Right Hand Rotation Unit

Diagnostic Information and Procedures

Diagnose Lower Unit Malfunction

CENDK1113104001

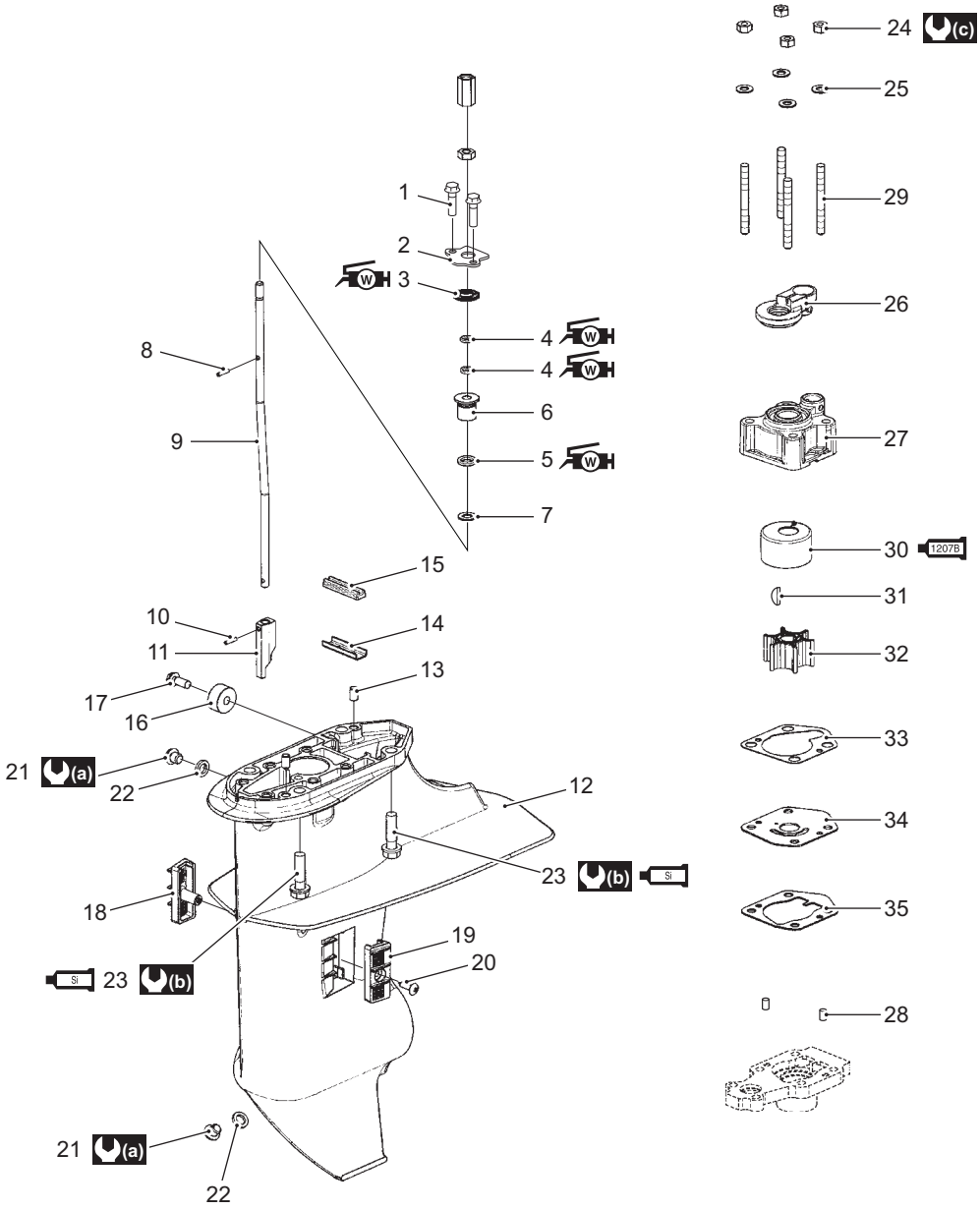
Trouble Check Chart

Condition	Possible cause	Correction / Reference item
Engine stalls when engaging gear	Idling speed set too low.	*Adjustment.*
	Propeller shaft bearings damaged, lacking lubrication or seized.	*Replace.*
Engaging gear(s) has no effect on propulsion	Clutch out of adjustment.	*Adjustment.*
	Driveshaft broken or splines damaged.	*Replace.*
	Chipped or worn dog clutches.	*Replace.*
	Propeller not secured correctly (fallen off).	*Inspection or retighten.*
Loss of power. (Assuming engine is OK)	Propeller bush slipping.	*Replace.*
	Bent or worn propeller.	*Repair or replace.*
Engine shakes the boat	Failed propeller bush.	*Replace.*
	Bent driveshaft or propeller shaft.	*Replace.*
	Damaged propeller.	*Replace.*
Clutch will not engage or disengage	Seized shift rod.	*Inspection.*
	Clutch shaft and clutch rod have become detached.	*Inspection.*
	Seized / broken remote control cable.	*Replace.*
	Problem at control box end.	*Inspection or replace.*

Service Instructions

Lower Unit Components

CENDK1113106001



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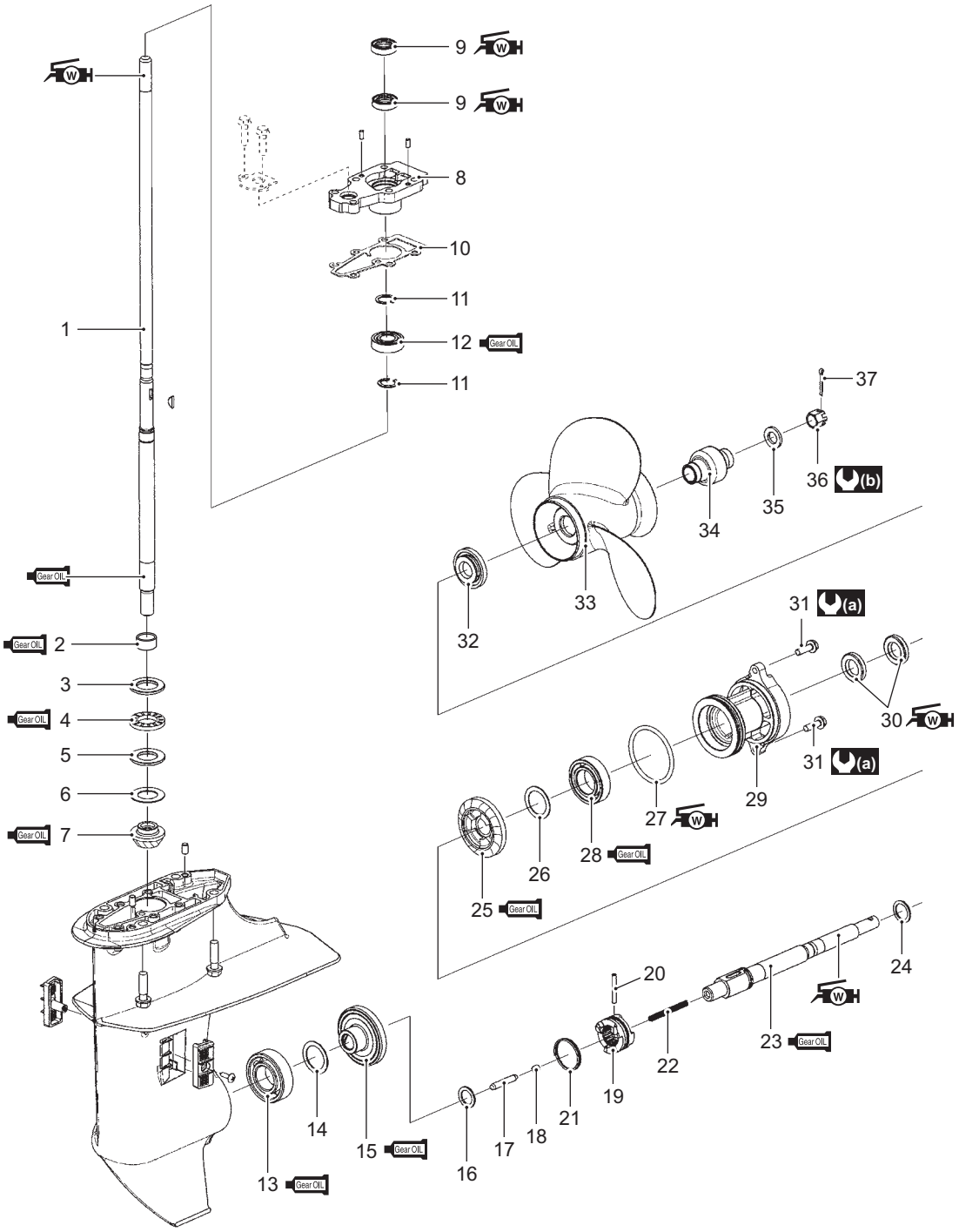
1. Bolt	12. Gearcase	23. Bolt	34. Under panel
2. Stopper	13. Dowel pin	24. Nut	35. Gasket
3. Dust seal	14. EX. Seal core	25. Washer	(a) : 5 N·m (0.5 kgf-m, 3.6 lbf-ft)
4. O-ring	15. EX.seal rubber	26. Grommet	(b) : 17 N·m (1.7 kgf-m, 12.3 lbf-ft)
5. O-ring	16. Anode	27. Water pump case	(c) : 6 N·m (0.6 kgf-m, 4.3 lbf-ft)
6. Shift rod guide	17. Bolt	28. Dowel pin	W : Apply SUZUKI Water Resistant Grease.
7. Washer	18. Water filter STBD	29. Stud bolt	Si : Apply SUZUKI Silicone seal.
8. Pin	19. Water filter PORT	30. Pump case inner sleeve	1207B : Apply SUZUKI Bond 1207B.
9. Shift rod	20. Screw	31. Key	
10. Pin	21. Plug	32. Water pump impeller	
11. Shift cam	22. Gasket	33. Gasket	



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1. Driveshaft	12. Bearing	23. Propeller shaft	34. Propeller bush
2. Pinion bearing	13. Forward gear bearing	24. Thrust washer	35. Washer
3. Thrust washer	14. Shim	25. Reverse gear	36. Nut
4. Bearing	15. Forward gear	26. Shim	37. Pin
5. Thrust washer	16. Thrust washer	27. O-ring	(a) : 8 N·m (0.8 kgf-m, 5.8 lbf-ft)
6. Shim	17. Push rod	28. Bearing	(b) : 18 N·m (1.8 kgf-m, 13.0 lbf-ft)
7. Pinion gear	18. Push pin	29. Propeller shaft bearing housing	W : Apply SUZUKI Water Resistant Grease.
8. Driveshaft oil seal housing	19. Clutch dog shifter	30. Oil seal	Gear OIL : Apply SUZUKI Outboard Motor Gear Oil.
9. Oil seal	20. Dog pin	31. Bolt	
10. Gasket	21. Dog spring	32. Stopper	
11. Circlip	22. Return spring	33. Propeller	

Propeller Removal and Installation

CENDK1113106002

⚠ WARNING

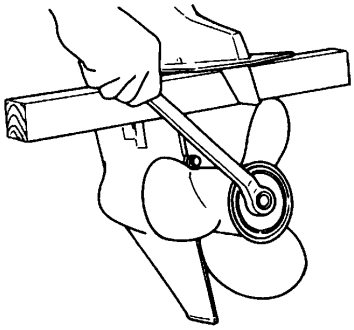
Failure to take proper precautions when installing or removing the propeller can result in severe personal injury.

