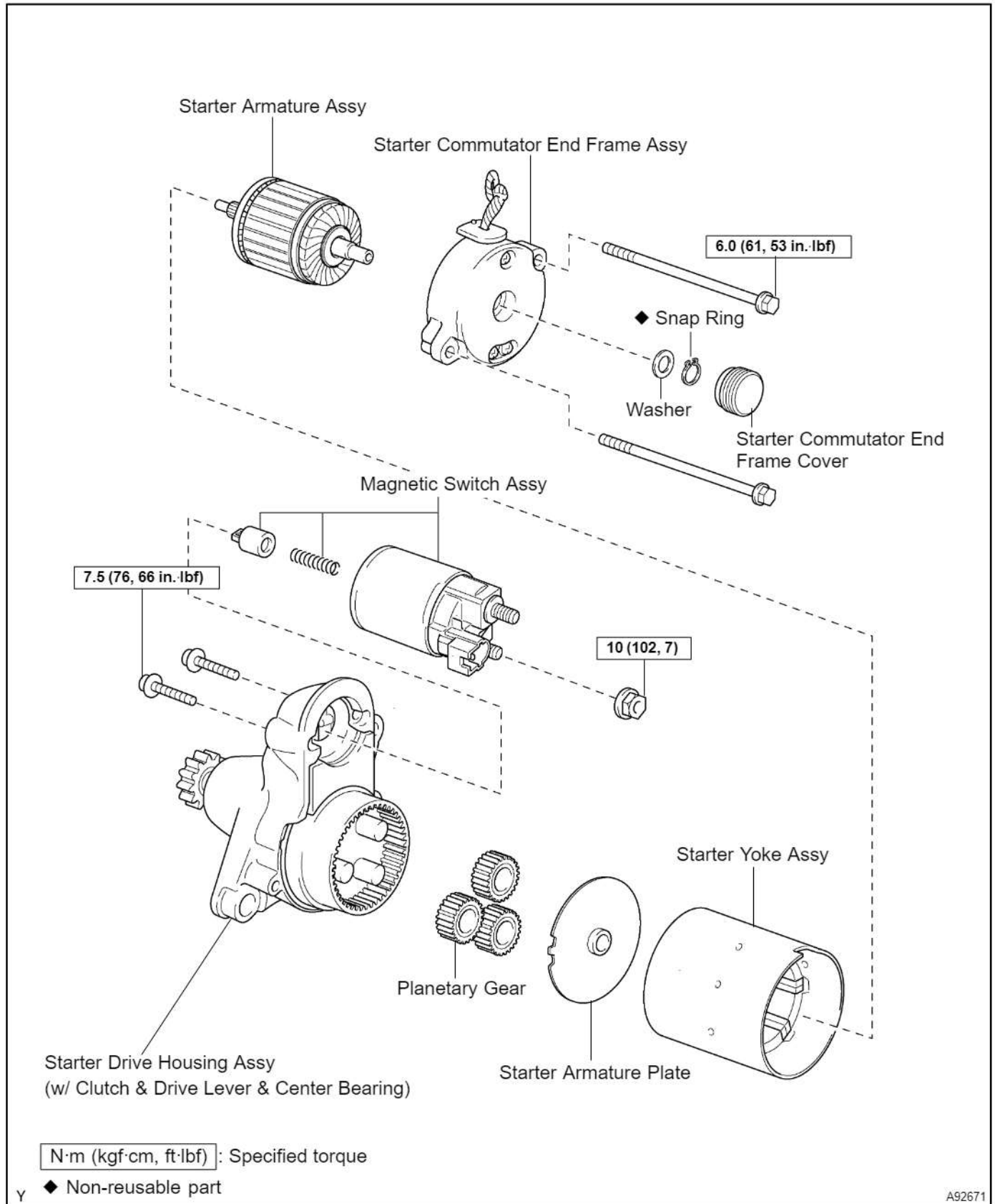


STARTER ASSY (2AZ-FE)

COMPONENTS

190RU-03



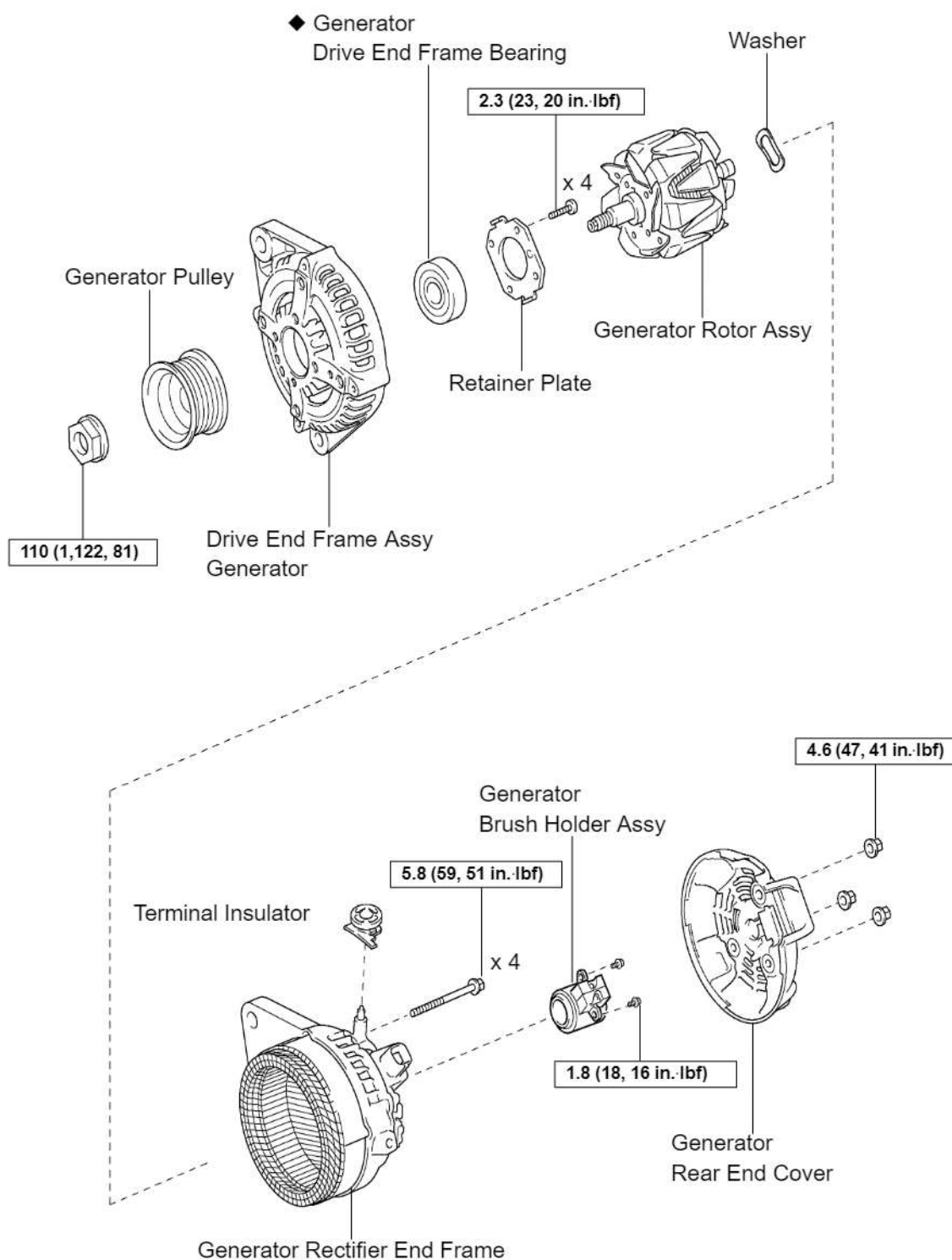
A92671

GENERATOR ASSY (2AZ-FE)

COMPONENTS

190V1-01

100 A

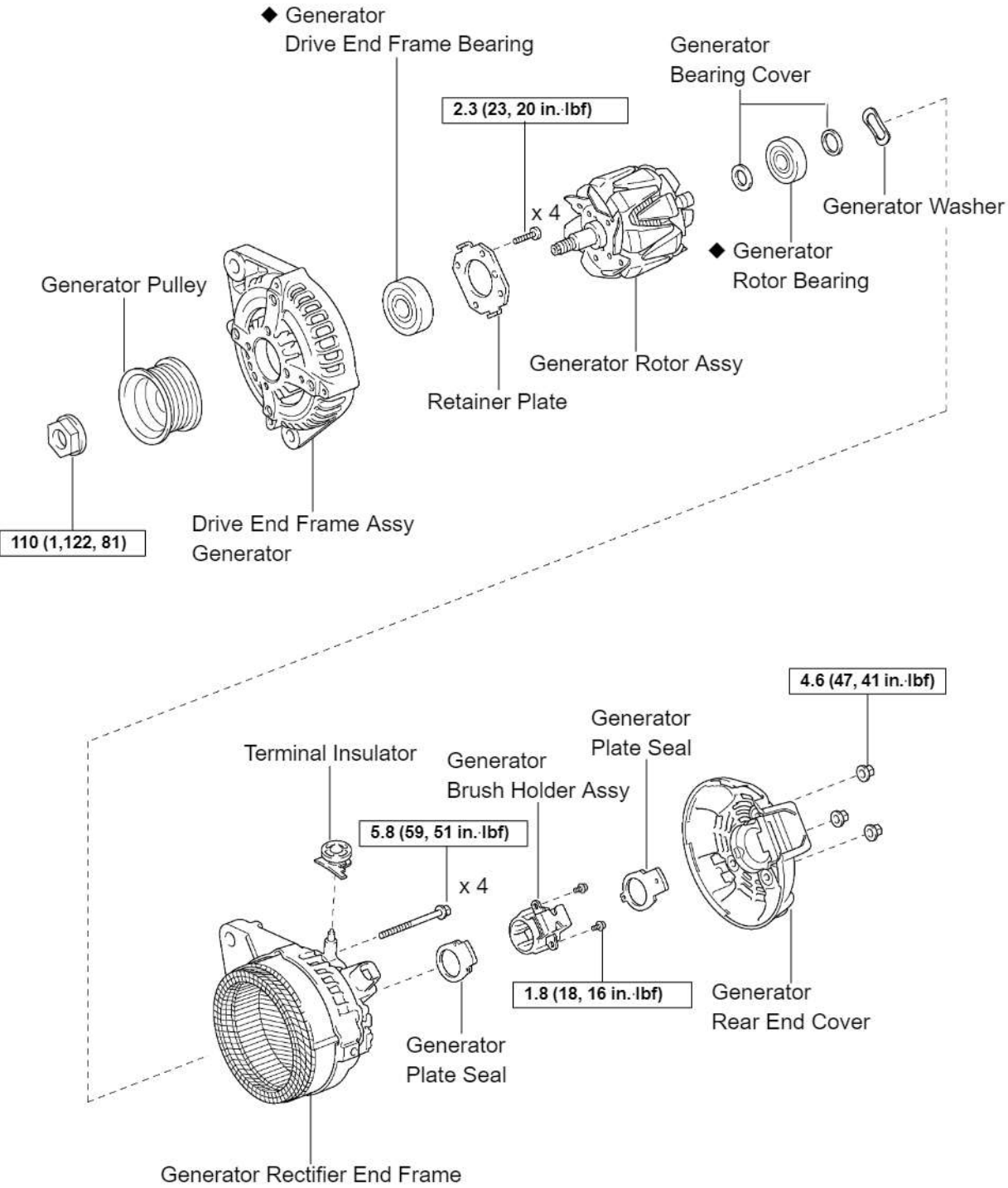


N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

A92688

130 A



N·m (kgf·cm, ft·lbf) : Specified torque

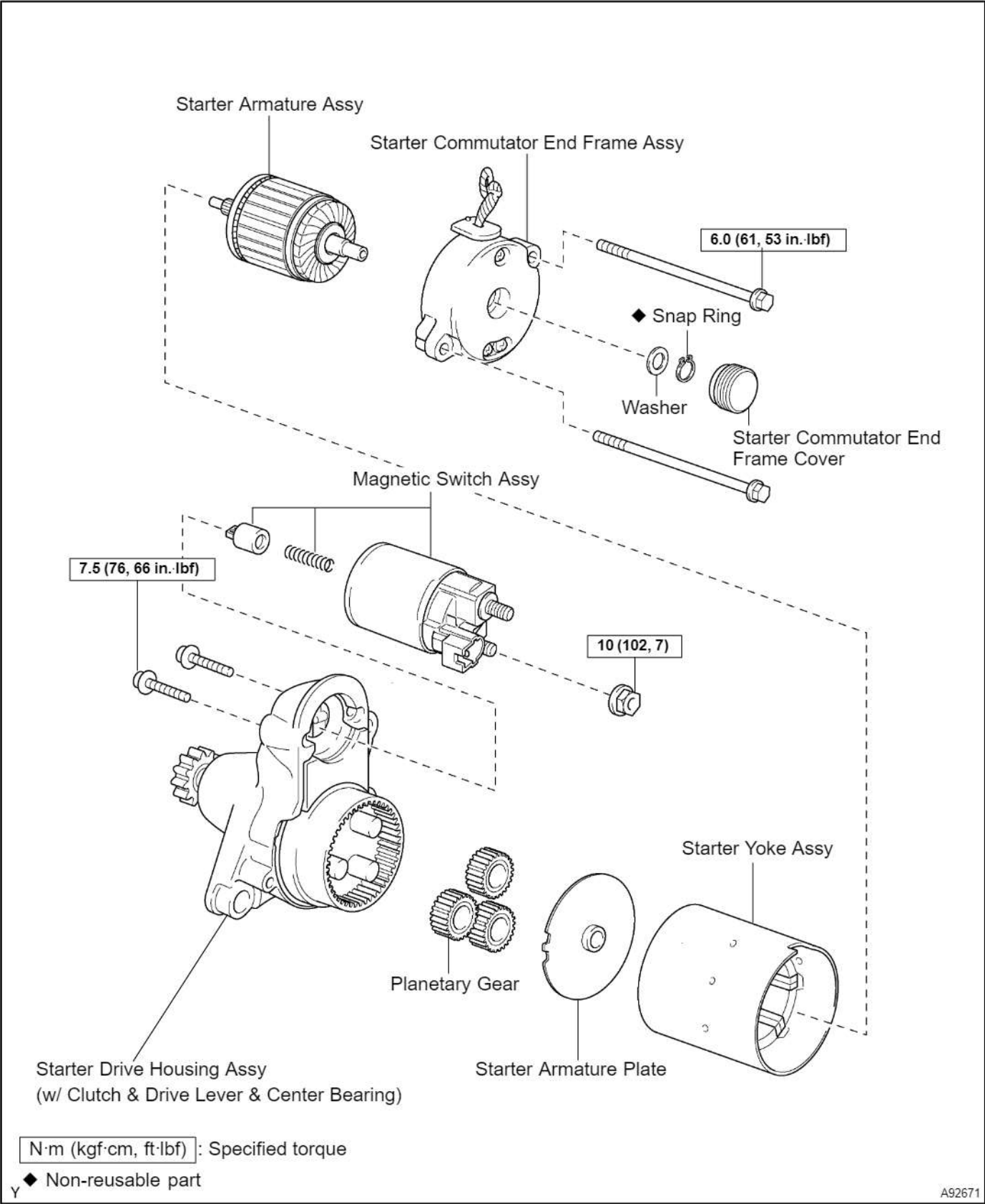
◆ Non-reusable part

A92683

STARTER ASSY (3MZ-FE)

COMPONENTS

1905T-03



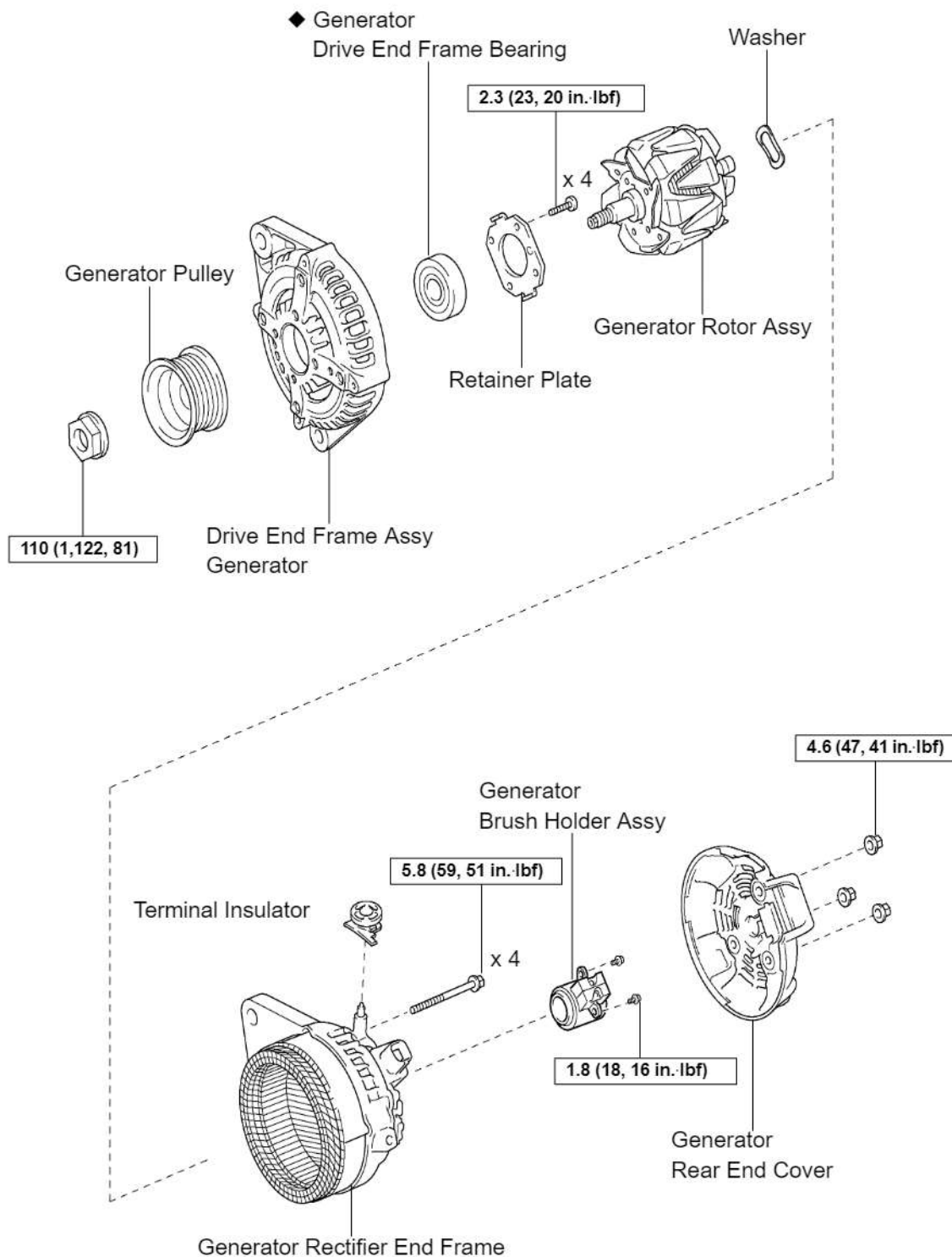
A92671

GENERATOR ASSY (3MZ-FE)

