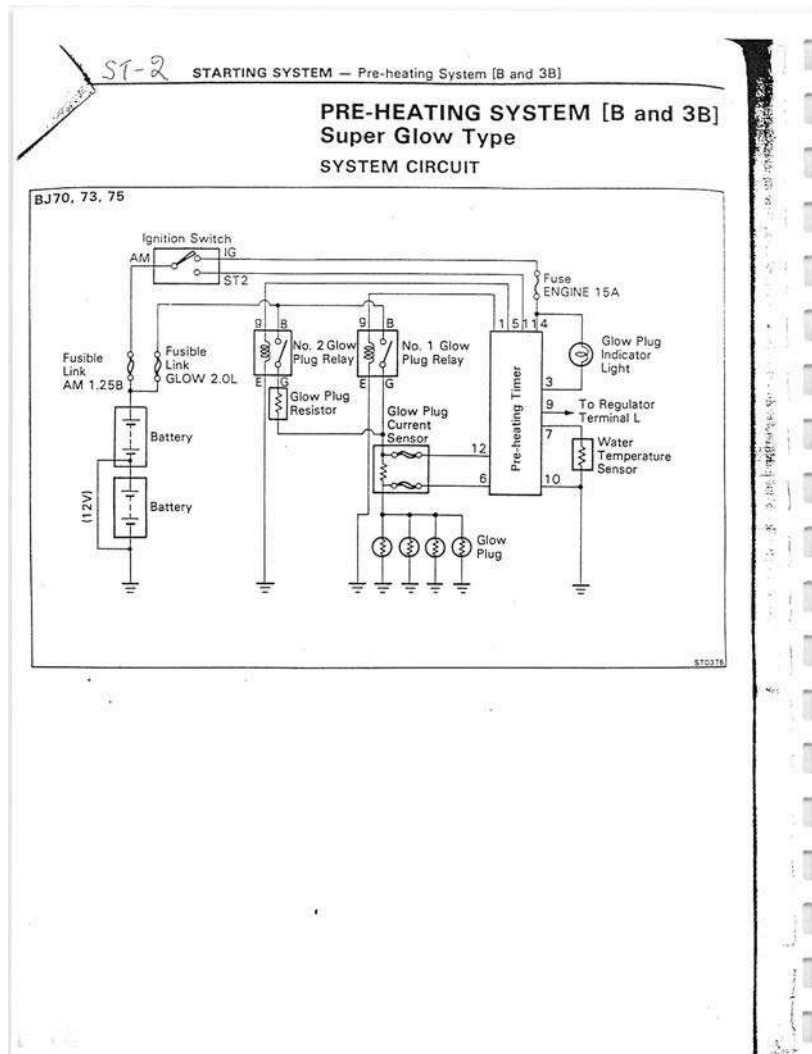


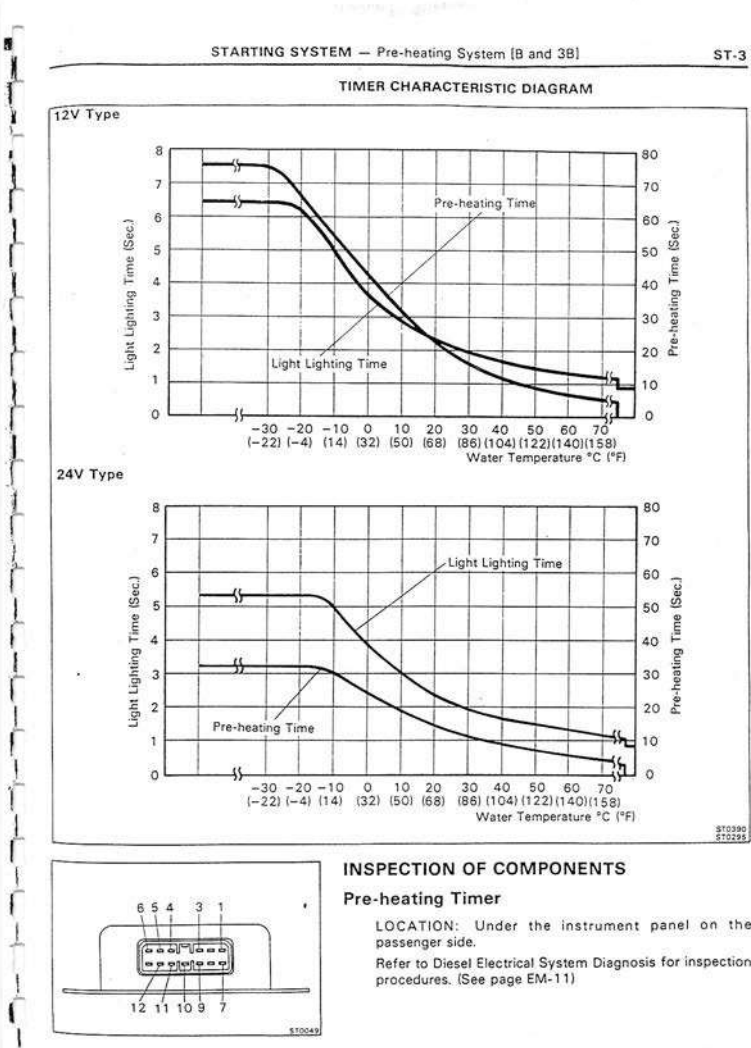
ST-1

STARTING SYSTEM

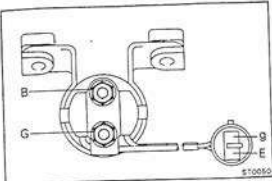
	Page
PRE-HEATING SYSTEM [B and 3B]	ST-2
PRE-HEATING SYSTEM [11B, 13B and 13B-T] ..	ST-9
TROUBLESHOOTING	ST-14
STARTING SYSTEM CIRCUIT	ST-14
STARTER	ST-15
STARTER RELAY [BB, BU and BY]	ST-24
STARTER RELAY [BJ]	ST-25
ELECTRICAL DIESEL INJECTION CONTROL [EDIC] SYSTEM [B and 3B (w/ EDIC System)] .	ST-26
FUEL CUT DIAPHRAGM [B (w/o EDIC System)]	ST-28
OVERINJECTION MAGNET [3B (w/o EDIC System)]	ST-30

ST





ST-4 **STARTING SYSTEM — Pre-heating System [B and 3B]**



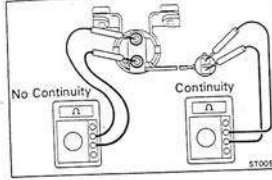
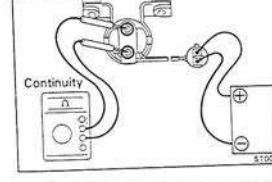
No. 1 Glow Plug Relay

LOCATION: On the fender apron in the engine compartment.

