

STARTING SYSTEM

(2RZ—FE, 3RZ—FE)

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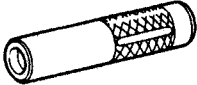
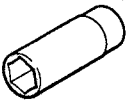
(5VZ—FE)

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ST

(2RZ—FE, 3RZ—FE)**PREPARATION****SST (SPECIAL SERVICE TOOLS)**

ST008—OT

	09286—46011	Injection Pump Spline Shaft Puller	Armature bearing
	09201—41020	Valve Stem Oil Seal Replacer	Armature rear bearing
	09285—76010	Injection Pump Camshaft Bearing Cone Replacer	Armature rear bearing
	09810—38140	Starter Magnet Switch Nut Wrench 14	Terminal nut

ST

RECOMMENDED TOOLS

ST00T—DJ

	09082—00050	TOYOTA Electrical Tester Set.	
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EQUIPMENT

ST00U—OE

Dial indicator	Commutator
Magnetic finger	
Pull scale	Brush spring
Sandpaper	Commutator
Torque wrench	
V—block	
Vernier calipers	Commutator, Brush

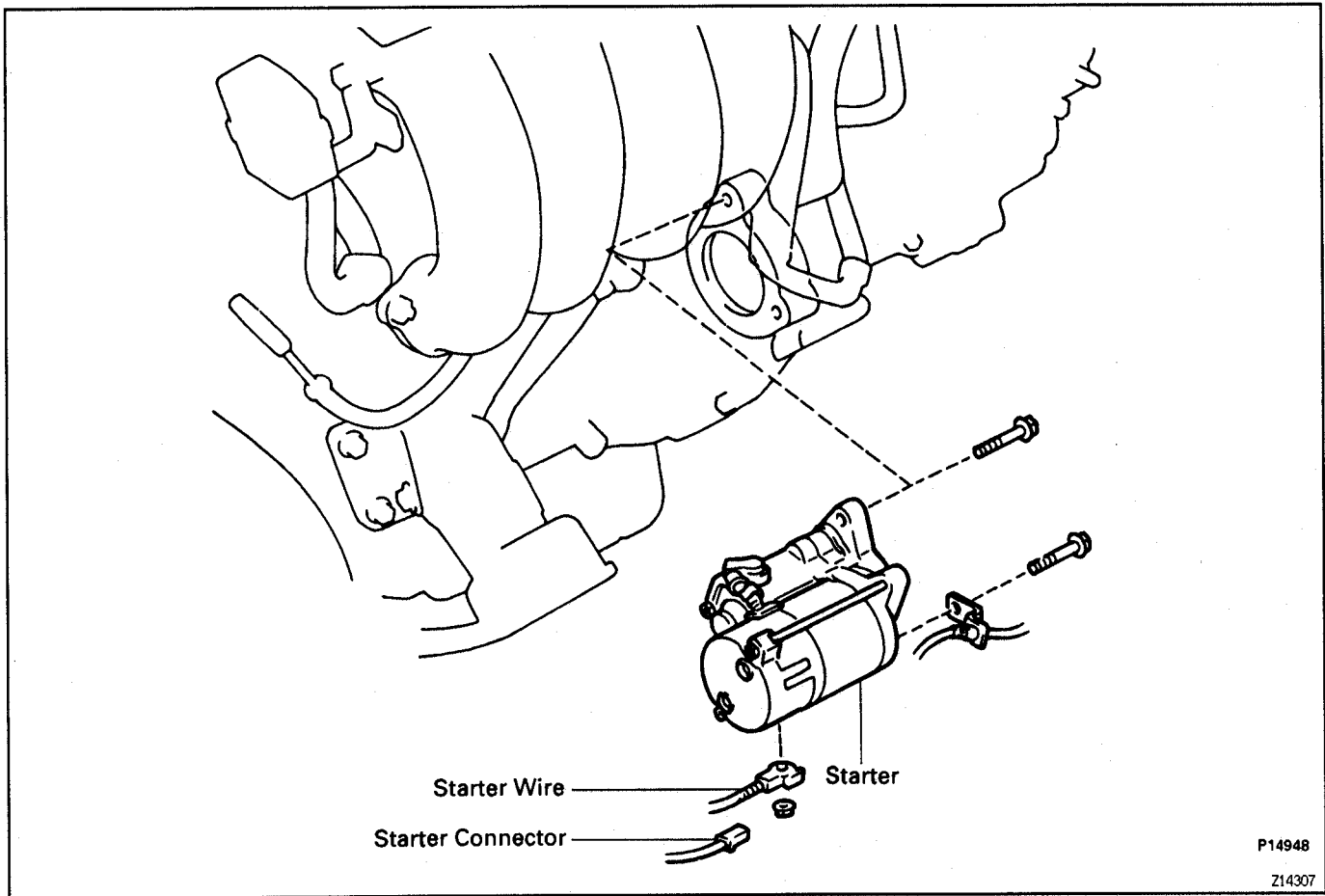
ON—VEHICLE INSPECTION**NOTICE:** Before changing the starter, check the following items again:

ST00K—OM

- Connector connection
- Accessory installation, e.g.: theft deterrent system

STARTER COMPONENTS FOR REMOVAL AND INSTALLATION

ST08Z-01

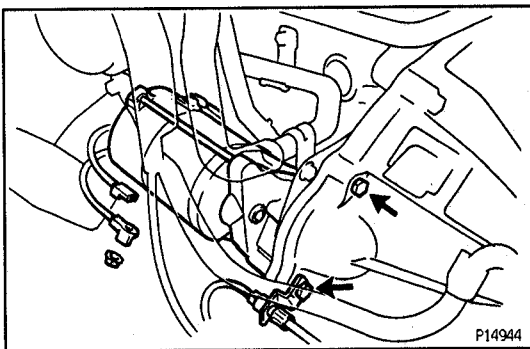


ST08Z-08

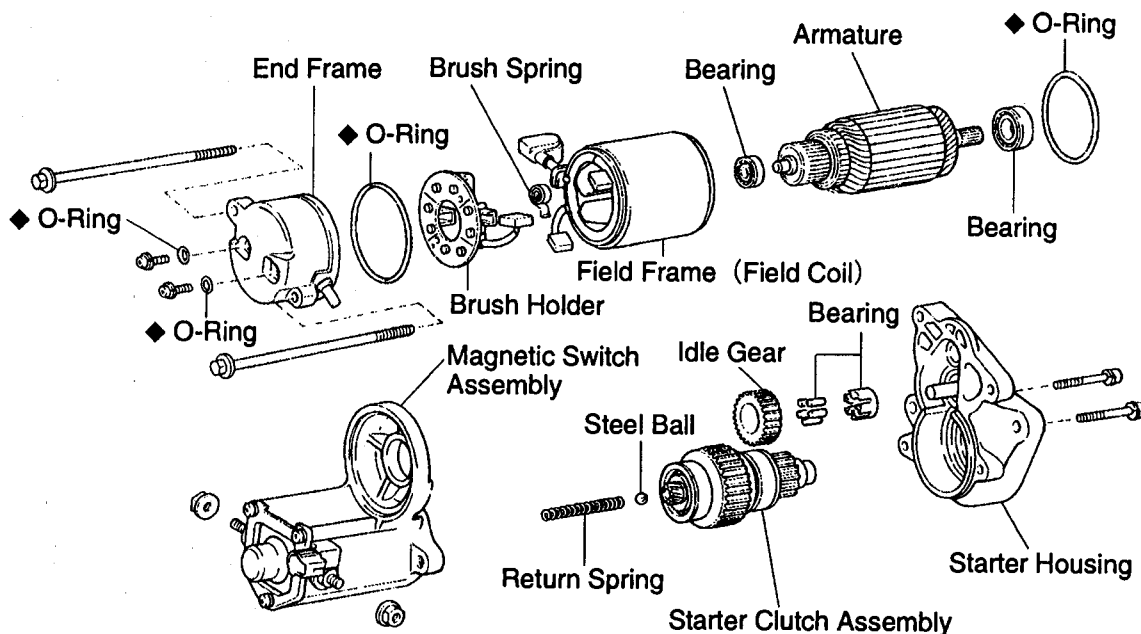
STARTER REMOVAL

REMOVE STARTER

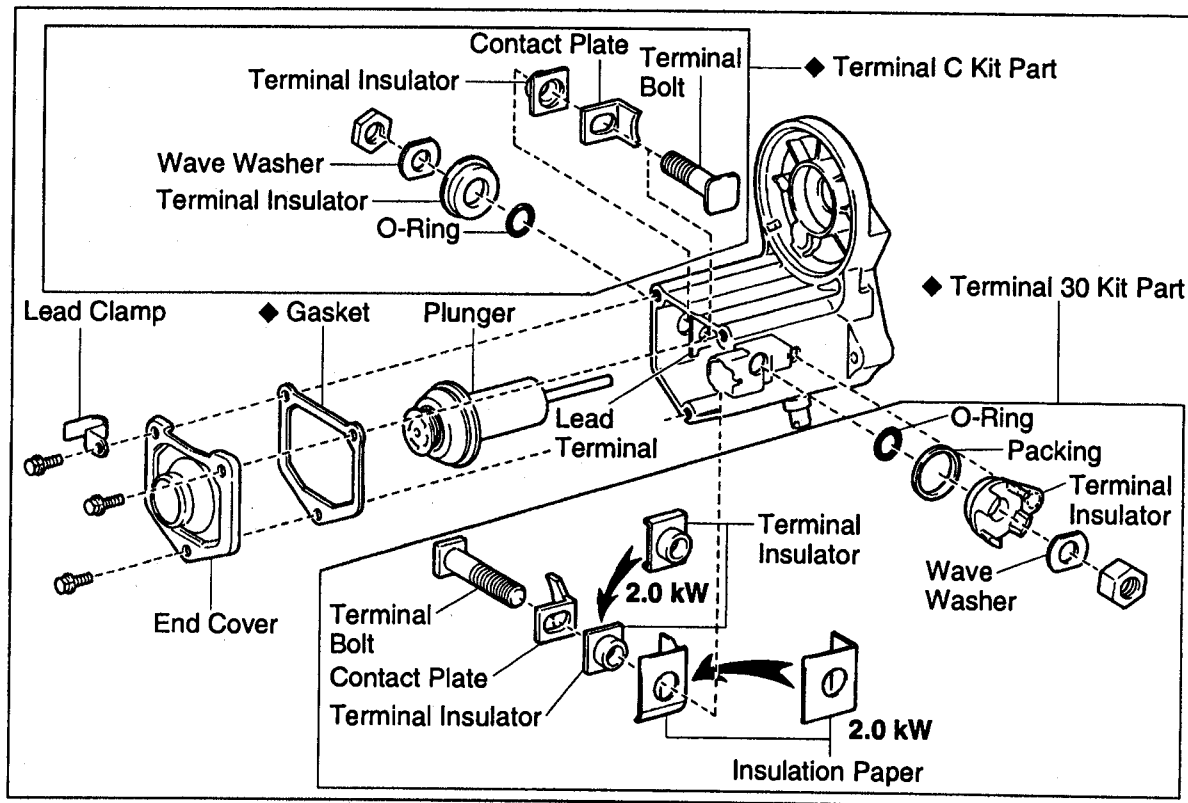
- Disconnect the starter connector.
- Remove the nut and disconnect the starter wire.
Torque: 8.8 N·m (90 kgf·cm, 78 in·lbf)
- Remove the 2 bolts and starter.
Torque: 39 N·m (400 kgf·cm, 29 ft·lbf)



COMPONENTS FOR DISASSEMBLY AND ASSEMBLY



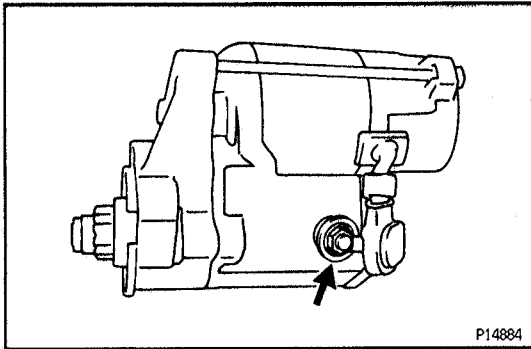
Magnetic Switch Assembly



P23129
P25132

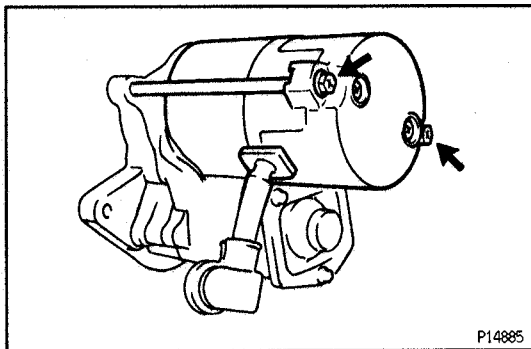
◆ Non-reusable part

Z16636

STARTER DISASSEMBLY**1. REMOVE FIELD FRAME AND ARMATURE**

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

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



- (b) Remove the 2 through bolts.