When installing or removing the propeller:

- **Shift into "Neutral" and remove the emergency stop switch lock plate so that the motor cannot be started accidentally.**
- **Wear gloves to protect hands, and lock the propeller by placing a block of wood between the propeller blade tips and the anti-cavitation plate before attempting to remove or install propeller nut.**

Removal

1) Shift to "Neutral" position.
2) Remove cotter pin (1) from propeller nut and remove propeller nut (2).
3) Remove washer (3), propeller (4) and stopper (5) from the propeller shaft.



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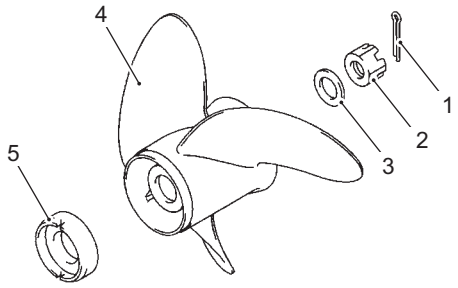

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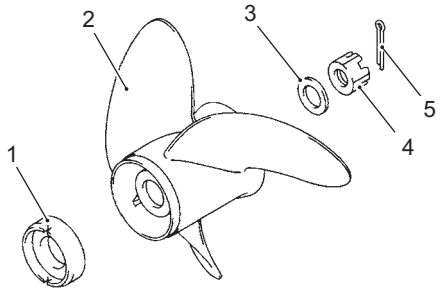
Installation

1) Coat the propeller shaft splines liberally with Suzuki water resistant grease.

: Grease 99000–25350 (SUZUKI Water Resistant Grease EP2 (250 g))

2) Install propeller stopper (1) onto propeller shaft, then slide on the propeller (2).
3) Fit washer (3) and nut (4), then tighten nut to specified torque.
4) Push cotter pin (5) through nut and shaft, then bend to secure.

Tightening torque
Propeller nut (a): 18 N·m (1.8 kgf-m, 13.0 lbf-ft)



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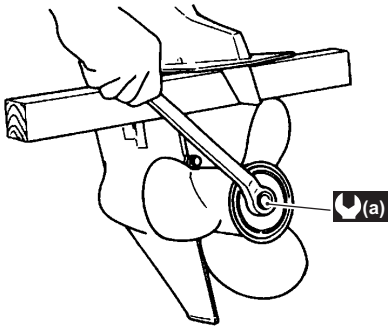

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Propeller / Nut / Cotter Pin Inspection

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Refer to "Propeller / Propeller Nut and Cotter Pin Inspection" in Section 0B (Page 0B-18).

Lower Unit Removal and Installation

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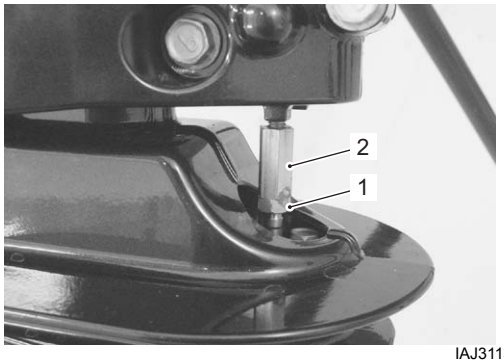
Removal

⚠ WARNING

Failure to take proper precautions when removing or installing the lower unit can result in severe personal injury.

Always disconnect the battery cable, before removing lower unit.

1) Loosen the clutch rod lock nut (1).
2) To separate the clutch rod from the shift rod, unscrew the connector (2).



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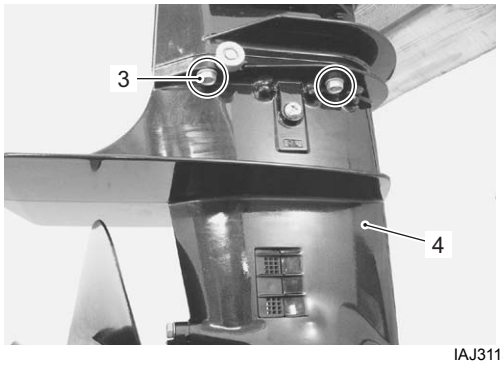
3) Remove four bolts (3) and separate gearcase (4) from driveshaft housing.



IAJ311310012-01

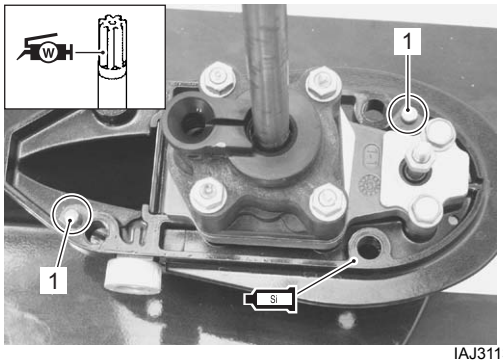
Installation

1) Insert two dowel pins (1).
2) Apply water resistant grease to driveshaft splines.

: Grease 99000–25350 (SUZUKI Water Resistant Grease EP2 (250 g))

3) Apply a light coating of Suzuki silicone seal to mating surfaces of gearcase and driveshaft housing.

: Sealant 93691–80030 (SUZUKI Silicone Seal (100 g))



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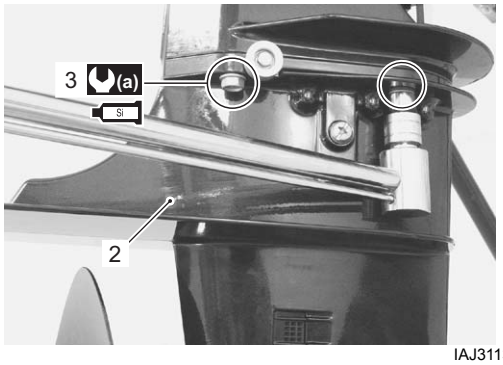
4) Slide the lower unit (2) into place, making sure that the top of the driveshaft engages properly with the crankshaft and that water tube locates in the water pump case outlet.
Apply SUZUKI SILICONE SEAL to the retaining bolts (3) and tighten them to specified torque.

: Sealant 93691–80030 (SUZUKI Silicone Seal (100 g))

Tightening torque
Gearcase bolt (a): 17 N·m (1.7 kgf-m, 12.3 lbf-ft)



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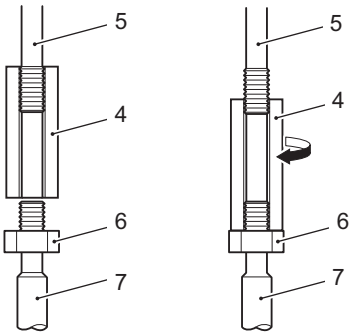
5) Connect the clutch rod and the shift rod using the clutch rod connector in the following procedure:

NOTE

The clutch rod connector is not a turnbuckle but just a long nut with right-hand thread.

a) Screw the clutch rod connector (4) onto the clutch rod (5) all the way to the end of its thread.
b) Screw the lower nut (6) onto the shift rod (7) all the way to the end of its thread.
c) Locate the shift cam at Neutral position by moving shift rod (7) up or down and then hold it at the position.
d) While holding the clutch lever (8), shift lever (9) and shift cam at neutral position, screw the clutch rod connector (4) onto the shift rod (7) until the connector contacts the lower nut (6).



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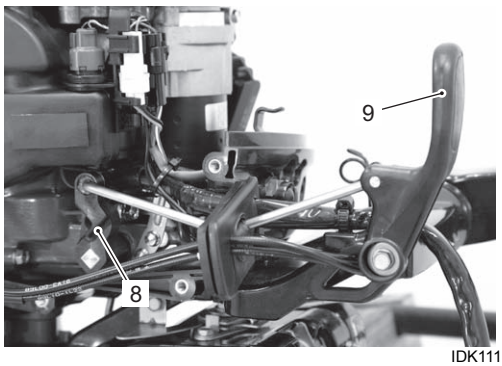

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e) With the clutch rod connector (4) securely held, tighten the lower nut (6) firmly against the connector.
f) Shift the shift lever from Neutral to Forward and Reverse to check that the gear starts engagement of both gears are at an equal angle from Neutral.

Water Pump Removal and Installation

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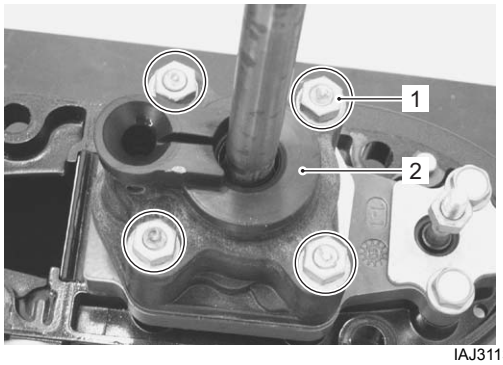
Removal

1) Remove the lower unit. Refer to “Lower Unit Removal and Installation” (Page 3A-5).
2) Loosen four nuts (1), then remove water pump case (2).



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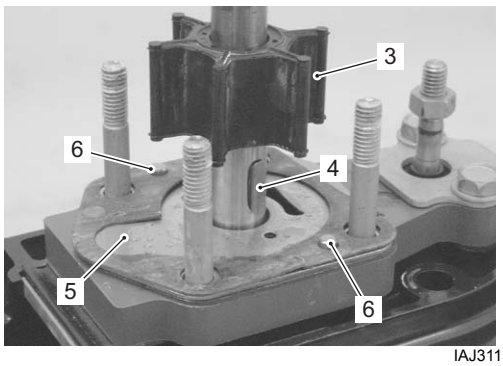
3) Remove impeller (3), impeller key (4), pump under plate (5) and dowel pins (6).
Keep impeller key (4) for reuse and discard the plate gasket.



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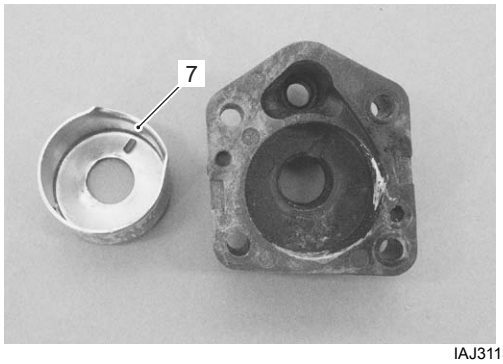
NOTE

To facilitate the removal of inner sleeve from pump case, warm up the entire case using a heater like hair dryer.

4) Remove inner sleeve (7) from pump case.



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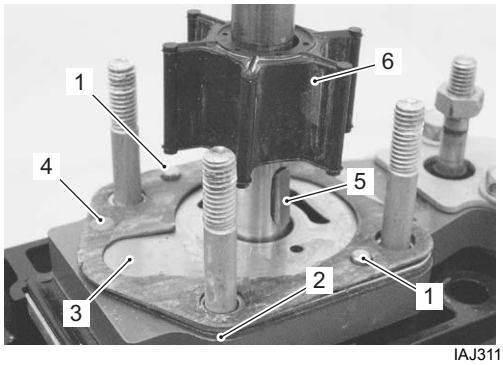
Installation

1) Place the dowel pins (1), under panel gasket (2) and under panel (3) into position.
2) Install the pump case gasket (4).
3) Insert the key (5) in the driveshaft and slide the impeller (6) onto driveshaft, ensuring that key and keyway is aligned.



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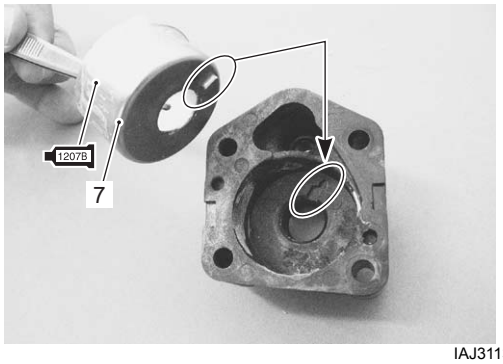
NOTE

- **Before installing pump inner sleeve, apply SUZUKI Bond 1207B lightly between inner sleeve and pump case mating surfaces.**
- **Do not apply bond to inner sleeve top surfaces.**

4) Install inner sleeve (7) into the pump case, ensuring that projection of inner sleeve and groove of pump case are aligned.

