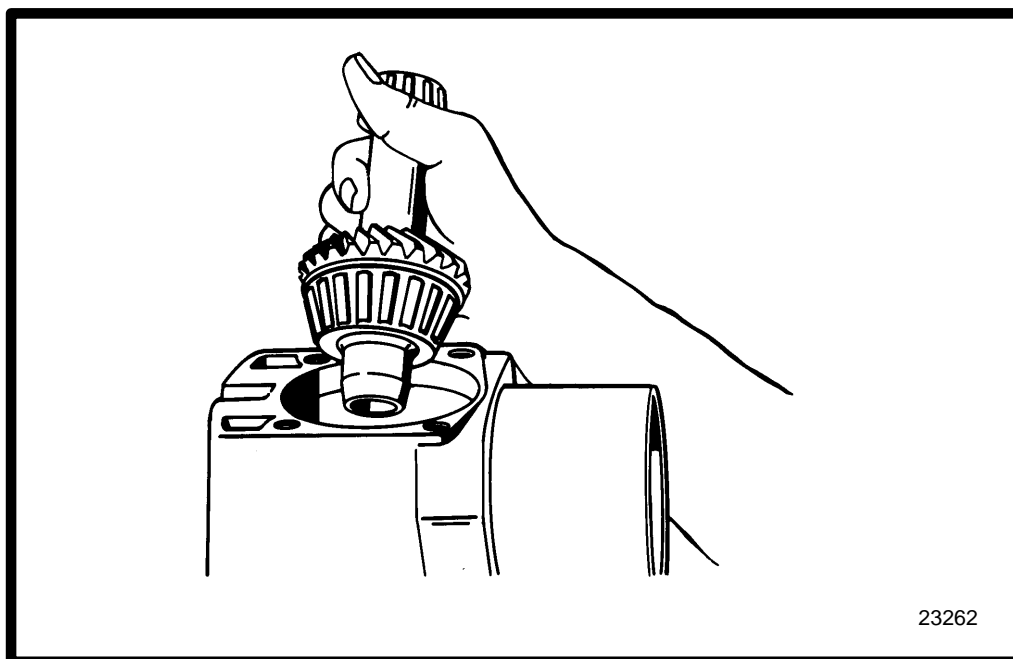


STERNDRIVE UNIT

3

A



DRIVE SHAFT HOUSING

Table of Contents

	Page		Page
Specifications	3A-1	Drive Unit Gear Ratio Identification	3A-8
Torque Specifications	3A-1	Drive Shaft Housing Exploded View	3A-11
Upper Drive Shaft Bearing Preload	3A-1	Drive Shaft Housing and Gear Housing Separation	3A-11
Gear Shimming Specifications	3A-1	Drive Shaft Housing Disassembly	3A-12
Lubricants/Sealers/Adhesives	3A-1	U-joint Assembly Servicing	3A-15
Special Tools	3A-1	Pre-Disassembly Inspection	3A-15
Overall Gear Ratios with 17/28		Disassembly	3A-16
Lower Gears	3A-2	Cleaning	3A-17
R/MR Models	3A-2	Reassembly	3A-18
Overall Gear Ratios When Serviced		U-joint Assembly-Setting Pinion Bearing Preload	3A-19
with 13/21 Lower Gears	3A-3	Upper Drive Shaft and Driven Gear Assembly Servicing	3A-20
R/MR Models	3A-3	Disassembly	3A-20
Overall Gear Ratio With 17/28		Cleaning	3A-22
Lower Gears	3A-4	Reassembly	3A-22
Alpha One / Alpha One SS Models	3A-4	Water Pocket Cover Servicing	3A-23
Overall Gear Ratio When Serviced With		Disassembly	3A-23
13/21 Lower Gears	3A-5	Cleaning and Inspection	3A-23
Alpha One / Alpha One SS Models	3A-5	Reassembly	3A-23
Special Information	3A-6	Drive Shaft Housing Reassembly and Shimming	3A-24
C-Ring Kit To Eliminate U-Joint Knocking	3A-6	Gear Housing Installation	3A-32
Remarking Mercruiser IR-IMR Sterndrive Units After Gear Ratio Conversion	3A-6	Alpha I And MC I Drive Shaft Changes	3A-32
Torquing U-joint Bearing Retainer	3A-7		
Torque Conversion Chart	3A-7		
Use Of Older Model Sterndrive Units On Mercruiser IR-IMR Models	3A-8		

Specifications

Torque Specifications

NOTE: Listed below are the torque specifications for those fasteners which have a specific torque value. Tighten all other fasteners (not listed) securely.

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N-m
Top Cover Screws		17-23	23-31
U-joint Retainer Nut		200	271
U-joint Drive Gear Nut		70-80	95-108
Water Pocket Cover Screws	30-40		3-4
Oil Vent Screw	30-50		3-6

Upper Drive Shaft Bearing Preload

DESCRIPTION	TORQUE	
	lb. in.	N-m
New Bearings	6-10	0.7-1
Used Bearings*	2.5-4	0.3-0.45

*Bearings are considered used if spun under load once.

Gear Shimming Specifications

DESCRIPTION	GEAR LOCATION	
	inches	millimeters
Drive Gear Height (Gears Marked "G-7")	.32	0.8
Drive Gear Height (All Others)	.025	0.64
Driven Gear Height	.025	0.64

Lubricants/Sealers/Adhesives

Description	Part No.
Quicksilver 2-4-C Marine Lubricant	92-825407A2
Quicksilver Special Lubricant 101	92-13872A1
Engine Coupler Spline Grease	92-816391A4
Quicksilver High Performance Gear Lube	92-816026A1
Loctite 27131	92-809820
Perfect Seal	92-34227--1

Special Tools

Description	Part No.
Adaptor	91-38756
Engine Alignment Tool	91-57797A3
Alignment Tool Assembly	91-805475A1
Bearing Cup Driver	91-38918
Bearing Driver Cup	91-33493
Oil Seal Driver	91-43591
Shimming Tool (Driven Gear)	91-60526
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

Overall Gear Ratios with 17/28 Lower Gears

R/MR Models

Model	1.32:1 (Drive/Driven) 20/16	1.50:1 22/20	1.65:1 24/24	1.84:1 17/19	1.98:1 20/24	2.40:1 20/24
120R					S	H ¹
120MR					S	H ¹
140R					S	H ¹
140MR					S	H ¹
170MR			O	S	O	
185R			O	S	O	
185MR			O	S	O	
190MR			O	S	O	
200MR		O	S	O	O	
205MR		O	S	O	O	
228R		S	O	O		
230MR		S	O	O		
260R	S ²	S	O	O		
260MR		S	O	O		
300MR		S	O	O		
470R			O	S	O	
488R			O	S	O	
898R		S	S ³	O		

S: Standard

O: Optional

H: High Elevation Only

¹: Ratio Changed in Gear Housing must be changed by dealer-not a factory option

²: Some Models This Ratio Standard

³: Newer Models This Ratio Standard

Overall Gear Ratios When Serviced with 13/21 Lower Gears

R/MR Models

Model	1.29:1 (Drive/Driven) 20/16	1.47:1 22/20	1.62:1 24/24	1.81:1 17/19	1.94:1 20/24	2.40:1 20/24
120R					S	H ¹
120MR					S	H ¹
140R					S	H ¹
140MR					S	H ¹
170MR			O	S	O	
185R			O	S	O	
185MR			O	S	O	
190MR			O	S	O	
200MR		O	S	O	O	
205MR		O	S	O	O	
228R		S	O	O		
230MR		S	O	O		
260R	S ²	S	O	O		
260MR		S	O	O		
300MR		S	O	O		
470R			O	S	O	
488R			O	S	O	
898R		S	S ³	O		

S: Standard
O: Optional
H: High Elevation Only

¹: Ratio Changed in Gear Housing must be changed by dealer-not a factory option

²: Some Models This Ratio Standard

³: Newer Models This Ratio Standard

Overall Gear Ratio with 17/28 Lower Gears

Alpha One / Alpha One SS Models

Model	1.32:1 (Drive/Driven) 20/16	1.50:1 22/20	1.65:1 24/24	1.84:1 17/19	1.98:1 20/24	2.40:1 20/24
120 Alpha One					S	H ¹
140 Alpha One					S	H ¹
165 Alpha One			O	S	O	
170 Alpha One			O	S	O	
175 Alpha One			O	S	O	
180 Alpha One			O	S	O	
185 Alpha One			O	S	O	
190 Alpha One			O	S	O	
200 Alpha One		O	S	O		
205 Alpha One			O	S	O	
230 Alpha One		S	O	O		
260 Alpha One		S	O	O		
300 (Tempest) Alpha One		S	O	O		
320 EFI Alpha One		S ²				
320 EFI Alpha One SS		S ²				
350 Magnum Alpha One		S ^{3,4}				
454 Magnum Alpha One	S					
454 Magnum Alpha One SS	S					
2.5 Litre Alpha One					S	H ¹
3.0 Litre Alpha One					S	H ¹
3.7 Litre Alpha One			O	S	O	
3.7 LX Alpha One			O	S	O	
4.3 Litre Alpha One			O	S	O	
4.3 LX Alpha One			O	S	O	
5.0 Litre Alpha One		O	S	O		
5.0 LX Alpha One		S ³	O	O		
5.7 Litre Alpha One		S ³	O	O		

S: Standard

O: Optional

H: High Elevation Only

¹: Ratio Changed in Gear Housing must be changed by dealer-not a factory option

²: Use 1.5:1 Heavy Duty Gears P/N 43-14010A1 set (320 EFI Only)

³: Drive Shaft Housing Gears P/N 43-18410A2 Gear set is replacement for P/N 43-59832A2 gear set

⁴: Use Replacement Lower Gear Housing Gears P/N 43-17064A3 (Propeller shaft identified with letter "M")

Overall Gear Ratio When Serviced with 13/21 Lower Gears

Alpha One / Alpha One SS Models

Model	1.32:1 (Drive/Driven) 20/16	1.50:1 22/20	1.65:1 24/24	1.84:1 17/19	1.98:1 20/24	2.40:1 20/24
120 Alpha One					S	H ¹
140 Alpha One					S	H ¹
165 Alpha One			O	S	O	
170 Alpha One			O	S	O	
175 Alpha One			O	S	O	
180 Alpha One			O	S	O	
185 Alpha One			O	S	O	
190 Alpha One			O	S	O	
200 Alpha One		O	S	O		
205 Alpha One			O	S	O	
230 Alpha One		S	O	O		
260 Alpha One		S	O	O		
300 (Tempest) Alpha One		S	O	O		
320 EFI Alpha One		S ²				
320 EFI Alpha One SS		S ²				
350 Magnum Alpha One		S ^{3,4}				
454 Magnum Alpha One	S					
454 Magnum Alpha One SS	S					
2.5 Litre Alpha One					S	H ¹
3.0 Litre Alpha One					S	H ¹
3.7 Litre Alpha One			O	S	O	
3.7 LX Alpha One			O	S	O	
4.3 Litre Alpha One			O	S	O	
4.3 LX Alpha One			O	S	O	
5.0 Litre Alpha One		O	S	O		
5.0 LX Alpha One		S ³	O	O		
5.7 Litre Alpha One		S ³	O	O		

S: Standard

O: Optional

H: High Elevation Only

¹: Ratio Changed in Gear Housing must be changed by dealer-not a factory option

²: Use 1.5:1 Heavy Duty Gears P/N 43-14010A1 set (320 EFI Only)

³: Drive Shaft Housing Gears P/N 43-18410A2 Gear set is replacement for P/N 43-59832A2 gear set

⁴: Use Replacement Lower Gear Housing Gears P/N 43-17064A3 (Propeller shaft identified with letter "M")

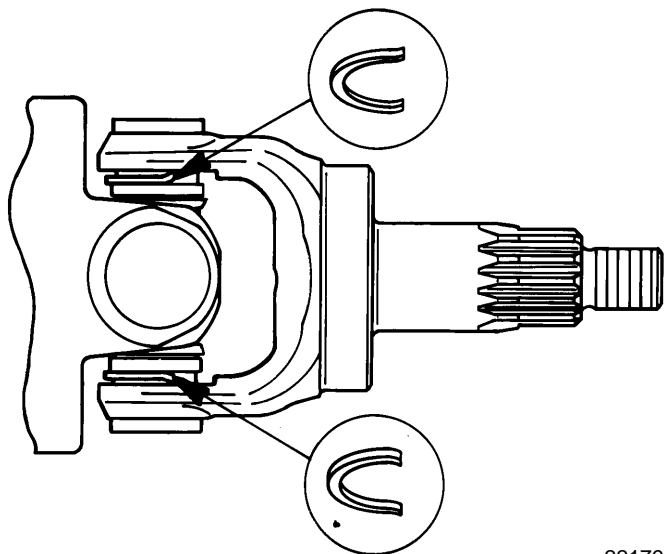
Special Information

C-Ring Kit To Eliminate U-Joint Knocking

If you encounter a MerCruiser I-R/I-MR sterndrive with a U-joint knocking or vibrating problem when turning or trimming, the problem may be caused by excessive side-to-side play in the U-joint cross and bearing assemblies. Replace standard cross and bearing assembly C-rings with C-ring Kit 53-12067A1. Kit contains 8 C-rings, which is enough for 1 drive unit. C-rings are curved at the ends and must be installed with the curve toward the yoke or center socket. Be sure C-rings are seated in grooves.

IMPORTANT: New C-rings can be used with original cross and bearing assemblies only. C-rings cannot be used with service replacement Spicer cross and bearing assembly 41431 as grooves in bearing caps are too narrow.

C-ring Kit 53-12067A1

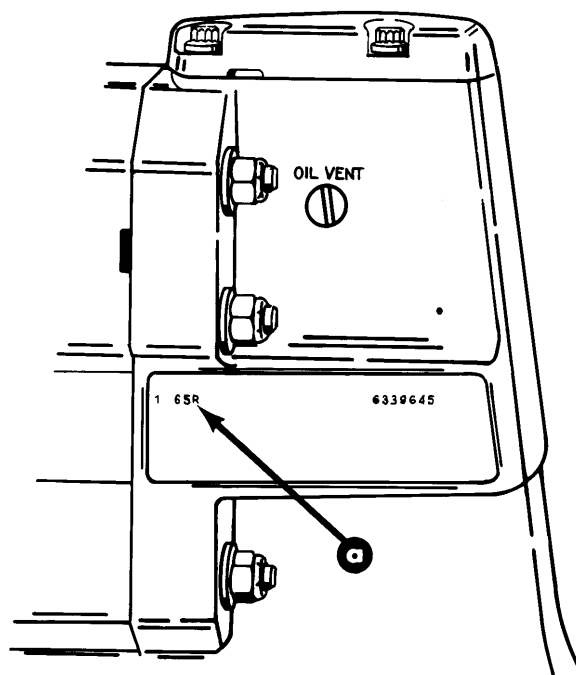


22179

C-ring Installation

Remarking Mercruiser IR-IMR Sterndrive Units After Gear Ratio Conversion

MerCruiser IR-IMR sterndrive units have the gear ratio stamped into the decal on the drive shaft housing. Should it be necessary to convert one of these units to a different gear ratio, be sure to mark the decal with the appropriate ratio. The customer also should be advised as to what gear ratio his unit is equipped with.



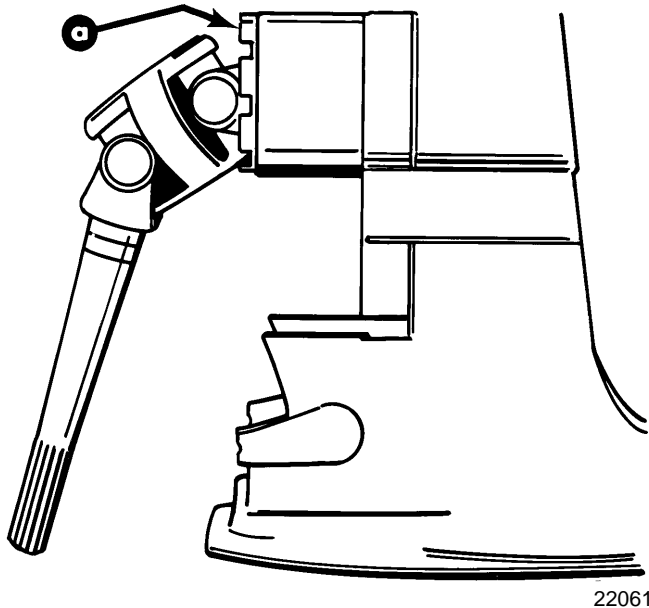
23263

Sterndrive Unit Gear Ratio Location

a - Gear Ratio

Torquing U-joint Bearing Retainer

1. Torque U-joint bearing retainer to 200 lb. ft. (271 N·m). Use the following procedure to allow torquing retainer with a torque wrench.



U-joint Bearing Retainer

a - Retainer

- a. Use Bearing Retainer Wrench 91-17256.
- b. Measure length of torque wrench as follows:
On beam-type torque wrenches, measure from square drive to fulcrum (pivot) point of handle.

