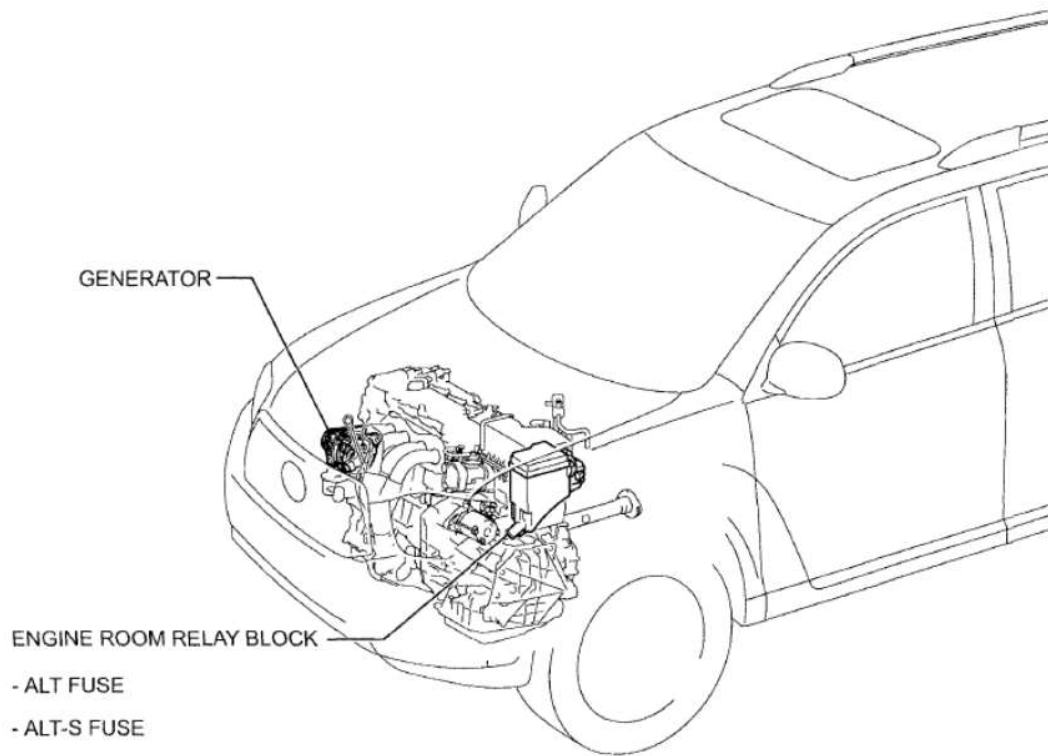


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2009 ELECTRICAL Charging (1AR-FE) - Highlander

2009 ELECTRICAL**Charging (1AR-FE) - Highlander****CHARGING SYSTEM****PRECAUTION**

1. Check that the battery cables are connected to the correct terminals.
2. Disconnect the battery cables when the battery is given a quick charge.
3. Do not perform tests with a high voltage insulation resistance tester.
4. Never disconnect the battery while the engine is running.
5. Check that the charging cable nuts are tightened on terminal B of the generator and the engine room relay block.

PARTS LOCATION

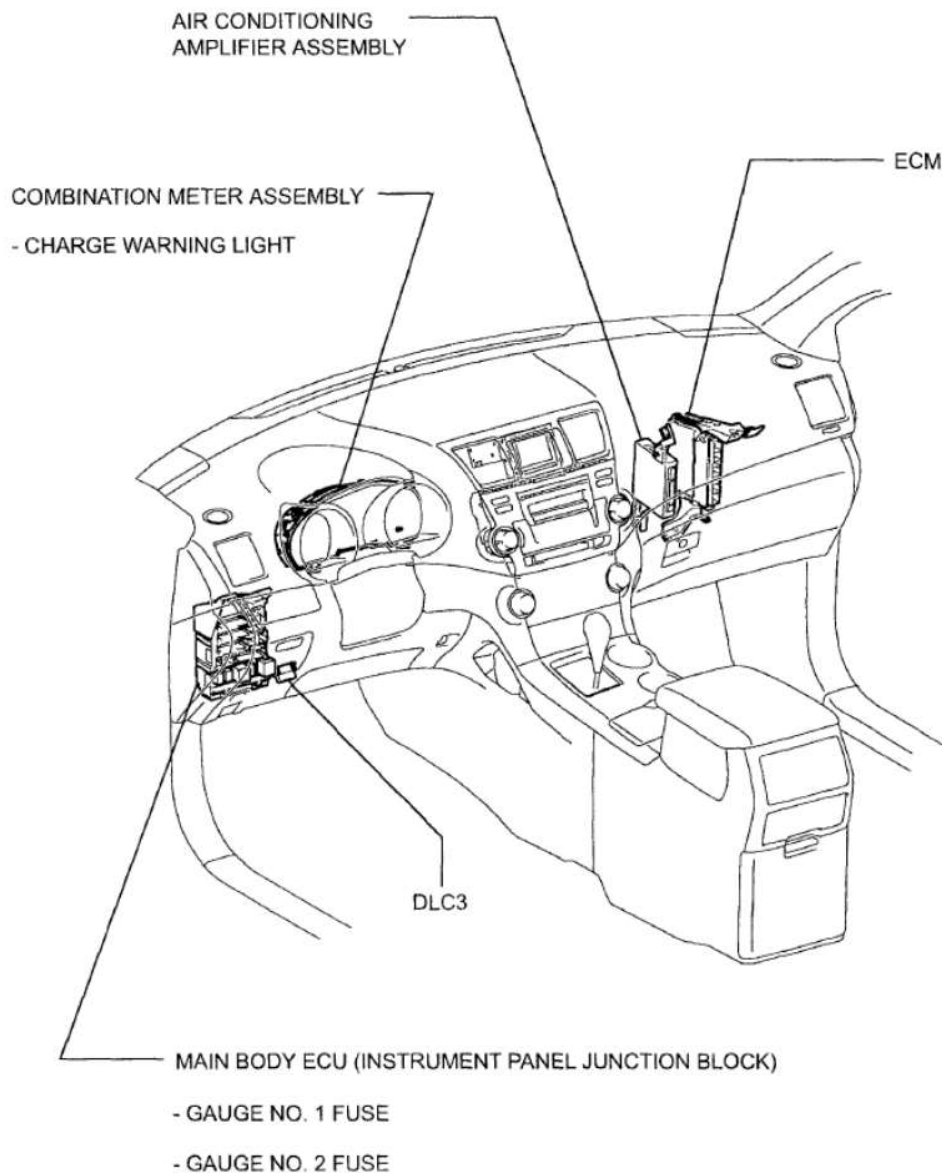
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2009 ELECTRICAL Charging (1AR-FE) - Highlander

Fig. 1: Identifying Charging System Parts Location (1 Of 2)

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.