1207B : Sealant 99000–31140 (SUZUKI Bond 1207B (100 g))

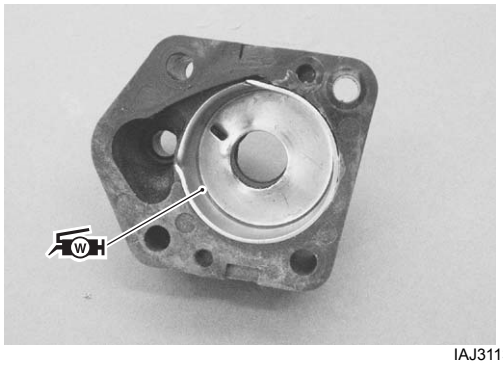


IAJ311310021-02

NOTE

Before installing water pump case assembly, apply water resistant grease lightly on pump case inner sleeve and under panel for initial lubrication.

W : Grease 99000–25350 (SUZUKI Water Resistant Grease EP2 (250 g))



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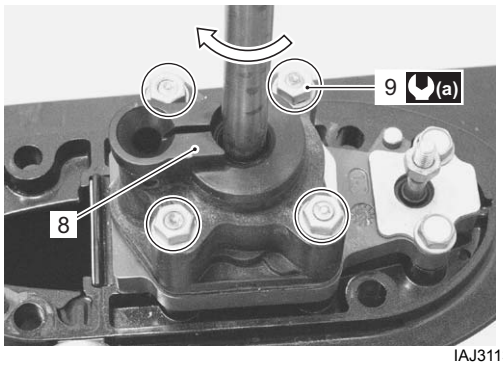
5) Install the pump case assembly (8) while rotating driveshaft clockwise to flex the impeller vanes in the correct direction.
Securely tighten the four pump case nuts (9) to the specified torque.

Tightening torque
Water pump case nut (a): 6 N·m (0.6 kgf-m, 4.3 lbf-ft)



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6) Install the Lower Unit. Refer to “Lower Unit Removal and Installation” (Page 3A-5).

Water Pump and Related Items Inspection

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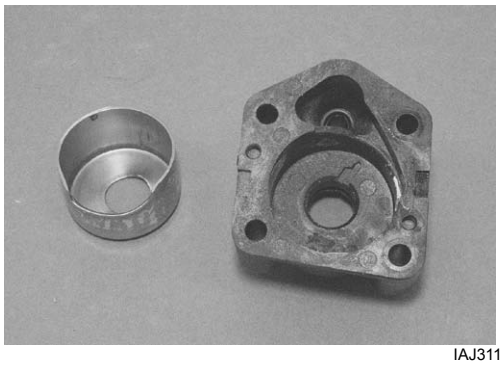
Inspect the following parts.

- Inspect impeller. Replace if vanes are cut, torn, worn or other abnormal conditions.
- Inspect pump case. Replace if cracked, distorted or other abnormal conditions are noted.
- Inspect pump inner sleeve. Replace if worn, cracked, distorted, corroded or other abnormal conditions are noted.
- Inspect under panel. Replace if cracked, distorted, corroded or other abnormal conditions are noted.



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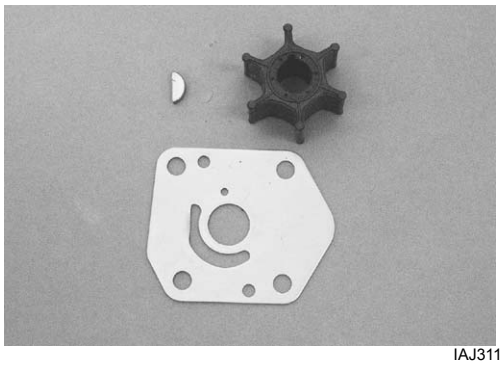

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Lower Unit Disassembly

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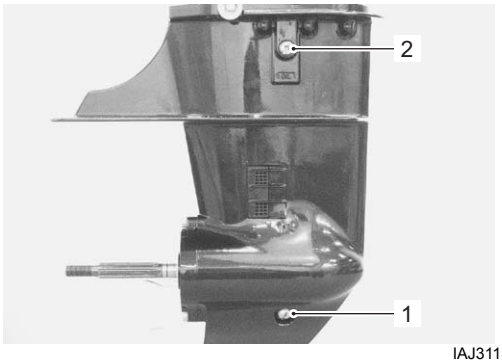
1) Remove the lower unit. Refer to “Lower Unit Removal and Installation” (Page 3A-5).
2) Remove the propeller. Refer to “Propeller Removal and Installation” (Page 3A-4).
3) Remove the water pump and related parts. Refer to “Lower Unit Removal and Installation” (Page 3A-5) and “Water Pump Removal and Installation” (Page 3A-6).
4) Place a drain pan under oil drain plug. Remove oil drain plug (1) first then oil level plug (2) and allow gear oil to drain.
   Inspect oil for water, contaminates or metal.



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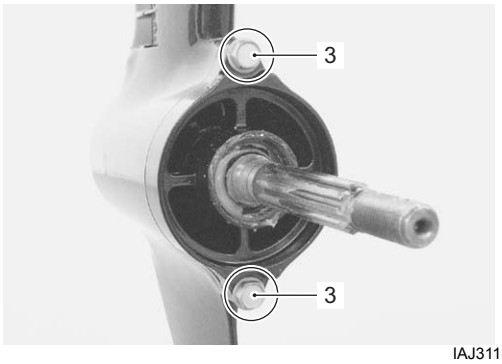
5) Remove the two bolts (3) securing the propeller shaft bearing housing to the gearcase.



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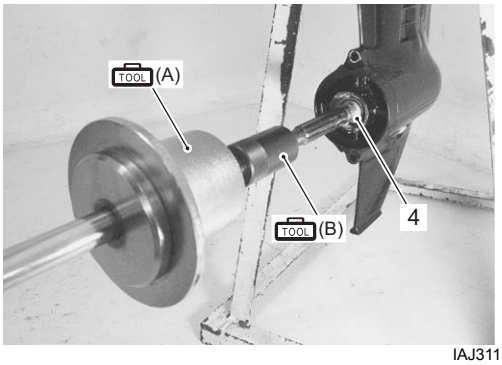
6) Using special tools, pull out the propeller shaft bearing housing.
   Remove the propeller shaft and bearing housing assembly (4).

Special tool

TOOL (A): 09930–30104 (Sliding hammer)
TOOL (B): 09950–59320 (Propeller shaft remover)



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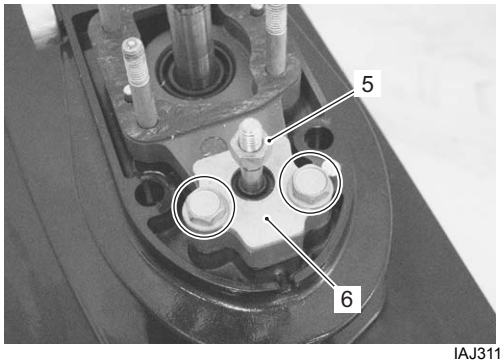
7) Remove the nut (5), two bolts and shift rod guide stopper (6).



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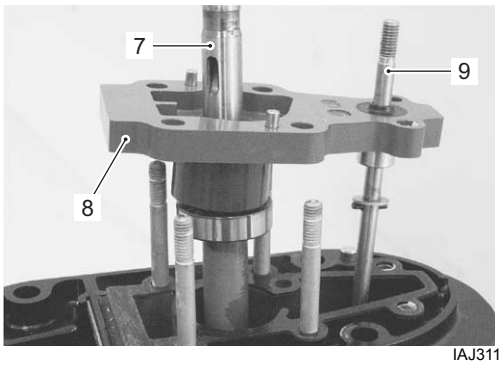
8) Lift out driveshaft (7), driveshaft oil seal housing (8) and shift rod assembly (9).



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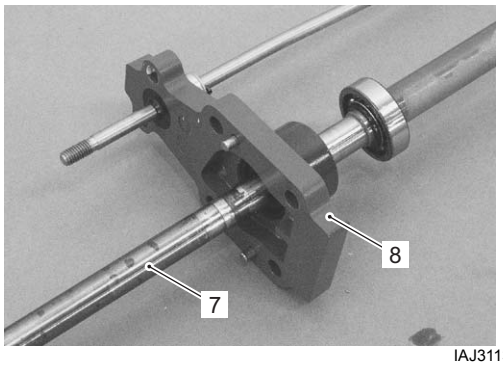
9) Remove driveshaft (7) from driveshaft oil seal housing (8).



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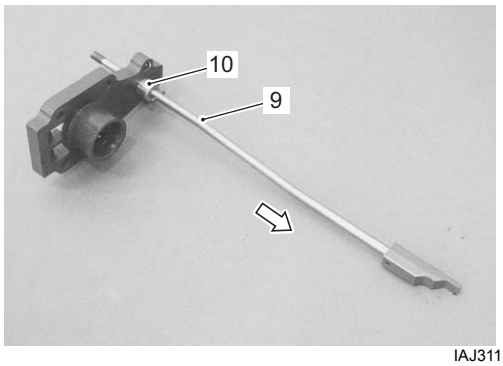
10) Slide the shift rod (9) out of the shift rod guide (10).



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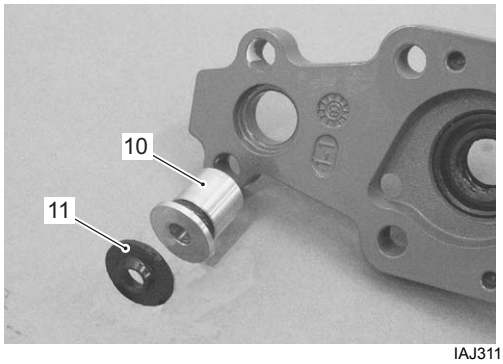
11) Push the dust seal (11) and shift rod guide (10) out from driveshaft oil seal housing.



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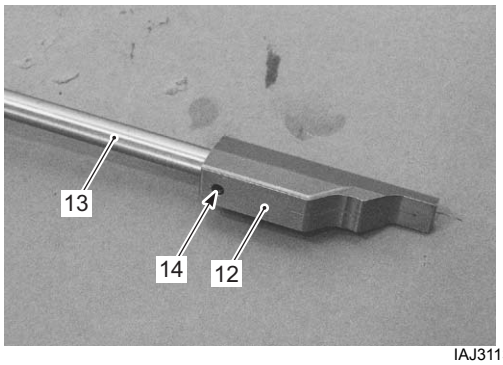
12) Separate the shift cam (12) from the shift rod (13) by driving out the spring pin (14).



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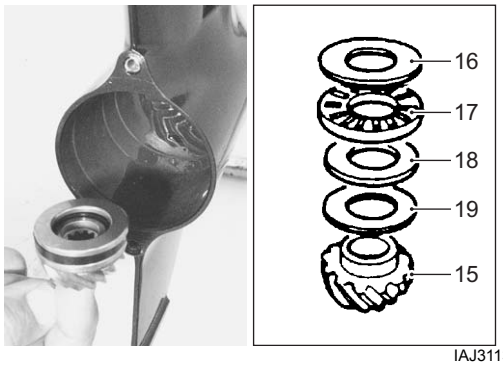
13) Remove the pinion gear (15), thrust washer (16), thrust bearing (17), thrust washer (18) and pinion gear back up shim (19).