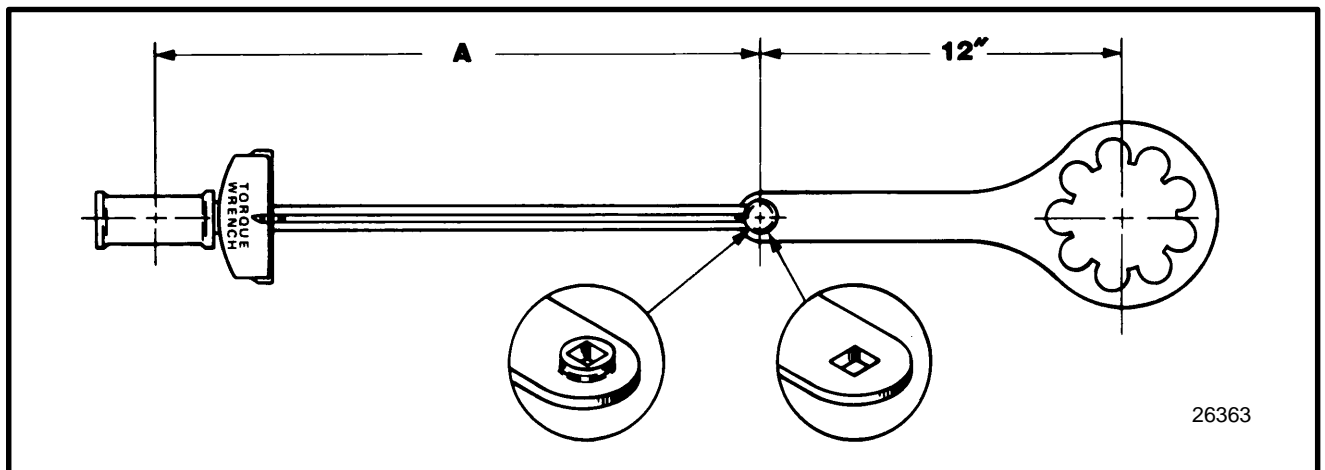
On click-stop or dial type torque wrenches, measure from square drive to reference mark on handle (2 bands, etc.).

2. Torque wrench reading will be less than actual torque being applied to retainer, due to torque reading being taken through retainer wrench. Use the following chart to determine torque wrench reading required to properly torque retainer.

TORQUE CONVERSION CHART

Torque Wrench Length in Inches (cm)	Torque Wrench Reading in Lb. Ft. (N·m)
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)

3. Torque retainer until prescribed reading is attained on torque wrench.

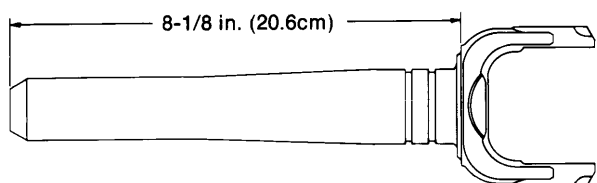


Machining Square in Retainer Wrench 91-36235

a - Torque Wrench Length

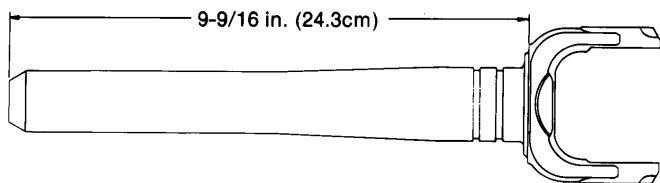
Use Of Older Model Sterndrive Units On Mercruiser IR-IMR Models

Mercury Marine does not recommend the use of older model sterndrive units on IR-IMR models, as the units will not mate up satisfactorily with the transom assembly. In addition, the older in-line model sterndrive units are equipped with U-joint coupling end yoke (39385A1). This yoke is shorter than yoke (59830A1) used on the IR-IMR sterndrive units and therefore, will not fully engage the engine coupler splines. **USE OF AN OLDER IN-LINE MODEL STERNDRIVE UNIT ON A IR-IMR MODEL WILL RESULT IN A SPLINE FAILURE TO COUPLING AND/OR YOKE.**



26363

U-joint Coupling End Yoke (39385A1) Used On Older In-Line Models



26363

U-joint Coupling End Yoke (59830A1) Used On Mercruiser IR-IMR Models

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 proceeding with any repairs. The first place to look is on the decal on the port side of the drive housing. It will have a number such as (1.50R) and then the seal 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

B = 1.98:1 & 1.94:1

C = 1.65:1 & 1.62:1

D = 1.84:1 & 1.81:1

F = 1.50:1 & 1.47:1

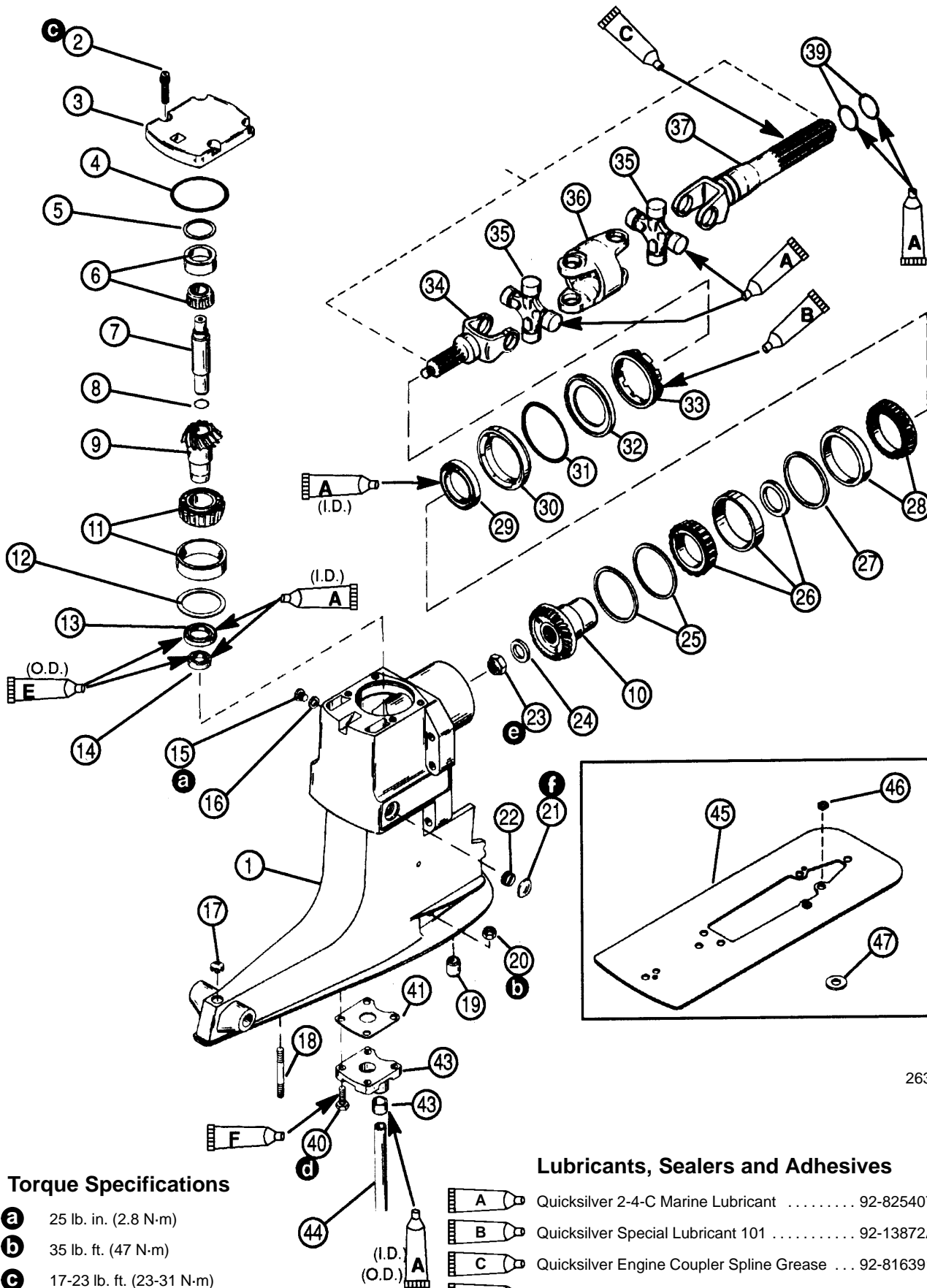
H = 1.32:1 & 1.29:1

M = 1.50:1 & 1.47:1 MAGNUM

This will be true for new drive units or drive units that have not been serviced. A drive unit could have had the gear ratio changed for high altitude or had the lower unit gears changed to a more recent version, which would void out any application of the above chart. The gear ratio would then 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.

Ratio	ALPHA	
	Drive	Driven
1.98:1 & 1.94:1	20	24
1.84:1 & 1.81:1	17	19
1.65:1 & 1.62:1	24	24
1.50:1 & 1.47:1	20	22
1.32:1 & 1.29:1	20	16

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26362

Torque Specifications

- a** 25 lb. in. (2.8 N-m)
- b** 35 lb. ft. (47 N-m)
- c** 17-23 lb. ft. (23-31 N-m)
- d** 30-40 lb. in. (3-4 N-m)
- e** 70-80 lb. ft. (95-108 N-m)
- f** 30-50 lb. in. (3.4-5.7 N-m)

Lubricants, Sealers and Adhesives

- A** Quicksilver 2-4-C Marine Lubricant 92-825407A2
- B** Quicksilver Special Lubricant 101 92-13872A1
- C** Quicksilver Engine Coupler Spline Grease ... 92-816391A4
- D** Quicksilver High Performance Gear Lube 92-816026A1
- E** Quicksilver Loctite 27131 92-809820
- F** Quicksilver Perfect Seal 92-34227-1

Drive Shaft Housing Exploded View

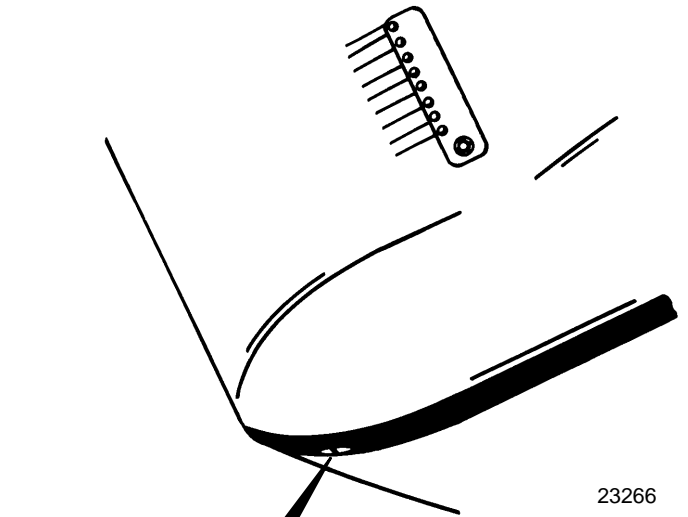
- 1 - Drive Shaft Housing
- 2 - Screw, Top Cover (4)
- 3 - Top Cover
- 4 - O-ring, Top Cover
- 5 - Shim, Bearing Cup To Top Cover
- 6 - Bearing Assembly, Drive Shaft
- 7 - Upper Drive Shaft
- 8 - O-ring, Upper Drive Shaft
- 9 - Driven Gear
- 10- Drive Gear
- 11- Roller Bearing Assembly, Driven Gear
- 12- Shim, Drive Gear Bearing Cup
- 13- Oil Seal, Upper-Drive Shaft Housing
- 14- Oil Seal, Lower-Drive Shaft Housing
- 15- Vent Screw
- 16- Sealing Washer, Vent Screw
- 17- Plug, Trim Tab Hole
- 18- Stud, Drive Shaft Housing (4)
- 19- Bushing, Drive Shaft Housing
- 20- Nut, Gear Housing Stud (3)
- 21- Welch Plug, Drive Shaft Housing
- 22- Pipe Plug, Water Pocket
- 23- Nut, Drive Gear To U-joint
- 24- Washer, Drive Gear To U-joint Nut
- 25- Shim, Bearing Cup
- 26- Roller Bearing Assembly, Drive Gear-Note 1
- 27- Spacer, Roller Bearing Cups
- 28- Roller Bearing Assembly, Drive Gear
- 29- Oil Seal, Carrier Assembly
- 30- Carrier Assembly, Oil Seal
- 31- O-ring, Oil Seal Carrier Assembly
- 32- Ring, Roller Bearing Retainer
- 33- Retainer
- 34- Yoke, U-joint-Gear End
- 35- Cross And Bearing Assembly, U-joint
- 36- Socket, Center U-joint
- 37- Yoke Assembly, U-joint-Coupling End
- 38- U-joint Assembly
- 39- O-ring, U-joint
- 40- Screw, Water Pocket Cover To Drive Shaft Housing (4)
- 41- Gasket, Water Pocket Cover
- 42- Water Pocket Cover
- 43- Seal, Rubber-Water Pocket Cover
- 44- Water Tube, Water Pocket Cover
- 45- Splash Plate Kit
- 46- Seal, Splash Plate Kit
- 47- Washer, Splash Plate Kit

NOTE 1: This item will not be included in Later Model units or when ordering the following gear sets:

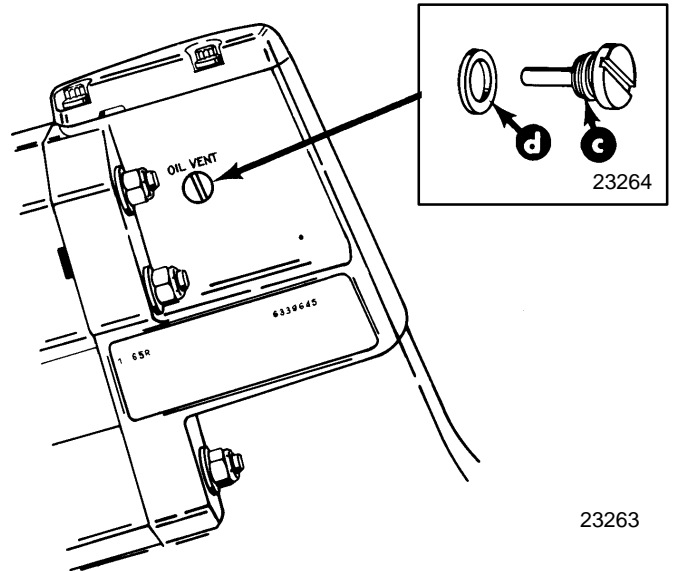
- 43-18411A2
- 43-45814A5
- 43-55778A3
- 43-75325A3

Drive Shaft Housing and Gear Housing Separation

1. Tilt drive unit at a 45 degree angle, remove fill/drain screw then remove drive shaft housing vent screw. Allow drive unit to drain completely.

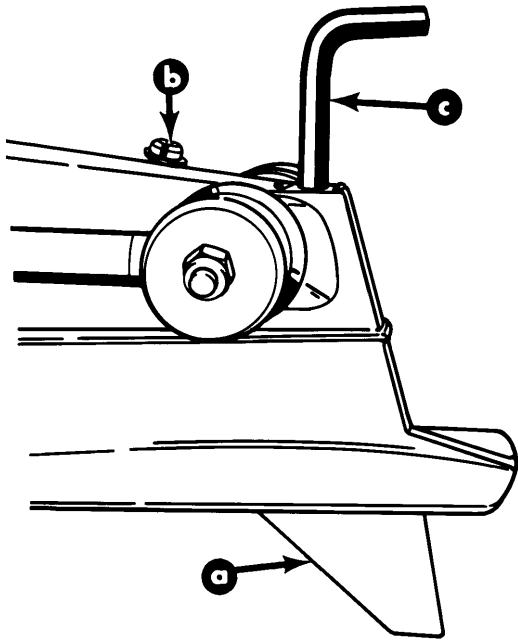


a - Fill/Drain Screw
b - Sealing Washer



c - Vent Screw
d - Sealing Washer

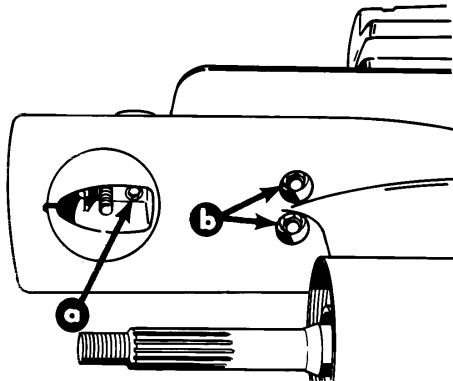
2. Mark position of trim tab with a piece of tape. Remove trim tab.



