Section 3

Lower Unit

CONTENTS

NOTE

For the items with asterisk (*) in the "CONTENTS" below, refer to the same section of the service manual mentioned in the "FOREWORD" of this manual.

Right Hand Rotation Unit

Service Instructions

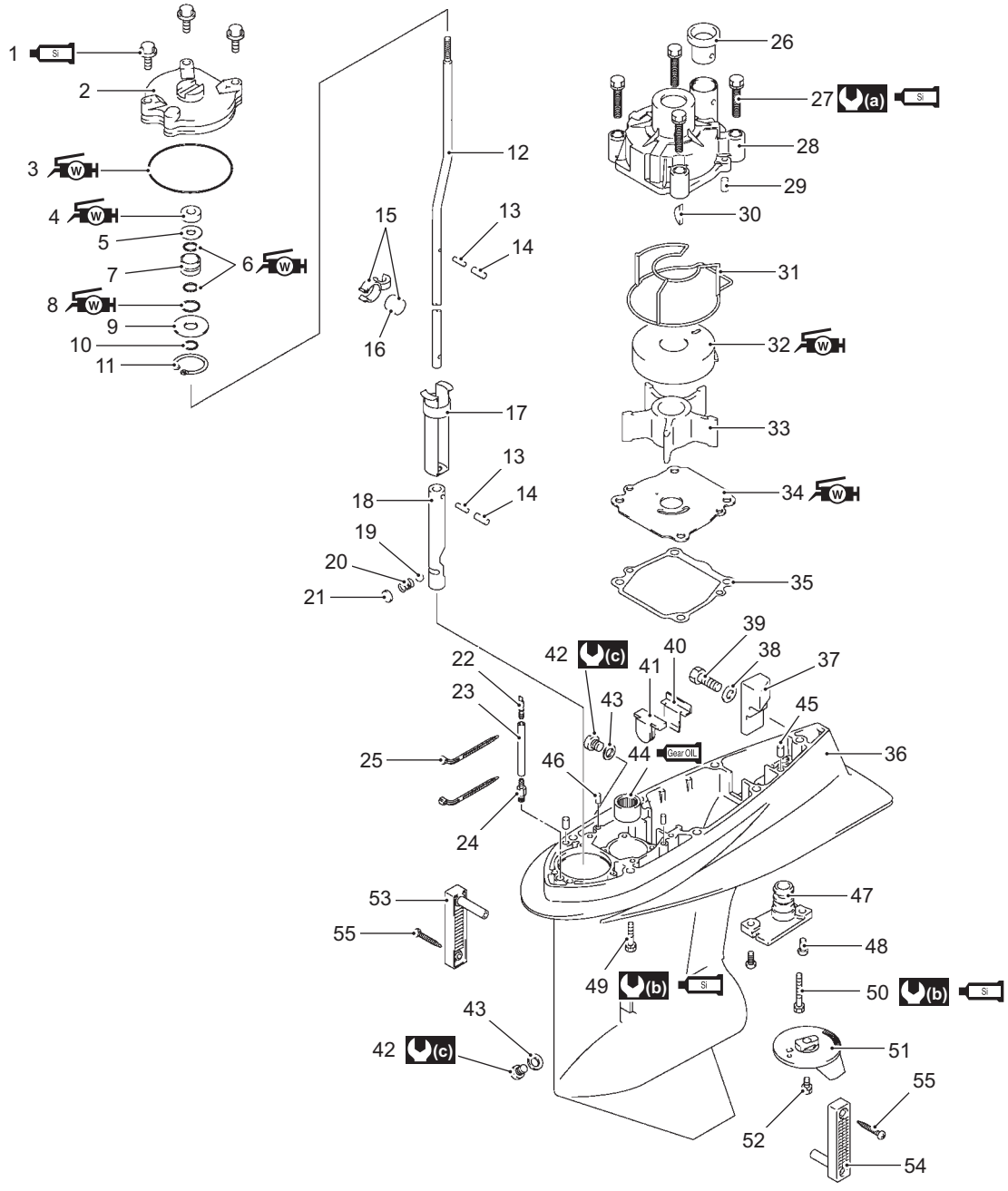
Lower Unit Components (DF50AV/60AV 2013/05)

CENEJ6113106015

Applicable Model and Effective Serial Number:
05004F – 410001 and Later,
06003F – 410001 and Later.

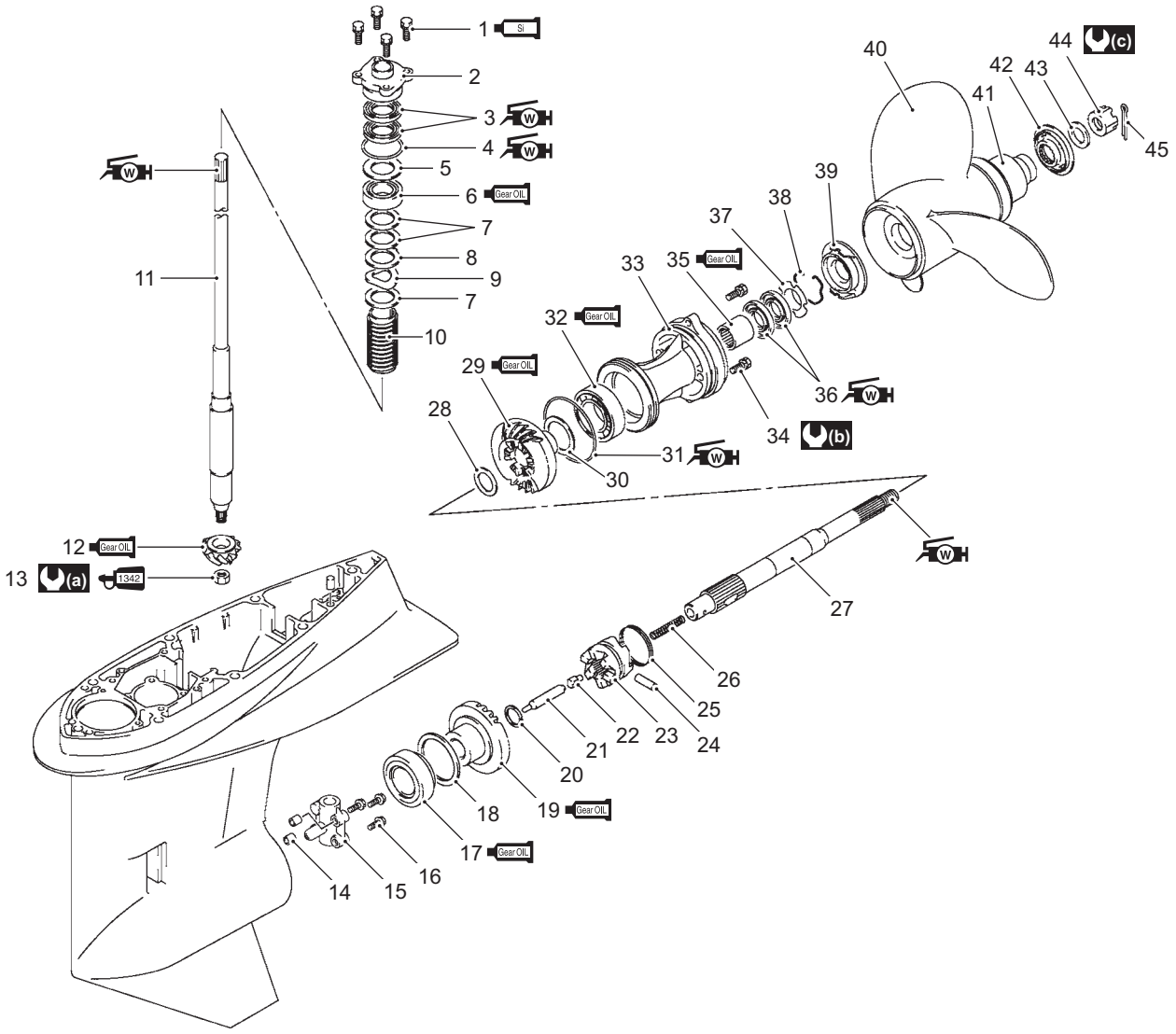
The lower unit has been changed.
In accordance with this change, the gear oil capacity has been changed.

Gear oil capacity
1 050ml



IEJ611310059-04

1. Bolt	17. Collar	33. Water pump impeller	49. Bolt
2. Shift rod guide housing	18. Shift cam	34. Under panel	50. Bolt
3. O-ring	19. Ball	35. Gasket	51. Trim tab
4. Seal	20. Spring	36. Gearcase	52. Bolt
5. Washer	21. Plate	37. Anode	53. Water filter STBD
6. O-ring	22. Union	38. Washer	54. Water filter PORT
7. Shift rod guide	23. Hose	39. Bolt	55. Screw
8. O-ring	24. Nipple	40. Exhaust seal plate	(a) : 17 N·m (1.7 kgf-m, 12.5 lbf-ft)
9. Washer	25. Clamp	41. Exhaust seal rubber	(b) : 55 N·m (5.5 kgf-m, 40.0 lbf-ft)
10. Washer	26. Bush	42. Plug	(c) : 10 N·m (1.0 kgf-m, 7.2 lbf-ft)
11. Circlip	27. Bolt	43. Gasket	(W) : Apply SUZUKI Water Resistant Grease.
12. Shift rod	28. Water pump case	44. Pinion bearing	Si : Apply SUZUKI Silicon Seal.
13. Pin	29. Dowel pin	45. Dowel Pin	GearOil : Apply SUZUKI Outboard Motor Gear Oil.
14. Pin	30. Key	46. Dowel Pin	
15. Magnet set	31. Water pump case sealing	47. Sub water tube plug	
16. Magnet	32. Inner sleeve	48. Screw	



IEJ611310060-01

1. Bolt	14. Dowel pin	27. Propeller shaft	40. Propeller
2. Driveshaft oil seal housing	15. Shift cam housing	28. Thrust washer	41. Propeller bush
3. Oil seal	16. Bolt	29. Reverse gear	42. Spacer
4. O-ring	17. Forward gear bearing	30. Shim	43. Washer
5. Shim	18. Shim	31. O-ring	44. Nut
6. Driveshaft bearing	19. Forward gear	32. Bearing	45. Pin
7. Washer	20. Thrust washer	33. Propeller shaft bearing housing	(a) : 120 N·m (12.0 kgf-m, 87.0 lbf-ft)
8. Washer (with tab)	21. Push rod	34. Bolt	(b) : 23 N·m (2.3 kgf-m, 16.6 lbf-ft)
9. Wave washer	22. Push pin	35. Bearing	(c) : 55 N·m (5.5 kgf-m, 40 lbf-ft)
10. Driveshaft collar	23. Clutch dog shifter	36. Oil seal	W : Apply SUZUKI Water Resistant Grease.
11. Driveshaft	24. Dog pin	37. Washer	Si : Apply SUZUKI Silicon Seal.
12. Pinion gear	25. Dog spring	38. Retainer ring	Gear OIL : Apply SUZUKI Outboard Motor Gear Oil.
13. Pinion nut	26. Spring	39. Stopper	1342 : Apply SUZUKI Thread Lock 1342.