Torque:

1.4 kW type:

5.9 N·m (60 kgf·cm, 52 in.-lbf)

2.0 kW type:

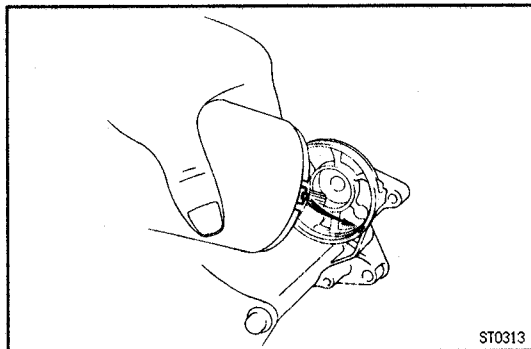
9.3 N·m (93 kgf·cm, 82 in.-lbf)

- (c) Pull out the field frame with the armature from the magnetic switch assembly.

- (d) Remove the O—ring.

ASSEMBLY HINT:

- Use a new O—ring.
- Align the protrusion of the field frame with the cutout of the magnetic switch.

**2. REMOVE STARTER HOUSING, CLUTCH ASSEMBLY AND GEAR**

- (a) Remove the 2 screws.

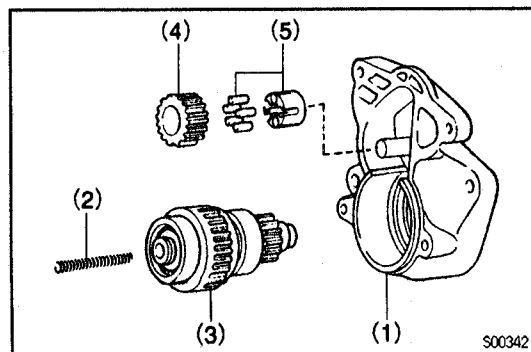
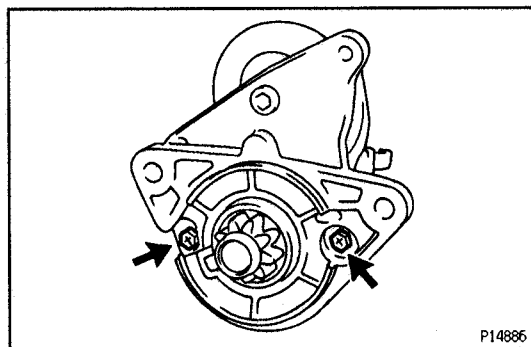
Torque:

1.4 kW type:

5.9 N·m (60 kgf·cm, 52 in.-lbf)

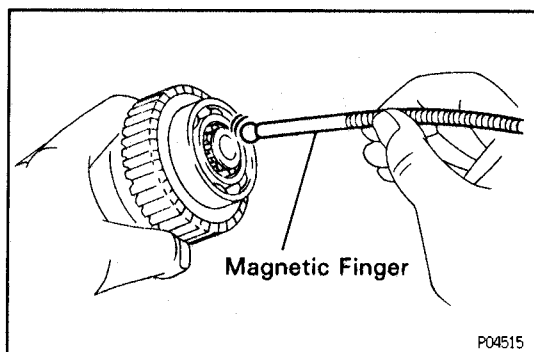
2.0 kW type:

9.3 N·m (93 kgf·cm, 82 in.-lbf)



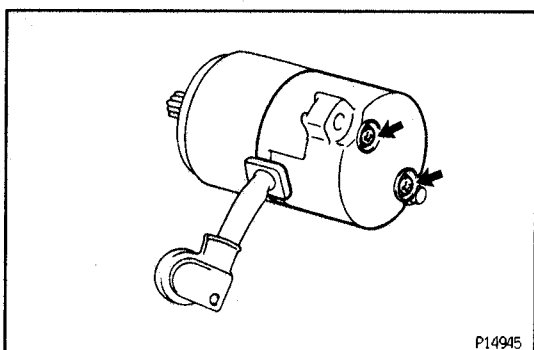
- (b) Remove these parts from the magnetic switch assembly:

- (1) Starter housing
- (2) Return spring
- (3) Clutch assembly
- (4) Idler gear
- (5) Bearing



3. REMOVE STEEL BALL

Using a magnetic finger, remove the steel ball from the clutch shaft hole.



4. REMOVE BRUSH HOLDER

- (a) Remove the 2 screws and end cover from the field frame.

Torque:

1.4 kW type:

1.5 N·m (15 kgf·cm, 13 in.-lbf)

2.0 kW type:

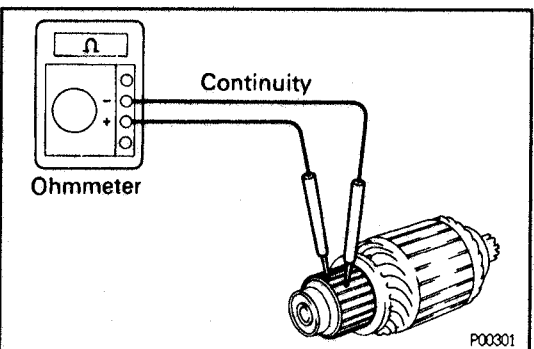
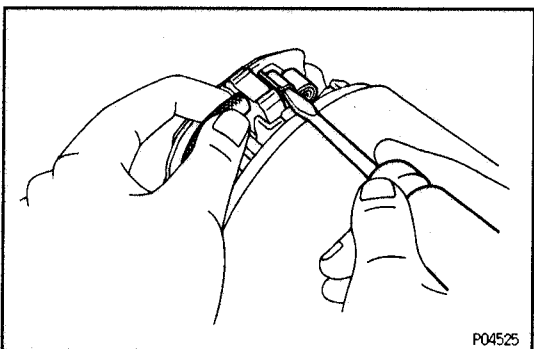
3.8 N·m (38 kgf·cm, 34 in.-lbf)

- (b) Remove the O—ring from the field frame.

ASSEMBLY HINT: Use a new O—ring.

- (c) Using a screwdriver, hold the spring back and disconnect the brush from the brush holder. Disconnect the 4 brushes and remove the brush holder.

5. REMOVE ARMATURE FROM FIELD FRAME



STARTER INSPECTION AND REPAIR

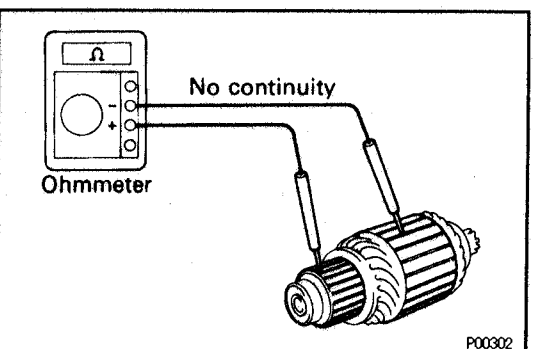
Armature Coil

8T00W-01

1. INSPECT COMMUTATOR FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the segments of the commutator.

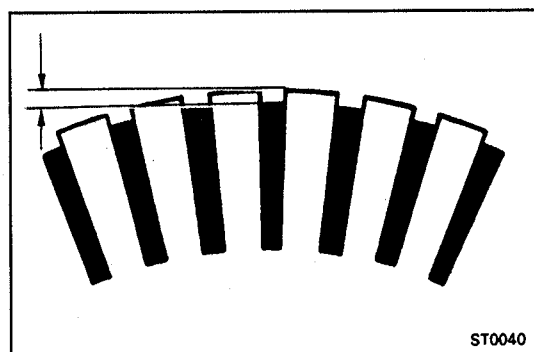
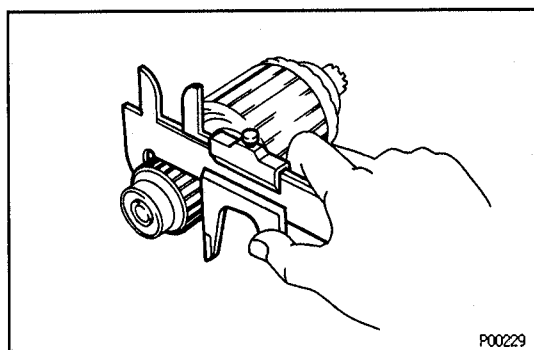
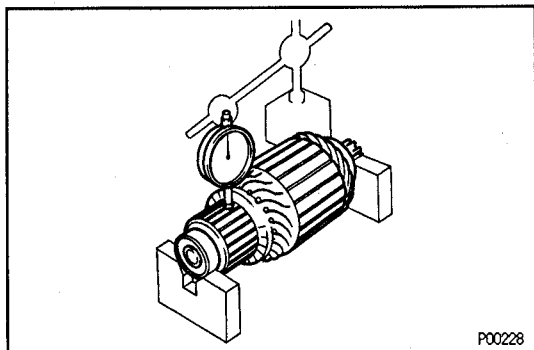
If there is no continuity between any segment, replace the armature.



2. INSPECT COMMUTATOR FOR GROUND

Using an ohmmeter, check that there is no continuity between the commutator and armature coil core.

If there is continuity, replace the armature.



Commutator

1. INSPECT COMMUTATOR FOR DIRTY AND BURNT SURFACES

If the surface is dirty or burnt, correct it with sandpaper (No. 400) or on a lathe.

2. INSPECT COMMUTATOR CIRCLE RUNOUT

- Place the commutator on V—blocks.
- Using a dial indicator, measure the circle runout.

Maximum circle runout:

0.05 mm (0.0020 in.)

If the circle runout is greater than the maximum, correct it on a lathe.

3. INSPECT COMMUTATOR DIAMETER

Using vernier calipers, measure the commutator diameter.

Standard diameter:

1.4 kW type: 30 mm (1.18 in.)

2.0 kW type: 35 mm (1.38 in.)

Minimum diameter:

1.4 kW type: 29 mm (1.14 in.)

2.0 kW type: 34 mm (1.34 in.)

If the diameter is less than the minimum, replace the armature.

4. INSPECT UNDERCUT DEPTH

Check that the undercut depth is clean and free of foreign materials. Smooth out the edge.

Standard undercut depth:

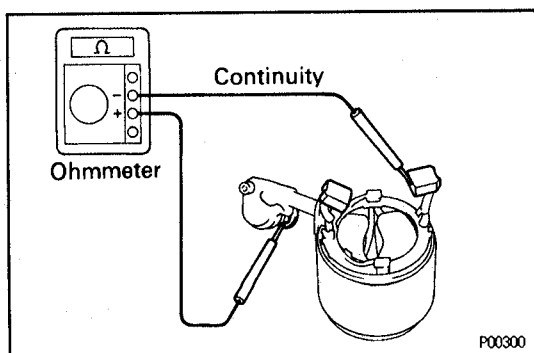
1.4 kW type: 0.6 mm (0.024 in.)

2.0 kW type: 0.7 mm (0.028 in.)

Minimum undercut depth:

0.2 mm (0.008 in.)

If the undercut depth is less than the minimum, correct it with a hacksaw blade.

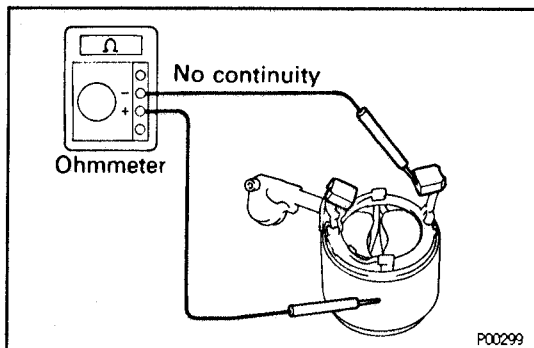


Field Frame (Field Coil)

1. INSPECT FIELD COIL FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the lead wire and field coil brush lead.

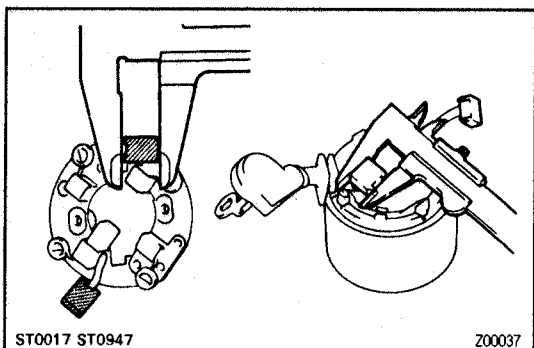
If there is no continuity, replace the field frame.



2. INSPECT FIELD COIL FOR GROUND

Using an ohmmeter, check that there is no continuity between the field coil end and field frame.

If there is continuity, repair or replace the field frame.



Brushes

INSPECT BRUSH LENGTH

Using vernier calipers, measure the brush length.

Standard length:

1.4 kW type: 15.5 mm (0.610 in.)

2.0 kW type: 15.0 mm (0.591 in.)

Minimum length:

1.4 kW type: 10.0 mm (0.394 in.)

2.0 kW type: 9.0 mm (0.355 in.)

