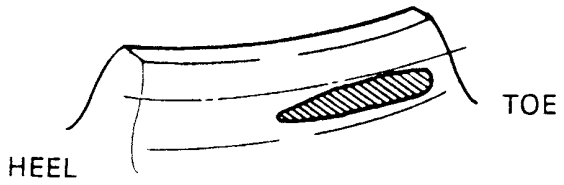
Bottom side toe contact



Step 7

8. After adjusting the tooth contact pattern, install the propeller shaft, bearing housing assembly, reverse gear and all related shims and washers.
9. Recheck the amount of backlash by slightly rotating the drive shaft by hand. Backlash should not be less than when checked at the start of this entire procedure.
10. If backlash is less, reduce the reverse gear back-up shim thickness.

CHECKING PROPELLER SHAFT THRUST PLAY

See Figure 17

To perform the thrust play measurement, obtain the following special tool
- Gear adjusting gauge (09951–09510).

After adjusting all the gear positions, measure the propeller shaft thrust play and if it is not within specification: 0.008–0.016 in. (0.2–0.4 mm), you must make a shim adjustment.

➡Maintain the forward gear thrust washer at standard thickness (1.5 mm) and adjust only the reverse gear thrust washer with shims.

1. Set the gear adjusting gauge to the propeller shaft.
2. Push the propeller shaft inward.
3. Hold the shaft in and set the dial gauge pointer to zero.
4. Slowly pull the propeller shaft outward and read the maximum thrust play measurement on the dial.
   - If the play is larger than specified, increase the reverse gear thrust washer thickness.
   - If the play is smaller than specified, reduce the reverse gear thrust washer thickness.

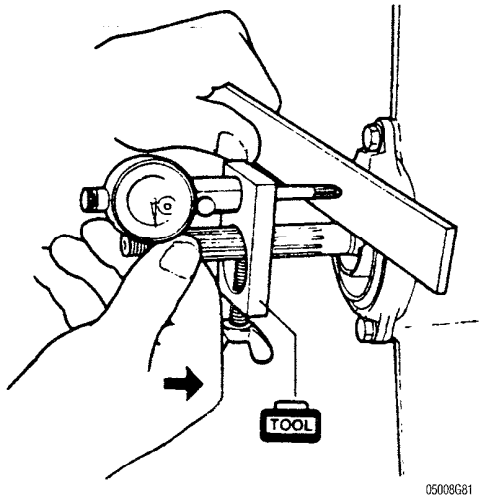


Fig. 17 Set the gear adjusting gauge to the propeller shaft

DT20, DT25 and DT30

DISASSEMBLY

See Figure 18 and 19

1. Remove the propeller bearing housing bolts.
2. Obtain the following special tools:
   - Sliding hammer (09930–30102)
   - Propeller shaft remover attachment (09950–59310).
3. Attach the special tools to the propeller shaft and using the slide hammer attachment, remove the propeller bearing housing assembly and propeller shaft assembly.
4. Remove the water pump assembly.
5. Remove the key, detach the pump case lower plate and gasket.
6. Fit the drive shaft holder (09921–29610) to the splined end of the driveshaft.
7. Pad the sides of the gearcase, hold the pinion nut with a wrench, and turn the driveshaft with the special tool, loosening the pinion nut securing the pinion gear to the driveshaft.
8. Remove the two bolts located on the driveshaft bearing housing.
9. To separate the driveshaft bearing housing from the gearcase, use two 6 mm jacking bolts to separate the two components. Make sure to screw the jacking bolts equally to prevent damage to the bearing housing and gearcase.
10. Pull out the driveshaft with the driveshaft bearing housing.
11. Remove the pinion gear from the gearcase.
12. Remove the forward gear with its shim and bearing.

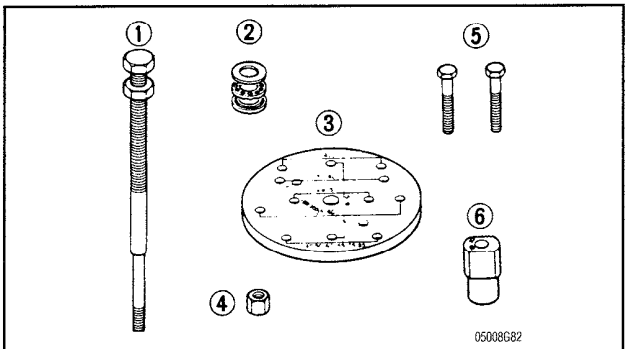


Fig. 18 To remove the pinion needle bearing from the gearcase, use the following special tools

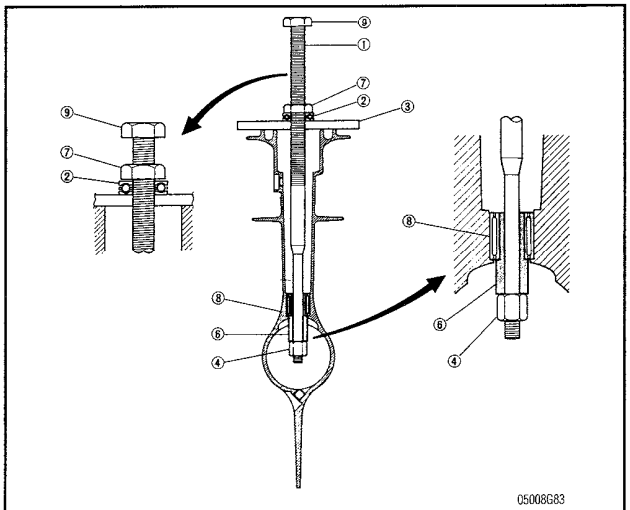


Fig. 19 Mount the plate "3" on the gearcase with two bolts "5"