23253

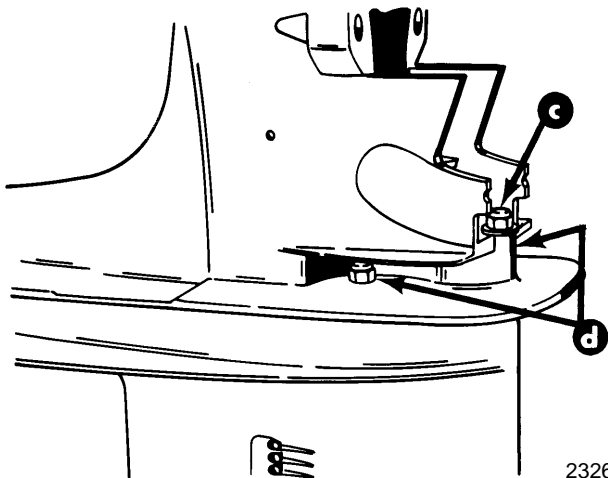
- a - Trim Tab
- b - Plastic Plug
- c - 3/8 in. Hex Wrench

3. Remove gear housing from drive shaft housing.



23263

- a - Hex Screw (Allen Screw)
- b - Locknuts

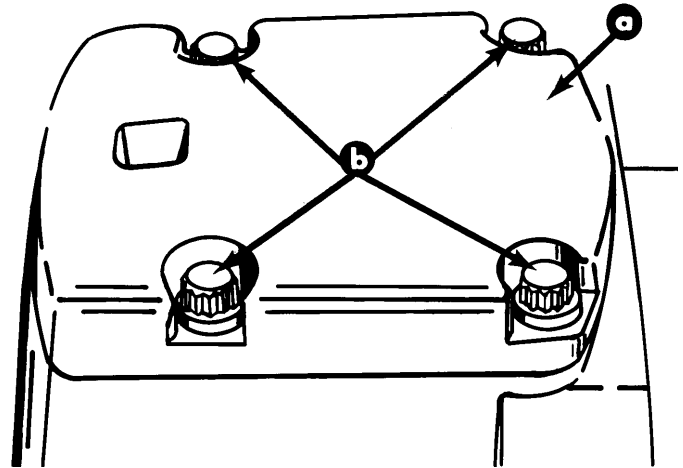


23261

- c - Locknut (1)
- d - Locknut (2)-One each side

Drive Shaft Housing Disassembly

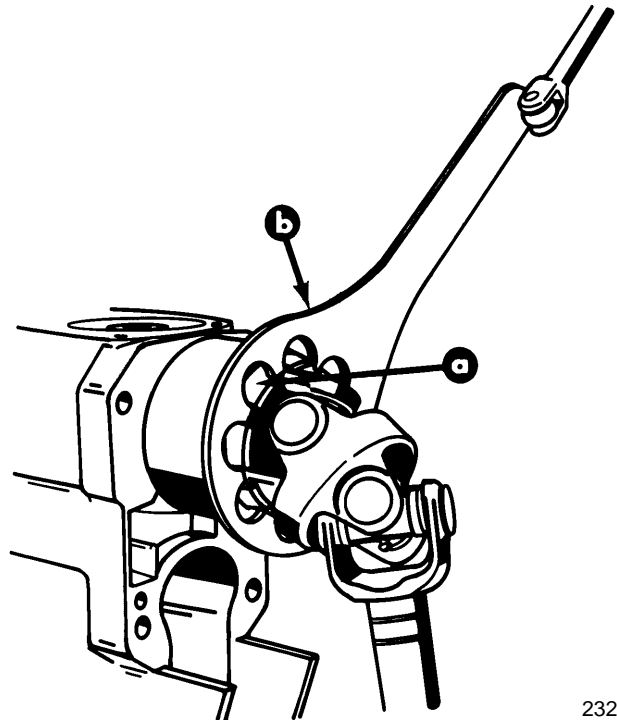
1. Remove top cover.



23261

- a - Top Cover
- b - Screws (4)

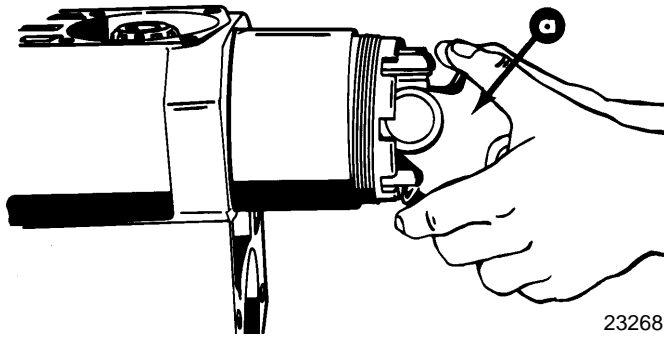
2. Loosen bearing retainer.



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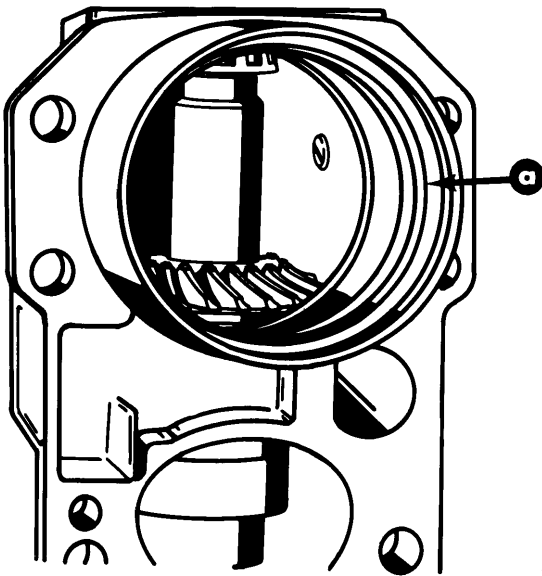
- a - Bearing Retainer
- b - Bearing Retainer Wrench (P/N 91-17256)

3. Remove U-joint Assembly by pulling straight out.



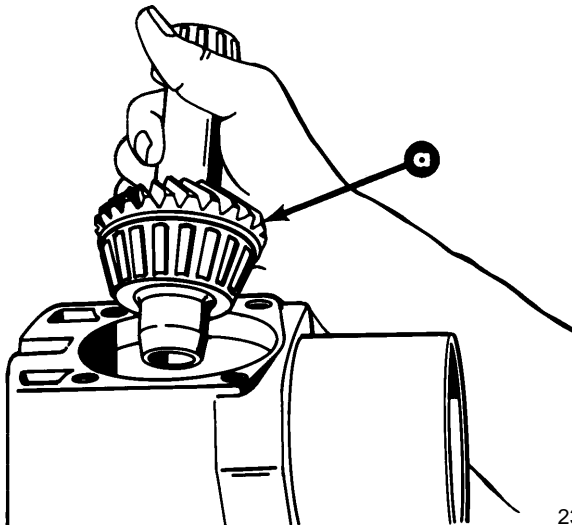
a - U-joint Assembly

4. Remove and retain shims.



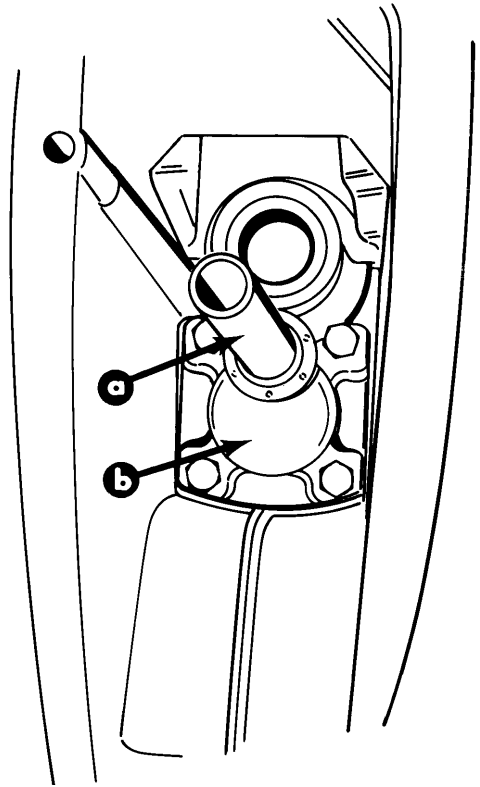
a - Shims

5. Remove upper drive shaft and driven gear assembly.



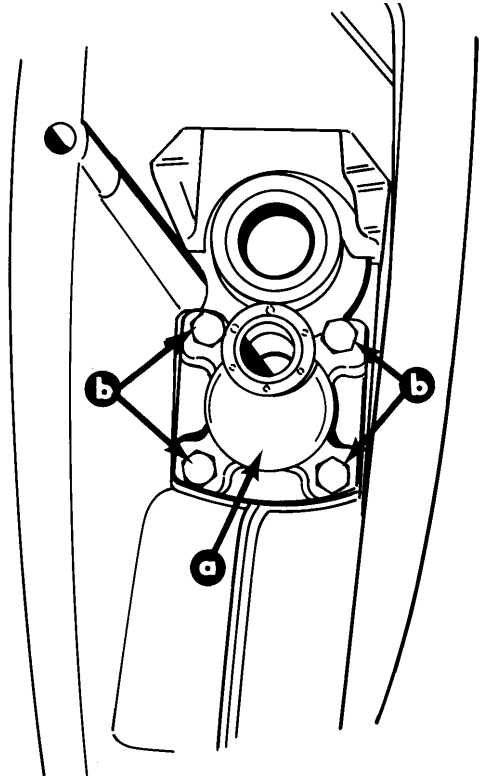
a - Upper Drive Shaft And Driven Gear Assembly

6. Remove water tube from water pocket cover.



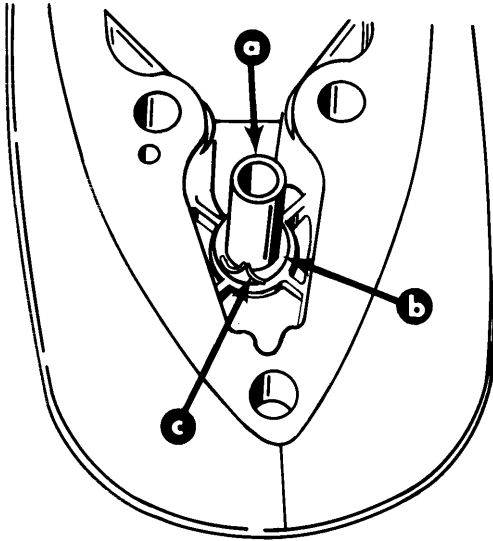
a - Water Tube (Copper)
b - Water Pocket Cover

7. Remove water pocket cover and gasket.



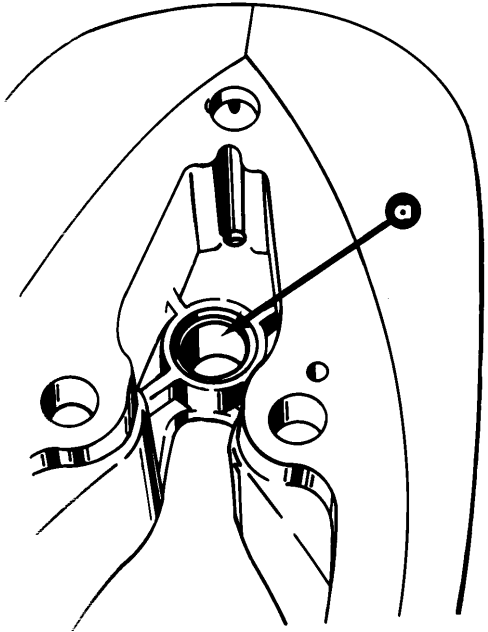
a - Water Pocket Cover (Gasket Beneath)
b - Screws (4)

8. Remove intermediate shift shaft.



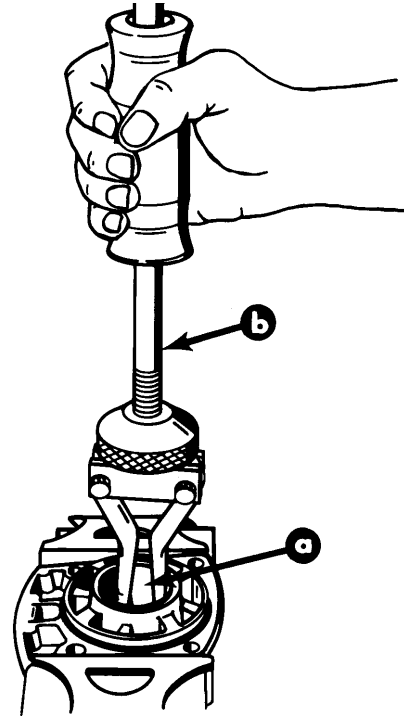
- a - Intermediate Shift Shaft
- b - Flat Washer
- c - Cotter Pin

9. Remove intermediate shift shaft bushing with a suitable mandrel (earlier models only). Discard the bushing on Alpha I, SS model drive units.



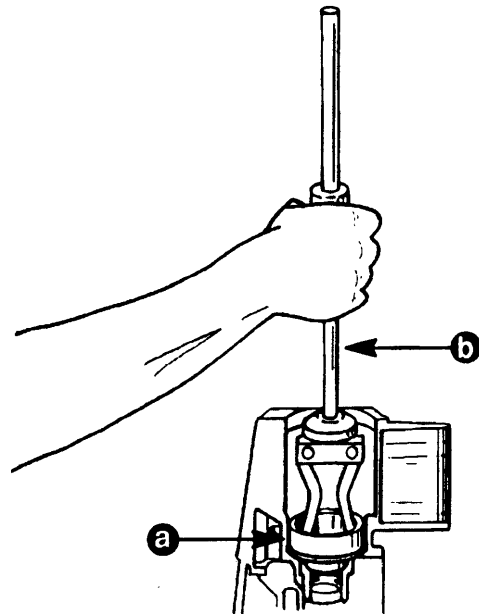
- a - Bushing

10. Remove top cover bearing cup and shims.



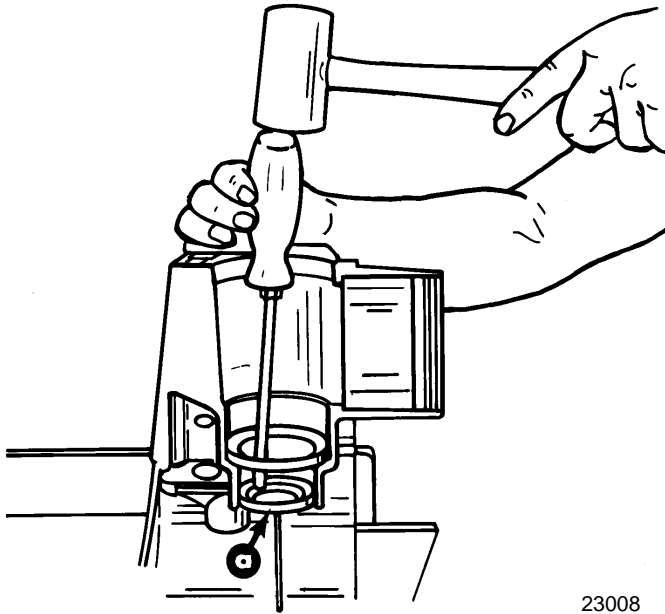
- a - Bearing Cup (Shims Underneath)
- b - Slide Hammer Puller (P/N 91-34569A1)

11. Remove driven gear bearing cup and shims.



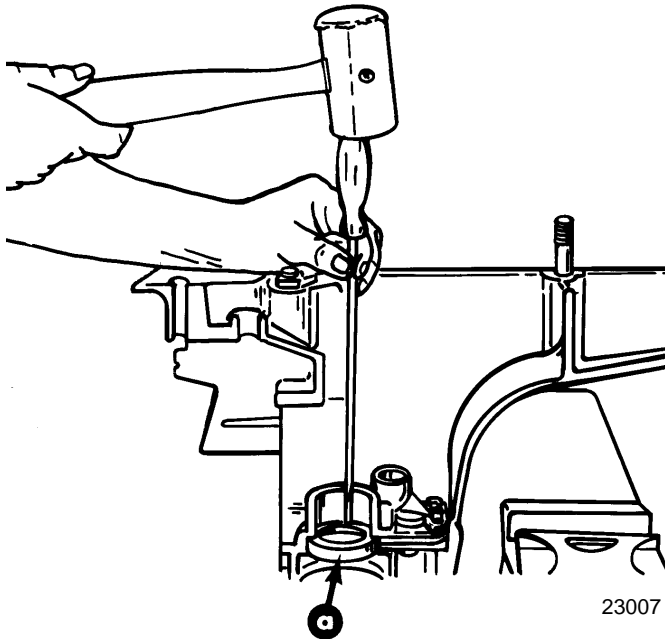
- a - Bearing Cup (Shims Underneath)
- b - Slide Hammer Puller (91-34569A1)

12. Remove drive shaft housing lower oil seal.



a - Oil Seal

13. Remove drive shaft housing upper oil seal.



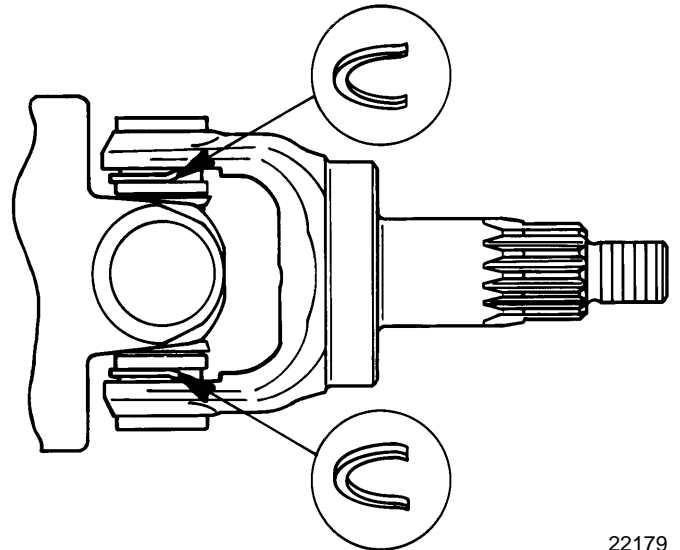
a - Oil Seal

U-joint Assembly Servicing

Pre-Disassembly Inspection

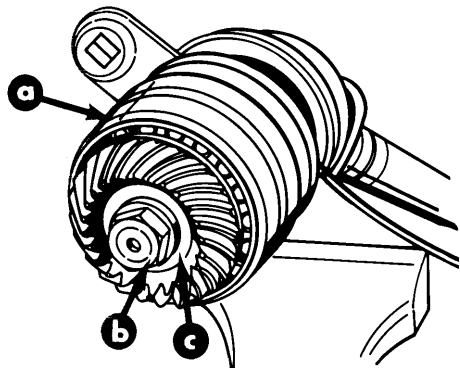
1. Inspect drive gear for pitting, chipped or broken teeth and excessive or uneven wear. If any of these conditions exist, it will be necessary to replace complete drive gear and bearing assembly.
2. Rotate bearings by hand; rough, uneven movement, or a loose condition indicates need for replacement. If drive gear is in good condition, then it will be necessary to replace bearings only.
3. Check splines on coupling end yoke for twisting or cracks.
4. If U-joint knocking is suspected, inspect for evidence of bearing caps hitting center socket.
5. Check cross and bearings for roughness and excessive side-to-side play.