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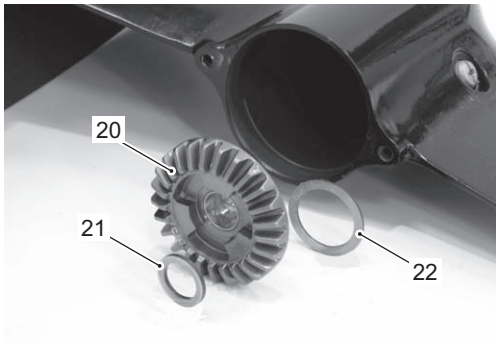
14) Remove the forward gear (20), thrust washer (21) and forward gear back-up shim (22).



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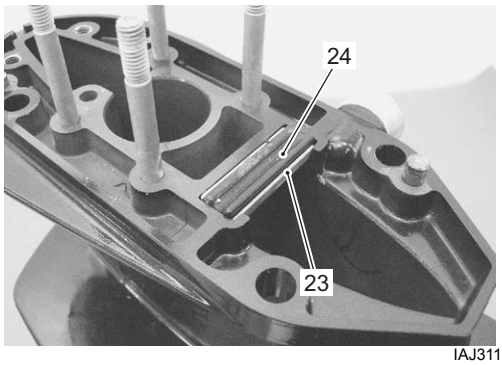
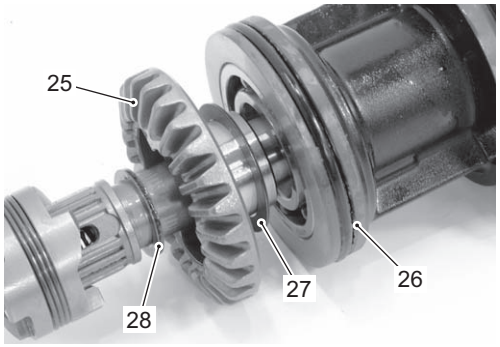
15) Remove the exhaust seal core (23) and seal rubber (24) (if necessary.)



IAJ311310037-01

16) To disassemble propeller shaft components, refer to following:
   a) Slide propeller shaft away from reverse gear (25) and bearing housing assembly (26).
   Account for the reverse gear back-up shim (27) and reverse gear thrust washer (28).



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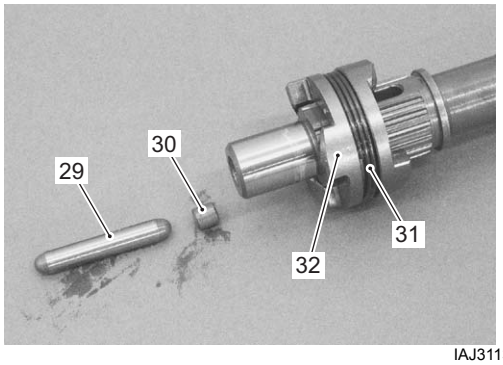
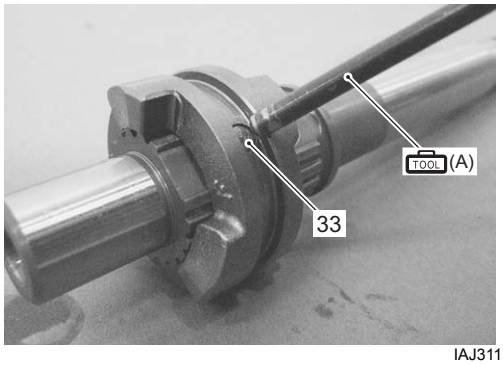
   b) Pull the push rod (29) and push pin (30) out of the propeller shaft.
   c) Remove the spring (31) from clutch dog shifter (32).



IAJ311310039-01

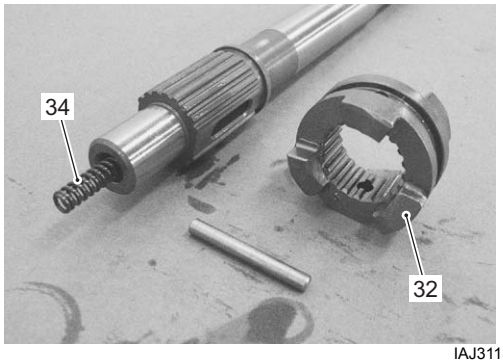
   d) Use special tool to push the dog pin (33) out of the clutch dog shifter.

Special tool
(A): 09922–89810 (Shift lock pin remover)



IAJ311310040-01

   e) Remove clutch dog shifter (32) and clutch return spring (34) from propeller shaft.



IAJ311310041-01

Pinion Bearing Removal and Installation

CENDK1113106008

NOTICE

Removing the bearing can cause damage to needle rollers and outer race. If the removed bearing is re-used, problem will occur in the lower unit.

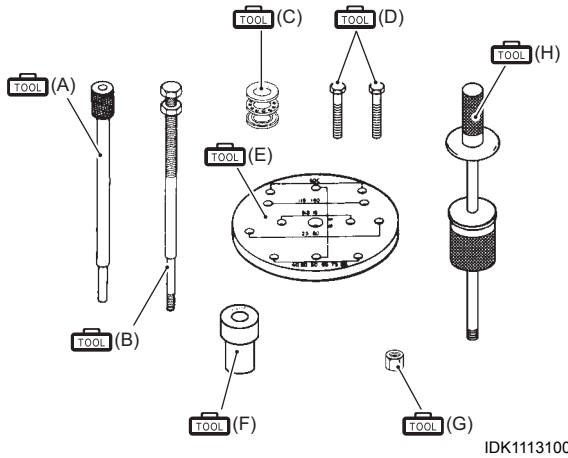
Do not reuse pinion bearings once removed. Always use new ones.

Removal and Installation Tools

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

Special tool

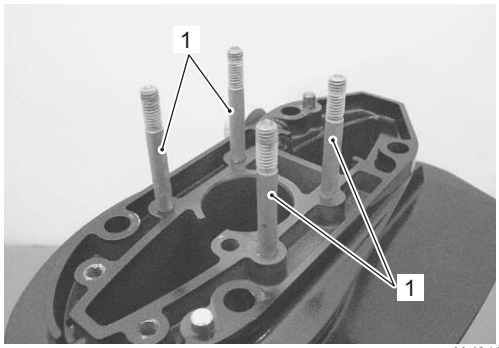
TOOL (A): 09951–59910 (Shaft (removal and installation))
TOOL (B): 09951–49910 (Removal shaft)
TOOL (C): 09951–69910 (Bearing)
TOOL (D): 01500–08403 (Bolt)
TOOL (E): 09951–38710 (Plate)
TOOL (F): 09951–18910 (Pinion bearing remover and installer attachment)
TOOL (G): 09951–29910 (Nut)
TOOL (H): 09930–30104 (Sliding hammer)



IDK111310004-01

Removal

1) Disassemble the lower unit.
   Refer to “Lower Unit Disassembly” (Page 3A-8).
2) Remove the water pump stud bolts (1).

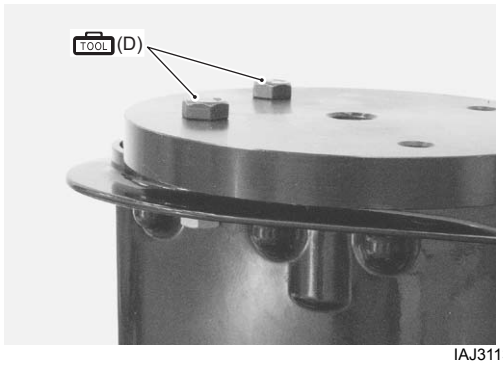


IAJ311310042-01

3) Set the plate (E) on the gearcase with two bolts (D).

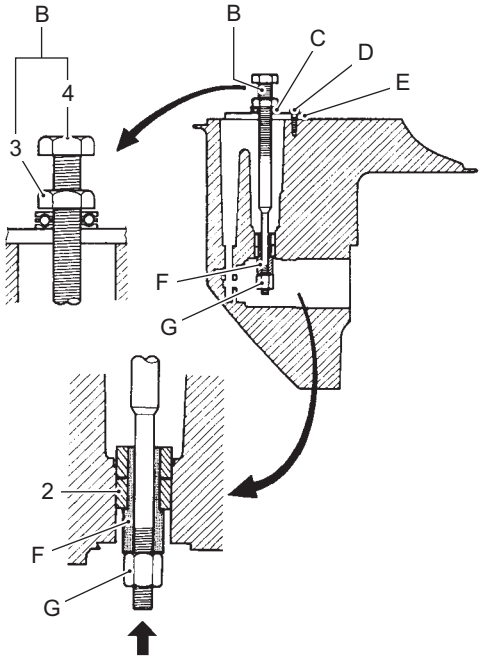
NOTE

For set the plate, using the two gearcase mounting bolt holes of forward side.



IAJ311310044-01

4) Set the removal shaft (B), bearing (C), attachment (F) and nut (G) as shown.
5) To push the pinion bearing (2) out of gearcase, turn the lower nut (3) clockwise while holding the removal shaft head (4) tightly.



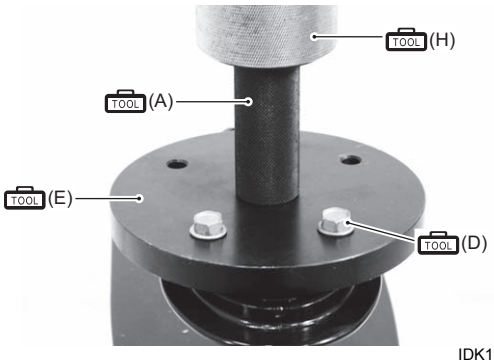
IDK111310005-02

Installation

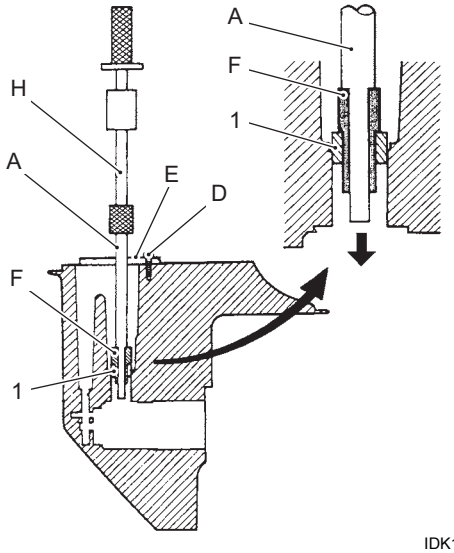
NOTE

- **Before installing bearing, ensure that inside of gearcase is clean and free of debris.**
- **Ensure that the bearing stamped mark faces upward.**

1) Set the installer shaft (A), plate (E), attachment (F) and pinion bearing (1) as shown.
2) Place the installer shaft (A) (with pinion bearing on end of installer shaft) into the gearcase.
3) Secure the plate (E) by tightening the bolts (D) and nuts.
4) Thread the sliding hammer (H) into the top of the installer shaft (A).
5) Drive the pinion bearing (1) down into position by gently striking the installer shaft (A) until the coupler touches the plate (E).
6) Assemble the lower unit. Refer to “Lower Unit Assembly” (Page 3A-16).



IDK111310010-01



IDK111310006-03

Lower Unit Related Items Inspection

CENDK1113106009

⚠ WARNING

Failure to following proper precautions during use of the compressed air may cause severe personal injury.

Wear safety glasses when using compressed air.