13. Take out the pinion shim.
14. Remove the screw holding the shift rod guide and pull out the shift rod assembly.
15. Using a pair of snap ring pliers, remove the circlip holding the collar preload spring and remove the drive shaft, preload spring, spring collar and washers.
16. Remove the dog spring from around the clutch dog shifter.
17. Remove the push rod from the end of the propeller shaft.
18. Using a drift, push out the pin from the clutch dog shifter.
19. Remove the clutch dog shifter, push pin and return spring from the propeller shaft.
20. To remove the pinion needle bearing from the gearcase, use the following special tools:
    - Remover shaft "1" (09951–49910)
    - Bearing "2" (09951–69910)
    - Plate "3" (09951–39914)
    - Nut "4" (09951–29910)
    - Bolts "5" (01107–08408)
    - Attachment "6" (09951–19610)
21. Remove the four stud bolts on the gearcase.
22. Mount the plate "3" on the gearcase with two bolts "5".
23. Have the remover shaft "1" threaded through the plate so that the bearing "2" stays between the plate and turning nut "7", and put it in the gearcase. Then, install the attachment "6" and hold it with the nut "4" at the end of the remover shaft.
24. Remove the pinion needle bearing "8" by turning the lower nut "7" clockwise with the upper nut "9" held tight.

CLEANING & INSPECTION

See Figure 20

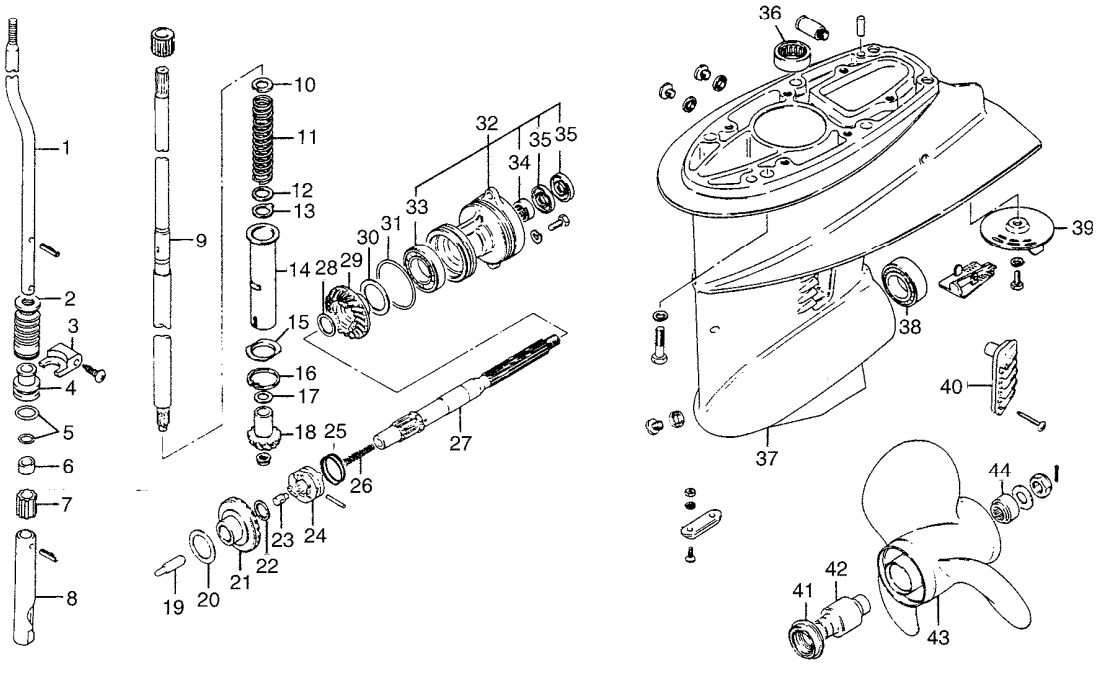
Wash all parts completely and dry them using compressed air. Inspect each part and service it, as necessary, or replace the part if it does not meet specification. Parts to be inspected and items to be checked are as follows:

- All bearings for wear and damage
- Propeller shaft and driveshaft for wear at oil seal contact points
- All gear teeth for damage or wear
- Dogs on clutch dog shifter for wear and damage
- Dogs on the forward and reverse gears for damage and wear
- Shifting cam and pushrod for wear
- Perform a gearcase pressure test to check the seals. Use the oil leakage tester (09950–69511) and air pump assembly (09821–00004) and pressurize the gearcase to 14.22 psi (1.0 kg/cm). With the gearcase pressurized, spray soapy water onto the seals and check for escaping air bubbles.
- O-rings and oil seals for cracks, tears and wear
- Propeller for nicks, bent blades or other damage and wear
- Cooling circuit for clogging or other obstructions
- Gearcase for rusting, pitting and distortion.

