

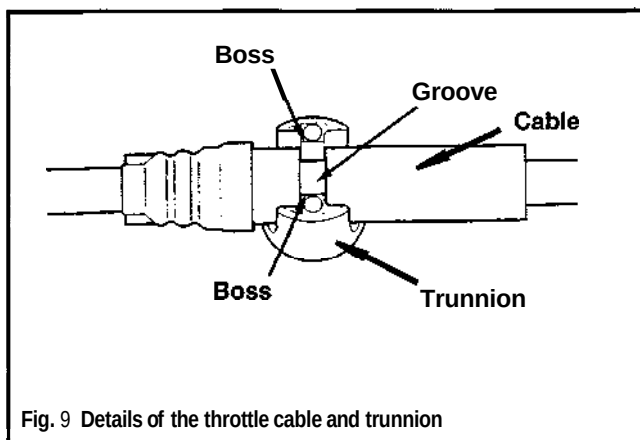


Fig. 9 Details of the throttle cable and trunnion

CAUTION

Always make certain that all switches and systems are turned OFF before reconnecting the battery cables.

Make sure all cables, wires and hoses are routed correctly before initially starting the engine.

30. Unplug the fuel line and pump/filter fitting and reconnect them. Remember to check for leaks as soon as you start the engine.
31. Install and adjust the throttle cable. For complete details, please refer to the Fuel System section):
 - a. Remember we asked you to determine if you had a "push-to-close" or "pull-to-open" throttle cable (the throttle arm stud)? Position the remote control handle in Neutral—the propeller should rotate freely.
 - b. Turn the propeller shaft and the shifter into the forward gear detent position and then move the shifter back toward the Neutral position halfway.
 - c. Position the trunnion over the groove in the throttle cable so the internal bosses align and then snap it into the groove until it is fully seated.
 - d. Install the trunnion/cable into the anchor block so the open side of the trunnion is against the block. Position the assembly onto the bracket over the original holes (they should be the lower two of the four holes) and then install the retaining bolt and nut. When the nut is securely against the back of the bracket, tighten the bolt securely.
 - e. Install the connector onto the throttle cable and then pull the connector until all end play is removed from the cable. Turn it sideways until the hole is in alignment with the correct stud on the throttle arm. Slide it over the stud and install the washer and a new cotter pin. Make sure the cable is on the same stud that it was removed from. Tighten the jam nut against the connector

On 1995-98 engines, the throttle arm connector nut must be installed on the cable with a minimum of 9 turns—meaning that at least 114 in. of thread should be showing between the end of the cable and the edge of the nut.

32. Install and adjust the shift cables. Please refer to the Drive Systems section for further details.
33. Check and refill all fluids. Start the engine and check for any fuel or coolant leaks. Go have fun!

DETERMINING MINIMUM ENGINE HEIGHT

1995-98 Engines

◆ See Figure 11

This procedure MUST be performed prior to removing the engine from the vessel.

1. With the engine compartment open, position a long level across the transom running fore and aft.
2. Have a friend or assistant steady the level while you measure from the bottom edge of the tool to the top of the exhaust elbow. Record the distance as "1".

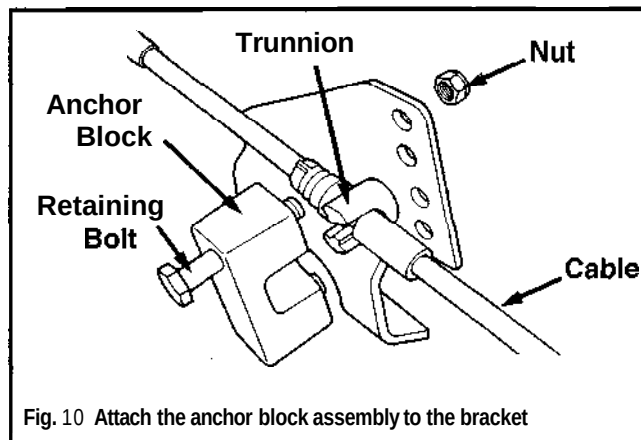


Fig. 10 Attach the anchor block assembly to the bracket

3. Now measure from the bottom of the level to the static water line on the drive unit. Record the distance as "2".

4. Subtract the elbow measurement (1) from the static waterline measurement (2). If the result is less than 9 in. (228mm), an exhaust elbow high rise kit must be installed (available from your local parts supplier).

ENGINE ALIGNMENT



◆ See Figures 12 and 13

Engine alignment is imperative for correct engine installation and also for continued engine and drive operation. It is a good idea to ensure proper alignment every time that the drive or engine have been removed. Engine alignment is checked by using OMC alignment tool #912273 and handle #311880 (Volvo #3851083-0 and #3850609-31). Engine alignment is adjusted by raising or lowering the front engine mount(s).

1. With the drive unit off the vessel, slide the alignment tool through the gimbal bearing and into the engine coupler. It should slide easily, with no binding or force. If not, check the gimbal bearing alignment as detailed in the Drive Systems section. If bearing alignment is correct, move to the next step.
2. If your engine utilizes a jam nut on the bottom of the mount bolt, loosen it and back it off at least 1/2 in.
3. Loosen the lock nut and back it off.
4. Now, determine if the engine requires raising or lowering to facilitate alignment—remember, the alignment tool should still be in position. Tighten or loosen the adjusting nut until the new engine height allows the alignment tool to slide freely.
5. Hold the adjusting nut with a wrench and then tighten the lock nut to 115-140 ft. lbs. (156-190 Nm). If your engine uses a jam nut, cinch it up against the lock nut.
6. Remove the alignment tool and handle.

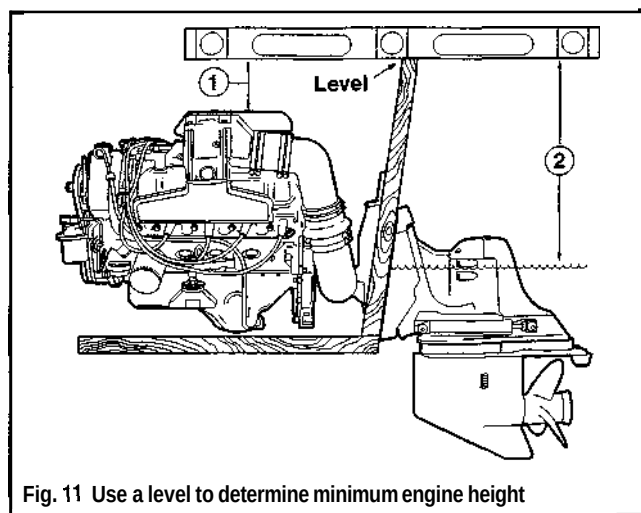


Fig. 11 Use a level to determine minimum engine height

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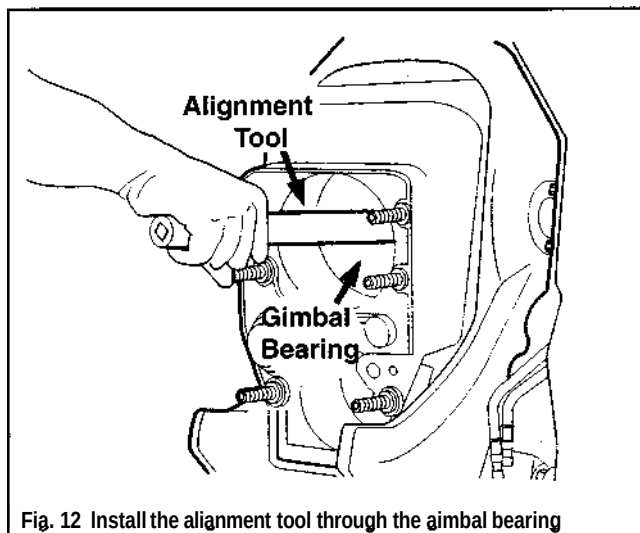


Fig. 12 Install the alignment tool through the gimbal bearing

Front Engine Mount

REMOVAL & INSTALLATION

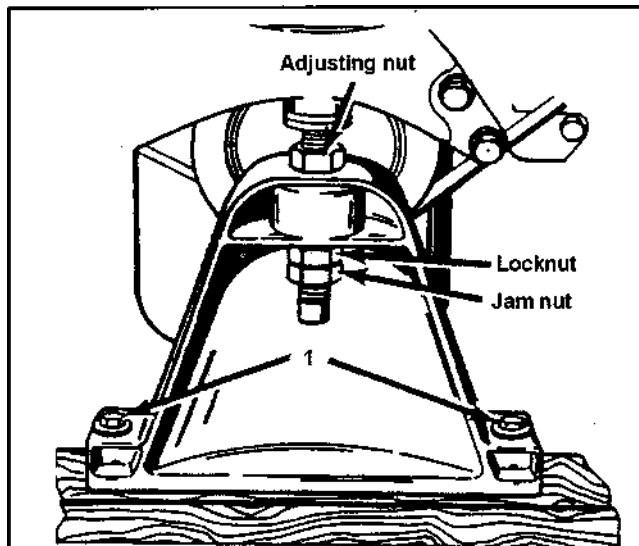
◆ See Figure 13



1. Position an engine hoist over the engine and hook it up to the two engine lifting eyes
2. Remove the two lag bolts on each side of the mount where it rests on the stringer
3. Raise the engine just enough to allow working room for removing the mount
4. Remove the four mount-to-engine mounting bolts with their lock washers and lift out the mount. Don't forget the spacer on the port side
5. Measure the distance between the bottom of the large washer on the lower side of the mounting bracket and the upper side of the smaller washer on top of the mount itself. Record it.
6. Position an open end wrench over the adjusting shaft just underneath the bracket to hold the shaft and then remove the top nut. Lift off the bracket and the spacer
7. Remove the two bolts attaching the rubber mount to the upper bracket and remove it
8. Remove the lower lock nut from the adjusting shaft and lift the shaft out of the lower mount. Some applications may have a jam nut under the locknut

To install:

9. Drop the adjusting shaft into the lower mount and spin on the lower locknut until it is fingertight
10. Slide the spacer over the top end of the shaft
11. Position the rubber mount back into the upper bracket and tighten the bolts to 30-35 ft. lbs. (41-47 Nm)
12. Position the upper bracket over the adjusting shaft and then tighten the upper nut to 50-60 ft. lbs. (68-81 Nm)
13. Position the assembly onto the engine, hold the spacer in place and install the two long bolts on the port side. Install the two shorter bolts into the starboard side. We suggest using new lock washers here. Tighten the long bolts to 48-56 ft. lbs. (65-76 Nm) and the short bolts to 32-40 ft. lbs. (43-54 Nm)
14. Retrieve the measurement you took earlier and check it now. Loosen the lower locknut and rotate the adjusting shaft until you achieve the correct distance between the two washers. Once this is done, cinch up the lower locknut until it is tight against the lower surface of the lower mount and then tighten the adjusting nut to 115-140 ft. lbs. (156-190 Nm)
15. Position the mount over the lag screw holes and then slowly lower the engine until all weight is off the hoist. Install and tighten the lag screws securely
16. If you're confident that your measurements and subsequent adjustment place the engine exactly where it was prior to removal, then you are through. If you're like us though, you may want to check the engine alignment before you fire up the engine



1- Lag bolts and flat washers

Fig. 13 A good view of the front engine mount—not all engines utilize the jam nut

Rear Engine Mounts

REMOVAL & INSTALLATION



1. Remove the engine as previously detailed.
2. Loosen the two bolts and remove the mount from the transom plate.
3. Hold the square nut with a wrench and remove the shaft bolt. Be sure to take note of the style and positioning of the two mount washers as you are removing the bolt. Mark them, lay them out, or write it down, but don't forget their orientation!!

To install

4. Slide the lower of the two washers onto the mount bolt, exactly as it came off.
5. Slide the bolt into the flat side of the rubber mount, install the remaining washer (as it came off) and then spin on the square nut. Do not tighten it yet.

❑ **Incorrect washer installation will cause excessive vibration during engine operation.**

6. Turn the assembly upside down and clamp the nut in a vise. Spin the assembly until the holes in the mounting plate are directly opposite any two of the flat sides on the nut. This is important, otherwise the slot on the engine pad will not engage the mount correctly. Secure the mount in this position and tighten the bolt to 18-20 ft. lbs. (24-27 Nm) on 1986-88 engines, or 44-52 ft. lbs. (60-71 Nm) on 1989-98 engines.

7. Remove the mount from the vise and position it on the transom plate. Install the bolts and washers and tighten each to 20-25 ft. lbs. (27-34 Nm).

8. Install the engine, making sure that the slot in the engine pad engages the square nut correctly. Install the two washers and locknut and tighten it to 28-30 ft. lbs. (38-41 Nm).

Cylinder Head (Valve) Cover

REMOVAL & INSTALLATION



1. Open or remove the engine compartment hatch. Disconnect the negative battery cable.
2. Loosen the clamp and remove the crankcase ventilation hose at the cover (if equipped). Carefully move it out of the way.
3. Tag and disconnect the shift cut-out switch leads at the terminal block.
4. If your engine has a spark plug wire retainer attached to the cover, unclip the wires or remove the retainer.

5. Remove the fuel line at the pump and plug it, and the fitting, to avoid spills and system contamination. Remove the overflow hose also, plugging it and moving it out of the way. Have some rags nearby, as there will be some seepage either way. Move the line out of the way of the cover.

6. Remove the circuit breaker bracket and carefully position it out of the way.

7. Loosen the cover mounting bolts and lift off the cylinder head cover. Take note of any harness or hose retainers and clips that might be attached to certain of the mounting bolts; you need to make sure they go back in the same place.

To install:

8. Clean the cylinder head and cover mounting surfaces of any residual gasket material with a scraper or putty knife.

9. Position a new gasket on the cylinder head and then position the cover (don't forget the J-clips!). Tighten the mounting bolts to 45 inch lbs. (5 Nm) on 1986-93 engines, or 65 inch lbs. (7.3 Nm) on 1994-98 engines. Make sure any retainers or clips that were removed are back in their original positions.

10. Reconnect the fuel line to the pump. Check for leaks now, and after you restart the engine.

11. Connect the crankcase ventilation hose and the cut-out switch leads. Check that there were no other wires or hoses you may have repositioned in order to gain access to the cover.

12. Connect the battery cables.

Rocker Arms and Push Rods

REMOVAL & INSTALLATION

◆ See Figure 14



1. Open or remove the engine hatch cover and disconnect the negative battery cable. Remove the cylinder head cover as detailed previously.

2. Bring the piston in the No. 1 cylinder to TDC. If servicing only one arm, bring the piston in that cylinder to TDC. The No. 1 cylinder is the first cylinder at the front of the engine.

3. Loosen and remove the rocker arm nuts and lift out the balls. Lift the arm itself off of the mounting stud and pull out the pushrod. It is very important to keep each cylinder's component parts together as an assembly. We suggest drilling a set of holes in a 2X4 and positioning the pieces in the holes.

To install:

4. Clean and inspect the rocker assemblies.

5. Coat all bearing surfaces of the rocker assembly with engine oil.

6. Slide the push rods into their holes. Make sure that each rod seats in its socket on the lifter.

7. Position the rocker arm over the stud so that the cupped side rides on the push rod. Slide the ball over the stud, install the nut and tighten it securely, or until all play in the push rod is taken up.

8. Adjust the valves and install the cylinder head cover.

9. Connect the battery cable and check the idle speed.

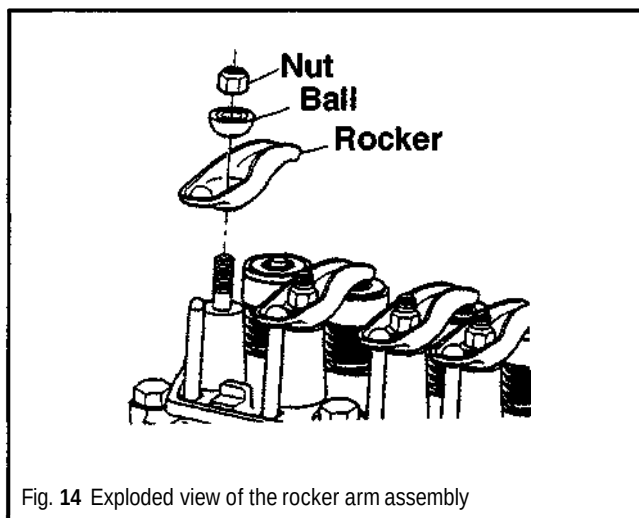


Fig. 14 Exploded view of the rocker arm assembly

VALVE ADJUSTMENT

◆ See Figure 15



CAUTION

OMC recommends adjusting the valves while the engine is cold and while the engine is OFF.

These engines utilize hydraulic valve lifters, although there is no need for periodic valve adjustment, it is necessary to perform a preliminary adjustment after any work on the valve train/rocker assembly. All adjustment should be undertaken while the lifter is on the base circle of the camshaft lobe for that particular cylinder. This means the opposite side of the pointy part of each lobe.

1. Rotate the crankshaft, or bump the engine with the starter until the No. 1 cylinder is at TDC of the compression stroke—remember, this is the first cylinder at the front of the engine). Both lifters should be on the base circle of the camshaft. Note that the notch or mark on the damper pulley will be lined up with the 0 mark on the timing scale. Be careful here though, this could mean that either the No. 1 or the No. 4 piston is at TDC. Place your hand on the No. 1 cylinder's valve and check that it does not move as the mark on the pulley is approaching the 0 mark on the tab. If it does not move, you're ready to proceed; if it does move, you are on the No. 4 cylinder and need to rotate the engine an additional full turn (360°). This is important so make sure you've gotten it right!

Another method is to mark the position of the No. 1 cylinder's terminal on the distributor; do this on the body of the distributor because you're about to remove the cap. Remove the distributor cap and bump the engine over with the starter until rotor points to the mark you made previously for the No. 1 cylinder terminal. Once again, you're at TDC on the compression stroke.

2. Now that the No. 1 cylinder is at TDC, you can adjust both valves. Loosen the adjusting nut on the rocker until you can feel lash (play in the push rod) and then tighten the nut until the lash has been removed. Carefully jiggle the push rod while tightening the nut until it won't move anymore—this is zero lash. Tighten the nut an additional full turn to set the lifter and then you're done. Perform this procedure on each of the valves for this cylinder.

3. Perform the first two steps on the remaining cylinders in the proper order (2-4, front to back), setting the respective piston for each cylinder at TDC.

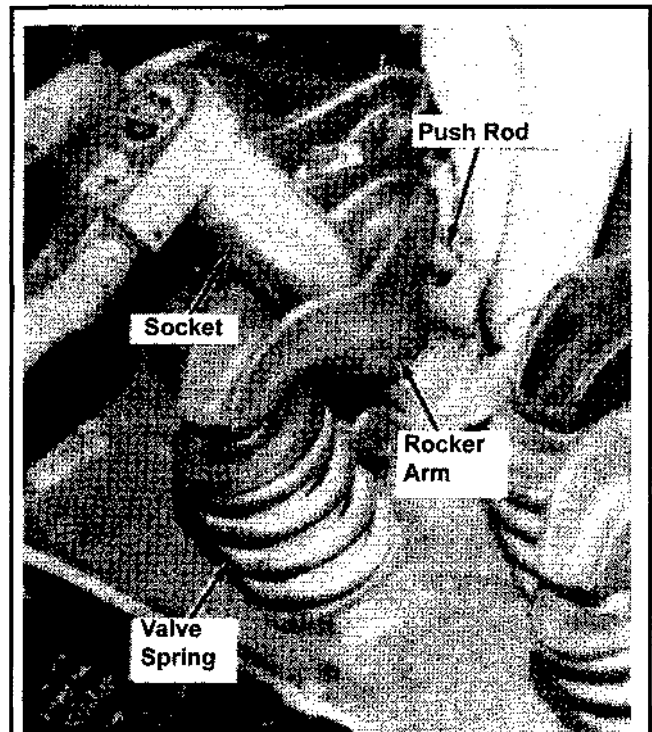


Fig. 15 Wiggle the push rod slowly while tightening the rocker adjusting nut

4-8 ENGINE MECHANICAL – GM 4 CYLINDER ENGINES

Hydraulic Valve Lifter

REMOVAL & INSTALLATION

1. Remove the cylinder head cover.
2. Using compressed air, thoroughly clean all dirt and grit from the cylinder head and related components.



❖❖ WARNING

If compressed air is not available, we highly recommend that you DO NOT proceed with this procedure. It is EXTREMELY important that no dirt gets into the lifter recesses before completing the installation.

3. Loosen the rocker arms and pivot the rockers off of the pushrods.
4. Disconnect the spark plug wires at the plugs.
5. Remove the high tension lead at the coil. Tag and disconnect both electrical connectors and then remove the coil and its bracket from the cylinder head.
6. Remove the distributor cap and mark the position of the rotor on the body of the distributor housing. Matchmark the distributor housing to the cylinder block and then remove the distributor, covering the hole carefully.
7. Remove the pushrod cover and gasket from the side of the cylinder block. On most later models, this will require removing the shift bracket assembly and moving it aside.
8. Remove the pushrods and lifters from the block, being very careful to keep track of where each one came from. Once again, we suggest using a 2x4 with holes drilled in it to store the rods and lifters; you'd be amazed at how quickly this job will fall apart if someone walks in and kicks the components that you have laid out on the floor!

To install:

9. Inspect the camshaft contact surface on the bottom of each lifter for excessive wear, galling or other damage. Discard the lifter if any of the above conditions are found. You'll probably also want to check out the camshaft lobe for damage also.
10. Coat the bottom of each lifter with Molykote® and then carefully install each one into its respective recess.
11. Install the pushrods and then install the pushrod cover with a new gasket. Tighten the retaining bolts securely. If you removed the shift bracket previously, install it now.
12. Install the distributor so the marks on the housing and block are in alignment. Confirm that the rotor orientation mark made on the housing still aligns with the direction that the rotor is pointing. If not, or if the engine has been rotated for some reason during this procedure, please refer to the Ignition System section for complete details.
13. Install the distributor cap.
14. Install the coil and its bracket. Reconnect all plug wires and electrical leads.
15. Move the rockers into position and then adjust the valve lash as detailed previously.
16. Install the cylinder head cover.

❖❖ CAUTION

If any, or all, of the lifters has been replaced with a new one it is very important that you add GM Engine Oil Supplement to the crankcase BEFORE starting the engine.

Combination Manifold

These engines incorporate the intake and exhaust manifolds into one unit called a combination manifold. It is serviced as a unit.

REMOVAL & INSTALLATION

◆ See Figure 16



1. Open or remove the engine compartment hatch. Disconnect the negative battery cable.
2. Drain all water from the engine, manifold and exhaust elbow as detailed in the Maintenance section.
3. Remove the flame arrestor and set it aside.

4. Disconnect the throttle cable from the carburetor, remove the anchor bolt and position the cable out of the way. Mark which anchor stud the cable was attached to for installation.
5. Disconnect the fuel line at the carburetor and fuel pump. Plug the pump inlet fitting. Make sure you have some rags handy to mop up the inevitable spill.
6. Remove the carburetor as detailed in the Fuel System section.
7. Remove the crankcase ventilation hose. Tag and disconnect any vacuum or electrical lines and then remove the carburetor.
8. Disconnect the shift cables.
9. Disconnect the water inlet line from the thermostat housing.
10. Remove the alternator and its mounting bracket as detailed in the Charging System section.

On certain early engines without power steering, it may not be necessary to remove the alternator.

11. Tag and disconnect any wires or hoses that may interfere with manifold removal.
12. Loosen the clamps and slide the exhaust pipe bellows off of the high rise elbow. Remove the mounting bolts (or nuts) and lift the elbow off of the manifold along with the throttle linkage plate.
13. If equipped, remove the oil cooler and mounting bracket.
14. Loosen and remove the manifold mounting bolts (4) and nuts (2) from the center outward and remove the manifold from the cylinder head—you may have to provide a little friendly persuasion.

To install:

15. Carefully clean all residual gasket material from the head, manifold and elbow mating surfaces with a scraper or putty knife. Inspect all gasket surfaces for scratches, cuts or other imperfections.
16. Position a new gasket on the cylinder head and install the manifold; making sure that everything is aligned properly. Tighten all bolts/nuts until they are just tight and then torque them to 20-25 ft. lbs. (27-34 Nm), starting in the center and alternately working your way out to the ends of the manifold.
17. Position a new gasket coated with sealer on the manifold, making sure that the indents line up and then install the elbow. You may also have an additional gasket and a restrictor plate on some models. Tighten the mounting bolts/nuts to 12-14 ft. lbs. (16-19 Nm). Connect the exhaust pipe/bellows and tighten the clamps securely.
18. Connect the water inlet line and the shift cables.
19. Install the carburetor with a new gasket and reconnect the throttle cable, choke wire and any vacuum lines. Remember which anchor stud the throttle was attached to.
20. Connect the fuel line to the carb and the fuel pump (remember to unplug the pump fitting) and then install the flame arrestor.
21. Install the alternator; tighten the alternator and bracket bolts to 26-30 ft. lbs. (35-41 Nm). Install the oil cooler if removed.
22. Make sure that any miscellaneous lines or hoses that you may have moved or disconnected during removal are reconnected and routed properly.
23. Fill the system with water, connect the battery cable and start the engine. When the engine reaches normal operating temperature, turn it off and re-torque the manifold bolts.

Exhaust Elbow

REMOVAL & INSTALLATION

◆ See Figure 16

1. Drain the cooling system.
2. Loosen the hose clamps and slide off the exhaust hose (bellows).
3. Reach into the open end of the elbow and loosen the hose clamp to disconnect the coolant hose if so equipped. Remove the hose and fitting, positioning them out of the way.
4. Disconnect the throttle cable from the arm and anchor bracket. Position it out of the way.
5. Remove the two bolts or nuts on the forward side of the elbow mating flange and swing the throttle cable anchor bracket out of the way.
6. Remove the two nuts/bolts and washers from the rear side of the elbow and lift it off the manifold. A little friendly persuasion with a soft rubber mallet may be necessary! Be careful though, no need to take out all your aggressions on the poor thing.
7. Remove the gasket(s) and restrictor plate (if equipped). You can throw away the gasket(s), but keep the plate if your engine uses it.

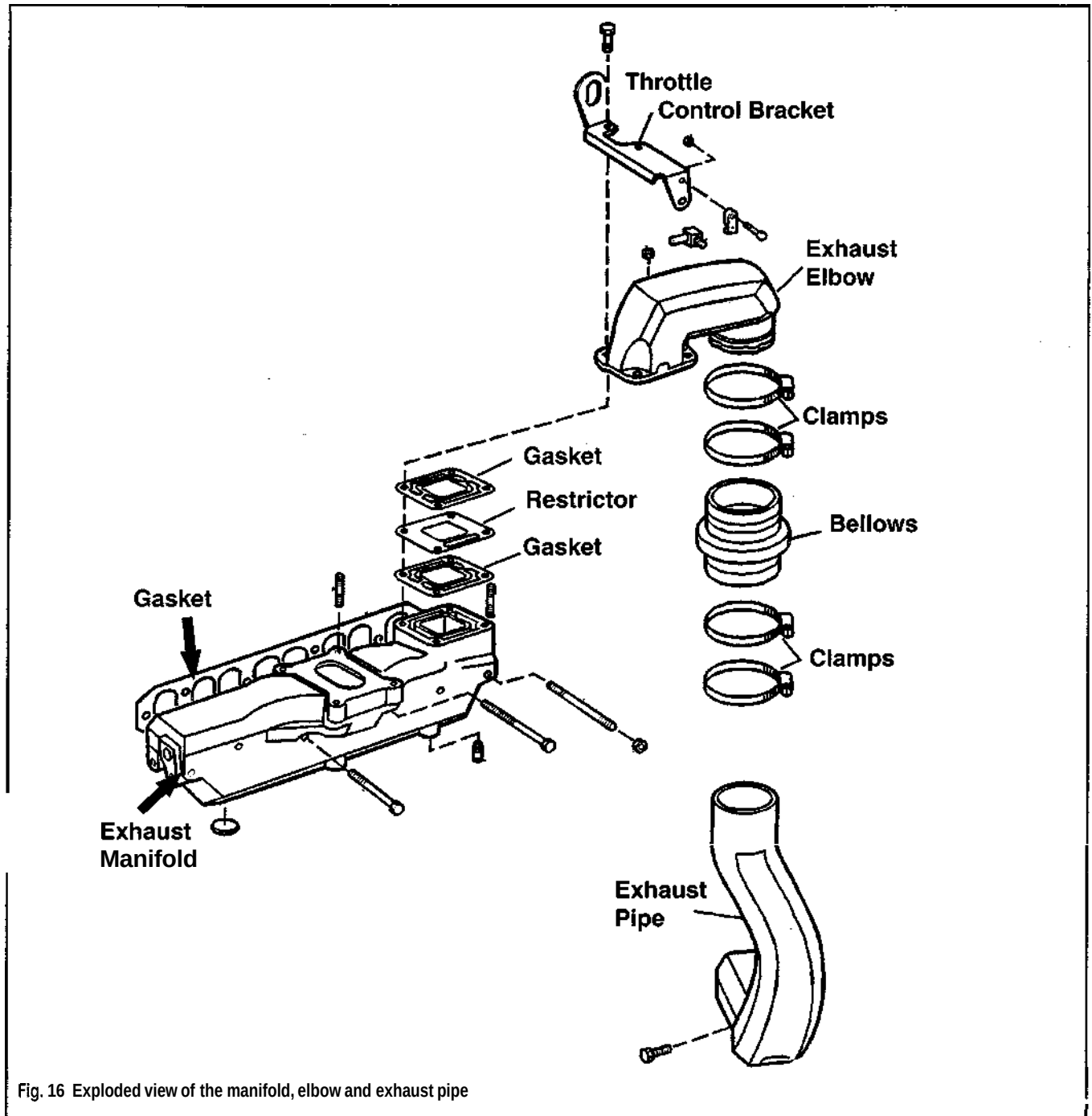


Fig. 16 Exploded view of the manifold, elbow and exhaust pipe

To install:

8. Clean the mating surfaces of the manifold and elbow thoroughly, coat both sides of a new gasket with Gasket Sealing compound and position it onto the manifold flange.
9. If your engine was so equipped, position the restrictor plate and/or second gasket onto the manifold. Don't forget to coat the gasket with sealing compound.
10. Position the elbow on the manifold, install the anchor bracket and screw the two bolts/nuts in finger tight. Install the remaining two bolts/nuts with new lock washers and then tighten all four to 12-14 ft lbs (16-19 Nm).
11. Connect the coolant hose into the elbow and tighten the clamp.
12. Slide the exhaust hose, while wiggling it, all the way onto the elbow and tighten the clamp screws securely.
13. Reconnect the throttle cable.

