

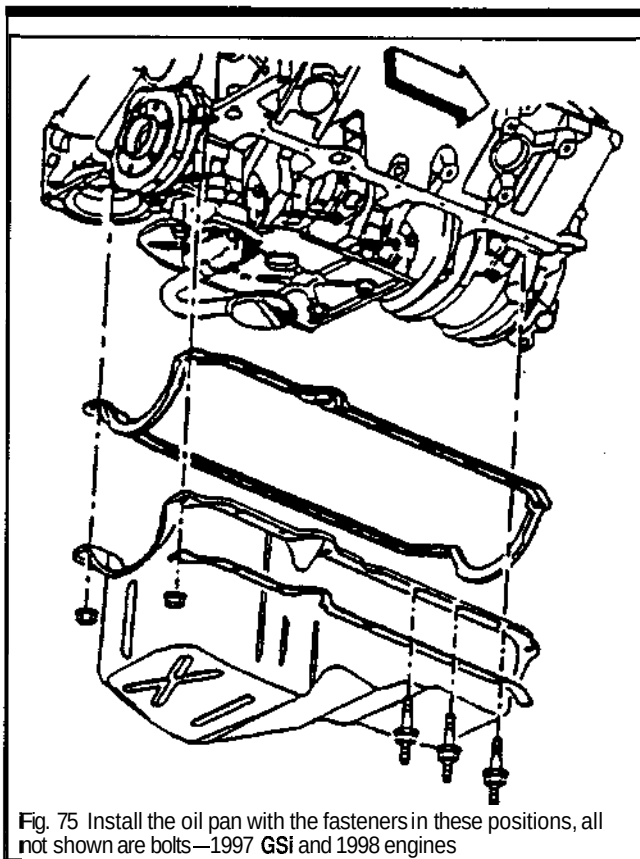


Fig. 75 Install the oil pan with the fasteners in these positions, all not shown are bolts—1997 GSi and 1998 engines

11. On 7.4L engines, install all bolts and nuts finger tight and then tighten the pan-to-front cover bolts to 70 inch lbs. (8 Nm) and the remaining bolts to 160 inch lbs. (18 Nm). On 8.2L engines, install all bolts and nuts finger tight and then tighten the pan-to-front cover bolts to 120 inch lbs. (13.6 Nm) and the remaining bolts to 200 inch lbs. (22.5 Nm). Refer to the tightening sequence illustration for 1988-91 engines; on 1992-93 engines, tighten them evenly and alternately from the center outward.

On the 1998 7.4Gi:

12. Apply RTV sealant to the four places that the front and rear main bearing caps mate with the cylinder block.

13. Position a new gasket and then install the oil pan. Thread in all mounting bolts finger tight and then tighten them to 18 ft. lbs. (25 Nm), alternately and from the center outward.

On all engines:

14. 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); 20 ft. lbs. (28 Nm) on the 1998 7.4Gi.

15. 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.



Fig. 76 A view of the pan, note the reinforcing strip

Oil Pump

The two-piece oil pump utilizes two pump gears and a pressure regulator valve enclosed in a two-piece housing. 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. Oil passes through the pick-up screen, through the pump and then through the oil filter.

REMOVAL & INSTALLATION

◆ See Figures 81, 82 and 83



1. Remove the oil pan as previously detailed. Remember that you probably need to remove the engine for this procedure.

2. Most V8 engines utilize an oil baffle (deflector) plate; remove the retaining nuts (three, and a bolt) and lift out the baffle. Certain V6 engines also use a baffle that is mounted to the pick-up screen.

3. Loosen and remove the pump mounting bolt(s) from the rear main bearing cap and lift off the pump assembly.

4. Pull out the driveshaft and retainer.

5. Loosen the four pump cover screws and lift off the cover with the screen attached.

The oil pump pick-up screen-and-pipe are press fit to the pump cover, they are serviced as an assembly so should not be separated; nor should they be replaced during normal service. If the assembly does require replacement, mount the pump in a vise and pull out the pipe. Do not reinstall the same assembly, use only a new replacement. Make sure that the screen is parallel with the bottom of the oil pan.

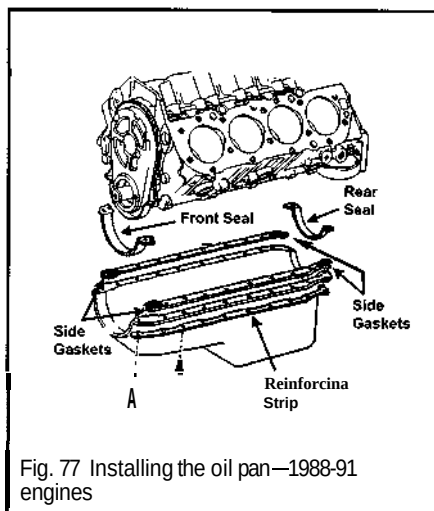


Fig. 77 Installing the oil pan—1988-91 engines

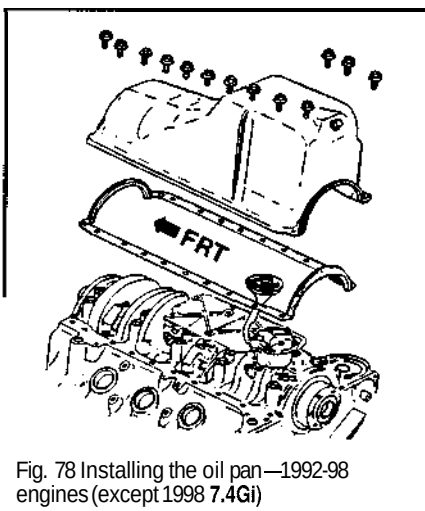


Fig. 78 Installing the oil pan—1992-98 engines (except 1998 7.4Gi)

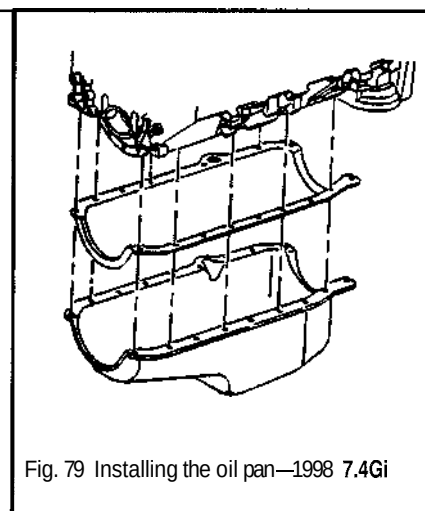


Fig. 79 Installing the oil pan—1998 7.4Gi

5-24 ENGINE MECHANICAL—GM V6 AND V8 ENGINES

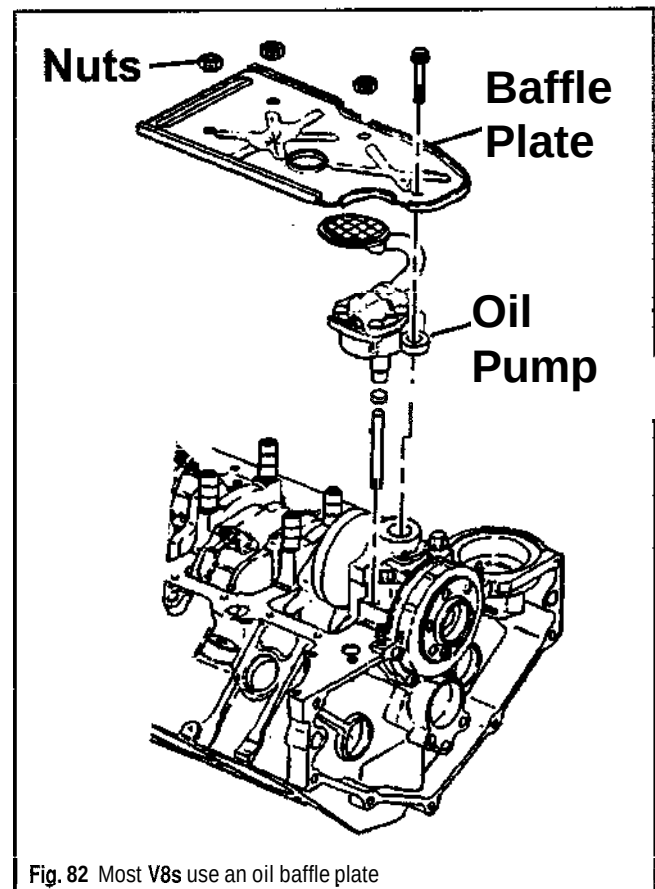
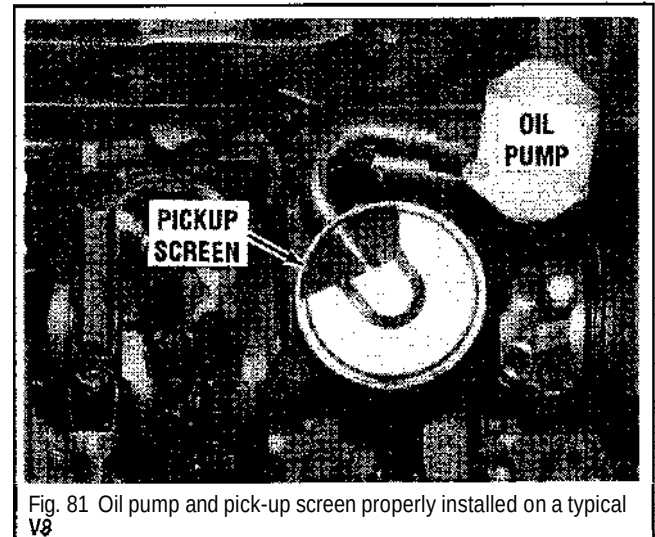
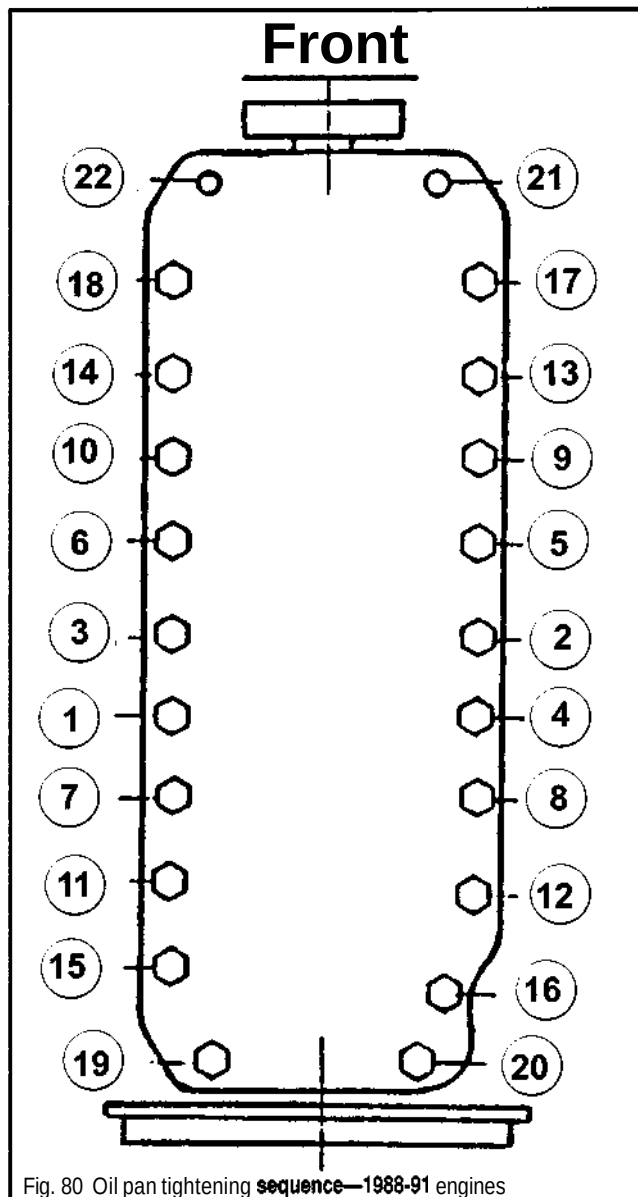
6. Matchmark the two gears where they mesh and then lift out the two gears. Remove the pressure regulator valve and its associated parts.
7. Clean all components in solvent and dry thoroughly. Inspect the pump body and gears for cracks, excessive wear or other damage.
8. Install the pressure regulator valve into the housing cover with a new spring.
9. Install the retaining pin.
10. Install the drive gear into the housing. Install the idler gear so that the matchmarks mesh with the drive gear and the smooth side is toward the cover.
11. Install the pump cover and tighten the screws to:
 - 6-9 ft. lbs. (8-12 Nm) on 1986-96 V6 engines
 - 106 inch lbs. (12 Nm) on 1997-98 V6 engines
 - 6-9 ft. lbs. (8-12 Nm) on 1986-97 5.0L/5.7L V8 engines (except the 1997 5.7GSi)
 - 106 inch lbs. (12 Nm) on the 1997 5.7GSi and 1998 5.0L/5.7L V8 engines
 - 80 inch lbs. (9 Nm) on all 7.4L/8.2L V8 engines (except the 1998 7.4Gi)
 - 106 inch lbs. (12 Nm) on 1998 7.4Gi
12. Check that the pump and block mating surfaces are clean and then position the pump over the block so that the pump extension shaft tang is aligned with the distributor driveshaft slot. Do not use a gasket or RTV sealant. Tighten the pump mounting bolts to 65 ft. lbs. (90 Nm) on all but the 8.2L engine, and 70 ft. lbs. (95 Nm) on 8.2L engines.

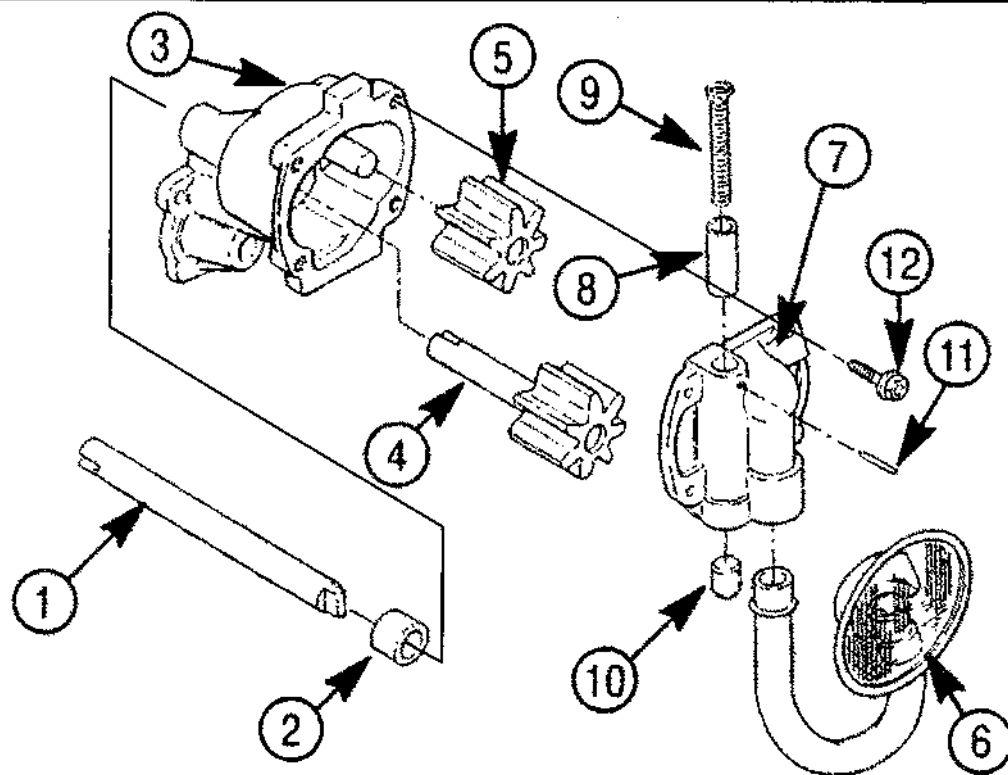
□ The pump should slide into place easily, if not recheck the alignment of the two shafts.

13. Install the oil baffle on engines so equipped and tighten the nuts to 30 ft. lbs. (40 Nm).
14. Install the oil pan and engine.

Oil Filter Bypass Valve

Almost all engines covered here utilize a 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.





- 1 - Extension Shaft
- 2 - Shaft Coupling
- 3 - Pump Body
- 4 - Drive Gear and Shaft
- 5 - Idler Gear
- 6 - Pickup Screen and Pipe

- 7 - Pump Cover
- 8 - Pressure Regulator Valve
- 9 - Pressure Regulator Spring
- 10 - Plug
- 11 - Retaining Pin
- 12 - Screws

Fig. 83 Exploded view of the oil pump

REMOVAL & INSTALLATION

◆ See Figure 84



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/Timing Ring And Flywheel

REMOVAL & INSTALLATION

Over the years, these engines were equipped in a variety of configurations—flywheel and torsional damper, flywheel, damper and coupler, flywheel and coupler, etc. And for a number of years, some models also had a timing ring attached. Early models are usually the ones equipped with a damper, while Cobra, SP and DP models usually were equipped with the coupler. King Cobra models are usually the ones that use the timing ring, although there were also some 4.3L engines that used it. Although we have attempted to narrow the applications in the following procedures, it was not always year or model specific. Please read the procedures FIRST in order to determine which one is appropriate for your particular engine's configuration.

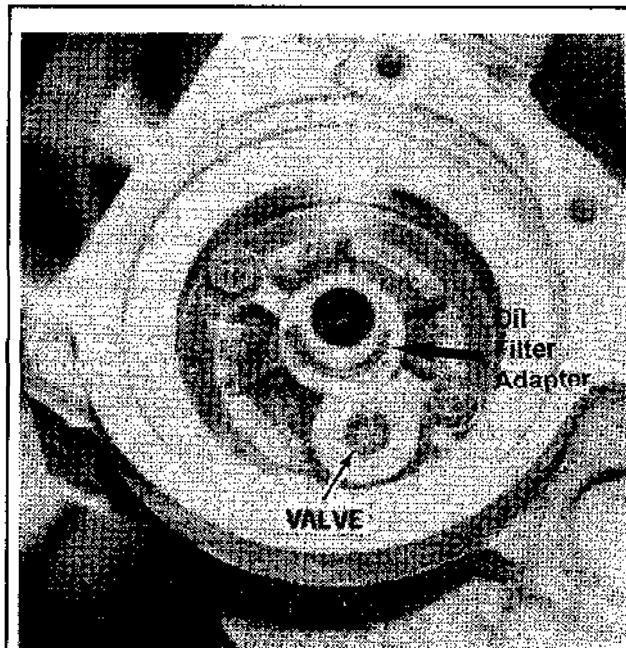


Fig. 84 Oil filter bypass valve

5-26 ENGINE MECHANICAL—GM V6 AND V8 ENGINES

Models With A Torsional Damper



Over the years, these engines were equipped in a **variety** of configurations—flywheel and torsional damper, flywheel, damper and coupler, flywheel and coupler, etc. And for a number of years, some models also had a timing ring attached. Early models are usually the ones equipped with a damper, while Cobra, SP and DP models usually were equipped with the coupler. King Cobra models are usually the ones that use the timing ring, although there were also some **4.3L** engines that used it. Although we have attempted to narrow the applications in the following procedures, it was not always year or model specific. Please read the procedures **FIRST** in order to determine which one is appropriate for your particular engine's configuration.

1. Remove the engine as detailed previously.
 2. Loosen the bolts and remove the flywheel housing and cover plate.
 3. Remove the three mounting bolts and pull off the rear torsional damper.
 4. Remove four of the six flywheel retaining bolts. Loosen the other two, any two is fine, and back them out about half way. Using the two bolts as a stop, carefully pull the flywheel off of the crankshaft flange. Remove the two bolts and flywheel.
- To install:
5. Position the flywheel over the dowel pin on the flange and make sure that the holes line up correctly. Coat the bolt threads with engine oil, install them and tighten to 59 ft. lbs. (82 Nm). Tighten the six bolts in a diagonal star pattern.
 6. Install the torsional damper and tighten the bolts securely.
 7. Install the housing and plate. Coat all mounting bolts with engine oil and tighten the 9116 in. housing bolts to 30 ft. lbs. (41 Nm), the 5116 in. plate bolts securely.
 8. Install the engine.

Models With A Timing Ring

◆ See Figures 86 and 87



■ Over the years, these engines were equipped in a variety of configurations—flywheel and torsional damper, flywheel, damper and coupler, flywheel and coupler, etc. And for a number of years, some models also had a timing ring attached. Early models are usually the ones equipped with a damper, while Cobra, SP and DP models usually were equipped with the coupler. King Cobra models are usually the ones that use the timing ring (**350,454, 502, 7.4L**), although there were also some **4.3L** engines that used it. Although we have attempted to narrow the applications in the following procedures, it was not always year or model specific. Please read the procedures **FIRST** in order to determine which one is appropriate for your particular engine's configuration.

1. Remove the engine from the boat as detailed previously in this section.
 2. 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.
 3. Loosen the 5 retaining bolts and slide out the lower housing cover.
 4. Although not strictly necessary, we recommend removing the starter.
 5. Locate the timing sensor cover on the housing, loosen the two nuts and lift off the cover. Remove the two nuts and washers and then pull out the sensor and position it out of the way.
 6. Cut the plastic tie that secures the housing drain hose and the pull the hose out of the fitting.
 7. Remove the flywheel housing retaining nuts/bolts and pull off the housing. Take note of the positioning of the oil cooler and its bracket.
 8. Slide an offset 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. Remove the coupler.
 9. Mark the dowel hole on the timing ring and pry it off the flywheel. Remove 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. Position the timing ring over the locating pin making sure the pin is in the correct hole—you did mark it, right? Press the ring into position.
 13. Slide the coupler over the studs so that it sits in the recess on the flywheel. Install new lock washers and tighten the mounting nuts to 40-45 ft. lbs. (54-61 Nm). Once again use the star pattern while tightening the bolts.

14. Install the flywheel housing and attach the oil cooler. Tighten the nuts/bolts to 32-40 ft. lbs. (43-54 Nm).

15. Install the washer, lock washer and inner nut on the ground stud and tighten it to 15-20 ft. lbs. (20-27 Nm). Attach the electrical leads, install another lock washer and then tighten the outer nut securely.

16. Slide the drain hose in and attach it with a new plastic tie.

17. Position the timing sensor onto the mounting studs and press in on the spring tab so that the sensor seats itself correctly over the timing ring. Install the washers and nuts, with the tab still depressed, and tighten them to 48-64 inch lbs. (5-7 Nm). Once the nuts are tightened, press in on the spring tab again and confirm that the tab **DOES NOT** touch the timing ring. If it does, loosen the nuts and try it again.

*** WARNING

If the sensor tab comes in contact with the teeth of the timing ring, it will be damaged on engine start-up.

18. Install the sensor and tighten the nuts to 48-64 inch lbs. (5-7 Nm).

19. Coat both sides of a new gasket with Gasket Sealing Compound and position it onto the cover. Slide the cover into position and tighten the bolts to 60-84 inch lbs. (7-9 Nm).

20. Install the engine.

Models With A Coupler

◆ See Figures 85, 86 and 87



□ Over the years, these engines were equipped in a variety of configurations—flywheel and torsional damper, flywheel, damper and coupler, flywheel and coupler, etc. And for a number of years, some models also had a timing ring attached. Early models are usually the ones equipped with a damper, while Cobra, SP and DP models usually were equipped with the coupler. King Cobra models are usually the ones that use the timing ring, although there were also some **4.3L** engines that used it. Although we have attempted to narrow the applications in the following procedures, it was not **always** year or model specific. Please read the procedures **FIRST** in order to determine which one is appropriate for your particular engine's configuration.

1. Remove the engine from the boat as detailed previously in this section.
 2. 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.
 3. Although not strictly necessary, we recommend removing the starter.
 4. Loosen the 4 or 5 retaining bolts and slide out the lower housing cover.
 5. Cut the plastic tie that secures the housing drain hose and the pull the hose out of the fitting.
 6. Remove the oil cooler and bracket, take note of the positioning of both and secure them out of the way.
 7. Remove the flywheel housing.
 8. Slide an offset 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 nuts to 40-45 ft. lbs. (54-61 Nm) except on 1992 engines where the spec is 35-40 ft. lbs. (47-54 Nm). Once again use the star pattern while tightening the bolts.
 13. Install the flywheel housing and attach the oil cooler. Tighten the bolts to 28-36 ft. lbs. (38-49 Nm) on 1986-91 engines or 32-40 ft. lbs. (43-54 Nm) on 1992-98 engines.
 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 1986-91 engines or 15-20 ft. lbs. (20-27 Nm) on 1992-98 engines. Attach the electrical leads, install another lock washer and then tighten the outer nut securely.
 15. Coat both sides of a new gasket with Gasket Sealing Compound and position it onto the cover. Slide the cover into position and tighten the bolts to 60-84 inch lbs. (7-9 Nm).
 16. Slide the drain hose in and attach it with a new plastic tie.
 17. Install the engine.