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Fig. 2: Identifying Charging System Parts Location (2 Of 2)

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

SYSTEM DIAGRAM

2009 ELECTRICAL Charging (1AR-FE) - Highlander

from Battery → 1 2 FL MAIN ALT-S

from IG2 Relay → GAUGE No.2

from IG1 Relay → GAUGE No.1

from Battery → 1 2 ALT

ALT → 25 ALT B49 ECM

E1 Combination Meter (Charge Warning Light)

1 IG+ 32 CHG-

2 4 1 3 B36 B36 B36 B36

B IG L S M

IC Regulator

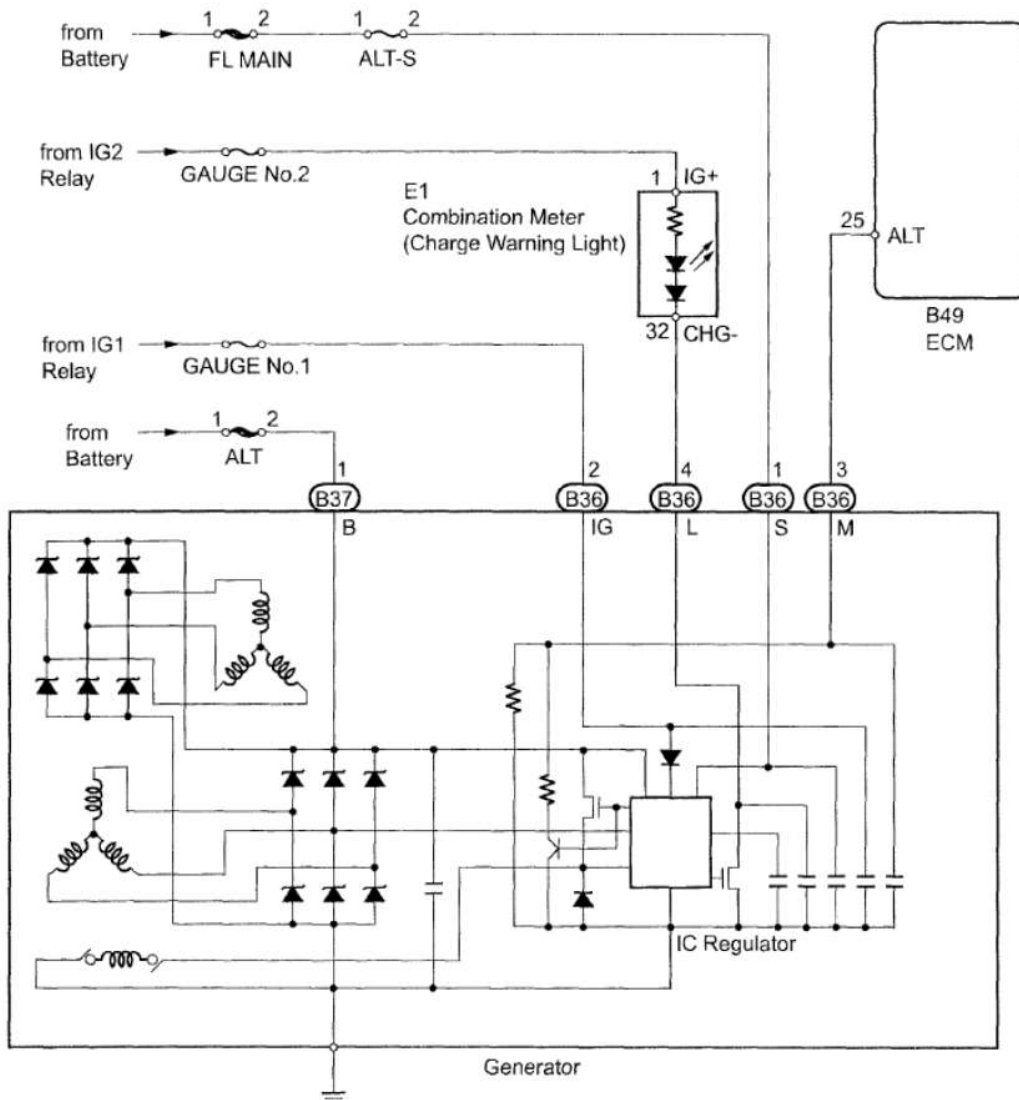
Generator

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for 130A 150A:



A206972E04

Fig. 4: Charging System Diagram (2 Of 2)

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

PROBLEM SYMPTOMS TABLE

HINT:

- Use the table below to help determine the cause of problem symptoms. If multiple suspected areas are listed, the potential causes of the symptoms are listed in order of probability in the "Suspected Area" column of the table. Check each symptom by checking the suspected areas in the order they are listed. Replace parts as necessary.
- Inspect the fuses and relays related to this system before inspecting the suspected areas below.

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Result**RESULT REFERENCE CHART**

Symptom	Suspected Area	Reference
Charge Warning Light Comes ON while Driving	Clutch pulley	<u>CHARGE WARNING LIGHT COMES ON WHILE DRIVING</u>
	Generator assembly	<u>CHARGE WARNING LIGHT COMES ON WHILE DRIVING</u>
Noise Occurs from Generator while Engine is Running	V-ribbed belt	<u>NOISE OCCURS FROM GENERATOR WHILE ENGINE IS RUNNING</u>
	Clutch pulley	<u>NOISE OCCURS FROM GENERATOR WHILE ENGINE IS RUNNING</u>
	Generator assembly	<u>NOISE OCCURS FROM GENERATOR WHILE ENGINE IS RUNNING</u>

ON-VEHICLE INSPECTION**1. CHECK BATTERY CONDITION**

NOTE: If the battery is weak or if the engine is difficult to start, perform the following procedure.

- a. Check the battery for damage or deformation. If severe damage, deformation or leakage is found, replace the battery.
- b. Check the electrolyte quantity of each cell.
 1. For maintenance-free batteries:
 - If the electrolyte quantity is below the lower line, replace the battery.
 - If the electrolyte quantity is above the lower line, check the battery voltage when cranking the engine. If the voltage is less than 9.6 V, recharge or replace the battery.

HINT:

Before checking the battery voltage, turn off all the electrical systems (headlights, blower motor, rear defogger, etc.).

- c. Turn the ignition switch off and turn on the headlights for 20 to 30 seconds. This will remove the surface charge from the battery.
- d. Measure the battery voltage between the negative (-) and positive (+) terminals of the battery.

Standard voltage:**12.6 to 12.8 V at 20°C (68°F)**

If the voltage is below the specification, recharge the battery.

2009 Toyota Highlander Limited**2009 ELECTRICAL Charging (1AR-FE) - Highlander****2. INSPECT BATTERY TERMINAL AND FUSE**

- a. Visually check the battery terminals.
 1. Check that the battery terminals are not loose or corroded.

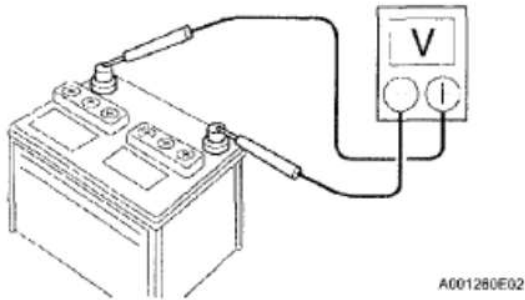


Fig. 5: Measuring Battery Voltage Between Negative (-) And Positive (+) Terminals Of Battery

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Measure the resistance of each fuse for the charging system.

HINT:

The fuses shown in the System Diagram are related to the charging system.

Standard resistance:

Below 1 ohms

If any of the results is not as specified, replace the fuse(s) as necessary.