Exhaust Hose (Bellows)

REMOVAL & INSTALLATION

◆ See Figures 16, 17, 18 and 19

1. Loosen all four hose clamps, two on top of the hose and two on the bottom.
2. Drizzle a soapy water solution over the top of hose where it mates with the exhaust elbow and let it sit for a minute.
3. Grasp the hose with both hands and wiggle it side-to-side while pulling down on it until it separates from the elbow.
4. Now wiggle it while pulling upwards until it pops off the exhaust pipe. Make sure that you secure the exhaust pipe while pulling off the hose.



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5. Check the hose for wear, cracks and deterioration.
6. Coat the inside of the lower end of the hose with soapy water and wiggle it into position on the pipe. Remember to install the two clamps before sliding it over the end of the pipe.

■ **There are usually two ribs on one end of the hose--this is the side that attaches to the exhaust elbow. Do not position this end onto the exhaust pipe.**

7. Slide two clamps over the upper end (the side with two ribs!), lubricate the inside with soapy water and wiggle the hose over the elbow until it is in position.
8. Tighten all four clamps securely.

Exhaust Pipe

REMOVAL & INSTALLATION

◆ See Figure 16



1. It is unlikely you will be able to get the pipe off **without removing the engine**, so remove the engine as previously detailed.
2. Loosen the four retaining bolts at the transom shield and then remove the exhaust pipe. Carefully scrape any remnants of the seal from the pipe and transom mounting surfaces.

■ **The pipe mounting holes in the transom shield utilize Heli-Coil® locking inserts. NEVER clean the holes or threads with a tapping tool or you risk damaging the locking feature of the threads.**

3. Coat a new seal with OMC Adhesive M or 3M Scotch Grip Rubber Adhesive and position it into the groove on the transom shield mating surface.
4. Coat the mounting bolts with Gasket Sealing Adhesive. Position the exhaust pipe, insert the bolts and tighten them to 10-12 ft. lbs. (14-16 Nm) on 1986-89 engines; or 20-25 ft. lbs. (27-34 Nm) on 1990-98 engines.

■ **Make sure that the trim/tilt lines are routed correctly (above and behind) before tightening the pipe to the transom.**

5. Install the engine.

EXHAUST VALVE (FLAPPER) REPLACEMENT



1. Remove the exhaust hose from the elbow and exhaust pipe. The flapper is located in the upper end of the pipe.
2. The valve is held in place by means of a pin running through two bushings in the sides of the pipe. Position a small punch over one end of the pin and carefully press the pin out of the pipe.

□ **Make sure you secure the valve while removing the retaining pin so it doesn't fall down into the exhaust pipe.**

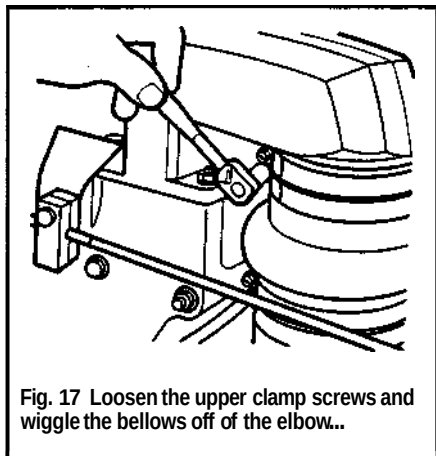


Fig. 17 Loosen the upper clamp screws and wiggle the bellows off of the elbow...

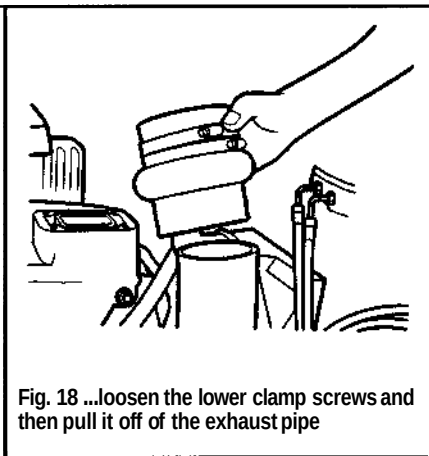


Fig. 18 ...loosen the lower clamp screws and then pull it off of the exhaust pipe

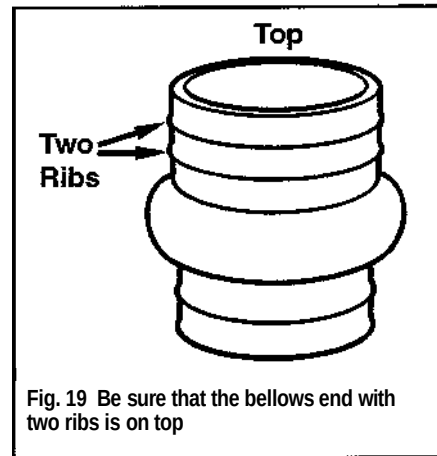


Fig. 19 Be sure that the bellows end with two ribs is on top

3. Press out the two bushings and discard them. Coat two new bushings with Scotch Grip Rubber Adhesive and press them back into the sides of the pipe.

4. Position the new valve into the pipe with the long side DOWN. When looking at the valve, the molded retaining rings are off-center—the side with the rings should face the top of the pipe. When the valve is in place, coat the pin lightly with engine oil and slowly slide it through one of the bushings, through the two retaining holes on the valve and then through the opposite bushing. Make sure the pin ends are flush with the sides of the pipe on both sides.

5. Install the exhaust hose.

Oil Pan

REMOVAL & INSTALLATION

4 See Figure 20



■ **More times than not this procedure will require the removal of the engine. Your boat and its unique engine installation will determine this, but the procedure is almost always easier with the engine removed from the boat.**

1. Remove the engine as previously detailed in this section.
2. If you haven't already drained the engine oil, do it now. Make sure you have a container and lots of rags available.
3. Remove the starter motor as detailed in the Electrical section. Although not absolutely necessary, this step will make the job much easier.
4. Remove the oil withdrawal tube from the oil drain plug fitting.
5. Loosen and remove the oil pan retaining bolts and nuts, starting with the center bolts and working out toward the pan ends. Lightly tap the pan with a rubber mallet to break the seal and then lift it off the cylinder block. If your engine stand will allow for rotating the engine, you'll find that this will be easier with the pan facing up.

To install:

6. Clean the pan mating surfaces of any residual gasket material with a scraper or putty knife. Make sure that no old gasket material has been pressed into the retaining bolt holes in the pan, block or front cover. Clean the pan itself thoroughly with solvent.
7. Coat a new gasket with RTV sealant and then position the gasket onto the pan being very careful to line up all the holes.
8. Move the pan and gasket onto the block. It is very important that you ensure all the holes line up correctly; sometimes a few bolts inserted through the pan and gasket will help the gasket stay in place.
9. Install all bolts and nuts finger tight and then tighten the 1/4-20 bolts to 80 inch lbs. (9 Nm) and the 5/16-18 bolts to 165 inch lbs. (19 Nm). Remember, on all engines, to start with the center bolts and work outward toward the ends of the pan.
10. Install the oil drain fitting and finger tighten the bolt. Rotate the fitting and then attach the withdrawal tube. Tighten the fitting bolt and flare nut to 15-18 ft. lbs. (20-24 Nm).
11. Install the starter motor and then install the engine (if removed). Run the engine up to normal operating temperature, shut it off and check the pan for any leaks.

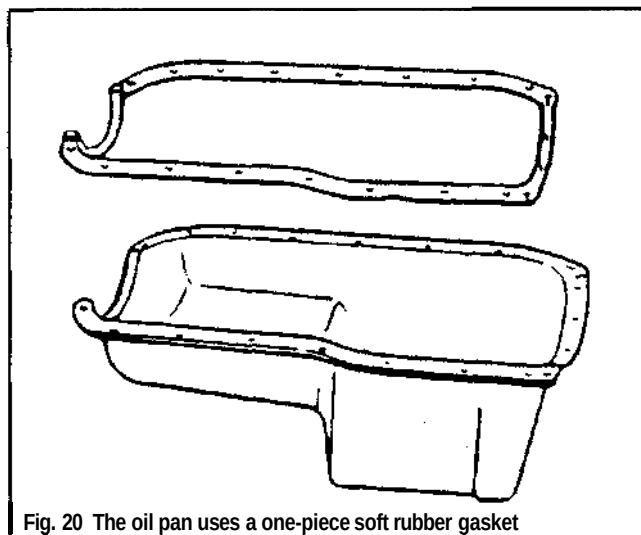


Fig. 20 The oil pan uses a one-piece soft rubber gasket

Oil Pump

The two-piece oil pump utilizes two pump gears and a pressure relief valve. A baffled pick-up tube is press-fit into the body of the pump. The pump is driven via the distributor shaft which is itself driven from a gear on the camshaft.

REMOVAL & INSTALLATION

◆ See Figure 21



1. Remove the oil pan as previously detailed. Remember that you probably need to remove the engine for this procedure.
2. Loosen and remove the pump pick-up tube support bracket bolt. The tube is pressed into the pump housing and should not be removed unless replacement is necessary.
3. Loosen and remove the two pump mounting bolts and lift off the pump assembly.
4. Check that the pump and block mating surfaces are clean and then position the pump over the block so that the pump drive shaft slot is aligned with the distributor tang. Make sure that the flange covers the alignment bushing. Do not use a gasket or RTV sealant.
5. Tighten the pump mounting bolts to 110-120 inch lbs. (12-14 Nm). Position the pick-up tube bracket and tighten the bolt to 60 inch lbs. (7 Nm).
6. Install the oil pan and engine.

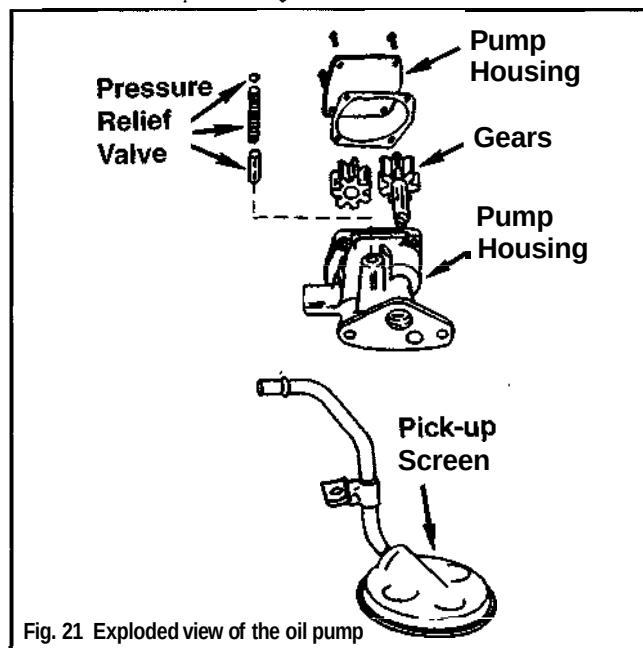


Fig. 21 Exploded view of the oil pump

Oil Filter Bypass Valve

After removing the oil filter, check the spring and small fiber valve for proper operation. Any signs of incorrect operation, or wear and deterioration will necessitate replacement.

REMOVAL & INSTALLATION



1. Drain the oil as detailed in the Maintenance section.
2. Remove the oil filter.
3. Using a small prybar, remove the valve.
4. Install a new valve and press it in by placing a 9116 in. deep socket over it and tapping the socket lightly with a hammer.
5. Install the oil filter and refill the engine with the appropriate oil.

Engine Coupler And Flywheel

REMOVAL & INSTALLATION

◆ See Figures 22, 23 and 24



1. Remove the engine from the boat as detailed previously in this section.
2. Although not strictly necessary, we recommend removing the starter.
3. Remove the 4 or 5 mounting bolts and slide out the flywheel housing cover.
4. Loosen and remove any connections attached to either of the ground studs on each side of the flywheel. Move the electrical leads out of the way.
5. Remove the ESA module/shift bracket and position it out of the way on early models. On later models, remove the mounting bolts for the 10-pin connector and relay, and then move the bracket out of the way.
6. Cut the plastic tie that secures the housing drain hose (if equipped) and the pull the hose out of the fitting.
7. Loosen the remaining retaining bolts (some of which were already removed with the shift bracket) for the flywheel housing and remove it. Take note of the positioning of any clamps so they may be installed in the same position.
8. Slide a wrench behind the coupler and loosen the six flywheel mounting nuts gradually and as you would the lug nuts on your car or truck—that is, in a diagonal star pattern.
9. Remove the coupler and then the flywheel.

To install:

10. Thoroughly clean the flywheel mating surface and check it for any nicks, cracks or gouges. Check for any broken teeth.
11. Install the flywheel over the dowel on the crankshaft.
12. Slide the coupler over the studs so that it sits in the recess on the flywheel. Install new lock washers and tighten the mounting bolts to 40-45 ft. lbs. (54-61 Nm). Once again use the star pattern while tightening the bolts.
13. Position the flywheel housing and the shift bracket. Make sure that the clamps are in their original positions and insert the mounting bolts. Tighten them to 28-36 ft. lbs. (38-49 Nm).
14. Install the washer, lock washer and inner nut on the ground stud and tighten it to 20-25 ft. lbs. (27-34 Nm) on 1986-93 engines, or 35-40 ft. lbs. (47-54 Nm) on 1994-98 engines. Attach the electrical leads, install another lock washer and then tighten the outer nut securely.
15. Slide the lower flywheel cover into place and tighten the bolts to 60-84 inch lbs. (7-9 Nm).
16. Attach the drain hose with a new plastic tie.
17. Install the starter and engine.

Rear Main Oil Seal

REMOVAL & INSTALLATION

Two Piece Oil Seal (1986-90)

+ See Figures 25, 26 and 27

These engines utilize a two-piece rear main seal. The seal can be removed without removing the crankshaft. You will need to remove the engine for this procedure though.

1. Remove the engine as detailed previously in this section.

4-12 ENGINE MECHANICAL – GM 4 CYLINDER ENGINES

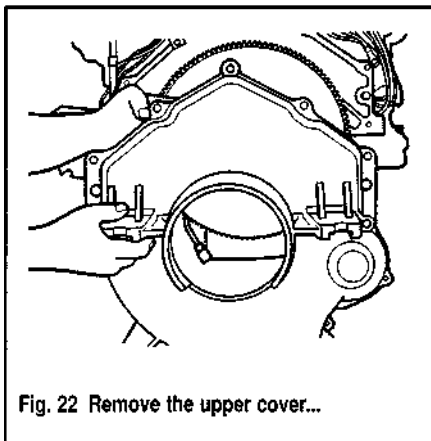


Fig. 22 Remove the upper cover...

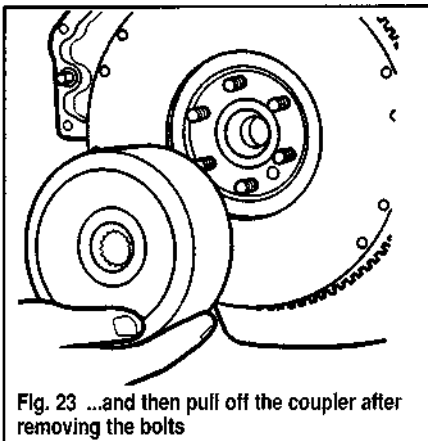


Fig. 23 ...and then pull off the coupler after removing the bolts

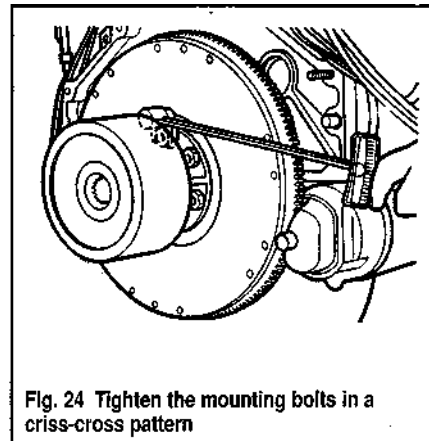


Fig. 24 Tighten the mounting bolts in a criss-cross pattern

2. Remove the oil pan and pump as detailed previously in this section.
3. Loosen the retaining bolts and remove the rear main bearing cap. Carefully insert a small prybar and remove the lower half of the seal from the cap. Do not damage the seal seating surface.
4. Using a hammer and a small drift, tap on the end of the upper seal until it starts to protrude from the other side of the race. Grab the protruding end with pliers and pull out the remaining seal half.

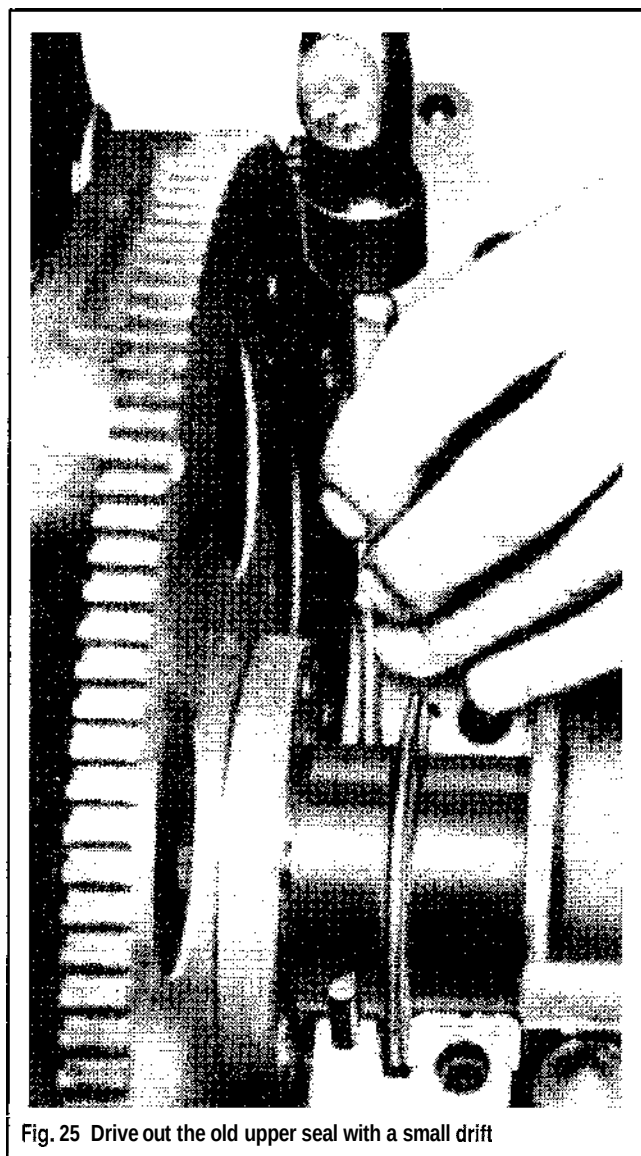


Fig. 25 Drive out the old upper seal with a small drift

■ Upper and lower seals must be replaced as a pair. Never replace only one seal.

5. Check that you have the correct new seal. Seals with a hatched inner surface can only be used on left hand rotation engines, smooth seals can be used on any engine. Coat the lip and bead thoroughly with motor oil. Keep oil away from the seal parting surfaces.

6. Your seal kit should come with an installation tool, if not, take a 0.004 in. feeler gauge and cut each side back about a half inch so that you're left with an 11/64 inch point. Bend the tool into the gap between the crankshaft and the seal seating surface. This will be your "shoe horn".

7. Position the upper half of the seal (lip facing the engine) between the crank and the tool so that the seal's bead is in contact with the tool tip. Roll the seal around the crankshaft using the tool as a guide until each end is flush with the cylinder block. Remove the tool.

8. Insert the lower seal half into the main bearing cap with the lip facing the cap. Start it so that one end is slightly below the edge of the cap and then use the tool to shimmy the seal all the way in until both edges are flush with the edge of the cap. Remove the tool.

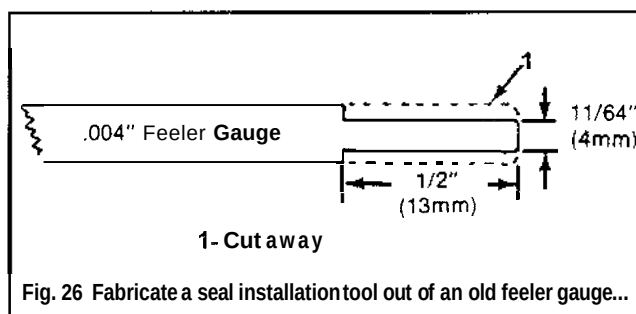


Fig. 26 Fabricate a seal installation tool out of an old feeler gauge...

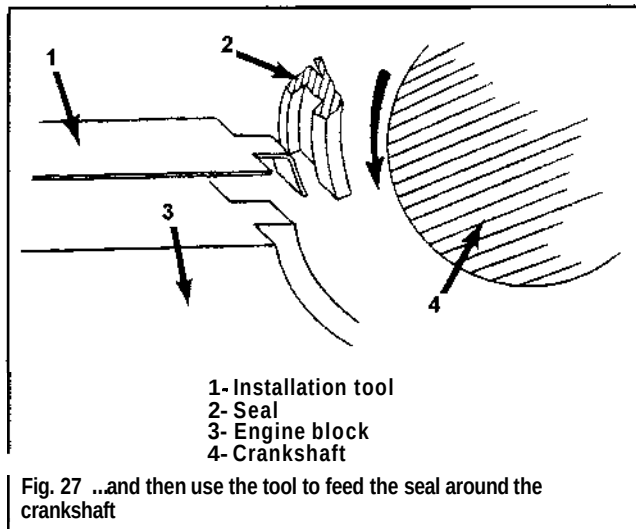


Fig. 27 ...and then use the tool to feed the seal around the crankshaft

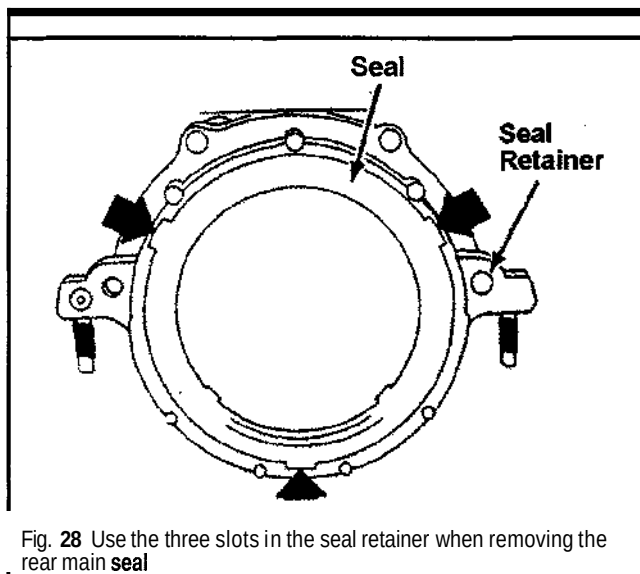


Fig. 28 Use the three slots in the seal retainer when removing the rear main seal

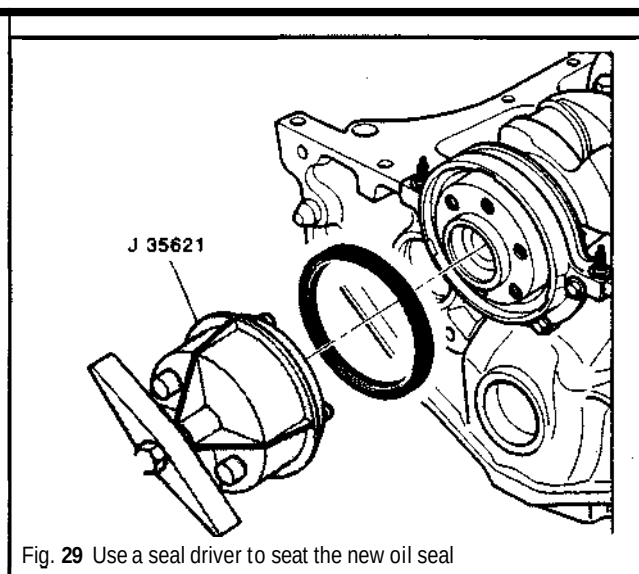


Fig. 29 Use a seal driver to seat the new oil seal

9. Make sure that the cap/block mating surfaces and the seal ends are free of any oil and then apply a small amount of Perfect Seal to the block just behind where the upper seal ends are.
10. Install the bearing cap and tighten the bolts to 10-12 ft. lbs. (14-16 Nm). Tap the end of the crankshaft forward and backward (as detailed in the appropriate section) and then tighten the bolts to 60-70 ft. lbs. (82-94 Nm).
11. Install the oil pump and pan.
12. Install the engine.

One Piece Oil Seal (1991-98)



◆ See Figures 28 and 29

It is not necessary to remove the engine or rear main bearing cap when removing the one-piece oil seal on these engines although you may find it easier to do just that.

1. Remove the flywheel housing and cover as detailed in this section.
2. Remove the engine coupler and flywheel from the engine as detailed in this section.
3. Remove the seal retainer. This is not absolutely necessary.
4. Insert a small prybar into one of the three slots in the edge of the seal retainer and slowly pry the seal out of the retainer. Be very careful not to nick or damage the sealing surface while prying out the seal.
5. Thoroughly clean the retainer surface and then install the retainer.
6. Spread a small amount of engine oil around the inside and outside edges of a new seal and position it over its slots in the retainer.
7. Position a seal driver (J-35621) over the seal and crankshaft and then thread the attaching screws into the holes in the crankshaft, tightening them securely. Turn the handle on the tool until it bottoms out—the seal is now in place.
8. Install the flywheel and engine coupler. Install the cover and flywheel housing.

Rear Main Oil Seal Retainer

REMOVAL & INSTALLATION

1991-98 Engines Only

◆ See Figure 28



It is not necessary to remove the engine or rear main bearing cap when removing the one-piece oil seal on these engines although you may find it easier to do just that.

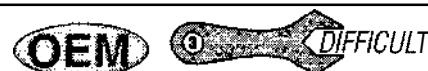
■ A new oil seal must be installed whenever the retainer is removed.

1. Remove the oil pan.
2. Remove the flywheel.

3. Loosen the nuts/bolts and then lift out the retainer and gasket.
4. Replace the oil seal.
5. Clean all traces of old gasket material from the mating surfaces and position a new seal on the cylinder block.
6. Install the seal retainer, and a new gasket, and tighten the nuts/bolts to 135 inch lbs. (15 Nm).
7. Install the oil pan and flywheel as previously detailed.

Harmonic Balancer, Pulley And Hub

REMOVAL & INSTALLATION



◆ See Figures 30 and 31

1. If the engine is in the boat, install an engine hoist and tighten the chain so that the engine's weight is removed from the front engine mount. Remove the front engine mount.

2. Remove the seawater pump from the front of the crankshaft on models so equipped.

3. Remove the drive belts.

4. Loosen the bolts securing the pulley/harmonic balancer to the hub and remove the assembly—the 2.5L does not use the balancer.

5. Install special tool #J-6978-E onto the hub with two 3/8-24 x 2 in. bolts and a 5/16-24 x 2 in. bolt for the 2.5L, or three 3/8-24 x 2 in. bolts on the 3.0L. Tighten the tool press bolt and remove the hub. OMC suggests that you do not use a conventional gear puller for this procedure.

To install:

6. Coat the front cover oil seal lip with clean engine oil and then install the balancer/pulley over the crankshaft and key. You can use a rubber mallet to position it temporarily.

7. Install the installation tool #J-5590 onto the hub. Be sure that you thread the tool into the crankshaft at least 1/2 in. to protect the threads.

❖ CAUTION

The crankshaft actually extends slightly through the front of the assembly, so make sure to use the correct tool.

■ In order that the timing mark can be properly positioned, there are two 3/16 in. holes and one 5/16 in. holes in the hub that must be matched.

8. Install the drive belts and make sure that it is adjusted properly.
9. Install the seawater pump if removed.
10. Install the front mount and unhook the engine hoist.

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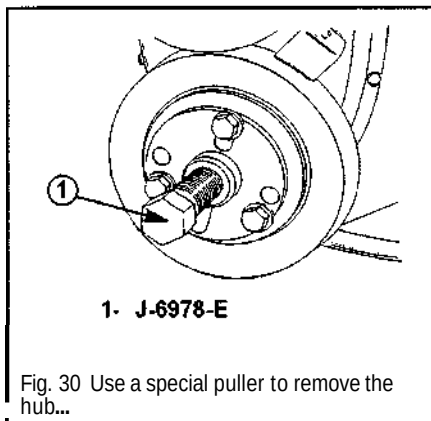


Fig. 30 Use a special puller to remove the hub...

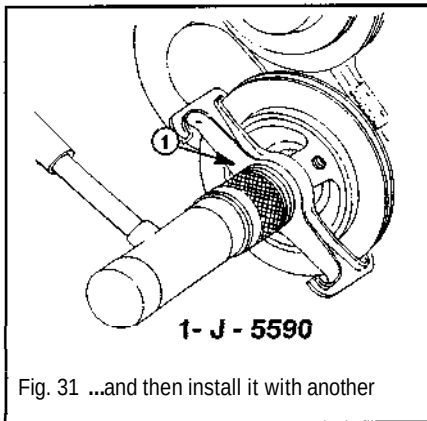


Fig. 31 ...and then install it with another

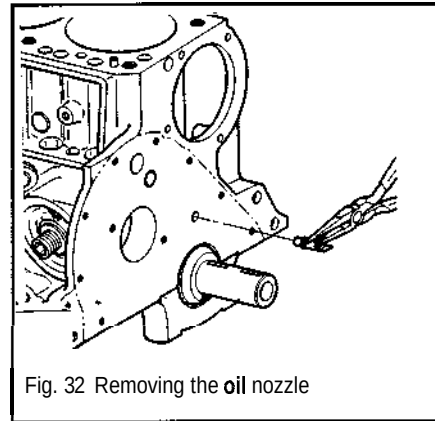
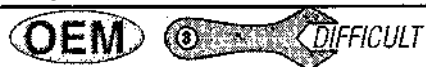


Fig. 32 Removing the oil nozzle

Front Cover And Oil Seal

REMOVAL & INSTALLATION



◆ See Figures 32, 33 and 34

This procedure may require engine removal, depending upon your particular boat. If necessary, remove the engine as detailed previously in this section.

