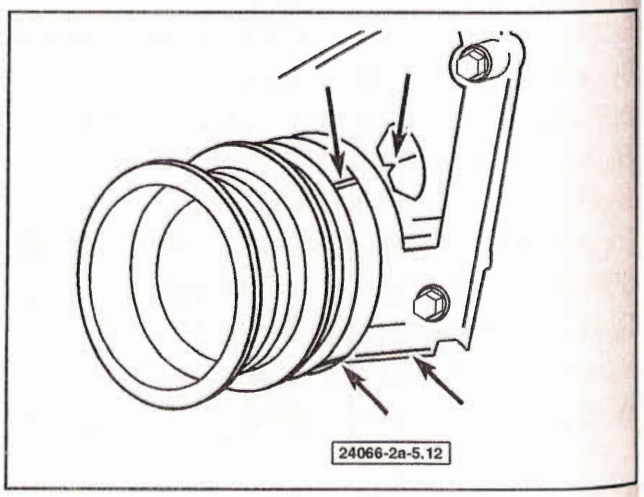
4 In order to bring any piston to TDC, the crankshaft must be turned using one of the methods outlined below. When looking at the front of the engine, normal crankshaft rotation is clockwise.

a) The preferred method is to turn the crankshaft with a socket and ratchet attached to the bolt threaded into the front of the crankshaft. Apply pressure on the bolt in a clockwise direction only. Never turn the bolt counterclockwise.

b) A remote starter switch, which may save some time, can also be used. Follow the instructions included with the switch. Once the piston is close to TDC, use a socket and ratchet as described in the previous paragraph.

c) If an assistant is available to turn the ignition switch to the Start position in short bursts, you can get the piston close to TDC without a remote starter switch. Make sure your assistant is out of the vehicle, away from the ignition switch, then use a socket and ratchet as described in Paragraph (a) to complete the procedure.

5 Place your finger partially over the number one spark plug hole



3.6 After compression is felt at the number one cylinder, align the timing marks on the vibration damper with the timing marks on the front cover

and rotate the crankshaft using one of the methods described above until air pressure is felt at the spark plug hole. Air pressure at the spark plug hole indicates that the cylinder has started the compression stroke. Once the compression stroke has begun, TDC for the number one cylinder is obtained when the piston reaches the top of the cylinder on the compression stroke.

6 To bring the piston to the top of the cylinder, continue to turn the crankshaft until the timing marks on the vibration damper align with the timing marks on the front cover (see illustration).

7 If you go past TDC, rotate the crankshaft counterclockwise until the piston is approximately one inch below TDC, then slowly rotate the crankshaft clockwise again until TDC is reached.

8 After the number one piston has been positioned at TDC on the compression stroke, TDC for any of the remaining pistons can be located by turning the crankshaft 120-degrees (1/3-turn) at a time and following the firing order.

4 Valve covers - removal and installation

REMOVAL

1 Disconnect the cable from the negative terminal of the battery.

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

2 Remove the air cleaner assembly and air intake duct (see Chapter 4).

3 Remove the secondary air injection crossover pipe, then remove the air injection check valve and pipe assembly from the exhaust manifold on the side from which you wish to remove the valve cover (see Chapter 6). If both valve covers are being removed, both air injection check valves and pipe assemblies must be removed.

Right side

Refer to illustration 4.7

4 Remove the heater hose bracket bolt and move the heater hoses aside without disconnecting them.

5 Unclip and lay aside the wiring harness.

6 Disconnect the spark plug wires from their clips and remove the spark plug wires from the spark plugs (see Chapter 1). Be sure each plug wire is labeled before removal to ensure correct reinstallation.

7 Remove the three valve cover bolts, then detach the cover from the cylinder head (see illustration).

Note: If the cover is stuck to the cylinder head, bump one end with a block of wood and a hammer to jar it loose. If that doesn't work, try to slip a flexible putty knife between the cylinder head and cover to break the gasket seal. Don't pry at the cover-to-head joint or damage to the sealing surfaces may occur (leading to oil leaks in the future).

Left side

Refer to illustration 4.11

8 Remove the nuts and bolts securing the engine wiring harness to the upper intake manifold and to the positive battery cable junction block bracket. Disconnect the connector from the engine coolant temperature sensor and position the engine wiring harness aside.

9 Remove the vacuum hose from the power brake booster.

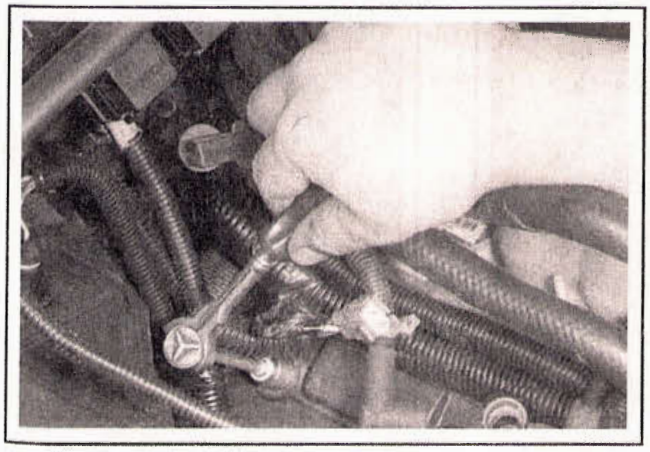
10 Disconnect the spark plug wires from their clips and remove the spark plug wires from the spark plugs (see Chapter 1). Be sure each plug wire is labeled before removal to ensure correct reinstallation.

11 Disconnect the PCV valve and the oil filler tube from the valve cover (see illustration).

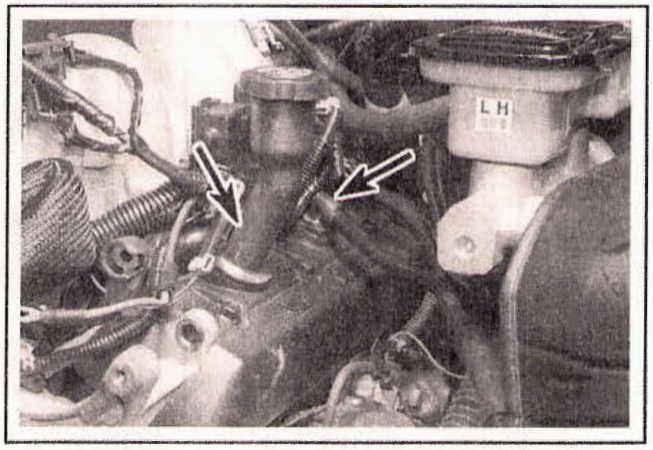
Note: On 2002 models, the PCV valve is located on the left side of the intake manifold, not on the valve cover.

12 Remove the three valve cover bolts, then detach the cover from the cylinder head.

Note: If the cover is stuck to the cylinder head, bump one end with a block of wood and a hammer to jar it loose. If that doesn't work, try to slip a flexible putty knife between the cylinder head and cover to break the gasket seal. Don't pry at the cover-to-head joint or damage to the sealing surfaces may occur (leading to oil leaks in the future).



4.7 Remove the three retaining bolts from the center of the valve cover



4.11 The PCV valve (right arrow) and hose must be disconnected and moved for left valve cover removal - the oil filler tube (left arrow) easily twists out of the valve cover

INSTALLATION

13 The mating surfaces of each cylinder head and valve cover must be perfectly clean when the covers are installed. Use a gasket scraper to remove all traces of sealant and old gasket material, then clean the mating surfaces with lacquer thinner or acetone. If there's sealant or oil on the mating surfaces when the cover is installed, oil leaks may develop.

14 Clean the mounting bolt threads with a die to remove any corrosion and restore damaged threads. Make sure the threaded holes in the cylinder head are clean - run a tap into them to remove corrosion and restore damaged threads.

15 The gaskets should be mated to the covers before the covers are installed. Apply a thin coat of RTV sealant to the cover flange, then position the gasket inside the cover lip and allow the sealant to set up so the gasket adheres to the cover.

16 Install new valve cover bolt grommets to the valve cover and carefully position the cover(s) on the cylinder head and install the bolts.

17 Tighten the bolts in three or four steps to the torque listed in this Chapter's Specifications.

18 The remaining installation steps are the reverse of removal.

19 Start the engine and check carefully for oil leaks as the engine warms up.

5 Rocker arms and pushrods - removal, inspection and installation

REMOVAL

Refer to illustration 5.4

Note: 2001 and later 4.3L V6 engines have roller rocker arms mounted with bolts, rather than the stud/ball/nut mounting on earlier models.

1 Detach the valve cover(s) from the cylinder head(s) (see Section 4).

2 Beginning at the front of one cylinder head, loosen and remove the rocker arm stud nuts. Store them separately in marked containers to ensure that they will be reinstalled in their original locations.

Note: If the pushrods are the only items being removed, loosen each nut just enough to allow the rocker arms to be rotated to the side so the pushrods can be lifted out.

3 Lift off the rocker arms and pivot balls and store them in the marked containers with the nuts (they must be reinstalled in their original locations).

4 Remove the pushrods and store them separately to make sure they don't get mixed up during installation (see illustration).

INSPECTION

5 Check each rocker arm for wear, cracks and other damage, especially where the pushrods and valve stems contact the rocker arm faces.

6 Make sure the hole at the pushrod end of each rocker arm is open.

7 Check each rocker arm pivot area for wear, cracks and galling. If the rocker arms are worn or damaged, replace them with new ones and use new pivot balls as well. On 2001 and later models, check the roller bearings in the rocker arm for free rotation.

8 Inspect the pushrods for cracks and excessive wear at the ends. Roll each pushrod across a piece of plate glass to see if it's bent (if it wobbles, it's bent).

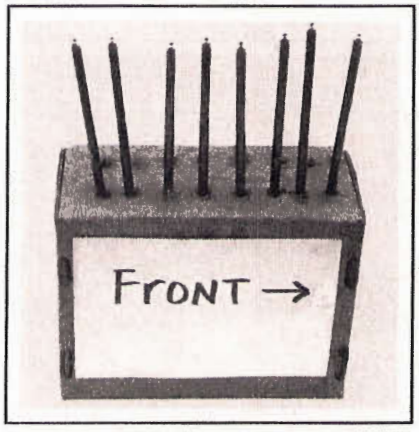
INSTALLATION

Refer to illustrations 5.10, 5.11 and 5.12

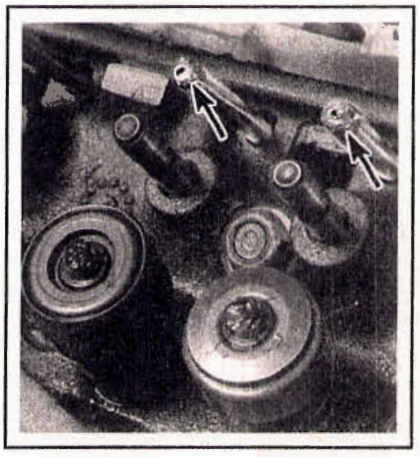
9 Lubricate the lower end of each pushrod with clean engine oil or moly-base grease and install them in their original locations. Make sure each pushrod seats completely in the lifter.

10 Apply moly-base grease to the ends of the valve stems and the upper ends of the pushrods before positioning the rocker arms over the studs (see illustration).

