1990 TOYOTA 4RUNNER REPAIR MANUAL VOLUME 1

NOTE: The screen toned sections below are in VOLUME 2 (Pub. No. RM143U2).

INTRODUCTION

HOW TO USE THIS MANUAL

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

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

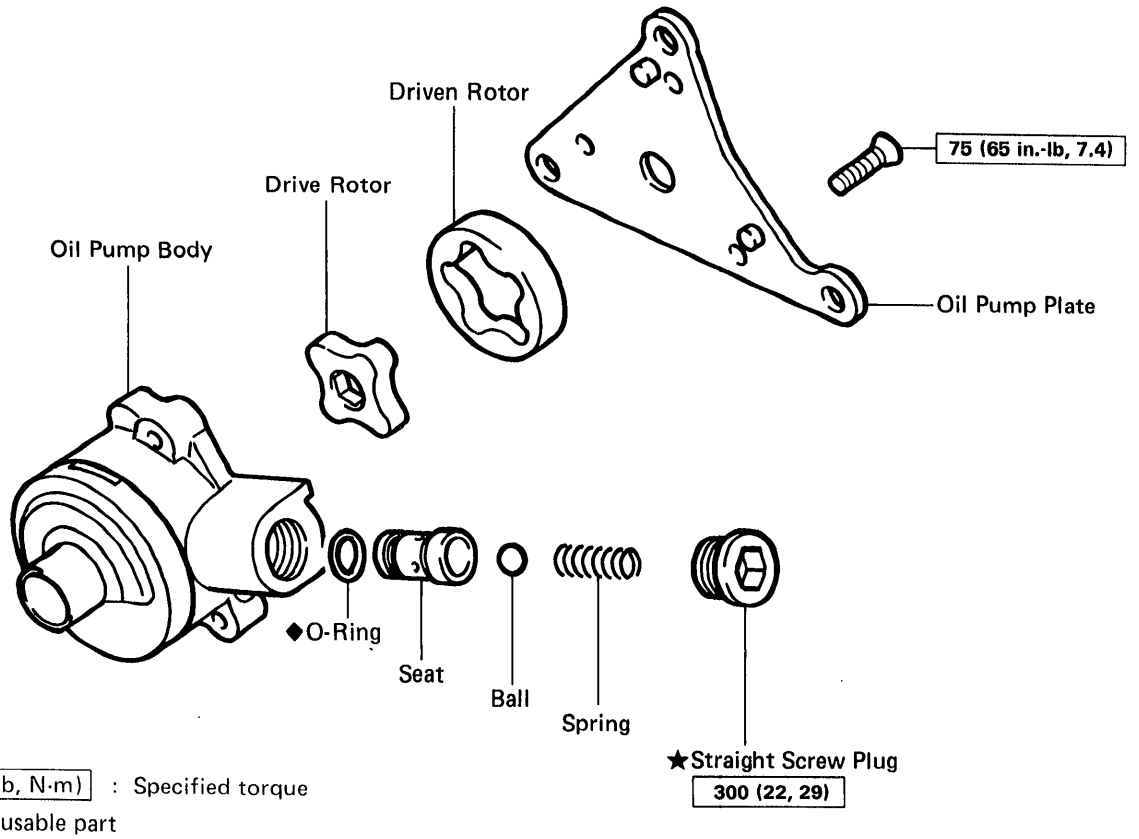
At the beginning of each section, **PRECAUTIONS** are given that pertain to *all* repair operations contained in that section. *Read these precautions before starting any repair task.*

TROUBLESHOOTING tables are included for each system to help you diagnose the 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:



The procedures are presented in a step-by-step format:

- The illustration shows *what* to do and *where* to do it.
- The task heading tells *what* to do.
- The detailed text tells *how* to perform the task and gives other information such as specifications and warnings.

Example:

Task heading: what to do

21. CHECK PISTON STROKE OF OVERDRIVE BRAKE

(a) Place SST and a dial indicator onto the overdrive brake piston as shown in the figure.

SST 09350-30020 (09350-06120)

Set part No. *Component part No.*

Detailed text: how to do task

(b) Measure the stroke applying and releasing the compressed air (4 — 8 kg/cm², 57 — 114 psi or 392 — 785 kPa) as shown in the figure.

Piston stroke: 1.40 — 1.70 mm(0.0551 — 0.0669 in.)

Specification

Illustration:
What to do and where

This format provides the experienced technician with a FAST TRACK to the information needed. The upper case task heading can be read at a glance when necessary, and the text below it provides detailed information. Important specifications and warnings always stand out in bold type.

REFERENCES

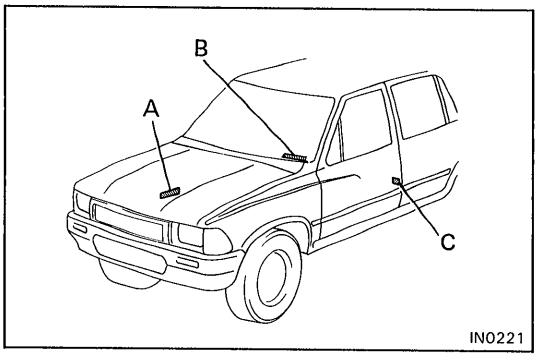
References have been kept to a minimum. However, when they are required you are given the page to refer to.

SPECIFICATIONS

Specifications are presented in bold type throughout the text where needed. You never have to leave the procedure to look up your specifications. They are also found in Appendix A, for quick reference.

CAUTIONS, NOTICES, HINTS:

- CAUTIONS are presented in bold type, and indicate there is a possibility of injury to you or other people.
- NOTICES are also presented in bold type, and indicate the possibility of damage to the components being repaired.
- HINTS are separated from the text but do not appear in bold. They provide additional information to help you efficiently perform the repair.

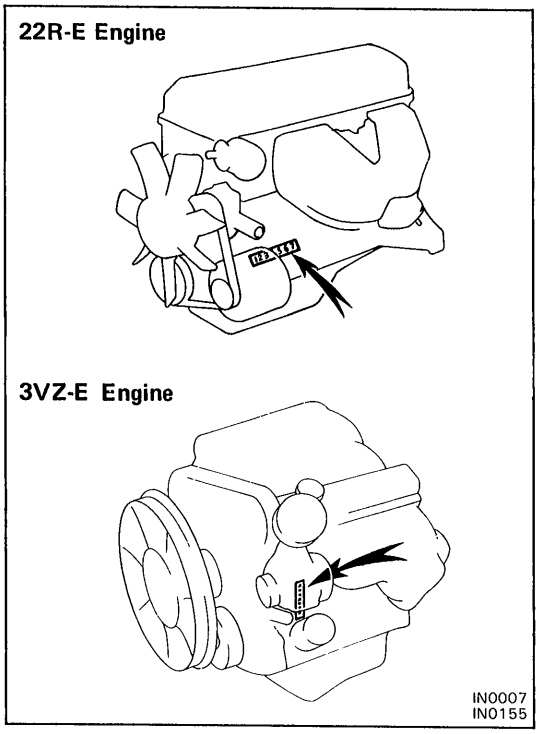


IDENTIFICATION INFORMATION

VEHICLE IDENTIFICATION NUMBER

The vehicle identification number is stamped on the outer surface of the front right side frame. This number is also stamped on the vehicle identification number plate and certification regulation label.

A: Vehicle Identification Number
B: Vehicle Identification Number Plate
C: Certification Regulation Label



ENGINE SERIAL NUMBER

The engine serial number is stamped on the engine block as shown.

GENERAL REPAIR INSTRUCTIONS

1. Use fender seat and floor covers to keep the vehicle clean and prevent damage.
2. During disassembly, keep parts in the appropriate order to facilitate reassembly.
3. Observe the following:
   (a) Before performing electrical work, disconnect the negative cable from the battery terminal.
   (b) If it is necessary to disconnect the battery for inspection or repair, always disconnect the cable from the negative (—) terminal which is grounded to the vehicle body.
   (c) To prevent damage to the battery terminal post, loosen the terminal nut and raise the cable straight up without twisting or prying it.
   (d) Clean the battery terminal posts and cable terminals with a shop rag. Do not scrape them with a file or other abrasive object.

(e) Install the cable terminal to the battery post with the nut loose, and tighten the nut after installation. Do not use a hammer to tap the terminal onto the post.

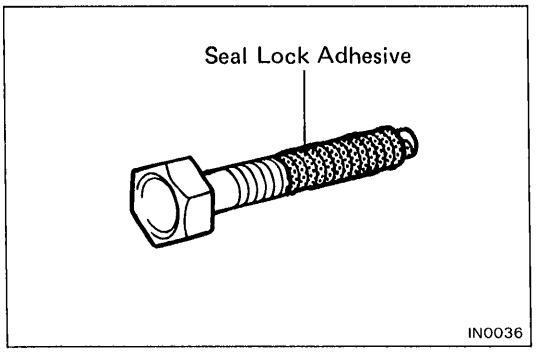
(f) Be sure the cover for the positive (+) terminal is properly in place.

4. Check hose and wiring connectors to make sure that they are secure and correct.

5. Non-reusable parts

(a) Always replace cotter pins, gaskets, O-rings and oil seals etc. with new ones.

(b) Non-reusable parts are indicated in the component illustrations by the "◆" symbol.



6. Precoated parts

Precoated parts are bolts and nuts, etc. that are coated with a seal lock adhesive at the factory.

(a) If a precoated part is retightened, loosened or caused to move in any way, it must be recoated with the specified adhesive.

(b) Recoating of precoated parts

(1) Clean off the old adhesive from the bolt, nut or threads.

(2) Dry with compressed air.

(3) Apply the specified seal lock adhesive to the bolt or nut threads.

(c) Precoated parts are indicated in the component illustrations by the "★" symbol.

7. When necessary, use a sealer on gaskets to prevent leaks.

8. Carefully observe all specifications for bolt tightening torques. Always use a torque wrench.

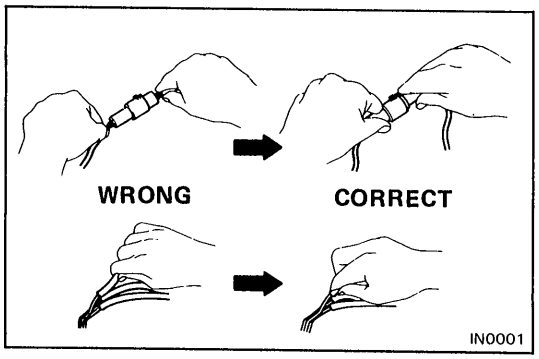
9. Use of special service tools (SST) and special service materials (SSM) may be required, depending on the nature of the repair. Be sure to use SST and SSM where specified and follow the proper work procedure. A list of SST and SSM can be found at the back of this manual.

10. When replacing fuses, be sure the new fuse has the correct amperage rating. DO NOT exceed the rating or use one with a lower rating.

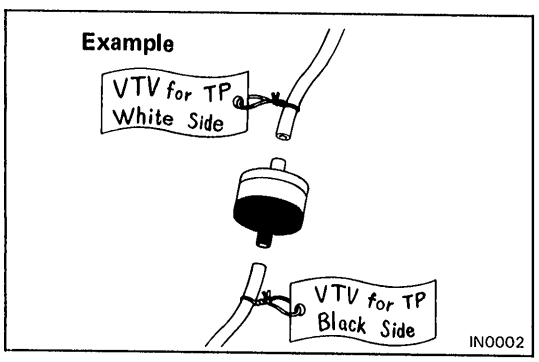
11. Care must be taken when jacking up and supporting the vehicle. Be sure to lift and support the vehicle at the proper locations. (See page IN-8)

(a) If the vehicle is to be jacked up only at the front or rear end, be sure to block the wheels at the opposite end in order to ensure safety.

(b) After the vehicle is jacked up, be sure to support it on stands. It is extremely dangerous to do any work on a vehicle raised on a jack alone, even for a small job that can be finished quickly.



12. Observe the following precautions to avoid damage to the parts:
    (a) **Do not open the cover or case of the ECU unless absolutely necessary. (If the IC terminals are touched, the IC may be destroyed by static electricity.)**
    (b) To disconnect vacuum hoses, pull on the end, not the middle of the hose.
    (c) To pull apart electrical connectors, pull on the connector itself, not the wires.
    (d) Be careful not to drop electrical components, such as sensors or relays. It they are dropped on a hard floor, they should be replaced and not reused.
    (e) When steam cleaning an engine, protect the distributor, coil and air filter from water.
    (f) Never use an impact wrench to remove or install temperature switches or temperature sensors.
    (g) When checking continuity at the wire connector, insert the tester probe carefully to prevent terminals from bending.
    (h) When using a vacuum gauge, never force the hose onto a connector that is too large. Use a step-down adapter instead. Once the hose has been stretched, it may leak.



13. Tag hoses before disconnecting them:
    (a) When disconnecting vacuum hoses, use tags to identify how they should be reconnected.
    (b) After completing a job, double check that the vacuum hoses are properly connected. A label under the hood shows the proper layout.

PRECAUTIONS FOR VEHICLES EQUIPPED WITH A CATALYTIC CONVERTER

CAUTION: If large amounts of unburned gasoline flow into the converter, it may overheat and create a fire hazard. To prevent this, observe the following precautions and explain them to your customer.

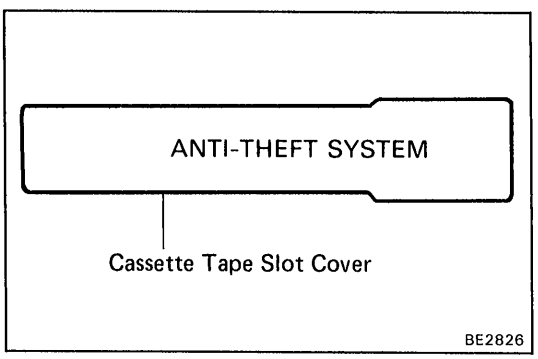
1. **Use only unleaded gasoline.**
2. **Avoid prolonged idling.**

   Avoid running the engine at idle speed for more than 20 minutes.
3. **Avoid spark jump test.**
   (a) Spark jump test only when absolutely necessary. Perform this test as rapidly as possible.
   (b) While testing, never race the engine.
4. **Avoid prolonged engine compression measurement.**

   Engine compression tests must be made as rapidly as possible.
5. **Do not run engine when fuel tank is nearly empty.**

   This may cause the engine to misfire and create an extra load on the converter.
6. **Avoid coasting with ignition turned off and prolonged braking.**
7. **Do not dispose of used catalyst along with parts contaminated with gasoline or oil.**

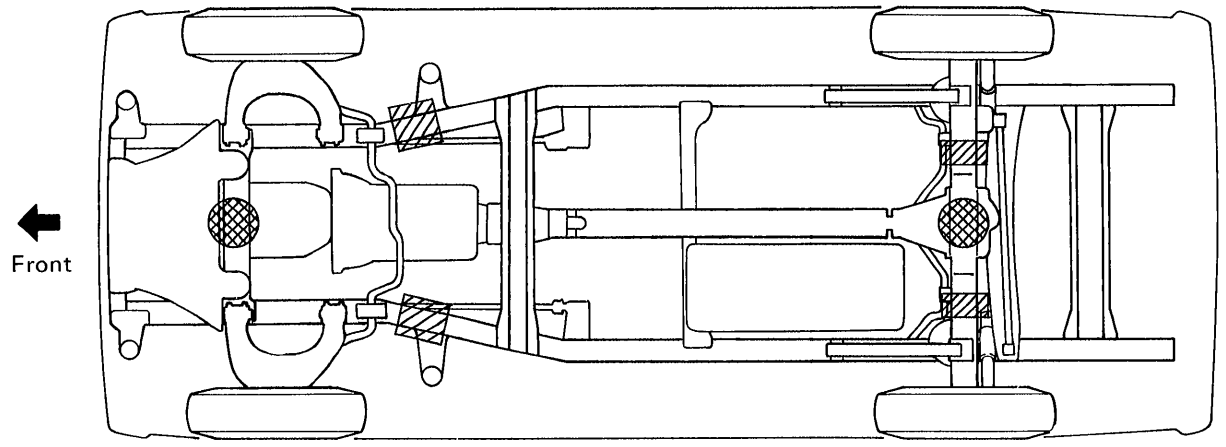
PRECAUTIONS FOR VEHICLES WITH AN AUDIO SYSTEM WITH BUILT-IN ANTI-THEFT SYSTEM



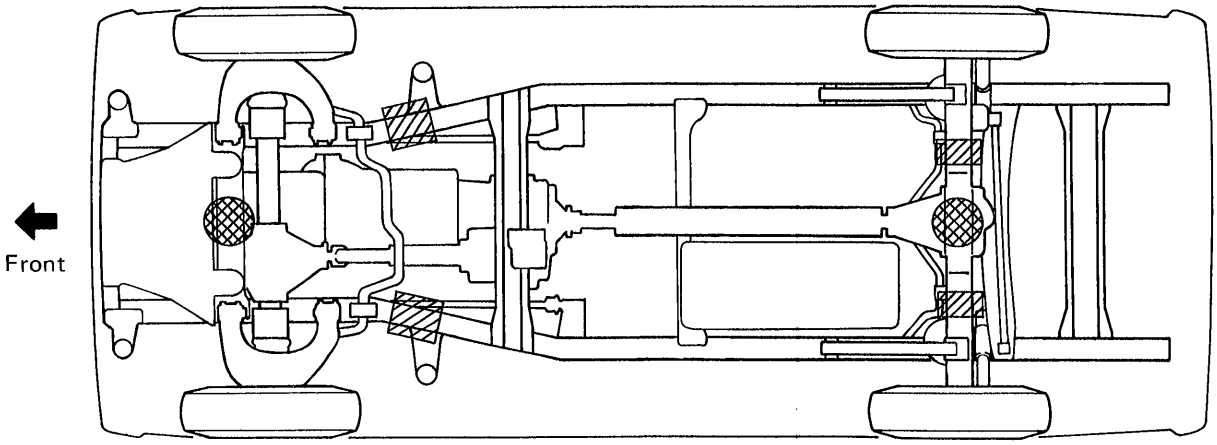
The Audio System with acoustic flavor only for USA specification vehicles shown on the left has a built-in anti-theft system which makes the audio system soundless if stolen.
If the power source for the audio system is cut even once, the anti-theft system operates so that even if the power source is reconnected, the audio system will not produce any sound unless the ID number selected by the customer is input again. Accordingly, when performing repairs on vehicles equipped with this system, before disconnecting the battery terminals or removing the audio system the customer should be asked for the ID number so that the technician can input the ID number afterwards, or else a request made to the customer to input the ID number. For the method to input the ID number or cancel the anti-theft system, refer to the Owner's Manual.

VEHICLE LIFT AND SUPPORT LOCATIONS

[2WD]



[4WD]



JACK POSITION .....

Front ..... Center of crossmember
Rear ..... Center of rear axle housing

SUPPORT POSITION

Safety stand .....

IN0222
IN0223

ABBREVIATIONS USED IN THIS MANUAL

A/C	Air Conditioner
A.D.D.	Automatic Disconnecting Differential
APPROX.	Approximate
AS	Air Suction
A/T, ATM	Automatic Transmission
ATF	Automatic Transmission Fluid
B_0	Overdrive Brake
B_1	Second Coast Brake, No. 1 Brake
B_2	Second Brake, No. 2 Brake
B_3	First and Reverse Brake, No. 3 Brake
B_4	Transfer Low Speed Brake
BTDC	Before Top Dead Center
BVSV	Bimetal Vacuum Switching Valve
C_0	Overdrive Direct Clutch
C_1	Forward Clutch, Front Clutch
C_2	Direct Clutch, Rear Clutch
C_3	Transfer Direct Clutch
C_4	Transfer Front Drive Clutch
CB	Circuit Breaker
CC	Cruise Control
DP	Dash Pot
ECT	Electronic Controlled Transmission
ECU	Electronic Controlled Unit
EFI	Electronic Fuel Injection
E/G	Engine
EGR	Exhaust Gas Recirculation
ELR	Emergency Locking Retractor
ESA	Electronic Spark Advance
EVAP	Evaporative (Emission Control)
EX	Exhaust (manifold, valve)
Ex.	Except
F_0	Overdrive One-Way Clutch
F_1	No. 1 One-Way Clutch
F_2	No. 2 One-Way Clutch
FIPG	Formed in Place Gasket
FL	Fusible Link
FPU	Fuel Pressure Up
IN	Intake (manifold, valve)
IG	Ignition
J/B	Junction Block
LH	Left-Hand
LSP & BV	Load Sensing Proportioning and By-Pass Valve
MAX.	Maximum
MP	Multipurpose
M/T, MTM	Manual Transmission
O/D	Overdrive
O/S	Oversize
PCV	Positive Crankcase Ventilation
PS	Power Steering
RH	Right-Hand
RR	Rear
SSM	Special Service Materials
SST	Special Service Tools
STD	Standard
SW	Switch
TCCS	Toyota Computer Controlled System
TDC	Top Dead Center
T/F	Transfer
T/M	Transmission
TWC	Three-Way Catalyst
U/S	Undersize
VSV	Vacuum Switching Valve
VTV	Vacuum Transmitting Valve
2WD	Two Wheel Drive Vehicles (4x2)
4WD	Four Wheel Drive Vehicles (4x4)
w/	With
w/o	Without

MAINTENANCE

GENERAL NOTES:

- Every service item in the periodic maintenance list must be performed.
- Failure to do even one item can cause the engine to run poorly and increase exhaust emissions.

MAINTENANCE SCHEDULE

SCHEDULE A

CONDITION

Maintenance operation: A = Check and adjust if necessary;
R = Replace, change or lubricate;
I = Inspect and correct or replace if necessary

- Towing a trailer, using a camper or car top carrier.
- Repeat short trips less than 5 miles (8 km) and outside temperatures remain below freezing.
- Extensive idling and/or low speed driving for a long distance such as police, taxi or door-to-door delivery use.
- Operating on dusty, rough, muddy or seat spread roads.

System	Service interval (Odometer reading or months, whichever comes first) / Maintenance items		Maintenance services beyond 60,000 miles (96,000 km) should be performed at the same intervals shown in each maintenance schedule.																	Months	See Page (item No.)
		Miles × 1,000	1	3.75	7.5	11.25	15	18.75	22.5	26.25	30	33.75	37.5	41.25	45	48.75	52.5	56.25	60		
		km × 1,000	1.6	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96		
ENGINE	Timing belt (1)	3VZ-E engine																	R	—	MA-6 (item 1)
	Valve clearance★	22R-E engine									A								A	A: Every 36 months	MA-10 (item 14)
	Valve clearance	3VZ-E engine																	A	A: Every 72 months	MA-9 (item 12)
	Drive belts		I: First period. 30,000 miles (48,000 km) or 36 months, 60,000 miles (96,000 km) or 72 months I: After that every 7,500 miles (12,000 km) or 12 months																		MA-6 (item 2)
	Engine oil and oil filter★			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R: Every 6 months	MA-8 (item 6)
	Engine coolant		R: First period. 45,000 miles (72,000 km) or 36 months R: After that every 30,000 miles (48,000 km) or 24 months																		MA-8 (item 7)
	Exhaust pipes and mountings						I				I				I				I	I: Every 24 months	MA-9 (item 11)
FUEL	Idle speed		A: First period. 7,500 miles (12,000 km) or 12 months, 30,000 miles (48,000 km) or 36 months R: After that every 30,000 miles (48,000 km) or 36 months																		MA-11 (item 15)
	Air filter★ (2)		I	I	I	I	I	I	I	I	R	I	I	I	I	I	I	I	R	I: Every 6 months R: Every 36 months	MA-7 (item 4)
	Fuel lines and connections (3)										I								I	I: Every 36 months	MA-9 (item 10)
	Fuel tank cap gasket																		R	R: Every 72 months	MA-9 (item 9)
IGNITION	Spark plugs★★										R								R	R: Every 36 months	MA-7 (item 3)
EVAP	Charcoal canister	Calif. only																	I	I: Every 72 months	MA-8 (item 8)
EXHAUST	Oxygen sensor	Fed. and Canada only	R: 80,000 miles (129,000 km) only																		MA-9 (item 13)
BRAKES	Brake linings and drums				I		I		I		I		I		I		I		I	I: Every 12 months	MA-13 (item 18)
	Brake pads and discs				I		I		I		I		I		I		I			I: Every 12 months	MA-12 (item 17)
	Brake line pipes and hoses						I				I				I				I	I: Every 24 months	MA-12 (item 16)

SCHEDULE A (Cont'd)

System	Service interval (Odometer reading or months, whichever comes first) / Maintenance items		Maintenance services beyond 60,000 miles (9,6000 km) should be performed at the same intervals shown in each maintenance schedule.																	Months	See Page (item No.)
		Miles × 1,000	1	3.75	7.5	11.25	15	18.75	22.5	26.25	30	33.75	37.5	41.25	45	48.75	52.5	56.25	60		
		km × 1,000	1.6	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96		
CHASSIS	Steering linkage				I		I		I		I		I		I		I		I	I: Every 12 months	MA-14 (item 19)
	Ball joints and dust covers				I		I		I		I		I		I		I		I	I: Every 12 months	MA-14 (item 22)
	Drive shaft boots	4WD			I		I		I		I		I		I		I		I	I: Every 12 months	MA-14 (item 21)
	Automatic transmission, manual transmission, transfer (4WD) and differential						R				R				R				R	I: Every 24 months	MA-15 (item 23) MA-15 (item 24) MA-17 (item 25) MA-18 (item 26)
	Steering gear housing oil (4)						I				I				I				I	I: Every 24 months	MA-14 (item 20)
	Front wheel bearing and thrust bush grease (4WD)	2WD									R								R	R: Every 48 months	MA-19 (item 27)
		4WD									R								R	R: Every 36 months	
	Propeller shaft grease (5)	4WD			R		R		R		R		R		R		R		R	R: Every 12 months	MA-19 (item 28)
	Bolts and nuts on chassis and body (6)				I		I		I		I		I		I		I		I	I: Every 12 months	MA-20 (item 29)

★ or * mark indicates maintenance which is part of the warranty conditions for the engine control system. The warranty period is in accordance with the owner's guide or the warranty booklet.

★ : California specification vehicles.

* : Vehicles other than California specification vehicles.

HINT:

(1) Applicable to vehicles operated under conditions of extensive idling and / or low speed driving for long distances such as police, taxi or door-to-door delivery use.

(2) Applicable when operating mainly on dusty roads.

(3) Includes inspection of vapor vent system.

(4) Check for oil leaks from steering gear box.

(5) If the propeller shaft has been immersed in water, it should be re-greased daily.

(6) Applicable only when operating mainly on rough, muddy roads. The applicable parts are listed below. For other usage conditions, refer to SCHEDULE B.

- Front and rear suspension member cross body.
- Bolts for sheet installation.

SCHEDULE B

CONDITION

Conditions other than those listed for SCHEDULE A.

System	Service interval (Use odometer reading or months, whichever comes first) / Maintenance items		Maintenance services beyond 60,000 miles (96,000 km) should continue to be performed at the same intervals shown for each maintenance schedule.										See Page (item No.)
		Miles × 1,000	1	7.5	15	22.5	30	37.5	45	52.5	60	Months	
		km × 1,000	1.6	12	24	36	48	60	72	84	96		
ENGINE	Valve clearance★	22R-E engine					A				A	A: Every 36 months	MA-10 (item 14)
	Valve clearance	3VZ-E engine									A	A: Every 72 months	MA-9 (item 12)
	Drive belts		I: First period. 30,000 miles (48,000 km) or 36 months, 60,000 miles (96,000 km) or 72 months I: After that every 7,500 miles (12,000 km) or 12 months										MA-6 (item 2)
	Engine oil and oil filter★			R	R	R	R	R	R	R	R	R: Every 12 months	MA-8 (item 6)
	Engine coolant		R: First period. 45,000 miles (72,000 km) or 36 months R: After that every 30,000 miles (48,000 km) or 24 months										MA-8 (item 7)
	Exhaust pipes and mountings				I		I		I		I	I: Every 24 months	MA-9 (item 11)
FUEL	Idle speed		A: First period. 7,500 mile (12,000 km) or 12 months, 30,000 miles (48,000 km) or 36 months A: After that every 30,000 miles (48,000 km) or 36 months										MA-11 (item 15)
	Air filter★						R				R	R: Every 36 months	MA-7 (item 4)
	Fuel lines and connections (1)						I				I	I: Every 36 months	MA-9 (item 10)
	Fuel tank cap gasket										R	R: Every 72 months	MA-9 (item 9)
IGNITION	Spark plugs★ *						R				R	R: Every 36 months	MA-7 (item 3)
EVAP	Charcoal canister	Calif. only									I	I: Every 72 months	MA-8 (item 8)
EXHAUST	Oxygen sensor	Fed. and Canada only	R: 80,000 miles (129,000 km) only										MA-9 (item 13)
BRAKES	Brake linings and drums				I		I		I		I	I: Every 24 months	MA-13 (item 18)
	Brake pads and discs				I		I		I		I	I: Every 24 months	MA-12 (item 17)
	Brake line pipes and hoses				I		I		I		I	I: Every 24 months	MA-12 (item 16)

SCHEDULE B (Cont'd)

System	Service interval (Use odometer reading or months, whichever comes first) / Maintenance items		Maintenance services beyond 60,000 miles (96,000 km) should continue to be performed at the same intervals shown for each maintenance schedule.										See Page (item No.)
		Miles × 1,000	1	7.5	15	22.5	30	37.5	45	52.5	60	Months	
		km × 1,000	1.6	12	24	36	48	60	72	84	96		
CHASSIS	Steering linkage				I		I		I		I	I: Every 24 months	MA-14 (item 19)
	Ball joints and dust covers				I		I		I		I	I: Every 24 months	MA-14 (item 22)
	Drive shaft boots	4WD			I		I		I		I	I: Every 24 months	MA-14 (item 21)
	Automatic transmission, manual transmission, transfer (4WD) and differential (2)				I		I		I		I	I: Every 24 months	MA-15 (item 23) MA-15 (item 24)
	Steering gear housing oil (3)				I		I		I		I	I: Every 24 months	MA-14 (item 20)
	Front wheel bearing and thrust bush grease (4WD)	2WD					R				R	R: Every 48 months	MA-19 (item 27)
		4WD					R				R	R: Every 36 months	
	Propeller shaft grease (4)	4WD			R		R		R		R	R: Every 24 months	MA-19 (item 28)
	Bolts and nuts on chassis and body (5)				I		I		I		I	I: Every 24 months	MA-20 (item 29)

★ or * mark indicates maintenance which is part of the warranty conditions for the engine control system. The warranty period is in accordance with the owner's guide or the warranty booklet.

★ : California specification vehicles.

* : Vehicles other than California specification vehicles.

HINT:

(1) Includes inspection of vapor vent system.

(2) Check for oil level.

(3) Check for oil leaks from steering gear box.

(4) If the propeller shaft has been immersed in water, it should be re-greased daily.

(5) Applicable only when operating mainly on rough, muddy roads. The applicable parts are listed below. For other usage conditions, refer to SCHEDULE B.

- Front and rear suspension member cross body.
- Bolts for sheet installation.

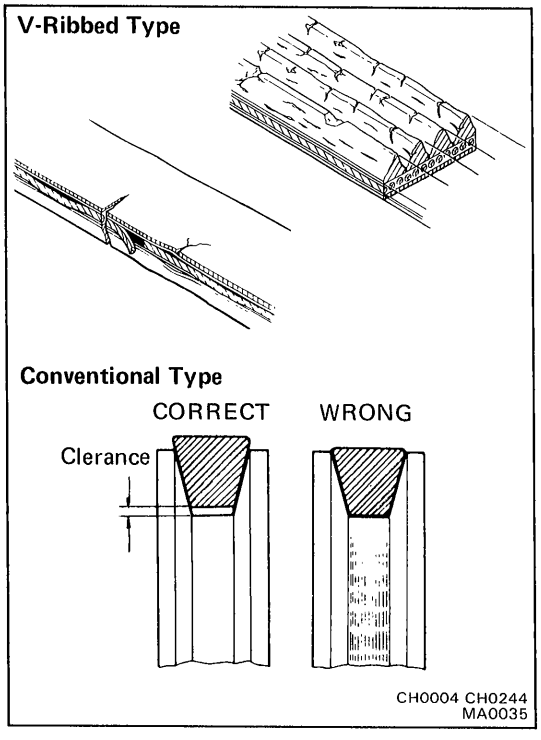
MAINTENANCE OPERATIONS

ENGINE

Cold Engine Operations

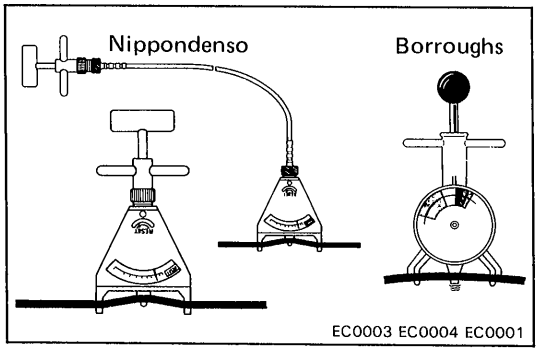
1. **(3VZ-E ENGINE)**
   REPLACE TIMING BELT
   (a) Remove the timing belt.
   (See pages EM-100 to 103)
   (b) Install the timing belt.
   (See pages EM-106 to 110)

2. **INSPECT DRIVE BELTS**
   (a) Visually check the belt for separation of the adhesive rubber above and below the core, core separation from the belt side, severed core, separation of the rib from the adhesive rubber, cracking or separation of the ribs, torn or worn ribs or cracks in the inner ridges of the ribs.



Conventional type only: 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.

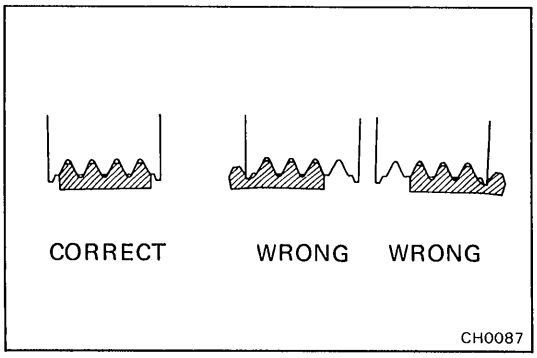
Belt tension gauge:

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

Drive belt tension:

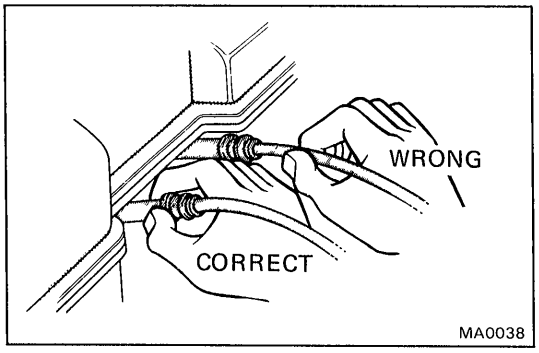
22R-E	**Used belt**	**80 ± 20 lb**
	New belt	**125 ± 25 lb**
3VZ-E		
Alternator	**Used belt**	**100 ± 20 lb**
	New belt	**160 ± 20 lb**
PS	**Used belt**	**80 ± 20 lb**
	New belt	**125 ± 25 lb**
A/C	**Used belt**	**80 ± 20 lb**
	New belt	**125 ± 25 lb**

If necessary, adjust the drive belt tension.



HINT:

- "New belt" refers to a belt which has been used less than 5 minutes on a running engine.
- "Used belt" refers to a belt which has been used on a running engine for 5 minutes or more.
- After replacing the drive belt, check that it fits properly in the ribbed grooves, especially in the places difficult to see.
- After installing a new belt, run the engine for approx. 5 minutes and then recheck the tension.

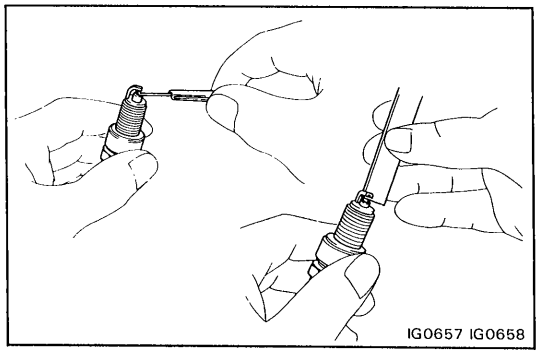


3. REPLACE SPARK PLUGS

(a) Disconnect the high-tension cords at the boot. Do not pull on the cords.

(b) (22R-E)
Remove the spark plugs.

(3VZ-E)
Using plug wrench (16 mm), remove the spark plugs.



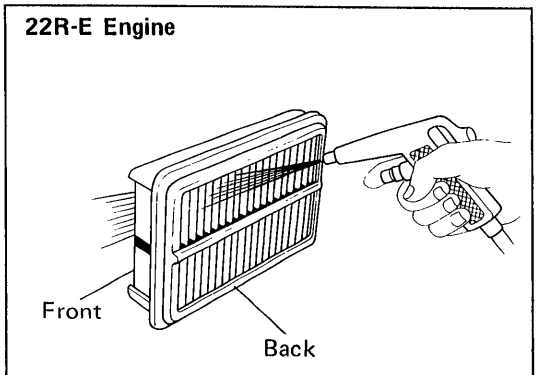
(c) Set the gap on the new plugs.

Gap: 0.8 mm (0.031 in.)

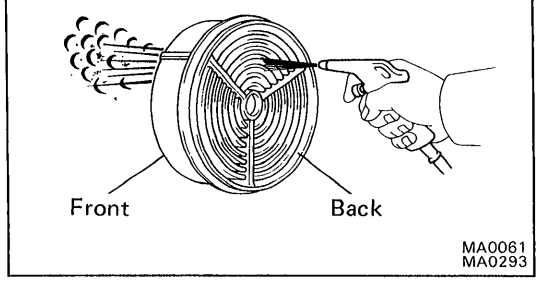
Recommended spark plugs:

22R-E	**ND**	**W16EXR-U**
	NGK	**BPR5EY**
3VZ-E	**ND**	**K16R-U**
	NGK	**BKR5EYA**

22R-E Engine



3VZ-E Engine



4. INSPECT AIR FILTER

(a) Visually check that the air cleaner element is not excessively dirty, damaged or oily.

HINT: Oiliness may indicate a stuck PCV valve.

If necessary, replace the air cleaner element.

(b) Clean the element with compressed air.

First blow from back side thoroughly, then blow off the front side of the element.

5. REPLACE AIR FILTER

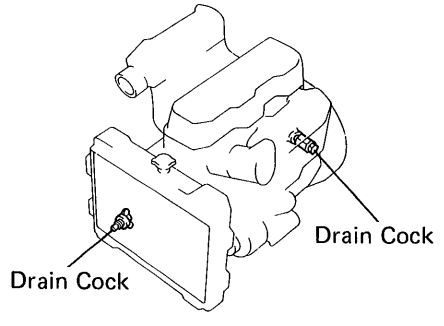
Replace the used air cleaner element with a new one.

6. **REPLACE ENGINE OIL AND OIL FILTER**
(22R-E: See page LU-6)
(3VZ-E: See page LU-17)

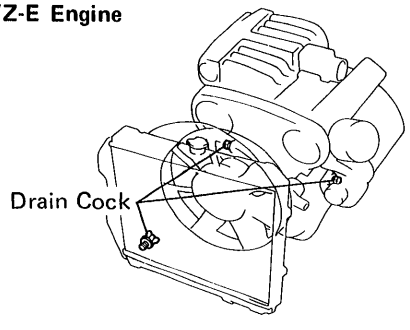
Oil grade: API grade SG multigrade, fuel-efficient and recommended viscosity oil.

Engine oil capacity:
Drain and refill
22R-E
w/o Oil filter change
3.8 liters (4.0 US qts, 3.3 Imp. qts)
w/ Oil filter change
4.3 liters (4.5 US qts, 3.8 Imp. qts)
3VZ-E
w/o Oil filter change
4.2 liters (4.4 US qts, 3.7 Imp. qts)
w/ Oil filter change
4.5 liters (4.8 US qts, 4.0 Imp. qts)

22R-E Engine



3VZ-E Engine



CO0734
CO0564

7. **REPLACE ENGINE COOLANT**

(a) Drain the coolant from the radiator and engine drain cocks.

(b) Close the drain cocks.

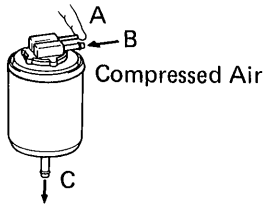
(c) Fill system with coolant.

Coolant capacity (w/ heater or air conditioner):

22R-E
Ex. 4WD A/T 8.4 liters (8.9 US qts, 7.4 Imp. qts)
4WD A/T 9.1 liters (9.6 US qts, 8.0 Imp. qts)

3VZ-E
2WD M/T 10.4 liters (11.0 US qts, 9.2 Imp. qts)
A/T 10.2 liters (10.8 US qts, 9.5 Imp. qts)
4WD M/T 10.5 liters (11.1 US qts, 9.2 Imp. qts)
A/T 10.3 liters (10.9 US qts, 9.1 Imp. qts)

Use a good brand of ethylene-glycol base coolant, mixed according to the manufacturer's instructions.



Air should flow through freely and no charcoal should come out.

EC3145

8. **(CALIFORNIA VEHICLES ONLY) INSPECT CHARCOAL CANISTER**

(a) Disconnect the hoses to the charcoal canister. Label hoses for correct installation.

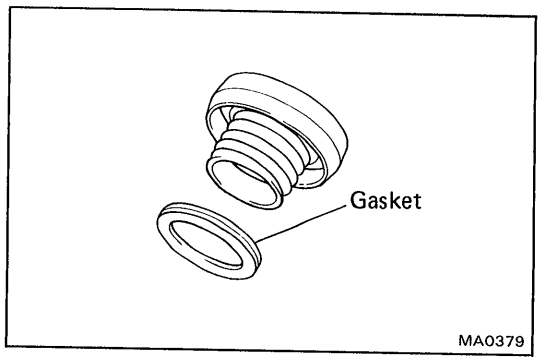
(b) Plug pipe A with your finger and blow compressed air (3 kg/cm², 43 psi or 294 kPa) through pipe B (fuel tank side).

- Check that air comes out of the bottom pipe C without resistance.
- Check that no activated charcoal comes out.

If necessary, replace the charcoal canister.

HINT: Do not attempt to wash the charcoal.

(c) Connect the hoses to the charcoal canister.



9. REPLACE GASKET IN FUEL TANK CAP

(a) Remove the old gasket (O-ring) from the tank cap. Do not damage the cap.

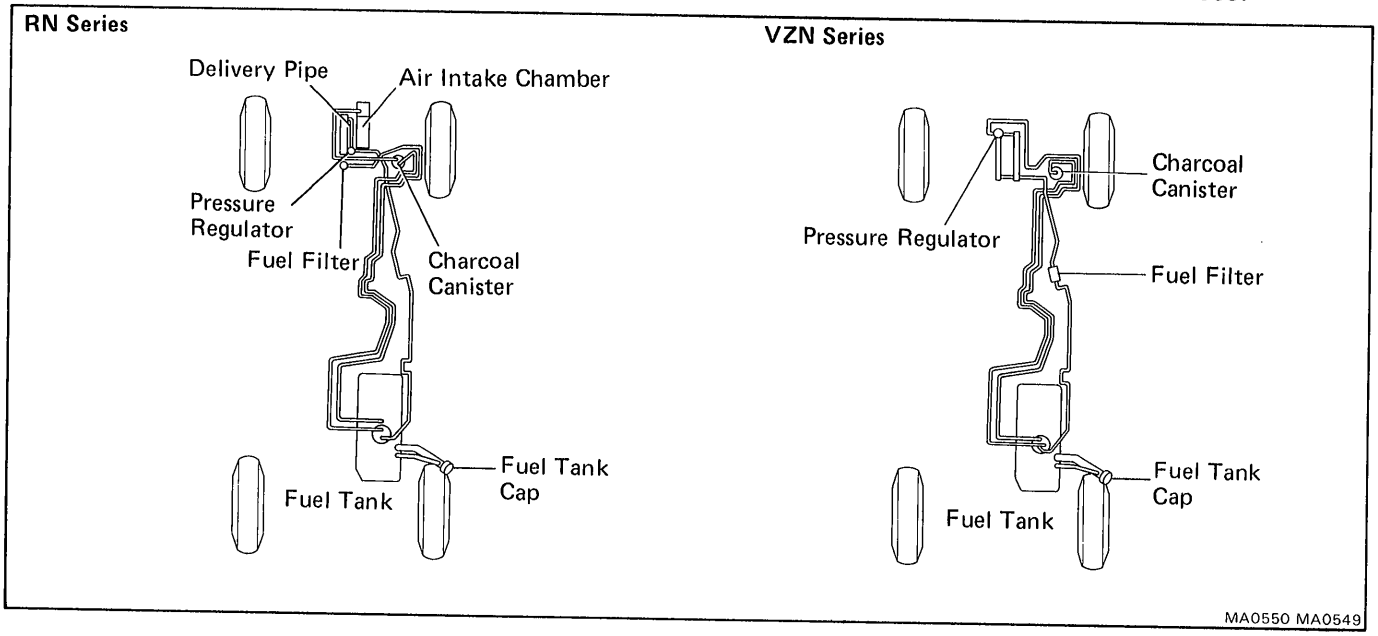
(b) Install a new gasket by hand.

(c) Inspect the cap for damage or cracks.

(d) Install the cap and check the torque limiter.

10. INSPECT FUEL LINES AND CONNECTIONS

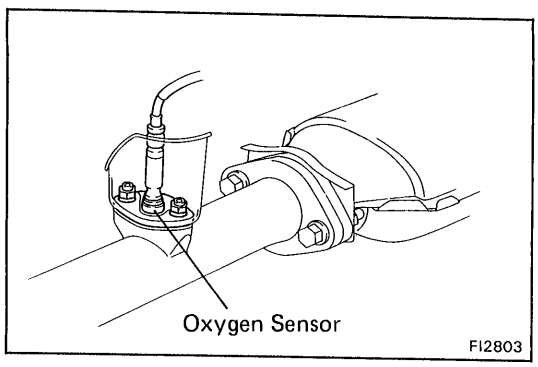
Visually inspect the fuel lines for cracks, leakage loose connections, deformation or tank band looseness.



11. INSPECT EXHAUST PIPES AND MOUNTINGS

Visually inspect the pipes, hangers and connections for severe corrosion, leaks or damage.

12. (3VZ-E ENGINE)
ADJUST VALVE CLEARANCE
(See page EM-84)



13. (FEDERAL AND CANADA)
REPLACE OXYGEN SENSOR

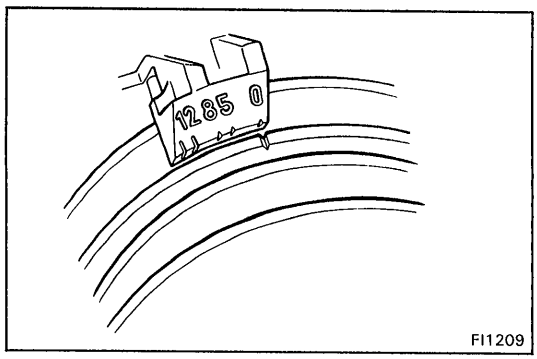
(a) Disconnect the oxygen sensor wiring connector.

(b) Remove the cover, oxygen sensor and gasket from the exhaust pipe.

(c) Install a new gasket, oxygen sensor and cover to the exhaust pipe.

Torque: 200 kg-cm (14 ft-lb, 20 N·m)

(d) Inspect oxygen sensor operation.
Inspect feedback control.
(See page FI-98 or 199)



Hot Engine Operations

14. (22R-E ENGINE)
ADJUST VALVE CLEARANCE

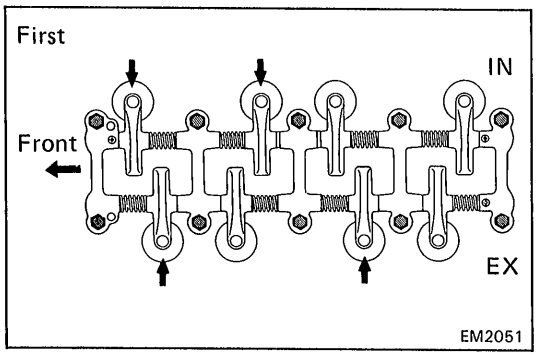
(a) Warm up the engine to normal operating temperature.

(b) Stop the engine and remove the cylinder head cover.

(c) Set No.1 cylinder to TDC/compression.

- Turn the crankshaft with a wrench to align the timing marks at TDC. Set the groove on the pulley to the O position.
- Check that the rocker arms on No.1 cylinder are loose and rockers on No.4 are tight.

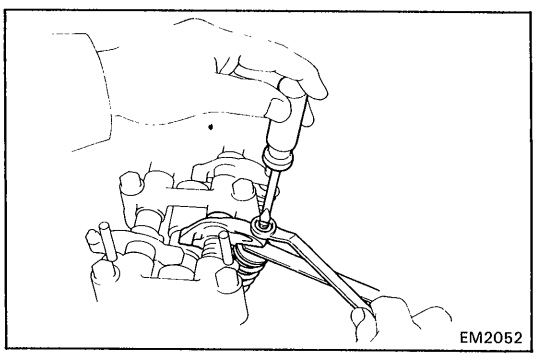
If not, turn the crankshaft one complete revolution and align marks as above.



(d) Adjust the clearance of half of the valves.

- Adjust only those valves indicated by arrows.

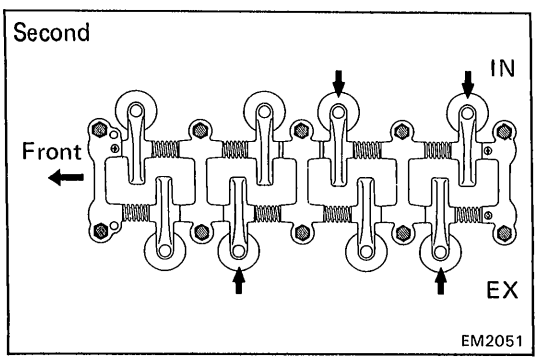
Valve clearance: Intake 0.20 mm (0.008 in.)
Exhaust 0.30 mm (0.012 in.)



- Using a thickness gauge to measure between the valve stem and rocker arm. Loosen the lock nut and turn the adjusting screw to set the proper clearance. Hold the adjusting screw in position, and tighten the lock nut.

Torque: 250 kg-cm (18 ft-lb, 25 N·m)

- Recheck the clearance. The thickness gauge should move with a very slight drag.



(e) Turn the crankshaft one complete revolution (360°) and align timing marks in the manner mentioned above. Adjust only the valves indicated by arrows.

(f) Reinstall the cylinder head cover.

15. ADJUST IDLE SPEED

(a) Preparation

- Install air cleaner.
- Connect all pipes and hoses of air intake system.
- Connect all vacuum lines (i.e., EVAP, EGR system, etc.).
- Make sure all EFI system wiring connectors are fully connected.
- Engine should be at normal operating temperature.
- Switch off accessories.
- Set transmission in neutral.

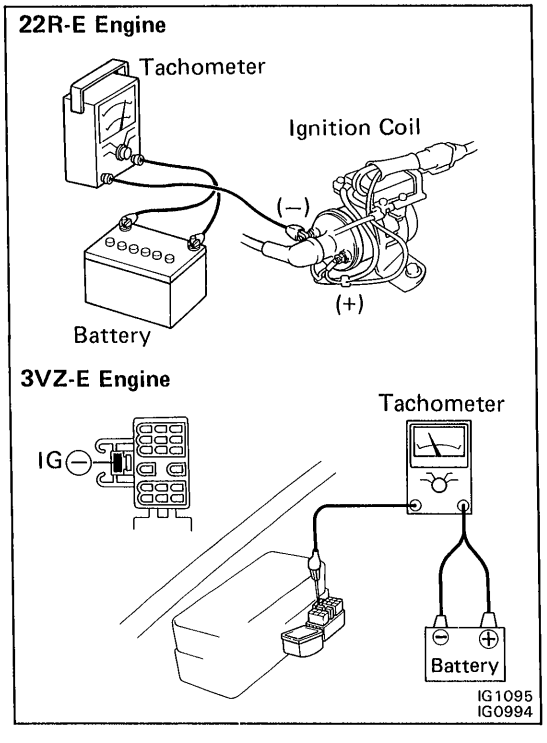
(b) Connect a tachometer to the engine.

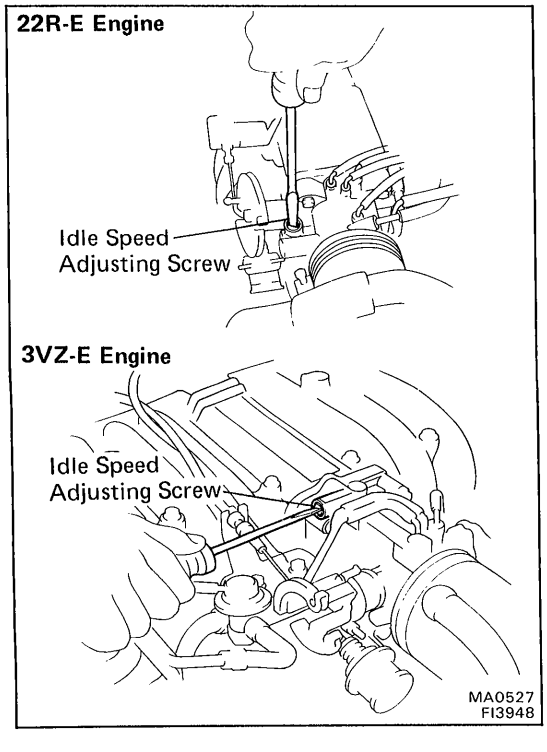
Connect the tachometer positive (+) terminal to the ignition coil negative (—) terminal (22R-E) or check connector IG ⊖ terminal (3VZ-E).

HINT (22R-E): The rpm signal can be also taken from the IG ⊖ terminal of the ckeck connector.

NOTICE:

- **NEVER allow the tachometer terminal to touch ground as it could result in damage to the igniter and/or ignition coil.**
- **As some tachometers are not compatible with this ignition system, we recommend that you confirm the compatibility of your unit before using it.**



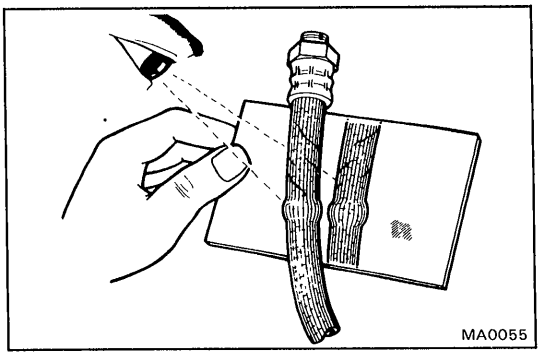


(c) Race the engine at 2,500 rpm for approx. 2 minutes.

(d) Set the idle speed by turning the idle speed adjusting screw.

Idle speed: 22R-E 750 rpm
3VZ-E 800 rpm

(e) Remove the tachometer.


MA0055

BRAKES

16. INSPECT BRAKE LINE PIPES AND HOSES

HINT: Inspect in a well lighted area. Inspect the entire circumference and length of the brake hoses using a mirror as required. Turn the front wheels fully right or left before inspecting the front brake.

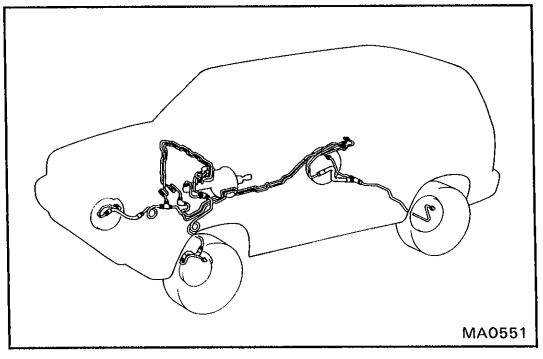
(a) Check all brake lines and hoses for:

- Damage
- Wear
- Deformation
- Cracks
- Corrosion
- Leaks
- Bends
- Twists

(b) Check all clamps for tightness and connections for leakage.

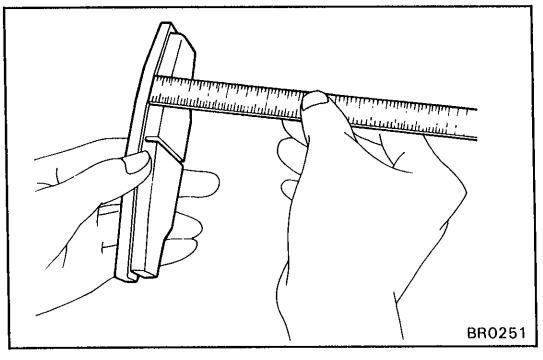
(c) Check that the hoses and lines are clear of sharp edges, moving parts and the exhaust system.

(d) Check that the lines installed in grommets pass through the center of the grommets.


MA0551

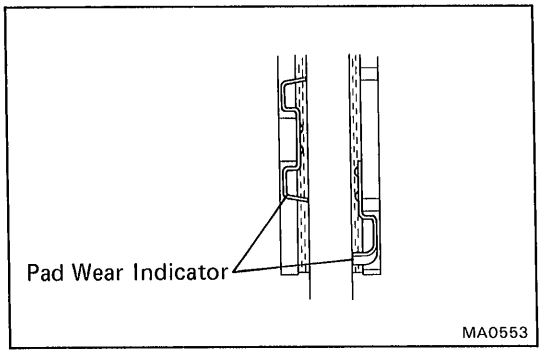
17. INSPECT FRONT BRAKE PADS AND DISCS

(See page BR-21)


BR0251

(a) Check the thickness of the disc brake pads and check for irregular wear.

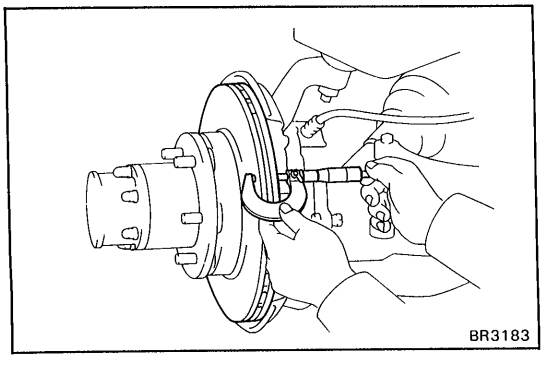
Minimum pad thickness: 1.0 mm (0.039 in.)



MA0553

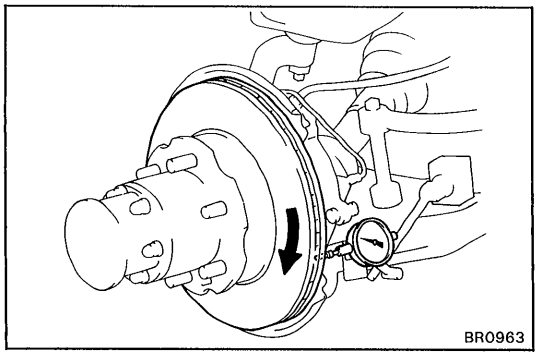
HINT: If a squealing or scraping noise occurs from the brake during driving, check the pad wear indicator.

If there are traces of the indicator contacting the disc rotor, the disc pad should be replaced.


BR3183

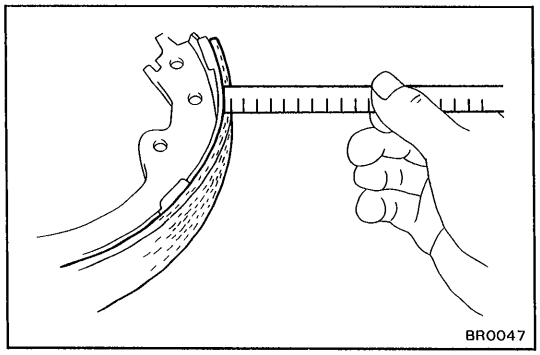
(b) Check the disc for wear.

Minimum disc thickness: 18.0 mm (0.709 in.)



(c) Check the disc for runout.

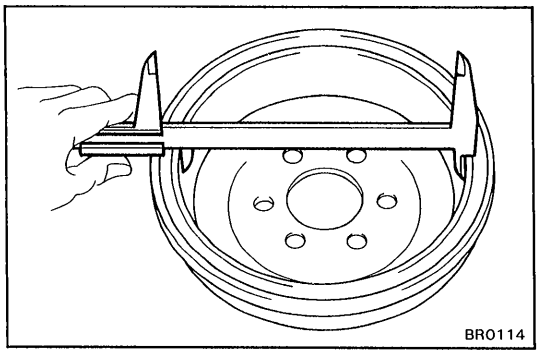
Maximum disc runout: 0.09 mm (0.0035 in.)



18. INSPECT REAR BRAKE LININGS AND DRUMS (See page BR-27)

(a) Check the linings for wear.

Minimum lining thickness: 1.0 mm (0.039 in.)

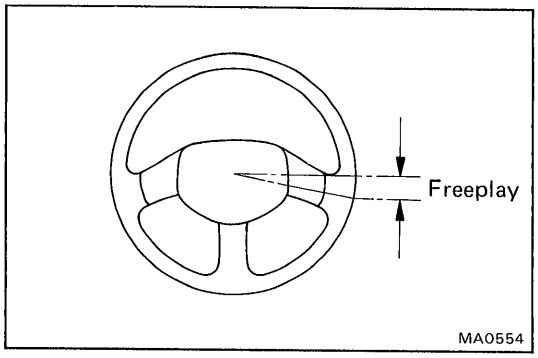


(b) Check the brake drums for scoring or wear.

Maximum drum inside diameter: 297.0 mm (11.693 in.)

(c) Clean the brake parts with a damp cloth.

HINT: Do not use compressed air to clean the brake parts.



CHASSIS

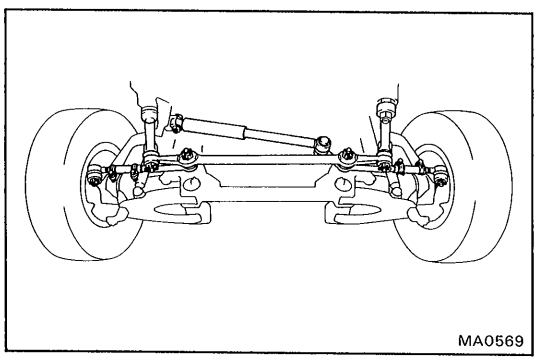
19. INSPECT STEERING LINKAGE

(a) Check the steering wheel freeplay.

Maximum: 30 mm (1.18 in.)

With the vehicle stopped and pointed straight ahead, rock the steering wheel gently back and forth with light finger pressure.

If incorrect, adjust or repair.



(b) Check the steering linkage for looseness or damage.

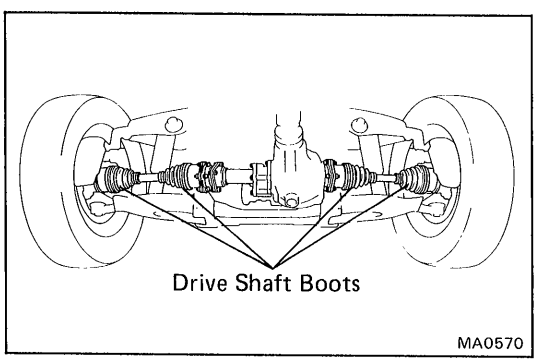
Check that:

- Tie rod ends and relay rod ends do not have excessive play.
- Dust seals are not damaged.

20. INSPECT STEERING GEAR HOUSING OIL

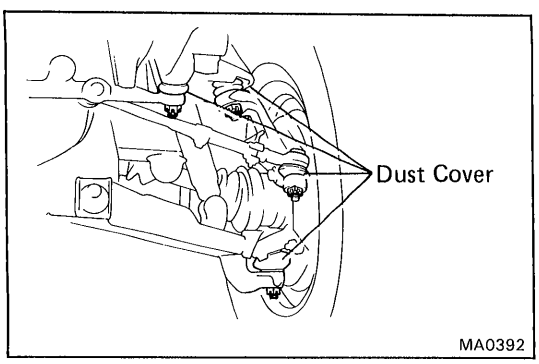
Check the steering gear housing for oil leaks.

If leakage is found, check for cause and repair.



21. (4WD) INSPECT DRIVE SHAFT BOOTS

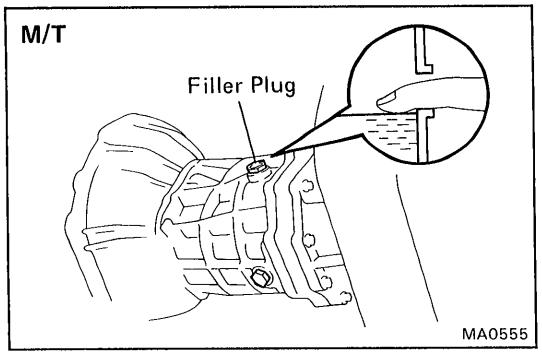
Inspect the drive shaft boots for clamp looseness, grease leakage or damage.



22. INSPECT BALL JOINTS AND DUST COVERS

(a) Inspect the ball joints for excessive looseness. (See page SA-95)

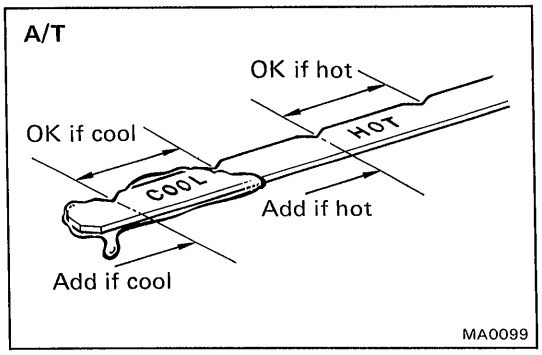
(b) Inspect the dust cover for damage.



23. (2WD)
CHECK OIL LEVEL IN MANUAL TRANSMISSION, AUTOMATIC TRANSMISSION AND DIFFERENTIAL

Remove the filler plug and feel inside the hole with your finger. Check that the oil comes to within 5 mm (0.20 in.) of the bottom edge of the hole. If the level is low, add oil until it begins to run out of the filler hole.

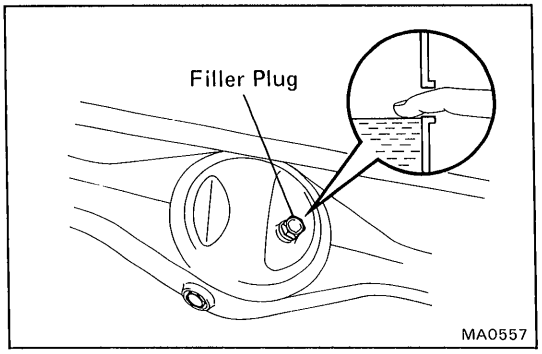
Transmission oil (M/T) —
Oil grade: API GL-4 or GL-5
Viscosity: SAE 75W-90



Check the automatic transmission for oil leakage.

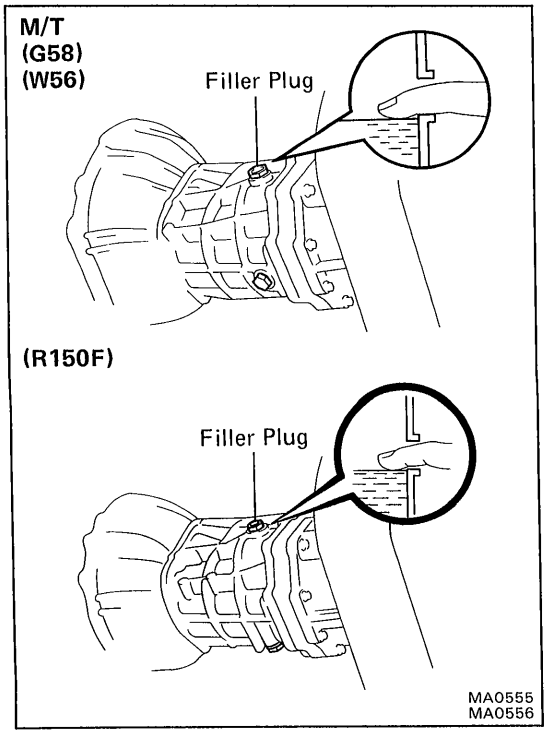
If leakage is found, check for cause and repair.

Transmission fluid (A/T): ATF DEXRON® II



Remove the filler plug and feel inside the hole with your finger. Check that the oil comes to within 5 mm (0.20 in.) of the bottom edge of the hole. If the level is low, add oil until it begins to run out of the filler hole.

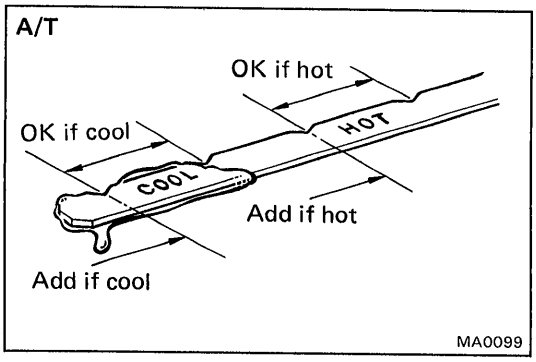
Differential oil —
Oil grade: API GL-5 hypoid gear oil
Viscosity: Above −18°C (0°F) SAE 90
Below −18°C (0°F) SAE 80W-90 or 80W



24. (4WD)
CHECK OIL LEVEL IN MANUAL TRANSMISSION, AUTOMATIC TRANSMISSION, TRANSFER AND DIFFERENTIAL

Remove the filler plug and feel inside the hole with your finger. Check that the oil comes to within 5 mm (0.20 in.) of the bottom edge of the hole. If the level is low, add oil until it begins to run out of the filler hole.

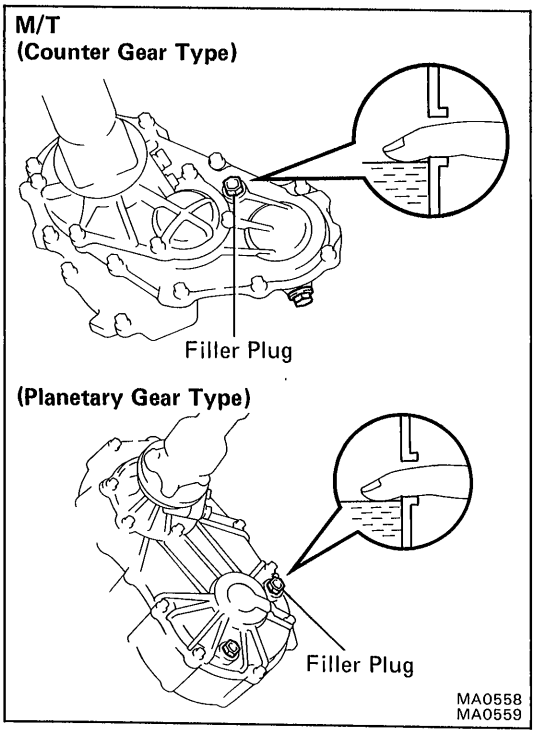
Transmission oil (M/T) —
Oil grade: API GL-4 or GL-5
Viscosity: SAE 75W-90



Check the automatic transmission for oil leakage.

If leakage is found, check for cause and repair.

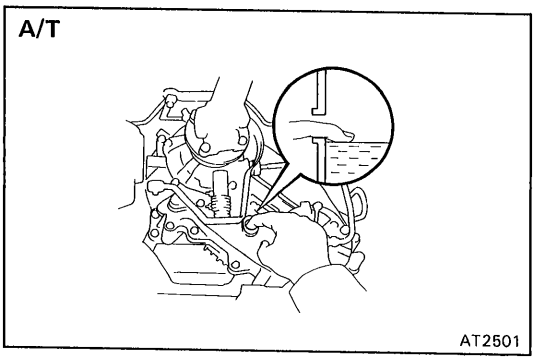
Transmission fluid (A/T): ATF DEXRON® II

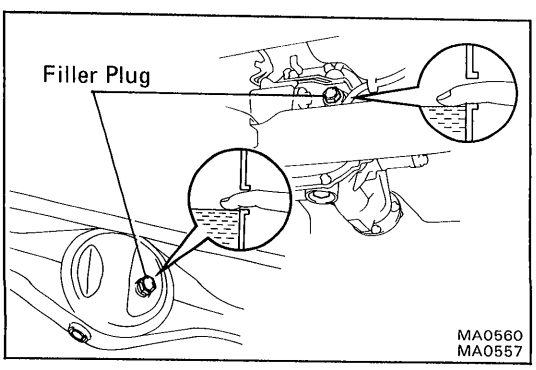


Remove the filler plug and feel inside the hole with your finger. Check that the oil comes to within 5 mm (0.20 in.) of the bottom edge of the hole. If the level is low, add oil until it begins to run out of the filler hole.

Transfer oil (M/T) —
Oil grade: API GL-4 or GL-5
Viscosity: SAE 75W-90

Transfer fluid (A/T): ATF DEXRON® II

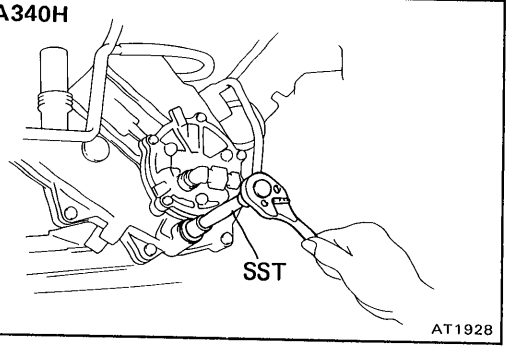




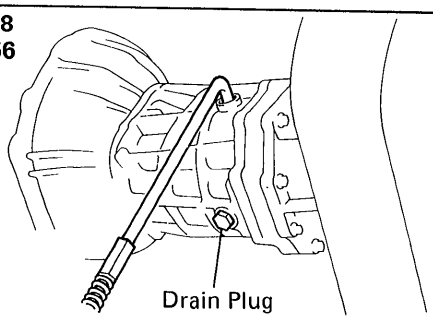
Remove the filler plug and feel inside the hole with your finger. Check that the oil comes to within 5 mm (0.20 in.) of the bottom edge of the hole. If the level is low, add oil until it begins to run out of the filler hole.

Differential oil —
Standard differential
Oil grade: API GL-5 hypoid gear oil
Viscosity: Above −18°C (0°F) SAE 90
Below −18°C (0°F) SAE 80W-90 or 80W
A.D.D.
Oil grade: Hypoid gear oil A.D.D. or hypoid gear oil API GL-5
Viscosity: SAE 75W-90

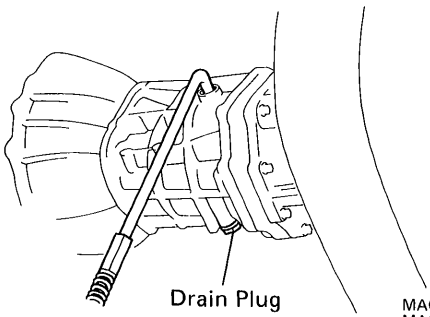
A340H



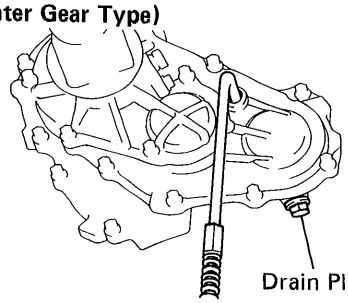
G58
W56



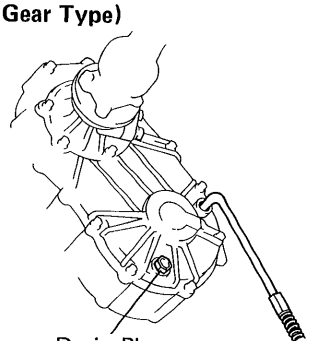
R150F



M/T
(Counter Gear Type)



(Planetary Gear Type)



25. REPLACE MANUAL TRANSMISSION, TRANSFER (4WD) AND DIFFERENTIAL OIL

(a) (Transfer)
Remove the transfer cover.

(b) Using SST (A340H Transfer), remove the drain plug and drain the oil.

SST 09043-38100

(c) Reinstall drain plug securely.

(d) Add new oil until it begins to run out of the filter hole.

Oil grade and viscosity: See pages MA-15, 16

Oil capacity:

Transmission —

2WD

W56	**2.4 liters (2.5 US qts, 2.1 Imp. qts)**

4WD

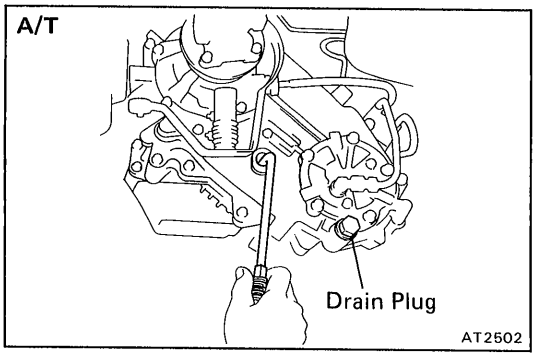
G58	**3.9 liters (4.1 US qts, 3.4 Imp. qts)**
W56	**3.0 liters (3.2 US qts, 2.6 Imp. qts)**
R150F	**3.0 liters (3.2 US qts, 2.6 Imp. qts)**

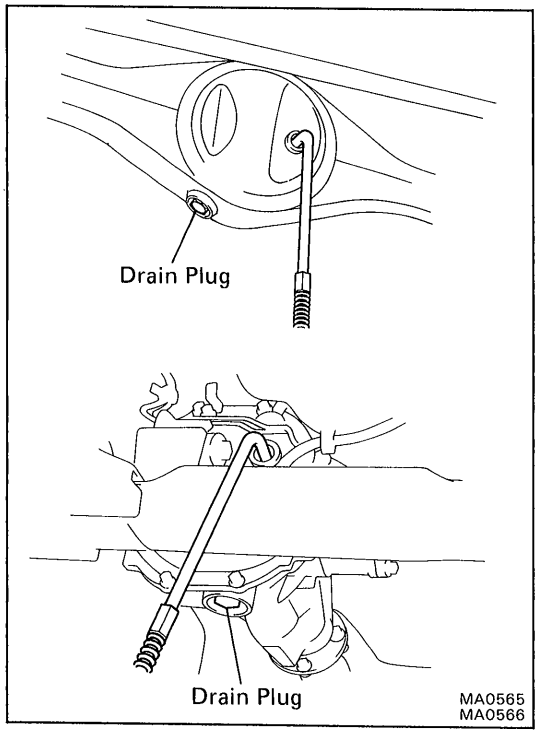
Transfer —

Counter gear type
1.6 liters (1.7 US qts, 1.4 Imp. qts)

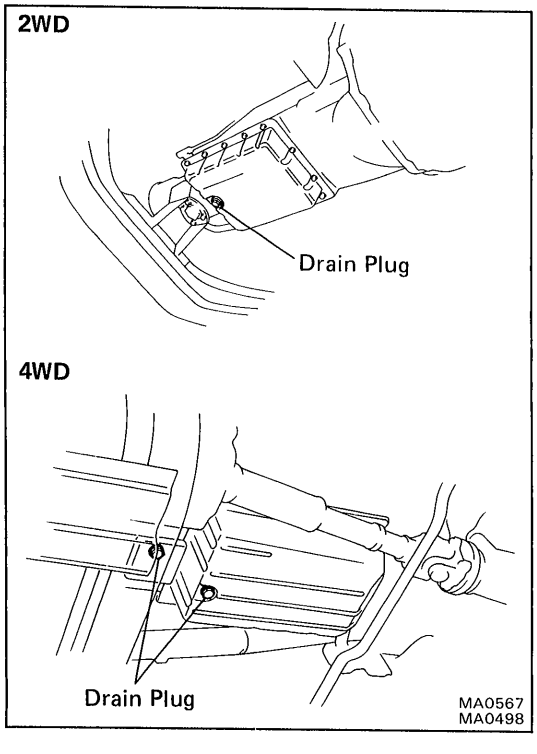
Planetary gear type
1.1 liters (1.2 US qts, 1.0 Imp. qts)

A340H	**0.8 liters (0.8 US qts, 0.7 Imp. qts)**





Differential –
2WD
7.5 in. 1.35 liters (1.4 US qts, 1.2 Imp. qts)
8.0 in. 1.8 liters (1.9 US qts, 1.6 Imp. qts)
4WD
Front Standard differential
1.6 liters (1.7 US qts, 1.4 Imp. qts)
A.D.D.
1.86 liters (2.0 US qts, 1.6 Imp. qts)
Rear For 22R-E Engine
2.2 liters (2.3 US qts, 1.9 Imp. qts)
For 3VZ-E Engine
2.35 liters (2.5 US qts, 2.1 Imp. qts)



26. REPLACE AUTOMATIC TRANSMISSION FLUID

(a) Remove the drain plug(s) and drain the fluid.

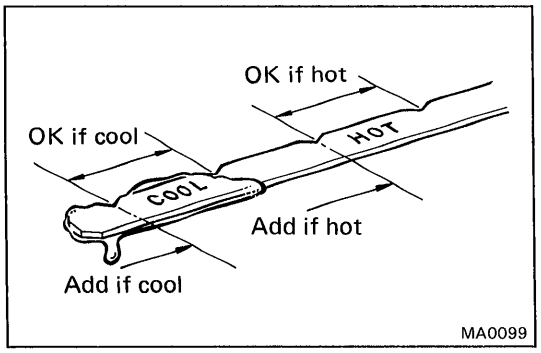
(b) Reinstall the drain plug(s) securely.

(c) With the engine OFF, add new fluid through the dipstick tube.

Fluid: ATF DEXRON® II

Drain and refill capacity:

2WD	**A44D**	**2.4 liters (2.5 US qts, 2.1 Imp. qts)**
	A340E	**1.6 liters (1.7 US qts, 1.4 Imp. qts)**
4WD	**A340H**	**4.5 liters (4.8 US qts, 4.0 Imp. qts)**



(d) Start the engine and shift the selector into all positions from "P" through "L", and then shift into "P".

(e) (4WD)
Shift the transfer lever position: H2 → H4 → L4 and L4 → H4 → H2.

(f) With the engine idling, check the fluid level.
Add fluid up to the "COOL" level on the dipstick.

CAUTION: Do not overfill.

27. REPACK FRONT WHEEL BEARING AND THRUST BUSH

(a) Change the front wheel bearing grease.
(See pages SA-17 to 21)

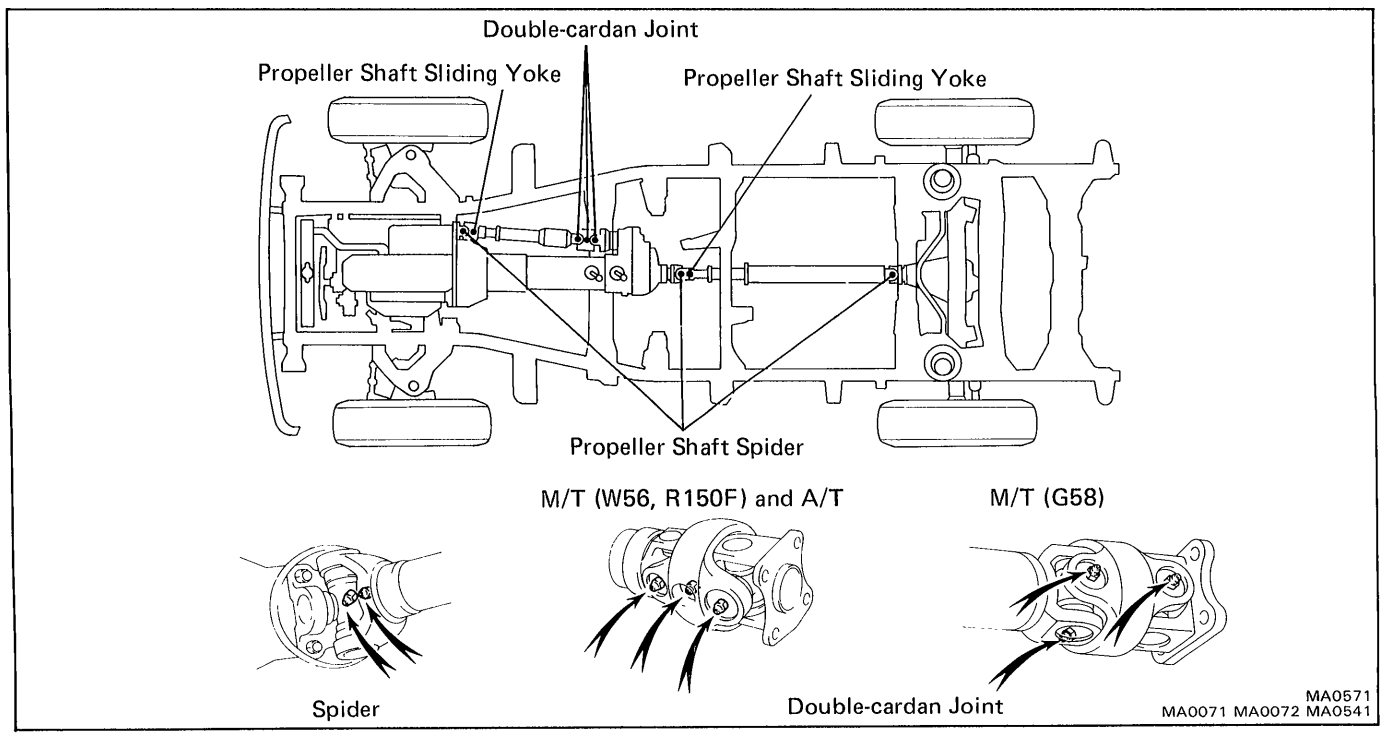
Grease grade: Lithium base multipurpose grease (NLGI No.2)
Wheel bearing friction preload (ar starting):
2.9 — 5.7 kg (6.4 — 12.6 lb, 28 — 56 N)

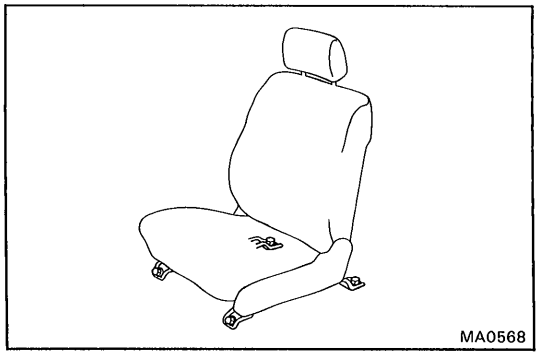
(b) Repack the drive shaft thrust bush grease.
(See pages SA-22 to 27)

28. (4WD) LUBE PROPELLER SHAFT

Lubricate propeller shaft, referring to the lubrication chart. Before pumping in grease, wipe off any mud and dust on the grease fitting.

Grease grade:
Propeller shaft (ex. Double-cardan joint) — Lithium base chassis grease (NLGI No.2)
Double-cardan joint — Molybdenum disulphide Lithium base chassis grease (NLGI No.2)





29. TIGHTEN BOLTS AND NUTS ON CHASSIS AND BODY

Tighten the following parts:

- Seat mounting bolts

Torque: 375 kg-cm (27 ft-lb, 37 N·m)

Under Severe Conditions:

In addition to the above maintenance items, check for loose or missing bolts and nuts on the following:

- Steering system
- Drive train
- Suspension system
- Fuel tank mounts
- Engine mounts, etc.

30. FINAL INSPECTION

(a) Check operation of body parts:

- Hood
  Auxiliary catch operates properly
  Hood locks securely when closed
- Doors
  Door locks operate properly
  Doors close properly
- Seats
  Seat adjusts easily and locks securely in any positions
  Seat backs lock securely at any angle
  Fold—down seat backs lock securely

(b) Road test

- Engine and chassis parts do not have abnormal noises.
- Vehicle does not wander or pull to one side.
- Brakes work properly and do not drag.

(c) Be sure to deliver a clean vehicle and especially check:

- Steering wheel
- Shift lever knob
- All switch knobs
- Door handles
- Seats

GENERAL MAINTENANCE

These are maintenance and inspections items which are considered to be the owner's responsibility. They can be performed by the owner or he can have them done at a service shop. These items include those which should be checked on a daily basis, those which, in most cases, do not require (special) tools and those which are considered to be reasonable for the owner to perform.
Items and procedures for general maintenance are as follows.

OUTSIDE VEHICLE

1. TIRES

(a) Check the pressure with a gauge. If necessary, adjust.

(b) Check for cuts, damage or excessive wear.

2. WHEEL NUTS

When checking the tires, check the nuts for looseness or for missing nuts. If necessary, tighten them.

3. TIRE ROTATION

It is recommended that the tires be rotated every 7,500 miles (12,000 km).

4. WINDSHIELD WIPER BLADES

Check for wear or cracks whenever they do not wipe clean. If necessary replace.

5. FLUID LEAKS

(a) Check underneath for leaking fuel, oil, water or other fluid.

(b) If you smell gasoline fumes or notice any leak, have the cause found and corrected.

6. DOORS AND ENGINE HOOD

(a) Check that all doors and the tailgate operate smoothly, and that all latches lock securely.

(b) Check that the engine hood secondary latch secures the hood from opening when the primary latch is released.

INSIDE VEHICLE

7. LIGHTS

(a) Check that the headlights, stop lights, taillights, turn signal lights, and other lights are all working.

(b) Check the headlight aim.

8. WARNING LIGHTS AND BUZZERS

Check that all warning lights and buzzers function properly.

9. HORN

Check that it is working.

10. WINDSHIELD GLASS

Check for scratches, pits or abrasions.

11. WINDSHIELD WIPER AND WASHER

(a) Check operation of the wipers and washer.

(b) Check that the wipers do not streak.

12. WINDSHIELD DEFROSTER

Check that air comes out from the defroster outlet when operating the heater or air conditioner.

13. REAR VIEW MIRROR

Check that it is mounted securely.

14. SUN VISORS

Check that they move freely and are mounted securely.

15. STEERING WHEEL

Check that it has specified freeplay. Be alert for changes in steering condition, such as hard steering, excessive freeplay or strange noise.

16. SEATS

(a) Check that the seat adjusters operate smoothly.

(b) Check that all latches lock securely in any position.

(c) Check that the head restraints move up and down smoothly and that the locks hold securely in any latched position.

(d) For fold-down seat backs, check that the latches lock securely.

17. SEAT BELTS

(a) Check that the seat belt system such as the buckles, retractors and anchors operate properly and smoothly.

(b) Check that the belt webbing is not cut, frayed, worn or damaged.

18. ACCELERATOR PEDAL

Check the pedal for smooth operation and uneven pedal effort or catching.

19. CLUTCH PEDAL (See page CL-3)

Check the pedal for smooth operation.

Check that the pedal has the proper freeplay.

20. BRAKE PEDAL (See page BR-6)

(a) Check the pedal for smooth operation.

(b) Check that the pedal has the proper reserve distance and freeplay.

(c) Check the brake booster function.

21. BRAKES

At a safe place, check that the brakes do not pull to one side when applied.

22. PARKING BRAKE (See page BR-8)

(a) Check that the lever has the proper travel.

(b) On a safe incline, check that vehicle is held securely with only the parking brake applied.

23. AUTOMATIC TRANSMISSION "PARK" MECHANISM

(a) Check the lock release button of the selector lever for proper and smooth operation.

(b) On a safe incline, check that vehicle is held securely with the selector lever in "P" position and all brakes released.

UNDER HOOD

24. WINDSHIELD WASHER FLUID

Check that there is sufficient fluid in the tank.

25. ENGINE COOLANT LEVEL

Check that the coolant level is between the "FULL" and "LOW" lines on the see-through reservoir.

26. RADIATOR AND HOSES

(a) Check that the front of the radiator is clean and not blocked with leaves, dirt or bugs.

(b) Check the hoses for cracks, kinks, rot or loose connections.

27. BATTERY ELECTROLYTE LEVEL

Check that the electrolyte level of all battery cells is between the upper and lower level lines on the case. If level is low, add distilled water only.

28. BRAKE AND CLUTCH FLUID LEVELS

(a) Check that the brake fluid level is near the upper level line on the see-through reservoir.

(b) Check that the clutch fluid level is within ±5 mm (0.20 in.) of the reservoir hem.

29. ENGINE DRIVE BELTS

Check all drive belts for fraying, cracks, wear or oiliness.

30. ENGINE OIL LEVEL

Check the level on the dipstick with the engine turned off.

31. POWER STEERING FLUID LEVEL

Check the level on the dipstick.
The level should be in the "HOT" or "COLD" range depending on the fluid temperature.

32. AUTOMATIC TRANSMISSION FLUID LEVEL

(a) Park the vehicle on a level surface.

(b) With the engine idling and the parking brake applied, shift the selector into all positions from "P" to "L", and then shift into "P".

(c) Pull out the dipstick and wipe off the fluid with a clean rag. Re-insert the dipstick and check that the fluid level is in the HOT range.

(d) Perform this check with the fluid at normal driving temperature (70 — 80°C or 158 — 176°F).

HINT: Wait until the engine cools down (approx. 30 min.) before checking the fluid level after extended high speed driving in hot weather, driving in heavy traffic or pulling a trailer.

33. EXHAUST SYSTEM

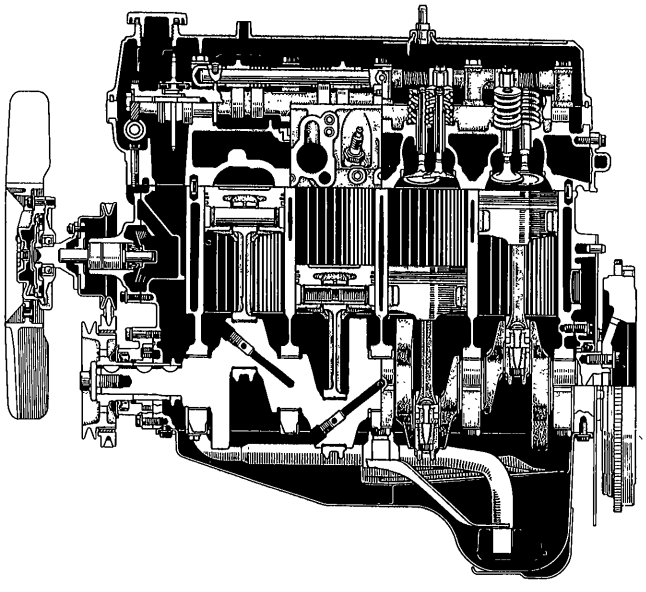
Visually inspect for cracks, holes or loose supports.
If any change in the sound of the exhaust or smell of the exhaust fumes is noticed, have the cause located and corrected.

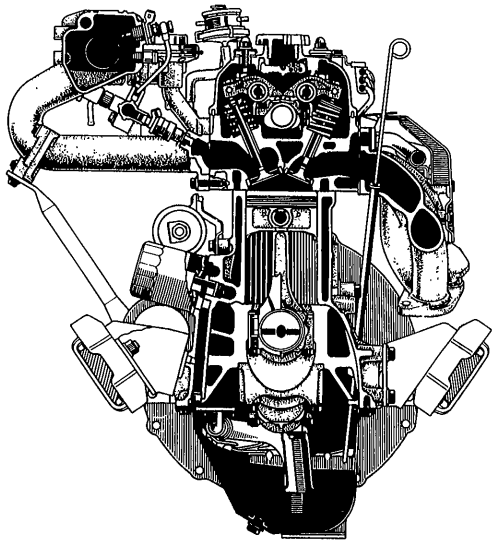
ENGINE MECHANICAL

DESCRIPTION

22R-E ENGINE

The 22R-E engine is in-line 4-cylinder 2.4 liter OHC 8 valve engine.





EM6678
EM6679

The 22R-E engine is in-line 4-cylinder engine with the cylinders numbered 1-2-3-4 from the front. The crankshaft is supported by 5 bearings inside the crankcase. These bearing are made of kelmet.

The crankshaft is integrated with 4 weights which are cast with it for balancing. Oil holes are made in the center of the crankshaft to supply oil to the connecting rods, bearing, pistons and other components.

The ignition order is 1-3-4-2. The cylinder head is made of aluminum alloy, with a cross flow type intake and exhaust layout and with pent roof type combustion chambers. The spark plugs are located to the left of the combustion chamber.

Coolant is introduced into the intake manifold, improving drivability during engine warmup.

Exhaust and intake valves are equipped with springs made of special valve spring carbon steel which are capable of following no matter what the engine speed.

The camshaft is driven by a timing chain. The cam journal is supported at 3 places, located at the center and the front and rear ends of each cylinder head. Lubrication of the cam journal gear is accomplished by oil supplied through the oil passage in the cylinder head.

Adjustment of the valve clearance is done by means of an adjusting screw on the rocker arm for easy adjustment.

The timing chain cover is made of alminumalloy, with a water pump and oil pump on the outside.

Pistons are made of highly temperature-resistant aluminumalloy, and a depression is built into the piston head to prevent interference with valves.

Piston pins are the full-floating type, with the pins fastened to neither the connecting rods nor the piston boss, but with a snap ring fitted to ends of each pin to prevent it from slipping out.

The No.1 compression ring is made of stainless steel and the No.2 compression ring is made of cast iron. The oil ring is made of stainless steel. The outer diameter of each piston ring is slightly larger than the diameter of the piston and the flexibility of the rings allows them to hug the cylinder walls when they are mounted on the piston. No.1 and No.2 compression rings work to prevent the leakage of gas from the cylinder and the oil ring works to scrape oil off the cylinder walls to prevent it from entering the combustion chambers.

The cylinder block is made of cast iron. It has 4 cylinders which are approximately 2 times the length of the piston stroke. The top of the cylinders is closed off by the cylinder head and in the lower end of the cylinders the crankshaft is installed, supported by 5 journals. In addition, the cylinder block contains a water jacket, through which coolant is pumped to cool the cylinders.

The oil pan is bolted onto the bottom of the cylinder block. The oil pan is an oil reservoir made of pressed steel sheet. A dividing plate is included inside the oil pan to keep sufficient oil in the bottom of the pan even when the vehicle is tilted. The dividing plate prevents the intake of air and allows oil circulation to be maintained even if the oil forms waves when the vehicle brakes suddenly.

TROUBLESHOOTING

ENGINE OVERHEATING

Problem	Possible cause	Remedy	Page
Engine overheats	Cooling system faulty	Troubleshoot cooling system	CO-4
	Incorrect ignition timing	Reset timing	IG-10

HARD STARTING

Problem	Possible cause	Remedy	Page
Engine will not crank or cranks slowly	Starting system faulty	Troubleshoot starting system	ST-2
Engine will not start/ Hard to start (cranks OK)	No fuel supply to injector	Troubleshoot EFI system	FI-9
	• No fuel in tank		
	• Fuel pump not working		
	• Fuel filter clogged		
	• Fuel line clogged or leaking		
	EFI system problems	Repair as necessary	
	Ignition problems	Perform spark test	IG-5
	• Ignition coil	Inspect coil	IG-7
	• Igniter		
	• Distributor	Inspect distributor	IG-8
	Spark plugs faulty	Inspect plugs	IG-6
	High-tension cords disconnected or broken	Inspect cords	IG-6
	Vacuum leaks	Repair as necessary	
	• PCV hoses		
	• EGR valve		
	• Intake manifold		
	• Air intake chamber		
	• Throttle body		
	Pulling in air between air flow meter and throttle body	Repair as necessary	
	Low compression	Check compression	EM-10

ROUGH IDLING

Problem	Possible cause	Remedy	Page
Rough idle, stalls or misses	Spark plugs faulty	Inspect plugs	IG-6
	High-tension cords faulty	Inspect cords	IG-6
	Ignition problems		
	• Ignition coil	Inspect coil	IG-7
	• Igniter		
	• Distributor	Inspect distributor	IG-8
	Incorrect ignition timing	Reset timing	IG-10
	Vacuum leaks	Repair as necessary	
	• PCV hoses		
	• EGR valve		
	• Intake manifold		
	• Air intake chamber		
	• Throttle body		
	Pulling in air between air flow meter and throttle body	Repaire as necessary	
	Incorrect idle speed	Adjust idle	MA-11
	EFI system problems	Repair as necessary	

ROUGH IDLING (CONT'D)

Problem	Possible cause	Remedy	Page
Rough idle, stalls or misses (cont'd)	Engine overheats	Check cooling system	CO-4
	Low compression	Check compression	EM-10
	Incorrect valve clearance	Adjust valve clearance	MA-10

ENGINE HESITATES/POOR ACCELERATION

Problem	Possible cause	Remedy	Page
Engine hesitates/ Poor acceleration	Spark plugs faulty	Inspect plugs	IG-6
	High-tension cords faulty	Inspect cords	IG-6
	Vacuum leaks • PCV hoses • EGR valve • Intake manifold • Air intake chamber • Throttle body	Repair as necessary	
	Pulling in air between air flow meter and throttle body	Repair as necessary	
	Incorrect ignition timing	Reset timing	IG-10
	Fuel system clogged	Check fuel system	
	Air cleaner clogged	Check air cleaner	MA-7
	EFI system problems	Repair as necessary	
	Emission control system problem (cold engine) • EGR system always on	Check EGR system	EC-10
	Engine overheats	Check cooling system	CO-4
	Low compression	Check compression	EM-10

ENGINE DIESELING

Problem	Possible cause	Remedy	Page
Engine dieseling (run after ignition switch is turned off)	EFI system problems	Repair as necessary	

AFTER FIRE, BACKFIRE

Problem	Possible cause	Remedy	Page
Muffler explosion (after fire) on deceleration only	Deceleration fuel cut system always off	Check EFI (fuel cut) system	FI-104
	As system faulty	Check AS system	EC-13
Muffler explosion (after fire) all the time	Air cleaner clogged	Check air cleaner	MA-7
	EFI system problem	Repair as necessary	
	Incorrect ignition timing	Reset timing	IG-10
	Incorrect valve clearance	Adjust valve clearance	MA-10

AFTER FIRE, BACKFIRE (CONT'D)

Problem	Possible cause	Remedy	Page
Engine backfires	EFI system problem	Repair as necessary	
	Vacuum leak • PCV hoses • EGR valve • Intake manifold • Air intake chamber • Throttle body	Check hoses and repair as necessary	
	Pulling in air between air flow meter and throttle body	Repair as necessary	
	Insufficient fuel flow	Troubleshoot fuel system	FI-9
	Incorrect ignition timing	Reset timing	IG-10
	Incorrect valve clearance	Adjust valve clearance	MA-10
	Carbon deposits in combustion chambers	Inspect cylinder head	EM-19

EXCESSIVE OIL CONSUMPTION

Problem	Possible cause	Remedy	Page
Excessive oil consumption	Oil leak	Repair as necessary	
	PCV line clogged	Check PCV system	EC-4
	Piston ring worn or damaged	Check rings	EM-59
	Valve stem and guide worn	Check valves	EM-19
	Valve stem seal worn	Check seals	

POOR GASOLINE MILEAGE

Problem	Possible cause	Remedy	Page
Poor gasoline mileage	Fuel leak	Repair as necessary	
	Air cleaner clogged	Check air cleaner	MA-7
	Incorrect ignition timing	Reset timing	IG-10
	EFI system problems • Injector faulty	Repair as necessary	
	• Deceleration fuel cut system faulty	Check EFI (fuel cut) system	FI-104
	Spark plugs faulty	Inspect plugs	IG-6
	EGR system always on	Check EGR system	EC-10
	Low compression	Check compression	EM-10
	Tires improperly inflated	Inflate tires to proper pressure	
	Clutch slips	Troubleshoot clutch	
	Brakes drag	Troubleshoot brakes	
Unpleasant odor	Incorrect idle speed	Adjust idle	MA-11
	Incorrect ignition timing	Reset timing	IG-10
	Vacuum leaks • PCV hoses • EGR valve • Intake manifold • Air intake chamber • Throttle body	Repair as necessary	
	EFI system problems	Repair as necessary	

ENGINE TUNE-UP

INSPECTION OF ENGINE COOLANT

(See steps 1, 2 on page CO-5)

INSPECTION OF ENGINE OIL

(See steps 1, 2 on page LU-5)

INSPECTION OF AIR FILTER

(See step 4 on page MA-7)

INSPECTION OF BATTERY

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

INSPECTION OF HIGH-TENSION CORD

(See page IG-6)

INSPECTION OF SPARK PLUGS

(See page IG-6)

INSPECTION OF DRIVE BELTS

(See step 2 on page MA-6)

INSPECTION AND ADJUSTMENT OF VALVE CLEARANCE

(See step 14 on page MA-10)

INSPECTION AND ADJUSTMENT OF IGNITION TIMING

(See step 5 on page IG-10)

INSPECTION AND ADJUSTMENT OF IDLE SPEED

(See step 15 on page MA-11)

HINT: Adjust idle mixture as necessary.

IDLE AND/OR 2,500 RPM HC/CO CONCENTRATION CHECK METHOD

NOTE: This check method is used only to determine whether or not the idle and /or 2,500 rpm HC/CO complies with regulations.

1. INITIAL CONDITIONS

(a) Normal engine operating temperature

(b) Air cleaner installed

(c) All pipe and hoses of air intake system connected

(d) All accessories switched OFF

(e) All vacuum lines properly connected

HINT: All vacuum hoses for the air suction, EGR systems, etc. should be properly connected.

(f) EFI system wiring connectors fully plugged

(g) Ignition timing set correctly

(h) Transmission in neutral

(i) Idle speed set correctly

(j) Tachometer and HC/CO meter calibrated and at hand

2. START ENGINE

3. RACE ENGINE AT 2,500 RPM FOR APPROX. 2 MINUTES

4. INSERT HC/CO METER TESTING PROBE INTO TAILPIPE AT LEAST 40 cm (1.3 ft)

5. CHECK HC/CO CONCENTRATION AT IDLE AND/OR 2,500 RPM

Complete the measuring within three minutes.

NOTE:

When performing the 2 mode (2,500 rpm and idle) test, follow the measurement order prescribed by the regulations.

If the HC/CO concentration at 2,500 rpm does not comply with regulations, try the following procedure.

Race the engine again at 2,500 rpm for approx. 1 minute, and quickly repeat step 4 and 5 above. This may correct the problem.

Troubleshooting

If the HC/CO concentration does not comply with regulations, perform troubleshooting in the order given below.

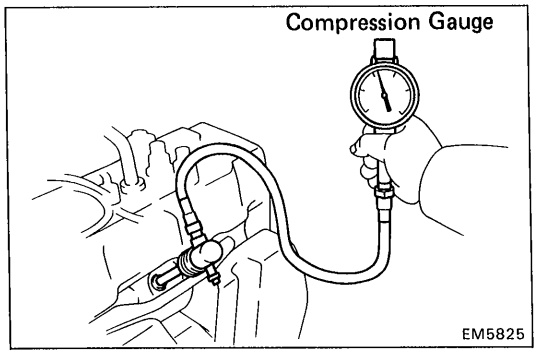
1. Check oxygen sensor operation
   (See page FI-98)
2. See the table below for possible cause, and then inspect and correct the applicable causes if necessary.

HC	CO	Symptoms	Causes
High	Normal	Rough idle	1. Faulty ignition: • Incorrect timing • Fouled, shorted or improperly gapped plugs • Open or crossed high-tension cords • Cracked distributor cap 2. Incorrect valve clearance 3. Leaky EGR valve 4. Leaky exhaust valves 5. Leaky cylinder
High	Low	Rough idle (Fluctuating HC reading)	1. Vacuum leak: • Vacuum hose • Intake manifold • Intake chamber • PCV line • Throttle body
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Plugged PCV valve 3. AS system problem 4. Faulty EFI system: • Faulty pressure regulator • Clogged fuel return line • Faulty air flow meter • Defective water temp. sensor • Defective air temp. sensor • Faulty ECU • Faulty injector • Faulty cold start injector

COMPRESSION CHECK

HINT: If there is lack of power, excessive oil consumption or poor fuel mileage, measure the cylinder compression pressure.

1. **WARM UP ENGINE**
2. **REMOVE SPARK PLUGS**
3. **DISCONNECT DISTRIBUTOR CONNECTOR**
4. **DISCONNECT COLD START INJECTOR CONNECTOR**
5. **MEASURE CYLINDER COMPRESSION PRESSURE**



(a) Insert a compression gauge into the spark plug hole.

(b) Fully open the throttle.

(c) While cranking the engine with the starter motor, measure the compression pressure.

NOTICE: This test must be done for as short a time as possible to avoid overheating of the catalytic converter.

HINT: A fully charged battery must be used to obtain at least 250 rpm.

(d) Repeat steps (a) through (c) for each cylinder.

Compression pressure:
12.0 kg/cm² (171 psi, 1,177 kPa)

Minimum pressure:
10.0 kg/cm² (142 psi, 981 kPa)

Difference between each cylinder:
Less than 1.0 kg/cm² (14 psi, 98 kPa)

(e) If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps (a) through (c) for the low compression cylinder.

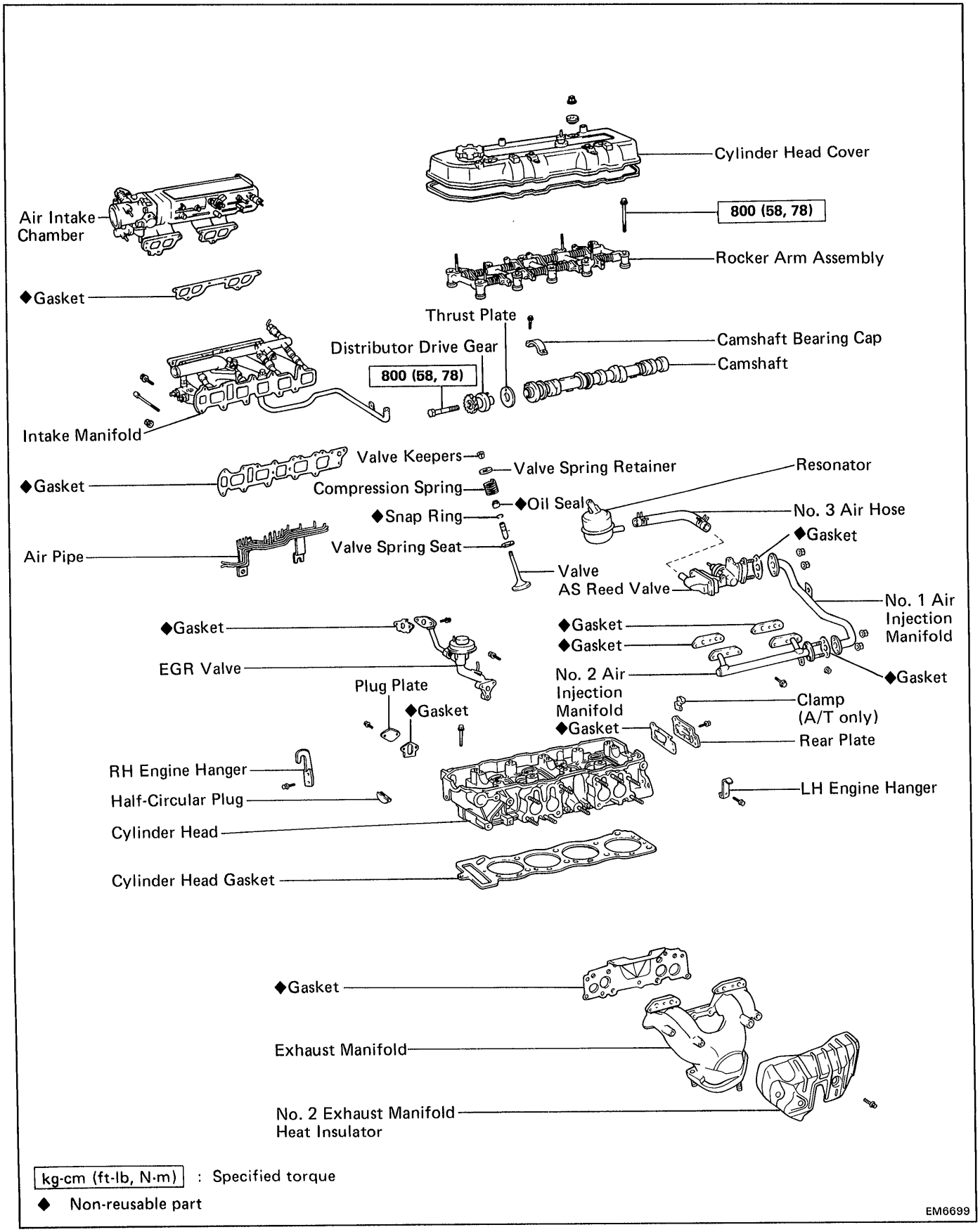
- If adding oil helps the compression, chances are that the piston rings and/or cylinder bore are worn or damaged.
- If pressure stays low, a valve may be sticking or seating improperly, or there may be leakage past the gasket.

6. **CONNECT COLD START INJECTOR CONNECTOR**
7. **CONNECT DISTRIBUTOR CONNECTOR**
8. **INSTALL SPARK PLUGS**

Torque: 180 kg-cm (13 ft-lb, 18 N·m)

CYLINDER HEAD

COMPONENTS



kg-cm (ft-lb, N·m) : Specified torque

◆ Non-reusable part

EM6699

PREPARATION FOR REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY**

2. **DRAIN COOLANT FROM RADIATOR AND CYLINDER BLOCK**
   (See step 3 on page CO-5)

3. **REMOVE INTAKE AIR CONNECTOR**

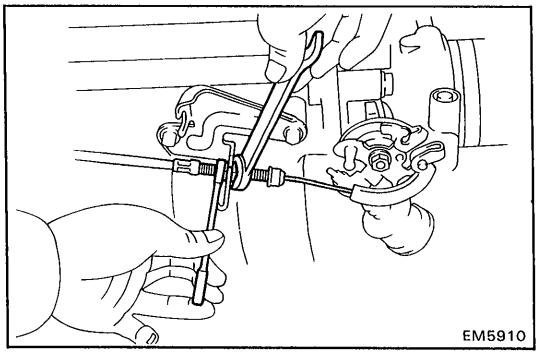
4. **DISCONNECT EXHAUST PIPE FROM EXHAUST MANIFOLD**
   (a) Remove the exhaust pipe clamp.
   (b) Remove the three nuts, and disconnect the exhaust pipe.

5. **REMOVE OIL DIPSTICK**

6. **REMOVE DISTRIBUTOR AND SPARK PLUGS**

7. **REMOVE RADIATOR INLET HOSE**

8. **DISCONNECT HEATER WATER INLET HOSE FROM HEATER WATER INLET PIPE**


EM5910

9. **DISCONNECT ACCELERATOR WIRE**

10. **(A/T)**
    DISCONNECT THROTTLE CABLE
    Disconnect the throttle cable from the bracket and clamp.

11. **DISCONNECT GROUND STRAP FROM ENGINE REAR SIDE**

12. **DISCONNECT FOLLOWING PARTS:**
    (a) No.1 and No.2 PCV hoses
    (b) Brake booster hose
    (c) (w/ PS)
    Air control valve hoses
    (d) (with A/C)
    VSV hoses
    (e) EVAP hose
    (f) EGR vacuum modulator hose
    (g) EGR valve hose
    (h) Fuel pressure up hose
    (i) Reed valve hose
    (j) Pressure regulator hose
    (k) Vacuum hoses from throttle body
    (l) No.2 and No.3 water by-pass hoses from the throttle body
    (m) (w/ Oil cooler)
    Disconect the No.1 oil cooler hose from the intake manifold.

    (w/o Oil cooler)
    Disconnect the No.1 water by-pass hose from the intake manifold.

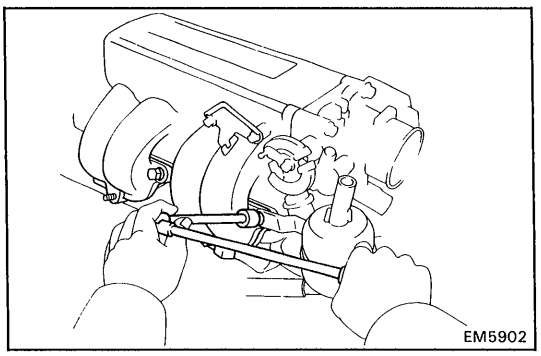
13. REMOVE EGR VACUUM MODULATOR

14. DISCONNECT FOLLOWING WIRES:

(a) Cold start injector wire

(b) Throttle position wire

(c) (California only)
EGR gas temp. sensor wire



15. REMOVE CHAMBER WITH THROTTLE BODY

(a) Remove the union bolt holding the cold start injector pipe to the chamber.

(b) Remove the bolts holding the No.1 EGR pipe to the chamber.

(c) Remove the bolts holding the manifold stay to the chamber.

(d) Remove the four bolts, two nuts, bond strap and fuel hose clamp.

(e) Remove the chamber with the throttle body, resonator and gasket.

16. DISCONNECT FUEL RETURN HOSE

17. DISCONNECT FOLLOWING WIRES:

(a) Knock sensor wire

(b) Oil pressure sender gauge wire

(c) Starter wire (terminal 50)

(d) Transmission wires

(e) (with A/C)
Compressor wires

(f) Injector wires

(g) Water temp. sender gauge wire

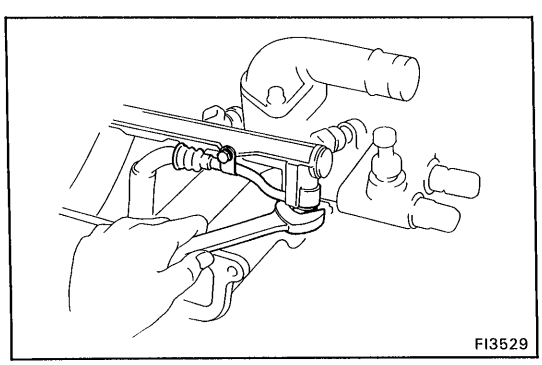
(h) (A/T)
OD temp. switch wire

(i) Igniter wire

(j) VSV wires

(k) Cold start injector time switch wire

(l) Water temp. sensor wire

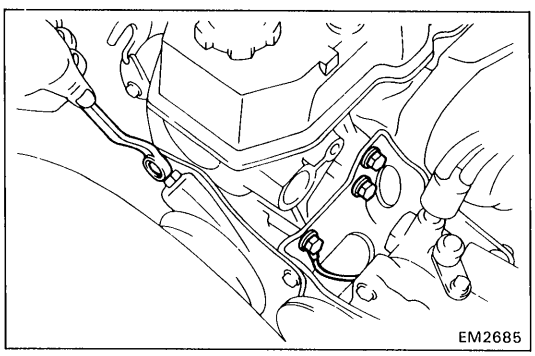


18. DISCONNECT FUEL HOSE FROM DELIVERY PIPE

Remove the bolt, union bolt and two gaskets.

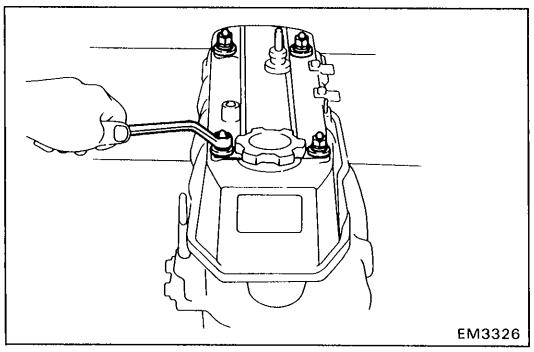
19. DISCONNECT BY-PASS HOSE FROM INTAKE MANIFOLD

20. (w/ PS)
REMOVE PS BELT



21. (w/ PS)
DISCONNECT PS BRACKET FROM CYLINDER HEAD

Remove the four bolts, disconnect the ground strap and bracket.


EM3326

REMOVAL OF CYLINDER HEAD

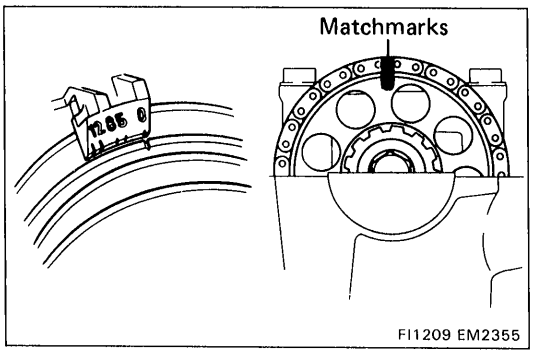
1. REMOVE HEAD COVER

(a) Remove the ground strap from the body.

(b) Remove the four nuts and seals.

(c) Remove the head cover.

NOTICE: Cover the oil return hole in the head with a rag to prevent objects from falling in.



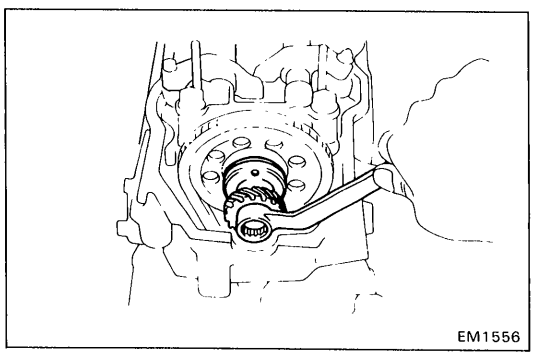
FI1209 EM2355

2. REMOVE CAM SPROCKET BOLT

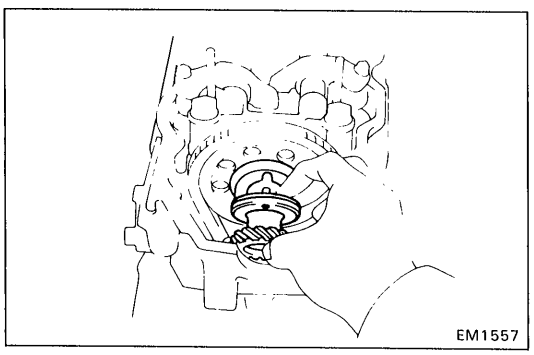
(a) Turn the crankshaft until the No.1 cylinder position is set at TDC compression.

(b) Place matchmarks on the sprocket and chain.

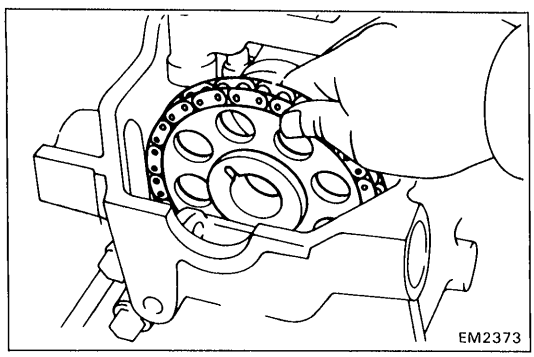
(c) Remove the half-circular plug.


EM1556

(d) Remove the cam sprocket bolt.

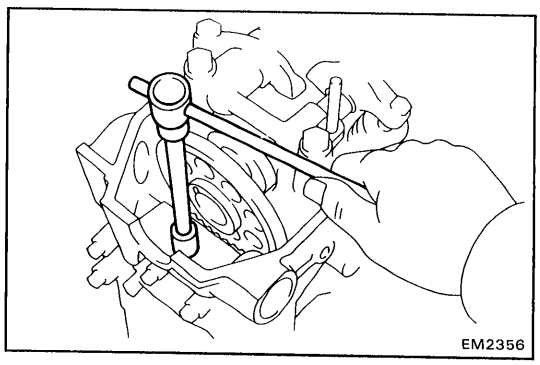

EM1557

3. REMOVE DISTRIBUTOR DRIVE GEAR AND CAMSHAFT THRUST PLATE


EM2373

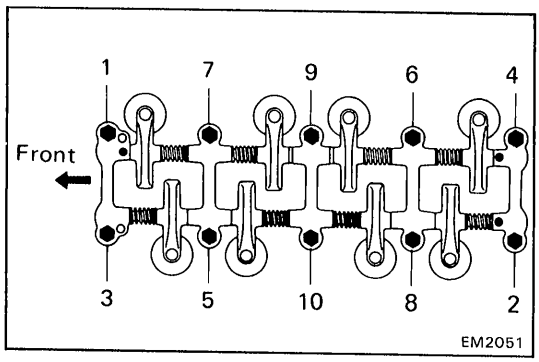
4. REMOVE CAM SPROCKET

Remove the cam sprocket and chain from the camshaft and leave on the vibration damper.



5. REMOVE CHAIN COVER BOLT

Remove the bolt in front of the head before the other head bolts are removed.



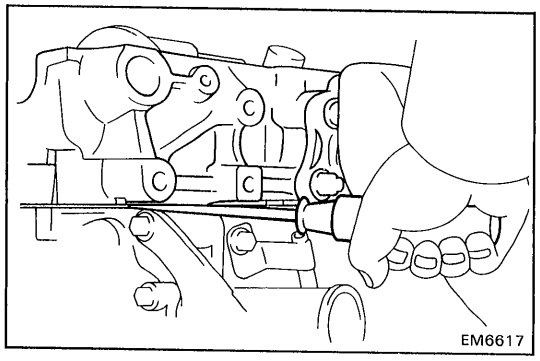
6. REMOVE CYLINDER HEAD BOLTS

Remove the head bolts gradually in two or three passes and in the numerical order shown.

NOTICE: Head warpage or cracking could result from removing in incorrect order.

7. REMOVE ROCKER ARM ASSEMBLY

It may be necessary to use a pry bar on the front and rear of the rocker arm assembly to separate it from the head.

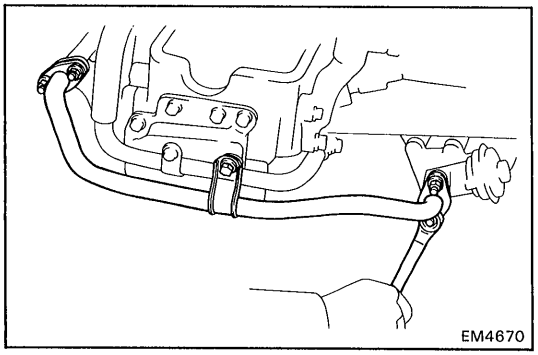


8. REMOVE CYLINDER HEAD

Lift the cylinder head from the dowels on the cylinder block and place the head on wooden blocks on a bench.

HINT: If the cylinder head is difficult to lift off, pry with a screwdriver between the head and block saliences.

NOTICE: Be careful not to damage the cylinder head and block surfaces of the cylinder head gasket side.

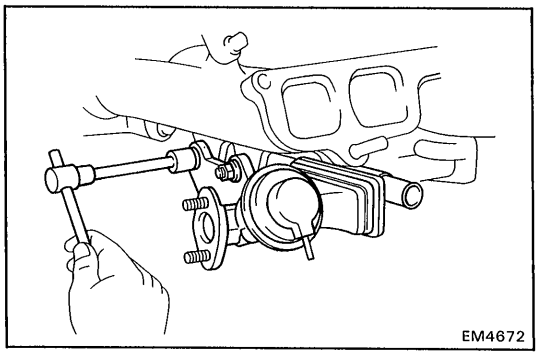


DISASSEMBLY OF CYLINDER HEAD

(See page EM-11)

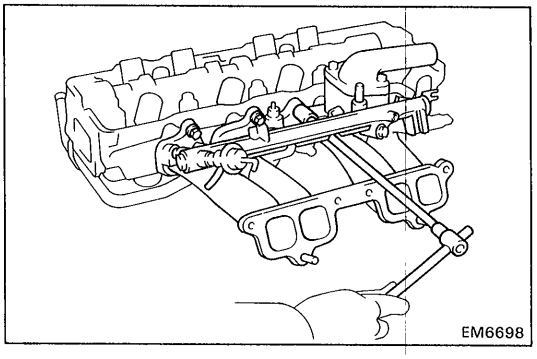
1. REMOVE NO.1 AIR INJECTION MANIFOLD

Remove the bolt, four nuts, No.1 air injection manifold and two gaskets.



2. REMOVE INTAKE MANIFOLD WITH DELIVERY PIPE AND INJECTION NOZZLE

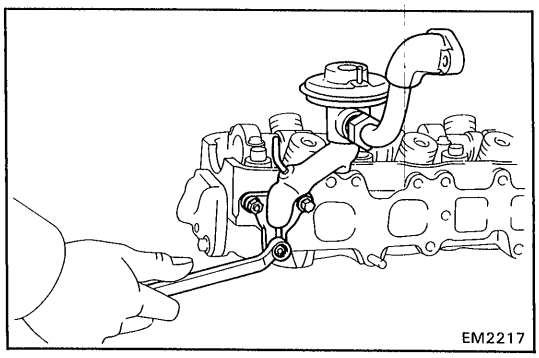
(a) Remove the two nuts and read valve.



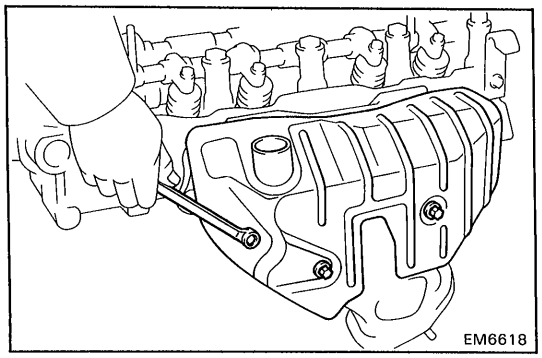
(b) Remove the bolt the heater inlet pipe from the cylinder head.

(c) Remove the seven bolts, one hexagon bolt, two nuts and No.1 air pipe.

(d) Remove the intake manifold together with the delivery pipe, injection nozzles and heater water inlet pipe.

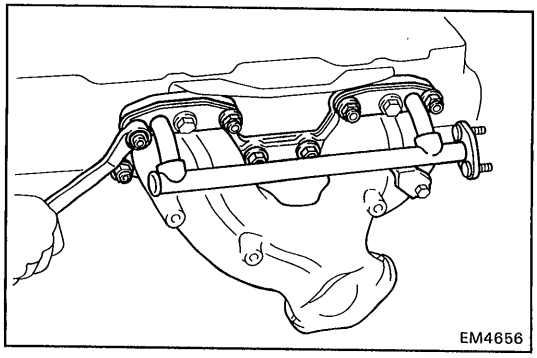


3. REMOVE EGR VALVE



4. REMOVE EXHAUST MANIFOLD WITH NO.2 AIR INJECTION MANIFOLD

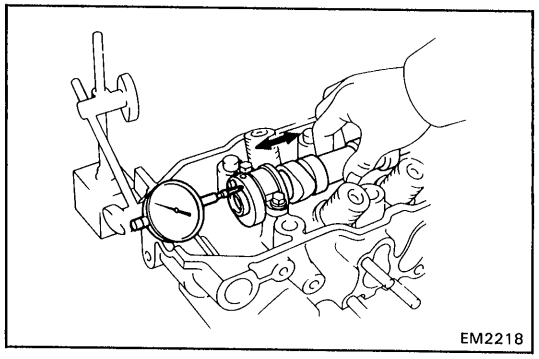
(a) Remove the three bolts and No.2 exhaust manifold heat insulator.



(b) Remove the eight nuts, exhaust manifold and No.1 exhaust manifold heat insulator.

5. REMOVE TWO ENGINE HANGERS AND GROUND STRAP

6. REMOVE CYLINDER HEAD REAR COVER



7. MEASUE CAMSHAFT THRUST CLEARANCE

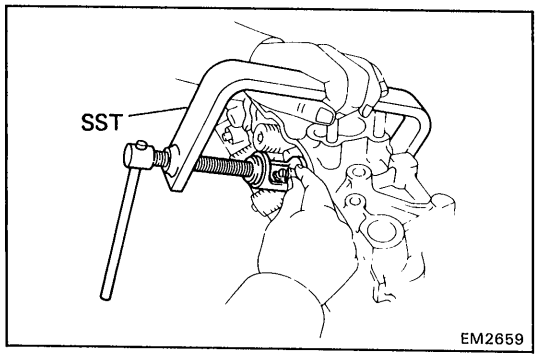
Using a dial gauge, measure the camshaft thrust clearance.

Standard clearance: **0.08 — 0.18 mm (0.0031 — 0.0071 in.)**

Maximum clearance: **0.25 mm (0.0098 in.)**

If clearance is greater than maximum, replace the head.

8. REMOVE CAM BEARING CAPS AND SHAFT



9. REMOVE VALVES

(a) Using SST, compress the valve retainer until the two keepers can be removed.

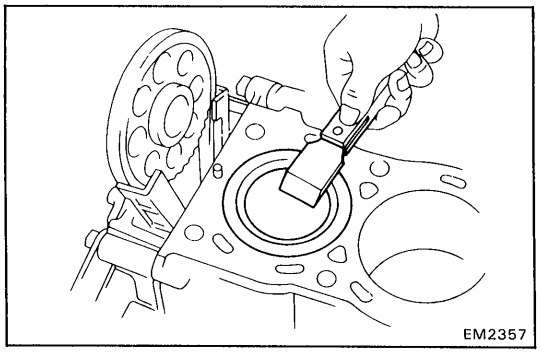
SST 09202-43013

(b) Remove the valve keepers, retainers, springs and valves.

(c) Pry out the oil seal.

(d) Using a small screwdriver or magnet, remove the valve spring seats.

HINT: Keep the valves arranged so they can be installed in the same order as removed.


EM2357

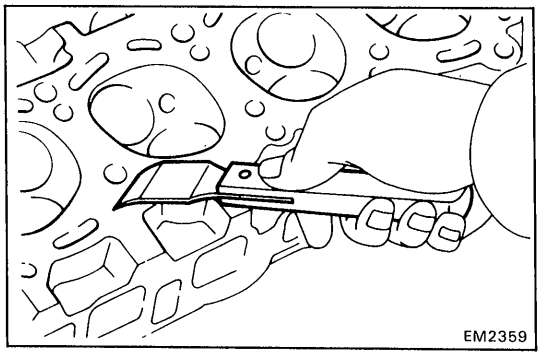
INSPECTION, CLEANING AND REPAIR OF CYLINDER HEAD COMPONENTS

1. CLEAN TOP OF PISTONS AND TOP OF CYLINDER BLOCK

(a) Turn the crankshaft and bring each piston to top dead center. Using a gasket scraper, remove all the carbon from the piston tops.

(b) Using a gasket scraper, remove all gasket material from the top of the block. Blow carbon and oil from the bolt holes.

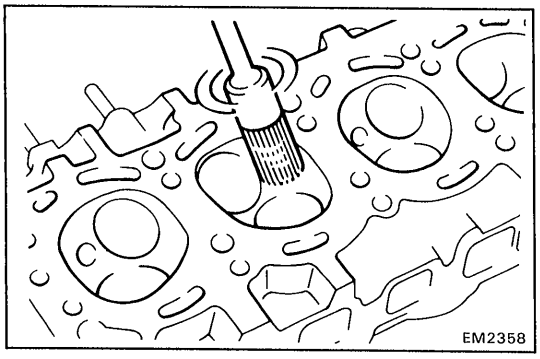
CAUTION: Protect your eyes when using high pressure air.


EM2359

2. REMOVE GASKET MATERIAL

Using a gasket scraper, remove all gasket material from the head and manifold surfaces.

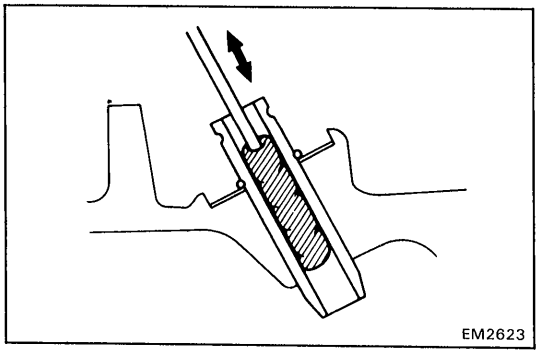
NOTICE: Be careful not to scratch the surfaces.


EM2358

3. CLEAN COMBUSTION CHAMBER

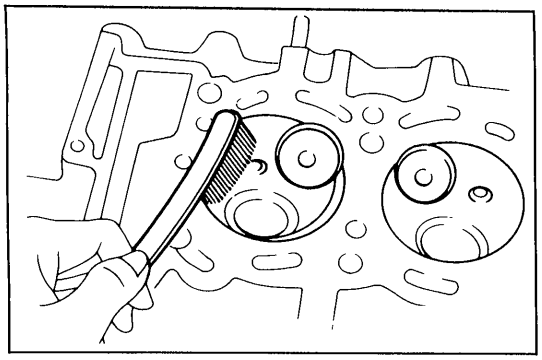
Using a wire brush, remove all the carbon from the combustion chambers.

NOTICE: Be careful not to scratch the head gasket contact surface.


EM2623

4. CLEAN VALVE GUIDE BUSHINGS

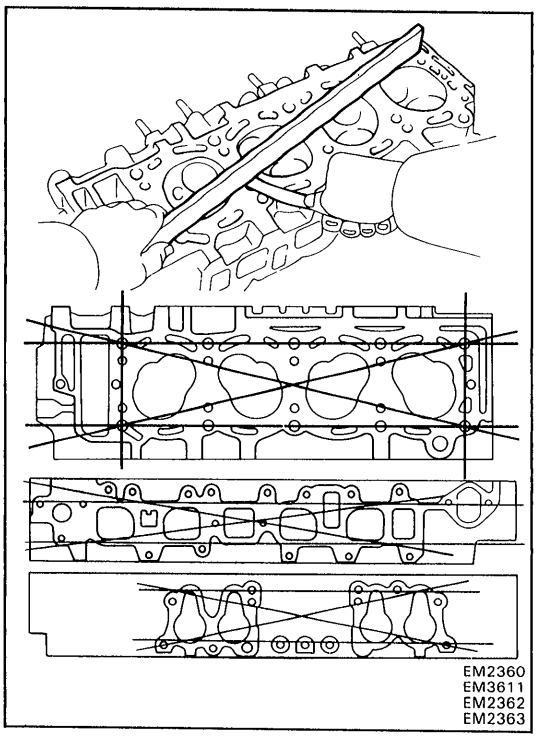
Using a valve guide brush and solvent, clean all the valve guides bushings.



5. CLEAN CYLINDER HEAD

Using a soft brush and solvent, clean the head.

NOTICE: Do not clean the head in a hot tank as this will seriously damage it.

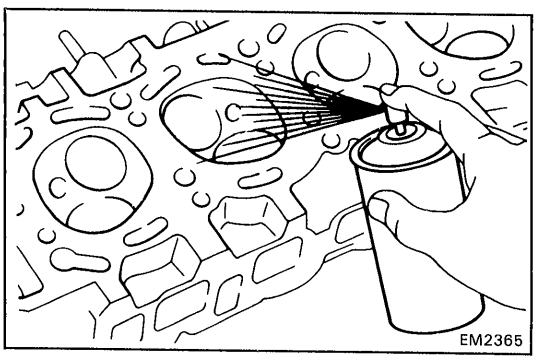


6. INSPECT CYLINDER HEAD FOR FLATNESS

Using a precision straight edge and thickness gauge, measure the surface contacting the cylinder block and manifold for warpage.

Maximum head surface warpage:
0.15 mm (0.0059 in.)
Maximum manifold surface warpage:
0.20 mm (0.0079 in.)

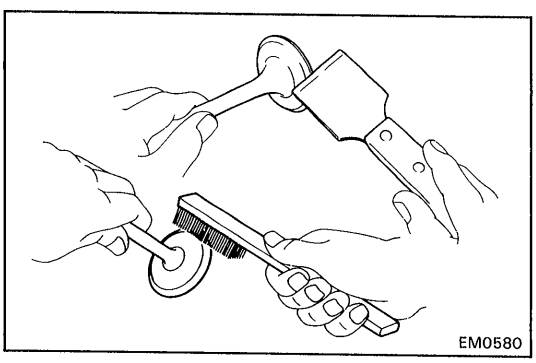
If warpage is greater than maximum, replace the cylinder head.



7. INSPECT CYLINDER HEAD FOR CRACKS

Using a dye penetrant, check the combustion chamber, intake and exhaust ports, head surface and the top of the head for cracks.

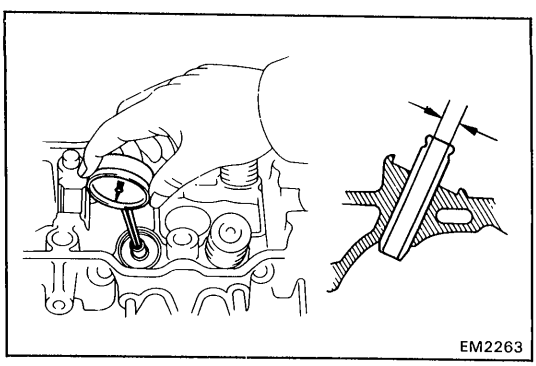
If a crack is found, replace the head.



8. CLEAN VALVES

(a) Use a gasket scraper to chip any carbon from the valve head.

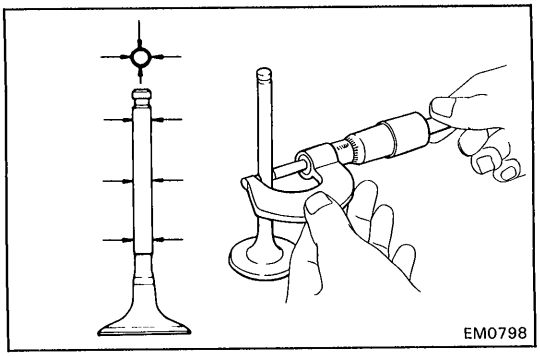
(b) Using a wire brush, thoroughly clean the valve.



9. INSPECT VALVE STEM GUIDE WEAR

(a) Using a dial indicator or telescoping gauge, measure the inside diameter of the valve guide.

Standard inside diameter: 8.01 — 8.03 mm (0.3154 — 0.3161 in.)



(b) Using a micrometer, measure the diameter of the valve stem.

Standard valve stem diameter:

Intake	**7.970 — 7.985 mm (0.3138 — 0.3144 in.)**
Exhaust	**7.965 — 7.980 mm (0.3136 — 0.3142 in.)**

(c) Subtract the valve stem measurement from the valve guide measurement.

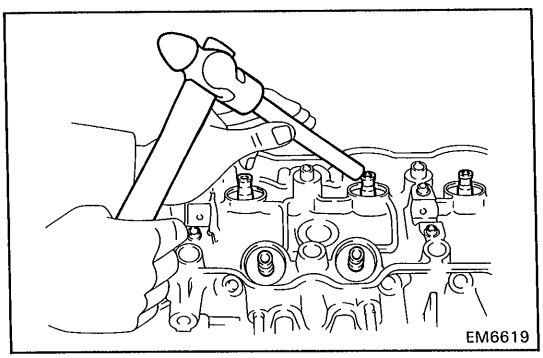
Standard oil clearance:

Intake	**0.025 — 0.060 mm (0.0010 — 0.0024 in.)**
Exhaust	**0.030 — 0.065 mm (0.0012 — 0.0026 in.)**

Maximum stem oil clearance:

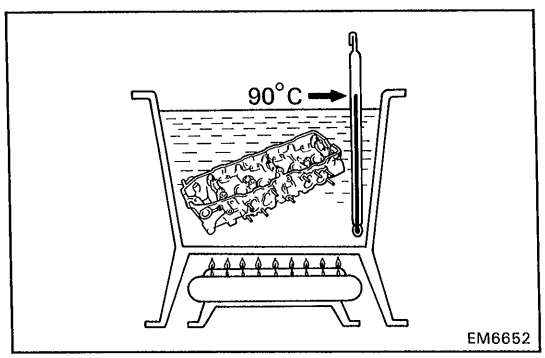
Intake	**0.08 mm (0.0031 in.)**
Exhaust	**0.10 mm (0.0039 in.)**

If the clearance is greater than maximum, replace the valve and guide.

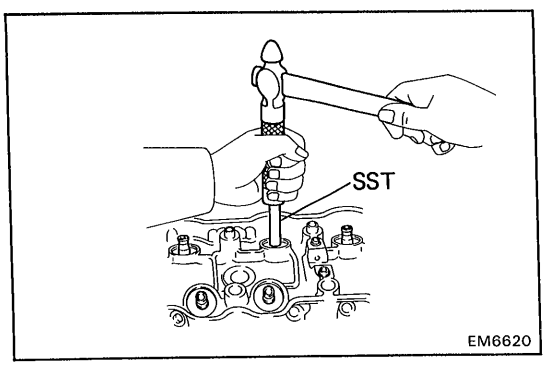


10. IF NECESSARY, REPLACE VALVE GUIDE BUSHINGS

(a) Using a brass bar and hammer, break the valve guide.

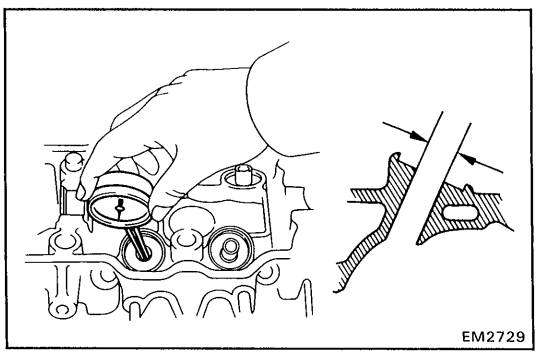


(b) Gradually heat the cylinder head to approx. 90°C (194°F).



(c) Using SST and hammer, drive out valve guide bushing.

SST 09201-60011



(d) Using a dial indicator or telescoping gauge, measure the valve guide bore of the cylinder head.

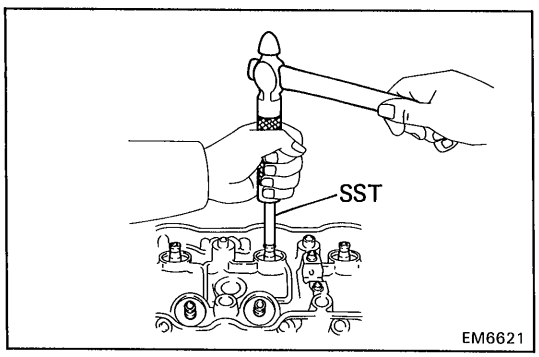
(e) Select a new valve guide.

If the valve guide bore of the cylinder head is more than 13.018 mm (0.5125 in.), machine the bore to the following dimension.

Rebored valve guide bushing bore dimension (cold): 13.050 — 13.068 mm (0.5138 — 0.5145 in.)

Bore intake and exhaust

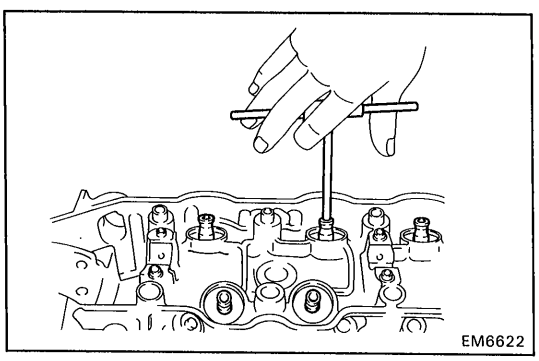
Guide bore mm (in.)	Guide size
13.000 – 13.018 (0.5118 – 0.5125)	Use STD
Over 13.018 (0.5125)	Use O/S 0.05



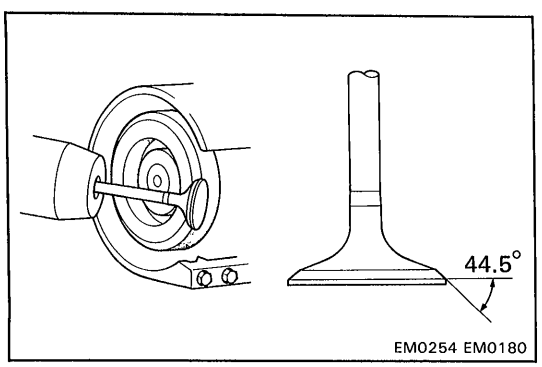
(f) Gradually heat the cylinder head to approx. 90°C (194°F).

(g) Using SST and hammer, drive in a new valve guide bushing until the snap ring makes contact with the cylinder head.

SST 09201-60011



(h) Using a sharp 8 mm (0.31 mm) reamer, ream the valve guide bushing to obtain standard specified clearance (See page EM-21) between the valve guide bushing and new valve.

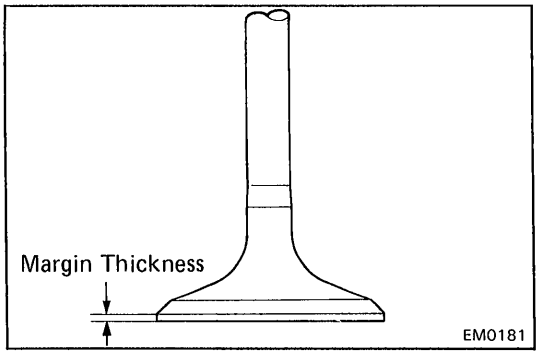


11. INSPECT AND GRIND VALVES

(a) Grind the valve only enough to remove pits and carbon.

(b) Check that the valve are ground to the correct valve face angle.

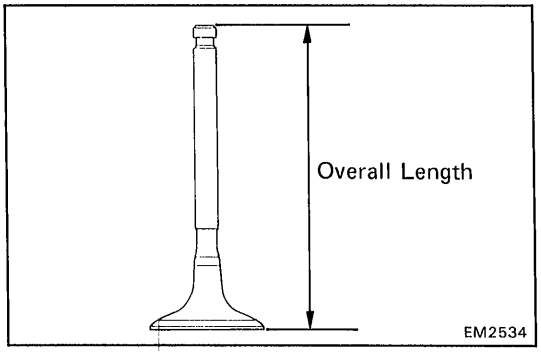
Valve face angle: 44.5°



(c) Check the valve head margin thickness.

Standard margin thickness: 1.0 mm (0.039 in.)
Minimum margin thickness: 0.6 mm (0.024 in.)

If the valve head margin thickness is less than minimum replace the valve.

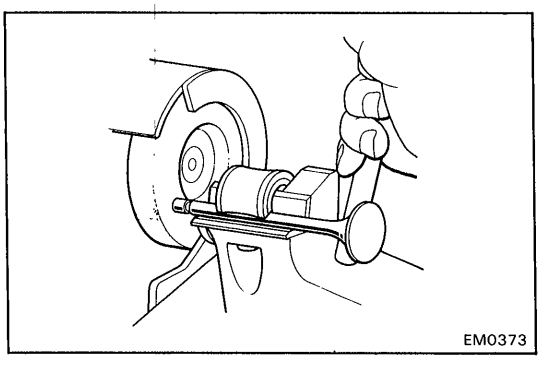


(d) Check the valve overall length.

Standard overall length:
Intake 113.5 mm (4.468 in.)
Exhaust 112.4 mm (4.425 in.)

Minimum overall length:
Intake 113.0 mm (4.449 in.)
Exhaust 111.9 mm (4.406 in.)

If the valve overall length is less than minimum, replace the valve.



(e) Check the surface of the valve stem tip for wear.

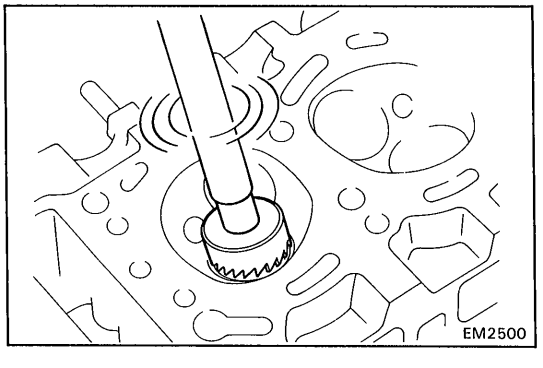
If the valve stem tip is worn, regrind it with grinder or replace the valve if necessary.

NOTICE: Do not grind off more than minimum overall length.

Minimum overall length:
Intake 113.0 mm (4.449 in.)
Exhaust 111.9 mm (4.406 in.)

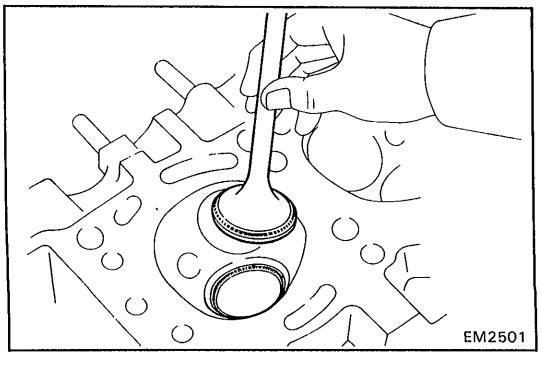
12. INSPECT AND CLEAN VALVE SEATS

(a) Using a 45° carbide cutter, resurface the valve seats. Remove only enough metal to clean the seats.



(b) Check the valve seating position.

Apply a thin coat of prussian blue (or white lead) to the valve face. Install the valve. Lightly press the valve against the seat. Do not rotate the valve.



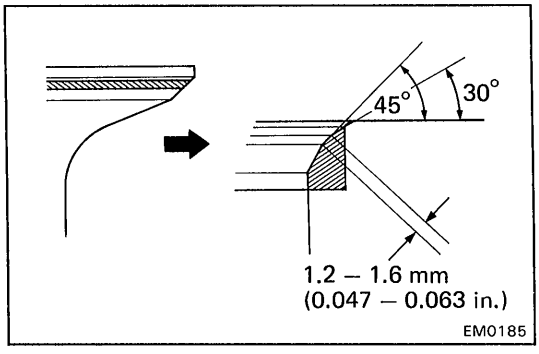
(c) Check the valve face and seat for the following:

- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
- If blue appears 360° around the valve seat, the guide and seat are concentric. If not, resurface the seat.
- Check that the seat contact is on the middle of the valve face with the following width:

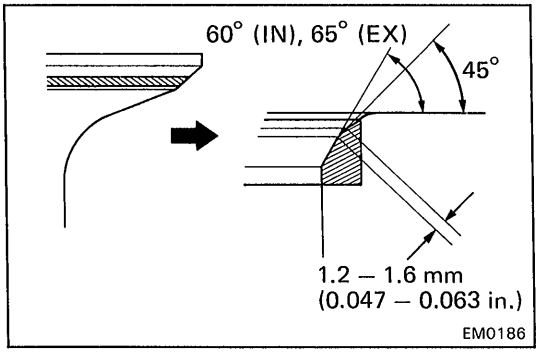
1.2 — 1.6 mm (0.047 — 0.063 in.)

If not, correct the valve seat as follows:

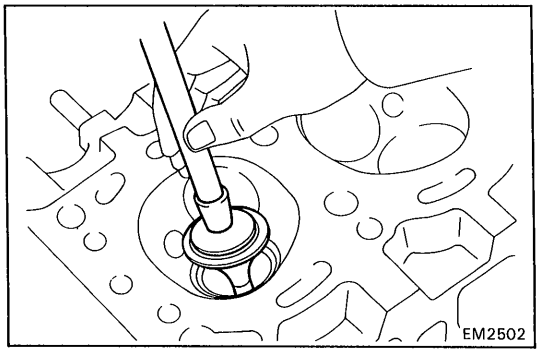
- If seating is too high on the valve face use 30° and 45° cutters to correct the seat.



- If seating is too low on the valve face, use 60° (IN) or 65° (EX) and 45° cutters to correct the seat.



(d) Hand-lap the valve and valve seat with abrasive compound.

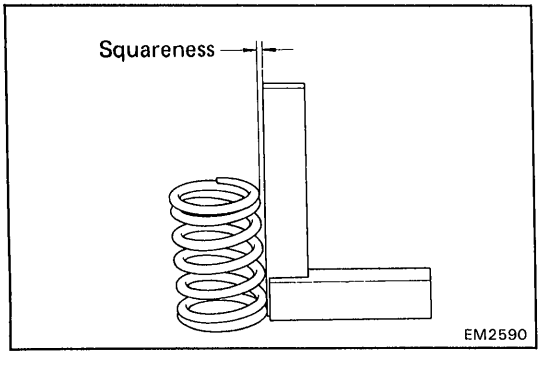


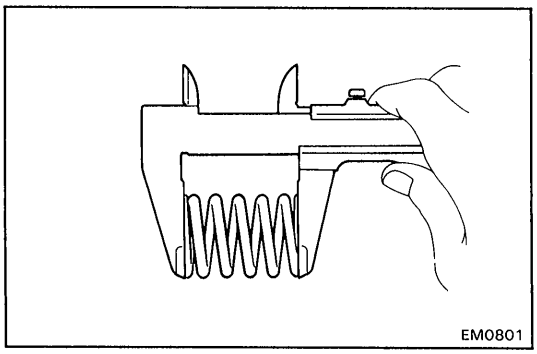
13. INSPECT VALVE SPRINGS

(a) Using a steel square, measure the squareness of the valve springs.

Maximum squareness: 1.6 mm (0.063 in.)

If squareness is greater than maximum, replace the valve spring.

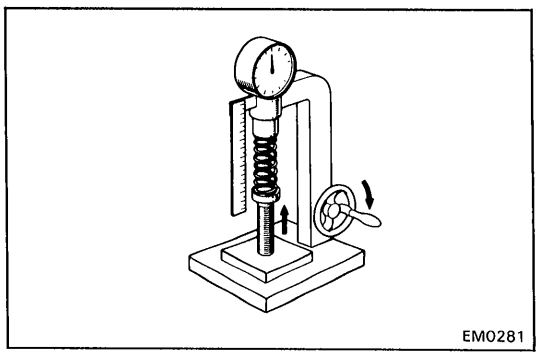



EM0801

(b) Using calipers, measure the free length of the valve spring.

Free height: 48.5 mm (1.909 in.)

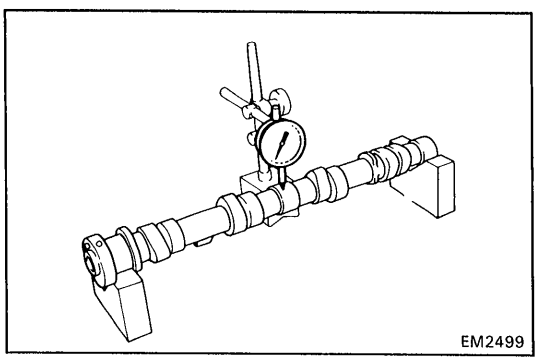
If the free length is not within specification, replace the valve spring.


EM0281

(c) Using a spring tester, check the tension of each spring at the specified installed height.

Installed height: 40.5 mm (1.594 in.)
Standard installed tension: 30.0 kg (66.1 lb, 294 N)
Minimum installed tension: 28.5 kg (62.8 lb, 279 N)

If the installed tension is less than minimum, replace the spring.

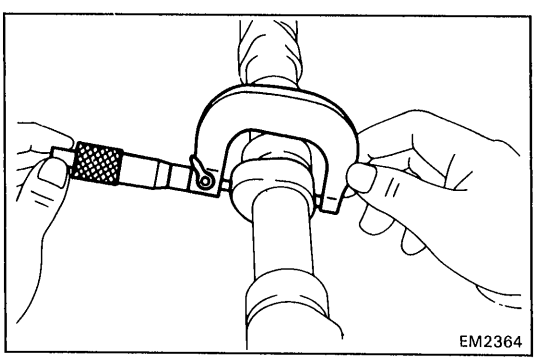

EM2499

14. INSPECT CAMSHAFT AND BEARING CAPS

(a) Place the camshaft on V-blocks and, using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.2 mm (0.008 in.)

If the circle runout is greater than maximum, replace the camshaft.

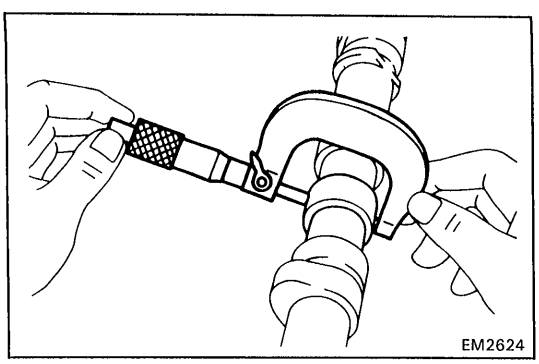

EM2364

(b) Using a micrometer, measure the cam lobe height.

Standard cam lobe height:
Intake 42.63 — 42.72 mm (1.6783 — 1.6819 in.)
Exhaust 42.69 — 42.78 mm (1.6807 — 1.6842 in.)

Minimum cam lobe height:
Intake 42.25 mm (1.6634 in.)
Exhaust 42.30 mm (1.6654 in.)

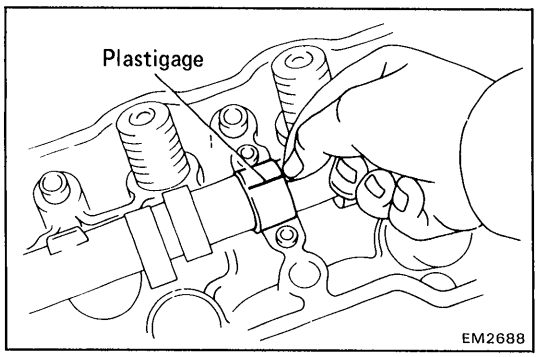
If the lobe height is less than minimum, replace the camshaft.


EM2624

(c) Using a micrometer, measure the journal diameter.

Standard diameter: 32.98 — 33.00 mm (1.2984 — 1.2992 in.)

If the journal diameter is less than specified, replace the camshaft.

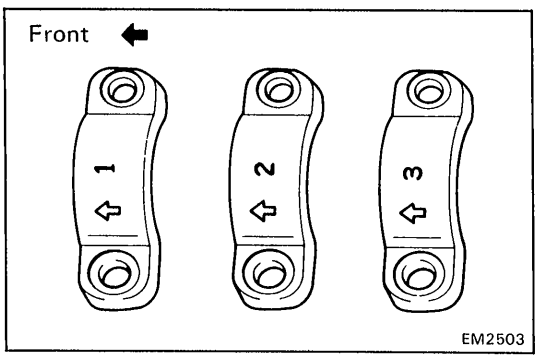


15. INSPECT CAMSHAFT OIL CLEARANCE

(a) Cleam the bearing caps and camshaft journal.

(b) Place the camshaft in the cylinder head.

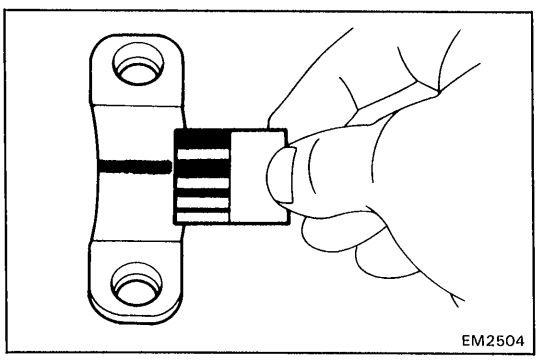
(c) Lay a strip of Plastigage across each journal.



(d) Install the correct numbered bearing cap on each journal with the arrows pointing toward the front. Torque each bolt.

Torque: 200 kg-cm (14 ft-lb, 20 N·m)

HINT: Do not turn the camshaft while the Plastigage is in place.



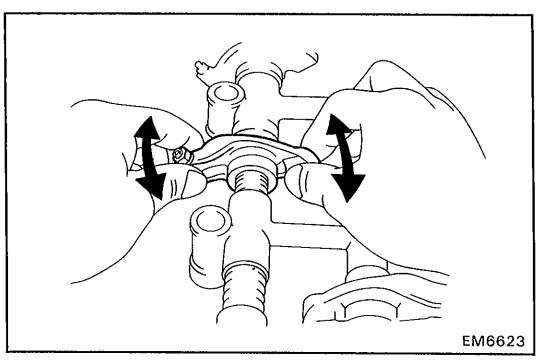
(e) Remove the caps and Measure the Plastigage at its widest point.

Standard clearance: 0.01 — 0.05 mm (0.0004 — 0.0020 in.)

Maximum clearance: 0.1 mm (0.004 in.)

If clearance is greater than maximum, replace the cylinder head and/or camshaft.

(f) Clean out the pieces of Plastigage from the bearing and journals.



16. INSPECT ROCKER ARMS

Check the clearance between the rocker arms and shaft by moving the rocker arms as shown. Little or no movement should be felt.

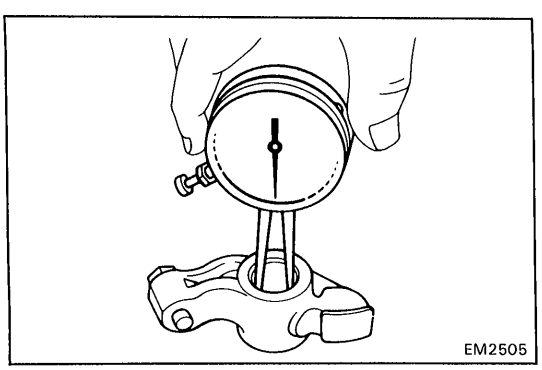
If movement is felt, disassemble the rocker arm assembly and measure the oil clearance as follows:

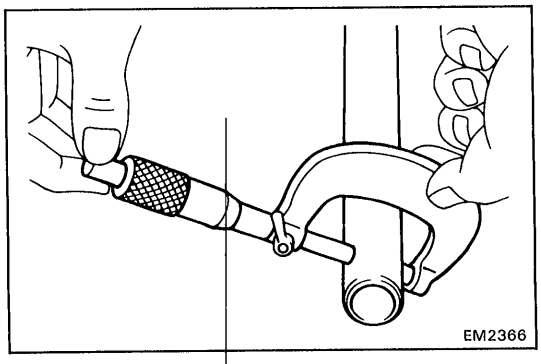
(a) Disassemble rocker arm assembly.

- Remove the three screws.
- Slide the rocker stands, springs and rocker arms off the shafts.

(b) Using a dial indicator or telescoping gauge, measure the inside diameter of the rocker arm.

Standard inside diameter: 16.000 — 16.018 mm (0.6299 — 0.6306 in.)




EM2366

(c) Using a micrometer, measure the outside diameter of the shaft.

Standard diameter: 15.97 — 15.99 mm (0.6287 — 0.6295 in.)

(d) Subtract the shaft diameter from the rocker arm diameter.

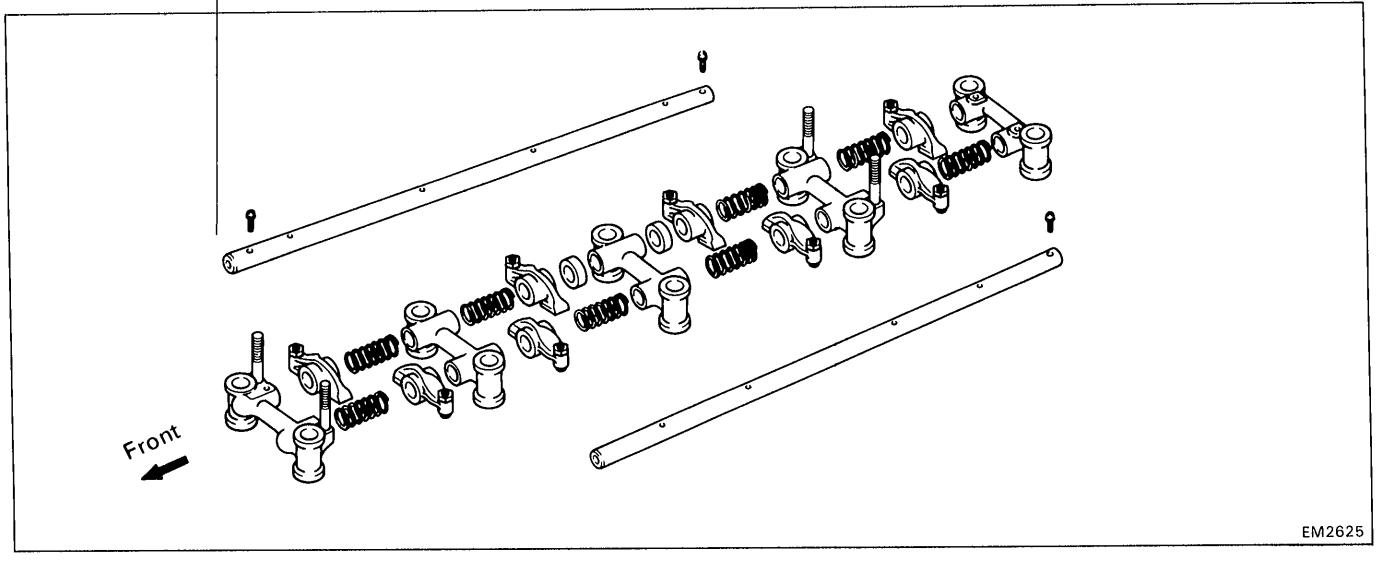
Standard oil clearance: 0.01 — 0.05 mm (0.0004 — 0.0020 in.)

Maximum oil clearance: 0.08 mm (0.0031 in.)

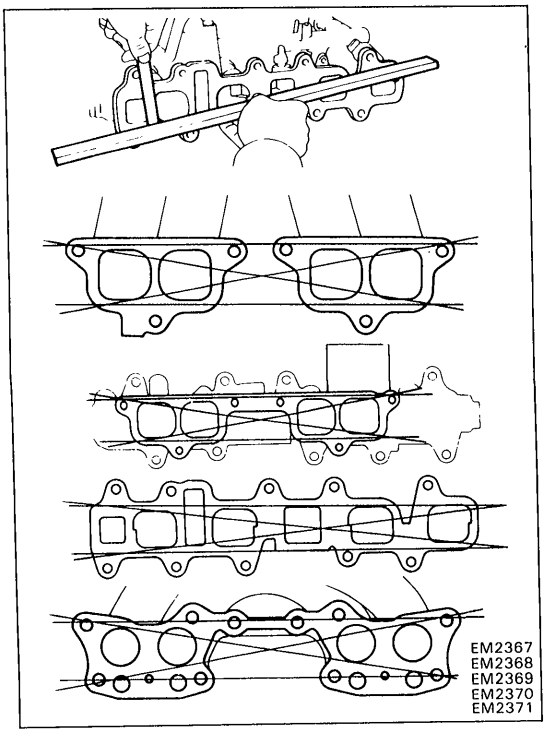
If the oil clearance is grater than maximum, replace the rocker arm and/or shaft.

(e) Assemble the rocker arm assembly as shown, and install the three screws.

HINT: All rocker arms are the same but all rocker stands are different and must be assembled in the correct order.



EM2625


EM2367
EM2368
EM2369
EM2370
EM2371

17. INSPECT INTAKE, EXHAUST MANIFOLD AND AIR INTAKE CHAMBER

Using a precision straight edge and thickness gauge, check the surfaces contacting the cylinder head or intake manifold for warpage.

Maximum intake warpage: 0.2 mm (0.008 in.)
Maximum exhaust warpage: 0.7 mm (0.028 in.)
Maximum air intake chamber warpage: 0.2 mm (0.008 in.)

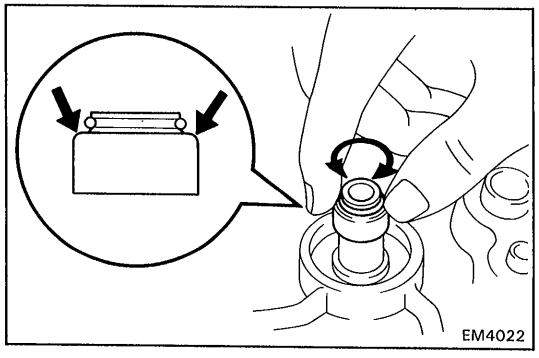
If warpage is greater than maximum, replace the manifold and/or air intake chamber.

ASSEMBLY OF CYLINDER HEAD

(See page EM-11)

HINT:

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply new engine oil to all sliding and rotating surfaces.
- Replace all gaskets and oil seals with new parts.


EM4022

1. INSTALL VALVES

(a) Install a new oil seal on the valve guide bushings.

HINT: Pushing down at the place shown in the illustration.

(b) Rotate the oil seal to check that it is firmly installed.

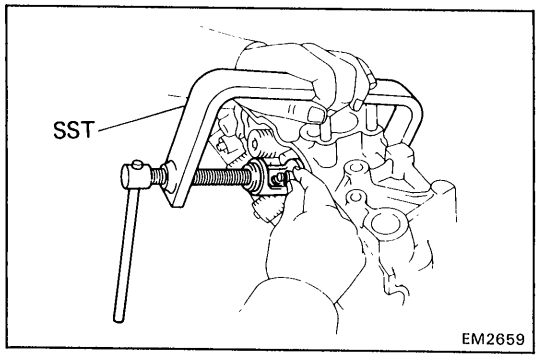
(c) Lubricate and insert valve in the valve guide bushing. Check that the valves are installed in the correct order.

(d) Install spring seat, spring and spring retainer on the cylinder head.

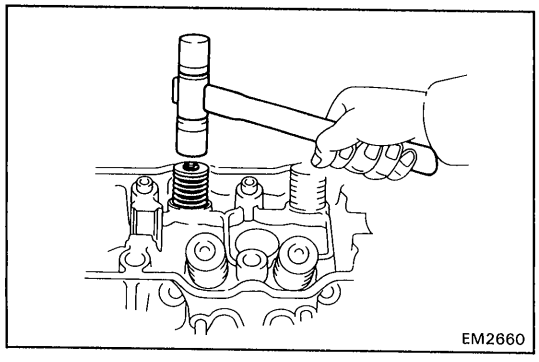
(e) Using SST, compress valve retainer and place two keepers around the valve stem.

SST 09202-43013

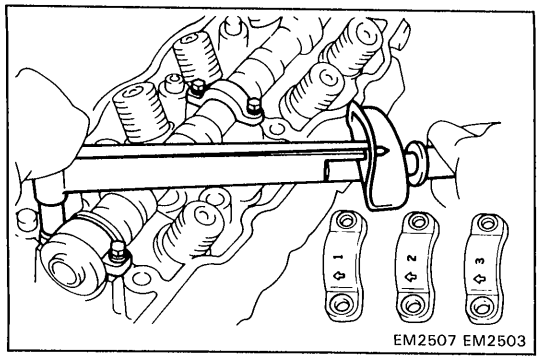
(f) Unscrew the SST confirm proper fit of the keepers.



EM2659


EM2660

(g) Tap the stem lightly to assure proper fit.



EM2507 EM2503

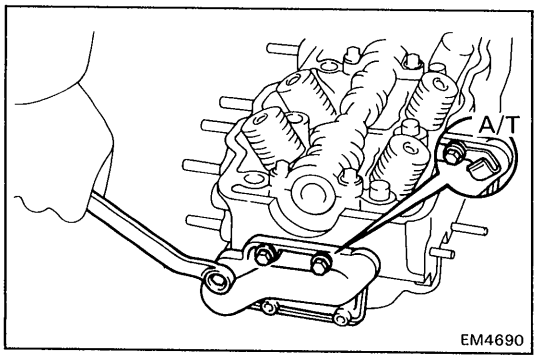
2. INSTALL CAMSHAFT

(a) Place the camshaft in the cylinder head and install the bearing caps in numbered order from the front with arrows pointing toward the front.

(b) Install and torque the cap bolts.

Torque: 200 kg-cm (14 ft-lb, 20 N·m)

(c) Turn the camshaft to position the dowel at the top.

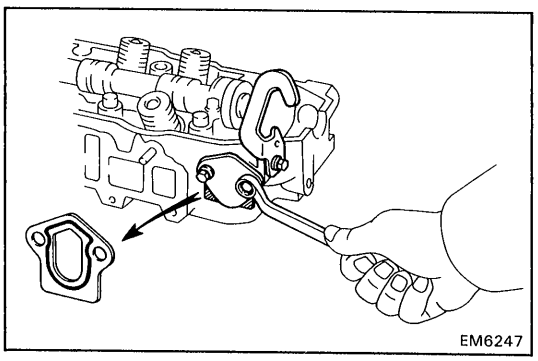


3. **INSTALL CYLINDER HEAD REAR COVER**

Install a new gasket, cylinder head rear cover and throttle cable clamp (for A/T) with the four bolts.

4. **INSTALL LH ENGINE HANGER AND GROUND STRAP**

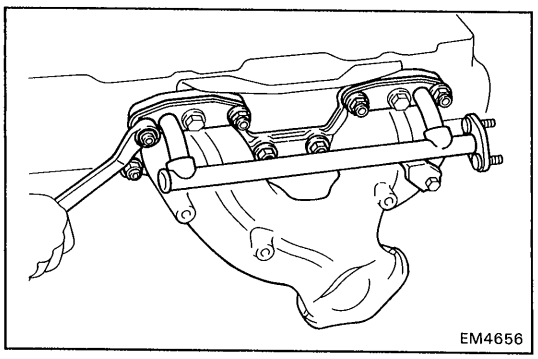
5. **INSTALL RH ENGINE HANGER**



6. **INSTALL PLUG PLATE**

Install a new gasket and plug plate with the two bolts.

HINT: Attach the flat side of the gasket to the cylinder head.

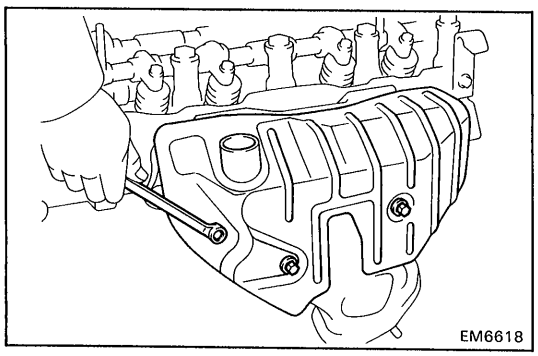


7. **INSTALL EXHAUST MANIFOLD**

(a) Position a new gasket on the cylinder head.

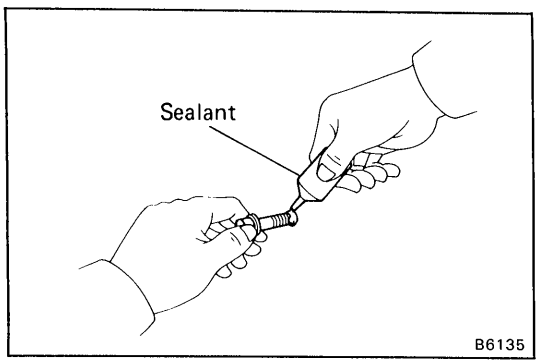
(b) Install the exhaust manifold with eight nuts. Torque the nuts.

Torque: 450 kg-cm (33 ft-lb, 44 N·m)



(c) Install the No.2 exhaust manifold heat insulator with the three bolts.

Torque: 195 kg-cm (14 ft-lb, 19 N·m)



8. **INSTALL EGR VALVE**

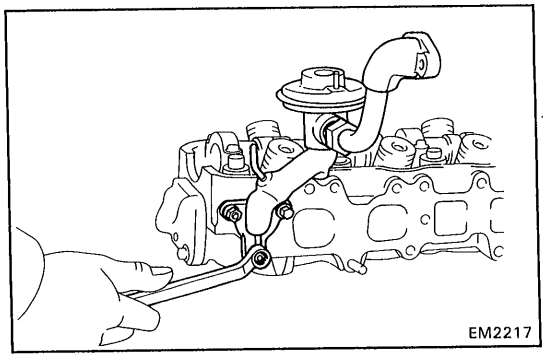
(a) Clean the set bolt (closest to the front) threads and cylinder head bolt holes of any sealer, oil or foreign particles.

Remove any oil with kerosene or gasoline.