NOTE: Excessive side-to-side play in cross and bearings can cause U-joint knocking. This condition can sometimes be eliminated by installing a C-ring Kit (P/N 53-12067). This kit contains 8 curved C-rings. These C-rings are used as standard equipment on later production units. Curved C-rings **CANNOT** be used with replacement cross and bearing assembly P/N 41431.



Disassembly

1. Remove locknut and washer from U-joint shaft and remove drive gear and bearings.

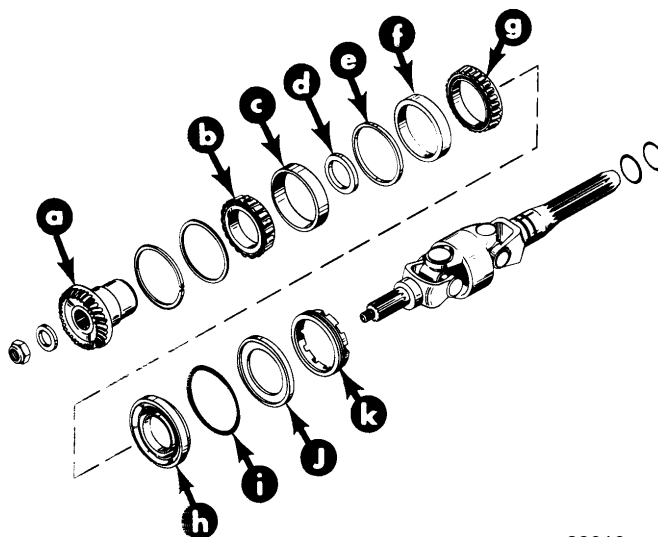


23267

- a - Drive Gear And Bearing Assembly
- b - Locknut
- c - Flat Washer

CAUTION

When disassembling drive gear and bearing assembly, be careful not to switch tapered roller bearings and cups. Bearings must be matched with its original bearing cup. Be sure to note order of components for reassembly. If bearings are to be replaced, replace both bearings and small and large spacers as an assembly, to ensure correct amount of preload when reassembling.



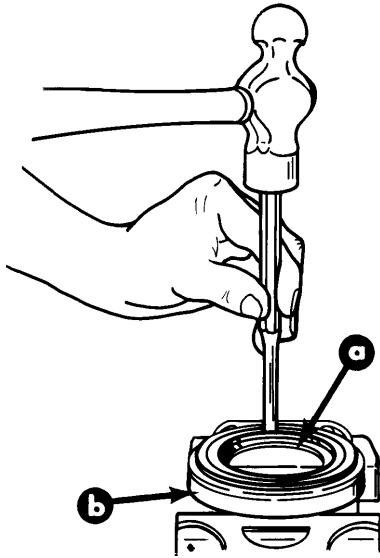
23010

- a - Drive Gear
- b - Tapered Roller Bearing
- c - Bearing Cup
- d - Small Spacer (Note 1)
- e - Large Spacer
- f - Bearing Cup
- g - Tapered Roller Bearing
- h - Oil Seal Carrier
- i - O-ring
- j - Roller Bearing Retainer Ring
- k - Retainer

NOTE 1-This item will not be included in Later Model units or when ordering the following gear sets:

43-18411A2
43-45814A5
43-55778A3
43-75325A3

- If seal is defective, remove U-joint seal from carrier using a punch and hammer.



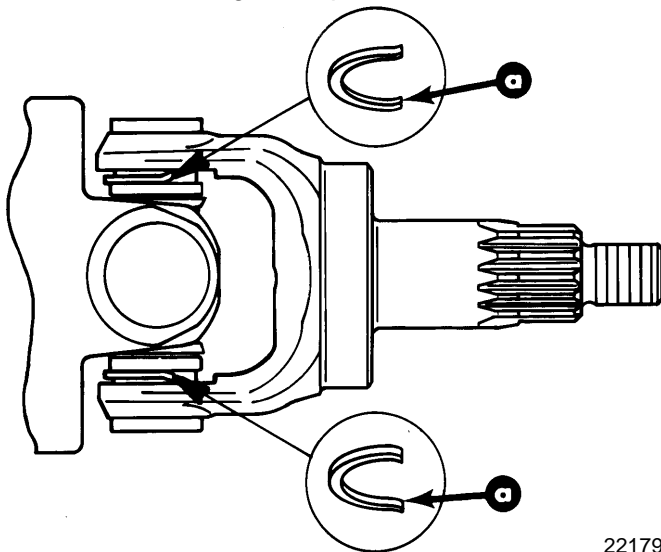
23009

- a - Oil Seal
- b - Oil Seal Carrier

IMPORTANT: If cross and bearings are to be re-used, liberally lubricate crosses with 2-4-C Marine Lubricant to help retain needle bearings in cap during disassembly.

If inspection determines that U-joint cross and bearings should be replaced proceed as follows:

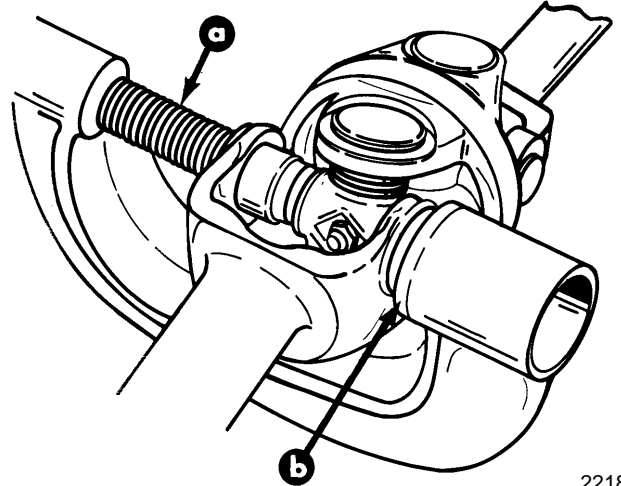
- Drive off C-rings with punch and hammer.



22179

- a - C-ring

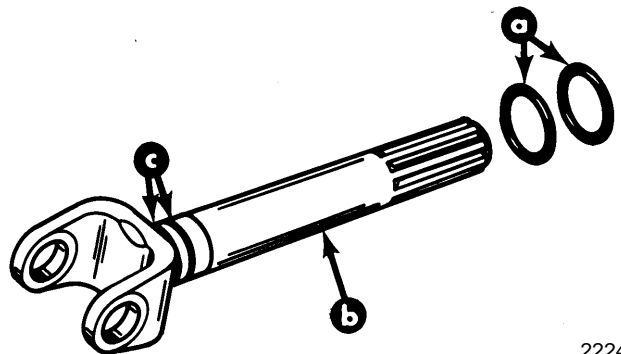
- Using Adaptor (P/N 91-38756) and U-joint press, press one bearing in until opposite bearing is pressed out into adaptor. Remove loose bearing.



22180

- a - U-joint Press
- b - Adaptor

- Turn U-joint assembly 180 degrees and press on cross until second bearing is pressed out into adaptor. Remove each pair of bearings in this manner.
- Remove both O-rings from coupling end of U-joint shaft. Discard the O-rings.



22249

- a - O-rings
- b - U-joint Shaft
- c - O-ring Grooves

Cleaning

- Clean all parts (except O-rings) with cleaning solvent.
- Remove all foreign debris.

CAUTION

DO NOT spin bearings when drying parts with air as damage to bearings could occur.

- Dry all parts with air or a lint free cloth. Ensure all cleaning solvent has been removed.

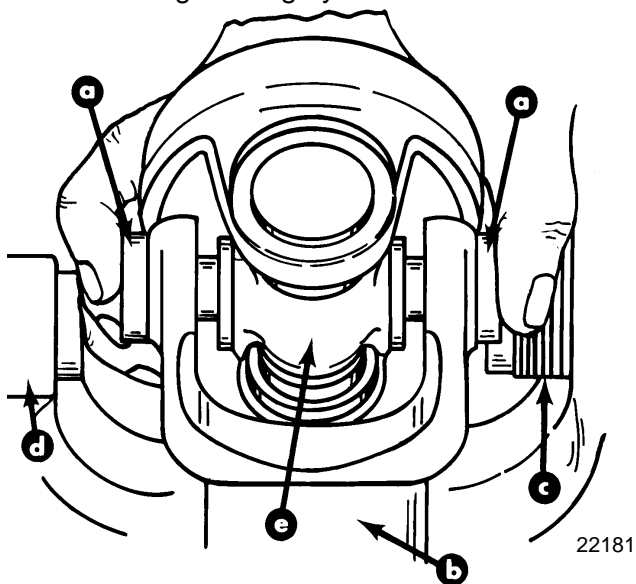
Reassembly

CAUTION

Use only 2-4-C Marine Lubricant for lubricating U-joint bearings. The use of any other lubricant will decrease the life of the bearings.

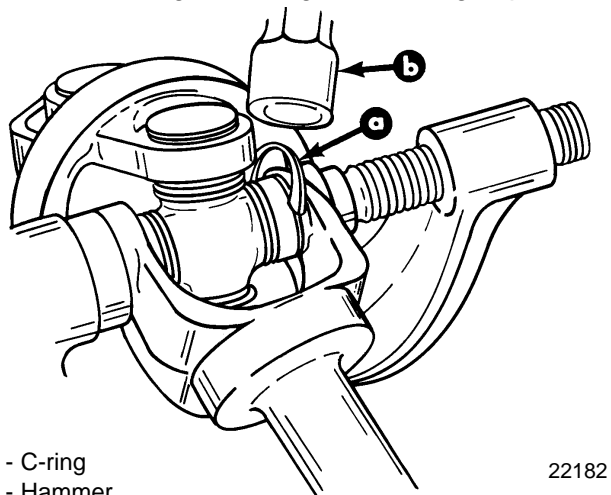
NOTE: When initially positioning crosses in yoke, be sure that grease fittings are facing toward coupler yoke (longer yoke).

1. Place U-joint bearing cups in yoke and start them onto cross members. Install by using Adaptor (P/N 91-38756) and U-joint Press and pressing both bearings through yoke and onto cross.



- a - Bearings
- b - Yoke
- c - Adaptor
- d - U-joint Press
- e - Cross

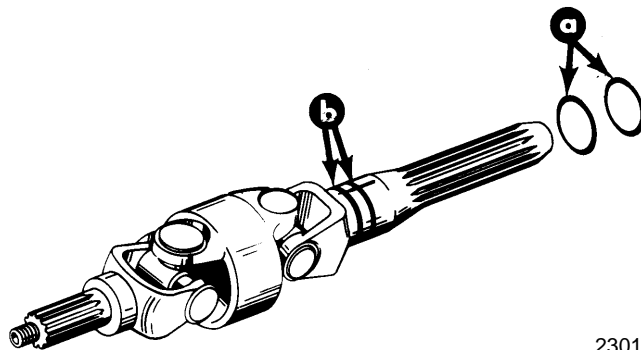
2. Install C-rings into edge of bearing cap.



- a - C-ring
- b - Hammer

3. Install each pair of bearings in this manner.

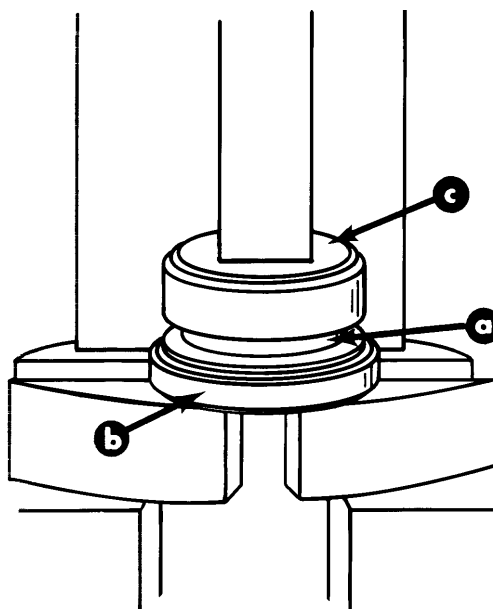
4. Install new O-rings in grooves on coupling end of U-joint shaft.



23010

- a - O-rings
- b - O-ring Grooves

5. Press oil seal into oil seal carrier with lip of seal facing away from stepped side of carrier. Use oil seal driver (P/N 91-36577) to press seal into place.



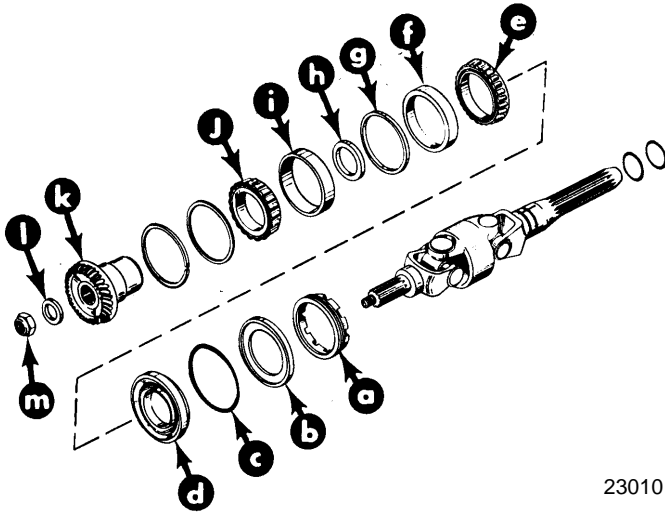
23009

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

CAUTION

When reassembling drive gear and bearing assembly, be careful not to switch tapered roller bearing cups. Each bearing must be matched with its original bearing cup. If using old bearings, be sure to use original small and large spacers. If new bearings are being used, be sure to use new spacers. This will ensure proper bearing preload.

6. Install components in order shown.



23010

- | | |
|----------------------------|----------------------------|
| a - Retainer | h - Small Spacer (Note) |
| b - Anti-galling Retainer | i - Bearing Cup |
| c - O-ring | j - Tapered Roller Bearing |
| d - Seal Carrier | k - Drive Gear |
| e - Tapered Roller Bearing | l - Washer |
| f - Bearing Cup | m - Locknut |
| g - Large Spacer | |

NOTE: This item will not be included in Later Model units or when ordering the following gear sets;

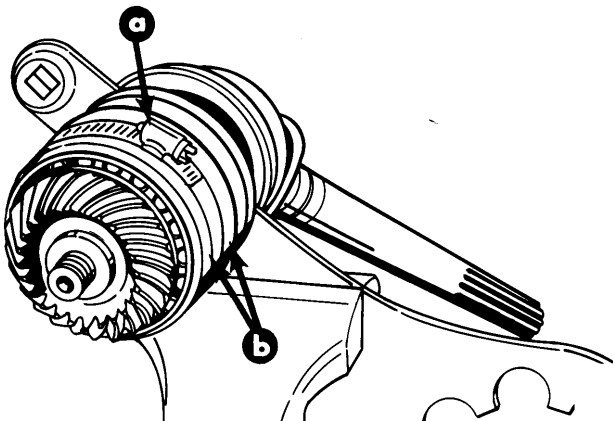
- 43-18411A2
- 43-45814A5
- 43-55778A3
- 43-75325A3

U-JOINT ASSEMBLY-SETTING PINION BEARING PRELOAD

NOTE: If not already done, lightly lubricate the gears and bearings with Quicksilver High Performance Gear Lube (P/N 816026A1) before checking preload. Bearings and gears must be lubricated to obtain accurate preload readings.