ASSEMBLY

See Figures 21, 22 and 23

Drive the pinion needle bearing into the gearcase using the following special tools:



1. Shift rod
2. Boot
3. Stopper
4. Guide
5. O-ring
6. Magnet spacer
7. Magnet
8. Cam
9. Drive shaft assy
10. Washer
11. Spring
12. Thrust washer
13. Washer
14. Collar
15. Barrier
16. Circlip
17. Shim
18. Pinion gear
19. Push rod
20. Shim
21. Forward gear
22. Thrust washer
23. Pin
24. Clutch dog shifter
25. Dog spring
26. Return spring
27. Propeller shaft
28. Thrust washer
29. Reverse gear
30. Shim
31. O-ring
32. Prop. shaft housing
33. Reverse bearing
34. Prop. shaft bearing
35. Oil seal
36. Pinion bearing
37. Gear case assy
38. Forward bearing
39. Trim tab
40. Water filter
41. Prop. bush stopper
42. Bush
43. Propeller
44. Spacer

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Fig. 20 Exploded view if the DT25 and DT30 lower unit assembly

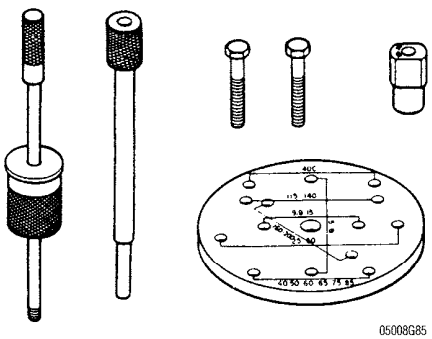


Fig. 21 Drive the pinion needle bearing into the gearcase using the following special tools

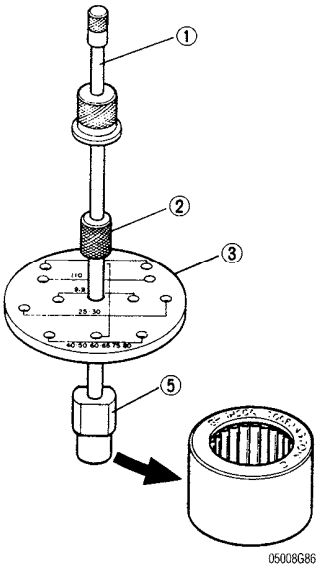


Fig. 22 Thread the slide shaft "1" into the top of the installer shaft "2" and have the installer shaft "2" inserted through the plate "3", then install the attachment "5" at the shaft end with the pinion needle bearing attached to it

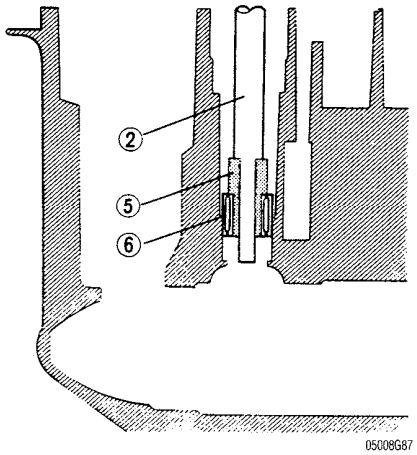


Fig. 23 Lay the gearcase down, and insert the installer shaft into it, making sure of the position of the pinion needle bearing "6" that is being installed

- "1" Rotor remover slide shaft (09930–30102)
- "2" Installer shaft (09951–59910)
- "3" Pinion needle bearing plate (09951–39914)
- "4" Bolts (01107–08408)
- "5" Attachment (09951–19610)

➡Make sure to thoroughly clean out the inside of the gearcase before installation.

1. Thread the slide shaft "1" into the top of the installer shaft "2" and have the installer shaft "2" inserted through the plate "3", then install the attachment "5" at the shaft end with the pinion needle bearing attached to it.

⁂ CAUTION

When installing the pinion needle bearing, make sure to have the stamped marks on the bearing facing up.

2. Lay the gearcase down, and insert the installer shaft into it, making sure of the position of the pinion needle bearing "6" that is being installed.
3. Set the gearcase upright and install the plate on the gearcase with the two bolts "4", then install the pinion needle bearing by hitting the installer shaft lightly until the coupler touches the plate.

⁂ CAUTION

If the pinion needle bearing does not install smoothly, it might be misaligned. Make sure to realign the bearing before proceeding or damage to the bearing and gearcase may result. Do not use force to set the bearing, just use repeated light hammering strokes on the special tool until the bearing is seated in the gearcase.

4. Before installing the preload spring, be sure to put the end of the spring into the notch that is provided in the inner race of the drive shaft tapered bearing.
5. Be sure to not miss the driveshaft lockwasher when putting the collar on the preload spring. Fit the onto the collar, making the tongue of the washer show out of the slip provided in the top of the collar, and then put on the collar. After this, insert the thrust washer at the near side.
6. After putting on the preload spring collar, push down the collar all the way to compress the preload spring inside, and then install the circlip to hold the collar in place.
7. Install the shift rod and shift rod guide assembly.
8. Install the pinion shim.
9. Install the forward gear, shim and bearing into the gearcase.
10. Install the pinion shim into the gearcase.
11. Install the driveshaft and driveshaft bearing housing into the gearcase and tighten the retaining bolts.
12. Install the water pump assembly.
13. Install the pinion gear into the gearcase, making sure to mesh it with the forward gear.
14. Using the special tool to turn the drive shaft, apply a small amount of thread locking compound to the driveshaft threads and tighten the pinion nut to 19.5–21.5 ft. lbs. (27–30 Nm). Make sure to pad the gearcase to prevent the wrench from damaging it.
15. The clutch dog shifter is marked for easy assembly. The end with the letter "F" must face the forward gear. Be sure to mount the clutch dog shifter correctly on the propeller shaft.
16. Insert the return spring and push pin into the propeller shaft.
17. Bring the push pin to the slot, making the hole of the push pin visible in the slot; then slide the dog shifter over the slot aligning the pin hole to the hole in the shaft. Insert the drive spring pin through the dog shifter and hole of the push pin.
18. Check to be sure that the pin is all the way in, with its driven end flush with the surface of the clutch dog shifter.
19. Fit the spring snugly into the groove on the clutch dog shifter to retain the pin in place.

