

1. Remove the lower unit and support it in an appropriate stand.
2. Grasp the intermediate shaft and pull it out of the housing.
3. Pull out the plastic water tube guide; remove the water tube and seal if they came out with the guide.

4. Remove the 5 locknuts on the water passage housing, throw away the nuts but keep the washers. The housing will need to be persuaded, so insert a small prybar between the housing and mating surface near one of the two forward studs and then lever the housing up while wiggling it back and forth. Once loose, pull it up and over the driveshaft housing. Throw away the gasket and O-ring.

5. Remove the 4 driveshaft bearing housing mounting bolts, but do not remove the housing yet.

6. Remove the propeller if you haven't already done so. Remove the 2 bolts running through the bearing housing, being careful to catch the retainers on the inside (460) or outside (Cobra) of the housing lip as they fall off of the end of the bolts.

7. Thread an adapter (# 432398) onto a slide hammer (# 432128) until it is fully seated and then thread the other end of the adapter onto the end of the propeller shaft. Use the hammer to back the bearing carrier and propeller shaft out of the housing bore.

8. Inspect the bearing carrier anode for signs of deterioration. If the anode appears to be less than 509 in size, replace it. Why not replace it while you've got the carrier out anyway? Cheap insurance.

9. Pull the O-rings off of the bearing carrier and carefully clamp the carrier in a vise. Fit a spanner wrench (# 432400 - Cobra, # 432399 - 460 King Cobra) into the small recesses and loosen the forward gear assembly.

The forward assembly is serviced as a unit only, no disassembly is possible.

10. Push the propeller shaft out of the carrier (from the aft side) and then reach in and remove the thrust bearing and washer if it did not come out with the shaft. Discard the thrust bearing.

11. Position a puller (# 432129) and bridge (# 432127) over the carrier so that the jaws of the puller are underneath the lower oil seal and then remove the two seals. Obviously, if you intend to replace the seals anyway, you can get away without the special tools and just pry them out (carefully!).

12. Neither bearing should be removed unless you intend to replace them, as they will be damaged during the removal process. A bridge (# 432127) and puller (# 432129) are the special tools required, but if the bearing is already worn or damaged...just drive it out with a drift.

13. Getting a wrench on the pinion nut is tough—rotate the propeller shaft and at the same time pull upward on the shift rod, this will engage forward gear and provide a bit more clearance. Now reinsert the intermediate shaft into the top of the unit and install a spline socket (# 311875) over it. Insert a pinion nut holder (# 334455) into the propeller shaft bore and over the nut, connect a breaker bar to the spline socket and then turn the driveshaft to loosen the pinion nut. Remove the nut, socket and intermediate shaft. Lift off the driveshaft bearing housing (you removed the nuts already).

14. Remove all of the driveshaft housing O-rings and throw them away. Insert your finger and rotate the needle bearings to ensure freedom of movement. Check for any damage or corrosion. If you notice a problem of any kind, replace the housing as an assembly.

15. Wiggle the lower driveshaft back and forth while pulling it up and out of the gearcase; the thrust bearing, washer and shims should come out with it but if not, remove them also.

16. Removal of the lower driveshaft bearing will destroy the bearing, so refrain from this step unless you suspect a problem with the bearing. Remove the small Phillips screw from the starboard side of the gearcase near the water inlets. Assemble the special tool (# 391257) as detailed in the illustrations and then pull the bearing up and out the top on all other engines.

☐ Make sure that all loose needles are properly positioned in the bearing cage **BEFORE** attempting to remove the lower bearing.

17. Reach into the propeller shaft bore and remove the pinion gear and nut. Check to see if any needle bearings may also have fallen loose and remove them too.

18. Back on top of the case, remove the 2 anode bolts and lift it off of the case. Press down on the shift rod to allow the detent lever clearance inside the gearcase when the propeller shaft is removed. Unscrew the shift rod until it is free, but do not remove it from the cover yet. Remove the 6 shift rod cover mounting bolts and then lift off the cover and rod as an assembly. Remove and throw away the gasket. Do not remove the shift rod from the cover unless you intend to replace the small O-ring and wiper as they will be damaged by the rod's threads while pulling it through.

19. Insert a long piece of stock (or a handle of some sort) into the shift rod bore from the top until you can depress the shift detent. Once the detent is held down sufficiently, grasp the clutch shaft and pull it (and the bearing housing) out of the propeller shaft bore.

20. Insert a small awl under one end of the clutch dog spring and pry it out of the groove while feeding it up and over the top of the clutch dog. Push the small pin out of the clutch dog, allowing the bearing housing assembly to separate from the clutch and both assemblies to come off of the clutch shaft.

☐ There are detent balls in the end of the shaft—these are not serviceable, and if damaged will necessitate replacement of the entire shaft.

21. Remove the reverse gear, thrust bearing and washer from the end of the bearing housing. There is a small bearing inside of the reverse gear which is not serviceable and should not be removed.

22. On all units but the 460 King Cobra, press the shifter pivot pin out of the housing and then pull out the shift shaft, cradle and shifter. Remove the shifter and cradle from the shift shaft.

On the 460, remove the shift shaft and cradle from the housing. Pull out the pivot pin and then lift out the shifter.

23. Remove all 25 needles from the bearing housing and then use a small awl or pick to press the detent out of the housing. Remove the detent ball and spring. On the 460, wrap a rag around the housing, rotate the detent 90° in either direction and then pull it out of the housing. Be careful here, as the detent ball and spring can pop out of the housing with considerable force while removing the detent.

To assemble:

24. Wash all parts in solvent and blow them dry with compressed air. Remove all traces of seal and gasket material from all mating surfaces. Blow all water, oil passageways and screw holes clean with compressed air. After cleaning, apply a light coating of gear lubricant to the bright surfaces of all gears, bearings, and shafts as prevention against rusting and corrosion.

25. Use a fine file to remove burrs. Replace all O-rings, gaskets, and seals to ensure satisfactory service from the unit. Clean the corrosion from inside the housing where the bearing carrier was removed.

26. Check to be sure the water intake is clean and free of any foreign material.

27. Inspect the gear case, housings, and covers inside and out for cracks. Check carefully around screw and shaft holes. Check for burrs around machined faces and holes. Check for stripped threads in screw holes and traces of gasket material remaining on mating surfaces.

28. Check O-ring seal grooves for sharp edges, which could cut a new seal. Check all oil holes.

29. Inspect the bearing surfaces of the shafts, splines, and keyways for wear and burrs. Look for evidence of an inner bearing race turning on the shaft. Check for damaged threads. Measure the run-out on all shafts to detect any bent condition. If possible, check the shafts in a lathe for out-of-roundness.

30. Inspect the gear teeth and shaft holes for wear and burrs. Hold the center race of each bearing and turn the outer race. The bearing must turn freely without binding or evidence of rough spots. Never spin a ball bearing with compressed air or it will be ruined. Inspect the outside diameter of the outer races and the inside diameter of the inner races for evidence of turning in the housing or on a shaft. Deep discoloration and scores are evidence of overheating.

31. Inspect the thrust washers for wear and distortion. Measure the washers for uniform thickness and flatness.

32. Replace ALL seals, O-rings, and gaskets to ensure maximum service after the work is completed.

33. Coat the detent ball and spring lightly with Needle Bearing grease, insert the spring into the reverse gear bearing housing, followed by the detent ball.

34. On 460 models, position the detent arm toward either side of the housing and then depress the detent ball and spring with a punch while pushing the detent into the housing. Once past the ball, rotate the lever toward the rear of the housing and then move it until the Neutral position is engaged. Insert the shifter so the side with the narrow arms is facing the bearing opening, reach inside and connect the shifter to the neck of the detent. Align the pivot holes with those in the housing and then insert the pivot pin.

35. On all other models, insert the detent into the housing and press it in until it is next to the detent ball—making sure that the ball is resting on the spring. Insert a small pick into the other end of the detent bore and press in the detent ball while pushing the detent in until it pops into the Neutral

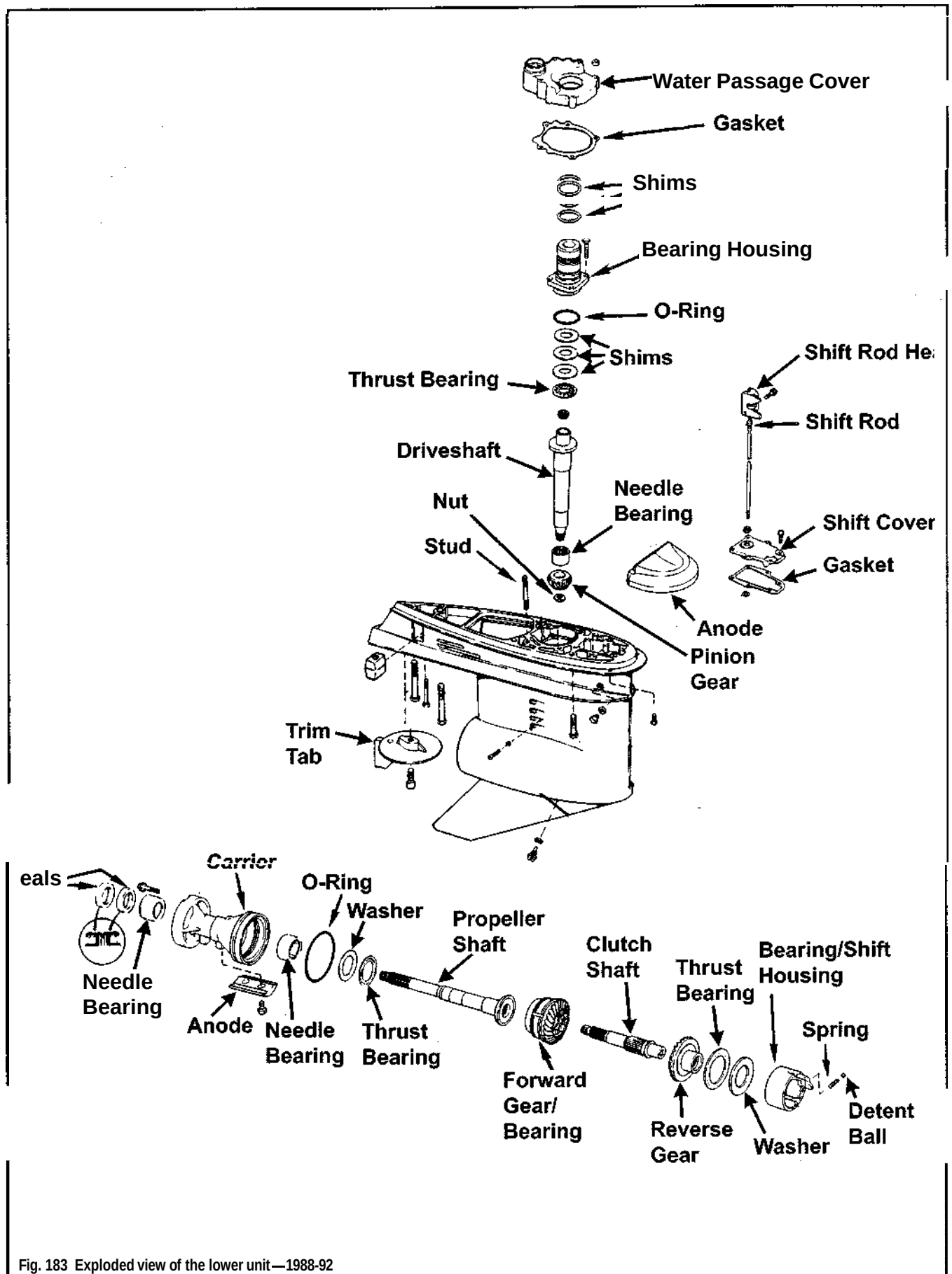


Fig. 183 Exploded view of the lower unit—1988-92

position. Position the cradle onto the shift shaft and lay the shifter in place on the cradle. Slide the shaft into the housing and insert the shifter tip into the pocket on the detent. Align the pivot holes with those in the housing and then insert the pivot pin.

36. Coat all 25 bearings with grease and install them into the cage if the bearing has not been replaced with a new one (in which case the new one is most likely a caged bearing with no loose needles).

37. On the 460, confirm that the detent is still in Neutral, rest the cradle on the shift shaft and then connect the cradle to the shifter arms. Depress the detent until it holds the shaft and cradle in place.

38. Insert the shift lever so the side with the narrow arms is facing the detent shifter. Attach it to the neck on the detent shifter, align the pivot holes with those in the housing and then insert the pivot pin.

39. Lay the thrust bearing on the back side of the reverse gear and then position the washer on the bearing. Carefully insert the assembly into the bearing housing without disturbing the thrust bearing or any of the needle bearings.

40. Take a look at the clutch dog and identify the end with the part number embossed on it (it should also have "Prop end" etched on this same side); this is the end of the dog that must face the rear of the clutch shaft, that is to say it must face the propeller. Once located, slide this end onto the inner (forward) end of the shaft so that the splines index properly and the retaining pin holes line up. Now insert the shift shaft into the clutch shaft until the retaining pin hole lines up with the other two holes and then press in the pin. Slide a new retaining spring down over the propeller shaft and position it so that at least 3 coils are covering each end of the retaining pin WITHOUT overlapping one another.

41. Obtain a driveshaft holding socket (# 314438) and clamp it in a vise. Slide the driveshaft into the socket and then set the pinion gear on the end of the shaft. Tighten the nut to 70-75 ft. lbs. (95-102 Nm), except on the 460 King Cobra models where it should be 100-110 ft. lbs. (136-149 Nm). Remove the shaft from the holder.

42. Position the thrust bearing, washer and driveshaft bearing housing on the other end of the driveshaft without any shims. Face the stepped side of an alignment plate (part of the shim gauge kit # 984329) away from the bearing housing, slide the plate over the shaft and seat it against the housing. Move the entire assembly into a shim fixture (# 984329). Tighten the tension screw on the fixture against the end of the driveshaft until the screw sleeve reaches the groove in the pointed end of the screw. Tighten the tension screw lock nut on the outside of the fixture until it is tight against the frame.

43. Tilt the entire fixture back until it is resting on the support lugs. Select the following gauge bars depending upon your particular application:

- V6 and V8 engines except the 460 King Cobra—# 328367
- 460 King Cobra—# 330224

44. Position the correct gauge into the fixture so the curved head is up and behind the pinion gear and the base is resting against the bearing housing. Hold the gauge tightly against the bearing housing and measure the clearance between the other end and the pinion gear. Make sure that you rotate the shaft a few times and take a few readings in different places. Take an average of your readings and then subtract this figure from 0.020 in. to determine the correct amount of shims required to properly position the pinion gear. On 460 King Cobra models, use 0.030 in. as the figure you subtract from.

45. Check your measuring accuracy by installing the shims and then checking the clearance again. If you come up with 0.020 in. (0.030 in. for the 460), then you measured correctly. Otherwise, repeat the last step and try it again. Once correct, remove the shaft from the fixture and disassemble the individual components.

46. If you removed the lower driveshaft bearing, use the same group of tools to press it back into the housing bore. Coat the outside of the bearing case lightly with Needle Bearing grease and then slide the bearing onto the tool so the side with letters on it is facing the installer. Position the assembly into the bore and drive it in until the driving rod is seated on the spacer. Note that the 460 King Cobra uses 19 needle bearings, while all others use 18.

47. Slide a new O-ring over the small bearing retaining bolt and spray the threads with LocQuic Primer. Once dry, coat them with Nut Lock, install the bolt and tighten it to 48-84 inch lbs. (5-9 Nm).

48. Press down on the detent lever in the reverse gear bearing housing until it engages the Reverse position (this is the lowest position in its travel). Tilt the top of the lower unit forward so that the propeller shaft bore is raised slightly and then insert the shift shaft assembly into the bore so that the locating pin on the front side of the bearing housing engages the recess in the nose of the gear housing. Once the pin is properly fit into the recess, the detent lever will be centered (front to back) on the shift rod cavity.

49. Coat both sides of a new shift rod cover gasket with Gasket Sealing compound and lay it on the gear housing mating surface. Take a look down the bore to gauge the distance to the detent lever and slide the shift rod through the cover far enough so that you will be able to begin threading it into the detent without having the cover touch the new gasket. Position the cover and rod over the bore and thread the rod into the detent 4-5 full turns. Now you can position the cover on the gasket! Coat the threads of the mounting bolts with Gasket Sealing compound and tighten them alternately to 60-84 inch lbs. (7-9 Nm).

50. Slowly rotate the clutch shaft while pushing down on the shift rod. Look down through the driveshaft bore and confirm that the clutch dog is fully engaged with the lugs on the reverse gear.

51. Install the anode and tighten the bolts securely.

52. Reach into the propeller shaft bore and hold the pinion gear under the lower driveshaft bearing while an assistant inserts the driveshaft into the gear from the top. Install the intermediate shaft and then slide a spline socket (# 311875) over the top splines. Position the pinion nut into a nut holder (# 334455) and hold it in place while rotating the shafts with a torque wrench attached to the spline socket. Tighten the nut to 70-75 ft. lbs. (95-102 Nm) except the 460 King Cobra which must be tightened to 100-110 ft. lbs. (136-149 Nm). Remove the socket and intermediate shaft.

53. Position the thrust bearing, thrust washer and shim material over the top of the driveshaft. Coat the small (new) O-ring with oil and slide it over the base of the driveshaft bearing housing. Next, coat the 3 larger exterior rings with Gasket Sealing compound and slide them over the top of the housing and into their recesses; position the upper ring first and then work down with the other two.

54. Coat the entire exterior surface (very lightly) of the housing with Gasket Sealing compound to reduce corrosion. Position the housing over the shaft so the bolt holes line up properly and then install the bolts and tighten them alternately to 14-16 ft. lbs. (19-22 Nm). Don't forget to coat the bolt threads with sealing compound.

55. Coat both sides of a new water passage cover gasket with Gasket Sealing compound and slide the gasket over the studs and into place on the mating surface. Position the cover itself over the studs and lightly tap it into place. Install new lock nuts and tighten them to 9-11 ft. lbs. (12-15 Nm).

56. If you replaced the large bearing on the propeller shaft bearing carrier, coat the outside of the case with oil. Position the housing in a holding fixture and then slide the bearing onto an installer (# 432401) so the side of the bearing with lettering is facing the large diameter side of the tool. Press the bearing into the housing until tool is seated.

57. Repeat the previous step for the smaller bearing, but face the lettered side toward the smaller end of the tool.

58. Coat the outer casing of 2 new seals with Gasket Sealing Compound. Position the inner seal on the stepped side of the installation tool so the lip is facing the housing. Turn the tool over and install the outer seal so the lip is facing away from the housing. Use tool # 326690. Make sure that the seal lips and inner cavity are coated with grease.

59. Secure the carrier housing in a vise and then insert the thrust washer and a new thrust bearing into place. Coat the bearing surfaces of the propeller shaft with gearcase oil and then slide it into and through the housing until it is resting on the thrust bearing.

60. Coat the threads of the forward gear lightly with oil and then thread it into the housing as far as you can by hand. Use a spanner (# 432400, or # 432399 on the 460) and tighten the gear to 100 ft. lbs. (136 Nm).

61. Make sure that the carrier anode is tightened to 60-84 inch lbs. (7-9 Nm).

62. Install new O-rings (3 on the 460 and 1 on the others) coated with Triple Guard grease into their respective grooves on the carrier and then coat the O-ring flanges with Gasket Sealing compound.

63. Install the intermediate shaft and then shift the gearcase into Reverse, making sure that the clutch dog and gear are fully engaged.

64. Slide the carrier/shaft into the bore so the anode is on the bottom and the mounting bolt holes are in the vertical position. Once the carrier assembly seats in the bore, hold the intermediate shaft and then wiggle the propeller shaft until the internal splines on the two shafts engage. Press the carrier in further by hand until the retaining tab slots are flush with those in the gearcase bore. Install the retaining tabs and then tighten the bolts to 18-20 ft. lbs. (24-27 Nm).

65. Position a shift rod height gauge (# 912277) on the upper mating surface of the gear housing. Now screw the rod (in or out) until the top of the shift rod head just contacts the upper arm of the gauge (about 7-13/64 in.). The notched side of the head must be facing forward, so it is acceptable if you have to turn the rod and additional 112 turn in either direction. That's it.

66. Remove the intermediate shaft and make sure that the small nylon plug is in place inside the lower driveshaft. Coat the splines on each end of the intermediate shaft with gear oil and then insert the shaft into the top of the lower driveshaft.

67. Spin the shift rod head 90° to the port side and then install the water tube into the guide on top of the gear case.

68. Install the upper gear housing as detailed in the appropriate section and then install the drive unit if it was removed. Fill the drive unit with oil.

1990-95 King Cobra And 1994-98 SP/SX/SX Cobra Single Propeller Models



◆ See Figures 184 thru 206

■ Please note that although not mentioned in the above head, the 1993 Cobra counter-rotating unit is also covered in this section.

□ All special tool part numbers listed below are OMC factory tool numbers—we realize that if you reading this after 2001, they may be difficult, if not impossible, to obtain. With the exception of some of the earliest tools, the vast majority of these tools should be available from a Volvo Penta representative. Although the part numbers themselves may be different in many cases, the tool should be the same.

DO NOT ATTEMPT THIS PROCEDURE WITHOUT THE SPECIAL TOOLS!! We know that most of us, whether professional technicians or shade-tree mechanics, hate spending money on special tools. Most of us don't want to spend the money, even if we had it, so we find ways to fabricate our own version of special tools. Be warned in advance that you will NOT be able to create these tools on your own. Please read through the following steps beforehand and make a list of the tools that you will need to acquire—if you are unwilling, or unable, to get your hands on them, take the drive to someone who already has them.

1. Remove the propeller if not already removed. Install the lower unit in an appropriate holding fixture.

2. Reach into the propeller shaft opening and remove the retainer screw on the upper starboard side. Lift out the retainer securing the bearing housing to the lower unit.

3. Use a T27 Torx bit and remove the propeller shaft bearing housing set screw on the upper port side of the aft end of the propeller shaft housing.

4. Remove the 3 Torx bolts securing the anode retainer to the propeller shaft bearing housing—the small bolt is a T30 bit and the 2 larger bolts are T40 bits. Grasp the retainer and pull it and the internal anode out of the housing. Replace the anode if it has deteriorated by more than a third.

5. Connect a bearing housing removal tool (# 914684) to the bearing housing and turn it counterclockwise, using a ratchet and breaker bar, until the housing is loosened and you can spin it all the way out of the case. Once out of the lower unit, remove the tool and carefully pull off any shim material. Remove the O-ring and throw it away.

6. Use a small punch or drift and pry out the small oil seal in the end of the bearing housing. The seal will be damaged during removal, so be sure that you throw it away now.

7. Turn the housing over and install the special bearing puller (# 432129), rod (# 432127) and guide plate (# 914700). Slide the guide plate over the rod so the stepped side facing upward and insert the assembly into the housing. Expand the jaws of the puller so they are tightly behind and under the bearing cup (race) and then pull out the cup.

8. Carefully pull the propeller shaft out of the housing bore. Reinstall the propeller nut to protect the threads and position the shaft/bearing into a bearing knife. Press off the bearing.

9. If you did not remove the intermediate shaft sleeve during case separation, remove it now and inspect the splines. If you did not already remove it, and you can't find it, look in the bottom of the upper housing where is sometimes get stuck. Same thing with the water tube, grommets and retainer; if you haven't already removed them, do it now.

□ Early SP models and most King Cobra models may use a retainer guide that is attached with 4 small screws.

10. Remove and discard any remaining O-rings on the top of the lower unit mating surface.

11. Install the special spanner tool (# 3850601- SP, # 914696 - KC) over the driveshaft and onto the retainer so that it indexes with the slots in the edge of the retainer. Back out the retainer, disconnect the tool and throw away the O-ring.

12. Install the special spline socket (# 3850598 - SP, # 914699) onto the upper end of the driveshaft. Slide the special handle (# 311880) through an alignment plate (# 914686) and then thread a pinion nut holder (# 914694 1993-94 SP or # 3854864 for 1995-98 SP and all KC) onto the end of the handle. Insert the assembly into the propeller shaft bore while wiggling the driveshaft back and forth until the holder slides onto the pinion nut. Turn the driveshaft counterclockwise with a wrench on the spline socket until the pinion nut is completely unthreaded from the bottom of the shaft.

13. Remove the tools and the pinion nut. Reach into the housing bore and put your hand under the pinion gear while someone else pulls upward on the shaft—you'll want to catch the gear and needle bearings while they are removing the shaft. The upper bearing race will probably come out with the bearing.

If you have long arms, you can probably accomplish this step alone; but it's really much easier with an assistant.

14. Reach into the bore again and remove the propeller shaft gear/bearing and needle bearings (which will fall out if they didn't already when you removed the pinion).

15. Insert a 3-armed puller into the housing bore and remove the bearing race (cup) at the back of the bore. Reach in and remove any shim material; which will have been damaged, so discard it.

✱ ✱ WARNING

Do not remove the propeller shaft bearing and oil slinger from the gear unless it is defective and you plan on replacing it.

16. Position the assembly in a universal bearing separator tool so the tool edge is between the bearing and the oil slinger. Place the separator onto a suitable support and press off the bearing with a bearing remover (# 914708) and handle (# 378737).

17. Repeat the previous procedure to remove the oil slinger, positioning the tool edge between the slinger and the gear. Remember the earlier Warning: if you do not intend to replace the oil slinger, do not remove it.

18. On 1993-94 SP drives and all King Cobra drives, assemble a 2-armed puller (# 432129) into a deck bridge (# 432127) and position them over the driveshaft bore so that it sits on a suitable support. Insert the arms of the puller through the lower driveshaft bearing race and under the shim material. Expand the arms out and under the race and then tighten the puller nut to remove the race (cup) and shims. Check the bore to be sure there are no additional shims left; throw away all shims, as they will have been damaged in the removal process.

On 1995-98 SP drives, assemble the race remover tip (# 3855859), the rod, nut and washer (# 3855860) and the guide plate (# 914700). Insert the remover tip into the driveshaft bore until the guide plate seats itself, tighten the nut and remove the lower bearing race and shims. Check the bore to be sure there are no additional shims left; throw away all shims, as they will have been damaged in the removal process.

19. Coat the 19 pinion bearing needles with Needle Bearing Grease and then assemble them back into the bearing case. Assemble a bearing puller (# 914706), guide plate (# 914700) and remover (# 914704) and then insert the tools into the top of the driveshaft bore until the remover rests on the top of the bearing and the guide plate is seated in the bore recess. Lay a small shop towel under the bearing in the propeller shaft bore and then tap the top of the special tool with a hammer until it forces the bearing out of its seat. Remove the tools, rag, bearing and needles.

✱ ✱ CAUTION

Do not attempt to remove the pinion bearing without re-installing the needles. Without the needle bearing in place, the cage will distort during the removal process and require replacement.

✱ ✱ WARNING

Do not remove the driveshaft bearings unless it/they are defective and you plan on replacing them.

20. Lift the loose upper bearing race off of the driveshaft. Position a universal bearing separator into an arbor press so the curved face is facing up and then insert the driveshaft so the lower bearing is sitting on the tool. Carefully press the shaft down and through the bearing until they are loose and then lift the bearings off of the shaft. Be sure that you take note of which bearing went in which position; they look alike but are not and cannot be interchanged.