1. Open the drain valves and drain the coolant from the block and exhaust manifold.
2. Loosen the alternator and power steering brackets to provide slack, and then remove the drive belts.
3. Remove the harmonic balancer/pulley/hub assembly.
4. Remove the water circulation pump.
5. Secure the engine with a hoist and remove the front engine mount if you haven't already removed the engine.
6. Drain the oil and remove the oil pan.
7. Loosen all of the front cover retaining screws and then pull off the cover and gasket. Clean all gasket material from the cover and block mating surfaces.
8. Pry the oil seal from the timing gear cover with a large drift or prybar.
9. Grasp the oil nozzle with a pair of pliers and pull it out of the cylinder block.

To install:

10. Insert a new oil nozzle into the block and drive it into position with a rubber mallet.
11. Coat both sides of a new oil seal lightly with grease and then position it into the cover so that the lip (open side) faces into the cover. With the cover on a clean flat surface, position a seal installer (#J-23042) over the seal and drive it into place with a hammer.
12. Clean all old gasket material from the cover and block mating surfaces. Coat a new gasket lightly with grease and stick it into position on the cylinder block.
13. The seal installer tool also acts as a centering tool. Install the tool onto the crankshaft and slide the cover over the tool and into position. Install the mounting screws and tighten them to 6-8 ft. lbs. (9-10 Nm) on 1986-92 engines, or 80 inch lbs. (9 Nm) on 1993-98 engines. Tighten the screws evenly and gradually.
14. Remove the centering tool.
15. Install the water circulation pump and the harmonic balancer/hub.
16. Install the oil pan.
17. Install all belts and check their tension.
18. Reinstall the engine mount; or if you removed the engine, install it now.
19. Refill the engine with oil and coolant.

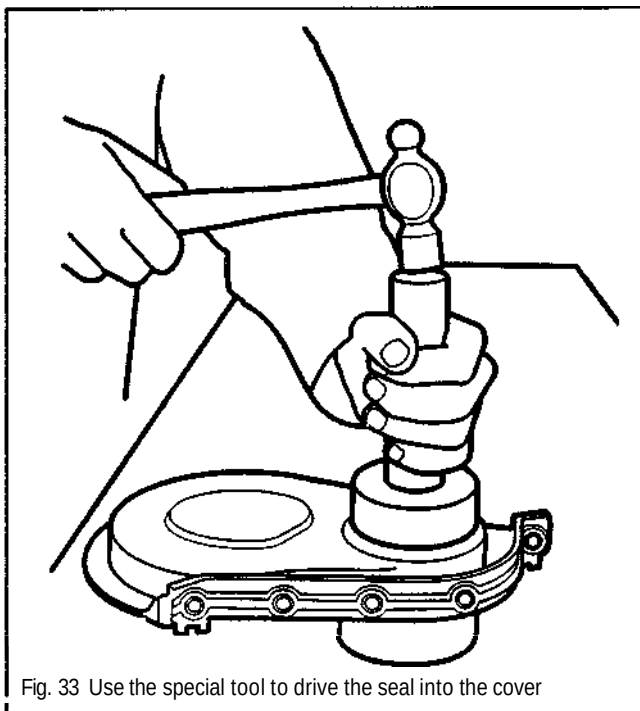


Fig. 33 Use the special tool to drive the seal into the cover

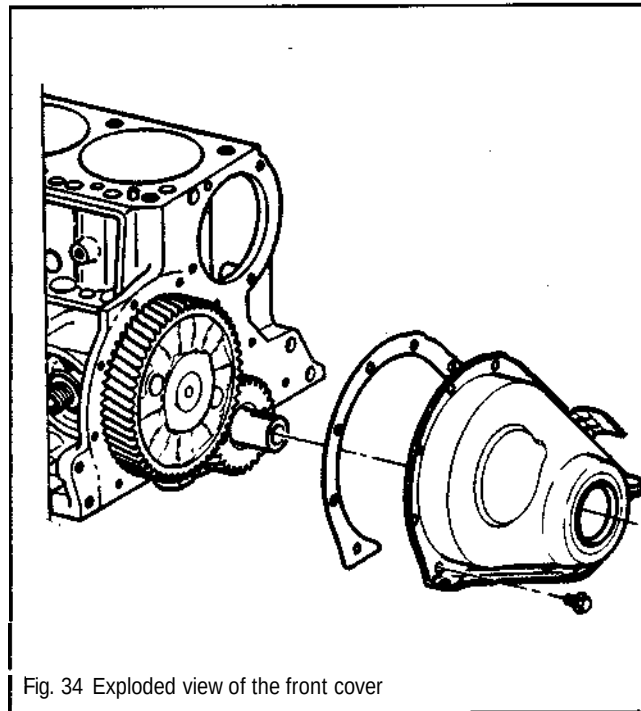


Fig. 34 Exploded view of the front cover

Camshaft, Bearings And Gear

We recommend checking the camshaft lift prior to removing it from the cylinder block.

CHECKING LIFT

◆ See Figure 35



1. Tag and disconnect the electrical connectors at the ignition coil.
2. Remove the cylinder head cover and rocker arms as detailed previously.
3. Using a special adaptor (#J-8520), connect a dial indicator so that its tip is positioned on the end of the pushrod—the adaptor should screw onto the end of the rocker stud.
4. Slowly rotate the crankshaft in the direction of engine rotation until the valve lifter is riding on the heel (back side of lobe) of the camshaft lobe. The pushrod should be at its lowest point when the lifter is on the heel.

A remote starter works well for turning the engine over in this situation.

5. Set the indicator to 0 and then rotate the engine until the pushrod is at the highest point of its travel. Camshaft lift should be 0.253 +/- 0.005 in. (6.426 +/- 0.127mm).
6. Continue rotating the engine until the pushrod is back at its lowest position—make sure that the indicator still reads 0.
7. Repeat this procedure for the remaining pushrods.
8. Install the rocker arms and adjust the valve clearance.
9. Install the cylinder head cover and reconnect the coil leads.

REMOVAL & INSTALLATION

◆ See Figure 36 thru 41



□ This procedure may require engine removal, depending upon your particular boat. If necessary, remove the engine as detailed previously in this section.

1. Drain the engine oil
2. Open the drain valves and drain the coolant from the cylinder block and exhaust manifold.
3. Remove the cylinder head cover and gasket. Loosen the rocker arm nuts just enough so that you can rotate the rockers off of the pushrod ends.
4. Mark the position of the distributor's No. 1 cylinder terminal on the housing of the distributor and then remove the cap. Matchmark the distributor and the cylinder block, loosen the hold down clamp and lift out the distributor.
5. Remove the ignition coil and side cover gasket. Take time to set up a system to keep the push rods and valve lifters in order, to ensure each will be installed back into the exact location from which it was removed. Withdraw each push rod and valve lifter in order.
6. Remove the harmonic balancer
7. Remove the water circulation pump.
8. Secure the engine with a hoist and remove the front engine mount if you haven't already removed the engine.
9. Remove the oil pan.
10. Remove the front cover and gasket. Clean all gasket material from the cover and block mating surfaces.
11. Rotate the camshaft gear until the holes in the gear are aligned with the thrust plate screws. Remove the two screws. Carefully withdraw the camshaft gear and camshaft by pulling the gear straight forward and the shaft out of the block.

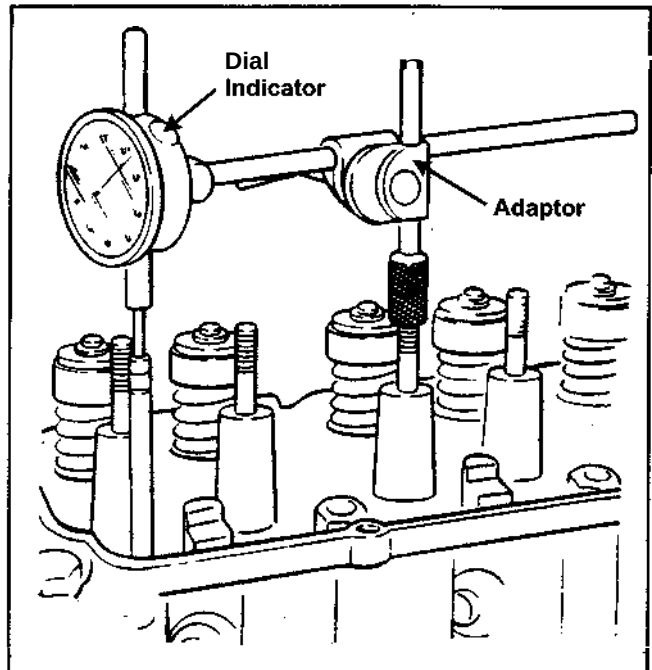


Fig. 35 Use a dial indicator when checking the camshaft lift

✖ CAUTION

Be very careful not to damage the camshaft bearings while removing the camshaft.

12. Check the gear and thrust plate end-play. This clearance should be 0.001-0.005 in. (0.025-0.127mm) max. If the decision is made to replace the camshaft gear, or the thrust plate, the gear must be pressed from the shaft. Gear removal from the camshaft requires the use of camshaft gear removal tool (#J-791) and an arbor press. Place the end of the removal tool onto the table of an arbor press, and then press the shaft free of the gear. The thrust plate must be positioned to prevent the woodruff key in the shaft from damaging the shaft when the shaft is pressed out of the gear. Also, be sure to support the end of the gear or the gear will be seriously damaged.

13. If the camshaft bearings are to be removed, you will need to remove the flywheel as previously detailed. Although it is not necessary, removing the crankshaft will also facilitate bearing removal, make sure that you move the connecting rods out of the way so they do not interfere with bearing removal.

14. Working from inside the block, drive out the rear cam bearing expansion plug (welch plug).

15. Slide the pilot tool into position in the inner bearing. Install a nut onto the puller screw so that the screw can be threaded into the tool with the nut still extending out the front of the cylinder block.

16. Install the remover onto the puller screw, slide the screw through the bore and thread it onto the pilot.

17. Hold the screw shaft with a wrench while turning the puller nut with another until the bearing comes out.

18. Now remove the pilot from the shaft and install it onto the drive handle so that the shoulder is against the handle. The front and rear bearings can now be driven out from the outside of the block.

To install:

19. Remove the handle from the pilot tool and install the inner bearing on the tool.

20. Position the tool and bearing to the rear of the inner bore. Install the screw shaft, with the remover, through the block and onto the pilot—from the front of the cylinder block.

21. Align the oil hole in the bearing with the oil gallery hole and then snug the puller nut up against the adaptor. Using two wrenches again, hold the screw shaft with one while turning the puller with the other until the bearing is in position.

The oil hole is on the top of the bearing and will not be visible during installation. To make installation easier, align the two holes and then mark the opposite side of the bearing block.

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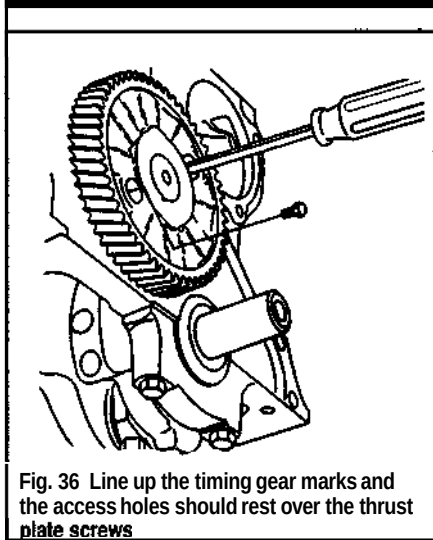


Fig. 36 Line up the timing gear marks and the access holes should rest over the thrust plate screws

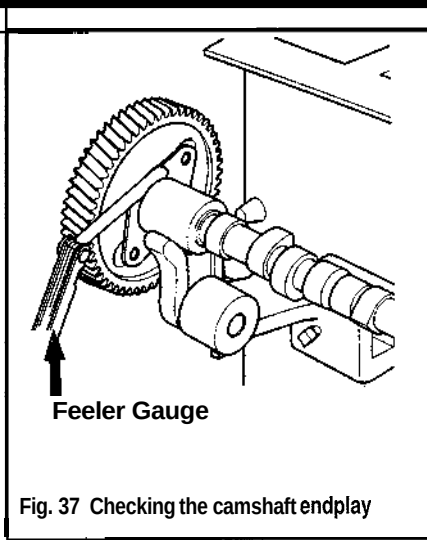


Fig. 37 Checking the camshaft endplay

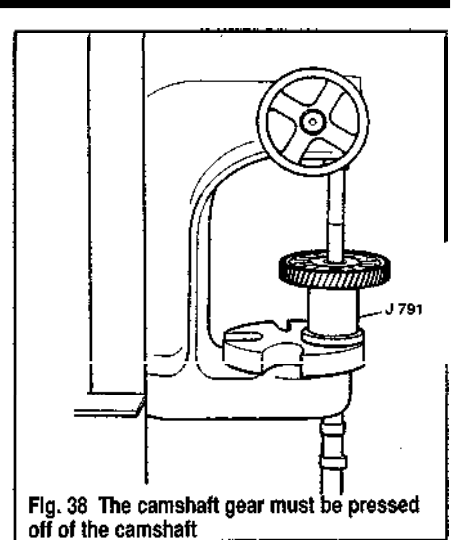


Fig. 38 The camshaft gear must be pressed off of the camshaft

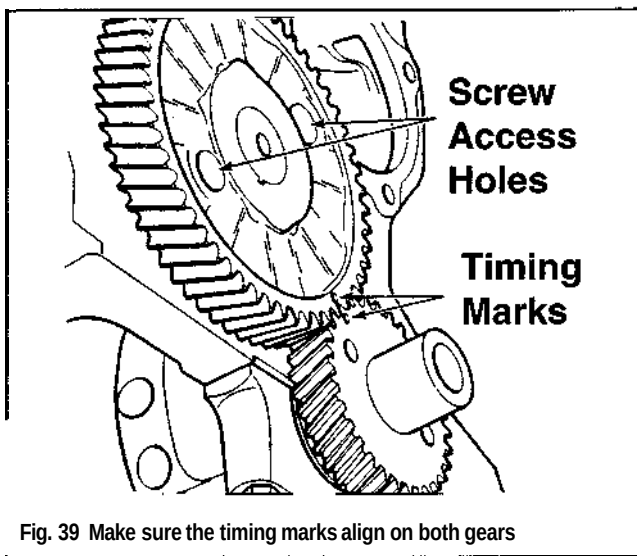


Fig. 39 Make sure the timing marks align on both gears

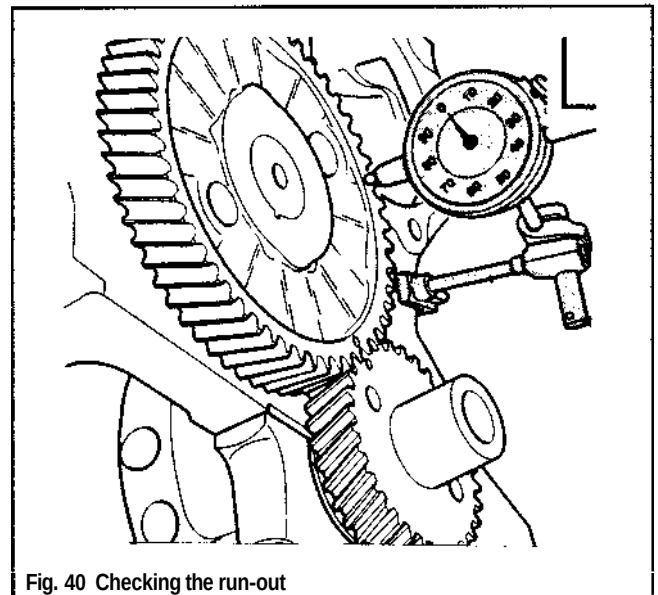


Fig. 40 Checking the run-out

22. Attach the drive handle to the tool and position the new front bearing onto the tool. Align the oil holes and drive the bearing in from the front (outside) of the cylinder block. Be sure that the bearing is driven in past the edge of the block at least $\frac{1}{16}$ in, in order to expose the oil hole for the timing gear nozzle.

23. Repeat the last step for the rear bearing, but remember there is no oil nozzle hole in this bore so the bearing must be flush with the block.

24. Install a new expansion plug at the rear bearing.

25. To assemble the camshaft parts, first firmly support the camshaft at the back of the front journal in an arbor press. Next, place the gear spacer ring and the thrust plate over the end of the shaft, and install the Woodruff key in the shaft keyway. Install the camshaft gear and press it onto the shaft until it bottoms against the gear spacer ring. Check the end-play again.

26. If you removed the crankshaft, install it now.

27. Coat the camshaft lobes with G.M. Super Engine Oil Supplement and then pour the remainder of the can into the crankcase when you refill the engine with oil later in this procedure.

28. Slowly slide the camshaft and gear into the block, being careful not to damage the lobes or bearings. When the shaft is almost all the way in, rotate the camshaft and crankshafts until the timing marks on the teeth of each gear line up and then slide the camshaft in until the thrust plate meets the cylinder block and the holes in the plate line up with those in the block. Slowly rotate the crankshaft until the access holes in the cam gear are over the thrust plate holes. Install the two retaining screws and tighten them to 72-90 inch lbs. (8-10 Nm.)

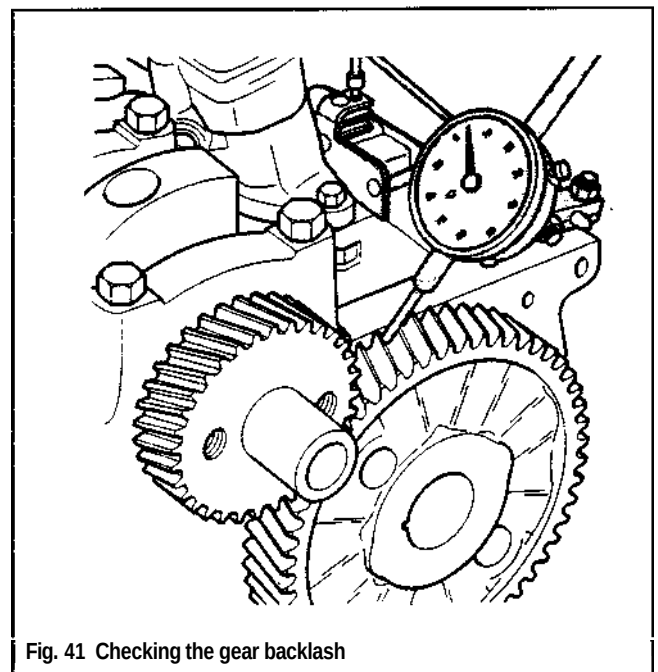


Fig. 41 Checking the gear backlash

29. Connect a dial indicator to the front of the cylinder block with an adaptor so that the needle on the indicator is in contact with the face of the camshaft gear. Rotate the engine 360° checking the run-out as you go. Repeat this procedure for the crankshaft gear. Camshaft runout should not exceed 0.004 in. (0.102mm). Crankshaft run-out should not exceed 0.003 in. (0.076mm). If run-out exceeds specification, remove the gear and check for burrs, otherwise replace the gear.

30. Move the dial indicator so that the needle is now riding on a gear tooth. Wiggle the shaft back and forth while checking the backlash reading on the indicator. Backlash should be 0.004-0.006 in. (0.102-0.152mm).

31. Install the oil pan. Install the front cover.

31. Install the harmonic balancer and water pump.

32. Installation of the remaining components is in the reverse order of removal. Don't forget to add the remainder of the Super Oil Supplement when refilling the engine with oil.

Cylinder Head

REMOVAL & INSTALLATION

◆ See Figures 42 and 43



1. Drain the water from the cylinder block and manifold.
2. Remove the fuel line support brackets. Disconnect the fuel line at the carburetor and fuel pump, plug the fitting holes and remove the line.
3. Remove the combination manifold as previously detailed in this section; you can leave the carburetor attached if you like.
4. Disconnect the coolant hoses at the thermostat housing and move them out of the way. Have some rags available, as there will still be some coolantwater in the hoses.
5. Tag and disconnect the temperature sending unit lead at the thermostat housing, loosen the mounting bolts and then remove the housing and thermostat.
6. Tag and disconnect all wires at the ignition coil and then remove the mounting bracket bolt and lift off the coil.
7. Tag and disconnect the spark plug wires at the plugs; move them out of the way. Although not necessary, it's a good idea to remove the plugs themselves also.
8. Remove the circuit breaker bracket and then unbolt and remove the engine lifting bracket (if equipped).
9. Remove the cylinder head cover and rocker assemblies as detailed previously in this section. Remove the pushrods.
10. Loosen the cylinder head bolts, from the center bolts and working out to the ends of the head and then carefully lift the head off the block. You may need to persuade it with a rubber mallet—be careful! Set the head down carefully do not sit it on cement.

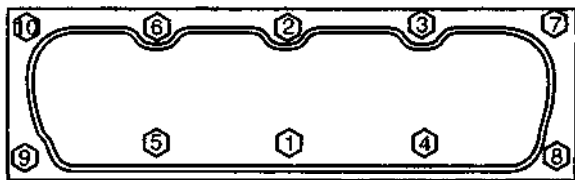


Fig. 42 Cylinder head tightening sequence

To install:

11. Carefully, and thoroughly, remove all residual head gasket material from the cylinder head and block mating surfaces with a scraper or putty knife. Check that the mating surfaces are free of any nicks or cracks. Make sure there is no dirt or old gasket material in any of the bolt holes. Refer to the Engine Rebuilding section for complete details on inspection and refurbishing procedures.

12. Position a new gasket over the cylinder block dowel pins. On models using a steel gasket, coat both sides of the gasket with a thin layer of Gasket Sealing Compound. Do not use too much sealing compound!!

13. Position the cylinder head over the dowels in the block. Coat the threads of the head bolts with Permatex® and install them finger tight. It never hurts to use new bolts, although it's not necessary. Tighten the bolts, a little at a time, in the sequence illustrated, until the proper tightening torque is achieved. 1986-93 engines have a final torque of 90-100 ft. lbs. (122-136 Nm), while 1994-98 engines have a final torque of 95 ft. lbs. (129 Nm)—make sure that you check the Torque Specifications chart for any preliminary steps/torques.

14. Install pushrods, rocker assemblies and the cylinder head cover.

15. Install the circuit breaker and engine lifting brackets, Install the spark plugs if they were removed and then connect the plug wires.

16. Install the coil and reconnect all the electrical leads.

17. Install the thermostat housing, the coolant hoses and the temperature sending lead.

18. Install the manifold and connect the fuel line. Don't forget to remove the fitting plugs.

19. Add coolantwater, connect the battery and check the oil. Start the engine and run it for a while to ensure that everything is operating properly. Keep an eye on the temperature gauge.