If the length is less than the minimum, replace the brush holder and field frame.

Brush Springs

INSPECT BRUSH SPRING LOAD

Take the pull scale reading the instant the brush spring separates from the brush.

Spring installed load:

1.4 kW type:

17.6 — 23.5 N (1.79 — 2.41 kgf, 3.9 — 5.3 lbf)

2.0 kW type:

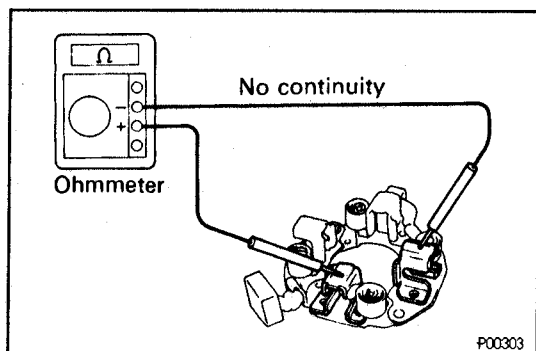
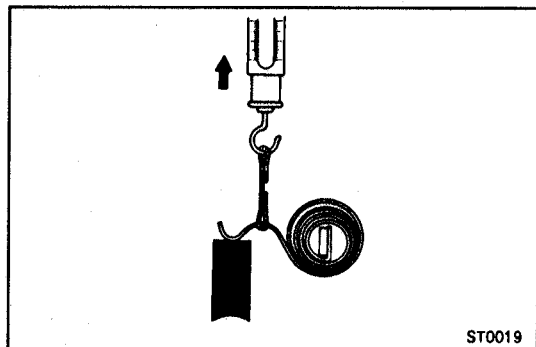
21.5 — 27.5 N (2.19 — 2.81 kgf, 4.9 — 6.2 lbf)

Minimum spring installed load:

1.4 kW type: 11.8 N (1.2 kgf, 2.6 lbf)

2.0 kW type: 12.7 N (1.3 kgf, 2.7 lbf)

If the installed load is not within specification, replace the brush springs.



Brush Holder

INSPECT BRUSH HOLDER INSULATION

Using an ohmmeter, check that there is no continuity between the positive (+) and negative (-) brush holders.

If there is continuity, repair or replace the brush holder.

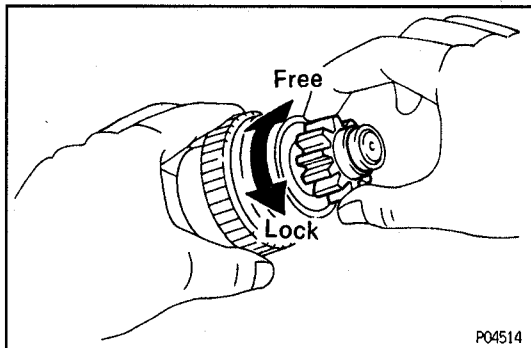
Clutch and Gears

1. INSPECT GEAR TEETH

Check the gear teeth on the pinion gear, idle gear and clutch assembly for wear or damage.

If damaged, replace the gear or clutch assembly.

If damaged, also check the fly wheel ring gear for wear or damage.

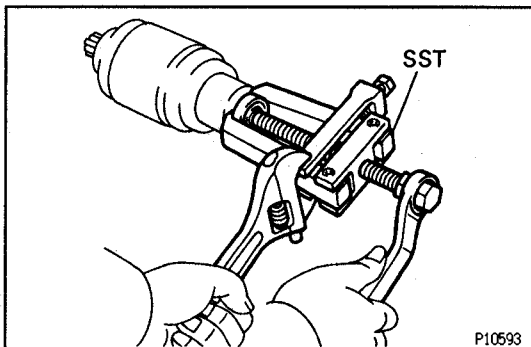


2. INSPECT CLUTCH PINION GEAR

Hold the starter clutch and rotate the pinion gear clockwise, and check that it turns freely. Try to rotate the pinion gear counterclockwise and check that it locks.

If necessary, replace the clutch assembly.

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Bearings

1. INSPECT FRONT BEARING

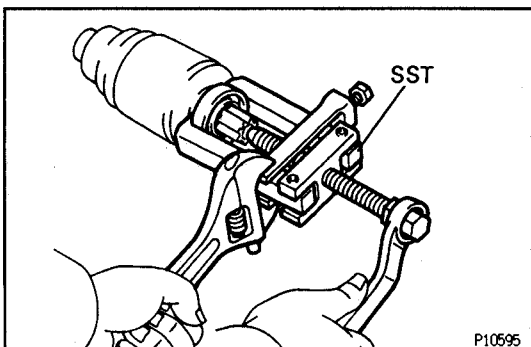
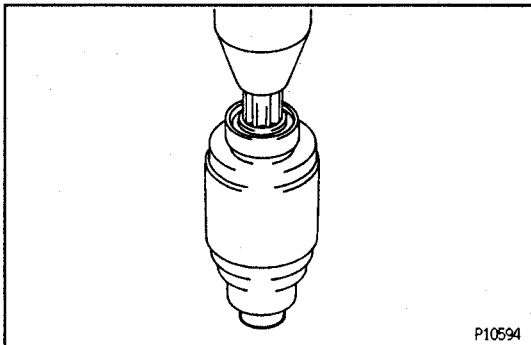
Turn the bearing by hand while applying inward force. If resistance is felt or the bearing sticks, replace the bearing.

2. IF NECESSARY, REPLACE FRONT BEARING

(a) Using SST, remove the bearing.

SST 09286—46011

(b) Using a press, press in a new front bearing.



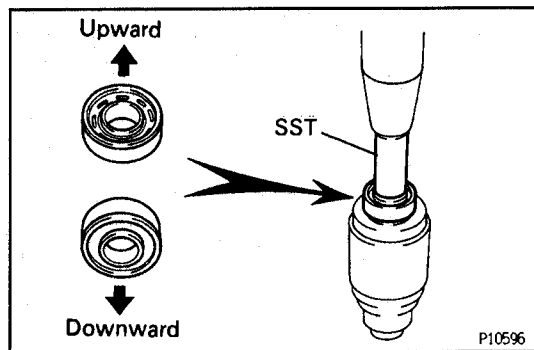
3. INSPECT REAR BEARING

Turn the bearing by hand while applying inward force. If resistance is felt or the bearing sticks, replace the bearing.

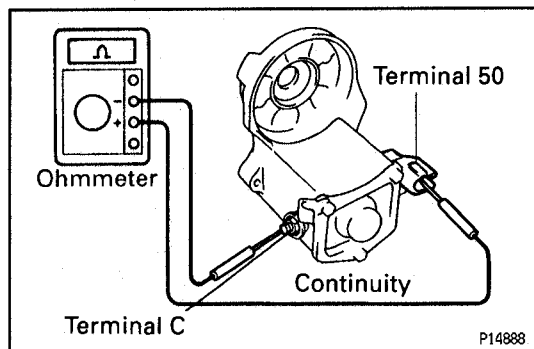
4. IF NECESSARY, REPLACE REAR BEARING

(a) Using SST, remove the bearing.

SST 09286—46011



- (b) Using a press, press in a new rear bearing.
NOTICE: Be careful of the bearing installation direction.
 SST 09201—41020

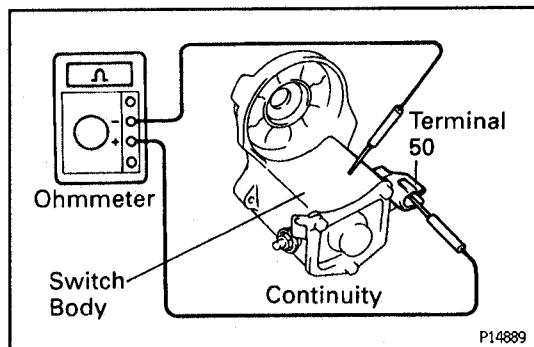


Magnetic Switch

1. DO PULL—IN COIL OPEN CIRCUIT TEST

Using an ohmmeter, check that there is continuity between terminals 50 and C.

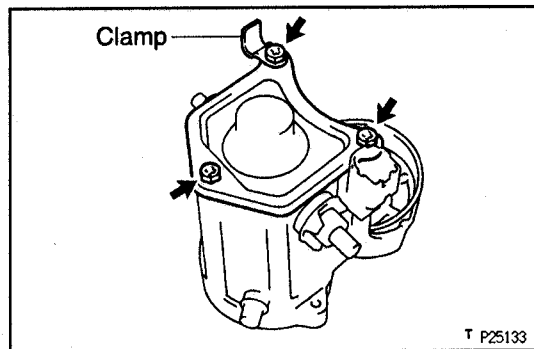
If there is no continuity, check and replace the magnetic switch.



2. DO HOLD—IN COIL OPEN CIRCUIT TEST

Using an ohmmeter, check that there is continuity between terminal 50 and the switch body.

If there is no continuity, replace the magnetic switch.

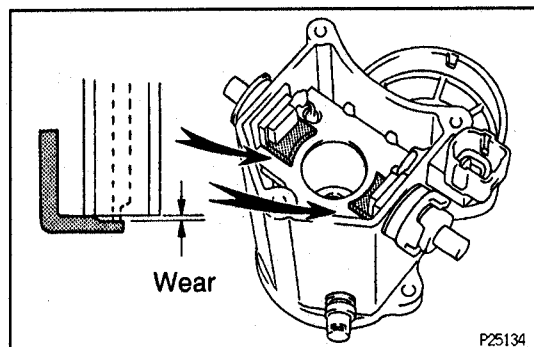


MAGNETIC SWITCH TERMINAL KIT PARTS REPLACEMENT

ST008-02

1. REMOVE MAGNETIC SWITCH END COVER

Remove the 3 bolts, lead clamp, end cover, gasket and plunger.



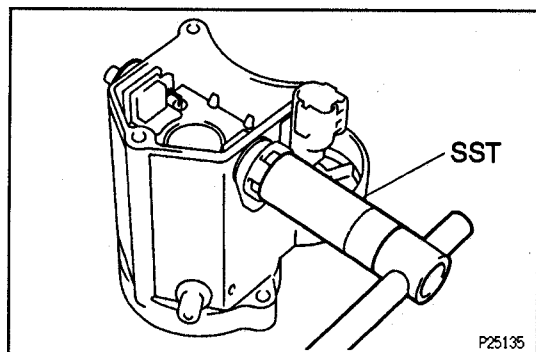
2. INSPECT CONTACT PLATE FOR WEAR

Using vernier calipers, measure the contact plate for depth of wear.

Maximum wear:

0.9 mm (0.035 in.)

If the depth of wear is greater than the maximum, replace the contact plate.



3. REMOVE TERMINAL KIT PARTS

- (a) Using SST, loosen the terminal nuts.
SST 09810—38140
- (b) Terminal C:
Remove the terminal nut, wave washer, terminal insulator (outside), O—ring, terminal bolt, contact plate and terminal insulator (inside).
- (c) Terminal 30:
Remove the terminal nut, wave washer, terminal insulator (outside), packing, O—ring, terminal bolt, contact plate, terminal insulator (inside) and insulation paper.

4. REINSTALL TERMINAL KIT PARTS

- (a) Install these new parts:

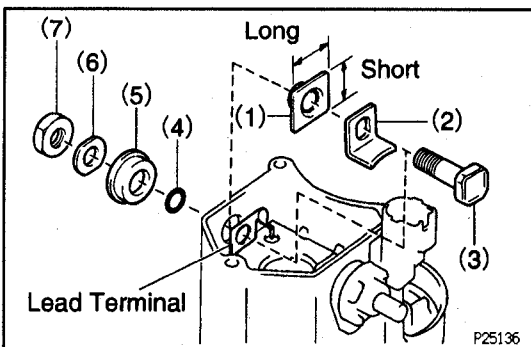
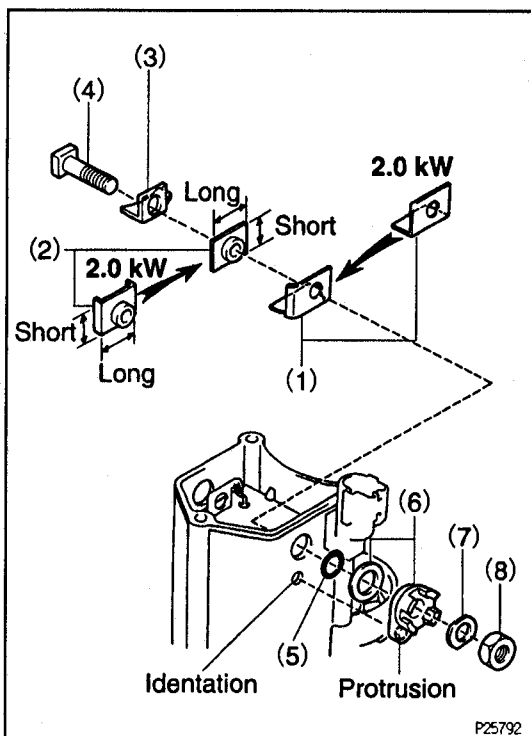
Terminal 30:

- (1) Insulation paper
- (2) Terminal insulator (inside)
- (3) Contact plate
- (4) Terminal bolt
- (5) O—ring
- (6) Packing and terminal insulator (outside)

Install the packing to the terminal insulator, and install them.