NOTE

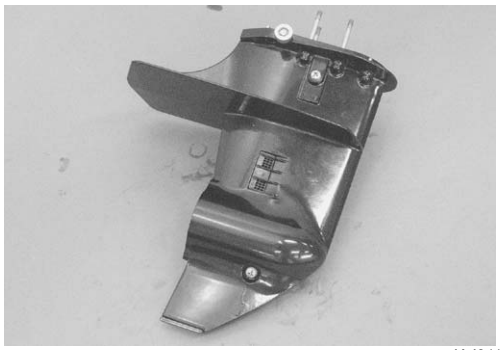
- **If any component is worn excessively, cracked, defective or damaged in any way, it must be replaced.**
- **Thoroughly wash all metal components with cleaning solvent and dry with compressed air.**

Gearcase

- Inspect the gearcase. Replace if cracked, damaged or other abnormal conditions are noted.
- Visually check the pinion bearing. Replace bearing if pitted, rough or other abnormal conditions are noted.

NOTE

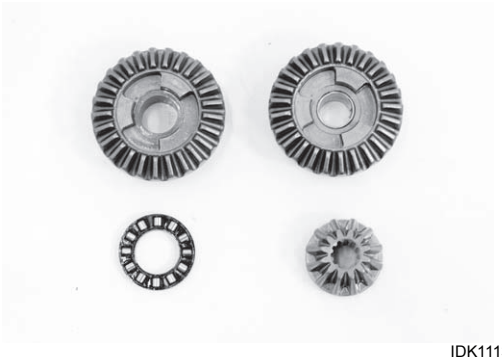
If removal and replacement are required, refer to “Pinion Bearing Removal and Installation” (Page 3A-11).



IAJ311310048-01

Gears / Bearing

- Inspect forward, reverse and pinion gear teeth and engaging dogs.
  Replace gears if damaged, worn or other abnormal conditions are noted.
- Inspect the thrust bearing and forward gear bearing. Replace bearing if pitted, noisy, rough or other abnormal conditions are noted.

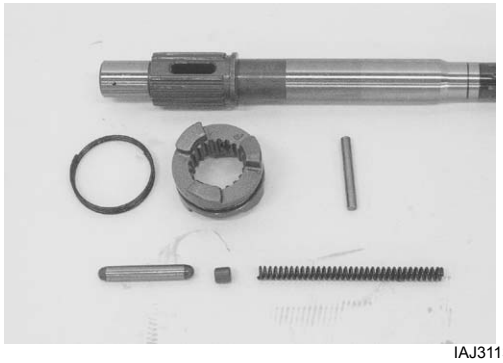


IDK111310011-01

IAJ311310050-01

Propeller Shaft Components

- Inspect the push rod and push rod pin. Replace if worn, damaged or other abnormal conditions are noted.
- Inspect clutch dog shifter. Replace if chipped, worn, damaged or other abnormal conditions are noted.
- Inspect dog pin. Replace if bent, worn or other abnormal conditions are noted.
- Inspect propeller shaft / splines. Replace if worn, twisted, damaged or other abnormal conditions are noted.

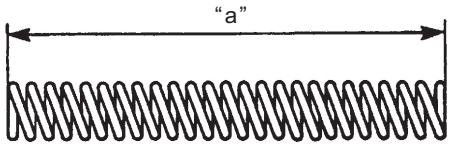


IAJ311310051-01

IAJ311310052-01

- Check clutch return spring by measuring its free length. If free length is not within specifications, replace clutch return spring.

  Clutch return spring free length “a”
  Standard: 70 mm (2.8 in.)
  Service limit: 67 mm (2.6 in.)



I9J011310062-01

Propeller Shaft Bearing Housing

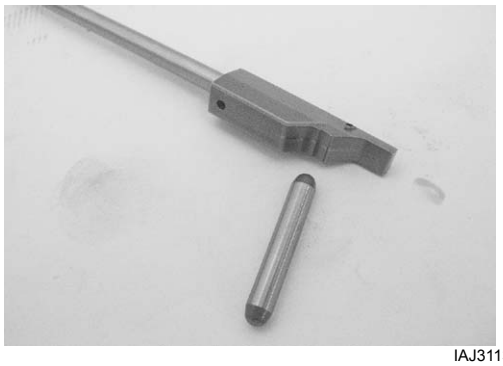
- Inspect housing. Replace if cracked, damaged or other abnormal conditions are noted.
- Inspect reverse gear bearing and propeller shaft bushing. Replace bushing if pitted, rough or other abnormal conditions are noted.
- Check condition of oil seal and O-ring. Replace oil seal and O-ring if nicked, cut, worn or other abnormal conditions are noted.

IAJ311310053-01

IAJ311310054-01

Shift Rod and Shift Cam Components

- Inspect the “stepped” surfaces of shift cam. Replace if worn, damaged or other abnormal conditions are noted.
- Inspect shift rod guide. Replace if cracked, damaged or other abnormal conditions are noted.
- Inspect O-ring. Replace if nicked, cut, torn, swollen or other abnormal conditions are noted.



IAJ311310055-01

IAJ311310056-01

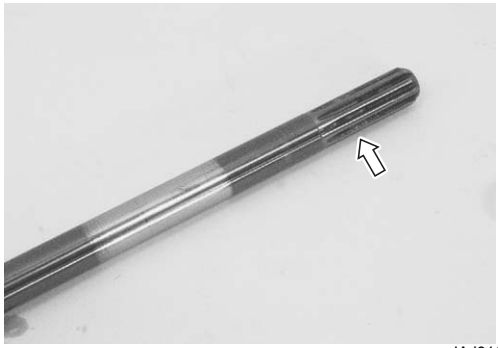
Driveshaft Oil Seal Housing

- Inspect housing. Replace if cracked, damaged or other abnormal conditions are noted.
- Check condition of oil seals. Replace if nicked, cut, worn or other abnormal conditions are noted.

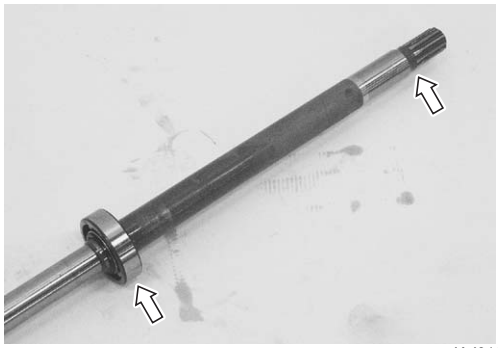
IAJ311310057-01

Driveshaft

- Inspect driveshaft / splines. Replace if worn, twisted, damaged or other abnormal conditions are noted.
- Inspect driveshaft bearing, replace if pitted, noisy, rough or other abnormal conditions are noted.



IAJ311310058-01



IAJ311310059-01

Propeller Shaft Oil Seal Replacement

CENDK1113106010

1) Remove the propeller shaft bearing housing. Refer to “Lower Unit Disassembly” (Page 3A-8).
2) Extract seals (1) with oil seal remover.

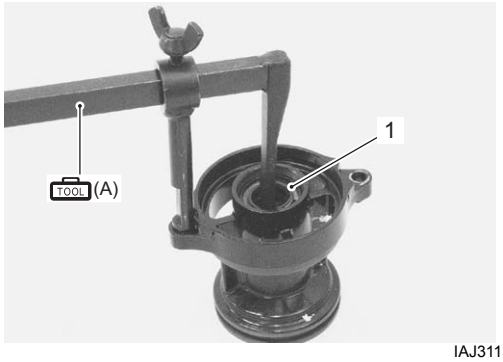
NOTICE

Removing the oil seal can cause damage to the seal lips, causing oil to leak.

Do not reuse the oil seal once removed. Always use new one.

Special tool

TOOL (A): 09913–50121 (Oil seal remover)

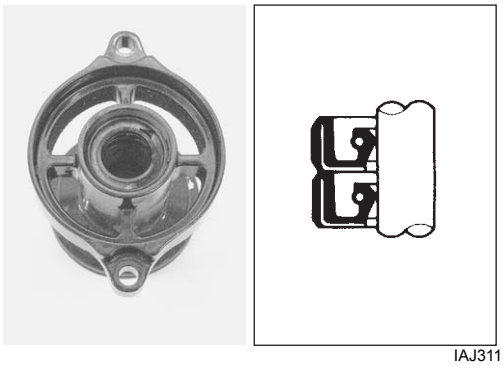


IAJ311310060-02

3) Apply water resistant grease to the inner circumference of the housing.

: Grease 99000–25350 (SUZUKI Water Resistant Grease EP2 (250 g))

4) Using an oil seal installer, drive the two oil seals (one at a time) into the propeller shaft bearing housing. The lipped portion of the seal must face towards the propeller. Apply water resistant grease to the seal lips.



IAJ311310010-02

5) Assemble the propeller shaft bearing housing. Refer to “Lower Unit Assembly” (Page 3A-16).

Driveshaft Oil Seal Replacement

CENDK1113106011

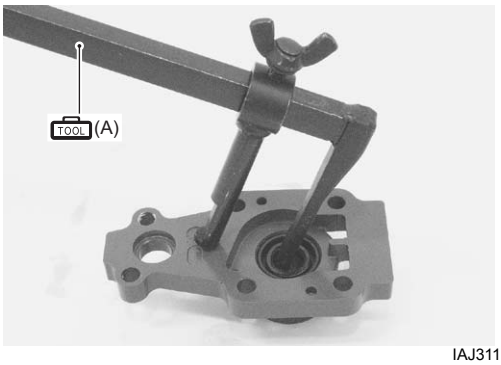
1) Remove the driveshaft oil seal housing. Refer to “Lower Unit Disassembly” (Page 3A-8).
2) Using special tool, remove two oil seals out of the driveshaft oil seal housing.

NOTICE

Removing the oil seal can cause damage to the seal lips, causing oil to leak.

Do not reuse the oil seal once removed. Always use new one.

Special tool
(A): 09913–50121 (Oil seal remover)

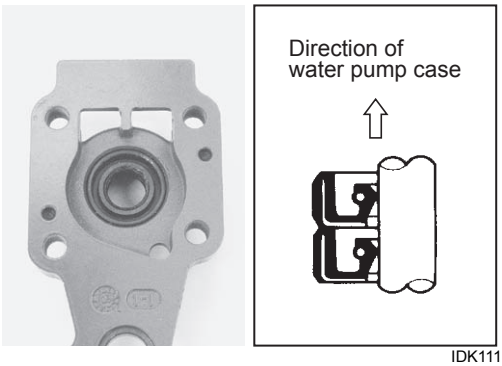


IAJ311310061-01

3) Apply water resistant grease to inner circumference of driveshaft oil seal housing.

: Grease 99000–25350 (SUZUKI Water Resistant Grease EP2 (250 g))

4) Grease the inner lips of oil seal.
With the lips facing away from driveshaft bearing, place seal in position and drive it into the oil seal housing.



IDK111310015-01

5) Assemble the driveshaft oil seal housing. Refer to “Lower Unit Assembly” (Page 3A-16).

Lower Unit Assembly

CENDK1113106012

Assembly is in reverse order of disassembly with special attention to the following steps.

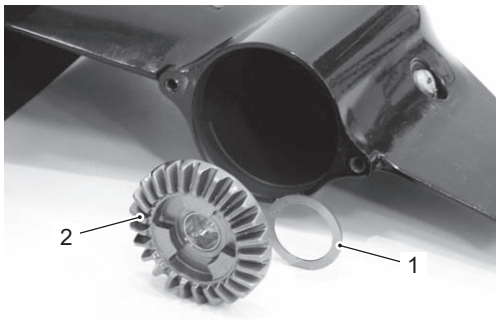
NOTICE

Failure to correctly adjust the gear position will result in lower unit damage.
Before final assembly of lower unit, be absolutely certain that all gear contact, shim adjustments and tolerances are correct.
(Refer to “Lower Unit Gears - Shimming and Adjustment” (Page 3A-21).)

