STERNDRIVE UNIT

Section 3A - Drive Shaft Housing

Table of Contents

Specifications

Torque Specifications

Description	Torque		
	lb-in.	lb-ft	Nm
Top Cover Screws		20	27
U-joint Retainer Nut*		200	271
Nuts, Bolts And Washers		35	47.5
Nut		35	47.5
Screw		28	41
Trim Tab Screw		23	31
Dipstick	17.5		2
Oil Vent Screw	40		4

*See Torque Wrench Chart.

Upper Drive Shaft Bearing Preload

Description	Torque	
	lb-in.	Nm
New Bearings	8	0.9
Used Bearings*	5	0.6

*Bearings are considered used if spun under load once.

U-joint Bearing Preload

Description	Torque	
	lb-in.	Nm
New Bearings	6-10	0.7-1.1
Used Bearings*	3-7.5	0.3-0.8

*Bearings are considered used if spun under load once.

Gear Shimming Specifications

Description	Gear Location	
	inches	millimeters
Drive Gear	.025	0.64
Driven Gear	.025	0.64

Lubricants/Sealers/Adhesives

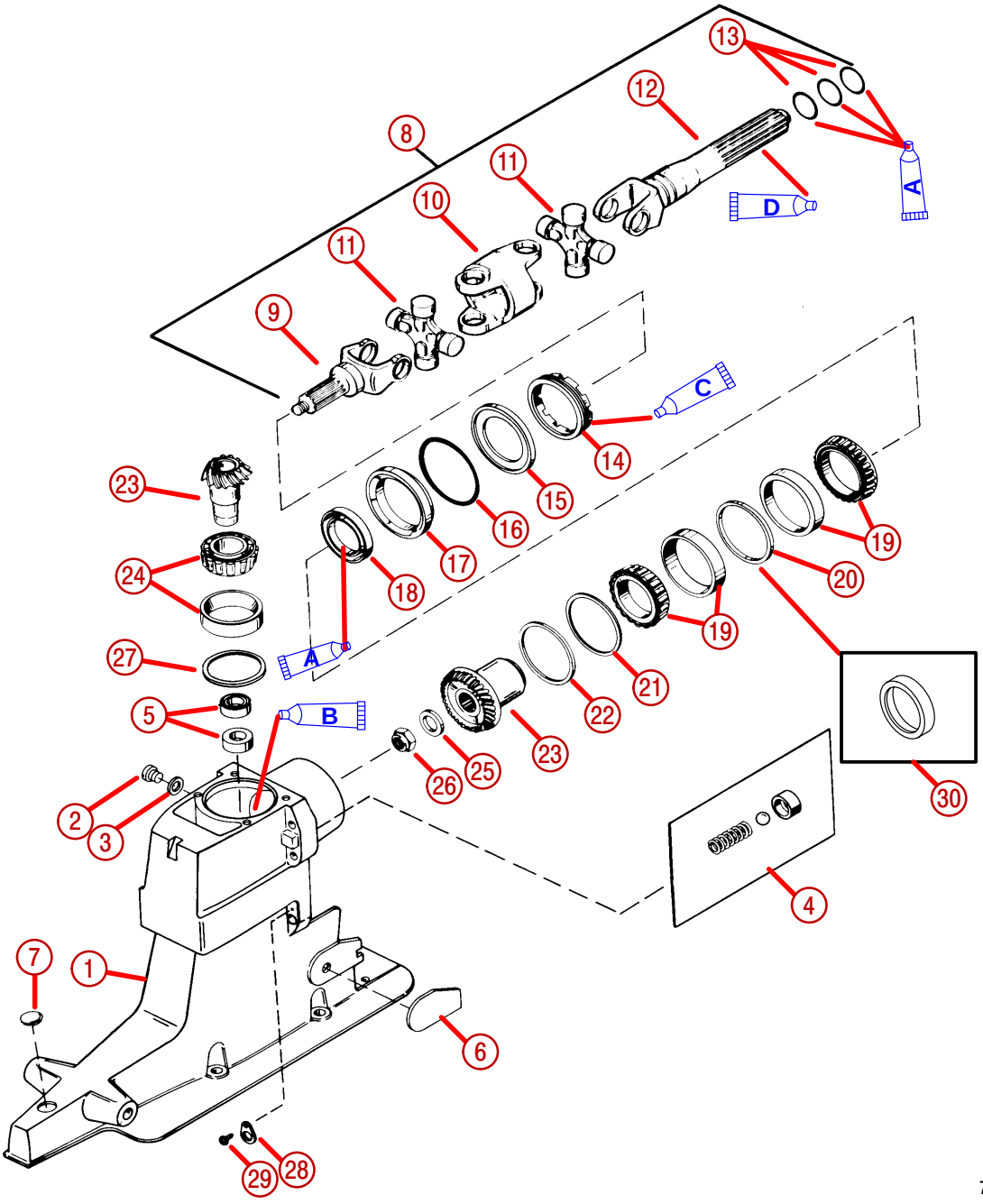
Description	Part Number
Quicksilver 2-4-C Marine LubricantWith Teflon	92-825407A12
Quicksilver U-jointAnd Gimbal Bearing-Grease	92-828052A2
3M Brand Adhesive	92-86166-1
Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
Quicksilver Perfect Seal	92-34227-1
Permatex Ultra Blue Silicone Sealant	Obtain Locally
Quicksilver Special Lubricant 101	92-13872A1
Quicksilver High Performance Gear Lube	92-816026A4

Special Tools

Description	Part Number
U-joint Adaptor	91-38756
Bearing Cup Driver	91-38918
Bearing Cup Driver	91-808053
Bearing Cup Driver	91-33493
Bearing Cup Driver	91-36577
Driver Rod	91-37323
Driver Tool	91-90774
Oil Seal Driver	91-817570
Shimming Tool (Driven Gear)	91-60526
Shimming Tool (Driven Gear)	91-854377
Shimming Tool (Drive Gear)	91-60523
Slide Hammer Puller	91-34569A1
Torque Wrench (lb-in.)	91-66274
U-joint Bearing Retainer Wrench	91-17256
Universal Puller Plate	91-37241

Drive Shaft Housing Exploded Parts View

U-joint and Driven Gear Components



1 - Drive Shaft Housing	**16** - O-ring
2 - Screw	**17** - Carrier Assembly
3 - O-ring Or Washer	**18** - Oil Seal
4 - Spring Assembly	**19** - Roller Bearing And Cups
5 - Oil Seal	**20** - Spacer Cup (S/N Prior To 0L100009)
6 - Wear Pad	**21** - Shim
7 - Plug	**22** - Shim
8 - Universal Joint	**23** - Drive Gear Assembly
9 - Yoke, Universal Joint-gear End	**24** - Roller Bearing And Cup
10 - Socket, Center-universal Joint	**25** - Washer
11 - Cross And Bearing	**26** - Nut
12 - Yoke Assembly, Universal Joint-coupling End	**27** - Shims
	28 - Ground Plate
13 - O-ring	**29** - Screw
14 - Retainer	**30** - Spacer Cup (S/N 0L100009 And Above)
15 - Ring	

Lubricants/Sealers/Adhesives

NOTE: *Fill Drive With High Performance Gear Lube*

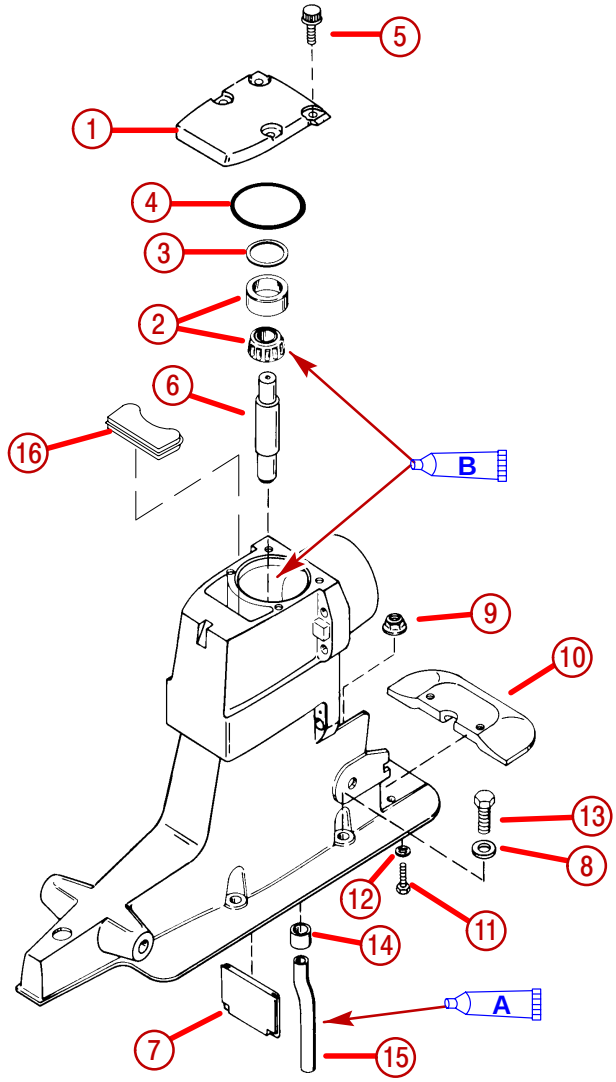
- 2-4-C Marine Lubricant With Teflon

- Quicksilver High Performance Gear Lube

- Special Lubricant 101

- Quicksilver Engine Coupler Spline Grease

Drive Shaft Components



1 - Cover, top	**9** - Nut
2 - Bearing and Cup	**10** - Anodic Plate
3 - Shim	**11** - Screw
4 - O-ring	**12** - Lockwasher
5 - Screw	**13** - Screw
6 - Drive Shaft, upper	**14** - Seal
7 - Filler Wall	**15** - Water Tube
8 - Washer	**16** - Stuffer Plug

Lubricants/Sealers/Adhesives

A - 2-4-C Marine Lubricant With Teflon

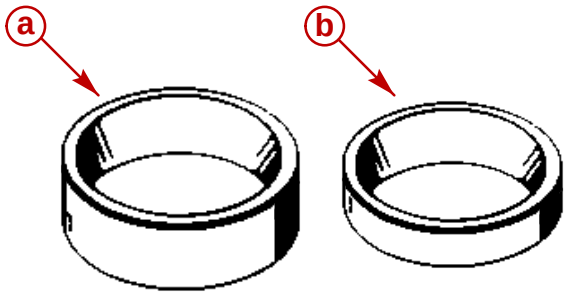
B - Quicksilver High Performance Gear Lube

NOTE: *Fill Drive with High Performance Gear Lube*

Special Information

Top Cover Bearing Cup

The later style bearing cup is thinner than the earlier style cup.



75240

a - Earlier Style Bearing Cup 1.938 in. (49 mm) Diameter (Prior to S/N OF680000)
b - Later Style Bearing Cup 1.781 in. (45 mm) Diameter (S/N OF680000 And Above)

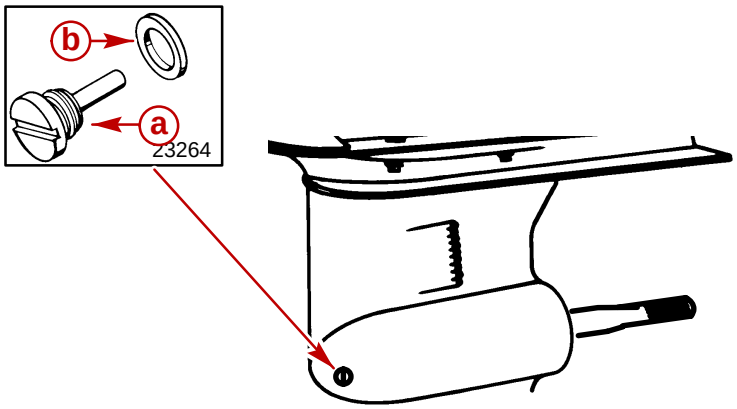
Universal Joint Bearing Set

IMPORTANT: Alpha One Sterndrive Units beginning with serial number 0L100009 and above no longer use the cone spacer between the bearings in the U-joint assembly to set the bearing preload. A new procedure has been established for adjusting this preload and is covered in the following instructions. The O.D. of the new drive gear bearing carrier has changed to 3.265 in. (82.9 mm).

