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# COOLING SYSTEM

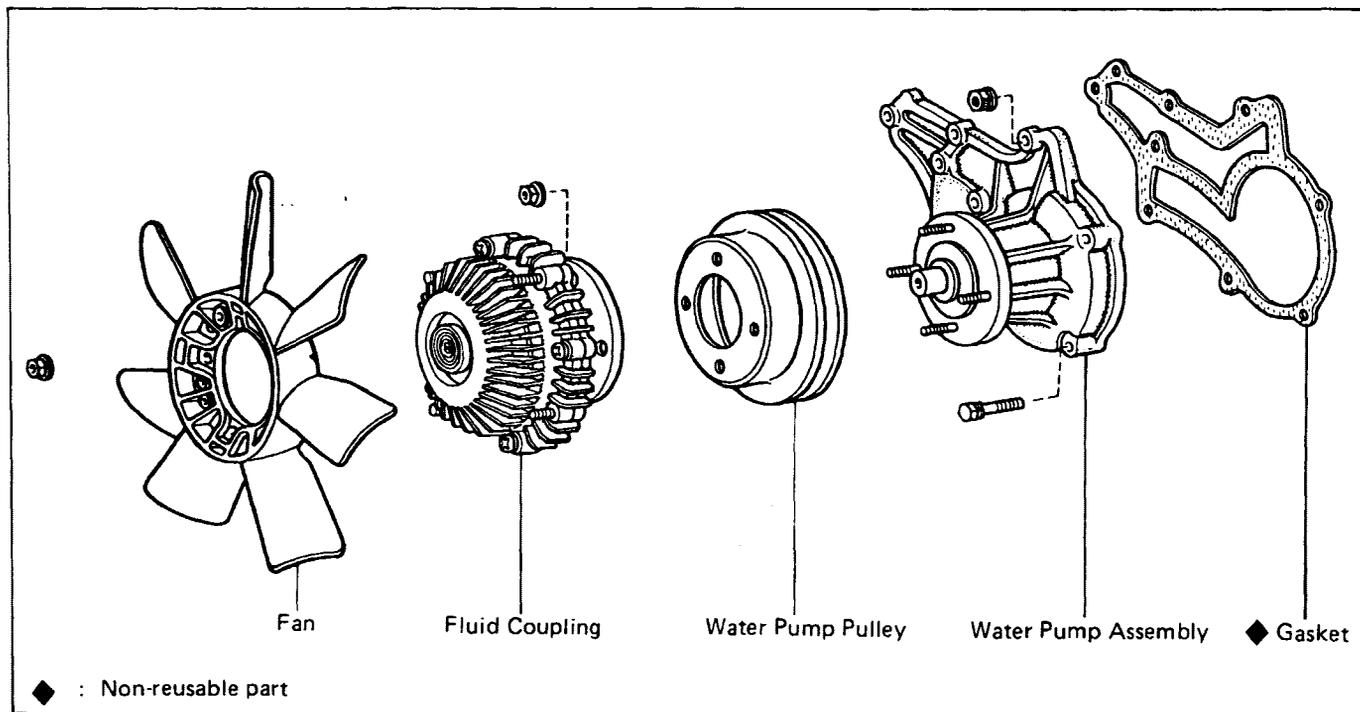
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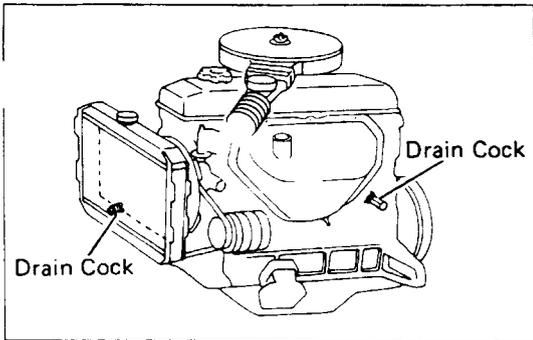
**CO**

## TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Engine overheats	Radiator plugged or cap faulty	Check radiator	CO-6
	Fan belt loose or missing	Adjust or replace belt	
	Dirt, leaves or insects on radiator or condenser	Clean radiator or condenser	CO-6
	Hoses, water pump, thermostat housing, radiator, heater, core plugs or head gasket leakage	Repair as necessary	
	Thermostat faulty	Check thermostat	CO-5
	Ignition timing retarded	Reset timing	IG-10
	Fluid coupling faulty	Replace fluid coupling	CO-3
	Radiator hose plugged or rotted	Replace hose	CO-6
	Water pump faulty	Replace water pump	CO-3
	Cylinder head or block cracked or plugged	Repair as necessary	

## WATER PUMP COMPONENTS

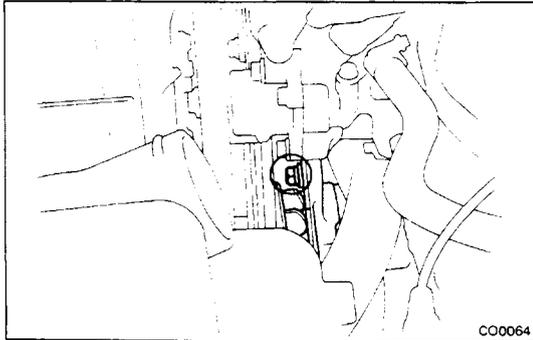




## REMOVAL OF WATER PUMP

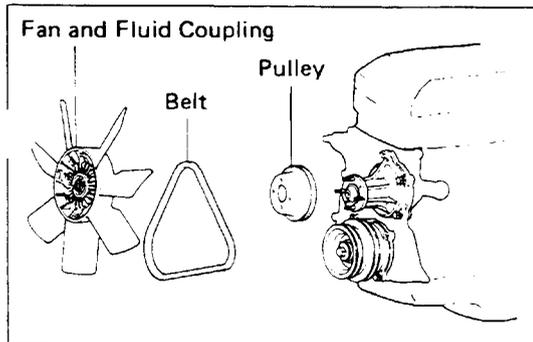
### 1. DRAIN COOLANT

Open the radiator and engine drain cocks, and allow coolant to drain into a suitable container.



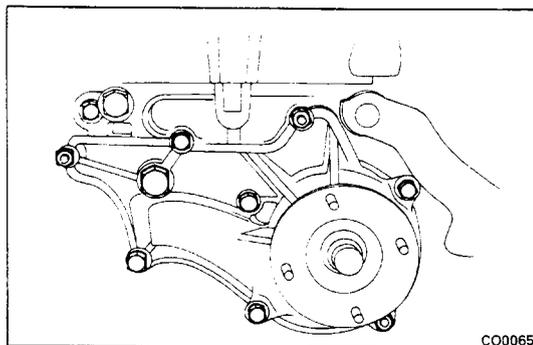
### 2. LOOSEN FAN BELT

Loosen alternator pivot and adjusting bolts. Swing the alternator toward the engine.



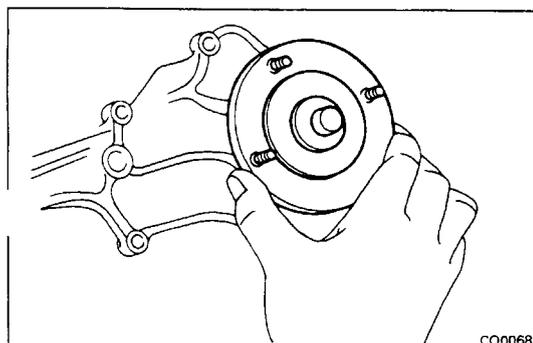
### 3. REMOVE FLUID COUPLING, FAN AND WATER PUMP PULLEY

- (a) Remove the four nuts from the fluid coupling flange.
- (b) Remove the fluid coupling, water pump pulley and fan belt.
- (c) Remove the fan from the fluid coupling.



### 4. REMOVE WATER PUMP

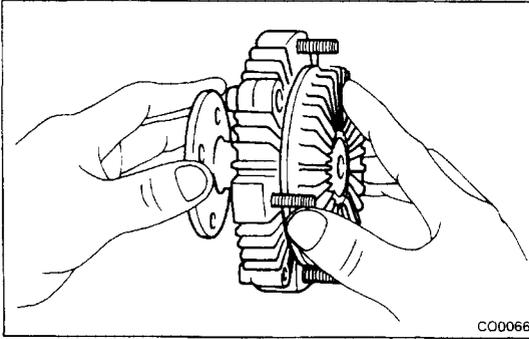
Remove the six bolts, three nuts, water pump and gasket.



## INSPECTION OF WATER PUMP

### 1. INSPECT WATER PUMP BEARING

Check that water pump bearing operation is not rough or noisy.



## 2. INSPECT FLUID COUPLING

Check the fluid coupling for damage and silicone oil leakage

## INSTALLATION OF WATER PUMP

(See page CO-2)

### 1. INSTALL WATER PUMP OVER NEW GASKET

Install the water pump and a new gasket with six bolts and three nuts.

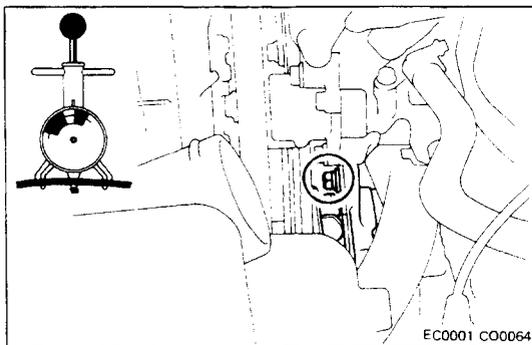
### 2. INSTALL FAN BELT AND PULLEY

- (a) Check the fan belt for cracks or damage.
- (b) Place the fan belt on the pulley and place the pulley on the water pump bolts.

### 3. INSTALL FAN ON FLUID COUPLING

### 4. INSTALL FLUID COUPLING

Install the fluid coupling on the pulley with four nuts.



### 5. ADJUST FAN BELT TENSION

Using a belt tension gauge, check the drive belt tension.

Belt tension gauge:

Nippondenso BTG-20 (95506-00020) or  
Borroughs No. BT-33-73F

Belt tension:

New belt	125 ± 25 lb
Used belt	80 ± 20 lb

### 6. REFILL COOLANT

Close the radiator and engine drain cocks. Fill with a good brand of ethylene-glycol coolant.

Total capacity: 8.4 liters (8.9 US qts, 7.4 Imp. qts)

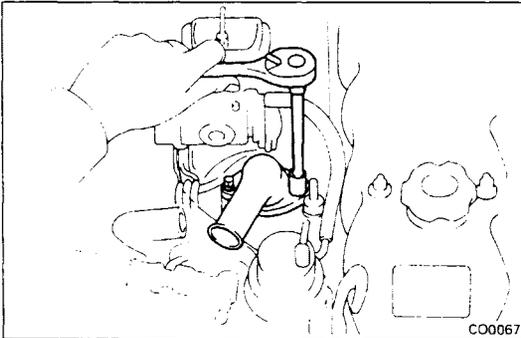
### 7. START ENGINE AND CHECK FOR LEAKS

## THERMOSTAT

### REMOVAL OF THERMOSTAT

#### 1. DRAIN COOLANT

Drain the coolant from the radiator into a clean container. The coolant may be reused if specific gravity is within specifications.



#### 2. REMOVE WATER OUTLET

Remove the two bolts and water outlet from the intake manifold.

#### 3. REMOVE THERMOSTAT AND GASKET

### INSPECTION OF THERMOSTAT

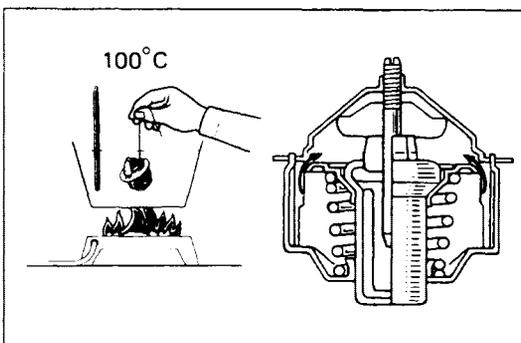
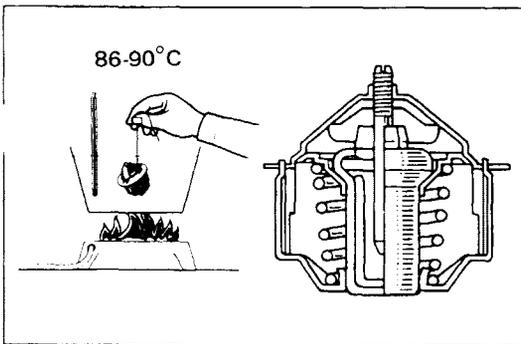
**NOTE:** The thermostat is marked with the valve opening temperature.

- (a) Immerse the thermostat in water and heat the water gradually.
- (b) Check the valve opening temperature and valve lift. If the valve opening temperature and valve lift are out of following specifications, replace the thermostat.

**Valve opening temperature:** 86 — 90 °C (187 — 194 °F)

**Valve lift:** More than 8 mm (0.31 in.) at 100 °C (212 °F)

- (c) Check that the valve spring is tight when the thermostat is fully closed, and replace if necessary.



### INSTALLATION OF THERMOSTAT

#### 1. PLACE THERMOSTAT IN INTAKE MANIFOLD

#### 2. INSTALL WATER OUTLET

Install the water outlet on a new gasket with two bolts.

#### 3. REFILL COOLANT

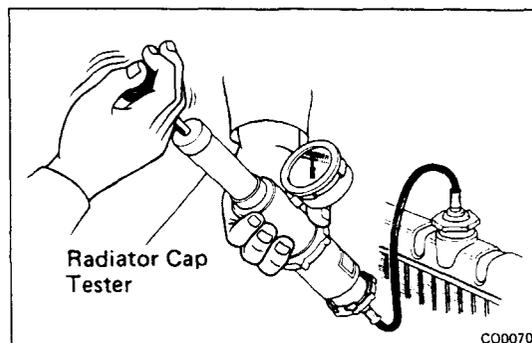
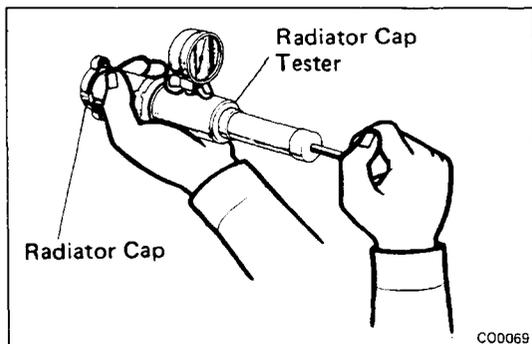
Close the radiator drain cock. Fill with a good brand of ethylene-glycol coolant.

## RADIATOR

### CLEANING OF RADIATOR

Using water or a steam cleaner, remove mud and dust from radiator core.

**CAUTION:** If using high pressure type cleaner, be careful not to deform the radiator core fins. For example, keep a distance of at least 40 — 50 cm (15.75 — 19.69 in.) between the radiator core and cleaner nozzle when the cleaner nozzle pressure is 30 — 35 kg/cm<sup>2</sup> (427 — 498 psi, 2,942 — 3,432 kPa).



### INSPECTION OF RADIATOR

#### 1. CHECK RADIATOR CAP

Using a pressure tester, pump the tester until the relief valve opens.

Check that the valve opens between 0.75 kg/cm<sup>2</sup> (10.7 psi, 74 kPa) and 1.05 kg/cm<sup>2</sup> (15 psi, 103 kPa).

Check that the pressure gauge does not drop rapidly when pressure on the cap is below 0.6 kg/cm<sup>2</sup> (8.5 psi, 59 kPa).

If either check is not within limits, replace the cap.

#### 2. CHECK COOLING SYSTEM FOR LEAKS

Attach the pressure tester to the radiator and pump the tester to 0.9 kg/cm<sup>2</sup> (12.8 psi, 88 kPa). Check that the pressure does not drop.

If the pressure drops, check for leaks from the hoses, radiator or water pump. If no external leaks are found, check the heater core, block and intake manifold.

### REMOVAL OF RADIATOR

#### 1. DRAIN COOLANT

Open radiator drain and engine drain cocks (located on the left of engine block). Drain the fluid into a suitable container.

#### 2. DISCONNECT TWO RADIATOR HOSES

#### 3. REMOVE FAN SHROUD

#### 4. DISCONNECT TWO COOLER HOSES (A/T only)

NOTE:

- (1) Be careful as some oil will leak out. Catch it in a suitable container.
- (2) Plug the hose to prevent oil from escaping.

#### 5. DISCONNECT COOLANT RESERVOIR TUBE

#### 6. REMOVE FOUR RADIATOR MOUNTING BOLTS AND RADIATOR

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# LUBRICATION SYSTEM

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## REPLACEMENT OF ENGINE OIL AND OIL FILTER

### 1. DRAIN ENGINE OIL

Remove the oil drain plug and drain the oil into a container.

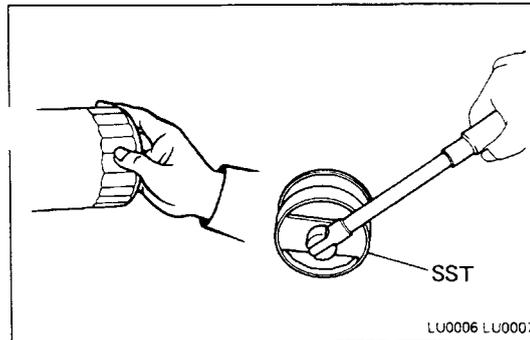
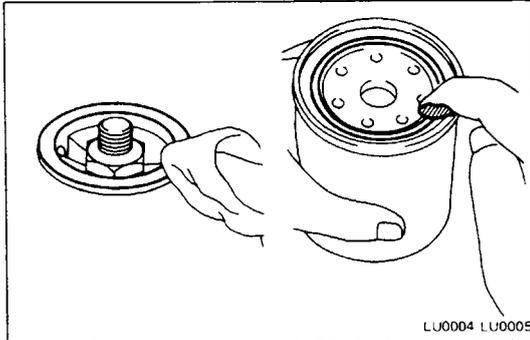
### 2. REPLACE OIL FILTER

(a) Using SST, remove the oil filter (located on right side of the engine block).