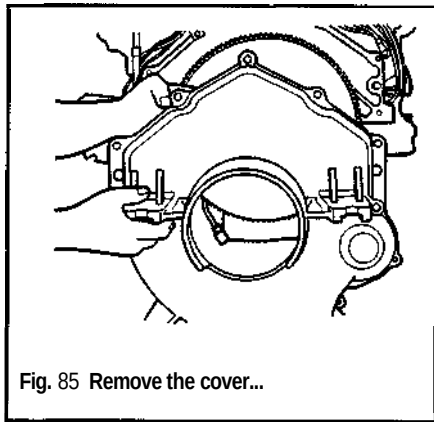


Fig. 85 Remove the cover...

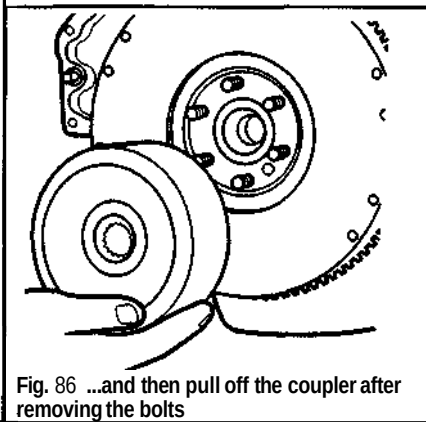


Fig. 86 ...and then pull off the coupler after removing the bolts

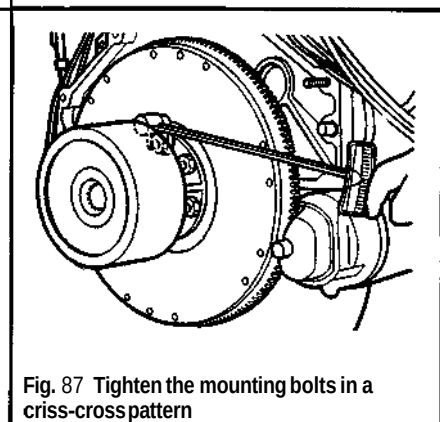


Fig. 87 Tighten the mounting bolts in a criss-cross pattern

Rear Main Oil Seal Retainer

REMOVAL & INSTALLATION

4.3L V6 And 5.0L/5.7L V8 Engines

◆ See Figure 88



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.

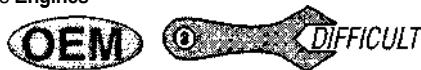
□ A new oil seal must be installed whenever the retainer is removed.

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, with a new gasket, and tighten the nuts/bolts to 135 inch lbs. (15 Nm).
7. Install the oil pan and flywheel as previously detailed.

Rear Main Oil Seal

REMOVAL & INSTALLATION

4.3L V6 And 5.0L/5.7L V8 Engines



Early engines may have been equipped with either a one piece or two piece oil seal.

One Piece Seal

◆ See Figures 88, 89 and 90

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 into a Seal Driver (7J-35621).
7. Position the driver and seal over the 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.

Two Piece Seal

◆ See Figures 91 and 92

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.
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. Do not damage the seal seating surface.

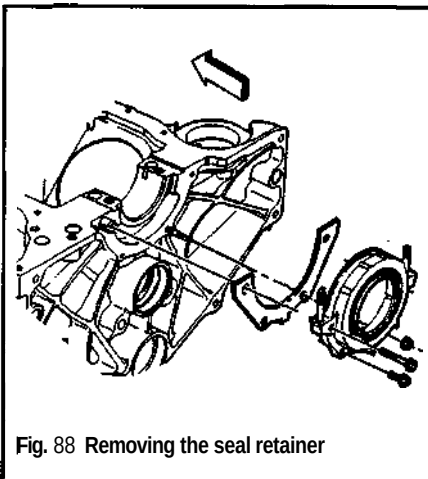


Fig. 88 Removing the seal retainer

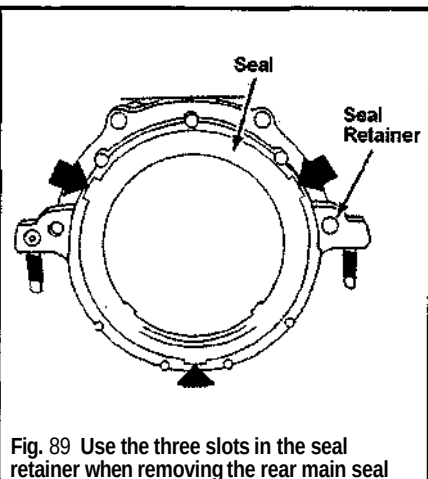


Fig. 89 Use the three slots in the seal retainer when removing the rear main seal

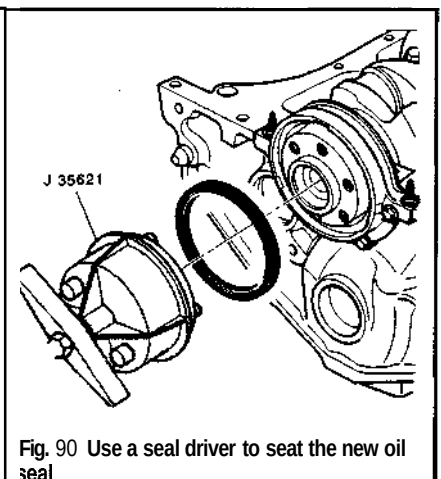
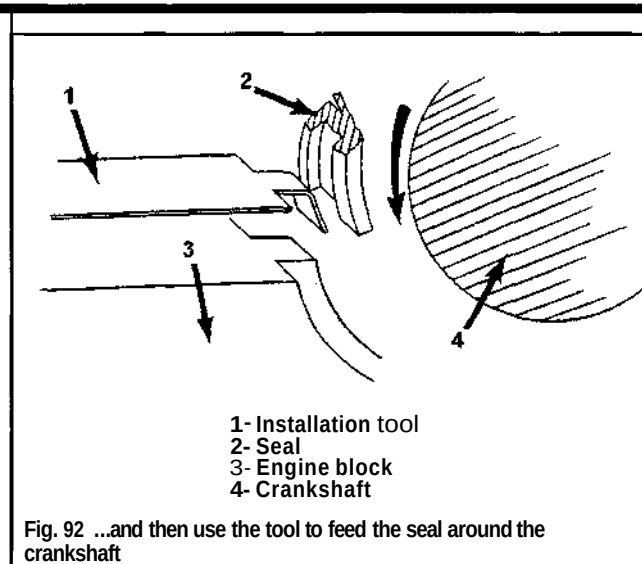
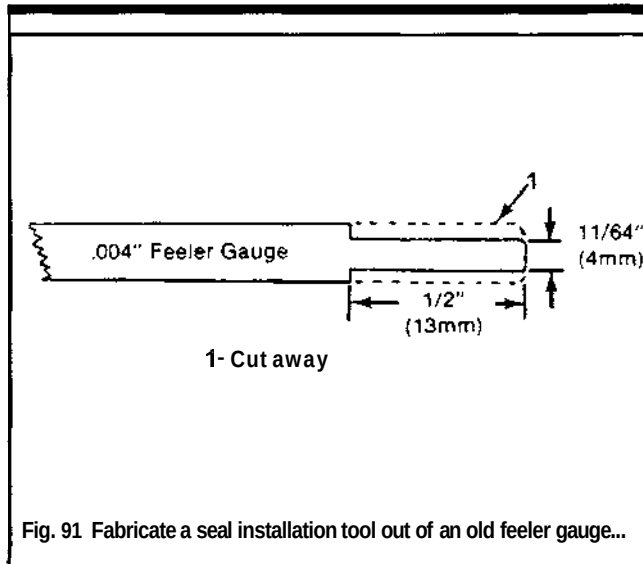


Fig. 90 Use a seal driver to seat the new oil seal



4. Using a hammer and a small drift, tap on 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.
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 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.
9. Make sure that the capblock 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 the correct torque as detailed in the Torque Specifications chart.
11. Install the oil pump and pan.
12. Install the engine.

7.4L/8.2L V8 Engines

◆ See Figures 90 and 93



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. Insert a small prybar into the seal groove and slowly pry the seal out of the groove. Be very careful not to nick or damage the sealing surface while prying out the seal.
4. Thoroughly clean the groove surface.
5. Spread a small amount of engine oil around the inside and outside edges of a new seal and position it into a Seal Driver (J-38841) so that the seal's lip faces the cylinder block.
6. Position the driver and seal over the 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 and you can remove the tool.
7. Install the flywheel and engine coupler. Install the cover and flywheel housing.

Harmonic Balancer, Pulley And Hub

REMOVAL & INSTALLATION

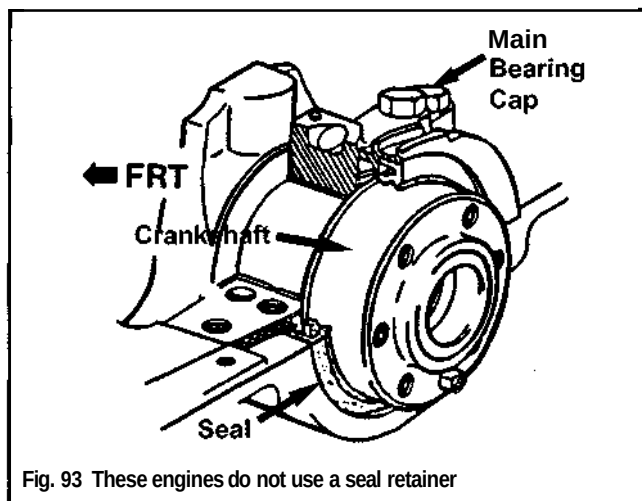
● See Figure 94



1. Disconnect the battery cables.
2. Remove the bracket mounting bolts for the alternator and power steering pump.
3. Drain the engine and manifolds. Loosen the two mounting bolts and remove the seawater pump from the crankshaft.
4. Remove the drive or serpentine belt(s) as detailed in the Maintenance section.
5. Remove the three bolts and pull off the drive pulley attached to the balancer.
6. Remove the balancer retaining bolt (if equipped) and install the special removal tool (#J-23523-03) onto the damper. Tighten the tool press bolt and remove the damper; don't lose the crankshaft key. OMC suggests that you do not use a conventional gear puller for this procedure.

To install:

7. Inspect the crank key and then install it into the shaft. Using a little GM Adhesive will make this easier.
8. Coat the front cover oil seal lip with clean engine oil and then install the damper with a proper installation tool (#J-23523-E or J-39046). Be sure that you thread the tool into the crankshaft at least 112 in. to protect the threads. In a pinch you can use a block of wood and a plastic mallet, but be careful that the pulley does not shift on its mountings while you're hammering. Or, you can use a large washer and a 7/16-20 x 4 in. bolt, but we suggest the tool.



9. Install the plate, thrust bearing and nut on to the rod. Tighten the nut until it bottoms out and then remove the tool.

10. Install the retaining bolt (if equipped) and tighten it to:

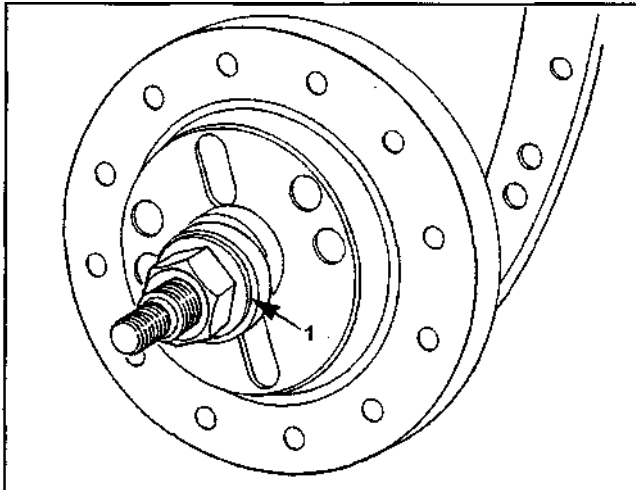
- 60 ft. lbs. (81 Nm) on 1986-90 4.3L V6 and 5.0L/5.7L V8 engines (except LE and 350)
- 70 ft. lbs. (95 Nm) on 1990 5.7 LE and 350 V8 engines
- 70 ft. lbs. (95 Nm) on 1991-96 4.3L V6 and 5.7L V8 engines
- 74 ft. lbs. (100 Nm) on 1997-98 4.3L V6 and 5.7L V8 engines
- 85 ft. lbs. (115 Nm) on 7.4L V8 engines (except 1998 7.4Gi)
- 110 ft. lbs. (149 Nm) on 1998 7.4Gi V8 engines
- 90 ft. lbs. (122 Nm) on 8.2L V8 engines

Squirt a little RTV sealant into the crankshaft keyway to guard against oil seepage.

11. Install the drive pulley and tighten the bolts to 35 ft. lbs (48 Nm) on the V6, 43 ft. lbs. (58 Nm) on V8 engines.

12. Install the drive serpentine belt and make sure that it is adjusted properly.

13. Install the seawater pump.



1- Special Tool

Fig. 94 Use a special tool to remove and install the balancer

Front Cover And Oil Seal

REMOVAL & INSTALLATION

All Except 1988-91 7.4L Engines



◆ See Figures 95 and 96

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(s). Loosen the alternator and power steering brackets to provide slack, and then remove the drive belts.

2. Remove the oil pan on the 7.4L/8.2L V8, not always a bad idea on the other engines either, but OMC suggests that it must be removed on the big block engines. Although we can't recommend it, many people will leave the pan on and cut the seal as detailed in the procedures for the 1988-91 7.4L.

3. Remove the alternator and power steering pump bracket bolts.

4. Remove the water circulation pump.

5. Remove the harmonic balancer and pulley as detailed previously in this section.

6. Loosen the mounting bolts and remove the front cover.

7. If the oil seal needs replacement, pry it out from the front (outer) side of the cover with a small prybar.

8. Remove the front cover gasket.

To install:

9. Clean all gasket material from the cover and block mating surfaces with a scraper or putty knife. Be careful not to knock any pieces of gasket

into the timing assembly.

10. If you removed the oil seal, install a new one with the lip toward the inside of the cover. Position a support under the seal and cover and then press the seal into the cover with the proper tool (#J-23042 - 1986-93 engines, #J-35468 - 1992-98 7.4L/8.2L engines and 1994-98 4.3L/5.0L/5.7L engines).

11. Coat the lip of the oil seal with engine oil. Coat both sides of a new gasket with sealant and then position the gasket onto the engine. Install the cover so that all the bolt holes line up; there are dowel pins on the cylinder block that will help alignment. Tighten the bolts to:

- 80 inch lbs. (9 Nm) on 1986-96 V6 engines
- 106 inch lbs. (12 Nm) on 1997-98 V6 engines
- 80 inch lbs. (9 Nm) on 1986-97 5.0L/5.7L V8 engines (except 1992 5.7 LE and 1997 5.7FSi)
- 100 inch lbs. (11 Nm) on 1992 5.7 LE engines
- 106 inch lbs. (12 Nm) on 1997 5.7FSi and all 1998 5.7L V8 engines
- 96 inch lbs. (11 Nm) on 1992-97 7.4L V8 engines
- 106 inch lbs. (12 Nm) on 1998 7.4L V8 engines
- 120 inch lbs. (14 Nm) on 8.2L V8 engines

Don't forget to use new cover on engines with a composite cover!

12. Install the oil pan.

13. Install the harmonic balancer and its pulley.

14. Install the circulation pump and its pulley. Pull the belts back on.

Check their tension adjustment.

15. Install the engine if removed. Add oil and water/coolant, start the engine and check for any leaks.

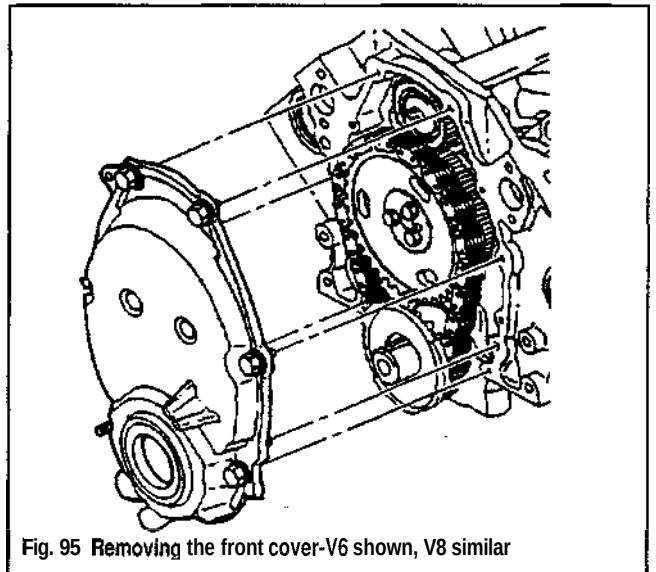


Fig. 95 Removing the front cover-V6 shown, V8 similar

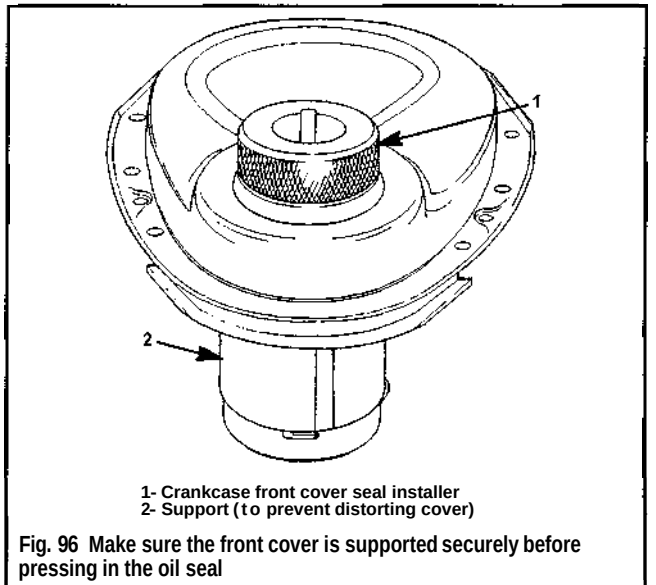


Fig. 96 Make sure the front cover is supported securely before pressing in the oil seal

5-30 ENGINE MECHANICAL—GM V6 AND V8 ENGINES

1988-91 7.4L Engines

4 See Figure 97



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. Loosen the alternator and power steering brackets (or the idler pulley) to provide slack, and then remove the drive belts.
2. Drain the oil if you haven't already done so.
3. Remove the alternator and power steering pump bracket bolts.
4. Remove the water circulation pump.
5. Remove the harmonic balancer and pulley as detailed previously in this section.
6. Remove the two 7/16 in. oil pan-to-front cover bolts. Loosen the 3/8 in. cover mounting bolts and pry the front cover outward slightly. Insert a razor knife between the cover and block so that it is flush with the inside of the cover and then carefully cut the oil pan seal at each side of the cover.
7. Remove the cover.
8. If the oil seal needs replacement, pry it out from the front (outer) side of the cover with a small prybar.
9. Remove the front cover gasket.

To install:

10. Clean all gasket material from the cover and block mating surfaces with a scraper or putty knife. Be careful not to knock any pieces of gasket into the timing assembly.
11. If you removed the oil seal, install a new one with the lip toward the inside of the cover. Position a support under the seal and cover and then press the seal into the cover with the proper tool (#J-22102).
12. Take a new oil pan gasket and cut out a portion of it equal to that which you cut previously when removing the cover. Coat the oil pan mating surface with RTV sealer and carefully position the cut gasket into the flange. While you have the sealer out, run a small bead along the joints where the three (pan, cover and block) surfaces come in contact with one another.
13. Coat the lip of the oil seal with engine oil. Coat both sides of a new gasket with sealant and then position the gasket onto the engine. Install the cover so that all the bolt holes line up; there are dowel pins on the cylinder block that will help alignment. Tighten the cover-to-pan bolts to 8 ft. lbs. (10 Nm). Tighten the cover-to-block bolts to 6 ft. lbs. (8 Nm).
14. Install the harmonic balancer and its pulley.
15. Install the circulation pump and its pulley. Pull the belts back on. Check their tension adjustment.
16. Install the engine if removed. Add oil and water/coolant, start the engine and check for any leaks.

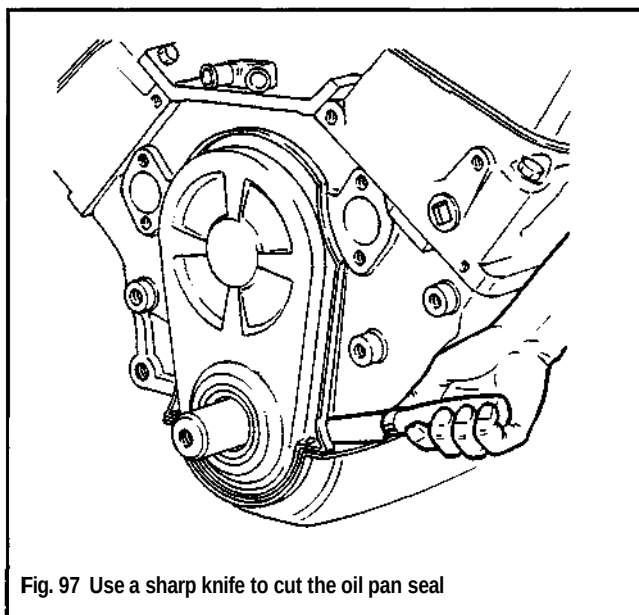


Fig. 97 Use a sharp knife to cut the oil pan seal

Timing Chain And Sprockets

REMOVAL & INSTALLATION

◆ See Figures 98 and 99



1. Disconnect the battery cables.
2. Remove the mounting bolts for the alternator and power steering pump brackets.
3. Remove the crankshaft pulley and harmonic balancer as previously detailed in this section.
4. Remove the front cover as previously detailed in this section.
5. Rotate the camshaft slightly so that it creates tension on one side of the timing chain (either side is OK). Find a reference point on the same side of the cylinder block as the side that the timing chain is tight on and then measure from this point to the outer edge of the chain.
6. Rotate the camshaft in the opposite direction until the other side of the chain is tight. Press the inner side of the chain outward until it stops and then measure from your reference point on the cylinder block (obviously, do this from the same side of the chain as you did in the previous step) to the outer edge of the chain. This is timing chain deflection and it should be no more than 0.625 in. (16mm). If it is more than specification, the chain will require replacement.
7. Look carefully at the camshaft and crankshaft sprockets—you should notice a small indent on the front edge of one of the teeth on each sprocket. Bump the engine over until these two marks are in alignment as shown in the illustration—crank mark at 12:00 and cam mark at 6:00, a remote starter will work or you can screw the damper bolt back into the crankshaft and turn it with a wrench.
8. Dab a little paint across one of the chain links and the camshaft sprocket. Loosen the camshaft sprocket retaining bolts (three, although on the certain 1994-98 V6 engines, one will be a nut—don't be concerned if the stud comes out with the nut), grasp the sprocket on each side with the chain still attached and wiggle it off the shaft. It should come off readily, but if not, tap the bottom edge lightly with a rubber mallet.

⚠ WARNING

Never rotate the crankshaft once the timing chain has been removed. If moved, you'll risk damage to the pistons and/or valve train.

