

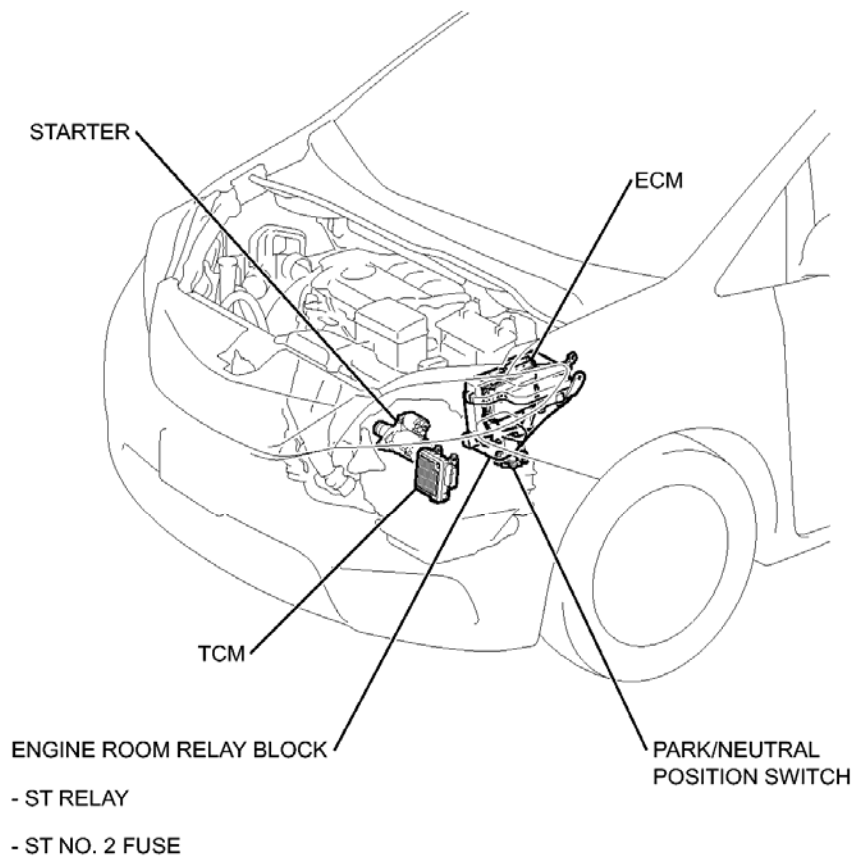
ENGINE

Starting System [1AR-FE] (Inspection) - Sienna

STARTING SYSTEM

PARTS LOCATION

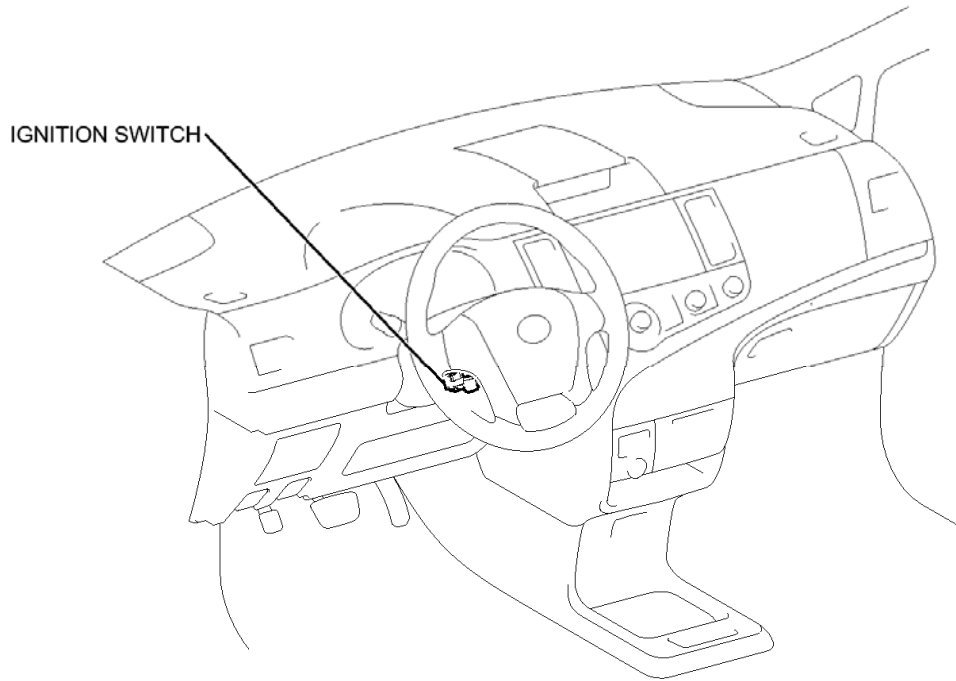
ILLUSTRATION



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Fig. 1: Starting System Components Location (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION

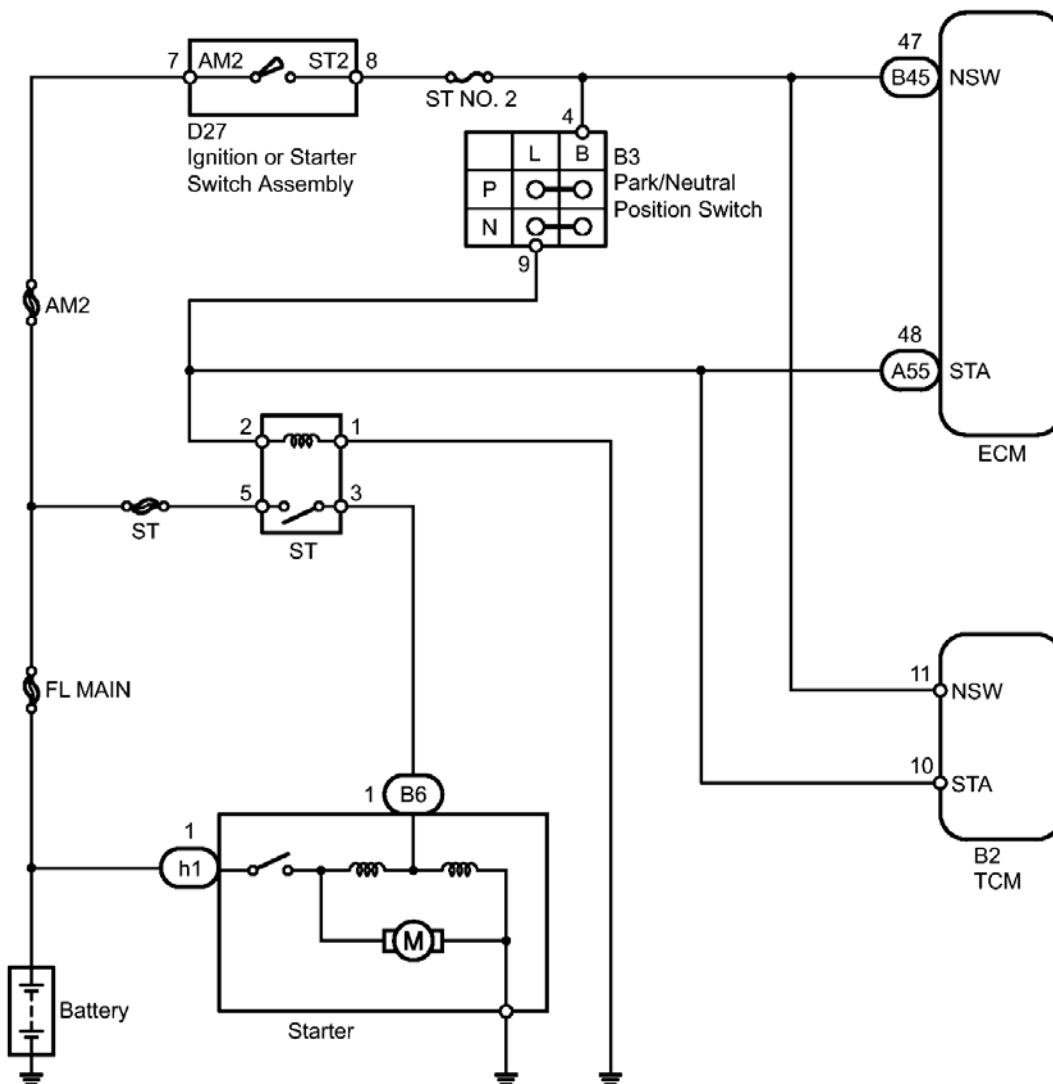


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Fig. 2: Starting System Components Location (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

SYSTEM DIAGRAM

SYSTEM DIAGRAM



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Fig. 3: Starting System Diagram

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

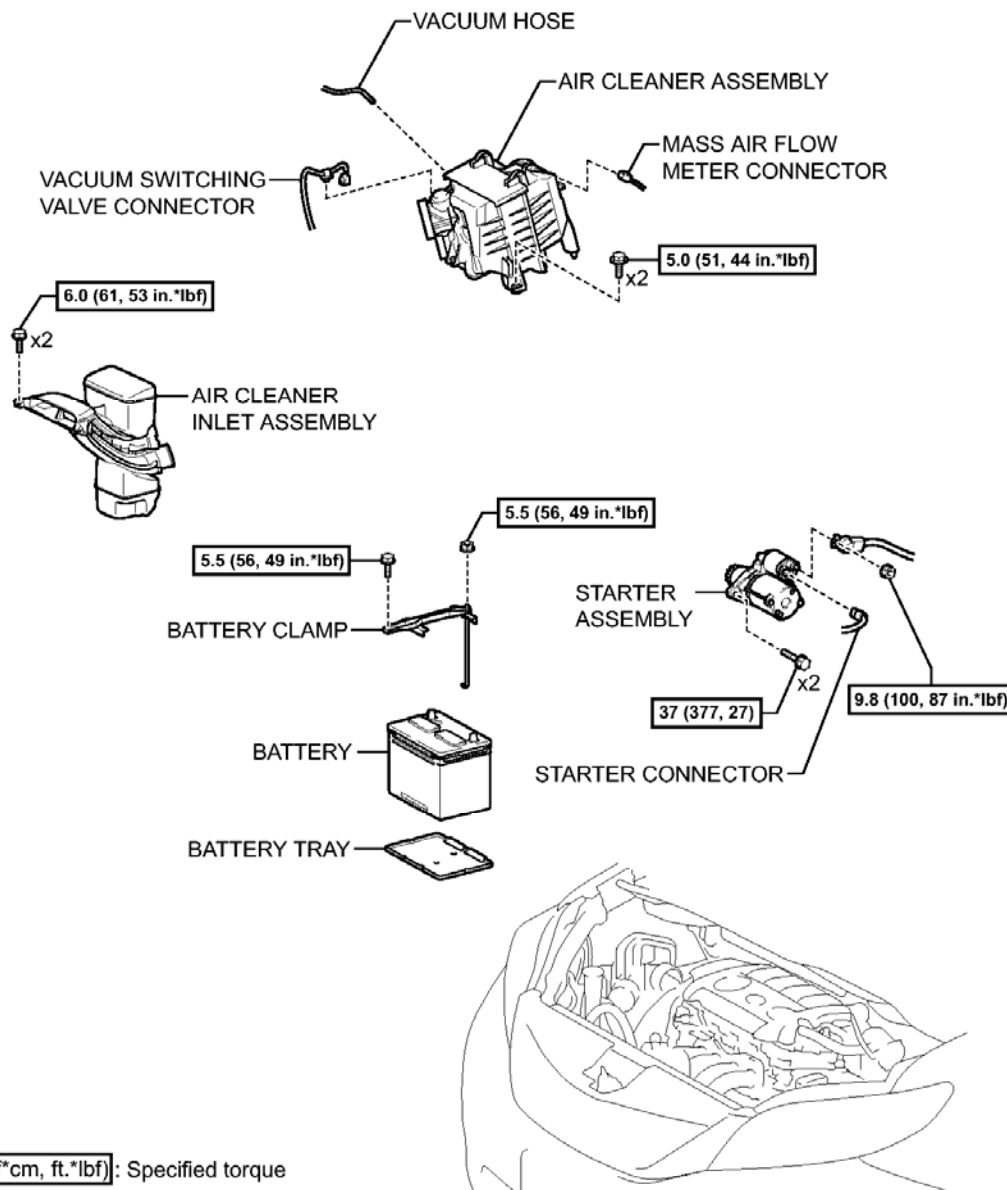
ENGINE

Starting System [1AR-FE]- Sienna

STARTER

COMPONENTS

ILLUSTRATION



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Fig. 1: Starter Replacement Components With Torque Specifications