Drive Shaft Housing/Gear Housing

Separation

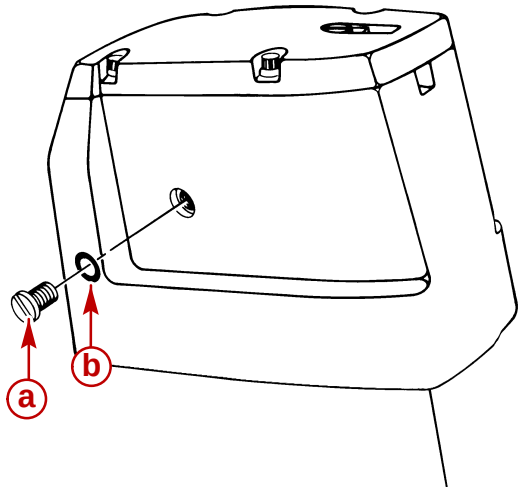
1. Clamp the unit on the gear case anti-ventilation plate in a suitable fixture.
2. Trim drive unit to full UP/OUT position.
3. Remove the oil fill/drain plug.



75703

a - Fill/Drain Screw
b - Sealing Washer

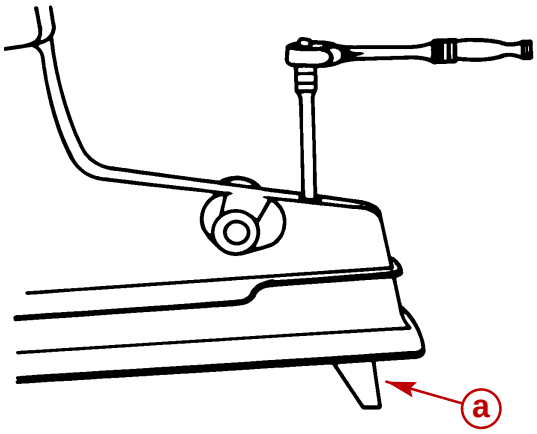
4. Remove the drive shaft housing vent screw. Allow the drive unit to drain completely.



70131

a - Vent Screw
b - Sealing Washer

5. If equipped, mark the trim tab position with a piece of tape on the gear housing and remove the trim tab.

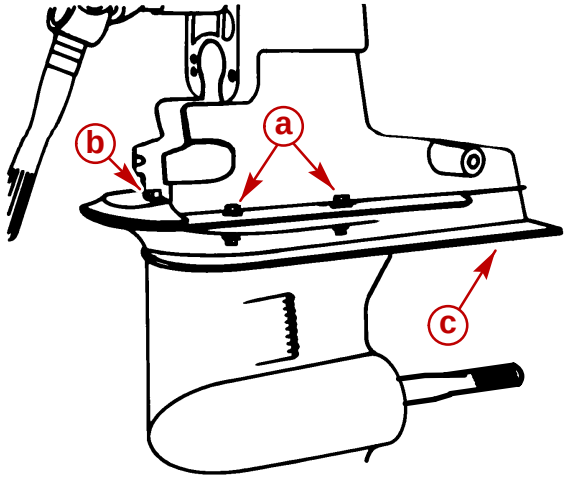


70116

a - Trim Tab

6. Remove the aft screw (in the trim tab well of the gear housing).
7. Remove the bolts, nuts and washers from the port and starboard sides of the unit.

8. Remove the nut from the forward end of the unit.



75703

a - Nuts, Bolts And Washers
b - Nut
c - Screw

9. Lift the drive shaft housing straight off of the gear case and set aside.

NOTE: *It may be necessary to lightly tap housing with a synthane hammer to assist removal.*

Drive Shaft Housing and Component Disassembly

Drive Unit Gear Ratio Identification

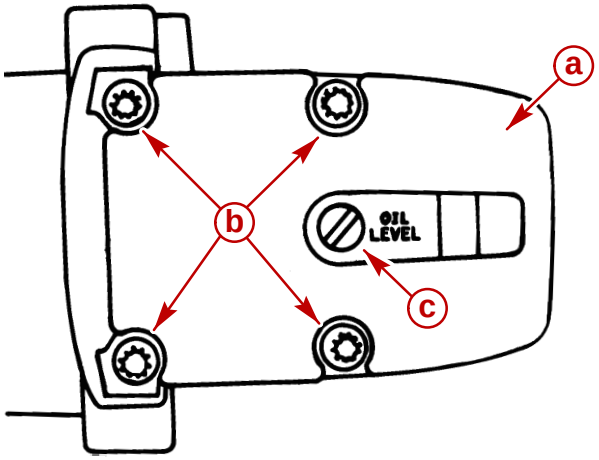
All drive unit gear ratios are identified on each drive in two places. It is important to note the ratio of the drive unit before preceding with any repairs. The first place to look is on the decal on the port side of the drive shaft housing. It will have a number such as (1.50R) and then the serial number. The second place to look will be on the universal joint splined yoke. It will be identified with a letter such as (F). This method is explained in the following chart.

ALPHA	
A	2.0:1
B	1.98:1
C	1.62:1, 1.65:1
D	1.81:1, 1.84:1
F	1.47:1, 1.50:1
H	1.32:1
K	2.40:1
M	1.50:1 MAGNUM

This will be true for new or with drive units that have not been altered. A drive unit could have had the gear ratio changed for high altitude, which would void any application of the above chart. The gear ratio then would have to be determined by counting the teeth on the drive gear and the driven gear in the drive shaft housing and using the following chart for reference.

Tooth Count	Ratio	Drive	Driven
14-28	2.40:1	20	24
14-28	2.0:1	24	24
17-28	1.98:1	20	24
17-28	1.81:1, 1.84:1	17	19
17-28	1.62:1, 1.65:1	24	24
17-28	1.47:1, 1.50:1	22	20
17-28	1.32:1	20	16

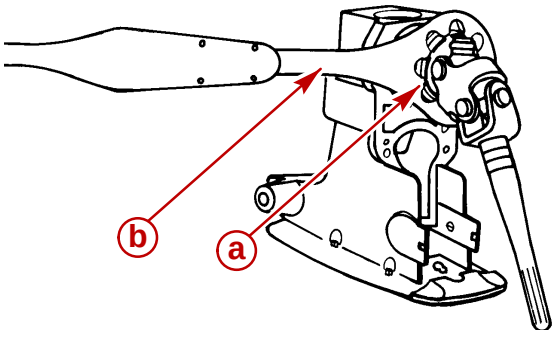
1. Remove the dipstick and washer, if present, in the top cover and remove the fasteners securing the top cover to the drive shaft housing. Lift the top cover straight off. It may be necessary to pry the top cover off by using a pair of screwdrivers (one on each side) in the slots provided at the junction of the top cover and the drive shaft housing.



70118

a - Top Cover
b - Screws
c - Dipstick (Early Models)

2. Remove the U-joint retainer.

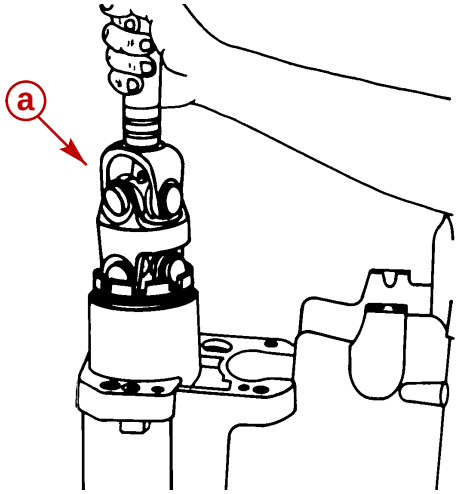


70209

a - U-joint Retainer
b - U-joint Retainer Tool

3. Remove the U-joint assembly by pulling it straight out.

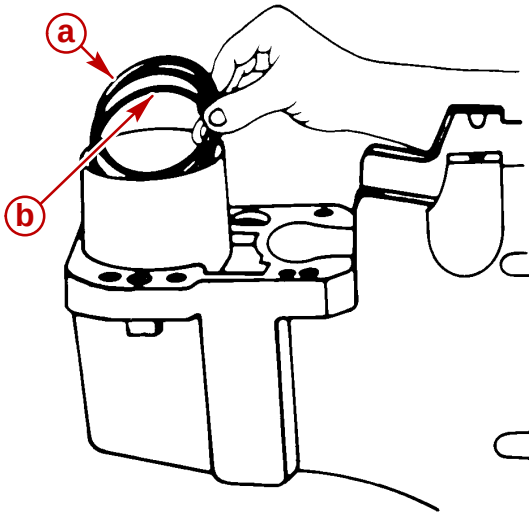
NOTE: *A synthane hammer may be used to tap on housing to assist removal.*



70122

a - U-joint Assembly

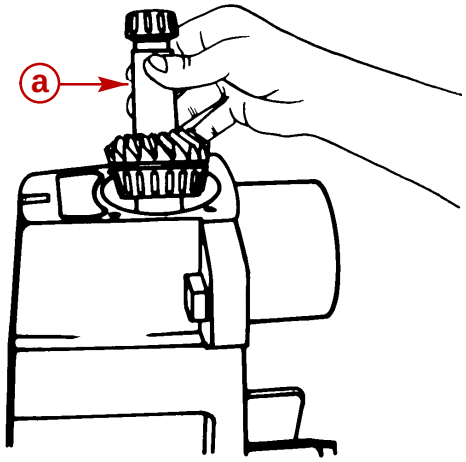
4. Remove the shim pack and the spacer ring. Measure and make note of the shim pack thickness. The shims may be reused if they are not damaged.



70123

a - Shims
b - Spacer Ring (On Some Models)

5. Remove the driven gear assembly by pulling it straight up and out of the drive shaft housing.

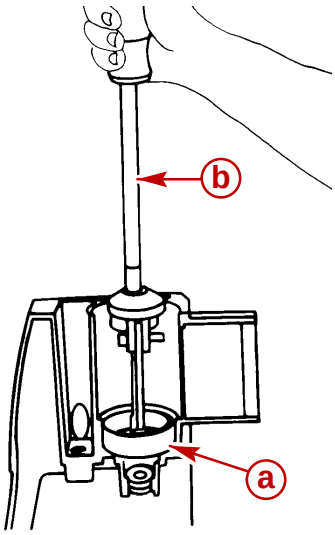


70124

a - Driven Gear Assembly

IMPORTANT: Removal of the driven gear bearing cup is only necessary for replacement of the cup or drive shaft housing, installing new oil seals and/or the changing of the shims below the cup for adjusting the driven gear location.

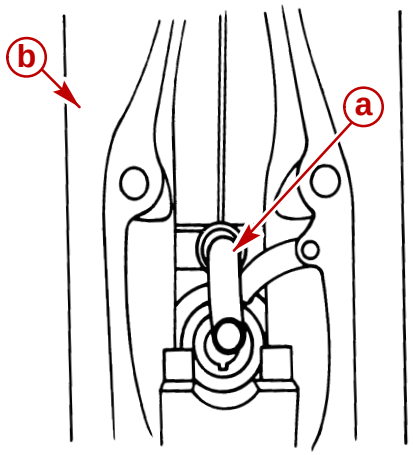
6. Remove the driven gear bearing cup and shim(s). Measure and make note of the shim pack thickness. Discard the shim(s) if they have been damaged.



70128

a - Bearing Cup
b - Slide Hammer Puller

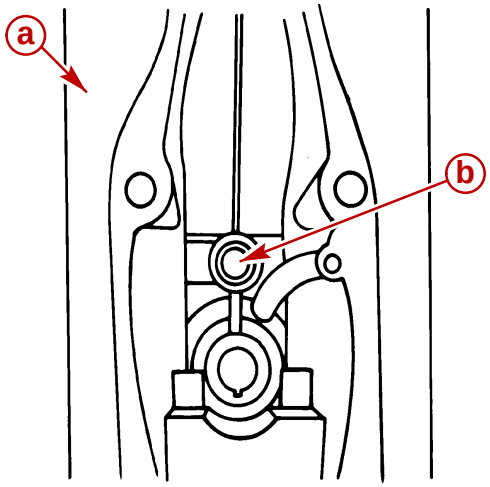
7. Remove the water tube from the drive shaft housing.