NOTE

- **Make sure that all parts used in assembly are clean and lubricated.**
- **It is recommended that all seals, gaskets and O-rings be replaced with new on assembly.**
- **After assembly, check parts for tightness and smoothness of operation.**

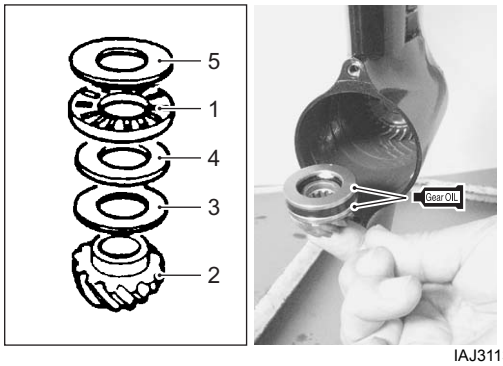
Forward Gear
Place the forward gear back-up shim (1) in position, then install forward gear (2).



IDK111310012-01

Pinion Gear

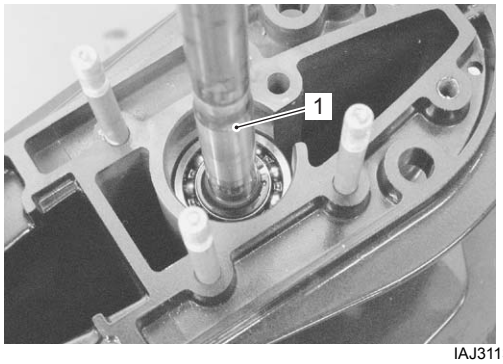
1) Apply gear oil to the thrust bearing (1) and pinion gear (2).
2) Assemble the back-up shim (3), thrust washer (I.D. 20 mm) (4), thrust bearing (1), thrust washer (I.D. 21 mm) (5) to the pinion gear (2), then place the pinion gear / washer assembly in gearcase.



IAJ311310063-02

Driveshaft

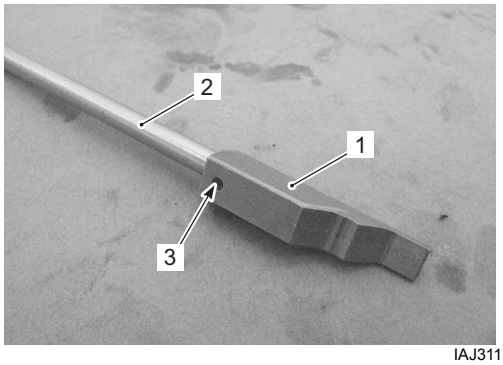
Lower the driveshaft assembly (1) down into the gearcase until the bottom of shaft passes to center of pinion gear.



IAJ311310064-01

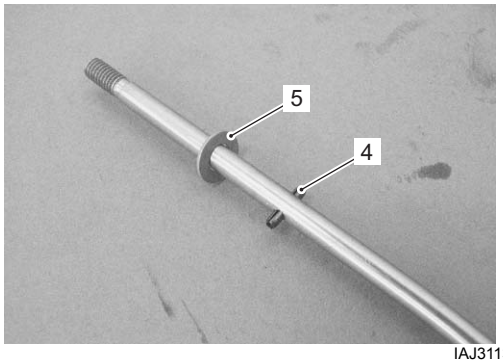
Shift Cam and Shift Rod

- Attach the shift cam (1) to shift rod (2), then insert pin (3).



IAJ311310065-01

- Install the pin (4) and washer (5) to shift rod.

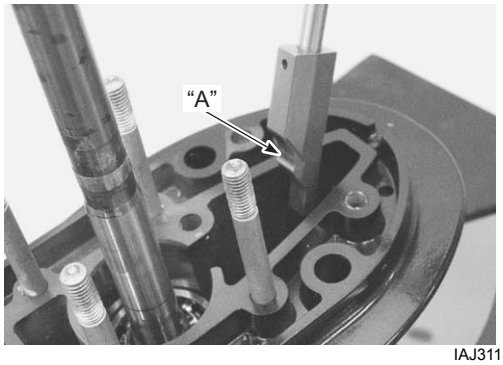


IAJ311310066-01

- Install the shift rod / cam assembly to gearcase.

NOTE

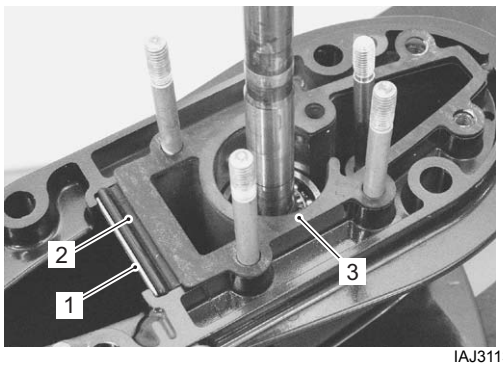
Be sure the stepped section “A” of shift cam faces towards propeller shaft.



IAJ311310067-01

Driveshaft Oil Seal Housing

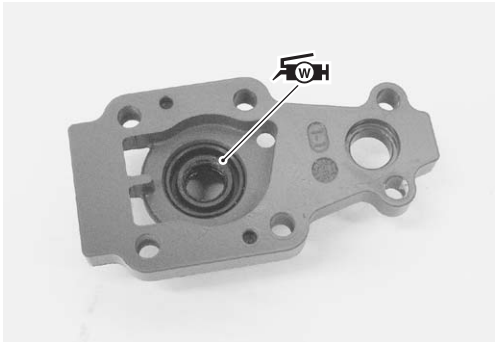
- Install the exhaust seal core (1) and seal rubber (2).
- Install the housing gasket (3).



IAJ311310068-01

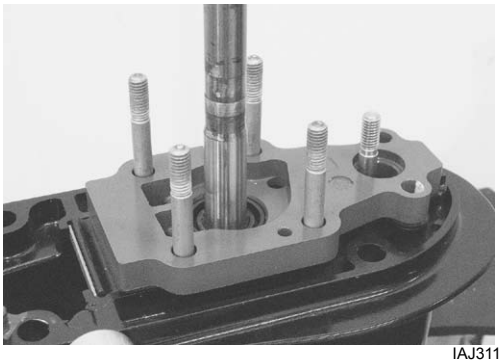
- Apply water resistant grease to the driveshaft oil seal.

  : Grease 99000–25350 (SUZUKI Water Resistant Grease EP2 (250 g))



IAJ311310069-01

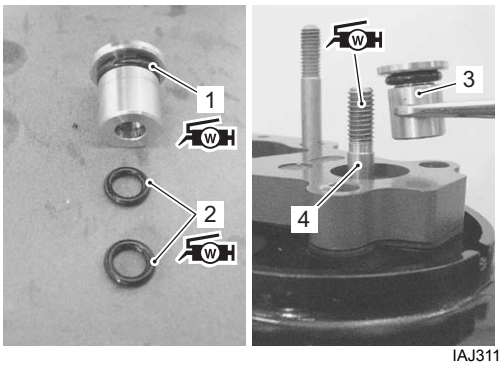
- Install driveshaft oil seal housing on gearcase.



IAJ311310070-01

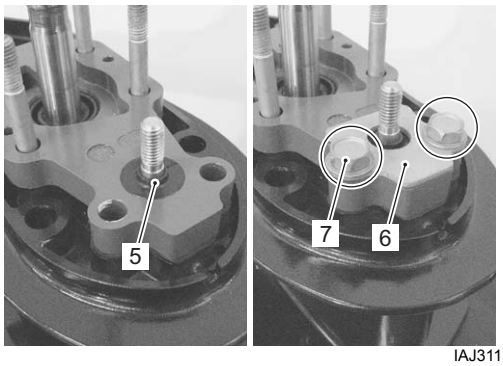
Shift Rod Guide

- Apply water resistant grease to the shift rod guide O-ring (1) · (2).
- Apply water resistant grease to the shift rod thread area, then install complete shift rod guide (3) to shift rod (4).
- Slide shift rod guide (3) into the driveshaft oil seal housing.



IAJ311310071-02

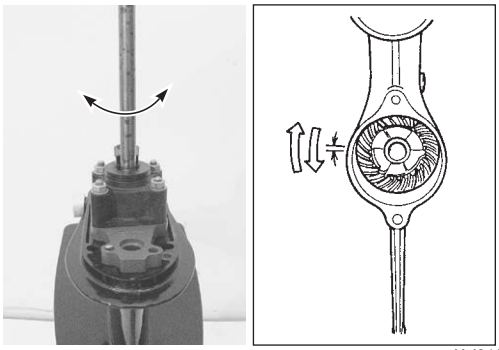
- Install the dust seal (5).
- Install the shift rod guide stopper (6), then secure it with the bolts (7).



IAJ311310072-01

Checking Gear Backlash

Before installing reverse gear, check the backlash exists between the pinion gear and forward gear.
Refer to “Lower Unit Gears - Shimming and Adjustment” (Page 3A-21).



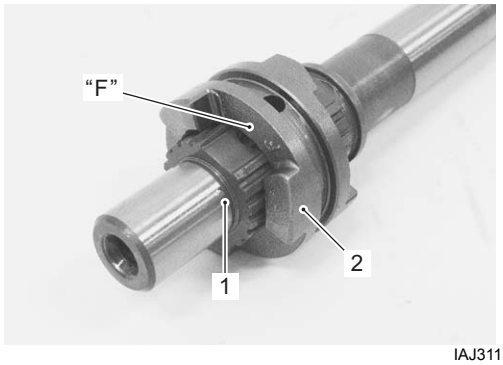
IAJ311310073-01

Propeller Shaft

- Slide the clutch dog shifter (2) onto the propeller shaft (1).

NOTE

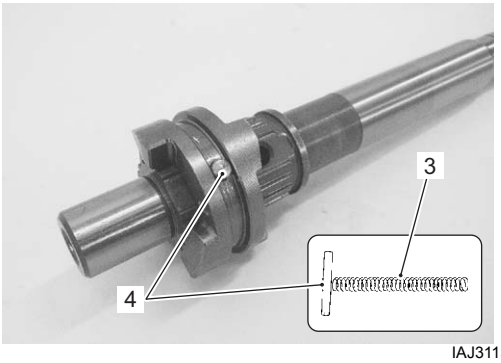
The side of the clutch dog shifter marked with the letter “F” must face towards forward gear.



IAJ311310074-01

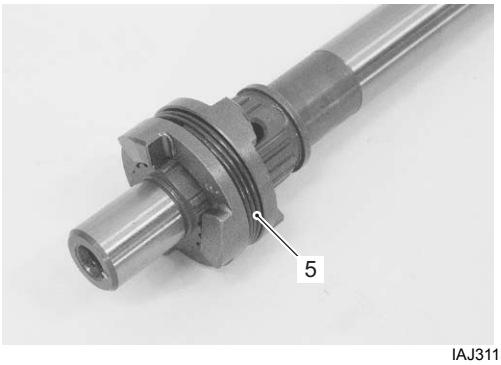
- Insert the return spring (3) into propeller shaft. Depress the return spring and then slide the dog pin (4) through both dog and propeller shaft as shown in figure.

IAJ311310075-01



IAJ311310076-01

- Install the dog pin retaining spring (5), ensuring that it fits snugly into the groove on the dog shifter.