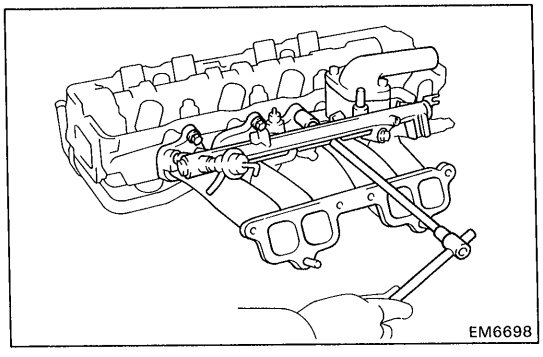
(b) Apply sealant to 2 or 3 threads of the bolt end.

Sealant: Part No. 08833-00070, THREE BOND 1324 or equivalent

- This adhesive will not harden while exposed to air. It will act as a sealer or binding agent only when applied to threads, etc. and air is cut off.



(c) Install the EGR valve with the two bolts and nut.



9. INSTALL INTAKE MANIFOLD

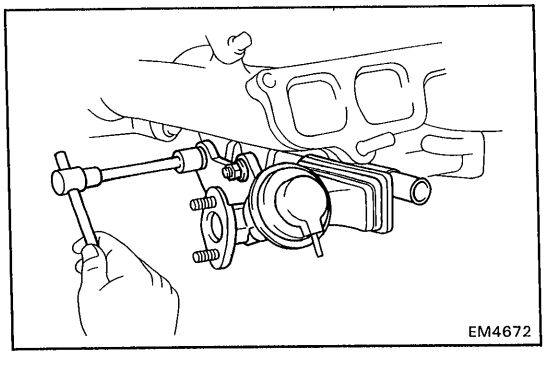
(a) Position a new gasket on the cylinder head.

(b) Install the intake manifold with the delivery pipe and injection nozzles and No.1 air pipe.

(c) Install the seven bolts, one hexagon bolt and two nuts. Torque the bolts and nuts.

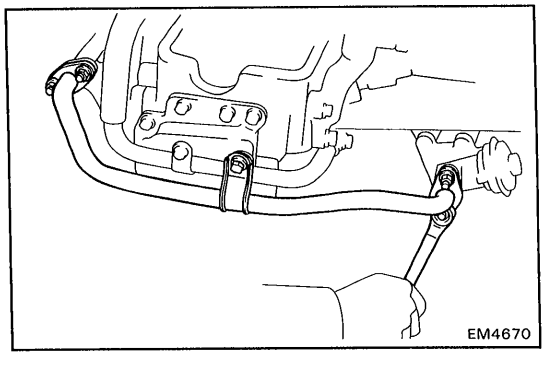
Torque: 195 kg-cm (14 ft-lb, 19 N·m)

(d) Install the bolt the heater inlet pipe to the cylinder head.



(e) Install the reed valve with the two nuts.

Torque: 130 kg-cm (9 ft-lb, 13 N·m)

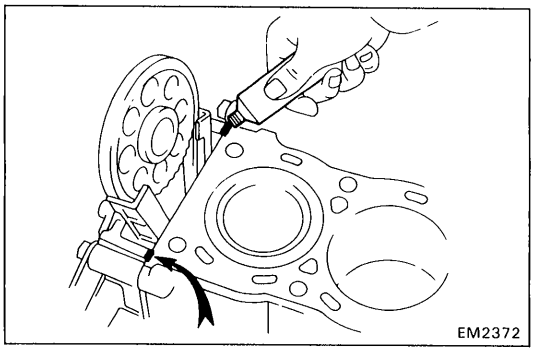


10. INSTALL NO.1 AIR INJECTION MANIFOLD

(a) Position new gaskets on the reed valve and No.2 air injection pipe.

(b) Install the No.1 air injection pipe with four nuts and bolt.

Torque: 130 kg-cm (9 ft-lb, 13 N·m)



INSTALLATION OF CYLINDER HEAD

(See page EM-11)

1. APPLY SEAL PACKING TO CYLINDER BLOCK

(a) Apply seal packing to two locations as shown.

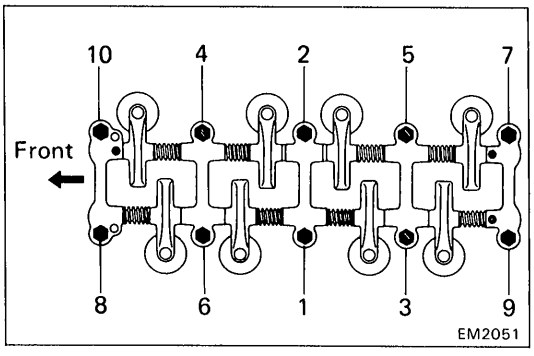
Seal packing: Part No. 08826-00080 or equivalent

(b) Place a new head gasket over dowels on the cylinder block.

2. INSTALL CYLINDER HEAD

(a) If the sprocket was removed, align the alignment marks placed on the sprocket and chain during removal.

(b) Position the cylinder head over dowels on the block.

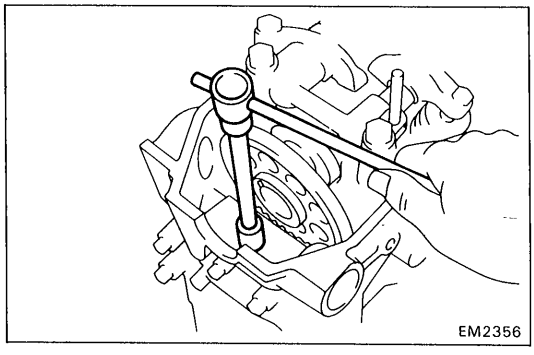


3. INSTALL ROCKER ARM ASSEMBLY

(a) Place the rocker arm assembly over the dowels on the cylinder head.

(b) Install and tighten the head bolts gradually in three passes and in the sequence shown. Torque the bolts on the final pass.

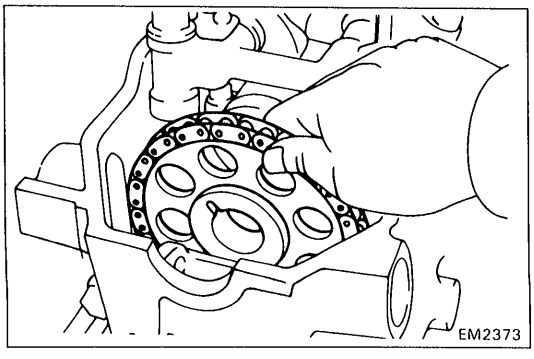
Torque: 800 kg-cm (58 ft-lb, 78 N·m)



4. INSTALL CHAIN COVER BOLT

Torque the bolt.

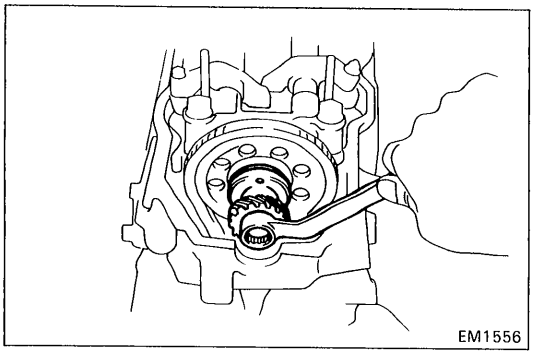
Torque: 130 kg-cm (9 ft-lb, 13 N·m)



(a) While holding up on the sprocket and chain, turn the crankshaft until the No. 1 and No. 4 cylinders are at top dead center.

(b) Place the chain sprocket over the camshaft dowel.

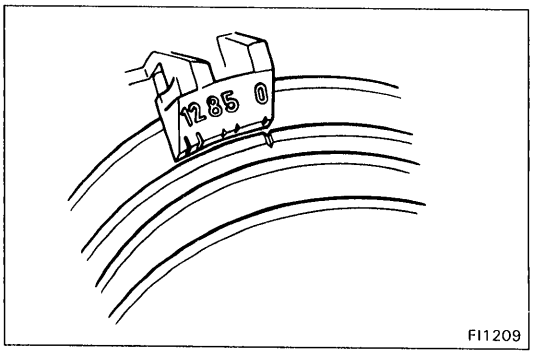
HINT: If the chain does not seem long enough, turn the crankshaft back and forth while pulling up on the chain and sprocket.


EM1556

5. INSTALL DISTRIBUTOR DRIVE GEAR AND CAMSHAFT THRUST PLATE

Place the distributor drive gear and camshaft thrust plate over the chain sprocket. Torque the bolt.

Torque: 800 kg-cm (58 ft-lb, 78 N·m)



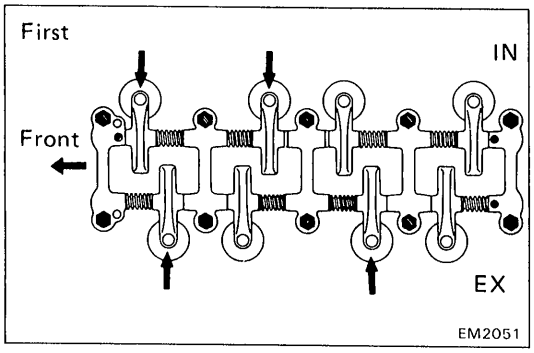
FI1209

6. ADJUST VALVES CLEARANCE

(a) Set the No.1 cylinder to TDC/compression.

- Turn the crankshaft with a wrench to align the timing marks at TDC. Set the groove on the pulley at the O mark position timing mark.
- Check that the rocker arms on the No.1 cylinder are loose and the rockers on No.4 are tight.

If not, turn the crankshaft one complete revolution and align the marks as above.



EM2051

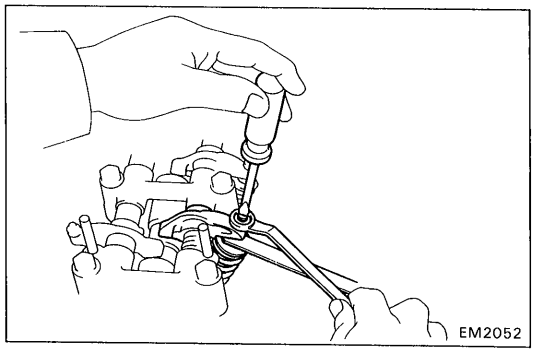
(b) Adjust the clearance of half of the valves.

- Adjust only those valves indicated by arrows as shown.

Valve clearance (Cold):

Intake	**0.20 mm (0.008 in.)**
Exhaust	**0.30 mm (0.012 in.)**

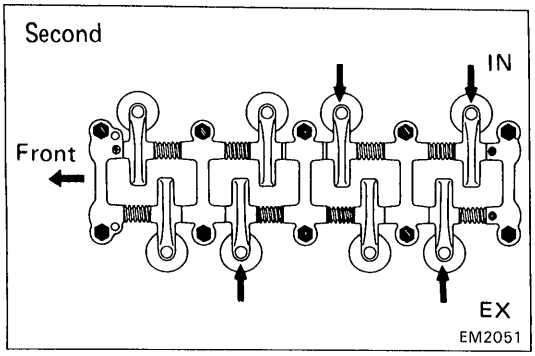
HINT: After installing the cylinder head, warm up the engine and adjust the valve clearance.


EM2052

- Use a thickness gauge to measure between the valve stem and rocker arm. Loosen the lock nut and turn the adjusting screw to set the proper clearance. Hold the adjusting screw in position and tighten the lock nut.

Torque: 250 kg-cm (18 ft-lb, 25 N·m)

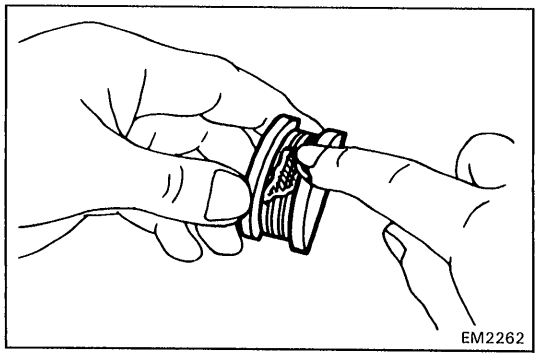
- Recheck the clearance. The thickness gauge should move with a very slight drag.



EM2051

(c) Turn the crankshaft one revolution and adjust the other valves.

(d) Set the No.1 cylinder to TDC/compression.

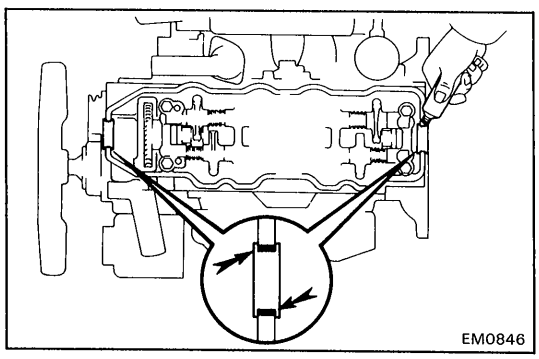


7. **INSTALL HALF-CIRCULAR PLUGS**

(a) Apply seal packing to the cylinder head installation surface of the plug.

Seal packing: Part No. 08826-00080 or equivalent

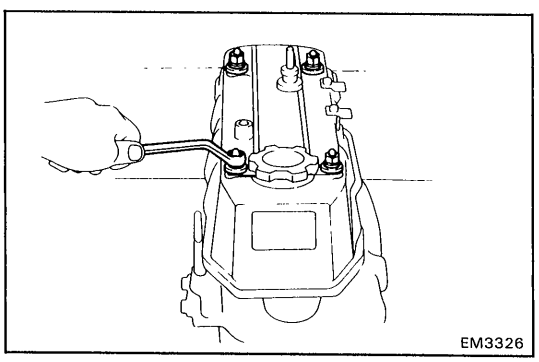
(b) Install the half-circular plugs to the cylinder head.



8. **INSTALL HEAD COVER**

(a) Apply seal packing to four the location shown.

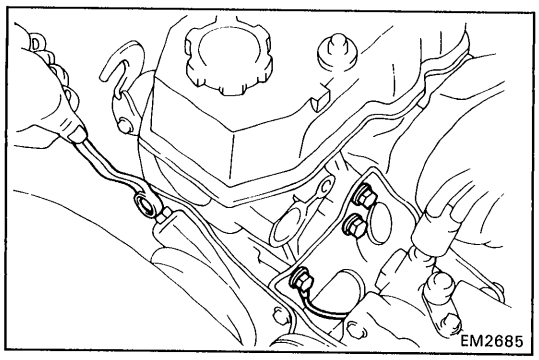
Seal packing: Part No. 08826-00080 or equivalent



(b) Install the gasket to the cylinder head.

(c) Place the head cover on the cylinder head and install the four seals and nuts.

Torque: 60 kg-cm (52 in.-lb, 5.9 N·m)

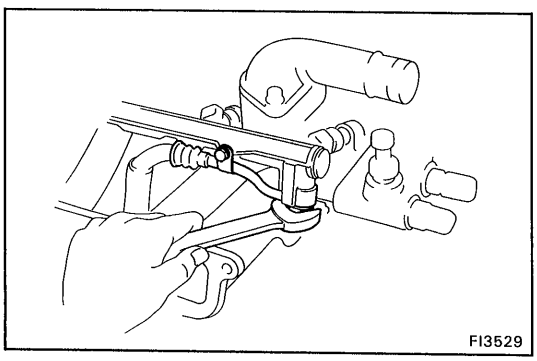


POST INSTALLATION

1. **(w/ PS)**
   CONNECT PS BRACKET TO CYLINDER HEAD
   Install the four bolts and bond strap. Torque the bolts.
   Torque: 450 kg-cm (33 ft-lb, 44 N·m)

2. **(w/ PS)**
   INSTALL DRIVE BELT AND ADJUST BELT TENSION
   (See step 2 on page MA-6)

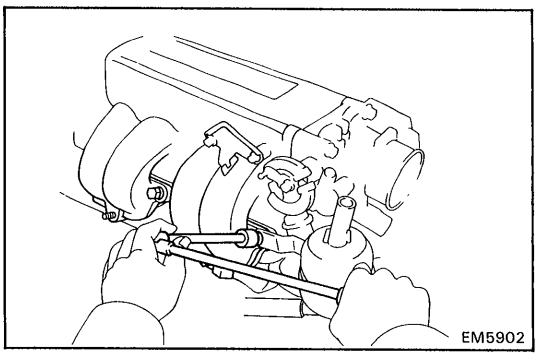
3. **CONNECT BY-PASS HOSE TO INTAKE MANIFOLD**



4. **CONNECT FUEL HOSE TO DELIVERY PIPE**
   Install new gaskets and the fuel hose with union bolt.
   Torque: 450 kg-cm (33 ft-lb, 44 N·m)

5. **CONNECT FOLLOWING WIRES:**
   (a) Water temp. sensor wire
   (b) Cold start injector time switch wire
   (c) VSV wires
   (d) Igniter wire
   (e) (A/T)
   OD temp. switch wire
   (f) Water temp. sender gauge wire
   (g) Injector wires
   (h) (with A/C)
   Compressor wires
   (i) Transmission wires
   (j) Starter wire (terminal 50)
   (k) Oil pressure sender gauge wire
   (l) Knock sensor wire

6. **CONNECT FUEL RETURN HOSE**



7. INSTALL CHAMBER WITH THROTTLE BODY

(a) Position new gaskets on the intake manifold and No.1 EGR pipe.

(b) Install the chamber, throttle body, fuel hose clamp, resonator and bond strap with the four bolts and two nuts.

(c) Connect the chamber and stay with a bolt.

(d) Install the bolts holding the EGR valve to the chamber.

(e) Install the new gaskets and cold start injector pipe.

8. CONNECT FOLLOWING WIRES:

(a) (California only)
EGR gas temp. sensor wire

(b) Throttle position wire

(c) Cold start injector wire

9. INSTALL EGR VACUUM MODULATOR

10. CONNECT FOLLOWING PARTS:

(a) (w/ Oil cooler)
Connect the No.1 oil cooler hose to the intake manifold.

(w/o Oil cooler)
Connect the No.1 water by-pass hose to the intake manifold.

(b) No.2 and No.3 water by-pass hoses to the throttle body

(c) Vacuum hoses to throttle body

(d) Pressure regulator hose

(e) Fuel pressure up hose

(f) Reed valve hose

(g) EGR valve hose

(h) EGR vacuum modulator hose

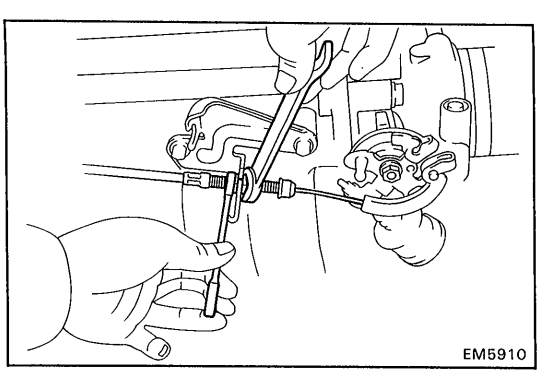
(i) EVAP hose

(j) (with A/C)
VSV hoses

(k) (w/ PS)
Air control valve hoses

(l) Brake booster hose

(m) No.1 and No.2 PCV hoses



11. CONNECT GROUND STRAP TO ENGINE REAR SIDE

12. (A/T)
CONNECT THROTTLE CABLE

Connect the throttle cable to the clamp and bracket.

13. CONNECT ACCELERATOR CABLE

14. **CONNECT HEATER WATER INLET HOSE TO HEATER WATER INLET PIPE**

15. **INSTALL RADIATOR INLET HOSE**

16. **INSTALL SPARK PLUGS AND DISTRIBUTOR**
(See page IG-9)

17. **INSTALL OIL DIPSTICK**

18. **CONNECT EXHAUST PIPE TO EXHAUST MANIFOLD**
    (a) Install the new gaskets, and connect the exhaust pipe to the exhaust manifold with the three nuts.
    (b) Install the exhaust pipe clamp.

19. **INSTALL INTAKE AIR CONNECTOR**

20. **FILL WITH ENGINE OIL**
(See step 3 on page LU-7)

21. **FILL WITH COOLANT**
(See step 3 on page CO-5)

22. **CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY**

23. **START ENGINE**
    Warm up the engine and inspect for leaks.

24. **PERFORM ENGINE ADJUSTMENT**
(See page EM-7)

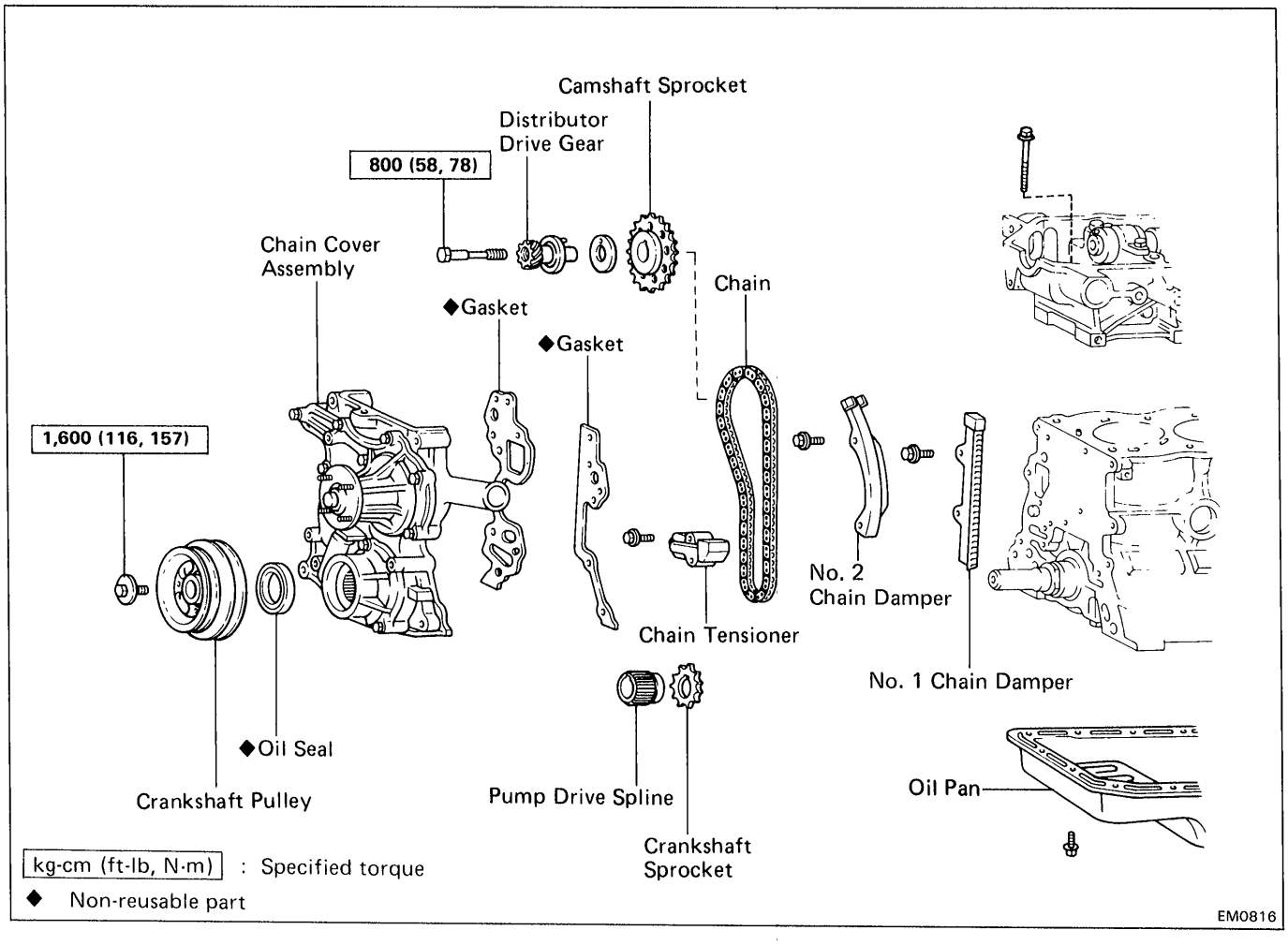
25. **RECHECK COOLANT AND ENGINE OIL LEVEL**

26. **ROAD TEST**
    Road test the vehicle.

27. **RECHECK COOLANT AND ENGINE OIL LEVEL**

TIMING CHAIN

COMPONENTS

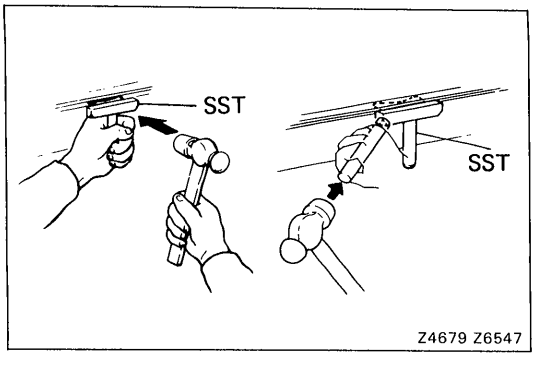


PREPARATION OF REMOVAL

1. **REMOVE CYLINDER HEAD**
   (See page EM-12)

2. **REMOVE RADIATOR**
   (See page CO-10)

3. **(4WD)**
   REMOVE FRONT DIFFERENTIAL
   (See page SA-40)



4. **REMOVE OIL PAN**

   (a) Remove the engine undercover.

   (b) Remove the sixteen bolts and two nuts.

   (c) Using SST and brass bar, separate the oil pan from the cylinder block.

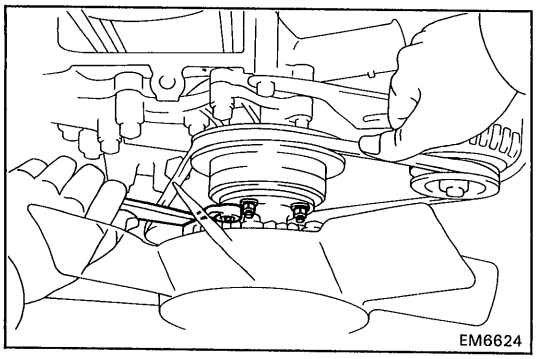
   SST 09032-00100

   HINT: When removing the oil pan, be careful not to damage the oil pan flange.

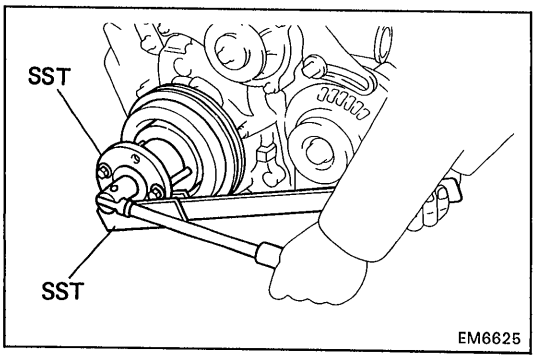
REMOVAL OF TIMING CHAIN

1. **(w/ PS)**
   REMOVE PS BELT

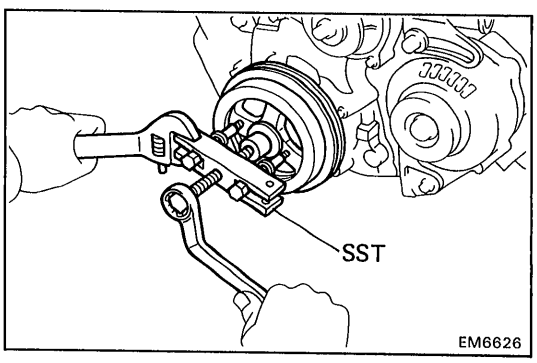
2. **(with A/C)**
   REMOVE A/C BELT, COMPRESSOR AND BRACKET



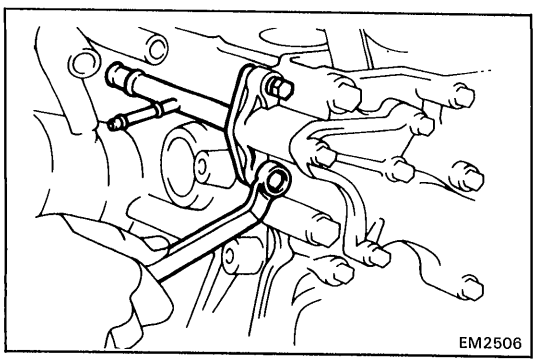
3. **REMOVE FLUID COUPLING WITH FAN AND WATER PUMP PULLEY**
   (a) Loosen the water pump pulley set bolts.
   (b) Loosen the belt adjusting bolt and pivot bolt of the alternator, and remove the drive belt.
   (c) Remove the set nuts, fluid coupling with fan and water pump pulley.



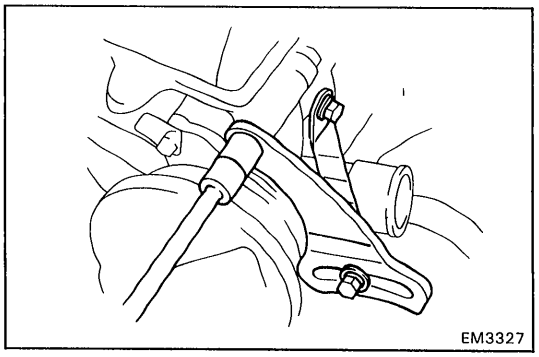
4. **REMOVE CRANKSHAFT PULLEY**
   (a) (with A/C)
   Remove the No.2 crankshaft pulley.
   (b) Using SST to hold the crankshaft pulley, loosen the pulley bolt.
   SST 09213-70010 and 09330-00021



   (c) Using SST, remove the crankshaft pulley.
   SST 09213-31021
   HINT: If the front seal is to be replaced, see page LU-6.



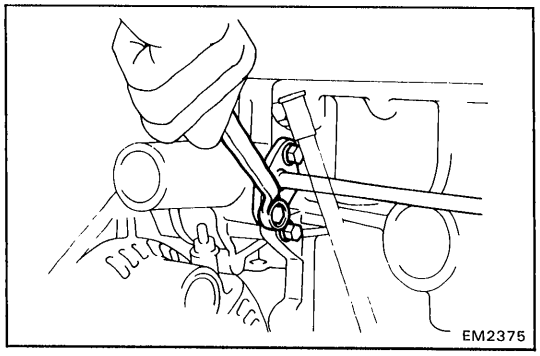
5. **REMOVE NO.1 WATER BY-PASS PIPE**
   Remove the two bolts and pipe.



6. REMOVE FAN BELT ADJUSTING BAR

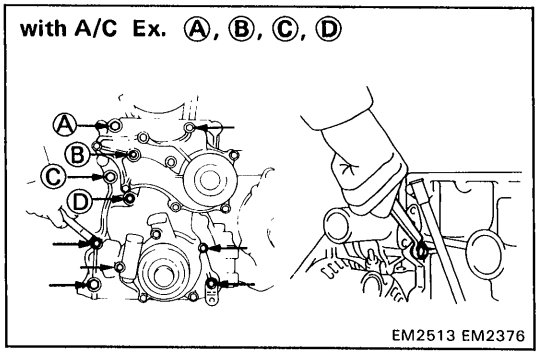
(a) (w/ PS)
Remove the bolt and PS lower bracket.

(b) Remove the three bolts and bar.



7. DISCONNECT HEATER WATER OUTLET PIPE

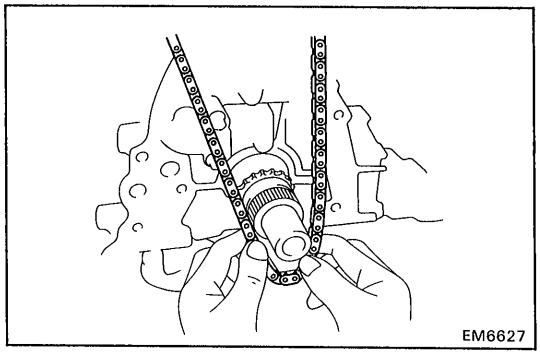
Remove the two bolts, and disconnect heater water outlet pipe.



8. REMOVE CHAIN COVER ASSEMBLY

(a) Remove timing chain cover bolts shown by the arrows.

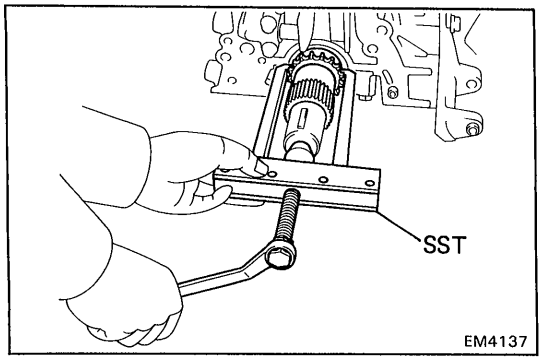
(b) Using a plastic faced hammer, loosen the chain cover and remove it.



9. REMOVE CHAIN AND CAMSHAFT SPROCKET

(a) Remove the chain from the damper.

(b) Remove the cam sprocket and chain together.

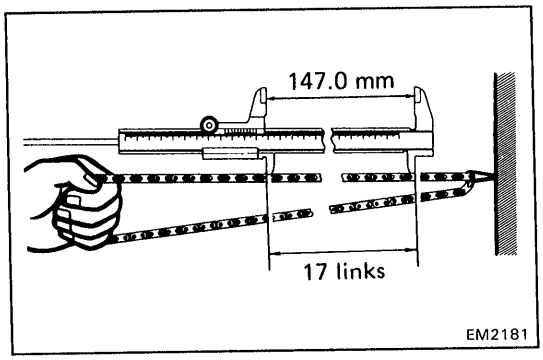


10. REMOVE PUMP DRIVE SPLINE AND CRANKSHAFT SPROCKET

If the oil pump drive spline and sprocket cannot be removed by hand, use SST to remove them together.

SST 09213-36020

11. REMOVE GASKET MATERIAL ON CYLINDER BLOCK



INSPECTION OF COMPONENTS

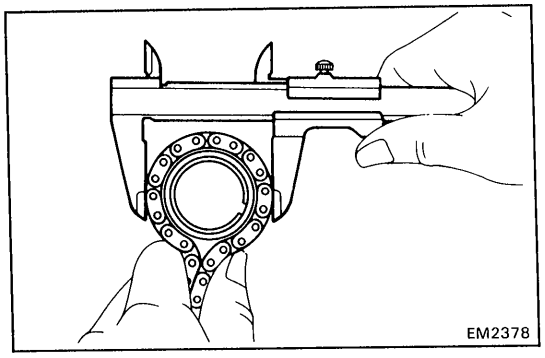
1. MEASURE CHAIN AND SPROCKET WEAR

(a) Measure the length of 17 links with the chain fully stretched.

(b) Make the same measurements at least three other places selected at random.

Chain elongation limit at 17 links: 147.0 mm (5.787 in.)

If over the limit at any one place, replace the chain.

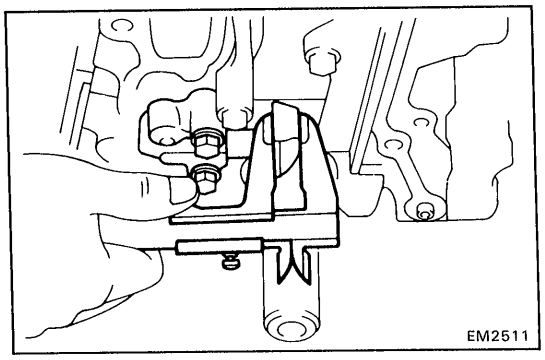


(c) Wrap the chain around the sprocket.

(d) Using a caliper gauge, measure the outer sides of the chain rollers as shown. Measure both sprockets.

Crankshaft sprocket minimum: 59.4 mm (2.339 in.)
Camshaft sprocket minimum: 113.8 mm (4.480 in.)

If the measurement is less than minimum, replace the chain and two sprockets.

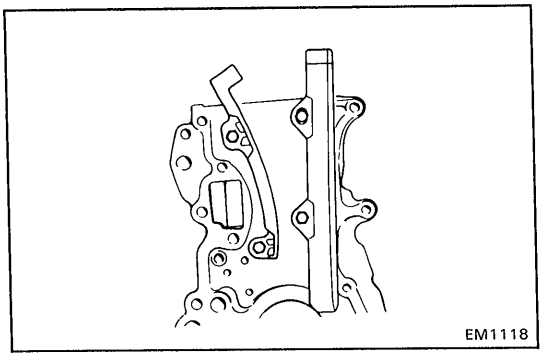


2. MEASURE CHAIN TENSIONER

Using a caliper gauge, measure the tensioner as shown.

Tensioner minimum: 11.0 mm (0.433 in.)

If the tensioner is worn or less than minimum, replace the chain tensioner.

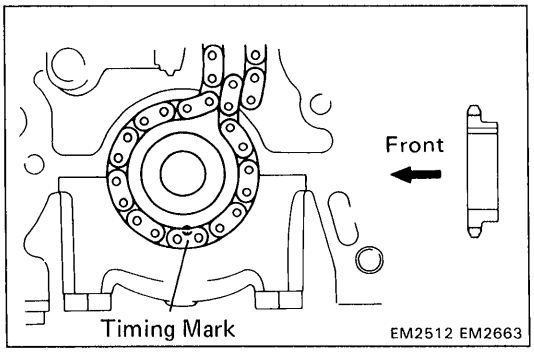


3. MEASURE CHAIN DAMPERS

Using a micrometer, measure each damper.

Damper wear limit: 0.5 mm (0.020 in.)

If either damper is worn or less than minimum, replace the damper.



INSTALLATION OF TIMING CHAIN

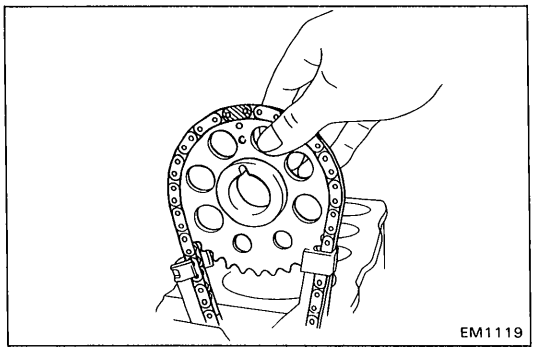
(See page EM-37)

1. INSTALL CRANKSHAFT SPROCKET AND CHAIN

(a) Turn the crankshaft until the shaft key is on top.

(b) Slide the sprocket over the key on the crankshaft.

(c) Place the timing chain on the sprocket with the single bright chain link aligned with the timing mark on the sprocket.

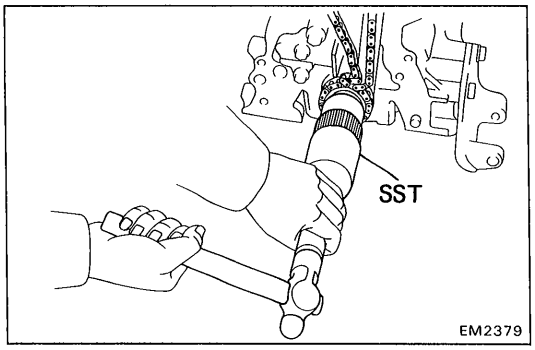


2. PLACE CHAIN ON CAMSHAFT SPROCKET

(a) Place the timing chain on the sprocket so that the space between the bright chain links is aligned with the timing mark.

(b) Make sure the chain is positioned dampers.

(c) Turn the camshaft sprocket counterclockwise to take the slack out of the chain.

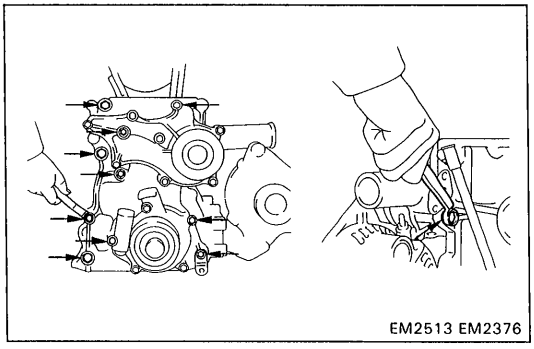


3. INSTALL OIL PUMP DRIVE SPLINE

Slide the oil pump drive spline over the crankshaft key.

HINT: If the oil pump drive spline is difficult to install by hand, install using SST.

SST 09608-35014 (09608-06040)



4. INSTALL TIMING CHAIN COVER ASSEMBLY

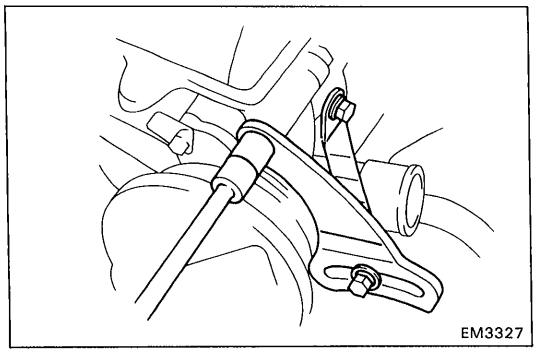
(a) Remove the old cover gaskets. Clean the gasket surface. Install new gaskets over the dowels.

(b) Slide the cover assembly over the dowels and pump spline.

(c) Insert the bolts as shown and torque them.

Torque:

8 mm bolt 130 kg-cm (9 ft-lb, 13 N·m)
10 mm bolt 400 kg-cm (29 ft-lb, 39 N·m)

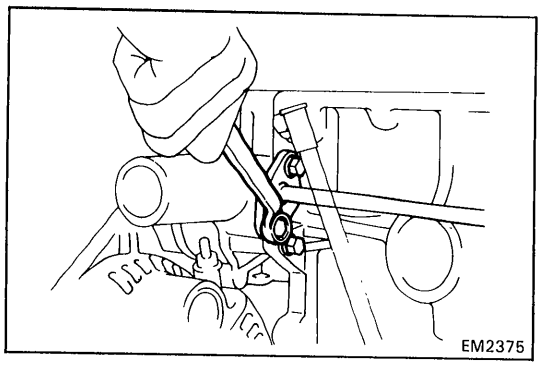


5. INSTALL FAN BELT ADJUSTING BAR

(a) Temporarily install the adjusting bar to the alternator.

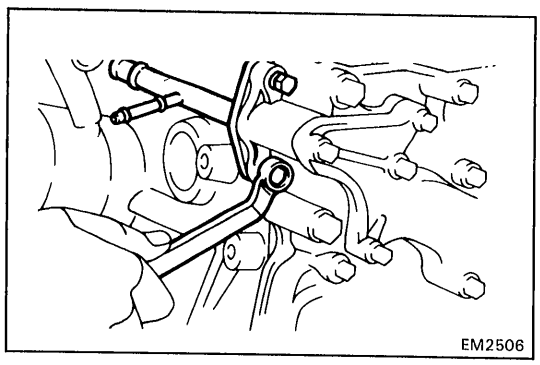
(b) Install the adjusting bar to the chain cover and cylinder head.

Torque: 130 kg-cm (9 ft-lb, 13 N·m)



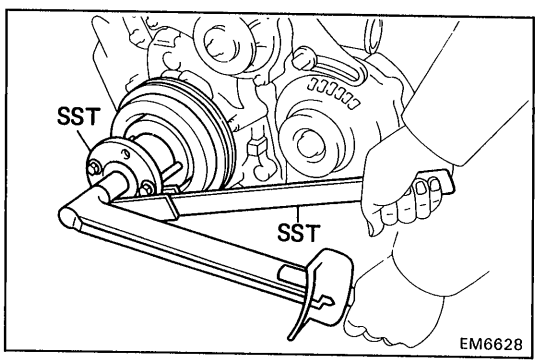
6. **INSTALL HEATER WATER OUTLET PIPE**

Connect the heater water outlet pipe to the timing chain cover with two bolts.



7. **INSTALL NO.1 WATER BY-PASS PIPE**

Install the pipe with the two bolts.



8. **INSTALL CRANKSHAFT PULLEY**

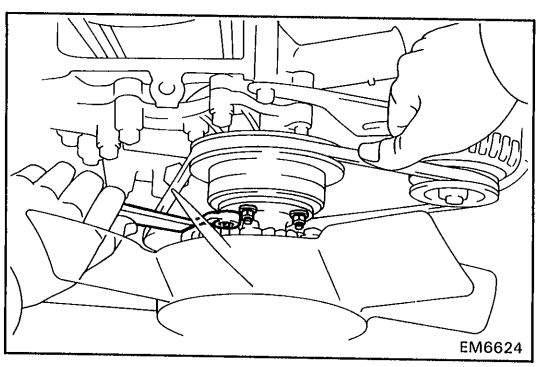
(a) Install the crankshaft pulley and bolt.

(b) Using SST to hold the crankshaft pulley, torque the bolt.

SST 09213-70010 and 09330-00021

Torque: 1,600 kg-cm (116 ft-lb, 157 N·m)

(c) (with A/C)
Install the No.2 crankshaft pulley.



9. **INSTALL WATER PUMP PULLEY AND FLUID COUPLING WITH FAN**

(a) Temporarily install the water pump pulley and fluid coupling with fan with four nuts.

(b) Place the drive belt on to each pulley.

(c) Stretch the belt tight and tighteen the four nuts.

10. **ADJUST DRIVE BELT TENSION**
(See step 2 on page MA-6)

11. **(with A/C)**
INSTALL A/C COMPRESSOR BRACKET, COMPRESSOR AND BELT
(See step 2 on page MA-6)

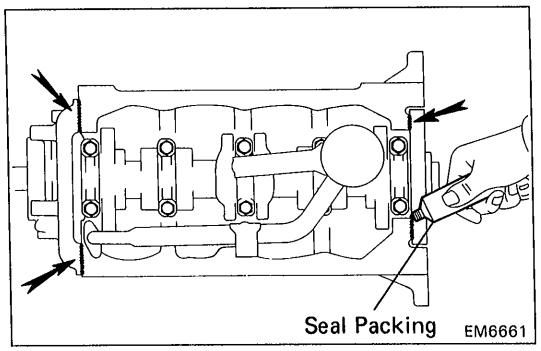
12. **(w/ PS)**
INSTALL PS BELT
(See step 2 on page MA-6)

13. INSTALL OIL PAN

(a) Remove any old packing material and be careful no to drop any oil on the contacting surfaces of the oil pan and cylinder block.

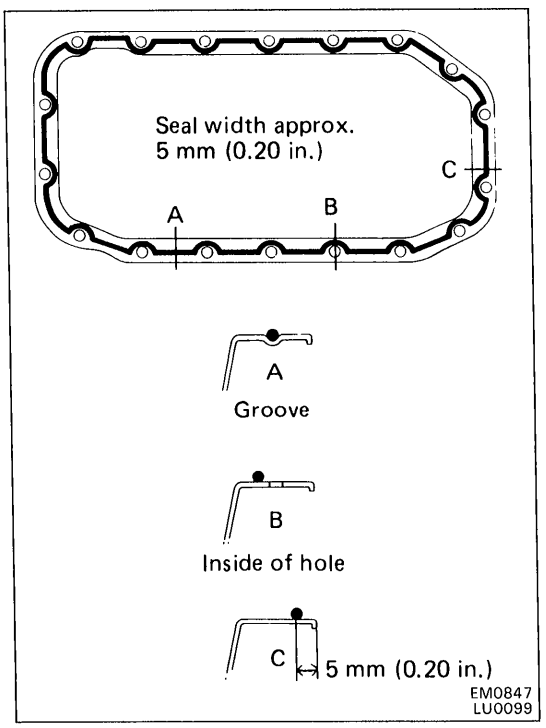
- Using a razor blade and gasket scraper, remove all the packing (FIPG) material from the gasket surfaces.
- Thoroughly clean all components to remove all the loose material.
- Clean both sealing surfaces with a non-residue solvent.

NOTICE: Do not use a solvent which will affect the painted surfaces.



(b) Apply seal packing to the joint part of the cylinder block and chain cover, cylinder block and rear oil seal retainer.

Seal packing: Part No. 08826-00080 or equivalent



(c) Apply seal packing to the oil pan as shown in the figure.

Seal packing: Part No. 08826-00080 or equivalent

- Install a nozzle that has been cut to a 5-mm (0.20 in.) opening.

HINT: Avoid applying an excess amount to the surface. Be especially careful near oil passages.

- Parts must be assembled within 5 minutes of application. Otherwise, the material must be removed and re-applied.
- Immediately remove nozzle from tube and reinstall cap.

(d) Install the oil pan over the studs on the block with sixteen bolts and two nuts. Torque the bolts and nuts.

Torque: 130 kg-cm (9 ft-lb, 13 N·m)

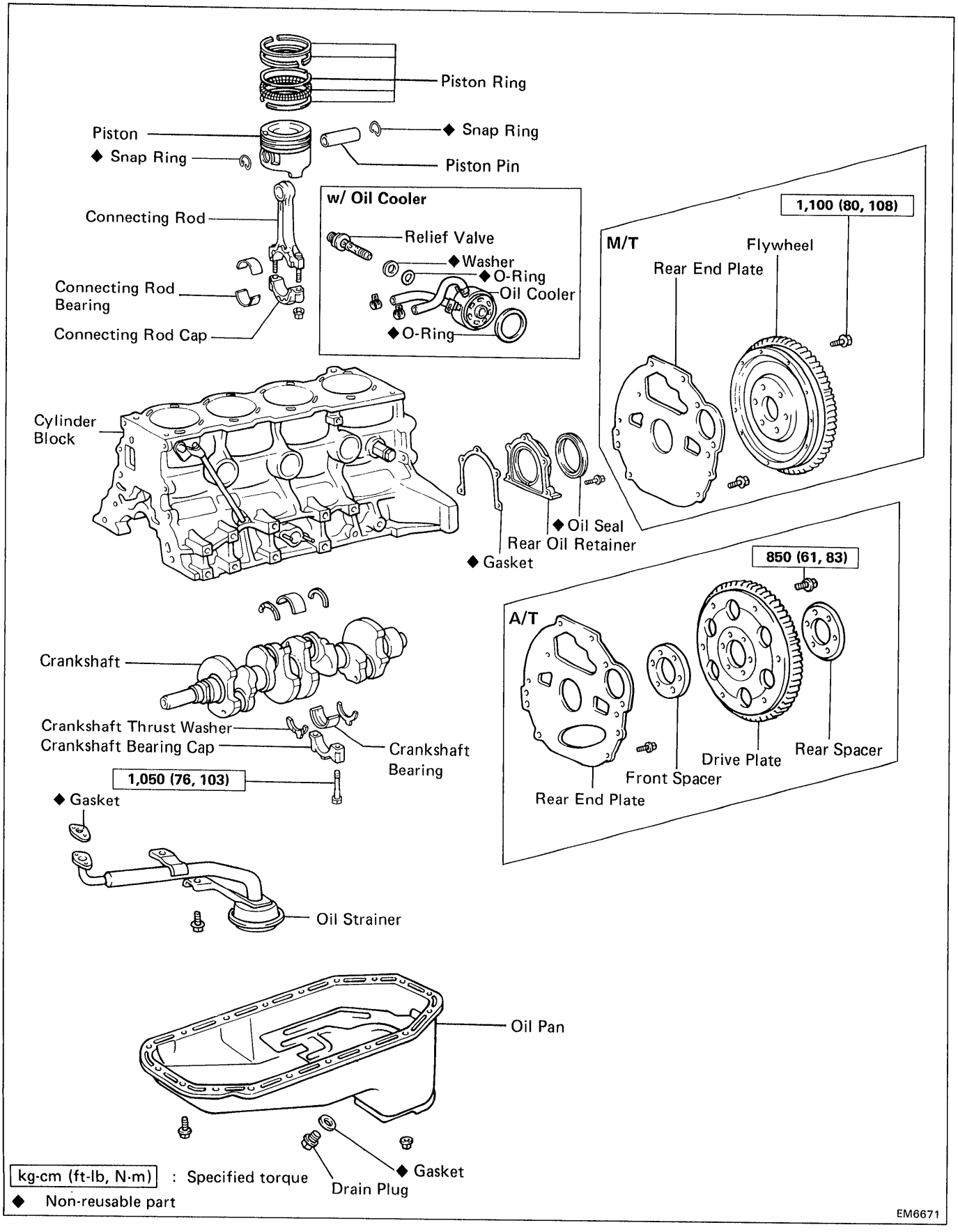
(e) Intall the engine under cover.

POST INSTALLATION

1. **INSTALL RADIATOR**
2. **INSTALL CYLINDER HEAD**
   (See page EM-31)
3. **(4WD)**
   INSTALL FRONT DIFFERENTIAL
   (See page SA-89)

CYLINDER BLOCK

COMPONENTS



REMOVAL OF ENGINE

1. **REMOVE HOOD**
2. **REMOVE BATTERY**
3. **REMOVE ENGINE UNDER COVER**
4. **DRAIN COOLANT FROM RADIATOR AND CYLINDER BLOCK**
   (See step 3 on page CO-5)
5. **DRAIN ENGINE OIL**
   (See step 1 on page LU-6)
6. **REMOVE AIR CLEANER CASE AND INTAKE AIR CONNECTOR**
7. **REMOVE RADIATOR**
   (See page CO-10)
8. **REMOVE PS BELT**
   (a) Stretch the belt tight and loosen the PS pump pulley lock nut.
   (b) Remove the PS belt.
9. **(with A/C)**
   REMOVE A/C BELT
10. **REMOVE ALTERNATOR DRIVE BELT, FLUID COUPLING AND FAN PULLEY**
    (See step 3 on page EM-38)
11. **DISCONNECT FOLLOWING WIRES AND CONNECTORS:**
    (a) Ground strap from LH fender apron
    (b) Alternator connector and wire
    (c) Igniter connector
    (d) Alternator wires
    (e) High-tension cord for ignition coil
    (f) Distributor wire from igniter
    (g) Ground strap from engine rear side
    (h) ECU connectors
    (i) (M/T)
    Starter relay connector
    (j) Check connector
    (k) (with A/C)
    A/C compressor connector

12. DISCONNECT FOLLOWING HOSES:

(a) PS air hoses from gas filter and air pipe

(b) Brake booster hose

(c) (w/ Cruise control)
Cruise control vacuum hose

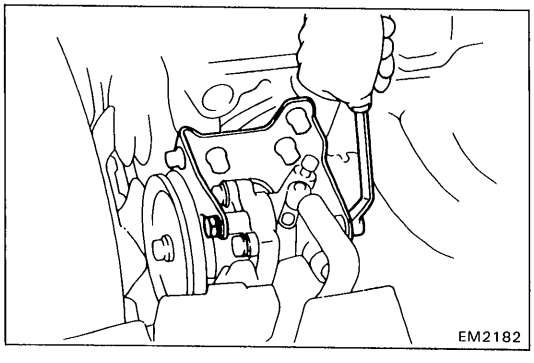
(d) Charcoal canister hose from canister

13. DISCONNECT FOLLOWING CABLES:

(a) Accelerator cable

(b) (A/T)
Throttle cable

(c) (w/ Cruise control)
Cruise control cable


EM2182

14. (w/ PS)
REMOVE VANE PUMP FROM BRACKET

(a) Remove the drive belt.

(b) Remove the four bolts.

(c) Remove the PS pump.

HINT: Lay the PS pump to one side without disconnecting the hoses.

15. DISCONNECT GROUND STRAP FROM VANE PUMP BRACKET

16. (with A/C)
REMOVE COMPRESSOR FROM BRACKET

(a) Loosen the drive belt adjusting bolt and remove the drive belt.

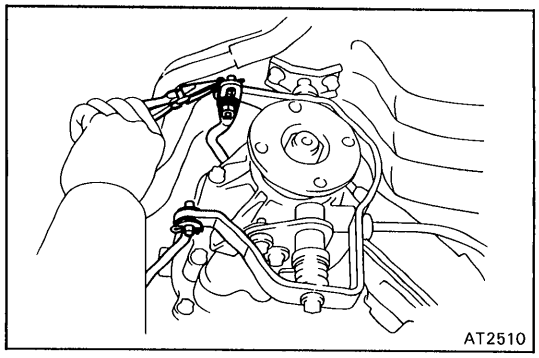
(b) Remove the compressor on the front side without disconnecting the hoses.

17. DISCONNECT GROUND STRAPS FROM ENGINE REAR SIDE AND RH SIDE

18. (M/T)
REMOVE SHIFT LEVER(S) FROM INSIDE OF VEHICLE

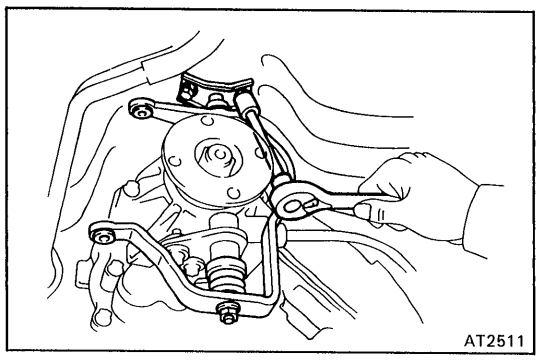
19. REMOVE REAR PROPELLER SHAFT
(See page 2WD PR-4)
(See page 4WD PR-5)

20. (2WD A/T)
DISCONNECT MANUAL SHIFT LINKAGE FROM NEUTRAL START SWITCH


AT2510

(4WD A/T)
DISCONNECT TRANSFER SHIFT LINKAGE

(a) Disconnect the No.1 and No.2 transfer shift linkages from the cross shaft.


AT2511

(b) Remove the cross shaft from the body.

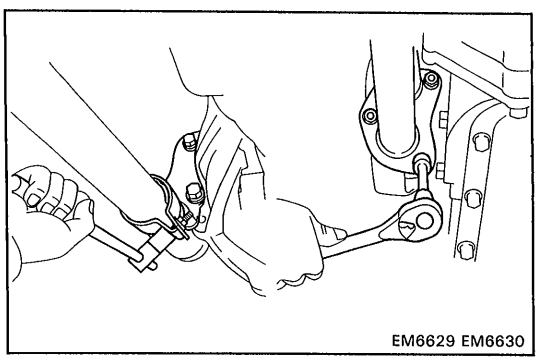
21. DISCONNECT SPEEDOMETER CABLE

NOTICE: Do not lose the felt dust protector and washers.

22. (4WD)
REMOVE TRANSFER UNDER COVER

23. REMOVE STABILIZAR BAR

24. (4WD)
REMOVE FRONT PROPELLER SHAFT
(See page PR-4)


EM6629 EM6630

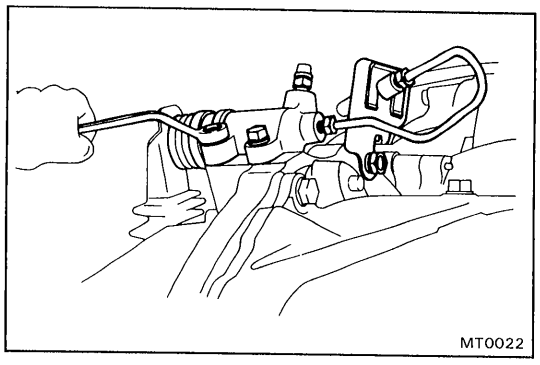
25. REMOVE FRONT EXHAUST PIPE

(a) Disconnect the oxygen sensor connector.

(b) Disconnect the exhaust pipe from the exhaust manifold.

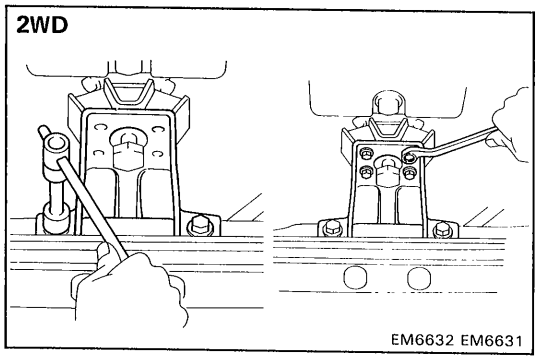
(c) Remove the exhaust pipe clamp from the clutch housing.

(d) Remove the exhaust pipe from the catalytic converter.



26. (M/T)
REMOVE CLUTCH RELEASE CYLINDER WITH BRACKET FROM TRANSMISSION

27. (4WD)
REMOVE NO.1 FRONT FLOOR HEAT INSULATOR AND BRAKE TUBE HEAT INSULATOR

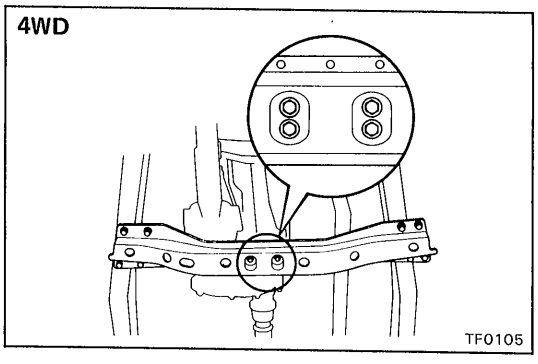


28. (2WD)
REMOVE ENGINE REAR MOUNTING AND BRACKET

(a) Remove the four bolts from the engine rear mounting.

(b) Raise the transmission slightly by raising the engine with a jack.

(c) Remove the four bolts from the support member.



(4WD)
REMOVE NO.2 FRAME CROSSMEMBER FROM SIDE FRAME

(a) Remove the four bolts from the engine rear mounting.

(b) Raise the transmission slightly with a jack.

(c) Remove the four bolts from the side frame and remove the No.2 frame crossmember.

29. REMOVE ENGINE WITH TRANSMISSION

(a) Attach the engine hoist chain to the two engine hangers.

(b) Remove the mounting nuts and bolts.

(c) Lift the engine with transmission out of the vehicle slowly and carefully.

HINT: Make sure the engine is clear of all wiring and hoses.

30. REMOVE TRANSMISSION FROM ENGINE

(a) (A/T)
Remove the A/T oil cooler pipes.

(b) Remove the starter.

(c) Remove the two stiffener plates and exhaust pipe bracket from engine.

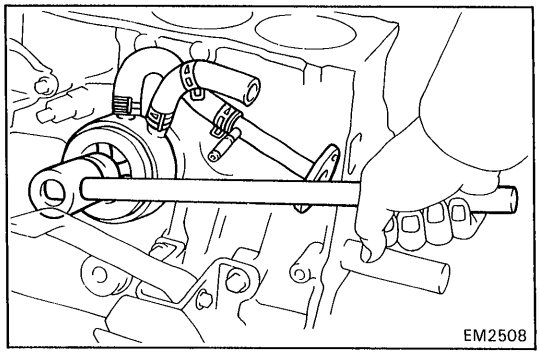
(d) Remove the transmission from the engine.

31. (M/T)
REMOVE CLUTCH COVER AND DISC

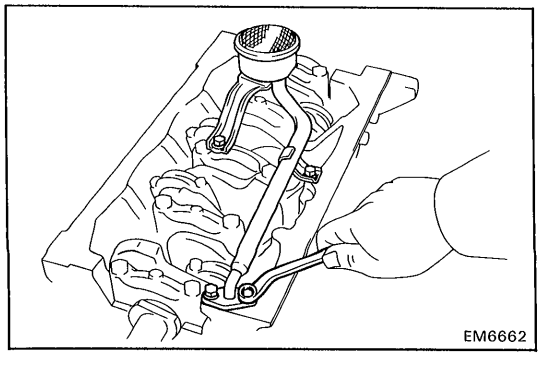
DISASSEMBLY OF CYLINDER BLOCK

(See page EM-44)

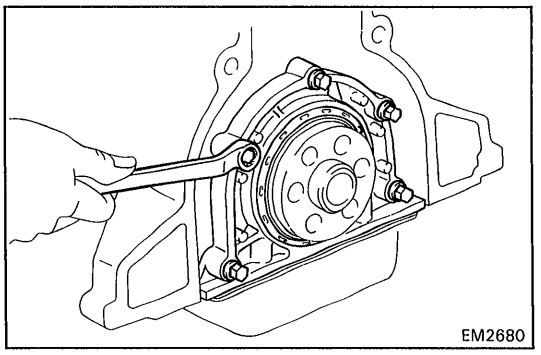
1. REMOVE FLYWHEEL OR DRIVE PLATE
2. REMOVE REAR END PLATE
3. INSTALL ENGINE STAND FOR DISASSEMBLY
4. REMOVE CYLINDER HEAD
   (See page EM-12)
5. REMOVE TIMING CHAIN (See page EM-37)
6. REMOVE ALTERNATOR (See page CH-7)
7. REMOVE LH ENGINE MOUNTING BRACKET AND ALTERNATOR BRACKET
8. REMOVE CHAIN DAMPERS
9. REMOVE CHAIN TENSIONER
10. REMOVE OIL FILTER
    (See step 2 on page LU-6)


EM2508

11. (w/ Oil cooler)
    REMOVE OIL COOLER
    Remove the oil cooler relief valve, gasket and oil cooler.
12. REMOVE RH ENGINE MOUNTING BRACKET, CHAMBAR STAY AND GROUND STRAP
13. (A/T)
    REMOVE FLEXIBLE HOSE CLAMP
14. REMOVE OIL PRESSURE SENDER GAUGE
15. REMOVE KNOCK CONTROL SENSOR
16. REMOVE FUEL FILTER AND BRACKET

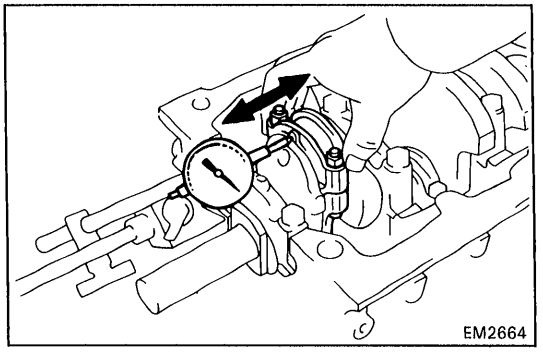

EM6662

17. REMOVE OIL STRAINER
    Remove the four bolts, strainer and gasket.



18. REMOVE REAR OIL SEAL RETAINER

Remove the five bolts, rear oil seal retainer and gasket.



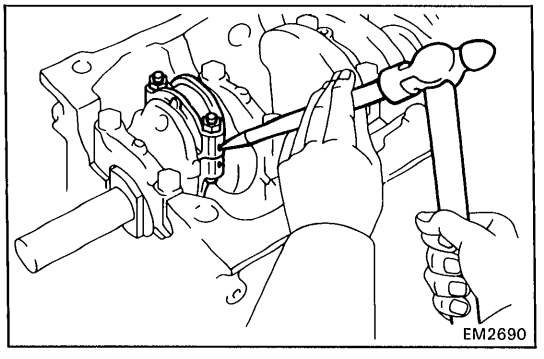
19. MEASURE CONNECTING ROD THRUST CLEARANCE

Using a dial gauge, measure the thrust clearance.

Standard clearance: **0.16 — 0.26 mm (0.0063 — 0.0102 in.)**

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

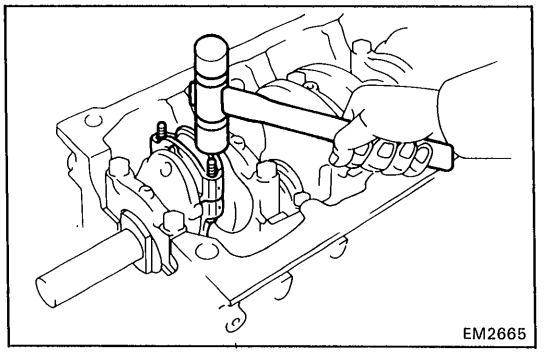
If clearance is greater than maximum, replace the connecting rod and/or crankshaft.



20. MEASURE CONNECTING ROD OIL CLEARANCE

(a) Using a punch or numbering stamp, mark connecting rods and caps to ensure correct reassembly.

(b) Remove the rod cap nuts.



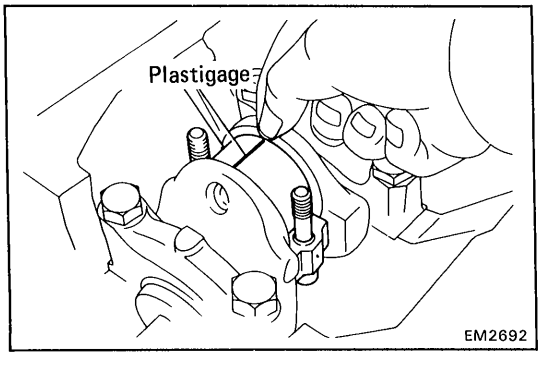
(c) Using a plastic-faced hammer, tap the rod bolts lightly and lift off the rod cap.

HINT: Keep the bearing inserted with the cap.

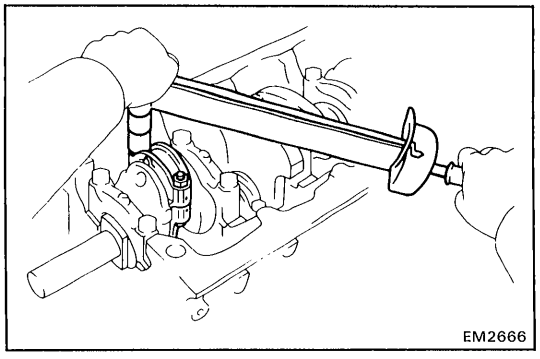
(d) Clean the bearings and crankshaft pins.

(e) Inspect each bearing for pitting and radial scratches.

If bearings are damaged, replace the bearings.



(f) Lay a strip of Plastigage across the crankshaft pin.

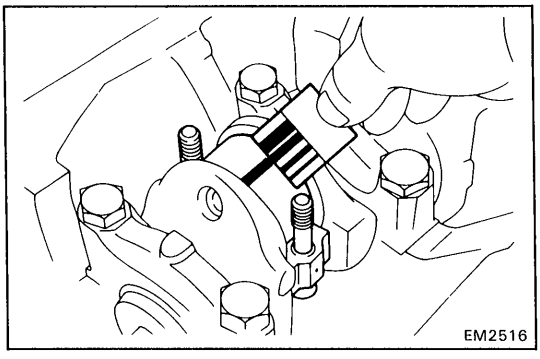

EM2666

(g) Align the rod and cap marks and fit on the cap. Install and torque the cap nuts.

Torque: 700 kg-cm (51 ft-lb, 69 N·m)

HINT:

- Do not turn the crankshaft.
- Apply a light coating of engine oil on the nut threads and under the nut before installation.


EM2516

(h) Remove the rod cap.

(i) Measure the Plastigage at its widest point.

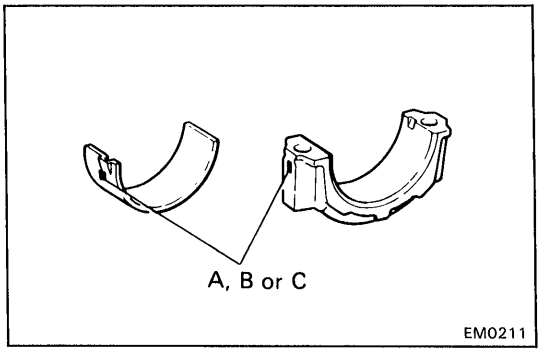
Standard clearance: 0.025 – 0.055 mm (0.0010 – 0.0022 in.)

Maximum clearance: 0.10 mm (0.0039 in.)

If the clearance is greater than maximum, replace the bearings and/or grind the crank pins.

Undersized bearing: U/S 0.25

(j) Clean any Plastigage from bearing and crankshaft pin.

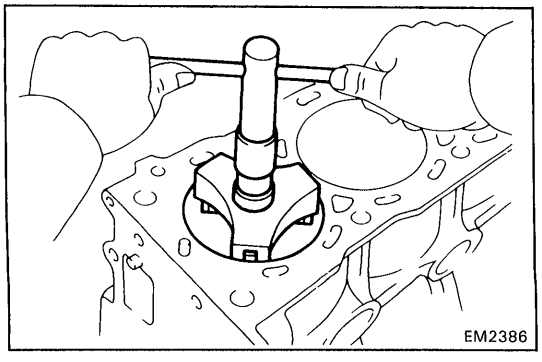


EM0211

HINT: If replacing a standard size bearing, replace with one having the same letter as marked on the bearing cap. There are three sized of standard bearings supplied, marked A, B or C respectively.

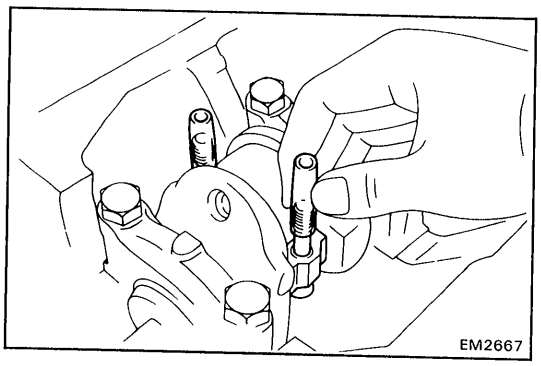
mm (in.)

Size	Big End Inner Diameter	Crank Pin Diameter	Bearing Center Wall Thickness
A	56.000 – 56.006 (2.2047 – 2.2050)	52.988 – 53.000 (2.0861 – 2.0866)	1.484 – 1.488 (0.0584 – 0.0586)
B	56.006 – 56.012 (2.2050 – 2.2052)		1.488 – 1.492 (0.0586 – 0.0587)
C	56.012 – 56.018 (2.2052 – 2.2054)		1.492 – 1.496 (0.0587 – 0.0589)
U/S 0.25	56.000 – 56.018 (2.2047 – 2.2054)	52.701 – 52.711 (2.0748 – 2.0752)	1.626 – 1.636 (0.0640 – 0.0644)


EM2386

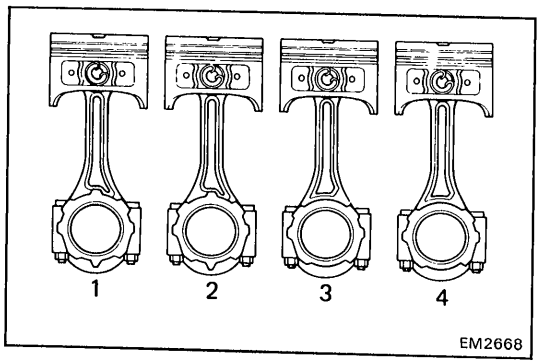
21. PUSH OUT PISTON AND CONNECTING ROD ASSEMBLY

(a) Remove all the carbon from top of the bore to the top of the cylinder.

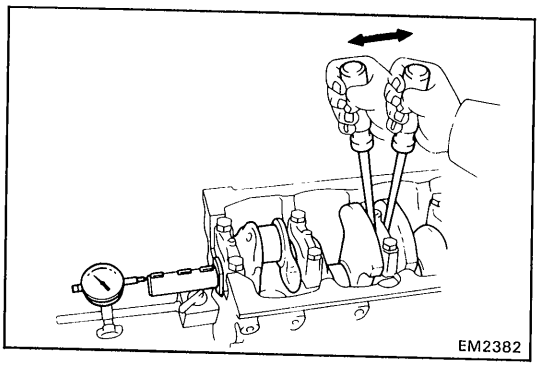


(b) Cover the rod bolts with a short piece of hose to protect the crank pin from damage.

(c) Push the piston and connecting rod assembly out through the top of the cylinder block.



(d) Arrange the piston and connecting rod caps in order.



22. MEASURE CRANKSHAFT THRUST CLEARANCE

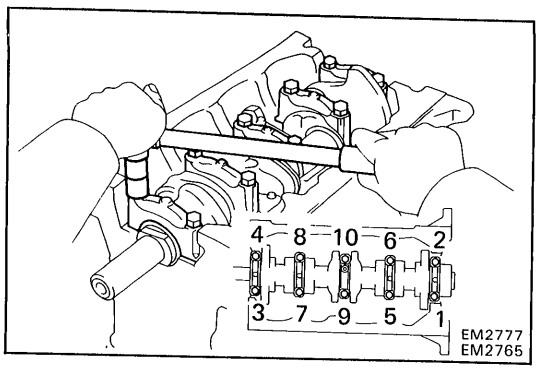
Using a dial gauge, measure the crankshaft thrust clearance while prying the crankshaft back and forth with a screwdriver.

Standard clearance: 0.02 — 0.22 mm (0.0008 — 0.0087 in.)
Maximum clearance: 0.3 mm (0.012 in.)

If the clearance is greater than maximum, replace the thrust washers as a set and/or crankshaft.

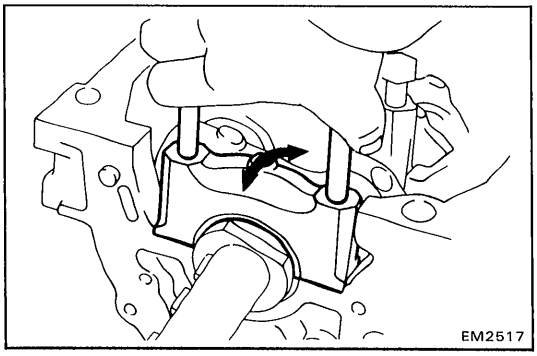
Thrust whasher thickness:

Standard	**2.690 — 2.740 mm (0.1059 — 0.1079 in.)**
O/S 1.25	**2.753 — 2.803 mm (0.1084 — 0.1104 in.)**
O/S 2.50	**2.815 — 2.865 mm (0.1108 — 0.1128 in.)**



23. MEASURE CRANKSHAFT OIL CLEARANCE

(a) Gradually loosen and remove the bearing cap bolts in three passes and in the numerical order shown.



(b) Using the removed bearing cap bolts, pry the bearing cap fore and aft, and remove it with the lower bearing and thrust washers (No. 3 journal only).

HINT:
- Keep the lower bearing inserted with the cap.
- Arrange the caps and lower thrust washers in correct order.

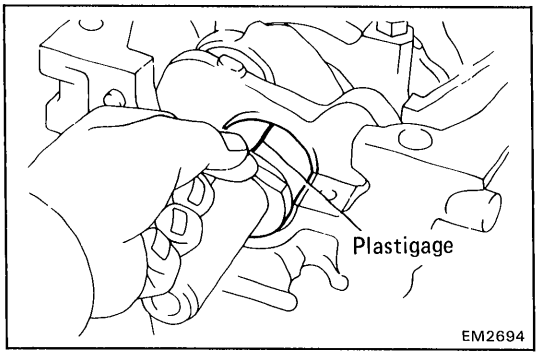
(c) Lift off the crankshaft.

HINT: Keep the upper bearings and upper thrust washers (for the No. 3 journal only) inserted in the cylinder block.

(d) Clean the journals and bearings.

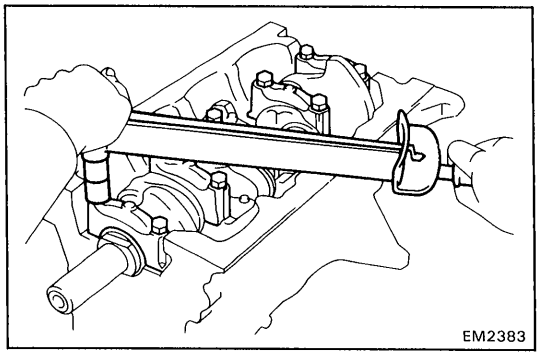
(e) Check the journals and bearings for pitting and scratches.

If the journal or bearing is damaged, grind or replace the crankshaft and replace the bearing.



(f) Install the upper main bearings on the cylinder block and crankshaft.

(g) Lay a strip of Plastigage across the main journals.

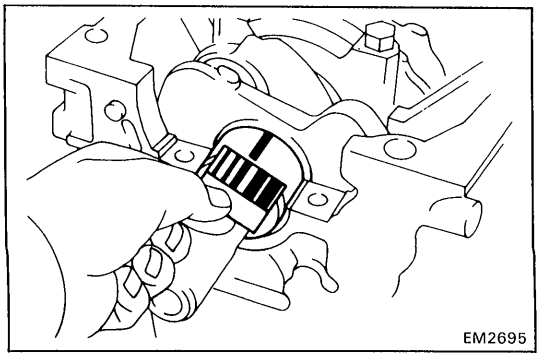


(h) Install the main bearing caps with the front mark facing forward.

Install and torque the cap bolts.

Torque: 1,050 kg-cm (76 ft-lb, 103 N·m)

HINT:
- Do not turn the crankshaft.
- Apply a light coating of engine oil on the bolt threads before installation.



(i) Remove the main bearing caps.

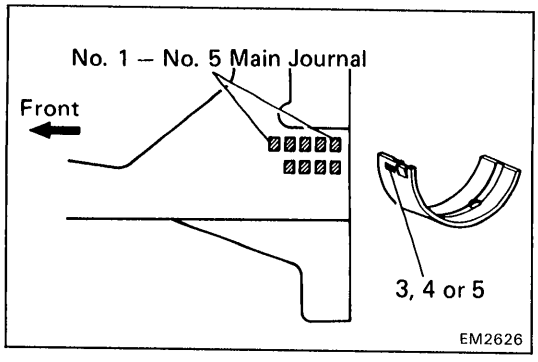
(j) Measure the Plastigage at its widest point.

Standard clearance: 0.025 — 0.055 mm (0.0010 — 0.0022 in.)
Maximum clearance: 0.08 mm (0.0031 in.)

If the clearance is greater than maximum, replace the bearings and/or grind the main journals.

Undersized bearing: U/S 0.25

(k) Clean out the pieces of Plastigage from the bearings and journals.



HINT: If using a standard bearing, replace with one having the same number as maked on the cylinder block. There are three sizes of standard bearings, marked 3, 4, 5 accordingly.

mm (in.)

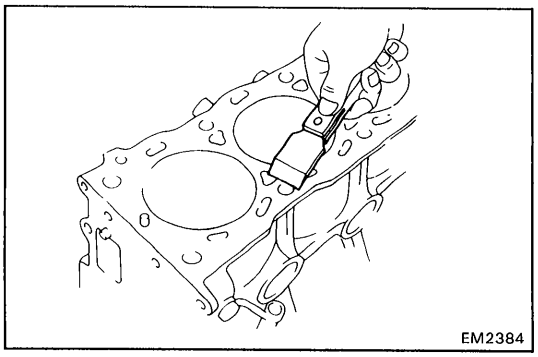
Size	Cylinder Block Main Journal Bore	Main Journal Diameter	Bearing Center Wall Thickness
3	64.004 — 64.010 (2.5198 — 2.5201)	59.984 — 60.000 (2.3616 — 2.3622)	1.988 — 1.992 (0.0783 — 0.0784)
4	64.010 — 64.016 (2.5201 — 2.5203)		1.992 — 1.996 (0.0784 — 0.0786)
5	64.016 — 64.022 (2.5203 — 2.5205)		1.996 — 2.000 (0.0786 — 0.0787)
U/S 0.25	64.004 — 64.022 (2.5198 — 2.5205)	59.701 — 59.711 (2.3504 — 2.3508)	2.126 — 2.136 (0.0837 — 0.0841)

24. REMOVE CRANKSHAFT

(a) Lift out the crankshaft.

(b) Remove the upper main bearings from the cylinder block.

(c) Arrange the caps and bearings in order.


EM2384

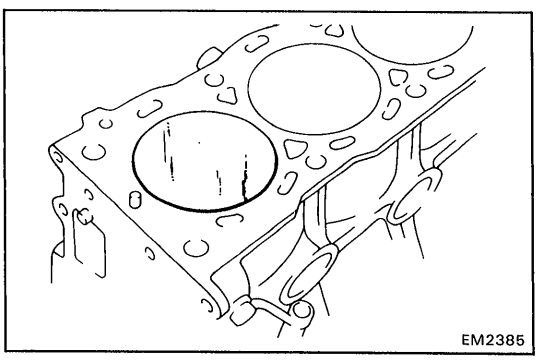
INSPECTION OF CYLINDER BLOCK

1. REMOVE GASKET MATERIAL

Using a gasket scraper, remove all gasket material from cylinder block surfaces.

2. CLEAN CYLINDER BLOCK

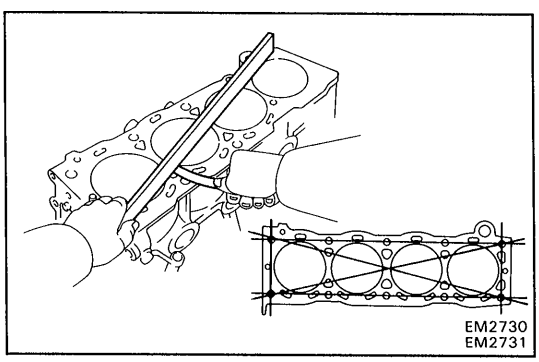
Using a soft brush and solvent, clean the block.


EM2385

3. INSPECT CYLINDERS

Visually inspect cylinders for vertical scratches.

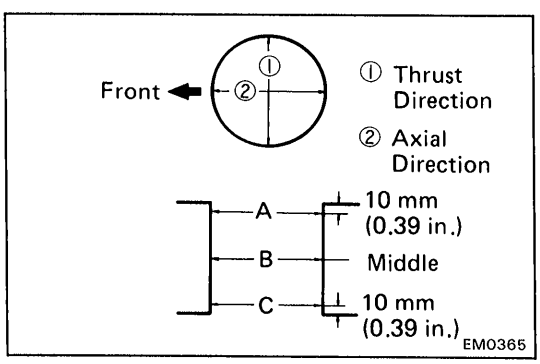
If deep scratches are present, rebore the cylinders.
(See page EM-67)


EM2730
EM2731

4. INSPECT CYLINDER BLOCK WARPAGE

Warpage limit: 0.05 mm (0.0020 in.)

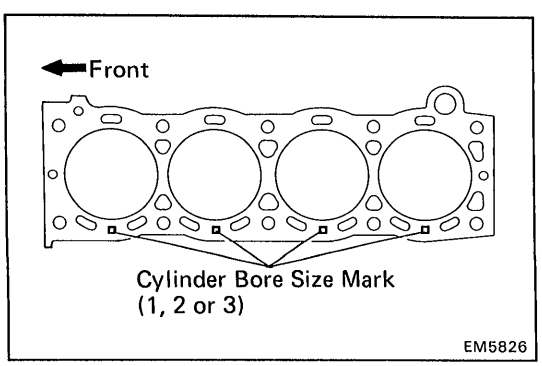
If warpage is greater than specified value, replace the cylinder block.



EM0365

5. MEASURE CYLINDER BORE

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



EM5826

HINT: There are three sizes of the standard cylinder bore diameter, marked "1", "2", and "3", accordingly. The marked is stamped on the cylinder block.

Standard diameter:

STD	**Mark "1"**	**92.00 — 92.01 mm (3.6220 — 3.6224 in.)**
	Mark "2"	**92.01 — 92.02 mm (3.6224 — 3.6228 in.)**
	Mark "3"	**92.02 — 92.03 mm (3.6228 — 3.6232 in.)**
O/S	**0.50**	**92.50 — 92.53 mm (3.6417 — 3.6429 in.)**
	1.00	**93.00 — 93.03 mm (3.6614 — 3.6626 in.)**

Maximum diameter:

STD	**92.23 mm (3.6311 in.)**
O/S 0.50	**92.73 mm (3.6508 in.)**
O/S 1.00	**93.23 mm (3.6705 in.)**

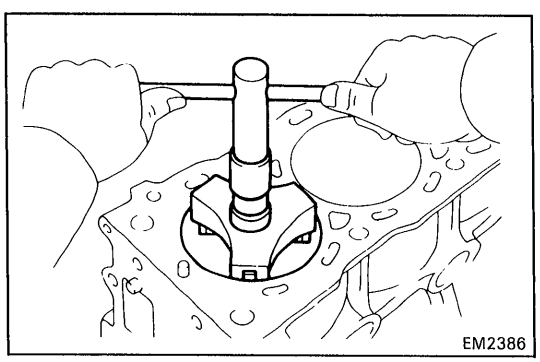
If the diameter is greater than maximum, rebore all four cylinders, or replace the cylinder block.

(a) If difference between A, B and C measurements is greater than taper limit, rebore the cylinder. (See page EM-67)

Taper limit: 0.02 mm (0.0008 in.)

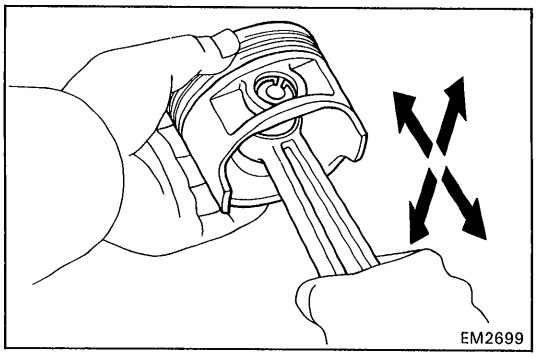
(b) If difference between thrust and axial measurements is greater than out-of-round limit, rebore the cylinder (See page EM-67)

Out-of-round limit: 0.02 mm (0.0008 in.)



6. REMOVE CYLINDER RIDGE

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

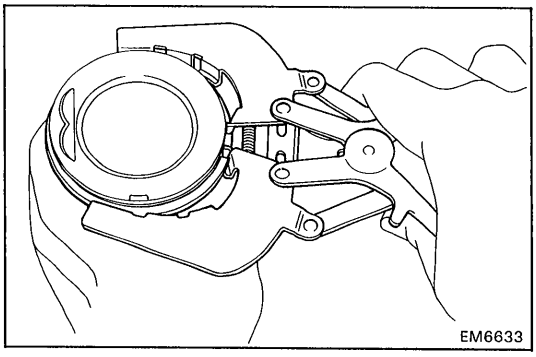


DISASSEMBLY OF PISTON AND CONNECTING ROD ASSEMBLY

1. CHECK FIT BETWEEN PISTON AND PIN

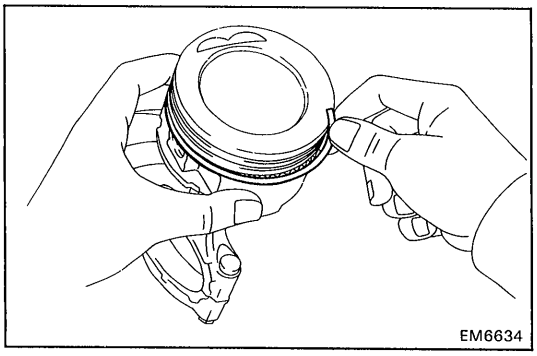
Try to move the piston back and forth on the piston pin.

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



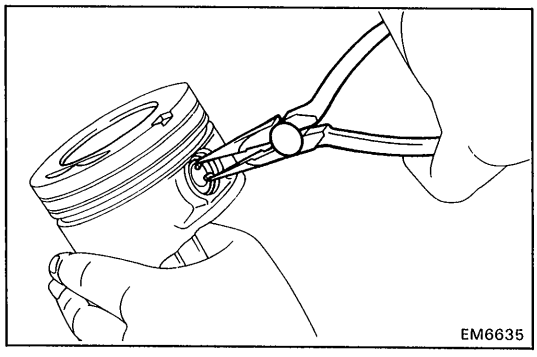
2. REMOVE PISTON RINGS

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



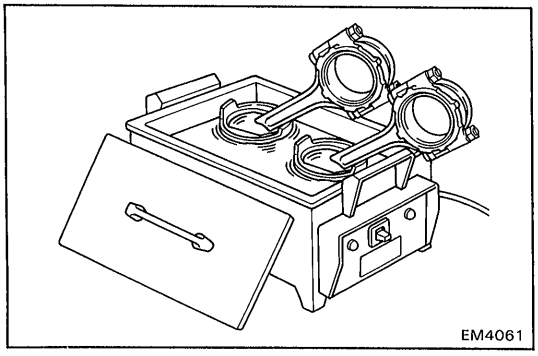
(b) Remove the two side rails and oil ring expander by hand.

HINT: Keep the rings for each cylinder separated.

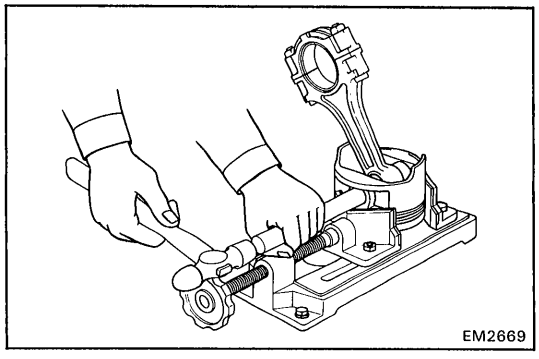


3. DISCONNECT CONNECTING ROD FROM PISTON

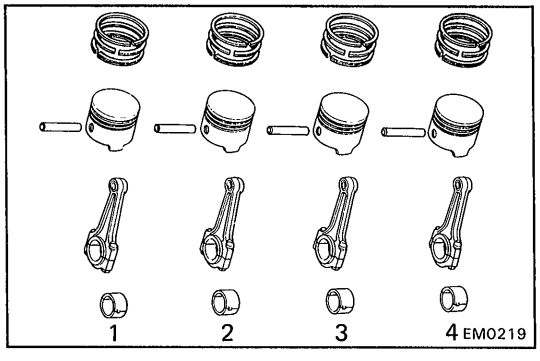
(a) Using needle-nose pliers, remove the snap rings from the piston.



(b) Heat the piston in hot water approx. 60°C (140°F).

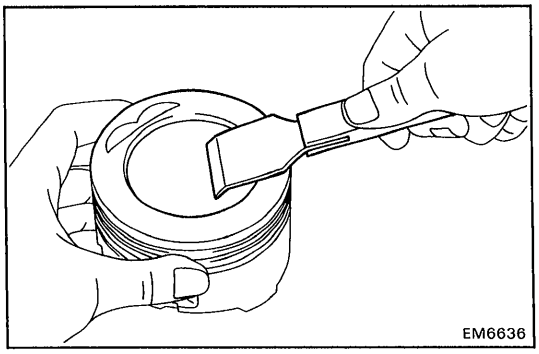


(c) Using a plastic-faced hammer and brass bar, lightly tap out the piston pin from the piston.



HINT:

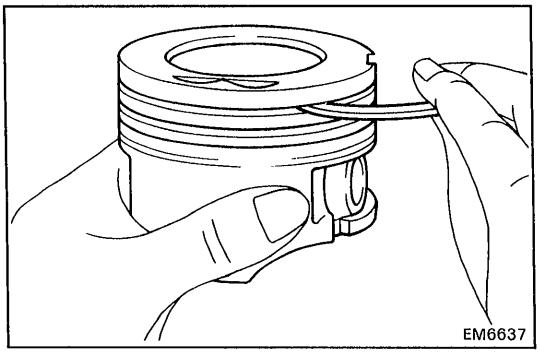
- The piston and pin are a matched set.
- Keep the piston, pin, rings and connecting rod together for each cylinder.



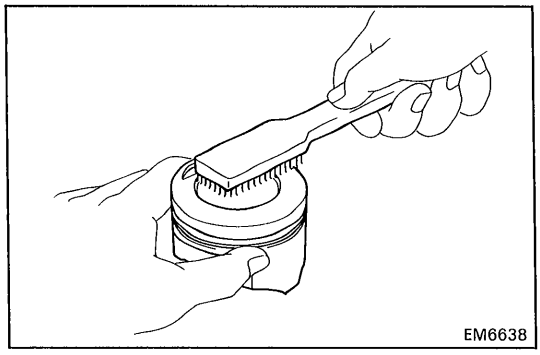
INSPECTION OF PISTON AND CONNECTING ROD ASSEMBLY

1. CLEAN PISTON

(a) Using a gasket scraper, remove the carbon from the piston top.



(b) Using a groove cleaning tool or broken ring, clean the ring grooves.



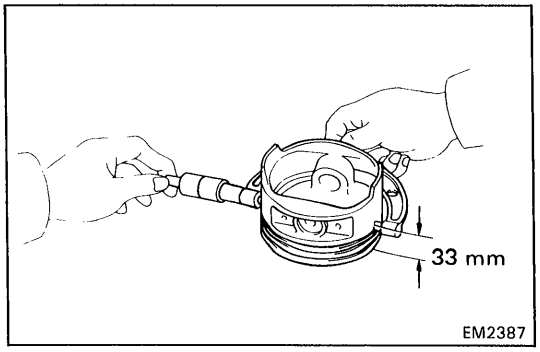
(c) Using solvent and brush, thoroughly clean the piston thoroughly.

NOTICE: Do not use a wire brush.

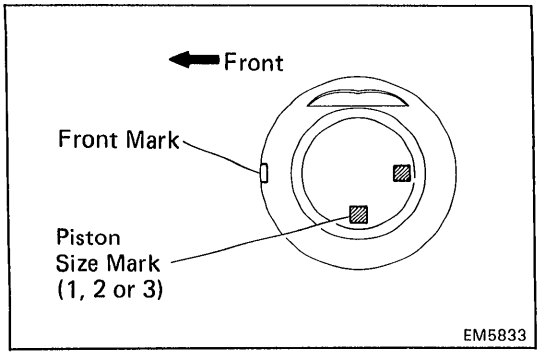
2. INSPECT PISTON DIAMETER AND OIL CLEARANCE

(a) Using a micrometer and with the piston upside down, measure the piston diameter at a right angles to the piston pin hole center line, the indicated distance from the piston head.

Distance: 33 mm (1.30 in.)

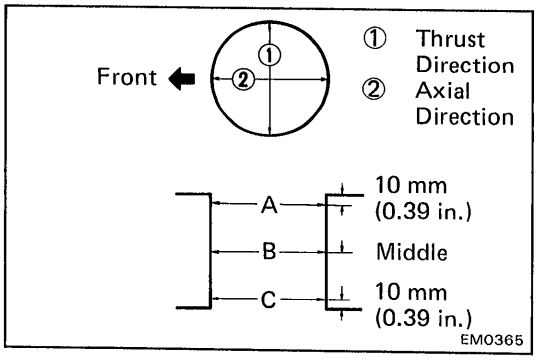


HINT: There are three sizes of the standard piston diameter, marked "1", "2", and "3", accordingly. The marked is stamped on the top of the piston.



Piston diameter:

STD	**Mark "1"**	**91.975 — 91.985 mm (3.6211 — 3.6214 in.)**
	Mark "2"	**91.985 — 91.995 mm (3.6214 — 3.6218 in.)**
	Mark "3"	**91.995 — 92.005 mm (3.6218 — 3.6222 in.)**
O/S	**0.50**	**92.475 — 92.505 mm (3.6407 — 3.6419 in.)**
	1.00	**92.975 — 93.005 mm (3.6604 — 3.6616 in.)**

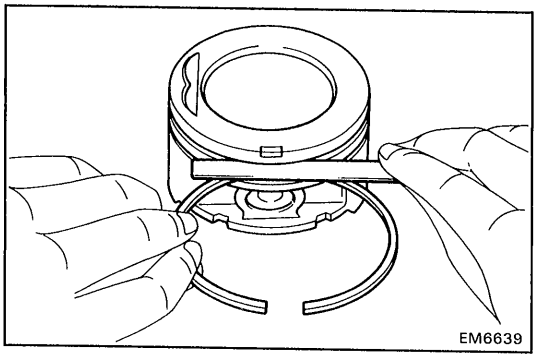


(b) Measure the cylinder bore diameter in thrust directions (See page EM-55) and subtract the piston diameter measurement from the cylinder bore diameter measurement.

Piston clearance: 0.015 — 0.035 mm (0.0006 — 0.0014 in.)

If not within specification, replace the pistons.
If necessary, rebore or replace the cylinder block.

HINT: (Use cylinder block sub-assembly)
When installing a standard piston, install one with the same mark as the standard bore diameter mark on the cylinder block.



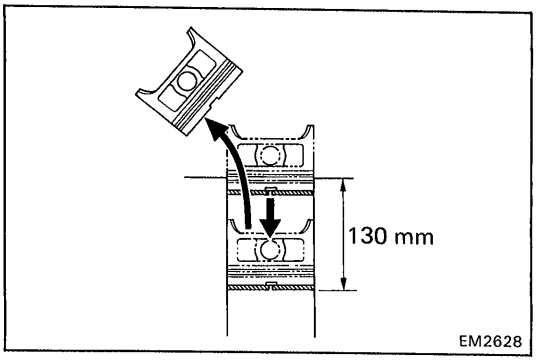
3. MEASURE CLEARANCE BETWEEN PISTON GROOVE AND PISTON RING

Using a thickness gauge, measure the clearance between the piston ring and the ring land.

Standard ring groove clearnce: 0.03 — 0.07 mm (0.0012 — 0.0028 in.)

Maximum ring groove clearance: 0.2 mm (0.008 in.)

If the clearance is greater than maximum, replace the piston ring and/or piston.

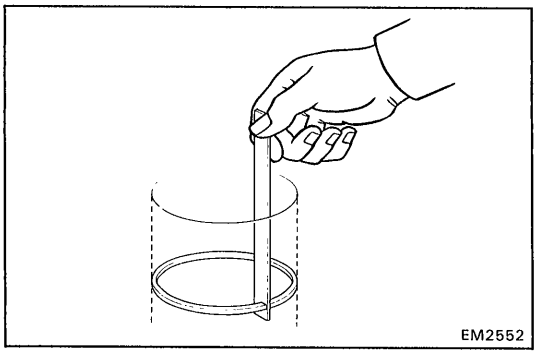


4. MEASURE RING END GAP

Measure the ring end gap.

(a) Insert the piston ring into the cylinder.

(b) Using a piston, push the ring a little beyond the bottom of the ring travel.
(130 mm (5.12 in.) from top surface of cylinder block)

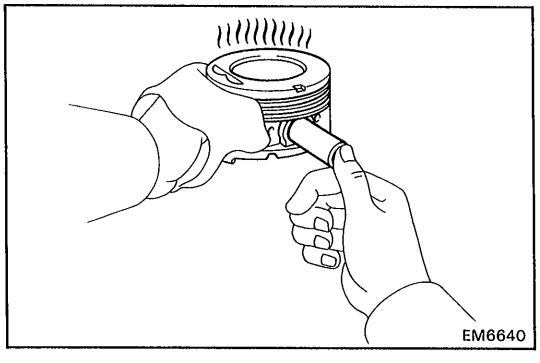

EM2552

(c) Using a thickness gauge, measure the end gap.

Ring end gap:

Standard	**No.1**	**0.25 — 0.47 mm (0.0098 — 0.0185 in.)**
	No.2	**0.60 — 0.82 mm (0.0236 — 0.0323 in.)**
	Oil	**0.20 — 0.57 mm (0.0079 — 0.0224 in.)**
Maximum	**No.1**	**1.07 mm (0.0421 in.)**
	No.2	**1.42 mm (0.0559 in.)**
	Oil	**1.17 mm (0.0461 in.)**

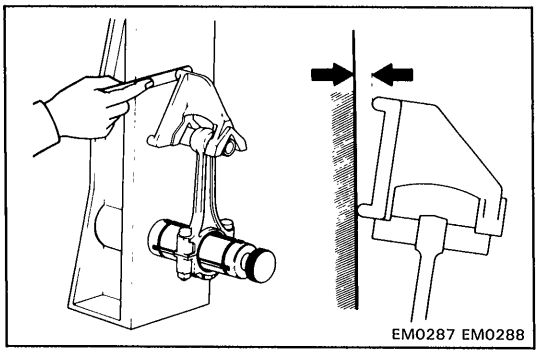
If the gap is greater than maximum, replace the ring. Do not file the ring end.


EM6640

5. INSPECT PISTON PIN FIT

At 80°C (176°F), you should be able to push the pin into the piston with your thumb.

If the pin can be installed at a lower temperature, replace it and the piston.


EM0287 EM0288

6. INSPECT CONNECTING RODS

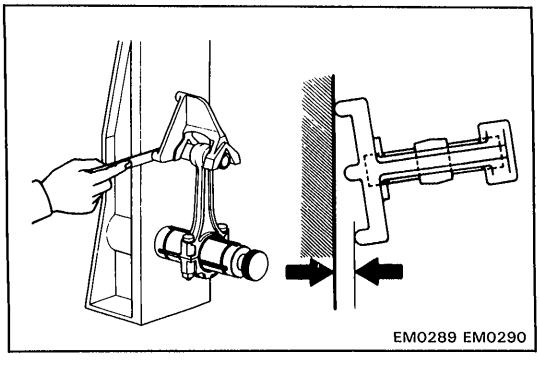
(a) Using a rod aligner, check the connecting rod alignment.

If the rod is bent or twisted, replace the connecting rod.

- Check that the rod is not bent.

Maximum bend:

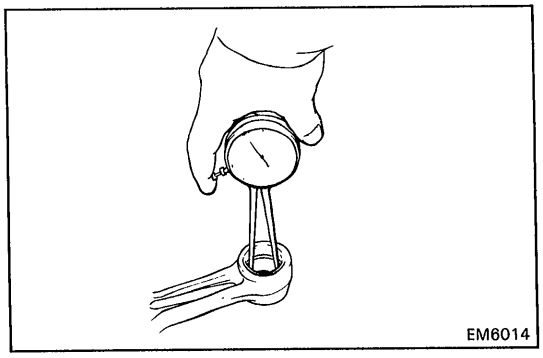
0.05 mm (0.0020 in.) per 100 mm (3.94 in.)


EM0289 EM0290

- Check that the rod is not twisted.

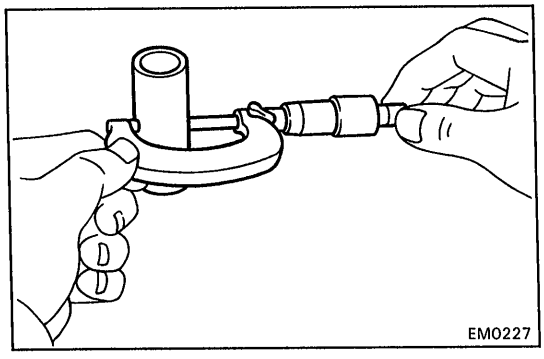
Maximum twist:

0.15 mm (0.0059 in.) per 100 mm (3.94 in.)


EM6014

(b) Measure the oil clearance between the rod bushing and piston pin.

- Using an inside dial indicator, measure the inside diameter of the rod bushing.

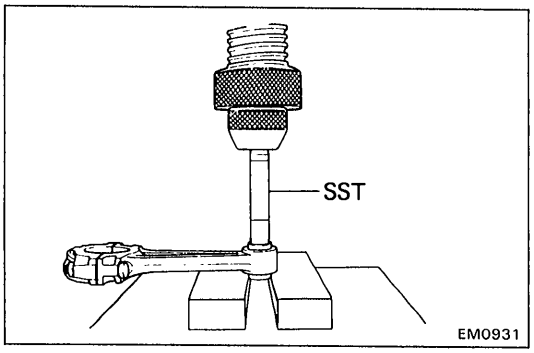

EM0227

- Using a micrometer, measure the diameter of the piston pin.
- Check that the difference between the measurements is less than the oil clearance limit.

Standard oil clearance: **0.005 — 0.011 mm (0.0002 — 0.0004 in.)**

Maximum oil clearance: **0.015 mm (0.0006 in.)**

If the clearance is greater than maximum replace the rod bushing.

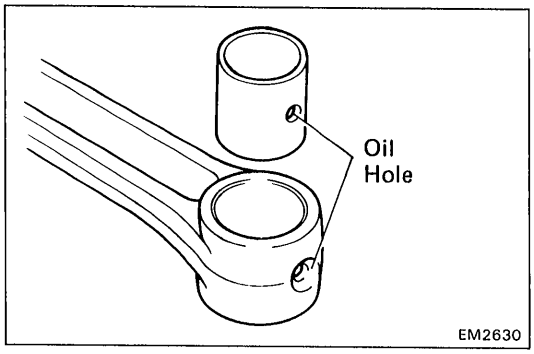


REPLACEMENT OF ROD BUSHING

1. REMOVE ROD BUSHING

Using SST, remove the rod bushing from the connecting rod.

SST 09222-30010

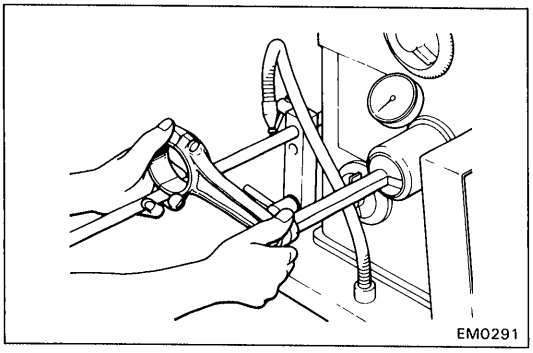


2. INSTALL NEW ROD BUSHING

Using SST, install the rod bushing to the connecting rod.

SST 09222-30010

HINT: Align the bushing oil hole with the connecting rod oil hole.



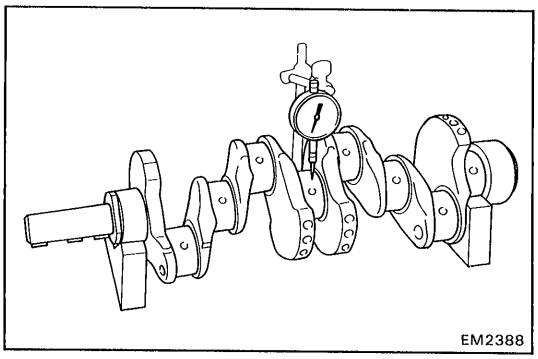
3. HONE NEW BUSHING AND CHECK PIN FIT IN CONNECTING ROD

(a) Hone the new bushing and check that the oil clearance is within standard specification.

Standard oil clearance: 0.005 — 0.011 mm (0.0002 — 0.0004 in.)

(b) Check the pin fit at the normal room temperature.

Coat the pin with engine oil and push the pin into the rod with thumb pressure.


EM2388

INSPECTION AND REPAIR OF CRANKSHAFT

1. MEASURE CRANKSHAFT FOR RUNOUT

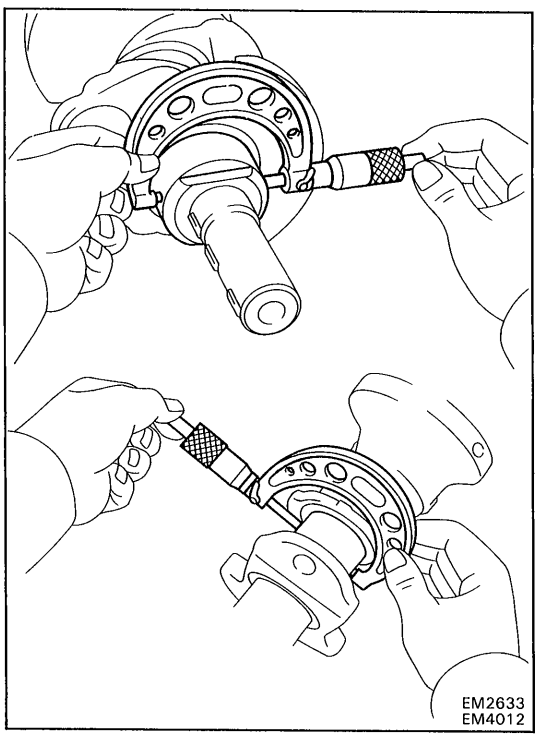
(a) Place the crankshaft on V-blocks.

(b) Using a dial gauge, measure the runout at the center journal.

Maximum circle runout: 0.1 mm (0.004 in.)

If the runout is greater than maximum, replace the crankshaft.

HINT: Use a long spindle on the dial gauge.

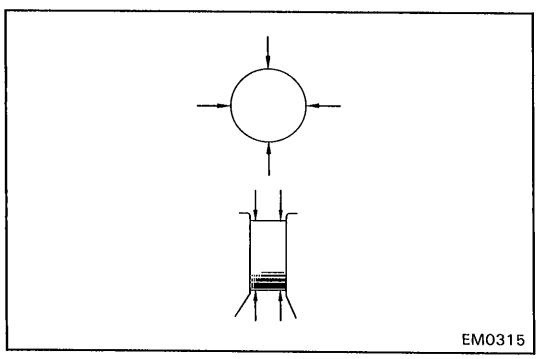

EM2633
EM4012

2. INSPECT MAIN JOURNAL AND CRANK PINS

(a) Using a micrometer, measure the diameter of the main and crank pin journal.

Main journal diameter: 59.984 — 60.000 mm (2.3616 — 2.3622 in.)
Crank pin diameter: 52.988 — 53.000 mm (2.0861 — 2.0866 in.)

If journals are worn, regrind or replace the crankshaft.


EM0315

(b) Measure the journals for out-of round and taper as shown.

Maximum taper: 0.01 mm (0.0004 in.)

Maximum out-of round: 0.01 mm (0.0004 in.)

If taper and out-of round are greater than maximum, regrind and/or replace the crankshaft.

3. GRIND CRANK PIN AND/OR MAIN JOURNAL, IF NECESSARY

(a) Grind the crank pins and/or main journals to the undersized finished diameter.

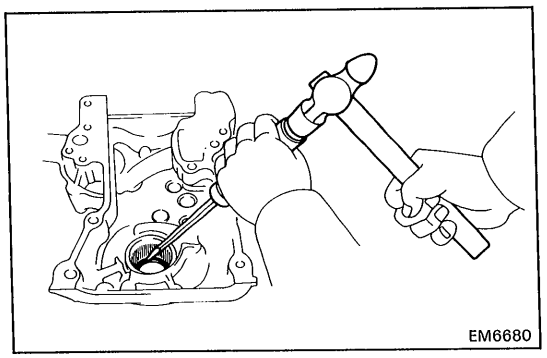
Bearing size (U/S 0.25)

Main journal finished diameter:
59.701 — 59.711 mm (2.3504 — 2.3508 in.)
Crank pin finished diameter:
52.701 — 52.711 mm (2.0748 — 2.0752 in.)

(b) Install a new pin and/or main undersize bearings.

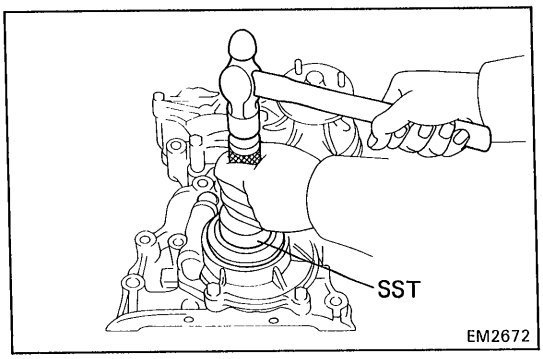
REPLACEMENT OF OIL SEALS

HINT: There are two ways of oil seal replacement in accordance with the timing chain cover or rear oil seal retainer condition.



1. IF TIMING CHAIN COVER IS REMOVED FROM CYLINDER BLOCK (Replacement of front oil seal)

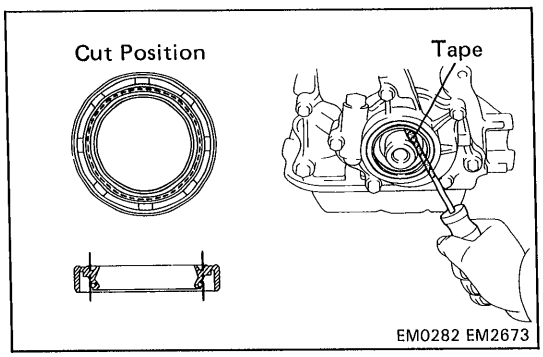
(a) Using a screwdriver, remove the oil seal.



(b) Apply MP grease to a new oil seal lip.

(c) Using SST, install the oil seal.

SST 09223-50010

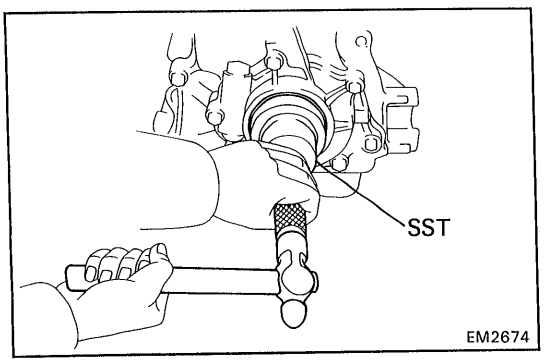


2. IF TIMING CHAIN COVER IS INSTALLED ON CYLINDER BLOCK (Replacement of front oil seal)

(a) Using a knife, cut off the oil seal lip.

(b) Using a screwdriver, pry out the oil seal.

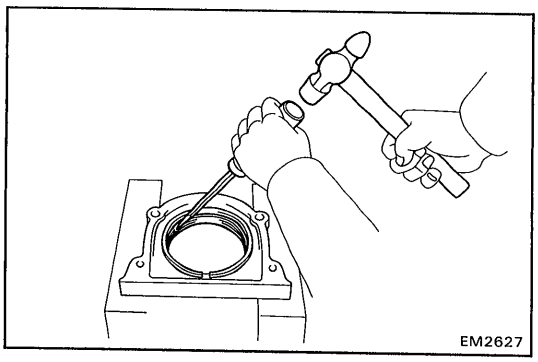
NOTICE: Be careful not to damage the crankshaft. Tape the screwdriver tip.



(c) Apply MP grease to a new oil seal lip.

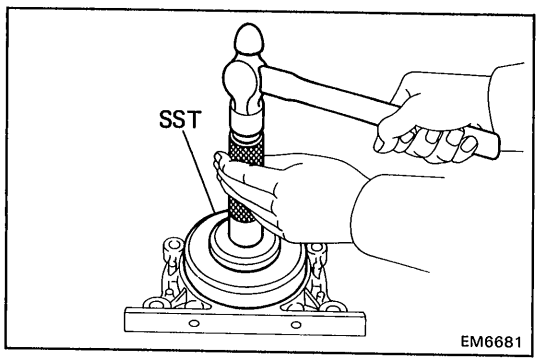
(d) Using SST and a hammer, tap in the oil seal until its surface is flush with the timing chain cover edge.

SST 09223-50010



3. **IF REAR OIL SEAL RETAINER IS REMOVED FROM CYLINDER BLOCK (Replacement of rear oil seal)**

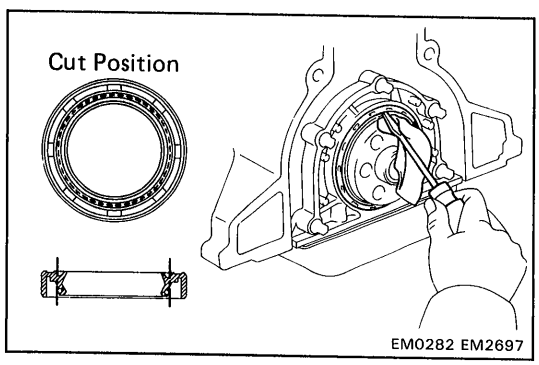
(a) Using a screwdriver, remove the oil seal.



(b) Apply MP grease to a new oil seal lip.

(c) Using SST, install the oil seal.

SST 09223-41020

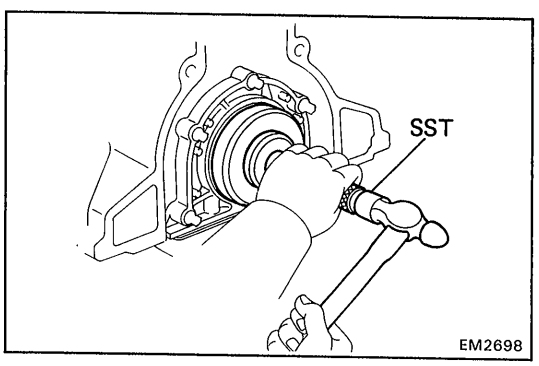


4. **IF REAR OIL SEAL RETAINER IS INSTALLED ON CYLINDER BLOCK (Replacement of rear oil seal)**

(a) Using a knife, cut off lip of oil seal.

(b) Using a screwdriver, pry out the oil seal.

NOTICE: Be careful not to damage the crankshaft. Tape the screwdriver tip.



(c) Apply MP grease to a new oil seal lip.

(d) Using SST and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.

SST 09223-41020

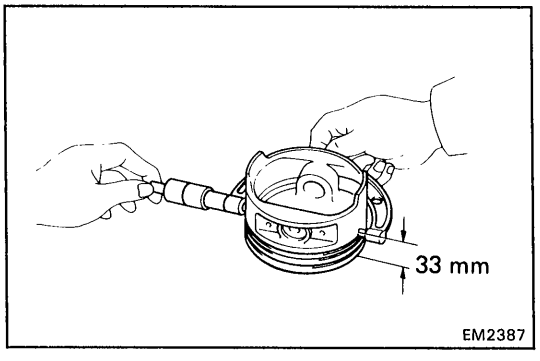
Size	Outside Diameter mm (in.)
O/S 0.50	92.475 — 92.505 (3.6407 — 3.6419)
O/S 1.00	92.975 — 93.005 (3.6604 — 3.6616)

BORING OF CYLINDERS

1. SELECT OVERSIZED PISTON

O/S pistons with pins are available in the sizes listed.

Replace pistons in matched sets. Take the largest bore measured and select the oversized piston for that bore. Bore all cylinders for the oversized piston selected.



2. CALCULATE DIMENSION TO BORE CYLINDERS

(a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, 33 mm (1.30 in.) from the piston head.

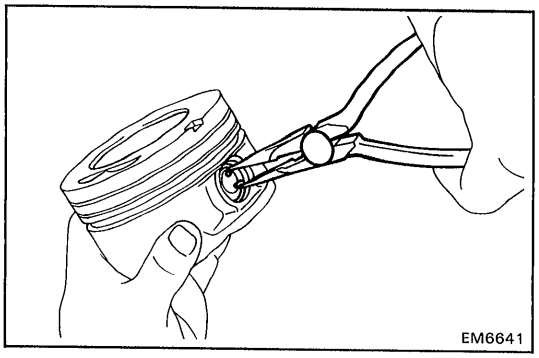
(b) Calculate the size each cylinder is to be rebored as follows:

Size to be rebored = P + C - H
P = piston diameter
C = piston clearance
0.015 — 0.035 mm (0.0006 — 0.0014 in.)
H = allowance for honing
Less than 0.02 mm (0.0008 in.)

3. BORE AND HONE CYLINDERS TO CALCULATED DIMENSIONS

Honing amount: 0.02 mm (0.0008 in.) maximum

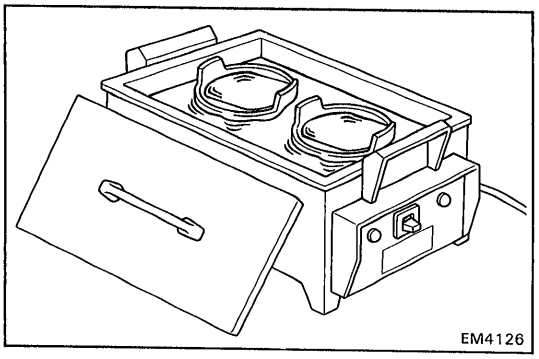
NOTICE: Excess honing will destroy the finished roundness.


EM6641

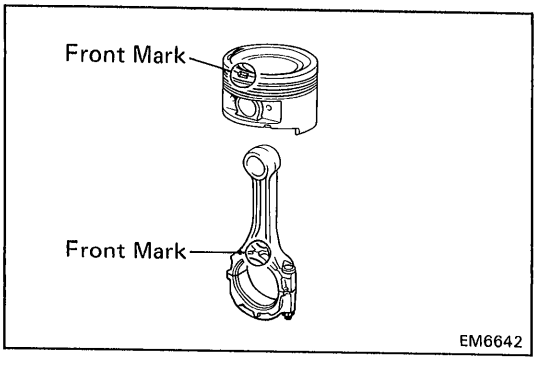
ASSEMBLY OF PISTON AND CONNECTING ROD ASSEMBLY

1. ASSEMBLY PISTON AND CONNECTING ROD

(a) Install a new snap ring on one side of the piston pin hole.


EM4126

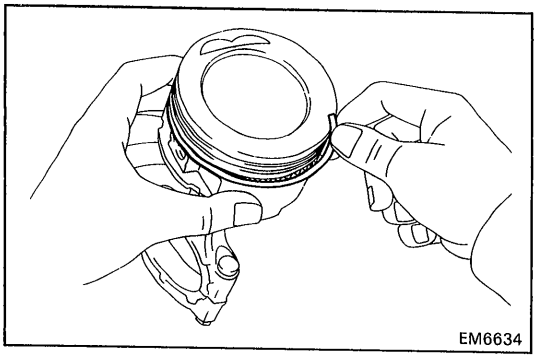
(b) Heat the piston in hot water to approx. 80°C (176°F).



EM6642

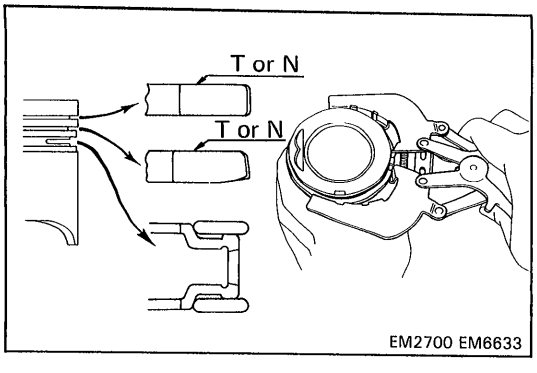
(c) Align the notch on the piston with the mark on the rod and push the piston pin in with your thumb.

(d) Install a new snap ring on the other side of the pin.


EM6634

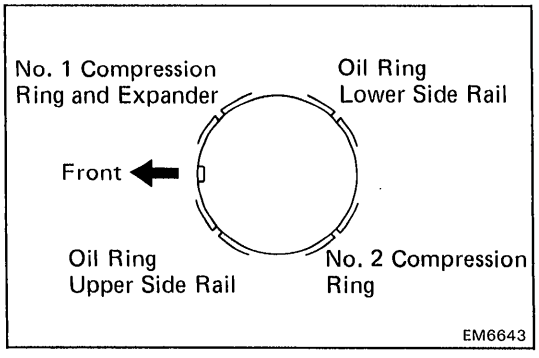
2. PLACE RINGS ON PISTON

(a) Install the oil ring expander and two side rails by hand.



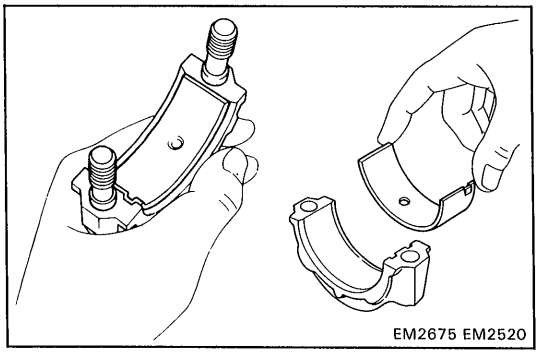
EM2700 EM6633

(b) Using a ring expander, install the two compression rings with the code marks facing upward.



(c) Position the piston rings so that the ring end are as shown.

NOTICE: Do not align the end gaps.



3. INSTALL BEARING

(a) Install the bearings in the connecting rods and rod caps.

(b) Lubricate the face of the bearings with engine oil.

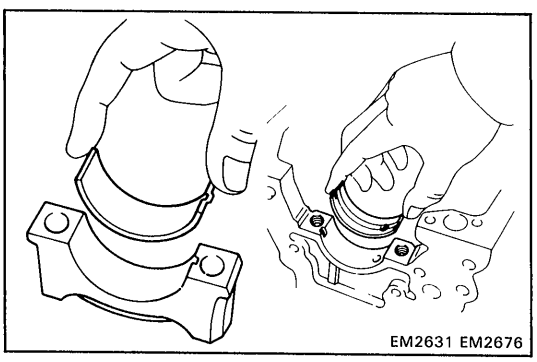
NOTICE: Install the bearing with the oil hole in the connecting rod.

INSTALLATION OF CRANKSHAFT, PISTON AND CONNECTING ROD ASSEMBLY

(See page EM-44)

GENERAL ASSEMBLY HINT:

- Thoroughly clean all parts to be assembled.
- Before installing parts, apply new engine oil to all sliding and rotating surfaces.
- Replace all gaskets O-ring and oil seals with new parts.


EM2631 EM2676

1. INSTALL MAIN BEARINGS

Install the bearing in the cylinder block and bearing caps.

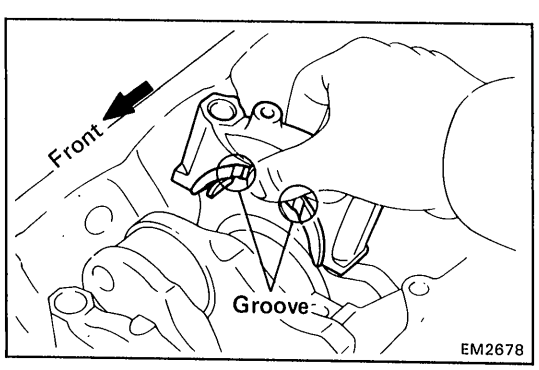
NOTICE: Install the upper bearing with the oil hole in the block.


EM2677

2. INSTALL UPPER THRUST WASHERS

Install the thrust washers under the No.3 main bearing cap position of the block with the oil grooves facing outward.

3. PLACE CRANKSHAFT ON CYLINDER BLOCK

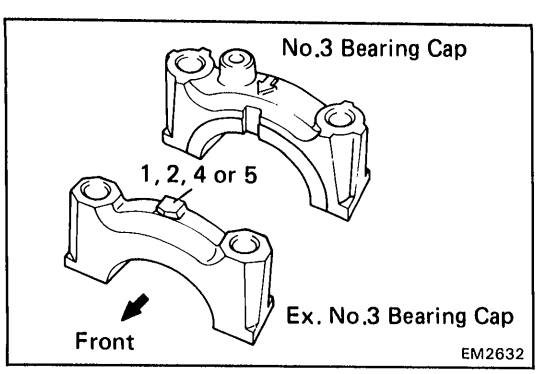


EM2678

4. INSTALL MAIN BEARINGS CAPS WITH LOWER THRUST WASHERS

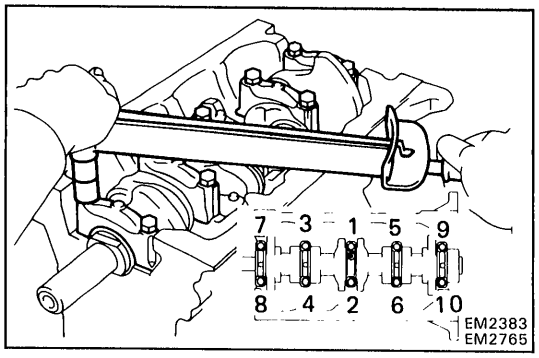
HINT: Each bearing cap is numbered.

(a) Install the thrust washers on the No.3 bearing cap with the grooves facing outward.



EM2632

(b) Install the bearing caps in their proper location.



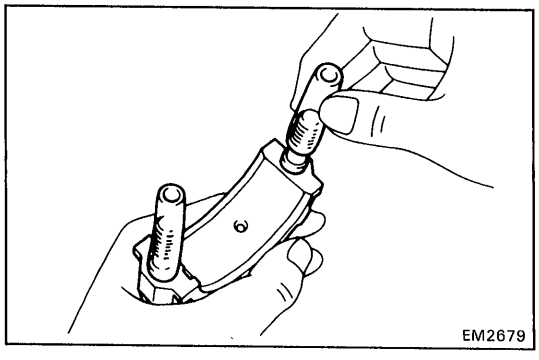
(c) Apply a light coating of engine oil on the threads and under the cap bolt heads.

(d) Install and tighten the cap bolts in two or three passes and in the sequence shown.

Torque: 1,050 kg-cm (76 ft-lb, 103 N·m)

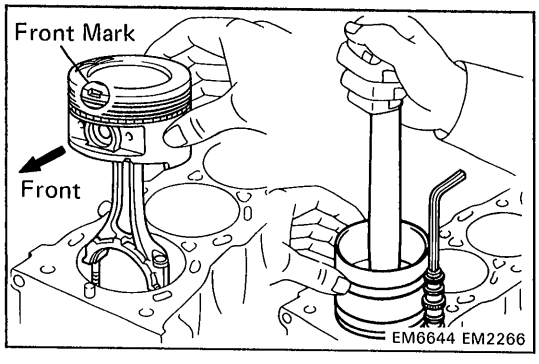
(e) Check that the crankshaft turns smoothly.

(f) Check the crankshaft thrust clearance. (See page EM-52)



5. INSTALL PISTON AND CONNECTING ROD ASSEMBLY

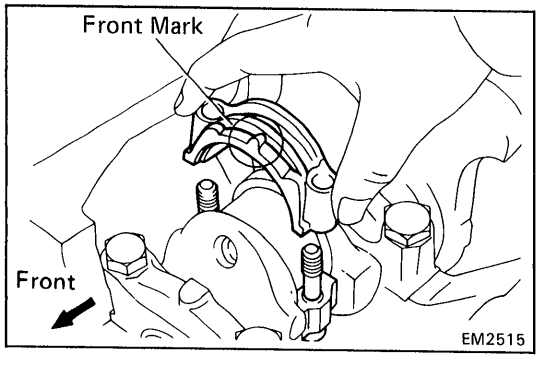
(a) Cover the rod bolts with a short piece of hose to protect the crankshaft from damage.



(b) Lubricate the cylinder bore and rod journal with clean engine oil.

(c) Using a ring compressor, tighten the compressor snugly but NOT tightly against the piston and gently tap the correctly numbered piston and rod assembly into its cylinders with a wooden hammer handle or like object. Make sure the notch and mark are facing forward.

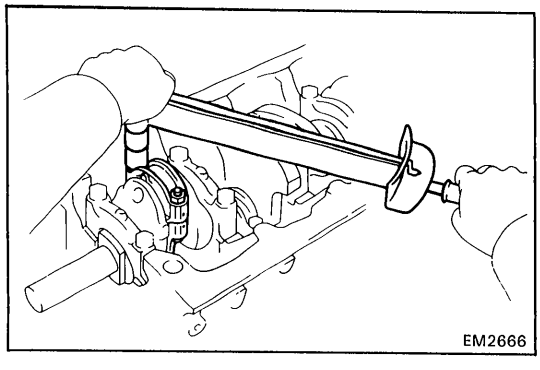
HINT: If the ring compressor is wound too tightly around the piston, the bottom edge of the ring compressor will catch against the beveled surface at the top of the cylinder when tapping the piston in.



6. INSTALL CONNECTING ROD CAPS

(a) Match the numbered cap with the numbered rod.

(b) Install the cap with the front mark facing forward.



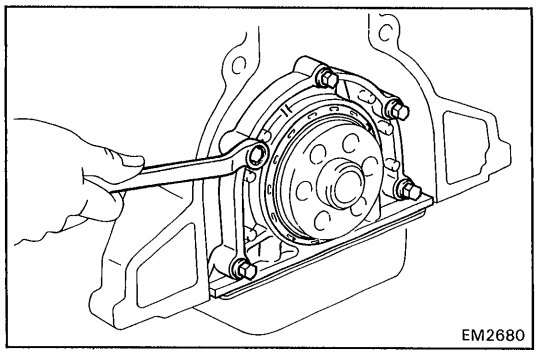
(c) Apply a light coat of the engine oil on the threads and under of the rod nuts.

(d) Install and tighten the rod nuts alternately and in two or three passes.

Torque: 700 kg-cm (51 ft-lb, 69 N·m)

(e) Check that the crankshaft turns smoothly.

(f) Check the rod thrust clearance. (See page EM-50)



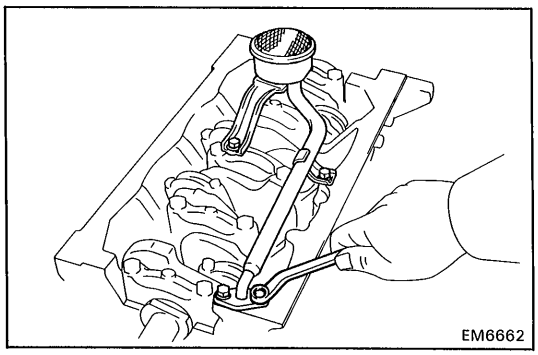
ASSEMBLY OF CYLINDER BLOCK

(See page EM-44)

1. **INSTALL REAR OIL SEAL RETAINER**

   Install a new gasket and the retainer with the four bolts. Torque the bolts.

   Torque: 180 kg-cm (13 ft-lb, 18 N·m)



2. **INSTALL OIL STAINER**

   (a) Clean the oil strainer.

   (b) Place the gasket in place and install the oil strainer assembly with four bolts. Torque the bolts.

   Torque: 130 kg-cm (9 ft-lb, 13 N·m)

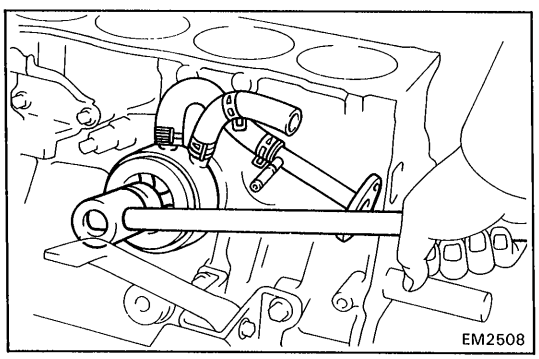
3. **INSTALL FUEL FILTER BRACKET AND FILTER**

4. **INSTALL KNOCK CONTROL SENSOR**

5. **INSTALL OIL PRESSURE SENDER GAUGE**

6. **(A/T)**
   INSTALL FLEXIBLE HOSE CLAMP

7. **INSTALL RH ENGINE MOUNTING BRACKET, CHAMBER STAY AND GROUND STRAP**



8. **(w/ OIL COOLER)**
   INSTALL OIL COOLER

   (a) Repalce the O-ring.

   (b) Install a new gasket on the oil cooler relief valve.

   (c) Install the oil cooler with the oil cooler relief valve.

   Torque: 700 kg-cm (51 ft-lb, 69 N·m)

9. **INSTALL OIL FILTER**
   (See step 2 on page LU-6)

10. **INSTALL CHAIN TENSIONER**

    Torque: 195 kg-cm (14 ft-lb, 19 N·m)

11. **INSTALL CHAIN DAMPERS**

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

12. **INSTALL ALTERNATOR BRACKET AND LH ENGINE MOUNTING BRACKET**

13. **INSTALL TIMING CHAIN (See page EM-41)**

14. **INSTALL ALTERNATOR**

15. **INSTALL CYLINDER HEAD (See page EM-31)**

16. **REMOVE ENGINE STANDS**

17. **INSTALL REAR END PLATE**

18. **INSTALL FLYWHEEL OR DRIVE PLATE**

Install the flywheel (M/T) or spacer, drive plate, spacer (A/T) on the crankshaft with the six bolts. Torque the bolts.

Torque: M/T 1,100 kg-cm (80 ft-lb, 108 N·m)
A/T 850 kg-cm (61 ft-lb, 83 N·m)

INSTALLATION OF ENGINE

1. **(M/T)**
   INSTALL CLUTCH DISC AND COVER TO FLYWHEEL
   (See page CL-13)

2. **CONNECT TRANSMISSION TO ENGINE**

3. **PLACE ENGINE WITH TRANSMISSION IN VEHICLE**
   (a) Attach the engine hoist chain to the lifting brackets on the engine.
   (b) Lower the engine with transmission into the engine compartment.

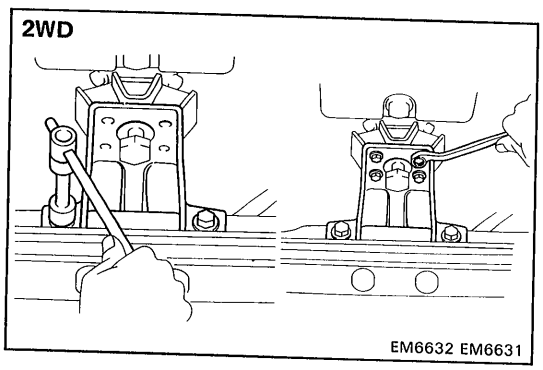
4. **(4WD)**
   PLACE JACK UNDER TRANSMISSION
   Be sure to put a wooden block between the jack and the transmission pan.

5. **JACK UP AND PUT TRANSMISSION ONTO MEMBER**

6. **INSTALL ENGINE MOUNTING TO FRAME BRACKET**
   (a) Align the engine mounting and frame bracket.
   (b) Install the engine mounting bolts on each side of the engine.
   (c) Remove the hoist chain.

7. **(2WD)**
   INSTALL ENGINE REAR MOUNTING AND BRACKET
   (a) Raise the transmission slightly by raising the engine with a jack and a wooden block under the transmission.

2WD



EM6632 EM6631

(b) Install the engine rear mounting bracket to the support member. Torque the bolts.

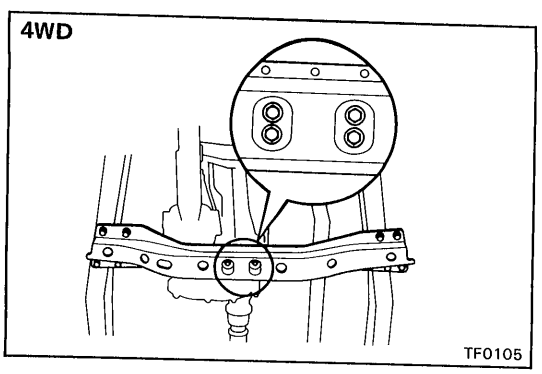
Torque: 130 kg-cm (9 ft-lb, 13 N·m)

(c) Lower the transmission and rest it on the extension housing.

(d) Install the bracket to the mounting. Torque the bolts.

Torque: 260 kg-cm (19 ft-lb, 25 N·m)

4WD



TF0105

(4WD)
INSTALL NO.2 FRAME CROSSMEMBER

(a) Raise the transmission slightly with a jack.

(b) Install the frame No. 2 crossmember to the side frame with the bolts. Torque the bolts.

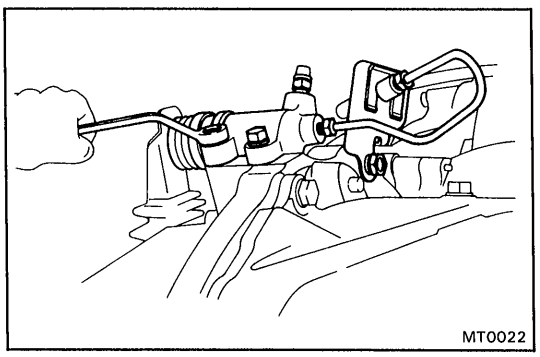
Torque: 970 kg-cm (70 ft-lb, 95 N·m)

(c) Lower the transmission and transfer.

(d) Install the four mounting bolts to the engine rear mounting. Torque the bolts.

Torque: 130 kg-cm (9 ft-lb, 13 N·m)

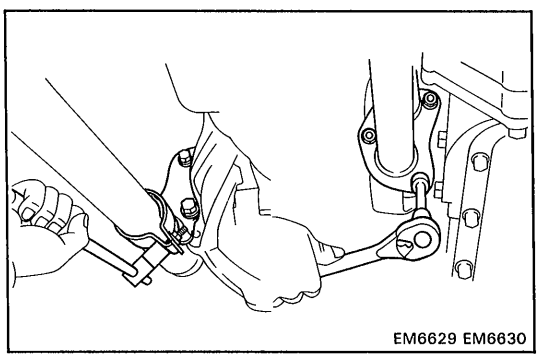
8. (4WD)
INSTALL BRAKE TUBE HEAT INSULATOR AND NO.1 FRONT FLOOR HEAT INSULATOR


MT0022

9. (M/T)
INSTALL CLUTCH RELEASE CYLINDER WITH BRACKET TO TRANSMISSION

Torque:

Bracket	**400 kg-cm (29 ft-lb, 39 N·m)**
Release cylinder	**120 kg-cm (9 ft-lb, 12 N·m)**


EM6629 EM6630

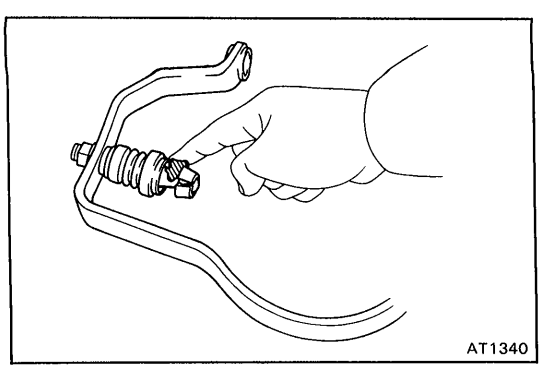
10. **INSTALL EXHAUST PIPE**
   (a) Connect the exhaust pipe to the catalytic converter.
   (b) Connect the exhaust pipe to the exhaust manifold.
   (c) Install the exhaust pipe clamp.
   (d) Connect the oxygen sensor connector.

11. (4WD)
INSTALL FRONT PROPELLER SHAFT
(See page PR-11)

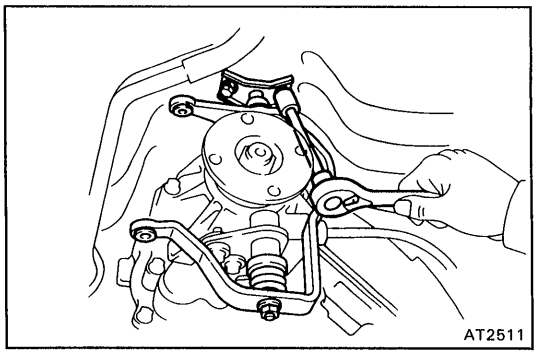
12. **INSTALL STABILIZAR BAR**
(See page SA-105)

13. (4WD)
INSTALL TRANSFER UNDER COVER

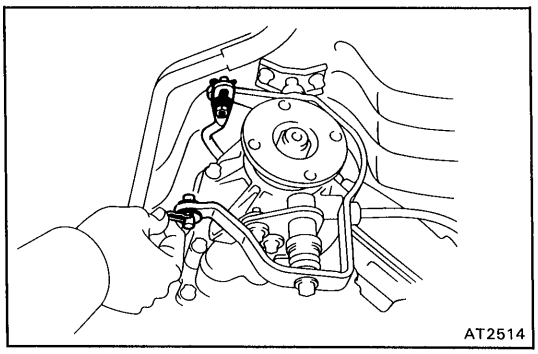
14. **CONNECT SPEEDOMETER CABLE**


AT1340

15. (4WD A/T)
CONNECT TRANSFER SHIFT LINKAGE
   (a) Apply MP grease to the cross shaft joint.



(b) Install the cross shaft to the body.



(c) Connect the No.1 and No.2 transfer shift linkage to the cross shaft.

(2WD A/T)
CONNECT MANUAL SHIFT LINKAGE TO NEUTRAL START SWITCH

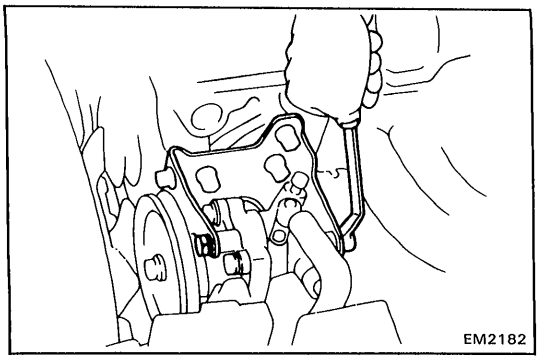
16. **INSTALL PROPELLER SHAFT**
(See page 2WD PR-11)
(See page 4WD PR-12)

17. **(M/T)**
INSTALL SHIFT LEVER(S)
(a) Apply MP grease to the shift lever.
(b) Install the shift lever to the transmission.

18. **CONNECT GROUND STRAPS TO ENGINE REAR SIDE AND RH SIDE**

19. **(with A/C)**
INSTALL COMPRESSOR TO BRACKET
(a) Install the compressor with four bolts.
(b) Install the drive belt and adjust the belt tension.

20. **CONNECT GROUND STRAP FOR VANE PUMP BRACKET**



21. **(w/ PS)**
INSTALL PS PUMP WITH VANE PUMP BRACKET
Install the PS pump with four bolts.

22. CONNECT FOLLOWING CABLES:

(a) (A/T)
Throttle cable

(b) (w/ Cruise control)
Cruise control cable

(c) Accelerator cable

23. CONNECT FOLLOWING HOSES:

(a) Charcoal canister hose to canister

(b) (w/ Cruise control)
Cruise control vacuum hose

(c) Brake booster hose

(d) PS air hoses to gas filter and air pipe

24. CONNECT FOLLOWING WIRES AND CONNECTORS:

(a) (with A/C)
A/C compressor connector

(b) Check connector

(c) (M/T)
Starter relay connectors

(d) ECU connectors

(e) Ground strap to engine rear side

(f) Distributor wire

(g) High-tension cords

(h) Alternator wires

(i) Igniter connector

(j) Alternator connector and wire

(k) Ground strap to LH fender apron

25. INSTALL FAN PULLEY, BELT GUIDE, FLUID COUPLING AND ALTERNATOR DRIVE BELT
(See step 9 on page EM-42)

26. (with A/C)
INSTALL A/C BELT
(See step 2 on page MA-6)

27. INSTALL PS PUMP AND BELT

(a) Place the PS drive belt on to each pulley.

(b) Stretch the belt tight and tighten the nuts.

(c) Torque the PS pump pulley lock nut.

Torque: 440 kg-cm (32 ft-lb, 43 N·m)

(d) Adjust the belt tension.
(See step 2 on page MA-6)

28. INSTALL RADIATOR

29. INSTALL AIR CLEANER CASE AND INTAKE AIR CONNECTOR

30. FILL WITH ENGINE OIL
(See step 3 on page LU-7)

31. FILL WITH COOLANT
(See step 3 on page CO-5)

32. INSTALL ENGINE UNDER COVER

33. INSTALL BATTERY

34. INSTALL HOOD

35. START ENGINE

Warm up the engine and inspect for leaks.

36. PERFORM ENGINE ADJUSTMENT
(See page EM-7)

37. ROAD TEST

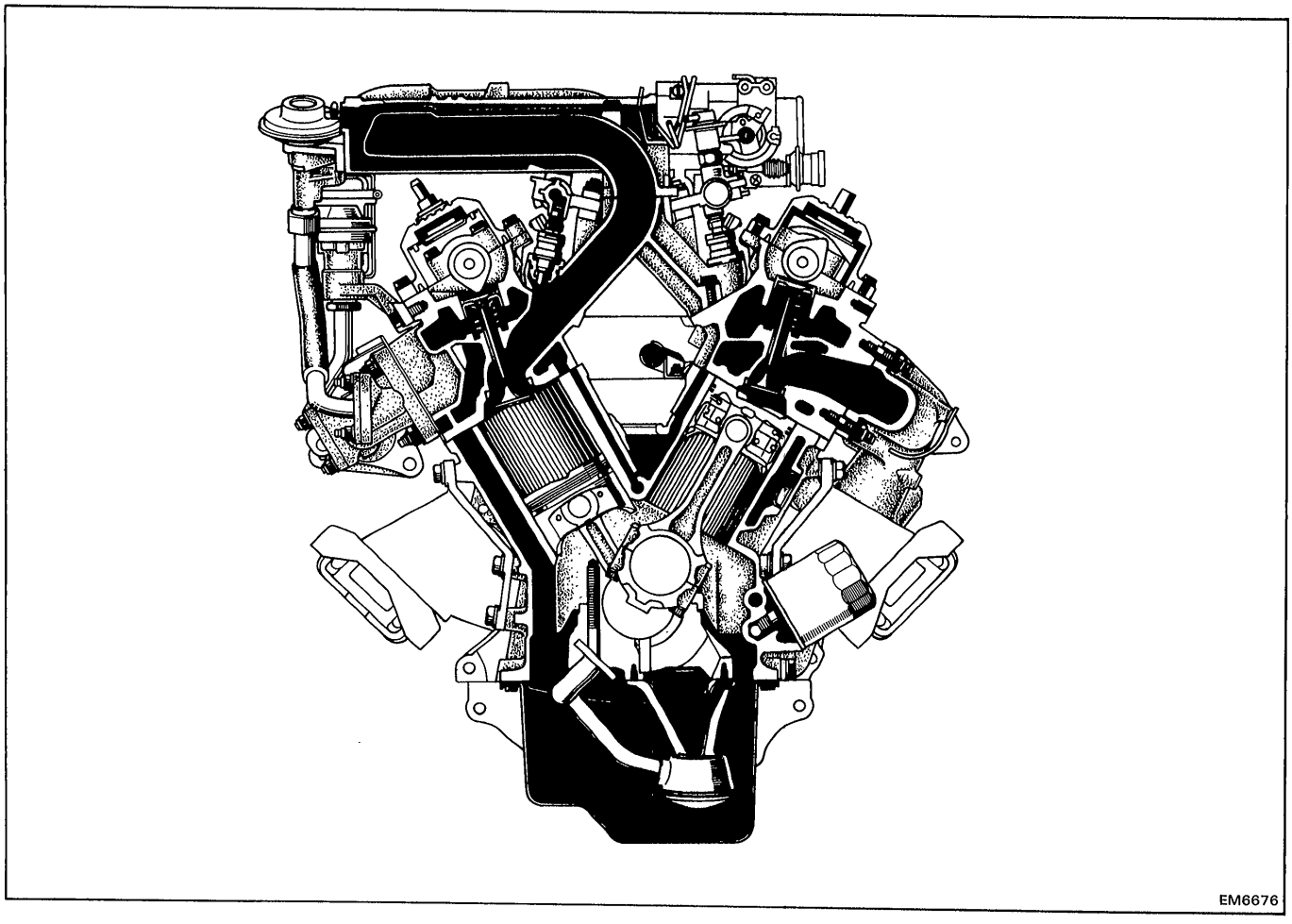
Road test vehicle

38. RECHECK COOLANT AND ENGINE OIL LEVEL

DESCRIPTION

3VZ-E ENGINE

The 3VZ-E engine is a V-6 3.0 liter OHC 12 valve engine.



The 3VZ-E engine has 6 cylinders in a V arrangement at a bank angle of 60°. From the front of the right bank the cylinders are numbered 1-3-5, and from the front of the left bank the cylinders are numbered 2-4-6.

The crankshaft is supported by 4 bearings inside the crankcase. The bearings are made of aluminum alloy.

The crankshaft is integrated with 5 weights which are cast with it for balance. There are oil holes in the center of the crankshaft to supply oil to the connecting rods and bearings, etc.

The ignition order is 1-2-3-4-5-6. The cylinder head is made of aluminum alloy, with a cross flow type intake and exhaust layout, and semi-heron type combustion chambers.

At the front and rear of the intake port of the intake manifold, a water passage has been provided which connects the left and right cylinder heads.

Each intake exhaust valve is equipped with irregular pitch springs made of special valve spring carbon steel which are capable of following no matter what the engine speed.

The left and right camshafts are driven by a single timing belt. The cam journal is supported at 5 places, between the valve lifters of each cylinder and on the front end of the cylinder head.

The cam journal and the cam are lubricated by oil supplied through the oiler port in the center of the camshaft.

Adjustment of the valve clearance is done by means of an outer shim type system with the valve adjusting shims located above the valve lifters so that the shims can be replaced without removing the camshafts.

The timing belt cover is composed of the resin type No.1 and No.2 above and below the fan bracket, and the No.3 and No.4, which are made of steel sheet to make removal of the intake manifold easier.

The pistons are made of high temperature resistant aluminum alloy, and the piston head is concaved to prevent interference with the valves.

The piston pins are the semi-floating type, with the connecting rods and pins pressure fitted so that the piston and pin float.

The No.1 compression ring is made of stainless steel and the No.2 compression ring is made of cast iron. The oil ring is made of steel. The outer diameter of each piston ring is slightly larger than the diameter of the piston, and when the piston ring is attached to the cylinder the expansion of the piston ring produces a close fit with the cylinder walls.

The No.1 and No.2 compression rings work to prevent gas leakage, and the oil ring works to scrape oil off the cylinders and prevent it from entering the combustion chambers.

The cylinder block is made of cast iron with a bank angle of 60°. It has 6 cylinders which are approximately twice the length of the piston stroke. The top of the cylinders is closed off by the cylinder head and the lower end becomes the crankcase where the crankshaft is installed. In addition, the cylinder block contains a water jacket to cool the cylinders.

The oil pan is bolted onto the bottom of the cylinder block. The oil pan is an oil reservoir made of pressed steel sheet. A baffle plate has been installed between the oil pan and cylinder block to reduce oil stir from the crankshaft and con rod.

TROUBLESHOOTING

ENGINE OVERHEATING

Problem	Possible cause	Remedy	Page
Engine overheats	Cooling system faulty	Troubleshoot cooling system	CO-15
	Incorrect ignition timing	Reset timing	IG-19

HARD STARTING

Problem	Possible cause	Remedy	Page
Engine will not crank or cranks slowly	Starting system faulty	Troubleshoot starting system	ST-2
Engine will not start /Hard to start (cranks OK)	No fuel supply to injector • No fuel in tank • Fuel pump not working • Fuel filter clogged • Fuel line clogged or leaking	Troubleshoot EFI system	FI-112
	EFI system problems	Repair as necessary	
	Ignition problems	Perform spark test	IG-14
	• Ignition coil	Inspect coil	IG-16
	• Igniter		
	• Distributor	Inspect distributor	IG-16
	Spark plugs faulty	Inspect plugs	IG-15
	High-tension cords disconnected or broken	Inspect cords	IG-15
	Vacuum leaks • PCV hoses • EGR valve • Intake manifold • Air intake chamber • Throttle body	Repair as necessary	
	Pulling in air between air flow meter and throttle body	Repair as necessary	
	Low compression	Check compression	EM-98

ROUGH IDLING

Problem	Possible cause	Remedy	Page
Rough idle, stalls or misses	Spark plugs faulty	Inspect plugs	IG-15
	High-tension cords faulty	Inspect cords	IG-15
	Ignition problems		
	• Ignition coil	Inspect coil	IG-16
	• Igniter		
	• Distributor	Inspect distributor	IG-16
	Incorrect ignition timing	Reset timing	IG-19
	Vacuum leaks • PCV hoses • EGR valve • Intake manifold • Air intake chamber • Throttle body	Repair as necessary	
	Pulling in air between air flow meter and throttle body	Repair as necessary	
	Incorrect idle speed	Adjust idle	MA-11
	EFI system problems	Repair as necessary	

ROUGH IDLING (CONT'D)

Problem	Possible cause	Remedy	Page
Rough idle, stalls or misses (cont'd)	Engine overheats	Check cooling system	CO-15
	Low compression	Check compression	EM-98
	Incorrect valve clearance	Adjust valve clearance	EM-84

ENGINE HESITATES/POOR ACCELERATION

Problem	Possible cause	Remedy	Page
Engine hesitates/ Poor acceleration	Spark plugs faulty	Inspect plugs	IG-15
	High-tension cords faulty	Inspect cords	IG-15
	Vacuum leaks • PCV hoses • EGR valve • Intake manifold • Air intake chamber • Throttle body	Repair as necessary	
	Pulling in air between air flow meter and throttle body	Repair as necessary	
	Incorrect ignition timing	Reset timing	IG-19
	Fuel system clogged	Check fuel system	
	Air cleaner clogged	Check air cleaner	MA-7
	EFI system problems	Repair as necessary	
	Emission control system problem (cold engine) • EGR system always on	Check EGR system	EC-26
	Engine overheats	Check cooling system	CO-15
	Low compression	Check compression	EM-98

ENGINE DIESELING

Problem	Possible cause	Remedy	Page
Engine dieseling (run after ignition switch is turned off)	EFI system problems	Repair as necessary	

AFTER FIRE, BACKFIRE

Problem	Possible cause	Remedy	Page
Muffler explosion (after fire) on deceleration only	Deceleration fuel cut system always off	Check EFI (fuel cut) system	FI-205
Muffler explosion (after fire) all the time	Air cleaner clogged	Check air cleaner	MA-7
	EFI system problem	Repair as necessary	
	Incorrect ignition timing	Reset timing	IG-19
	Incorrect valve clearance	Adjust valve clearance	EM-84

AFTER FIRE, BACKFIRE (CONT'D)

Problem	Possible cause	Remedy	Page
Engine backfires	EFI system problem	Repair as necessary	
	Vacuum leak • PCV hoses • EGR valve • Intake manifold • Air intake chamber • Throttle body	Check hoses and repair as necessary	
	Pulling in air between air flow meter and throttle body	Repair as necessary	
	Insufficient fuel flow	Troubleshoot fuel system	FI-112
	Incorrect ignition timing	Reset timing	IG-19
	Incorrect valve clearance	Adjust valve clearance	EM-84
	Carbon deposits in combustion chambers	Inspect cylinder head	EM-124

EXCESSIVE OIL CONSUMPTION

Problem	Possible cause	Remedy	Page
Excessive oil consumption	Oil leak	Repair as necessary	
	PCV line clogged	Check PCV system	EC-20
	Piston ring worn or damaged	Check rings	EM-164
	Valve stem and guide worn	Check valves	EM-125
	Valve stem seal worn	Check seals	

POOR GASOLINE MILEAGE

Problem	Possible cause	Remedy	Page
Poor gasoline mileage	Fuel leak	Repair as necessary	
	Air cleaner clogged	Check air cleaner	MA-7
	Incorrect ignition timing	Reset timing	IG-19
	EFI system problems • Injector faulty • Deceleration fuel cut system faulty	Repair as necessary Check EFI (fuel cut) system	FI-205
	Spark plugs faulty	Inspect plugs	IG-15
	EGR system always on	Check EGR system	EC-26
	Low compression	Check compression	EM-98
	Tires improperly inflated	Inflate tires to proper pressure	
	Clutch slips	Troubleshoot clutch	
	Brakes drag	Troubleshoot brakes	
Unpleasant odor	Incorrect idle speed	Adjust idle	MA-11
	Incorrect ignition timing	Reset timing	IG-19
	Vacuum leaks • PCV hoses • EGR valve • Intake manifold • Air intake chamber • Throttle body	Repair as necessary	
	EFI system problems	Repair as necessary	

ENGINE TUNE-UP

INSPECTION OF ENGINE COOLANT

(See steps 1, 2 on page CO-14)

INSPECTION OF ENGINE OIL

(See steps 1, 2 on page LU-16)

INSPECTION OF AIR FILTER

(See step 4 on page MA-7)

INSPECTION OF BATTERY

(See step 1 on page CH-3)

INSPECTION OF HIGH-TENSION CORD

(See step 3 on page IG-15)

INSPECTION OF SPARK PLUGS

(See page IG-15)

INSPECTION OF DRIVE BELTS

(See step 2 on page MA-6)

INSPECTION AND ADJUSTMENT OF VALVE CLEARANCE

HINT: Check and adjust the valve clearance while the engine is cold.

1. **REMOVE AIR INTAKE CHAMBER**
(See step 3 on pages EM-115, 116)

2. **REMOVE ENGINE WIRE**
(See step 4 on pages EM-116, 117)

3. **REMOVE CYLINDER HEAD COVERS**

4. **REMOVE SPARK PLUGS**

5. **MEASURE VALVE CLEARANCE**

(a) Set the No.1 cylinder to TDC/compression.

- Turn the crankshaft pulley and align its groove with the "0" mark on the No.1 timing belt cover.
- Check that the valve lifters on the No.1 cylinder are loose and valve lifters on the No.4 are tight.

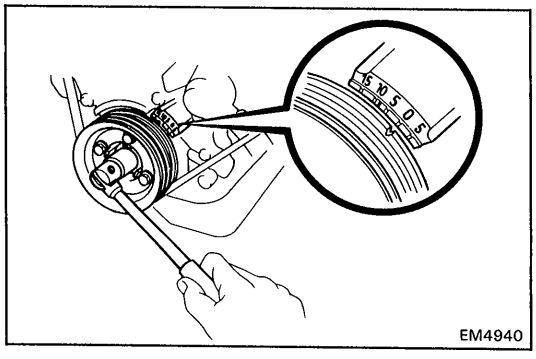
(b) Measure the clearance of IN (No.6) and EX (No.2) valves.

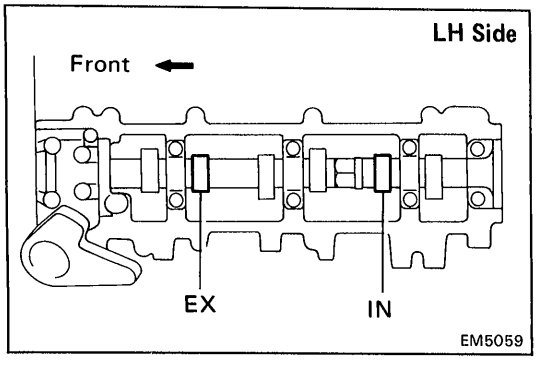
- Measure only those valves indicated in the figure.
- Record the measurements which are out of specification.

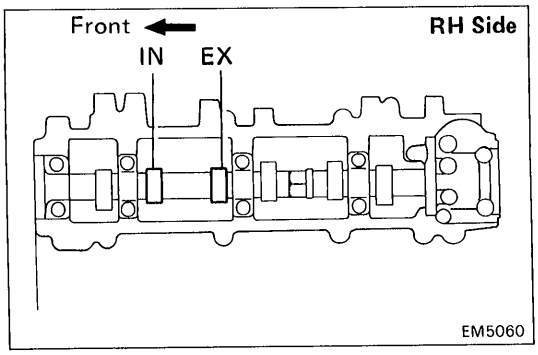
They will be used later to determine the required replacement shims.

Valve clearance (Cold):

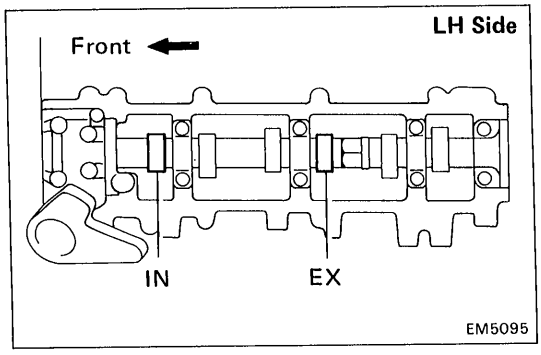
Intake	**0.18 — 0.28 mm (0.007 — 0.011 in.)**
Exhaust	**0.22 — 0.32 mm (0.009 — 0.013 in.)**



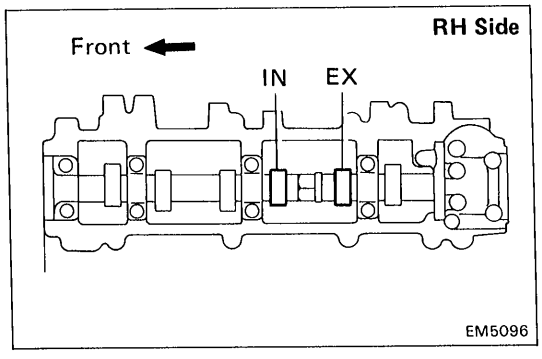




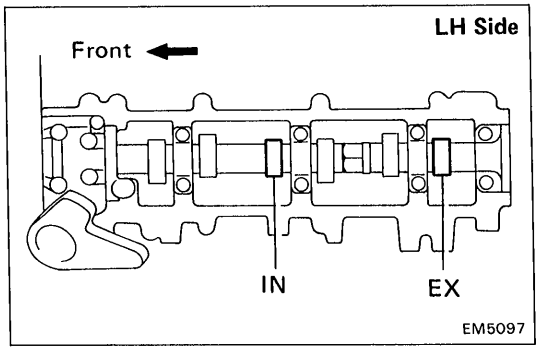
(c) Measure the clearance of IN (No.1) and EX (No.3) valves.
- Turn the crankshaft pulley 1/3 revolution (120°).
- Measure only those valves indicated in the figure.
- Record the measurements which are out of specification.



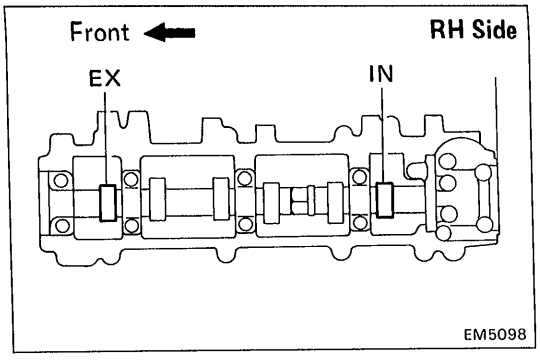
(d) Measure the clearance of IN (No.2) and EX (No.4) valves.
- Turn the crankshaft pulley 1/3 revolution (120°).
- Measure only those valves indicated in the figure.
- Record the measurements which are out of specification.



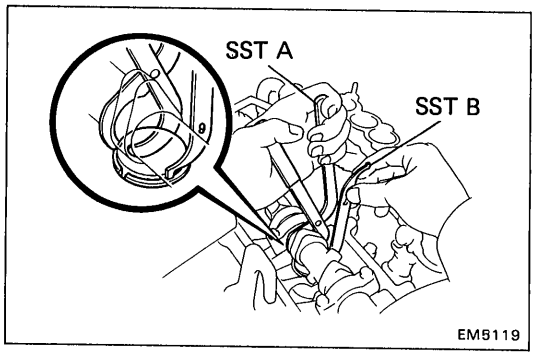
(e) Measure the clearance of IN (No.3) and EX (No.5) valves.
- Turn the crankshaft pulley 1/3 revolution (120°).
- Measure only those valves indicated in the figure.
- Record the measurements which are out of specification.



(f) Measure the clearance of IN (No.4) and EX (No.6) valves.
- Turn the crankshaft pulley 1/3 revolution (120°).
- Measure only those valves indicated in the figure.
- Record the measurements which are out of specification.



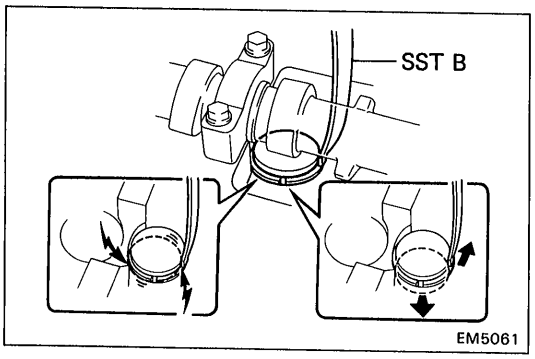
(g) Measure the clearance of IN (No.5) and EX (No.1) valves.
- Turn the crankshaft pulley 1/3 revolution (120°).
- Measure only those valves indicated in the figure.
- Record the measurements which are out of specification.



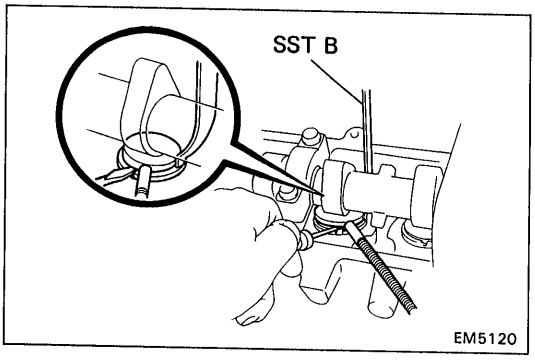
6. ADJUST VALVE CLEARANCE

(a) Using SSTs, press down the valve lifter with SST A and hold the valve lifter down SST B.

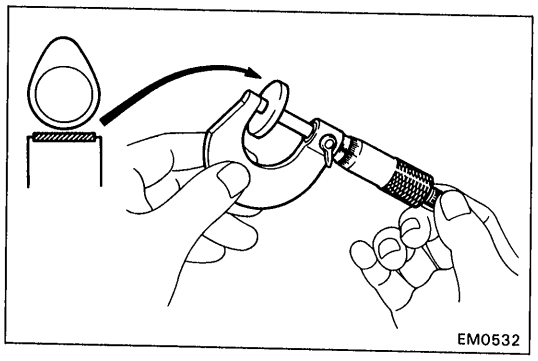
SST 09248-55010



HINT: For easy removal of the shim, when setting SST B, set it on the lifter so there is a wide space in the removal direction.



(b) Remove the adjusting shim with a small screwdriver and magnetic finger.



(c) Determine the replacement shim size by using the following (Formula or Chart).

- Using a replacement shim size by using the following (Formula or Chart).
- Calculate the thickness of the new shim so the valve clearance comes within specified value.

T .... Thickness of shim used

A .... Valve clearance measured

N .... Thickness of shim new

Intake side: N = T + (A − 0.23 mm (0.0091 in.))

Exhaust side: N = T + (A − 0.27 mm (0.0106 in.))

HINT: Shims are available in 25 sizes, in increments of 0.050 mm (0.0020 in.), from 2.200 mm (0.0866 in.) to 3.400 mm (0.1339 in.). Thickness is stamped on the new shims.

7. RECHECK VALVE CLEARANCE

8. INSTALL SPARK PLUGS

9. INSTALL CYLINDER HEAD COVERS
(See step 16 on page EM-142)

10. INSTALL ENGINE WIRE
(See step 17 on page EM-142)

11. INSTALL AIR INTAKE CHAMBER
(See step 18 on pages EM-142 to 144)

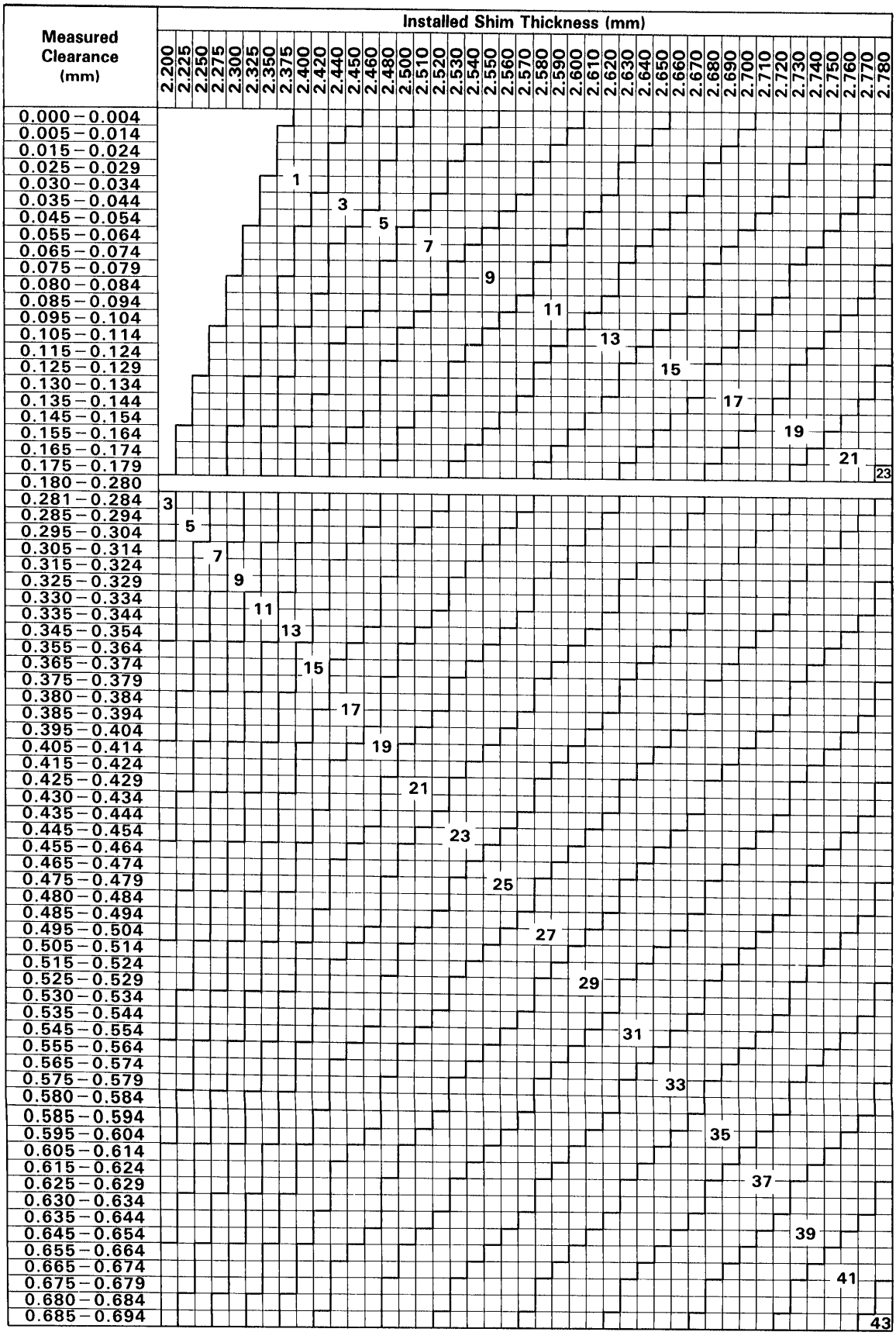
INSPECTION AND ADJUSTMENT OF IGNITION TIMING

(See step 8 on pages IG-19, 20)

INSPECTION AND ADJUSTMENT OF IDLE SPEED

(See step 15 on page MA-11)

SHIM SELECTION CHART
Intake



Intake (Cont'd)

Measured Clearance (mm)	Installed Shim Thickness (mm)																																									
	2.200	2.225	2.250	2.275	2.300	2.325	2.350	2.375	2.400	2.420	2.440	2.450	2.460	2.480	2.500	2.510	2.520	2.530	2.540	2.550	2.560	2.570	2.580	2.590	2.600	2.610	2.620	2.630	2.640	2.650	2.660	2.670	2.680	2.690	2.700	2.710	2.720	2.730	2.740	2.750	2.760	2.770	2.780
0.695-0.704	19																																									
0.705-0.714																																										
0.715-0.724		21																																								
0.725-0.729																																										
0.730-0.734			23																																							
0.735-0.744																																										
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1.380-1.404																																										
1.405-1.429																																										
1.430-1.450																																										

Intake (Cont'd)

Measured Clearance (mm)	Installed Shim Thickness (mm)																																								
	2.790	2.800	2.810	2.820	2.830	2.840	2.850	2.860	2.870	2.880	2.890	2.900	2.910	2.920	2.930	2.940	2.950	2.960	2.970	2.980	2.990	3.000	3.020	3.040	3.050	3.060	3.080	3.100	3.120	3.140	3.150	3.160	3.180	3.200	3.225	3.250	3.275	3.300	3.325	3.350	3.375	3.400
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0.665 - 0.674																																										
0.675 - 0.679																																										
0.680 - 0.684																																										
0.685 - 0.694																																										

Intake (Cont'd)

Measured Clearance (mm)	Installed Shim Thickness (mm)															
	2.790	2.800	2.810	2.820	2.830	2.840	2.850	2.860	2.870	2.880	2.890	2.900	2.910	2.920	2.930	2.940	2.950
0.695 – 0.704	43																
0.705 – 0.714																	
0.715 – 0.724																	
0.725 – 0.729			45														
0.730 – 0.734																	
0.735 – 0.744																	
0.745 – 0.754					47												
0.755 – 0.764																	
0.765 – 0.774																	
0.775 – 0.779																	
0.780 – 0.784							49										
0.785 – 0.794																	
0.795 – 0.804																	
0.805 – 0.814																	
0.815 – 0.824																	
0.825 – 0.829																	
0.830 – 0.834																	
0.835 – 0.844																	
0.845 – 0.854																	
0.855 – 0.864																	

Shim Thickness

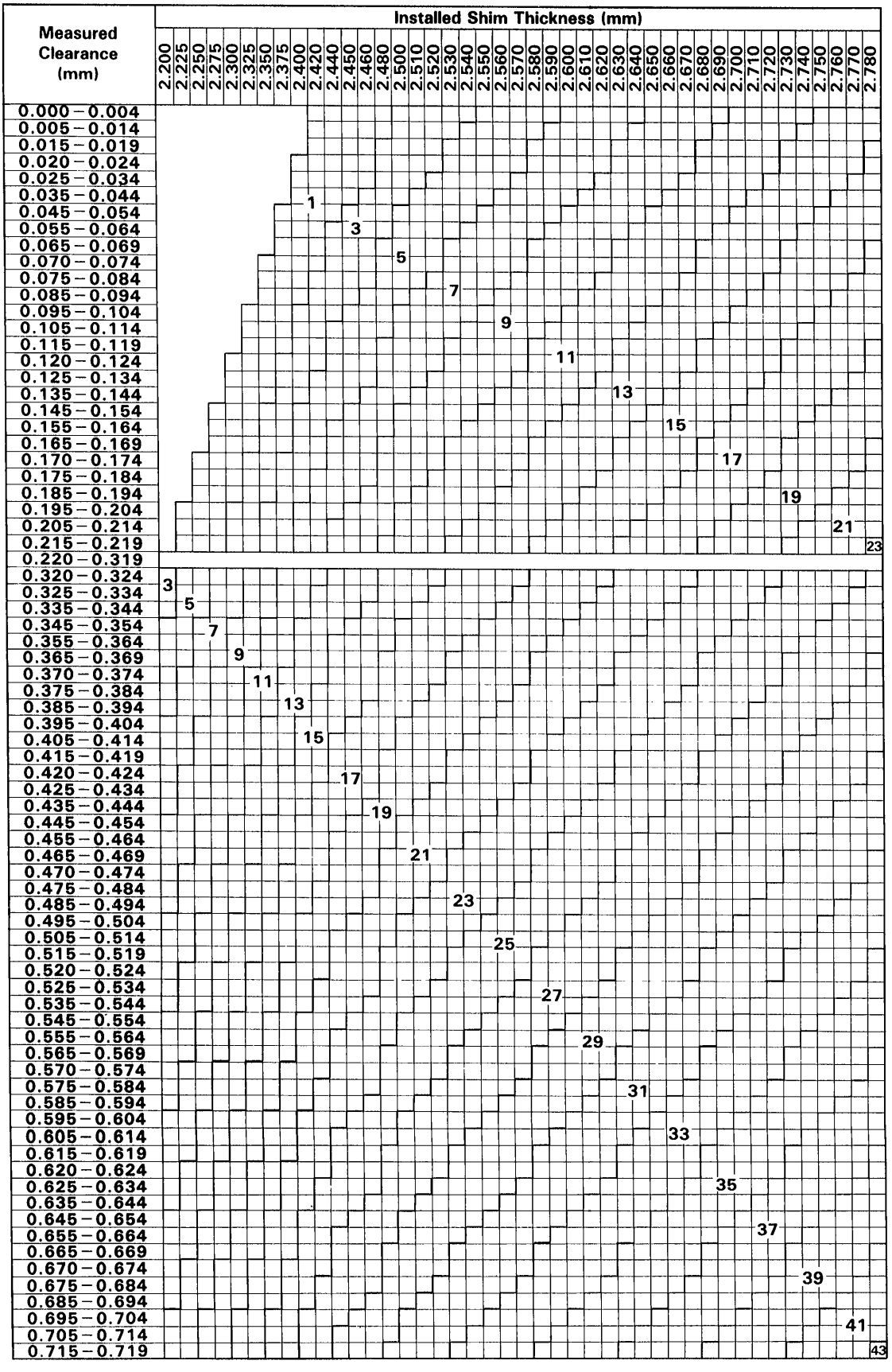
Shim No.	Thickness mm (in.)	Shim No.	Thickness mm (in.)
01	2.20 (0.0866)	27	2.85 (0.1122)
03	2.25 (0.0886)	29	2.90 (0.1142)
05	2.30 (0.0906)	31	2.95 (0.1161)
07	2.35 (0.0925)	33	3.00 (0.1181)
09	2.40 (0.0945)	35	3.05 (0.1201)
11	2.45 (0.0965)	37	3.10 (0.1220)
13	2.50 (0.0984)	39	3.15 (0.1240)
15	2.55 (0.1004)	41	3.20 (0.1260)
17	2.60 (0.1024)	43	3.25 (0.1280)
19	2.65 (0.1043)	45	3.30 (0.1299)
21	2.70 (0.1063)	47	3.35 (0.1319)
23	2.75 (0.1083)	49	3.40 (0.1339)
25	2.80 (0.1102)		

Intake valve clearance (Cold):
0.18 – 0.28 mm (0.007 – 0.011 in.)