70126

a - Water Tube
b - Drive Shaft Housing

8. Remove the rubber seal from the drive shaft housing.



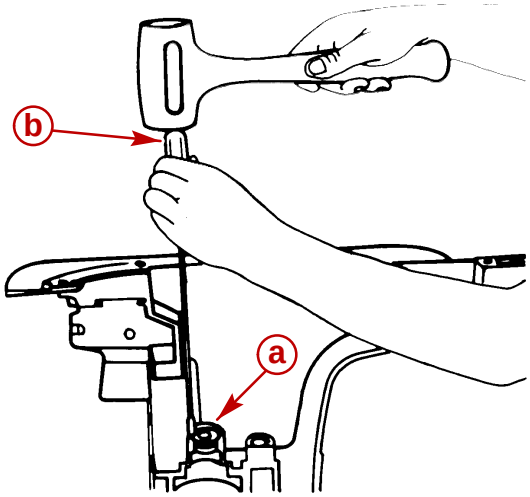
70125

a - Rubber Seal
b - Drive Shaft Housing

⚠ CAUTION

Eye protection must be worn when performing the following procedure. Failure to do so may cause personal injury.

9. Remove the drive shaft housing oil seals as shown in the figure below.



70129

a - Oil Seals (2)
b - Suitable Tool

Drive Shaft Housing Cleaning and Inspection

⚠ CAUTION

Eye protection must be worn when performing the following procedure. Failure to do so may cause personal injury.

1. Clean the drive shaft housing thoroughly with a suitable solvent and a hard bristle brush. Dry the drive shaft housing thoroughly using compressed air. Ensure that all sealants, locking agents and debris are removed.
2. Inspect the drive shaft housing for corrosion and any other damage. Excessive damage will require the replacement of the drive shaft housing.
3. Inspect the U-joint retainer threads in the drive shaft housing for corrosion, stripped and/or cross-threaded threads. Excessive damage to the threads will require the replacement of the drive shaft housing.
4. Inspect for blockage of the water and oil passages. Clean as necessary.

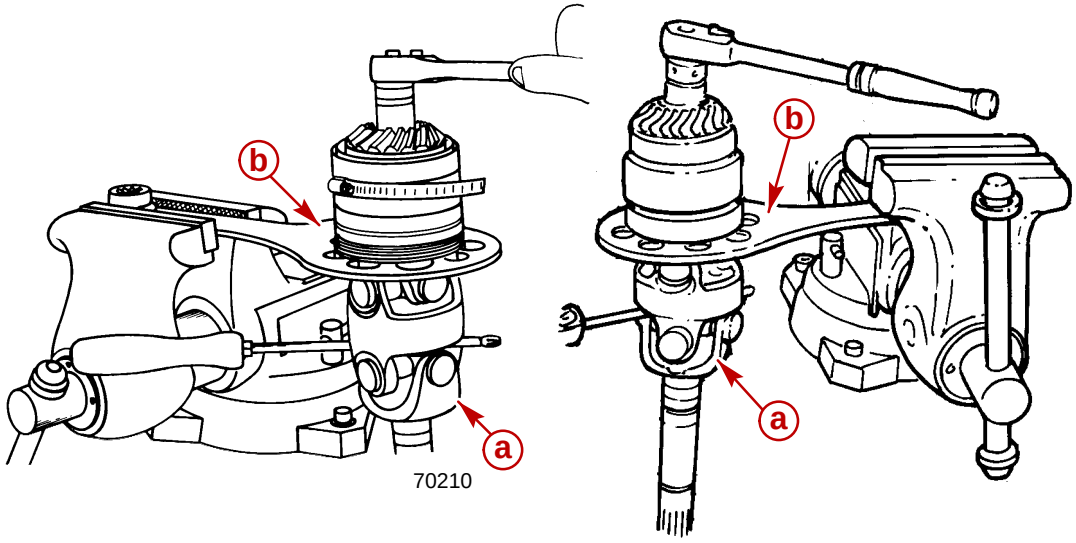
U-joint Assembly - Inspection and Disassembly

1. Remove and discard the two small O-rings on the spline end of the U-joint.
2. Clamp the U-joint retainer tool in a vise and insert the U-joint assembly into it from the top.

⚠ CAUTION

When accomplishing the following steps it is necessary to prevent the U-joint from falling when removing the lock nut. Failure to follow this instruction may cause personal injury and/or damage to the assembly.

3. While holding the U-joint, remove the locknut and washer from the U-joint shaft.



..... Earlier Model ..... Later Model

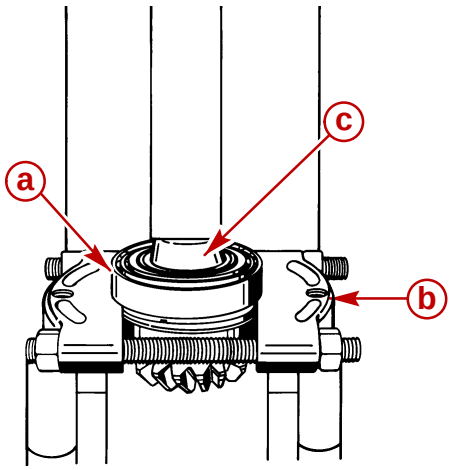
a - U-joint Assembly
b - U-joint Retainer Tool

⚠ CAUTION

Eye protection must be worn when performing the following procedure. Failure to do so may cause personal injury.

4. Remove gear and bearing assembly from shaft.
5. Remove bearings from gear and ensure that the bearing cones and cups remain together as a set utilizing a piece of wire to keep them together.

IMPORTANT: After disassembly inspect the bearing cones and cups for damage that may have occurred during removal from the gear. If either of the bearing cups or cones have been damaged, it will be necessary to replace both bearing cups and both bearing cones.

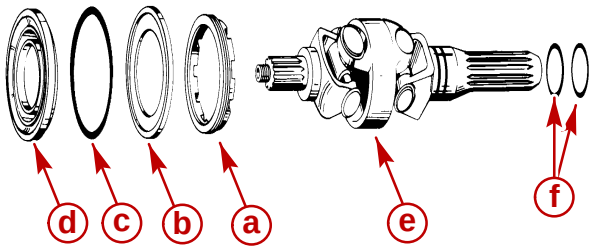


22393

a - Gear/Bearing Assembly
b - Universal Puller Plate
c - Suitable Mandrel

6. Clean all components with a suitable solvent and dry them thoroughly using compressed air.
7. Inspect the pinion gear bearings by rotating them by hand. Rough, uneven movement or a loose condition indicates the need for replacement of the bearings and cups.
8. Inspect the large O-ring around the oil seal carrier for damage or excessive compression. Replace the O-ring if it is found to be defective.
9. Inspect the gear for pitting, chipped or broken teeth, hairline fractures and excessive or uneven wear. Replace both the drive (pinion) gear and the driven gear if any of these conditions exist.
10. Inspect the U-joint retainer for damage, cracks and/or broken or corroded threads. Replace it if any of these conditions are found.

11. Inspect the thrust ring for cracks, damage and/or excessive wear. Replace it if any are found.



23010

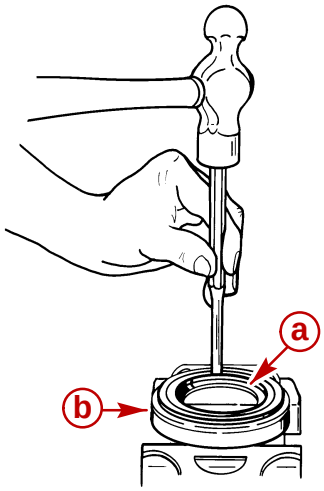
a - Retainer
b - Thrust Ring
c - O-ring, Large
d - Oil Seal Carrier
e - U-joint
f - O-rings

Oil Seal Carrier Subassembly

INSPECTION AND DISASSEMBLY

1. Inspect the oil seal carrier and oil seal for damage or excessive wear. If the carrier is found to be defective, replace the carrier and the oil seal as a unit. If only the oil seal is found to be defective, replace it as outlined.

   a. Remove the U-joint oil seal from the oil seal carrier using a punch and a hammer.

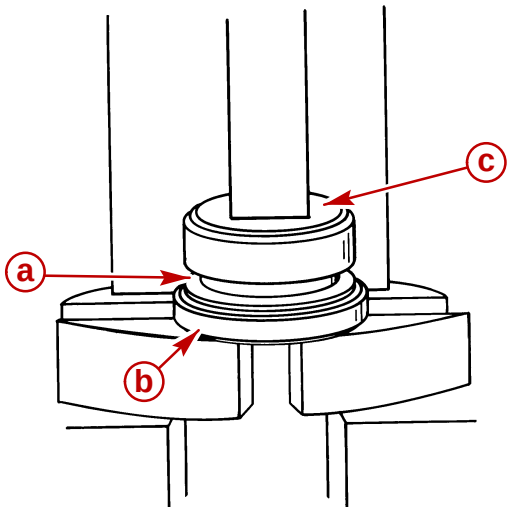


23009

a - Oil Seal
b - Oil Seal Carrier

OIL SEAL CARRIER - REASSEMBLY

1. Assemble the oil seal into the oil seal carrier by pressing it with the lip of the seal facing away from the stepped side of the carrier. Use the oil seal driver tool (91-36577) to press the seal into place.



23009

a - Oil Seal
b - Oil Seal Carrier
c - Oil Seal Driver Tool

Pinion Gear Subassembly

DISASSEMBLY

NOTE: *For removal of bearing pack from gear, refer to page 3A-16 .*

NOTE: *If by previous inspection both the pinion gear and the bearings have been found to be in good condition, skip this whole section.*

NOTE: *If by previous inspection both the pinion gear and the bearings have been found to be in need of replacement, order new parts, (pinion gear, pinion gear bearings and cups and driven gear), skip this disassembly section and go to "Reassembly."*

NOTE: *If by previous inspection the pinion gear has been found to be in need of replacement* ***both the pinion gear and the driven gear must be replaced as a set.***

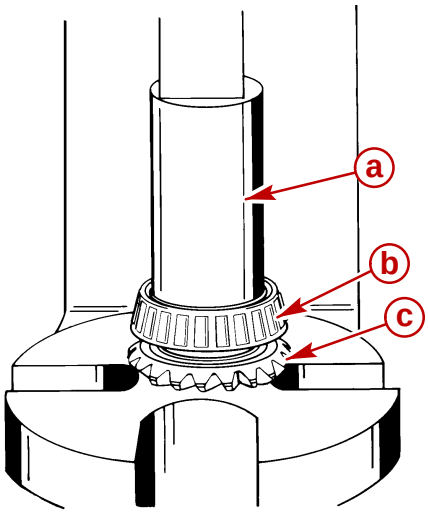
NOTE: *If by previous inspection the bearings have been found to be in need of replacement* ***both bearing cups and both bearing cones must be replaced as a set****.*

IMPORTANT: If the bearings are to be re-used (when replacing only the pinion and driven gears), make sure that the bearing cones and cups were kept together in their original pairing and are reassembled in the same order, (i.e. the bearing cone and cup that were closest to the old gears' teeth must be reinstalled closest to the new gears' teeth).

REASSEMBLY

IMPORTANT: Lightly lubricate the gears and bearings with Quicksilver High Performance Gear Lube before installing. Bearings and gears must be lubricated to obtain accurate preload readings.