11 Set the rocker arms in place, then install the pivot balls and nuts. Apply moly-base grease to the pivot balls to prevent damage to the mating surfaces before engine oil pressure builds up (see illustration).



5.4 A perforated cardboard box can be used to store the pushrods to ensure that they're installed in their original positions - note the label indicating the front of the engine



5.10 Lube the ends of the pushrods and the valve stems with moly-base grease prior to installation of the rocker arms

5.11 Moly-base grease applied to the pivot balls will ensure adequate lubrication until oil pressure builds up when the engine is started

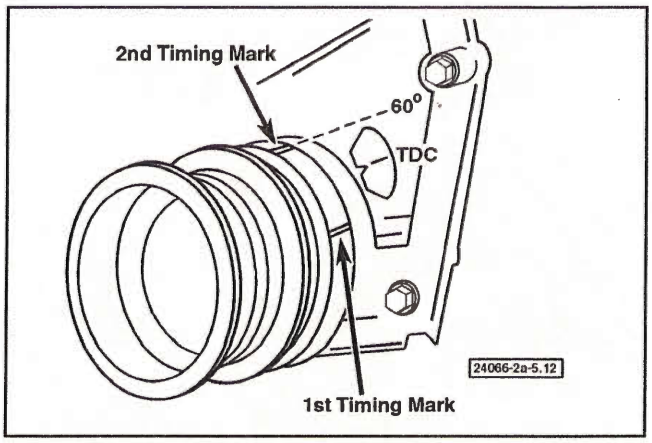
Be sure to install each nut with the flat side against the pivot ball.

➡Note: On 2001 and later models, lubricate the roller bearings in the rocker arms with clean engine oil. If the rocker arm supports (below the rocker arms) were removed, make sure to reinstall them with the cast-in arrows pointing UP (away from the cylinder head) before installing the rocker arms.

12 Rotate the crankshaft so that the second timing mark on the vibration damper is 60-degrees before TDC (see illustration). This is a neutral position in the engine rotation and will allow less valve spring tension as the rocker arms are tightened. Tighten the rockerarm nuts to the torque listed in this Chapter's Specifications.

13 The remainder of the installation is the reverse of removal.

14 Start the engine and check for valve cover leaks and valvetrain noise.



5.12 Before tightening the rocker arm nuts, position the crankshaft so that the 2nd timing mark is 60 degrees before TDC

6 Valve springs, retainers and seals - replacement

♦ Refer to illustrations 6.5, 6.7a, 6.7b, 6.13a, 6.13b and 6.15

➡Note: Broken valve springs and defective valve stem seals can be replaced without removing the cylinder heads. Two special tools and a compressed air source are normally required to perform this operation, so read through this Section carefully and rent or buy the tools before beginning the job.

1 Remove the valve cover from the cylinder head (see Section 4). If all of the valve stem seals are being replaced, remove both valve covers.

2 Remove the spark plug from the cylinder which has the defective component. If all of the valve stem seals are being replaced, all of the spark plugs should be removed.

3 Turn the crankshaft until the piston in the affected cylinder is at top dead center on the compression stroke (see Section 3). If you are replacing all of the valve stem seals, begin with cylinder number 1 and work on the valves for one cylinder at a time. Move from cylinder-to-cylinder following the firing order sequence (1-6-5-4-3-2). Each cylinder in the firing order is 120-degrees of crankshaft rotation (clockwise) from the previous one.

4 Remove the nut, pivot ball and rocker arm for the valve with the defective part and pull out the pushrod (see Section 5). If all the valve stem seals are being replaced, all of the rocker arms and pushrods should be removed.

5 Thread an adapter into the spark plug hole (see illustration) and connect an air hose from a compressed air source to it. Most auto parts stores can supply the air hose adapter.

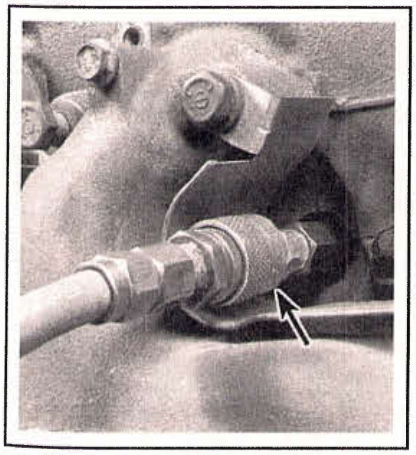
➡Note: Many cylinder compression gauges utilize a screw-in fitting that may work with your air hose quick-disconnect fitting.

6 Apply 90 to 100 psi of compressed air to the cylinder. The valves should be held in place by the air pressure.

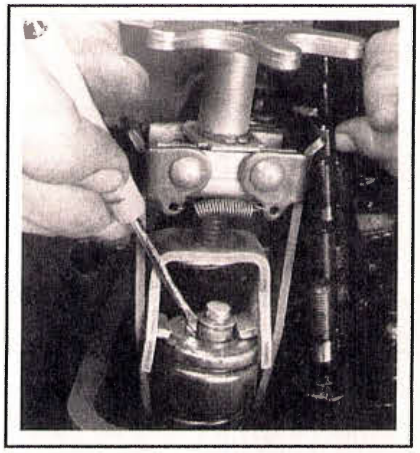
WARNING:

If the cylinder isn't exactly at TDC, air pressure may cause the engine to rotate. Do not leave a socket or wrench on the vibration damper bolt; damage or personal injury may result.

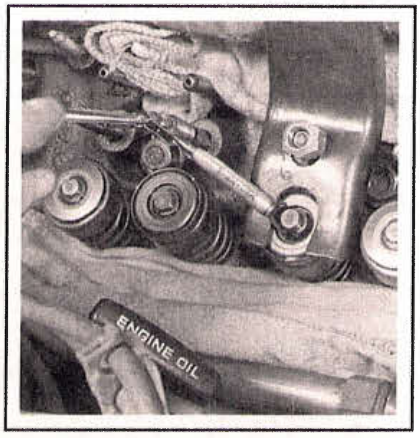
7 Stuff shop rags into the cylinder head holes to prevent parts and



6.5 Use compressed air to hold the valve closed when the springs are removed - the air hose adapter (arrow) threads into the spark plug hole and accepts the hose from the compressor

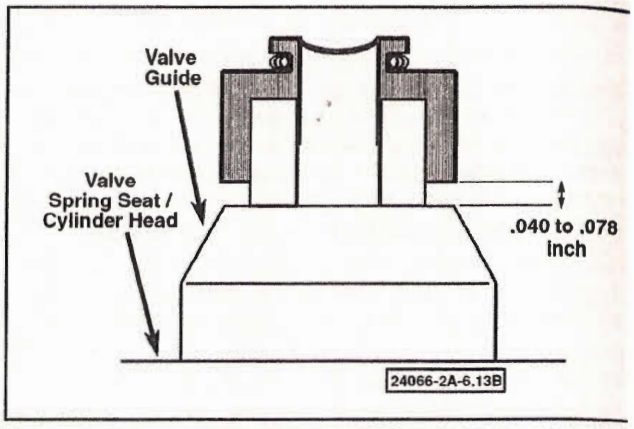


6.7a Once the spring is depressed, the keepers can be removed with a small magnet or needle-nose pliers (a magnet is preferred to prevent dropping the keepers



6.7b Lever-type valve spring compressors use the rocker arm stud and nut as a pivot point to apply leverage to the valve spring - it is usually less expensive than the type that grips the spring coils

6.13a Using a deep socket and hammer, gently tap the new seals onto the valve guide to the specified depth



6.13b Valve seal installation depth - don't bottom the seal against the valve guide

tools from falling into the engine, then use a valve spring compressor to compress the valve spring and the valve spring retainer. Remove the keepers with small needle-nose pliers or a magnet (see illustration).

➡Note: A couple of different types of tools are available for compressing the valve springs with the cylinder head in place. One type grips the lower spring coils and presses on the retainer as the knob is turned, while the other type utilizes the rocker arm stud and nut for leverage (see illustration). Both types work very well, although the lever type is usually less expensive.

8 Remove the spring retainer or rotator and valve spring assembly (on some models there is both an inner and outer valve spring for each valve - the inner is called a spring damper), then remove the valve stem seal from the valve guide.

➡Note: If air pressure fails to hold the valve in the closed position during this operation, the valve face and/or seat is probably damaged. If so, the cylinder head will have to be removed for additional repair operations.

9 Wrap a rubber band or tape around the top of the valve stem so the valve won't fall into the combustion chamber, then release the air pressure.

10 Inspect the valve stem for damage. Rotate the valve in the guide and check the end for eccentric movement, which would indicate that the valve is bent.

11 Move the valve up-and-down in the guide and make sure it does not bind. If the valve stem binds, either the valve is bent or the guide is damaged. In either case, the cylinder head will have to be removed for repair.

12 Reapply air pressure to the cylinder to retain the valve in the closed position, then remove the tape or rubber band from the valve stem.

13 Lubricate the valve stems with engine oil and install the new valve stem seals. Using the stem of the valves as a guide, slide the seals down to the top of each valve guide, then use a hammer and a deep socket or seal installation tool to gently tap each seal into place until it's positioned to the specified depth (see illustrations).

CAUTION:

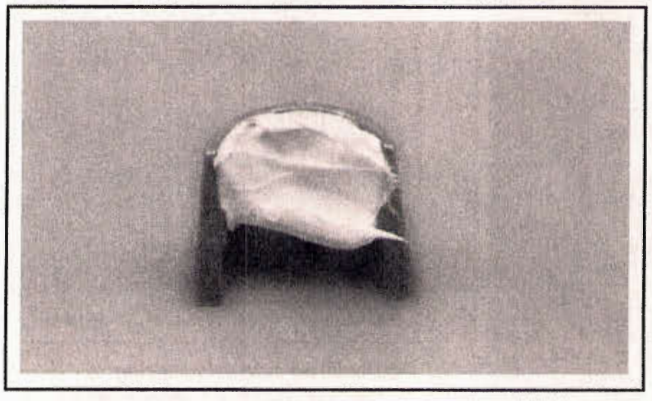
Intake and exhaust seals are color coded - do not mix them up. Intake seals are typically white or off-white in color, while exhaust valve stem seals are brown with a white stripe. Don't twist or cock the seals during installation or they won't seal properly on the valve stems. Make sure the garter spring is still in place around the top of the seal.

14 Install the valve spring and damper (if equipped) over the valve, with the more closely-wound spring coils toward the cylinder head.

15 Install the valve spring retainer or rotator.

➡Note: Rotators are used on the exhaust valves only.

Compress the valve springs and carefully position the valve stem keepers in the groove. Apply a small dab of grease to the inside of each keeper to hold it in place (see illustration).



6.15 Apply a small dab of grease to each keeper as shown here before installation - it will hold them in place on the valve stem as the spring is released

16 Disconnect the air hose and remove the adapter from the spark plug hole.

17 Repeat the above procedure on the remaining cylinders, following the firing order sequence (see the Specifications). Bring each piston to top dead center on the compression stroke before applying a pressure.