HINT: Match the protrusion of the insulator with the indentation of the housing.

- (7) Wave washer
- (8) Terminal nut



Terminal C:

- (1) Terminal insulator (inside)

NOTICE: Be careful to install the terminal insulator in the correct direction.

- (2) Contact plate
- (3) Terminal bolt
- (4) O—ring
- (5) Terminal insulator (outside)
- (6) Wave washer
- (7) Terminal nut

- (b) Temporarily tighten the terminal nuts.

5. TIGHTEN TERMINAL NUT

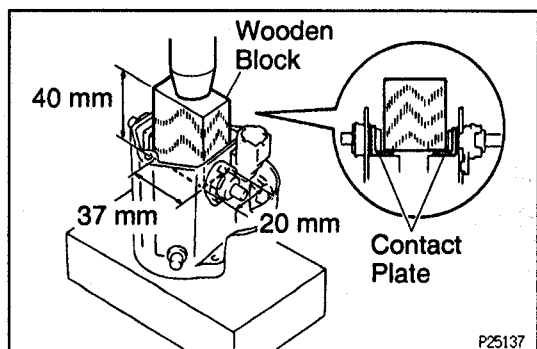
- (a) Put a wooden block on the contact plate and press it down with a hand press.

Dimensions of wooden block:

20 x 37 x 40 mm (0.79 x 1.46 x 1.57 in.)

Press force:

981 N (100 kgf, 221 lbf)



NOTICE:

- Check the diameter of the hand press ram. Then calculate the gauge pressure of the press when 981 N (100 kgf, 221 lbf) of force is applied.

Gauge pressure:

$$(\text{kgf/cm}^2) = \frac{100 \text{ kgf}}{\left(\frac{\text{Ram diameter (cm)}}{2} \right)^2 \times 3.14 (\pi)}$$

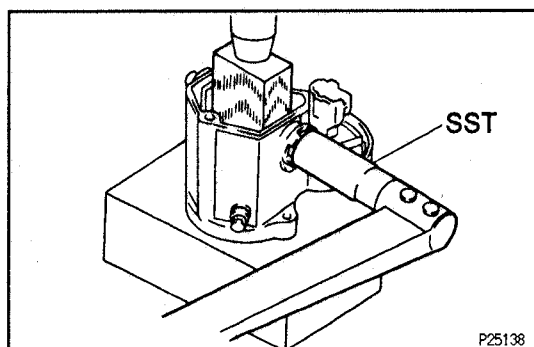
$$(\text{psi}) = \frac{221 \text{ lbf}}{\left(\frac{\text{Ram diameter (in.)}}{2} \right)^2 \times 3.14 (\pi)}$$

$$(\text{kPa}) = (\text{kgf/cm}^2) \times 98.1$$

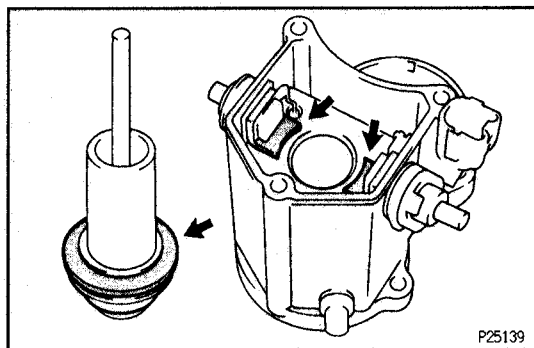
$$(\text{kPa}) = (\text{psi}) \times 6.9$$

V06796

- If the contact plate is not pressed down with the specified pressure, the contact plate may tilt due to coil deformation or the tightening of the nut.



- (b) Using SST, tighten the nuts to the specified torque.
SST 09810-38140
Torque: 17 N·m (170 kgf·cm, 12 ft·lbf)
NOTICE: If the nut is over tightened, it may cause cracks on the inside of the insulator.

**6. CLEAN CONTACT SURFACES OF CONTACT PLATE AND PLUNGER**

Clean the contact surfaces of the remaining contact plate and plunger with a dry shop rag.

7. REINSTALL MAGNETIC SWITCH END COVER

Install the plunger, new gasket, end cover and lead clamp with the 3 bolts.

Torque:

1.4 kW type:

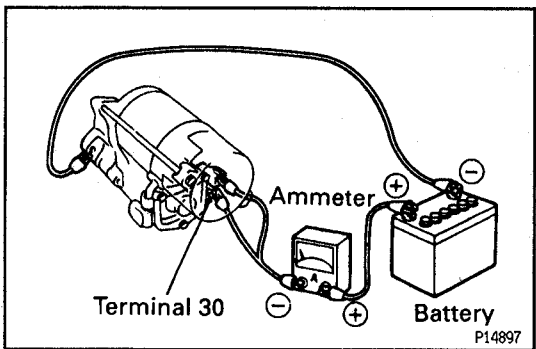
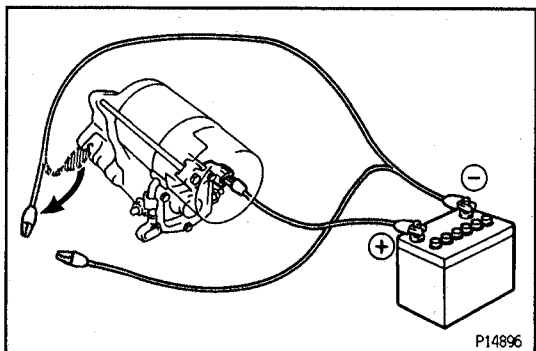
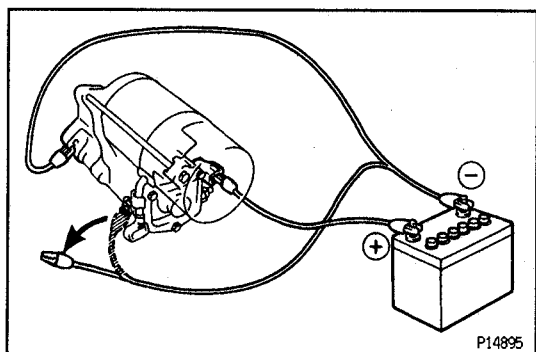
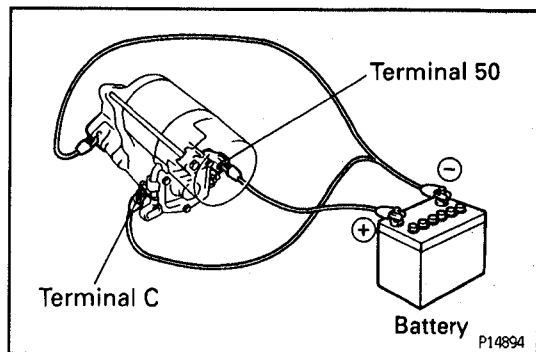
2.5 N·m (26 kgf·cm, 23 in·lbf)

2.0 kW type:

3.6 N·m (37 kgf·cm, 32 in·lbf)

8T0AA-01

STARTER ASSEMBLY**Assembly is in the reverse order of disassembly.****HINT:** Use high-temperature grease to lubricate the bearings and gears when assembling the starter.



STARTER PERFORMANCE TEST

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

1. DO PULL—IN TEST

- Disconnect the field coil lead wire from terminal C.
- Connect the battery to the magnetic switch as shown. Check that the clutch pinion gear moves outward.

2. DO HOLD—IN TEST

With battery connected as above with the clutch pinion gear out, disconnect the negative (—) lead from terminal C. Check that the pinion gear remains out.

3. INSPECT CLUTCH PINION GEAR RETURN

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

4. DO NO—LOAD PERFORMANCE TEST

- Connect the battery and ammeter to the starter as shown.
- Check that the starter rotates smoothly and steadily with the pinion gear moving out. Check that the ammeter shows the specified current.

Specified current:

1.4 kW type

At 11.5 V: 90 A or less

2.0 kW type

At 11.5 V: 100 A or less

STARTER INSTALLATION

Installation is in the reverse order of removal.

STARTER RELAY

STARTER RELAY INSPECTION

ST000-05

1. REMOVE STARTER RELAY

LOCATION: The relay is located in the junction block on the driver's side.

2. INSPECT STARTER RELAY

A. Inspect relay continuity

- (a) Using an ohmmeter, check that there is continuity between terminals 1 and 2.

If there is no continuity, replace the relay.

- (b) Check that there is no continuity between terminals 3 and 5.

If there is continuity, replace the relay.

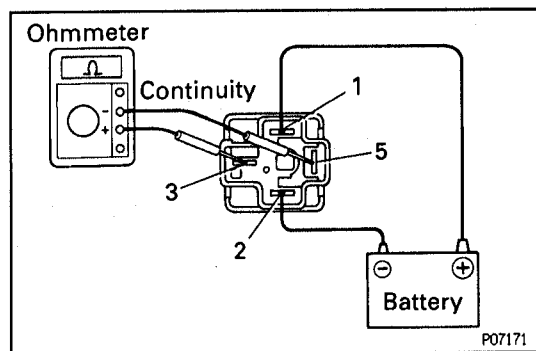
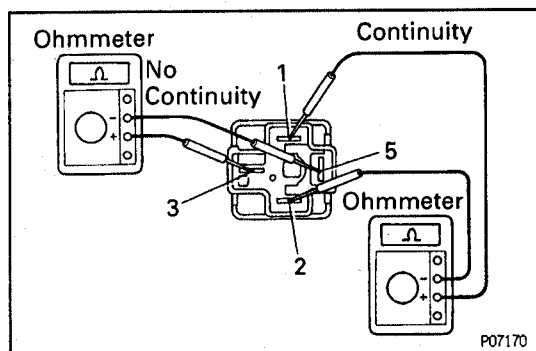
B. Inspect relay operation

- (a) Apply battery voltage across terminals 1 and 2.

- (b) Using an ohmmeter, check that there is continuity between terminals 3 and 5.

If operation is not as specified, replace the relay.

3. REINSTALL STARTER RELAY



SERVICE SPECIFICATIONS

SERVICE DATA

ST015-16

Starter (1.4 kW type)	Rated voltage and output power		12 V 1.4 kW
	No—load characteristics	Current	90 A or less at 11.5 V
		rpm	3,000 rpm or more
	Brush length	STD	15.5 mm (0.610 in.)
		Minimum	10.0 mm (0.394 in.)
	Spring installed load	STD	17.6 — 23.5 N (1.79 — 2.41 kgf, 3.9 — 5.3 lbf)
		Minimum	11.8 N (1.2 kgf, 2.6 lbf)
	Commutator		
	Diameter	STD	30 mm (1.18 in.)
		Minimum	29 mm (1.14 in.)
	Undercut depth	STD	0.6 mm (0.024 in.)
		Minimum	0.2 mm (0.008 in.)
	Circle runout	Maximum	0.05 mm (0.0020 in.)
	Magnetic switch		
	Contact plate for wear	Maximum	0.9 mm (0.035 in.)
Starter (2.0 kW type)	Rated voltage and output power		12 V 2.0 kW
	No—load characteristics	Current	100 A or less at 11.5 V
		rpm	2,500 rpm or more
	Brush length	STD	15.0 mm (0.591 in.)
		Minimum	9.0 mm (0.355 in.)
	Spring installed load	STD	21.5 — 27.5 N (2.19 — 2.81 kgf, 4.9 — 6.2 lbf)
		Minimum	12.7 N (1.3 kgf, 2.7 lbf)
	Commutator		
	Diameter	STD	35 mm (1.38 in.)
		Minimum	34 mm (1.34 in.)
	Undercut depth	STD	0.7 mm (0.028 in.)
		Minimum	0.2 mm (0.008 in.)
	Circle runout	Maximum	0.05 mm (0.0020 in.)
	Magnetic switch		
	Contact plate for wear	Maximum	0.9 mm (0.035 in.)