9. Mount a gear puller (#J-1619) over the crankshaft pulley and pull it off the shaft. Don't lose the key.

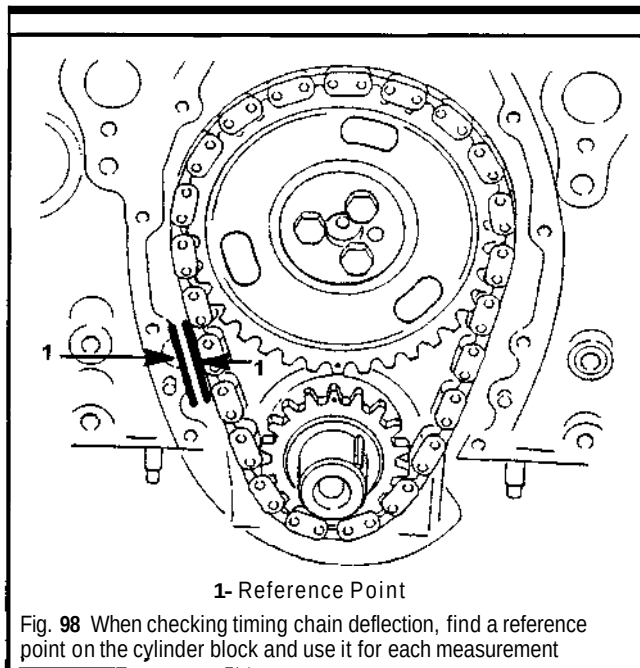
To install:

10. Clean the chain and sprockets in solvent and let them air dry. Check the chain for wear and damage, making sure there are no loose or cracked links. Check the sprockets for cracked or worn teeth.
11. Coat the woodruff key lightly with adhesive and position it on the crankshaft. Install the crankshaft sprocket onto the shaft with an installation tool (#J-22102).
12. Install the timing chain onto the camshaft sprocket so that the paint marks made during removal match up. If they do, and you haven't moved the engine, the timing marks on the two sprockets should also. Hold the sprocket/khain in both hands so the chain is hanging down, engage the chain around the crankshaft sprocket and then slide the cam sprocket/khain onto the camshaft making sure the dowel pin aligns with the hole in the sprocket. Do not force it! On 1994-98 V6 engines, make sure the balance shaft drive gear stud fits through the hole. Tighten the three mounting bolts/nut to:
 - 20 ft. lbs. (27 Nm) on 1986-93 4.3L V6 and 5.0L/5.7L V8 (except 1992 5.7 LE) and all 7.4L V8 engines
 - 100 inch lbs. (11 Nm) on 1992 5.7 LE
 - 21 ft. lbs. (28 Nm) on 1994-98 4.3L V6 and 5.0L/5.7L V8 engines
 - 25 ft. lbs. (34 Nm) on 8.2L V8 engines

⚠ CAUTION

Never force the camshaft sprocket onto the shaft or use a hammer, lest you loosen the rear Welch plug.

13. Install the front cover, harmonic balancer and water pump pulley.
14. Install and adjust the drive belts.
15. Install the seawater pump and reconnect the alternator and power steering brackets.



□ Remember that when the timing marks were aligned properly, the No. 4 (or No. 6, V8) cylinder was at TDC so if you removed the distributor for some reason, the rotor should be at the No. 4 (No. 6) post on the cap, NOT at the No. 1 post.

Balance Shaft

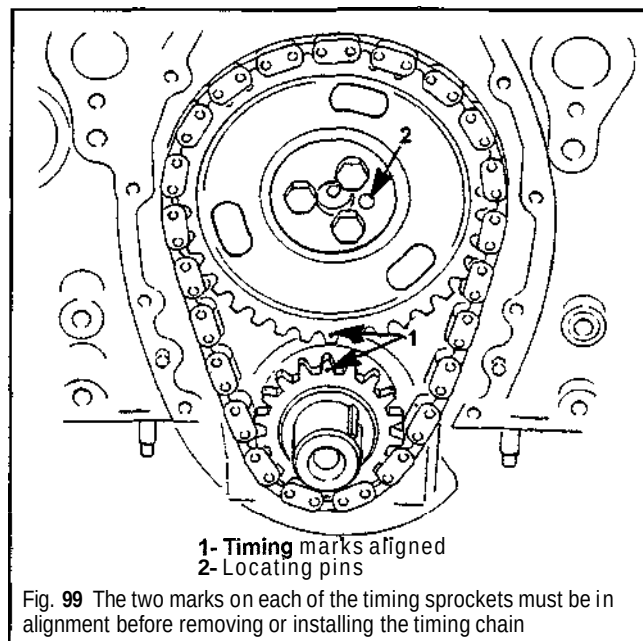
REMOVAL & INSTALLATION

1994-98 4.3L V6 Engines Only



◆ See Figures 100, 101 and 102

1. Remove the distributor cap and mark the position of the No. 1 cylinder terminal on the side of the housing. Matchmark the housing to the engine and then remove the distributor.
2. Remove the intake manifold.
3. Remove the drive belts and then remove the water circulating pump and its pulley.
4. Remove the harmonic balancer and its pulley.
5. Remove the oil pan.
6. Remove the front cover.
7. Fashion a small wedge out of an old piece of wood and jam it (carefully!) in between the teeth of the balance shaft driven gear and the camshaft drive gear (this is behind the sprocket) to hold the shafts from turning. Loosen, but do not remove, the driven gear bolt—although not on all applications, the chances are very good that this will be a Torx® head.
8. Loosen the three camshaft sprocket bolts/nut and then pull off the sprocket with the timing chain attached. Remove the camshaft drive gear.
9. Now you can remove the bolt loosened previously and pull off the balance shaft drive gear.
10. Remove the two mounting bolts from the balance shaft retainer and lift off the plate. You've probably already noticed that these will be Torx® fasteners also.
11. Insert a suitable prybar between the rear of the shaft and the cylinder block and carefully shimmy the shaft forward and out of the bearing housing in the rear of the block. Slide the entire shaft out through the front of the block. Be careful not to knock any debris into the inside of the cylinder block. You can also use a soft mallet and carefully tap the front bearing assembly to accomplish this step.
- To install:
12. Clean the balance shaft in solvent and let it dry completely. Inspect the rear bearing for wear or damage. Inspect the front bearing for excessive side play on the shaft, wear or damage. Check the bearing bore in the front of the cylinder block for scoring.



13. Lubricate the front and rear bearing with motor oil and then carefully slide the shaft through the front bore until it feeds into the rear bearing. OMC suggests using a Driver Handle (#J-8092) and Shaft Installer (#J-36996) to accomplish shaft installation, but many technicians simply tap the front edge of the shaft with a plastic mallet until the retaining ring on the front bearing seats against the cylinder block—you make the call as to which option you choose.

14. Install the thrust plate and tighten the two fasteners to 120 inch lbs. (14 Nm).

15. Position the driven gear onto the balance shaft with the bolt finger tight. Make sure that the timing mark is at the bottom of the gear.

16. Install the camshaft drive gear so that the mark aligns with the one on the balance shaft driven gear (it will be pointing UP). You may have to wiggle the two shafts until you get the marks to align correctly. Install the stud and tighten to 12 ft. lbs. (16 Nm).

17. Remove the balance shaft drive gear bolt again and coat the threads with Loctite. Screw it in and tighten it to 15 ft. lbs. (20 Nm); and then turn the bolt an additional 35°.

18. Install the timing chain and front cover.

19. Install the intake manifold.

Camshaft

CHECKING LIFT



◆ See Figures 103, 104 and 105

If the shaft is out of the engine, you can use a micrometer to take the heel-to-lobe measurement and the side-to-side measurement. Subtract the second measurement from the first to get lobe lift. Most times though, the shaft will still be in the cylinder block so perform the following procedure.

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.

5-32 ENGINE MECHANICAL—GM V6 AND V8 ENGINES

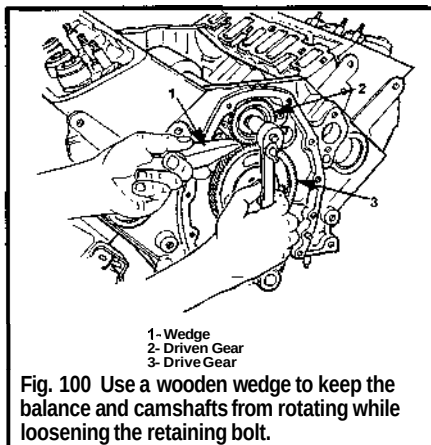


Fig. 100 Use a wooden wedge to keep the balance and camshafts from rotating while loosening the retaining bolt.

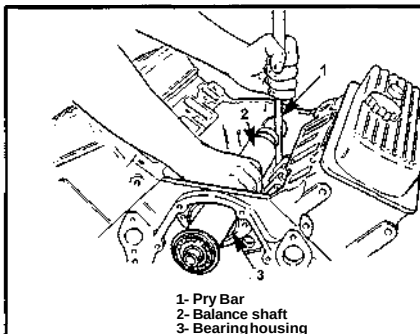


Fig. 101 Carefully lever the balance shaft forward and out of the cylinder block

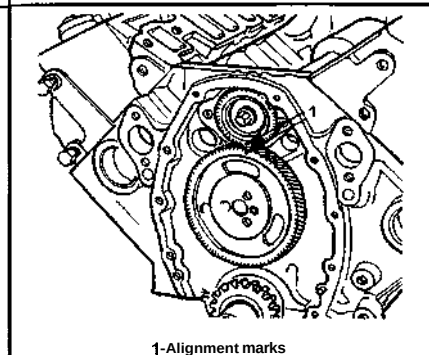


Fig. 102 The timing marks on the balance shaft driven gear and the camshaft drive gear must be aligned on installation

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 as detailed in the Engine Specifications chart.

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 Figures 106 and 107

1. Remove the cylinder head covers and rocker assemblies as previously detailed in this section. Remove the pushrods.

2. Remove the intake manifold.

3. Remove the lifter restrictor mounting bolts and lift out the restrictors (if equipped). Matchmark the lifters to their bores and then lift out the valve lifters with a small magnet and store them in a rack with labels so they can be reinstalled in their original locations.

4. Remove the front cover and timing chain/sprockets as previously detailed in this section.

5. Remove the fuel pump and push rod on early V6 and small block V8 engines.

6. Remove the inner camshaft drive gear on 1994-98 V6 engines.

7. Remove the thrust plate/retainer.

8. Thread two (three on later V8s) 5/16-18 x 4 in. bolts into the camshaft bolt holes and carefully pull the camshaft out of the cylinder block. You may have to wiggle it back and forth a bit, so be sure you don't lean it up or down or else you could damage the bearings.

9. 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.

1986-96 engines:

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

11. Slide the pilot tool (#J-6098-01) into position in the inner bearing—the bearing closest to the center of the engine.

12. Install a nut and washer 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.

13. Index the pilot over the screw so that the open end is toward the nut on the puller screw.

14. Install the remover so the shoulder is facing the No. 3 bearing and it has sufficiently engaged the threads of the tool.

15. Hold the screw shaft with a wrench while turning the puller nut (front) with another until the bearing comes out. Repeat this procedure for the No. 2 bearing.

16. Now remove the pilot from the shaft, remove the tool and reassemble it on the rear of the engine to remove the No. 4 bearing.

17. Install the remover 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.

1997-98 engines:

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

19. Insert the camshaft bearing removal tool (#J-33049) through the first bearing (front of block) and into the bearing being removed. Make sure the collet is the correct one for your engine and turn the tool until it has seated into the bearing.

20. Push the centering cone up against the cylinder block and into the recess of the No. 1 bearing so that the tool centers itself. Drive the bearing out of the block.

21. Repeat the procedure to remove the remaining bearings; noting that the No. 1 bearing needs to be removed from the rear of the block to allow for proper centering of the tool.

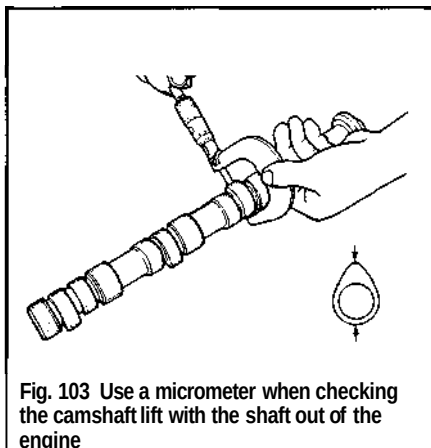


Fig. 103 Use a micrometer when checking the camshaft lift with the shaft out of the engine

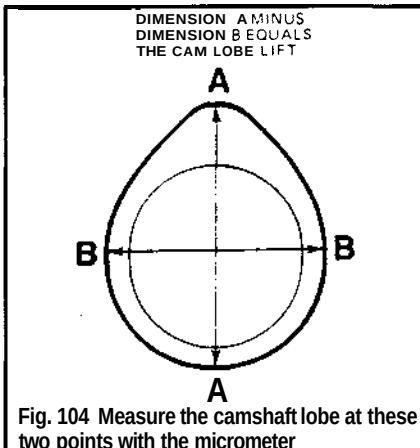


Fig. 104 Measure the camshaft lobe at these two points with the micrometer

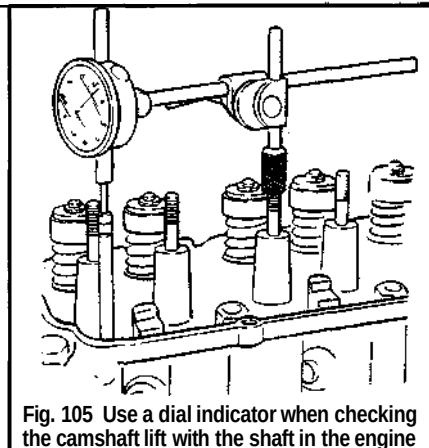


Fig. 105 Use a dial indicator when checking the camshaft lift with the shaft in the engine

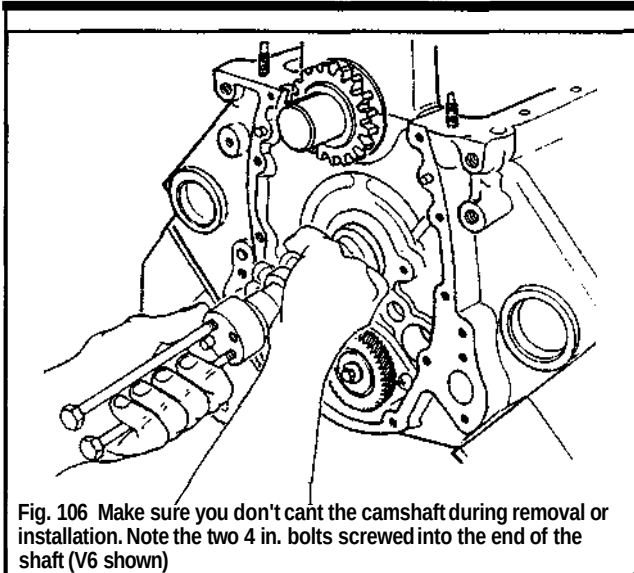


Fig. 106 Make sure you don't cant the camshaft during removal or installation. Note the two 4 in. bolts screwed into the end of the shaft (V6 shown)

To install:

22. If you removed the bearings:
- 1986-96 engines:**
23. Install the installer tool on the driver handle and then drive the front and rear bearings into the block from the outside toward the center (see the following Note on oil hole alignment).
24. Remove the handle from the pilot tool and install the inner bearing on the tool.
25. 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.
26. 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(s) will not be visible during installation. To make installation easier, align the holes in the bearing with those in the block and then mark the opposite side of the bearing block. To make it easier for you, the No. 1 bearing should have the holes on equal sides of the 6 o'clock position; Nos. 2, 3 and 4 bearing holes should be positioned at the 5 o'clock position (toward the left side of engine) and even with the bottom of the cylinder bore; No. 5's oil hole should be at the 12 o'clock position.

27. Repeat the last step for the remaining bearings.
28. Coat a new rear welch plug with sealant and install it so that it is flush with the surface of the cylinder block, or no more than 1132 in. (0.792mm) deep when measured from the outer edge of its recess.
- 1997-98 engines:**
29. Bearing installation on these engines is essentially the reverse of removal. Take note of the following though:
 - Install the front and rear bearings first, from the outside toward the inside.
 - Bearing bore sizes may vary, be sure you have the correct bearings when replacing them.
 - Make sure that the oil holes in the bearing align with the holes in the block, during and after installation.
 - Coat a new rear welch plug with sealant and install it so that it is flush with the surface of the cylinder block, or no more than 1132 in. (0.792mm) deep when measured from the outer edge of its recess.

On all engines now:

30. Inspect the camshaft as detailed previously.
31. Coat the camshaft journals with engine oil. Coat the camshaft lobes and distributor drive gear teeth with GM Engine oil supplement or Molykote (in a pinch, just use engine oil).
32. Reinstall the long bolts and carefully insert the shaft into the cylinder block and slide it all the way in. Be very careful not to damage the bearings.
33. Remove the installation bolts and install the thrust plate/retainer (if equipped) and tighten the bolts to 106 inch lbs. (12 Nm) on 1986-96 V6 engines and all V8 engines, or 124 inch lbs. (14 Nm) on 1997-98 V6 engines.

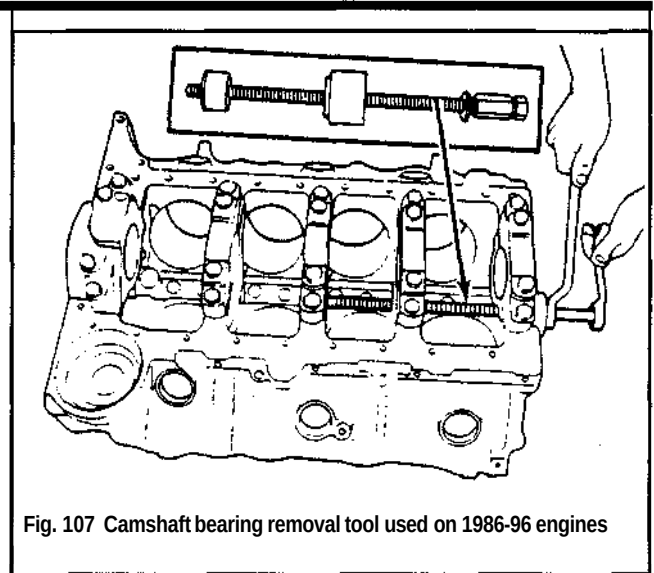


Fig. 107 Camshaft bearing removal tool used on 1986-96 engines

34. Install the fuel pump and push rod on engines so equipped.
35. Install the drive gears, timing chain and front cover.
36. Drop the lifters back into their original bores so that they are aligned with the matchmarks and then install the restrictors. Install the push rods.
37. Install the intake manifold.
38. Install the rocker assemblies and the cylinder head covers.

Cylinder Head

REMOVAL & INSTALLATION



◆ See Figures 108,109,110,111,112 and 113

1. Drain the water from the cylinder block and manifold.
2. Remove the fuel line support brackets. Disconnect the fuel line at the carburetor/throttle body and fuel pump, plug the fitting holes and remove the line.
3. Remove the cylinder head cover and rocker assemblies as detailed previously in this section.
4. Remove the intake and exhaust manifolds as previously detailed; you can leave the carburetor/throttle body attached to the intake manifold if you like.
5. If you intend to remove the valve lifters, now is the time to do it. Either way, make sure that you cover the valley of the cylinder block carefully with plenty of rags to prevent dirt from entering any of the passages or settling on any components.
6. 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; plug the holes if you do.
7. Remove or relocate any components or connections that may interfere with the removal of an individual cylinder head.
8. Loosen the cylinder head bolts in the reverse order of the illustrated tightening sequence 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 on two support blocks; do not sit it on cement.

❑ It's always a good idea to keep a record of which bolts came from which holes. It may sound silly, but on many engines they are different sizes and you wouldn't be the first person to break off a long bolt while tightening it in a short hole. Spend the extra few seconds and do this!

To install:

9. 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 found for complete details on inspection and refurbishing procedures.

5-34 ENGINE MECHANICAL—GM V6 AND V8 ENGINES

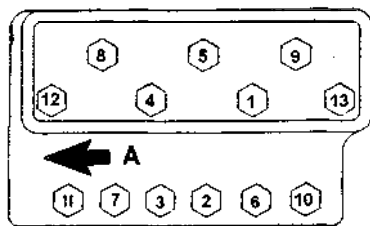


Fig. 108 Cylinder head tightening sequence—1986-94 4.3L V6 engines

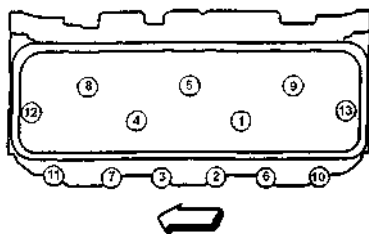


Fig. 109 Cylinder head tightening sequence—1997-98 4.3L V6 engines

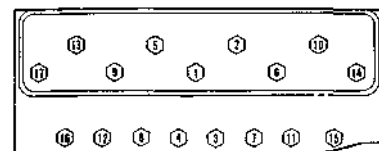


Fig. 110 Cylinder head tightening sequence—5.0L/5.7L V8 engines



Fig. 111 Cylinder head tightening sequence—7.4L/8.2L V8 engines

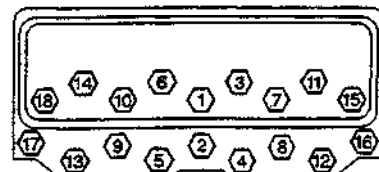


Fig. 112 Cylinder head tightening sequence—8.1L V8 engines

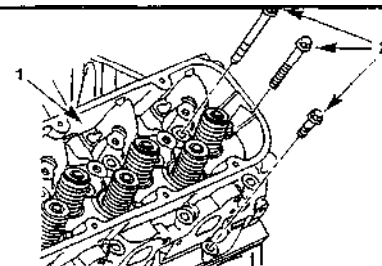


Fig. 113 Many engines have three different size bolts

10. Position a new gasket over the cylinder block dowel pins. Do not use any sealer as the gasket is coated with a laquer which will provide the proper sealing effect once the engine gets to normal operating temperature the first time. DO NOT use automotive-type steel gaskets. Make sure the word UP is facing, you guessed it, up, if noted on your gasket.

11. Position the cylinder head over the dowels in the block. Coat the threads of the head bolts with Gasket Sealing compound and install them finger tight. It never hurts to use new bolts, although it's not necessary.

12. Tighten the bolts, a little at a time, in the sequence illustrated, until the proper tightening torque is achieved.

- 1986-97 4.3L V6 and 5.0L/5.7L V8 engines (except the 1997 5.7GSI: the first step should be 25 ft. lbs. (34 Nm), the second step should be 45 ft. lbs. (61 Nm), while the last step should be to 65 ft. lbs. (88 Nm).

- 1998 4.3L V6 engines: tighten all the bolts, in sequence, to 22 ft. lbs. (30 Nm). Next, turn the short bolts (#11, 7, 3, 2, 6 & 10) an additional 55°; the medium bolts (#12 & 13) an additional 65°; and the long bolts (#1, 4, 8, 5 & 9) an additional 75°. Obviously you will need a torque/angle meter for these last passes.

- 1997 5.7GSI and all 1998 5.0L/5.7L V8 engines: tighten all the bolts, in sequence, to 22 ft. lbs. (30 Nm). Next, turn the short bolts (#3, 4, 7, 8, 11, 12, 15 & 16) an additional 55°; the medium bolts (#14 & 17) an additional 65°; and the long bolts (#1, 2, 5, 6, 9, 10 & 13) an additional 75°. Obviously you will need a torque/angle meter for these last passes.

- 7.4L/8.2L V8 engines: the first step should be 35 ft. lbs. (47 Nm), the second step should be 65 ft. lbs. (88 Nm), while the last step should be to 80 ft. lbs. (108 Nm) on 1988-91 engines or 85 ft. lbs. (115 Nm) on 1992-98 engines.

13. Install the rocker assemblies and the cylinder head cover. Don't forget the baffle plate and restrictors/retainers on engines so equipped.

14. Install the manifolds and connect the fuel line. Don't forget to remove the fitting plugs.

15. Install the spark plugs if they were removed and then connect the plug wires.

16. Install or connect any other components removed to facilitate getting the head off.

17. Add coolant/water, 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.

18. It never hurts to re-tighten the cylinder head bolts again after 20 hours of operation.

Engine Circulating (Water) Pump

REMOVAL & INSTALLATION

♦ See Figure 114



1. Disconnect the battery cables and then drain all water from the block and manifolds.

2. Drain all water/coolant from the cylinder block.

3. Loosen, but do not remove, the pump pulley mounting bolts.

4. Loosen the power steering pump and alternator bracket bolts and swivel them in until you are able to remove the belt(s). Different engines may have different systems, follow the belt back and loosen the appropriate components.

5. Now you can remove the pump pulley bolts along with the lock washers and clamping ring. Pull off the pulley.

6. Disconnect the water hoses at the pump.

7. Remove the mounting bolts and lift the pump off of the block.

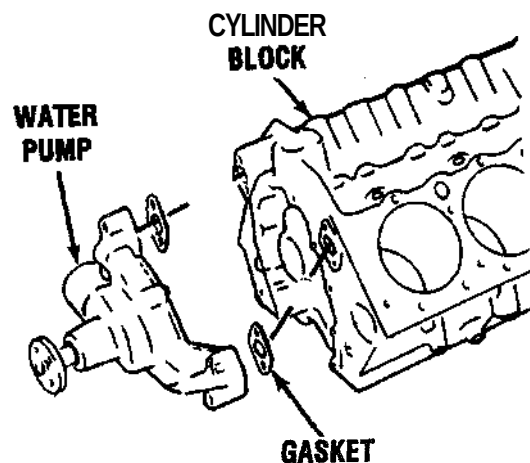


Figure 114 Removing the water circulating pump

To install:

8. Carefully scrape any old gasket material off both mounting surfaces. Inspect the pump for blockage, cracks or any other damage. Inspect the impeller for cracks. Replace either if necessary.