Lower Unit Removal and Installation (DF50AV/ 60AV 2013/05)

CENEJ6113106016

Applicable Model and Effective Serial Number:
05004F – 410001 and Later,
06003F – 410001 and Later.

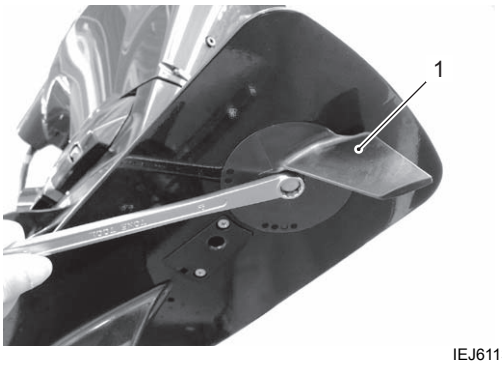
Removal

⚠ WARNING

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

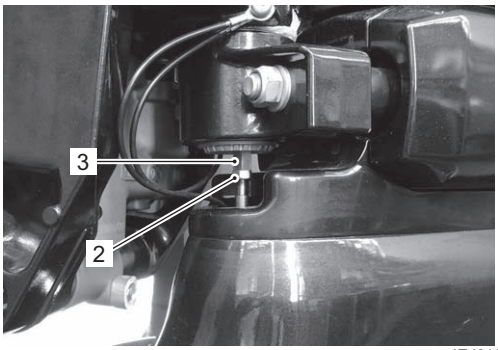
Always disconnect the battery cable, before removing lower unit.

1) Shift to “Neutral” position. Remove bolt and trim tab (1).



IEJ611310006-01

2) To separate the clutch rod from the shift rod, loosen the clutch rod lock nut (2), then unscrew the connector (3).

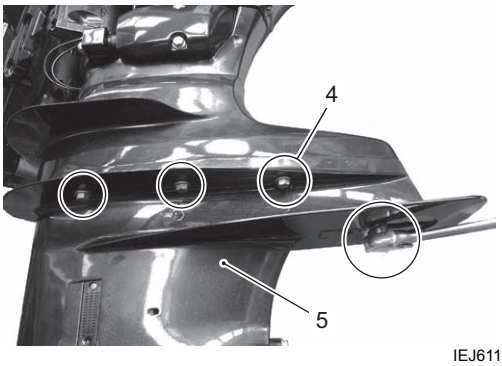


IEJ611310007-01

3) Remove seven bolts (4) and separate gearcase (5) from extension case.

NOTE

Before gearcase is removed completely, disconnect speedometer pick up tube (6) from gearcase (if necessary).



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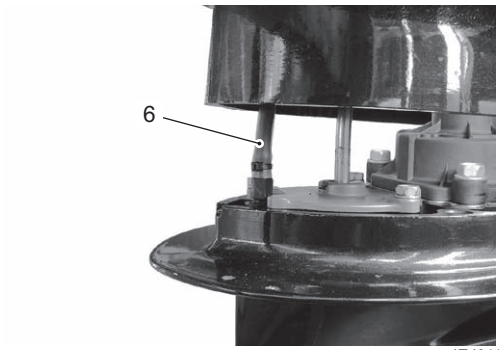


IEJ611310009-01

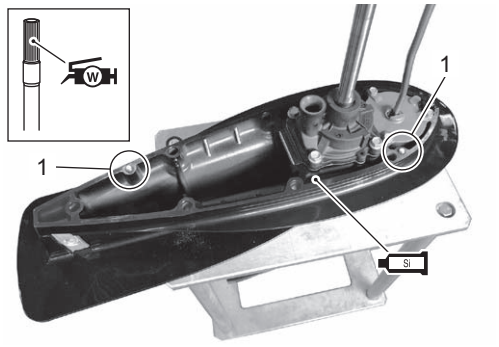
Installation

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 extension case.

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

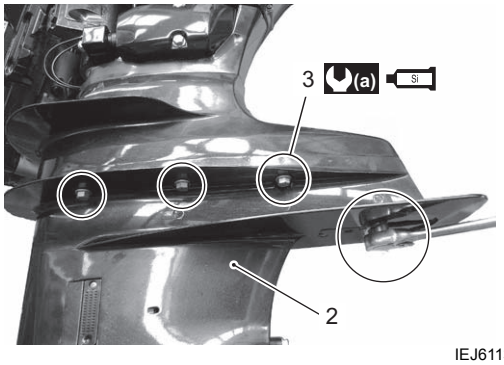


IEJ611310010-04

4) Slide the lower unit (2) into place, ensuring that the top of driveshaft engages properly with crankshaft and that water tube locates in water pump case outlet.
5) Apply suzuki silicone seal to seven gearcase bolts (3) and tighten them to specified torque.

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

Tightening torque
Gearcase bolt (a): 55 N·m (5.5 kgf-m, 40.0 lbf-ft)



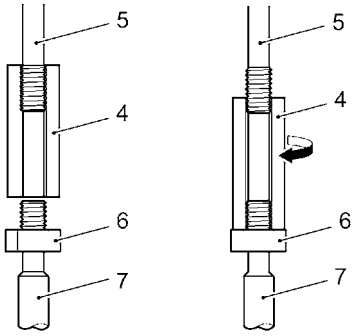
IEJ611310011-01

6) 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 control lever (8) 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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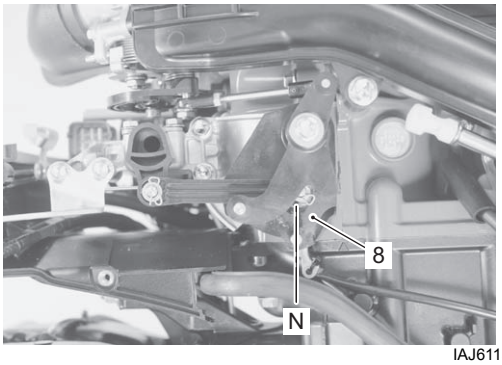

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e) With the clutch rod connector (4) securely held, tighten the lower nut (6) firmly against the connector.

7) Shift the clutch control lever to “Forward” and “Reverse” position from “Neutral” position to check proper gear engagement.

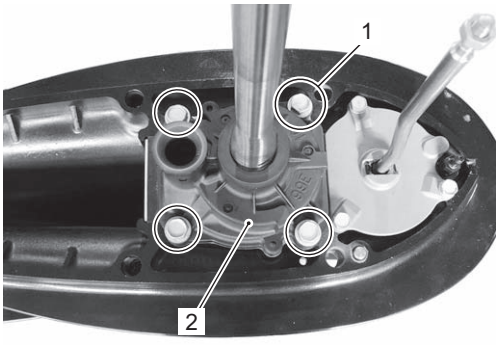
Water Pump Removal and Installation (DF50AV/60AV 2013/05)

CENEJ6113106017

Applicable Model and Effective Serial Number:
05004F – 410001 and Later,
06003F – 410001 and Later.

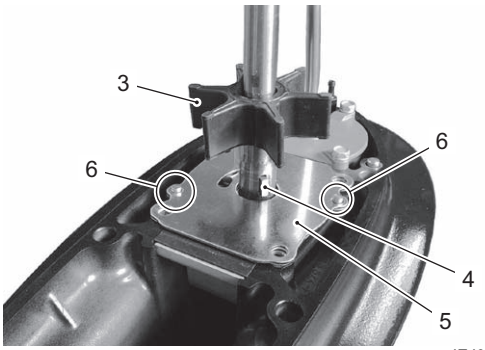
Removal

1) Remove the lower unit.
Refer to “Lower Unit Removal and Installation (DF50AV/60AV 2013/05)” (Page 3A-4).
2) Loosen four bolts (1), then remove water pump case (2).



IEJ611310012-01

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



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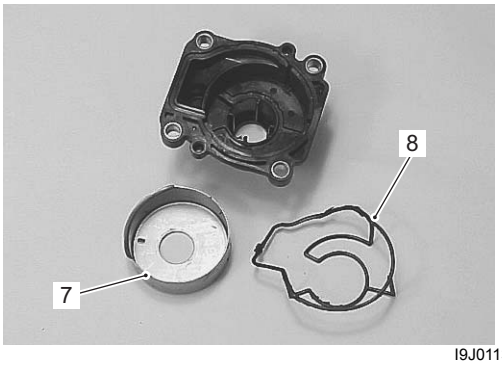
4) Remove inner sleeve (7) and rubber seal ring (8).