After fitting the dog shifter and connecting pin on the propeller shaft, install the reverse gear, using the forward and reverse thrust washers and reverse shim that were removed during disassembly.

Use the following special tools to install the bearing housing into the gearcase.

- Propeller shaft housing installer (09922–59410)
- Bearing installer handle (09922–59420)

20. With the special tool installed, drive the bearing housing into the gearcase until it is seated firmly.
21. Tighten the propeller shaft housing bolts to 11.0–14.5 ft. lbs. (15–20 Nm).

SHIMMING PROCEDURE

Transmission Gear Adjustment

See Figure 24

PINION GEAR TO FORWARD GEAR BACKLASH

See Figure 25

1. To measure the backlash, hold the driveshaft steady and move the forward gear back and forth.
2. Check the backlash at the heel of the forward gear.
3. If the amount of backlash is larger than 0.004–0.008 in. (0.1–0.2 mm), increase the thickness of each of the pinion gear back-up shim(s).
4. If the backlash is smaller, decrease the thickness of each shim.

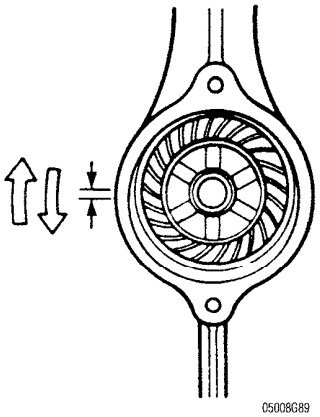
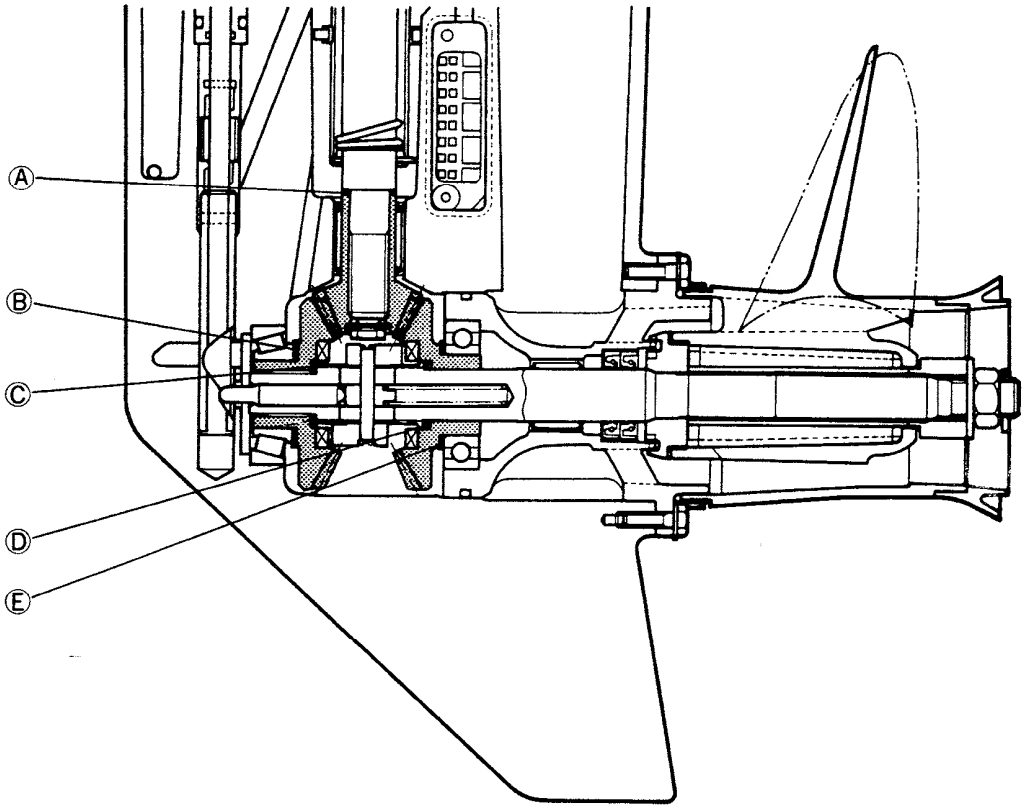


Fig. 25 To measure the backlash, hold the driveshaft steady and move the forward gear back and forth



Part Name	Type of Thickness (mm)	Standard Thickness (mm)
Ⓐ Pinion gear back-up shim	1.7, 1.8, 1.9, 2.0, 2.1, 2.2	2.0
Ⓑ Forward gear back-up shim	0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5	1.2
Ⓒ Forward gear thrust washer	1.5	1.5
Ⓓ Reverse gear thrust washer	0.8, 0.9, 1.0, 1.1, 1.2, 1.3	2.0
Ⓔ Reverse gear back-up shim	0.2, 0.5, 0.8, 1.0	1.5