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

ILLUSTRATION

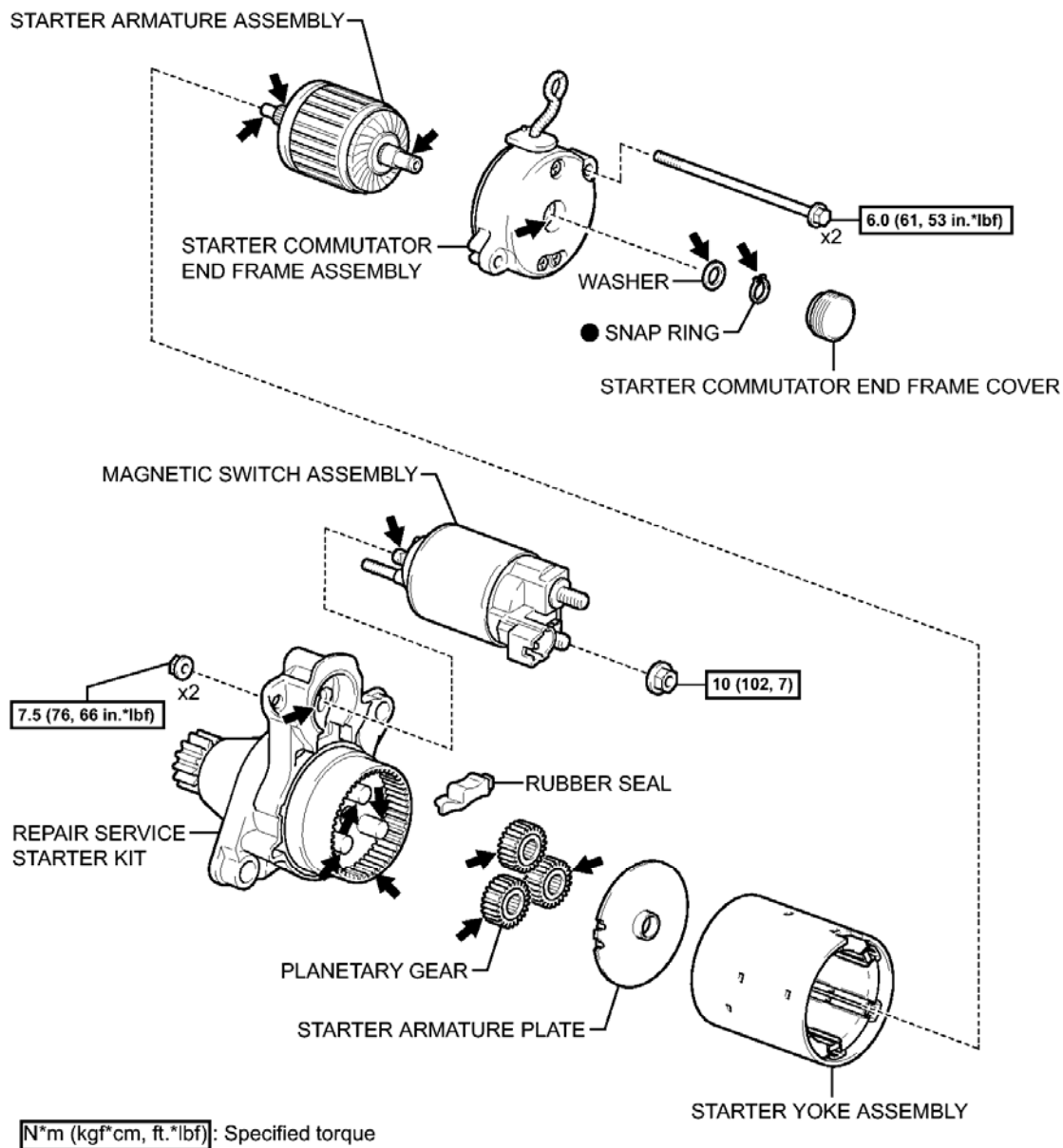


Fig. 2: Exploded View Of Starter Components With Torque Specifications
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**

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

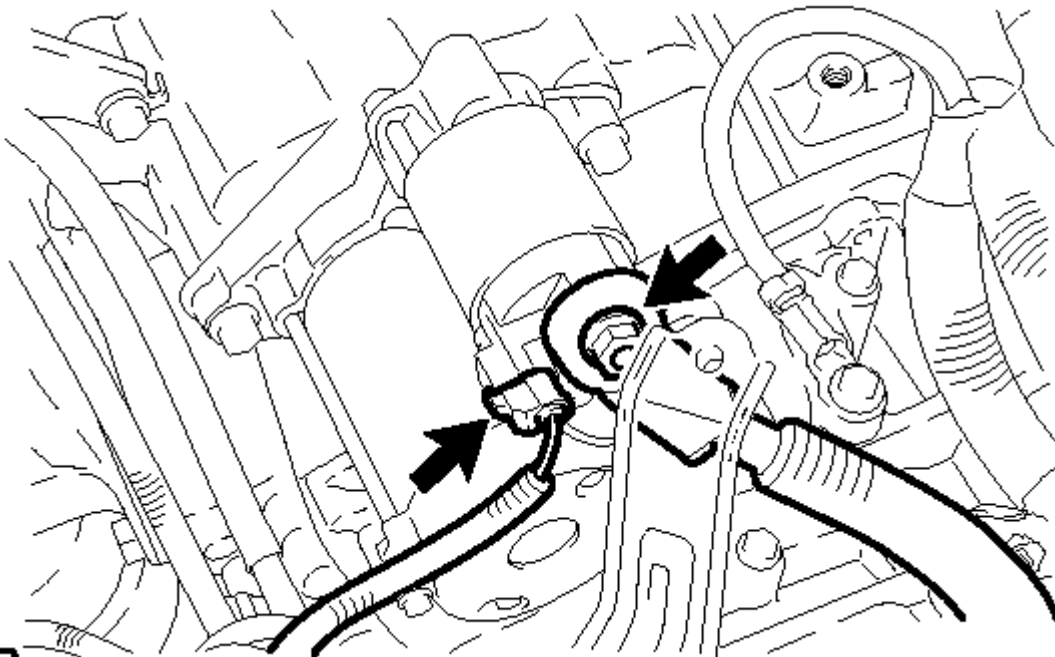
2. **REMOVE AIR CLEANER INLET ASSEMBLY** . Refer to REMOVAL - Step 22

3. **REMOVE BATTERY** . Refer to REMOVAL - Step 23

4. **REMOVE AIR CLEANER ASSEMBLY** . Refer to REMOVAL - Step 24

5. **REMOVE STARTER ASSEMBLY**

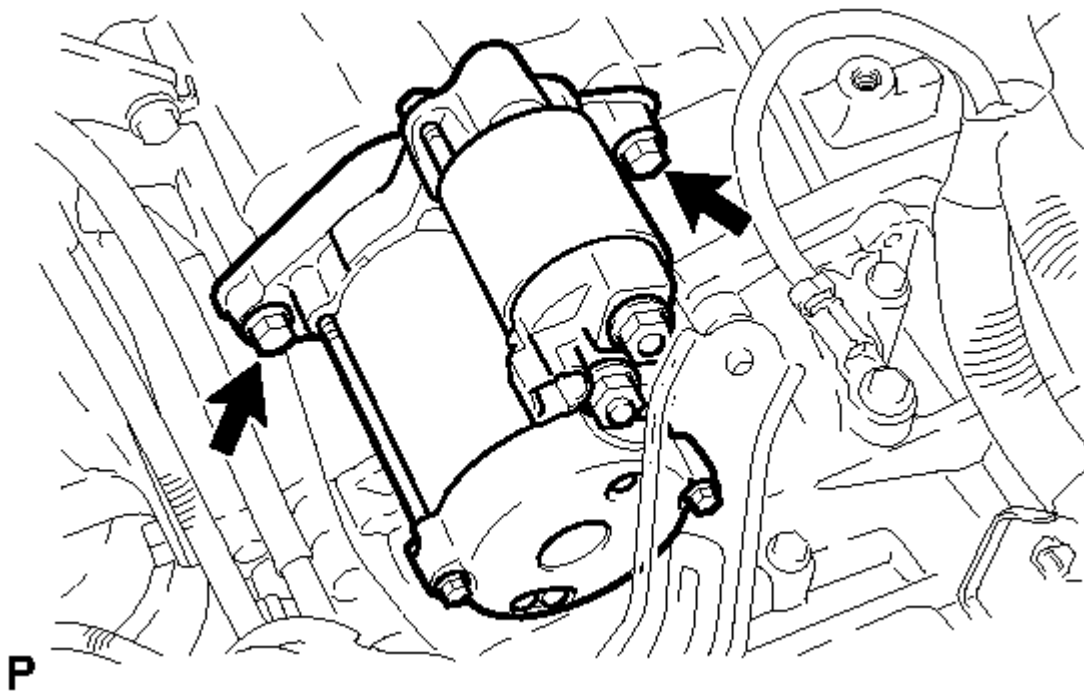
- a. Disconnect the starter connector.



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Fig. 3: Identifying Starter Assembly Connector, Terminal & Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Open the terminal cap.
- c. Remove the nut and disconnect the terminal 30.
- d. Remove the 2 bolts and the starter assembly.



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Fig. 4: Identifying Starter Assembly Bolts

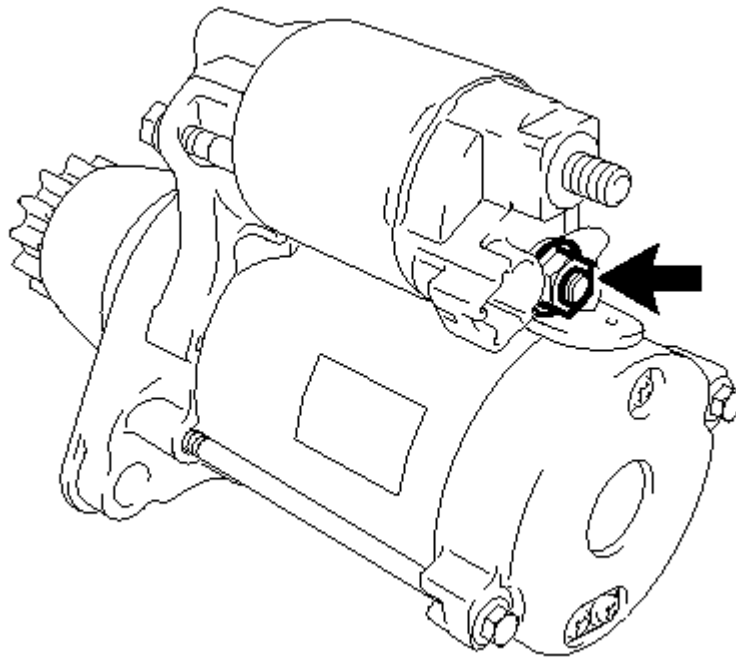
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY

DISASSEMBLY

1. REMOVE MAGNETIC SWITCH ASSEMBLY

- a. Remove the nut and disconnect the lead wire from the terminal C.

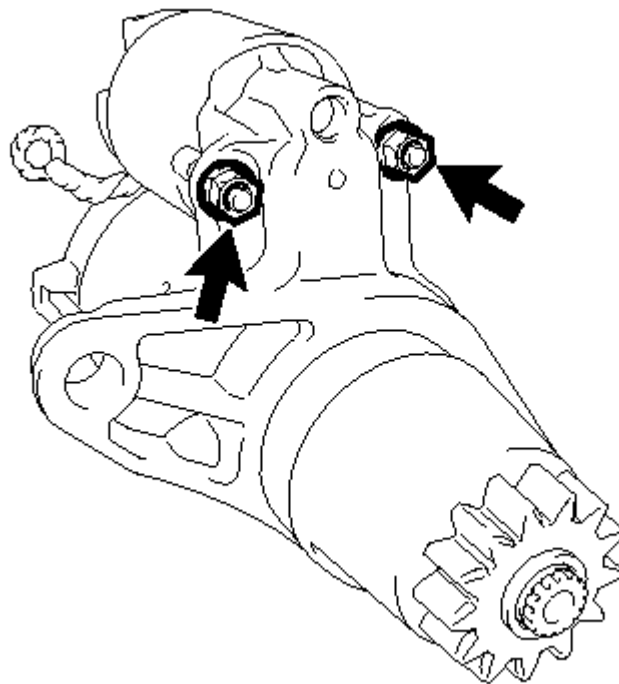


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Fig. 5: Identifying Magnet Starter Switch Nut

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

- b. Remove the 2 nuts that hold the magnetic switch assembly from the starter housing assembly.



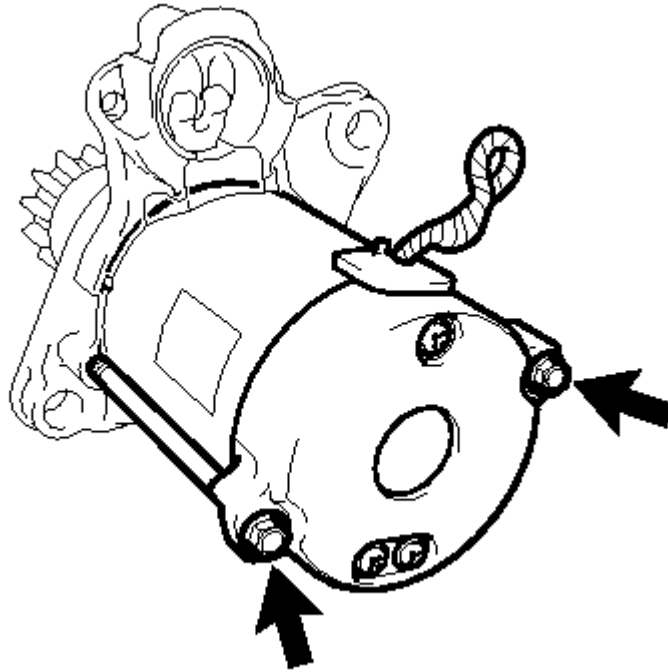
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Fig. 6: Identifying Magnet Starter Switch Nuts

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

2. REMOVE STARTER YOKE ASSEMBLY

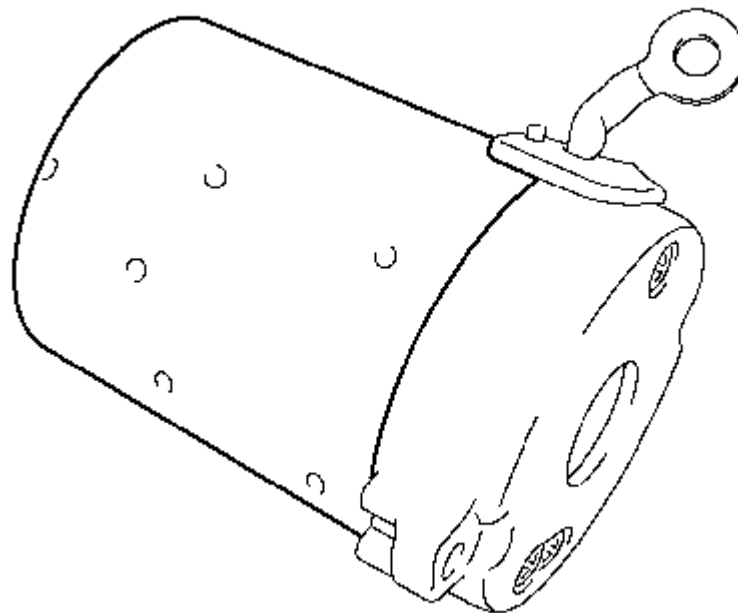
- a. Remove the 2 through bolts and pull out the starter yoke assembly together with the starter commutator end frame assembly.