20. Re-tighten the cylinder head bolts after 20 hours of operation.

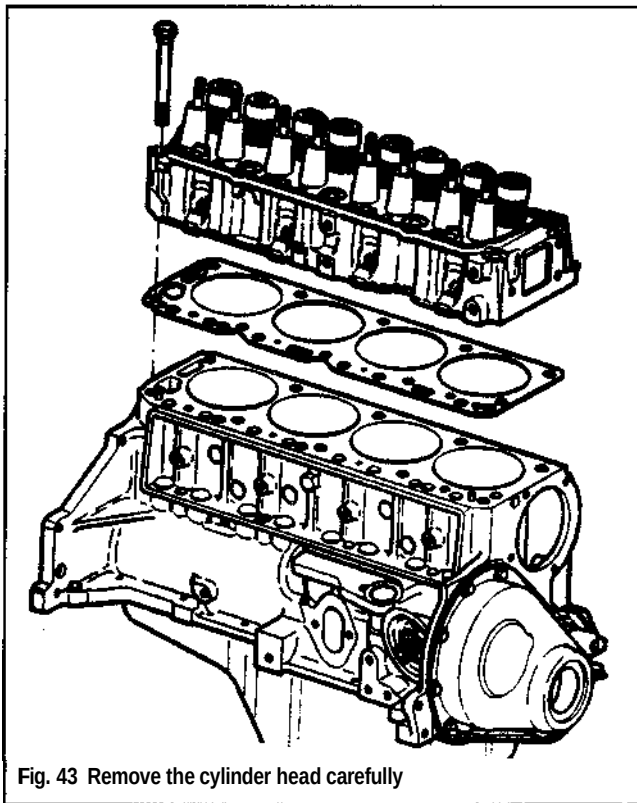


Fig. 43 Remove the cylinder head carefully

EXPLODED VIEWS

◆ See Figures 44, 45 and 46

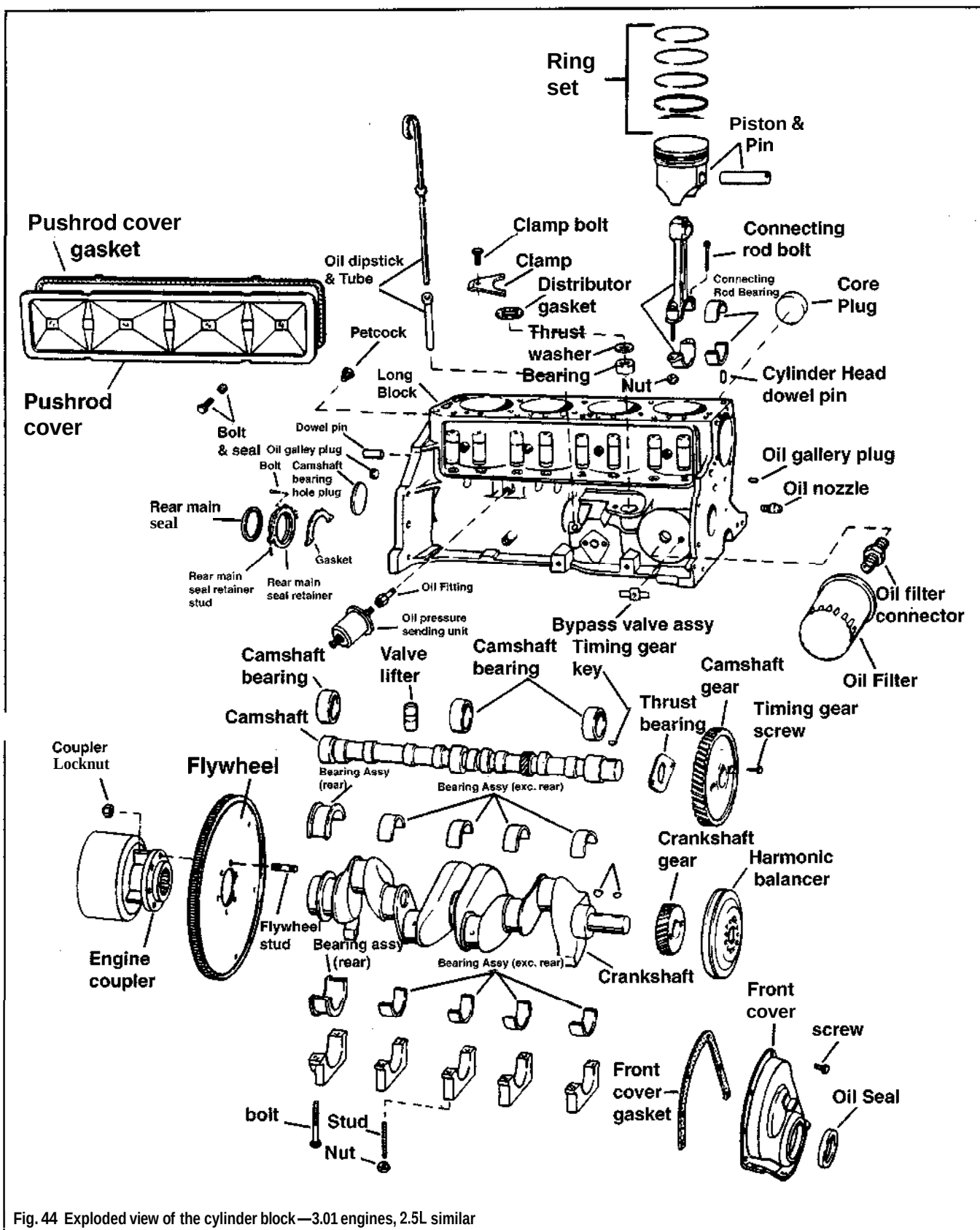


Fig. 44 Exploded view of the cylinder block—3.0L engines, 2.5L similar

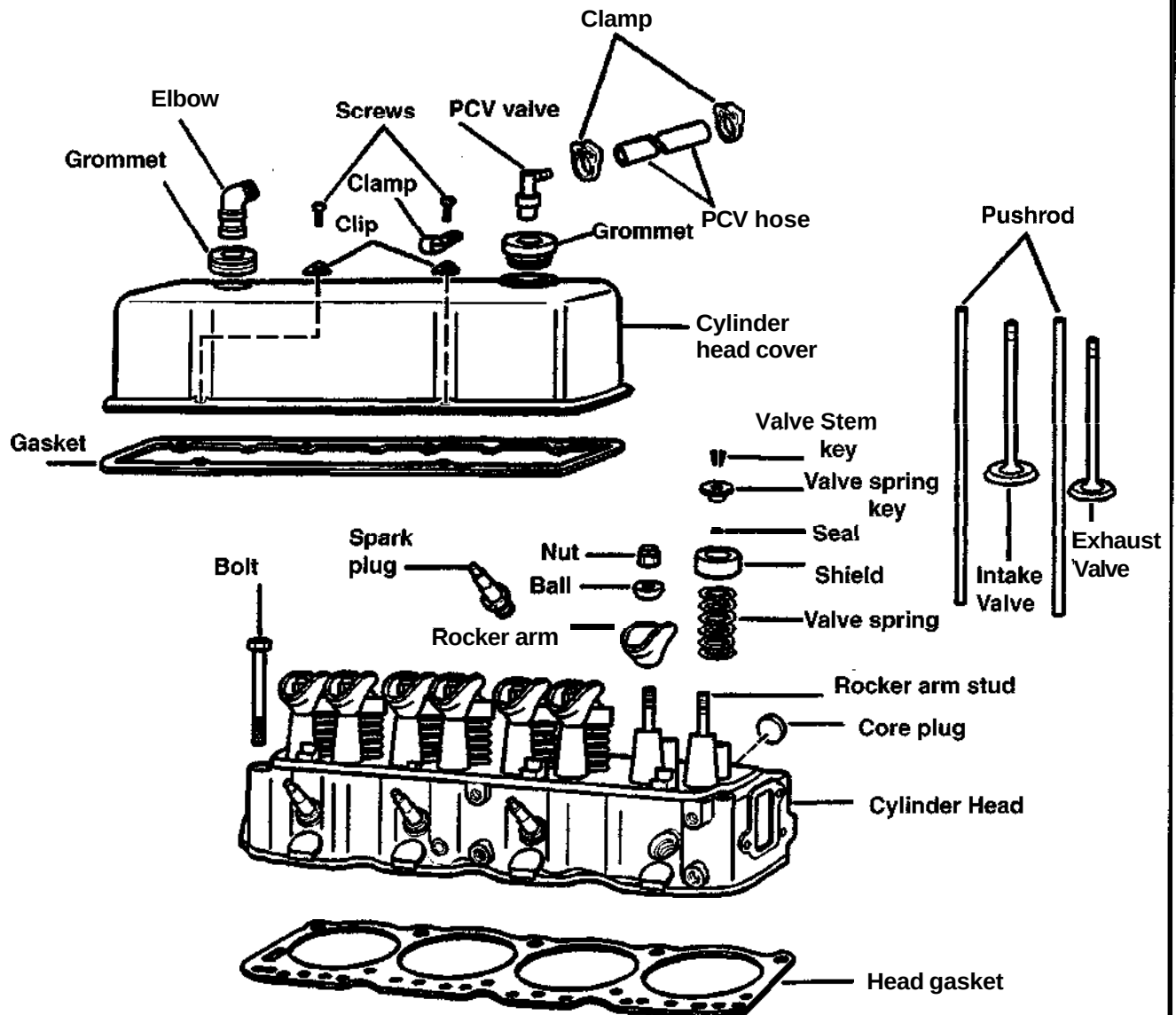


Fig. 45 Exploded view of the cylinder head—3.0L engines, 2.5L similar

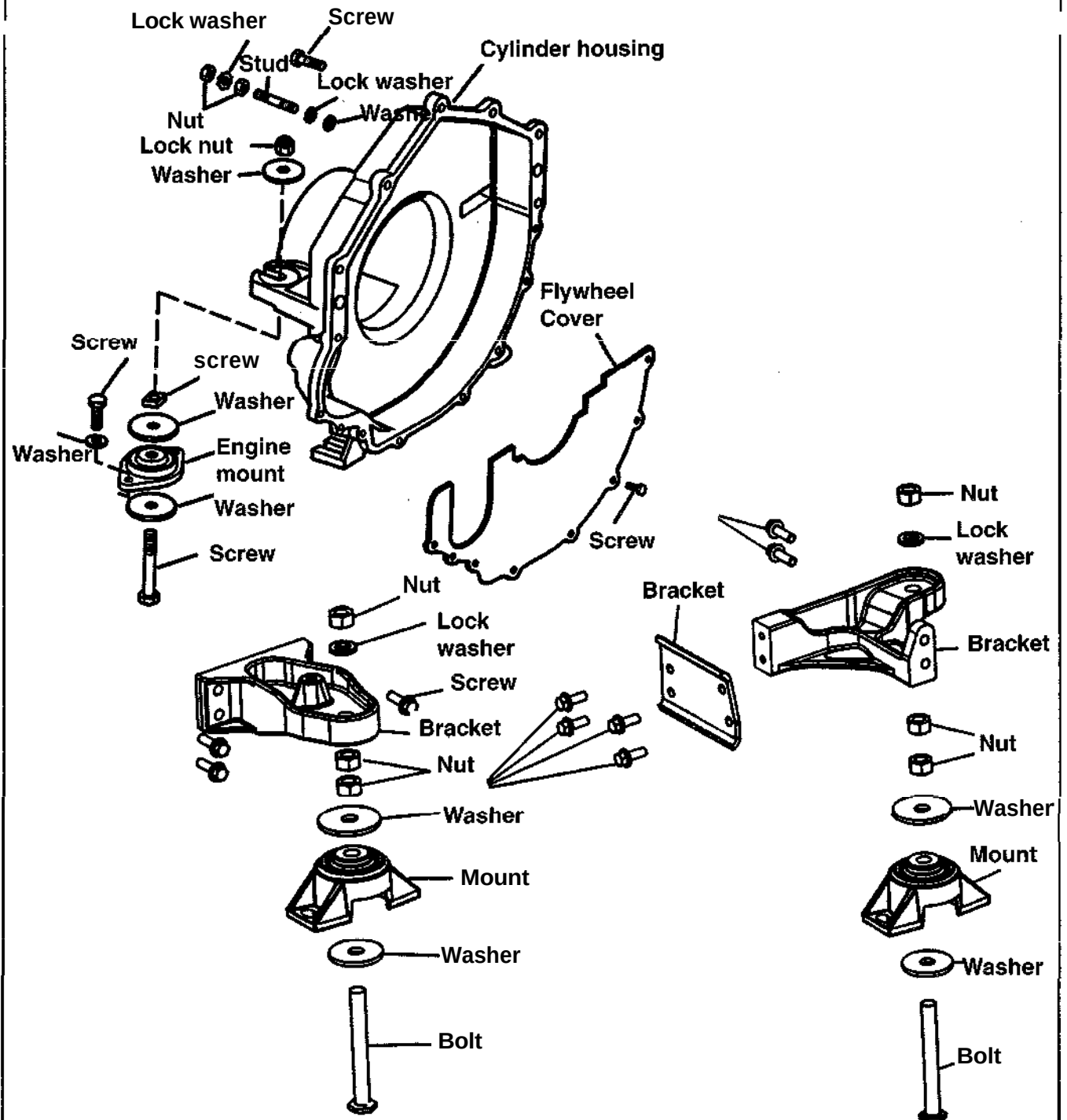


Fig. 46 Exploded view of the flywheel housing and rear mounts—3.0L engines, 2.5L similar

TORQUE SPECIFICATIONS

Component		ft. lbs.	inch lbs.	Nm
Alternator bracket to engine		26-30	-	35-41
Camshaft sprocket	Sprocket	①	-	①
	Thrust plate	-	72-90	8-10
Combination manifold	Nut/bolt	20-25	-	27-34
Connecting rod cap		35	-	47
Crankshaft	Main bearing cap (exc. rear)	60-70	-	81-95
	Main bearing cap (rear)			
	Step 1	10-12	-	14-16
	Step 2 1986-90	60-70	-	82-94
	Oil seal retainer			
	1991-98		135	15.3
Cylinder head	1986-93	90-100	-	122-136
	1994-98			
	Step 1	35	-	47
	Step 2	65	-	88
	Step 3	95	-	129
Cylinder head cover	1986-93		45	5
	1994-98	-	65	7.3
Distributor clamp bolt		20	-	27
Engine coupler	Flywheel housing	28-36	-	38-49
	Coupler nut	40-45	-	54-61
	Coupler ground stud	1986-93 20-25	-	27-34
		1994-98 35-40	-	47-54
	Cover	-	60-84	7.9
Engine mounts	Front			
	Bracket bolts	30-35	-	41-47
	Upper nut	50-60	-	68-81
	Lower nut	115-140	-	156-190
	Mounting bolts	Port 48-56	-	65-76
		Starboard 32-40	-	43-54
	Rear			
	Center bolt	1986-88 18-20	-	24-27
		1989-98 44-52	-	60-71
	Lock nut	28-30	-	38-40
	Mounting bolts	20-25	-	27-34
Exhaust Elbow		12-14	-	16-19
Exhaust Pipe	1986-89	10-12	-	14-16
	1990-98	27-34	-	27-34
Front cover	1986-92	6-8	-	9-10
	1993-98		80	9
Main bearing cap	Exc. rear	60-70	-	81-95
	Rear			
	Step 1	10-12	-	14-16
	Step 2	60-70	-	81-95
Oil pan	1/4 x 20 bolts		80	9
	5/16 x 18 bolts		165	18.6
	Drain retainer	15-18	-	20-24

① Sprocket is press-fit to camshaft

TORQUE SPECIFICATIONS

Component		ft. lbs.	inch lbs.	Nm
Oil pump				
	Cover bolts	-	65-75	7-8
	Mounting bolts	-	110-120	12-14
	Pick-up Tube	-	60	7
Oil pressure sender adapter		10-14	-	14-19
Oil seal retainer	1991-98	-	135	15.3
Oil withdrawal tube (flare)		15-18	-	20-24
Power steering pump				
	Bracket			
	Bolt	26-30	-	35-41
	Stud	13-15	-	18-20
	Hydraulic line fitting			
	Large	15-17	-	20-23
	Small	10-12	-	14-16
Raw water pump bracket		13-17	-	18-23
Timing chain cover	1986-92	6-8	-	9-10
	1993-98	-	80	9
Valve cover				
	1986-93	-	45	5
	1994-98		65	7.3
Water pump (circulating pump)		13-17	-	18-23
Water temperature sender		20	-	27

① Sprocket is press-fit to camshaft

ENGINE SPECIFICATIONS

Component		Standard (in.) ①	Metric (mm) ②
Camshaft	Bearing Length	0.86	21.84
	Bearing Outer Diameter		
	#1, #2	1.999-2.001	50.78-50.83
	#3	2.009-2.011	51.03-51.08
	Journal Diameter	1.8687	47.48
Connecting Rod		1.8692	47.47
	Lobe Lift	0.253 +/- 0.005	6.43 +/- 0.13
	Bearing Clearance	2.5L 0.0007-0.0027	0.018-0.069
		3.0L 0.00085-0.00135	0.022-0.034
	End Play	0.008-0.015	0.20-0.38
Crankshaft	Length	2.5L 0.797-0.802	20.24-20.37
		3.0L 0.792-0.822	20.12-20.88
	Crankpin	2.5L 1.999-2.000	50.78-50.80
		3.0L 2.099-2.100	53.32-53.34
	Crankshaft End Play	0.002-0.006	0.05-0.15
Main Bearing			
	Clearance	0.0003-0.0029	0.008-0.074
	Journal Diameter	2.2983-2.2993	58.38-58.40
	Length		
	#1 thru 4	0.83 ③	21.08 ③
Piston		#5	0.822
	Clearance		
	Limit at top land	2.5L 0.0245-0.0335	0.622-0.851
		3.0L 0.0255-0.0345	0.648-0.876
	Limit at skirt	2.5L 0.0005-0.0015	0.013-0.038
Groove Depth		3.0L 0.0025-0.0035	0.064-0.089
	Compression ring	2.5L 0.200-0.208	5.08-5.28
		3.0L 0.209-0.211	5.31-5.36
	Oil ring	2.5L 0.194-0.202	4.93-5.13
		3.0L 0.190-0.199	4.83-5.06
Piston Pin	Clearance		
	Production	0.0003-0.0004	0.008-0.010
	Service Limit	0.001 Max	0.02 Max
	Diameter	0.9270-0.9273	23.55-23.56
	Interference fit	0.0008-0.0021	0.020-0.050
Length		2.990-3.010	75.95-76.45

① Unless otherwise noted

② 2.5L: 0.802 (20.37)

③ 3/4 to 1 full turn down from zero lash

ENGINE SPECIFICATIONS

Component		Standard (in.) ①	Metric (mm) ②
Piston Rings	Compression		
	Gap		
	2.5L	0.010-0.020	0.25-0.51
	3.0L		
	Upper	0.010-0.020	0.25-0.51
Oil			
	Lower	0.013-0.025	0.33-0.64
	Width	0.0775-0.0780	1.97-1.98
	Gap	0.015-0.055	0.38-1.40
	Width		
Valve system			
	Groove	0.188-0.189	4.78-4.80
	Ring		
	2.5L	0.150-0.156	3.81-3.96
	3.0L	0.154-0.160	3.91-4.06
Face Angle		45 deg.	
	Lash (hot)	③	③
	Lifter	Hydraulic	Hydraulic
	Rocker arm ratio	1.75:1	
	Seat Angle	45 deg.	
Seat Width			
	Intake	0.0312-0.0625	0.79-1.59
	Exhaust	0.0625-0.0937	1.59-2.39
	Spring (Outer)		
	Free length	2.08	52.83
Stem Clearance			
	Pressure	78-86 lbs.	347-383 N
	@ 1.66	@ 42.16	
	Intake	0.0010-0.0027	0.025-0.069
	Exhaust	2.5L 0.0015-0.0032	0.038-0.081
3.0L		0.0010-0.0027	0.025-0.069

① Unless otherwise noted

② 2.5L: 0.802 (20.37)

③ 3/4 to 1 full turn down from zero lash

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5

ENGINE MECHANICAL GM V6 AND V8 ENGINES

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5-2 ENGINE MECHANICAL—GM V6 AND V8 ENGINES

ENGINE MECHANICAL

General Information

NEVER, NEVER attempt to use standard automotive parts when replacing anything on your engine. Due to the uniqueness of the environment in which they are operated in, and the levels at which they are operated at, marine engines require different versions of the same part; even if they look the same. Stock and most aftermarket automotive parts will not hold up for prolonged periods of time under such conditions. Automotive parts may appear identical to marine parts, but be assured, OMC marine parts are specially manufactured to meet OMC marine specifications. Most marine items are super heavy-duty units or are made from special metal alloy to combat against a corrosive saltwater atmosphere.

OMC marine electrical and ignition parts are extremely critical. In the United States, all electrical and ignition parts manufactured for marine application must conform to stringent U.S. Coast Guard requirements for spark or flame suppression. A spark from a non-marine cranking motor solenoid could ignite an explosive atmosphere of gasoline vapors in an enclosed engine compartment.

V6 ENGINES

The OMC 4.3L, 262 cubic inch displacement V6 engine is manufactured by GMC. This engine is used in numerous models known as the 4.3, 4.3 HO, 4.3GL, 4.3GS and 4.3Gi.

The 4.3 and 4.3GL models are equipped with a 2-barrel carburetor, while the 4.3, 4.3 HO and 4.3GS models are equipped with a 4-barrel carburetor. Throttle body fuel injection was introduced on the 4.3Gi in 1996.

The lubrication systems and component locations on this engine are virtually identical to the larger V8 engines, except for having only three cylinders in each bank.

A balance shaft is mounted above the camshaft on all 1994 and later models and extends the entire length of the block and is supported on each end by a bearing. The balance shaft is driven by gears on the end of the camshaft and equalizes the dynamic forces known as harmonic vibrations minimizing engine vibration during routine operation of a V6 engine. Cylinder numbering and firing order is identified in the illustrations at the end of the Maintenance Section.

All 4.3L engines are left hand (counterclockwise) rotation when viewed from the stern of the boat. This does not necessarily indicate that your prop rotation is the same— always check them both!

V8 ENGINES

The OMC 5.0L, 305 cubic inch and 5.7L, 350 cubic inch displacement (small block) V8 engines are manufactured by GMC. These engines are used in the following configurations:

- 5.0 (214 bbl)
- 5.0GL (2 bbl)
- 5.7 (4 bbl)
- 5.7Gi (TBI)
- 5.7GL (2 bbl)
- 5.7GS (2/4 bbl)
- 5.7GSi (TBI)
- 5.7 LE (4 bbl)
- 350 (4 bbl)

The OMC 7.4L, 454 cubic inch and 8.2L, 502 cubic inch displacement (big block) V8 engines are also manufactured by GMC. These engines are used in the following configurations:

- 7.4 (4 bbl)
- 7.4 454 (4 bbl)
- 7.4 EFI (MPI)
- 7.4GL (4 bbl)
- 7.4Gi (MPI)
- 7.4GSi (MPI)
- 8.2GL (4 bbl)
- 8.2GSi (MPI)
- 454 (4 bbl)
- 454 HO (4 bbl)
- 502 (4 bbl)

The lubrication system is a force fed type where oil is supplied under full pressure to the crankshaft, main and connecting rod bearings, camshaft bearings and the valve lifters. Oil flow from the valve lifters is metered and pumped by the lifter through the hollow core pushrods to lubricate the rocker arms and valve train. All other components are lubricated by gravity and splash methods.

The oil pump is mounted on the rear main bearing cap and is driven by an extension shaft from the distributor—driven by the camshaft. Oil is drawn into the pump through the oil pick-up tube and screen. Should the screen become clogged, a relief valve in the screen will open and allow oil to be drawn into the pump.

Once oil reaches the pump, the pump forces oil through the lubrication system. A spring-loaded relief valve in the oil pump limits the maximum pump output pressure.

The pressurized oil flows out the pump through a full-flow disposable oil filter cartridge. On engines equipped with an oil cooler, the oil flows through the filter, out to the oil cooler via hoses and then returns to the block. Should the oil filter and/or cooler become clogged, a by-pass valve will open allowing the pressurized oil to by-pass the filter and cooler.

Some of the oil is then routed to the No. 5 crankshaft main bearing, the remainder of the oil pressure is routed to the main oil gallery. The main oil gallery is located above the camshaft and runs the full length of the block. Oil from the main gallery is routed through individual passages to the camshaft bearings, No's 1, 2, 3, and 4, crankshaft main bearings and the lifter gallery's on each side of the block.

Holes in the camshaft bearings and crankshaft main bearings align with the holes in the block for oil flow. Grooves in the bearings allow oil to flow between the bearing and the component.

Oil in the lifter galleries is forced into each hydraulic lifter through a hole in the side of the lifter. Oil flowing through the lifter must pass through a metering valve in each of the lifters. The metered volume of oil then flows up through the hollow push-rods to the valve rockers. A small hole in the rocker arm allows oil to lubricate the valve train bearing surfaces. All excess oil drains back to the oil pan through oil return holes in the cylinder head.

A baffle plate or "splash pan" mounted below the main bearing caps prevents excess oil being thrown off the crankshaft from aerating the oil in the oil pan.

The distributor shaft and gear is lubricated by oil in the starboard lifter gallery. The timing chain and gears are lubricated with oil flowing out the front of the No. 1 main bearing journal. The mechanical fuel pump and pushrod is lubricated with oil thrown off the camshaft eccentric.

All V8 engines are left hand (counterclockwise) rotation when viewed from the stern of the boat except some inboards which are right hand (clockwise). This does not necessarily indicate that your prop rotation is the same— always check them both!

Cylinder numbering and firing order is identified in the illustrations at the end of the Maintenance Section.

Engine Identification

ENGINE

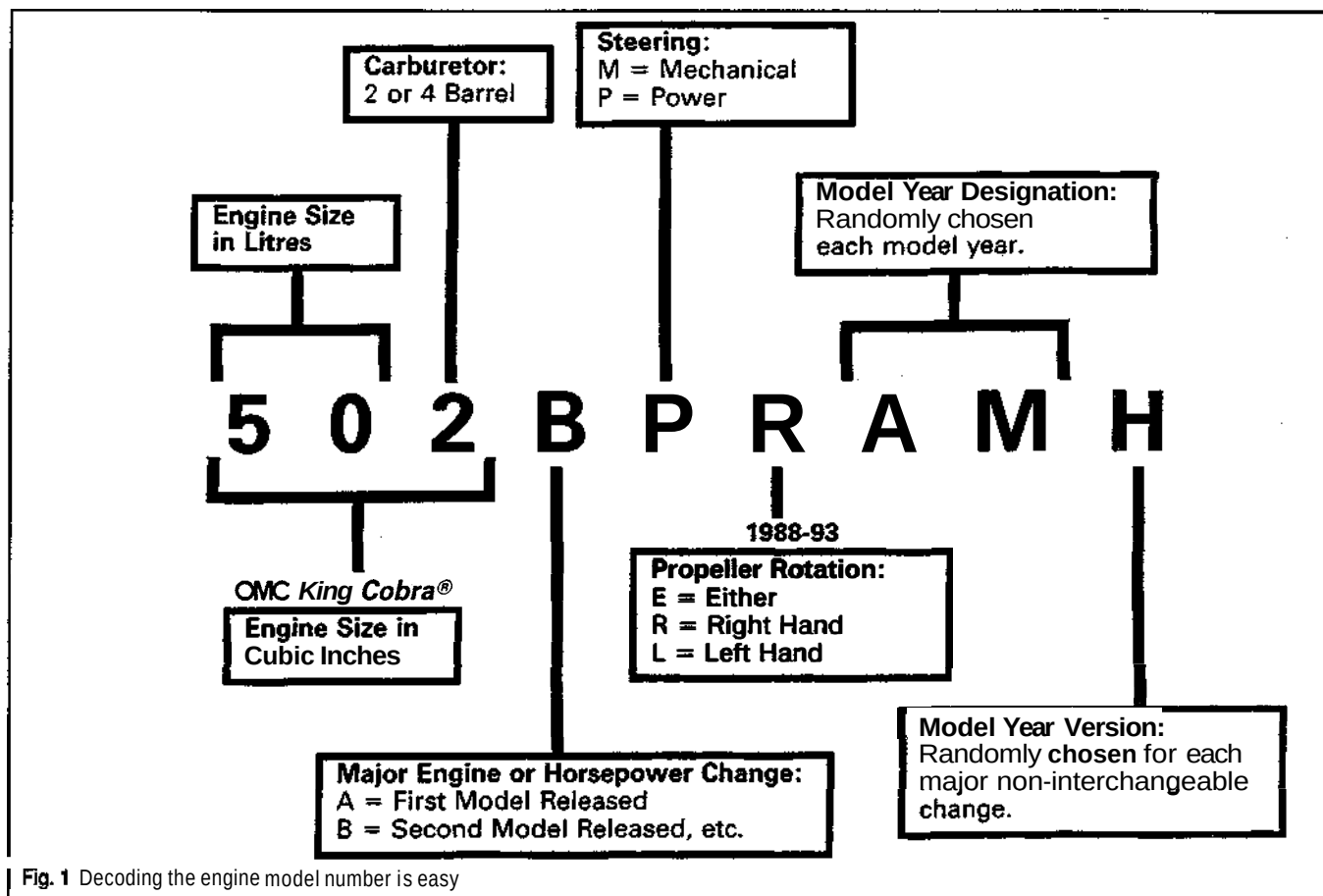
◆ See Figures 1, 2, 3 and 4

The engine serial numbers are the manufacturer's key to engine changes. These alpha-numeric codes identify the year of manufacture, the horsepower rating and various model/options differences. If any correspondence or parts are required, the engine serial number must be used for proper identification.

Remember that the serial number establishes the year in which the engine was produced, which is often not the year of first installation.

The engine specifications decal contains information such as the model number or code, the serial number (a unique sequential identifier given ONLY to that one engine) as well as other useful information.

An engine specifications decal can generally be found on top of the flame arrester, on the side of the thermostat housing (early V6/V8 engines), or on the inner side of the rocker arm cover, usually near the breather/PCV line (port side on most models) - all pertinent serial number information can be found here—engine and drive designations, serial numbers and model numbers. Unfortunately this decal is not always legible on older boats and it's also quite difficult to find, so please refer to the following procedures for each individual unit's serial number location.



Serial numbers tags are frequently difficult to see when the engine is installed in the boat; a mirror can be a handy way to read all the numbers.

The engine serial/model number is sometimes also stamped on the port rear side of the engine where it attaches to the bell housing; although on most later models it may instead be a metal plate attached in the same location. If your engine has a stamped number it will simply be the serial number; if you have a plate (and you should), it will always show a Model number and then the actual Serial number. Additionally, most models will also have this plate or sticker on the transom bracket.

- The first two characters identify the engine size in liters (L); 43 represents the 4.3L, 50 represents the 5.0L and so forth.
- The third character identifies the fuel delivery system; 2 designates a 2 bbl carburetor, 4 is a 4 bbl carburetor, and F is a fuel injected engine.
- The fourth character designates a major engine or horsepower change—it doesn't let you know what the change was, just that there was some sort of change. A means it is the first model released, B would be the second, and so forth.

- The fifth character designates what type of steering system was used; M would be manual steering and P would be power steering.

- Now here's where it gets interesting; on 1986-87 engines and 1994-98 engines, the sixth, seventh and eighth characters designate the model year. The sixth and seventh actually show the model year, while the eighth is a random model year version code. KWB and WXS represent 1986; and ARJ, ARF, FTC, SRC or SRY show 1987. MDA is 1994, HUB is 1995, NCA is 1996, LKD is 1997 and BYC is 1998.

- On 1988-93 engines, the sixth character designates the direction of propeller rotation. R is right hand, L is left hand and E is either.

- Also on 1988-93 engines, the seventh, eighth and ninth characters designate the model year. The seventh and eighth actually show the model year, while the ninth is a random model year version code. GDE or GDP is 1988, MED or MEF is 1989, PWC, PWR or PWS is 1990, RGD or RGF is 1991, AMH or AMK is 1992 and JVB or JVN is 1993.

Any remaining characters are proprietary. So in example, a Model number on the ID plate that reads **574AMFTC** would designate a 1987 5.7L engine with a 4 bbl carburetor and manual steering, first model released. A number reading **74FAPRJVB** would designate a 1993 7.4L engine with fuel injection, power steering and a right hand propeller, first release; get the picture?

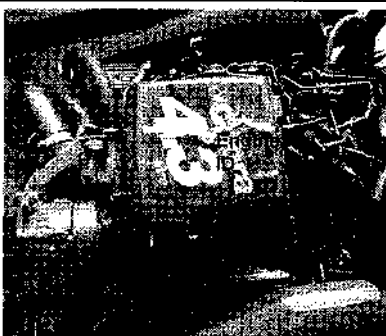


Fig. 2 Engine serial number sticker—4.3L engines

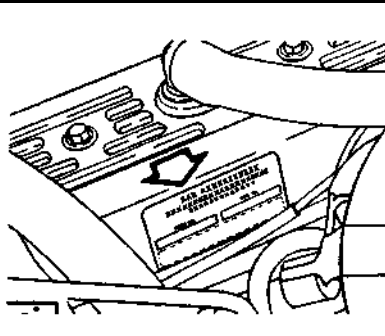


Fig. 3 Engine serial number sticker—V6 and V8 engines



Fig. 4 You should also be able to find a plate on the transom bracket

5-4 ENGINE MECHANICAL—GM V6 AND V8 ENGINES

Engine Model Designations

Most engines covered here utilize unique identifiers assigned by OMC; surnames if you will—4.3GL, 5.0GL, 8.2GSI, etc. Obviously the first two characters designate the engine size in litres (L). The second letter, a G or and F designate the engine manufacturer; General Motors (G) or Ford (F). The third through fifth letters can be found in different combinations, but the individual letter designates the same thing regardless of position. L designates limited output. S and X designate superior output—a 4.3GL will always have a lesser horsepower rating than a 4.3GS in a given model year; a 5.7GL will be less than a 5.7GS. An i designates that the engine is fuel injected, if there is no i then you know the engine uses a carburetor.

Engine

REMOVAL & INSTALLATION



◆ See Figures 5 thru 12

Prior to removing the engine from your vessel on all 1994-98 models, it is imperative to measure the engine height as detailed in the **Determining Minimum Engine Height** section. **DO NOT** remove the engine until you have completed this procedure!

1. Check the clearance between the front of the engine and the inside edge of the engine compartment bulkhead. If clearance is less than 6 in. (152mm), you will need to remove the stern drive unit because there won't be enough room to disengage the driveshaft from the engine coupler. More than 6 in. will provide enough working room to get the engine out without removing the drive. BUT, we recommend removing the drive anyway. If you intend on doing anything to the mounts or stringers, you will need to re-align the engine as detailed in the Engine Alignment section—which requires removing the drive, so remove the drive!
2. Remove the stern drive unit as detailed in the Drive Systems section.
3. Open or remove the engine hatch cover.
4. Disconnect the battery cables (negative first) at the battery and then disconnect them from the engine block and starter.

✱✱ CAUTION

Make sure that all switches and systems are OFF before disconnecting the battery cables.

5. Disconnect the two power steering hydraulic lines at the steering cylinder (models w/ps). Carefully plug them and then tie them off somewhere on the engine, making sure that they are higher than the pump to minimize any leakage.
6. Disconnect the fuel inlet line at the fuel pump or filter (whichever comes first on your particular engine) and quickly plug it and the inlet—a clean golf tee and some tape works well in this situation. Make sure you have rags handy, as there will be some spillage.
7. Tag and disconnect the two-wire trim/tilt connector.
8. Pop the two-wire trim/tilt sender connector out of the retainer and then disconnect it. You may have to cut the plastic tie securing the cable in order to move it out of the way.
9. Locate the large rubber coated instrument cable connector (should be on the starboard side), loosen the hose clamp and then disconnect it from the bracket. Move it away from the engine and secure it. On early models, you will also need to unplug the three-wire trim/tilt cable connector just above it.

Take note of you throttle arm attachment stud—is it a “push-to-close” or a “pull-to-close”? What hole is it on??

10. Remove the cotter pin and washer from the throttle arm. Loosen the anchor block retaining nut and then spin the retainer away from the cable trunnion. Remove the throttle cable from the arm and anchor bracket. Be sure to mark the position of the holes that the anchor block was attached to.
11. Loosen the 4 hose clamps and disconnect the intermediate exhaust hose bellows from intermediate pipe. You may want to spray some WD-40 around the lip of the hose where it connects to the elbow, grasp it with both hands and wiggle it back and forth while pulling down on it. Slide it down over the lower pipe.

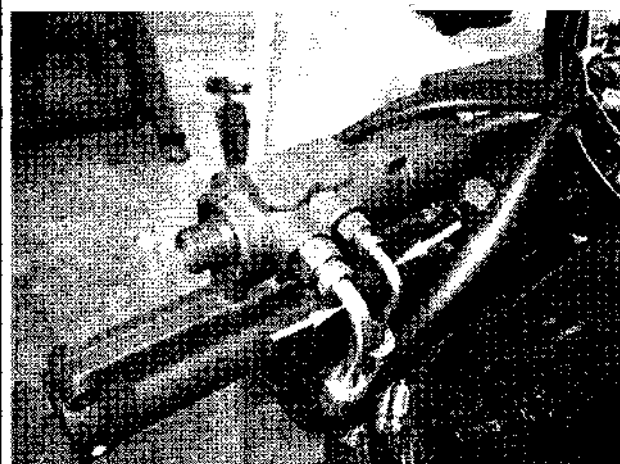


Fig. 5 Disconnect the power steering lines at the cylinder

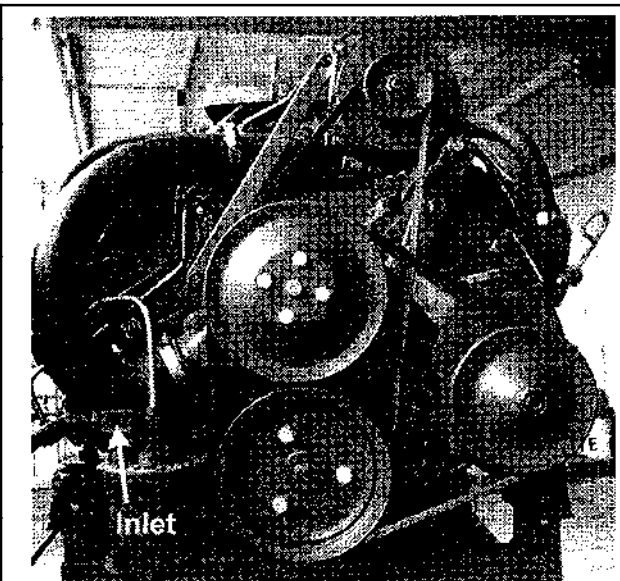


Fig. 6 Disconnect the fuel inlet line

12. Drain the cooling system as detailed earlier in this section.
13. Loosen the hose clamp on the water supply hose at the transom bracket and carefully slide it off the water tube. Attach the hose to the engine. On big block engines, disconnect the water line at the oil cooler on the rear of the block.
14. Disconnect the shift cables and position them out of the way.
15. Tag and disconnect any remaining lines, wires or hoses at the engine.
16. Attach a suitable engine hoist to the lifting eyes and take up any line slack until it is just taut.