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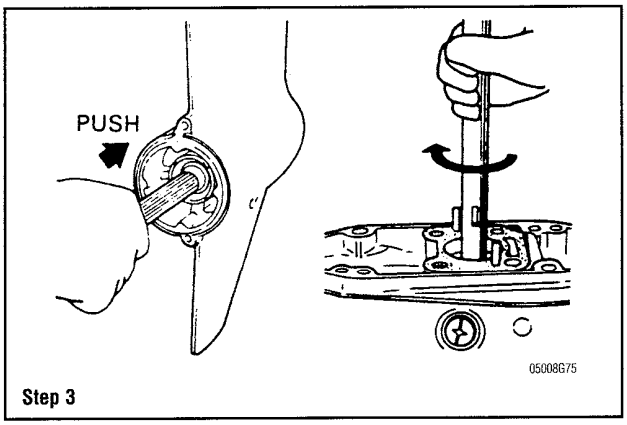
Fig. 24 Back-up shim and thrust washer mounting locations and shim thickness chart

CHECKING AND ADJUSTING TOOTH CONTACT (FORWARD/PINION GEARS)

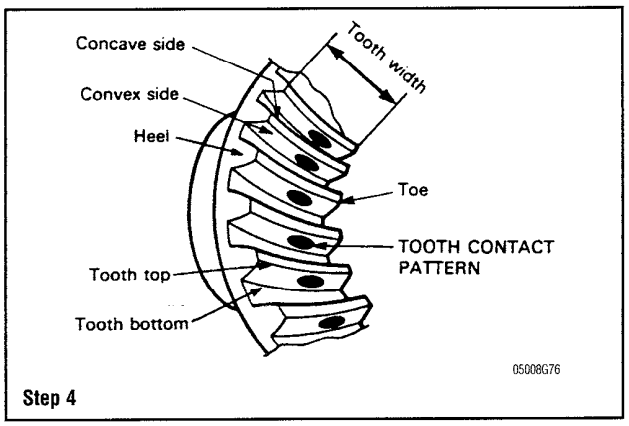
▸ See accompanying illustrations

Check tooth contact pattern using the following procedure.

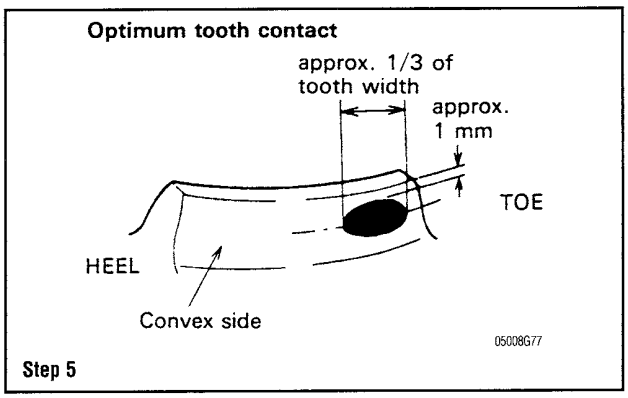
1. Too correctly assess tooth contact, smear a light coating of Prussian Blue compound on the convex surface of the forward gear.
2. Install the propeller shaft and bearing housing assembly (minus the reverse gear and internal components).
3. Push the propeller shaft inward and hold it in that position. Rotate the driveshaft clockwise 5–6 times by hand.
4. Then pull out the propeller shaft and bearing housing and then check the gear tooth contact pattern.
5. This is the optimum tooth contact. Doing a shim adjustment may be necessary to obtain this contact pattern.
6. An example of incorrect top side toe contact. To correct this condition, decrease the forward gear shim thickness and slightly increase the pinion gear shim thickness.



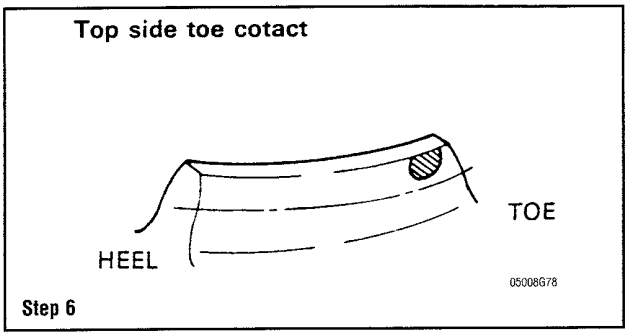
Step 3



Step 4



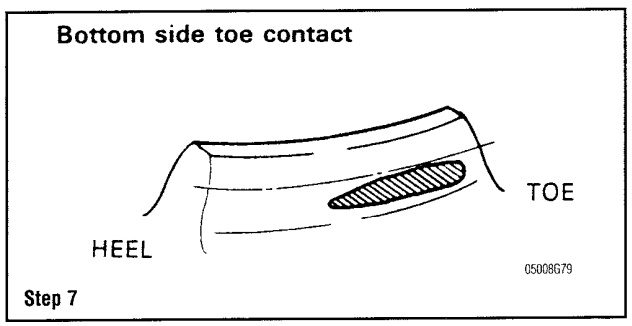
Step 5



Step 6

➦Do not set the tooth contact in this position (top side toe contact). Damage and chipping of the pinion and forward gear may result.

7. An example of incorrect bottom side toe contact. To correct this condition, increase the forward gear shim thickness and slightly decrease the pinion gear shim thickness.