NOTE

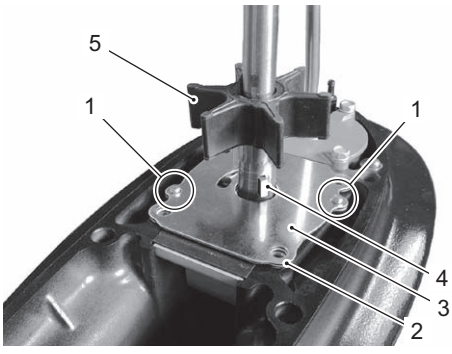
To facilitate the removal of inner sleeve from pump case, warm up the entire case using a heater like hair dryer.



I9J011310030-01

Installation

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

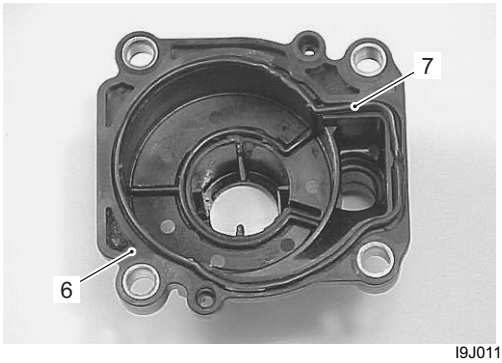


IEJ611310014-01

3) Place the seal ring (7) into groove of the pump case (6).

NOTE

Do not reuse seal ring once removed. Always use new ring.



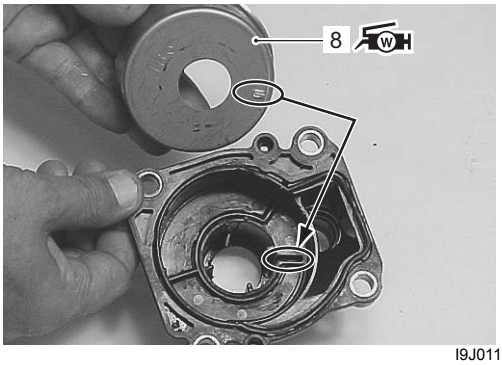
I9J011310032-01

4) Install inner sleeve (8) into the pump case, ensuring that projection of inner sleeve and groove of pump case are aligned.

NOTE

Before installing pump inner sleeve, apply water resistant grease lightly between inner sleeve and pump case mating surfaces.

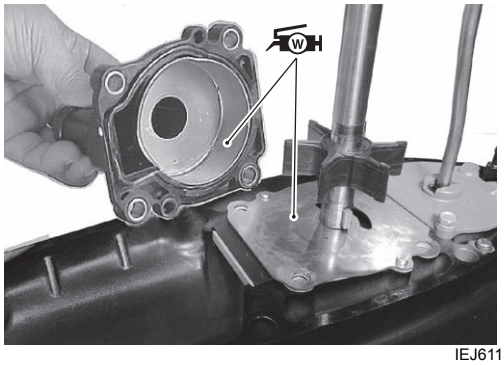
: Grease 99000–25350 (SUZUKI Water Resistant Grease EP2 (250 g))



I9J011310033-01

NOTE

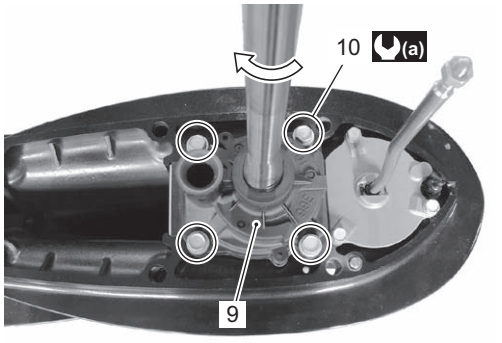
Before installing water pump case assembly, apply water resistant grease lightly on pump case inner sleeve and under panel for initial lubrication.



IEJ611310015-01

5) Install the pump case assembly (9) while rotating driveshaft clockwise to flex the impeller vanes in the correct direction.
Securely tighten the four pump case bolts (10) to the specified torque.

Tightening torque
Water pump case bolt (a): 17 N·m (1.7 kgf-m, 12.5 lbf-ft)



IEJ611310016-01

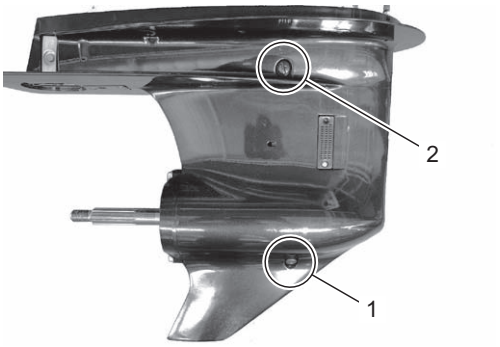
6) Install the Lower Unit.
Refer to “Lower Unit Removal and Installation (DF50AV/60AV 2013/05)” (Page 3A-4).

Lower Unit Disassembly (DF50AV/60AV 2013/05)

CENEJ6113106018

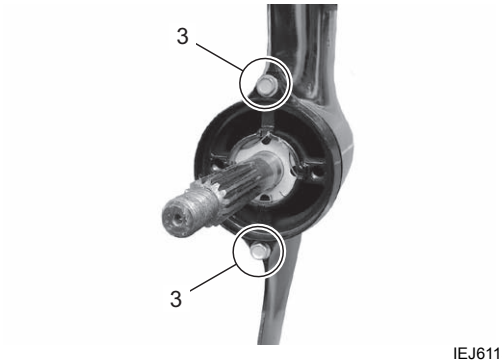
Applicable Model and Effective Serial Number:
05004F – 410001 and Later,
06003F – 410001 and Later.

1) Remove the lower unit.
Refer to “Lower Unit Removal and Installation (DF50AV/60AV 2013/05)” (Page 3A-4).
2) Remove the propeller.
Refer to “Propeller Removal and Installation” in related manual.
3) Remove the water pump and related parts.
Refer to “Lower Unit Removal and Installation (DF50AV/60AV 2013/05)” (Page 3A-4) and “Water Pump Removal and Installation (DF50AV/60AV 2013/05)” (Page 3A-5).
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.



IEJ611310017-01

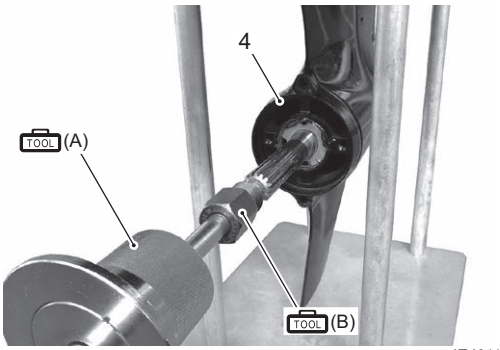
5) Remove two bolts (3) securing the propeller shaft bearing housing to the gearcase.



IEJ611310018-01

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

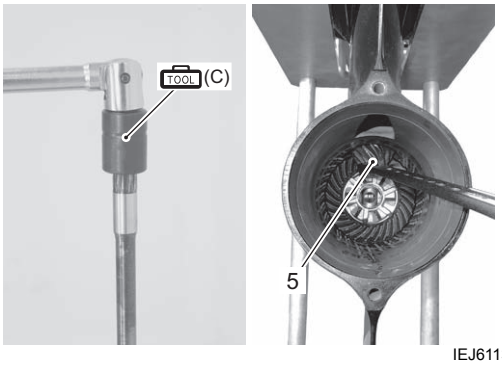
Special tool
TOOL (A): 09930–30104 (Sliding hammer)
TOOL (B): 09930–30161 (Propeller shaft remover)



IEJ611310019-03

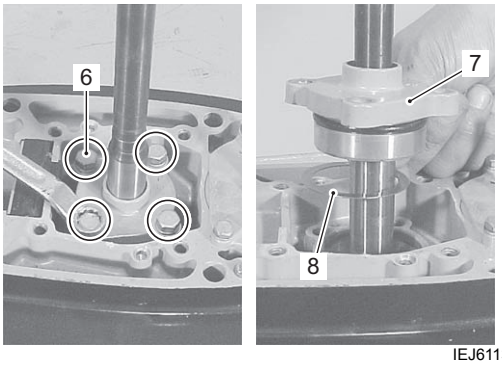
7) Hold the pinion nut securely, then fit special tool to the driveshaft and loosen the pinion nut. Remove pinion nut (5).

Special tool
(C): 09921–29511 (Driveshaft holder)



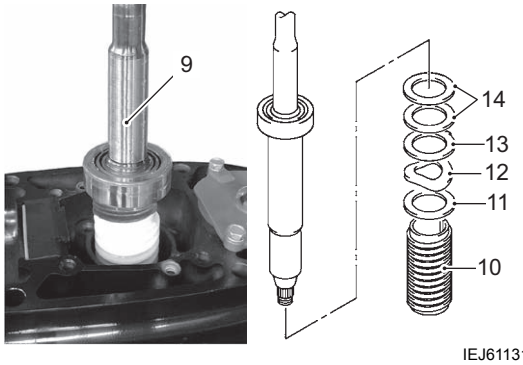
IEJ611310020-02

8) Remove the four bolts (6), then remove the driveshaft oil seal housing (7) and the pinion shim (8).



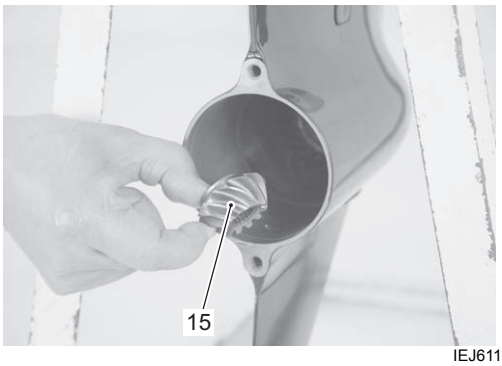
IEJ611310021-01

9) Lift out the driveshaft assembly (9).
Remove the driveshaft collar (10), washer (11), wave washer (12), washer (with tab) (13) and washers (14) from the driveshaft.