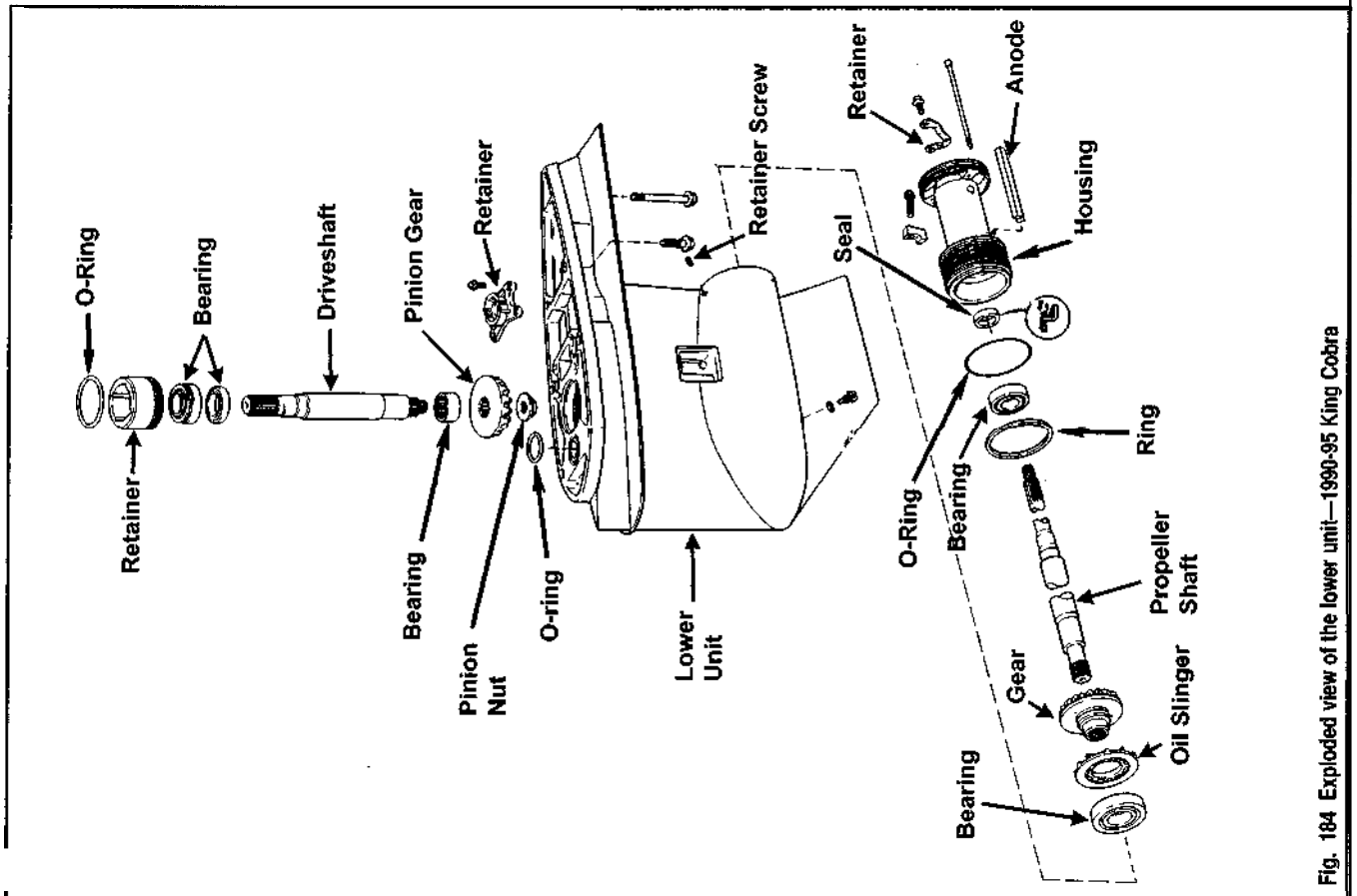


Fig. 184 Exploded view of the lower unit—1990-95 King Cobra

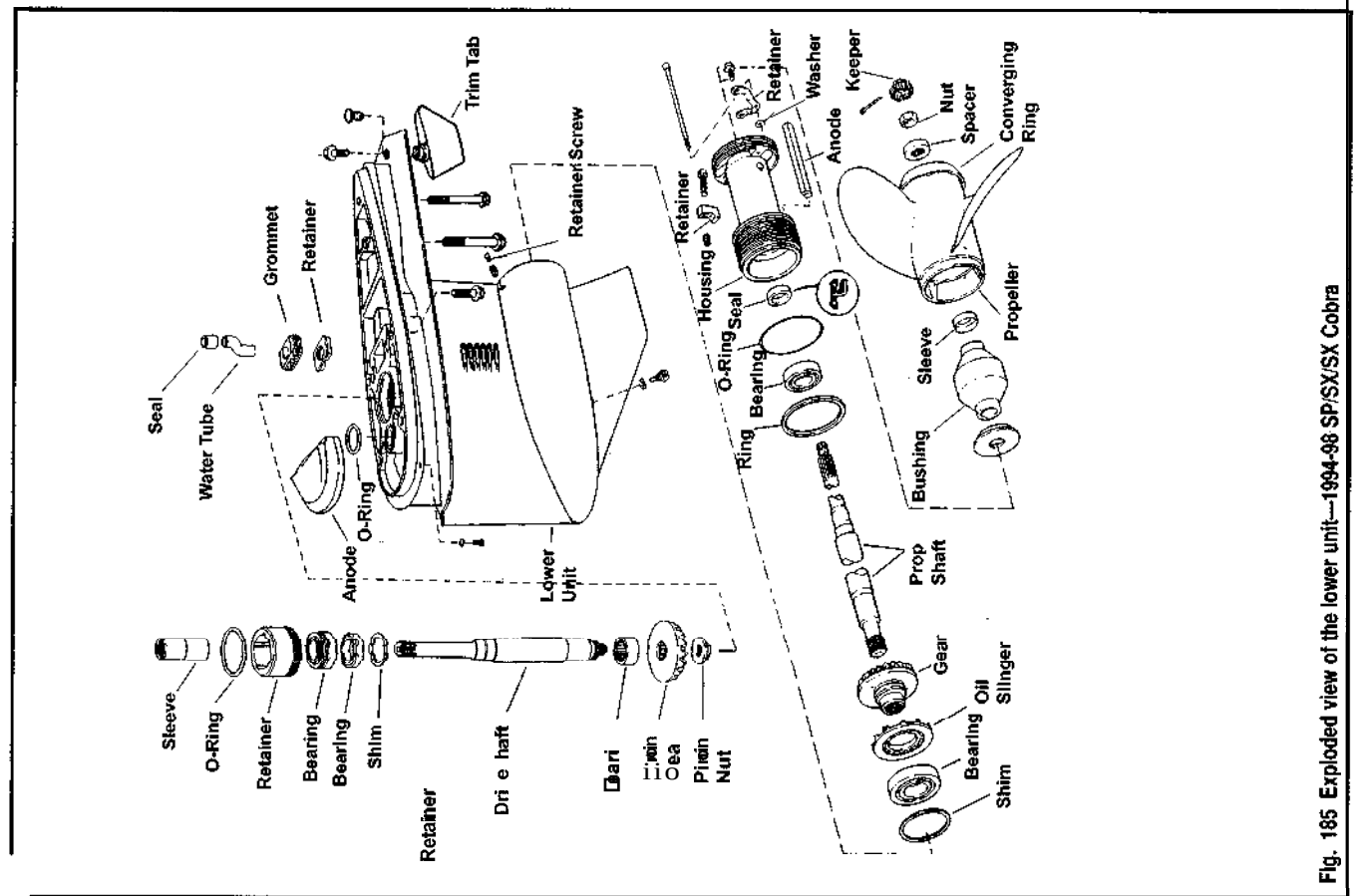


Fig. 185 Exploded view of the lower unit—1994-98 SP/SX/SX Cobra

To assemble:

21. Wash all parts in solvent and blow them dry with compressed air. Remove all traces of seal and gasket material from all mating surfaces. Blow all water, oil passageways and screw holes clean with compressed air. After cleaning, apply a light coating of gear lubricant to the bright surfaces of all gears, bearings, and shafts as prevention against rusting and corrosion.

22. Use a fine file to remove burrs. Replace all O-rings, gaskets, and seals to ensure satisfactory service from the unit. Clean the corrosion from inside the housing where the bearing carrier was removed.

23. Check to be sure the water intake is clean and free of any foreign material.

24. Inspect the gear case, housings, and covers inside and out for cracks. Check carefully around screw and shaft holes. Check for burrs around machined faces and holes. Check for stripped threads in screw holes and traces of gasket material remaining on mating surfaces.

25. Check O-ring seal grooves for sharp edges, which could cut a new seal. Check all oil holes.

26. Inspect the bearing surfaces of the shafts, splines, and keyways for wear and burrs. Look for evidence of an inner bearing race turning on the shaft. Check for damaged threads. Measure the run-out on all shafts to detect any bent condition. If possible, check the shafts in a lathe for out-of-roundness.

27. Inspect the gear teeth and shaft holes for wear and burrs. Hold the center race of each bearing and turn the outer race. The bearing must turn freely without binding or evidence of rough spots. Never spin a ball bearing with compressed air or it will be ruined. Inspect the outside diameter of the outer races and the inside diameter of the inner races for evidence of turning in the housing or on a shaft. Deep discoloration and scores are evidence of overheating.

28. Inspect the thrust washers for wear and distortion. Measure the washers for uniform thickness and flatness.

29. Replace ALL seals, O-rings, and gaskets to ensure maximum service after the work is completed.

30. All bearings utilize an assembly notch, this notch must always be facing AWAY from the respective gear when installed.

31. Coat the inside of the smaller driveshaft bearing with GL5 synthetic gear lube. Thread the pinion nut into the lower end of the driveshaft for protection and then slide the bearing onto the splined end (top) of the shaft so that the tapered side is facing the bottom of the shaft (the end with the pinion nut). Install a bearing installer (# 914698) over the end of the shaft so that the raised lip on the tool contacts the backside of the bearing. Now rest the entire assembly (pinion nut UP) on an arbor press and press the bearing into place on the shaft.

32. Repeat the previous step for the remaining bearing, with the tapered side of the bearing facing the top of the shaft this time. Press the bearing into position until it seats against the lower bearing.

33. Clamp a spline socket (# 3850598 - SP or # 914699 - KC) in a vise with the spline end facing UP. Insert the upper end (splined) of the shaft into the socket and slide the bearing race down over the smaller bearing—this is the lower bearing, but it will be on top at the moment. Now slide a pinion shim fixture tool (# 3855098 - SP or # 986617 - KC) over the shaft and against the race so that the side of the tool with 3 slots is facing up toward the pinion end of the shaft.

34. Install the pinion gear and nut, tightening the nut to 150-160 ft. lbs. (203-217 Nm) on SP drives or 60-80 ft. lbs. (81-109 Nm) on King Cobras. Rotate the shim fixture tool through a few revolutions until the bearing seats itself and then insert a flat bladed feeler gauge into each of the 3 slots, measuring the clearance between the top of the inner hub on the tool and the bottom of the pinion gear. Mark each measurement down, add them up and divide by three to determine the average clearance. Round off this figure to the nearest thousandth of an inch (3 places after the decimal point) and record this figure. This figure is the shim thickness needed on King Cobra drives; on all others, proceed to the next step. On the King Cobra, you must always use at least one shim, and never more than three shims.

35. Remove the pinion nut and gear; throw away the nut. Locate the shim allowance number etched onto the backside of the gear and convert it to a decimal equivalent in thousandths of an inch—+5 translates to 0.005 in., -2 translates to -0.002 in. Add this figure to the one arrived at in the previous step and record it as your pinion gear shim thickness. When adding shim material later on, remember that in arriving at this thickness, you must always use at least one shim, and never more than three shims (1993-94 SP drives), or never more than five shims (1995-98 SP drives).

Not to be silly, but please remember that if the etching of your pinion gear is a negative number (-2), you will then SUBTRACT this number from the pinion gear clearance figure rather than adding it.

36. Assemble the correct amount of shim material for the pinion gear and position it onto the bearing shoulder in the top of the driveshaft bore.

37. Coat the outer surface of the bearing race with GL5 synthetic gear lube and position it squarely into the driveshaft bore so that the taper, or large opening, is facing upward. Now assemble the race driver (# 914706), guide plate (# 914700) and installer (# 914703) so the stepped end of the guide plate faces the threads on the driver and the stepped end of the installer is also facing the threads. Insert the tool into the bore and push down on the plate until it indexes with the bore. Tap the end of the driver with a hammer until the races seats against the shim material on the shoulder.

38. Coat the propeller shaft gear and oil slinger lightly with GL5 synthetic gear lube. Place the gear (teeth down) on a universal bearing separator for support and slide the oil slinger over the hub so that the pins align with the holes in the gear. Install a support plate (# 914698) and bearing installer (# 914687) over the hub and press the slinger into place on the gear. Make sure that the pins and holes are aligned BEFORE pressing the slinger into place.

39. With the gear and oil slinger still sitting in the separator tool, coat the inner race of the bearing with GL5 synthetic gear lube and slide the bearing over the gear hub so the tapered side is facing UP. Press the bearing into place with the installer tool (# 914707) until it is seated against the oil slinger.

40. On the King Cobra, place the gear and bearing on the race and rotate the gear to properly position the rollers. Set the bearing in the groove of a shim fixture tool (# 986631). Rotate the arm of the fixture over the gear and tighten the set screw. Slide a feeler gauge between the bottom of the arm and the top of the gear. Record your measurement as this is your shim thickness. You must always use at least one shim, and never more than three.

41. On SP drives, with the gear and bearing assembly still sitting in the separator tool, slide the bearing race into position over the bearing and then turn it a few revolutions until the bearings are fully seated. Position a shimming fixture (# 3850600) onto the bearing so its recessed side faces the bearing. Install a depth gauge over the shim fixture and measure the depth from the top of the fixture to the end of the gear hub; subtract 0.5 in. (thickness of the fixture) and record the resulting figure.

42. Locate the shim allowance number etched onto the backside of the gear and convert it to a decimal equivalent in thousandths of an inch—+5 translates to 0.005 in., -2 translates to -0.002 in. Add this figure to the one arrived at in the previous step and record it. OMC suggests a nominal dimension of 0.106 in., so subtract the figure you just recorded from this number and record the new number as your propeller shaft gear shim thickness. When adding shim material later on, remember that in arriving at this thickness, you must always use at least one shim, and never more than three.

43. Turn the lower unit over so that it can rest on its forward edge (use a piece of wood to support it). Select the correct number of shims and insert them into the propeller shaft bore so that they sit in the bearing race recess at the forward end. Coat the outer surface of the bearing race with GL5 synthetic gear lube and position squarely into the bore as far as it will go so that the larger opening is facing out or aft. Assemble the same tools used during the removal procedure and the press the race into the recess until it is fully seated.

44. If the needle bearings are not still in the pinion bearing cage, coat them with grease and re-install all 19 of them...again! Coat the outside of the cage with GL5 synthetic gear lube and install the bearing into the bottom of the driveshaft bore with the same tools used during removal. Insert the tool through the top of the driveshaft bore and then position the pinion bearing into the installer and thread the installer onto the bottom of the rod through the propeller shaft bore. Once the guide plate is seated in the top of the bore, tighten the nut until the bearing is pulled up into its recess and fully seated against the shoulder in the bottom of the bore.

If the bearing appears to be spinning in the installer, insert the pinion nut holder into the propeller shaft bore to hold it in place.

45. Install the propeller shaft gear/bearing into the bore so that it seats into the bearing race with the gear teeth facing aft. Insert the driveshaft into the top of the bore and feed it carefully through the pinion bearing without disturbing the needles. When the shaft is in far enough that the lower bearing seats into the race, install the pinion gear onto the shaft and then screw in the new pinion nut until it is finger-tight. You may have to lift the driveshaft slightly in order to get the pinion gear teeth to engage the teeth on the propeller shaft gear.

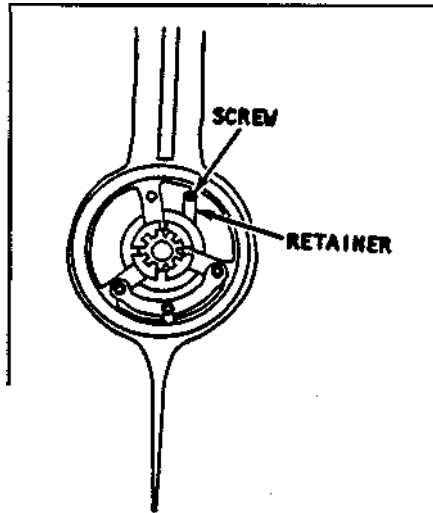


Fig. 186 Remove the retainer and screw...

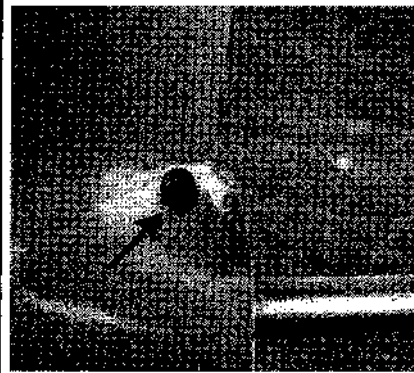


Fig. 187 ...and then remove the bearing housing set screw

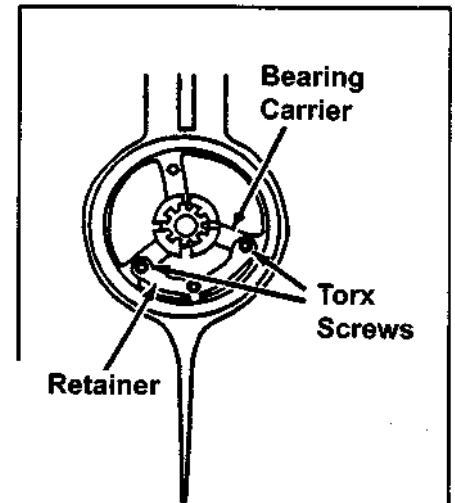


Fig. 188 Remove the 3 retainer screws...

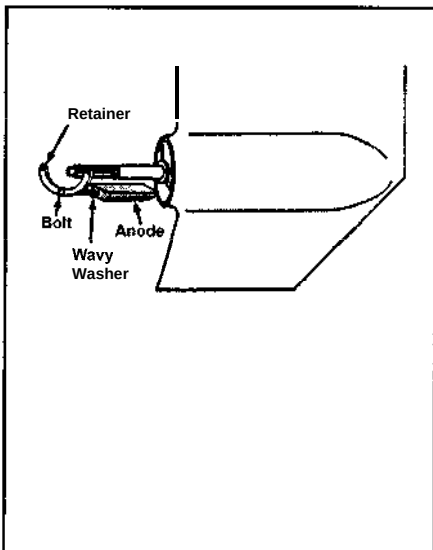


Fig. 189 ...and then pull out the retainer with the anode

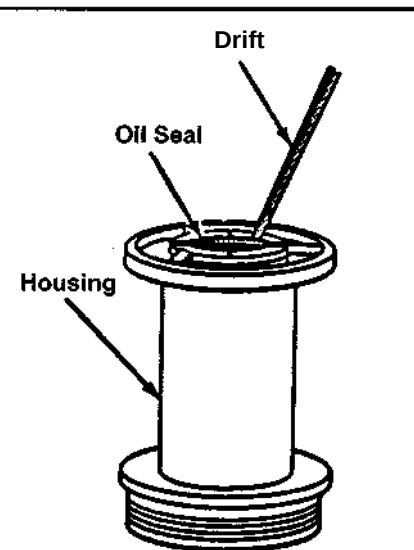


Fig. 190 Pry out the oil seal...

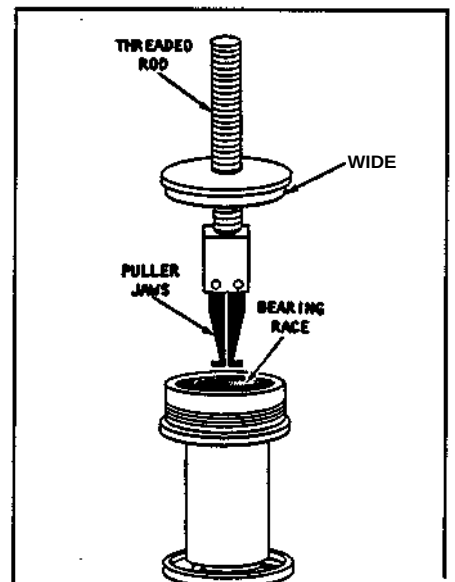


Fig. 191 ...and then remove the bearing race with the special tools

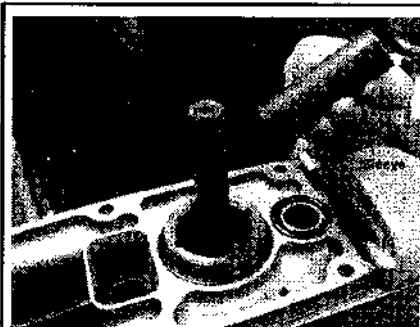


Fig. 192 If you haven't done it already, remove the shaft sleeve...

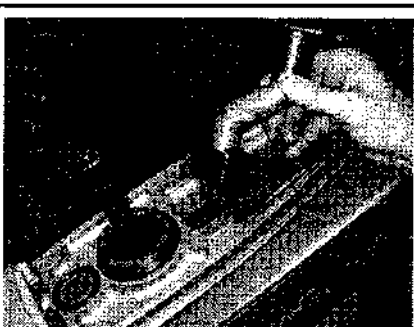


Fig. 193 ...and the water tube (some models may have a different retainer)



Fig. 194 After removing the driveshaft retainer...

46. Coat the upper bearing race with synthetic gear lube and press it into place until it seats over the bearing. Install a new O-ring (coated with clean oil) and then thread in the shaft retainer. Install the spanner tool over the retainer and screw it in all the way until it seats on the upper bearing race.

47. Install the spline socket over the top of the driveshaft. Carefully remove the pinion nut and coat the threads with Loctite Primer. Once the primer has dried, coat the threads again, this time with Loctite locking compound and then thread the nut into the shaft. Install the nut holder tools and then tighten the nut to 150-160 ft. lbs. (203-217 Nm) on SP drives or 175-185 ft. lbs. (237-251 Nm) on King Cobra drives by turning the driveshaft.

48. With the spline socket still installed on the upper end of the driveshaft, turn the lower unit over so that it can rest on its forward edge (use a piece of wood to support it). Attach a breaker bar to the socket and rotate the driveshaft a few times to ensure that the bearings are seated fully. Remove the bar and install a dial torque wrench; pull on the wrench and observe the gauge reading as the driveshaft just begins to rotate. The driveshaft rolling torque should be 2-4 inch lbs. (0.22-0.45 Nm) on SP drives or 1-4 inch lbs. (0.11-0.45 Nm) on King Cobras; if not, remove the wrench and install the spanner wrench so you can tighten or loosen the driveshaft retainer until the rolling torque comes into specification. Do this slowly, a little at a time, checking the torque in between each time you tighten or loosen the retainer. Record the actual setting.

49. Sit the propeller shaft bearing housing on a flat surface with the aft side facing down. Assemble the special seal installer tool (bolt # 914706, guide # 914700, and installer # 915970) so that the tapered side of the guide is facing the threads. Slide the bearing housing seal onto the bolt so that the lip is facing the guide. Coat the outside casing (metal) of the seal with Gasket Sealing compound and then position the assembly into the housing so that the guide seats itself into the housing. Tap the end of the bolt until the seal is seated fully. Remove the tool and coat the seal lip with grease.

50. Coat the outside of the housing bearing race with GL5 synthetic gear lube and then press it into the housing using the same tools as for the seal except that the race must use a different installer (# 914703).

51. Coat the threads of the propeller shaft bearing housing with GL5 synthetic gear lube and then coat a 0.160 in. shim ring (# 914720) with Needle Bearing grease. Position the shim ring on the housing and thread the housing into the bore. Do not use an O-ring yet. Connect a housing installer (# 914684) so that the slots align with the ribs and then tighten the housing to 80 ft. lbs. (108.5 Nm).

52. Use a depth gauge and measure the depth from the edge of the propeller shaft housing bore to the top of each of the 3 ribs on the bearing housing. Make sure that the gauge pointer is well away from the hole in each rib to avoid a false reading from the slight indentation around each hole. Add the 3 measurements together and divide them by three—round the results off to thousandths of an inch. Record this figure and then add 0.160 in. to it (thickness of the shim ring). Record the final figure for the initial propeller shaft bearing preload shim thickness; although it is not necessarily the actual shim thickness you will end up using, read on.

53. Remove the bearing housing again and pull off the shim ring. Install the propeller shaft into the bore and then re-install the bearing housing again (without the shim ring or the O-ring) until it is hand-tight. Install the housing installer tool and re-install the spline socket to the top of the driveshaft if you had already removed it. In order to set the final rolling torque, you'll need to turn the driveshaft with the torque wrench while turning the housing installer tool with a breaker bar at the same time, until the torque wrench shows a reading of:

- 14-23 inch lbs. (1.58-2.60 Nm) on SP drives with drive ratios of 1.43:1, 1.51:1, 1.60:1, 1.79:1 and 1.89:1
- 11-18 inch lbs. (1.24-2.03 Nm) on SP drives with gear ratios of 1.66:1, 1.85:1, 1.95:1, 1.97:1 and 2.18:1

It's a little different on the King Cobra, final rolling torque should be set based on your figure taken earlier for the initial rolling torque. If your initial rolling torque figure was:

- 1 inch lb. - set the final rolling torque to 2-5 inch lbs. (0.23-0.57 Nm)
- 2 inch lb. - set the final rolling torque to 3-6 inch lbs. (0.34-0.68 Nm)
- 3 inch lb. - set the final rolling torque to 4-7 inch lbs. (0.45-0.79 Nm)
- 4 inch lb. - set the final rolling torque to 5-8 inch lbs. (0.57-0.90 Nm).

54. Install your propeller without the thrust washer. Install the brass pacer and then tighten the propeller nut BY HAND until the propeller will no longer rotate freely. Install a gear lash extension (# 986616 - KC, # 3850602 - all others) over the upper end of the driveshaft. Now rig a support bracket with a dial indicator so that the indicator needle runs parallel to the case mating surface and contacts the groove in the arm on the special tool. Grab the tool and attempt to rotate it while confirming that the indicator reads 0.009-0.013 in. (0.23-0.33mm) on the King Cobra, or 0.005-0.012 in. (0.13-0.30mm) on all others.