Step 7

➦Do not set the tooth contact in this position (bottom side toe contact). Damage and chipping of the pinion gear may result.

8. After adjusting the tooth contact pattern, install the propeller shaft, bearing housing assembly, reverse gear and all related shims and washers.
9. Recheck the amount of backlash by slightly rotating the drive shaft by hand. Backlash should not be less than when checked at the start of this entire procedure.
10. If backlash is less, reduce the reverse gear back-up shim thickness.

PINION GEAR TO FORWARD GEAR THRUST PLAY

Obtain the following special tools to perform the measurement:

- Gear adjusting set (09951–09510)

1. Fit the propeller shaft to the forward gear and press the forward gear forward by pushing with the propeller shaft. (In this case, first remove the push rod from the propeller shaft)
2. Set the special tool up on the driveshaft.
3. Push the driveshaft down. Hold this position and place the gauge with its rod pushed in approximately 2 mm.
4. Still keeping this position, zero the dial gauge. Then pull up on the driveshaft and read the maximum play on the gauge.

If the amount of backlash is larger than specified, increase the thickness of each of the pinion gear back-up shim(s) or forward gear back-up shim(s). If smaller, decrease the thickness of each shim.

5. When the pinion and forward gear back-up shim are determined to be the correct size, note the amount of thrust play measured. The thrust play measurement will be necessary for the adjustment of the reverse gear.

REVERSE GEAR THRUST PLAY ADJUSTMENT

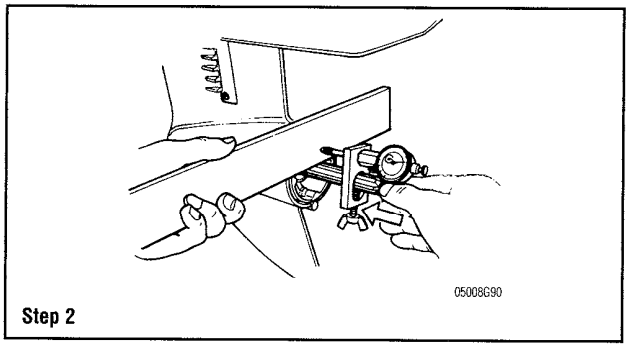
1. Perform the same procedure as above with the exception of installing the propeller shaft and propeller shaft bearing housing into the gearcase.
2. If the measurement of the play is equal to the pinion gear to forward gear measurement, the condition is correct.
3. If the amount of play is smaller, decrease the thickness of the reverse gear back-up shim.

PROPELLER SHAFT THRUST PLAY ADJUSTMENT

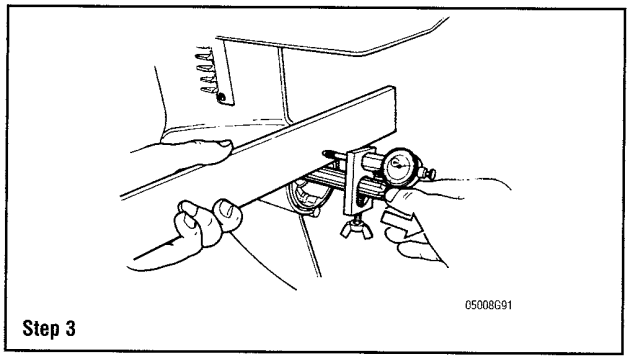
See accompanying illustrations

1. Install the dial gauge adaptor plate and dial gauge with the long rod on the propeller shaft.
2. Push the propeller shaft inward. Hold the shaft in this position and preload the dial gauge 2 mm. Now zero the gauge.
3. Pull the driveshaft slowly out and read the amount of play on the gauge. Maximum propeller shaft thrust play is 0.008–0.016 in. (0.2–0.4 mm).

If the amount of thrust play is larger than specified, increase the thickness of the reverse gear thrust washer. If smaller, decrease the thickness of the thrust washer.



Step 2



Step 3

DT35 and DT40

DISASSEMBLY

See Figure 26

1. Remove the oil vent screw and oil fill screw and drain the gear oil into a suitable container.
2. Loosen the clutch rod lock nut.
3. Loosen the clutch rod turn buckle, and separate the clutch rod from the shift rod.
4. Separate the gearcase assembly from the drive shaft housing by removing the six attaching bolts.
5. Place the gearcase in suitable holding fixture or padded vice.
6. Remove the trim tab.
7. Remove the propeller.
8. Remove the bearing housing bolts.
9. Use the following special tools to remove the propeller shaft bearing housing:
   - Slide hammer (09930–30102)
   - Propeller shaft bearing housing remover (09930–30161)
10. Remove the bearing housing from the gearcase.
11. Remove the water pump seal tube from the pump case.
12. Remove the water pump assembly.
13. Using the driveshaft holder tool (09921–29610) and a wrench, remove the pinion gear nut.

➡Make sure to pad the gearcase with rag so that the wrench won't damage or distort the gearcase.