9. Coat both sides of a new gasket(s) with sealant and position on the cylinder block. Coat the threads of the pump mounting bolts with sealant, install the pump and tighten the bolts to:

- 30 ft. lbs. (41 Nm) on 4.3L V6 and 5.0L/5.7L/7.4L V8 engines
- 35 ft. lbs. (47 Nm) on 8.2L V8 engines.

10. Reconnect the water hoses and tighten the hose clamps securely.

11. Position the pump pulley and clamping ring on the boss. Screw the mounting bolts and lock washers in and tighten them securely.

12. Install the drive belt(s) and adjust them as detailed previously. Start the engine and check the system for leaks.

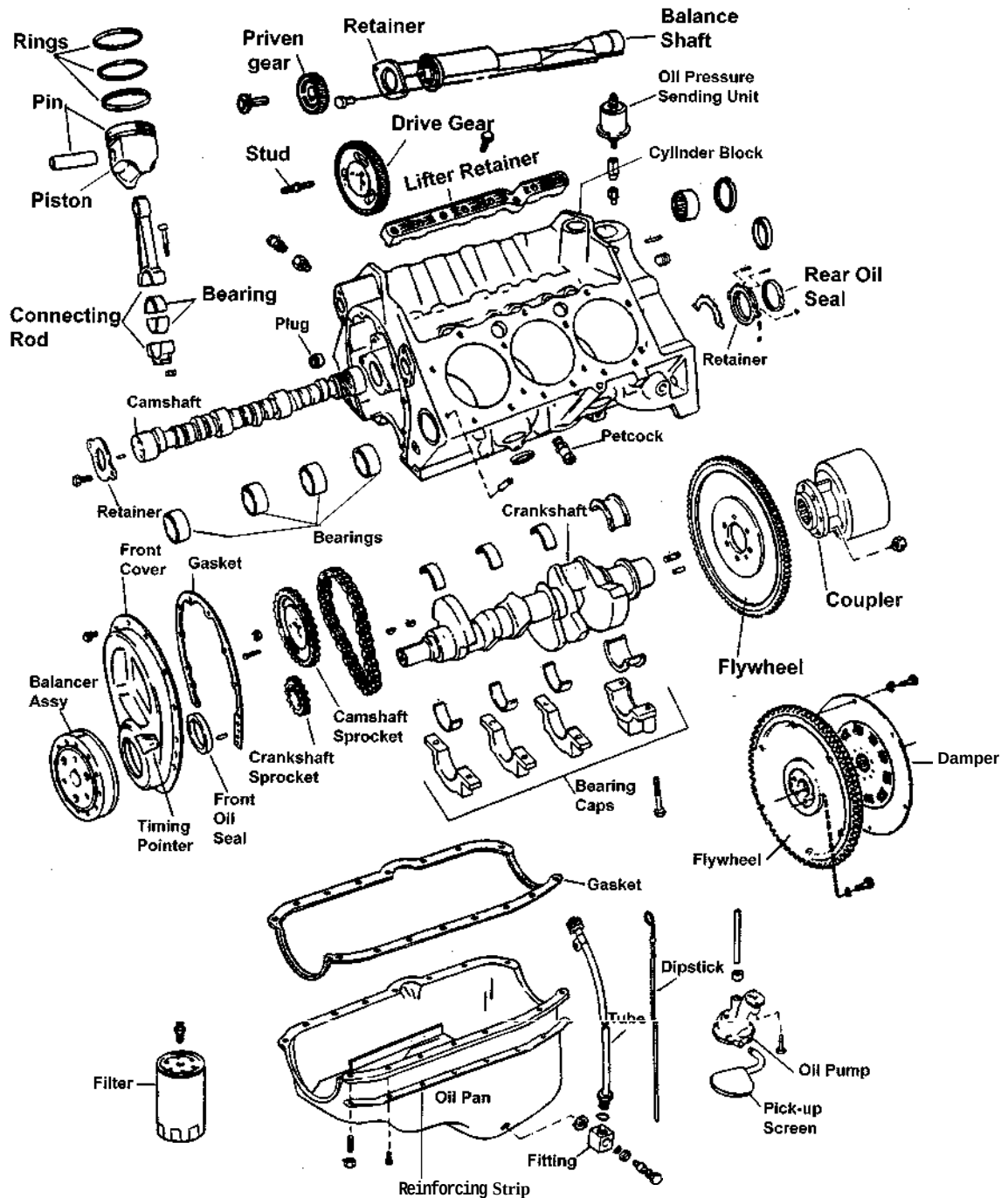
EXPLODED VIEWS

Fig. 115 Exploded view of the cylinder block, all years similar—V6 engines

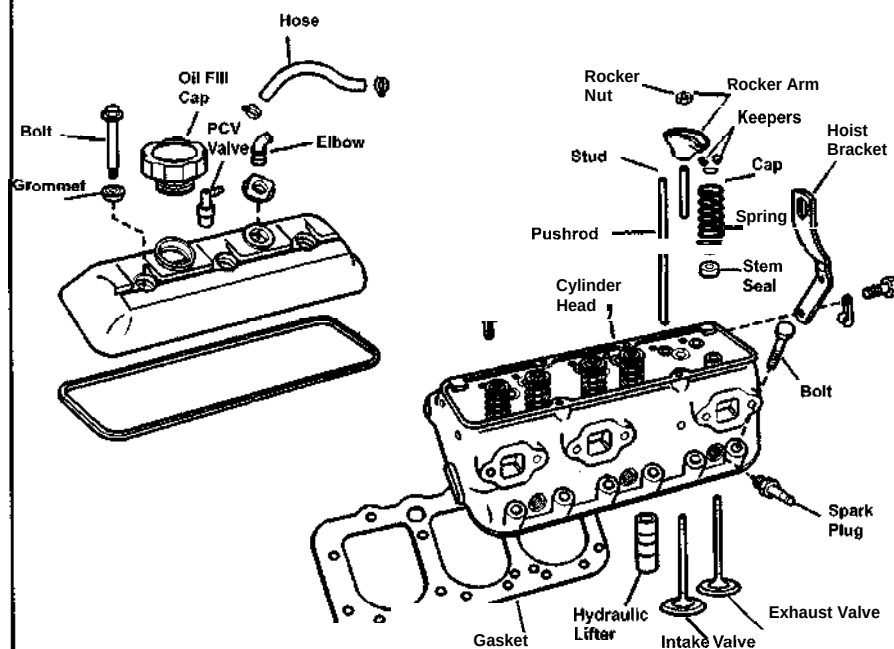


Fig. 118 Exploded view of the cylinder head, all years similar—5.0L/5.7L V8 engines

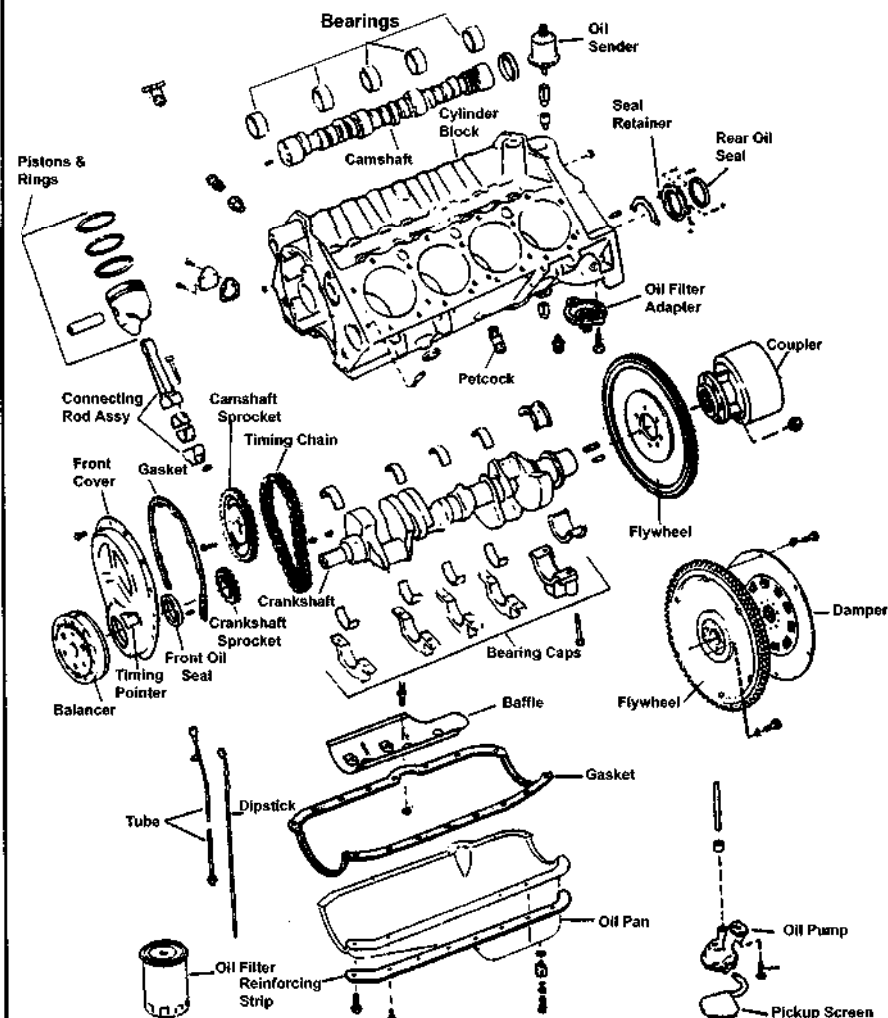


Fig. 116 Exploded view of the cylinder block, all years similar—V8 engines

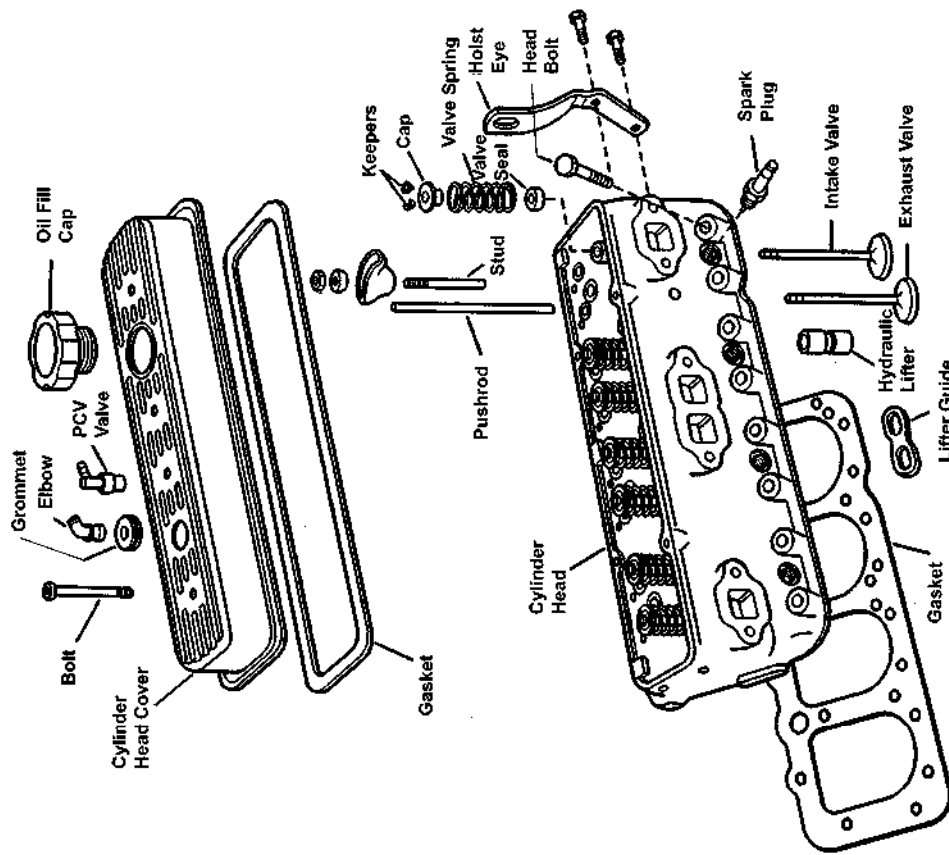


Fig. 117 Exploded view of the cylinder head, all years similar—V6 engines

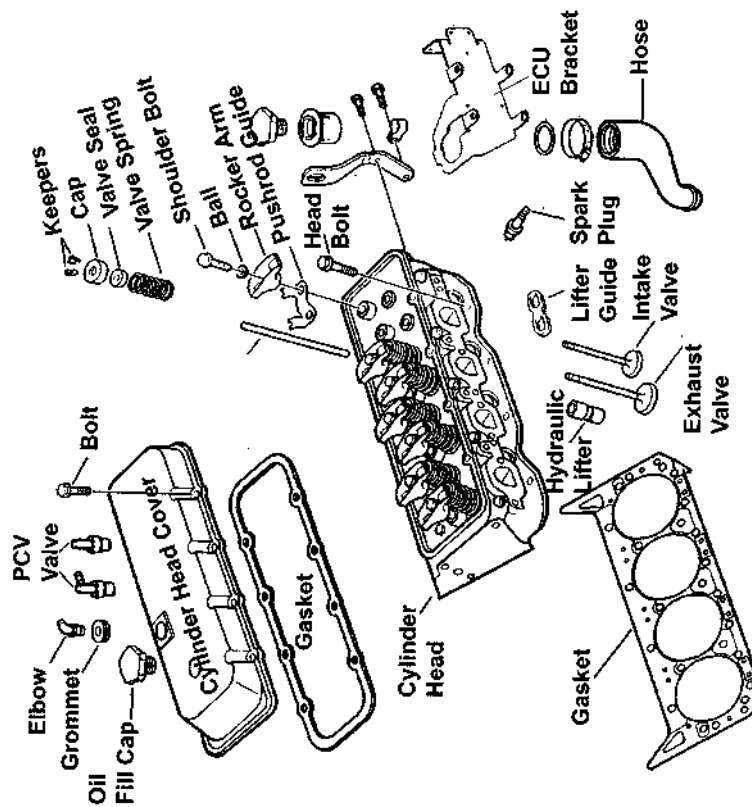


Fig. 118 Exploded view of the cylinder head, all years similar—7.4L/8.2L V8 engines

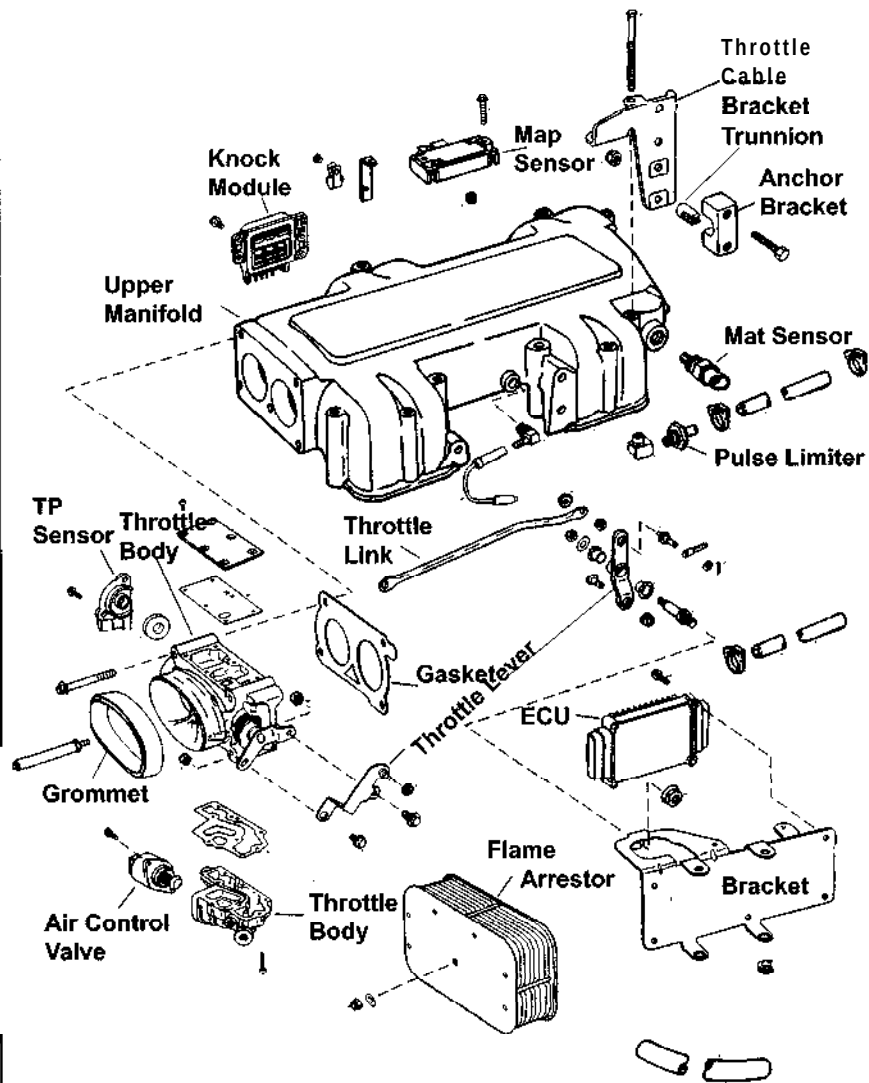


Fig. 121 Exploded view of the upper intake manifold—1996-98 7.4L/8.2L MPI V8 engines

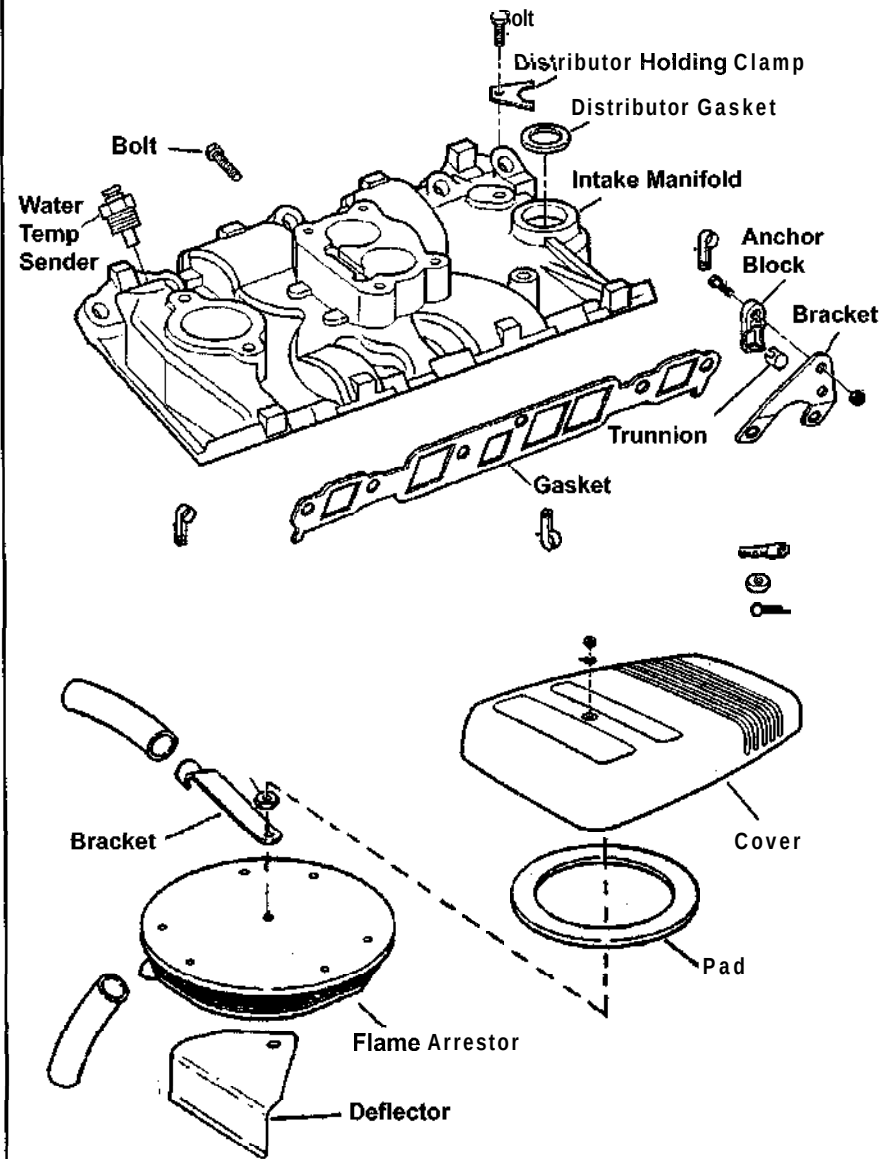


Fig. 120 Exploded view of the intake manifold, all years similar—V6 engines, 5.0L/5.7L V8 and 7.4L/8.2L carbureted V8 engines very similar

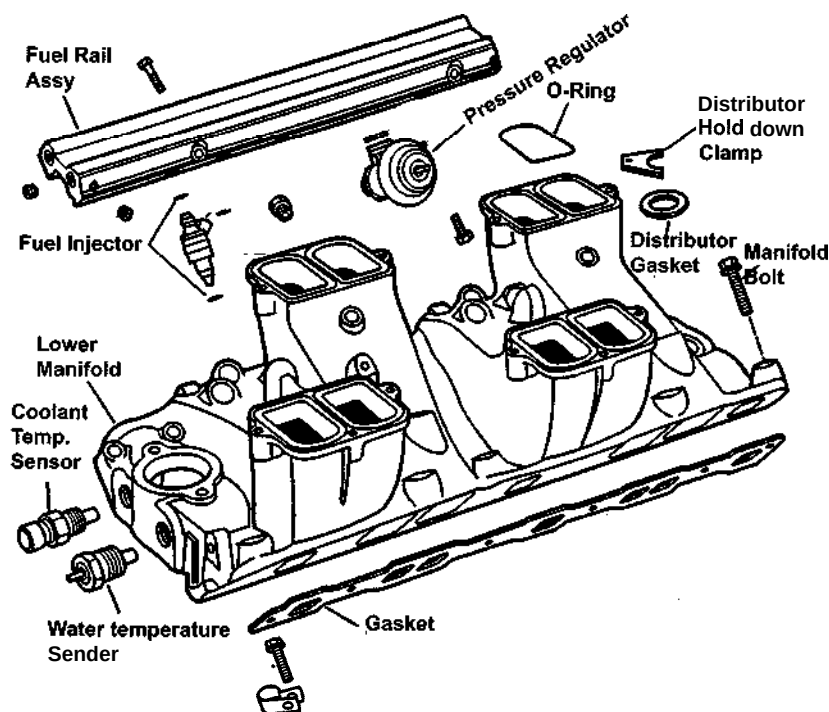


Fig. 122 Exploded view of the lower intake manifold—1996-98 7.4L/8.2L MPI V8 engines

SPECIFICATION CHARTS

TORQUE SPECIFICATIONS - 4.3L V6

Component	ft. lbs.	Inch lbs.	Nm
Inlet Shaft	15 + 35 deg.	-	20 + 35 deg.
Driven Gear	-	120	14
Retainer (thrust plate)	-	-	-
Sprocket	-	-	-
1986-93	20	-	27
1994-98	21	-	28
Thrust plate	-	-	-
1986-93	-	106	12
1997-98	-	124	14
Connecting Rod Cap	45	-	60
1986-96	-	-	-
1997-98	20 + 70 deg.	-	27 + 70 deg.
Crankshaft	-	-	-
Main Bearing Cap	-	-	-
1986-91	70	-	95
1992-96	-	-	-
Outer on #2, #4	70	-	95
All others	80	-	110
1997-98	77	-	105
Oil Seal Retainer	-	135	15.3
Drain Plug	15	-	20
Oil Gallery Plug	-	-	-
Cylinder Block	-	-	-
Port	15	-	20
Exhaust	18	-	25
Cylinder Head	-	-	-
Bolts	-	-	-
1986-97	-	-	-
Step 1	25	-	34
Step 2	45	-	61
Step 3	65	-	88
1998	①	-	①
1986-93	-	100	11
1994-96	-	62-115	7-13
1997-98	-	106	12
15-18	-	-	20-24
20	-	-	27
Dipstick Tube	-	-	-
Distributor Clamp nut	-	-	-
Engine Mount	-	-	-
To engine	32-40	-	43-54
Adjusting nut	100-120	-	136-163
Bolt	60-75	-	81-102
Rear	-	-	-
Locknut	28-30	-	38-40
Mounting bolts	20-25	-	27-34
Exhaust Elbow	-	-	-
1986-93	10-12	-	14-16
1994-98	12-18	-	16-24
Exhaust Manifold	-	-	-
1986-90	18-22	-	24-30
1991-98	20-26	-	27-35

① 1st pass: 22 ft. lbs. (30 Nm); 2nd pass: short bolt - 55 deg., medium bolt - 65 deg., long bolt - 75 deg.