The engine hoist should have a capacity of at least 1500 lbs. (680 kg).

17. Locate the rear engine mounts and remove both lock nuts and flat washers.
18. Locate the front engine mounts and remove the two (per mount) lag bolts.
19. If you listened to us at the beginning of the procedure, the drive unit should be removed. If so, slowly and carefully, lift out the engine. Try not to hit the power steering control valve, or any other accessories, while removing it from the engine compartment. If you didn't listen to us, and you had sufficient clearance in the engine compartment, the drive unit is probably still installed. Raise the hoist slightly until the weight is removed from the mounts and then carefully pull the engine forward until the driveshaft disengages from the coupler, now raise the engine out of the compartment.

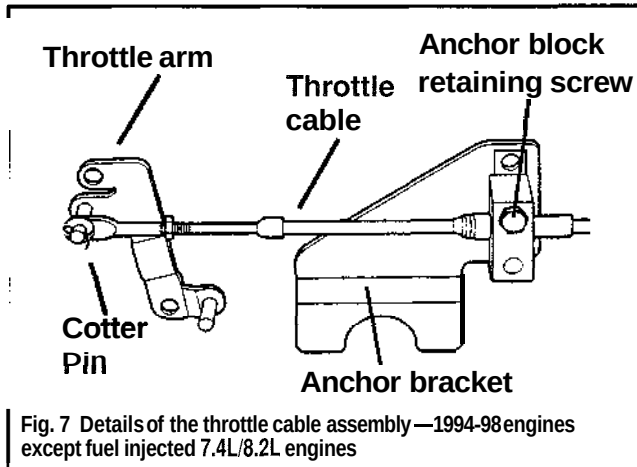


Fig. 7 Details of the throttle cable assembly—1994-98 engines except fuel injected 7.4L/8.2L engines

To install:

20. Apply Engine Coupler grease to the splines of the coupler.

21. Slowly lower the engine into the compartment. If the drive unit was not removed, AND the crankshaft has not been rotated, insert the driveshaft into the coupler as you push the engine backwards until they engage completely and then lower the engine into position over the rear mounts until the front mounts just touch the stringers. If the shaft and coupler will not align completely, turn the crankshaft or driveshaft slightly until they mate correctly.

If the drive was removed, or the mounts were disturbed in any way, lower the engine into position over the rear mounts until the front mount just touches the stringer.

22. Install the two flat washers into the recess in the engine bracket side of the rear mounts and then install the two lock nuts. Tighten them to 28-30 ft. lbs. (38-40 Nm).

✖ ✖ CAUTION

Never use an impact wrench or power driver to tighten the locknuts.

23. Install the lag bolts into their holes on the front mounts and tighten each bolt securely.

24. If the drive was removed, the mounts were disturbed or the driveshaft/coupler didn't mate correctly, perform the engine alignment procedure detailed in this section. We think it's a good idea to do this regardless!

25. Reconnect the exhaust bellows by sliding it up and over the pipe, position the clamps between the ribs in the hose and then tighten the clamps securely. Make sure you don't position the clamps into the expanding area.

26. Reconnect the water inlet hose. Lubricate the inside of the hose and wiggle it onto the inlet tube. Slide the clamp over the ridge and tighten it securely. This sounds like an easy step, but it is very important—if the hose, particularly the underside, is not installed correctly the hose itself may collapse or come off. Either scenario will cause severe damage to your engine, so make sure you do this correctly!

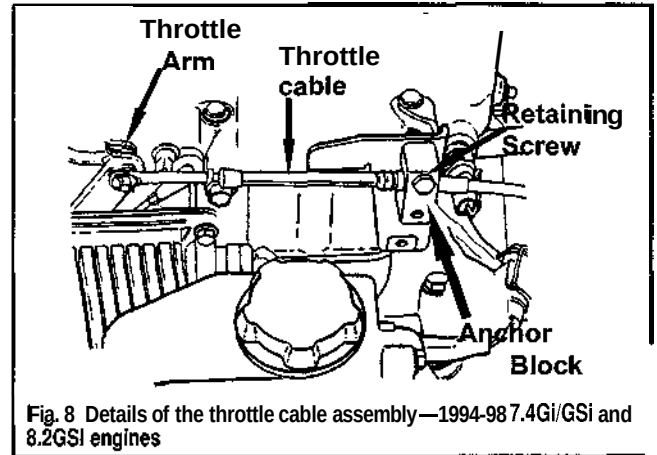


Fig. 8 Details of the throttle cable assembly—1994-98 7.4Gi/GSi and 8.2GSI engines

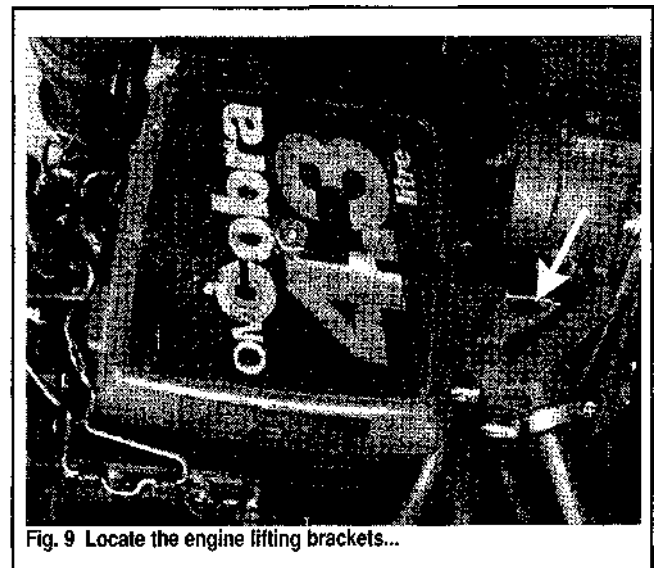


Fig. 9 Locate the engine lifting brackets...

27. Carefully, and quickly, remove the tape and plugs so you can connect the power steering lines. Tighten the large fitting to 15-17 ft. lbs. (20-23 Nm) and the small fitting to 10-12 ft. lbs. (14-16 Nm). Don't forget to check the fluid level and bleed the system when you are finished with the installation.

28. Reconnect the trim/tilt connector so the two halves lock together.

29. Reconnect the trim position sender leads, the instrument cable, the engine ground wire, the battery cables and all other wires, lines of hoses that were disconnected during removal. Make sure you swab a light coat of grease around the fitting for the large engine/instrument cable plug.

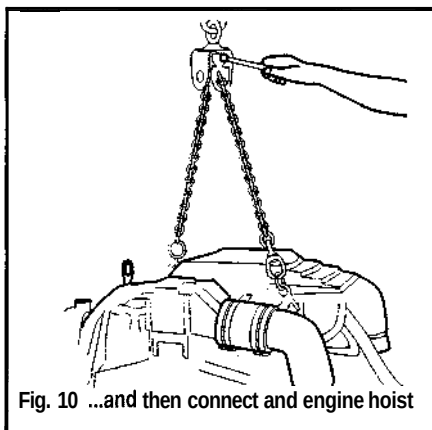


Fig. 10 ...and then connect and engine hoist

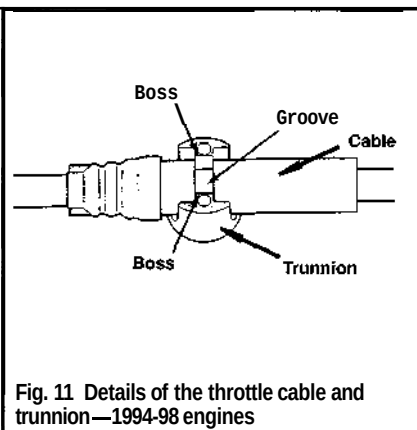


Fig. 11 Details of the throttle cable and trunnion—1994-98 engines

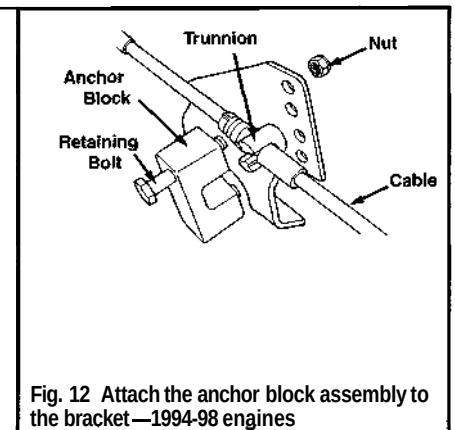


Fig. 12 Attach the anchor block assembly to the bracket—1994-98 engines

5-6 ENGINE MECHANICAL—GM V6 AND V8 ENGINES

CAUTION

Always make certain that all switches and systems are turned OFF before reconnecting the battery cables.

■ Make sure all cables, wires and hoses are routed correctly before initially starting the engine.

30. Unplug the fuel line and pump/filter fitting and reconnect them. Remember to check for leaks as soon as you start the engine.

31. Install and adjust the throttle cable. For complete details, please refer to the Fuel System section):

a. Remember we asked you to determine if you had a "push-to-close" or "pull-to-open" throttle cable (the throttle arm stud)? Position the remote control handle in Neutral—the propeller should rotate freely.

b. Turn the propeller shaft and the shifter into the forward gear detent position and then move the shifter back toward the Neutral position halfway.

c. Position the trunnion over the groove in the throttle cable so the internal bosses align and then snap it into the groove until it is fully seated.

d. Install the trunnion/cable into the anchor block so the open side of the trunnion is against the block. Position the assembly onto the bracket over the original holes (they should be the lower two of the four holes) and then install the retaining bolt and nut. When the nut is securely against the back of the bracket, tighten the bolt securely.

e. Install the connector onto the throttle cable and then pull the connector until all end play is removed from the cable. Turn it sideways until the hole is in alignment with the correct stud on the throttle arm. Slide it over the stud and install the washer and a new cotter pin. Make sure the cable is on the same stud that it was removed from. Tighten the jam nut against the connector

The throttle arm connector nut must be installed on the cable with a minimum of 9 turns—meaning that at least 1 1/4 in. of thread should be showing between the end of the cable and the edge of the nut.

32. Install and adjust the shift cables. Please refer to the Drive Systems section for further details.

33. Check and refill all fluids. Start the engine and check for any fuel or coolant leaks. Go have fun!

DETERMINING MINIMUM ENGINE HEIGHT

1994-98 Engines Only

4 See Figure 13



This procedure MUST be performed prior to removing the engine from the vessel.

1. With the engine compartment open, position a long level across the transom running fore and aft.

2. Have a friend or assistant steady the level while you measure from the bottom edge of the tool to the top of the exhaust elbow. Record the distance as "1".

3. Now measure from the bottom of the level to the static water line on the drive unit. Record the distance as "2".

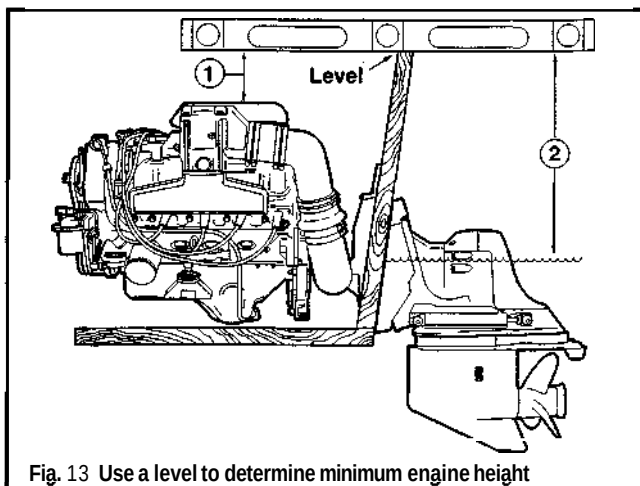


Fig. 13 Use a level to determine minimum engine height

4. Subtract the elbow measurement (1) from the static waterline measurement (2). If the result is less than 13 in. (330mm) on V6 engines or 14 in. (356mm) on V8 engines, an exhaust elbow high rise kit must be installed (available from your local parts supplier).

ENGINE ALIGNMENT



4 See Figures 14 and 15

Engine alignment is imperative for correct engine installation and also for continued engine and drive operation. It is a good idea to ensure proper alignment every time that the drive or engine has been removed. Engine alignment is checked by using OMC alignment tool (#912273) and handle (#311880). Engine alignment is adjusted by raising or lowering the front engine mount(s).

1. With the drive unit off the vessel, slide the alignment tool through the gimbal bearing and into the engine coupler. It should slide easily, with no binding or force. If not, check the gimbal bearing alignment as detailed in the Drive Systems section. If bearing alignment is correct, move to the next step.

2. If your engine utilizes a jam nut on the bottom of the mount bolt, loosen it and back it off at least 1/2 in.

3. Loosen the lock nut and back it off.

4. Now, determine if the engine requires raising or lowering to facilitate alignment—remember, the alignment tool should still be in position. Tighten or loosen the adjusting nut until the new engine height allows the alignment tool to slide freely.

5. Hold the adjusting nut with a wrench and then tighten the lock nut to 100-120 ft. lbs. (136-163 Nm). If your engine uses a jam nut, cinch it up against the lock nut.

6. Remove the alignment tool and handle.

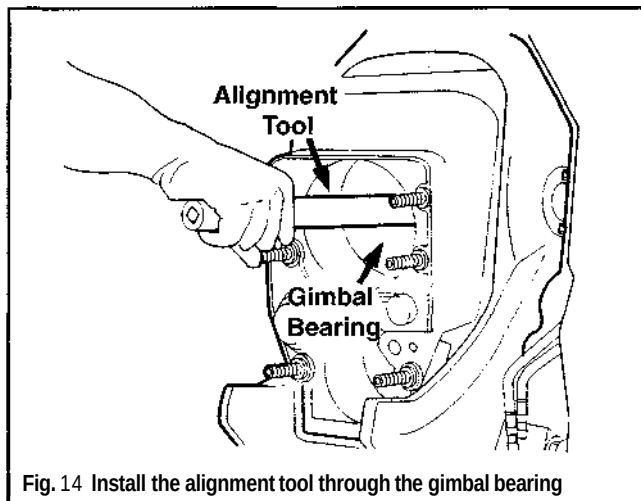


Fig. 14 Install the alignment tool through the gimbal bearing

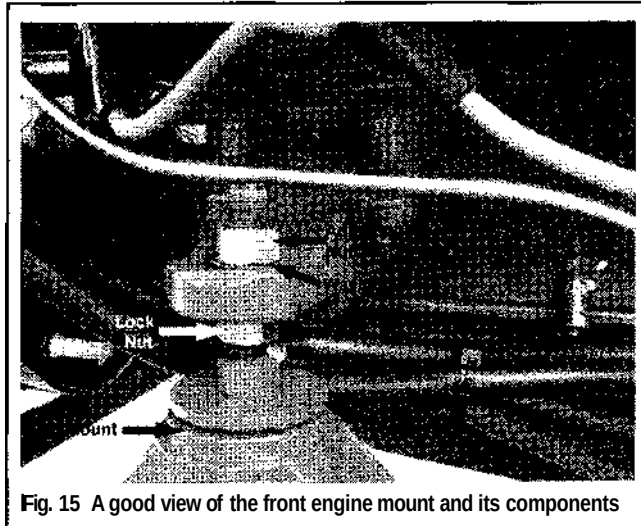


Fig. 15 A good view of the front engine mount and its components

Front Engine Mounts

REMOVAL & INSTALLATION

◆ See Figures 15 and 16



1. Position an engine hoist over the engine and hook it up to the two engine lifting eyes.
2. Remove the two lag screws/bolts on each side of the mount where it rests on the stringer.
3. Raise the engine just enough to allow working room for removing the mount.
4. Remove the three mount-to-engine mounting bolts with their lock washers and lift out the mount. One of the bolts is hidden under the bracket, behind the mount bolt.

☐ Some engines may use bolts of different lengths; mark them so you can replace them in their original locations.

5. Measure the distance between the top of the large washer on the mount and the flat on the lower side of the mounting bracket. Record it.
 6. Position a wrench over the bottom nut on the adjusting bolt, just underneath the mount, to hold the shaft and then remove the top nut. Lift off the bracket.
 7. Remove the two lock nuts from the bolt and slide out the adjusting bolt. Remember which washer goes where.
- To install:**
8. Slide the adjusting bolt up through the mount and then position the small and large washers over the bolt—large over small.
 9. Spin on the first (lower) lock nut and tighten it to 60-75 ft. lbs. (81-102 Nm).
 10. Screw on the upper lock nut and then position the mount bracket over the bolt. Install the washer and adjusting nut and check the measurement taken in Step 5. Move the upper lock nut up or down until the correct specification is achieved and then tighten the adjusting nut to 100-120 ft. lbs. (136-163 Nm) on V6 and 5.0L/5.7L engines; 50-70 ft. lbs. (68-95 Nm) on 7.4L and 8.2L engines.

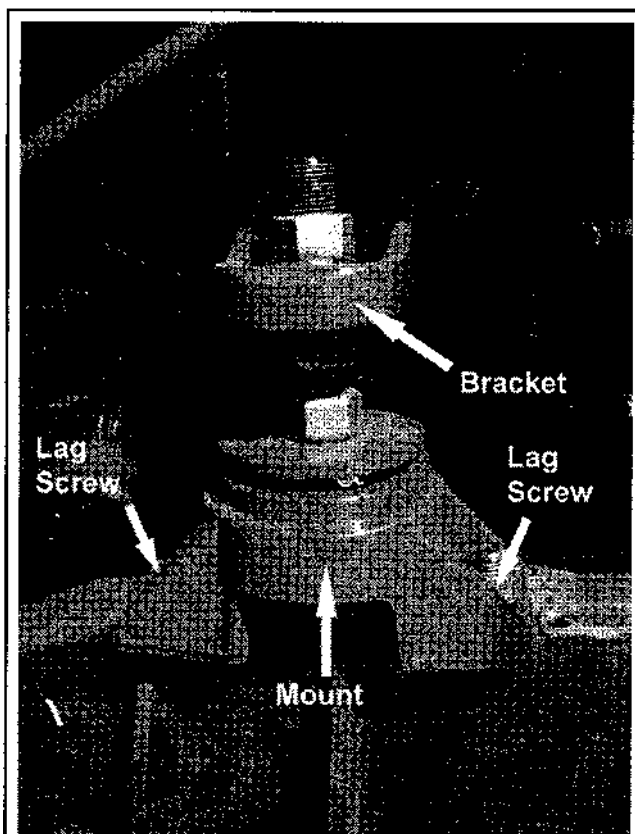


Fig. 16 There is a third mounting bolt hidden behind the adjusting bolt in this shot

11. Spray the three mounting bolts with Loctite Primer N and allow them to air dry. Once dry, coat the bolts with Loctite or OMC Thread Sealing Agent and attach the mount to the engine. Tighten the bolts to 32-40 ft. lbs. (43-54 Nm).

12. Position the mount over the lag screw holes and then slowly lower the engine until all weight is off the hoist. Install and tighten the lag screws securely.

13. If you're confident that your measurements and subsequent adjustment place the engine exactly where it was prior to removal, then you are through. If you're like us though, you may want to check the engine alignment before you fire up the engine.

Rear Engine Mounts

REMOVAL & INSTALLATION



◆ See Figure 17

1. Remove the engine as detailed previously.
2. Loosen the two bolts and remove the mount from the transom plate. Remember, you will already have removed the top lock nut and the washer during engine removal.
3. Hold the square nut with a wrench and remove the shaft bolt. Be sure to take note of the style and positioning of the two mount washers as you are removing the bolt. Mark them, lay them out, or write it down, but don't forget their orientation!!

To install:

4. Slide the lower of the two washers onto the mount bolt, exactly as it came off.
5. Slide the bolt into the flat (bottom) side of the rubber mount, install the remaining washer (as it came off!) and then spin on the square nut. Do not tighten it yet.

Incorrect washer installation will cause excessive vibration during engine operation.

6. Turn the assembly upside down and clamp the square nut in a vise. Spin the assembly until the holes in the mounting plate are directly opposite any two of the flat sides on the nut. This is important, otherwise the slot on the engine pad will not engage the mount correctly. Secure the mount in this position and tighten the bolt to 18-20 ft. lbs. (24-27 Nm) on 1986-88 engines, or 44-52 ft. lbs. (60-71 Nm) on 1989-98 engines.

7. Remove the mount from the vise and position it on the transom plate. Install the bolts and washers and tighten each to 20-25 ft. lbs. (27-34 Nm).

8. Install the engine, making sure that the slot in the engine pad engages the square nut correctly. Install the two washers and locknut and tighten it to 28-30 ft. lbs. (38-41 Nm).

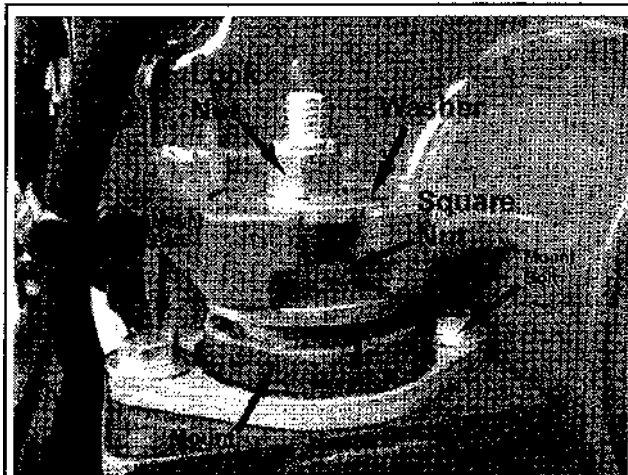


Fig. 17 A good look at the rear mount

5-8 ENGINE MECHANICAL—GM V6 AND V8 ENGINES

Cylinder Head (Valve) Cover

REMOVAL & INSTALLATION

◆ See Figures 18, 19 and 20



□ In order to perform this procedure efficiently, we recommend removing the exhaust manifold in order to have sufficient working room to remove the cylinder head cover. Although not completely necessary, it's worth the extra effort to avoid the aggravation of working around the manifolds. Please refer to the manifold procedure later in this section.

1. Open or remove the engine compartment hatch. Disconnect the negative battery cable.
2. Loosen the clamp and remove the crankcase ventilation hose at the cover. Carefully move it out of the way.
3. Tag and disconnect any lines, leads or hoses that might be in the way of removal. In some instances you may be able to simply secure them out of the way without disconnecting them—you be the judge.
4. If your engine has a spark plug wire retainer attached to the cover, unclip the wires or remove the retainer and then tag and disconnect the plug wires at the spark plugs.
5. Loosen the cover mounting bolts (usually three on the V6, four on the 5.0L/5.7L and seven or eight on the 7.4L/8.2L) and lift off the cylinder head cover. Take note of any harness or hose retainers and clips that might be attached to certain of the mounting bolts; you need to make sure they go back in the same place.

To install:

6. Clean the cylinder head and cover mounting surfaces of any residual gasket material with a scraper or putty knife.
7. Position a new gasket on the cylinder head and then position the cover (don't forget the J-clips!). Tighten the mounting bolts to:
 - 100 inch lbs. (11.3 Nm) on 1986-93 4.3L engines
 - 62-115 inch lbs. (7-13 Nm) on 1994-96 4.3L engines
 - 106 inch lbs. (12 Nm) on 1997-98 4.3L engines
 - 45 inch lbs. (5 Nm) on 1986-96 5.0L/5.7L engines
 - 65 inch lbs. (7.3 Nm) on 1991 350 engines
 - 65 inch lbs. (7.3 Nm) on 1992 5.7 LE engines
 - 90 inch lbs. (10 Nm) on 1997 5.0L/5.7L engines (except the 1997 5.7GSI)
 - 106 inch lbs. (12 Nm) on 1997 5.7GSI and 1998 V8 engines
 - 115 inch lbs. (13 Nm) on 7.4L/8.2L engines, except 1996-97 and 1998 7.4Gi
 - 60-90 inch lbs. (7-10 Nm) on 1996-97 7.4L/8.2L engines
 - 72 inch lbs. (8 Nm) on 1998 7.4Gi engines
8. Make sure any retainers or clips that were removed are back in their original positions.
9. Connect the crankcase ventilation hose and any other lines or hoses that may have been disconnected. Check that there were no other wires or hoses you may have repositioned in order to gain access to the cover.
10. Install the exhaust manifold.
11. Connect the battery cables.

Rocker Arms and Push Rods

REMOVAL & INSTALLATION

1992-98 4.3L V6 and 1992-98 7.4L/8.2L V8 Engines

◆ See Figure 21



1. Open or remove the engine hatch cover and disconnect the negative battery cable. Remove the cylinder head cover as detailed previously.
2. Bring the piston in the No. 1 cylinder to TDC. If servicing only one arm, bring the piston in that cylinder to TDC. The No. 1 cylinder is the first cylinder at the port side of the engine.
3. Loosen and remove the rocker arm nut on the V6, shoulder bolt on the V8. Lift out the ball.
4. Lift the arm itself off of the mounting stud (or boss) and pull out the pushrod. On the V8, lift off the pushrod guide before removing the pushrod if it didn't come off with the rocker. It is very important to keep each cylinder's component parts together as an assembly. We suggest drilling a set of holes in a 2X4 and positioning the pieces in the holes.

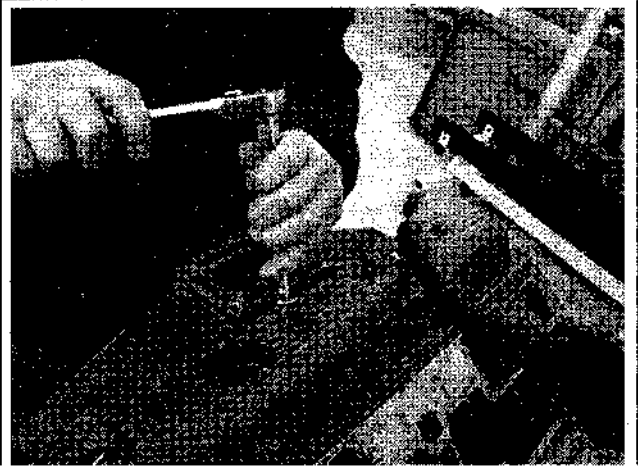


Fig. 18 Remove the bolts (5.7L shown)...

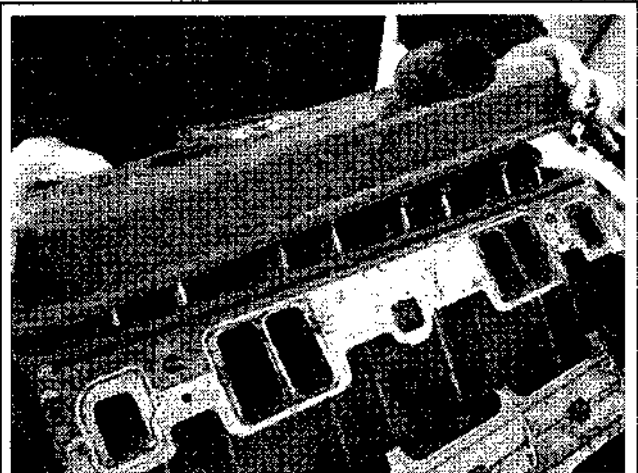


Fig. 19 ...and then lift off the cover



Fig. 20 Position a new gasket on the head

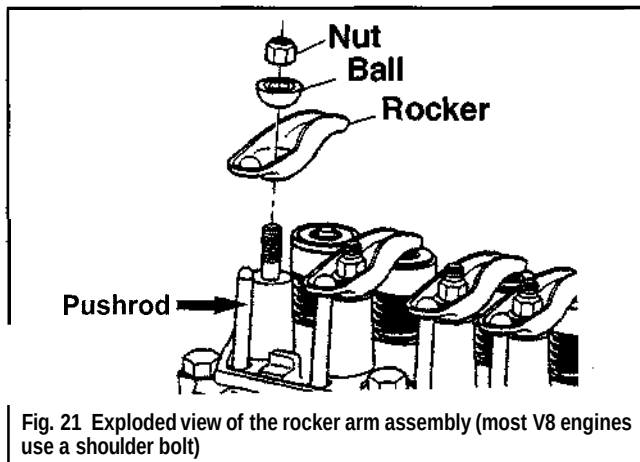


Fig. 21 Exploded view of the rocker arm assembly (most V8 engines use a shoulder bolt)

To install:

5. Clean and inspect the rocker assemblies. If any scuffing, wear or obvious deterioration is found replace the entire assembly (rocker, ball and pushrod, and guide if equipped). Roll each push rod across a flat, even surface (countertops work great for this); if it does not roll smoothly, replace it.
6. Coat all bearing surfaces of the rocker assembly with engine oil.
7. Slide the push rods into their holes. Make sure that each rod seats in its socket on the lifter.
8. On V8 engines, position the guide over the rod so the other side is sitting on the boss.
9. Position the rocker arm over the stud (boss) so that the cupped side rides on the push rod. Slide the ball over the stud, install the nut or bolt and tighten it to:
 - 40 ft. lbs. (54 Nm) on 1992-96 V6 engines
 - 20 ft. lbs. (27 Nm) on 1997-98 V6 engines
 - 40 ft. lbs. (54 Nm) on 1992-98 V8 engines, except 1998 7.4Gi
 - 45 ft. lbs. (61 Nm) on 1998 7.4Gi engines
10. No additional adjustment of the valves is necessary as the lash is set automatically when the rocker is tightened to specifications.
11. Install the cylinder head cover, connect the battery cable and check the idle speed.