55. If gear lash is within specifications, remove the tool and gauge. Gear lash is controlled by the amount of shim material under the lower bearing

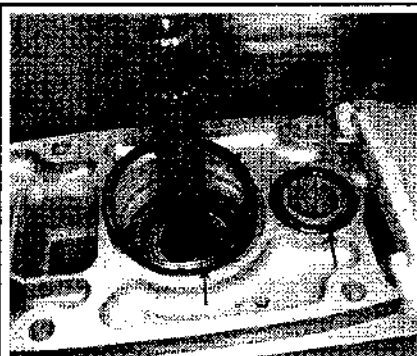


Fig. 195 ...and the O-rings

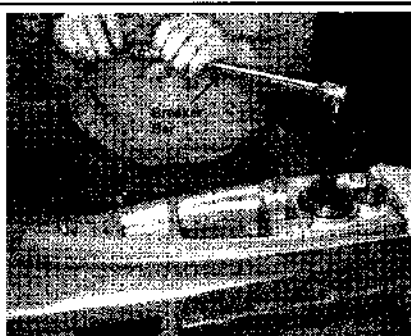


Fig. 196 Turn the spline socket and...

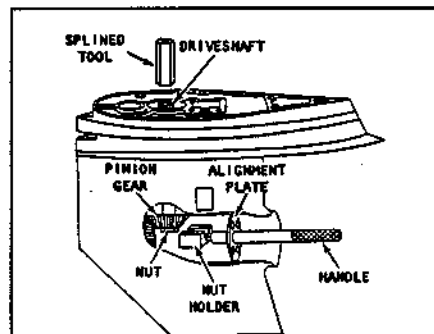


Fig. 197 ...use the special tools to remove the pinion nut

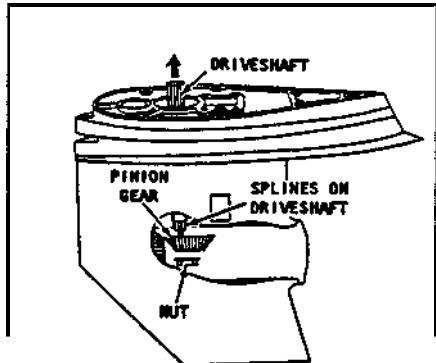


Fig. 198 Catch the pinion gear...



Fig. 199 ...while removing the driveshaft

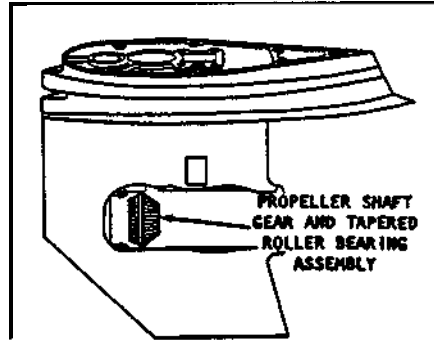


Fig. 200 Pull out the propeller shaft gear and bearing...

race on the driveshaft and behind the propeller gear bearing race; if backlash is less than the minimum figure in the range or more than the maximum figure in the range, ALL shimming procedures MUST be performed again. Recheck all of your shimming measurements; if you find differences in your calculations, recheck the backlash. If it is still out of specification, or if all of your shim measurements came out the same the second time around, move to the next two steps.

56. If backlash was less than 0.009 in. on King Cobra drives, subtract your actual figure from 0.011 in. (which is the upper limit of correct backlash) and then divide the result by two and round it off to thousandths of an inch. THIS figure is the shim thickness that will have to be ADDED under the lower bearing race, and REMOVED from behind the propeller shaft bearing race.

57. If backlash was less than 0.005 in. on 1993-94 SP drives, subtract your actual figure from 0.012 in. (which is the upper limit of correct backlash) and then divide the result by two and round it off to thousandths of an inch. THIS figure is the shim thickness that will have to be ADDED under the lower bearing race, and REMOVED from behind the propeller shaft bearing race.

58. If backlash was less than 0.005 in. on 1995-98 SP drives, subtract your actual figure from 0.0085 in. (which is the optimum backlash) and then divide the result by two and round it off to thousandths of an inch. THIS figure is the shim thickness that will have to be ADDED under the lower bearing race, and REMOVED from behind the propeller shaft bearing race.

59. If backlash was more than 0.013 in. on King Cobra drives, subtract 0.011 in. (which is the lower limit of correct backlash) from your actual figure and then divide the result by two and round it off to thousandths of an inch. THIS figure is the shim thickness that will have to be REMOVED from under the lower bearing race, and ADDED behind the propeller shaft bearing race.

60. If backlash was more than 0.012 in. on 1993-94 SP drives, subtract 0.005 in. (which is the lower limit of correct backlash) from your actual figure and then divide the result by two and round it off to thousandths of an inch. THIS figure is the shim thickness that will have to be REMOVED from under the lower bearing race, and ADDED behind the propeller shaft bearing race.

61. If backlash was more than 0.012 in. on 1995-98 SP drives, subtract 0.0085 in. (which is the optimum backlash) from your actual figure and then divide the result by two and round it off to thousandths of an inch. THIS figure is the shim thickness that will have to be REMOVED from under the lower bearing race, and ADDED behind the propeller shaft bearing race.

62. Reinstall the propeller shaft bearing housing. Use a depth gauge and measure the depth from the edge of the propeller shaft housing bore to the top of each of the 3 ribs on the bearing housing. Make sure that the gauge pointer is well away from the hole in each rib to avoid a false reading from the slight indentation around each hole. Add the 3 measurements together and divide them by three—round the results off to thousandths of an inch. Record this figure and then subtract it from the figure determined when calculating the initial propeller shaft bearing preload shim thickness a few steps ago. The result will be the thickness of shims that need to be added to the forward edge of the housing; lightly coat it with needle bearing grease and then position it on the housing.

63. Coat the housing threads and a new O-ring with GL5 synthetic gear lube, install the O-ring and then thread the assembly into the bore.

64. Install the housing installation tool again, making sure the slots and ribs line up and then connect a torque wrench at a 90° angle to the tool. Tighten the housing to 200-225 ft. lbs. (271-305 Nm) and then re-check the rolling torque.

a. If the final rolling torque is too HIGH (as per the specifications detailed previously), remove the bearing housing and install the next size LARGER shim ring.

b. If the final rolling torque is too LOW (as per the specifications detailed previously), remove the bearing housing and install the next size SMALLER shim ring.

c. Re-install the housing (again!!) and confirm that rolling torque is now within specification.

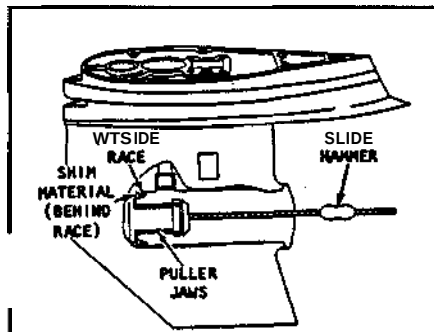


Fig. 201 ...and then remove the bearing race

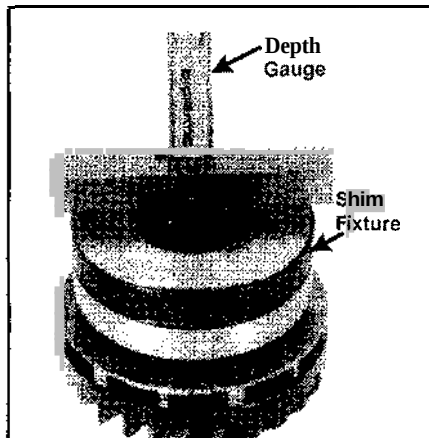


Fig. 202 Measuring the propeller shaft gear/bearing shim thickness

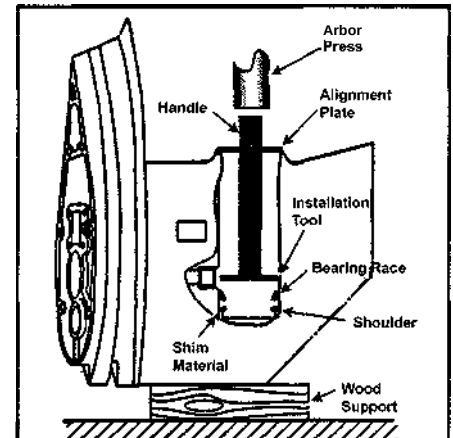


Fig. 203 Install the propeller shaft bearing race...

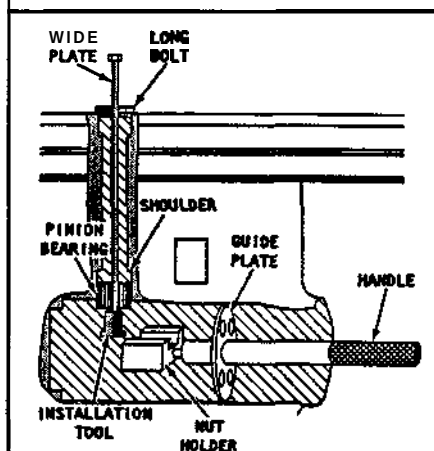


Fig. 204 ...and then pull in the pinion bearing

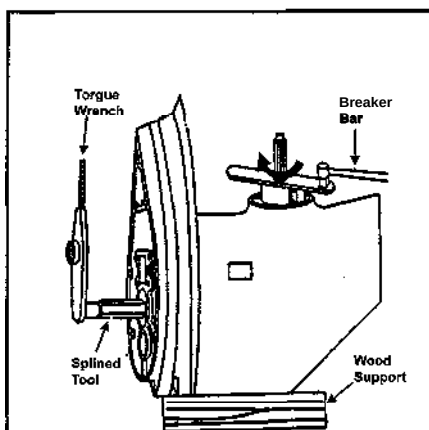


Fig. 205 Checking the rolling torque

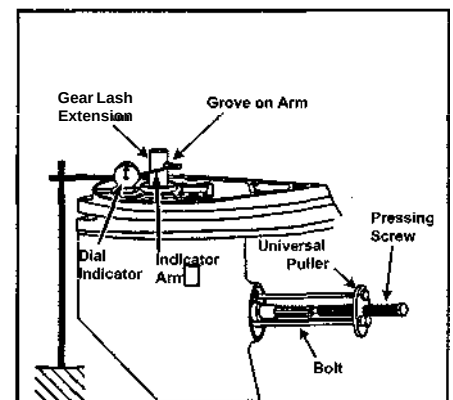


Fig. 206 Checking the backlash. If a puller is not available, install the propeller

65. Coat the threads of the bearing housing set screw with Loctite Primer. After the primer dries, coat the threads with Loctite locking compound (or OMC Ultra Lock) and install the screw into the lower unit casing. Tighten it to 42-60 inch lbs. (4.8-6.8 Nm), do not tighten the screw more than recommended or you will distort the lip of the bearing housing.

66. Coat the threads of the housing retainer screw with Gasket Sealing compound. Position the thicker edge of the retainer toward the handle of the retainer installation tool (# 3850603) while compressing the spring-loaded tip. Insert the tool into the exhaust bore on top of the lower unit and lower it until it lines up with the hole in the housing. Use a 114 in. drive ratchet with a 318 in. socket and an extension to install the retainer screw. Tighten it to 20-25 ft. lbs. (27-34 Nm). Push the tool toward the rear of the chamber until it pops off the retainer and then remove it.

67. Install the water tube retainer into the recess on top of the unit; remember that some drives may secure this retainer with 4 small screws—if yours is one of these, tighten the screws to 10-12 ft. lbs. Coat the grommet with gasket sealing compound and position it into the recess over the retainer.

68. Coat new driveshaft retainer and oil passage O-rings with synthetic gear lube and install them into their respective grooves.

69. Install the anode and tighten the 2 bolts to 60-84 inch lbs. (6.8-9.5 Nm).

Install the intermediate driveshaft sleeve over the driveshaft so that the groove is facing UP.

70. Install the water tube and upper seal into the lower grommet. Make sure that the oil filter screen is clean and debris-free, and then install it.

71. Move the lower unit underneath the drive and raise it into position while guiding in the water tube and indexing the sleeve to the upper housing. You may have to wiggle the propeller shaft to get the sleeve to index with the upper shaft splines. Coat the threads of the mounting bolts with gasket sealing compound and then install the 4 short ones on the side and the 2 long ones at the rear. On SP drives, tighten the side (short) bolts to 22-24 ft. lbs. (30-33 Nm) and the aft (long) bolts to 32-40 ft. lbs. (43-54 Nm). On King Cobra drives, tighten all 7 bolts to 32-40 ft. lbs. (43-54 Nm).

72. Install the trim tab so that the marks made previously are in alignment and then tighten the bolt to 14-16 ft. lbs. (19-22 Nm).

73. Install the propeller as detailed elsewhere in this section. Fill the unit with lubricant.

1996-98 Dual Propeller Models (DPIDP DuoProp)



4 See Figures 207 thru 226

DO NOT ATTEMPT THIS PROCEDURE WITHOUT THE SPECIAL TOOLS!! We know that most of us, whether professional technicians or shade-tree mechanics, hate spending money on special tools. Most of us don't want to spend the money, even if we had it, so we find ways to fabricate our own version of special tools. Be warned in advance that you will NOT be able to create these tools on your own. Please read through the following steps beforehand and make a list of the tools that you will need to acquire—if you are unwilling, or unable, to get your hands on them, take the drive to someone who already has them.

1. Remove the propellers if not already removed. The outer propeller bearing may remain on the outer shaft; if so, make sure that you remove it also. Install the lower unit in an appropriate holding fixture.

2. We're sure that you've already drained the oil, but if you happened to replace the drain plug, you'll need to remove it again. Use an 8mm Allen wrench.

3. Pull the shaft sleeve (sometimes called the intermediate shaft) off of the upper end of the driveshaft; if not there, look in the bottom end of the upper housing.

4. Pull the water tube out of the recess in the top of the lower unit. Discard the upper seal and pry out the retainer in the bottom of the recess.

5. Remove the anode from the forward edge of the unit. If more than 113 of the anode has deteriorated, replace it. Certain models may utilize a cover over the anode.

6. Position a spanner tool (# 3855877) over the propeller shafts and on the retaining ring so that the waves in the tool match those on the inside of the ring. Insert a breaker bar into the cut-out in the tool, loosen the retaining ring and then remove it and the 2 O-rings. Throw away the O-rings.

7. Lift out the bearing housing retainer ring and then pull out the O-ring and throw it away.

8. Thread a puller tool (# 884789) onto the end of the outer propeller shaft. Tighten the 5/8-11 in. bolt on the end of the tool against the inner shaft and slowly let the tool remove the outer shaft and bearing housing. Remove the tool once the assembly is out of the lower unit and then press the outer shaft out of the housing. Remove the 2 O-rings on the housing and throw them away.

9. Assemble the pusher tip (# 3855921) to the tube (# 3855922) and tighten the set screw securely. Thread a shaft adaptor (# 3855919) into the end of the inner propeller shaft and then slide the tool over the adaptor and shaft until the notch in the end of the pusher slides over the pinion nut and seats on the forward gear—you will probably need to wiggle the driveshaft slightly until the nut and notch line up correctly.

10. Install a spline socket (# 3850598) onto the upper end of the driveshaft. Insert a breaker bar into the socket and turn the shaft a few times to loosen (but NOT remove!) the pinion nut, which you are holding with the pusher tool.

11. Coat the shaft adaptor in the end of the inner shaft with wheel bearing grease and then thread on the special nut (# 3855920). Position a wrench on the flats at the end of the tube and then tighten the special nut (while holding the tube) until the inner shaft pulls out of the forward gear. Remove the tools and pull the shaft out of the bore.

12. Loosen the screw and remove the pusher tip from the tube. Set the pusher tip in a press so that the notch is facing down and then insert the propeller shaft into the top of the tip with the tapered side of the bearing facing up. Thread an old propeller nut onto the end of the shaft, to protect the threads, and then press the bearing off of the shaft. Remove any shim material.

13. Reach into the propeller shaft bore and unscrew the pinion nut; do not throw it away yet.

14. Install a spanner wrench (# 3850601) over the upper end of the driveshaft and onto the retainer so that the ridges in the tool index with the notches in the retainer. Loosen and remove the retainer. If the O-ring does not come out with the retainer, reach in and pull it out; either way, throw it away. While you're at it, pull out the O-ring for the oil screen also.

15. Slide a driveshaft puller (# 3855923) over the upper end of the shaft and tighten the 2 Allen screws on the sides until it clamps securely onto the shaft. Now tighten the 2 bolts alternately and a little at a time until the shaft is pulled out of the pinion gear. Make sure that you have a rag in the bore under the gear so it doesn't damage the case when it drops. Remove the tool and pull the shaft out of the bore.

16. Reach into the propeller shaft bore and remove the pinion and forward gears.

17. Assemble a race remover (# 3855859) to one end of a special rod (# 3855860), slide on a guide plate (# 914700) so the stepped side is facing the remover and then install a washer and nut on top of the plate. Insert the tool into the driveshaft bore so the remover is under the lip of the lower bearing race. Slide the guide plate down the rod so it sits in the recess at the top of the bore and then tighten the nut slowly until the race breaks free. Remove any shim material that does not come out with the tool and race.

×× WARNING

The pinion bearing will be damaged during removal so do not remove it unless you intend to replace it.

18. If the pinion bearing needles fell out when removing the gear and shaft, coat them with grease and re-install them into the bearing case. Remove the race remover tip from the tool used in the previous step and insert the rod down through the driveshaft bore, carefully feeding it through the pinion bearing. Reach into the propshaft bore and thread a pinion removal tip (# 3855868) onto the end of the rod. Seat the guide plate into the recess at the top of the bore and tighten the nut until the pinion bearing breaks free. Remove the tool and bearing.

19. Carefully turn the lower unit over and support is on a piece of wood so that the propeller shaft bore is facing upward. Assemble a race remover (# 3855862) onto the end of a special rod (# 3855860), slide on a guide plate (# 3855863) so the stepped side is facing the remover and then install a washer and nut on top of the plate. Insert the tool into the propshaft bore and then push the remover into the forward bearing race until it locks into place behind the race. Slide the guide plate down the rod so it sits in the recess at the top of the bore and then tighten the nut slowly until the race breaks free. Remove any shim material that does not come out with the tool and race.

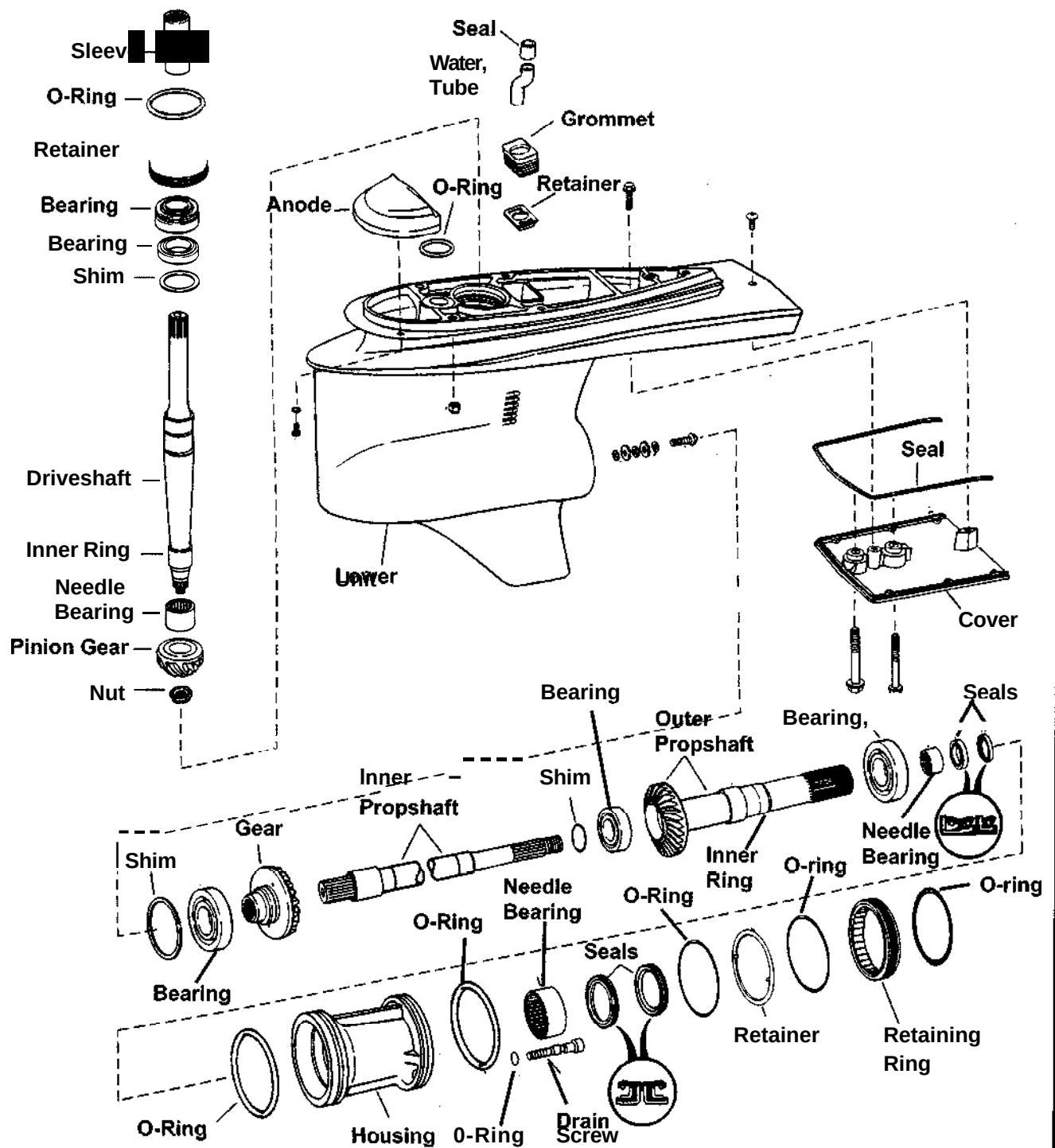


Fig. 207 Exploded view of the lower unit—1996-98 DP/DuoProp models

×× WARNING

The propeller bearing will be damaged during removal so do not remove it from the housing unless you intend to replace it.

20. Lay a support base (# 3855926) on a press so the notched side is facing up and then position the bearing housing into the support so the aft side is down. Insert a seal and bearing removal tool (# 3855924) into the housing and press out the bearing and seals. Throw them all away.

21. Push a race remover (# 3855862) into the housing so that it snaps into place behind the bearing race. Sit the housing back into the support base with the aft side facing up and then use a puller (# 884789) to press out the race.

×× WARNING

The outer propeller bearing will be damaged during removal so do not remove it unless you intend to replace it.

22. Thread a puller (# 884789) onto the end of the outer propeller shaft and position the assembly in a press with the gear facing up.

23. Slide a dismantling tool (# 884803) and a drift (# 884143) into open end of the gear and then press the seals and bearing out of the gear. Now position a puller tool (# 884832) into the gear opening so that the flanges on the tool grip the inner lip of the bearing race, insert a drift (# 884143) through the shaft and remove the race.

24. Clamp a universal bearing separator in between the bearing and the gear and thread the puller (# 884789) onto the end of the shaft. Support the assembly in a press and remove the bearing and the sleeve.

You will probably need to heat the sleeve to get it off--do this carefully and slowly. Do not create any hot spots on the shaft.

** WARNING

The forward gear and/or driveshaft bearings will be damaged during removal so do not remove it unless you intend to replace it.

25. Install a universal bearing separator between the forward gear and bearing and then position the unit in a press with the gear side down. Position a suitably sized mandrel on the gear hub and press the gear out of the bearing.

26. Thread the pinion nut into the end of the driveshaft and then install a universal bearing separator between the two bearings. Position the assembly on a press with the nut facing upward and then press off the two bearing. Move the separator to the sleeve and repeat the procedure, paying attention to the previous Note with regard to applying heat.

27. Reach into the propshaft bore and loosen the mounting bolt for the magnets. Remove the 2 magnets and 3 spring washers.

28. If necessary, remove the 2 bolts and pull down the exhaust cover. Discard the seal.

To assemble:

29. Wash all parts in solvent and blow them dry with compressed air. Remove all traces of seal and gasket material from all mating surfaces. Blow all water, oil passageways and screw holes clean with compressed air. After cleaning, apply a light coating of gear lubricant to the bright surfaces of all gears, bearings, and shafts as prevention against rusting and corrosion.

30. Use a fine file to remove burrs. Replace all O-rings, gaskets, and seals to ensure satisfactory service from the unit. Clean the corrosion from inside the housing where the bearing carrier was removed.

31. Check to be sure the water intake is clean and free of any foreign material.

32. Inspect the gear case, housings, and covers inside and out for cracks. Check carefully around screw and shaft holes. Check for burrs around machined faces and holes. Check for stripped threads in screw holes and traces of gasket material remaining on mating surfaces.

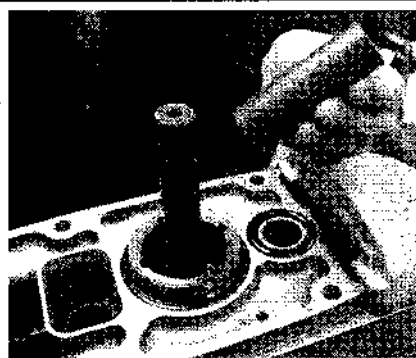


Fig. 208 Lift off the shaft sleeve...

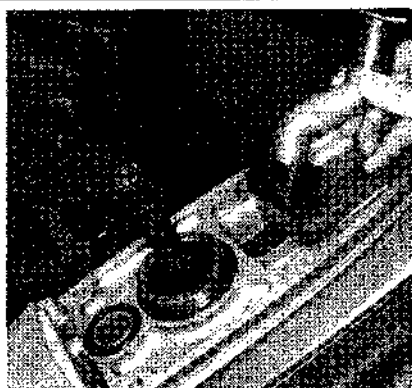


Fig. 209 ...and then pull out the water tube

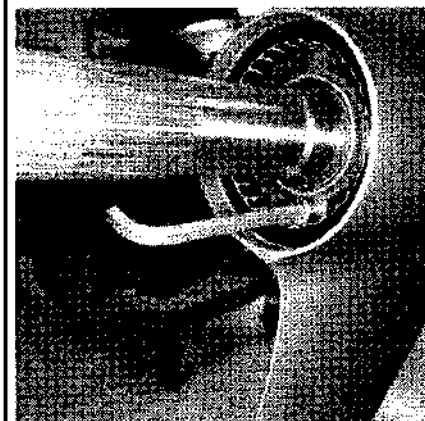


Fig. 210 Remove the drain screw

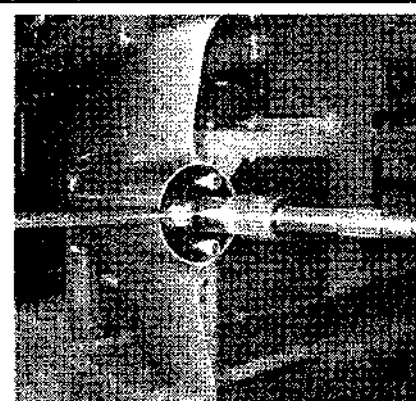


Fig. 211 Loosen the retaining ring with the spanner wrench...