Example: **2.700 mm (0.1063 in.) shim installed**
Measured clearance is 0.350 mm (0.0138 in.)
Replace 2.700 mm (0.1063 in.) shim with shim No.25.

SHIM SELECTION CHART

Exhaust



Exhaust (Cont'd)

Measured Clearance (mm)	Installed Shim Thickness (mm)																																										
	2.200	2.225	2.250	2.275	2.300	2.325	2.350	2.375	2.400	2.420	2.440	2.450	2.460	2.480	2.500	2.510	2.520	2.530	2.540	2.550	2.560	2.570	2.580	2.590	2.600	2.610	2.620	2.630	2.640	2.650	2.660	2.670	2.680	2.690	2.700	2.710	2.720	2.730	2.740	2.750	2.760	2.770	2.780
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0.965-0.969																																											
0.970-0.974																																											
0.975-0.984																																											
0.985-0.994																		43																									
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1.005-1.014																																											
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1.420-1.444																																											
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1.470-1.494																																											

Exhaust (Cont'd)

Installed Shim Thickness (mm)

Measured Clearance (mm)	2.790	2.800	2.810	2.820	2.830	2.840	2.850	2.860	2.870	2.880	2.890	2.900	2.910	2.920	2.930	2.940	2.950	2.960	2.970	2.980	2.990	3.000	3.020	3.040	3.050	3.060	3.080	3.100	3.120	3.140	3.150	3.160	3.180	3.200	3.225	3.250	3.275	3.300	3.325	3.350	3.375	3.400
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0.715-0.719																																										

Exhaust (Cont'd)

Measured Clearance (mm)	Installed Shim Thickness (mm)																			
	2.790	2.800	2.810	2.820	2.830	2.840	2.850	2.860	2.870	2.880	2.890	2.900	2.910	2.920	2.930	2.940	2.950	2.960	2.970
0.720 – 0.724																			
0.725 – 0.734	43																		
0.735 – 0.744																			
0.745 – 0.754																			
0.755 – 0.764			45																
0.765 – 0.769																			
0.770 – 0.774																			
0.775 – 0.784																			
0.785 – 0.794					47														
0.795 – 0.804																			
0.805 – 0.814																			
0.815 – 0.819								49											
0.820 – 0.824																			
0.825 – 0.834																			
0.835 – 0.844																			
0.845 – 0.854																			
0.855 – 0.864																			
0.865 – 0.869																			
0.870 – 0.874																			
0.875 – 0.884																			
0.885 – 0.894																			
0.895 – 0.904																			

Shim Thickness

Shim No.	Thickness mm (in.)	Shim No.	Thickness mm (in.)
01	2.20 (0.0866)	27	2.85 (0.1122)
03	2.25 (0.0886)	29	2.90 (0.1142)
05	2.30 (0.0906)	31	2.95 (0.1161)
07	2.35 (0.0925)	33	3.00 (0.1181)
09	2.40 (0.0945)	35	3.05 (0.1201)
11	2.45 (0.0965)	37	3.10 (0.1220)
13	2.50 (0.0984)	39	3.15 (0.1240)
15	2.55 (0.1004)	41	3.20 (0.1260)
17	2.60 (0.1024)	43	3.25 (0.1280)
19	2.65 (0.1043)	45	3.30 (0.1299)
21	2.70 (0.1063)	47	3.35 (0.1319)
23	2.75 (0.1083)	49	3.40 (0.1339)
25	2.80 (0.1102)		

Exhaust valve clearance (Cold):
0.22 – 0.32 mm (0.009 – 0.013 in.)

Example: **2.700 mm (0.1063 in.) shim installed**
Measured clearance is 0.450 mm (0.0177 in.)
Replace 2.700 mm (0.1063 in.) shim with shim No.29.

IDLE AND/OR 2,500 RPM HC/CO CONCENTRATION CHECK METHOD

NOTE: This check method is used only to determine whether or not the idle and/or 2,500 rpm HC/CO complies with regulations.

1. INITIAL CONDITIONS

(a) Normal engine operating temperature.

(b) Air cleaner installed.

(c) All pipe and hoses of air intake system connected.

(d) All accessories switched OFF.

(e) All vacuum lines properly connected.

HINT: All vacuum hoses for EGR system, etc. should be properly connected.

(f) EFI system wiring connectors fully plugged.

(g) Ignition timing set correctly.

(h) Idle speed set correctly.

(i) Transmission in neutral.

(j) Tachometer and HC/CO meter calibrated and at hand.

2. START ENGINE

3. RACE ENGINE AT 2,500 RPM FOR APPROX. 2 MINUTES

4. INSERT TESTING PROBE OF HC/CO METER INTO TAILPIPE AT LEAST 40 cm (1.3 ft)

5. CHECK HC/CO CONCENTRATION AT IDLE AND/OR 2,500 RPM

Complete the measuring within three minutes.

NOTE:
When performing the 2 mode (2,500 rpm and idle) test, follow the measurement order prescribed by the regulations.

If the HC/CO concentration at 2,500 rpm does not comply with regulations, try the following procedure.

Race the engine again at 2,500 rpm for approx. 1 minute, and quickly repeat step 4 and 5 above. This may correct the problem.

Troubleshooting

If the HC/CO concentration does not comply with regulations, perform troubleshooting in the order given below.

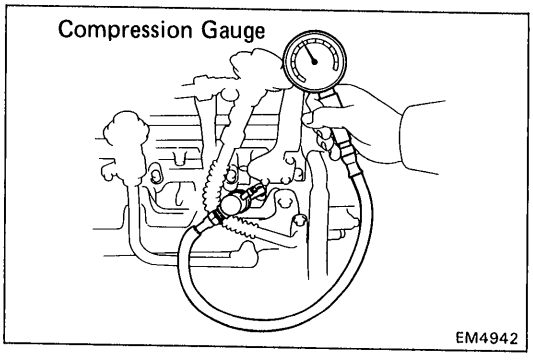
1. Check oxygen sensor operation
(See page FI-199)
2. See the table below for possible cause, and then inspect and correct the applicable causes if necessary.

HC	CO	Symptoms	Causes
High	Normal	Rough idle	1. Faulty ignition: • Incorrect timing • Fouled, shorted or improperly gapped plugs • Open or crossed high-tension cords • Cracked distributor cap 2. Incorrect valve clearance 3. Leaky EGR valve 4. Leaky exhaust valves 5. Leaky cylinder
High	Low	Rough idle (Fluctuating HC reading)	1. Vacuum leak: • Vacuum hose • Intake manifold • Intake chamber • PCV line • Throttle body
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Plugged PCV valve 3. AS system problem 4. Faulty EFI system: • Faulty pressure regulator • Clogged fuel return line • Faulty air flow meter • Defective water temp. sensor • Defective air temp. sensor • Faulty ECU • Faulty injector • Faulty cold start injector

COMPRESSION CHECK

HINT: If there is lack of power, excessive oil consumption or poor fuel mileage, measure the cylinder compression pressure.

1. **WARM UP ENGINE**
2. **REMOVE AIR CLEANER HOSE**
3. **DISCONNECT COLD START INJECTOR CONNECTOR**
4. **DISCONNECT IGNITER CONNECTOR**
5. **REMOVE SPARK PLUG**



6. **MEASURE CYLINDER COMPRESSION PRESSURE**

(a) Insert a compression gauge into the spark plug hole.

(b) Fully open the throttle.

(c) While cranking the engine with the starter motor, measure the compression pressure.

NOTICE: This test must be done for as short a time as possible to avoid overheating of the catalytic converter.

HINT: A fully charged battery must be used to obtain at least 250 rpm.

(d) Repeat steps (a) through (c) for each cylinder.

Compression pressure:
12.0 kg/cm² (171 psi, 1,177 kPa)

Minimum pressure:
10.0 kg/cm² (142 psi, 981 kPa)

Difference between each cylinder:
Less than 1.0 kg/cm² (14 psi, 98 kPa)

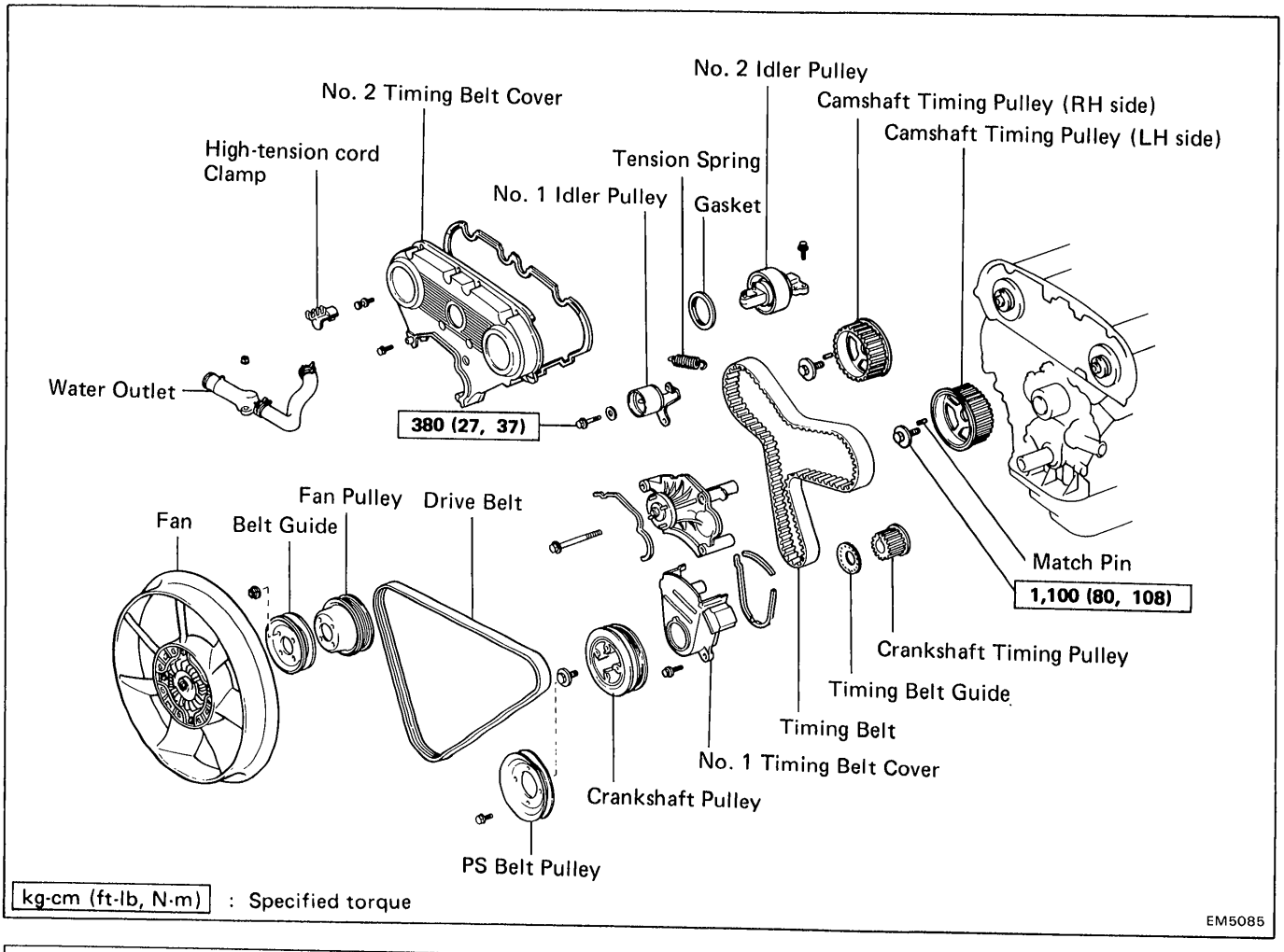
(e) If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps (a) through (c) for the low compression cylinder.

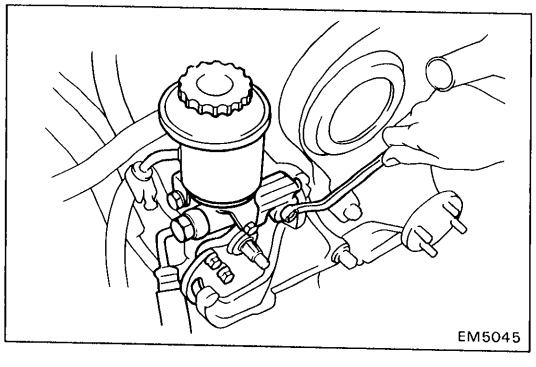
- If adding oil helps the compression, chances are that the piston rings and/or cylinder bore are worn or damaged.
- If pressure stays low, a valve be sticking or seating improperly, or there may be leakage past the gasket.

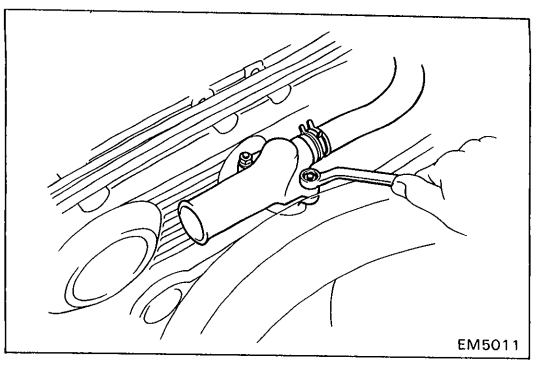
7. INSTALL SPARK PLUGS
8. CONNECT IGNITER CONNECTOR
9. CONNECT COLD START INJECTOR CONNECTOR
10. INSTALL AIR CLEANER HOSE

TIMING BELT

COMPONENTS







REMOVAL OF TIMING BELT

1. **REMOVE RADIATOR**
   (See page CO-18)

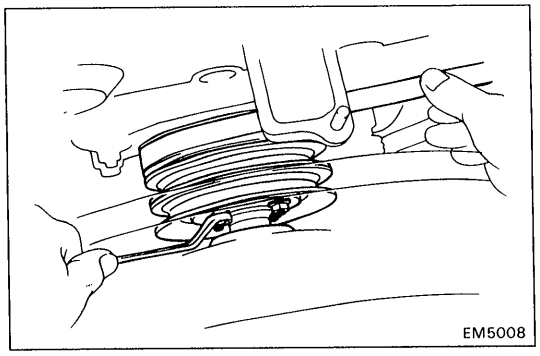
2. **REMOVE PS BELT AND PUMP**
   (a) Stretch the belt tight and loosen the PS pump pulley lock nut.
   (b) Remove the PS pump pulley and belt.
   (c) Remove the four bolts and PS pump with hoses.

3. **REMOVE SPARK PLUGS**

4. **DISCONNECT NO.2 AND NO.3 AIR HOSES FROM AIR PIPE**

5. **REMOVE WATER OUTLET**
   (a) Disconnect the No.1 water by-pass hose from the air pipe.
   (b) Remove the two nuts and water outlet.

6. **REMOVE A/C BELT**

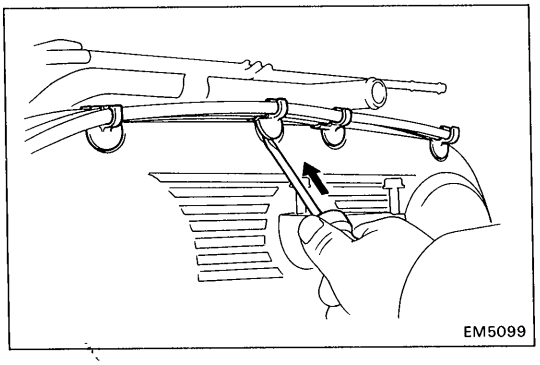


7. REMOVE ALTERNATOR DRIVE BELT, FLUID COUPLING, BELT GUIDE AND FAN PULLEY

(a) Stretch the belt tight and loosen the fan pulley set nuts.

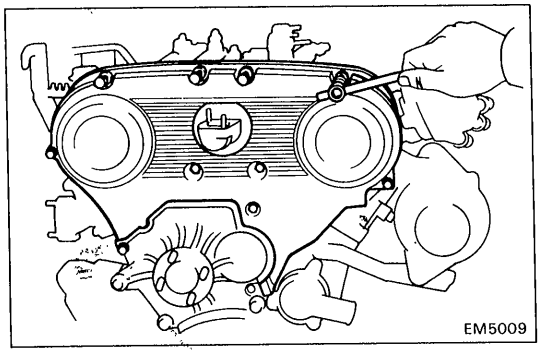
(b) Loosen the pivot bolt and adjusting bolt, and remove the drive belt.

(c) Remove the four nuts, fluid coupling, belt guide and fan pulley.

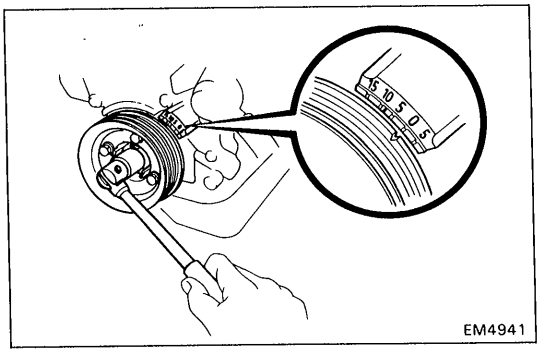


8. REMOVE NO.2 TIMING BELT COVER

(a) Disconnect the high-tension cords with clamps from the four bolts.

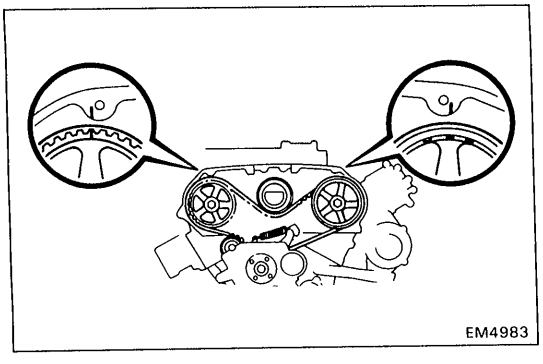


(b) Remove the eleven bolts and No.2 timing belt cover with three gaskets.



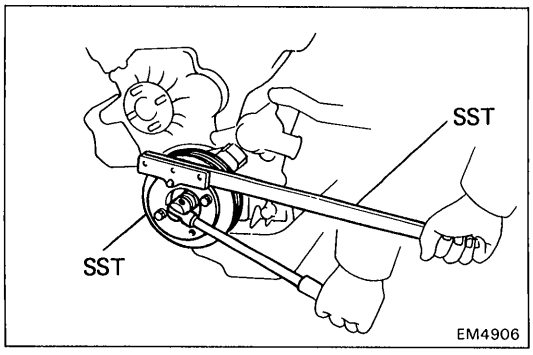
9. SET NO.1 CYLINDER AT TDC/COMPRESSION

(a) Turn the crankshaft pulley and align its groove with the "0" mark on the No.1 timing belt cover.



(b) Check that the matchmarks on the camshaft timing pulleys and No.3 timing belt cover are aligned.

If not, turn the crankshaft pulley one complete revolution.



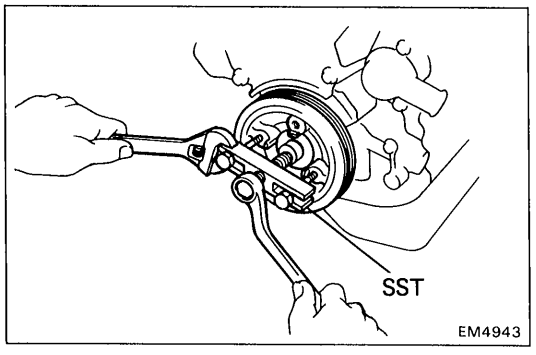
10. REMOVE CRANKSHAFT PULLEY

(a) Remove the four bolts and PS belt pulley.

(b) Using SST to hold the crankshaft pulley, loosen the pulley bolt.

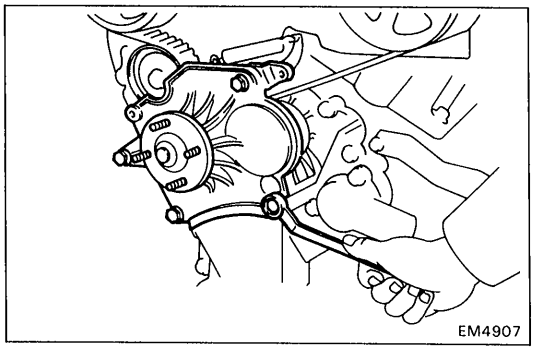
SST 09213-58011 and 09330-00021

(c) Remove SST and pulley bolt.



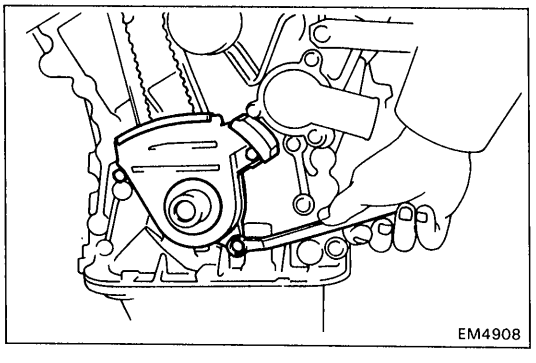
(d) Using SST, remove the pulley.

SST 09213-31021



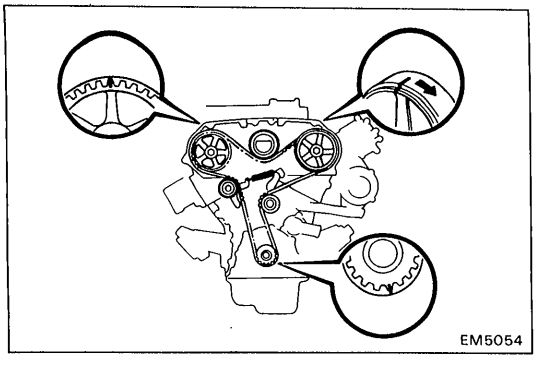
11. REMOVE FAN PULLEY BRACKET

Remove the four bolts and fan pulley bracket.



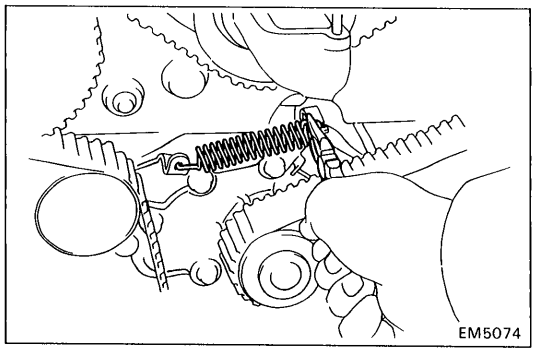
12. REMOVE NO.1 TIMING BELT COVER

Remove the three bolts, No.1 timing belt cover and two gaskets.



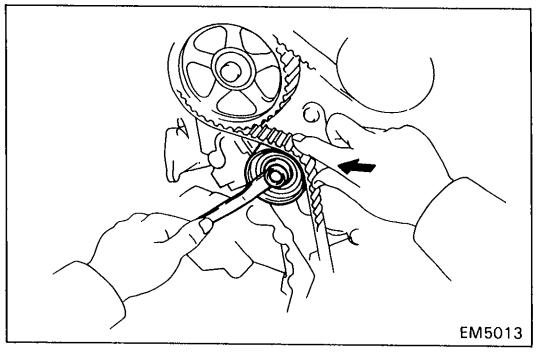
13. REMOVE TIMING BELT

HINT: If reusing the timing belt, draw a direction arrow on the belt (in direction of engine revolution), and place matchmarks on the pulley and timing belt.



(a) Remove timing belt guide.

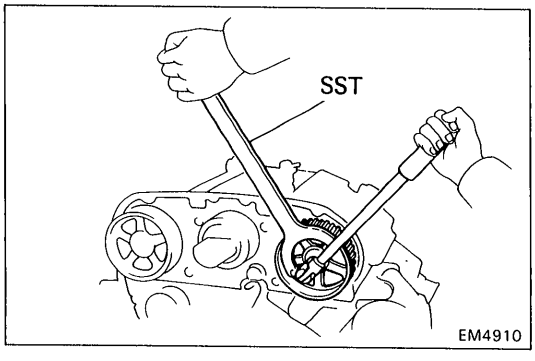
(b) Remove the tension spring.



(c) Loosen the idler pulley bolt and shift it left as far as it will go.

(d) Temporarily tighten the set bolt and then relieve the timing belt tension.

(e) Remove the belt from each timing pulleys.



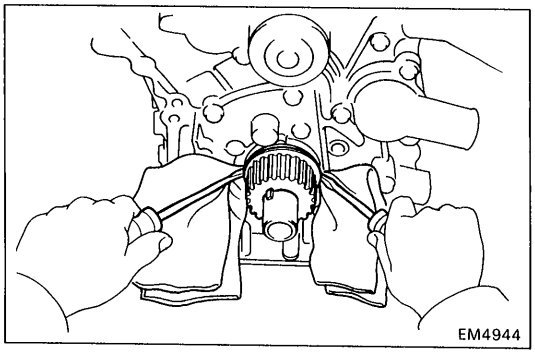
14. REMOVE CAMSHAFT TIMING PULLEYS

Using SST to hold the pulley, remove the pulley bolt, timing pulley and match pin.

SST 09278-54012

NOTICE: Do not make use of the timing belt tension when remove and installing the pulley set bolts.

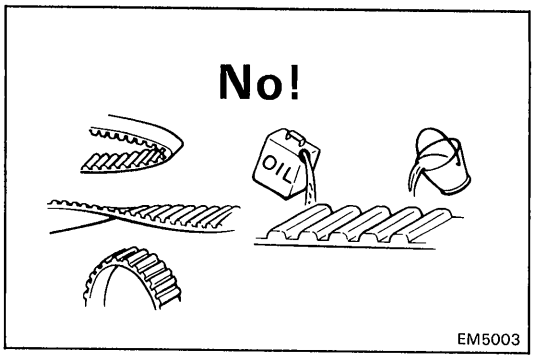
15. REMOVE NO.1 IDLER PULLEY



16. REMOVE CRANKSHAFT TIMING PULLEY

If the timing pulley cannot be removed by hand, use two screwdrivers.

HINT: Position shop rags as shown to prevent damage.

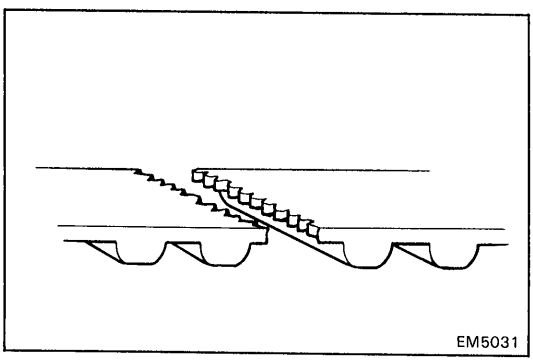


INSPECTION OF COMPONENTS

1. INSPECT TIMING BELT

NOTICE:

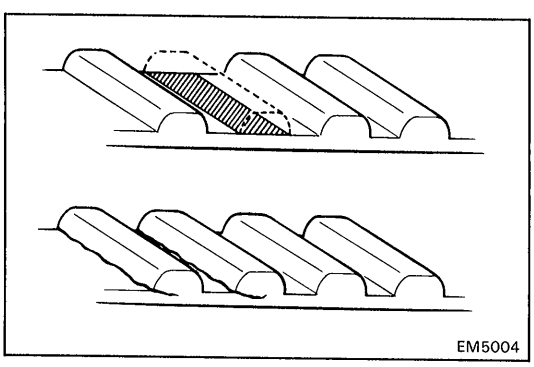
- **Do not bend, twist or turn the belt inside out.**
- **Do not allow the belt to come into contact with oil, water or steam.**
- **Do not utilize belt tension when installing or removing the set bolt of the camshaft timing pulley.**



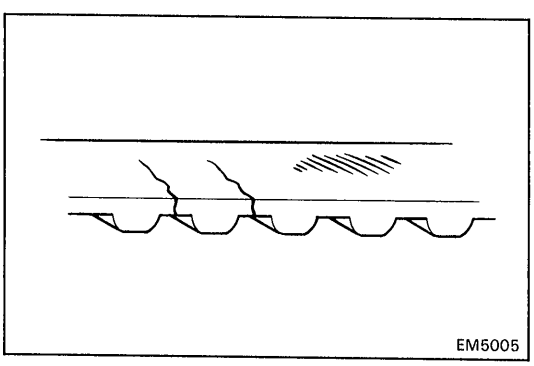
If there are defects as shown in the figures, check the following points and replace the timing belt if necessary.

(a) Premature severance

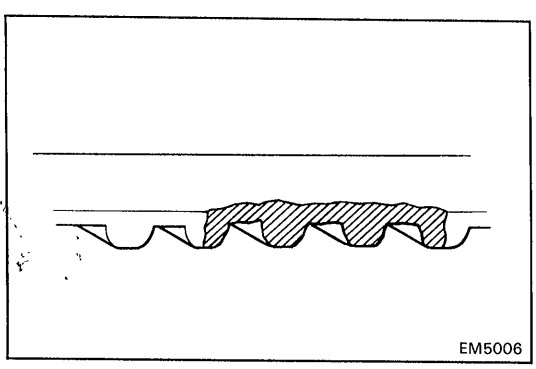
- Check for proper installation.
- Check the timing belt cover gasket for damage and proper installation.



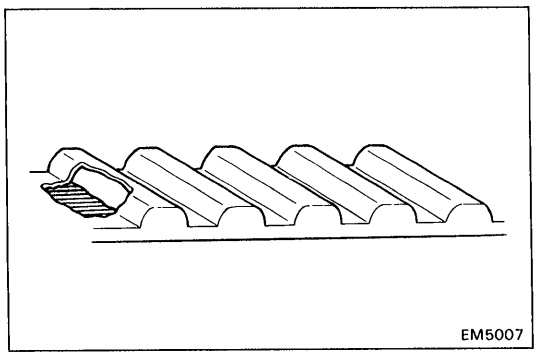
(b) If the belt teeth are cracked or damaged, check to see if the camshaft is locked.



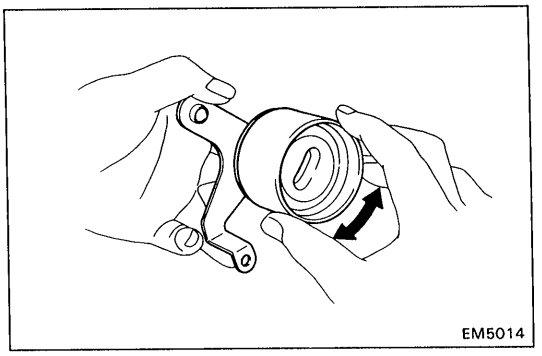
(c) If there is noticeable wear of cracks on the belt face, check to see if there are nicks on one side of the idler pulley lock.



(d) If there is wear or damage on only one side of the belt, check the belt guide and the alignment of each pulley.



(e) If there is noticeable wear on the belt teeth, check the timing belt cover gasket for damage and check for foreign materials on the pulley teeth.

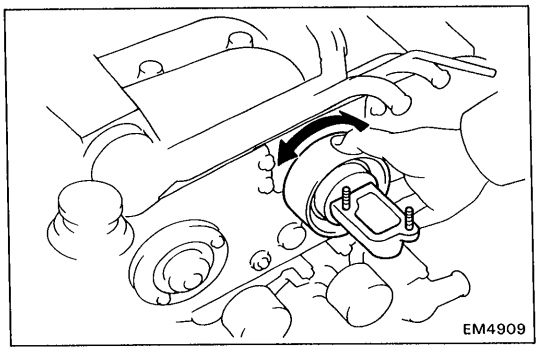


2. INSPECT IDLER PULLEYS

Check the turning smoothness of the timing belt idler pulleys.

If necessary, replace the idler pulley(s).

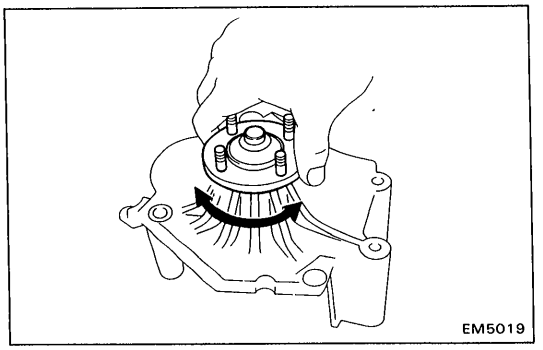
If replacing the No.2 idler pulley, see steps 3 to 7 on pages EM-115 to 117.



3. INSPECT FAM PULLEY BRACKET

Check the turning smoothness of the fan pulley.

If necessary, replace the fan pulley bracket.

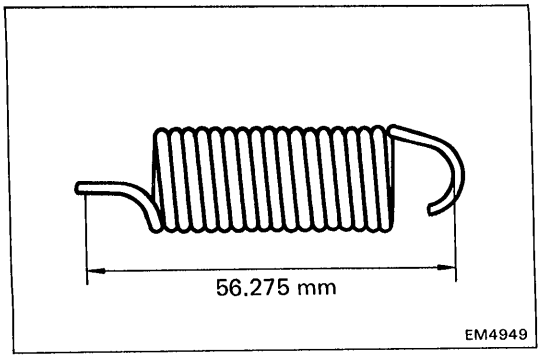


4. INSPECT TENSION SPRING

Check the free length of the spring.

Free length: 56.275 mm (2.2155 in.)

If not specified, replace the spring.



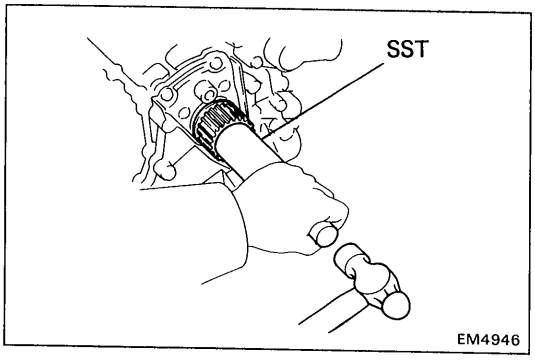
INSTALLATION OF TIMING BELT

(See page EM-100)

NOTICE:

- **The engine should be cold.**
- **Adjust the timing belt tension only when the intake manifold installed.**

HINT: Remove any oil or water on the timing and idler pulleys and keep then clean.

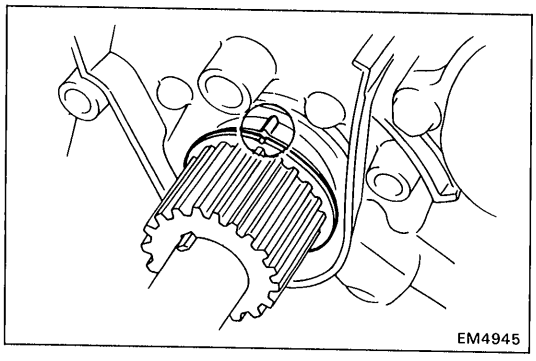


1. INSTALL CRANKSHAFT TIMING PULLEY

Align the woodruff key groove of the timing pulley with the woodruff key on the crankshaft.

If the timing pulley cannot be installed by hand, use SST.

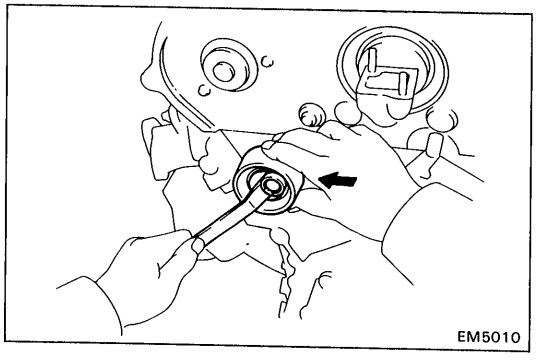
SST 09214-60010



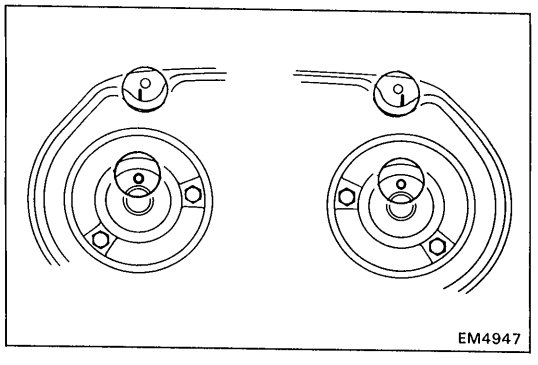
2. TEMPORARILY INSTALL NO.1 IDLER PULLEY

(a) Temporarily install the idler pulley.

(b) Align the groove of the timing pulley with the cavity of the oil pump.

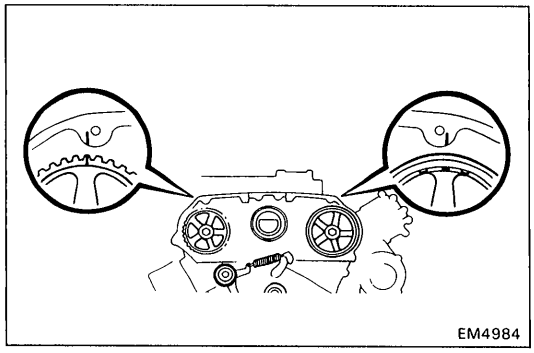


(c) Pry the idler pulley toward the left as far as it will go and temporarily tighten it.



3. INSTALL CAMSHAFT TIMING PULLEYS

(a) Align the camshaft match hole with the No.3 timing belt cover as shown in the figure.

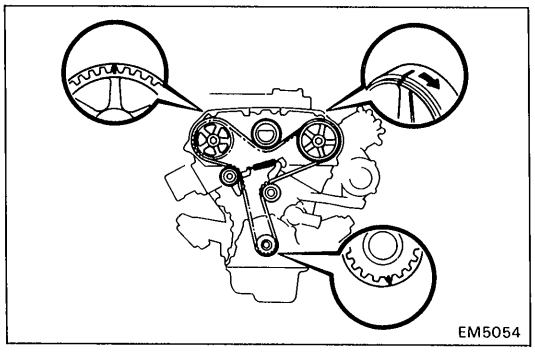


(b) Install the timing pulley and bolt.

HINT:

- Do not install the match pin.
- Check that the bolt head is not touching the pulley.

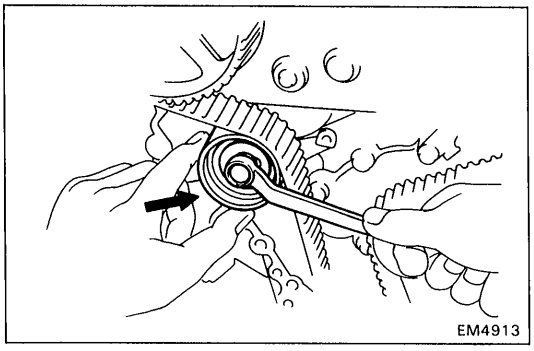
(c) Align the timing pulley matchmark with the No.3 timing belt cover matchmark.



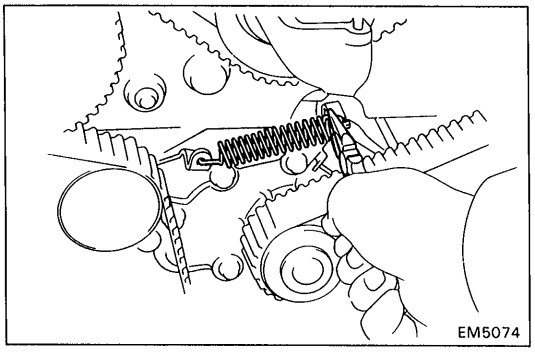
4. INSTALL TIMING BELT

HINT: If reusing the timing belt, align the points marked during removal and install the timing belt with the arrow pointing in the direction of engine revolution.

(a) Install the timing belt on the camshaft timing pulleys, idler pulleys, water pump pulley and crankshaft timing pulley.

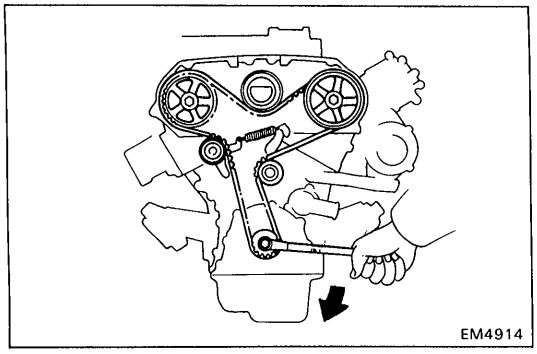


(b) Pry the No.1 idler pulley toward the right far as it will go and temporarily tighten it.



(c) Install the tension spring.

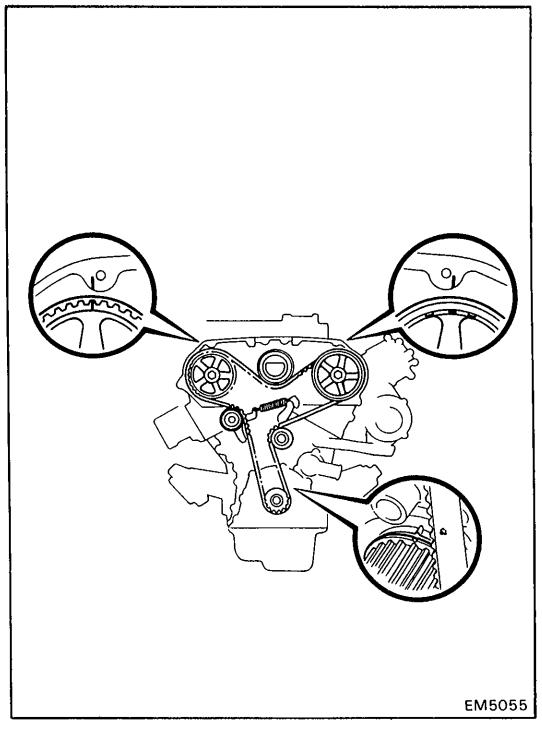
(d) Loosen the idler pulley bolt to where the idler pulley lightly moves with tension spring force.



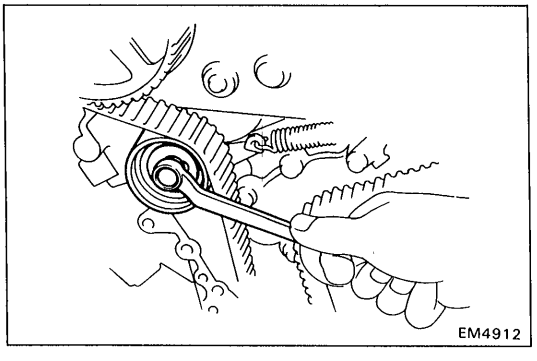
5. CHECK VALVE TIMING AND TIMING BELT TENSION

(a) Temporarily install the crankshaft pulley bolt and turn the crankshaft two revolutions from TDC to TDC.

HINT: Always turn the crankshaft clockwise.



(b) Check that each pulley aligns with the marks as shown in the figure.



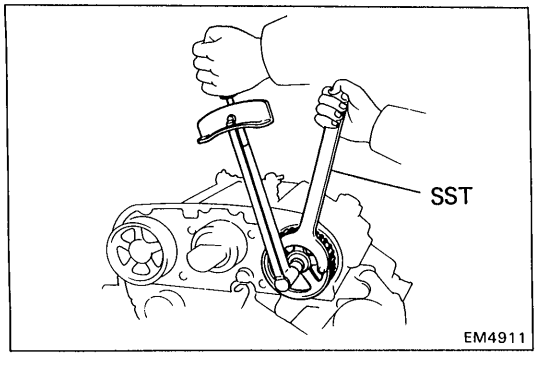
(c) Torque the No.1 idler pulley bolt.

Torque: 380 kg-cm (27 ft-lb, 37 N·m)

(d) Remove the camshaft timing pulley bolts.

(e) Align the camshaft match pin hole with camshaft match pin hole.

(f) Install the match pin and camshaft pulley bolt.

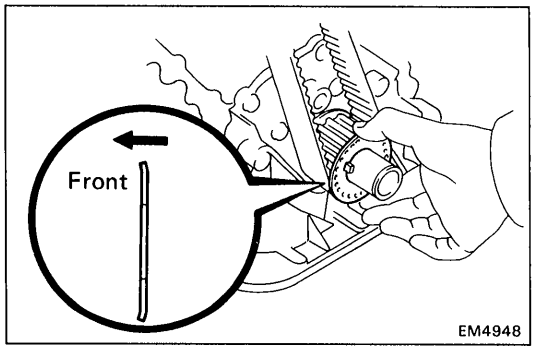


6. TORQUE CAMSHAFT TIMING PULLEY BOLT

Using SST to hold the pulley, torque the bolt.

SST 09278-54012

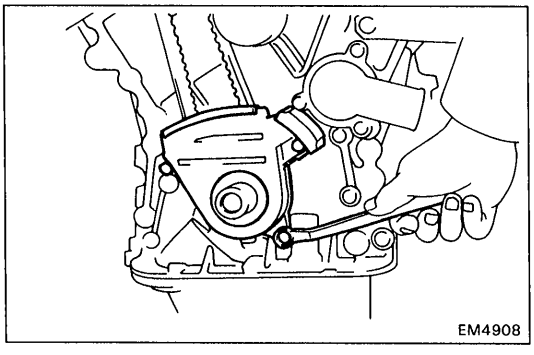
Torque: 1,100 kg-cm (80 ft-lb, 108 N·m)



7. INSTALL TIMING BELT GUIDE

(a) Remove the crankshaft pulley bolt.

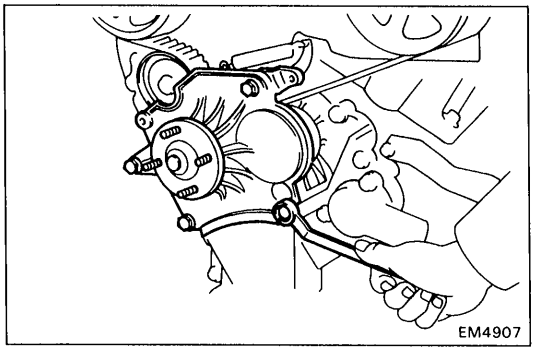
(b) Place the belt guide on the crankshaft timing pulley, facing the cup side outward.



8. INSTALL NO.1 TIMING BELT COVER

Install the No.1 timing belt cover and two gasket with the three bolts.

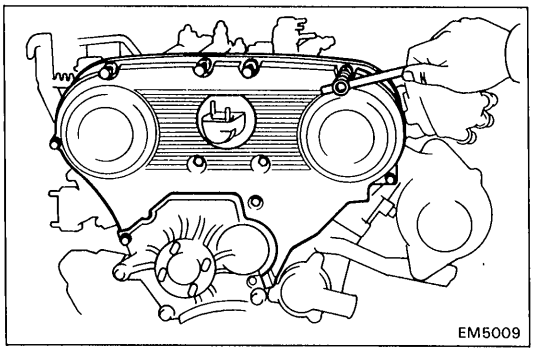
Torque: 55 kg-cm (48 in.-lb, 5.4 N·m)



9. INSTALL FAN PULLEY BRACKET

Install the fan pulley bracket and gasket with the four bolts.

Torque: 420 kg-cm (30 ft-lb, 41 N·m)

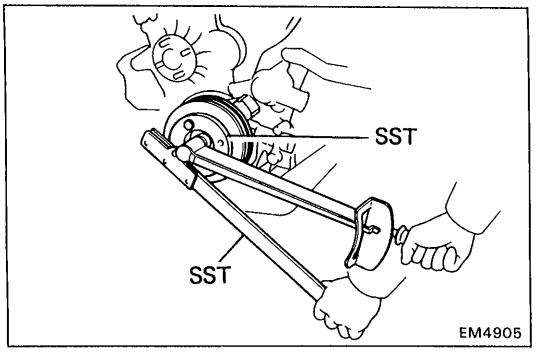


10. INSTALL NO.2 TIMING BELT COVER

(a) Install the No.2 timing belt cover and two gaskets with the eleven bolts.

Torque: 55 kg-cm (48 in.-lb, 5.4 N·m)

(b) Connect the high-tension cords with clamps to the four bolts.



11. INSTALL CRANKSHAFT PULLEY

(a) Align the woodruff key groove of the crankshaft pulley with the woodruff key on the crankshaft.

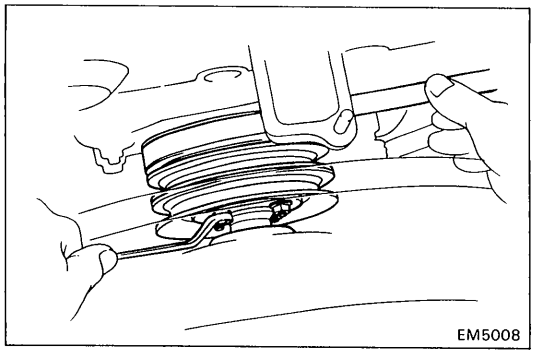
(b) Install the pulley bolt and SST to the crankshaft pulley.

(c) Using SST to hold the crankshaft pulley, torque the pulley bolt.

SST 09213-58011 and 09330-00021

Torque: 2,500 kg-cm (181 ft-lb, 245 N·m)

(d) Install the PS belt pulley with the four bolts.


EM5008

12. INSTALL FAN PULLEY, BELT GUIDE, FLUID COUPLING AND ALTERNATOR DRIVE BELT

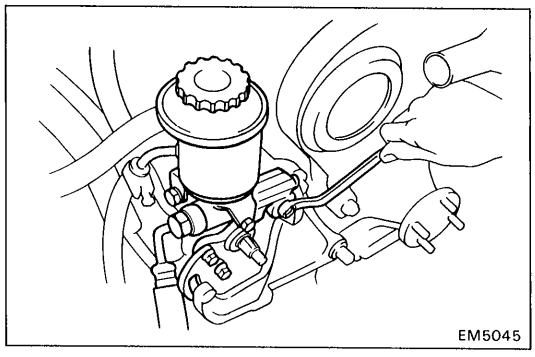
(a) Install the fan pulley, belt guide, fluid coupling with the four nuts.

(b) Place the alternator drive belt on to each pulley.

(c) Stretch the belt tight and tighten the four nuts.

Torque: 55kg-cm (48 in.-lb, 5.4 N·m)

13. INSTALL A/C BELT
(See step 2 on page MA-6)


EM5045

14. INSTALL PS PUMP AND BELT

(a) Install the PS pump with the four bolts.

(b) Install the pulley, washer and nuts.

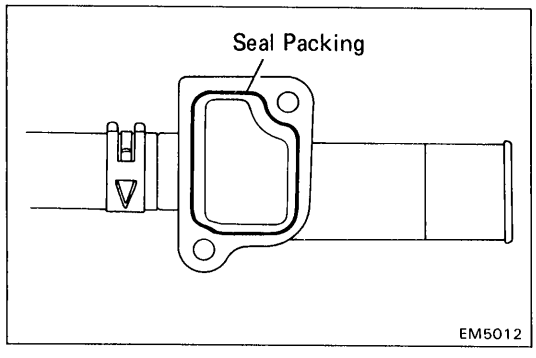
(c) Place the PS drive belt on to the each pulley.

(d) Stretch the belt tight and tighten the nut.

(e) Torque the PS pump pulley lock nut.

Torque: 400 kg-cm (32 ft-lb, 43 N·m)

(f) Adjust the drive belt tension.
(See step 2 on page MA-6)



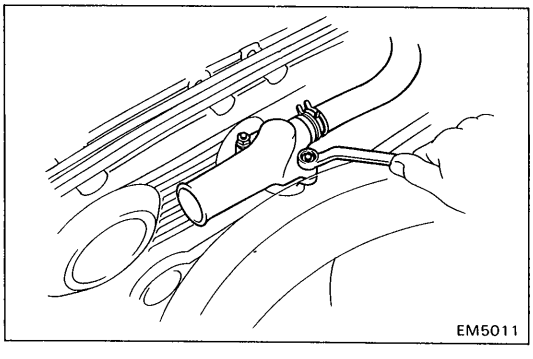
EM5012

15. INSTALL WATER OUTLET

(a) Apply seal packing to the water outlet.

Seal packing: Part No. 08826-00100 or equivalent

HINT: Cleaning and application of seal packing to the installation surface. However, use a nozzle cut to 2 mm (0.08 in.). (See page LU-23)


EM5011

(b) Install the water outlet with the two nuts.

Torque: 85 kg-cm (74 in.-lb, 8.3 N·m)

(c) Connect the No.1 water by-pass hose to the air pipe.

16. CONNECT NO.2 AND NO.3 AIR HOSES TO AIR PIPE

17. INSTALL SPARK PLUGS

18. INSTALL RADIATOR

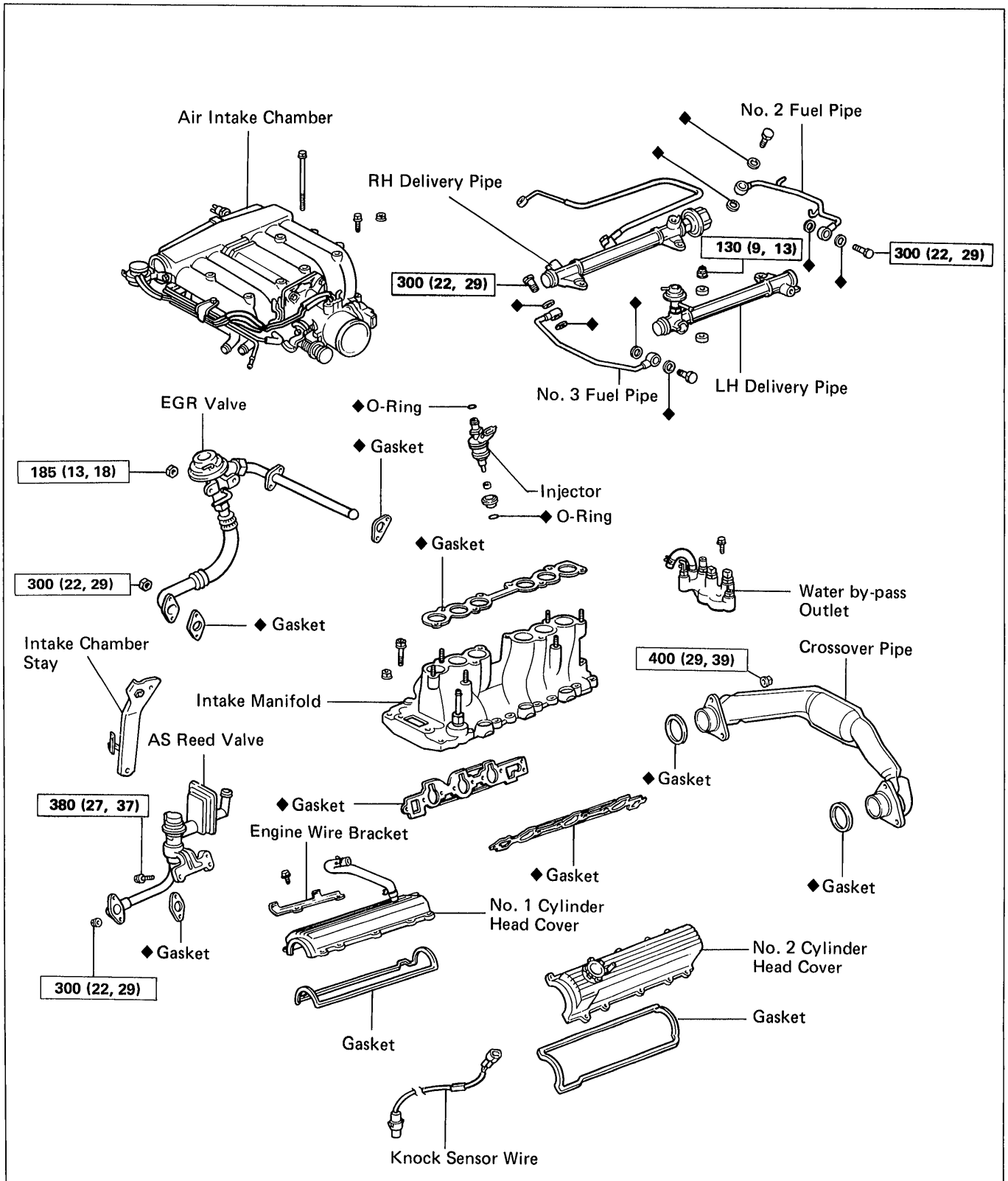
19. ROAD TEST

Road test vehicle.

20. RECHECK COOLANT LEVEL
(See step 1 on page CO-14)

CYLINDER HEAD

COMPONENTS

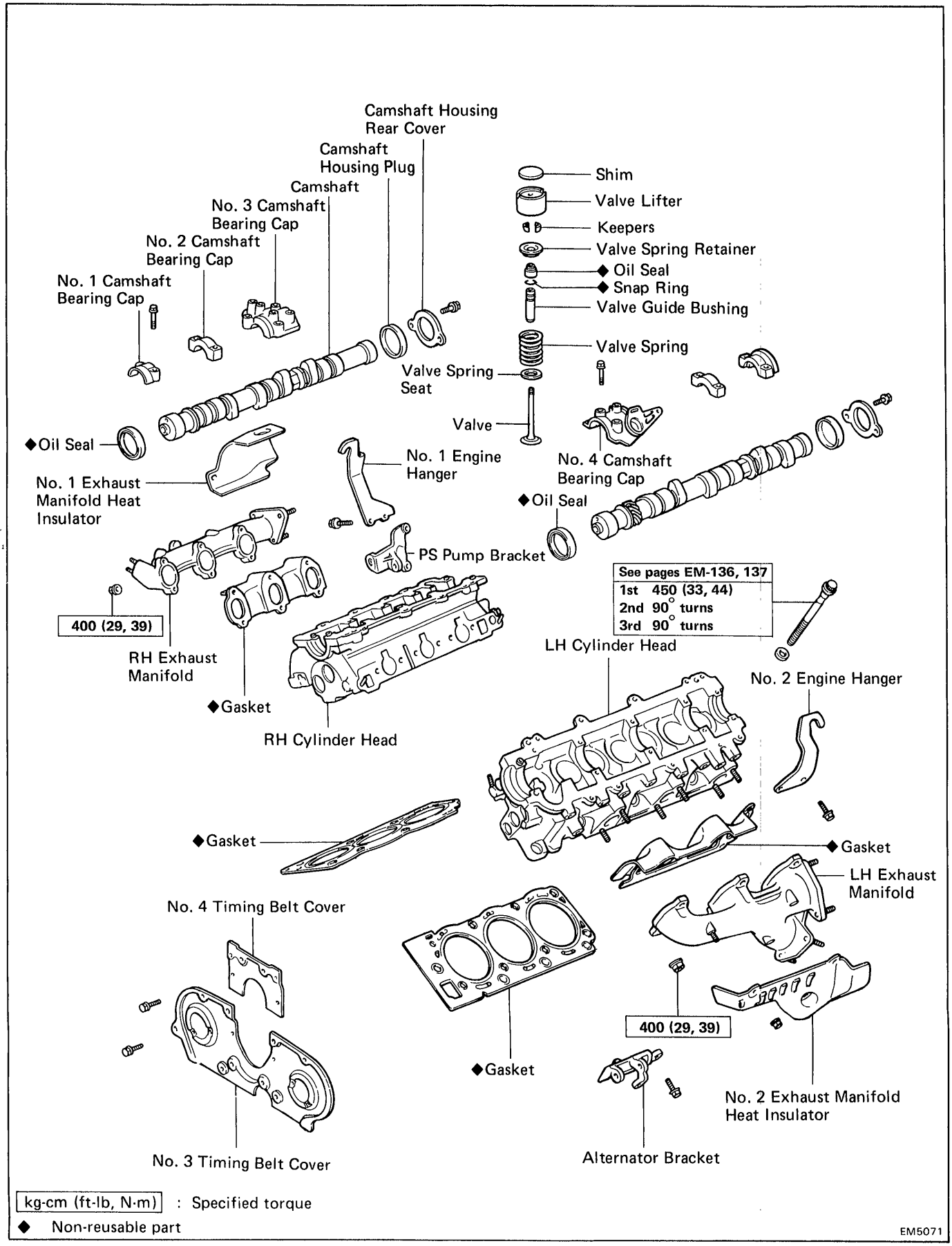


kg-cm (ft-lb, N·m) : Specified torque

◆ Non-reusable part

EM6658

COMPONENTS (Cont'd)



kg-cm (ft-lb, N·m) : Specified torque

◆ Non-reusable part

EM5071

PREPARATION FOR REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE TERMINAL FROM BATTERY**

2. **REMOVE AIR CLEANER HOSE WITH CASE**

3. **DRAIN COOLANT FROM RADIATOR AND CYLINDER BLOCK**
   (See step 3 on page CO-14)

4. **REMOVE RADIATOR**
   (See page CO-18)

5. **REMOVE PS PUMP WITH HOSES**
   (See step 2 on page EM-100)

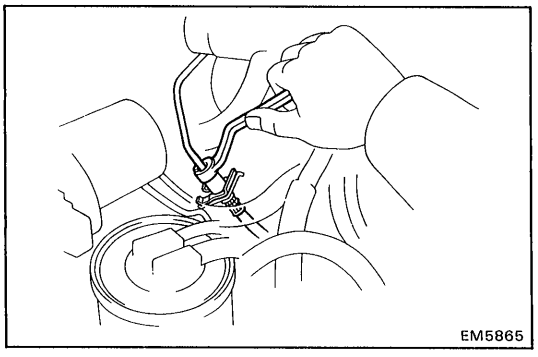
6. **(with A/C)**
   REMOVE A/C BELT

7. **REMOVE ALTERNATOR DRIVE BELT, FLUID COUPLING AND FAN PULLEY**
   (See step 7 on page EM-101)

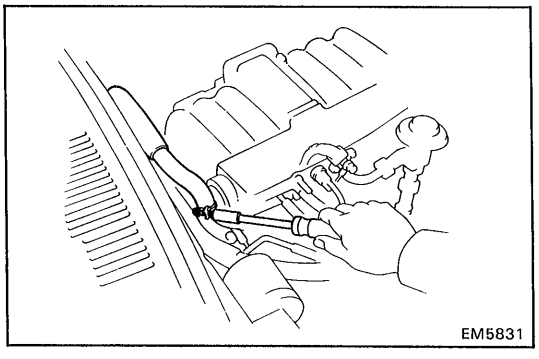
8. **DISCONNECT FOLLOWING WIRES AND CONNECTORS:**
   (a) Ground strap from LH fender apron
   (b) Alternator connector and wire
   (c) Igniter connector
   (d) Oil pressure sender gauge connector
   (e) Ground strap from engine rear side
   (f) ECU connectors
   (g) VSV connectors
   (h) (M/T)
   Starter relay connector
   (i) Solenoid resister connector
   (j) Check connector
   (k) A/C compressor connector

9. **DISCONNECT FOLLOWING HOSES:**
   (a) PS air hoses from gas filter and air pipe
   (b) Brake booster hose
   (c) (w/ Cruise control)
   Cruise control vacuum hose
   (d) Charcoal canister hose from canister
   (e) VSV vacuum hoses

10. **DISCONNECT FOLLOWING CABLES:**
    (a) Accelerator cable
    (b) (A/T)
    Throttle cable
    (c) (w/ Cruise control)
    Cruise control cable

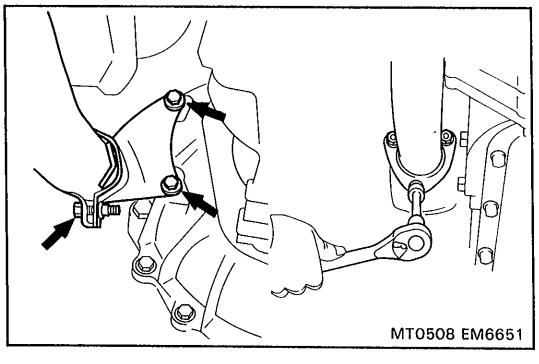


11. (M/T)
DISCONNECT CLUTCH RELEASE CYLINDER HOSE



12. DISCONNECT TWO HEATER HOSES

13. DISCONNECT FUEL INLET AND OUTLET HOSES



14. REMOVE FRONT EXHAUST PIPE

(a) Disconnect the oxygen sensor connector.

(b) Remove the exhaust pipe clamp from the clutch housing.

(c) Disconnect the exhaust pipe from the exhaust manifold.

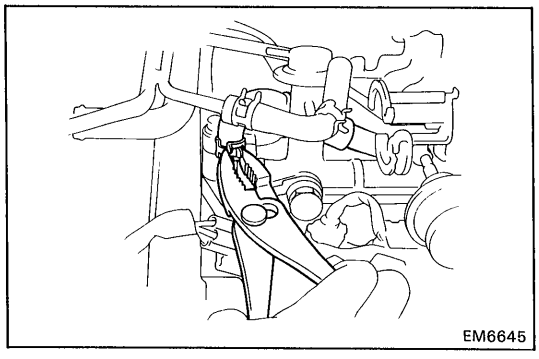
(d) Remove the exhaust pipe from the catalytic converter.

REMOVAL OF CYLINDER HEAD (RH and LH side)

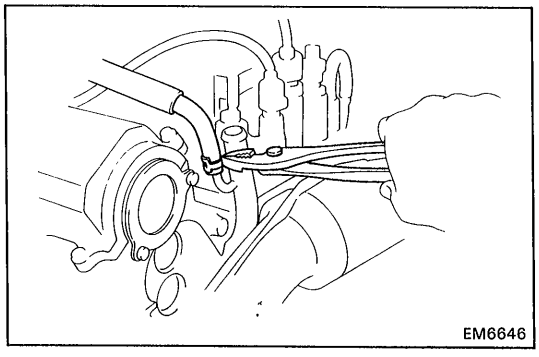
1. **REMOVE TIMING BELT**
   (See steps 5,8,9,11,13 to 15 on pages EM-100 to 103)

2. **REMOVE DISTRIBUTOR AND HIGH-TENSION CORDS**

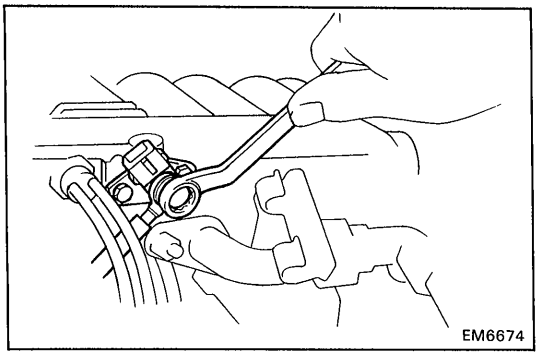
3. **REMOVE AIR INTAKE CHAMBER**
   (a) Disconnect the throttle position sensor connector.
   (b) Disconnect the canister vacuum hose from the throttle body.
   (c) Disconnect the vacuum and fuel hoses from the pressure regulator.
   (d) Disconnect the PCV hose from the union.


EM6645

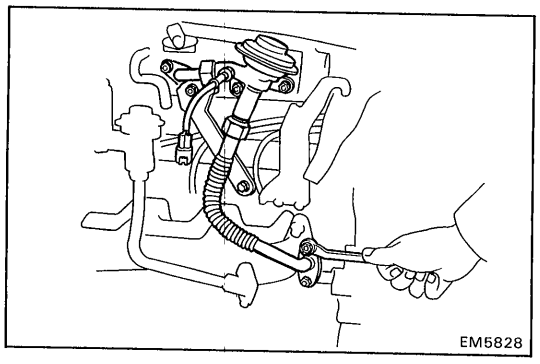
(e) Disconnect the No.4 water by-pass hose from the union of intake manifold.


EM6646

(f) Remove the No.5 water by-pass hose from the water by-pass pipe.


EM6674

(g) Disconnect the cold start injector connector.
(h) Disconnect the vacuum hose from the gas filter.
(i) Remove the union bolt and two gaskets and cold start injector tube.

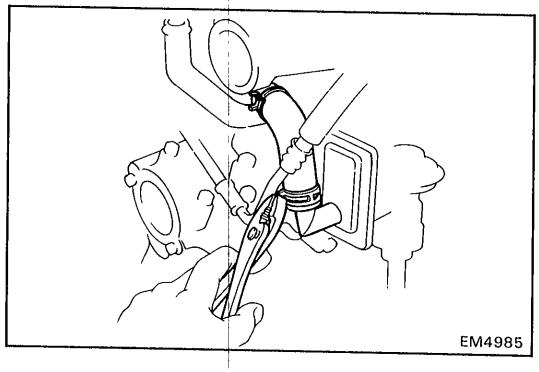


(j) (California only)
Disconnect the EGR gas temp. sensor connector.

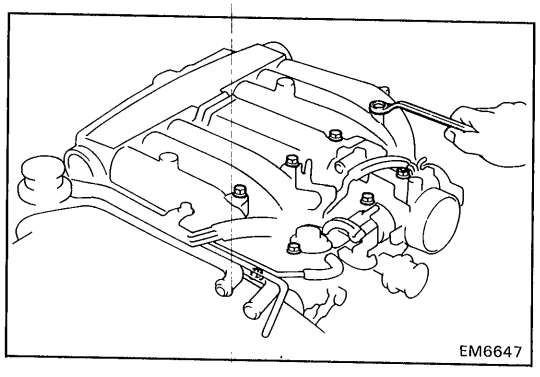
(k) Disconnect the EGR vacuum hoses from the air pipe and EGR vacuum modulator.

(l) Remove the nut, bolt and intake chamber stay.

(m) Remove the five nuts, EGR valve with pipes and two gaskets.



(n) Disconnect the No.1 air hose from the reed valve.

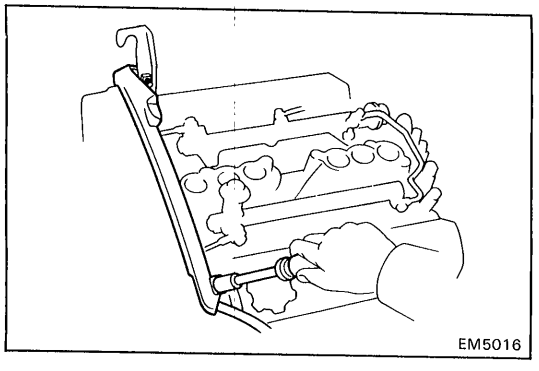


(o) Remove the six bolts, two nuts, intake chamber and gasket.

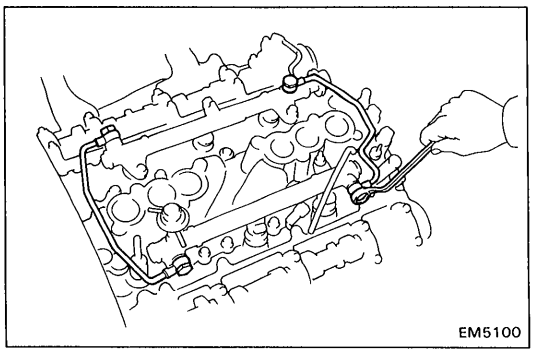
4. REMOVE ENGINE WIRE

(a) Disconnect following connectors:

- Knock sensor connector
- No.2 water temp. switch connector
- Star injector time switch connector
- Water temp. sensor connector
- Water temp. sender gauge connector
- RH ground strap from No.3 camshaft bearing cap
- Injector connectors



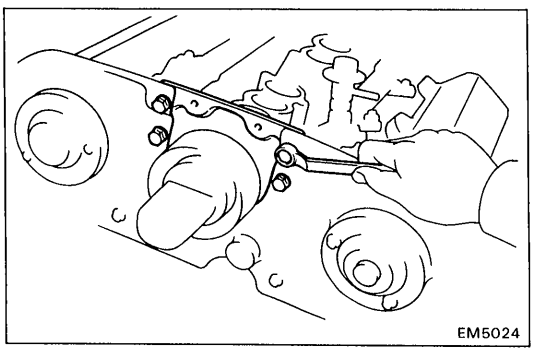
(b) Remove the two bolts and engine wire.



5. REMOVE NO.2 AND NO.3 FUEL PIPES

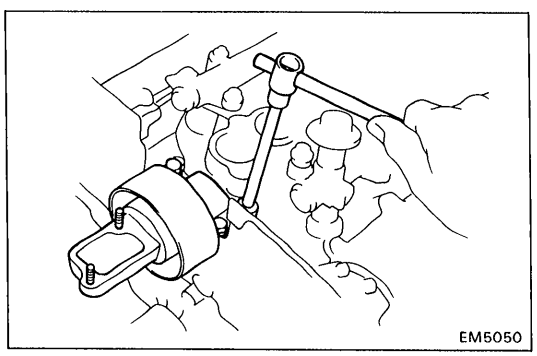
(a) Disconnect the vacuum hose from the BVSV.

(b) Remove the four union bolts, No.2, No.3 fuel pipes and eight gaskets.



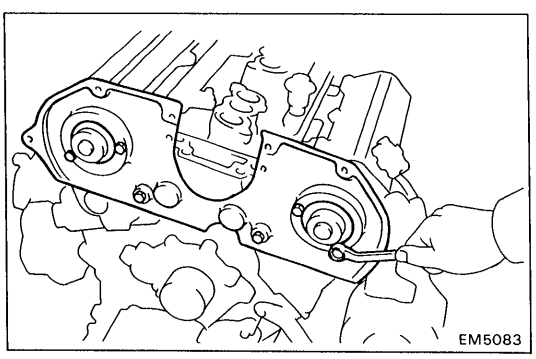
6. REMOVE NO.4 TIMING BELT COVER

Remove the four bolts and No.4 timing belt cover.

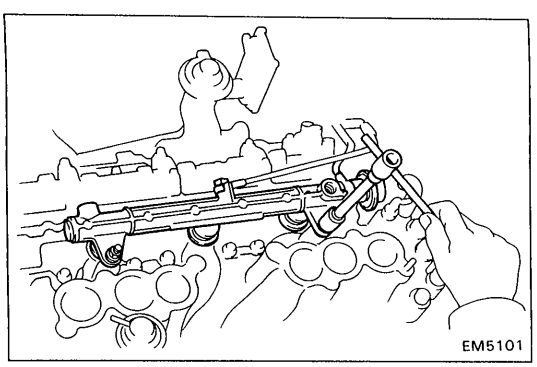


7. REMOVE NO.2 IDLER PULLEY AND NO.3 TIMING BELT COVER

(a) Remove the four blots and No.2 idler pulley.



(b) Remove the six bolts, No.3 timing belt cover.



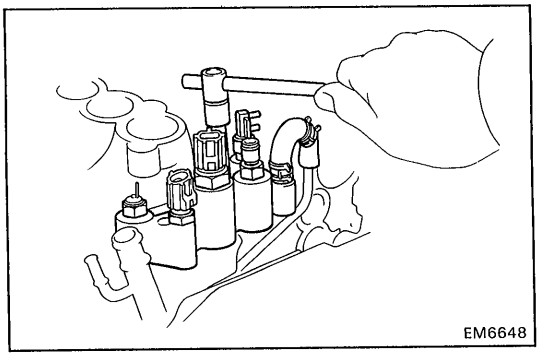
8. REMOVE RH DELIVERY PIPE AND INJECTORS

(a) Remove the two nuts and two spacers.

(b) Remove the RH delivery pipe with injectors and spacers.

(c) Remove the two spacers.

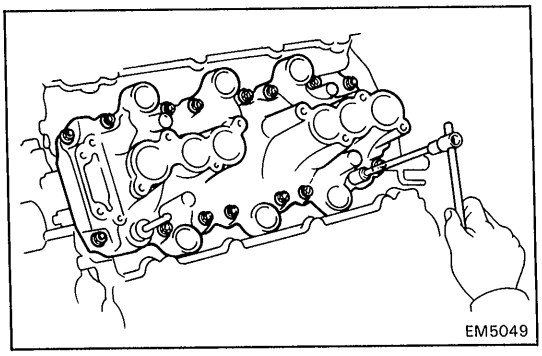
9. REMOVE LH DELIVERY PIPE AND INJECTORS



10. REMOVE WATER BY-PASS OUTLET

(a) Disconnect the No.3 water hose from the water by-pass pipe.

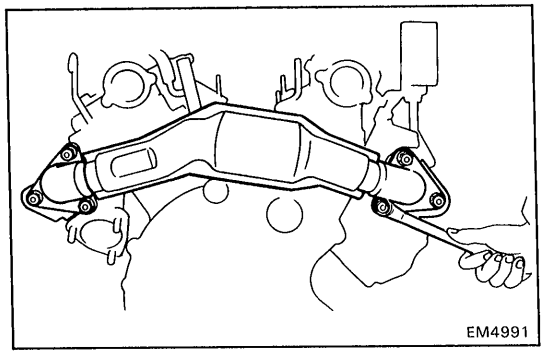
(b) Remove the two bolts, water outlet and gasket.



11. REMOVE INTAKE MANIFOLD

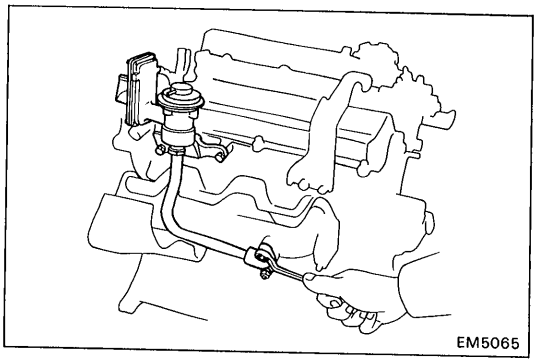
Remove the twelve bolts, four nuts, intake manifold and two gaskets.

12. REMOVE KNOCK SENSOR WIRE



13. REMOVE CROSSOVER PIPE

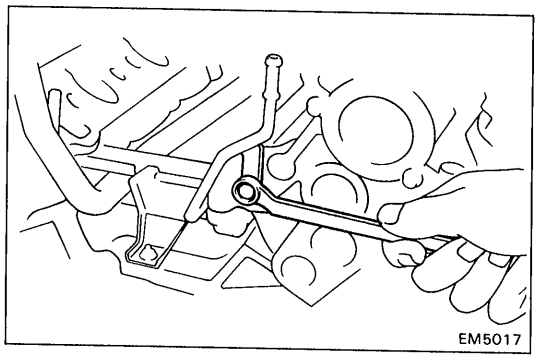
Remove the six nuts, crossover pipe and two gaskets.



(RH Side)

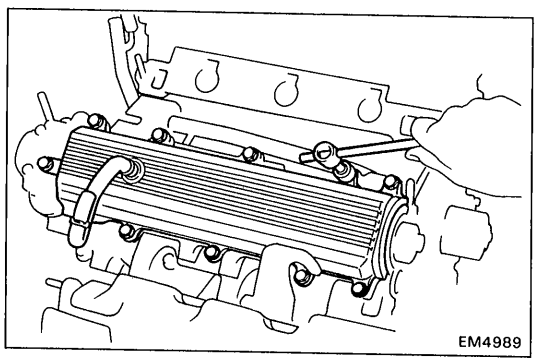
14. REMOVE AS REED VALVE WITH NO.1 AIR INJECTION MANIFOLD

Remove the two bolts, two nuts, AS reed valve with No.1 injection manifold and gasket.



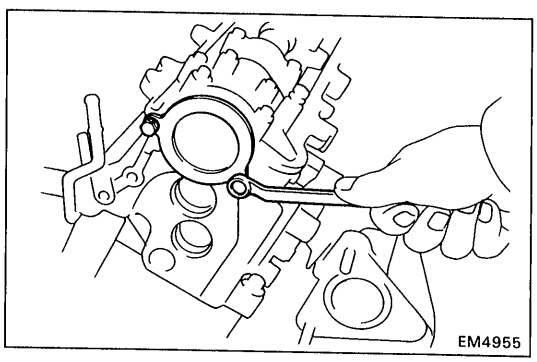
15. REMOVE WATER BY-PASS PIPE MOUNTING BOLT

16. REMOVE ALTERNATOR



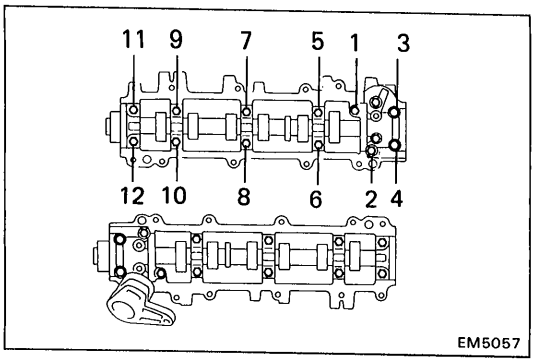
17. REMOVE NO.1 CYLINDER HEAD COVER

Remove the eleven bolts, bracket and No.1 cylinder head cover.



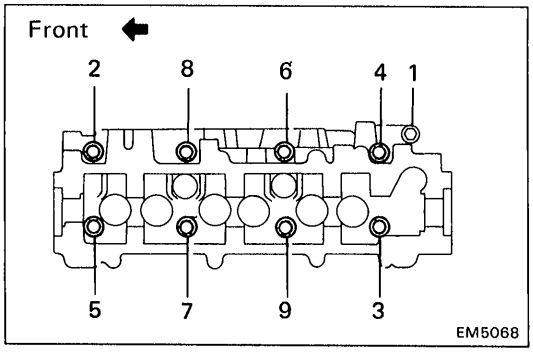
18. REMOVE NO.1 CAMSHAFT

(a) Remove the two bolts and camshaft housing rear cover.



(b) Loosen each bearing cap bolts a little at a time and in the sequence shown in the figure.

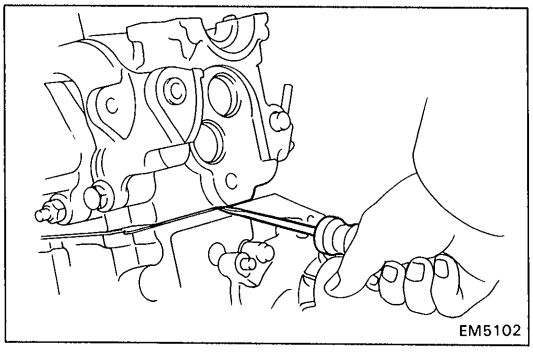
(c) Remove the camshaft bearing caps, camshaft housing plug, oil seal and camshaft.



19. REMOVE RH CYLINDER HEAD

(a) Using a 12-sided socket wrench, remove the nine bolts and washers gradually in three passes and in the numerical order shown.

NOTICE: Head warpage or cracking could result from removing bolts in incorrect order.

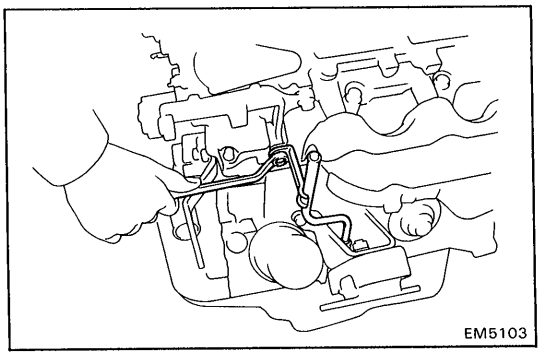


(b) Remove the RH cylinder head and gasket.

If the cylinder head is difficult to lift off, pry with a screwdriver between the cylinder head and block projection.

(c) Place the head on wooden blocks on a bench.

NOTICE: Be careful not to damage the cylinder head and block surface on the cylinder and head gasket side.



(LH side)

14. REMOVE ALTERNATOR

15. REMOVE OIL DIPSTICK GUIDE

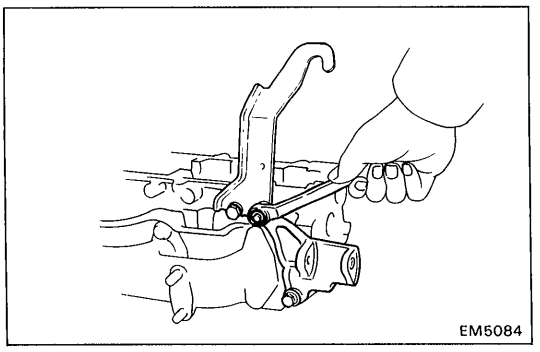
(a) Remove the oil dipstick.

(b) Remove the bolt and oil dipstick guide.

16. REMOVE NO.2 CYLINDER HEAD COVER
(See step 17 on page EM-119)

17. REMOVE NO.2 CAMSHAFT
(See step 18 on page EM-119)

18. REMOVE LH CYLINDER HEAD
(See step 19 on page EM-120)

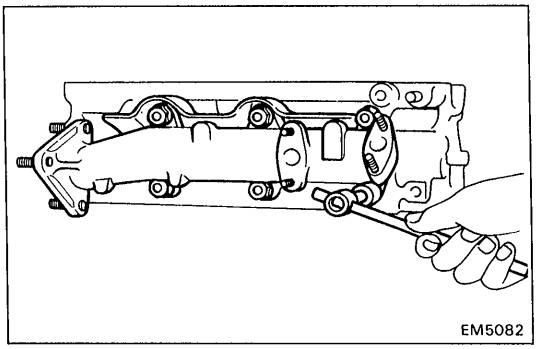


DISASSEMBLY OF CYLINDER HEAD

(See page EM-112)

(RH side)

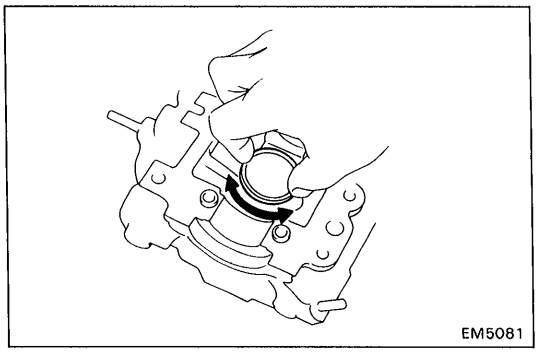
1. REMOVE PS PUMP BRACKET AND NO.1 ENGINE HANGER



2. REMOVE RH EXHAUST MANIFOLD

(a) Remove the bolt, nut and No.1 exhaust manifold heat insulator.

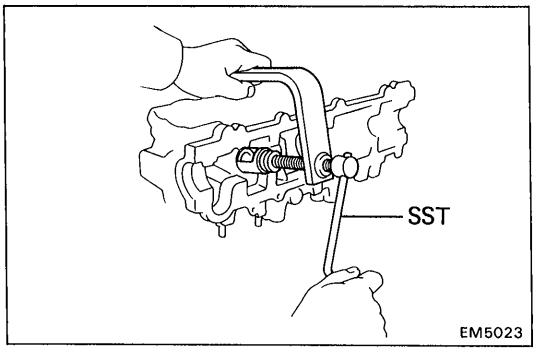
(b) Remove the six nuts, exhaust manifold and gasket.



3. REMOVE VALVE LIFTERS WITH SHIMS

(a) Pull out the valve lifter with shim by hand.

(b) Arrange the valve lifters and shims in order.



4. REMOVE VALVES

(a) Using SST, compress the valve retainer until the two keepers can be removed.

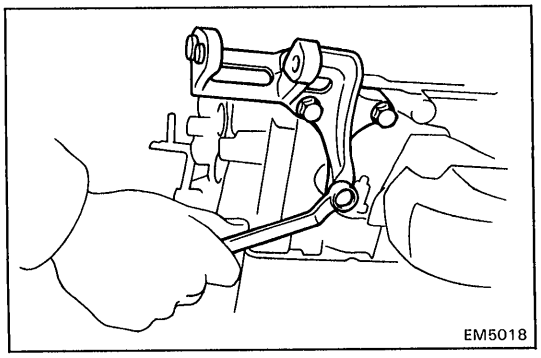
SST 09202-43013

(b) Remove the valve keepers, retainers, springs and valves.

(c) Pry out the oil seal.

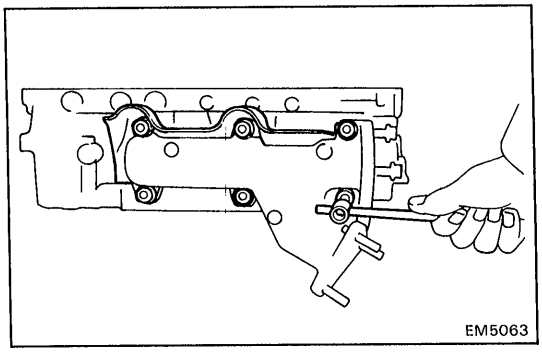
(d) Using a small screwdriver or magnet, remove the valve spring seats.

HINT: Keep the valves arranged so they can be installed in the same order as removed.



(LH side)

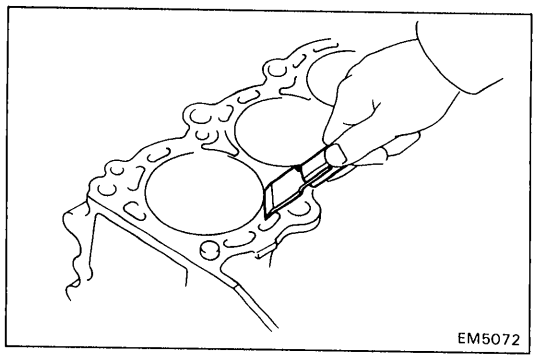
1. **REMOVE NO.2 ENGINE HANGER AND ALTERNATOR BRACKET**

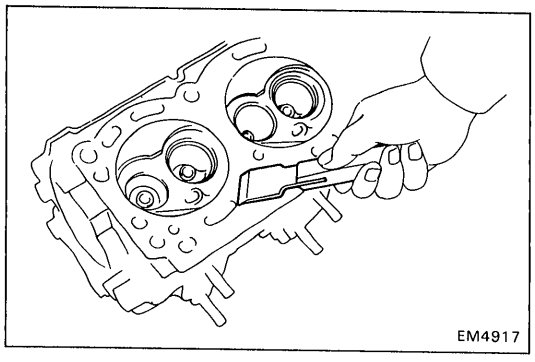


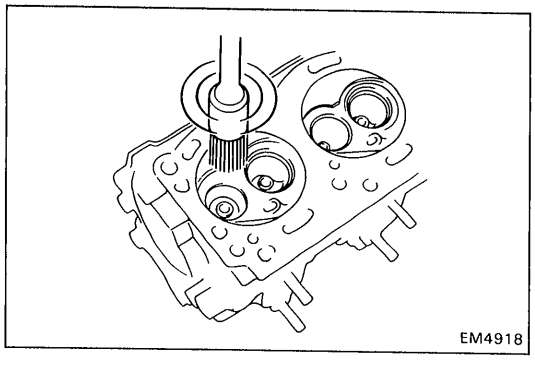
2. **REMOVE LH EXHAUST MANIFOLD**
   (a) Remove the three nuts and No.2 exhaust manifold heat insulator.
   (b) Remove the six nuts, exhaust manifold and gasket.

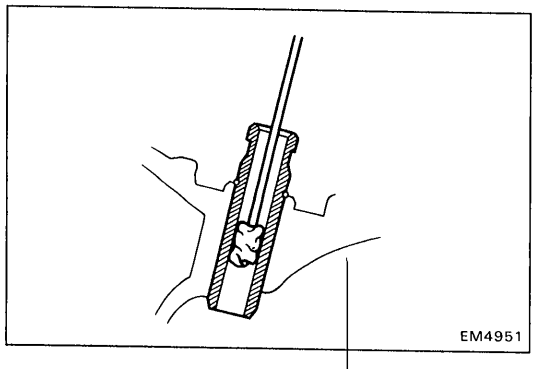
3. **REMOVE VALVE LIFTERS WITH SHIMS**
   (See step 3 on page EM-122)

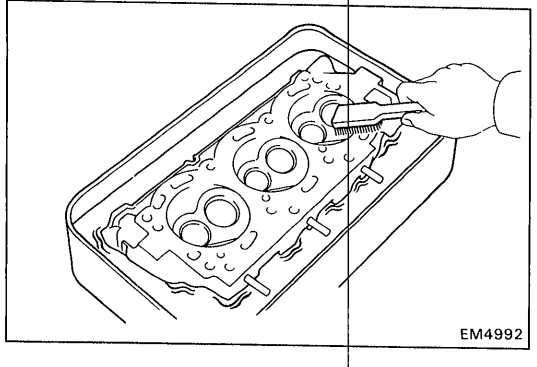
4. **REMOVE VALVES**
   (See step 4 on page EM-122)


EM5072


EM4917


EM4918


EM4951


EM4992

INSPECTION, CLEANING AND REPAIR OF CYLINDER HEAD COMPONENTS

1. CLEAN TOP OF PISTONS AND TOP OF CYLINDER BLOCK

(a) Turn the crankshaft and bring each piston to top dead center. Using a gasket scraper, remove all the carbon from the piston tops.

(b) Using a gasket scraper, remove all gasket material from the top of the block. Blow carbon and oil from the bolt holes.

CAUTION: Protect your eyes when using high pressure air.

2. REMOVE GASKET MATERIAL

Using a gasket scraper, remove all gasket material from the head and manifold surfaces.

NOTICE: Be careful not to scratch the surfaces.

3. CLEAN COMBUSTION CHAMBER

Using a wire brush, remove all the carbon from the combustion chambers.

NOTICE: Be careful not to scratch the head gasket contact surface.

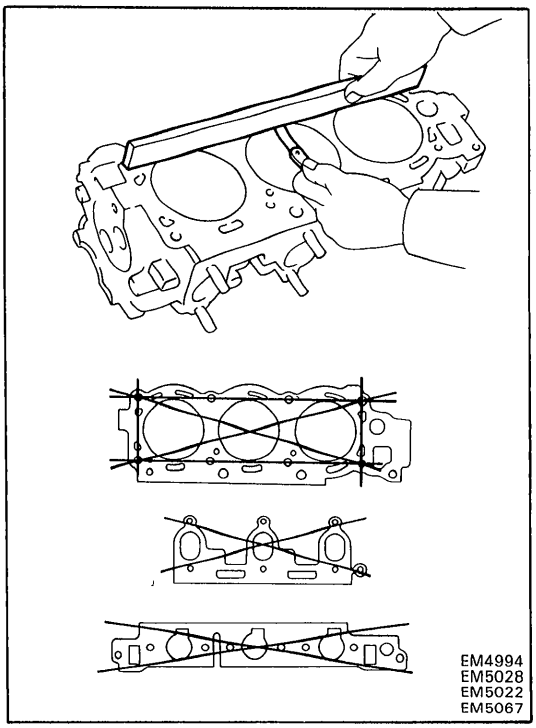
4. CLEAN VALVE GUIDE BUSHINGS

Using a valve guide brush and solvent, clean all the valve guide bushings.

5. CLEAN CYLINDER HEAD

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

NOTICE: Do not clean the head in a hot tank as this will seriously damage it.

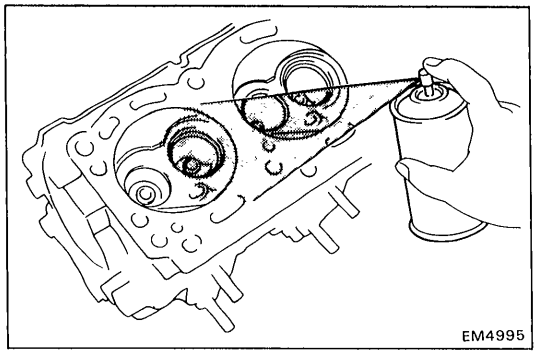


6. INSPECT CYLINDER HEAD FOR FLATNESS

Using a precision straight edge and thickness gauge, measure the surface contacting the cylinder block and manifold for warpage.

Maximum warpage: 0.10mm (0.0039 in.)

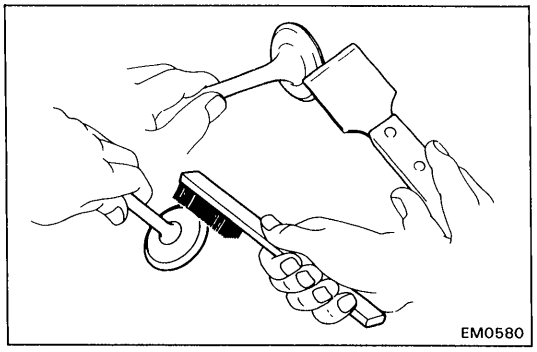
If warpage is greater than maximum, replace the cylinder head.



7. INSPECT CYLINDER HEAD FOR CRACKS

Using a dye penetrant, check the combustion chamber, intake and exhaust ports, head surface and the top of the head for cracks.

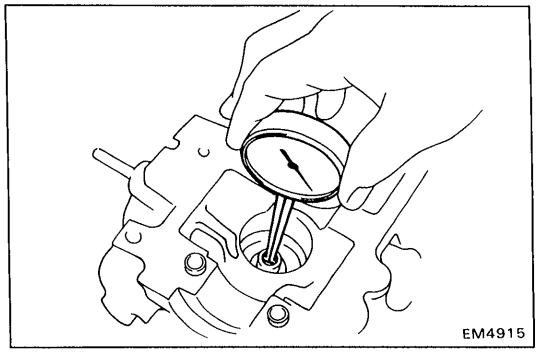
If cracked, replace the head.



8. CLEAN VALVES

(a) Use a gasket scraper to chip any carbon from the valve head.

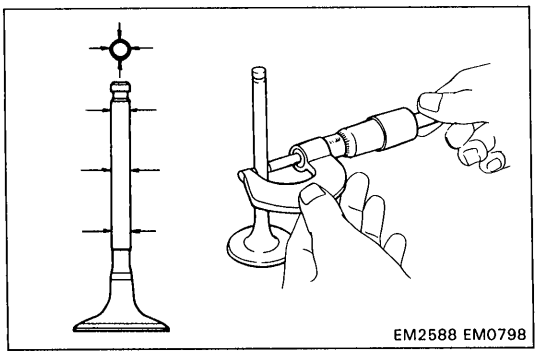
(b) Using a wire brush, thoroughly clean the valve.



9. INSPECT VALVE STEM AND GUIDE BUSHINGS

(a) Using a dial indicator or telescoping gauge, measure the inside diameter of the valve guide.

Guide inside diameter: 8.010 – 8.030 mm (0.3154 – 0.3161 in.)



(b) Using a micrometer, measure the diameter of the valve stem.

Stem diameter:

Intake	**7.970 — 7.985 mm (0.3138 — 0.3144 in.)**
Exhaust	**7.965 — 7.980 mm (0.3136 — 0.3142 in.)**

(c) Subtract the valve stem measurement from the valve guide measurement.

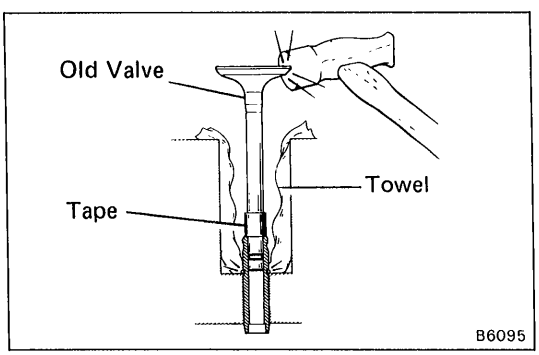
Standard stem oil clearance:

Intake	**0.025 — 0.060 mm (0.0010 — 0.0024 in.)**
Exhaust	**0.030 — 0.065 mm (0.0012 — 0.0026 in.)**

Maximum stem oil clearance:

Intake	**0.08 mm (0.0031 in.)**
Exhaust	**0.10 mm (0.0039 in.)**

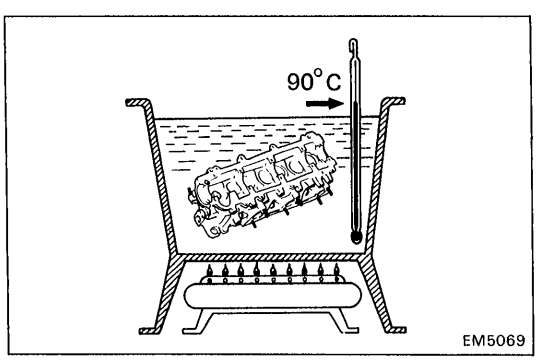
If the clearance is greater than maximum, replace the valve and guide.



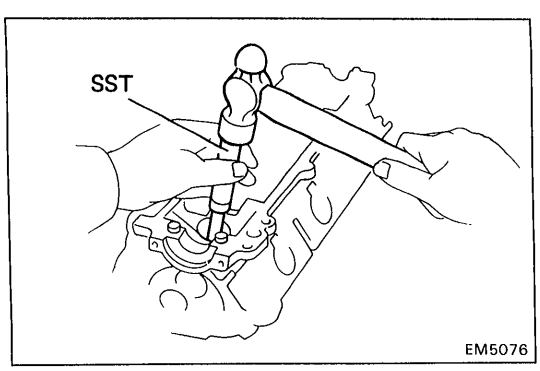
10. IF NECESSARY, REPLACE VALVE GUIDE BUSHINGS

(a) Insert an old valve wrapped with tape into the valve guide bushing and break off the valve guide bushing by hitting it with a hammer.

NOTICE: Be careful not to damage the lifter hole.

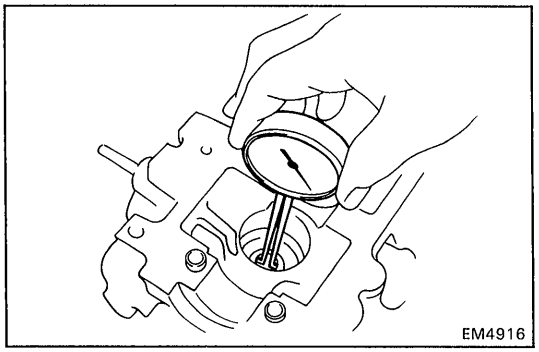


(b) Gradually heat the cylinder head to approx. 90°C (194°F).



(c) Using SST and hammer, drive out valve guide bushing.

SST 09201-60011



(d) Using a dial indicator or telescoping gauge, measure the valve guide bore of the cylinder head.

Standard valve guide bore: 13.000 — 13.027 mm (0.5118 — 0.5129 in.)

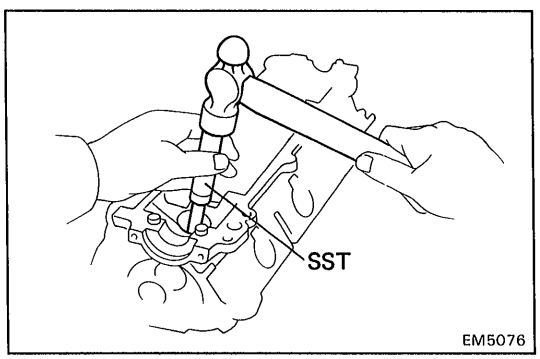
Bore intake and exhaust

Guide bore mm (in.)	Guide size
13.000–13.027 (0.5118–0.5129)	Use STD
Over 13.027 (0.5129)	Use O/S 0.05

(e) Select a new valve guide bushing.

If the valve guide bushing bore of the cylinder head is more than 13.027 mm (0.5129 in.), machine the bore to the following dimension.

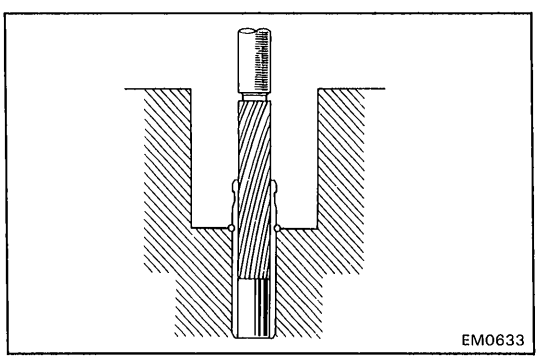
Rebored valve guide bushing bore dimension: 13.050 — 13.077 mm (0.5138 — 0.5148 in.)



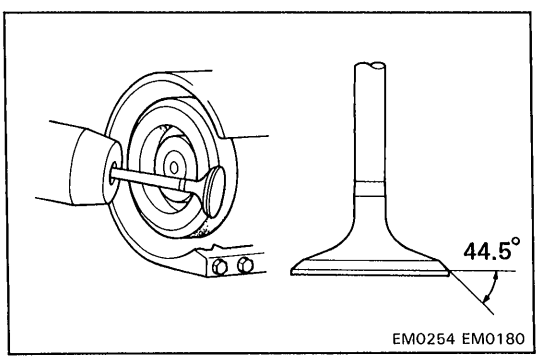
(f) Gradually heat the cylinder head to approx. 90°C (194°F).

(g) Using SST and hammer, drive in a new valve guide bushing until the snap ring makes contact with the cylinder head.

SST 09201-60011



(h) Using a sharp 8 mm (0.31 in.) reamer, ream the valve guide bushing to obtain standard specified clearance (See page EM-126) between the valve guide bushing and new valve.

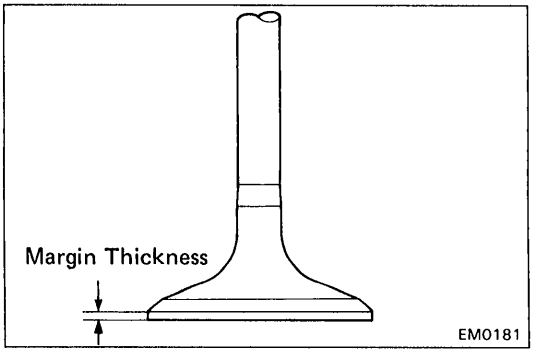


11. INSPECT AND GRIND VALVES

(a) Grind the valve only enough to remove pits and carbon.

(b) Check that the valve are ground to the correct valve face angle.

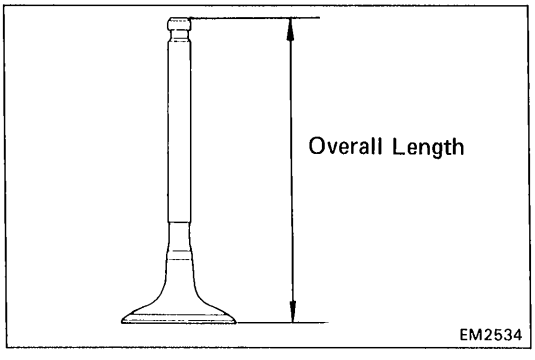
Valve face angle: 44.5°



(c) Check the valve head margin thickness.

Standard margin thickness: 1.5 mm (0.059 in.)
Minimum margin thickness: 1.3 mm (0.051 in.)

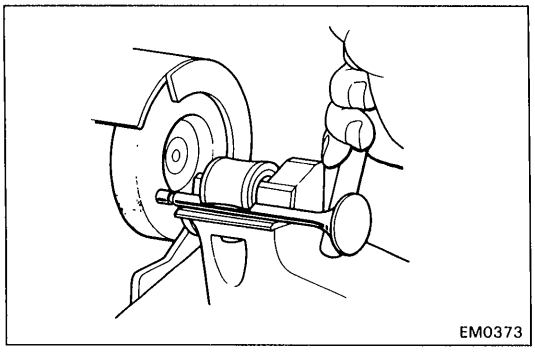
If the valve head margin thickness is less than minimum replace the valve.



(d) Check the valve overall length.

Standard overall length: 104.3 mm (4.106 in.)
Minimum overall length: 104.0 mm (4.094 in.)

If the valve overall length is less than minimum, replace the valve.

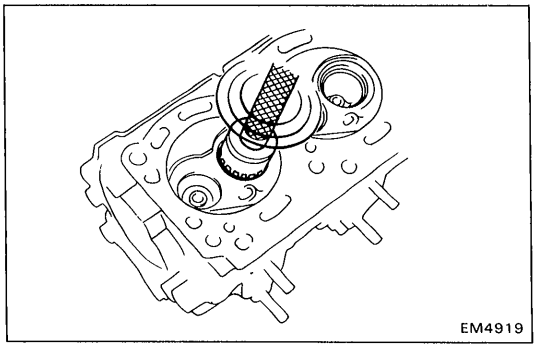


(e) Check the surface of the valve stem tip for wear.

If the valve stem tip is worn, regrind it with grinder or replace the valve if necessary.

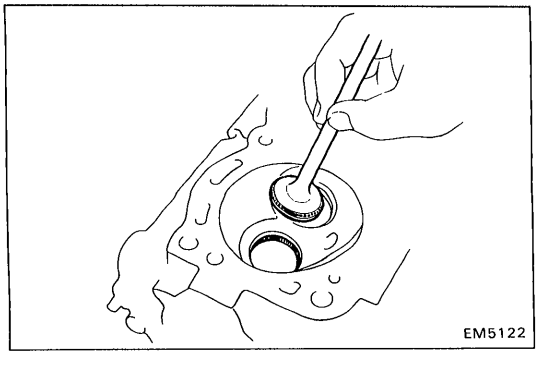
NOTICE: Do not grind off more than minimum overall length.

Minimum overall length: 104.0 mm (4.094 in.)



12. INSPECT AND CLEAN VALVE SEATS

(a) Using a 45° carbide cutter, resurface the valve seats. Remove only enough metal to clean the seats.



(b) Check the valve seating position.

Apply a thin coat of prussian blue (or white lead) to the valve face. Install the valve. Lightly press the valve against the seat. Do not rotate the valve.

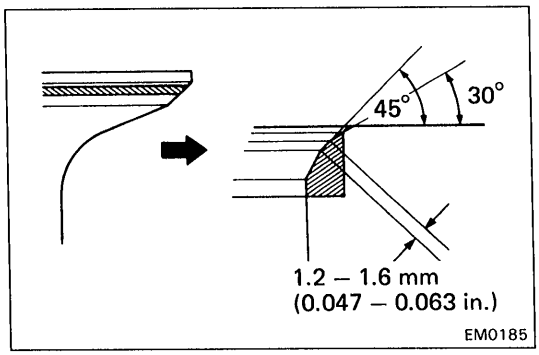
(c) Check the valve face and seat for the following:

- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
- If blue appears 360° around the valve seat, the guide and seat are concentric. If not, resurface the seat.
- Check that the seat contact is on the middle of the valve face with the following width:

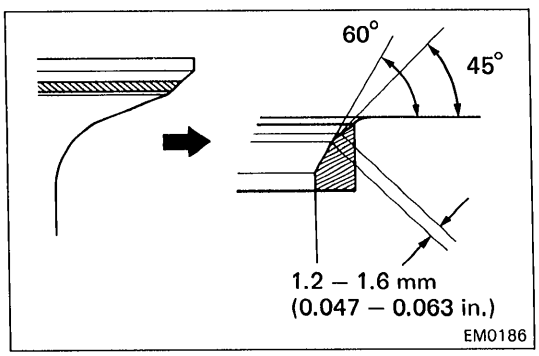
1.2 — 1.6 mm (0.047 — 0.063 in.)

If not, correct the valve seat as follows:

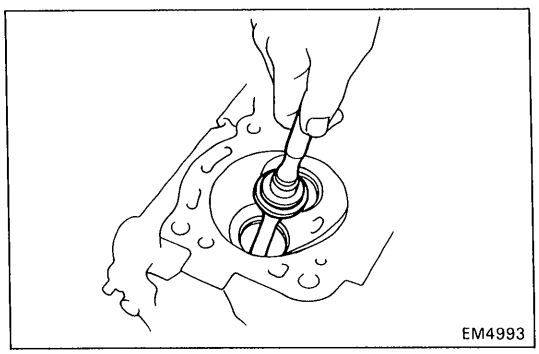
- If seating is too high on the valve face use 30° and 45° cutters to correct the seat.



- If seating is too low on the valve face, use 60° and 45° cutters to correct the seat.



(d) Hand-lap the valve and valve seat with abrasive compound.

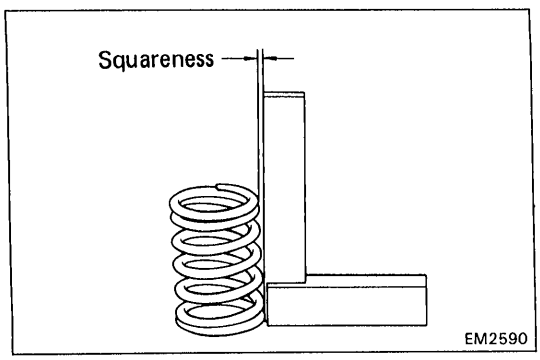


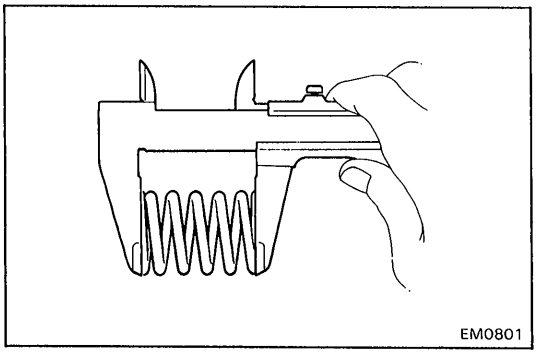
13. INSPECT VALVE SPRINGS

(a) Using a steel square, measure the squareness of the valve springs.

Maximum squareness: 1.23 mm (0.0484 in.)

If squareness is greater than maximum, replace the valve spring.

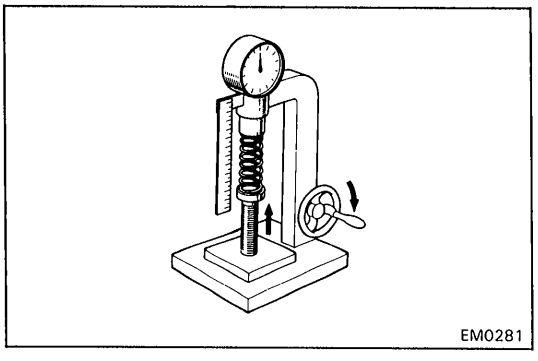



EM0801

(b) Using calipers, measure the free length of the valve spring.

Free length: 47.01 mm (1.8508 in.)

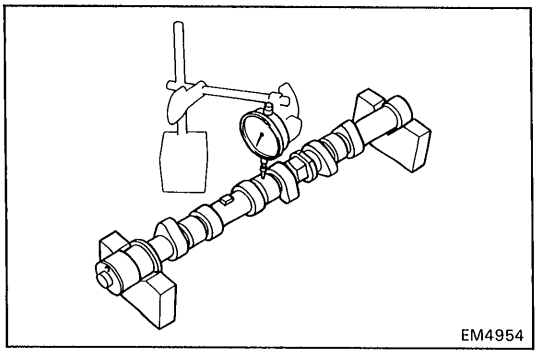
If the free length is not within specification, replace the valve spring.


EM0281

(c) Using a spring tester, check the tension of each spring at the specified installed height.

Installed height: 40.0 mm (1.575 in.)
Standard installed tension: 26.0 kg (57 lb, 255 N)
Minimum installed tension: 24.7 kg (54 lb, 242 N)

If the installed tension is less than minimum, replace the spring.

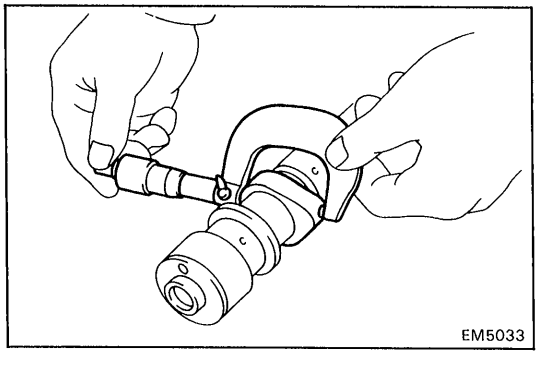

EM4954

14. INSPECT CAMSHAFT AND BEARING CAPS

(a) Place the camshaft on V-blocks and, using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.06 mm (0.0024 in.)

If the circle runout is greater than maximum, replace the camshaft.

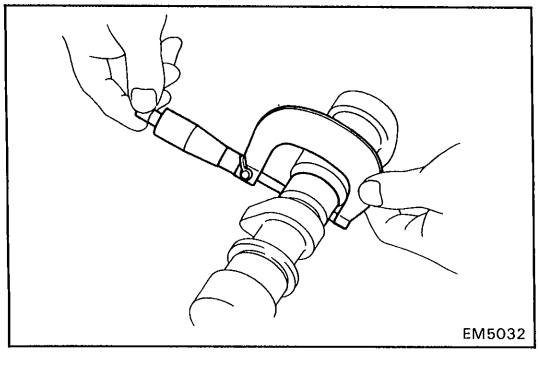

EM5033

(b) Using a micrometer, measure the cam lobe height.

Standard cam lobe height: 47.83 — 47.93 mm (1.8830 — 1.8870 in.)

Minimum cam lobe height: 47.50 mm (1.8701 in.)

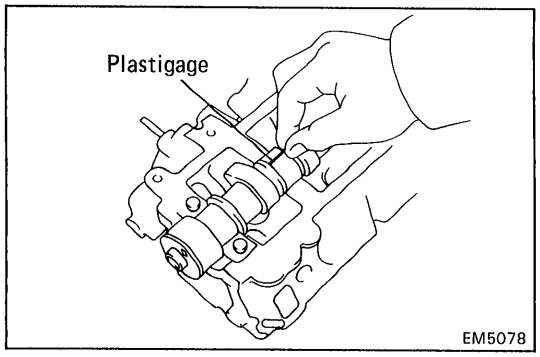
If the cam lobe height is less than minimum, replace the camshaft.


EM5032

(c) Using a micrometer, measure the journal diameter.

Standard diameter: 33.959 — 33.975 mm (1.3370 — 1.3376 in.)

If the journal diameter is less than specified, replace the camshaft.



15. INSPECT CAMSHAFT OIL CLEARANCE

(a) Clean the bearing caps and camshaft journal.

(b) Place the camshaft in the cylinder head.

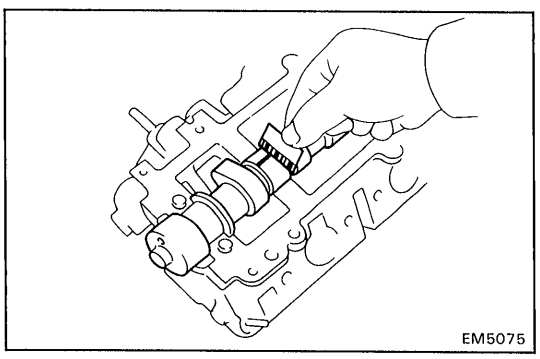
(c) Lay a strip of Plastigage across each journal.

(d) Place the bearing caps with the top of the number on the cap pointing toward the front (RH side) or rear (LH side) and in numerical order from the front side. (See step 2 on page EM-137)

(e) Install and torque the cap bolts gradually from the inside in three passes. (See step 2 on page EM-137)

Torque: 160 kg-cm (12 ft-lb, 16 N·m)

HINT: Do not turn the camshaft while the Plastigage is in place.



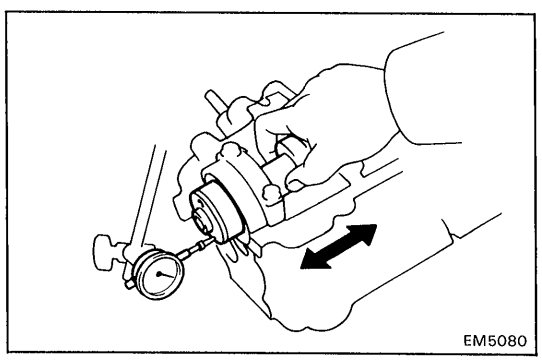
(f) Remove the caps and measure the Plastigage at its widest point.

Standard oil clearance: 0.025 — 0.066 mm (0.0010 — 0.0026 in.)

Maximum oil clearance: 0.10 mm (0.0039 in.)

If clearance is greater than maximum, replace the cylinder head and/or camshaft.

(g) Clean out the pieces of Plastigage from the bearing caps and journals.



16. INSPECT CAMSHAFT THRUST CLEARANCE

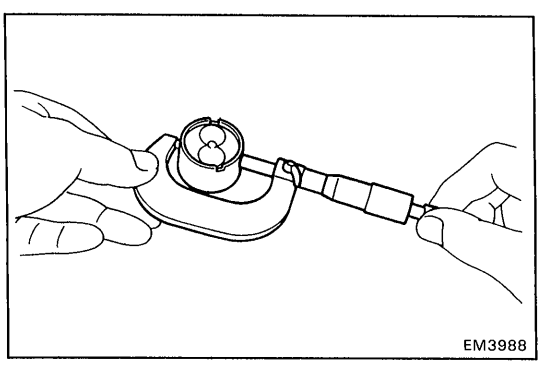
(a) Clean and install the camshaft and bearing caps.

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

Standard thrust clearance: 0.08 — 0.19 mm (0.0031 — 0.0075 in.)

Maximum thrust clearance: 0.25 mm (0.0098 in.)

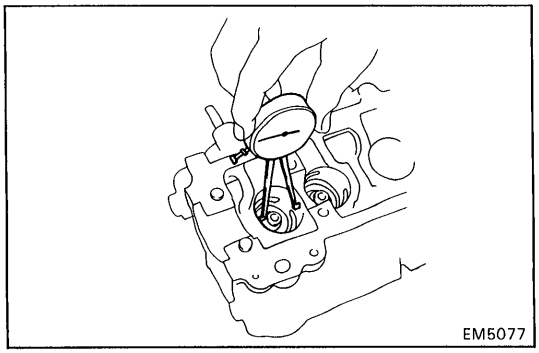
If clearance is greater than maximum, replace the head and/or camshaft.



17. MEASURE VALVE LIFTER OIL CLEARANCE

(a) Using a micrometer, measure the diameter of the valve lifter.

Standard diameter: 37.922 — 37.932 mm (1.4930 — 1.4934 in.)


EM5077

(b) Using a dial indicator or telescoping gauge, measure the inside diameter of the cylinder head bore.

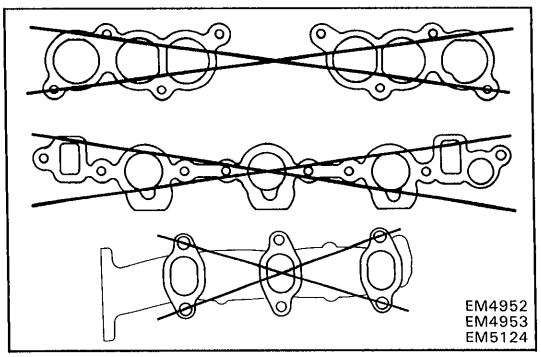
Standard inside diameter: 37.960 — 37.975 mm (1.4945 — 1.4951 in.)

(c) Subtract the valve lifter measurement from the cylinder head bore.

Standard oil clearance: 0.028 — 0.053 mm (0.0011 — 0.0021 in.)

Maximum oil clearance: 0.1 mm (0.004 in.)

If clearance is greater than maximum, replace the cylinder head and/or valve lifter.


EM4952
EM4953
EM5124

18. INSPECT INTAKE, EXHAUST MANIFOLD AND AIR INTAKE CHAMBER

Using a precision straight edge and thickness gauge, check the surfaces contacting the cylinder head or intake manifold for warpage.

Maximum warpage:

Intake manifold	**0.10 mm (0.0039 in.)**
Exhaust manifold	**0.70 mm (0.0276 in.)**
Intake chamber	**0.10 mm (0.0039 in.)**

If warpage is greater than maximum, replace the manifold and/or air intake chamber.

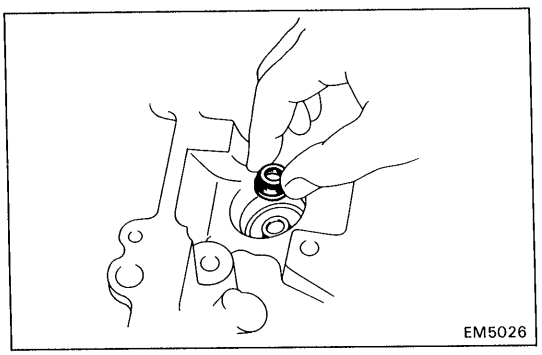
ASSEMBLY OF CYLINDER HEAD

(See page EM-112)

(RH side)

HINT:

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply new engine oil to all sliding and rotating surfaces.
- Replace all gaskets and oil seals with new ones.

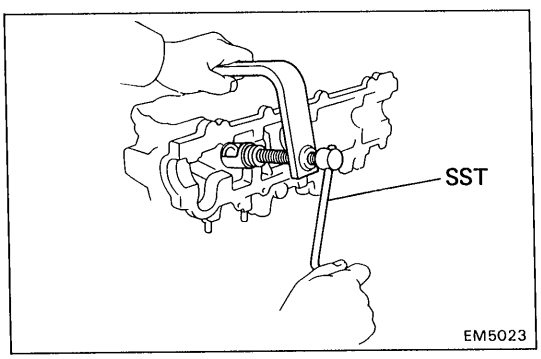


1. INSTALL VALVES

(a) Insert the valves in the cylinder head valve guide bushing. Make sure the valves are installed in the correct order.

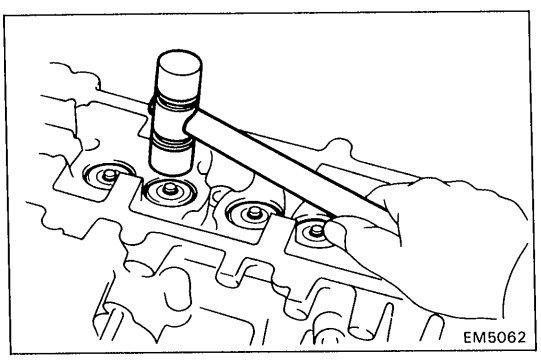
(b) Install new oil seals on the valve.

(c) Install spring seats, springs and spring retainers.

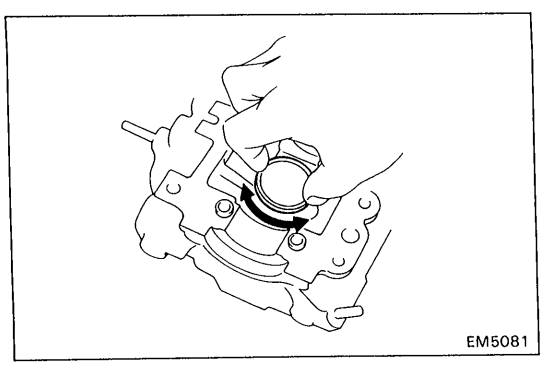


(d) Using SST, compress the valve retainers and place two keepers around the valve stem.

SST 09202-43013

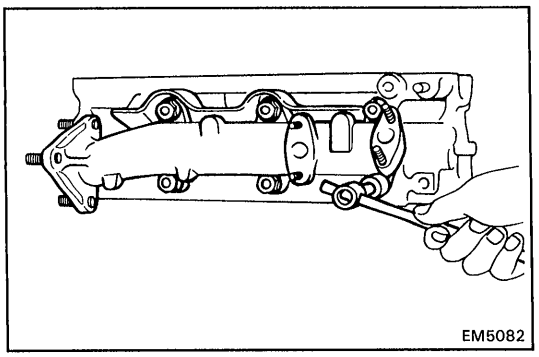


(e) Tap the stem lightly to assure proper fit.



2. INSTALL VALVE LIFTERS WITH SHIMS

Make sure the valve lifters with their shims are installed in the correct order.



3. **INSTALL RH EXHAUST MANIFOLD**

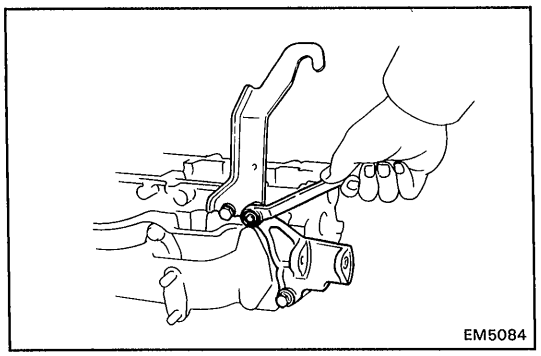
(a) Position a new gasket on the RH cylinder head.

(b) Install the exhaust manifold with the six nuts.

Torque: 400 kg-cm (29 ft-lb, 39 N·m)

(c) Install the No.1 exhaust manifold heat insulator with the bolt and nut.

Torque: 50 kg-cm (43 in.-lb, 4.9 N·m)



4. **INSTALL NO.1 ENGINE HANGER AND PS PUMP BRACKET**

Torque: 410 kg-cm (30 ft-lb, 40 N·m)

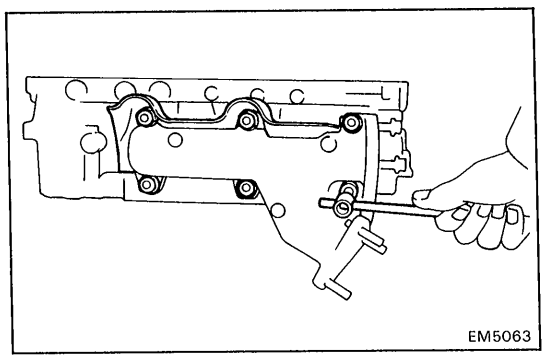
(LH side)

HINT:

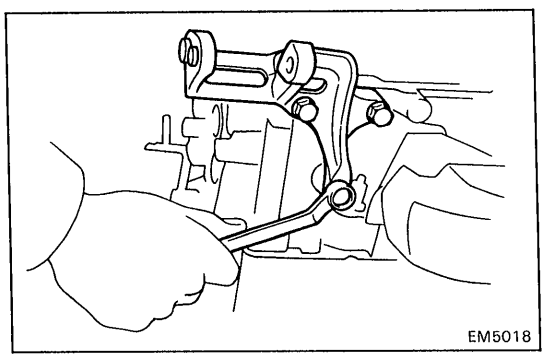
- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply new engine oil to all sliding and rotating surfaces.
- Replace all gaskets and oil seals with new ones.

1. **INSTALL VALVES**
   (See step 1 on page EM-133)

2. **INSTALL VALVE LIFTERS WITH SHIMS**
   (See step 2 on page EM-133)



3. **INSTALL LH EXHAUST MANIFOLD**
   (a) Position a new gasket on the LH cylinder head.
   (b) Install the exhaust manifold with the six nuts.
   Torque: 400 kg-cm (29 ft-lb, 39 N·m)
   (c) Install the No.2 exhaust manifold heat insulator with the three bolts.
   Torque: 50 kg-cm (43 in.-lb, 4.9 N·m)



4. **INSTALL NO.2 ENGINE HANGER AND ALTERNATOR BACKET**
   Torque:

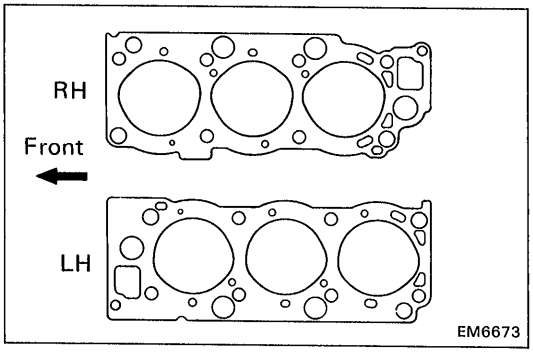
No.2 engine hanger	**410 kg-cm (30 ft-lb, 40 N·m)**
Alternator bracket	**380 kg-cm (27 ft-lb, 37 N·m)**

INSTALLATION OF CYLINDER HEAD

(See pages EM-111, 112)

HINT:

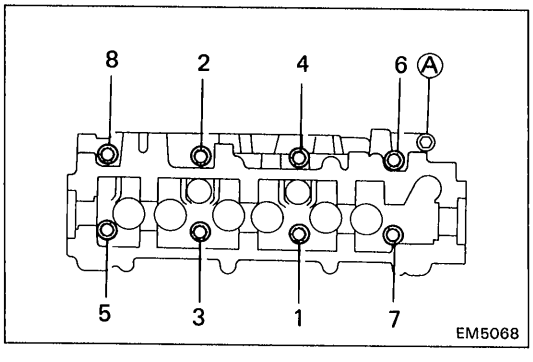
- The cylinder head bolts are tighten in three progressive steps.
- If any of the bolts break or deform, replace them.



(RH side)

1. INSTALL RH CYLINDER HEAD

(a) Place a new cylinder head gasket on the cylinder block.

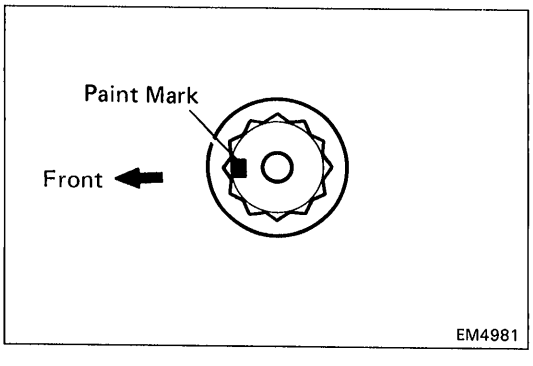


(b) Apply a light coat of the engine oil on the threads and under the cylinder head bolts.

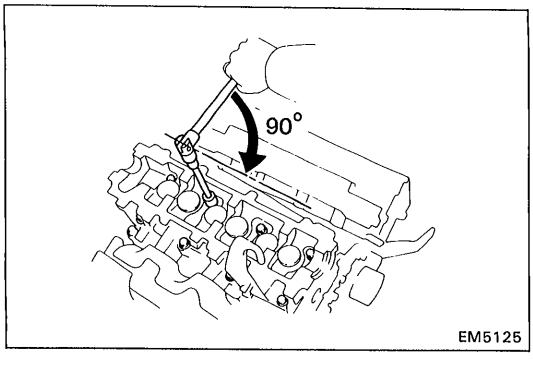
(c) Using a 12-sided socket wrench, first, alternately torque the head bolts in several passes. (Ex. Ⓐ)

Torque: 450 kg-cm (33 ft-lb, 44 N·m)

If any one of the bolts does not meet the torque specification, replace the bolt.

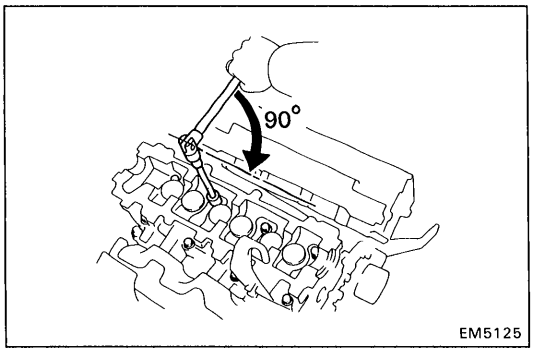


(d) Mark the front side of the top of bolt with paint.



(e) Second, uniformly torque the bolts by an additional 90°.

(f) Check that the paint mark is now facing sideward.

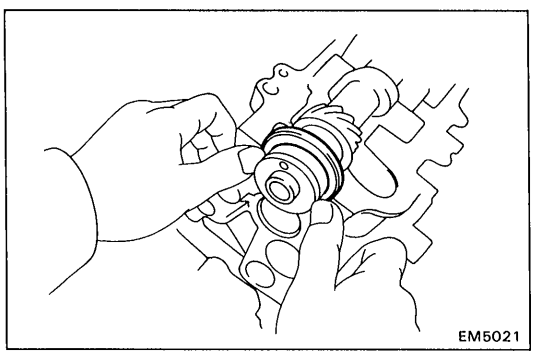


(g) Third, uniformly torque the bolts by an additional 90°.

(h) Check that the paint mark is now facing rearward.

(i) Install and torque the bolt Ⓐ.

Torque: 380 kg-cm (27 ft-lb, 37 N·m)



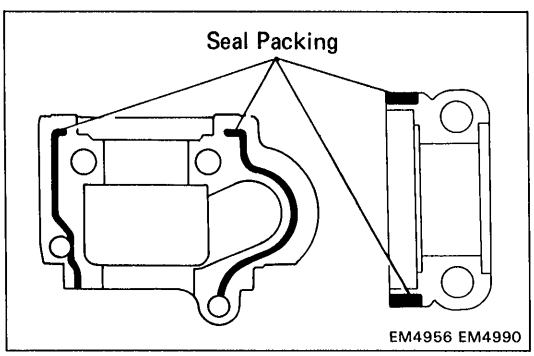
2. INSTALL NO.1 CAMSHAFT

(a) Coat all bearing journals with engine oil.

(b) Place the camshaft on the cylinder head.

(c) Apply engine oil to the lip of a new oil seal.

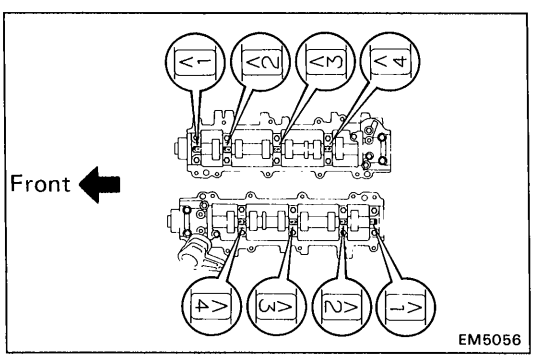
(d) Install the oil seal and camshaft housing plug to the camshaft.



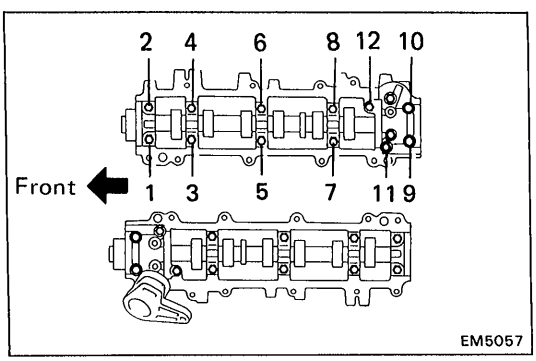
(e) Apply seal packing to the No.1 and No.3 bearing caps as shown in the figure.

Seal packing: Part No. 08826-00080 or equivalent

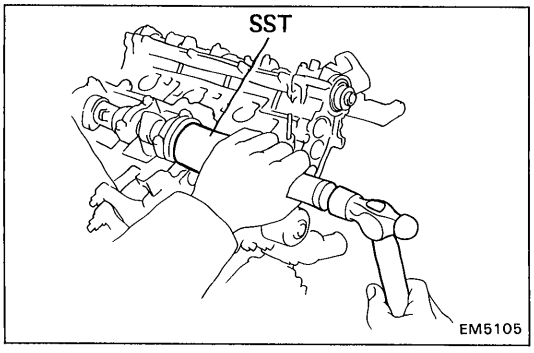
HINT: Install the No.1 and No.3 bearing caps immediately after applying the seal packing.



(f) Place bearing caps on each journal with the arrows pointing toward the front (RH side) or rear (LH side).



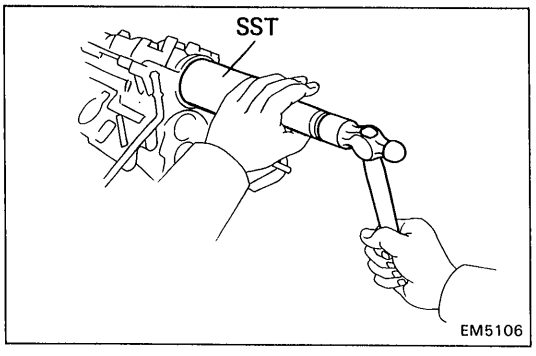
(g) Temporarily tighten each of the bearing cap bolts a little at a time and in the sequence shown in the figure.



(h) Using SST, drive in the camshaft oil seals.

SST 09214-60010

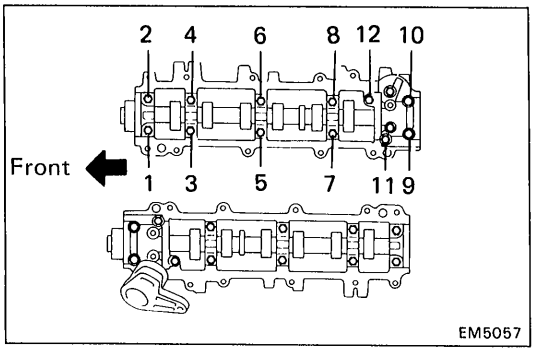
HINT: Be careful not to install the oil seal slantwise.



(i) Using SST, drive in the camshaft housing plug.

SST 09214-60010

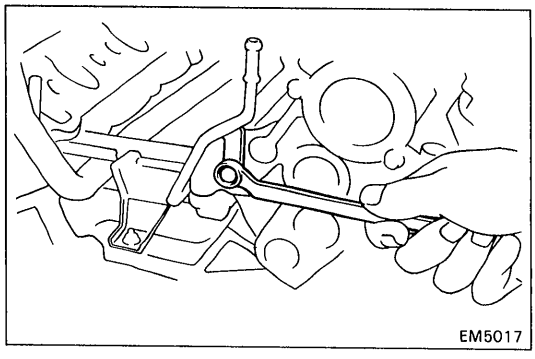
(j) Install the camshaft housing rear cover with the two bolts.



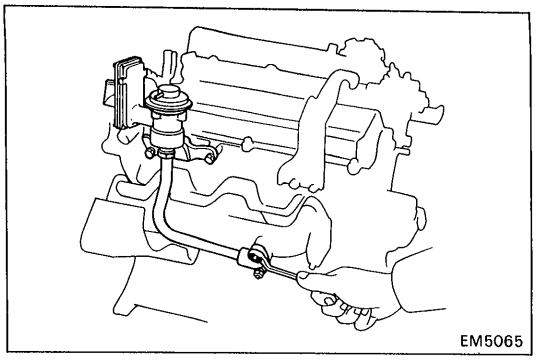
(k) Torque the bearing cap bolts a little at a time and in the sequence shown in the figure.

Torque: 160 kg-cm (12 ft-lb, 16 N·m)

3. INSTALL ALTERNATOR



4. INSTALL WATER BY-PASS PIPE MOUNTING BOLT



5. INSTALL AS REED VALVE WITH NO.1 INJECTION MANIFOLD

(a) Position a new gasket on the RH exhaust manifold.

(b) Install the AS reed valve with No.1 injection manifold with the two nuts and two bolts.

Torque:

To cylinder head

380 kg-cm (27 ft-lb, 37 N·m)

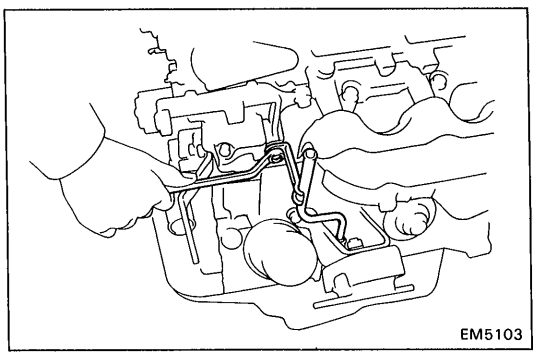
To exhaust manifold

300 kg-cm (22 ft-lb, 29 N·m)

(LH side)

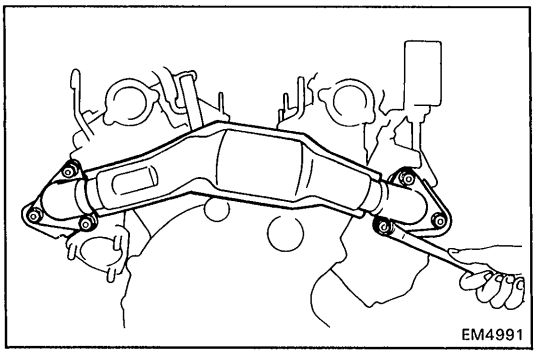
1. **INSTALL LH CYLINDER HEAD**
   (See step 1 on page EM-136)

2. **INSTALL NO.2 CAMSHAFT**
   (See step 2 on page EM-137)



3. **INSTALL OIL DIPSTICK GUIDE**
   (a) Install a new O-ring on the oil dipstick.
   (b) Install the oil dipstick guide with bolt.
   (c) Install the oil dipstick.

4. **INSTALL ALTERNATOR**



(RH and LH side)

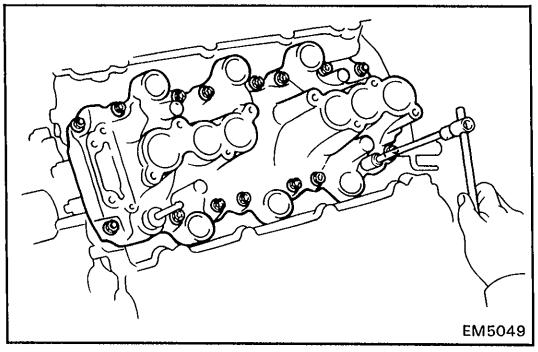
5. INSTALL EXHAUST CROSSOVER PIPE

(a) Position two new gaskets on the exhaust crossover pipe.

(b) Install the exhaust crossover pipe to the RH and LH exhaust manifold with six nuts.

Torque: 400 kg-cm (29 ft-lb, 39 N·m)

6. INSTALL KNOCK SENSOR WIRE

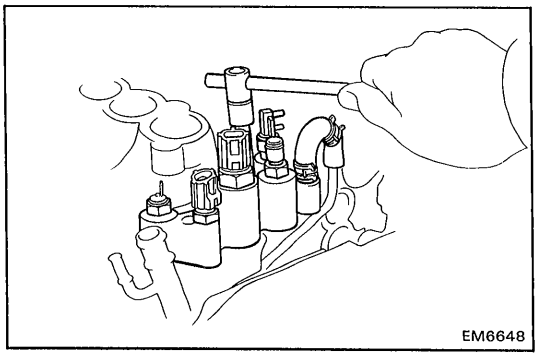


7. INSTALL INTAKE MANIFOLD

(a) Position two new gaskets on the RH and LH cylinder heads.

(b) Install the intake manifold with the twelve bolts and four nuts.

Torque: 185 kg-cm (13 ft-lb, 18 N·m)



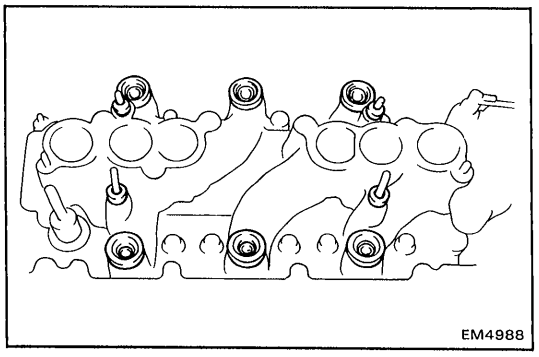
8. INSTALL WATER BY-PASS OUTLET

(a) Position a new gasket on the intake manifold.

(b) Install the water by-pass outlet with the two bolts.

Torque: 185 kg-cm (13 ft-lb, 18 N·m)

(c) Connect the No.3 water by-pass hose to the No.1 water by-pass pipe.

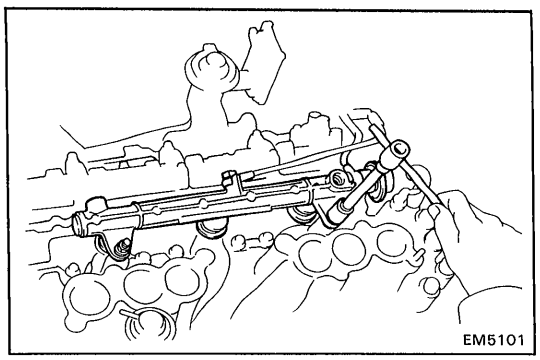


9. INSTALL RH DELIVERY PIPE WITH INJECTORS

(a) Install the three spacers with new O-ring into the intake manifold.

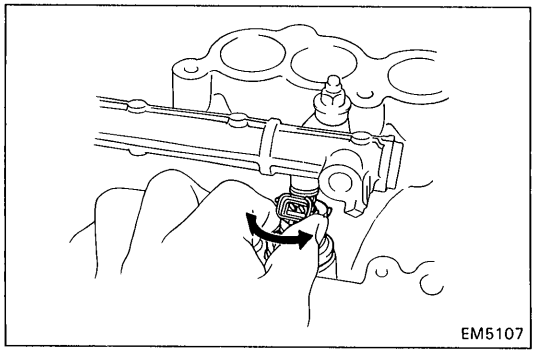
(b) Install the two spacers on the delivery pipe mounting bolts.

(c) Install the injectors into the delivery pipe.
(See step 1 on page FI-182)



(d) Place the injectors with the RH delivery pipe to the intake manifold.

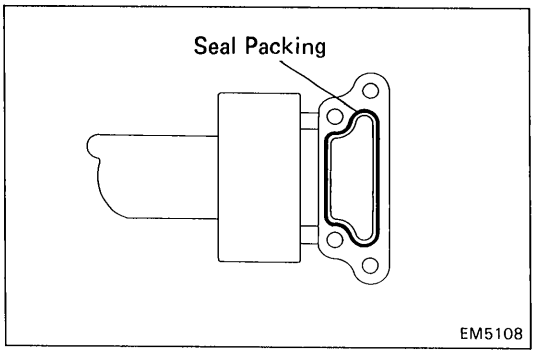
Torque: 130 kg-cm (9 ft-lb, 13 N·m)



(e) Make sure that the injectors rotate smoothly.

(f) Connect the No.1 fuel pipe to the No.3 bearing cap with bolt.

10. INSTALL INJECTORS AND LH DELIVERY PIPE
(See step 9 on page EM-140)



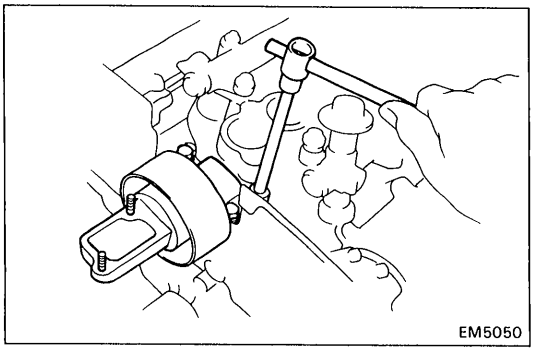
11. INSTALL NO.2 IDLER PULLEY AND NO.3 TIMING BELT COVER

(a) Install the No.3 timing belt cover with the six bolts.

Torque: 85 kg-cm (74 in.-lb, 8.3 N·m)

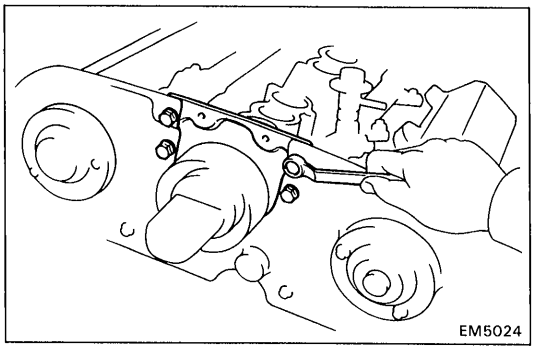
(b) Apply seal packing to No.2 idler pulley as shown in the figure.

Seal packing: Part No. 08826-00100 or equivalent



(c) Install the No.2 idler pulley with the four bolts.

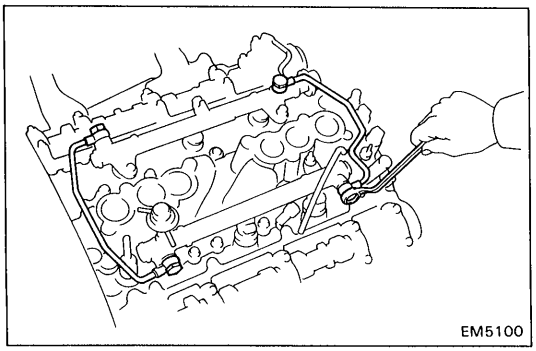
Torque: 185 kg-cm (13 ft-lb, 18 N·m)



12. INSTALL NO.4 TIMING BELT COVER

Install the No.4 timing belt cover with the four bolts.

Torque: 85 kg-cm (74 in.-lb, 8.3 N·m)



13. INSTALL NO.2 AND NO.3 FUEL PIPES

(a) Install the No.2 fuel pipe with new gaskets and two union bolts.

Torque: 300 kg-cm (22 ft-lb, 29 N·m)

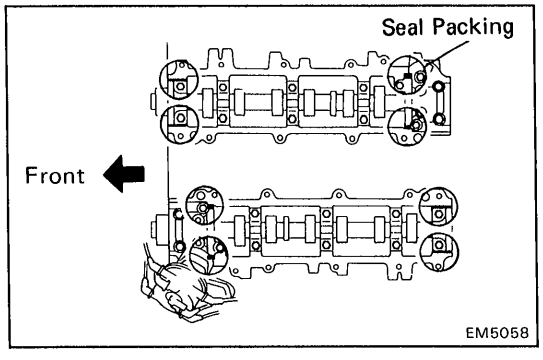
(b) Install the No.3 fuel pipe with new gaskets and two union bolts.

Torque: 300 kg-cm (22 ft-lb, 29 N·m)

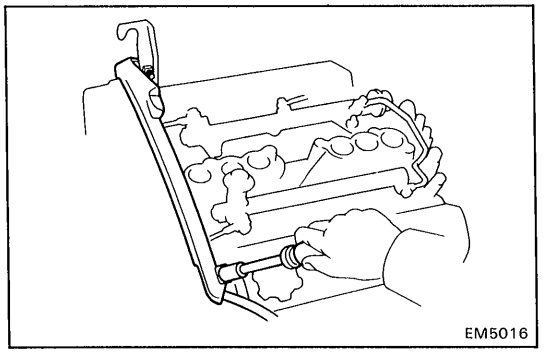
(c) Connect the vacuum hose to the BVSV.

14. **INSTALL TIMING BELT**
(See steps 2 to 6 and 9 to 18 on pages EM-106 to 110)

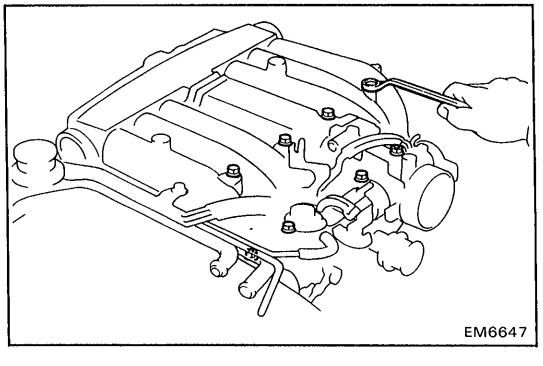
15. **ADJUST VALVE CLEARANCE**
(See step 5 to 6 on pages EM-84 to 86)



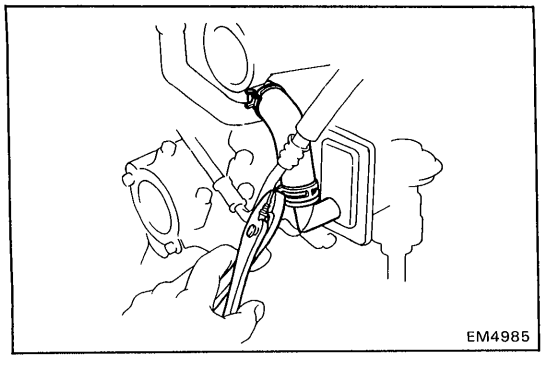
16. **INSTALL CYLINDER HEAD COVER**
(a) Place the head cover gasket on the head cover.
(b) Apply seal packing to the eight locations shown.
Seal packing: Part No. 08826-00080 or equivalent
(c) Place the head cover, bracket on the cylinder head, and install and torque the eleven bolts.



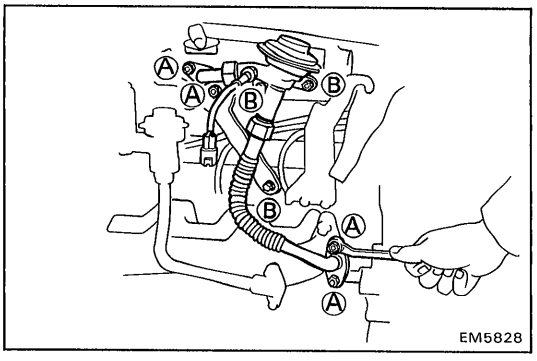
17. **INSTALL ENGINE WIRE**
(a) Install the engine wire with the two bolts.
(b) Connect following connectors:
- Injector connectors
- LH ground strap
- Water temp. sender gauge connector
- Water temp. sensor connector
- Star injector time switch connector
- No.2 water temp. switch connector
- Knock sensor connector



18. **INSTALL AIR INTAKE CHAMBER**
(a) Position a new gasket on the intake manifold.
(b) Install the intake chamber with the six bolts and two nuts.
Torque: 185 kg-cm (13 ft-lb, 18 N·m)



(c) Connect the No.1 air hose to the reed valve.



(d) Position two new gaskets to the intake chamber and RH exhaust manifold.

(e) Install the EGR valve with the pipes to the intake chamber and RH exhaust manifold.

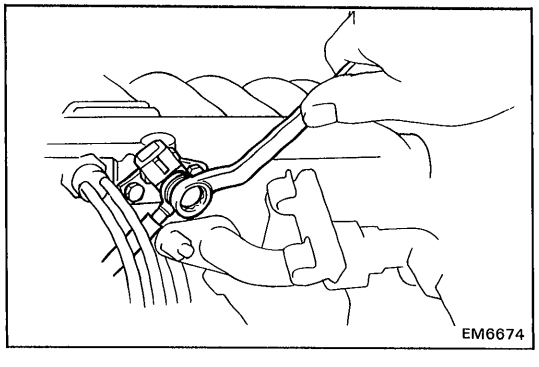
(f) Install the air intake chamber stay.

Install and torque the six nuts and bolt.

Torque: (A) 300 kg-cm (22 ft-lb, 29 N·m)
(B) 185 kg-cm (13 ft-lb, 18 N·m)

(g) Connect the EGR hoses to the air pipe and EGR vacuum modulator.

(h) (California only)
Connect the EGR gas temp. sensor connector.

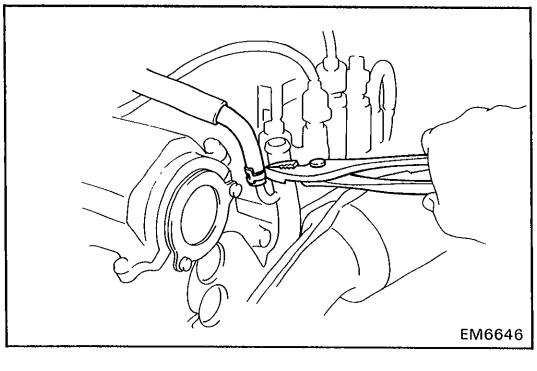


(i) Connect the cold start injector tube with new gasket and union bolt.

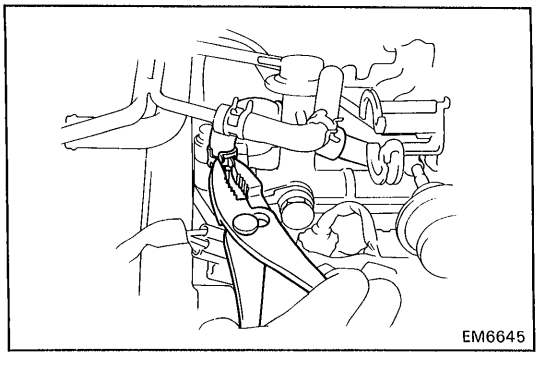
Torque: 180 kg-cm (13 ft-lb, 18 N·m)

(j) Connect the vacuum hose to the gas filter.

(k) Connect the cold start injector connector.



(l) Install the No.5 water by-pass hose to the water by-pass pipe.



(m) Connect the No.4 water by-pass hose to the union of intake manifold.

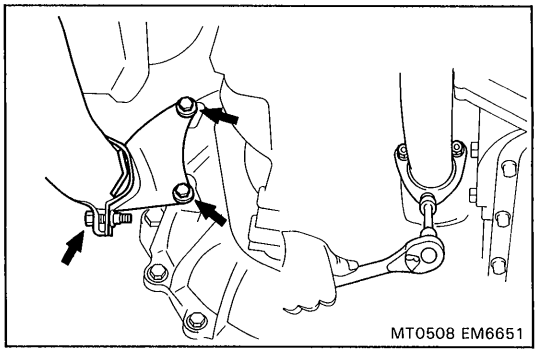
(n) Connect the PCV hose to the union.

(o) Connect the vacuum and fuel hoses to the pressure regulator.

(p) Connect the canister vacuum hose to the throttle body.

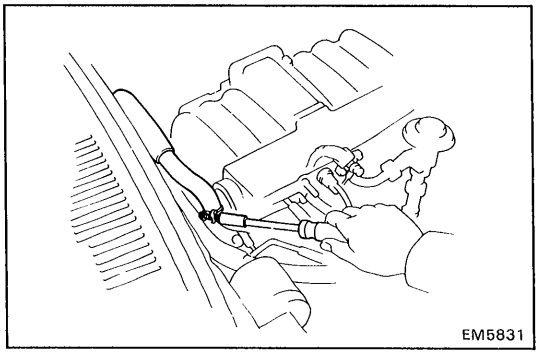
(q) Connect the throttle position sensor connector.

19. INSTALL DISTRIBUTOR AND HIGH-TENSION CORDS
(See step 2 on page IG-19)



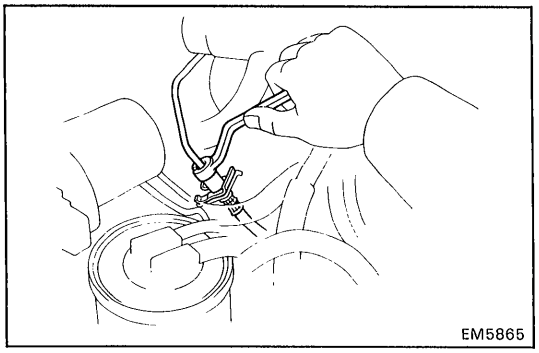
POST INSTALLATION

1. **INSTALL FRONT EXHAUST PIPE**
   (a) Connect the exhaust pipe to the catalytic converter.
   (b) Connect the exhaust pipe to the exhaust manifold.
   (c) Install the exhaust pipe clamp.
   (d) Connect the oxygen sensor connector.

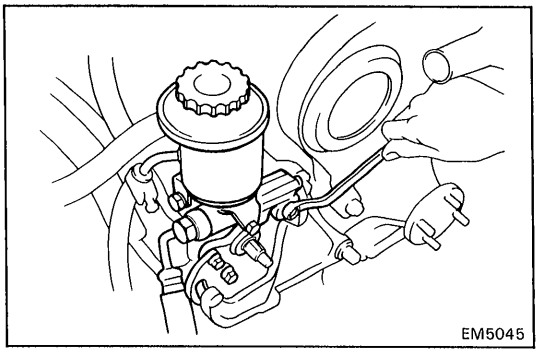


2. **CONNECT FUEL INLET AND OUTLET HOSES**

3. **CONNECT TWO HEATER HOSES**



4. **(M/T)**
   CONNECT CLUTCH RELEASE CYLINDER HOSE



5. **INSTALL PS PUMP WITH HOSES**
   (a) Install the PS pump with four bolts.
   (b) Temporarily install the PS pump pulley, washer and nut.

6. **CONNECT FOLLOWING CABLES:**
   (a) (A/T)
   Throttle cable
   (b) (w/ Cruise control)
   Cruise control cable
   (c) Accelerator cable

7. **CONNECT FOLLOWING HOSES:**
   (a) VSV vacuum hoses
   (b) Charcoal canister hose to canister
   (c) (w/ Cruise control)
   Cruise control vacuum hose
   (d) Brake booster hose
   (e) PS air hoses to gas filter and air pipe

8. **CONNECT FOLLOWING WIRES AND CONNECTORS**
   (a) A/C compressor connector
   (b) Check connector
   (c) Solenoid resister connectors
   (d) (M/T)
   Starter relay connectors
   (e) VSV connectors
   (f) ECU connectors
   (g) Ground strap to engine rear side
   (h) Oil pressure sender gauge connector
   (i) Igniter connector
   (j) Alternator connector and wire
   (k) Ground strap to LH fender apron

9. **INSTALL FAN PULLEY, BELT GUIDE, FLUID COUPLING AND ALTERNATOR DRIVE BELT**
   (See step 12 on page EM-110)

10. **(with A/C)**
    INSTALL A/C BELT
    (See step 2 on page MA-6)

11. **INSTALL PS BELT**
    (a) Place the PS drive belt on to each pulley.
    (b) Stretch the belt tight and tighten the nuts.
    (c) Torque the PS pump pulley lock nut.
    Torque: 440 kg-cm (32 ft-lb, 43 N·m)
    (d) Adjust the belt tenson.
    (See step 2 on page MA-6)

12. **INSTALL RADIATOR**

13. **INSTALL AIR CLEANER CASE WITH HOSE**

14. **FILL WITH COOLANT**
    (See step 3 on page CO-14)

15. **CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY**

16. **START ENGINE**
    Warm up the engine and inspect for leaks.

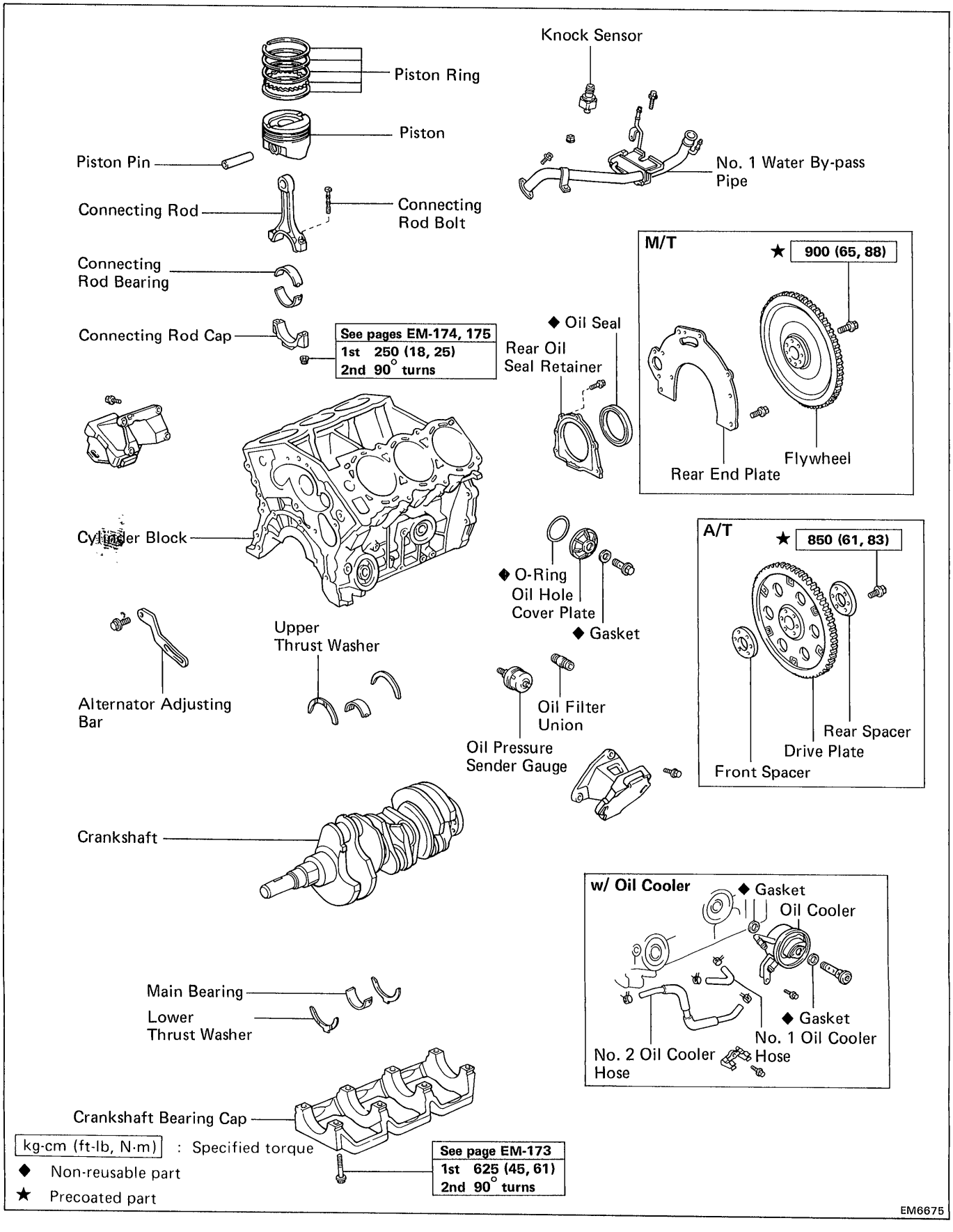
17. **PERFORM ENGINE ADJUSTMENT**
    (See page EM-84)

18. **ROAD TEST**
    Road test vehicle

19. **RECHECK COOLANT AND ENGINE OIL LEVEL**

CYLINDER BLOCK

COMPONENTS



REMOVAL OF ENGINE

1. **REMOVE HOOD**

2. **REMOVE BATTERY**

3. **REMOVE ENGINE UNDER COVER**

4. **DRAIN COOLANT FROM RADIATOR AND CYLINDER BLOCK**
   (See step 3 on page CO-14)

5. **DRAIN ENGINE OIL**
   (See step 1 on page LU-17)

6. **REMOVE AIR CLEANER CASE WITH HOSE**

7. **REMOVE RADIATOR**
   (See page CO-18)

8. **REMOVE PS BELT**
   (a) Stretch the belt tight and loosen the PS pump pulley lock nut.
   (b) Remove the PS belt.

9. **REMOVE A/C BELT**

10. **REMOVE ALTERNATOR DRIVE BELT, FLUID COUPLING AND FAN PULLEY**
    (See step 7 on page EM-101)

11. **DISCONNECT FOLLOWING WIRES AND CONNECTORS:**
    (a) Ground strap from LH fender apron
    (b) Alternator connector and wire
    (c) Igniter connector
    (d) Oil pressure sender gauge connector
    (e) Ground strap from engine rear side
    (f) ECU connectors
    (g) VSV connectors
    (h) (M/T)
    Starter relay connector
    (i) Solenoid resister connector
    (j) Check connector
    (k) A/C compressor connector

12. DISCONNECT FOLLOWING HOSES:

(a) PS air hoses from gas filter and air pipe

(b) Brake booster hose

(c) (w/ Cruise control)
Cruise control vacuum hose

(d) Charcoal canister hose from canister

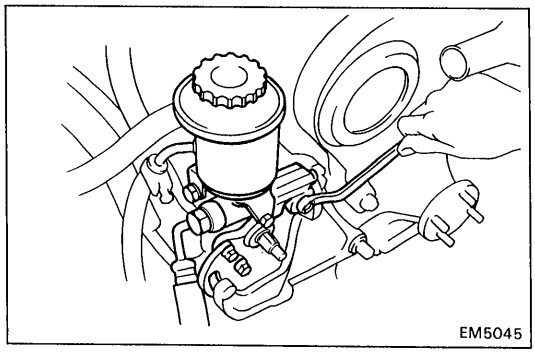
(e) VSV vacuum hoses

13. DISCONNECT FOLLOWING CABLES:

(a) Accelerator cable

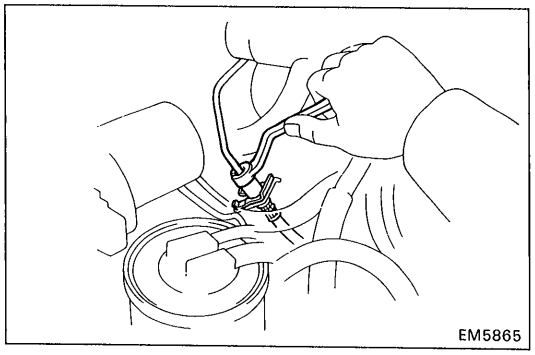
(b) (A/T)
Throttle cable

(c) (w/ Cruise control)
Cruise control cable

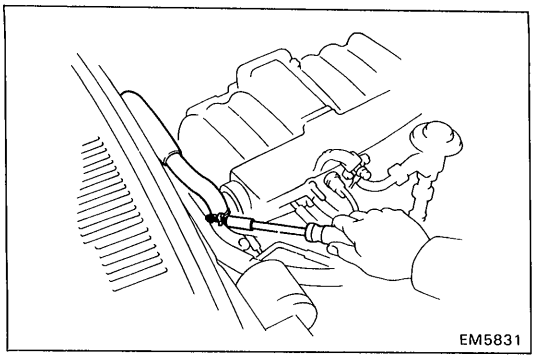


14. REMOVE PS PUMP WITH HOSES
(See step 2 on page EM-100)

15. REMOVE A/C COMPRESSOR



16. (M/T)
DISCONNECT CLUTCH RELEASE CYLINDER HOSE



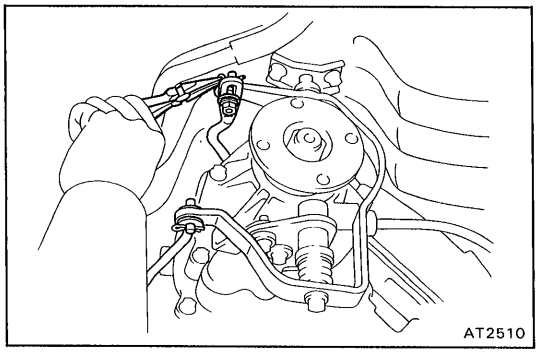
17. DISCONNECT TWO HEATER HOSES

18. DISCONNECT FUEL INLET AND OUTLET HOSES

19. (M/T)
REMOVE SHIFT LEVERS(S) FROM INSIDE OF VEHICLE

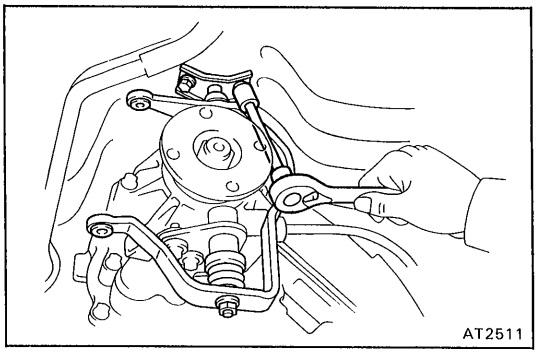
20. REMOVE REAR PROPELLER SHAFT
(See page PR-4) 2WD
(See page PR-5) 4WD

21. (2WD A/T)
DISCONNECT MANUAL SHIFT LINKAGE


AT2510

(4WD A/T)
DISCONNECT TRANSFER SHIFT LINKAGE

(a) Disconnect the No.1 and No.2 transfer shift linkages from the cross shaft.


AT2511

(b) Remove the cross shaft from the body.

22. DISCONNECT SPEEDOMETER CABLE

NOTICE: Do not loose the felt dust protector and washers.

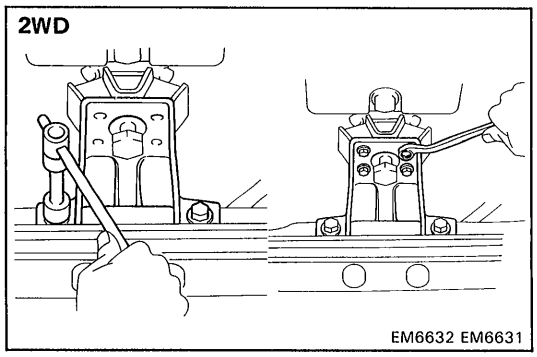
23. (4WD)
REMOVE TRANSFER UNDER COVER

24. REMOVE STABILIZER BAR

25. (4WD)
REMOVE FRONT PROPELLER SHAFT
(See page PR-5)

26. REMOVE FRONT EXHAUST PIPE
(See step 14 on page EM-114)

27. REMOVE NO.1 FRONT FLOOR HEAT INSULATOR AND BRAKE TUBE HEAT INSULATOR (4WD)

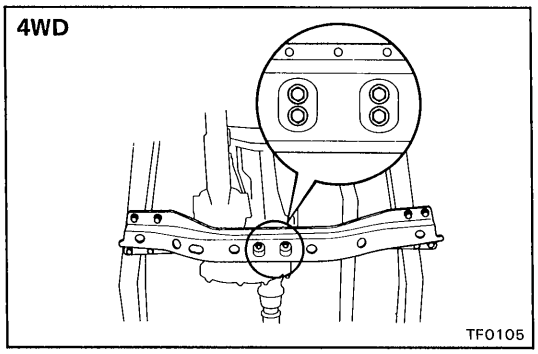


28. (2WD)
REMOVE ENGINE REAR MOUNTING AND BRACKET

(a) Remove the four bolts from the engine rear mounting.