COMPONENTS

190VN-01

100 A

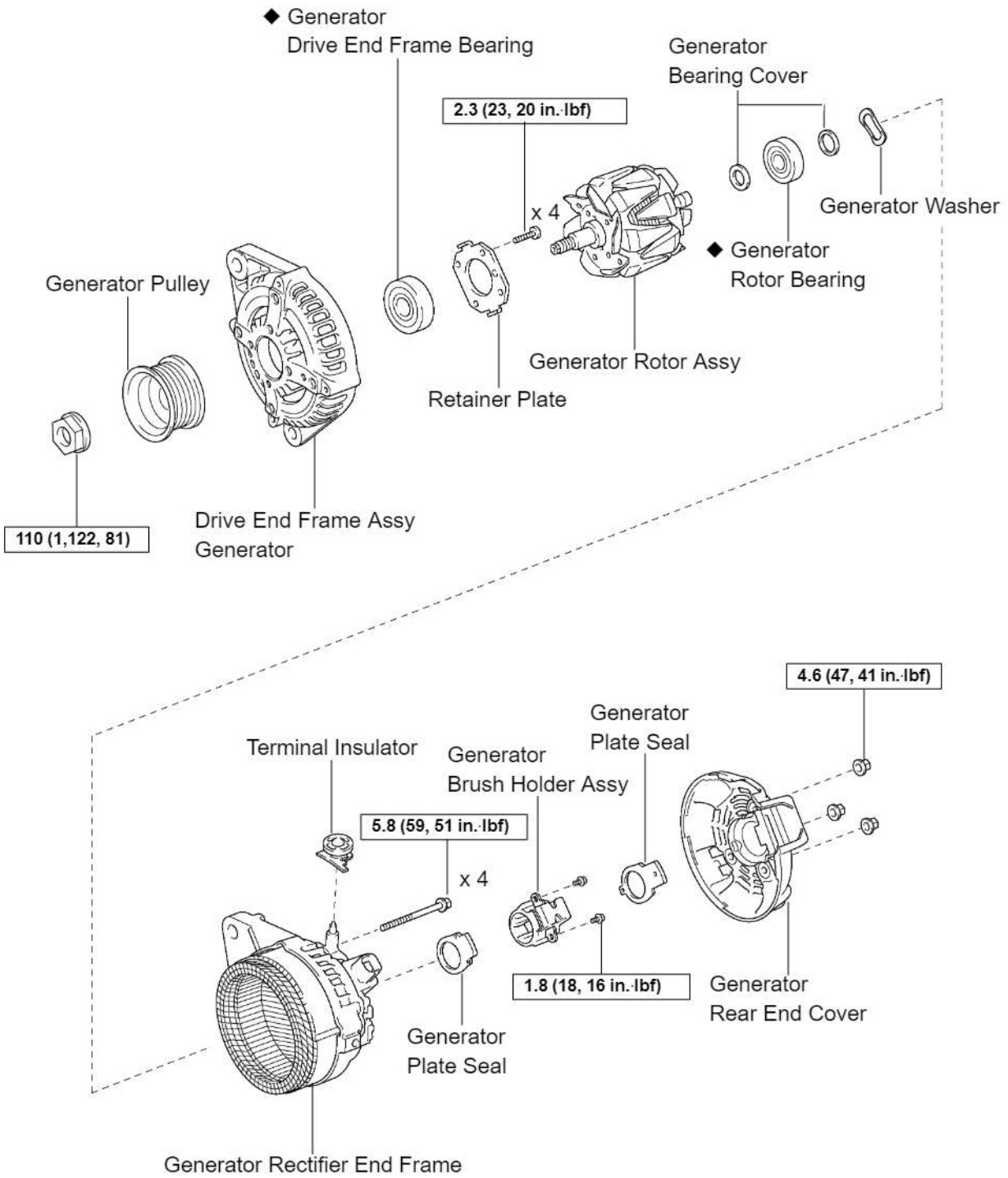


N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

A92688

130 A



N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

A92683

STARTING SYSTEM (2AZ-FE)

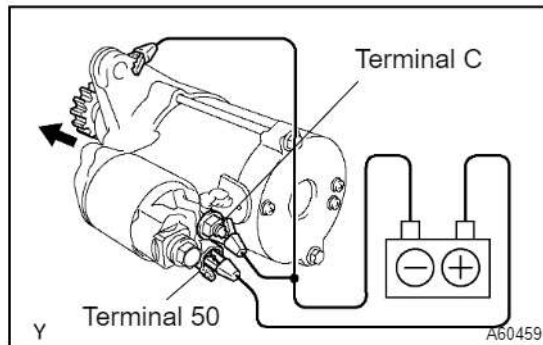
INSPECTION

190VG-01

1. INSPECT STARTER ASSY

NOTICE:

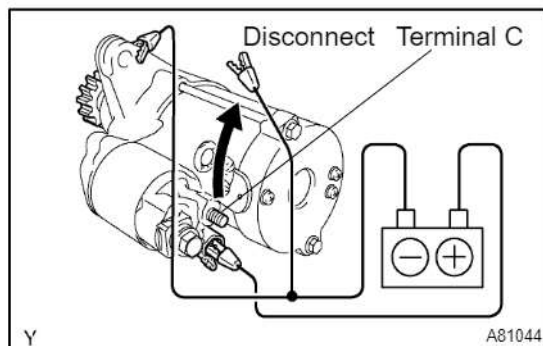
These tests must be performed within 3 to 5 seconds to avoid burning out the coil.



(a) Do the pull-in test.

- (1) Disconnect the lead wire from terminal C.
- (2) Connect the battery to the magnetic switch as shown in the illustration on the left. Check that the clutch pinion gear extends.

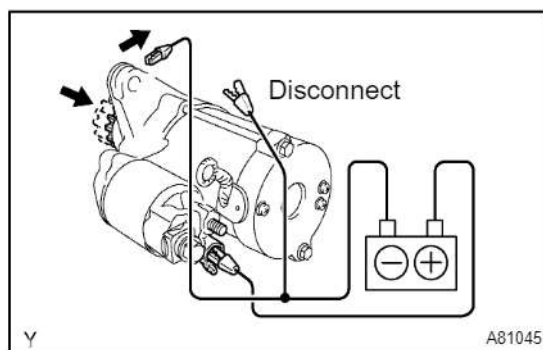
If the clutch pinion gear does not move, replace the magnetic switch Assy.



(b) Do the hold-in test.

- (1) Maintain the battery connections in step (a), but disconnect the negative (-) lead from terminal C. Check that the pinion gear remains extended.

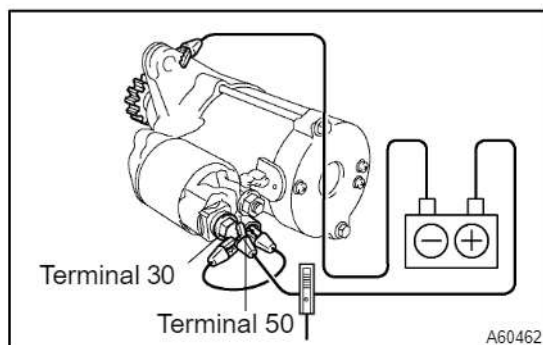
If the clutch pinion gear returns inward, replace the magnetic switch Assy.



(c) Check the clutch pinion gear return.

- (1) Disconnect the negative (-) lead from the switch body. Check that the clutch pinion gear returns.

If the clutch pinion gear does not return, replace the magnetic switch Assy.



(d) Do the no-load performance test.

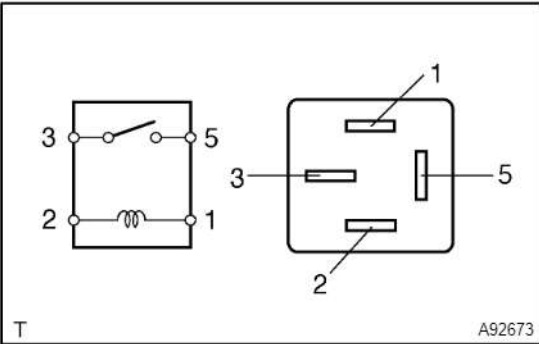
- (1) Connect the lead wire to terminal C. Make sure that the lead is not grounded.

Torque: 10 N·m (102 kgf·cm, 7 ft·lbf)

- (2) Clamp the starter in a vise.
- (3) Connect the battery and an ammeter to the starter as shown in the illustration.

- (4) Check that the starter rotates smoothly and steadily with the clutch pinion gear extended. Check that the ammeter reads the specified current.

Specified current: 90 A or less at 11.5 V



2. INSPECT RELAY (Marking: STARTER)

- (a) Check the resistance of the STARTER relay.

Standard:

Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1Ω (when battery voltage is applied to terminals 1 and 2)

If the result is not as specified, replace the relay.

STARTING SYSTEM (3MZ-FE)

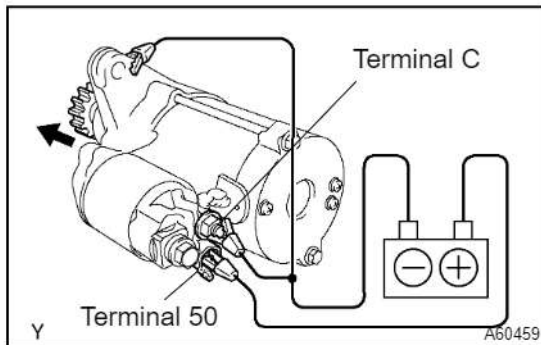
INSPECTION

190VL-01

1. INSPECT STARTER ASSY

NOTICE:

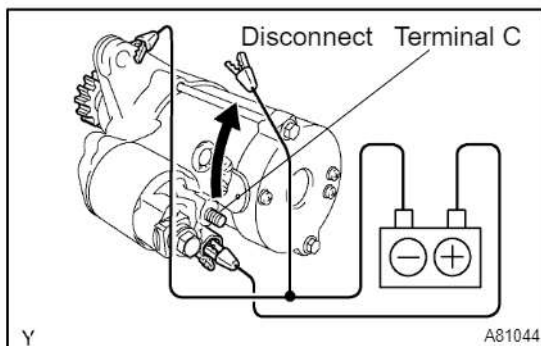
These tests must be performed within 3 to 5 seconds to avoid burning out the coil.



(a) Do the pull-in test.

- (1) Disconnect the lead wire from terminal C.
- (2) Connect the battery to the magnetic switch as shown in the illustration on the left. Check that the clutch pinion gear extends.

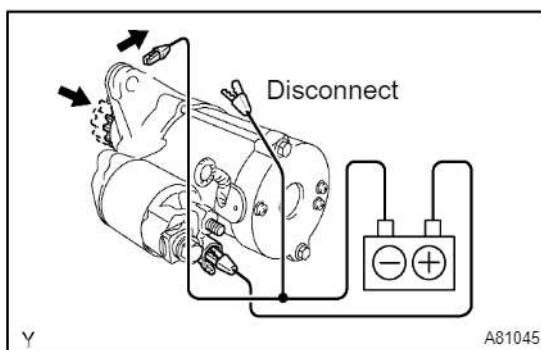
If the clutch pinion gear does not move, replace the magnetic switch assy.



(b) Do the hold-in test.

- (1) Maintain the battery connections in step (a), but disconnect the negative (-) lead from terminal C. Check that the pinion gear remains extended.

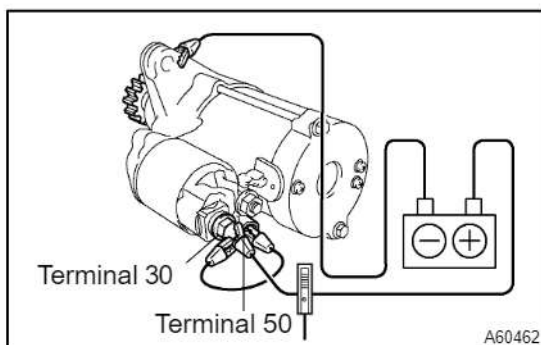
If the clutch pinion gear returns inward, replace the magnetic switch assy.



(c) Check the clutch pinion gear return.

- (1) Disconnect the negative (-) lead from the switch body. Check that the clutch pinion gear returns.

If the clutch pinion gear does not return, replace the magnetic switch assy.



(d) Do the no-load performance test.

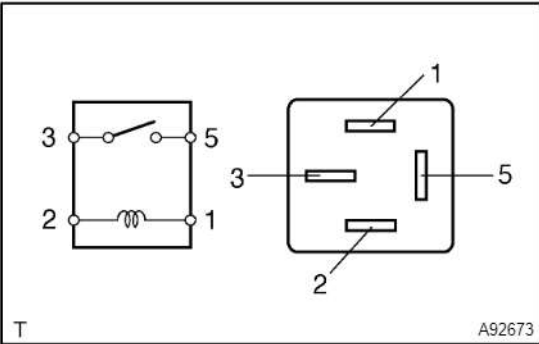
- (1) Connect the lead wire to terminal C. Make sure that the lead is not grounded.

Torque: 10 N·m (102 kgf·cm, 7 ft·lbf)

- (2) Clamp the starter in a vise.
- (3) Connect the battery and an ammeter to the starter as shown in the illustration.

- (4) Check that the starter rotates smoothly and steadily with the clutch pinion gear extended. Check that the ammeter reads the specified current.

Specified current: 90 A or less at 11.5 V



2. INSPECT RELAY (Marking: STARTER)

- (a) Check the resistance of the STARTER relay.

Standard:

Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1Ω (when battery voltage is applied to terminals 1 and 2)

If the result is not as specified, replace the relay.

ON-VEHICLE INSPECTION

1. CHECK BATTERY ELECTROLYTE LEVEL

- (a) Check the electrolyte quantity of each cell.

Maintenance-free battery:

If it is under the lower level, replace the battery.

Except Maintenance-free battery:

If it is under the lower level, add distilled water.

2. Except Maintenance-free battery:

CHECK BATTERY SPECIFIC GRAVITY

- (a) Check the specific gravity of each cell.

Standard specific gravity: 1.25 to 1.29 at 20°C (68°F)

If the specific gravity is less than the specification, charge the battery.

3. Maintenance-free battery:

CHECK BATTERY VOLTAGE

- (a) After the vehicle has run for 20 minutes, stop the engine.
 (b) Turn the ignition switch ON, and operate the headlight, blower fan and defogger for 1 minute.
 (c) Turn the ignition switch OFF.
 (d) Measure the battery voltage.

Standard voltage: 12.5 to 12.9 V at 20°C (68°F)

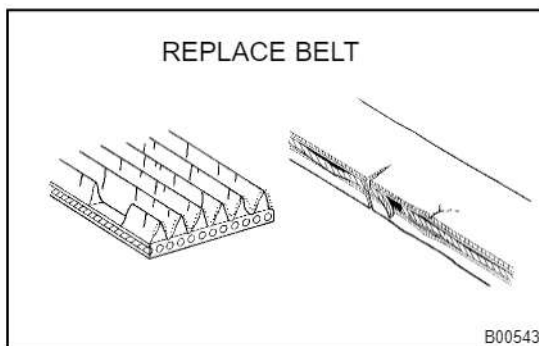
If the voltage is less than specification, charge the battery.

4. CHECK BATTERY TERMINALS, FUSIBLE LINK AND FUSES

- (a) Check that the battery terminals are not loose or corroded.

If the terminals are corroded, clean the terminals.

- (b) Check the fusible link and fuses for resistance of below 1 Ω .



5. INSPECT DRIVE BELT

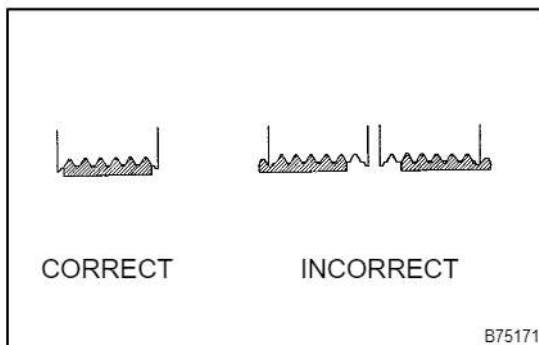
- (a) Check the belt for wear, cracks and other signs of damage.

If any defect is found, replace the drive belt.

HINT:

Replace the drive belt if the following defects are found:

- If the belt has worn out until the wire can be seen.
- If the cracks reach the wire more than one place.
- If the belt has chunks missing from the ribs.



- (b) Check that the belt fits properly in the ribbed grooves.

HINT:

With your hand, confirm that the belt has not slipped out of the groove on the bottom of the pulley.

6. VISUALLY CHECK GENERATOR WIRING

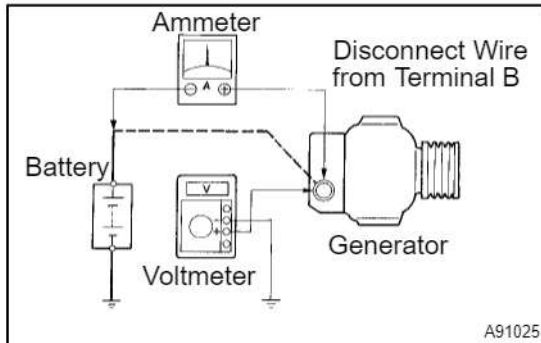
- (a) Check that the wiring is in good condition.

7. LISTEN FOR ABNORMAL NOISES FROM GENERATOR

- (a) Check that there is no abnormal noise from the generator while the engine is running.

8. INSPECT CHARGE WARNING LAMP CIRCUIT

- (a) Turn the ignition switch ON. Check that the charge warning lamp turns on.
 - (b) Start the engine and check that the lamp turns off.
- If the lamp does not operate as specified, troubleshoot the charge warning lamp circuit.



9. INSPECT CHARGING CIRCUIT WITHOUT LOAD

HINT:

If a battery/generator tester is available, connect the tester to the charging circuit according to the manufacturer's instructions.

- (a) If a tester is not available, connect an ammeter and voltmeter to the charging circuit as follows.
 - (1) Disconnect the wire from terminal B of the generator and connect it to the negative (-) lead of the ammeter.
 - (2) Connect the ammeter's positive (+) lead to terminal B of the generator.
 - (3) Connect the voltmeter's positive (+) lead to terminal B of the generator.
 - (4) Ground the voltmeter's negative (-) lead.
- (b) Check the charging circuit.
 - (1) Keep the engine speed at 2,000 rpm, check the reading on the ammeter and voltmeter.

Standard amperage: 10 A or less

Standard voltage: 13.2 to 14.8 V

If the result is not as specified, replace the generator.

10. INSPECT CHARGING CIRCUIT WITH LOAD

- (a) With the engine running at 2,000 rpm, turn on the high-beam headlamps and turn the heater blower switch to the HI position.
- (b) Check the reading on the ammeter.

Standard amperage: 30 A or more

HINT:

- If the ammeter reading is less than the standard amperage, repair the generator.
- If the battery is fully charged, the indication will sometimes be less than the standard amperage.

ON-VEHICLE INSPECTION

1. CHECK BATTERY ELECTROLYTE LEVEL

- (a) Check the electrolyte quantity of each cell.

Maintenance-free battery:

If it is under the lower level, replace the battery.

Except Maintenance-free battery:

If it is under the lower level, add distilled water.

2. Except Maintenance-free battery:

CHECK BATTERY SPECIFIC GRAVITY

- (a) Check the specific gravity of each cell.

Standard specific gravity: 1.25 to 1.29 at 20°C (68°F)

If the specific gravity is less than the specification, charge the battery.

3. Maintenance-free battery:

CHECK BATTERY VOLTAGE

- After the vehicle has run for 20 minutes, stop the engine.
- Turn the ignition switch ON, and operate the headlight, blower fan and defogger for 1 minute.
- Turn the ignition switch OFF.
- Measure the battery voltage.

Standard voltage: 12.5 to 12.9 V at 20°C (68°F)

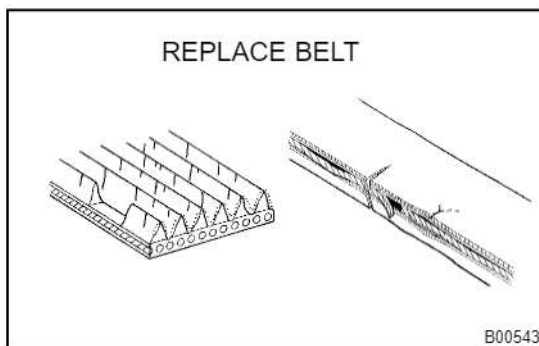
If the voltage is less than specification, charge the battery.

4. CHECK BATTERY TERMINALS, FUSIBLE LINK AND FUSES

- (a) Check that the battery terminals are not loose or corroded.

If the terminals are corroded, clean the terminals.

- (b) Check the fusible link and fuses for resistance of below 1 Ω .



5. INSPECT DRIVE BELT

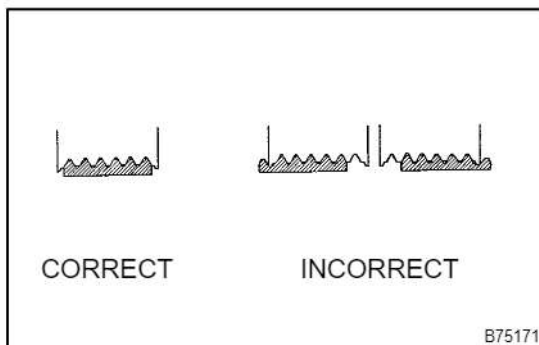
- (a) Check the belt for wear, cracks and other signs of damage.

If any defect is found, replace the drive belt.

HINT:

Replace the drive belt if the following defects are found:

- If the belt has worn out until the wire can be seen.
- If the cracks reach the wire more than one place.
- If the belt has chunks missing from the ribs.



- (b) Check that the belt fits properly in the ribbed grooves.