SST 09228-44010

(b) Inspect and clean the oil filter installation surface.

(c) Apply clean engine oil to the gasket of the new oil filter.



(d) Lightly screw in the oil filter to where you feel resistance.

(e) Then, using SST, tighten the oil filter an extra 3/4 turn.

SST 09228-44010

### 3. FILL WITH ENGINE OIL

(a) Clean and install the oil drain plug with a new gasket.

(b) Fill the engine with new oil API grade SF or SF/CC, multigrade, fuel efficient and recommended viscosity oil.

#### Oil capacity:

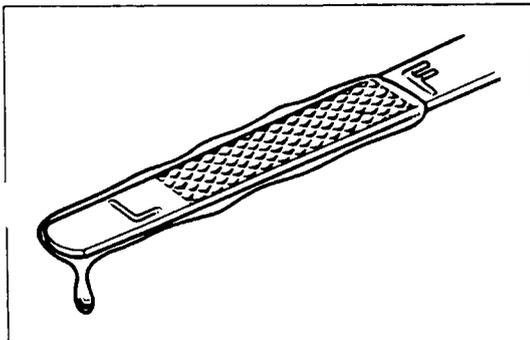
Dry fill	4.8 liters (5.1 US qts, 4.2 Imp. qts)
Drain and refill	
w/o Oil filter change	4.0 liters (4.2 US qts, 3.5 Imp. qts)
w/ Oil filter change	4.6 liters (4.9 US qts, 4.0 Imp. qts)

### 4. START ENGINE AND CHECK FOR LEAKS

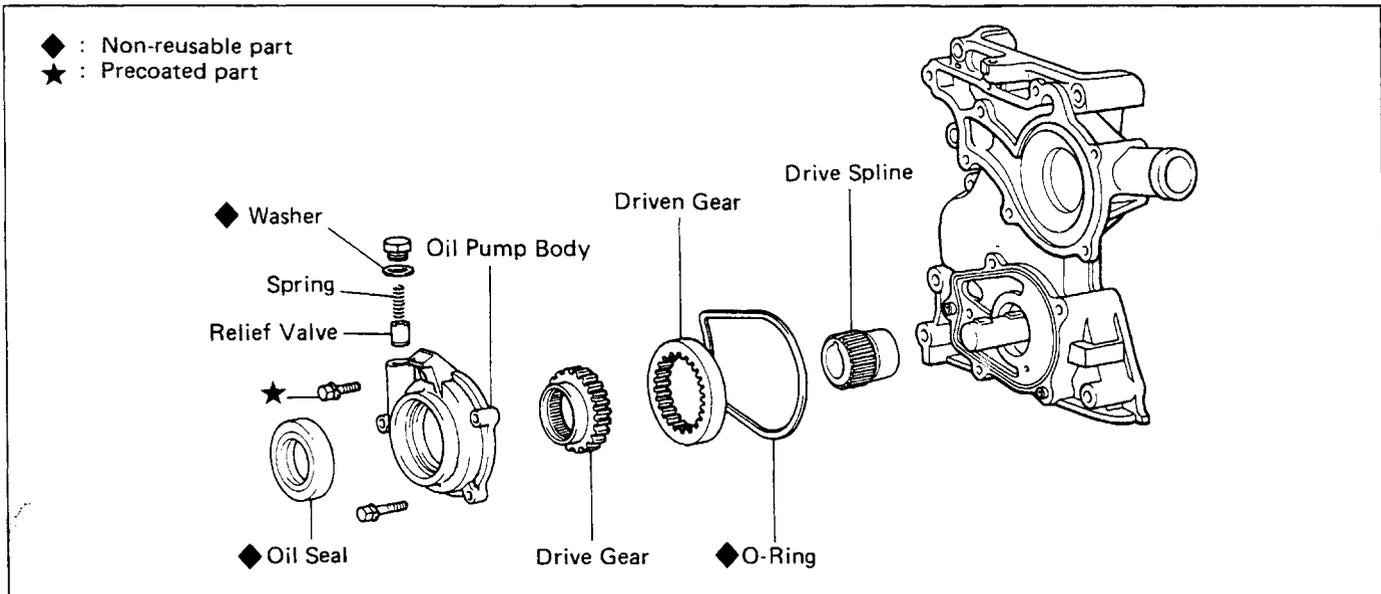
### 5. RECHECK ENGINE OIL LEVEL

Recheck the engine oil level and refill as necessary.

NOTE: Insert the oil level gauge with the curved tip pointed toward the engine.



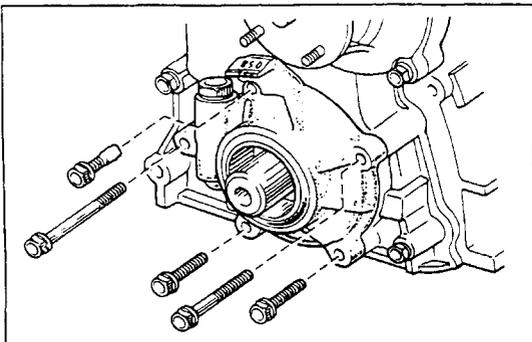
## OIL PUMP COMPONENTS

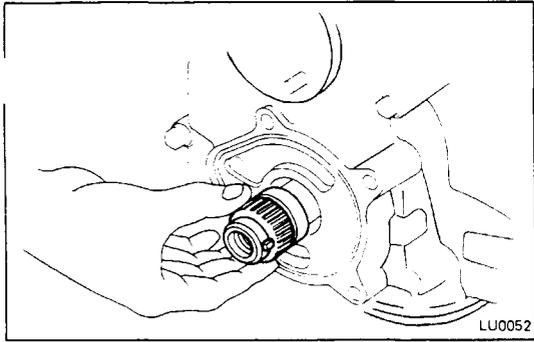


### REMOVAL AND DISASSEMBLY OF OIL PUMP

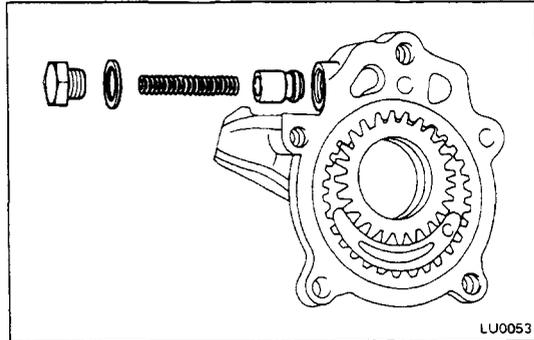
NOTE: When repairing the oil pump, the oil pan and strainer should be removed and cleaned.

1. **REMOVE OIL PAN (ON-VEHICLE)**  
(See step 3 on page EM-40)
2. **REMOVE OIL STRAINER**  
Remove the four bolts holding the oil strainer.
3. **REMOVE DRIVE BELTS**
4. **REMOVE CRANKSHAFT PULLEY**  
(See step 3 on page EM-41)
5. **REMOVE OIL PUMP ASSEMBLY**  
Remove the five bolts and the oil pump assembly.



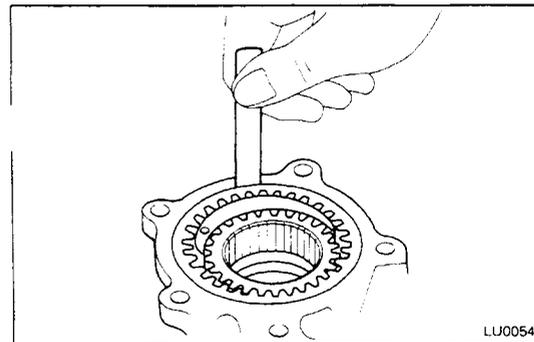


## 6. REMOVE OIL PUMP DRIVE SPLINE AND O-RING



## 7. DISASSEMBLE OIL PUMP ASSEMBLY

- (a) Unscrew the relief valve plug, and remove the spring and the relief valve piston.
- (b) Remove the drive and the driven gears.



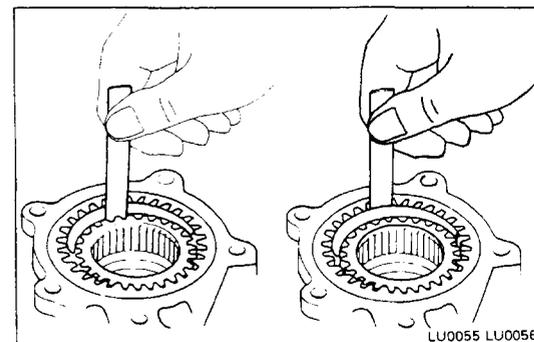
## INSPECTION OF OIL PUMP

### 1. MEASURE BODY CLEARANCE

Using a feeler gauge, measure the clearance between the driven gear and body.

If the clearance is greater than the maximum, replace the gear and/or body.

**Maximum clearance: 0.2 mm (0.008 in.)**

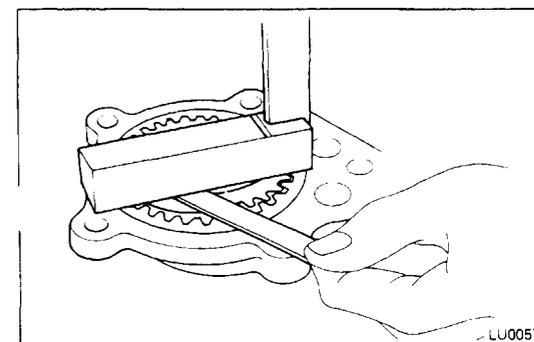


### 2. MEASURE TIP CLEARANCE

Using a feeler gauge, measure the clearance between both gear tips and the crescent.

If the clearance is greater than the maximum, replace the gears and/or body.

**Maximum clearance: 0.3 mm (0.012 in.)**

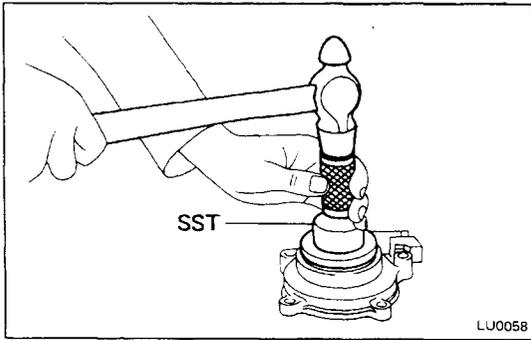


### 3. MEASURE SIDE CLEARANCE

Using a feeler gauge and a flat block, measure the side clearance as shown.

If the clearance is greater than the maximum, replace the gears and/or body.

**Maximum clearance: 0.15 mm (0.0059 in.)**



## REPLACE FRONT OIL SEAL

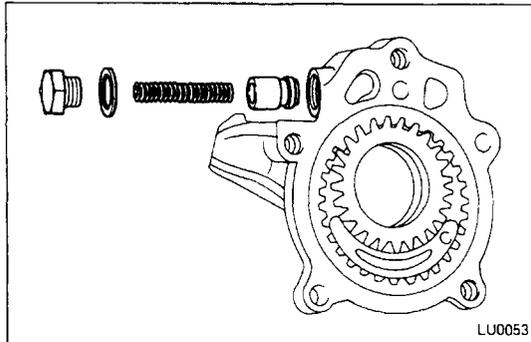
### 1. REMOVE OIL SEAL

Remove the oil seal with a small screwdriver.

### 2. INSTALL OIL SEAL

Drive in the new oil seal with SST.

SST 09223-50010

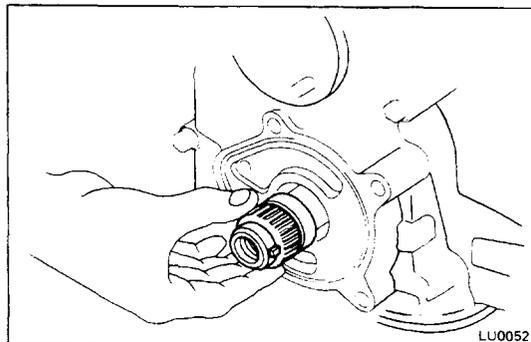


## ASSEMBLY AND INSTALLATION OF OIL PUMP

(See page LU-4)

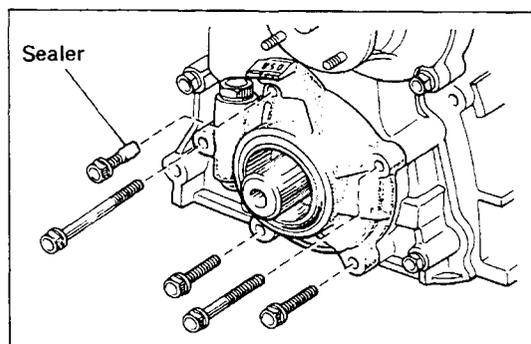
### 1. ASSEMBLE OIL PUMP ASSEMBLY

- (a) Install relief valve piston and the spring in the body, and screw on the relief valve plug with the gasket.
- (b) Insert the drive and driven gears into the pump body.



### 2. INSTALL OIL PUMP DRIVE SPLINE AND O-RING

- (a) Slide the pump drive spline onto the crankshaft.
- (b) Place the O-ring into the groove.



### 3. INSTALL OIL PUMP

Apply the sealer to the upper bolt and tighten the five bolts.

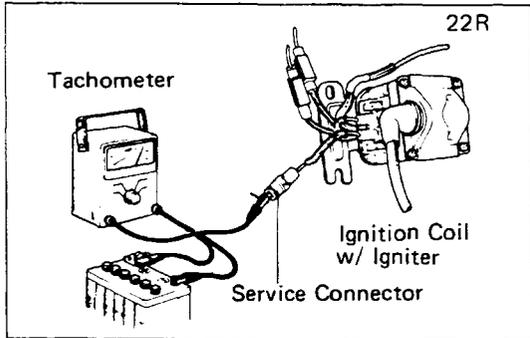
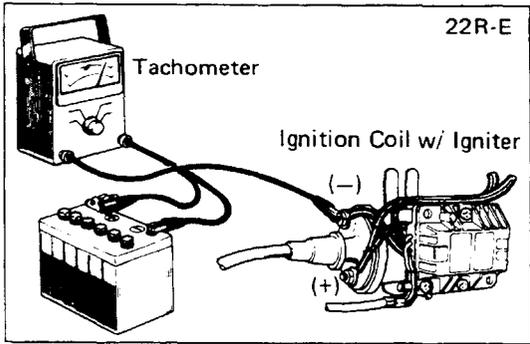
### 4. INSTALL FOLLOWING ITEMS:

- (a) Clean oil strainer with four bolts.
- (b) Clean oil pan and cylinder block. (See step 10 on page EM-46)
- (c) Crankshaft pulley. (See step 8 on page EM-45)
- (d) Drive belts. (See step 9 on page EM-45)

# IGNITION SYSTEM

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**IG**



## PRECAUTIONS

1. Do not allow the ignition switch to be ON for more than 10 minutes if the engine will not start.
2. As some tachometers are not compatible with this ignition system, it is recommended that you consult with the manufacturer.
3. NEVER allow the ignition coil terminals to touch ground as it could result in damage to the igniter and/or ignition coil.
4. Do not disconnect the battery when the engine is running.
5. Make sure that the igniter is properly grounded to the body.
6. When a tachometer is connected to the system, connect the tachometer test probe to the ignition coil negative terminal.