(b) Raise the transmission slightly by raising the engine with a jack.

(c) Remove the four bolts from the support member.



(4WD)
REMOVE NO.2 FRAME CROSS MEMBER FROM SIDE FRAME

(a) Remove the four bolts from the engine rear mounting.

(b) Raise the transmission slightly with a jack.

(c) Remove the four bolts from the side frame and remove the No.2 frame crossmember.

29. REMOVE ENGINE WITH TRANSMISSION

(a) Attach the engine hoist chain to the two engine hangers.

(b) Remove the mounting nuts and bolts.

(c) Lift the engine with transmission out of the vehicle slowly and carefully.

HINT: Make sure the engine is clear of all wiring and hoses.

30. REMOVE TRANSMISSION FROM ENGINE

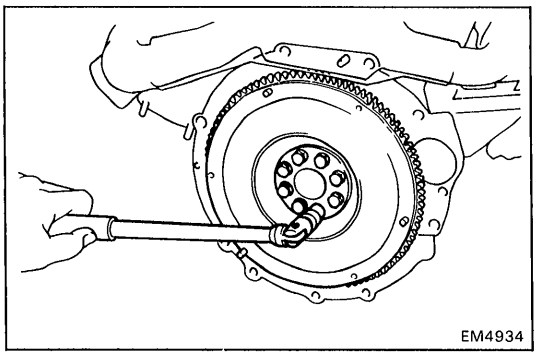
(a) (A/T)
Remove the A/T oil cooler pipes.

(b) Remove the starter.

(c) Remove the two stiffener plates and exhaust pipe bracket from engine.

(d) Remove the transmission from the engine.

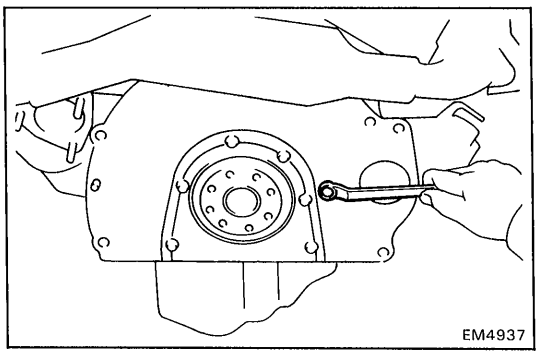
31. (M/T)
REMOVE CLUTCH COVER AND DISC



DISASSEMBLY OF CYLINDER BLOCK

(See page EM-148)

1. REMOVE FLYWHEEL OR DRIVE PLATE

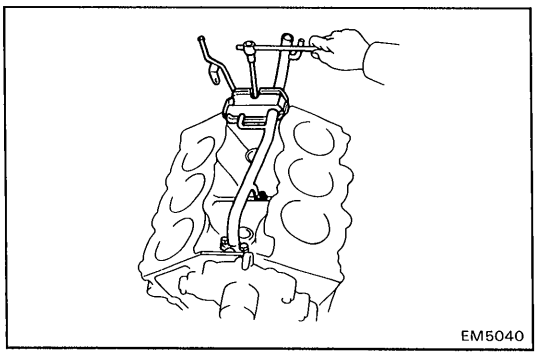


2. REMOVE REAR END PLATE

3. INSTALL ENGINE STAND FOR DISASSEMBLY

4. REMOVE TIMING BELT
(See steps 5, 7, 8, 10 to 16 on pages EM-100 to 103)

5. REMOVE CYLINDER HEAD
(See steps 2 to 18 on pages EM-115 to 121)



6. REMOVE NO.1 WATER BY-PASS PIPE
Remove the two nuts, two bolts and water by-pass pipe.

7. REMOVE ALTERNATOR ADJUSTING BAR

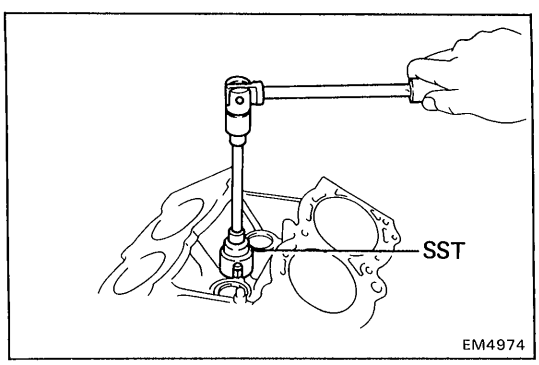
8. REMOVE WATER PUMP
(See steps 3, 4 on page CO-15)

9. REMOVE OIL PRESSURE SENDER GAUGE

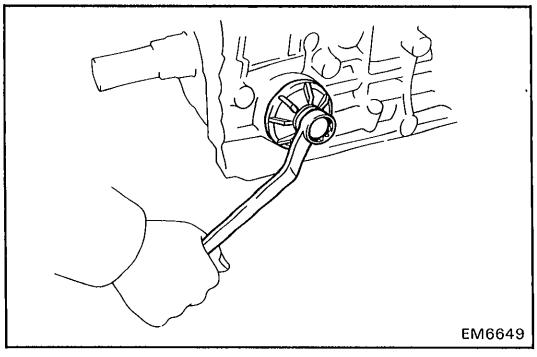
10. REMOVE OIL FILTER
(See step 2 on page LU-17)

11. REMOVE RH AND LH ENGINE MOUNTINGS

12. REMOVE COOLANT DRAIN PLUGS

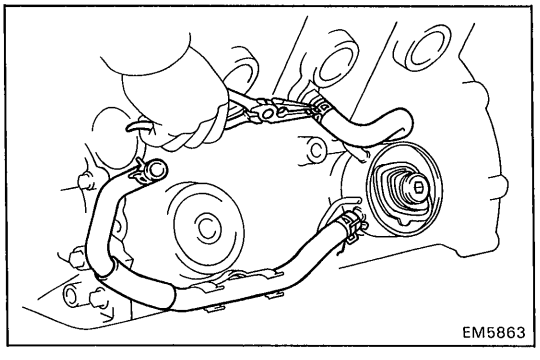


13. REMOVE KNOCK SENSOR
Using SST, remove the knock sensor.
SST 09817-16011



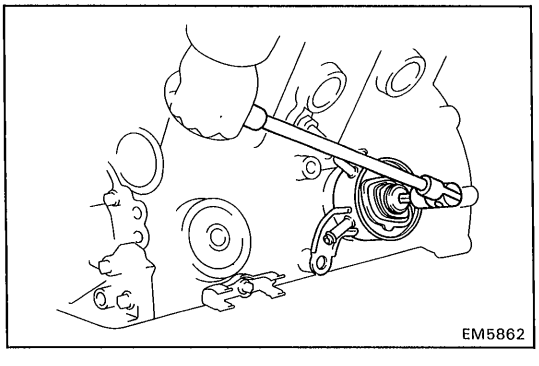
14. (w/o OIL COOLER)
REMOVE OIL HOLE COVER PLATE

Remove the union bolt, gasket, plate and O-ring.

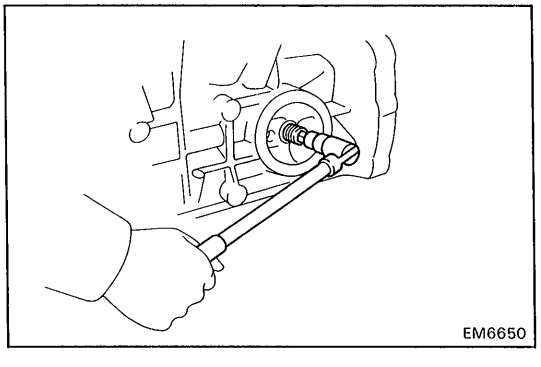


15. (w/ OIL COOLER)
REMOVE OIL COOLER

(a) Remove the No.1 and No.2 oil cooler hoses.



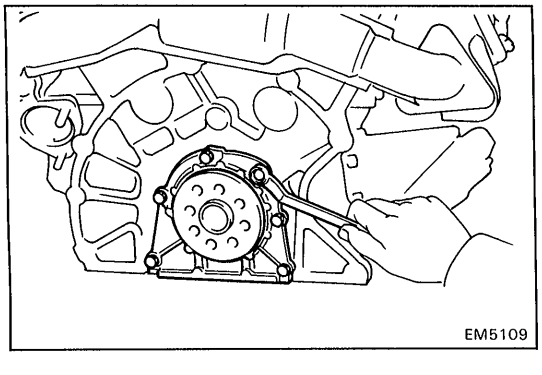
(b) Remove the bolt, relief valve and oil cooler.



16. REMOVE OIL FILTER UNION

Using hexagon wrench, remove the oil filter union.

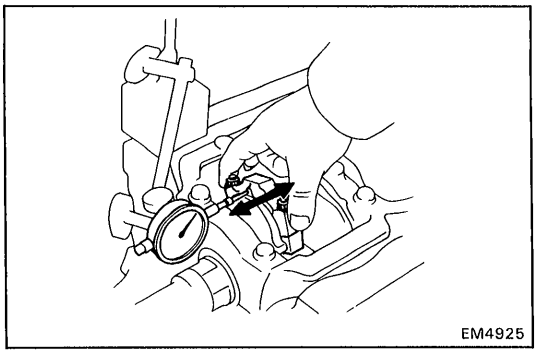
17. REMOVE OIL PAN, OIL STRAINER AND BUFFLE PLATE
(See steps 6 to 8 on pages LU-19 to 20)



18. REMOVE REAR OIL SEAL RETAINER

Remove the five bolts and rear oil seal retainer.

19. REMOVE OIL PUMP
(See step 9 on page LU-20)


EM4925

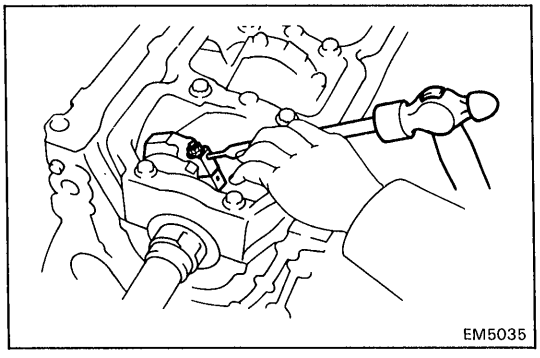
20. MEASURE CONNECTING ROD THRUST CLEARANCE

Using a dial gauge, measure the thrust clearance.

Standard clearance: **0.15 — 0.33 mm (0.0059 — 0.0130 in.)**

Maximum clearance: **0.38 mm (0.0150 in.)**

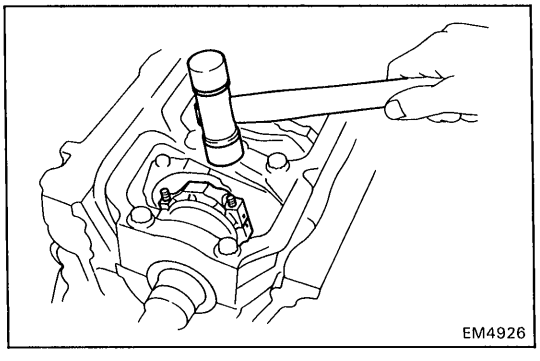
If clearance is greater than maximum, replace the connecting rod and/or crankshaft.


EM5035

21. MEASURE CONNECTING ROD OIL CLEARANCE

(a) Using a punch or numbering stamp, mark connecting rods and caps to ensure correct reassembly.

(b) Using a 12-sided socket wrench, remove the rod cap nuts.


EM4926

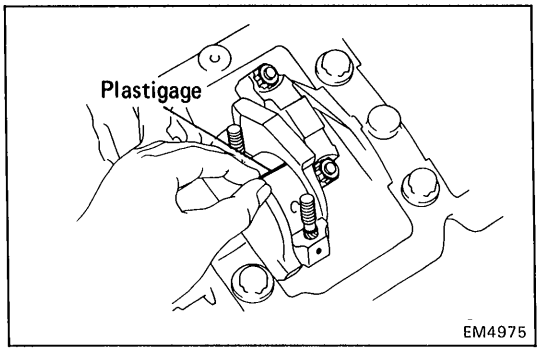
(c) Using a plastic-faced hammer, tap the rod bolts lightly and lift off the rod cap.

HINT: Keep the bearing inserted with the cap.

(d) Clean the bearings and crankshaft pins.

(e) Inspect each bearing for pitting and radial scratches.

If bearings are damaged, replace the bearings.



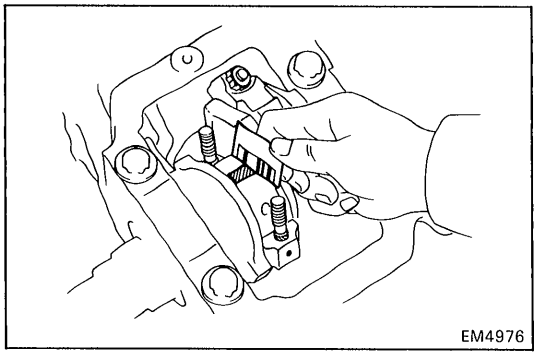
EM4975

(f) Lay a strip of Plastigage across the crankshaft pin.

(g) Align the rod and cap marks and fit on the cap. Install and torque the cap nuts.
(See step 8 on pages EM-174, 175)

HINT:

- Do not turn the crankshaft.
- Apply a light coating of engine oil on the nut threads and under the nut before installation.


EM4976

(h) Remove the rod cap.

(i) Measure the Plastigage at its widest point.

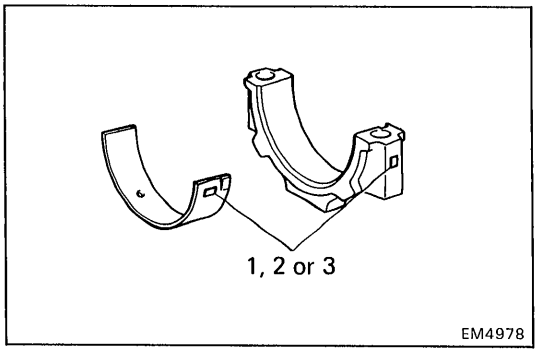
Standard clearance: **0.024 — 0.053 mm (0.0009 — 0.0021 in.)**

Maximum clearance: **0.08 mm (0.0031 in.)**

If the clearance is greater than maximum, replace the bearings and/or grind the crank pins.

Undersized bearing: **U/S 0.25, 0.50**

(j) Clean any Plastigage from bearing and crankshaft pin.

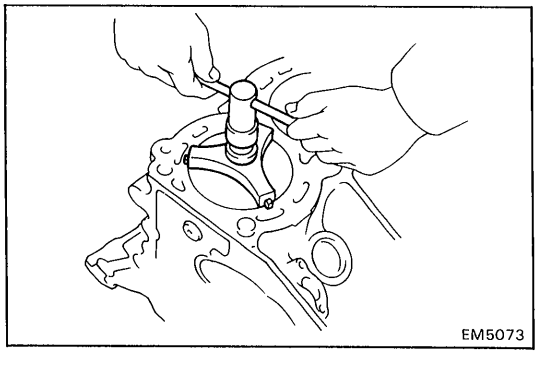


EM4978

HINT: If replacing a standard size bearing, replace with one having the same number as marked on the bearing cap. There are three sized of standard bearings supplied, marked 1, 2 or 3 respectively.

mm (in.)

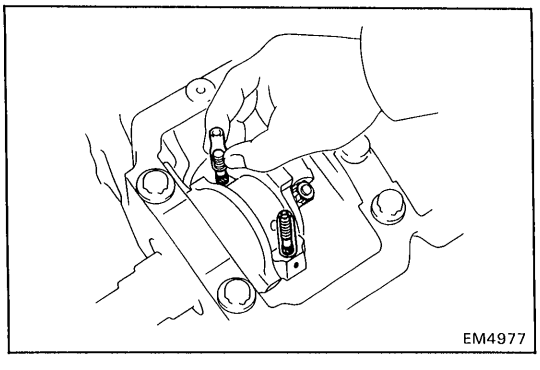
Size	Big End Inner Diameter	Crank Pin Diameter	Bearing Center Wall Thickness
1	58.000 — 58.008 (2.2835 — 2.2838)	54.987 — 55.000 (2.1648 — 2.1654)	1.484 — 1.488 (0.0584 — 0.0586)
2	58.009 — 58.016 (2.2838 — 2.2841)		1.489 — 1.492 (0.0586 — 0.0587)
3	58.017 — 58.024 (2.2843 — 2.2844)		1.493 — 1.496 (0.0588 — 0.0589)
U/S 0.25	58.000 — 58.024 (2.2835 — 2.2844)	54.745 — 54.755 (2.1553 — 2.1557)	1.605 — 1.611 (0.0632 — 0.0634)
U/S 0.50		54.495 — 54.505 (2.1455 — 2.1459)	1.730 — 1.736 (0.0681 — 0.0683)


EM5073

22. PUSH OUT PISTON AND CONNECTING ROD ASSEMBLY

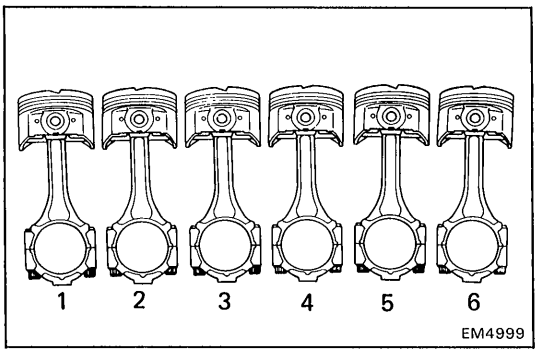
(a) Remove all the carbon from top of the cylinder.

HINT: Turn the cylinder on the piston removal side at right angles.

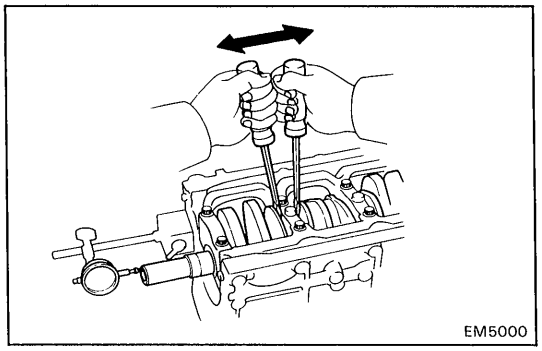

EM4977

(b) Cover the rod bolts with a short piece of hose to protect the crank pin from damage.

(c) Push the piston and connecting rod assembly out through the top of the cylinder block.



(d) Arrange the piston and connecting rod caps in order.



23. MEASURE CRANKSHAFT THRUST CLEARANCE

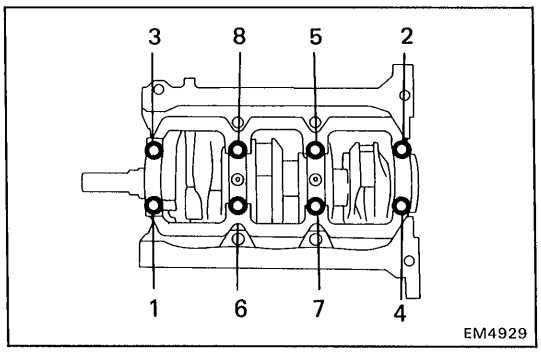
Using a dial gauge, measure the crankshaft thrust clearance while prying the crankshaft back and forth with a screwdriver.

Standard clearance: **0.02 — 0.22 mm (0.0008 — 0.0098 in.)**

Maximum clearance: **0.30 mm (0.0118 in.)**

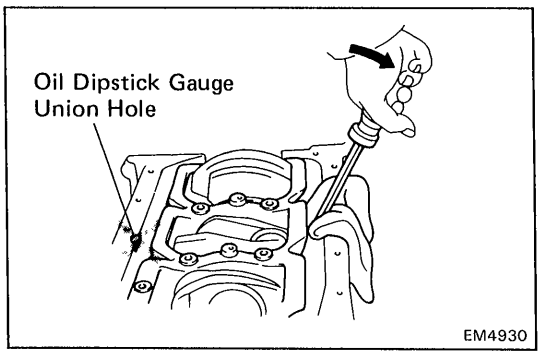
If the clearance is greater than maximum, replace the thrust washers as a set and/or crankshaft.

Thrust washer thickness: **2.44 — 2.49 mm (0.0961 — 0.0980 in.)**



24. MEASURE CRANKSHAFT OIL CLEARANCE

(a) Using a 12-sided socket wrench, gradually loosen and remove the bearing cap bolts in three passes and in the numerical order shown.



(b) Using a screwdriver, pry off the bearing cap, and remove it with the lower bearing and thrust washers (No.2 journal only).

NOTICE: To prevent damage, do not touch the oil dipstick gauge union hole with the screwdriver.

HINT:

- Keep the lower bearing inserted with the cap.
- Arrange the lower thrust washers in correct order.

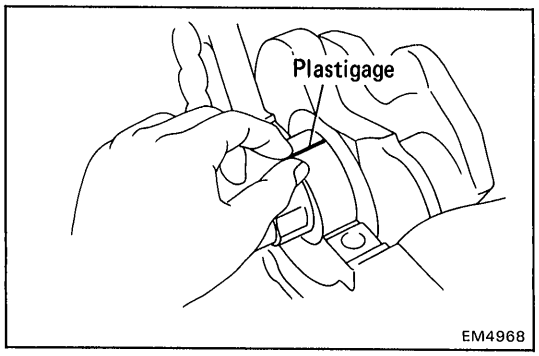
(c) Lift off the crankshaft.

HINT: Keep the upper bearings and upper thrust washers (for the No.2 journal only) inserted in the cylinder block.

(d) Clean the journals and bearings.

(e) Check the journals and bearings for pitting and scratches.

If the journal or bearing is damaged, grind or replace the crankshaft and replace the bearing.



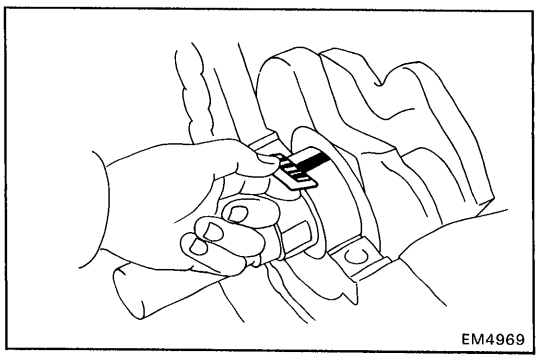
(f) Install the upper main bearing on the cylinder block and crankshaft.

(g) Lay a strip of Plastigage across the main journals.

(h) Install the main bearing cap with the front mark facing forward.

Install and torque the cap bolts.
(See step 5 on page EM-173)

HINT:
- Do not turn crankshaft.
- Apply a light coating of engine oil on the bolt threads before installation.



(i) Remove the main bearing cap.
(See procedure (a) and (b) above)

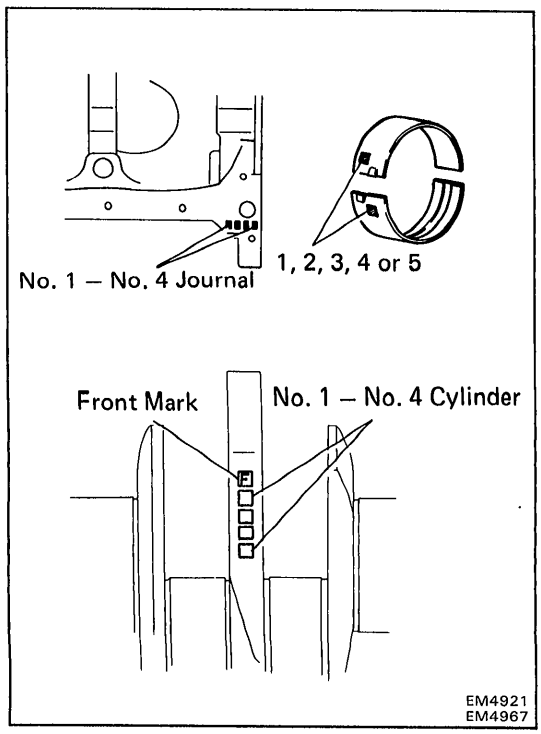
(j) Measure the Plastigage at its widest point.

Standard clearance: **0.024 — 0.042 mm (0.0009 — 0.0017 in.)**

Maximum clearance: **0.08 mm (0.0031 in.)**

Undersized bearing: **U/S 0.25, 0.50**

If the clearance is greater than the maximum, replace the bearings and/or grind the main journals.



HINT: If replacing a standard size bearing with a standard oil clearance, replace with one having the same number. If the number of the bearing cannot be determined, select a bearing from the table below according to the numbers imprinted on the cylinder block and crankshaft.

Cylinder Block No.	1	2	1	3	2	1	3	2	3
Crankshaft No.	0	0	1	0	1	2	1	2	2
Bearing No.	1	2	2	3	3	3	4	4	5

Example: Cylinder Block No. 2, Crankshaft No. 1 = Bearing No. 3

mm (in.)

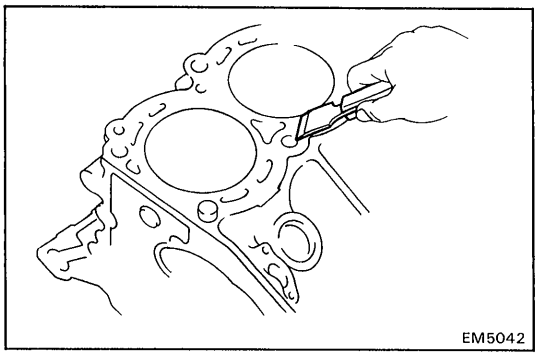
Size	Cylinder Block Main Journal Bore	Main Journal Diameter	Bearing Center Wall Thickness
0	–	63.996 – 64.000 (2.5195 – 2.5197)	–
1	68.010 – 68.016 (2.6776 – 2.6778)	63.990 – 63.995 (2.5193 – 2.5195)	1.989 – 1.992 (0.0783 – 0.0784)
2	68.017 – 68.022 (2.6778 – 2.6780)	63.985 – 63.989 (2.5191 – 2.5192)	1.993 – 1.995 (0.0785 – 0.0785)
3	68.023 – 68.028 (2.6781 – 2.6783)	–	1.996 – 1.998 (0.0786 – 0.0787)
4	–	–	1.999 – 2.001 (0.0787 – 0.0788)
5	–	–	2.002 – 2.004 (0.0788 – 0.0789)
U/S 0.25	68.010 – 68.028 (2.6776 – 2.6783)	63.745 – 63.755 (2.5096 – 2.5100)	2.110 – 2.116 (0.0831 – 0.0833)
U/S 0.50		63.495 – 63.505 (2.4998 – 2.5002)	2.235 – 2.241 (0.0880 – 0.0882)

25. REMOVE CRANKSHAFT

(a) Lift out the crankshaft.

(b) Remove the upper main bearings from the cylinder block.

(c) Clean out the scraps of plastigage from bearing and journals.



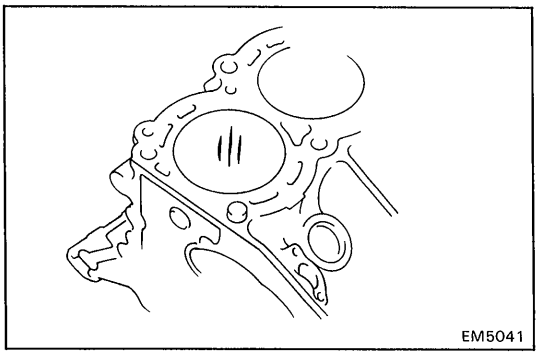
INSPECTION OF CYLINDER BLOCK

1. REMOVE GASKET MATERIAL

Using a gasket scraper, remove all gasket material from the cylinder block surfaces.

2. CLEAN CYLINDER BLOCK

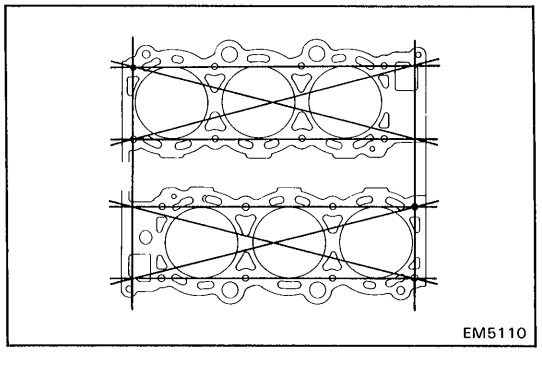
Using a soft brush and solvent, clean the block.



3. INSPECT CYLINDERS

Visually inspect cylinder for vertical scratches.

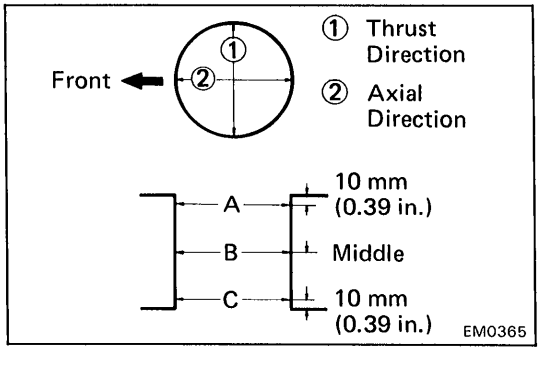
If deep scratches are present, rebore the cylinder.
(See page EM-169)



4. INSPECT CYLINDER BLOCK WARPAGE

Warpage limit: 0.05 mm (0.0020 in.)

If warpage is greater than specified value, replace the cylinder block.



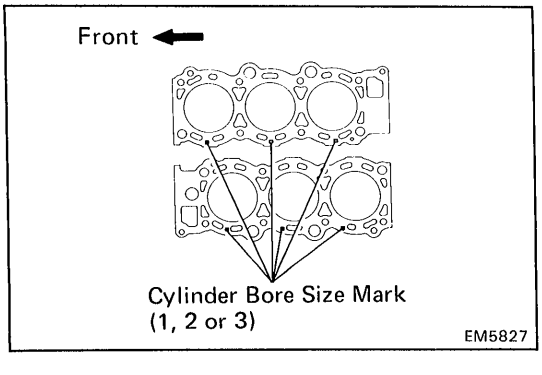
5. INSPECT CYLINDER BORE DIAMETER

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

HINT: There are three sizes of the standard cylinder bore diameter, marked "1", "2", and "3", accordingly. The marked is stamped on the cylinder block.

Standard diameter:

STD	
Mark "1"	**87.500 — 87.510 mm (3.4449 — 3.4453 in.)**
Mark "2"	**87.511 — 87.520 mm (3.4453 — 3.4457 in.)**
Mark "3"	**87.521 — 87.530 mm (3.4457 — 3.4461 in.)**
O/S 0.50	**88.000 — 88.030 mm (3.4646 — 3.4657 in.)**



Maximum diameter:

STD	**87.73 mm (3.4539 in.)**
O/S 0.50	**88.21 mm (3.4728 in.)**

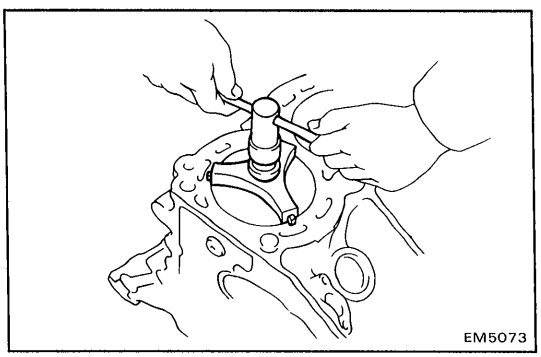
If the diameter is greater than maximum, rebore all six cylinders, or replace the cylinder block.

(a) If difference between A, B and C measurements is greater than taper limit, rebore the cylinder.
(See page EM-169)

Taper limit: 0.02 mm (0.0008 in.)

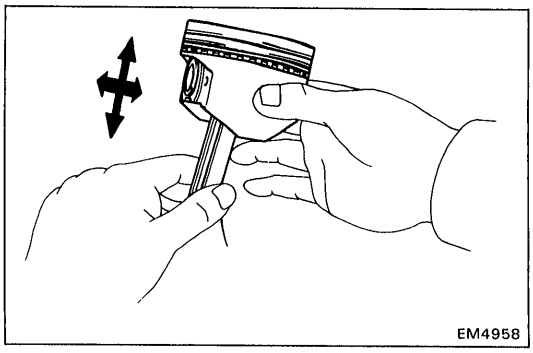
(b) If difference between thrust and axial measurements is greater than out-of-round limit, rebore the cylinder.
(See page EM-169)

Out-of-round limit: 0.02 mm (0.0008 in.)



6. REMOVE CYLINDER RIDGE

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

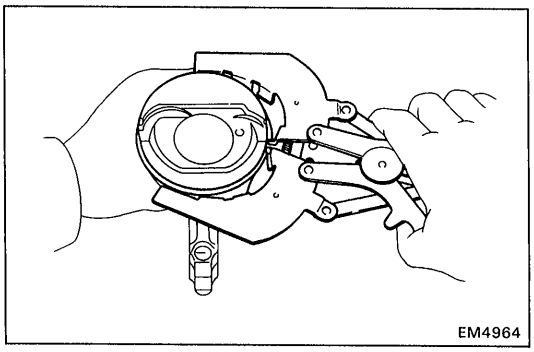


DISASSEMBLY OF PISTON AND CONNECTING ROD ASSEMBLY

1. CHECK FIT BETWEEN PISTON AND PIN

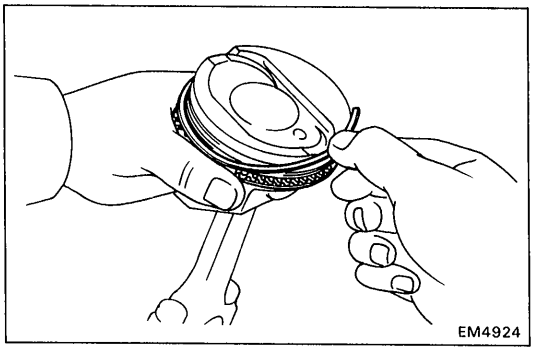
Try to move the piston back and forth on the piston pin.

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



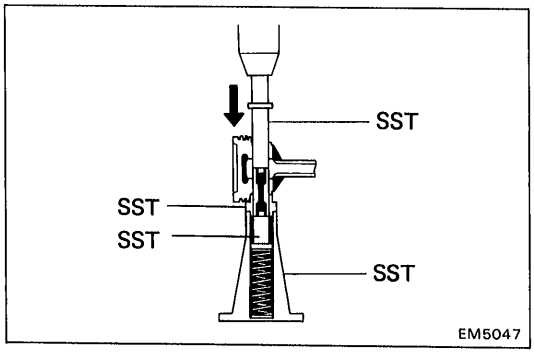
2. REMOVE PISTON RINGS

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



(b) Remove the two side rails and oil ring expander by hand.

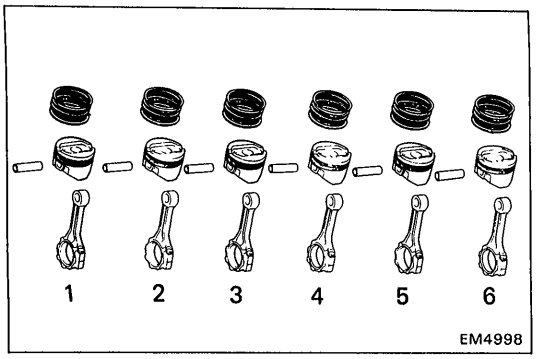
HINT: Keep the rings for each cylinder separated.



3. DISCONNECT CONNECTING ROD FROM PISTON

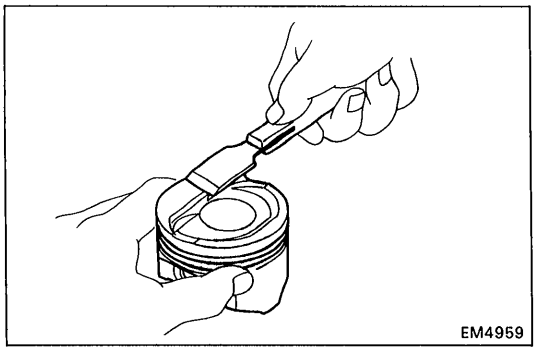
Using SST, press out the pin from the piston.

SST 09221-25024 (09221-00020, 09221-00030, 09221-00181, 09221-00190, 09221-00200)



HINT:

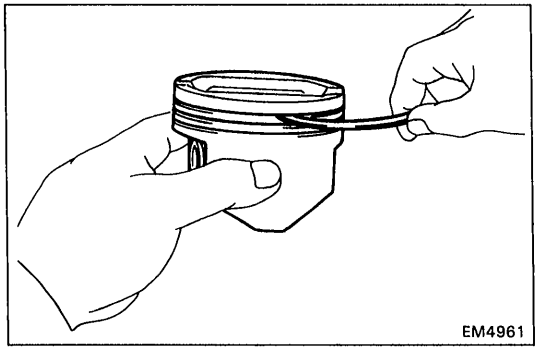
- The piston and pin are a matched set.
- Keep the piston, pin and rings and connecting rod together for each cylinder.



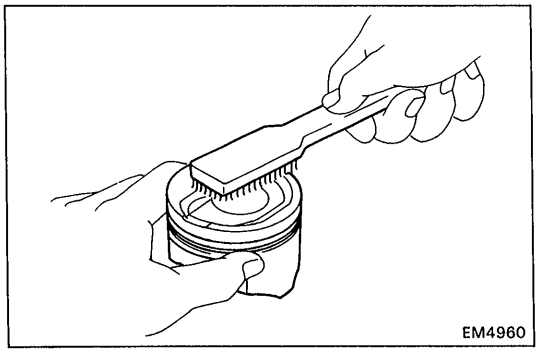
INSPECTION OF PISTON AND CONNECTING ROD ASSEMBLY

1. CLEAN PISTON

(a) Using a gasket scraper, remove the carbon from the piston top.



(b) Using a groove cleaning tool or broken ring, clean the ring grooves.



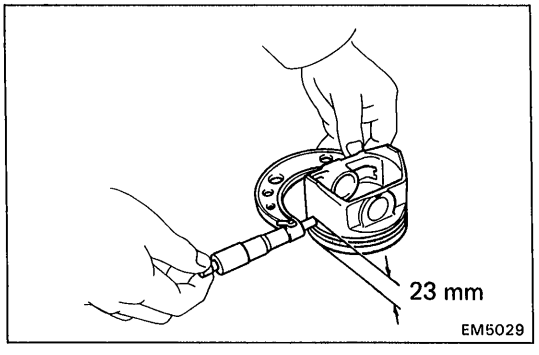
(c) Using solvent and brush, thoroughly clean the piston thoroughly.

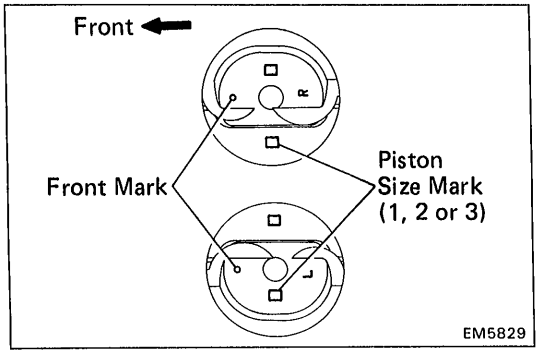
NOTICE: Do not use a wire brush.

2. INSPECT PISTON DIAMETER AND OIL CLEARANCE

(a) Using a micrometer and with the piston upside down, measure the piston diameter at a right angles to the piston pin hole center line, the indicated distance from the piston head.

Distance: 23 mm (0.91 in.)



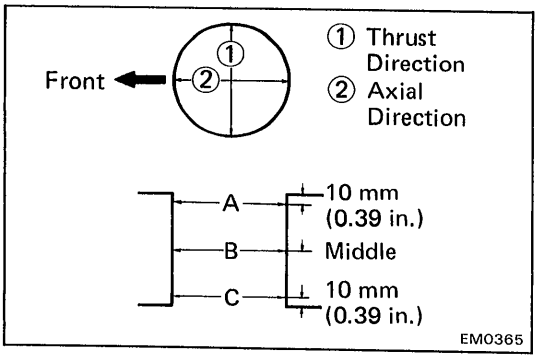


HINT: There are three sizes of the standard piston diameter, marked "1", "2", and "3", accordingly. The marked is stamped on the top of the piston.

Piston diameter:

STD

Mark "1"	**87.410 – 87.420 mm (3.4413 – 3.4417 in.)**
Mark "2"	**87.421 – 87.430 mm (3.4418 – 3.4421 in.)**
Mark "3"	**87.431 – 87.440 mm (3.4422 – 3.4425 in.)**
O/S 0.50	**87.910 – 87.940 mm (3.4610 – 3.4622 in.)**

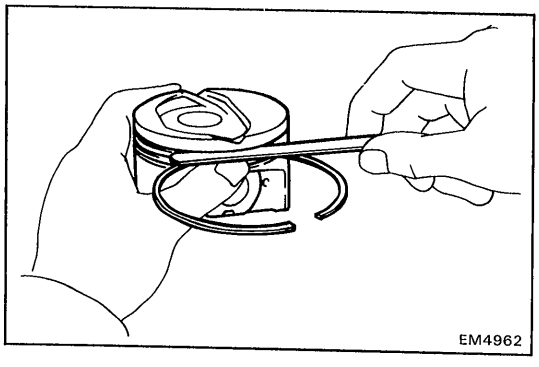


(b) Measure the cylinder bore diameter in thrust directions (See page EM-160) and subtract the piston diameter measurement from the cylinder bore diameter measurement.

Piston oil clearance: 0.08 – 0.10 mm (0.0031 – 0.0039 in.)

If not within specification, replace the pistons.
If necessary, rebore or replace the cylinder block.

HINT: (Use cylinder block sub-assembly)
When installing a standard piston, install one with the same mark as the standard bore diameter mark on the cylinder block.



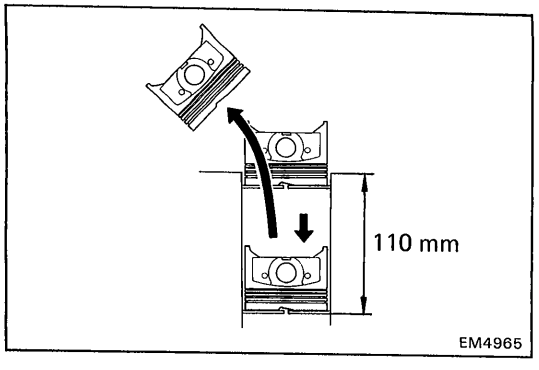
3. MEASURE CLEARANCE BETWEEN PISTON GROOVE AND PISTON RING

Using a thickness gauge, measure the clearance between the piston ring and the ring land.

Standard ring groove clearance: 0.03 – 0.07 mm (0.0012 – 0.0028 in.)

Maximum ring groove clearance: 0.2 mm (0.008 in.)

If the clearance is greater than maximum, replace the piston ring and/or piston.

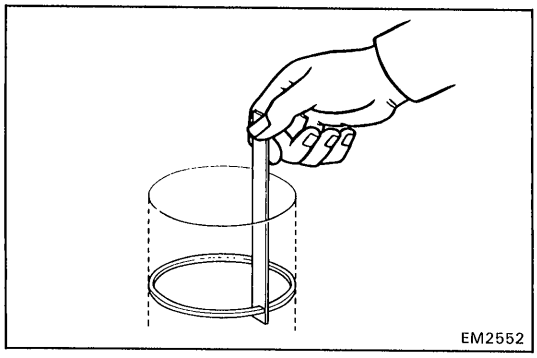


4. MEASURE PISTON RING END GAP

(a) Insert the compression ring into the cylinder.

(b) Using a piston, push the ring a little beyond the bottom of the ring travel.

(110 mm (4.33 in.) from top surface of cylinder block)

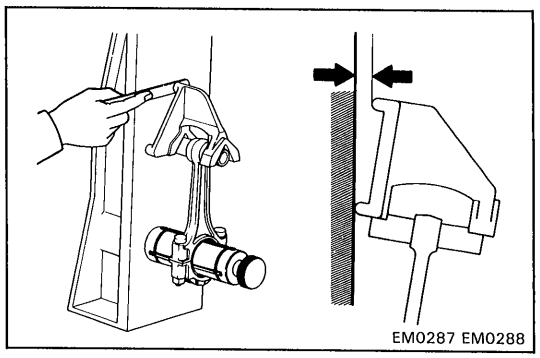

EM2552

(c) Using a thickness gauge, measure the end gap.

Ring end gap:

No. 1	**STD**	**0.23 — 0.33 mm (0.0091 — 0.0130 in.)**
	Maximum	**0.83 mm (0.0327 in.)**
No. 2	**STD**	**0.38 — 0.48 mm (0.0150 — 0.0189 in.)**
	Maximum	**0.93 mm (0.0366 in.)**
Oil	**STD**	**0.15 — 0.40 mm (0.0059 — 0.0157 in.)**
	Maximum	**0.90 mm (0.0354 in.)**

If the gap is greater than maximum, replace the ring. Do not file the ring end.


EM0287 EM0288

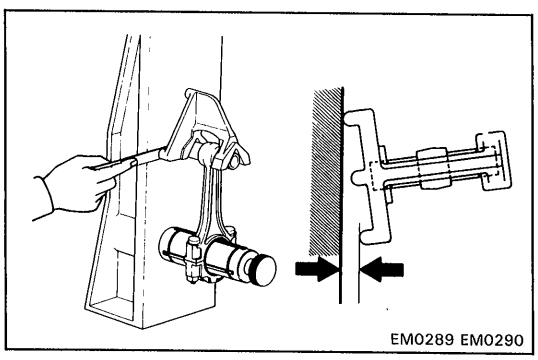
5. INSPECT CONNECTING RODS

(a) Using a rod aligner, check the connecting rod alignment.

If the rod is bent or twisted, replace the connecting rod.

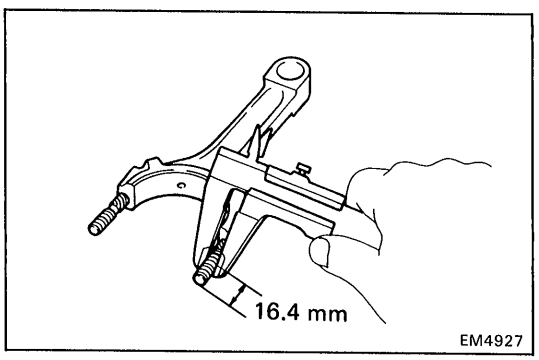
- Check that the rod is not bent.

Maximum bend:
0.05 mm (0.0020 in.) per 100 mm (3.94 in.)


EM0289 EM0290

- Check that the rod is not twisted.

Maximum twist:
0.15 mm (0.0059 in.) per 100 mm (3.94 in.)



EM4927

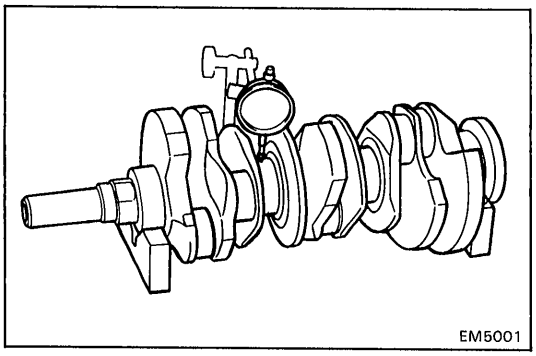
(b) Inspect connecting rod bolts.

- Fix a nut to each of the connecting rod bolts threads and check that the nut can be turned by hand to the end of the threads.
- If a nut cannot be moved all the way down the threads, measure the compressed thread outer diameter with a measuring gauge.
- If the location of this area cannot be judged by visual inspection, use the dimension locations in the illustration and measure the outer diameter.

Standard diameter: 7.860 — 8.000 mm (0.3094 — 0.3150 in.)

Minimum diameter: 7.60 mm (0.2992 in.)

If the outer diameter is less than minimum, replace the connecting rod bolt and cap nut as a set.


EM5001

INSPECTION AND REPAIR OF CRANKSHAFT

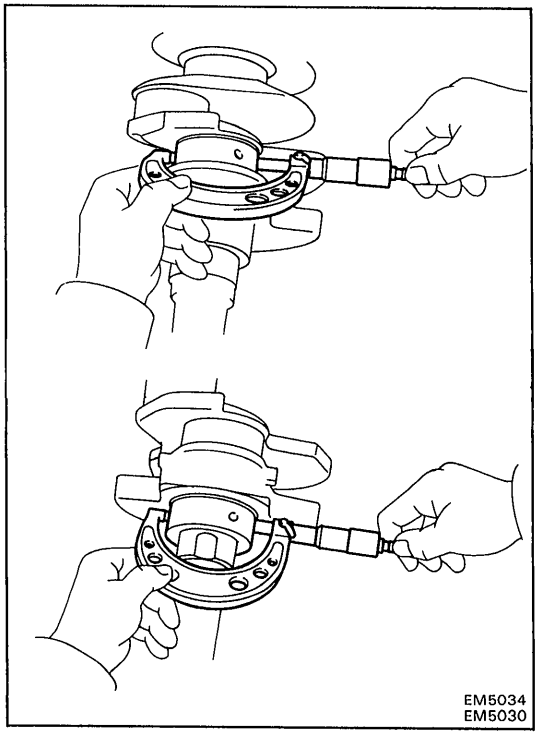
1. MEASURE CRANKSHAFT

(a) Place the crankshaft on V-blocks.

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

Maximum circle runout: 0.06 mm (0.0024 in.)

If the runout is greater than maximum, replace the crankshaft.


EM5034
EM5030

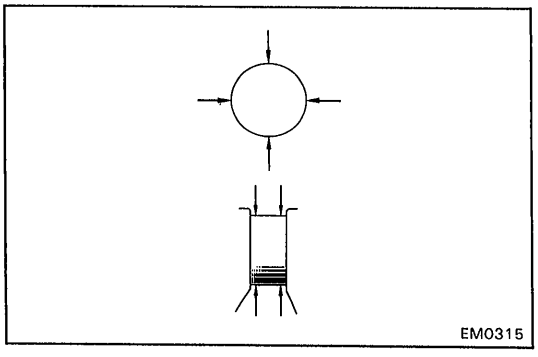
2. INSPECT MAIN JOURNAL AND CRANK PINS

(a) Using a micrometer, measure the diameter of the main and crank pin journal.

Measure journal diameter: 63.985 — 64.000 mm (2.5190 — 2.5197 in.)

Crank pin diameter: 54.987 — 55.000 mm (2.1648 — 2.1654 in.)

If journals are worn, regrind or replace the crankshaft.


EM0315

(b) Measure the journals for out-of-round and taper as shown.

Maximum taper: 0.02 mm (0.0008 in.)

Maximum out-of-round: 0.02 mm (0.0008 in.)

If taper and out-of-round are greater than maximum, regrind and/or replace the crankshaft.

3. GRIND CRANK PIN AND/OR MAIN JOURNAL, IF NECESSARY

(a) Grind the crank pins and/or main journals to the undersized finished diameter.

Bearing size (U/S 0.25, 0.50)

Main journal finished diameter:

U/S 0.25 63.745 — 63.755 mm (2.5096 — 2.5100 in.)

U/S 0.50 63.495 — 63.505 mm (2.4998 — 2.5002 in.)

Crank pin finished diameter:

U/S 0.25 54.745 — 54.755 mm (2.1553 — 2.1557 in.)

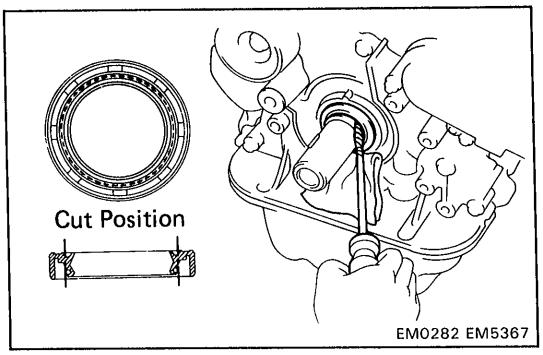
U/S 0.50 54.495 — 54.505 mm (2.1455 — 2.1459 in.)

(b) Install a new pin and/or main undersize bearings.

REPLACEMENT OF OIL SEALS

HINT: There are two ways of oil seal replacement in accordance with the oil pump body or rear oil seal retainer condition.

1. **IF TIMING OIL PUMP BODY IS REMOVED FROM CYLINDER BLOCK (Replacement of front oil seal)**
(See page LU-22)

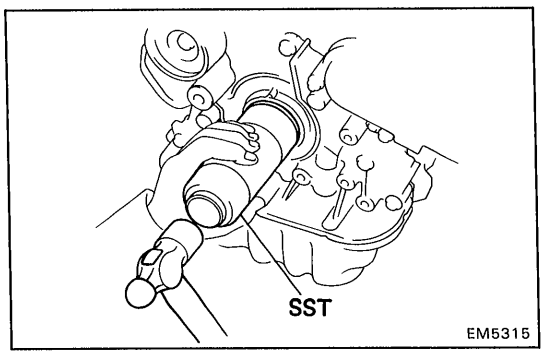


2. **IF OIL PUMP BODY IS INSTALLED ON CYLINDER BLOCK (Replacement of front oil seal)**

(a) Using a knife, cut off the oil seal lip.

(b) Using a screwdriver, pry out the oil seal.

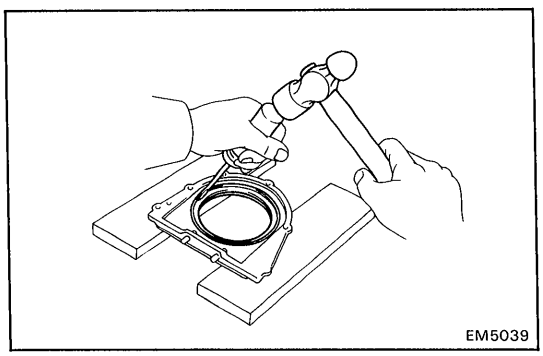
NOTICE: Be careful not to damage the crankshaft. Tape the screwdriver tip.



(c) Apply MP grease to a new oil seal lip.

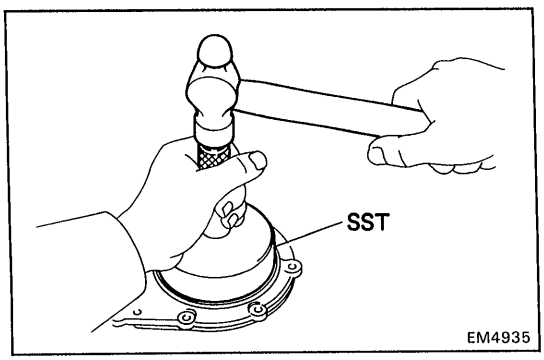
(d) Using SST and a hammer, tap in the oil seal until its surface is flush with the oil pump case edge.

SST 09309-37010



3. **IF REAR OIL SEAL RETAINER IS REMOVED FROM CYLINDER BLOCK (Replacement of rear oil seal)**

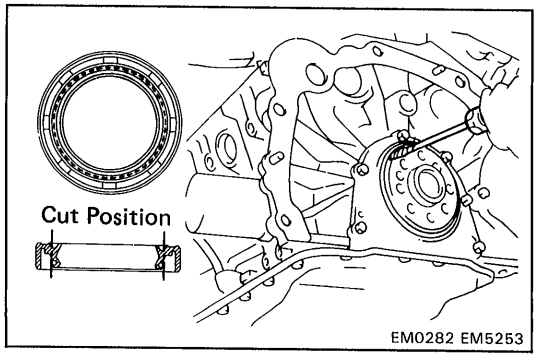
(a) Using a screwdriver, remove the oil seal.



(b) Apply MP grease to a new oil seal lip.

(c) Using SST, install the oil seal.

SST 09223-41020

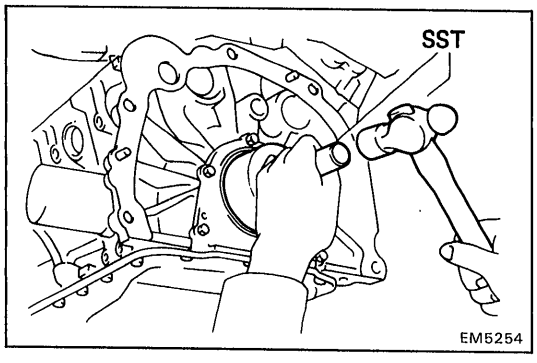


4. **IF REAR OIL SEAL RETAINER IS INSTALLED ON CYLINDER BLOCK (Replacement of rear oil seal)**

(a) Using a knife, cut off the oil seal lip.

(b) Using a screwdriver, pry out the oil seal.

NOTICE: Be careful not to damage the crankshaft. Tape the screwdriver tip.



(c) Apply MP grease to a new oil seal lip.

(d) Using SST and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.

SST 09223-56010

Size	Outside diameter mm (in.)
O/S 0.50	87.910 — 87.940 (3.4610 — 3.4622)

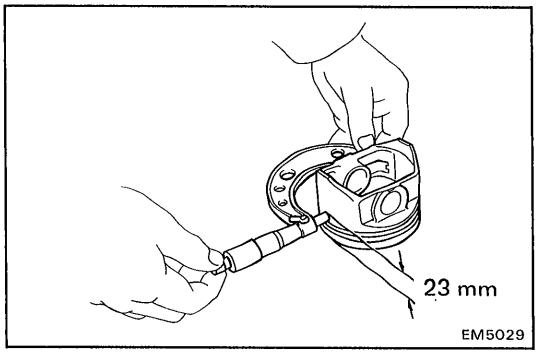
BORING OF CYLINDERS

1. SELECT OVERSIZED PISTON

O/S pistons with pins are available in the sizes listed.

Replace pistons in matched sets. Take the largest bore measured and select the oversized piston for that bore.

Bore all cylinders for the oversized piston selected.



2. CALCULATE DIMENSION TO BORE CYLINDERS

(a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, 23 mm (0.91 in.) from the piston head.

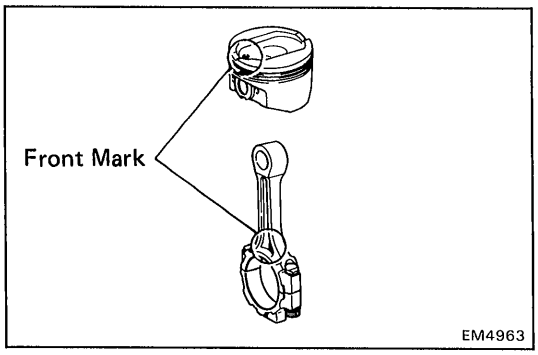
(b) Calculate the size each cylinder is to be rebored as follows:

Size to be rebored = P + C — H
P = piston diameter
C = piston clearance
0.08 — 0.10 mm (0.0031 — 0.0039 in.)
H = allowance for honing
Less than 0.02 mm (0.0008 in.)

3. BORE AND HONE CYLINDERS TO CALCULATED DIMENSIONS

Honing amount: 0.02 mm (0.0008 in.) maximum

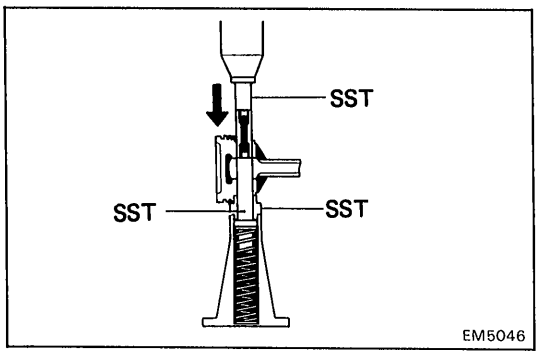
NOTICE: Excess honing will destroy the finished roundness.



ASSEMBLY OF PISTON AND CONNECTING ROD ASSEMBLY

1. ASSEMBLE PISTON AND CONNECTING ROD

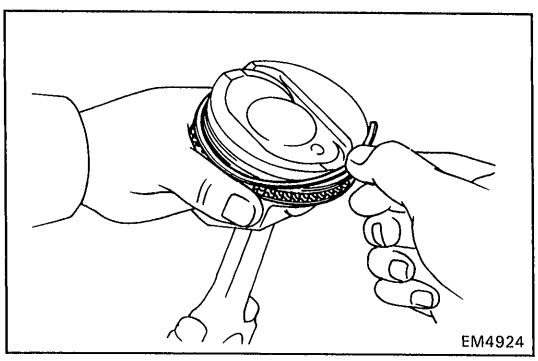
(a) Align the cavity on the piston with the mark on the rod.



(b) Using SST, press in the piston pin.

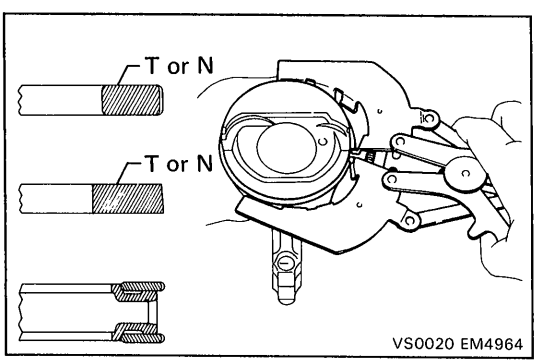
SST 09221-25024 (09221-00020, 09221-00030, 09221-00181, 09221-00190, 09221-00200)

HINT: Coat the piston pin and hole with engine oil.

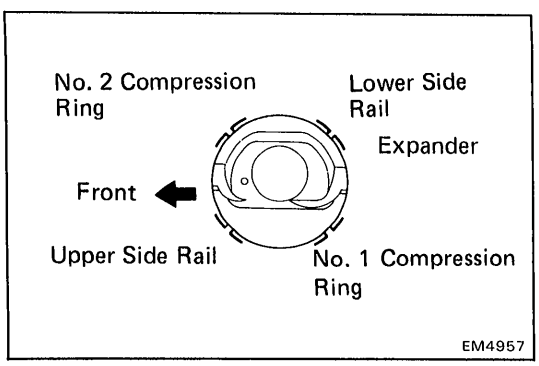


2. PLACE RINGS ON PISTON

(a) Install the oil expander and two side rails by hand.

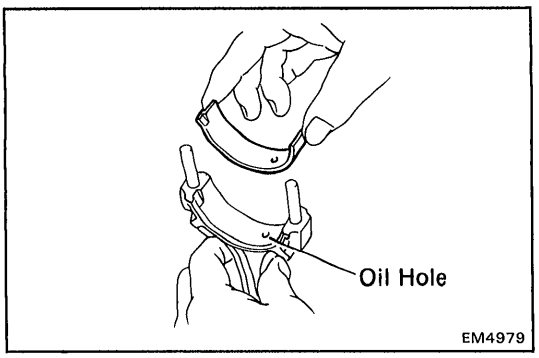


(b) Using a ring expander, install the two compression rings with the code marks facing upward.



(c) Position the piston rings so that the ring end are as shown.

NOTICE: Do not align the end gaps.



3. INSTALL BEARING

(a) Install the bearings in the connecting rods and rod caps.

(b) Lubricate the face of the bearings with engine oil.

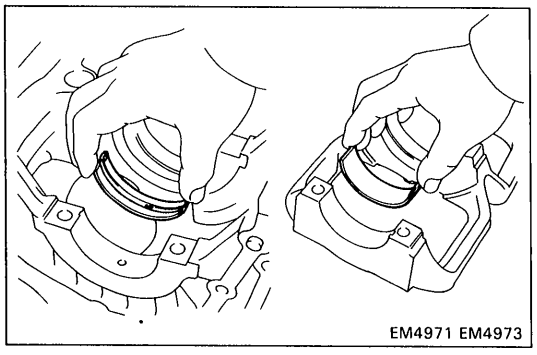
NOTICE: Install the bearing with the oil hole in the connecting rod.

INSTALLATION OF CRANKSHAFT, PISTON AND CONNECTING ROD ASSEMBLIES

(See page EM-148)

GENERAL ASSEMBLY HINT:

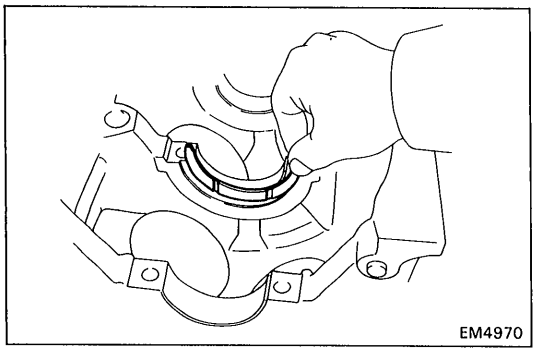
- Thoroughly clean all parts to be assembled.
- Before installing parts, apply new engine oil to all sliding and rotating surfaces.
- Replace all gaskets O-rings and oil seals with new parts.


EM4971 EM4973

1. INSTALL CRANKSHAFT BEARING

Install the bearing in the cylinder block and bearing cap.

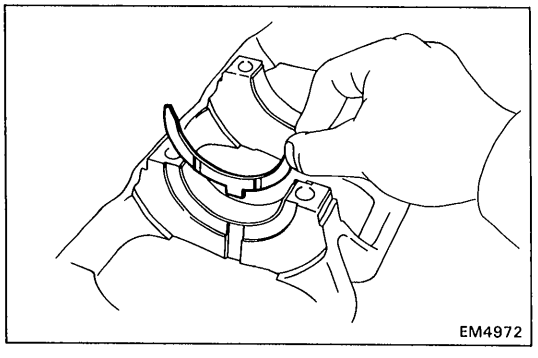
NOTICE: Install the bearing with the oil hole in the block.


EM4970

2. INSTALL UPPER THRUST WASHERS

Install the upper thrust washers on the No.2 main bearing with the oil grooves facing outward.

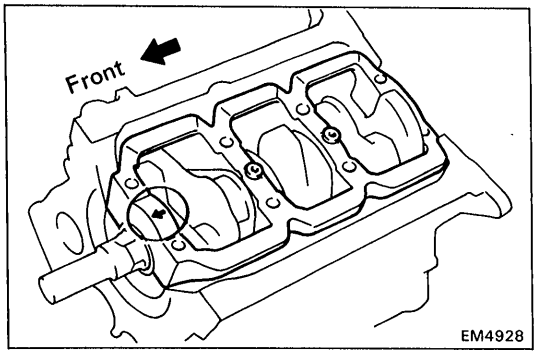
3. PLACE CRANKSHAFT IN CYLINDER BLOCK


EM4972

4. INSTALL CRANKSHAFT BEARING CAP

(a) Install lower thrust washers on the No.2 main bearing with the oil grooves facing out.

(b) Place the crankshaft in cylinder block.



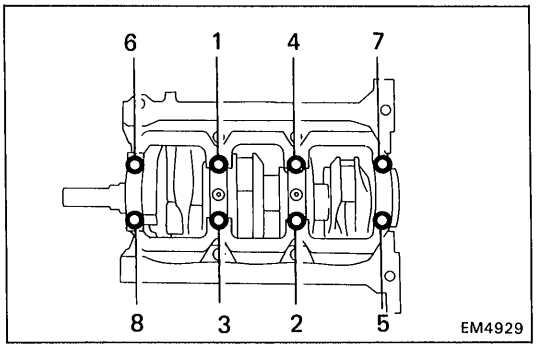
EM4928

(c) Install the bearing cap with arrows facing forward.

5. TORQUE CRANKSHAFT BOLTS

HINT:

- The crankshaft bearing cap bolts are tighten in two progressive steps.
- If any of the cap bolts break or deform, replace them.

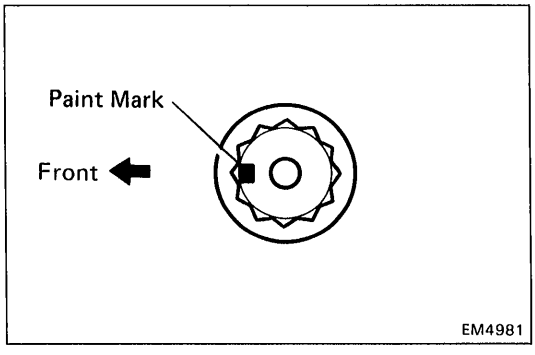


(a) Apply a light coat of the engine oil on the threads and under the cap bolts.

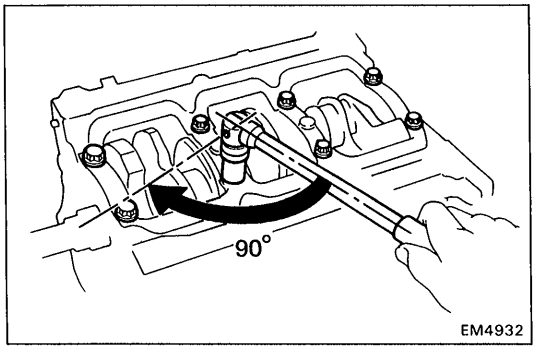
(b) Using a 12-sided socket wrench, first, alternately torque the cap bolts in several passes.

Torque: 625 kg-cm (45 ft-lb, 61 N·m)

If any one of the bolts does not meet the torque specification, replace the bolt.



(c) Mark the front side of the top of bolt with paint.

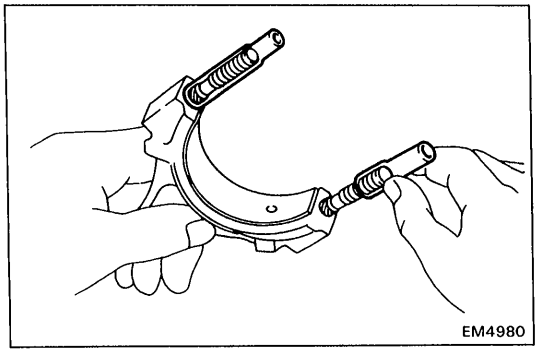


(d) Torque the bolts by an additional 90°.

(e) Check that the paint mark is now facing sideward.

(f) Check that the crankshaft turns smoothly.

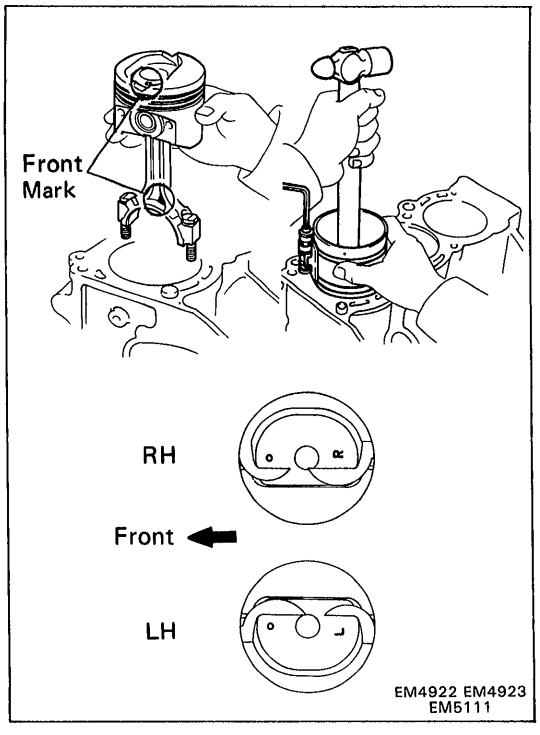
(g) Check the crankshaft thrust clearance.
(See step 23 on page EM-157)



6. INSTALL PISTON AND CONNECTING ROD ASSEMBLY

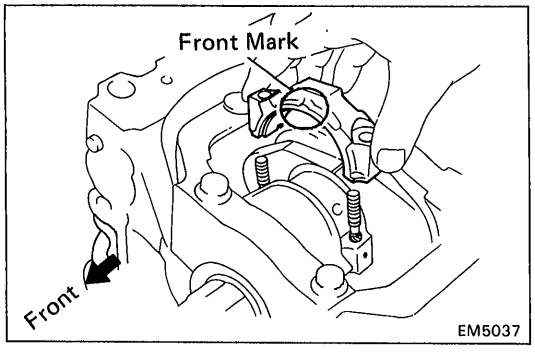
(a) Cover the rod bolts with a short piece of hose to protect the crankshaft from damage.

HINT: Turn the cylinder on the piston installation side at right angles.



(b) Lubricate the cylinder bore and rod journal with clean engine oil.

(c) Using a ring compressor, tighten the compressor snugly but NOT tightly against the piston and gently tap the correctly numbered piston and rod assembly into its cylinders with a wooden hammer handle or like object. Make sure the notch and mark are facing forward.



7. INSTALL CONNECTING ROD CAPS

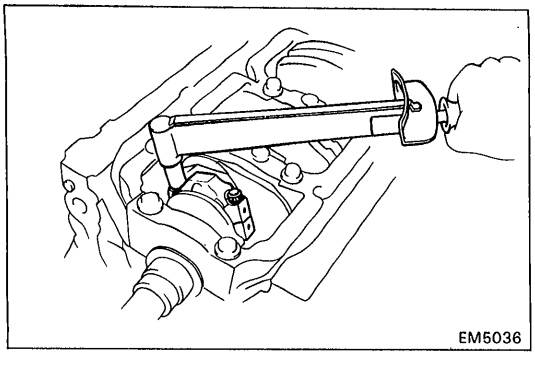
(a) Match the numbered cap with the numbered rod.

(b) Install the cap with the front mark facing forward.

8. TORQUE CONNECTING ROD CAP NUTS

HINT:

- The connecting rod nuts are tighten in two progressive steps.
- If any of the cap bolts break or deform, replace them.

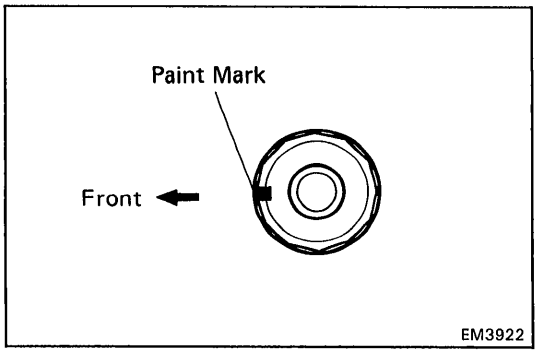


(a) Apply a light coat of the engine oil on the threads and under the nuts.

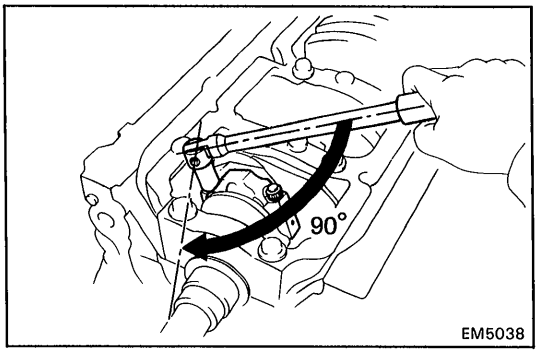
(b) Using 12-sided socket wrench, first, alternately torque the cap bolts in several passes.

Torque: 250 kg-cm (18 ft-lb, 25 N·m)

If any one of the nuts does not meet the torque specification, replace the bolt.



(c) Mark the front side of the top of nuts with paint.

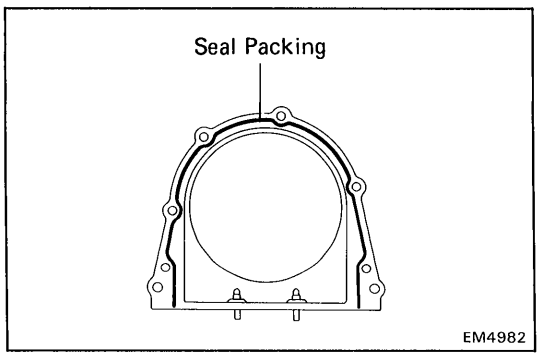


(d) Torque the nuts by an additional 90°.

(e) Check that the paint mark is now facing sideward.

(f) Check that the crankshaft turns smoothly.

(g) Check the connecting rod thrust clearance.
(See step 20 on page EM-155)



ASSEMBLY OF CYLINDER BLOCK

(See page EM-148)

1. INSTALL OIL PUMP

(See step 1 on page LU-23)

2. INSTALL REAR OIL SEAL RETAINER

(a) Apply seal packing to the oil seal retainer as shown in the figure.

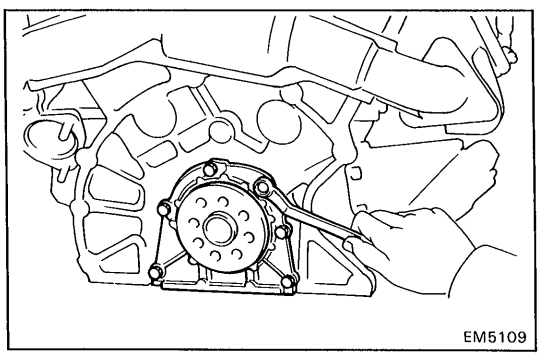
Seal packing: Part No. 08826-00080 or equivalent

HINT: Cleaning and application of seal packing to the installation surface is the same as for the oil pan.

However, use a nozzle cut to 2 mm (0.08 in.)

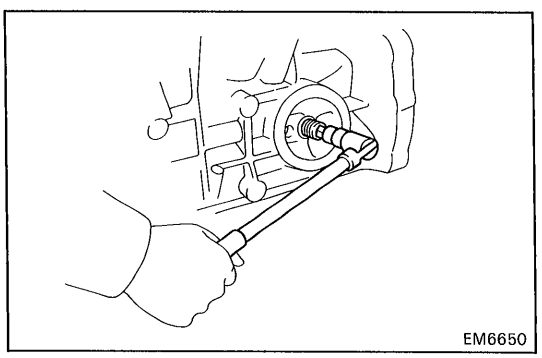
(b) Install the oil seal retainer with the five bolts.

Torque: 80 kg-cm (69 in.-lb, 7.8 N·m)



3. INSTALL BUFFLE PLATE, OIL STRAINER AND OIL PAN

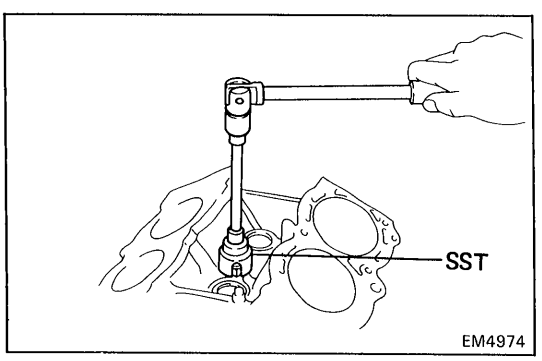
(See steps 2 to 4 on pages LU-23, 24)



4. INSTALL OIL FILTER UNION

Using hexagon wrench, install and torque the oil filter union.

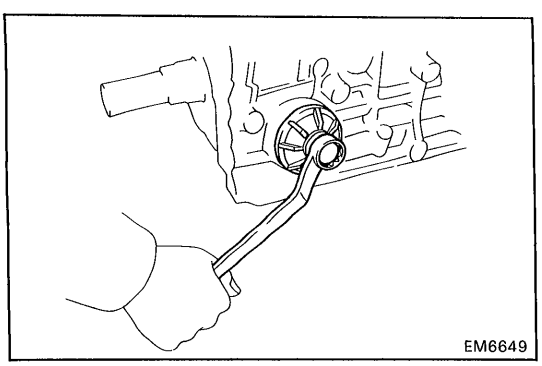
Torque: 250 kg-cm (18 ft-lb, 25 N·m)



5. INSTALL KNOCK SENSOR

Using SST, install and torque the knock sensor.

SST 09817-16011



6. INSTALL OIL HOLE COVER PLATE

(a) Install a new O-ring to the plate.

(b) Install the plate, new gasket with the union bolt.

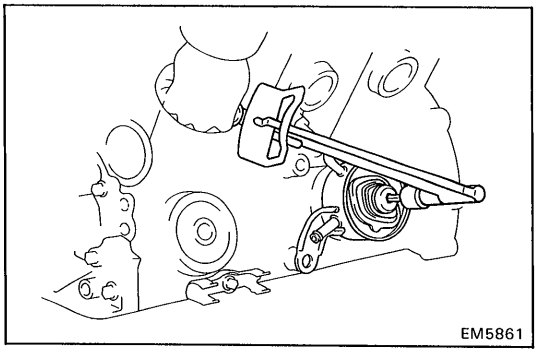
Torque the union bolt.

Torque: 500 kg-cm (36 ft-lb, 49 N·m)

7. **(w/ OIL COOLER)**
INSTALL OIL COOLER

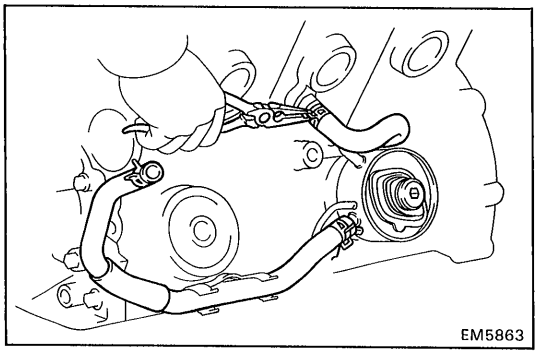
(a) Replace the O-ring with new part.

(b) Install a new gasket to the relief valve.



(c) Install the oil cooler with the relief valve and bolt.

Torque: 450 kg-cm (33 ft-lb, 44 N·m)



(d) Install the No.1 and No.2 oil cooler hoses.

8. **INSTALL COOLANT DRAIN COCKS**

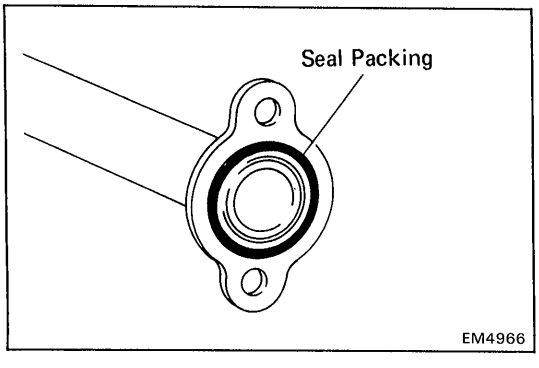
9. **INSTALL LH AND RH ENGINE MOUNTINGS**

10. **INSTALL OIL FILTER**
(See step 2 on page LU-17)

11. **INSTALL OIL PRESSURE SENDER GAUGE**

12. **INSTALL WATER PUMP**
(See step 1 on page CO-16)

13. **INSTALL ALTERNATOR ADJUSTING BAR**



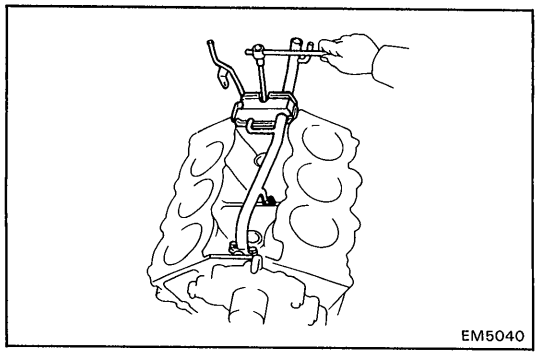
14. **INSTALL NO.1 WATER BY-PASS PIPE**

(a) Apply seal packing to the water by-pass pipe as shown in the figure.

Seal packing: Part No. 08826-00100 or equivalent

HINT: Cleaning and application of seal packing to the installation surface is the same as for the cylinder block.

However, use a nozzle cut to 2 mm (0.08 in.)

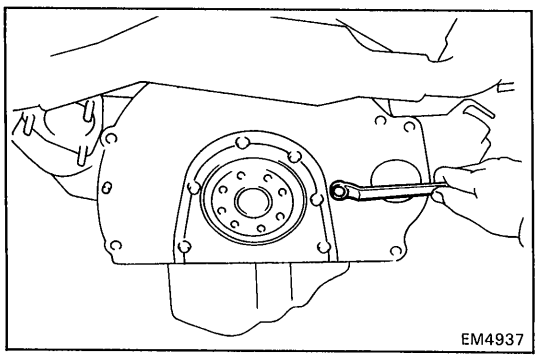


(b) Install the water by-pass pipe with the two bolts and two nuts.

Torque: Bolt 50 kg-cm (43 in.-lb, 4.9 N·m)
Nut 70 kg-cm (61 in.-lb, 6.9 N·m)

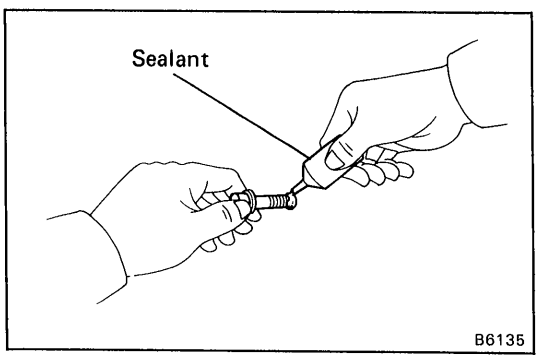
15. INSTALL CYLINDER HEAD AND TIMING BELT
(See steps 1 to 19 on pages EM-136 to 144)

16. REMOVE ENGINE STAND



17. INSTALL REAR END PLATE

Torque: 75 kg-cm (65 in.-lb, 7.4 N·m)

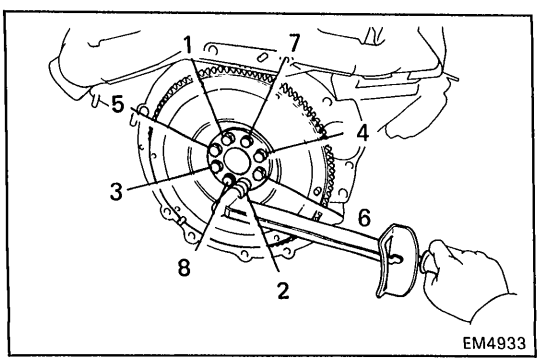


18. INSTALL FLYWHEEL OR DRIVE PLAT

(a) Apply sealant to 2 or 3 threads of the bolt end.

Sealant: Part No. 08833-00070, THREE BOND 1324 or equivalent

HINT: This adhesive will not harden while exposed to air. It will act as a sealant or binding agent only when applied to threads, etc., where air is cut off.



(b) Install the flywheel (M/T) or front spacer, drive plate, rear spacer (A/T) on crankshaft with eight bolts.

Torque the bolts to the specified torque in two or three passes in the sequence shown.

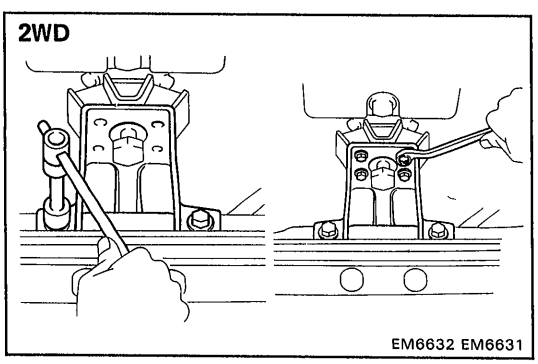
Torque: M/T 900 kg-cm (65 ft-lb, 88 N·m)
A/T 850 kg-cm (61 ft-lb, 83 N·m)

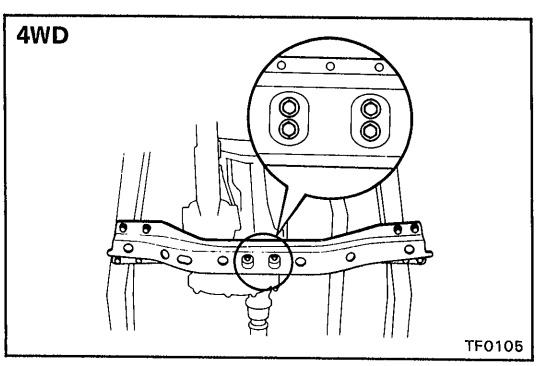
INSTALLATION OF ENGINE

1. (M/T)
INSTALL CLUTCH DISC AND COVER
(See page CL-13)

2. **INSTALL TRANSMISSION TO ENGINE**

3. **INSTALL ENGINE WITH TRANSMISSION IN VEHICLE**
   (a) Attach the engine hoist chain to the engine hangers.
   (b) Lower the engine into the engine compartment.
   (c) Be sure to put a wooden block between the jack and the transmission.
   (d) Align the engine with the transmission and engine mounting supports.
   (e) Install the engine mounting bolts, washers and nuts on each side of the engine.
   (f) Jack up and put the transmission onto the member.





4. (2WD)
INSTALL ENGINE REAR MOUNTING AND BRACKET
   (a) Raise the transmission slightly by raising the engine with a jack and a wooden block under the transmission.
   (b) Install the engine rear mounting bracket to the support member. Torque the bolts.
   Torque: 130 kg-cm (9 ft-lb, 13 N·m)
   (c) Lower the transmission and rest it on the extension housing.
   (d) Install the bracket to the mounting. Torque the bolts.
   Torque: 260 kg-cm (19 ft-lb, 25 N·m)

(4WD)
INSTALL NO.2 FRAME CROSSMEMBER
   (a) Raise the transmission slightly with a jack.
   (b) Install the frame No.2 crossmember to the side frame with the bolts. Torque the bolts.
   Torque: 970 kg-cm (70 ft-lb, 95 N·m)
   (c) Lower the transmission and transfer.
   (d) Install the four mounting bolts to the engine rear mounting. Torque the bolts.
   Torque: 130 kg-cm (9 ft-lb, 13 N·m)

5. (4WD)
INSTALL NO.1 FRONT FLOOR AND BRAKE TUBE HEAT INSULATOR

6. **INSTALL EXHAUST PIPE**
(See step 1 on page EM-145)

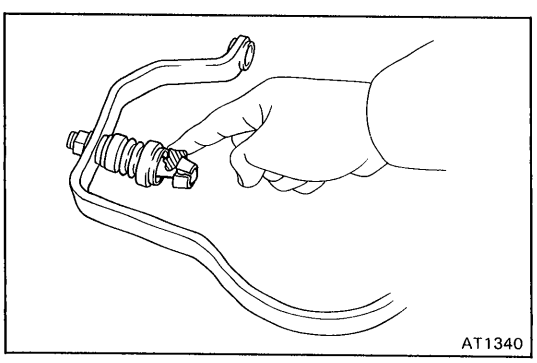
7. **(4WD)**
INSTALL FRONT PROPELLER SHAFT
(See page PR-11)

8. **INSTALL STABILIZER BAR**

9. **(4WD)**
INSTALL TRANSFER UNDER COVER

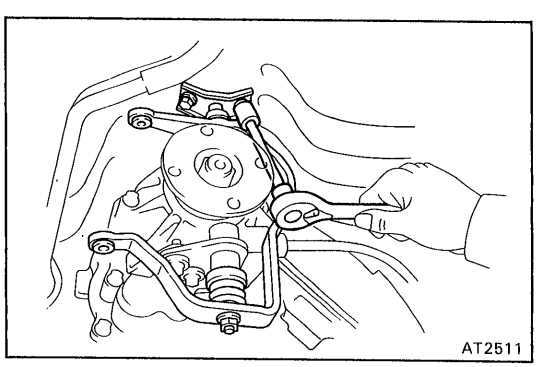
10. **CONNECT SPEEDOMETER CABLE**

11. **(2WD A/T)**
CONNECT MANUAL SHIFT LINKAGE TO NEUTRAL START SWITCH

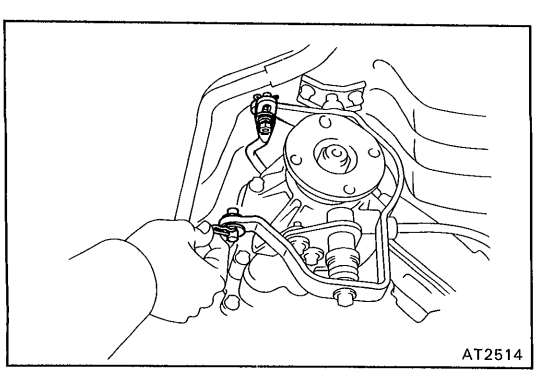

AT1340

(4WD A/T)
CONNECT TRANSFER SHIFT LINKAGE

(a) Apply MP grease to the cross shaft joint.


AT2511

(b) Install the cross shaft to the body.

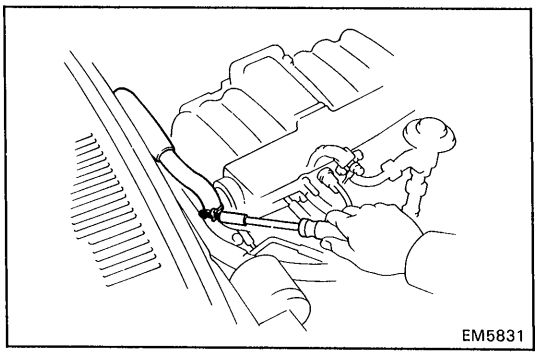

AT2514

(c) Connect the No.1 and No.2 transfer shift linkage to the cross shaft.

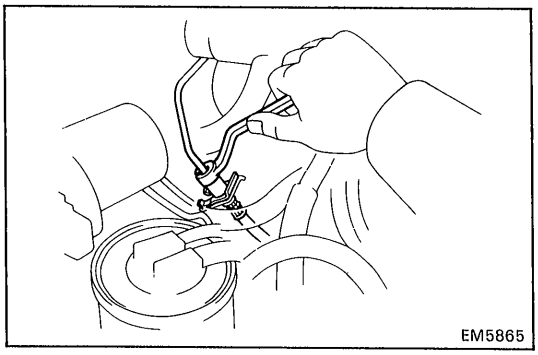
12. **INSTALL REAR PROPELLER SHAFT**
(See page PR-11) 2WD
(See page PR-12) 4WD

13. **(M/T)**
INSTALL SHIFT LEVER(S)

14. **CONNECT FUEL INLET AND OUTLET HOSES**

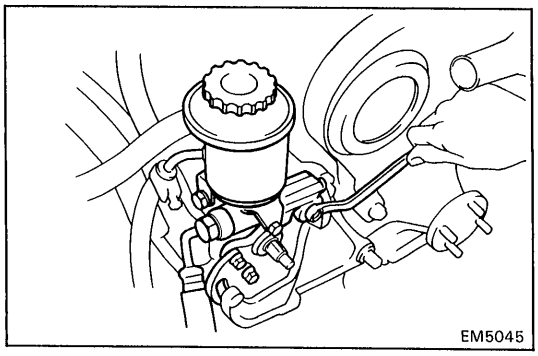

EM5831

15. **CONNECT TWO HEATER HOSES**


EM5865

16. **CONNECT CLUTCH RELEASE CYLINDER HOSE**

17. **INSTALL A/C COMPRESSOR**


EM5045

18. **INSTALL PS PUMP WITH HOSES**
(See step 14 on page EM-110)

19. **CONNECT FOLLOWING CABLES:**
(a) (A/T)
Throttle cable
(b) (w/ Cruise control)
Cruise control cable
(c) Accelerator cable

20. CONNECT FOLLOWING HOSES:

(a) VSV vacuum hoses

(b) Charcoal canister hose to canister

(c) (w/ Cruise control)
Cruise control vacuum hose

(d) Brake booster hose

(e) PS air hoses to gas filter and air pipe

21. CONNECT FOLLOWING WIRES AND CONNECTORS

(a) A/C compressor connector

(b) Check connector

(c) Solenoid resister connectors

(d) (M/T)
Starter relay connectors

(e) VSV connectors

(f) ECU connectors

(g) Ground strap to engine rear side

(h) Oil pressure switch connector

(i) Igniter connector

(j) Alternator connector and wire

(k) Ground strap to LH fender apron

22. INSTALL FAN PULLEY, BELT GUIDE, FLUID COUPLING AND ALTERNATOR DRIVE BELT
(See step 12 on page EM-110)

23. INSTALL A/C BELT
(See step 2 on page MA-6)

24. INSTALL PS PUMP AND BELT

(a) Place the PS drive belt on to each pulley.

(b) Stretch the belt tight and tighten the nuts.

(c) Torque the PS pump pulley lock nut.

Torque: 440 kg-cm (32 ft-lb, 43 N·m)

(d) Adjust the belt tension.
(See step 2 on page MA-6)

25. **INSTALL RADIATOR**

26. **INSTALL AIR CLEANER CASE WITH HOSE**

27. **FILL WITH ENGINE OIL**
    (See step 3 on page LU-18)

28. **FILL WITH COOLANT**
    (See step 3 on page CO-14)

29. **INSTALL ENGINE UNDER COVER**

30. **INSTALL BATTERY**

31. **INSTALL HOOD**

32. **START ENGINE**
    Warm up the engine and inspect for leaks.

33. **PERFORM ENGINE ADJUSTMENT**
    (See page EM-84)

34. **ROAD TEST**
    Road test vehicle

35. **RECHECK COOLANT AND ENGINE OIL LEVEL**

EMISSION CONTROL SYSTEMS

NOTE: TROUBLESHOOTING

See page EM-4 (22R-E)
See page EM-81 (3VZ-E)

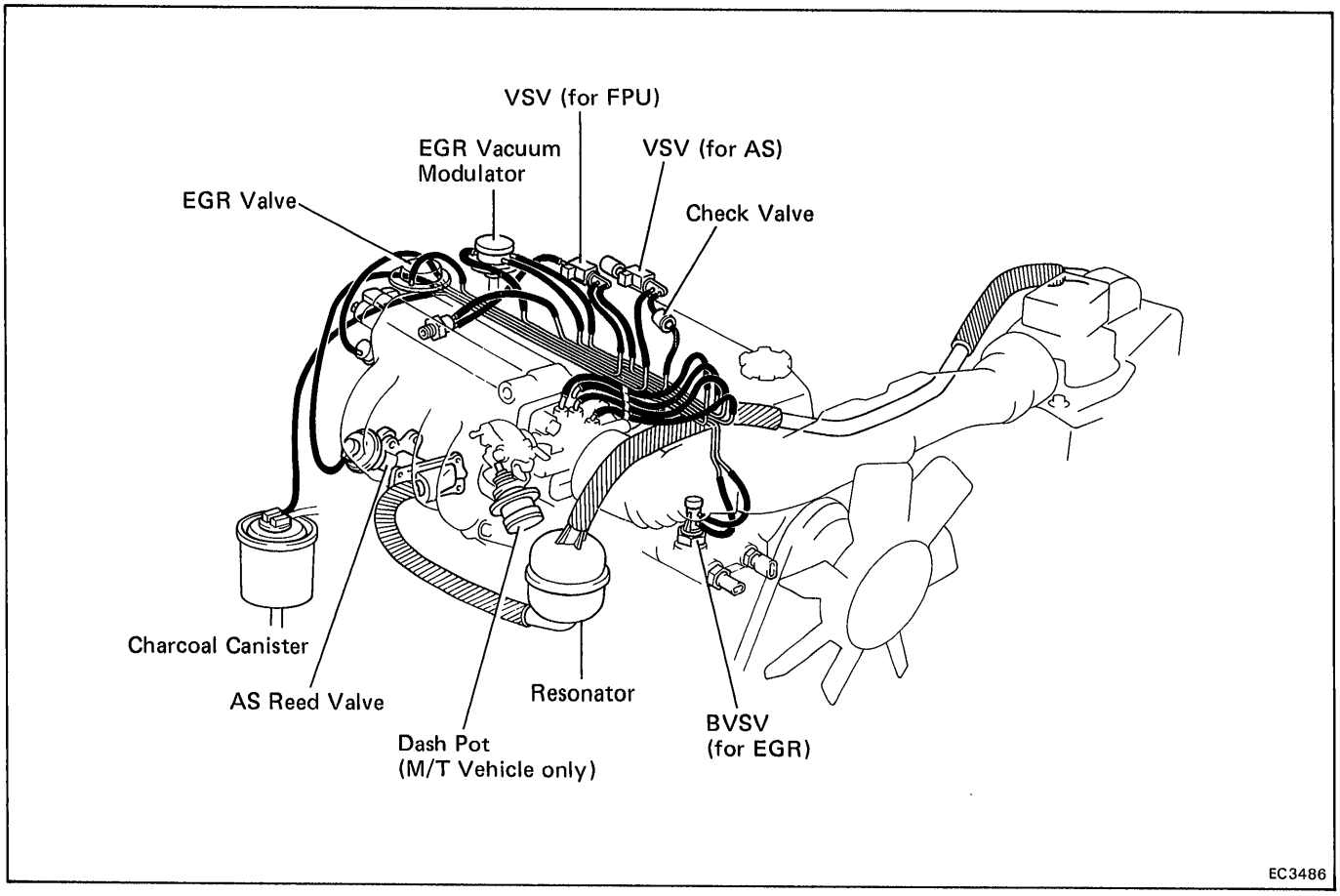
EC

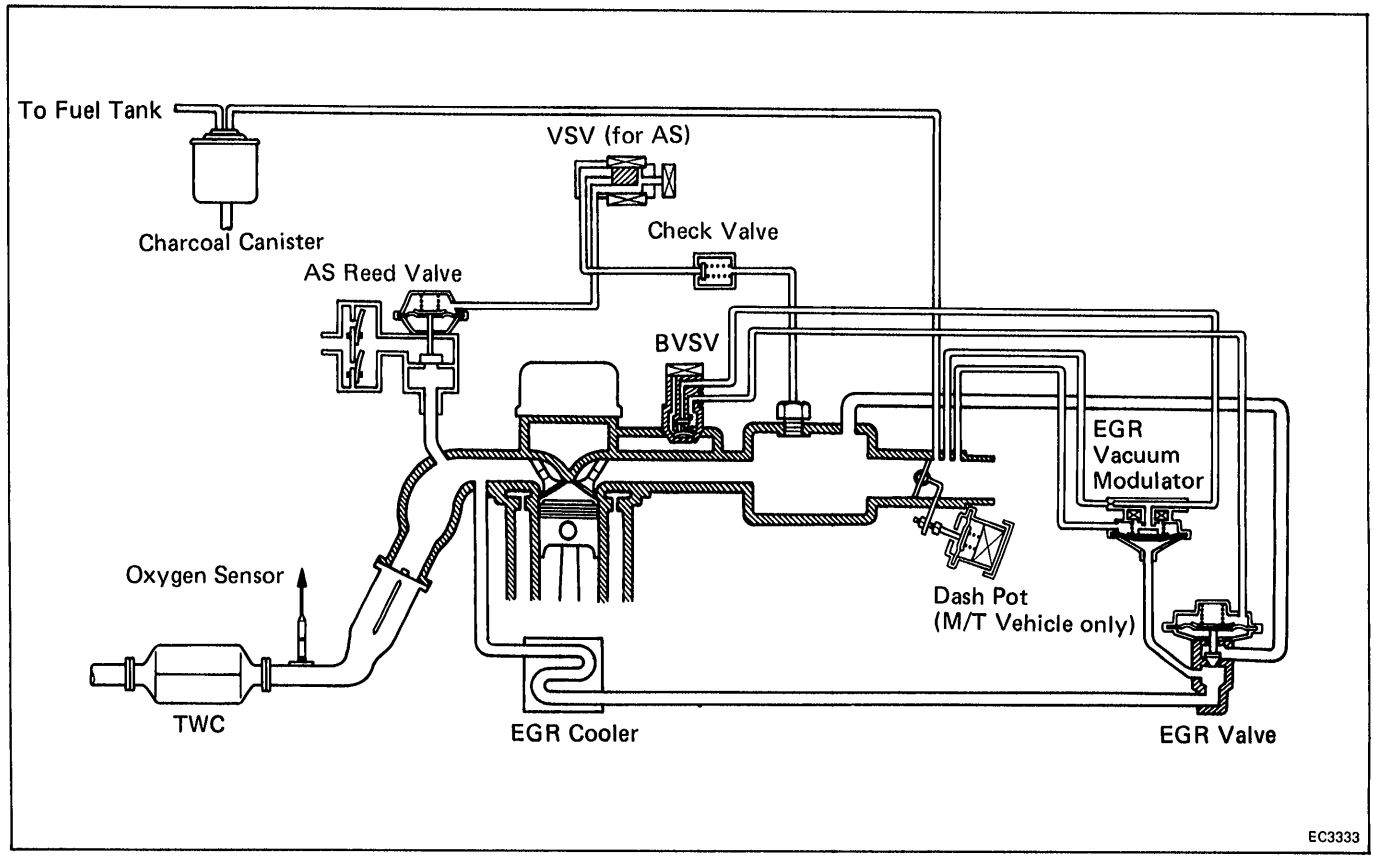
SYSTEM PURPOSE

System	Abbreviation	Purpose
Positive crankcase ventilation	PCV	Reduces blow-by gas (HC)
Fuel evaporative emission control	EVAP	Reduces evaporative HC
Dash pot *1	DP	Reduces HC and CO
Exhaust gas recirculation	EGR	Reduces NOx
Air suction	AS	Reduces HC and CO
Three-way catalyst	TWC	Reduces HC,CO and NOx
Electronic fuel injection *2	EFI	Regulates all engine conditions for reduction of exhaust emissions.

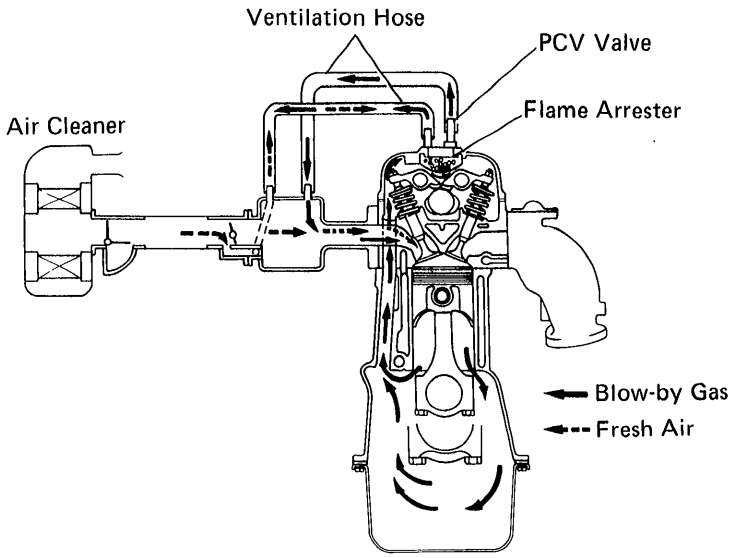
Remarks: *1 M/T vehicles only
*2 For inspection and repair of the EFI system, refer to the EFI section of this manual.

COMPONENT LAYOUT AND SCHEMATIC DRAWING





POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

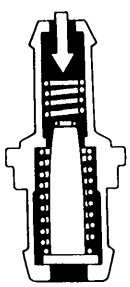


EC2572

To reduce HC emissions, crankcase blow-by gas (HC) is routed through the PCV valve to the intake manifold for combustion in the cylinders.

Engine not Running or Backfiring

Intake Manifold Side

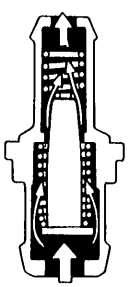


Cylinder Head Side

EC1001

○PCV VALVE IS CLOSED.

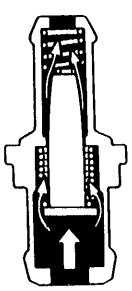
Normal Operation



EC1002

○PCV VALVE IS OPEN.
○VACUUM PASSAGE IS LARGE.

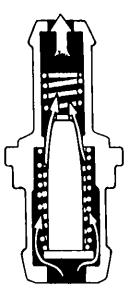
Idling or Decelerating



EC1003

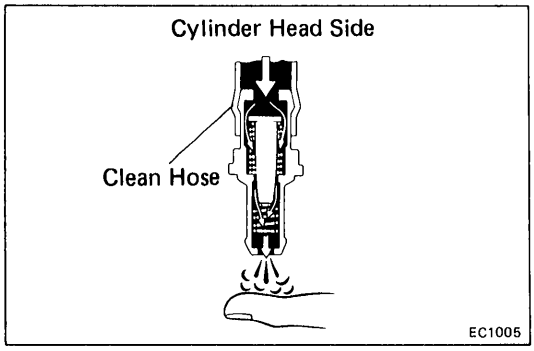
○PCV VALVE IS OPEN.
○VACUUM PASSAGE IS SMALL.

Acceleration or Heavy Load



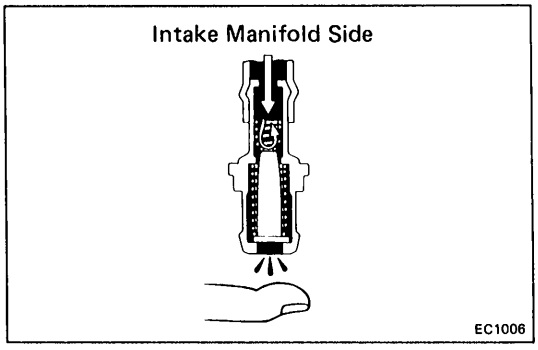
EC1004

○PCV VALVE IS FULLY OPEN.

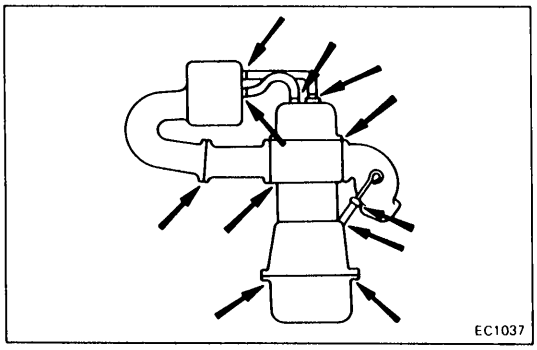


INSPECTION OF PCV VALVE

1. **REMOVE PCV VALVE**
2. **ATTACH CLEAN HOSE TO PCV VALVE**
3. **BLOW FROM CYLINDER HEAD SIDE**
   Check that air passes through easily.
   NOTICE: Do not suck air through the valve.
   Petroleum substances inside the valve are harmful.



4. **BLOW FROM INTAKE MANIFOLD SIDE**
   Check that air passes through with difficulty.
   If the PCV valve fails either check, replace it.
5. **REINSTALL PCV VALVE**

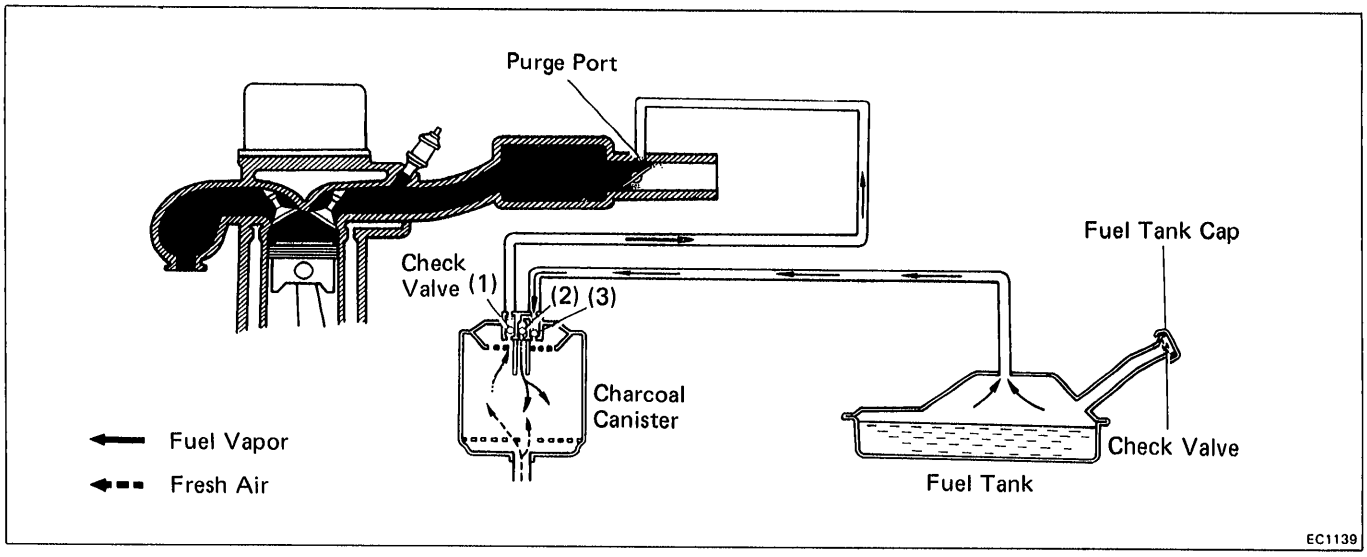


INSPECTION OF PCV HOSES AND CONNECTIONS

VISUALLY INSPECT HOSES, CONNECTIONS AND GASKETS

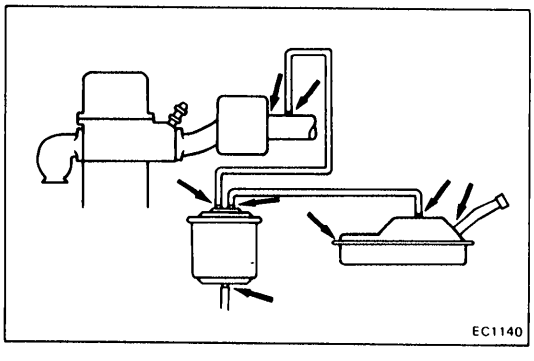
Check for cracks, leaks or damage.

FUEL EVAPORATIVE EMISSION CONTROL (EVAP) SYSTEM



To reduce HC emission, evaporated fuel from the fuel tank is routed through the charcoal canister to the intake manifold for combustion in the cylinders.

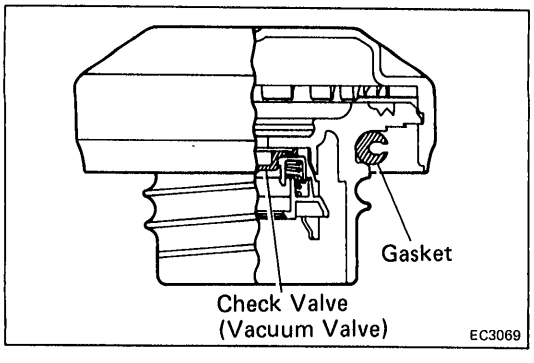
Condition	Check Valve in Charcoal Canister			Check valve in Fuel Tank Cap	Evaporated Fuel (HC)
	(1)	(2)	(3)		
Parking, idling and low speed	CLOSED	—	—	—	HC from tank is absorbed in the canister.
Medium and high speed	OPEN	—	—	—	HC from canister is led into intake manifold.
High pressure in tanlk	—	OPEN	CLOSED	CLOSED	HC from tank is absorbed in the canister.
High vacuum in Tank	—	CLOSED	OPEN	OPEN	(Air is led into the tank.)



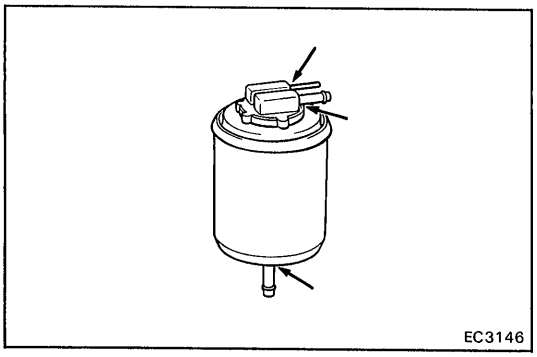
INSPECTION OF FUEL VAPOR LINES, FUEL TANK AND TANK CAP

1. **VISUALLY INSPECT LINES AND CONNECTIONS**
   Look for loose connections, sharp bends or damage.

2. **VISUALLY INSPECT FUEL TANK**
   Look for deformation, cracks or fuel leakage.



3. **VISUALLY INSPECT FUEL TANK CAP**
   Look for a damaged or deformed gasket and cap.
   If necessary, repair or replace the cap.

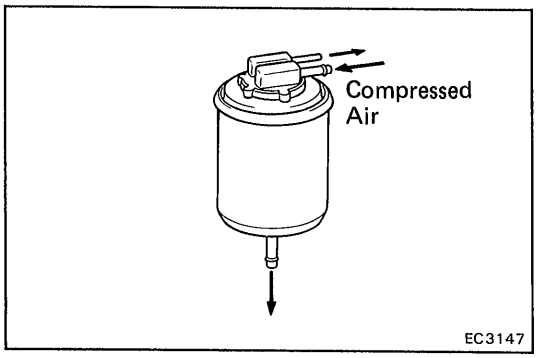

EC3146

INSPECTION OF CHARCOAL CANISTER

1. REMOVE CHARCOAL CANISTER

2. VISUALLY INSPECT CHARCOAL CANISTER CASE

Look for cracks or damage.



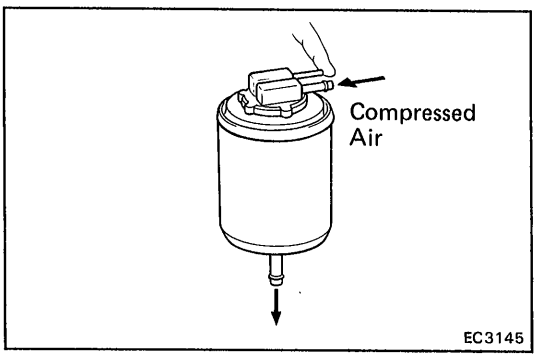
EC3147

3. CHECK FOR CLOGGED FILTER AND STUCK CHECK VALVE

(a) Using low pressure compressed air, blow into the tank pipe and check that the air flows without resistance from the other pipes.

(b) Blow into the purge pipe and check that the air does not flow from the other pipes.

If a problem is found, replace the charcoal canister.



EC3145

4. CLEAN FILTER IN CANISTER

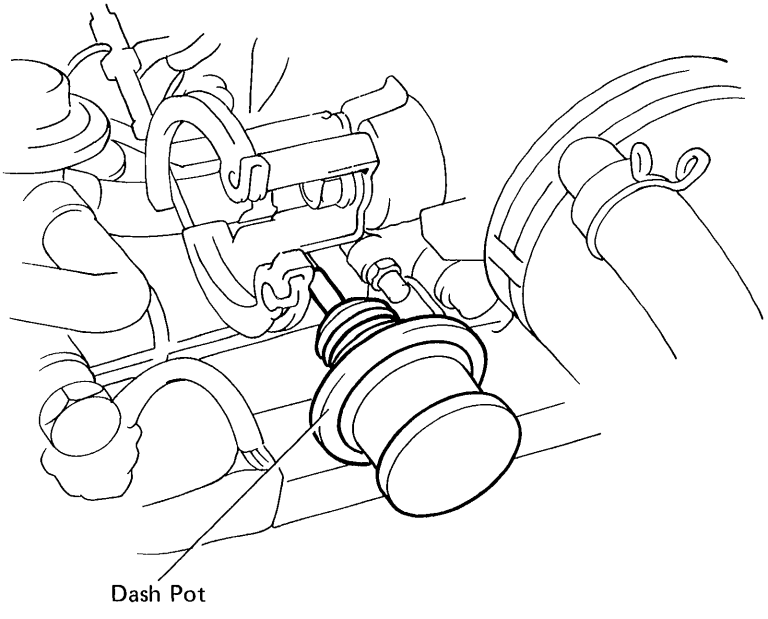
Clean the filter by blowing 3 kg/cm^2 (43 psi, 294 kPa) of compressed air into the tank pipe, while holding the purge pipe closed.

HINT:

- Do not attempt to wash the canister.
- No activated carbon should come out.

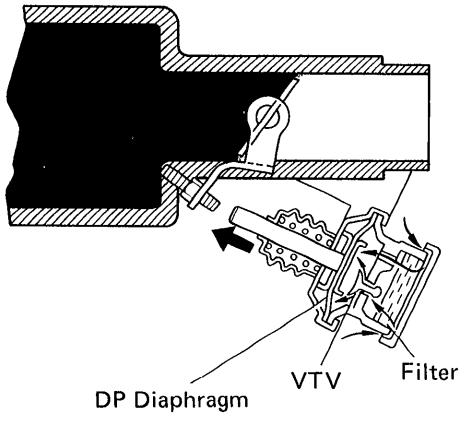
5. INSTALL CHARCOAL CANISTER

DASH POT (DP) SYSTEM
(M/T Vehicle only)



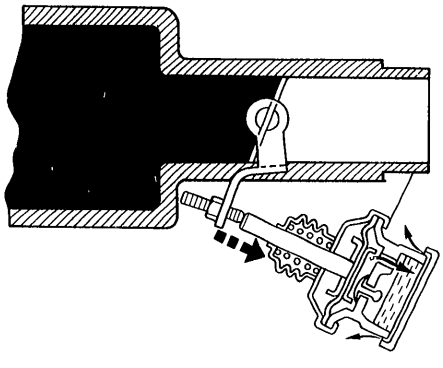
EC3598

Normal Driving



EC3122

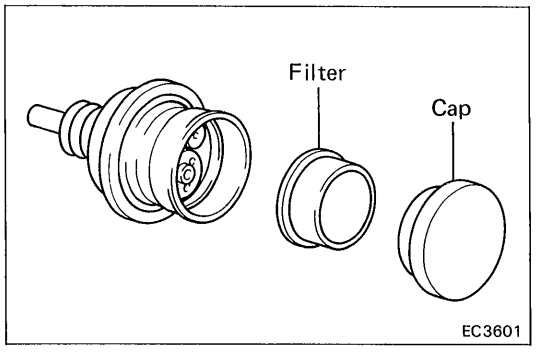
Deceleration



EC3123

To reduce HC and CO emissions, when decelerating the dash pot opens the throttle valve slightly more than at idle. This causes the air-fuel mixture to burn completely.

Condition	Diaphragm	VTV	Throttle Valve
Idling	Pushed in by return force of throttle valve	CLOSED	Idle speed position
Normal driving	Pushed out by diaphragm spring	OPEN	High speed position
Deceleration	Pushed in by return force of throttle valve	CLOSED	Slightly opens and then slowly closes to idle position



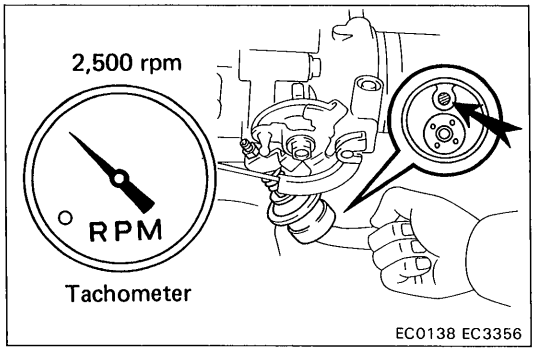
INSPECTION OF DP SYSTEM

1. **WARM UP ENGINE**

2. **CHECK IDLE SPEED AND ADJUST, IF NECESSARY**

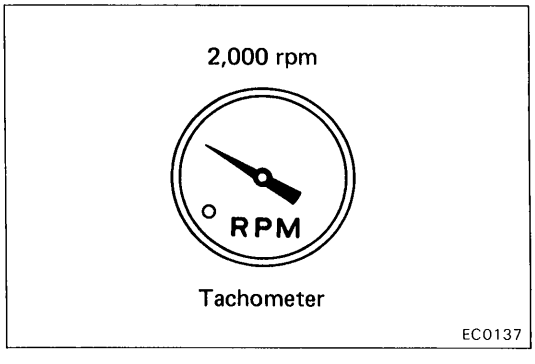
3. **CHECK DP SETTING SPEED**

(a) Remove the cap, filter from the DP.



(b) Race the engine at 2,500 rpm for a few seconds.

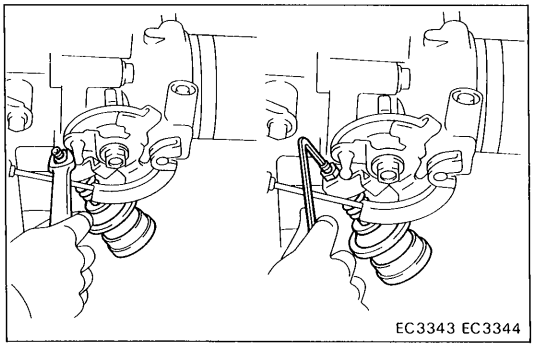
(c) Plug the VTV hole.



(d) Release the throttle valve.

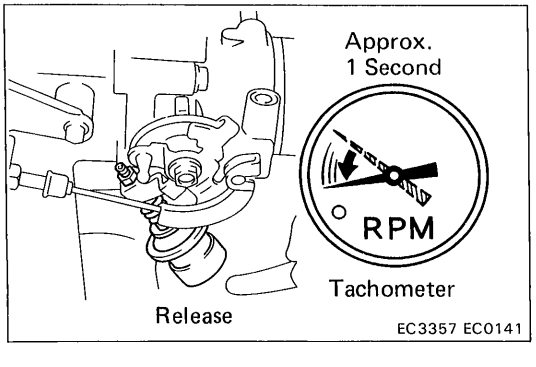
(e) Check that the DP setting speed.

DP setting speed: 2,000 rpm



If not at specified speed, adjust with the DP adjusting screw.

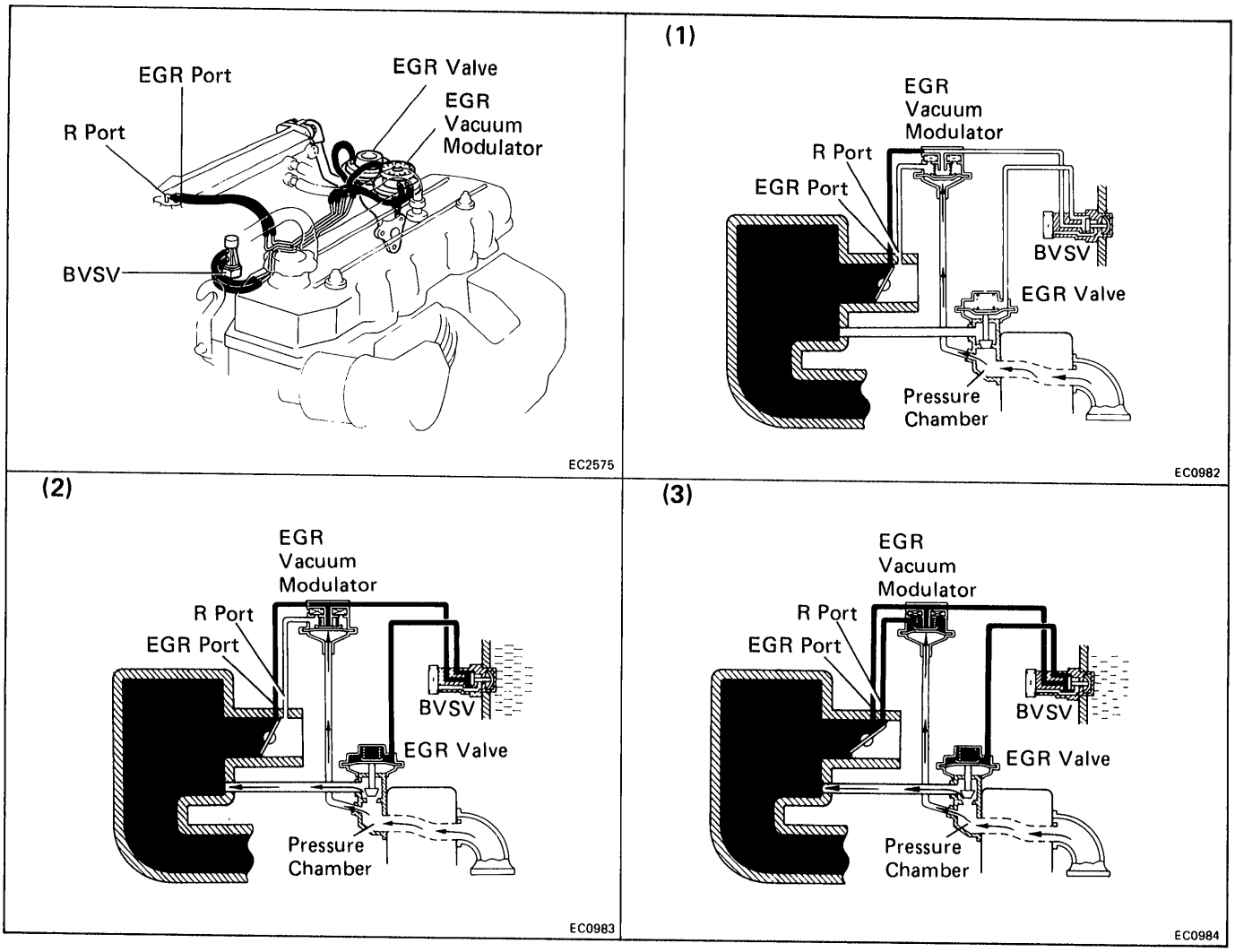
(f) Reinstall the DP filter and cap.



4. **CHECK VTV OPERATION**

Race the engine at 2,500 rpm for few seconds, release the throttle valve and check that the engine returns to idle in approx. 1 second.

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

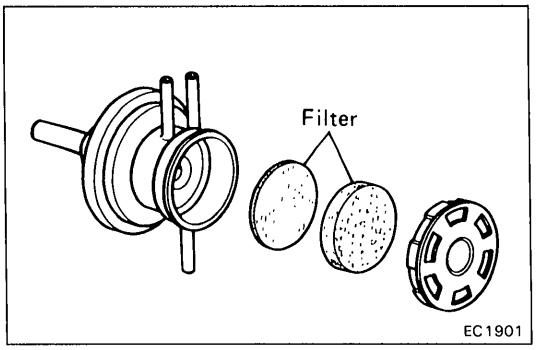


To reduce NOx emission, part of the exhaust gases are recirculated through the EGR valve to the intake manifold to lower the maximum combustion temperature.

Coolant Temp.	BVSV	Throttle Valve Opening Angle	Pressure in the EGR Valve Pressure Chamber		EGR Vacuum Modulator	EGR Valve	Exhaust Gas
Below 30°C (86°F)	CLOSED	—	—		—	CLOSED	Not recirculated
Above 44°C (111°F)	OPEN	Positioned below EGR port	—		—	CLOSED	Not recirculated
		Positioned between EGR port and R port	(1) LOW	*Pressure constantly alternating between low and high	OPENS passage to atmosphere	CLOSED	Not recirculated
			(2) HIGH		CLOSES passage to atmosphere	OPEN	Recirculated
		Positioned above R port	(3) HIGH	**	CLOSES passage to atmosphere	OPEN	Recirculated (increase)

Remarks: *Pressure increase→Modulator closes→EGR valve opens→Pressure drops→EGR valve closes←Modulator opens←

**When the throttle valve is positioned above the R port, the EGR vacuum modulator will close the atmosphere passage and open the EGR valve to increase the EGR gas, even if the exhaust pressure is insufficiently low.

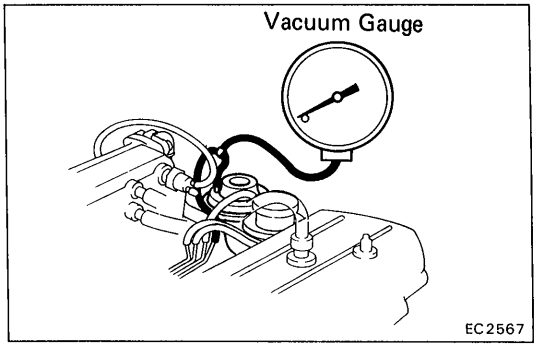


INSPECTION OF EGR SYSTEM

1. CHECK AND CLEAN FILTER IN EGR VACUUM MODULATOR

(a) Check the filter for contamination or damage.

(b) Using compressed air, clean the filter.

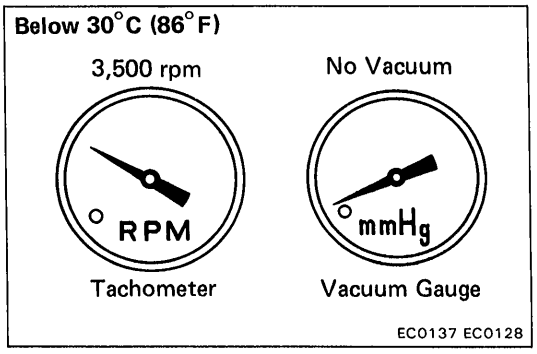


2. PREPARATION

Disconnect the vacuum hose from the EGR valve and, using a three way union, connect a vacuum gauge to it.

3. CHECK SEATING OF EGR VALVE

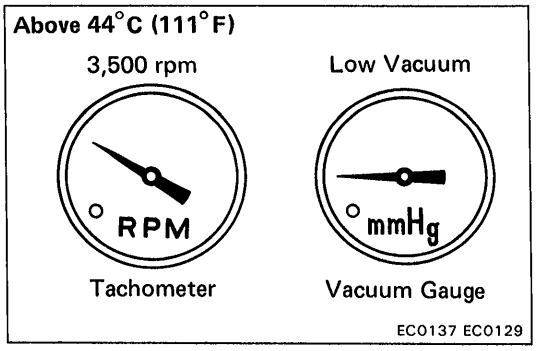
Start the engine and check that the engine starts and runs at idle.



4. CHECK BVSV WITH COLD ENGINE

(a) The coolant temperature should be below 30°C (86°F).

(b) Check that the vacuum gauge indicates zero at 3,500 rpm.

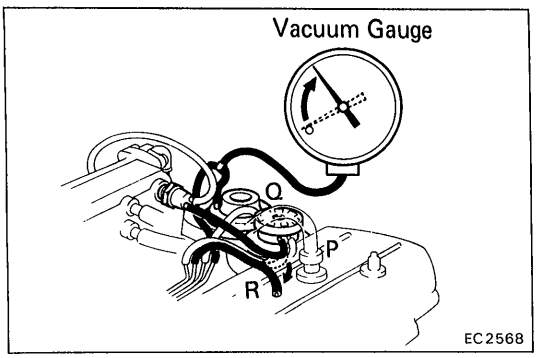


5. CHECK BVSV AND EGR VACUUM MODULATOR WITH HOT ENGINE

(a) Warm up the engine.

(b) Check that the vacuum gauge indicates is zero at idle.

(c) Check that the vacuum gauge indicates low vacuum at 3,500 rpm.

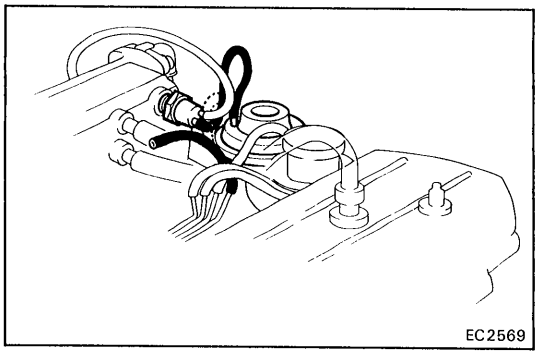


(d) Disconnect the vacuum hose from R port of the EGR vacuum modulator and connect R port directly to the intake manifold with another hose.

(e) Check that the vacuum gauge indicates high vacuum at 3,000 rpm.

HINT: As a large amount of EGR gas enters, the engine will misfire slightly at this time.

(f) Disconnect the vacuum gauge and reconnect the vacuum hoses to the proper locations.


EC2569

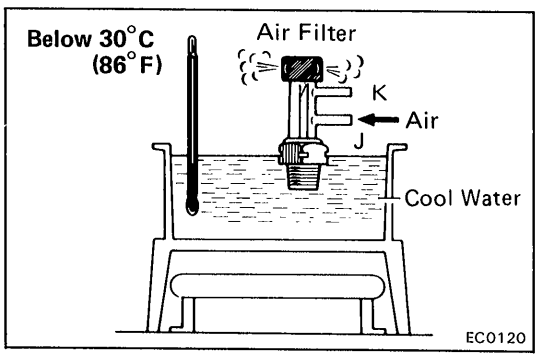
6. CHECK EGR VALVE

(a) Apply vacuum directly to the EGR valve with the engine idling.

(b) Check that the engine runs rough or dies.

(c) Reconnect the vacuum hoses to the proper location.

IF NO PROBLEM IS FOUND WITH THIS INSPECTION, THE SYSTEM IS OKAY; OTHERWISE INSPECT EACH PART



EC0120

INSPECTION OF BVSV

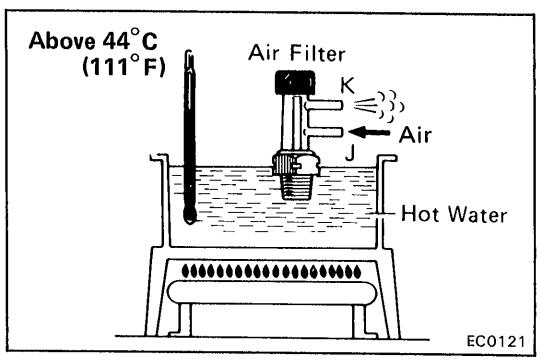
CHECK BVSV BY BLOWING AIR INTO PIPE

(a) Drain the coolant from the radiator into a suitable container.

(b) Remove the BVSV.

(c) Cool the BVSV to below 30°C (86°F).

(d) Check that air flows from pipe J to the air filter.



EC0121

(e) Heat the BVSV to above 44°C (111°F).

(f) Check that air flows from pipe J to pipe K.

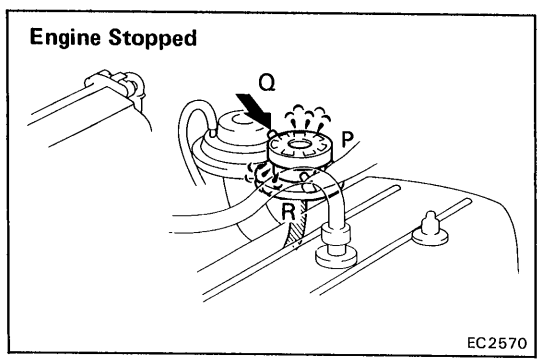
If a problem is found, replace the BVSV.

(g) Apply sealant to the threads of the BVSV and reinstall.

Sealant: Part No. 08833-00070, THREE BOND 1324 or equivalent

Torque: 300 kg-cm (22 ft-lb, 29 N·m)

(h) Fill the radiator with coolant.



EC2570

INSPECTION OF EGR VACUUM MODULATOR

CHECK EGR VACUUM MODULATOR OPERATION

(a) Disconnect the vacuum hoses from port P, Q and R of the EGR vacuum modulator.

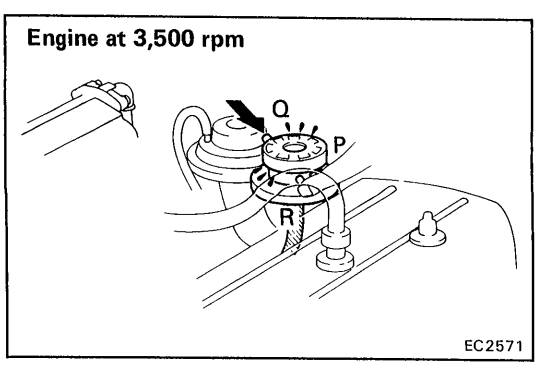
(b) Plug port P and R with your finger.

(c) Blow air into port Q. Check that the air passes through to the air filter side freely.

(d) Start the engine and maintain the speed at 3,500 rpm.

(e) Repeat the above test. Check that there is a strong resistance to air flow.

(f) Reconnect the vacuum hoses to the proper locations.



EC2571

INSPECTION OF EGR VALVE

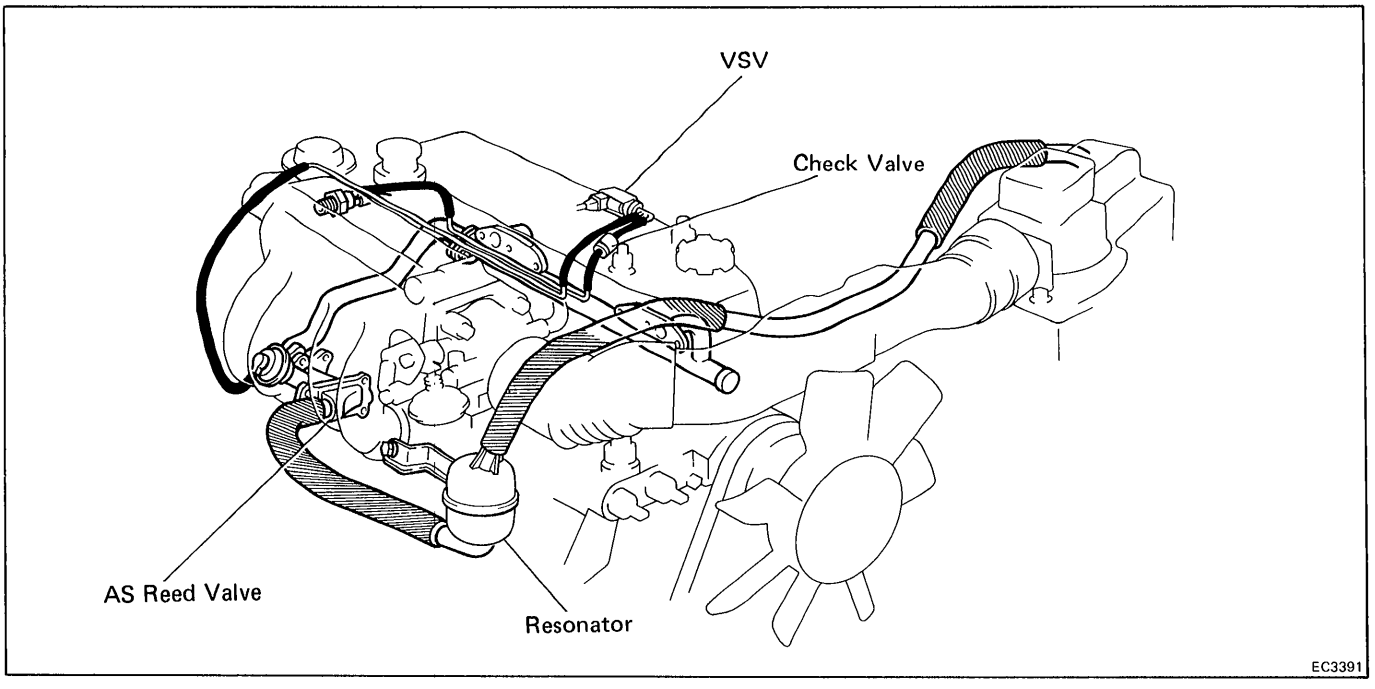
1. REMOVE EGR VALVE

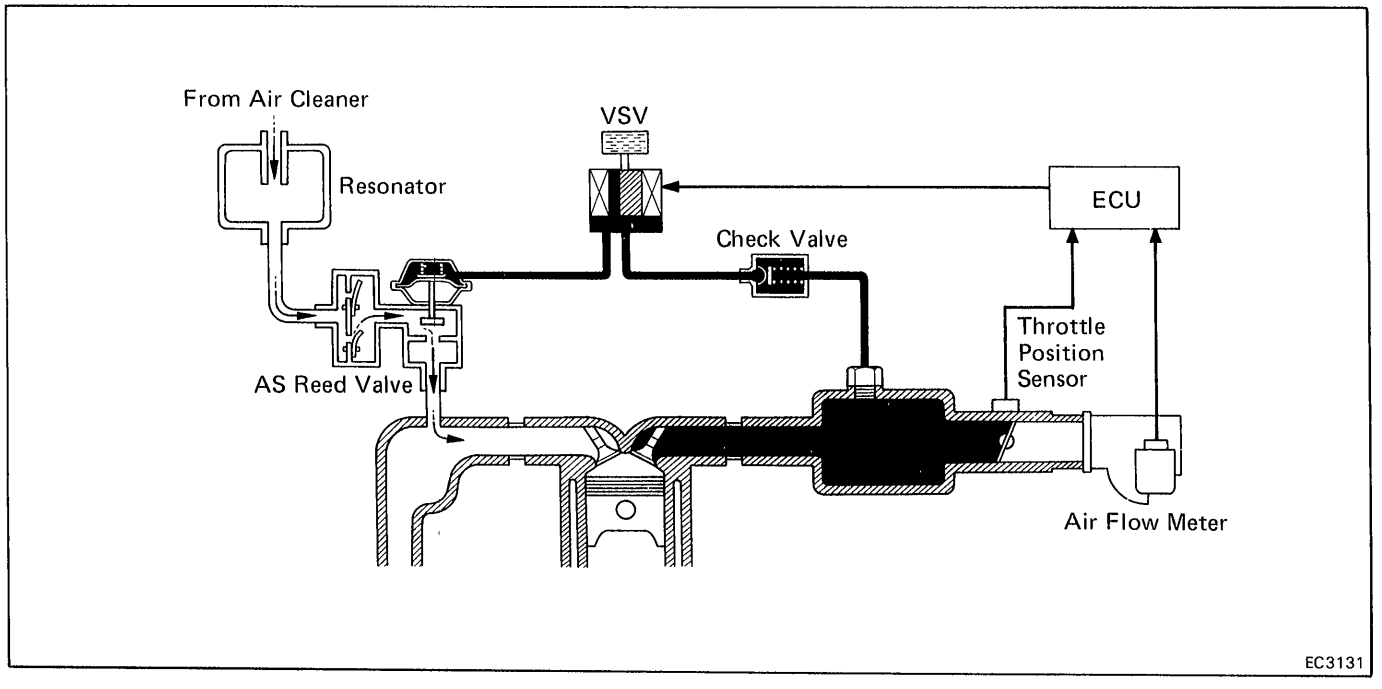
Check the valve for sticking and heavy carbon deposits.

If a problem is found, replace it.

2. INSTALL EGR VALVE WITH NEW GASKET

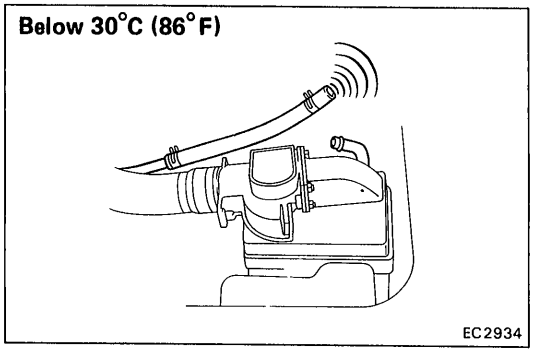
AIR SUCTION (AS) SYSTEM

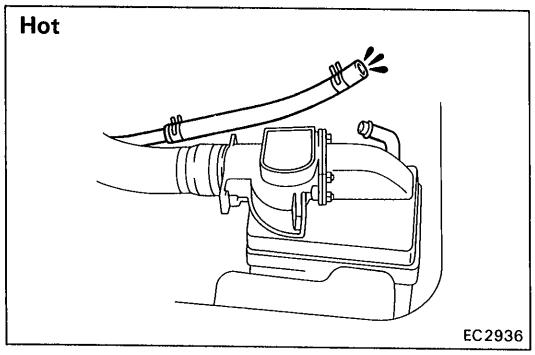


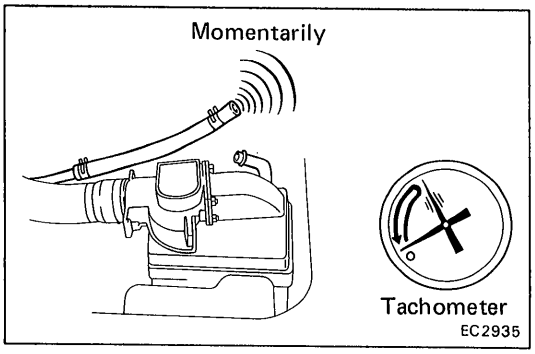


To reduce HC and CO emissions, this system draws in air into exhaust ports to accelerate oxidation, using vacuum generated by the exhaust pulsation in the exhaust manifold.

Condition	Coolant Temp.	Throttle valve position	Vehicle speed	Engine RPM	VSV	AS
Normal driving	Below 30°C (86°F)	—	—	Below 3,600 rpm	ON	ON
				Above 3,600 rpm	OFF	OFF
Deceleration	Above 40°C (104°F)	Idling	Below 4 km/h (2 mph)	Below 1,000 rpm	OFF	OFF
				Above 1,000 rpm	ON	ON
			Above 4 km/h (2 mph)	Below 1,000 rpm	ON	ON
				Above 1,000 rpm	ON	ON





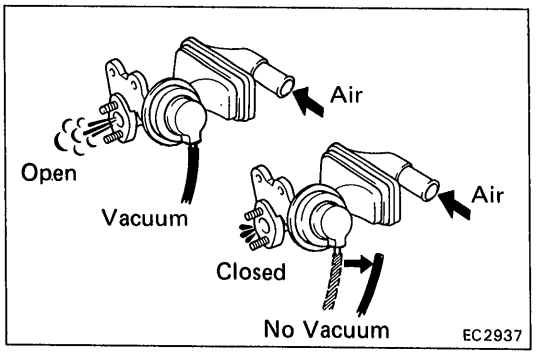


INSPECTION OF AS SYSTEM

1. **VISUALLY CHECK HOSES AND TUBES FOR CRACKS, KINKS, DAMAGE OR LOOSE CONNECTIONS**

2. **CHECK AS SYSTEM WITH COLD ENGINE**
   (a) The coolant temperature should be below 30°C (86°F).
   (b) Disconnect the No.1 AS hose from the air cleaner case.
   (c) Check that a bubbling noise is heard from the No.1 AS hose at idle.

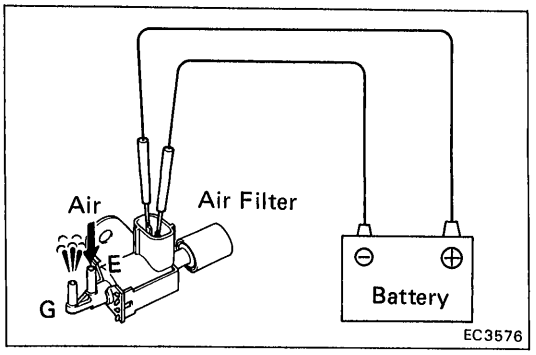
3. **CHECK AS SYSTEM WITH WARM ENGINE**
   (a) Warm up the engine to above 40°C (104°F).
   (b) With the engine idling, check that a bubbling noise is not heard from the No.1 AS hose.
   (c) Race the engine above 2,000 rpm and quickly close the throttle valve. Check that a bubbling noise stops momentarily.



INSPECTION OF REED VALVE

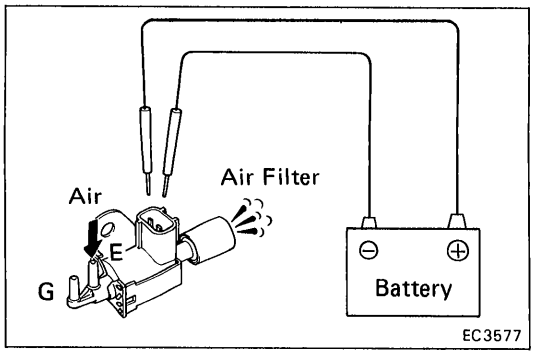
CHECK REED VALVE BY BLOWING AIR INTO PIPE

(a) Apply vacuum to the reed valve diaphragm.
(b) Blow air into a pipe and check that the reed valve is open.
(c) Release the vacuum and check that the reed valve is closed.



INSPECTION OF VSV

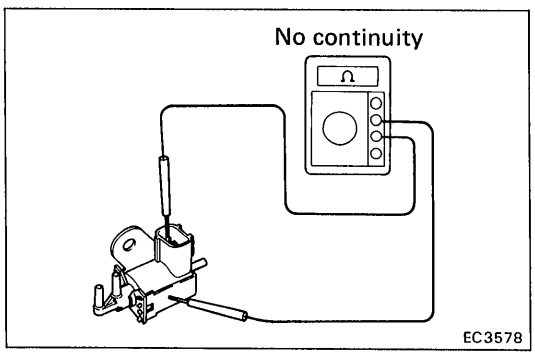
1. **CHECK VACUUM CIRCUIT CONTINUITY IN VSV BY BLOWING AIR INTO PIPE**
   (a) Connect the VSV terminals to the battery terminals as illustrated.
   (b) Blow into pipe E and check that air comes out of pipe G.



(c) Disconnect the battery.

(b) Blow into pipe E and check that air comes out of air filter.

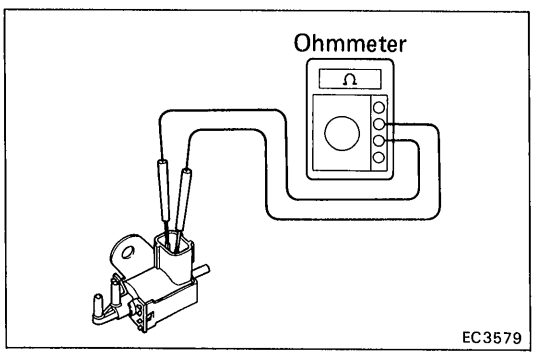
If a problem is found, repair the VSV.



2. CHECK FOR SHORT CIRCUIT

Using an ohmmeter, check that there is no continuity between the terminals and the VSV body.

If there is continuity, replace the VSV.

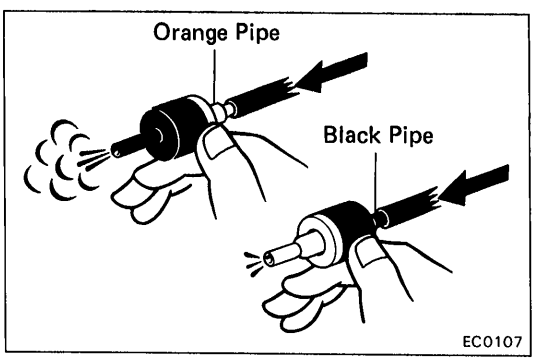


3. CHECK FOR OPEN CIRCUIT

Using an ohmmeter, measure the resistance between the terminals as shown.

Specified resistance: 30 — 50 Ω at 20°C (68°F)

If resistance is not within specification, replace the VSV.



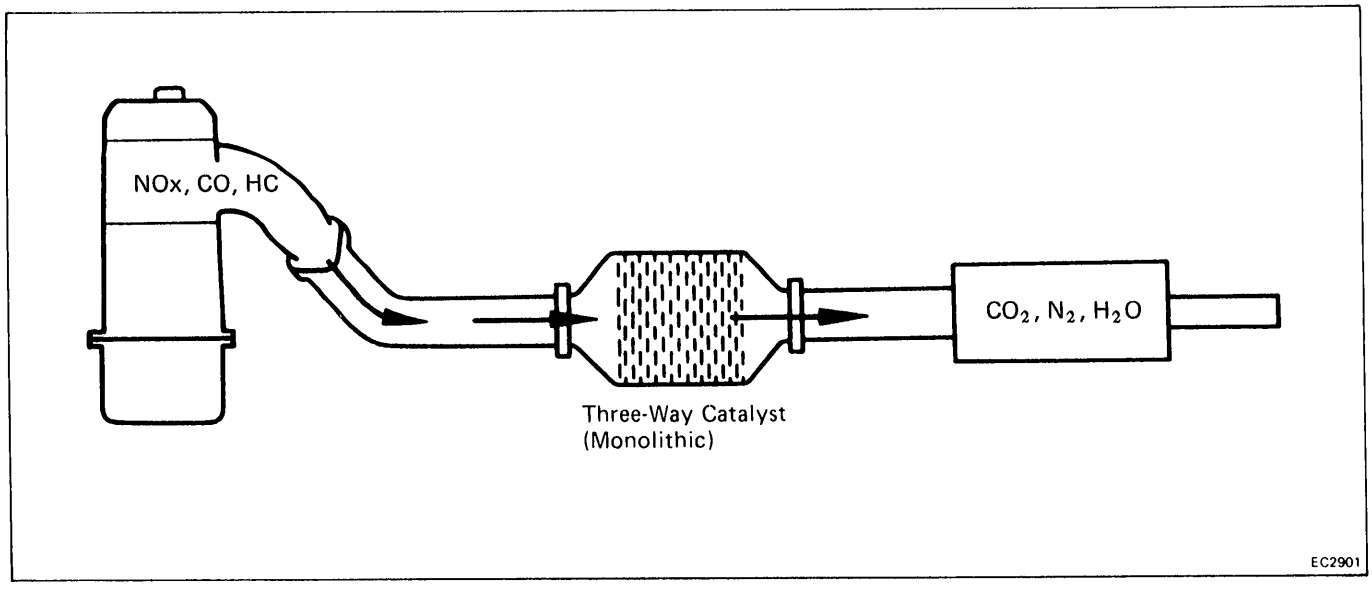
INSPECTION OF CHECK VALVE

CHECK VALVE BY BLOWING AIR INTO EACH PIPE

(a) Check that air flows from the orange pipe to the black pipe.

(b) Check that air does not flow from the block pipe to the orange pipe.

THREE-WAY CATALYST (TWC) SYSTEM

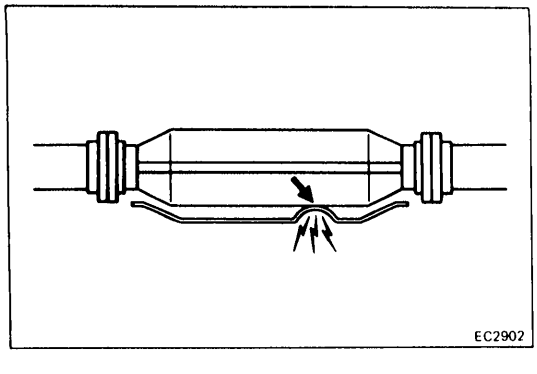


To reduce HC, CO and NOx emissions, they are oxidized, reduced and converted to nitrogen (N_2), carbon dioxide (CO_2) and water (H_2O) by the catalyst.

Exhaust Port		TWC		Exhaust Gas
HC, CO and NOx	→	Oxidation and reduction	→	CO_2 H_2O N_2

INSPECTION OF EXHAUST PIPE ASSEMBLY

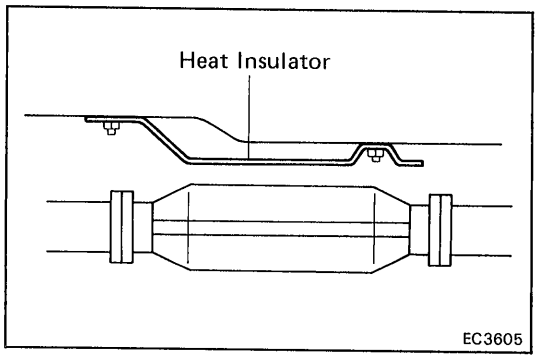
1. **CHECK CONNECTIONS FOR LOOSENESS OR DAMAGE**
2. **CHECK CLAMPS FOR WEAKNESS, CRACKS OR DAMAGE**



INSPECTION OF CATALYTIC CONVERTER

CHECK FOR DENTS OR DAMAGE

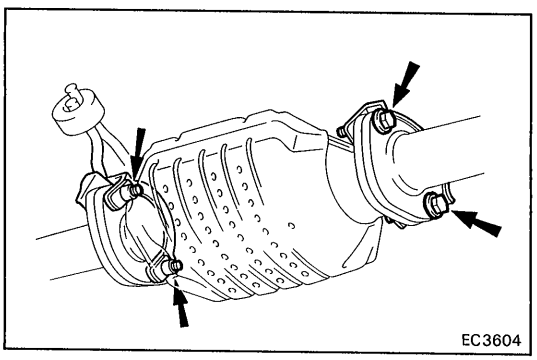
If any part of the protector is damaged or dented to the extent that it contacts the catalyst, repair or replace it.



INSPECTION OF HEAT INSULATOR

1. **CHECK HEAT INSULATOR FOR DAMAGE**

2. **CHECK FOR ADEQUATE CLEARANCE BETWEEN CATALYTIC CONVERTER AND HEAT INSULATOR**



REPLACEMENT OF CATALYTIC CONVERTER

1. **REMOVE CONVERTER**
   (a) Jack up the vehicle.
   (b) Check that the converter is cool.
   (c) Remove the bolts at the front and rear of the converter.
   (d) Remove the converter and gaskets.

2. **INSTALL CONVERTER**
   (a) Place new gaskets on the converter front and rear pipes, and connect the converter to the exhaust pipes.
   (b) Torque the bolts.

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

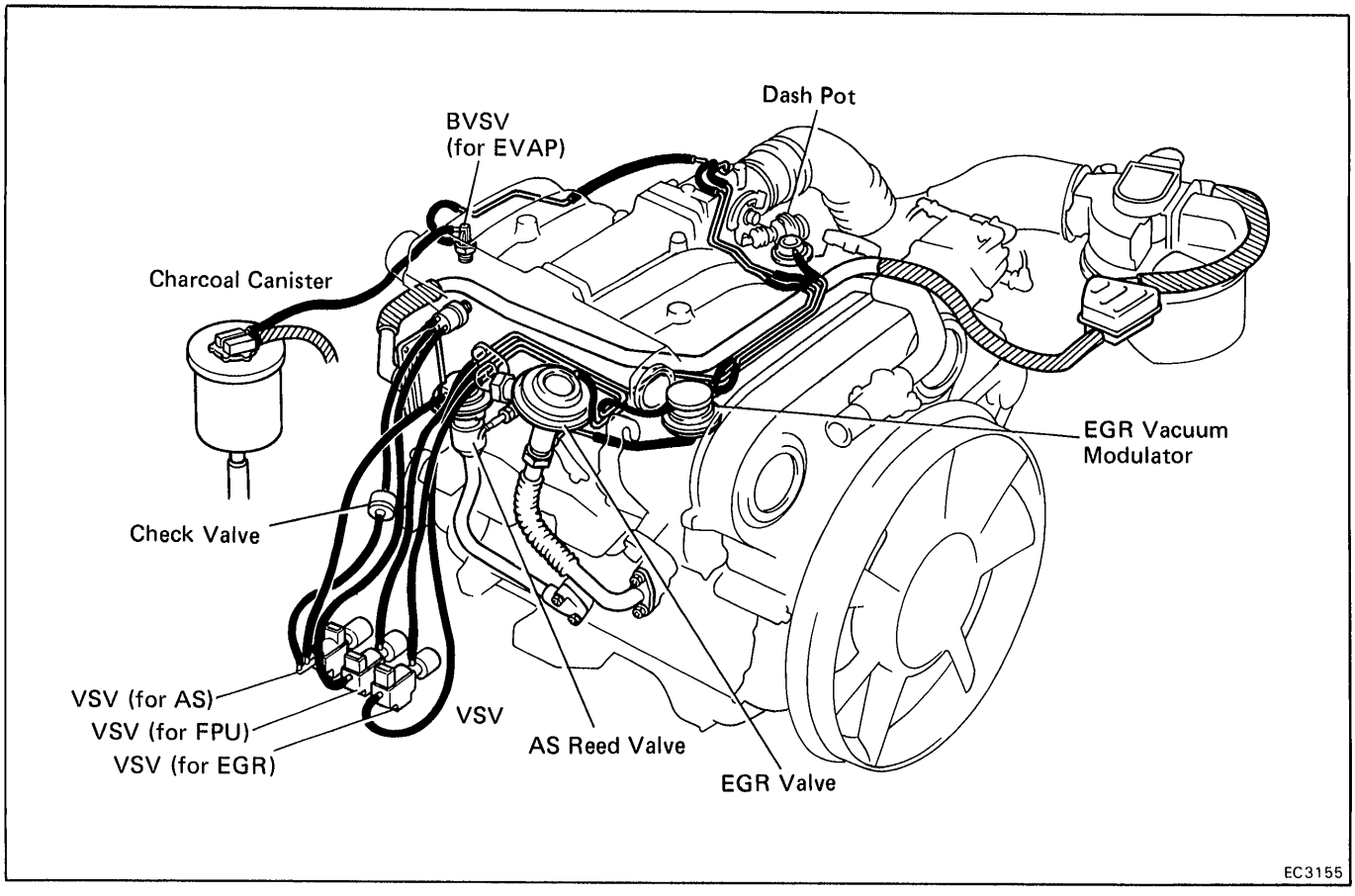
   (c) Reinstall the bracket bolts and tighten them.

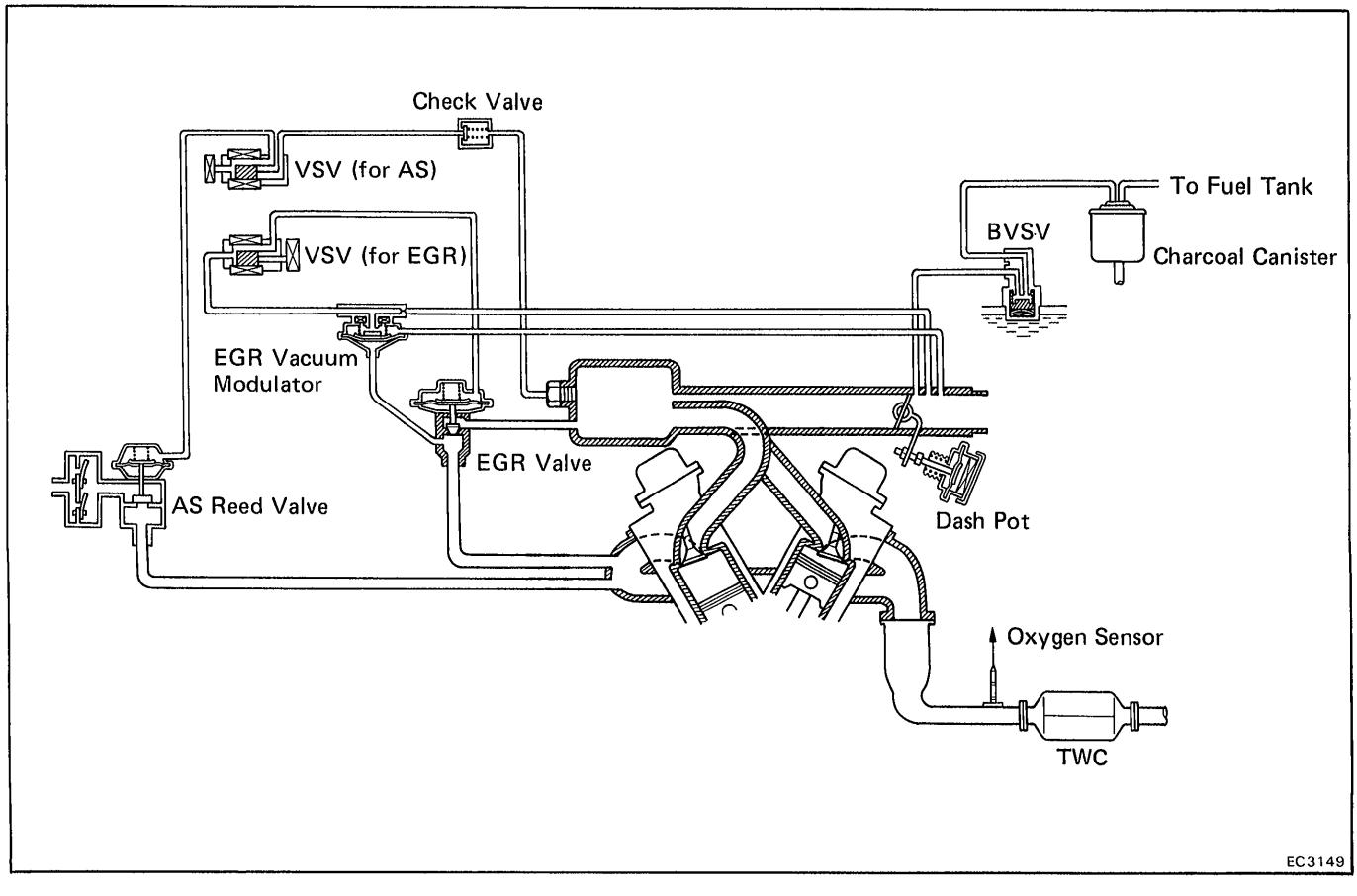
SYSTEM PURPOSE

System	Abbreviation	Purpose
Positive crankcase ventilation	PCV	Reduces blow-by gas (HC)
Fuel evaporative emission control	EVAP	Reduces evaporative HC
Dash pot	DP	Reduces HC and CO
Exhaust gas recirculation	EGR	Reduces NOx
Air suction	AS	Reduces HC and CO
Three-way catalyst	TWC	Reduces HC, CO and NOx
Electronic fuel injection*	EFI	Regulates all engine conditions for reduction of exhaust emissions.

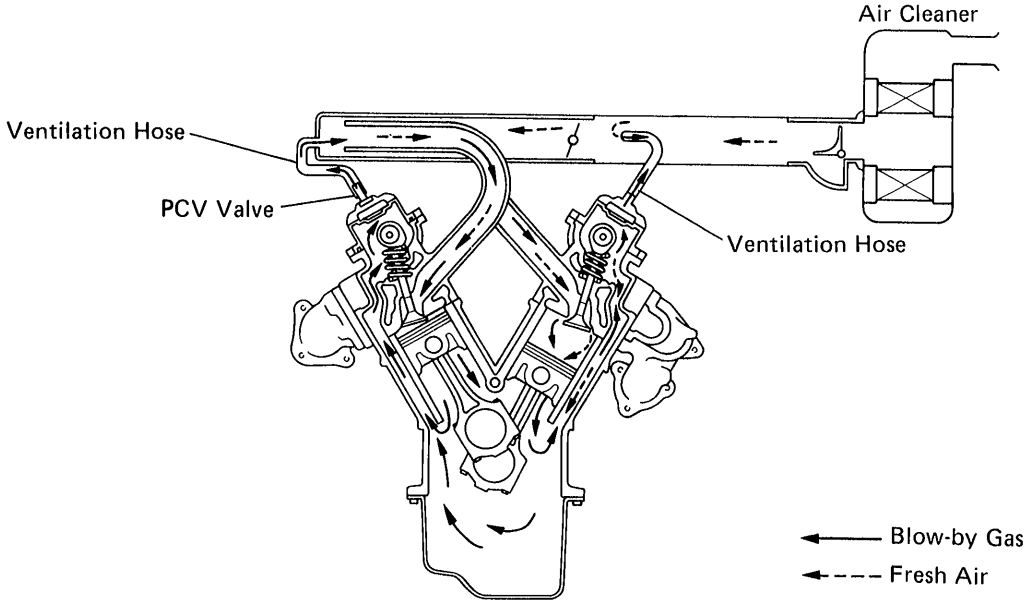
Remarks: For inspection and repair of the EFI system, refer to the EFI section of this manual.

COMPONENT LAYOUT AND SCHEMATIC DRAWING





POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

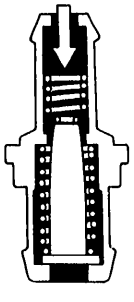


EC3141

To reduce HC emissions, crankcase blow-by gas (HC) is routed through the PCV valve to the intake manifold for combustion in the cylinders.

Engine not Running or Backfiring

Intake Manifold Side

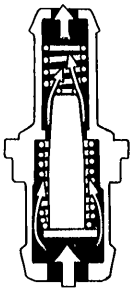


Cylinder Head Side

- PCV VALVE IS CLOSED.

EC1001

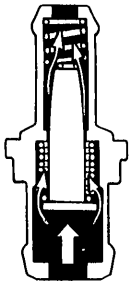
Normal Operation



- PCV VALVE IS OPEN.
- VACUUM PASSAGE IS LARGE.

EC1002

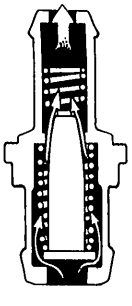
Idling or Decelerating



- PCV VALVE IS OPEN.
- VACUUM PASSAGE IS SMALL.

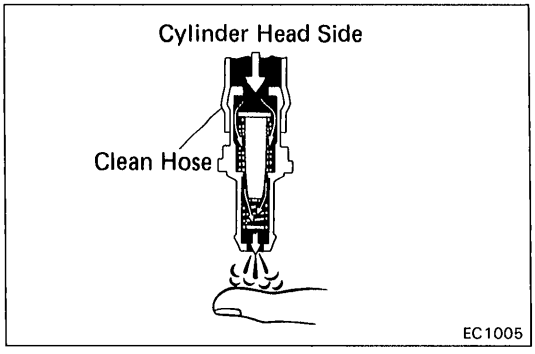
EC1003

Acceleration or Heavy Load



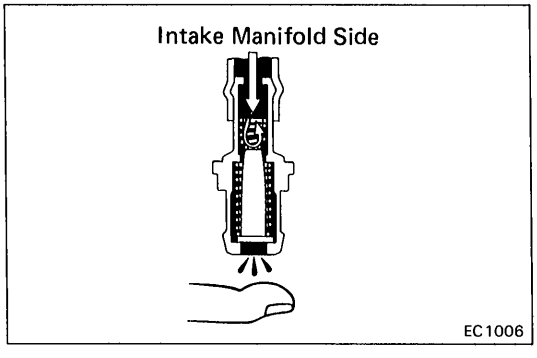
- PCV VALVE IS FULLY OPEN.

EC1004

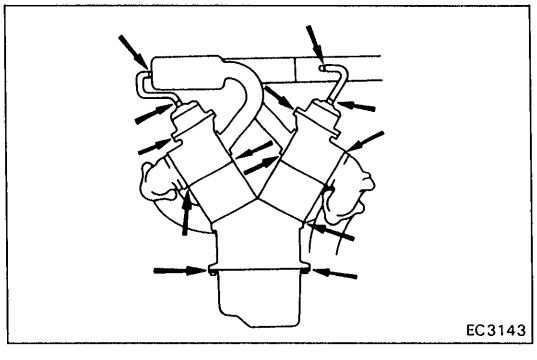


INSPECTION OF PCV VALVE

1. **REMOVE PCV VALVE**
2. **ATTACH CLEAN HOSE TO PCV VALVE**
3. **BLOW FROM CYLINDER HEAD SIDE**
   Check that air passes through easily.
   NOTICE: Do not suck air through the valve.
   Petroleum substances inside the valve are harmful.



4. **BLOW FROM INTAKE MANIFOLD SIDE**
   Check that air passes through with difficulty.
   If the PCV valve fails either check, replace it.
5. **REINSTALL PCV VALVE**

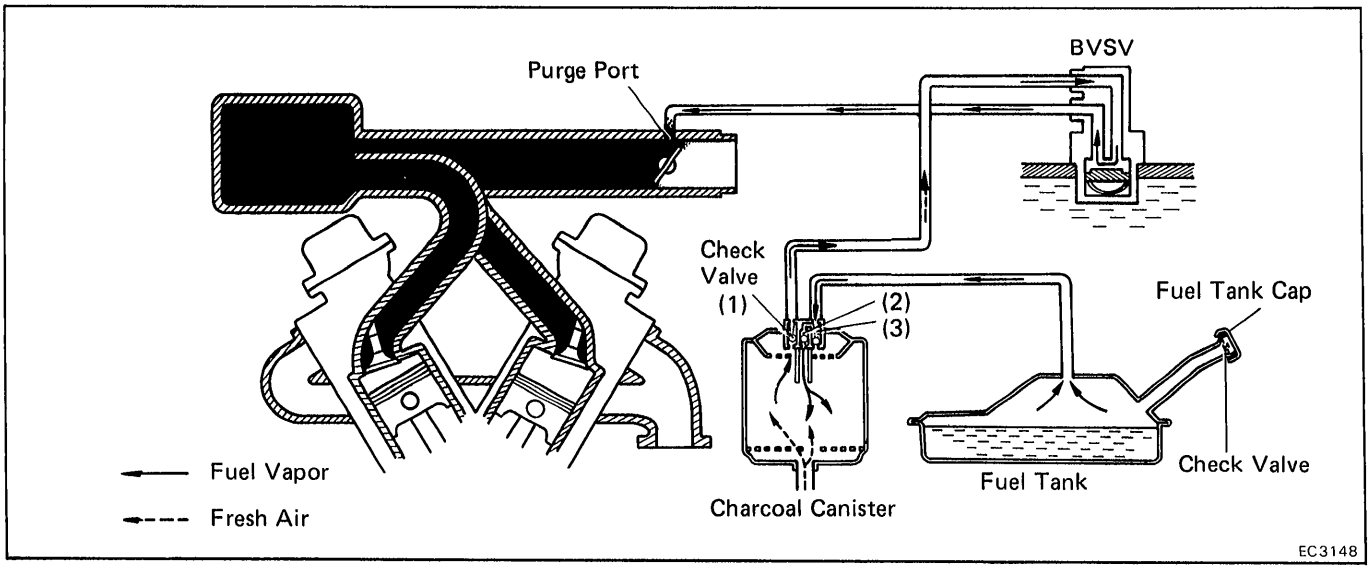


INSPECTION OF PCV HOSES AND CONNECTIONS

VISUALLY INSPECT HOSES, CONNECTIONS AND GASKETS

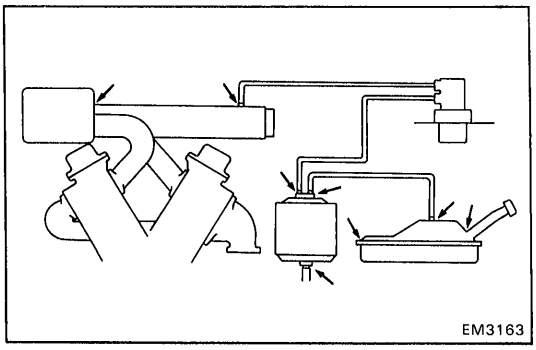
Check for cracks, leaks or damage.

FUEL EVAPORATIVE EMISSION CONTROL (EVAP) SYSTEM



To reduce HC emission, evaporated fuel from the fuel tank is routed through the charcoal canister to the intake manifold for combustion in the cylinders.

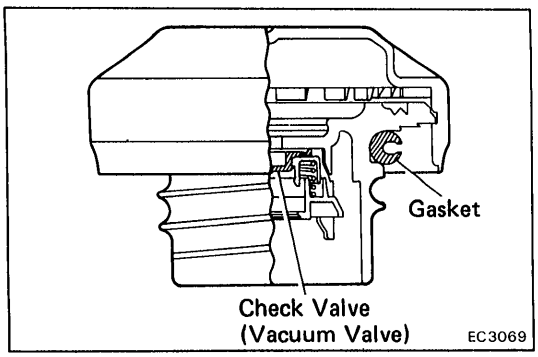
Coolant Temp.	BVSV	Throttle Valve Opening	Check Valve in Charcoal Canister			Check Valve in Cap	Evaporated Fuel (HC)
			(1)	(2)	(3)		
Below 35°C (95°F)	CLOSED	–	–	–	–	–	HC from tank is absorbed in the canister.
Above 54°C (129°F)	OPEN	Positioned below purge port	CLOSED	–	–	–	
		Positioned above purge port	OPEN	–	–	–	HC from canister is led into air intake manifold.
High pressure in tank	–	–	–	OPEN	CLOSED	CLOSED	HC from tank is absorbed in the canister.
High vacuum in tank	–	–	–	CLOSED	OPEN	OPEN	(Air is led into the fuel tank.)



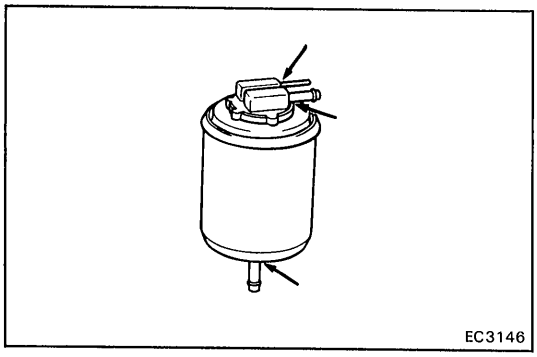
INSPECTION OF FUEL VAPOR LINES, FUEL TANK AND TANK CAP

1. **VISUALLY INSPECT LINES AND CONNECTIONS**
   Look for loose connections, sharp bends or damage.