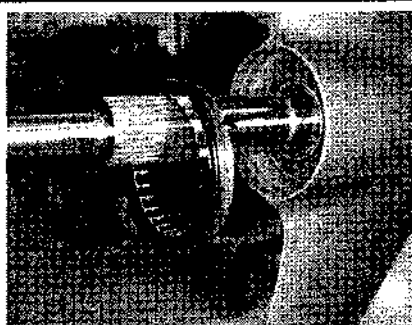


Fig. 212 ...and then remove the ring

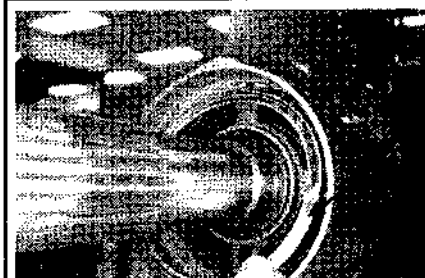


Fig. 213 Lift out the bearing housing retainer

33. Check O-ring seal grooves for sharp edges, which could cut a new seal. Check all oil holes.

34. Inspect the bearing surfaces of the shafts, splines, and keyways for wear and burrs. Look for evidence of an inner bearing race turning on the shaft. Check for damaged threads. Measure the run-out on all shafts to detect any bent condition. If possible, check the shafts in a lathe for out-of-roundness.

35. Inspect the gear teeth and shaft holes for wear and burrs. Hold the center race of each bearing and turn the outer race. The bearing must turn freely without binding or evidence of rough spots. Never spin a ball bearing with compressed air or it will be ruined. Inspect the outside diameter of the outer races and the inside diameter of the inner races for evidence of turning in the housing or on a shaft. Deep discoloration and scores are evidence of overheating.

36. Inspect the thrust washers for wear and distortion. Measure the washers for uniform thickness and flatness.

37. Replace ALL seals, O-rings, and gaskets to ensure maximum service after the work is completed.

38. Coat the inside of the smaller driveshaft bearing with GL5 synthetic gear lube. Thread the pinion nut into the lower end of the driveshaft for protection and then slide the bearing onto the splined end (top) of the shaft so that the tapered side is facing the bottom of the shaft (the end with the pinion nut). Install a bearing installer (# 3850617) over the end of the shaft so that the raised lip on the tool contacts the backside of the bearing. Now rest the entire assembly (pinion nut UP) on an arbor press and press the bearing into place on the shaft.

39. Repeat the previous step for the remaining bearing, with the tapered side of the bearing facing the top of the shaft this time. Press the bearing into position until it seats against the lower bearing.

40. Clamp a spline socket (# 3850598) in a vise with the spline end facing UP. Insert the upper end (splined) of the shaft into the socket and slide the bearing race down over the smaller bearing—this is the lower bearing, but it will be on top at the moment. Now slide a pinion shim fixture tool (# 3855870) over the shaft and against the race so that the side of the tool with 3 slots is facing up toward the pinion end of the shaft.

41. Install the pinion gear and nut, tightening the nut to 72-87 ft. lbs. (98-118 Nm). Rotate the shim fixture tool through a few revolutions until the bearing seats itself and then insert a flat bladed feeler gauge into each of the 3 slots, measuring the clearance between the top of the inner hub on the tool and the bottom of the pinion gear. Mark each measurement down, add them up and divide by three to determine the average clearance. Round off this figure to the nearest thousandth of an inch (3 places after the decimal point) and record this figure.

42. Loosen the pinion nut a few turns (don't remove it), clamp the upper portion of the shim fixture in a vise and then strike the nut and shaft with a mallet until the pinion comes loose from the shaft.

43. Remove the pinion nut and gear; throw away the nut. Locate the shim allowance number etched onto the backside of the gear and convert it to a decimal equivalent in thousandths of an inch—+5 translates to 0.005 in., -2 translates to -0.002 in. Add this figure to the one arrived at previously and record it as your pinion gear shim thickness. When adding shim material later on, remember that in arriving at this thickness, you must always use at least one shim, and never more than five shims.



Fig. 214 Use the tool to pull out the outer shaft and housing..

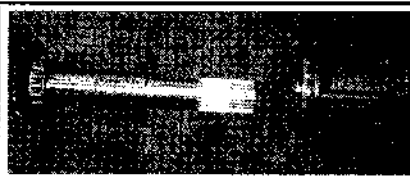


Fig. 215 ...and then press the shaft out of the housing



Fig. 216 Slide the special tool over the inner shaft...

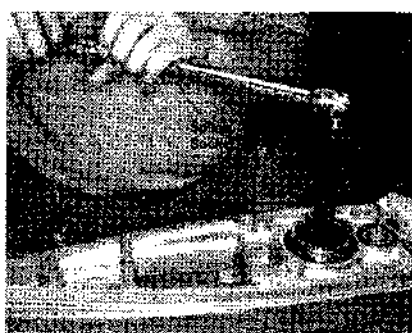


Fig. 217 ...and then turn the driveshaft to loosen the pinion nut



Fig. 218 See how the notch must fit around the pinion nut?



Fig. 219 Remove the retainer...

Not to be silly, but please remember that if the etching of your pinion gear is a negative number (-2), you will then SUBTRACT this number from the pinion gear clearance figure rather than adding it.

44. Assemble the correct amount of shim material for the pinion gear and position it onto the bearing shoulder in the top of the driveshaft bore.

45. Coat the outer surface of the bearing race with GL5 synthetic gear lube and position it squarely into the driveshaft bore so that the taper, or large opening, is facing upward. Now assemble the race driver (# 3850623), guide plate (# 3850619) and installer (# 385021) so the stepped end of the guide plate faces the threads on the driver and the stepped end of the installer is also facing the threads. Insert the tool into the bore and push down on the plate until it indexes with the bore. Tap the end of the driver with a hammer until the races seats against the shim material on the shoulder.

46. If the needle bearings are not still in the pinion bearing cage, coat them with grease and re-install all of them. Coat the outside of the cage with GL5 synthetic gear lube and install the bearing into the bottom of the driveshaft bore with the same tools used during removal. Insert the tool through the top of the driveshaft bore and then position the pinion bearing into the installer and thread the installer onto the bottom of the rod through the propeller shaft bore. Once the guide plate is seated in the top of the bore, tighten the nut until the bearing is pulled up into its recess and fully seated against the shoulder in the bottom of the bore.

If the bearing appears to be spinning in the installer, insert the pinion nut holder into the propeller shaft bore to hold it in place.

47. Coat the forward gear and the inner race of the bearing lightly with GL5 synthetic gear lube. Place the gear (teeth down) on a universal bearing separator for support and slide the bearing over the gear hub so the tapered side is facing UP. Press the bearing into place with the installer tool (# 3855861) until it is seated.

48. Remove the separator tool and sit the gear/bearing on a flat surface with the gear teeth facing down. Slide the bearing race into position over the bearing and then turn it a few revolutions until the bearings are fully seated. Position a shimming fixture (# 3850600) onto the bearing so its recessed side faces the bearing. Install a depth gauge over the shim fixture and measure the depth from the top of the fixture to the end of the gear hub; subtract 0.5 in. (thickness of the fixture) and record the resulting figure.

49. Locate the shim allowance number etched onto the backside of the gear and convert it to a decimal equivalent in thousandths of an inch—+5 translates to 0.005 in., -2 translates to -0.002 in. Add this figure to the one arrived at in the previous step and record it. OMC suggests a nominal dimension of 0.055 in., so subtract the figure you just recorded from this number and record the new number as your forward gear shim thickness. When adding shim material later on, remember that in arriving at this thickness, you must always use at least one shim, and never more than three shims.

50. Thread a puller (# 884789) onto the end of the outer shaft to protect the threads and position the unit onto a press with the puller side resting on the press surface. Coat the inner surface of the bearing race with GL5 synthetic gear lube, position it over the end of the shaft and then press it into position with a race installer (# 3855865) until it seats fully in the gear.

51. Remove the shaft and tool and then position the race installer on the on the press with the gear side of the shaft sitting in it. Lightly coat the inner surface of the bearing with synthetic gear lube and slide it over the end of the shaft so the tapered side is facing upward. Press the bearing into place with an installer tool (# 3855866) until it seats fully on the back of the gear.

52. Coat the inside of the sleeve and the area on the shaft where it rides with Loctite Primer; once dry, coat the shaft area with Loctite 609. Slide the sleeve over the shaft and then use the installer to press it into position.

53. Coat the outside of the needle bearing cage with GL5 synthetic gear lube and position the bearing into the end of the shaft. Press the bearing all of the way into the shaft with a bearing installer (# 3855928).

54. Position the double lipped seal into the installer tool so that the rubber case faces the stepped side on the installer, coat the outside surface with gasket sealing compound and then press it into the shaft until the tool seats on the upper edge of the shaft. Position the single lip seal into the installer so the open side is facing the tool and then press it into the shaft until the tool seats itself. Coat the seal lips with water repellent grease.

55. Position a bearing installer (# 3855861) into a press so that the recessed side is facing upward. Center the forward gear on top of the tool so the bearing is facing down. Lubricate the splined end of the inner shaft with synthetic gear lube and slip the shaft into the gear. Thread a propeller nut into the end of the shaft and lightly tap the shaft into the gear until it is seated.

56. Position a shim fixture tool (# 3855872) onto a flat surface and then place the forward gear bearing race into the tool so the tapered side faces up and the race rests on the 3 feet in the tool.

57. Insert the shaft and gear into the tool so the bearing is resting in the race. Slide a different shim fixture (# 3855871) down and over the shaft until it seats on the bearing flange. Now slide the outer gear bearing over the shaft until it seats on the top of the fixture tool.

58. Position a protection sleeve (# 884976) over the seals in the end of the outer shaft and then slide the shaft down and over the inner shaft and into the outer fixture tool. Remove the seal protector.

59. Rotate each of the shaft a few times to ensure that the gears are seated. Press down on the assembly to load it and then tighten each of the 3 set screws to stabilize the assembly. Use a depth gauge to measure the distance between the top edge of the shim fixture and the small ridge on the back of the outer gear; take three measurements, each one over the set screws in the tool. Round your measurements off to thousandths of an inch, add them up and divide by three to reach an average measurement and record the figure

60. Subtract the forward gear shim figure arrived at earlier from the average figure in the previous step and record this figure. Locate the shim allowance number etched onto the backside of the outer gear (or on the outside of the outer shaft) and convert it to a decimal equivalent in thousandths of an inch—+5 translates to 0.005 in., -2 translates to -0.002 in. Add this figure to the one arrived at in the previous step and record it as your outer gear shim thickness. When adding shim material later on, remember that in arriving at this thickness, you must always use the least amount of shim material possible to get to the figure.

61. Turn the lower unit over so that it can rest on its forward edge (use a piece of wood to support it). Select the correct number of shims (as determined earlier) and insert them into the propeller shaft bore so that they sit in the forward gear bearing race recess at the forward end of the bore. Coat the outer surface of the bearing race with GL5 synthetic gear lube and position squarely into the bore as far as it will go. Assemble the same tools used during the removal procedure and the press the race into the recess until it is fully seated.

62. Lightly coat the forward gear bearing with GL5 synthetic gear lube and then install it into the bore so that it seats into the bearing race with the gear teeth facing aft. Insert the driveshaft into the top of the bore and feed it carefully through the pinion bearing without disturbing the needles. When the shaft is in far enough that the lower bearing seats into the race, install the pinion gear onto the shaft and then screw in the new pinion nut until it is **finger-tight**. We recommend using a pinion nut installation tool (# 3855930). You may have to lift the driveshaft slightly in order to get the pinion gear teeth to engage the teeth on the forward gear.

63. Coat the upper bearing race with synthetic gear lube and press it into place until it seats over the bearing. Thread in the shaft retainer hand-tight after coating its threads with gear lube.

64. Thread a propeller shaft adaptor onto the end of the inner shaft and then slide a pusher tip and tube over the shafts so that the notch lines up around the pinion nut. Thread the special nut (# 3855920) onto the adaptor and tighten it just enough to secure the tools to the shaft, but not so much as to pull the shaft out of the forward gear.

65. Install the spline socket over the top of the driveshaft and then tighten the nut to 72-87 ft. lbs. (98-118 Nm) by turning the driveshaft.

66. With the spline socket still installed on the upper end of the driveshaft, turn the lower unit over so that it can rest on its forward edge (use a piece of wood to support it). Attach a beaker bar to the socket and rotate the driveshaft a few times to ensure that the bearings are seated fully. Remove the bar and install a dial torque wrench; pull on the wrench and observe the gauge reading as the driveshaft just begins to rotate. The driveshaft initial rolling torque should be 2-4 inch lbs. (0.22-0.45 Nm); if not, remove the wrench and install the spanner wrench so you can tighten or loosen the driveshaft retainer until the rolling torque comes into specification. Do this slowly, a little at a time, checking the torque in between each time you tighten or loosen the retainer. Record the actual setting.

67. Select the correct amount of shim material for the outer gear, remembering that you must use as few as possible to arrive at the proper thickness and that the thinnest shims should be positioned in between the thickest ones. Slide the shims over the inner shaft and into position.

68. Coat the inner race of the outer gear bearing lightly with GL5 synthetic gear lube and slide it over the inner shaft and up against the shims

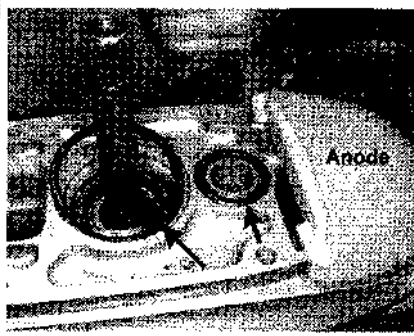


Fig. 220 ...and remove these two O-rings



Fig. 221 Lift out the driveshaft

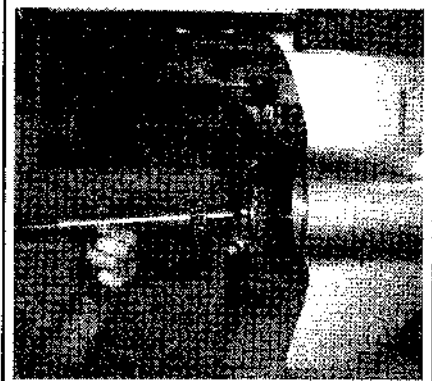


Fig. 222 A nice look at how the shafts and gears are oriented in the case

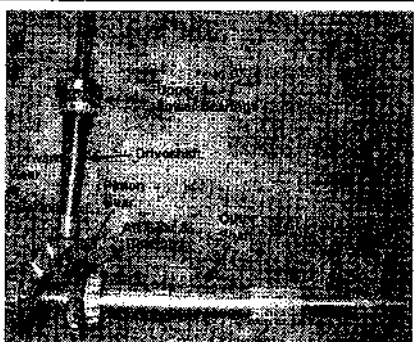


Fig. 223 Installing the inner propeller shaft

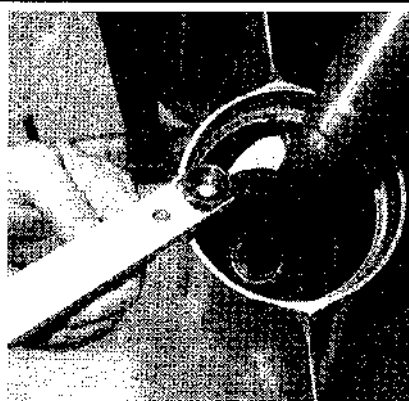


Fig. 224 Install the pinion nut

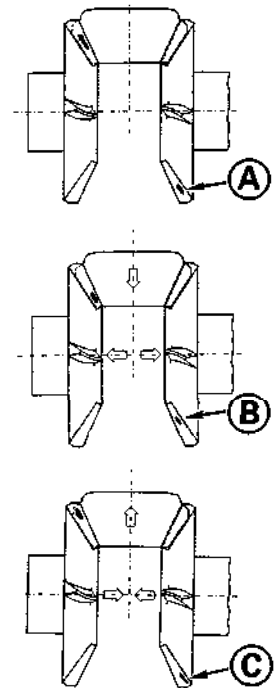


Fig. 225 Gear tooth contact patterns

69. Thread the shaft adaptor onto the inner shaft again and then slide the special tube (# 3855922) over the shaft until it is resting on the outer gear bearing. Coat the threads on the end of the tube with wheel bearing grease and thread the special nut (# 3855920) onto the adaptor. Tighten the nut slowly until the bearing seats itself.

70. Coat the gear teeth on the outer gear with marking dye. Install a seal protector (# 884976) onto the end of the outer shaft and then slide the shaft into place over the inner shaft. Remove the protector.

71. Install another seal protector sleeve (# 884807) over the bearing housing seals and then slide the housing into position over the shafts—no O-rings yet. Seat the housing in the bore so that the oil drain hole is facing the skeg on the bottom of the case. Install the bearing housing retainer over the housing so that the tab on the retainer fits into the hole in the side of the bore.

72. Coat the threads of the retaining ring with synthetic gear lube and then spin it into the case and against the retainer; once again, no O-rings yet.

73. Reinstall the spline socket to the top of the driveshaft and the spanner tool to the retaining ring and set the final rolling torque by turning the driveshaft while tightening the retaining ring. Set the rolling torque to 18-27 inch lbs. (2-3 Nm) on 1.95:1 and 2.30:1 drives, or 27-35 inch lbs. (3-4 Nm) on 1.68:1 and 1.78:1 drives. Record your actual measurement.

☐ Before attempting to check backlash, you must first verify that there is 0 (zero) endplay at any of the shafts.

74. Install the driveshaft puller tool (# 3855923) and lock it down on the shaft to prevent it from turning. Install a lash tool (# 3855873) on the inner propeller shaft (but not on the splines) and then connect a dial indicator so that the tip is resting on the outer line on the arm of the tool. Wiggle the inner shaft back and forth while checking the indicator gauge—forward gear lash should be 0.006-0.012 in. (0.15-0.30mm). Record the actual measurement.

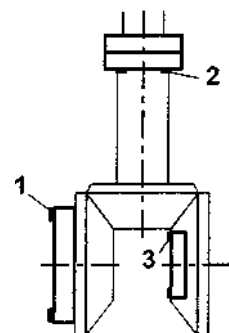


Fig. 226 Shim locations used to change tooth contact patterns

75. Reposition the lash tool so that it is on the outer shaft, position the needle of the dial indicator on the inner line and then wiggle the outer shaft while observing the indicator gauge—outer gear lash should be 0.006-0.014 in. (0.15-0.35mm). Record the actual measurement.

76. If backlash is within specifications, remove the tool and gauge. If not within the correct range, you must first confirm that the gear teeth contact patterns are correct.

77. Wrap a thick rag around the propeller shafts and hold the shafts tightly while turning the driveshaft slightly to load the gears. Remove the bearing housing and outer shaft as detailed previously and check the tooth contact pattern made in the dye you applied during installation against the illustration.

a. Correct contact should look like **A** in the illustration.

b. If the contact pattern looks like **B** in the illustration, you will need to remove shims from locations 1 and 2 in the illustration. You will also need to add shims to location 3 in the illustration. There is no set formula, so you'll have to try it a few times in small increments until the patterns look good.

c. If the contact pattern looks like **C** in the illustration, you will need to add shims to locations 1 and 2 in the illustration. You will also need to remove shims from location 3 in the illustration. There is no set formula, so you'll have to try it a few times in small increments until the patterns look good.

❑ Backlash and contact pattern must always be corrected in consecutive steps; contact pattern must be correct BEFORE finalizing any backlash issues. If it is determined that shims need to be added or removed to correct the contact pattern, then you must recheck the backlash and then recheck the contact pattern again.

78. If the forward gear backlash must be increased (your lash reading was less than the specifications) without changing the contact pattern, remove shims from location 1 in the illustration and then add an equal amount of shims to locations 2 and 3 in the illustration.

79. If the forward gear backlash must be decreased (your lash reading was higher than the specifications) without changing the contact pattern, add shims to location 1 in the illustration and then remove an equal amount of shims from locations 2 and 3 in the illustration.

80. Reinstall the outer shaft and bearing housing using new O-rings coated with synthetic gear lube.

81. Reinstall the retaining ring and recheck the final rolling torque—use the spline socket and spanner wrench to tighten the ring until the actual rolling torque figure has been achieved. Make sure that the oil drain holes are aligned and then install the drain screw with a new O-ring. Tighten the screw to 10-15 ft. lbs. (14-20 Nm).

82. Run a bead of yellow Loctite around the exhaust cover seal groove and then install a new seal into the groove. Coat the mounting bolt threads with Loctite 242, install the cover and tighten the bolts to 14-17 ft. lbs. (19.5-22.5 Nm).

83. Install the water tube retainer into the recess on top of the unit; remember that some drives may secure this retainer with 4 small screws—if yours is one of these, tighten the screws to 10-12 ft. lbs. Coat the grommet with gasket sealing compound and position it into the recess over the retainer.

84. Coat new driveshaft retainer and oil passage O-rings with synthetic gear lube and install them into their respective grooves.

85. Install the anode and tighten the 2 bolts to 60-84 inch lbs. (6.8-9.5 Nm).

86. Install the intermediate driveshaft sleeve over the driveshaft so that the groove is facing UP.

87. Install the water tube and upper seal into the lower grommet. Make sure that the oil filter screen is clean and debris-free, and then install it.

88. Move the lower unit underneath the drive and raise it into position while guiding in the water tube and indexing the sleeve to the upper housing. You may have to wiggle the propeller shaft to get the sleeve to index with the upper shaft splines. Coat the threads of the mounting bolts/studs with gasket sealing compound and then install the 4 nuts on the side and the 2 bolts at the rear. Tighten the nuts to 22-24 ft. lbs. (30-33 Nm) and the aft bolts to 32-40 ft. lbs. (43-54 Nm).

89. Install the trim tab (if equipped) so that the marks made previously are in alignment and then tighten the bolt to 14-16 ft. lbs. (19-22 Nm).

90. Install the propeller as detailed elsewhere in this section. Fill the unit with lubricant.

Propeller

REMOVAL & INSTALLATION

SP Single Prop Models



◆ See Figures 227, 228 and 229

All SP drives are shipped from the factory as standard right hand rotation propellers; which is to say that they rotate clockwise when viewed from the behind the vessel. As mentioned elsewhere in this section, it is possible to switch the unit to a left hand rotation. A different propeller is required depending on the direction of rotation—you can't just switch it back and forth at your whim! In fact, OMC suggests that a counter-rotation propeller should be used **ONLY** in twin engine configurations, and **ONLY** on the Port engine. Most propellers will be marked with an R or an L.

1. Disconnect the negative battery cable to ensure that the engine will not start while working on the propeller.

2. Bend around the ends of the cotter pin and pull it out. Remove the keeper over the propeller nut.

3. Wedge a block of wood between the propeller and the anti-ventilation plate. Loosen and remove the propeller nut and thrust washer.

4. Grasp the propeller and pull it from the shaft. Lift off the thrust bushing.

❑ The rubber hub inside the propeller is serviceable, but only by an authorized OMC facility.

To install:

5. Clean the splines and threads on the propeller shaft thoroughly. Check for nicks, burrs or other obvious signs of damage.

6. Check for and remove any fishing line that may be entangled.

7. Coat the splines on the propeller shaft lightly with OMC Triple Guard grease. Slide the thrust bushing onto the shaft so that inner taper is toward the gearcase and matches the taper on the shaft.

8. Slide the propeller onto the shaft so that it engages the bushing and then seats against the taper on the shaft.

9. Slide on the thrust washer and then move the control lever to the FORWARD position to lock up the propeller shaft. Install the nut and tighten it to 70-80 ft. lbs. (95-108 Nm).

10. Position the keeper over the nut so that the cotter pin holes line up and then push in a new pin and bends the ends back against the keeper.

11. Shift the control into NEUTRAL and confirm that the propeller turns freely.

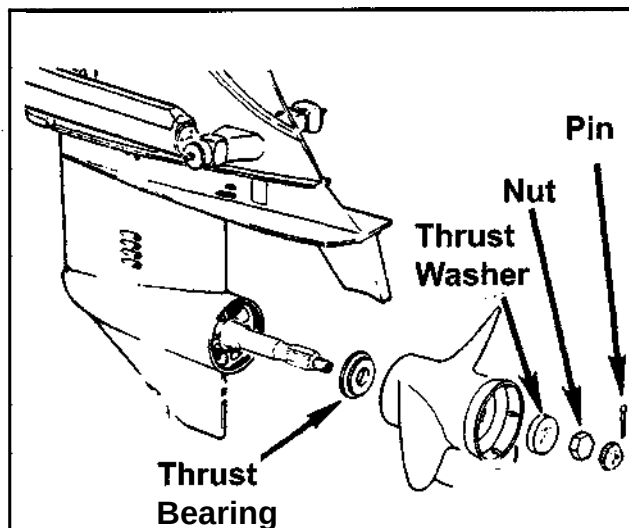


Fig. 227 Exploded view of an SP propeller

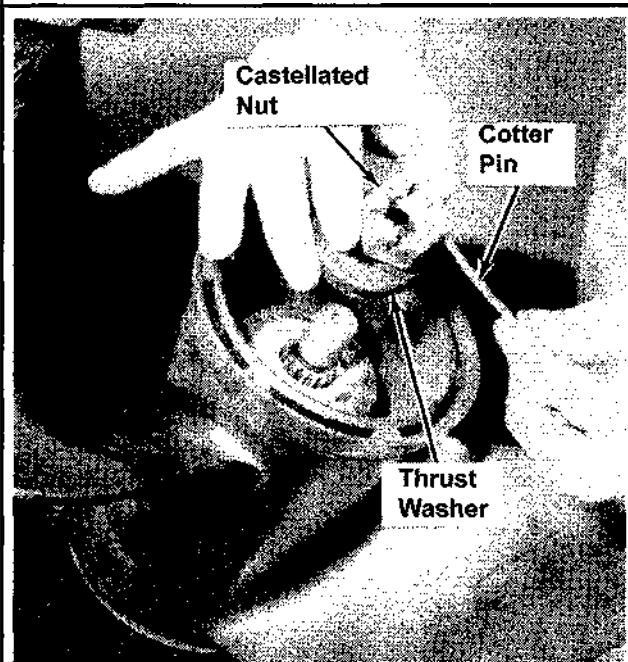


Fig. 228 Remove the propeller nut and washer (keeper not shown)...



Fig. 229 ...and then pull off the propeller and bushin2

DP Duo Prop Models

◆ See Figure 230



1. Disconnect the negative battery cable to prevent accidental starting of the engine while working on the propeller.
2. Position a small block of wood between the drive and aft propeller to keep it from turning. Move the shift lever into FORWARD and then remove the propeller nut with a 30mm wrench.
3. Grasp the propeller and slide it aft and off of the shaft. If the propeller will not slide off easily, you are going to need to apply heat from a torch—we do not recommend persuading it with a mallet. Use your torch sparingly, heating the hub only so much as to allow removal. There is a good chance that when it finally comes off, the rubber hub will stay with the shaft; if so, cut the hub off of the shaft with a saw and replace it with a new one. In fact, we highly recommend replacing the rubber hub after using a torch even if it does come off with the propeller.

■ OMC suggests that although the hub is serviceable, it may only be serviced by an authorized OMC facility, so try to avoid using the torch if at all possible.

4. Now wedge the block of wood in between the forward propeller and the housing and move the remote control lever to the REVERSE position. Remove the inner nut with the special tool (# 3855876) and then pull off the propeller, paying attention to the comments in the previous step regarding 'stuck' propellers.