IEJ611310022-04

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



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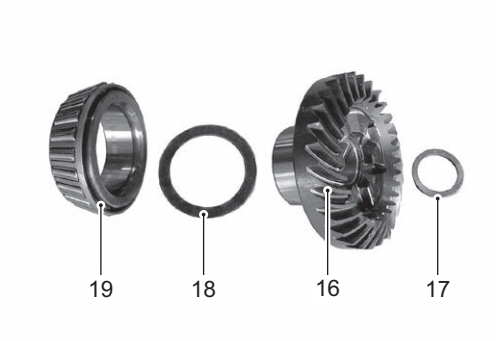
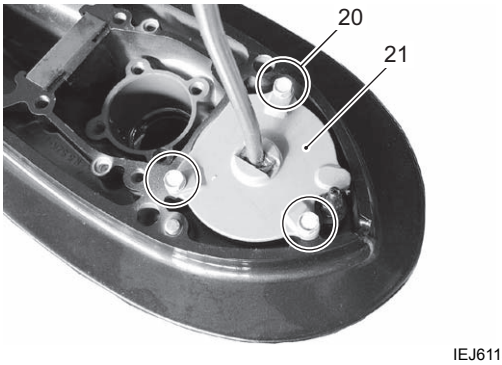


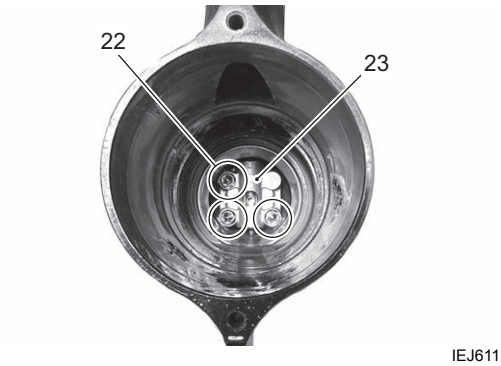
IEJ611310024-01

11) Remove the three bolts (20) and lift out the shift rod guide housing assembly (21).



IEJ611310025-03

12) Remove the three bolts (22), then remove the shift cam housing (23).
Account for the dowel pins (24).



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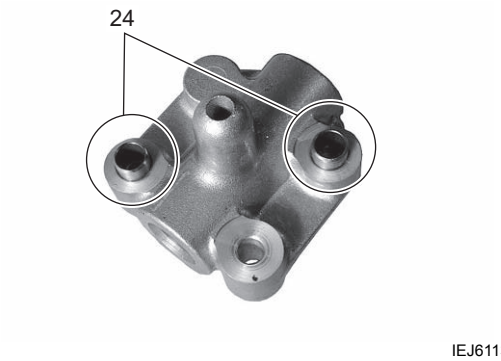
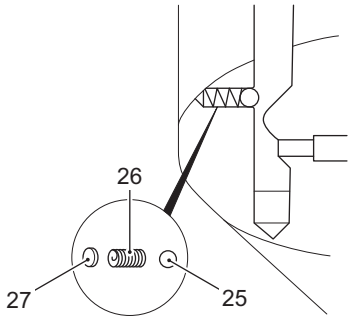


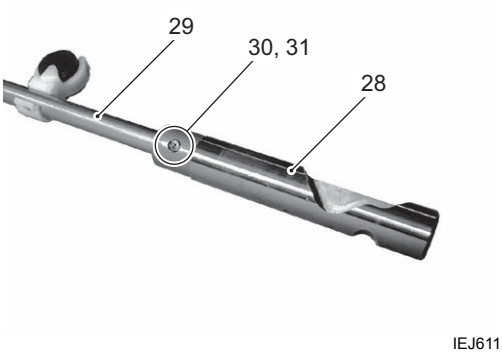
IEJ611310072-01

13) Remove the detent ball (25), spring (26) and plate (27).



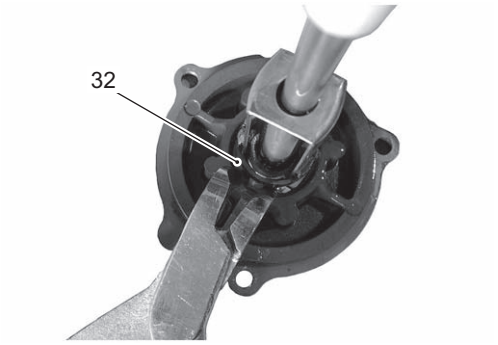
IEJ611310028-01

14) Separate the shift cam (28) from the shift rod (29) by driving out the spring pin (30) and (31).



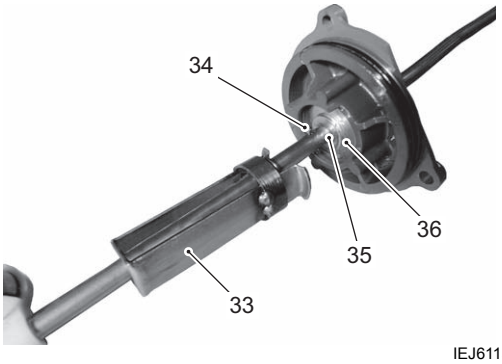
IEJ611310029-01

15) Remove the circlip (32).



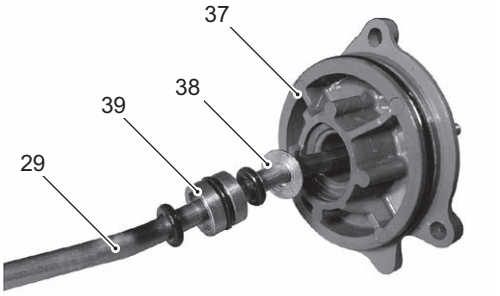
IEJ611310030-02

16) Remove the shift rod collar (33) by turning it.
Remove pins (34) (if necessary), washer (35) and the washer (36).



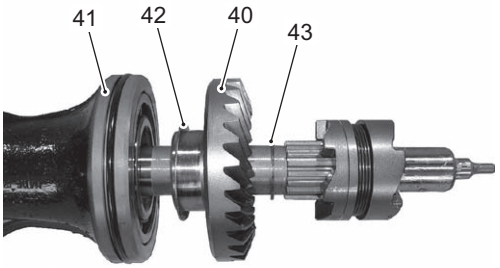
IEJ611310031-02

17) Remove the shift rod (29) from the housing.
Remove the shift rod guide housing (37) (with the O-ring), the washer (38) and the shift rod guide (39).



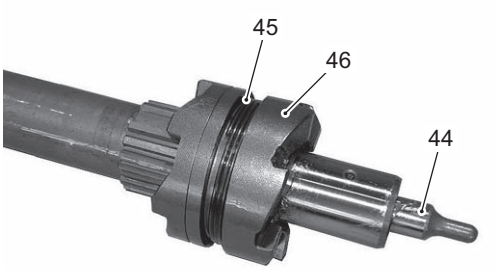
IEJ611310032-01

18) To disassemble propeller shaft components, refer to following.
   a) Slide propeller shaft away from reverse gear (40) and bearing housing assembly (41).
   Account for the reverse gear back-up shim (42) and reverse gear thrust washer (43).



IEJ611310033-02

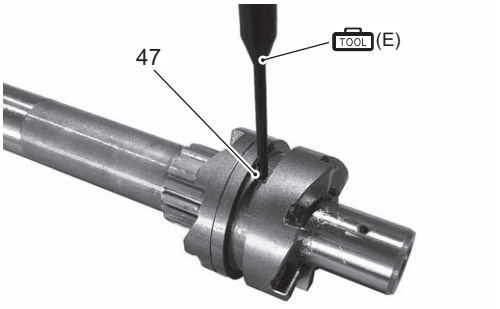
   b) Pull the push rod (44) out of the propeller shaft. Remove spring (45) from clutch dog shifter (46).



IEJ611310034-03

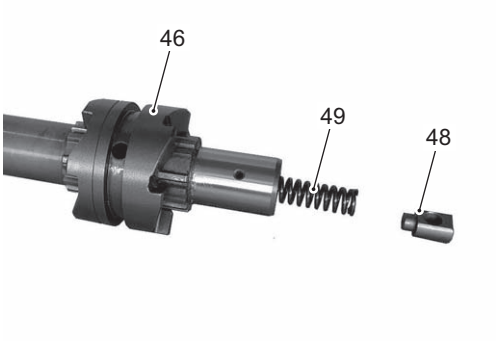
   c) Use special tool to push the dog pin (47) out of the clutch dog shifter.

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



IEJ611310073-01

   d) Remove the clutch dog shifter (46), push pin (48), and return spring (49) from propeller shaft.



IEJ611310036-02

Pinion Bearing Removal and Installation (DF50AV/60AV 2013/05)

CENEJ6113106019

Applicable Model and Effective Serial Number:
05004F – 410001 and Later,
06003F – 410001 and Later.

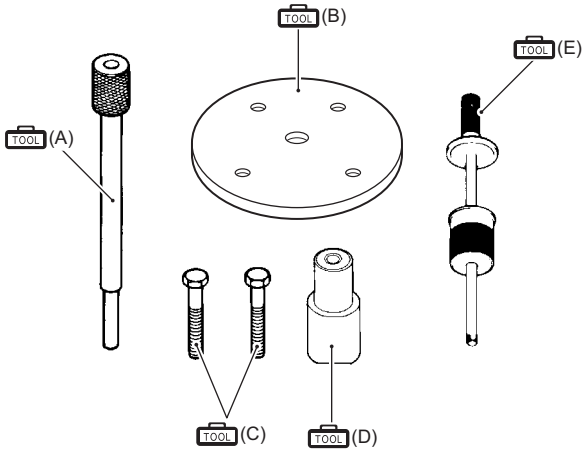
NOTICE

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.