1986-91 4.3L V6, 1986-98 5.0L/5.7L V8, 1990-91 7.4L V8 Engines



4 See Figures 21, 22 and 23

1. Open or remove the engine hatch cover and disconnect the negative battery cable. Remove the cylinder head cover as detailed previously.
2. Bring the piston in the No. 1 cylinder to TDC. If servicing only one arm, bring the piston in that cylinder to TDC. The No. 1 cylinder is the first cylinder at the port side of the engine.
3. Loosen and remove the rocker arm nuts and lift out the balls.
4. Lift the arm itself off of the mounting stud and pull out the pushrod. It is very important to keep each cylinder's component parts together as an assembly. We suggest drilling a set of holes in a 2X4 and positioning the pieces in the holes.

On certain engines, the exhaust valve pushrods are longer than those for the intake valve.

To install:

5. Clean and inspect the rocker assemblies, particularly the balls where they mate with the rockers.
6. Coat all bearing surfaces of the rocker assembly with engine oil.
7. Slide the push rods into their holes. Make sure that each rod seats in its socket on the lifter.
8. Position the rocker arm over the stud so that the cupped side rides on the push rod. Slide the ball over the stud, install the nut and tighten it until zero lash is present.
9. Adjust the valves as detailed in the Valve Adjustment section.
10. Install the cylinder head cover, connect the battery cable and check the idle speed.

VALVE ADJUSTMENT

1986-91 4.3L V6, 1986-98 5.0L/5.7L V8, 1988-91 7.4L V8 And 1998 7.4L/8.2L V8 Engines



4 See Figure 24

These engines utilize hydraulic valve lifters, although there is no need for periodic valve adjustment, it is necessary to perform a preliminary adjustment after any work on the valve train/rocker assembly. All adjustment should be undertaken while the lifter is on the base circle of the camshaft lobe for that particular cylinder. This means the opposite side of the pointy part of each lobe.

1. Rotate the crankshaft, or bump the engine with the starter until the No. 1 cylinder is at TDC. Note that the notch or mark on the damper pulley will be lined up with the 0 mark on the timing scale. Be careful here though, this could mean that either the No. 1 or the No. 6 (No. 4, V6) piston is at TDG. Place your hand on the No. 1 cylinder's valve and check that it does not move as the mark on the pulley is approaching the 0 mark on the tab. If it does not move, you're ready to proceed; if it does move, you are on the No. 6 (No. 4) cylinder and need to rotate the engine an additional full turn. This is important so make sure you've gotten it right!

2. Now that the No. 1 cylinder is at TDC, you can adjust the following valves on V6 engines:

- No. 1 cylinder: intake and exhaust
- No. 2 cylinder: intake
- No. 3 cylinder: intake
- No. 5 cylinder: exhaust
- No. 6 cylinder: exhaust

Or these valves on V8 engines:

- No. 1 cylinder: intake and exhaust
- No. 2 cylinder: intake
- No. 3 cylinder: exhaust

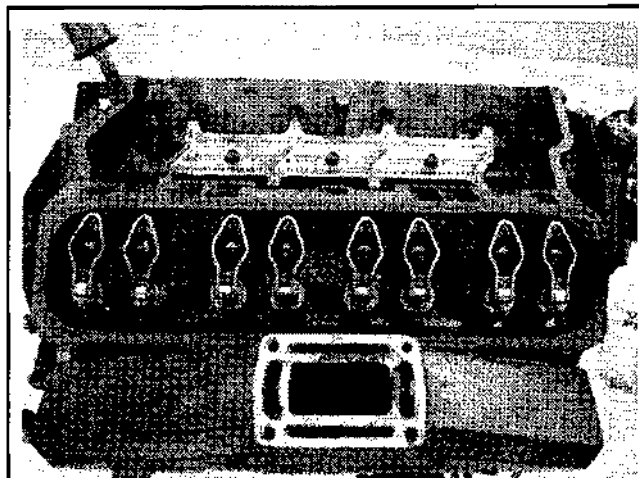


Fig. 22 Wouldn't it be nice if your valve train looked this good?

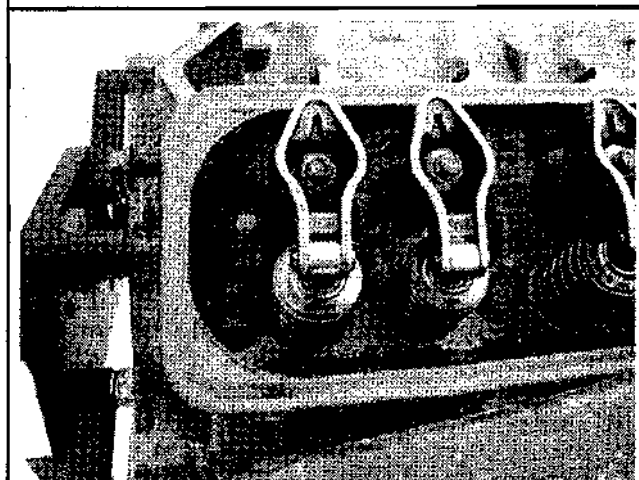


Fig. 23 Close-up of the rocker assembly

5-10 ENGINE MECHANICAL—GM V6 AND V8 ENGINES

- No. 4 cylinder: exhaust
- No. 5 cylinder: intake
- No. 7 cylinder: intake
- No. 8 cylinder: exhaust

3. Loosen the adjusting nut on the rocker until you can feel lash (play in the push rod) and then tighten the nut until the lash has been removed. Carefully jiggle the push rod while tightening the nut until it won't move anymore—this is zero lash. Tighten the nut an additional full turn (3/4 turn for the 1988-91 big block) to set the lifter and then you're done. Perform this procedure on each of the valves listed above.

4. Slowly rotate the engine an additional full turn and this will bring the No. 6 (No. 4 on V6) piston to TDC. The pulley notch/mark should once again be in line with the 0 on the timing tab. You can now adjust the remaining valves as you just did on the first pass:

- No. 2 cylinder: exhaust
- No. 3 cylinder: intake
- No. 4 cylinder: intake and exhaust
- No. 5 cylinder: intake
- No. 6 cylinder: intake

Or these valves on V8 engines:

- No. 2 cylinder: exhaust
- No. 3 cylinder: intake
- No. 4 cylinder: intake
- No. 5 cylinder: exhaust
- No. 6 cylinder: intake and exhaust
- No. 7 cylinder: exhaust
- No. 8 cylinder: intake

1992-98 4.3L V6, 1992-97 7.4L/8.2L V8 And 1998 7.4Gi V8 Engines

No initial valve lash adjustment is necessary on these engines; net lash is set when tightening the rocker arm nut or shoulder bolt to the proper torque. The rocker studs on engines with nuts are equipped with 'positive stop' shoulders.

Hydraulic Valve Lifter

REMOVAL & INSTALLATION

◆ See Figures 25 thru 33



Although all engines covered here are equipped with hydraulic lifters, some utilize conventional flat lifters, while others will be equipped with roller lifters. Procedures for each type are different, yet similar enough that we will cover them both within this procedure.

1. Using compressed air, thoroughly clean all dirt and grit from the cylinder head and related components.

✖✖ WARNING

If compressed air is not available, we highly recommend that you DO NOT proceed with this procedure. It is EXTREMELY important that no dirt gets into the lifter recesses before completing the installation.

2. Remove the cylinder head cover.
3. Remove the intake and exhaust manifolds.
4. Loosen the rocker arms and pivot the rockers off of the pushrods; or just remove them completely.
5. Remove the pushrods from the block, being very careful to keep track of where each one came from.
6. Remove the splash shield on 1998 7.4Gi engines.
7. On V6 and certain later V8 engines, loosen and remove the mounting bolts (two or four) and then lift off the lifter guide retainer, with the restrictors/guides. It is a good idea to mark the front side of the retainer for proper installation later on.

Not all engines utilize a guide retainer or restrictors/guides in all years, but it will be obvious whether or not your particular engine has them.

8. Remove the lifters. Although they should come right out, you may want to use a magnet, or in some cases on later engines you will need to use a lifter extractor tool (#J9290-1 or J-3049-A) to extract each lifter. On engines with roller lifters and lifter guides, it is important that the two match

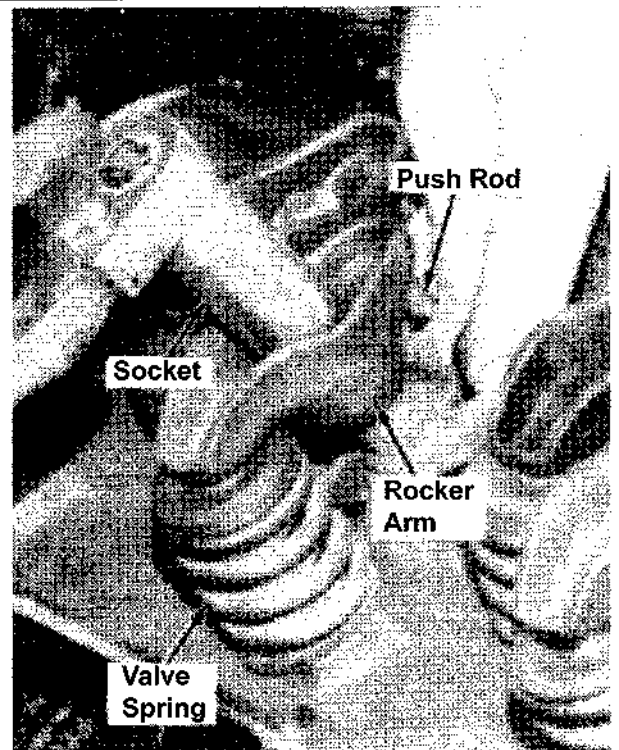


Fig. 24 Wiggle the push rod slowly while tightening the rocker arm adjusting nut

each other and that the roller rolls in the same direction as when it was removed; for this reason we think it's a good idea to match mark each lifter to its guide prior to removing it.

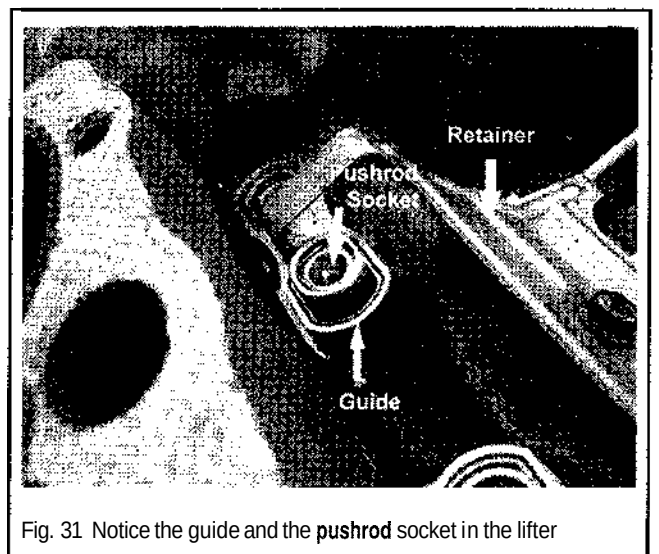
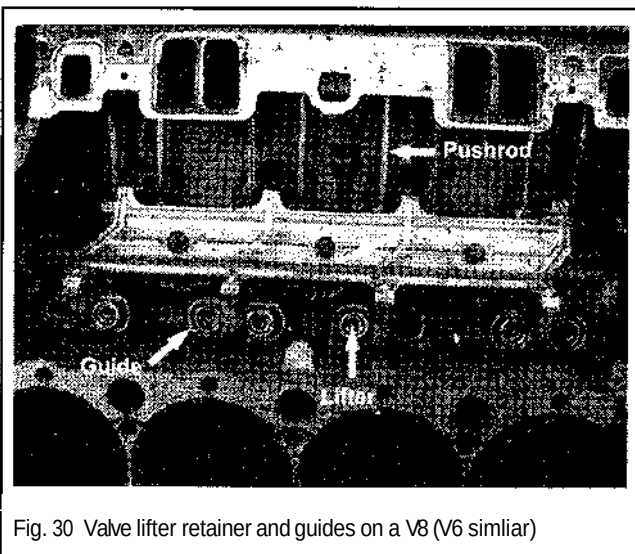
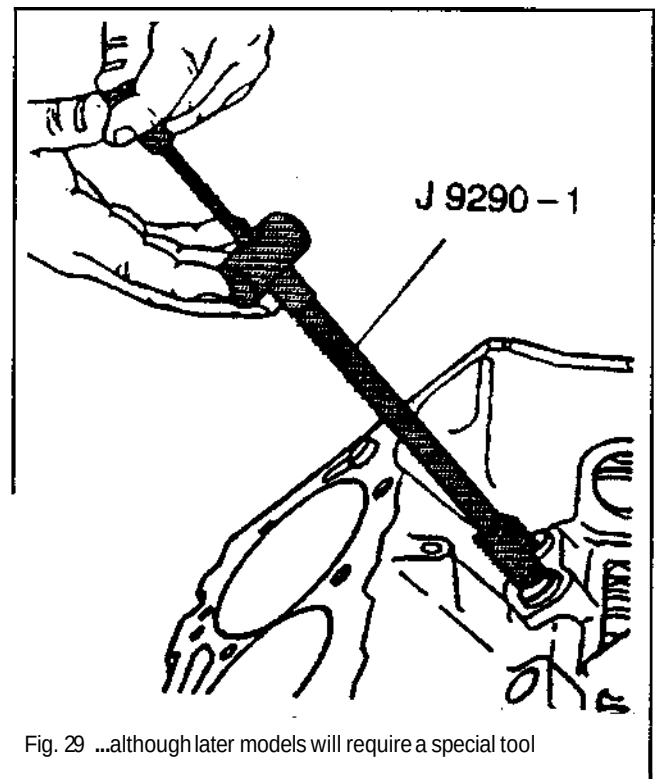
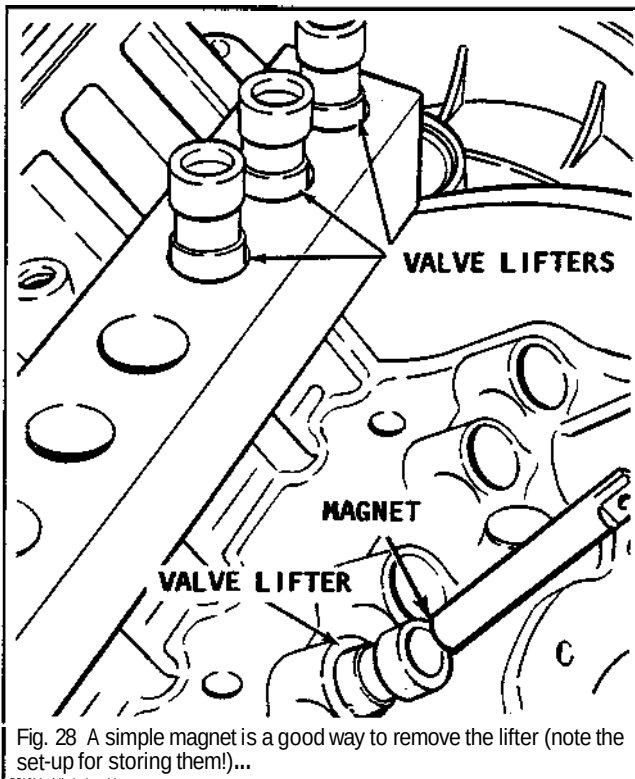
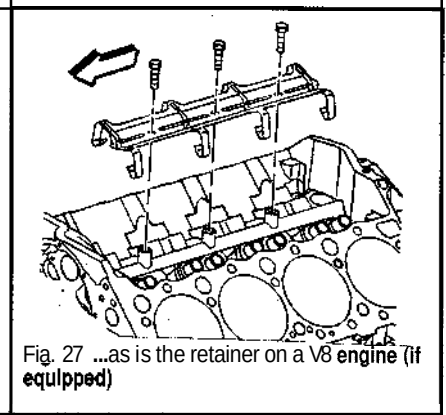
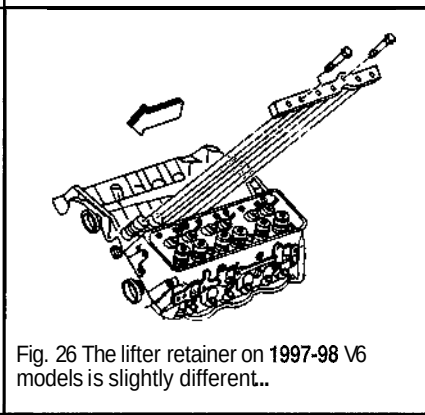
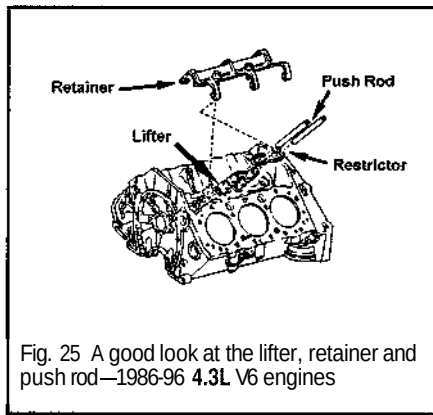
□ Once again, we suggest using a 2x4 with holes drilled in it to store the rods and lifters; you'd be amazed at how quickly this job will fall apart if someone walks in and kicks the components that you have laid out on the floor!

To install:

9. Clean all components thoroughly and let dry completely, use compressed air if at all possible.
10. Make sure that the push rod oil passages are clean and clear. Inspect the camshaft contact surface on the bottom of each lifter for excessive wear, galling or other damage. Discard the lifter if any of the above conditions are found. You'll probably want to check out the camshaft lobe for damage also.
11. Coat the bottom of each flat lifter with Molykote®, but on models with roller lifters use GM Engine Oil Supplement, and then carefully install each one into its respective recess.
12. Install the retainer, with restrictors/guides if equipped, and tighten the bolts to 12 ft. lbs. (16 Nm) on V6 engines, 18 ft. lbs. (25 Nm) on 5.0L/5.7L V8 engines and 20 ft. lbs. (26 Nm) on the big blocks. Make sure that the marks you made across the roller lifters and their guides match up and that the mark you made on the retainer is toward the front of the engine!!
- On engines with restrictors/guides, the retainer MUST contact ALL guides. If bent, and it does not make contact, replace it with a new one. DO NOT attempt to bend it back into position.
13. Install the pushrods into the sockets on the lifters. Install the splash shield on the Gi.
14. Move the rockers into position and then tighten the nut as detailed in your engine's respective Rocker Arm procedure as detailed previously.
15. Install the intake and exhaust manifolds.
16. Install the cylinder head cover.

✖✖ CAUTION

If any, or all, of the lifters has been replaced with a new one it is very important that you add GM Engine Oil Supplement to the crankcase BEFORE starting the engine.



5-12 ENGINE MECHANICAL—GM V6 AND V8 ENGINES

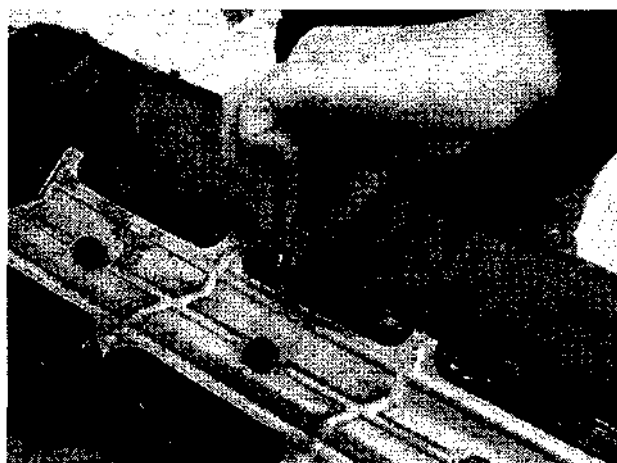


Fig. 32 The lifter should come out easily...

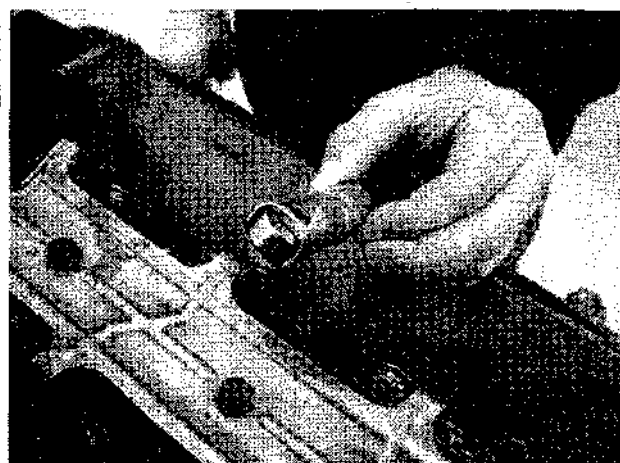


Fig. 33 ...and look like this (roller lifter shown)

Intake Manifold

REMOVAL & INSTALLATION

4.3L V6 Engines

◆ See Figures 34 thru 40



1. Open or remove the engine compartment hatch. Disconnect the negative battery cable.
2. Loosen the clamp and remove the crankcase ventilation or PCV hoses at the cylinder head covers. Carefully move them out of the way.
3. Drain all water from the cylinder block and manifolds.
4. Tag and disconnect all water hoses at the manifold and thermostat housing. Have some rags handy, since there will still be some water in them. Carefully move them out of the way.
5. Remove the flame arrestor and then disconnect the throttle cable at the carburetor/throttle body anchor block.
6. Disconnect the fuel line and **plug** the line end and the carb/throttle body. If you have a non-flexible line, disconnect it at the fuel pump also. Move both the cable and fuel line out of the way.
7. Tag and disconnect the lead at the temperature gauge sender unit. Do the same with the harness connected to the rear of the alternator. Tag and disconnect any other lines, leads or hoses that might be in the way of removal. In some instances you may be able to simply secure them out of the way without disconnecting them—you be the judge.
8. If your engine has a spark plug wire retainer attached to the cylinder head cover, unclip the wires or remove the retainer and then tag and disconnect the plug wires at the spark plugs.
9. Remove the distributor cap with the leads still connected. Mark the position of the distributor rotor to the distributor body. Scribe a matchmark across the distributor and the manifold. Loosen the clamp bolt and remove the distributor. Please refer to the Electrical section for further details on distributor removal. DO NOT turn the engine over once the distributor has been removed.
10. Remove the alternator and its mounting bracket.

11. Tag and disconnect any leads at the ignition module and move them out of the way.
12. Tag and disconnect the wire at the oil sending unit and then remove the unit itself.

13. Loosen and remove the manifold mounting bolts in the reverse order of the illustrated tightening sequence and then remove the manifold. Don't forget the solenoid bracket. There is a good likelihood you will need to pry the manifold off the block; be very careful that you don't scratch or mar the mating surfaces on the block, manifold or heads.

To install:

14. Carefully remove all remaining gasket material from the manifold mating surfaces with a scraper or putty knife. Be careful that you don't accidentally drop any old gasket into the crankcase or intake ports on the cylinder head.
15. Inspect the manifold and all mating surfaces for any cracks or nicks.
16. On 1986-96 engines, position new seals on the cylinder block mating surfaces. Position new gaskets on the cylinder head mating surfaces. Use GM Silicone Rubber Sealer at all water passages and/or wherever a seal butts against a gasket.

Some engines may not have front or rear cylinder block seals. If yours is one of them, apply a 3/16 in. (5mm) bead of RTV sealant to the forward and aft edges of the cylinder block mating surface. Make sure that you run the bead at least a 1/2 in. up onto the gaskets.

17. On 1997-98 engines, coat the cylinder head side of the gasket with RTV sealant. DO NOT apply too much sealer—see the illustration. Position the gaskets onto the heads over the locator pins.

18. Apply a 1/2 in. (13mm) bead of RTV sealant to the forward and aft edges of the cylinder block mating surface. Make sure that you run the bead at least a 1/2 in. up onto the gaskets.

19. On all engines, install the manifold into place so that all the bolt holes line up, insert the bolts and tighten them to:

- 30 ft. lbs. (41 Nm) on 1986-95 engines
- 35 ft. lbs. (48 Nm) on 1996 engines
- 11 ft. lbs. (15 Nm) on 1997-98 engines. This is final torque, so be sure you check the Specifications chart for the first two stages.

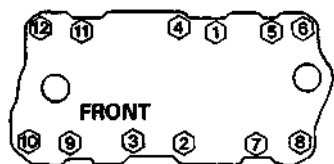


Fig. 34 Intake manifold tightening sequence—1986-95 engines

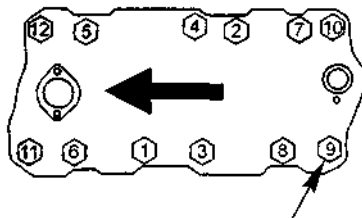


Fig. 35 Intake manifold tightening sequence—1996 engines



Fig. 36 Intake manifold tightening sequence—1997-98 engines

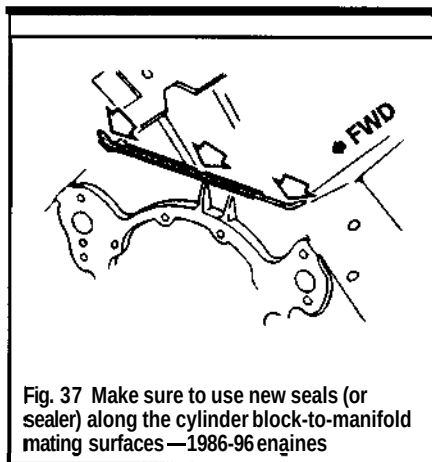


Fig. 37 Make sure to use new seals (or sealer) along the cylinder block-to-manifold mating surfaces—1986-96 engines

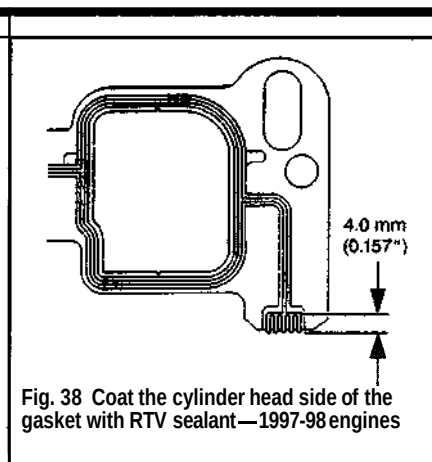


Fig. 38 Coat the cylinder head side of the gasket with RTV sealant—1997-98 engines

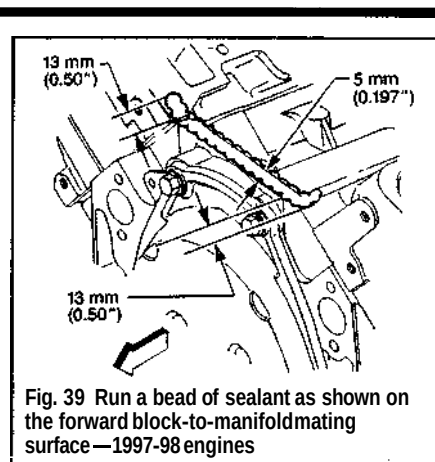


Fig. 39 Run a bead of sealant as shown on the forward block-to-manifold mating surface—1997-98 engines

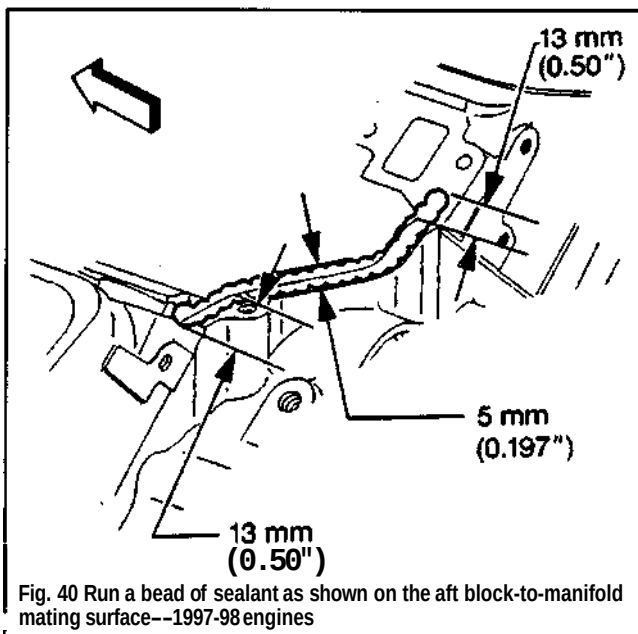


Fig. 40 Run a bead of sealant as shown on the aft block-to-manifold mating surface—1997-98 engines

Check the Torque Specifications chart for any further details on tightening needs. Tighten all bolts in the order shown in the illustration. On all 1997-98 engines, coat all eight bolts with thread locking sealant prior to installing them; remember also that these engines utilize a three step tightening process.

20. Install the oil sending unit and connect the wire.
21. Connect the ignition module leads and install the distributor as detailed in the Electrical section. Put the cap back on and reconnect the plug wires to the spark plugs.
22. Install all water hoses and tighten their clamps securely.
23. Install the fuel line at the carburetor/throttle body and fuel pump. Make sure you remove any plugs you may have inserted on removal.
24. Install the throttle cable and adjust it as detailed in the Fuel System section. Install the flame arrestor.
25. Connect all other lines, leads and hoses that may have been removed to facilitate manifold removal.
26. Install the alternator and mounting bracket. Reconnect the harness.
27. Connect the battery cable and start the engine. Check the ignition timing and idle speed. Check all hoses and seals for leaks.

5.0L And 5.7L V8 Engines

◆ See Figures 41, 42, 43, 44, 45 and 46



1. Open or remove the engine compartment hatch. Disconnect the negative battery cable.
2. Loosen the clamp and remove the crankcase ventilation or PCV hoses at the cylinder head covers. Carefully move them out of the way.
3. Drain all water from the cylinder block and manifolds.

4. Tag and disconnect all water hoses at the manifold and thermostat housing. Have some rags handy, since there will still be some water in them. Carefully move them out of the way.

5. Remove the flame arrestor and then disconnect the throttle cable at the carburetor/throttle body anchor block.

6. Disconnect the fuel line and plug the line end and the carb/throttle body/fuel rail fitting. If you have a non-flexible line, disconnect it at the fuel pump also. Move both the cable and fuel line out of the way.