18 Install the rocker arm(s) and pushrod(s) (see Section 5).

19 Install the valve cover(s) (see Section 4).

20 Install the spark plug(s) and hook up the wire(s).

21 Start and run the engine, then check for oil leaks and unusual sounds coming from the valve cover area.

7 Intake manifold - removal and installation

➡Note: The upper and lower intake manifolds can be removed as a unit, by removing only the lower intake manifold bolts. For repairs or inspection of the fuel-meter body or injectors, refer to Chapter 4 for removal of the upper intake plenum.

REMOVAL

1 Disconnect the cable from the negative terminal of the battery.

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

2 Refer to Chapter 4 and relieve the fuel system pressure, then remove the air intake duct and detach the throttle cable and the cruise control cable from the throttle body.

3 Drain the cooling system and remove the drivebelt (see Chapter 1).

4 Remove the secondary air injection crossover pipe (see Chapter 6).

5 Label and disconnect the hoses and electrical connectors attached to the intake manifold and throttle body. Also disconnect the electrical connectors from the A/C compressor and the alternator.

6 Remove the ground strap from the rear of the right cylinder head.

7 Remove the wiring harness brackets from the studs on the intake manifold and set the wiring harness aside.

8 Remove the upper radiator hose from the intake manifold. Remove the coolant bypass hose from the intake manifold and the water pump. Remove the heater hose support bracket from the alternator bracket and detach the heater hoses from the engine (see Chapter 3).

9 Remove the spark plug wires (see Chapter 1) and the distributor (see Chapter 5).

10 Refer to Chapter 6 and remove the EGR pipe from the intake manifold and the exhaust manifold.

11 Disconnect the fuel feed and return lines at the rear of the intake manifold (see Chapter 4).

12 Loosen the retaining nut securing the side of the power steering pump to the power steering pump rear bracket, then remove the lower nut securing the front of the pump to the rear bracket.

13 Remove the bolts and nuts securing the power steering pump mounting bracket to the front of the engine and slide the bracket forward with the A/C compressor attached. This will allow access to the front intake manifold bolt on the driver's side.

14 Loosen the intake lower manifold mounting bolts in 1/4-turn increments in the reverse order of the tightening sequence until they can be removed by hand (see illustration 7.23). The manifold will probably be stuck to the cylinder heads and force may be required to break the gasket seal. A pry bar can be positioned to pry up a casting projection at the front of the manifold to break the bond made by the gasket.

CAUTION:

Do not pry between the block and manifold or the heads and manifold or damage to the gasket sealing surfaces may result and vacuum leaks could develop.

15 Remove the intake manifold (see illustration). As the manifold is lifted from the engine, be sure to check for and disconnect anything still attached to the manifold.

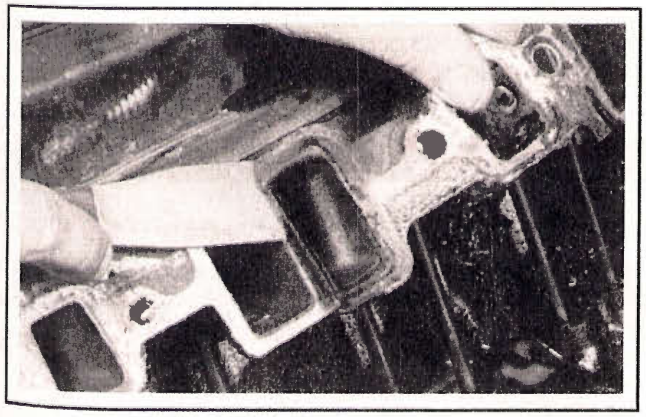
INSTALLATION

Refer to illustrations 7.16, 7.17, 7.18, 7.20 and 7.23

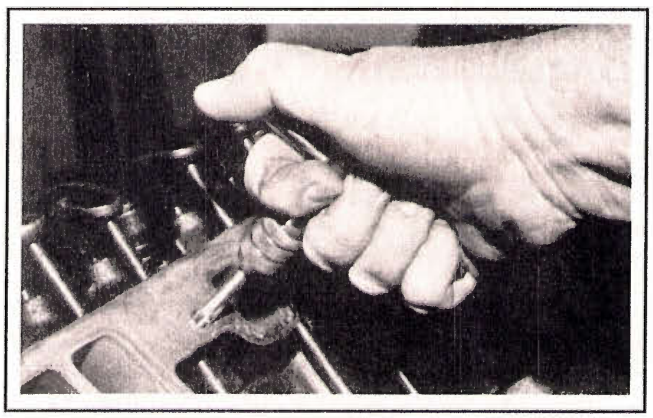
➡Note: The mating surfaces of the cylinder heads, block and manifold must be perfectly clean when the manifold is installed. Gasket removal solvents in aerosol cans are available at most auto parts stores and may be helpful when removing old gasket material that is stuck to the heads and manifold. Be sure to follow the directions printed on the container.

16 Use a gasket scraper to remove all traces of sealant and old gasket material, then clean the mating surfaces with lacquer thinner or acetone. If there's old sealant or oil on the mating surfaces when the manifold is installed, oil or vacuum leaks may develop. When working on the cylinder heads and block, cover the lifter valley with shop rags to keep debris out of the engine (see illustration). Use a vacuum cleaner to remove any gasket material that falls into the intake ports in the cylinder heads.

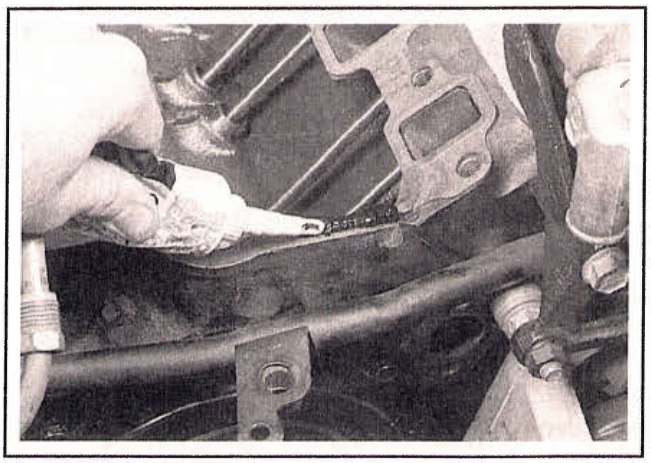
17 Use a tap of the correct size to chase the threads in the bolt



7.16 After covering the lifter valley, use a gasket scraper to remove all traces of sealant and old gasket material from the cylinder head and manifold mating surfaces



7.17 The bolt hole threads must be clean and dry to ensure accurate torque readings when the manifold mounting bolts are installed



7.18 Apply a 3/16-inch bead of RTV sealant to the front and rear manifold mating surfaces of the engine block - be sure the beads extend up the cylinder heads 1/2-inch on each side.

holes, then use compressed air (if available) to remove the debris from the holes (see illustration).

WARNING:

Wear safety glasses or a face shield to protect your eyes when using compressed air! Remove excessive carbon deposits and corrosion from the exhaust, EGR and coolant passages in the cylinder heads and manifold.

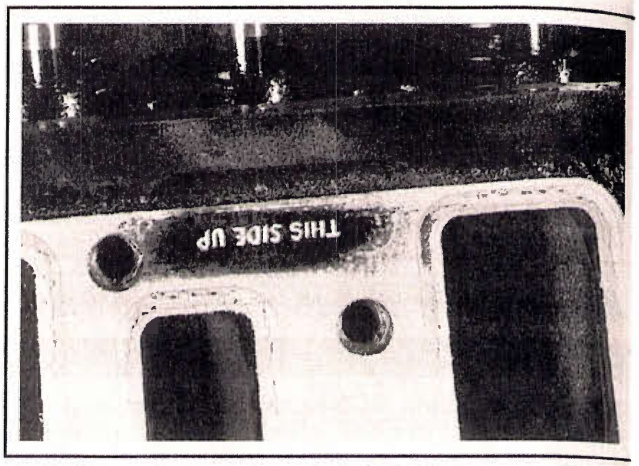
18 Apply a 3/16-inch wide bead of RTV sealant to the front and rear manifold mating surfaces of the block (see illustration). Make sure the beads extend up the cylinder heads 1/2-inch on each side.

19 If the new manifold gaskets do not come equipped with a rubber sealing ring around the coolant passages, apply a thin coat of RTV sealant around the coolant passage holes on the cylinder head side of the new intake manifold gaskets.

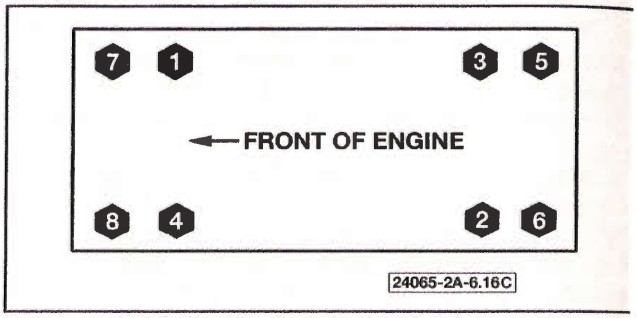
➡Note: Factory replacement gaskets come equipped with a rubber sealant ring around the coolant passages and do not require extra RTV sealant around the coolant passages.

20 Position the gaskets on the cylinder heads, with the ears at each end overlapping the bead of RTV sealant on the cylinder head. The upper side of each gasket should have a THIS SIDE UP label stamped into it to ensure correct installation (see illustration).

21 Make sure all intake port openings, coolant passage holes and bolt holes are aligned correctly. Some gaskets may have small tabs which must be bent over until they're flush with the rear surface of each cylinder head.



7.20 Be sure the gaskets are installed with the marks UP!



7.23 Lower intake manifold bolt tightening sequence

22 Carefully set the manifold in place while the sealant is still wet.

CAUTION:

Don't disturb the gaskets and don't move the manifold fore-and aft after it contacts the sealant on the block.

23 Following the recommended sequence, install the bolts (with thread-locking compound on the bolts) and tighten them to the torque listed in this Chapter's Specifications (see illustration). Work up to the final torque in three stages.

24 The remaining installation steps are the reverse of removal. If the upper intake manifold was removed, refer to Chapter 4 for installation. Start the engine and check carefully for oil and coolant leaks at the intake manifold joints.

8 Exhaust manifolds - removal and installation

REMOVAL

Refer to illustrations 8.4, 8.8 and 8.12

WARNING:

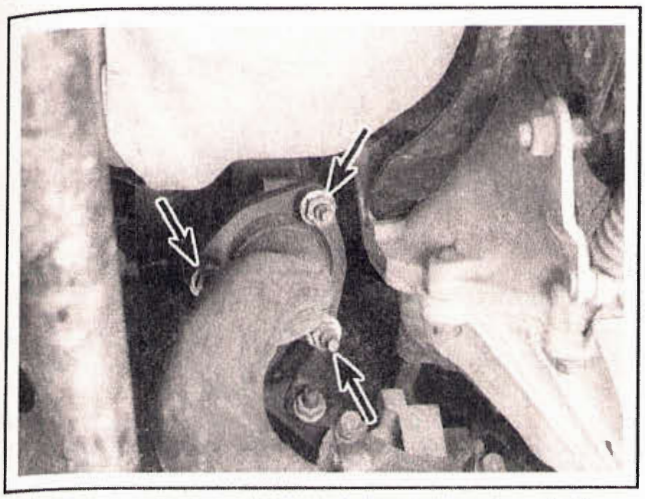
Use caution when working around the exhaust manifolds, the sheetmetal heat shields can be sharp on the edges. Also, the engine should be cold when this procedure is followed.