Reassembly with Small Spacer:

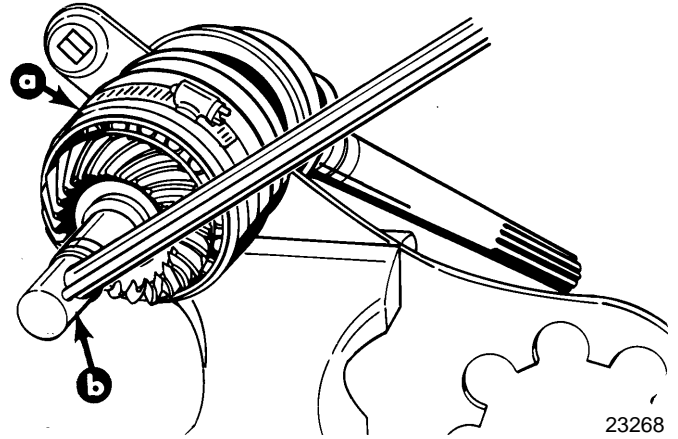
1. Install a hose clamp around large spacer (between Bearing Cups).



23267

- a - Clamp
- b - Bearing Cups

2. While rotating bearing assembly, torque locknut to 70-80 lb. ft. (95-108 N·m).

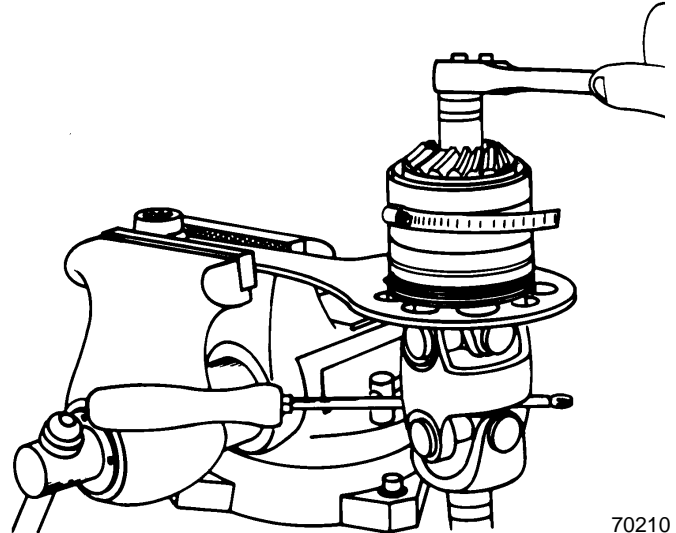


23268

- a - Bearing Assembly
- b - Torque Wrench

Reassembly without Small Spacer:

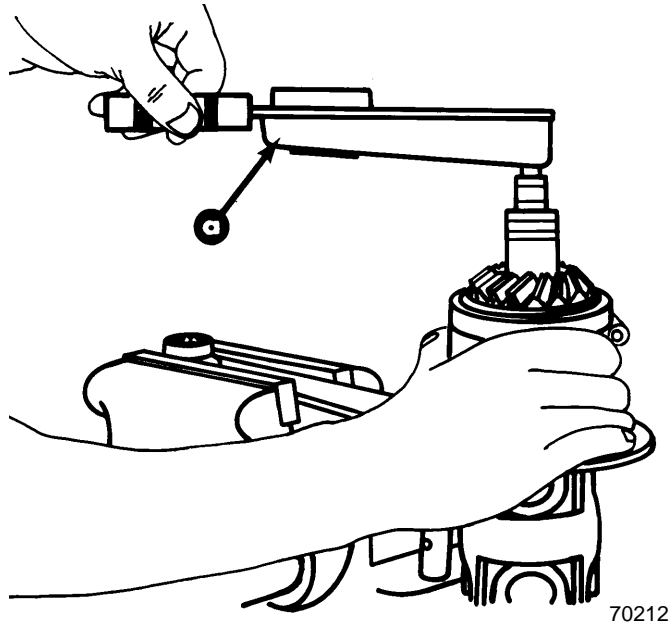
1. Insert a suitable tool, such as a screwdriver, between the U-joint yokes as shown in the next figure, to prevent the U-joint from rotating when tightening down the pinion nut. Tighten the pinion nut down until the preload on the bearings starts to go up just slightly and remove the hose clamp.



70210

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

2. While holding the bearings, rotate the pinion nut at least two full revolutions. Check preload by rotating the pinion nut very slowly a third time and, while rotating, take a reading of the preload. If the preload is under the specification of 6-10 lb. in. (0.7-1.1 N·m), torque the pinion nut slightly more (as instructed in the previous step) and recheck preload as outlined above. Continue this sequence until the proper preload is achieved.



70212

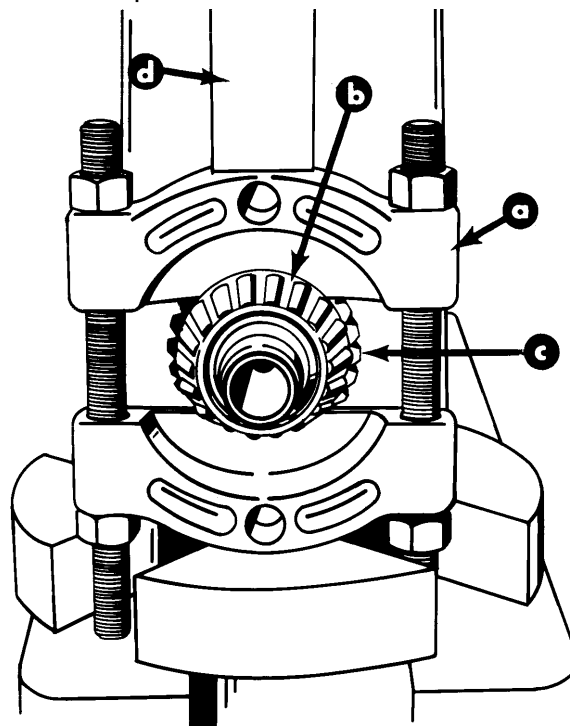
a - Torque Wrench (lb. in.)

IMPORTANT: If while accomplishing the preceding procedure the preload goes over the specified limit of 6-10 lb. in. (0.7-1.1 N·m), the bearings must be totally separated from the gear and reassembled following the appropriate previous instructions starting with “U-Joint Assembly,” ‘Inspection and Disassembly’ section found on page 3A-8. Failure to follow these instructions will cause premature failure of the unit.

Upper Drive Shaft and Driven Gear Assembly Servicing

Disassembly

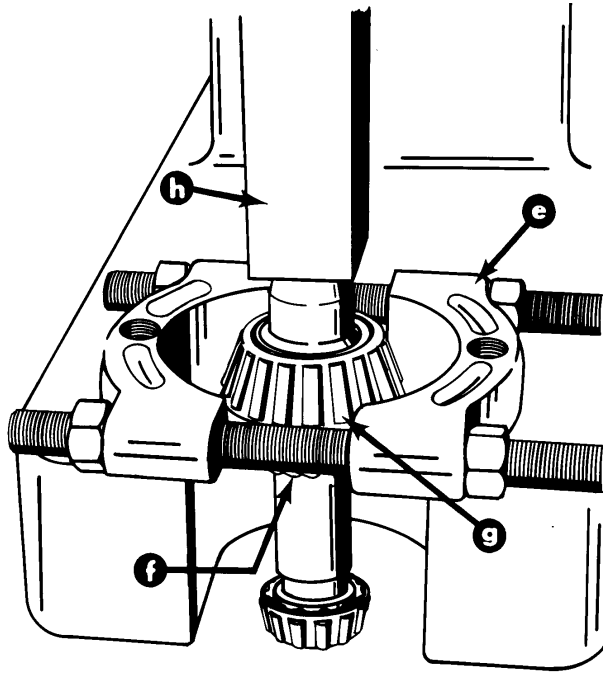
1. Position Universal Puller Plate (P/N 91-37241) between driven gear and tapered roller bearing.
2. Press on plate until it bottoms.



23265

- a - Universal Puller Plate
- b - Tapered Roller Bearing
- c - Driven Gear
- d - Arbor Press

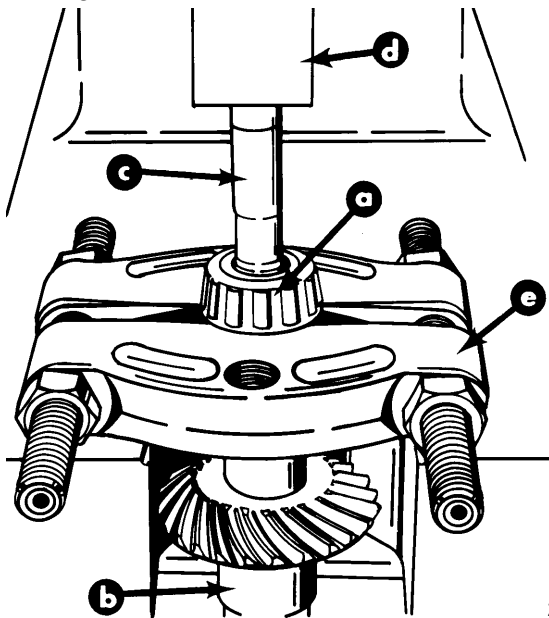
- Press on driven gear end until tapered roller bearing slides off.



23264

- e - Universal Puller Plate
- f - Driven Gear
- g - Tapered Roller Bearing
- h - Arbor Press

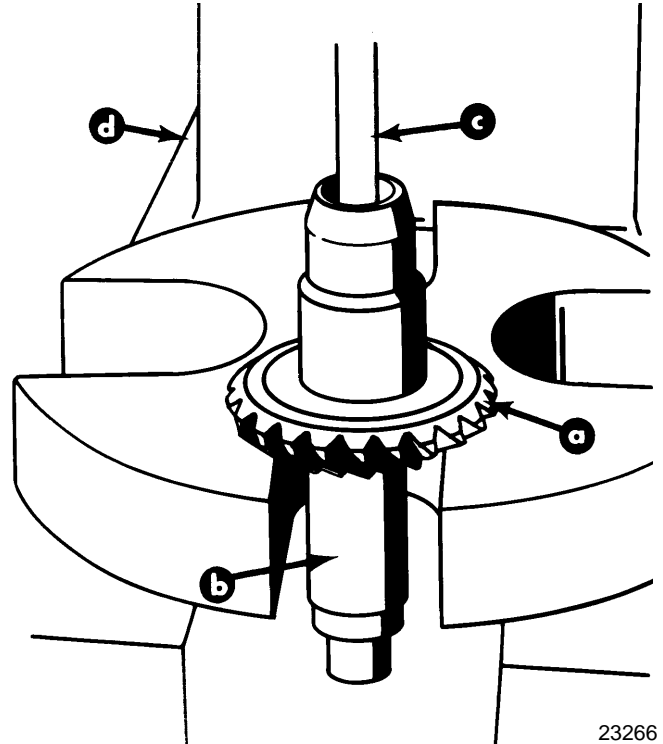
- Remove (smaller) upper drive shaft tapered roller bearing.



23265

- a - Upper Drive Shaft Bearing (Smaller)
- b - Upper Drive Shaft
- c - Suitable Tool
- d - Arbor Press
- e - Universal Puller Plate (P/N 91-37241)-Flat Side Of Plate Toward Bearing

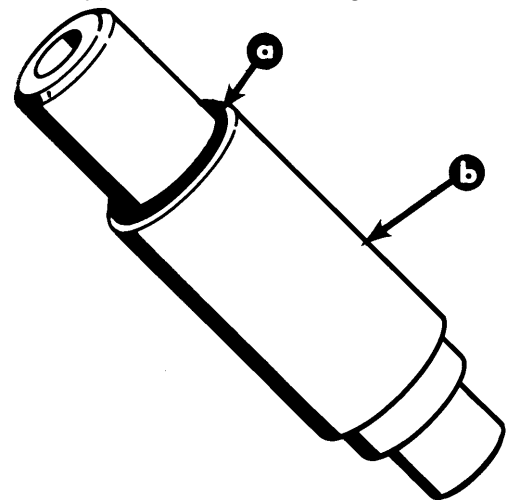
- Press driven gear from upper drive shaft.



23266

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

- Remove upper drive shaft O-ring (on gear side of shaft only). Discard the O-ring.



50313

- a - O-ring
- b - Upper Drive Shaft

Cleaning

1. Clean all parts (except O-ring) with cleaning solvent.
2. Remove all foreign debris.

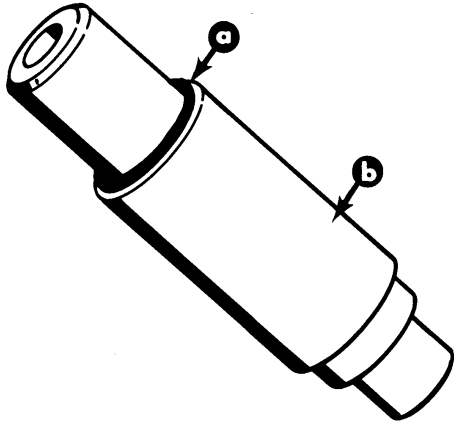
CAUTION

DO NOT spin bearings when drying components off with compressed air, as damage to bearings could occur.

3. Dry all parts with compressed air or a lint free cloth. Ensure all solvent has been removed.

Reassembly

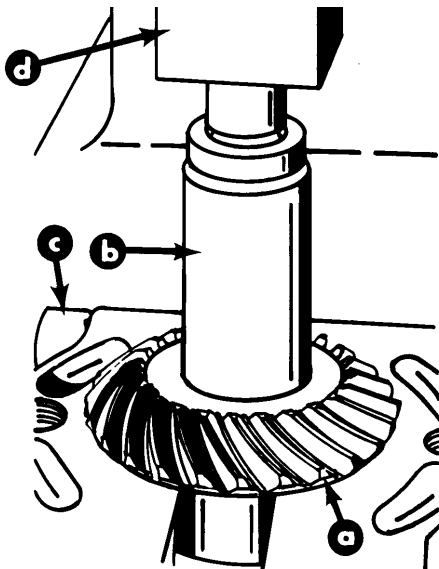
1. Place new O-ring on the upper drive shaft.



50313

- a - O-ring
- b - Upper Drive Shaft

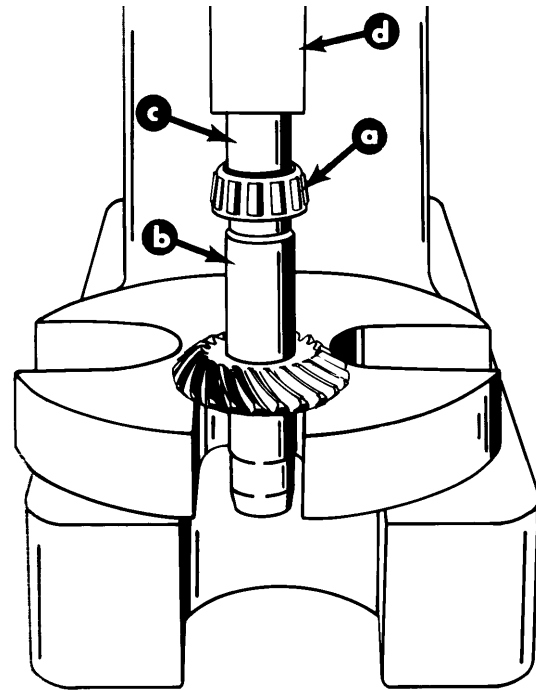
2. Press upper drive shaft onto driven gear until it bottoms.



23264

- a - Driven Gear
- b - Upper Drive Shaft
- c - Universal Puller Plate
- d - Arbor Press

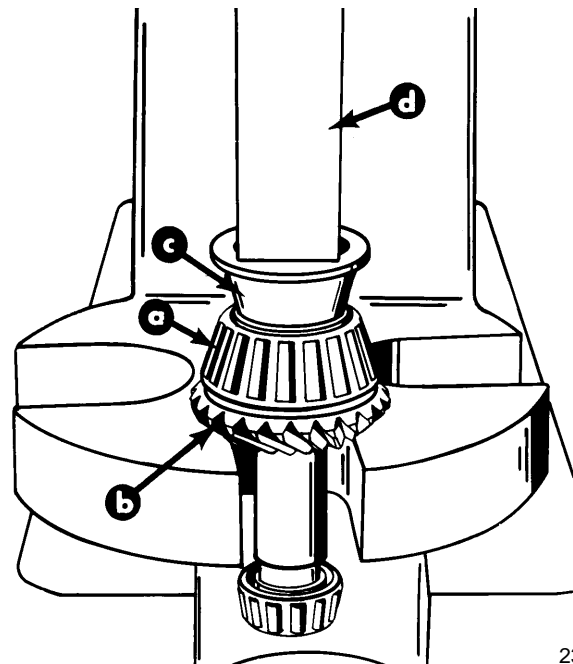
3. Press upper drive shaft (smaller) bearing onto upper drive shaft until it bottoms.