- 1. INSPECT RELAY CONTINUITY**
 - (a) Check that there is continuity between terminals E and g.
 - (b) Check that there is no continuity between terminals B and G.

If continuity is not as specified, replace the relay.
- 2. INSPECT RELAY OPERATION**
 - (a) Apply battery voltage across terminals E and g.
 - (b) Check that there is continuity between terminals B and G.

If operation is not as specified, replace the relay.

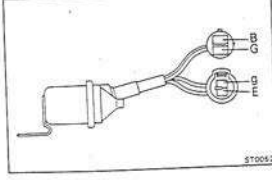
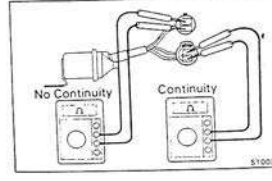



No. 2 Glow Plug Relay

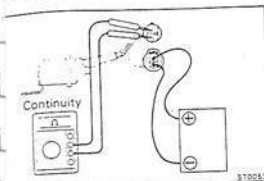
LOCATION: On the fender apron in the engine compartment.

- 1. INSPECT RELAY CONTINUITY**
 - (a) Check that there is continuity between terminals E and g.
 - (b) Check that there is no continuity between terminals B and G.

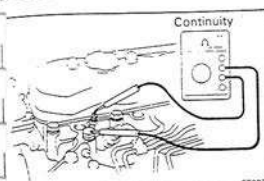
If continuity is not as specified, replace the relay.

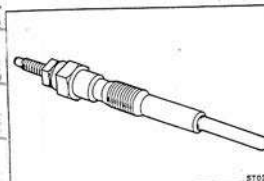
STARTING SYSTEM — Pre-heating System [B and 3B] **ST-5**



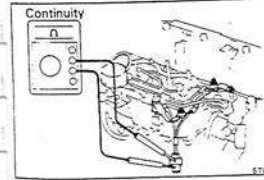
ST0033



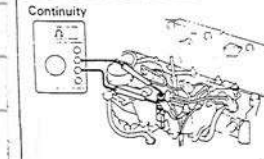
ST0034



ST0035



ST0036



ST0037

2. INSPECT RELAY OPERATION

(a) Apply battery voltage across terminals E and G.

(b) Check that there is continuity between terminals B and G.

If operation is not as specified, replace the relay.

Glow Plug

INSPECT GLOW PLUG

Using an ohmmeter, check that there is continuity between the glow plug terminal and ground.

If there is no continuity, replace the glow plug.

NOTE:

- Be careful not to damage the glow plug pipes as it could cause an open circuit or shorten the life of the plugs.
- Avoid getting oil and gasoline on the glow plugs when cleaning.
- During inspection, use a cloth be sure to wipe any oil off the glow plug terminals and bakelite washer.
- Be careful not to apply more than 7 volts to the glow plug as it could cause an open circuit.

Glow Plug Current Sensor

INSPECT GLOW PLUG CURRENT SENSOR

Using an ohmmeter, check that there is continuity between the current sensor terminals.

If there is no continuity, replace the current sensor.

Glow Plug Resistor

INSPECT GLOW PLUG RESISTOR

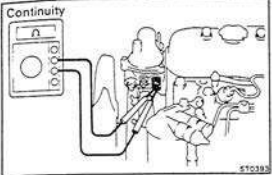
Using an ohmmeter, check that there is continuity between the resistor terminals.

If there is no continuity, replace the resistor.

ST-6

STARTING SYSTEM — Pre-heating System [B and 3B]

Continuity



510393

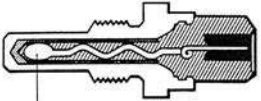
Water Temperature Sensor

INSPECT WATER TEMPERATURE SENSOR

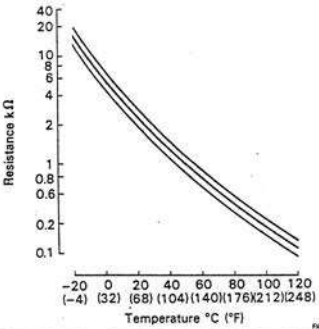
Using an ohmmeter, check the resistance between the water temperature sensor terminals.

Resistance: Refer to the chart.

If the resistance is not as specified, replace the water temperature sensor.



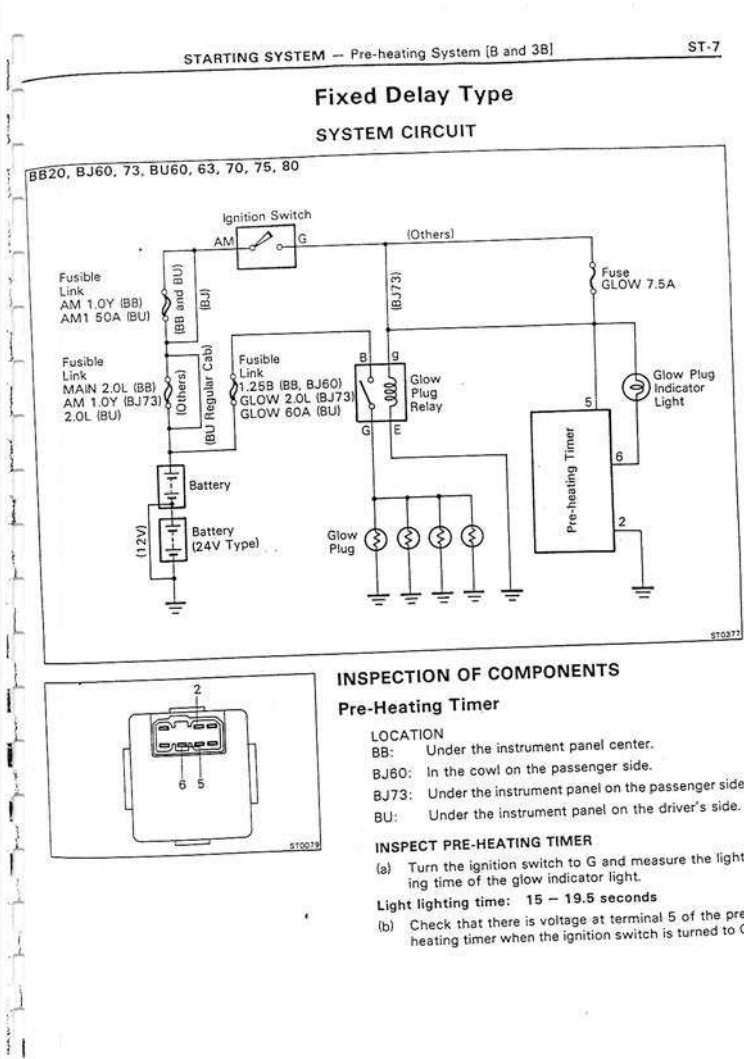
Thermistor



Resistance kΩ

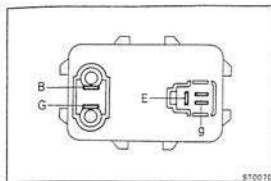
Temperature °C (°F)