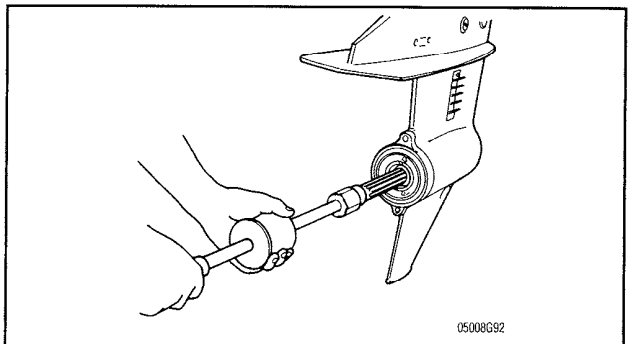


Fig. 26 Remove the bearing housing from the gearcase

14. Take out the forward gear, shim(s) and bearing.
15. Remove the pinion gear.
16. Remove the driveshaft bearing housing and shift rod assembly from the gearcase.
17. Remove the driveshaft.
18. Remove the driveshaft spring housing from the gearcase.
19. Remove the two pinion washers.
20. Pull off the driveshaft spring pin and remove the shaft spring from the driveshaft.
21. Pull out the push rode from the inboard end of the propeller shaft.
22. Remove the reverse gear and bearing housing from the propeller shaft assembly.
23. Remove the clutch dog spring from around the shift dog clutch.
24. Using a drift, remove the pin from the clutch dog shifter, and slide the shifter off the propeller shaft.
25. Remove the push pin and return spring from the end of the propeller shaft.

CLEANING & INSPECTION

See Figures 27, 28 and 29

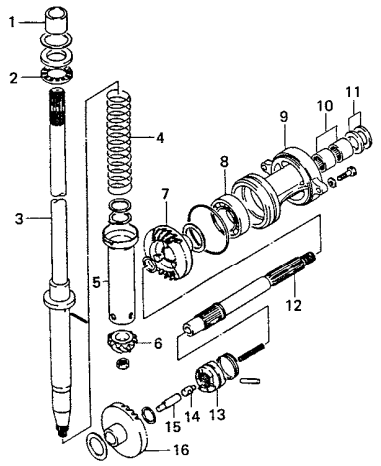
Wash all parts completely and dry them using compressed air. Inspect each part and service it, as necessary, or replace the part if it does not meet specification. Parts to be inspected and items to be checked are as follows:

- All bearings for wear and damage
- Propeller shaft and driveshaft for wear at oil seal contact points
- All gear teeth for damage or wear
- Dogs on clutch dog shifter for wear and damage
- Dogs on the forward and reverse gears for damage and wear
- Shifting cam and pushrod for wear
- Perform a gearcase pressure test to check the seals. Use the oil leakage tester (09950–69511) and air pump assembly (09821–00004) and pressurize the gearcase to 14.22 psi (1.0 kg/cm). With the gearcase pressurized, spray soapy water onto the seals and check for escaping air bubbles.
- O-rings and oil seals for cracks, tears and wear
- Propeller for nicks, bent blades or other damage and wear
- Cooling circuit for clogging or other obstructions
- Gearcase for rusting, pitting and distortion.

ASSEMBLY

Liberally apply outboard motor gear oil to the forward gear, drive shaft and propeller shaft before assembly.

1. Install the push pin and return spring into the end of the propeller shaft.
2. Slide the shifter onto the propeller shaft. The letter "F" marked on the shifter faces toward the forward gear. Then, using a drift, install the pin through the clutch dog shifter.
3. Install the clutch dog spring around the dog clutch shifter.
4. Install the reverse gear and bearing housing onto the propeller shaft assembly.
5. Install the push rode into the inboard end of the propeller shaft.
6. Install the shaft spring and pin onto the driveshaft.
7. Install the two pinion washers.
8. Install the driveshaft spring housing onto the gearcase.
9. Install the driveshaft.



1. Bush, drive shaft
2. Bearing
3. Shaft, drive
4. Spring
5. Housing, drive shaft spring
6. Pinion
7. Gear, reverse
8. Bearing
9. Housing, propeller shaft
10. Bearing
11. Oil seal
12. Shaft, propeller
13. Shifter, clutch dog
14. Pin
15. Rod, push
16. Gear, forward

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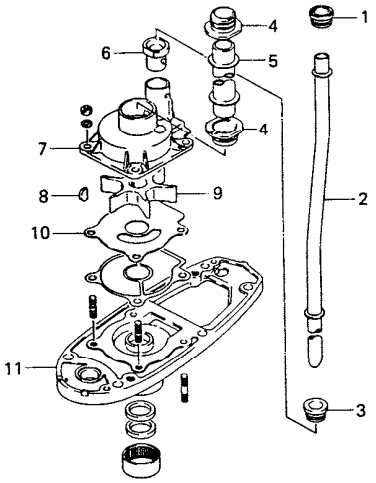
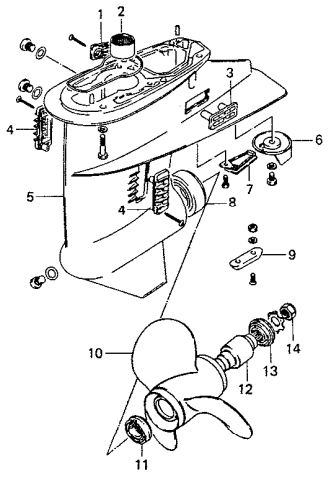
Fig. 27 Exploded view of the DT35 and DT40 transmission assembly



1. Grommet, water tube, upper
2. Tube, water
3. Grommet, water tube, middle
4. Grommet, water pump seal tube
5. Tube, water pump seal
6. Grommet, water tube, lower
7. Case, water pump
8. Key
9. Impeller, water pump
10. Panel, pump case under
11. Housing, driveshaft bearing