TORQUE SPECIFICATIONS - 4.3L V6

Component		ft. lbs.	inch lbs.	Nm
Exhaust Pipe	To transom	1986-90	10-12	14-16
		1991-98	20-25	27-34
Flywheel	Bellhousing	1986-91	28-36	38-39
		1992-98	32-40	43-54
	Coupler Nut		40-45	54-61
	Cover		60-84	7-9
	Stud	1986-91	20-25	27-34
		1992-98	15-20	20-27
	Timing Sensor		48-64	5-7
Front Cover		1986-96	80	9
		1997-98	-	106
Harmonic Balancer		1986-90	60	81
		1991-96	70	95
		1997-98	74	100
Ignition Coil	Clamp		7-10	0.8-1.13
Intake Manifold		1986-95	30	41
		1996	35	48
		1997-98	11	15
Main Bearing Cap		1986-91	70	95
		1992-96		
Manifolds	Exhaust	1986-90	18-22	24-30
		1991-98	20-26	27-35
	Intake	1986-95	30	41
		1996	35	48
		1997-98	11	15
Oil Filter Adaptor (Remote)	To block		20-25	27-34
Oil Filter Bypass Valve			20	27
Oil Pan	Bolts/nuts	1986-96		
		1/4 x 20 bolts	6-7.5	8-10
		5/16 x 18 bolts	12-15	16-20
		1997-98		
	Nuts		17	23
	Bolts/Studs		18	25
	Dipstick Tube Fitting		15-18	20-24
	Drain Retainer		15-18	20-24

TORQUE SPECIFICATIONS - 4.3L V6

Component		ft. lbs.	inch lbs.	Nm
Oil Pump	Cover bolts	1986-96	6-9	8-12
		1997-98	-	106
Oil Pressure Sender	Mounting Bolts		65	90
			10-14	14-19
			10-14	14-19
Oil Seal Retainer			135	15.3
Oil Withdrawal Tube (flare)			15-18	20-24
Power Steering Pump	Bracket	Bolt	26-30	35-41
		Stud/nut	13-15	18-20
	Lines	Large fitting	15-17	20-23
		Small fitting	10-12	14-16
Raw Water Pump Bracket			30	41
Rocker Arm	Nut	1986-96	40	54
		1997-98	20	27
Spark Plugs	Stud		35	47
Timing Chain Cover		1986-96	22 ①	30 ①
		1997-98		
Valve Cover		1986-93	-	80
		1994-96	-	106
		1997-98	-	100
Valve Lifter Guide Retainer			12	16
Water Pump (circulating pump)			30	41
Water Temperature Sender			18-22	24-30

① 1997 and later: New - 22 ft. lbs. (30 Nm); used - 15 ft. lbs. (20 Nm)

TORQUE SPECIFICATIONS* 5.0L/5.7L V8

Component				ft. lbs.	inch lbs.	Nm
Camshaft	Sprocket	1986-93		20		22
			1992 5 7 LE		100	11
	Retainer Bolt	1994-98		21		28
		1986-97			124	14
Connecting Rod Cap	1992-97 ①	1998			106	12
			45			60
			20 +55 deg	-	27 +55 deg	
Coolant Temp Sender				15		20
Crankshaft	Main Bearing Cap	1986-91		70		95
		1992-97 ①				
			Outer on #2, 3, 4	70		95
			All others	80		110
	Oil Seal Retainer	1998		②		②
					135	15.3
	Pulley Bolt			43		58
	Cylinder Head	Bolts	1986-97 ①	Step 1	25	
			Step 2	As		61
			Step 3	65		88
1998				③		③
Core Plug				15		20
Cover		1986-96 ④			45	5
		1997 ①		-	90	10
		1998-03		-	106	12
Dipstick Tube				15-18	-	20-24
Distributor	Cap Bolt				21	2.4
	Clamp Bolt	1986-97 ①		20		27
Engine Mounts	Front	1998		18		25
			To engine	32-40	-	43-54
			Adjusting nut	100-120	-	136-163
	Rear		Bolt/Lower Nut	60-75	-	81-102
			28-30		38-40	
Exhaust Elbow	To Manifold	1986-93		10-12	-	14-16
		1994-98		12-18	-	16-24
Exhaust Manifold				20-26	-	27-35
Exhaust Pipe	To transom	1986-90		10-12	-	14-16
		1991-98		20-25	-	27-34
Flame Arrestor	Cover			-	30-40	3.4-4.5
	Mounting studs			-	65-80	7-9
Flywheel	Bellhousing	1986-91		28-36	-	38-49
		1992-98		32-40		43-64
	Coupler nut			As 45		54-61
		1986-91		20-25	-	27-34
	Coupler stud	1992-98		15-20	-	20-27
					60-84	7-9
Front Cover	1986-97 ①				80	9
		1998		-	108	12

- ① 1997 5.7GSI: use 1998 specifications
 ② Inboard bolt: 74 ft. lbs. (100 Nm); Outboard bolt (4 bolt caps): 67 ft. lbs. (90 Nm)
 ③ 1st pass: 22 ft. lbs. (30 Nm); 2nd pass: short bolt - 55 deg., medium bolt - 65 deg., long bolt - 75 deg
 ④ 1991 350 and 1992 5.7 LE: 65 inch lbs. (7 Nm)

TORQUE SPECIFICATIONS* 5.0L/5.7L V8

Component			ft. lbs.	Inch lbs.	Nm
Harmonic Balancer		1986-90	60	-	81
		1991-96	70	-	95
		1997-98	74	-	100
		Clamp	-	7-10	0.8-1.13
Intake Manifold		1986-97	30		41
		1998	④		④
Main Bearing Cap		1986-91	70	-	95
		1992-97 ⑤	70	-	95
		Outer on #2, 3, 4			
		All others	80	-	110
Manifolds		1998	②		②
		Exhaust	20-26	-	27-35
		Intake	1986-97	30	41
		1998	⑤		⑤
Oil Pan	1986-97 ①	114x20 bolts	6-7.5	-	8-10
		5116x18 bolts	12-15	-	16-20
		Corners	15	-	20
		All others	-	106	12
	1998	Dipstick Tube Fitting	15-18	-	20-24
		Drain Plug	18	-	25
		Drain Retainer	15-18	-	20-24
		Cover bolts	6-9	-	8-12
Oil Pump		1986-97 ①			12
		1998	-	106	12
Oil Pressure Sender		Mounting bolts	65	-	90
		Sender	10-14	-	14-19
Oil Pressure Gauge Sensor		Adaptor	10-14	-	14-19
			11	-	15
Oil Seal Retainer				135	15.3
Oil Withdrawal Tube (flare)			15-18	-	20-24
Power Steering Pump	Bracket	Bolt	26-30	-	35-41
		Stud/nut	13-15	-	18-20
	Lines	Large fitting	15-17	-	20-23
		Small fitting	10-12	-	14-16
Raw Water Pump Bracket			30		41
Rocker Arm	Nut		40	-	54
		Stud	35	-	47
Spark Plugs			22 ⑥		30 ⑥
Timing Chain Cover		1986-97 ①		80	9
		1998	-	106	12
Valve Cover		1986-96 ④	-	45	5
		1997 ①	-	90	10
		1998-03	-	106	12
Valve Lifter Guide Retainer			18	-	25
Water(Circulating) Pump			30	-	41
Water Temperature Sender			18-22	-	24-30
Windage Tray Nut			29	-	40

- ① 1997 5.7GSI: use 1998 specifications
 ② Inboard bolt: 74 ft. lbs. (100 Nm); Outboard bolt (4 bolt caps): 67 ft. lbs. (90 Nm)
 ④ 1991 350 and 1992 5.7 LE: 65 inch lbs. (7 Nm)
 ⑤ 1st pass: 27 inch lbs (3 Nm); 2nd pass: 106 inch lbs. (12 Nm); 3rd pass: 11 ft. lbs. (15 Nm)
 ⑥ 1998: New - 22 ft. lbs. (30 Nm); used - 11 ft. lbs. (15 Nm)

TORQUE SPECIFICATIONS- 7.4L/8.2L V8

Component			ft. lbs.	inch lbs.	Nm
Camshaft	Sprocket	7.4L	20		27
		8.2L	25		34
Connecting rod cap	1992-96	7.4L	48		65
		8.2L	70		99
	1997	7.4L	48	-	65
		7.4Gi	45	-	61
		7.4GSI	48	-	65
		8.2GSI	73		99
Coolant Temp. Sensor			15		20
Crankshaft	Main Bearing Cap	1988-91	70		95
		Others	110		149
	1992-98	7.4L	100		135
		8.2L	110		149
Cylinder Head	1988-91	Step 1	35		47
		Step 2	65		88
		Step 3	80		108
	1992-98	Step 1	35		47
		Step 2	65		88
		Step 3	85		115
	Cover	1988-95	Nuts	115	13
			Stud	60-90	7-10
		1996-97		60-90	7-10
		1998 (exc. Gi)	Nuts	115	13
			Stud	60-90	7-10
		1998 7.4Gi		72	8
				15-18	20-24
Dipstick Tube			25		34
Distributor	Clamp Bolt		32-40		43-54
Engine Mounts	Front	To engine	50-70		68-95
		Adjusting nut	50-75		81-102
		Bolt/Lower Nut	28-30		38-40
	Rear		10-12		14-16
Exhaust Elbow	To Manifold	1988-93	12-18		16-24
		1994-98	20-26		27-35
Exhaust Manifold	Nut		24-28		33-38
			10-12		14-16
Exhaust Pipe	To transom	1988-90	20-25		27-34
		1991-98	32-40		43-54
Flywheel	Bellhousing		70		95
		Bolt To Crank	40-45		54-61
		Coupler Nut	20-25		20-27
		Coupler Stud		60-84	7-9
		Cover		48-64	5-7
Front Cover	Timing sensor				
	1988-91	Block bolts			
		Pan bolts			
	1992-97	7.4L	96		10.8
		8.2L	120		13.6
1998		7.4L	106		12
		8.2L	120		13.6

TORQUE SPECIFICATIONS - 7.4L/8.2L V8

Component			ft. lbs.	inch lbs.	Nm
Fuel Rail	Bolt			89	10
		Stud	18		25
Harmonic Balancer	7.4L	Exc. 1998 Gi	85		115
		1998 7.4Gi	110		149
		8.2L	90		122
Intake Manifold	7.4L		30.0		41.0
		8.2L	35		47
Main Bearing Cap	1988-91	Rear	70		95
		Others	110		149
	1992-98	7.4L	100		135
		8.2L	110		149
Manifolds	Exhaust	Nut	20-26		27-35
		Bolt	24-28		33-38
	Intake	7.4L	30.0		41.0
		8.2L	35		47
MAP Sensor			18		25
Oil Filter Adaptor (Remote)			20-25		27-34
Oil Filter Bypass Valve			20		27
Oil Pan	All exc. 1998 7.4Gi	7.4L	To Block	160	18
			To Front Cover	70	8
		8.2L	To Block	200	22.5
	1998 7.4Gi		To Front Cover	120	14
				18	25
			Dipstick tube fitting	15-18	20-24
Oil Pump	Cover Bolts	Exc. 1998 7.4Gi		80	9
		1998 7.4Gi		106	12
	Mounting Bolts	7.4L	65		90
		8.2L	70		95
Power Steering Pump	Bracket	Bolt	26-30		35-41
		Stud/nut	13-15		18-20
	Lines	Large fitting	15-17		20-23
		Small fitting	10-12		14-16
Rocker Arm	Bolt	1992-98	Exc. 1998 Gi	40	54
			1998 7.4Gi	45	61
Spark Plugs			22 @		30 @
Timing Chain Cover	1988-91	Block bolts	6		8
		Pan bolts	8		10
	1992-97	7.4L		96	10.8
		8.2L		120	13.6
	1998	7.4L		106	12
		8.2L		120	13.6
Valve Cover	1988-95	Nuts		115	13
		Stud		60-90	7-10
	1996-97			60-90	7-10
				115	13
	1998 (exc. Gi)	Nuts		60-90	7-10
Water (Circulating) Pump					
Water Temperature Sender			18-22		24-30
Windage Tray Nut			29		40

① 7.4Gi Lower manifold only, upper - 10 ft. lbs. (14 Nm)

② 1998: New - 22 ft. lbs. (30 Nm); used - 15 ft. lbs. (20 Nm)

ENGINE SPECIFICATIONS - 4.3L V6

Component			Standard (in.) ①	Metric (mm) ①
Balance Shaft	Front Bearing Journal		2.1648-2.1664	55.985-55.991
	Rear Bearing Journal		1.4994-1.5000	38.084-38.100
	Rear Bearing Clearance		0.001-0.0036	0.0254-0.0914
Camshaft	End Play	1986-96	0.004-0.012	0.11-0.30
		1997-98	0.001-0.009	0.0254-0.2286
	Journal Diameter	1986-96	1.8682-1.8692	47.452-47.478
		1997-98	1.8677-1.8687	47.440-47.490
	Journal Out-of-Round		0.001 Max	0.025 Max
	Lobe Lift (+/- 0.002)	Intake	1986-96	0.234
		1997-98	0.2763	7.018
Connecting Rod	Exhaust	1986-96	0.257	6.527
		1997-98	0.2655	7.025
	Runout		0.0015 Max	0.051 Max
	Bearing Clearance	1986-96	0.0013-0.0035	0.0330-0.0889
		1997-98	0.003 Max	0.07 Max
	Side Clearance	1986-96	0.0010-0.0030	0.0254-0.0762
		1997-98	0.008-0.014	0.152-0.356
Crankpin	Journal Diameter	1986-94	2.0988-2.0998	53.31-53.34
		1995-98	2.2487-2.2497	57.117-57.142
	Taper	Production	0.005 Max	0.0127 Max
		Service Limit	0.001 Max	0.02 Max
	Out-of-round	Production	0.0005 Max	0.0127 Max
		Service Limit	0.001 Max	0.02 Max
Crankshaft	Crankshaft End Play	1986-96	0.002-0.008	0.05-0.15
		1997-98	0.002-0.008	0.05-0.20
	Bearing Clearance	Production	#1	0.0008-0.0020
			#2, 3	0.0011-0.0023
			#4	0.0017-0.0032
		Service Limit	#1	0.0010-0.0015
	Journal Diameter		#2, 3	0.0010-0.0025
			#4	0.0025-0.0035
		1986-96	#1	2.4484-2.4493
			#2, 3	2.4481-2.4490
			#4	2.4479-2.4488
		1997-98	#1	2.4486-2.4495
			#2, 3	2.4485-2.4494
			#4	2.4479-2.4489
	Taper	Production	0.0002 Max	0.005 Max
	Out-of-round	Service Limit	0.001 Max	0.02 Max
Cylinder Bore	Diameter	Production	4.0007-4.0017	101.618-101.643
		Service Limit	0.001 Max	0.025 Max
	Out-of-round	Service Limit	0.002 Max	0.05 Max
Cylinder Head	Gasket surface fitness	Production	0.001 Max	0.025 Max
		Service Limit	0.004 Max	0.10 Max
	Clearance	Production	0.0007-0.0017	0.0178-0.0431
Piston	Clearance	1986-96	0.0007-0.002	0.017-0.05
		1997-98	0.0007-0.002	0.017-0.05
	Service Limit	1986-96	0.0027 Max	0.07 Max
		1997-98	0.0024 Max	0.60 Max

① Unless otherwise noted

ENGINE SPECIFICATIONS - 4.3L V6

Component			Standard (in.) ①	Metric (mm) ①
Piston Rings - Compression	Groove Clearance	Production	1986-96	0.0012-0.0032
			1997-03	0.020-0.06
	Service Limit	1986-96	MOOI	+0.025
		1997-98	0.004 Max	0.10 Max
	Gap	Production	Top:	0.010-0.020
Piston Rings - Oil	Groove clearance	2nd:	0.0100-0.025	0.254-0.508
		1986-96	+0.010	0.254-0.635
	Service Limit	1997-98	0.035 Max	0.89 Max
			0.002-0.007	0.051-0.177
	Gap	Production	1986-96	+0.001
Piston pin	Diameter	1986-96	0.008 MAX	0.203 MAX
		1997-98	0.015-0.055	0.381-1.397
	Clearance	Production	0.0150-0.050	0.381-1.27
		Service Limit	1986-96	+0.010
	Interference fit	1997-98	0.065	1.651
Valve system	Face Angle	1986-96	0.0025-0.00035	0.006-0.009
		1992-98	0.001 Max	0.025 Max
	Lash	1986-91	0.008-0.0016	0.0203-0.04060
	Net Lash	1992-98	45 deg.	45 deg.
		1997-98	1 turn down	1 turn down
	Lift	Intake	Net Lash	Net Lash
		Exhaust	0.414	10.51
	Lifter	1986-91	0.428	10.87
	Rocker Arm Ratio	1992-98	Hydraulic	Hydraulic
	Seat Angle	1986-96	1.50:1	1.50:1
Stem-to-Guide Clear.	Seat Width	Intake	46 deg.	46 deg.
		Exhaust	0.0312-0.0625	0.7937-0.1587
	Spring Free Length	1986-96	0.040-0.065	1.0161-651
		1997-98	0.0825-0.0937	0.1587-0.2381
	Spring installed Ht.	1986-96	0.065-0.098	1.651-2.489
		1997-98	2.03	51.6
	Spring Pressure	Open	1.690-1.710	42.92-43.43
		1986-96	194-206 lbs. @ 1.25	863-918 N @ 31.75
	Closed	1997-98	187-203 lbs. @ 1.27	832-903 N @ 32.25
		Production	76-84 lbs. @ 1.70	338-374 N @ 43.16
Stem-to-Guide Clear.	Service Limit	Production	0.0010-0.0027	0.0254-0.0686
		Service Limit	Intake	0.001 Max
			Exhaust	0.002 Max

① Unless otherwise noted

ENGINE SPECIFICATIONS * 5.0L/5.7L V8

Component			Standard (in.) ①	Metric (mm) ①		
Camshaft	End Play		0.004-0.012	0.10-0.31		
	Journal Diameter	1986-87 ②	1.8682-1.8692	47.452-47.478		
		1998	1.8677-1.8697	47.440-47.490		
	Journal Out-of-Round		0.001 Max	0.025 Max		
	Lobe Lift (+/- 0.002)	Intake	1986-87 ②	0.269	6.833	
			1998	0.274-0.278	6.97-7.07	
		Exhaust	1986-87 ②	0.276	7.01	
			1998	0.283-0.287	7.20-7.30	
Runout		0.0015 Max	0.051 Max			
Connecting Rod	Bearing Clearance	1986-87	Production 0.0013-0.0035 Service Limit 0.003 Max	0.0330-0.0889 0.076 Max		
		1998	0.0013-0.0035	0.033-0.088		
	Side Clearance	1986-87 ②	0.008-0.014	0.152-0.356		
		1998	0.006-0.014	0.16-0.35		
	Crankpin	Journal Diameter	1986-87	2.0986-2.0998	53.31-53.34	
			1998	2.0986-2.0998	53.30-53.33	
Taper		Production 1986-87	0.005 Max	0.0127 Max		
		1998-03	0.0003 MAX	0.007 MAX		
Out-of-round		Service Limit	0.001 Max	0.0254 Max		
		Production 1986-87	0.0005 Max	0.0127 Max		
Crankshaft	Crankshaft End Play	1986-87 ②	0.002-0.006	0.05-0.15		
		1998	0.002-0.008	0.05-0.20		
	Bearing Clearance 1986-87	Production	#1	0.0008-0.0020	0.0203-0.0508	
			#2, 3, 4	0.0011-0.0023	0.0279-0.0584	
			#5	0.0017-0.0032	0.043-0.081	
			Service Limit	#1	0.0010-0.0015	0.025-0.064
#2, 3, 4				0.0010-0.0025	0.025-0.064	
#5				0.0025-0.0035	0.064-0.089	
1998		Production	#1	0.0007-0.0021	0.018-0.053	
			#2, 3, 4	0.0009-0.0024	0.022-0.061	
			#5	0.0010-0.0027	0.0254-0.069	
			Service Limit	#1	0.0010-0.0020	0.025-0.061
				#2, 3, 4	0.0010-0.0025	0.025-0.064
				#5	0.0015-0.003	0.038-0.076
Journal Diameter		#1	2.4484-2.4493	62.1894-62.2122		
		#2, 3, 4	2.4481-2.4490	62.1817-62.2046		
		#5	2.4479-2.4488	62.1767-62.1995		
		Taper	Production	0.0002 Max	0.005 Max	
			Service Limit	0.001 Max	0.0254 Max	
Cylinder Bore	Diameter	5.0L	3.735-3.737	94.88-94.92		
		5.7L	4.0007-4.0017	101.618-101.843		
	Out-of-round	Production	0.005 Max	0.012 Max		
		Service Limit	0.002 Max	0.051 Max		
Cylinder Head	Gasket surface flatness		0.001 Max	0.025 Max		
			0.004 Max	0.102 Max		

① Unless otherwise noted

② 1997 5.7GSi: Use 1998 specifications

ENGINE SPECIFICATIONS * 5.0L/5.7L V8

Component		Standard (in.) ①		Metric (mm) ①	
Piston	Clearance	Production	1986-87 ②	0.0007-0.0017	0.0178-0.0431
			1998	0.0007-0.0021	0.018-0.053
Piston Rings - Compression	Groove Clearance	Service Limit		0.0027 Max	0.076 Max
			Production	0.0012-0.0032	0.031-0.081
	Gap	Service Limit		+0.001	ffi.025
			Production	Too:	
Piston Rings - Oil	Groove clearance	Production	1986-87 ②	0.010-0.020	0.254-0.508
			1998	0.010-0.028	0.254-0.51
	Gap	Service Limit	1986-87 ②	0.010-0.025	0.254-0.635
			1998	0.018-0.028	0.46-0.68
	Oil	Production		0.002-0.007	0.051-0.177
			Service Limit	+0.001	+0.025
Piston Pin	Diameter	1986-87 ②		0.9270-0.9273	23.546-23.553
			1998	0.9270-0.9271	23.545-23.548
	Clearance	Production	1986-87 ②	0.00025-0.00035	0.006-0.009
			1998	0.0004-0.0008	0.010-0.020
Valve system	Interference fit	Service Limit		0.001 Max	0.025 Max
				0.0008-0.00016	0.0203-0.04060
	Face Angle			45 deg.	45 deg.
				1 turn dn. from zero	1 turn dn. from zero
	Lash			Hydraulic	Hydraulic
				1.50 1	1.50 1
	Rocker Arm Ratio			46 deg.	46 deg.
				46 deg.	46 deg.
	Seat Width	Intake	1986-87 ②	0.0312-0.0625	0.7937-0.1587
			1998	0.045-0.065	1.14-1.65
Valve system	Exhaust	1986-87 ②		0.0625-0.0937	0.1587-0.2381
			1998	0.065-0.098	1.65-2.489
	Spring Free Length	1986-87 ②		2.03	51.6
			1998	2.02	51.3
	Spring Installed Ht.	1998		1.69-1.71	42.92-43.43
				1.69-1.71	42.92-43.43
	Spring Pressure	Open	1986-87 ②	194-206 lbs. @ 1.25	863-916 N @ 31.75
			1998	187-203 lbs. @ 1.27	832-903 N @ 32.25
	Closed			76-84 lbs. @ 1.70	338374 N @ 43.16
Stem-to-Guide Clear.	Production	Intake		0.0010-0.0027	0.0254-0.0686
			Exhaust	+0.001	+0.0254
Stem-to-Guide Clear.	Service Limit			+0.002	+0.0508