2. **VISUALLY INSPECT FUEL TANK**
   Look for deformation, cracks or fuel leakage.



3. **VISUALLY INSPECT FUEL TANK CAP**
   Look for a damaged or deformed gasket and cap.
   If necessary, repair or replace the cap.

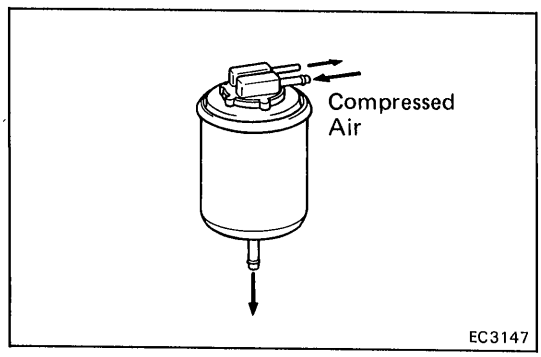

EC3146

INSPECTION OF CHARCOAL CANISTER

1. **REMOVE CHARCOAL CANISTER**

2. **VISUALLY INSPECT CHARCOAL CANISTER CASE**

   Look for cracks or damage.



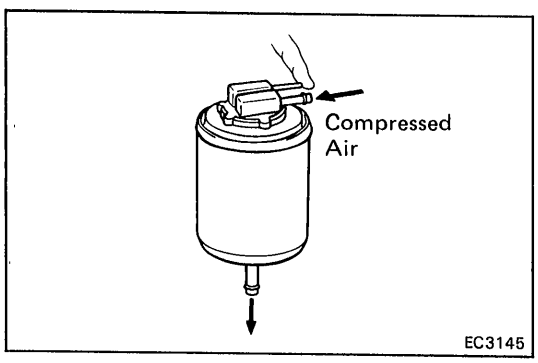
EC3147

3. **CHECK FOR CLOGGED FILTER AND STUCK CHECK VALVE**

   (a) Using low pressure compressed air, blow into the tank pipe and check that the air flows without resistance from the other pipes.

   (b) Blow into the purge pipe and check that the air does not flow from the other pipes.

   If a problem is found, replace the charcoal canister.



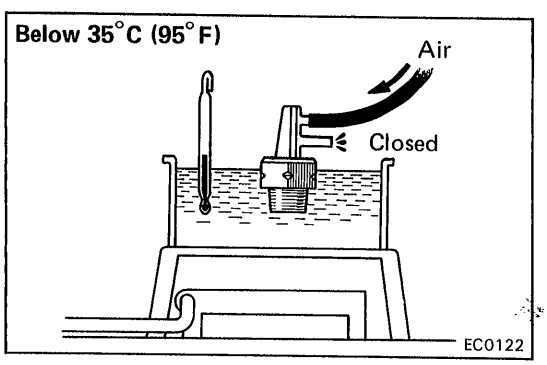
EC3145

4. **CLEAN FILTER IN CANISTER**

   Clean the filter by blowing 3 kg/cm² (43 psi, 294 kPa) of compressed air into the tank pipe, while holding the purge pipe closed.

   HINT:
   - Do not attempt to wash the canister.
   - No activated carbon should come out.

5. **INSTALL CHARCOAL CANISTER**



EC0122

INSPECTION OF BVSV

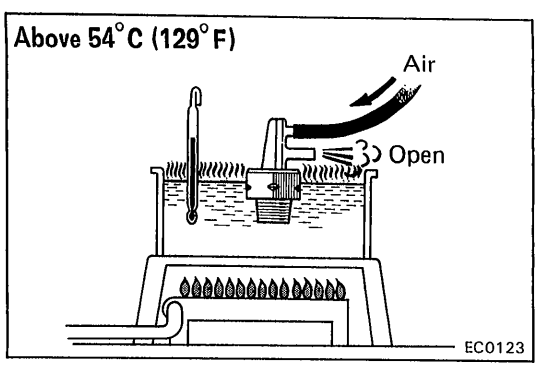
CHECK BVSV BY BLOWING AIR INTO PIPE

(a) Drain the coolant from the radiator into a suitable container.

(b) Remove the BVSV from the intake manifold.

(c) Cool the BVSV to below 35°C (95°F) with cold water.

(d) Blow air into a pipe and check that the BVSV closed.



EC0123

(e) Heat the BVSV to above 54°C (129°C) with hot water.

(f) Blow air into a pipe and check that the BVSV opens.

If a problem is found, replace the BVSV.

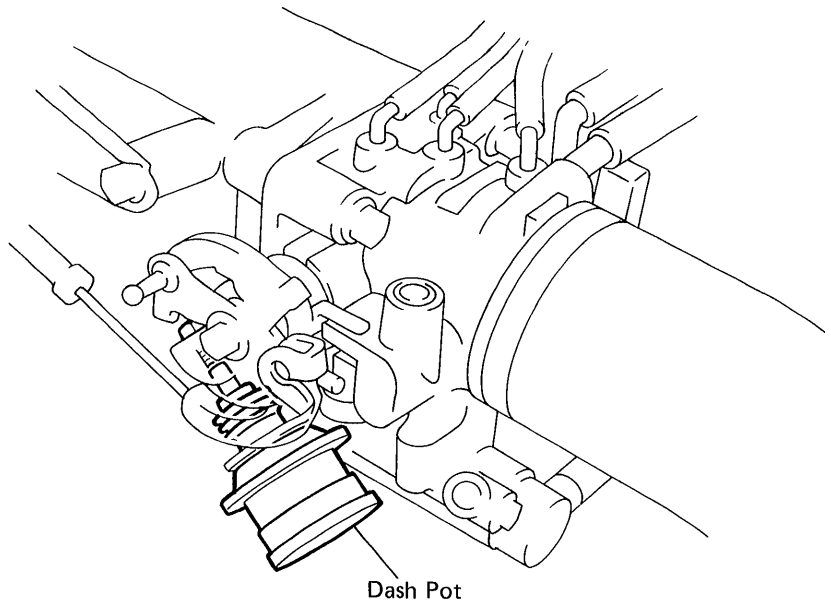
(g) Apply sealant to the threads of the BVSV and reinstall.

Sealant: Part No.08833-00070, THREE BOND 1324 or equivelent

Torque: 250 kg-cm (18 ft-lb, 25 N·m)

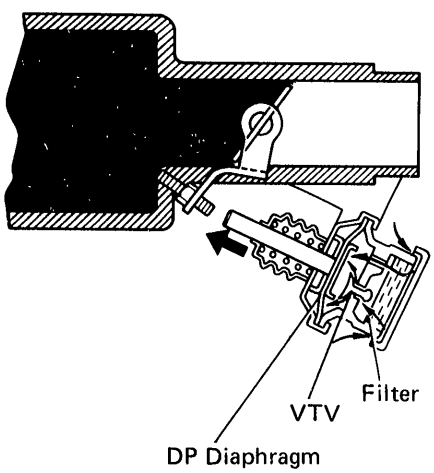
(h) Fill the radiator with coolant.

DASH POT (DP) SYSTEM



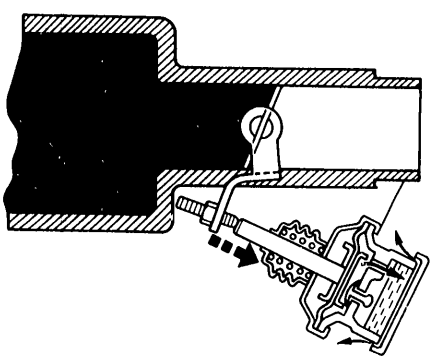
EC3342

Normal Driving



EC3122

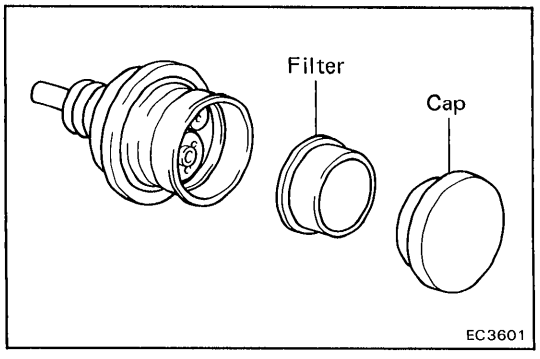
Deceleration



EC3123

To reduce HC and CO emissions, when decelerating the dash pot opens the throttle valve slightly more than at idle. This causes the air-fuel mixture to burn completely.

Condition	Diaphragm	VTV	Throttle Valve
Idling	Pushed in by return force of throttle valve	CLOSED	Idle speed position
Normal driving	Pushed out by diaphragm spring	OPEN	High speed position
Deceleration	Pushed in by return force of throttle valve	CLOSED	Slightly opens and then slowly closes to idle position



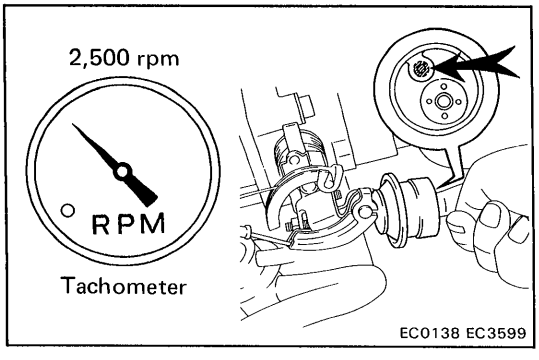
INSPECTION OF DP SYSTEM

1. **WARM UP ENGINE**

2. **CHECK IDLE SPEED AND ADJUST, IF NECESSARY**

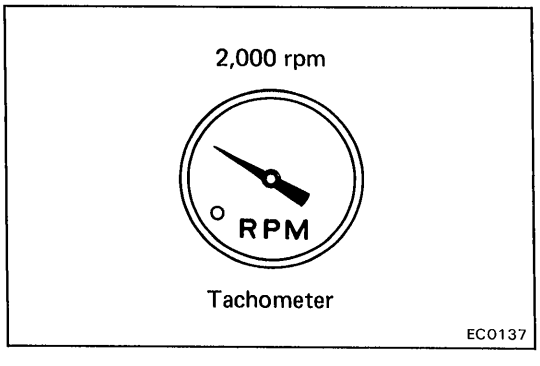
3. **CHECK DP SETTING SPEED**

(a) Remove the cap, filter from the DP.



(b) Race the engine at 2,500 rpm for a few seconds.

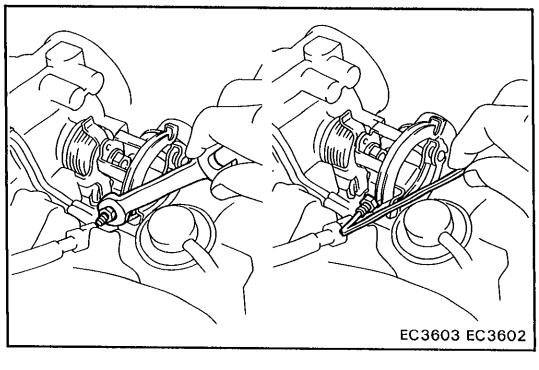
(c) Plug the VTV hole.



(d) Release the throttle valve.

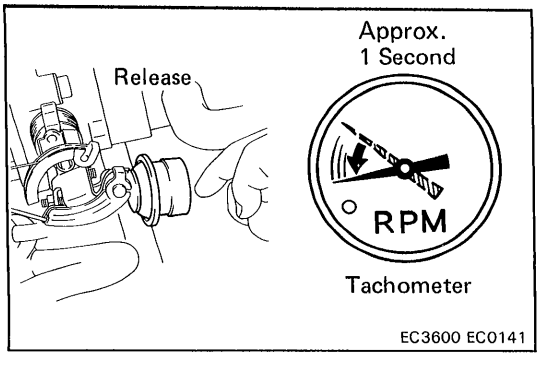
(e) Check the DP setting speed.

DP setting speed: 2,000 rpm



If not at specified speed, adjust with the DP adjusting screw.

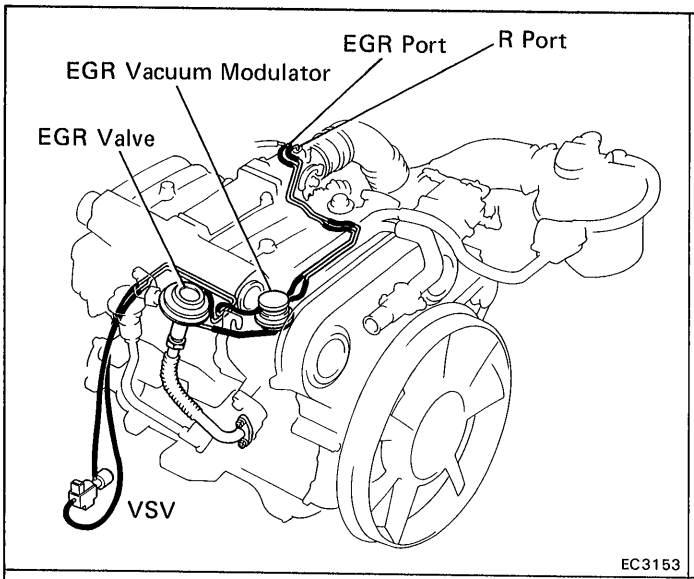
(f) Reinstall the DP filter and cap.



4. **CHECK VTV OPERATION**

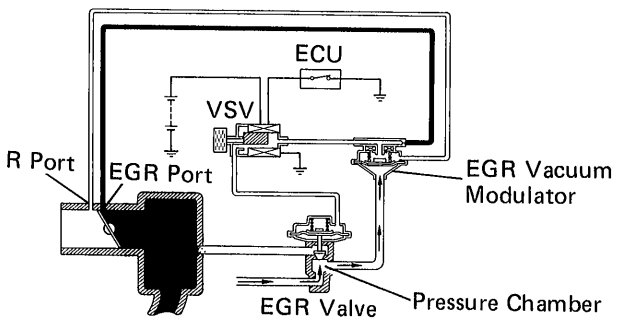
Race the engine at 2,500 rpm for few seconds, release the throttle valve and check that the engine returns to idle in approx. 1 second.

EXHAUST GAS RECIRCULATION (EGR) SYSTEM



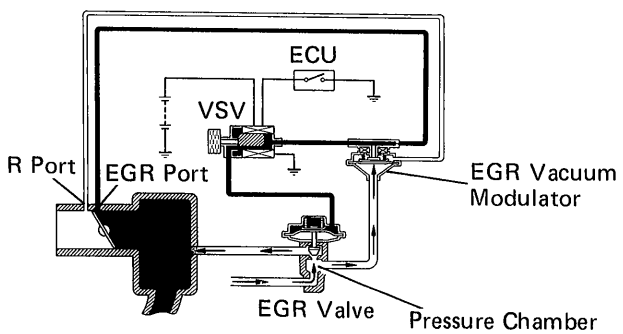
EC3153

(1)



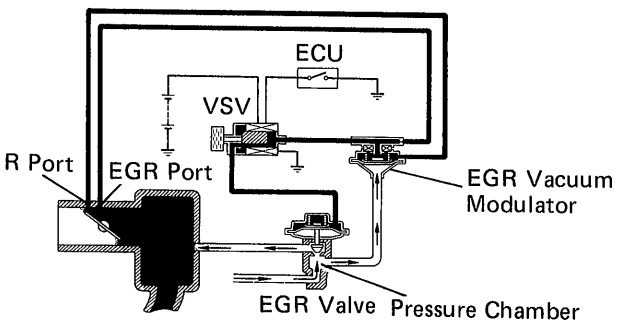
EC3606

(2)



EC3607

(3)



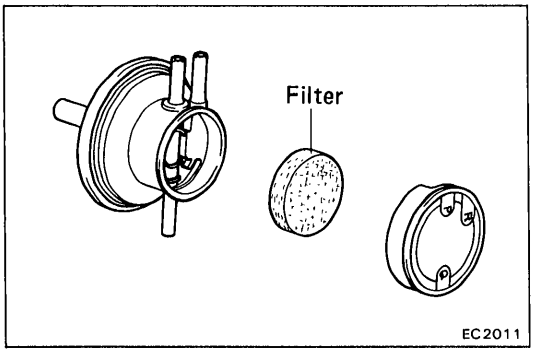
EC3608

To reduce NOx emissions, part of the exhaust gases are recirculated through the EGR valve to the intake manifold to lower the maximum combustion temperature.

Coolant Temp.	VSV	Throttle Valve Opening Angle	Pressure in the EGR Valve Pressure Chamber		EGR Vacuum Modulator	EGR Valve	Exhaust Gas
Below 48°C (118°F)	CLOSED	–	–		–	CLOSED	Not recirculated
Above 52°C (126°F)	OPEN	Positioned below EGR port	–		–	CLOSED	Not recirculated
		Positioned between EGR port and R port	(1) LOW	* Pressure constantly alternating between low and high	OPENS passage to atmosphere	CLOSED	Not recirculated
			(2) HIGH		CLOSES passage to atmosphere	OPEN	Recirculated
		Positioned above R port	(3) HIGH	**	CLOSES passage to atmosphere	OPEN	Recirculated (increase)

Remarks: * Pressure increase → Modulator closes → EGR valve opens → Pressure drops
↑ EGR valve closes ← Modulator opens ←

** When the throttle valve is positioned above the R port, the EGR vacuum modulator will close the atmosphere passage and open the EGR valve to increase the EGR gas, even if the exhaust pressure is insufficiently low.

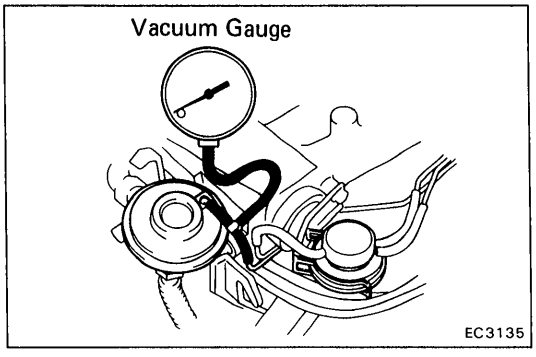


INSPECTION OF EGR SYSTEM

1. CHECK AND CLEAN FILTER IN EGR VACUUM MODULATOR

(a) Check the filter for contamination or damage.

(b) Using compressed air, clean the filter.

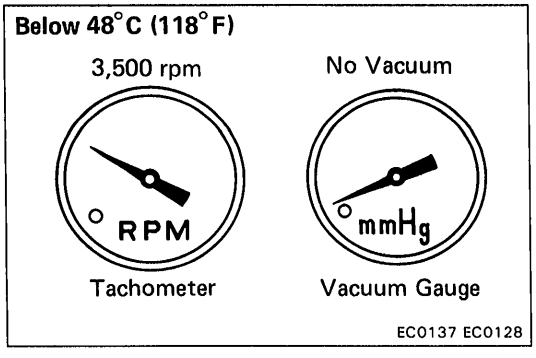


2. PREPARATION

Disconnect the vacuum hose from the EGR valve and using a three way union, connect a vacuum gauge to it.

3. CHECK SEATING OF EGR VALVE

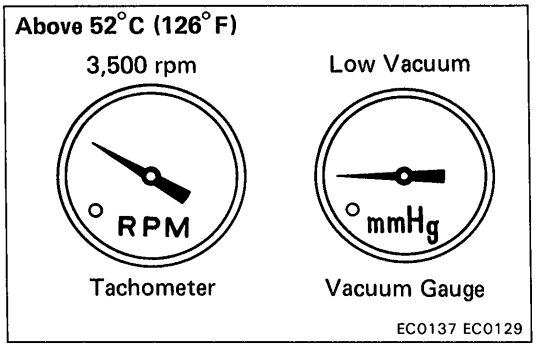
Start the engine and check that the engine starts and runs at idle.



4. CHECK VSV WITH COLD ENGINE

(a) The coolant temperature should be below 48°C (118°F).

(b) Check that the vacuum gauge indicates is zero at 3,500 rpm.

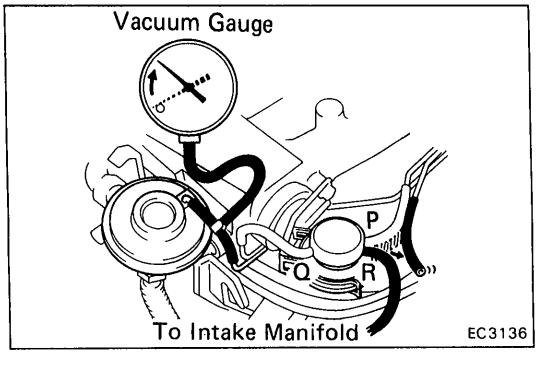


5. CHECK VSV AND EGR VACUUM MODULATOR WITH WARM ENGINE

(a) Warm up the engine.

(b) Check that the vacuum gauge indicates is zero at idle.

(c) Check that the vacuum gauge indicates low vacuum at 3,500 rpm.

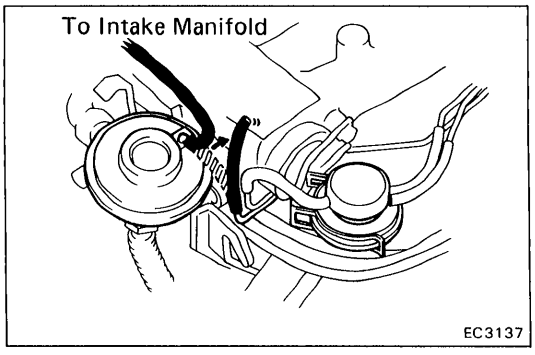


(d) Disconnect the vacuum hose from R port of the EGR vacuum modulator and connect R port directly to the intake manifold with another hose.

(e) Check that the vacuum gauge indicates high vacuum at 3,500 rpm.

HINT: As a large amount of EGR gas enters, the engine will misfire slightly.

(f) Disconnect the vacuum gauge and reconnect the vacuum hoses to the proper locations.



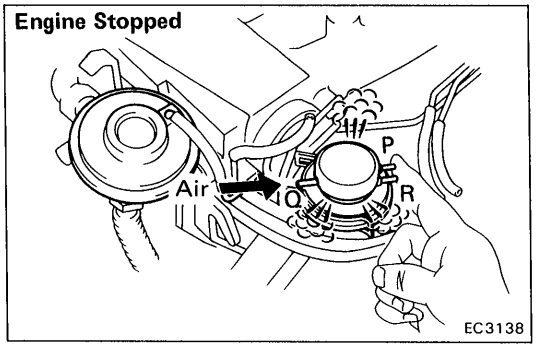
6. CHECK EGR VALVE

(a) Apply vacuum directly to the EGR valve with the engine runs rough or dies.

(b) Check that the engine runs rough or dies.

(c) Reconnect the vacuum hoses to the proper locations.

If no problem is found with this inspection, the system is okay; otherwise inspect each part.



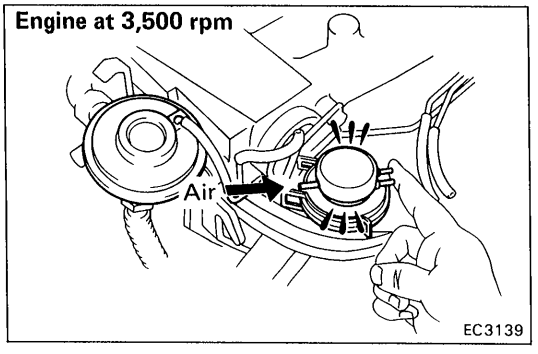
INSPECTION OF EGR VACUUM MODULATOR

CHECK EGR VACUUM MODULATOR OPERATION

(a) Disconnect the vacuum hoses from port P, Q and R of the EGR vacuum modulator.

(b) Plug ports P and R with your finger.

(c) Blow air into port Q. Check that the air passes through to the air filter side freely.

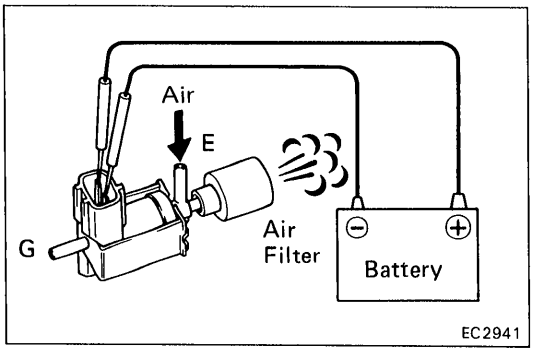


(d) Start the engine and maintain speed at 3,500 rpm.

(e) Repeat the above test. Check that there is a strong resistance to air flow.

(f) Reconnect the vacuum hoses to the proper locations.

If a problem is found, replace the EGR vacuum modulator.

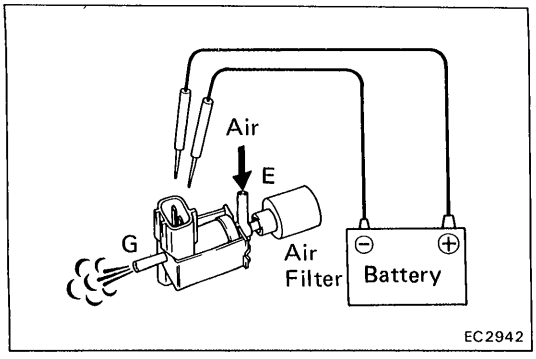


INSPECTION OF VSV

1. CHECK VACUUM CIRCUIT CONTINUITY IN THE VSV BY BLOWING AIR INTO PIPE

(a) Connect the VSV terminals to the battery terminals as illustrated.

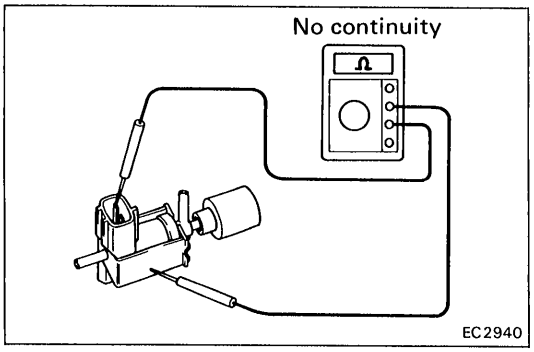
(b) Blow air into a pipe E and check that comes out of air filter.



(c) Disconnect the battery.

(d) Blow air into a pipe E and check that air comes out of pipe G.

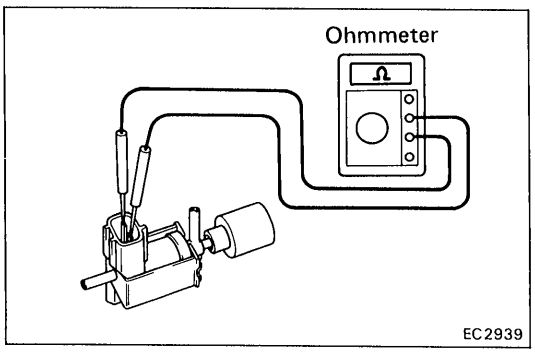
If a problem is found, replace the VSV.



2. **CHECK FOR SHORT CIRCUIT**

Using an ohmmeter, check that there is no continuity between the terminals and the VSV body.

If there is continuity, replace the VSV.



3. **CHECK FOR OPEN CIRCUIT**

Using an ohmmeter, measure the resistance between the terminals.

Specified resistance: 30 — 50 Ω at 20°C (68°F)

If the resistance is not within specification, replace the VSV.

INSPECTION OF EGR VALVE

1. **REMOVE EGR VALVE**

Check the valve for sticking and heavy carbon deposits.

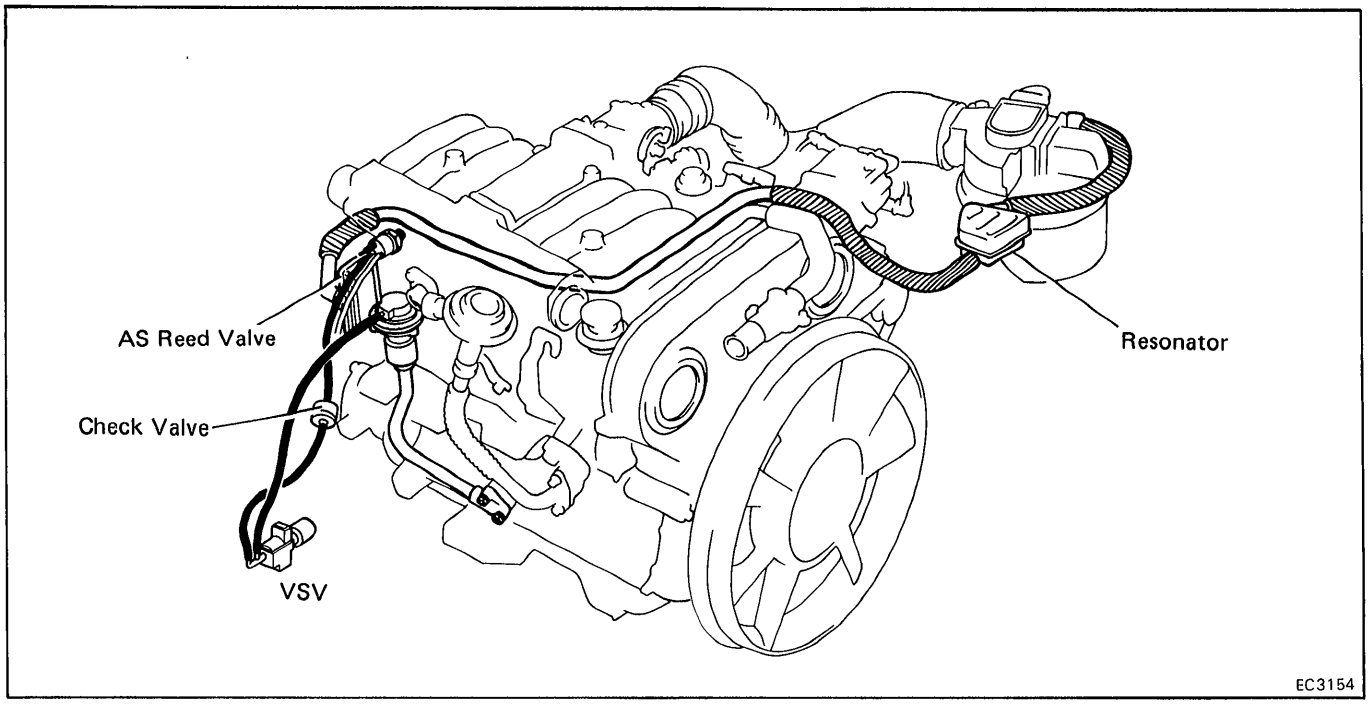
If a problem is found, replace it.

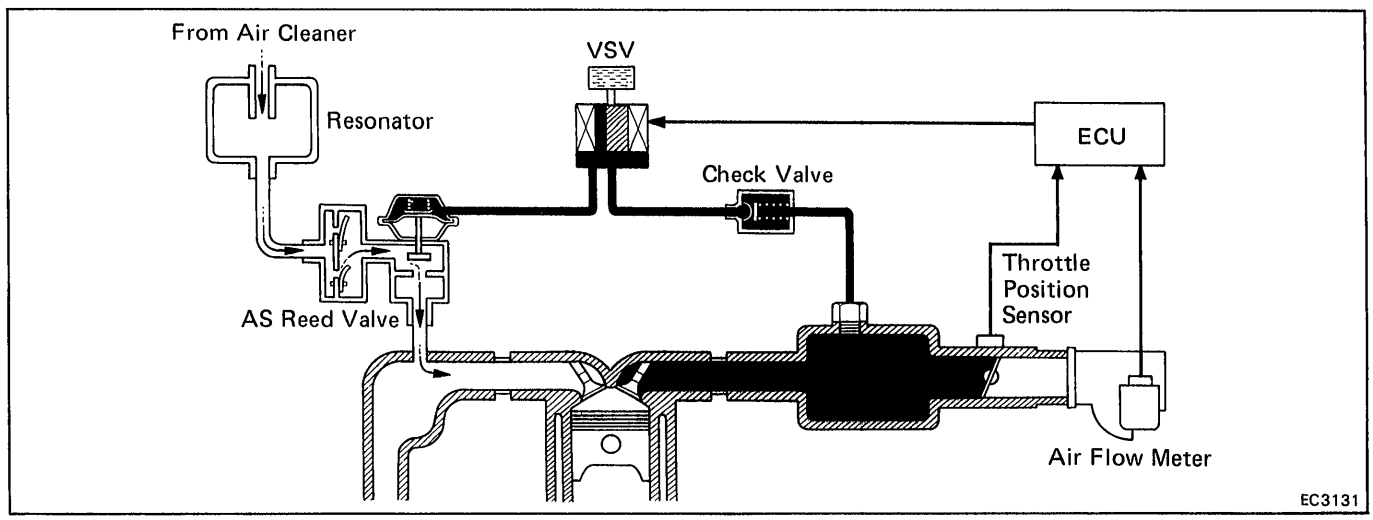
2. **INSTALL EGR VALVE WITH NEW GASKET**

INSPECTION OF WATER TEMP. SENSOR

(See page FI-196)

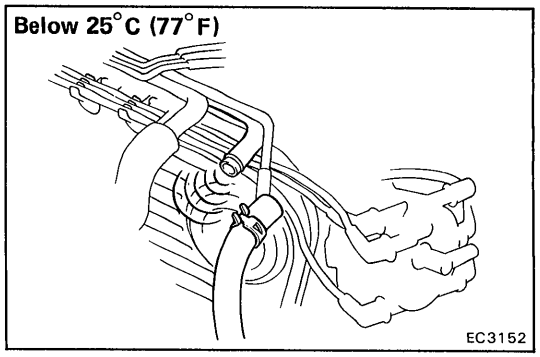
AIR SUCTION (AS) SYSTEM





To reduce HC and CO emissions, this system draws in air into exhaust ports to accelerate oxidation, using vacuum generated by the exhaust pulsation in the exhaust manifold.

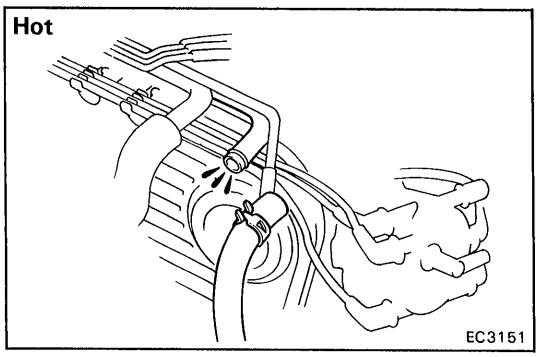
Condition	Coolant Temp.	Throttle Valve Position	Engine RPM	VSV	AS
Normal driving	Below 25°C (77°F)	–	–	ON	ON
Deceleration	Above 35°C (95°F)	Idling	Below 1,000 rpm	OFF	OFF
			Between 1,200 – 3,200 rpm	ON	ON



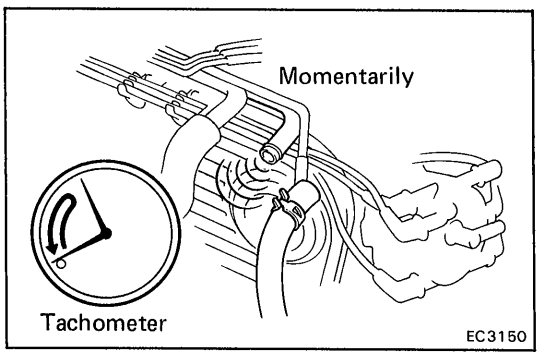
INSPECTION OF AS SYSTEM

1. **VISUALLY CHECK HOSES AND TUBES AND FOR CRACKS, KINKS, DAMAGE OR LOOSE CONNECTIONS**

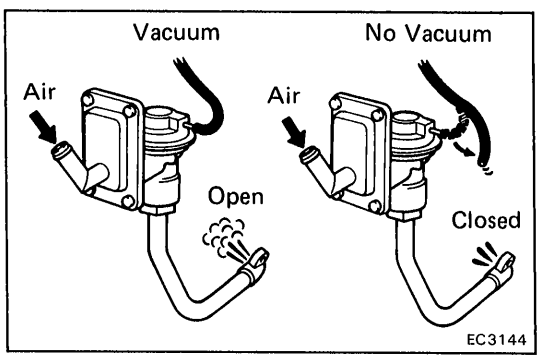
2. **CHECK AS SYSTEM WITH COLD ENGINE**
   (a) The coolant temperature should be below 25°C (77°F).
   (b) Disconnect the No.2 air hose from the air pipe.
   (c) Check that a bubbling noise is head from the air pipe at idle.



3. **CHECK AS SYSTEM WITH WARM ENGINE**
   (a) Warm up the engine.
   (b) With the engine idling, check that a bubbling noise in not head from the air pipe.



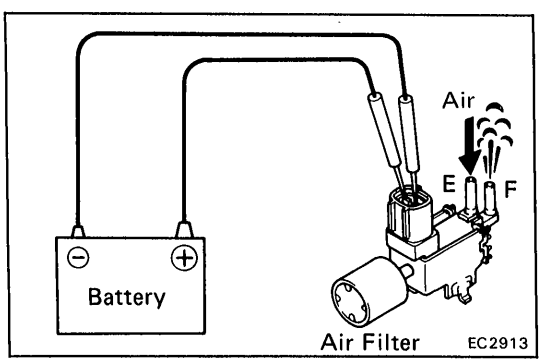
   (c) Race the engine above 2,000 rpm and quickly close the throttle valve. Check that a bubbling noise stops momentarily.



INSPECTION OF AS REED VALVE

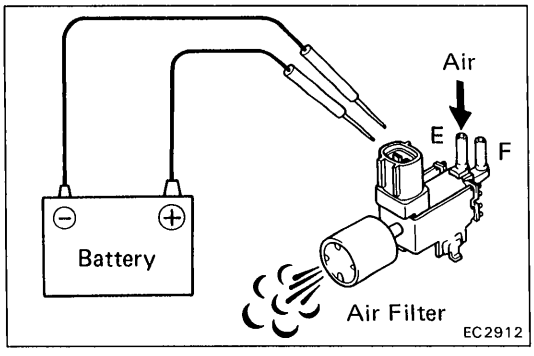
CHECK REED VALVE BY BLOWING AIR INTO PIPE

(a) Apply vacuum to the reed valve diaphragm.
(b) Blow air into a pipe and check that the reed valve is open.
(c) Release the vacuum and check that the reed valve is closed.



INSPECTION OF VSV

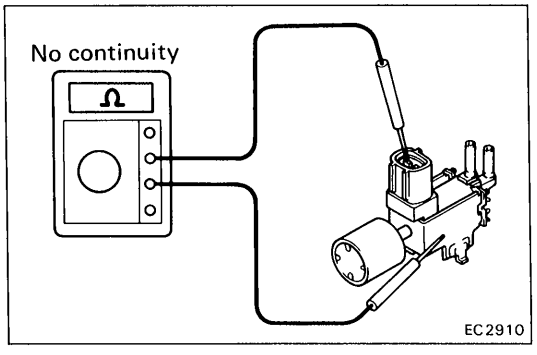
1. **CHECK VACUUM CIRCUIT CONTINUITY IN THE VSV BY BLOWING AIR INTO PIPE**
   (a) Connect the VSV terminals to the battery terminals as illustrated.
   (b) Blow air into pipe E and check that air comes out of pipe F.



(c) Disconnect the battery.

(d) Blow air into a pipe E and check that air comes out of air filter.

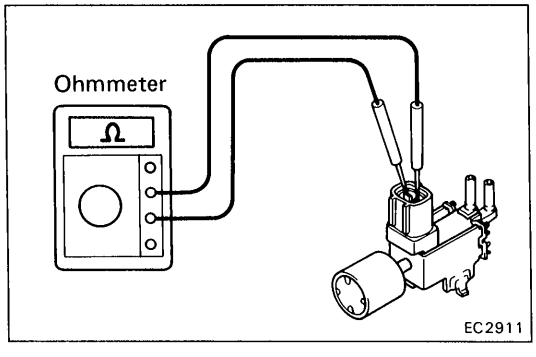
If a problem is found, replace the VSV.



2. CHECK FOR SHORT CIRCUIT

Using an ohmmeter, check that there is no continuity between the terminals and the VSV body.

If there is continuity, replace the VSV.

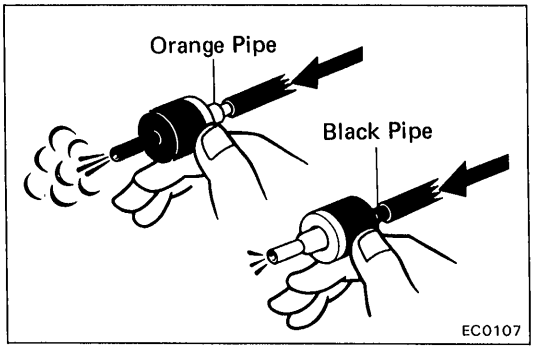


3. CHECK FOR OPEN CIRCUIT

Using an ohmmeter, measure the resistance between the terminals.

Specified resistance: 30 — 50 Ω at 20°C (68°F)

If the resistance is not within specification, replace the VSV.



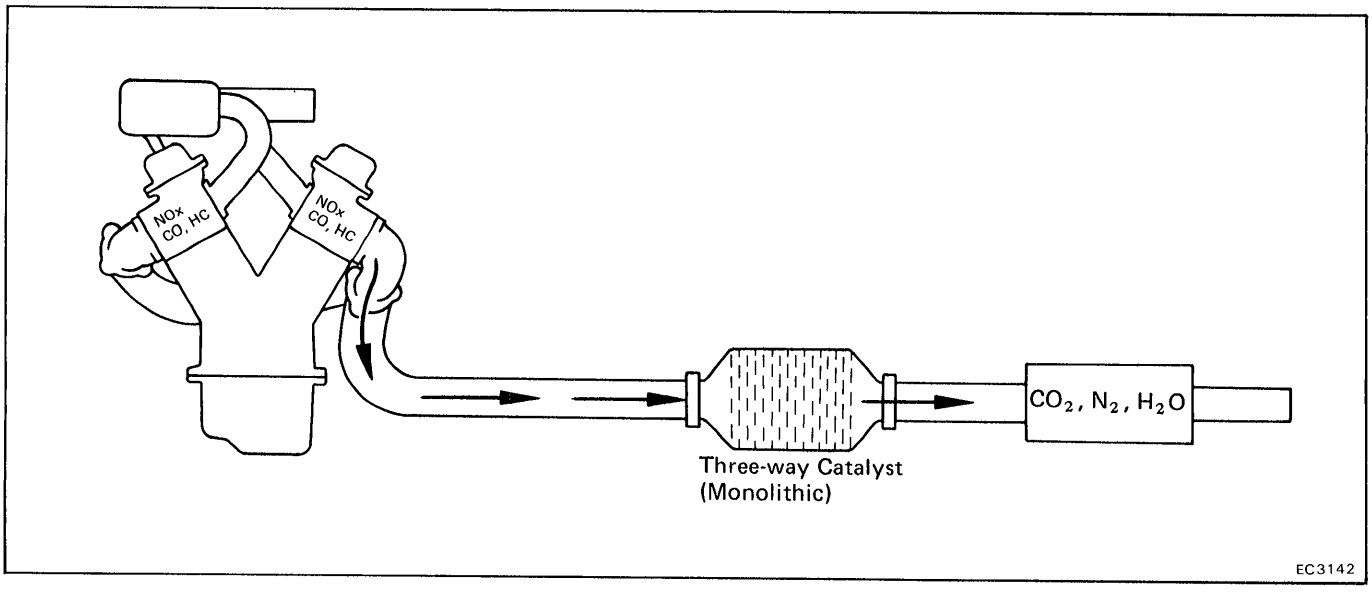
INSPECTION OF CHECK VALVE

CHECK VALVE BY BLOWING AIR INTO EACH PIPE

(a) Check that air flows from the orange pipe to the black pipe.

(b) Check that air does not flow from the black pipe to the orange pipe.

THREE-WAY CATALYST (TWC) SYSTEM

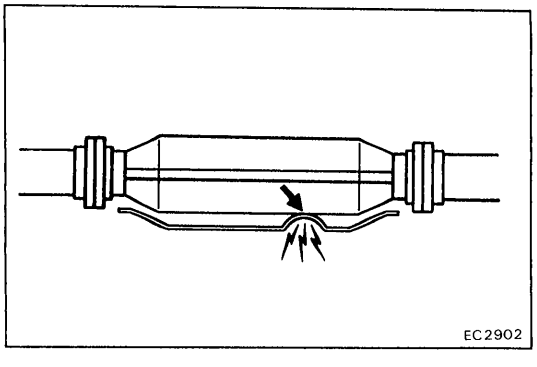


To reduce HC, CO and NOx emissions, they are oxidized, reduced and converted to nitrogen (N_2), carbon dioxide (CO_2) and water (H_2O) by the catalyst.

Exhaust Port		TWC		Exhaust Gas
HC, CO and NOx	→	Oxidation and reduction	→	CO_2 H_2O N_2

INSPECTION OF EXHAUST PIPE ASSEMBLY

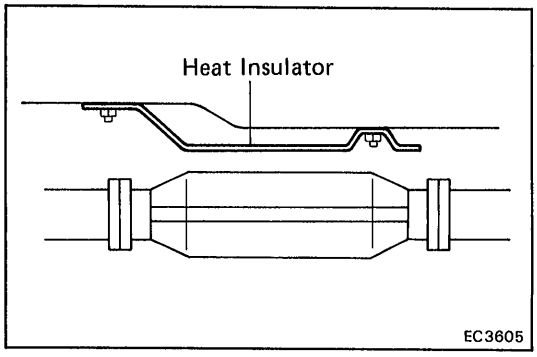
1. CHECK CONNECTIONS FOR LOOSENESS OR DAMAGE
2. CHECK CLAMPS FOR WEAKNESS, CRACKS OR DAMAGE



INSPECTION OF CATALYTIC CONVERTER

CHECK FOR DENTS OR DAMAGE

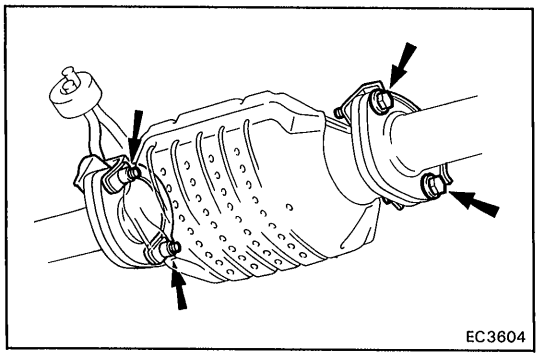
If any part of the protector is damaged or dented to the extent that it contacts the catalyst, repair or replace it.



INSPECTION OF HEAT INSULATOR

1. **CHECK HEAT INSULATOR FOR DAMAGE**

2. **CHECK FOR ADEQUATE CLEARANCE BETWEEN CATALYTIC CONVERTER AND HEAT INSULATOR**



REPLACEMENT OF CATALYTIC CONVERTER

1. **REMOVE CONVERTER**
   (a) Jack up the vehicle.
   (b) Check that the converter is cool.
   (c) Remove the bolts at the front and rear of the converter.
   (d) Remove the converter and gasket.

2. **INSTALL CONVERTER**
   (a) Place new gaskets on the converter front and rear pipes, and connect the converter to the exhaust pipes.
   (b) Torque the bolts.

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

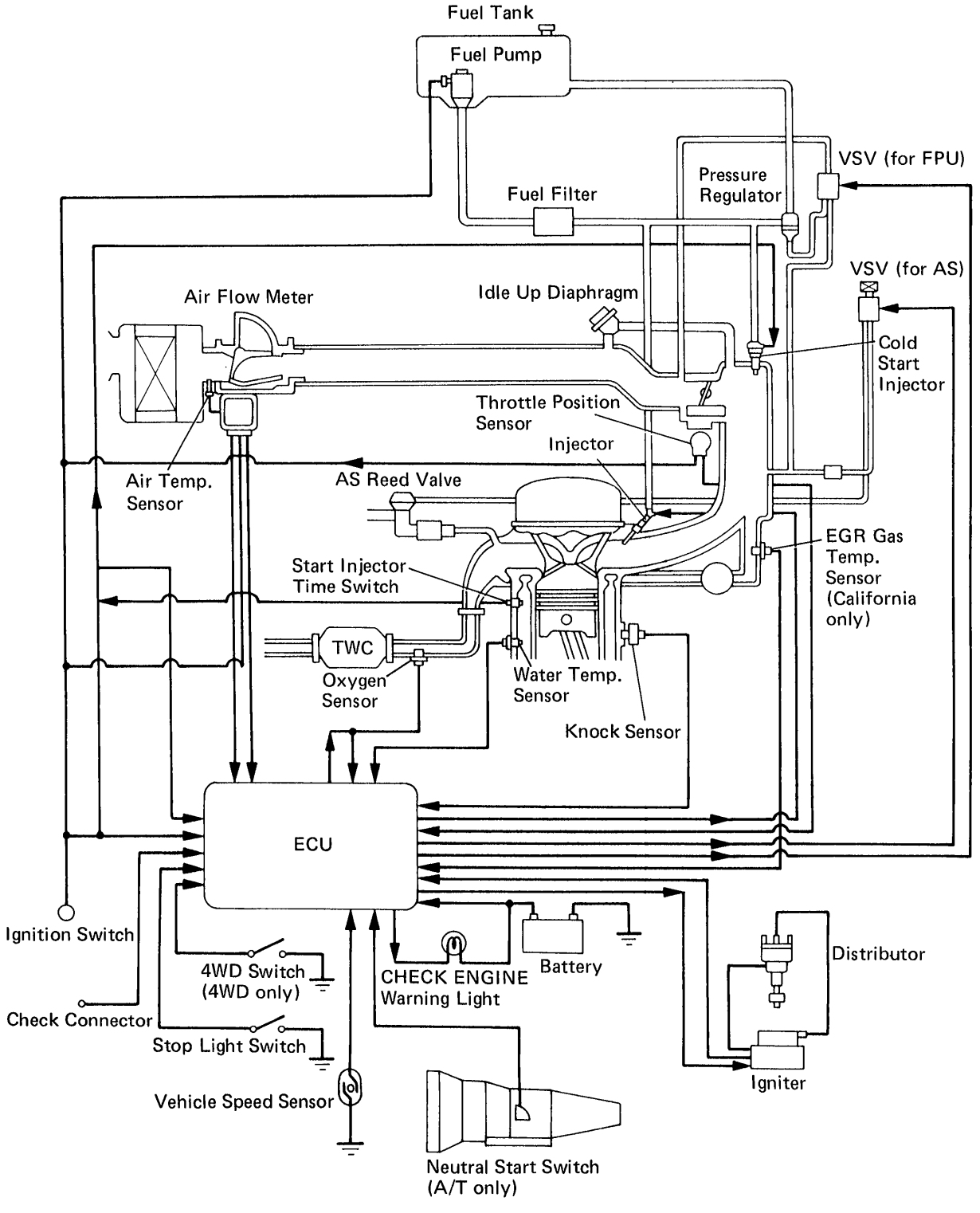
   (c) Reinstall the bracket bolts and tighten them.

EFI SYSTEM (22R-E, 3VZ-E)

(22R-E ENGINE)

(3VZ-E ENGINE)

SYSTEM DESCRIPTION



FI3736

The EFI system is composed of three basic subsystems: Fuel, Air Induction and Electronic Control Systems.

FUEL SYSTEM

An electric fuel pump supplies sufficient fuel, under a constant pressure, to the EFI injectors.
These injectors inject a metered quantity of fuel into the intake manifold in accordance with signals from the ECU. Each injector injects, at the same time, one half of the fuel required for ideal combustion with each engine revolution.

AIR INDUCTION SYSTEM

The air induction system provides sufficient air for engine operation.

ELECTRONIC CONTROL SYSTEM

The 22R-E engine is equipped with a Toyota Computer Control System (TCCS) which centrally controls the EFI, ESA, ECT (4WD), diagnosis systems, etc. by means of an Electronic Control Unit (ECU — formerly EFI computer) employing a microcomputer.

By means of the ECU, the TCCS controls the following functions:

1. Electronic Fuel Injection (EFI)

   The ECU receives signals from various sensors indicating changing engine operation conditions such as:

   Intake air volume
   Intake air temperature
   Coolant temperature
   Engine rpm
   Acceleration/deceleration
   Exhaust oxygen content etc.

   These signals are utilized by the ECU to determine the injection duration necessary for an optimum air-fuel ratio.

2. Electronic Spark Advance (ESA)

   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, coolant temperature, etc.), the microcomputer (ECU) triggers the spark at precisely the right instant.

3. Diagnosis

   The ECU detects any malfunctions or abnormalties in the sensor network and lights the "CHECK ENGINE" warning light on the instrument panel. At the same time, the trouble is identified and a diagnostic code is recorded by the ECU. The diagnostic code can be read by the number of blinks of the "CHECK ENGINE" warning light when terminals T_{E1} and E_1 are connected. There are 16 (Federal and Canada), 17 (California), different diagnostic codes including one for "normal operation."

4. Fail-Safe

   In the event of a sensor malfunction, a back-up circuit will take over to provide minimal drivability, and the "CHECK ENGINE" warning light will light.

PRECAUTIONS

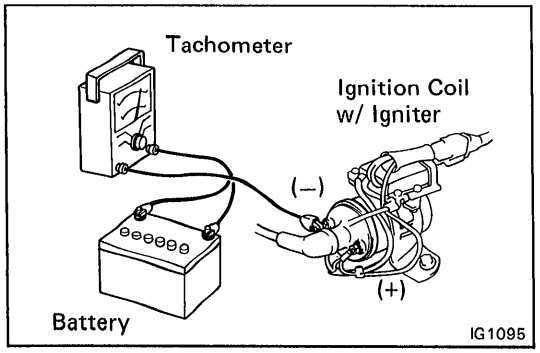
1. **Before working on the fuel system, disconnect the negative terminal from the battery.**

   HINT: Any diagnosis code retained by the computer will be erased when the battery terminal is removed.

   Therefore, if necessary, read the diagnosis before removing the battery terminal.

2. **Do not smoke or work near an open flame when working on the fuel system.**

3. **Keep gasoline off rubber or leather parts.**



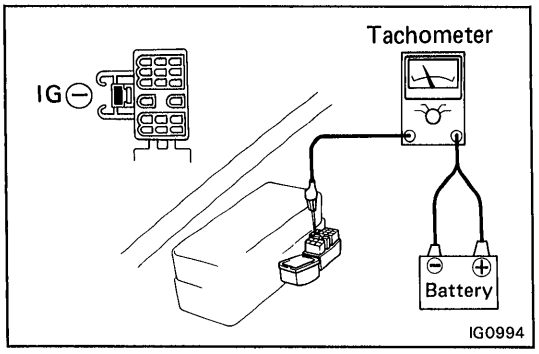
INSPECTION PRECAUTIONS

MAINTENANCE PRECAUTIONS

1. **INSURE CORRECT ENGINE TUNE-UP**

2. **PRECAUTIONS WHEN CONNECTING GAUGE**

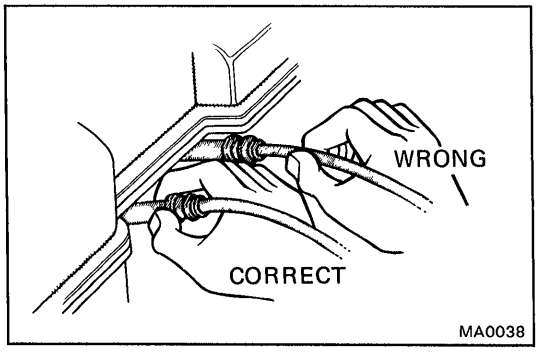
   (a) Connect the tachometer positive terminal to the ignition coil negative terminal.



   HINT: If the SST is used, the rpm signal can also be taken from the IG ⊖ terminal of the check connector.

   SST 09843-18020

   (b) Use the battery as the power source for the timing light, tachometer, etc.

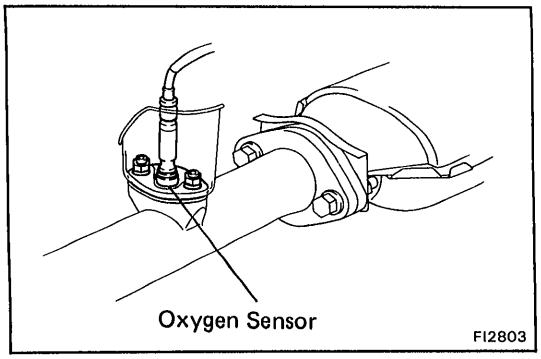


3. **IN EVENT OF ENGINE MISFIRE THE FOLLOWING PRECAUTIONS SHOULD BE TAKEN**

   (a) Check proper connection of battery terminals, etc.

   (b) Handle high-tension cords carefully.

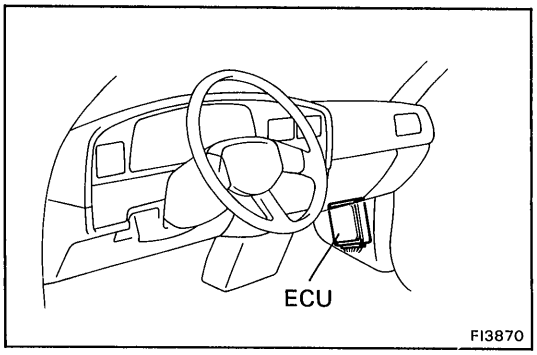
   (c) After repair work, check that the ignition coil terminals and all other ignition system from water.



4. **PRECAUTIONS WHEN HANDLING OXYGEN SENSOR**

   (a) Do not allow the oxygen sensor to drop or hit against an object.

   (b) Do not allow water to come into contact with the sensor or attempt to cool it.



WHEN CAR IS EQUIPPED WITH A MOBILE RADIO SYSTEM (HAM, CB, ETC.)

The ECU been designed so that it will not be affected by outside interference.
However, if your vehicle is equipped with an amateur radio transceiver, etc. (even one with approx. 10 W output), it may, at times, have an effect upon ECU operation, especially if the antenna and feeder are installed nearby. Therefore, observe the following precautions.

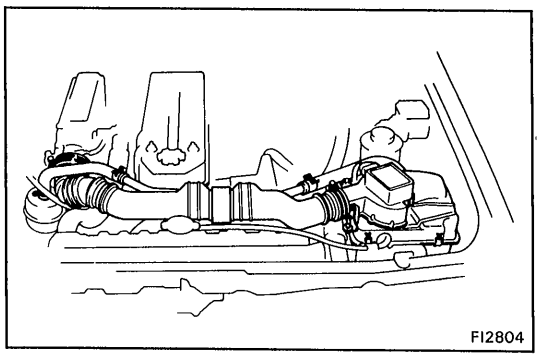
(a) Install the antenna as far as possible from the ECU. The ECU is located in the right side kick panel so the antenna should be installed at the rear, left side of the vehicle.
If installing on the bumper, do so on the right side, if possible.

(b) Keep the antenna feeder as far away as possible from the ECU wires — at least 20 cm (7.87 in.) — and, especially, do not wind them together.

(c) Insure that the feeder and antenna are properly adjusted.

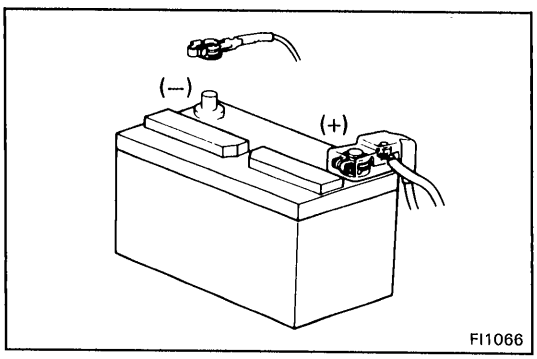
(d) Do not equip your vehicle with a powerful mobile radio system.

(e) Do not open the cover or the case of the ECU unless absolutely necessary. (If the IC terminals are touched, the IC may be destroyed by static electricity.)



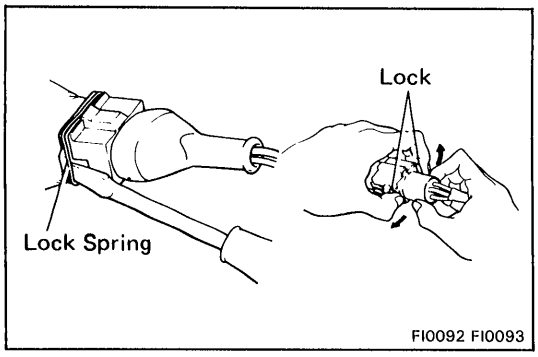
AIR INDUCTION SYSTEM

1. Separation of the engine oil dipstick, oil filler cap, PCV hose, etc. may cause the engine to run out of tune.
2. Disconnection, looseness or cracks in the parts of the air induction system between the air flow meter and cylinder head will allow air suction and cause the engine to run out of tune.



ELECTRONIC CONTROL SYSTEM

1. Before removing EFI wiring connectors, terminals, etc., first disconnect power by either turning OFF the ignition switch or disconnecting the battery terminals.
2. When installing a battery, be especially careful not to incorrectly connect the positive and negative cables.
3. Do not permit parts to during removal or installation. Handle all EFI parts carefully and, in particular, the ECU.
4. Take great care during troubleshooting as there are numerous transistor circuits and even slight terminal contact can cause further troubles.
5. Do not open the ECU cover.
6. When inspecting during rainy weather, take care to prevent entry of water. Also, when washing the engine compartment, prevent water from getting on the EFI parts and wiring connectors.
7. Parts should be replaced as an assembly.



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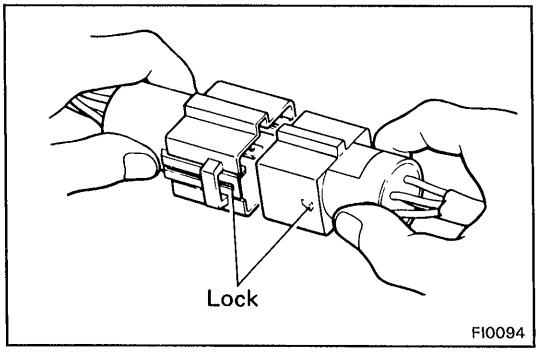
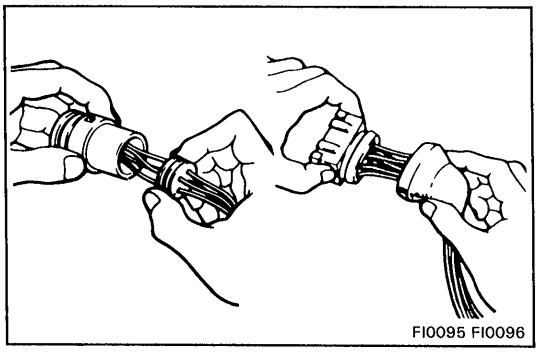
8. Sufficient care is required when pulling out and inserting wiring connectors.
   (a) To pull the connector out, release the lock and pull on the connector.

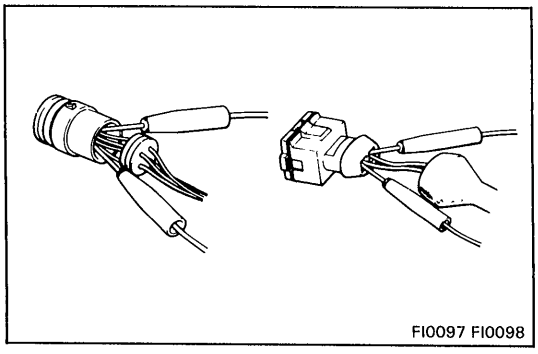


FI0094

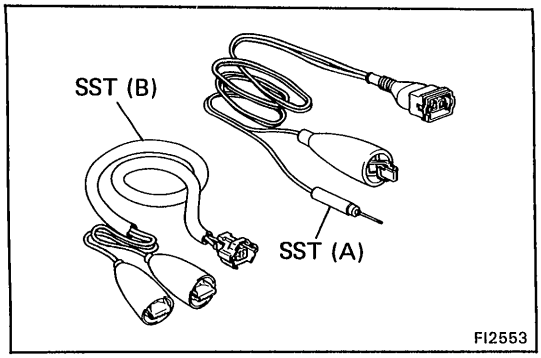
   (b) Fully insert the connector and insure that it is locked.


FI0095 FI0096

9. When inspecting a connector with a volt/ohmmeter.
   (a) Carefully take out the water-proofing rubber if it is a water-proof type connector.

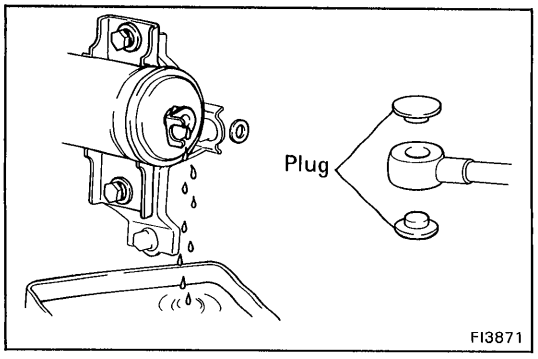

FI0097 FI0098

   (b) Insert the tester probe into the connector from the wiring side when checking the continuity, amperage or voltage.
   (c) Do not apply unnecessary force to the terminal.
   (d) After the check, securely install the water-proofing rubber on the connector.



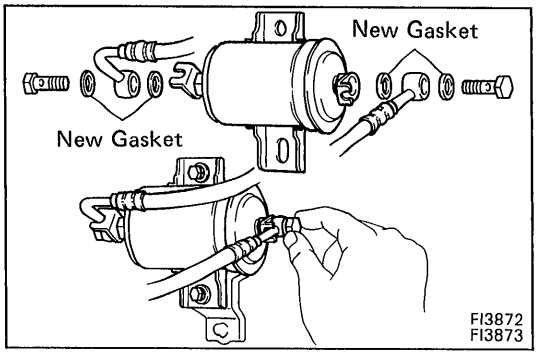
FI2553

10. Use SST for inspection or testing of the injector, cold start injector or their wiring connectors.
    SST 09842-30050(A) and 09842-30070(B)

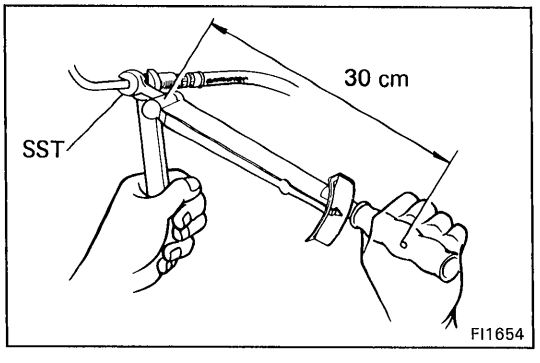


FUEL SYSTEM

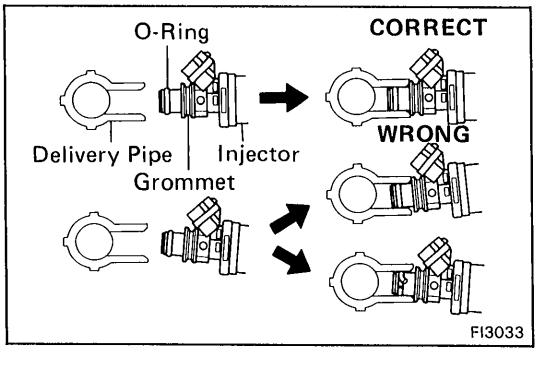
1. When disconnecting the connection of the high fuel pressure line, a large amount of gasoline may come out so observe the following procedure:
   (a) Put a container under the connection.
   (b) Slowly loosen the connection.
   (c) Disconnect the connection.
   (d) Plug the connection with a rubber plug.



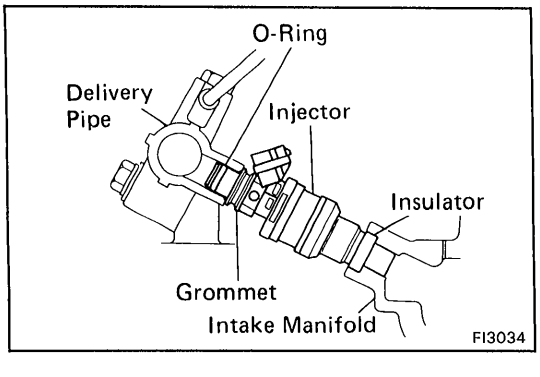
2. When connecting the flare nut or union bolt on the high pressure pipe union, observe the following procedure:
   (Union bolt type)
   (a) Always use a new gasket.
   (b) Hand tighten the union bolt.
   (c) Torque the bolt to the specified torque.
   Torque: 310 kg-cm (22 ft-lb, 30 N·m)



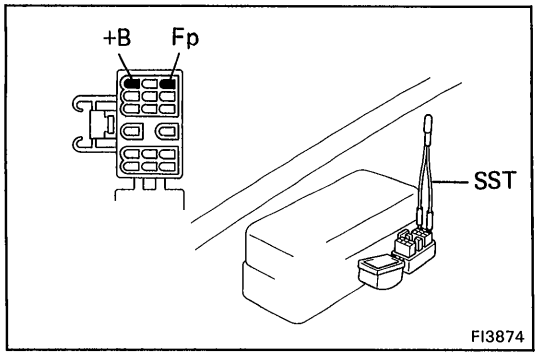
   (Flare nut type)
   (a) Apply a thin coat of oil to the flare and tighten the flare nut.
   (b) Then using SST, tighten the unit to the specified torque.
   SST 09631-22020
   Torque: 280 kg-cm (20 ft-lb, 27 N·m)
   HINT: Use a torque wrench with a fulcrum length of 30 cm (11.81 in.).



3. Take the following precautions when removing and installing the injectors.
   (a) Never re-use an O-ring.
   (b) When placing an O-ring on the injector, use care not to damage it in any way.
   (c) Lubricate the O-ring with spindle oil or gasoline before installing — never use engine, gear or brake oil.



4. Install the injector to the delivery pipe and intake manifold as shown in the figure.



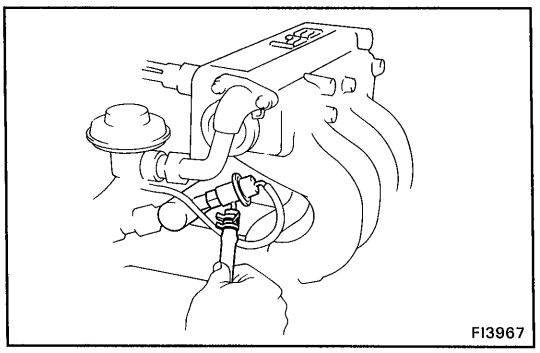
5. Confirm that there are no fuel leaks after performing maintenance on the fuel system.

(a) With engine stopped, turn the ignition switch on.

(b) Using SST, connect terminals Fp and +B of the check connector.

SST 09843-18020

HINT: The check connector is located near the No. 2 relay block.



(c) When the pressure regulator fuel return hose (shown in the figure at left), is pinched, the pressure within the high pressure line will rise to approx. 4 kg/cm^2 (57 psi, 392 kPa). In this state, check to see that there are no leaks from any part of the fuel system.

NOTICE: Always pinch the hose. Avoid bending the hose as it may cause the hose to crack.

TROUBLESHOOTING

TROUBLESHOOTING HINTS

1. Engine troubles are usually not caused by the EFI system. When troubleshooting, always first check the condition of these systems.
   (a) Electronic source
      - Battery
      - Fusible links
      - Fuses

   (b) Body ground

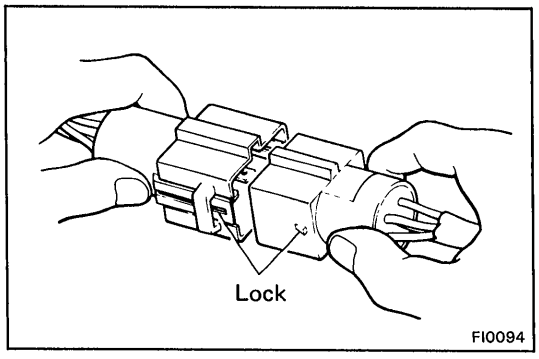
   (c) Fuel supply
      - Fuel leakage
      - Fuel filter
      - Fuel pump

   (d) Ignition system
      - Spark plug
      - High-tension cord
      - Distributor
      - Igniter and ignition coil

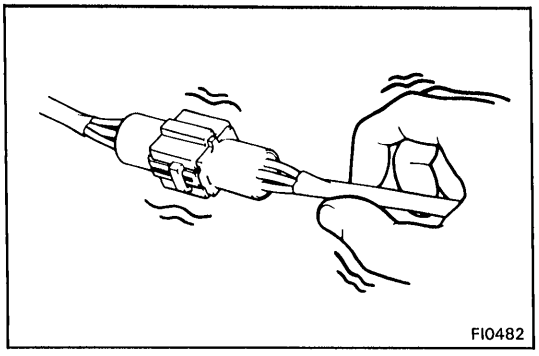
   (e) Air induction system
      - Vacuum leaks

   (f) Emission control system
      - PCV system
      - EGR system

   (g) Others
      - Ignition timing (ESA system)
      - Idle speed
      - etc.

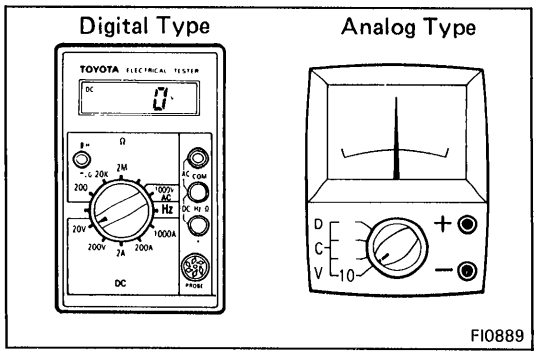


2. The most frequent cause of problems is simply a bad contact in wiring connectors. So always make sure that connections are secure.
   When inspecting the connector, pay particular attention to the following points:
   (a) Check to see that the terminals are no bent.
   (b) Check to see that the connector is pushed in completely and locked.



   (c) Check to see that there is no signal change when the connector is slightly tapped or wiggled.

3. Sufficiently troubleshoot for other causes before replacing the ECU. The ECU is of high quality and it is expensive.



4. Use a volt/ohmmeter with a high impedance (10 kΩ/V minimum) for troubleshooting an electrical circuit. (See page FI-28)

TROUBLESHOOTING PROCEDURES

SYMPTOM — DIFFICULT TO START OR NO START (ENGINE WILL NOT CRANK OR CRANKS SLOWLY)

CHECK ELECTRONIC SOURCE

BAD →
1. Battery
   (1) Connection
   (2) Gravity — Drive belt — Charging system
   (3) Voltage
2. Fusible link

OK ↓

CHECK STARTING SYSTEM

BAD →
1. Ignition switch
2. Starter relay (M/T)
3. Clutch start switch (M/T)
4. Neutral start switch (A/T)
5. Starter
6. Wiring/Connection

SYMPTOM — DIFFICULT TO START OR NO START (CRANKS OK)

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-22)

→ Malfunction code → Diagnostic code(s) (See pages FI-25, 26)

↓ Normal code

CHECK FOR VACUUM LEAKS IN AIR INTAKE LINE

→ BAD →
1. Hose connections
2. PCV hoses
3. EGR system — EGR valve stays open

↓ OK

CHECK IGNITION SPARK
1. Unplug connectors of start injector time switch.
2. Check by holding high-tension cord 8 — 10 mm (0.31 — 0.39 in.) away from cylinder block while engine is cranking. A strong spark should be noted.

→ BAD →
1. High-tension cords
2. Distributor
3. Ignition coil, igniter
4. ECU

↓ OK

CHECK IGNITION TIMING
STD: 5° BTDC @ idle
(T_{E_1} and E_1 connect)

→ NO → Adjust ignition timing

↓ OK

CHECK FUEL SUPPLY TO INJECTOR
1. Fuel in tank
2. Fuel pressure in fuel line
   (1) Connect terminals Fp and +B of the check connector.
   (2) Fuel pressure at fuel hose of fuel filter can be felt.
   (See page FI-66)

→ BAD →
1. Fuel line — Leakage — Deformation
2. Fuse
3. Circuit opening relay (See page FI-93)
4. Fuel pump (See page FI-65)
5. Fuel filter
6. Fuel pressure regulator (See page FI-74)

↓ OK

CHECK FUEL PUMP SWITCH IN AIR FLOW METER
Check continuity between terminals Fc and E_1 while measuring plate of air flow meter is open.

→ BAD → Air flow meter (See page FI-83)

↓ OK

CHECK SPARK PLUGS
Plug gap: 0.8 mm (0.031 in.)
HINT:
Check compression pressure if necessary.

→ NO →
1. Spark plug
2. Compression pressure
   Limit: 10.0 kg/cm² (142 psi, 981 kPa) at 250 rpm
3. Injector — Leakage (See page FI-75)

→ NO All Plugs Wet →
1. Injector(s) — Shorted
2. Injector wiring shorted
3. Cold start injector — Leakage (See page FI-71)
4. Start injector time switch (See page FI-94)

↓ OK CONTINUED ON PAGE FI-12

OK CONTINUED FROM PAGE FI-11

CHECK AUXILIARY AIR VALVE
(See page FI-90)

BAD →
1. Auxiliary air valve
2. Water hoses

OK

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER

NO →
1. Wiring connection
2. Power to ECU
   (1) Fusible link
   (2) Fuse (EFI 15A)
   (3) EFI main relay
3. Air flow meter
4. Water temp. sensor
5. Injection signal
   (1) Injector wiring
   (2) ECU

SYMPTOM — ENGINE OFTEN STALLS

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-22)

→ Malfunction code → Diagnostic code(s) (See pages FI-25, 26)

↓ Normal code

CHECK FOR VACUUM LEAKS IN AIR INTAKE LINE

→ BAD →
1. Hose connections
2. PCV hoses
3. EGR system — EGR valve stays open

↓ OK

CHECK FUEL SUPPLY TO INJECTOR
1. Fuel in tank
2. Fuel pressure in fuel line
   (1) Connect terminals Fp and +B of the check connector.
   (2) Fuel pressure at fuel hose of fuel filter can be felt.
   (See page FI-66)

→ BAD →
1. Fuel line — Leakage — Deformation
2. Fuse
3. Circuit opening relay (See page FI-93)
4. Fuel pump (See page FI-65)
5. Fuel filter
6. Fuel pressure regulator (See page FI-74)

↓ OK

CHECK AIR FILTER ELEMENT

→ BAD → Element — Clean or replace

↓ OK

CHECK IDLE SPEED
STD: 750 rpm

→ BAD → Adjust idle speed

↓ OK

CHECK IGNITION TIMING
STD: 5° BTDC @ idle
(T_{E1} and E_1 connect)

→ BAD → Adjust ignition timing

↓ OK

CHECK SPARK PLUGS
Plug gap: 0.8 mm (0.031 in.)
HINT:
Check compression pressure if necessary.

→ BAD →
1. Spark plug
2. Compression pressure
   Limit: 10.0 kg/cm² (142 psi, 981 kPa) at 250 rpm

↓ OK

CHECK COLD START INJECTOR
(See page FI-71)

→ BAD →
1. Cold start injector
2. Start injector time switch
   (See page FI-94)

↓ OK CONTINUED ON PAGE FI-14

OK CONTINUED FROM PAGE FI-13

CHECK AUXILIARY AIR VALVE
(See page FI-90)
→ BAD → 1. Auxiliary air valve
2. Water hoses

OK

RECHECK FUEL PRESSURE
(See page FI-66)
→ BAD → 1. Fuel pump (See page FI-65)
2. Fuel filter
3. Fuel pressure regulator
(See page FI-74)

OK

CHECK INJECTORS
(See page FI-75)
→ BAD → Injection condition

OK

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER
→ BAD → 1. Wiring connection
2. Power to ECU
(1) Fusible link
(2) EFI main relay
3. Air flow meter
4. Water temp. sensor
5. Injection signal
(1) Injector wiring
(2) ECU

SYMPTOM — ENGINE SOMETIMES STALLS

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-22)
→ Malfunction code → Diagnostic code(s) (See pages FI-25, 26)

Normal code

CHECK AIR FLOW METER
(See page FI-83)
→ BAD → Air flow meter

OK

CHECK WIRING CONNECTORS AND RELAYS
Check that there is a signal change when the connector or relay is slightly tapped or wiggled.
→ BAD → 1. Connector
2. EFI main relay (See page FI-92)
3. Circuit opening relay (See page FI-93)

SYMPTOM — ROUGH IDLING AND/OR MISSING

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-22)

→ Malfunction code → Diagnostic code(s) (See pages FI-25, 26)

↓ Normal code

CHECK FOR VACUUM LEAKS IN AIR INTAKE LINE

→ BAD → 1. Hose connections
2. PCV hoses
3. EGR system — EGR valve stays open

↓ OK

CHECK AIR FILTER ELEMENT

→ BAD → Element — Clean or replace

↓ OK

CHECK IDLE SPEED
STD: 750 rpm

→ BAD → Adjust idle speed

↓ OK

CHECK IGNITION TIMING
STD: 5° BTDC @ idle
(T_{E_1} and E_1 connect)

→ BAD → Adjust ignition timing

↓ OK

CHECK SPARK PLUGS AND PLUG CORDS
Plug gap: 0.8 mm (0.031 in.)
HINT:
Check compression pressure if necessary.

→ BAD → 1. Spark plugs and high-tension cords
2. Compression pressure
Limit: 10.0 kg/cm² (142 psi, 981 kPa) at 250 rpm

↓ OK

CHECK COLD START INJECTOR
(See page FI-71)

→ BAD → 1. Cold start injector
2. Start injector time switch.
(See page FI-94)

↓ OK

CHECK FUEL PRESSURE
(See page FI-66)

→ BAD → 1. Fuel pump (See page FI-65)
2. Fuel filter
3. Fuel pressure regulator (See page FI-74)

↓ OK

CHECK INJECTORS
(See page FI-75)

→ BAD → Injection condition

↓ OK CONTINUED ON PAGE FI-16

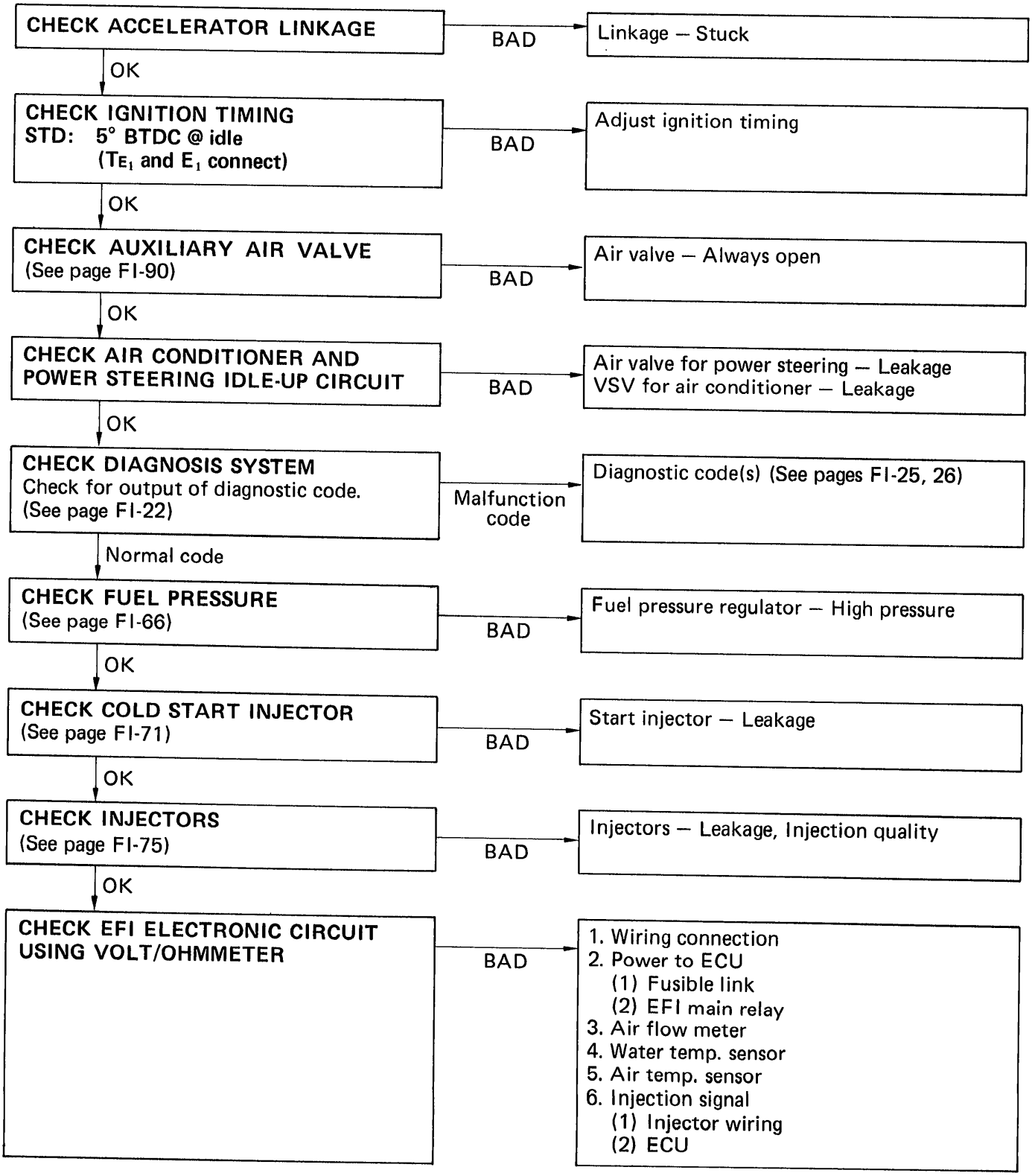
OK CONTINUED FROM PAGE FI-15

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER

BAD →

1. Wiring connection
2. Power to ECU
   (1) Fusible link
   (2) EFI main relay
3. Air flow meter
4. Water temp. sensor
5. Air temp. sensor
6. Throttle position sensor
7. Injection signal
   (1) Injector wiring
   (2) ECU
8. Oxygen sensor

SYMPTOM — HIGH ENGINE IDLE SPEED (NO DROP)



SYMPTOM — ENGINE BACKFIRES-Lean Air Fuel Mixture

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-22)

→ Malfunction code → Diagnostic code(s) (See pages FI-25, 26)

↓ Normal code

CHECK FOR VACUUM LEAKS IN AIR INTAKE LINE

→ BAD →
1. Hose connections
2. PCV hoses
3. EGR system — EGR valve stays open

↓ OK

CHECK IGNITION TIMING
STD: 5° BTDC @ idle
(T_{E1} and E_1 connect)

→ BAD → Adjust ignition timing

↓ OK

CHECK COLD START INJECTOR
(See page FI-71)

→ BAD →
1. Cold start injector
2. Start injector time switch.
(See page FI-94)

↓ OK

CHECK FUEL PRESSURE
(See page FI-66)

→ BAD →
1. Fuel pump (See page FI-65)
2. Fuel filter
3. Fuel pressure regulator (See page FI-74)

↓ OK

CHECK INJECTORS
(See page FI-75)

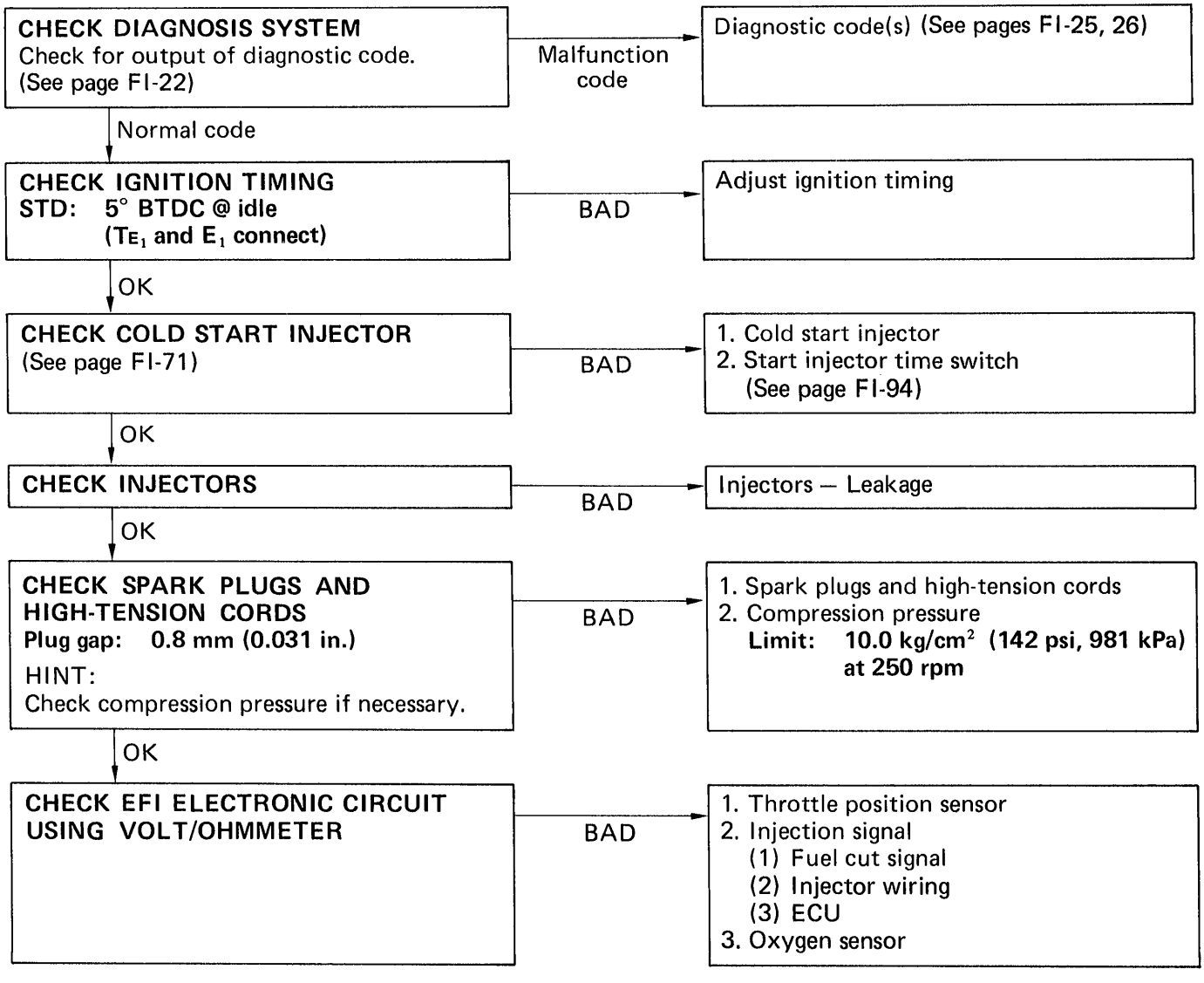
→ BAD → Injectors — Clogged

↓ OK

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER

→ BAD →
1. Wiring connection
2. Power to ECU
   (1) Fusible link
   (2) EFI main relay
3. Air flow meter
4. Water temp. sensor
5. Air temp. sensor
6. Throttle position sensor
7. Injection signal
   (1) Injection wiring
   (2) ECU
   (3) Fuel cut signal
8. Oxygen sensor

SYMPTOM — MUFFLER EXPLOSION (AFTER FIRE) -Rich Air Fuel Mixture-Misfire



SYMPTOM — ENGINE HESITATES AND/OR POOR ACCELERATION

CHECK CLUTCH, BRAKE → BAD → 1. Clutch — Slips; 2. Brakes — Drag

OK

CHECK FOR VACUUM LEAKS IN AIR INTAKE LINE → BAD → 1. Hose connections; 2. PCV hoses; 3. EGR system — EGR valve stays open

OK

CHECK AIR FILTER ELEMENT → BAD → Element — Clean or replace

OK

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-22) → Malfunction code → Diagnostic code(s) (See pages FI-25, 26)

Normal code

CHECK IGNITION SPARK
1. Unplug connectors of start injector time switch.
2. Check by holding high-tension cord 8 — 10 mm (0.31 — 0.39 in.) away from cylinder block while engine cranking. A strong spark should be noted.

→ BAD → 1. High-tension cord; 2. Distributor; 3. Ignition coil, Igniter

OK

CHECK IGNITION TIMING
STD: 5° BTDC @ idle (TE_1 and E_1 connect) → BAD → Adjust ignition timing

OK

CHECK FUEL PRESSURE
(See page FI-66) → BAD → 1. Fuel pump (See page FI-65); 2. Fuel filter; 3. Fuel pressure regulator (See page FI-74)

OK CONTINUED ON PAGE FI-21

OK CONTINUED FROM PAGE FI-20

CHECK INJECTORS
(See page FI-75)

BAD → Injection condition

OK

CHECK SPARK PLUGS
Plug gap: 0.8 mm (0.031 in.)
HINT:
Check compression pressure if necessary.

BAD → 1. Spark plugs
2. Compression pressure
Limit: 10.0 kg/cm² (142 psi, 981 kPa) at 250 rpm

OK

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER

BAD → 1. Wiring connection
2. Power to ECU
(1) Fusible link
(2) EFI main relay
3. Air flow meter
4. Water temp. sensor
5. Air temp. sensor
6. Throttle position sensor
7. Injection signal
(1) Injector wiring
(2) ECU

DIAGNOSIS SYSTEM

DESCRIPTION

The ECU contains a built-in self-diagnosis system by which troubles with the engine signal network are detected and a "CHECK ENGINE" warning light on the instrument panel flashes.

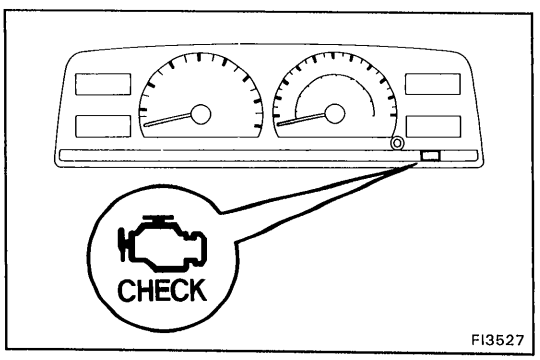
By analyzing various signals as shown in the table (See pages FI-25, 26) the ECU detects system malfunctions which are related to the various operating parameter sensors or to the actuator. The ECU stores the failure code associated with the detected failure until the diagnostic system is cleared by removing the EFI fuse with ignition switch off.

The "CHECK ENGINE" warning light on the instrument panel alerts the driver that a malfunction has been detected. The light goes out automatically when the malfunction has been corrected.

"CHECK ENGINE" LIGHT CHECK

1. The "CHECK ENGINE" warning light will come on when the ignition switch is placed at ON and the engine is not running.
2. When the engine is started, the "CHECK ENGINE" warning light should go out.

   If the light remains on, the diagnosis system has detected a malfunction in or abnormality in the system.



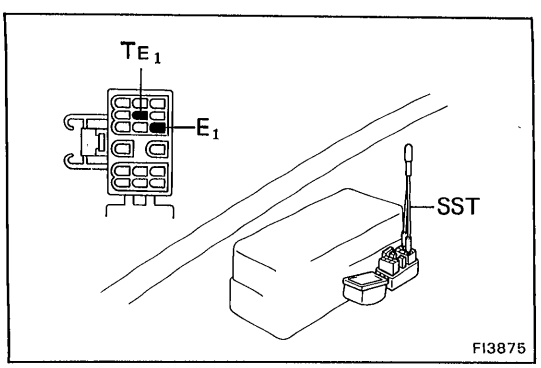
OUTPUT OF DIAGNOSTIC CODES

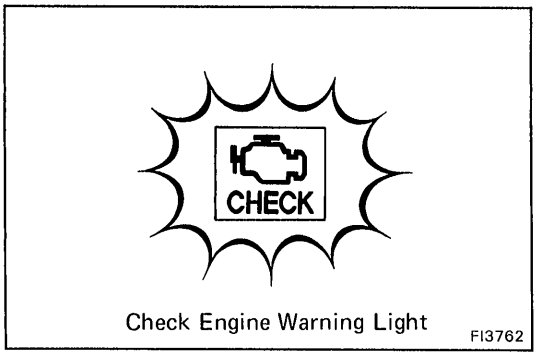
To obtain an output of diagnostic codes, proceed as follows:

1. Initial conditions
   (a) Battery voltage above 11 volts.
   (b) Throttle valve fully closed (throttle position sensor IDL points closed).
   (c) Transmission in neutral position.
   (d) Accessory switches OFF.
   (e) Engine at normal operating temperature.
2. Turn the ignition switch to ON. Do not start the engine.
3. Using SST, connect terminals T_{E1} and E_1 of the check connector.

   SST 09843-18020

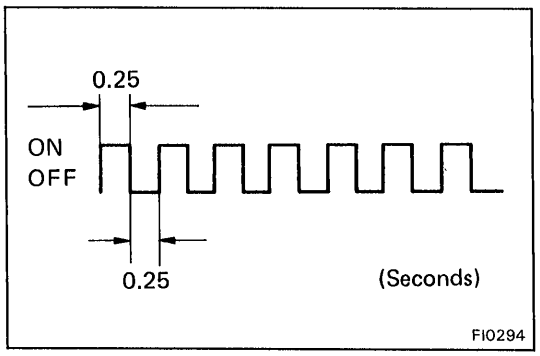
   HINT: The check connector is located near the No. 2 relay block.





Check Engine Warning Light
FI3762

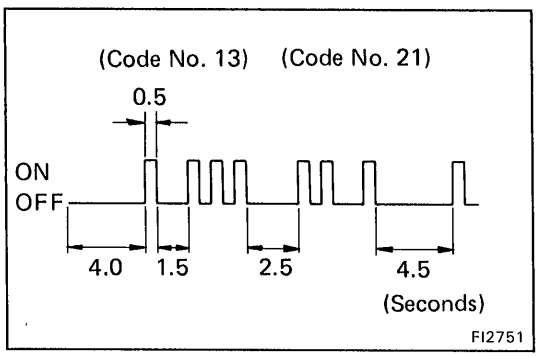
4. Read the diagnostic code as indicated by the number of flashes of the "CHECK ENGINE" warning light.



FI0294

Diagnostic code (See pages FI-25, 26)

(a) Normal System Operation
The light will blink 2 times per second.



FI2751

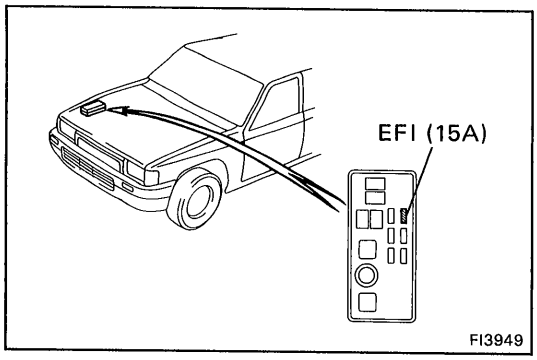
(b) Malfunction Code Indication

- The light will blink a number of times equal to the malfunction code indication as follows:
  1. Between the first digit and second digit, 1.5 seconds.
  2. Between code and code, 2.5 seconds.
  3. Between all malfunction codes, 4.5 seconds.

The diagnostic code series will be repeated as long as the check connector terminals T_{E1} and E_1 are connected.

HINT: In event of a number of trouble codes, indication will begin from the small value and continue to the larger in order.

5. After the diagnosis check, remove SST.



CANCELLING OUT DIAGNOSTIC CODE

1. After repair of the trouble area, the diagnostic code retained in memory by the ECU must be cancelled out by removing the fuse EFI (15A) for 30 seconds or more, depending on ambient temperature (the lower the temperature, the longer the fuse must be left out) with the ignition switch off.

   HINT:
   - Cancellation can also be done by removing the battery negative (—) terminal, but in this case other memory systems (radio clock, etc.) will also be cancelled out.
   - If the diagnostic code is not cancelled out, it will be retained by the ECU and appear along with a new code in event of future trouble.
   - If it is necessary to work on engine components requiring removal of the battery terminal, a check must first be made to see if a diagnostic code has been recorded.

2. After cancellation, road test the vehicle, if necessary, confirm that a "normal" code is now read on the "CHECK ENGINE" warning light.

   If the same diagnostic code is still indicated, it indicates that the trouble area has not been repaired thoroughly.

DIAGNOSIS INDICATION

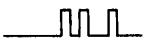
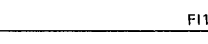
(1) Including "normal", the ECU is programmed with the following 16 (Federal and Canada), 17 (California) diagnostic codes.

(2) When 2 or more codes are indicated, the lowest number (code) will appear first.

(3) All detected diagnostic codes, except 51 and 53, will be retained in memory be the ECU from the time of detection until cancelled out.

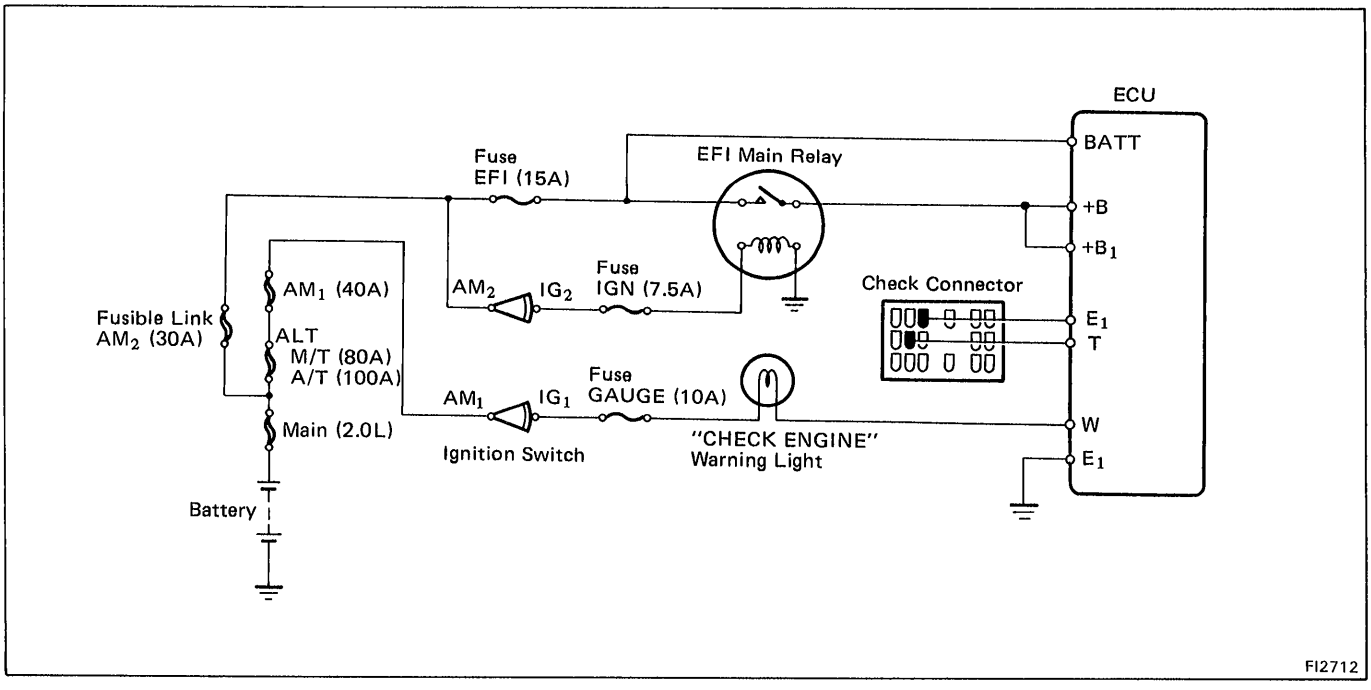
(4) Once the malfunction is cleared, the "CHECK ENGINE" warning light on the instrument panel will go out but the diagnostic code(s) remain stored in ECU memory (except for code 51 and 53).

DIAGNOSTIC CODES

Code No.	Number of blinks "CHECK ENGINE"	System	Diagnosis	Trouble area
—	 ON OFF FI1401	Normal	This appears when none of the other codes are identified.	———
12	 FI1389	RPM Signal	No "Ne" signal to ECU within 2 seconds after engine has been cranked.	•Distributor circuit •Distributor •Igniter circuit •Igniter •Starter signal circuit •ECU
13	 FI1390	RPM Signal	No "Ne" signal to ECU when engine speed is above 1,500 rpm.	•Distributor circuit •Distributor •Igniter circuit •Igniter •ECU
14	 FI1391	Ignition Signal	No "IGf" signal to ECU 4—5 times in succession.	•Igniter and ignition coil circuit •Igniter and ignition coil •ECU
21	 FI1400	Oxygen Sensor Signal	•Detection of oxygen sensor detrioration.	•Oxygen sensor circuit •Oxygen sensor •ECU
		Oxygen Sensor Heater Signal	•Open or short circuit in oxygen sensor heater (HT1).	•Oxygen sensor heater circuit •Oxygen sensor heater •ECU
22	 FI1392	Water Temp. Sensor Signal	•Open or short circuit in water temp. sensor signal (THW).	•Water temp. sensor circuit •Water temp. sensor •ECU
24	 FI1611	Intake Air Temp. Sensor Signal	•Open or short circuit in intake air temp. sensor signal (THA).	•Intake air temp. sensor circuit •Intake air temp. sensor •ECU
25	 FI2562	•Air-fuel Ratio Lean Malfunction •Oxygen Sensor	•When oxygen sensor signal continues at the upper (rich) or lower (lean) limit for a certain period of time during feedback condition. •When air-fuel ratio feedback compensation value or adaptive control value continues at the upper (lean) or lower (rich) limit renewed for a certain period of time. •Open circuit in oxygen sensor (Ox).	•Injector circuit •Injector •Fuel line pressure •Oxygen sensor circuit •Oxygen sensor •Air flow meter •Air intake system •ECU
26	 FI2563	•Air-fuel Ratio Rich Malfunction (Federal and Canada) •Oxygen Sensor		•Injector circuit •Injector •Fuel line pressure •Air flow meter •Cold start injector •ECU (Federal and Canada) •Oxygen sensor circuit •Oxygen sensor

Code No.	Number of blinks "CHECK ENGINE"	System	Diagnosis	Trouble area
31	 FI1394	Air flow Meter Signal	•Short circuit between Vc and VB, Vc and E2, or Vs and Vc. •Open circuit between Vc and E2.	•Air flow meter circuit •Air flow meter
41	 FI1396	Throttle Position Sensor Signal	•Open or short circuit in throttle position sensor signal (VTA).	•Throttle position sensor circuit •Throttle position sensor
42	 FI1397	Vehicle Speed Sensor Signal	•No "SPD" signal for 5 seconds when engine speed is above 2,500 rpm.	•Vehicle speed sensor circuit •Vehicle speed sensor •ECU
43	 FI1398	Starter Signal	•No "STA" signal to ECU until engine speed reaches 800 rpm with vehicle not moving.	•IG switch circuit •IG switch •ECU
52	 FI1618	Knock Sensor Signal	•Open or short circuit in knock sensor signal (KNK).	•Knock sensor circuit •Knock sensor •ECU
53	 FI1619	Knock Control Signal in ECU	•Knock control in ECU faulty.	•ECU
71	(California only)  FI2622	EGR System Malfunction	•EGR gas temp. below predetermined level during EGR operation. •Open circuit EGR gas temp. sensor signal (THG).	•EGR valve •EGR hose •EGR gas temp. sensor circuit •EGR gas temp. sensor •VSV for EGR circuit •ECU
51	 FI1399	Switch Signal	•No "IDL" signal or No "NSW" signal ECU, with the check connector E1 and TE1 connected.	•Throttle position sensor circuit •Throttle position sensor •(A/T) Neutral start switch circuit •(A/T) Neutral start switch •ECU

INSPECTION OF DIAGNOSIS CIRCUIT



1. Does CHECK ENG. light come on when ignition switch is at ON?
   - YES → System Normal
   - NO → Does CHECK ENG. light come on when ECU terminal W is grounded to the body?
     - YES → Check wiring between ECU terminal E_1 and body ground.
       - OK → Try another ECU.
       - BAD → Repair or replace.
     - NO → Check bulb, fuse and wiring between ECU and ignition switch.
       - BAD → Repair or replace.

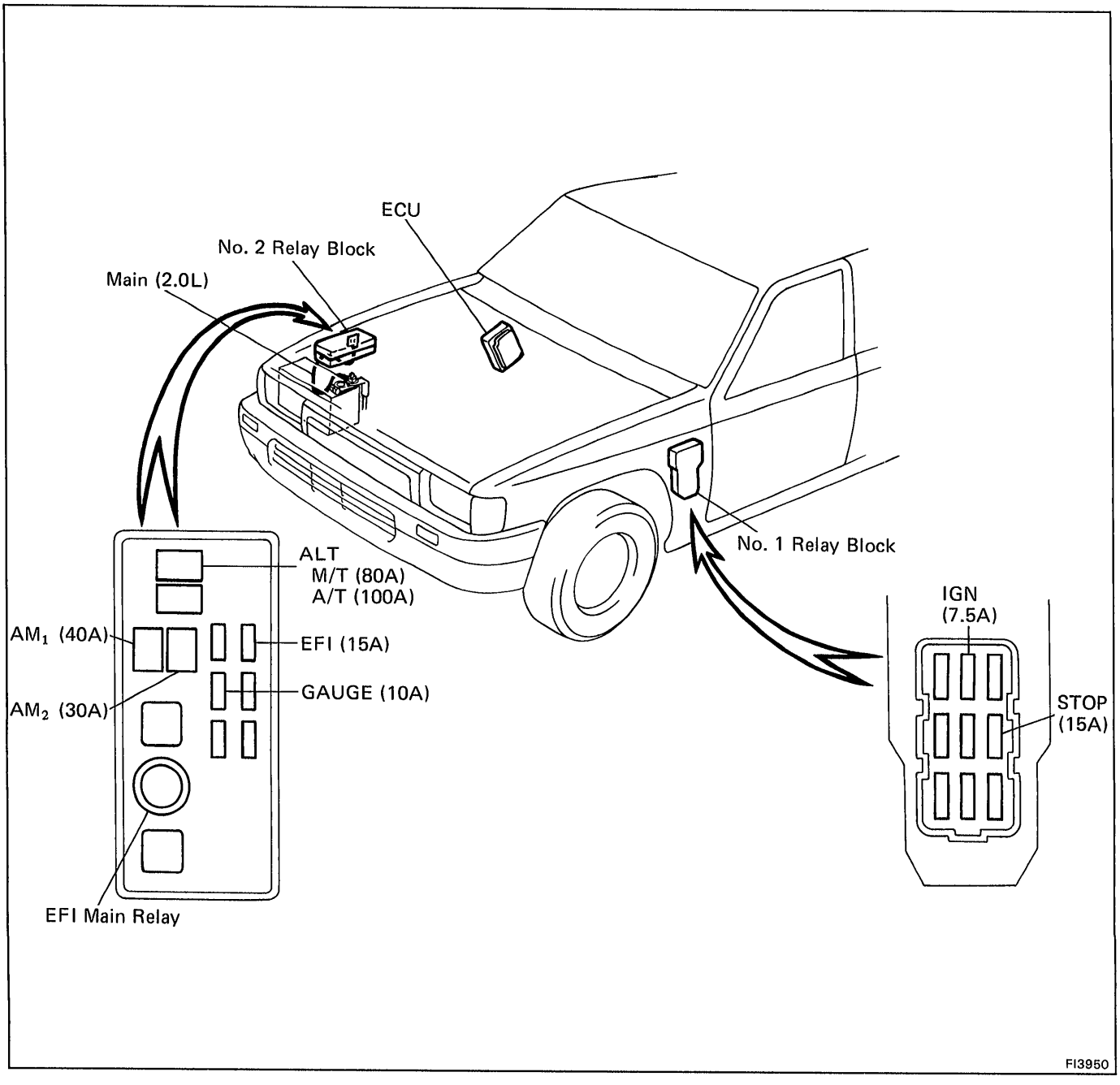
2. Does CHECK ENG. light go OFF when engine is started?
   - YES → System Normal
   - NO → Check wiring between ECU and CHECK ENG. light.
     - BAD → Repair
     - OK → Is there diagnosis code output when check connector T_{E_1} and E_1 is connect circuited?
       - NO → Try another ECU.
       - YES → Does CHECK ENG. light go out after repair according to malfunction code?
         - NO → Further repair required.
         - YES → System OK
           - NO → Cancel out diagnostic code.

TROUBLESHOOTING FOR EFI ELECTRONIC CIRCUIT WITH VOLT/OHMMETER

HINT: Because the following troubleshooting procedures are designed for inspection of each separate system, the actual troubleshooting procedure may vary somewhat.
However, please refer to these procedures and perform actual troubleshooting, conforming to the inspection methods described.
For example, it is better to first make a simple check of the fuses, fusible links and connecting condition of the connectors before making your inspection according to the procedures listed.

The following troubleshooting procedures are based on the supposition that the trouble lies in either a short or open circuit in a component outside the computer or a short circuit within the computer. If engine trouble occurs even though proper operating voltage is detected in the computer connector, then the ECU is faulty and should be replaced.

LOCATION OF FUSES AND FUSIBLE LINKS



PREPARATION FOR TROUBLESHOOTING

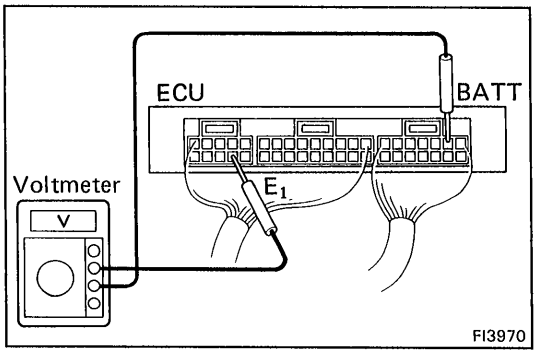
1. Remove the right kick panel.
2. Remove the ECU with the wire harness.

EFI SYSTEM CHECK PROCEDURE

HINT:

- The EFI circuit can be checked by measuring the resistance and voltage at the wiring connectors of the ECU.
- Perform all voltage measurement with the connectors connected.
- Verify that the battery voltage is 11V or above when the ignition switch is ON.

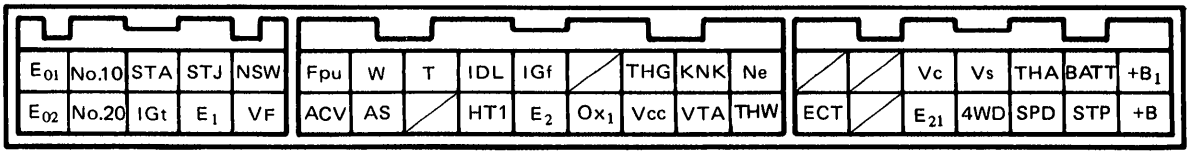
Using a voltmeter with high impedance (10 kΩ/V minimum), measure the voltage at each terminal of the wiring connector.



Connectors of ECU (Ex. 4WD A/T)

Symbol	Terminal Name	Symbol	Terminal Name
E_{01}	ENGINE GROUND	Ox_1	OXYGEN SENSOR
E_{02}	ENGINE GROUND	*1 THG	EGR GAS TEMP. SENSOR
No. 10	INJECTOR	Vcc	THROTTLE POSITION SENSOR
No. 20	INJECTOR	KNK	KNOCK SENSOR
STA	STARTER SWITCH	VTA	THROTTLE POSITION SENSOR
IGt	IGNITER	Ne	DISTRIBUTOR
STJ	COLD START INJECTOR	THW	WATER TEMP. SENSOR
E_1	ENGINE GROUND	*2 ECT	OD RELAY
*2NSW	NEUTRAL START SWITCH	Vc	AIR FLOW METER
V_F	CHECK CONNECTOR	E_{21}	SENSOR GROUND
Fpu	FUEL PRESSURE UP VSV	Vs	AIR FLOW METER
ACV	A/C IDLE UP VSV	*3 4WD	4WD SWITCH
W	CHECK ENGINE WARNING LIGHT	THA	AIR TEMP. SENSOR
AS	AS VSV	SPD	SPEED SENSOR
T	CHECK CONNECTOR	BATT	BATTERY +B
IDL	THROTTLE POSITION SENSOR	STP	STOP LIGHT SWITCH
HT_1	OXYGEN SENSOR HEATER	$+B_1$	MAIN RELAY
IGf	IGNITER	+B	MAIN RELAY
E_2	SENSOR GROUND		

*1: California only *2: A/T only *3: 4WD only

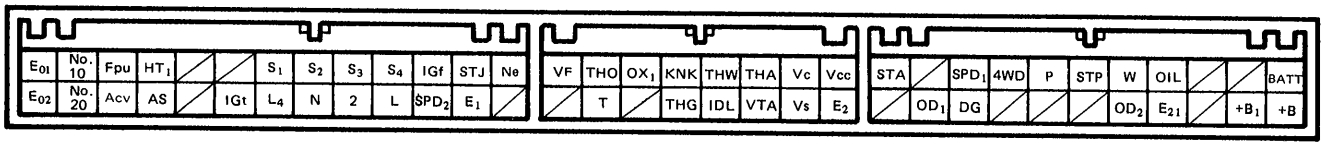


FI0605

Connectors of ECU (4WD A/T)

Symbol	Terminal Name	Symbol	Terminal Name
E_{01}	ENGINE GROUND	Ox_1	OXYGEN SENSOR
E_{02}	ENGINE GROUND	KNK	KNOCK SENSOR
No. 10	INJECTOR	* THG	EGR GAS TEMP. SENSOR
No. 20	INJECTOR	THW	WATER TEMP. SENSOR
Fpu	FUEL PRESSURE UP VSV	IDL	THROTTLE POSITION SENSOR
ACV	A/C IDLE UP VSV	THA	AIR TEMP. SENSOR
HT_1	OXYGEN SENSOR HEATER	VTA	THROTTLE POSITION SENSOR
AS	AS VSV	Vc	AIR FLOW METER
IGt	IGNITER	Vs	AIR FLOW METER
S_1	ECT SOLENOID	Vcc	THROTTLE POSITION SENSOR
L_4	TRANSFER POSITION SWITCH	E_2	SENSOR GROUND
S_2	ECT SOLENOID	STA	STARTER SWITCH
N	NEUTRAL START SWITCH	OD_1	CRUISE CONTROL COMPUTER
S_3	ECT SOLENOID	SPD_1	SPEED SENSOR
2	NEUTRAL START SWITCH	DG	CHECK CONNECTOR
S_4	ECT SOLENOID	4WD	4WD SWITCH
L	NEUTRAL START SWITCH	P	PATTERN SELECT SWITCH
IGf	IGNITER	STP	STOP LIGHT SWITCH
SPD_2	SPEED SENSOR	W	CHECK ENGINE WARNING LIGHT
STJ	COLD START INJECTOR	OD_2	CRUISE CONTROL COMPUTER
E_1	ENGINE GROUND	OIL	A/T OIL TEMP. WARNING LIGHT
Ne	DISTRIBUTOR	E_{21}	SENSOR GROUND
V_F	CHECK CONNECTOR	$+B_1$	MAIN RELAY
THO	T/M OIL TEMP. SENSOR	BATT	BATTERY +B
T	CHECK CONNECTOR	+B	MAIN RELAY

*: California only



FI2796

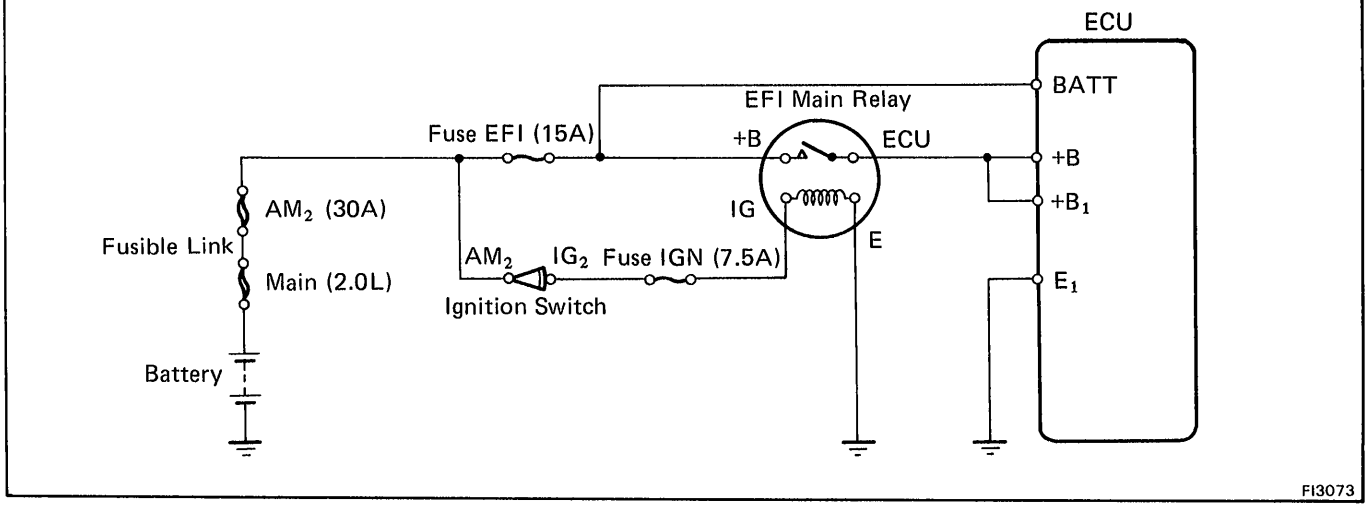
Voltage at ECU wiring connectors (Ex. 4WD A/T)

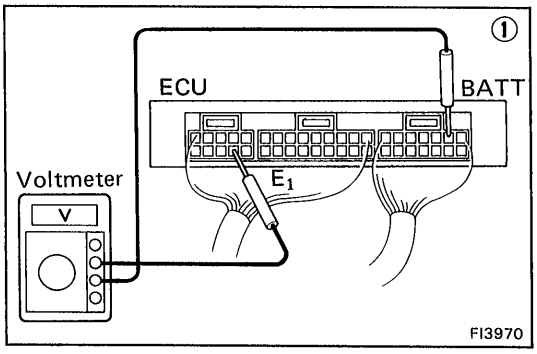
No.	Terminals	Condition		STD voltage	See page
1	BATT — E_1	—		10—14	FI-33
	+B — E_1	Ignition switch ON		10—14	
	$+B_1$ — E_1				
2	IDL — E_2 (E_{21})	Ignition switch ON	Throttle valve open	8—14	FI-35
	Vcc — E_2 (E_{21})		—	4—6	
	VTA — E_2 (E_{21})		Throttle valve fully closed	0.1—1.0	
			Throttle valve fully open	3—5	
3	Vc — E_2 (E_{21})	Ignition switch ON	—	6—10	FI-37
	Vs — E_2 (E_{21})		Measuring plate fully closed	0.5—2.5	
			Measuring plate fully open	5—10	
		Idling		2—8	
	THA — E_2 (E_{21})	Ignition switch ON	Intake air temperature 20°C (68°F)	1—3	
4	THW — E_2 (E_{21})	Ignition switch ON	Coolant temperature 80°C (176°F)	0.1—1.0	FI-39
5	STA — E_1	Ignition switch ST position		6—12	FI-40
6	No. 10 — E_{01} No. 20 — E_{02}	Ignition switch ON		10—14	FI-41
7	IGt — E_1	Idling		0.7—1.0	FI-42
8	W — E_1	No trouble (CHECK ENGINE light off) and engine running		10—14	FI-43
9	STJ — E_1	Ignition switch ST position	Coolant temperature 80°C (176°F)	6—12	FI-44
10	STP — E_1	Stop light switch ON		8—14	FI-45

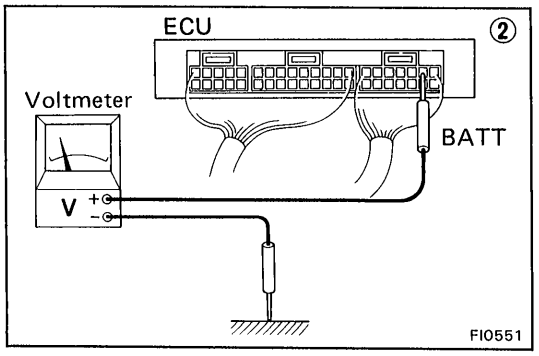
Voltage at ECU wiring connectors (4WD A/T)

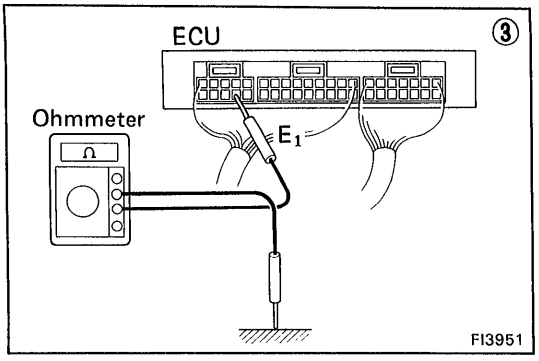
No.	Terminals	Condition		STD voltage	See page
11	BATT — E_1	—		10—14	FI-49
	+B — E_1	Ignition switch ON		10—14	
	+B_1 — E_1			10—14	
12	IDL — E_2 (E_{21})	Ignition switch ON	Throttle valve open	8—14	FI-51
	Vcc — E_2 (E_{21})		—	4—6	
	VTA — E_2 (E_{21})		Throttle valve fully closed	0.1—1.0	
			Throttle valve fully open	3—5	
13	Vc — E_2 (E_{21})	Ignition switch ON	—	6—10	FI-53
	Vs — E_2 (E_{21})		Measuring plate fully closed	0.5—2.5	
			Measuring plate fully open	5—10	
		Idling		2—8	
	THA — E_2 (E_{21})	Ignition switch ON	Intake air temperature 20°C (68°F)	1—3	
14	THW — E_2 (E_{21})	Ignition switch ON	Coolant temperature 80°C (176°F)	0.1—1.0	FI-55
15	STA — E_1	Ignition switch ST position		6—12	FI-56
16	No. 10 — E_{01} No. 20 — E_{02}	Ignition switch ON		10—14	FI-57
17	IGt — E_1	Idling		0.7—1.0	FI-58
18	W — E_1	No trouble (CHECK ENGINE light off) and engine running		10—14	FI-59
19	STJ — E_1	Ignition switch ST position	Coolant temperature 80°C (176°F)	6—12	FI-60
20	STP — E_1	Stop light switch ON		8—14	FI-61

No.	Terminals	Trouble	Condition	STD Voltage
1	BATT – E_1	No voltage	–	10 – 14 V
	+B – E_1		Ignition switch ON	
	$+B_1$ – E_1			









- **BATT – E_1**

① There is no voltage between ECU terminals BATT and E_1.

↓

② Check that there is voltage between ECU terminal BATT and body ground.

NO ← ② → OK

OK → ③ Check wiring between ECU terminal E_1 and body ground.

③ OK → Try another ECU.

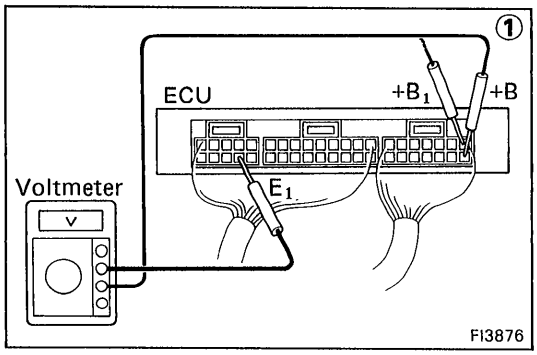
③ BAD → Repair or replace

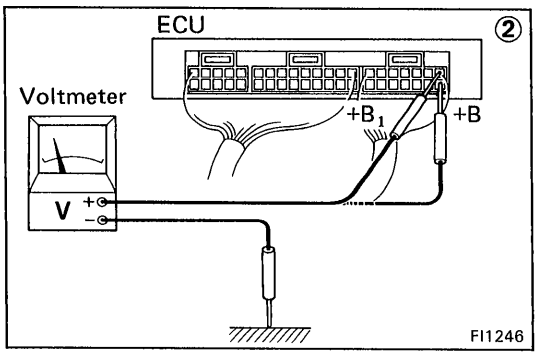
NO → Check fuse and fusible link.

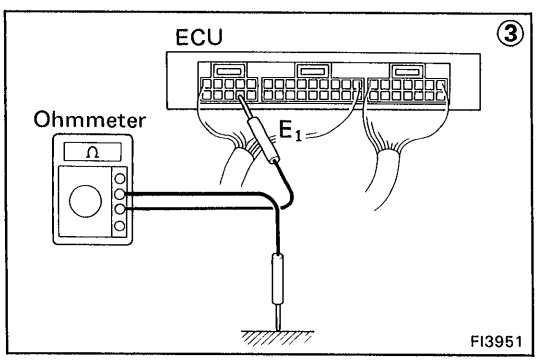
Check fuse and fusible link. BAD → Replace

Check fuse and fusible link. OK → Check wiring between fuse and ECU.

Check wiring between fuse and ECU. BAD → Repair or replace







● **+B ($+B_1$) – E_1**

① There is no voltage between ECU terminals +B ($+B_1$) and E_1. **(IG SW ON)**

② Check that there is voltage between ECU terminal +B ($+B_1$) and body ground. **(IG SW ON)**

NO

OK

③ Check wiring between ECU terminal E_1 and body ground.

OK → Try another ECU.

BAD → Repair or replace

Check fuse, fusible link and ignition switch. → BAD → Repair or replace

OK

Check EFI main relay. → BAD → Replace

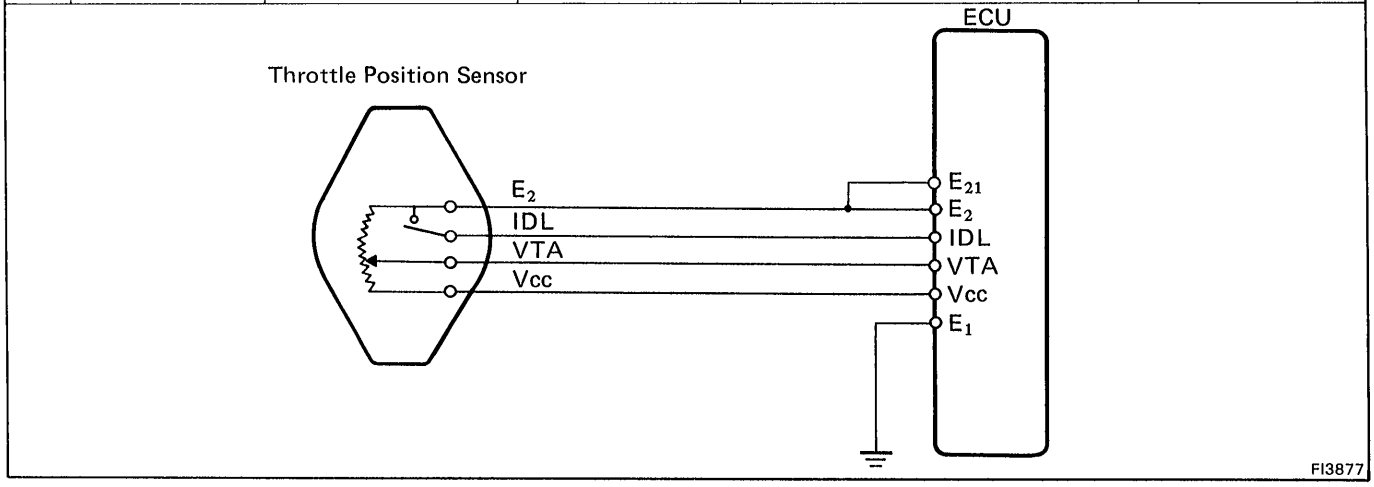
OK

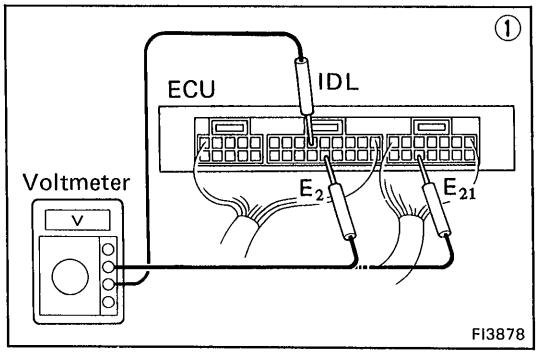
Check wiring between EFI main relay and battery. → BAD → Repair or replace

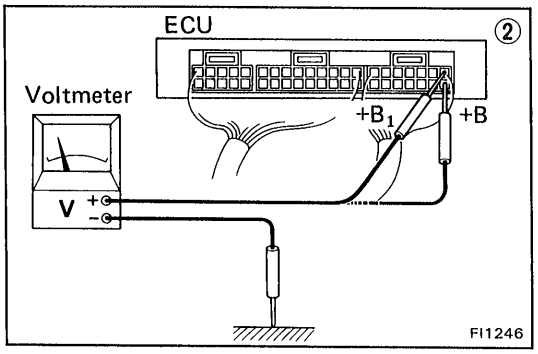
OK

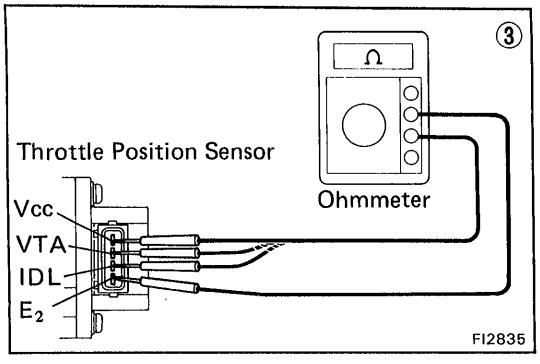
Check wiring between EFI main relay and ECU terminal +B ($+B_1$). → BAD → Repair or replace

No.	Terminals	Trouble	Condition		STD Voltage
2	IDL – E_2 (E_{21})	No voltage	Ignition switch ON	Throttle valve open	8 – 14 V
	Vcc – E_2 (E_{21})			–	4 – 6 V
	VTA – E_2 (E_{21})			Throttle valve fully closed	0.1 – 1.0 V
				Throttle valve fully open	3 – 5 V









• IDL – E_2 (E_{21})

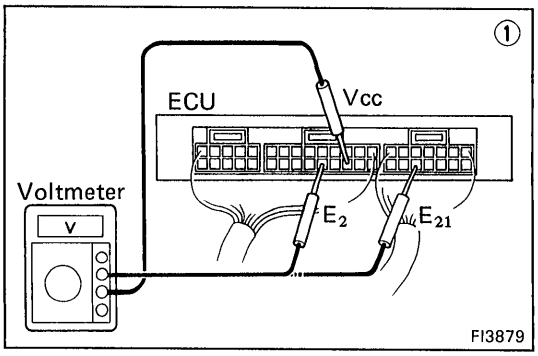
① There is no voltage between ECU terminal IDL and E_2 (E_{21}). **(IG SW ON)** (Throttle valve open)

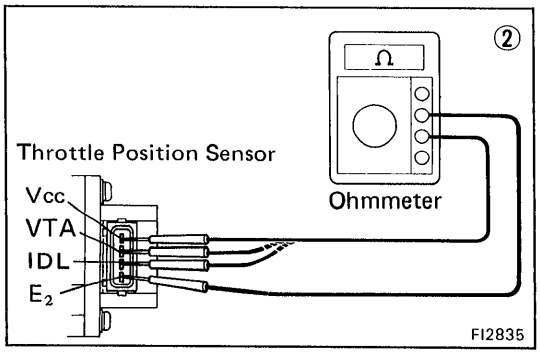
② Check that there is voltage between ECU terminal +B ($+B_1$) and body ground. **(IG SW ON)**

- ② NO → Refer to No. 1
  - Refer to No. 1 BAD → Replace or repair.
  - Refer to No. 1 OK → ③ Check throttle position sensor.
- ② OK → Check wiring between ECU terminals E_1 and body ground.
  - OK → ③ Check throttle position sensor.
  - BAD → Replace or repair.

③ Check throttle position sensor.

- BAD → Replace or repair throttle position sensor.
- OK → Check wiring between ECU and throttle position sensor.
  - OK → Try another ECU.
  - BAD → Replace or repair.





- **Vcc – E_2 (E_{21})**

① There is no voltage between ECU terminals Vcc and E_2 (E_{21}). **(IG SW ON)**

↓

Check that there is voltage between ECU terminal +B (+B_1) and E_1. **(IG SW ON)**

↓ OK — NO → Refer to No. 1.

↓

② Check throttle position sensor.

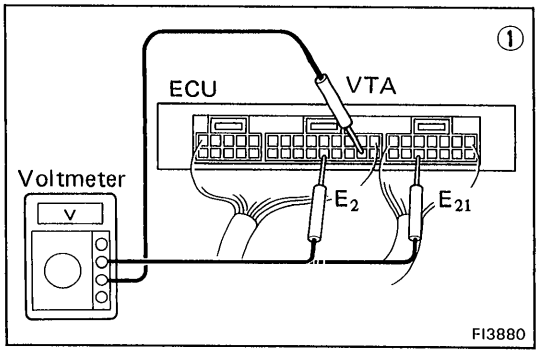
↓ BAD — Repair or replace.

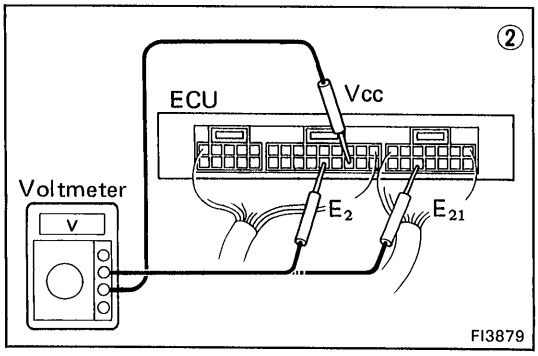
↓ OK

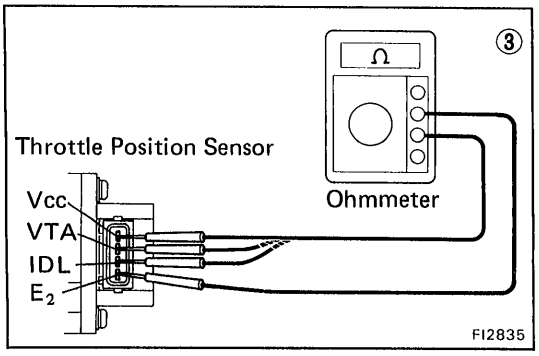
Check wiring between ECU and throttle position sensor.

↓ OK — Try another ECU.

↓ BAD — Repair or replace wiring.







- **VTA – E_2 (E_{21})**

① There is no specified voltage between ECU terminals VTA and E_2 (E_{21}). **(IG SW ON)**

↓

② Check that there is voltage between ECU terminals Vcc and E_2 (E_{21}). **(IG SW ON)**

↓ OK — NO → Perform inspection of Vcc – E_2 (E_{21})

↓

③ Check throttle position sensor. — BAD → Repair or replace.

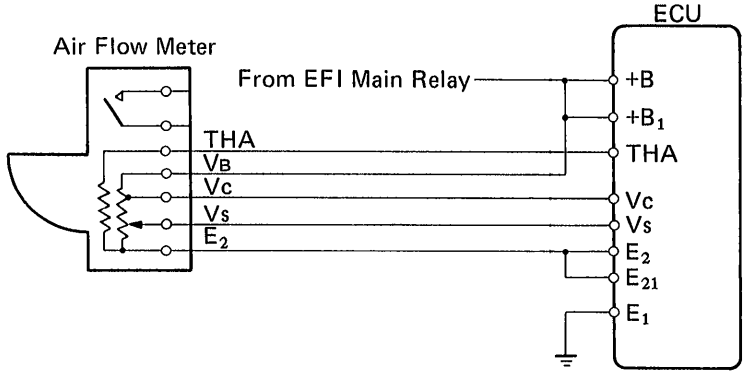
↓ OK

Check wiring between ECU and throttle position sensor. — BAD → Repair or replace.

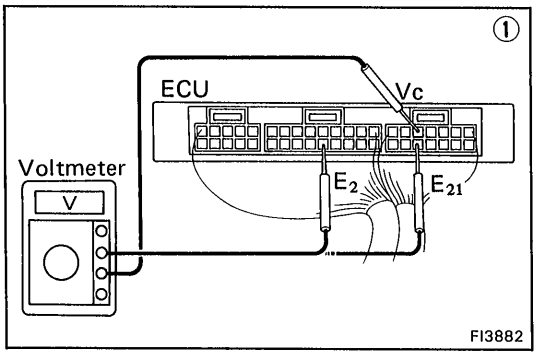
↓ OK

Try another ECU.

No.	Terminals	Trouble	Condition		STD Voltage
3	Vc – E_2 (E_{21})	No voltage	Ignition switch ON	–	6 – 10 V
	Vs – E_2 (E_{21})			Measuring plate fully closed	0.5 – 2.5 V
				Measuring plate fully open	5 – 10 V
			Idling		2 – 8 V
	THA – E_2 (E_{21})		Ignition switch ON	Intake air temperature 20°C (68°F)	1 – 3 V



FI3881



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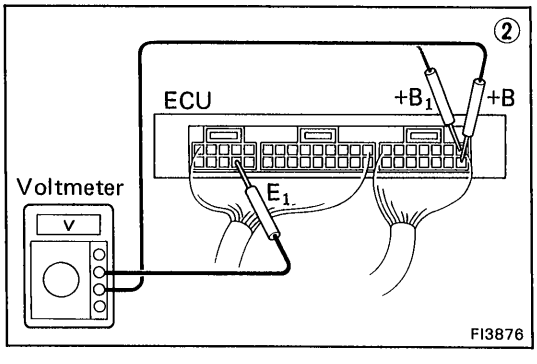

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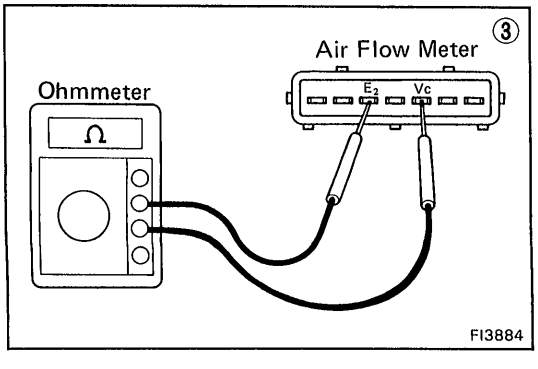


FI3884

● **Vc – E_2 (E_{21})**

① There is no specified voltage at ECU terminals Vc and E_2 (E_{21}). **(IG SW ON)**

↓

② Check that there is voltage between ECU terminal +B (+B_1) and E_1. **(IG SW ON)**

OK → ↓

NO → Refer to No. 1.

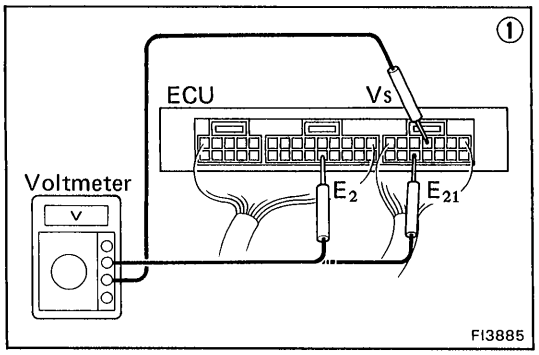
③ Check air flow meter.

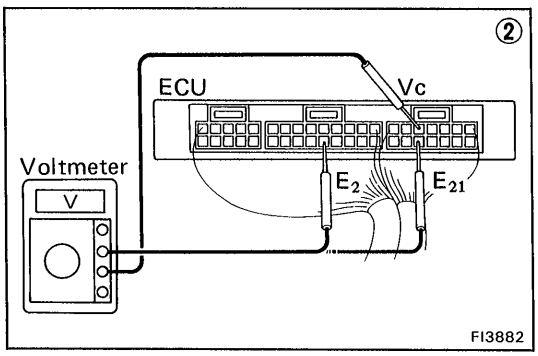
NO → Replace or repair air flow meter.

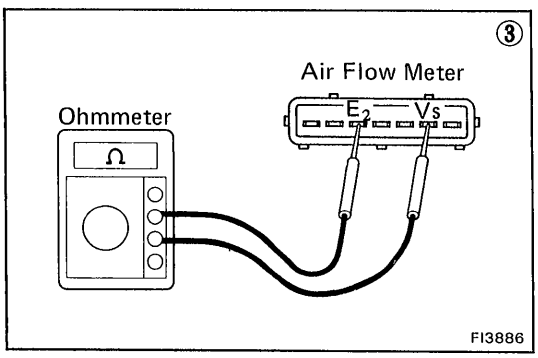
OK → Check wiring between ECU and air flow meter.

OK → Try another ECU.

NO → Replace or repair wiring.







- **Vs – E_2 (E_{21})**

① There is no specified voltage between ECU terminals Vs and E_2 (E_{21}). **(IG SW ON)**

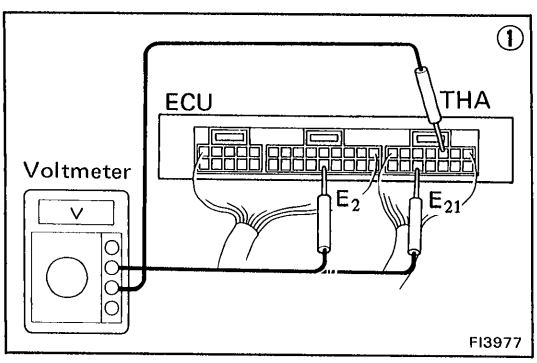
② Check that there is voltage between ECU terminals Vc and E_2 (E_{21}). **(IG SW ON)**

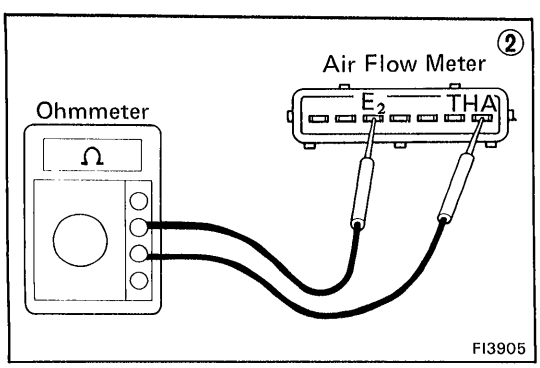
OK → ③ Check air flow meter.
NO → Refer to Vcc – E_2 (E_{21}) → BAD → Repair or replace

③ Check air flow meter. → BAD → Repair or replace

OK → Check wiring between ECU and air flow meter. → BAD → Repair or replace

OK → Try another ECU.





- **THA – E_2 (E_{21})**

① There is no voltage between ECU terminals THA and E_2 (E_{21}). **(IG SW ON)**

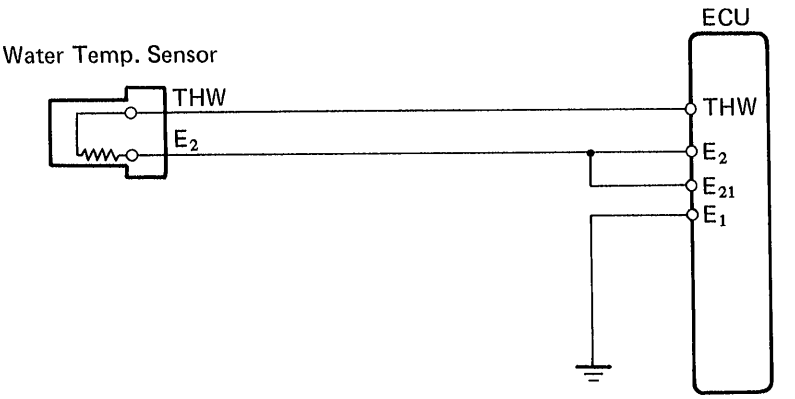
Check that there is voltage between ECU terminal +B (+B_1) and body ground. **(IG SW ON)**

OK → ② Check air temp. sensor.
NO → Refer to No. 1.

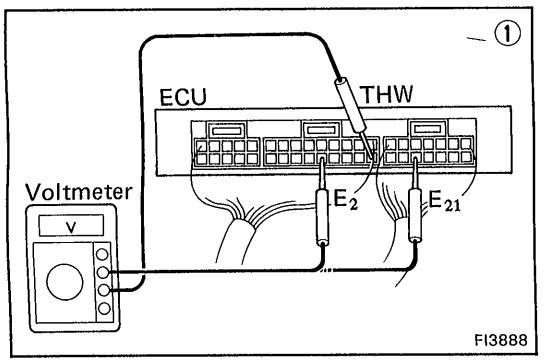
② Check air temp. sensor.
BAD → Replace air flow meter.
OK → Check wiring between ECU and air temp. sensor.

Check wiring between ECU and air temp. sensor.
OK → Try another ECU.
BAD → Repair or replace wiring.

No.	Terminals	Trouble	Condition		STD Voltage
4	THW – E_2 (E_{21})	No voltage	Ignition switch ON	Coolant temperature 80°C (176°F)	0.1 – 1.0 V



FI3887



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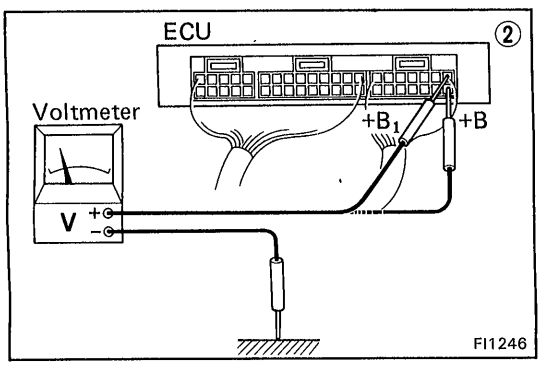
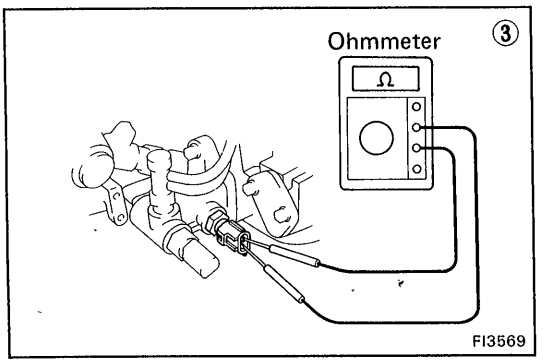


FI1246



FI3569

① There is no voltage between ECU terminals THW and E_2 (E_{21}). **(IG SW ON)**

↓

② Check that there is voltage between ECU terminal +B ($+B_1$) and body ground. **(IG SW ON)**

OK ↓

NO → Refer to No. 1.

↓

Check wiring between ECU terminals E_1 and body ground.

OK ↓

BAD → Repair or replace.

↓

③ Check water temp. sensor.

BAD ↓

OK →

Replace water temp. sensor.

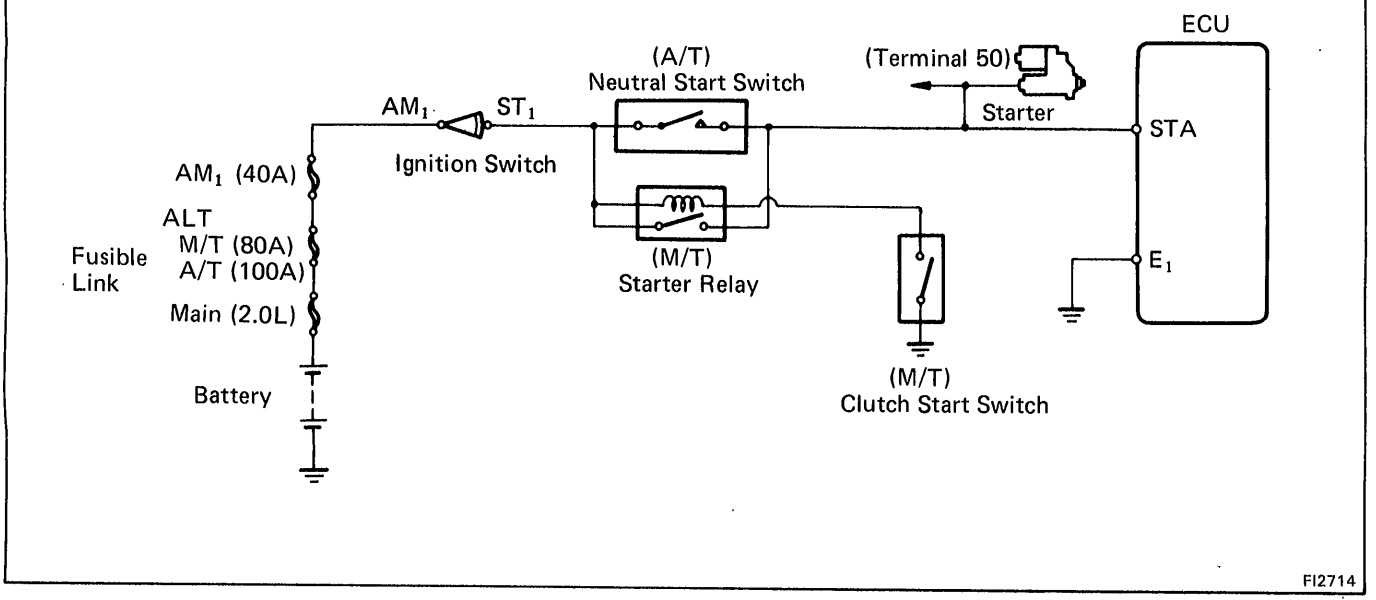
Check wiring between ECU and water temp. sensor.

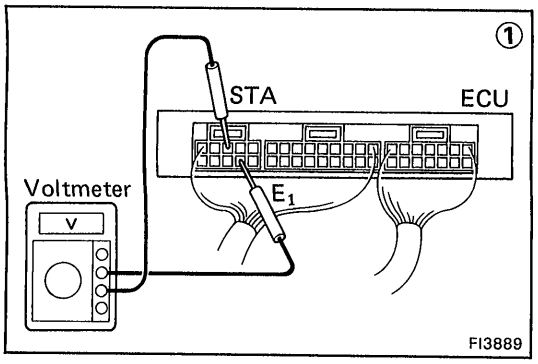
OK ↓

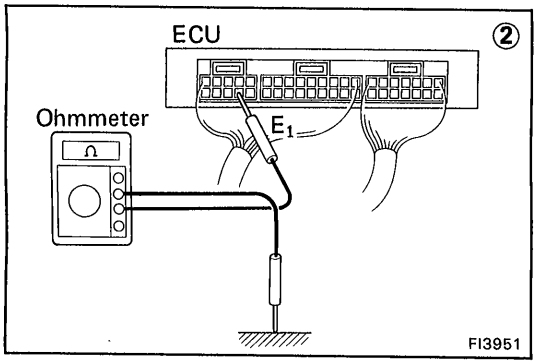
BAD → Repair or replace.

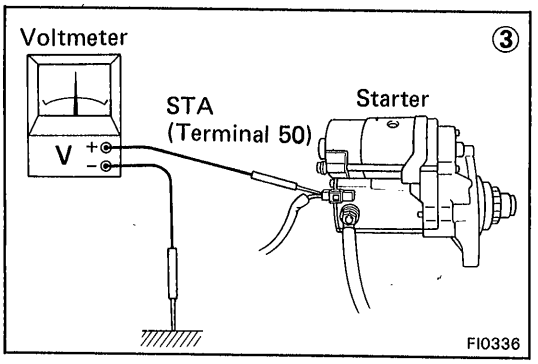
Try another ECU.

No.	Terminals	Trouble	Condition	STD Voltage
5	STA – E_1	No voltage	Ignition switch ST position	6 – 12 V





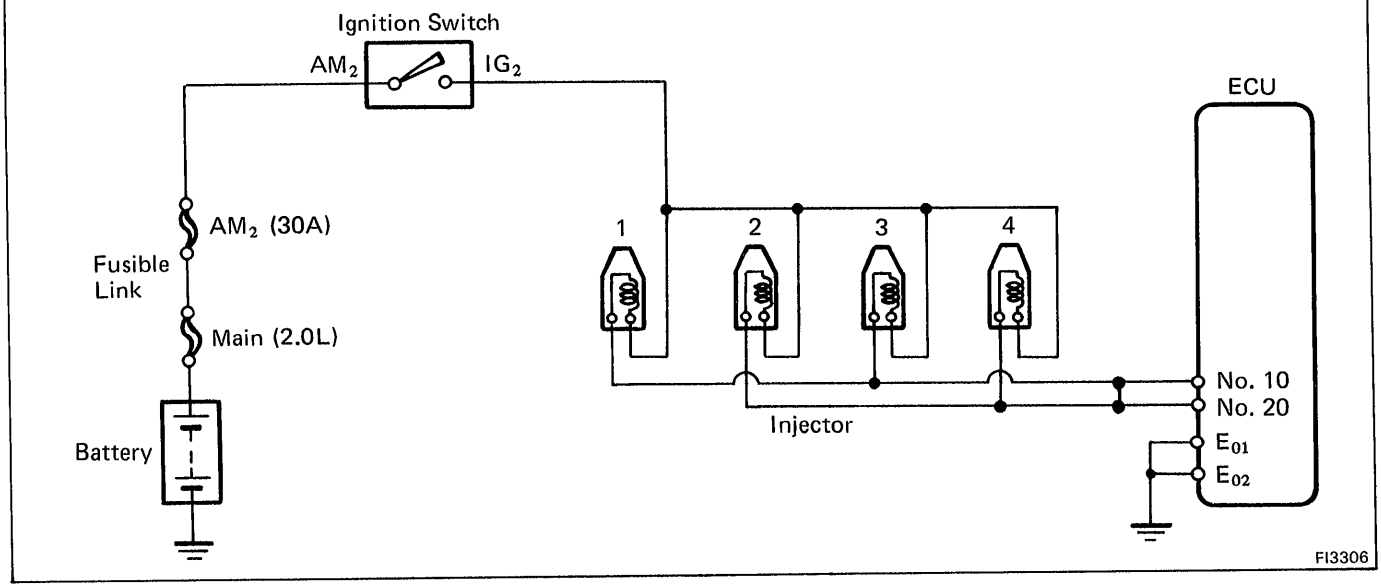


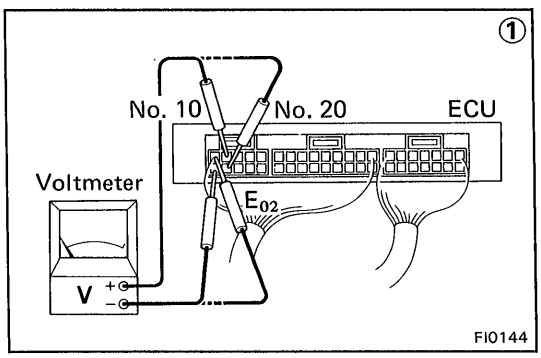


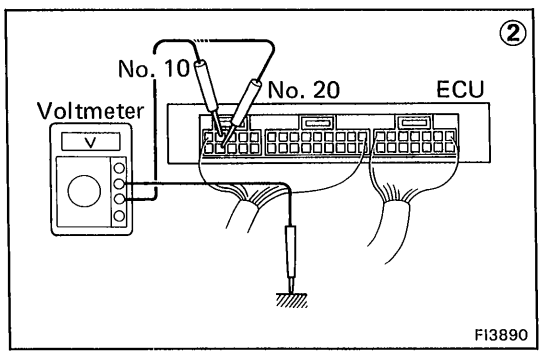
① There is no voltage between ECU terminals STA and E_1. **(IG SW ST)**

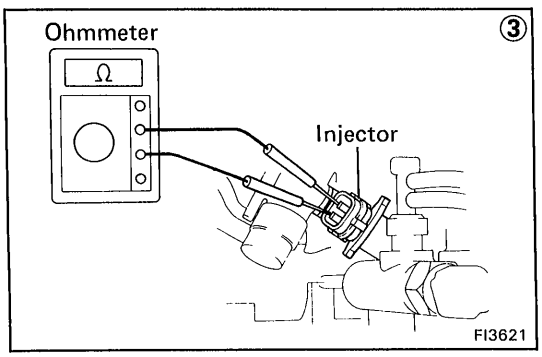
Check starter operation.
- OK → Check wiring between ECU and ignition switch terminal ST.
  - OK → ② Check wiring between ECU terminal E_1 and body ground.
    - OK → Try another ECU.
    - BAD → Repair or replace
  - BAD → Repair or replace
- BAD → Check fusible link, battery, wiring and ignition switch.
  - BAD → Repair or replace
  - OK → ③ Check that there is voltage at STA (50) terminal of starter. **(IG SW ST) STD voltage: 6 – 12 V**
    - OK → Check starter. (See page ST-3)
    - NO → Check wiring between ignition switch ST terminal and starter STA (50) terminal.

No.	Terminals	Trouble	Condition	STD Voltage
6	No. 10 _ E_{01} No. 20 E_{02}	No voltage	Ignition switch ON	10 – 14 V









① There is no voltage between ECU terminals No. 10 and/or No. 20 and E_{01} and/or E_{02}. **(IG SW ON)**

② Check that there is voltage between ECU terminal No. 10 and/or No. 20 and body ground.

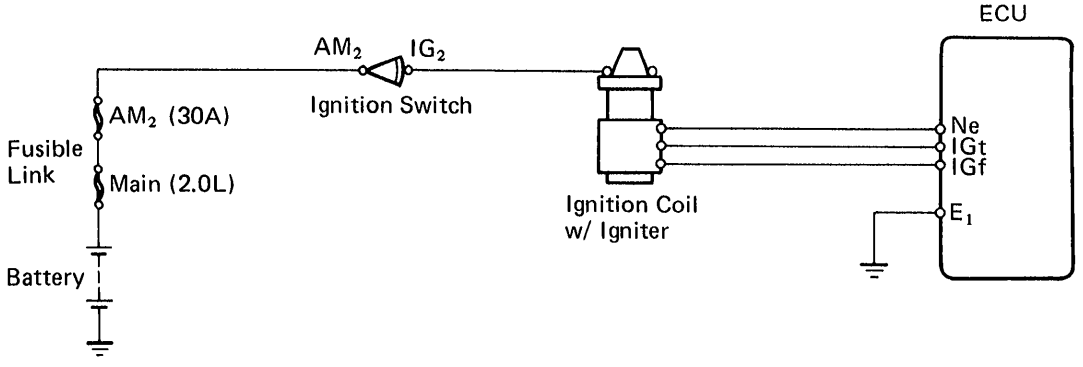
NO → Check wiring between ECU terminal E_{01} and/or E_{02} and body ground.
- OK → Try another ECU.
- BAD → Repair or replace.

OK → Check fusible link and ignition switch.
- BAD → Repair or replace.

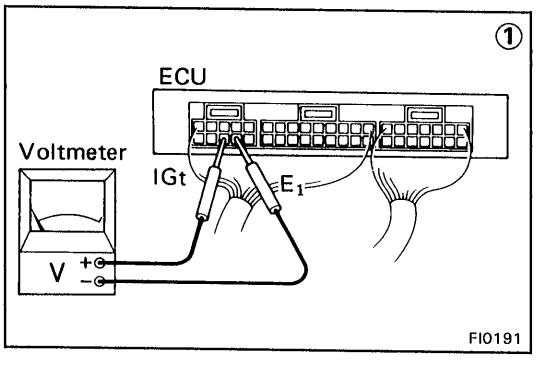
OK → ③ Check resistance of magnetic coil in each injector.
STD resistance: 13.4 – 14.2 Ω
- BAD → Replace injector.

OK → Check wiring between ECU terminal No. 10 and/or No. 20 and battery.
- BAD → Repair or replace.

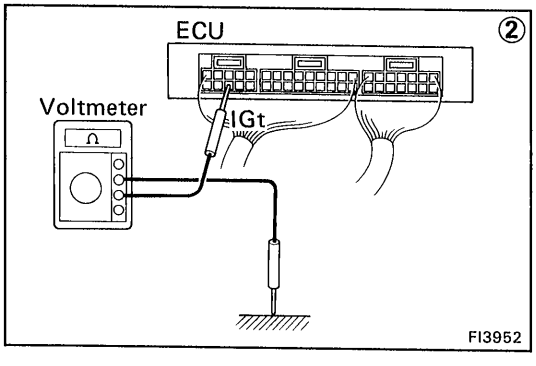
No.	Terminals	Trouble	Condition	STD Voltage
7	IGt — E_1	No voltage	Idling	0.7 — 1.0 V



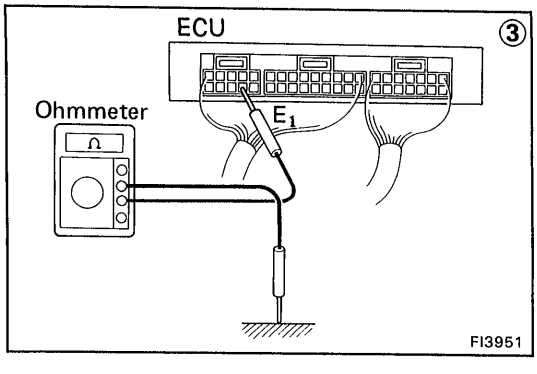
FI2720



FI0191



FI3952



FI3951

① There is no voltage between ECU terminals IGt and E_1. **(Idling)**

↓

② Check that there is voltage between ECU terminal IGt and body ground. **(Idling)**

NO ↓ / OK →

③ Check wiring between ECU terminal E_1 and body ground.

BAD ↓

Refer to No. 1. — BAD → Repair or replace.

OK ↓

Check wiring between igniter and distributor. — BAD → Repair or replace.

OK ↓

Check distributor. — BAD → Replace.

OK ↓

Check wiring between ECU and igniter. — BAD → Repair or replace.

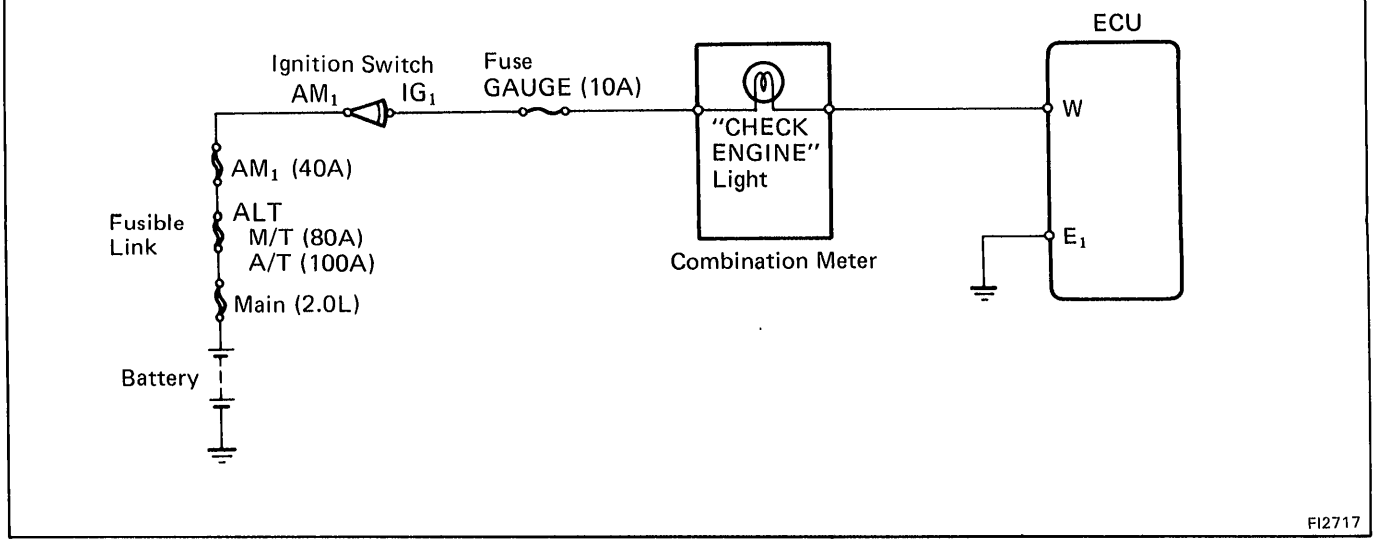
OK ↓

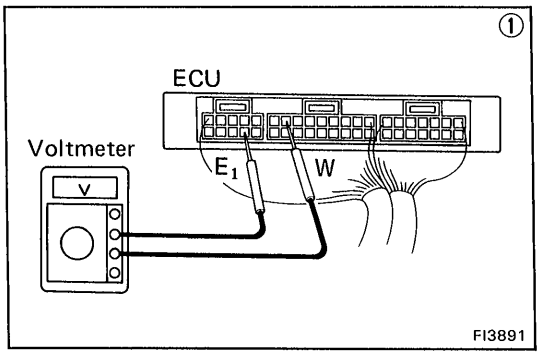
Check igniter. — BAD → Repair or replace.

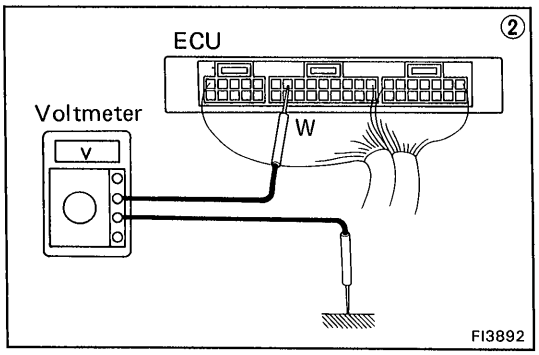
OK ↓

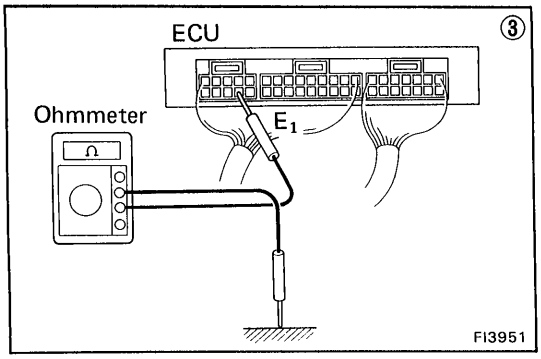
Try another ECU.

No.	Terminals	Trouble	Condition	STD Voltage
8	W – E_1	No voltage	No trouble (CHECK ENGINE light off) and engine running	10 – 14 V









① There is no voltage between ECU terminals W and E_1. **(Idling)**

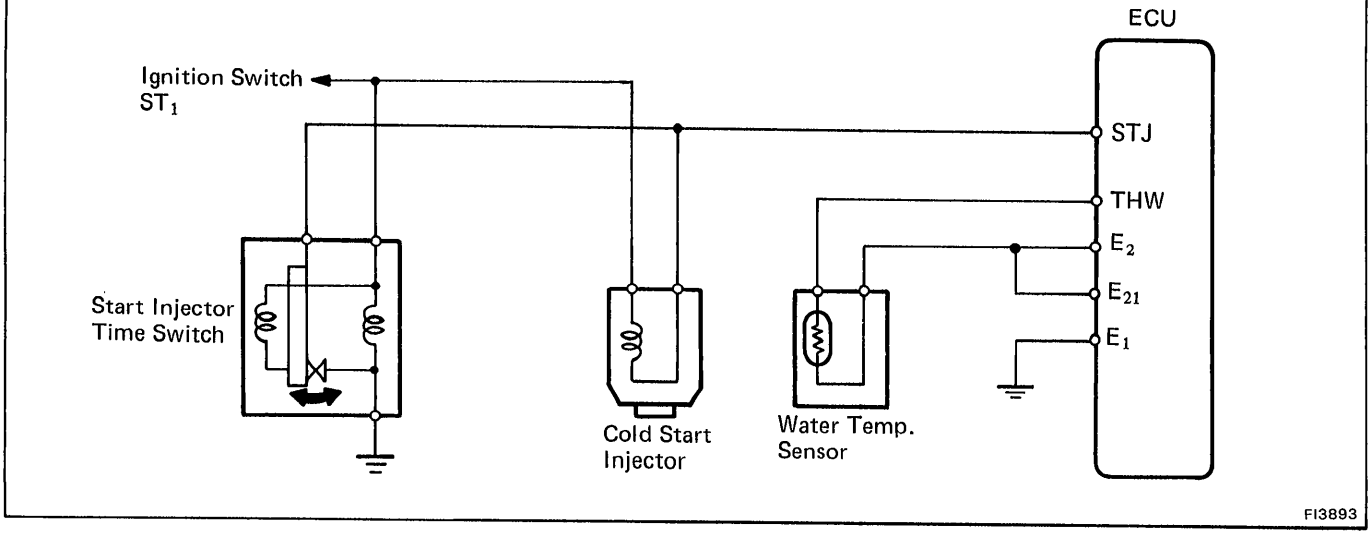
↓

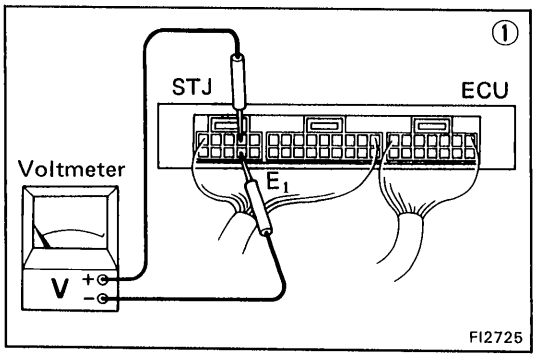
② Check that there is voltage between ECU terminal W and body ground.

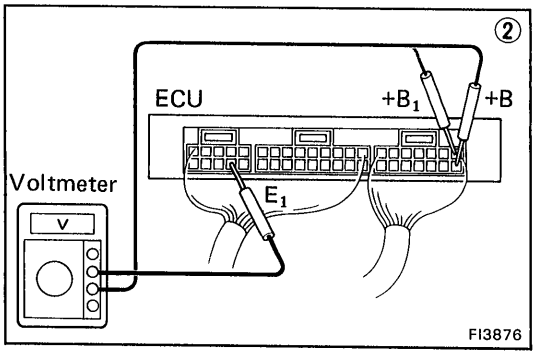
NO → Check GAUGE fuse (10A) and Check Engine light.
- BAD → Repair or replace
- OK → Check wiring between ECU terminal W and CHECK ENGINE light.
  - BAD → Repair or replace

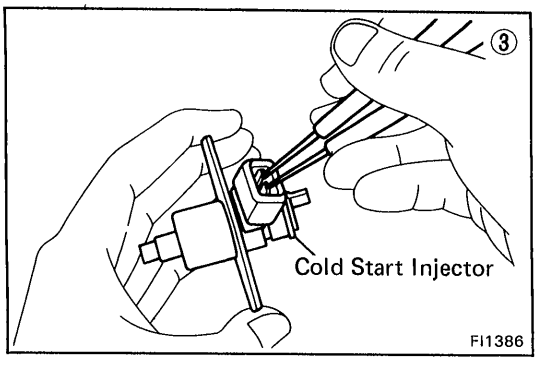
OK → ③ Check wiring between ECU terminal E_1 and body ground.
- OK → Try another ECU.
- BAD → Repair or replace

No.	Terminal	Trouble	Condition		STD Voltage
9	STJ – E_1	No voltage	Ignition switch ST position	Coolant temperature 80°C (176°F)	6 – 12 V









① There is no voltage between ECU terminals STJ and E_1. **(IG SW ON)**

↓

② Check that there is voltage between ECU terminal +B ($+B_1$) and body ground. **(IG SW ON)**

OK → ↓

NO → Refer to No. 1.

↓

③ Check cold start injector.

BAD → Replace cold start injector.

OK → Check wiring between ECU and cold start injector.

OK → ↓

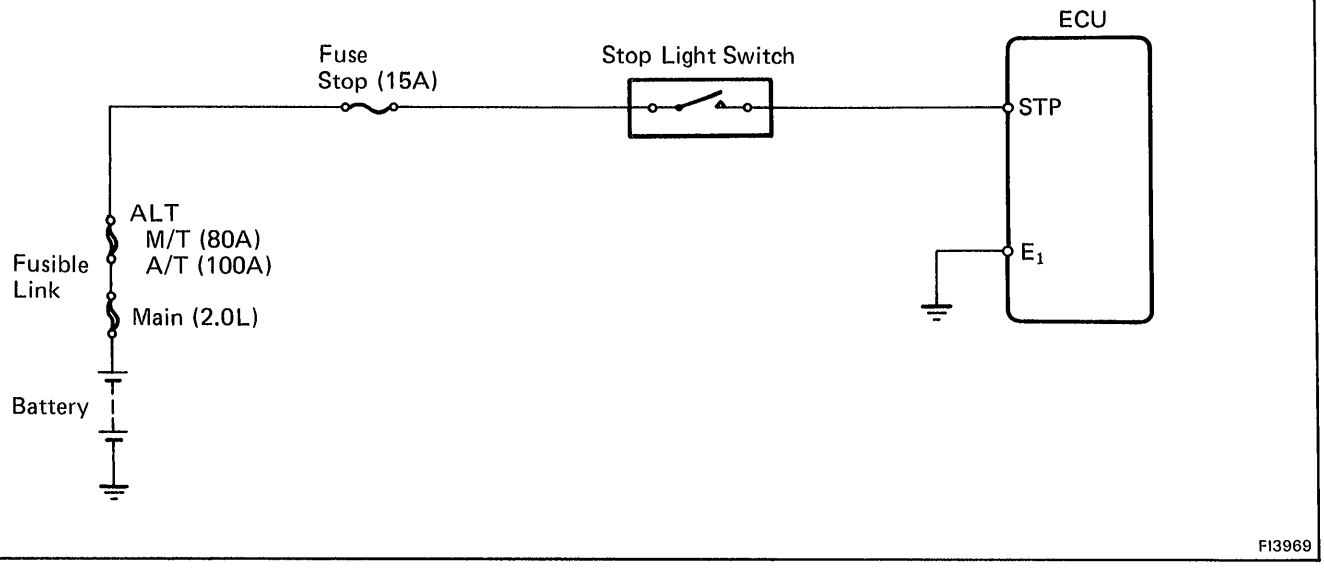
BAD → Repair or replace wiring.

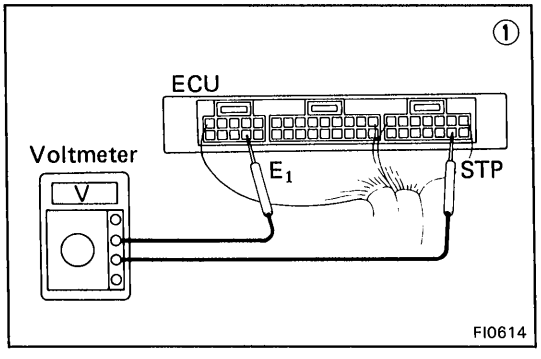
Check wiring between ECU terminal E_1 and body ground.

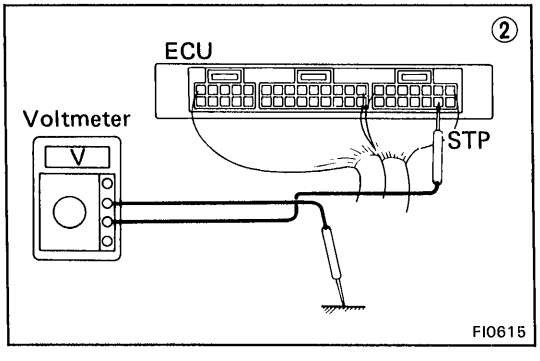
OK → ↓

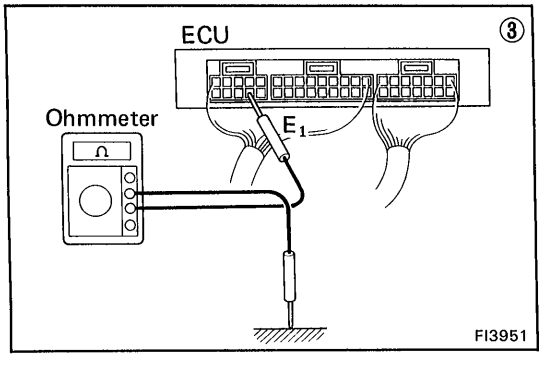
Try another ECU.