1. Press the bearing cone onto the pinion gear until it seats fully against the back side of the gear.



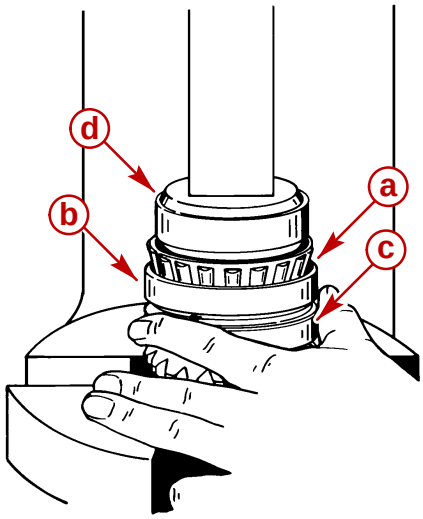
22393

a - Driver Tool (91-90774)
b - Bearing Cone
c - Drive Gear

2. Place the bearing cup onto the bearing cone.
3. Place the large bearing spacer onto the bearing cup.
4. Place the second bearing cup onto the spacer.

IMPORTANT: Do not over-press the second bearing cone, as damage to one or both of the bearings could occur. If an over-pressed condition occurs (the spacer does not move freely), completely disassemble the bearings from the gear and start again.

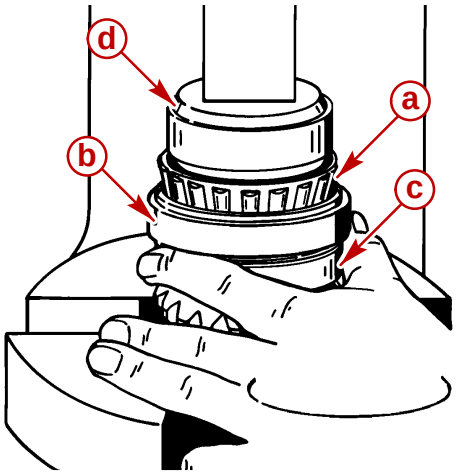
5. Press the bearing cone (positioned as shown in the next figures) onto the pinion gear until the bearing rollers make light contact with the bearing cup.



22393

Models With Serial Numbers Prior To 0L100009

a - Bearing Cone
b - Bearing Cup
c - Spacer (Must Move Freely)
d - Suitable Mandrel - Must Push On Inner Bearing Race



75631

Models With Serial Numbers 0L100009 and Later

a - Bearing Cone
b - Bearing Cup
c - Spacer (Must Move Freely)
d - Suitable Mandrel – Must Push On Inner Bearing Race

U-joint Subassembly

INSPECTION

1. Inspect the splines on both ends for a twisted or cracked condition. Replace the appropriate parts if either condition is found.
2. If U-joint knocking is suspected, inspect the bearing caps for roughness and excessive side-to-side play. Replace the appropriate parts if either condition is found.
3. Inspect the crosses and bearings for roughness and excessive side-to-side play. Replace the appropriate parts if either condition is found.

DISASSEMBLY

IMPORTANT: If any of the crosses and bearings are to be reused, liberally lubricate the crosses with Quicksilver U-joint and Gimbal Bearing Grease to help retain the needle bearings in the caps during disassembly.

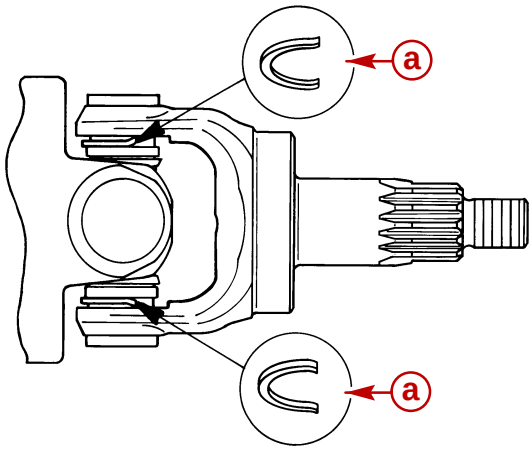
NOTE: *The U-joint has been changed to a Perm-A-Lube U-joint assembly following the serial number 0D899000. The serial numbers prior to 0D899000 do not use the Perm-A-Lube U-joint.*

NOTE: *If by previous inspection, it has been determined that the U-joint is not in need of servicing, skip this disassembly and the following reassembly section.*

⚠ CAUTION

Eye protection must be worn when performing the following procedure. Failure to do so may cause personal injury.

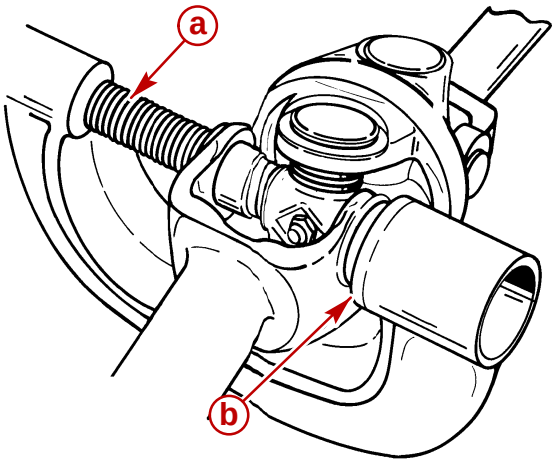
1. Remove the C-rings by driving them off with a punch and a hammer.



22179

a - C-ring

2. Using the adaptor and a U-joint press, press one bearing cap in until the opposite bearing is pressed out into the adaptor. Remove the loose bearing cap.



22180

a - U-joint Press
b - Adaptor (91-38756)

3. Turn the U-joint assembly 180 degrees and press on the cross until the second bearing is pressed out into the adapter. Remove each pair of bearing caps in this manner.

INSPECTION

1. Clean all components (except the bearing caps and bearings) with a suitable solvent and dry thoroughly with compressed air.
2. Inspect the bearing cap seals for damage or deterioration. Replace bearing caps and crosses if either condition is found.

IMPORTANT: If the crosses are found to be in need of replacement, all the needle bearings, caps and cross must be replaced. Do not reuse any individual component(s) of a cross assembly.

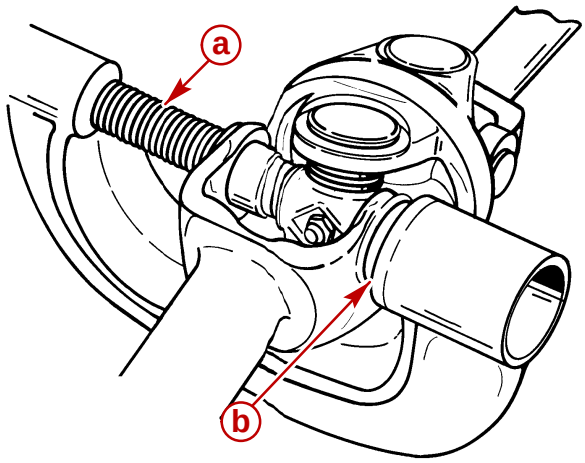
3. Inspect the bearing surfaces of the crosses for hairline fractures, excessive pitting, wear, grooves, scores, uneven wear, discoloration (from overheating) and embedded particles, or breakage. Replace the appropriate cross assembly (cross, bearings and caps) if any of these conditions exist.
4. Inspect all remaining components for excessive wear or damage. Replace the appropriate components if either is found.

REASSEMBLY

IMPORTANT: Use only Quicksilver U-joint and Gimbal Bearing Grease for lubricating the U-joint bearings. The use of any other lubricant will decrease the life of the bearings.

NOTE: *When initially positioning the crosses in the yoke, be sure that the grease fittings are facing toward the coupler (long end) yoke.*

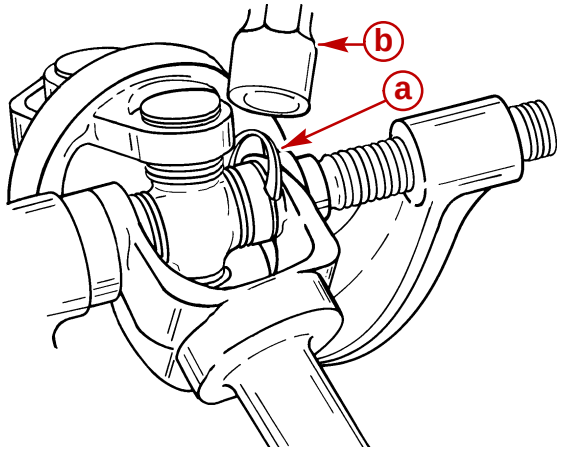
1. Using the adaptor and a U-joint press, assemble the cross between the yoke and press one bearing cup in until it is **nearly** through its yoke.



22180

a - U-joint Press
b - Adaptor (91-38756)

2. Turn the U-joint assembly 180 degrees and press the other bearing cup on until both cups are positioned correctly. Assemble each pair of bearings in this manner.
3. Install the C-rings into the groove of the bearing caps. Ensure that all of the C-rings are properly seated.



22182

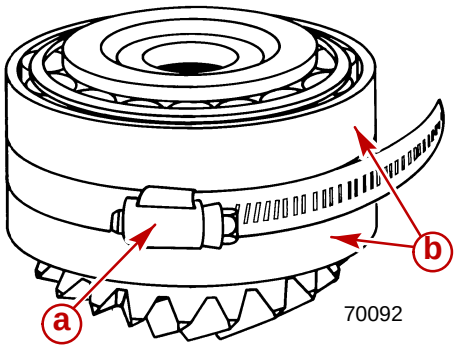
a - C-ring
b - Hammer

4. Repeat Step 1 for all pairs of bearings.
5. Lubricate the grease fittings with Quicksilver U-joint and Gimbal Bearing Grease.

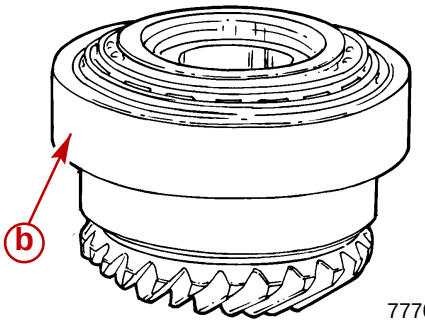
U-joint Assembly

REASSEMBLY

1. **On Models With Serial Numbers Prior To 0L100009:** temporarily install a hose clamp on the bearing assembly to keep the bearing cups aligned with the spacer while accomplishing the next step.



70092

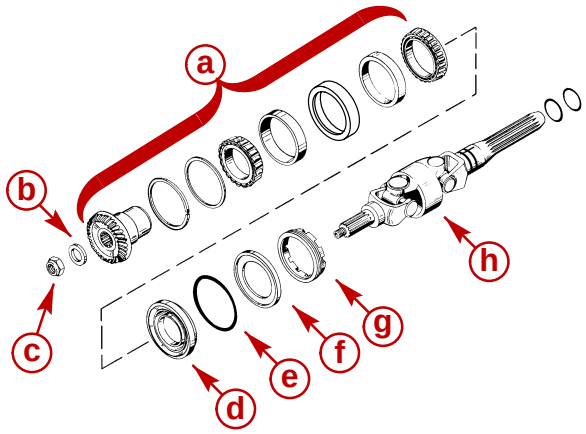


77709

. . . . . Earlier Style . . . . . Later Style

a - Hose Clamp
b - Bearing Cups

2. Assemble the retainer ring, thrust washer, O-ring and oil seal carrier. Then assemble the gear/bearing assembly, the washer and the nut. Tighten the nut finger tight.

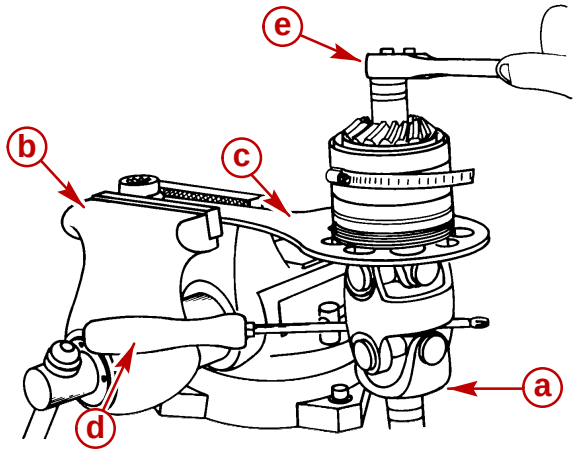


75632

a - Gear Assembly
b - Washer
c - Nut
d - Oil Seal Carrier
e - O-ring
f - Thrust Washer
g - Retainer Ring
h - U-joint Assembly

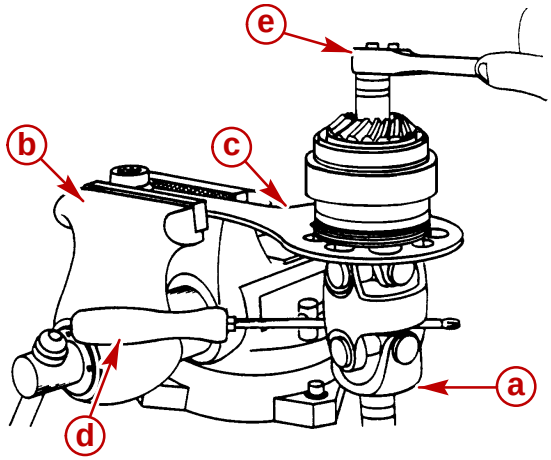
3. Place the U-joint into the U-joint retainer tool.