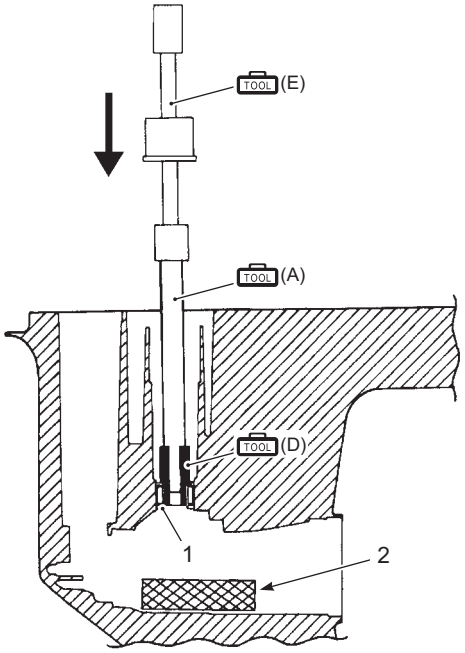
Special tool
TOOL (A): 09951–59910 (Shaft (removal and installation))
TOOL (B): 09951–38710 (Plate)
TOOL (C): 01500–0840A (Bolt)
TOOL (D): 09951–19220 (Attachment)
TOOL (E): 09930–30104 (Sliding hammer)



I9J011310018-03

Removal

1) Disassemble the lower unit.
   Refer to “Lower Unit Disassembly (DF50AV/60AV 2013/05)” (Page 3A-7).
2) Place the attachment (D) inside the pinion bearing.
3) Insert the removal shaft (A) into attachment (D).
4) Thread sliding hammer (E) into top of removal shaft (A).
5) Put wood block under pinion bearing.
6) Drive the pinion bearing out downwards by striking top of shaft (A) with sliding hammer (E).



I9J011310005-03

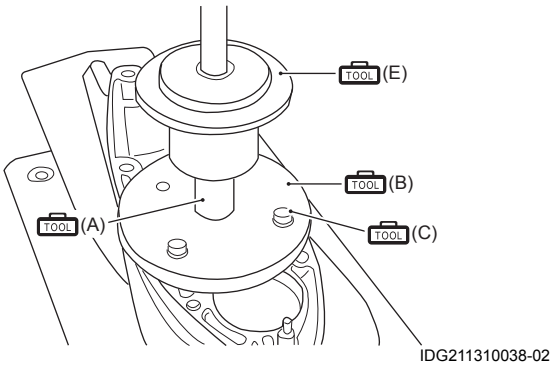
1. Pinion bearing	2. Wood block

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 (B), attachment (D) and pinion bearing as shown in the figure.
2) Place the installer shaft (A) (with pinion bearing on end of installer shaft) into the gearcase.
3) Secure the plate (B) by tightening the bolt (C).
4) Thread the sliding hammer (E) into the top of the installer shaft (A).
5) Drive the pinion bearing down into position by gently striking the installer shaft (A) until the coupler touches plate.
6) Assemble the lower unit.
   Refer to “Lower Unit Assembly (DF50AV/60AV 2013/05))” (Page 3A-13).



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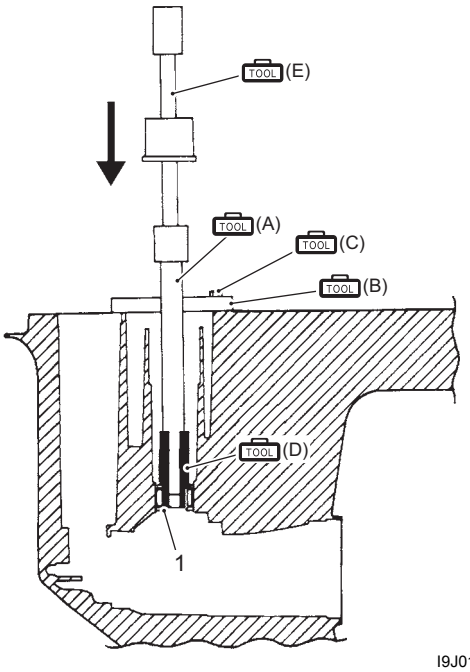


I9J011310006-04

1. Pinion bearing

Lower Unit Related Items Inspection (DF50AV/60AV 2013/05)

CENEJ6113106020

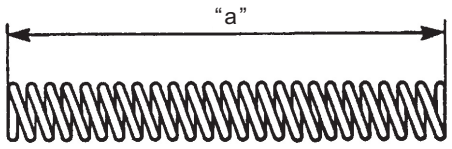
Applicable Model and Effective Serial Number:
05004F – 410001 and Later,
06003F – 410001 and Later.

NOTE

For details other than the following information of Lower Unit Related Items Inspection, refer to “Lower Unit Related Items Inspection” in related manual.

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

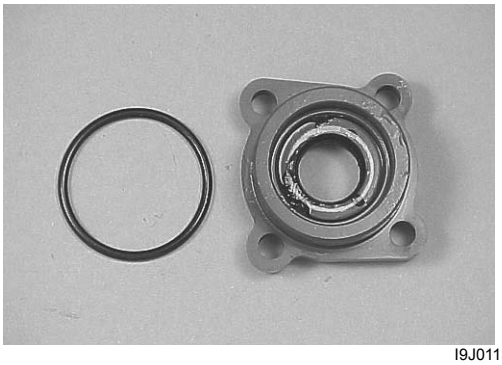
Clutch return spring free length "a"
Standard: 67 mm (2.6 in.)
Service limit: 64 mm (2.5 in.)



I9J011310062-01

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.
- Inspect O-ring. Replace if worn, nicked, cut or other abnormal conditions are noted.



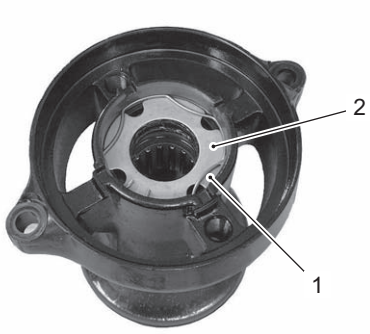
I9J011310067-01

Propeller Shaft Oil Seal Replacement (DF50AV/60AV 2013/05)

CENEJ6113106021

Applicable Model and Effective Serial Number:
05004F – 410001 and Later,
06003F – 410001 and Later.

1) Remove the propeller shaft bearing housing. Refer to "Lower Unit Disassembly (DF50AV/60AV 2013/05)" (Page 3A-7).
2) Remove the retaining ring (1) and washer (2).



IEJ611310037-01

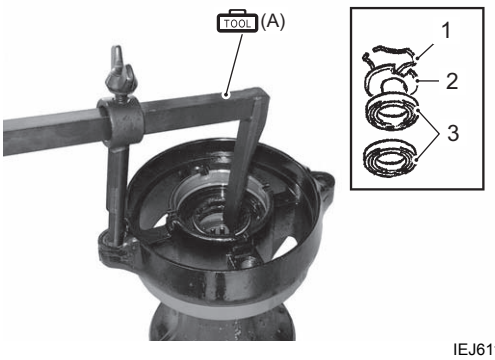
3) Extract seals (3) with oil seal remover.

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
(A): 09913–50121 (Oil seal remover)

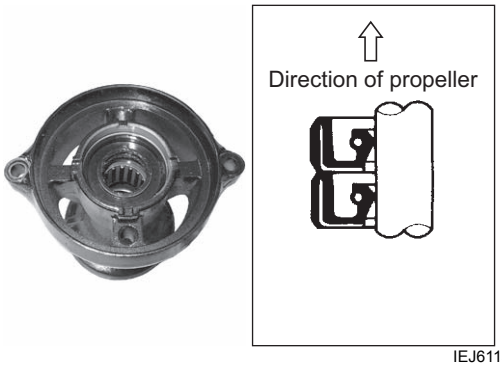


IEJ611310038-01

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

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

5) 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.



IEJ611310039-03

6) Install the washer and retainer ring.
7) Assemble the propeller shaft bearing housing. Refer to "Lower Unit Assembly (DF50AV/60AV 2013/05))" (Page 3A-13).

Driveshaft Oil Seal Replacement (DF50AV/60AV 2013/05)

CENEJ6113106022

Applicable Model and Effective Serial Number:
05004F – 410001 and Later,
06003F – 410001 and Later.

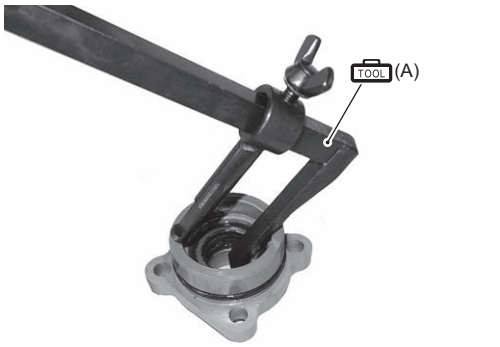
1) Remove the driveshaft oil seal housing. Refer to "Lower Unit Disassembly (DF50AV/60AV 2013/05)" (Page 3A-7).
2) Using special tool, remove two oil seals out of the driveshaft oil seal housing.

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)

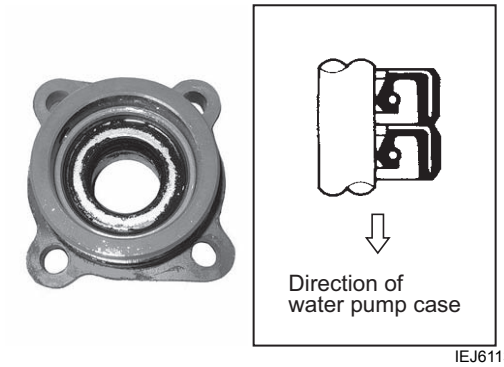


IEJ611310040-01

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.