ST

TORQUE SPECIFICATIONS

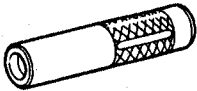
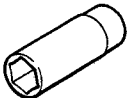
ST016-10

Part tightened		N·m	kgf·cm	ft·lbf
Starter mounting bolt		39	400	29
Starter wire mounting nut		8.8	90	78 in·lbf
Field frame x Armature	1.4 kW type	5.9	60	52 in·lbf
	2.0 kW type	9.3	93	82 in·lbf
Starter housing x Clutch assembly	1.4 kW type	5.9	60	52 in·lbf
	2.0 kW type	9.3	93	82 in·lbf
End cover x Field frame	1.4 kW type	1.5	15	13 in·lbf
	2.0 kW type	3.8	38	34 in·lbf
Lead wire x Terminal C		5.9	60	52 in·lbf
Terminal nut x Terminal 30 of starter, Terminal C of starter		17	170	12
Magnetic switch end cover x Magnetic switch	1.4 kW type	2.5	26	23 in·lbf
	2.0 kW type	3.6	37	32 in·lbf

(5VZ—FE)**PREPARATION**

ST03P—07

SST (SPECIAL SERVICE TOOLS)

	09286—46011 Injection Pump Spline Shaft Puller	Armature bearing
	09201—41020 Valve Stem Oil Seal Replacer	Armature front bearing
	09810—38140 Starter Magnet Switch Nut Wrench 14	Terminal kit

ST03Q—05

RECOMMENDED TOOLS

	09082—00050 TOYOTA Electrical Tester Set.	
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ST03R—05

EQUIPMENT

Dial indicator	Commutator
Magnetic finger	Steel ball
Press	Magnetic switch terminal kit
Pull scale	Brush spring
Sandpaper	Commutator
Torque wrench	
V—block	Commutator
Vernier calipers	Commutator, Brush

ON—VEHICLE INSPECTION

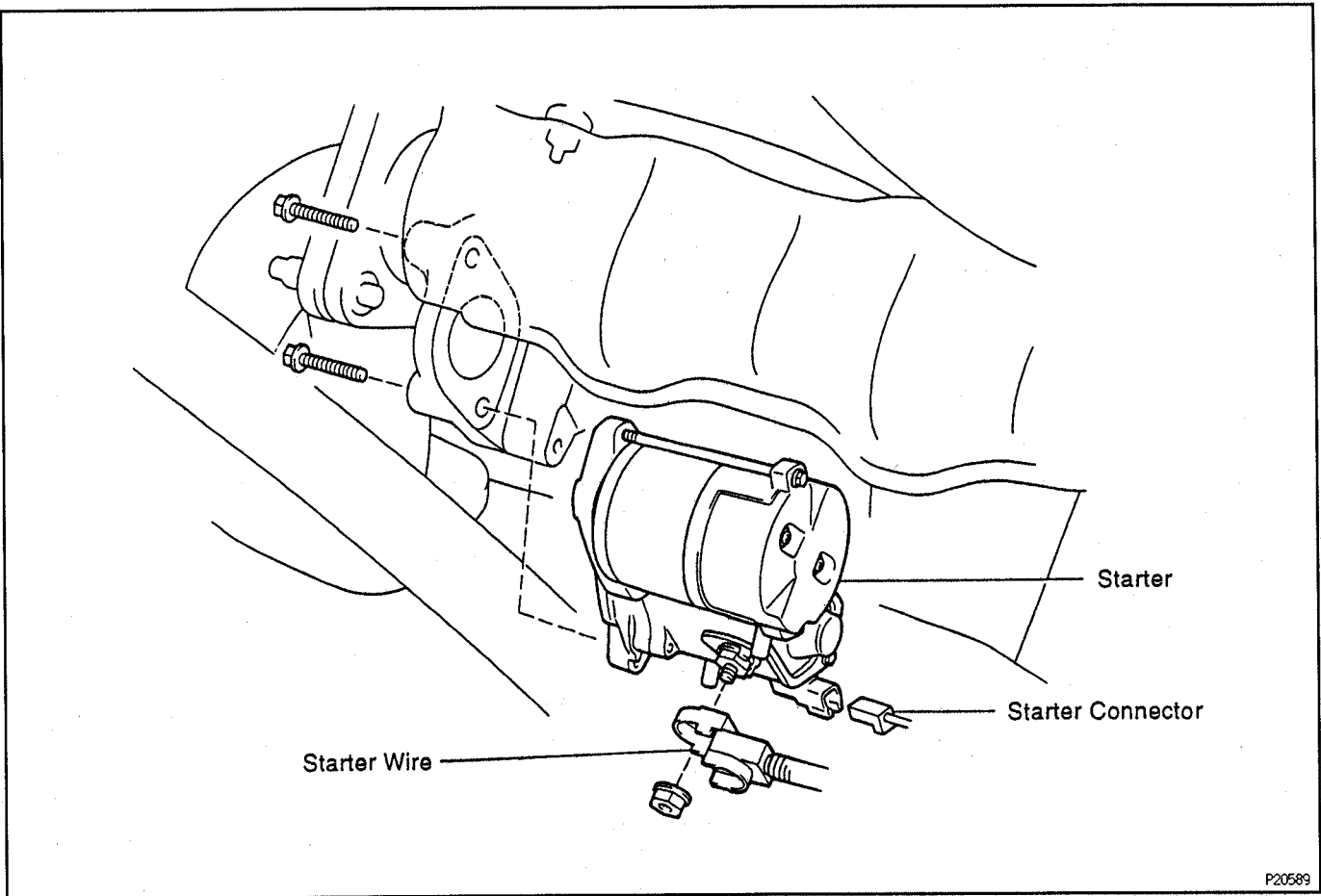
ST03K—04

NOTICE: Before changing the starter, check these items again:

- Connector connection
- Accessory installation, e.g.: theft deterrent system

STARTER COMPONENTS FOR REMOVAL AND INSTALLATION

ST06A—03

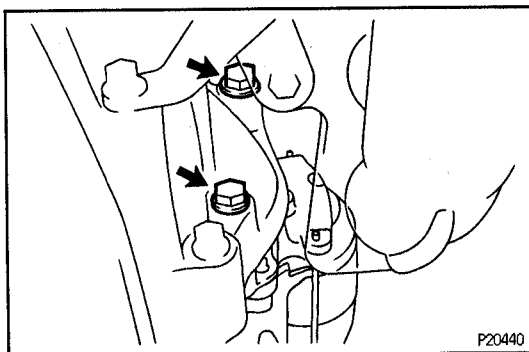
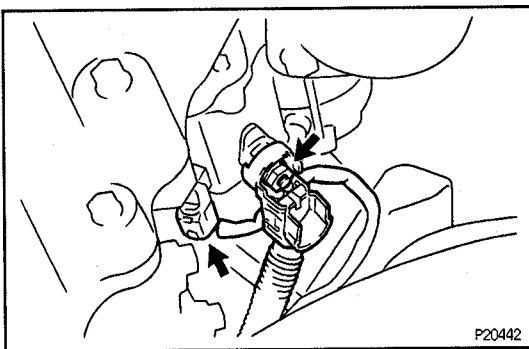


ST06B—03

STARTER REMOVAL

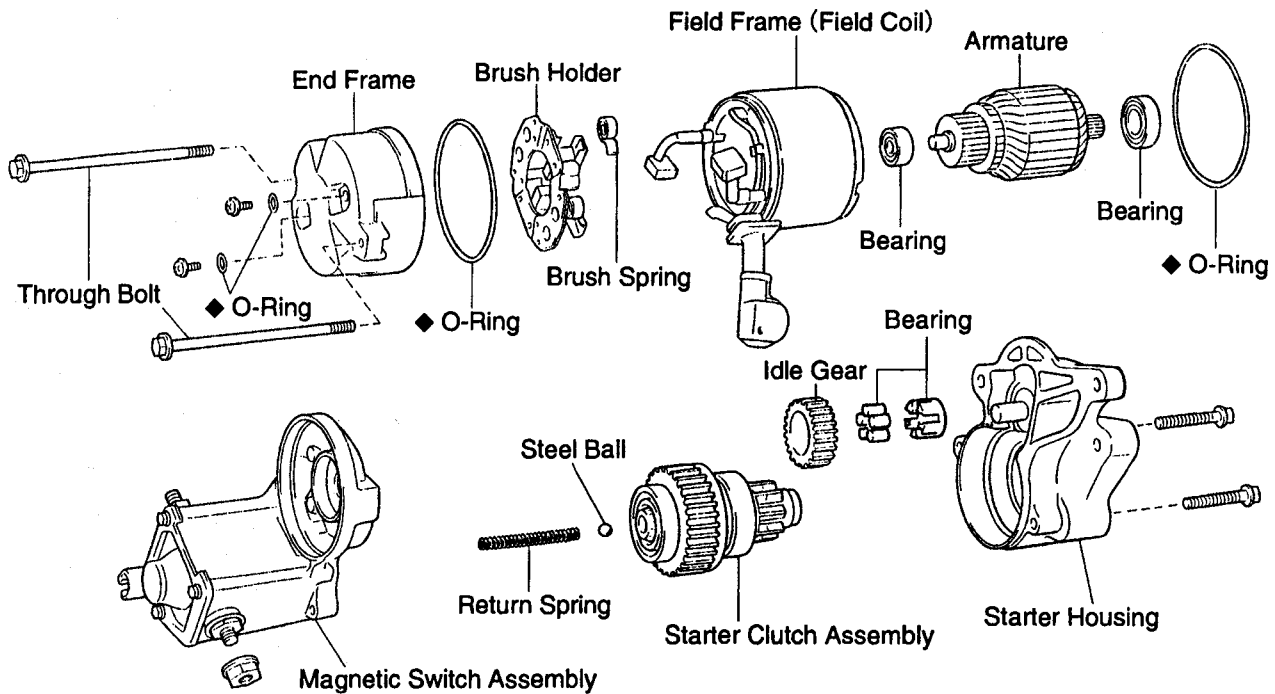
REMOVE STARTER

- (a) Disconnect the starter connector.
- (b) Remove the nut and disconnect the starter wire.
Torque: 8.8 N·m (90 kgf·cm, 70 in.-lbf)
- (c) Remove the 2 bolts and starter.
Torque: 39 N·m (400 kgf·cm, 29 ft.-lbf)

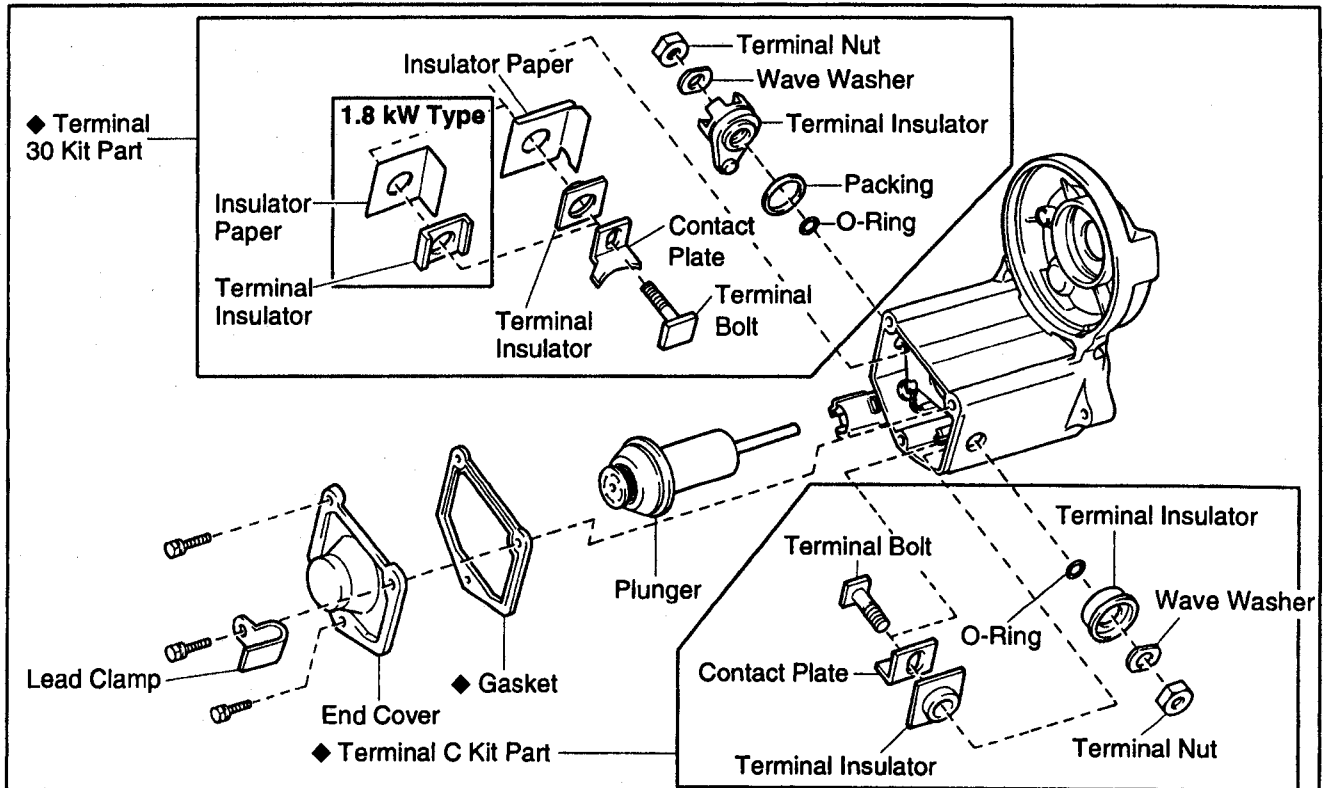


COMPONENTS FOR DISASSEMBLY AND ASSEMBLY

ST03T-00



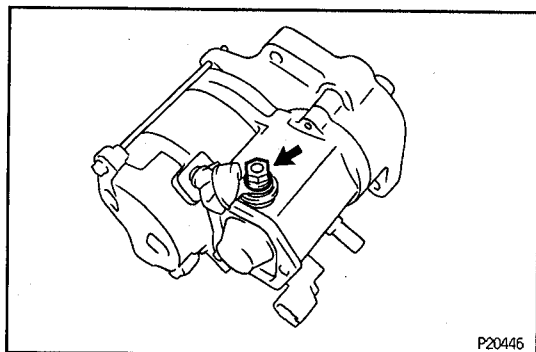
Magnetic Switch Assembly



P23105
P24363

◆ Non-reusable parts

Z16517

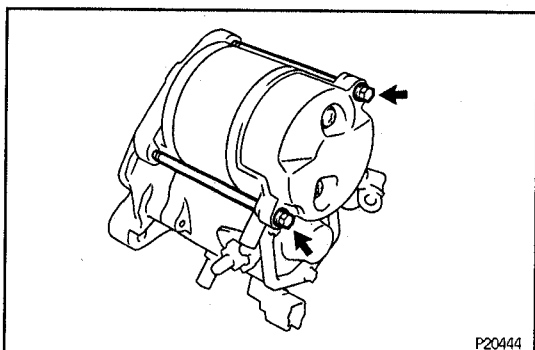


STARTER DISASSEMBLY

1. REMOVE FIELD FRAME WITH ARMATURE FROM MAGNETIC SWITCH ASSEMBLY

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

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



- (b) Remove the 2 through bolts. Pull out the field frame with the armature from the magnetic switch assembly.