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Fig. 7: Identifying Starter Yoke Assembly Through-Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Remove the starter yoke assembly from the starter commutator end frame assembly.



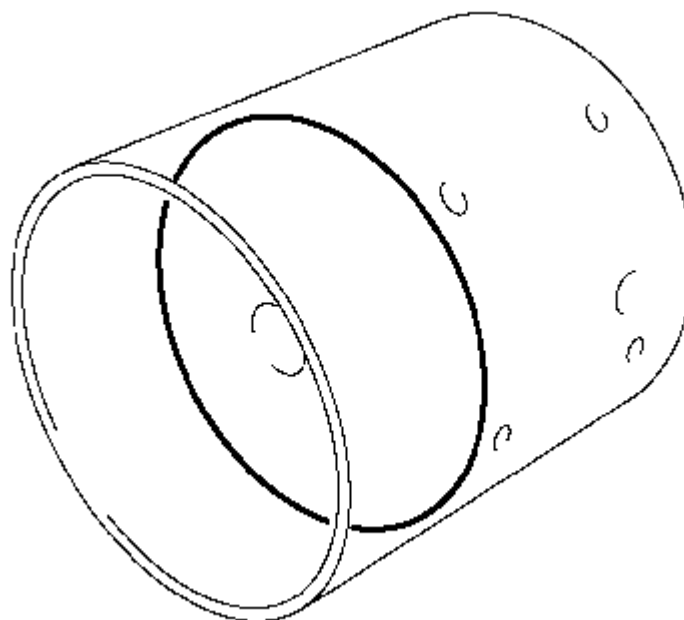
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Fig. 8: Identifying Starter Commutator End Frame
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. REMOVE STARTER ARMATURE PLATE

- a. Remove the starter armature plate from the starter yoke assembly.



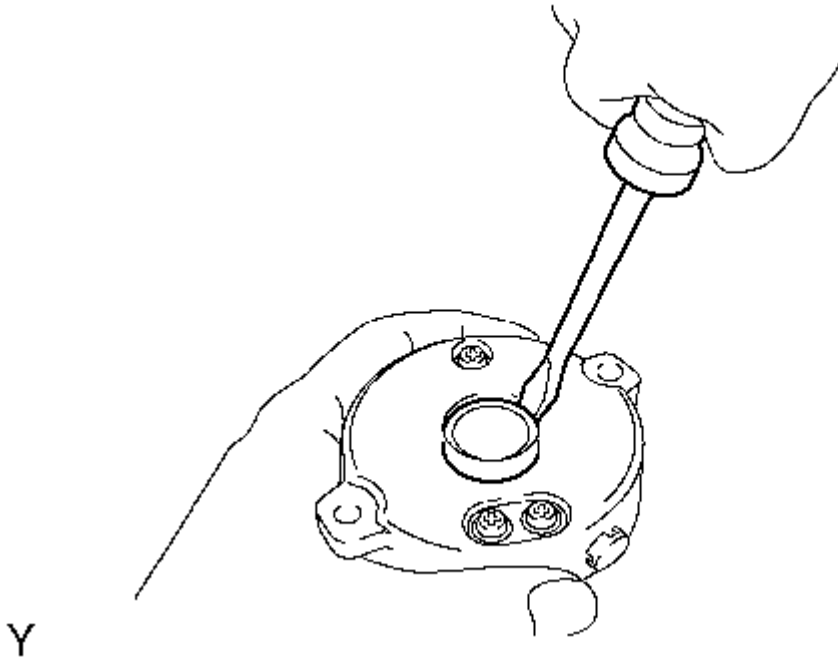
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A79722

Fig. 9: Identifying Starter Armature Plate
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. REMOVE STARTER COMMUTATOR END FRAME COVER

- a. Using a screwdriver, pry out the starter commutator end frame cover.

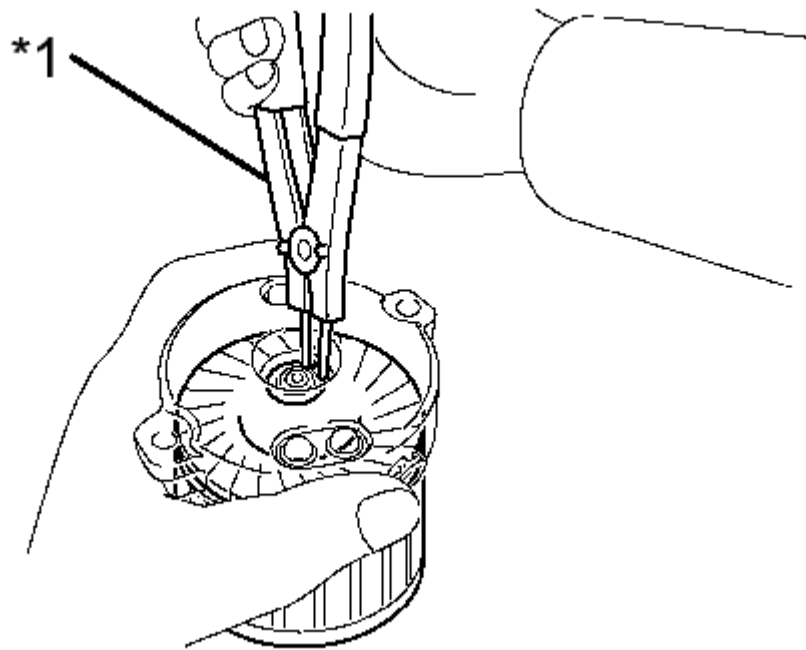


A79723

Fig. 10: Prying Out Commutator End Frame Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. REMOVE STARTER ARMATURE ASSEMBLY

- a. Using snap ring pliers, remove the snap ring and the plate washer.



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Fig. 11: Remove/Install Starter Armature Assembly Using Snap Ring Pliers
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Do not drop the starter armature assembly.

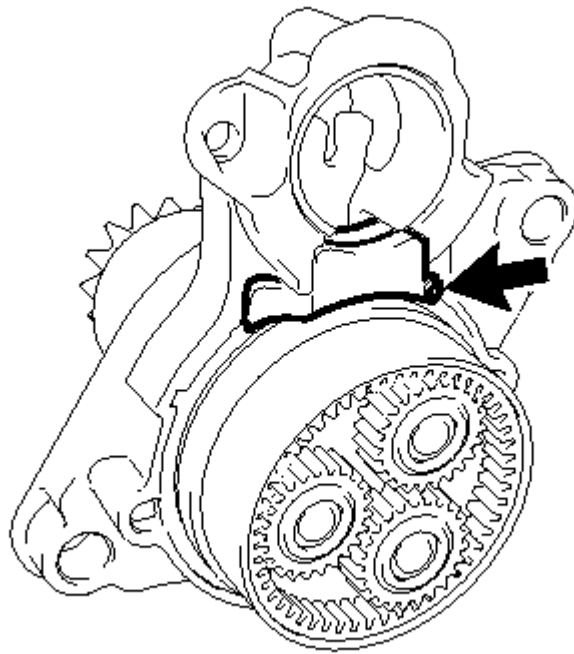
TEXT IN ILLUSTRATION

	Snap
*1	Ring
	Pliers

- b. Remove the starter armature assembly from the commutator end frame assembly.

6. REMOVE RUBBER SEAL

- a. Remove the rubber seal.



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Fig. 12: Identifying Starter Armature Assembly Rubber Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. REMOVE PLANETARY GEAR

- a. Remove the 3 planetary gears from the repair service starter kit.

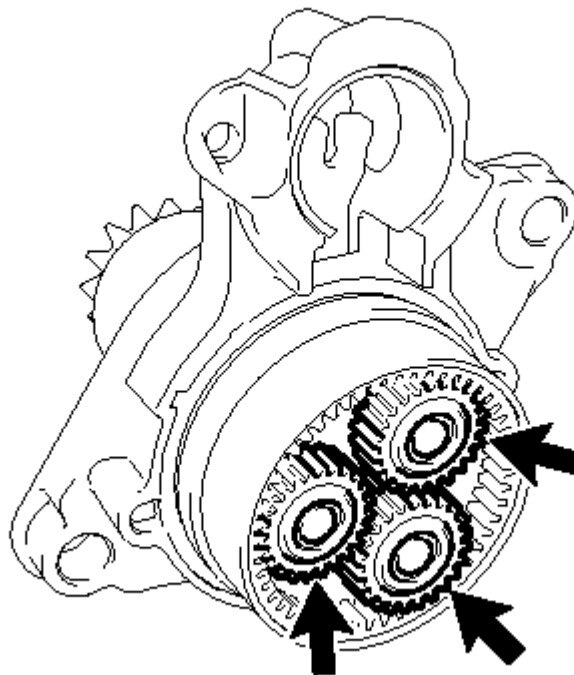


Fig. 13: Removing The 3 Planetary Gears

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

INSPECTION

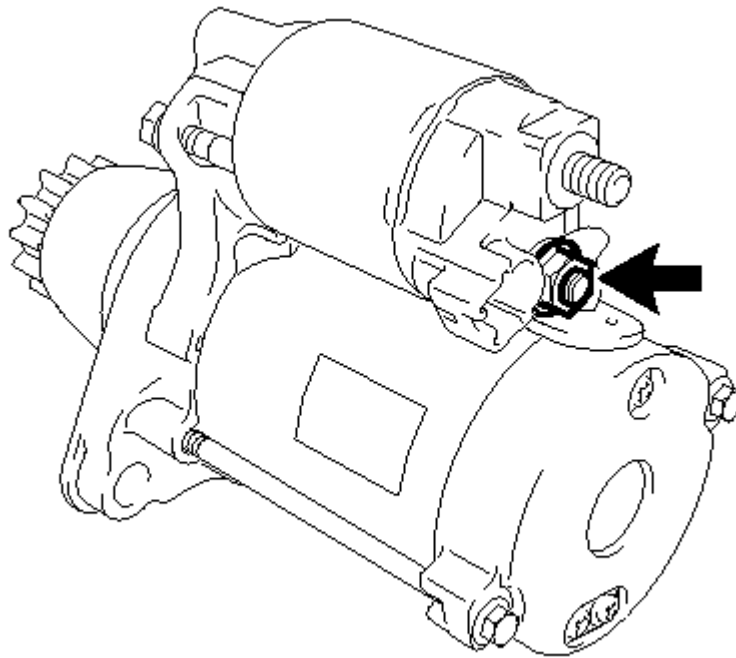
INSPECTION

1. INSPECT STARTER ASSEMBLY

WARNING: As a large electric current passes through the cable during this inspection, a thick cable must be used. If not, the cable may be hot and cause injury.

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

- a. Perform a pull-in test.



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Fig. 14: Identifying Magnet Starter Switch Nut

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

1. Remove the nut and disconnect the lead wire from terminal C.
2. Connect the battery to the magnetic switch as shown in the illustration. Check that the clutch pinion gear is extended.

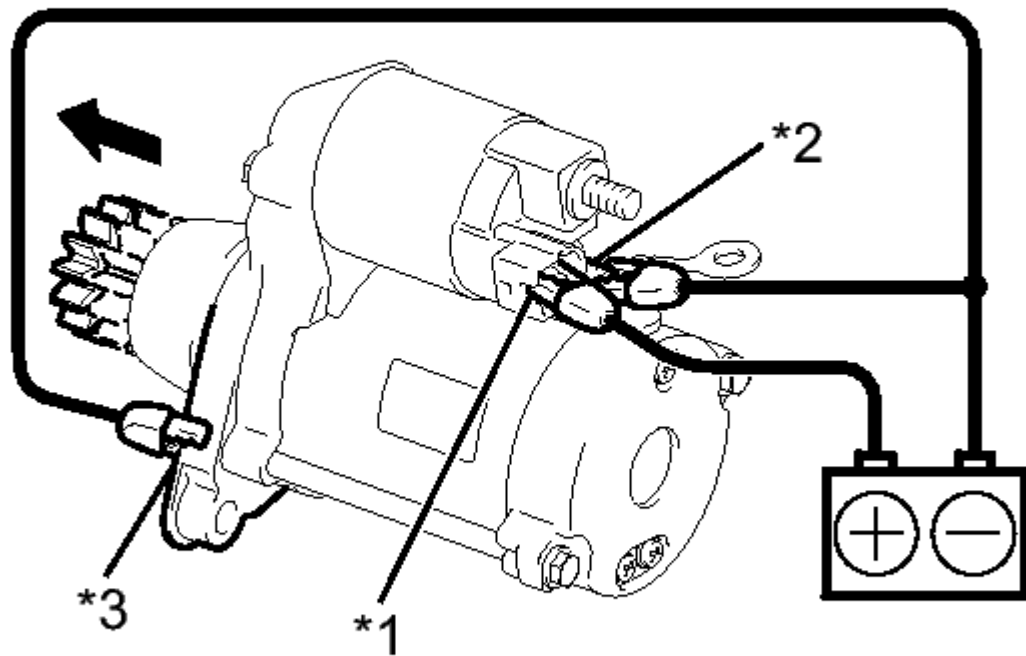


Fig. 15: Checking Starter Assembly Operation With Battery Voltage Applied
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Terminal 50
*2	Terminal C
*3	Body

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

- b. Perform a holding test.