① Unless otherwise noted

② 1997 5.7GSi: Use 1998 specifications

ENGINE SPECIFICATIONS - 7.4L/8.2L V8

Component				Standard (in.) ①	Metric (mm) ①	
Camshaft	End Play			0.004-0.012	0.10-0.31	
	Journal Diameter	All Exc. 1998 7.4Gi		1.9482-1.9492	49.484-49.510	
		1998 7.4Gi		1.9477-1.9497	49.471-49.522	
		Journal Out-of-Round		0.001 Max	0.025 Max	
	Lobe Lift (+/- 0.002)	Intake	7.4L			
			1998 7.4Gi	0.282	7.163	
			All others	0.234	5.94	
		Exhaust	8.2L	0.51	12.95	
			7.4L			
			1998 7.4Gi	0.284	7.214	
			All others	0.253	6.43	
			8.2L	0.51	12.95	
			Runout		0.002 Max	0.051 Max
Connecting Rod	Bearing Clearance	Production	1988-91	0.0009-0.0025	0.0229-0.0635	
			1992-98	0.0011-0.0029	0.0279-0.0737	
		Service Limit	1998 7.4Gi	0.0011-0.0039	0.028-0.099	
			All others	0.0035 Max	0.076 Max	
	Side Clearance	1988-91		0.015-0.021	0.033-0.584	
		1992-98		0.0013-0.0230	0.033-0.584	
Crankpin	Journal Diameter	7.4L		2.1988-2.1996	55.85-55.87	
		8.2L		2.2	55.88	
	Taper	Production		0.0005 Max	0.0127 Max	
		Service Limit		0.001 Max	0.02 Max	
	Out-of-round	Production		0.0005 Max	0.0127 Max	
		Service Limit		0.001 Max	0.0254 Max	
Crankshaft	Crankshaft End Play	1998 7.4Gi		0.005-0.011	0.127-0.279	
		All others		0.006-0.010	0.152-0.254	
	Bearing Clearance					
	1988-91	Production	#1, 2, 3, 4	0.0013-0.0025	0.033-0.064	
			#5	0.0024-0.0040	0.061-0.102	
		Service Limit	#1	0.002 Max	0.051 Max	
			#2, 3, 4, 5	0.0035 Max	0.089 Max	
	1992-98	Production	#1, 2, 3, 4	0.0017-0.0030	0.043-0.076	
			#5	0.0025-0.0040	0.064-0.097	
		Service Limit	#1, 2, 3, 4	0.0010-0.0030	0.025-0.076	
			#5	0.0025-0.0040	0.064-0.102	
	1998 7.4Gi	Production	#1	0.0017-0.0030	0.043-0.076	
			#2, 3, 4	0.0011-0.0024	0.028-0.061	
			#5	0.0025-0.0038	0.063-0.096	
		Service Limit	#1, 2, 3, 4	0.0010-0.0030	0.025-0.076	
			#5	0.0025-0.0040	0.064-0.102	
	Journal Diameter		2.7482-2.7489		69.804-69.822	
	Taper	Production	1998 7.4Gi	0.0004 Max	0.010 Max	
			All others	0.0002 Max	0.005 Max	
		Service Limit	0.001 Max	0.025 Max		
	Out-of-round	Production	1998 7.4Gi	0.0004 Max	0.010 Max	
			All others	0.0002 Max	0.005 Max	
		Service Limit	0.001 Max	0.025 Max		
	Cylinder Bore	Diameter	7.4L		4.2500-4.2507	107.95-107.97
			8.2L		4.4655-4.4661	113.42-113.44
		Out-of-round		0.002 Max	0.05 Max	
		Taper		0.001 Max	0.025 Max	

① Unless otherwise noted

ENGINE SPECIFICATIONS - 7.4L/8.2L V8

Component				Standard (in.) ①	Metric (mm) ①	
Cylinder Head	Gasket surface flatness			0.003 Max	0.08 Max	
Piston	Clearance	Production	7.4L			
			1988-91	0.0008-0.0028	0.020-0.071	
			1992-98	0.003-0.004	0.076-0.102	
			1998 Gi	0.0018-0.0030	0.046-0.076	
		8.2	0.004-0.005	0.102-0.127		
		Service Limit		0.005 Max	0.127	
Piston Rings - Compression	Groove Clearance	Production	1988-91	0.0017-0.0032	0.043-0.081	
			1992-98	0.0012-0.0029	0.030-0.074	
		Service Limit	1998 7.4Gi	0.0012-0.0039	0.031-0.099	
			All others	+0.001	+0.025	
	Gap	Production	1988-91	0.010-0.020	0.254-0.508	
			1992-98			
		Top	0.010-0.018	0.254-0.457		
			2nd	0.016-0.024	0.406-0.609	
		Service Limit	1998 Gi	Top	0.010-0.028	0.254-0.711
				2nd	0.016-0.034	0.406-0.864
			All others	+0.010	+0.254	
Piston Rings - Oil	Groove clearance	Production	1988-91	0.0005-0.007	0.013-0.178	
			1992-98	0.0050-0.0065	0.127-0.165	
		Service Limit	1998 7.4Gi	0.0050-0.0075	0.127-0.191	
			All others	+0.001	+0.025	
	Gap	Production	1988-91	0.015-0.055	0.381-1.397	
			1992-98	0.010-0.030	0.254-0.762	
		Service Limit	1998-00 Gi	0.010-0.040	0.254-1.016	
			All others	+0.010	+0.254	
	Piston Pin	Diameter			0.9895-0.9897	25.133-25.138
		Clearance	Production	1988-91	0.00025-0.00035	0.006-0.009
1992-98				0.0002-0.0007	0.005-0.018	
Service Limit				0.001 Max	0.025 Max	
Interference fit		1988-91	0.013-0.0021	0.330-0.053		
		1992-96	0.0008-0.0016	0.020-0.0406		
	1997-98	0.0021-0.0031	0.053-0.079			
Valve System	Face Angle			45 deg.	45 deg.	
	Lash	1988-91		3/4 turn down	3/4 turn down	
		1992-97		Net Lash	Net Lash	
		1998	7.4Gi	Net Lash	Net Lash	
			All others	1 turn down	1 turn down	
	Lifter			Hydraulic	Hydraulic	
	Rocker Arm Ratio			1.70:1	1.70:1	
	Seat Angle			46 deg.	46 deg.	
	Seat Width	Intake	All exc. 98 Gi	0.0312-0.0625	0.7937-0.1587	
			1998 7.4Gi	0.030-0.060	0.762-1.524	
		Exhaust	All exc. 98 Gi	0.0625-0.0937	0.1587-0.2381	
			1998 7.4Gi	0.060-0.095	1.524-2.413	

① Unless otherwise noted

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6

ENGINE MECHANICAL GM V8 ENGINES

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6-2 ENGINE MECHANICAL—FORD 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.

V8 ENGINES

The OMC 5.0L, 302 cubic inch and 5.8L, 351 cubic inch and 7.5L, 460 cubic inch displacement V8 engines are manufactured by Ford Motor Company. These engines are used in the following configurations:

- 5.0 (24 bbl)
- 5.0 EFI (EFI)
- 5.0Fi (EFI)
- 5.0FL (2 bbl)
- 5.0 HO (2 bbl)
- 5.8 (4 bbl)
- 5.8 EFI (EFI)
- 5.8Fi (EFI)
- 5.8FL (4 bbl)
- 5.8FSi (EFI)
- 5.8 HO (EFI)
- 5.8 LE (4 bbl)
- 7.5 (4 bbl)
- 351 (4 bbl)
- 351 EFI (EFI)
- 460 (4 bbl)

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

Engine Identification

ENGINE

◆ See Figures 1 and 2

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/option 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 arrestor (early models), or on the inner side of the rocker arm cover, usually near the breather/PCV line (port side on most models); further, on fuel injected engine you can find it on the side of the TFI module bracket - 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 usually 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 Product number, a Type/Model number and then the actual Serial number.

- The first two characters identify the engine size in liters (L); 50 represents the 5.0L, 58 represents the 5.8L 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.

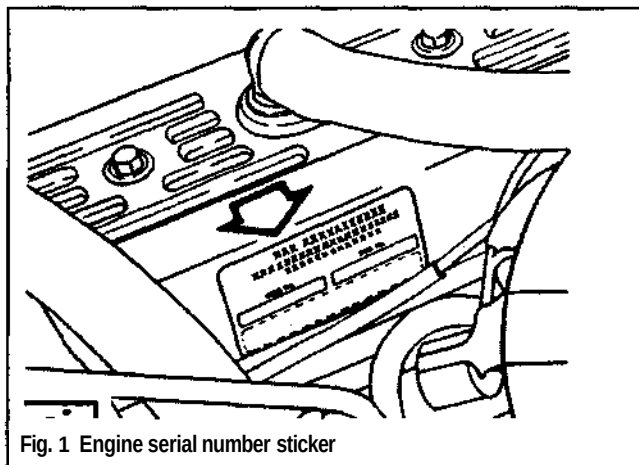


Fig. 1 Engine serial number sticker

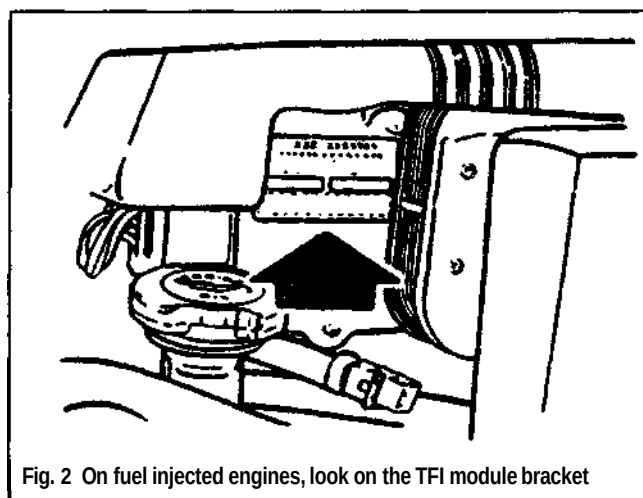


Fig. 2 On fuel injected engines, look on the TFI module bracket

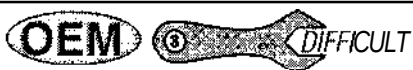
Any remaining characters are proprietary. So in example, a Model number on the ID plate that reads **754APFTC** would designate a 1987 7.5L engine with a 4 bbl carburetor and power steering, first model released. A number reading **58FAPRJVB** would designate a 1993 5.8L engine with fuel injection, power steering and a right hand propeller, first release; get the picture?

Engine Model Designations

All engines covered here utilize unique identifiers assigned by OMC; surnames if you will—5.0FL, 5.8Fi, etc. Obviously the first two characters designate the engine size in litres (L). The second letter, a **G** or **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 5.8Fi will always have a lesser horsepower rating than a 5.8FSi in a given model year. 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 3, 4, 5, 6, 7, 8 and 9

Prior to removing the engine from your 1994-96 vessel, 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. (15.2mm), 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 instrument 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 hose clamps and disconnect the exhaust hose bellows from intermediate or exhaust 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.

12. Drain the cooling system as detailed in the Maintenance section.



Fig. 3 Disconnect the power steering lines at the cylinder



Fig. 4 Disconnect the instrument cable connector

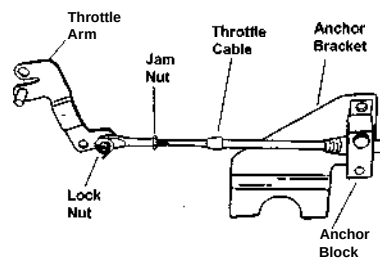


Fig. 5 Details of the throttle cable assembly—FL engines

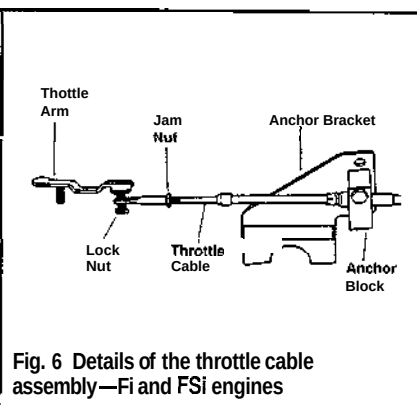


Fig. 6 Details of the throttle cable assembly—Fi and FSi engines

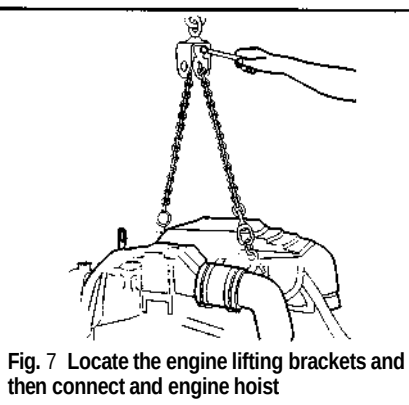


Fig. 7 Locate the engine lifting brackets and then connect and engine hoist

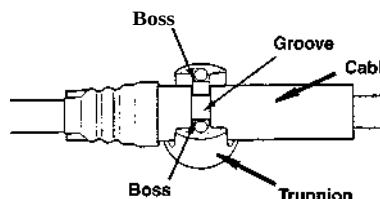


Fig. 8 Details of the throttle cable and trunnion

6-4 ENGINE MECHANICAL—FORD V8 ENGINES

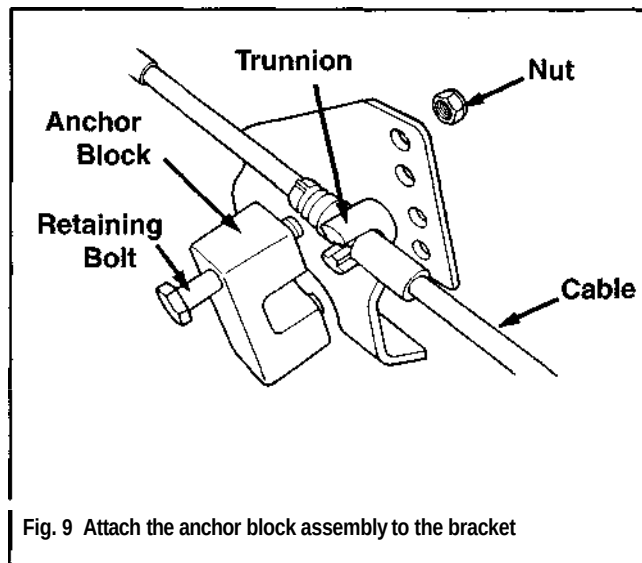


Fig. 9 Attach the anchor block assembly to the bracket

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.
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 taught.

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.

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!

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.

✱✱ 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 1¼ 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

4 See Figure 10



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".

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

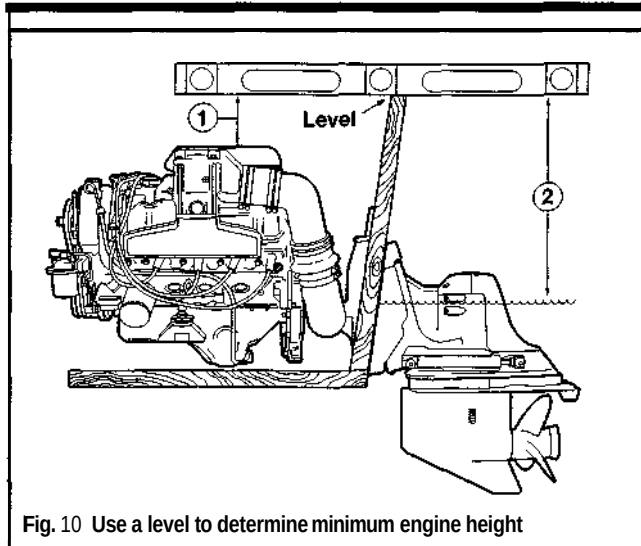


Fig. 10 Use a level to determine minimum engine height

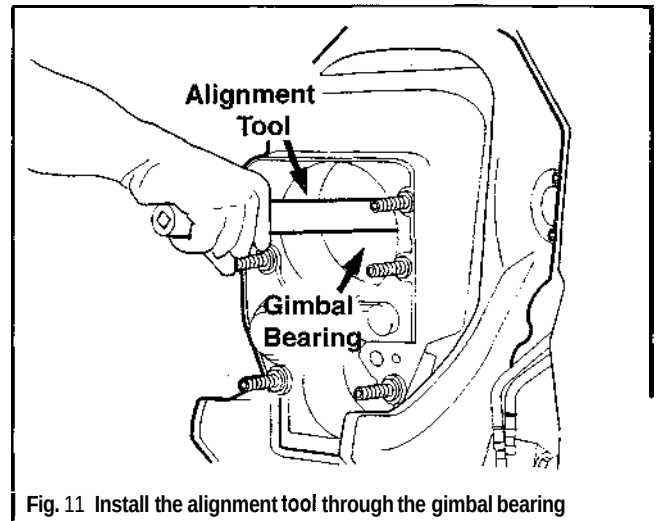


Fig. 11 Install the alignment tool through the gimbal bearing

ENGINE ALIGNMENT

5.0L/5.8L And 1990 7.5L V8 Engines



◆ See Figures 11 and 12

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 40-50 ft. lbs. (54-60 Nm) on 1989-92 engines or 50-70 ft. lbs. (68-95 Nm) on 1993-96 engines. If your engine uses a jam nut, cinch it up against the lock nut.

6. Remove the alignment tool and handle.

1987-89 7.5L V8 Engines



● See Figures 11 and 12

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. There will be a slot on the lower mount providing access to the head of the mount bolt. Slide a 15116 in. open end wrench into the slot and hold the bolt so that you can loosen the upper lock nut. It is not necessary to remove the nut.

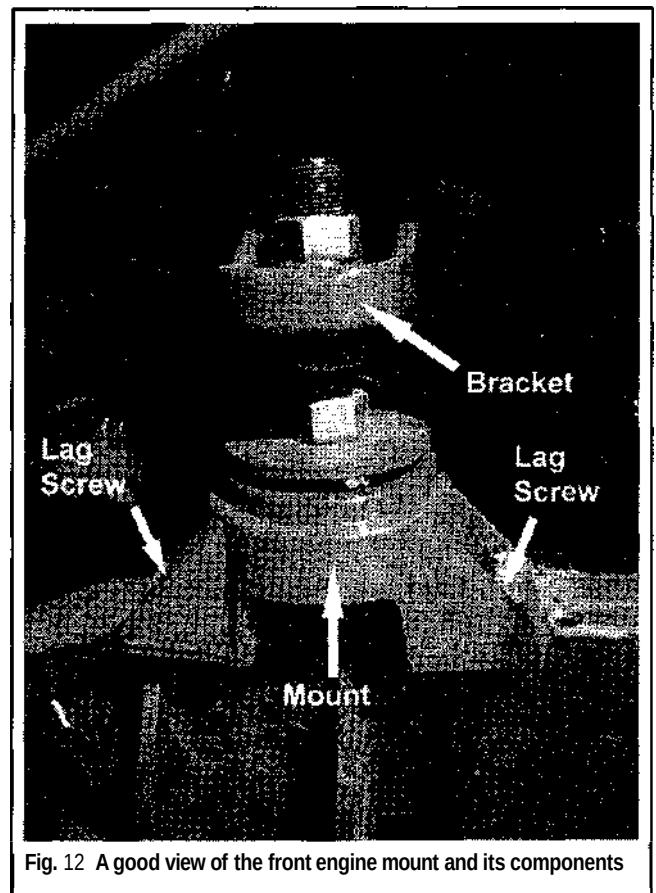


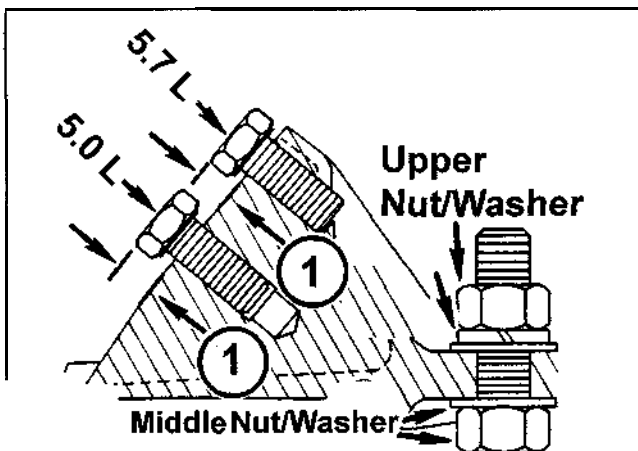
Fig. 12 A good view of the front engine mount and its components

3. Now, determine if the engine requires raising or lowering to facilitate alignment—remember, the alignment tool should still be in position.

4. There should be a total of 4 slotted shims situated above and/or below the rubber mount; rearrange the shims until the new engine height allows the alignment tool to slide freely. The shims are slotted and will slide in and out of the mount easily. Never use more than 4 shims on an individual mount.

5. Install the nut and tighten it to 100-120 ft. lbs. (136-63 Nm).

6. Remove the alignment tool and handle.



1 - Support Screw Height

Fig. 13 Always preset the support screw height on 1993-96 engines

Front Engine Mounts

REMOVAL & INSTALLATION

5.0L/5.8L V8 Engines



◆ See Figures 12 and 13

1. Position an engine hoist over the engine and hook it up to the two engine lifting eyes (usually front starboard side, rear port side).
2. 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.
3. Remove the two lag bolts on each side of the mount where it rests on the stringer.
4. Raise the engine just enough to allow working room for removing the mount.
5. Remove the two mount bracket-to-engine mounting bolts with their lock washers and lift out the mount bracket.

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

6. Carefully position the mount in a vise. Position a wrench over the head of the adjusting bolt, just underneath the mount to hold the shaft and then remove the upper nut and washer. 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. Drop the small washer over the shaft and then slide the adjusting bolt up through the mount. Position the large washer over the bolt so it rests on the mount and then spin on the first (lower) lock nut and tighten it to 60-75 ft. lbs. (81-102 Nm).

9. Check that the mount support screw height is set to 112 in. (12.7mm) on the 1993 5.0L engine or 114 in. (6.35mm) on the 1994-96 5.0L. On the 1993 5.8L, set the screw to 7/16 in. (11.1mm), while on the 1994-96 5.8L engines set the screw to 3/16 in. (4.74mm). On all engines, make sure there is no paint on the head of the bolt, or on the mating surface at the block.

■ 1987-92 engines do not use a height support bolt,

10. Spray the two mounting bolts with Loctite Primer N and allow them to air dry. Once dry, coat the bolts with Loctite or OMC Nut Lock and attach the mount bracket to the engine. Tighten the bolts to 32-40 ft. lbs. (43-54 Nm).

11. On engines with a height support bolt, tighten the correct support bolt for your engine until it just contacts the cylinder block. Now tighten it an additional 1/4 of a turn.

12. Screw on the middle lock nut and washer onto the mount bolt and then position the mount bracket over the bolt. Install the washer and upper adjusting nut and check the measurement taken previously. Move the upper and middle lock nuts up or down until the correct specification is achieved.

13. 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.

14. Hold the middle nut with a wrench and then tighten the upper nut to 40-50 ft. lbs. (54-60 Nm) on 1989-92 engines or 50-70 ft. lbs. (68-95 Nm) on 1993-96 engines.

15. 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.

7.5L V8 Engines



1. Position an engine hoist over the engine and hook it up to the two engine lifting eyes (usually front starboard side, rear port side).

2. Remove the 2 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 3 mount bracket-to-engine mounting bolts with their lock washers and lift out the mount bracket.

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

5. Hold the mount bolt head and remove the upper lock nut. Note the positions of the adjusting shims and then remove them.

6. Pry out the rubber mounts.

To Install:

7. Coat the smaller side of a new rubber mount with soapy water and then press it into the top of the mount bracket. Repeat the procedure with the lower rubber mount.

8. Slide a small flat washer over the mount bolt and then insert the bolt into the lower mount foot and through the rubber mounts. Slide the larger washer over the end of the bolt and thread on the lock nut.

9. Insert the slotted shims around the bolt so that they are in the same position as when removed and then tighten the lock nut to 100-120 ft. lbs. (136-63 Nm).

10. Position the mount against the cylinder block, install the 3 mounting bolts and tighten them to 32-40 ft. lbs. (43-54 Nm).

11. Install the lag bolts and tighten them securely.

12. Remove the engine hoist.

Rear Engine Mounts

REMOVAL & INSTALLATION

◆ See Figure 14



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 44-52 ft. lbs. (60-71 Nm).

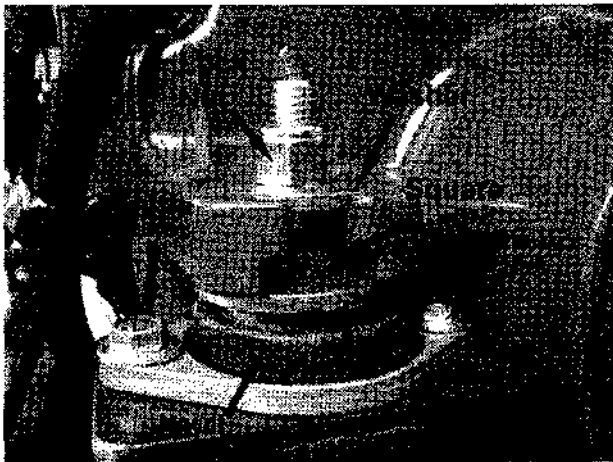


Fig. 14 A good look at the rear mount

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

◆ See Figures 15 and 16



■ 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 (if equipped). 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 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 onto the cover making sure that the tabs in the gasket engage the notches in the cover. Position the cover (don't forget the J-clips!) on the cylinder head and then tighten the mounting bolts to 60-72 inch lbs. (6.8-8.1 Nm) on 1987-93 engines or 36-60 inch lbs. (4-6 Nm) on 1994-96 engines. Make sure any retainers or clips that were removed are back in their original positions. On 1987-93 engines, wait 2 minutes and then retighten all of the bolts to the same specification once again.
8. 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.
9. Install the exhaust manifold.
10. Connect the battery cables.