3. INSPECT V-RIBBED BELT

- a. Check the belt for wear, cracks or other signs of damage.

If any of the following defects is found, replace the V-ribbed belt.

- The belt is cracked.
- The belt is worn out to the extent that the cords are exposed.
- The belt has chunks missing from the ribs.

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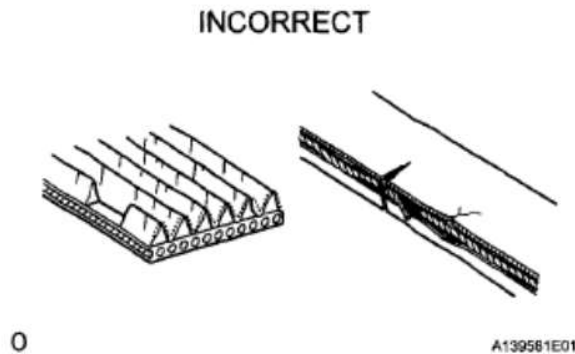


Fig. 6: Checking Belt For Wear, Cracks Or Damage
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

HINT:

Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley. If it has slipped out, replace the V-ribbed belt. Install a new V-ribbed belt correctly.

4. INSPECT GENERATOR WIRING

- a. Visually check the generator wiring.
 1. Check that the wiring is in good condition.



Fig. 7: Checking Belt Fits Properly In Ribbed Grooves
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. CHECK FOR ABNORMAL NOISES

- a. Listen for abnormal noises from the generator.
 1. Check that no abnormal noises are heard from the generator while the engine is running.

6. INSPECT CHARGE WARNING LIGHT CIRCUIT

- a. Turn the ignition switch to ON. Check that the charge warning light comes on.
- b. Start the engine and check that the light goes off. If the light does not operate as specified, troubleshoot the charge warning light circuit.

7. INSPECT CHARGING CIRCUIT WITHOUT LOAD

- a. Connect a voltmeter and ammeter to the charging circuit as follows.
 1. Disconnect the wire from terminal B of the generator, and then connect it to the negative (-) lead of the ammeter.

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2. Connect the positive (+) lead of the ammeter to terminal B of the generator.
3. Connect the positive (+) lead of the voltmeter to the positive (+) terminal of the battery.
4. Ground the negative (-) lead of the voltmeter.
- b. Check the charging circuit.
 1. Keep the engine speed at 2000 rpm and 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, repair or replace the generator.

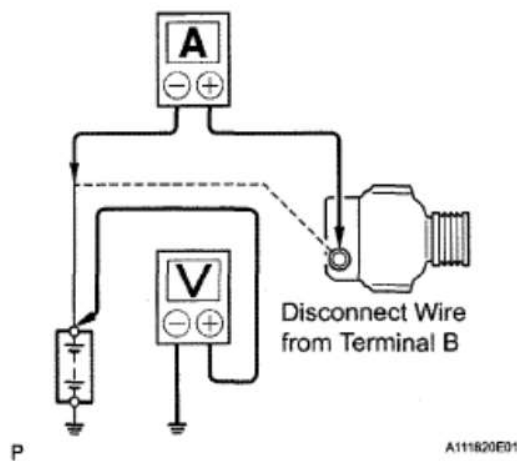


Fig. 8: Inspecting Charging Circuit Without Load
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

If the battery is not fully charged, the ammeter reading will sometimes be more than the standard amperage.

8. INSPECT CHARGING CIRCUIT WITH LOAD

- a. With the engine running at 2000 rpm, turn the high beam headlights on and turn the heater blower switch to the "HI" position.
- b. Check the reading on the ammeter.

Standard amperage:

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30 A or more

If the ammeter reading is less than the standard amperage, repair or replace the generator.

HINT:

If the battery is fully charged, the indication will sometimes be less than the standard amperage. If this is the case, add more electrical load (operate the wipers, rear window defogger, etc.) and check the reading on the ammeter again.

CHARGE WARNING LIGHT COMES ON WHILE DRIVING**INSPECTION PROCEDURE****1. CHECK LOCK FUNCTION OF CLUTCH PULLEY**

- a. Check the lock function with the pulley installed in the vehicle.
 1. Visually check that the rotor in the generator operates with the engine started.
- b. Check the lock function with the pulley removed from the vehicle.
 1. Remove the generator pulley cap. Using SST, hold the generator rotor.
 2. Turn the clutch pulley clockwise and check that the outer ring locks.

OK:

The outer ring locks.

SST 09820-63021

NG: REPLACE CLUTCH PULLEY (See GENERATOR)



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Fig. 9: Checking Lock Function Of Clutch Pulley
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. CHECK LOCK OF CLUTCH PULLEY

- a. Start the engine and visually check for looseness of the clutch pulley.

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OK:**The clutch pulley is not loose.****NG: TIGHTEN CLUTCH PULLEY TO THE SPECIFIED TORQUE (See GENERATOR)****OK: REPLACE GENERATOR ASSEMBLY (See GENERATOR)****NOISE OCCURS FROM GENERATOR WHILE ENGINE IS RUNNING****INSPECTION PROCEDURE****1. CHECK LOOSENESS OF V-RIBBED BELT**

- a. Check the tension of the belt by pushing it down with a finger.

OK:**The tension of the belt is enough.****NG: REPLACE V-RIBBED BELT TENSIONER ASSEMBLY (See DRIVE BELT)****OK: Go to next step****2. CHECK V-RIBBED BELT FOR WEAR**

- a. Check the V-ribbed belt for wear.

OK:**The V-ribbed belt is not worn.****NG: REPLACE V-RIBBED BELT (See DRIVE BELT)****OK: Go to next step****3. CHECK CLUTCH PULLEY FOR WEAR**

- a. Check the clutch pulley groove for wear or other defects.

OK:**The clutch pulley groove is not damaged.****NG: REPLACE CLUTCH PULLEY (See GENERATOR)****OK: Go to next step****4. CHECK FOR NOISE WHILE CLUTCH PULLEY IS OPERATING**

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- a. Perform a road test and check if noise occurs when decelerating.

OK:

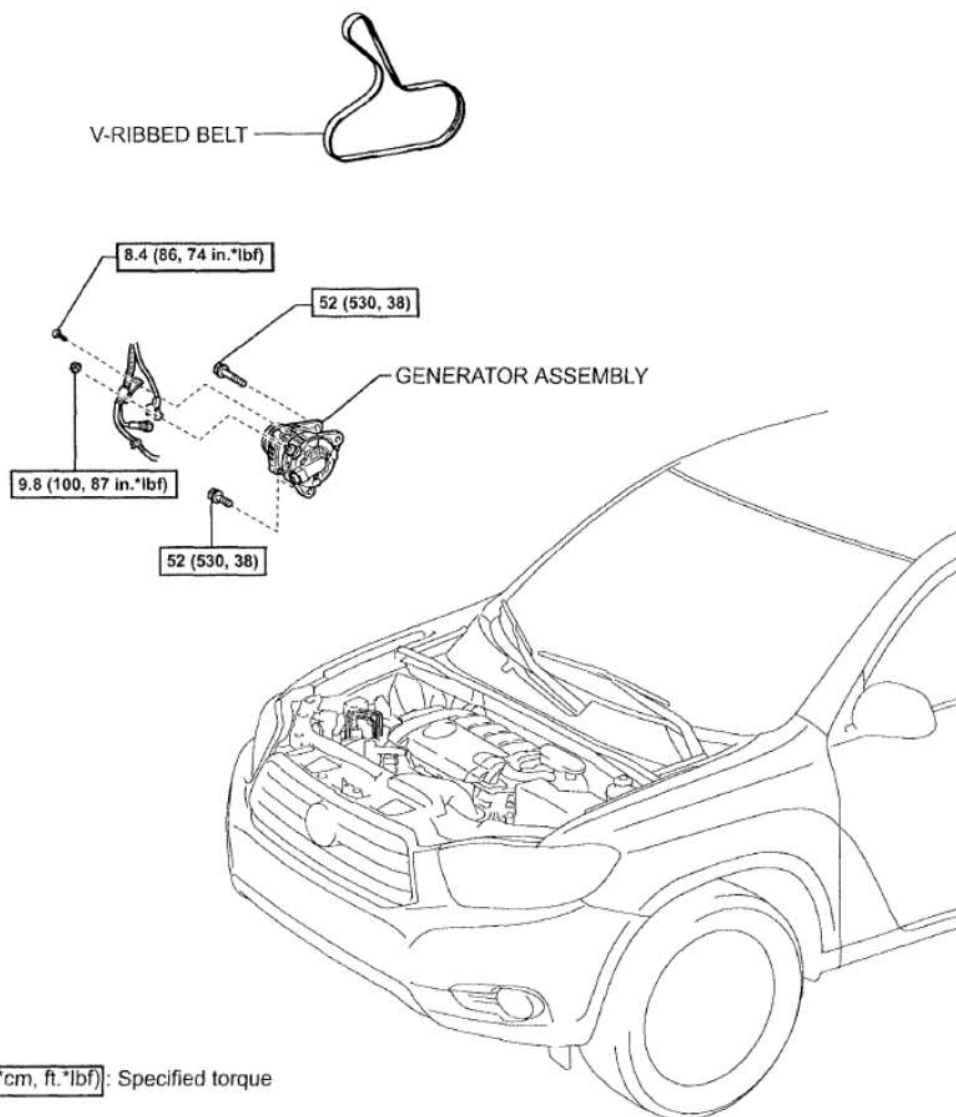
Noise does not occur.

NG: REPLACE CLUTCH PULLEY (See GENERATOR)

OK: REPLACE GENERATOR ASSEMBLY (See GENERATOR)

GENERATOR

COMPONENTS

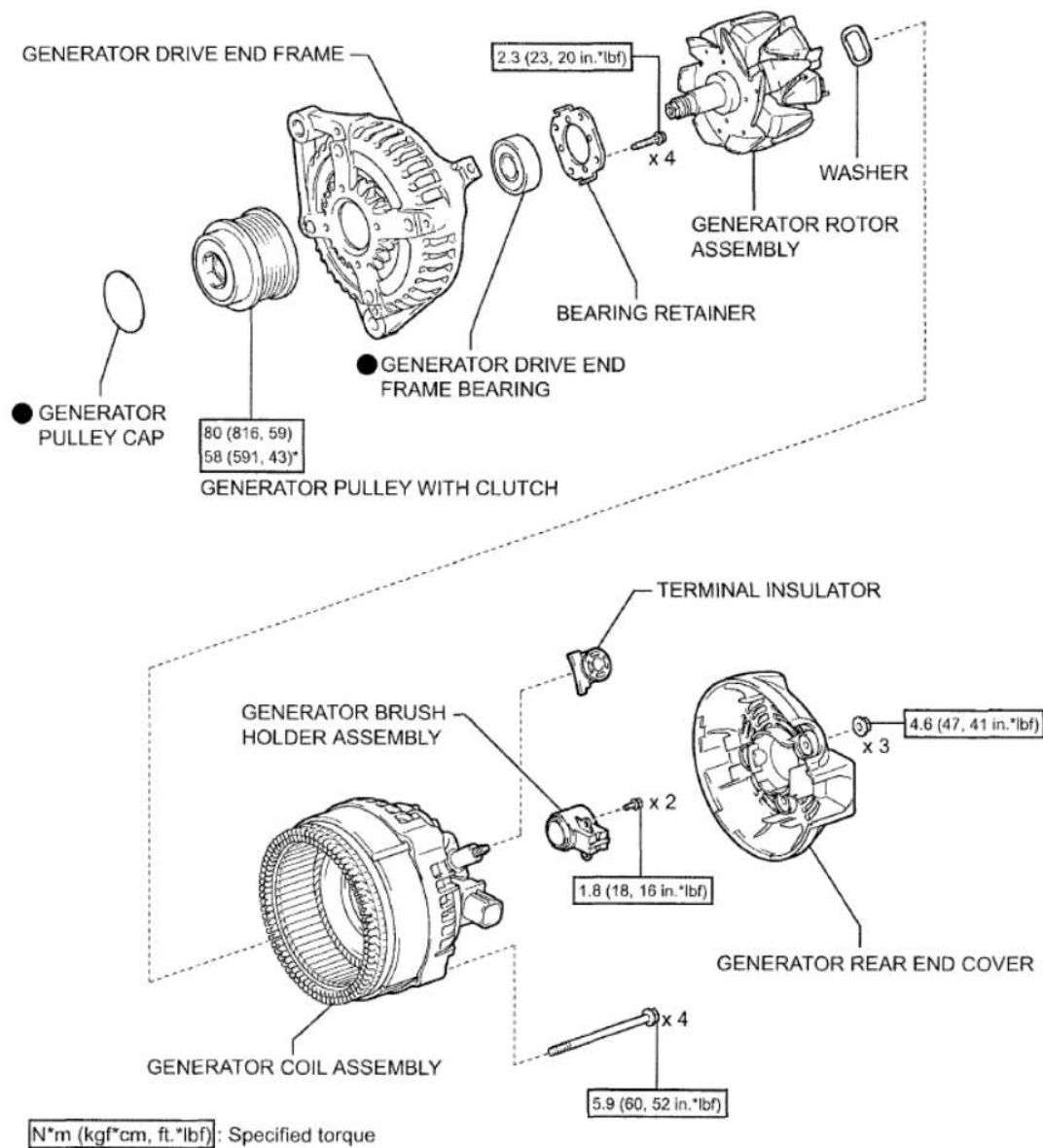


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Fig. 10: Identifying Generator Components (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.



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Fig. 11: Identifying Generator Components (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

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NOTE: When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).

2. REMOVE V-RIBBED BELT

- a. Remove the belt (See ON-VEHICLE INSPECTION).

3. REMOVE GENERATOR ASSEMBLY

- a. Disconnect the generator connector.
- b. Remove the terminal cap.
- c. Remove the nut and disconnect the generator wire.
- d. Remove the bolt and wire harness clamp bracket.

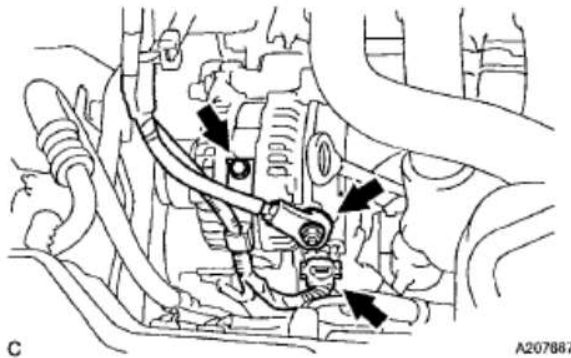


Fig. 12: Locating Wire Harness Clamp Bracket Bolt And Generator Wire Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- e. Remove the 2 bolts and generator.

