STARTING SYSTEM

PREPARATION

SST (SPECIAL SERVICE TOOLS)

	09286–46011	Injection Pump Spline Shaft Puller	Armature bearing
	09820–00030	Alternator Rear Bearing Replacer	Armature front bearing

RECOMMENDED TOOLS

	09082–00050	TOYOTA Electrical Tester Set ◆	

EQUIPMENT

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

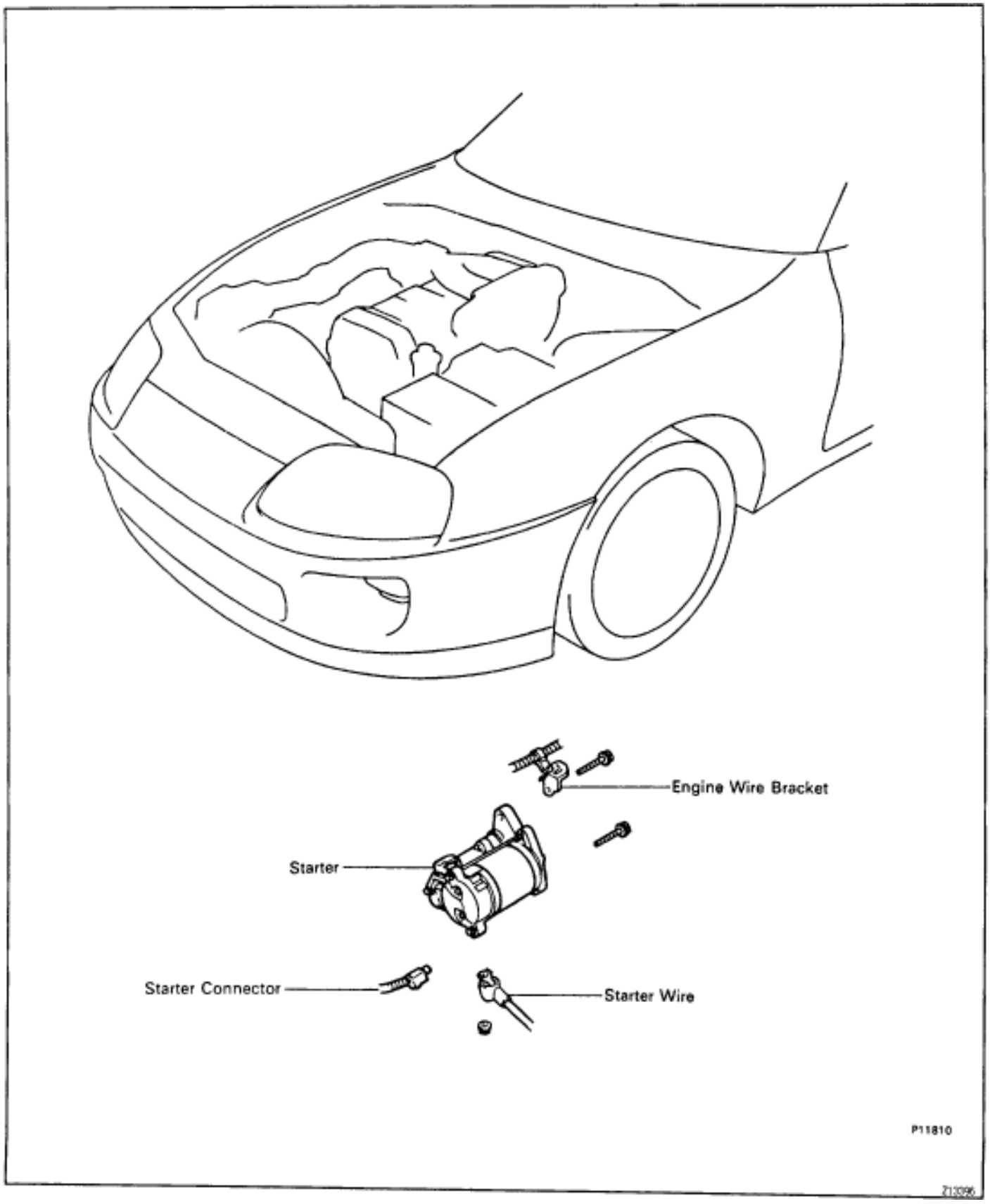
ON–VEHICLE INSPECTION

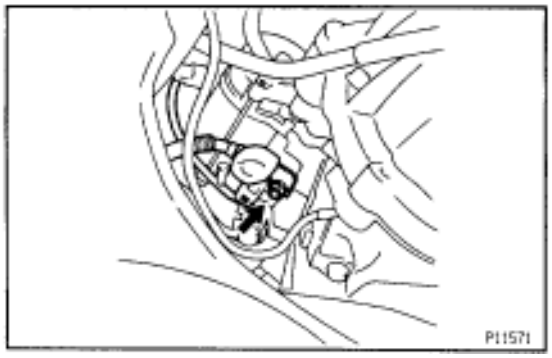
NOTICE: Before changing the starter, check the following items again:

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

STARTER

COMPONENTS FOR REMOVAL AND INSTALLATION





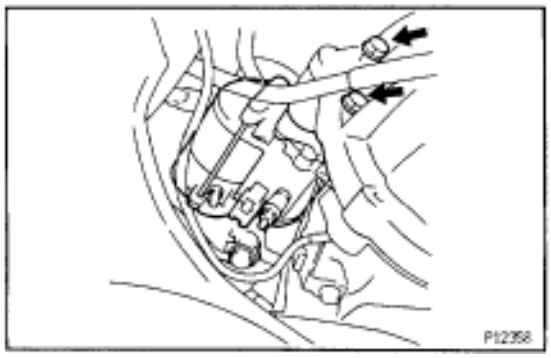
STARTER REMOVAL

Installation is in the reverse order of removal.

REMOVE STARTER

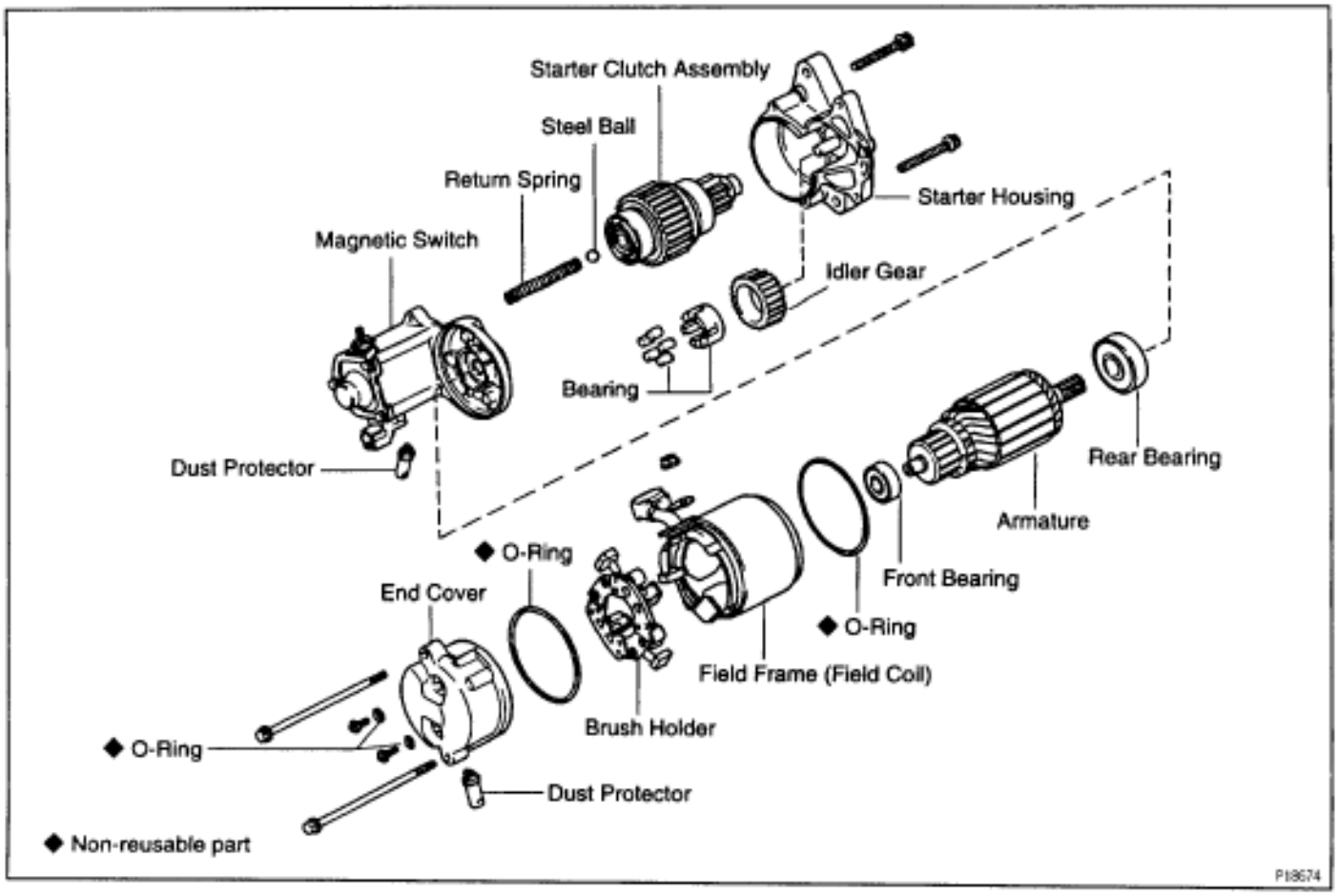
(a) Remove the rubber cap and nut, and disconnect the starter wire.