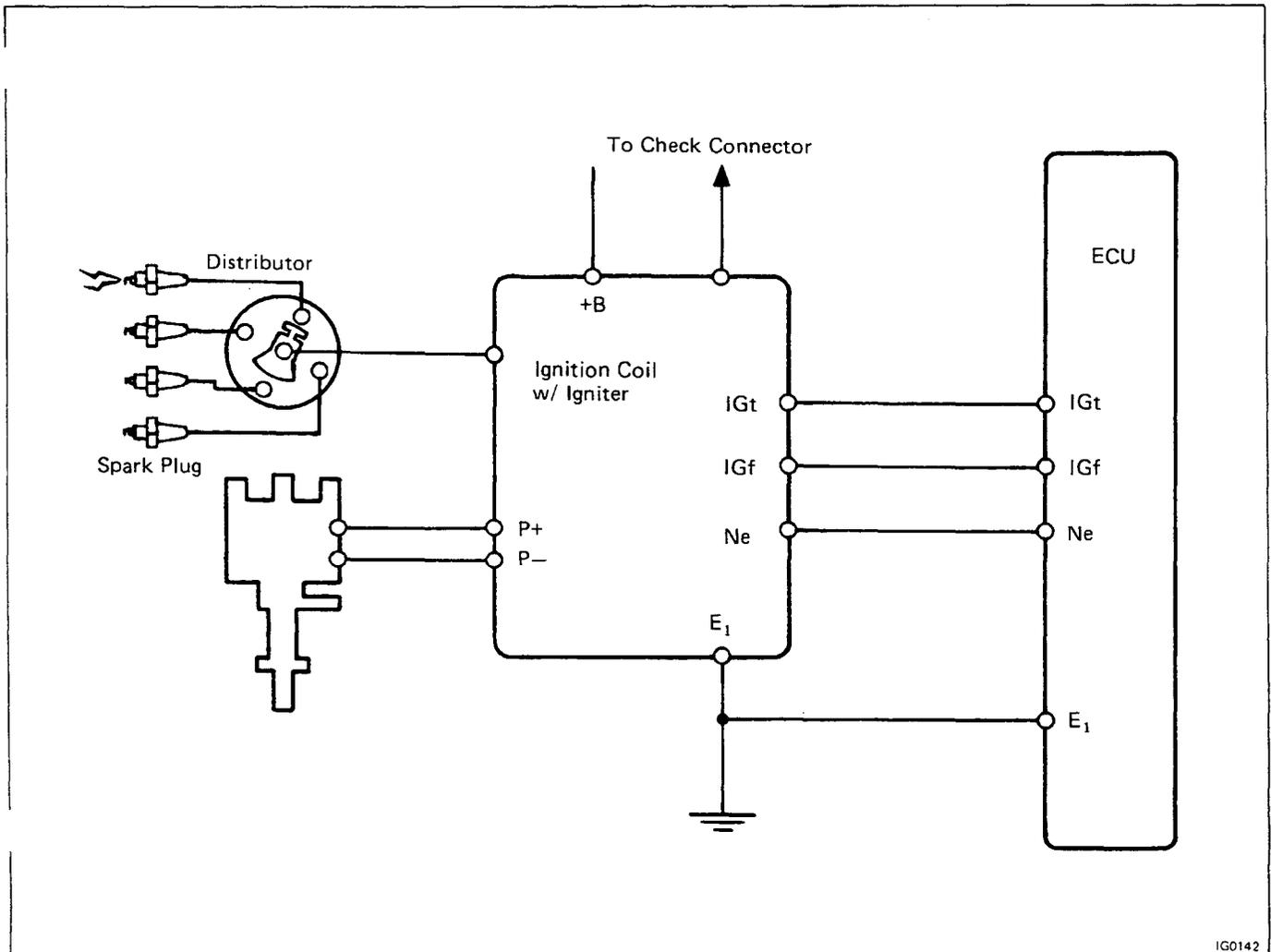
## TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Engine will not start/ Hard to start (cranks ok)	Ignition problems <ul style="list-style-type: none"> <li>• Ignition coil</li> <li>• Igniter</li> <li>• Distributor</li> </ul> Spark plugs faulty Ignition wiring disconnected or broken	Perform spark test Inspect coil Inspect igniter Inspect distributor Inspect plugs Inspect wiring	IG-4 IG-5,7 IG-6,8 IG-9,10 IG-4 IG-4
Rough idle or stalls	Spark plugs faulty Ignition wiring faulty Incorrect ignition timing Ignition problems <ul style="list-style-type: none"> <li>• Ignition coil</li> <li>• Igniter</li> <li>• Distributor</li> </ul>	Inspect plugs Inspect wiring Reset timing Perform spark test Inspect coil Inspect igniter Inspect distributor	IG-4 IG-4 IG-10 IG-4 IG-5,7 IG-6,8 IG-9,10
Engine hesitates/ Poor acceleration	Spark plugs faulty Ignition wiring faulty Incorrect ignition timing	Inspect plugs Inspect wiring Reset timing	IG-4 IG-4 IG-10
Engine dieseling (for carb.) (runs after ignition switch is turned off)	Fuel cut system faulty	Repair fuel cut system	
Muffler explosion (after fire) all the time	Incorrect ignition timing	Reset timing	IG-10
Engine backfires	Incorrect ignition timing	Reset timing	IG-10
Poor gasoline mileage	Spark plugs faulty Incorrect ignition timing	Inspect plugs Reset timing	IG-4 IG-10
Engine overheats	Incorrect ignition timing	Reset timing	IG-10

## ELECTRONIC SPARK ADVANCE (ESA) FOR 22R-E

The ECU is programmed with data for optimum ignition timing under any and all operating conditions. Using data provided by sensors which monitor various engine functions (rpm, intake air volume, eng. temperature, etc.) the microcomputer (ECU) triggers the spark at precisely the right instant.

### ESA SYSTEM CIRCUIT



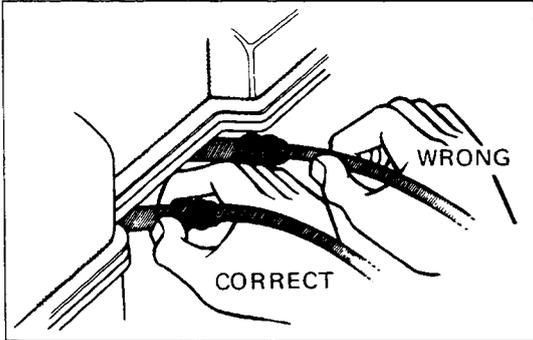
## ON-VEHICLE INSPECTION

### SPARK TEST

NOTE: Perform this test to check that current is coming from the distributor.

1. **CONNECT TIMING LIGHT TO EACH SPARK PLUG**
2. **CRANK ENGINE AND CHECK THAT LIGHT FLASHES**

If the timing light does not flash, check the wiring connections, ignition coil, igniter, distributor or ignition switch.



### INSPECTION OF HIGH TENSION CORD

1. **CAREFULLY REMOVE HIGH TENSION CORDS BY RUBBER BOOT**

**CAUTION:** DO NOT pull on or bend the cords to avoid damaging the conductor inside.

2. **INSPECT CORD TERMINALS**

Check the terminals for corrosion, breaks or distortion. Replace cords as required.

3. **CHECK CORD RESISTANCE**

Using an ohmmeter, check that the resistance does not exceed the maximum. Replace cords as required.

**Maximum resistance: 25 k $\Omega$  per cord**

### INSPECTION OF SPARK PLUGS

1. **REMOVE SPARK PLUGS**

2. **CLEAN AND INSPECT SPARK PLUGS**

(a) Clean the spark plugs with a spark plug cleaner or wire brush.

(b) Inspect the spark plugs for electrode wear, thread damage and insulator damage.

If a problem is found, replace the plugs.

**Spark plug: ND W16EXR-U**

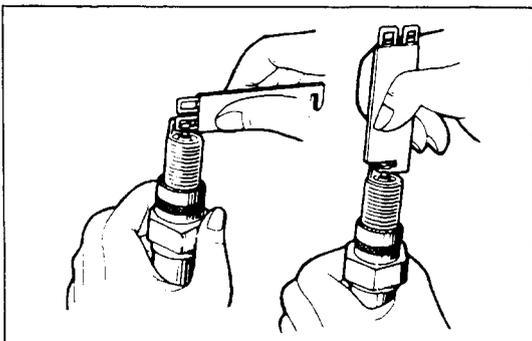
**NGK BPR5EY**

3. **ADJUST ELECTRODE GAP**

Carefully bend the outer electrode to obtain the correct electrode gap.

**Correct electrode gap: 0.8 mm (0.031 in.)**

4. **INSTALL SPARK PLUGS**

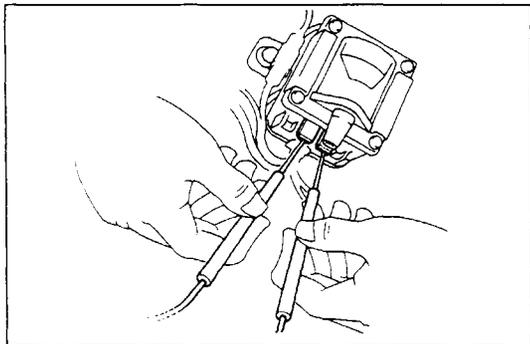


**[FOR 22R]****INSPECTION OF IGNITION COIL**

1. **DISCONNECT HIGH TENSION WIRE AND IGNITION COIL CONNECTOR**

2. **CLEAN COIL AND CHECK FOLLOWING:**

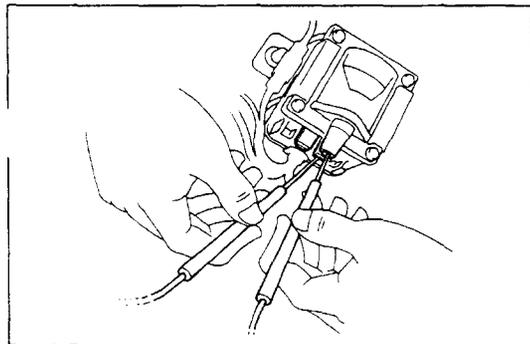
- (a) Check for cracks or damage.
- (b) Check the terminals for carbon tracks.
- (c) Check the high-tension wire hole for carbon deposits and corrosion.



3. **MEASURE PRIMARY COIL RESISTANCE**

Using an ohmmeter, measure the resistance between the positive (+) (brown side) and negative (—) (black side) terminals.

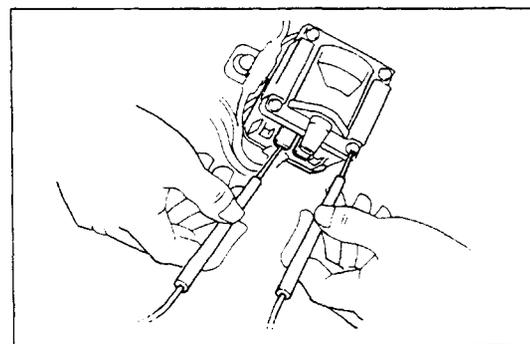
**Primary coil resistance (cold): 0.4 — 0.5  $\Omega$**



4. **MEASURE SECONDARY COIL RESISTANCE**

Using an ohmmeter, measure the resistance between the positive (+) terminal (brown side) and the high tension terminal.

**Secondary coil resistance (cold): 8.5 — 11.5 k $\Omega$**



5. **MEASURE INSULATION RESISTANCE**

Using an ohmmeter, measure the resistance between the positive (+) terminal and the igniter body.

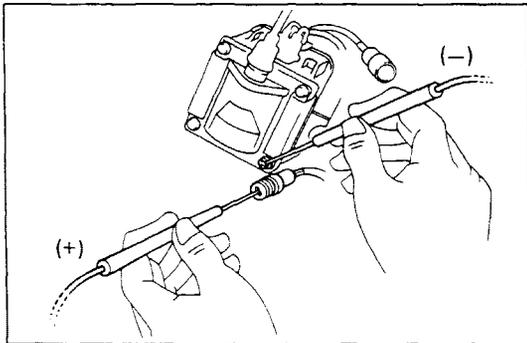
**Insulation resistance: Infinity**

If a problem with the coil is found, replace it.

6. **CONNECT HIGH TENSION WIRE AND IGNITION COIL CONNECTOR**

## INSPECTION OF IGNITER

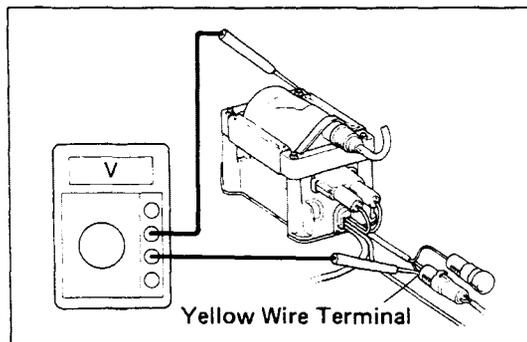
## 1. TURN IGNITION SWITCH ON



## 2. CHECK POWER SOURCE LINE VOLTAGE

- (a) Disconnect the wiring connector for brown wire and yellow wire.
- (b) Using a voltmeter, connect the positive (+) probe to the brown wire for the wire harness side and the negative (-) probe to body ground.

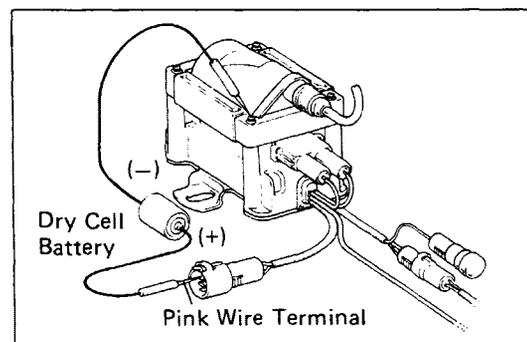
**Voltage: Approx. 12 V**



## 3. CHECK POWER TRANSISTOR IN IGNITER

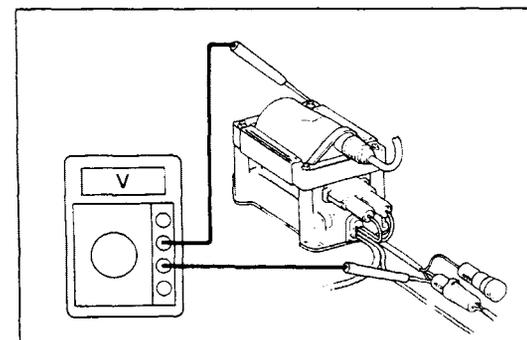
- (a) Connect the wiring connector for brown wire and yellow wire.
- (b) Using a voltmeter, connect the positive (+) probe to the yellow wire for the igniter side and the negative (-) probe to body ground.

**Voltage: Approx. 12 V**



- (c) Unplug the wiring connector from the distributor.
- (d) Using a dry cell battery (1.5 V), connect the positive (+) pole of the battery to the pink wire terminal and the negative (-) pole to the white wire terminal.

**CAUTION: Do not apply voltage more than 5 seconds to avoid destroying the power transistor in the igniter.**



- (e) Using a voltmeter, connect the positive (+) probe to the yellow connector for the igniter side and the negative (-) probe to body ground.

**Voltage: 8 — 10 V**

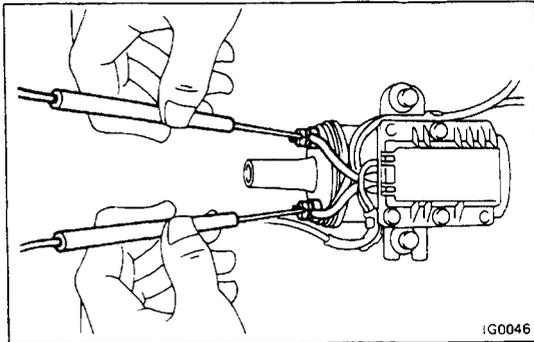
If a problem is found, replace the igniter.

## 4. TURN IGNITION SWITCH OFF

## 5. REMOVE TEST EQUIPMENT AND RECONNECT WIRING

**[FOR 22R-E]**  
**INSPECTION OF IGNITION COIL**

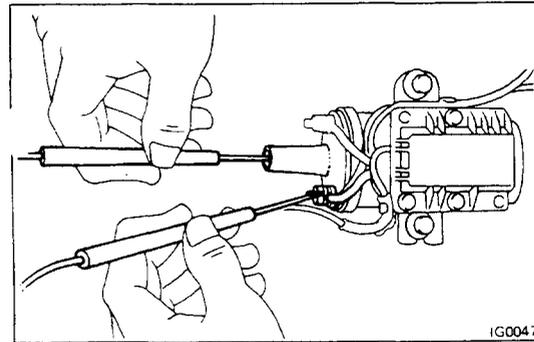
**1. DISCONNECT HIGH TENSION WIRE**



**2. MEASURE PRIMARY COIL RESISTANCE**

Using an ohmmeter, measure the resistance between the positive (+) and negative (–) terminals.

**Primary coil resistance (cold): 0.5 – 0.7  $\Omega$**



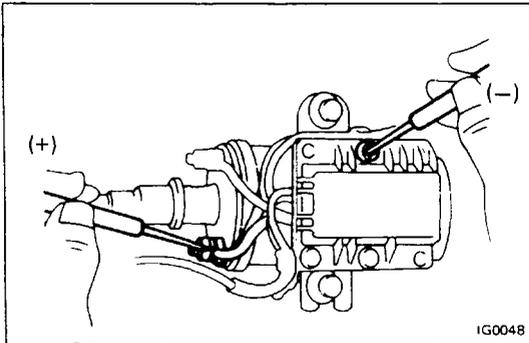
**3. MEASURE SECONDARY COIL RESISTANCE**

Using an ohmmeter, measure the resistance between the positive (+) terminal and high-tension terminal.

**Secondary coil resistance (cold): 11.4 – 15.6 k $\Omega$**

## INSPECTION OF IGNITER

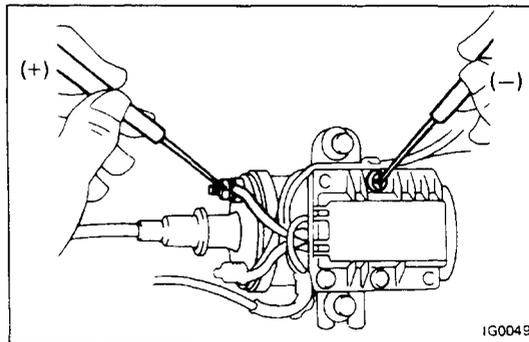
### 1. TURN IGNITION SWITCH ON



### 2. CHECK POWER SOURCE LINE VOLTAGE

Using a voltmeter, connect the positive (+) probe to the ignition coil positive (+) terminal and the negative (-) probe to body ground.

**Voltage: Approx. 12V**

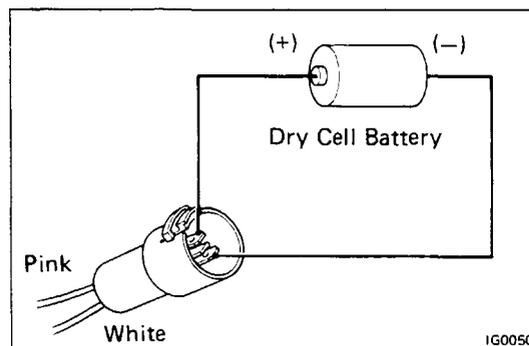


### 3. CHECK POWER TRANSISTOR IN IGNITER

(a) Using a voltmeter, connect the positive (+) probe to the ignition coil negative (-) terminal and the negative (-) probe to body ground.

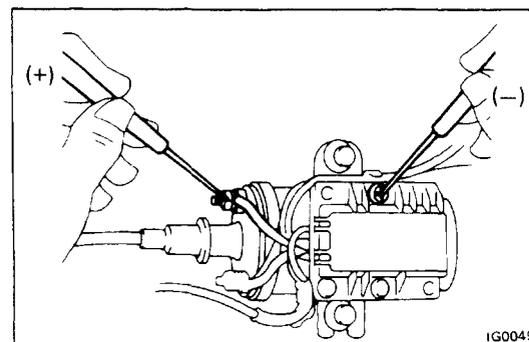
**Voltage: Approx. 12V**

(b) Unplug the wiring connector from the distributor.