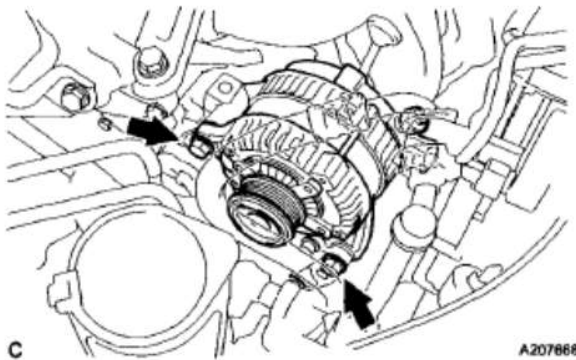


Fig. 13: Locating Generator Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY**1. REMOVE GENERATOR PULLEY CAP**

- a. Using a screwdriver, puncture the center of the generator pulley cap and pry it off.

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NOTE: Do not reuse the generator pulley cap.

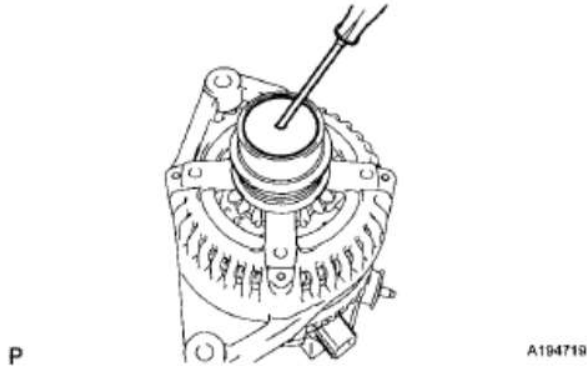


Fig. 14: Removing Generator Pulley Cap

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. REMOVE GENERATOR PULLEY WITH CLUTCH

- Mount the generator in a vise.
- Install SST (A) and (B) to the pulley as shown in the illustration.

SST 09820-63021

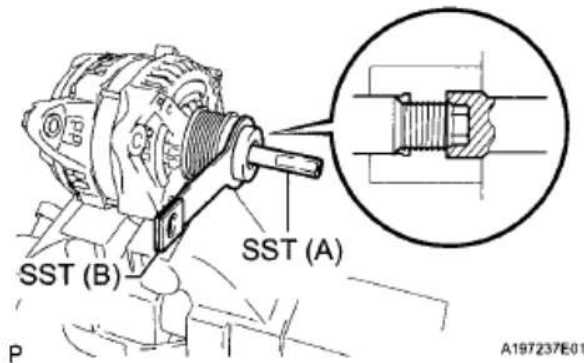


Fig. 15: Installing SST (A) And (B) To Pulley

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- Use a wrench to hold SST (A), and turn SST (B) counterclockwise to loosen the generator pulley.

NOTE:

- Check that the drive end frame is secured in the vise tightly.
- Hold SST (A) tightly during the operation.

- Remove the generator pulley.

3. REMOVE GENERATOR REAR END COVER

- Place the generator on the generator pulley.

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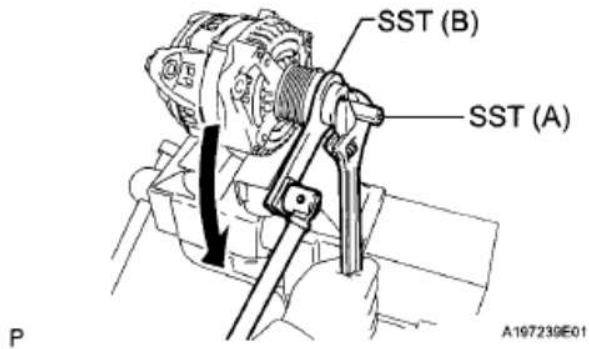


Fig. 16: Removing Generator Pulley

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Remove the 3 nuts and generator rear end cover.

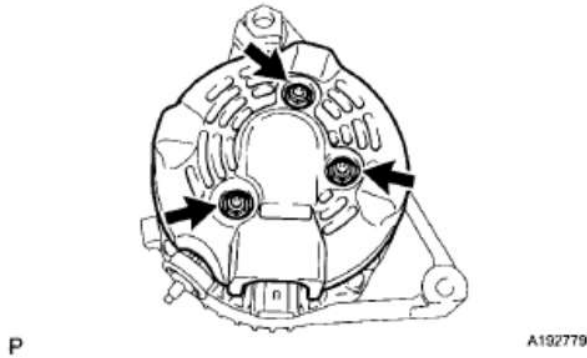


Fig. 17: Locating Generator Rear End Cover Nuts

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Remove the terminal insulator.

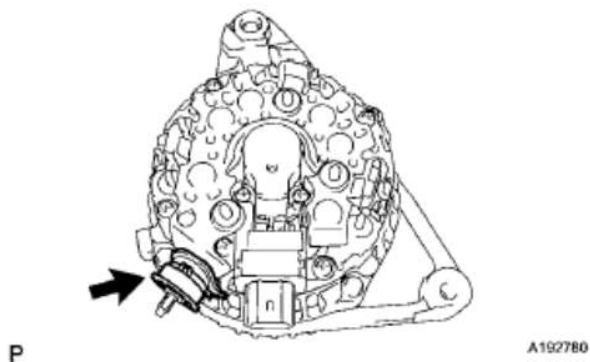


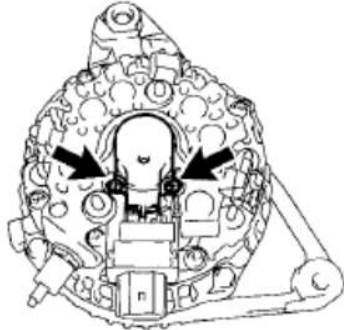
Fig. 18: Locating Terminal Insulator

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. REMOVE GENERATOR BRUSH HOLDER ASSEMBLY

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- a. Remove the 2 screws and generator brush holder.



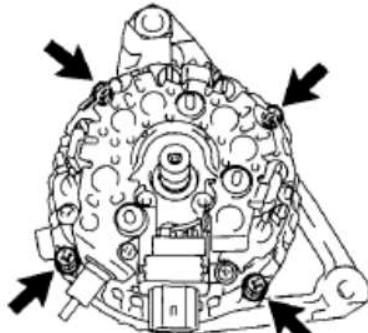
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Fig. 19: Locating Generator Brush Holder Screws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. REMOVE GENERATOR COIL ASSEMBLY

- a. Remove the 4 bolts.



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Fig. 20: Locating Generator Coil Assembly Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Using SST, remove the generator coil.

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

- c. Remove the washer.