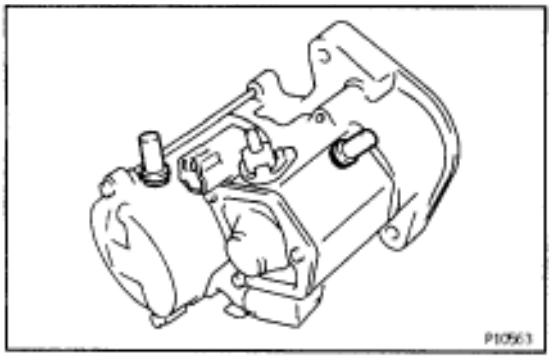
(b) Disconnect the starter connector.



(c) Remove the 2 bolts and starter.
Torque: 39 N·m (400 kgf·cm, 29 ft·lbf)

COMPONENTS FOR DISASSEMBLY AND ASSEMBLY





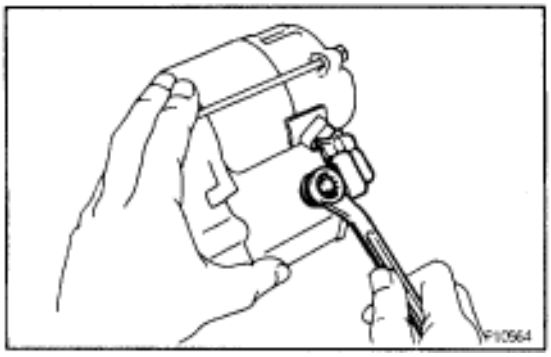
STARTER DISASSEMBLY

Assembly is in the reverse order of disassembly.

ASSEMBLY HINT: Use high–temperature grease to lubricate the bearings, gears return spring and steel ball when assembling the starter.

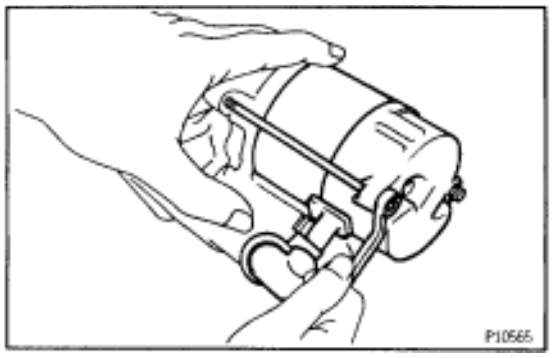
1. REMOVE DUST PROTECTORS

Remove the 2 dust protectors.



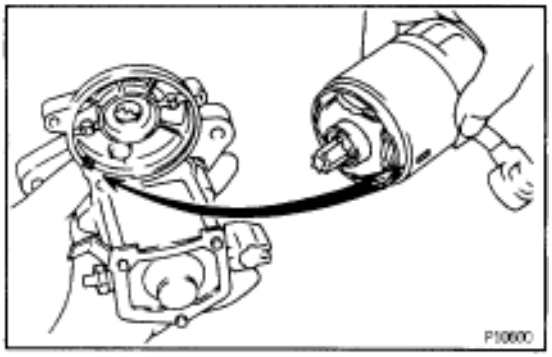
2. REMOVE FIELD FRAME AND ARMATURE

(a) Remove the nut, and disconnect the lead wire from the magnetic switch terminal.
Torque: 7.9 N·m (81 kgf·cm, 70 in.·lbf)



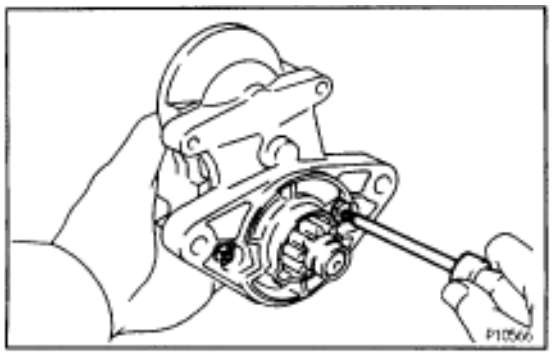
(b) Remove the 2 through bolts.
Torque: 5.9 N·m (60 kgf·cm, 52 in.·lbf)

(c) Pull out the field frame together with the armature.



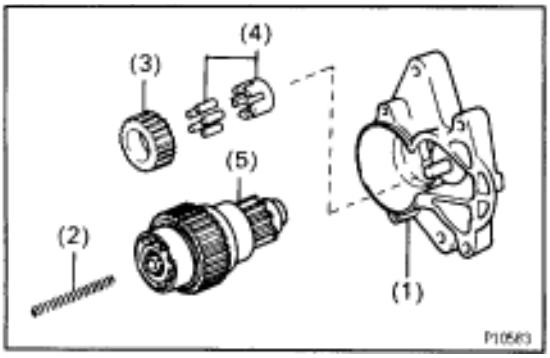
ASSEMBLY HINT: Align the protrusion of the field frame with the groove of the magnetic switch.

(d) Remove the O–ring from the field frame.
ASSEMBLY HINT: Use a new O–ring.