IEJ611310041-01

5) Assemble the driveshaft oil seal housing. Refer to "Lower Unit Assembly (DF50AV/60AV 2013/05))" (Page 3A-13).

Lower Unit Assembly (DF50AV/60AV 2013/05))

CENEJ6113106023

Applicable Model and Effective Serial Number:
05004F – 410001 and Later,
06003F – 410001 and Later.

NOTE

For details other than the following information of Lower Unit Assembly, refer to "Lower Unit Assembly" in related manual.

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

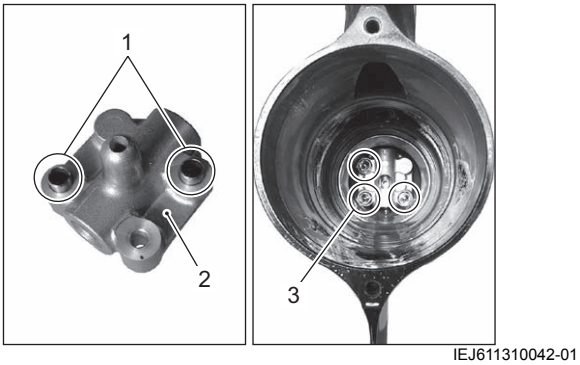
NOTICE

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 (DF50AV/60AV 2013/05)" (Page 3A-18).)

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.**

Shift Cam Housing
Install dowel pins (1) and shift cam housing (2), then tighten the three bolts (3) securely.

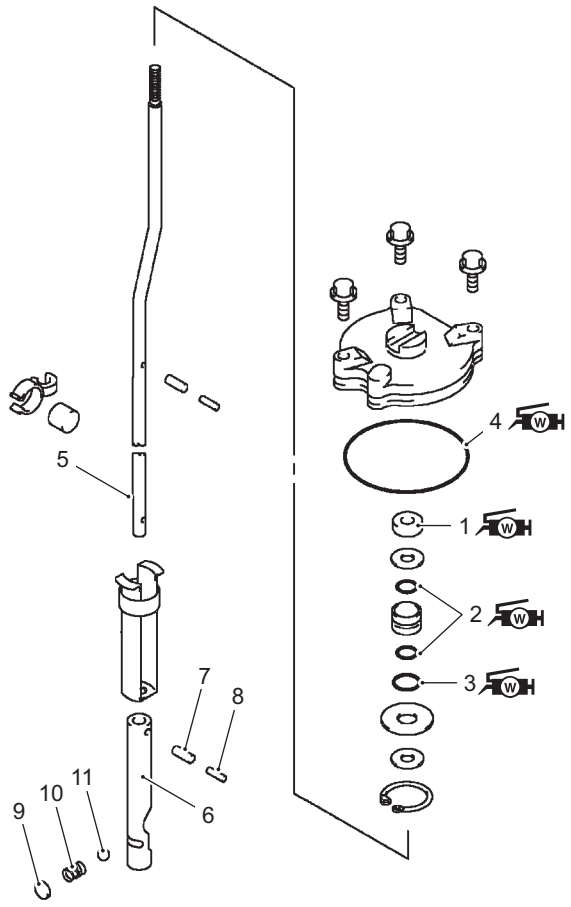


IEJ611310042-01

Shift Rod Guide Housing

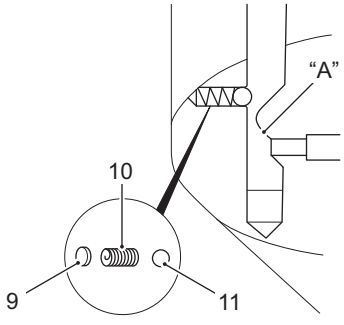
- Apply the Water Resistant Grease to the inside of the dust seal (1), the O-ring (2), (3) and (4).
- Align the pin holes of the shift rod (5) and the shift cam (6).
  Insert the pin (7) through the pin holes first, then insert the pin (8) into the pin (7).

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



IEJ611310043-01

- Insert the plate (9), spring (10) and detent ball (11) into gearcase.



IEJ611310044-02

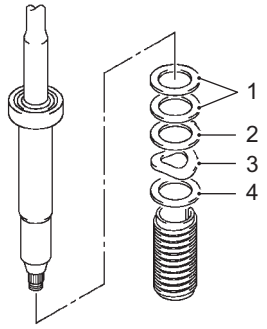
- Install the shift rod/cam assembly to gearcase.

NOTE

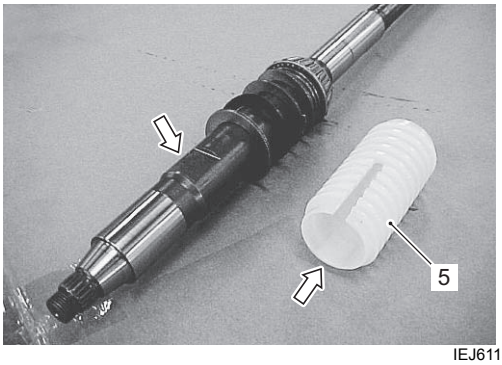
Be sure the stepped section "A" of shift cam faces towards propeller shaft. Also be sure the rear side of the shift cam (with detent notch) is positioned over the detent ball (11) in the gearcase.

Driveshaft

- Assemble the washers (1), washer (with tab) (2), wave washer (3), washer (4) and driveshaft collar (5) to driveshaft.After installing driveshaft collar, fit the convex part of collar in the concave part of driveshaft by turning collar.



IEJ611310058-03

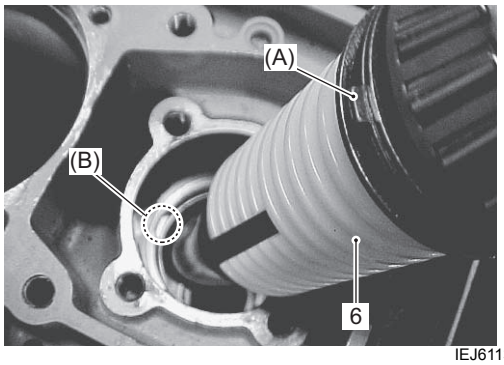


IEJ611310045-03

- Lower the driveshaft assembly (6) down into the gearcase until the bottom of shaft protrudes through center of pinion gear.

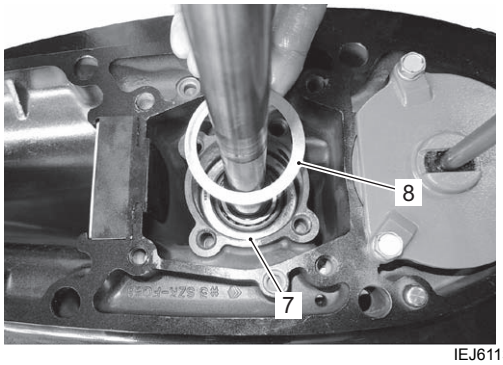
NOTE

The washer tab (A) should be located into the groove (B) on the gearcase.



IEJ611310046-01

- Install the bearing outer race (7) and pinion gear shim (8) to driveshaft.



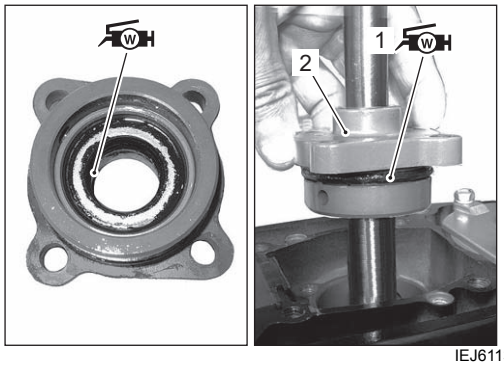
IEJ611310047-02

Driveshaft Oil Seal Housing

- Apply water resistant grease to the driveshaft oil seal.

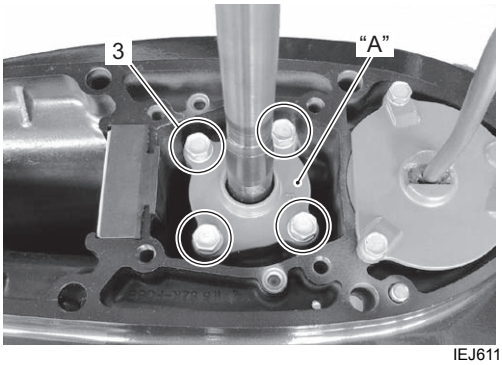
: Grease 99000–25350 (SUZUKI Water Resistant Grease EP2 (250 g))

- Apply water resistant grease to O-ring (1), then install O-ring into groove on the driveshaft oil seal housing (2).



IEJ611310048-02

- Install the driveshaft oil seal housing on the gearcase, then tighten four bolts (3) securely.



IEJ611310049-02

"A": F mark

Pinion Nut

- Apply thread lock 1342 to the threads of pinion nut (1) before threading it onto driveshaft.

: Thread lock cement 99000–32050 (SUZUKI Thread Lock 1342 (50 g))

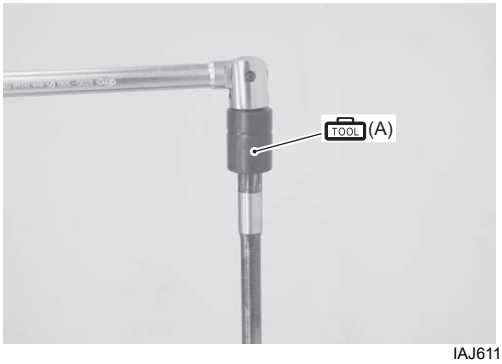
- Tighten pinion nut to specified torque.