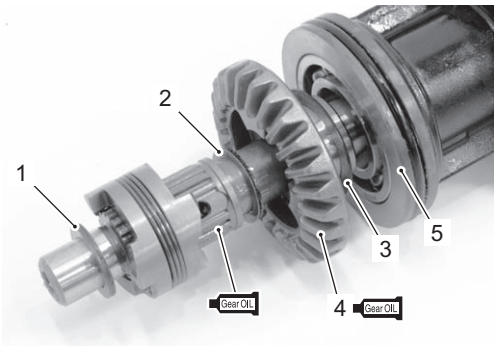


IAJ311310077-01

Propeller Shaft / Bearing Housing

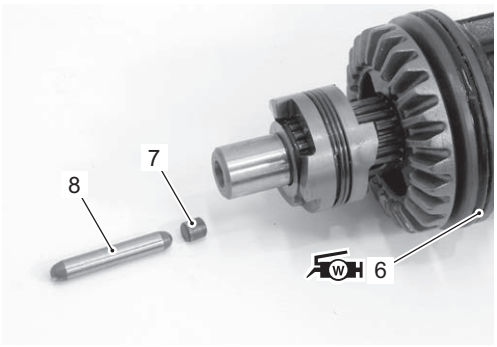
- Place the forward thrust washer (1) and reverse thrust washer (2) on the propeller shaft.
- Install back-up shim (3) and reverse gear (4) to propeller shaft bearing housing (5).
- Slide propeller shaft into reverse gear and propeller shaft bearing housing.

: Grease 99000–25350 (SUZUKI Water Resistant Grease EP2 (250 g))
: Gear Oil 99000–22B22 (SUZUKI Outboard Motor Gear Oil)



IDK111310013-01

- Apply water resistant grease to the bearing housing O-ring (6).
- Insert the push pin (7) and push rod (8) into propeller shaft.



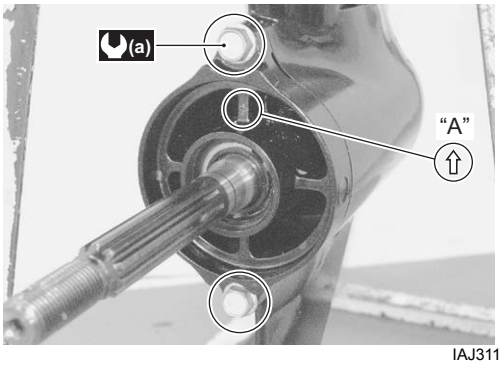
IDK111310014-01

NOTE

Before installing propeller shaft / bearing housing assembly, bring shift cam to the forward position by moving shift rod up or down.

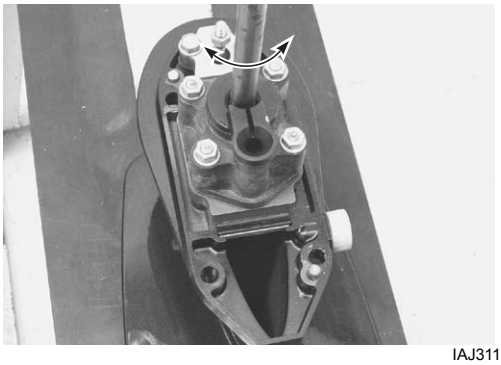
- Install the propeller shaft and housing assembly in the gearcase with the arrow mark “A” of housing toward upside.
- When the housing is fully seated, tighten both retaining bolts to the specified torque.

Tightening torque
Bearing housing bolt (a): 8 N·m (0.8 kgf-m, 5.8 lbf-ft)

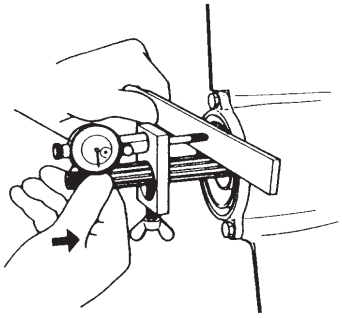


IAJ311310080-01

Rechecking Gear Backlash
Recheck the gear backlash. This should not be less than previously checked. If less, reduce the number / thickness of the reverse gear back-up shims.
Refer to “Lower Unit Gears - Shimming and Adjustment” (Page 3A-21).


IAJ311310081-02

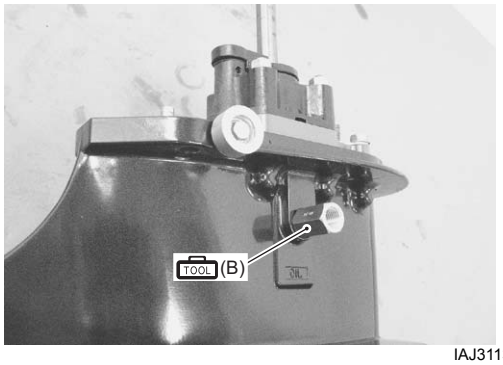
Checking Propeller Shaft Thrust Play
Check propeller shaft thrust play.
Refer to “Lower Unit Gears - Shimming and Adjustment” (Page 3A-21).


IAJ311310082-01

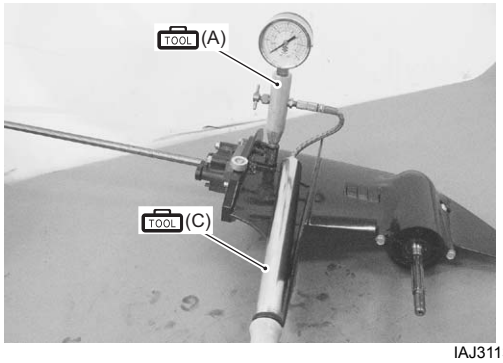
Leakage Check
Check for leakage of oil seal and O-ring when applying specified pressure inside of the gearcase.

1) Temporarily fasten the driveshaft oil seal housing to gearcase with water pump case and nuts.
   Install the water pump case, then tighten the pump case nuts securely.
2) Install the test tool into the oil level hole.
3) Connect the air pump to the tester.

Special tool
TOOL (A): 09950–69512 (Gearcase oil leakage tester)
TOOL (B): 09950–69710 (Attachment)
TOOL (C): 09952–99320 (Hand air pump)



IAJ311310083-01



IAJ311310084-01

4) Rotate driveshaft and propeller shaft clockwise several times and then apply specified pressure for the test.

NOTICE

Failure to correctly apply the test pressure will result in oil seal damage.

Do not exceed pressure of 110 kPa (1.1 kg/cm², 15.6 psi.).

Leakage pressure test
100 kPa (1.0 kg/cm², 14.2 psi.)

5) Once stabilized, pressure should remain steady for at least 5 min.
   If pressure does not fall, sealing performance is correct.
6) Remove the water pump case.

Water Pump
Install the water pump and related parts.
Refer to “Lower Unit Removal and Installation” (Page 3A-5) and “Water Pump Removal and Installation” (Page 3A-6).

Propeller
Install the propeller.
Refer to “Propeller Removal and Installation” (Page 3A-4).

Lower Unit
Install the Lower Unit.
Refer to “Lower Unit Removal and Installation” (Page 3A-5).

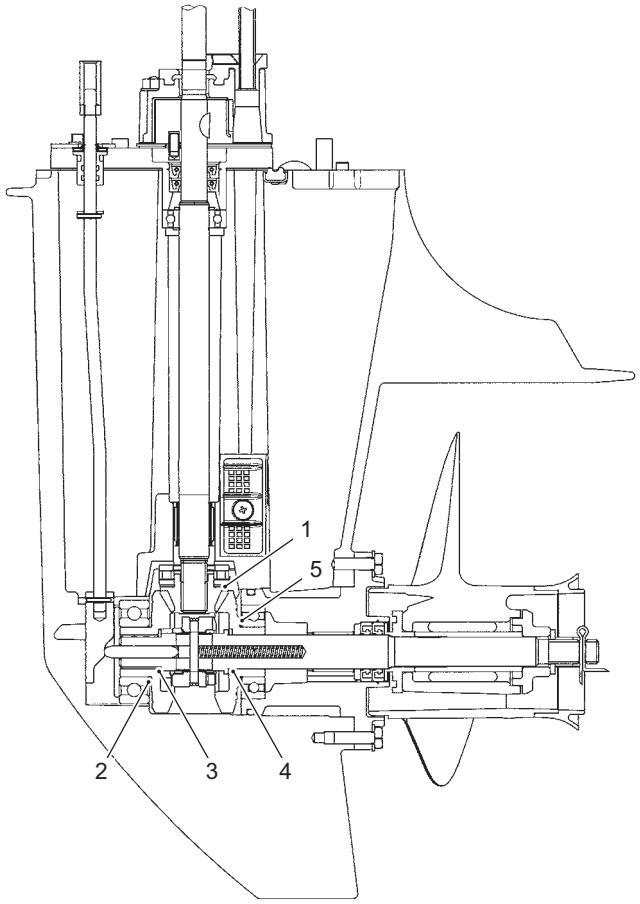
Lower Unit Gears - Shimming and Adjustment

CENDK1113106013

If the lower unit has been rebuilt or has had components replaced, shimming for the correct gear contact and backlash will have to be checked and/or adjusted to ensure smooth, reliable operation.

Shim / Washer and mounting position

Item	Available thickness (mm)	Design specification thickness (mm)
Pinion gear back up shim	**0.70, 0.80, 0.90, 1.00, 1.10, 1.20, 1.30**	**1.00**
Forward gear back up shim	**0.70, 0.80, 0.90, 1.00, 1.10, 1.20, 1.30**	**1.00**
Forward gear thrust washer	**2.0**	**2.00**
Propeller shaft reverse thrust washer	**1.10, 1.20, 1.30, 1.40, 1.50, 1.60, 1.70, 1.80, 1.90**	**1.50**
Reverse gear back up shim	**0.70, 0.80, 0.90, 1.00, 1.10, 1.20, 1.30**	**1.00**



IAJ311310007-02

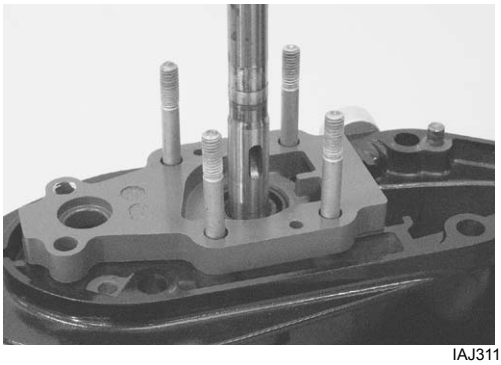
1. Pinion gear back up shim	3. Forward gear thrust washer	5. Reverse gear back up shim
2. Forward gear back up shim	4. Propeller shaft reverse thrust washer	

Forward Gear / Pinion Gear Back-Up Shim Adjustment

Follow the procedure below to adjust forward gear / pinion gear.

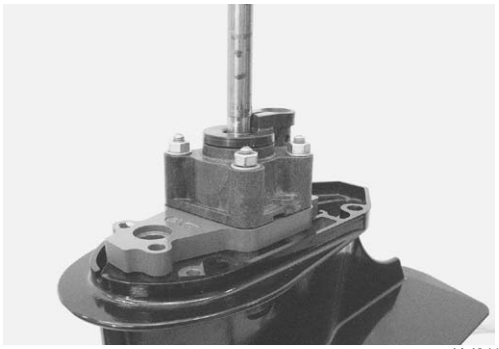
Prior to adjustment

1) Correctly assemble driveshaft oil seal housing, driveshaft, forward gear, pinion gear and related components.
   Do not install reverse gear at this time.
   Refer to “Lower Unit Assembly” (Page 3A-16).



IAJ311310085-01

2) Temporarily fasten the driveshaft oil seal housing to gearcase with water pump case and nuts.
   Install the water pump case, then tighten the pump case nuts securely.
   Do not install water pump impeller at this time.