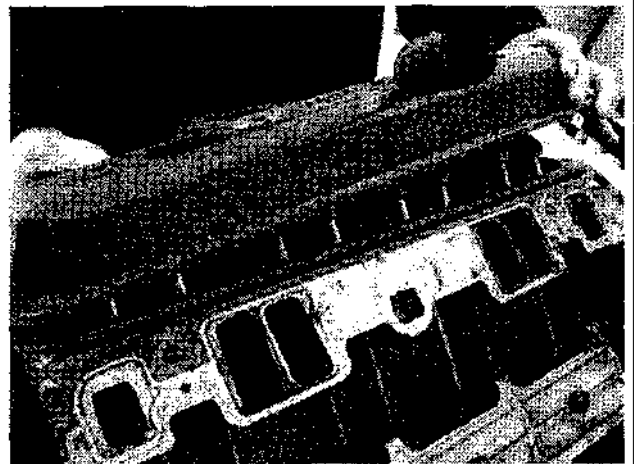


Fig. 15 Lift off the cylinder head cover

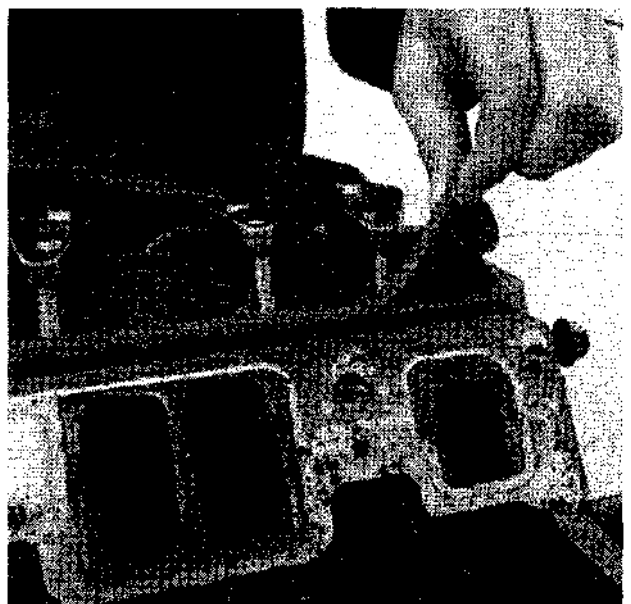


Fig. 16 Always use a new gasket before installing the cover

Rocker Arms and Push Rods

REMOVAL & INSTALLATION



◆ See figures 17, 18, 19 and 20

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 starboard side of the engine.
3. Loosen and remove the rocker arm bolt. Lift out the oil deflector on the 7.5L and the fulcrum on all engines.
4. Lift the arm itself off of the mounting stud (or boss) and pull out the pushrod. 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.

6-8 ENGINE MECHANICAL—FORD V8 ENGINES

To Install:

5. Clean and inspect the rocker assemblies. If any scuffing, wear or obvious deterioration is found replace the entire assembly (rocker, fulcrum and pushrod, and guide). 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 (valve stem tips, arm contact surfaces, fulcrum seat and push rod tip) with LubriPlate or Ford Multi-Purpose grease.

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

8. Install a remote starter.

9. Bump the engine over until the No. 1 cylinder is at TDC after the compression stroke.

Valve arrangement running from front to back on the port side is: E-I-E-I-E-I-E-I, while on the starboard side it is: I-E-I-E-I-E-I-E.

10. Install the guide, rocker arm, fulcrum and bolt on the following valves:

5.0L and 7.5L engines

- No. 1: intake and exhaust
- No. 4: exhaust
- No. 5: exhaust
- No. 7: intake
- No. 8: intake

5.8L engines

- No. 1: intake and exhaust
- No. 3: exhaust
- No. 4: intake
- No. 7: exhaust
- No. 8: intake

11. Now bump the crankshaft around 180° from TDC and install the guide, rocker arm, fulcrum, deflector and bolt on the following valves:

5.0L and 7.5L engines

- No. 2: exhaust
- No. 4: intake
- No. 5: intake
- No. 6: exhaust

5.8L engines

- No. 2: exhaust
- No. 3: intake
- No. 6: exhaust
- No. 7: intake

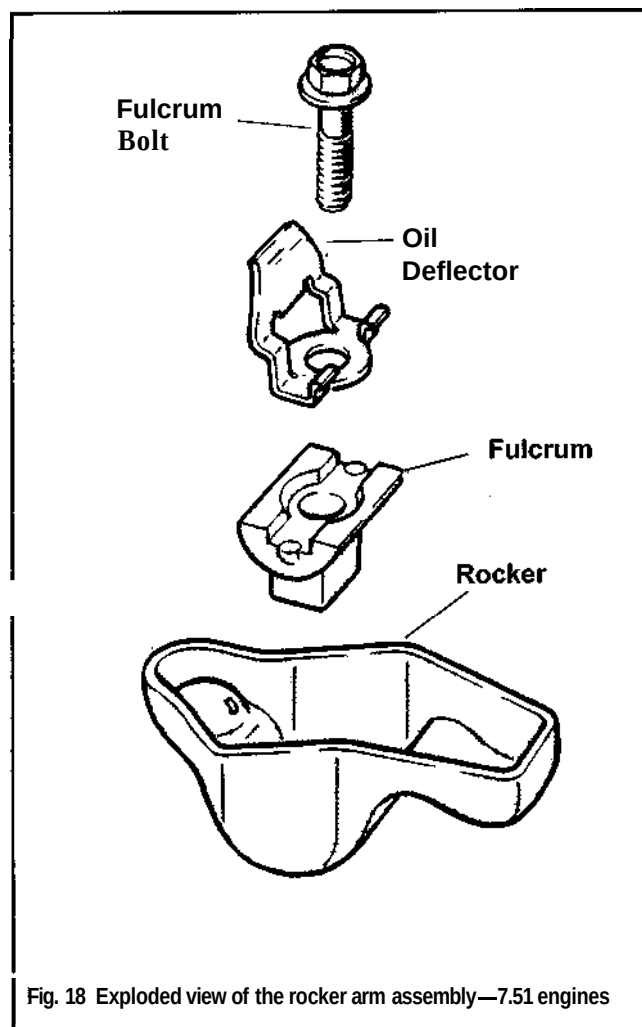
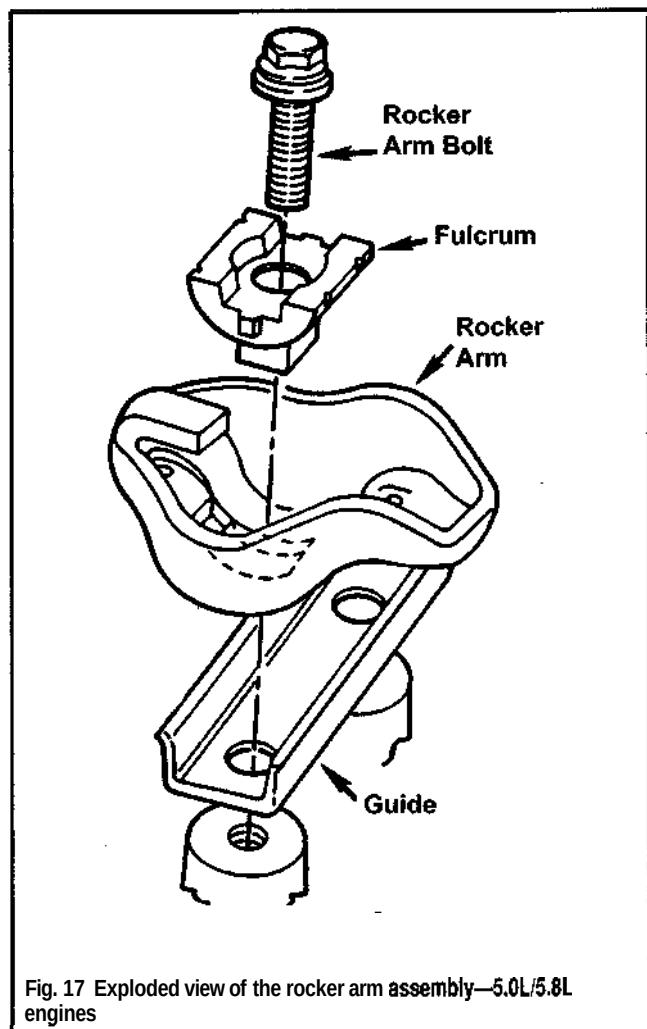
12. Now bump the crankshaft around a further 90° (for a total of 270° from TDC where you started) on the 5.0L/5.8L engines. On the 7.5L engine, bump the crankshaft around a further 270° (that's a full 360° from TDC, plus an additional 90°). Install the guide, deflector, rocker arm, fulcrum and bolt on the following valves:

5.0L and 7.5L engines

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

5.8L engines

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



13. Now tighten all the fulcrum bolts to 18-25 ft. lbs (24-34 Nm).

■ **The fulcrum base MUST be inserted in the slot on the cylinder head BEFORE tightening any of the bolts.**

14. No additional adjustment of the valves is necessary as the lash is set automatically when the positive-stop rocker is tightened to specifications. To make sure that all components are operating properly though, it's a good idea to check the valve clearance as detailed following.

15. Install the cylinder head cover, connect the battery cable and check the idle speed.

VALVE CLEARANCE CHECK



◆ See Figures 19 and 20

Positive-stop rocker arm bolts virtually eliminate the need for a regular valve clearance adjustment, but wear, tear or damage will sometimes only be revealed by virtue of a preliminary clearance check with the hydraulic lifter in the fully collapsed position. Clearance figures for each engine are detailed in the Engine Specification chart and should be checked between the rocker arm and the tip of the valve stem with a feeler gauge.

■ **Valve arrangement running from front to back on the port side is: E-I-E-I-E-I-E-I, while on the starboard side it is: I-E-I-E-I-E-I-E.**

1. Locate the purple wire coming off of the I terminal on the starter solenoid, tag it and disconnect it—this will prevent the engine from starting when you install a remote starter. Install a remote starter.

2. Bump the engine over until the No. 1 cylinder is at TDC after the compression stroke.

3. Install a Lifter Compressor tool (#T71P-6513-B) onto the appropriate rocker arm and slowly apply enough pressure to bleed down the lifter until the rod is bottomed out. Check the clearance on the following valves:

5.0L and 7.5L engines

- No. 1: intake and exhaust
- No. 4: exhaust
- No. 5: exhaust
- No. 7: intake
- No. 8: intake

5.8L engines

- No. 1: intake and exhaust
- No. 3: exhaust
- No. 4: intake
- No. 7: exhaust
- No. 8: intake

4. Now bump the crankshaft around 180° from TDC, install the tool on the appropriate rocker arm, and check the clearance on the following valves:

5.0L and 7.5L engines

- No. 2: exhaust
- No. 4: intake
- No. 5: intake
- No. 6: exhaust

5.8L engines

- No. 2: exhaust
- No. 3: intake
- No. 6: exhaust
- No. 7: intake

5. Now bump the crankshaft around a further 90° (for a total of 270° from TDC where you started) on the 5.0L/5.8L engines. On the 7.5L engine, bump the crankshaft around a further 270° (that's a full 360° from TDC, plus an additional 90°). Install the tool and check the clearance on the following valves:

5.0L and 7.5L engines

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

5.8L engines

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

6. Allowable clearance on all valves should be:

- 5.0L—0.071-0.193 in. (1.8-4.9mm)
- 5.8L—0.098-0.198 in. (2.5-5.0mm)
- 7.5L—0.075-0.175 in. (1.9-4.4mm)

7. If clearance is not within specifications on 1986-93 engines, OMC makes replacement pushrods that are available either 0.060 in. longer or shorter than stock. If clearance is lower than spec, install the shorter rod; if higher than spec, install the longer pushrod. Valve clearance that is out of specification on 1994-96 engines will require replace components in the valvetrain.

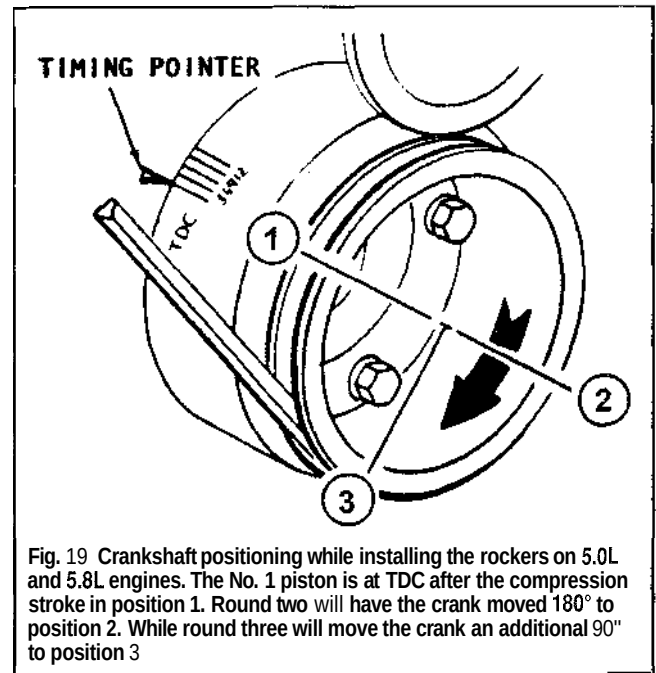


Fig. 19 Crankshaft positioning while installing the rockers on 5.0L and 5.8L engines. The No. 1 piston is at TDC after the compression stroke in position 1. Round two will have the crank moved 180° to position 2. While round three will move the crank an additional 90° to position 3

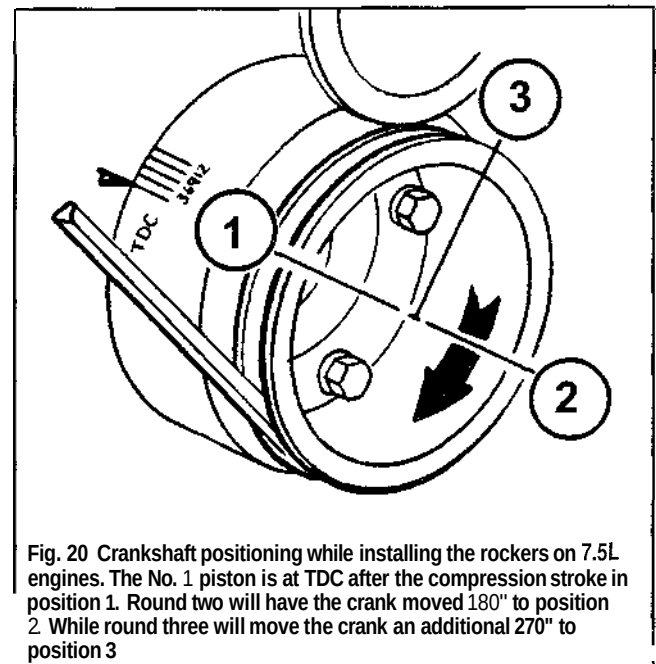


Fig. 20 Crankshaft positioning while installing the rockers on 7.5L engines. The No. 1 piston is at TDC after the compression stroke in position 1. Round two will have the crank moved 180° to position 2. While round three will move the crank an additional 270° to position 3

Hydraulic Valve Lifter

REMOVAL & INSTALLATION



■ If you have installed a new camshaft, always use new lifters.

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.
5. Remove the pushrods from the block, being very careful to keep track of where each one came from. As always, we recommend using a 2x4 with holes drilled in it—mark the holes for each rod and insert into the appropriate hole.

6. Remove the lifters. Although they should come right out, you may want to use a magnet; or more likely, you will need to use a lifter extractor tool (#T70L-6500-A for the 5.0L/5.8L or #T52T-6500-DJD on the 7.5L)) to extract each lifter.

■ 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:

7. Clean all components thoroughly and let dry completely, use compressed air if at all possible.

8. 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.

9. Coat each lifter, bore and camshaft lobe with clean engine oil or Multi-Purpose grease, and then carefully install each one into its respective recess.

10. Install the pushrods into the sockets on the lifters and coat their tips with Ford Multi-Purpose grease. Coat the valve stem ends as well.

■ When reusing existing components, it is imperative that the lifters and push rods are installed in their original bores.

11. Lubricate the rockers and fulcrum seats with multi-purpose grease. Move the rockers into position and then tighten the bolt as detailed in the Rocker Arm procedure as detailed previously.

12. Check the valve clearance as previously detailed.

13. Install the intake and exhaust manifolds.

14. Install the cylinder head cover.

Intake Manifold

REMOVAL & INSTALLATION

5.0L, 5.8L And 7.5L Engines W/Carburetor

◆ See Figures 21, 22, 23 and 24



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 cover. 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 thermostat housing.

6. Remove the flame arrestor and then disconnect the throttle cable at the carburetor. Remove the throttle cable bracket from the manifold.

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. There should also be a fuel pump vent line connected to the carburetor—tag it, disconnect it and move it out of the way.

8. Tag and disconnect the lead at the ignition coil.

9. Remove the distributor cap with the leads still connected and set it aside temporarily. Mark the position of the distributor rotor to the distributor body. Scribe a match mark 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. Tag and disconnect the electrical leads at the ignition coil. Remove the coil and its bracket.

11. Tag and disconnect the lead at the temperature gauge sender unit. 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.

12. 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. Move the wires (and the cap) out of the way.

13. Loosen and remove the 12 manifold mounting bolts (16 on the 7.5L) in the reverse order of the illustrated tightening sequence and then remove the manifold. Leave the carburetor and decel valve attached. 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. Apply a 118 in. (3.2mm) bead of RTV sealant to the forward and aft edges (4 corners) of the cylinder block mating surface where it meets the cylinder head. Make sure that you run the bead at least as wide as width of each seal.

17. Install the manifold gaskets onto the head. Position the cylinder block seals and run a 1116 in. (1.6mm) bead of RTV sealant along the edge of each seal where it mates with the gaskets on the cylinder head.

■ The sealer sets up fairly quickly, so don't dawdle here!

18. Carefully install the manifold into place so that all the bolt holes line up. Run your finger along the edge of all seal areas to make certain that they are still positioned correctly; if not, remove the manifold and reposition it again. Insert the bolts, tighten them finger-tight and then tighten all bolts in sequence to 23-25 ft. lbs. (31-34 Nm) on the 5.0L/5.8L engines or 25-27 ft. lbs. (34-40 Nm) on the 7.5L. When you're through, repeat the tightening sequence one more time and then make sure to recheck at the end of the season.

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

19. Install the thermostat housing and adaptor.

20. Install the distributor making sure that the match marks align. Do the same with the distributor cap and reconnect the spark plug wires.

21. Install the coil and bracket. Reconnect the electrical leads and the distributor lead.

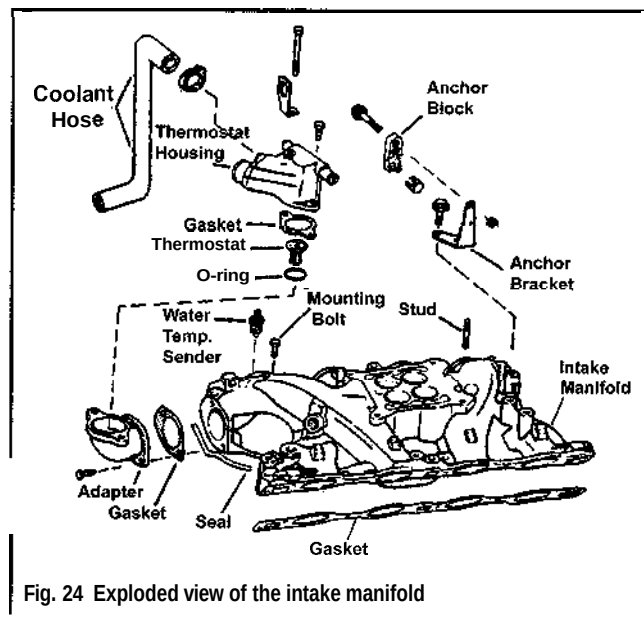
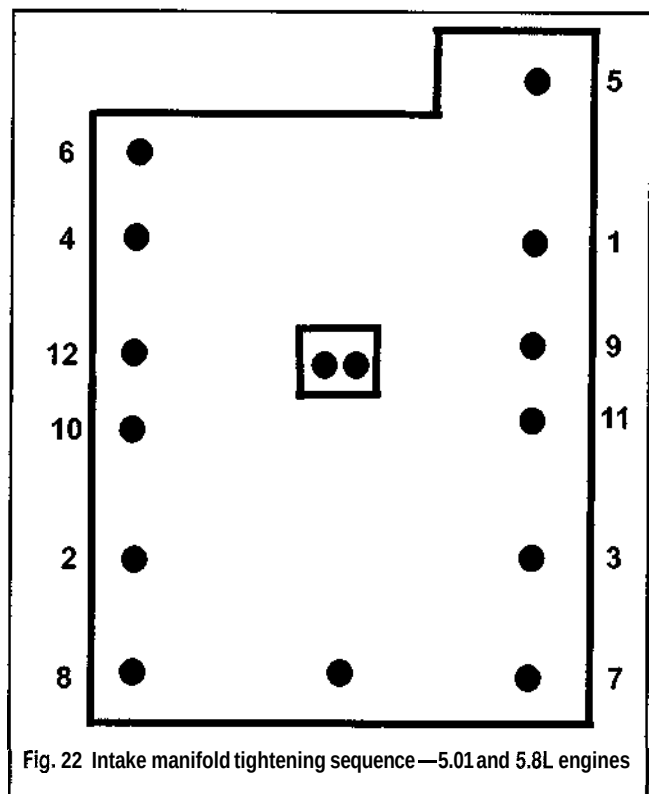
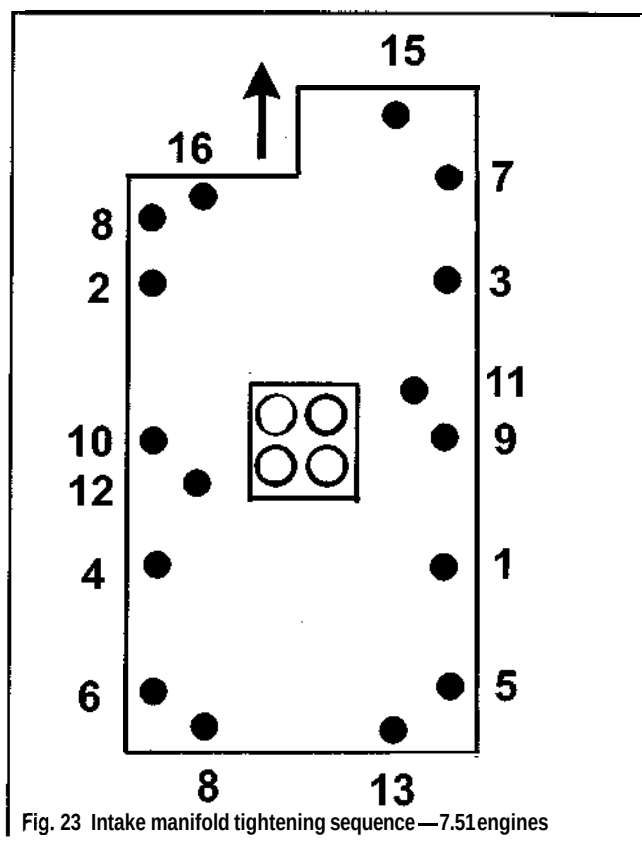
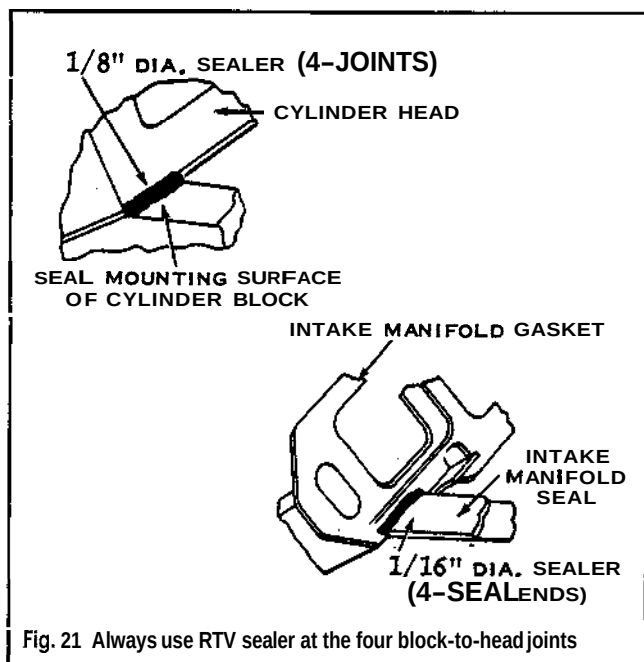
22. Unplug the fuel line(s) and reconnect them. Connect the vent hose and the PCV hose.

