TOYOTA
3S-GE, 3S-GTE, 5S-FE
ENGINE REPAIR MANUAL

INTRODUCTION IN
ENGINE MECHANICAL EM
TURBOCHARGER SYSTEM TC
EFI SYSTEM FI
COOLING SYSTEM CO
LUBRICATION SYSTEM LU
IGNITION SYSTEM IG
STARTING SYSTEM ST
CHARGING SYSTEM CH
SERVICE SPECIFICATIONS A
STANDARD BOLT TORQUE SPECIFICATIONS B
SST AND SSM C

HOW TO USE THIS MANUAL

To assist you in finding your way through this manual, the Section Title and major heading are given at the top of every page.

An **INDEX** is provided on the 1st page of each section to guide you to the item to be repaired.

At the beginning of each section, **PRECAUTIONS** are given that pertain to all repair operations contained in that section.

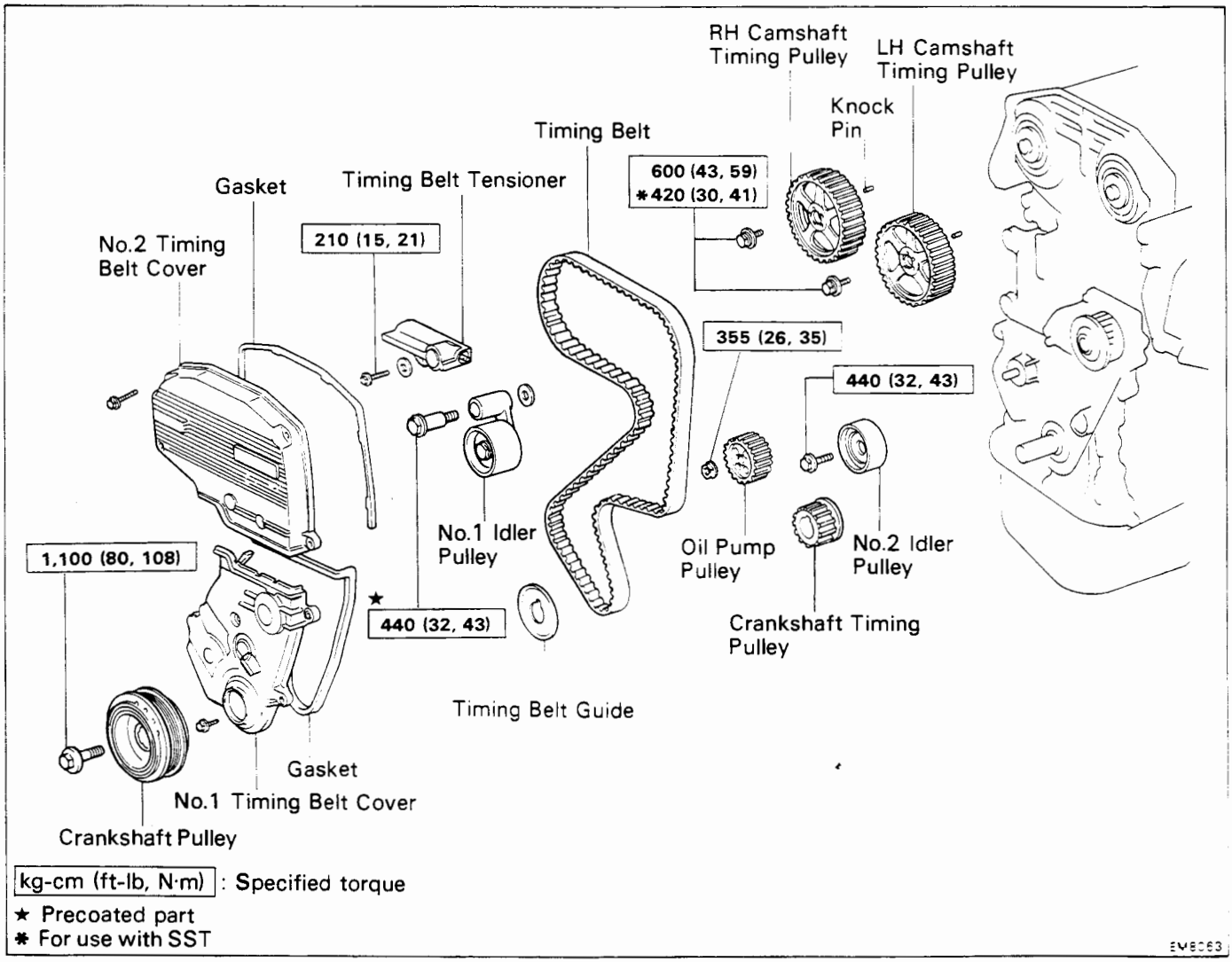
Read these precautions before starting any repair task.

TROUBLESHOOTING tables are included for each system to help you diagnose the system problem and find the cause. The repair for each possible cause is referenced in the remedy column to quickly lead you to the solution.

REPAIR PROCEDURES

Most repair operations begin with an overview illustration. It identifies the components and shows how the parts fit together.

Example:



ENGINE TUNE-UP

INSPECTION OF ENGINE COOLANT

(See steps 1 and 2 on page CO-6)

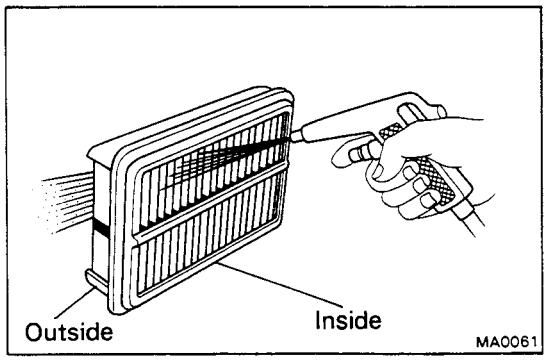
INSPECTION OF ENGINE OIL

(See steps 1 and 2 on page LU-6)

INSPECTION OF BATTERY

(See steps 1 and 2 on page CH-3)

Standard specific gravity:
1.25 — 1.27 when fully charged at 20°C (68°F)



INSPECTION OF AIR FILTER

1. INSPECT AIR FILTER

Visually check that the element is not excessively dirty, damage or oily.

2. CLEAN AIR FILTER

Clean the element with compressed air.

First blow air from the inside thoroughly. Then blow off the outside of the element.

INSPECTION OF HIGH-TENSION CORDS

(See page IG-6)

Maximum resistance: 25 kΩ per cord

INSPECTION AND ADJUSTMENT OF SPARK PLUGS (Conventional Type only)

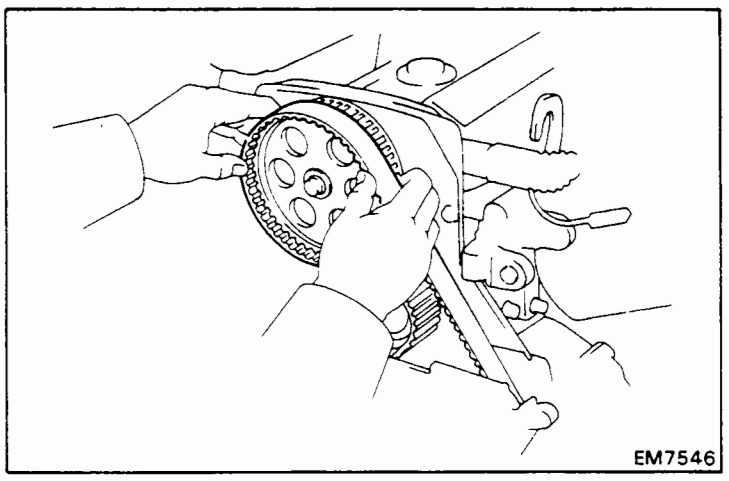
(See page IG-7)