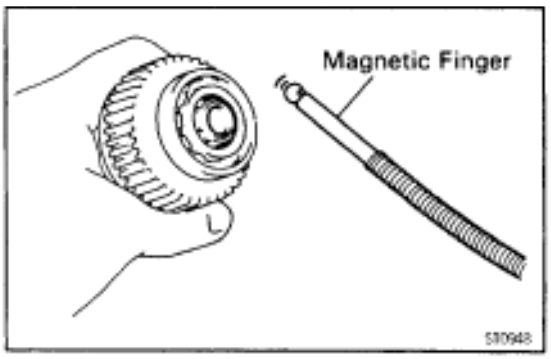


3. REMOVE STARTER HOUSING, CLUTCH ASSEMBLY AND GEAR

(a) Remove the 2 bolts.
Torque: 5.9 N·m (60 kgf·cm, 52 in.·lbf)

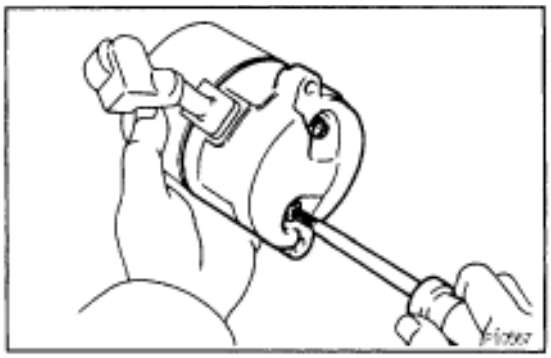


(b) Remove these parts from the magnetic switch:
(1) Starter housing
(2) Return spring
(3) Idler gear
(4) Bearing
(5) Clutch assembly



4. REMOVE STEEL BALL

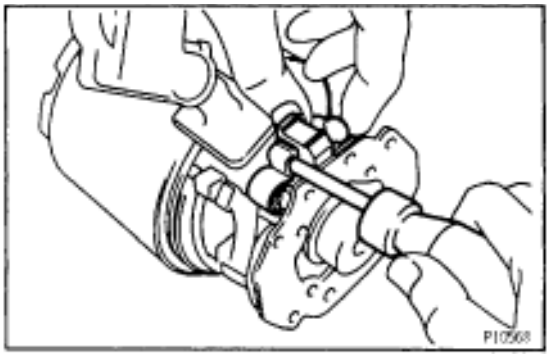
Using a magnetic finger, remove the steel ball from the clutch shaft hole.



5. REMOVE BRUSH HOLDER

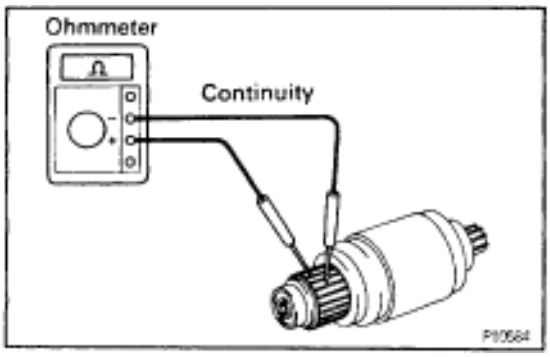
(a) Remove the 2 screws, 2 O–rings and end cover from the field frame.
ASSEMBLY HINT: Use 2 new O–rings.
Torque: 1.5 N·m (15 kgf·cm, 13 in.·lbf)

(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.
ASSEMBLY NOTICE: Check that the positive (+) lead wires are not grounded.

6. REMOVE ARMATURE FROM FIELD FRAME

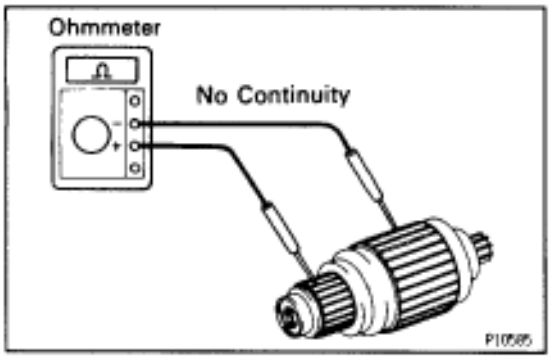


STARTER INSPECTION AND REPAIR

Armature Coil

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

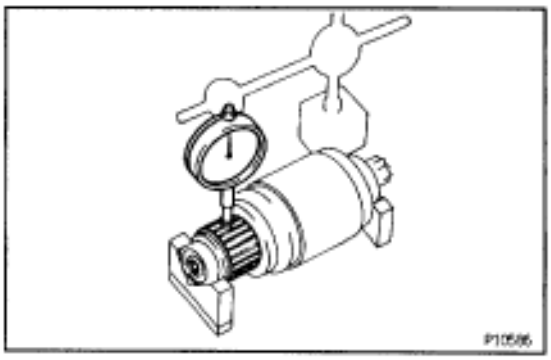
Using an ohmmeter, check that there is no continuity between the commutator and armature coil core.

If there is continuity, replace the armature.