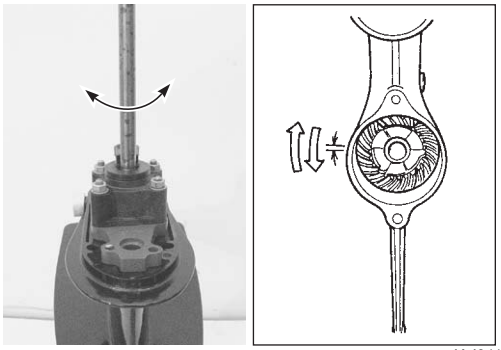


IAJ311310086-01

Checking gear backlash

Check a slight amount of backlash exists between the pinion gear and forward gear by slightly rotating forward gear or driveshaft by hand.

- If backlash is larger than specified, the forward gear back-up shim thickness must be increased.
- If backlash is smaller than specified, the forward gear back-up shim thickness must be decreased.



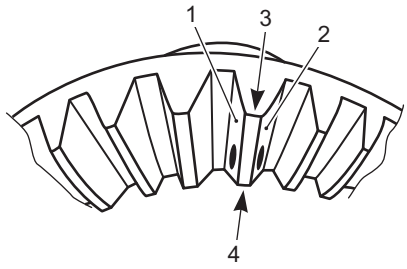
IAJ311310087-01

Checking and adjusting tooth contact pattern (for pinion and forward gear)

Check tooth contact pattern using the following procedure.

Initial checking

1) To assess tooth contact, apply a light coat of Prussian Blue on both sides (drive side and coast side) of the forward gear surface.



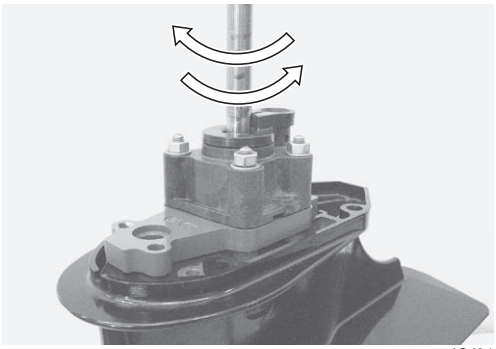
ICJ311310006-01

1. Drive side	3. Heel
2. Coast side	4. Toe

2) Install the propeller shaft and bearing housing assembly (without reverse gear and related internal components).
3) Push the propeller shaft inward and hold it in position.

IAJ311310088-01

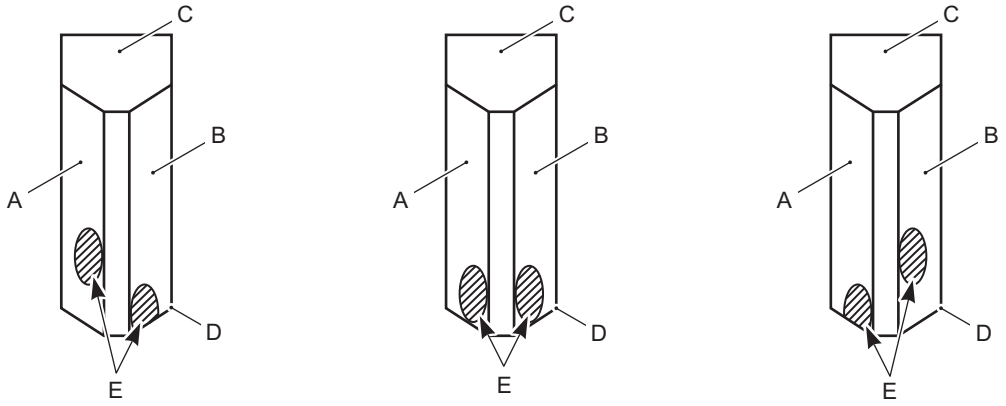
4) Rotate the driveshaft clockwise 5 – 6 times by hand, then rotate driveshaft counterclockwise 5 – 6 times in a same way.



ICJ311310011-01

5) Carefully remove the propeller shaft and the housing to check the tooth contact pattern on forward gear. The tooth contact pattern will appear similar as one of the following three figures.

Pattern-1 **Pattern-2** **Pattern-3**



ICJ311310007-02

A. Drive side	C. Heel	E. Tooth contact pattern
B. Coast side	D. Toe	

Optimum tooth contact

Optimum tooth contact is different according to the tooth contact pattern obtained by an initial check.
The optimum tooth contact is shown in the figure below.
A shim adjustment may be necessary to obtain the optimum contact pattern.

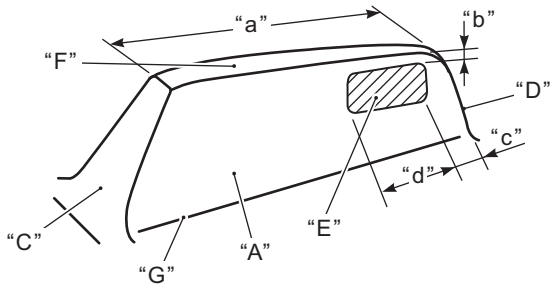
NOTE

The gear backlash should be checked when increasing or decreasing shim thickness to adjust tooth contact.

Adjustment for pattern – 1 and 2:

Rotate the driveshaft clockwise and confirm the tooth contact pattern on the drive side surface of forward gear.

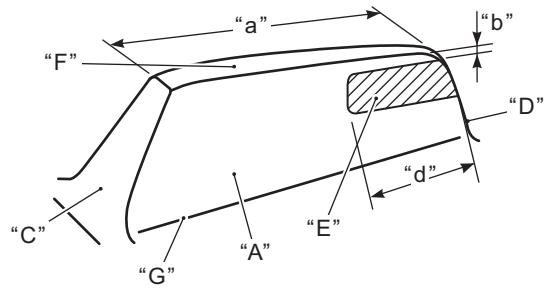
Pattern – 1: Optimum tooth contact



ICJ311310003-03

A: Drive side	G: Tooth bottom
C: Heel	“a”: Tooth width
D: Toe	“b”: 0.5 – 1.0 mm
E: Tooth contact pattern	“c”: 0 – 2 mm
F: Tooth top	“d”: Approx. 1/3 of tooth width

Pattern – 2: Optimum tooth contact

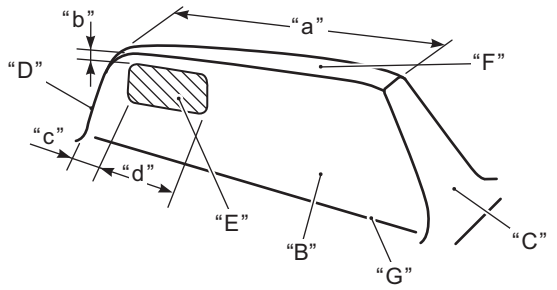


ICJ311310004-02

A: Drive side	G: Tooth bottom
C: Heel	“a”: Tooth width
D: Toe	“b”: 0.5 – 1.0 mm
E: Tooth contact pattern	“d”: Approx. 1/3 of tooth width
F: Tooth top	

Adjustment for pattern –3:
Rotate the driveshaft counterclockwise and confirm the tooth contact pattern on the coast side surface of forward gear.

Pattern – 3: Optimum tooth contact



ICJ311310005-04

B: Coast side	G: Tooth bottom
C: Heel	“a”: Tooth width
D: Toe	“b”: 0.5 – 1.0 mm
E: Tooth contact pattern	“c”: 0 – 2 mm
F: Tooth top	“d”: Approx. 1/3 of tooth width

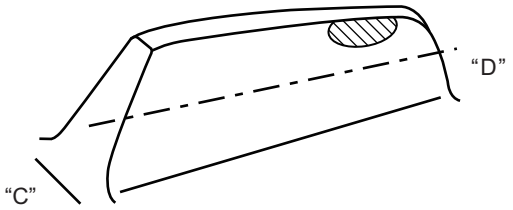
Example [A]
Incorrect topside toe contact.
Correction measures.

- Decrease thickness of forward gear shim.
- Slightly increase pinion gear shim thickness.

NOTICE

Setting the tooth contact in the top side toe contact may cause damage and chipping on forward and pinion gears.
Do not set the tooth contact as such top side toe contact.

Example of incorrect contact



ICJ311310008-02

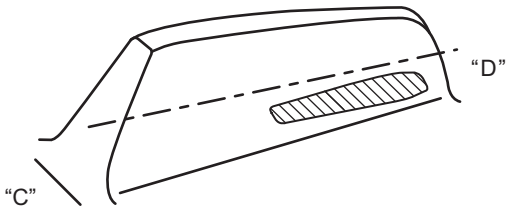
Example [B]
Incorrect bottom side toe contact.
Correction measures.

- Increase thickness of forward gear shim.
- Slightly decrease pinion gear shim thickness.

NOTICE

Setting the tooth contact in the bottom side toe contact may cause chipping on pinion gear.
Do not set the tooth contact as such bottom side toe contact.

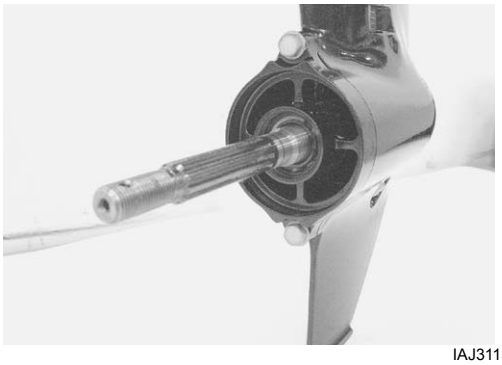
Example of incorrect contact



ICJ311310009-02

Reverse Gear Back-Up Shim Adjustment
After adjusting the forward gear tooth contact pattern, follow the procedure below to adjust the reverse gear.

1) Correctly assemble and install reverse gear, propeller shaft, propeller shaft bearing housing and related components.



IAJ311310090-01

2) Temporarily fasten the driveshaft oil seal housing to gearcase with water pump case and nuts.
   Install the water pump case, then tighten the pump case nuts securely.
   Do not install water pump impeller at this time.
3) Check the amount of backlash by slightly rotating the driveshaft by hand.
   This should not be less than previously checked.
   Refer to “Checking gear backlash” (Page 3A-22) in “Forward Gear / Pinion Gear Back-Up Shim Adjustment” (Page 3A-22).
   If less, reduce the number / thickness of the reverse gear back-up shims.

IAJ311310091-01

Checking propeller shaft thrust play
After adjusting all gear positions, measure the propeller shaft thrust play. If not within the following specification, a shim adjustment is required.

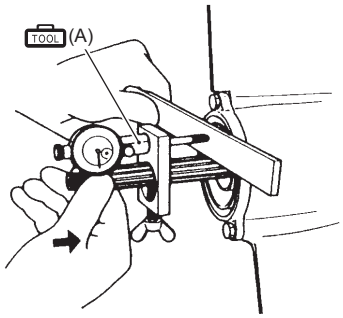
NOTE

Maintain the forward gear thrust washer at standard thickness (2.0 mm) and use only the propeller shaft reverse thrust washer to adjust thrust play.

Propeller shaft thrust play
Approx. 0.2 – 0.4 mm (0.01 – 0.02 in.)

1) Assemble the lower unit.
   Refer to “Lower Unit Assembly” (Page 3A-16).
2) Temporarily fasten the driveshaft oil seal housing to gearcase with water pump case and nuts.
   Install the water pump case, then tighten the pump case nuts securely.
   Do not install water pump impeller at this time.
3) Assemble the gear adjusting gauge to the propeller shaft.

   Special tool
   TOOL (A): 09951–09530 (Gear adjusting gauge)



IAJ311310092-02

4) Push propeller shaft inward.
5) Hold the shaft in and set the dial gauge pointer to zero.
6) Slowly pull the shaft outward and read the maximum thrust play on the dial gauge.
   - If the measurement is more than the specification, increase the propeller shaft reverse thrust washer thickness.
   - If the measurement is less than the specification, reduce the propeller shaft reverse thrust washer thickness.