5S-FE

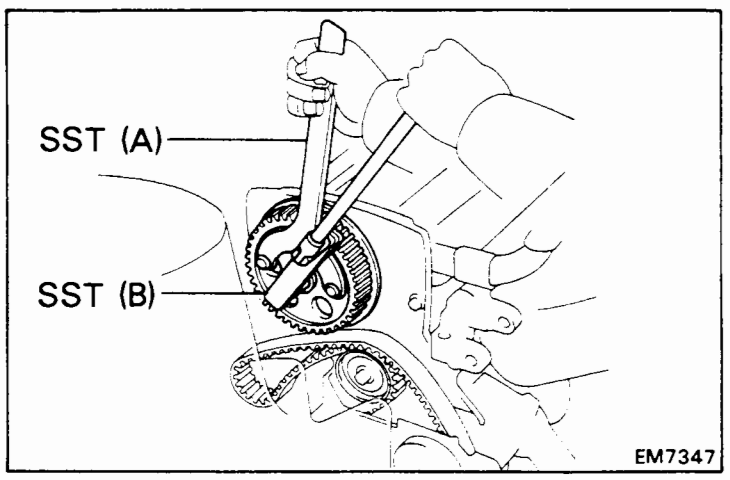
Correct electrode gap:	1.1 mm (0.043 in.)	
Recommended spark plugs:	ND	K16R-U11
	NGK	BKR5EYA11

3S-GE

Correct eletrode gap:		
Recommended spark plugs:	ND	K20R-U
	NGK	BKR6EYA



(b) Remove the timing belt from the camshaft timing pulley.



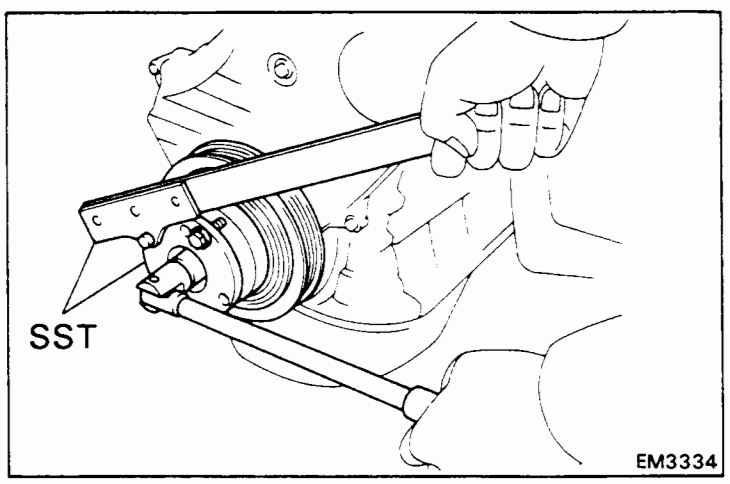
8. REMOVE CAMSHAFT TIMING PULLEY

Using SST, remove the bolt, plate washer and timing pulley.

SST 09278-54012 (A)

HINT (On vehicle): Use SST.

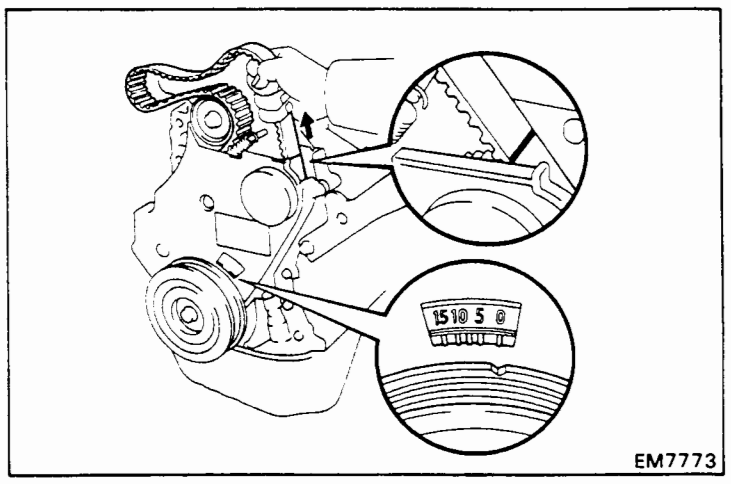
SST 09249-63010 (B)



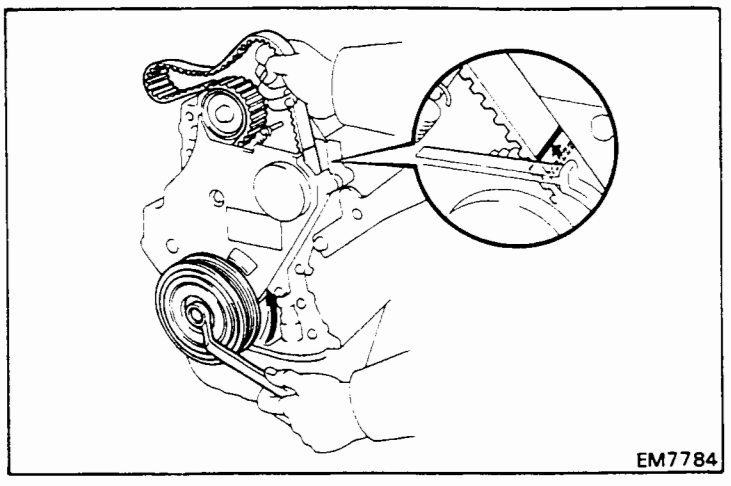
9. REMOVE CRANKSHAFT PULLEY

(a) Using SST, remove the pulley bolt.

SST 09213-54015 (09214-00030) and 09330-00021

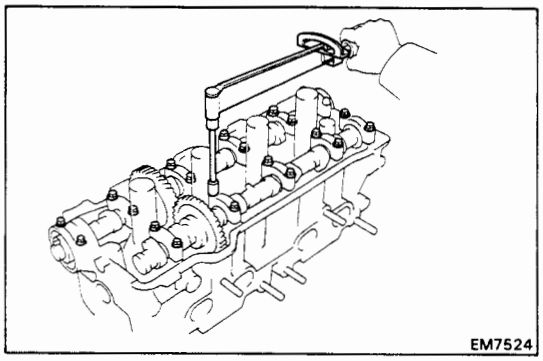


HINT (When re-using timing belt): After loosening the crankshaft pulley bolt, check that the timing belt matchmark aligns with the end of the No.1 timing belt cover when the crankshaft pulley groove is aligned with the timing mark "0" of the No.1 timing belt cover. If the matchmark does not align, align as follows:



(When matchmark is out of alignment clockwise)

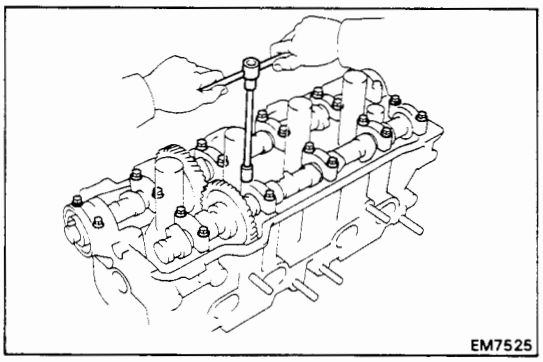
- Align the matchmark by pulling the timing belt up on the water pump pulley side while turning the crankshaft pulley counterclockwise.



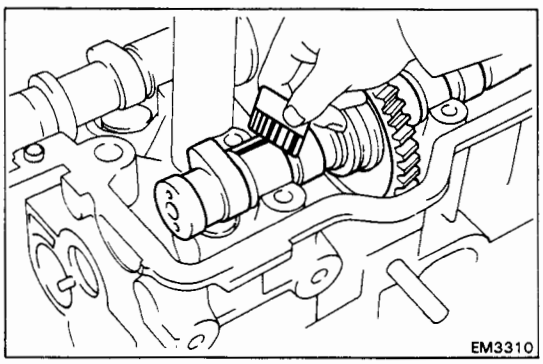
(d) Install the bearing caps.
(See step 4 on pages EM-89 to 91)

Torque: 190 kg-cm (14 ft-lb, 19 N·m)

NOTICE: Do not turn the camshaft.