(c) Using a dry cell battery (1.5V), connect the positive (+) pole of the battery to the pink wire terminal and the negative (-) pole to the white wire terminal.

**CAUTION: Do not apply voltage more than 5 seconds to avoid destroying the power transistor in the igniter.**



(d) Using a voltmeter, connect the positive (+) probe to the ignition coil negative (-) terminal and the negative (-) probe to the body ground.

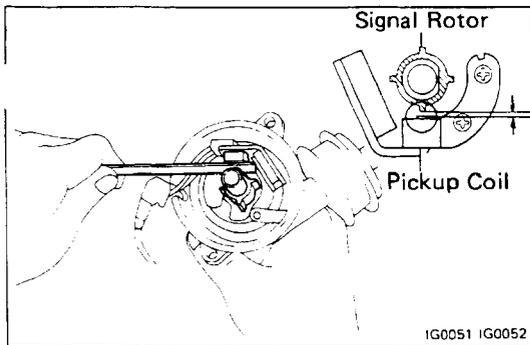
(e) Check the voltage reading.

**Voltage: 5 — 8V**

If a problem is found, replace the igniter.

### 4. TURN IGNITION SWITCH OFF

### 5. REMOVE TEST EQUIPMENT AND RECONNECT WIRING



## ON-VEHICLE INSPECTION OF DISTRIBUTOR

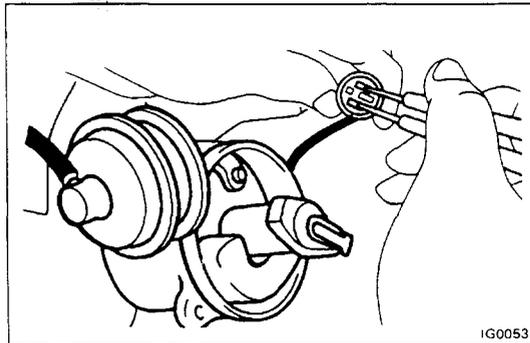
### 1. CHECK AIR GAP

- (a) Using a feeler gauge, measure the gap between the signal rotor and the pickup coil projection.

**Air gap:** 0.2 — 0.4 mm (0.008 — 0.016 in.)

- (b) Adjust the gap if necessary.

- Loosen the two screws and move the signal generator until the gap is correct. Tighten the screws and recheck the gap.

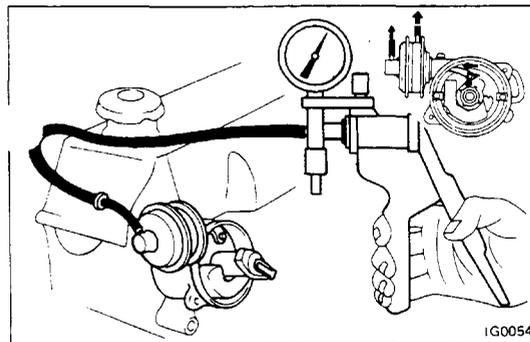


### 2. CHECK SIGNAL GENERATOR

Using an ohmmeter, check the resistance of the signal generator.

**Generator resistance:** 140 — 180Ω

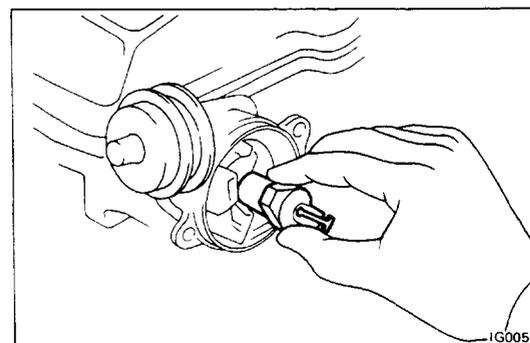
If the resistance is not correct, replace the signal generator.



### 3. CHECK VACUUM ADVANCE (FOR 22R)

- (a) Disconnect the vacuum hose and connect a vacuum pump to the diaphragms.
- (b) Apply vacuum and check that the vacuum advance moves.

If the vacuum advance does not work, repair or replace as necessary.



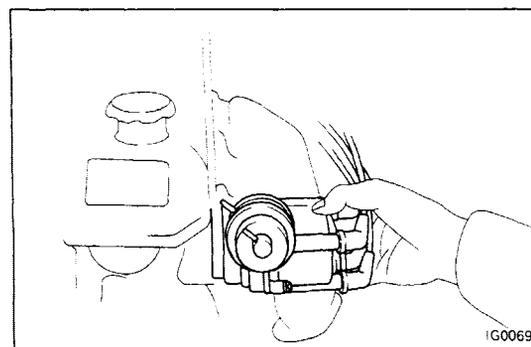
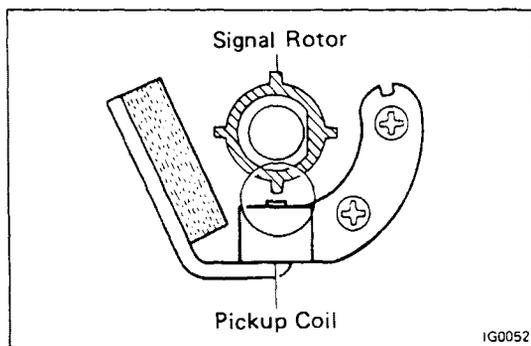
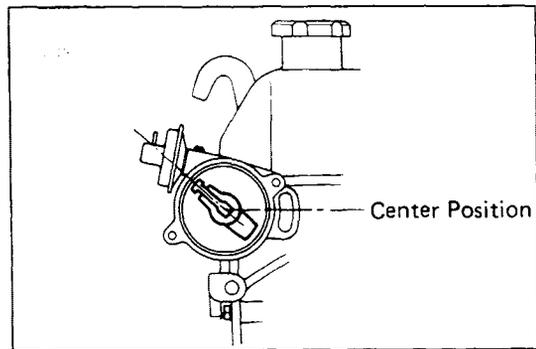
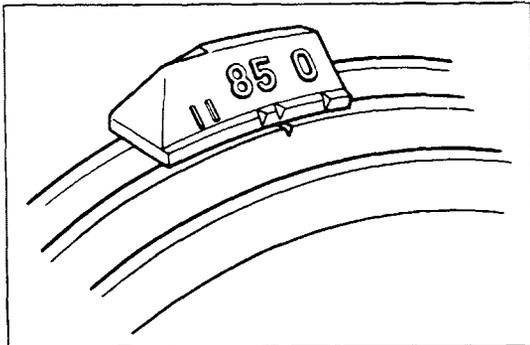
### 4. CHECK GOVERNOR ADVANCE (FOR 22R)

- (a) Turn the rotor shaft clockwise, release it and check that the rotor returns slightly counterclockwise.
- (b) Check that the rotor shaft is not excessively loose.

## DISTRIBUTOR

### REMOVAL OF DISTRIBUTOR

1. DISCONNECT VACUUM HOSES (FOR 22R), HIGH TENSION CORDS AND WIRING CONNECTOR
2. REMOVE TWO SCREWS AND PULL OFF DISTRIBUTOR CAP
3. REMOVE HOLD-DOWN BOLT AND PULL OUT DISTRIBUTOR



### INSTALLATION OF DISTRIBUTOR

#### 1. INSTALL DISTRIBUTOR AND SET TIMING

- (a) Turn the crankshaft pulley until the timing mark is aligned with 0° TDC (22R) and 5° BTDC (22R-E) mark.

NOTE: Check that the rocker arms on the No.1 cylinder are loose. If not, turn the crankshaft one full turn.

- (b) Temporarily install the rotor.
- (c) Begin insertion of the distributor with the rotor pointing upward and the distributor mounting hole approximately at center position of the bolt hole.
- (d) When fully installed, the rotor will rotate to the position shown.

- (e) Align the rotor tooth with the pickup coil projection.
- (f) Coat the distributor set bolt with sealer and install the bolt. Torque the bolt.

**Torque: 220 kg-cm (16 ft-lb, 22 N-m)**

- (g) Install the rotor and distributor cap with wires.

#### 2. INSTALL FOLLOWING PARTS:

- (a) Vacuum hoses (for 22R)
- (b) Wiring connector

#### 3. ADJUST IGNITION TIMING

- (a) Connect a timing light to the engine.
- (b) Start the engine and run it at idle.
- (c) Using a timing light, slowly turn the distributor until the timing mark on the crankshaft pulley is aligned with the 12° mark. Tighten the distributor bolt.
- (d) Recheck the ignition timing.

**Ignition timing: 22R 0° TDC (Max. 950 rpm)  
(w/vacuum advance cut)**  
**22R-E 5° BTDC at idle  
(short terminal "T")**

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# STARTING SYSTEM

	Page
TROUBLESHOOTING .....	ST-2
STARTER .....	ST-3

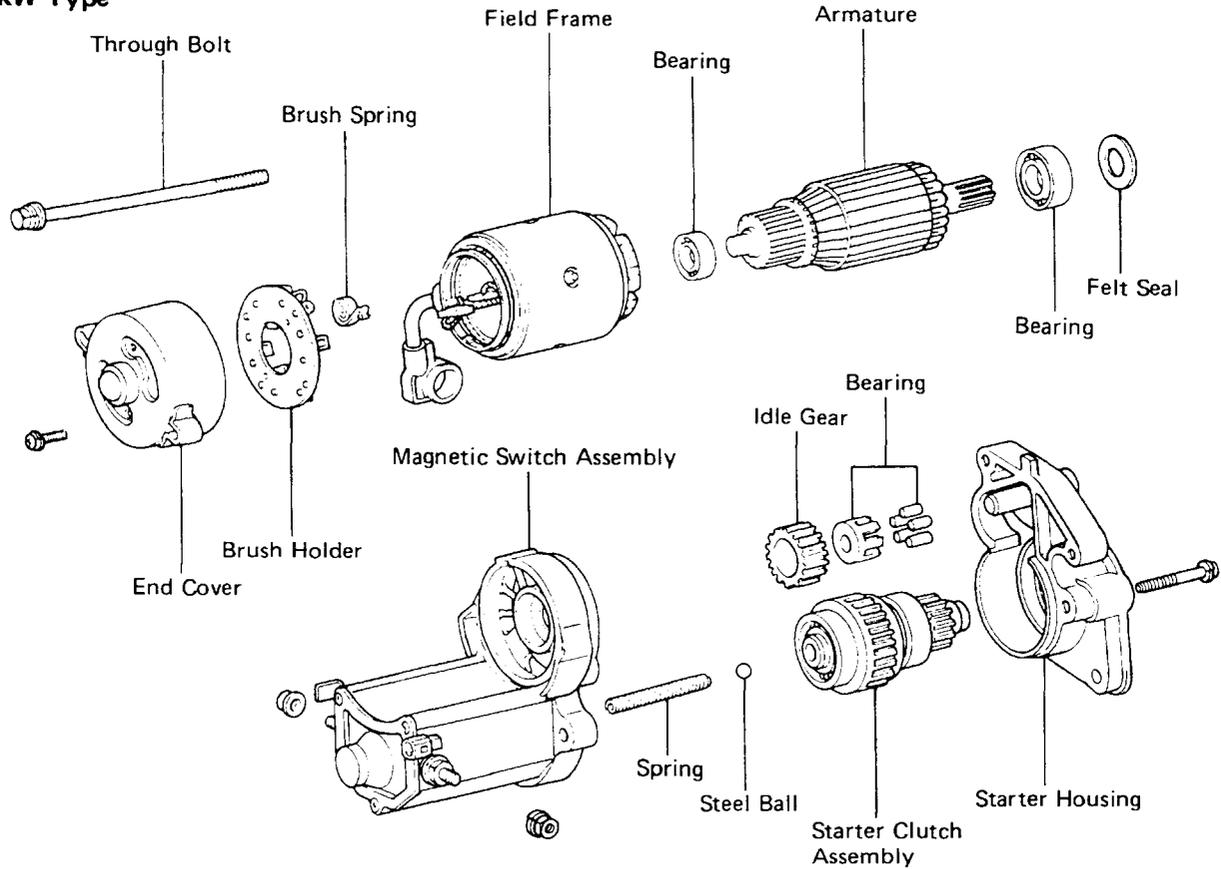
**ST**

## TROUBLESHOOTING

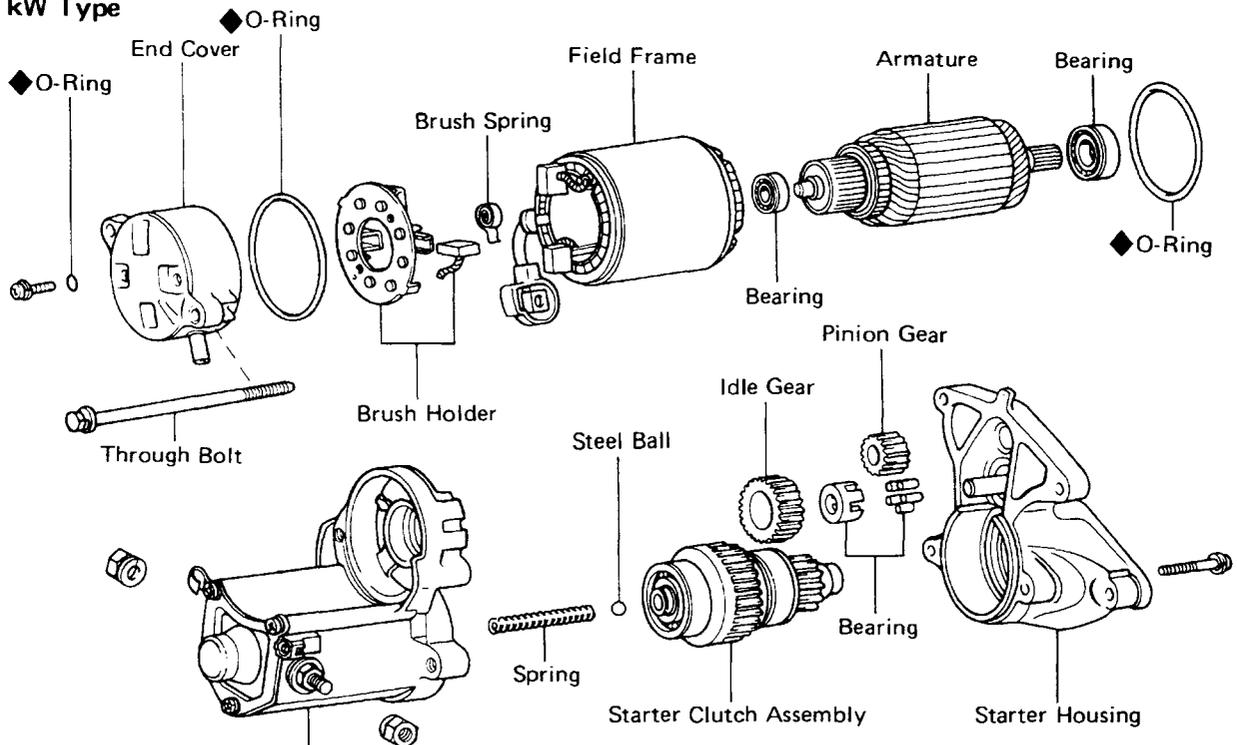
Problem	Possible cause	Remedy	Page
Engine will not crank	Battery charge low  Battery cables loose, corroded or worn Neutral start switch faulty (A/T) Fusible link blown Starter faulty Ignition switch faulty	Check battery specific gravity Charge or replace battery Repair or replace cables Replace switch Replace fusible link Repair starter Replace ignition switch	CH-3     ST-3
Engine cranks slowly	Battery charge low  Battery cables loose, corroded or worn Starter faulty	Check battery specific gravity Charge or replace battery Repair or replace cables Repair starter	CH-3   ST-3
Starter keeps running	Starter faulty Ignition switch faulty Short in wiring	Repair starter Replace ignition switch Repair wiring	ST-3
Starter spins – engine will not crank	Pinion gear teeth broken or faulty starter Flywheel teeth broken	Repair starter Replace flywheel	ST-3

# STARTER COMPONENTS

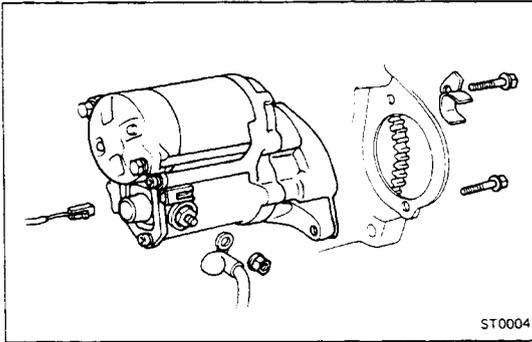
## 1.0 kW Type



## 1.4 kW Type



◆ : Non-reusable part    Magnetic Switch Assembly



ST0004

## REMOVAL OF STARTER

1. **DISCONNECT CABLE FROM NEGATIVE TERMINAL BATTERY**
2. **REMOVE TRANSMISSION OIL FILLER TUBE (A/T only)**
3. **DISCONNECT TWO WIRES FROM STARTER**

Remove the nut and disconnect the battery cable from the magnetic switch on the starter motor. Disconnect the other wire from terminal 50.

4. **REMOVE STARTER MOTOR**

Remove the two bolts, and remove the starter motor from the flywheel bellhousing.