HINT:

With your hand, confirm that the belt has not slipped out of the groove on the bottom of the pulley.

6. VISUALLY CHECK GENERATOR WIRING

- (a) Check that the wiring is in good condition.

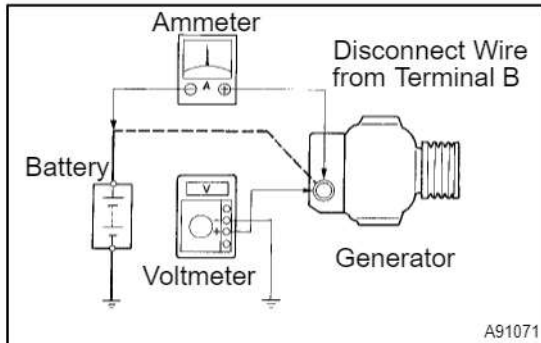
7. LISTEN FOR ABNORMAL NOISES FROM GENERATOR

- (a) Check that there is no abnormal noise from the generator while the engine is running.

8. INSPECT CHARGE WARNING LAMP CIRCUIT

2005 HIGHLANDER REPAIR MANUAL (RM1144U)

- (a) Turn the ignition switch ON. Check that the charge warning lamp turns on.
 - (b) Start the engine and check that the lamp turns off.
- If the lamp does not operate as specified, troubleshoot the charge warning lamp circuit.



9. INSPECT CHARGING CIRCUIT WITHOUT LOAD

HINT:

If a battery/generator tester is available, connect the tester to the charging circuit according to the manufacturer's instructions.

- (a) If a tester is not available, connect an ammeter and voltmeter to the charging circuit as follows.
 - (1) Disconnect the wire from terminal B of the generator and connect it to the negative (-) lead of the ammeter.
 - (2) Connect the ammeter's positive (+) lead to terminal B of the generator.
 - (3) Connect the voltmeter's positive (+) lead to terminal B of the generator.
 - (4) Ground the voltmeter's negative (-) lead.
- (b) Check the charging circuit.
 - (1) Keep the engine speed at 2,000 rpm, check the reading on the ammeter and voltmeter.

Standard amperage: 10 A or less

Standard voltage: 13.2 to 14.8 V

If the result is not as specified, replace the generator.

10. INSPECT CHARGING CIRCUIT WITH LOAD

- (a) With the engine running at 2,000 rpm, turn on the high-beam headlamps and turn the heater blower switch to the HI position.
- (b) Check the reading on the ammeter.

Standard amperage: 30 A or more

HINT:

- If the ammeter reading is less than the standard amperage, repair the generator.
- If the battery is fully charged, the indication will sometimes be less than the standard amperage.

CHARGING SYSTEM (2AZ-FE)

19020-08

PRECAUTION

CAUTION:

- Check that the battery cables are connected to the correct terminals.
- Disconnect the battery cables when the battery is given a quick charge.
- Do not perform tests with a high voltage insulation resistance tester.
- Never disconnect the battery while the engine is running.
- Check that the charging cable is tightened on terminal **B** of the generator and the fuse box.

CHARGING SYSTEM (3MZ-FE)

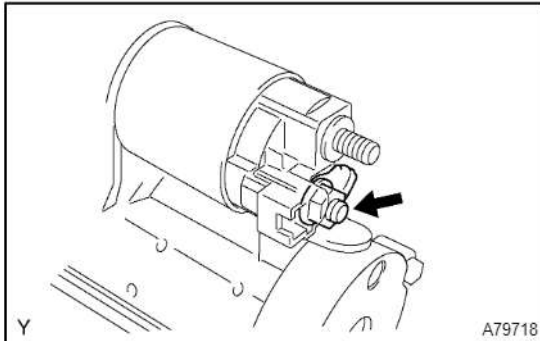
190NY-04

PRECAUTION

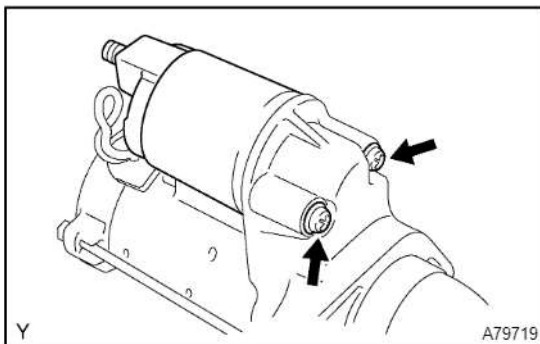
CAUTION:

- Check that the battery cables are connected to the correct terminals.
- Disconnect the battery cables when the battery is given a quick charge.
- Do not perform tests with a high voltage insulation resistance tester.
- Never disconnect the battery while the engine is running.
- Check that the charging cable is tightened on terminal **B** of the generator and the fuse box.

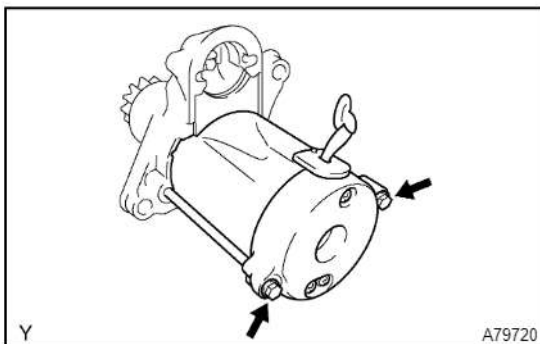
OVERHAUL

**1. REMOVE MAGNETIC SWITCH ASSY**

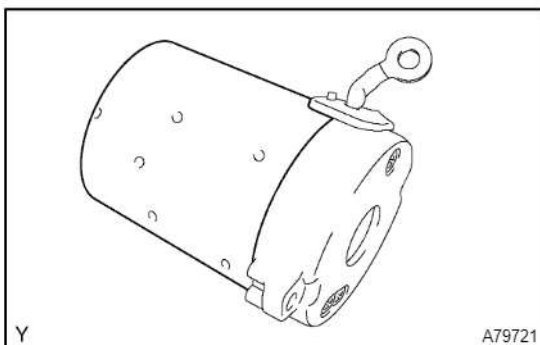
- (a) Remove the nut and disconnect the lead wire from the magnetic switch.



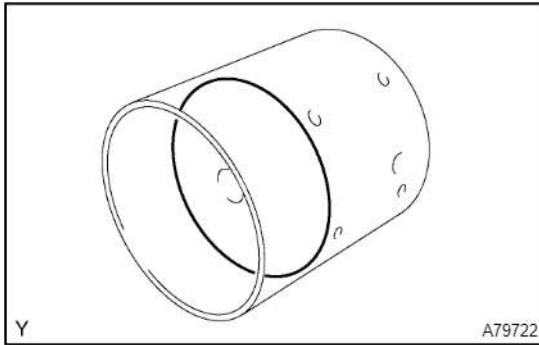
- (b) Remove the 2 screws holding the magnetic switch to the starter drive housing.
 (c) Remove the magnetic switch.
 (d) Remove the return spring and plunger from the drive housing.

**2. REMOVE STARTER YOKE ASSY**

- (a) Remove the 2 through bolts, and pull out the yoke together with the commutator end frame.

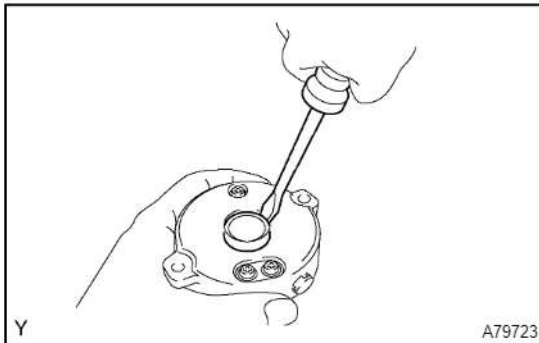


- (b) Remove the yoke from the commutator end frame.



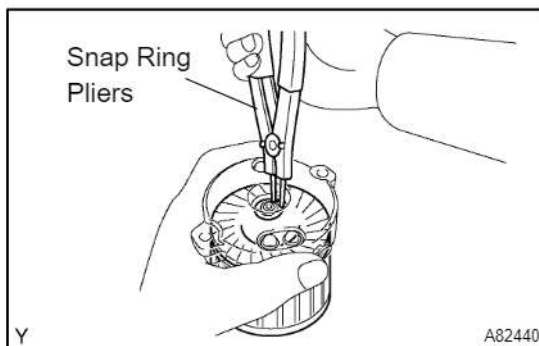
3. REMOVE STARTER AMATURE PLATE

- (a) Remove the armature plate from the yoke.



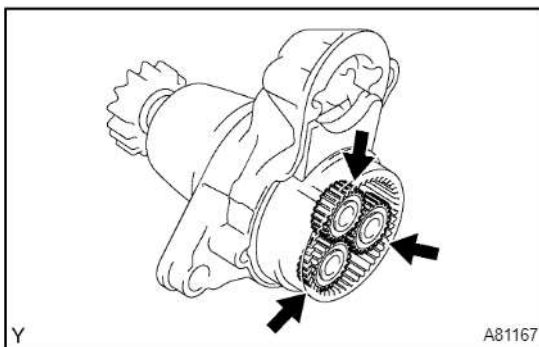
4. REMOVE STARTER COMMUTATOR END FRAME COVER

- (a) Using a screwdriver, remove the frame cover.



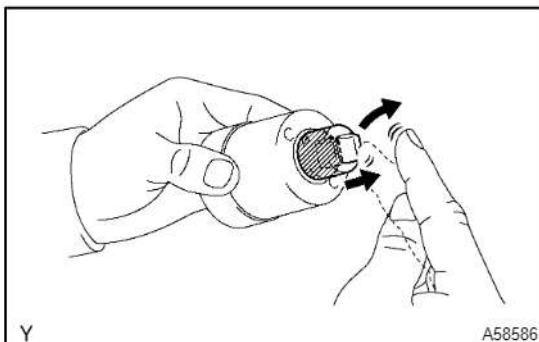
5. REMOVE STARTER ARMATURE ASSY

- (a) Using snap ring pliers, remove the snap ring and plate washer.
 (b) Remove the armature from the commutator end frame.



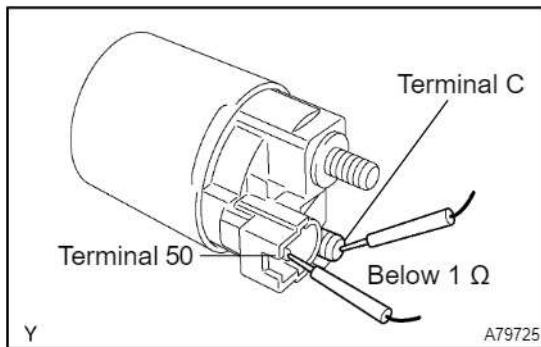
6. REMOVE PLANETARY GEAR

- (a) Remove the 3 planetary gears from the drive housing.

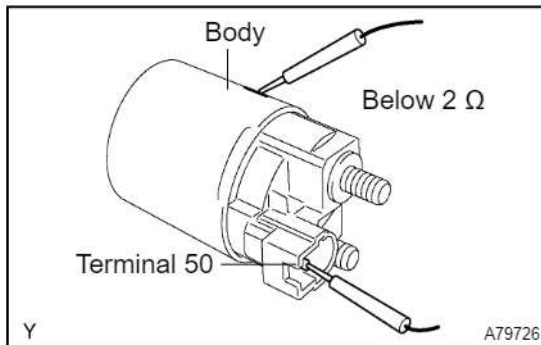


7. INSPECT MAGNETIC SWITCH ASSY

- (a) Check the plunger.
 (1) Push in the plunger and check that it returns quickly to its original position.
 If necessary, replace the magnetic switch assy.

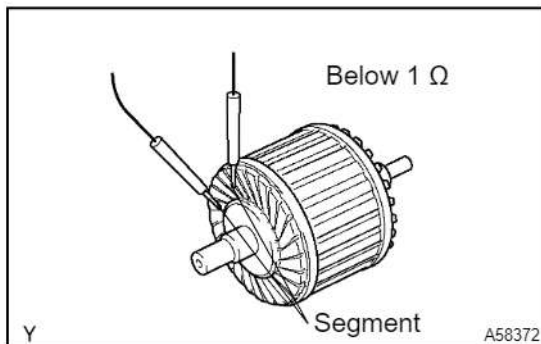


- (b) Check if the pull-in coil has an open circuit.
- (1) Check the resistance between terminals 50 and C.
- Standard: Below 1 Ω**
- If the result is not as specified, replace the magnetic switch assy.

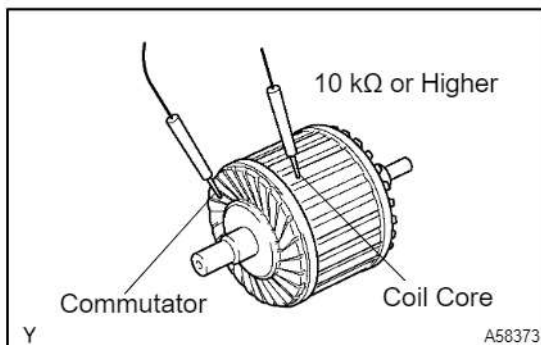


- (c) Check if the hold-in coil has an open circuit.
- (1) Check the resistance between terminal 50 and the switch body.
- Standard: Below 2 Ω**
- If the result is not as specified, replace the magnetic switch assy.

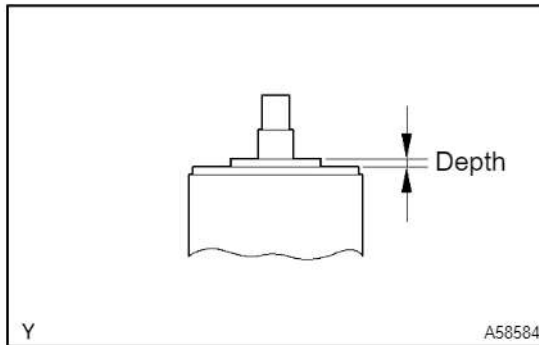
8. INSPECT STARTER ARMATURE ASSY



- (a) Check the commutator for contamination and burns on its surface.
- If the surface is dirty or burnt, correct it with sandpaper (No. 400) or a lathe.
- (b) Check if the commutator has an open circuit.
- (1) Check the resistance between the segments of the commutator.
- Standard: Below 1 Ω**
- If the result is not as specified, replace the armature assy.

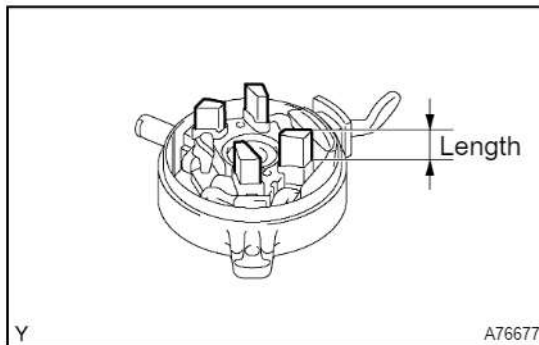


- (c) Check if the commutator is grounded.
- (1) Check the resistance between the commutator and armature coil core.
- Standard: 10 k Ω or higher**
- If the result is not as specified, replace the armature assy.



- (d) Using a vernier caliper, measure the commutator's depth.
Specified depth: 3.1 mm (0.122 in.)
Maximum depth: 3.8 mm (0.150 in.)

If the depth is greater than the maximum, replace the starter armature.



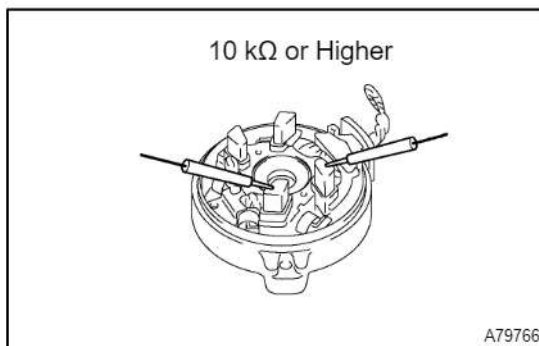
9. INSPECT STARTER COMMUTATOR END FRAME ASSY

- (a) Using a vernier caliper, measure the brush length.

Standard length: 9.0 mm (0.354 in.)

Minimum length: 4.0 mm (0.157 in.)

If the length is less than the minimum, replace the end frame assy.

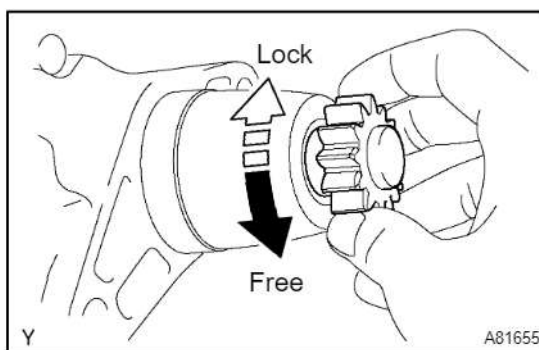


- (b) Check the brush insulation.

- (1) Check the resistance between the positive (+) and negative (-) brush.

Standard: 10 kΩ or higher

If the result is not as specified, repair or replace the end frame assy.

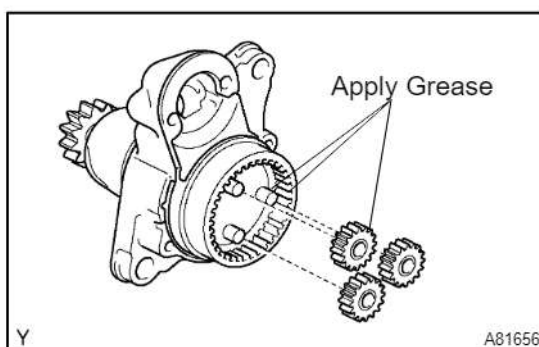


10. INSPECT STARTER DRIVE HOUSING ASSY

- (a) Check the starter clutch.

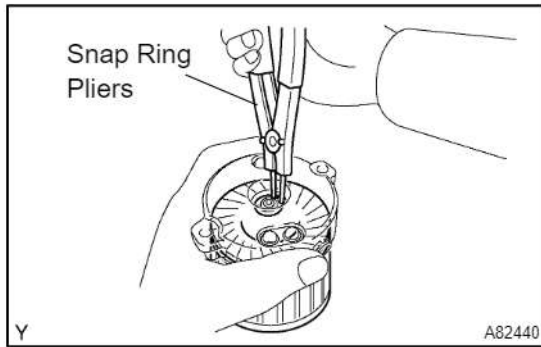
- (1) Rotate the clutch pinion gear counterclockwise and check that it turns freely. Try to rotate the clutch pinion gear clockwise and check that it locks.

If necessary, replace the drive housing assy.

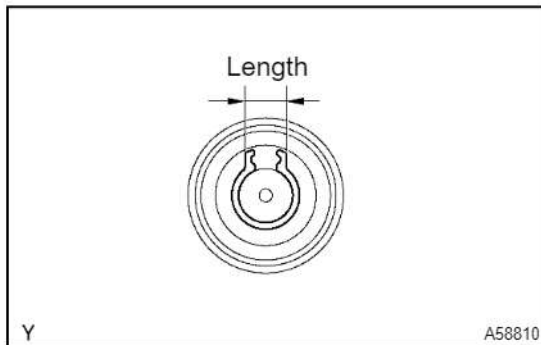


11. INSTALL PLANETARY GEAR

- (a) Apply grease to the planetary gears and pin parts of the planetary shaft.
 (b) Install the 3 planetary gears.

**12. INSTALL STARTER ARMATURE ASSY**

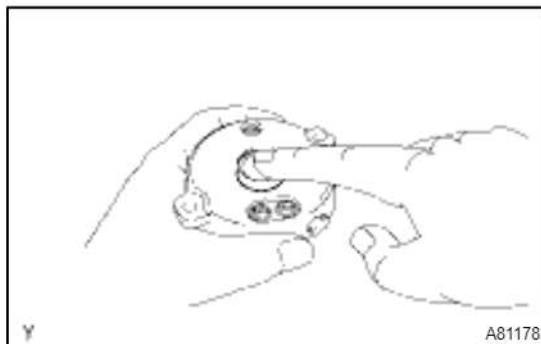
- (a) Apply grease to the plate washer and the armature shaft.
- (b) Install the armature to the starter commutator end frame.
- (c) Using snap ring pliers, install the plate washer and a new snap ring.