No.	Terminals	Trouble	Condition	STD Voltage
10	STP – E_1	No voltage	Stop light switch ON	8 – 14 V









① There is no voltage between ECU terminals STP and E_1.

↓

② Check that there is voltage between ECU terminal STP and body ground when the brake pedal is depressed.

NO ↓ / OK →

③ Check wiring between ECU terminal E_1 and body ground.

OK → Try another ECU.

BAD → Repair or replace.

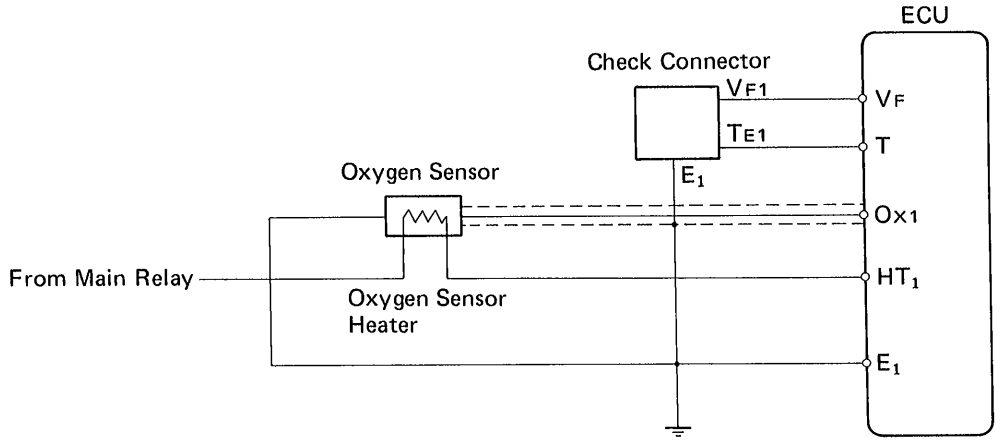
↓ (from NO)

Check STOP fuse (15A) and stop light switch. — BAD → Repair or replace.

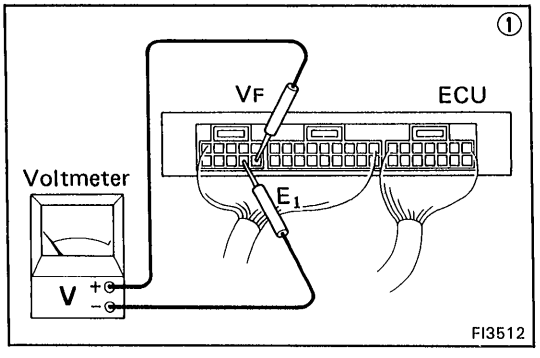
OK ↓

Check wiring between ECU terminal STP and battery. — BAD → Repair or replace.

(California vehicles only)



FI3933



FI3512

① There is no voltage between ECU terminals VF and E_1.

Check that there is voltage between ECU terminal VF and body ground.

NO

OK

Check wiring between ECU terminal E_1 and body ground.

OK

BAD

Try another ECU.

Repair or replace.

Is air leaking into air induction system?

BAD

Repair air leak.

OK

Check spark plugs.

BAD

Repair or replace.

OK

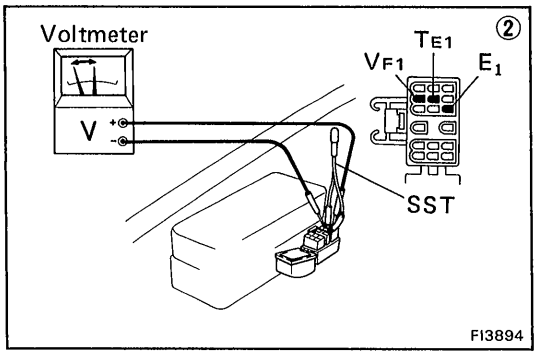
Check distributor and ignition system.

BAD

Repair or replace.

OK

CONTINUED ON PAGE FI-47.



CONTINUED FROM PAGE FI-46.

OK

Check fuel pressure. — BAD → Repair or replace.

OK

Check injector. — BAD → Repair or replace.

OK

Check cold start injector.* — BAD → Repair or replace.

OK

Check air flow meter. — BAD → Repair or replace.

OK

② Check operation of oxygen sensor. — OK → System normal.

BAD

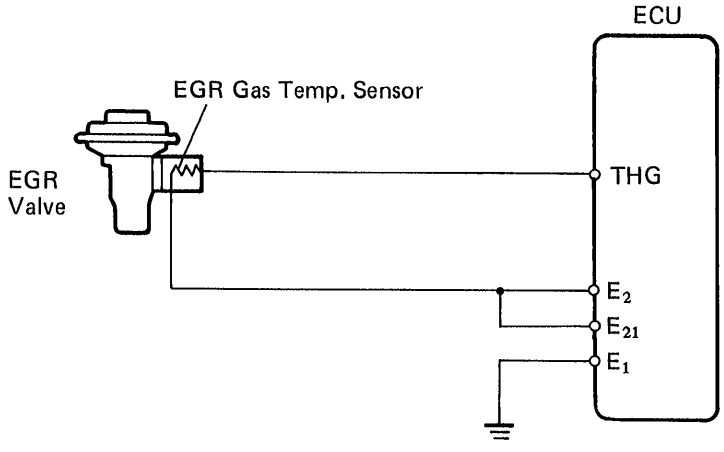
Check wiring between oxygen sensor and ECU connector. — BAD → Repair wiring.

OK

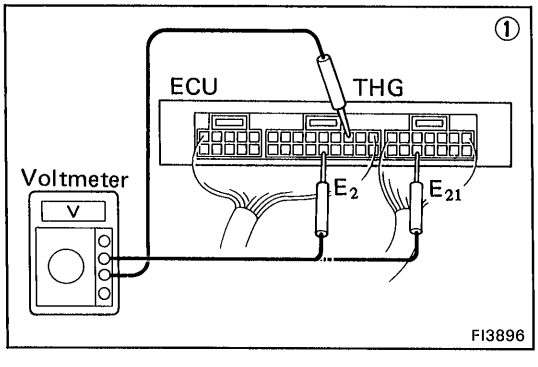
Replace oxygen sensor.

*Rich malfunction only.

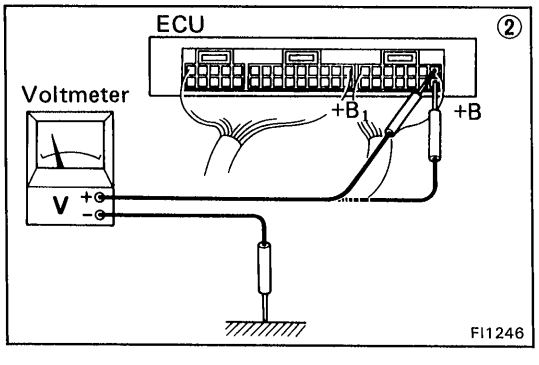
(California vehicles only)



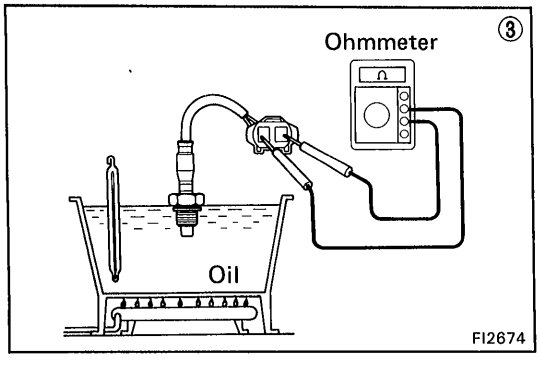
FI3895



FI3896



FI1246



FI2674

① There is no voltage between ECU terminals THG and E_2 (E_{21}). **(Engine running at 2,000 rpm)**

② Check that there is voltage between ECU terminal +B ($+B_1$) and body ground. **(IG SW ON)**

OK → Check wiring between ECU terminal E_1 and body ground.

NO → Refer to No. 1.

OK → Check EGR system.

BAD → Repair or replace.

BAD → Repair or replace.

OK → ③ Check EGR gas temp. sensor.

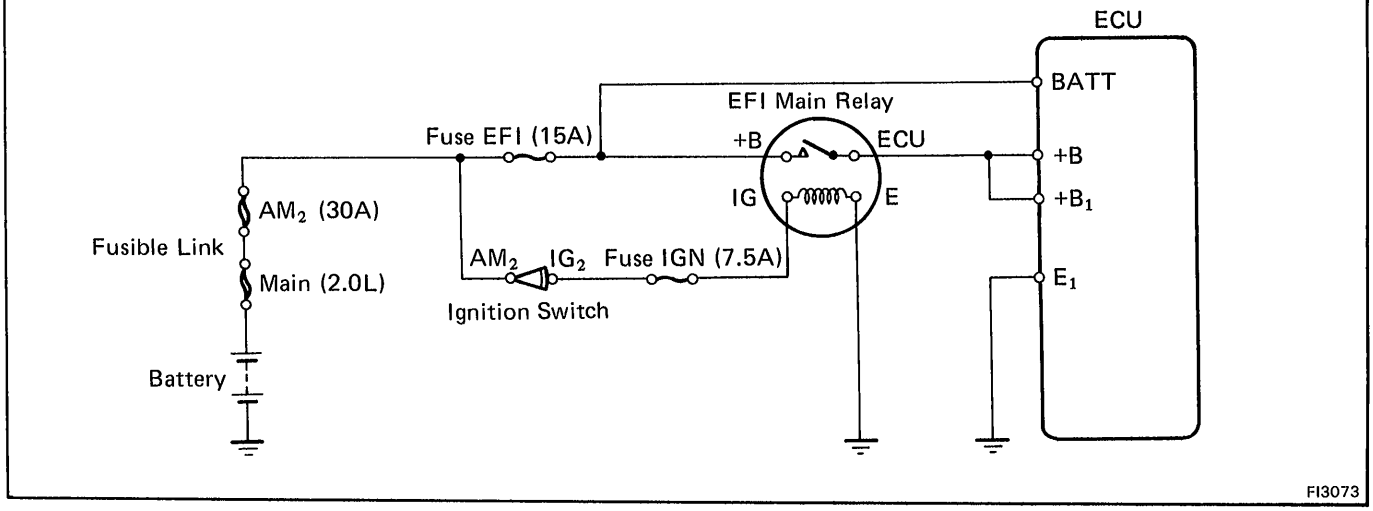
BAD → Replace EGR gas temp. sensor.

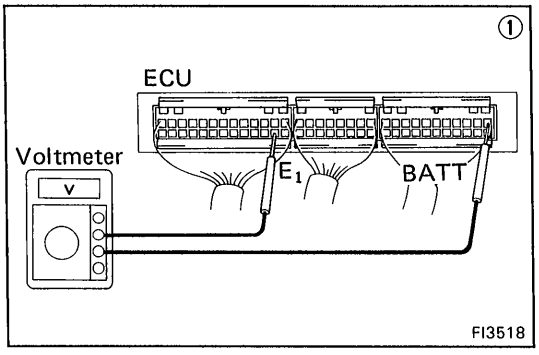
OK → Check wiring between ECU and EGR gas temp. sensor.

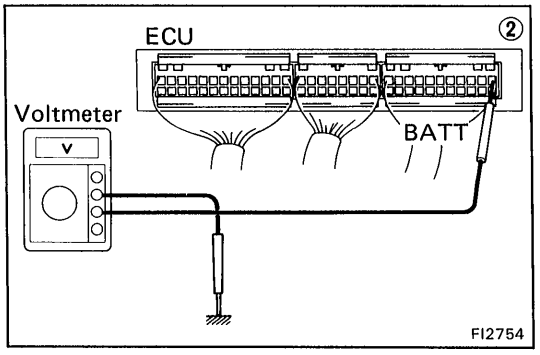
OK → Try another ECU.

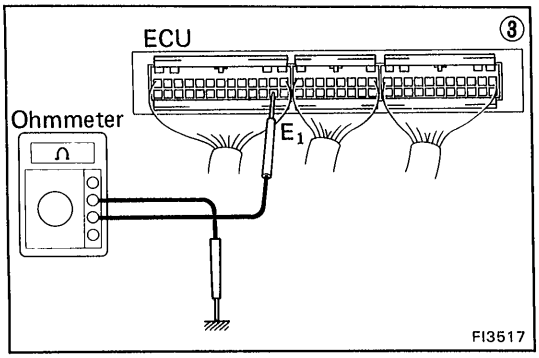
BAD → Repair or replace.

No.	Terminals	Trouble	Condition	STD Voltage
11	BATT – E_1	No voltage	–	10 – 14 V
	+B – E_1		Ignition switch ON	
	$+B_1$ – E_1			









- **BATT – E_1**

① There is no voltage between ECU terminals BATT and E_1.

↓

② Check that there is voltage between ECU terminal BATT and body ground.

NO → ↓ OK

③ Check wiring between ECU terminal E_1 and body ground.

OK → Try another ECU.

BAD → Repair or replace

↓

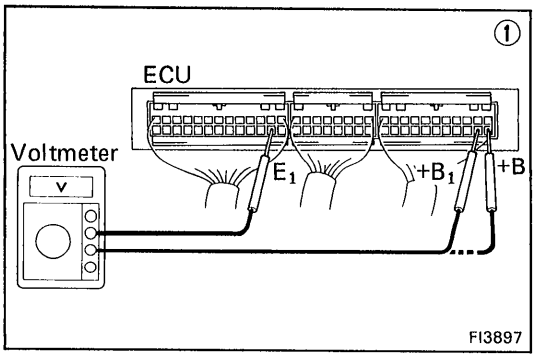
Check fuse and fusible link.

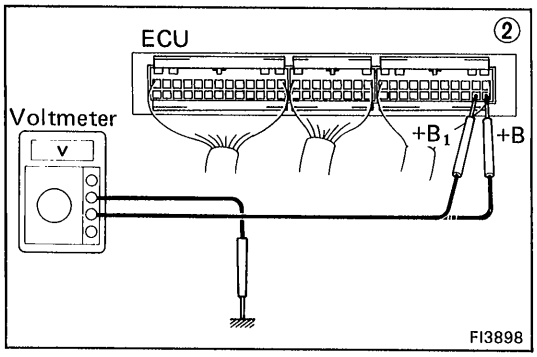
BAD → Replace

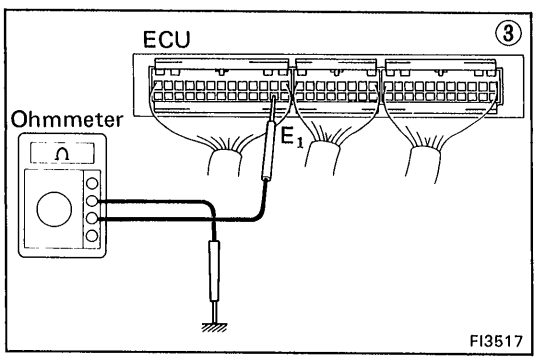
↓ OK

Check wiring between fuse and ECU.

BAD → Repair or replace







- **+B (+B_1) – E_1**

① There is no voltage between ECU terminals +B (+B_1) and E_1. **(IG SW ON)**

② Check that there is voltage between ECU terminal +B (+B_1) and body ground. **(IG SW ON)**

NO → ③ Check wiring between ECU terminal E_1 and body ground.
- OK → Try another ECU.
- BAD → Repair or replace

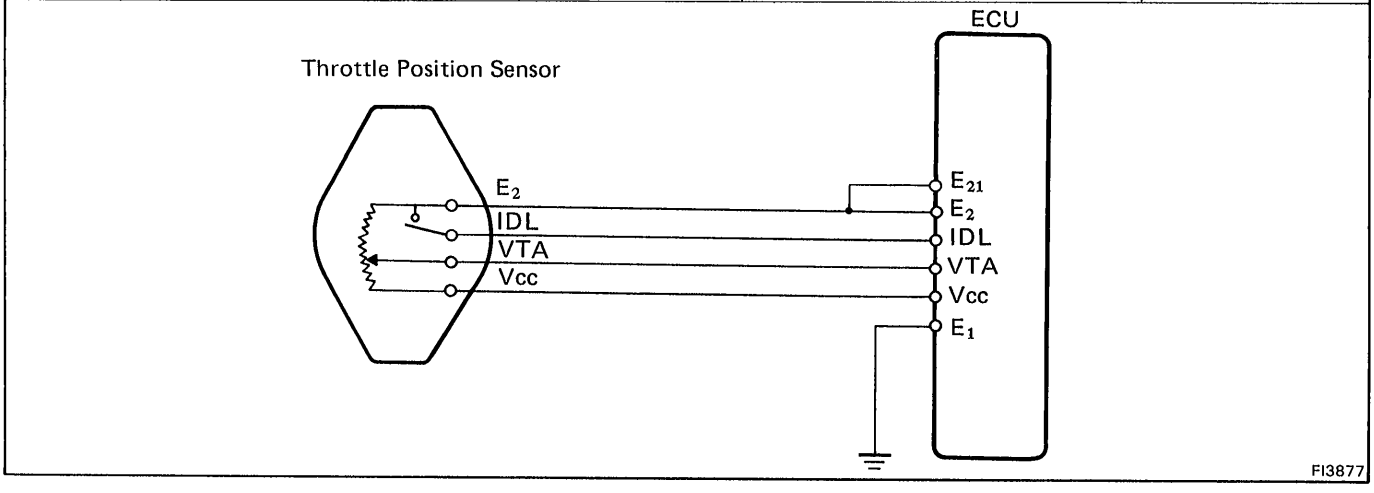
OK → Check fuse, fusible link and ignition switch.
- BAD → Repair or replace

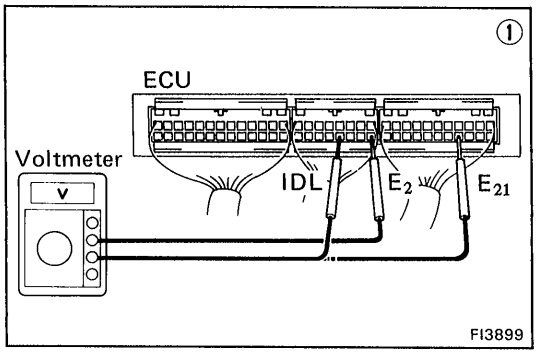
OK → Check EFI main relay.
- BAD → Replace

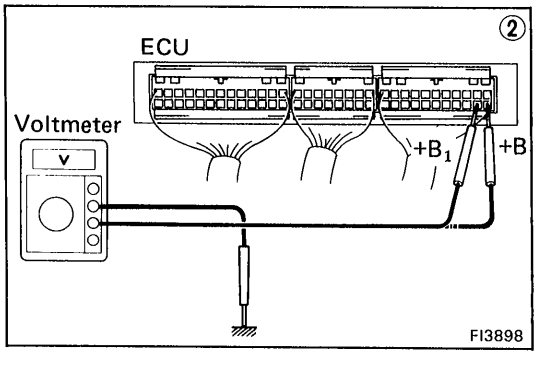
OK → Check wiring between EFI main relay and battery.
- BAD → Repair or replace

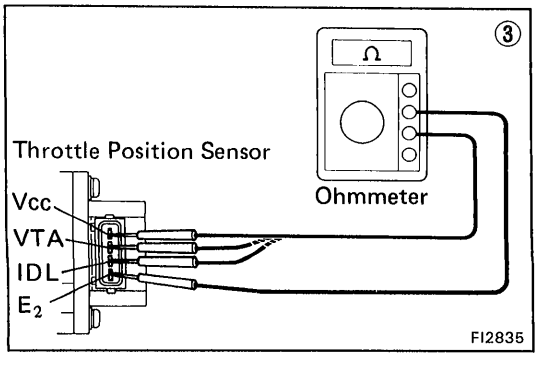
OK → Check wiring between EFI main relay and ECU terminal +B (+B_1).
- BAD → Repair or replace

No.	Terminals	Trouble	Condition		STD Voltage
12	IDL – E_2 (E_{21})	No voltage	Ignition switch ON	Throttle valve open	8 – 14 V
	Vcc – E_2 (E_{21})			–	4 – 6 V
	VTA – E_2 (E_{21})			Throttle valve fully closed	0.1 – 1.0 V
				Throttle valve fully open	3 – 5 V









● **IDL – E_2 (E_{21})**

① There is no voltage between ECU terminals IDL and E_2 (E_{21}). **(IG SW ON)** (Throttle valve open)

② Check that there is voltage between ECU terminal +B ($+B_1$) and body ground. **(IG SW ON)**

NO → Refer to No. 11. → BAD → Replace or repair.

OK → Check wiring between ECU terminals E_1 and body ground.

OK → ③ Check throttle position sensor.

BAD → Replace or repair throttle position sensor.

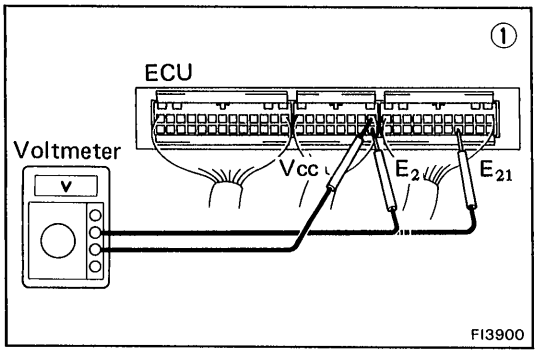
OK → Check wiring between ECU and throttle position sensor.

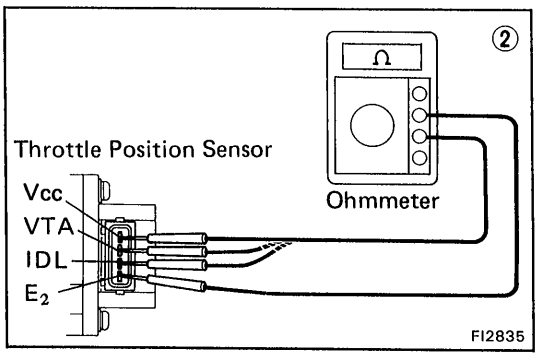
OK → Try another ECU.

BAD → Replace or repair.

BAD → Replace or repair.

OK → ③ Check throttle position sensor.





- **Vcc – E_2 (E_{21})**

① There is no voltage between ECU terminals Vcc and E_2. **(IG SW ON)**

↓

Check that there is voltage between ECU terminal +B (+B_1) and E_1. **(IG SW ON)**

↓ OK — NO → Refer to No. 11.

② Check throttle position sensor.

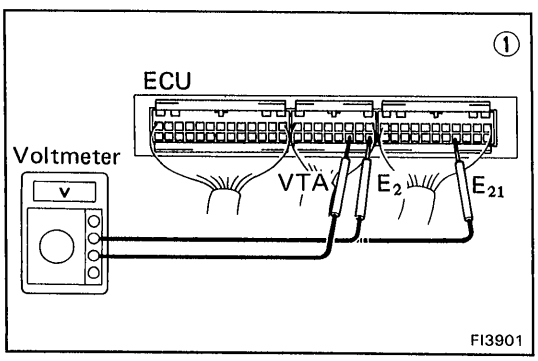
↓ BAD — Repair or replace.

↓ OK

Check wiring between ECU and throttle position sensor.

↓ OK — Try another ECU.

↓ BAD — Repair or replace wiring.



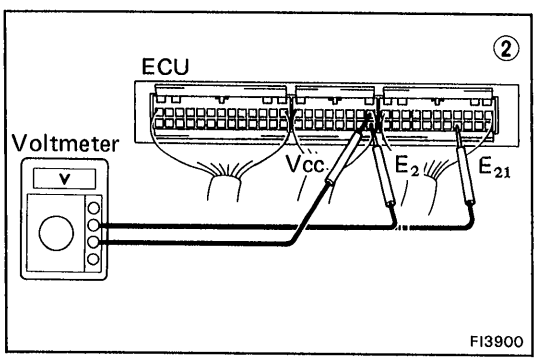
- **VTA – E_2 (E_{21})**

① There is no specified voltage between ECU terminals VTA and E_2 (E_{21}). **(IG SW ON)**

↓

② Check that there is voltage between ECU terminals Vcc and E_2 (E_{21}). **(IG SW ON)**

↓ OK — NO → Perform inspection of Vcc – E_2 (E_{21})



↓ OK

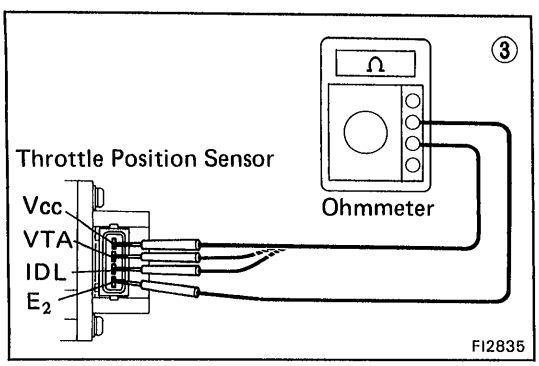
③ Check throttle position sensor. — BAD → Repair or replace.

↓ OK

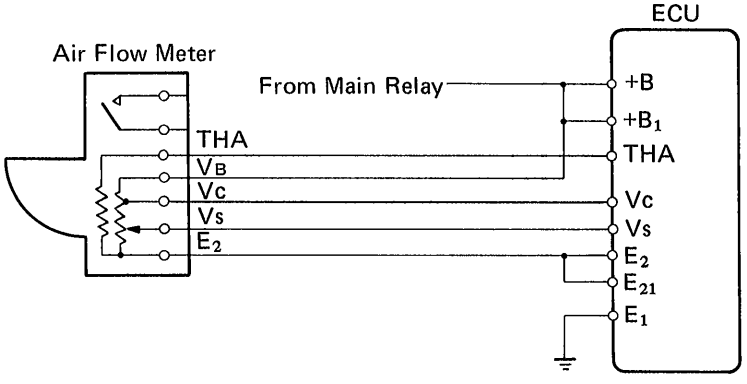
Check wiring between ECU and throttle position sensor. — BAD → Repair or replace.

↓ OK

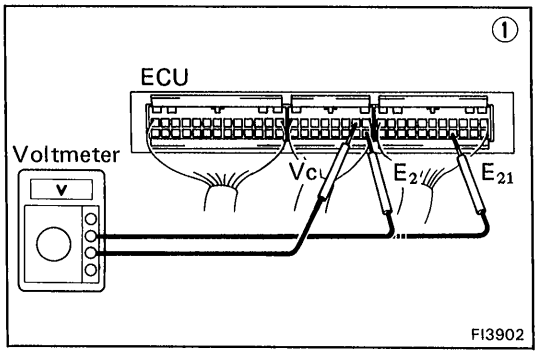
Try another ECU.



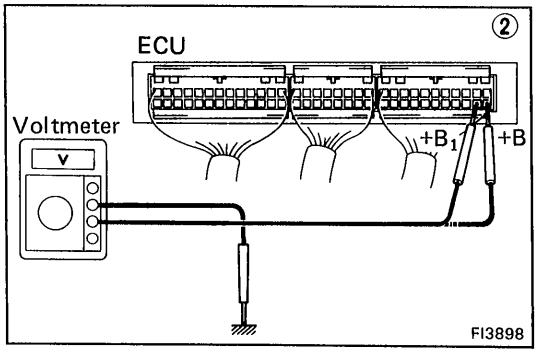
No.	Terminals	Trouble	Condition		STD Voltage
13	Vc – E_2 (E_{21})	No voltage	Ignition switch ON	–	6 – 10 V
	Vs – E_2 (E_{21})			Measuring plate fully closed	0.5 – 2.5 V
				Measuring plate fully open	5 – 10 V
			Idling		2 – 8 V
	THA – E_2 (E_{21})		Ignition switch ON	Intake air temperature 20°C (68°F)	1 – 3 V



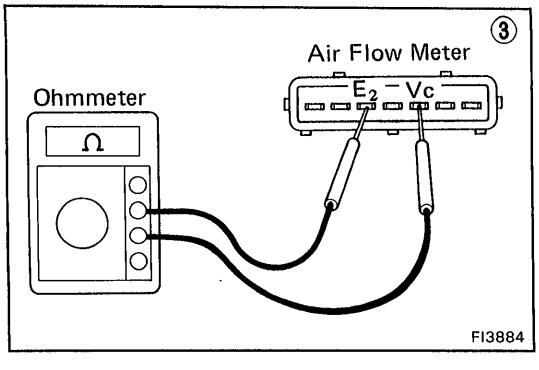
FI3881



FI3902



FI3898



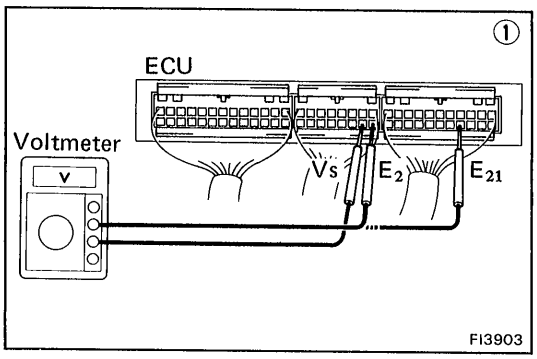
FI3884

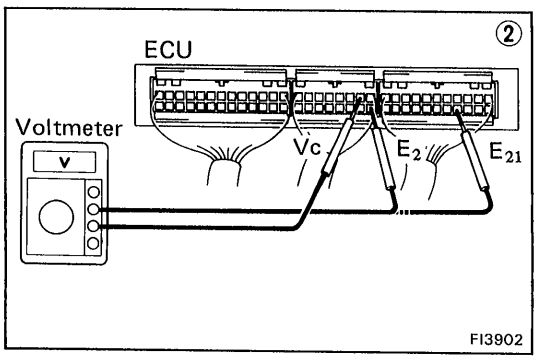
● **Vc – E_2 (E_{21})**

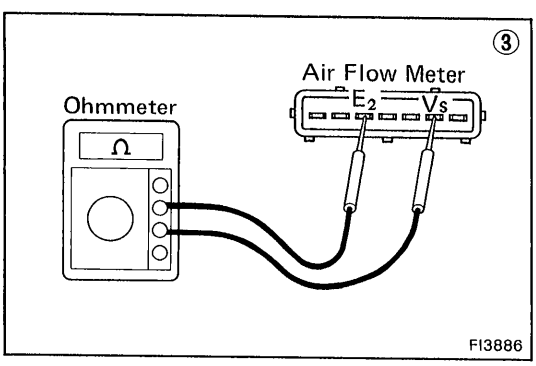
① There is no specified voltage at ECU terminals Vc and E_2 (E_{21}). **(IG SW ON)**

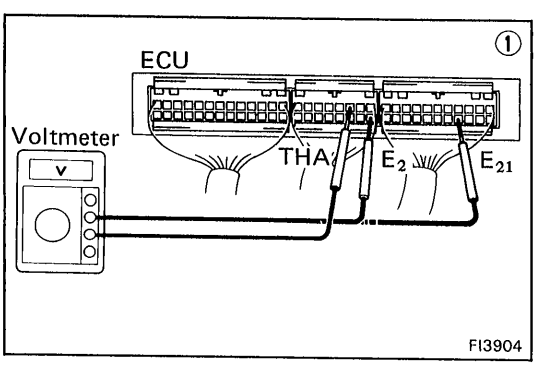
② Check that there is voltage between ECU terminals +B (+B_1) and E_1. **(IG SW ON)**

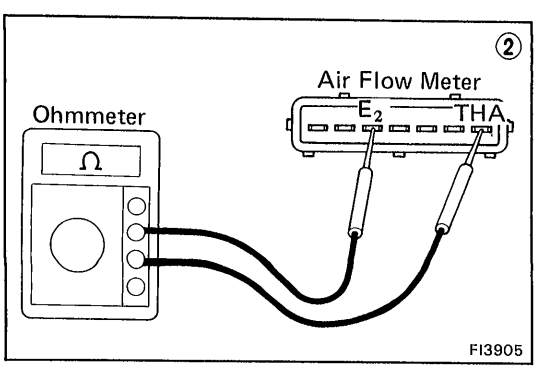
- ② OK → ③ Check air flow meter.
  - ③ NO → Replace or repair air flow meter.
  - ③ OK → Check wiring between ECU and air flow meter.
    - OK → Try another ECU.
    - NO → Replace or repair wiring.
- ② NO → Refer to No. 11.











● **Vs – E_2 (E_{21})**

① There is no specified voltage between ECU terminals Vs and E_2 (E_{21}). **(IG SW ON)**

② Check that there is voltage between ECU terminals Vc and E_2 (E_{21}). **(IG SW ON)**

OK → ③ Check air flow meter.

NO → Refer to Vcc – E_2 (E_{21}) → BAD → Repair or replace

③ Check air flow meter. → BAD → Repair or replace

OK → Check wiring between ECU and air flow meter. → BAD → Repair or replace

OK → Try another ECU.

● **THA – E_2 (E_{21})**

① There is no voltage between ECU terminals THA and E_2 (E_{21}). **(IG SW ON)**

Check that there is voltage between ECU terminal +B (+B_1) and body ground. **(IG SW ON)**

OK → ② Check air temp. sensor.

NO → Refer to No. 11.

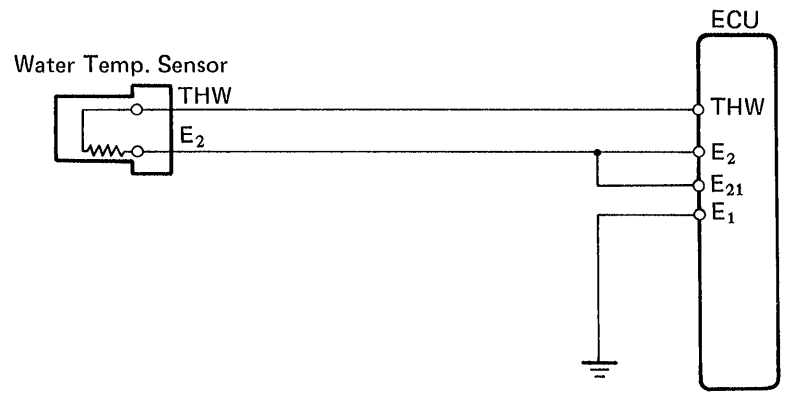
② Check air temp. sensor. → BAD → Replace air flow meter.

② Check air temp. sensor. → OK → Check wiring between ECU and air temp. sensor.

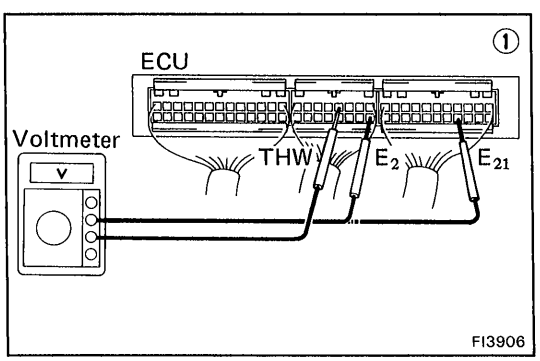
Check wiring between ECU and air temp. sensor. → OK → Try another ECU.

Check wiring between ECU and air temp. sensor. → BAD → Repair or replace wiring.

No.	Terminals	Trouble	Condition		STD Voltage
14	THW – E_2 (E_{21})	No voltage	Ignition switch ON	Coolant temperature 80°C (176°F)	0.1 – 1.0 V



FI3887



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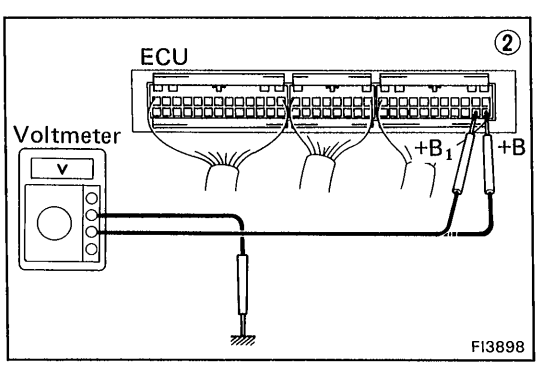
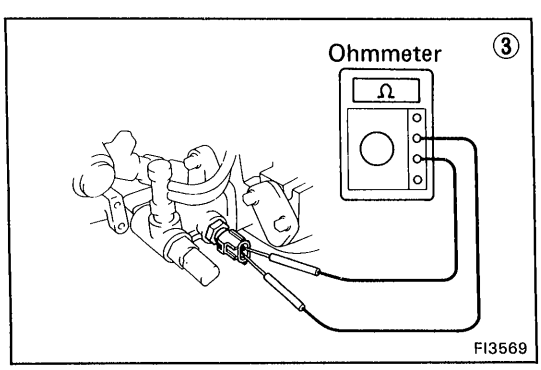


FI3898



FI3569

① There is no voltage between ECU terminals THW and E_2 (E_{21}). **(IG SW ON)**

② Check that there is voltage between ECU terminal +B ($+B_1$) and body ground. **(IG SW ON)**

OK → Check wiring between ECU terminals E_1 and body ground.

NO → Refer to No. 11.

OK → ③ Check water temp. sensor.

BAD → Repair or replace.

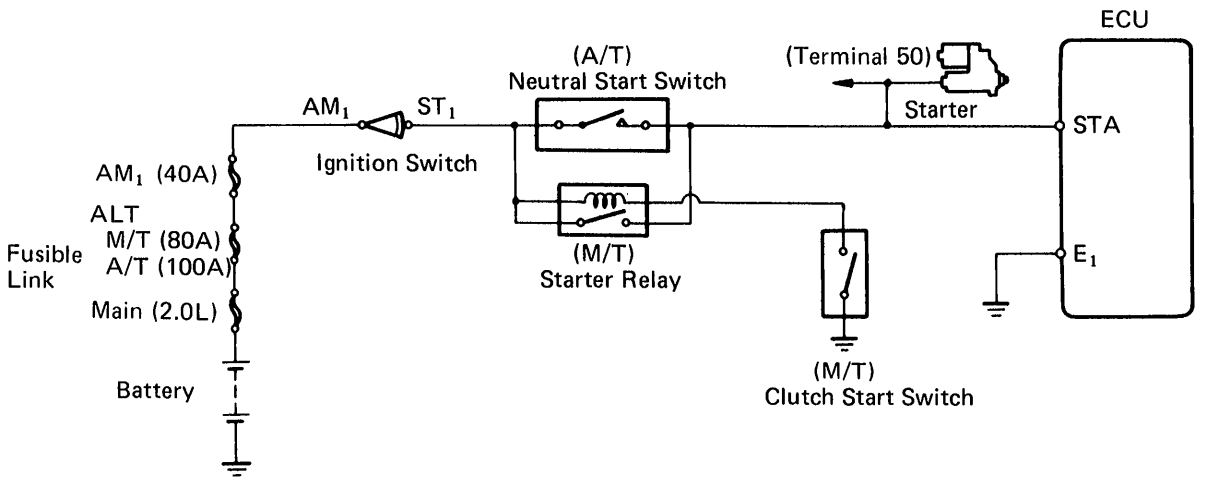
BAD → Replace water temp. sensor.

OK → Check wiring between ECU and water temp. sensor.

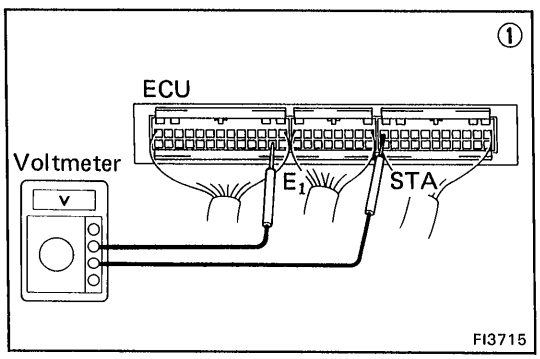
OK → Try another ECU.

BAD → Repair or replace.

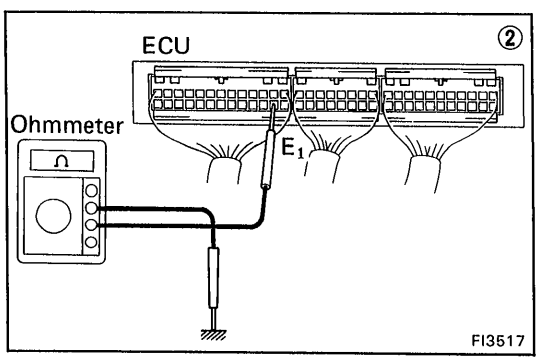
No.	Terminals	Trouble	Condition	STD Voltage
15	STA – E_1	No voltage	Ignition switch ST position	6 – 12 V



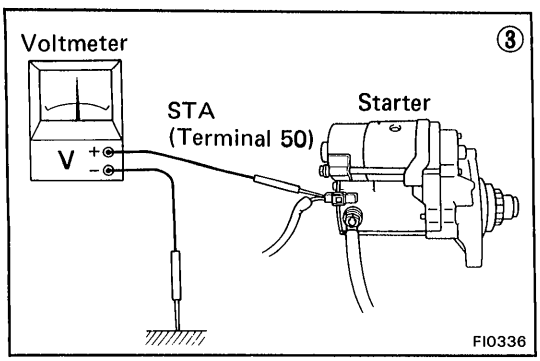
FI2714



FI3715



FI3517

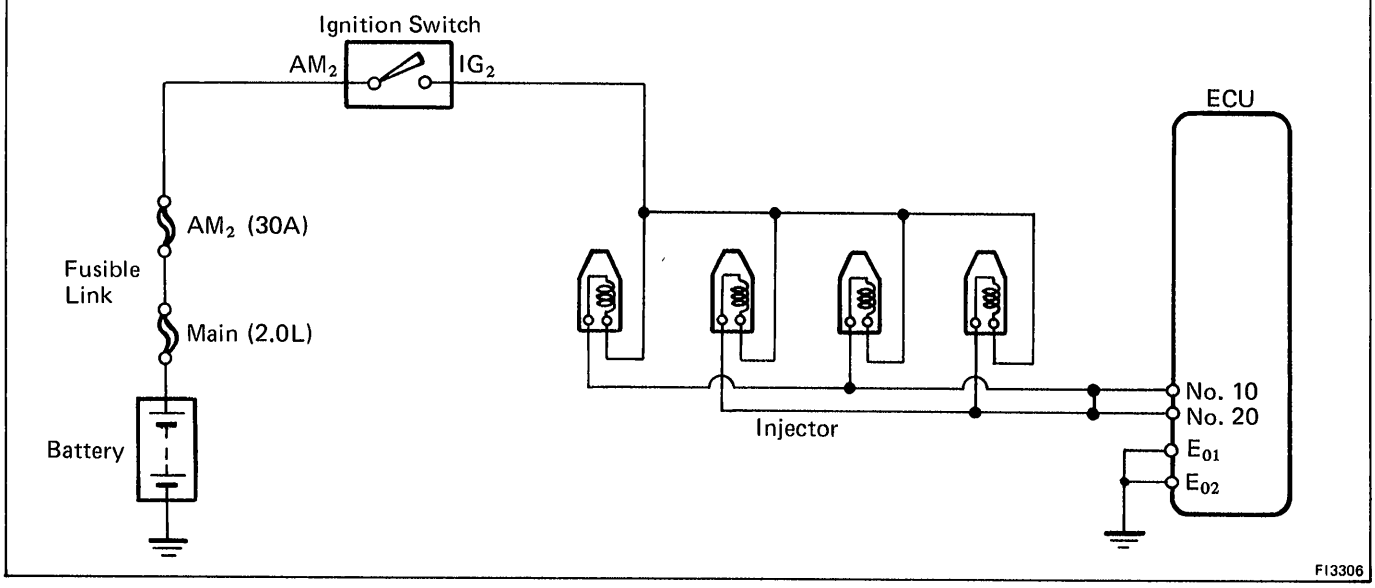


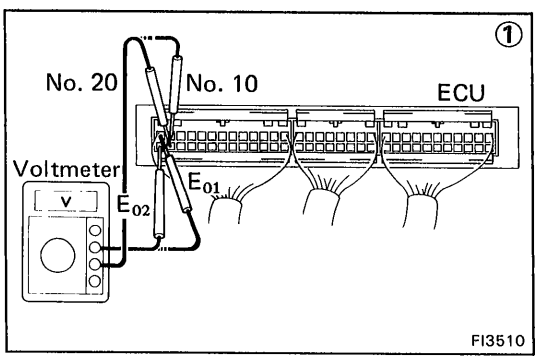
FI0336

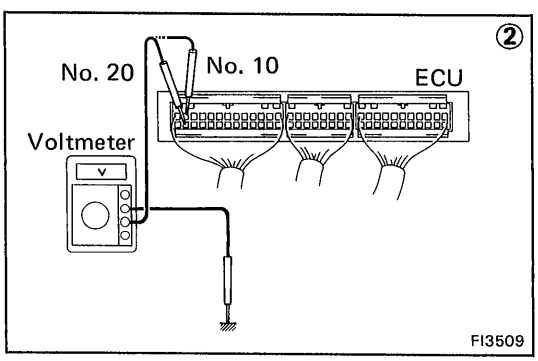
① There is no voltage between ECU terminals STA and E_1. **(IG SW ST)**

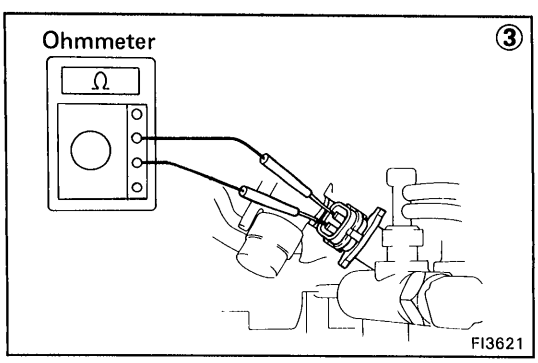
Check starter operation.
- OK → Check wiring between ECU and ignition switch terminal ST.
  - OK → ② Check wiring between ECU terminal E_1 and body ground.
    - OK → Try another ECU.
    - BAD → Repair or replace
  - BAD → Repair or replace
- BAD → Check fusible link, battery, wiring and ignition switch.
  - BAD → Repair or replace
  - OK → ③ Check that there is voltage at STA (50) terminal of starter. **(IG SW ST) STD voltage: 6 – 12 V**
    - OK → Check starter. (See page ST-3)
    - NO → Check wiring between ignition switch ST terminal and starter STA (50) terminal.

No.	Terminals	Trouble	Condition	STD Voltage
16	No. 10 – E_{01} No. 20 – E_{02}	No voltage	Ignition switch ON	10 – 14 V









① There is no voltage between ECU terminals No. 10 and/or No. 20 and E_{01} and/or E_{02}. **(IG SW ON)**

↓

② Check that there is voltage between ECU terminal No. 10 and/or No. 20 and body ground.

NO → OK

OK → Check wiring between ECU terminal E_{01} and/or E_{02} and body ground.

OK → Try another ECU.

BAD → Repair or replace.

NO → Check fusible link and ignition switch.

BAD → Repair or replace.

OK

↓

③ Check resistance of magnetic coil in each injector.
STD resistance: 13.4 – 14.2 Ω

OK

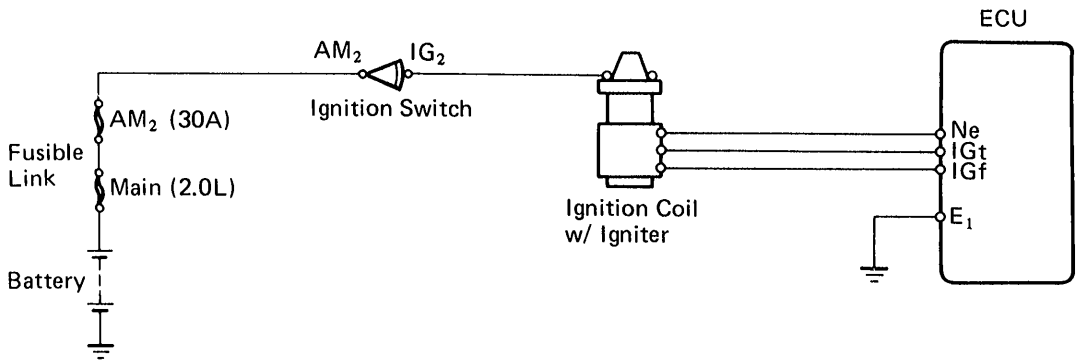
↓

BAD → Replace injector.

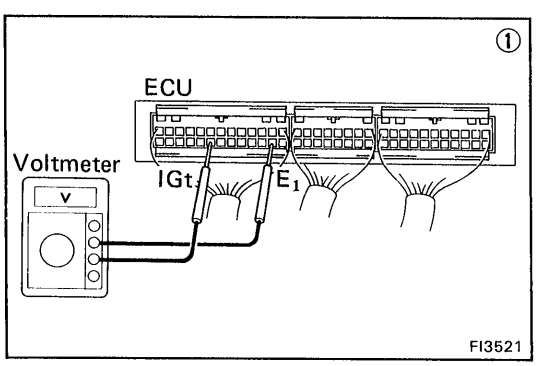
Check wiring between ECU terminal No. 10 and/or No. 20 and battery.

BAD → Repair or replace.

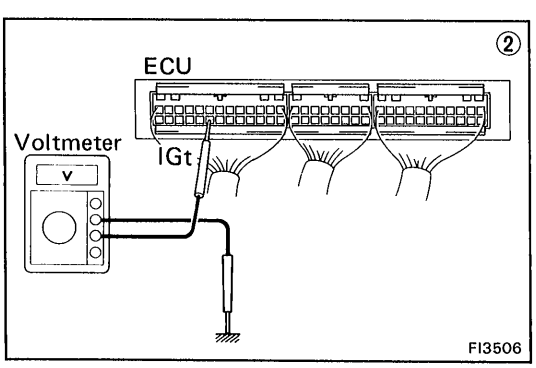
No.	Terminals	Trouble	Condition	STD Voltage
17	IGt – E_1	No voltage	Idling	0.7 – 1.0 V



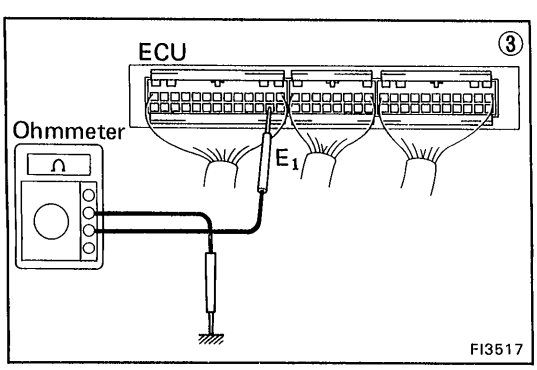
FI2720



FI3521



FI3506



FI3517

① There is no voltage between ECU terminals IGt and E_1. **(Idling)**

↓

② Check that there is voltage between ECU terminal IGt and body ground. **(Idling)**

NO → ↓

OK → ③ Check wiring between ECU terminal E_1 and body ground.

③ BAD → Repair or replace.

↓

Refer to No. 11. BAD → Repair or replace.

↓ OK

Check wiring between igniter and distributor. BAD → Repair or replace.

↓ OK

Check distributor. BAD → Replace.

↓ OK

Check wiring between ECU and igniter. BAD → Repair or replace.

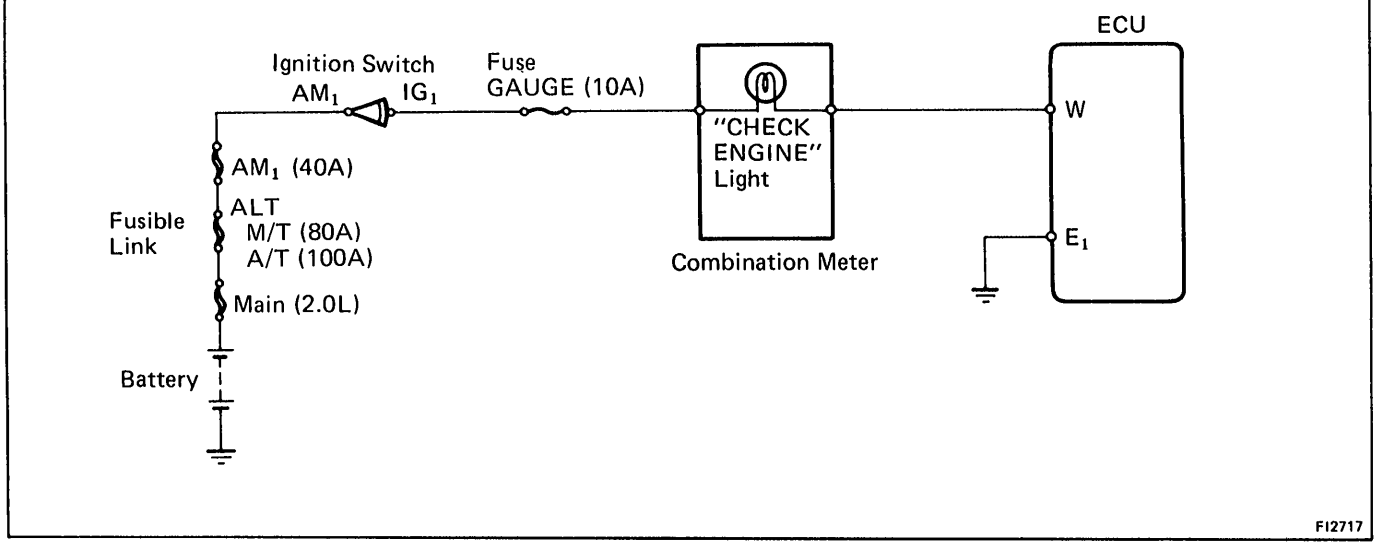
↓ OK

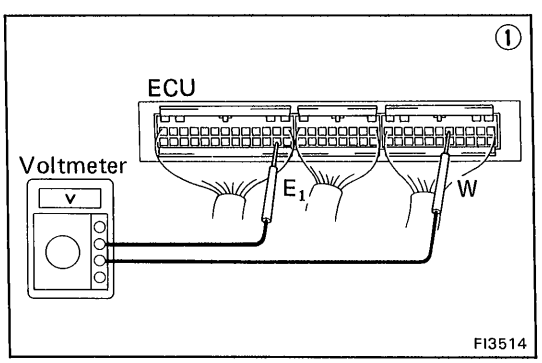
Check igniter. BAD → Repair or replace.

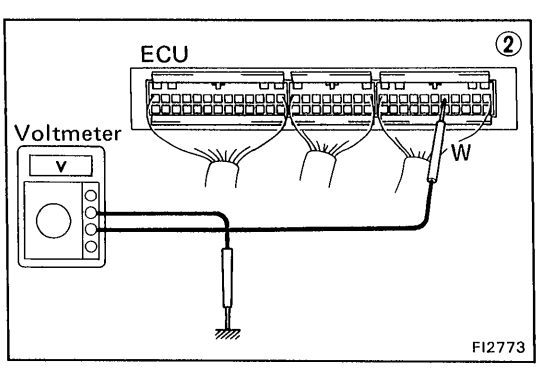
↓ OK

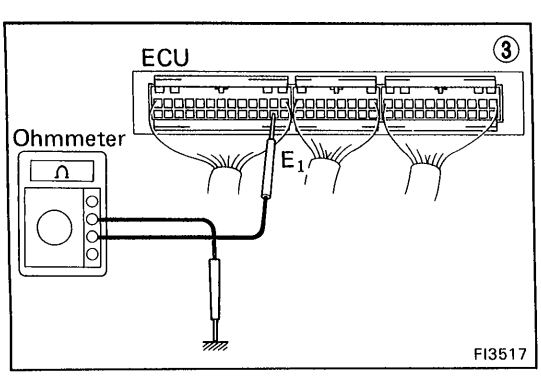
Try another ECU.

No.	Terminals	Trouble	Condition	STD Voltage
18	W – E_1	No voltage	No trouble (CHECK ENGINE light off) and engine running	10 – 14 V









① There is no voltage between ECU terminal W and E_1. **(Idling)**

↓

② Check that there is voltage between ECU terminal W and body ground.

NO → ↓ OK → ↓

③ Check wiring between ECU terminal E_1 and body ground.

OK → Try another ECU.

BAD → Repair or replace

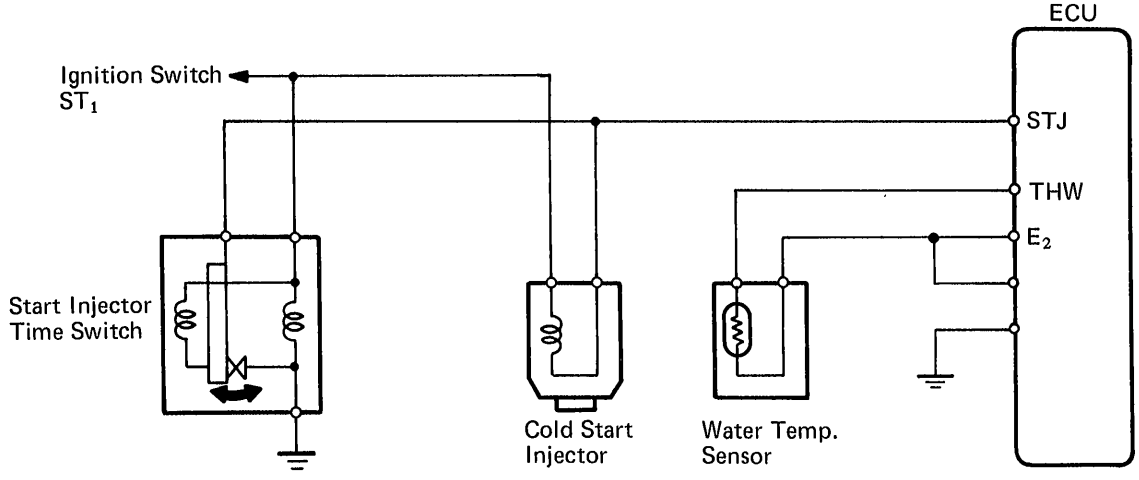
NO → ↓

Check GAUGE fuse (10A) and Check Engine light. → BAD → Repair or replace

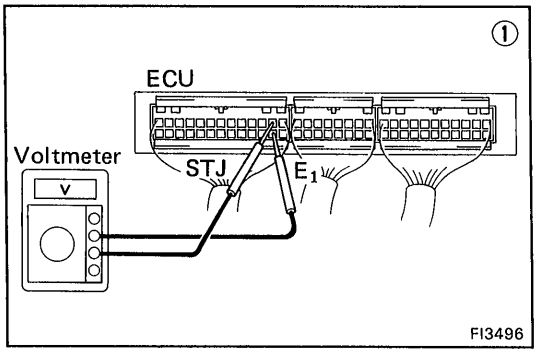
↓ OK

Check wiring between ECU terminal W and fuse. → BAD → Repair or replace

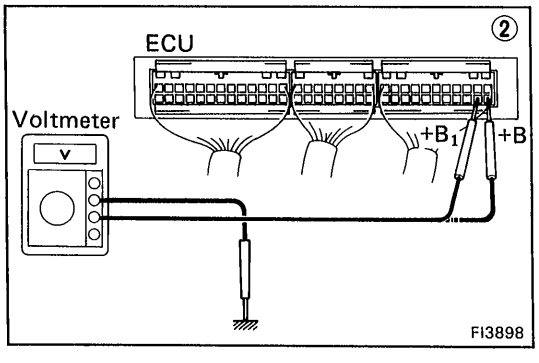
No.	Terminal	Trouble	Condition		STD Voltage
19	STJ – E_1	No voltage	Ignition switch ST position	Coolant temperature 80°C (176°F)	6 – 12 V



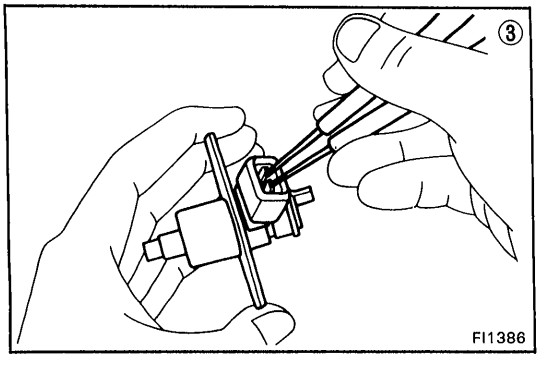
FI3893



FI3496



FI3898



FI1386

① There is no voltage between ECU terminals STJ and E_1. **(IG SW ON)**

↓

② Check that there is voltage between ECU terminal +B ($+B_1$) and body ground. **(IG SW ON)**

OK → ③ Check cold start injector.

NO → Refer to No. 11.

③ BAD → Replace cold start injector.

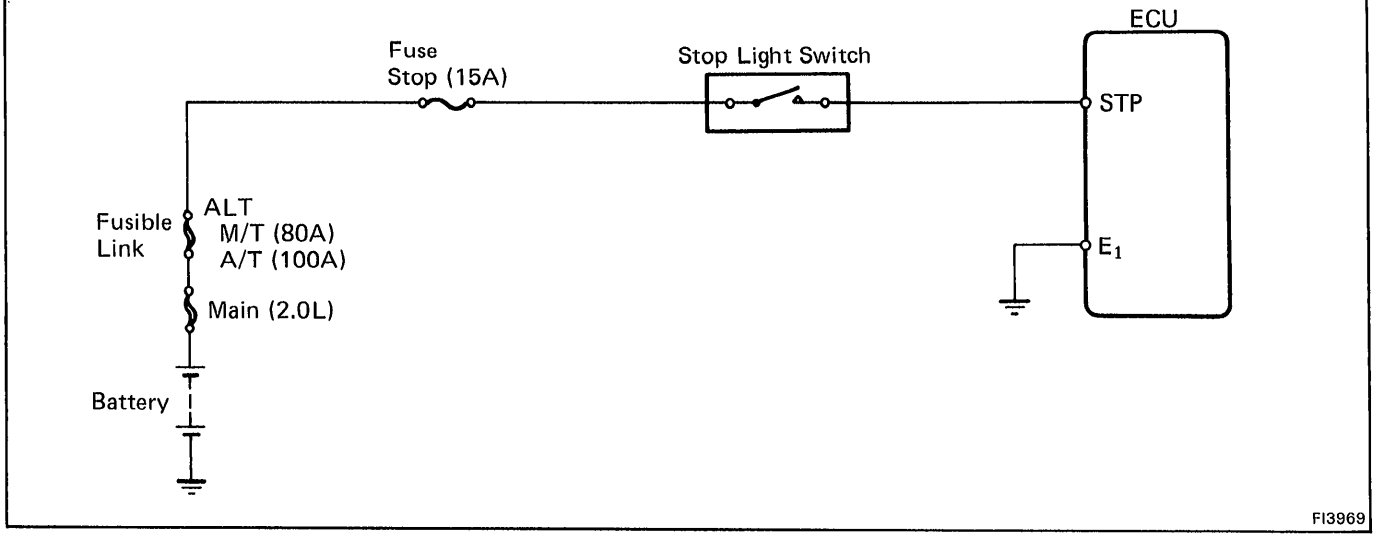
③ OK → Check wiring between ECU and cold start injector.

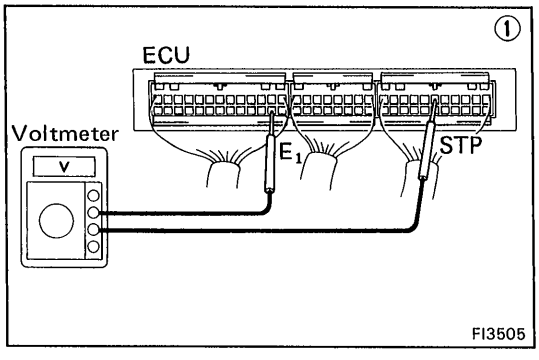
OK → Check wiring between ECU terminal E_1 and body ground.

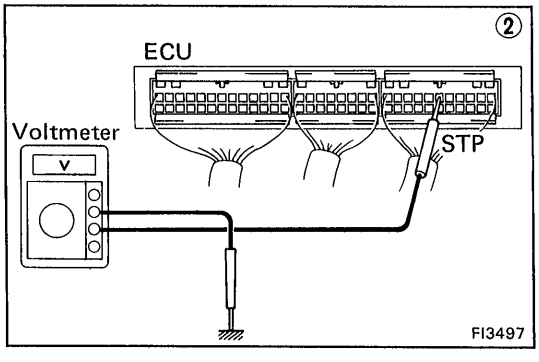
OK → Try another ECU.

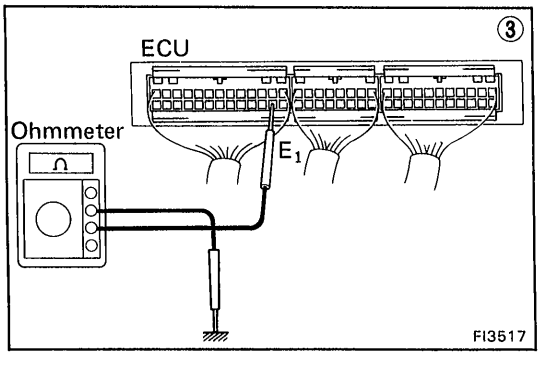
BAD → Repair or replace wiring.

No.	Terminals	Trouble	Condition	STD Voltage
20	STP – E_1	No voltage	Stop light switch ON	8 – 14 V









① There is no voltage between ECU terminals STP and E_1.

↓

② Check that there is voltage between ECU terminal STP and body ground when the brake pedal is depressed.

NO → Check STOP fuse (15A) and stop light switch. — BAD → Repair or replace.

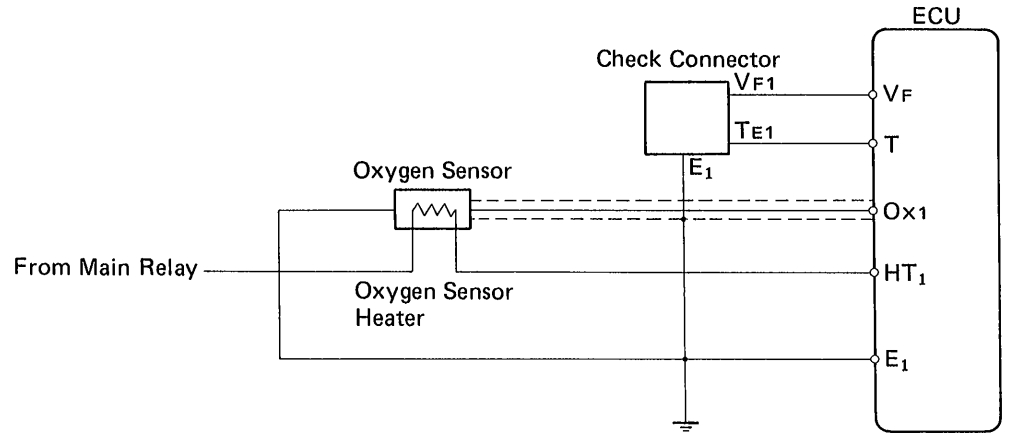
OK → Check wiring between ECU terminal STP and battery. — BAD → Repair or replace.

OK → ③ Check wiring between ECU terminal E_1 and body ground.

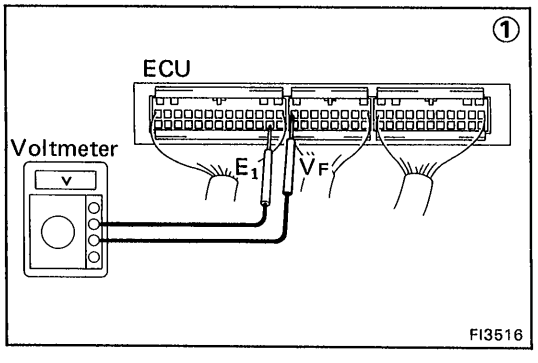
OK → Try another ECU.

BAD → Repair or replace.

(California Vehicles only)



FI3933



FI3516

① There is no voltage between ECU terminals VF and E_1.

Check that there is voltage between ECU terminal VF and body ground.

NO — OK

Check wiring between ECU terminal E_1 and body ground.

OK — BAD

Try another ECU.

Repair or replace.

Is air leaking into air induction system? — BAD → Repair air leak.

OK

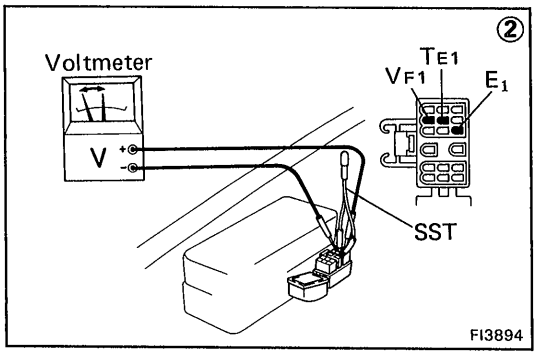
Check spark plugs. — BAD → Repair or replace.

OK

Check distributor and ignition system. — BAD → Repair or replace.

OK

CONTINUED ON PAGE FI-63.



CONTINUED FROM PAGE FI-62.

OK

Check fuel pressure. — BAD → Repair or replace.

OK

Check injector. — BAD → Repair or replace.

OK

Check cold start injector.* — BAD → Repair or replace.

OK

Check air flow meter. — BAD → Repair or replace.

OK

② Check operation of oxygen sensor. — OK → System normal.

BAD

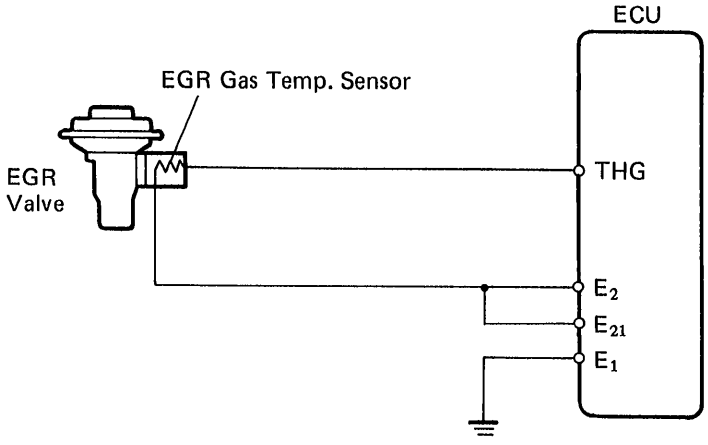
Check wiring between oxygen sensor and ECU connector. — BAD → Repair wiring.

OK

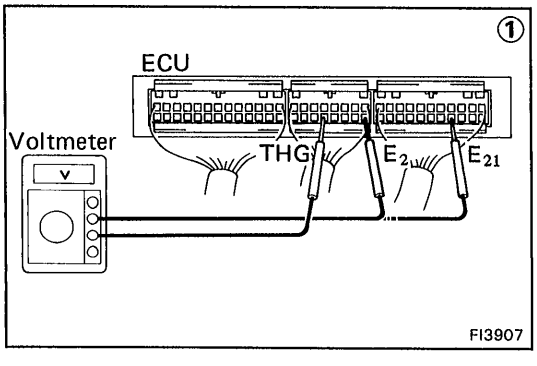
Replace oxygen sensor.

*Rich malfunction only.

(California Vehicles only)



FI3895



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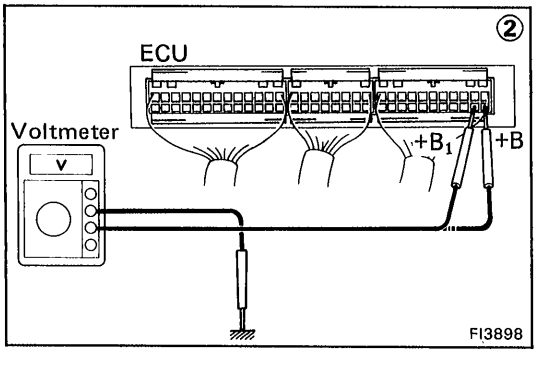

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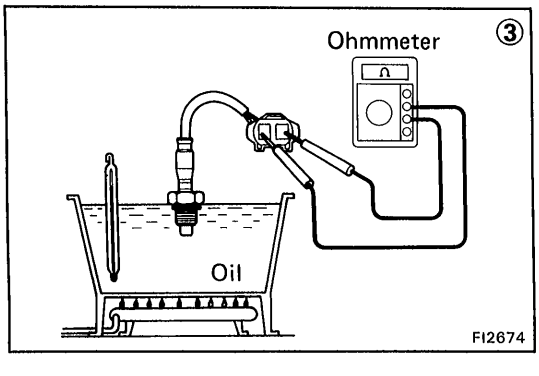


FI2674

① There is no voltage between ECU terminals THG and E_2 (E_{21}). **(Engine running at 2,000 rpm)**

② Check that there is voltage between ECU terminal +B ($+B_1$) and body ground. **(IG SW ON)**

OK → Check wiring between ECU terminal E_1 and body ground.

NO → Refer to No. 11.

OK → Check EGR system.

BAD → Repair or replace.

BAD → Repair or replace.

OK → ③ Check EGR gas temp. sensor.

BAD → Replace EGR gas temp. sensor.

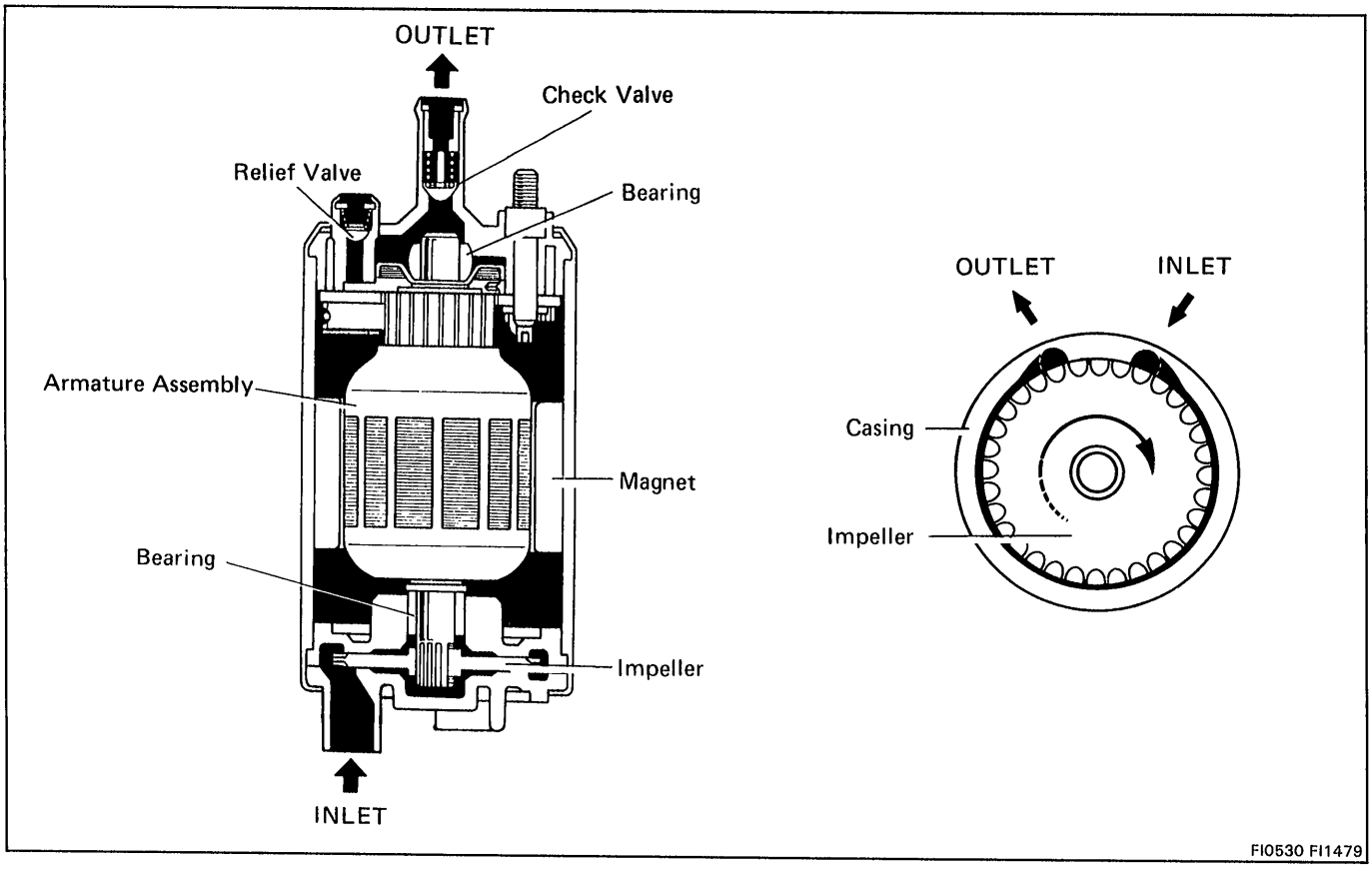
OK → Check wiring between ECU and EGR gas temp. sensor.

OK → Try another ECU.

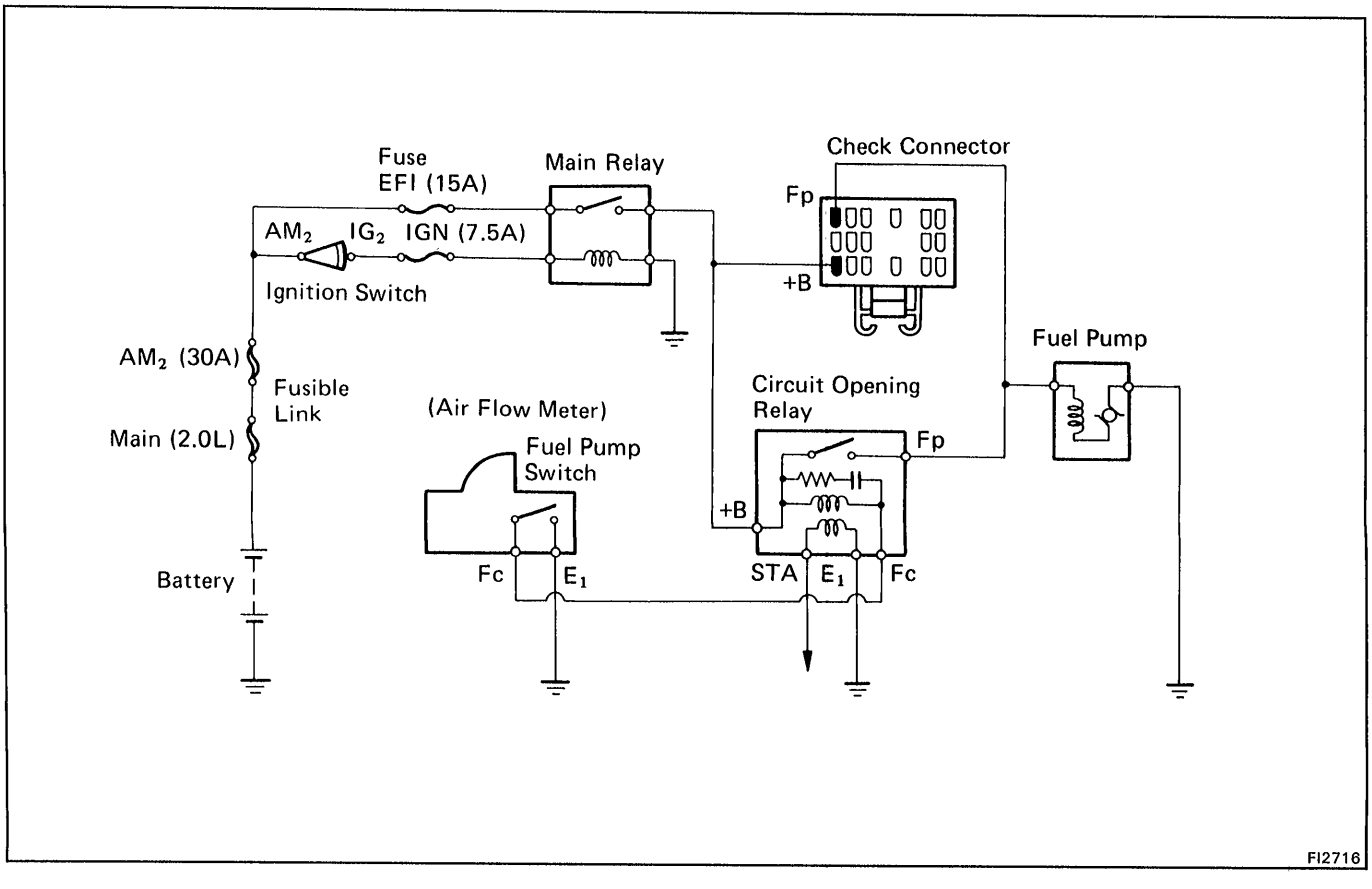
BAD → Repair or replace.

FUEL SYSTEM

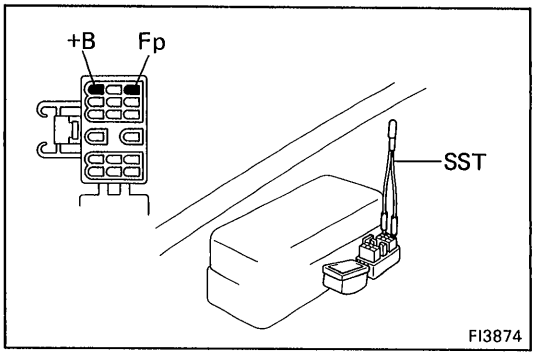
Fuel Pump

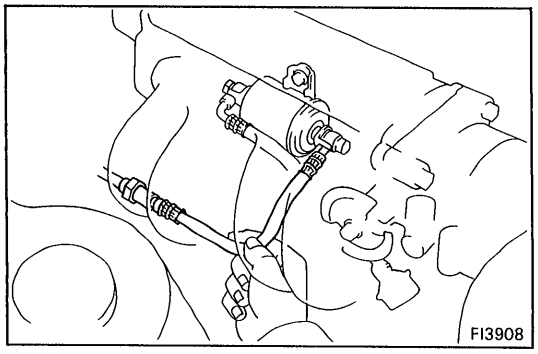


FI0530 FI1479



FI2716





ON-VEHICLE INSPECTION

1. CHECK FUEL PUMP OPERATION

(a) Turn the ignition switch to ON.

HINT: Do not start the engine.

(b) Using SST, connect terminals Fp and +B of the check connector.

SST 09843-18020

HINT: The check connector is located near the No.2 relay block.

(c) Check that there is pressure in the fuel inlet hose.

HINT: At this time, you will hear fuel return noise from the pressure regulator.

(d) Remove SST from the check connector.

(e) Turn the ignition switch to OFF.

If there is no pressure, check the following parts:

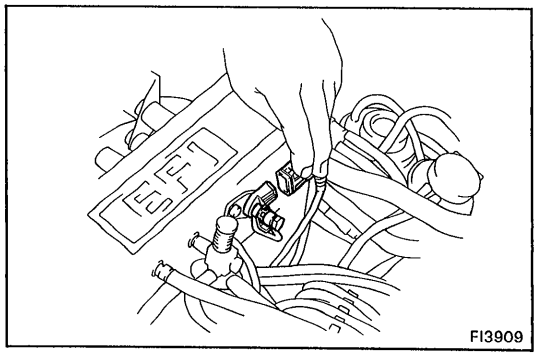
- Fusible link
- Fuse (EFI 15A, IGN 7.5A)
- EFI main relay
- Circuit opening relay
- Fuel pump
- Wiring connections

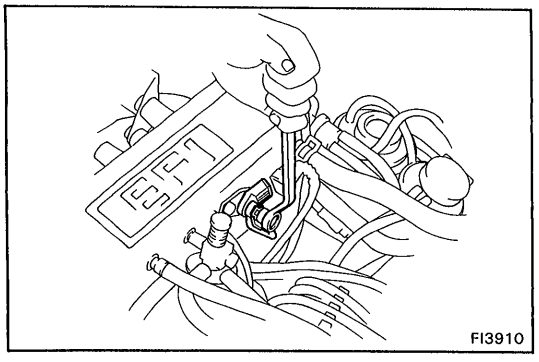
2. CHECK FUEL PRESSURE

(a) Check that the battery voltage is above 12 volts.

(b) Disconnect the cable from the negative terminal of the battery.

(c) Disconnect the wiring connector from the cold start injector.

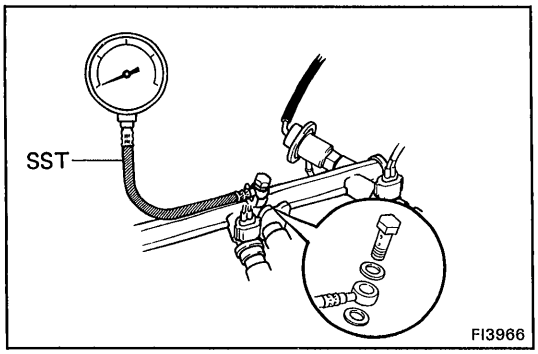




(d) Put a suitable container or shop towel under cold start injector pipe.

(e) Slowly loosen the union bolts of the cold start injector pipe and remove the bolts, cold start injector pipe and four gaskets.

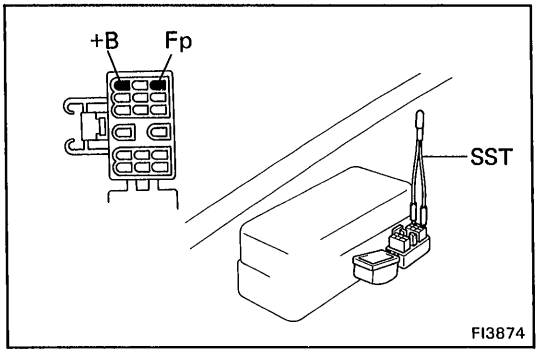
(f) Drain the fuel from the delivery pipe.



(g) Install a gasket, SST, another gasket and union bolt to the delivery pipe as shown in the figure.

SST 09268-45012

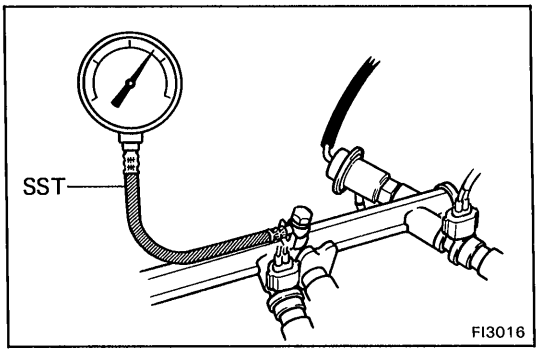
(h) Wipe off any splattered gasoline.



(i) Reconnect the battery negative terminal.

(j) Using SST, connect terminals Fp and +B of the check connector.

SST 09843-18020



(k) Turn the ignition switch to ON.

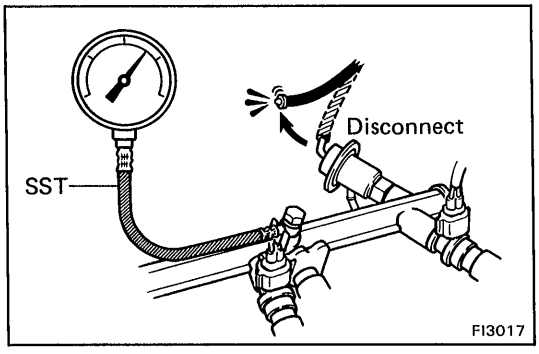
(l) Measure the fuel pressure.

Fuel pressure: 2.7 — 3.1 kg/cm² (38 — 44 psi, 265 — 304 kPa)

If high, replace the pressure regulator.

If low, check the following parts:

- Fuel hoses and connections
- Fuel pump
- Fuel filter
- Pressure regulator



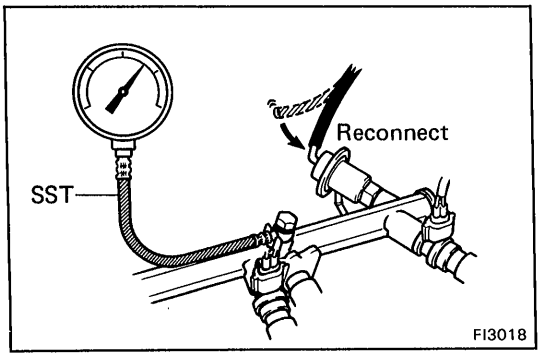
(m) Remove SST from the check connector.

(n) Start the engine.

(o) Disconnect the vacuum hose from the pressure regulator and plug it closed.

(p) Measure the fuel pressure at idling.

Fuel pressure: 2.7 — 3.1 kg/cm² (38 — 44 psi, 265 — 304 kPa)



(q) Reconnect the vacuum hose to the pressure regulator.

(r) Measure the fuel pressure at idling.

Fuel pressure: 2.3 — 2.6 kg/cm² (33 — 37 psi, 226 — 265 kPa)

If not within the specified pressure, check the vacuum hose and pressure regulator.

(s) Stop the engine. Check that the fuel pressure remains above 1.5 kg/cm² (21 psi, 147 kPa) for 5 minutes after the engine is turned off.

If not within specification, check the fuel pump, pressure regulator and/or injectors.

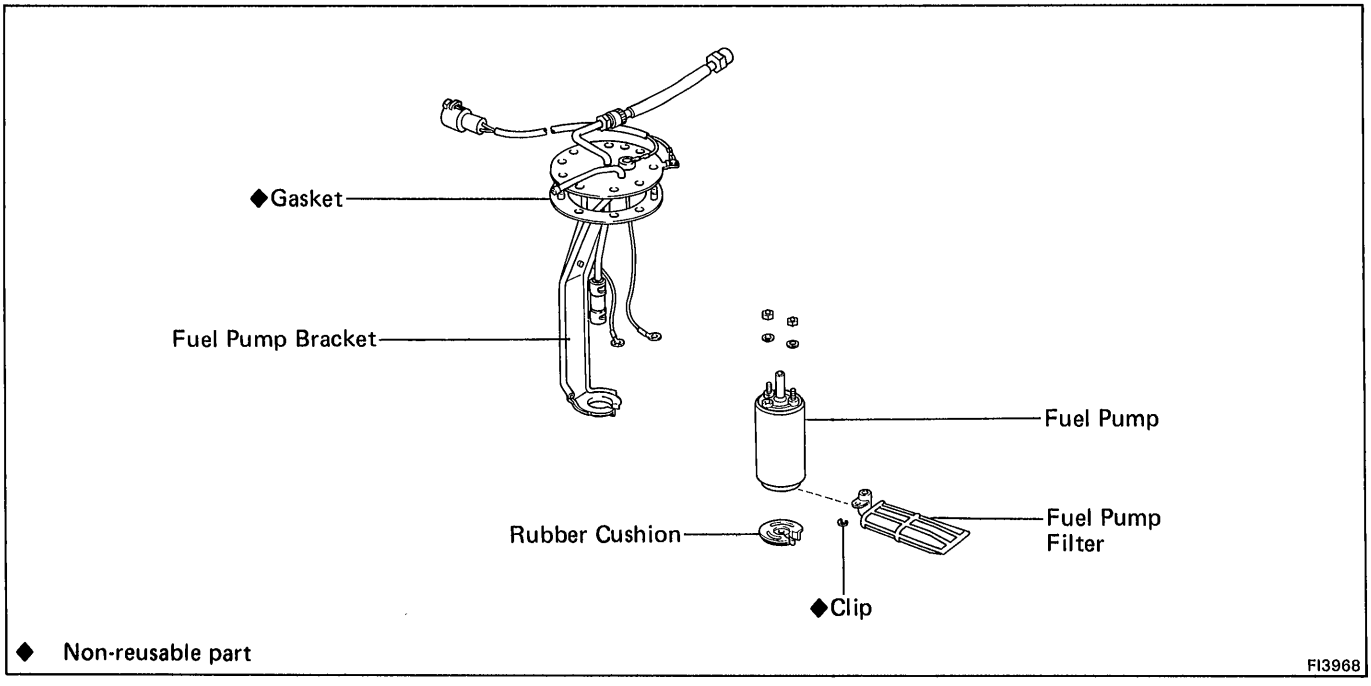
(t) After checking fuel pressure, disconnect the battery ground strap and carefully remove the SST to prevent gasoline from splashing.

(u) Using new gaskets, reconnect the cold start injector pipe to the delivery pipe and cold start injector.

(v) Connect the wiring connector to the cold start injector.

(w) Start the engine and check for fuel leakage.

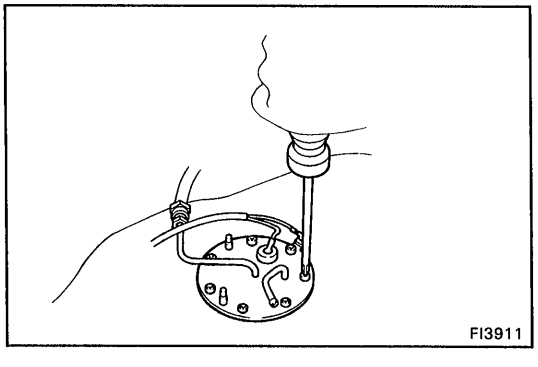
REMOVAL OF FUEL PUMP



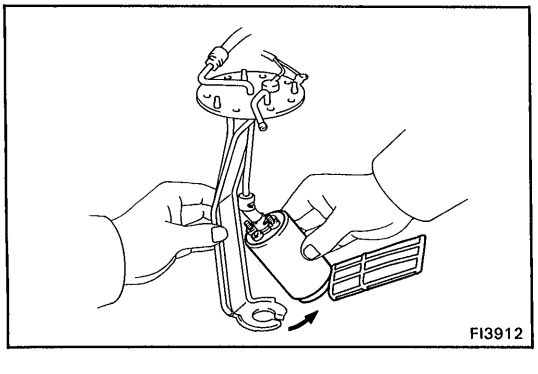
1. **DRAIN FUEL FROM FUEL TANK**

   CAUTION: Do not smoke or work near an open flame when working on the fuel pump.

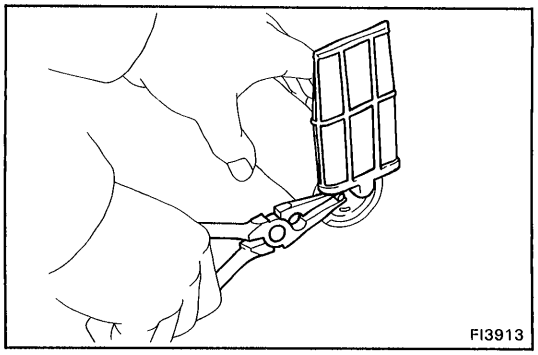
2. **REMOVE FUEL TANK**



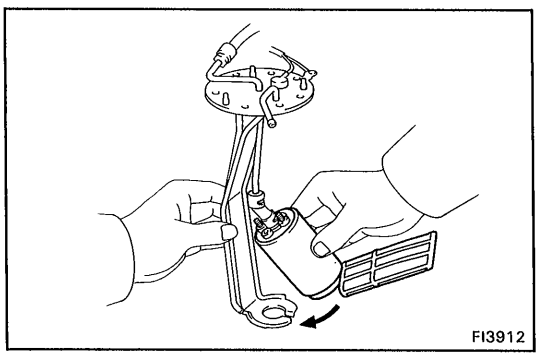
3. **REMOVE FUEL PUMP BRACKET**
   (a) Remove the seven bolts.
   (b) Pull out the fuel pump bracket.

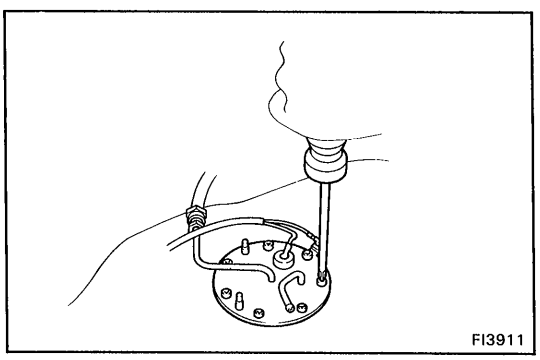


4. **REMOVE FUEL PUMP**
   (a) Remove the two nuts and disconnect the wires from the fuel pump.
   (b) Pull off the fuel pump from the lower side of the bracket.
   (c) Remove the fuel pump from the fuel hose.



5. **REMOVE FUEL PUMP FILTER**
   (a) Remove the rubber cushion.
   (b) Remove the clip and pull out the filter.





INSTALLATION OF FUEL PUMP

(See page FI-69)

1. **INSTALL FUEL PUMP FILTER**

2. **INSTALL FUEL PUMP**
   (a) Insert the outlet port of the fuel pump into the fuel hose.
   (b) Install the rubber cushion to the lower side of the fuel pump.
   (c) Push the lower side of the fuel pump, together with the rubber cushion, into the fuel pump bracket.

3. **INSTALL FUEL PUMP BRACKET**
   (a) Place the bracket with a new gasket on the fuel tank.
   (b) Install and torque the seven screws.

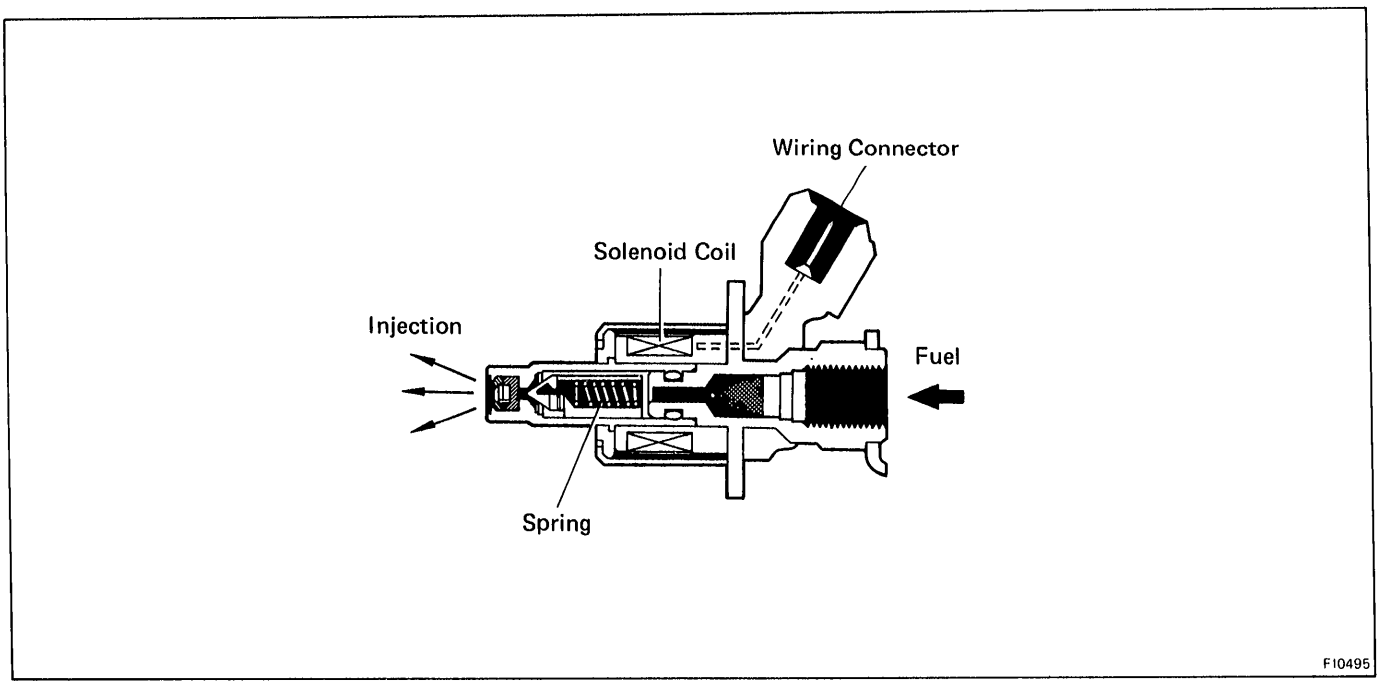
   Torque: 40 kg-cm (34 in.-lb, 3.9 N·m)

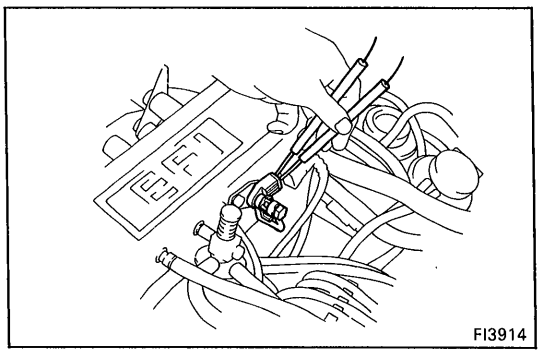
4. **INSTALL FUEL TANK**

   NOTICE:
   - **Tighten the fuel tank mounting bolts, etc. to the specified torque.**
   - **Tighten the pipe and flare nut type hose to the specified torque.**
   - **Push in the pipe and insert-type hose to the specified position, and install the clip to the specified location.**
   - **If reusing the hose, reinstall the clip at the original location.**

5. **REFILL WITH GASOLINE**

Cold Start Injector





ON-VEHICLE INSPECTION

MEASURE RESISTANCE OF COLD START INJECTOR

(a) Disconect the cold start injector connector.

(b) Using an ohmmeter, check the resistance of the injector.

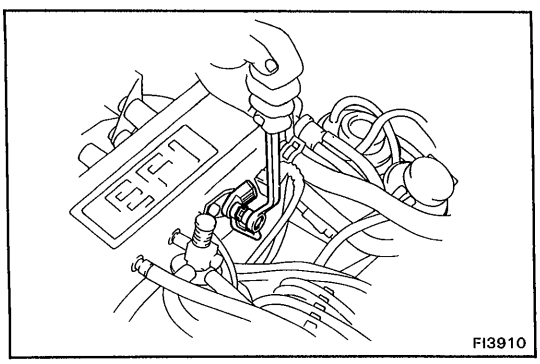
Resistance: 2 — 4 Ω

(c) Connect the cold start injector connector.

REMOVAL OF COLD START INJECTOR

1. DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY

2. DISCONNECT COLD START INJECTOR CONNECTOR



3. REMOVE COLD START INJECTOR

(a) Put a suitable container or shop towel under the cold star injector pipe.

(b) Remove the union bolts and four gasket, and remove the cold start injector pipe.

HINT: Slowly loosen the union bolt.

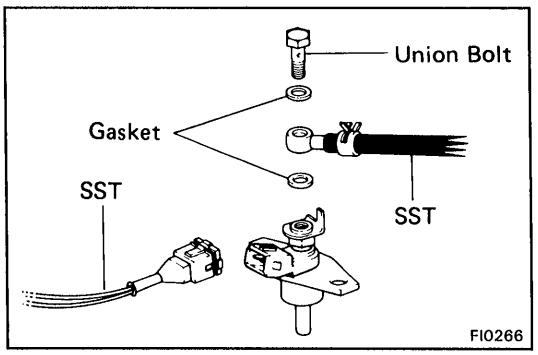
(c) Remove the two bolts and cold start injector with the gasket

INSPECTION OF COLD START INJECTOR

CHECK INJECTION OF COLD START INJECTOR

HINT: The engine should be cold.

(a) Remove the cold start injector.



(b) Install a gasket, SST (two unions), another gasket and two union bolts to the delivery pipe and injector.

(c) Connect the SST (hose) to each union.

SST 09268-41045 (09268-41080)

(d) Connect the SST (wire) to the injector.

SST 09842-30050

CAUTION: Position the injector as far away from the battery as possible.

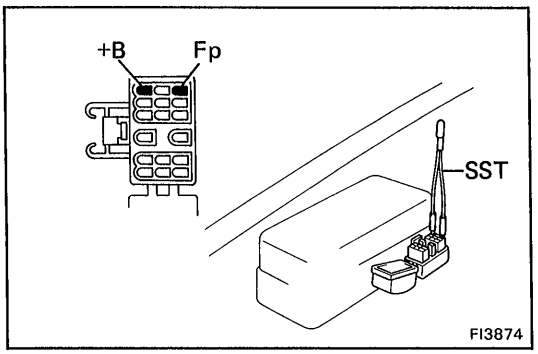
(e) Put a container under the injector.

(f) Turn the ignition switch to ON.

HINT: Do not start the engine.

(g) Using SST, connect terminals Fp and +B of the check connector.

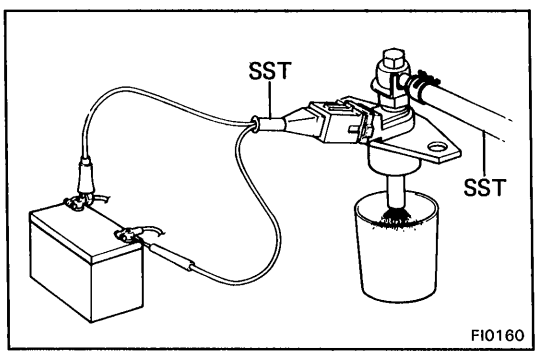
SST 09843-18020

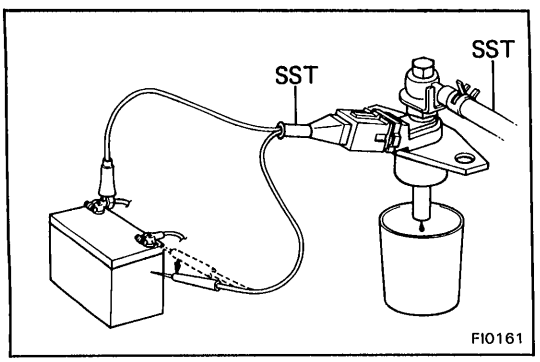


(h) Connect the test probes of the SST to the battery and check that the fuel injection is as shown.

SST 09842-30050

NOTICE: Perform this check within the shortest possible time.



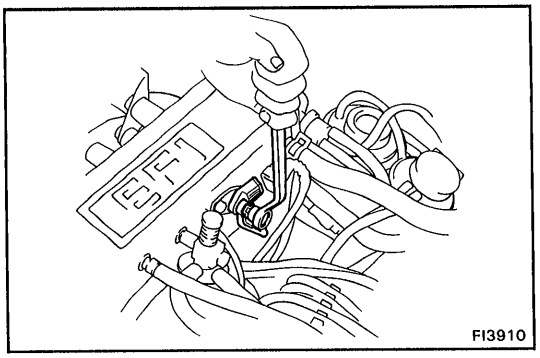


(i) Disconnect the test probes from the battery and check fuel leakage from the injector.

Fuel drop: Less than one drop of fuel per minute

(j) After checking, remove SST and restore the following parts to their original condition.

- Check connector
- Ignition switch
- Cold start injector
- Injector wiring



INSTALLATION OF COLD START INJECTOR

1. **INSTALL COLD START INJECTOR**

   (a) Using a new gasket, install the cold start injecctor with two bolts.

   Torque: 80 kg-cm (69 in.-lb, 7.8 N·m)

   (b) Install the fuel pipe between the cold start injector and fuel delivery pipe with new gaskets.

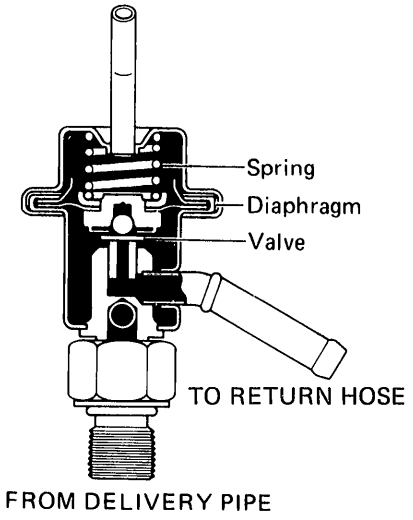
   Torque: 195 kg-cm (14 ft-lb, 19 N·m)

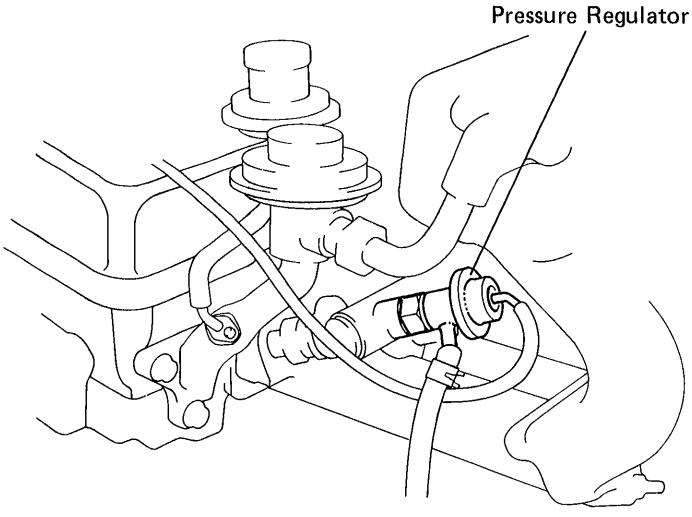
2. **CONNECT COLD START INJECTOR CONNECTOR**

3. **CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY**

4. **CHECK FOR FUEL LEAKAGE**

Pressure Regulator





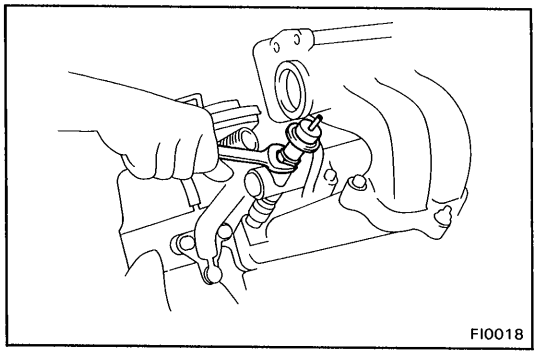
FI1447 FI3959

ON-VEHICLE INSPECTION

CHECK FUEL PRESSURE (See page FI-66)

REMOVAL OF PRESSURE REGULATOR

1. **DISCONNECT VACUUM SENSING HOSE**
2. **REMOVE NO.1 EGR PIPE**
3. **DISCONNECT FUEL HOSE**
   (a) Put a suitable container or shop towel under the pressure regulator.
   (b) Disconnect the fuel hose from the pressure regulator.
4. **REMOVE PRESSURE REGULATOR**
   Loosen the lock nut, and remove pressure regulator.

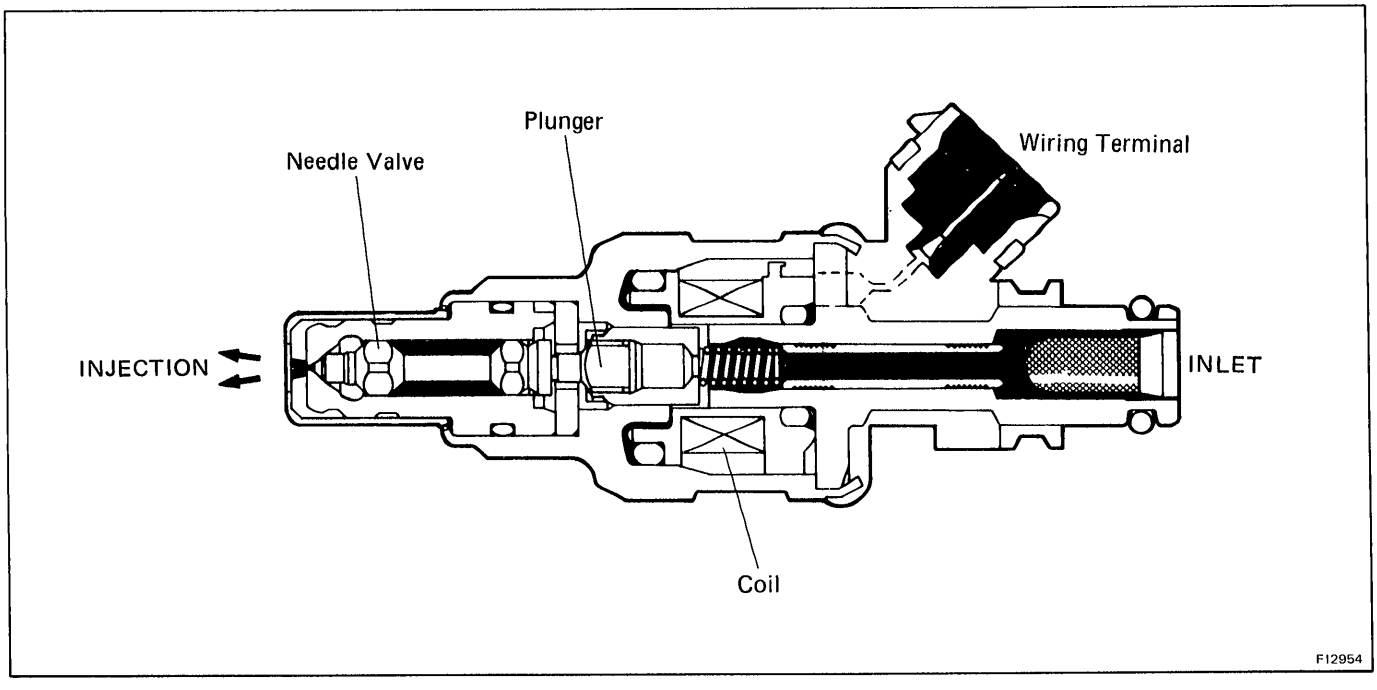


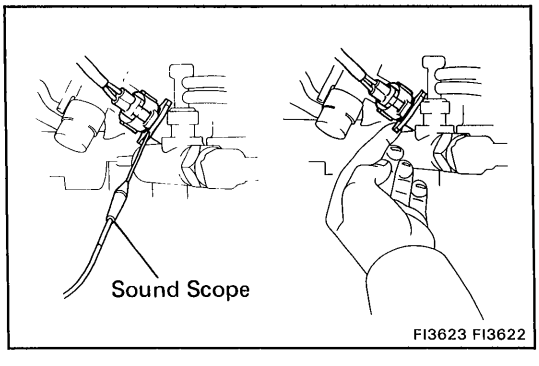
FI0018

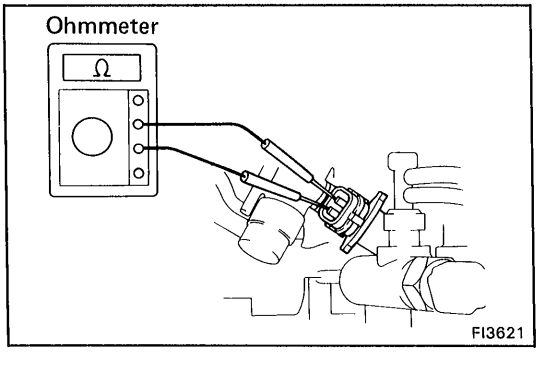
INSTALLATION OF PRESSURE REGULATOR

1. **INSTALL PRESSURE REGULATOR**
   Install the pressure regulator.
   Torque the lock nut.
   Torque: 300 kg-cm (22 ft-lb, 29 N·m)
2. **CONNECT FUEL HOSE**
3. **INSTALL NO.1 EGR PIPE**
   Install a new gasket and No.1 EGR pipe.
4. **CONNECT VACUUM SENSING HOSE**

Injector







ON-VEHICLE INSPECTION

1. CHECK INJECTOR OPERATION

Check for operating sound from each injector.

(a) With the engine running or cranking, use a sound scope to check that there is normal operating noise in proportion to engine rpm.

(b) If you have no sound scope, you can check the injector transmission operation with your finger.

If no sound or an unusual sound is heard, check the wiring connector, injector or injection signal from ECU.

2. MEASURE RESISTANCE OF INJECTOR

(a) Unplug the wiring connector from the injector.

(b) Using an ohmmeter, measure the resistance of both terminals.

Resistance: 13.4 — 14.2 Ω

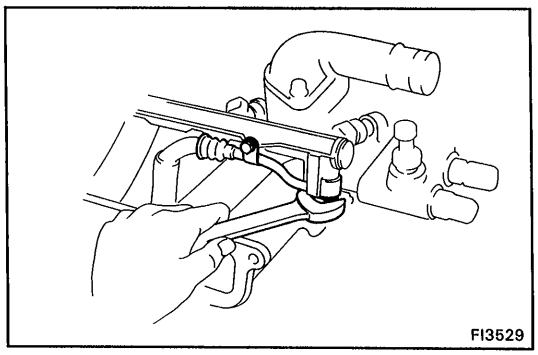
REMOVAL OF INJECTOR

1. **DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY**

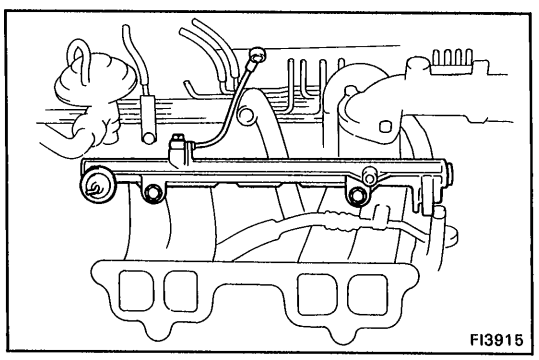
2. **DRAIN COOLANT**

3. **REMOVE CHAMBER WITH THROTTLE BODY**
   (See steps 9 to 15 on pages EM-12,13)

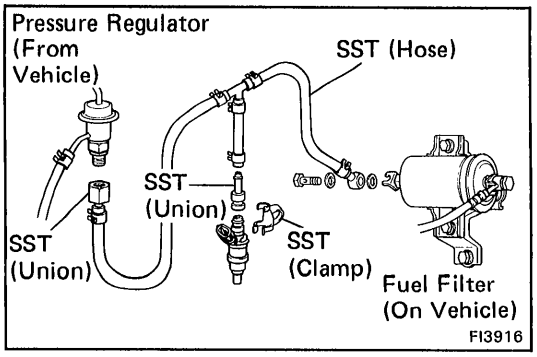
4. **DISCONNECT WIRES**
   (See step 17 on page EM-13)



5. **DISCONNECT FUEL HOSE FROM DELIVERY PIPE**
   Remove the bolt, union bolt and two gaskets.



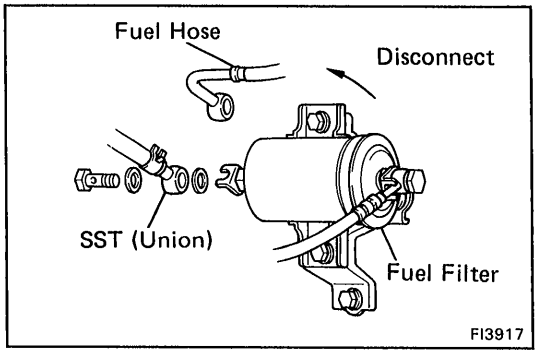
6. **REMOVE DELIVERY PIPE WITH INJECTORS**
   Remove two bolts and then remove the delivery pipe with the injectors.



INSPECTION OF INJECTOR

1. TEST INJECTION OF INJECTORS

CAUTION: Keep clear of sparks during the test.

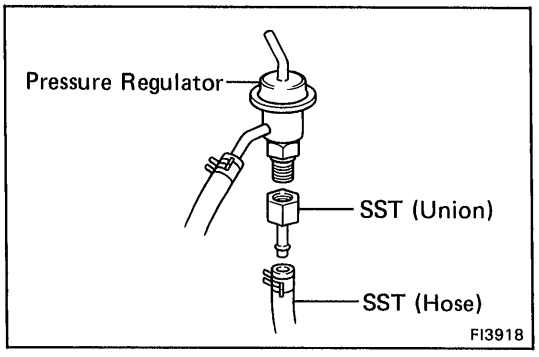


(a) Disconnect the fuel hose from the fuel filter outlet.

(b) Connect SST (Union) to the fuel filter outlet.

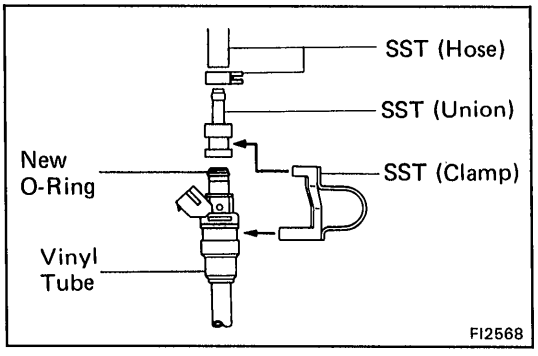
SST 09268-41045 (90405-09015)

HINT: Use the vehicle's fuel filter.



(c) Install SST (Union) to the removed pressure regulator.

SST 09268-41045 (09268-52010)



(d) Install SST (Union) to the injector and hold the injector and union with SST (Clamp).

SST 09268-41045

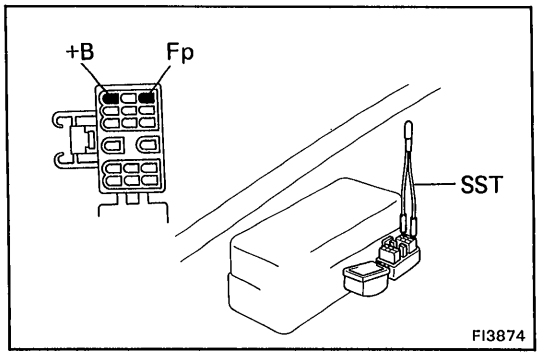
(e) Put the injector into the graduated cylinder.

HINT: Install a suitable vinyl tube onto the injector to prevent gasoline from splashing out.

(f) Connect the battery cable.

(g) Turn the ignition switch to ON.

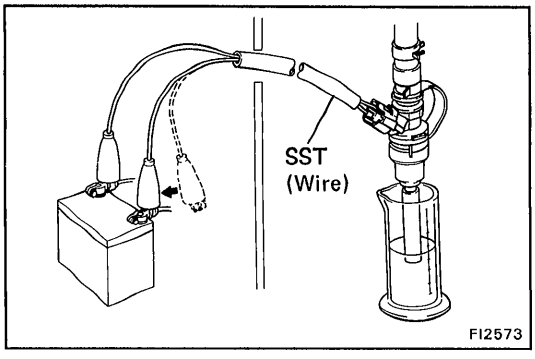
HINT: Do not start the engine.



(h) Using SST, connect terminals Fp and +B of the check connector.

SST 09843-18020

HINT: Fuel pump will operate.



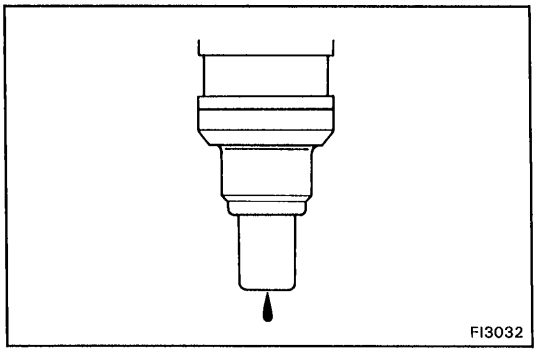
(i) Connect SST (Wire) to the injector and battery for 15 seconds and measure the injection volume with a graduated cylinder. Test each injector two or three times.

SST 09842-30070

Volume: 45 — 55 cc/15 sec. (2.7 — 3.4 cu in.)

Difference between each injector:
Less than 6 cc (0.4 cu in.)

If not within specified volume, replace the injector.



2. CHECK LEAKAGE

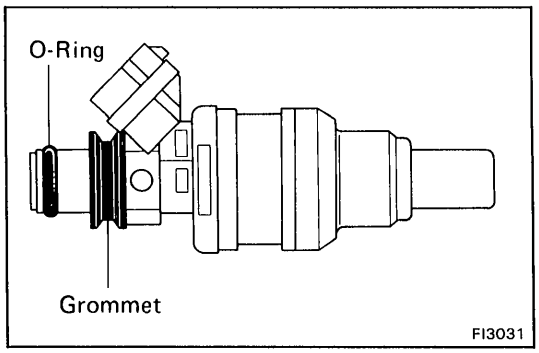
(a) In the condition above, disconnect SST from the battery and check for fuel leakage from the injector nozzle.

SST 09842-30060

Fuel drop: Less than one fuel drop of fuel per minute

(b) Disconnect the battery cable.

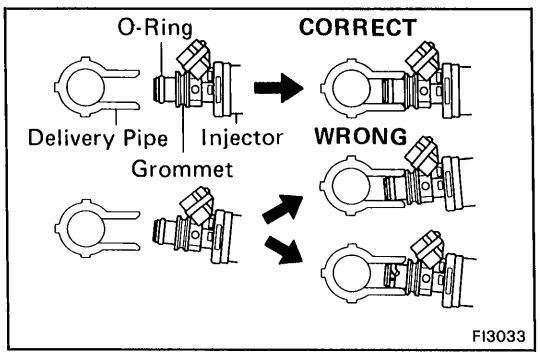
(c) Remove SST.



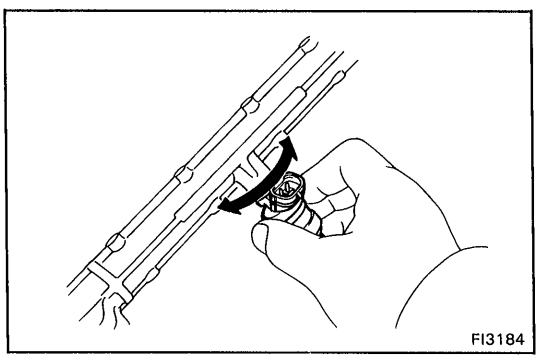
INSTALLATION OF INJECTORS

1. INSTALL INJECTORS INTO DELIVERY PIPE

(a) Install the grommet and a new O-ring to the injector.

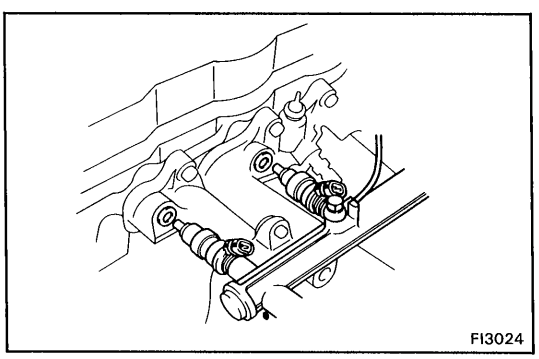


(b) Apply a thin coat of gasoline to the O-rings and install the injectors into the delivery pipe.



(c) Make sure that the injectors rotate smoothly.

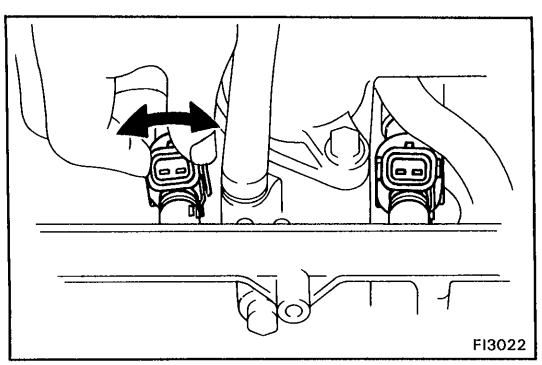
HINT: If the injectors do not rotate smoothly, the O-rings are probably incorrectly installed. Replace the O-rings.



2. INSTALL DELIVERY PIPE WITH INJECTORS

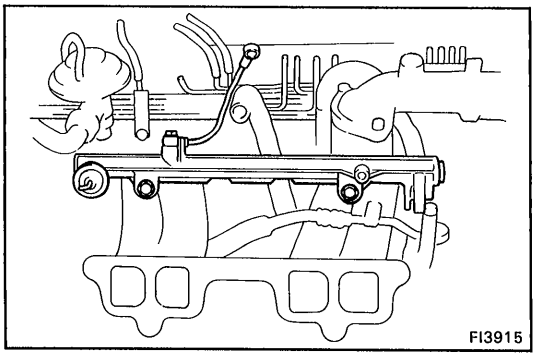
(a) Install the four insulators into the injector hole of the intake manifold.

(b) Place the injectors together with the delivery pipe to the manifold.



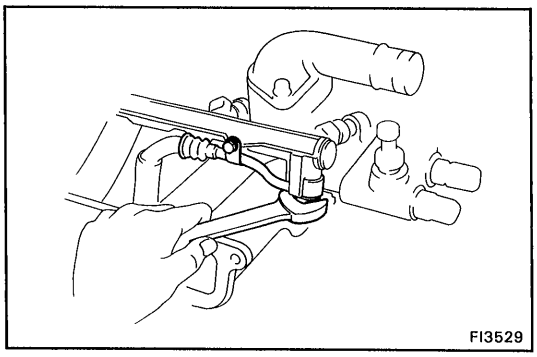
(c) Make sure that the injectors rotate smoothly.

HINT: If the injectors do not rotate smoothly, probable cause may be incorrect installation of O-rings. Replace O-rings again after removing the injectors.



(d) Install and torque the bolts.

Torque: 195 kg-cm (14 ft-lb, 19 N·m)

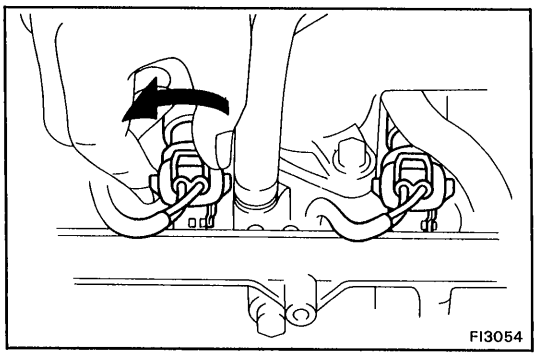


3. CONNECT FUEL HOSE TO DELIVERY PIPE

(a) Install the fuel hose with a bolt.

(b) Install the union bolt and new gaskets. Torque the union bolt.

Torque: 450 kg-cm (33 ft-lb, 44 N·m)



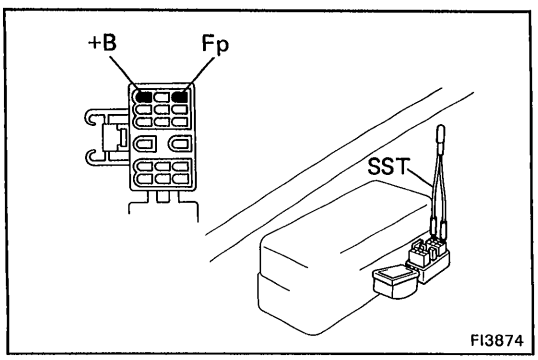
4. CONNECT WIRES
(See step 5 on page EM-34)

Turn the injector so the injector positioning guide is aligned with the positioning rib of the delivery pipe.

5. INSTALL CHAMBER WITH THROTTLE BODY
(See steps 7 to 14 on pages EM-35, 36)

6. FILL WITH COOLANT
(See step 3 on page CO-14)

7. CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY



8. CHECK FOR FUEL LEAKAGE

(a) With the ignition switch ON, use SST to connect terminals Fp and +B of the check connector.

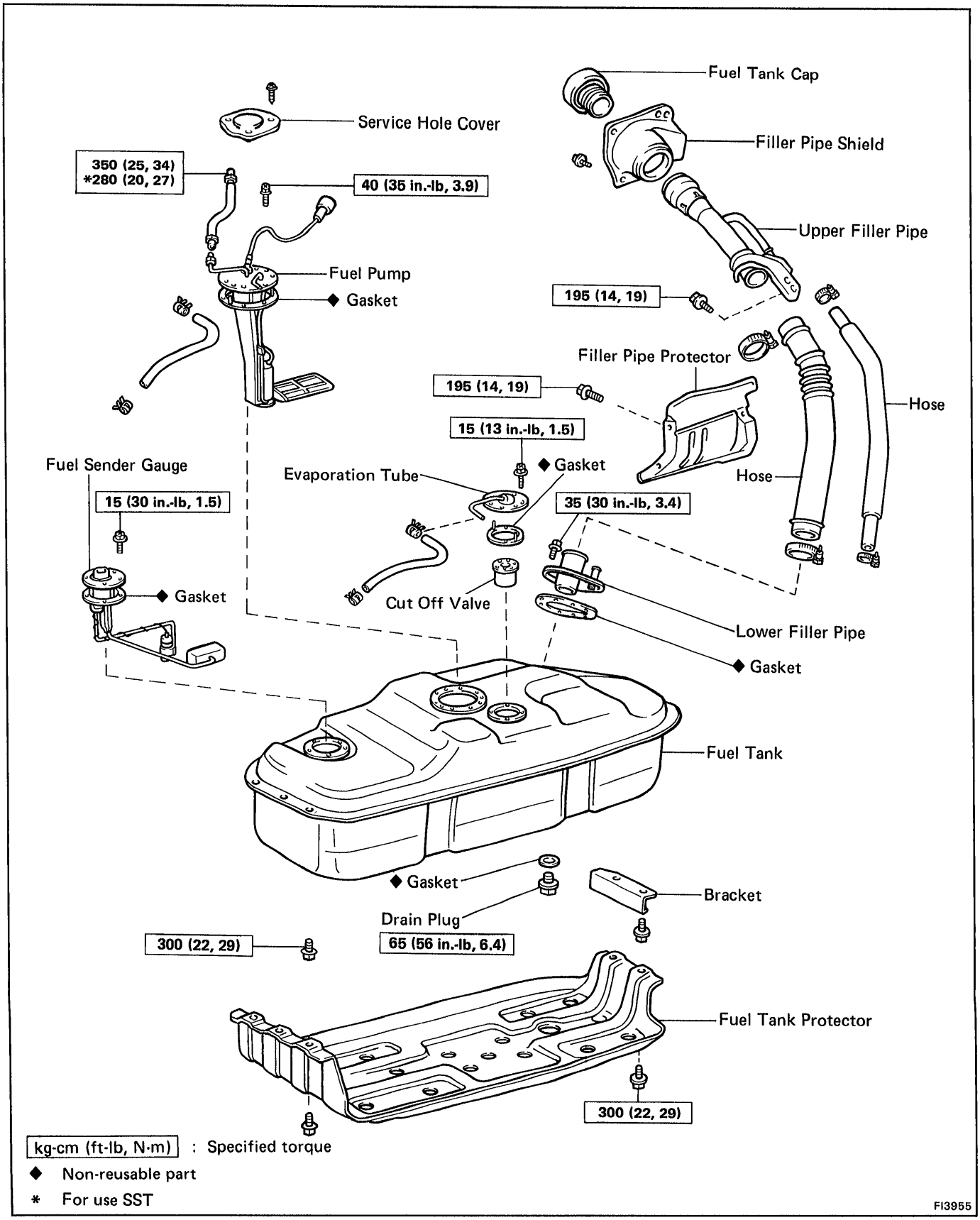
SST 09843-18020

(b) Check for fuel leakage.

(c) Remove SST from the check connector.

Fuel Tank and Line

COMPONENTS



kg-cm (ft-lb, N·m) : Specified torque

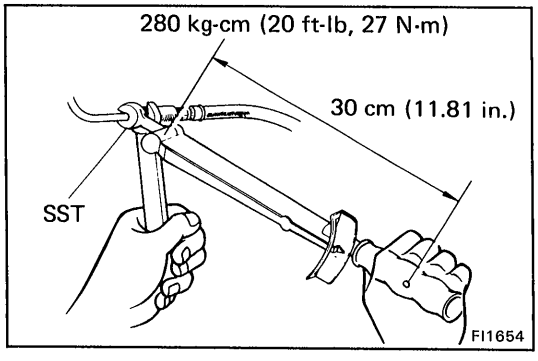
◆ Non-reusable part

* For use SST

FI3955

PRECAUTIONS

1. **Always use new gaskets when replacing the fuel tank or component part.**
2. **Apply the proper torque to all parts tightened.**



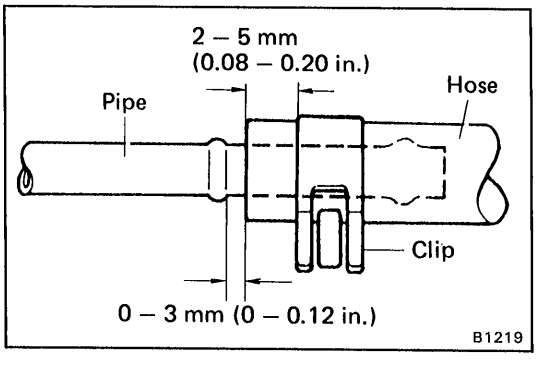
INSPECT FUEL LINES AND CONNECTIONS

(a) Inspect the fuel lines for cracks or leakage, and all connections for deformations.

(b) Inspect the fuel tank vapor vent system hoses and connections for looseness, sharp bends or damage.

(c) Inspect the fuel tank for deformations, cracks or fuel leakage.

(d) Inspect the filler neck for damage or fuel leakage.

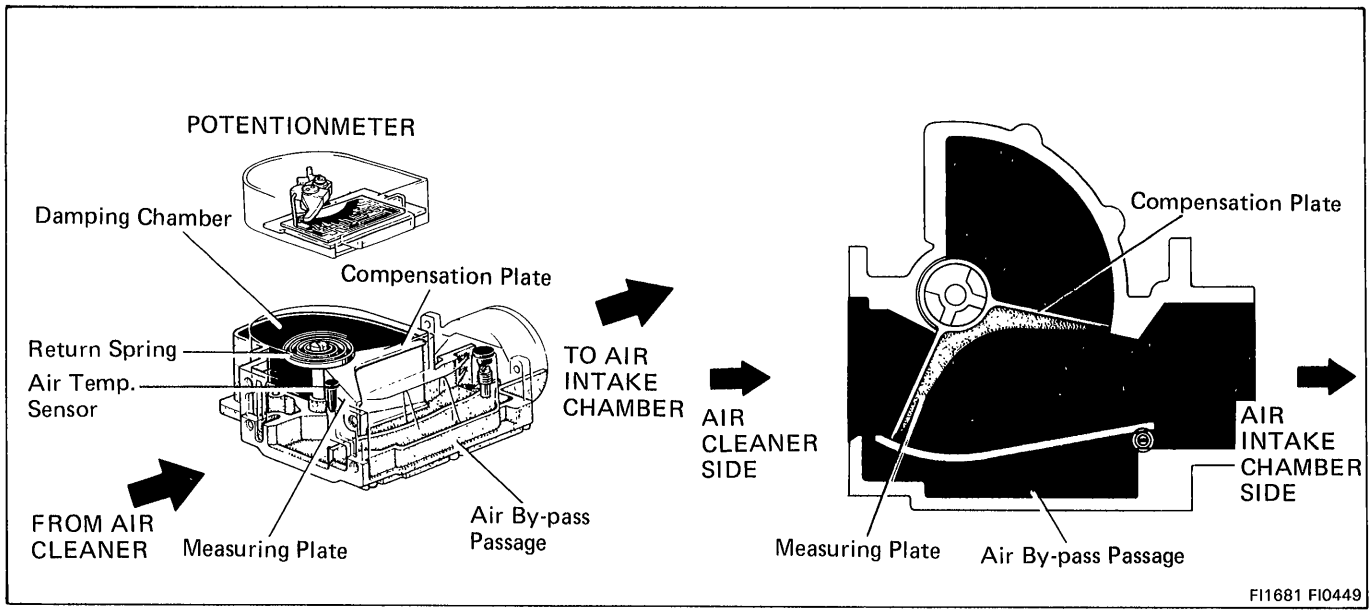


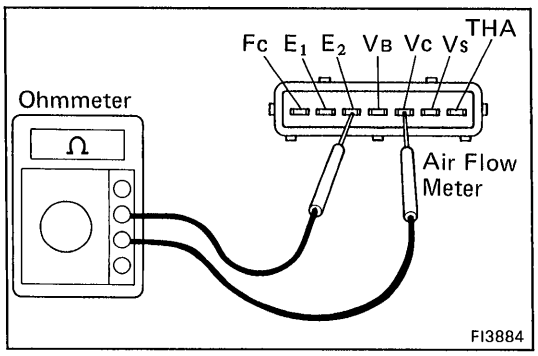
(e) Hose and tube connections are as shown in the illustration.

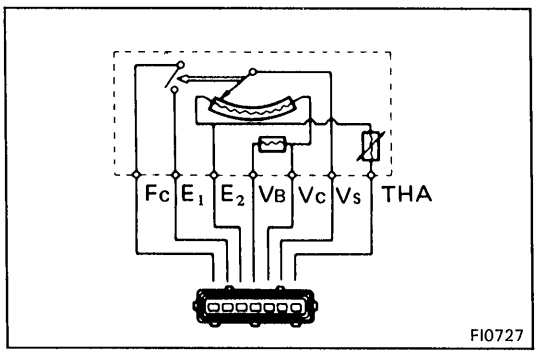
If a problem is found, repair or replace the parts as necessary.

AIR INDUCTION SYSTEM

Air Flow Meter







ON-VEHICLE INSPECTION

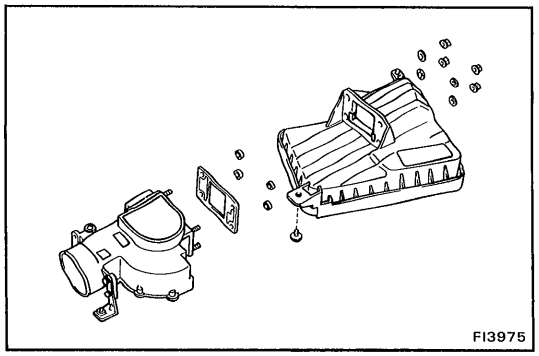
MEASURE RESISTANCE OF AIR FLOW METER

(a) Unplug the connector from the air flow meter.

(b) Using an ohmmeter, measure the resistance between each terminal.

Between terminals	Resistance	Temperature
E_2 — V_S	20 — 400 Ω	—
E_2 — V_C	100 — 300 Ω	—
E_2 — V_B	200 — 400 Ω	—
E_2 — THA	10 — 20 kΩ 4 — 7 kΩ 2 — 3 kΩ 0.9 — 1.3 kΩ 0.4 — 0.7 kΩ	−20°C (−4°F) 0°C (32°F) 20°C (68°F) 40°C (104°F) 60°C (140°F)
E_1 — F_C	Infinity	—

If not within specification, replace the air flow meter.

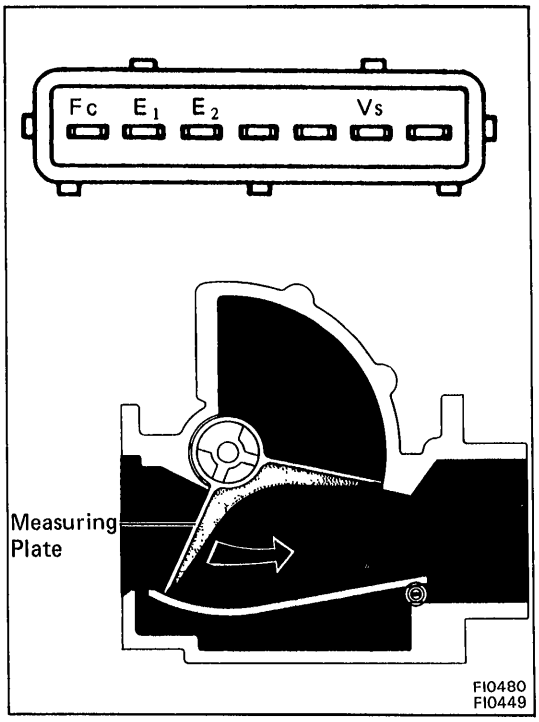

FI3975

REMOVAL OF AIR FLOW METER

1. **DISCONNECT INTAKE AIR CONNECTOR**

2. **REMOVE AIR CLEANER CAP WITH AIR FLOW METER**
   (a) Disconnect the air flow meter connector.
   (b) Remove the air cleaner cap with air flow meter.

3. **REMOVE AIR FLOW METER**
   Remove the bolt, four nuts washers, air flow meter and gasket.



FI0480
FI0449

INSPECTION OF AIR FLOWE METER

MEASURE RESISTANCE OF AIR FLOW METER

Move the measuring plate and, using an ohmmeter, measure the resistance between each terminal.

Between terminals	Resistance (Ω)	Measuring plate opening
E_1 — F_C	Infinity	Fully closed
	Zero	Other than closed position
E_2 — V_S	20 — 400	Fully closed
	20 — 1,200	Fully open

HINT: Resistance between terminals E_2 and V_S will change in a wave pattern as the measuring plate slowly opens.

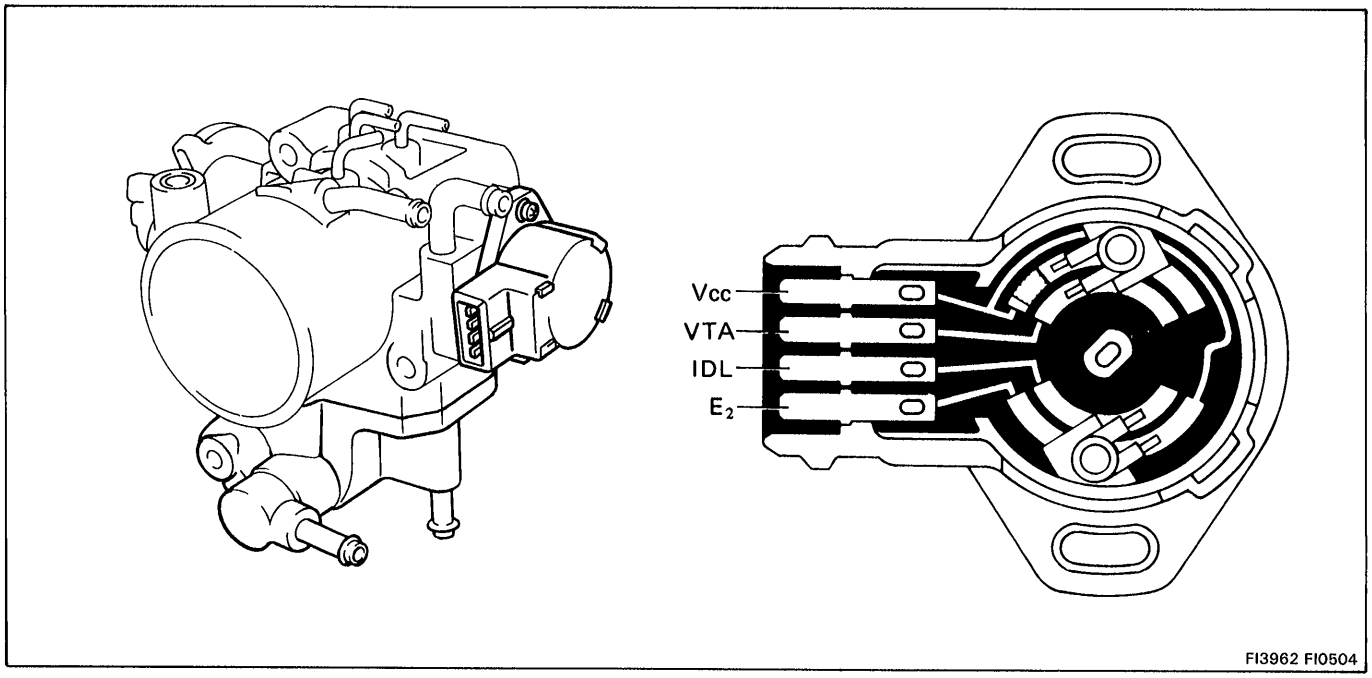
INSTALLATION OF AIR FLOW METER

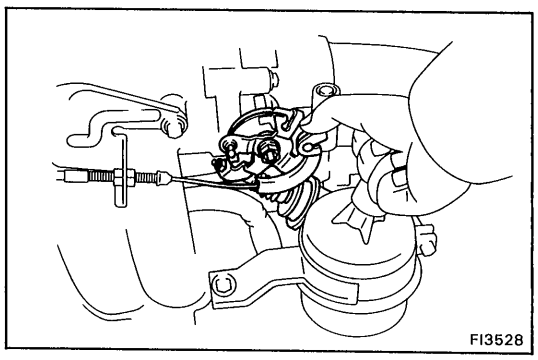
1. **INSTALL AIR FLOW METER**
   Install the gasket, air flow meter, washers, nuts and bolt. Torque the nuts and bolt.

2. **INSTALL AIR CLEANER CAP WITH AIR FLOW METER**
   (a) Install the air cleaner cap with air flow meter to the air cleaner case.
   (b) Connect the air flow meter connector.

3. **INSTALL INTAKE AIR CONNECTOR**

Throttle Body

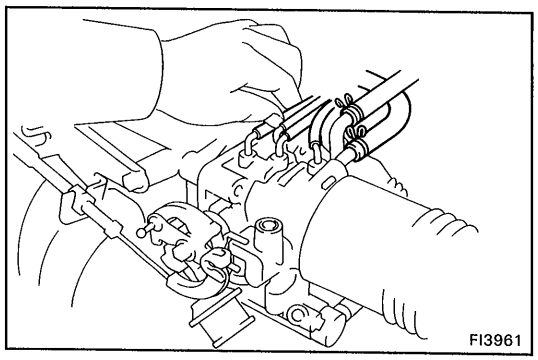




ON-VEHICLE INSPECTION

1. CHECK THROTTLE BODY

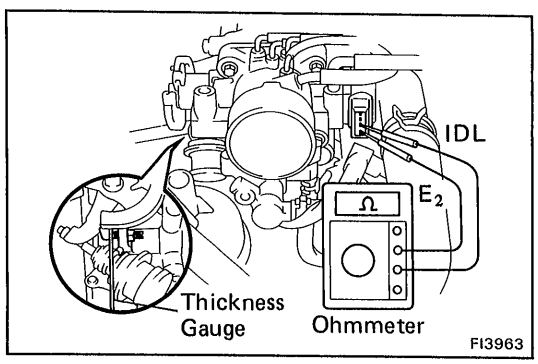
(a) Check that the throttle linkage moves smoothly.



(b) Check the vacuum at each port.

- Start the engine.
- Check the vacuum with your finger.

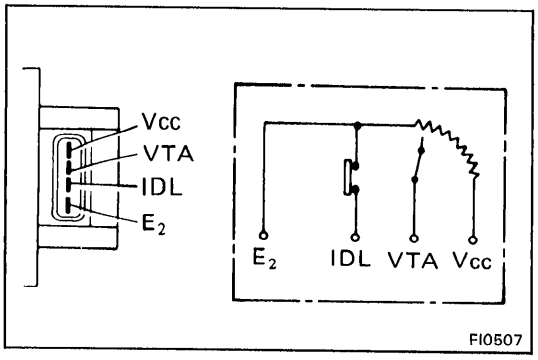
Port name	At idling	At 3,500 rpm
E	No vacuum	Vacuum
R	No vacuum	Vacuum
P	No vacuum	Vacuum



2. CHECK THROTTLE POSITION SENSOR

Check the resistance between the terminals.

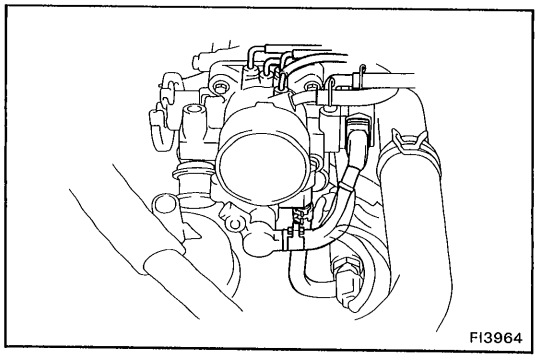
- Unplug the connector from the sensor.
- Insert a thickness gauge between the throttle stop screw and stop lever.
- Using an ohmmeter, check the resistance between each terminal.



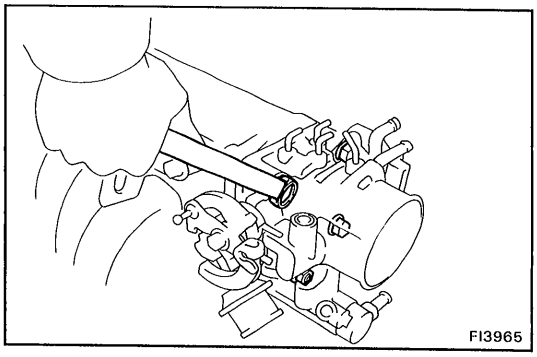
Clearance between lever and stop screw	Between terminals	Resistance
0 mm (0 in.)	VTA — E2	0.2 — 0.8 kΩ
0.57 mm (0.0224 in.)	IDL — E2	Less than 2.3 kΩ
0.85 mm (0.0335 in.)	IDL — E2	Infinity
Throttle valve fully opened position	VTA — E2	3.3 — 10 kΩ
—	Vcc — E2	4 — 9 kΩ

REMOVAL OF THROTTLE BODY

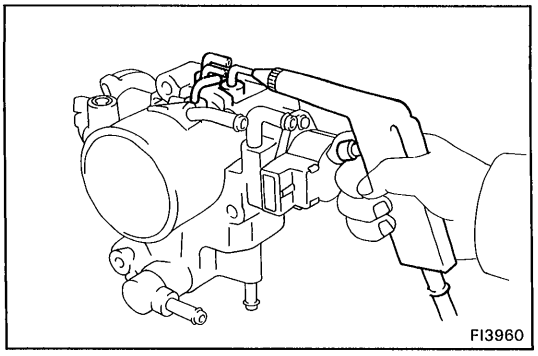
1. **REMOVE INTAKE AIR CONNECTOR**
2. **DRAIN COOLANT**
3. **DISCONNECT ACCELERATOR CABLE**



4. **DISCONNECT FOLLOWING HOSES:**
   (a) (with A/C)
   A/C idle up hose.
   (b) PCV hose
   (c) No.2 and No.3 water by-pass hoses.
   (d) Label and disconnect the emission control hoses.
5. **DISCONNECT THROTTLE SENSOR CONNECTOR**



6. **REMOVE THROTTLE BODY**
   Remove the three bolts and nut, and remove the throttle body and gasket.


FI3960

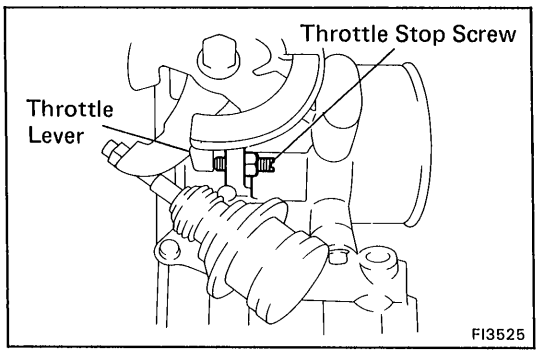
INSPECTION OF THROTTLE BODY

1. CLEAN THROTTLE BODY BEFORE INSPECTION

(a) Wash and clean the cast parts with a soft brush in carburetor cleaner.

(b) Using compressed air, blow all passages and apertures in the throttle body.

NOTICE: To prevent deterioration, do not clean the throttle position sensor.



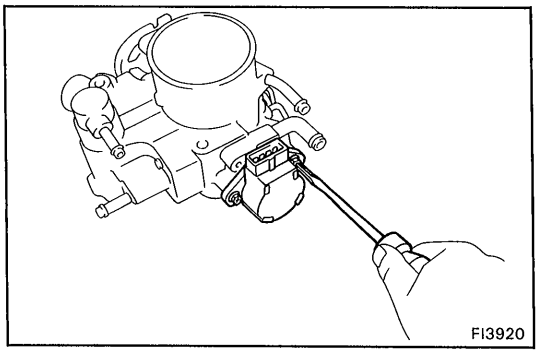
FI3525

2. CHECK THROTTLE VALVE

Check that there is no clearance between the throttle stop screw and throttle lever when the throttle valve is fully closed.

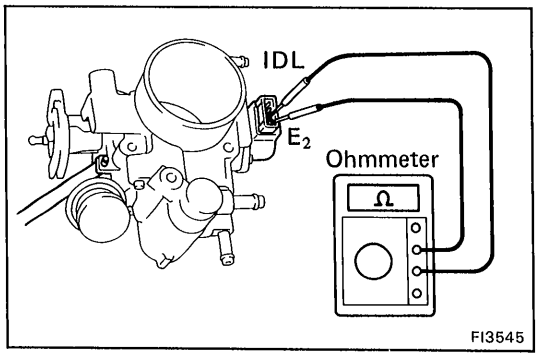
3. CHECK THROTTLE POSITION SENSOR

(See step 2 on page FI-85)


FI3920

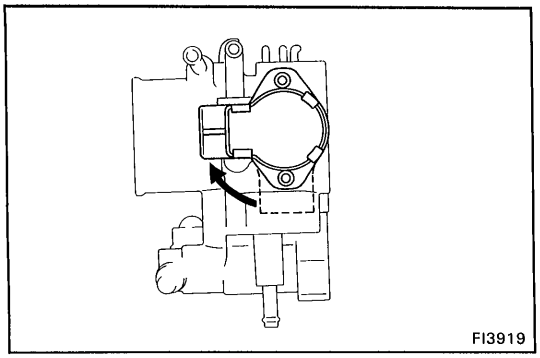
4. IF NECESSARY, ADJUST THROTTLE POSITION SENSOR

(a) Loosen the two screws of the sensor.



FI3545

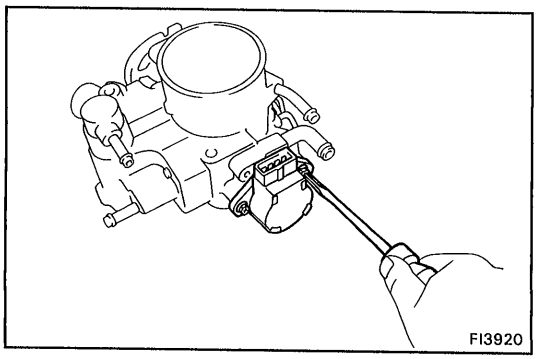
(b) Insert a thickness gauge (0.70 mm or 0.0276 in.) between the throttle stop screw and lever, and connect the ohmmeter to terminals IDL and E_2.


FI3919

(c) Gradually turn the sensor clockwise until the ohmmeter deflects, and secure the sensor with two screws.

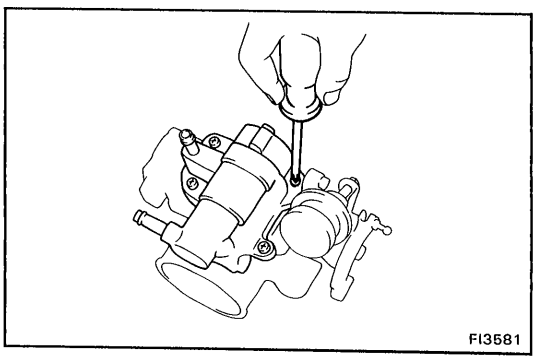
(d) Using a thickness gauge, recheck the continuity between terminals IDL and E_2.

Clearance between lever and stop screw	Continuity (IDL — E_2)
0.57 mm (0.0224 in.)	Continuity
0.85 mm (0.0335 in.)	No continuity


FI3920

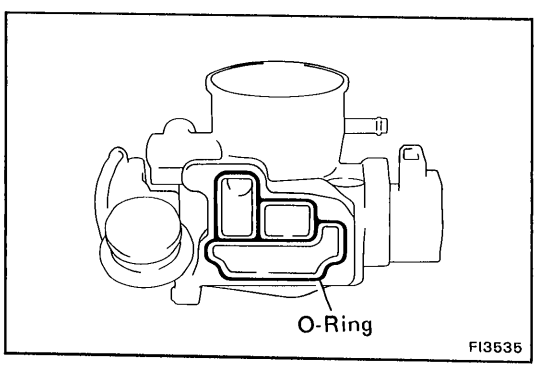
DISASSEMBLY OF THROTTLE BODY

1. **REMOVE THROTTLE POSITION SENSOR**
   Remove the two screws and sensor.


FI3581

2. **REMOVE AUXILIARY AIR VALVE**
   Remove the four screws, air valve and o-ring.

3. **(M/T)**
   REMOVE DASH POT

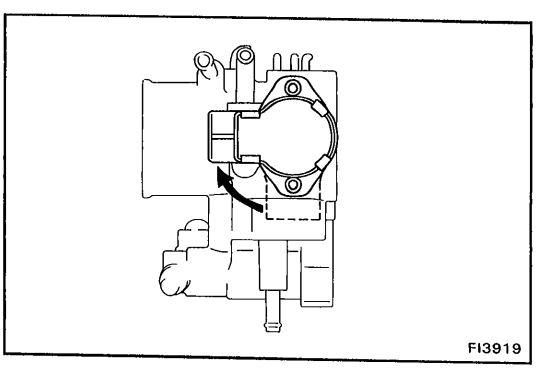


FI3535

ASSEMBLY OF THROTTLE BODY

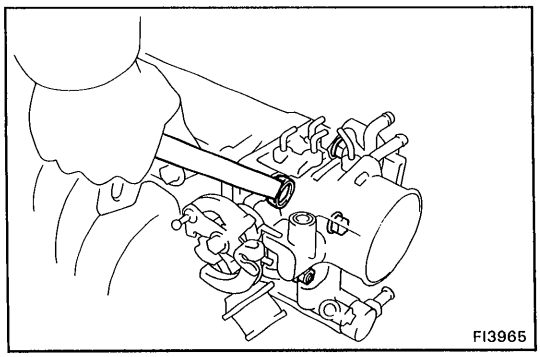
1. **(M/T)**
   INSTALL DASH POT

2. **INSTALL AIR VALVE**
   (a) Place a new O-ring on the throttle body.
   (b) Install the air valve with four screws.


FI3919

3. **INSTALL THROTTLE POSITION SENSOR**
   (a) Check that the throttle valve is fully closed.
   (b) Place the sensor on the throttle body as shown in the figure.
   (c) Turn the sensor clockwise, and temporarily install the two screws.

4. **ADJUST THROTTLE POSITION SENSOR**
   (See step 5 on page FI-87)

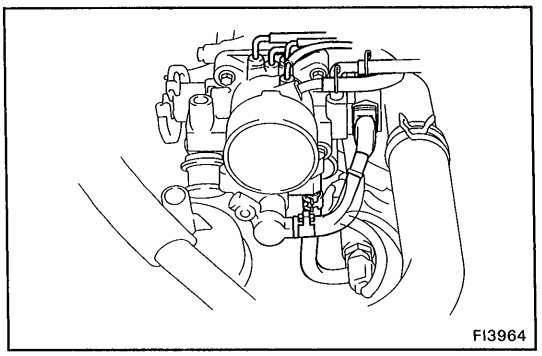


INSTALLATION OF THROTTLE BODY

1. **INSTALL THROTTLE BODY**

   Using a new gasket, install the throttle body, three bolts and nut.

   Torque: 195 kg-cm (14 ft-lb, 19 N·m)



2. **CONNECT THROTTLE SENSOR CONNECTOR**

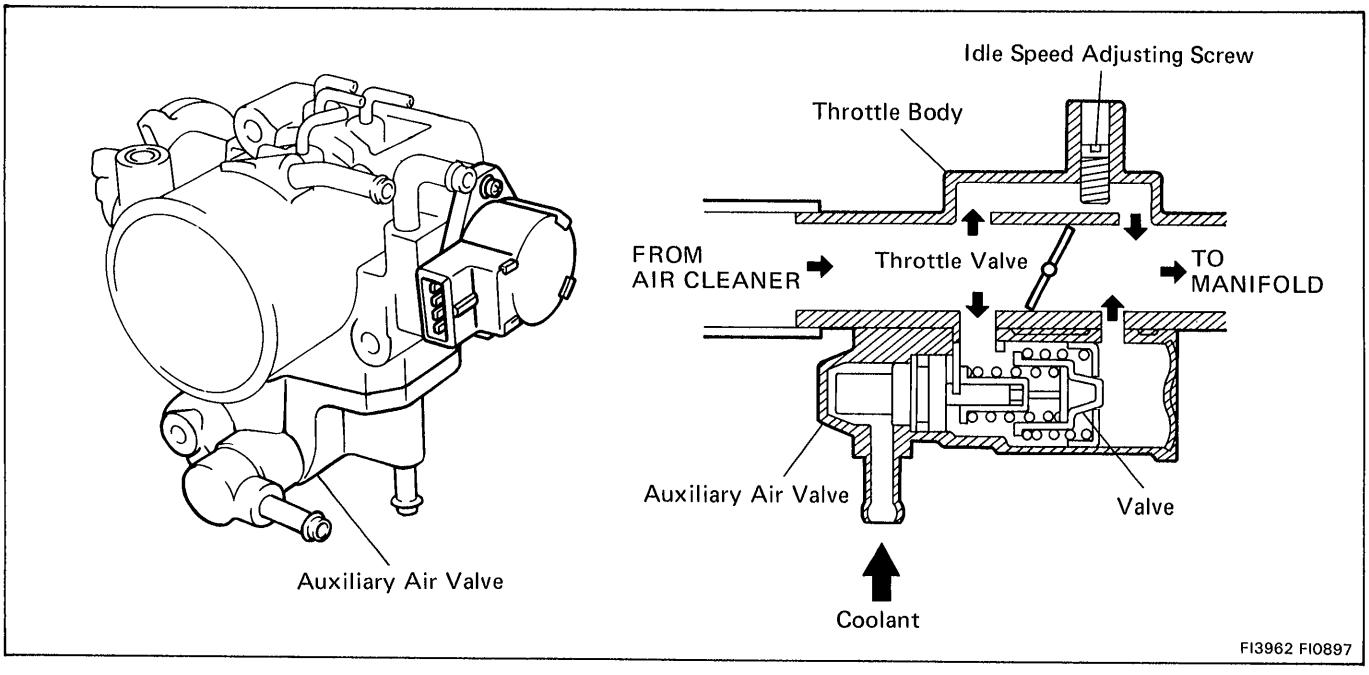
3. **CONNECT FOLLOWING HOSES:**
   (a) Emission control hoses.
   (b) No.2 and No.3 water by-pass hoses.
   (c) PCV hose
   (d) (with A/C)
   A/C idle up hose.

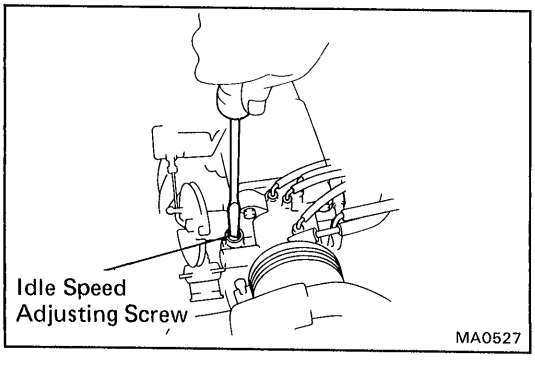
4. **CONNECT ACCELERATOR CABLE**

5. **INSTALL AIR INTAKE CONNECTOR**

6. **FILL WITH COOLANT**

Auxiliary Air Valve





ON-VEHICLE INSPECTION

CHECK OPERATION OF AUXILIARY AIR VALVE

Check the engine rpm by fully screwing in the idle speed adjusting screw.

At low temp. (Coolant temp.: below 80°C or 176°F)

- When the idle speed adjusting screw is in, the engine rpm should drop.

After warm-up

- When the idle speed adjusting screw is in, the engine rpm should drop below idle speed stop.

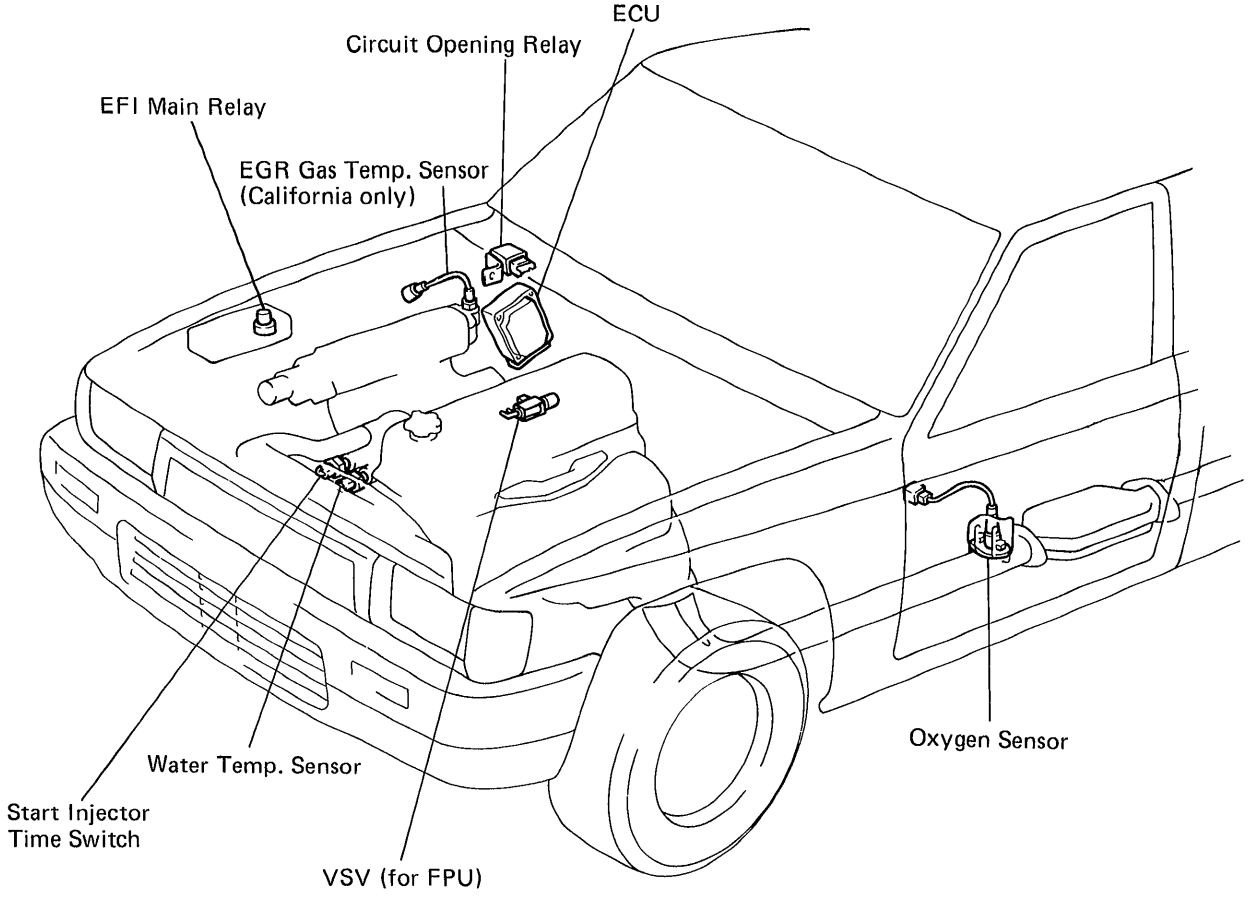
REMOVAL OF AUXILIARY AIR VALVE

1. **REMOVE THROTTLE BODY (See page FI-86)**
2. **REMOVE AUXILIARY AIR VALVE (See step 2 on page FI-88)**

INSTALLATION OF AUXILIARY AIR VALVE

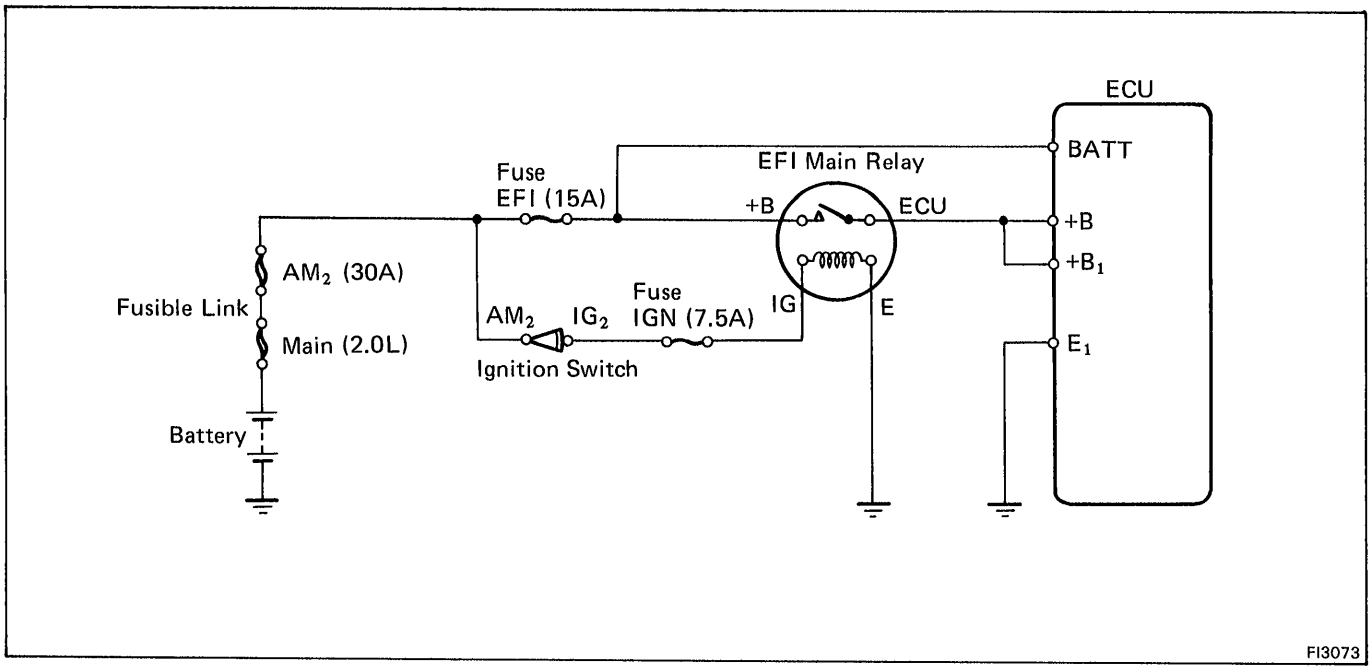
1. **INSTALL AUXILIARY AIR VALVE (See step 2 on page FI-88)**
2. **INSTALL THROTTLE BODY (See page FI-89)**

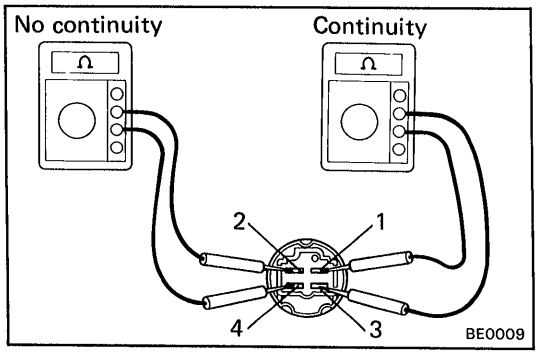
ELECTRONIC CONTROL SYSTEM
Location of Electronic Control Parts

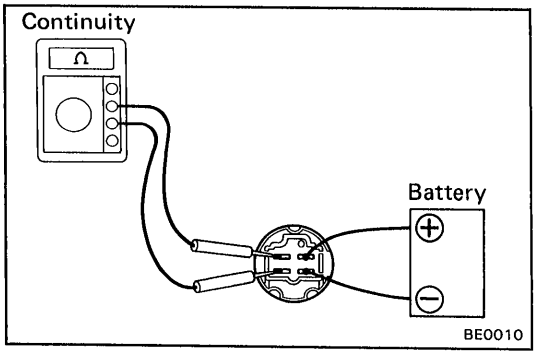


FI3953

EFI Main Relay







INSPECTION OF EFI MAIN RELAY

1. INSPECT RELAY CONTINUITY

(a) Using an ohmmeter, check that there is continuity between terminals 1 and 3.

(b) Check that there is no continuity between terminals 2 and 4.

(c) Check that there is no continuity between terminals 3 and 4.

If continuity is not as specified, replace the relay.

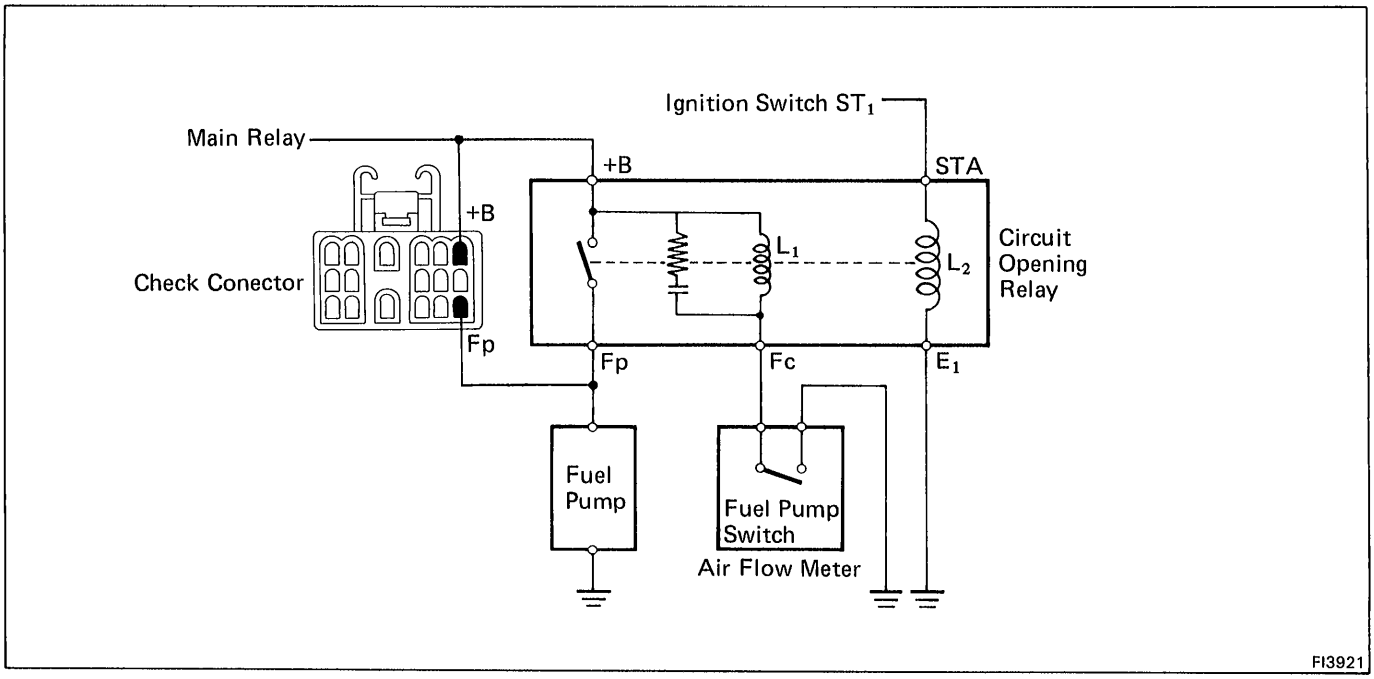
2. INSPECT RELAY OPERATION

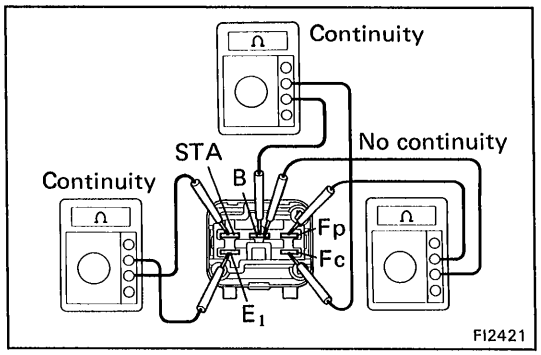
(a) Apply battery voltage across terminals 1 and 3.