## DISASSEMBLY OF STARTER

(See page ST-3)

1. **REMOVE FIELD FRAME WITH ARMATURE FROM MAGNETIC SWITCH ASSEMBLY**

- (a) Disconnect the lead wire from the magnetic switch terminal.
- (b) Remove the two through bolts. Pull out the field frame with the armature from the magnetic switch assembly.
- (c) Remove the felt seal. (1.0 kW type only)
- (d) Remove the O-ring. (1.4 kW type only)

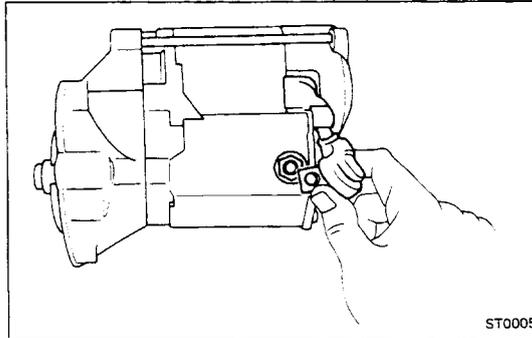
2. **REMOVE STARTER HOUSING FROM MAGNETIC SWITCH ASSEMBLY**

**[1.0 kW type]**

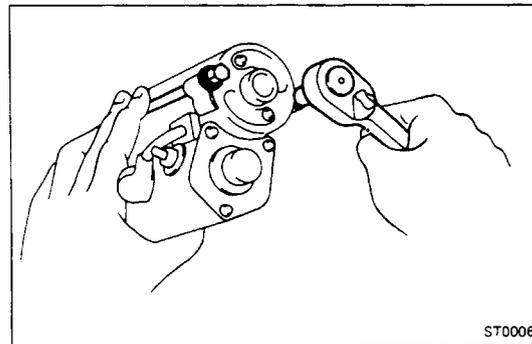
Remove the two screws and remove the starter housing with the idler gear and clutch assembly.

**[1.4 kW type]**

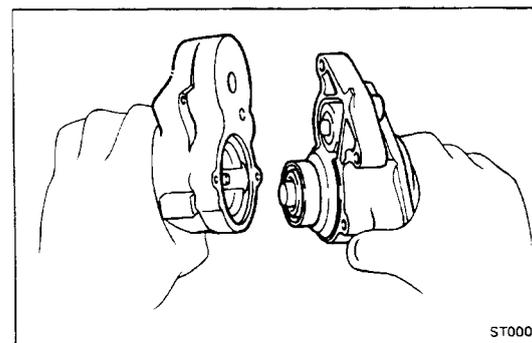
Remove the two screws and remove the starter housing with the pinion gear, idler gear and clutch assembly.



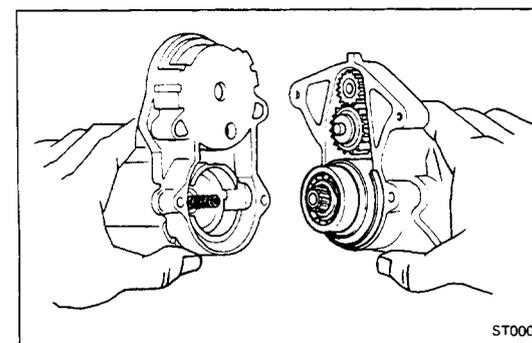
ST0005



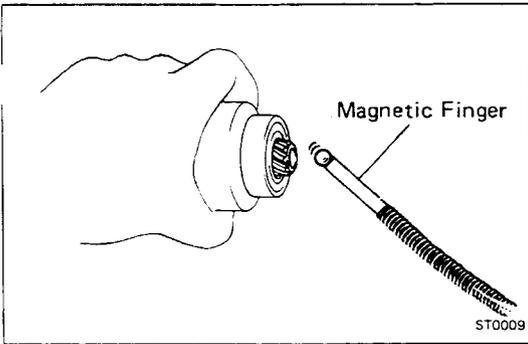
ST0006



ST0007



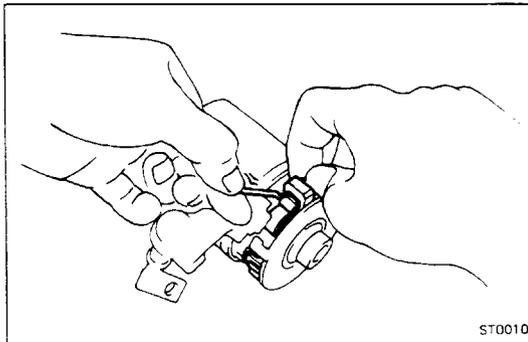
ST0008



**3. REMOVE CLUTCH ASSEMBLY AND GEARS FROM STARTER HOUSING**

**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 end cover from the field frame.

(b) Remove the O-ring (1.4 kW type only).

(c) Using a screwdriver or steel wire, separate the brush springs, and remove the brushes from the brush holder.

(d) Pull the brush holder off the field frame.

**6. REMOVE ARMATURE FROM FIELD FRAME**

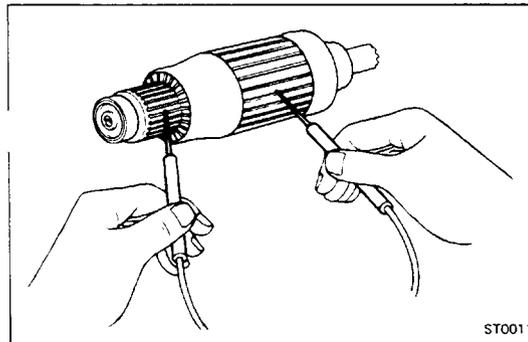
**INSPECTION OF STARTER**

**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.

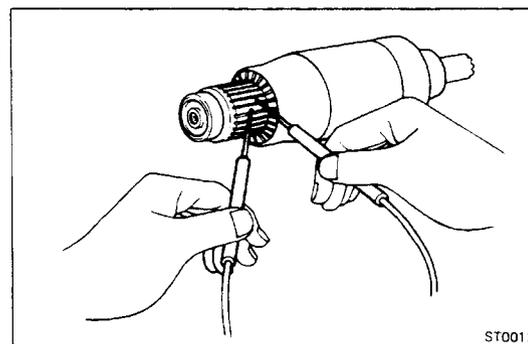
If there is continuity, replace the armature.



**2. INSPECT COMMUTATOR FOR OPEN CIRCUIT**

Using an ohmmeter, check for continuity between the segments of the commutator.

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



**Commutator**

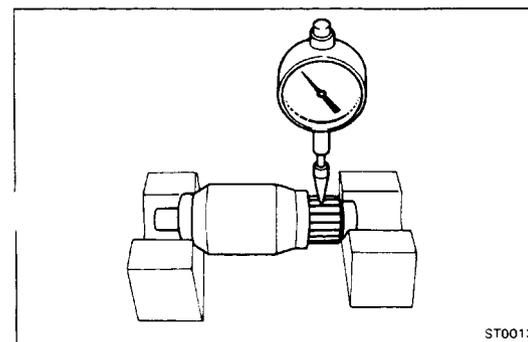
**1. INSPECT COMMUTATOR FOR DIRTY AND BURNT SURFACES**

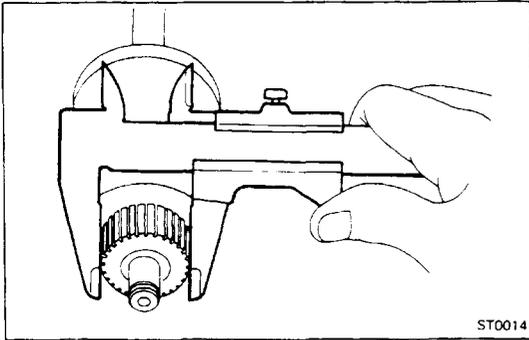
If the surface is dirty or burnt, correct with sandpaper (No. 400) or a lathe.

**2. INSPECT COMMUTATOR CIRCLE RUNOUT**

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

**Maximum circle runout: 0.05 mm (0.0020 in.)**





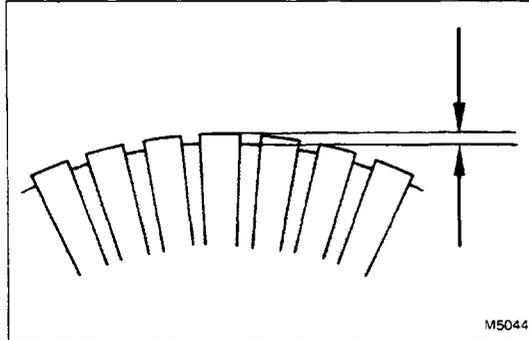
ST0014

### 3. MEASURE DIAMETER OF COMMUTATOR

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

**Standard diameter:** 30 mm (1.18 in.)

**Minimum diameter:** 29 mm (1.14 in.)



M5044

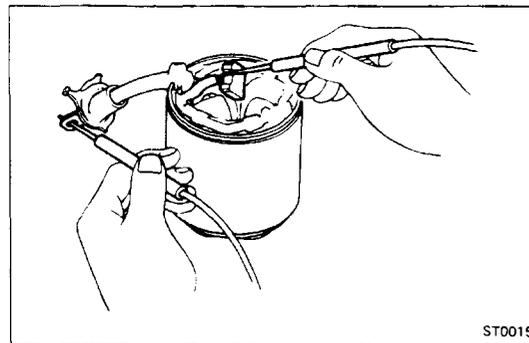
### 4. INSPECT UNDERCUT DEPTH

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

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

**Standard undercut depth:** 0.5 — 0.8 mm  
(0.020 — 0.031 in.)

**Minimum undercut depth:** 0.2 mm (0.008 in.)



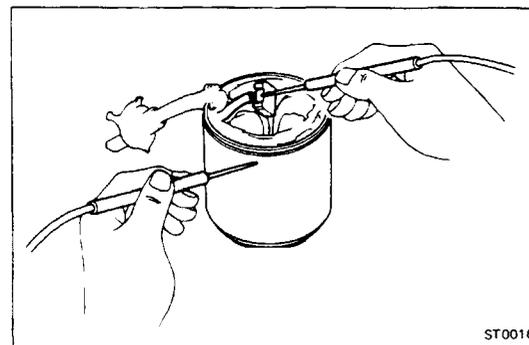
ST0015

## Field Coil

### 1. INSPECT FIELD COIL FOR OPEN CIRCUIT

Using an ohmmeter, check for continuity between the lead wire and field coil brush lead.

If there is no continuity, replace the field frame.

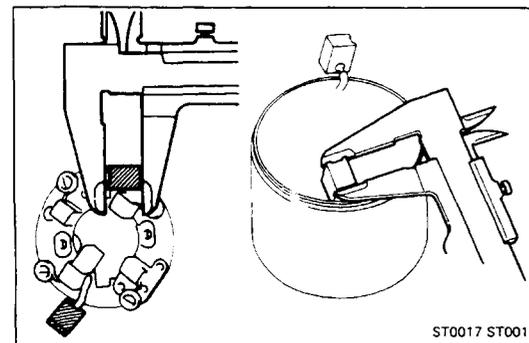


ST0016

### 2. INSPECT THAT FIELD COIL IS NOT GROUNDED

Using an ohmmeter, check for continuity between the field coil end and field frame.

If there is continuity, replace the field frame.



ST0017 ST0018

## Brushes

### MEASURE BRUSH LENGTH

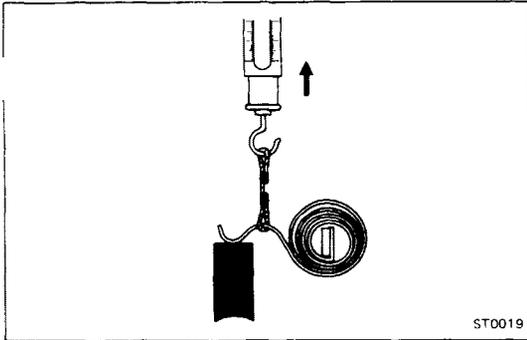
If length is less than the minimum, replace the brush and dress with an emery cloth.

**Standard length:** 1.0 kW 13.0 mm (0.512 in.)

1.4 kW 15.0 mm (0.591 in.)

**Minimum length:** 1.0 kW 8.5 mm (0.335 in.)

1.4 kW 10.0 mm (0.394 in.)



ST0019

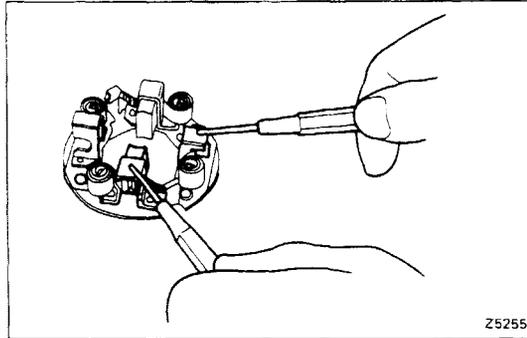
## Brush Spring

### MEASURE BRUSH SPRING LOAD WITH A PULL SCALE

If the reading is below standard, replace the brush spring.

Spring installed load: 1.785 – 2.415 kg  
(3.9 – 5.3 lb, 18 – 24 N)

NOTE: Take the pull scale reading at the very instant the brush spring separates from the brush.



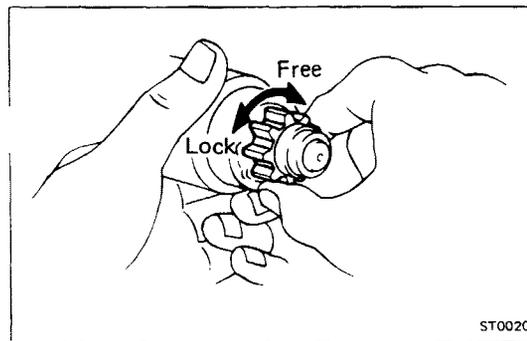
Z5255

## Brush Holder

### INSPECT INSULATION OF BRUSH HOLDER

Using an ohmmeter, check for continuity between the positive and negative brush holders.

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



ST0020

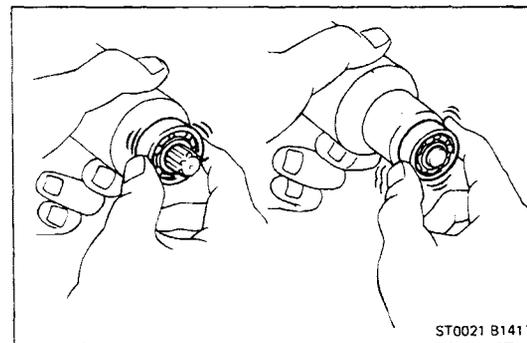
## Clutch and Gears

### 1. INSPECT GEAR TEETH

Check the gear teeth on the pinion gear, idler gear and clutch assembly for wear or damage. Replace if damaged. If damaged, also check the flywheel ring gear for wear or damage.

### 2. INSPECT CLUTCH

Rotate the pinion clockwise and check that it turns freely. Try to rotate the pinion counterclockwise and check that it locks.



ST0021 B1417

## Bearings

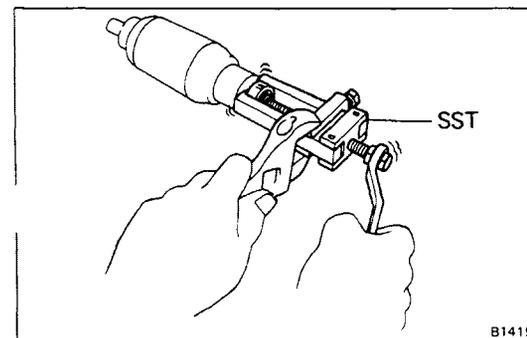
### 1. INSPECT BEARINGS

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

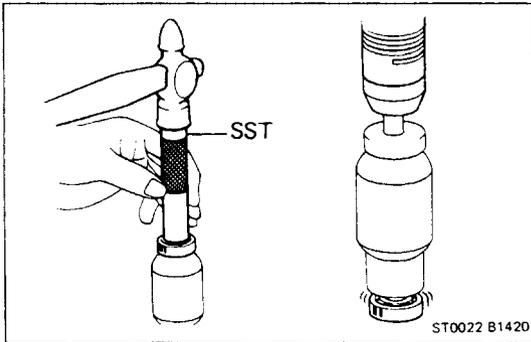
### 2. IF NECESSARY, REPLACE BEARINGS

- Using SST, remove the bearing from the armature shaft.
- Using SST, remove the other bearing on the opposite side.

SST 09286-46011



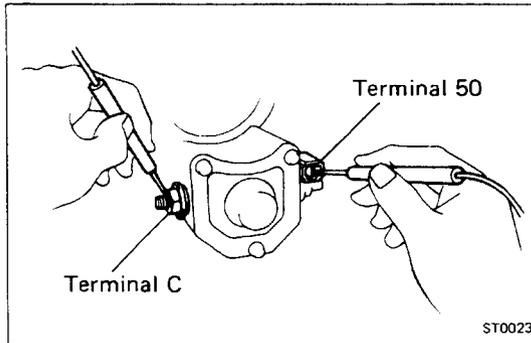
B1419



(c) Using SST and a hammer, tap a new large bearing onto the shaft.

SST 09285-76010

(d) Using a press, install a new small bearing onto the shaft.

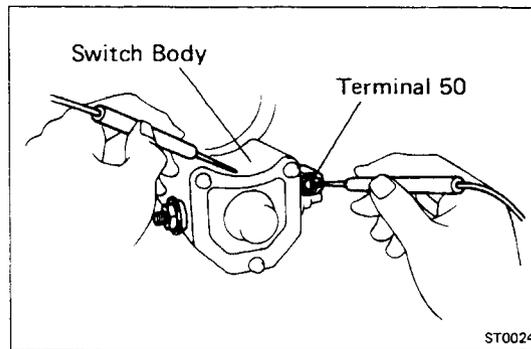


## Magnetic Switch

### 1. PERFORM PULL-IN COIL OPEN CIRCUIT TEST

Using an ohmmeter, check for continuity between terminal 50 and terminal C.

If there is no continuity, replace the magnetic switch.