Commutator

1. INSPECT COMMUTATOR FOR DIRTY AND BURNT SURFACE

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



2. INSPECT COMMUTATOR CIRCLE RUNOUT

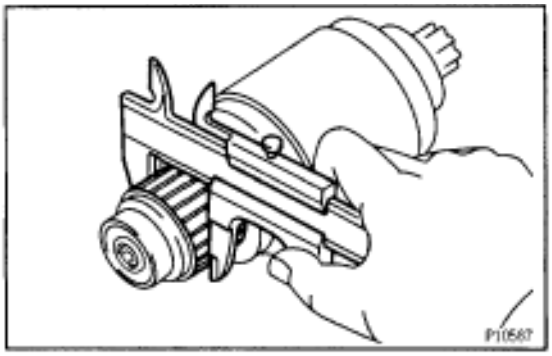
(a) Place the commutator on V–blocks.

(b) Using a dial gauge, measure the circle runout.

Maximum circle runout:

0.05 mm (0.0020 in.)

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



3. INSPECT COMMUTATOR DIAMETER

Using a vernier caliper, measure the commutator diameter.

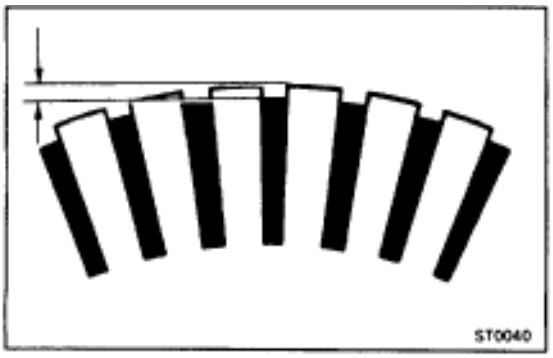
Standard diameter:

30.0 mm (1.181 in.)

Minimum diameter:

29.0 mm (1.412 in.)

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



4. INSPECT UNDERCUT DEPTH

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

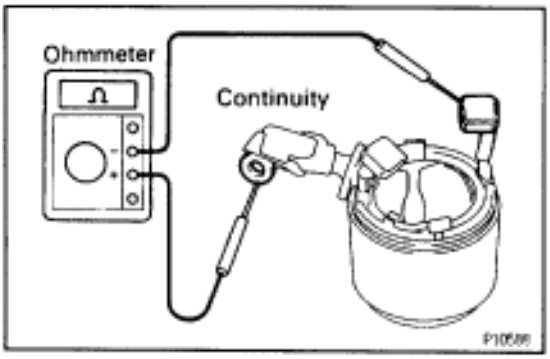
Standard undercut depth:

0.6 mm (0.024 in.)

Minimum undercut depth:

0.2 mm (0.008 in.)

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

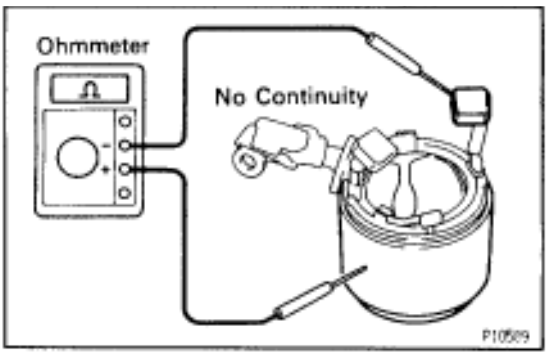


Field Frame (Field Coil)

1. INSPECT FIELD COIL FOR OPEN CIRCUIT

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

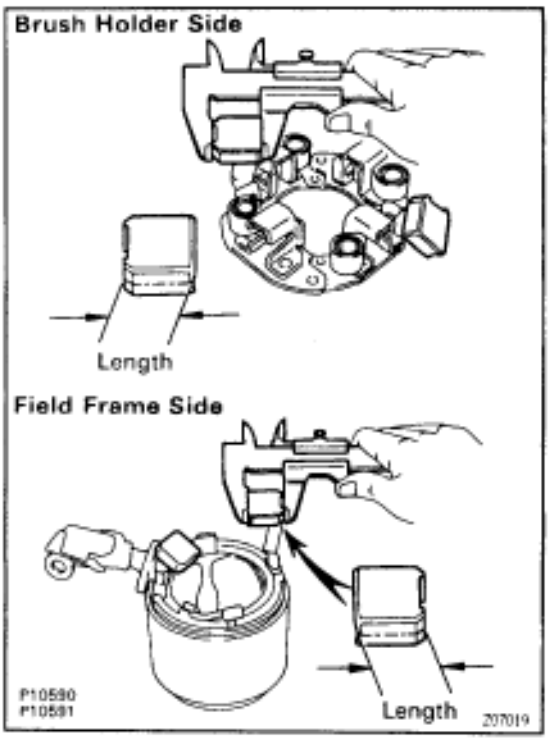
If there is no continuity, replace the field frame.



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, replace the field frame.



Brushes

INSPECT BRUSH LENGTH

Using a vernier caliper, measure the brush length.

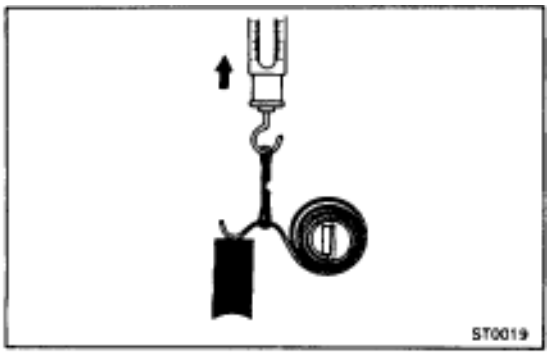
Standard length:

15.5 mm (0.610 in.)