6. REMOVE GENERATOR ROTOR ASSEMBLY

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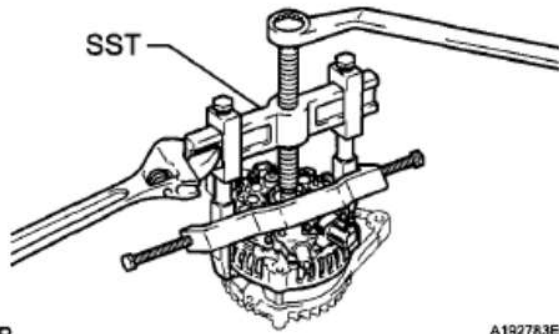


Fig. 21: Removing Generator Coil

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. REPLACE GENERATOR DRIVE END FRAME BEARING

- a. Remove the 4 screws and bearing retainer.

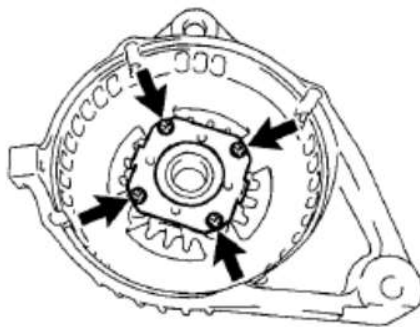


Fig. 22: Locating Bearing Retainer Screws

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Using SST and a hammer, tap out the bearing.

SST 09950-60010 (09951-00250), 09950-70010 (09951-07100)

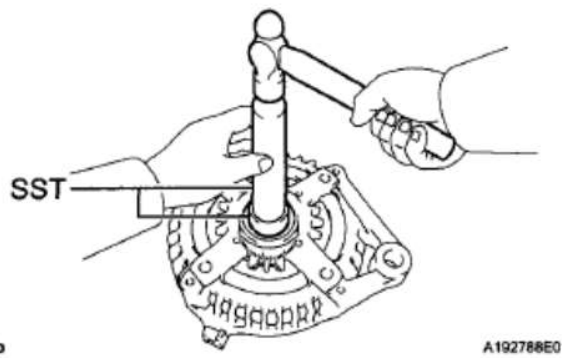


Fig. 23: Tapping Out Bearing

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Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Using SST and a press, press in a new bearing.

SST 09950-60010 (09951-00520), 09950-70010 (09951-07100)

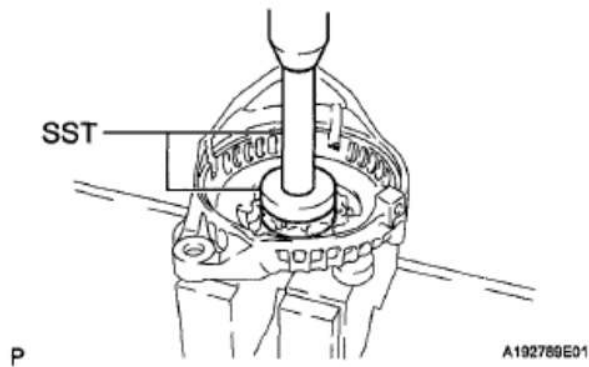


Fig. 24: Pressing In Bearing

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- d. Install the bearing retainer with the 4 screws.

Torque: 2.3 N*m (23 kgf*cm, 20 in.*lbf)

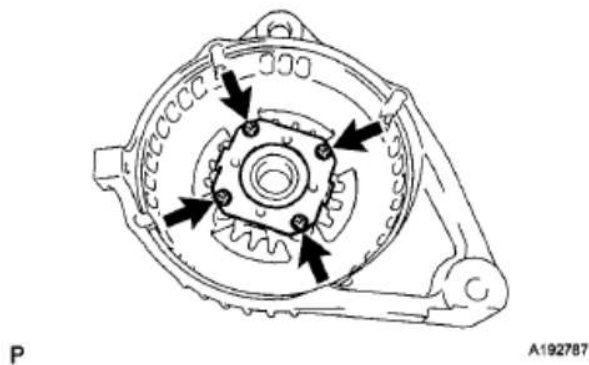


Fig. 25: Locating Bearing Retainer Screws

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. INSPECT GENERATOR BRUSH HOLDER ASSEMBLY

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

Standard length:

9.5 to 11.5 mm (0.374 to 0.453 in.)

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Minimum length:

4.5 mm (0.177 in.)

If the brush length is less than the minimum, replace the generator brush holder assembly.

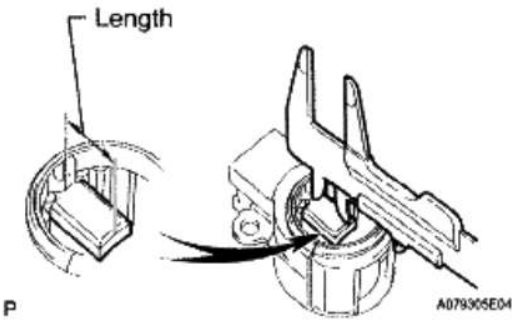


Fig. 26: Measuring Brush Length
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. INSPECT GENERATOR ROTOR ASSEMBLY
- a. Check the rotor for an open circuit.

1. Measure the resistance according to the value(s) in the table below.

Standard Resistance

STANDARD RESISTANCE	
Condition	Specified Condition
Approx. 20°C (68°F)	except 150 A 2.3 to 2.7 ohms
	150 A 1.5 to 1.9 ohms

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

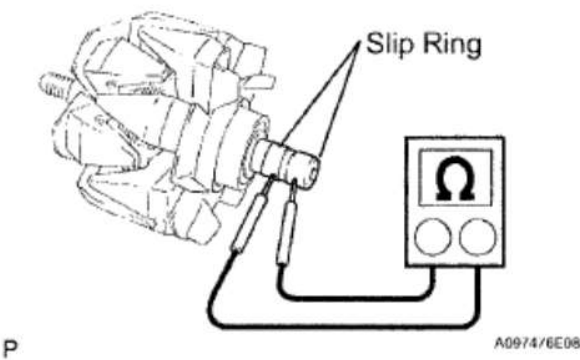


Fig. 27: Checking Rotor For An Open Circuit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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- b. Check if the rotor is grounded.
1. Measure the resistance according to the value(s) in the table below.

Standard Resistance

STANDARD RESISTANCE

Tester Connection	Condition	Specified Condition
Slip ring - Rotor	Always	10 kohms or higher

If the result is not as specified, replace the rotor assembly.

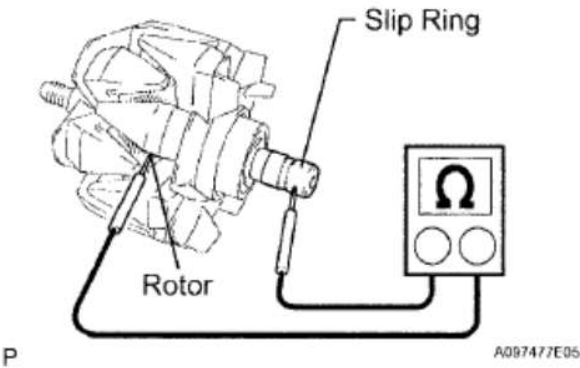


Fig. 28: Checking Rotor Is Grounded
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Check the slip ring diameter.
1. Using a vernier caliper, measure the diameter of each slip ring.