### 2. PERFORM HOLD-IN COIL OPEN CIRCUIT TEST

Using an ohmmeter, check for continuity between terminal 50 and the switch body.

If there is no continuity, replace the magnetic switch.

## ASSEMBLY OF STARTER

(See page ST-3)

**NOTE:** Use high-temperature grease to lubricate the bearings and gears when assembling the starter.

### 1. PLACE ARMATURE INTO FIELD FRAME

Apply grease to the armature bearings and insert the armature into the field frame.

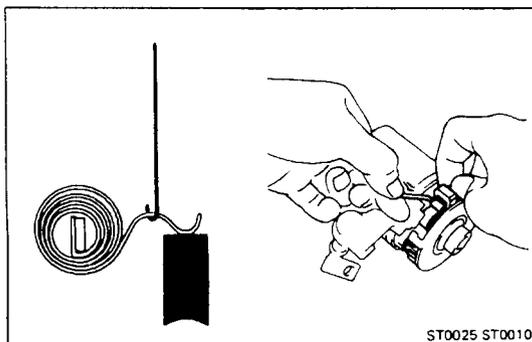
### 2. INSTALL BRUSH HOLDER AND BRUSHES

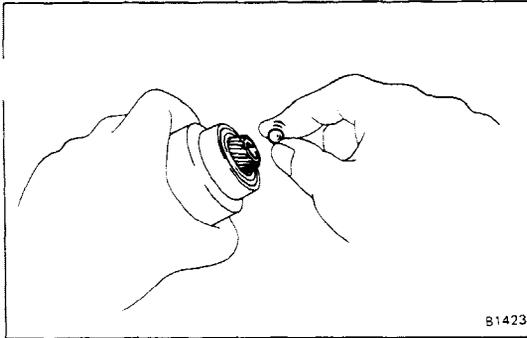
(a) Using a screwdriver or steel wire, hold the brush spring back, and install the brush into the brush holder. Install four brushes.

**NOTE:** Make sure that the positive lead wires are not grounded.

(b) Place the O-ring on the field frame (1.4 kW type only).

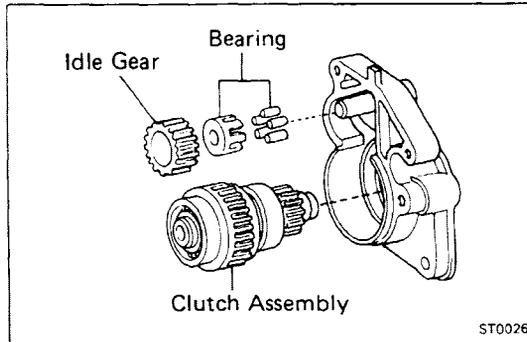
(c) Install the end cover to the field frame.





**3. INSERT STEEL BALL INTO CLUTCH SHAFT HOLE**

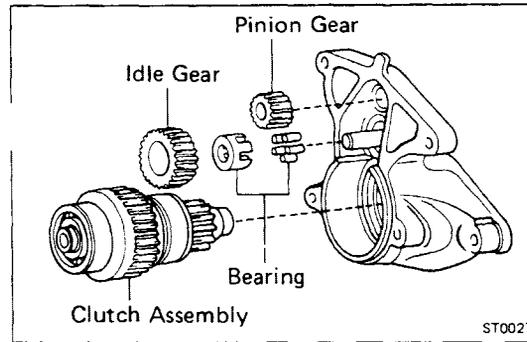
Apply grease to the ball and spring, and insert them into the clutch shaft hole.



**4. INSTALL GEARS AND CLUTCH ASSEMBLY TO STARTER HOUSING**

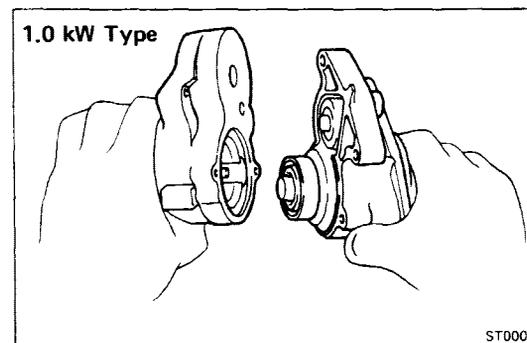
[1.0 kW type]

- (a) Apply grease to the gear and clutch assembly.
- (b) Place the clutch assembly, idle gear and bearing in the starter housing.



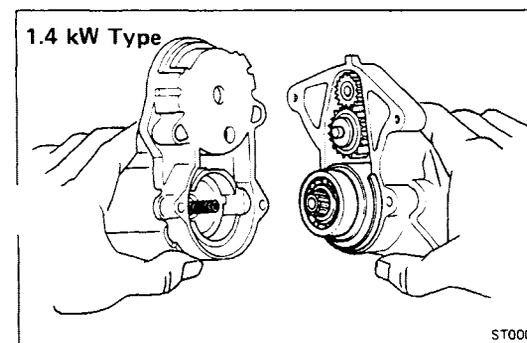
[1.4 kW type]

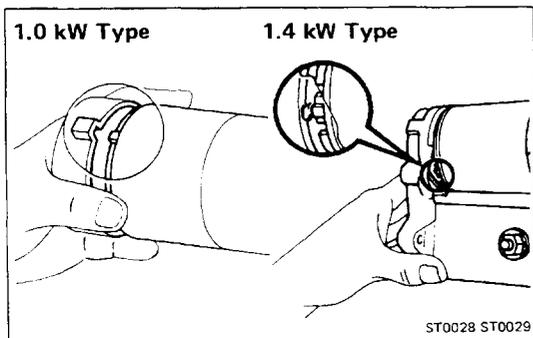
- (a) Apply grease to the gears and clutch assembly.
- (b) Place the clutch assembly, idle gear, bearing and pinion gear in the starter housing.



**5. INSTALL STARTER HOUSING**

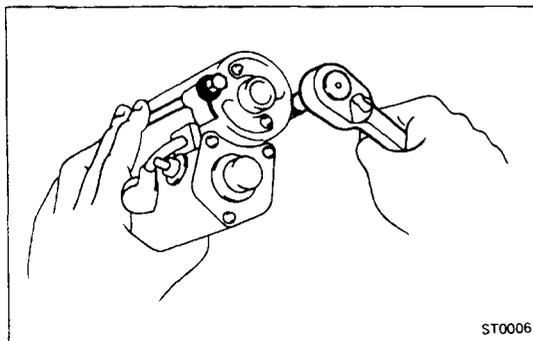
- (a) Insert the spring into the clutch shaft hole.
- (b) Place the starter housing on the magnetic switch and install the two screws.





## 6. INSTALL FIELD FRAME WITH ARMATURE IN MAGNETIC SWITCH ASSEMBLY

- (a) Place the felt seal on the armature shaft (1.0 kW type only).
- (b) Place the O-ring on the field frame (1.4 kW type only).
- (c) Match the protrusion of the field frame with the magnetic switch assembly.
- (d) Install the two through bolts.
- (e) Connect the coil lead to the terminal on the magnetic switch assembly.

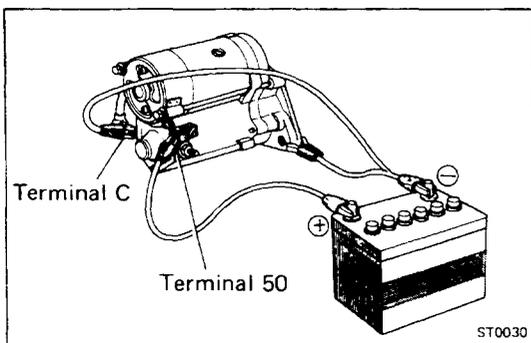


## PERFORMANCE TEST OF STARTER

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

### 1. PERFORM PULL-IN TEST

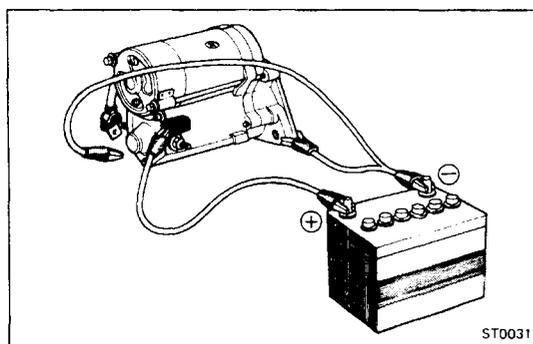
- (a) Disconnect the field coil lead from terminal C.
- (b) Connect the battery to the magnetic switch as shown. Check that the plunger moves outward. If the plunger does not move, replace the magnetic switch.



### 2. PERFORM HOLD-IN TEST

While connected as above with the plunger out, disconnect the negative lead from terminal C. Check that the plunger remains out.

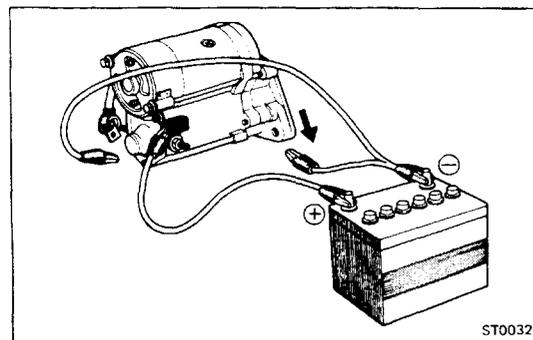
If the plunger returns inward, replace the magnetic switch.

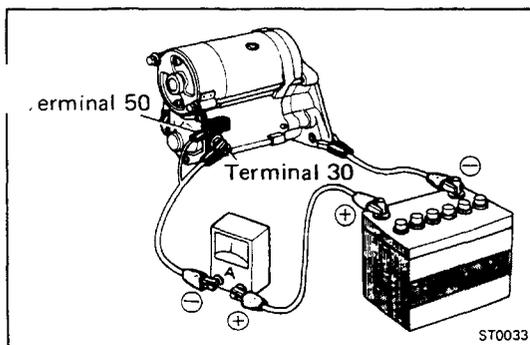


### 3. INSPECT PLUNGER RETURN

Disconnect the negative lead from the switch body. Check that the plunger returns inward.

If the plunger does not return, replace the magnetic switch.

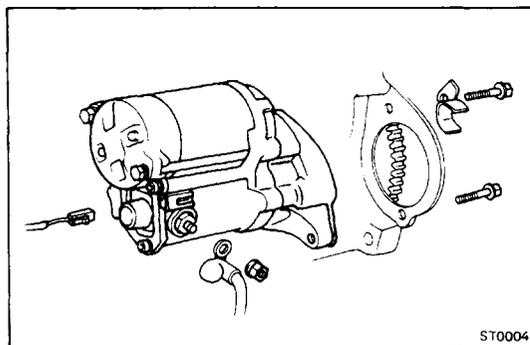




#### 4. PERFORM NO-LOAD PERFORMANCE TEST

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

**Specified current: Less than 90 A at 11.5 V**



### INSTALLATION OF STARTER

#### 1. INSTALL STARTER MOTOR IN FLYWHEEL BELL-HOUSING

Place the starter motor in the flywheel bellhousing. Install and torque the two bolts.

**Torque: 400 kg-cm (29 ft-lb, 39 N·m)**

#### 2. CONNECT TWO WIRES TO STARTER

Connect the connector to the terminal on the magnetic switch. Connect the cable from the battery to the terminal on the switch, and install the nut.

#### 3. INSTALL TRANSMISSION OIL FILLER TUBE (A/T only)

#### 4. CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY

Check that the car starts.

# CHARGING SYSTEM

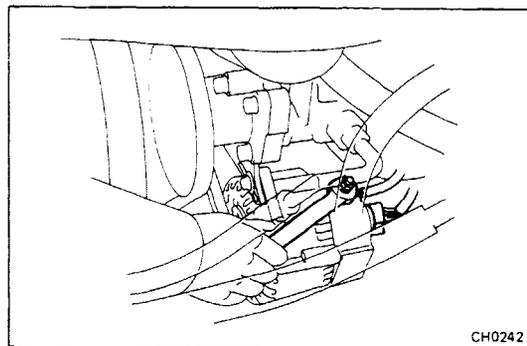
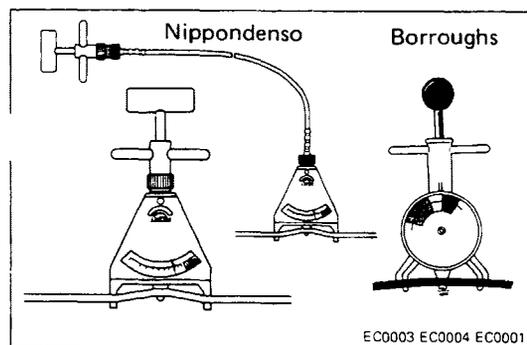
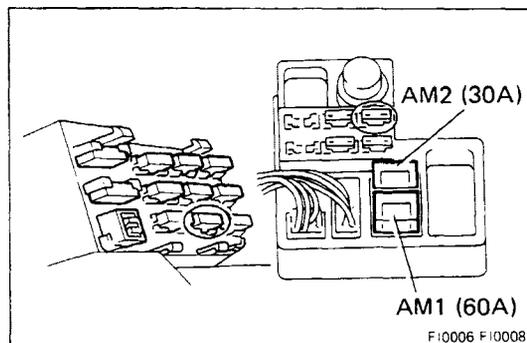
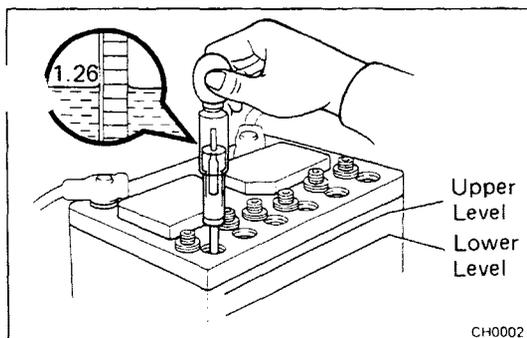
	Page
PRECAUTIONS .....	CH-2
TROUBLESHOOTING .....	CH-2
ON-VEHICLE INSPECTION .....	CH-3
ALTERNATOR.....	CH-5

## PRECAUTIONS

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 when the engine is running.

## TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Discharge warning light does not light with ignition ON and engine off	Fuse blown	Check "CHARGE" and "IGN" fuses	CH-6
	Light burned out	Replace light	
	Wiring connection loose	Tighten loose connections	
	IC regulator faulty	Replace IC regulator	
Discharge warning light does not go out with engine running (battery requires frequent recharging)	Drive belt loose or worn	Adjust or replace drive belt	CH-3
	Battery cables loose, corroded or worn	Repair or replace cables	CH-4
	Fuse blown	Check "ENGINE" fuse	
	Fusible link blown	Replace fusible link	
	IC regulator or alternator faulty	Check charging system	
Wiring faulty	Repair wiring		



## ON-VEHICLE INSPECTION

### 1. CHECK BATTERY SPECIFIC GRAVITY AND ELECTROLYTE LEVEL

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

#### Standard specific gravity

When fully charged at 20°C (68°F): 1.25 — 1.27

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

If insufficient, refill with distilled water (or purified water).

### 2. CHECK BATTERY TERMINALS, FUSIBLE LINK AND FUSES

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

- (b) Check the fusible link and fuses for continuity.

**FUSIBLE LINK** AM1, AM2

**Fuse ENGINE** (15A)

**Fuse CHARGE** (7,5A)

### 4. INSPECT DRIVE BELT

- (a) Visually check the drive belt for crack, oiliness or wear. Check that the belt does not touch the bottom of the pulley groove.

If necessary, replace the drive belt.

- (b) Using a belt tension gauge, check the drive belt tension.

Belt tension gauge:

Nippondenso BTG-20 (95506-00020) or

Borroughs No. BT-33-73F

**Drive belt tension:**

**New belt** 125 ± 25 lb

**Used belt** 80 ± 20 lb

If necessary, adjust the drive belt tension.

### 5. VISUALLY CHECK ALTERNATOR WIRING AND LISTEN FOR ABNORMAL NOISES

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

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

### 6. CHECK DISCHARGE WARNING LIGHT CIRCUIT

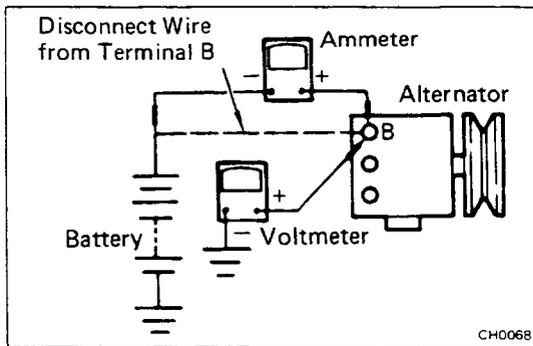
- (a) Warm up the engine and then turn it off.

- (b) Turn off all accessories.

- (c) Turn the ignition switch to ON. Check that the discharge warning light is lit.

- (d) Start the engine. Check that the light goes out.

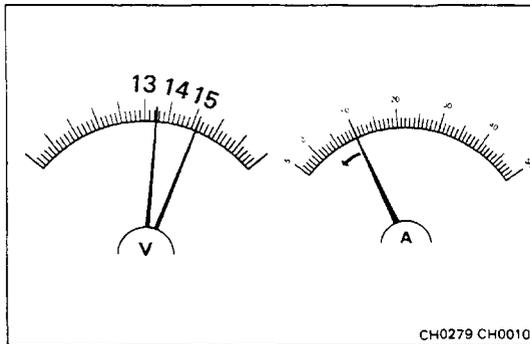
If the light does not come on and go off as specified, troubleshoot the warning light circuit.