Torque:

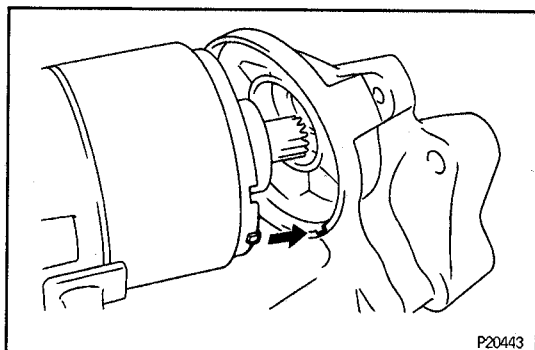
1.4 kW type: 5.9 N·m (60 kgf·cm, 52 in.-lbf)

1.8 kW type: 9.3 N·m (95 kgf·cm, 82 in.-lbf)

- (c) Remove the O-ring.

INSTALLATION HINT: Use a new O-ring.

INSTALLATION HINT: Align the protrusion of the field frame with cutout of the magnetic switch.



2. REMOVE STARTER HOUSING FROM MAGNETIC SWITCH ASSEMBLY

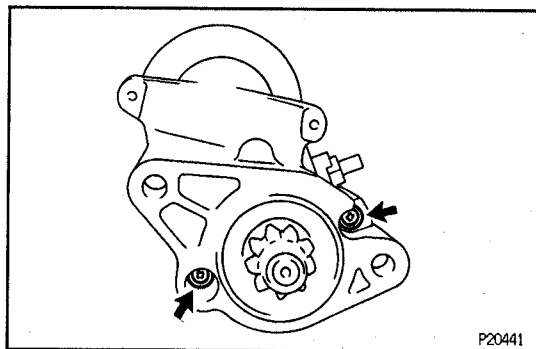
- (a) Remove the 2 screws.

Torque:

1.4 kW type: 5.9 N·m (60 kgf·cm, 52 in.-lbf)

1.8 kW type: 9.3 N·m (95 kgf·cm, 82 in.-lbf)

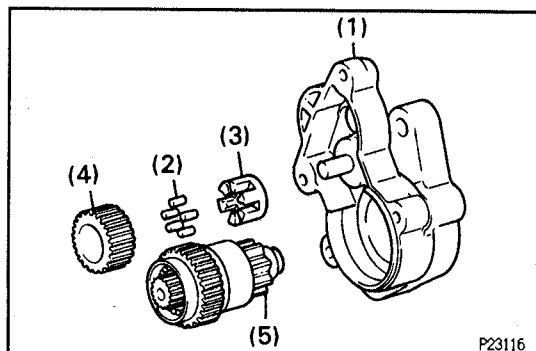
- (b) Remove the starter housing with the pinion gear, idler gear, bearing and clutch assembly.

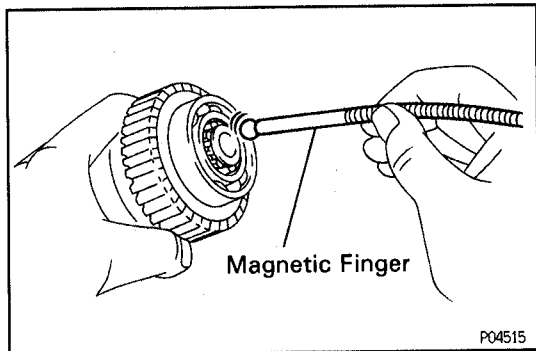


3. REMOVE CLUTCH ASSEMBLY AND GEARS FROM STARTER HOUSING

Remove these parts from the magnetic switch assembly:

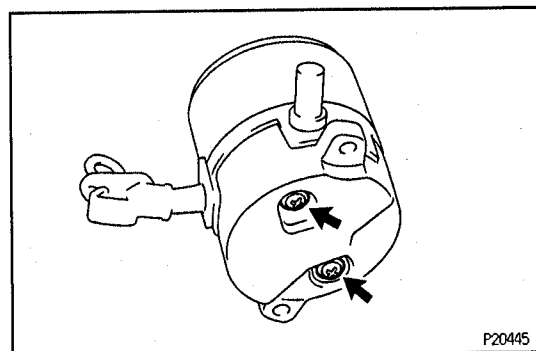
- (1) Starter housing
- (2) Roller
- (3) Retainer
- (4) Idler Gear
- (5) Clutch assembly





4. REMOVE STEEL BALL AND SPRING

Using a magnetic finger, remove the spring and steel ball from the clutch shaft hole.



5. REMOVE BRUSHES AND BRUSH HOLDER

- (a) Remove the 2 screws and pull the end cover with O—ring of the field frame.

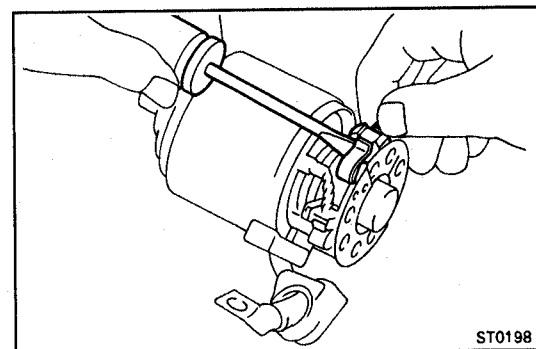
Torque:

1.4 kW type: 1.5 N·m (15 kgf·cm, 13 in.·lbf)

1.8 kW type: 3.8 N·m (38 kgf·cm, 34 in.·lbf)

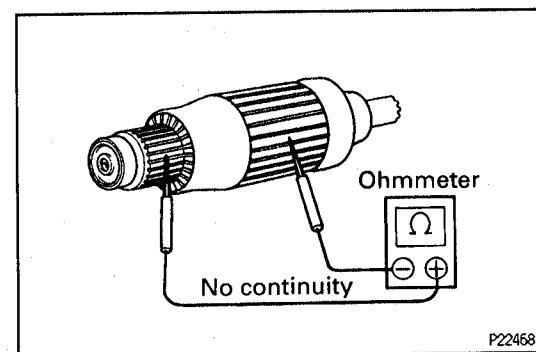
- (b) Remove the O—ring from the field frame.

ASSEMBLY HINT: Use a new O—ring.



- (c) Using a screwdriver, hold the spring back and disconnect the brush from the brush holder. Disconnect the 4 brushes and remove the brush holder.

6. REMOVE ARMATURE FROM FIELD FRAME

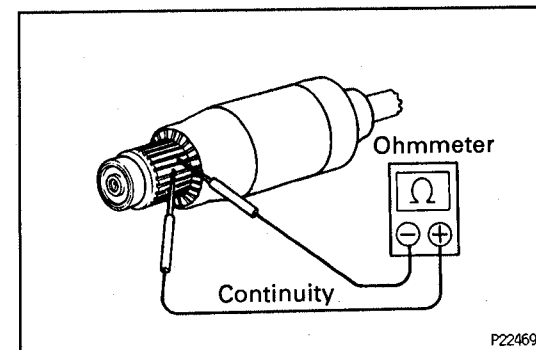


STARTER INSPECTION

Armature Coil

1. INSPECT THAT COMMUTATOR IS NOT GROUNDED

Using an ohmmeter, check that there is no continuity between the commutator and armature coil core. If there is continuity, replace the armature.



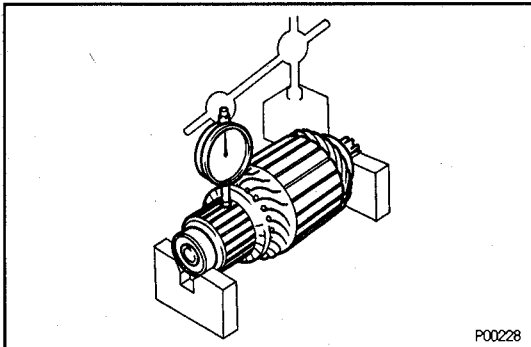
2. INSPECT COMMUTATOR FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the segments of the commutator. If there is no continuity between any segment, replace the armature.

Commutator

1. INSPECT COMMUTATOR FOR DIRTY AND BURNT SURFACES

If the surface is dirty or burnt, clean it with sandpaper (No.400) or on a lathe.



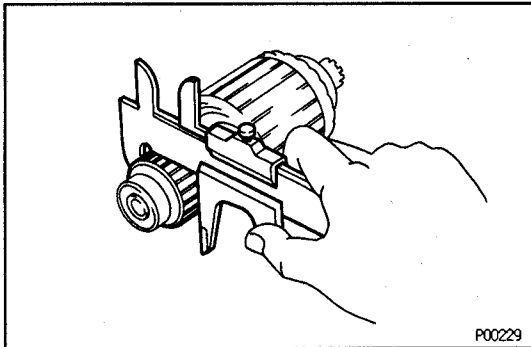
2. INSPECT COMMUTATOR CIRCLE RUNOUT

- Place the commutator on V—blocks.
- Using a dial indicator, measure the circle runout.

Maximum circle runout:

0.05 mm (0.0020 in.)

If the circle runout is greater than the maximum, correct it on a lathe.



3. INSPECT COMMUTATOR DIAMETER

Using vernier calipers, measure the commutator diameter.

Standard diameter:

1.4 kW type: 30.0 mm (1.181 in.)

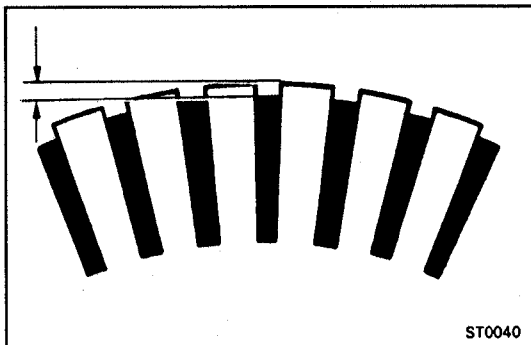
1.8 kW type: 35.0 mm (1.380 in.)

Minimum diameter:

1.4 kW type: 29.0 mm (1.142 in.)

1.8 kW type: 34.0 mm (1.340 in.)

If the diameter is less than the minimum, replace the armature.



4. INSPECT UNDERCUT DEPTH OF SEGMENT

Check that the undercut depth is clean and free of foreign material. Smooth out the edge.

Standard undercut depth:

1.4 kW type: 0.6 mm (0.024 in.)

1.8 kW type: 0.7 mm (0.028 in.)

Minimum undercut depth:

0.2 mm (0.008 in.)

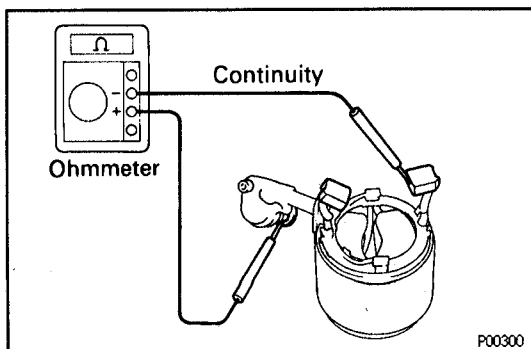
If the undercut depth is less than the minimum, correct it with a hacksaw blade.