60515 RD028



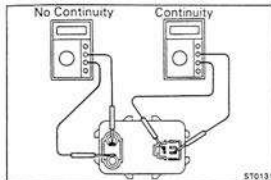
ST-8

STARTING SYSTEM — Pre-heating System [B and 3B]

**Glow Plug Relay [BB and BU]****LOCATION**

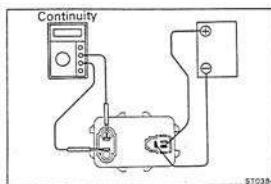
BB: Below the left fender apron.

BU: In the cowl on the passenger side.

**1. INSPECT RELAY CONTINUITY**

- Check that there is continuity between terminals E and G.
- Check that there is no continuity between terminals B and G.

If continuity is not as specified, replace the relay.

**2. INSPECT RELAY OPERATION**

- Apply battery voltage across terminals E and G.
- Check that there is continuity between terminals B and G.

If operation is not as specified, replace the relay.

Glow Plug Relay [BJ]

(See No. 2 Glow Plug Relay on page ST-4)

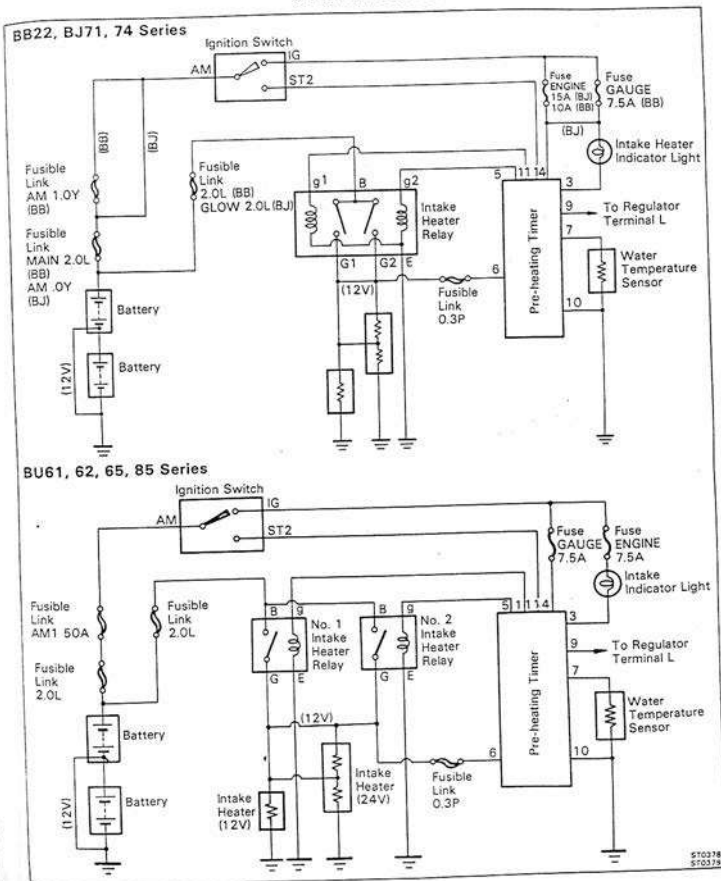
LOCATION: On the fender apron in the engine compartment.**Glow Plug**

(See page ST-5)

STARTING SYSTEM — Pre-heating System (11B, 13B and 13B-T)

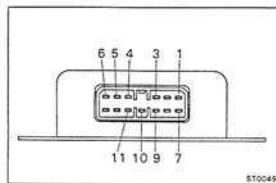
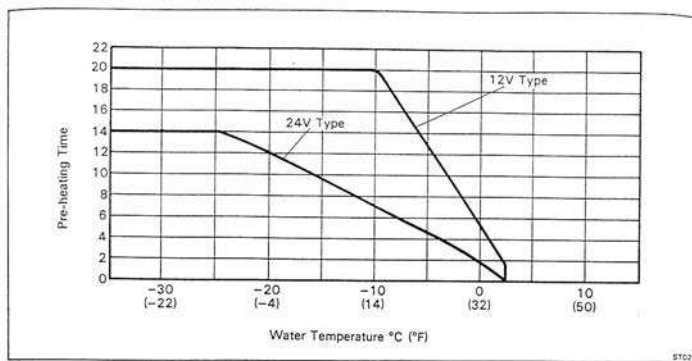
ST-9

PRE-HEATING SYSTEM [11B, 13B and 13B-T] SYSTEM CIRCUIT



ST-10 STARTING SYSTEM — Pre-heating System [11B, 13B and 13B-T]

TIMER CHARACTERISTIC DIAGRAM



INSPECTION OF COMPONENTS

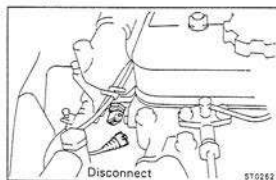
Pre-heating Timer

LOCATION

BB: Under the instrument panel center.

BJ: Under the instrument panel on the passenger side.

BU: Under the instrument panel on the driver's side.



INSPECT PRE-HEATING TIMER

(a) Disconnect the water temperature sensor connector.

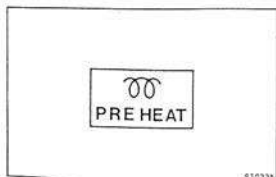
(b) Turn the ignition switch to "ON," and measure the time the pre-heating indicator is lit.

Light lighting time:

12V type Approx. 20 seconds

24V type Approx. 14 seconds

CAUTION: Since power consumption is high, perform this check as few times as possible.



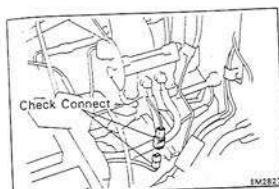
STARTING SYSTEM — Pre-heating System (11b, 13b and 15b)

ST-11

- (c) Turn the ignition switch to "START," and then check that there is voltage at terminal 5 of the pre-heating timer.

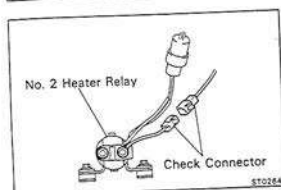
After-heating time: Approx. 70 seconds

CAUTION: Since power consumption is high, perform this check as few times as possible.