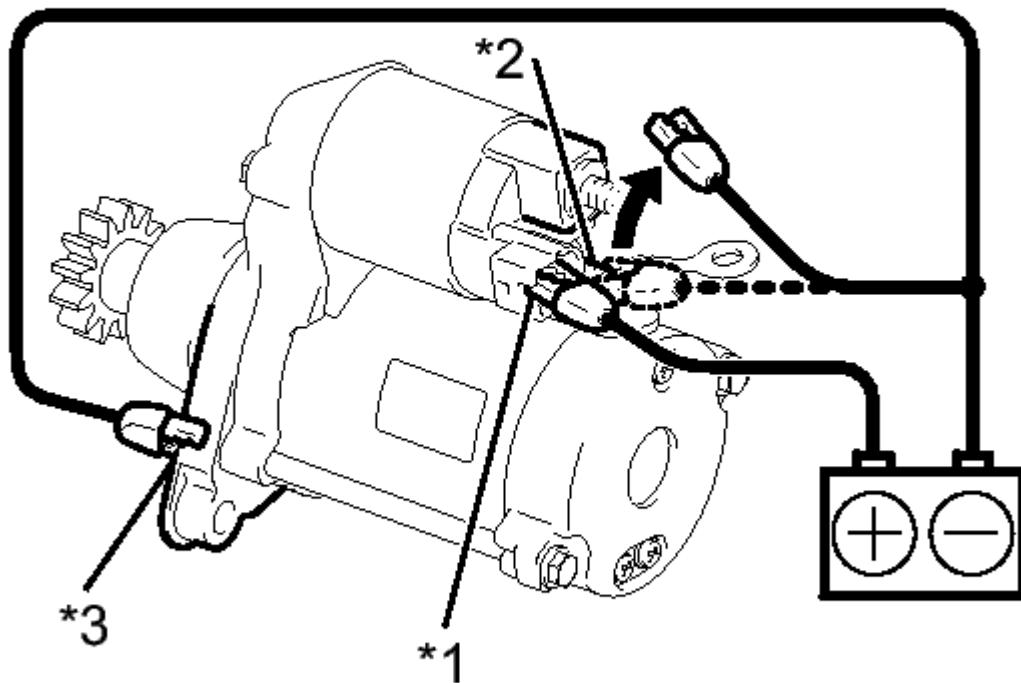


Fig. 16: Performing Holding Test With Negative (-) Lead Disconnected From Terminal C
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Disconnect the negative (-) lead from terminal C. Check that the clutch pinion gear remains extended.

TEXT IN ILLUSTRATION

*1	Terminal 50
*2	Terminal C
*3	Body

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

- c. Inspect the clutch pinion gear return.

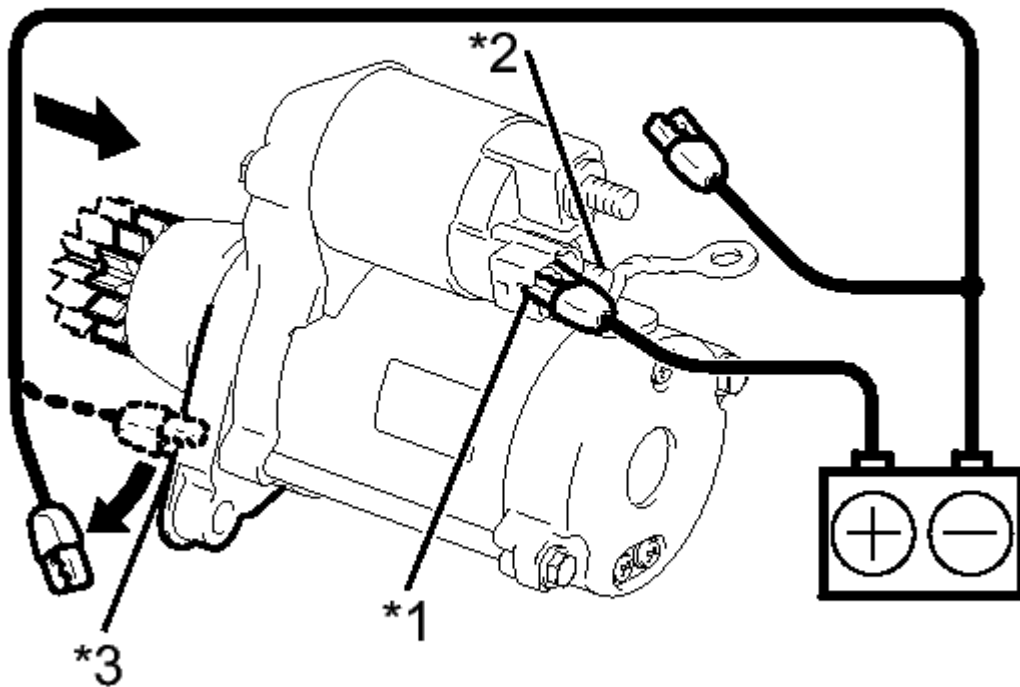


Fig. 17: Inspecting Clutch Pinion Gear Return With Negative (-) Lead Disconnected From Starter Body

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

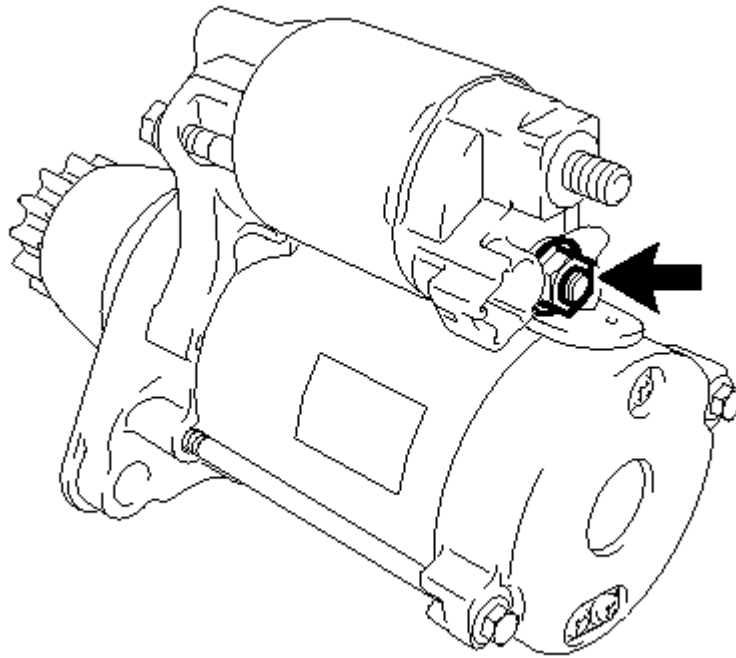
1. Disconnect the negative (-) lead from the starter body. Check that the clutch pinion gear returns.

TEXT IN ILLUSTRATION

*1	Terminal 50
*2	Terminal C
*3	Body

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

- d. Perform a no-load performance test.



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Fig. 18: Identifying Magnet Starter Switch Nut

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

1. Connect the lead wire to terminal C with the nut. 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.

NOTE: **Ensure that the starter is secured firmly in the vise to prevent from falling out.**

3. Connect the battery and an ammeter to the starter as shown in the illustration.

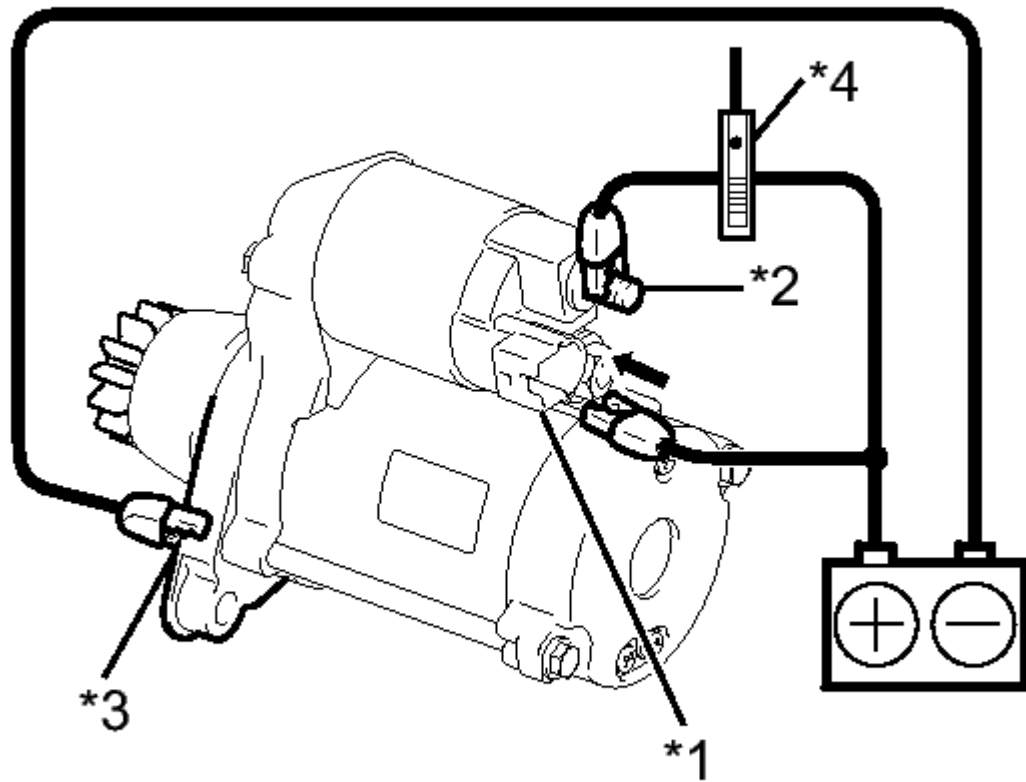


Fig. 19: Performing No-Load Performance Test With Battery & Ammeter Connected
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Do not allow any lead to get caught as the pinion gear rotates.

TEXT IN ILLUSTRATION

*1	Terminal 50
*2	Terminal 30
*3	Body
*4	Ammeter

4. Check that the starter rotates smoothly and steadily with the pinion gear extended.
5. Measure the current according to the value(s) in the table below.

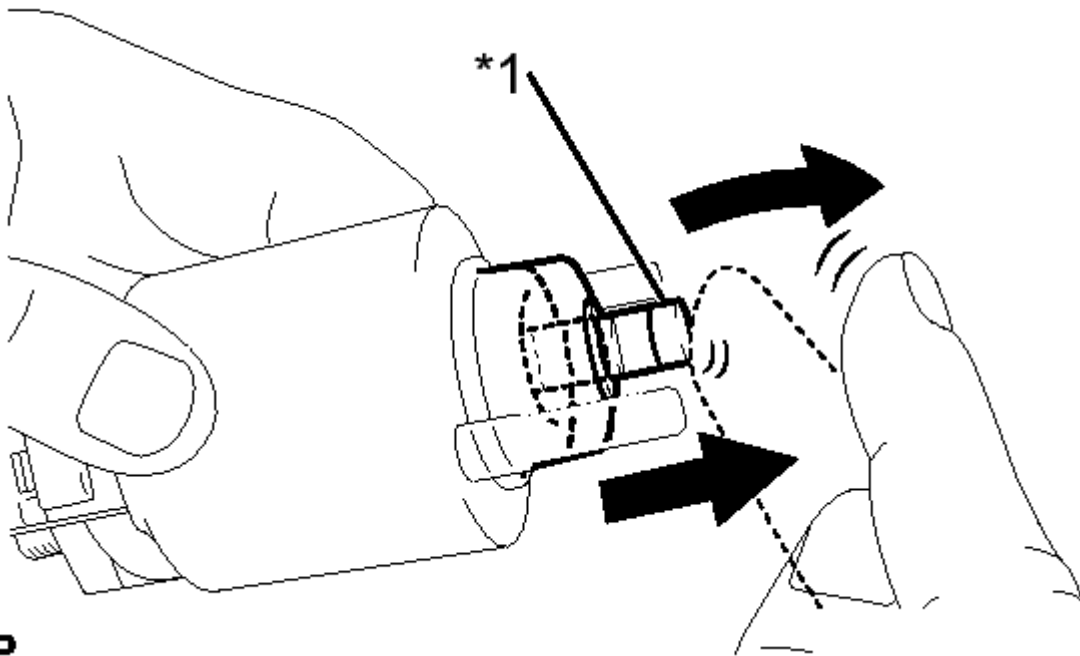
Standard Current

Tester Connection	Condition	Specified Condition
Battery positive terminal - Terminal 30	11.5 V	90 A or less

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

2. INSPECT MAGNETIC SWITCH ASSEMBLY

- a. Check the plunger.