(b) Using an ohmmeter, check that there is continuity between terminals 2 and 4.

If operation is not as specified, replace the relay.

Circuit Opening Relay





INSPECTION OF CIRCUIT OPENING RELAY

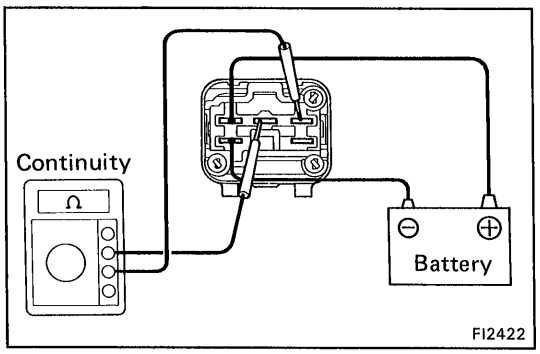
1. INSPECT RELAY CONTINUITY

(a) Using an ohmmeter, check that there is continuity between terminals STA and E_1.

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

(c) Check that there is no continuity between terminals B and F_P.

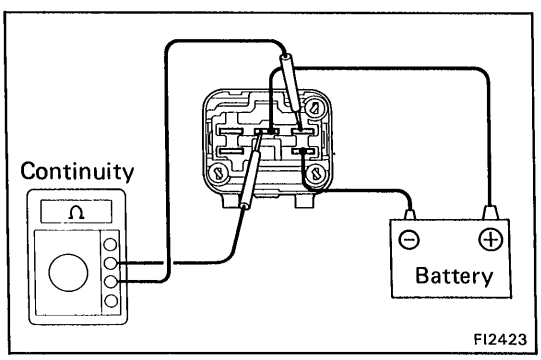
If continuity is not as specified, replace the relay.



2. INSPECT RELAY OPERATION

(a) Apply battery voltage across terminals STA and E_1.

(b) Using an ohmmeter, check that there is continuity between terminals B and F_P.

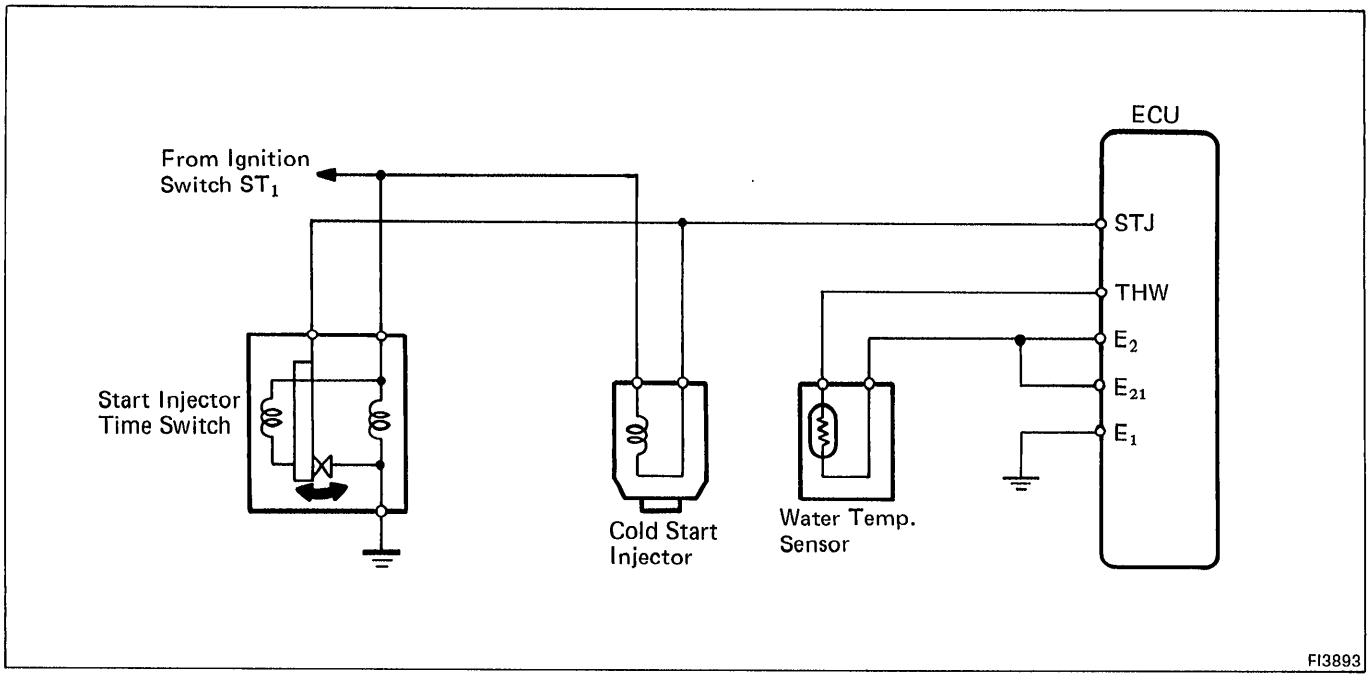


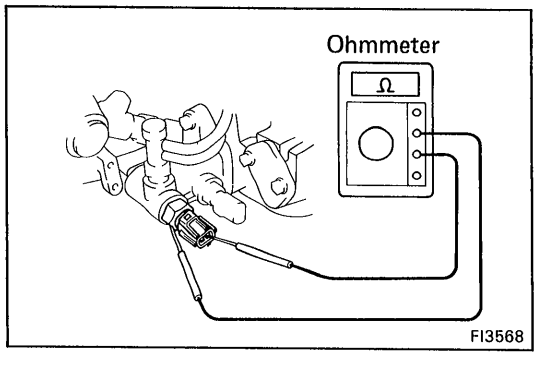
(c) Apply battery voltage across terminals B and F_C.

(d) Check that there is continuity between terminals B and F_P.

If operation is not as specified, replace the relay.

Start Injector Time Switch





INSPECTION OF START INJECTOR TIME SWITCH

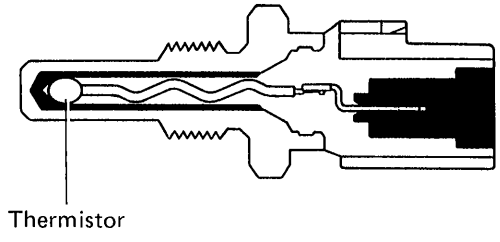
MEASURE RESISTANCE OF START INJECTOR TIME SWITCH

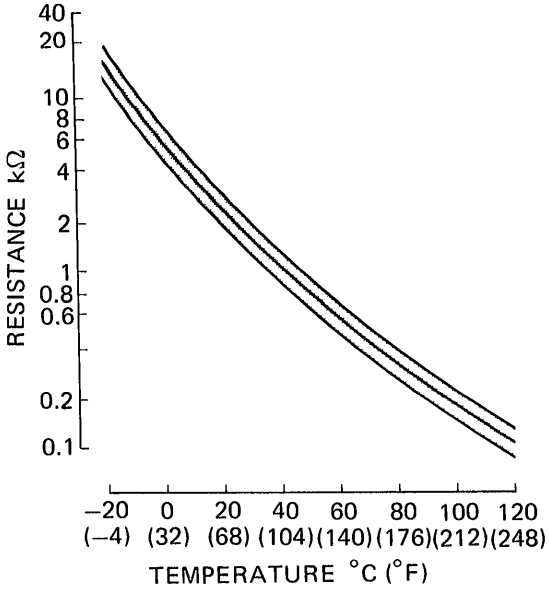
(a) Disconnect the connector.

(b) Using an ohmmeter, measure the resistance between terminals.

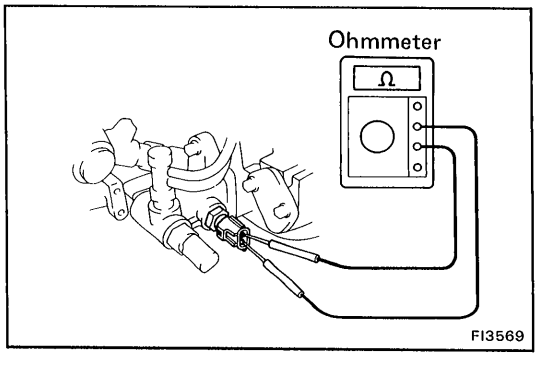
Between terminals	Resistance (Ω)	Coolant temperature
STA — STJ	30 — 50	below 10°C(50°F)
	70 — 90	above 25°C(77°F)
STA — Ground	30 — 90	—

Water Temp. Sensor





FI3524 FI0709



FI3569

INSPECTION OF WATER TEMP. SENSOR

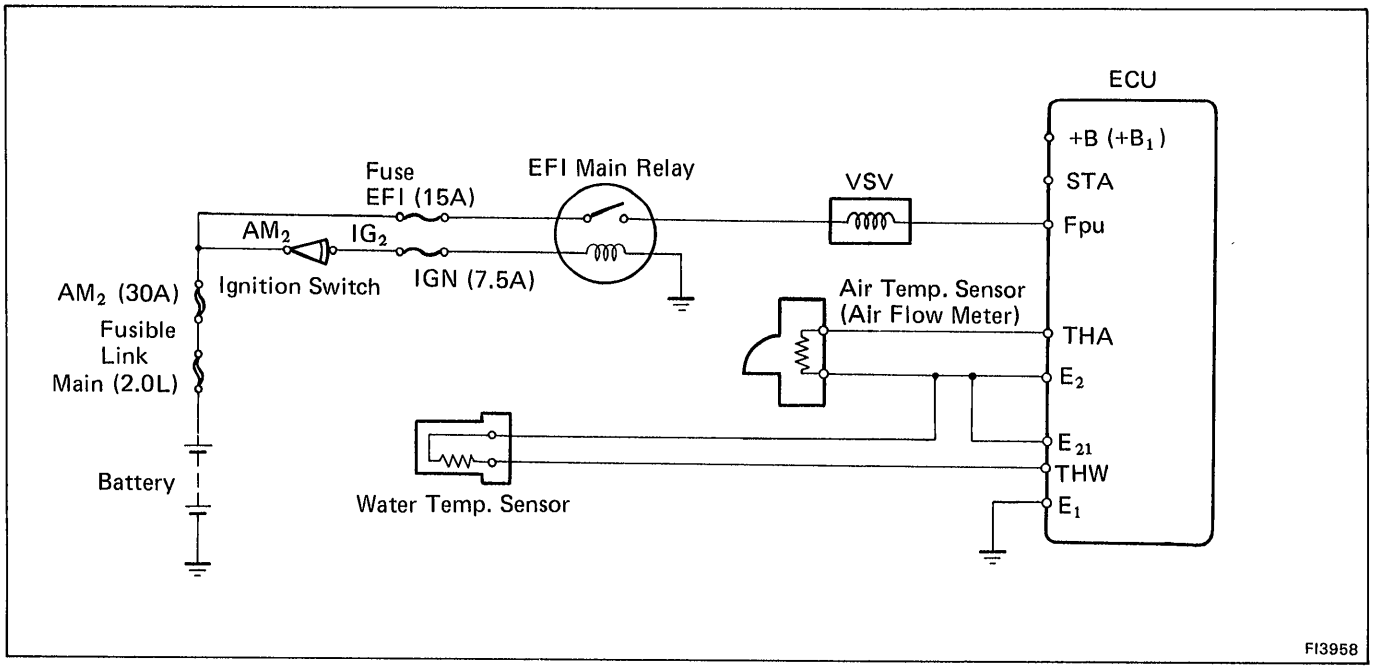
MEASURE RESISTANCE OF WATER TEMP. SENSOR

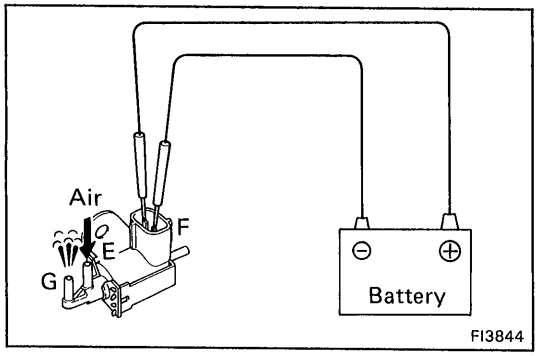
(a) Disconnect the connector.

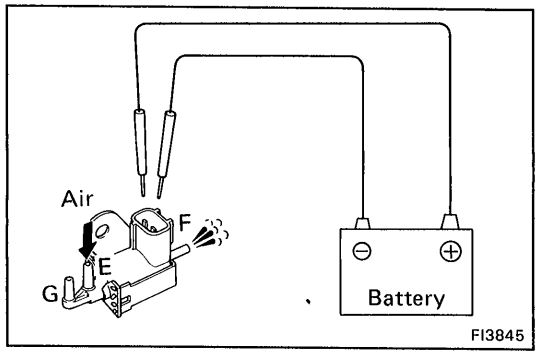
(b) Using an ohmmeter, measure the resistance between the terminals.

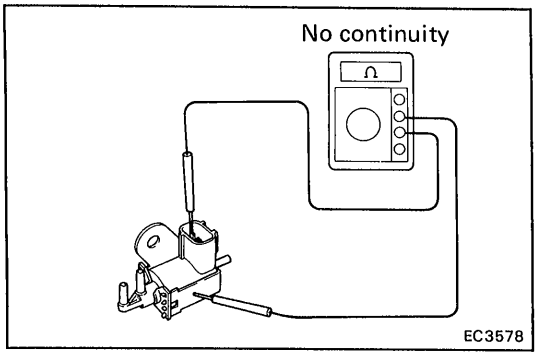
Resistance: Refer to the chart above.

High Temp. Line Pressure Up System









INSPECTION OF VSV

1. **CHECK VACUUM CIRCUIT CONTINUITY IN VSV BY BLOWING AIR INTO PIPE**

   (a) Connect the VSV terminals to the battery terminals as illustrated.

   (b) Blow into pipe E and check that air comes out of pipe G.

   (c) Disconnect the battery.

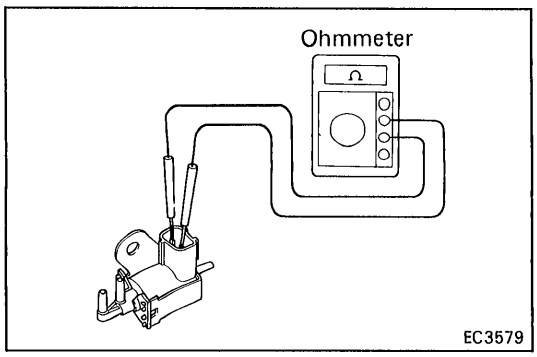
   (d) Blow into pipe E and check that air comes out of pipe F.

   If a problem is found, repair or replace the VSV.

2. **CHECK FOR SHORT CIRCUIT**

   Using an ohmmeter, check that there is no continuity between the terminal and the VSV body.

   If there is continuity, replace the VSV.

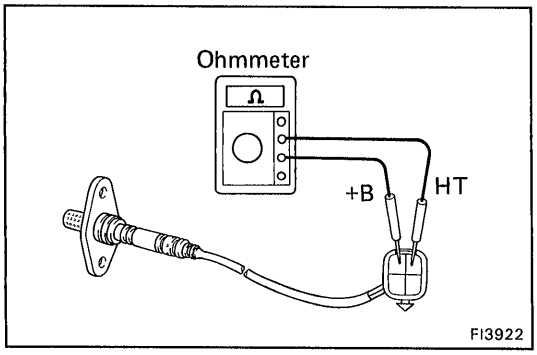


3. CHECK FOR OPEN CIRCUIT

Using an ohmmeter, measure the resistance between both terminals as illustrated.

Specified resistance: 30 — 50 Ω at 20°C (68°F)

If resistance is not within specification, replace the VSV.



Oxygen Sensor

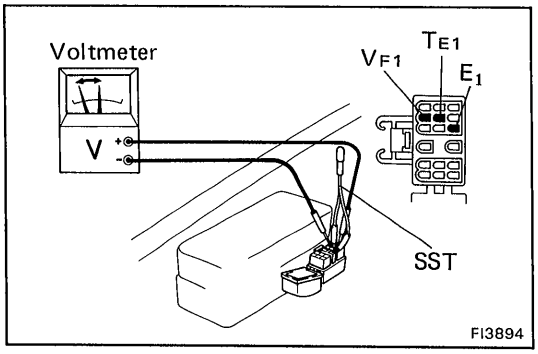
INSPECTION OF OXYGEN SENSOR

1. INSPECT HEATER RESISTANCE OF OXYGEN SENSOR

Using an ohmmeter, measure the resistance between the terminals +B and HT.

Resistance: 5.1 — 6.3 Ω at 20°C (68°F)

If the resistance is not as specified, replace the oxygen sensor.



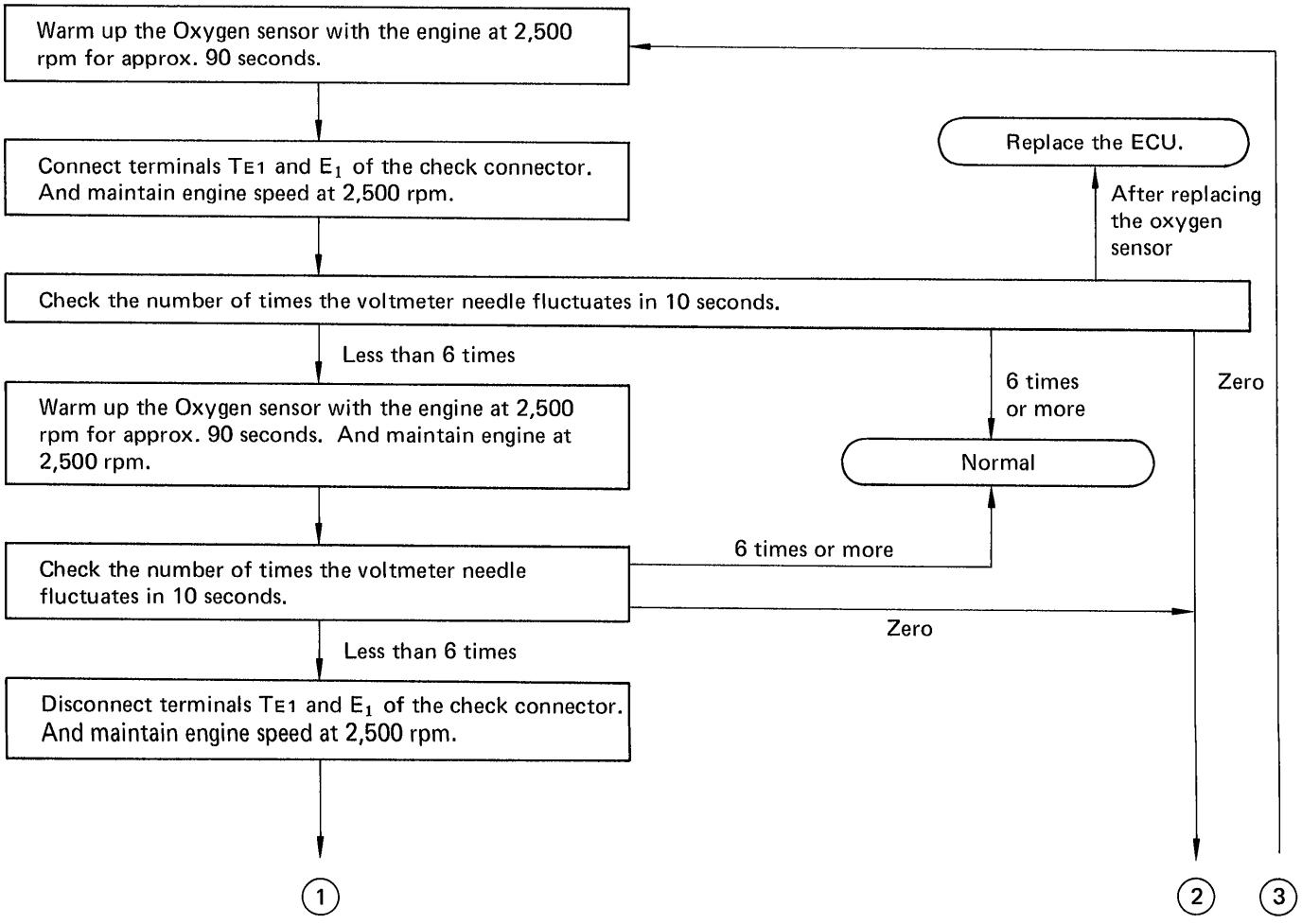
2. INSPECTION OF FEEDBACK VOLTAGE (V_{F1})

(a) Warm up the engine.

(b) Connect the voltmeter to the check connector terminals V_{F1} and E_1.

HINT: Use SST when connecting between terminals T_{E1} and E_1 of the check connector.

SST 09843-18020



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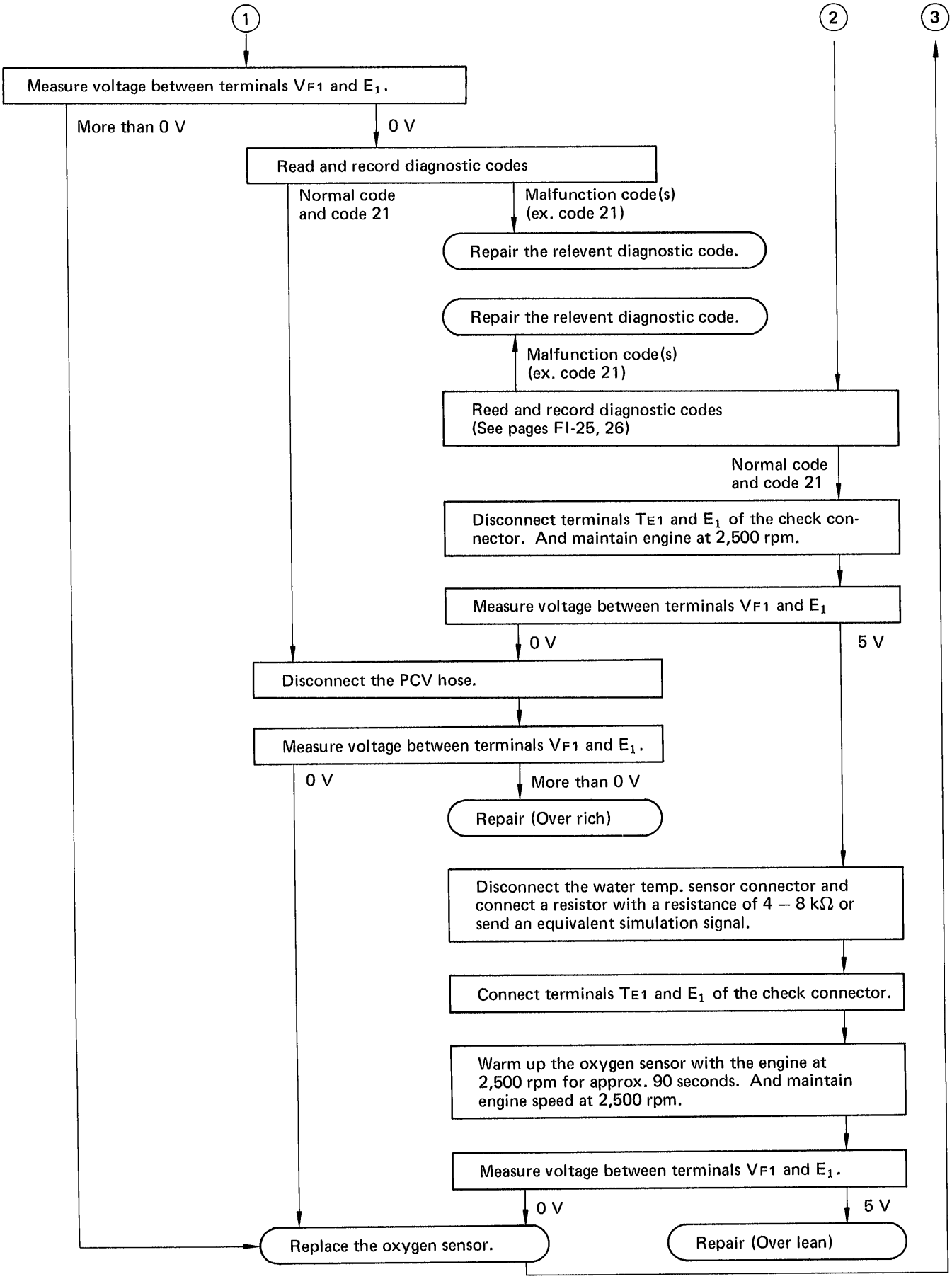
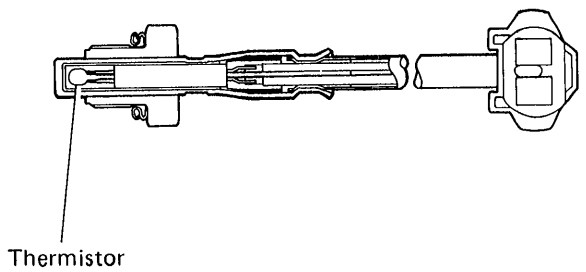
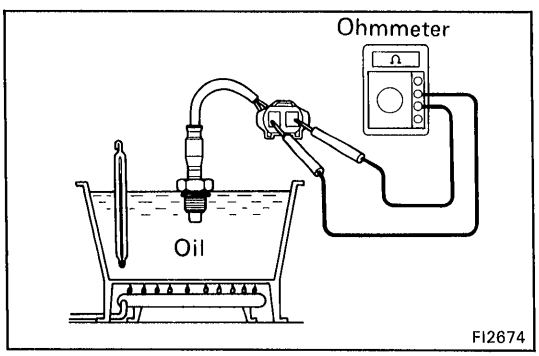


EGR Gas Temp. Sensor

(California Vehicles only)



FI2673



FI2674

INSPECTION OF EGR GAS TEMP. SENSOR

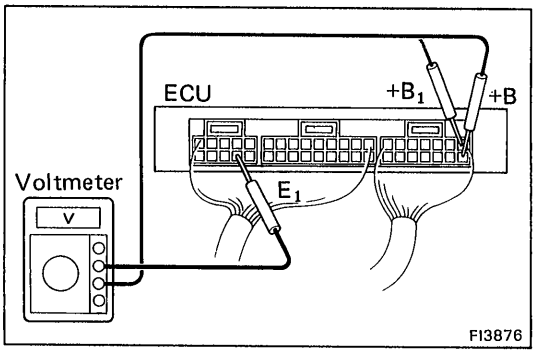
MEASURE RESISTANCE EGR GAS TEMP. SENSOR

Using an ohmmeter, measure the resistance between both terminals.

Resistance

69.40 — 88.50 kΩ at 50°C (122°F)
11.89 — 14.37 kΩ at 100°C (212°F)
2.79 — 3.59 kΩ at 150°C (302°F)

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



ECU

INSPECTION OF ECU

HINT:
- The ECU itself cannot be checked directly.
- The EFI circuit can be checked by measuring the resistance and voltage at the wiring connectors of the ECU.

1. MEASURE VOLTAGE OF ECU

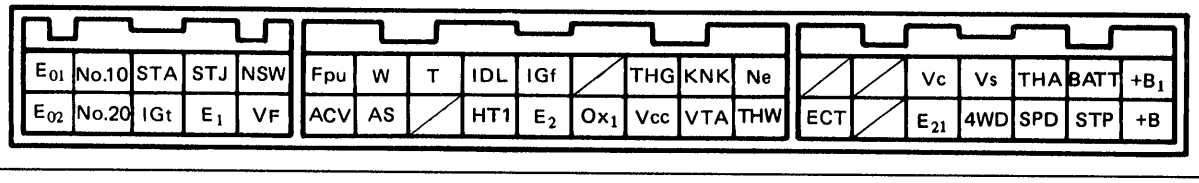
Check the voltage between each terminal of the wiring connectors.

- Remove the right kick panel.
- Turn the ignition switch to ON.
- Measure the voltage at each terminal.

HINT: 1. Reform all voltage measurements with the connectors connected.
2. Verify that the battery voltage is 11 V or above when the ignition switch is ON.

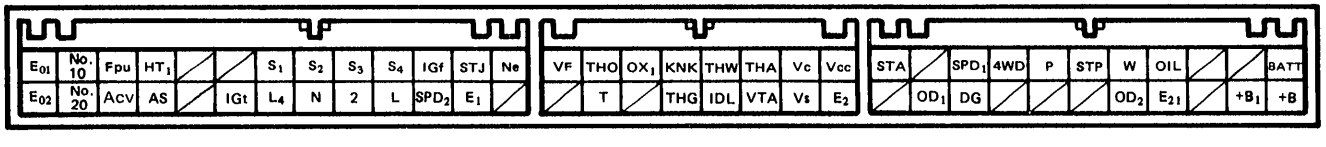
Voltage at ECU Wiring Connectors (Ex. 4WD A/T)

Terminals	Condition		STD voltage
BATT — E_1	—		10 — 14
+B — E_1	Ignition switch ON		10 — 14
+B_1 — E_1			
IDL — E_2 (E_{21})	Ignition switch ON	Throttle valve open	8 — 14
Vcc — E_2 (E_{21})		—	4 — 6
VTA — E_2 (E_{21})		Throttle valve fully closed	0.1 — 1.0
		Throttle valve fully open	3 — 5
Vc — E_2 (E_{21})	Ignition switch ON	—	6 — 10
Vs — E_2 (E_{21})		Measuring plate fully closed	0.5 — 2.5
		Measuring plate fully open	5 — 10
	Idling		2 — 8
THA — E_2 (E_{21})	Ignition switch ON	Intake air temperature 20°C (68°F)	1 — 3
THW — E_2 (E_{21})	Ignition switch ON	Coolant temperature 80°C (176°F)	0.1 — 1.0
STA — E_1	Ignition switch ST position		6 — 12
No.10 — E_{01} No.20 — E_{02}	Ignition switch ON		10 — 14
IGt — E_1	Idling		0.7 — 1.0
W — E_1	No trouble (CHECK ENGINE light off) and engine running		10 — 14
STJ — E_1	Ignition switch ST position	Coolant temperature 80°C (176°F)	6 — 12
STP — E_1	Stop light switch ON		8 — 14

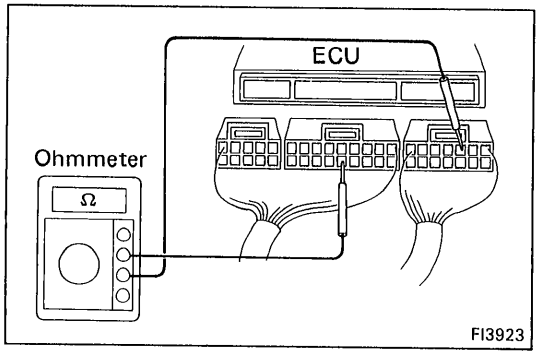


Voltage at ECU Wiring Connectors (4WD A/T)

Terminals	Condition		STD voltage
BATT — E_1	—		10 — 14
+B — E_1	Ignition switch ON		10 — 14
$+B_1$ — E_1			10 — 14
IDL — E_2 (E_{21})	Ignition switch ON	Throttle valve open	8 — 14
Vcc — E_2 (E_{21})		—	4 — 6
VTA — E_2 (E_{21})		Throttle valve fully closed	0.1 — 1.0
		Throttle valve fully open	3 — 5
Vc — E_2 (E_{21})	Ignition switch ON	—	6 — 10
Vs — E_2 (E_{21})		Measuring plate fully closed	0.5 — 2.5
		Measuring plate fully open	5 — 10
	Idling		2 — 8
THA — E_2 (E_{21})	Ignition switch ON	Intake air temperature 20°C (68°F)	1 — 3
THW — E_2 (E_{21})	Ignition switch ON	Coolant temperature 80°C (176°F)	0.1 — 1.0
STA — E_1	Ignition switch ST position		6 — 12
No.10 — E_{01} No.20 E_{02}	Ignition switch ON		9 — 14
IGt — E_1	Idling		0.7 — 1.0
W — E_1	No trouble (CHECK ENGINE light off) and engine running		8 — 14
STJ — E_1	Ignition switch ST position	Coolant temperature 80°C (176°F)	6 — 12
STP — E_1	Stop light switch ON		8 — 14



FI2796



2. MEASURE RESISTANCE OF ECU

NOTICE:

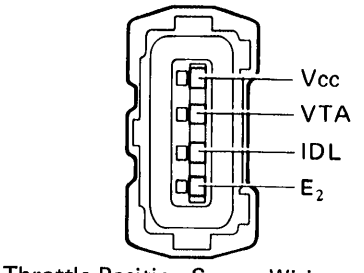
- **Do not touch the ECU terminals.**
- **The tester probe should be inserted into the wiring connector from the wiring side.**

Check the resistance between each terminal of the wiring connector.

- Remove the right kick panel.
- Unplug the wiring connectors from the ECU.
- Measure the resistance between each terminal of the wiring connectors.

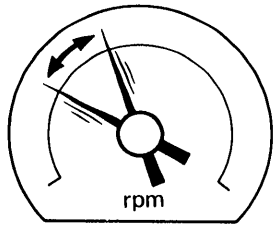
Resistance at ECU Wiring Connectors

Terminals	Condition	Resistance (kΩ)
IDL — E_2 (E_{21})	Throttle valve open	Infinity
	Throttle valve fully closed	0 — 0.1
VTA — E_2 (E_{21})	Throttle valve fully open	3.3 — 10
	Throttle valve fully closed	0.2 — 0.8
Vcc — E_2 (E_{21})	—	4 — 9
THA — E_2 (E_{21})	Intake air temperature 20°C (68°F)	2 — 3
THW — E_2 (E_{21})	Coolant temperature 80°C (176°F)	0.2 — 0.4
+B — E_2 (E_{21})	—	0.2 — 0.4
Vc — E_2 (E_{21})	—	0.1 — 0.3
Vs — E_2 (E_{21})	Measuring plate fully closed	0.02 — 0.4
	Measuring plate fully open	0.02 — 1.00
Ne — E_1	—	0.14 — 0.18
STJ — E_1	—	Infinity
FPU — E_1	—	Infinity
HT — E_1	—	Infinity



Throttle Position Sensor Wiring Connector Side

FI0547



Tachometer

FI1142

Fuel Cut RPM

INSPECTION OF FUEL CUT RPM

(a) Start and warm up the engine.

(b) Disconnect the connector from the throttle position sensor.

(c) Connect terminals IDL and E_2 on wiring connector side.

(d) Gradually raise the engine rpm and check that there is fluctuatuion between the fuel cut and fuel return points.

HINT:

- The vehicle should be stopped.
- Accessories switched off.

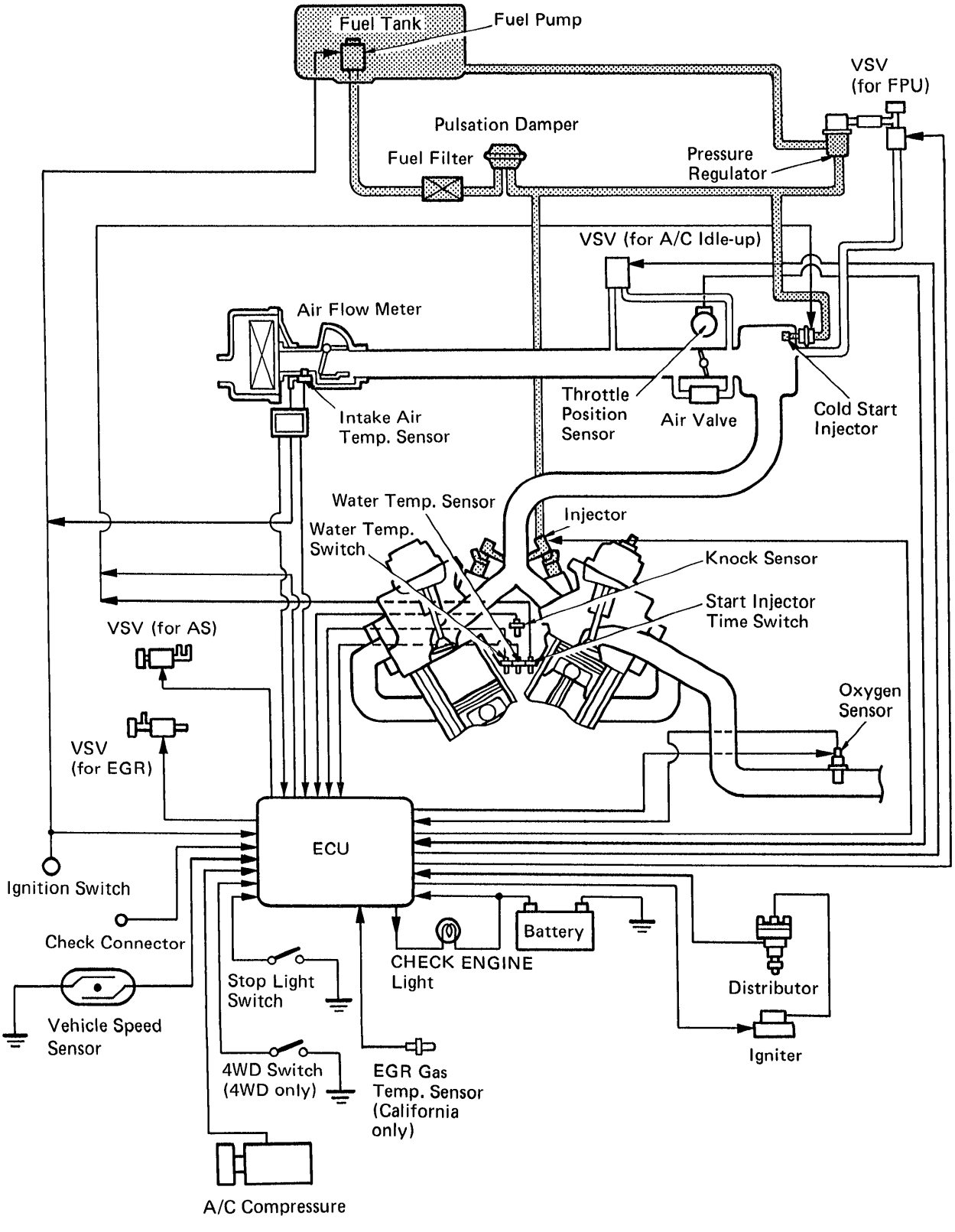
2WD A/T (stop light switch ON)

Fuel cut rpm: 1,300 rpm
Fuel return rpm: 1,000 rpm

Others

Fuel cut rpm: 1,900 rpm
Fuel return rpm: 1,600 rpm

SYSTEM DESCRIPTION



The EFI system is composed of three basic subsystems: Fuel, Air Induction and Electronic control Systems.

FUEL SYSTEM

An electric fuel pump supplies sufficient fuel, under a constant pressure, to the EFI injectors. These injectors inject a metered quantity of fuel into the intake manifold in accordance with signals from the ECU. Each injector injects, at the same time, one half of the fuel required for ideal combustion with each engine revolution.

AIR INDUCTION SYSTEM

The air induction system provides sufficient air for engine operation.

ELECTRONIC CONTROL SYSTEM

The 3VZ-E engine is equipped with a Toyota Computer Control System (TCCS) which centrally controls the EFI, ESA, Diagnosis systems, etc. by means of an Electronic Control Unit (ECU — formerly EFI computer) employing a microcomputer.

By means of the ECU, the TCCS controls the following functions:

1. Electronic Fuel Injection (EFI)

   The ECU receives signals from various sensors indicating changing engine operation conditions such as:

   Intake air volume
   Intake air temperature
   Coolant temperature
   Engine rpm
   Acceleration/deceleration
   Exhaust oxygen content etc.

   These signals are utilized by the ECU to determine the injection duration necessary for an optimum air-fuel ratio.

2. Electronic Spark Advance (ESA)

   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, coolant temperature, etc.), the microcomputer (ECU) triggers the spark at precisely the right instant.

3. Diagnosis

   The ECU detects any malfunctions abnormalties in the sensor network and lights the "CHECK ENGINE" warning light on the instrument panel. At the same time, the trouble is identified and a diagnostic code is recorded by the ECU. The diagnostic code can be read by the number of blinks of the "CHECK ENGINE" warning light when terminals T_{E1} and E_1 are connect-circuited. There are 17 (Federal and Canada), 18 (California) different diagnostic codes including one for "normal operation."

4. Fail-Safe

   In the event of a sensor malfunction, a back-up circuit will take over to provide minimal drivability, and the "CHECK ENGINE" warning light will light.

PRECAUTIONS

1. **Before working on the fuel system, disconnect the negative terminal from the battery.**

   HINT: Any diagnosis code retained by the computer will be erased when the battery terminal is removed.

   Therefore, if necessary, read the diagnosis before removing the battery terminal.

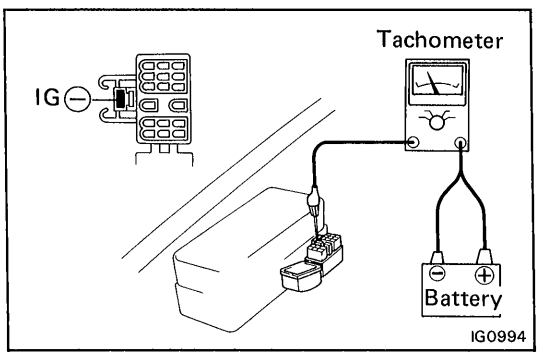
2. **Do not smoke or work near an open flame when working on the fuel system.**

3. **Keep gasoline off rubber or leather parts.**

INSPECTION PRECAUTIONS

MAINTENANCE PRECAUTIONS

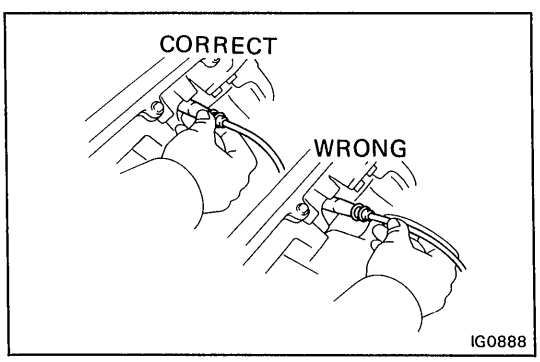
1. INSURE CORRECT ENGINE TUNE-UP



2. PRECAUTIONS WHEN CONNECTING GAUGE

(a) Connect the tachometer positive terminal to the IG⊖ terminal of the check connector.

(b) Use the battery as the power source for the timing light, tachometer, etc.

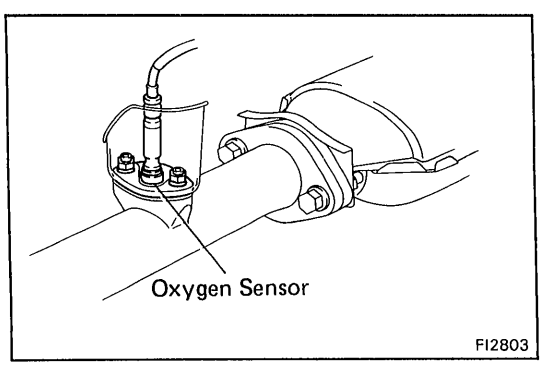


3. IN EVENT OF ENGINE MISFIRE THE FOLLOWING PRECAUTIONS SHOULD BE TAKEN

(a) Check proper connection of battery terminals, etc.

(b) Handle high-tension cords carefully.

(c) After repair work, check that the ignition coil terminals and all other ignition system from water.



4. PRECAUTIONS WHEN HANDLING OXYGEN SENSOR

(a) Do not allow the oxygen sensor to drop or hit against an object.

(b) Do not allow water to come into contact with the sensor or attempt to cool it.

IF CAR IS EQUIPPED WITH MOBILE RADIO SYSTEM (HAM, CB, ETC)

The ECU has been designed so that it will not be affected by outside interference.

However, if your vehicle is equipped with a amateur radio transceiver, etc. (even one with approx. 10 W output), it may, at times, have an affect upon ECU operation, especially if the antenna and feeder are installed nearby.

Therefore, observe the following precautions:

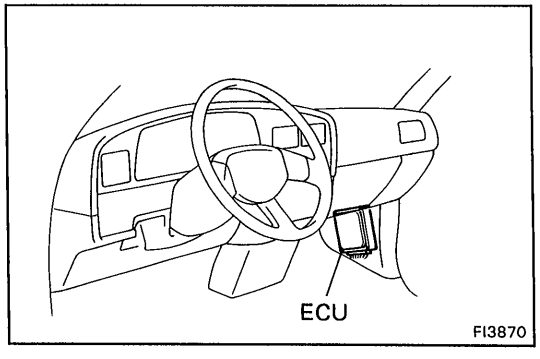
(a) Install the antenna as far as possible from the ECU. The ECU is located in the right side kick panel so the antenna should be installed at the rear, left side of the vehicle.
If installing on the bumper, do so on the right side, if possible.

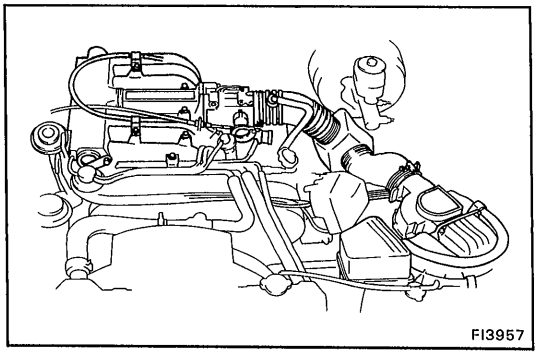
(b) Keep the antenna feeder as far away as possible from the ECU wires — at least 20 cm (7.87 in.) — and, especially, do not wind them together.

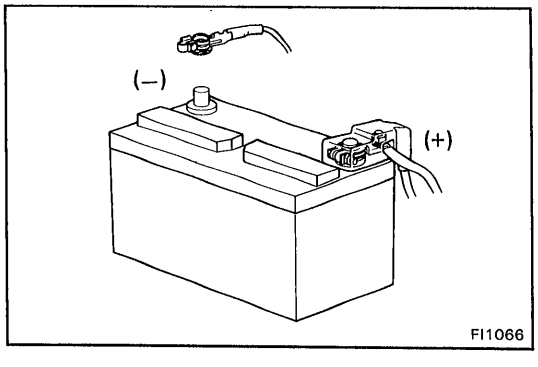
(c) Insure that the feeder and antenna are properly adjusted.

(d) Do not equip your vehicle with a powerful mobile radio system.

(e) Do not open the cover or the case of the ECU unless absolutely necessary. (If the IC terminals are touched, the IC may be destroyed by static electricity.)





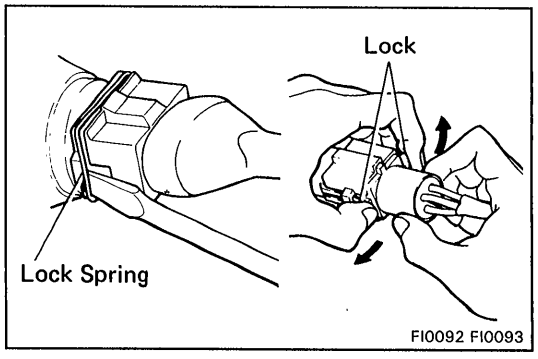


AIR INDUCTION SYSTEM

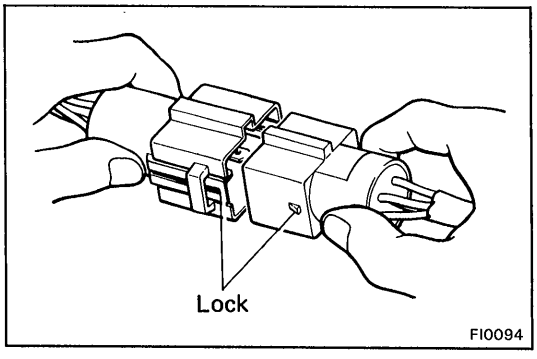
1. Separation of the engine oil dipstick, oil filler cap, PCV hose, etc., may cause the engine to run out of tune.
2. Disconnection, looseness or cracks in the parts of the air induction system between the air flow meter and cylinder head will allow air suction and cause bad engine tuning.

ELECTRONIC CONTROL SYSTEM

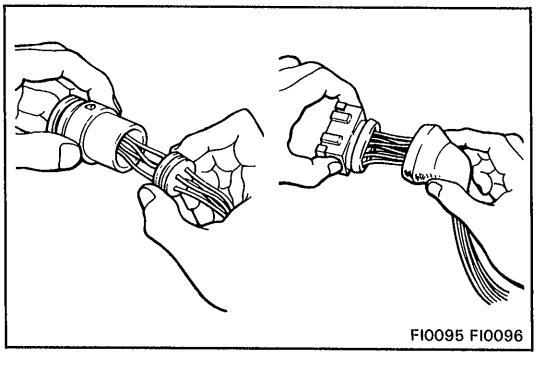
1. Before removing EFI wiring connectors, terminals, etc., first disconnect the power by either turning the ignition switch OFF or disconnecting the battery terminals.
2. When installing a battery, be especially careful not to incorrectly connect the positive and negative cables.
3. Do not permit parts to receive a severe impact during removal or installation. Handle all EFI parts carefully, especially the ECU.
4. Take great care during troubleshooting as there are numerous transistor circuits and even slight terminal contact can cause further troubles.
5. Do not open the ECU cover.
6. When inspecting during rainy weather, take care to prevent entry of water. Also, when washing the engine compartment, prevent water from getting on the EFI parts and wiring connectors.
7. Parts should be replaced as an assembly.



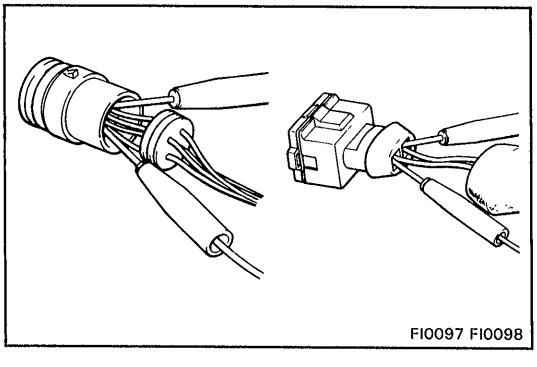
8. Care is required when pulling out the inserting wiring connectors.
   (a) To pull the connector out, release the lock and pull on the connector.



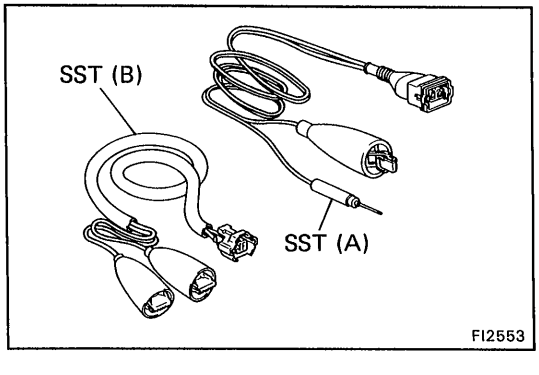
   (b) Fully insert the connector and insure that it is locked.



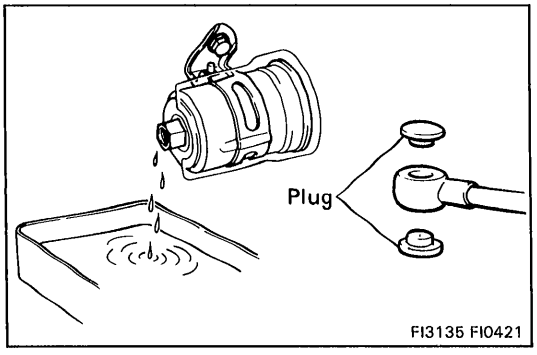
9. When inspecting a connector with a volt/ohmmeter.
   (a) Carefully take out the water-proofing rubber if it is a water-proof type connector.



   (b) Insert the tester probe into the connector from the wiring side when checking the continuity, amperage or voltage.
   (c) Do not apply unnecessary force to the terminal.
   (d) After the check, securely install the water-proofing rubber on the connector.

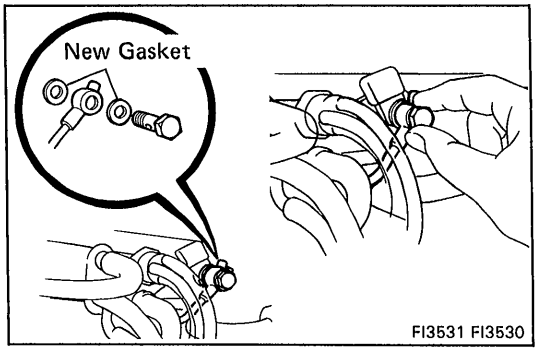


10. Use SST for inspection or testing of the injector, cold start injector or their wiring connectors.
    SST 09842-30050(A) and 09842-30070(B)

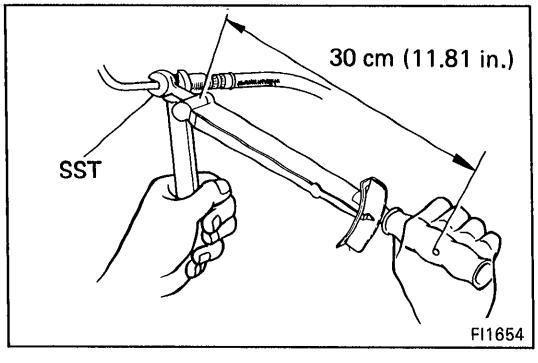


FUEL SYSTEM

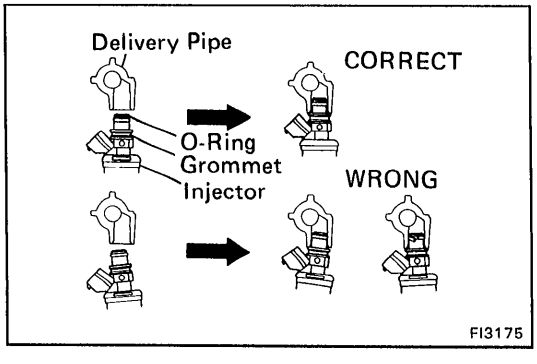
1. When disconnecting the connection of the high fuel pressure line, a large amount of gasoline may come out so observe the following procedure:
   (a) Put a container under the connection.
   (b) Slowly loosen the connection.
   (c) Disconnect the connection.
   (d) Plug the connection with a rubber plug.



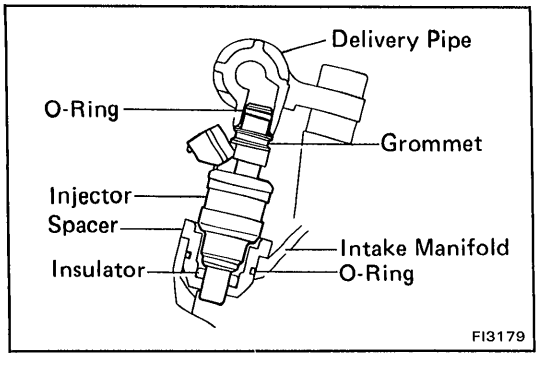
2. When connecting the flare nut or union bolt on the high pressure pipe union, observe the following procedure:
   (Union bolt type)
   (a) Always use a new gasket.
   (b) Hand tighten the union bolt.
   (c) Tighten the bolt to the specified torque.
   Torque: 310 kg-cm (22 ft-lb, 30 N·m)



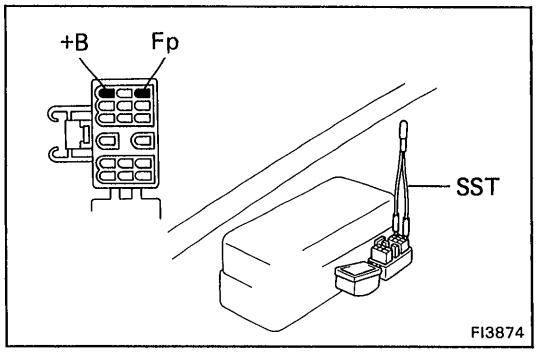
   (Flare nut type)
   (a) Apply a thin coat of oil to the flare and tighten the flare nut.
   (b) Then using SST, tighten the nut to the specified torque.
   SST 09631-22020
   Torque: 280 kg-cm (20 ft-lb, 27 N·m)
   HINT: Use a torque wrench with a fulcrum length of 30 cm (11.81 in.)



3. Observe the following precautions when removing and installing the injectors.
   (a) Never reuse a O-ring.
   (b) When placing an O-ring on the injector, take care not to damage it in any way.
   (c) Lubricate the O-ring with spindle oil or gasoline before installing—never use engine, gear or brake oil.

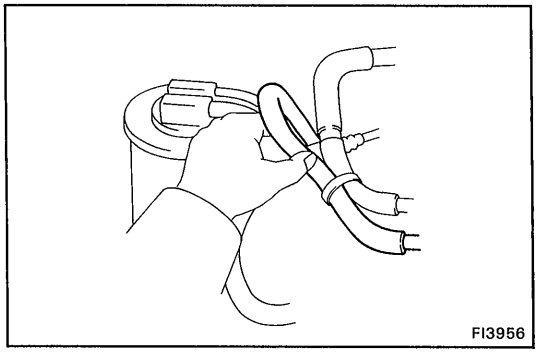


4. Install the injector to the delivery pipe and intake manifold as shown in the figure.



5. Confirm that there are no fuel leaks after performing any maintenance on the fuel system.
   (a) With engine stopped, turn the ignition switch to ON.
   (b) Using SST, connect terminals Fp and +B of the check connector.

   SST 09843-18020



   (c) When the fuel return hose is pinched, the pressure within the high pressure line will rise to approx. 4 kg/cm² (57 psi, 392 kPa). In this state, check to see that there are no leaks from any part of the fuel system.

NOTICE: Always pinch the hose Avoid bending the hose as it may cause the hose to crack.

TROUBLESHOOTING

TROUBLESHOOTING HINTS

1. Engine troubles are usually not caused by the EFI system. When troubleshooting, always first check the condition of the other systems.
   (a) Electronic source
      - Battery
      - Fusible links
      - Fuses

   (b) Body ground

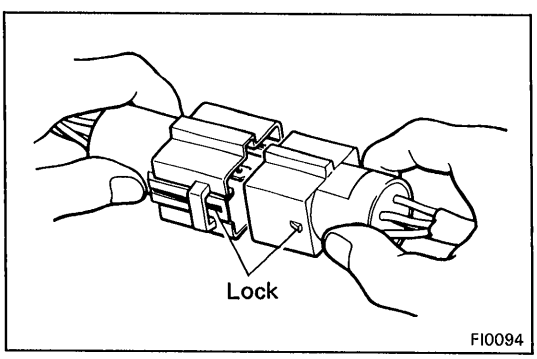
   (c) Fuel supply
      - Fuel leakage
      - Fuel filter
      - Fuel pump

   (d) Ignition system
      - Spark plug
      - High-tension cord
      - Distributor
      - Igniter and ignition coil

   (e) Air induction system
      - Vacuum leaks

   (f) Emission control system
      - PCV system
      - EGR system

   (g) Others
      - Ignition timing (ESA system)
      - Idle speed
      - etc.



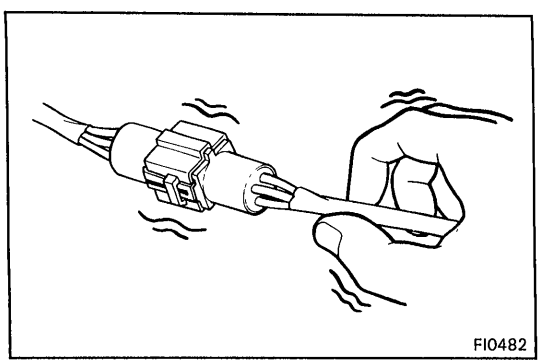
2. The most frequent cause of problems is simply a bad contact in wiring connectors. Always make sure that connections are secure.

   When inspecting the connector, pay particular attention to the following points:

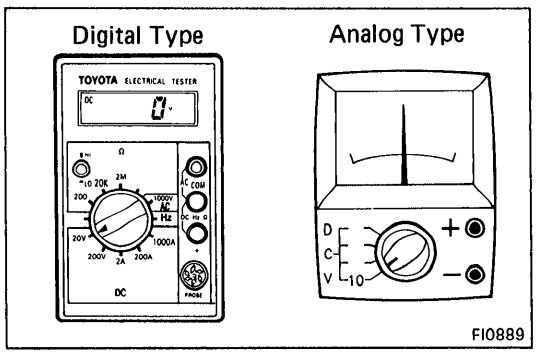
   (a) Check to see that the terminals are not bent.

   (b) Check to see that the connector is pushed in completely and locked.

   (c) Check to see that there is no signal change when the connector is slightly tapped or wiggled.



3. Sufficiently troubleshoot for other causes before replacing the ECU. The ECU is of high quality and it is expensive.



4. Use a volt/ohmmeter with high impedance (10 k /V minimum) for troubleshooting of the electrical circuit. (See page FI-131)

TROUBLESHOOTING PROCEDURES

SYMPTOM — DIFFICULT TO START OR NO START (ENGINE WILL NOT CRANK OR CRANKS SLOWLY)

CHECK ELECTRONIC SOURCE

BAD →
1. Battery
   (1) Connection
   (2) Gravity — Drive belt — Charging system
   (3) Voltage
2. Fusible link

OK ↓

CHECK STARTING SYSTEM

BAD →
1. Ignition switch
2. Starter relay (M/T)
3. Clutch start switch (M/T)
4. Neutral start switch (A/T)
5. Starter
6. Wiring/Connection

SYMPTOM — DIFFICULT TO START OR NO START (CRANKS OK)

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-125)

→ Malfunction code → Diagnostic code(s) (See pages FI-128, 129)

↓ Normal code

CHECK FOR VACUUM LEAKS IN AIR INTAKE LINE

→ BAD →
1. Hose connections
2. PCV hoses
3. EGR system — EGR valve stays open

↓ OK

CHECK IGNITION SPARK
1. Unplug connectors of start injector time switch.
2. Check by holding high-tension cord 8 — 10 mm (0.31 — 0.39 in.) away from cylinder block while engine is cranking.
   A strong spark should be noted.

→ BAD →
1. High-tension cords
2. Distributor
3. Ignition coil, igniter
4. ECU

↓ OK

CHECK IGNITION TIMING
STD: 10° BTDC @ idle
(T_{E_1} and E_1 connect)

→ NO → Adjust ignition timing

↓ OK

CHECK FUEL SUPPLY TO INJECTOR
1. Fuel in tank
2. Fuel pressure in fuel line
   (1) Connect terminals Fp and +B of the check connector.
   (2) Fuel pressure at fuel hose of inlet can be felt. (See page FI-169)

→ BAD →
1. Fuel line — Leakage — Deformation
2. Fuse
3. Circuit opening relay (See page FI-194)
4. Fuel pump (See page FI-168)
5. Fuel filter
6. Fuel pressure regulator (See page FI-177)

↓ OK

CHECK FUEL PUMP SWITCH IN AIR FLOW METER
Check continuity between terminals Fc and E_1 while measuring plate of air flow meter is open.

→ BAD → Air flow meter (See page FI-186)

↓ OK

CHECK SPARK PLUGS
Plug gap: 0.8 mm (0.031 in.)
HINT:
Check compression pressure if necessary.

→ NO →
1. Spark plug
2. Compression pressure
   Limit: 10.0 kg/cm² (142 psi, 981 kPa) at 250 rpm
3. Injector — Leakage (See page FI-179)

→ NO (All Plugs Wet) →
1. Injector(s) — Shorted
2. Injector wiring between shorted.
3. Cold start injector — Leakage (See page FI-174)
4. Start injector time switch (See page FI-195)

↓ OK

CONTINUED ON PAGE FI-115

OK CONTINUED FROM PAGE FI-114

CHECK AUXILIARY AIR VALVE
(See page FI-189)

BAD →
1. Auxiliary air valve
2. Water hoses

OK

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER

NO →
1. Wiring connection
2. Power to ECU
   (1) Fusible link
   (2) Fuse (EFI 15A)
   (3) EFI main relay
3. Air flow meter
4. Water temp. sensor
5. Injection signal
   (1) Injector wiring
   (2) ECU

SYMPTOM — ENGINE OFTEN STALLS

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-125)

→ Malfunction code → Diagnostic code(s) (See pages FI-128, 129)

↓ Normal code

CHECK FOR VACUUM LEAKS IN AIR INTAKE LINE

→ BAD →
1. Hose connections
2. PCV hoses
3. EGR system — EGR valve stays open

↓ OK

CHECK FUEL SUPPLY TO INJECTOR
1. Fuel in tank
2. Fuel pressure in fuel line
   (1) Connect terminals Fp and +B of the check connector.
   (2) You can feel fuel pressure at fuel inlet hose. (See page FI-169)

→ BAD →
1. Fuel line — Leakage — Deformation
2. Fuse
3. Circuit opening relay (See page FI-194)
4. Fuel pump (See page FI-168)
5. Fuel filter
6. Fuel pressure regulator (See page FI-177)

↓ OK

CHECK AIR FILTER ELEMENT

→ BAD → Element — Clean or replace

↓ OK

CHECK IDLE SPEED
STD: 800 rpm

→ BAD → Adjust idle speed

↓ OK

CHECK IGNITION TIMING
STD: 10° BTDC @ idle
(T_{E1} and E_1 connect)

→ BAD → Adjust ignition timing

↓ OK

CHECK SPARK PLUGS
Plug gap: 0.8 mm (0.031 in.)
HINT:
Check compression pressure if necessary.

→ BAD →
1. Spark plug
2. Compression pressure
   Limit: 10.0 kg/cm² (142 psi, 981 kPa) at 250 rpm

↓ OK

CHECK COLD START INJECTOR
(See page FI-174)

→ BAD →
1. Cold start injector
2. Start injector time switch
   (See page FI-195)

↓ OK

CONTINUED ON PAGE FI-117

OK CONTINUED FROM PAGE FI-116

CHECK AUXILIARY AIR VALVE
(See page FI-189)
→ BAD → 1. Auxiliary air valve
2. Water hoses

OK

RECHECK FUEL PRESSURE
(See page FI-169)
→ BAD → 1. Fuel pump (See page FI-168)
2. Fuel filter
3. Fuel pressure regulator
(See page FI-177)

OK

CHECK INJECTORS
(See page FI-179)
→ BAD → Injection condition

OK

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER
→ BAD → 1. Wiring connection
2. Power to ECU
(1) Fusible link
(2) Main relay
3. Air flow meter
4. Water temp. sensor
5. Injection signal
(1) Injector wiring
(2) ECU

SYMPTOM — ENGINE SOMETIMES STALLS

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-125)
→ Malfunction code → Diagnostic code(s) (See pages FI-128, 129)

Normal code

CHECK AIR FLOW METER
(See page FI-186)
→ BAD → Air flow meter

OK

CHECK WIRING CONNECTORS AND RELAYS
Check that there is a signal change when the connector or relay is slightly tapped or wiggled.
→ BAD → 1. Connector
2. EFI main relay (See page FI-193)
3. Circuit opening relay (See page FI-194)

SYMPTOM — ROUGH IDLING AND/OR MISSING

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-125)

Malfunction code → Diagnostic code(s) (See pages FI-128, 129)

Normal code ↓

CHECK FOR VACUUM LEAKS IN AIR INTAKE LINE

BAD → 1. Hose connections
2. PCV hoses
3. EGR system — EGR valve stays open

OK ↓

CHECK AIR FILTER ELEMENT

BAD → Element — Clean or replace

OK ↓

CHECK IDLE SPEED
STD: 800 rpm

BAD → Adjust idle speed

OK ↓

CHECK IGNITION TIMING
STD: 10° BTDC @ idle
(T_{E_1} and E_1 connect)

BAD → Adjust ignition timing

OK ↓

CHECK SPARK PLUGS AND PLUG CORDS
Plug gap: 0.8 mm (0.031 in.)
HINT:
Check compression pressure if necessary.

BAD → 1. Spark plugs and high-tension cords
2. Compression pressure
Limit: 10.0 kg/cm² (142 psi, 981 kPa) at 250 rpm

OK ↓

CHECK COLD START INJECTOR
(See page FI-174)

BAD → 1. Cold start injector
2. Start injector time switch.
(See page FI-195)

OK ↓

CHECK FUEL PRESSURE
(See page FI-169)

BAD → 1. Fuel pump (See page FI-168)
2. Fuel filter
3. Fuel pressure regulator (See page FI-177)

OK ↓

CHECK INJECTORS
(See page FI-179)

BAD → Injection condition

OK ↓ CONTINUED ON PAGE FI-119

OK CONTINUED FROM PAGE FI-118

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER

BAD →

1. Wiring connection
2. Power to ECU
   (1) Fusible link
   (2) EFI main relay
3. Air flow meter
4. Water temp. sensor
5. Air temp. sensor
6. Throttle position sensor
7. Injection signal
   (1) Injector wiring
   (2) ECU
8. Oxygen sensor

SYMPTOM — HIGH ENGINE IDLE SPEED (NO DROP)

CHECK ACCELERATOR LINKAGE
→ BAD → Linkage — Stuck
↓ OK

CHECK IGNITION TIMING
STD: 10° BTDC @ idle
(T_{E_1} and E_1 connect)
→ BAD → Adjust ignition timing
↓ OK

CHECK AUXILIARY AIR VALVE
(See page FI-189)
→ BAD → Air valve — Always open
↓ OK

CHECK AIR CONDITIONER AND POWER STEERING IDLE-UP CIRCUIT
→ BAD → Air valve for power steering — Leakage
VSV for air conditioner — Leakage
↓ OK

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-125)
→ Malfunction code → Diagnostic code(s) (See pages FI-128, 129)
↓ Normal code

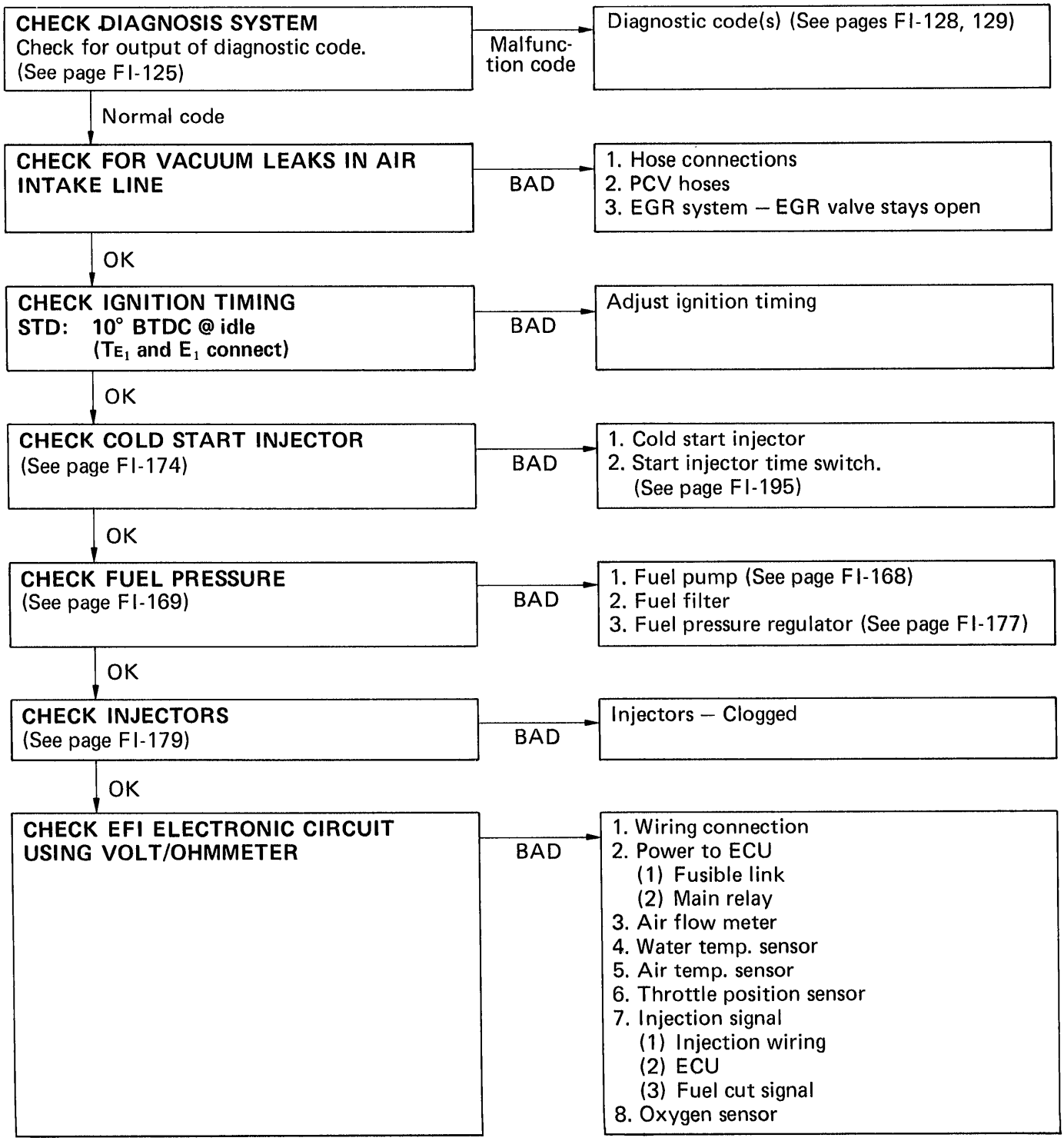
CHECK FUEL PRESSURE
(See page FI-169)
→ BAD → Fuel pressure regulator — High pressure
↓ OK

CHECK COLD START INJECTOR
(See page FI-174)
→ BAD → Start injector — Leakage
↓ OK

CHECK INJECTORS
(See page FI-179)
→ BAD → Injectors — Leakage, Injection quality
↓ OK

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER
→ BAD →
1. Wiring connection
2. Power to ECU
   (1) Fusible link
   (2) EFI main relay
3. Air flow meter
4. Water temp. sensor
5. Air temp. sensor
6. Injection signal
   (1) Injector wiring
   (2) ECU

SYMPTOM — ENGINE BACKFIRES-Lean Air Fuel Mixture



SYMPTOM — MUFFLER EXPLOSION (AFTER FIRE) -Rich Air Fuel Mixture-Misfire

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-125)

→ Malfunction code → Diagnostic code(s) (See pages FI-128, 129)

↓ Normal code

CHECK IGNITION TIMING
STD: 10° BTDC @ idle
(T_{E_1} and E_1 connect)

→ BAD → Adjust ignition timing

↓ OK

CHECK COLD START INJECTOR
(See page FI-174)

→ BAD →
1. Cold start injector
2. Cold start injector time switch.
(See page FI-195)

↓ OK

CHECK INJECTORS

→ BAD → Injectors — Leakage

↓ OK

CHECK SPARK PLUGS AND HIGH-TENSION CORDS
Plug gap: 0.8 mm (0.031 in.)
HINT:
Check compression pressure if necessary.

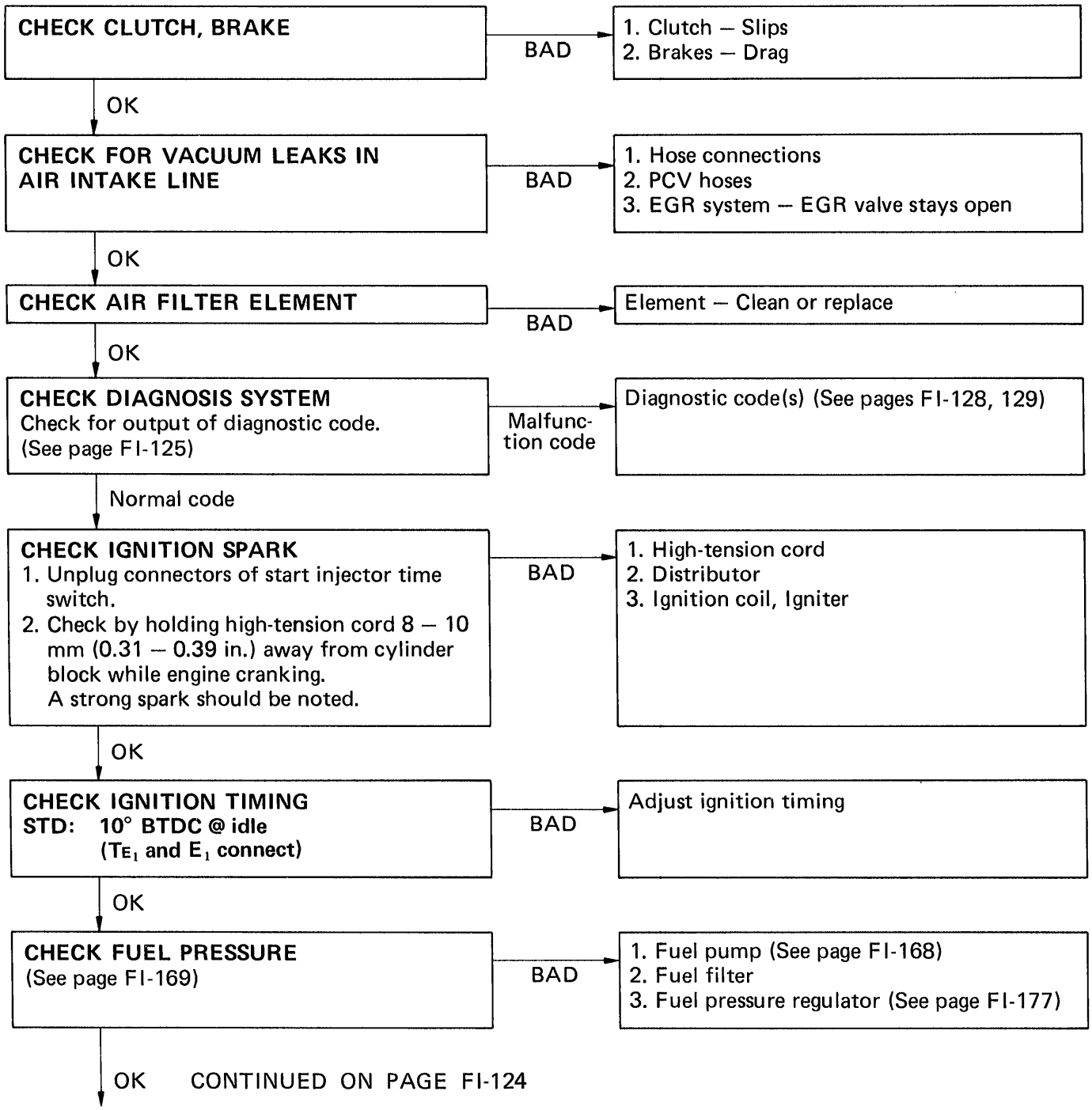
→ BAD →
1. Spark plugs and high-tension cords
2. Compression pressure
Limit: 10.0 kg/cm² (142 psi, 981 kPa) at 250 rpm

↓ OK

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER

→ BAD →
1. Throttle position sensor
2. Injection signal
(1) Fuel cut signal
(2) Injector wiring
(3) ECU
3. Oxygen sensor

SYMPTOM — ENGINE HESITATES AND/OR POOR ACCELERATION



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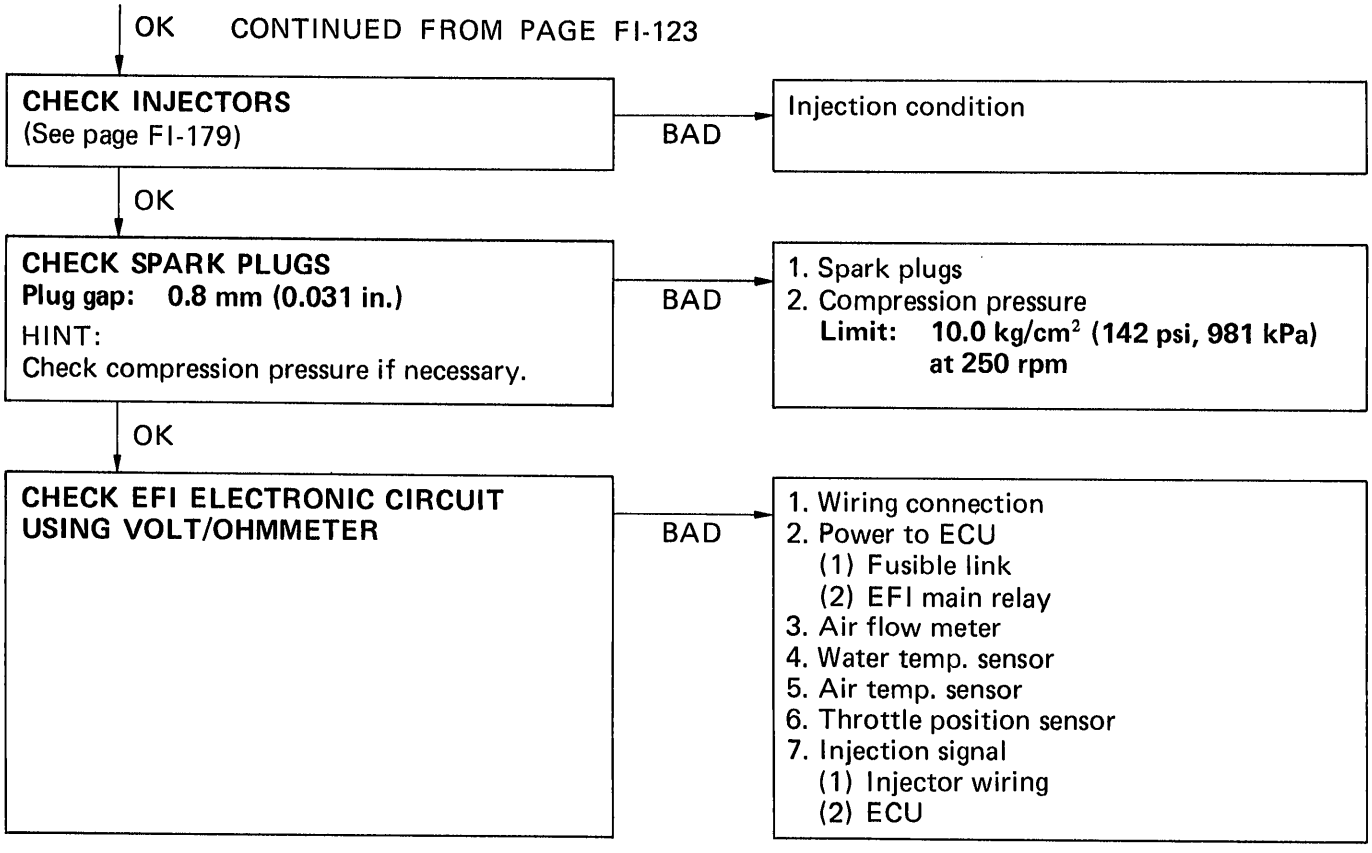

OK
CONTINUED FROM PAGE FI-123
CHECK INJECTORS
(See page FI-179)
BAD
Injection condition
OK
CHECK SPARK PLUGS
Plug gap: 0.8 mm (0.031 in.)
HINT:
Check compression pressure if necessary.
BAD
1. Spark plugs
2. Compression pressure
Limit: 10.0 kg/cm² (142 psi, 981 kPa) at 250 rpm
OK
CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER
BAD
1. Wiring connection
2. Power to ECU
(1) Fusible link
(2) EFI main relay
3. Air flow meter
4. Water temp. sensor
5. Air temp. sensor
6. Throttle position sensor
7. Injection signal
(1) Injector wiring
(2) ECU

DIAGNOSIS SYSTEM

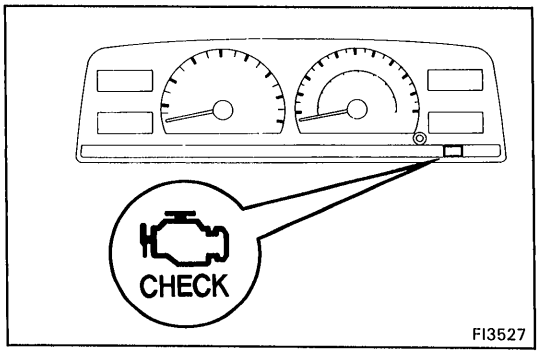
DESCRIPTION

The ECU contains a built-in self-diagnosis system by which troubles with the engine signal network are detected and a "CHECK ENGINE" warning light on the instrument panel flashes.
By analyzing various signals as shown in the table (See pages FI-128, 129) the ECU detects system malfunctions which are related to the various operating parameter sensors or to the actuator. The ECU stores the failure code associated with the detected failure until the diagnostic system is cleared by removing the EFI fuse with ignition switch off.
The "CHECK ENGINE" warning light on the instrument panel alerts the driver that a malfunction has been detected. The light goes out automatically when the malfunction has been corrected.

"CHECK ENGINE" WARNING LIGHT CHECK

1. The "CHECK ENGINE" warning light will comes on when the ignition switch is placed at ON and the engine not running.
2. When the engine is started, the "CHECK ENGINE" warning light should go out.

   If the light remains on, the diagnosis system has detected a malfunction or abnormality in the system.



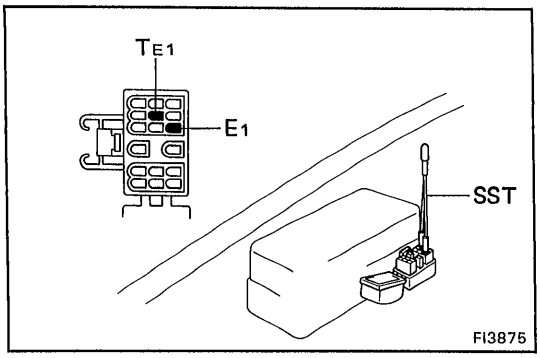
OUTPUT OF DIAGNOSIS CODES

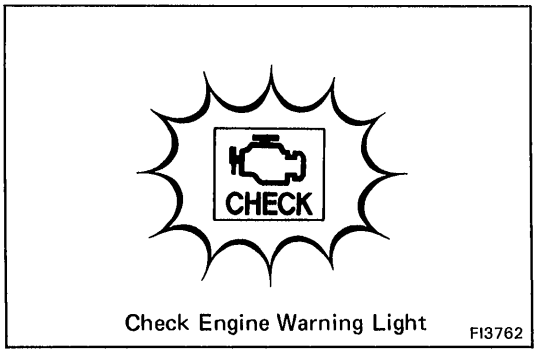
To obtain an output of diagnostic codes, proceed as follows:

1. Initial conditions
   (a) Battery voltage above 11 volts
   (b) Throttle valve fully closed (throttle position sensor IDL points closed)
   (c) Transmission in neutral position
   (d) Accessory switches OFF
2. Turn the ignition switch to ON. Do not start the engine.
3. Using SST, connect terminals T_{E1} and E_1 of the check connector.

   SST 09843-18020

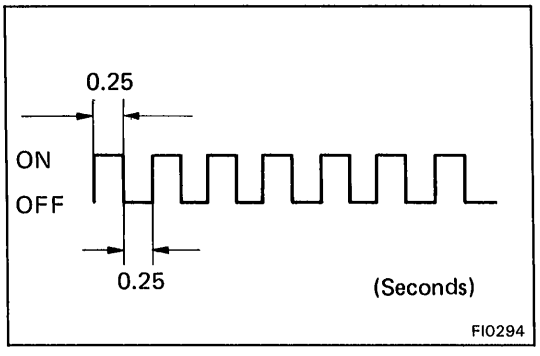
   HINT: The check connector is located near the No.2 relay block.





Check Engine Warning Light FI3762

4. Read the diagnosis code as indicated by the number of flashes of the "CHECK ENGINE" warning light.

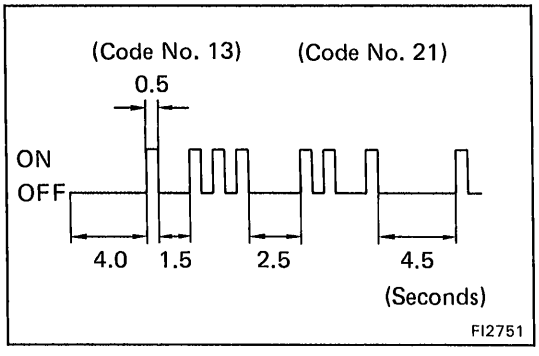


FI0294

Diagnosis code (See pages FI-128,129)

(a) Normal System Operation

The light will blink 2 times per second.



FI2751

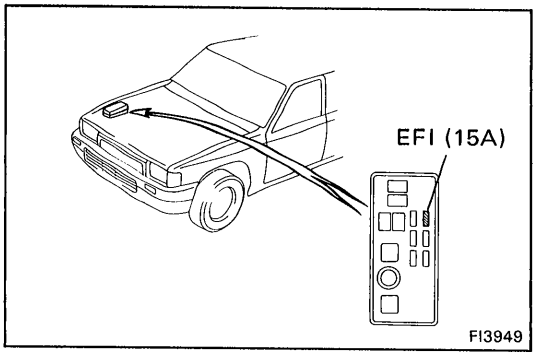
(b) Malfunction Code Indication

- The light will blink a number of times equal to the malfunction code indication as follows:
  1. Between the first digit and second digit, 1.5 seconds.
  2. Between code and code 2.5 seconds.
  3. Between all malfunction codes 4.5 seconds.

The diagnostic code series will be repeated as long as the check connector terminals T_{E1} and E_1 are connected.

HINT: In event of a number of trouble codes, indication will begin from the small value and continue to the larger in order.

5. After the diagnosis check, remove SST.



CANCELLING OUT DIAGNOSTIC CODE

1. After repair of the trouble area, the diagnostic code retained in memory by the ECU must be cancelled out by removing the fuse EFI (15A) for 30 seconds or more, depending on ambient temperature (the lower the temperature, the longer the fuse must be left out) with the ignition switch off.

   HINT:
   - Cancellation can also be done by removing the battery negative (−) terminal, but in this case other memory systems (radio clock, etc.) will also be cancelled out.
   - If the diagnostic code is not cancelled out, it will be retained by the ECU and appear along with a new code in event of future trouble.
   - If it is necessary to work on engine components requiring removal of the battery terminal, a check must first be made to see if a diagnostic code has been recorded.

2. After cancellation, road test the vehicle, if necessary, confirm that a "normal" code is now read on the "CHECK ENGINE" warning light.

   If the same diagnostic code is still indicated, it indicates that the trouble area has not been repaired thoroughly.

DIAGNOSIS INDICATION

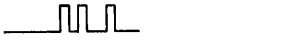
(1) Including "normal", the ECU is programmed with the following 17 (Federal and Canada), 18 (California) diagnostic codes.

(2) When 2 or more codes are indicated, the lowest number (code) will appear first.

(3) All detected diagnostic codes, except 51 and 53, will be retained in memory by the ECU from the time of detection until cancelled out.

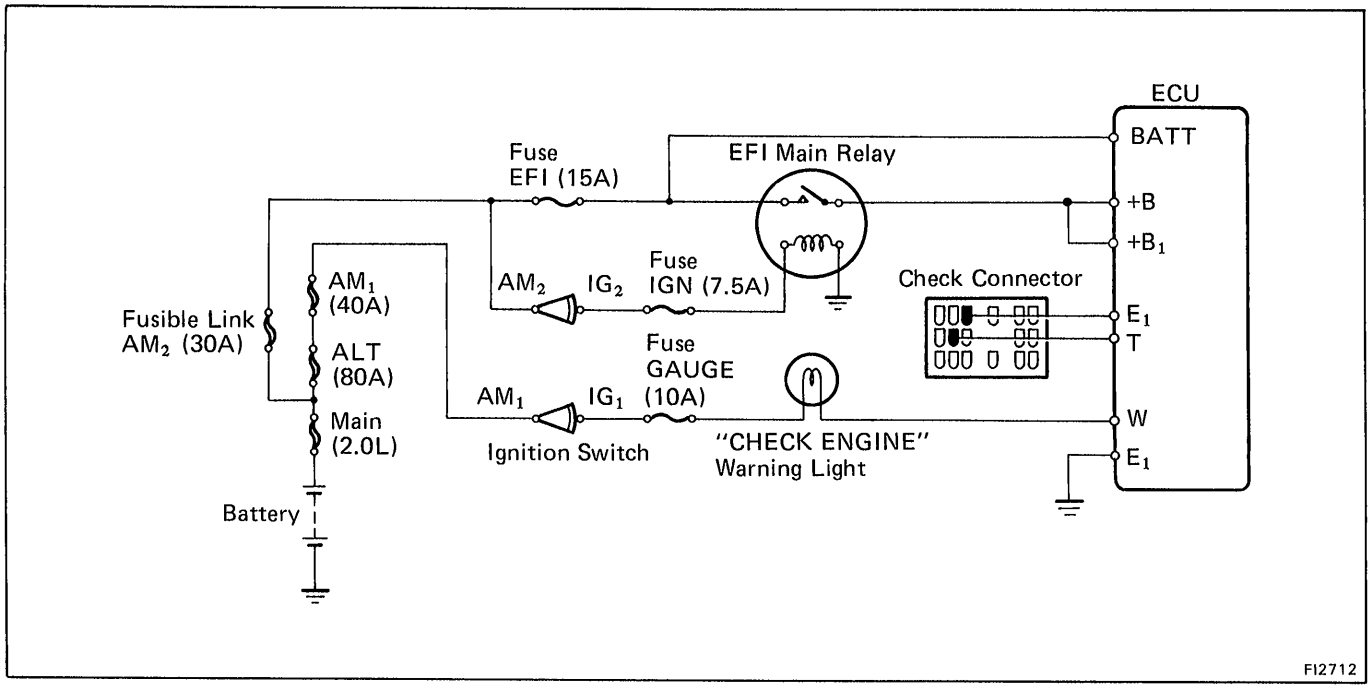
(4) Once the malfunction is cleared, the "CHECK ENGINE" warning light on the instrument panel will go out but the diagnostic code(s) remain stored in ECU memory (except for code 51 and 53).

DIAGNOSTIC CODES

Code No.	Number of blinks "CHECK ENGINE"	System	Diagnosis	Trouble area
—	 ON OFF FI1401	Normal	This appears when none of the other codes are identified.	—
12	 FI1389	RPM Signal	No "Ne and G" signal to ECU within 2 seconds after the engine is cranked.	•Distributor circuit •Distributor •Starter signal circuit •ECU
13	 FI1390	RPM Signal	No "Ne" signal to ECU when engine speed is above 1,000 rpm.	•Distributor circuit •Distributor •ECU
14	 FI1391	Ignition Signal	No "IGf" signal to ECU 6 — 8 times in succession.	•Igniter and ignition coil circuit •Igniter and ignition coil
21	 FI1400	Oxygen Sensor Signal	•Detection of oxygen sensor detrioration	•Oxygen sensor circuit •Oxygen sensor •ECU
		Oxygen Sensor Heater Signal	•Open or short circuit in oxygen sensor heater signal (HT).	•Oxygen sensor heater circuit •Oxygen sensor heater •ECU
22	 FI1392	Water Temp. Sensor Signal	•Open or short circuit in water temp. sensor signal (THW).	•Water temp. sensor circuit •Water temp. sensor •ECU
24	 FI1611	Intake Air Temp. Sensor Signal	•Open or short circuit in intake air temp. sensor signal (THA).	•Intake air temp. sensor circuit •Intake air temp. sensor •ECU
25	 FI2562	•Fuel Malfunction •Oxygen Sensor Signal	•When the air-fuel ratio feedback correction value or adaptive control valve feedback frequency is abnormally high during feedback condition. •Open circuit in oxygen sensor signal (Ox).	•Injector circuit •Injector •Fuel line pressure •Ignition system •Oxygen sensor circuit •Oxygen sensor •Air flow meter •Water temp. sensor •ECU
26	 FI2563	•Fuel Malfunction		•Injector circuit •Injector •Fuel line pressure •Cold start injector •Air flow meter •ECU
		(Federal and Canada) •Oxygen Sensor Signal		(Federal and Canada) •Oxygen sensor circuit •Oxygen sensor

Code No.	Number of blinks "CHECK ENGINE"	System	Diagnosis	Trouble area
31	 FI1394	Air Flow Meter Signal	•Open circuit in Vc signal or short circuit between Vs and E_2. •When idle contacts are closed.	•Air flow meter circuit •Air flow meter •ECU
32	 FI1395	Air Flow Meter Signal	•Open circuit in E_2 or short circuit between Vc and Vs.	•Air flow meter circuit •Air flow meter •ECU
41	 FI1396	Throttle Position Sensor Signal	•Open or short circuit in throttle position sensor signal (VTA).	•Throttle position sensor circuit •Throttle position sensor •ECU
42	 FI1397	Vehicle Speed Sensor Signal	•No "SPD" signal to ECU for 8 seconds when engine speed is between 1,500 rpm and 4,000 rpm and coolant temp. is above 80°C (176°F) except when racing the engine.	•Vehicle speed sensor circuit •Vehicle speed sensor •ECU
43	 FI1398	Starter Signal	•No "STA" signal to ECU until engine speed reaches 800 rpm with vehicle not moving.	•IG switch circuit •IG switch •ECU
52	 FI1618	Knock Sensor Signal	•Open circuit in knock sensor signal (KNK).	•Knock sensor circuit •Knock sensor •ECU
53	 FI1619	Knock Control Signal in ECU	•Knock control program faulty.	•ECU
71	(California only)  FI2622	EGR System Malfunction	•EGR gas temp. below predetermined level during EGR operation. •Open circuit EGR gas temp. sensor signal (THG).	•EGR valve •EGR hose •EGR gas temp. sensor circuit •EGR gas temp. sensor •VSV for EGR circuit •ECU
51	 FI1399	Switch Signal	•Air conditioner switch ON, idle switch OFF during diagnosis check.	•A/C switch circuit •A/C switch •A/C Amplifire •Throttle position sensor circuit •Throttle position sensor •ECU

INSPECTION OF DIAGNOSIS CIRCUIT



1. Does CHECK ENG. light come on when ignition switch is at ON?
   - YES → System Normal
   - NO → Does CHECK ENG. light come on when ECU terminal W is grounded to the body?
     - YES → Check wiring between ECU terminal E_1 and body ground.
       - OK → Try another ECU.
       - BAD → Repair or replace
     - NO → Check bulb, fuse and wiring between ECU and ignition switch.
       - BAD → Repair or replace

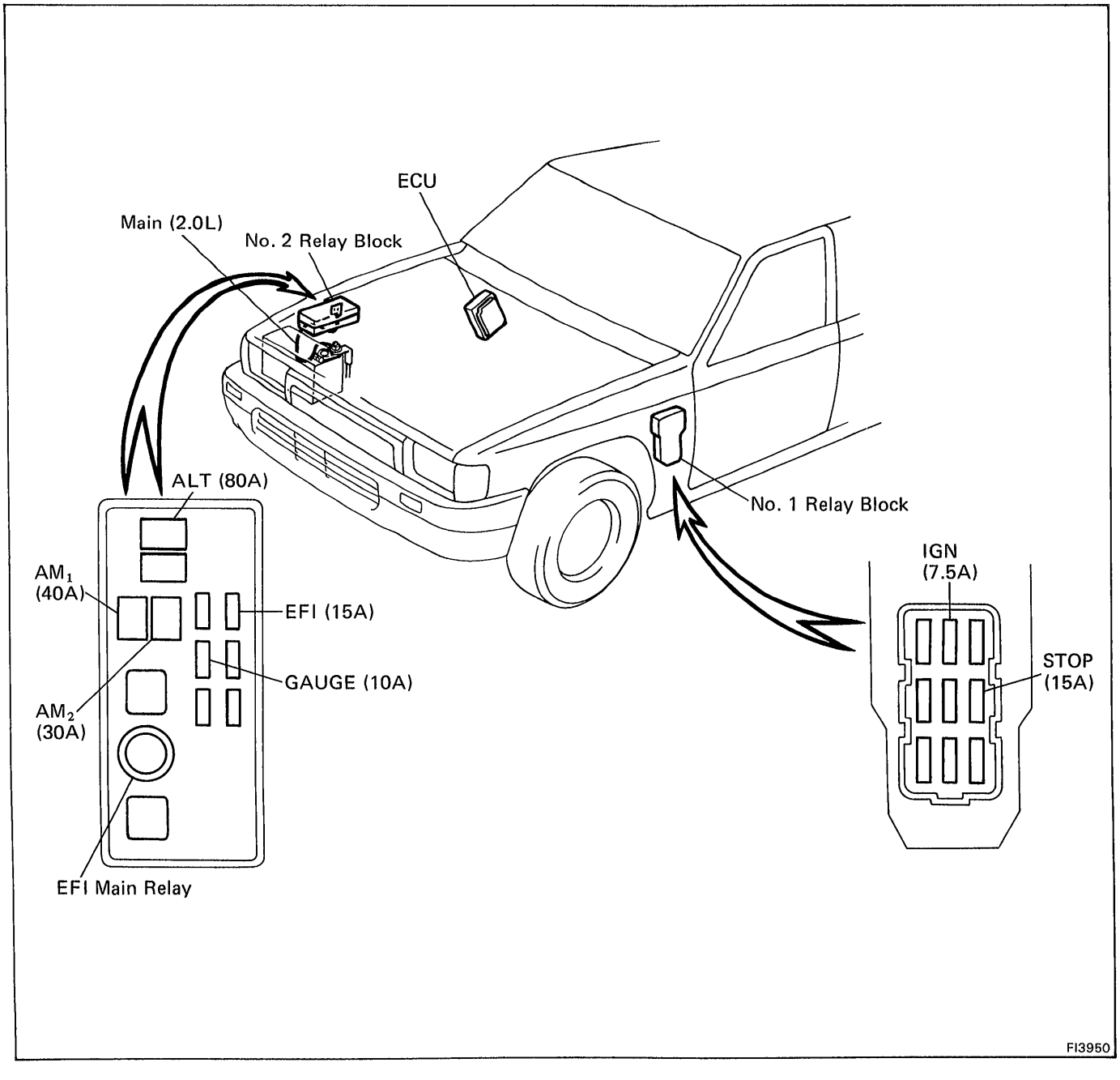
2. Does CHECK ENG. light go OFF when engine is started?
   - YES → System Normal
   - NO → Check wiring between ECU and CHECK ENG. light.
     - BAD → Repair
     - OK → Is there diagnosis code output when check connector T_{E_1} and E_1 is connect circuited?
       - NO → Try another ECU.
       - YES → Does CHECK ENG. light go out after repair according to malfunction code?
         - NO → Further repair required.
         - YES → System OK
           - NO → Cancel out diagnostic code.

TROUBLESHOOTING FOR EFI ELECTRONIC CIRCUIT WITH VOLT/OHMMETER

HINT: Because the following troubleshooting procedures are designed for inspection of each separate system, the actual troubleshooting procedure may vary somewhat.
However, please refer to these procedures and perform actual troubleshooting, conforming to the inspection methods described.
For example, it is better to first make a simple check of the fuses, fusible links and connecting condition of the connectors before making your inspection according to the procedures listed.

The following troubleshooting procedures are based on the supposition that the trouble lies in either a short or open circuit in a component outside the computer or a short circuit within the computer. If engine trouble occurs even though proper operating voltage is detected in the computer connector, then the ECU is faulty and should be replaced.

LOCATION OF FUSES AND FUSIBLE LINKS



PREPARATION

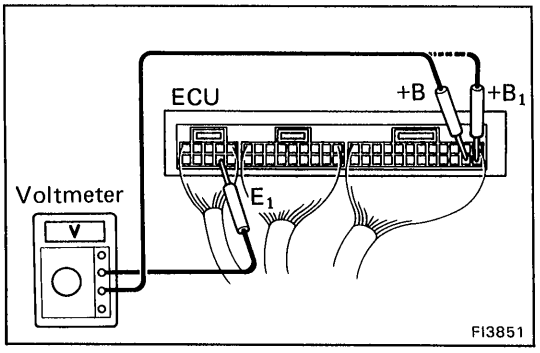
1. Remove the right kick panel.
2. Remove the ECU with wire harness.

EFI SYSTEM CHECK PROCEDURE

HINT:

- The EFI circuit can be checked by measuring the voltage at the wiring connectors of the ECU.
- Perform all voltage measurements with the connectors connected.
- Verify that the battery voltage is 11V or above when the ignition switch is ON.

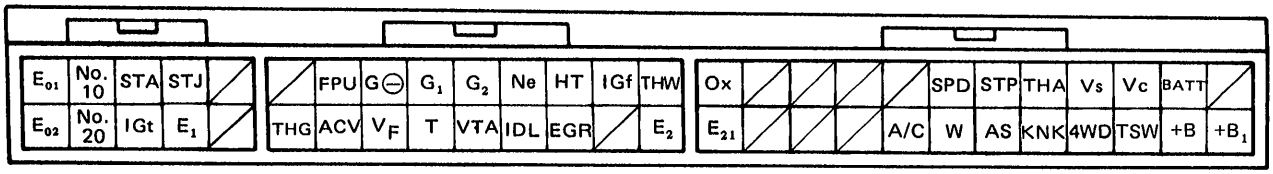
Using a voltmeter with high-impedance (10 k /V minimum), measure the voltage at each terminal of the wiring connector.



Connectors of ECU (M/T)

Symbol	Terminal name	Symbol	Terminal name	Symbol	Terminal name
E_{01}	ENGINE GROUND	T	CHECK CONNECTOR	SPD	SPEEDOMETER
E_{02}	ENGINE GROUND	G_2	DISTRIBUTOR	W	WARNING LIGHT
No. 10	INJECTOR	VTA	THROTTLE POSITION SENSOR	STP	STOP LIGHT SWITCH
No. 20	INJECTOR	Ne	DISTRIBUTOR	AS	VSV (for AS)
STA	IGNITION SWITCH	IDL	THROTTLE POSITION SENSOR	THA	AIR TEMP. SENSOR
IGt	IGNITER	HT	OXYGEN SENSOR HEATER	KNK	KNOCK SENSOR
STJ	COLD START INJECTOR	EGR	VSV (for EGR)	Vs	AIR FLOW METER
E_1	ENGINE GROUND	IGf	IGNITER	*2 4WD	4WD SWITCH
*1 THG	EGR GAS TEMP. SENSOR	THW	WATER TEMP. SENSOR	Vc	AIR FLOW METER
FPU	VSV (for FPU)	E_2	SENSOR EARTH	TSW	WATER TEMP. SWITCH
ACV	VSV (for A/C)	Ox	OXYGEN SENSOR	BATT	BATTERY +B
G ⊖	DISTRIBUTOR	E_{21}	SENSOR EARTH	+B	MAIN RELAY
VF	CHECK CONNECTOR	E_{11}	ENGINE GROUND	$+B_1$	MAIN RELAY
G_1	DISTRIBUTOR	A/C	A/C MAGNETIC SWITCH		

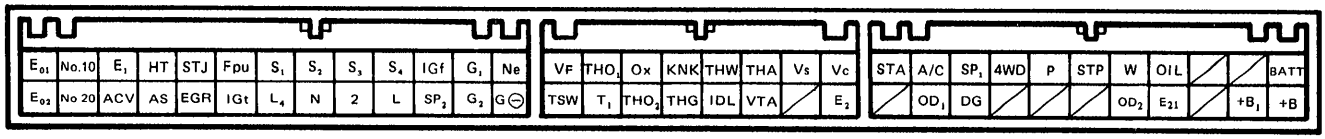
*1 : California only *2 : 4WD only



Connectors of ECU (A/T)

Symbol	Terminal name	Symbol	Terminal name	Symbol	Terminal name
E_{01}	ENGINE GROUND	L	NEUTRAL START SWITCH	Vs	AIR FLOW METER
E_{02}	ENGINE GROUND	IGf	IGNITER	Vc	AIR FLOW METER
No.10	INJECTOR	SP_2	SPEED SENSOR	E_2	SENSOR GROUND
No.20	INJECTOR	G_1	DISTRIBUTER	STA	STARTER SWITCH
E_1	ENGINE GROUND	G_2	DISTRIBUTER	A/C	COMPRESSOR SWITCH
ACV	VSV (for A/C)	Ne	DISTRIBUTER	OD_1	CRUISE CONTROL COMPUTER
HT	OXYGEN SENSOR HEATER	G⊖	DISTRIBUTER	SP_1	SPEED SENSOR
AS	VSV (for AS)	VF	CHECK CONNECTOR	DG	CHECK CONNECTOR
STJ	COLD START INJECTOR	TSW	WATER TEMP. SWITCH	*14WD	4WD SWITCH
EGR	VSV (for EGR)	*1THO_1	T/M OIL TEMP. SENSOR	P	PATTERN SELECT SWITCH
Fpu	VSV (for FPU)	T_1	CHECK CONNECTOR	STP	STOP LIGHT SWITCH
IGt	IGNITER	Ox	OXYGEN SENSOR	W	CHECK ENGINE WARNING LIGHT
S_1	ECT SOLENOID	*1THO_2	T/M OIL TEMP. SENSOR	OD_2	CRUISE CONTROL COMPUTER
*1 L_4	TRANSFER POSITION SWITCH	KNK	KNOCK SENSOR	*1OIL	A/T OIL TEMP. WARNING LIGHT
S_2	ECT SOLENOID	*2THG	EGR GAS TEMP. SENSOR	E_{21}	SENSOR GROUND
N	NEUTRAL START SWITCH	THW	WATER TEMP. SENSOR	$+B_1$	MAIN RELAY
S_3	ECT SOLENOID	IDL	THROTTLE POSITION SENSOR	BATT	BATTERY +B
2	NEUTRAL START SWITCH	THA	AIR TEMP. SENSOR	+B	MAIN RELAY
*1 S_4	ECT SOLENOID	VTA	THROTTLE POSITION SENSOR		

*1 : 4WD only *2 : California only



FI2796

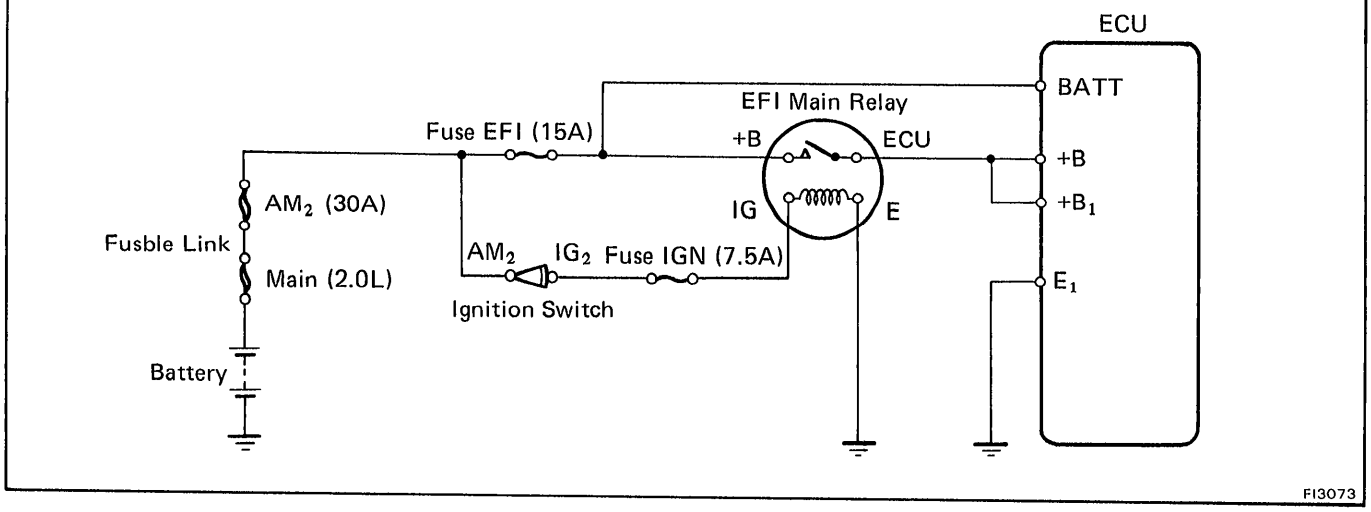
Voltages at ECU wiring connectors (M/T)

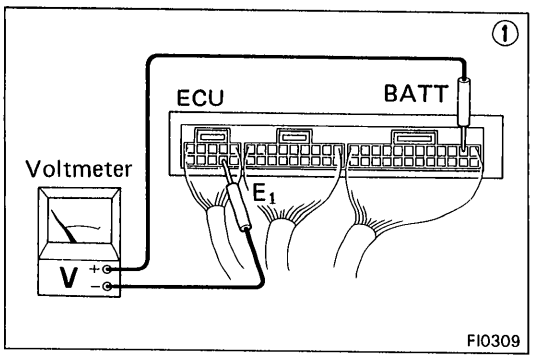
No.	Terminals	Condition		STD voltage	See page
1	BATT — E_1	—		10 — 14	FI-136
	+B — E_1	Ignition SW ON			
	$+B_1$ — E_1				
2	IDL — E_2 (E_{21})	Ignition SW ON	Throttle valve open	8 — 14	FI-138
	Vc — E_2 (E_{21})		—	4 — 6	
	VTA — E_2 (E_{21})		Throttle valve fully closed	0.1 — 1.0	
			Throttle valve fully opened	3 — 5	
3	Vc — E_2 (E_{21})	Ignition SW ON	—	4 — 6	FI-140
	Vs — E_2 (E_{21})		Measuring plate fully closed	3.7 — 4.3	
			Measuring plate fully open	0.2 — 0.5	
		Idling		2.3 — 2.8	
	THA — E_2 (E_{21})	IG SW ON	Intake air temperature 20°C (68°F)	1 — 3	
4	THW — E_2 (E_{21})	IG SW ON	Coolant temperature 80°C (176°F)	0.1 — 1.0	FI-142
5	STA — E_1	Ignition SW ST position		6 — 12	FI-143
6	No.10 — E_{01} No.20 — E_{02}	Ignition SW ON		10 — 14	FI-144
7	IGt — E_1	Cranking or idling		0.7 — 1.0	FI-145
8	W — E_1	No trouble (CHECK ENGINE light off) and engine running		10 — 14	FI-146
9	STJ — E_1	Ignition SW ST position	Coolant temperature 80°C (176°F)	6 — 12	FI-147
10	STP — E_1	Stop light switch ON		10 — 14	FI-148

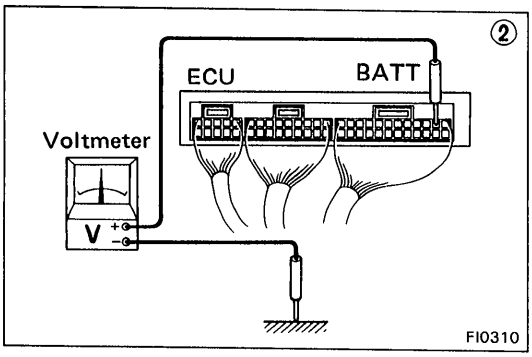
Voltages at ECU wiring connectors (A/T)

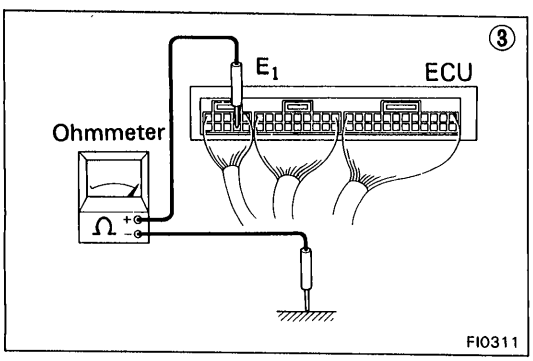
No.	Terminals	Condition		STD voltage	See page
11	BATT — E_1	—		10 — 14	FI-152
	+B — E_1	Ignition SW ON			
	$+B_1$ — E_1				
12	IDL — E_2 (E_{21})	Ignition SW ON	Throttle valve open	8 — 14	FI-154
	Vc — E_2 (E_{21})		—	4 — 6	
	VTA — E_2 (E_{21})		Throttle valve fully closed	0.1 — 1.0	
			Throttle valve fully opened	3 — 5	
13	Vc — E_2 (E_{21})	Ignition SW ON	—	4 — 6	FI-156
	Vs — E_2 (E_{21})		Measuring plate fully closed	3.7 — 4.3	
			Measuring plate fully open	0.2 — 0.5	
		Idling		2.3 — 2.8	
	THA — E_2 (E_{21})	IG SW ON	Intake air temperature 20°C (68°F)	1 — 3	
14	THW — E_2 (E_{21})	IG SW ON	Coolant temperature 80°C (176°F)	0.1 — 1.0	FI-158
15	STA — E_1	Ignition SW ST position		6 — 12	FI-159
16	No.10 — E_{01} No.20 — E_{02}	Ignition SW ON		10 — 14	FI-160
17	IGt — E_1	Cranking or idling		0.7 — 1.0	FI-161
18	W — E_1	No trouble (CHECK ENGINE light off) and engine running		10 — 14	FI-162
19	STJ — E_1	Ignition SW ST position	Coolant temperature 80°C (176°F)	6 — 12	FI-163
20	STP — E_1	Stop light switch ON		8 — 14	FI-164

No.	Terminals	Trouble	Condition	STD Voltage
1	BATT – E_1	No voltage	–	10 – 14 V
	+B – E_1		Ignition switch ON	
	$+B_1$ – E_1			









- **BATT – E_1**

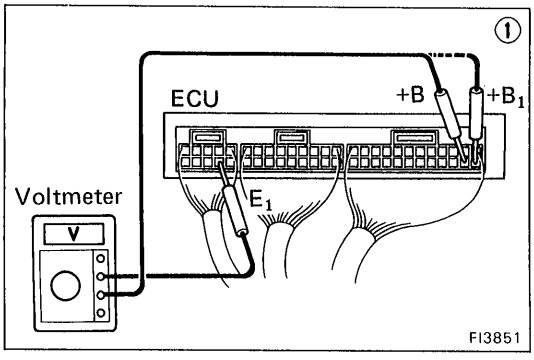
① There is no voltage between ECU terminals BATT and E_1.

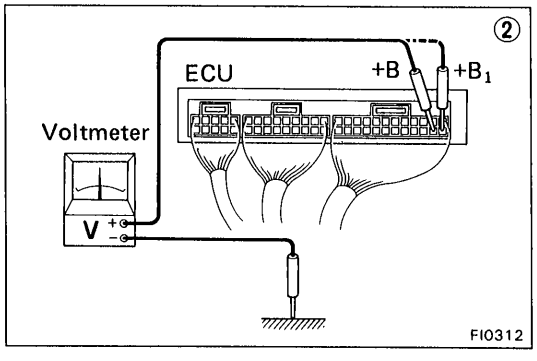
② Check that there is voltage between ECU terminal BATT and body ground.

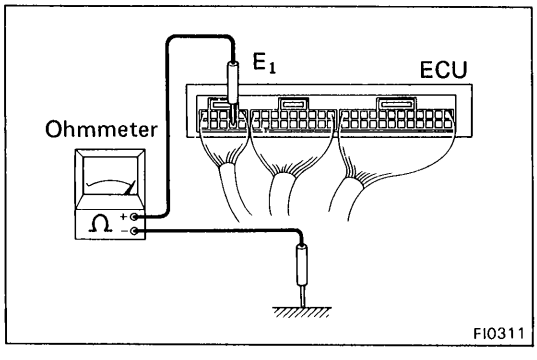
NO → ③ Check wiring between ECU terminal E_1 and body ground.
- OK → Try another ECU.
- BAD → Repair or replace

OK → Check fuse and fusible link.
- BAD → Replace

OK → Check wiring between fuse and ECU.
- BAD → Repair or replace







● **+B (+B_1) – E_1**

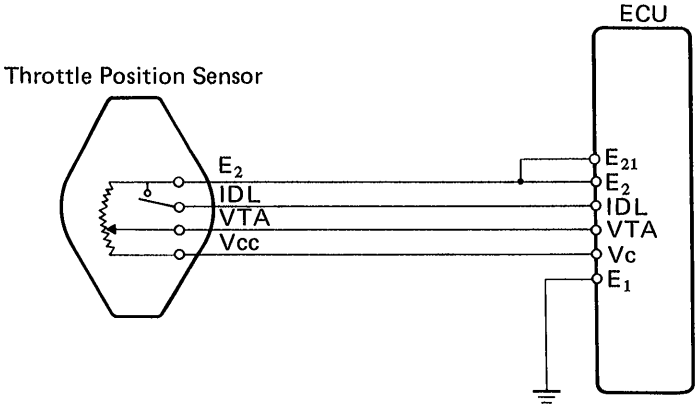
① There is no voltage between ECU terminals +B (+B_1) and E_1. **(IG SW ON)**

② Check that there is voltage between ECU terminal +B (+B_1) and body ground. **(IG SW ON)**

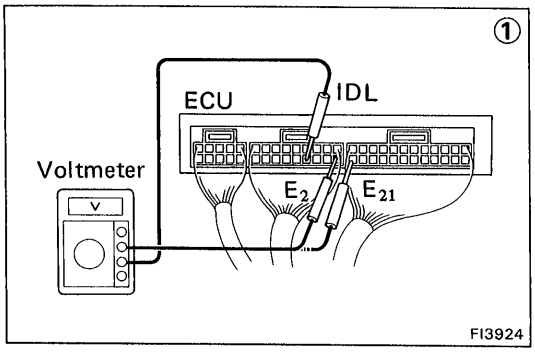
NO → Check fuse, fusible link and ignition switch.
- BAD → Repair or replace
- OK → Check EFI main relay.
  - BAD → Replace
  - OK → Check wiring between EFI main relay and battery.
    - BAD → Repair or replace
    - OK → Check wiring between EFI main relay and ECU terminal +B (+B_1).
      - BAD → Repair or replace

OK → ③ Check wiring between ECU terminal E_1 and body ground.
- OK → Try another ECU.
- BAD → Repair or replace

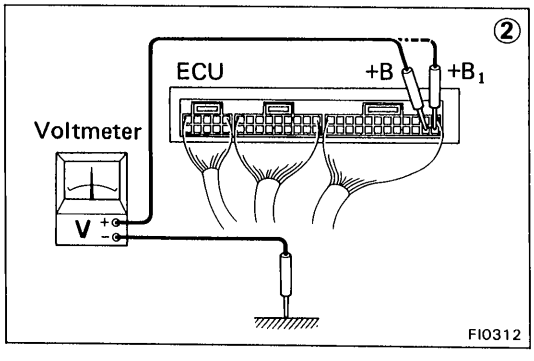
No.	Terminals	Trouble	Condition		STD Voltage
2	IDL – E_2 (E_{21})	No voltage	Ignition switch ON	Throttle valve open	8 – 14 V
	Vc – E_2 (E_{21})			–	4 – 6 V
	VTA – E_2 (E_{21})			Throttle valve fully closed	0.1 – 1.0 V
				Throttle valve fully open	3 – 5 V



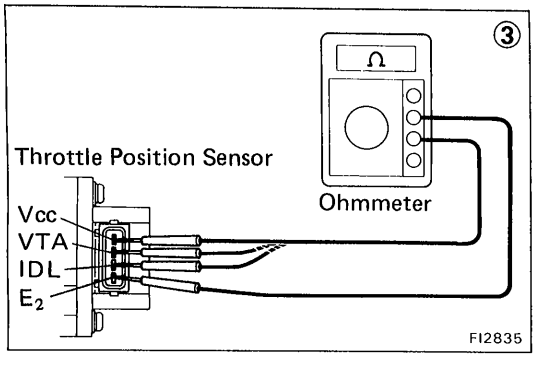
FI3877



FI3924



FI0312



FI2835

● IDL – E_2

① There is no voltage between ECU terminals IDL and E_2 (E_{21}). **(IG SW ON)** (Throttle valve open)

② Check that there is voltage between ECU terminal $+B_1$ (+B) and body ground. **(IG SW ON)**

② NO → Refer to No. 1 → BAD → Replace or repair.

② OK → Check wiring between ECU terminals E_1 and body ground.

Check wiring between ECU terminals E_1 and body ground. OK → ③ Check throttle position sensor.

Check wiring between ECU terminals E_1 and body ground. BAD → Replace or repair.

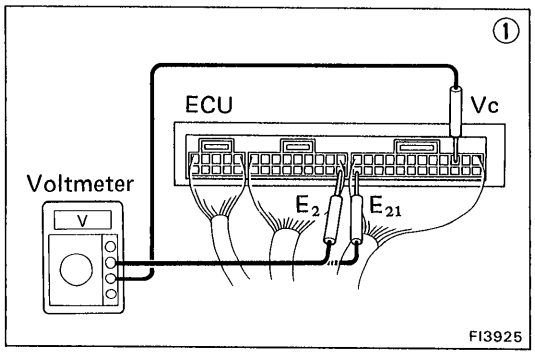
Refer to No. 1 OK → ③ Check throttle position sensor.

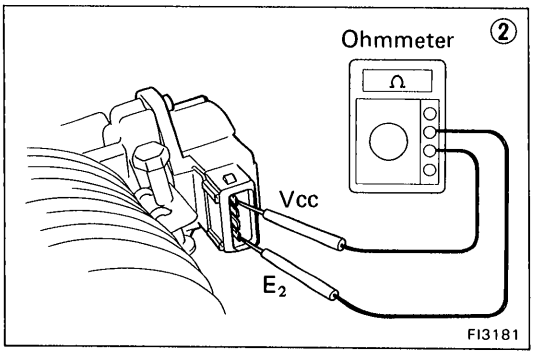
③ Check throttle position sensor. BAD → Replace or repair throttle position sensor.

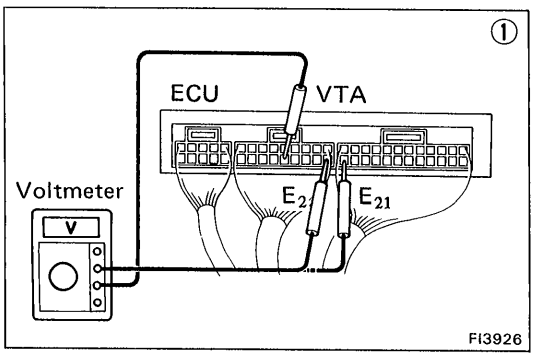
③ Check throttle position sensor. OK → Check wiring between ECU and throttle position sensor.

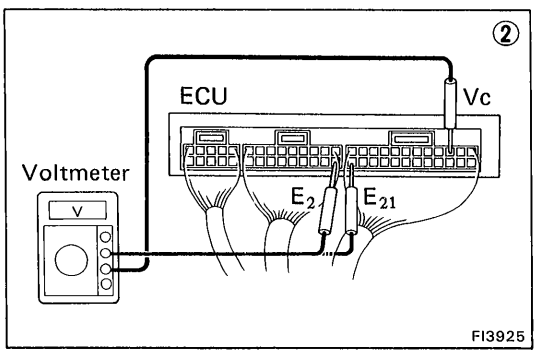
Check wiring between ECU and throttle position sensor. BAD → Replace or repair.

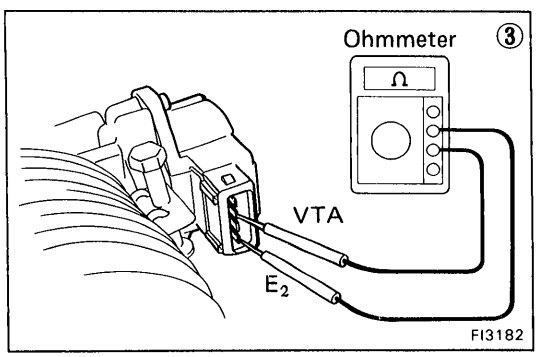
Check wiring between ECU and throttle position sensor. OK → Try another ECU.











- **Vc – E_2 (E_{21})**

① There is no voltage between ECU terminals Vc and E_2 (E_{21}). **(IG SW ON)**

↓

Check that there is voltage between ECU terminals $+B_1$ (+B) and E_1. **(IG SW ON)**

↓ OK — NO → Refer to No. 1.

↓

② Check throttle position sensor.

↓ BAD — OK →

Repair or replace.

Check wiring between ECU and throttle position sensor.

↓ OK — BAD →

Try another ECU.

Repair or replace wiring.

- **VTA – E_2 (E_{21})**

① There is no specified voltage between ECU terminals VTA and E_2 (E_{21}). **(IG SW ON)**

↓

② Check that there is voltage between ECU terminals Vc and E_2 (E_{21}). **(IG SW ON)**

↓ OK — NO →

Perform inspection of Vc – E_2 (E_{21})

↓

③ Check throttle position sensor. — BAD → Repair or replace.

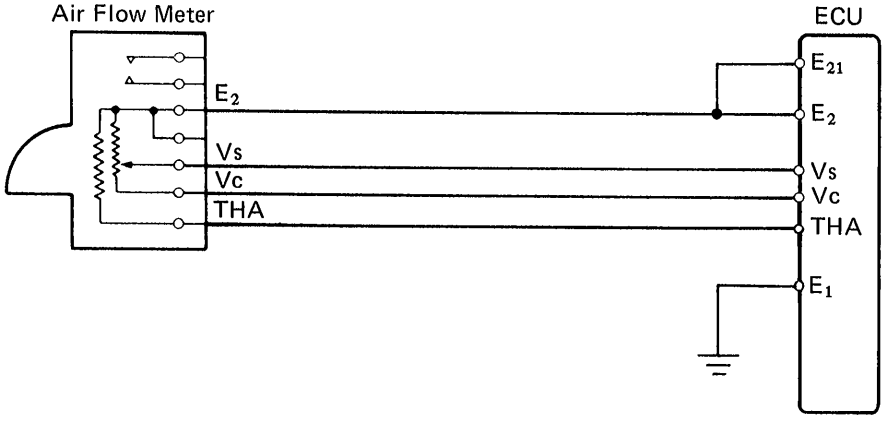
↓ OK

Check wiring between ECU and throttle position sensor. — BAD → Repair or replace.

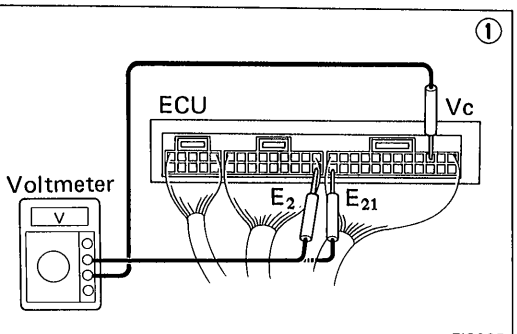
↓ OK

Try another ECU.

No.	Terminal	Trouble	Condition		STD Voltage
3	Vc – E_2 (E_{21})	No voltage	Ignition SW ON	–	4 – 6 V
	Vs – E_2 (E_{21})			Measuring plate fully closed	0.2 – 0.5 V
				Measuring plate fully open	3.7 – 4.3 V
			Idling		2.3 – 2.8 V
	THA – E_2 (E_{21})		IG SW ON	Intake air temperature 20°C (68°F)	1 – 3 V



FI3927



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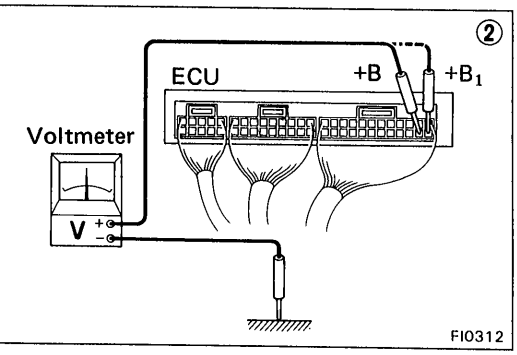
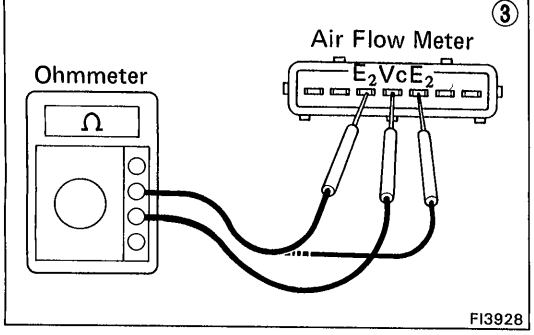


FI0312



FI3928

● **Vc – E_2 (E_{21})**

① There is no specified voltage between ECU terminals Vc and E_2 (E_{21}). **(IG SW ON)**

↓

② Check that there is voltage between ECU terminal +B (+B_1) and body ground. **(IG SW ON)**

OK → ↓

NO → Refer to section 1.

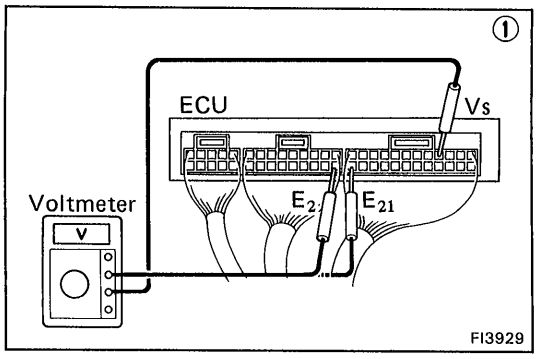
③ Check air flow meter.

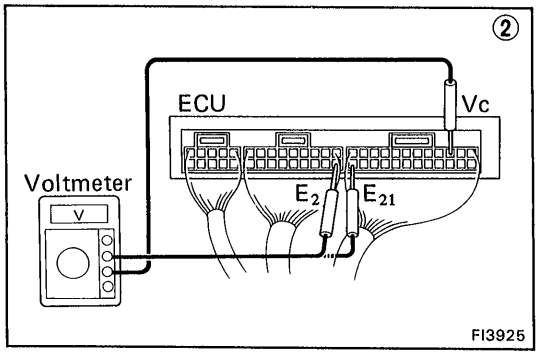
NO → Replace or repair air flow meter.

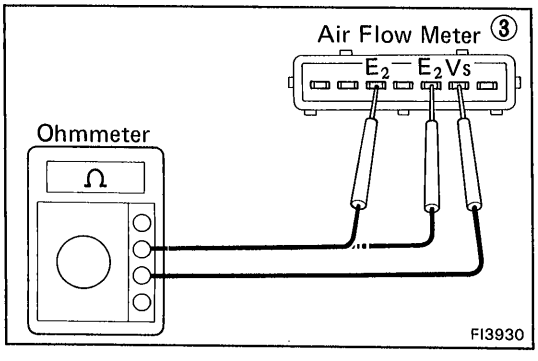
OK → Check wiring between ECU and air flow meter.

OK → Try another ECU.

NO → Replace or repair wiring.







- **Vs – E_2 (E_{21})**

① There is no specified voltage between ECU terminals Vs and E_2 (E_{21}). **(IG SW ON)**

↓

② Check that there is voltage between ECU terminals Vc and E_2 (E_{21}). **(IG SW ON)**

OK ↓ / NO → Refer to Vc – E_2(E_{21}) → BAD → Repair or replace

↓

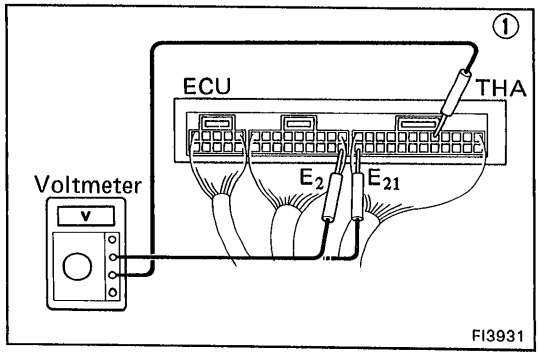
③ Check air flow meter. → BAD → Repair or replace

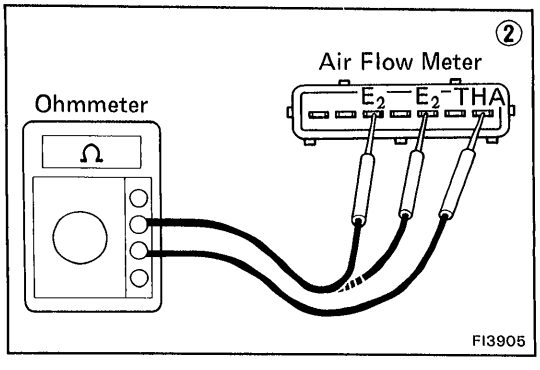
OK ↓

Check wiring between ECU and air flow meter. → BAD → Repair or replace

OK ↓

Try another ECU.





- **THA – E_2 (E_{21})**

① There is no voltage between ECU terminals THA and E_2 (E_{21}). **(IG SW ON)**

↓

Check that there is voltage between ECU terminal +B (+B_1) and body ground. **(IG SW ON)**

OK ↓ / NO → Refer to No. 1.

② Check air temp. sensor.

BAD ↓ / OK →

Replace air flow meter.

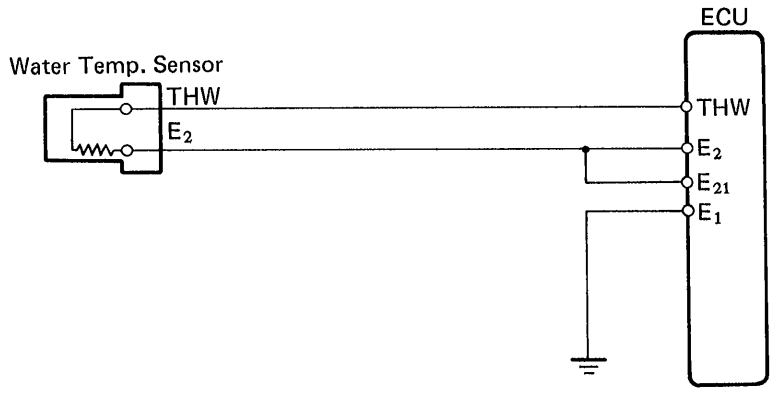
Check wiring between ECU and air temp. sensor.

OK ↓ / BAD →

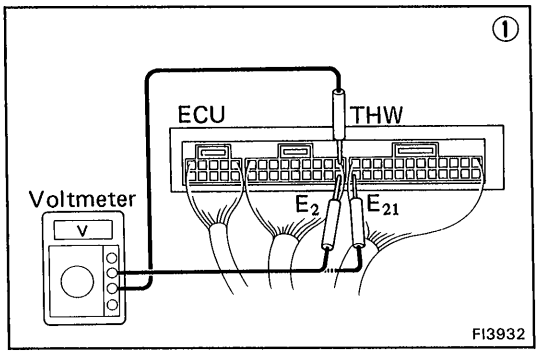
Try another ECU.

Repair or replace wiring.

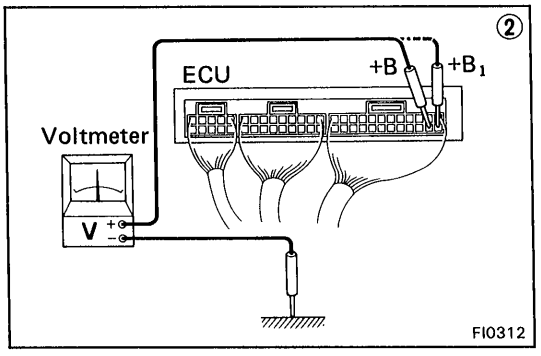
No.	Terminals	Trouble	Condition		STD Voltage
4	THW – E_2 (E_{21})	No voltage	Ignition switch ON	Coolant temperature 80°C (176°F)	0.1 – 1.0 V



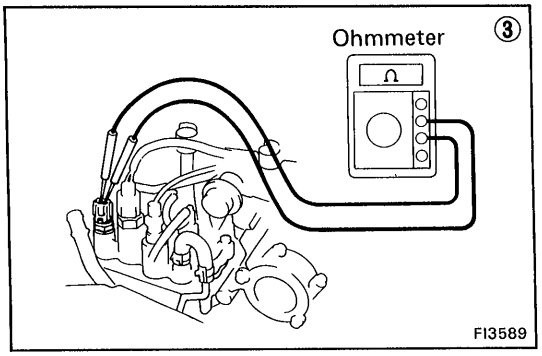
FI3887



FI3932



FI0312



FI3589

① There is no voltage between ECU terminals THW and E_2 (E_{21}). **(IG SW ON)**

↓

② Check that there is voltage between ECU terminal +B (+B_1) and body ground. **(IG SW ON)**

OK ↓

NO → Refer to No. 1.

↓

Check wiring between ECU terminal E_1 and body ground.

OK ↓

BAD → Repair or replace.

↓

③ Check water temp. sensor.

BAD → Replace water temp. sensor.

↓

OK → Check wiring between ECU and water temp. sensor.

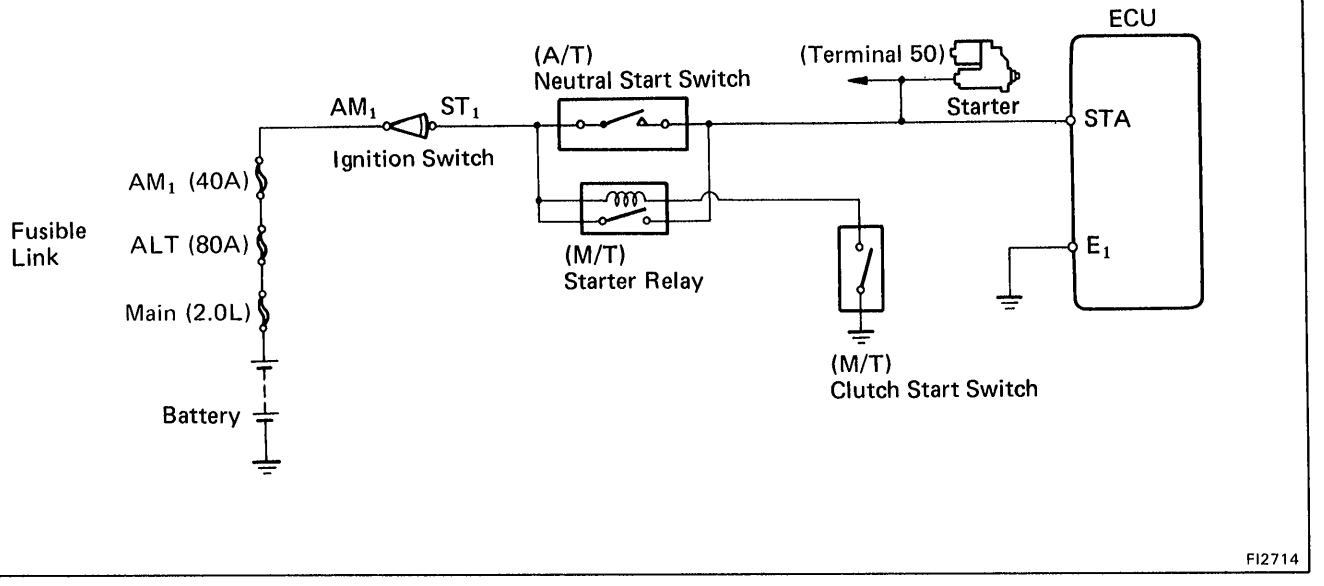
OK ↓

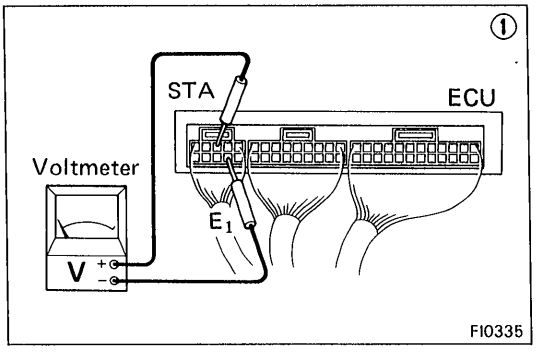
BAD → Repair or replace.

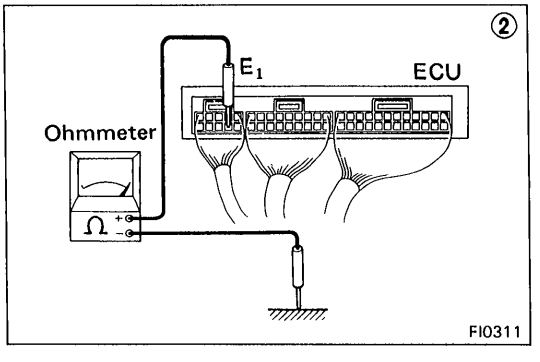
↓

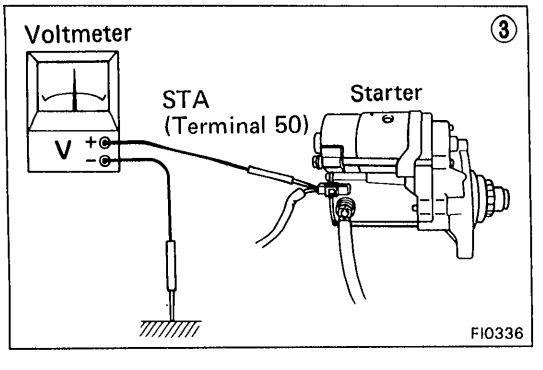
Try another ECU.

No.	Terminals	Trouble	Condition	STD Voltage
5	STA – E_1	No voltage	Ignition switch ST position	6 – 12 V





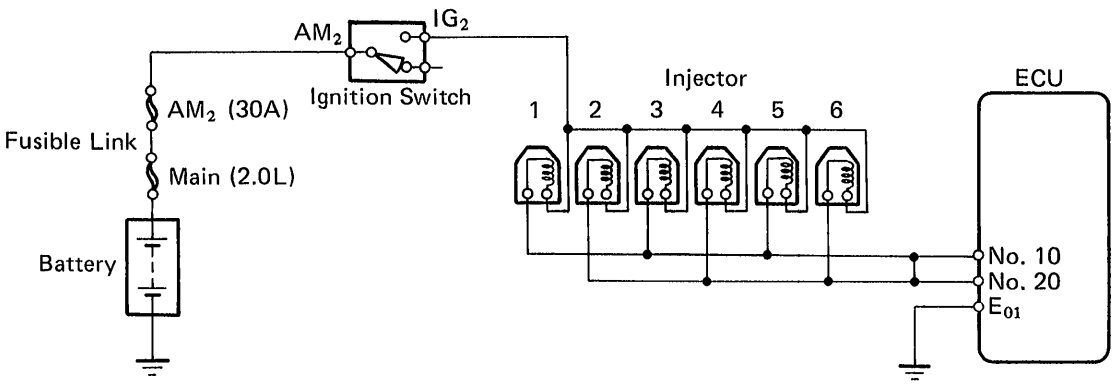




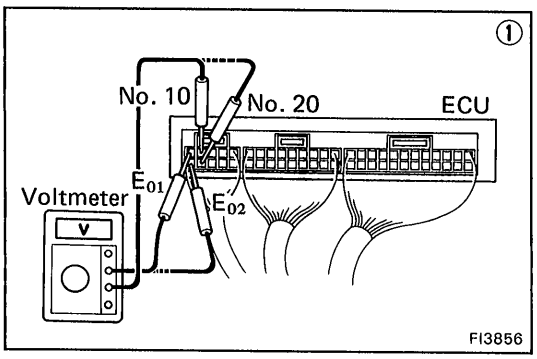
① There is no voltage between ECU terminals STA and E_1. **(IG SW ST)**

Check starter operation.
- OK → Check wiring between ECU terminal STA and starter terminal 50.
  - OK → ② Check wiring between ECU terminal E_1 and body ground.
    - BAD → Repair or replace
  - BAD → Repair or replace
- BAD → Check fusible link, battery, wiring and ignition switch.
  - BAD → Repair or replace
  - OK → ③ Check that there is voltage at STA (50) terminal of starter. **(IG SW ST)** **STD voltage: 6 – 12 V**
    - OK → Check starter.
    - NO → Check wiring between ignition switch ST terminal and starter STA (50) terminal.

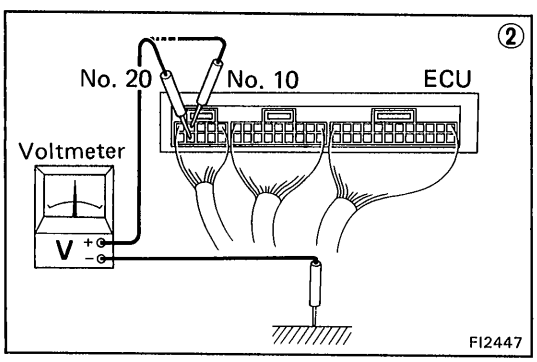
No.	Terminals	Trouble	Condition	STD Voltage
6	No. 10 — E_{01} No. 20 — E_{02}	No voltage	Ignition switch ON	10 – 14 V



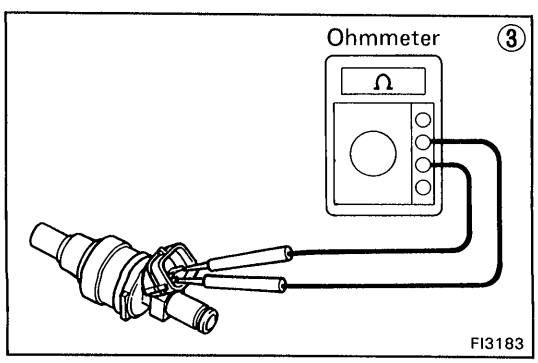
FI3716



FI3856



FI2447



FI3183

① There is no voltage between ECU terminals No. 10 and/or No. 20 and E_{01} and/or E_{02}. **(IG SW ON)**

② Check that there is voltage between ECU terminal No. 10 and/or No. 20 and body ground.

NO

OK

Check wiring between ECU terminal E_{01} and/or E_{02} and body ground.

OK → Try another ECU.

BAD → Repair or replace.

Check fusible link and ignition switch.

BAD → Repair or replace.

OK

③ Check resistance of magnetic coil in each injector.
STD resistance: 13.4 – 14.2 Ω

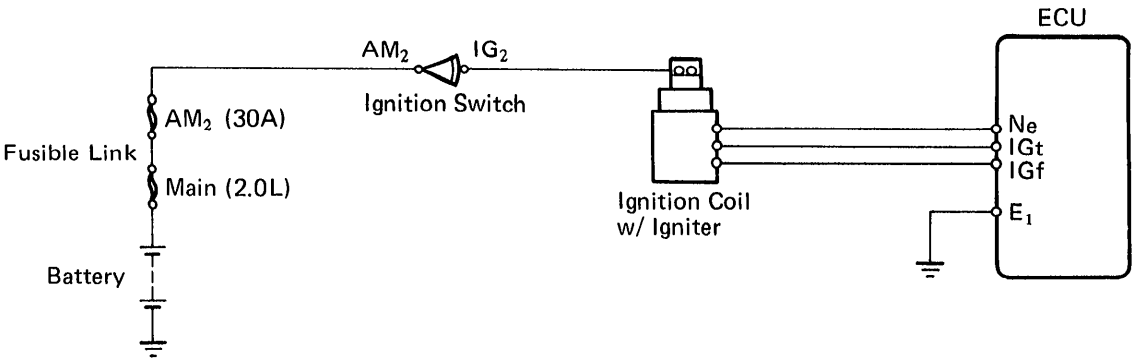
OK

BAD → Replace injector.

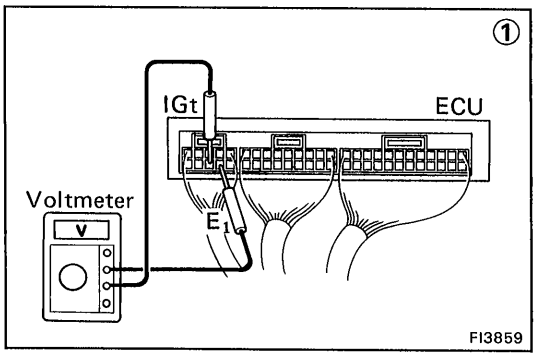
Check wiring between ECU terminal No. 10 and/or No. 20 and battery.

BAD → Repair or replace.

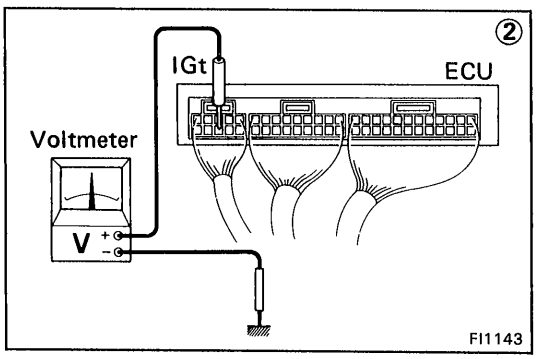
No.	Terminals	Trouble	Condition	STD Voltage
7	IGt – E_1	No voltage	Cranking or Idling	0.7 – 1.0 V



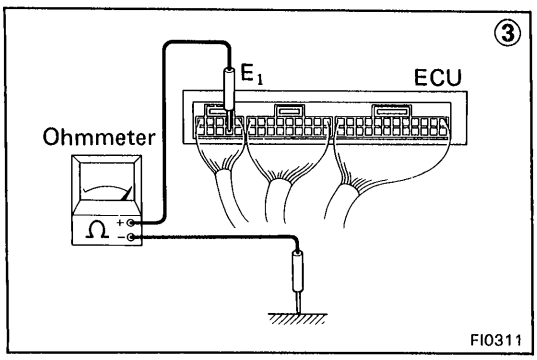
FI3489



FI3859



FI1143



FI0311

① There is no voltage between ECU terminals IGt and E_1. **(Idling)**

↓

② Check that there is voltage between ECU terminal IGt and body ground. **(Idling)**

NO → ↓

OK → ③ Check wiring between ECU terminal E_1 and body ground.

③ → BAD → Repair or replace.

↓

Refer to No. 1. → BAD → Repair or replace.

OK ↓

Check wiring between igniter and distributor. → BAD → Repair or replace.

OK ↓

Check distributor. → BAD → Replace.

OK ↓

Check wiring between ECU and igniter. → BAD → Repair or replace.

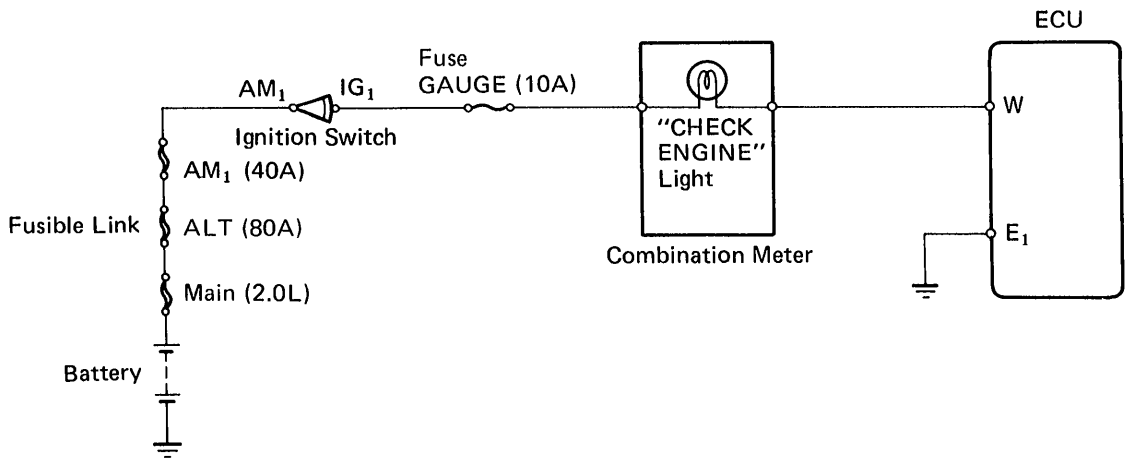
OK ↓

Check igniter. → BAD → Repair or replace.

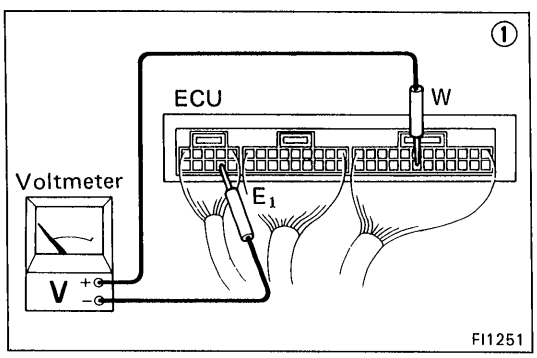
OK ↓

Try another ECU.

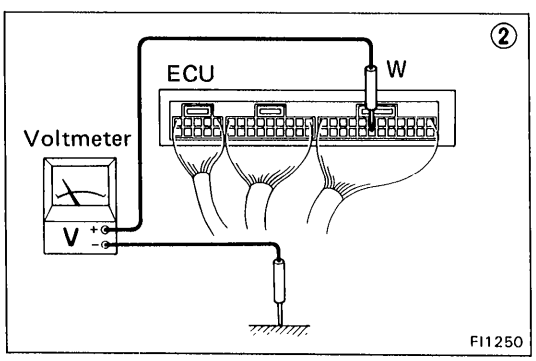
No.	Terminals	Trouble	Condition	STD Voltage
8	W – E_1	No voltage	No trouble (CHECK ENGINE light off) and engine running	10 – 14 V



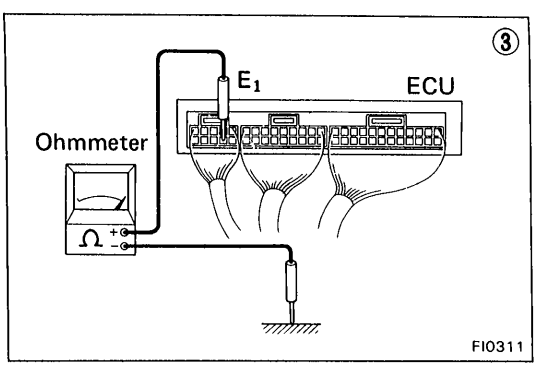
FI2717



FI1251



FI1250



FI0311

① There is no voltage between ECU terminals W and E_1. **(Idling)**

↓

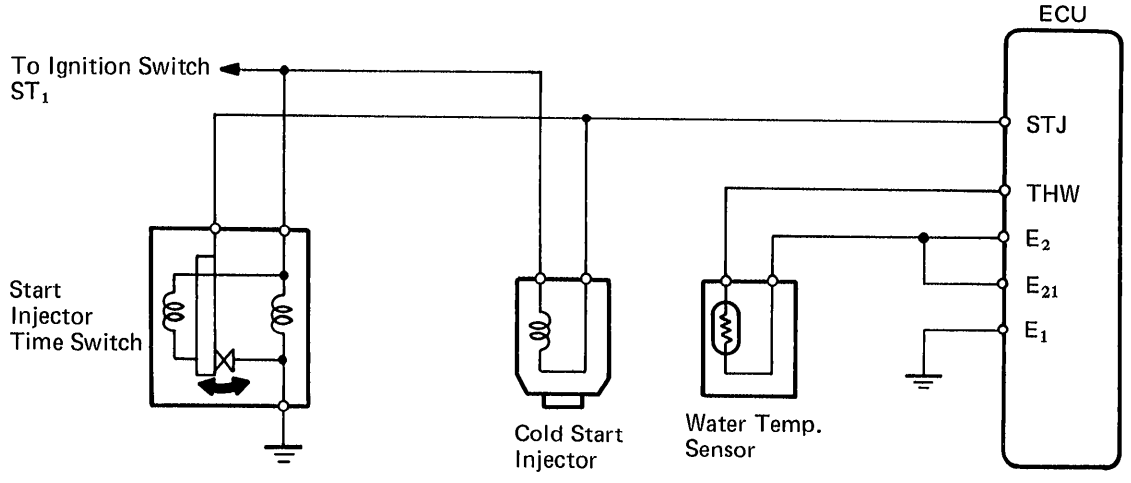
② Check that there is voltage between ECU terminal W and body ground.

NO → ③ Check wiring between ECU terminal E_1 and body ground.
- OK → Try another ECU.
- BAD → Repair or replace.

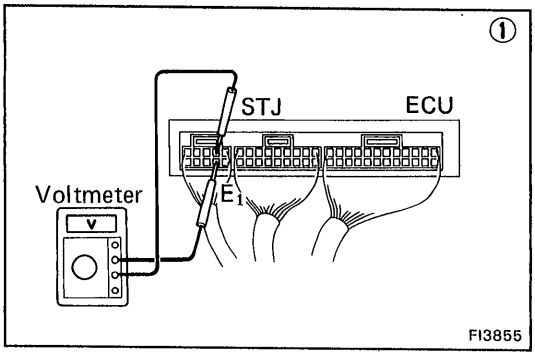
OK → Check GAUGE fuse (10A) and CHECK ENGINE light.
- BAD → Repair or replace.

OK → Check wiring between ECU terminal W and CHECK ENGINE light.
- BAD → Repair or replace.

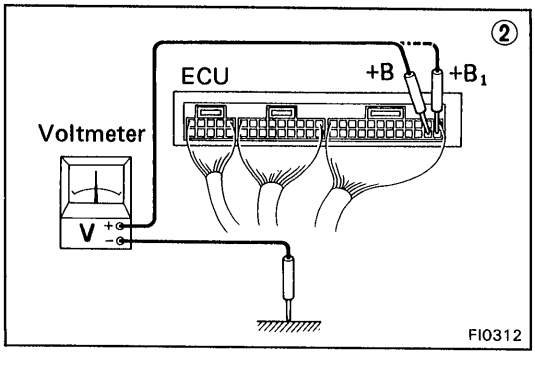
No.	Terminals	Trouble	Condition		STD Voltage
9	STJ – E_1	No voltage	Ignition switch ST position	Coolant temperature 80°C (176°F)	6 – 12 V



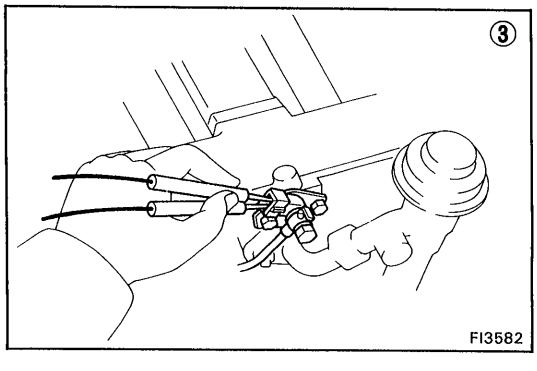
FI3893



FI3855



FI0312



FI3582

① There is no voltage between ECU terminals STJ and E_1. **(IG SW ON)**

② Check that there is voltage between ECU terminal +B (+B_1) and body ground. **(IG SW ON)**

OK → ③ Check cold start injector.

NO → Refer to No. 1.

③ BAD → Replace cold start injector

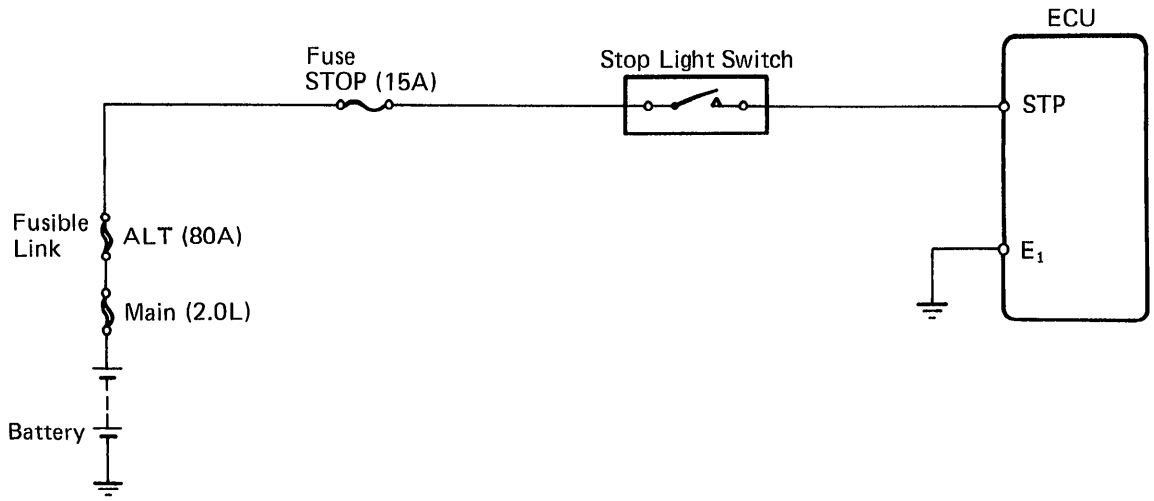
③ OK → Check wiring between ECU and cold start injector.

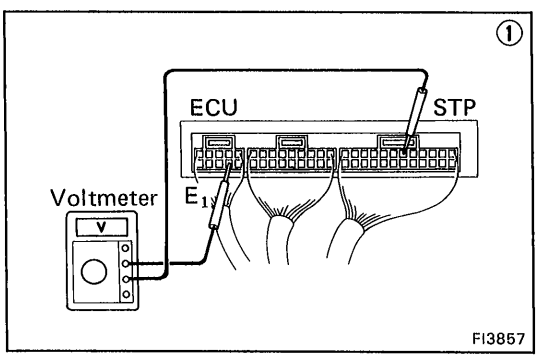
Check wiring between ECU and cold start injector. OK → Check wiring between ECU terminal E_1 and body ground.

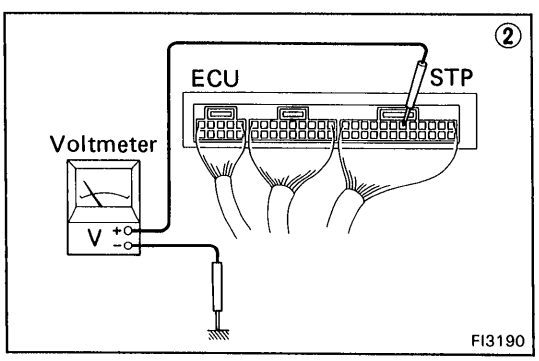
Check wiring between ECU and cold start injector. BAD → Repair or replace wiring.

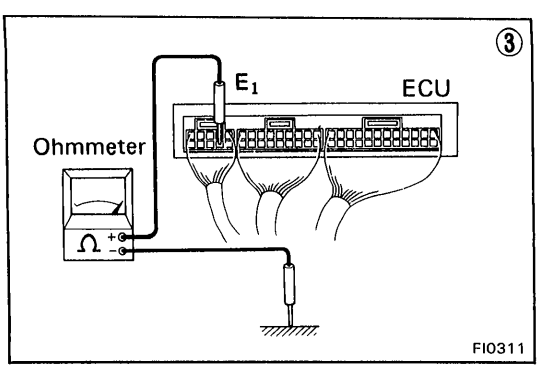
Check wiring between ECU terminal E_1 and body ground. OK → Try another ECU.

No.	Terminals	Trouble	Condition	STD Voltage
10	STP – E_1	No voltage	Stop light switch ON	8 – 14 V









① There is no voltage between ECU terminals STP and E_1.

② Check that there is voltage between ECU terminal STP and body ground when the brake pedal is depressed.

NO

OK

③ Check wiring between ECU terminal E_1 and body ground.

OK

Try another ECU.

BAD

Repair or replace

BAD

Repair or replace

Check STOP fuse (15A) and stop light switch.

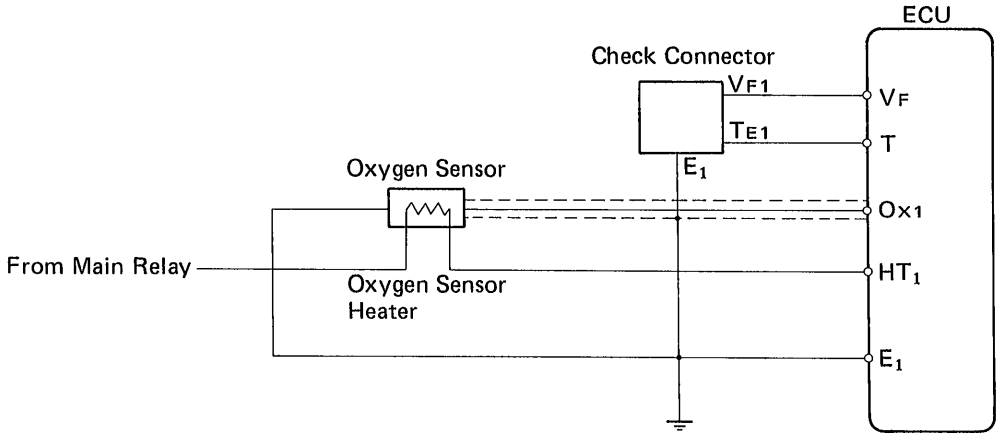
OK

BAD

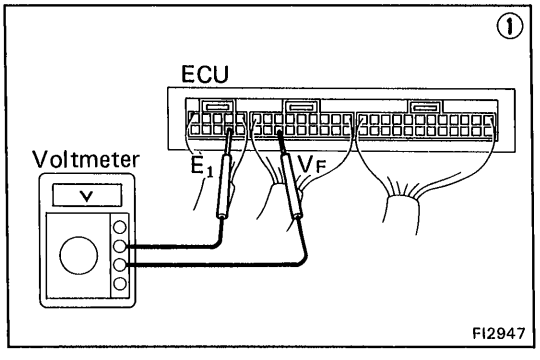
Repair or replace

Check wiring between ECU terminal STP and battery.

(California Vehicles only)



FI3933



FI2947

① There is no voltage between ECU terminals V_F and E_1.

Check that there is voltage between ECU terminal V_F and body ground.

NO — OK

Check wiring between ECU terminal E_1 and body ground.

OK — BAD

Try another ECU. | Repair or replace.

Is air leaking into air induction system? — BAD → Repair air leak.

OK

Check spark plugs. — BAD → Repair or replace.

OK

Check distributor and ignition system. — BAD → Repair or replace.

OK

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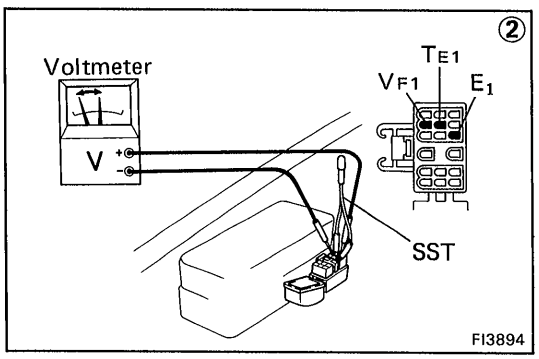
CONTINUED FROM PAGE FI-149.



OK

Check fuel pressure. — BAD → Repair or replace.

OK

Check injector. — BAD → Repair or replace.

OK

Check cold start injector.* — BAD → Repair or replace.

OK

Check air flow meter. — BAD → Repair or replace.

OK

② Check operation of oxygen sensor. — OK → System normal.

BAD

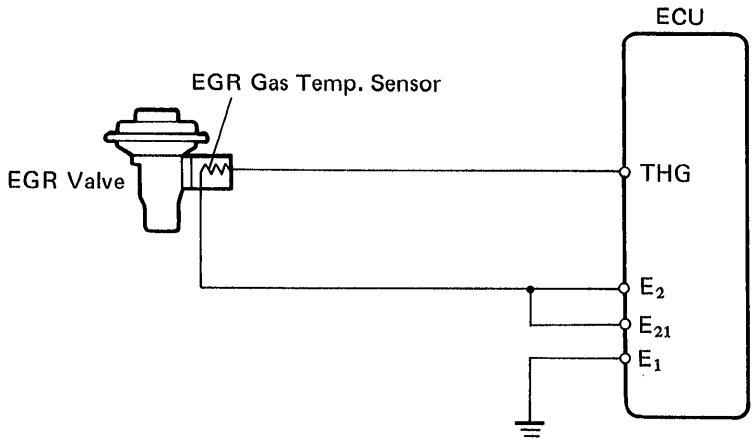
Check wiring between oxygen sensor and ECU connector. — BAD → Repair wiring.

OK

Replace oxygen sensor.

* Rich malfunction only

(California Vehicles only)



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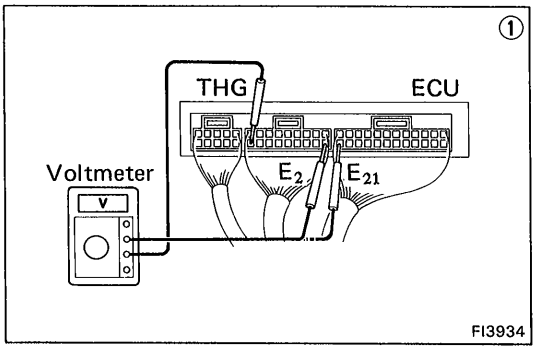
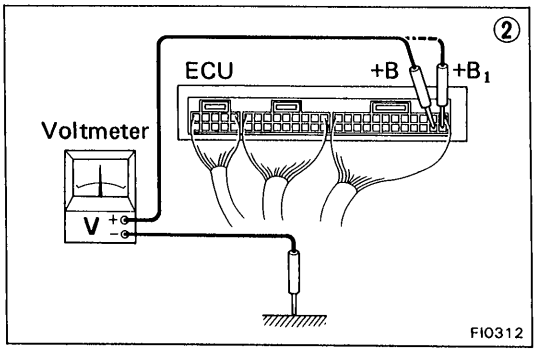
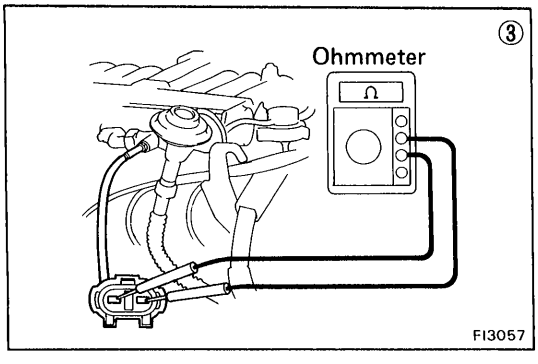


FI3934



FI0312



FI3057

① There is no voltage between ECU terminals THG and E_2 (E_{21}). **(Engine running at 2,000 rpm)**

② Check that there is voltage between ECU terminal +B ($+B_1$) and body ground. **(IG SW ON)**

OK → Check wiring between ECU terminal E_1 and body ground.

NO → Refer to No. 1.

OK → Check EGR system.

BAD → Repair or replace.

OK → ③ Check EGR gas temp. sensor.

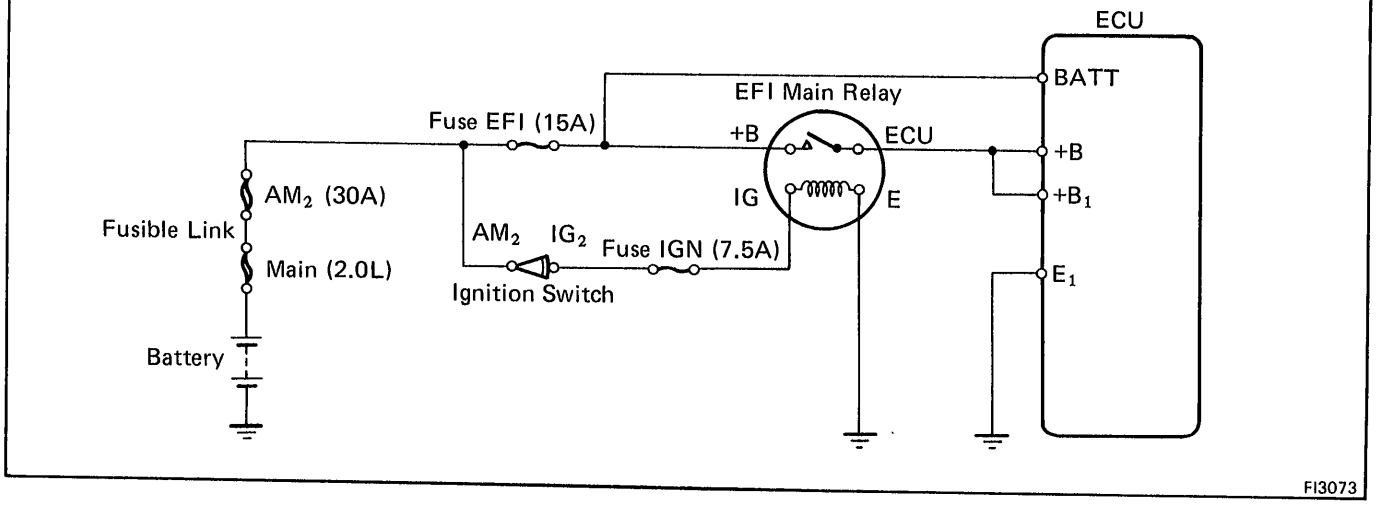
BAD → Replace EGR gas temp. sensor.

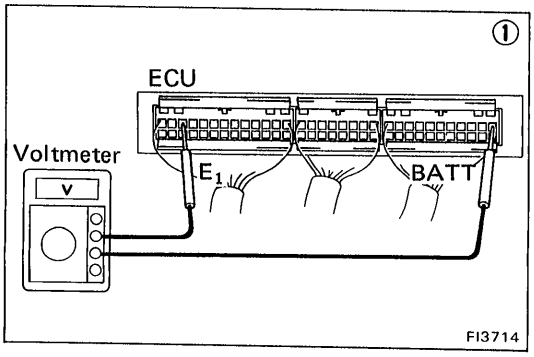
OK → Check wiring between ECU and EGR gas temp. sensor.

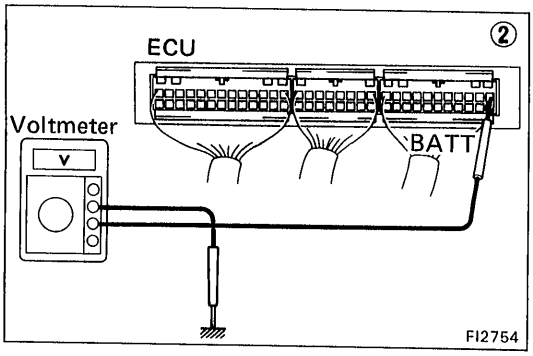
OK → Try another ECU.

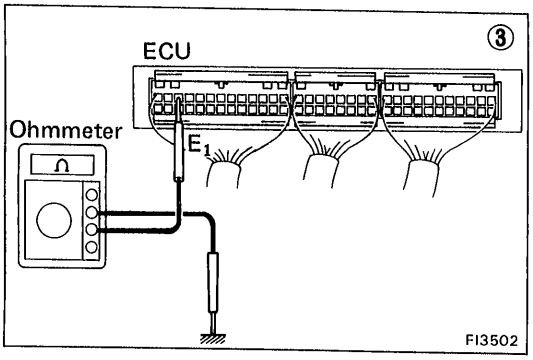
BAD → Repair or replace.

No.	Terminals	Trouble	Condition	STD Voltage
11	BATT – E_1	No voltage	–	10 – 14 V
	+B – E_1		Ignition switch ON	
	+B_1 – E_1			









- **BATT – E_1**

① There is no voltage between ECU terminals BATT and E_1.

② Check that there is voltage between ECU terminal BATT and body ground.

NO

OK

③ Check wiring between ECU terminal E_1 and body ground.

OK

Try another ECU.

BAD

Repair or replace

Check fuse and fusible link.