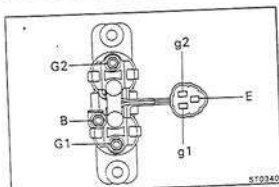


- (d) Turn the ignition switch to "START."

- (e) [BJ and BB]
Disconnect the MALFUNCTION CHECK connector of the intake heater, and check that the "PREHEAT" light comes on when the after-heating is finished.

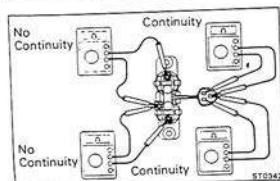


- (f) [BU]
Disconnect the MALFUNCTION CHECK connector of the No. 2 heater relay, and check that the "PREHEAT" light comes on when the after-heating is finished.



Intake Heater Relay [BB]

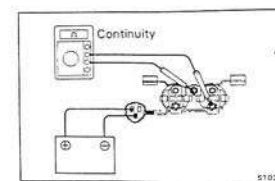
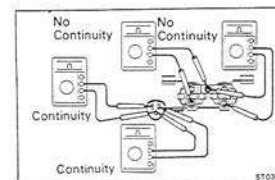
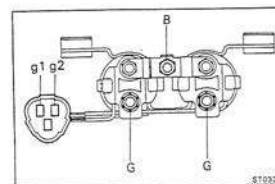
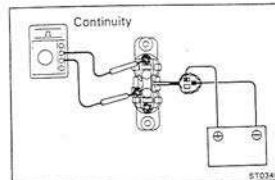
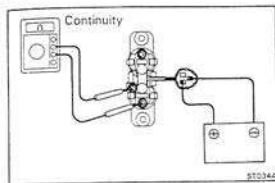
LOCATION: Below the left fender apron.



1. INSPECT RELAY CONTINUITY

- Check that there is continuity between terminals E and g1.
- Check that there is continuity between terminals E and g2.
- Check that there is no continuity between terminals B and G1.
- Check that there is no continuity between terminals B and G2.

If continuity is not as specified, replace the relay.

ST-12 STARTING SYSTEM — Pre-heating System [11B, 13B and 13B-T]

2. INSPECT RELAY OPERATION

- (a) Apply battery voltage across terminals E and g1.
- (b) Check that there is continuity between terminals B and G1.

- (c) Apply battery voltage across terminals E and g2.
- (d) Check that there is continuity between terminals B and G2.

If operation is not as specified, replace the relay.

Intake Heater Relay [BJ]

LOCATION: In front of the battery.

1. INSPECT RELAY CONTINUITY

- (a) Check that there is continuity between terminals E and g1.
- (b) Check that there is continuity between terminals E and g2.
- (c) Check that there is no continuity between terminals B and G1.
- (d) Check that there is no continuity between terminals B and G2.

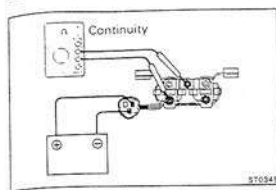
If continuity is not as specified, replace the relay.

2. INSPECT RELAY OPERATION

- (a) Apply battery voltage across terminals E and g1.
- (b) Using an ohmmeter, check that there is continuity between terminals B and G1.

STARTING SYSTEM — Pre-heating System [11B, 13B and 13B-T]

ST-13



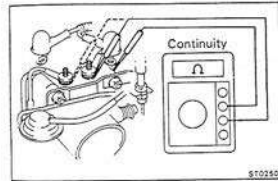
- (c) Apply battery voltage across terminals E and g2.
- (d) Using an ohmmeter, check that there is continuity between terminals B and G2.

If operation is not as specified, replace the relay.

No. 1 and No. 2 Intake Heater Relays [BU]

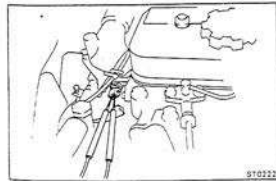
(See No. 1 Glow Plug Relay on page ST-4)

LOCATION: On the frame at the rear of the engine.

**Intake Heater****INSPECT INTAKE HEATER**

Using an ohmmeter, check that there is continuity between each terminal of the intake heater and ground.

If there is no continuity, replace the intake heater.

**Water Temperature Sensor**

(See page ST-6)

ST-14 **STARTING SYSTEM — Troubleshooting, Starting System Circuit**

TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Engine will not crank	Battery charge low	Check battery specific gravity Charge or replace battery	CH-7 ST-15
	Battery cables loose, corroded or worn	Repair or replace cables	
	Neutral start switch faulty (A/T only)	Replace switch	
	Fusible link blown	Replace usable link	
	Starter faulty	Repair starter	
	Ignition switch faulty	Replace ignition switch	
Engine cranks slowly	Battery charge low	Check battery specific gravity Charge or replace battery	CH-7 ST-15
	Battery cables loose, corroded or worn	Repair or replace cables	
	Starter faulty	Repair starter	
Starter keeps running	Starter faulty	Repair starter	ST-15
	Ignition switch faulty	Replace ignition switch	
	Short in wiring	Repair wiring	
Starter spins but engine will not crank	Pinion gear teach broken or faulty starter	Repair starter	ST-15
	Flywheel teeth broken	Replace flywheel	

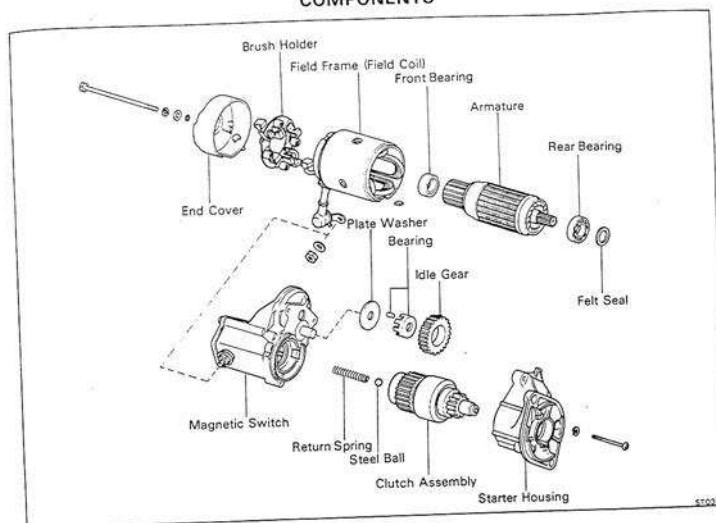
STARTING SYSTEM CIRCUIT

STARTING SYSTEM — Starter

ST-15

STARTER

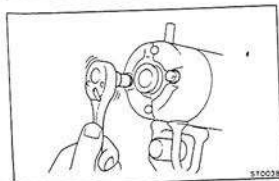
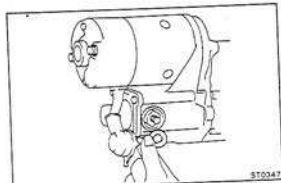
COMPONENTS



DISASSEMBLY OF STARTER

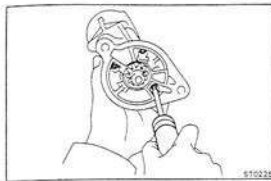
1. REMOVE FIELD FRAME AND ARMATURE ASSEMBLY

- (a) Remove the nut and disconnect the lead wire from the magnetic switch terminal.
- (b) Remove the two through bolts.
- (c) Pull out the field frame together with the armature.
- (d) Remove the felt seal and lock plate.