23264

- a - Upper Drive Shaft Bearing (Smaller)
- b - Upper Drive Shaft
- c - Suitable Tool
- d - Arbor Press

4. Press tapered roller bearing onto driven gear until it bottoms.



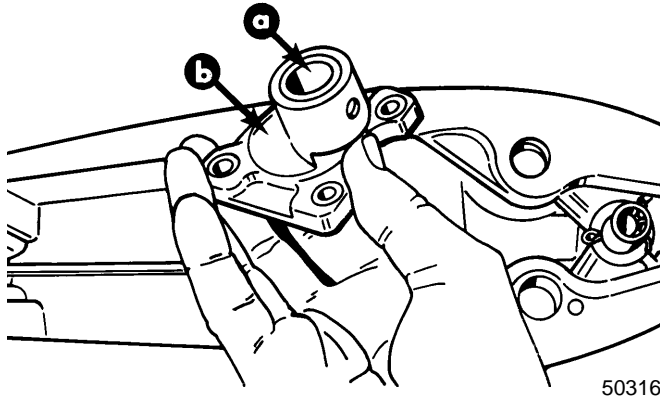
23263

- a - Tapered Roller Bearing (Larger)
- b - Driven Gear
- c - Suitable Tool
- d - Arbor Press

Water Pocket Cover Servicing

Disassembly

1. Remove rubber seal from water pocket cover.



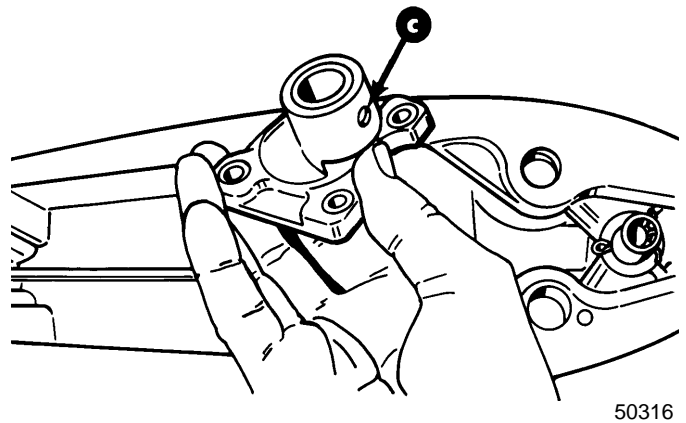
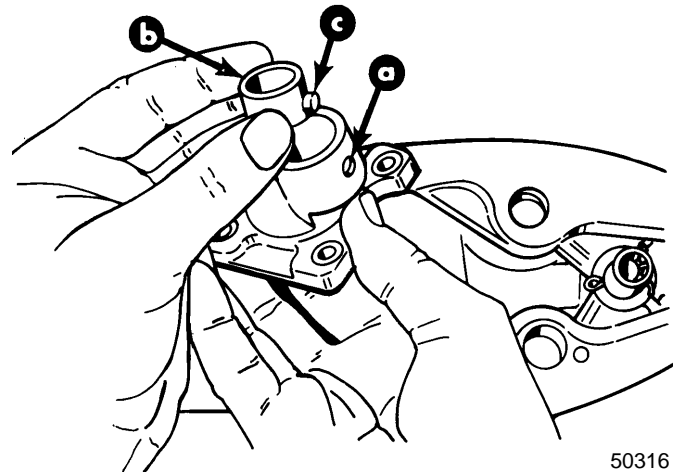
- a - Rubber Seal
- b - Water Pocket Cover

Cleaning and Inspection

1. Clean water pocket cover and rubber seal with a water and soap solution.
2. Dry parts completely with compressed air or a lint free cloth.
3. Inspect parts for signs of overheating (melting, warping or cracks).

Reassembly

1. Install rubber seal into water pocket cover. Ensure that embossment on seal fits into hole in water pocket cover.

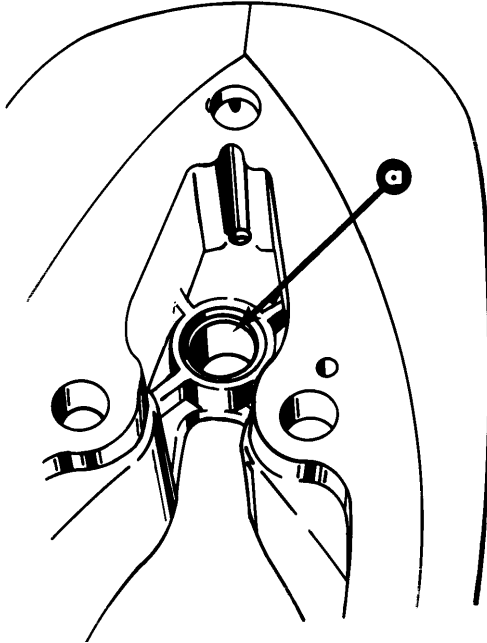


- a - Water Pocket Cover Hole
- b - Rubber Seal
- c - Embossment

Drive Shaft Housing Reassembly and Shimming

IMPORTANT: The shifter shaft bushing for the Alpha One SS is made of plastic. Use care when installing this bushing to avoid cracking it.

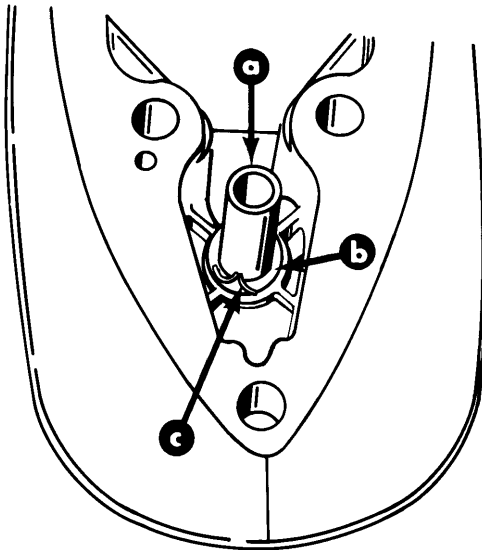
1. Install shifter shaft bushing using a suitable tool.



23261

a - Bushing (Not Used On Later Models)

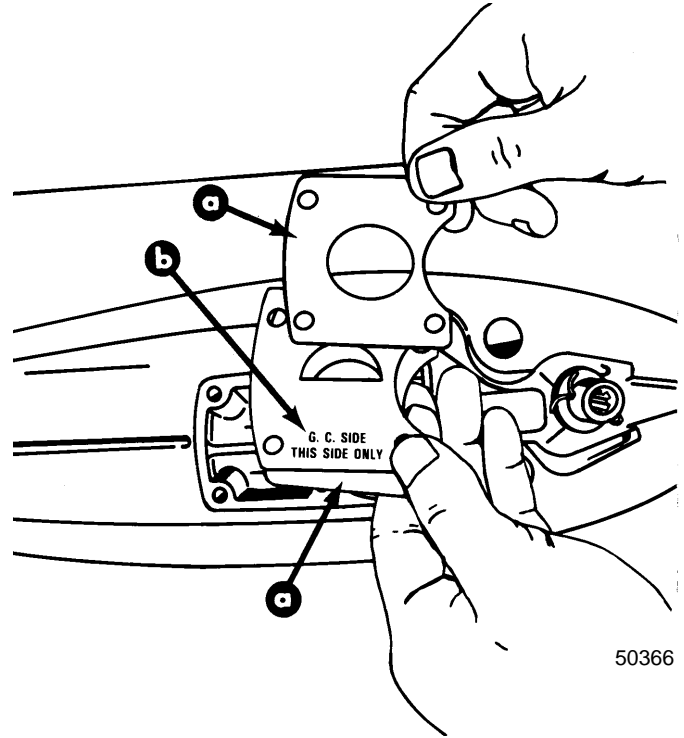
2. Install intermediate shift shaft.



23261

a - Intermediate Shift Shaft
b - Flat Washer
c - Cotter Pin-Spread Both Ends

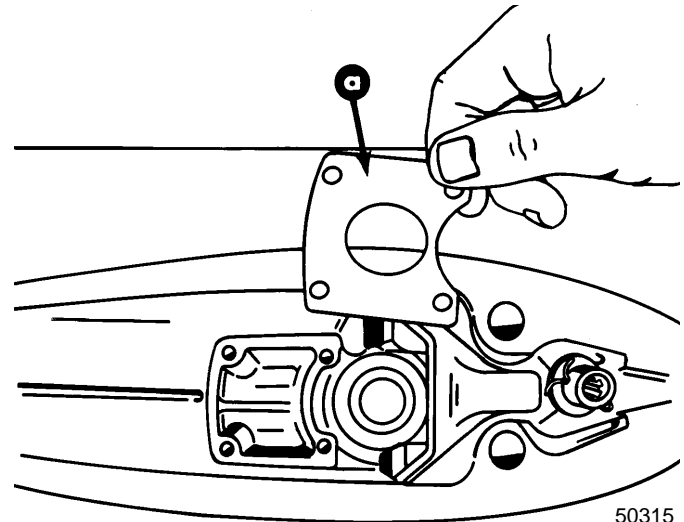
IMPORTANT: The Alpha One SS drive shaft housing has a restrictor plate sandwiched between two gaskets located beneath the water pocket cover (the Alpha One and MR units have only a gasket). This restrictor plate must be installed with the side marked "G.C. SIDE-THIS SIDE ONLY" facing toward gear case.



50366

Alpha One SS

a - Gaskets
b - Restrictor Plate

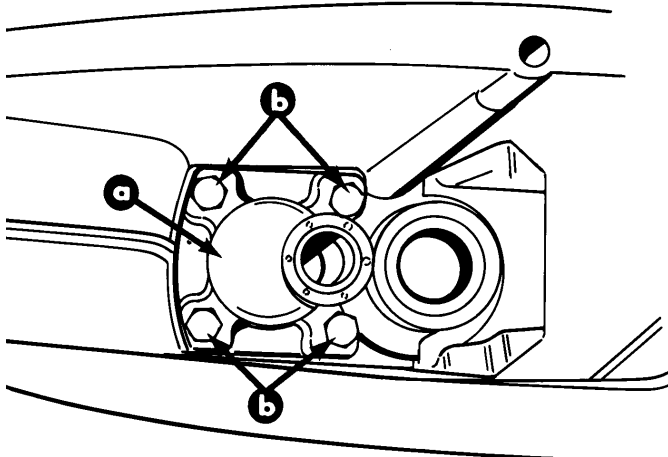


50315

Alpha One and MR

a - Gasket

3. Install water pocket cover and gasket(s). Apply Perfect Seal to screw threads and torque to 30-40 lb. in. (3-4 N·m).



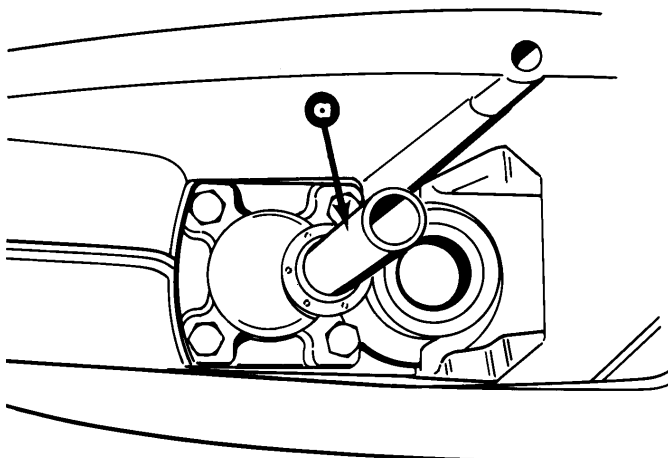
50316

- a - Water Pocket Cover [Gasket(s) Beneath]
- b - Screws (4)

CAUTION

Alpha One SS has a shorter water tube than the Alpha One or MR drive units. Be careful not to install a short tube (Alpha One SS) in an Alpha One or MR drive unit, as this would substantially reduce water flow to the engine, causing engine to overheat.

4. Install water tube (copper) into water pocket cover.



50316

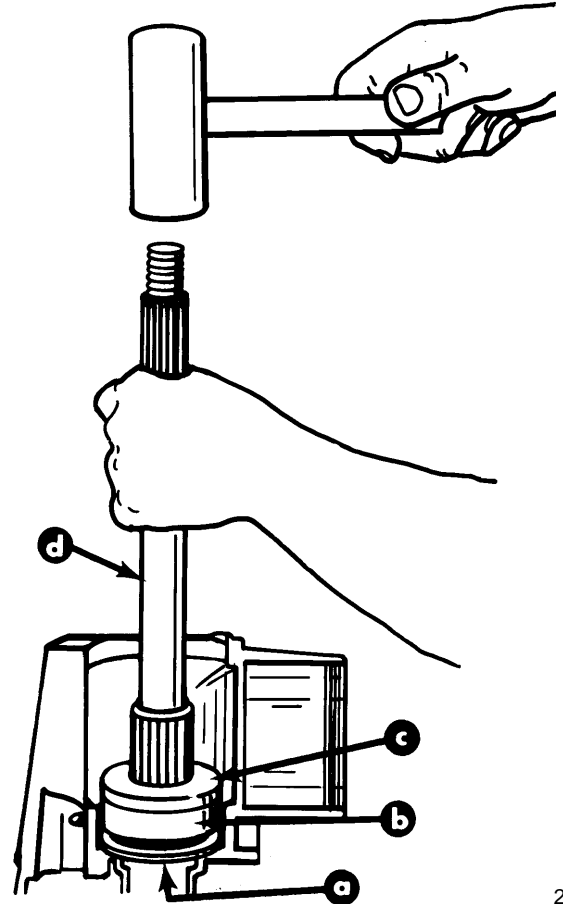
- a - Water Tube

IMPORTANT: Lubricate 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, following.

5. Place shims in drive shaft housing.

NOTE: If installing the upper driven gear bearing cup 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.

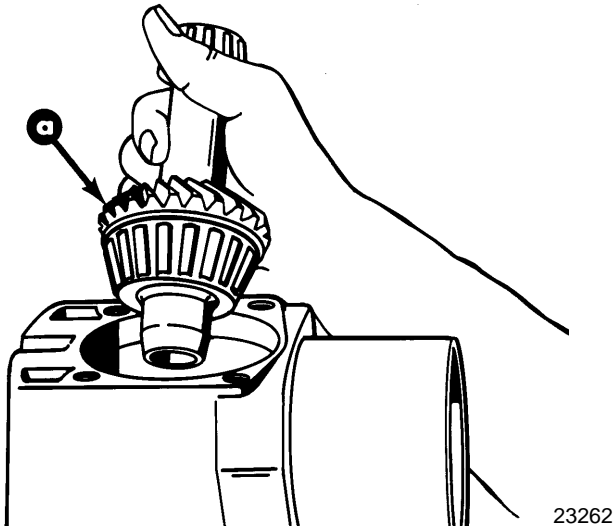
6. Install driven gear tapered roller bearing cup.



23011

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

7. Install upper drive shaft and driven gear assembly.



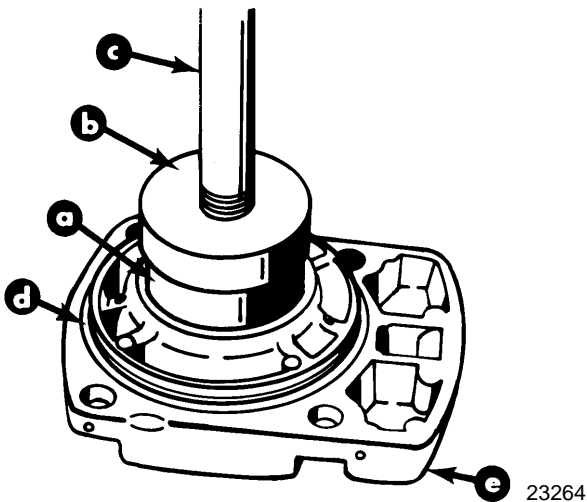
23262

a - Upper Drive Shaft And Driver Gear Assembly

8. Place shims in top cover.

NOTE: If using new shims, start with .015-.020 in. shim pack.

9. Install upper drive shaft bearing cup into top cover. Install O-ring.

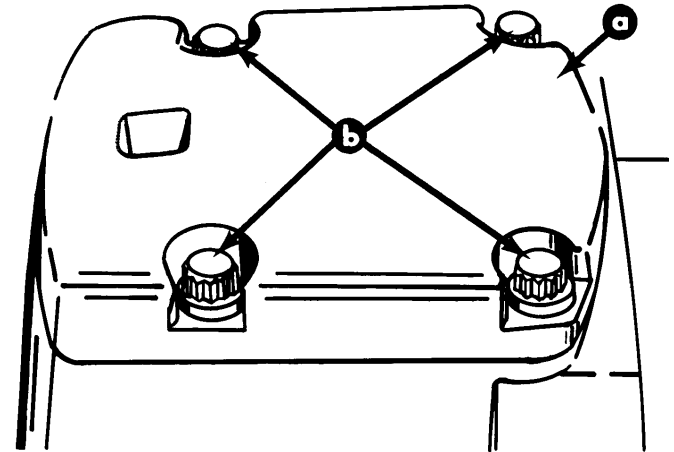


23264

a - Bearing Cup (Shims Underneath)
 b - Bearing Cup Driver (P/N 91-38918)
 c - Driver Rod (P/N 91-37323)
 d - O-ring
 e - Top Cover

IMPORTANT: Top cover must be torqued to specifications to ensure proper upper drive shaft bearing preload.

10. Install top cover. Torque screws to 20 lb. ft. (27 N·m).

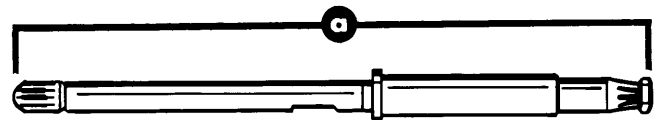


23261

a - Top Cover
 b - Screws (4)

11. Check upper drive shaft bearing preload and shim as follows:

- a. Invert upper drive shaft housing.
- b. Insert gear housing drive shaft (with pinion gear nut installed) into upper drive shaft splines.