7. Tag and disconnect the lead at the temperature gauge sender unit. Do the same with the harness connected to the rear of the alternator. Tag and disconnect any other lines, leads or hoses that might be in the way of removal. In some instances you may be able to simply secure them out of the way without disconnecting them—you be the judge.

8. If your engine has a spark plug wire retainer attached to the cylinder head cover, unclip the wires or remove the retainer and then tag and disconnect the plug wires at the spark plugs.

9. Remove the distributor cap with the leads still connected. Mark the position of the distributor rotor to the distributor body. Scribe a matchmark across the distributor and the manifold. Loosen the clamp bolt and remove the distributor. Please refer to the Electrical section for further details on distributor removal. DO NOT turn the engine over once the distributor has been removed.

10. Remove the alternator and its mounting bracket.

11. Tag and disconnect any leads at the ignition module and move them out of the way.

12. Tag and disconnect the wire at the oil sending unit and then remove the unit itself.

13. Loosen and remove the manifold mounting bolts in the reverse order of the illustrated tightening sequence and then remove the manifold. Don't forget the solenoid bracket. There is a good likelihood you will need to pry the manifold off the block; be very careful that you don't scratch or mar the mating surfaces on the block, manifold or heads.

To install:

14. Carefully remove all remaining gasket material from the manifold mating surfaces with a scraper or putty knife. Be careful that you don't accidentally drop any old gasket into the crankcase or intake ports on the cylinder head.

15. Inspect the manifold and all mating surfaces for any cracks or nicks.

16. On 1992-97 engines (exc. 1997 5.7GSI), position new seals on the cylinder block mating surfaces. Position new gaskets on the cylinder head mating surfaces. Use GM Silicone Rubber Sealer at all water passages and/or wherever a seal butts against a gasket.

❑ Some engines may not have front or rear cylinder block seals. If yours is one of them, apply a 3116 in. (5mm) bead of RTV sealant to the forward and aft edges of the cylinder block mating surface. Make sure that you run the bead at least a 1/2 in. up onto the gaskets.

17. On 1997 5.7GSI and all 1998 engines, coat the cylinder head side of the gasket with RTV sealant. DO NOT apply too much sealer—see the illustration. Position the gaskets onto the heads over the locator pins.

18. Apply a 1/2 in. (13mm) bead of RTV sealant to the forward and aft edges of the cylinder block mating surface. Make sure that you run the bead at least a 1/2 in. up onto the gaskets.

5-14 ENGINE MECHANICAL—GM V6 AND V8 ENGINES

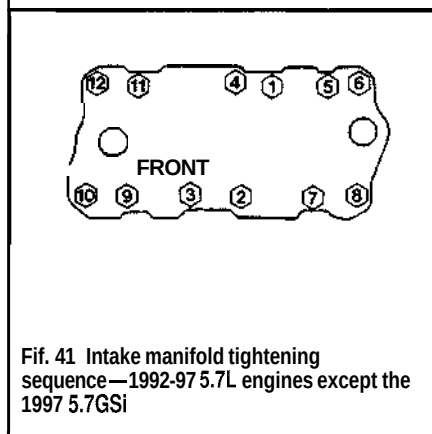


Fig. 41 Intake manifold tightening sequence—1992-97 5.7L engines except the 1997 5.7GSI

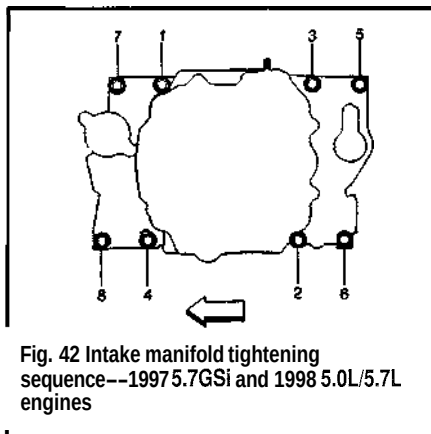


Fig. 42 Intake manifold tightening sequence—1997 5.7GSI and 1998 5.0L/5.7L engines

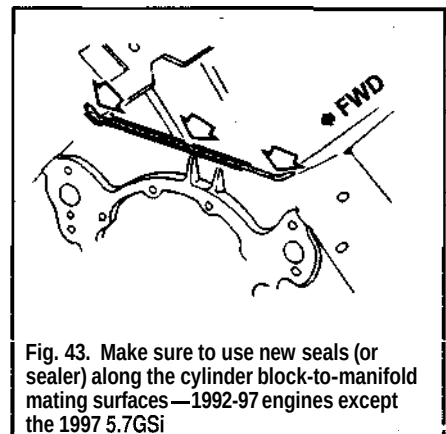


Fig. 43 Make sure to use new seals (or sealer) along the cylinder block-to-manifold mating surfaces—1992-97 engines except the 1997 5.7GSI

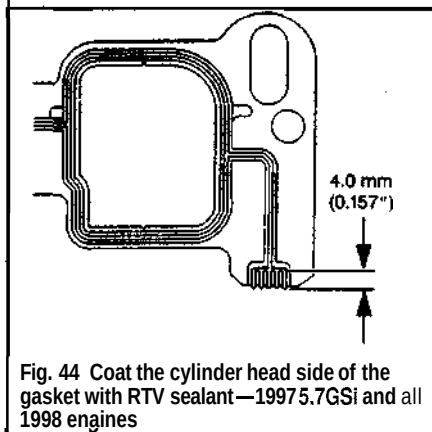


Fig. 44 Coat the cylinder head side of the gasket with RTV sealant—1997 5.7GSI and all 1998 engines

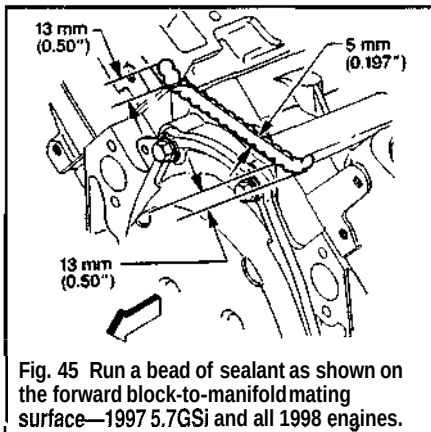


Fig. 45 Run a bead of sealant as shown on the forward block-to-manifold mating surface—1997 5.7GSI and all 1998 engines.

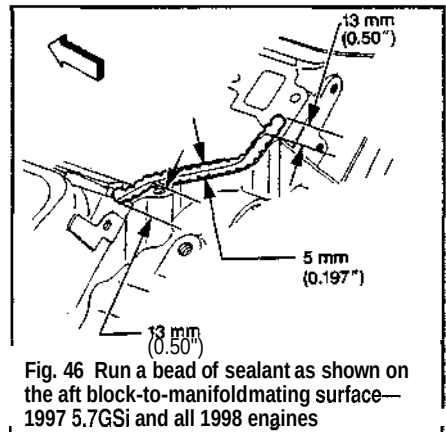


Fig. 46 Run a bead of sealant as shown on the aft block-to-manifold mating surface—1997 5.7GSI and all 1998 engines

19. On all engines, install the manifold into place so that all the bolt holes line up, insert the bolts and tighten them to:

- 30 ft. lbs. (41 Nm) on 1986-97 engines
- 11 ft. lbs. (15 Nm) on 1997 GSI and 1998 engines. This is final torque, so be sure you check. This is final torque, so be sure you check the Specifications chart for the first two stages—27 inch lbs. (3 Nm) on the first pass, 106 inch lbs. (12 Nm) on the second.

Check the Torque Specifications chart for any further details on tightening needs. Tighten all bolts in the order shown in the illustration. On all 1998 engines (yes, this also goes for the 1997 5.7GSI), coat all eight bolts with thread locking sealant prior to installing them; remember also that these engines utilize a three step tightening process.

20. Install the oil sending unit and connect the wire.

21. Connect the ignition module leads and install the distributor as detailed in the Electrical section. Put the cap back on and reconnect the plug wires to the spark plugs.

22. Install all water hoses and tighten their clamps securely.

23. Install the fuel line at the carburetor/throttle body and fuel pump. Make sure you remove any plugs you may have inserted on removal.

24. Install the throttle cable and adjust it as detailed in the Fuel System section. Install the flame arrestor.

25. Connect all other lines, leads and hoses that may have been removed to facilitate manifold removal.

26. Install the alternator and mounting bracket. Reconnect the harness.

27. Connect the battery cable and start the engine. Check the ignition timing and idle speed. Check all hoses and seals for leaks.

7.4L And 8.2L V8 Engines (Except 1997-98 Gt/GSi)

◆ See Figures 47 thru 52



1. Open or remove the engine compartment hatch. Disconnect the negative battery cable.

2. Loosen the clamp and remove the crankcase ventilation or PCV hoses at the cylinder head covers. Carefully move them out of the way.

3. Drain all water from the cylinder block and manifolds.

4. Remove the flame arrestor cover. Remove the flame arrestor itself and then disconnect the throttle cable at the carburetor anchor block.

5. Disconnect the electrical leads and remove the alternator.

6. Tag and disconnect all water hoses at the manifold and thermostat housing. Have some rags handy, since there will still be some water in them. Carefully move them out of the way and then remove the thermostat housing.

7. Disconnect the fuel line and plug the line end and the carburetor fitting. If you have a non-flexible line, disconnect it at the fuel pump also. Move both the cable and fuel line out of the way.

8. Tag and disconnect the purple/white wire at the choke housing.

9. Unplug the main harness at the connector block. Disconnect it from the retaining clips and move it out of the way.

10. Tag and disconnect any other lines, leads or hoses that might be in the way of removal. In some instances you may be able to simply secure them out of the way without disconnecting them—you be the judge.

11. If your engine has a spark plug wire retainer attached to the cylinder head cover, unclip the wires or remove the retainer and then tag and disconnect the plug wires at the spark plugs.

12. Remove the distributor cap with the leads still connected. Mark the position of the distributor rotor to the distributor body. Scribe a matchmark across the distributor and the manifold. Loosen the clamp bolt and remove the distributor. Please refer to the Electrical section for further details on distributor removal. DO NOT turn the engine over once the distributor has been removed.

13. Tag and disconnect any leads at the ignition module and move them out of the way.

14. Loosen and remove the manifold mounting bolts in the reverse order of the illustrated tightening sequence and then remove the manifold; no need to separate the carburetor unless you are replacing the manifold. There is a good likelihood you will need to pry the manifold off the block; be very careful that you don't scratch or mar the mating surfaces on the block, manifold or heads.

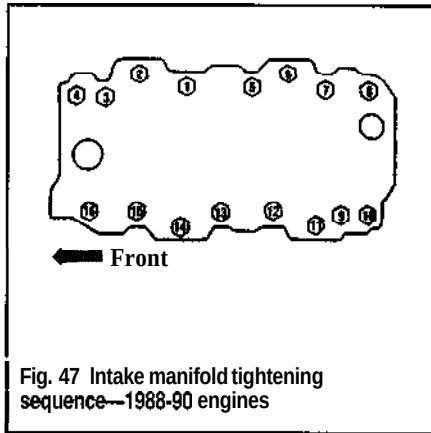


Fig. 47 Intake manifold tightening sequence—1988-90 engines

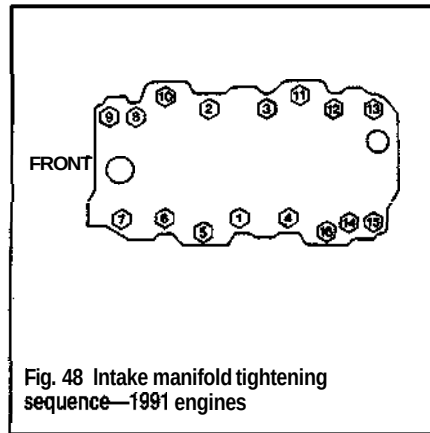


Fig. 48 Intake manifold tightening sequence—1991 engines

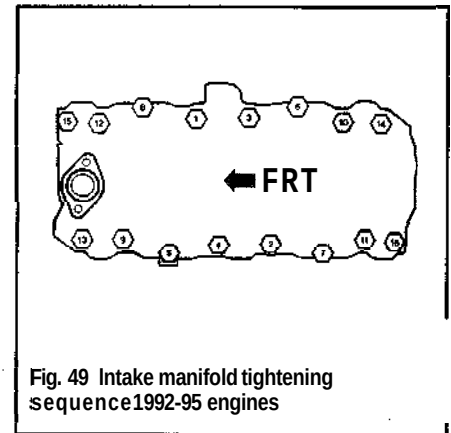


Fig. 49 Intake manifold tightening sequence—1992-95 engines

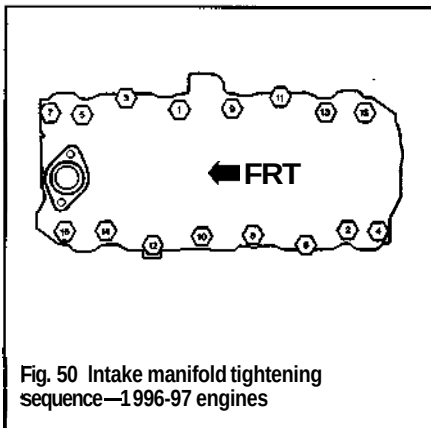


Fig. 50 Intake manifold tightening sequence—1996-97 engines

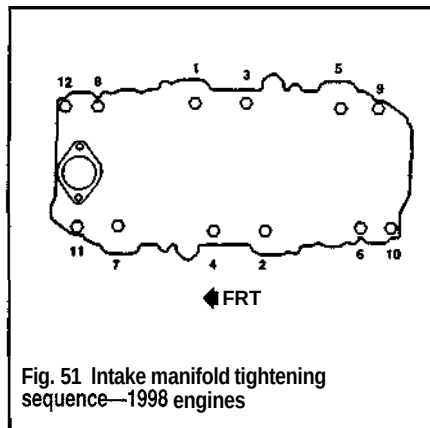


Fig. 51 Intake manifold tightening sequence—1998 engines

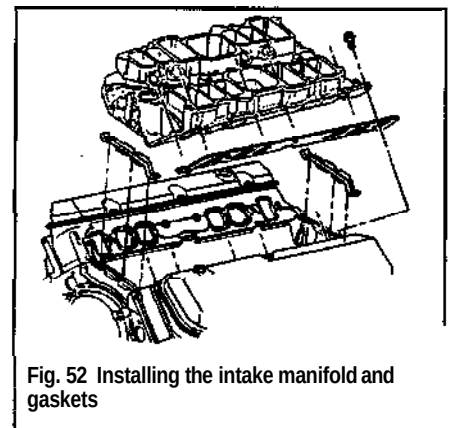


Fig. 52 Installing the intake manifold and gaskets

To install:

15. Carefully remove all remaining gasket material from the manifold mating surfaces with a scraper or putty knife. Be careful that you don't accidentally drop any old gasket into the crankcase or intake ports on the cylinder head.

16. Inspect the manifold and all mating surfaces for any cracks or nicks.

17. Position new seals on the cylinder block mating surfaces. Position new gaskets on the cylinder head mating surfaces—make sure the gaskets have the metal inserts covering the center exhaust port. Use GM Silicone Rubber Sealer at all water passages and/or wherever a seal butts against a gasket.

☐ Some engines may not have front or rear cylinder block seals. If yours is one of them, apply a 3/16 in. (5mm) bead of RTV sealant to the forward and aft edges of the cylinder block mating surface. Make sure that you run the bead at least a 1/2 in. up onto the gaskets.

18. Install the manifold into place so that all the bolt holes line up, insert the bolts and tighten them to:

- 30 ft. lbs. (41 Nm) on 7.4L engines.
- 35 ft. lbs. (47 Nm) on 8.2L engines

Check the Torque Specifications chart for any further details on tightening needs. Tighten all bolts in the order shown in the illustration.

19. Connect the ignition module leads and install the distributor as detailed in the Electrical section. Put the cap back on and reconnect the plug wires to the spark plugs.

20. Install all water hoses and tighten their clamps securely.

21. Install the fuel line at the carburetor and fuel pump. Make sure you remove any plugs you may have inserted on removal.

22. Install the throttle cable and adjust it as detailed in the Fuel System section. Install the flame arrestor and cover.

23. Connect all other lines, leads and hoses that may have been removed to facilitate manifold removal.

24. Install the alternator and mounting bracket. Reconnect the harness.

25. Connect the battery cable and start the engine. Check the ignition timing and idle speed. Check all hoses and seals for leaks.

1997-98 7.4L/8.2L Gi/GSi V8 Engines

Upper Manifold (Plenum)

◆ See Figures 53 thru 59



1. Open or remove the engine compartment hatch. Disconnect the negative battery cable.
2. Relieve the fuel system pressure as detailed in the Maintenance or Fuel System sections.
3. Loosen the clamp and remove the crankcase ventilation or PCV hoses at the cylinder head covers. Carefully move them out of the way.
4. Remove the flame arrestor cover. Remove the flame arrestor itself and then disconnect the throttle cable at the throttle body bell crank.
5. Tag and disconnect the electrical leads at the following:
 - ECM J1 and J2
 - Knock sensor module
 - Throttle position sensor
 - IAC valve
 - MAP sensor
 - IAT sensor
6. Tag and disconnect the hose from the pressure regulator at the nipple on the port side of the plenum (1997 7.4Gi and 1998 GSi).
7. Tag and disconnect the vapor line at the pulse limiter on the port side, rear.
8. Loosen the mounting bolts (8 or 12) in the reverse order of the illustrated tightening sequence and lift off the plenum. Make sure that you take note of how the throttle and fuel line brackets were positioned. Remove and discard the eight O-rings.
9. Carefully cover the lower manifold port openings to prevent dirt from entering the engine.

✱✱ CAUTION

Upper intake plenums are made of aluminum—be extremely careful of how you handle it and where you set it down, particularly the mating surfaces.

5-16 ENGINE MECHANICAL—GM V6 AND V8 ENGINES

To install:

10. Carefully remove any remaining gasket material from the plenum and manifold mating surfaces. Make sure the O-ring recesses in the lower manifold runners are free of grime and dirt.

11. Clean the inside of the plenum with Carburetor Cleaner or something similar. Do not use anything with methyl ethyl ketone!

*** WARNING

Never soak the plenum in commercial liquid cleaners or solvents.

12. Coat the new O-rings lightly with grease and insert them into the recesses on the lower manifold.

13. Position the plenum onto the manifold in such a way that you do not dislodge the O-rings. Coat the threads of the mounting bolts with Lubriplate® 777 (or similar) and install them. Tighten the bolts in sequence, in several steps, to 124 inch lbs. (14 Nm).

14. Connect the pulse limiter hose and tighten the clamp securely.

15. Reconnect all electrical leads previously removed.

16. Reconnect all vacuum lines previously removed.

17. Install the flame arrestor and reconnect the throttle cable. Check for correct throttle operation and adjust if necessary.

18. Connect the battery cables.

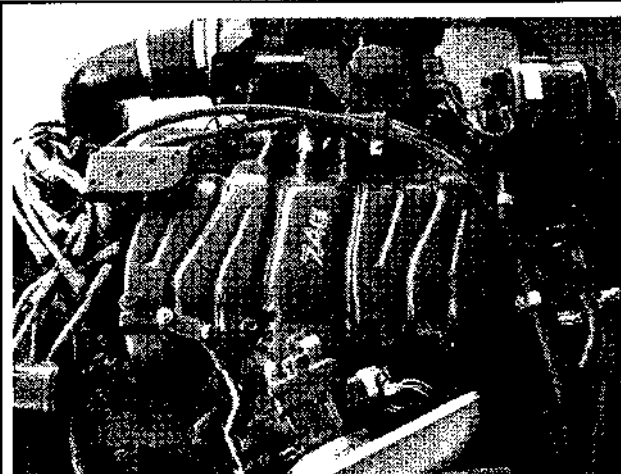


Fig. 53 A good look at the intake plenum (1998 7.4Gi)



Fig. 54 Disconnect the throttle linkage (7.4Gi)

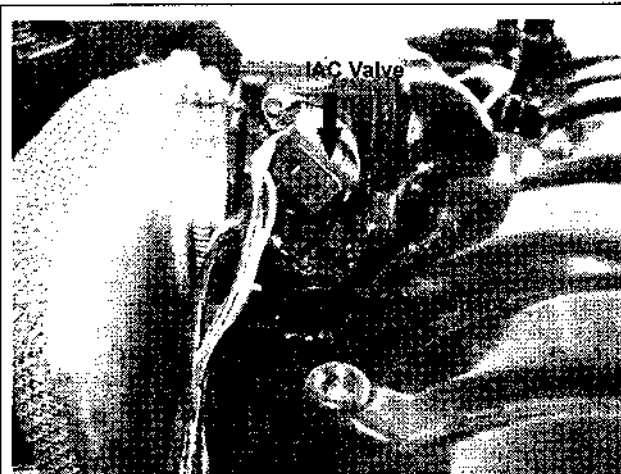


Fig. 55 Disconnect the sensor leads...

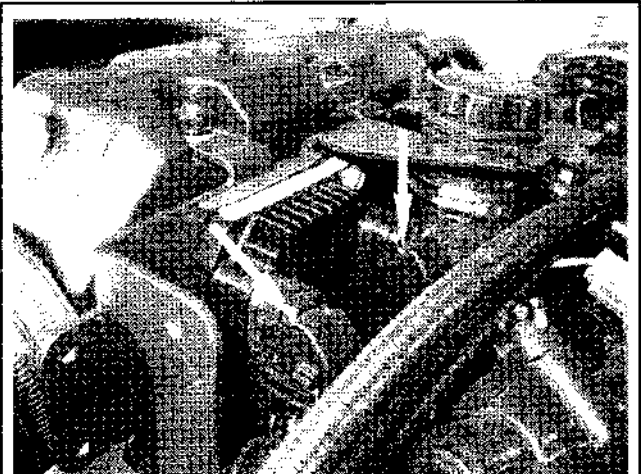


Fig. 56 ...and the ECM connectors

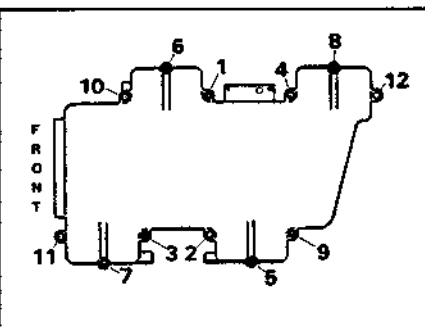


Fig. 57 Upper intake plenum tightening sequence—1997 7.4Gi and 1998 7.4GSI/8.2GSI

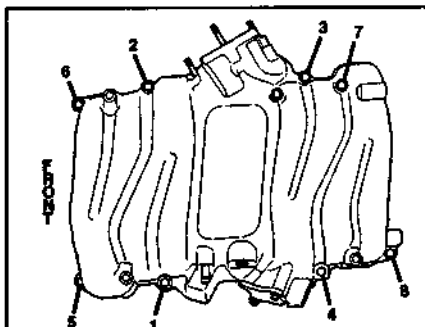


Fig. 58 Upper intake plenum tightening sequence—1998 7.4Gi

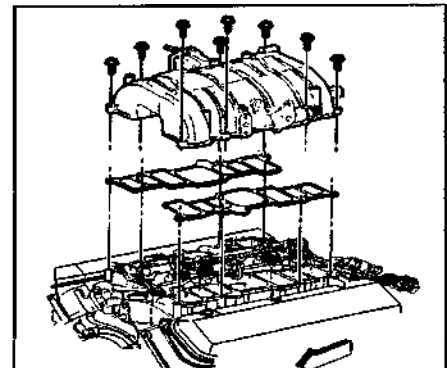


Fig. 59 Installing the intake plenum and gaskets

Lower Manifold

◆ See Figures 52, 60 and 61

1. Open or remove the engine compartment hatch. Disconnect the negative battery cable.
2. Drain all water from the cylinder block and manifolds.
3. Remove the upper intake manifold (plenum).
4. Disconnect the electrical leads and remove the alternator.
5. Tag and disconnect all water hoses at the manifold and thermostat housing. Have some rags handy, since there will still be some water in them. Carefully move them out of the way and then remove the thermostat housing.
6. Disconnect the fuel line and plug the line end and the throttle body fitting if not already done. If you have a non-flexible line, disconnect it at the fuel pump also. Move both the cable and fuel line out of the way.
7. Unplug the main harness at the connector block. Disconnect it from the retaining clips and move it out of the way.
8. Tag and disconnect any other lines, leads or hoses that might be in the way of removal. In some instances you may be able to simply secure them out of the way without disconnecting them—you be the judge.
9. If your engine has a spark plug wire retainer attached to the cylinder head cover, unclip the wires or remove the retainer and then tag and disconnect the plug wires at the spark plugs.
10. Remove the distributor cap with the leads still connected. Mark the position of the distributor rotor to the distributor body. Scribe a matchmark across the distributor and the manifold. Loosen the clamp bolt and remove the distributor. Please refer to the Electrical section for further details on distributor removal. DO NOT turn the engine over once the distributor has been removed.
11. Tag and disconnect any leads at the module and move them out of the way.
12. Loosen and remove the manifold mounting bolts in the reverse order of the illustrated tightening sequence and then remove the manifold; no need to separate the carburetor unless you are replacing the manifold. There is a good likelihood you will need to pry the manifold off the block; be very careful that you don't scratch or mar the mating surfaces on the block, manifold or heads.

To install:

13. Carefully remove all remaining gasket material from the manifold mating surfaces with a scraper or putty knife. Be careful that you don't accidentally drop any old gasket into the crankcase or intake ports on the cylinder head.
14. Inspect the manifold and all mating surfaces for any cracks or nicks.
15. Position new seals on the cylinder block mating surfaces. Position new gaskets on the cylinder head mating surfaces—make sure the gaskets have the metal inserts covering the center exhaust port. Use GM Silicone Rubber Sealer at all water passages and/or wherever a seal butts against a gasket.

□ Some engines may not have front or rear cylinder block seals. If yours is one of them, apply a 3/16 in. (5mm) bead of RTV sealant to the forward and aft edges of the cylinder block mating surface. Make sure that you run the bead at least a 1/2 in. up onto the gaskets.

16. On all engines, install the manifold into place so that all the bolt holes line up, insert the bolts and tighten them to:

- 30 ft. lbs. (41 Nm) on 7.4L engines.
- 35 ft. lbs. (47 Nm) on 8.2L engines

Check the Torque Specifications chart for any further details on tightening needs. Tighten all bolts in the order shown in the illustrations. On 1998 G1 engines, coat all bolts with thread locking sealant prior to installing them.

17. Connect the module leads and install the distributor as detailed in the Electrical section. Put the cap back on and reconnect the plug wires to the spark plugs.

18. Install all water hoses and tighten their clamps securely.
19. Install the fuel line at the carburetor/throttle body and fuel pump. Make sure you remove any plugs you may have inserted on removal.
20. Connect all other lines, leads and hoses that may have been removed to facilitate manifold removal.
21. Install the alternator and mounting bracket. Reconnect the harness.
22. Install the upper plenum.
23. Connect the battery cable and start the engine. Check the ignition timing and idle speed. Check all hoses and seals for leaks.

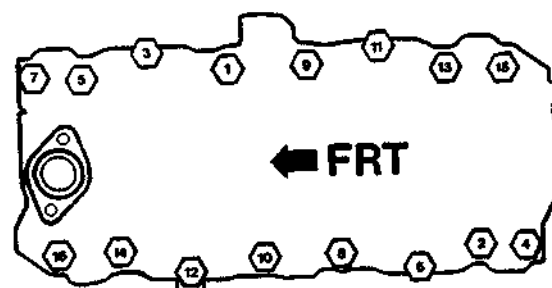


Fig. 60 Intake manifold tightening sequence— all 1997 7.4L engines

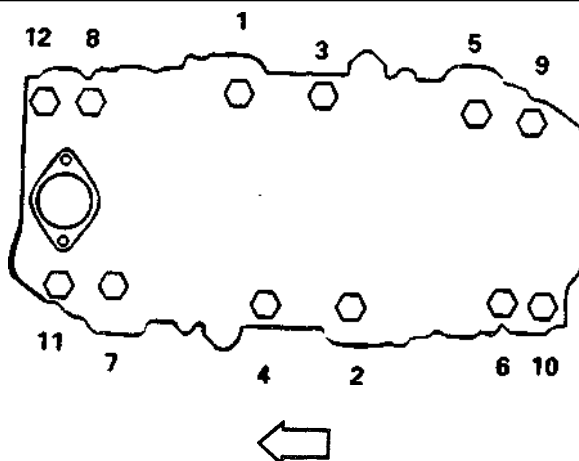


Fig. 61 Intake manifold tightening sequence—1998 7.4L/8.2L

Exhaust Manifold

REMOVAL & INSTALLATION



◆ See Figures 62, 63, 64, 65, 66 and 67

1. Open or remove the engine compartment hatch. Disconnect the negative battery cable.
2. Drain all water and/or coolant from the engine, manifold and exhaust elbow as detailed in the Maintenance section.
3. Disconnect all water/coolant lines at the manifold and move them out of the way. It's a good idea to tag these so that you can ensure proper reconnection. Make sure that you have some rags handy, because there will probably be some spillage even though you've already drained the system.
4. Loosen the hose clamps (two/four) and then disconnect the exhaust pipe hose (bellows) at the elbow and move it out of the way. Grasp the hose with both hands and wiggle it back and forth while pulling it off the elbow. Take note of where all the hose clamps were situated.
5. If you intend to remove the starboard manifold, many engines will have the circuit breaker bracket attached to the elbow, loosen the mounting bolt(s) and remove the circuit breaker bracket (breaker still attached) and position it out of the way. Many later models will also have the ignition module bracket attached to the rear side as well; detach it and move it aside.
6. If you intend to remove the port elbow on EFI models, remove the fuel reservoir water hose and position it out of the way.
7. Also on the port elbow, all models with remote oil filters will have the filter bracket attached to the forward side of the elbow—be sure you support this carefully when removing the mounting bolts.
8. Remove, disconnect, or simply move out of the way, any hoses or wires which may be in the way of removal on your particular engine.
9. Loosen the manifold retaining bolts/nuts from the center outward and then pry off the manifold/elbow assembly.