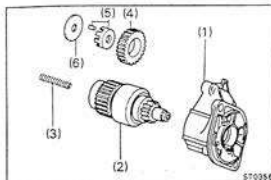


ST-16

STARTING SYSTEM — Starter

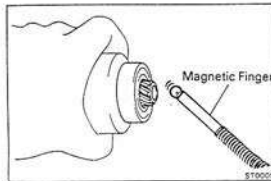
**2. REMOVE STARTER HOUSING, CLUTCH ASSEMBLY AND GEAR**

(a) Remove the three screws.

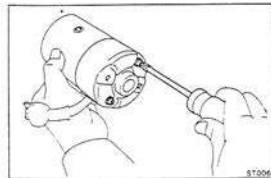


(b) Remove the following parts from the magnetic switch:

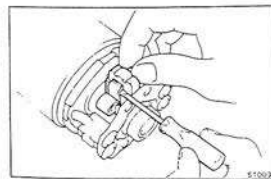
- (1) Starter housing
- (2) Clutch assembly
- (3) Return spring
- (4) Idle gear
- (5) Bearing
- (6) Plate washer

**3. REMOVE STEEL BALL**

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

**4. REMOVE BRUSH HOLDER**

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



(b) Using a screwdriver, hold the spring back and disconnect the brush from the brush holder. Disconnect the four brushes and remove the brush holder.

5. REMOVE ARMATURE FROM FIELD FRAME

STARTING SYSTEM — Starter

ST-17

INSPECTION OF STARTER**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, 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 with sandpaper (No. 400) or on a lathe.

2. INSPECT COMMUTATOR CIRCLE RUNOUT

Maximum circle runout: 0.05 mm (0.0020 in.)

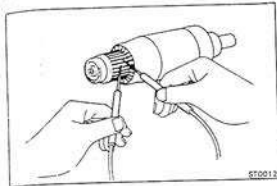
If the circle runout is greater than maximum, correct on a lathe.

3. INSPECT DIAMETER OF COMMUTATOR

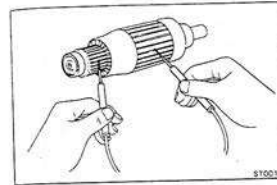
Standard diameter: 36 mm (1.42 in.)

Minimum diameter: 35 mm (1.38 in.)

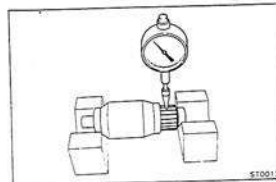
If the diameter is less than minimum, replace the armature.



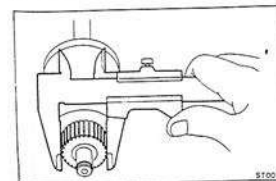
ST0012



ST0013

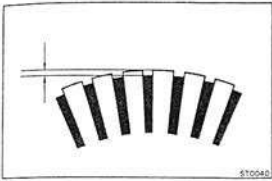


ST0013



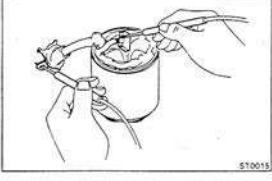
ST0014

ST-18 STARTING SYSTEM — Starter

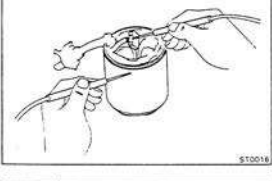


4. INSPECT UNDERCUT DEPTH
Check that the undercut depth is clean and free of foreign material. Smooth out the edge.
Standard undercut depth: 0.7 mm (0.028 in.)
Minimum undercut depth: 0.2 mm (0.008 in.)
If the undercut depth is less than minimum, correct it with a hacksaw blade.

Field Coil (Field Frame)

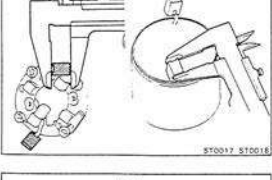


1. INSPECT FIELD COIL FOR OPEN CIRCUIT
Using an ohmmeter, check that there is continuity between the lead wire and field coil brush lead.
If there is no continuity, replace the field frame.

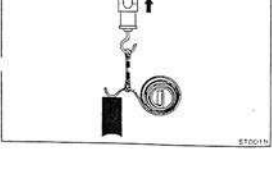


2. INSPECT FIELD COIL FOR GROUND
Using an ohmmeter, check that there is no continuity between the field coil end and field frame.
If there is continuity, repair or replace the field frame.

Brushes



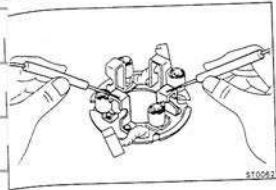
INSPECT BRUSH LENGTH
Using calipers, measure the brush length.
Standard length: 20.5 mm (0.807 in.)
Minimum length: 13.0 mm (0.512 in.)
If the length is less than minimum, replace the brush holder and field frame.



Brush Springs

INSPECT BRUSH SPRING LOAD
Take the pull scale reading the instant the brush spring separates from the brush.
Spring installed load:
3.2 – 4.0 kg (7.1 – 8.8 lb, 31 – 39 N)
If the reading is not within specification, replace the brush springs.

STARTING SYSTEM — Starter
ST-19



Brush Holder

INSPECT INSULATION OF BRUSH HOLDER

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



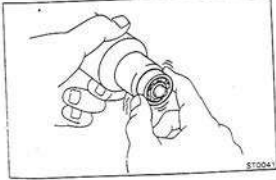
Clutch and Gears

1. INSPECT GEAR TEETH

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

2. INSPECT CLUTCH PINION GEAR

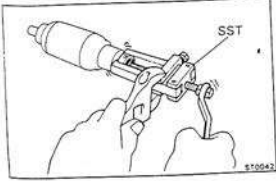
Rotate the pinion gear clockwise and check that it turns freely. Try to rotate the pinion gear counterclockwise and check that it locks. If necessary, replace the clutch assembly.