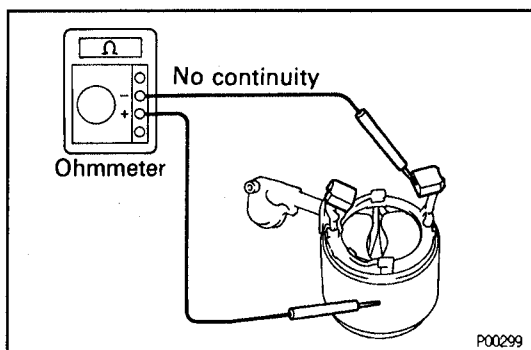
Field Frame (Field Coil)

1. INSPECT FIELD COIL FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the lead wire and field coil brush lead.

If there is no continuity, replace the field frame.





2. INSPECT THAT FIELD COIL IS NOT GROUNDED

Using an ohmmeter, check that there is no continuity between the field coil end and field frame.

If there is continuity, repair or replace the field frame.

Brushes

INSPECT BRUSH LENGTH

Using vernier calipers, measure the brush length.

Standard length:

1.4 kW type: 15.5 mm (0.610 in.)

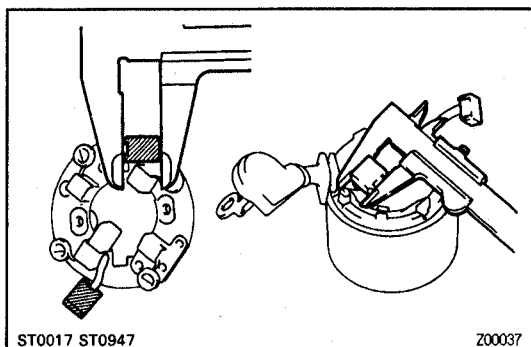
1.8 kW type: 15.0 mm (0.591 in.)

Minimum length:

1.4 kW type: 10.0 mm (0.394 in.)

1.8 kW type: 9.0 mm (0.354 in.)

If the length is less than the minimum, replace the brush holder and field frame.



Brush Springs

INSPECT BRUSH SPRING LOAD

Take the pull scale reading the instant the brush spring separates from the brush.

Spring installed load:

1.4 kW type:

17.6 — 23.5 N (1.79 — 2.41 kgf, 3.9 — 5.3 lbf)

1.8 kW type:

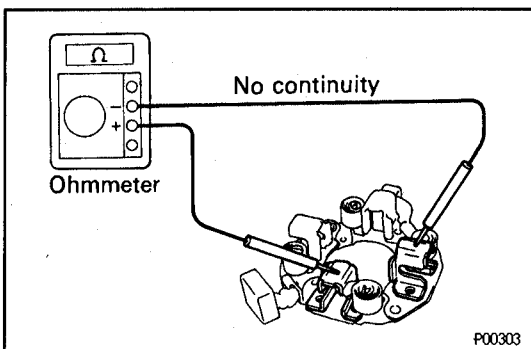
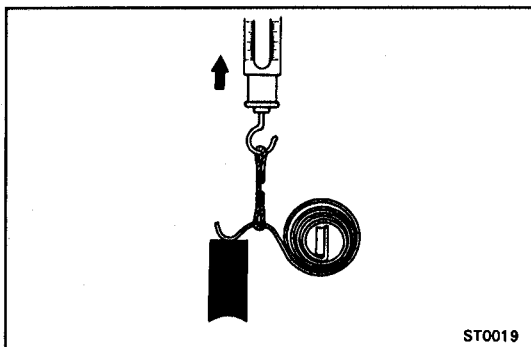
21.5 — 27.5 N (2.19 — 2.81 kgf, 4.9 — 6.2 lbf)

Minimum spring installed load:

1.4 kW type: 11.8 N (1.2 kgf, 2.6 lbf)

1.8 kW type: 12.7 N (1.3 kgf, 2.7 lbf)

If the installed load is less than the minimum, replace the brush springs.



Brush Holder

INSPECT INSULATION OF BRUSH HOLDER

Using an ohmmeter, check that there is no continuity between the positive (+) and negative (-) brush holders.

If there is continuity, repair or replace the brush holder.

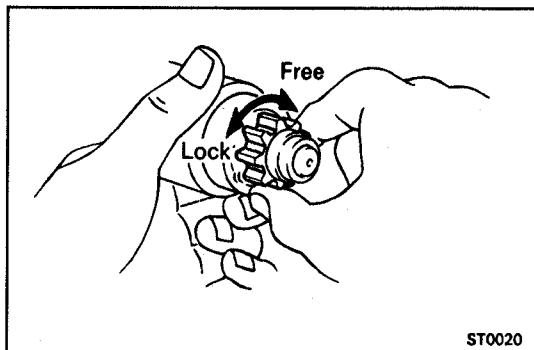
Clutch and Gears

1. INSPECT GEAR TEETH

Check the gear teeth on the pinion gear, idler gear and clutch assembly for wear or damage.

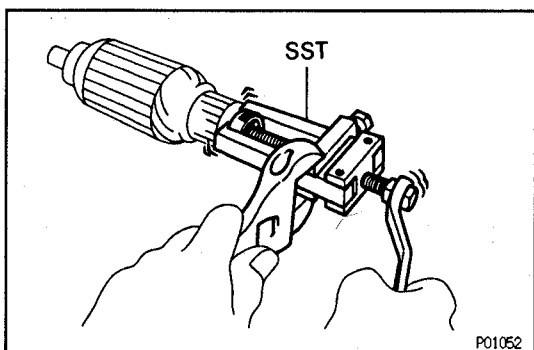
If damaged, replace the gear or clutch assembly.

If damaged, also check the flywheel ring gear for wear or damage.



2. INSPECT CLUTCH

Rotate the clutch pinion gear clockwise and check that it turns freely. Try to rotate the clutch pinion counterclockwise and check that it locks. If necessary, replace the clutch assembly.



Bearings

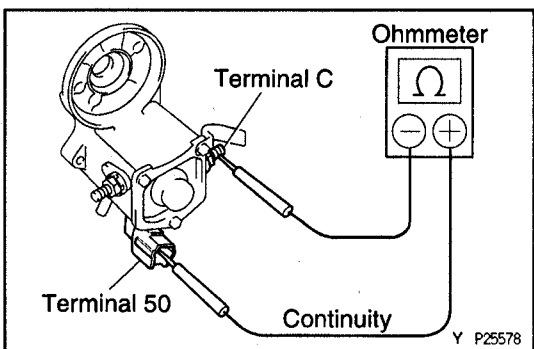
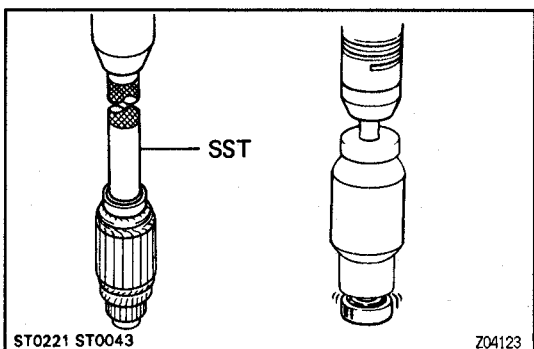
1. INSPECT BEARINGS

Turn each bearing by hand while applying inward force.

If the resistance is felt or if the bearing sticks, replace the bearing.

2. IF NECESSARY, REPLACE BEARINGS

- Using SST, remove the bearing.
SST 09286—46011
- Using SST and a press, press in a new bearing.
SST 09201—41020

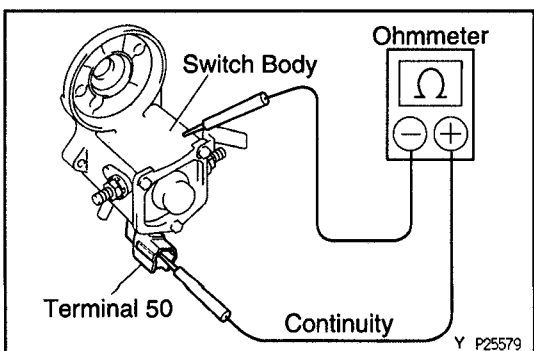


Magnetic Switch:

1. DO PULL—IN COIL OPEN CIRCUIT TEST

Using an ohmmeter, check that there is continuity between terminals 50 and C.

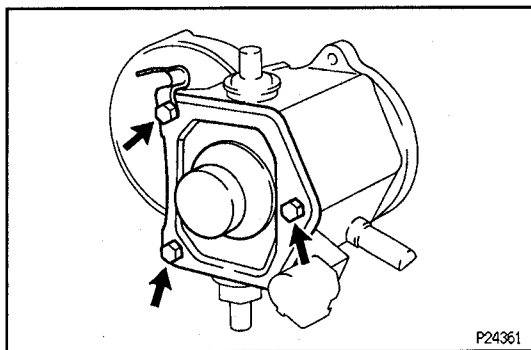
If there is no continuity, check and replace the magnetic switch assembly.



2. DO HOLD—IN COIL CIRCUIT TEST

Using an ohmmeter, check that there is continuity between terminal 50 and the switch body.

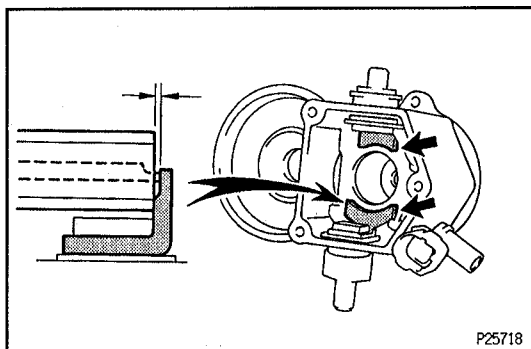
If there is no continuity, check and replace the magnetic switch assembly.



MAGNETIC SWITCH TERMINAL KIT PARTS REPLACEMENT

1. REMOVE MAGNETIC SWITCH END COVER

Remove the 3 bolts, end cover, gasket and plunger from the magnetic switch assembly.



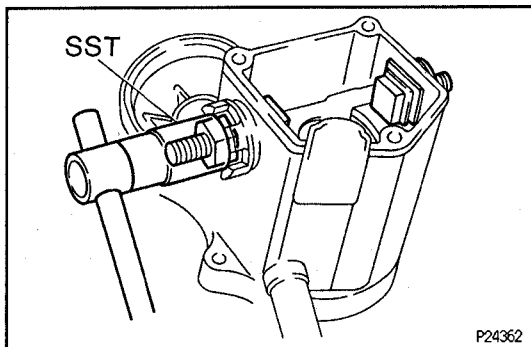
2. INSPECT CONTACT PLATE FOR WEAR

Using vernier calipers, measure the contact plate for depth of wear.

Maximum wear:

0.9 mm (0.035 in.)

If the depth of wear is greater than the maximum, replace the contact plate.



3. REMOVE TERMINAL KIT PARTS

- (a) Using SST, remove the nut and washer.

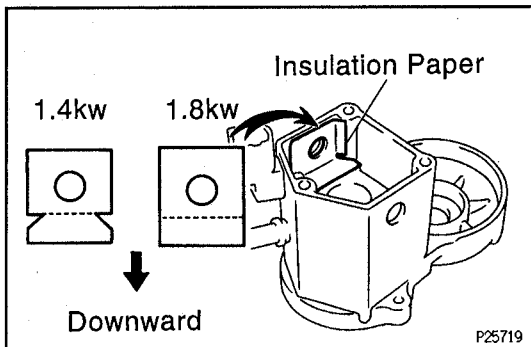
SST 09810-38140

- (b) Terminal C:

Remove the nut, terminal insulator outer, O-ring, terminal bolt, contact plate and terminal insulator inner.

- (c) Terminal 30:

Remove the nut, terminal insulator outer, packing, O-ring, the contact plate, terminal bolt, terminal insulator inner, insulation paper.

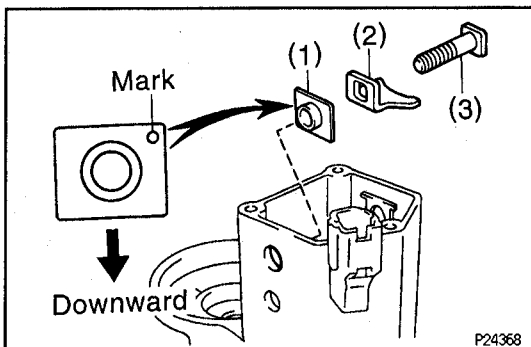


4. REINSTALL TERMINAL KIT PARTS

Terminal 30:

- (a) Insert the insulation paper between the coil and housing.

HINT: Install the insulation paper facing the correct direction as shown in the illustration.