1 Disconnect the cable from the negative terminal of the battery.

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

2 Raise the vehicle and support it securely on jackstands.



8.4 Access the exhaust pipe bolts/nuts from underneath the vehicle - on some models it may be easier to remove the wheel and work through the fenderwell opening

3 Working under the vehicle, apply penetrating oil to the exhaust pipe-to-manifold studs and nuts (they're usually rusty).

4 Remove the nuts retaining the exhaust pipe(s) to the manifold(s) (see illustration).

Right side manifold

5 Remove the air cleaner assembly (see Chapter 4).

6 Remove the secondary air injection pipe (if equipped) from the exhaust manifold (see Chapter 6).

7 Detach the spark plug wires from the plugs, then remove the plug wire retaining bracket from the cylinder head and position them out of the way.

8 Remove the oil dipstick, unbolt the dipstick tube bracket and move the dipstick tube (see illustration).

9 Bend the lock tabs back (if equipped), then remove the mounting bolts and separate the exhaust manifold from the cylinder head. Remove the heat shields from the manifold after the bolts are removed.

Left side manifold

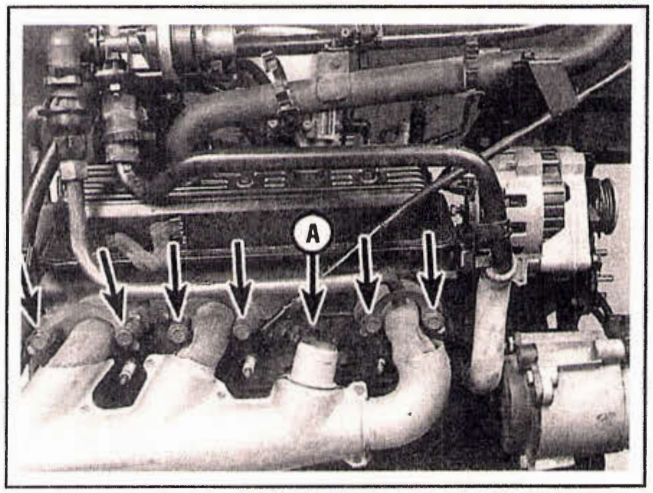
10 Remove the secondary air injection pipe (if equipped) from the exhaust manifold (see Chapter 6).

11 Detach the spark plug wires from the plugs, then remove the plug wire retaining bracket from the cylinder head and position them out of the way.

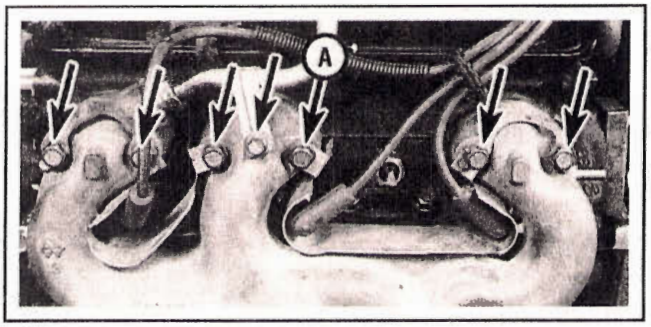
12 Disconnect the EGR pipe from the exhaust manifold (see illustration).

13 Disconnect the electrical connector from the Engine Coolant Temperature (ECT) sensor (see Chapter 6).

14 Bend the lock tabs back (if equipped), then remove the mounting bolts and separate the exhaust manifold from the cylinder head. Remove the heat shields from the manifold after the bolts are removed.



8.8 Right exhaust manifold mounting bolts and the oil dipstick tube mounting bolt (A)



8.12 Left exhaust manifold mounting bolts and the EGR tube mounting nut (A)

INSTALLATION

15 Check the manifold for cracks and make sure the bolt threads are clean and undamaged. The manifold and cylinder head mating surfaces must be clean before the manifolds are reinstalled - use a gasket scraper to remove all carbon deposits.

16 Position the manifold on a bench and install the heat shields, bolts and gaskets onto the manifold. Retaining tabs surrounding the gasket bolt holes will hold the assembly together as the manifold is installed. Place the manifold on the cylinder head install the mounting bolts finger tight.

17 When tightening the mounting bolts, work from the center to the ends and be sure to use a torque wrench. Tighten the bolts in two steps to the torque listed in this Chapter's Specifications. If equipped bend the locking tabs back against the bolt heads.

18 The remaining installation steps are the reverse of removal.

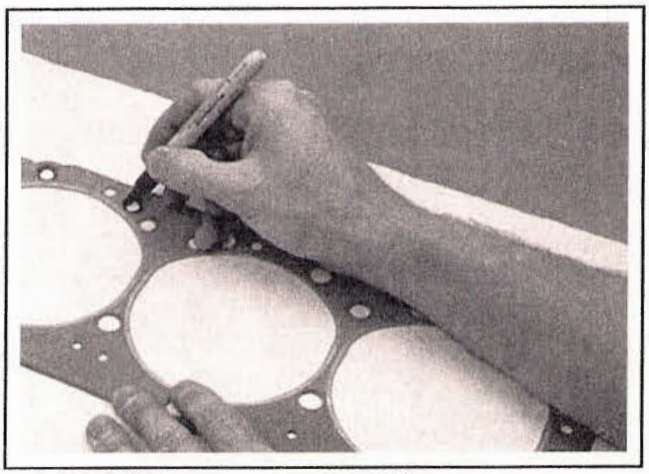
19 Start the engine and check for exhaust leaks.

9 Cylinder heads - removal and installation

➡Note: The engine must be completely cool when the cylinder heads are removed. Failure to allow the engine to cool off could result in cylinder head warpage. When cool, refer to Chapter 1 and drain the cooling system.

REMOVAL

1 Remove the intake manifold (see Section 7), and exhaust manifolds (see Section 8).



9.11 To avoid mixing up the cylinder head bolts, use a new gasket to transfer the bolt hole pattern to a piece of cardboard, then punch holes to accept the bolts

2 Remove the valve covers (see Section 4).
3 Remove the pushrods (see Section 5).
4 Remove the engine cooling fan (see Chapter 3).

Right cylinder head

5 Remove the alternator (see Chapter 5)
6 Remove the alternator mounting bracket from the cylinder head.

Left cylinder head

7 Remove the engine ground wire and electrical harness at the rear of the cylinder head.

8 Unbolt the air conditioning compressor from the engine and set it aside without disconnecting the refrigerant lines (see Chapter 3). If the vehicle is not equipped with air conditioning it will be necessary to remove the drivebelt idler pulley from the accessory mounting bracket.

9 Unbolt and lay aside the power steering pump, without disconnecting the power steering hoses (see Chapter 10).

10 Remove the accessory mounting brackets from the left cylinder head.

Both cylinder heads

♦ Refer to illustration 9.11

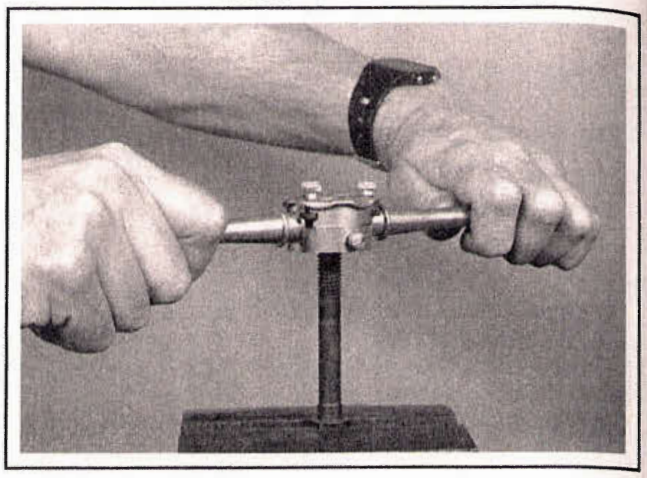
11 Using a new cylinder head gasket, outline the cylinders and bolt pattern on a piece of cardboard (see illustration). Be sure to indicate the front of the engine for reference. Punch holes at the bolt locations.

12 Loosen the cylinder head bolts in 1/4-turn increments until they can be removed by hand. Work from bolt-to-bolt in a pattern that's the reverse of the tightening sequence shown in illustration 9.22.

➡Note: Don't overlook the row of bolts on the lower edge of each cylinder head, near the spark plug holes. Store the bolts in the cardboard holder as they're removed; this will ensure that the bolts are reinstalled in their original holes.

13 Lift the cylinder head(s) off the engine. If resistance is felt, DO NOT pry between the cylinder head and block as damage to the mating surfaces will result. To dislodge the cylinder head, place a block of wood against the end of it and strike the wood block with a hammer. Store the cylinder heads on wood blocks to prevent damage to the gasket sealing surfaces.

14 Cylinder head disassembly and inspection procedures are covered in detail in Chapter 2, Part C.



9.18 A die should be used to remove sealant and corrosion from the cylinder head bolt threads prior to installation

INSTALLATION

♦ Refer to illustrations 9.18, 9.19a, 9.19b, 9.21 and 9.22

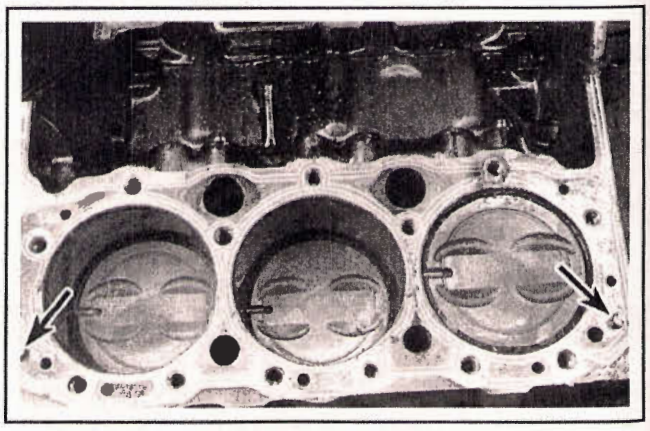
15 The mating surfaces of the cylinder heads and block must be perfectly clean when the cylinder heads are installed.

16 Use a gasket scraper to remove all traces of carbon and old gasket material, then clean the mating surfaces with lacquer thinner or acetone. If there's oil on the mating surfaces when the cylinder heads are installed, the gaskets may not seal correctly and leaks may develop. When working on the block, cover the lifter valley with shop rags to keep debris out of the engine. Use a vacuum cleaner to remove any debris that falls into the cylinders.