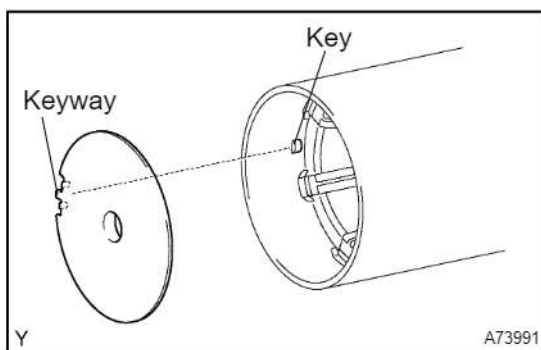
- (d) Using a vernier caliper, measure the length of the snap ring.

Maximum length: 5.0 mm (0.197 in.)

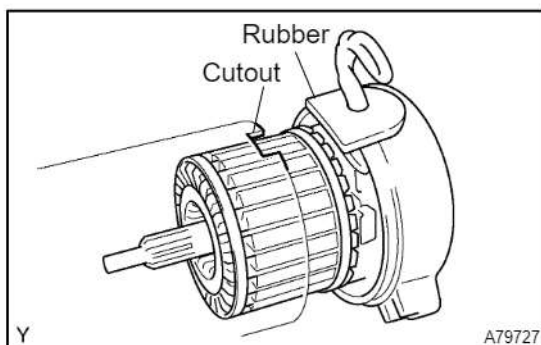
If the length is greater than the maximum, replace it with a new snap ring.

**13. INSTALL STARTER COMMUTATOR END FRAME COVER**

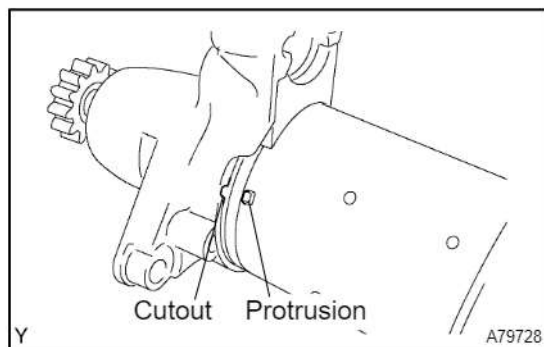
- (a) Install the end frame cover to the commutator end frame.

**14. INSTALL STARTER ARMATURE PLATE**

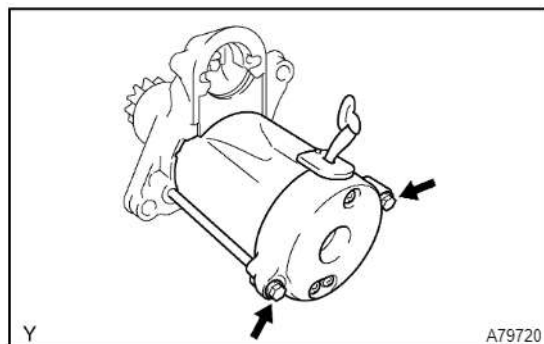
- (a) Align the keyway of the starter plate with the key inside the field frame, and install the plate.

**15. INSTALL STARTER COMMUTATOR END FRAME ASSY**

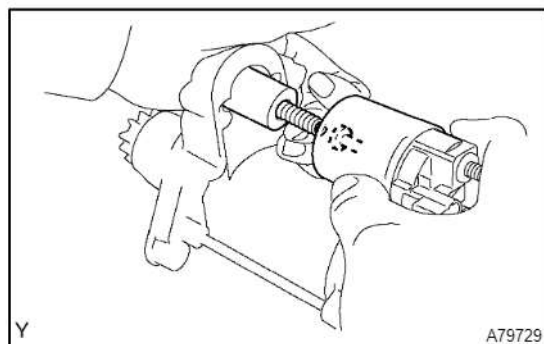
- (a) Align the rubber of the end frame with the cutout of the yoke.
- (b) Install the end frame to the yoke.

**16. INSTALL STARTER YOKE ASSY**

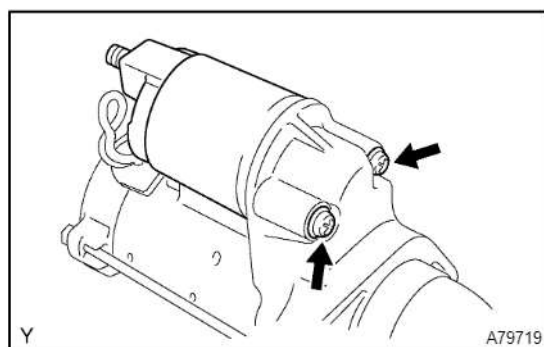
- (a) Align the protrusion of the yoke with the cutout of the drive housing.



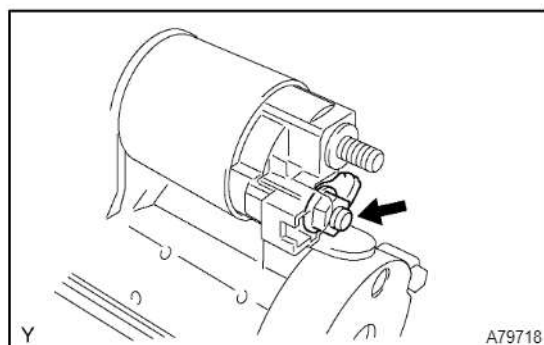
- (b) Install the yoke with the 2 through bolts.
Torque: 6.0 N·m (61 kgf·cm, 53 in.·lbf)

**17. INSTALL MAGNETIC SWITCH ASSY**

- (a) Apply grease to the plunger and the hook.
(b) Hang the plunger hook of the magnetic switch to the drive lever.
(c) Install the plunger and return spring.

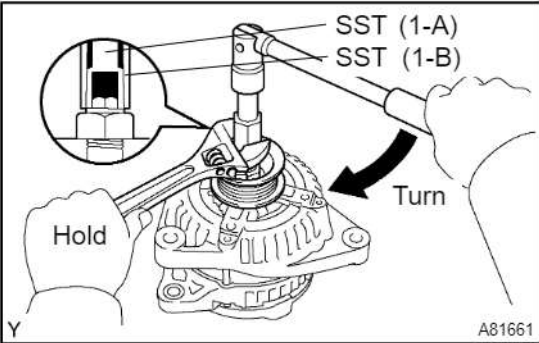
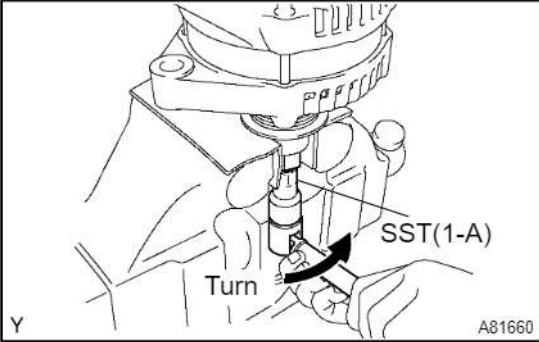
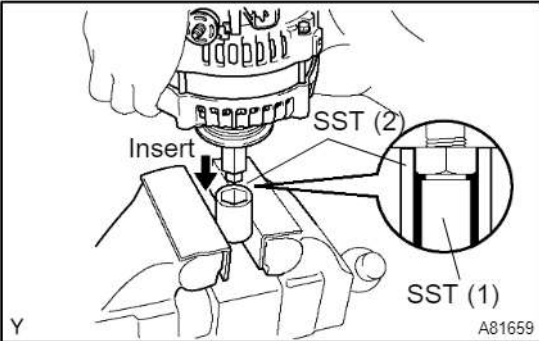
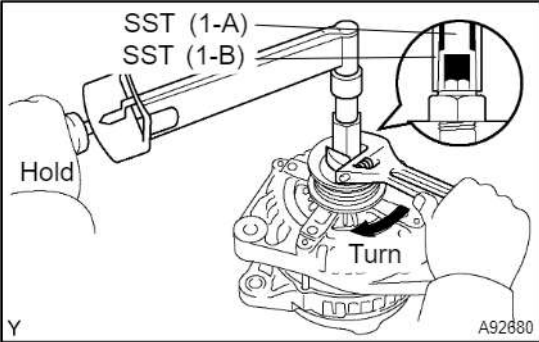


- (d) Install the magnetic switch with the 2 screws.
Torque: 7.5 N·m (76 kgf·cm, 66 in.·lbf)



- (e) Connect the lead wire to the magnetic switch with the nut.
Torque: 10 N·m (102 kgf·cm, 7 ft.·lbf)

OVERHAUL



1. REMOVE GENERATOR PULLEY

SST 09820-63010 (09820-06010, 09820-06020)

HINT:

SST (1-A, B)	09820-06010
SST (2)	09820-06020

- (a) Hold SST (1-A) with a torque wrench, and tighten SST (1-B) clockwise to the specified torque.

Torque: 39 N·m (400 kgf·cm, 29 ft·lbf)

NOTICE:

Check that SST is secured to the rotor shaft.

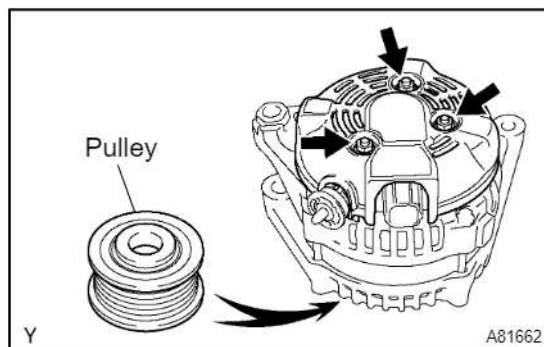
- (b) Mount SST (2) in a vise.
(c) Insert SST (1-A, B) into SST (2), and attach the pulley nut to SST (2).

- (d) To loosen the pulley nut, turn SST (1-A) in the direction shown in the illustration.

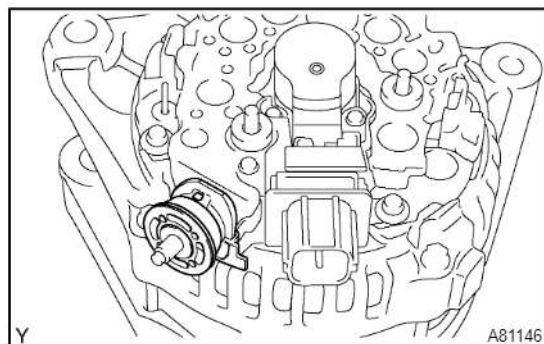
NOTICE:

To prevent damage to the rotor shaft, do not loosen the pulley nut more than one-half turn.

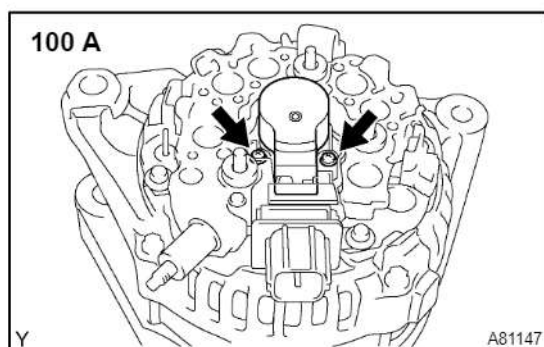
- (e) Remove the generator from SST (2).
(f) Turn SST (1-B) and remove SST (1-A, B).
(g) Remove the pulley nut and pulley.

**2. REMOVE GENERATOR REAR END COVER**

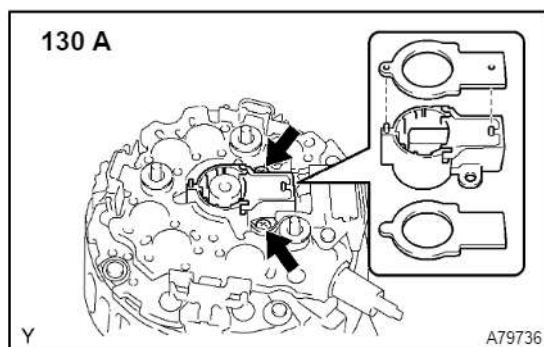
- (a) Place the generator on the pulley.
- (b) Remove the 3 nuts and rear end cover.

**3. REMOVE TERMINAL INSULATOR**

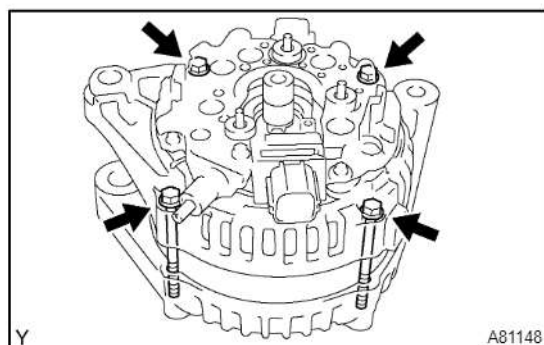
- (a) Remove the terminal insulator from the rectifier end frame.

**4. REMOVE GENERATOR BRUSH HOLDER ASSY**

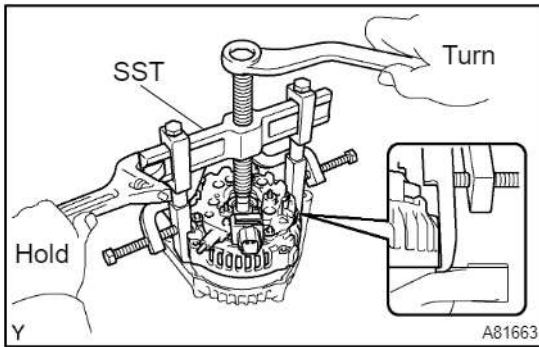
- (a) 100 A:
Remove the 2 screws and brush holder.



- (b) 130 A:
Remove the brush holder.
 - (1) Remove the plate seal.
 - (2) Remove the 2 screws and brush holder.
 - (3) Remove the plate seal.

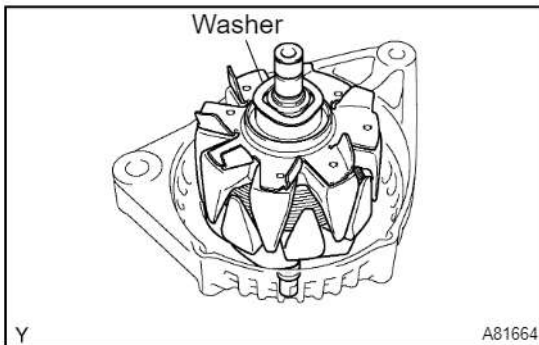
**5. REMOVE GENERATOR COIL ASSY**

- (a) Remove the 4 bolts.



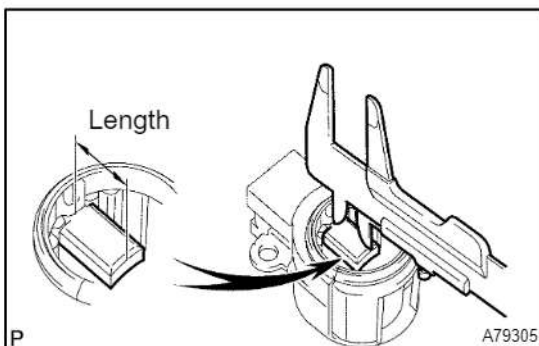
- (b) Using SST, remove the rectifier end frame.

SST 09950-40011 (09951-04020, 09952-04010, 09953-04020, 09954-04010, 09955-04071, 09957-04010, 09958-04011)



6. REMOVE GENERATOR ROTOR ASSY

- (a) Remove the washer and rotor.



7. INSPECT GENERATOR BRUSH HOLDER ASSY

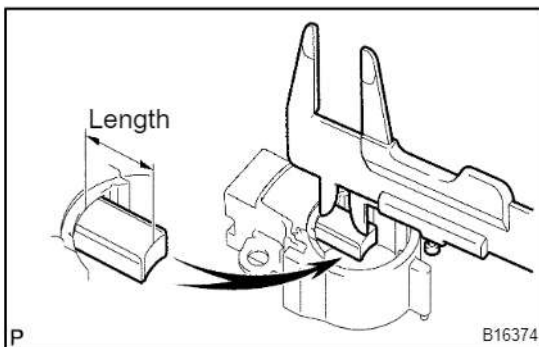
- (a) 100 A:

Using a vernier caliper, measure the exposed brush length.

Standard exposed brush length: 10.5 mm (0.413 in.)

Minimum exposed brush length: 4.5 mm (0.177 in.)

If the exposed brush length is less than the minimum, replace the brush holder assy.



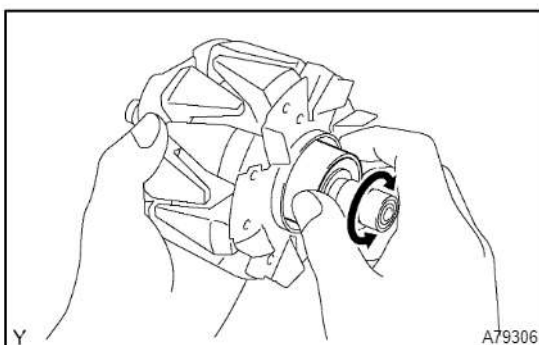
- (b) 130 A:

Using a vernier caliper, measure the exposed brush length.

Standard exposed brush length: 10.5 mm (0.413 in.)

Minimum exposed brush length: 4.5 mm (0.177 in.)

If the exposed brush length is less than the minimum, replace the brush holder assy.



8. INSPECT GENERATOR ROTOR ASSY

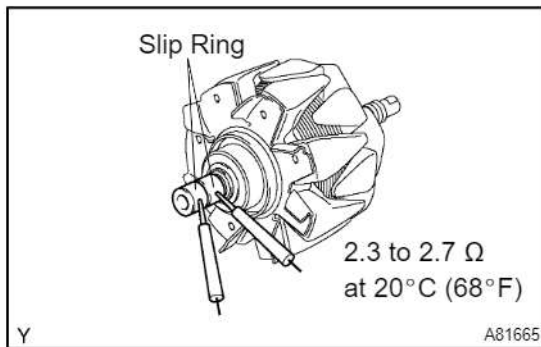
- (a) Check that the bearing is not rough or worn.

100 A:

If necessary, replace the rotor assy.

130 A:

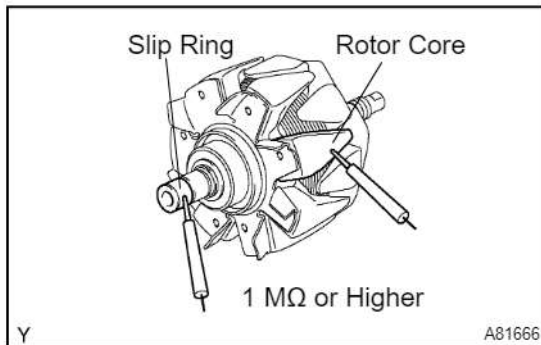
If necessary, replace the rotor bearing.



- (b) Check if the rotor has open circuit.
(1) Measure the resistance between the slip ring.

Resistance:**2.3 to 2.7 Ω at 20°C (68°F)**

If the resistance is not as specified, replace the rotor assy.

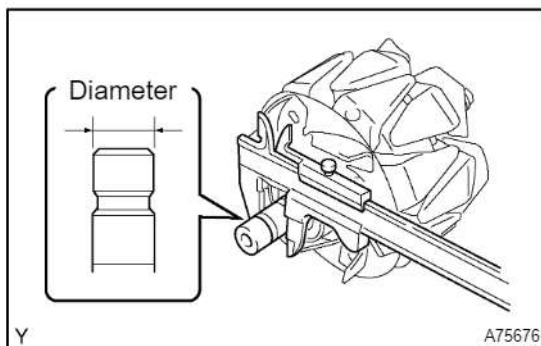


- (c) Check the rotor for ground.
(1) Measure the resistance between the slip ring and rotor core.

Standard: 1 M Ω or higher

If the resistance is not as specified, replace the rotor assy.

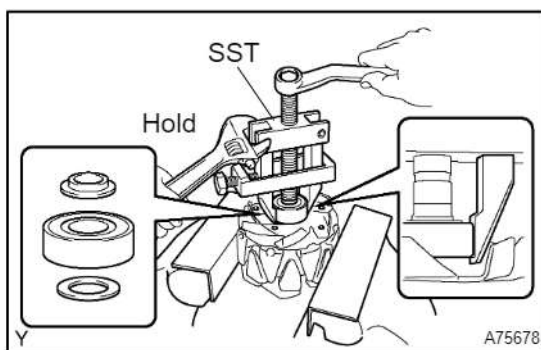
- (d) Check that the slip rings are not rough or scored.
If rough or scored, replace the rotor assy.



- (e) Using vernier calipers, measure the slip ring diameter.