## 7. CHECK CHARGING CIRCUIT WITHOUT LOAD

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

- (a) If a tester is not available, connect a voltmeter and ammeter to the charging circuit as follows:
- Disconnect the wire from terminal B of the alternator and connect it to the negative terminal of the ammeter.
  - Connect the test lead from the positive terminal of the ammeter to terminal B of the alternator.
  - Connect the positive lead of the voltmeter to terminal B of the alternator.
  - Connect the negative lead of the voltmeter to ground.



- (b) Check the charging circuit as follows:

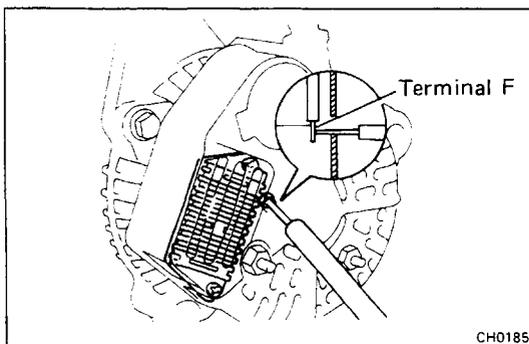
With the engine running from idling to 2,000 rpm, check the reading on the ammeter and voltmeter.

**Standard amperage: Less than 10 A**

**Standard voltage: 13.5 – 15.1 V**

**(Regulator case 25°C or 77°F)**

- If the voltage reading is greater than standard voltage, replace the IC regulator.
- If the voltage reading is less than standard voltage, check the IC regulator and alternator as follows: With terminal F grounded, start the engine and check the voltage reading of terminal B.
- If the voltage reading is greater than standard voltage, replace the IC regulator.
- If the voltage reading is less than standard voltage, check the alternator.



## 8. CHECK CHARGING CIRCUIT WITH LOAD

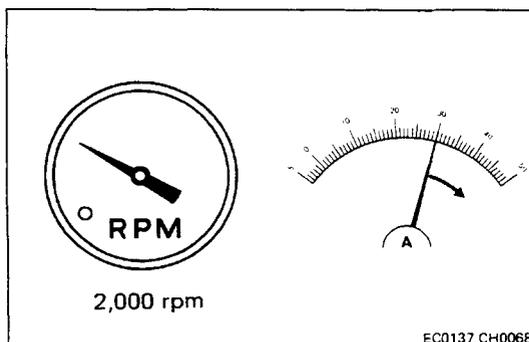
- (a) With the engine running at 2,000 rpm, turn on the high beam headlights and place the heater fan control switch at HI.

- (b) Check the reading on the ammeter.

**Standard amperage: More than 30 A**

If the ammeter reading is less than 30 A, repair the alternator. (See page CH-5)

NOTE: With the battery fully charged, sometimes the indication will be less than 30 A.

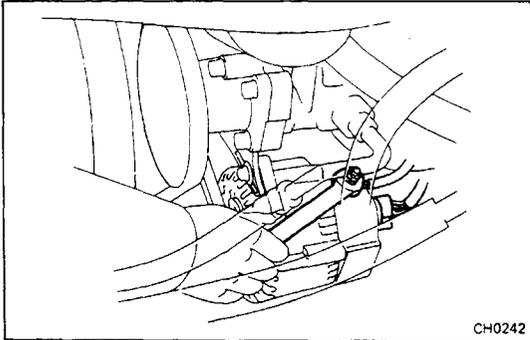


# ALTERNATOR

## REMOVAL OF ALTERNATOR

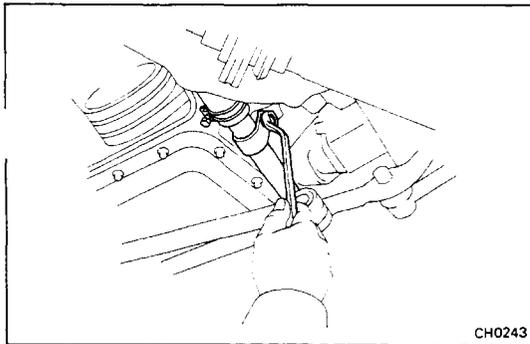
1. DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY

2. DRAIN COOLANT



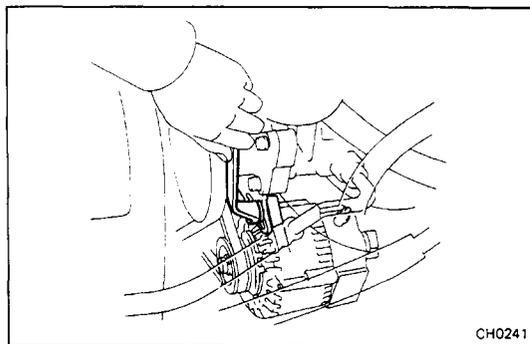
3. DISCONNECT WIRING FROM ALTERNATOR

- (a) Disconnect the connector from the alternator.
- (b) Remove the nut and wire from the alternator.



4. DISCONNECT WATER INLET HOSE

- (a) Remove the engine under cover.
- (b) Remove the two water inlet pipe bolts.
- (c) Disconnect the water inlet hose from the engine.



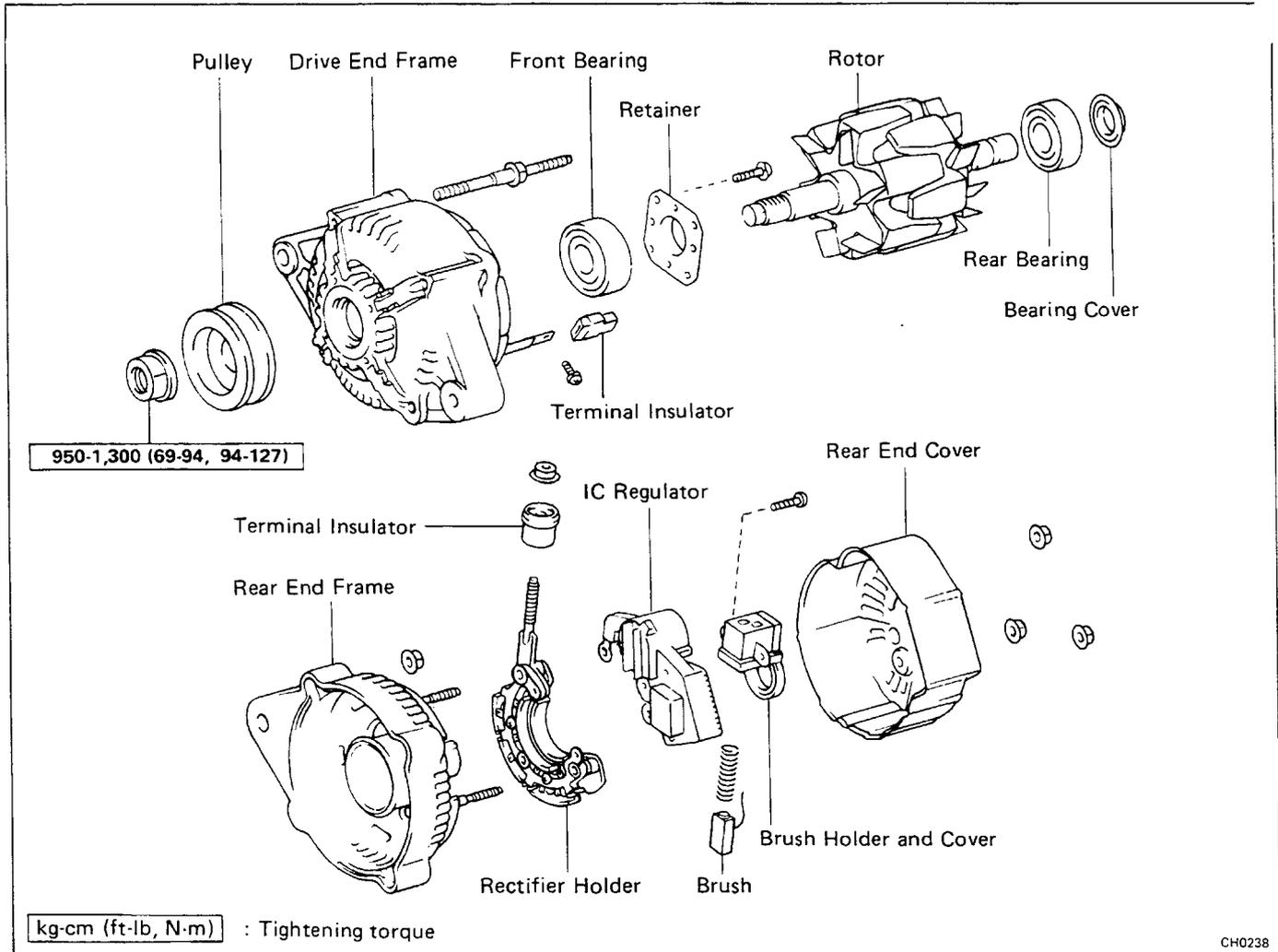
5. REMOVE FAN BELT

- (a) Loosen the alternator pivot and remove the adjust bolt.
- (b) Remove the fan belt.

6. REMOVE ALTERNATOR

- (a) Hold the alternator and remove the pivot.
- (b) Remove the alternator.

## COMPONENTS



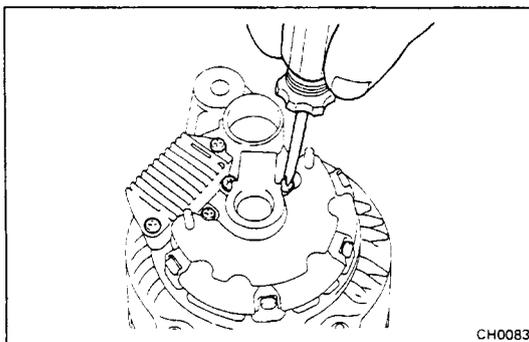
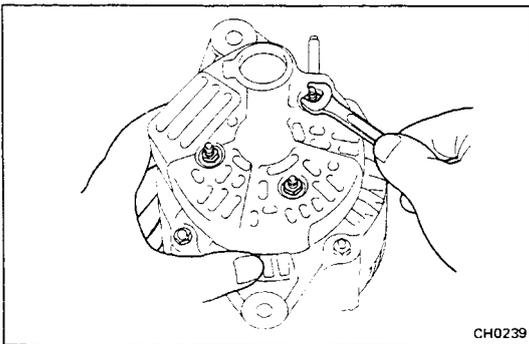
## DISASSEMBLY OF ALTERNATOR

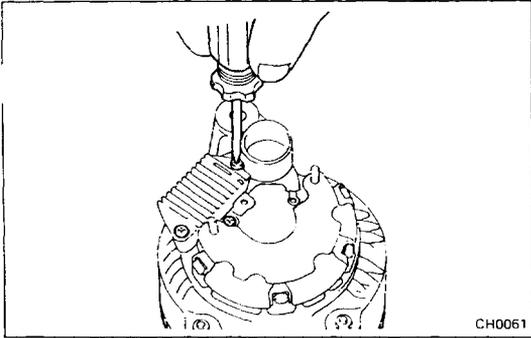
## 1. REMOVE REAR END COVER

- (a) Remove the nut and terminal insulator.
- (b) Remove the three nuts and end cover.

## 2. REMOVE BRUSH HOLDER

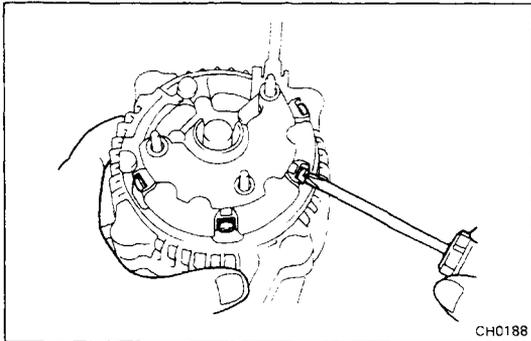
- Remove the two screws, brush holder and brush holder cover.





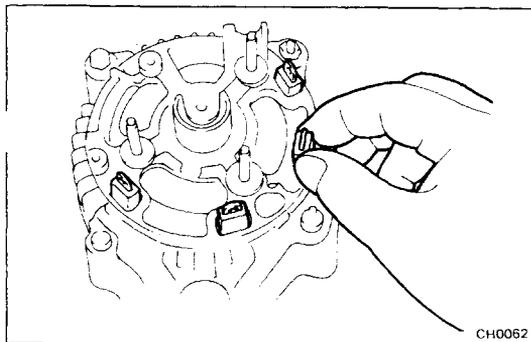
### 3. REMOVE IC REGULATOR

Remove the three screws and IC regulator.

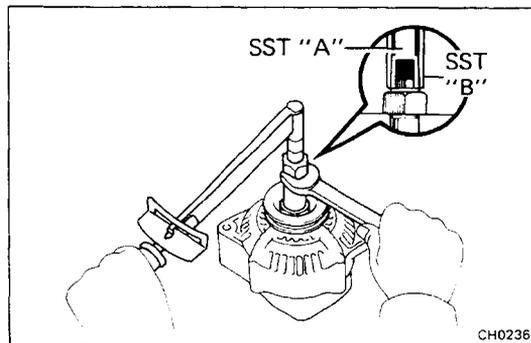


### 4. REMOVE RECTIFIER HOLDER

Remove the four screws and rectifier holder.



### 5. REMOVE TERMINAL INSULATOR



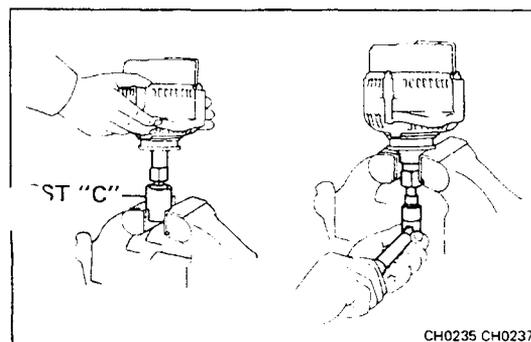
### 6. REMOVE PULLEY

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

SST 09820-63010

**Torque: 400 kg-cm (29 ft-lb, 39 N-m)**

- (b) Confirm that SST "A" is secured to the pulley shaft.



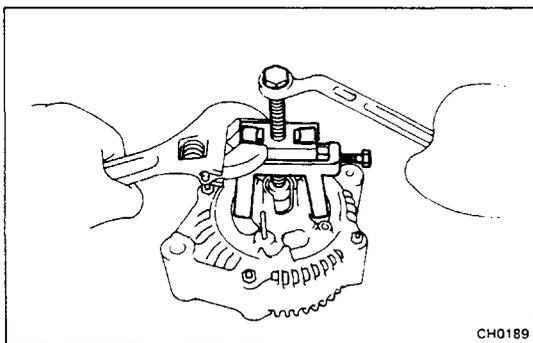
- (c) As shown in the figure, grip SST "C" in a vise and then install the alternator to SST "C".

- (d) To loosen the pulley nut turn SST "A" in the direction shown in the figure.

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

- (e) Turn SST "B" and remove all SSTs.

- (f) Remove the pulley nut and the pulley.

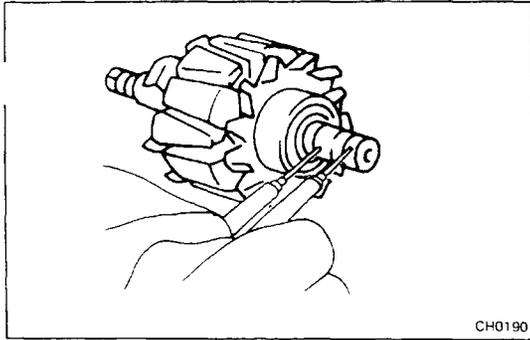
**7. REMOVE REAR END FRAME**

(a) Remove the four nuts.

(b) Using SST, remove the rear end frame and four terminal insulators.

SST 09286-46011

**8. REMOVE ROTOR FROM DRIVE END FRAME**



## INSPECTION AND REPAIR OF ALTERNATOR

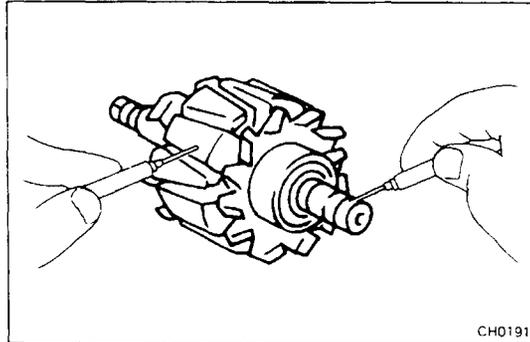
### Rotor

#### 1. CHECK ROTOR FOR OPEN CIRCUIT

Using an ohmmeter, check for continuity between the slip rings.

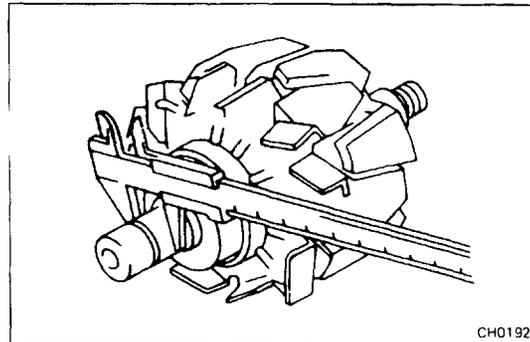
**Standard resistance: 2.8 — 3.0  $\Omega$**

If there is no continuity, replace the rotor.



#### 2. CHECK ROTOR FOR GROUND

Using an ohmmeter, check that there is no continuity between the slip ring and the rotor. If there is continuity, replace the rotor.