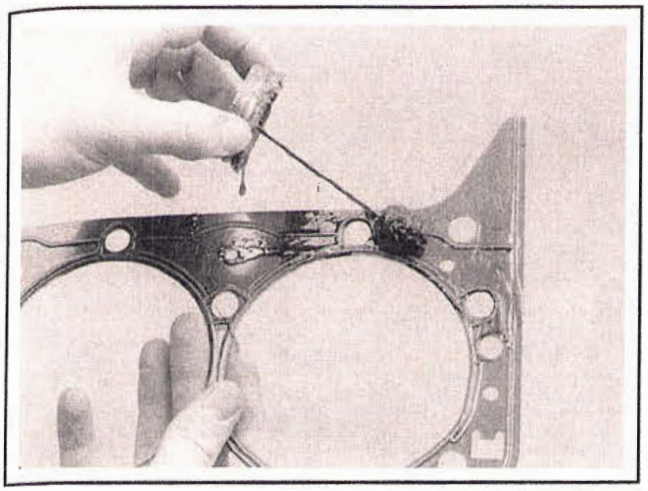
17 Check the block and cylinder head mating surfaces for nicks, deep scratches and other damage. If damage is slight, it can be removed with a file - if it's excessive, machining may be the only alternative.

18 Use a tap of the correct size to chase the threads in the cylinder head bolt holes. Mount each bolt in a vise and run a die down the threads to remove corrosion and restore the threads (see illustration). Dirt, corrosion, sealant and damaged threads will affect torque readings.

19 Position the new gaskets over the dowel pins in the block (see illustrations).



9.19a Locating dowels (arrows) are used to position the cylinder head gaskets on the block



9.19b Steel gaskets should be coated with a sealant such as K&W Copper Coat before installation - composite gaskets do not use sealant

➡Note: If a steel gasket is used, apply a thin, even coat of a sealant such as K&W Copper Coat to both sides prior to installation (see illustration).

WARNING:

Composition-type gaskets are used on some engines, with a thin, sheetmetal core. Be very careful when handling because the edges may be very sharp. Composition gaskets do not require sealant.

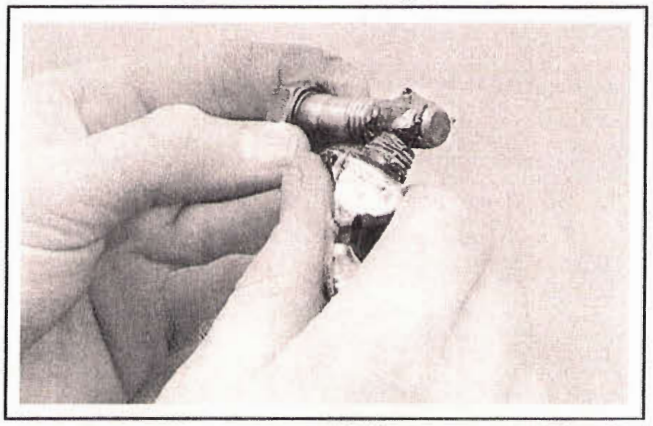
20 Carefully position the cylinder heads on the block without disturbing the gaskets.

21 Before installing the cylinder head bolts, coat the threads with a non-hardening sealant such as Permatex no. 2 (see illustration).

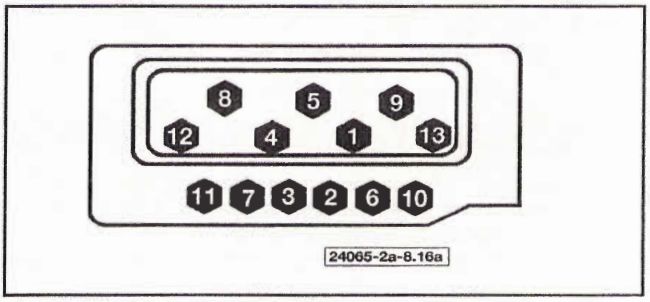
22 Install the bolts in their original locations and tighten them finger tight. Follow the recommended sequence and tighten the bolts in several steps to the torque and angle of rotation listed in this Chapter's Specifications (see illustration).

23 The remaining installation steps are the reverse of removal.

24 Change the engine oil and filter (see Chapter 1), then start the engine and check carefully for oil and coolant leaks.



9.21 The cylinder head bolts MUST be coated with a non-hardening sealant (such as Permatex no. 2) before they're installed - coolant will leak past the bolts if this isn't done



9.22 Cylinder head bolt TIGHTENING sequence

10 Vibration damper and pulley - removal and installation

Refer to illustrations 10.3, 10.5 and 10.6

1 Disconnect the cable from the negative terminal of the battery.

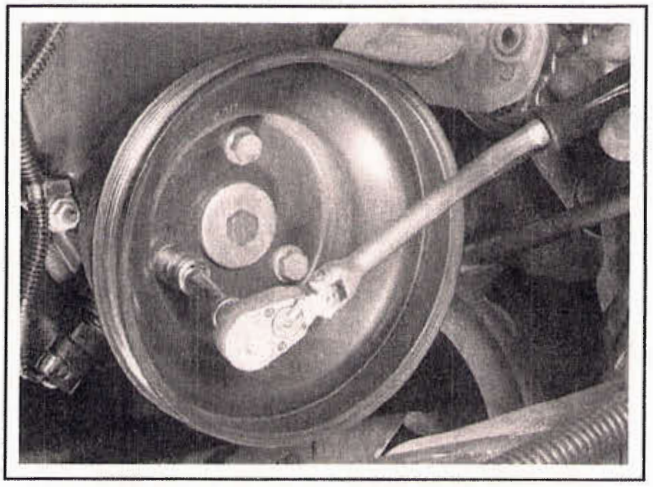
CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

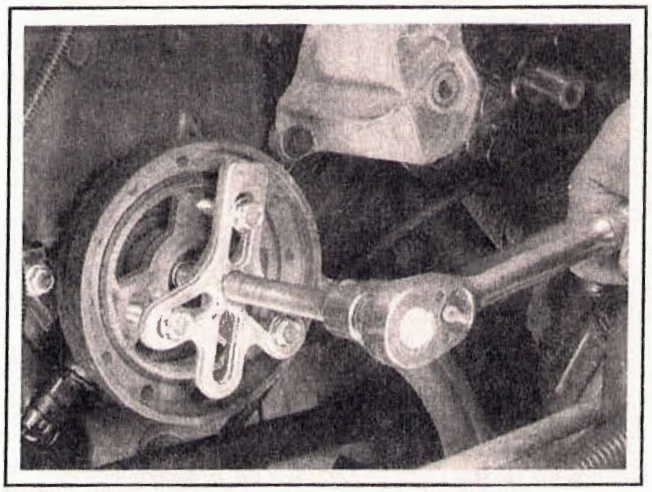
2 Refer to Chapter 3 and remove the fan shroud and the engine cooling fan, then refer to Chapter 1 and remove the engine drivebelt.

3 Remove the bolts and separate the crankshaft pulley from the vibration damper (see illustration).

4 Remove the large vibration damper-to-crankshaft bolt. To keep the crankshaft from turning, remove the starter (see Chapter 5) and have an assistant wedge a large screwdriver against the ring gear teeth.



10.3 Remove the crankshaft pulley bolts and separate the pulley from the vibration damper



10.5 Use a bolt-on-type puller to remove the vibration damper

5 Using the proper puller (commonly available from auto parts stores), detach the vibration damper from the crankshaft (see illustration).

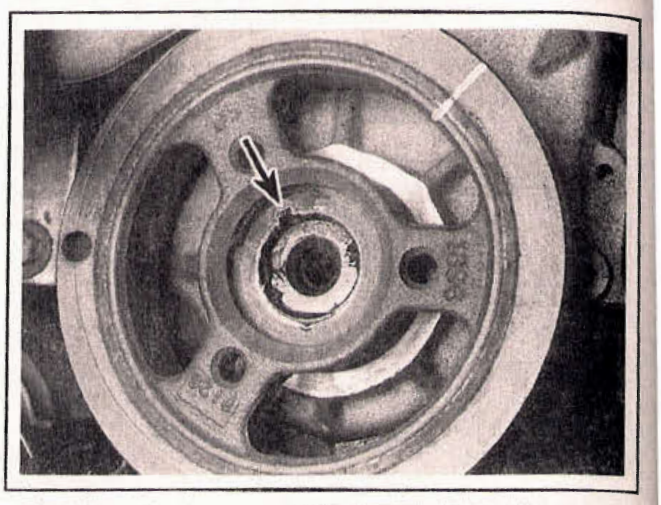
CAUTION:

Do not use a puller with jaws that grip the outer edge of the damper. The puller must be the type that utilizes bolts to apply force to the center of the damper hub only.

Be careful not to lose the Woodruff key.

CAUTION:

Insert a short bolt somewhat smaller than the damper bolt into the crankshaft for the tip of the tool to push against, to avoid damage to the threads in the crankshaft.



10.6 The pulley keyway must be aligned with the Woodruff key (arrow) in the crankshaft nose

6 Make sure the Woodruff key is in place, then position the vibration damper on the crankshaft and slide it on as far as it will go. Use a small dab of RTV sealant on the keyway of the damper before installation. Note that the slot (keyway) in the hub must be aligned with the Woodruff key in the end of the crankshaft (see illustration).

7 Using a vibration damper installation tool, press the damper onto the crankshaft. Note that the crankshaft bolt can also be used to press the crankshaft balancer into position, but when doing so, use a liberal amount of clean engine oil on the bolt threads to prevent galling. Make sure the raised crown of the damper bolt washer is away from the crankshaft.

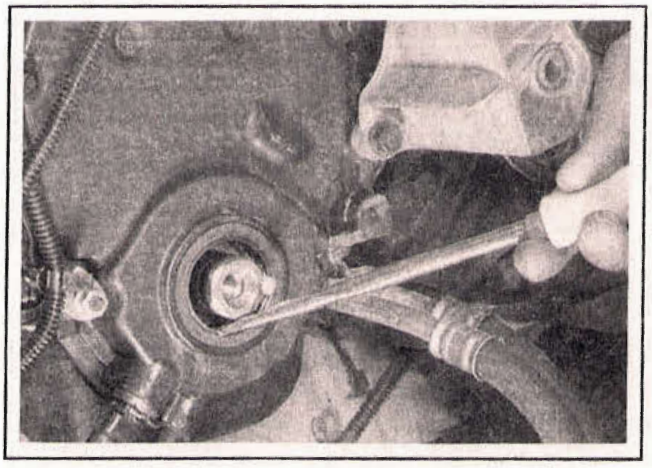
8 Tighten the crankshaft bolt to the torque listed in this Chapter's Specifications.

9 The remaining installation steps are the reverse of removal.

11 Crankshaft front oil seal - replacement

Refer to illustrations 11.2, 11.3, 11.5 and 11.6

1 Remove the crankshaft pulley and vibration damper (see Section 10).



11.2 If you're replacing the seal with the timing chain cover installed, pry it out with a seal removal tool or a large screwdriver

2 Note how the seal is installed - the new one must be installed to the same depth and facing the same way. Carefully pry the oil seal out of the cover with a seal puller or a large screwdriver (see illustration).

CAUTION:

Be careful not to scratch, gouge or distort the area that the seal fits into or an oil leak will develop. Wrap electrician's tape around the tip of the screwdriver to avoid damage to the crankshaft.

3 If the seal is being replaced with the timing chain cover removed, support the cover on top of two blocks of wood and drive the seal out from the backside with a hammer and punch (see illustration).

CAUTION:

Be careful not to scratch, gouge or distort the area that the seal fits into or a leak will develop.