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.

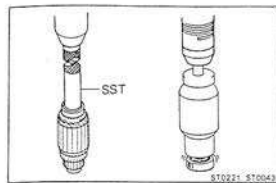


2. IF NECESSARY, REPLACE BEARINGS

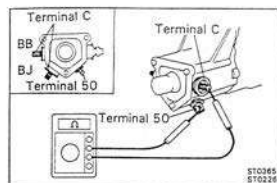
(a) Using SST, remove the bearing. SST 09286-46011.

ST-20

STARTING SYSTEM — Starter

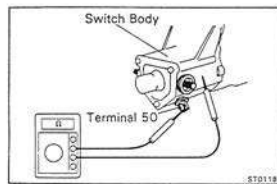


- (b) Using SST and a press, press in a new front bearing SST 09285-76010
- (c) Using a press, press in a new rear bearing.

**Magnetic Switch****1. PERFORM 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. PERFORM 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.

STARTING SYSTEM — Starter

ST-21

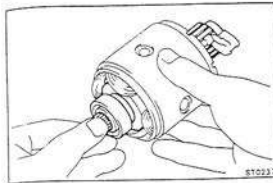
ASSEMBLY OF STARTER

(See page ST-15)

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

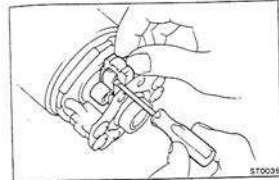
1. PLACE ARMATURE INTO FIELD FRAME

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

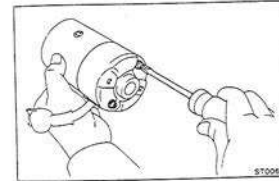
**2. INSTALL BRUSH HOLDER**

- (a) Place the brush holder on the armature.
- (b) Using a screwdriver, hold the brush spring back, and connect the brush into the brush holder. Connect the four brushes.

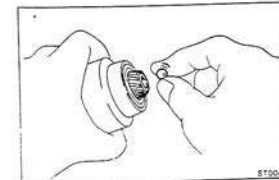
NOTE: Check that the positive (+) lead wires are not grounded.



- (c) Install the end cover with the two screws.

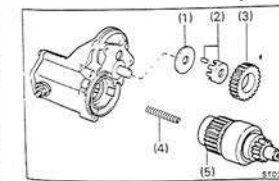
**3. INSERT STEEL BALL INTO CLUTCH SHAFT HOLE**

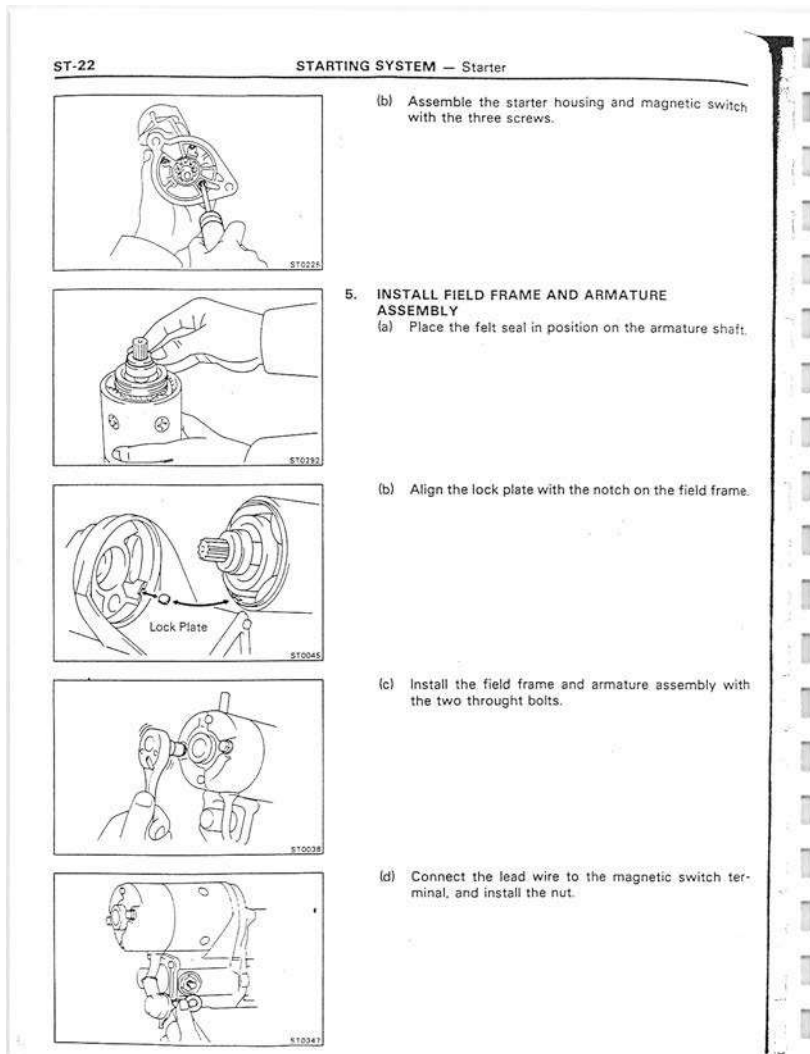
- (a) Apply grease to the steel ball.
- (b) Insert the steel ball into the clutch shaft hole.

**4. INSTALL CLUTCH ASSEMBLY AND GEAR**

- (a) Place the following parts in position on the magnetic switch:

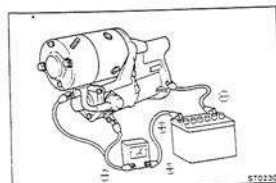
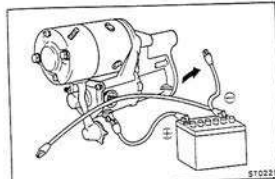
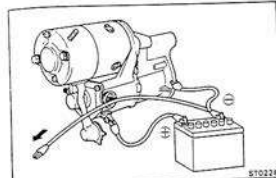
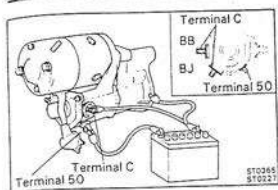
- (1) Plate washer
- (2) Bearing
- (3) Idle gear
- (4) Return spring
- (5) Clutch assembly





STARTING SYSTEM — Starter

ST-23

**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

- Disconnect the field coil lead from terminal C.
- 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 assembly.