(e) Remove the bearing caps.



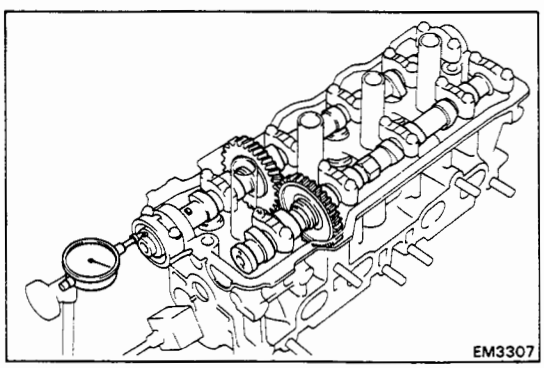
(f) Measure the Plastigage at its widest point.

Standard oil clearance: 0.025 — 0.062 mm (0.0010 — 0.0024 in.)

Maximum oil clearance: 0.10 mm (0.0039 in.)

If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

(g) Completely remove the Plastigage.



G. Inspect camshaft thrust clearance

(a) Install the camshafts.
(See step 4 on pages EM-89 to 91)

(b) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

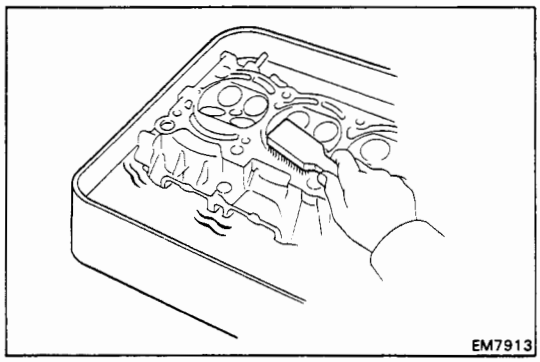
Standard thrust clearance:

Intake	**0.045 — 0.100 mm (0.0018 — 0.0039 in.)**
Exhaust	**0.030 — 0.085 mm (0.0012 — 0.0033 in.)**

Maximum thrust clearance:

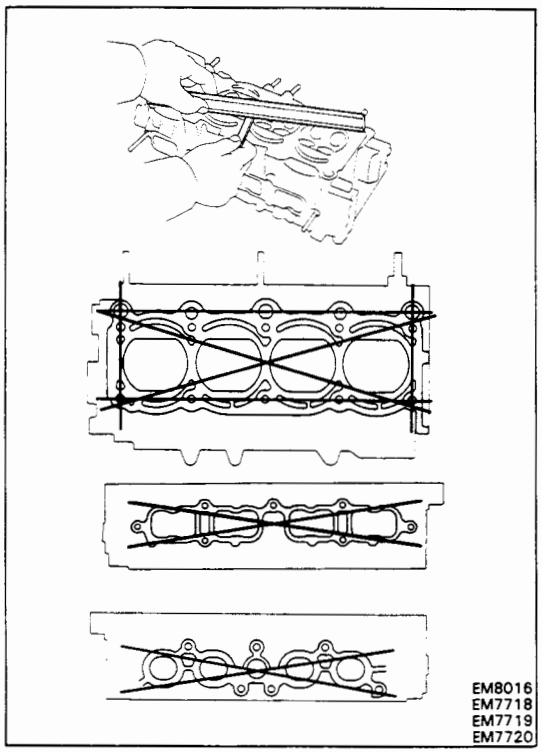
Intake	**0.12 mm (0.0047 in.)**
Exhaust	**0.10 mm (0.0039 in.)**

If the thrust clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.



D. Clean cylinder head

Using a soft brush and solvent, thoroughly clean the cylinder head.



3. INSPECT CYLINDER HEAD

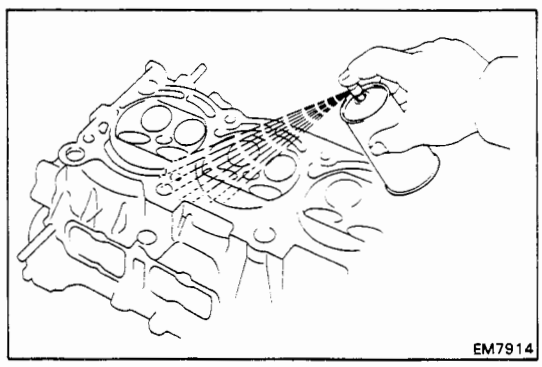
A. Inspect for flatness

Using precision straight edge and feeler gauge, measure the surfaces contacting the cylinder block, manifolds and T-VIS valve (3S-GTE) for warpage.

Maximum warpage:

Cylinder block side	**0.20 mm (0.0079 in.)**
Intake manifold side	**0.20 mm (0.0079 in.)**
Exhaust manifold side	**0.30 mm (0.0118 in.)**

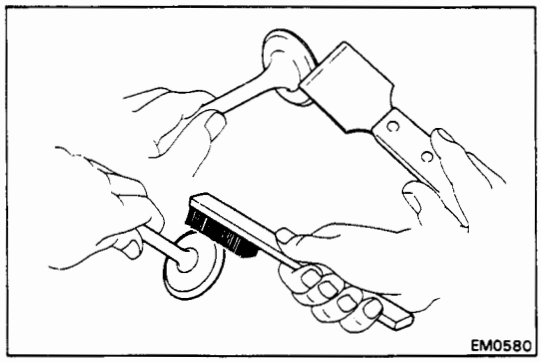
If warpage is greater than maximum, replace the cylinder head.



B. Inspect for cracks

Using a dye penetrant, check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks.

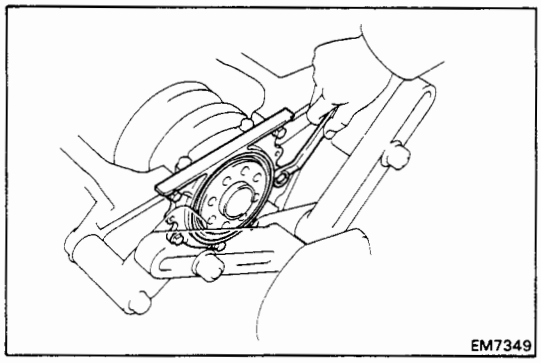
If cracked, replace the cylinder head.



4. CLEAN VALVES

(a) Using a gasket scraper, chip off any carbon from the valve head.

(b) Using a wire brush, thoroughly clean the valve.

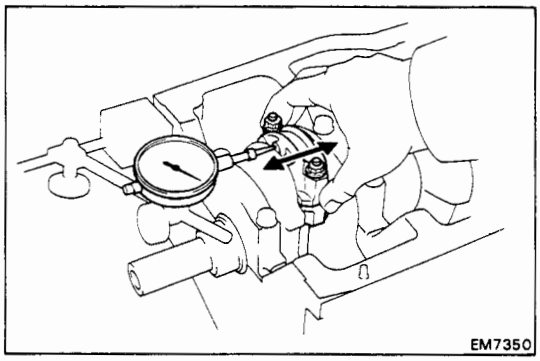


DISASSEMBLY OF CYLINDER BLOCK

(See page EM-148)

1. REMOVE REAR OIL SEAL RETAINER

Remove the six bolts, retainer and gasket.