4 Clean the seal bore to remove any old seal material and corrosion. Position the new seal in the bore with the seal lip (usually the side

with the spring) facing IN (toward the engine). A small amount of oil applied to the outer edge of the new seal will make installation easier.

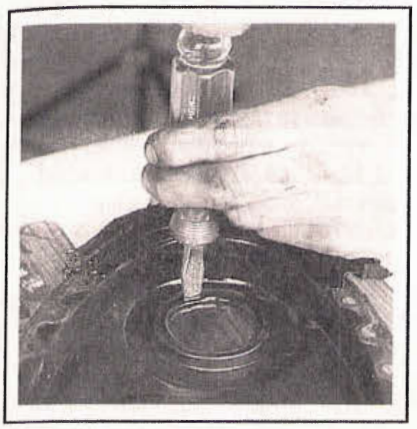
5 Drive the seal into the bore with a seal driver or a large socket and hammer until it's completely seated (see illustration). Select a socket that's the same outside diameter as the seal and make sure the new seal is pressed into place until it bottoms against the cover flange.

6 Check the surface of the damper that the oil seal rides on. If the surface has been grooved from long-time contact with the seal, a press-on sleeve may be available to renew the sealing surface (see illustration). This sleeve is pressed into place with a hammer and a block of wood and is commonly available from auto parts stores.

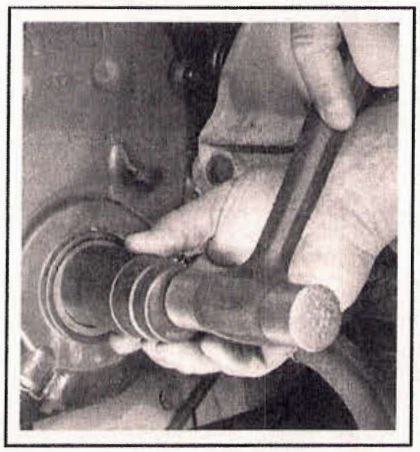
7 Lubricate the seal lips with engine oil and reinstall the vibration damper. Use a vibration damper installation tool to press the damper onto the crankshaft.

8 Install the vibration damper-to-crankshaft bolt and tighten it to the torque listed in this Chapter's Specifications. Install the crankshaft pulley and tighten the bolts to the torque listed in this Chapter's Specifications.

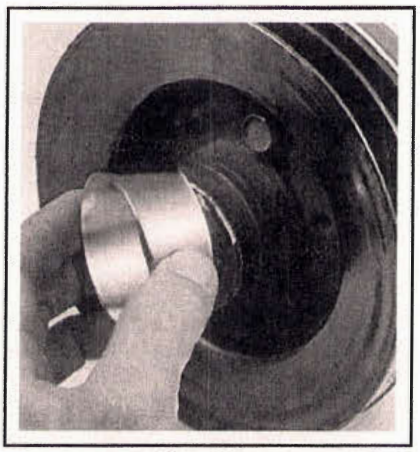
9 The remainder of installation is the reverse of the removal.



11.3 If you're replacing the seal with the timing chain cover removed, drive the old seal out from the inside with a hammer and punch or a screwdriver while supporting the cover near the seal bore,



11.5 Use a seal driver or large socket to drive the new seal into the cover



11.6 If the sealing surface of the damper hub has a wear groove from contact with the seal, repair sleeves are available at most auto parts stores

12 Timing chain and sprockets - removal and installation

WARNING:

Wait until the engine is completely cool before beginning this procedure.

REMOVAL

♦ Refer to illustrations 12.5, 12.8 and 12.9

1 Disconnect the cable from the negative terminal of the battery.

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual). Drain the cooling system (see Chapter 1).

2 Refer to Chapter 3 and remove the upper and lower fan shrouds, drivebelt, cooling fan and water pump.

3 Position the number four piston at TDC on the compression stroke (see Section 3).

CAUTION:

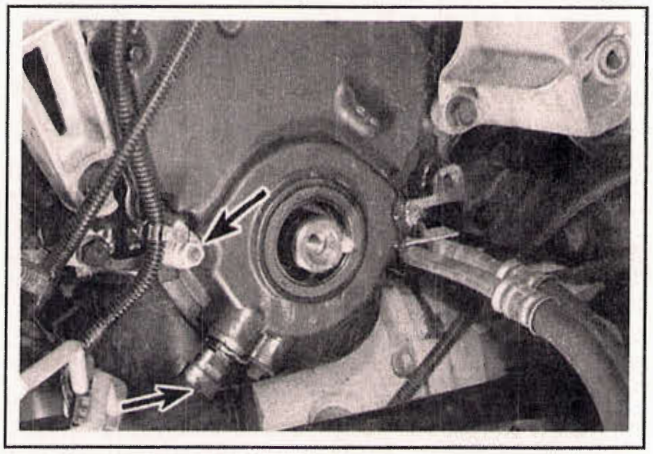
Once this has been done, DO NOT turn the crankshaft until the timing chain and sprockets have been reinstalled!

4 Refer to Section 10 and remove the drivebelt pulley and the vibration damper.

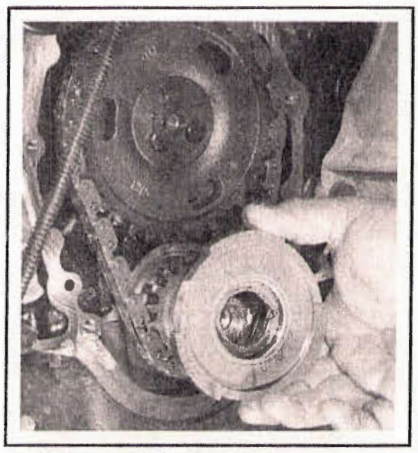
5 Remove the crankshaft position sensor and the nut retaining the wiring harness to the front cover (see illustration).

6 Remove the oil pan (see Section 14).

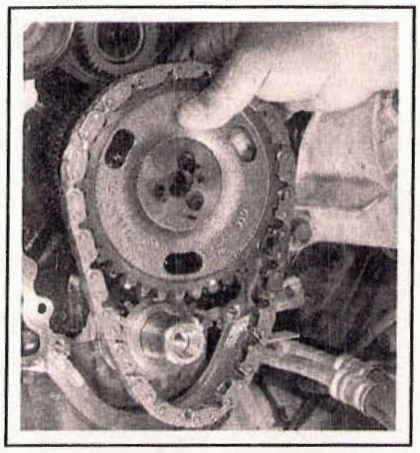
7 Remove the cover bolts and separate the timing chain cover from the block. It may be stuck - if so, use a putty knife or screwdriver to break the gasket seal.



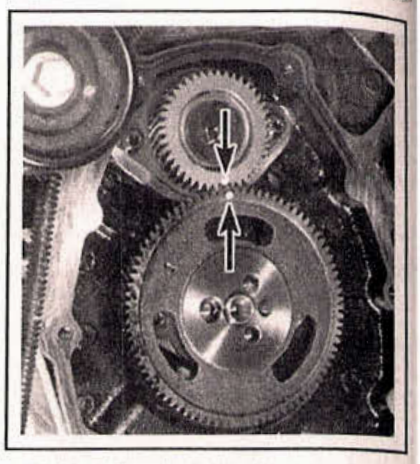
12.5 Remove the crankshaft position sensor (lower arrow) and remove the nut (upper arrow) retaining the wiring harness to the cover stud



12.8 Before removing the sprockets or chain, remove the reluctor ring from the crankshaft



12.9 Remove the three bolts from the end of the camshaft and remove the camshaft sprocket and chain as an assembly



12.12 Before installing the camshaft sprocket, make sure the timing marks on the balance shaft gears are properly aligned (arrows)

➡Note: This engine uses a timing chain cover that is made of a composite material, which is not reusable. It is recommended to replace the front cover and the oil seal rather than try to reseal it and have it leak later.

8 Remove the crankshaft position sensor reluctor ring just inside the front cover (see illustration). Measure the timing chain freeplay. If it is more than 5/8 inch, the chain and both sprockets should be replaced.

9 Remove the three bolts from the end of the camshaft, then detach the camshaft sprocket and chain as an assembly (see illustration).

➡Note: The balance shaft drive gear will stay attached to the camshaft and the driven gear will stay attached to the balance shaft.

If replacement of the timing chain is necessary, remove the sprocket on the crankshaft with a two- or three-jaw puller, but be careful not to damage the threads in the end of the crankshaft.

INSTALLATION

♦ Refer to illustrations 12.12 and 12.13

10 Use a gasket scraper to remove all traces of old gasket material and sealant from the engine block. Clean the block sealing surfaces with lacquer thinner or acetone.

11 If a new timing chain is being installed, be sure to align the keyway in the crankshaft sprocket with the Woodruff key in the end of the crankshaft. Press the sprocket onto the crankshaft with the vibration damper bolt, a large socket and some washers, or tap it gently into place until it's completely seated.

⁂ CAUTION:

If resistance is encountered, DO NOT hammer the sprocket onto the crankshaft. It may eventually move onto the shaft, but it may be cracked in the process and fail later, causing extensive engine damage.

12 Before installing the timing chain and camshaft sprocket, align the balance shaft gears (see illustration). The camshaft should be positioned with the balance shaft drive gear timing mark at 12 o'clock and the driven gear mark at 6 o'clock.

13 Position the crankshaft so the sprocket timing mark is in the 12 o'clock position. Loop the chain over the camshaft sprocket, mesh the chain with the crankshaft sprocket and position the camshaft sprocket on the camshaft with the timing mark in the 6 o'clock position. When correctly installed, the marks on the sprockets will be aligned as shown (see illustration).

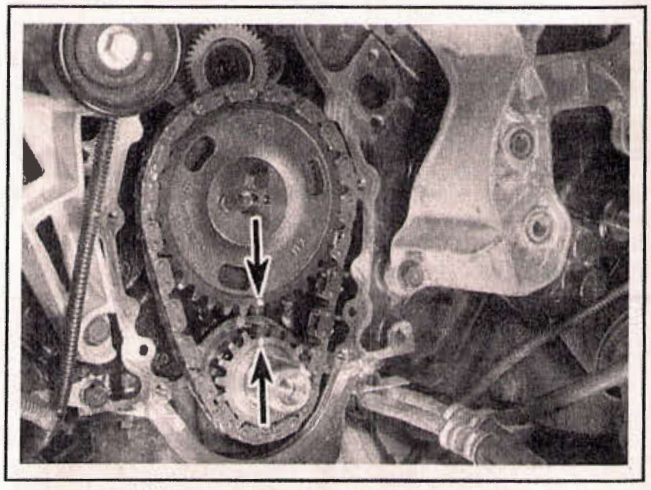
➡Note: The number four piston will be at TDC on the compression stroke with the sprockets aligned as shown.

14 Apply a non-hardening thread locking compound to the camshaft sprocket bolt threads, then install and tighten them to the torque listed in this Chapter's Specifications. Lubricate the chain with clean engine oil.

15 Install the crankshaft position sensor reluctor ring. Be sure to install the reluctor with the dished side facing OUT!

16 Apply a thin layer of RTV sealant to the engine block sealing surface, then position a **new** front cover and oil seal assembly on the engine block (the dowel pins and sealant will hold it in place).