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Fig. 20: Inspecting Magnetic Switch Assembly Plunger Operation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

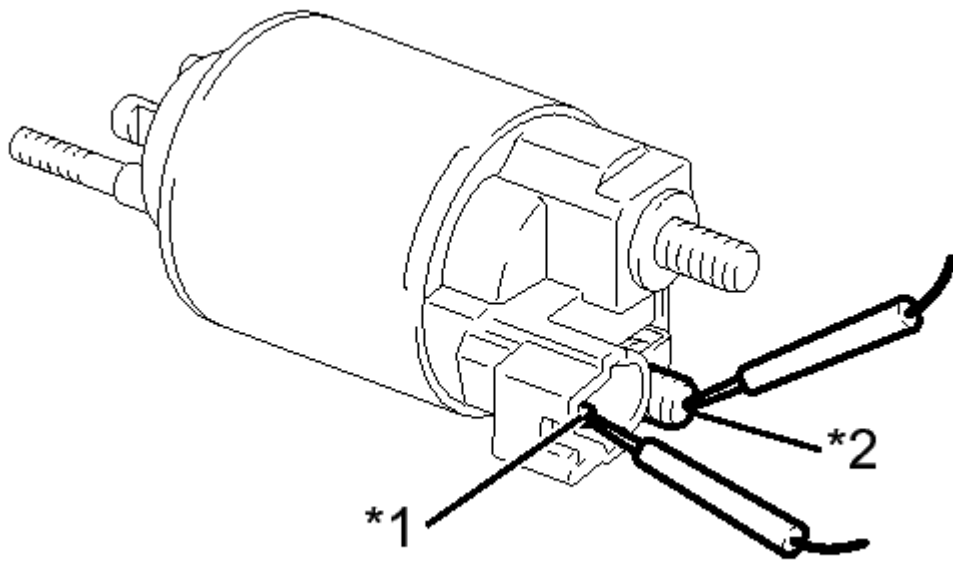
1. Push in the plunger and check that it returns quickly to its original position.

TEXT IN ILLUSTRATION

*1 Plunger

If necessary, replace the magnetic switch assembly.

- b. Check the pull-in coil for an open circuit.



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Fig. 21: Measuring Resistance

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

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

TEXT IN ILLUSTRATION

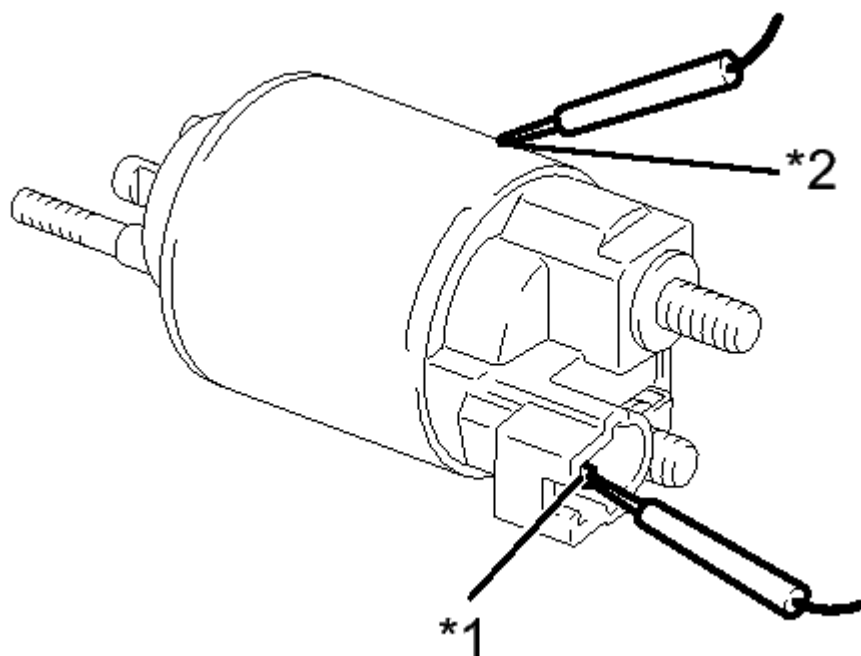
*1	Terminal 50
*2	Terminal C

Standard Resistance

Tester Connection	Condition	Specified Condition
Terminal 50 - Terminal C	Always	Below 1 ohms

If the result is not as specified, replace the magnetic switch assembly.

- c. Check the holding coil for an open circuit.



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Fig. 22: Checking Holding Coil For Open Circuit
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

TEXT IN ILLUSTRATION

*1	Terminal 50
*2	Body

Standard Resistance

Tester Connection	Condition	Specified Condition
Terminal 50 - Body	Always	Below 2 ohms

If the result is not as specified, replace the magnetic switch assembly.

3. INSPECT STARTER ARMATURE ASSEMBLY

HINT:

If there is no continuity between any segments, replace the starter armature assembly.

- 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 the commutator.

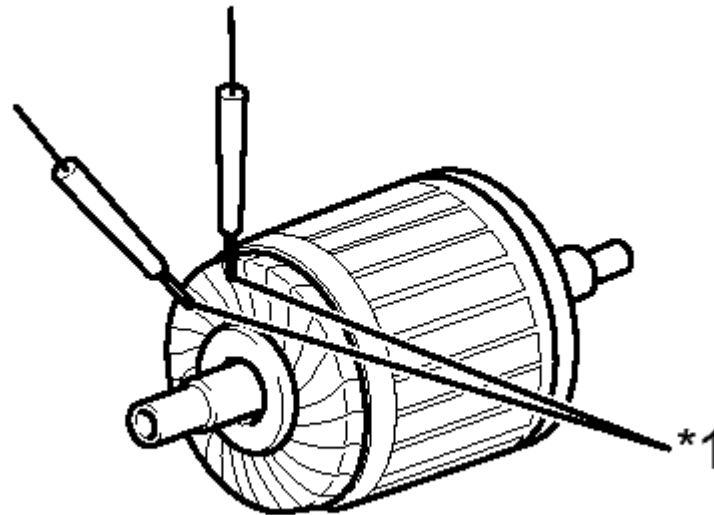


Fig. 23: Measuring Commutator Resistance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

TEXT IN ILLUSTRATION

*1 Commutator

Standard Resistance

Tester Connection	Condition	Specified Condition
Segment - Segment	Always	Below 1 ohms

If the result is not as specified, replace the starter armature assembly.

- c. Check the commutator.

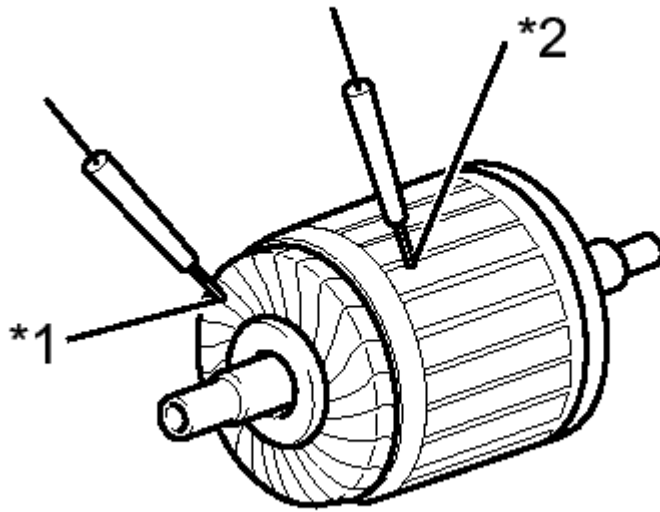


Fig. 24: Measuring Commutator & Armature Coil Core Resistance
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

TEXT IN ILLUSTRATION

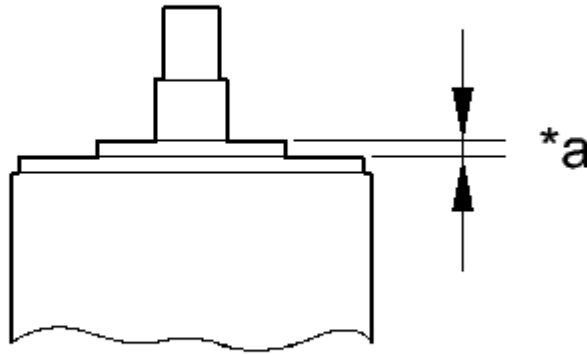
*1	Commutator
*2	Armature Coil Core

Standard Resistance

Tester Connection	Condition	Specified Condition
Commutator - Armature coil core	Always	10 kohms or higher

If the result is not as specified, replace the starter armature assembly.

- d. Using a vernier caliper, measure the commutator length.



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Fig. 25: Identifying Commutator Length Measurement
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*a Length

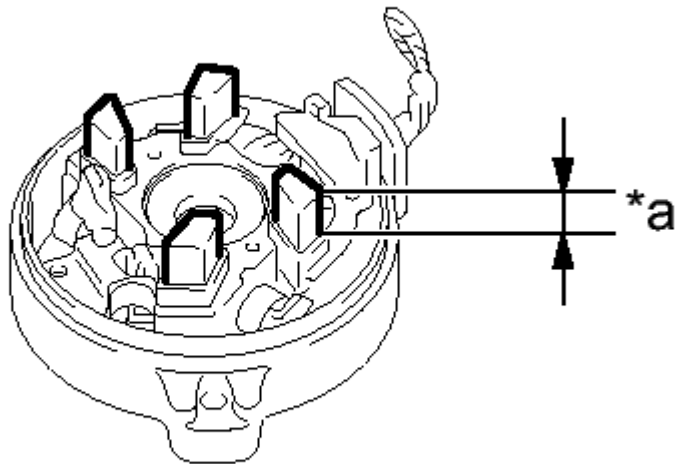
Standard length

3.1 to 3.8 mm (0.122 to 0.149 in.)

If the length is greater than the maximum, replace the starter armature assembly.

4. INSPECT STARTER COMMUTATOR END FRAME ASSEMBLY

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



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Fig. 26: Measuring Starter Commutator End Frame Assembly Brush Length With Vernier Caliper

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

TEXT IN ILLUSTRATION

$*a$	Length
------	--------

Standard length

4.0 to 9.0 mm (0.158 to 0.354 in.)

If the length is less than the minimum, replace the starter commutator end frame assembly.

- b. Check the brush insulation.

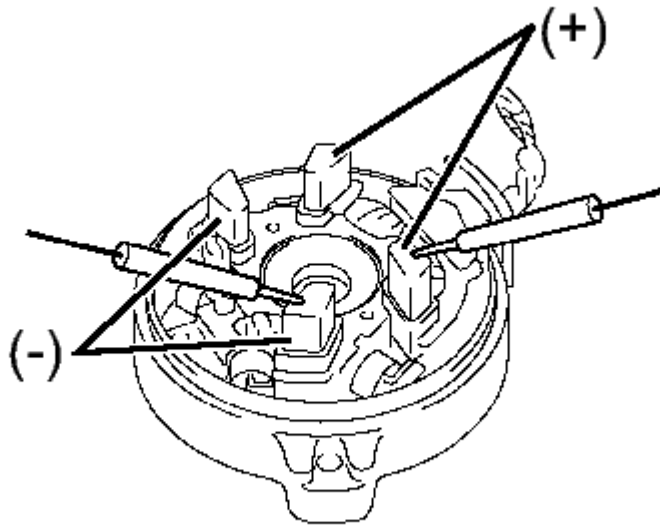


Fig. 27: Checking Brush Insulation

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

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

Standard Resistance

Tester Connection	Condition	Specified Condition
Positive brush holder - Negative brush holder	Always	10 kohms or higher

If the result is not as specified, replace the starter commutator end frame assembly.

5. INSPECT STARTER CLUTCH SUB-ASSEMBLY

- a. 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.

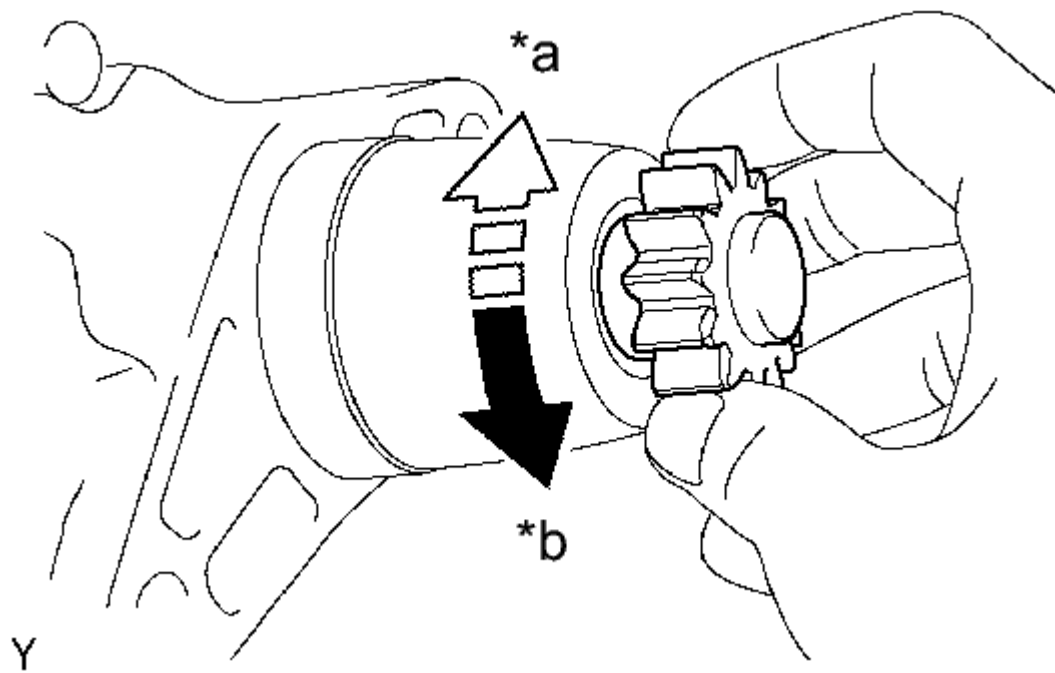


Fig. 28: Rotating Pinion Gear

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

TEXT IN ILLUSTRATION

*a	Lock
*b	Free

If necessary, replace the repair service starter kit.