NOTE

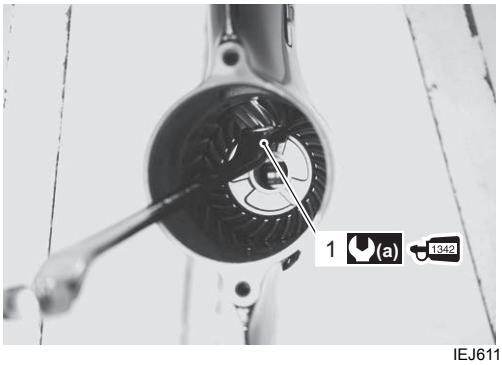
It is recommended the original pinion nut be used for the purposes of shimming during repair. A new pinion nut should be used on final assembly.

Special tool
(A): 09921–29511 (Driveshaft holder)

Tightening torque
Pinion nut (a): 120 N·m (12.0 kgf-m, 87.0 lbf-ft)



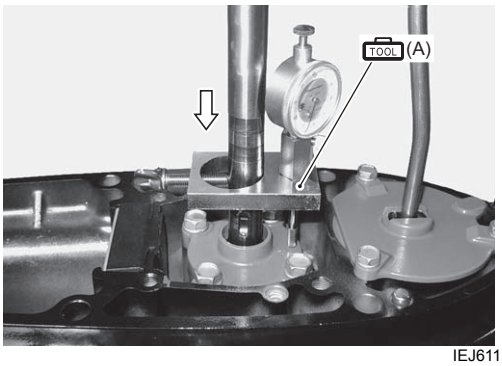
IAJ611310072-01



IEJ611310067-01

Checking Driveshaft Thrust Play
Before installing reverse gear, driveshaft thrust play should checked.
Refer to “Lower Unit Gears - Shimming and Adjustment (DF50AV/60AV 2013/05)” (Page 3A-18).

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



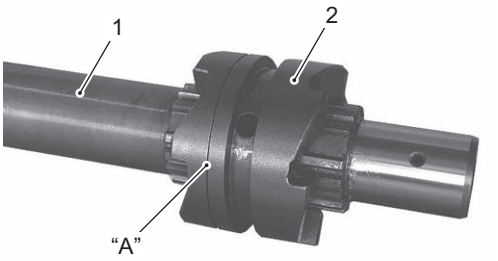
IEJ611310070-01

Propeller Shaft

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

NOTE

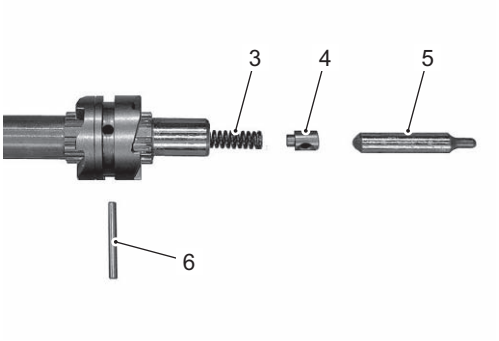
The side of the clutch dog shifter marked with the Groove “A” must face towards Reverse gear.



IEJ611310051-04

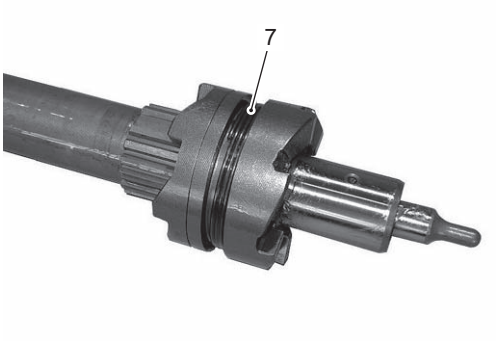
“A”: Groove

- Insert the return spring (3), push pin (4) and push rod (5) into propeller shaft.
  Align the holes in the shifter dog and push pin.
  Depress the push rod and slide the dog pin (6) through both dog and push pin.



IEJ611310052-02

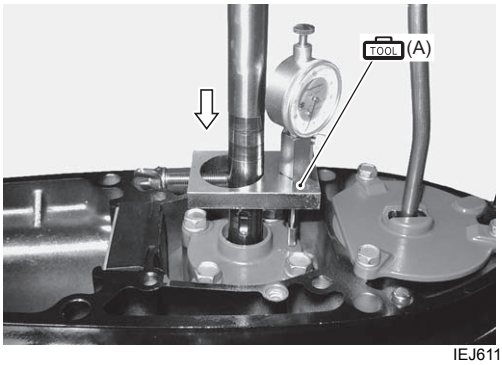
- Install the dog pin retaining spring (7), ensuring that it fits snugly into the groove on the dog shifter.



IEJ611310053-03

Rechecking Driveshaft Thrust Play
Recheck the driveshaft thrust play. 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 (DF50AV/60AV 2013/05)” (Page 3A-18).

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



IEJ611310070-01

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

1) Install the test tool into the oil level hole.
2) Connect the air pump to the tester.
3) 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.

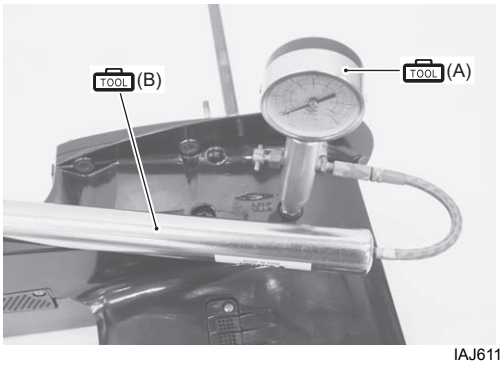
Do not exceed pressure of 110 kPa (1.1 kg/cm², 15.6 psi.).

NOTE

Apply low initial pressure of 20 – 40 kPa (0.2 – 0.4 kg/cm², 2.8 – 5.7 psi.) first, then apply specified pressure.

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

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



IAJ611310085-01

4) Once stabilized, pressure should remain steady for at least 5 min.
If pressure does not fall, sealing performance is correct.

Water Pump
Install the water pump and related parts.
Refer to “Lower Unit Removal and Installation (DF50AV/60AV 2013/05)” (Page 3A-4) and “Water Pump Removal and Installation (DF50AV/60AV 2013/05)” (Page 3A-5).

Lower Unit
Install the Lower Unit.
Refer to “Lower Unit Removal and Installation (DF50AV/60AV 2013/05)” (Page 3A-4).

Gear Oil
Fill the gearcase with specified gear oil. Refer to “Gear Oil Change” in Section 0B in related manual.

Gear oil amount
1 050 ml (35.5 / 37.0 US/Imp. oz)

Lower Unit Gears - Shimming and Adjustment (DF50AV/60AV 2013/05)

CENEJ6113106024

Applicable Model and Effective Serial Number:
05004F – 410001 and Later,
06003F – 410001 and Later.

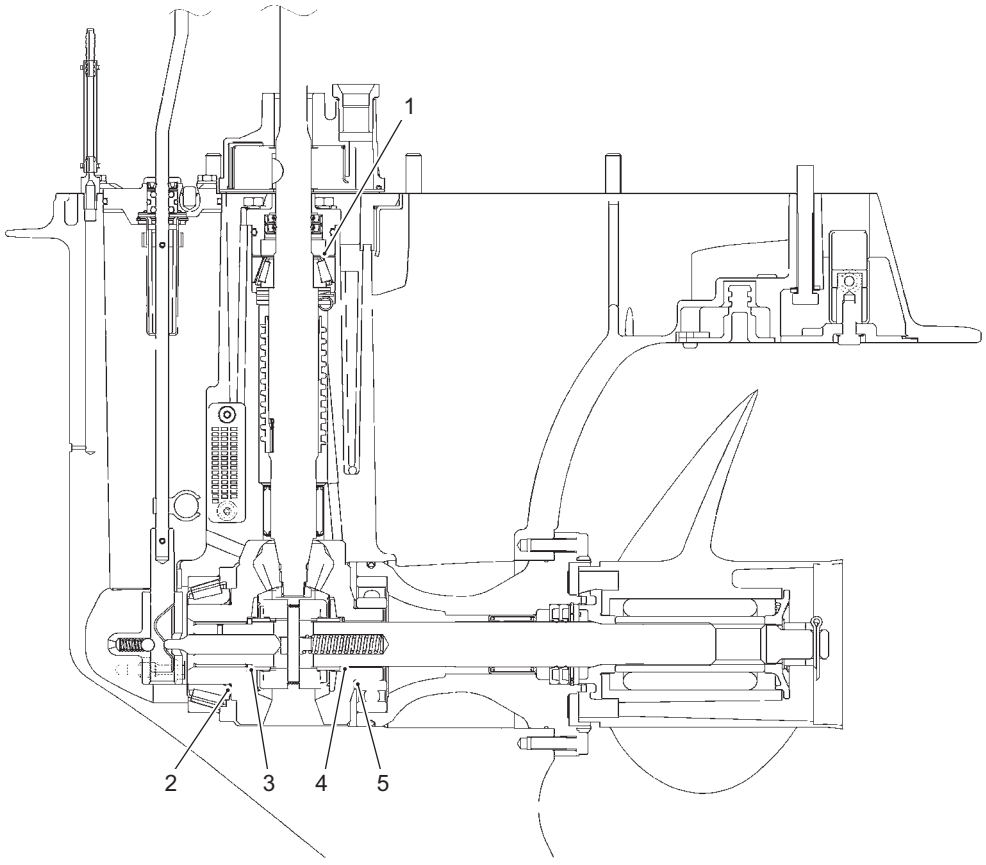
NOTE

For details other than the following information of Lower Unit Gears - Shimming and Adjustment, refer to "Lower Unit Gears - Shimming and Adjustment" in related manual.