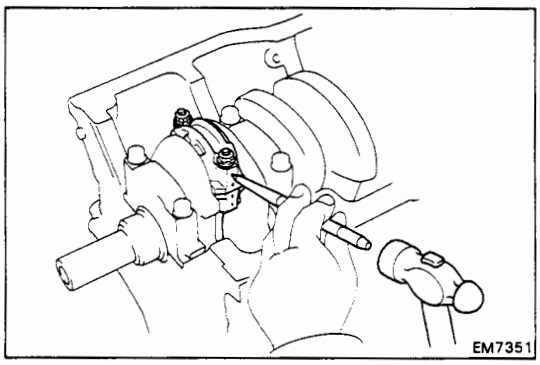
2. CHECK CONNECTING ROD THRUST CLEARANCE

Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

Standard thrust clearance: **0.160 – 0.312 mm (0.0063 – 0.0123 in.)**

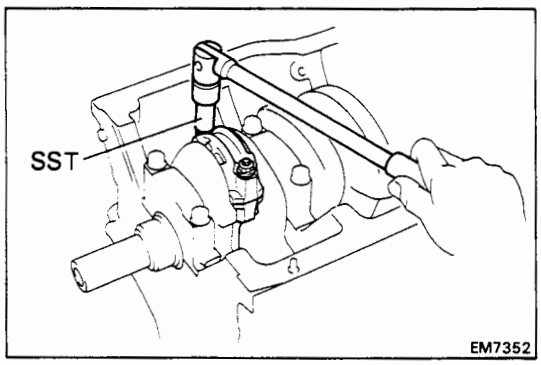
Maximum thrust clearance: **0.35 mm (0.0138 in.)**

If the thrust clearance is greater than maximum, replace the connecting rod assembly. If necessary, replace the crankshaft.



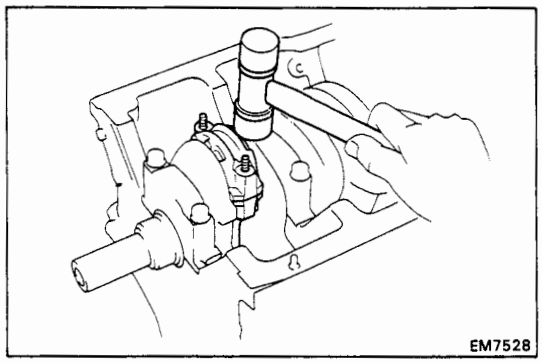
3. REMOVE CONNECTING ROD CAPS AND CHECK OIL CLEARANCE

(a) Using a punch or numbering stamp, place the matchmarks on the connecting rod and cap to ensure correct reassembly.



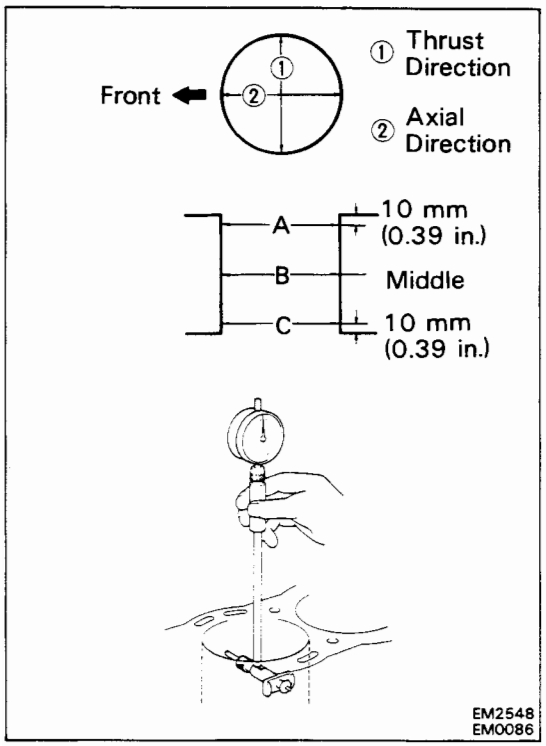
(b) Using SST, remove the connecting rod cap nuts.

SST 09011-38121



(c) Using a plastic-faced hammer, lightly tap the connecting rod bolts and lift off the connecting rod cap.

HINT: Keep the lower bearing inserted with the connecting cap.



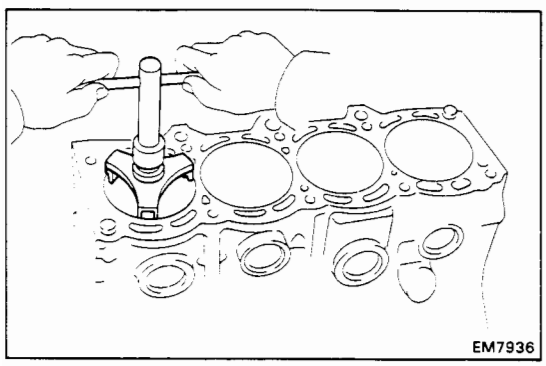
Using a cylinder gauge, measure the cylinder bore diameter at positions A, B and C in the thrust axial directions.

Standard diameter:

Mark "1"	**86.000 – 86.010 mm (3.3858 – 3.3862 in.)**
Mark "2"	**86.010 – 86.020 mm (3.3862 – 3.3866 in.)**
Mark "3"	**86.020 – 86.030 mm (3.3866 – 3.3870 in.)**

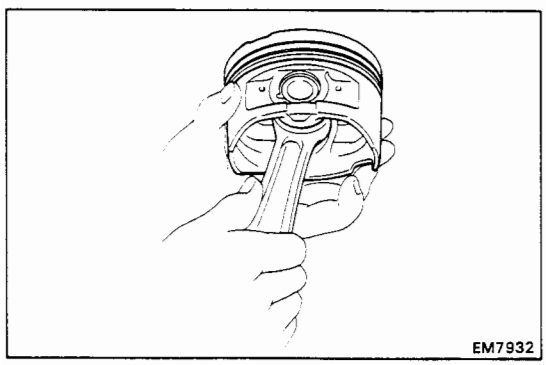
Maximum diameter: 86.23 mm (3.3949 in.)

If the diameter is greater than maximum, replace the cylinder block.



5. REMOVE CYLINDER RIDGE

If the wear is less than 0.2 mm (0.008 in.), using a ridge reamer, grind the top of the cylinder.

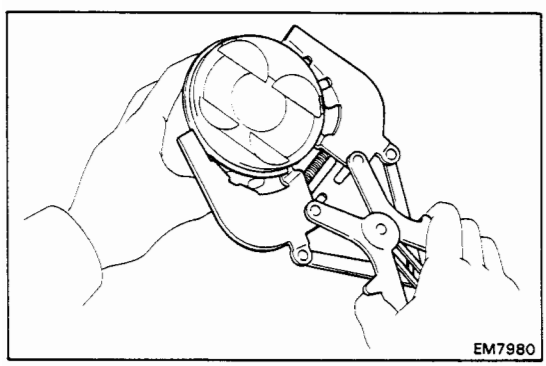


DISASSEMBLY OF PISTON AND CONNECTING ROD ASSEMBLIES

1. CHECK FIT BETWEEN PISTON AND PISTON PIN

Try to move the piston back and forth on the piston pin.

If any movement is felt, replace the piston and pin as a set.