Minimum length:

10.0 mm (0.394 in.)

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



Brush Springs

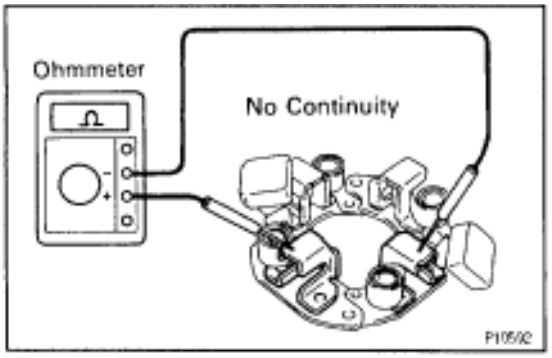
INSPECT BRUSH SPRING LOAD

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

Spring installed load:

18–24 N (1.79–2.41 kgf, 3.9–5.3 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.

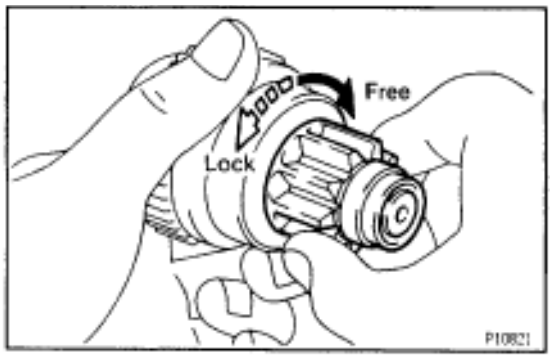
Clutch and Gears

1. INSPECT GEAR TEETH

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

If damaged, replace the gear or clutch assembly.

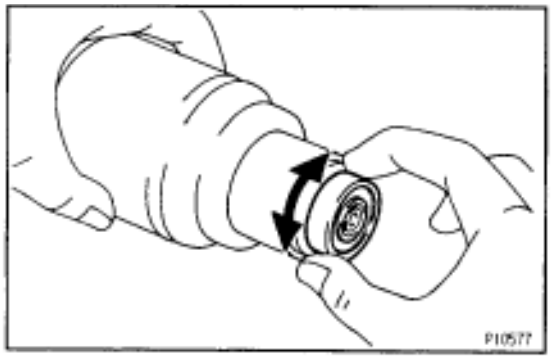
If damaged, also check the drive plate ring gear for wear or damage.



2. INSPECT CLUTCH PINION GEAR

Rotate the pinion gear counterclockwise, and check that it turns freely. Try to rotate the pinion gear clock–wise and check that it locks.

If necessary, replace the clutch assembly.

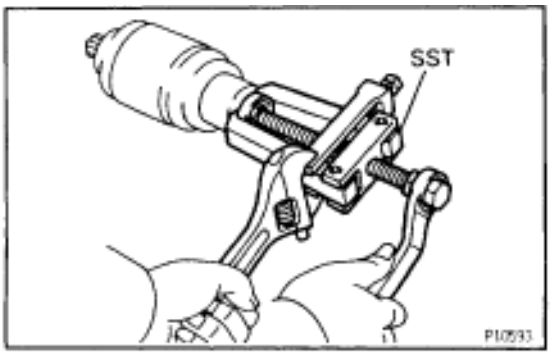


Bearings

1. INSPECT FRONT BEARING

Turn each bearing by hand while applying inward force.

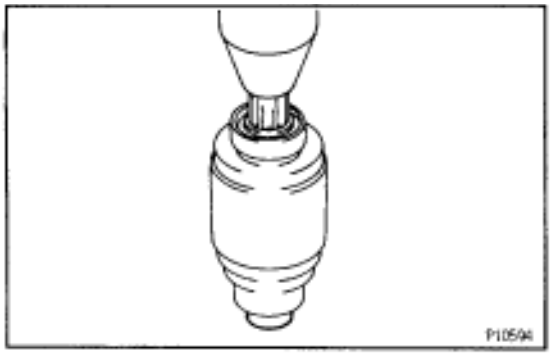
If resistance is felt or the bearing sticks, replace the bearing.



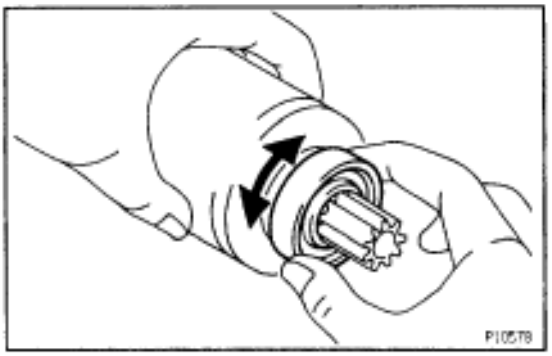
2. IF NECESSARY, REPLACE FRONT BEARING

(a) Using SST, remove the bearing.