23262

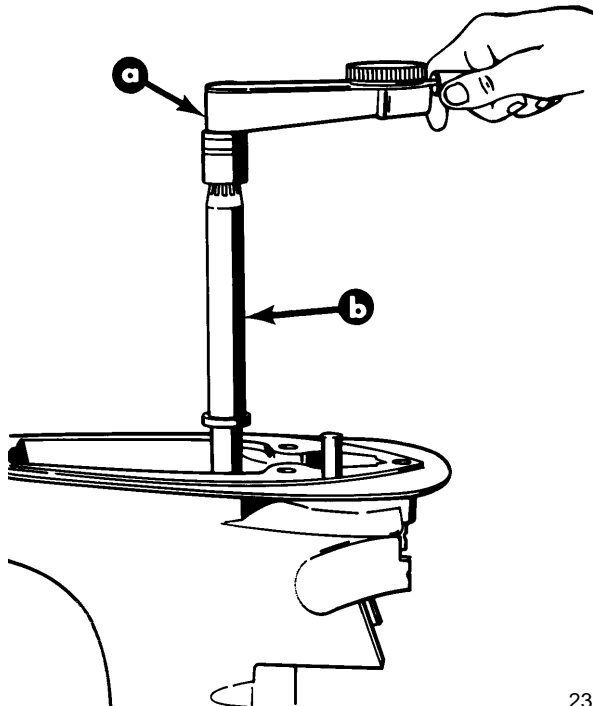
a - Gear Housing Drive Shaft

- c. Make sure bearings and gear have been lubricated. Turn drive shaft clockwise several times to seat bearings.
- d. Using lb. in. torque wrench (P/N 91-66274) on drive shaft; SLOWLY turn drive shaft clockwise and not gauge reading. Reading should be:

USED BEARINGS: 2.5-4 lb. in.
(0.3-0.45 N·m).

NEW BEARINGS: 6-10 lb. in.
(0.71-1.0 N·m).

NOTE: Bearings are considered used if spun under load once.



23262

- a - Torque Wrench (lb. in.)
- b - Drive Shaft

- e. Re-shim as necessary:

If reading is too high; remove shims from beneath bearing cup in top cover.

If reading is too low; add shims beneath bearing cup in top cover.

If reading is within specifications; reinstall top cover and torque screws to 20 lb. ft. (27 N·m).

- f. Recheck bearing preload and adjust shim thickness until specified preload is attained.

- 12. Check upper drive shaft driven gear height and shim as follows:

IMPORTANT: Upper drive shaft bearing preload must be correct and top cover must be properly torqued before checking driven gear height.

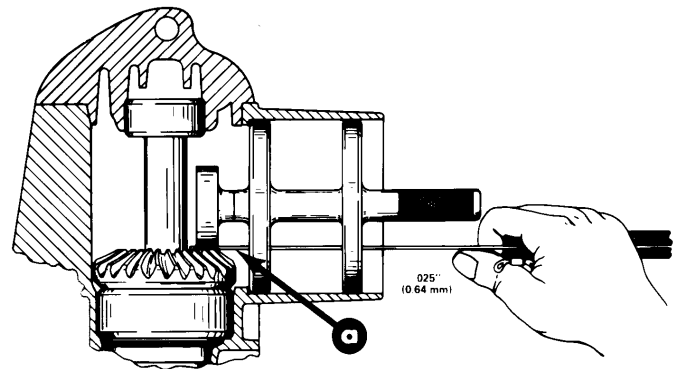
- a. Using the chart following, select proper opening in shimming tool (P/N 91-60526).
- b. Insert shimming tool into drive shaft housing with appropriate opening toward gear.

SHIMMING TOOL 91-60526	
Overall Drive Unit Gear Ratio	Tool Position
1.32:1	Z
1.50:1	Z
1.65:1	X
1.84:1	Y
1.98:1	Y

IMPORTANT: The following procedure must be done exactly as stated to position shimming tool gauging surface parallel with gear to obtain an accurate measurement.

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

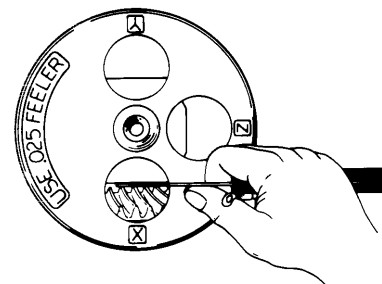
Rotate shimming tool until gauging surface contacts feeler gauge and a slight drag on feeler gauge is felt.



23012

- a - .025 in. (0.64 mm) Feeler Gauge

- d. Without moving shimming tool, remove feeler gauge and insert gauge between other tooth and gauging surface.



23012

If feeler gauge can be inserted with only a slight drag, shimming is correct. Proceed in reassembly with step 13.

If feeler gauge inserts with no drag, gear is too low. Repeat steps 12-c and 12-d with progressively thicker feeler gauges until the same clearance is obtained between both gear teeth and gauging surface. Calculate the thickness of shims to add under driven gear bearing cup as shown following.

Clearance Between Gear-Tooth and Shimming Tool	.025 in. =	Additional Thickness Shims Required
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Example: .028 in.-.025 in. = .003 in.
(0.71 mm-0.64 mm) = (.076 mm)

Shims equal to the resulting difference must be added beneath driven gear bearing cup.

IMPORTANT: Be sure to remove shims from beneath top cover bearing cup in proportion to those added under driven gear bearing cup, in order to maintain proper preload.

If feeler gauge cannot be inserted without moving shim tool, gear is too high. Repeat steps 12-c and 12-d with progressively thinner feeler gauges until the same clearance is obtained between both gear teeth and gauging surface. Calculate the thickness of shims to be removed from under driven gear bearing cup as follows:

.025 in. (0.64 mm)	- Clearance Between Gear Teeth and Shimming Tool	= Reduction in Shim Thickness Required
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Example: .025 in.-.021 in. = .004 in.
(0.64 mm-.522 mm) = (.10 mm)

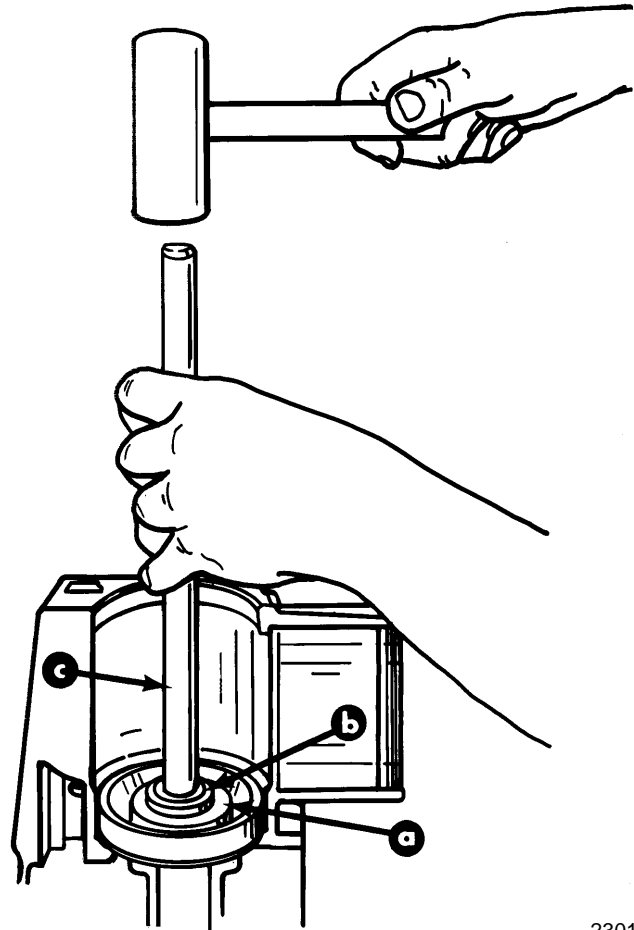
Shims equal to the resulting difference must be removed from beneath driven gear bearing cup.

IMPORTANT: Be sure to add shims beneath top cover bearing cup in proportion to those removed from under driven gear bearing cup, in order to maintain proper preload.

e. Recheck bearing preload and proceed with reassembly, Step 13.

13. Remove top cover and upper drive shaft and driven gear assembly.

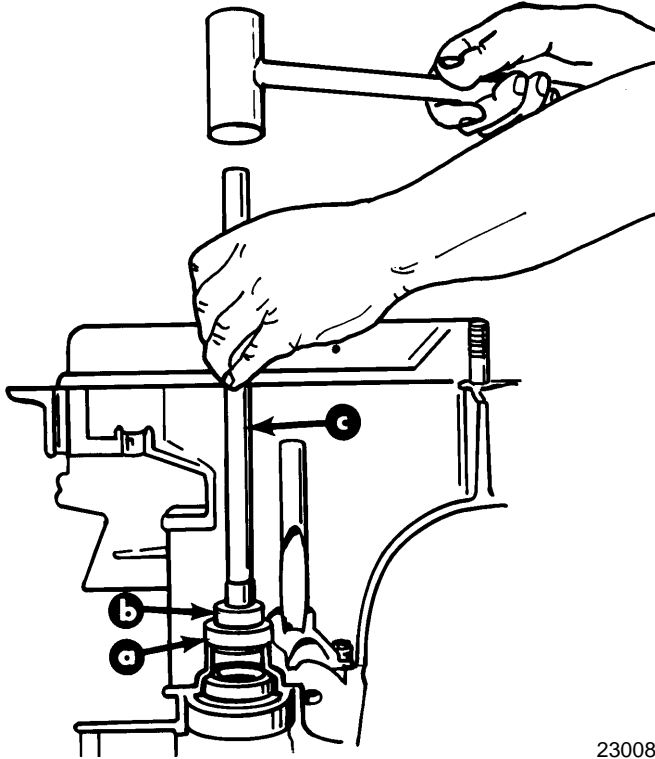
14. Apply Loctite 27131 or Type "A" to outside diameter of drive shaft housing upper oil seal and install oil seal with lips facing up.



23011

a - Upper Oil Seal
b - Oil Seal Installation Tool (P/N 91-43591)
c - Driver Rod (P/N 91-37323)

15. Apply Loctite 27131 or Type "A" to outside diameter of drive shaft housing lower oil seal and install oil seal with lips facing up (toward top of housing).



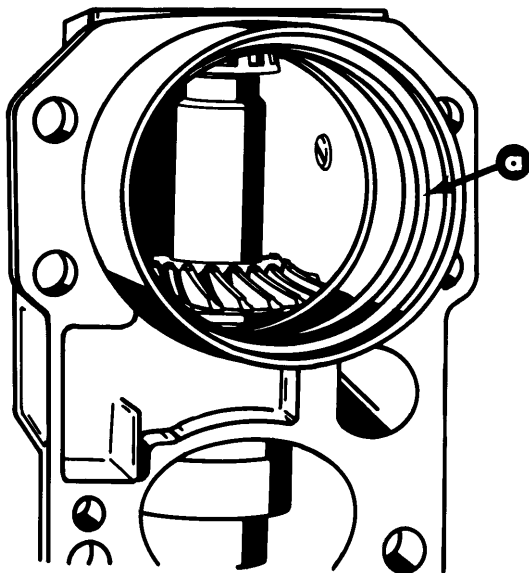
23008

- a - Lower Oil Seal
 b - Oil Seal Installation Tool (P/N 91-43591)
 c - Driver Rod (P/N 91-37323)

16. Reinstall upper drive shaft and driven gear assembly. Do not install top cover at this time.

17. Place drive gear shims in drive shaft housing.

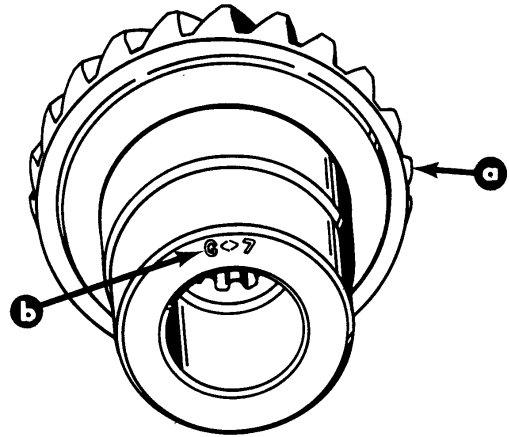
NOTE: If using new shims, start with a .025 in. (0.65 mm) shim pack.



23266

- a - Shims

IMPORTANT: Before beginning drive gear shimming, make a note of the date code that is stamped on the face of the drive gear if using heavy duty gears. A variation in feeler gauge used for checking drive gear depth is needed for checking gears stamped with date code "G-7".



50366

Units with 1.65:1 Gear Ratio Only

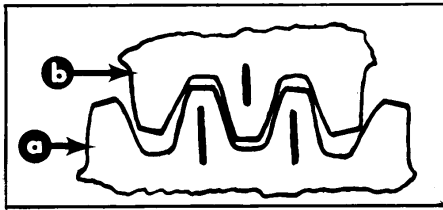
- a - Drive Gear
 b - Date Code (G-7)

18. Install U-joint assembly into drive shaft housing as follows:

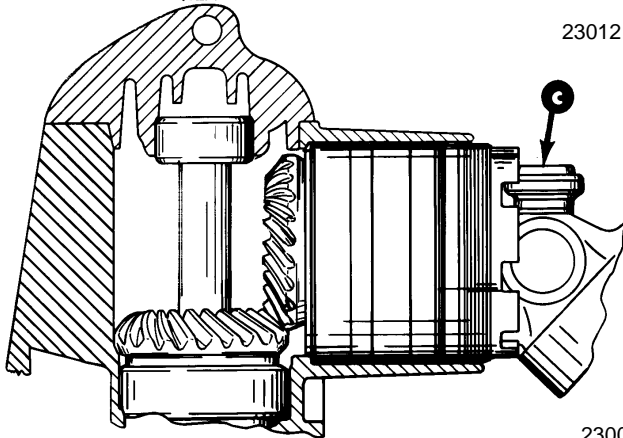
NOTE: Newer 1.65:1 replacement gears do not have index marks. For these units, refer to the next step on the following page.

- a. Align index marks on drive gear with index mark on driven gear.

- b. Push U-joint assembly straight into drive shaft housing so that index marked teeth properly mesh.



23012

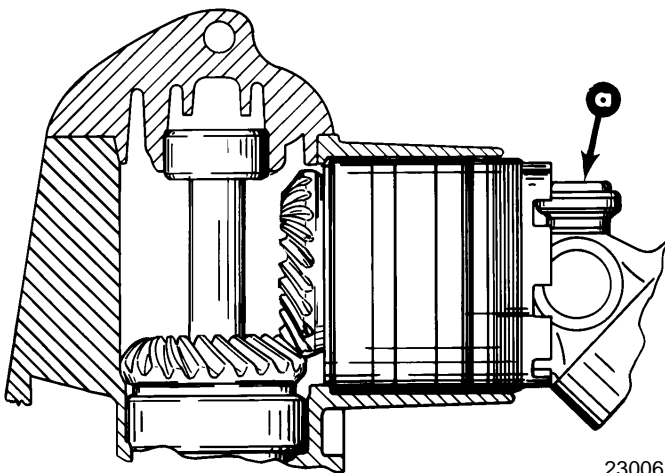


23006

- a - Drive Gear Index Marks
- b - Driven Gear Index Marks
- c - U-joint Assembly

All Units without 1.65:1 Gear Ratio

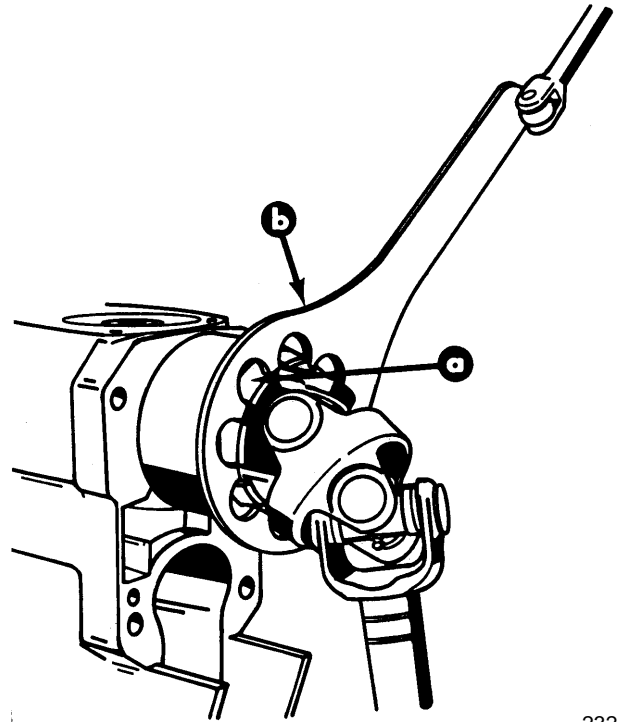
- a. Push U-joint assembly straight into drive shaft housing so that gear teeth mesh.