□ Most later models utilize a plastic nut on the forward propeller—we suggest replacing it whenever you remove it.

■ You can fabricate the special tool for removing the inner nut in less than an hour. Purchase a 12 in. length of pipe (2 in. inner diameter) at your local building supplies store. Cut three 1/2 in. deep slots into one end of the pipe with a metal-cutting hacksaw blade—each slot should be 120° apart, although you can position the pipe over the nut and mark the location of each rib on the nut. Slide the pipe over the shafts and onto the inner nut and then turn it with a plumber's pipe wrench.

To install:

□ The two propellers on these units are a matched set. The part number and size coding will be marked on the sides of each propeller; D for an aluminum propeller or a F for a stainless steel propeller. This letter will be followed by a number which indicates the pitch; as the number increases, so does the pitch. Propellers for these units come only in matched sets, propellers with different part numbers, pitch of construction materials should NEVER be used together.

5. Clean the splines and threads on the propeller shafts thoroughly. Check for nicks, burrs or other obvious signs of damage. Check for any entangled fishing line and remove it.
6. Coat the entire length of both propeller shafts with Triple Guard propeller shaft grease. Move the control lever into the FORWARD position.
7. Slide the forward propeller and nut onto the shaft and then tighten the nut to 45 ft. lbs. (60 Nm).
8. Move the control lever to the REVERSE position and slide on the aft propeller and nut. Tighten the nut to 50 ft. lbs. (70 Nm).
9. Reconnect the battery cable.

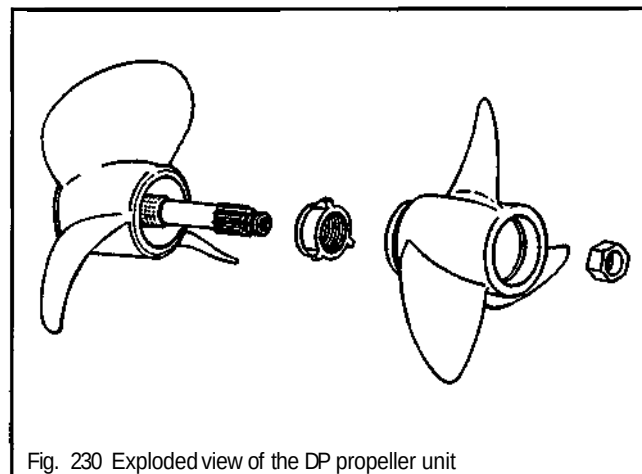


Fig. 230 Exploded view of the DP propeller unit

TRANSOM ASSEMBLY

Description

† See Figures 231,232,233 and 234

The transom assembly consists of four main components: the pivot housing, gimbal ring, gimbal housing and the inner transom plate.

The pivot housing connects to the upper housing of the stern drive unit at its aft side and rides in the gimbal ring via pivot bolts. The pivot housing also serves as the aft terminus of the exhaust bellows, U-joint bellows and water tube. Tilt capability, via the trim/tilt cylinders is enabled by the pivot housing.

The gimbal ring, aside from holding the pivot housing, rides in the gimbal housing and allows for side-to-side motion of the drive assembly. The steering arm and a lower pivot shaft control this motion.

The gimbal housing is attached to the vessels transom and the inner transom plate.

Pivot Housing

REMOVAL & INSTALLATION



◆ See Figures 231 thru 241

1. Remove the stern drive unit as detailed elsewhere in this section.
2. Turn the steering wheel so the transom assembly is hard over to Port. Loosen the shift cable anchor bracket bolt and then slide out the bracket, disengaging the shift cable. Push (or pull) the shift cable through the pivot and gimbal housings and then pull it all the way through the inner sleeve and connector tube. Remove the seals.

■ If you only intend to remove the pivot housing and have no need for shift cable service, simply push the cable through the pivot housing and then secure it out of the way.

3. Use a magic marker and draw a line across the trim sender and the gimbal ring. Remove the 2 mounting screws, but do not pull out the sender unit.
4. Reach into the housing and disengage the U-joint bellows from the housing lip and then push the bellows out of the housing.
5. On all models except the King Cobra, insert a pair of snap-ring pliers into the exhaust bore and remove the exhaust bellows retaining ring—wear safety glasses and make sure you are very careful when releasing the ring from the pliers. Push the bellows out of the housing.
6. Disconnect the water hose if you haven't already and then the water line nipple nut. Press the nipple as far through the case as you able at this time.
7. Turn the steering wheel hard over to Starboard this time and then find the ground strap bolt on the side of the gimbal ring. Loosen the bolt and remove the ground strap(s). On early models, there may be two bolts; if so, remove the strap from the upper bolt.
8. Straighten out the steering wheel so the housing is centered and then remove the pivot pin from each side of the gimbal ring using a 112 in. hex drive and ratchet. Although it is unlikely that the housing will fall out of the ring on its own, support it while removing the pins just to be safe. Otherwise, grasp the bottom of the housing and pull up on it while swiveling it free of the gimbal ring. Pull the friction and thrust washers off of the pivot pin lugs in the housing.

If you are simply removing the pivot housing to get to another component, ignore the following steps if you wish, but we recommend performing them either way—once again, cheap insurance!

9. Pick the water passage seal (O-ring) out of its recess and throw it away.
 10. Unscrew the small water passage drain plug on the port side of the housing and throw away the O-ring.
- To install:**
11. Clean the housing thoroughly in solvent and allow it to air dry completely.
 12. Carefully remove any sealant or adhesive from the coolant passage and bellows openings. Clean all threads and drain holes thoroughly.

13. Check the ground strap connectors for frayed or loose ends. Inspect the friction and thrust washers for any damage and replace them if necessary, although it's not a bad idea to do it anyway while you have the unit apart—your call.

14. Coat a new drain screw O-ring with sealing compound, slide it onto the screw and then thread in the screw. Tighten it to 50-60 inch lbs. (6-7 Nm).

15. Run a bead of 3M adhesive around the water passage recess and then press in a new seal.

16. Install the friction and pivot washers onto each lug. Coat the thrust washer with grease.

17. Position the housing into the gimbal ring while guiding the water line nipple into the housing. Make sure that each bellows is in place directly behind the opening in the housing.

18. Align one side of the housing so that the hole lines up with the hole in the gimbal ring. Look through the hole to ensure that the neither of the washers has moved and is blocking the hole. Insert the pivot pin and screw it in until it just seats itself, but do not tighten it yet.

19. Repeat the previous step for the other side of the housing. When the pin is in place, tilt the housing up and down with your hand to ensure freedom of movement. If OK, tighten each pin to 105-120 ft. lbs. (142-163 Nm). Make sure that you hold the housing while tightening the pins, because it will have a tendency to swivel in the direction that you are tightening.

20. Push, and pull, the nipple all the way through the housing. Make sure that the drain hole is facing down and then install the nut and tighten it to 96-120 inch lbs. (11-14 Nm). Ensure that the nipple does not spin while tightening the nut and make sure that the nipple threads extend past the end of the nut. If they do not, loosen the nut and check the positioning of the square nipple collar on the other side of the housing.

21. Coat the entire surface of the V-shaped lip for the U-joint bellows with Gasket Sealing compound. Pull the bellows through the opening in the housing and press it into the groove until it seats around its entire circumference. Any flat spots on the bellows will indicate that it has not completely engaged the V-groove.

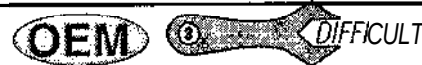
22. Reach into the exhaust bore and pull the top of the bellows into the bore. Tilt the housing, reach around and push the rest of the bellows into the bore. Make sure that it seats in the bellows channel around the lip of the housing bore and there are no flat spots indicating that the bellows has not engaged the lip fully. Reinstall the retaining clip with snap-ring pliers so the opening is at the top of the bellows. Don't forget to wear safety glasses.

23. Reconnect the ground strap(s) on the port side of the gimbal ring.

24. Feed the shift cable through its opening and install the retainer. Install the stern drive.

Gimbal Ring

REMOVAL & INSTALLATION



◆ See Figures 231,232,233 and 242

1. Remove the stern drive unit and pivot housing as detailed elsewhere in this section. If you left the trim/tilt cylinders connected to the gimbal ring when removing the drive, remove them now.

2. Turn the steering wheel hard over to port. Use a magic marker and draw a small line across the trim sender and gimbal ring on the starboard side of the ring. Remove the 2 mounting screws, but do not yet remove the unit itself.

3. Remove the bolt, washer and ground wire on the side of the ring (if equipped).

4. Reach under the gimbal housing and remove the 3 mounting bolts (4 on the King Cobra) for the steering support bracket. Disconnect any ground straps that may be attached to the bolts and then pry down the bracket—you may have to persuade it with a few taps on a drift so be careful.

5. Working inside the boat, pull the cotter pin out of the steering arm pin and then remove the pin. Loosen the bolt on the steering arm and disconnect the ground strap.

6. Remove the 2 bolts and lift off the gimbal housing cover (1998 models may use 4 bolts). Now remove the 2 bolts and lift off the steering cavity cap, throwing away the small foam gasket.

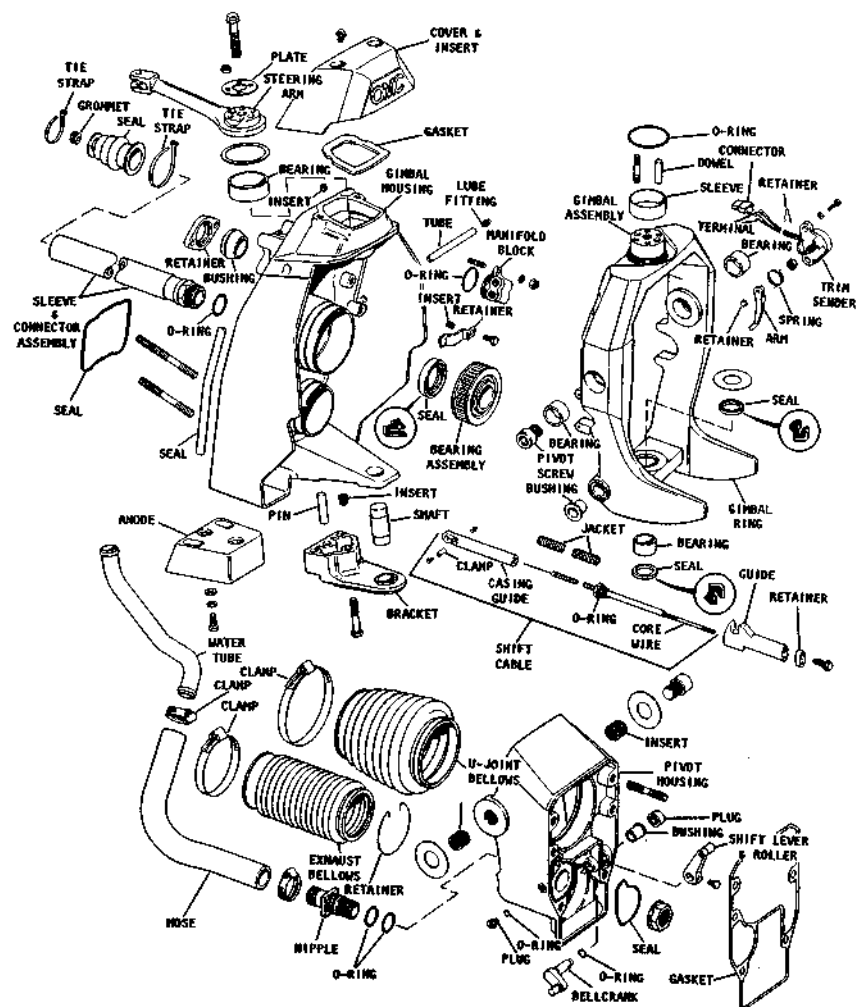


Fig. 231 Exploded view of the transom assembly and related components—1986-94 Cobra, SP, SX and SX Cobra models and 1988-89 King Cobra models

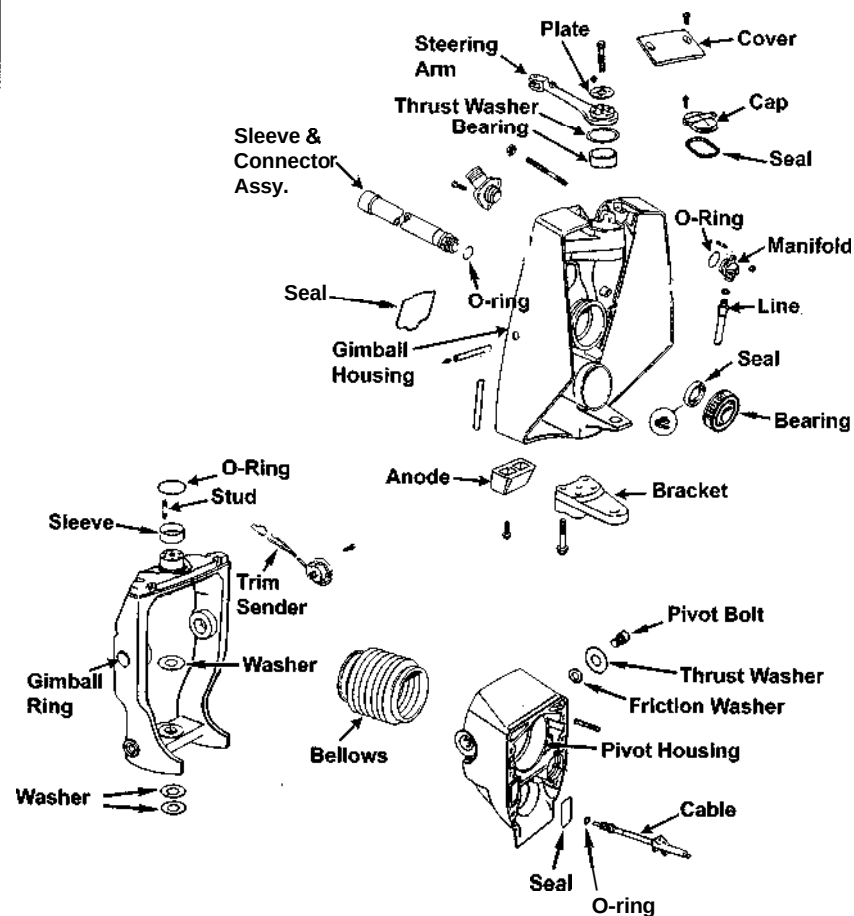


Fig. 232 Exploded view of the transom assembly and related components—1990-95 King Cobra models

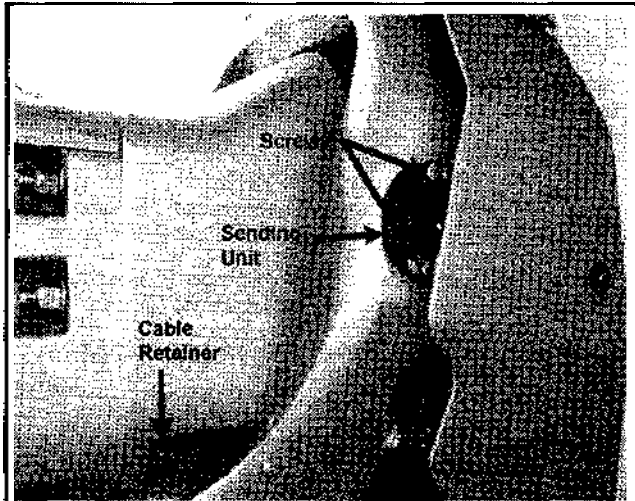


Fig. 235 The shift cable retainer is located on the starboard side of the unit

□ 1998 models may not use the inner steering cavity cap, so just pull out the inner sealing ring.

7. Remove the 4 locknuts and lift the retaining plate off of the steering arm. Remove the center steering arm bolt. Position a steering arm puller (# 984146) over the 2 dowels inside the arm and then thread in the removal bolt. Tighten the bolt slowly while holding the gimbal ring; when the ring comes free, remove the tool and the steering arm.

8. Lift the thrust washer out of the top of the gimbal housing.

□ If you are simply removing the gimbal ring to get to another component, ignore the following steps if you wish, but we recommend performing them either way—once again, cheap insurance!

9. Remove the O-ring from the upper steering post and throw it away.

10. Insert the large diameter end of a removal tool (# 912281) into either of the tilt bearing holes on the sides of ring and drive out the bearing. Repeat the procedure on the opposite side.

11. Use a slide hammer and puller tool (# 432130) to pull out the trim/tilt cylinder nylon bushing on each side of the lower end of the ring.

12. Insert the smaller end of the removal tool used earlier into the lower steering support shaft bearing and drive out the pivot bearing.

13. If the upper steering post bushing appears to be damaged, use a small chisel and split one side of it until you can remove it.

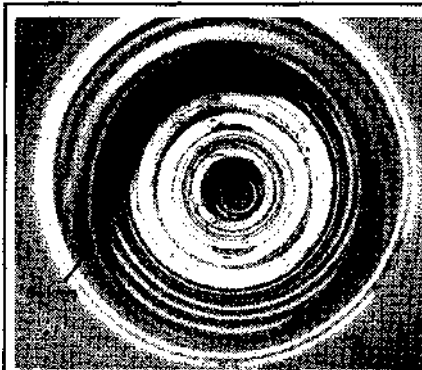


Fig. 236 Disengage the U-joint bellows from the lip and then push it through



Fig. 237 Next, remove the exhaust bellows retaining clip (except on King Cobras)

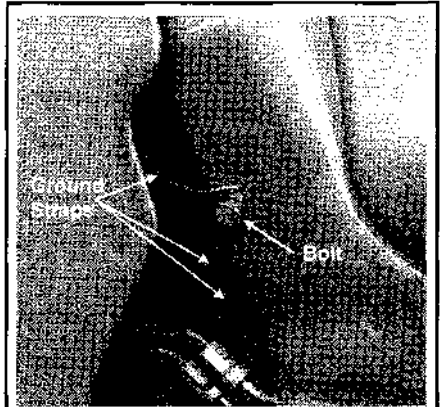


Fig. 238 Later models may have more than one ground strap attached here

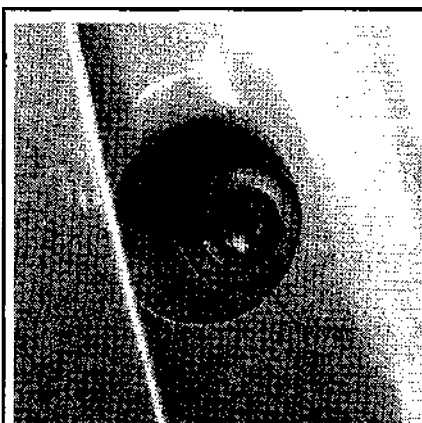


Fig. 239 Find the pivot pin...



Fig. 240 ...and then remove it with a hex wrench

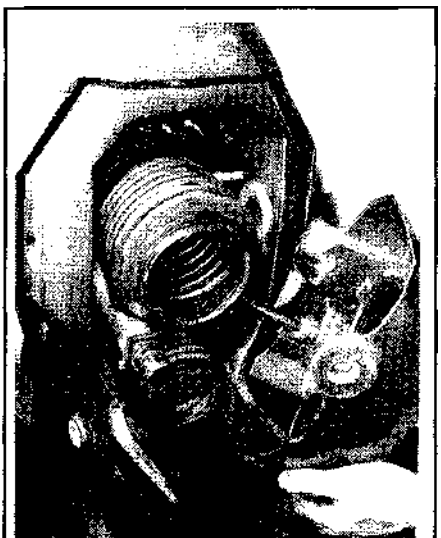


Fig. 241 Removing the pivot housing

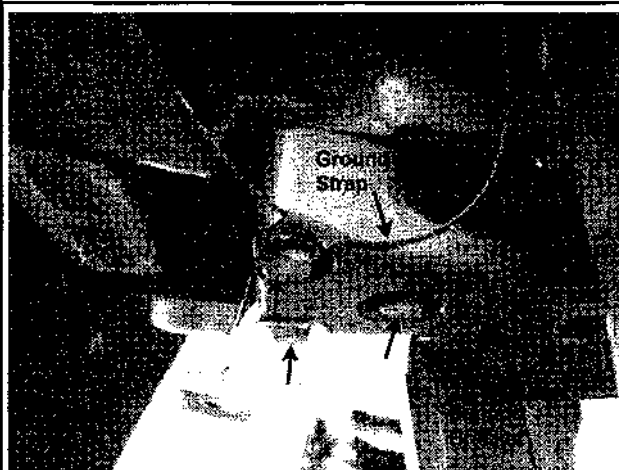


Fig. 242 A good look at the lower steering support (except King Cobra)

To install:

14. Coat the outer surface of a new lower pivot bearing with clean engine oil and position it into the bore on the bottom of the ring. Use the removal tool and drive it into the bore from the bottom of the ring.

15. Coat the outer surface of two lower bushings and then press them into the ring until they seat with the removal tool used earlier. Make sure you coat the inside of each bushing with grease.

16. Coat the outer surface of each new pivot pin bearing lightly with clean engine oil and position the bearings into the outside of the gimbal ring. Insert the blunt end of the removal tool into the bearing and drive it into the ring with a rubber mallet. The bearing must seat somewhere between being flush with the INNER edge of the gimbal ring and 0.010 in. (0.254mm) inside the edge.

17. If you had to cut off the upper steering post bushing, lubricate the inside of a new one with grease and then position it over the post. Thread the center steering arm and bolt in and tighten it until the bushing seats itself. Remove the arm and bolt. Coat a new O-ring with grease and install it over the post and into the recess at the base.

18. Coat the thrust washer with grease and position it over the upper pivot bearing in the top of the gimbal housing. Move the steering arm into position over the washer from inside the boat. Guide the gimbal ring up and into the gimbal housing until the post engages the steering arm and then install the center bolt so that it is finger-tight.

A good way to ensure that the ring is centered correctly in the upper bearing is to observe the gimbal studs—when the center bolt is still only finger-tight, the top of the studs should either flush or above the upper surface of the steering arm. If this is case, DO NOT tighten the center bolt or you will damage the bearing.

19. After confirming correct positioning, tighten the center bolt to 64-72 ft lbs (88-98 Nm). Position the plate over the arm and studs and then thread on 4 new locknuts. Tighten them to 13-15 ft lbs. (18-20 Nm)

20. On models using a cap, position a new foam gasket into the cap so that the notches align correctly. Install the cap and tighten the bolts to 60-84 inch lbs (7-9 Nm). If you have a drive that does not use a cap, run a bead of 3M adhesive along the seal groove and then press in a new sealing ring.

21. Install the gimbal housing cover and tighten the bolts to 60-84 inch lbs (7-9 Nm). On models with only 2 mounting bolts, make sure that the dowels under the cover align with the holes in the gimbal housing BEFORE tightening the bolts.

22. Working inside the boat, connect the ground strap to the steering arm and tighten the bolt securely. Slide the hydraulic ram assembly over the steering arm so that the holes line up. Coat the steering pin with grease and insert it down through the top of the arm. Install a new cotter pin and bend back the arms around the pin.

23. Coat a new nylon washer and the lower pivot post with grease. Slide the washer between the gimbal ring and housing, ensure that all three holes line up and then slide the pivot post up through the holes until it is seated.

24. Now position the lower steering support bracket and seat it by tapping it a few times with a rubber mallet. Apply a light upward pressure to the bracket and the gimbal ring and then use the thrust washers to estimate

how many you'll need to fit between the upper surface of the bracket and the lower surface of the ring.

□ The support bracket will have lip that protrudes from its upper surface that fits over the pivot pin. This is where the thrust washer estimation must be done, anywhere else will lead to an incorrect estimate and the wrong preload.

25. Add one extra thrust washer to your estimate from the previous step and then slide them into position, never using less than one or more than five.

26. Connect the ground straps to the steering support mounting bolts and then tighten the bolts (with new lock washers) to 18-20 ft. lbs. (24-27 Nm).

27. Adjust the trim sender as detailed in the Trim/Tilt section and then tighten the screws to 18-24 inch lbs. (2-3 Nm).

28. Install the pivot housing and stern drive.

Gimbal Housing And Transom Plate

REMOVAL & INSTALLATION



◆ See Figures 231,232,233,243 and 244

It is not necessary to remove the pivot housing and gimbal ring when removing the gimbal housing/transom plate assembly, although you may find it easier if you do. Because the housing is attached to the trim lines and pump, you'll need to decide whether to disconnect the lines at the manifold or to disconnect the pump and feed it through—neither way is preferred.

1. Remove the engine, drive unit, lower exhaust pipe and the steering cylinder as detailed in their appropriate sections.

2. Remove the bolt and washer attaching the ground strap to the steering arm (if equipped).

3. Working inside the boat, remove the 2 bolts and 4 nuts (and washers) and then lift the transom plate off of the studs. If you are doing anything other than laying the plate aside, disconnect the shift cable sleeve as detailed in the next procedure. On 1990-95 King Cobra models and 1998 7.4L/8.2L models, there are two additional bolts and washers.

■ Remember that the hydraulic lines will be routed ABOVE the upper stud on the port side and through a recess in the inner plate.

4. Pry out the exhaust bore O-ring seal and throw it away.

5. Remove the 2 remaining nuts and their washers and then pull off the transom bearing plate. Lift off the gimbal housing assembly.

6. Pry the large gimbal housing seal out of the inner mating surface recess.

To install:

7. Clean the outer transom-to-gimbal housing mating surfaces. Coat the entire seal groove in the inner edge of the housing with 3M Scotch Grip Rubber Adhesive 1300. Start at the top of the housing and work the seal into the groove as you move around the housing. When you get back to the top, cut the seal to fit and coat each end with adhesive before pressing them together.

8. Install the gimbal housing onto the transom. If you left the pump and lines attached, make sure that you feed them through the cut-out in the transom first.

Do not apply sealer between the transom and the housing seal.

9. If the trim lines had been disconnected, reinstall them at this time as detailed in the Disassembly procedure and paying attention to the Note in the Removal portion of this procedure regarding line routing.

10. Coat the threads of each of the housing studs lightly with Gasket Sealing Compound. Coat the inside of the transom plate alignment tube lightly with grease.

11. Make sure that the two hydraulic lines are positioned over the upper port stud and then install the inner transom plate.

12. Position the transom bearing plate over the two lowest studs so the flat side is against the transom. Install the washers and new locknuts;

tightening the nuts until they just make contact with the plate.

13. Install the remaining 4 washers with new locknuts; tightening the nuts until they just make contact with the plate. Don't forget the ground strap on the upper port stud!

14. Coat the threads of the 2 upper alignment bolts lightly with Gasket Sealing Compound and screw them in until they are finger-tight.

15. Tighten the 6 locknuts, in the sequence shown, to 20-25 ft. lbs. (27-34 Nm). Now tighten the 2 upper bolts to 12-14 ft. lbs. (16-19 Nm). On 1998 7.4/8.2L models, use the same torque figures, but refer to the second illustration for the tightening sequence.

16. Install the ground strap to the steering arm on models so equipped and tighten the bolt securely.

17. Run a bead of the 3M Scotch Grip around the exhaust bore seal recess and then install a new O-ring, lightly pressing it into the groove all the way around the bore.