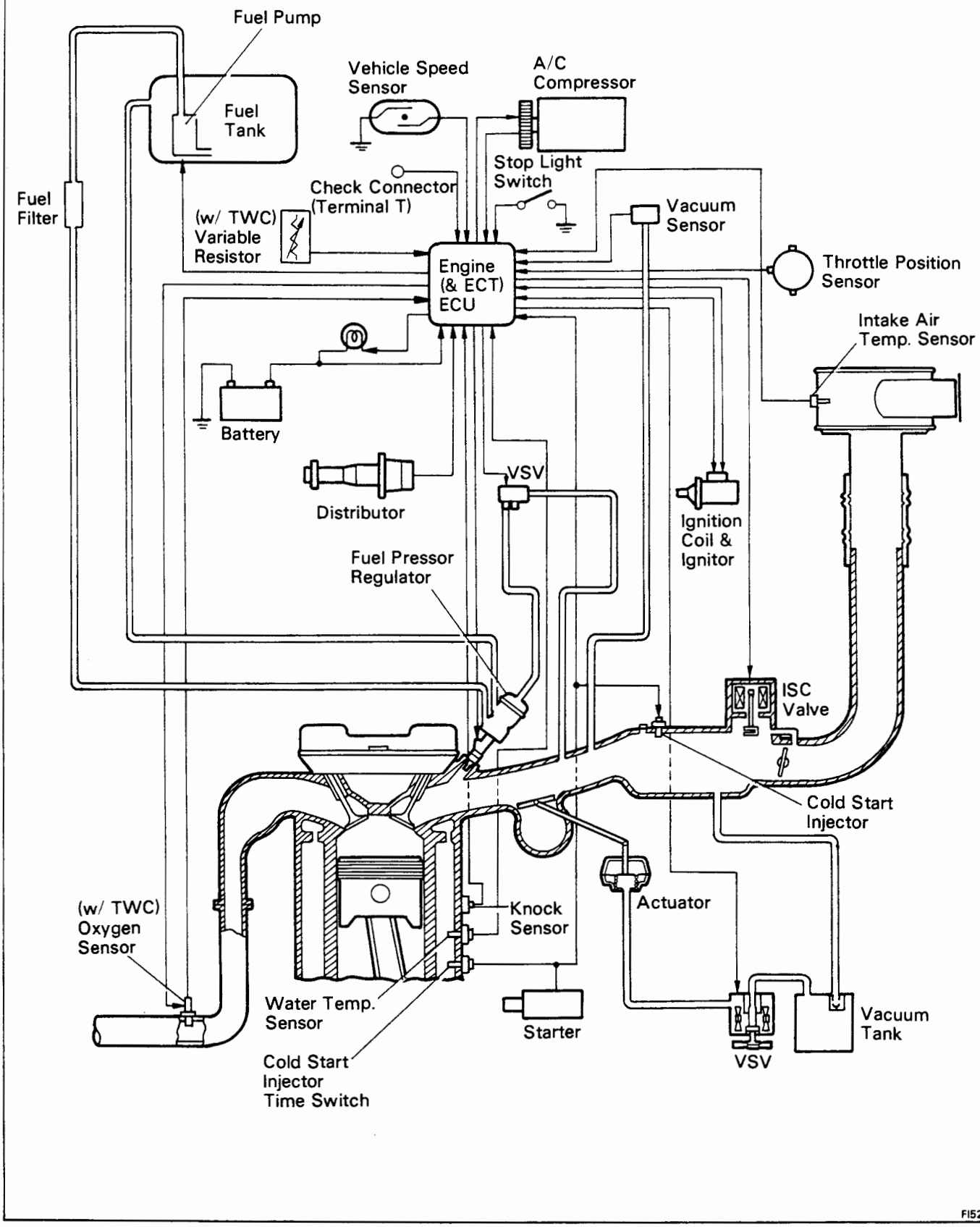


2. REMOVE PISTON RINGS

(a) Using a piston ring expander, remove the two compression rings.

SYSTEM DESCRIPTION (Cont'd)

3S-GE



SYMPTOM — ENGINE HESITATES AND/OR POOR ACCELERATION

CHECK CLUTCH OR BRAKES → BAD → 1. Clutch – Slips; 2. Brakes – Drag

OK

CHECK FOR VACUUM LEAKS IN AIR INTAKE LINE → BAD → 1. Oil filler cap; 2. Oil dipstick; 3. Hose connection(s); 4. PCV hose(s); 5. EGR system – EGR valve stays open

OK

CHECK AIR FILTER → BAD → Element – Clean or replace

OK

CHECK DIAGNOSIS SYSTEM
Check for output of diagnosis code.
(See page FI-28)
→ Malfunction code(s) → Diagnostic code(s) (See page FI-31, 33 or 35)

Normal code

CHECK IGNITION SPARK
(See page IG-5)
→ BAD → 1. High-tension cords; 2. Distributor; 3. Ignition coil; 4. Igniter

OK

CHECK IGNITION TIMING
1. Connect terminal TE1 and E1 of the check connector.
2. Check ignition timing.
Standard: 10° BTDC @ idle
→ NO → Ignition timing – Adjust (See page EM-22 or 23)

OK

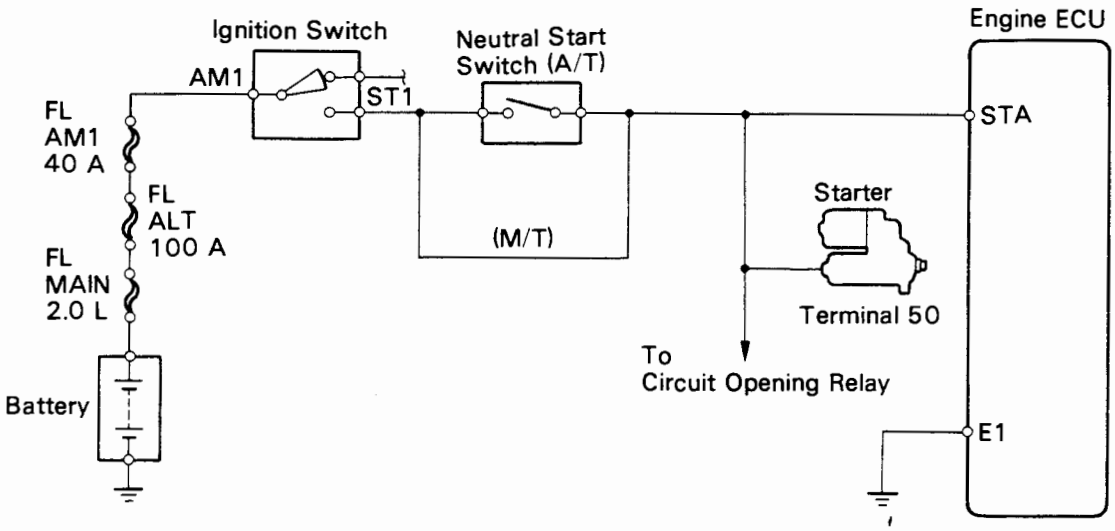
CHECK FUEL PRESSURE
(See page FI-105 or 108)
→ BAD → 1. Fuel pump (See page FI-103); 2. Fuel filter; 3. Fuel pressure regulator (See page FI-127, 129 or 131)

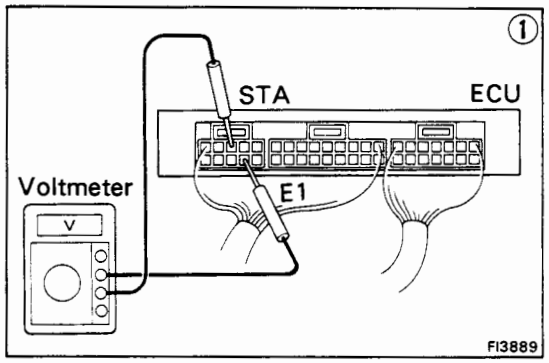
OK

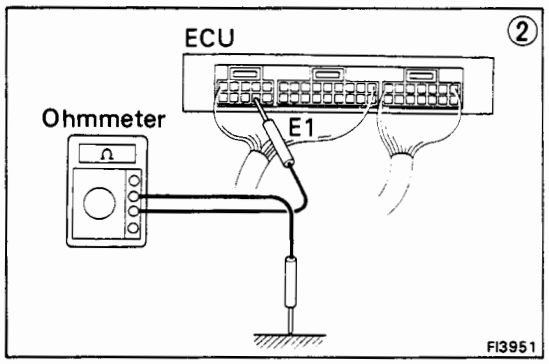
CHECK INJECTORS
(See page FI-134, 141 or 150)
→ BAD → Injector – Clogged

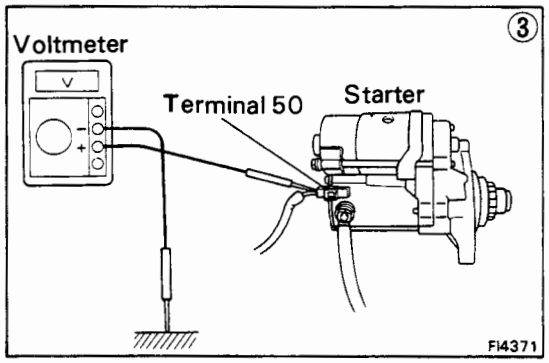
OK CONTINUED TO PAGE FI-27

No.	Terminals	Trouble	Condition	STD Voltage
8	STA – E1	No voltage	Cranking	6 – 14 V









① There is no voltage between ECU terminals STA and E1. **(IG SW START)**

Check starter operation. — OK → Check wiring between ECU terminal STA and ignition switch terminal ST1. — OK → ② Check wiring between ECU terminal E1 and body ground. — OK → Try another ECU. / BAD → Repair or replace.