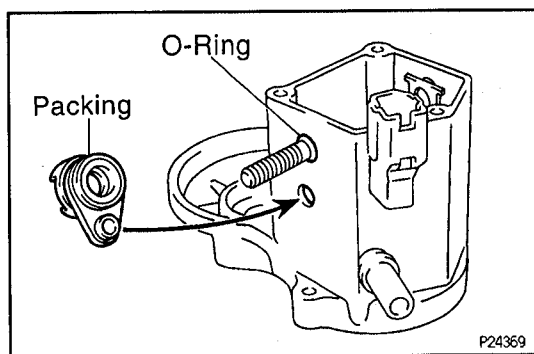
- (b) Install these parts to the magnetic switch assembly:

(1) Terminal insulator inner

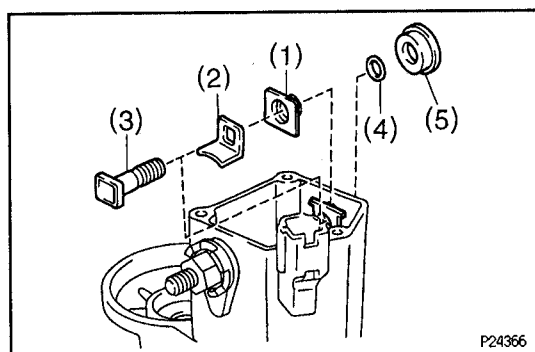
(2) Contact plate

(3) Terminal bolt

HINT: Install the terminal insulator inner in the direction as shown in the illustration.



- (c) Install the O—ring on the terminal bolt.
- (d) Place the packing to the terminal insulator outer, and install it to the terminal.
HINT: Match the protrusion of the insulator with the indentation of the housing.
- (e) Install the washer and nut, temporarily tighten the nut.

**Terminal C:**

- (a) Install these parts to the magnetic switch assembly:

- (1) Terminal insulator inner
- (2) Contact plate
- (3) Terminal bolt
- (4) O—ring
- (5) Terminal insulator outer

HINT: Install the terminal insulator inner in the same direction as terminal 30.

- (b) Install the washer and nut, temporarily tighten the nut.

5. TIGHTEN TERMINAL NUT

- (a) Put a wood block on the contact plate and press it down with a hand press.

Dimensions of wood block:

20 x 37 x 40 mm (0.79 x 1.46 x 1.57 in.)

Press force:

981 N (100 kgf, 221 lbf)

NOTICE:

- Check the diameter of the hand press ram. Then calculate the gauge pressure of the press when 981 N (100 kgf, 221 lbf) of force is applied.

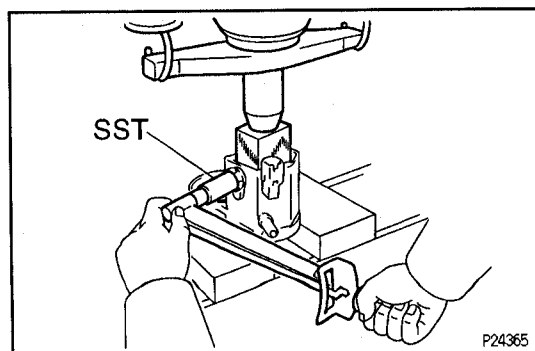
$$(\text{kgf/cm}^2) = \frac{100 \text{ kgf}}{\left(\frac{\text{Ram diameter (cm)}}{2} \right)^2 \times 3.14 (\pi)}$$

$$(\text{psi}) = \frac{221 \text{ lbf}}{\left(\frac{\text{Ram diameter (in.)}}{2} \right)^2 \times 3.14 (\pi)}$$

$$(\text{kPa}) = (\text{kgf/cm}^2) \times 98.1$$

$$(\text{kPa}) = (\text{psi}) \times 6.9$$

V06796



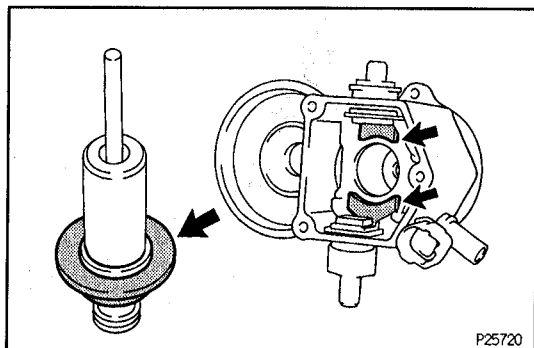
- If the contact plate is not pressed down with the specified pressure, the contact plate may tilt due to coil deformation or the tightening of the nut.

- (b) Using SST, tighten the nut to the specified torque.

SST 09810—38170

Torque: 17 N·m (170 kgf·cm, 12 ft·lbf)

NOTICE: If the nut is over tightened, it may cause cracks on the inside of the insulator.



6. CLEAN CONTACT SURFACES OF CONTACT PLATE AND PLUNGER

Clean the contact surfaces of the remaining contact plate and plunger with a dry shop rag.

7. REINSTALL MAGNETIC SWITCH END COVER

Install the plunger, gasket and magnetic switch end cover with the 3 bolts.

Torque:

1.4 kW type: 2.5 N·m (26 kgf·cm, 22 in.-lbf)

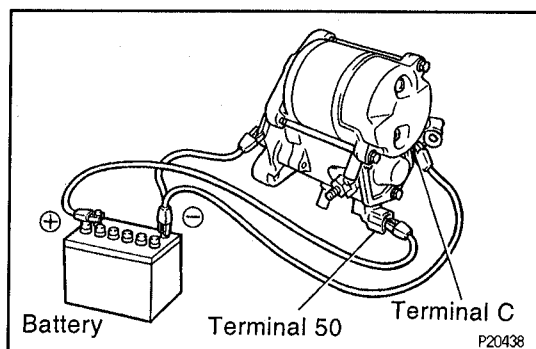
1.8 kW type: 3.6 N·m (37 kgf·cm, 32 in.-lbf)

STARTER ASSEMBLY

8T0AD-01

Assembly is in the reverse order of disassembly.

ST



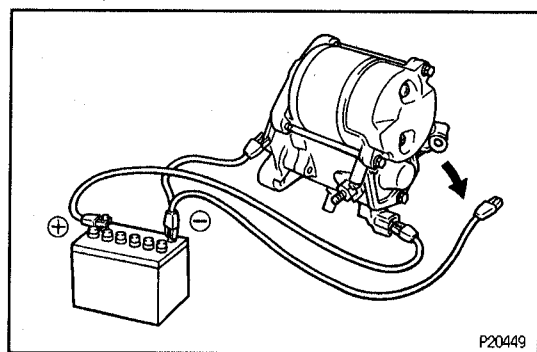
STARTER PERFORMANCE TEST

8T0AX-0C

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

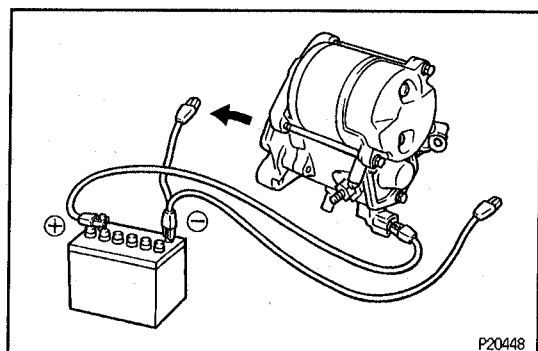
1. DO PULL-IN TEST

- Disconnect the field coil lead wire from terminal C.
- Connect the battery to the magnetic switch as shown. Check that the clutch pinion gear moves outward.



2. DO HOLD-IN TEST

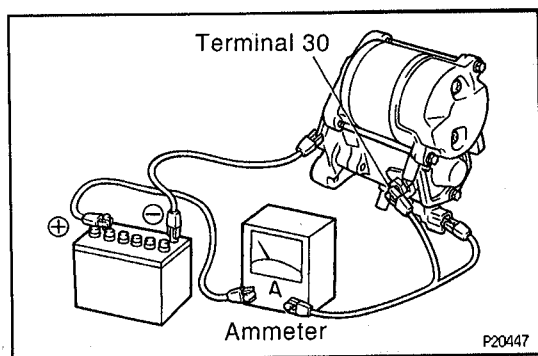
With battery connected as above with the clutch pinion gear out, disconnect the negative (—) lead from terminal C. Check that the pinion gear remains out.



3. INSPECT CLUTCH PINION GEAR RETURN

Disconnect the negative (—) lead from the switch body.

Check that the clutch pinion gear returns inward.



4. DO NO—LOAD PERFORMANCE TEST

- Connect the battery and ammeter to the starter as shown.
- Check that the starter rotates smoothly and steadily with the pinion gear moving out. Check that the ammeter reads the specified current.

Specified current:

1.4 kW type

At 11.5 V: 90 A or less

1.8 kW type

At 11.5 V: 100 A or less

STARTER INSTALLATION

STOAE-01

Installation is in the reverse order of removal.

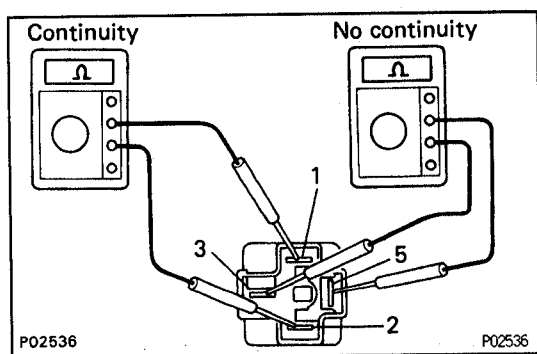
STARTER RELAY

STOGE-04

STARTER RELAY INSPECTION

LOCATION: The relay is located in the Relay Block No.2 in the engine compartment.

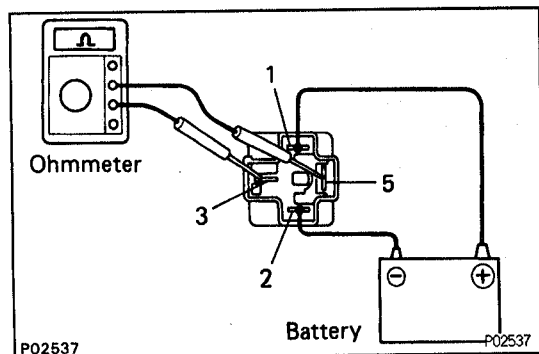
1. REMOVE STARTER RELAY



2. INSPECT STARTER RELAY

A. Inspect relay continuity

- Using an ohmmeter, check that there is continuity between terminals 1 and 2.
If there no continuity, replace the relay.
- Check that there is no continuity between terminals 3 and 5.
If there continuity, replace the relay.



B. Inspect relay operation

- Apply battery voltage across terminals 1 and 2.
- Check that there is continuity between terminals 3 and 5.
If operation is not as described, replace the relay.

3. REINSTALL STARTER RELAY

SERVICE SPECIFICATIONS

SERVICE DATA

ST00F—06

Starter (1.4 kW type)	Rated voltage and output power		12 V 1.4 kW
	No—load characteristics	Current	90 A or less at 11.5 V
		rpm	3,000 rpm or more
	Brush length	STD	15.5 mm (0.610 in.)
		Minimum	10.0 mm (0.394 in.)
	Spring installed load	STD	17.6 — 23.5 N (1.79 — 2.41 kgf, 3.9 — 5.3 lbf)
		Minimum	11.8 N (1.2 kgf, 2.6 lbf)
	Commutator Diameter	STD	30.0 mm (1.181 in.)
		Minimum	29.0 mm (1.142 in.)
	Undercut depth	STD	0.8 mm (0.024 in.)
		Minimum	0.2 mm (0.008 in.)
	Circle runout	Maximum	0.05 mm (0.0020 in.)
Starter (1.8 kW type)	Rated voltage and output power		12 V 1.8 kW
	No—load characteristics	Current	100 A or less at 11.5 V
		rpm	2,500 rpm or more
	Brush length	STD	15.0 mm (0.591 in.)
		Minimum	9.0 mm (0.354 in.)
	Spring installed load	STD	21.5 — 27.5 N (2.19 — 2.81 kgf, 4.9 — 6.2 lbf)
		Minimum	12.7 N (1.3 kgf, 2.7 lbf)
	Commutator Diameter	STD	35.0 mm (1.380 in.)
		Minimum	34.0 mm (1.340 in.)
	Undercut depth	STD	0.7 mm (0.028 in.)
		Minimum	0.2 mm (0.008 in.)
	Circle runout	Maximum	0.05 mm (0.0020 in.)
	Magnetic switch Contact plate for wear		
		Maximum	0.9 mm (0.035 in.)

TORQUE SPECIFICATIONS

ST043—00

Part tightened		N·m	kgf·cm	ft·lbf
Starter wire x Starter		8.8	90	78 in·lbf
Starter x Transaxle		39	400	29
Lead wire x Terminal C of starter		5.9	60	52 in·lbf
End cover, Magnetic switch x Starter housing	1.4 kW type	5.9	60	52 in·lbf
	1.8 kW type	9.3	95	82 in·lbf
End cover x Field frame	1.4 kW type	1.5	15	13 in·lbf
	1.8 kW type	3.8	38	34 in·lbf
Terminal nut x Terminal C of starter, Terminal 30 of starter		17	170	12
Magnetic switch end cover x Magnetic switch	1.4 kW type	2.5	26	23 in·lbf
	1.8 kW type	3.6	37	32 in·lbf