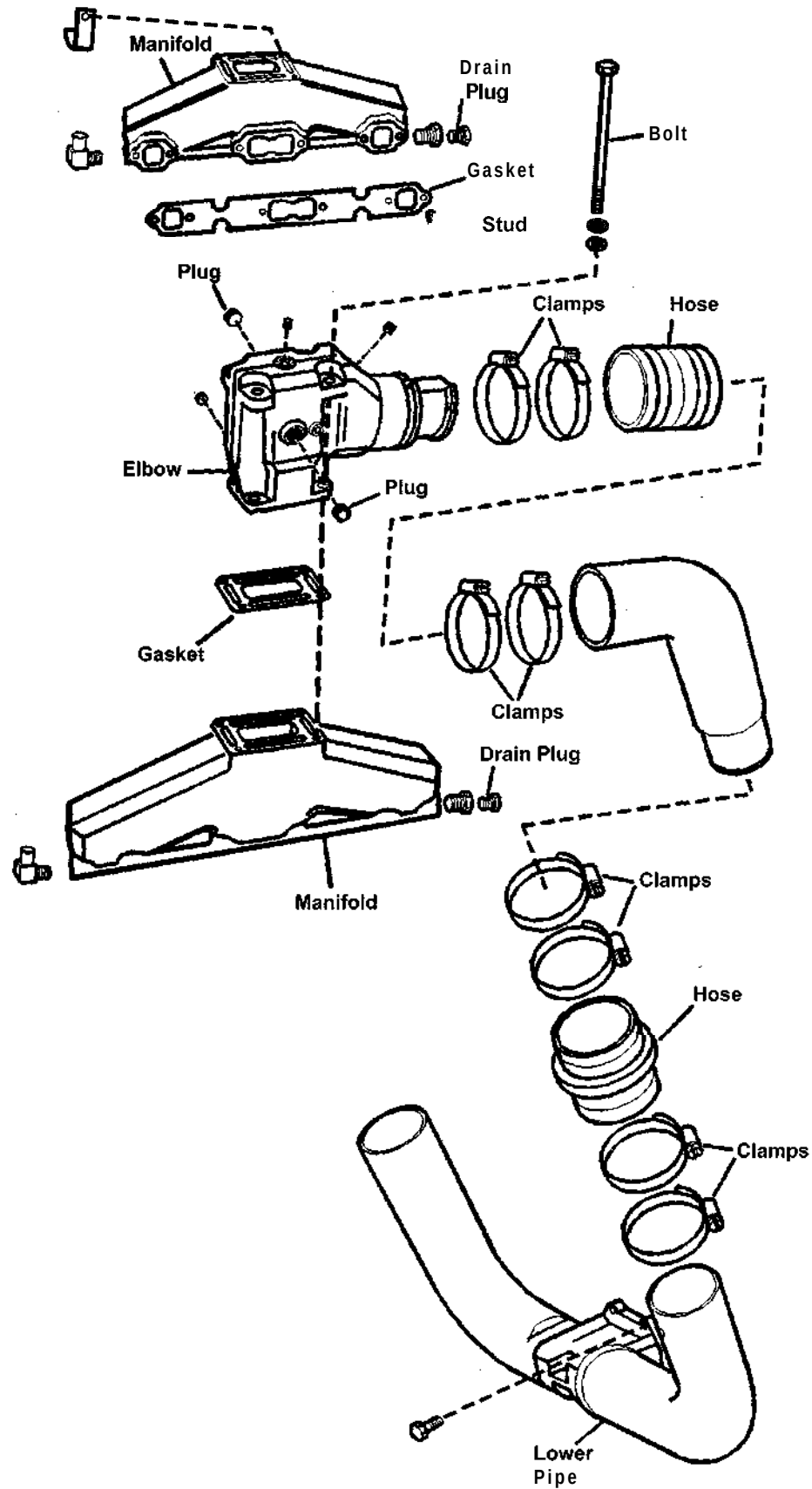


Fig. 62 Exploded view of the exhaust system on a typical V8 engine

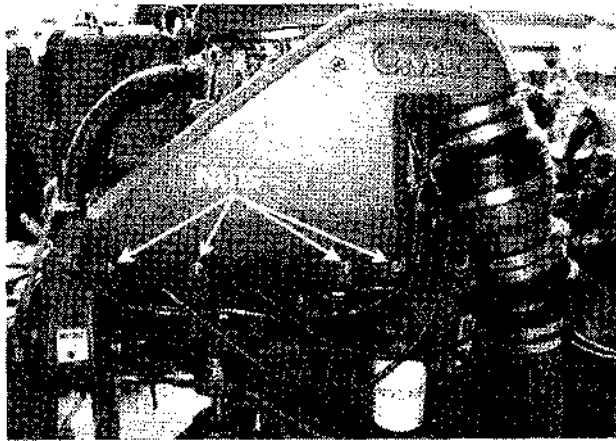


Fig. 63 The port exhaust manifold uses 4 mounting nuts on the V6...

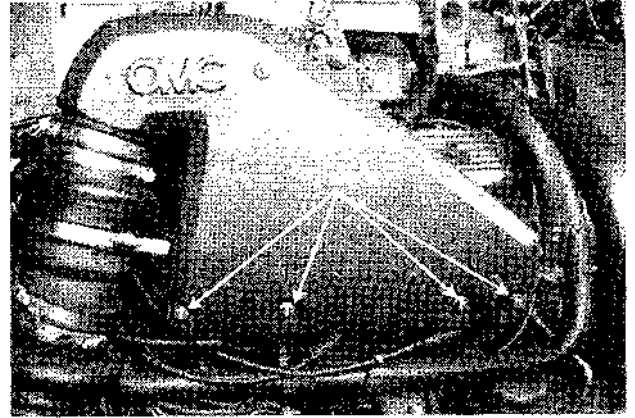


Fig. 64 ...as does the starboard side. Note that these engines did not use an elbow until 1991

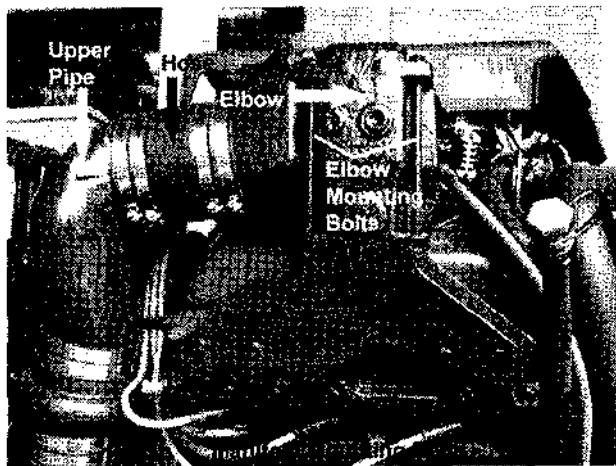


Fig. 65 Close-up of the manifold and related components--except 7.4L/8.2L engines

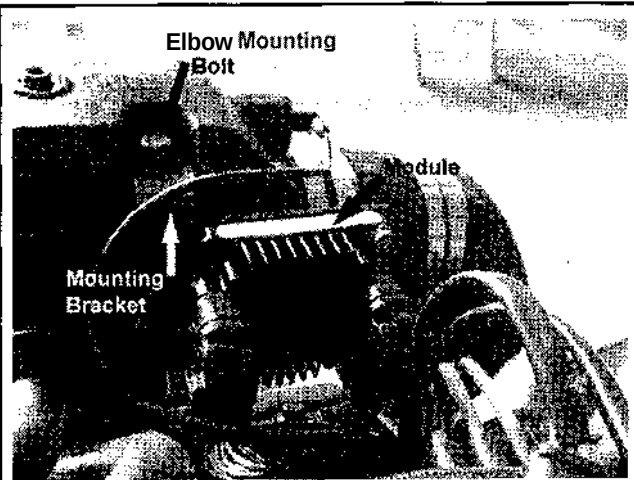


Fig. 66 The module bracket is held in place by one of the elbow mounting bolts on certain later models

10. If necessary, loosen the four retaining bolts and remove the exhaust elbow (except 1986-90 V6) from the manifold.

To install:

11. Carefully clean all residual gasket material from the head, manifold and elbow mating surfaces with a scraper or putty knife. Inspect all gasket surfaces for scratches, cuts or other imperfections.

12. Position a new gasket, without any sealant, on the cylinder head and install the manifold, making sure that everything is aligned properly. Tighten all nuts until they are just tight and then tighten them to 18-22 ft. lbs. (24-30 Nm) on the 1986-90 4.3L V6 and 20-26 ft. lbs. (27-35 Nm) on 1991-98 V6 and all V8 engines, starting in the center, and working your way out to the ends of the manifold. On 7.4L/8.2L engines, tighten any mounting bolts to 24-28 ft. lbs. (33-38 Nm).

13. If you removed the elbow, position a new gasket on the manifold, making sure that the indentations line up (on seawater cooled engines) and then install the elbow. Tighten the mounting bolts to 10-12 ft. lbs. (14-16 Nm) on 1986-93 engines or 12-18 ft. lbs. (16-24 Nm) on 1994-98 engines, refer to the Exhaust Elbow procedures found later for more detail on installing the elbow.

14. Connect the exhaust pipe/bellows to the elbow and tighten the clamps securely.

15. If you removed the manifold or elbow plugs for some reason, make sure that the threads are coated with sealant before screwing them back in.

16. Connect the water/coolant hoses and tighten the clamps securely.

17. Make sure that any miscellaneous lines or hoses that you may have moved or disconnected during removal are reconnected and routed properly.

18. Fill the system with water or coolant, connect the battery cable and start the engine. When the engine reaches normal operating temperature, turn it off and re-torque the manifold bolts.

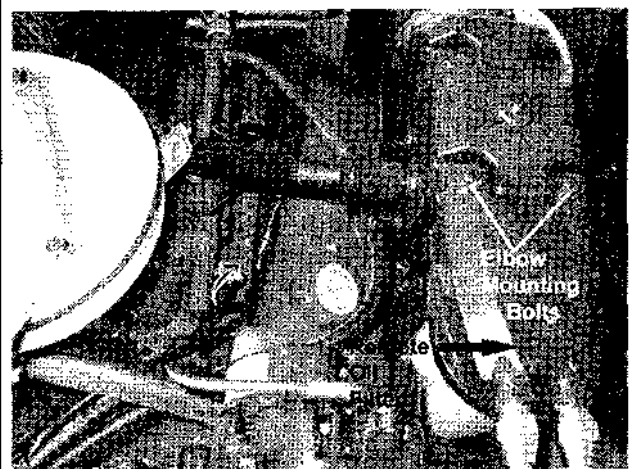


Fig. 67 On models with a remote oil filter, the filter bracket is secured by the two forward mounting bolts

High Rise Exhaust Elbow

REMOVAL & INSTALLATION

◆ See Figures 62 and 65



■ 1986-90 4.3L V6 engines did not use a high rise exhaust elbow.

1. Drain the cooling system.
2. Loosen the two hose clamps and slide off the exhaust hose (bellows). Grasp it with both hands and pull it off while wiggling it from side to side. If it sticks, drip a little bit of soapy water around the lip.
3. If you intend to remove the starboard elbow, first loosen the mounting bolts and remove the circuit breaker bracket (if equipped) and position it out of the way. Many later models will also have the ignition module bracket attached to the rear side as well; detach it and move it aside.
4. If you intend to remove the port elbow on EFI models, remove the fuel reservoir water hose and position it out of the way.
5. Also on the port elbow, all models with remote oil filters will have the filter bracket attached to the forward side of the elbow—be sure you support this carefully when removing the mounting bolts.
6. Remove the four bolts, lock washers and washers from the elbow and lift it off the manifold. A little friendly persuasion with a soft rubber mallet may be necessary! Be careful though, no need to take out all your aggressions on the poor thing.
7. Remove the gasket and discard it.
- To install:
8. Clean the mating surfaces of the manifold and elbow thoroughly, coat both sides of a new gasket with Gasket Sealing compound and position it onto the manifold flange.
9. Position the elbow on the manifold so the bolt holes are in alignment. Position any anchor brackets or mounting hardware for other components and then install the four mounting bolts and their washers. Tighten the mounting bolts to 10-12 ft. lbs. (14-16 Nm) on 1986-93 engines or 12-18 ft. lbs. (16-24 Nm) on 1994-98 engines.
10. Slide the exhaust hose, while wiggling it, all the way onto the elbow. Position the two clamps in their channels and tighten the clamp screws securely. Coating the inside of the hose with a soapy water solution will help you slip it on.

Exhaust Hoses (Bellows) And Intermediate Exhaust Pipe

REMOVAL & INSTALLATION

◆ See Figures 62, 68 and 69



□ Not all engines will use an intermediate pipe between the upper bellows and the lower exhaust pipe.

1. Starting with the upper hose, loosen all four hose clamps, two on top of the hose and two on the bottom.
2. Drizzle a soapy water solution over the top of the hose where it mates with the exhaust elbow and let it sit for a minute.
3. Grasp the hose with both hands and wiggle it side-to-side while pulling down on it until it separates from the elbow (or the top of the manifold on early V6 engines).
4. Now wiggle it while pulling upwards until it pops off the intermediate exhaust pipe.
5. The lower hose should be removed in the same manner as the upper.
6. Check the hose for wear, cracks and deterioration.
7. Coat the inside of the lower end of the lower hose with soapy water and wiggle it into position on the Y-pipe (lower). Remember to install the two clamps before sliding it over the end of the pipe.

□ There is a step about 1 1/2 in. into the inside of one end on each the upper and lower hoses; upper only on the 7.4L/8.2L engines. The stepped side of BOTH hoses should fit over the intermediate pipe. This means that the stepped side on the upper hose faces DOWN, and the stepped side on the lower hose faces UP!

8. Slide the two clamps over the upper end of the lower hose and then coat the inside with the soapy water solution and insert the bottom of the intermediate pipe into it fully until it seats on the step. Tighten the clamp screws securely.

9. Coat the inside of the lower end of the upper hose with soapy water and wiggle it into position on the intermediate pipe until it meets the step. Remember to install the two clamps before sliding it over the end of the pipe.

10. Slide two clamps over the upper end, lubricate the inside with soapy water and wiggle the hose over the elbow.

11. Tighten all four clamp screws securely.

Lower Exhaust Pipe (Y-Pipe)

REMOVAL & INSTALLATION

◆ See Figure 62



1. It is unlikely you will be able to get the pipe off without removing the engine, so remove the engine as previously detailed.

2. Loosen the four retaining bolts at the transom shield and then remove the exhaust pipe. Carefully scrape any remnants of the seal from the pipe and transom mounting surfaces.

■ The pipe mounting holes in the transom shield utilize Heli-Coil® locking inserts. Never clean the holes or threads with a tapping tool or you risk damaging the locking feature of the threads.

3. Coat a new seal with 3M Rubber Adhesive and position it into the groove on the transom shield mating surface.

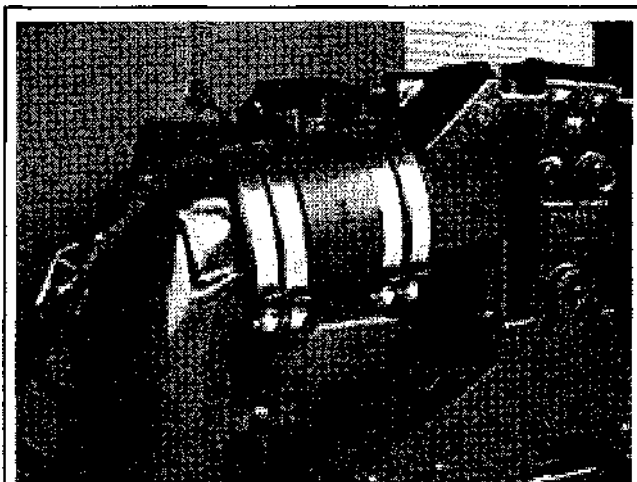


Fig. 68 A good look at the upper hose...



Fig. 69 ...and the lower hose—not all engines will have the bulge in the lower hose like shown here

4. Coat the mounting bolts with Gasket Sealing Adhesive. Position the exhaust pipe, insert the bolts and tighten them to 10-12 ft. lbs. (14-16 Nm) on 1986-90 engines or 20-25 ft. lbs. (27-34 Nm) on 1991-98 engines.
5. Install the engine.

EXHAUST VALVE (FLAPPER) REPLACEMENT



1. Remove the exhaust hoses and the intermediate exhaust pipe. The flapper is located in the upper end of the y-pipe.
2. The valve is held in place by means of a pin running through two bushings in the sides of the pipe. Position a small punch over one end of the pin and carefully press the pin out of the pipe.

Make sure you secure the valve while removing the retaining pin so it doesn't fall down into the exhaust pipe.

3. Press out the two bushings and discard them. Coat two new bushings with Scotch Grip Rubber Adhesive and press them back into the sides of the pipe.
4. Position the new valve into the pipe with the long side DOWN. When looking at the valve, the molded retaining rings are off-center—the side with the rings should face the top of the pipe. When the valve is in place, coat the pin lightly with engine oil and slowly slide it through one of the bushings, through the two retaining holes on the valve and then through the opposite bushing. Make sure the pin ends are flush with the sides of the pipe on both sides.
5. Install the exhaust hose.

Oil Pan

REMOVAL & INSTALLATION

1986-96 4.3L V6 and 1986-97 5.7L V8 Engines (Except 1997 5.7GSI)



□ More times than not, this procedure will require the removal of the engine. Your boat and its unique engine installation will determine this, but the procedure is almost always easier with the engine removed from the boat.

1. Remove the engine as previously detailed in this section.
2. If you haven't already drained the engine oil, do it now. Make sure you have a container and lots of rags available.
3. Remove the oil dipstick and then remove the dipstick tube(s).
4. Remove the oil withdrawal tube from the oil drain plug fitting.
5. Loosen and remove the oil pan retaining bolts and nuts, starting with the center bolts and working out toward the pan ends. Lightly tap the pan with a rubber mallet to break the seal and then lift it off the cylinder block. If your engine stand will allow for rotating the engine, you'll find that this will be easier with the pan facing up.

TO install:

6. Clean the pan mating surfaces of any residual gasket material with a scraper or putty knife. Make sure that no old gasket material has been pressed into the retaining bolt holes in the pan, block or front cover. Clean the pan itself thoroughly with solvent.
7. Position a new seal into the rear main bearing cap groove and press it into place; make sure that the ends are pressed into the small openings in the cylinder block.
8. Coat new side gaskets lightly with grease and position them so that the aft ends overlap the rear seal and the front ends are pressed into the groove between the timing cover and the cylinder block.
9. Install all bolts finger tight and then tighten the front and rear 5116 in. bolts to 12-15 ft. lbs. (16-20 Nm) and the remaining 114 in. bolts to 6-7.5 ft. lbs. (8-10 Nm). Remember to start with the center bolts and work outward toward the ends of the pan.
10. Install the oil drain fitting and finger tighten the bolt. Rotate the fitting and then attach the withdrawal tube. Tighten the fitting bolt and flare nut to 15-18 ft. lbs. (20-24 Nm).
11. Install the engine (if removed). Refill with all fluids. Run the engine up to normal operating temperature, shut it off and check the pan for any leaks.

1997-98 4.3L V6 Engines



◆ See Figures 70, 71, 72, 73 and 74

More times than not, this procedure will require the removal of the engine. Your boat and its unique engine installation will determine this, but the procedure is almost always easier with the engine removed from the boat.

1. Remove the engine as previously detailed in this section.
2. If you haven't already drained the engine oil, do it now. Make sure you have a container and lots of rags available.
3. Remove the oil dipstick and then remove the dipstick tube(s).
4. Remove the oil withdrawal tube from the oil drain plug fitting.
5. Loosen and remove the oil pan retaining bolts and nuts, starting with the center bolts and working out toward the pan ends. Lightly tap the pan with a rubber mallet to break the seal and then lift it off the cylinder block. If your engine stand will allow for rotating the engine, you'll find that this will be easier with the pan facing up.

TO install:

6. Clean the pan mating surfaces of any residual gasket material with a scraper or putty knife. Make sure that no old gasket material has been pressed into the retaining bolt holes in the pan, block or front cover. Clean the pan itself thoroughly with solvent.
7. Apply a small dab of RTV sealer to the joints on either side of the rear oil seal retainer and front cover, position a new pan gasket onto the pan being very careful to line up all the holes—do not use RTV sealant with this gasket other than where noted. Make sure that the sealer is applied at least 1 in. (25.4mm) in either direction from each of the four joints.
8. Move the pan and gasket onto the block; don't dawdle here because the RTV sealant applied in the previous step sets up very quickly. It is very important that you ensure all the holes line up correctly.

□ On these engines, proper alignment of the rear edge of the pan and the block is imperative—if both surfaces are not flush, the engine-to-transom bracket alignment will not be rigid.

9. Install the special straight edge (#J346773) at the rear and slide the pan back against it. Install the pan retaining bolts and nuts finger-tight.
10. Check the clearance between the three oil pan-to-bell housing contact points with a feeler gauge. If clearance exceeds 0.010 in. (0.254mm) at any of the three points you will need to remove the pan and start over again. Continue this until all three points are within specifications.
11. Now tighten the bolts to 18 ft. lbs. (25 Nm) and the nuts to 17 ft. lbs. (23 Nm). Remember to follow the torque sequence shown in the illustration.
12. On all engines again, install the oil drain fitting and finger tighten the bolt. Rotate the fitting and then attach the withdrawal tube. Tighten the fitting bolt and flare nut to 15-18 ft. lbs. (20-24 Nm).
13. Install the engine (if removed). Refill with all fluids. Run the engine up to normal operating temperature, shut it off and check the pan for any leaks.

1997 5.7GSI And 1998 5.0L/5.7L V8 Engines



◆ See Figures 70, 71, 75 and 76

More times than not, this procedure will require the removal of the engine. Your boat and its unique engine installation will determine this, but the procedure is almost always easier with the engine removed from the boat.

1. Remove the engine as previously detailed in this section.
2. If you haven't already drained the engine oil, do it now. Make sure you have a container and lots of rags available.
3. Remove the oil dipstick and then remove the dipstick tube(s).
4. Remove the oil withdrawal tube from the oil drain plug fitting.
5. Loosen and remove the oil pan retaining bolts, studs and nuts, starting with the center fasteners and working out toward the pan ends. Lift off the reinforcing strips and then lightly tap the pan with a rubber mallet to break the seal and then lift it off the cylinder block. If your engine stand will allow for rotating the engine, you'll find that this will be easier with the pan facing up.

5-22 ENGINE MECHANICAL—GM V6 AND V8 ENGINES

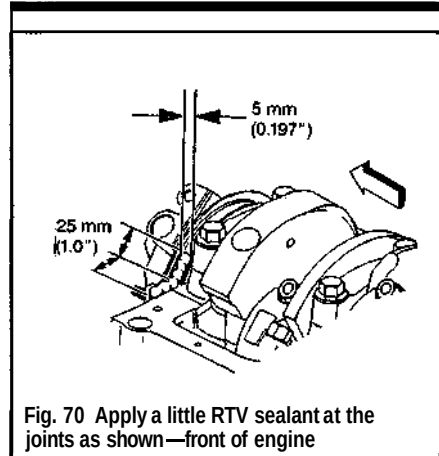


Fig. 70 Apply a little RTV sealant at the joints as shown—front of engine

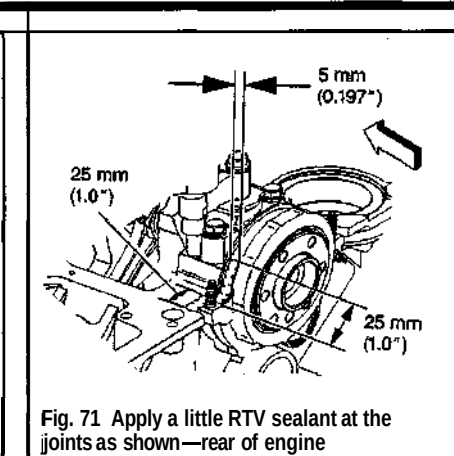


Fig. 71 Apply a little RTV sealant at the joints as shown—rear of engine

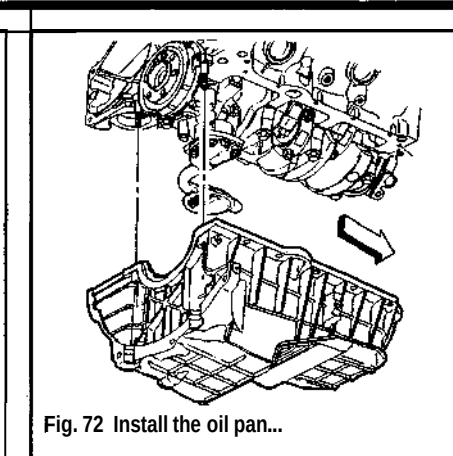


Fig. 72 Install the oil pan...

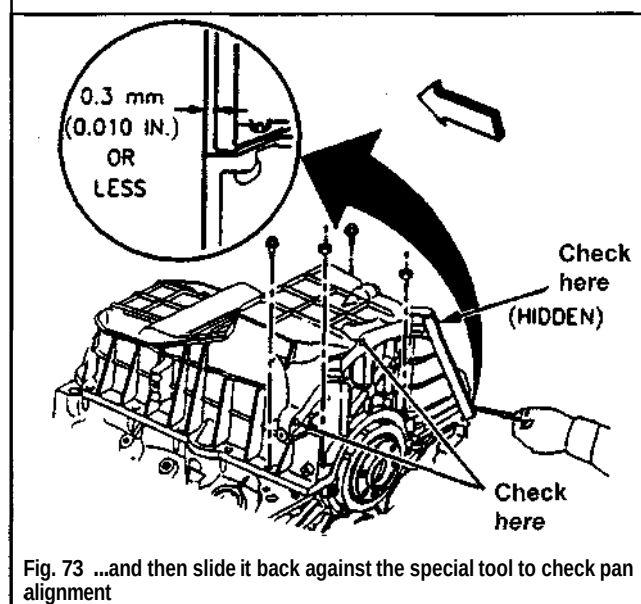


Fig. 73 ...and then slide it back against the special tool to check pan alignment

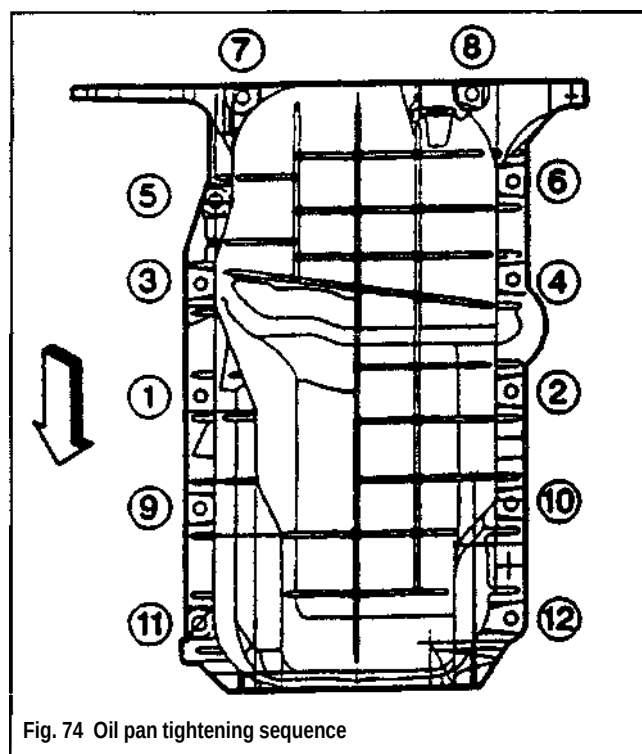


Fig. 74 Oil pan tightening sequence

To install:

6. Clean the pan mating surfaces of any residual gasket material with a scraper or putty knife. Make sure that no old gasket material has been pressed into the retaining bolt holes in the pan, block or front cover. Clean the pan itself thoroughly with solvent.

7. Apply a small dab (5mm) of GM Adhesive sealer to the joints on either side of the rear oil seal retainer and front cover, position a new pan gasket onto the pan being very careful to line up all the holes--do not use RTV sealant with this gasket other than where noted. Make sure that the sealer is applied at least 1 in. (25.4mm) in either direction from each of the four joints.

8. Move the pan and gasket onto the block; don't dawdle here because the RTV sealant applied in the previous step sets up very quickly. It is very important that you ensure all the holes line up correctly.

9. Position the reinforcing strips on each side and then tighten the bolts, stud or nuts on each corner to 15 ft. lbs. (20 Nm); tighten the remaining bolts and studs to 106 inch lbs. (12 Nm).

10. Install the oil drain plug or the oil drain fitting and finger tighten the bolt. Rotate the fitting and then attach the withdrawal tube. Tighten the fitting bolt and flare nut to 15-18 ft. lbs. (20-24 Nm).

11. Install the engine (if removed). Refill with all fluids. Run the engine up to normal operating temperature, shut it off and check the pan for any leaks.

1988-98 7.4L/8.2L V8 Engines

◆ See Figures 77, 78, 79 and 80



More times than not, this procedure will require the removal of the engine. Your boat and its unique engine installation will determine this, but the procedure is almost always easier with the engine removed from the boat.

1. Remove the engine as previously detailed in this section.
2. If you haven't already drained the engine oil, do it now. Make sure you have a container and lots of rags available.
3. Remove the oil dipstick and then remove the dipstick tube(s).
4. Remove the oil withdrawal tube from the oil drain plug fitting.
5. Loosen and remove the oil pan retaining bolts and nuts, starting with the center bolts and working out toward the pan ends. Lightly tap the pan with a rubber mallet to break the seal and then lift it off the cylinder block. If your engine stand will allow for rotating the engine, you'll find that this will be easier with the pan facing up.
6. Lift the pan reinforcement strips on 1988-91 engines.

To install:

7. Clean the pan mating surfaces of any residual gasket material with a scraper or putty knife. Make sure that no old gasket material has been pressed into the retaining bolt holes in the pan, block or front cover. Clean the pan itself thoroughly with solvent.

On all but the 1998 7.4Gi:

8. Apply RTV sealer (Silicone Rubber Sealer) to the four corners (front and rear) of new side gaskets. Coat them with sealer and position them onto the cylinder block.

9. Position a new seal into the groove in the rear main bearing cap so that the ends mate evenly with the side gaskets.

10. Position a new front seal onto the bottom of the front cover and press the locating tips into the holes in the cover. Make sure that the ends of the seal mate evenly with the side gaskets.