Check starter operation. — BAD → Repair or replace.

Check wiring between ECU terminal STA and ignition switch terminal ST1. — BAD → Repair or replace.

② Check wiring between ECU terminal E1 and body ground. — BAD → Repair or replace.

Check fusible links, battery, wiring and ignition switch. — BAD → Repair or replace.

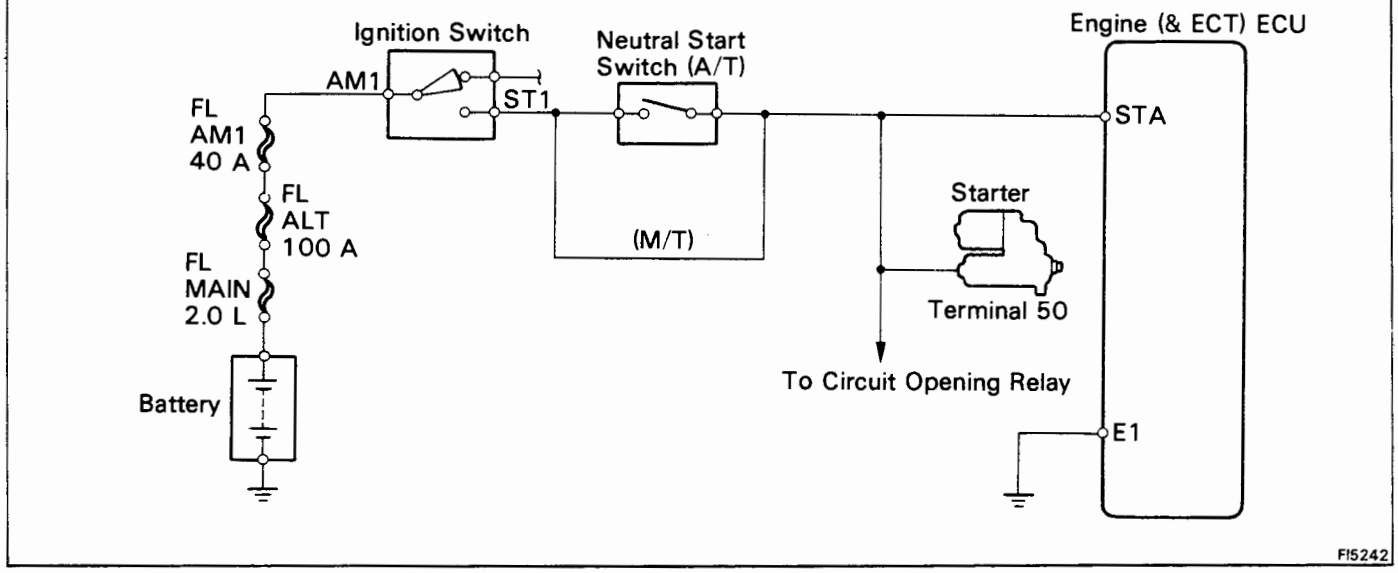
OK

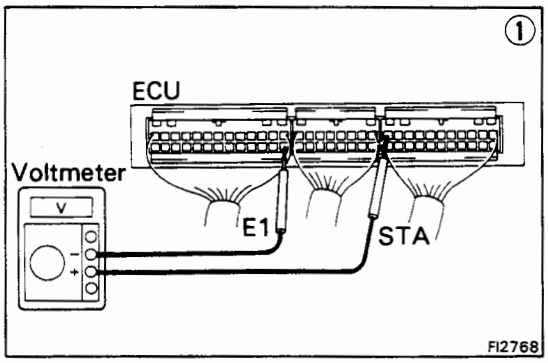
③ Check that there is voltage at terminal 50 of starter. **(IG SW START) STD voltage: 6 – 14 V**

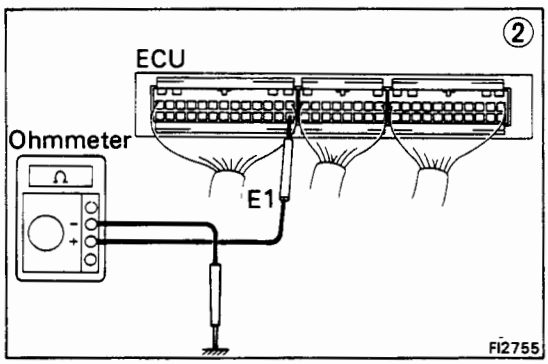
OK → Check starter.

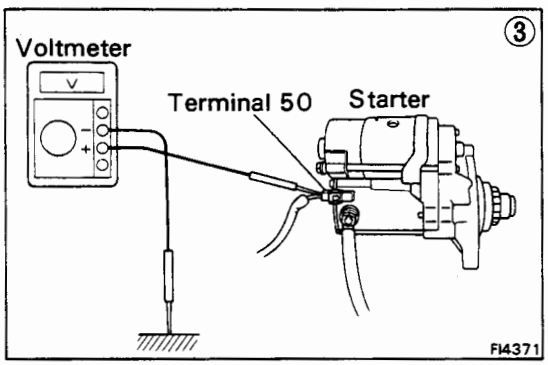
NO → Check wiring between ignition switch terminal ST1 and starter terminal 50.

No.	Terminals	Trouble	Condition	STD voltage
8	STA – E1	No voltage	Cranking	6 – 14 V









① There is no voltage between ECU terminals STA and E1. **(IG SW START)**

Check starter operation. — OK → Check wiring between ECU terminal STA and ignition switch terminal ST1. — BAD → Repair or replace.

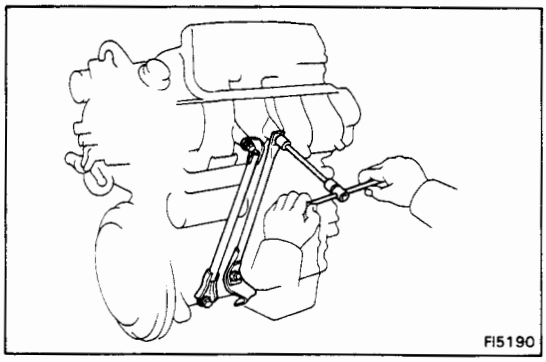
BAD → ② Check wiring between ECU terminal E1 and body ground. — OK → Try another ECU. — BAD → Repair or replace.

Check fusible links, battery, wiring and ignition switch. — BAD → Repair or replace.

OK → ③ Check that there is voltage at terminal 50 of starter. **(IG SW START) STD voltage: 6 – 14 V**

OK → Check starter.

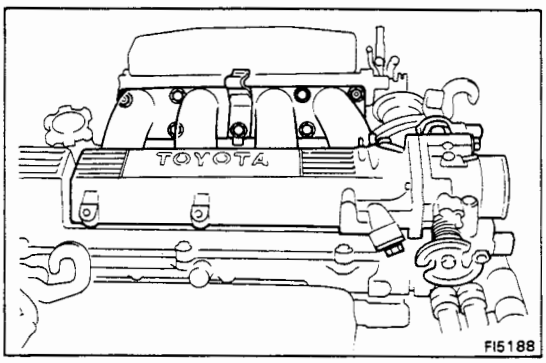
NO → Check wiring between ignition switch terminal ST1 and starter terminal 50.