REASSEMBLY

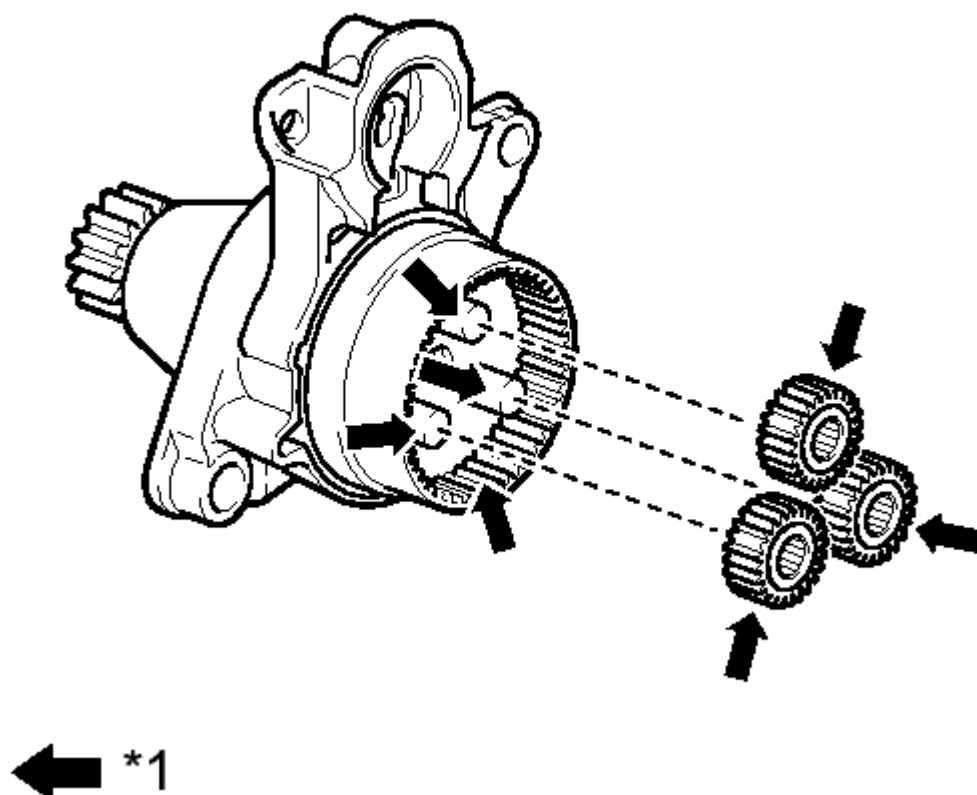
REASSEMBLY

HINT:

Use high-temperature grease to lubricate the bearing and gears when assembling the starter.

1. INSTALL PLANETARY GEAR

- a. Apply high-temperature grease to the planetary gears and pin parts of the planetary shaft.



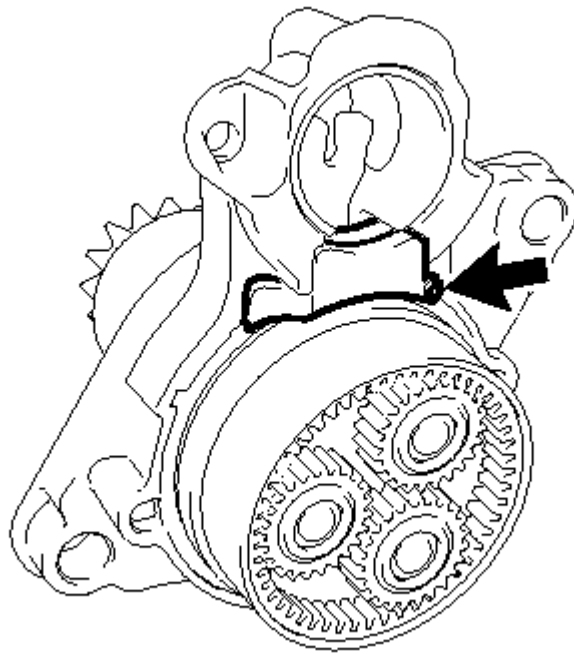
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Fig. 29: Identifying Planetary Gears & Pin Parts Of Planetary Shaft
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	High-temperature grease
----	-------------------------

- b. Install the 3 planetary gears.
- 2. **INSTALL RUBBER SEAL**
 - a. Install the rubber seal.

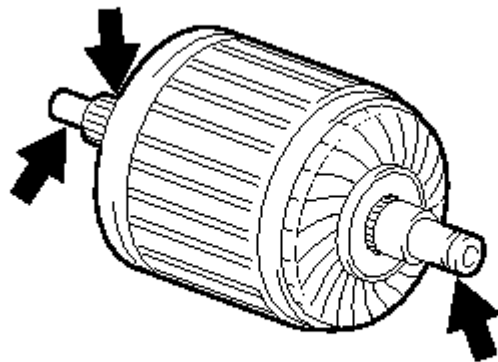


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Fig. 30: Identifying Starter Armature Assembly Rubber Seal
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. INSTALL STARTER ARMATURE ASSEMBLY

- a. Apply high-temperature grease to the washer and armature shaft.



← *1

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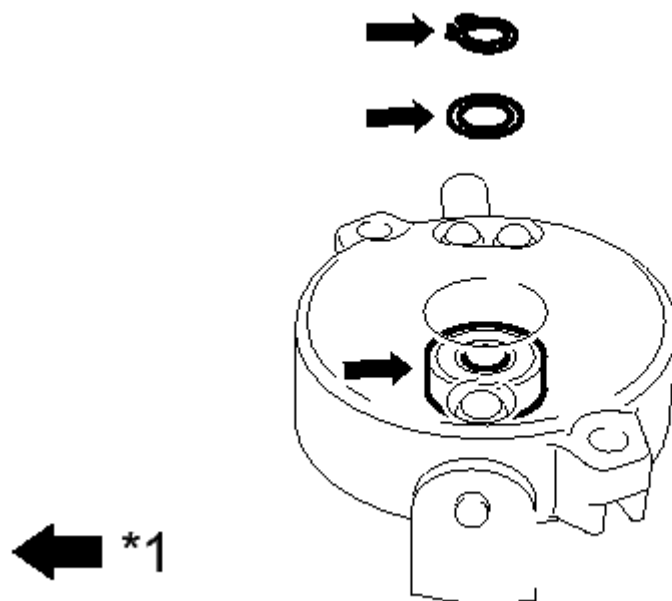
Fig. 31: Identifying Starter Armature Assembly Greasing Areas

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

TEXT IN ILLUSTRATION

*1	High-temperature grease
----	-------------------------

- b. Apply high-temperature grease to the plate washer and a new snap ring.



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Fig. 32: Identifying Plate Washer & Snap Ring Greasing Areas
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

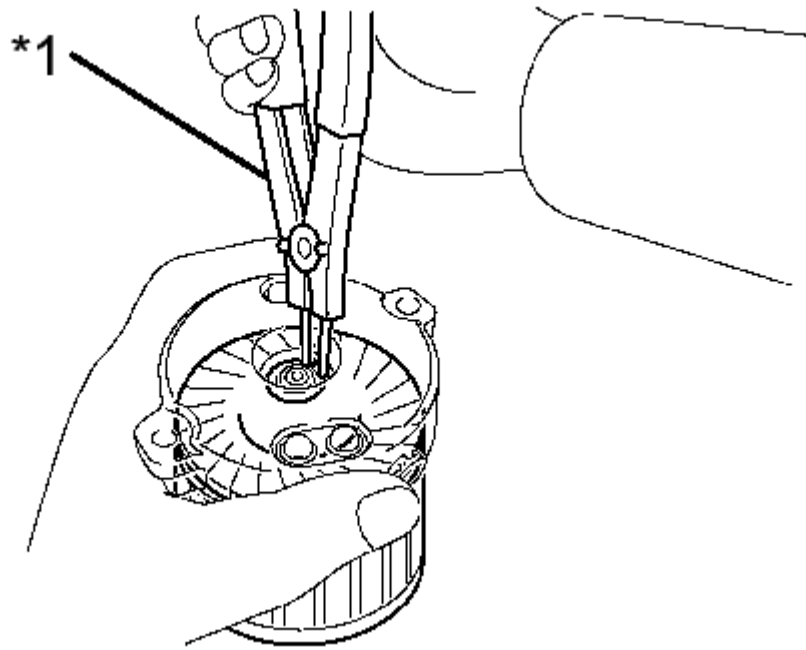
TEXT IN ILLUSTRATION

*1	High-temperature grease
----	-------------------------

NOTE:

- Be sure to install the snap ring in the armature shaft groove securely.
- Be sure to properly install the snap ring because it expands easily.

- c. Install the starter armature assembly to the starter commutator end frame assembly.
- d. Using snap ring pliers, install the plate washer and a new snap ring.



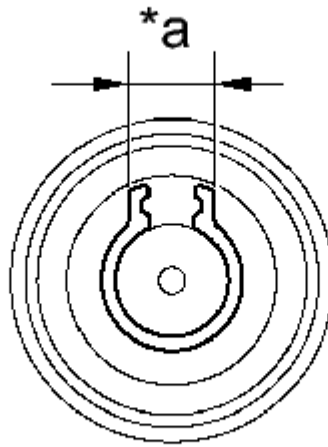
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Fig. 33: Removing Starter Armature Assembly Using Snap Ring Pliers
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

	Snap
*1	Ring
	Pliers

- e. Using a vernier caliper, measure the length of the snap ring.



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Fig. 34: Identifying Snap Ring Length

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

TEXT IN ILLUSTRATION

***a** Length

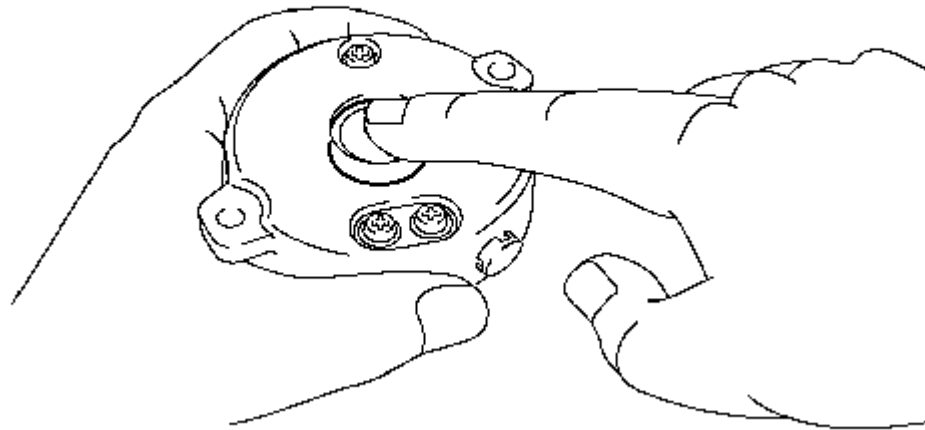
Maximum length

5.0 mm (0.197 in.)

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

4. INSTALL STARTER COMMUTATOR END FRAME COVER

- a. Install the starter commutator end frame cover to the starter commutator end frame assembly.



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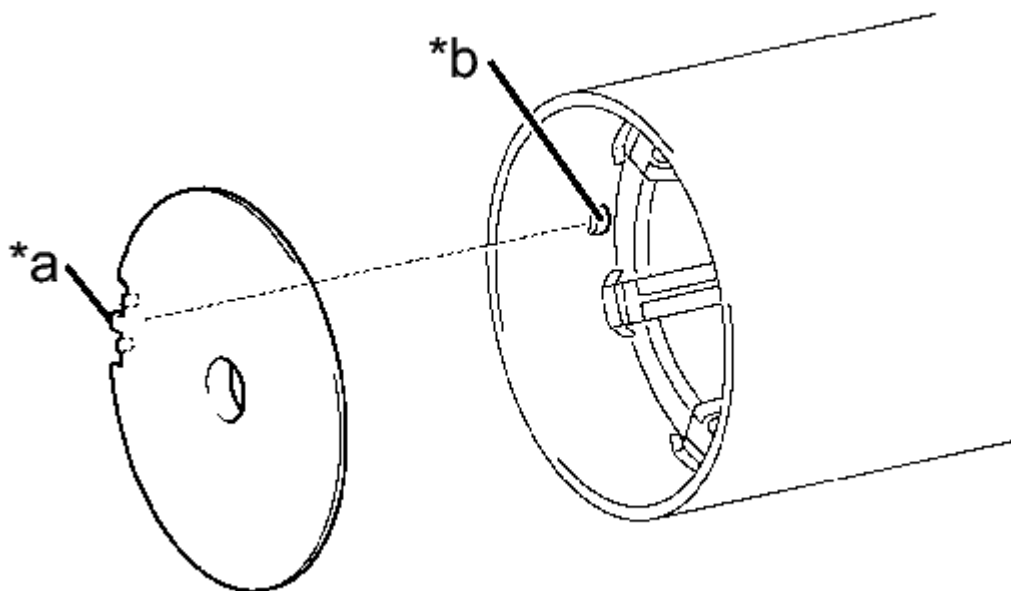
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Fig. 35: Installing End Frame Cover

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

5. INSTALL STARTER ARMATURE PLATE

- a. Insert the starter armature plate to the starter yoke assembly.