Standard diameter:**14.2 to 14.4 mm (0.559 to 0.567 in.)****Minimum diameter: 14.0 mm (0.551 in.)**

If the diameter is less than the minimum, replace the rotor assy.

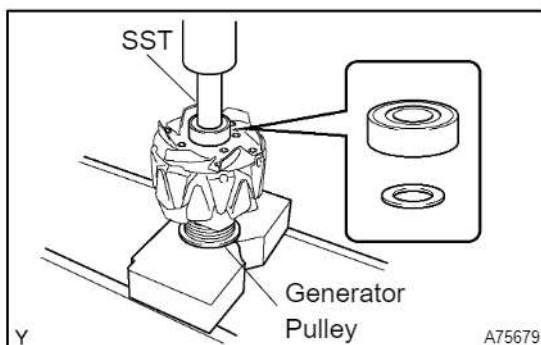
**9. 130 A:****REMOVE GENERATOR ROTOR BEARING**

- (a) Using SST, remove the bearing cover (outside) and bearing.

SST 09820-00021

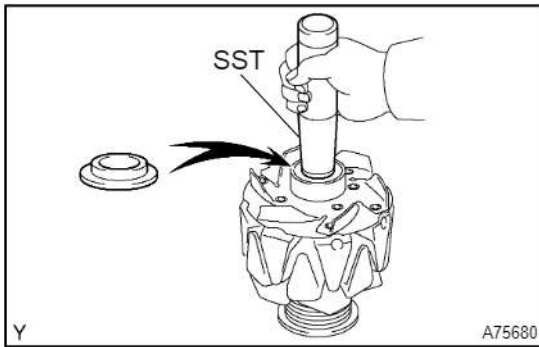
NOTICE:**Be careful not to damage the fan.**

- (b) Remove the bearing cover (inside).

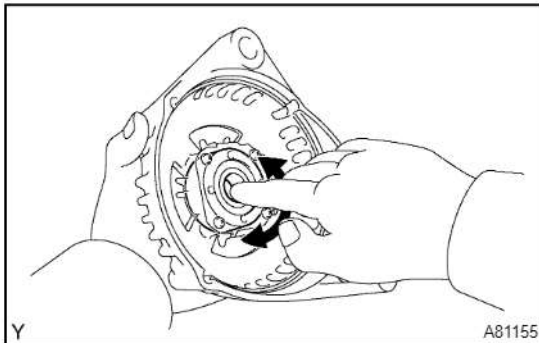
**10. 130 A:****INSTALL GENERATOR ROTOR BEARING**

- (a) Place the generator rotor on the generator pulley.
(b) Install the bearing cover (inside).
(c) Using SST and a press, press in a new bearing.

SST 09820-00031

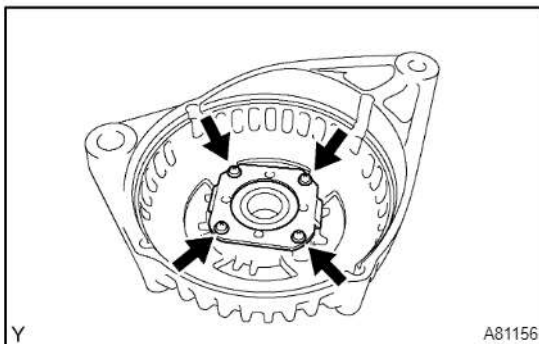


- (d) Using SST, push in the bearing cover (outside).
SST 09285-76010



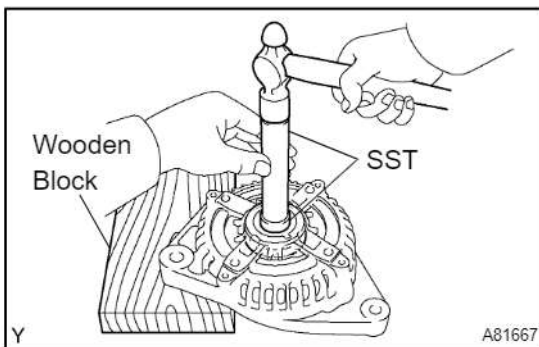
11. INSPECT GENERATOR DRIVE END FRAME BEARING

- (a) Check that the bearing is not rough or worn.
If necessary, replace the bearing.

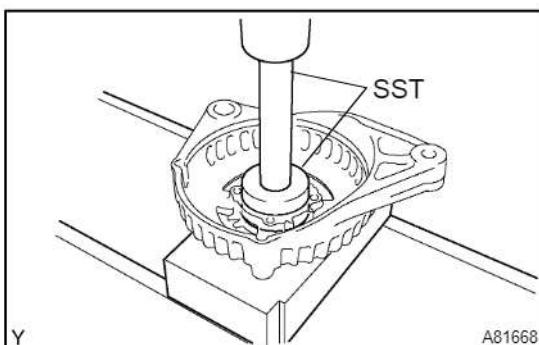


12. REMOVE GENERATOR DRIVE END FRAME BEARING

- (a) Remove the 4 screws and retainer plate.

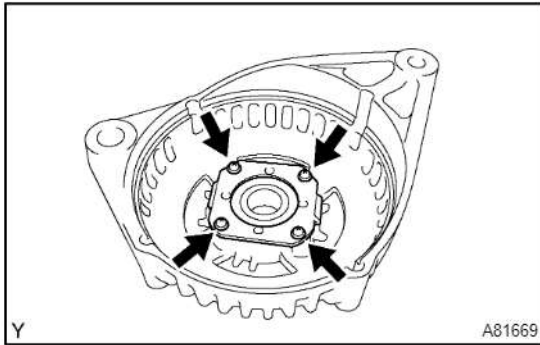


- (b) Using SST and a wooden block, tap out the bearing.
SST 09950-60010 (09951-00250), 09950-70010 (09951-07100)

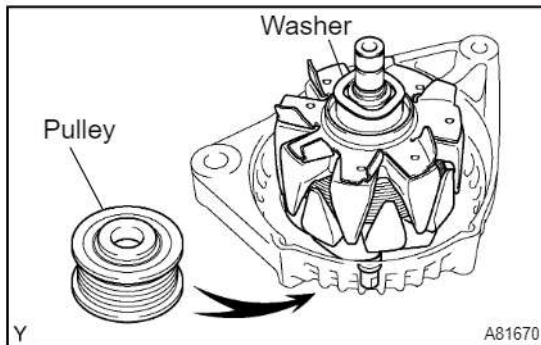


13. INSTALL GENERATOR DRIVE END FRAME BEARING

- (a) Using SST and a press, press in a new bearing.
SST 09950-60010 (09951-00470), 09950-70010 (09951-07100)

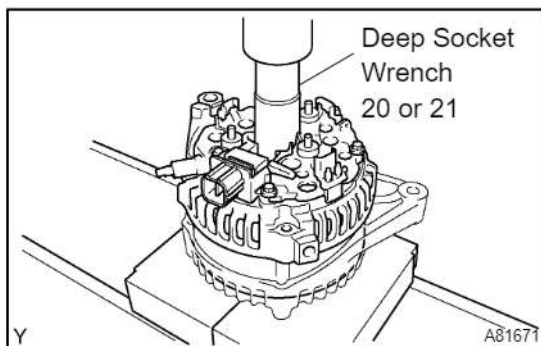


- (b) Install the retainer plate with the 4 screws.
Torque: 2.3 N·m (23 kgf·cm, 20 in·lbf)



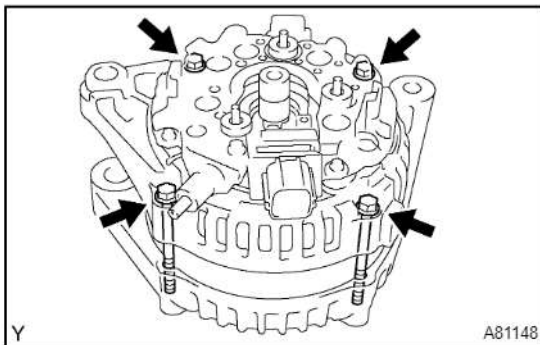
14. INSTALL GENERATOR ROTOR ASSY

- (a) Place the generator drive end frame on the pulley.
 (b) Install the rotor and washer.

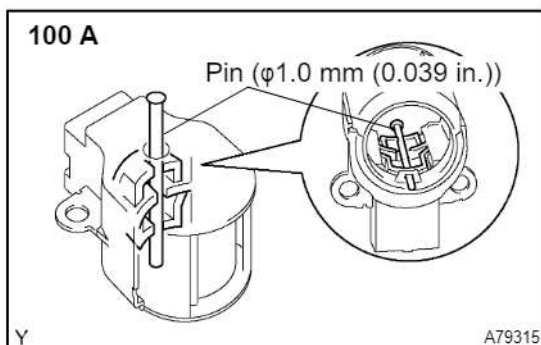


15. INSTALL GENERATOR RECTIFIER END FRAME

- (a) 100 A:
 Using deep socket wrench 21 and a press, press in the coil carefully.
 (b) 130 A:
 Using deep socket wrench 20 and a press, press in the coil carefully.

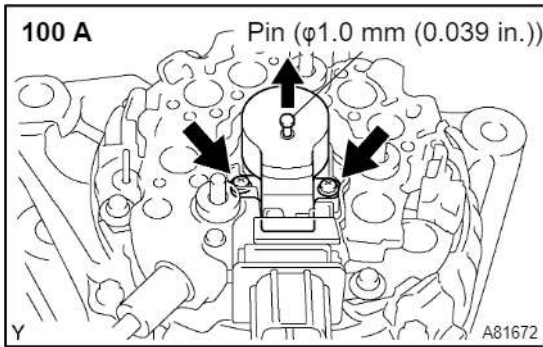


- (c) Tighten the 4 bolts.
Torque: 5.8 N·m (59 kgf·cm, 51 in·lbf)



16. INSTALL GENERATOR BRUSH HOLDER ASSY

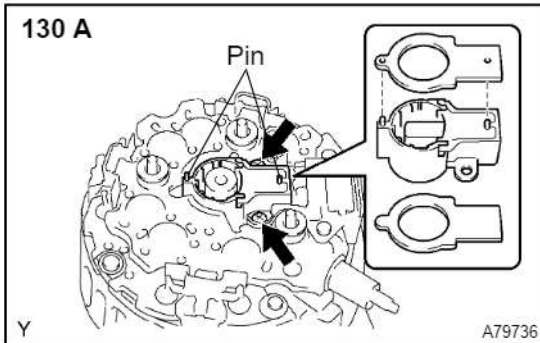
- (a) 100 A:
 Install the brush holder.
 (1) While pushing the 2 brushes to inside the brush holder, insert a pin (φ1.0 mm (0.039 in.)) into the brush holder hole.



- (2) Install the brush holder with the 2 screws.

Torque: 1.8 N·m (18 kgf·cm, 16 in.·lbf)

- (3) Pull out the pin (φ1.0 mm (0.039 in.)) from the brush holder.



- (b) 130 A:

Install the brush holder

- (1) Install the plate seal (inside).

- (2) Place the brush holder with the pin facing upward.

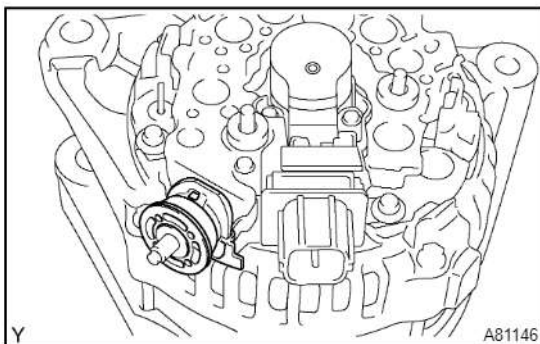
NOTICE:

Be careful of the generator brush holder installing direction.

- (3) Tighten the 2 screws.

Torque: 1.8 N·m (18 kgf·cm, 16 in.·lbf)

- (4) Align the pins of the brush holder with the holes of the plate seal (outside), and install the plate seal (outside).

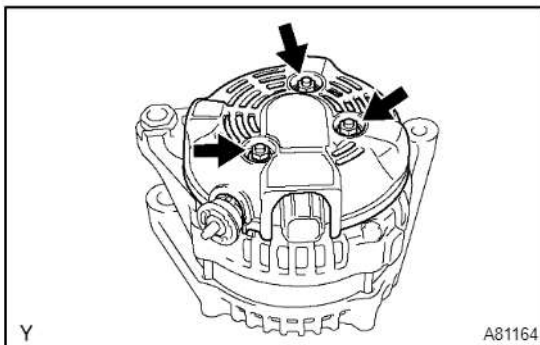


17. INSTALL TERMINAL INSULATOR

- (a) Install the terminal insulator.

NOTICE:

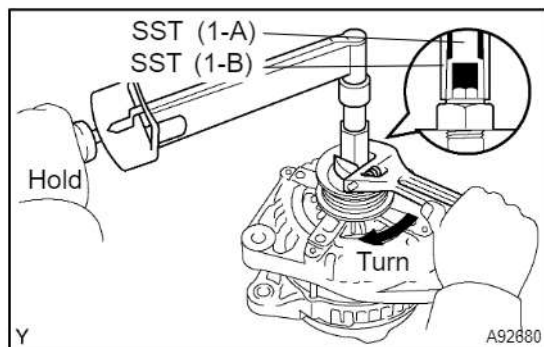
pay attention to the mounting direction of the terminal insulator.



18. INSTALL GENERATOR REAR END COVER

- (a) Install the rear end cover with the 3 nuts.

Torque: 4.6 N·m (47 kgf·cm, 41 in.·lbf)

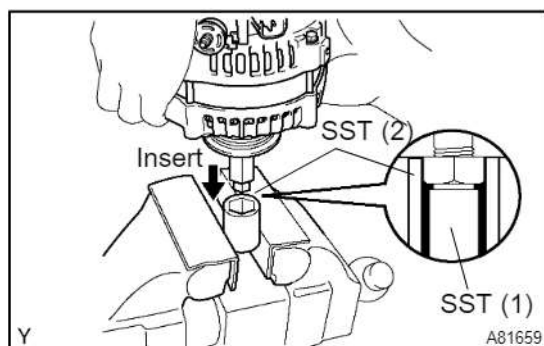
**19. INSTALL GENERATOR PULLEY**

SST 09820-63010 (09820-06010, 09820-06020)

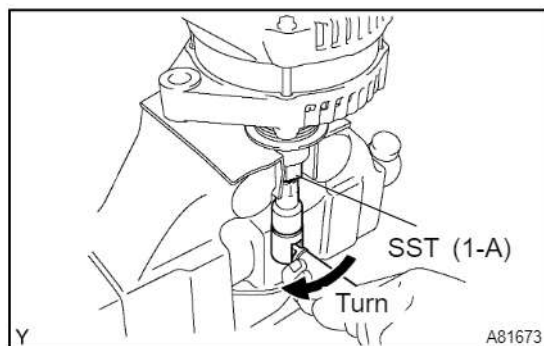
HINT:

SST 1-A and B	09820-06010
SST 2	09820-06020

- Install the pulley to the rotor shaft by tightening the generator pulley nut by hand.
- Hold SST (1-A) with a torque wrench, and tighten SST (1-B) clockwise with the specified torque.

Torque: 39 N·m (400 kgf·cm, 29 ft·lbf)**NOTICE:****Check that SST is secured to the rotor shaft.**

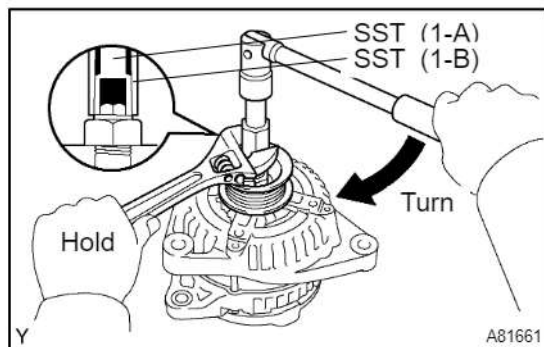
- Mount SST (2) in a vise.
- Insert SST (1-A) and (B) into SST (2), and attach the generator pulley nut to SST (2)



- Tighten the pulley nut by turning SST (1-A) in the direction shown in the illustration.

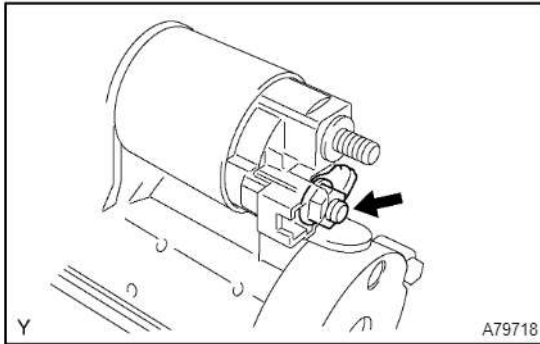
Torque: 111 N·m (1,125 kgf·cm, 81 ft·lbf)

- Remove the generator from SST (2).



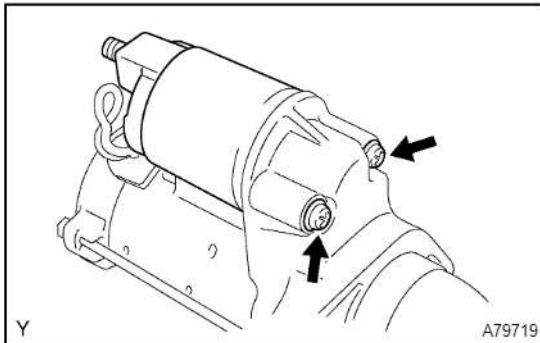
- Turn SST (1-B), and remove SST (1-A), (B).
- Turn the pulley, and check that the pulley moves smoothly.

OVERHAUL

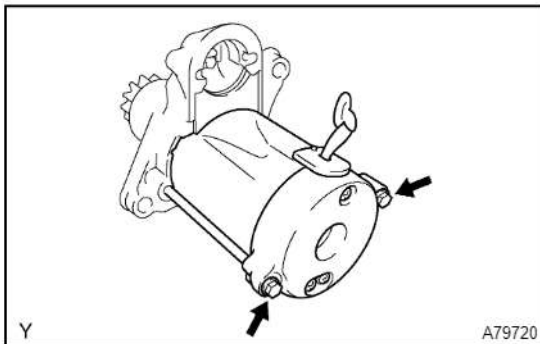


1. REMOVE MAGNETIC SWITCH ASSY

- (a) Remove the nut and disconnect the lead wire from the magnetic switch.

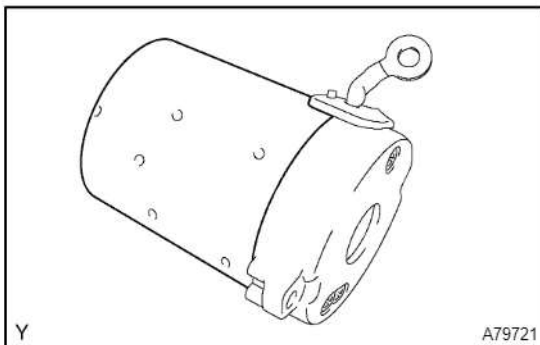


- (b) Remove the 2 screws holding the magnetic switch to the starter drive housing.
- (c) Remove the magnetic switch.
- (d) Remove the return spring and plunger from the drive housing.

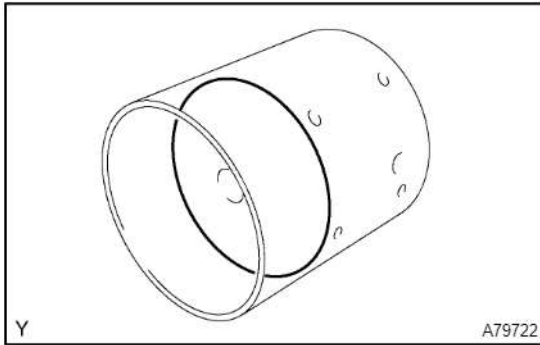


2. REMOVE STARTER YOKE ASSY

- (a) Remove the 2 through bolts, and pull out the yoke together with the commutator end frame.

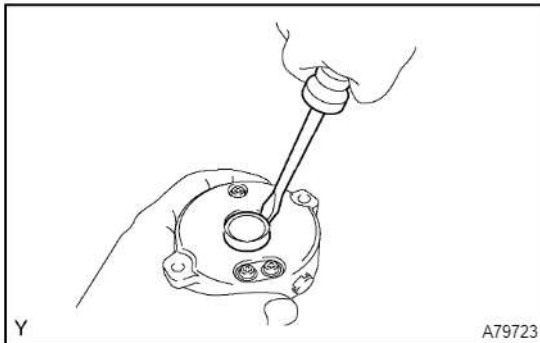


- (b) Remove the yoke from the commutator end frame.