4. Insert a suitable tool, such as a screwdriver, between the U-joint yokes as shown in the next figure, to prevent the U-joint from rotating when turning down the pinion nut. Turn the pinion nut down until the preload is on the bearings. Remove the screwdriver or holding device.



70210

Models With Serial Numbers Prior To 0L100009



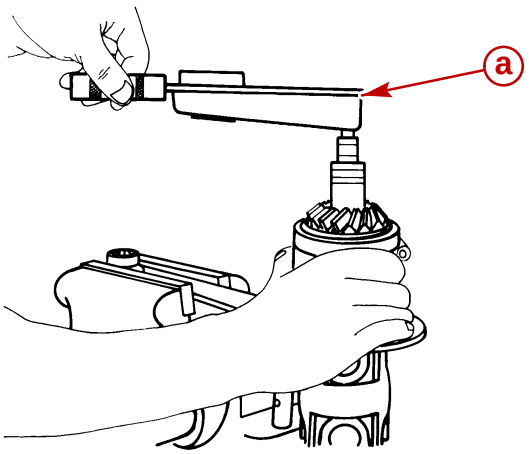
75633

Models With Serial Numbers After 0L100009

a - U-joint Assembly
b - Vice
c - U-joint Retainer Tool (91-17256)
d - Screwdriver
e - Socket and Ratchet Wrench

SETTING BEARING PRELOAD

1. Set the preload by holding the bearings and turning the pinion nut at least two full revolutions. Check preload by turning the pinion nut very slowly a third time and, while turning, take a reading of the preload. If the preload is under the specification of 8 lb-in. (0.9 Nm) [5.25 lb-in. (0.55 Nm) for used bearings], torque the pinion nut slightly more as instructed in the previous step. Recheck preload. Continue this sequence until the proper preload is achieved.



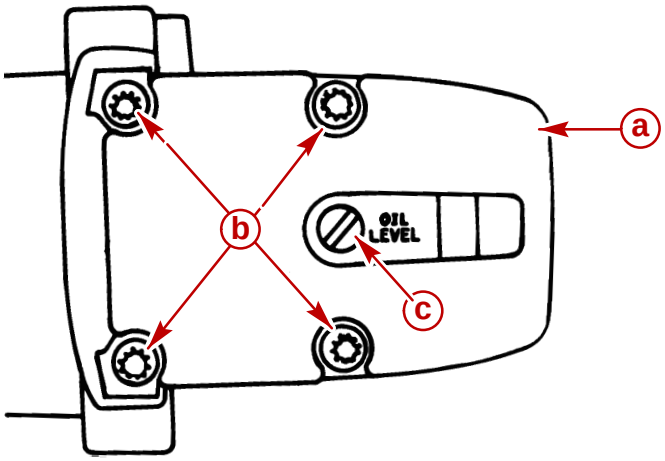
70212

a - Torque Wrench

IMPORTANT: If the preload goes over the specified limit of 8 lb-in. (0.9 Nm) [5.5 lb-in. (0.55 Nm) for used bearings], the bearings must be totally separated from the gear and reassembled following the appropriate previous instructions. Failure to follow these instructions will cause premature failure of the unit.

Top Cover Subassembly

INSPECTION



70118

a - Top Cover
b - Screws
c - Dipstick (Early Models)

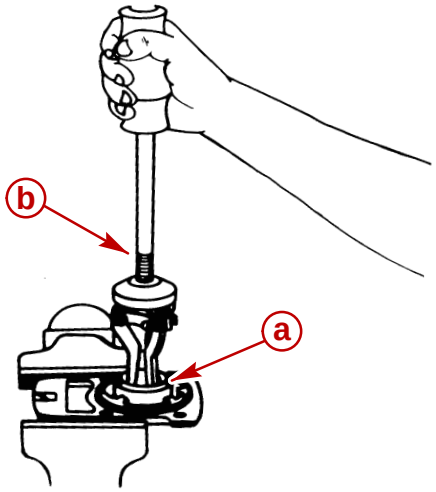
1. Remove and inspect the O-ring on the top cover for damage or deterioration. Replace it if either of these conditions exist.

2. Remove the top cover bearing cup and shim(s). Measure and make a note of the thickness of the shim pack. The shim(s) may be reused if they are not damaged.
3. Clean the top cover with a suitable solvent and a hard bristle brush. Ensure that all sealants and locking agents are removed. Dry the top cover thoroughly using compressed air.
4. Inspect the oil passage to ensure that it is clean and free of debris.
5. Inspect the bearing cup in the top cover for pits, grooves, scores, uneven wear, discoloration from overheating, or embedded particles. Replace it and the small bearing on the end of the upper drive shaft if any of these conditions exist.
6. Ensure that the bearing cup is not spinning in the top cover bore. If this condition exists, replace the top cover, the bearing cup and the bearing on the upper drive shaft.

DISASSEMBLY

NOTE: *Disassembly of the top cover is for replacement of the bearing cup or changing the thickness of the shim pack for adjusting the upper driven gear bearing preload or gear location.*

1. Remove the top cover bearing cup and shim(s). Measure and make a note of the thickness of the shim pack. The shim(s) may be reused if they are not damaged.
2. Inspect the top cover bearing cup bore for evidence of the bearing cup spinning in the bore. If this condition exists, replace the top cover, the bearing cup and the small bearing on the upper drive shaft.



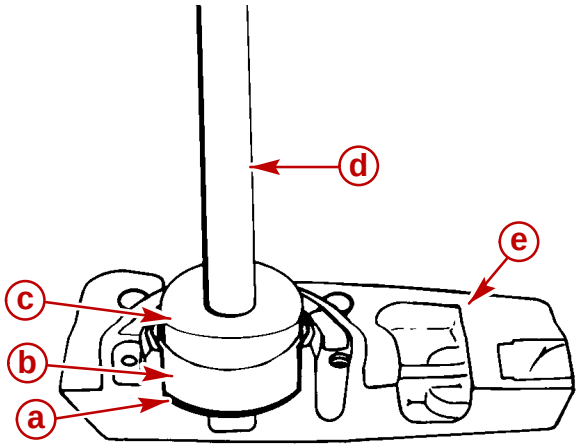
70127

a - Bearing Cup
b - Slide Hammer Puller (91-34569A1)

REASSEMBLY

NOTE: *If installing the top cover bearing race for the first time, use the same thickness of shims that were removed or a .015 in. (0.38 mm) shim pack if the original shim pack thickness is not known.*

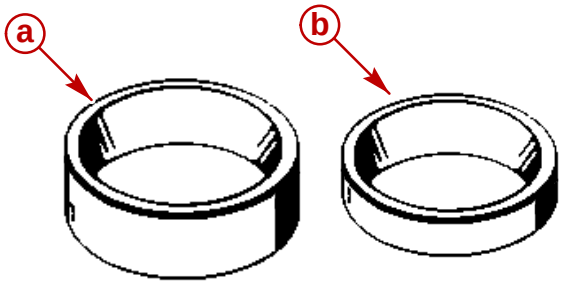
1. Lubricate the top cover bore with Quicksilver High Performance Gear Lube
2. Place the shims(s) into the top cover bore.
3. Install the bearing cup into the top cover using the tools as shown in the following figure.
4. Reinstall the top cover O-ring.



70701

a - Shims
b - Bearing Cup
c - Bearing Cup Driver (91-38918) Used With 31-61100A1 Bearing Or Bearing Cup Driver (91-808053) Used With 31-32575A1 Bearing
d - Driver Rod (91-37323)
e - Top Cover

NOTE: *The later style bearing cup is thinner than the earlier style cup.*

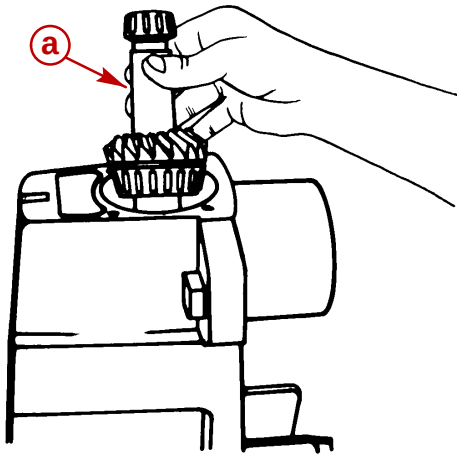


75240

a - Earlier Style Bearing Cup 1.938 in Diameter (Prior To S/N OF680000)
b - Later Style Bearing Cup 1.781 in. Diameter (S/N 680000 And Above)

Upper Driven Gear Subassembly

DISASSEMBLY



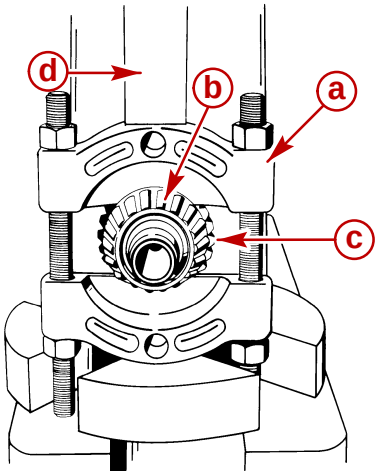
70124

a - Driven Gear Assembly

1. Clean the bearing race in the drive shaft housing and dry it thoroughly. Inspect it for excessive pits, grooves, scores, uneven wear, discoloration due to excessive heat and/or embedded particles. Replace the bearing and the bearing cup in the drive shaft housing (explained later in this section) if any of these conditions exist.

NOTE: *Disassembly of the upper driven gear assembly is for replacement of components only.*

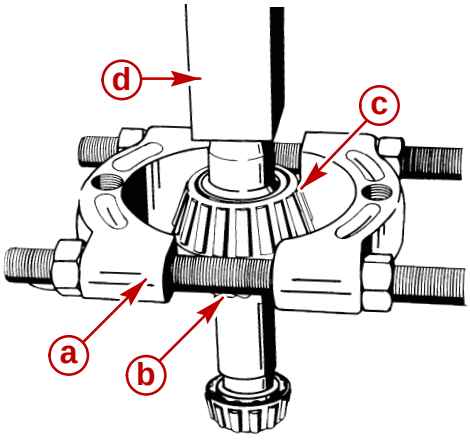
2. Position the Universal Puller Plate between the driven gear and the tapered roller bearing with the tapered side of the plate toward the roller bearing.
3. Press on the sides of plate until it bottoms out on the gear.



23265

a - Universal Puller Plate (91-37241)
b - Tapered Roller Bearing
c - Driven Gear
d - Arbor Press

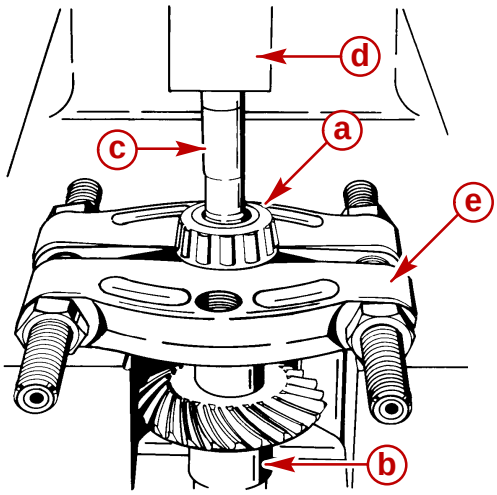
4. Reposition the plate and gear assembly and press the gear until the tapered roller bearing slides off. Ensure the puller plates are aligned on the press with the threaded rods on the support brackets of the press.