05008G94

Fig. 28 Exploded view of the DT35 and DT40 water pump/driveshaft housing assembly



1. Cover, gear case starboard
2. Bearing
3. Cover, gear case
4. Filter, water
5. Case assy, gear
6. Tab, trim
7. Filter
8. Bearing
9. Zinc, protection
10. Propeller
11. Stopper, propeller bush
12. Bush, propeller
13. Spacer, propeller nut
14. Nut

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Fig. 29 Exploded view of the DT35 and DT40 gearcase assembly

10. Apply silicone sealant to both surfaces and install the driveshaft bearing housing and shift rod assembly into the gearcase.
11. Install the forward gear, shim(s) and bearing.
12. Install the pinion gear.
13. Using the driveshaft holder tool (09921–29610) and a wrench, tighten the pinion gear nut to 21.7–28.9 ft. lbs. (30–40 Nm).

➦Make sure to pad the gearcase with rag so that the wrench won't damage or distort the gearcase.

14. Install the water pump assembly. Make sure to fit the impeller key onto the driveshaft before installing the impeller.
15. After mounting the water pump impeller, put on the pump case while turning the driveshaft clockwise by hand. Force the case onto the impeller being rotated. This will ensure that the vanes are turning in the correct direction. Tighten the mounting nuts to 4.5–7.0 ft. lbs. (6–10 Nm).
16. Install the water pump seal tube into the pump case.
17. Before installing the bearing housing into the gearcase, apply a coat of water proof marine grease onto the push rod and O-ring.
18. Use the following special tools to install the bearing housing:
    - Propeller shaft bearing housing installer (09922–59410)
    - Installer hammer (09922–59420)
19. Install the bearing housing bolt and tighten to 11.5–14.5 ft. lbs. (15–20 Nm)
20. Install the propeller and tighten the nut, while using the drive shaft holder tool, to 36.0–43.5 ft. lbs. (50–60 Nm).
21. Install the trim tab.
22. Apply water proof marine grease to the splines of the driveshaft.
23. Install the gearcase assembly onto the drive shaft housing by the six attaching bolts.
24. Attach the clutch rod and shift to the clutch rod turn buckle.
25. Tighten the clutch rod lock nut.
26. Fill the gearcase through the drain hole with the proper amount of gear oil (20.6 oz.) until oil drips from the vent hole, then install and tighten the screws.

⁂ CAUTION

Recheck the oil level and top off the gearcase after the initial operation. Usually the level will need to be topped off. Failure to check this could result in damage to the gearcase due to lack of lubrication.

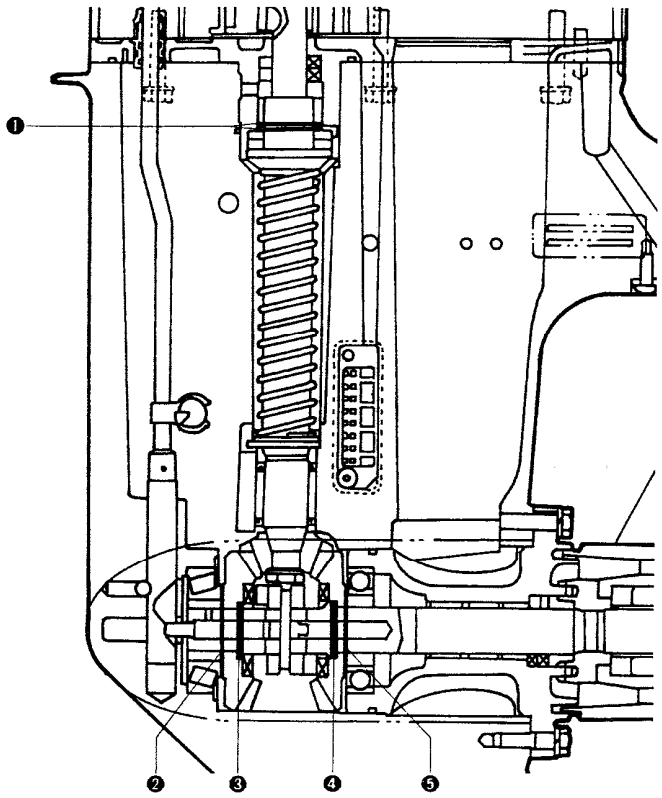
SHIMMING PROCEDURE

Transmission Gear Adjustment

➧See Figure 30

PINION GEAR TO FORWARD GEAR BACKLASH

To measure the backlash, hold the driveshaft steady and move the forward gear back and forth. Check the backlash at the heel of the forward gear.



	Parts Name	Type of Thickness	Standard Thickness
1	Pinion gear back-up shim & thrust washer (mm)	0.5, 0.6, 0.7, 0.8, 0.9, 1.0	2.0
2	Forward gear back-up shim & thrust washer (mm)	0.5, 0.6, 0.7, 0.8, 0.9, 1.0	1.2
3	Propeller shaft front thrust washer (mm)	2.0, 2.2	2.0
4	Propeller shaft rear thrust washer (mm)	1.8, 1.9, 2.0, 2.1, 2.2, 2.3	2.0
5	Reverse gear back-up shim & thrust washer (mm)	0.5, 0.6, 0.7, 0.8, 0.9, 1.0	1.5

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Fig. 30 Thrust washer and shim locations and shim thickness chart