2. PERFORM 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 assembly.

3. INSPECT PLUNGER RETURN

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

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

4. PERFORM NO-LOAD PERFORMANCE TEST

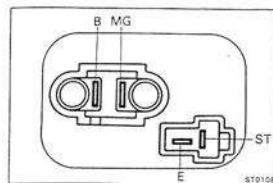
- Connect the battery and ammeter to the starter as shown.
- Check that the starter rotates smoothly and steadily with the pinion gear moving out. Check that the ammeter reads the specified current.

Specified current:

12V Type 180 A or less at 11 V
24V Type 90 A or less at 23 V

ST-24

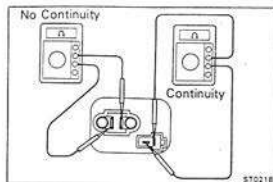
STARTING SYSTEM — Starter Relay [BB, BU and BY]

**STARTER RELAY [BB, BU and BY]****LOCATION:**

BY: Under the instrument panel on the driver's side.

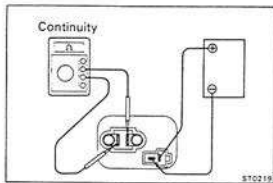
BU: Under the instrument panel center.

BB: Inside wall adjacent to passenger door.

**INSPECTION OF STARTER RELAY****1. INSPECT RELAY CONTINUITY**

- (a) Check that there is continuity between terminals E and ST.
- (b) Check that there is no continuity between terminal B and MG.

If continuity is not as specified, replace the relay.

**2. INSPECT RELAY OPERATION**

- (a) Apply battery voltage across terminals E and ST.
- (b) Check that there is continuity between terminals B and MG.

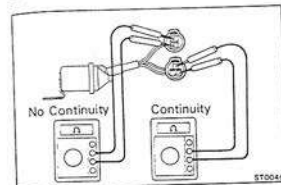
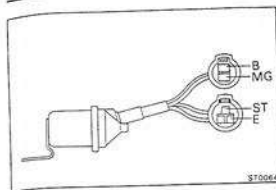
If operation is not as specified, replace the relay.

STARTING SYSTEM -- Starter Relay [BJ]

ST-25

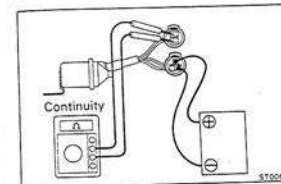
STARTER RELAY [BJ]

LOCATION: On the fender apron in the engine compartment.

**INSPECTION OF STARTER RELAY****1. INSPECT RELAY CONTINUITY**

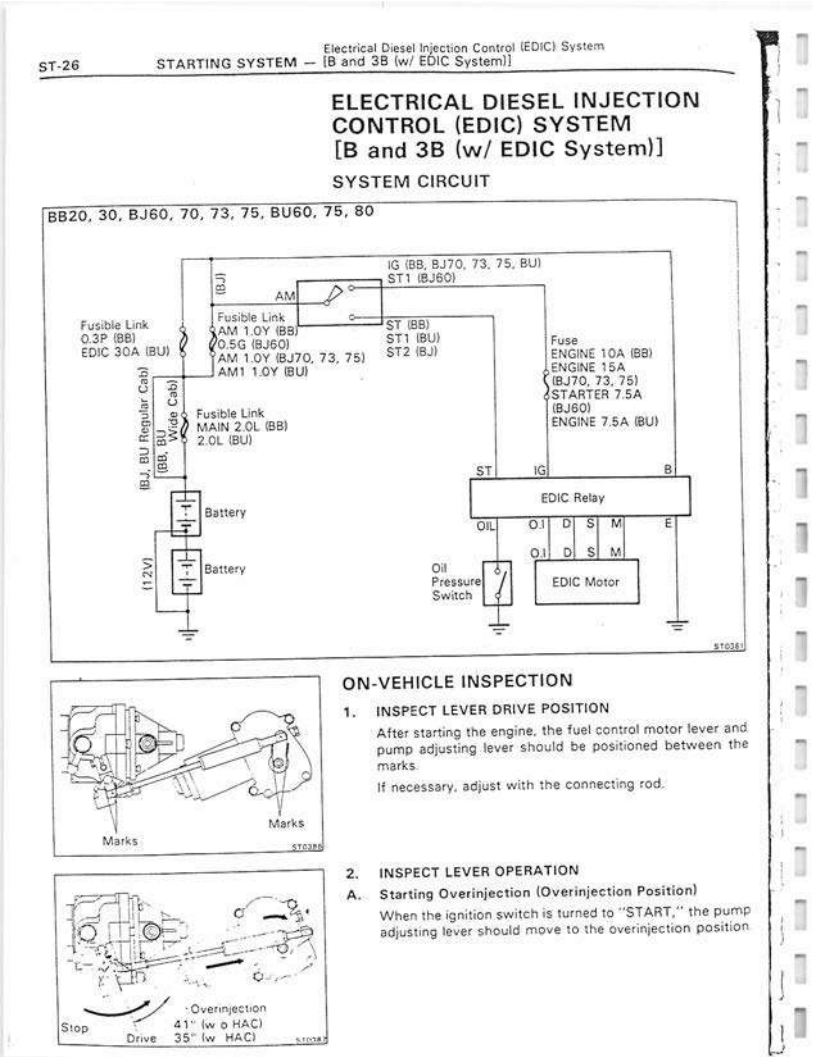
- Check that there is continuity between terminals E and ST.
- Check that there is no continuity between terminal B and MG.

If continuity is not as specified, replace the relay.

**2. INSPECT RELAY OPERATION**

- Apply battery voltage across terminals E and ST.
- Check that there is continuity between terminals B and MG.

If operation is not as specified, replace the relay.



Electrical Diesel Injection Control (EDIC) System
STARTING SYSTEM — (B and 3B (w/ EDIC System))

ST-27

Overinjection
Drive 19.5° (B)
22.5° (3B)

Stop 49° (B)
52° (3B)
Drive

Stop 49° (B)
52° (3B)
Drive

Stop 47°30'
Drive 47°30'
Overinjection

B. After starting (Drive Position)
After starting the engine, the pump adjusting lever should be positioned to the drive position.

C. Engine Stopping Action (Stop Position)
When the ignition switch is turned to "OFF," the pump adjusting lever should move to the stop position and the engine should stop.

D. Reverse Rotation Prevention
Start the engine, and ground the oil pressure switch connector. Then the pump adjusting lever should move to the stop position and the engine should stop.

INSPECTION OF COMPONENTS

EDIC Motor

INSPECT EDIC MOTOR

Check the continuity between the terminals and body ground.

Lever Position	Terminal	S	D	O.I	Body
Overinjection position		○	○	○	○
Drive position		○	○	○	○
Stop position		○	○	○	○

If continuity is not as specified, replace the motor.