18. Install all remaining components

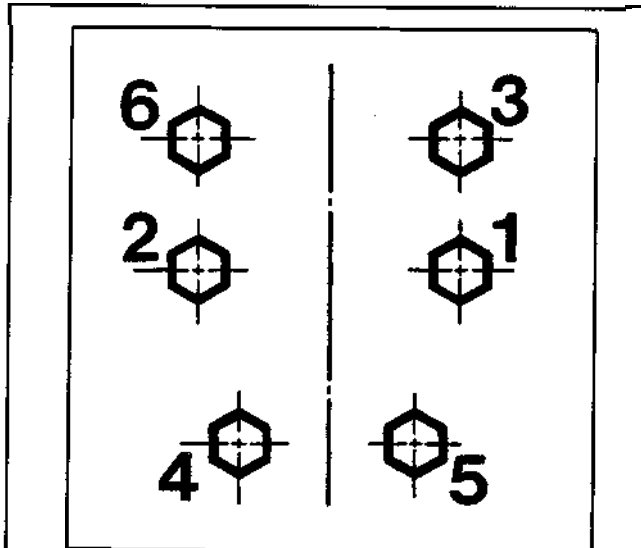


Fig. 243 Transom plate tightening sequence—all except 1998 7.4/8.2L models

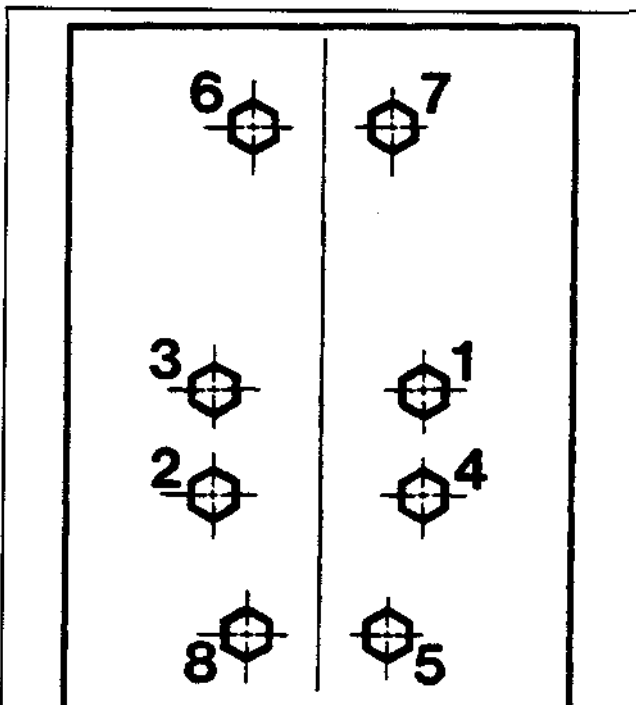


Fig. 244 Transom plate tightening sequence—1990-95 King Cobra models and 1998 7.4/8.2L model

SHIFT CABLE SLEEVE REPLACEMENT



1. Using a crows-foot adapter on your wrench, unscrew the sleeve connector at the transom plate, pull away the sleeve and throw away the O-ring.

2. Coat a new O-ring with Gasket Sealing compound and then slide it onto the connector until it sits against the inner side of the hex head.

3. Coat the connector threads lightly with sealing compound, thread it into the plate and tighten it to 46-52 ft. lbs. (62-71 Nm).

DISASSEMBLY & ASSEMBLY



◆ See Figures 231, 232, and 233

Disconnect the battery cables. Remove the trim/tilt cylinders, pivot housing and gimbal ring as previously detailed. Once these procedures are accomplished, move through the following procedures as necessary to remove or disassemble what is necessary.

Disassembly of the gimbal housing really consists of removing those remaining components that are attached to it and we suggest that you perform each of these procedures in the order that they are shown here; reverse the order when assembling everything.

U-Joint & Exhaust Bellows

◆ See Figures 231, 232, 233, 245 and 246

■ 1990-95 King Cobra models have no exhaust bellows.

1. Loosen the hose clamp screws and pull out the ground strap.
2. Pull off the two bellows.

To install:

3. Coat the outer surface of the gimbal bearing flange with Gasket Sealing Compound.

■ It is not necessary to coat the exhaust flange with sealer,

4. Slide a clamp ring over the smaller side of the U-joint bellows and then slip the bellows over the bearing flange so that the rib on the inner surface of the bellows end rides in the groove on the surface of the flange.

5. Insert the ground strap under the clamp ring at the 9 o'clock position and then spin the clamp until the screw mechanism is between the 1 and 2 o'clock position; with the screw head facing down. Tighten the clamp ring securely.

6. The larger end of the exhaust bellows also has a rib on the inner side; slide a clamp ring over this end and then push the bellows onto the flange until the rib seats into the groove on the flange. Make sure that the exhaust relief cut-out is facing down.

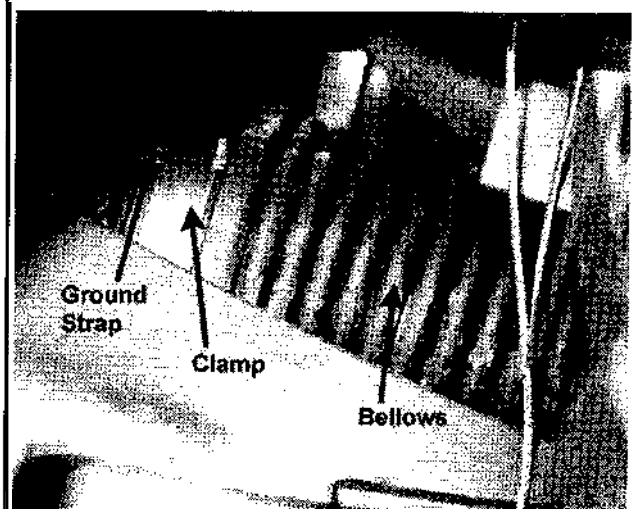


Fig 245 A close view of the bellows

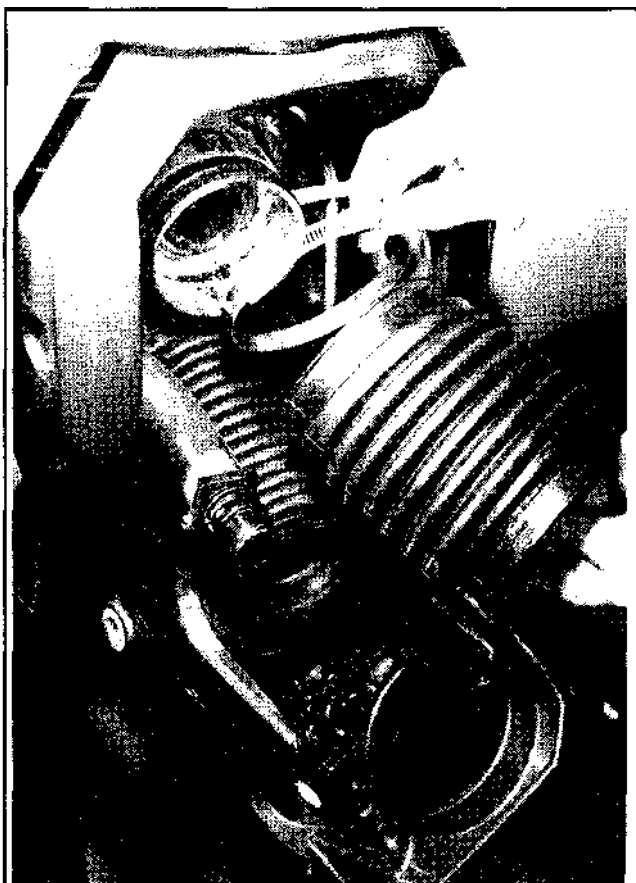


Fig. 246 Make sure that you slide the clamp on first

7. Insert the ground strap under the clamp ring at the 9 o'clock position and then spin the clamp until the screw mechanism is at the 3 o'clock position; with the screw head facing upward. Tighten the clamp ring securely.

Water Hose And Tube

◆ See Figures 231,232,233 and 247

1. Remove the exhaust and U-joint bellows.
2. Working through the two hydraulic lines attached to the trim manifold, loosen the water line hose clamp and wiggle the end of the hose off of the water tube in the housing. Don't forget to pull off the ground strap and position it out of the way.
3. Working from inside the boat loosen the 2 (or 3) water tube-to-transom plate mounting bolts and then pull the tube and its grommet out of the housing and through the transom. If you have trouble with the grommet, push it through from the gimbal housing side.

To install:

4. Check the grommet on the water tube for any cracks or other obvious signs of deterioration or wear. If necessary to replace it, slide a new one onto the tube so that the tapered end is facing the hooked side of the water tube.
5. Push the water tube and grommet through the transom plate and into the gimbal housing so that the hooked end goes in first and is pointing upward. Hold the tube in place and insert the 2 bolts, tightening them to 120-144 inch lbs. (14-16 Nm). On the 1990-95 King Cobra, tighten the 3 bolts to 60-84 inch lbs. (7-9 Nm).
6. Check the water hose for any cracks or other obvious signs of deterioration or wear; pay particular attention to the hose clamp seating areas on each end.
7. Check the nipple in the aft end of the hose; clean it thoroughly and then pull off the O-ring and replace it with a new one. Coat the O-ring with grease and make sure that it seats into the groove closest to the square on the inner side of the nipple. If the nipple requires replacement, simply loosen the hose clamp and pull it from the end of the hose.

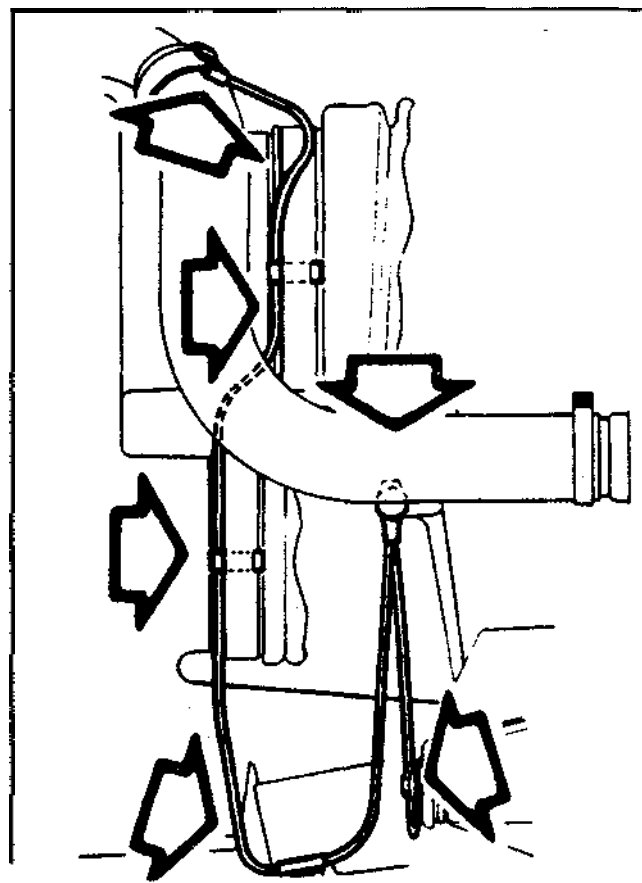


Fig. 247 Note the correct positioning of the water hose and ground strap (except King Cobra)

** CAUTION

Make sure that the O-ring is seated in the correct groove. The outer groove, the one closest to the threads, is for the drain hole and placing an O-ring into this groove will cause big problems.

8. Slide a new hose clamp over the upper end of the hose and then press the hose end onto the water tube. Swivel the hose so that the nipple (aft) end is pointing directly outward and to the rear. Slide the ground clamp under the hose clamp and then position the screw head on the clamp so that it is accessible between the 2 hydraulic lines before tightening it securely.

** WARNING

The hose clamp screw head must be behind, and between, the 2 hydraulic lines or else it will come in contact with the pivot housing and limit the tilt range. This contact will, obviously, also cause damage to the hose and clamp.

9. Check the nipple at the outer end of the hose and confirm that the drain hole is facing down. If not, loosen the hose clamp and rotate the nipple in the hose until achieving the correct position.

Gimbal Housing Anode

◆ See Figures 231,232,233 and 248

□ It should not be necessary to remove the lower anode unless you determine that it is less than 213 deteriorated and requires replacement.

1. Working underneath the gimbal housing, reach up and remove the 2 mounting bolts and their washers. Pull down the anode. 1998 7.4L and 8.2L engines may use two smaller anodes with 4 bolts here.

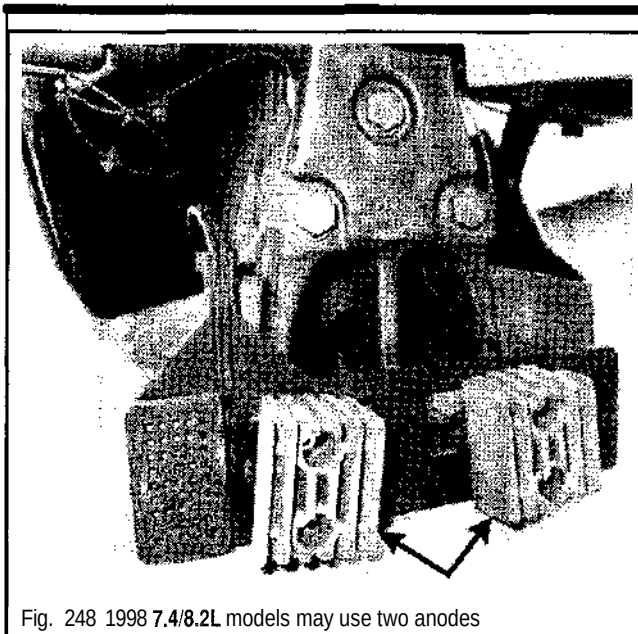


Fig. 248 1998 7.4/8.2L models may use two anodes

2. Clean the mounting surface thoroughly and then install a new anode(s). Use new lock washers and tighten the mounting bolts to 12-14 ft. lbs. (16-19 Nm) except on the 1998 7.4L/8.2L applications using two anodes where they should be tightened to 5-7 ft. lbs. (6-9 Nm).

Trim Sender

◆ See Figures 231,232,233 and 249

Remember that you removed the trim sender during gimbal ring removal but, did not disconnect it.

1. Working inside the boat, disconnect the trim sender harness connector at the engine.

2. Take note of the wire positioning inside of the plug and then use a socket removal tool (# 322699) and push the wire terminals out of the connector plug.

3. Now, back outside the vessel, locate the harness grommet where it feeds through the transom assembly—just above the water tube in the gimbal housing. Carefully pull off the retaining clip with a pair of needle nosed pliers.

4. Grasp the grommet and pull backward on it while prying it out with a small screwdriver. Once free of the housing, pull the wires all the way through the transom assembly. Cut any plastic ties securing the harness and then remove the trim assembly.

To install:

5. Coat the harness grommet with grease and then feed the leads through the hole in the gimbal housing and press the grommet into place until it is seated. Pop the retaining clip into position over the base of the grommet.

✱✱ WARNING

Make sure that you do not route the harness leads under the extension tube or hydraulic lines.

6. Coat the connector plug with alcohol or solvent and then use the special tool and press the leads back into the connector plug until they seat—make sure they go back in the same positions as they were prior to removal. On MOST models, the ribbed black wire goes into the A terminal, the white wire into the B terminal and the smooth black wire into the C terminal.

7. Reconnect the harness at the engine.

8. Use a new plastic tie and secure the harness to one of the hydraulic lines.

9. Install the sender unit into the gimbal ring when you install the ring.

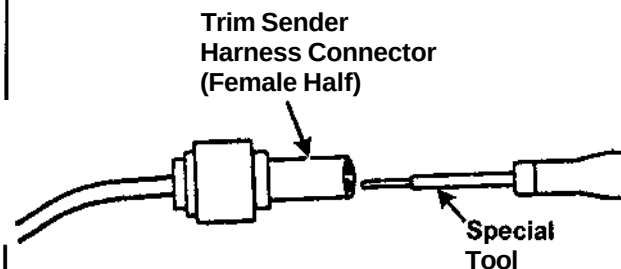


Fig. 249 Use a special tool to pop the leads out of the connector.

Hydraulic Lines & Manifold

◆ See Figures 231,232 and 233

1. Loosen and remove the hydraulic line retaining clamps on each side of the gimbal housing.

2. Although not strictly necessary, we recommend removing the grease extension tube in order to gain access to the starboard hydraulic lines. Clamp a pair of vise grips onto the tube (not too tight please) as close to the gimbal bearing bore as possible. Insert a small prybar between the pliers and the bearing flange and then pry the tube out with the bar while rotating back and forth with the pliers.

3. Loosen each of the hydraulic line nuts at the manifold and carefully pull each line out of its recess. Remove each O-ring and throw them away. It's a good idea to plug the line ends with a golf tee or something similar to minimize fluid leakage.

4. Move inside the vessel and remove the 2 lines connected to the inner side of the manifold. Mark them for installation, plug them and secure them out of the way.

5. Back outside the boat, loosen and remove the mounting nut on the upper side of the manifold from the stud. The manifold is a tight fit in the housing with an O-ring—you may be able to pull it right out, but you'll probably need to position a small drift on the back (inner) side and force it through.

To install:

6. Coat a new manifold O-ring with Gasket Sealing compound and slide it onto the manifold flange. Coat 2 new O-rings for the inner hydraulic lines with hydraulic fluid and slide them over the line tips.

7. Pull the 2 inside lines through the bore in the housing and then position the manifold near the bore so that the inner side is facing to Starboard. Route the lines to the manifold so they are parallel and then tighten the fittings to 14-18 ft. lbs. (19-24 Nm). It is imperative that the lines get reinstalled on the port from which they were detached! As a check, once installed, the lower line should be attached to the UP inlet on the trim pump valve body.

■ Yes, we know it is unlikely that you will be able to get a torque wrench on the line nut—do it by feel, it's about as tight as a spark plug, just don't over-tighten them.

8. Feed the lines and through the hole in the housing until the manifold seats on it's mounting stud. Install a new locknut onto the stud and tighten it to 108-132 inch lbs. (12-15 Nm).

9. Coat 4 new O-rings with hydraulic fluid and install them on each of the outer (gimbal housing side) hydraulic line tips. Attach the lower of the 2 Port lines and then the upper. The shorter of the 2 Starboard lines should be connected to the lower of the two fittings on the starboard side of the manifold and then connect the remaining (longer) line to the upper fitting. Tighten all lines to 14-18 ft. lbs. (19-24 Nm)—see the previous Note.

10. Route each pair of lines together and then install the retaining clamp on each side. Tighten the bolts securely.

11. If you removed the grease extension tube, pull the grease fitting off of the outer end of the tube. Coat the last 1/4 in. of the tube on the fitting side with Gasket Sealing compound and then insert the tube through the outer wall of the housing.

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12. Spray the tapered end of the tube and the hole in the housing with Loctite primer and allow it to dry completely. Once dry, coat the tapered end with Loctite and then drive the end of the tube into the bearing flange. Wipe off any excess Loctite and then install the grease fitting to the opposite end of the tube.

Gimbal Bearing/Seal & Steering Bearing

◆ See Figures 231, 232 and 233



Gimbal and steering bearing removal is not necessary to remove the gimbal housing and transom plate. Do not remove these bearing unless absolutely necessary.

1. Insert a standard 3-jawed puller (Owatonna # OEM-4184 or the equivalent) into the gimbal bearing bore and position the jaws between the bearing and the inner seal. Expand the jaws tightly and then remove the bearing. The bearing will be damaged during removal so throw it away.
2. Reinsert the puller into the bearing bore again and position the jaws under the seal this time. Tighten the jaws and remove the seal.
3. Remove the thrust washer from the steering bearing in the top of the gimbal housing. Install a driver tool (# 912270) into a remover tool (# 912287) and position the tools underneath the bearing. Work the driver and press the bearing up and out of the housing bracket.

To install:

4. Position a new gimbal bearing seal onto the installer tool (# 912279) so the open end is facing the tool. Coat the metal casing with Gasket Sealing compound.
5. Thread the installer (and seal) onto a driver handle (# 311880) and then drive the seal into the bore until it seats. Remove the tools and coat the lip of the seal with grease.
6. Rotate the outer band of the gimbal bearing until the slot is aligned with the lubrication hole and scribe a reference mark across the bearing case.
7. Coat the exterior of the bearing with clean engine oil and then position it into the bore so that the reference mark is facing the extension tube opening.
8. Thread the raised side of a gimbal housing seal installer (# 912279) onto the driver handle (# 311880) and then drive the bearing in until it seats fully. Lubricate the bearing with grease through the grease fitting on the end of the extension tube—starboard side of the gimbal housing.
9. Slide a steering bearing installer (# 912287) onto the rod (# 326582) and then position the bearing over the rod and onto the installer. Coat the outside of the bearing lightly with clean engine oil.
10. Position a stopper (# 912286) over the bearing so the recessed side is against the bearing and the rod is threaded into the tool so that it's flush with the top of the stopper. Insert the tools and bearing into the steering cavity from inside the vessel, hold the rod and tighten the nut until the bearing seats fully.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Component			Torque		
			Ft. Lbs.	inch Lbs.	Nm
Anode	Gimbal Housing	All Except	12-14		16-19
	Lower Unit			60-84	6.8-9.5
Gimbal Ring	Bolts To Pivot Housing		105-120		142-163
	Support Bracket		18-20		24-27
Lower Unit - DP/DP DuoProp					
	Drain Plug		10-15		14-20
	Exhaust Plate		14-17		19.5-22.5
	Fill Plug		4-6		5.4-8.1
	Pinion Nut		72-87		98-118
	Propeller Nut				
		Front	45		60
		Rear	50		70
	Upper Unit Bolts				
		3/8	22-24		30-33
		7/16	32-40		43-54
	Upper Unit Nuts		22-24		30-33
Lower Unit - SP, SX SX Cobra, King Cobra					
	Anode			60-84	6.8-9.5
	Anode Retainer		12-14		16-19
	Drain Screw		-	60-84	6.8-9.5
	Fill Screw		-	60-84	6.8-9.5
	Oil Level Gauge (Dipstick)		-	48-72	5.4-8.1
	Pinion Nut	King Cobra	175-185	-	237-251
		All Others	150-160	-	203-217
	Propshaft Bearing Housing		200-225	-	271-305
	Propshaft Bearing Housing Retainer		20-25	-	27-34
	Propeller Nut		70-80	-	95-108
	Upper Unit Bolts - King Cobra		32-40		43-54
	Upper Unit Bolts - SP/SX/SX Cobra				
		3/8-16	22-24	-	30-33
		7/16-14	32-40		43-54
	Set Screw			42-60	4.8-6.8
	Trim Tab		14-16	-	19-22
	Water Tube Guide		10-12		14-16
Manifold Nut			-	108-132	12-15
Pivot Housing	Bolts To Gimbal Ring		105-120		142-163
	Drain			50-60	6-7
Shift Cable Sleeve	1994-97		46-52		62-71
Steering Arm	Bolt		65-72		88-98
	Cover			60-84	7-9
	Studs		13-15		18-20
Transom Plate	Nuts		20-25		27-34
	Bolts		12-14		16-19
Transom Shield Cover				60-84	7-9
Trim Line Nut	1990-95 King Cobra		14-18		19-24
	All Others		-	84-108	9.5-12.2
Trim Sender			-	18-24	2.0-2.7

TORQUE SPECIFICATIONS (Cont'd)

Component		Torque		
		Ft. Lbs.	Inch Lbs.	Nm
Trim/Tilt	Pivot Pin		120-144	14-16
Upper Housing	Bearing Retainer Ring	145-165		197-224
	Bellcrank	King Cobra		
	Drain Screw			
		DP/DP DuoProp	10-15	14-20
		All Others	60-84	6.8-9.5
	Fill Screw		60-84	6.8-9.5
	Impeller Plate	10-12		14-16
	Lower Unit Bolts - DPIDP DuoProp			
		3/8	23	31
		7/16	36	49
	Lower Unit Bolts - King Cobra			
			32-40	43-54
	Lower Unit Bolts - SP/SX/SX Cobra			
		3/8-16	22-24	30-33
		7/16-14	32-40	43-54
	Lower Unit Nuts - DP/DP DuoProp			
			23	31
	Oil Level Gauge/Plug	-	48-72	5.4-8.1
	Output Gear Housing	King Cobra	140-160	190-217
	Pinion Bearing Carrier		12-14	6.8-9.5
	Pinion Gear	Cobra/King Cobra	80-90	108-122
	Rear Cover		-	108-132
				12-15
	Shift Shoe Stop Screw	King Cobra	15-20	20-27
		All Others	10-12	14-16
	Shift Housing	King Cobra	9-11	12-15
	Side Cover	King Cobra	12-14	16-19
	Top Cover	King Cobra	32-40	43-54
		All Others	16-18	22-24
	Upper Driveshaft Nut		96-110	130-149
	Water Passage Cover		-	60-84
				6.8-9.5
	Water Pump Adapter	Cobra/King Cobra	10-12	14-16
	Water Pump Housing	Cobra/King Cobra	9-11	12-15
Water Nipple			-	96-120
Water Outlet				11-14
	1990-95 King Cobra	-	60-84	7-9
	All Others	-	120-144	14-16

DRIVE MODEL APPLICATIONS

Year	Engine	Model	Model Number	Gear Ratio
1986	2.5, 3.0	Cobra	983841	1.71:1
	4.3	Cobra	983842	1.68:1
	5.0	Cobra	983843	1.50:1
	5.7	Cobra	983844	1.41:1
1987	2.3	Cobra	984540, 985193	2.00:1
	3.0	Cobra	984042, 985194	1.71:1
	4.3	Cobra	984541, 985195	1.68:1
	5.0	Cobra	984542	1.50:1
	5.7	Cobra	984543, 985196	1.41:1
1988	7.5	Cobra	984544, 985197	1.43:1
	2.3	Cobra	985267	2.00:1
	3.0	Cobra	985268	1.71:1
	4.3	Cobra	985269, 985279	1.68:1
	5.0	Cobra	985271, 985272	1.50:1
	5.7	Cobra/King	985273, 985274	1.41:1
	7.4 454	King Cobra	985275, 985276	1.43:1
1989	7.5 460	King Cobra	984275, 985276	1.43:1
	2.3	Cobra	985683	2.00:1
	3.0	Cobra	985684	1.71:1
	4.3	Cobra	985685, 985686	1.68:1
	5.0	Cobra	985687, 985688	1.59:1
	5.7	Cobra	985689, 985690	1.41:1
	5.8	Cobra	985689, 985690	1.41:1
	262	King Cobra	985685, 985686	1.68:1
	350	King Cobra	985689, 985690	1.41:1
	460	King Cobra	985691, 985692	1.43:1
1990	2.3	Cobra	986030	2.00:1
	3.0, 3.0 HO	Cobra	986321, 986322	1.86:1
	4.3, 4.3 HO	Cobra	986032, 986033	1.68:1
	5.0, 5.0 HO	Cobra	986035, 986036	1.59:1
	5.7	Cobra	986037, 986038	1.41:1
	5.7 LE	King Cobra	986043	1.42:1
	5.8	Cobra	986037, 986038	1.41:1
	350, 454, 460	King Cobra	986043	1.43:1
1991	3.0, 3.0 HO	Cobra	986696	1.86:1
	4.3, 4.3 HO	Cobra	986698, 986699	1.68:1
	5.0, 5.0 HO	Cobra	986700, 986701	1.59:1
	5.7, 5.8	Cobra	986702, 986703	1.41:1
	5.7 LE, 350	King Cobra	986704	1.43:1
	7.4GL, 454, 454 HO	King Cobra	986704	1.43:1