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Fig. 36: Installing Starter Armature Plate

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

TEXT IN ILLUSTRATION

*a	Keyway
*b	Key

- b. Align the keyway of the starter armature plate with the key inside the starter yoke assembly, and install the starter armature plate.

6. INSTALL STARTER COMMUTATOR END FRAME ASSEMBLY

- a. Align the rubber of the starter commutator end frame assembly with the cutout of the starter yoke assembly.

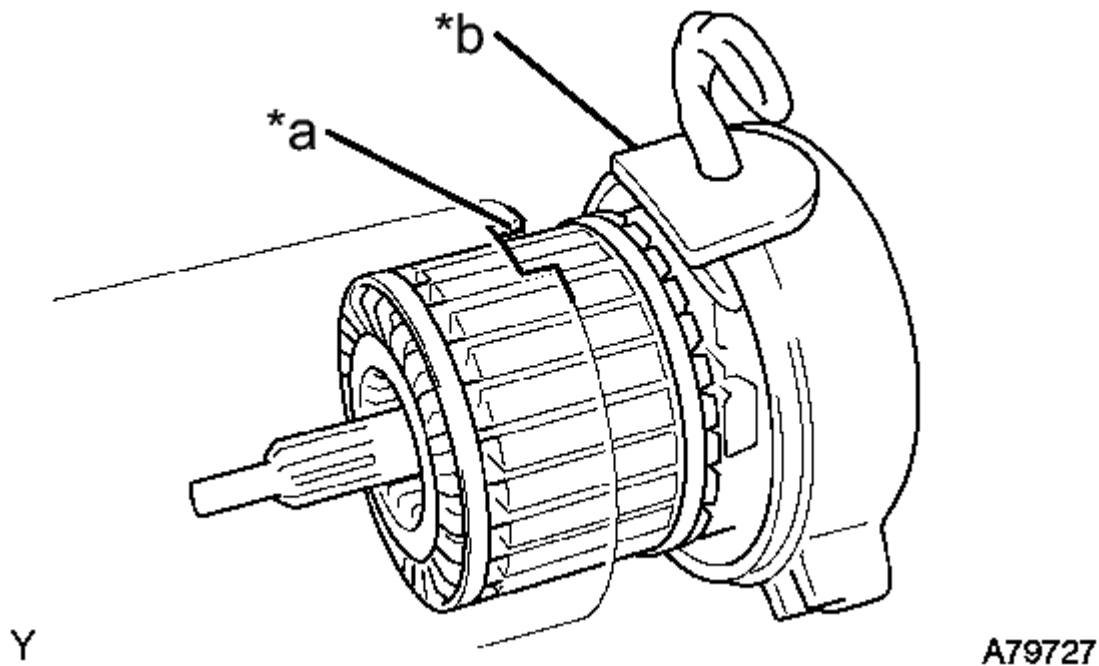


Fig. 37: Identifying Commutator End Cutout And Rubber
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*a	Cutout
*b	Rubber

- b. Install the starter commutator end frame to the starter yoke assembly.

NOTE: The magnet of the starter yoke assembly may attract the starter armature assembly when the starter commutator end frame assembly is installed, causing the magnet to break.

7. INSTALL STARTER YOKE ASSEMBLY

- a. Align the protrusion of the starter yoke assembly with the cutout of the repair service starter kit.

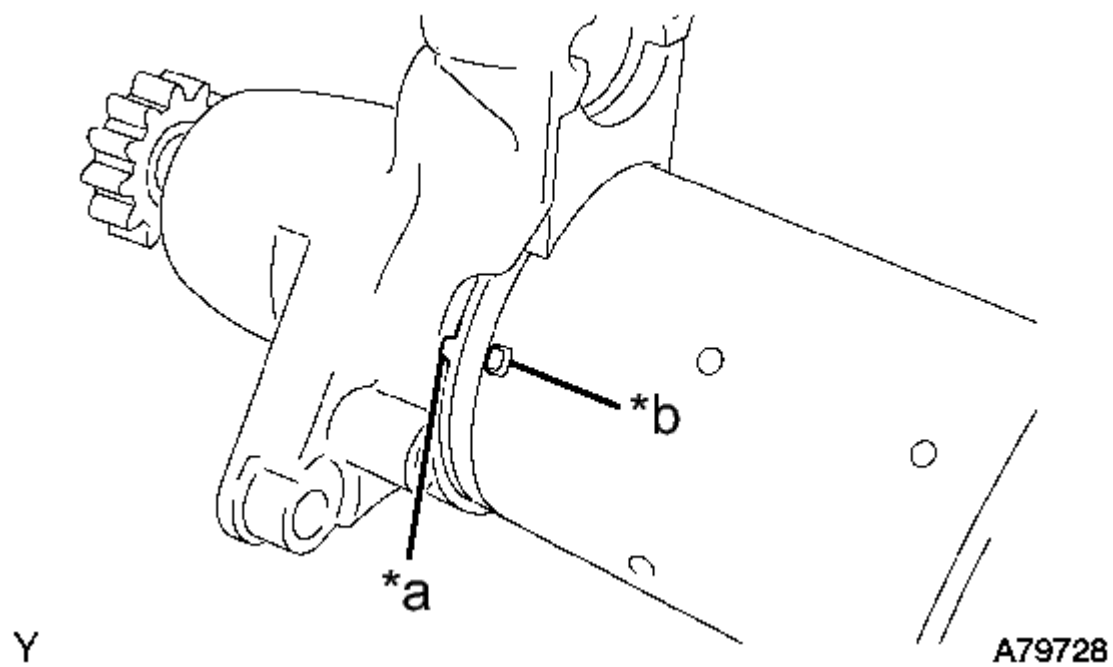
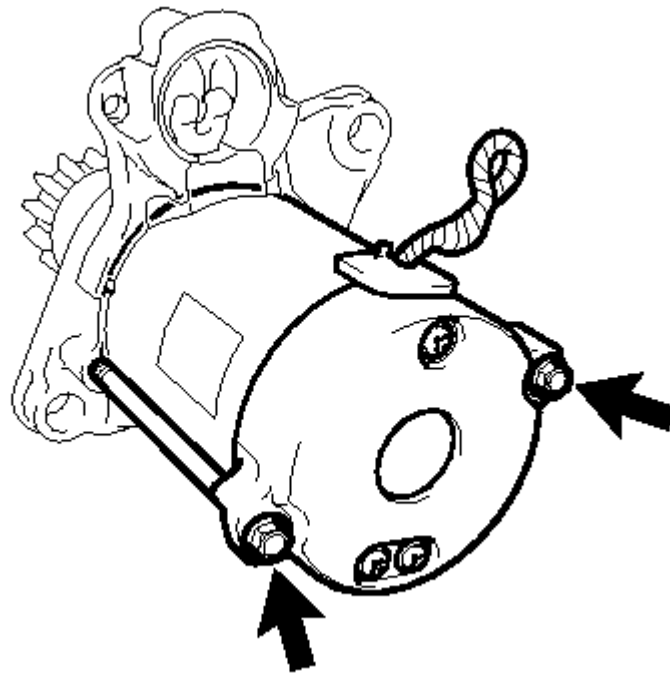


Fig. 38: Identifying Starter Yoke Assembly Cutout & Protrusion Alignment
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*a	Cutout
*b	Protrusion

- b. Install the starter yoke assembly with the 2 through bolts.



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Fig. 39: Identifying Starter Yoke Assembly Through-Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Torque: 6.0 N*m (61 kgf*cm, 53 in.*lbf)

8. INSTALL MAGNETIC SWITCH ASSEMBLY

- a. Apply high-temperature grease to the plunger and the pinion drive lever.

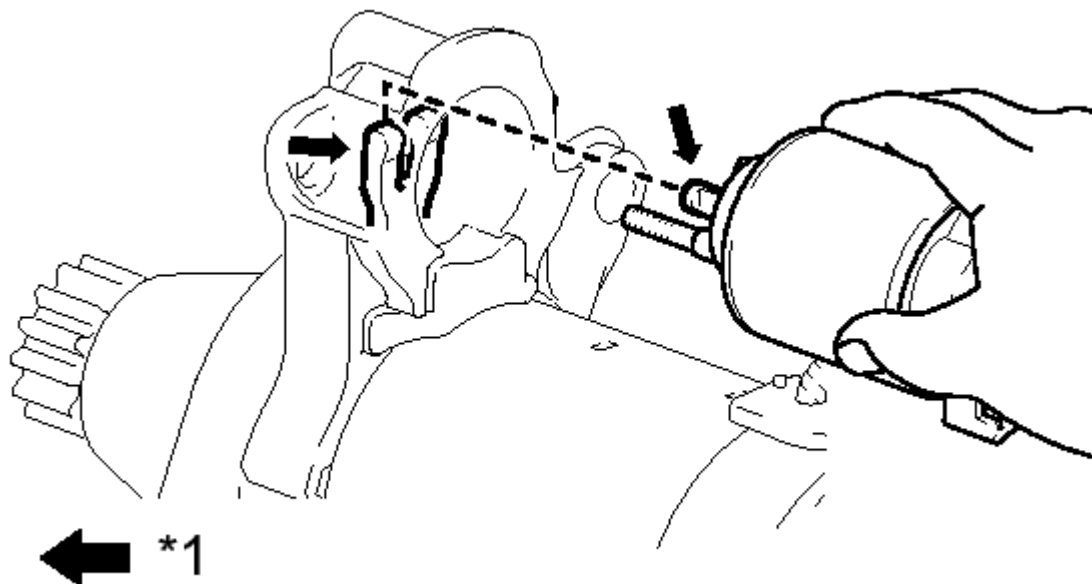
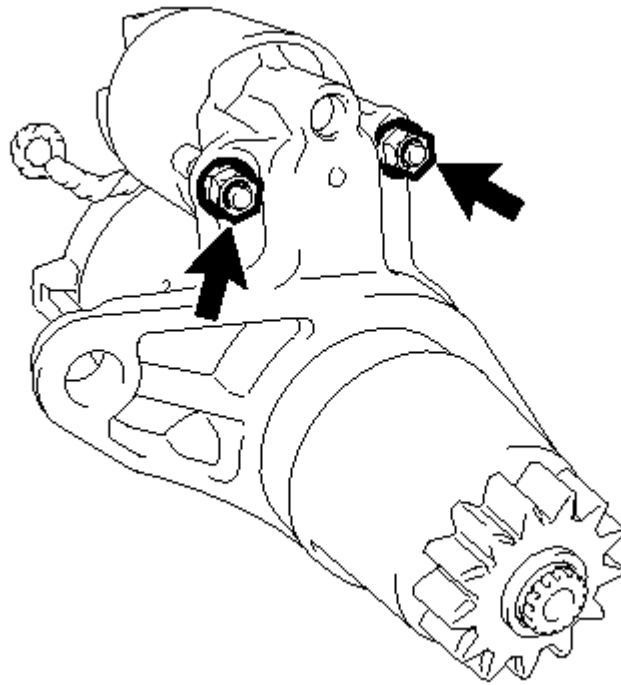


Fig. 40: Identifying Magnetic Switch Assembly Plunger & Pinion Drive Lever Greasing Areas
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	High- temperature grease
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- b. Install the magnetic switch assembly by hanging the magnet starter switch plunger on the upper area of the pinion drive lever.
- c. Install the magnetic switch assembly with the 2 nuts.

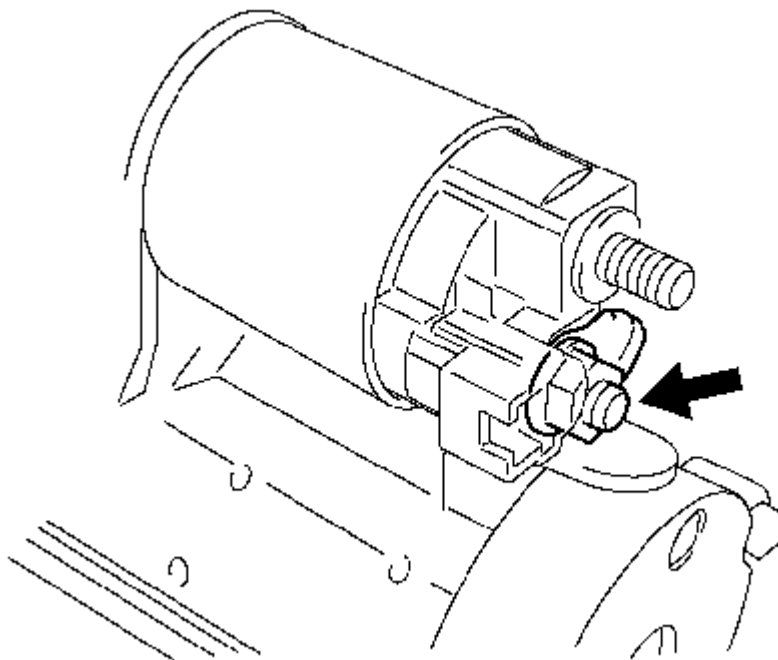


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Fig. 41: Identifying Magnet Starter Switch Nuts
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Torque: 7.5 N*m (76 kgf*cm, 66 in.*lbf)

- d. Connect the lead wire to the terminal C with the nut.



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Fig. 42: Identifying Magnetic Switch Nut

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

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

INSTALLATION

INSTALLATION

1. INSTALL STARTER ASSEMBLY

- a. Install the starter assembly with the 2 bolts.