10. INSTALL INTAKE MANIFOLD STAYS

Install the two intake manifold stays with the two bolts and nuts.

Torque: 400 kg-cm (29 ft-lb, 39 N·m)



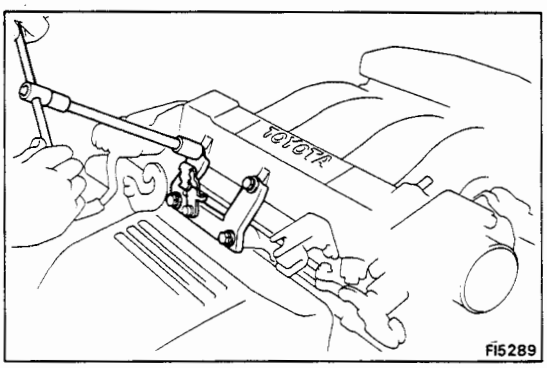
11. INSTALL AIR INTAKE CHAMBER

(a) Install a new gasket, air intake chamber with the five bolts and two nuts.

Torque: 195 kg-cm (14 ft-lb, 19 N·m)

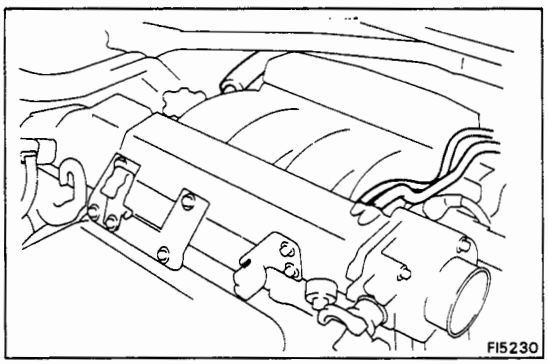
(b) Install and tighten the bolt holding the air intake chamber and intake pipe stay.

Torque: 400 kg-cm (29 ft-lb, 39 N·m)



(c) Install the intake chamber stay with the four bolts.

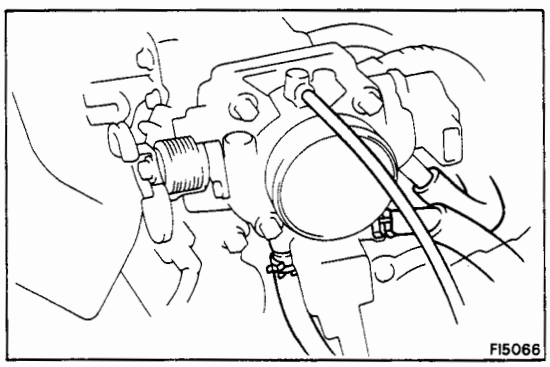
Torque: 195 kg-cm (14 ft-lb, 19 N·m)



12. CONNECT HOSES TO THROTTLE BODY AND AIR INTAKE CHAMBER

(a) Vacuum and air hoses from air pipe

(b) Brake booster hose from by-pass pipe



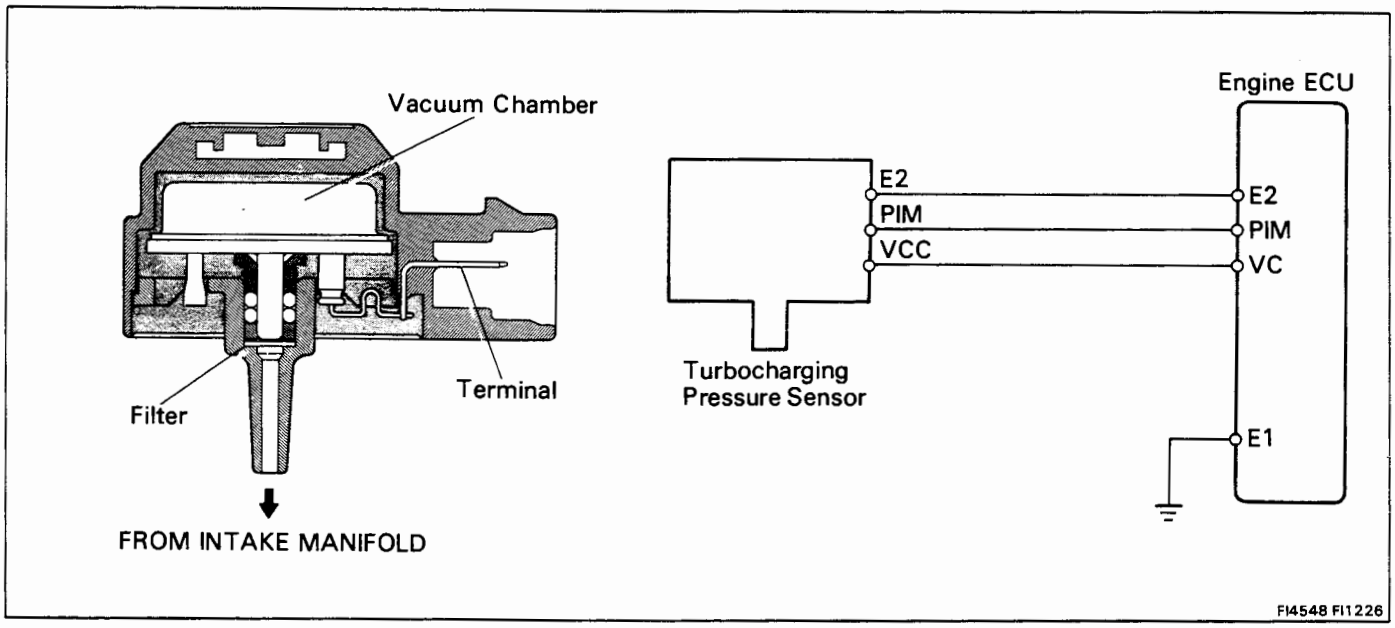
(c) PCV hose

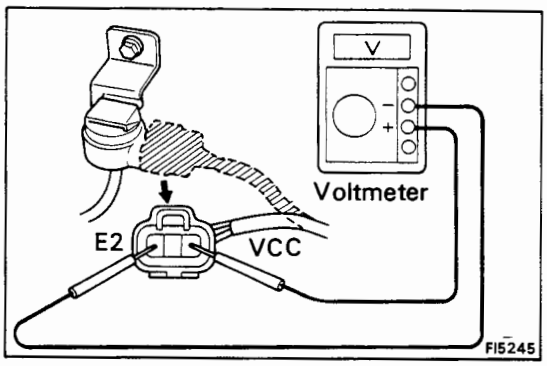
(d) (w/ TWC)
Vacuum hose from EVAP BVSV

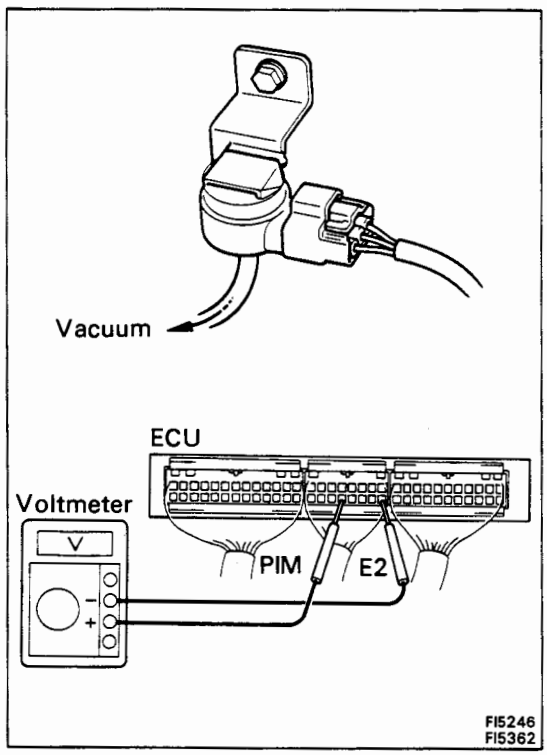
(e) Water by-pass hose from water outlet

(f) Water by-pass hose from water by-pass pipe

Turbocharging Pressure Sensor (3S-GTE only)







INSPECTION OF TURBOCHARGING PRESSURE SENSOR

1. INSPECT POWER SOURCE VOLTAGE OF TURBOCHARGING PRESSURE SENSOR

(a) Disconnect the turbocharging pressure sensor connector.