23006

- a - U-joint Assembly

19. Tighten bearing retainer. Torque to 200 lb. ft. (271 N-m).

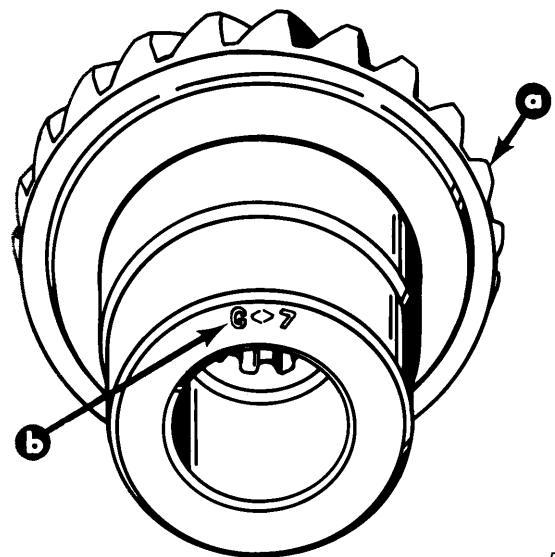


23268

- a - Bearing Retainer
- b - Bearing Retainer Wrench

IMPORTANT: The following procedure must be performed exactly as stated to position shimming tool gauging surface parallel with gear to obtain an accurate measurement.

IMPORTANT: When using heavy duty gears with date code "G-7" stamped on face of gear, use of a .032 in. feeler gauge should be used instead of .025 in.



50366

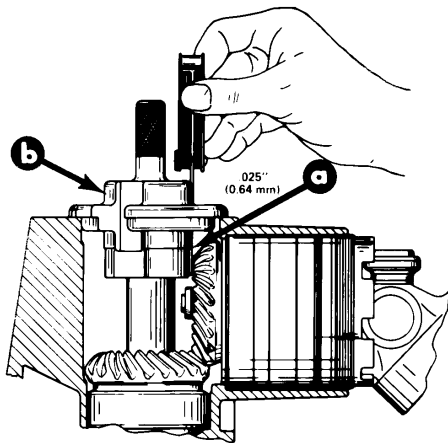
- a - Drive Gear
- b - Date Code "G-7"

20. Check drive gear (U-joint assembly) depth and shim as follows:

- a. Using chart following, select proper opening in Shimming Tool (P/N 91-60523).
- b. Insert shimming tool into drive shaft housing with appropriate opening toward gear.

SHIMMING TOOL 91-60523	
Overall Drive Unit Gear Ratio	Tool Position
1.32:1	Z
1.50:1	Z
1.65:1	Y
1.84:1	Y
1.98:1	Y

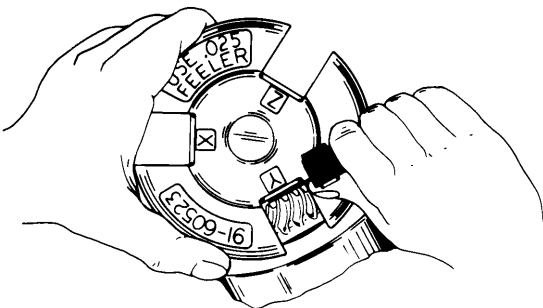
- c. Position gear so that at least two full teeth are centered on gauging surface. One full tooth must be on each side of gauging surface centerline. Insert a .025 in. (0.64 mm) (.032 in. with Heavy Duty Gears Stamped G-7) feeler gauge between one of the teeth and gauging surface. Rotate shimming tool until gauging surface contacts feeler gauge and a slight drag is felt (while holding shimming tool down on housing).



23012

- a - Feeler Gauge-(.025 in. or .032 in.)
- b - Shimming Tool

- d. Without moving shimming tool, remove feeler gauge and insert gauge between other tooth and gauging surface.



23012

If feeler gauge can be inserted with only a slight drag, shimming is correct. Proceed with reassembly Step 21.

If feeler gauge inserts with no drag, gear is too far away from tool. Repeat Steps 20-c and 20-d with progressively thicker feeler gauges until the same clearance is obtained between both gear teeth and gauging surface. Calculate shim thickness to be removed from between U-joint assembly bearing cup and drive shaft housing shoulder, as shown following.

NOTE: Be sure to substitute .032 in. for .025 in. if using heavy duty gears with date code "G-7", when making the following calculations.

Clearance Between-.025 in. = Shimming Thickness
 Gear Teeth and (0.64 mm) Change Required Shimming Tool

Example: .030 in.-.025 in. = .005 in.
 (.762 mm-0.64 mm = .127 mm)

Shims equal to the resulting difference must be removed from between U-joint assembly bearing cup and drive shaft housing shoulder.

If feeler gauge cannot be inserted without moving shimming tool, gear is too close to tool. Repeat Steps 20-c and 20-d with progressively thinner feeler gauges until some clearance is obtained between both gear teeth and gauging surface. Calculate shim thickness to be added between U-joint assembly bearing cup and drive shaft housing shoulder, as shown following.

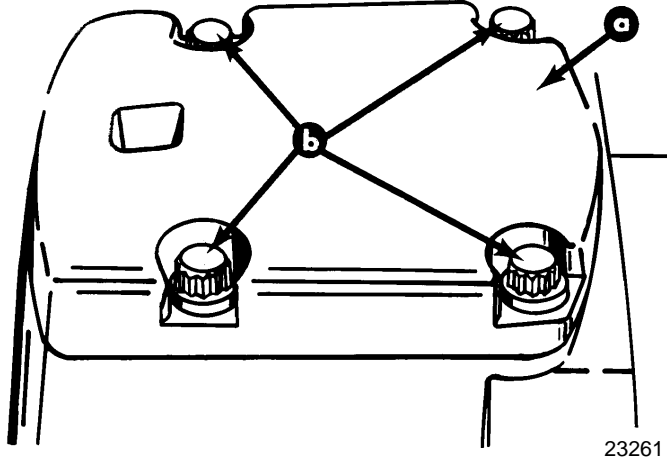
NOTE: Be sure to substitute .032 in. for .025 in., if using heavy duty gears with date code "G-7", when making the following calculations.

.025 in.-Clearance Between = Shimming Thickness
 (0.64 mm) Gear Teeth and Change Required Shimming Tool

Example: .025 in.-.023 in. = .002 in.
 (0.64 mm-.584 mm = .056 mm)

Shims equal to the resulting difference must be added between U-joint assembly bearing cup and drive shaft housing shoulder.

21. Ensure U-joint retainer nut is torqued to 200 lb. ft. (217 N·m).
22. Install top cover and torque screws to 20 lb. ft. (27 N·m).

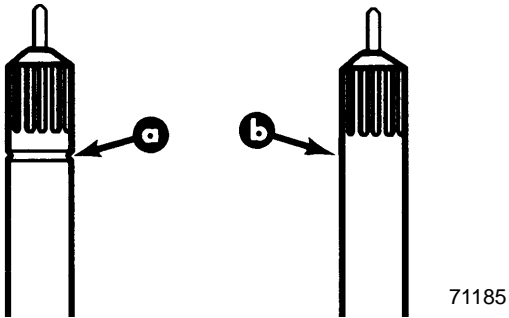


a - Top Cover
b - Screws

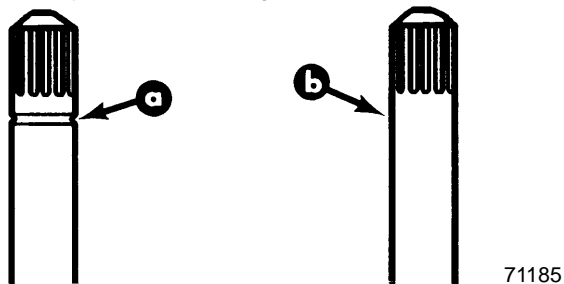
Gear Housing Installation

ALPHA I AND MC I DRIVE SHAFT CHANGES

The service drive shaft for the lower unit will no longer have an O-ring groove at the top of the shaft under the splines on all Alpha One 1990 and prior and also MC through 1976. All present production units contain the New Style shaft without an O-ring groove also.

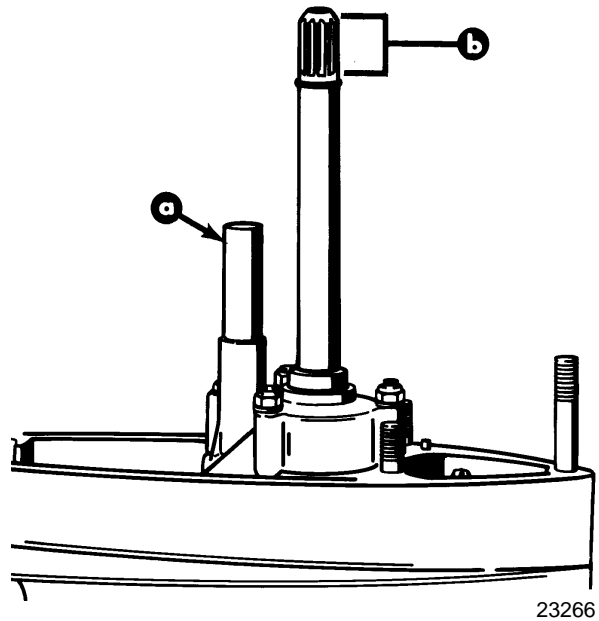


a - MC I Old Style (With O-ring Groove)
b - MC I New Style (Without O-ring Groove)



a - Alpha One Old Style (With O-ring Groove)
b - Alpha One New Style (Without O-ring Groove)

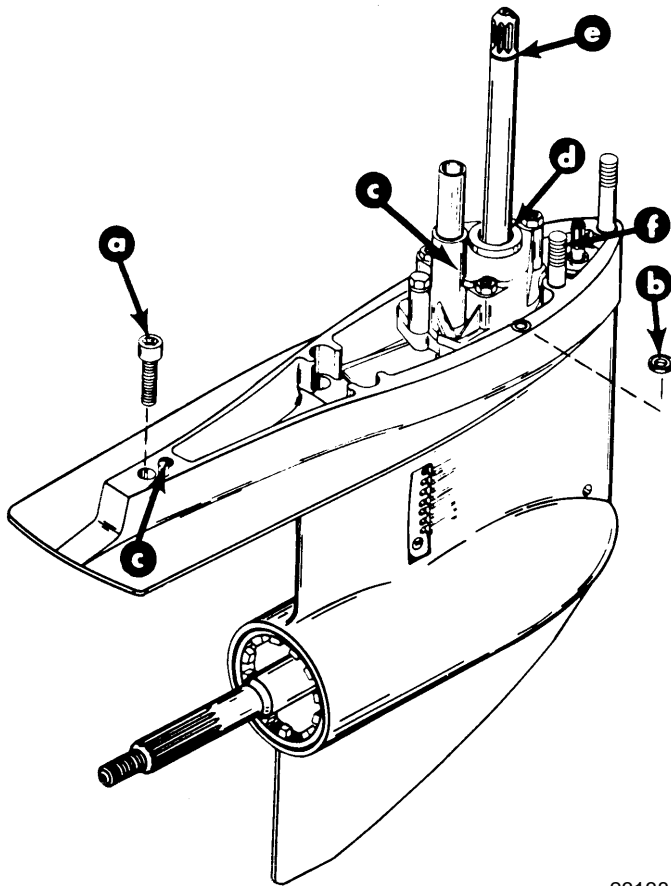
1. Lubricate end of water tube and drive shaft splines with 2-4-C Marine Lubricant.



a - Water Tube
b - Drive Shaft Splines-Lubricate

2. Install trim tab allen screw.
3. Install oil seal and apply Special Lubricant 101, 2-4-C Marine Lubricant, or Perfect Seal to oil seal.
4. Check that alignment pins, centrifugal slinger and drive shaft O-ring is in place.
5. Move gear housing shift shaft clockwise to shift gear housing into forward gear.

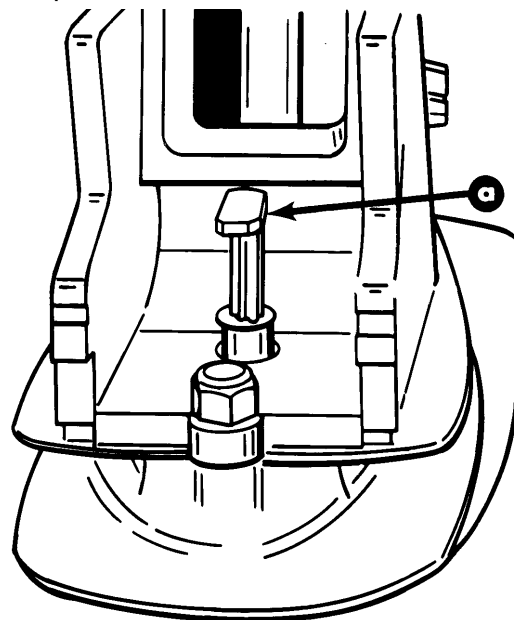
NOTE: Gear housing may be held in forward gear by applying light pressure to propeller shaft in counterclockwise direction.



23138

- a - Trim Tab Allen Screw
- b - Oil Seal
- c - Alignment Pins
- d - Centrifugal Slinger
- e - O-ring (If Present)
- f - Shift Shaft

6. Place drive shaft housing shift shaft in the full forward position.



23265

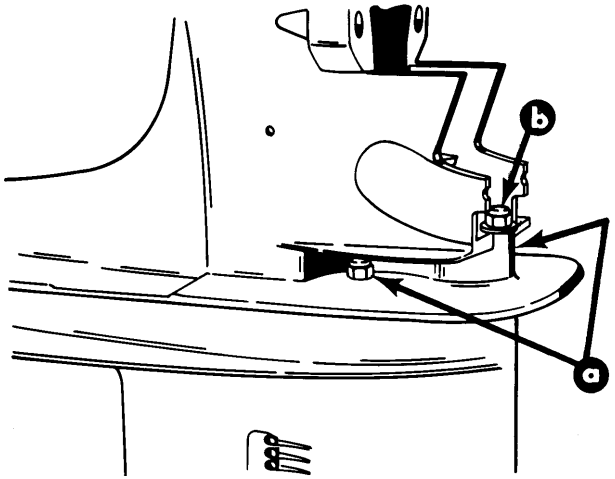
- a - Shift Shaft

NOTE: If propeller shaft is rotated in a clockwise direction before shift shafts are coupled, gear housing must be shifted back into forward gear and held in position.

7. Align water tube with tube guide and drive shaft and shift shaft splines with upper drive shaft and shift shaft splines and install gear housing.

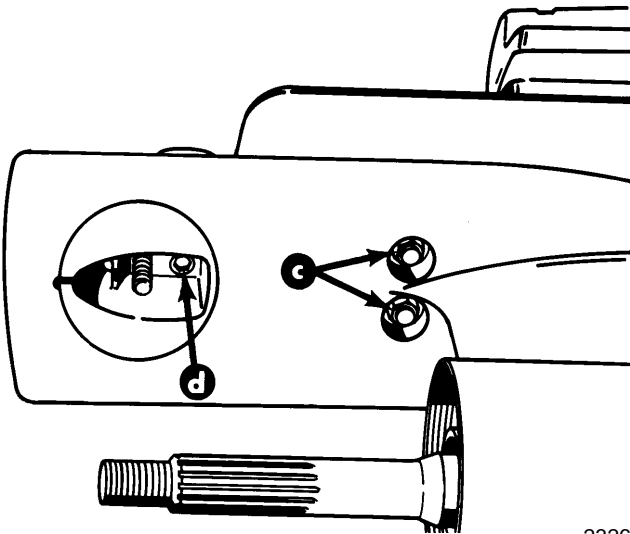
NOTE: Rotate propeller shaft counterclockwise only after shift shaft splines have engaged. This will help engage drive shaft splines.

8. Secure gear housing to drive shaft housing as shown. Torque locknuts to 35 lb. ft. (47 N-m). Torque allen screw to 38 lb. ft. (38 N-m).



23261

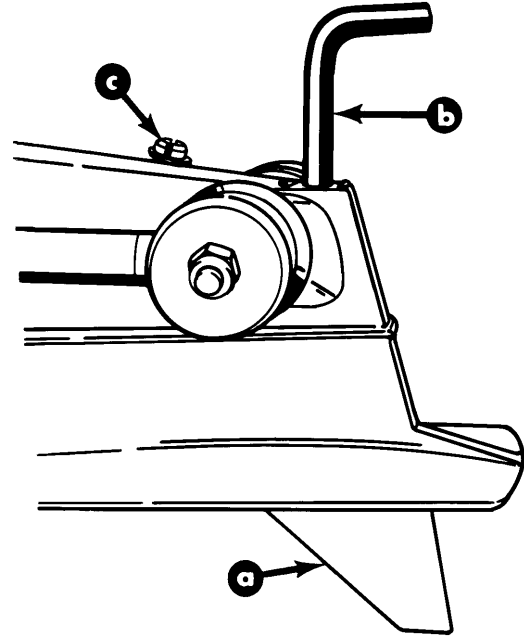
- a - Locknuts (One Each Side)
b - Locknut



23263

- c - Locknuts
d - Allen Screw

9. Install trim tab and position according to marks made before disassembly. Torque to 23 lb. ft. (32 N-m). Reinstall plastic plug.



23253

- a - Trim Tab
b - Allen Wrench
c - Plastic Plug