SST 09286–46011

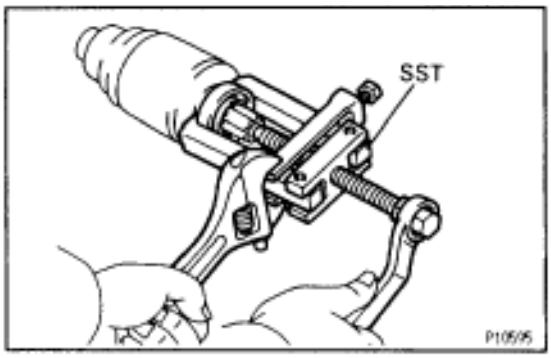


(b) Using a press, press in a new front bearing.



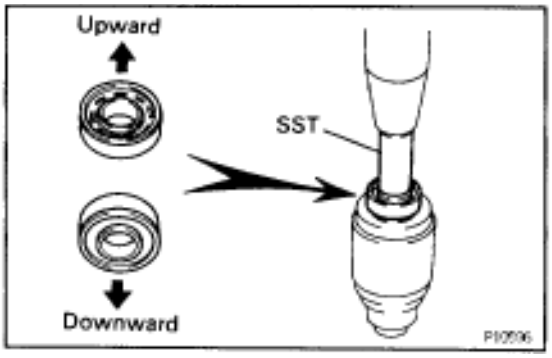
3. INSPECT REAR BEARING

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

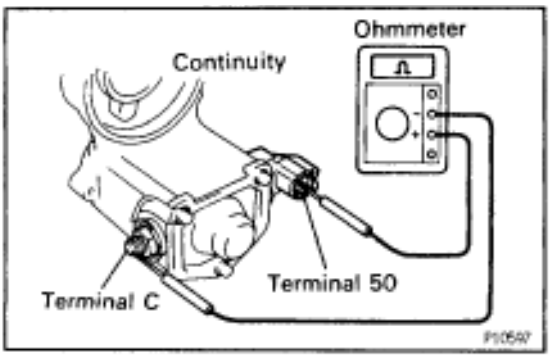


4. IF NECESSARY, REPLACE REAR BEARING

(a) Using SST, remove the bearing.
SST 09286–46011



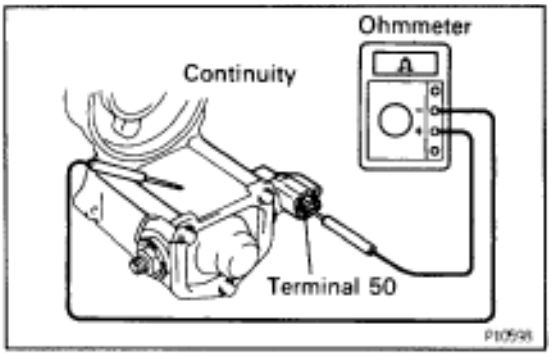
(b) Using SST and a press, press in a new bearing.
NOTICE: Be careful of the bearing installation direction.
SST 09820–00030



Magnetic Switch

1. DO PULL–IN COIL OPEN CIRCUIT TEST

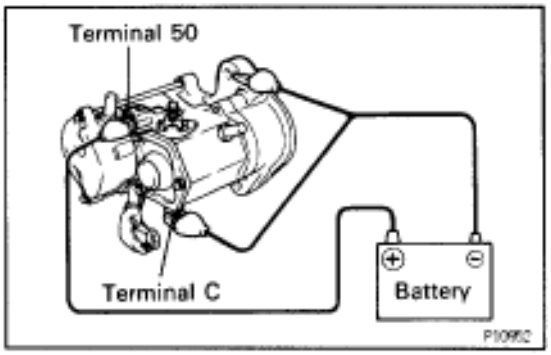
Using an ohmmeter, check that there is continuity between terminals 50 and C.
If there is no continuity, replace the magnetic switch.



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.



STARTER PERFORMANCE TEST

NOTICE: These tests must be performed with in 3 to 5 seconds to avoid burning out the coil.

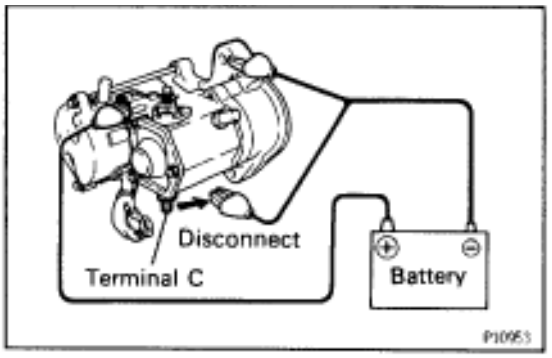
1. DO PULL–IN TEST

(a) Disconnect the field coil lead wire from terminal C.

(b) Connect the battery to the magnetic switch as shown.

Check that the pinion gear moves outward.