(b) Turn the ignition switch ON.

(c) Using a voltmeter, measure the voltage between terminals VCC and E2 of the vacuum sensor connector.

Voltage: 4 – 6 V

(d) Reconnect the turbocharging pressure sensor connector.

2. INSPECT POWER OUTPUT OF TURBOCHARGING PRESSURE SENSOR

(a) Turn the ignition switch ON.

(b) Disconnect the vacuum hose of the air intake manifold (chamber) side.

(c) Connect a voltmeter to terminals PIM and E2 of the pressure sensor, and measure and record the output voltage under ambient atmospheric pressure.

(d) Apply vacuum to the pressure sensor in 100 mmHg (3.94 in.Hg, 13.3 kPa) segments to 500 mmHg (19.69 in.Hg, 66.7 kPa).

(e) Measure the voltage drop from step (c) above for each segment.

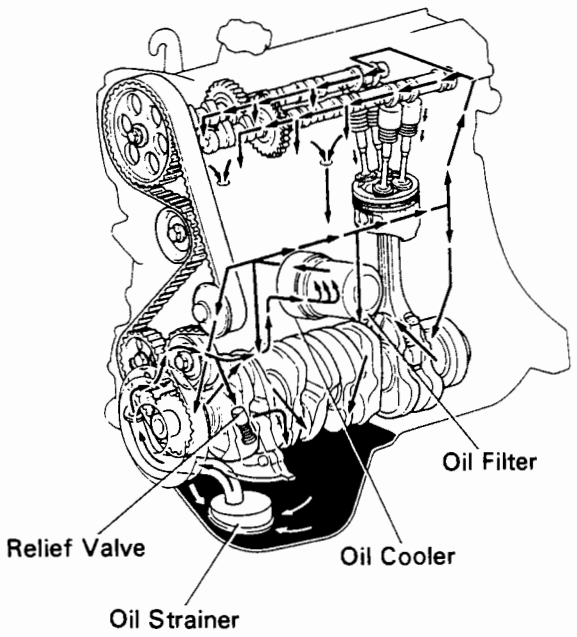
Voltage drop

Applied Vacuum mmHg (in.Hg, kPa)	100 (3.94) (13.3)	200 (7.87) (26.7)	300 (11.81) (40.0)	400 (15.75) (53.3)	500 (19.69) (66.7)
Voltage drop (V)	0.15 – 0.35	0.4 – 0.6	0.65 – 0.85	0.9 – 1.1	1.15 – 1.35

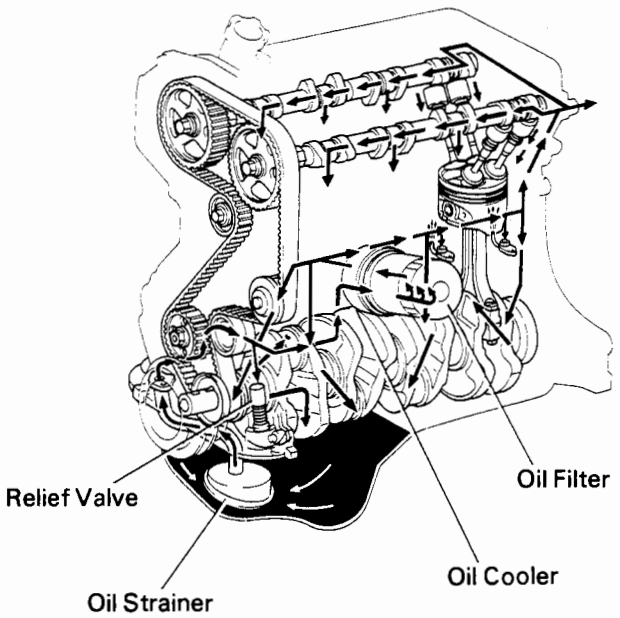
DESCRIPTION

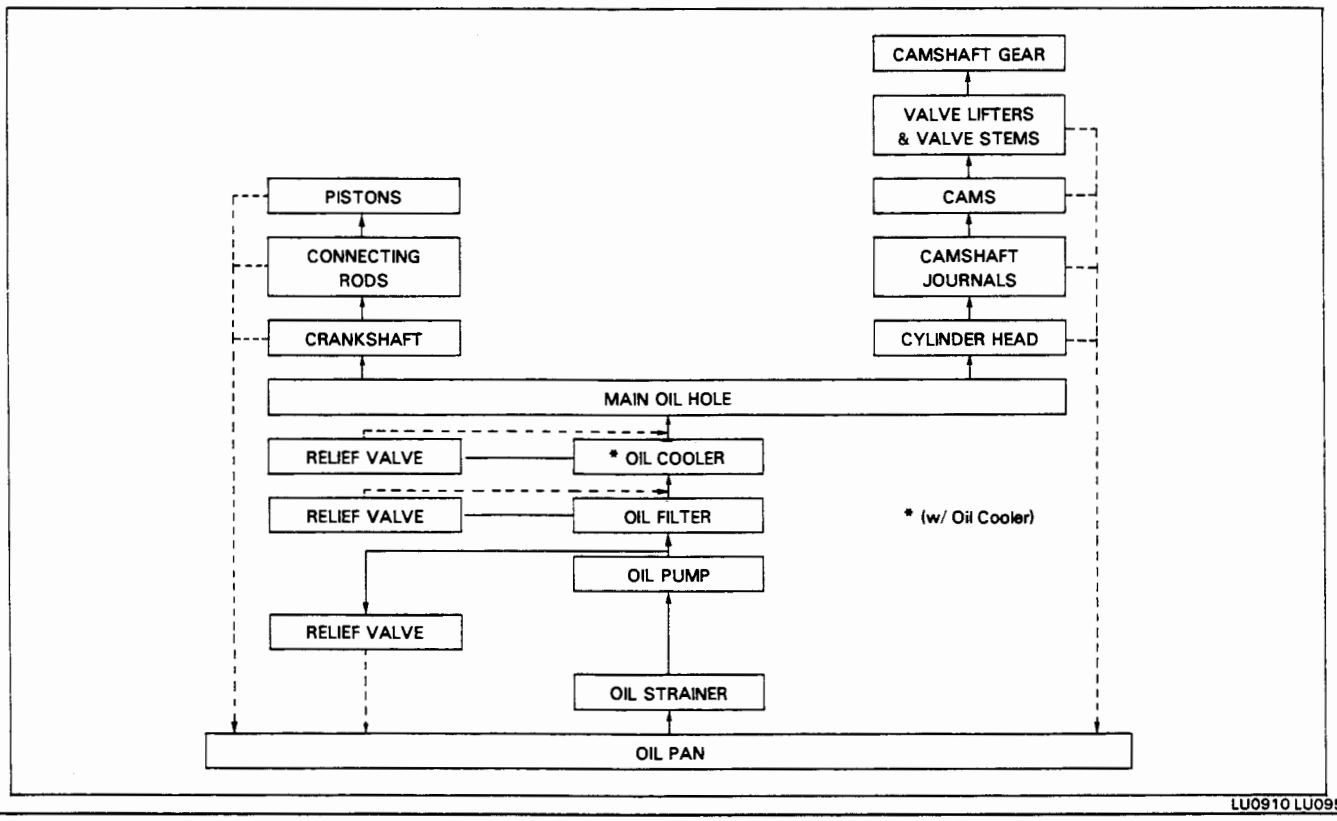
A fully pressurized, fully filtered lubrication system has been adopted for this engine.

5S-FE



3S-GE





LU0910 LU0951