Torque: 37 N*m (377 kgf*cm, 27 ft.*lbf)

- b. Connect the starter connector.
- c. Connect the terminal 30 with the nut.

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

- d. Close the terminal cap.

2. INSTALL AIR CLEANER ASSEMBLY . Refer to INSTALLATION - Step 5

3. INSTALL BATTERY . Refer to INSTALLATION - Step 46

4. INSTALL AIR CLEANER INLET ASSEMBLY . Refer to INSTALLATION - Step 47

5. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

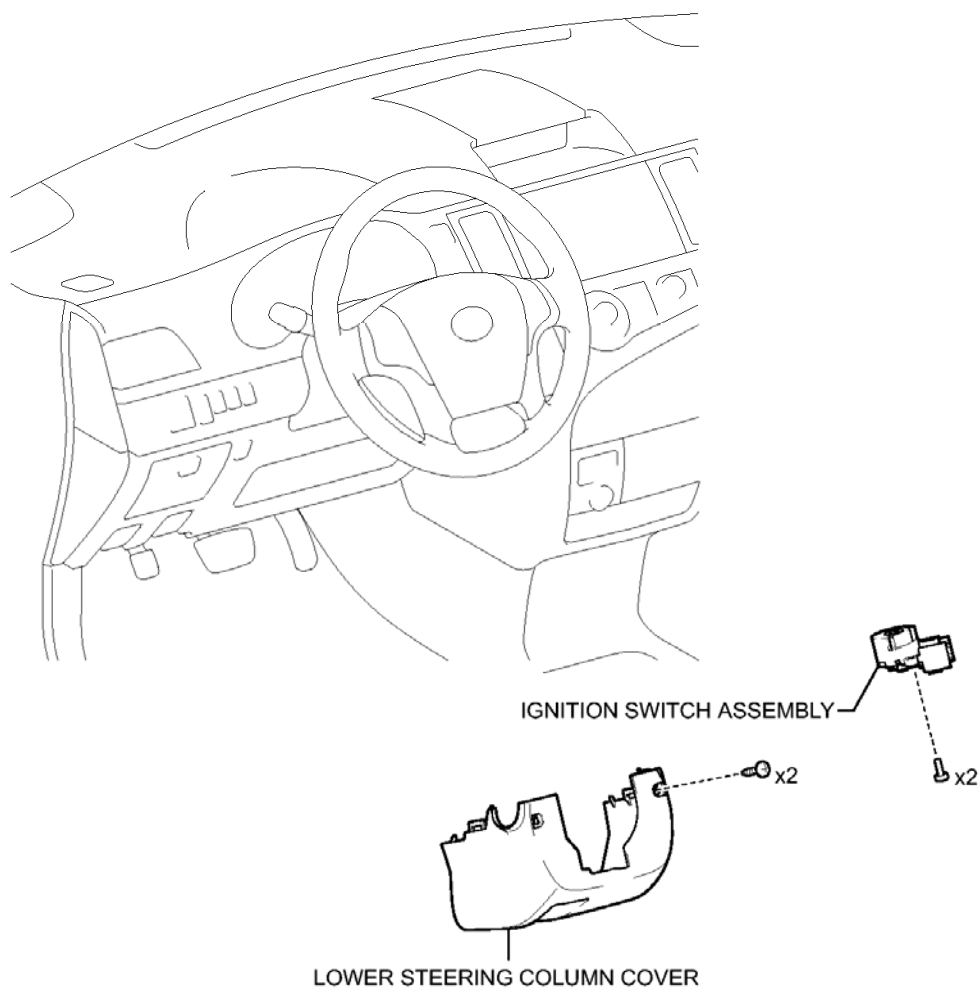
Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)

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

IGNITION SWITCH

COMPONENTS

ILLUSTRATION



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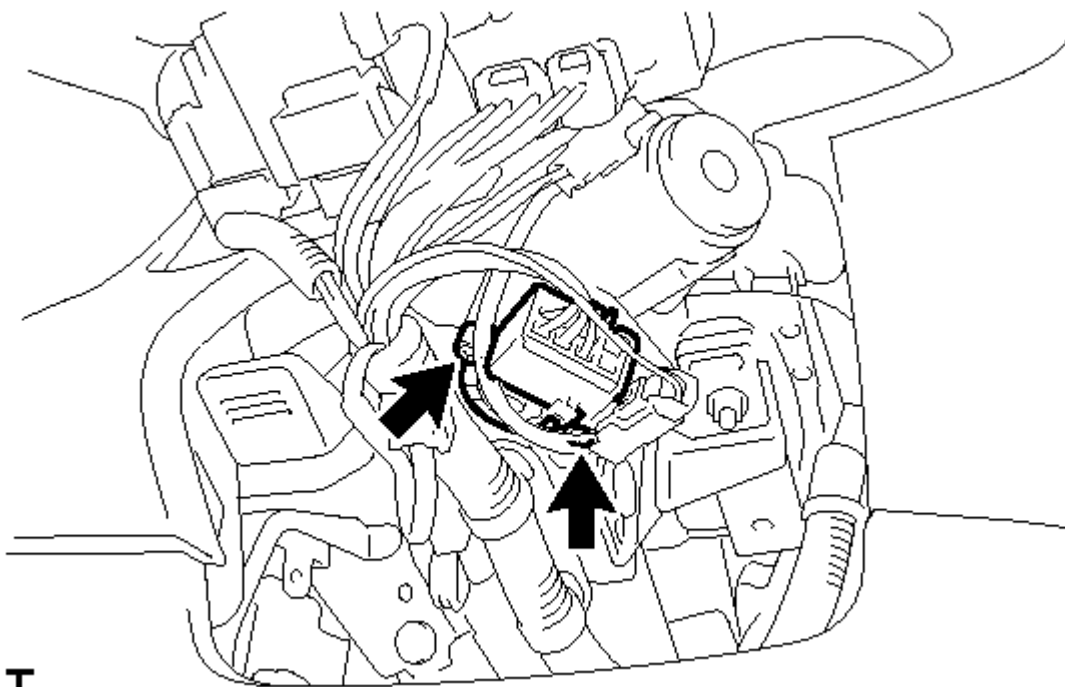
Fig. 43: Ignition Switch Replacement Components

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

REMOVAL

REMOVAL

1. **REMOVE LOWER STEERING COLUMN COVER** . Refer to **REMOVAL - Step 1**
2. **REMOVE IGNITION SWITCH ASSEMBLY**
 - a. Remove the 2 screws and the ignition switch.



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Fig. 44: Identifying Ignition Switch Assembly Screws & Connector
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Disconnect the connector.

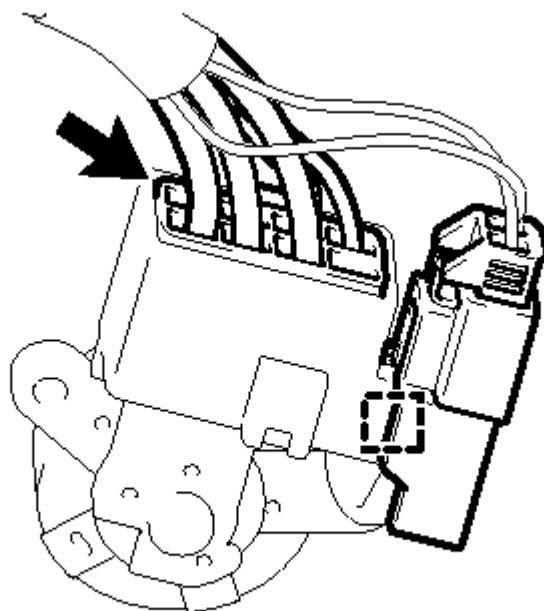


Fig. 45: Identifying Ignition Switch Connector
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Disconnect the connector clamp from the ignition switch.

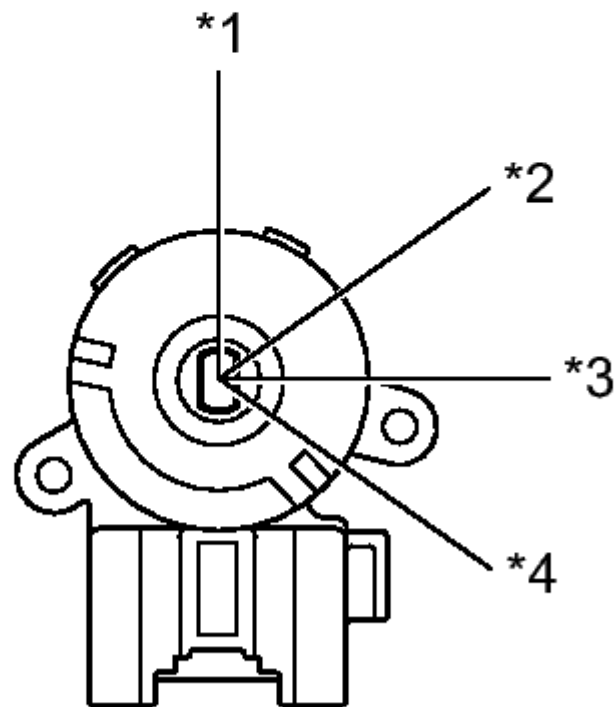
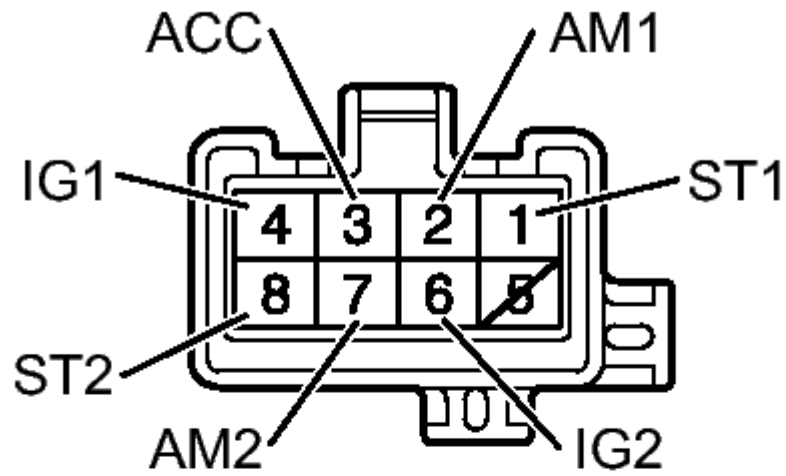
INSPECTION

INSPECTION

1. INSPECT IGNITION SWITCH

- a. Check the ignition switch resistance.

*a



N

Fig. 46: Inspecting Ignition Switch Resistance

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

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

TEXT IN ILLUSTRATION

*1	LOCK
*2	ACC
*3	ON
*4	START
*a	Component without harness connected (Ignition Switch)

Standard Resistance

Tester Connection	Switch Condition	Specified Condition
Between all terminals	LOCK	10 kohms or higher
2 (AM1) - 3 (ACC)	ACC	Below 1 ohms
2 (AM1) - 3 (ACC) - 4 (IG1)	ON	Below 1 ohms
6 (IG2) - 7 (AM2)		
1 (ST1) - 2 (AM1) - 4 (IG1)	START	Below 1 ohms
6 (IG2) - 7 (AM2) - 8 (ST2)		

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

INSTALLATION**INSTALLATION****1. INSTALL IGNITION SWITCH ASSEMBLY**

- Connect the connector.
- Connect the connector clamp to the ignition switch.
- Install the ignition switch with the 2 screws.

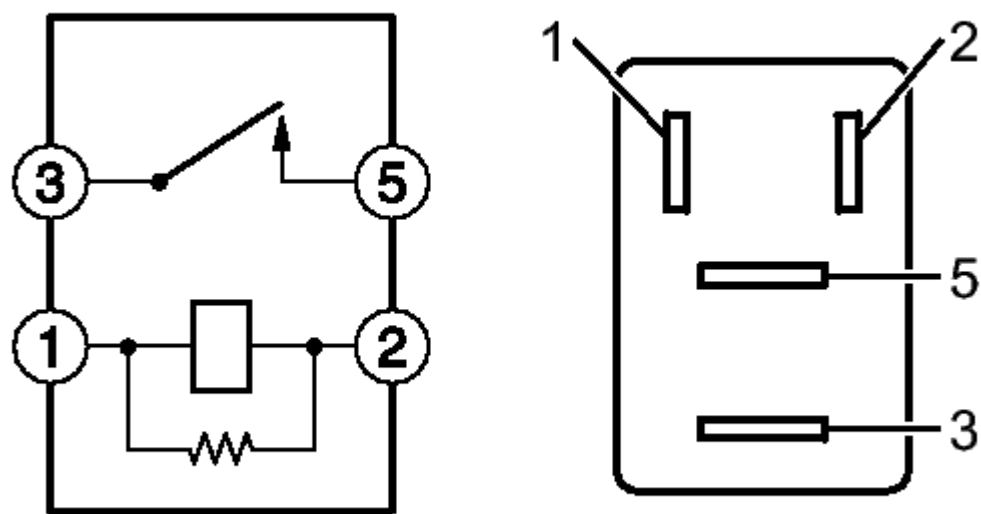
2. INSTALL LOWER STEERING COLUMN COVER . Refer to INSTALLATION - Step 4

RELAY

ON-VEHICLE INSPECTION

ON-VEHICLE INSPECTION

- 1. INSPECT STARTER RELAY
 - a. Check the resistance.



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Fig. 47: Inspecting Battery Blower Terminal Relays
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

Standard Resistance

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage not applied	10 kohms or higher
3 - 5	Battery voltage applied to terminals	Below 1 ohms

	1 and 2	
--	---------	--

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