➡Note: Composite covers do not have a gasket, they use



12.13 Position the timing marks on the camshaft and crankshaft sprockets in the 6 and 12 o'clock positions, respectively. When aligned as shown the number four piston is at TDC on the compression stroke

sealant only. Always purchase a New front cover and oil seal assembly to avoid sealing problems caused by the distortion of prying the old cover off.

17 Install the cover retaining bolts and tighten them to the torque listed in this Chapter's Specifications.

18 Refer to the appropriate Sections and install the oil pan, vibration damper and the crankshaft position sensor. Be sure to use a new O-ring on the crankshaft position sensor.

19 The remaining installation steps are the reverse of removal.

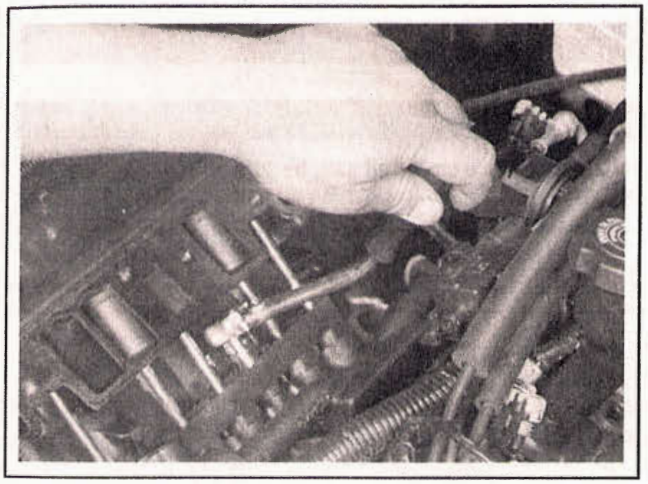
13 Camshaft and lifters - removal and installation

➡Note: The camshaft should always be thoroughly inspected before installation and camshaft endplay should always be checked prior to camshaft removal. Refer to Chapter 2C for the camshaft inspection procedures.

REMOVAL

▸ Refer to illustrations 13.2, 13.4 and 13.5

1 Refer to the appropriate Sections and remove the intake manifold, the rocker arms, the pushrods, the timing chain, camshaft sprocket and the balance shaft drive gear. The balance shaft drive gear can easily be removed after the camshaft sprocket and timing chain are removed. The fan shrouds, fan, radiator and condenser should be removed as well (see Chapter 3).



13.2 The roller lifters are held in place by a retainer - remove the four retainer bolts and remove the retainer

2 Before removing the lifters, arrange to store them in a clearly labeled box to ensure that they're reinstalled in their original locations. Remove the lifter retainer (see illustration). Remove the lifters and store them where they won't get dirty. DO NOT attempt to withdraw the camshaft with the lifters in place.

3 There are several ways to extract the lifters from the bores. A special tool designed to grip and remove lifters is manufactured by many tool companies and is widely available, but it may not be required in every case. On newer engines, without a lot of varnish buildup, the lifters can often be removed with a small magnet or even with your fingers. A machinist's scribe with a bent end can be used to pull the lifters out by positioning the point under the retainer ring in the top of each lifter.

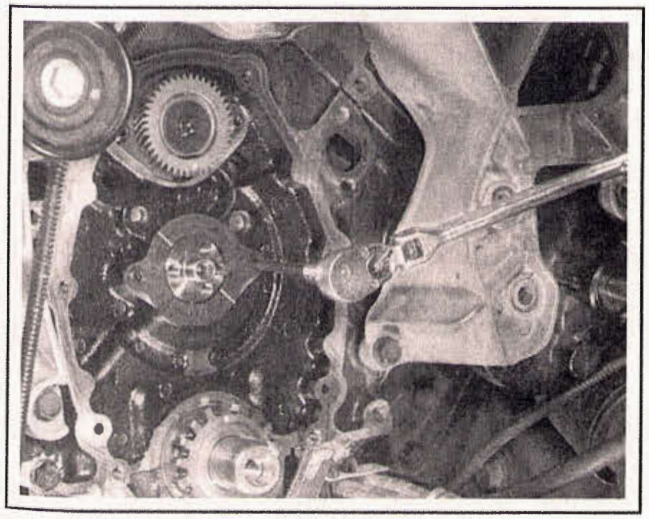
⁂ CAUTION:

Don't use pliers to remove the lifters unless you intend to replace them with new ones (along with the camshaft). The pliers will damage the precision machined and hardened lifters, rendering them useless.

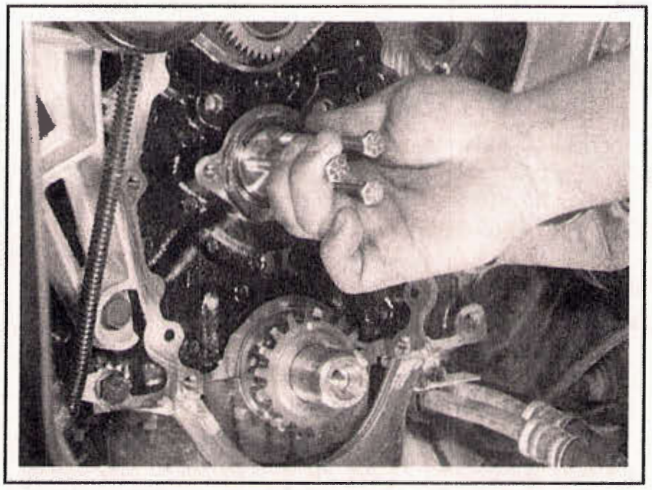
4 Remove the two Torx bolts and the camshaft retainer plate, noting which direction faces the block (see illustration).

5 Thread three 6-inch long, 5/16-18 bolts into the camshaft sprocket bolt holes to use as a "handle" when removing the camshaft from the block (see illustration).

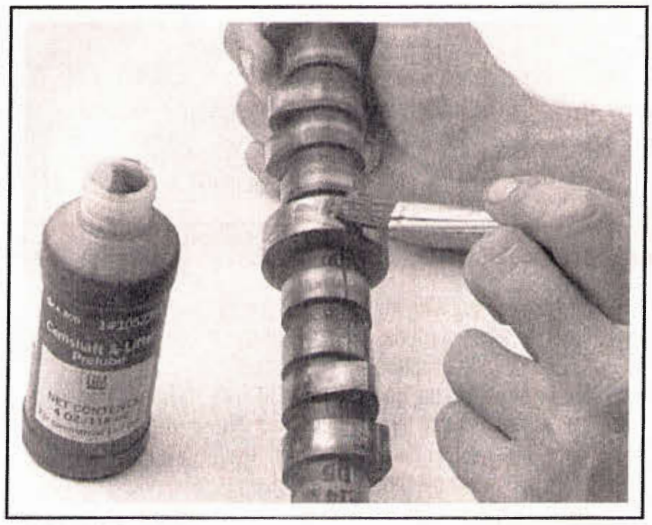
6 Carefully pull the camshaft out. Support the cam near the block so the lobes don't nick or gouge the bearings as it's withdrawn.



13.4 Remove the Torx bolts and take off the camshaft retainer plate, noting which side faces the block



13.5 Thread three long bolts into the camshaft to use as a handle - pull the camshaft straight out, without nicking the bearings



13.7 Lubricate the camshaft journals and lobes with camshaft and lifter assembly lube before installation to provide initial lubrication

INSTALLATION

Refer to illustration 13.7

7 Lubricate the camshaft bearing journals and cam lobes with camshaft and lifter assembly lube (see illustration).

8 Slide the camshaft into the engine. Support the cam near the block and be careful not to scrape or nick the bearings.

9 Turn the camshaft until the dowel pin is in the 3 o'clock position, install the camshaft thrust plate, then tighten the bolts to the torque listed in this Chapter's Specifications.

10 Install the balance shaft drive gear over the camshaft, aligning the dowel pin. Make sure the balance shaft timing marks are properly aligned (see illustration 12.12).

11 Install the timing chain and sprockets (see Section 12).

12 Lubricate the lifters with clean engine oil and install them in the block. If the original lifters are being reinstalled, be sure to return them to their original locations. If a new camshaft is being installed, install new lifters as well.

13 The remaining installation steps are the reverse of removal.

14 Before starting and running the engine, change the oil and install a new oil filter (see Chapter 1).

14 Oil pan - removal and installation

Refer to illustrations 14.16a and 14.16b

REMOVAL

1 Disconnect the cable from the negative terminal of the battery.

CAUTION:

On models equipped with a Delco Loc II audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery.

2 Raise the vehicle and support it securely on jackstands, then refer to Chapter 1 and drain the engine oil and remove the oil filter.

3 Remove the oil pan skid plate if equipped.

4 Remove the lower control arm crossmember from below the oil pan.

5 On 4WD vehicles remove the front differential carrier (see Chapter 8).

6 Disconnect the front exhaust Y pipe from the engine and the exhaust system and remove it from the vehicle. This step is not absolutely necessary, but it will help facilitate removal of the oil pan.

7 Remove the starter motor (see Chapter 5). Also remove the plastic bellhousing covers (see illustrations 8.8a and 8.8b in Chapter 7B).

8 Remove the battery cable bracket from the front of the oil pan and the bracket on the passenger side of the oil pan securing the transmission oil cooler lines (if equipped) and the starter motor wiring.

9 Disconnect the electrical connector from the oil level sensor.

10 Remove the transmission-to-oil pan bolts (see Chapter 7). On 2001 and later models, remove the four bolts and the frame crossbar.

11 Remove the access plugs covering the nuts at the rear of the oil pan.

12 Remove all the oil pan bolts, then lower the pan from the engine. The pan will probably stick to the engine, so strike the pan with a rubber mallet until it breaks the gasket seal.

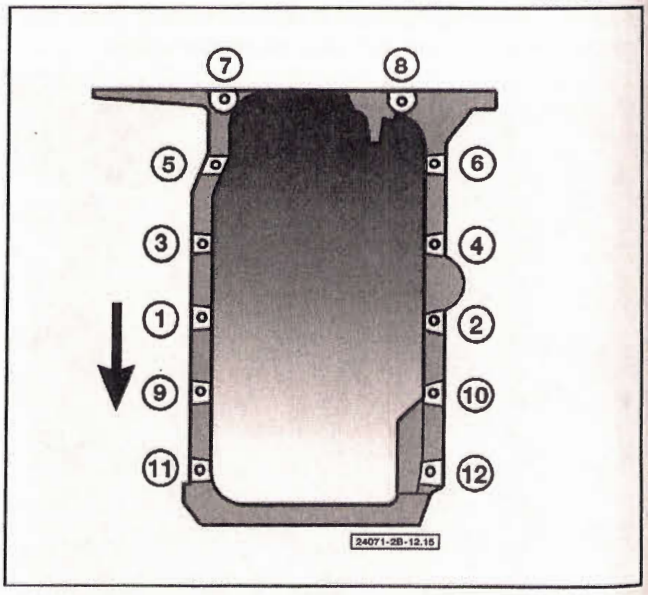
CAUTION:

Before using force on the oil pan, be sure all the bolts have been removed. Carefully slide the oil pan out, to the rear.