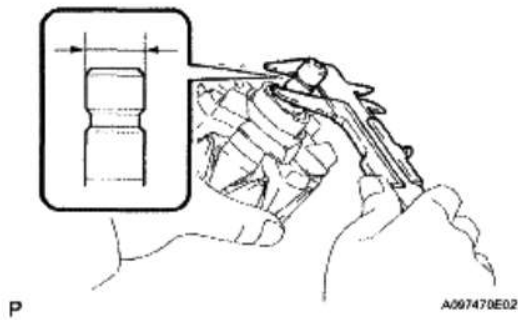
Standard diameter:

14.2 to 14.4 mm (0.559 to 0.567 in.)

Minimum diameter:

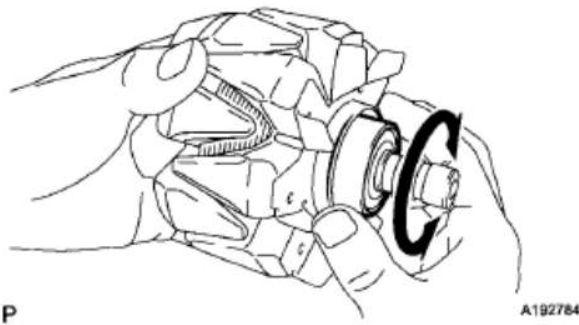
14 mm (0.551 in.)

If the diameter is less than the minimum, replace the generator rotor assembly.

2009 Toyota Highlander Limited**2009 ELECTRICAL Charging (1AR-FE) - Highlander****Fig. 29: Measuring Slip Ring Diameter****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

- d. Check the appearance.
 1. Check that the bearing is not rough or worn and that it rotates smoothly

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

**Fig. 30: Checking Bearing Is Not Rough Or Worn And Rotates Smoothly****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.****3. INSPECT GENERATOR DRIVE END FRAME BEARING**

- a. Check that the bearing is not rough or worn and that it rotates smoothly.

If the bearing does not rotate smoothly, replace the bearing.

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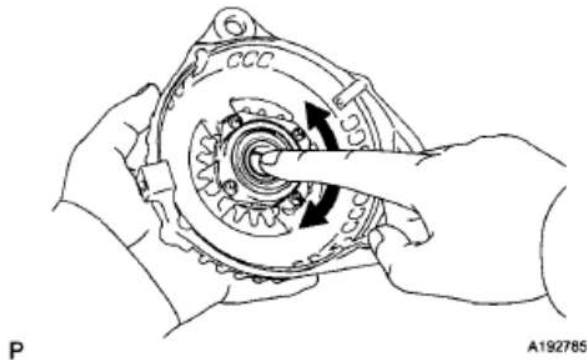


Fig. 31: Inspecting Generator Drive End Frame Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. INSPECT GENERATOR PULLEY WITH CLUTCH

- Hold the center of the pulley, and confirm that the outer ring turns counterclockwise and does not turn clockwise.

If the result is not as specified, replace the generator pulley with clutch.



Fig. 32: Inspecting Generator Pulley With Clutch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REASSEMBLY

1. INSTALL GENERATOR ROTOR ASSEMBLY

- Place the generator drive end frame on the generator pulley.
- Install the generator rotor to the generator drive end frame.

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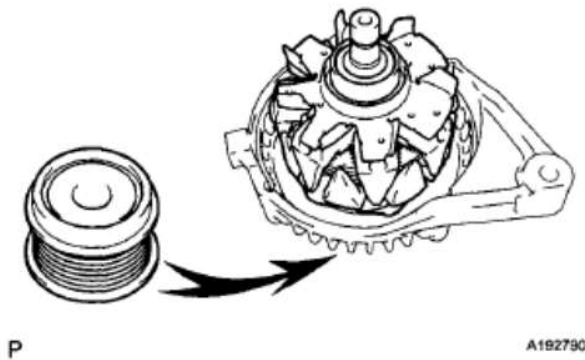


Fig. 33: Placing Generator Drive End Frame On Generator Pulley
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Place the washer on the generator rotor.

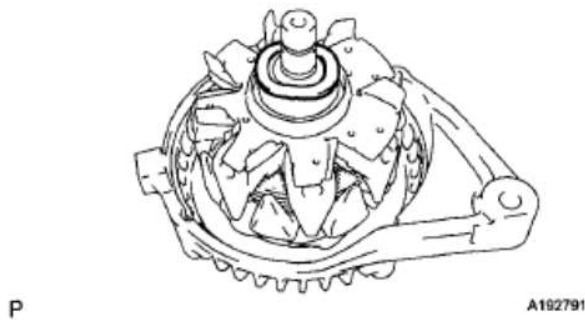


Fig. 34: Placing Washer On Generator Rotor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. INSTALL GENERATOR COIL ASSEMBLY

- a. Using a 21 mm socket wrench and a press, slowly press in the generator coil.

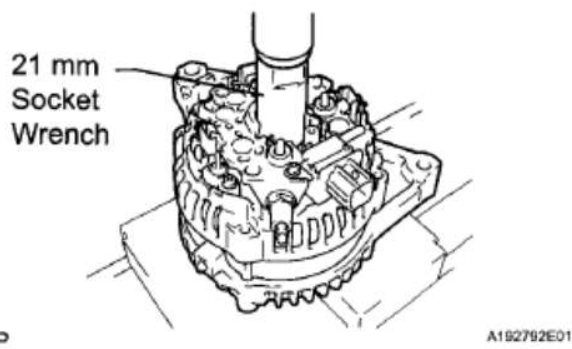


Fig. 35: Pressing In Generator Coil
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Install the 4 bolts.

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Torque: 5.9 N*m (60 kgf*cm, 52 in.*lbf)

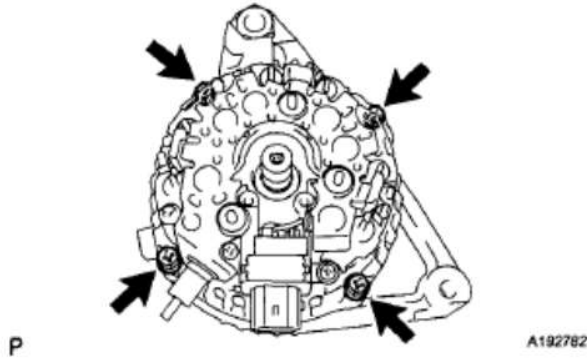


Fig. 36: Locating Generator Coil Assembly Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. INSTALL GENERATOR BRUSH HOLDER ASSEMBLY

- a. While pushing the 2 brushes into the generator brush holder, insert a 1.0 mm (0.0394 in.) pin into the generator brush holder.

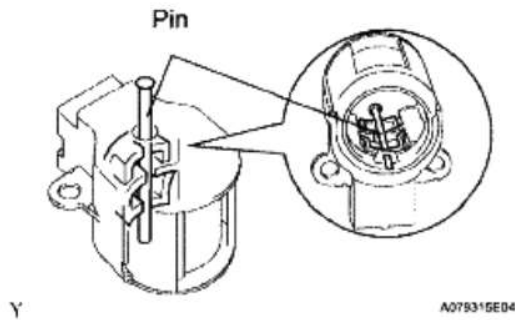


Fig. 37: Inserting Pin Into Generator Brush Holder
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Install the generator brush holder with the 2 screws.

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

- c. Pull the pin out of the generator brush holder.