23264

a - Universal Puller Plate (91-37241)
b - Driven Gear
c - Tapered Roller Bearing
d - Arbor Press

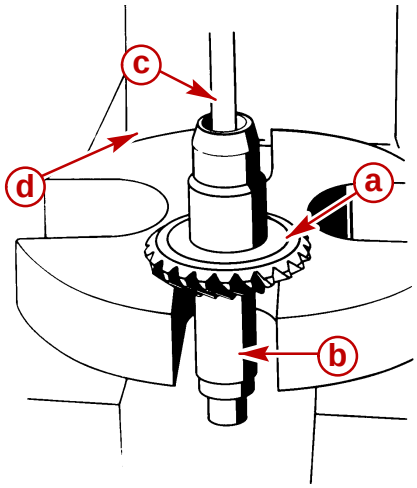
5. Reassemble the plate with the flat side of the plate toward the bearing and remove the small upper drive shaft tapered roller bearing using a suitable mandrel.



23265

a - Upper Drive Shaft Bearing (small)
b - Gear
c - Suitable Tool
d - Arbor Press
e - Universal Puller Plate (91-37241)

6. Press the driven gear from the upper drive shaft.



23266

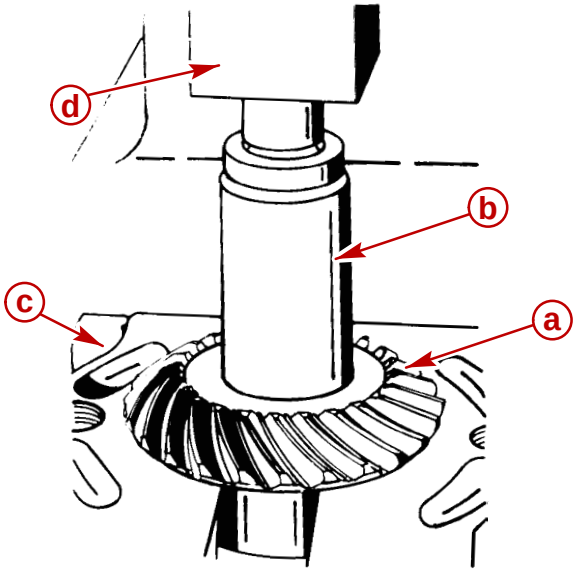
a - Driven Gear
b - Upper Drive Shaft
c - Suitable Tool
d - Arbor Press

INSPECTION

1. Clean all parts with a suitable solvent and dry them thoroughly with compressed air. Be careful not to spin the bearing.
2. Inspect the gear for pitting, chipped or broken teeth, hairline fractures and excessive or uneven wear. Replace both the drive (pinion) and the driven gear if any of these conditions exist.
3. Inspect the gear hub for evidence of the bearing spinning. Replace the tapered roller bearing, the driven gear and the pinion gear on the U-joint if any evidence of spinning is found.
4. Inspect the upper drive shaft for damage, hairline fractures and evidence of the gear spinning on the shaft. Replace the upper drive shaft, the driven gear and the pinion gear on the U-joint if any of these conditions are found.
5. Inspect the upper drive shaft to ensure that the hole through the center of the shaft is clean and clear. Clean out the hole if it has any debris.

REASSEMBLY

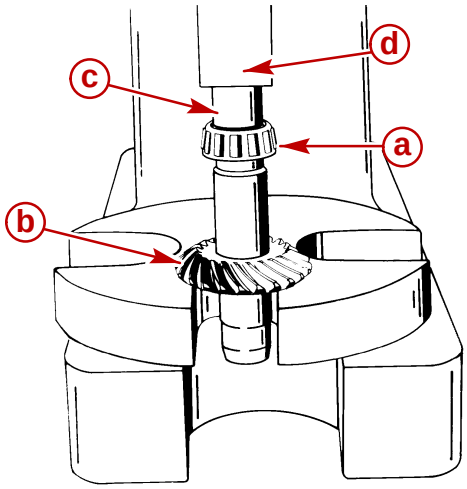
1. Press the upper drive shaft onto the driven gear until it bottoms.



23264

a - Driven Gear
b - Upper Drive Shaft
c - Universal Puller Plate (91-37241)
d - Arbor Press

2. Press the small tapered roller bearing onto the upper drive shaft until it bottoms out on the shaft.



23264

a - Tapered Roller Bearing (large)
b - Driven Gear
c - Suitable Tool (An Old Upper Driven Gear Bearing Inner Race)
d - Arbor Press

Drive Shaft Housing Reassembly

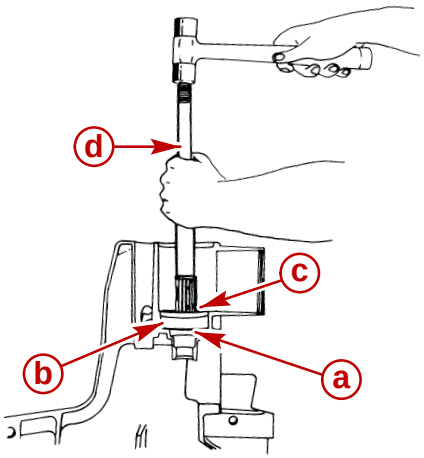
Drive Shaft Housing Inspection

1. Inspect the locating pin holes on the drive shaft housing (at the gear housing mating surface) to ensure that they are not elongated. Elongation of the holes may cause the drive shaft to break because the housings may not align properly when assembled.

Installation

NOTE: *If installing the upper driven gear bearing cup for the first time use the same thickness of shims that were removed or approximately a .015 in. (0.38mm) shim pack if the original shim pack thickness is not known.*

1. Lubricate the bore in the drive shaft housing (into which the upper driven gear bearing cup is to be installed) with Quicksilver High Performance Gear Lube.
2. Place the shim(s) into the bore of the drive shaft housing.
3. Install the upper driven gear bearing cup as shown below.



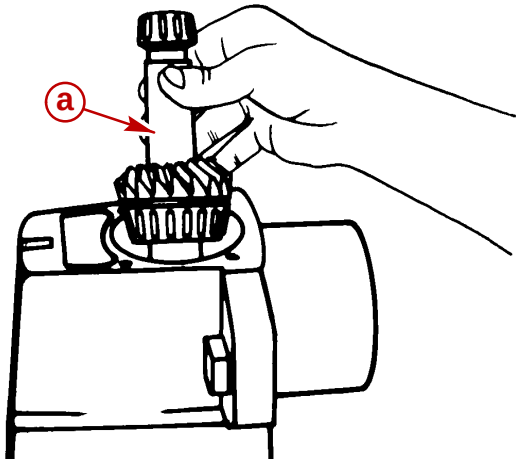
70445

a - Shims
b - Bearing Cup
c - Bearing Cup Driver (91-33493)
d - Driver Rod (An Old Propeller Shaft Shown)

IMPORTANT: Lightly lubricate the gears, bearings, seals and O-rings with Quicksilver High Performance Gear Lube before installing. Bearings and gears must be lubricated to obtain accurate preload readings.

IMPORTANT: The top cover screws must be torqued to 20 lb-ft (27 Nm), to properly check the upper drive shaft bearing preload.

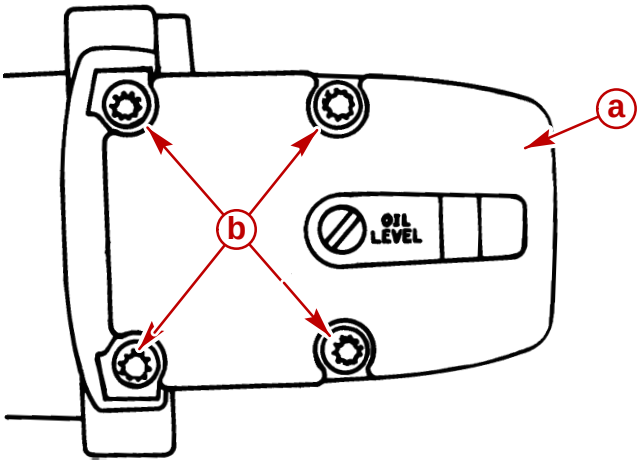
4. Lightly lubricate both of the bearings on the upper driven gear assembly with Quicksilver High Performance Gear Lube and install the upper driven gear assembly into the drive shaft housing.



70124

a - Upper Driven Gear Assembly

5. Install the top cover and torque the screws 20 lb-ft (27 Nm).

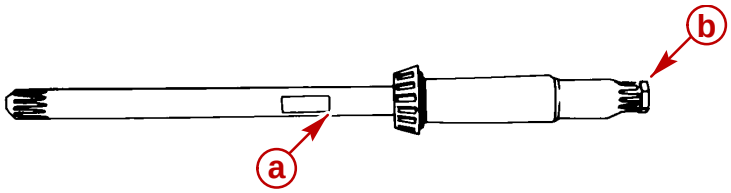


70118

a - Top Cover
b - Screws (4)

6. Check and adjust the upper driven gear bearing preload as follows:

   a. Insert a drive shaft with a pinion nut assembled to it into the upper driven gear splines.



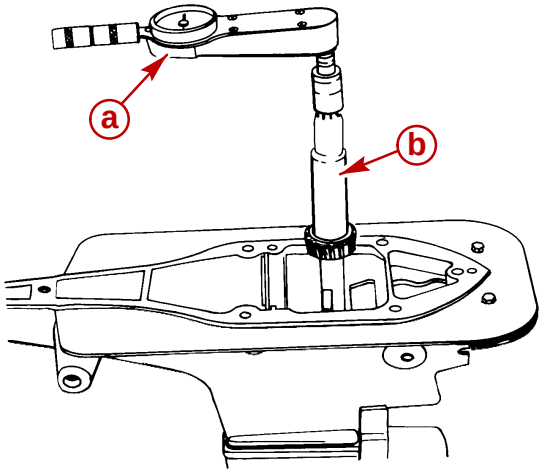
70702

a - Drive Shaft
b - Pinion Nut

   b. Using an inch - pound torque wrench, rotate the drive shaft clockwise at least two full turns. Check the preload by rotating the drive shaft very slowly in the same direction a third time and while rotating, take a reading of the preload. The preload reading should be within specification as follows:

New Bearings	6-10 in. lb. (0.7-1.7 Nm)
Used Bearings	3-7.5 in. lb. (0.3-0.8 Nm)

NOTE: *The bearings are considered used if spun under load once.*



70703

a - Torque Wrench
b - Drive Shaft

If the preload did not check to specification follow the appropriate instructions:

If The Preload Is Higher Than Specified: remove shims from beneath the top cover bearing cup. Reinstall the top cover and recheck the preload as outlined above.

If The Preload Is Lower Than Specified: add shims beneath the top cover bearing cup. Reinstall the top cover and recheck the preload as outlined above.

   c. Continue this process until the preload check is within specification.

Assembly and Checking Driven Gear Location

IMPORTANT: The upper driven gear preload must be to specification before checking the upper driven gear location.