INSTALLATION

13 Wash out the oil pan with solvent.

14 Thoroughly clean the mounting surfaces of the oil pan and engine block of old gasket material and sealer. Wipe the gasket surfaces clean with a rag soaked in lacquer thinner or acetone.



14.16a Bolt tightening sequence for the cast aluminum oil pan

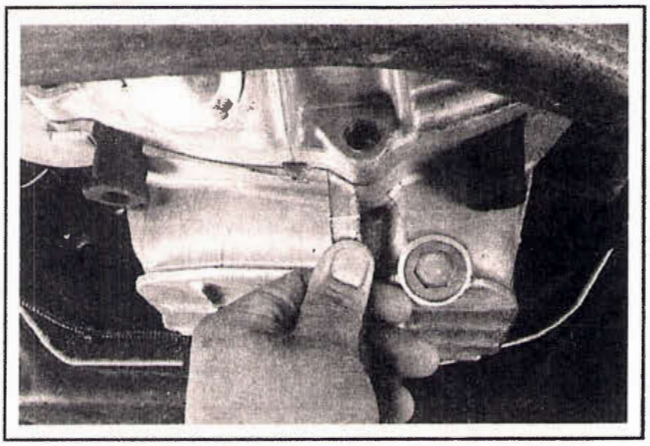
➡Note: On models with a low-oil-level sensor, remove the sensor and install a new sensor upon assembly.

15 Apply a 3/16-inch wide, one inch long bead of RTV sealant to the corners where the front cover meets the block and at the rear where the rear main cap meets the block. Then attach the new gasket to the pan, install the pan and tighten the bolts/studs finger-tight.

16 The alignment of the rear face of the aluminum pan to the rear of the block is important. Measure between the rear face of the pan and the front face of the transmission bellhousing with feeler gauges. Clearance should ideally be flush, but up to 0.011-inch is allowable. If the clearance is OK, tighten the pan bolts/studs in sequence to the torque listed in this Chapter's Specifications (see illustrations).

17 The remainder of installation is the reverse of removal.

18 Add the proper type and quantity of oil (see Chapter 1), start the engine and check for leaks before placing the vehicle back in service.



14.16b Before tightening the oil pan bolts, measure the gap between the bellhousing and the oil pan in three places - if the gap is greater than 0.011 the oil pan will have to move towards the bellhousing - ideally the oil pan should be flush with the bellhousing

15 Oil pump - removal and installation

1 Remove the oil pan (see Section 14).

2 While supporting the oil pump, remove the pump-to-rear main bearing cap bolt.

3 Lower the pump and remove it along with the pump driveshaft.

4 If a new oil pump is installed, make sure the pump driveshaft is mated with the shaft inside the pump and a new driveshaft retainer is used.

5 Position the pump over the dowel pins on the rear main cap and make sure the slot in the upper end of the driveshaft is aligned with the tang on the lower end of the distributor shaft. The distributor drives the oil pump, so it is absolutely essential that the components mate properly. Also note that no gasket is used between the oil pump and the rear main cap.

6 Install the mounting bolt and tighten it to the torque listed in this Chapter's Specifications.

7 Install the oil pan and refill the engine with fresh oil. The remainder of assembly is the reverse of the disassembly procedures.

16 Flywheel/driveplate - removal and installation

REMOVAL

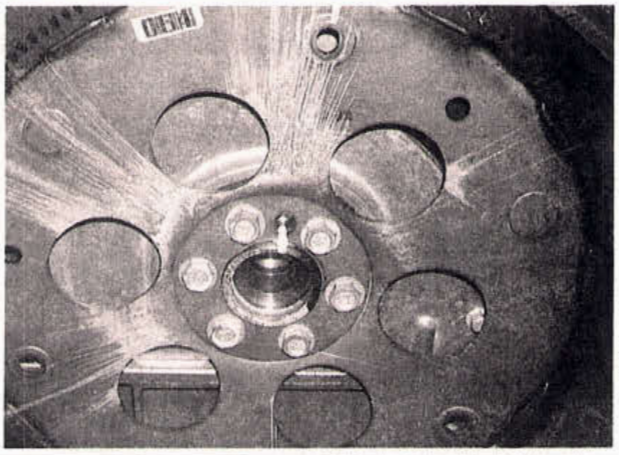
◗ Refer to illustration 16.2

1 Raise the vehicle and support it securely on jackstands, then refer to Chapter 7 and remove the transmission. If the vehicle is equipped with a manual transmission, remove the clutch components (see Chapter 8).

2 Mark the relationship between the flywheel/driveplate and the crankshaft with a marker or similar device, then remove the bolts that secure the flywheel/driveplate to the crankshaft (see illustration). If the crankshaft turns, wedge a screwdriver in the ring gear teeth to jam the flywheel/driveplate.

➡Note: If there is a retaining ring between the bolts and the driveplate, note which side faces the driveplate when removing it.

3 Remove the flywheel/driveplate from the crankshaft. Since the flywheel/driveplate is fairly heavy, be sure to support it while removing the last bolt.



16.2 Before removing the flywheel or driveplate, mark its relationship to the crankshaft

CAUTION:

When removing a flywheel, wear gloves to protect your fingers - the edges of the ring gear teeth may be sharp.

4 Clean the flywheel/driveplate to remove grease and oil. Inspect the surface for cracks, and check for cracked and broken ring gear teeth. Lay the driveplate on a flat surface to check for warpage.

5 Clean and inspect the mating surfaces of the flywheel/driveplate and the crankshaft. If the rear main oil seal is leaking, replace it before reinstalling the driveplate (see Section 17).

INSTALLATION

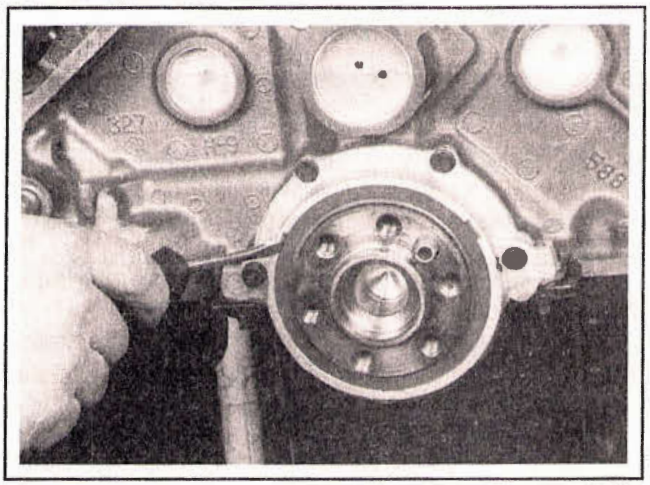
6 Position the flywheel/driveplate against the crankshaft. Be sure to align the marks made during removal. Note that some engines have an alignment dowel or staggered bolt holes to ensure correct installation. Before installing the bolts, apply thread locking compound to the threads and place the retaining ring (if equipped) in position on the flywheel/driveplate.

➡Note: If you're installing a new flywheel on a V6 engine with a manual transmission, be sure to remove the weights from the old flywheel and install them in the new flywheel in the exact positions from which they were removed from the old flywheel.

7 Wedge a screwdriver through the ring gear teeth to keep the flywheel/driveplate from turning as you tighten the bolts to the torque listed in this Chapter's Specifications. On vehicles equipped with automatic transmissions, if the front pump seal/O-ring leaking, now would be a very good time to replace it.

8 The remainder of installation is the reverse of the removal procedure.

17 Rear main oil seal - replacement



17.4 Carefully pry the old seal out

Refer to illustration 17.4

1 Remove the transmission (see Chapter 7).

2 Remove the flywheel/driveplate (see Section 16).

3 Inspect the oil seal, as well as the oil pan and engine block surface for signs of leakage. Sometimes an oil pan gasket leak can appear to be a rear oil seal leak.

4 Pry the oil seal from the block with a screwdriver (see illustration). Be careful not to nick or scratch the crankshaft or the seal bore. Thoroughly clean the seal bore in the block with a shop towel. Remove all traces of oil and dirt.

5 Lubricate the seal surface on the crankshaft with a very small amount engine oil. Install the seal over the end of the crankshaft (make sure the lips of the seal point toward the engine) and carefully tap it into place. A special aftermarket tool may be available at your local auto parts store. The tool just fits the diameter of the seal and, used with a hammer, drives the seal in.

➡Note: Do not drive it in any further than the original seal was installed.

6 Install the flywheel/driveplate (see Section 16).

7 Install the transmission (see Chapter 7).

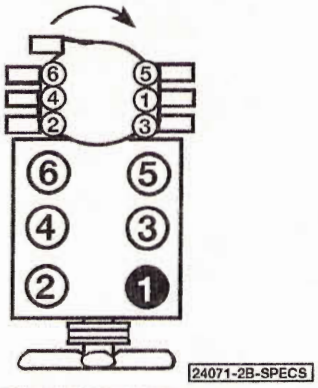
18 Engine mounts - check and replacement

The engine mount replacement for V6 engines is identical to the engine mount replacement procedure for the V8 engines. Refer to Chapter 2 Part B for the procedure and use the torque figures in this Chapter's Specifications.

Specifications

General

Displacement	262 cubic inches (4.3 liters)
Bore and stroke	4.012 x 3.480 inches
Cylinder numbers	
Left bank	1-3-5
Right bank	2-4-6
Firing order	1-6-5-4-3-2
Distributor rotation (viewed from above)	Clockwise



FIRING ORDER
1-6-5-4-3-2

Cylinder location and distributor rotation diagram

Camshaft

Journal diameter	1.8677 to 1.8696 inch
Endplay	0.0010 to 0.0090 inch
Lobe lift	
1999 through 2004 models	
Intake	0.274 to 0.278 inch
Exhaust	0.283 to 0.287 inch
2005 models	
Intake	0.270 inch
Exhaust	0.279 inch
Runout	
1999 through 2004 models	0.0026 inch
2005 models	0.0039 inch

Torque specifications — Ft-lbs (unless otherwise indicated)

Camshaft retainer bolt	106 in-lbs
Camshaft sprocket bolt	18
Crankshaft pulley bolts	43
Cylinder head bolts (in sequence - see illustration 9.22)	
Step 1 (all bolts)	22
Step 2	
Long bolts	Tighten an additional 75 degrees
Medium length bolts	Tighten an additional 65 degrees
Short bolts	Tighten an additional 55 degrees
Driveplate-to-crankshaft bolts	74
Flywheel-to-crankshaft bolts	74
Upper intake manifold stud	
Step 1	44 in-lbs
Step 2	80 in-lbs
Lifter retainer bolts	144 in-lbs
Lower intake manifold bolts	
Step 1	27 in-lbs
Step 2	106 in-lbs
Step 3	132 in-lbs
Exhaust manifold bolt/stud	
Step 1	132 in-lbs
Step 2	22

Torque specifications (continued) Ft-lbs (unless otherwise indicated)

Oil pan mounting bolt/nut	18
Oil pan baffle bolt	106 in-lbs
Oil pump mounting bolt	66
Rocker arm ballstud (2000 and earlier models)	35
Rocker arm nut(s) (2000 and earlier models)	18
Rocker arm bolts (2001 and later)	22
Valve cover-to-cylinder head bolts	106 in-lbs
Timing chain cover-to-block bolts	106 in-lbs
Vibration damper bolt	70