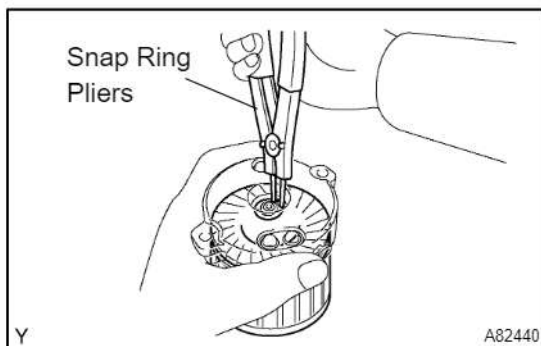
3. REMOVE STARTER ARMATURE PLATE

- (a) Remove the armature plate from the field frame.



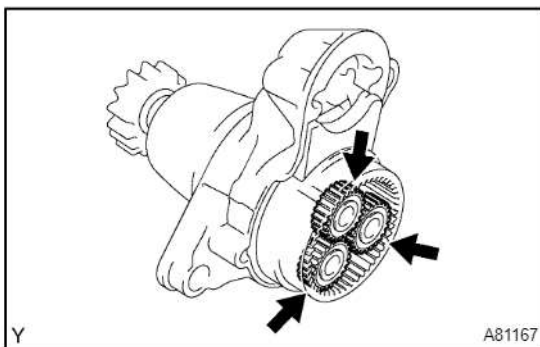
4. REMOVE STARTER COMMUTATOR END FRAME COVER

- (a) Using a screwdriver, remove the frame cover.



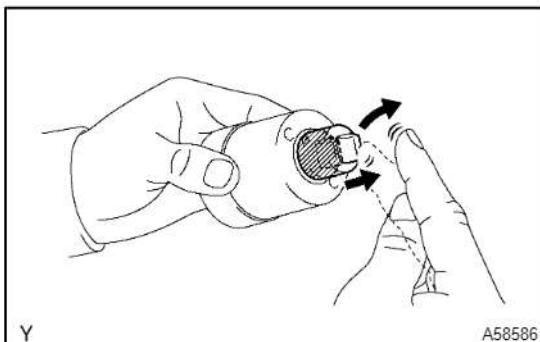
5. REMOVE STARTER ARMATURE ASSY

- (a) Using snap ring pliers, remove the snap ring and plate washer.
(b) Remove the armature from the commutator end frame.



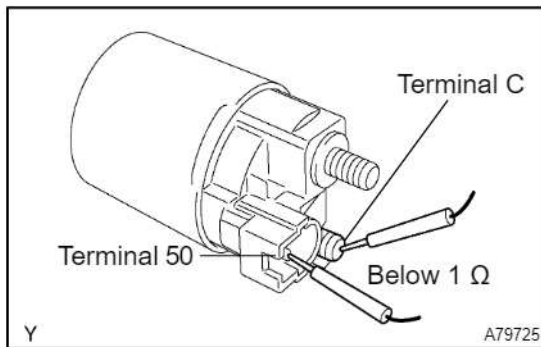
6. REMOVE PLANETARY GEAR

- (a) Remove the 3 planetary gears from the drive housing.

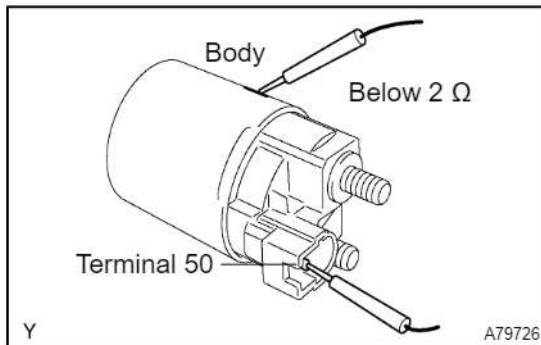


7. INSPECT MAGNETIC SWITCH ASSY

- (a) Check the plunger.
(1) Push in the plunger and check that it returns quickly to its original position.
If necessary, replace the magnetic switch assy.

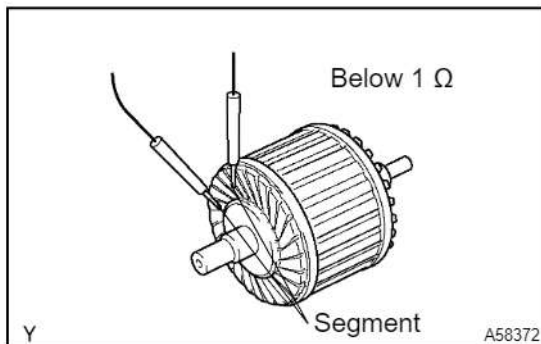


- (b) Check if the pull-in coil has an open circuit.
 (1) Check the resistance between terminals 50 and C.
Standard: Below 1 Ω
 If the result is not as specified, replace the magnetic switch assy.

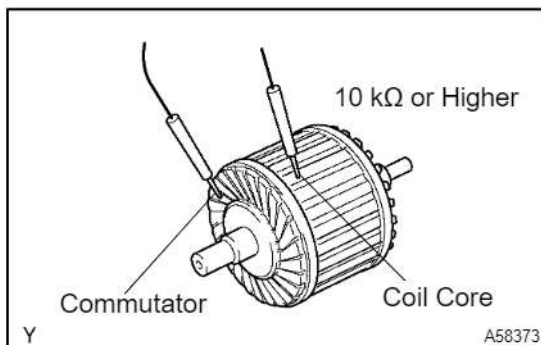


- (c) Check if the hold-in coil has an open circuit.
 (1) Check the resistance between terminal 50 and the switch body.
Standard: Below 2 Ω
 If the the result is not as specified, replace the magnetic switch assy.

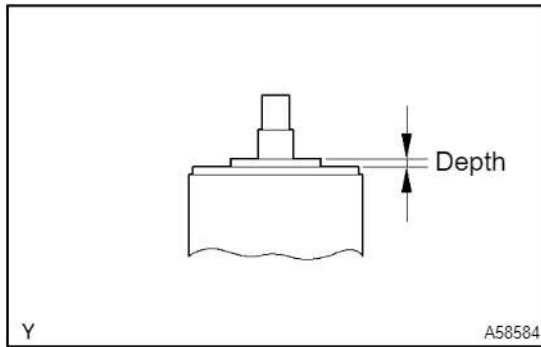
8. INSPECT STARTER ARMATURE ASSY



- (a) Check the commutator for contamination and burns on its surface.
 If the surface is dirty or burnt, correct it with sandpaper (No. 400) or a lathe.
- (b) Check if the commutator has an open circuit.
 (1) Check the resistance between the segments of the commutator.
Standard: Below 1 Ω
 If the result is not as specified, replace the armature assy.

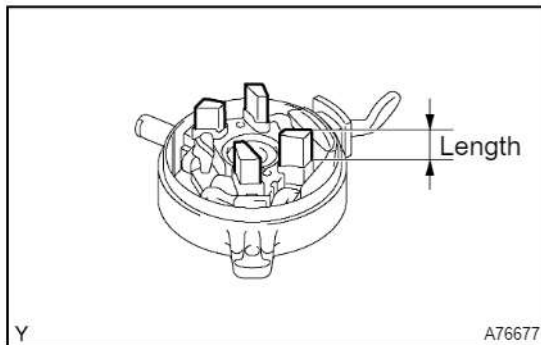


- (c) Check if the commutator is grounded.
 (1) Check the resistance between the commutator and armature coil core.
Standard: 10 k Ω or higher
 If the result is not as specified, replace the armature assy.



- (d) Using a vernier caliper, measure the commutator's depth.
Specified depth: 3.1 mm (0.122 in.)
Maximum depth: 3.8 mm (0.150 in.)

If the depth is greater than the maximum, replace the starter armature.



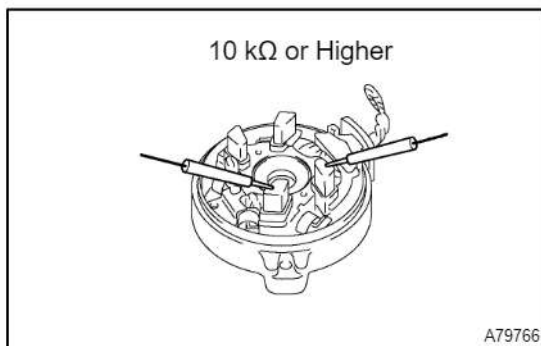
9. INSPECT STARTER COMMUTATOR END FRAME ASSY

- (a) Using a vernier caliper, measure the brush length.

Standard length: 9.0 mm (0.354 in.)

Minimum length: 4.0 mm (0.157 in.)

If the length is less than the minimum, replace the end frame assy.

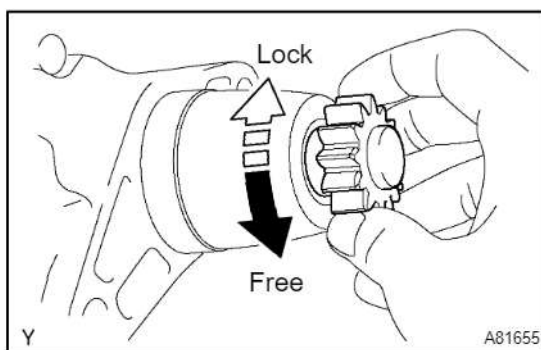


- (b) Check the brush insulation.

- (1) Check the resistance between the positive (+) and negative (-) brush.

Standard: 10 kΩ or higher

If the result is not as specified, repair or replace the end frame assy.

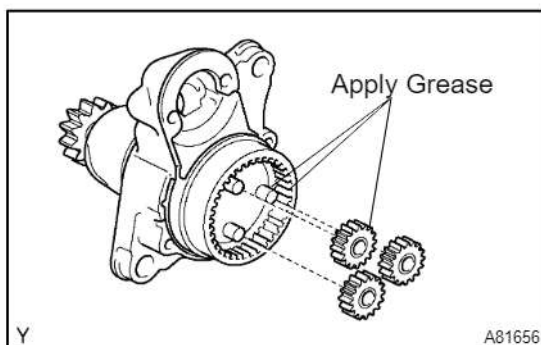


10. INSPECT STARTER DRIVE HOUSING ASSY

- (a) Check the starter clutch.

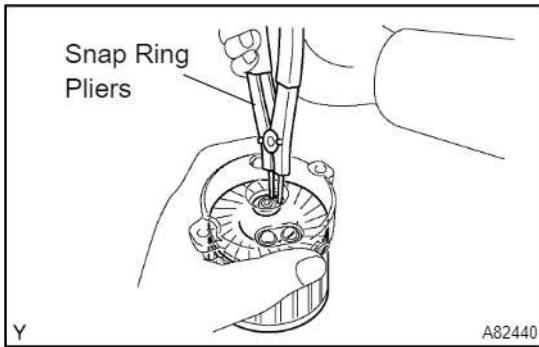
- (1) Rotate the clutch pinion gear counterclockwise and check that it turns freely. Try to rotate the clutch pinion gear clockwise and check that it locks.

If necessary, replace the drive housing assy.

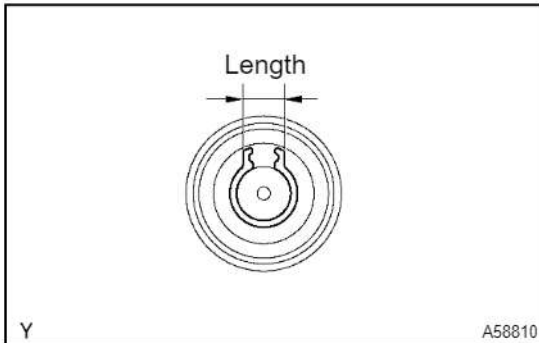


11. INSTALL PLANETARY GEAR

- (a) Apply grease to the planetary gears and pin parts of the planetary shaft.
 (b) Install the 3 planetary gears.

**12. INSTALL STARTER ARMATURE ASSY**

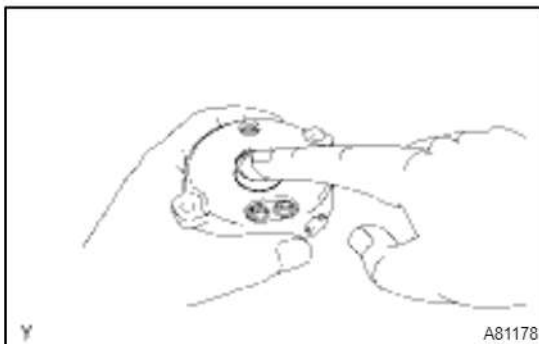
- (a) Apply grease to the plate washer and the armature shaft.
- (b) Install the armature to the starter commutator end frame.
- (c) Using snap ring pliers, install the plate washer and a new snap ring.



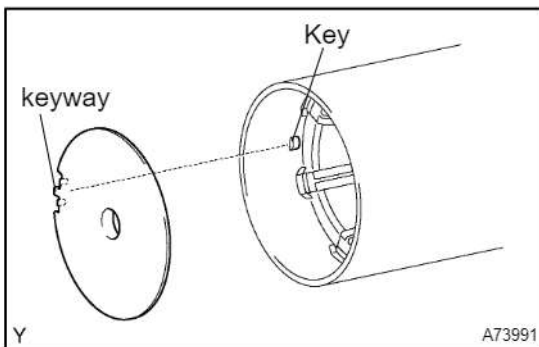
- (d) Using a vernier caliper, measure the length of the snap ring.

Maximum length: 5.0 mm (0.197 in.)

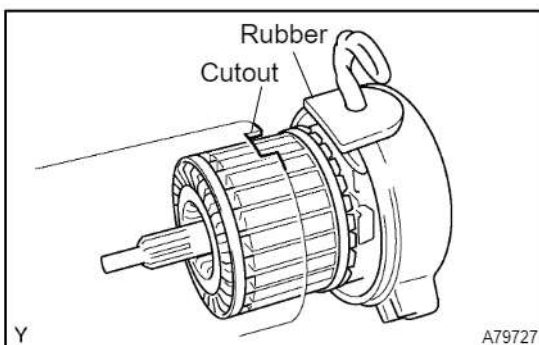
If the length is greater than the maximum, replace it with a new snap ring.

**13. INSTALL STARTER COMMUTATOR END FRAME COVER**

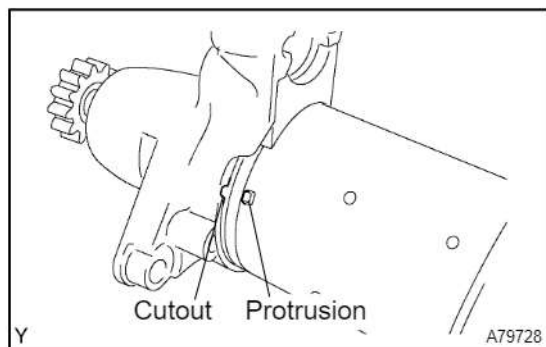
- (a) Install the end frame cover to the commutator end frame.

**14. INSTALL STARTER ARMATURE PLATE**

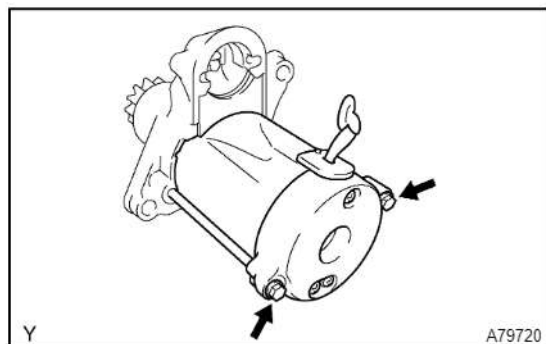
- (a) Align the keyway of the starter plate with the key inside the yoke, and install the plate.

**15. INSTALL STARTER COMMUTATOR END FRAME ASSY**

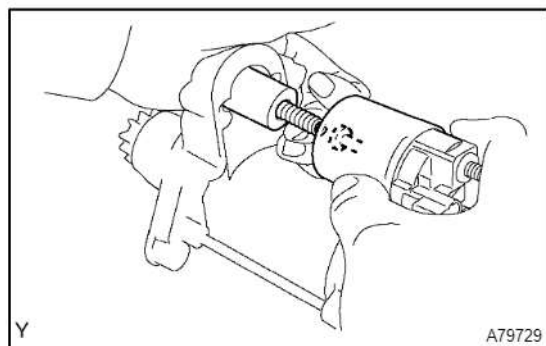
- (a) Align the rubber of the end frame with the cutout of the yoke.
- (b) Install the end frame to the yoke.

**16. INSTALL STARTER YOKE ASSY**

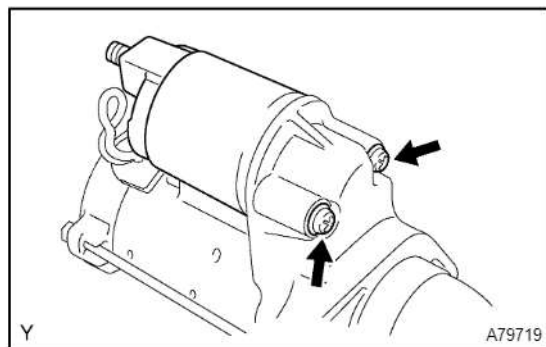
- (a) Align the protrusion of the yoke with the cutout of the drive housing.



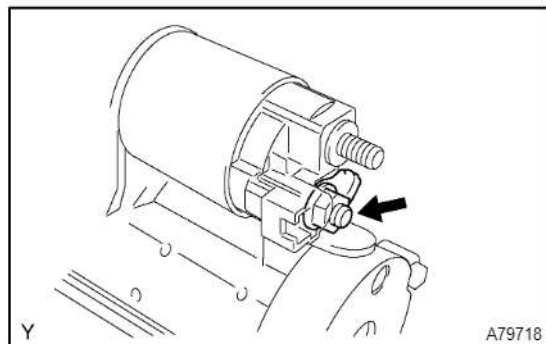
- (b) Install the yoke with the 2 through bolts.
Torque: 6.0 N·m (61 kgf·cm, 53 in.·lbf)

**17. INSTALL MAGNETIC SWITCH ASSY**

- (a) Apply grease to the plunger and the hook.
(b) Hang the plunger hook of the magnetic switch to the drive lever.
(c) Install the plunger and return spring.

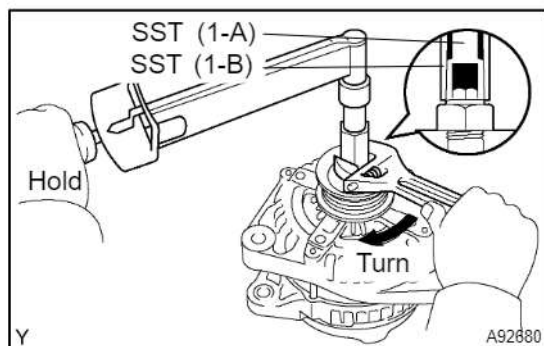


- (d) Install the magnetic switch with the 2 screws.
Torque: 7.5 N·m (76 kgf·cm, 66 in.·lbf)



- (e) Connect the lead wire to the magnetic switch with the nut.
Torque: 10 N·m (102 kgf·cm, 7 ft.·lbf)

OVERHAUL



1. REMOVE GENERATOR PULLEY

SST 09820-63010 (09820-06010, 09820-06020)

HINT:

SST (1-A, B)	09820-06010
SST (2)	09820-06020

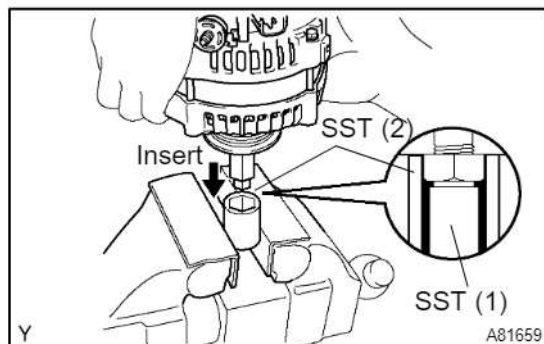
- (a) Hold SST (1-A) with a torque wrench, and tighten SST (1-B) clockwise to the specified torque.

Torque: 39 N·m (400 kgf·cm, 29 ft·lbf)

NOTICE:

Check that SST is secured to the rotor shaft.

- (b) Mount SST (2) in a vise.
 (c) Insert SST (1-A, B) into SST (2), and attach the pulley nut to SST (2).