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	**0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00, 1.05, 1.10, 1.15**	**1.0**
Forward gear back up shim	**0.45, 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90**	**1.0**
Forward gear thrust washer	**3.0**	**3.0**
Propeller shaft reverse thrust washer	**0.9, 1.0, 1.2, 1.3, 1.4, 1.6**	**2.2**
Reverse gear back up shim	**1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6**	**1.5**



IEJ611310081-01

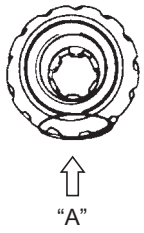
1. Pinion gear back up shim	3. Forward gear thrust washer	5. Reverse gear back up shim
2. Forward gear back up shim	4. Propeller shaft reverse thrust washer	

Forward Gear / Pinion Gear Back-Up Shim Adjustment

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

Prior to adjustment

1) Install standard pinion gear back-up shim thickness according to ± design specification mark on the gear.



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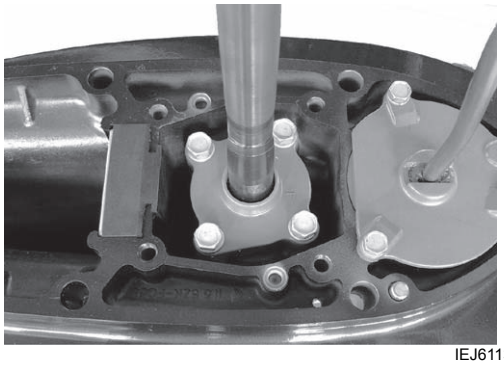
"A": ± design spec. mark

2) Correctly assemble driveshaft oil seal housing, driveshaft, forward gear, pinion gear and related components. Refer to "Lower Unit Assembly (DF50AV/60AV 2013/05))" (Page 3A-13).
Do not install reverse gear at this time.



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3) Tighten pinion nut to specified torque.

Tightening torque
Pinion nut: 120 N·m (12.0 kgf-m, 87.0 lbf-ft)

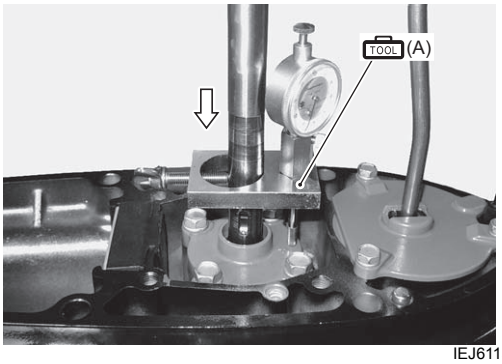
Checking driveshaft thrust play

1) Affix the gear adjusting gauge to driveshaft.

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

2) To check driveshaft thrust play, push the forward gear inward and hold it in this position. Slowly push the driveshaft downward completely, then read the maximum thrust play.

Driveshaft thrust play
0.08 – 0.28 mm (0.003 – 0.011 in.)



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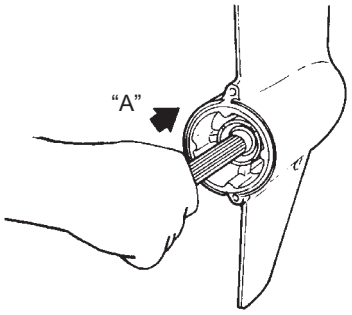


IEJ611310055-02

"A": Push

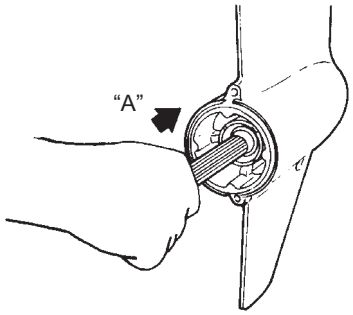
- If thrust play is larger than specified, the forward gear back-up shim thickness must be increased.
- If thrust play is smaller than specified, the forward gear back-up shim thickness must be decreased.

Checking and adjusting tooth contact pattern (Pinion and forward gear)

Check tooth contact pattern using the following procedure.

1) To assess tooth contact, apply a light coat of prussian blue on the convex surface of the forward gear.
2) Install the propeller shaft and housing assembly (minus reverse gear and internal components).

3) Push the propeller shaft inward and hold it in position.



IEJ611310055-02

"A": Push

4) Using the driveshaft holder tool, rotate the driveshaft 5 – 6 times.

Special tool
(A): 09921–29511 (Driveshaft holder)

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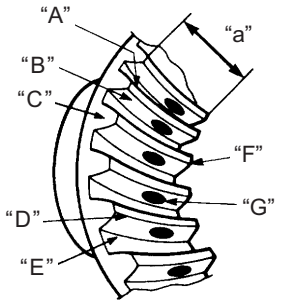
5) Carefully remove the propeller shaft and housing to check the tooth contact pattern.



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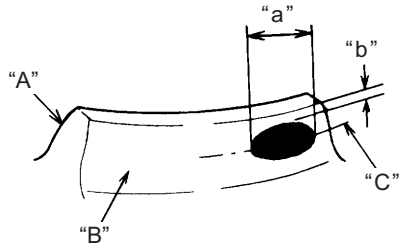
"A": Concave side	"E": Tooth bottom
"B": Convex side	"F": Toe
"C": Heel	"G": Tooth contact pattern
"D": Tooth top	"a": Tooth width

Optimum tooth contact
The optimum tooth contact is shown in the figure. A shim adjustment may be necessary to obtain this contact pattern.

NOTE

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

Optimum tooth contact



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"A": Heel	"a": Approx. 1/3 of tooth width
"B": Convex side	"b": Approx. 1 mm
"C": Toe	

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

I9J011310015-01

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

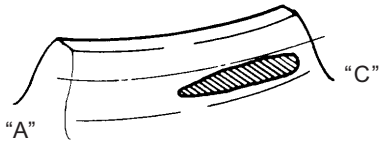
- Increase thickness of forward gear shim.
- Slightly decrease pinion gear shim thickness.

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



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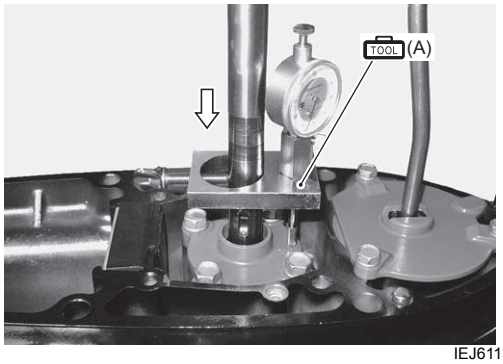
Rechecking driveshaft thrust play
After obtaining optimum tooth contact, driveshaft thrust play should be measured.

1) Affix the gear adjusting gauge to the driveshaft.

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



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2) To check driveshaft thrust play, push the forward gear inward and hold it in this position.
Push the driveshaft down completely, then read the maximum thrust play.
Designate this amount of play as "A".

NOTE

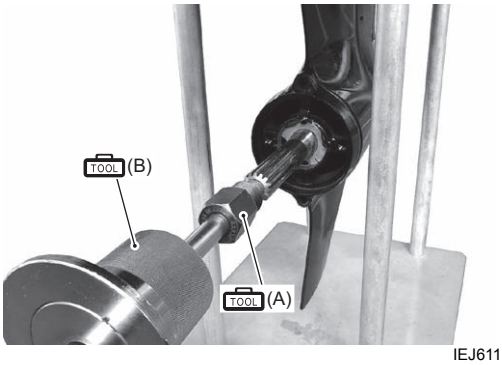
Driveshaft thrust play "A" must be known to adjust reverse gear shim.

Driveshaft thrust play
0.08 – 0.28 mm (0.003 – 0.011 in.)

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.
2) Screw a slide hammer assembly onto the propeller shaft and strike it a few gentle outward taps.

Special tool
TOOL (A): 09930–30161 (Propeller shaft remover)
TOOL (B): 09930–30104 (Sliding hammer)



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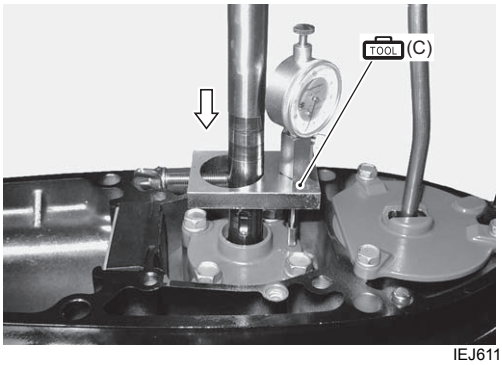
3) Affix the gear adjusting gauge to driveshaft.

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

4) Slowly push the driveshaft downward completely, then read the maximum thrust play. Designate this measurement as play "B".



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5) Compare play "B" to play "A".
Refer to "Lower Unit Assembly (DF50AV/60AV 2013/05))" (Page 3A-13).
6) Reverse gear back-up shim adjustment is correct if "B" is equal to "A".
If "B" is less than "A", reduce reverse gear back-up shim thickness.

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.

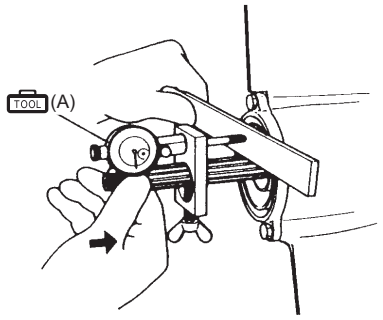
NOTE

Maintain the forward gear thrust washer at standard thickness (3.0 mm) and use only the reverse gear thrust washer to adjust thrust play.

Propeller shaft thrust play
Approx. 0.05 – 0.25 mm (0.002 – 0.010 in.)

1) Assemble the gear adjusting gauge to the propeller shaft.

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



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2) Push propeller shaft inward.
3) Hold the shaft in and set the dial gauge pointer to zero.
4) 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 reverse gear thrust washer thickness.
   - If the measurement is less than the specification, reduce the reverse gear thrust washer thickness.