DRIVE MODEL APPLICATIONS

Year	Engine	Model	Model Number	Gear Ratio
1992	3.0, 3.0 HO	Cobra	987120	1.86:1
	4.3	Cobra	987122, 987123	1.68:1
	5.0, 5.0 HO	Cobra	987124, 987125	1.59:1
	5.7, 5.8	Cobra	987126, 987127	1.41:1
	5.7/5.8 LE, 351	King Cobra	987526	1.50:1
	7.4GL, 454, 454 HO	King Cobra	987128	1.43:1
	8.2GL, 502	King Cobra	987128	1.43:1
1993	3.0, 3.0 HO	Cobra	987343	1.86:1
	4.3, 4.3 HO	Cobra	987344, 987345	1.68:1
	5.0, 5.0 HO	Cobra	987346, 987347	1.59:1
	5.0 EFI	Cobra	987683, 987684, 988103, 988104	1.59:1
	5.8	Cobra	987999, 988000	1.41:1
	5.8 EFI	Cobra	987683, 987684	1.50:1
	5.8 LE, 351	King Cobra	987351, 987685	1.49:1/1.63:1
	7.4GL, 454, 454 HO	King Cobra	987350, 987351	1.49:1/1.63:1
	8.2GL, 502	King Cobra	987350	1.42:1
1994	3.0GL, 3.0GS	Cobra	3868029, 3868102	1.85:1
	4.3GL	Cobra	3868041, 3868076, 3868107, 3868095	1.66:1
	5.0FL, 5.0FI	Cobra	3868076, 3868095	1.66:1
	5.7GL	Cobra	3868065, 3868114	1.60:1
	5.8FL, 5.8FI	Cobra	3868052, 3868096	1.51:1
	351 EFI	King Cobra	3868129	1.63:1
	7.4GL	King Cobra	3868074, 3868122, 3868121, 3868073	1.63:1
				1.42:1
1995	3.0GS	Cobra	3868155	1.85:1
	4.3GL, 5.0FL	Cobra	3868156	1.66:1
	5.0 EFI	Cobra	3868157	1.60:1
	5.8FL, 5.8 EFI	Cobra	3868158	1.51:1
	5.8 HO EFI	Cobra	3868207	1.43:1
	7.4GL	King Cobra	3868212	1.63:1
			3868211	1.42:1
	7.4 EFI	King Cobra	3868211	1.42:1
1996	3.0GS	SP	3868391	1.97:1
			3868464	1.85:1
	4.3GL, 4.3GL, 4.3GS	SP	3868464	1.85:1
			3868389	1.66:1
		DP	3868440	2.32:1
	5.0FI	SP	3868389	1.66:1
			3868388	1.60:1
		DP	3868441	1.95:1
	5.0FL	SP	3868389	1.66:1
		DP	3868441	1.95:1

SP Single Prop
DP Duo Prop

DRIVE MODEL APPLICATIONS

Year	Engine	Model	Model Number	Gear Ratio
1996	5.7GL	SP	3868388	1.60:1
(cont'd)			3868441	1.95:1
	5.7Gi, 5.8Fi, 5.8FL	DP	3868387	1.51:1
		DP	3868441	1.95:1
	5.8FSi	SP	3868387	1.51:1
		DP	3868441	1.95:1
	7.4Gi	SP	3868442	1.78:1
		DP	3868386	1.43:1
	7.4GL	SP	3868443	1.68:1
		DP	3868386	1.43:1
		DP	3868442	1.78:1
1997	5.7GS	SP	3868391	2.18:1
	5.7Gi, 5.7GL, 5.7G	SP	385846 *	1.85:1
		DP	3868387	1.66:1
		DP	3868440	2.32:1
		DP	3868441	1.95:1
	5.7GL	SP	3868388	1.60:1
		DP	3858441	1.95:1
	5.7G, 5.7G	SP	3858387	1.51:1
		DP	3858441	1.95:1
	5.7GSi	SP	3858387	1.51:1
		DP	3868386	1.43:1
		DP	3868441	1.95:1
	7.4Gi	SP	3868386	1.43:1
		DP	3868443	1.68:1
	7.4GL	SP	3868386	1.43:1
		DP	3868442	1.78:1

SP Single Prop
DP Dual Prop

DRIVE MODEL APPLICATIONS

Year	Engine	Model	Model Number	Gear Ratio
1998	5.7GS	SP	3868814	2.18:1
		DP	3868722	1.97:1
	5.7GL	DP	3868721	1.89:1
		DP	3868720	1.79:1
		DP	3868688	2.32:1
		DP	3868708	1.95:1
	4.3GS, 4.3Gi	SP	3868720	1.79:1
		DP	3868688	2.32:1
		DP	3868708	1.95:1
	5.0GL	SP	3868856	1.60:1
		DP	3868708	1.95:1
	5.7GS	SP	3868718	1.51:1
		DP	3868717	1.43:1
		DP	3868708	1.95:1
	5.7GSi	SP	3868717	1.43:1
		DP	3868708	1.95:1
		DP	3868709	1.78:1
	7.4Gi	SP	3868717	1.43:1
		DP	3868708	1.95:1
		DP	3868709	1.78:1
	7.4G	DP	3858710	1.68:1
		DP	3858709	1.78:1
		DP	3858710	1.68:1
	8.2GSi	DP	3858709	1.78:1
		DP	3858710	1.68:1

SP Single Prop
DP Dual Prop

**POWER TRIM AND TILT - 1989-98 COBRA,
KING COBRA, SP(SX) AND DP 13-15**

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TRIM AND TILT

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13-2 TRIM AND TILT

SELECT (POWER) TRIM AND TILT—1986-88 COBRA AND KING COBRA

Description

◆ See Figure 1

Not all models use all components in all years.

This power trim/tilt system is a hydro-mechanical, electrically controlled system allowing the stern drive to be raised when moving through the water at idle speed, when approaching the beach or shore, and when trailering the boat. The drive can also be adjusted through-out its trim range while the boat is underway and at any speed. Thus enabling the helmsman to maintain the best bow position for maximum speed, efficiency and ride for any water or throttle conditions.

An electric motor, controlled by a switch and relays, provides the power for a hydraulic pump. The pump, in turn, forces fluid through a set of hydraulic hoses to a set of hydraulic cylinders. Depending on the motor's direction, fluid will flow into one end of the cylinders to raise or lower the drive unit.

A control switch may be mounted on the remote control handle or on the control panel. When activated, the **UP** or **DOWN** relay is energized. Current to the motor rotates the motor in one of two directions, thus raising or lowering the drive unit.

The power trim/tilt system consists of a valve body (manifold), hydraulic reservoir, electric motor, up and down solenoids, trim/tilt switch, trim sending unit, trim indicator gauge, trim limit switch, two hydraulic trim cylinders, and the necessary hydraulic lines and electrical harnesses for the system to function efficiently.

The manifold, hydraulic reservoir, electric motor, and up/down solenoids make up a single unit known as the pump assembly that is mounted inside the boat. Two hydraulic trim cylinders are mounted, one on each side, of the stern drive unit. One end of the cylinder is connected to the gimbal housing and the opposite end is attached to the drive housing.

The trim sender unit is mounted on the starboard side of the gimbal ring and is connected to the trim gauge on the control panel through the wiring harness. When the stern drive is trimmed **IN** or **OUT** the gauge moves to indicate the stern drive's position.

A trim limit switch may be connected to the **UP** solenoid on the trim/tilt hydraulic pump. This limit switch allows the stern drive to be trimmed out only to a preset position. If the stern drive is moved out past the support brackets under high throttle setting could impose high stress loads on the boat transom and possibly loss of steering control. There may also be a 10 amp circuit breaker or fuse serving the same purpose.

The relationship of the various units in the trim/tilt system are discussed in the following paragraphs.

VALVE BODY/MANIFOLD

◆ See Figure 1

The valve body, or manifold, is the central mounting point for the pump, valves, reservoir and electric motor. The hydraulic pump is capable of creating pressure up to 3000 psi. Internal pressure relief valves set at the factory control the output pressure in the UP and DOWN circuits. A system thermal relief valve protects the pump, valves, lines, and cylinder packing from thermal expansion of the hydraulic fluid in the system when operating or sitting in the hot sun. The pump, pressure and thermal relief valves are all set at the factory and adjustments are not possible. If any of these components are found to be defective during troubleshooting or disassembly, they must be replaced with identical items. A replaceable filter is mounted on the inlet opening to the pump.

All models utilize a manual release valve. If the pump or motor fails, manually raising or lowering the stern drive would require the appropriate hydraulic line be loosened on the manifold external fitting.

RESERVOIR

All models utilize an integrated reservoir. A large screw-on cap and opening provides for easy servicing of the reservoir. The cap vents the reservoir to atmosphere pressure when the fill neck seal is removed inside the cap.

HYDRAULIC PUMP

The hydraulic fluid pump (valve body) is a gear-type pump, very similar to an engine oil pump. The pump is attached to the manifold with four fasteners and cannot be disassembled. If the pump fails, it must be replaced as an assembly. The reservoir must be drained and removed to gain access to the pump.

MANUAL RELEASE VALVE

◆ See Figure 2

The manual release (or relief) valve is used on all models and is located on the base of the manifold. This valve allows the drive unit to be raised or lowered manually without the use of electric or hydraulic power. By rotating the valve counterclockwise, the drive unit will lower under its own weight; closing the valve will stop the process. The valve must be fully open to raise the unit, and it must be tightly closed in order to hold a trim or tilt position while static or moving forward.

TRIM-IN/TILT-DOWN CHECK VALVE

◆ See Figure 1

The trim-in/tilt-down check valve is located in the valve body. This valve opens under pressure to allow hydraulic fluid from the pump to the aft chambers during the Down cycle. The aft chamber with the rod is identified as the chamber behind the cylinder.

The valve also allows fluid to return from the aft chambers to the pump during the Up cycle, after the valve has been opened by the pump control piston.

In addition to the above, the valve prevents the drive unit from raising during operation in Reverse, acting as a reverse lock; and prevents fluid flow from the high volume side of the cylinders during a high pressure impact condition.

PUMP CONTROL PISTON

◆ See Figure 1

The pump control piston is located directly behind the trim-in/tilt-down check valve inside the valve body. A spring at both ends of the piston tends to keep the piston centered in the valve body bore. The piston is moved via pressure acting on the trim-in/tilt-down check valve as the drive is moved UP or DOWN.

TRIM-OUT/TILT-UP CHECK VALVE

◆ See Figure 1

This valve is located externally at the bottom of the valve body. It opens under pressure to allow fluid to flow from the forward chambers (in front of the piston) back to the pump. The valve serves to maintain oil pressure in both cylinders so that the drive unit will hold a particular trim or tilt position while moving forward. It will return fluid to the pump during the Down cycle after having been opened by the pump control piston.

TILT-UP RELIEF VALVE

4 See Figure 1

This valve is located externally on the back of the valve body. It functions to control maximum pressure in the circuit during the UP cycle. It also limits pressure at the full tilt-up 'stall' position to a maximum of 1200-1600 psi.

TRIM-IN RELIEF VALVE

◆ See Figure 1

This valve controls pressure in the system during the DOWN cycle. Due to rod volume, more fluid returns from the high volume side of the trim cylinders than the low volume side can handle; excess fluid passes through the valve which will keep pressure on the Down side at 400-800 psi.

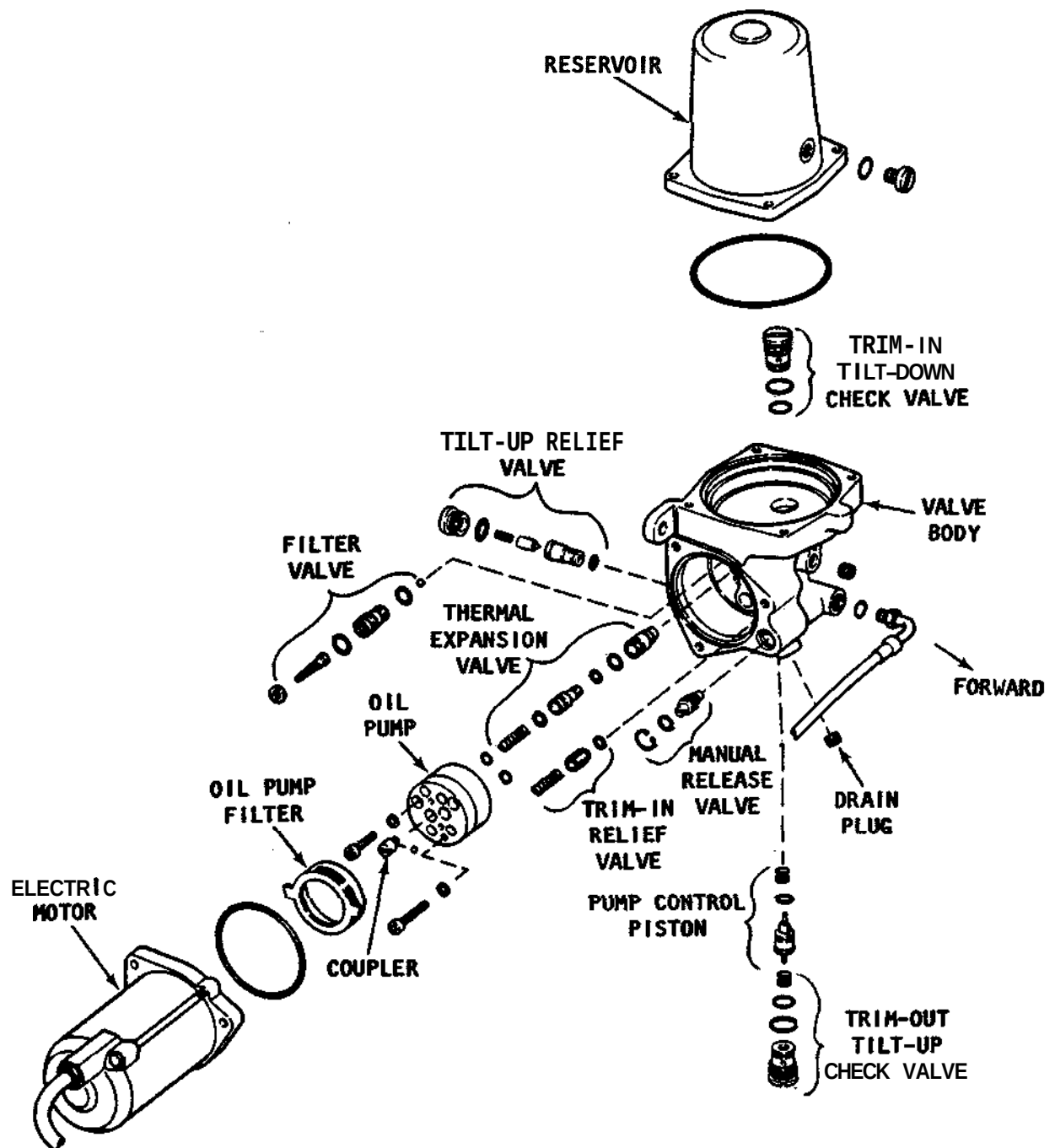


Fig. 1 Exploded view of the trim/tilt motor and pump assembly—most models similar

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FILTER VALVE

◆ See Figure 1

This valve is located in the center of the valve body. It permits fluid to be drawn into the aft chambers behind the piston when the drive is lowered by using the manual release valve. The check ball behind the filter prevents any fluid from returning to the reservoir.

THERMAL EXPANSION RELIEF VALVE

● See Figure 1

This valve is located inside the valve body and it prevents hydraulic lock-up when the drive is in the full TILT UP position, which can be caused by heat-related expansion of the fluid (thermal expansion). The valve will open only when it senses unusually high pressure (approx. 2250-2750 psi).

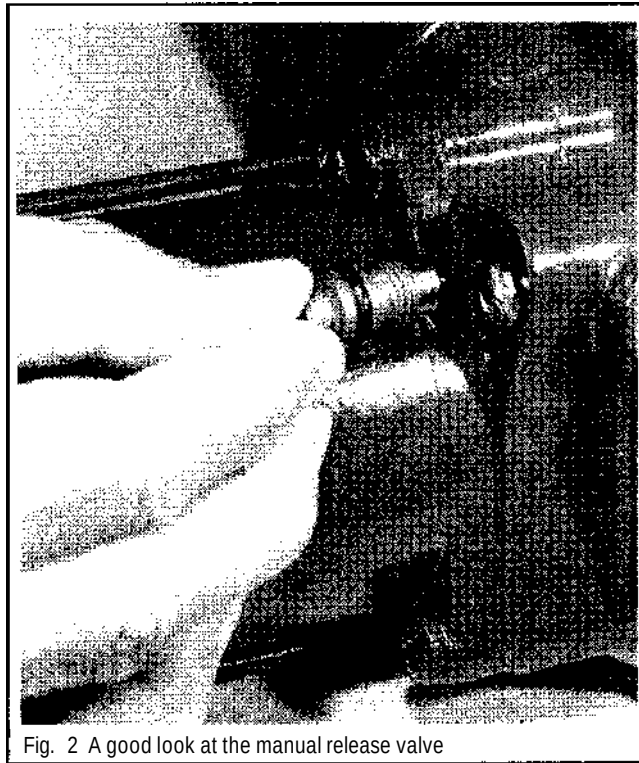


Fig. 2 A good look at the manual release valve

Troubleshooting

◆ See Figure 3

The electric pump motor must operate to drive the mechanical hydraulic pump. The hydraulic pump will convert the electrical energy into mechanical energy. The mechanical energy moves the hydraulic fluid to extend and retract the trim cylinders. Use the following troubleshooting procedures to determine if the problem is electrical or mechanical.

DETERMINE IF PROBLEM IS ELECTRICAL OR MECHANICAL



1. Verify that the battery is fully charged before continuing the troubleshooting procedure. If the battery is not fully charged, the system could give a false indication of a problem when none actually exists.
2. Verify the fluid level in the reservoir is up to the MAX mark on the side of the reservoir; or the bottom of the filler hole on earlier models.
3. Depress the UP or DOWN button on the control panel and listen for the pump motor to operate or the solenoid to click.
4. If the pump motor does not operate, and the solenoids do not "click," the problem is electrical.

5. If the pump motor operates, but the stern drive does not move, the problem is most likely a hydraulic or mechanical problem. Refer to hydraulic/mechanical troubleshooting.

6. On early models, check the manual release valve — it MUST be closed and tightened to 45-55 inch lbs. (5-6 Nm).

HYDRAULIC AND MECHANICAL PROBLEMS



All testing procedures should be performed using a OMC Trim/Tilt In-Line Pressure Tester (# 983977) consisting of a pressure gauge, adapter, tester body, shut-off valve and hydraulic line.

To install the tester:

1. Raise the stern drive up to its full tilt-up position and block it securely with wood.
2. Open the manual release valve one complete turn.
3. The body of the tester has two ports (marked A and B). Port A is always connected to the gauge, while port B can be shut off by closing the valve on the tester. The A port must always be the one that is connected to the component or circuit thus allowing the circuit to be isolated when the vessel's line is connected to port B and the valve is closed.

Trim-In/Trim-Out Creep



This condition is frequently caused by an internal leak at the trim cylinders—the internal piston seals or the impact relief valves may be dirty or damaged, causing fluid to slowly leak from one side of the piston to the other.

Trim-Out/Tilt-Out Creep In Reverse



1. Check to see if the pump control piston is sticking. Look for dirt under the check balls or in the small oil passages in the piston itself. Check the piston and its bore for scuffing or other signs of damage. Check the ball seat for signs of wear.
2. The trim-in/tilt-down check valve may be sticking due to a damaged seal tip. Check for dirt under the seal, leaking O-ring or a damaged spring.
3. Check the manual release check ball and seat for leakage or damage (if equipped).
4. Check all components for external leaks or damage.
5. Confirm that the UP and DOWN hydraulic hoses are connected to the correct ports on the manifold.

No Tilt-Down From Full Tilt-Up Position



Check the O-ring and seal on the thermal expansion valve. Confirm that the valve is not sticking and that the spring is not damaged.

No Or Slow Trim-Out/Tilt-Up With Motor Running



1. Check the hydraulic fluid level in the reservoir. Fill if necessary and bleed the system.
2. If equipped with a manual release valve, confirm that it is tight and not leaking. Tighten the valve to 45-55 inch lbs. (5-6 Nm). If leaking, drain the system and move the drive unit to the full Down position. Remove the valve and check the plastic seal, O-ring and seat.
3. Check the thermal expansion valve and O-ring. Look for sticking, damage to the spring or dirt under the check ball.
4. Check the trim-out/tilt-up check valve for damage. Check the seal tip, dirt under the seal, leaking O-ring or a damaged spring.
5. Check to see if the pump control piston is sticking. Check the condition of the piston and the O-ring. Poor piston performance may also be affected by an internal leak in the trim cylinders—the cylinder piston seals or impact relief valves may be damaged.
6. The trim-in/tilt-down check valve may be sticking due to a damaged seal tip. Check for dirt under the seal, leaking O-ring or a damaged spring.
7. Check the tilt-up relief valve for sticking, damaged spring or a dirty seal tip. Check that the manifold O-ring is not distorted.

Power Trim Diagnostic Chart 1986-88

Symptom/Problem	Possible Cause
Static leak-down and/or trim-in creep in Forward gear	③ ⑤ ④ ⑥ ⑦
Trim-out/tilt-up creep in Reverse gear (no reverse lock)	⑧ ⑨ ⑥ ⑦
Leaking, Up and Down (trim-in/out creep)	⑦
Slow or no trim-out/tilt-up while motor running	① ③ ④ ⑤ ⑥ ⑦ ⑧ ⑪ ⑬ ⑭
No trim-out/tilt-up, motor does not run	⑬ ⑭ ⑮
Slow or no trim-in/tilt-down while motor running	① ⑤ ⑥ ⑧ ⑨ ⑩
No trim-in/tilt-down, motor does not run	⑬ ⑭ ⑮
No trim/tilt Up or Down, motor runs	① ⑬ ⑭
No trim/tilt Up or Down, motor runs fast	⑫
No trim/tilt Up or Down, motor does not run	⑬ ⑭ ⑮ ⑯
No tilt-down from full tilt-up position, motor stalls	④
Erratic operation, jumpy motion, pulsing/hissing fluid sounds	②
Continual use or loss of hydraulic fluid	⑰

- ① Air or low/no oil in reservoir. Fill reservoir and cycle pump
- @ Air in hydraulic system. Cycle pump through range 3-5 times. Fill reservoir
- ③ Manual release valve loose or leaking. Check seal ring, O-ring and seats.
Tighten valve to 45-55 inch lbs. (5-6 Nm).
- ④ Thermal expansion valve sticking or damaged spring. Dirt under check ball.
- ⑤ Trim-out/tilt-up check valve sticking, damaged seal tip, dirt under seal, leaking O-ring, damaged spring
- ⑥ Pump control piston sticking, dirt under check balls or in small oil passages.
- ⑦ Trim/tilt cylinder internal leak. Check for damaged piston seal impact relief valves, or dirt under relief valves
- ⑧ Trim-in/tilt-down check valves sticking. Damaged seal tip, dirt under seal, leaking O-ring or bad spring
- ⑨ Manual release check ball leaking. Check for damaged or dirty ball or seat.
- ⑩ Trim-in relief valve leaking. Check seal tip, seat or spring. Check for sticking or dirt.
- ⑪ Tilt-up relief valve leaking. Check sticking valve, seal tip, seal or spring. Check valve body O-ring.
- ⑫ Pump coupling broken.
- ⑬ 10 or 50 amp circuit breaker tripped
- ⑭ Motor inoperative, replace motor.
- ⑮ Relay control box malfunction. Replace box.
- ⑯ Switch circuit malfunction.
- ⑰ External oil leak. Check all lines, connections, cylinders and valve body.
- ⑱ Pump-to-manifold oil line attachment reversed.

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8. Check the condition of the oil pump. Dirt can be in the pump or the coupling may have failed.
9. Check that the motor output is up to specification.

No Or Slow Trim-Out/Tilt-Down With Motor Running



1. Check the hydraulic fluid level in the reservoir. Fill if necessary and bleed the system.
2. Check the trim-ouftilt-up check valve for damage. Check the seal tip, dirt under the seal, leaking O-ring or a damaged spring.
3. Check to see if the pump control piston is sticking. Check the condition of the piston and the O-ring. Poor piston performance may also be affected by an internal leak in the trim cylinders—the cylinder piston seals or impact relief valves may be damaged.
4. The trim-in/tilt-down check valve may be sticking due to a damaged seal tip. Check for dirt under the seal, leaking O-ring or a damaged spring.
5. The filter valve, or the check valve behind it, may be damaged or leaking.
6. Check the trim-in relief valve for sticking, damaged spring or a dirty seal tip.
7. Check the condition of the oil pump. Dirt can be in the pump or the coupling may have failed.
8. Check that the motor output is up to specification.

No Trim/Tilt, Motor Will Not Run

More times than not this condition is caused by an electrical problem in the switch circuit, relaysolenoid circuit, or with the motor. Please refer to the Electrical Problems section.

No Trim/Tilt, Motor Runs



1. Check the hydraulic fluid level in the reservoir. Fill if necessary and bleed the system.
2. If equipped with a manual release valve, confirm that it is tight and not leaking. Tighten the valve to 45-55 inch lbs. (5-6 Nm). If leaking, drain the system and move the drive unit to the full Down position. Remove the valve and check the plastic seal, O-ring and seat.
3. Check the thermal expansion valve located in the end of the manual release valve. Look for sticking, damage to the spring or dirt under the check ball.
4. Check the condition of the oil pump. Dirt can be in the pump or the coupling may have failed.

ELECTRICAL PROBLEMS



■ Please refer to the electrical schematics later in this section.

Before performing any electrical tests, always verify that the battery has a full charge. A low battery can always give a false indication that some other problem in the system exists.

Check the circuit breakers in the main engine electrical box and in the trim/tilt relay control box have not been tripped for some reason. Push in the button and reset the breaker.

Trim/Tilt Switch



During switch operation, electrical current flows from the input terminal (red/purple wire) to the respective output terminals.

1. Check all electrical connections. Check the trim/tilt fuse or circuit breaker and the trim/tilt pump fuse/breaker. Check the battery.
2. Connect a test light or a multi-meter as per the manufacturer's instructions and touch the probe to the red/purple wire terminal. The tester should light or the meter should indicate battery voltage; if not, recheck the fuses or circuit breakers and/or check any related electrical connections.
3. Move the probe to the green/white wire terminal and move the switch to the Down position. The tester should light or the meter should indicate battery voltage; if not, confirm that all electrical connections are OK and then replace the switch.