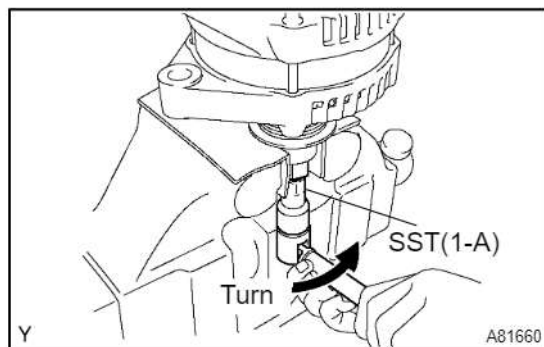


- (d) To loosen the pulley nut, turn SST (1-A) in the direction shown in the illustration.

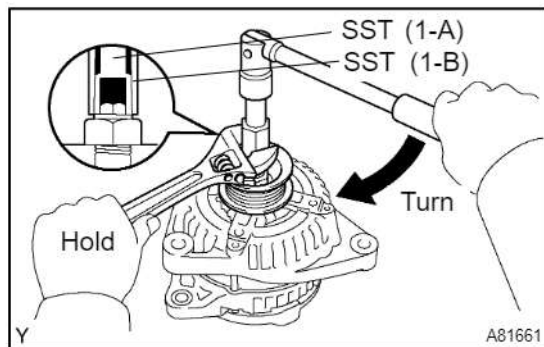
NOTICE:

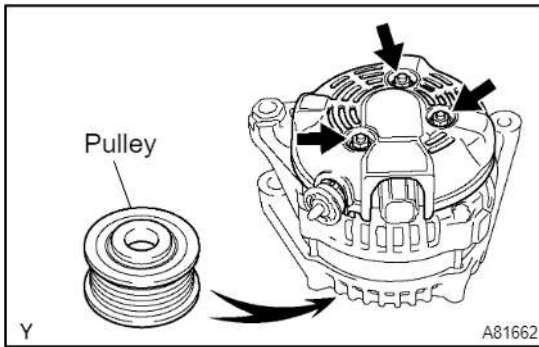
To prevent damage to the rotor shaft, do not loosen the pulley nut more than one-half turn.

- (e) Remove the generator from SST (2).



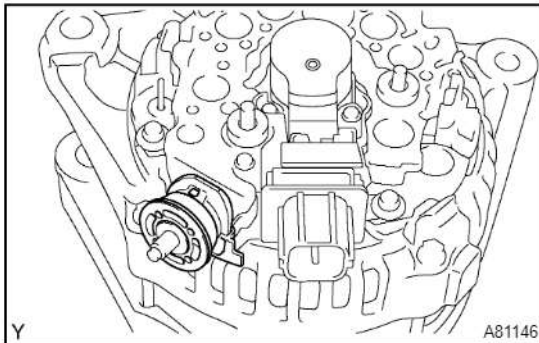
- (f) Turn SST (1-B) and remove SST (1-A, B).
 (g) Remove the pulley nut and pulley.





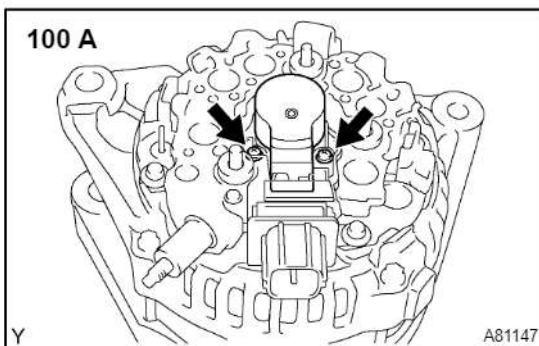
2. REMOVE GENERATOR REAR END COVER

- (a) Place the generator on the pulley.
- (b) Remove the 3 nuts and rear end cover.



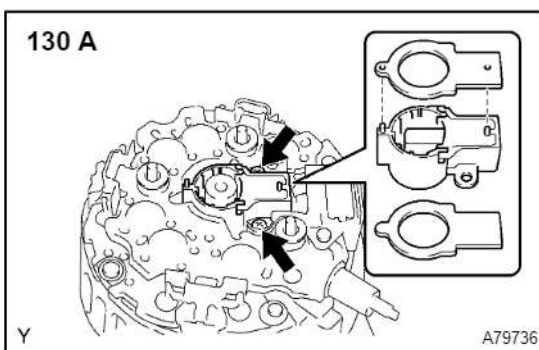
3. REMOVE TERMINAL INSULATOR

- (a) Remove the terminal insulator from the rectifier end frame.

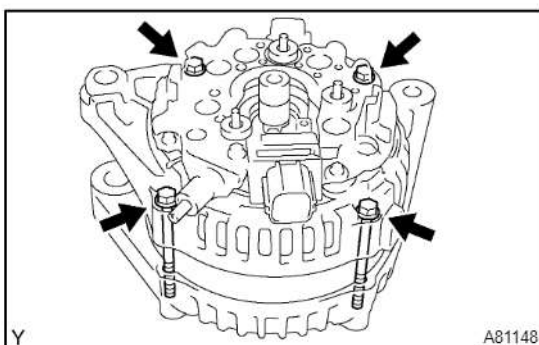


4. REMOVE GENERATOR BRUSH HOLDER ASSY

- (a) 100 A:
Remove the 2 screws and brush holder.

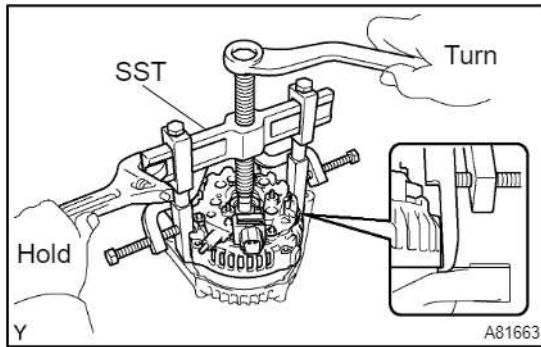


- (b) 130 A:
Remove the brush holder.
 - (1) Remove the plate seal.
 - (2) Remove the 2 screws and brush holder.
 - (3) Remove the plate seal.

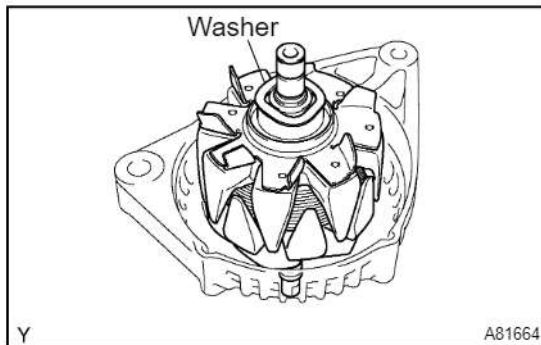


5. REMOVE GENERATOR RECTIFIER END FRAME

- (a) Remove the 4 bolts.

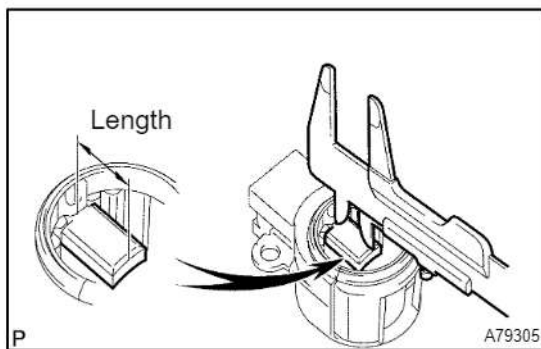


- (b) Using SST, remove the rectifier end frame.
 SST 09950-40011 (09951-04020, 09952-04010, 09953-04020, 09954-04010, 09955-04071, 09957-04010, 09958-04011)



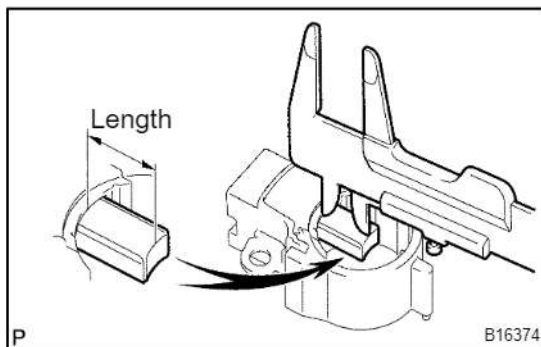
6. REMOVE GENERATOR ROTOR ASSY

- (a) Remove the washer and rotor.

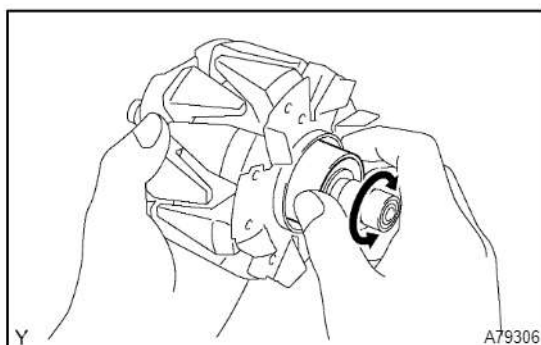


7. INSPECT GENERATOR BRUSH HOLDER ASSY

- (a) 100 A:
 Using a vernier caliper, measure the exposed brush length.
Standard exposed brush length: 10.5 mm (0.413 in.)
Minimum exposed brush length: 4.5 mm (0.177 in.)
 If the exposed brush length is less than the minimum, replace the brush holder assy.

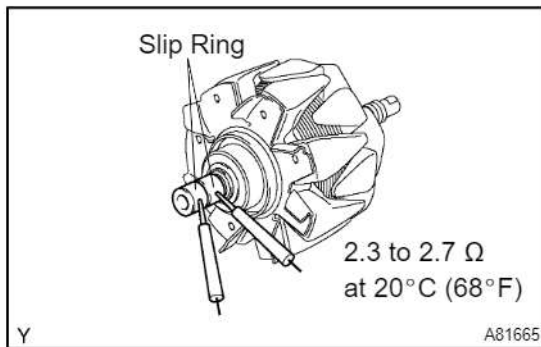


- (b) 130 A:
 Using a vernier caliper, measure the exposed brush length.
Standard exposed brush length: 10.5 mm (0.413 in.)
Minimum exposed brush length: 4.5 mm (0.177 in.)
 If the exposed brush length is less than the minimum, replace the brush holder assy.



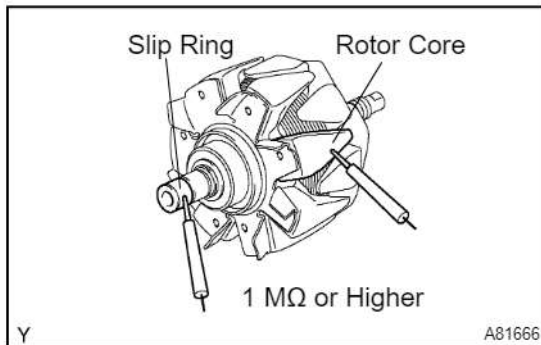
8. INSPECT GENERATOR ROTOR ASSY

- (a) Check that the bearing is not rough or worn.
 100 A:
 If necessary, replace the rotor assy.
 130 A:
 If necessary, replace the rotor bearing.

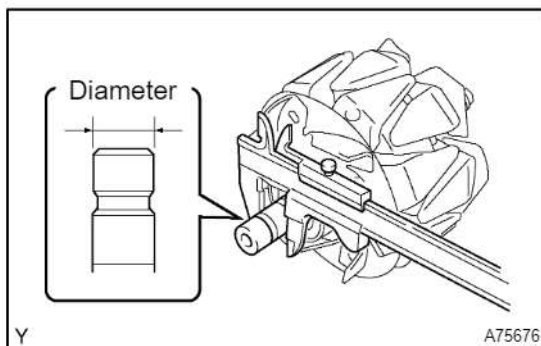


- (b) Check if the rotor has open circuit.
 (1) Measure the resistance between the slip ring.
Resistance:
2.3 to 2.7 Ω at 20°C (68°F)

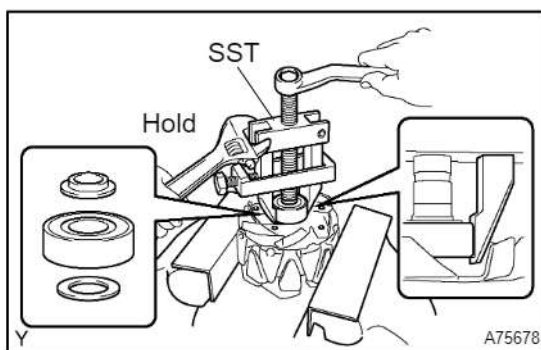
If the resistance is not as specified, replace the generator rotor.



- (c) Check the rotor for ground.
 (1) Measure the resistance between the slip ring and rotor core.
Standard: 1 M Ω or higher
 If the resistance is not as specified, replace the rotor assy.
 (d) Check that the slip rings are not rough or scored.
 If rough or scored, replace the rotor assy.



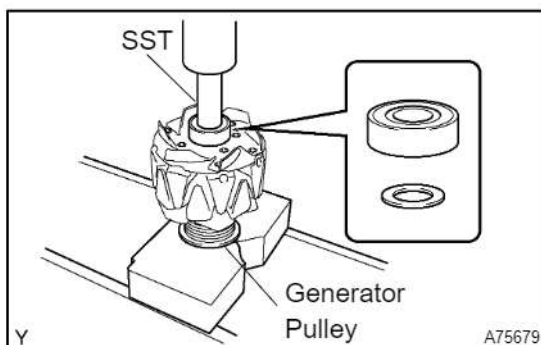
- (e) Using vernier calipers, measure the slip ring diameter.
Standard diameter:
14.2 to 14.4 mm (0.559 to 0.567 in.)
Minimum diameter: 14.0 mm (0.551 in.)
 If the diameter is less than the minimum, replace the rotor assy.



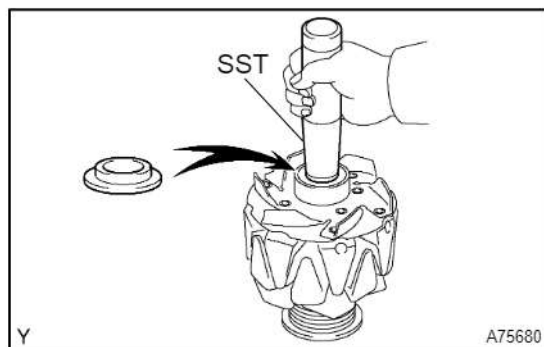
9. **130 A:**
REMOVE GENERATOR ROTOR BEARING
 (a) Using SST, remove the bearing cover (outside) and bearing.
 SST 09820-00021

NOTICE:
Be careful not to damage the fan.

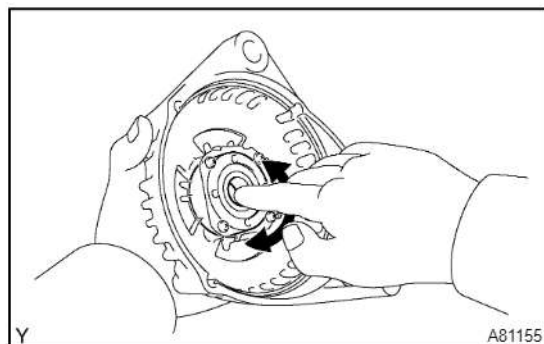
- (b) Remove the bearing cover (inside).



10. **130 A:**
INSTALL GENERATOR ROTOR BEARING
 (a) Place the generator rotor on the generator pulley.
 (b) Install the bearing cover (inside).
 (c) Using SST and a press, press in a new bearing.
 SST 09820-00031

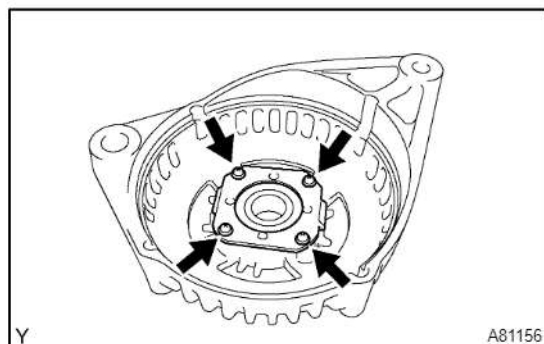


- (d) Using SST, push in the bearing cover (outside).
SST 09285-76010



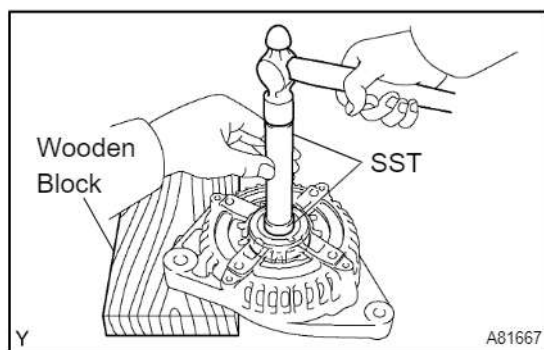
11. INSPECT GENERATOR DRIVE END FRAME BEARING

- (a) Check that the bearing is not rough or worn.
If necessary, replace the bearing.

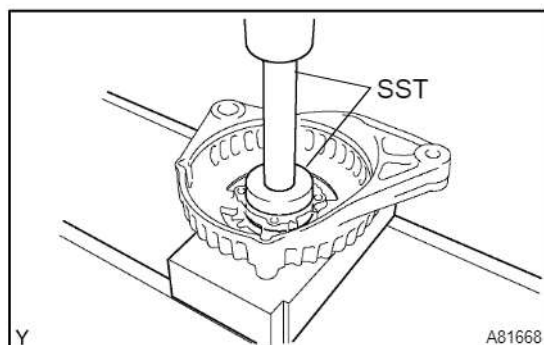


12. REMOVE GENERATOR DRIVE END FRAME BEARING

- (a) Remove the 4 screws and retainer plate.

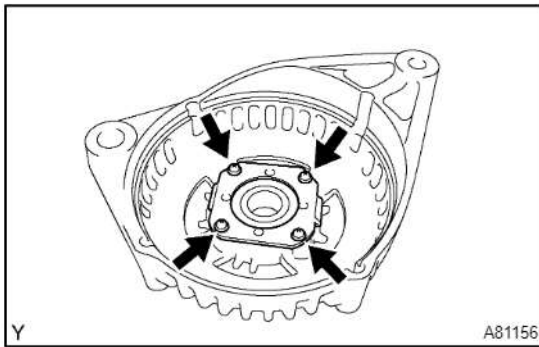


- (b) Using SST and a wooden block, tap out the bearing.
SST 09950-60010 (09951-00250), 09950-70010 (09951-07100)

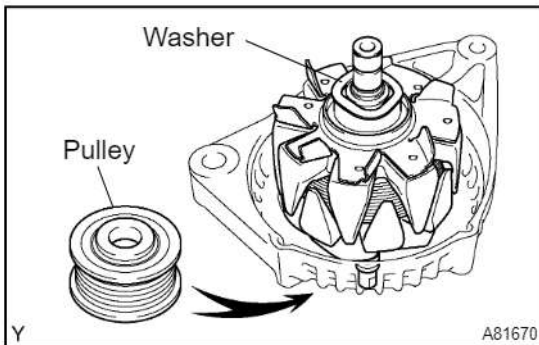


13. INSTALL GENERATOR DRIVE END FRAME BEARING

- (a) Using SST and a press, press in a new bearing.
SST 09950-60010 (09951-00470), 09950-70010 (09951-07100)

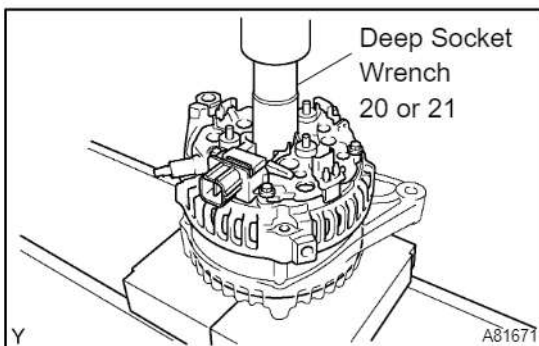


- (b) Install the retainer plate with the 4 screws.
Torque: 2.3 N·m (23 kgf·cm, 20 in·lbf)



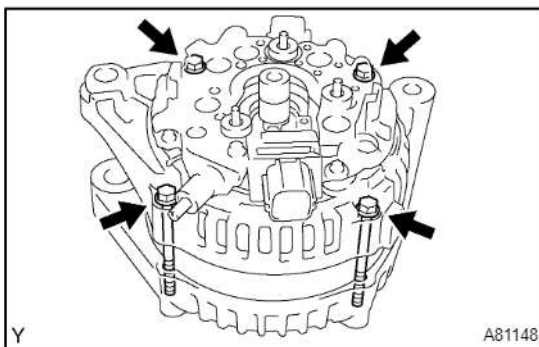
14. INSTALL GENERATOR ROTOR ASSY

- (a) Place the drive end frame on the pulley.
 (b) Install the rotor and washer.