Oil Pressure Switch

INSPECT OIL PRESSURE SWITCH

Check the continuity between the terminal and body ground.

(a) Check that there is continuity with the engine stopped.

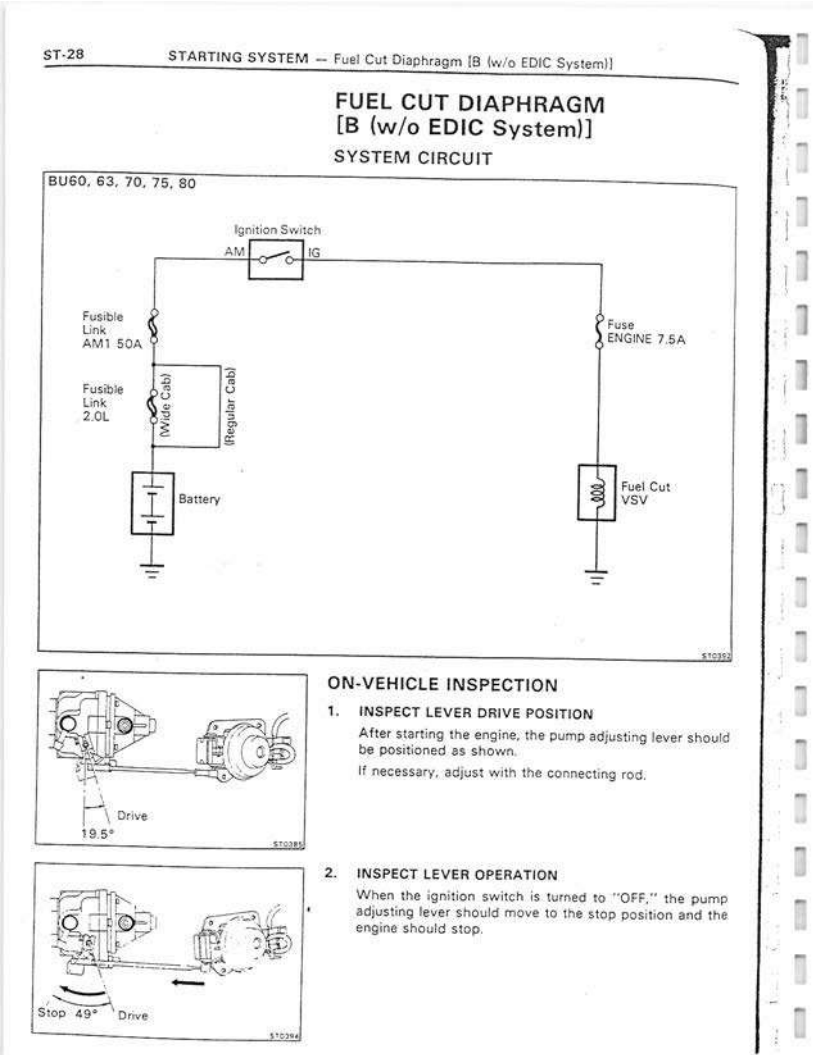
(b) Check that there is no continuity with the engine running.

NOTE: After the engine has started, oil pressure should rise over 0.2 kg/cm² (2.8 psi, 20 kPa).

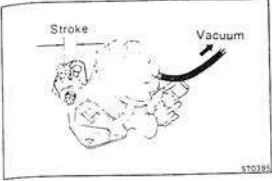
If operation is not correct, replace the switch.

<https://cardiagn.com/starting-system-b-engine/>

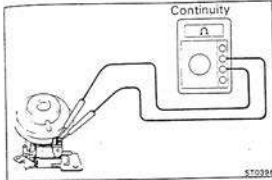
27/30



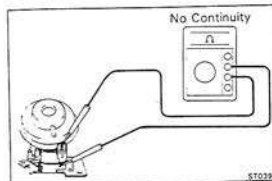
STARTING SYSTEM — Fuel Cut Diaphragm [B (w/o EDIC System)] **ST-29**



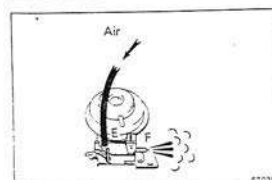
ST0295



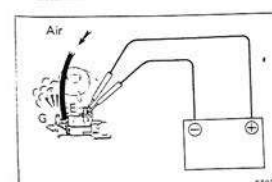
ST0296



ST0297



ST0298



ST0299

INSPECTION OF FUEL CUT DIAPHRAGM

INSPECT FUEL CUT DIAPHRAGM

A. Inspect lever stroke
 (a) Apply 400 mmHg (15.75 in.Hg, 53.3 kPa) of vacuum to the diaphragm, and measure the lever stroke.
Lever stroke: 12.5 – 14.5 mm (0.492 – 0.571 in.)
 If the stroke is not within specification, replace the diaphragm assembly.
 (b) Check that vacuum does not drop immediately.

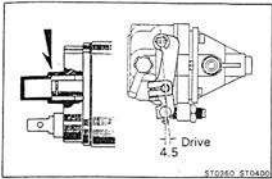
B. Inspect vacuum switching valve (VSV) for open circuit
 Using an ohmmeter, check that there is continuity between the terminals.
Resistance: 38 – 44 Ω at 20°C (68°F)
 If there is no continuity, replace the diaphragm assembly.

C. Inspect vacuum switching valve (VSV) for ground
 Using an ohmmeter, check that there is no continuity between each terminal and the VSV body.
 If there is continuity, replace the diaphragm assembly.

D. Inspect vacuum switching valve (VSV) operation
 (a) Check that air flows from pipe E to pipe F.
 (b) Apply battery voltage across the terminals.
 (c) Check that air flows from pipe E to pipe G.
 If operation is not as specified, replace the diaphragm assembly.

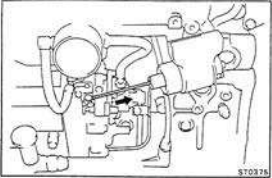
ST-30

STARTING SYSTEM — Overinjection Magnet [3B (w/o EDIC System)]

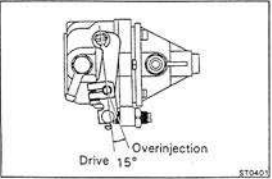


Drive 4.5°

ST0360 ST0400



ST0376



Drive 15° Overinjection

ST0400

OVERINJECTION MAGNET
[3B (w/o EDIC System)]

ON-VEHICLE INSPECTION

1. INSPECT LEVER DRIVE POSITION

After starting the engine, the pump adjusting lever should be positioned as shown.
If necessary, adjust with the connecting wire.

2. INSPECT LEVER OPERATION

When the ignition switch is turned to "START," the pump adjusting lever should move to the overinjection position.