4. Now move the probe to the blue/white wire terminal and move the switch to the Up position. The tester should light or the meter should indicate battery voltage; if not, confirm that all electrical connections are OK and then replace the switch.

5. If all test prove to be good and the pump will still not operate, refer to the Pump Relay test later in this section.

Trim/Tilt Motor

◆ See Figures 4 and 5



A stall-torque test is the only reliable means of checking motor performance. Trim/tilt motors are not serviceable and must be replaced as a unit.

WARNING

Never operate the trim/tilt motor for any longer than it takes to complete the following tests. Always allow the motor to cool sufficiently between each test. Performing the two successive tests on a hot motor will lead to inaccurate stall-torque readings.

1. Check all electrical connections. Check the trim/tilt circuit breaker or fuse and the trim/tilt pump fuse/breaker. Check the battery.
2. Remove the pump/motor assembly and then remove the motor from the valve body. Install it carefully in a soft-jawed vise.
3. Connect an ammeter or multi-meter in series with the B+ terminal on the battery (make sure it's fully charged!) and the blue lead at the motor. Next connect a voltmeter (or DVOM) so the positive lead is at the motor's blue lead and the negative lead is at the motor's green lead.
4. Install an inch lb. torque wrench with a suitable adapter to the armature shaft on the pump. Have someone study the wrench while you move to the next step.
5. Now complete the circuit by running a jumper wire between the negative battery cable and the green lead and then take note of all of the readings. The ammeter should show 185 amps, the voltmeter should show 12 volts (min.) and the torque wrench should show a stall-torque of not less than 20.6 inch lbs.
6. Disconnect the 2 meters and the jumper and then reconnect the ammeter in series between the battery positive terminal and the green lead at the motor.
7. Next, make sure that the motor has cooled down and then complete the circuit by connecting the jumper wire between the negative terminal on the battery and the blue lead. This will allow you a stall-torque reading in the opposite direction; both the stall-torque reading and the ammeter reading should be the same as in the earlier step.
8. A low current reading coupled with a low torque reading indicates high resistance in the internal connections or in the brush contacts. Conversely, a high current reading and a low torque reading indicates a bad armature or field windings. Either way, the motor will have to be replaced.

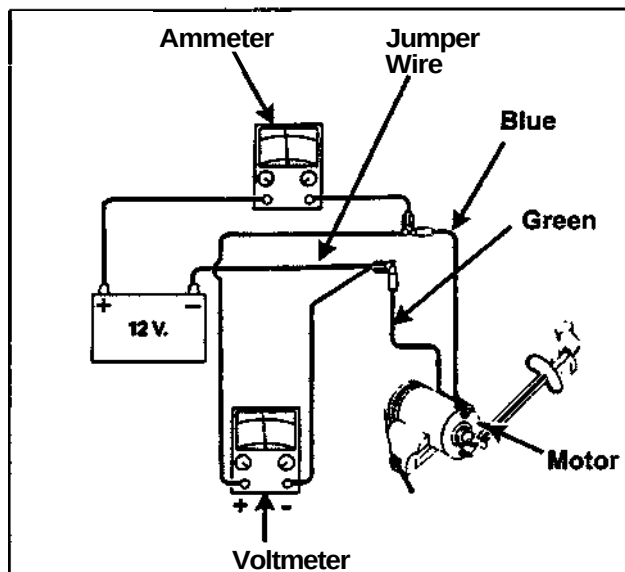
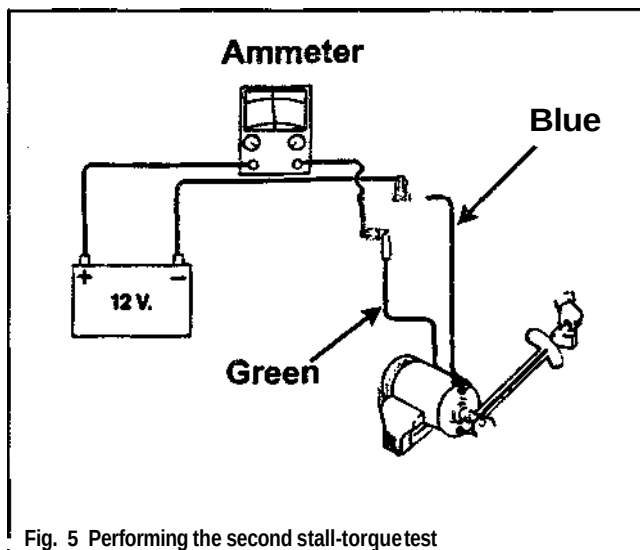


Fig. 4 Performing the first stall-torque test



Trim Sending Unit



1. Check all electrical connections. Check the trim/tilt circuit breaker or fuse and the trim/tilt pump breaker/fuse. Check the battery.
2. Tag and disconnect the sending unit harness at the connector.
3. Install an ohmmeter, or multi-meter, as per the manufacturer's instructions. Connect the probes to the 2 sender leads and then move the sender arm through a full Up and Down cycle while observing the meter.
4. If the meter does not read 0 to 190-210 ohms through out the cycle, the unit must be replaced.

Service Precautions



The following nine points should always be observed when installing, testing, or servicing any part of the power trim/tilt system.

1. Coat the threads of all fittings and O-rings with Power Trim/Tilt or Steering Fluid, or an equivalent product.
2. Use only clean, new, Power Trim/Tilt and Steering fluid when filling the hydraulic fluid reservoir. If the Power Trim and Steering fluid is not available, substitute with SAE 10W-30 or 10W-40 motor oil in an emergency and then drain the system as soon as possible.
3. The stern drive must be in the full UP/OUT position to relieve hydraulic pressure when checking the fluid level or adding fluid to the reservoir. Normal fluid level should be maintained between the **MIN** and **MAX** marks on the side of the reservoir. If the quantity is low, add fluid until the level is up to the **MAX** mark on the side of the reservoir. Obviously, on models without the plastic reservoir, the level should be to the bottom of the filler hole.
4. If the pump stops during long use, allow the pump motor to cool at least five minutes before starting again. An internal thermal circuit protects the pump motor from overheating. If the pump still will not operate, the system breaker may have tripped or the fuse may have blown.
5. Keep the work area clean when servicing or disassembling parts. The smallest amount of dirt or lint can cause failure of the pump to operate.
6. The manifold, pump assembly, pressure relief valves, and thermal relief valves must be replaced as individual assemblies. There are no piece parts available for these components except for the O-rings that are sold in a kit.
7. The motor is protected from internal fluid leaks and external moisture by seals, O-rings, and a grommet on the field winding harness. If the motor fails due to hydraulic fluid, clean the motor thoroughly and replace the pump internal seal and O-ring. If the motor fails from moisture as evidenced by internal corrosion, the wire harness grommet is damaged or deteriorated, and the pump motor should be replaced. Sometimes liquid neoprene can be used on the wire harness grommet to seal minor cracks. Use liquid neoprene with care to prevent contaminating the electric motor or hydraulic valves.

8. Keep the trim cylinders attached to the forward anchor pin during servicing and repairs. Do not allow the trim cylinders to hang by their hydraulic hoses. Such practice may kink and damage the hoses. Use care when handling trim cylinders during removal/installation of the stern drive unit. Rough treatment of the hoses could result in a weakened hose, partial separation at the fittings, or bending of the metal tubing, any one of which could restrict the flow of fluid to the trim cylinders.

9. Always hold both fittings with a wrench when tightening or loosening hydraulic hoses and fittings. When installing flex hoses, be sure there are no twists or sharp bends in the flex hose.

System Testing

High pressure testing of hydraulic components requires expensive special gauges, tools and highly trained personnel to accurately interpret test results. A danger to the operator and others in the area always exists during the testing process. Therefore, it is highly recommended that the boat, with the trim/tilt system installed, be taken to a qualified repair facility having the necessary equipment to conduct the testing properly and safely.

Do not attempt to work on hydraulic hose connections without the proper tools designed for that specific purpose. The use of a common box end wrench will quite likely result in "rounding off" the flats on a hydraulic fitting. It is imperative that you have a set of "flare" or "line" wrenches that will almost guarantee the fitting will not to be damaged.

System Bleeding

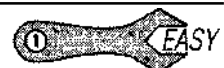
TRIM CYLINDERS



Before installing a new or rebuilt trim cylinder:

1. Compress the trim cylinders so they are in their fully retracted (Down) position.
2. Unscrew the end caps on each cylinder (use the special spanner wrench as detailed in the Disassembly & Assembly procedure) and fill the low-volume chamber with OMC Power Trim/Tilt & Steering Fluid. Install the end caps and tighten to 25-30 ft. lbs. (34-41 Nm).
3. Install the cylinders and connect the hydraulic lines.

TRIM MOTOR & PUMP



■ Please refer to the Maintenance section for procedures on filling the pump reservoir.

Verify that the manual release valve is in the fully closed position and that the drive is in the full **UP** position.

*** WARNING

Never remove the pump reservoir fill plug unless the drive is in the full UP position.

Remove the reservoir plug and fill the reservoir with fluid until the level reaches the bottom of the hole. Replace the plug. Run the drive unit through at least 5 Up/Down cycles to purge any residual air in the system, stop the drive in the full Up position and check the fluid level one last time; topping off if necessary.

Trim Sender

ADJUSTMENT



□ Before adjusting the trim sender, the sender must be installed in the gimbal ring and the drive must be installed on the boat.

1. Turn the drive over hard to port and set it to full negative (Down) trim. Turn the ignition switch to the ON position; if the trim gauge shows the drive to be in the Full Down position there is no need to proceed with the adjustment, if not, move to the next step.

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2. Loosen the 2 trim sender mounting screws, turn the ignition switch back to the **ON** position and then slowly rotate the sender until the trim gauge registers a Full Down position. Obviously, you'll need an assistant for this step unless you've got a long neck and great eyes.

3. Tighten the sender mounting screws to 18-24 inch lbs. (2.0-2.7 Nm) and then recheck the gauge.

Trim/Tilt Cylinder

If troubleshooting procedures have isolated a problem to the trim/tilt cylinders, for example: a leaking oil scraper seal around the rod or a defective impact valve, it is strongly recommended that the **cylinder(s)** be removed and replaced with new ones, rather than attempting to disassemble the cylinders. This recommendation is based on the fact considerable difficulty may be encountered in removing the end cap from the cylinder. Even with the aid of the special tool for this purpose, the task is most difficult.

REMOVAL & INSTALLATION

◆ See Figures 6 thru 12



1. Remove the plastic cap on the aft (drive) end of each trim/tilt cylinder. Remove the elastic lock nut and flat washer.

2. Support the hydraulic cylinder and lightly tap the pivot rod out of the cylinders with a rubber mallet—tap on one side while pulling on the other side. Carefully lower the cylinders down.

If the bushings come out with the pivot rod, make sure that you keep the two grounding clips.

3. Grab the pivot ends of each cylinder and pull them out to the fully extended position. Loosen the manual release valve on models so equipped and then remove the filler plug at the reservoir to relieve any residual pressure in the system. Close the valve and install the cap.

4. Working at the forward end of the cylinder, unscrew the bolt and disconnect the ground wire. Remove the cylinder cover retainer and lift off the cover. These models will also have a small screw and line retainer over the hydraulic line running to the aft end of the cylinder; remove them.

5. With the stern drive still in the full DOWN position, place a suitable drain pan under the hydraulic lines, tag and then disconnect the two hydraulic hoses from the end of the cylinder (cover with rag) using the correct size "Flare Nut" or "Line Wrench". These wrenches will prevent damaging the hex flats on the line or hose fittings if they are extremely tight and/or a slight amount of corrosion has built up on the fitting. Most standard open-end wrenches will flex under high torque loads, causing the wrench to slip, damaging the hex fitting on the hydraulic line.

6. Remove the O-rings on the end of each line fitting. Install plugs into the hoses and/or fittings to prevent draining the trim/tilt hydraulic system any more than necessary.

7. Pry off (or unscrew) the plastic pivot pin cap (if equipped) on the end of the forward pin. Remove the locknut from the end of the pin and then slide off the flat washer and then the bushing from the pivot pin.

8. Pull the pivot pin out of the cylinder and gimbal ring, or grasp the cylinder on the inside of each pin and pull it off the anchor pins. Remove the flat washer and bushing on the inside surface of the cylinder ends or the anchor pins.

To Install:

Certain models may come equipped with limited tilt cylinders. They will contain a spacer that reduces total tilt rod travel and can be identified by the letter L that is stamped on the end of the tilt rod eye. Limited tilt cylinders must always be installed in pairs and never mixed with standard rods providing full travel.

9. Press the trim/tilt cylinder bushing into the boss on each side of the gimbal ring. Install bushings into the outer side of each cylinder. Although it is not necessary to replace the bushings unless they are worn excessively or damaged, you may want to consider replacing them anyway while you have everything apart.

10. Align the forward pivot pin and then coat it with grease. Apply a light coat of Gasket Sealing Compound to the threaded ends of the pin and then center it in the ring.

11. Align the cylinder and then press it on to the pivot pin very carefully. You may have to give it a few taps with a rubber mallet.

12. Install the washers and then the lock nuts (new!). Tighten the nuts until there is an equal amount of thread exposed on each side of the pin and then tighten both nuts to 32-34 ft. lbs. (43-46 Nm). Replace the plastic caps.

13. Coat new O-rings with hydraulic fluid and then install them into the grooves on the end of each hydraulic line fitting. Remove the plugs and attach each line to its respective fitting on the cylinder. Tighten each fitting to 14-18 ft. lbs. (19-24 Nm) with a flare wrench.

14. Install the aft line retainer and tighten the bolt securely. Also on these models, position and install the cylinder cover.

15. Install the retainer; and then on all models, install the ground strap and tighten the bolt securely.

16. Clean the aft pivot pin thoroughly and then coat it with grease.

17. Make sure that the grounding clips are in position and then press the bushings into the end of each cylinder and into the bore boss in the drive unit. As we did with the forward end bushings, we suggest replacing the bushing as preventative maintenance, although it is perfectly acceptable to reuse the old bushing as long as they are in good shape.

18. Align the cylinder ends with the bores on each side of the drive and then insert the pivot pin into one end and press it through until it comes out the other side—you will probably have to give it a few taps with a mallet.

19. Install the flat washers and lock nuts. Tighten the nuts until there is an equal amount of thread showing on each side and then tighten each nut to 32-34 ft. lbs. (43-46 Nm). Install the plastic caps.

20. Fill the reservoir with Power Trim/Tilt & Steering fluid and run the drive through its full range of motion at least 5 times to purge any air in the system.

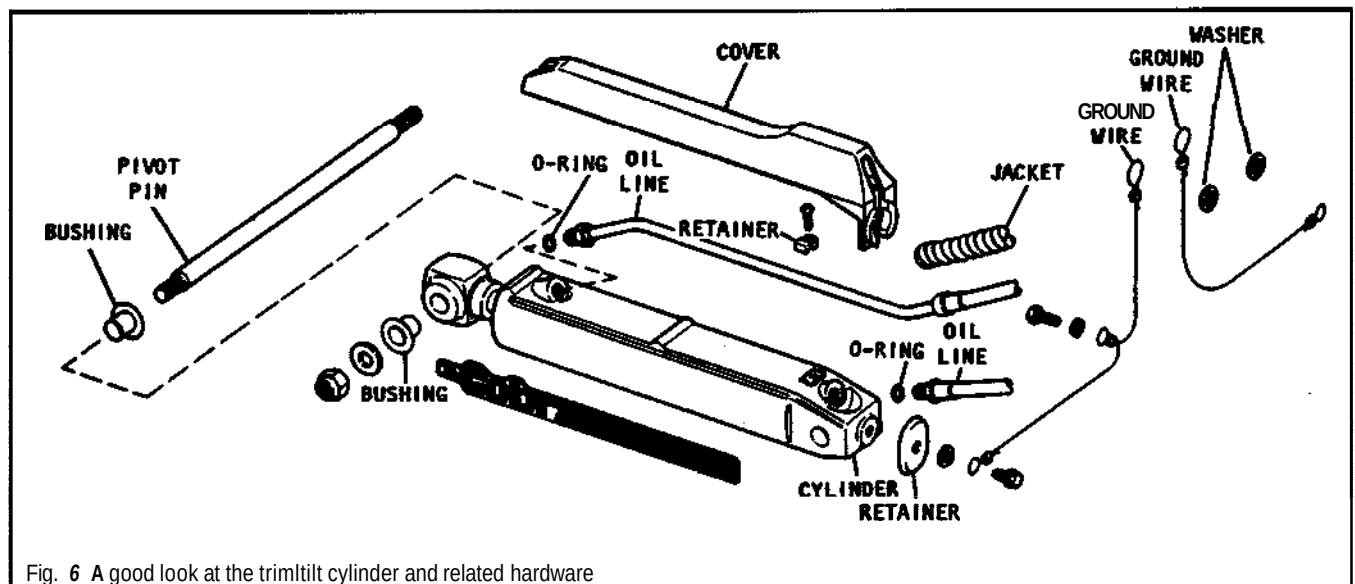


Fig. 6 A good look at the trim/tilt cylinder and related hardware

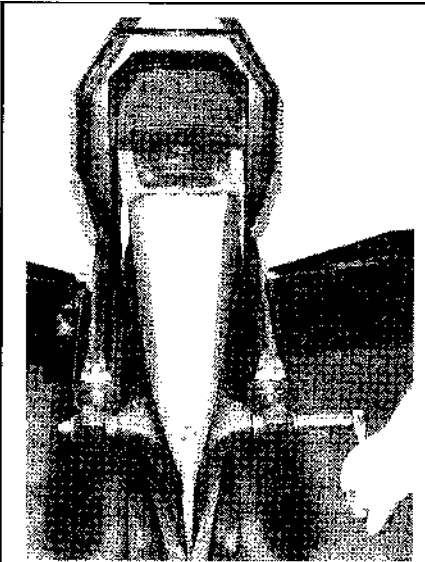


Fig. 7 Removing the aft nuts



Fig. 8 Carefully pull the cylinder off of the drive...



Fig. 9 ...and then remove the rear nut



Fig. 10 Pull of the cylinder cover...



Fig. 11 ...remove the retainer...

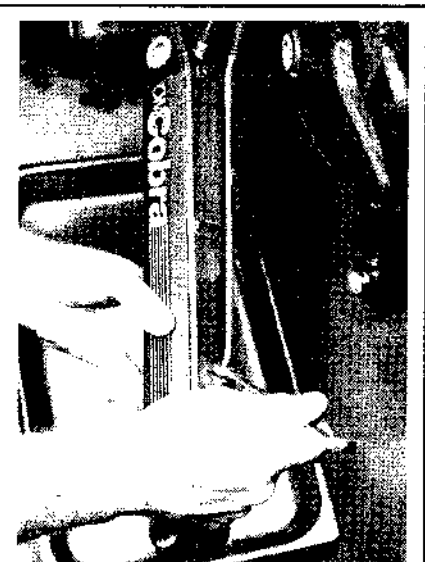
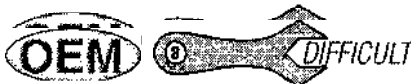


Fig. 12 ...and then disconnect the aft hydraulic line

DISASSEMBLY & ASSEMBLY

◆ See Figures 6 thru 19



□ If troubleshooting procedures have isolated a problem to the trim/tilt cylinders, for example: a leaking oil scraper seal around the rod or a defective impact valve, it is strongly recommended that the cylinder(s) be removed and replaced with new ones, rather than attempting to disassemble the cylinders. This recommendation is based on the fact considerable difficulty may be encountered in removing the end cap from the cylinder. Even with the aid of the special tool for this purpose, the task is most difficult.

1. Remove the trim cylinder(s) as previously detailed.
2. Hold the cylinder over a drain pan with the hydraulic line ports facing down and into the pan; extend, and then retract the cylinder 2-3 times to remove all fluid from the cylinder.
3. Remove the pivot pin bushings if you intend to replace them.
4. Place the cylinder in a vise equipped with soft jaws and carefully tighten it.

5. Obtain a spanner wrench (# 912084) or an equivalent tool. Removal of the end cap is difficult using the special tool so exercise care. Insert the tangs of the spanner into the holes in the end cap. If needed, slide a long breaker bar onto the tool so the bar is in the same plane as the tool. This position will provide maximum mechanical advantage. Remove the end cap. Tap the breaker bar, if necessary, but bear in mind—if the holes in the end of the cap become damaged (elongated), the cylinder might as well be given the "deep six". Continue to unscrew the end cap until it is held by a single thread. Extend the rod, and then continue to remove the end cap and piston assembly.

6. Clean and degrease the piston rod thoroughly and then install it in a vise using a rod holder (# 983213). Carefully insert the pivot pin through the hole in the end piece and spin it off the end of the rod. If you are unable to loosen the end piece, heat the shank very carefully with a torch or heat gun and then try it again.

■ If you find that the piston rod is slipping in the holder tool while trying to spin off the end piece, wrap a piece of paper around the rod before inserting it into the tool.

13-10 TRIM AND TILT

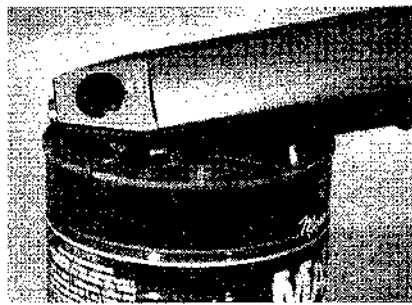


Fig. 13 Drain the cylinder into a container

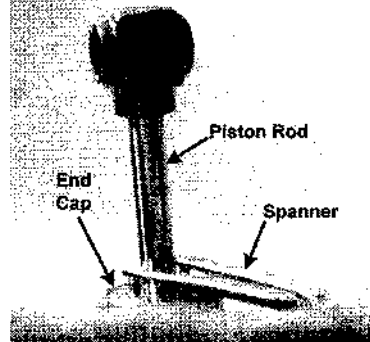


Fig. 14 Remove the end cap...

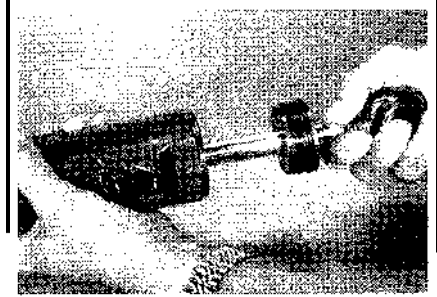


Fig. 15 ...and then pull the piston rod out of the cylinder

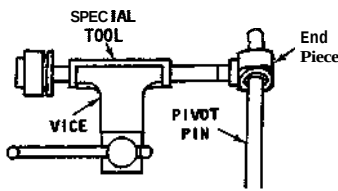


Fig. 16 Use the pivot pin to remove the end piece

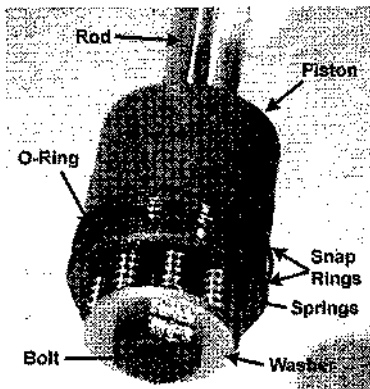
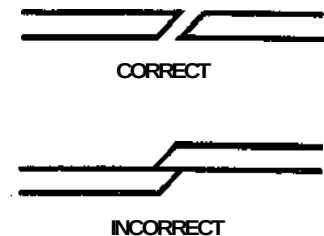


Fig. 17 A good look at the piston



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7. Pull the end cap off of the end of the rod and then pry out the scraper with a small awl. Do the same with the 2 O-rings, one inside and one outside. Discard the scraper and the O-rings.

8. Move to the end piston and remove the 2 split rings and the O-ring; throw them all away.

9. There are no serviceable components in the assembly, so there is no service procedure. This being said though, if you suspect impact valve leakage there is a quick procedure to try before replacing everything. Install the piston rod in the holder tool again and then loosen the large bolt on the end of the piston just enough to allow the relief check balls to unseat themselves; but not too much. Clean the piston components with solvent and then blow everything dry with compressed air. Tighten the bolt securely until the balls seat themselves.

To Assemble:

10. Make an effort to keep the work area clean, because any contamination on the piston could lead to a malfunction. Inspect the interior of the cylinder for any signs of scoring or roughness. Clean all surfaces with safety solvent and blow them dry with compressed air.

11. If the piston has any signs of corrosion or damage it must be replaced with a new unit.

12. Clean the end cap threads with a wire brush until you have removed all traces of old sealant.

13. Lubricate all O-rings and interior components with Power Trim/Tilt and Steering Fluid.

14. Position a new scraper over the end cap so that the lip is facing upward and then use a small seal installer (# 326545), or an appropriately sized socket, to press the scraper into the cap.

15. Coat new O-rings with fluid and then install them into their respective grooves in side and outside the end cap.

16. Coat a new piston O-ring with fluid and roll it into place in the recess in the piston. Position new split ring retainers on each side of the O-ring so that their ends match but do not overlap. These rings are quite fragile, so be careful when installing them into the recess.

17. Install a seal protector tool (# 326005) over the end of the piston rod and slide on the end cap. Make sure that the rod, O-ring and cap are thoroughly lubricated with hydraulic fluid.

18. Make sure that the piston rod threads are free of all old sealant and then spray some Loctite Primer on the threads. While waiting for it to dry, secure the rod in the holding fixture again and then coat the threads with Loctite. Screw on the end piece and tighten it securely. Remove the rod and tool from the vise.

19. Re-clamp the cylinder in the vise and coat the cylinder bore and piston thoroughly with fluid. Grab the piston body so that you compress the split rings with your fingers and then feed it into the cylinder bore. Push the piston and rod all of the way into the cylinder. Once the piston is completely in, cap the hydraulic line ports and fill the cylinder with as much hydraulic fluid as possible.

20. Slide the end cap down the rod and thread it into the cylinder. Install the spanner wrench and tighten it to 25-30 ft. lbs. (34-41 Nm). Once there, continue rotating the end cap until the two holes are parallel with the pivot pin hole in the end piece.

21. Attach the cylinders, check the fluid level in the reservoir and then run the drive through its full range of motion 5 times to purge any remaining air in the system.

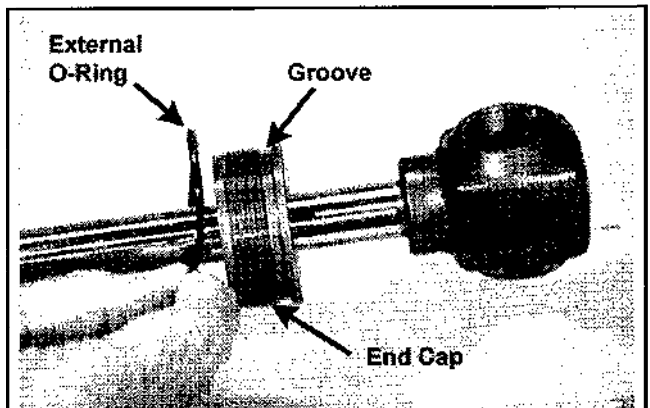


Fig. 19 Install a new O-ring on the end cap.