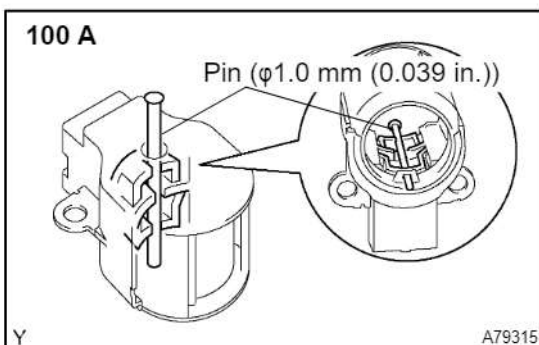


15. INSTALL GENERATOR RECTIFIER END FRAME

- (a) 100 A:
 Using deep socket wrench 21 and a press, press in the coil carefully.
 (b) 130 A:
 Using deep socket wrench 20 and a press, press in the coil carefully.

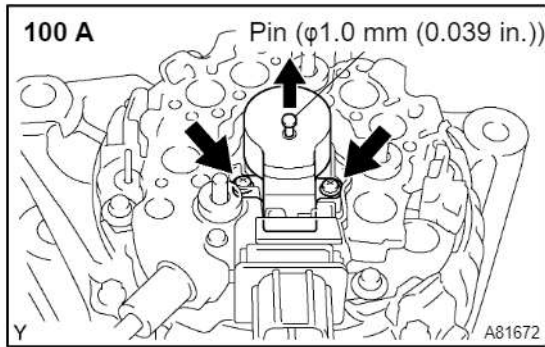


- (c) Tighten the 4 bolts.
Torque: 5.8 N·m (59 kgf·cm, 51 in·lbf)

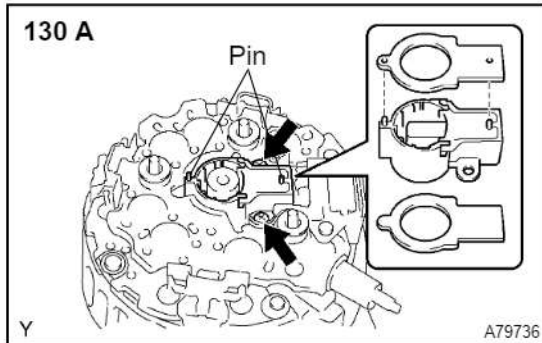


16. INSTALL GENERATOR BRUSH HOLDER ASSY

- (a) 100 A:
 Install the brush holder.
 (1) While pushing the 2 brushes to inside the brush holder, insert a pin (φ1.0 mm (0.039 in.)) into the brush holder hole.



- (2) Install the generator brush holder with the 2 screws.
Torque: 1.8 N·m (18 kgf·cm, 16 in.·lbf)
- (3) Pull out the pin (φ1.0 mm (0.039 in.)) from the generator brush holder.

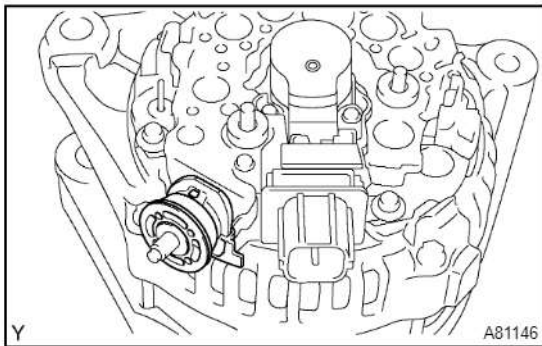


- (b) 130 A:
Install the brush holder.
- (1) Install the plate seal (inside).
- (2) Place the brush holder with the pin facing upward.

NOTICE:

Be careful of the generator brush holder installing direction.

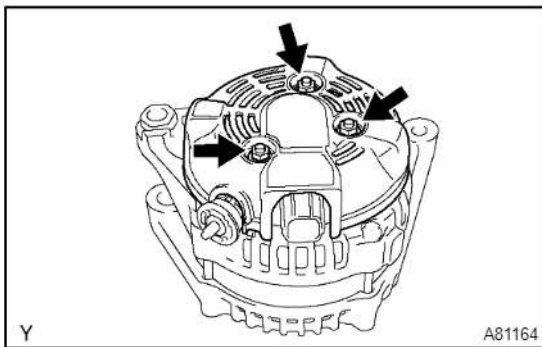
- (3) Tighten the 2 screws.
Torque: 1.8 N·m (18 kgf·cm, 16 in.·lbf)
- (4) Align the pins of the brush holder with the holes of the plate seal (outside), and install the plate seal (outside).

**17. INSTALL TERMINAL INSULATOR**

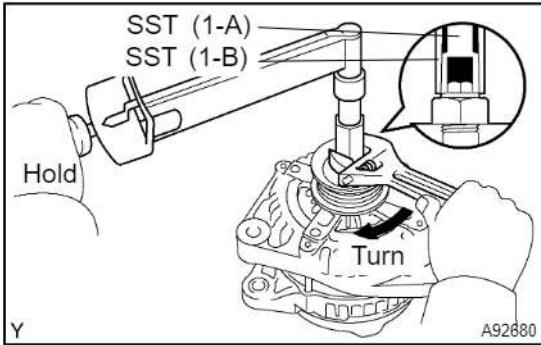
- (a) Install the terminal insulator.

NOTICE:

pay attention to the mounting direction of the terminal insulator.

**18. INSTALL GENERATOR REAR END COVER**

- (a) Install the rear end cover with the 3 nuts.
Torque: 4.6 N·m (47 kgf·cm, 41 in.·lbf)



19. INSTALL GENERATOR PULLEY

SST 09820-63010 (09820-06010, 09820-06020)

HINT:

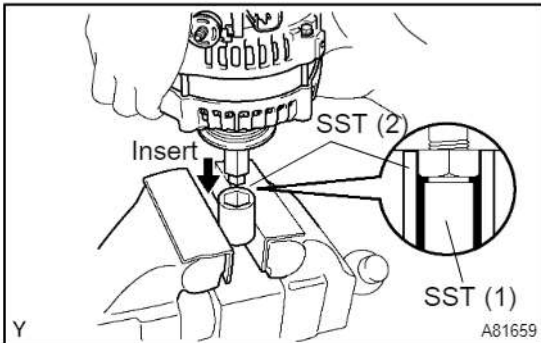
SST 1-A and B	09820-06010
SST 2	09820-06020

- Install the pulley to the rotor shaft by tightening the generator pulley nut by hand.
- Hold SST (1-A) with a torque wrench, and tighten SST (1-B) clockwise with the specified torque.

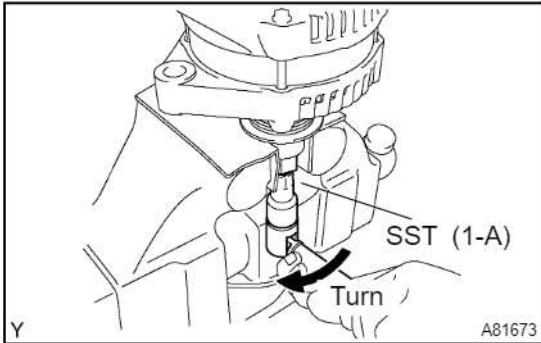
Torque: 39 N·m (400 kgf·cm, 29 ft·lbf)

NOTICE:

Check that SST is secured to the rotor shaft.



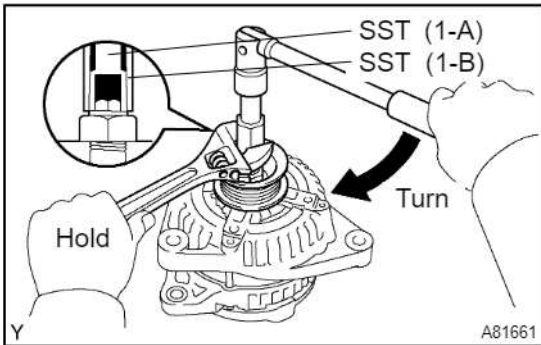
- Mount SST (2) in a vise.
- Insert SST (1-A) and (B) into SST (2), and attach the generator pulley nut to SST (2).



- Tighten the pulley nut by turning SST (1-A) in the direction shown in the illustration.

Torque: 111 N·m (1,125 kgf·cm, 81 ft·lbf)

- Remove the generator from SST (2).



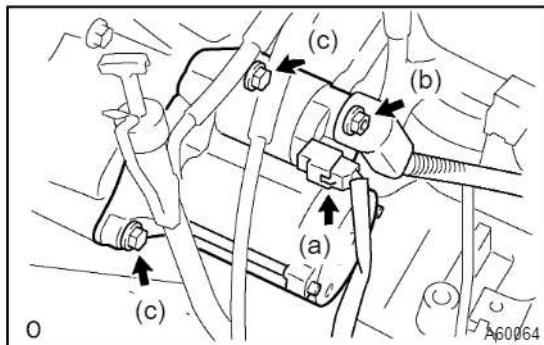
- Turn SST (1-B), and remove SST (1-A), (B).
- Turn the pulley, and check that the pulley moves smoothly.

REPLACEMENT

NOTICE:

Before changing the starter, check the following again:

- Connector connection
 - Accessory installation
1. REMOVE BATTERY
 2. REMOVE BATTERY TRAY



3. REMOVE STARTER ASSY

- (a) Disconnect the starter connector.
- (b) Open the terminal cap, remove the nut and disconnect the starter wire.
- (c) Remove the 2 bolts and starter.

4. INSTALL STARTER ASSY

- (a) Install the starter with the 2 bolts.
Torque: 37 N·m (377 kgf·cm, 27 ft·lbf)
- (b) Install the starter wire with the nut.
Torque: 9.8 N·m (100 kgf·cm, 7 ft·lbf)
- (c) Connect the starter connector.

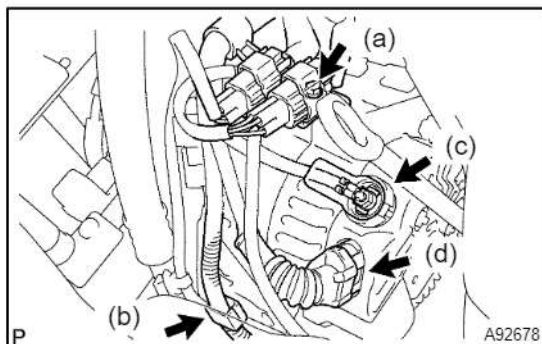
5. INSTALL BATTERY TRAY

6. INSTALL BATTERY

- (a) Install the battery clamp with the bolt and nut.
Torque: 5.5 N·m (56 kgf·cm, 49 in·lbf)
- (b) Connect the cables to the battery terminals.
Torque: 3.5 N·m (36 kgf·cm, 31 in·lbf)

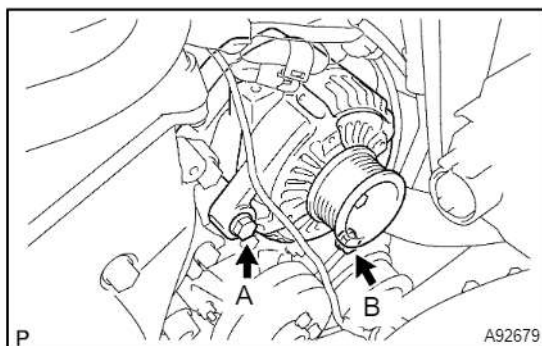
REPLACEMENT

1. REMOVE V BELT (See page 14-5)



2. REMOVE GENERATOR ASSY

- (a) Remove the bolt, and disconnect the wire clip on the wire connectors from the generator.
- (b) Disconnect the wire clamp from the wire clip.
- (c) Remove the cap and nut, and disconnect the generator wire.
- (d) Disconnect the generator connector.



- (e) Remove the 2 bolts and generator.

3. INSTALL GENERATOR ASSY

- (a) Install the generator.

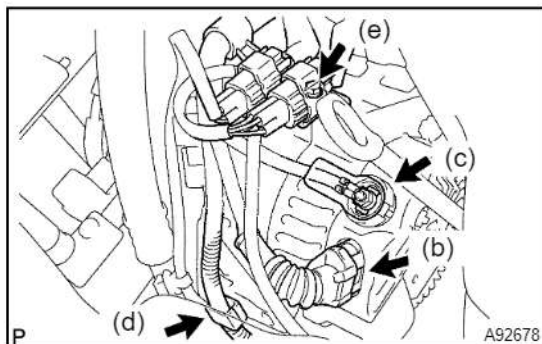
Torque:

52 N·m (530 kgf·cm, 38 ft·lbf) for bolt A

21 N·m (214 kgf·cm, 15 ft·lbf) for bolt B

NOTICE:

Be careful not to put the wire harness between the engine and the generator when install the generator.



- (b) Connect the generator connector.
- (c) Connect the generator wire with the nut, and install the cap.
- Torque: 9.8 N·m (100 kgf·cm, 7.0 ft·lbf)**
- (d) Install the wire clamp to the wire clip.
- (e) Install the wire clip on the wire connectors to the generator.

4. INSTALL V BELT (See page 14-5)

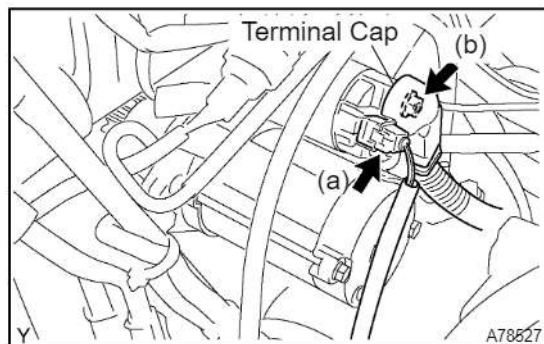
REPLACEMENT

NOTICE:

Before changing the starter, check the following again:

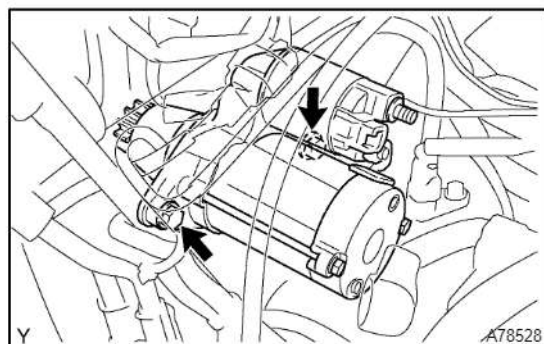
- Connector connection
- Accessory installation

1. REMOVE BATTERY
2. REMOVE BATTERY TRAY



3. REMOVE STARTER ASSY

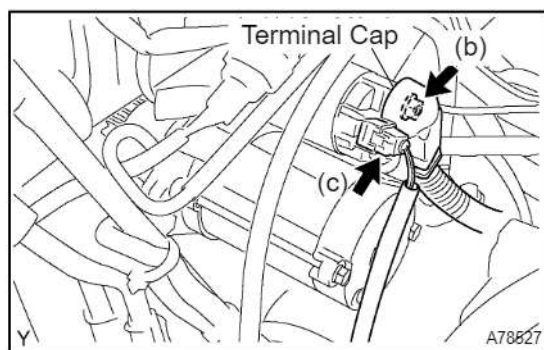
- (a) Disconnect the starter connector.
- (b) Open the terminal cap, remove the nut and disconnect the starter wire.



- (c) Remove the 2 bolts and starter.

4. INSTALL STARTER ASSY

- (a) Install the starter with the 2 bolts.
Torque: 37 N·m (377 kgf·cm, 27 ft·lbf)



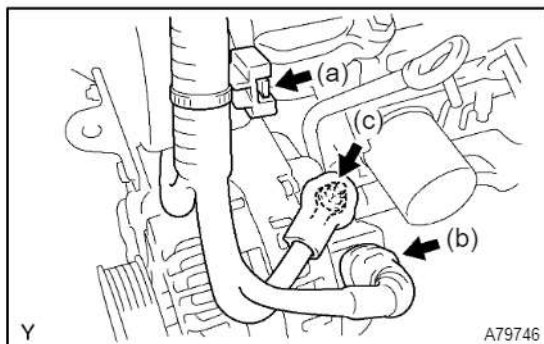
- (b) Install the terminal nut and cover the nut with the cap.
Torque: 9.8 N·m (100 kgf·cm, 7 ft·lbf)
- (c) Connect the starter wire.

5. INSTALL BATTERY TRAY

6. INSTALL BATTERY

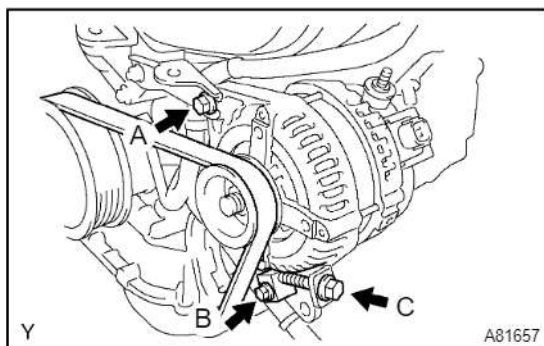
- (a) Install the battery clamp with the bolt and nut.
Torque: 5.5 N·m (56 kgf·cm, 49 in·lbf)
- (b) Connect the cables to the battery terminals.
Torque: 3.5 N·m (36 kgf·cm, 31 in·lbf)

REPLACEMENT

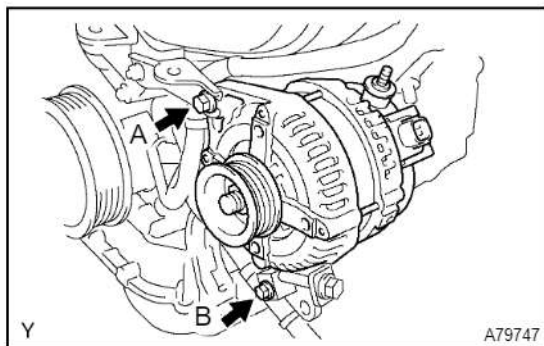


1. REMOVE GENERATOR ASSY

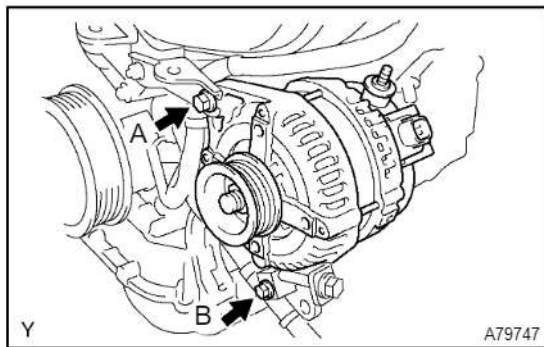
- (a) Remove the wire harness clamp.
- (b) Disconnect the generator connector.
- (c) Open the terminal cap, remove the nut and disconnect the generator wire.



- (d) Loosen bolts A and B.
- (e) Loosen bolt C to lessen the tension of the V belt.

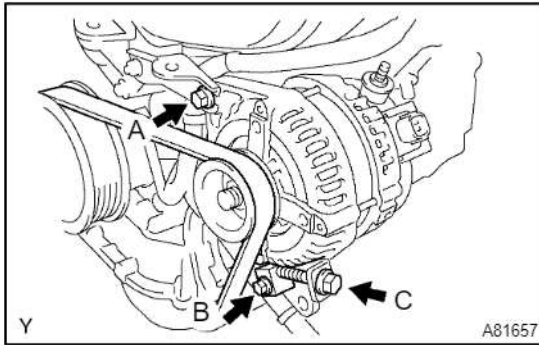


- (f) Remove bolts A and B, and the generator.



2. INSTALL GENERATOR ASSY

- (a) Temporarily install the generator with bolts A and B.



- (b) Adjust the V belt tension by tightening bolt C (see page [14-125](#)).
- (c) Tighten bolts A and B.

Torque:**58 N·m (592 kgf·cm, 43 ft·lbf) for bolt A****18 N·m (184 kgf·cm, 13 ft·lbf) for bolt B**

- (d) Install the generator wire with the nut.
Torque: 9.8 N·m (100 kgf·cm, 7.0 ft·lbf)
- (e) Connect the generator connector.
- (f) Install the wire harness clamp.

3. INSPECT V BELT (See page [14-121](#))