1. Install the upper driven gear shimming tool into the drive shaft housing with the appropriate opening (see chart following) toward the upper driven gear and check the upper driven gear location as follows:

1997 1/2 AND EARLIER MODELS (S/N 0K999999 AND BELOW)

Shimming Tool 91-60526	
Overall Drive Unit Gear Ratio	**Tool Position**
1.47:1, 1.50:1	Z
1.65:1	X
1.84:1	Y
1.98:1	Y
2.40:1	Y

1998 AND LATER (S/N 0L100009 AND ABOVE)

Shimming Tool 91-854377	
Overall Drive Unit Gear Ratio	Tool Position
1.47:1	C
1.62:1	A
1.81:1	B
1.94:1	B
2.0:1	A
2.40:1	B

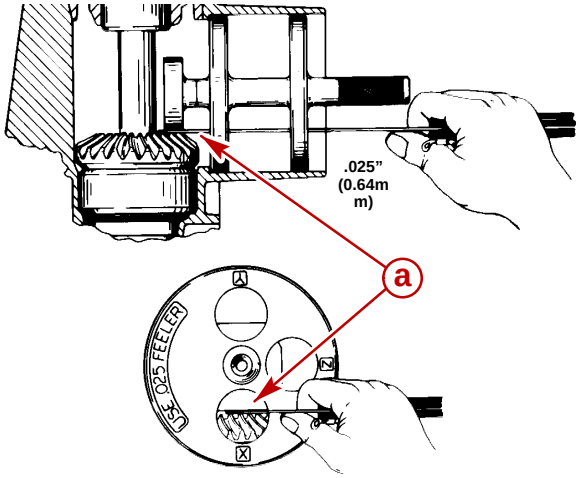
IMPORTANT: The following procedure must be done exactly as stated to properly check the upper driven gear location.

a. Position the gear so that at least two full teeth are centered on the gauging surface. One full tooth must be on each side of the gauging surface centerline. Insert a .025 in. (0.64 mm) feeler gauge between one of the teeth and the gauging surface.

b. Rotate the shimming tool until one side of the gauging surface contacts the feeler gauge and a slight drag is felt on the feeler gauge.

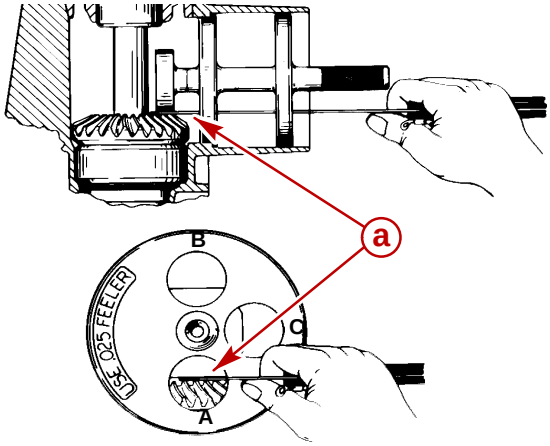
c. Without moving the shimming tool, remove the feeler gauge and re-insert it between the other tooth and the gauging surface.

If The Feeler Gauge Can Be Inserted With Only A Slight Drag: the shimming is correct.



23012

Shimming Tool 91-60526



75660

Shimming Tool 91-854377

a - Feeler Gauge - .025 in. (0.635 mm)

Adjusting Gear Location

IMPORTANT: If the feeler gauge can be inserted without any drag; the shimming is incorrect (the gear is to far away from the shimming tool). Repeat Steps a, b and c (as previously described) with progressively thicker feeler gauges until the gear location is known.

Example: (the gear is too far away from the shimming tool) the gear location is too low.		
If feeler gauge thickness is.	.30 in.	0.760 mm
Subtract specification	.025 in.	0.635 mm
you get	.005 in.	0.125 mm
Add this amount of shims beneath the driven gear assembly race in the drive shaft housing and subtract the same amount of shims from beneath the top cover bearing race.		

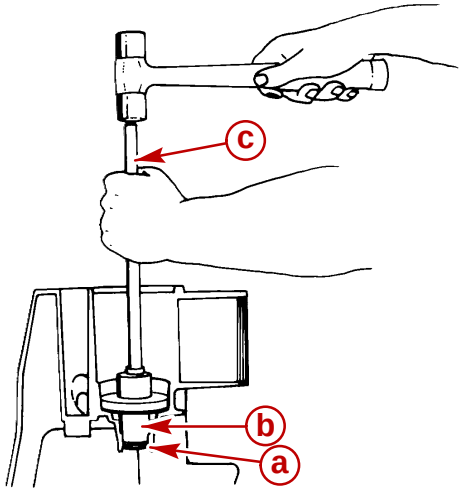
***If The Feeler Gauge Cannot Be Inserted On Both Sides Without Moving The Shimming Tool:** the shimming is incorrect (the gear is too close to the shimming tool). Repeat Steps a, b and c (as described on page 3A-23) with progressively thinner feeler gauges until the gear location is known.

Example: (the gear is too close to the shimming tool) the gear location is too high.		
Specification	.025 in.	0.635 mm
Subtract feeler gauge thickness:	.020 in.	0.510 mm
you get	.005 in.	0.125 mm
Subtract this amount of shims beneath the upper gear assembly race in the drive shaft housing and add the same amount of shims beneath the top cover bearing race.		

1. Reassemble the top cover as outlined in “Top Cover Assembly,” ‘Component Reassembly’ section and add or subtract the appropriate quantity of shims beneath the top cover bearing race.
2. Remove the upper driven gear assembly and remove the upper driven gear bearing cup as outlined in “Upper Driven Gear Bearing Cup,” ‘Removal’ section and add or subtract the appropriate quantity of shims beneath the upper driven gear bearing cup race.
3. Install the upper driven gear bearing cup.
4. Install the upper driven gear assembly and recheck preload.
5. Recheck the upper driven gear location.
6. Remove the top cover and upper driven gear assembly and upper driven gear bearing cup.

Seal Installation

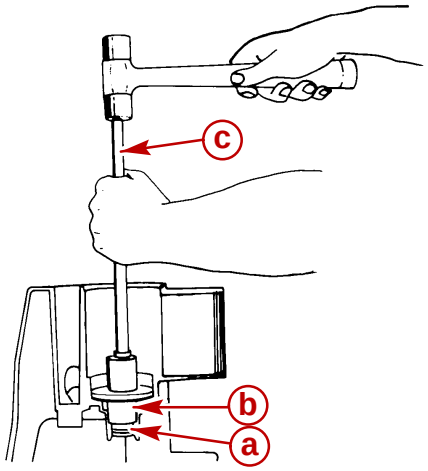
1. Lightly oil the bore with Quicksilver High Performance Gear Lube.
2. Assemble the first seal to the long end of the driver tool with the lip (spring) side facing away from the driver shoulder and press the seal into the bore.



70705

a - Oil Seal (Lip Down)
b - Drive Tool (91-817570) (Long End)
c - Driver Rod (91-37323)

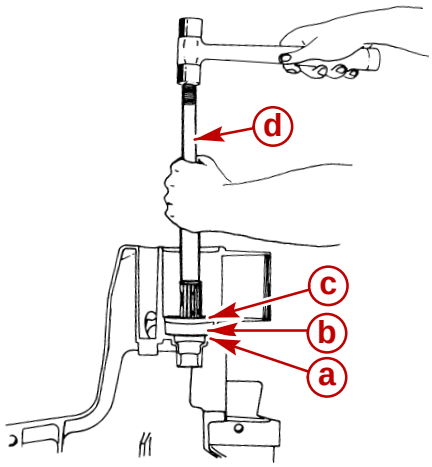
3. Lightly oil the bore again with Quicksilver High Performance Gear Lube.
4. Assemble the second seal to the short end of the driver tool with the lip (spring) side facing toward the driver shoulder and press the seal into the bore.



70706

a - Oil Seal (Lip Up)
b - Drive Tool (91-817570) (Short End)
c - Driver Rod (91-37323)

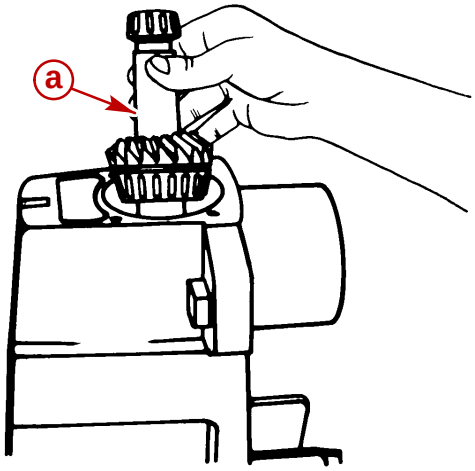
5. Reinstall the driven gear bearing cup and shims.



70445

a - Shims
b - Bearing Cup
c - Bearing Cup Driver (91-33493)
d - Driver Rod (An Old Propeller Shaft Shown)

6. Completely fill the space between the two seals with 2-4-C Marine Lubricant with Teflon and install the upper driven gear assembly. Do not install the top cover at this time.

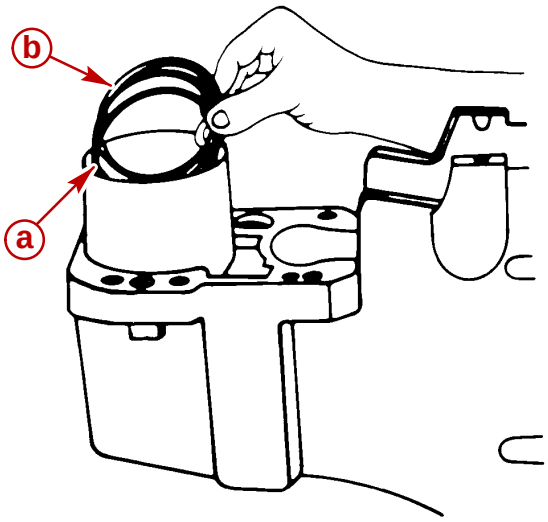


70124

a - Upper Driven Gear Assembly

NOTE: *Install the same thickness of shims as were originally removed during disassembly. If original shim thickness is not known, start with approximately a .015 in. (0.38 mm) shim pack.*

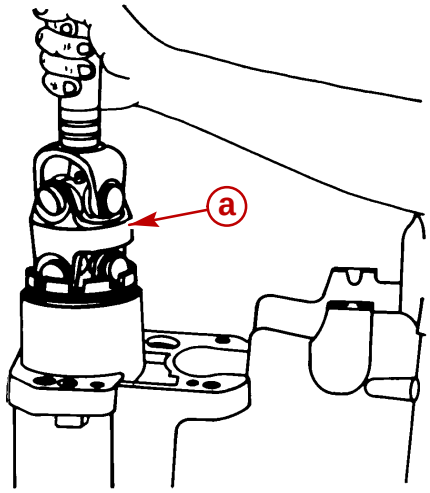
7. Place the spacer ring into the drive shaft housing U-joint bore and place the shims(s) into the bore.



70123

a - Spacer Ring (Installed First)
b - Shims

8. Lightly lubricate the drive shaft housing U-joint bore with Quicksilver High Performance Gear Lube.
9. Thoroughly lubricate the U-joint retainer threads on the U-joint retainer (not in the drive shaft housing bore) with Quicksilver Special Lubricant 101.
10. Install the U-joint assembly straight into the drive shaft housing and screw down the retainer using the following procedure.



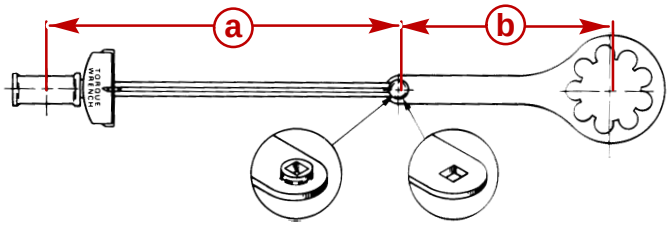
70122

a - U-joint Assembly

NOTE: *The torque wrench reading will be less than the actual torque being applied to the retainer, due to the torque reading being taken through the retainer wrench. Use the following procedure to torque the retainer to 200 lb-ft (271 Nm).*

11. Measure the length of the torque wrench as follows:
    a. On beam type torque wrenches, measure from the square drive to the fulcrum (pivot) point of the handle.
    b. On click-stop or dial type torque wrenches, measure from the square drive to the reference mark on the handle (marked with 2 bands, a line, etc.).
12. Use the following chart to determine the torque wrench reading required to properly torque the retainer to 200 lb-ft (271 Nm).