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

24. Install the throttle cable bracket and then connect the cable itself. 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. Connect the battery cable and start the engine. Check the ignition timing and idle speed. Check all hoses and seals for leaks.



5.0 EFI, 5.0Fi And 5.8Fi/FSi Engines

Upper Intake Manifold (Plenum)



■ Please refer to the Exploded Views section for detailed illustrations of the upper manifold and related components.

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 4 retaining screws and lift off the engine's plastic cover.
4. Tag and disconnect the ISC solenoid and Throttle Position sensor leads at the throttle body.
5. Remove the lock nut and disconnect the throttle cable at the lever on the throttle body. Remove the 2 manifold mounting bolts at the rear of the plenum that secure the throttle cable bracket. Position the cable and bracket out of the way.
6. Tag and disconnect the pressure regulator hose and the fuel reservoir line at the rear of the plenum.
7. Tag and disconnect the PCV hose at the valve.
8. On the forward starboard side, tag and disconnect the vacuum line at the MAP sensor. Move it and the filter out of the way.

6-12 ENGINE MECHANICAL—FORD V8 ENGINES

9. Right next to the filter, remove the 2 forward plenum mounting bolts and lift off the shift bracket support.

10. At the module bracket next to the throttle body, tag and disconnect the high tension lead from the ignition coil, the primary lead also at the coil and the TFI-IV lead.

11. Remove the 2 remaining plenum screws and lift off the upper manifold with the throttle body attached.

✖ ✖ CAUTION

Be extremely careful of how you handle the and where you set it down, particularly the mating surfaces. You need also to safeguard against any foreign material entering the lower intake runners.

To Install:

12. Carefully remove any remaining gasket material from the plenum and manifold mating surfaces. Make sure that any vacuum lines running under the center of the plenum are plastic tied correctly and in a position so they don't get crimped on installation.

✖ ✖ WARNING

Never soak the plenum in commercial liquid cleaners or solvents.

13. Lay a new gasket onto the lower manifold runners. There are studs available to aid in positioning, but if you're careful and patient there should be no need for them.

14. Position the plenum onto the manifold in such a way that you do not dislodge the gasket. Install the 2 long mounting bolts and tighten them finger-tight.

15. Coat the terminal with Electrical Terminal grease and reconnect the 3 leads at the module bracket.

16. Install the shift support bracket with the next two manifold screws and screw them down finger-tight.

Install the throttle cable bracket with the 2 remaining manifold screws and then tighten all 6 mounting screws to 12-18 ft. lbs. (16-24 Nm).

17. Reconnect the remaining vacuum lines.

18. Reconnect the throttle cable. Check for correct throttle operation and adjust if necessary.

19. Connect the battery cables.

Lower Intake Manifold

◆ See Figures 21 and 25

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 as detailed previously.

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 thermostat housing and adaptor.

6. Remove the distributor cap with the leads still connected and set it aside temporarily. Mark the position of the distributor rotor to the distributor body. Scribe a match mark 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.

7. Tag and disconnect the lead at the temperature gauge sender unit.

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. Move the wires (and the cap) out of the way.

10. Loosen and remove the 12 manifold mounting bolts in the reverse order of the illustrated tightening sequence and then remove 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:

11. 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.

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

13. Apply a 118 in. (3.2mm) bead of RTV sealant to the forward and aft edges (4 corners) of the cylinder block mating surface where it meets the cylinder head. Make sure that you run the bead at least as wide as width of each seal.

14. Install the manifold gaskets onto the head. Position the cylinder block seals and run a 1116 in. (1.6mm) bead of RTV sealant along the edge of each seal where it mates with the gaskets on the cylinder head.

The sealer sets up fairly quickly, so don't dawdle here!

15. Carefully install the manifold into place so that all the bolt holes line up. Run your finger along the edge of all seal areas to make certain that they are still positioned correctly; if not, remove the manifold and reposition it again. Insert the bolts, tighten them finger-tight and then tighten all bolts in sequence to 23-25 ft. lbs. (31-34 Nm). When you're through, repeat the tightening sequence one more time and then make sure to recheck at the end of the season.

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

16. Install the thermostat housing and adaptor.

17. Install the distributor making sure that the match marks align. Do the same with the distributor cap and reconnect the spark plug wires.

18. Install the upper manifold.

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

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

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

Exhaust Manifold

REMOVAL & INSTALLATION

◆ See Figures 26, 27 and 28



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

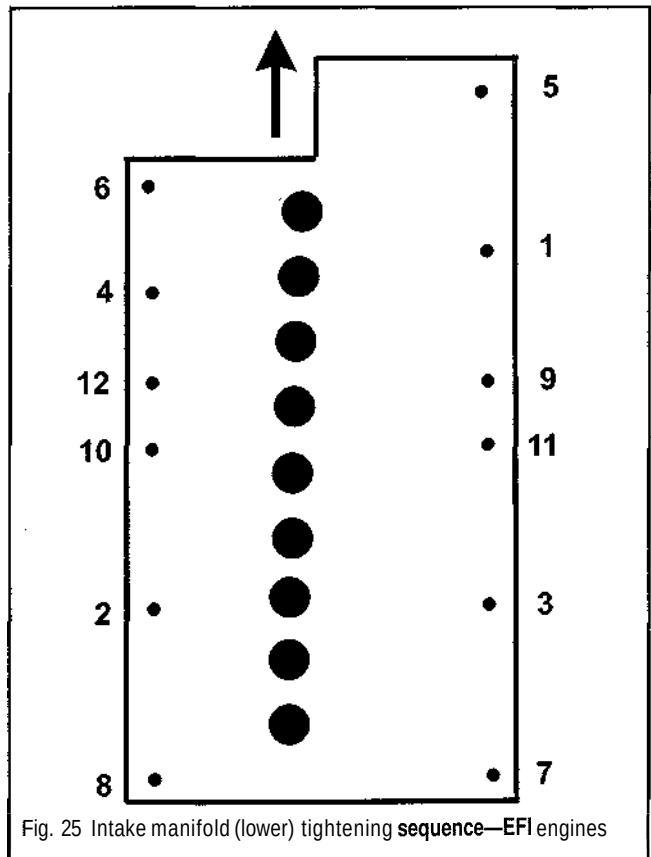


Fig. 25 Intake manifold (lower) tightening sequence—EFI engines

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.

4. Loosen the hose clamps (two) and then squirt a little soapy water in between the hose and the elbow. 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.

■ **If you are unable to gain enough clearance to slide the hose off the elbow, remove it completely (as detailed elsewhere).**

5. If you intend to remove the starboard manifold, unsnap the electrical cable from the retaining clip and move it out of the way on FL models. On Fi and FSi models, remove the two bolts and lift off the ECA.

6. Carefully tag and disconnect the spark plug wires at the plugs and secure them above the manifold and out of the way.

7. 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.

8. Loosen the 8 manifold retaining nuts from the center outward and then pry off the manifold/elbow assembly.

9. If necessary, loosen the four retaining bolts and remove the exhaust elbow from the manifold.

To Install:

10. 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.

11. Position a new gasket, without any sealant, on the cylinder head and install the manifold over the studs; making sure that everything is aligned properly. Tighten all nuts (with new lock washers) until they are just tight and then tighten them to 20-26 ft. lbs. (27-35 Nm). Starting in the center, and working your way out to the ends of the manifold.

12. If you removed the elbow, coat a new gasket with sealing compound and position it onto the manifold, making sure that everything lines up. Install the elbow. Tighten the mounting bolts to 12-14 ft. lbs. (16-20 Nm) on 1987-90 engines, or 12-18 ft. lbs. (16-24 Nm) on 1991-96 engines, refer to the Exhaust Elbow procedures found later for more detail on installing the elbow.

13. Connect the exhaust pipelbellows to the elbow and tighten the clamps securely.

14. 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.

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

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

17. 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.

Exhaust Elbow

REMOVAL & INSTALLATION

◆ See Figures 26, 27 and 28



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 removing the starboard elbow on Fi and FSi models, remove the screws and disconnect the ECA—or ESA on carbureted engines

4. 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.

5. Remove the gasket and discard it.

To Install:

6. 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.

7. 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 all four to 12-14 ft. lbs. (16-20 Nm) on 1987-90 engines, or 12-18 ft. lbs. (16-24 Nm) on 1991-96 engines.

8. Install the ECA/ESA on the starboard elbow and tighten the screws securely.

9. 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 26, 29 and 30



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.

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. 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 26



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 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.

4. Coat the mounting bolts with Gasket Sealing Adhesive. Position the exhaust pipe, insert the bolts and tighten them to 20-25 ft. lbs. (27-34 Nm).

5. Install the engine.

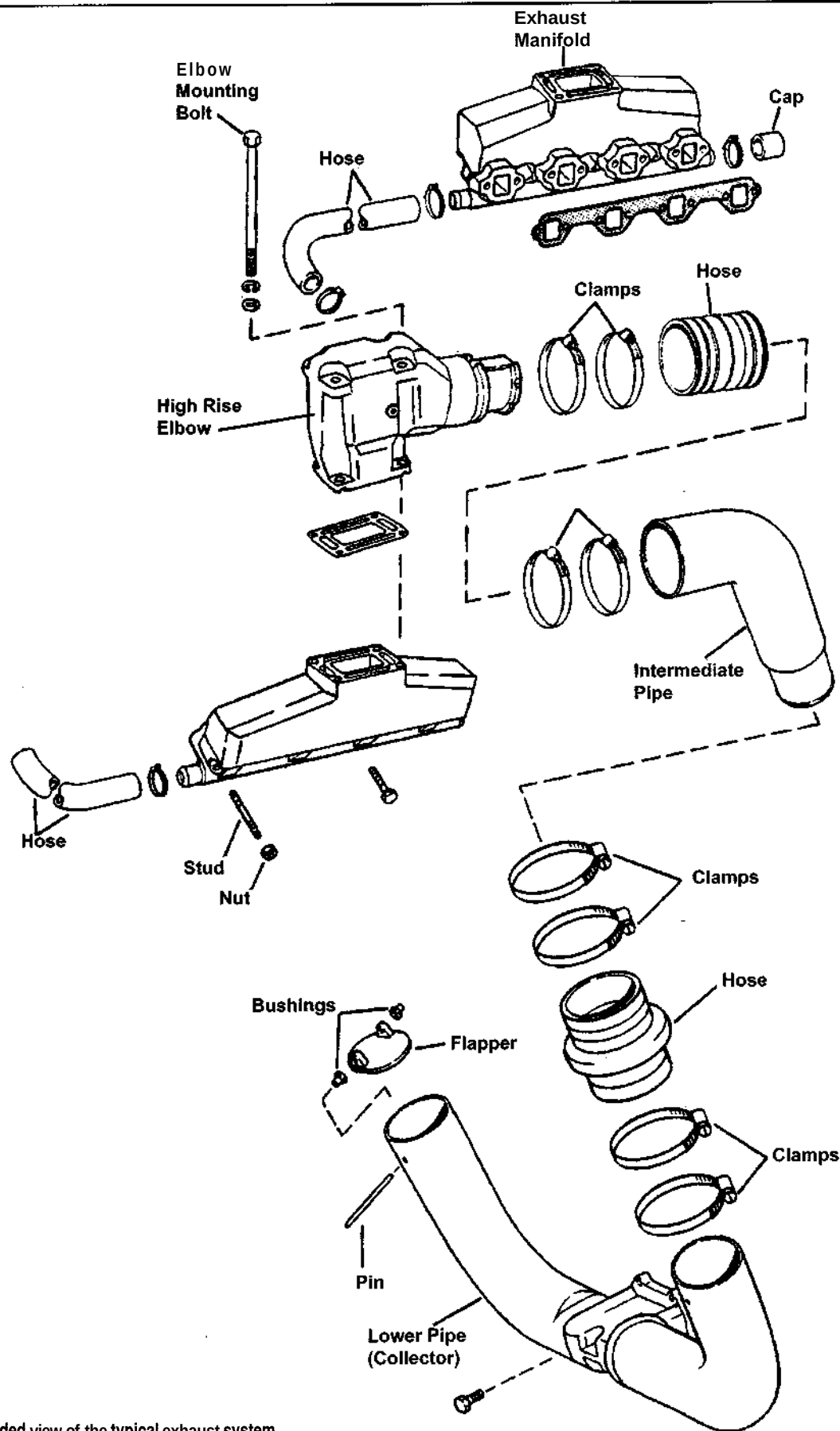
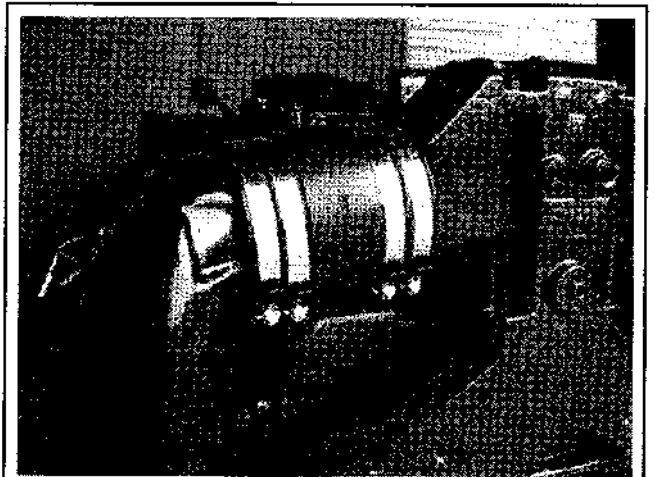
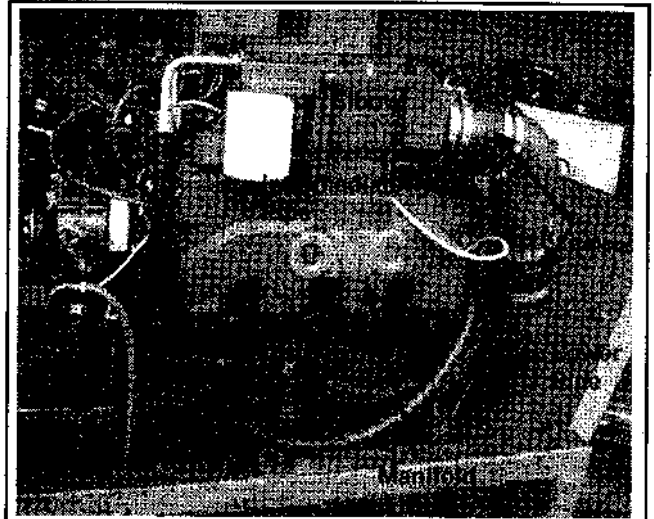
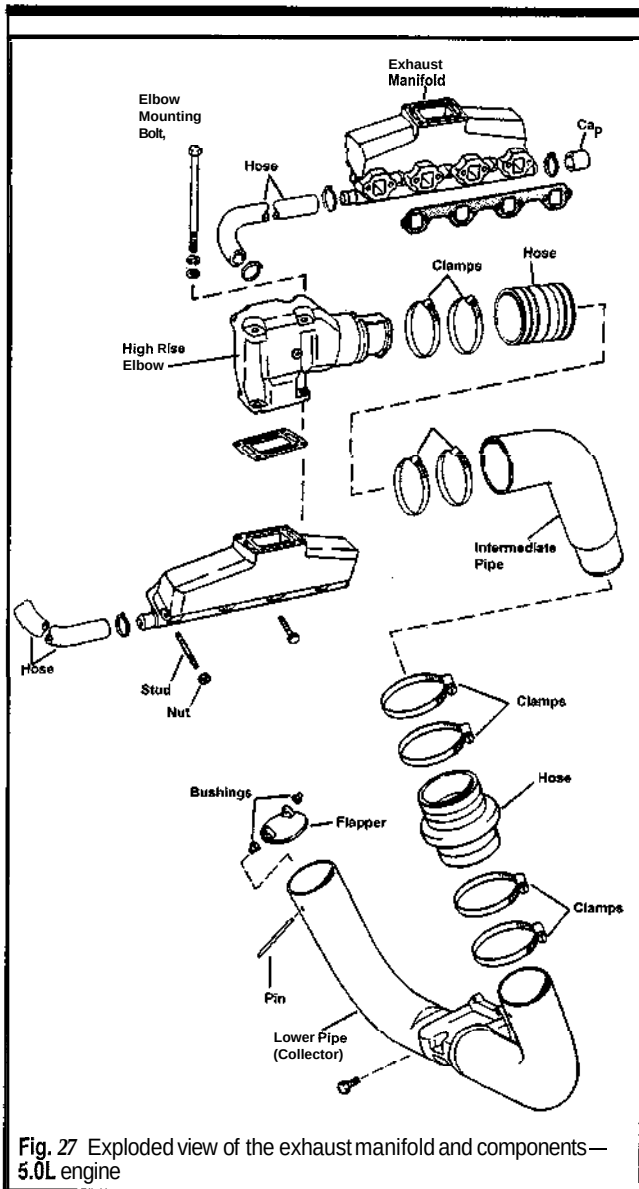


Fig. 26 Exploded view of the typical exhaust system



EXHAUST VALVE (FLAPPER) REPLACEMENT



6. Remove the exhaust hoses and the intermediate exhaust pipe. The flapper is located in the upper end of the y-pipe.

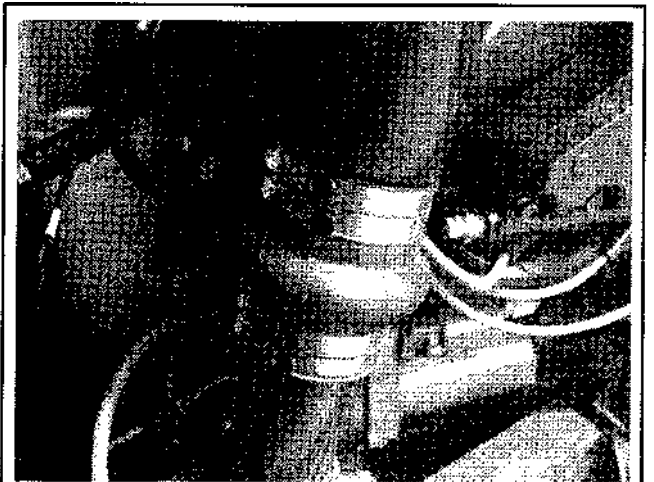
7. The valve is held in place by means of a pin running through two bushings in the sides of the pipe. Position a small punch over one end of the pin and carefully press the pin out of the pipe.

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

8. 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.

9. 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.

10. Install the exhaust hose.



Oil Pan**REMOVAL & INSTALLATION**

◆ See Figure 31



□ 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 pan braces 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.

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 the mating surfaces of the oil pan and cylinder block with an oil-resistant sealant and then position a new gasket onto the block—make sure all the holes line up. In place of a one piece gasket like the other engines, the 7.5L uses 2 side gaskets and 2 seals—make sure that the tabs in the front cover seal and the rear main bearing seal are over the edges of each side gasket.
8. Move the pan 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 pan braces on each side and then install a bolt at each corner to hold the pan in place. Install the rest of the bolts and tighten the 1/4-20 bolts to 84-108 inch lbs. (9.5-12.2 Nm) and the 5/16-18 bolts to 108-132 inch lbs. (12.2-14.9 Nm) from the center outward. On the fuel injected engines, tighten all bolts to 9-11 ft. lbs. (13-14 Nm); from the center outward.
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.

Oil Pump

The two-piece oil pump utilizes two pump rotors and a pressure regulator valve enclosed in a two-piece housing. A baffled pick-up tube is attached to the body of the pump. Oil passes through the pick-up screen, through the pump and then through the oil filter.

REMOVAL & INSTALLATION

◆ See Figures 31, 32 and 33



1. Remove the oil pan as previously detailed. Remember that you probably need to remove the engine for this procedure.
2. Loosen the two inlet tube mounting bolts and the bracket bolt and then remove the pick-up tube/screen.
3. Loosen and remove the 2 pump mounting bolts and lift off the pump assembly along with the intermediate shaft.
4. Pull out the driveshaft and retainer.
5. Loosen the 4 cover mounting screws and lift off the pump cover.
6. Match mark the two rotors where they mesh and then lift out the outer rotor and shaft.
7. Pull out the cotter pin retaining the relief valve plug. To remove the plug itself, you will need to drill a small hole in the plug, insert a self-tapping screw and pull it out with a pair of pliers—don't lose the spring. Now you can remove the valve itself. Are you sure you want to do this?
8. Clean all components in solvent and dry thoroughly. Inspect the pump body and rotors for cracks, excessive wear or other damage

9. Install the relief valve into the housing cover with a new spring. Press in the plug until it seats itself and then install a new cotter pin.

10. Install the outer rotor and shaft into the housing so the earlier marks line up. Fill the housing with fresh engine oil, install the pump cover and tighten the screws to 72-120 inch lbs. (8-16 Nm).

11. Now fill the pump with engine oil through the inlet to prime it—wiggle the pump shaft to aid the oil in coating all internal parts.

12. Insert the intermediate shaft into the distributor socket until it seats itself fully. The stop on the shaft should just contact the crankcase, so position it until this is the case.

13. When the stop is positioned correctly, insert into the pump and install them as an assembly. Do NOT force anything into position; if it will not seat properly, the drive is probably not aligned with the distributor shaft correctly. Rotate the intermediate shaft slightly until they align. Tighten the oil pump bolts to 22-32 ft. lbs. (30-43 Nm).

14. Install the pick-up tube and screen. Tighten the tube-to-pump bolts to 10-15 ft. lbs. (14-20 Nm). Tighten the support bracket bolt to 22-32 ft. lbs. (30-43 Nm).

15. Install the oil pan and engine. Fill the engine with oil.

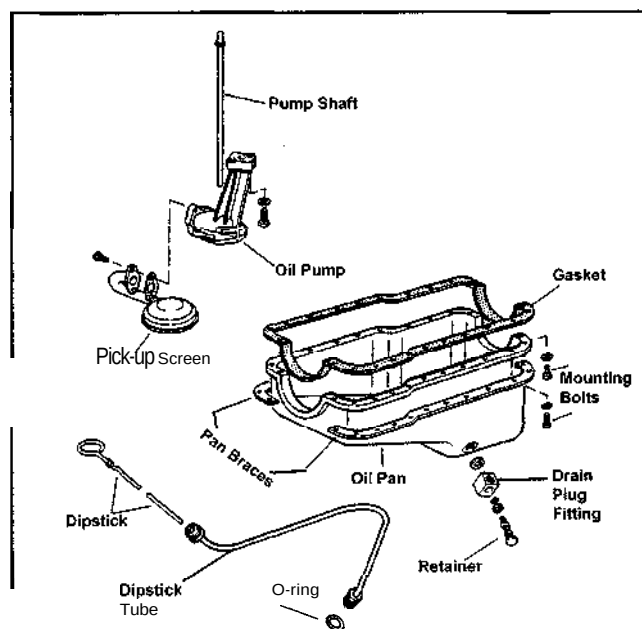


Fig. 31 Exploded view of a typical oil pan and pump—5.0L and 5.8L engines

Engine Coupler/Timing Ring And Flywheel**REMOVAL & INSTALLATION**

Over the years, these engines were equipped in a variety of configurations—flywheel and torsional damper, flywheel, damper and coupler, flywheel and coupler, etc. And for a number of years, some models also had a timing ring attached. Early models are usually the ones equipped with a damper, while **Cobra, SP** and DP models usually were equipped with the coupler. King Cobra models are usually the ones that use the timing ring. Although we have attempted to narrow the applications in the following procedures, it was not always year or model specific. Please read the procedures **FIRST** in order to determine which one is appropriate for your particular engine's configuration.

Models With A Torsional Damper



Over the years, these engines were equipped in a **variety** of configurations—flywheel and torsional damper, flywheel, damper and coupler, flywheel and coupler, etc. And for a number of years, some models also had a timing ring attached. Early models are usually the ones equipped with a damper, while Cobra, SP and DP models usually were equipped with the coupler. King Cobra models are usually the ones that use the timing ring. Although we have attempted to narrow