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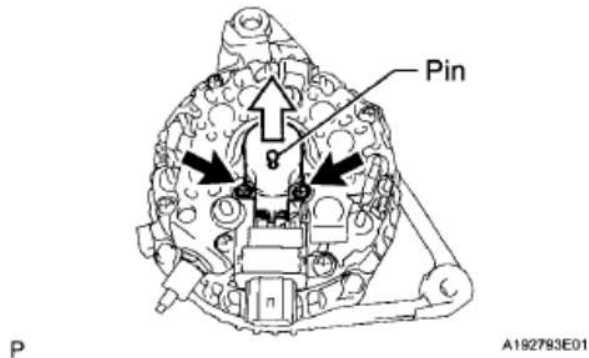


Fig. 38: Locating Generator Brush Holder Screws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. INSTALL GENERATOR REAR END COVER

- a. Install the terminal insulator onto the generator coil assembly.

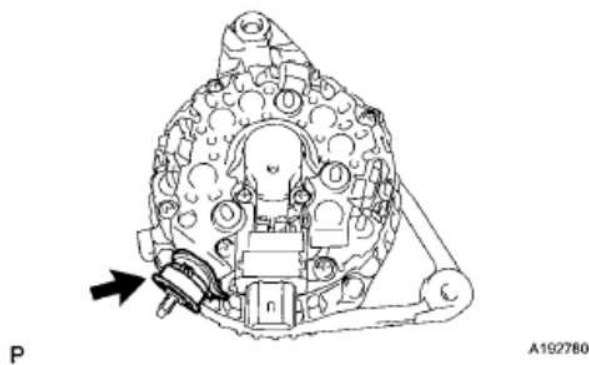


Fig. 39: Locating Generator Coil Assembly Terminal Insulator
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Install the generator rear end cover with the 3 nuts.

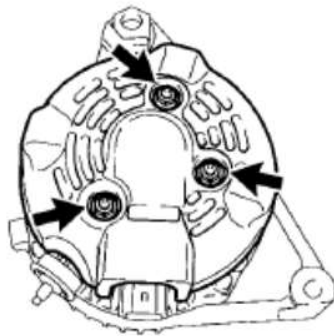
Torque: 4.6 N*m (47 kgf*cm, 41 in.*lbf)

5. INSTALL GENERATOR PULLEY WITH CLUTCH

- a. Temporarily install the generator pulley by hand.
- b. Mount the generator in a vise.

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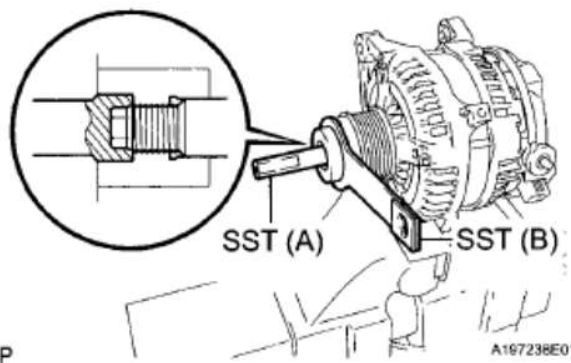
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Fig. 40: Locating Generator Rear End Cover Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Install SST (A) and (B) to the generator pulley as shown in the illustration.

SST 09820-63021



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Fig. 41: Installing SST (A) And (B) To Generator Pulley
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- d. Using a wrench to hold SST (A), turn SST (B) clockwise to tighten the generator pulley.

Torque: without SST

80 N*m (816 kgf*cm, 59 ft.*lbf)

with SST

58 N*m (591 kgf*cm, 43 ft.*lbf)

NOTE:

- Use a torque wrench with a fulcrum length of 260 mm (10.24 in.).
- This torque value is effective when SST is parallel to a torque wrench.
- Check that the drive end frame is secured in the vise tightly.

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- Hold SST (A) tightly during the operation.

e. Check that the generator pulley rotates smoothly.

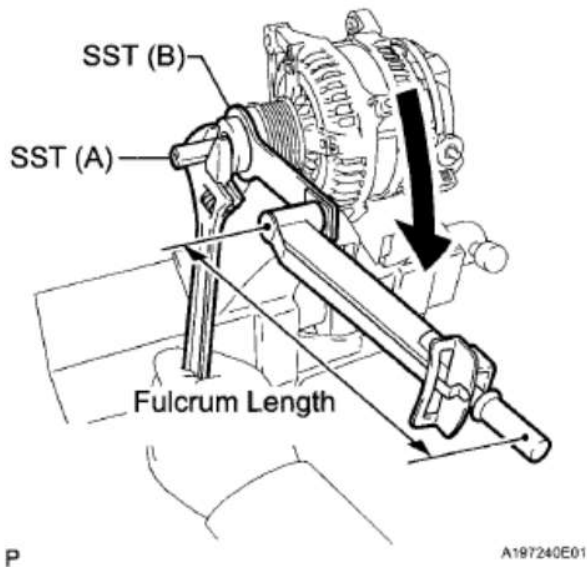


Fig. 42: Tightening Generator Pulley

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. INSTALL GENERATOR PULLEY CAP

a. Install a new generator pulley cap to the pulley.



Fig. 43: Installing Generator Pulley Cap To Pulley

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. INSTALL GENERATOR ASSEMBLY

a. Install the generator with the 2 bolts.

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Torque: 52 N*m (530 kgf*cm, 38 ft.*lbf)

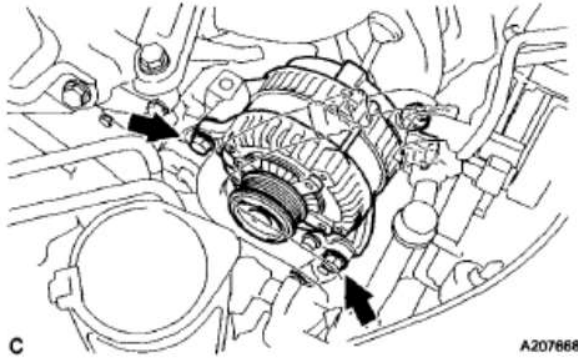


Fig. 44: Locating Generator Bolts

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Install the wire harness clamp bracket with the bolt.

Torque: 8.4 N*m (86 kgf*cm, 74 in.*lbf)

- c. Connect the generator wire with the nut.

Torque: 9.8 N*m (100 kgf*cm, 87 in.*lbf)

- d. Install the terminal cap.
- e. Connect the generator connector.

2. INSTALL V-RIBBED BELT

- a. Install the belt (See INSTALLATION).

3. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTE: When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).

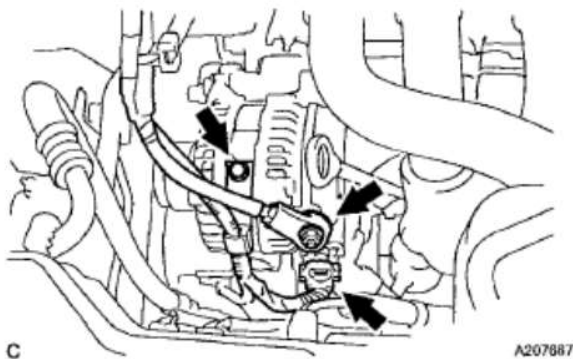


Fig. 45: Locating Wire Harness Clamp Bracket Bolt And Generator Wire Nut

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