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

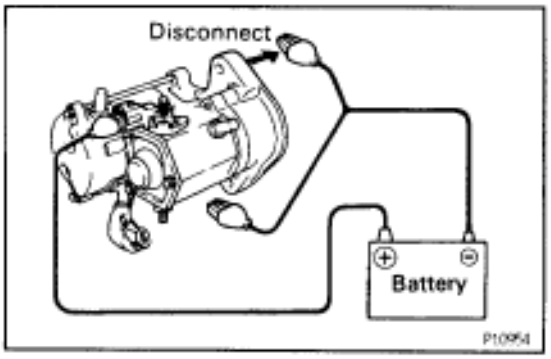


2. DO HOLD–IN TEST

While connected as above with the pinion gear out, disconnect the negative (–) lead from terminal C.

Check that the pinion gear remains out.

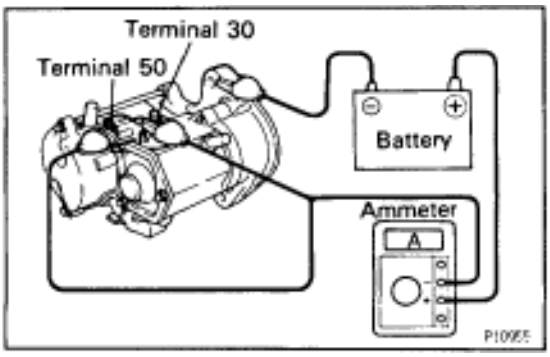
If the pinion gear returns inward, replace the magnetic switch.



3. INSPECT CLUTCH PINION GEAR RETURN

Disconnect the negative (–) lead from the starter body. Check that the pinion gear returns inward.

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



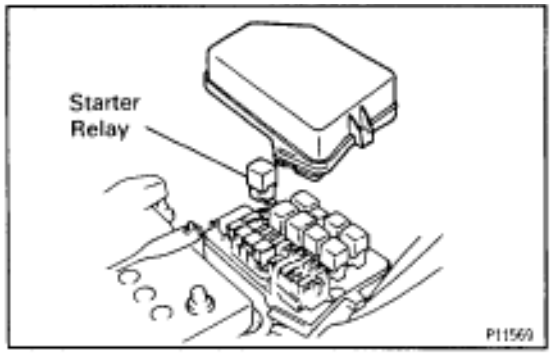
4. DO NO–LOAD PERFORMANCE TEST

(a) Connect the battery and ammeter to the starter as shown.

(b) Check that the starter rotates smoothly and steadily with the pinion gear moving out. Check that the ammeter shows the specified current.

Specified current:

90 A or less at 11.5 V

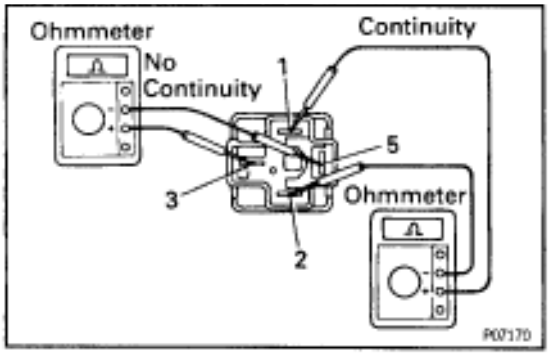


STARTER RELAY

STARTER RELAY INSPECTION

1. REMOVE STARTER RELAY (”ST”)

LOCATION: In the engine compartment relay box.
Remove the relay box cover and starter relay.

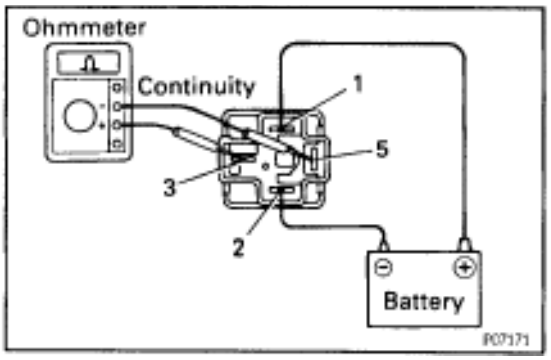


2. INSPECT STARTER RELAY

A. Inspect relay continuity

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

(b) Check that there is no continuity between terminals 3 and 5.
If continuity is not as specified, 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 2 and 5.
If operation is not as specified, replace the relay.

3. REINSTALL STARTER RELAY

SERVICE SPECIFICATIONS

SERVICE DATA

Starter	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		18–24 N (1.79–2.41 kgf, 3.9–5.3 lbf)
	Commutator		
	Diameter	STD	30.0 mm (1.181 in.)
		Minimum	29.0 mm (1.412 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.)

TORQUE SPECIFICATIONS

Part tightened	N·m	kgf·cm	ft·lbf
End cover X Brush holder	1.5	15	13 in.·lbf
Starter housing X Magnetic switch	5.9	60	52 in.·lbf
End cover X Starter housing	5.9	60	52 in.·lbf
Lead wire of field frame X Magnetic switch	7.9	81	70 in.·lbf
Starter X Clutch housing	39	400	29