Torque Wrench Length In Inches (cm)	Torque Wrench Reading, in lb-ft (Nm) to achieve 200 lb-ft (271 Nm) of torque
15 (38)	111 (151)
16 (41)	114 (155)
17 (43)	117 (159)
18 (46)	120 (163)
19 (48)	123 (167)
20 (51)	125 (170)
21 (53)	127 (172)
22 (56)	129 (175)
23 (58)	131 (178)
24 (61)	133 (180)
25 (64)	135 (183)
26 (66)	136 (184)
27 (69)	138 (187)
28 (71)	140 (190)
29 (74)	141 (191)
30 (76)	143 (194)
31 (79)	144 (195)
32 (81)	145 (197)
33 (84)	147 (200)
34 (86)	148 (201)
35 (89)	149 (202)
36 (91)	150 (203)



26363

a - Torque Wrench Length
b - 12 in. retainer Wrench

a. Torque the retainer until the torque reading for your length of torque wrench is attained.

Checking and Adjusting Drive Gear Location

1. Install the drive gear shimming tool into the drive shaft housing with the appropriate opening (see chart following) toward the drive gear. Check the gear location as follows:

Shimming Tool 91-60523	
Overall Drive Unit Gear Ratio	**Tool Position**
1.47 or 1.50:1	Z
1.62 or 1.65:1	Y
1.81 or 1.84:1	Y
1.94 or 1.98:1	Y
2.0:1	Y
2.40:1	Y

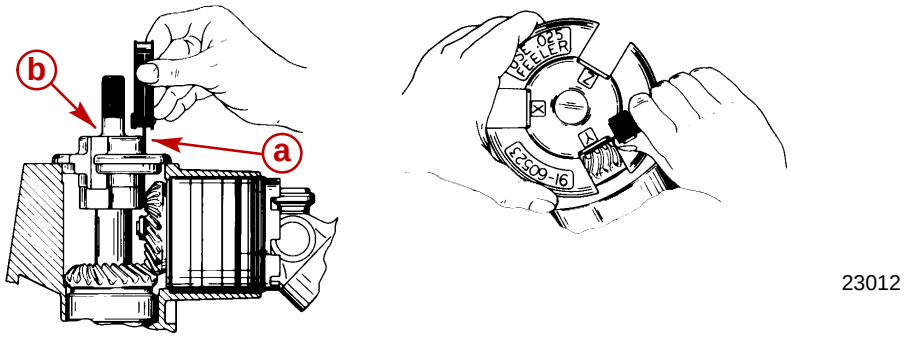
IMPORTANT: The following procedure must be done <u>exactly</u> as stated to properly check the upper driven gear location.

a. Position the gear so that at least two full teeth are centered on the gauging surface. One full tooth must be on each side of the gauging surface centerline. Insert a .025 in. (0.64 mm) feeler gauge between one of the teeth and the gauging surface.

b. Rotate the shimming tool until one side of the gauging surface contacts the feeler gauge and a slight drag is felt on the feeler gauge.

c. Without moving the shimming tool, remove the feeler gauge and re-insert it between the other tooth and the gauging surface.

NOTE: If the feeler gauge can be inserted with only a slight drag: *the shimming is correct (the gear is the correct distance from the shimming tool).*



23012

a - Feeler Gauge
b - Shimming Tool

ADJUSTING PINION GEAR LOCATION (U-JOINT ASSEMBLY)

NOTE: If the feeler gauge inserts with no drag: *the shimming is incorrect (the gear is too far away from the shimming tool). Repeat Steps a, b and c (as described previously) with progressively thicker feeler gauges until the gear location is known.*

Example: the gear location is too high (the gear is too far away from the shimming tool),		
If feeler gauge thickness is:	.030 in.	0.760 mm
Subtract specification	.025 in.	0.635mm
you get	.005 in.	0.125 mm
Remove the U-joint and subtract this amount of shims, then reinstall the U-joint.		

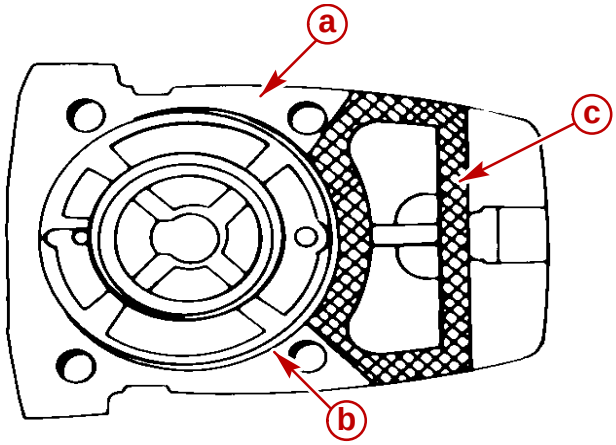
NOTE: If the feeler gauge cannot be inserted on both sides without moving the shimming tool: *the shimming is incorrect (the gear is too close to the shimming tool). Repeat Steps a, b and c above with progressively thinner feeler gauges until the gear location is known.*

Example: the gear location is too low (the gear is too close to the shimming tool)		
Specification	.025 In.	0.635 mm
Subtract feeler gauge thickness:	.020 In.	0.510mm
you get	.005 In.	.0125 mm
Add this amount of shims to position gear to its proper location.		

2. Recheck the pinion gear location as outlined previously and readjust if necessary.

Final Reassembly

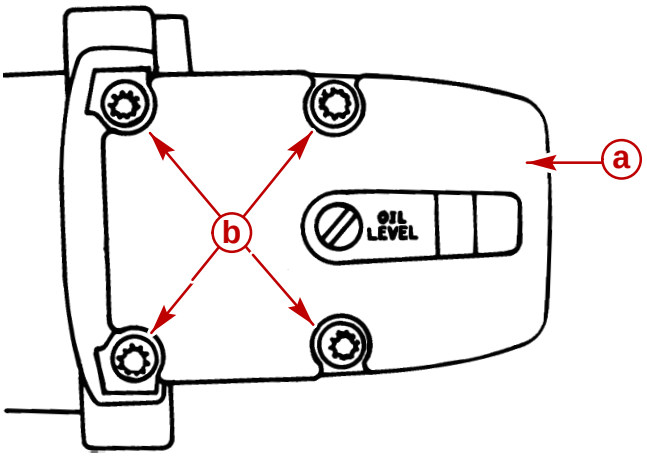
1. Assemble the O-ring to the top cover.
2. Apply Quicksilver Perfect Seal to the top cover (or the drive shaft housing) in the area highlighted in the next figure.



70725

a - Top Cover
b - O-ring
c - Quicksilver Perfect Seal

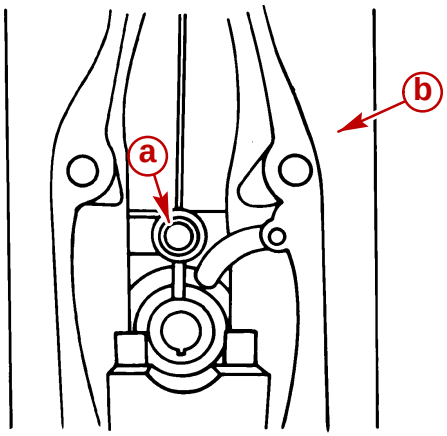
3. Install the top cover and torque the screws to 20 lb-ft (27 Nm).



70118

a - Top Cover
b - Screws

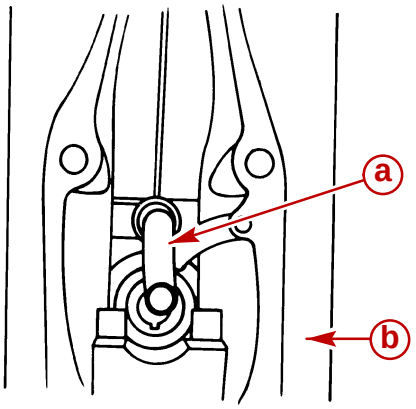
4. Install the rubber seal into the drive shaft housing.



70125

a - Rubber Seal
b - Drive Shaft Housing

5. Lubricate the end of the water tube (that goes into the drive shaft housing) with Quicksilver 2-4-C Marine Lubricant with Teflon. Install the water tube into the rubber seal in the drive shaft housing. Make sure that the tube is positioned with the bend towards the forward end of the unit and the longest straight section toward the gear housing mating surface.



70126

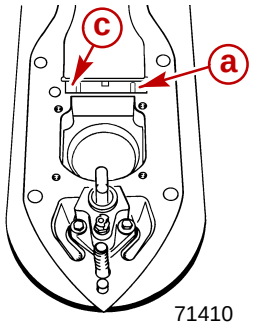
a - Water Tube (Correctly Positioned)
b - Drive Shaft Housing

Joining Drive Shaft Housing/Gear Housing

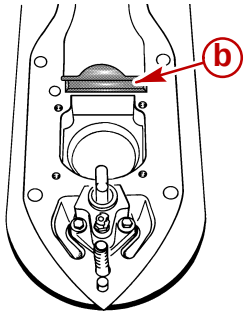
1. Lubricate the end of the water tube (in the drive shaft housing) and the splines of the drive shaft with Quicksilver 2-4-C Marine Lubricant with Teflon.

NOTE: *The aluminum dam in the gear housing has been changed to a rubber filler plug. If the aluminum water pump dam in the gear housing has become corroded or damaged, it can be replaced with the rubber filler plug.*

IMPORTANT: Ensure that the drain hole of the aluminum water pump dam is not clogged with any foreign material. Damage may occur if passage is blocked.



71410

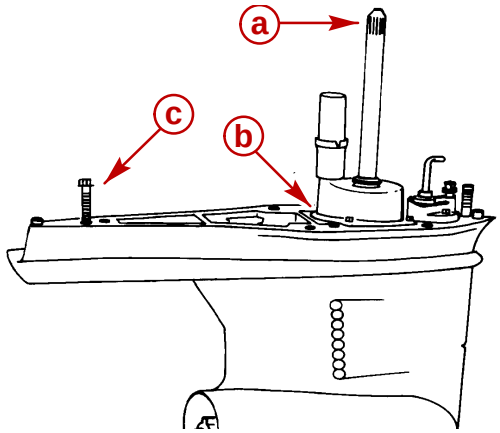


71436

a - Aluminum Dam
b - Rubber Filler Plug
c - Drain Hole

2. Units with an aluminum dam require a bead of Permatex Ultra Blue Silicone Sealant along the top of the dam. If rubber filler plug is present, it is not necessary to use this sealant.
3. To replace the aluminum dam if it has been removed and undamaged, place a bead of Permatex Ultra Blue Silicone Sealant down both sides of it.
4. Ensure that the water pump dam in the drive shaft housing is present and installed correctly. Ensure that all parts are present on the gear housing and the drive shaft housing.

IMPORTANT: Install the Trim Tab (or Anodic plate) bolt into the gear housing.

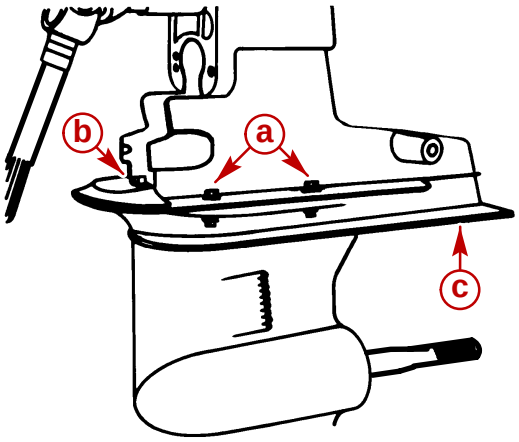


70710

a - Drive Shaft Splines
b - Sealant - Aluminum Dam Only
c - Trim Tab Bolt

5. Position the drive shaft housing straight above the gear housing. Align the water tube sleeve with the water tube and the drive shaft with the upper drive gear and assemble the drive shaft housing to the gear housing. It may be necessary to rotate the propeller shaft or the U-joint to align the drive shaft splines with the upper drive gear splines.

6. Assemble the front nut to the front stud of the unit.
7. Assemble the aft screw into the forward hole in the trim tab well of the gear housing.
8. Assemble the bolts, nuts and washers to the port and starboard sides of the unit.



70117

a - Nuts, Bolts, Washers
b - Nut
c - Screw

9. Assemble the trim tab (or anodic plate) and align it to the mark made previously on the gear housing. Torque the screw to 23 lb-ft (31 Nm).
10. Position drive unit so anti-ventilation plate is level.
11. Refill drive unit with gear lube. Refer to Section 1B.

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