#### 3. INSPECT SLIP RINGS

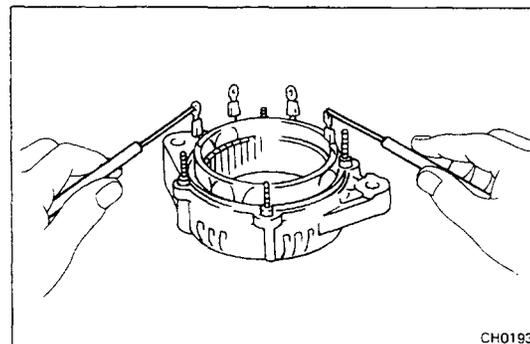
(a) Check that the slip rings are not rough or scored. If rough or scored, replace the rotor.

(b) Using calipers, measure the slip ring diameter.

If the diameter of the slip ring is less than the minimum, replace the rotor.

**Minimum diameter: 14.0 mm (0.551 in.)**

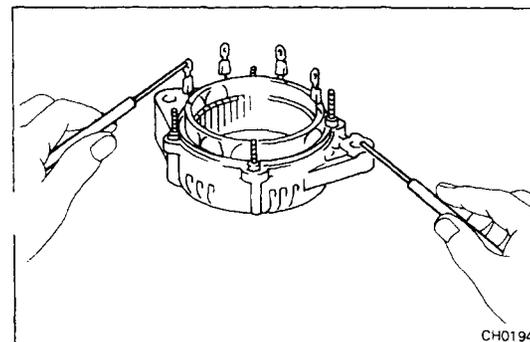
**Standard diameter: 14.4 mm (0.567 in.)**



### Stator

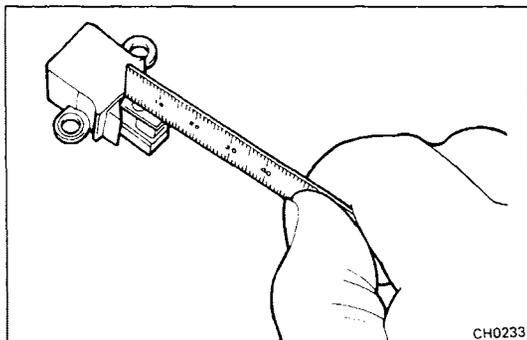
#### 1. INSPECT STATOR FOR OPEN CIRCUIT

Using an ohmmeter, check all leads for continuity. If there is no continuity, replace the drive end frame assembly.



#### 2. INSPECT THAT STATOR IS NOT GROUNDED

Using an ohmmeter, check that there is no continuity between the coil leads and drive end frame. If there is continuity, replace the drive end frame assembly.



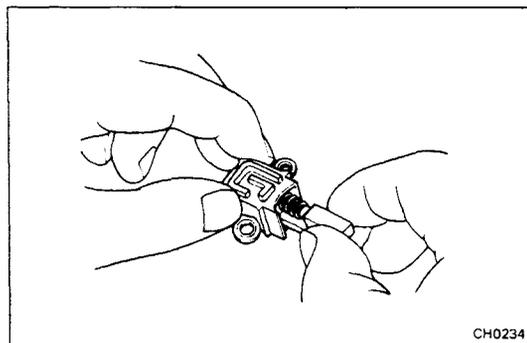
CH0233

## Brush and Brush Holder

### 1. MEASURE EXPOSED BRUSH LENGTH

Minimum exposed length: 4.5 mm (0.177 in.)

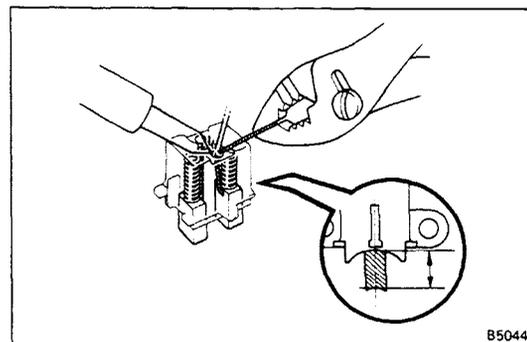
If the brush length is less than the minimum, replace the brush.



CH0234

### 2. IF NECESSARY, REPLACE BRUSH

- (a) Unsolder and remove the brush and the spring.
- (b) Put the brush wire through the spring and insert the brush holder.

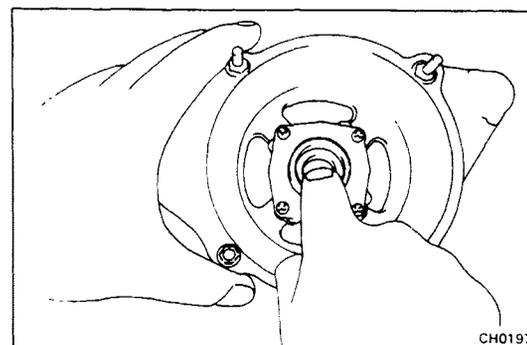


B5044

- (c) Solder the wire to the brush holder as shown.

Standard exposed length: 10.5 mm (0.413 in.)

- (d) Check that the brush moves smoothly in the brush holder.
- (e) Cut off any excess wire.

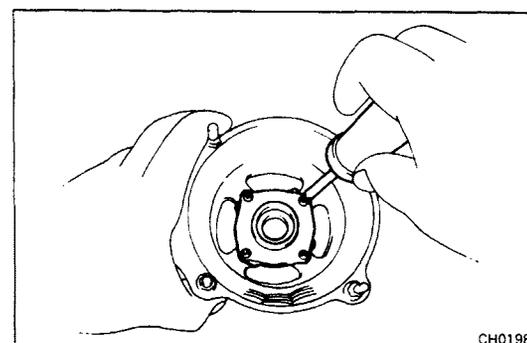


CH0197

## Bearings

### 1. INSPECT FRONT BEARING

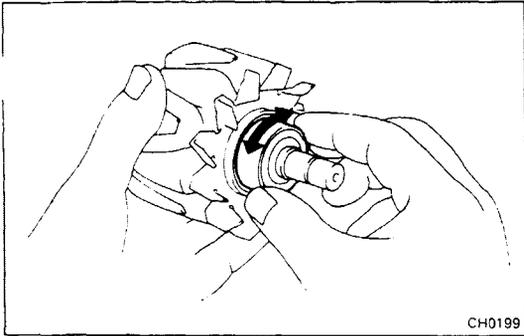
Check that the front bearing is not rough or worn. Replace if necessary.



CH0198

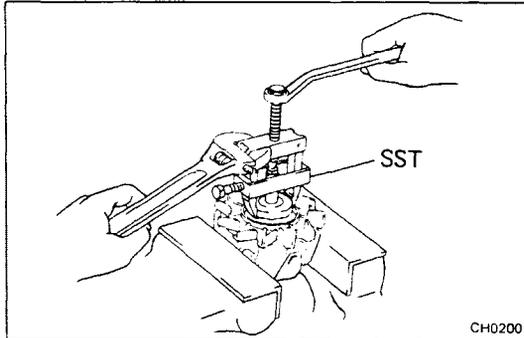
### 2. IF NECESSARY, REPLACE FRONT BEARING

Remove the four screws and bearing retainer, and replace the front bearing.



### 3. INSPECT REAR BEARING

Check that the rear bearing is not rough or worn. Replace if necessary.

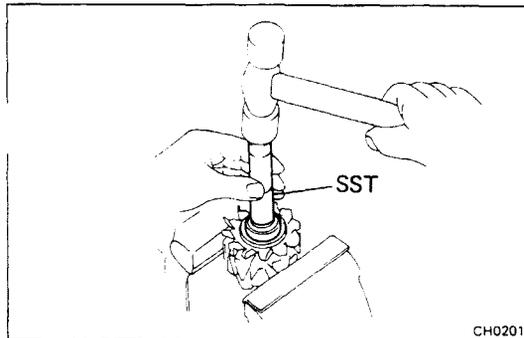


### 4. IF NECESSARY, REPLACE REAR BEARING

- (a) Using SST, remove the rear bearing with the bearing cover from the rotor shaft.

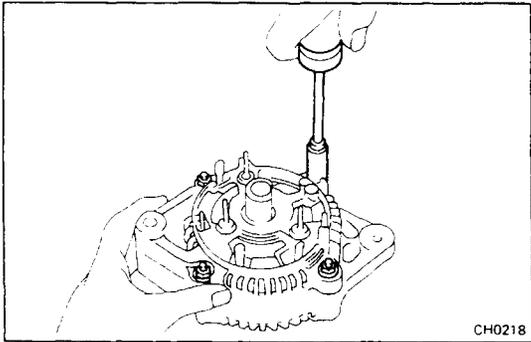
SST 09820-00020

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



- (b) Using SST, install the rear bearing and bearing cover onto the rotor shaft.

SST 09285-76010



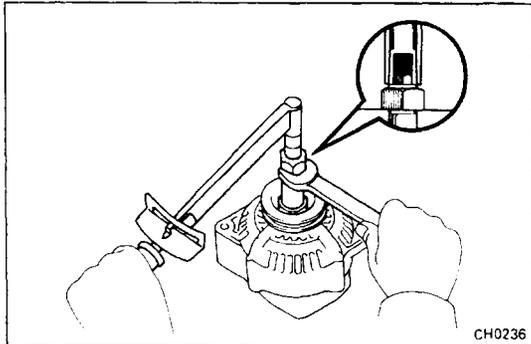
## ASSEMBLY OF ALTERNATOR

(See page CH-6)

### 1. INSTALL ROTOR TO DRIVE END FRAME

### 2. INSTALL REAR END FRAME

- (a) Using a plastic hammer, lightly tap the rear end frame on the drive end frame.
- (b) Install the four nuts.



### 3. INSTALL PULLEY

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

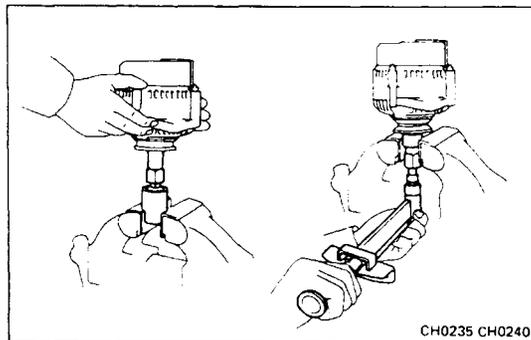
SST 09820-63010

**Torque: 400 kg-cm (29 ft-lb, 39 N·m)**

- (c) Confirm that SST "A" is secured to the pulley shaft.
- (d) As shown in the figure, grip SST "C" in a vise and then install the alternator to SST "C".
- (e) To torque the pulley nut turn SST "A" in the direction shown in the figure.

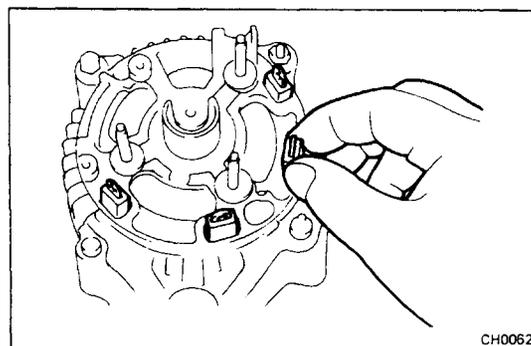
**Torque: 950 – 1,300 kg-cm  
(69 – 94 ft-lb, 94 – 127 N·m)**

- (f) Turn SST "B" and remove all SSTs.



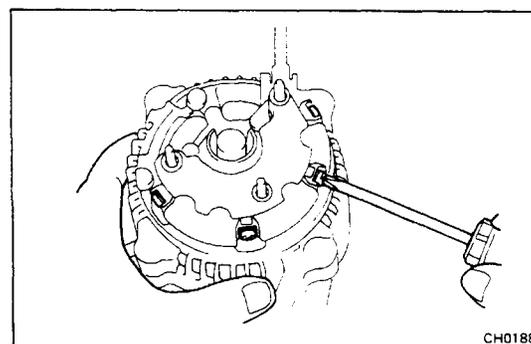
### 4. INSTALL FOUR TERMINAL INSULATORS

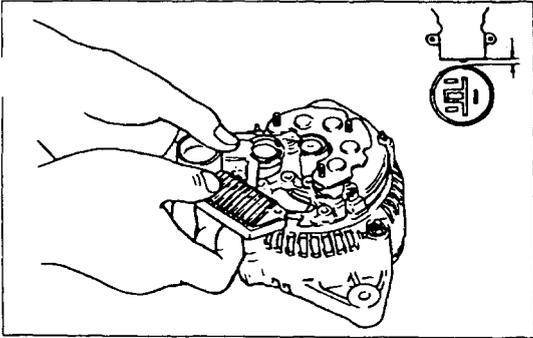
Install the four terminal insulators on the lead wires.



### 5. INSTALL RECTIFIER HOLDER

Install the rectifier holder with the four screws.

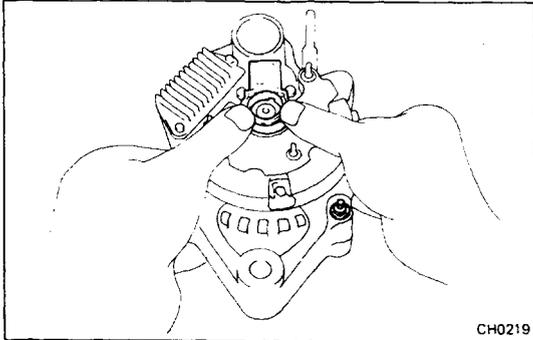


**6. INSTALL BRUSH HOLDER WITH IC REGULATOR**

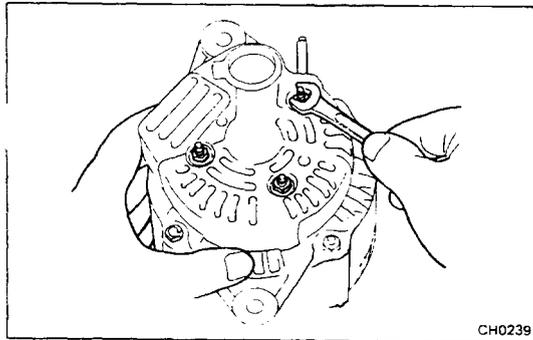
- (a) Install the brush holder with IC regulator.
- (b) Install the two screws to IC regulator.

**NOTE:** Check the clearance between the brush holder and connector as 1 mm or more.

- (c) Install the three screws.

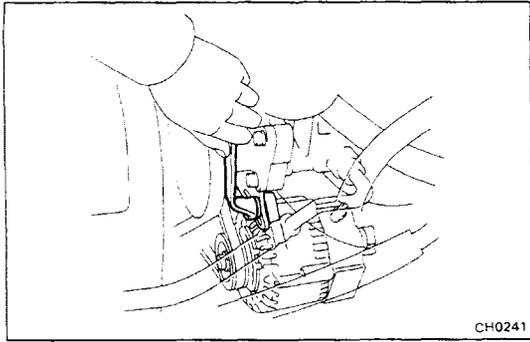


- (d) Install the brush holder cover to the rear end frame.

**7. INSTALL REAR END COVER**

- (a) Install the end cover with the three nuts.
- (b) Install the terminal insulator with the nut.

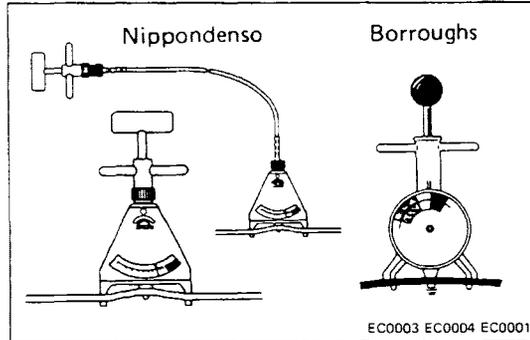
**8. MAKE SURE ROTOR ROTATES SMOOTHLY**



## INSTALLATION OF ALTERNATOR

### 1. INSTALL ALTERNATOR

Mount the alternator on the bracket with the pivot and adjust bolt.



### 2. INSTALL DRIVE BELT

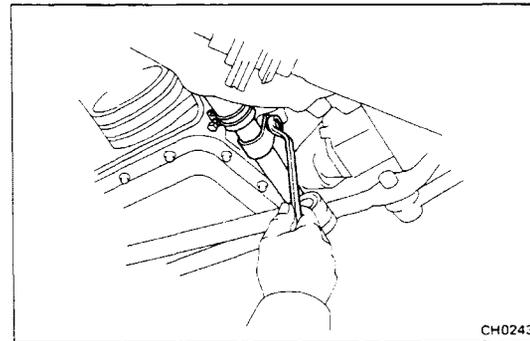
- Place the drive belt on the alternator, fan and crankshaft pulleys.
- Using a belt tension gauge, check the drive belt tension.

Belt tension gauge:

Nippondenso BTG-20 (95506-00020) or  
Borroughs No. BT-33-73F

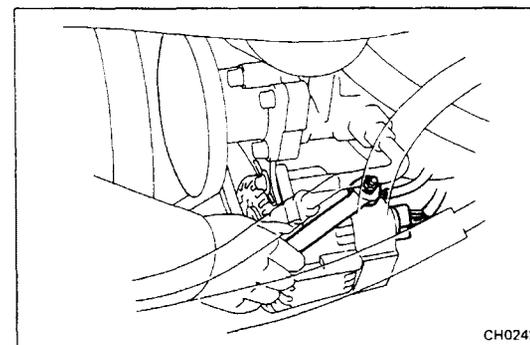
Drive belt tension:

New belt       $125 \pm 25$  lb  
Used belt       $80 \pm 20$  lb



### 3. CONNECT WATER INLET HOSE

- Connect the water inlet hose to the engine.
- Install the two water inlet pipe bolts.
- Install the engine under cover.



### 4. CONNECT WIRING TO ALTERNATOR

- Connect the wire to the alternator and install the nut.
- Connect the connector to the alternator.

### 5. FILL WITH COOLANT

Close the radiator drain cock and fill with coolant.

### 6. CONNECT NEGATIVE CABLE TO BATTERY

### 7. PERFORM ON-VEHICLE INSPECTION

(See page CH-3)