BAD

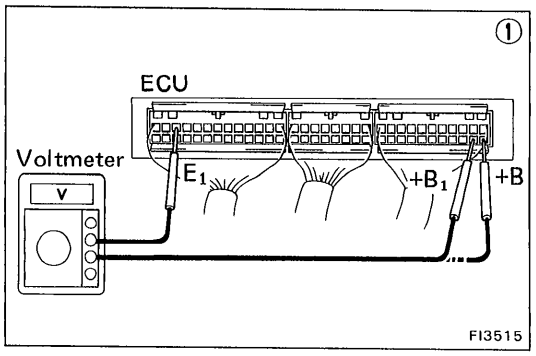
Replace

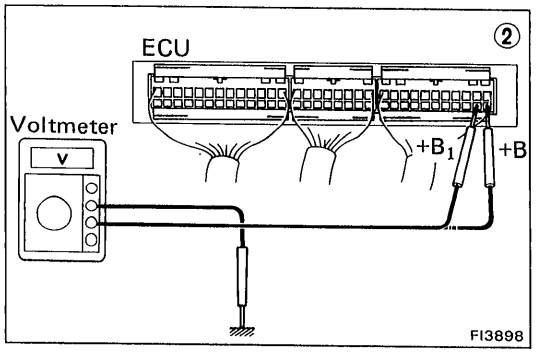
OK

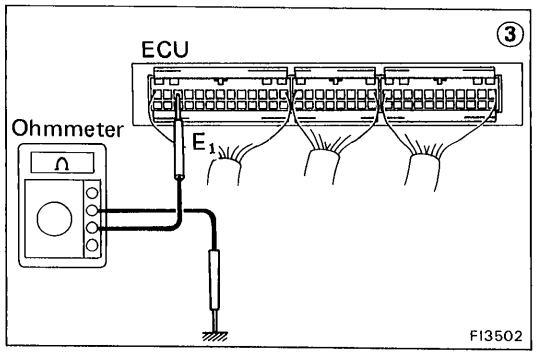
Check wiring between fuse and ECU.

BAD

Repair or replace







● **+B (+B_1) – E_1**

① There is no voltage between ECU terminals +B (+B_1) and E_1. **(IG SW ON)**

② Check that there is voltage between ECU terminal +B (+B_1) and body ground. **(IG SW ON)**

NO

OK

③ Check wiring between ECU terminal E_1 and body ground.

OK

Try another ECU.

BAD

Repair or replace

Check fuse, fusible link and ignition switch.

BAD

Repair or replace

OK

Check EFI main relay.

BAD

Replace

OK

Check wiring between EFI main relay and battery.

BAD

Repair or replace

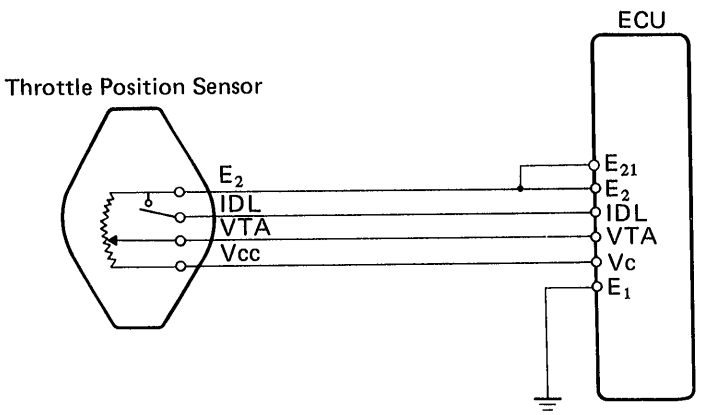
OK

Check wiring between EFI main relay and ECU terminal +B (+B_1).

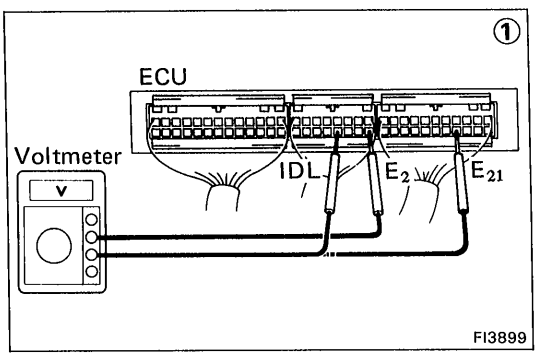
BAD

Repair or replace

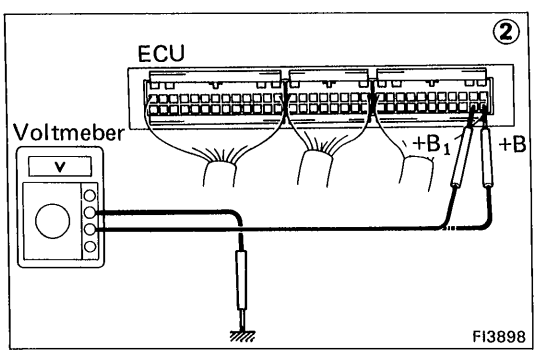
No.	Terminals	Trouble	Condition		STD Voltage
12	IDL – E_2 (E_{21})	No voltage	Ignition switch ON	Throttle valve open	8 – 14 V
	Vc – E_2 (E_{21})			–	4 – 6 V
	VTA – E_2 (E_{21})			Throttle valve fully closed	0.1 – 1.0 V
				Throttle valve fully open	3 – 5 V



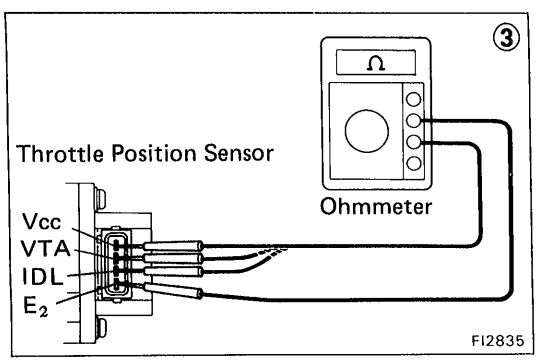
FI3877



FI3899



FI3898



FI2835

● **IDL – E_2 (E_{21})**

① There is no voltage between ECU terminals IDL and E_2 (E_{21}). **(IG SW ON)** (Throttle valve open)

② Check that there is voltage between ECU terminal $+B_1$ (+B) and body ground. **(IG SW ON)**

② NO → Refer to No. 11. → BAD → Replace or repair.

② OK → Check wiring between ECU terminals E_1 and body ground.

Check wiring between ECU terminals E_1 and body ground. OK → ③ Check throttle position sensor.

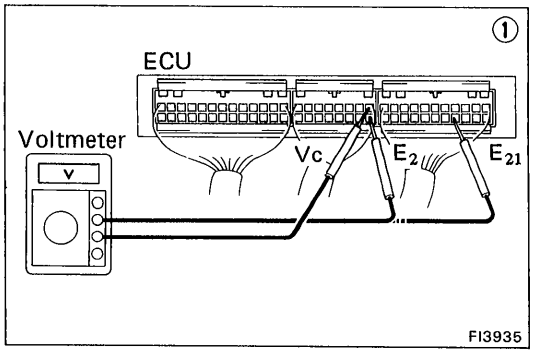
Check wiring between ECU terminals E_1 and body ground. BAD → Replace or repair.

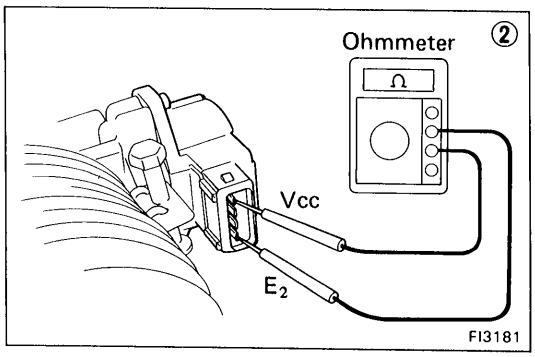
Replace or repair. → BAD → ③ Check throttle position sensor.

③ Check throttle position sensor. BAD → Replace or repair throttle position sensor.

③ Check throttle position sensor. OK → Check wiring between ECU and throttle position sensor.

Check wiring between ECU and throttle position sensor. OK → Try another ECU.





- **Vc – E_2 (E_{21})**

① There is no voltage between ECU terminals Vc and E_2 (E_{21}). **(IG SW ON)**

↓

Check that there is voltage between ECU terminals $+B_1$ (+B) and E_1. **(IG SW ON)**

↓ OK — NO → Refer to No. 11.

② Check throttle position sensor.

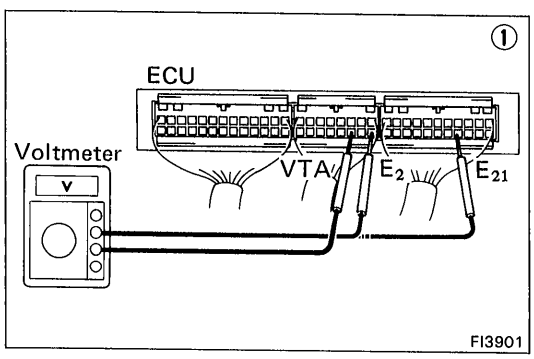
↓ BAD → Repair or replace.

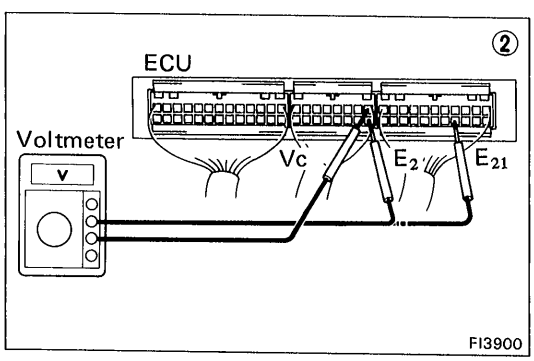
↓ OK

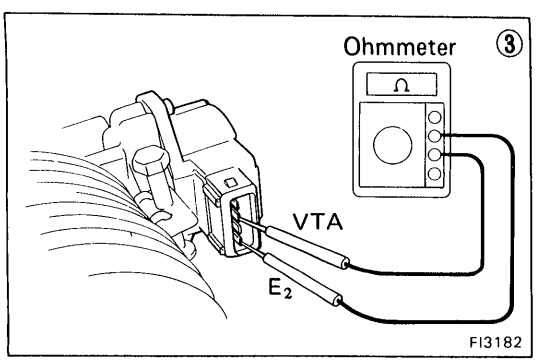
Check wiring between ECU and throttle position sensor.

↓ OK → Try another ECU.

↓ BAD → Repair or replace wiring.







- **VTA – E_2 (E_{21})**

① There is no specified voltage between ECU terminals VTA and E_2 (E_{21}). **(IG SW ON)**

↓

② Check that there is voltage between ECU terminals Vc and E_2 (E_{21}). **(IG SW ON)**

↓ OK — NO → Perform inspection of Vc – E_2 (E_{21})

↓

③ Check throttle position sensor. — BAD → Repair or replace.

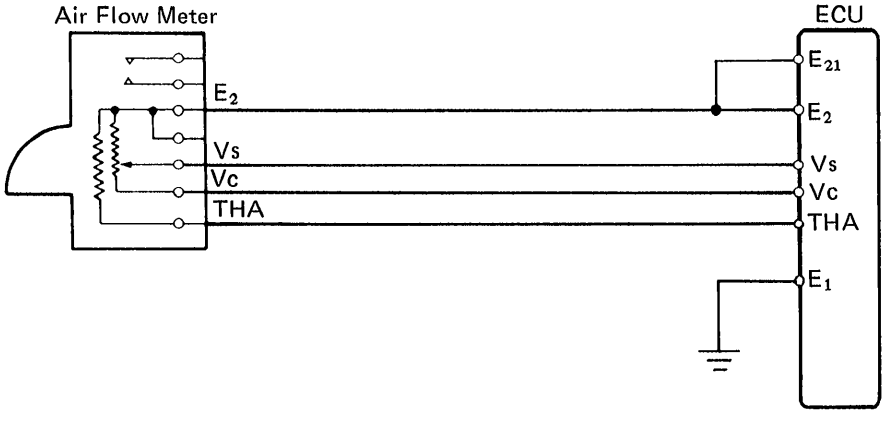
↓ OK

Check wiring between ECU and throttle position sensor. — BAD → Repair or replace.

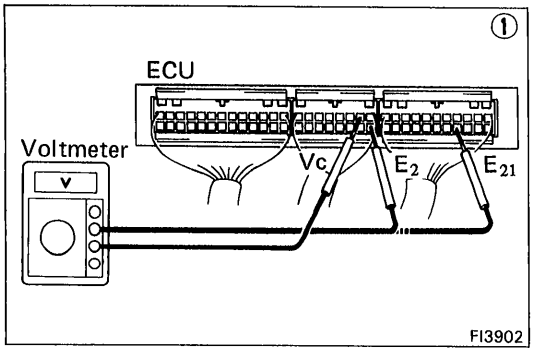
↓ OK

Try another ECU.

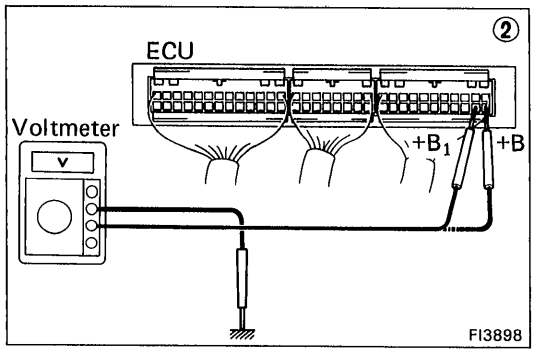
No.	Terminal	Trouble	Condition		STD Voltage
13	Vc – E_2 (E_{21})	No voltage	Ignition SW ON	–	4 – 6 V
	Vs – E_2 (E_{21})			Measuring plate fully closed	3.7 – 4.3 V
				Measuring plate fully open	0.2 – 0.5 V
			Idling		2.3 – 2.8 V
	THA – E_2 (E_{21})		IG SW ON	Intake air temperature 20°C (68°F)	1 – 3 V



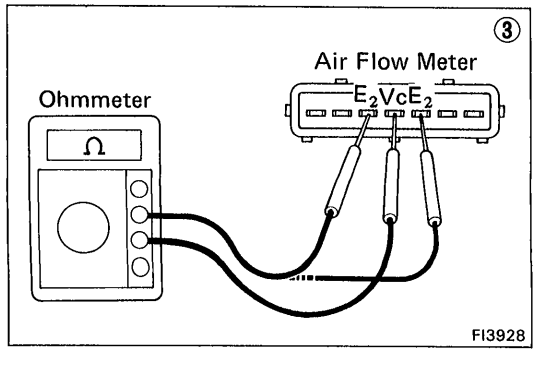
FI3927



FI3902



FI3898



FI3928

• **Vc – E_2 (E_{21})**

① There is no specified voltage between ECU terminals Vc and E_2 (E_{21}). **(IG SW ON)**

↓

② Check that there is voltage between ECU terminals +B (+B_1) and body ground. **(IG SW ON)**

OK ↓ / NO → Refer to No. 11.

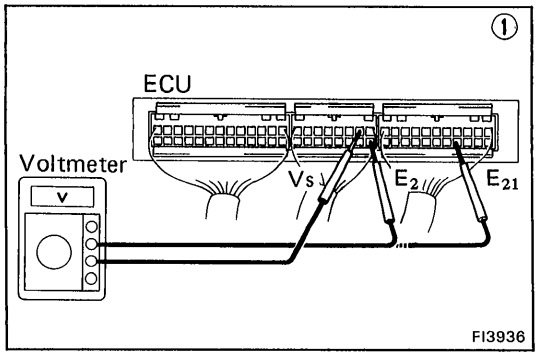
③ Check air flow meter.

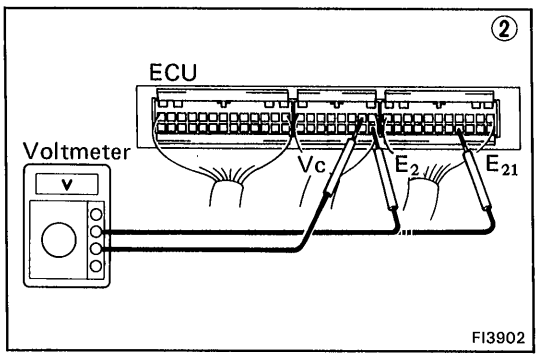
NO ↓ Replace or repair air flow meter.

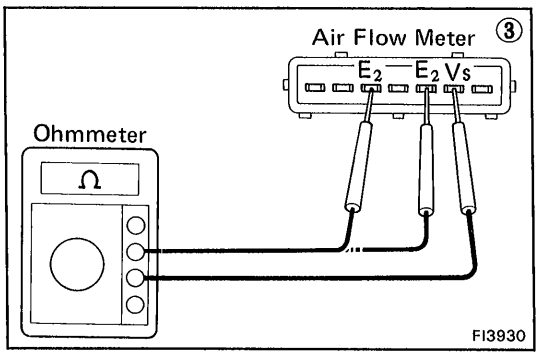
OK ↓ Check wiring between ECU and air flow meter.

OK ↓ Try another ECU.

NO → Replace or repair wiring.







- **Vs – E_2 (E_{21})**

① There is no specified voltage between ECU terminals Vs and E_2 (E_{21}). **(IG SW ON)**

↓

② Check that there is voltage between ECU terminals Vc and E_2 (E_{21}). **(IG SW ON)**

OK ↓ / NO → Refer to Vc – E_2 (E_{21}) → BAD → Repair or replace

↓

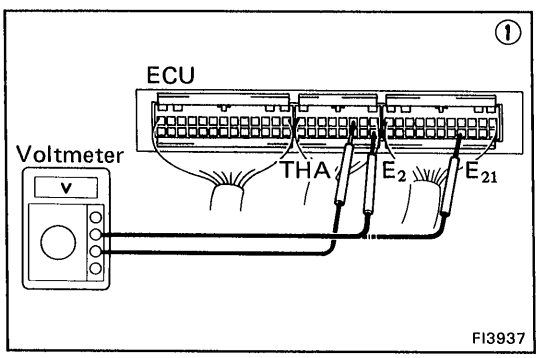
③ Check air flow meter. → BAD → Repair or replace

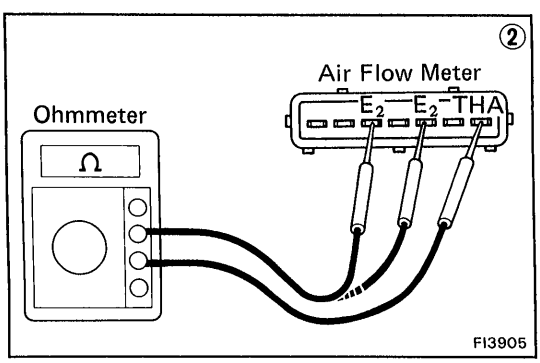
↓ OK

Check wiring between ECU and air flow meter. → BAD → Repair or replace

↓ OK

Try another ECU.





- **THA – E_2 (E_{21})**

① There is no voltage between ECU terminals THA and E_2 (E_{21}). **(IG SW ON)**

↓

Check that there is voltage between ECU terminal +B (+B_1) and body ground. **(IG SW ON)**

OK ↓ / NO → Refer to No. 11.

② Check air temp. sensor.

BAD ↓ / OK →

Replace air flow meter.

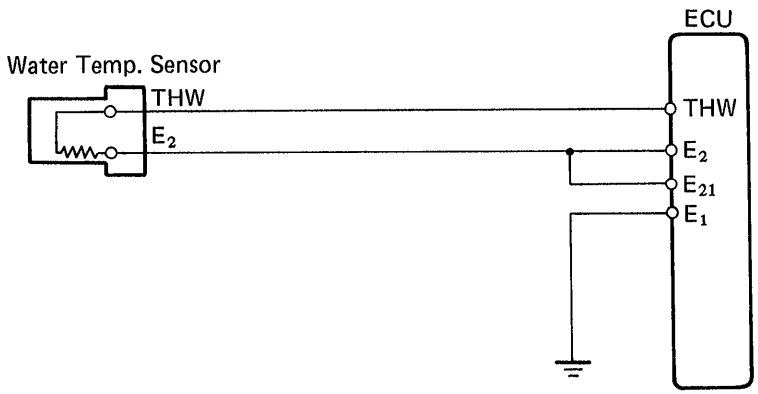
Check wiring between ECU and air temp. sensor.

OK ↓ / BAD →

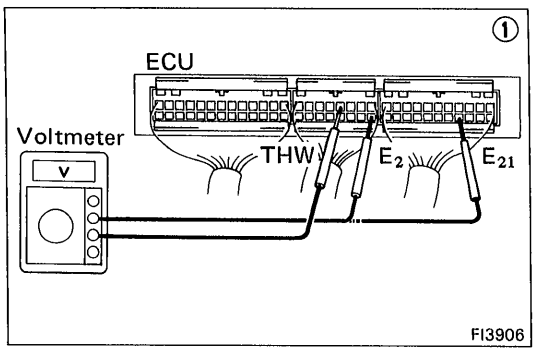
Try another ECU.

Repair or replace wiring.

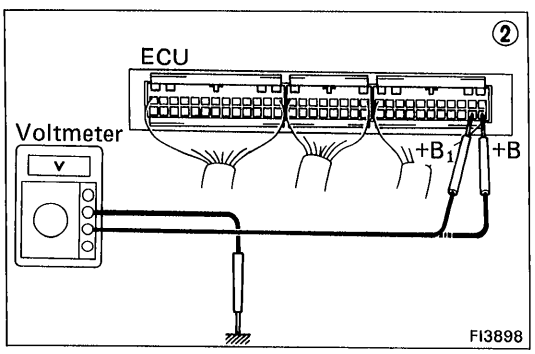
No.	Terminals	Trouble	Condition		STD Voltage
14	THW – E_2 (E_{21})	No voltage	Ignition switch ON	Coolant temperature 80°C (176°F)	0.1 – 1.0 V



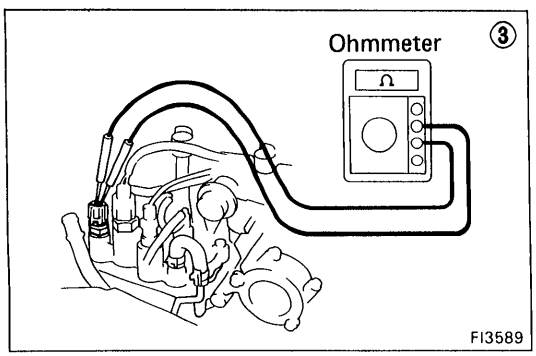
FI3887



FI3906



FI3898



FI3589

① There is no voltage between ECU terminals THW and E_2 (E_{21}). **(IG SW ON)**

② Check that there is voltage between ECU terminal +B ($+B_1$) and body ground. **(IG SW ON)**

OK → Check wiring between ECU terminal E_1 and body ground.

NO → Refer to No. 11.

OK → ③ Check water temp. sensor.

BAD → Repair or replace.

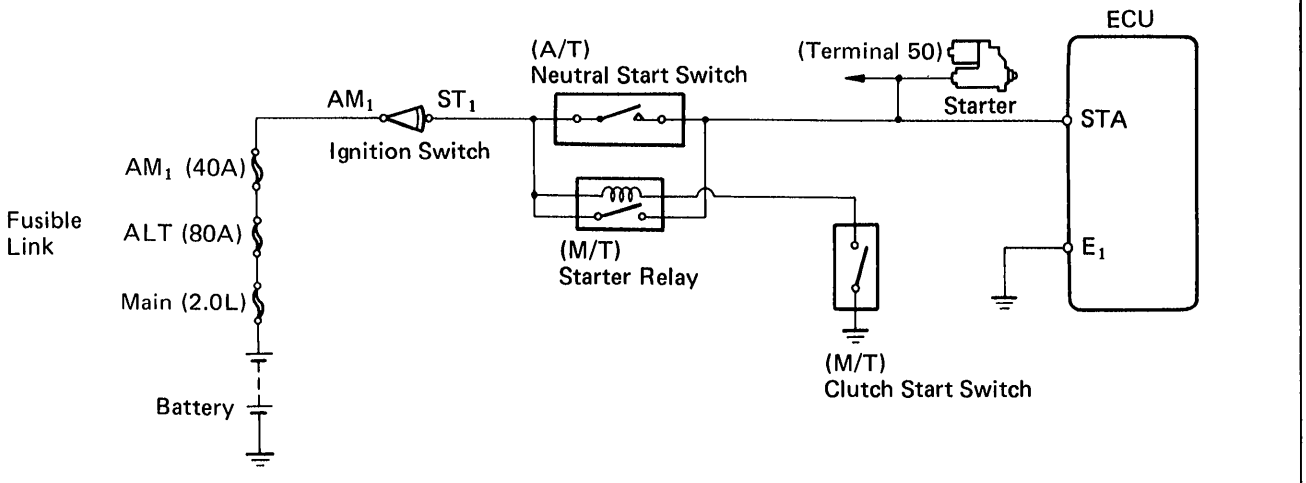
BAD → Replace water temp. sensor.

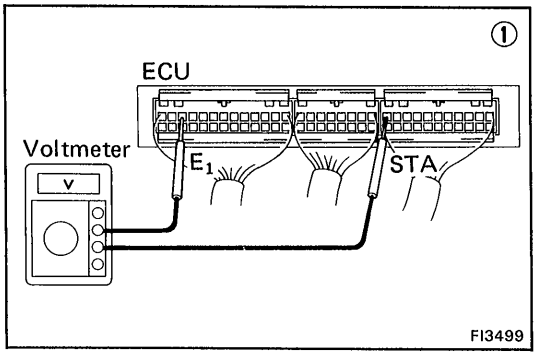
OK → Check wiring between ECU and water temp. sensor.

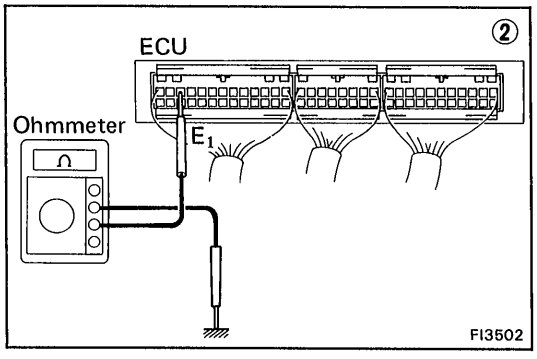
OK → Try another ECU.

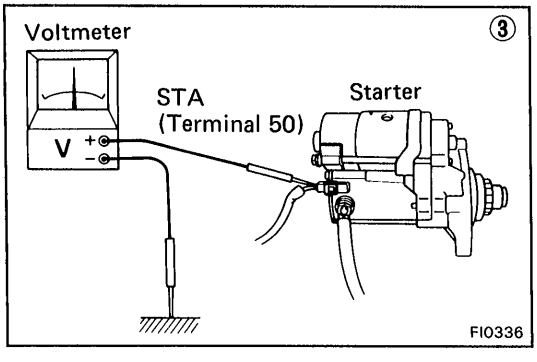
BAD → Repair or replace.

No.	Terminals	Trouble	Condition	STD Voltage
15	STA – E_1	No voltage	Ignition switch ST position	6 – 12 V





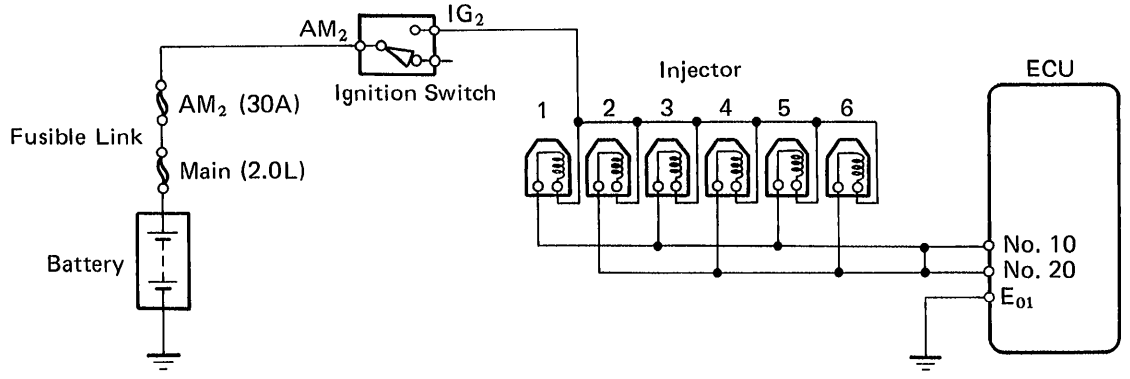




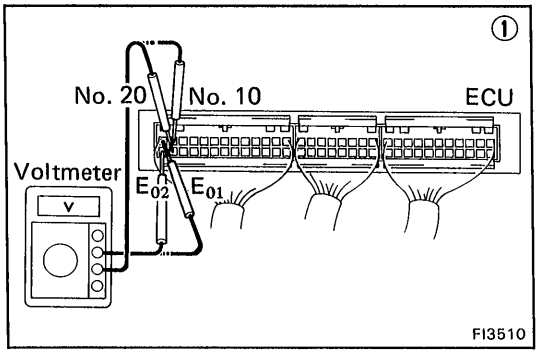
① There is no voltage between ECU terminals STA and E_1. **(IG SW ST)**

Check starter operation.
- OK → Check wiring between ECU terminal STA and starter terminal 50.
  - OK → ② Check wiring between ECU terminal E_1 and body ground.
    - BAD → Repair or replace
  - BAD → Repair or replace
- BAD → Check fusible link, battery, wiring and ignition switch.
  - BAD → Repair or replace
  - OK → ③ Check that there is voltage at STA (50) terminal of starter. **(IG SW ST)** **STD voltage: 9 – 11 V**
    - OK → Check starter.
    - NO → Check wiring between ignition switch ST terminal and starter STA (50) terminal.

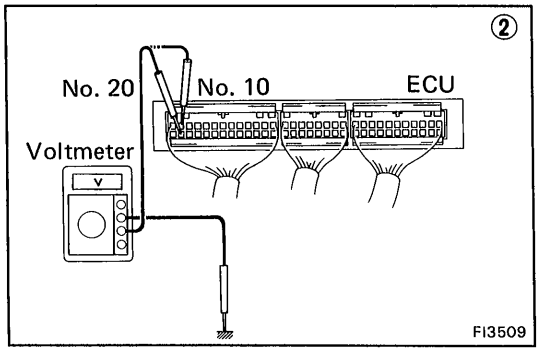
No.	Terminals	Trouble	Condition	STD Voltage
16	No. 10 – E_{01} No. 20 – E_{02}	No voltage	Ignition switch ON	10 – 14 V



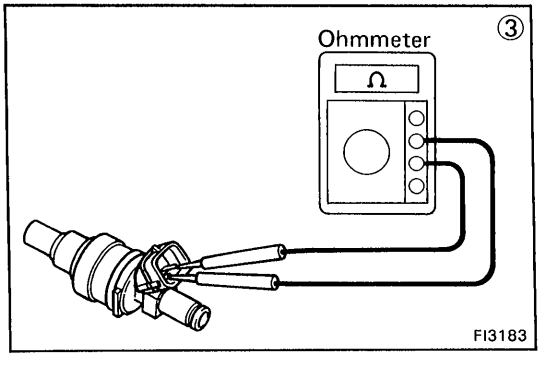
FI3716



FI3510



FI3509



FI3183

① There is no boltage between ECU terminals No. 10 and/or No. 20 and E_{01} and/or E_{02}. **(IG SW ON)**

↓

② Check that there is voltage between ECU terminal No. 10 and/or No. 20 and body ground.

NO → ↓

OK → Check wiring between ECU terminal E_{01} and/or E_{02} and body ground.

OK → Try another ECU.

BAD → Repair or replace.

↓

Check fusible link and ignition switch. → BAD → Repair or replace.

OK ↓

③ Check resistance of magnetic coil in each injector.
STD resistance: 13.4 – 14.2 Ω

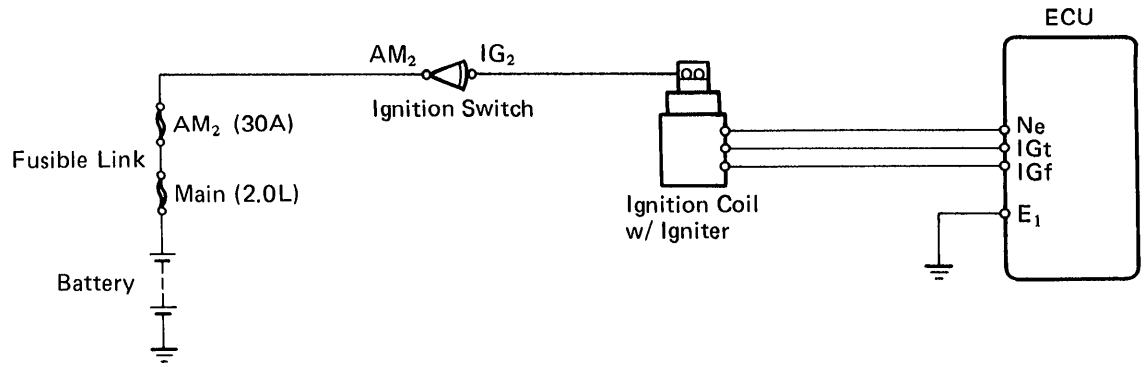
OK ↓

BAD → Replace injector.

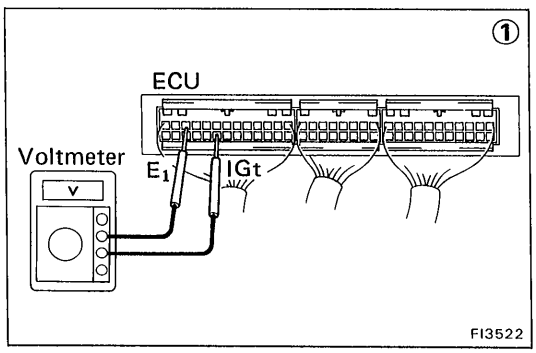
↓

Check wiring between ECU terminal No. 10 and/or No. 20 and battery. → BAD → Repair or replace.

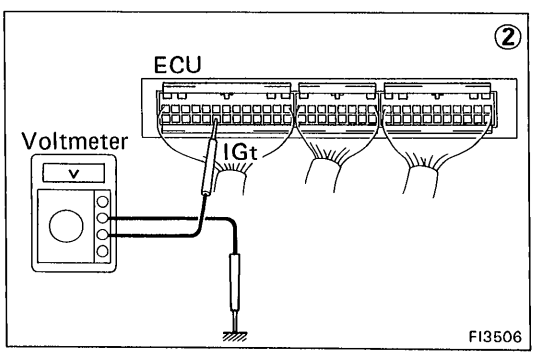
No.	Terminals	Trouble	Condition	STD Voltage
17	IGt – E_1	No voltage	Cranking or Idling	0.7 – 1.0 V



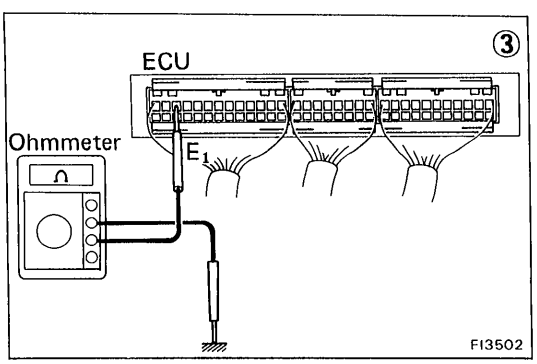
FI3489



FI3522



FI3506



FI3502

① There is no voltage between ECU terminals IGt and E_1. **(Idling)**

② Check that there is voltage between ECU terminal IGt and body ground. **(Idling)**

OK

③ Check wiring between ECU terminal E_1 and body ground.

BAD

Refer to No. 11. — BAD → Repair or replace.

OK

Check wiring between igniter and distributor. — BAD → Repair or replace.

OK

Check distributor. — BAD → Replace.

OK

Check wiring between ECU and igniter. — BAD → Repair or replace.

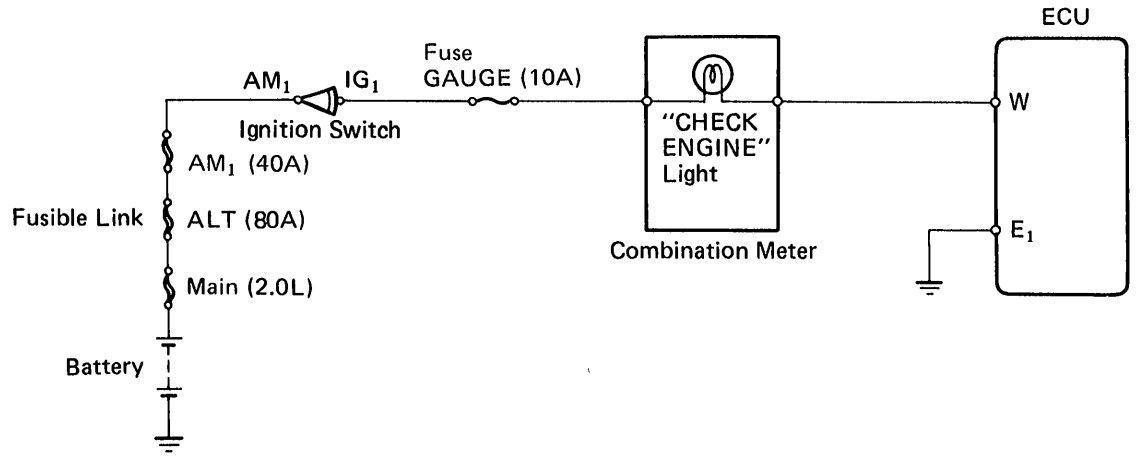
OK

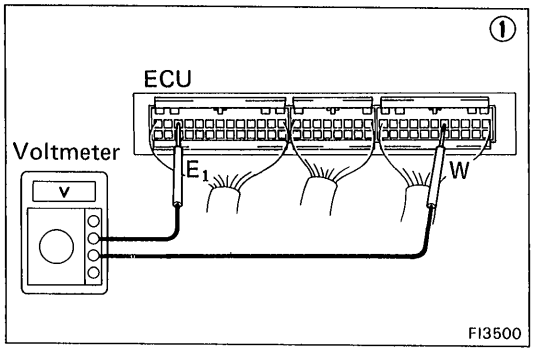
Check igniter. — BAD → Repair or replace.

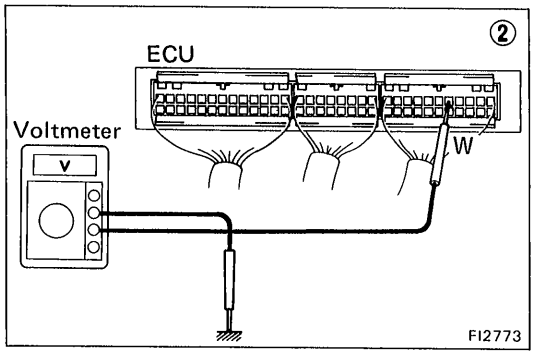
OK

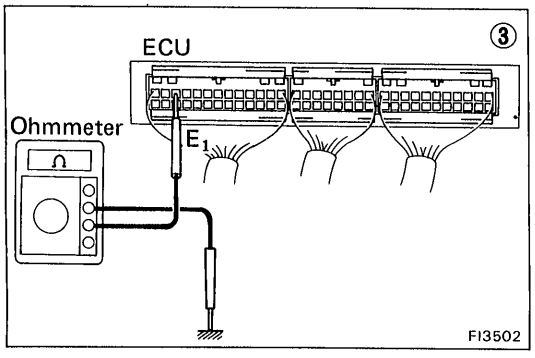
Try another ECU.

No.	Terminals	Trouble	Condition	STD Voltage
18	W – E_1	No voltage	No trouble (CHECK ENGINE light off) and engine running	10 – 14 V









① There is no voltage between ECU terminals W and E_1. **(Idling)**

↓

② Check that there is voltage between ECU terminal W and body ground.

NO → ↓ OK

→ ③ Check wiring between ECU terminal E_1 and body ground.

→ OK → Try another ECU.

→ BAD → Repair or replace.

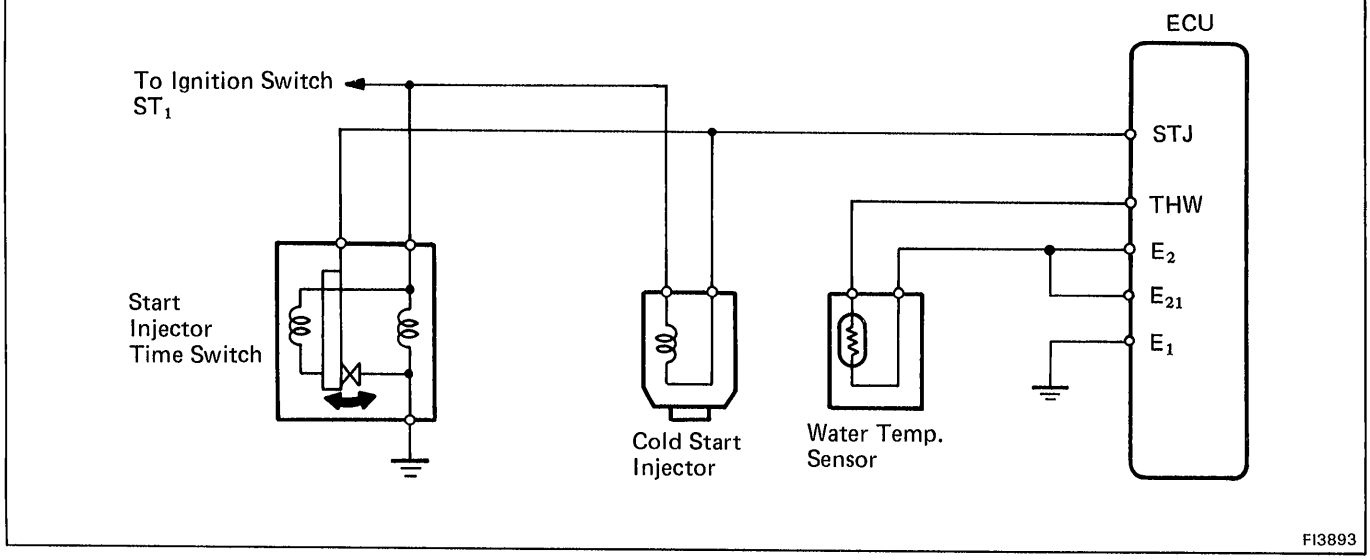
↓

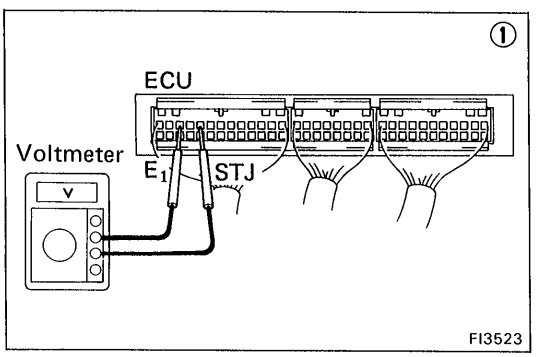
Check GAUGE fuse (10A) and CHECK ENGINE light. → BAD → Repair or replace.

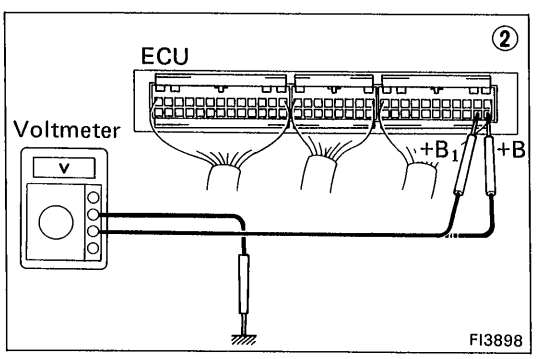
↓ OK

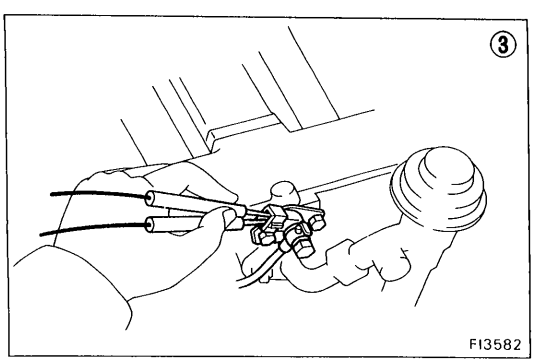
Check wiring between ECU terminal W and CHECK ENGINE light. → BAD → Repair or replace.

No.	Terminals	Trouble	Condition		STD Voltage
19	STJ – E_1	No voltage	Ignition switch ST position	Coolant temperature 80°C (176°F)	6 – 12 V









① There is no voltage between ECU terminals STJ and E_1. **(IG SW ON)**

↓

② Check that there is voltage between ECU terminal +B ($+B_1$) and body ground. **(IG SW ON)**

OK → ↓ NO → Refer to No. 11.

↓

③ Check cold start injector.

BAD → Replace cold start injector

OK → Check wiring between ECU and cold start injector.

OK → ↓ BAD → Repair or replace wiring.

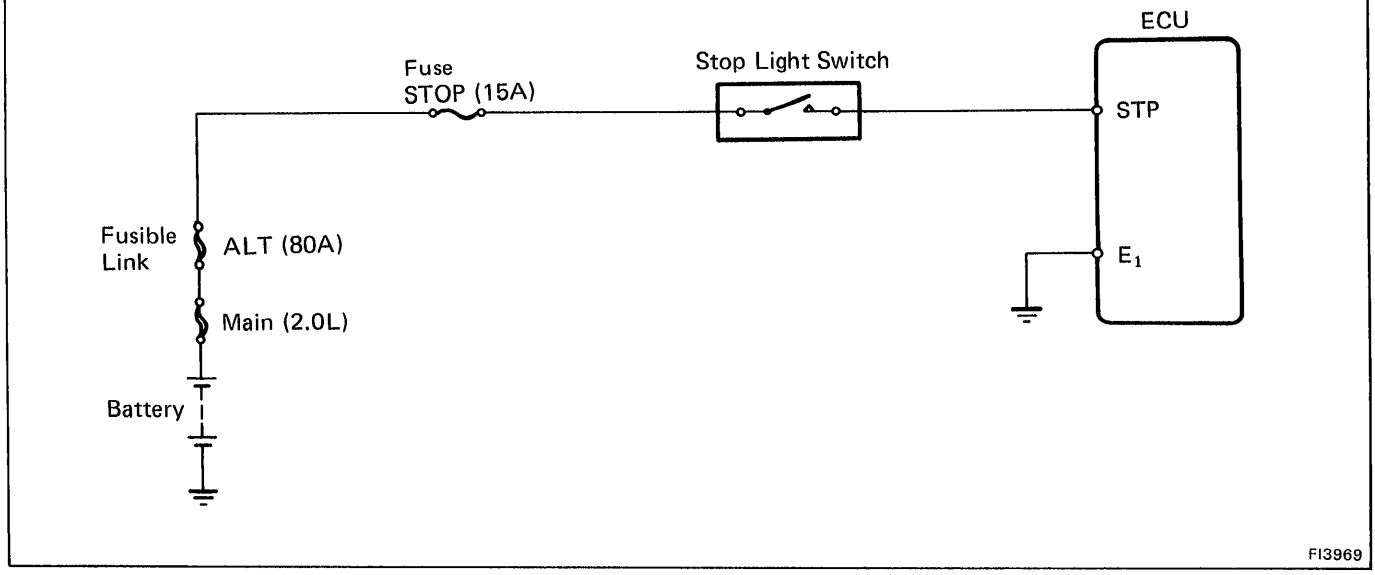
↓

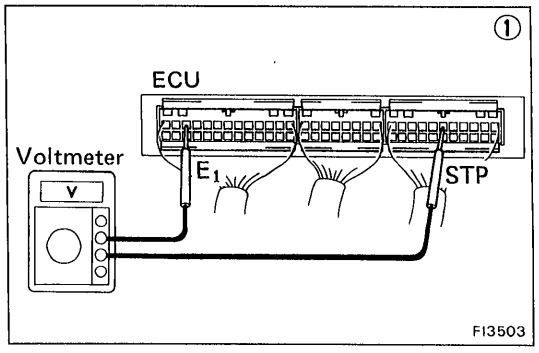
Check wiring between ECU terminal E_1 and body ground.

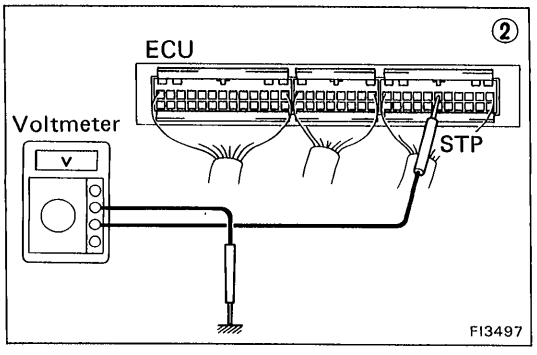
↓

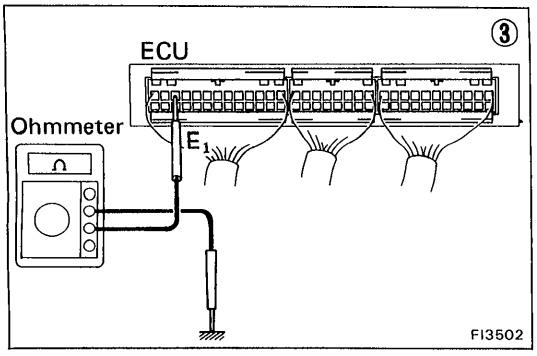
OK → Try another ECU.

No.	Terminals	Trouble	Condition	STD Voltage
20	STP – E_1	No voltage	Stop light switch ON	8 – 14 V









① There is no voltage between ECU terminals STP and E_1.

② Check that there is voltage between ECU terminal STP and body ground when the brake pedal is depressed.

NO

OK

③ Check wiring between ECU terminal E_1 and body ground.

OK

BAD

Try another ECU.

Repair or replace

Check STOP fuse (15A) and stop light switch.

BAD

Repair or replace

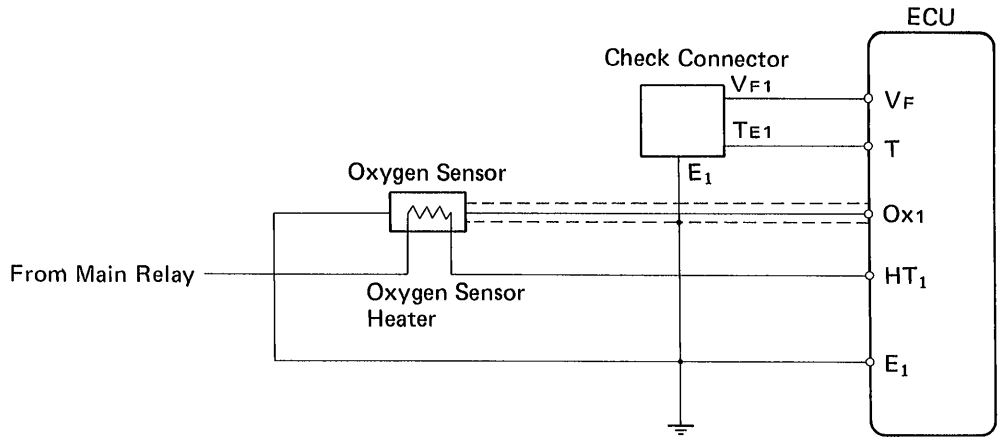
OK

Check wiring between ECU terminal STP and battery.

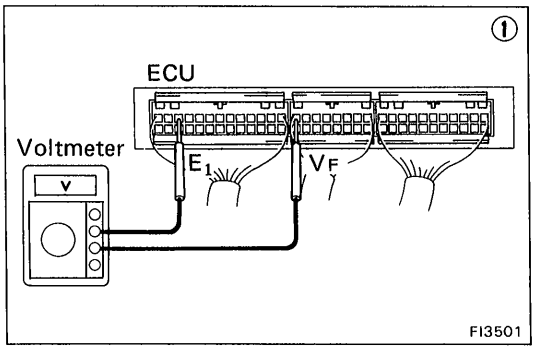
BAD

Repair or replace

(California Vehicles only)



FI3933



FI3501

① There is no voltage between ECU terminals V_F and E_1.

Check that there is voltage between ECU terminal V_F and body ground.

NO — OK

Check wiring between ECU terminal E_1 and body ground.

OK — Try another ECU.

BAD — Repair or replace.

Is air leaking into air induction system? — BAD — Repair air leak.

OK

Check spark plugs. — BAD — Repair or replace.

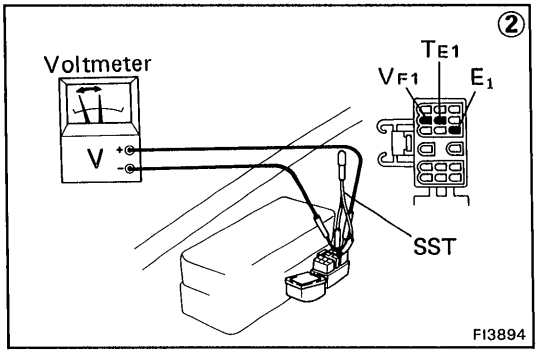
OK

Check distributor and ignition system. — BAD — Repair or replace.

OK

CONTINUED ON PAGE FI-166.

CONTINUED FROM PAGE FI-165.



OK

Check fuel pressure. — BAD → Repair or replace.

OK

Check injector. — BAD → Repair or replace.

OK

Check cold start injector.* — BAD → Repair or replace.

OK

Check air flow meter. — BAD → Repair or replace.

OK

② Check operation of oxygen sensor. — OK → System normal.

BAD

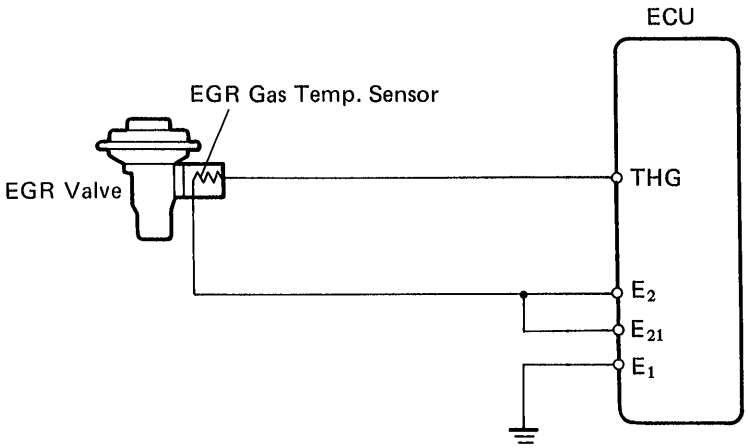
Check wiring between oxygen sensor and ECU connector. — BAD → Repair wiring.

OK

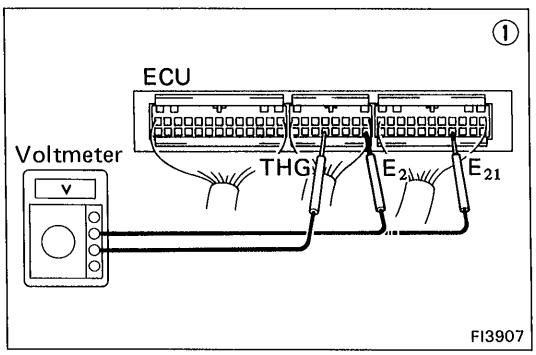
Replace oxygen sensor.

* Rich malfunction only

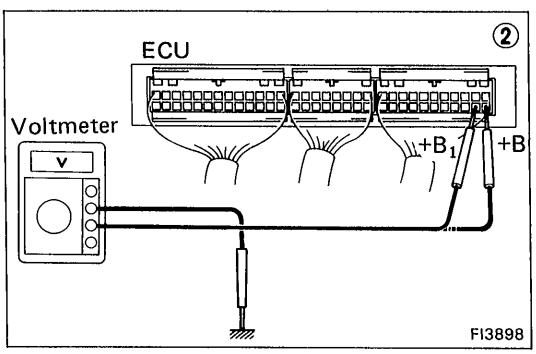
(California Vehicles only)



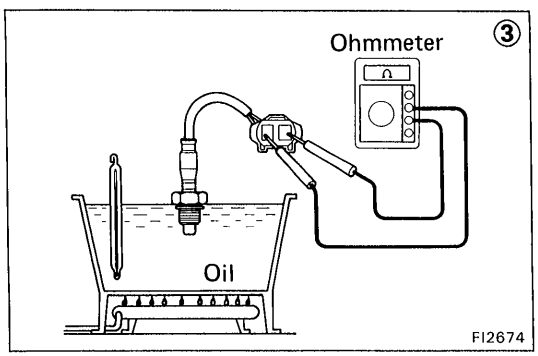
FI3895



FI3907



FI3898



FI2674

① There is no voltage between ECU terminals THG and E_2 (E_{21}). **(Engine running at 2,000 rpm)**

② Check that there is voltage between ECU terminal +B ($+B_1$) and body ground. **(IG SW ON)**

OK → Check wiring between ECU terminal E_1 and body ground.

NO → Refer to No. 11.

OK → Check EGR system.

BAD → Repair or replace.

OK → ③ Check EGR gas temp. sensor.

BAD → Replace EGR gas temp. sensor.

OK → Check wiring between ECU and EGR gas temp. sensor.

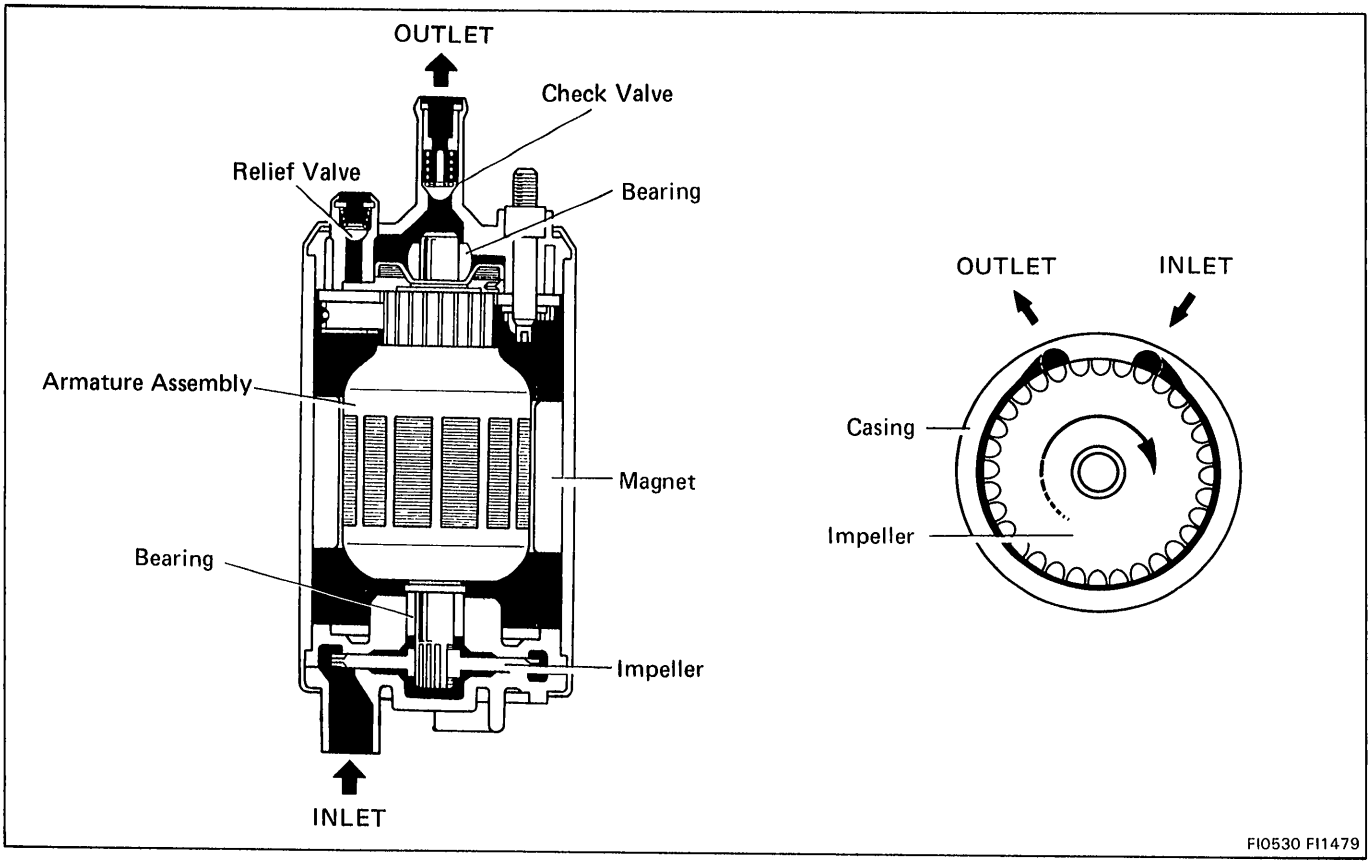
OK → Try another ECU.

BAD → Repair or replace.

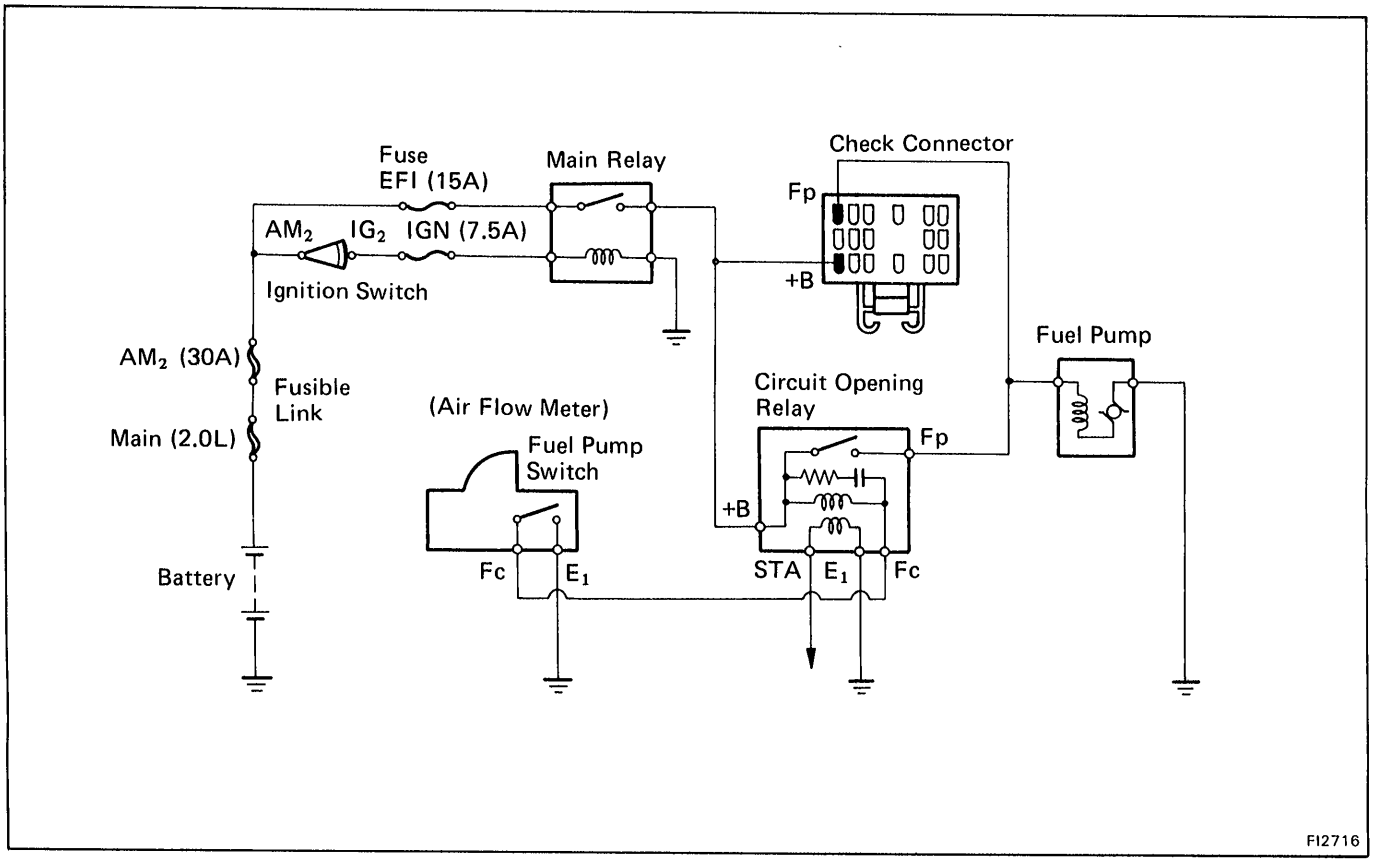
BAD → Repair or replace.

FUEL SYSTEM

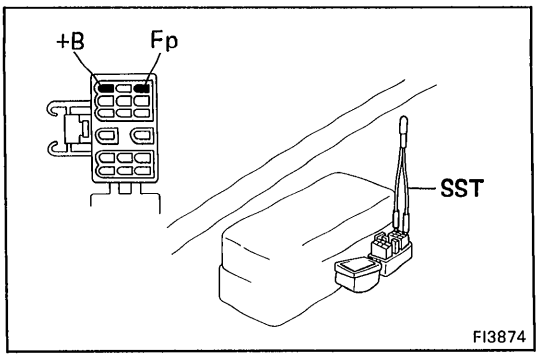
Fuel Pump

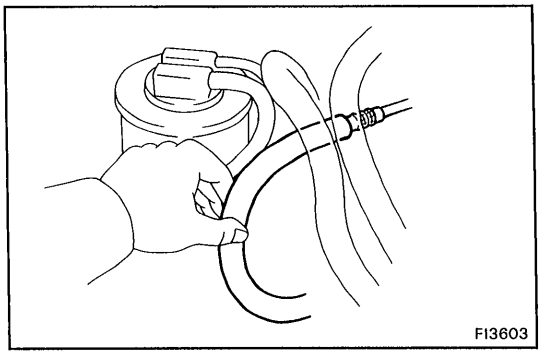


FI0530 FI1479



FI2716





ON-VEHICLE INSPECTION

1. CHECK FUEL PUMP OPERATION

(a) Turn the ignition switch to ON.

HINT: Do not start the engine.

(b) Using SST, connect terminals Fp and +B of the check connector.

SST 09843-18020

HINT: The check connector is located near the No.2 relay block.

(c) Check that there is pressure in the fuel inlet hose.

HINT: At this time, you will hear fuel return noise from the fuel return hose.

(d) Remove SST from the check connector.

(e) Turn the ignition switch to OFF.

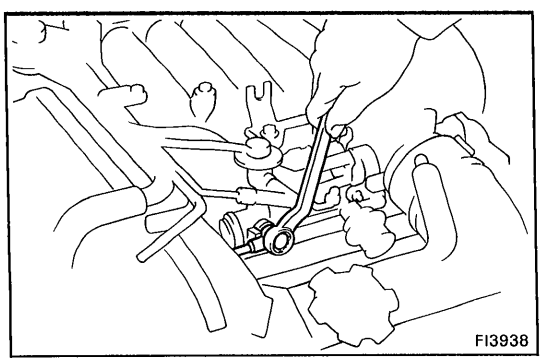
If there is no pressure, check the following parts:

- Fusible link
- Fuse (EFI 15A, IGN 7.5A)
- EFI main relay
- Circuit opening relay
- Fuel pump
- Wiring connections

2. CHECK FUEL PRESSURE

(a) Check that battery voltage is above 12 bolts.

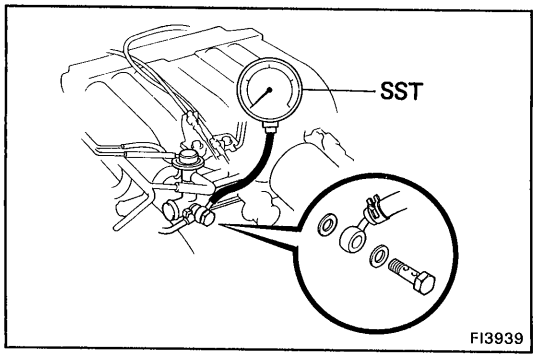
(b) Disconnect the battery negative terminal of the battery.



(c) Place a suitable container or shop towel under the LH delivery pipe.

(d) Slowly loosen the union bolt of the No.3 fuel pipe and remove the union bolt and two gaskets from the delivery pipe.

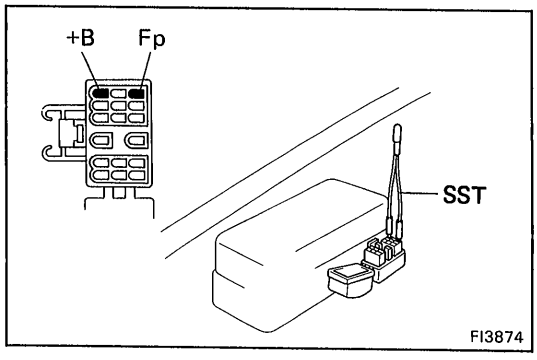
(e) Drain the fuel in the LH delivery pipe.



(f) Install the No.3 fuel pipe and SST (pressure gauge) to the LH delivery pipe with new three gaskets and SST(union bolt) as shown in the figure.

SST 09268-45012

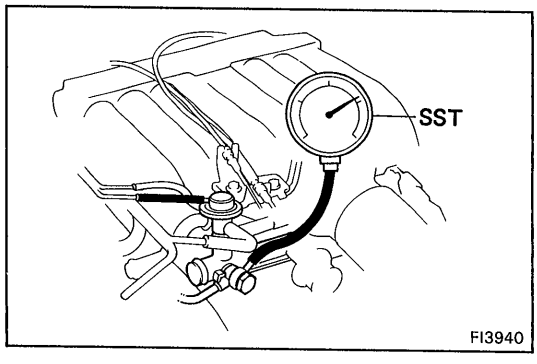
(g) Wipe off any splattered gasoline.



(h) Reconnect the battery negative terminal.

(i) Using SST, connect terminals Fp and +B of the check connector.

SST 09843-18020



(j) Turn the ignition switch to ON.

(k) Measure the fuel pressure.

Fuel pressure: 2.7 — 3.1 kg/cm² (38 — 44 psi, 265 — 304 kPa)

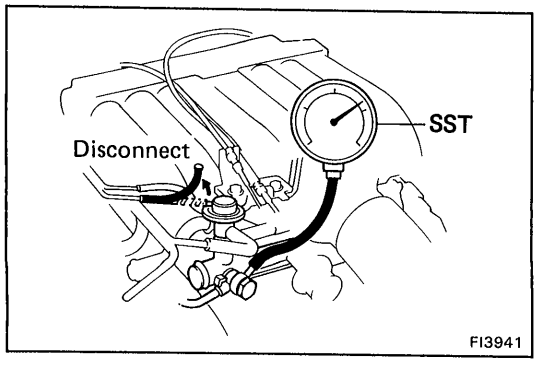
If high, replace the pressure regulator.

If low, check the following parts:

- Fuel hoses and connections
- Fuel pump
- Fuel filter
- Pressure regulator

(l) Remove SST from the check connector.

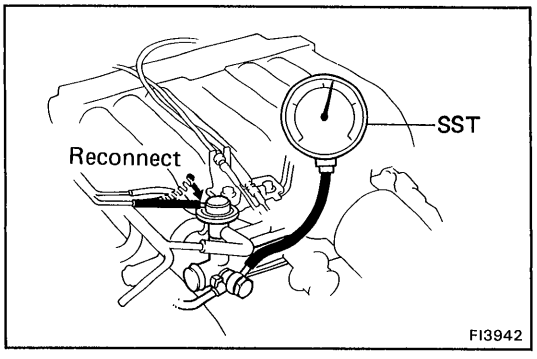
(m) Start the engine.



(n) Disconnect the vacuum hose from the pressure regulator and plug it closed.

(o) Measure the fuel pressure at idling.

Fuel pressure: 2.7 — 3.1 kg/cm² (38 — 44 psi, 265 — 304 kPa)

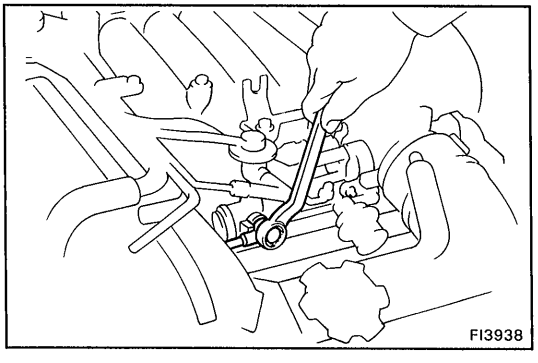


(p) Reconnect the vacuum hose to the pressure regulator.

(q) Measure the fuel pressure at idling.

Fuel pressure: 2.3 — 2.6 kg/cm² (33 — 37 psi, 226 — 265 kPa)

If not within the specified pressure, check the vacuum hose and pressure regulator.



(r) Stop the engine. Check that the fuel pressure remains above 1.5 kg/cm² (21 psi, 147 kPa) for 5 minutes after the engine is turned off.

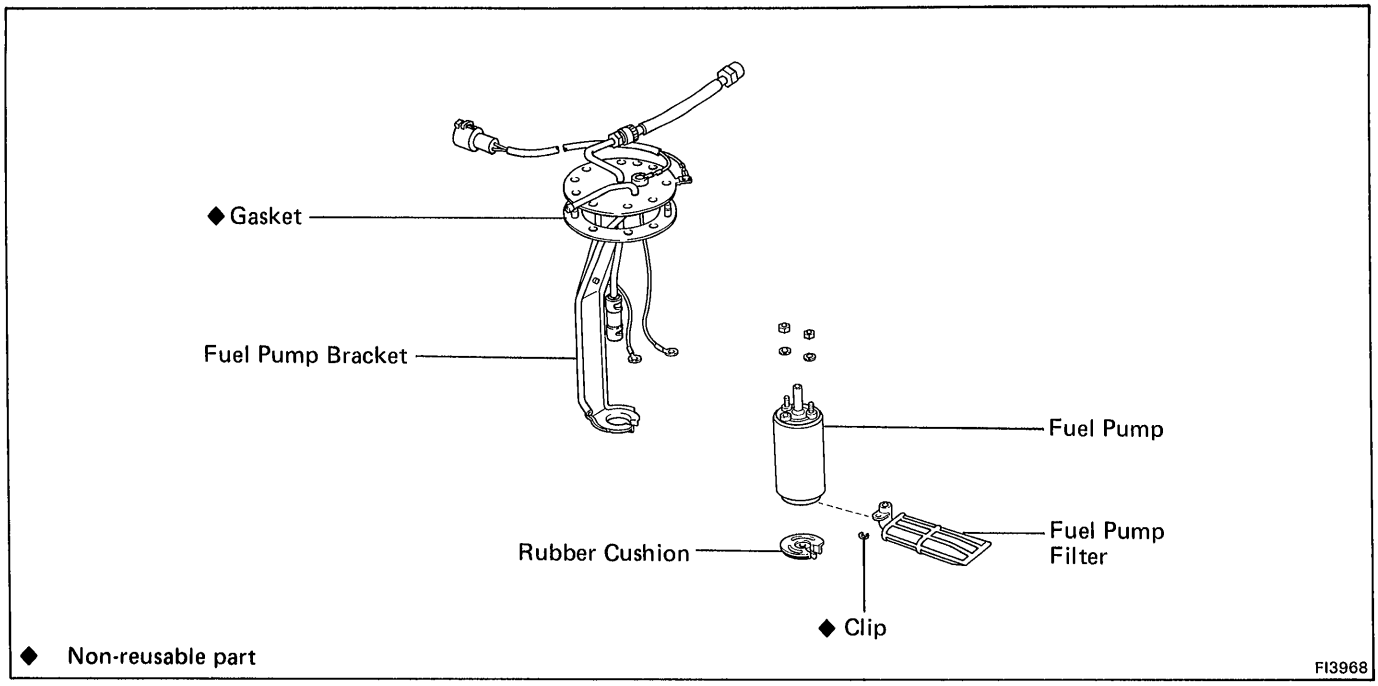
If not within specification, check the fuel pump, pressure regulator and/or injectors.

(s) After checking fuel pressure, disconnect the battery negative terminal and carefully remove the SST to prevent gasoline from splashing.

(t) Using new gaskets, reconnect the No.3 fuel pipe to the delivery pipe.

(u) Start the engine and check for fuel leakage.

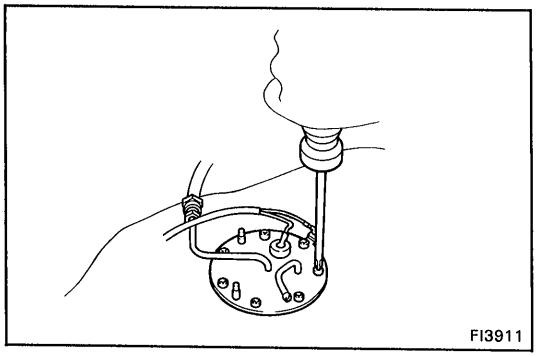
REMOVAL OF FUEL PUMP



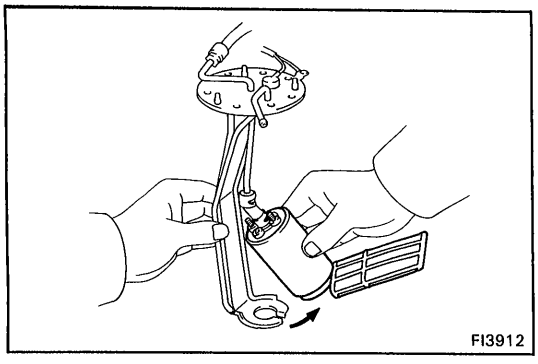
1. **DRAIN FUEL FROM FUEL TANK**

   CAUTION: Do not smoke or work near an open flame when working on the fuel pump.

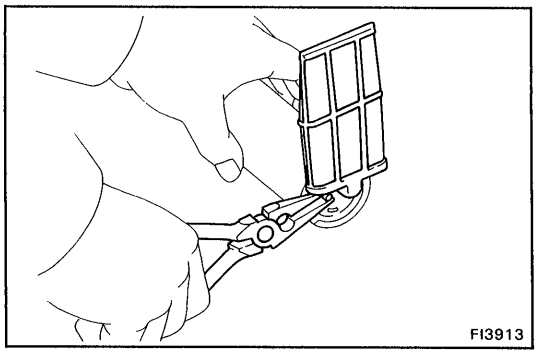
2. **REMOVE FUEL TANK**



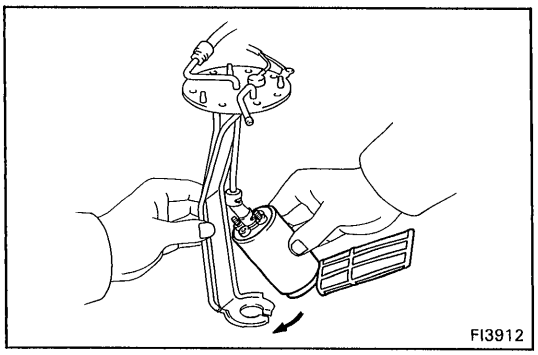
3. **REMOVE FUEL PUMP BRACKET**
   (a) Remove the seven bolts.
   (b) Pull out the fuel pump bracket.

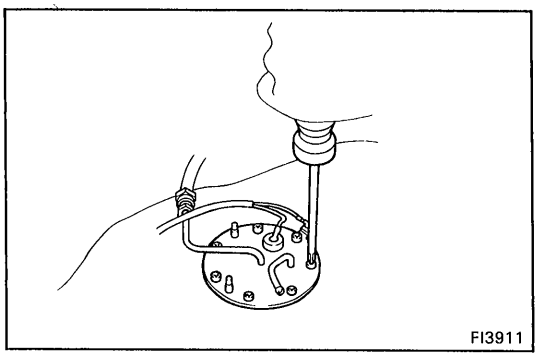


4. **REMOVE FUEL PUMP**
   (a) Remove the two nuts and disconnect the wires from the fuel pump.
   (b) Pull off the fuel pump from the lower side of the bracket.
   (c) Remove the fuel pump from the fuel hose.



5. REMOVE FUEL PUMP FILTER
   (a) Remove the rubber cushion.
   (b) Remove the clip and pull out the filter.





INSTALLATION OF FUEL PUMP

(See page FI-172)

1. INSTALL FUEL PUMP FILTER

2. INSTALL FUEL PUMP
   (a) Insert the outlet port of the fuel pump into the fuel hose.
   (b) Install the rubber cushion to the lower side of the fuel pump.
   (c) Push the lower side of the fuel pump, together with the rubber cushion, into the fuel pump bracket.

3. INSTALL FUEL PUMP BRACKET
   (a) Place the bracket with a new gasket on the fuel tank.
   (b) Install the tighten the seven bolts.

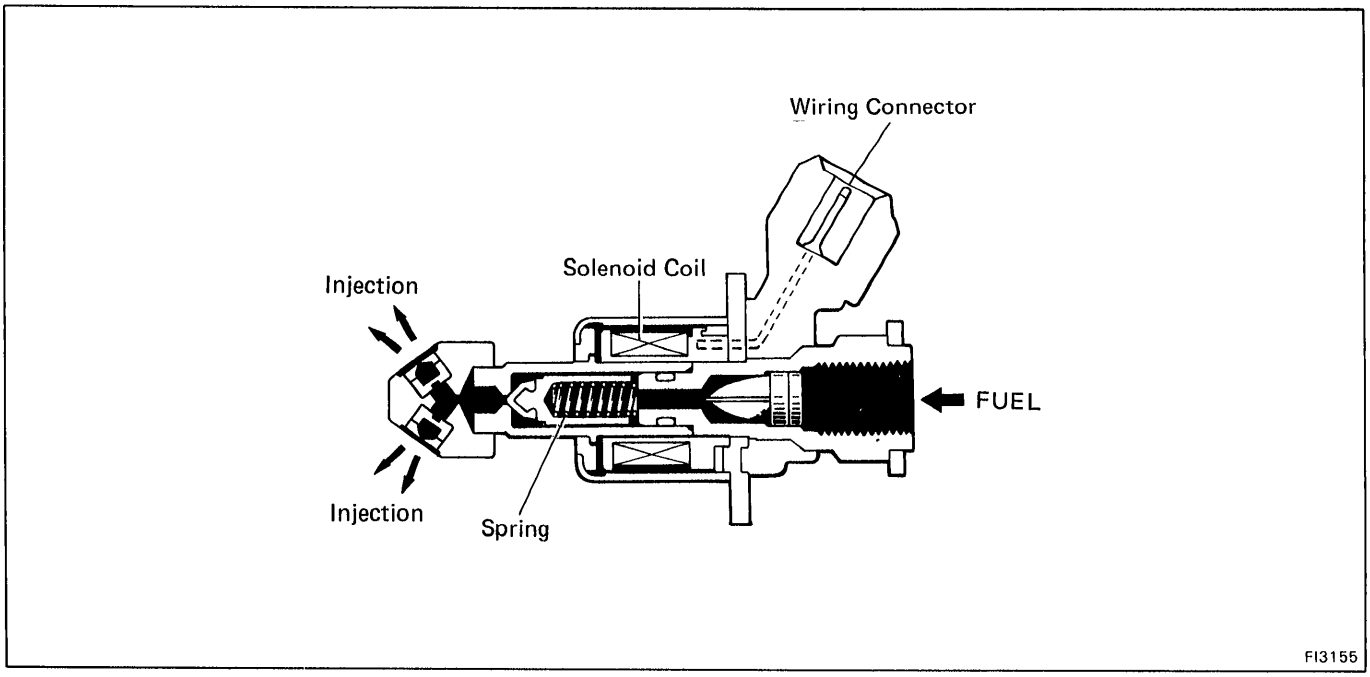
   Torque: 40 kg-cm (34 in.-lb, 3.9 N·m)

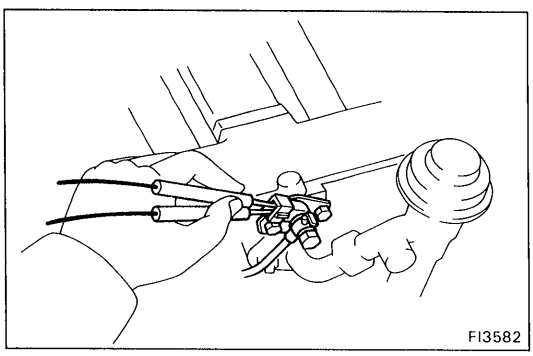
4. INSTALL FUEL TANK

   NOTICE:
   - **Tighten the fuel tank mounting bolts, etc. to the specified torque.**
   - **Tighten the pipe and flare nut type hose to the specified torque.**
   - **Push in the pipe and insert-type hose to the specified position, and install the clip to the specified location.**
   - **If reusing the hose, reinstall the clip at the original location.**

5. REFILL WITH GASOLINE

Cold Start Injector





ON-VEHICLE INSPECTION

MEASURE RESISTANCE OF COLD START INJECTOR

(a) Disconnect the cold start injector connector.

(b) Using an ohmmeter, check the resistance of the injector.

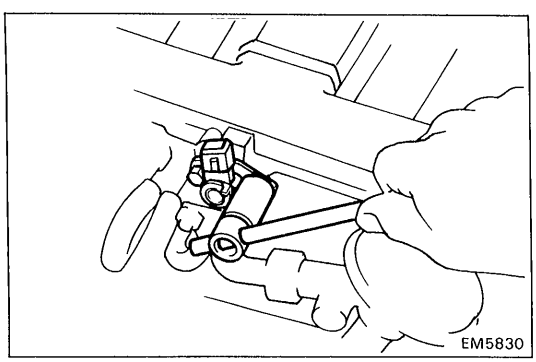
Resistance: 2 — 4 Ω

(c) Connect the cold start injector connector.

REMOVAL OF COLD START INJECTOR

1. DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY

2. DISCONNECT COLD START INJECTOR CONNECTOR



3. REMOVE COLD START INJECTOR

(a) Put a suitable container or shop towel under the cold star injector tube.

(b) Remove the union bolt and two gasket, and disconnect the cold start injector tube.

HINT: Slowly loosen the union bolt.

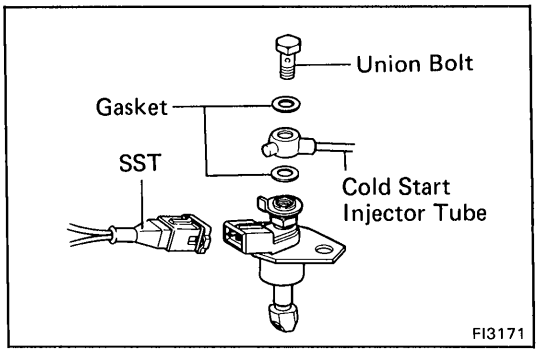
(c) Remove the two bolts and cold start injector with the gasket.

INSPECTION OF COLD START INJECTOR

CHECK INJECTION OF COLD START INJECTOR

HINT: The engine should be cold.

(a) Remove the cold start injector.



(b) Install a gasket, cold start injector tube, another gasket and union bolt to the injector.

(c) Connect the SST (Wire) to the injector.

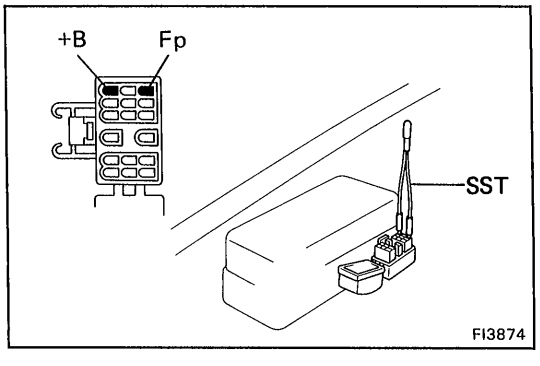
SST 09842-30050

CAUTION: Position the injector as far away from the battery as possible.

(d) Put a container under the injector.

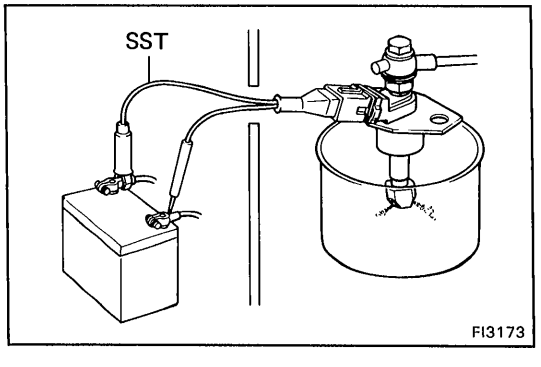
(e) Turn the ignition switch to ON.

HINT: Do not start the engine.



(f) Using SST, connect terminals Fp and +B of the check connector.

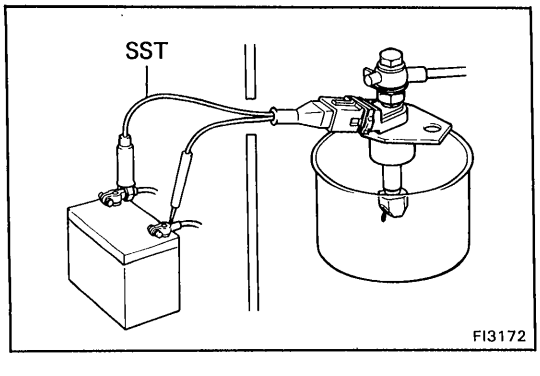
SST 09843-18020



(g) Connect the test probes of the SST to the battery and check that the fuel injection is as shown.

SST 09842-30050

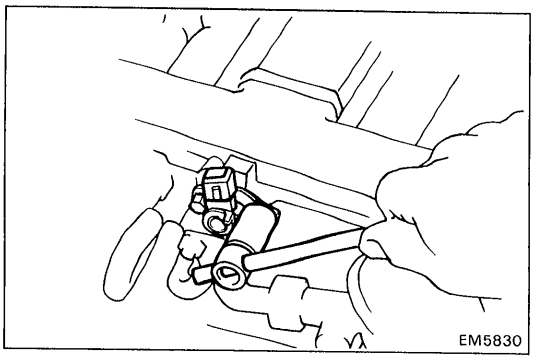
NOTICE: Perform this check within the shortest possible time.

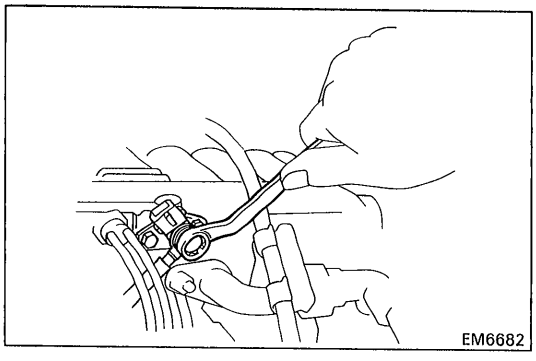


(h) Disconnect the test probes from the battery and check that there is less than one drop of fuel per minute from the injector.

(i) After checking, remove SST and restore the following parts to their original condition.

- Check connector
- Ignition switch OFF
- Cold start injector
- Injector connector





INSTALLATION OF COLD START INJECTOR

1. **INSTALL COLD START INJECTOR**

   (a) Apply sealant to 2 or 3 threads of the bolt end.

   Sealant: Part No. 08833-00070, THREE BOND 1324 or equivalent

   HINT: This adhesive will not harden while exposed to air. It will act as a sealant or binding agent only when applied to threads, etc., where air is cut off.

   (b) Place on a new gasket and install the cold start injector with the two bolts.

   Torque: 80 kg-cm (69 in-lb, 7.8 N·m)

2. **INSTALL COLD START INJECTOR TUBE**

   Using new gaskets, connect the cold start injector tube with the union bolts.

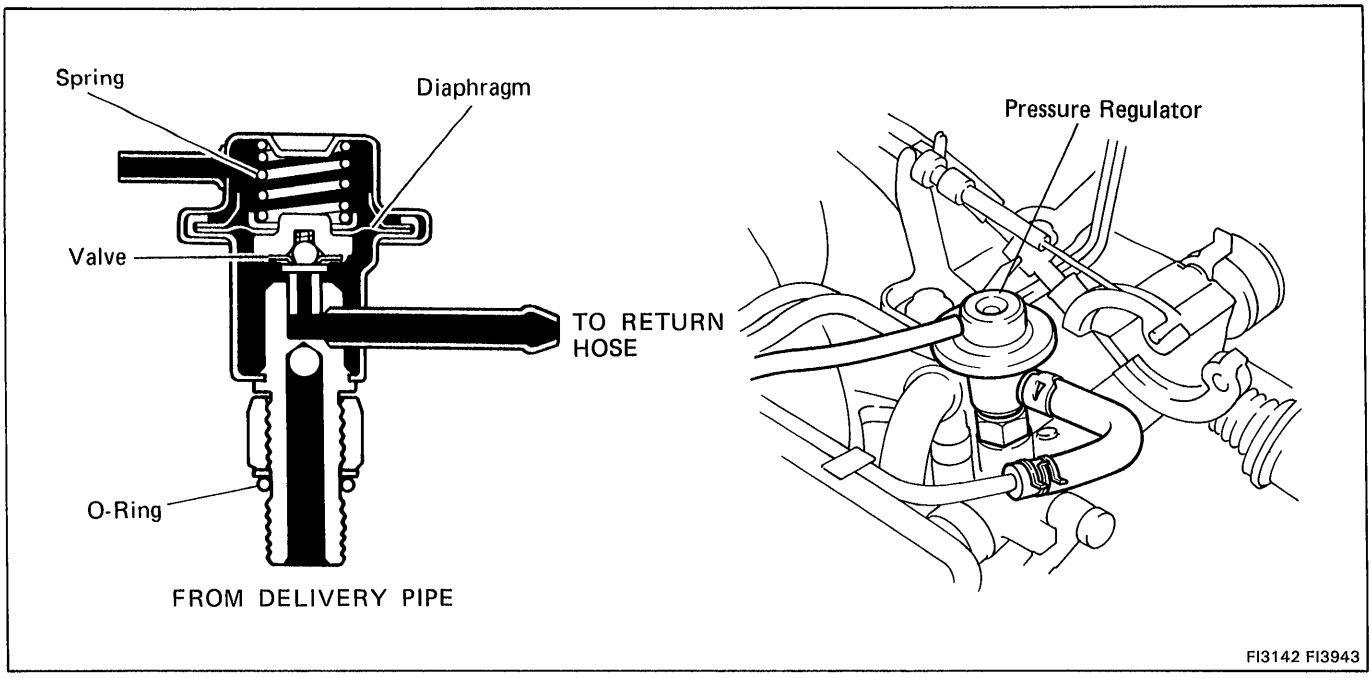
   Torque: 180 kg-cm (13 ft-lb, 18 N·m)

3. **CONNECT COLD START INJECTOR CONNECTOR**

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

5. **CHECK FOR FUEL LEAKAGE**

Pressure Regulator



ON-VEHICLE INSPECTION

CHECK FUEL PRESSURE

(See step 2 on pages FI-169 to 171)

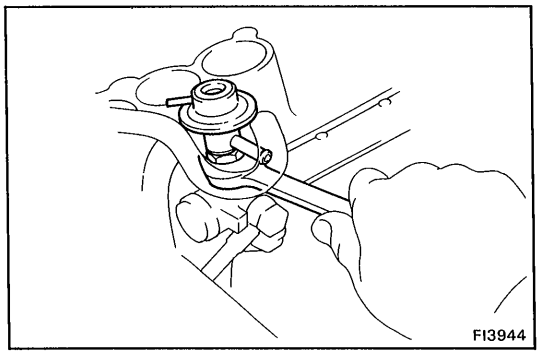
REMOVAL OF PRESSURE REGULATOR

1. **DISCONNECT VACUUM SENSING HOSE**

2. **DISCONNECT FUEL RETURN HOSE**

   (a) Place a suitable container or shop towel under the pressure regulator.

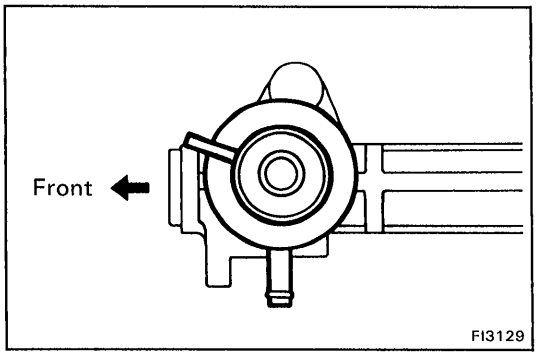
   (b) Disconnect the fuel return hose from the pressure regulator.

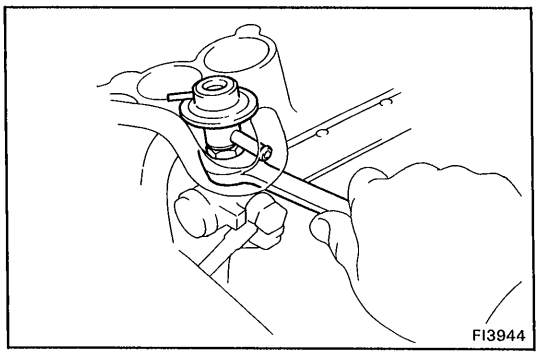


3. **REMOVE AIR INTAKE CHAMBER**
   (See step 3 on pages EM-115, 116)

4. **REMOVE PRESSURE REGULATOR**

   Loosen the lock nut, and remove the pressure regulator.





INSTALLATION OF PRESSURE REGULATOR

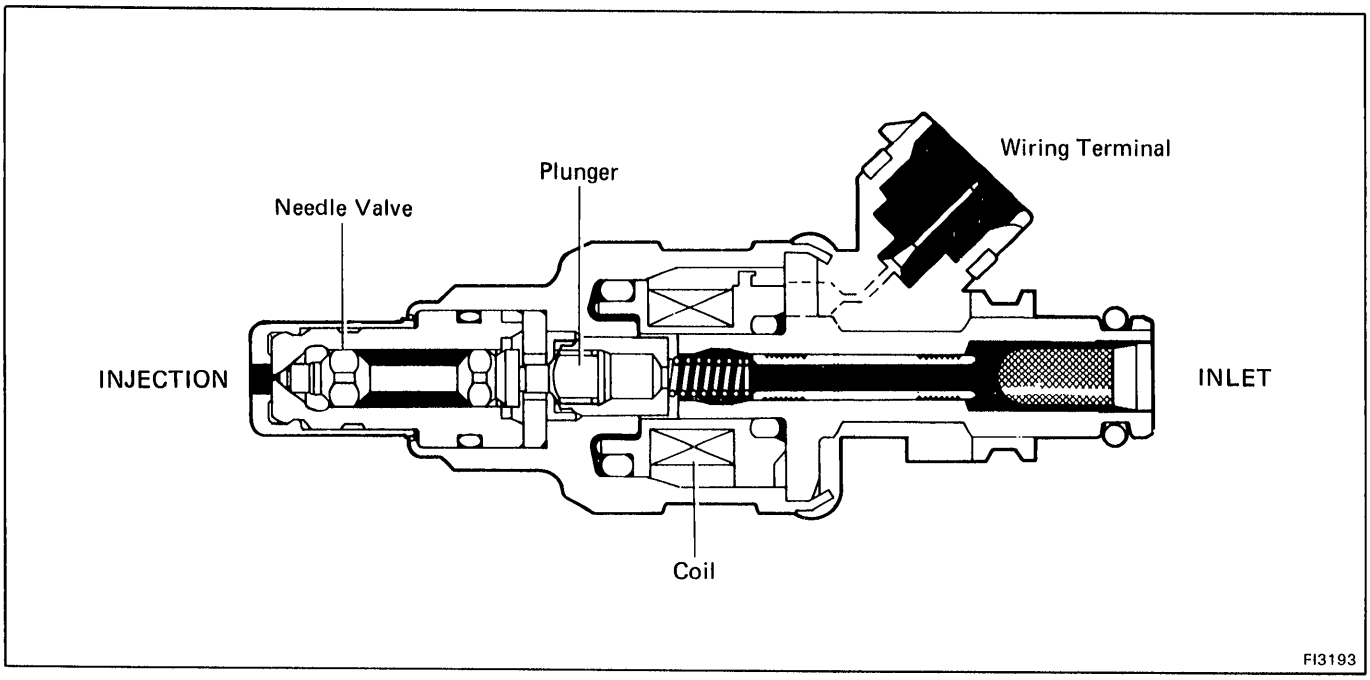
1. **INSTALL PRESSURE REGULATOR**
   (a) Fully loosen the lock nut of the pressure regulator.
   (b) Apply a thin coat of gasoline to a new O-ring and install it to the pressure regulator.
   (c) Thrust the pressure regulator completely into the delivery pipe by hand.
   (d) Turn the pressure regulator counterclockwise until the outlet faces in the direction indicated in the figure.
   (e) Torque the lock nut.
   Torque: 300 kg-cm (22 ft-lb, 29 N·m)

2. **INSTALL AIR INTAKE CHAMBER**
   (See step 18 on pages EM-142 to 144)

3. **CONNECT FUEL RETURN HOSE**

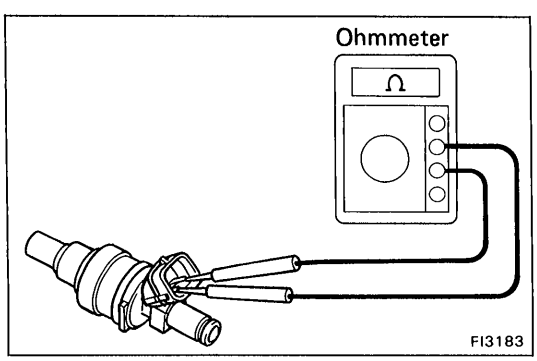
4. **CONNECT VACUUM SENSING HOSE**

Injector



REMOVAL OF INJECTOR

1. **DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY**
2. **DRAIN COOLANT**
3. **REMOVE AIR INTAKE CHAMBER**
   (See step 3 on pages EM-115, 116)
4. **REMOVE ENGINE WIRE**
   (See step 4 on page EM-116)
5. **REMOVE INJECTORS**
   (a) Disconnect the vacuum hose from the BVSV.
   (b) Remove the four union bolts, No.2, No.3 fuel pipes and eight gasket.
   (c) Pull out the injectors from the delivery pipes.
   (d) Remove the O-rings from the injector and spacer.

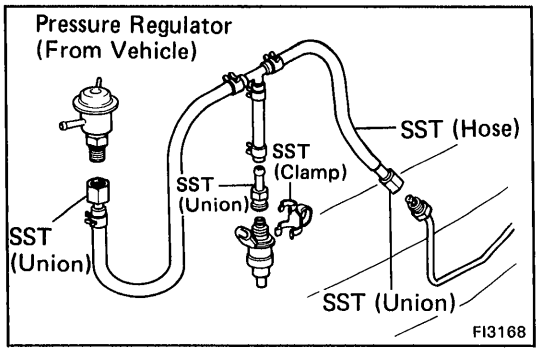


INSPECTION OF INJECTOR

1. **MEASURE RESISTANCE OF INJECTOR**
   Using an ohmmeter, check the resistance of both terminals.
   Resistance: 13.4 — 14.2 Ω

2. TEST INJECTION OF INJECTORS

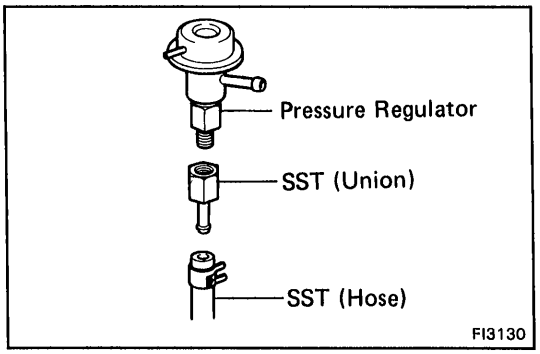
CAUTION: Keep clear of sparks during the test.



(a) Disconnect the No.1 fuel hose from the fuel tube.

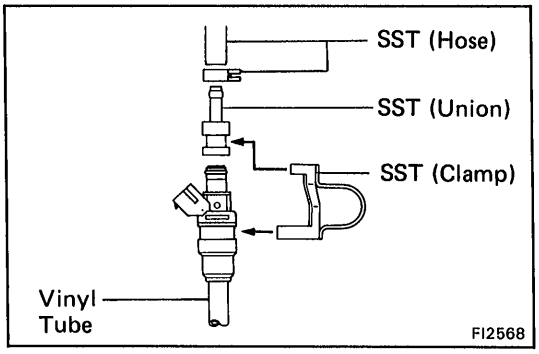
(b) Connect SSTs (Hose and Union) to the fuel tube.

SST 09268-41045 (09268-52010)



(c) Install SST (Union) to the removed pressure regulator.

SST 09268-41045 (09268-52010)



(d) Install SST (Union) to the injector and hold the injector and union with SST (Clamp).

SST 09268-41045

(e) Put the injector into the graduated cylinder.

HINT: Install a suitable vinyl tube onto the injector to prevent gasoline from splashing out.

(f) Connect the battery cable.

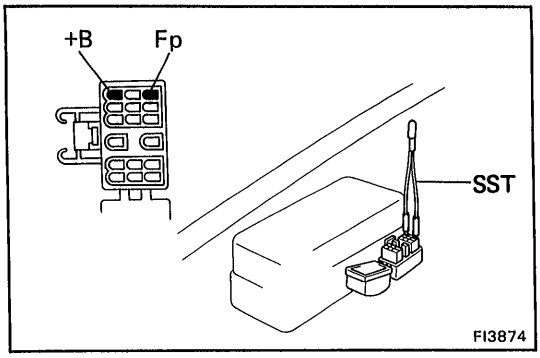
(g) Turn the ignition switch to ON.

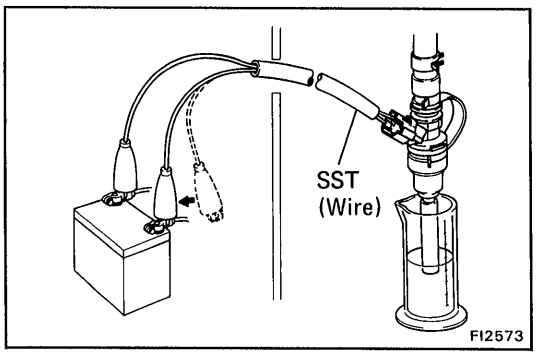
HINT: Do not start the engine.

(h) Using SST, connect terminals Fp and +B of the check connector.

SST 09843-18020

HINT: Fuel pump will operate.





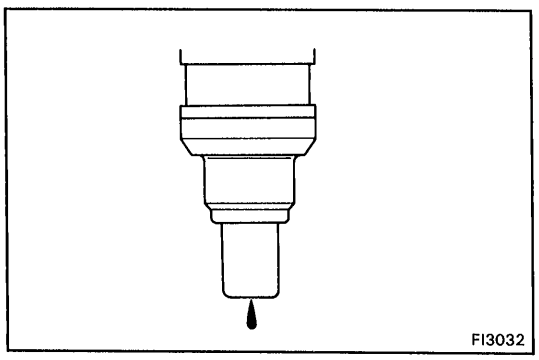
(i) Connect SST (Wire) to the injector and battery for 15 seconds and measure the injection volume with a graduated cylinder. Test each injector two or three times.

SST 09842-30070

Volume: 45 — 55 cc/15 sec. (2.7 — 3.4 cu in.)

Difference between each injector:
Less than 6 cc (0.4 cu in.)

If not within specified volume, replace the injector.



3. CHECK LEAKAGE

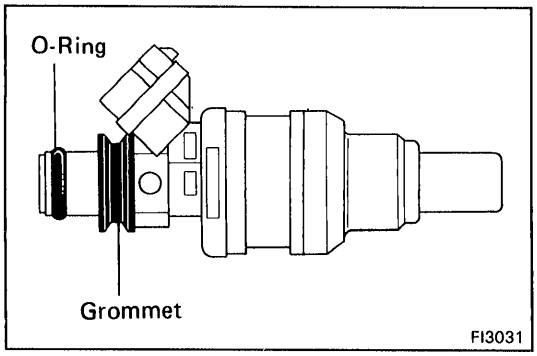
(a) In the condition above, disconnect SST from the battery and check for fuel leakage from the injector nozzle.

SST 09842-30060

Fuel drop: Less than one fuel drop of fuel per minute

(b) Disconnect the battery cable.

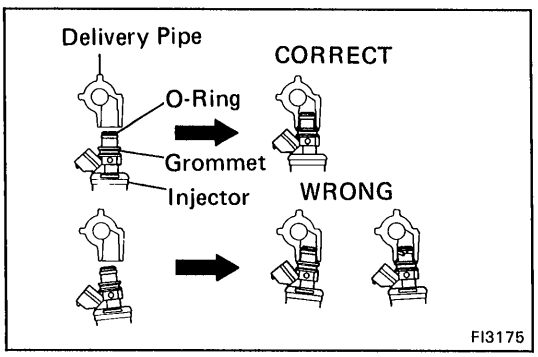
(c) Remove SST.



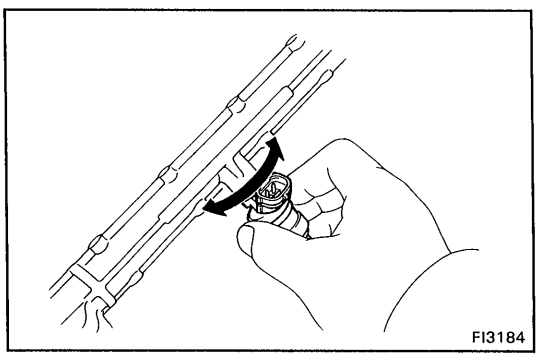
INSTALLATION OF INJECTORS

1. INSTALL INJECTORS INTO DELIVERY PIPES

(a) Install the grommet and a new O-ring on to the injector.



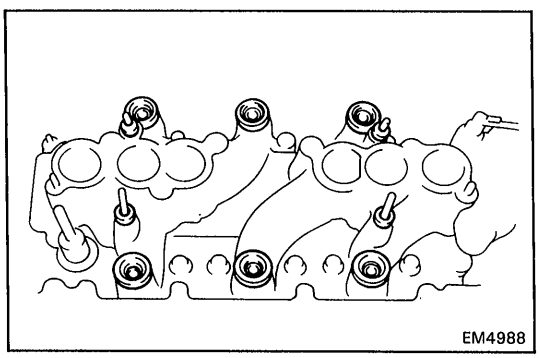
(b) Apply a thin coat of gasoline to the O-rings and install the injectors into the delivery pipes.



(c) Make sure that the injectors rotate smoothly.

HINT: If the injectors do not rotate smoothly, the O-rings are probably incorrectly installed. Replace the O-rings.

2. INSTALL DELIVERY PIPES WITH INJECTORS

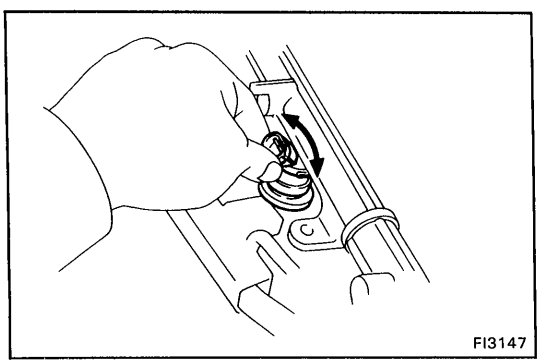


(a) Install a new O-ring on to the spacer.

(b) Install the six spacers with insulator into the injector hole of the intake manifold.

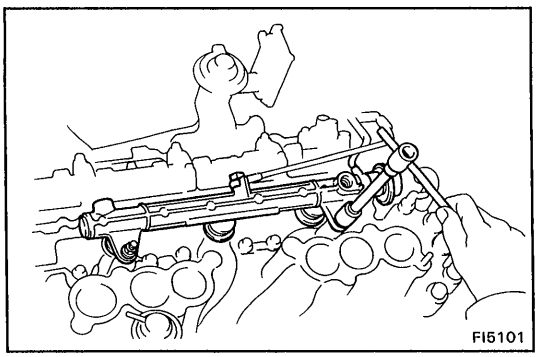
(c) Install the four spacers on the delivery pipe mounting bolt of intake manifold.

(d) Place the injectors together with the delivery pipes on the intake manifold.



(e) Make sure that the injectors rotate smoothly.

HINT: If the injectors do not rotate smoothly, protable cause may be incorrect installation of O-rings, replace O-rings again after removing the injectors.



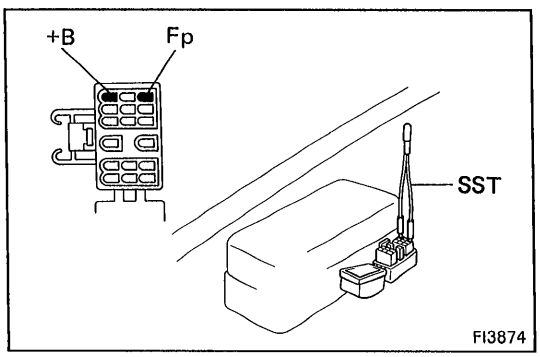
(f) Install the four spacers and nuts.
Torque the nut.

Torque: 130 kg-cm (9 ft-lb, 13 N·m)

3. **INSTALL AIR INTAKE CHAMBER**
(See step 18 on pages EM-142 to 144)

4. **FILL WITH COOLANT**
(See step 3 on page CO-14)

5. **CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY**



6. **CHECK FOR FUEL LEAKAGE**

(a) With the ignition switch ON, use SST to connect terminals Fp and +B of the check connector.

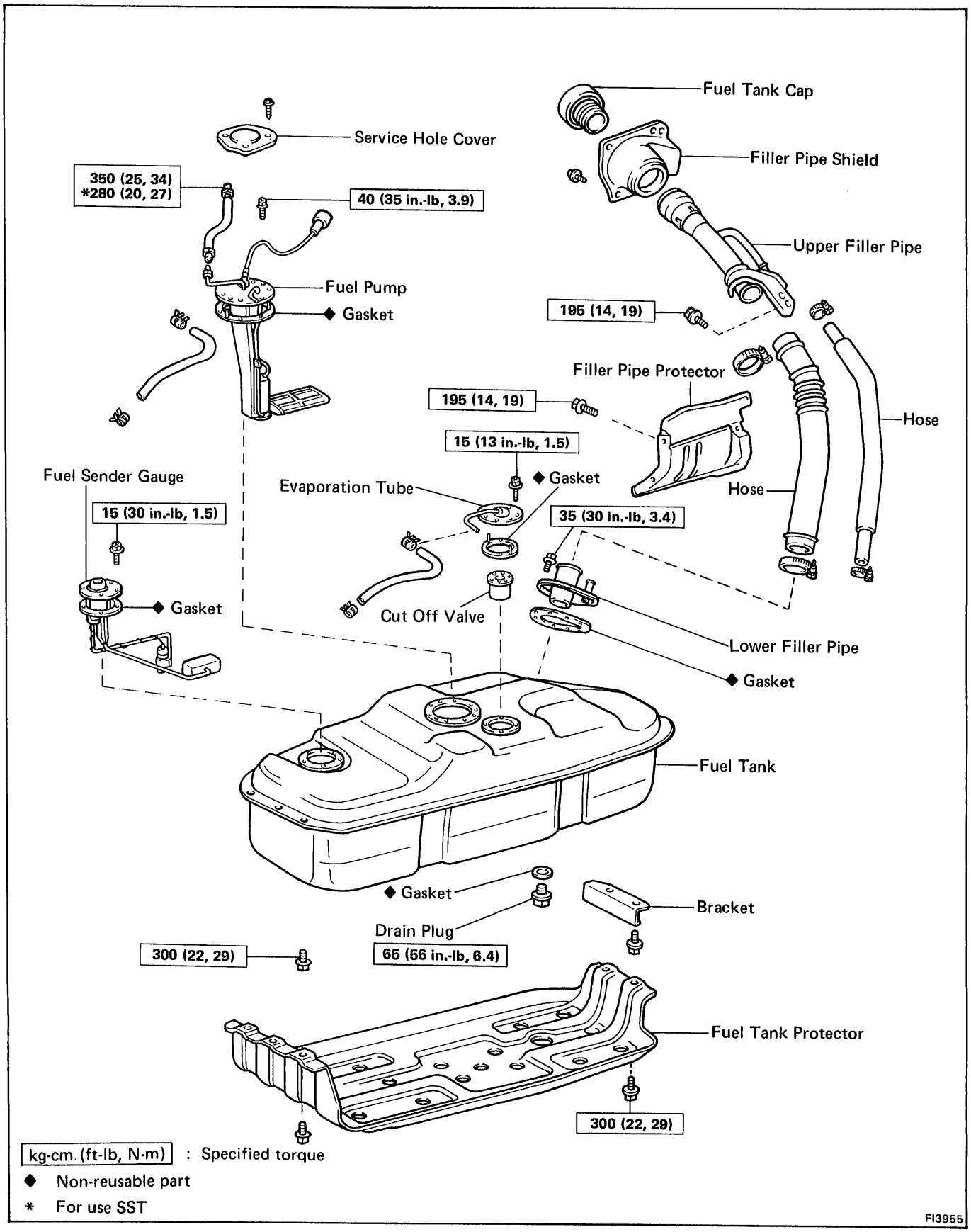
SST 09843-18020

(b) Check for fuel leakage.

(c) Remove SST from the check connector.

Fuel Tank and Line

COMPONENTS



kg-cm (ft-lb, N·m) : Specified torque

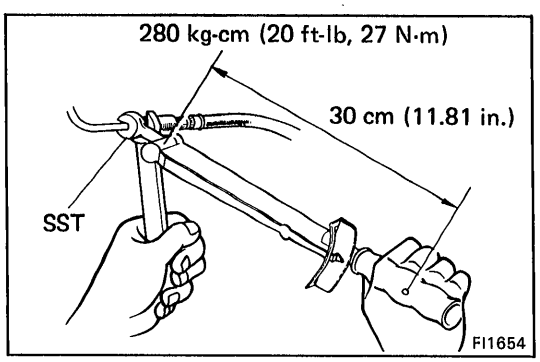
◆ Non-reusable part

* For use SST

FI3955

PRECAUTIONS

1. **Always use new gaskets when replacing the fuel tank or component part.**
2. **Apply the proper torque to all parts tightened.**



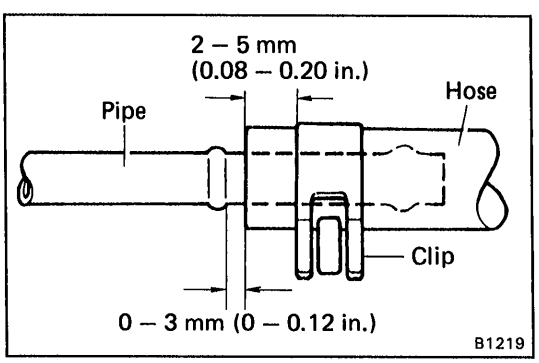
INSPECT FUEL LINES AND CONNECTIONS

(a) Inspect the fuel lines for cracks or leakage, and all connections for deformations.

(b) Inspect the fuel tank vapor vent system hoses and connections for looseness, sharp bends or damage.

(c) Inspect the fuel tank for deformations, cracks or fuel leakage.

(d) Inspect the filler neck for damage or fuel leakage.

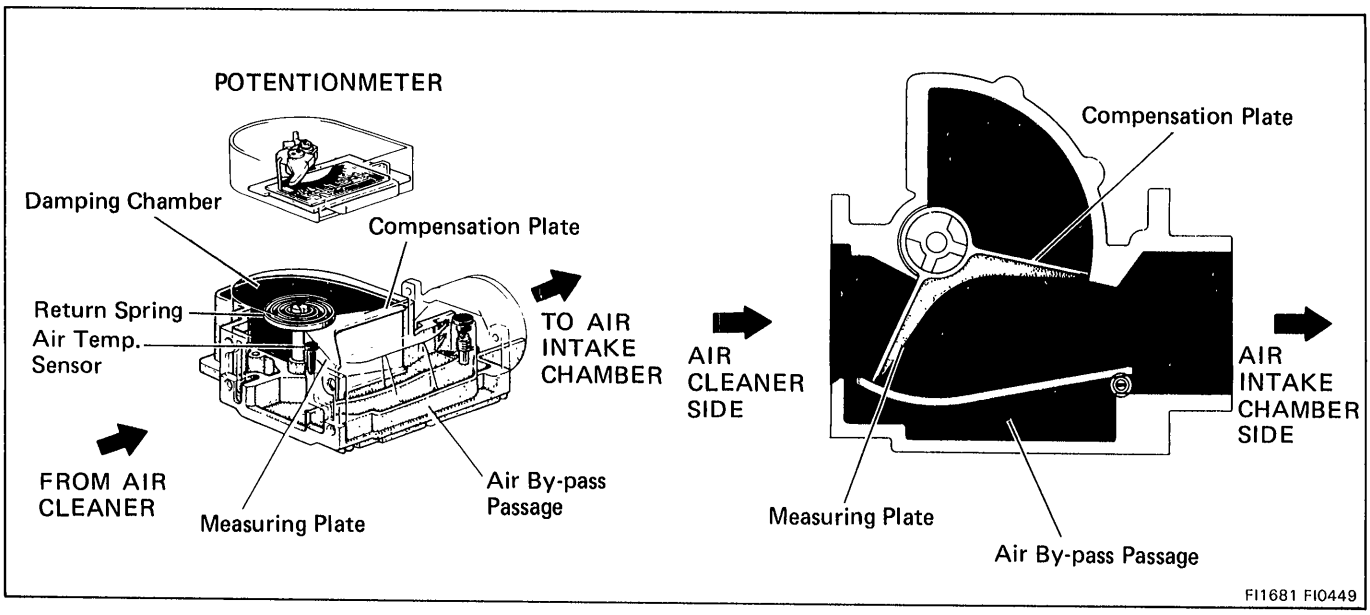


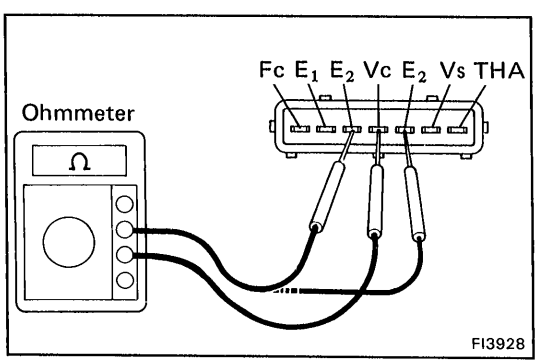
(e) Hose and tube connections are as shown in the illustration.

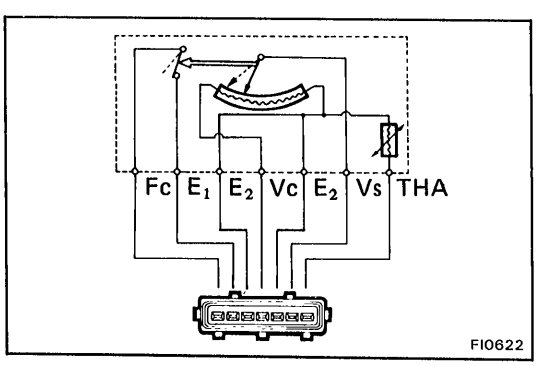
If a problem is found, repair or replace the parts as necessary.

AIR INDUCTION SYSTEM

Air Flow Meter







ON-VEHICLE INSPECTION

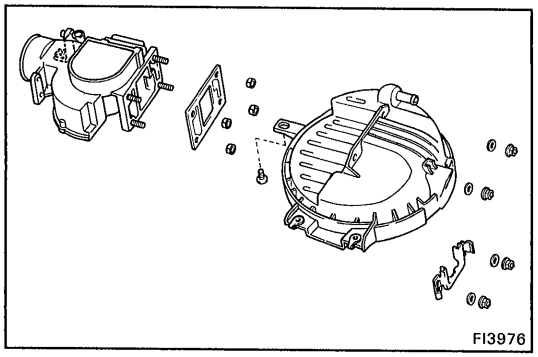
MEASURE RESISTANCE OF AIR FLOW METER

(a) Unplug the connector from the air flow meter.

(b) Using an ohmmeter, measure the resistance between each terminal.

Terminals	Resistance	Temperature
Vs – E_2	200 – 600 Ω	–
Vc – E_2	200 – 400 Ω	–
THA – E_2	10 – 20 kΩ 4 – 7 kΩ 2 – 3 kΩ 0.9 – 1.3 kΩ 0.4 – 0.7 kΩ	–20°C (4°F) 0°C (32°F) 20°C (68°F) 40°C (104°F) 60°C (140°F)
Fc – E_1	Infinity	–

If not within specification, replace the air flow meter.


FI3976

REMOVAL OF AIR FLOW METER

1. REMOVE RESONATOR BRACKET

(a) Disconnect the two hoses.

(b) Remove the two bolts and resonator bracket.

2. REMOVE AIR CLEANER CAP WITH AIR FLOW METER

(a) Disconnect the air flow meter connector.

(b) Remove the air cleaner cap with air flow meter.

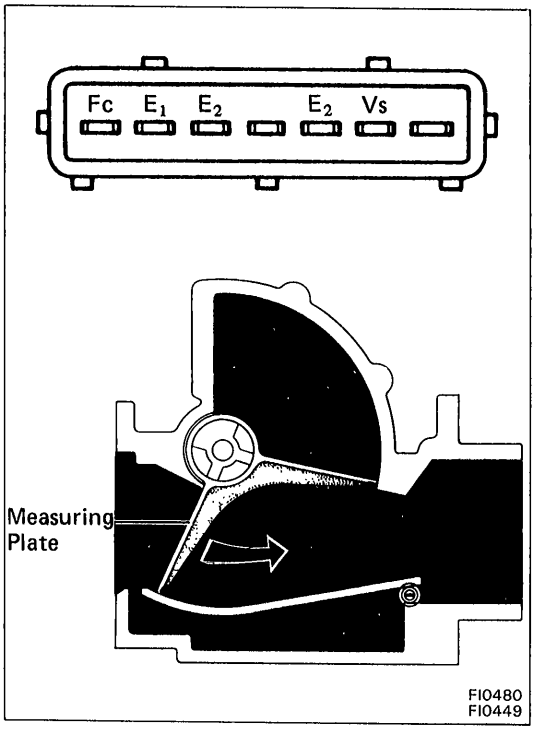
3. REMOVE AIR FLOW METER

Remove the bolt, four washers, air flow meter and gasket.

INSPECTION OF AIR FLOW METER

MEASURE RESISTANCE OF AIR FLOW METER

Using an ohmmeter, measure the resistance between each terminal by moving the measuring plate.



FI0480
FI0449

Between terminals	Resistance (Ω)	Measuring plate opening
E_1 – Fc	Infinity	Fully closed
	Zero	Other than closed position
E_2 – Vs	200 – 600	Fully closed
	20 – 1,200	Fully open

HINT: Resistance between Terminals E_2 and Vs will change in a wave pattern as the measuring plate slowly opens.

INSTALLATION OF AIR FLOW METER

1. INSTALL AIR FLOW METER

Install the gasket, air flow meter, washers, nuts and bolt. Torque the nuts and bolts.

2. INSTALL AIR CLEAER CAP WITH AIR FLOW METER

(a) Install the air cleaner cap with air flow meter to the air cleaner case.

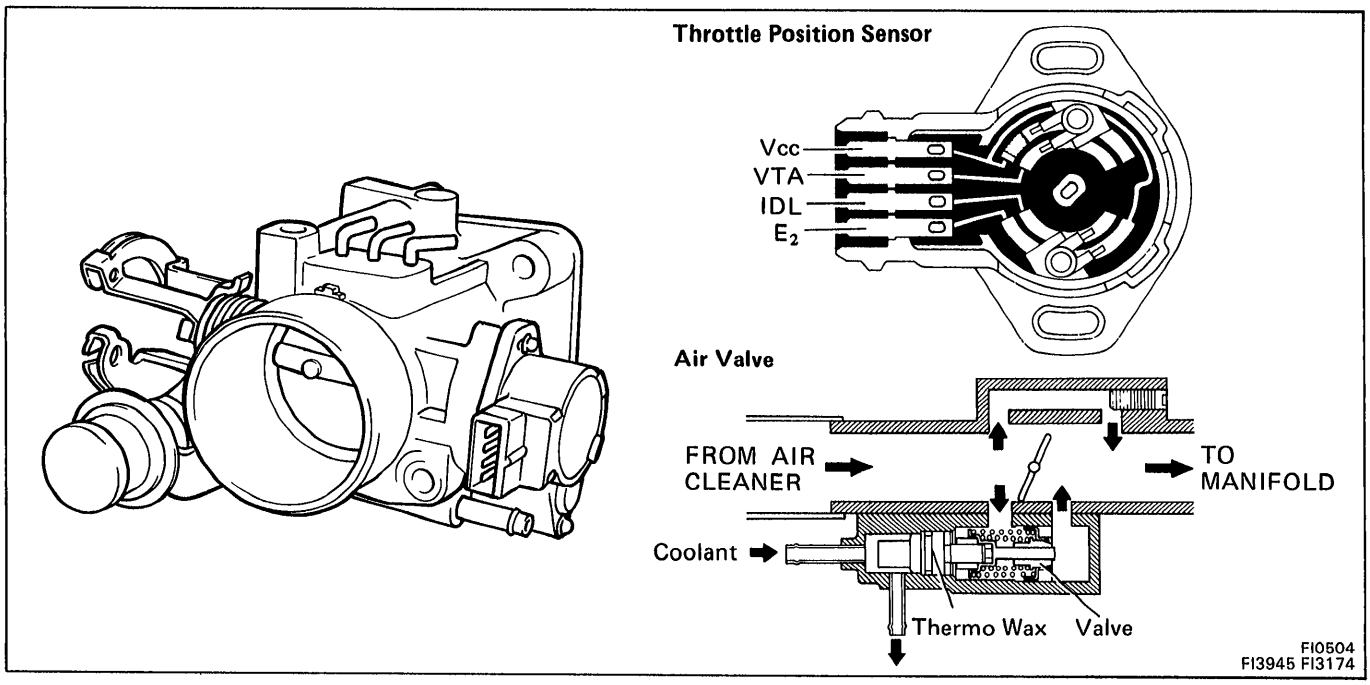
(b) Connect the air flow meter connector.

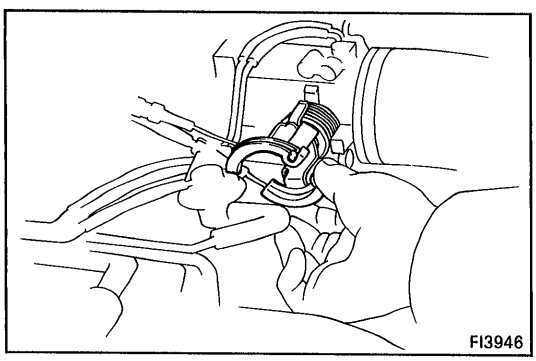
3. INSTALL RESONATOR BRACKET

(a) Install the resonator bracket with two bolts.

(b) Connect the two hoses.

Throttle Body

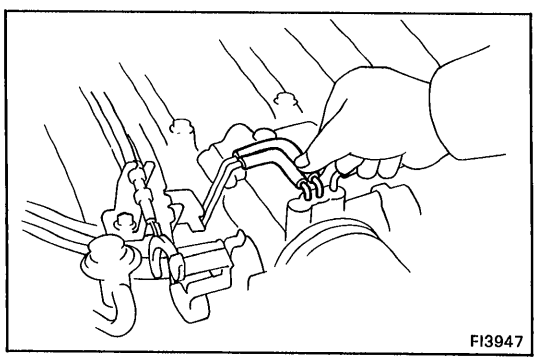




ON-VEHICLE INSPECTION

1. CHECK THROTTLE BODY

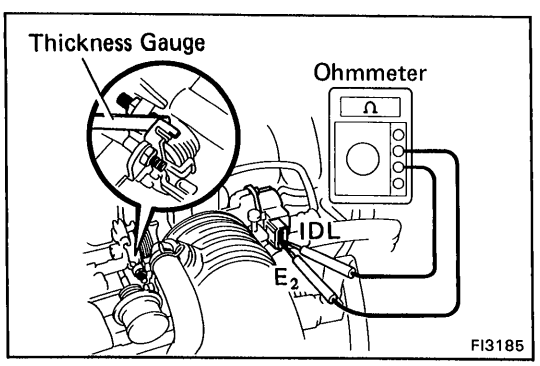
(a) Check that the throttle linkage moves smoothly.



(b) Check the vacuum at each port.

- Start the engine.
- Check the vacuum with your finger.

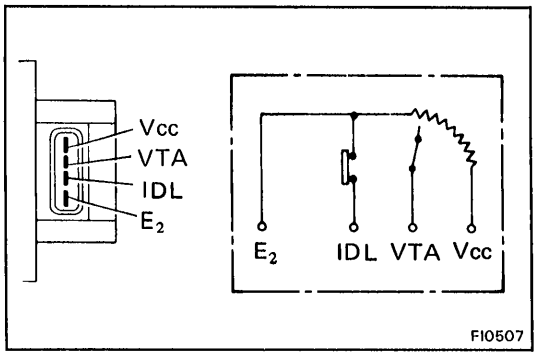
Port name	At idling	At 3,500 rpm
E	No vacuum	Vacuum
R	No vacuum	Vacuum
P	No vacuum	Vacuum



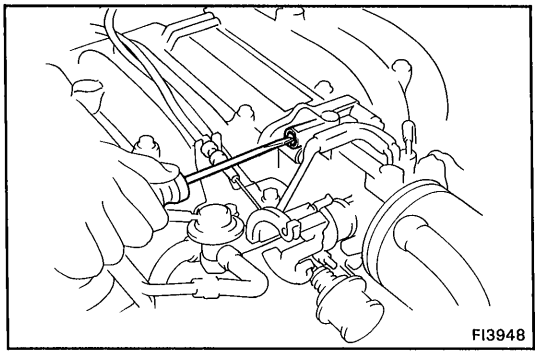
2. CHECK THROTTLE POSITION SENSOR

Check the resistance between the terminals.

- Unplug the connector from the sensor.
- Insert a thickness gauge between the throttle stop screw and stop lever.
- Using an ohmmeter, check the resistance between each terminal.



Clearance between lever and stop screw	Between terminals	Resistance
0 mm (0 in.)	VTA – E_2	0.2 – 0.8 kΩ
0.50 mm (0.0197 in.)	IDL – E_2	Less than 2.3 kΩ
0.77 mm (0.0303 in.)	IDL – E_2	Infinity
Throttle valve fully opened position	VTA – E_2	3.3 – 10 kΩ
–	Vcc – E_2	4 – 9 kΩ



3. INSPECT AIR VALVE OPERATION

Check the engine rpm by fully screwing in the idle speed adjusting screw.

At low temp. (Coolant temp.: below 80°C (176°F))

- When the idle speed adjusting screw is in, the engine rpm should drop.

After warm-up

- When the idle speed adjusting screw is in, the engine rpm should drop below idle speed stop.

REMOVAL OF THROTTLE BODY

1. DRAIN COOLANT FROM THROTTLE BODY

2. DISCONNECT FOLLOWING CABLES:

(a) (w/ Cruise control)
Control cable

(b) Accelerator cable

(c) (A/T)
Throttle cable

3. DISCONNECT AIR CLEANER HOSE

4. DISCONNECT THROTTLE POSITION SENSOR CONNECTOR

5. DISCONNECT VACUUM HOSES

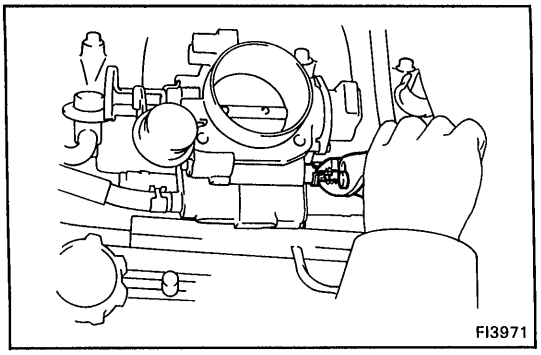
6. REMOVE ACCELERATOR CABLE

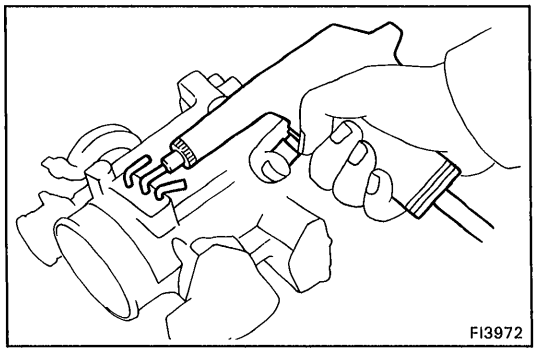
7. DISCONNECT WATER NO.4 WATER BY-PASS HOSE

8. REMOVE THROTTLE BODY

(a) Remove the four bolts, throttle body and the gasket.

(b) Disconnect the No.5 water by-pass hose from throttle body.





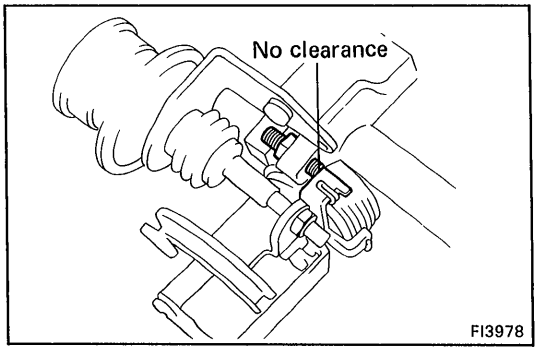
INSPECTION OF THROTTLE BODY

1. CLEAN THROTTLE BODY BEFORE INSPECTION

(a) Wash and clean the cast parts with a soft brush and carburetor cleaner.

(b) Using compressed air, below all passages and apertures in the throttle body.

NOTICE: To prevent deterioration, do not clean the throttle position sensor and dash pot.

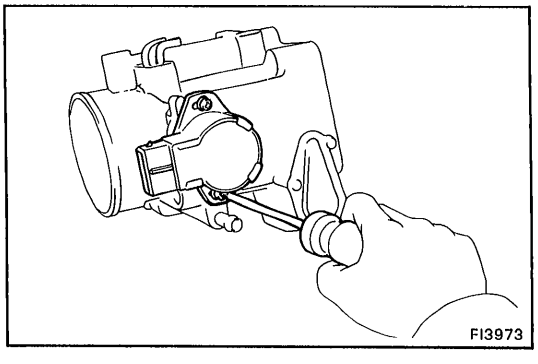


2. CHECK THROTTLE VALVE

Check that there is no clearance between the throttle stop screw and throttle lever when the throttle valve is fully closed.

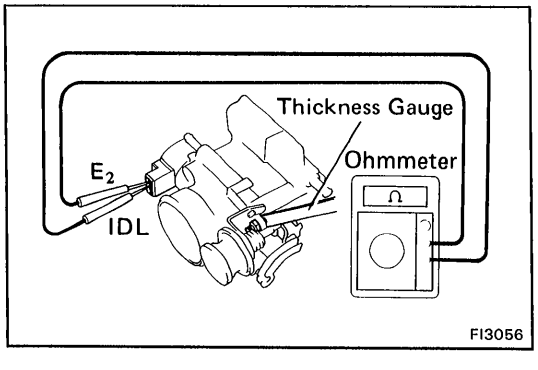
3. CHECK THROTTLE POSITION SENSOR

(See step 2 on pages FI-188, 189)

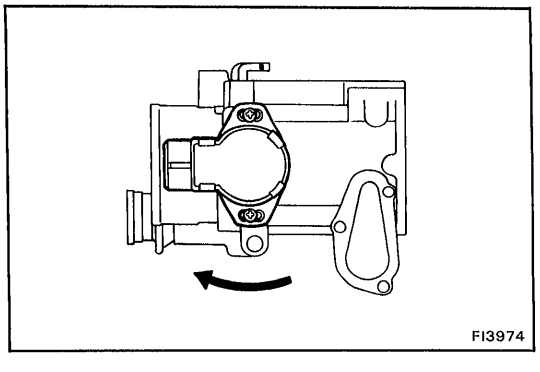


4. IF NECESSARY, ADJUST THROTTLE POSITION SENSOR

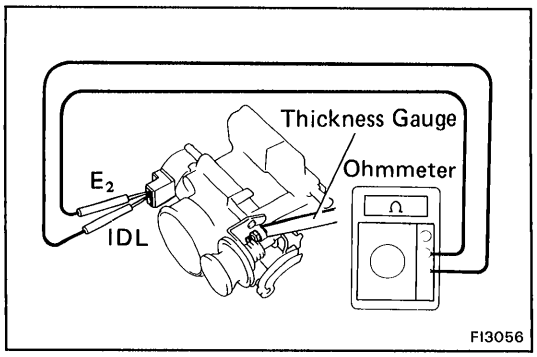
(a) Loosen the two screws of the sensor.



(b) Insert a thickness gauge (0.62 mm or 0.0244 in.) between the throttle stop screw and lever, and connect the ohmmeter to terminals IDL and E_2.



(c) Gradually turn the sensor clockwise until the ohmmeter deflects, and secure the sensor with two screws.



(d) Using a thickness gauge, recheck the continuity between terminals IDL and E_2.

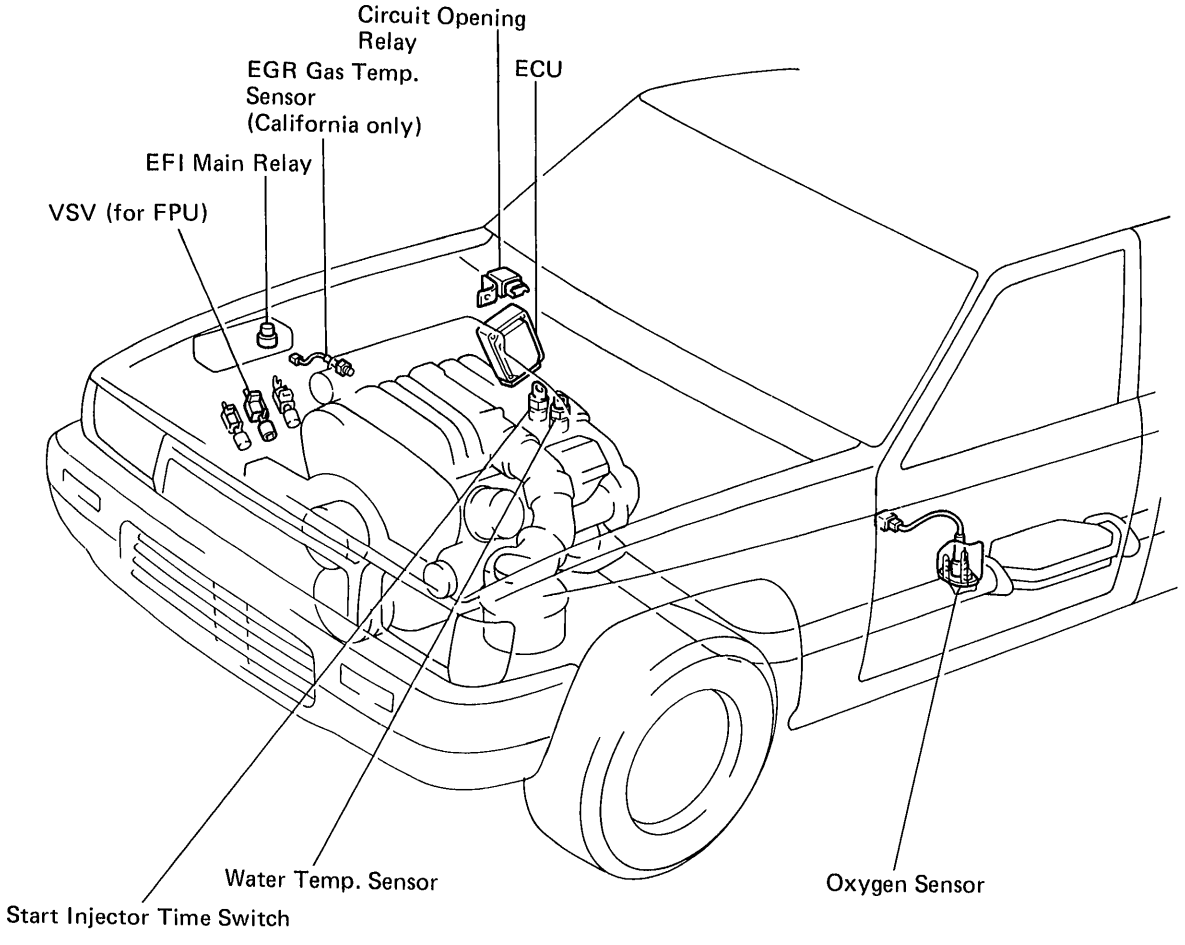
Clearance between lever and stop screw	Continuity (IDL – E_2)
0.50 mm (0.0197 in.)	Continuity
0.77 mm (0.0303 in.)	No continuity

INSTALLATION OF THROTTLE BODY

1. **INSTALL THROTTLE BODY**
   (a) Connect the No.5 water by-pass hose to throttle body.
   (b) Place on a new gasket and install the throttle body with four bolts.
   Torque: 185 kg-cm (13 ft-lb, 18 N·m)
2. **CONNECT NO.4 WATER BY-PASS HOSE**
3. **INSTALL ACCELERATOR CABLE BRACKET**
4. **CONNECT VACUUM HOSES**
5. **CONNECT THROTTLE POSITION SENSOR CONNECTOR**
6. **CONNECT AIR CLEANER HOSE**
7. **CONNECT FOLLOWING CABLES:**
   (a) (A/T)
   Throttle cable
   (b) Accelerator cable
   (c) (w/ Cruise control)
   Controle cable
8. **REFILL WITH COOLANT**

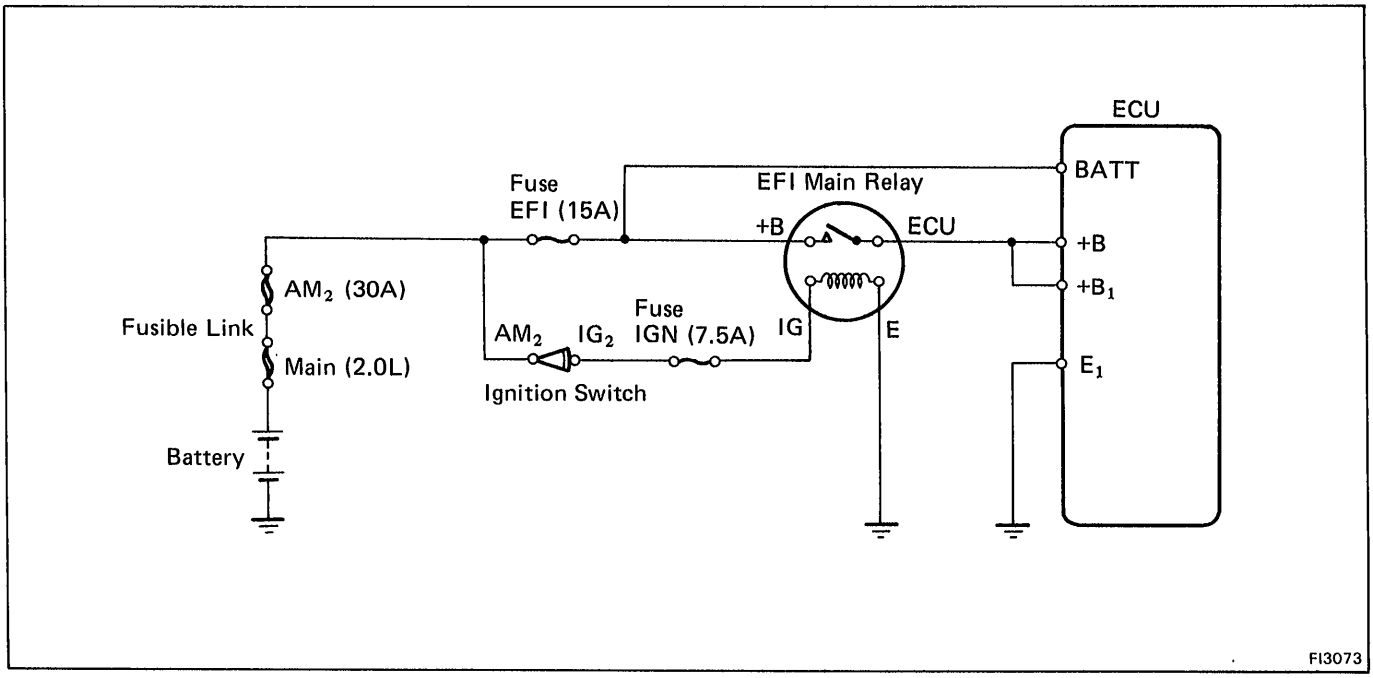
ELECTRONIC CONTROL SYSTEM

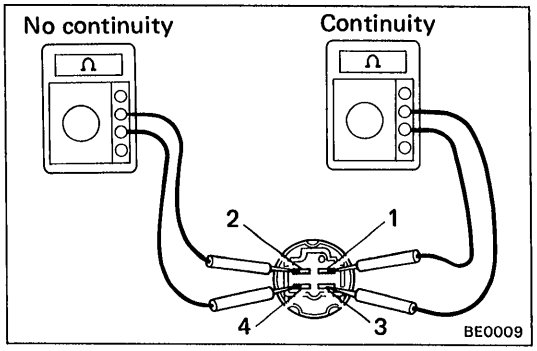
Location of Electronic Control Parts

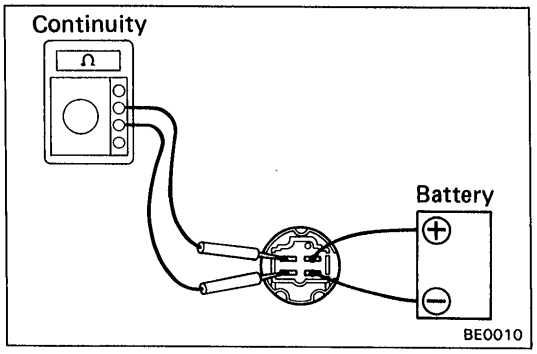


FI3979

EFI Main Relay







INSPECTION OF EFI MAIN RELAY

1. INSPECT RELAY CONTINUITY

(a) Using an ohmmeter, check that there is continuity between terminals 1 and 3.

(b) Check that there is no continuity between terminals 2 and 4.

(c) Check that there is no continuity between terminals 3 and 4.

If continuity is not as specified, replace the relay.

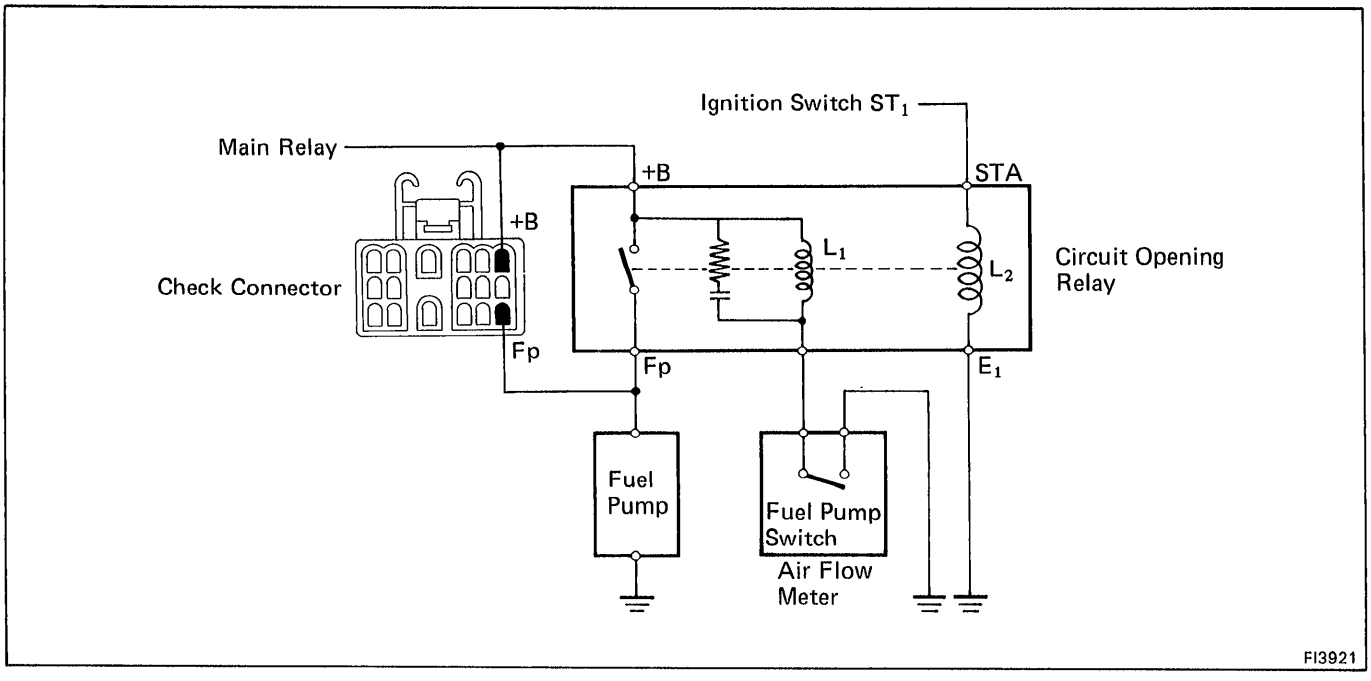
2. INSPECT RELAY OPERATION

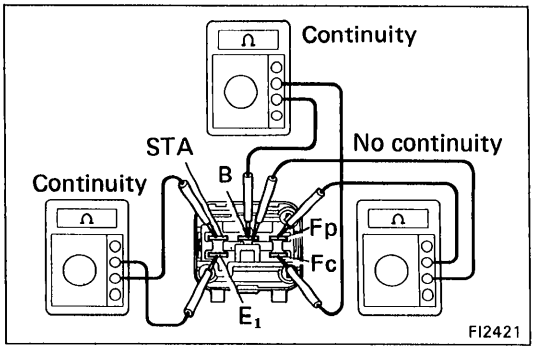
(a) Apply battery voltage across terminals 1 and 3.

(b) Using an ohmmeter, check that there is continuity between terminals 2 and 4.

If operation is not as specified, replace the relay.

Circuit Opening Relay





INSPECTION OF CIRCUIT OPENING RELAY

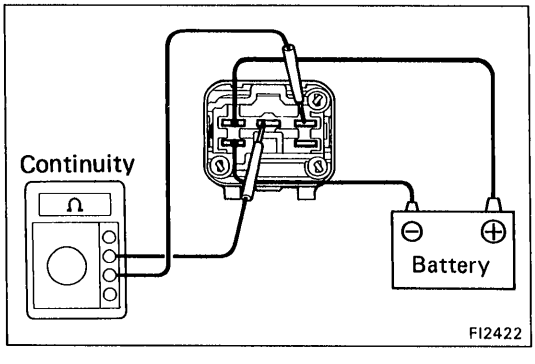
1. INSPECT RELAY COUNTINUITY

(a) Using an ohmmeter, check that there is continuity between terminals STA and E_1.

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

(c) Check that there is no continuity between terminals B and F_P.

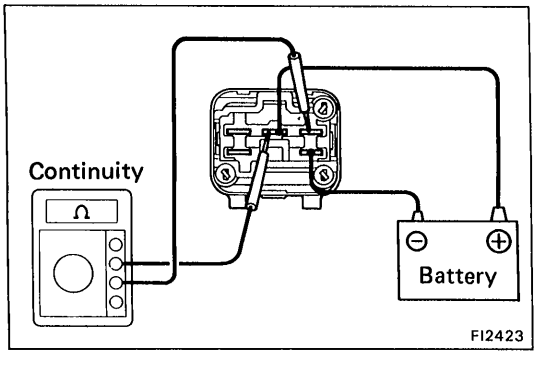
If continuity is not as specified, replace the relay.



2. INSPECT RELAY OPERATION

(a) Apply battery voltage across terminals STA and E_1.

(b) Using an ohmmeter, check that there is continuity between terminals B and F_P.

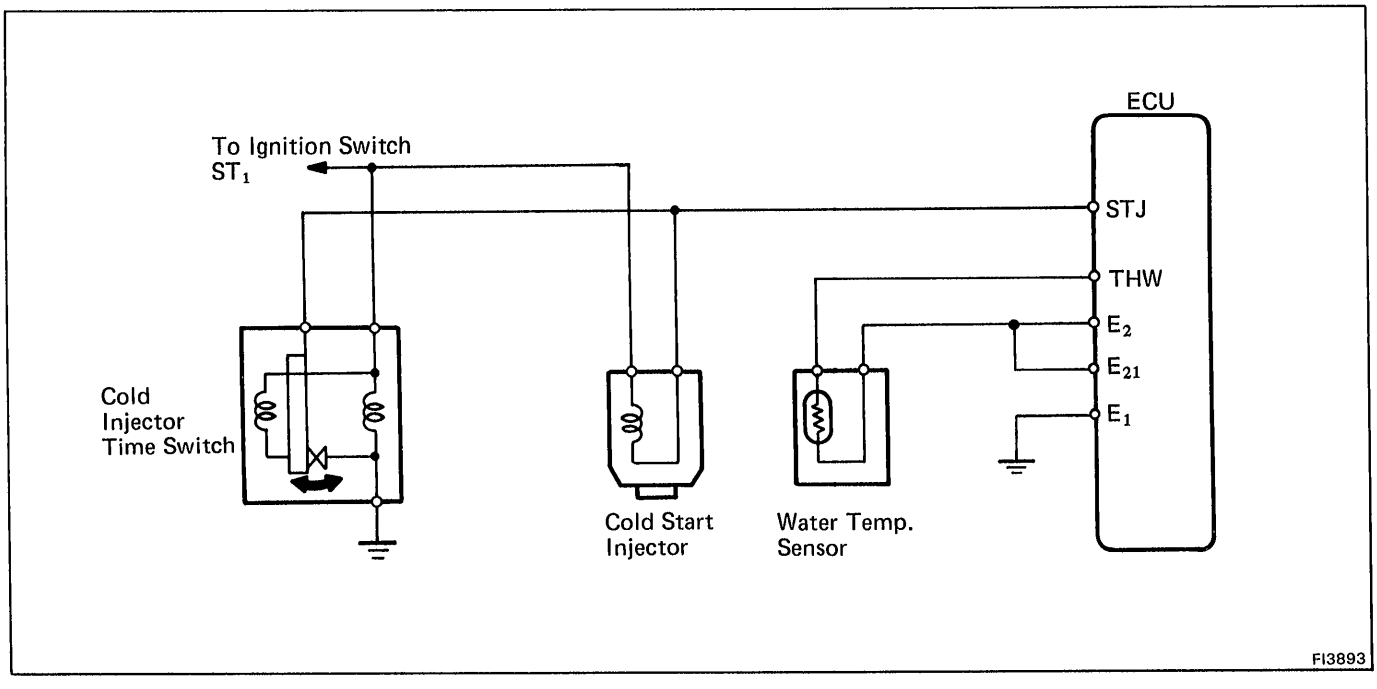


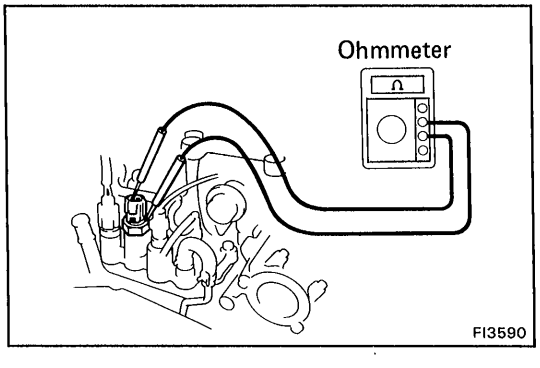
(c) Apply battery voltage across terminals B and F_C.

(d) Check that there is continuity between terminals B and F_P.

If operation is not as specified, replace the relay.

Start Injector Time Switch





INSPECTION OF START INJECTOR TIME SWITCH

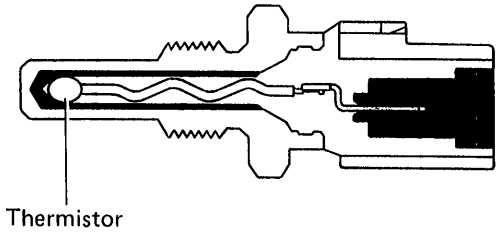
MEASURE RESISTANCE OF START INJECTOR TIME SWITCH

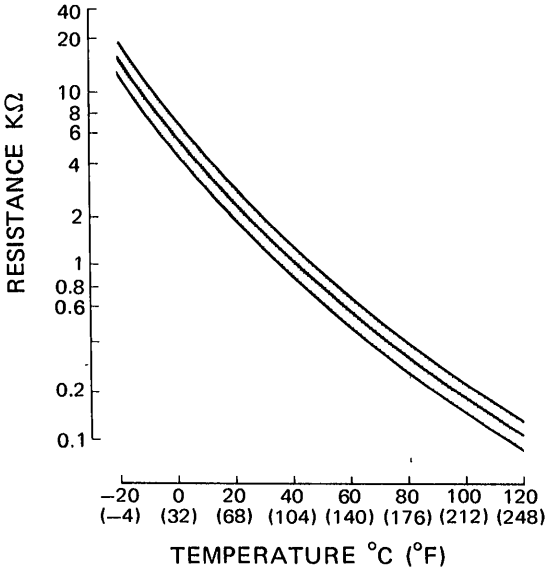
(a) Disconnect the connector.

(b) Using an ohmmeter, measure the resistance between terminals.

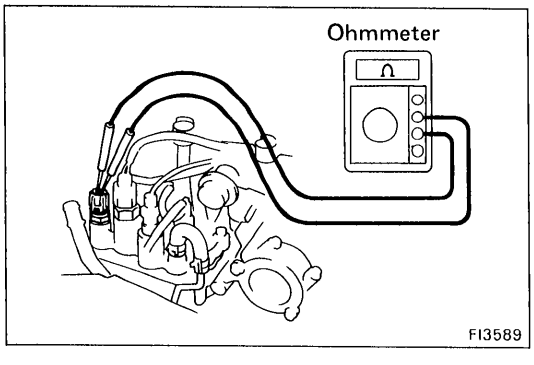
Between terminals	Resistance (Ω)	Coolant temperature
STA – STJ	30 – 50	Below 10°C (50°F)
	70 – 90	Above 25°C (77°F)
STA – Ground	30 – 90	–

Water Temp. Sensor





FI3524 FI0709



FI3589

INSPECTION OF WATER TEMP. SENSOR

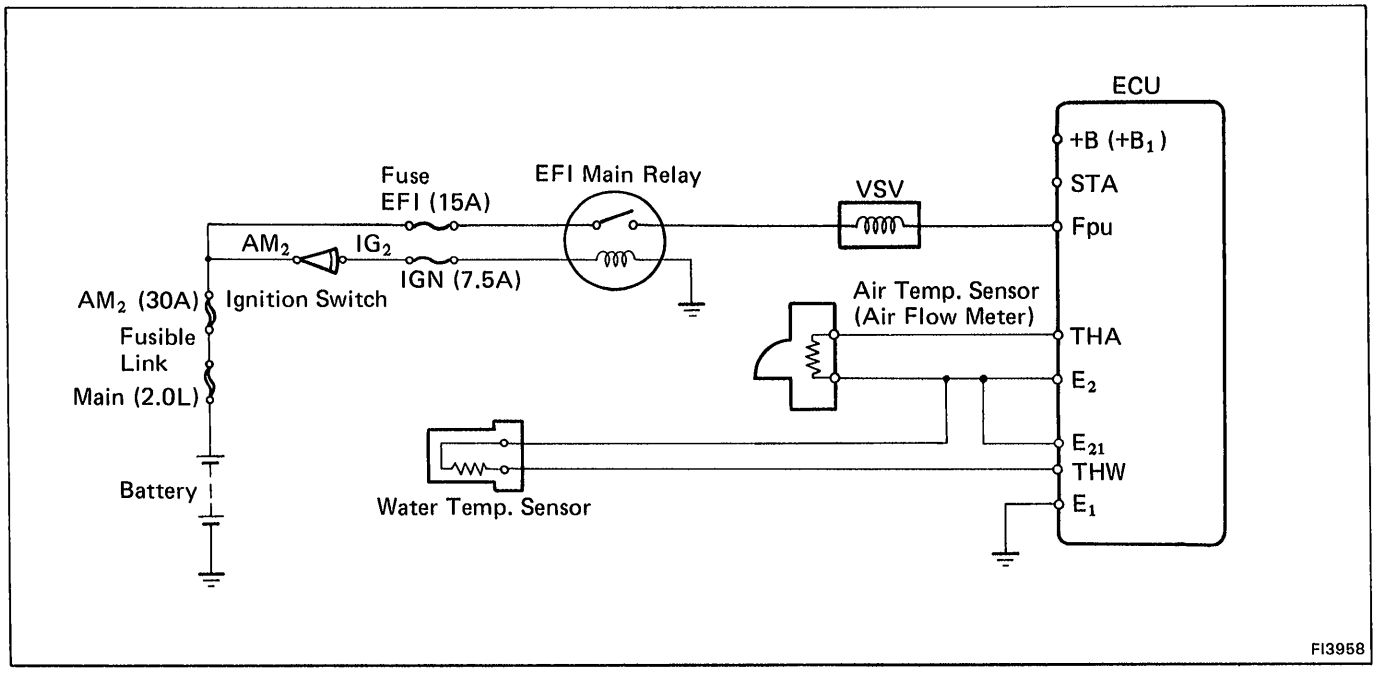
MEASURE RESISTANCE OF WATER TEMP. SENSOR

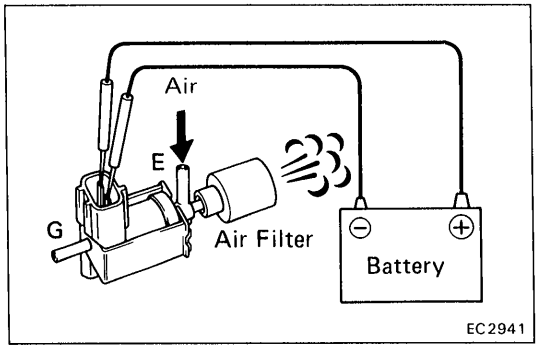
(a) Disconnect the connector.

(b) Using an ohmmeter, measure the resistance between terminals.

Resistance: Refer to chart above.

High Temp. Line Pressure Up System



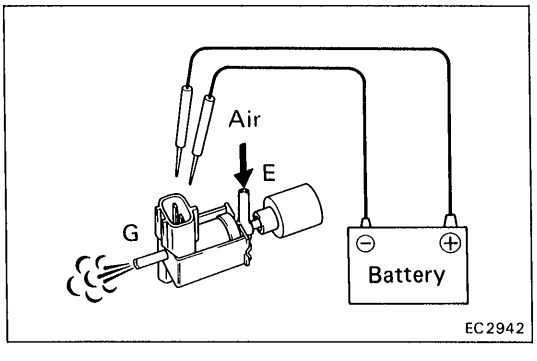


INSPECTION OF VSV

1. **CHECK VACUUM CIRCUIT CONTINUITY IN VSV BY BLOWING AIR INTO PIPE**

   (a) Connect the VSV terminals to the battery terminals as illustrated.

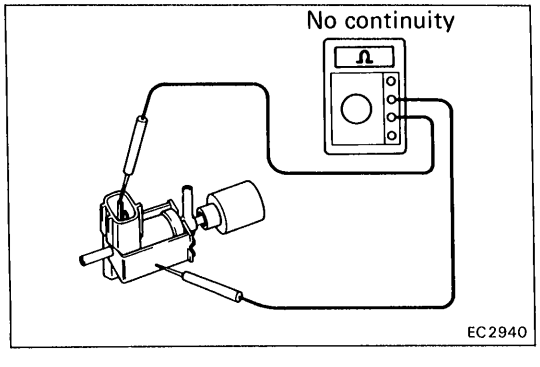
   (b) Blow into pipe E and check that air comes out of air filter.



   (c) Disconnect the battery.

   (d) Blow into pipe E and check air comes out of pipe G.

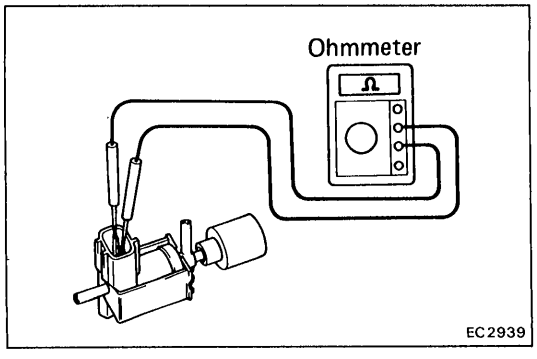
   If a problem is found, repair or replace the VSV.



2. **CHECK FOR SHORT CIRCUIT**

   Using an ohmmeter, check that there is no continuity between the terminal and the VSV body.

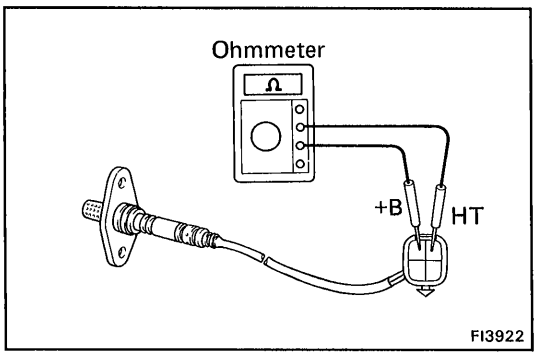
   If there is continuity, replace the VSV.



3. CHECK FOR OPEN CIRCUIT

Using an ohmmeter, measure the resistance between both terminals as illustrated.

Specified resistance: 30 — 50 Ω at 20°C (68°F)



Oxygen Sensor

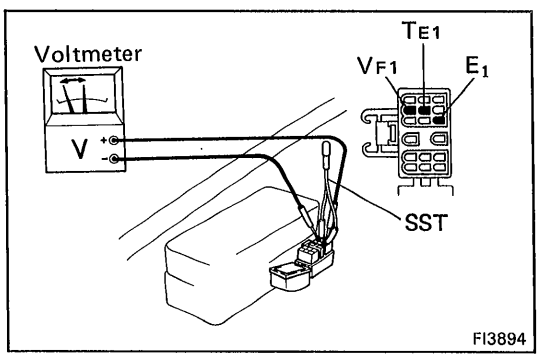
INSPECTION OF OXYGEN SENSOR

1. INSPECT HEATER RESISTANCE OF OXYGEN SENSOR

Using an ohmmeter, measure the resistance between the terminals +B and HT.

Resistance: 5.1 — 6.3 Ω at 20°C (68°F)

If the resistance is not as specified, replace the oxygen sensor.



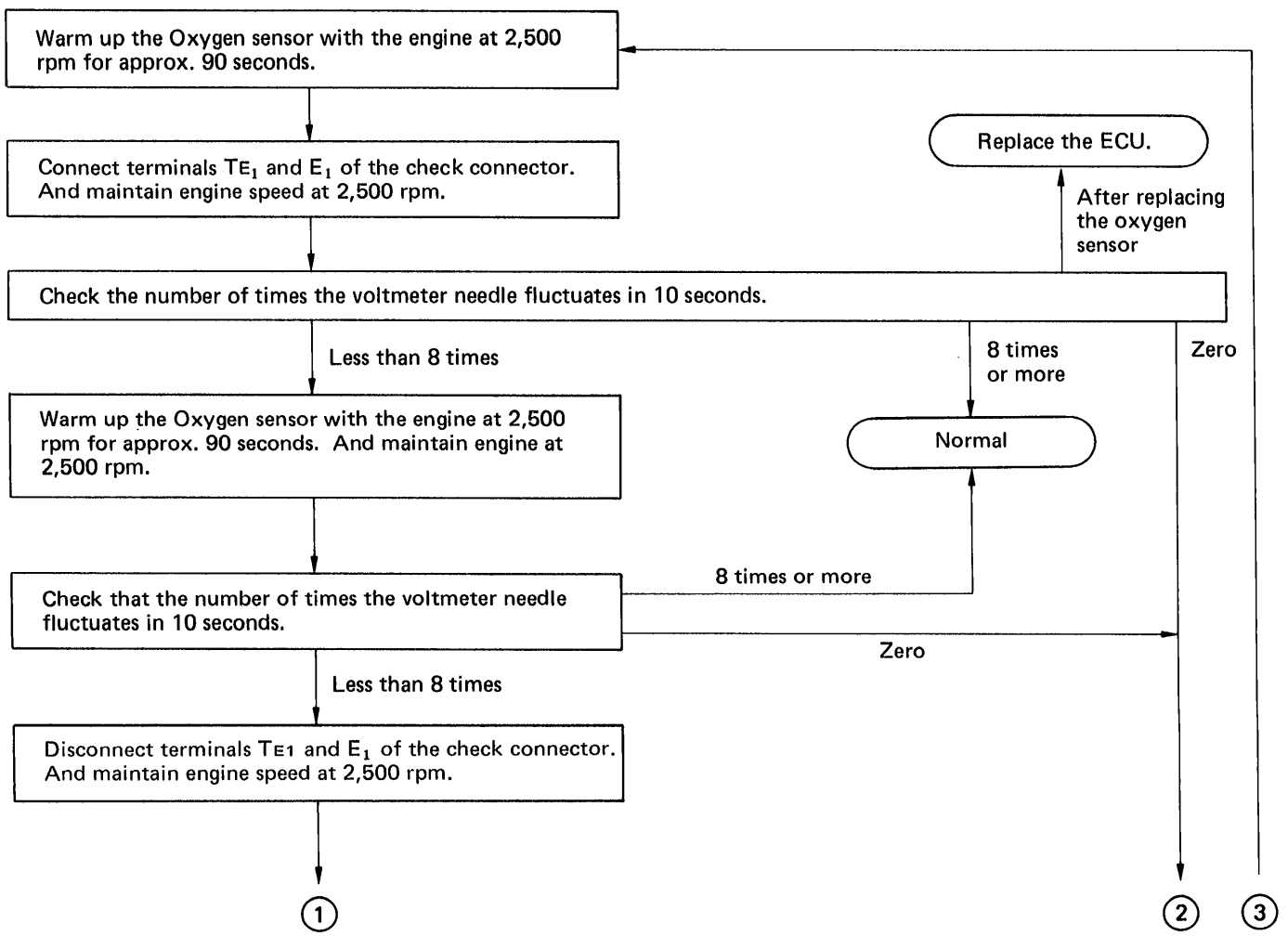
2. INSPECTION OF FEEDBACK VOLTAGE (V_{F1})

(a) Warm up the engine.

(b) Connect the voltmeter to the check connector terminals V_{F1} and E_1.

HINT: Use SST when connecting between terminals T_{E1} and E_1 of the check connector.

SST 09843-18020



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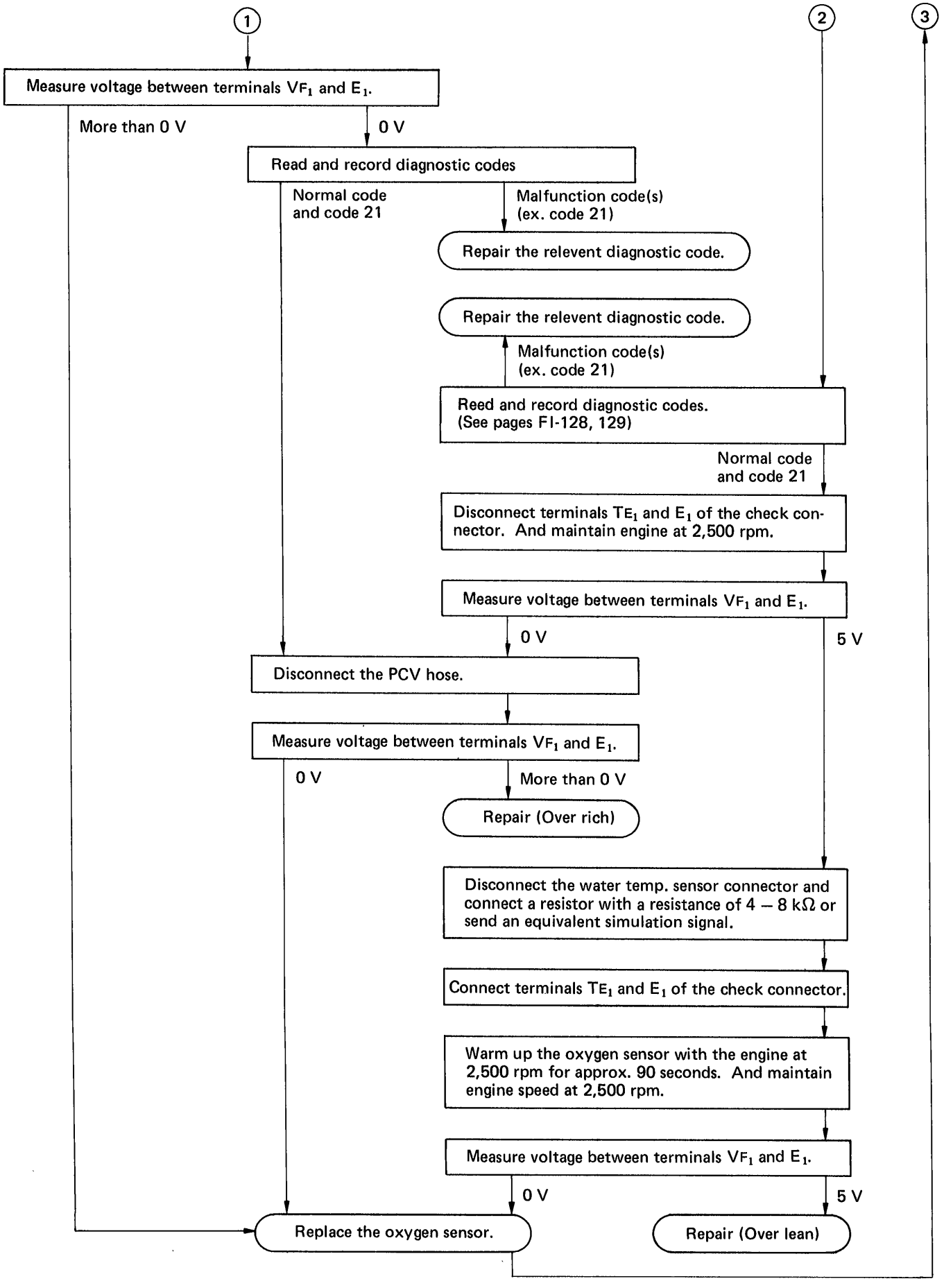
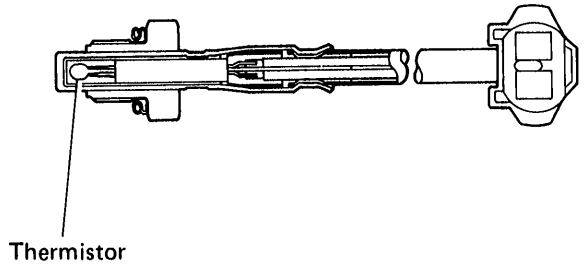
CONTINUED FROM PAGE FI-199.

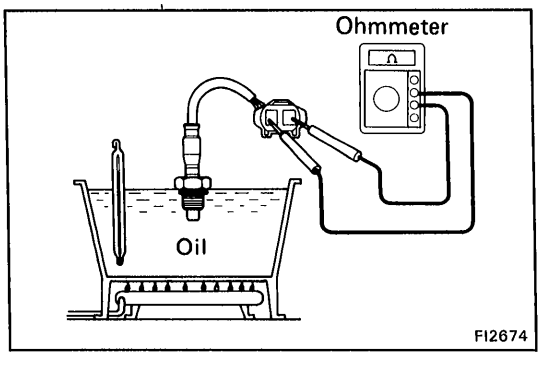


EGR Gas Temp. Sensor

(California Vehicles only)



FI2673



FI2674

INSPECTION OF EGR GAS TEMP. SENSOR

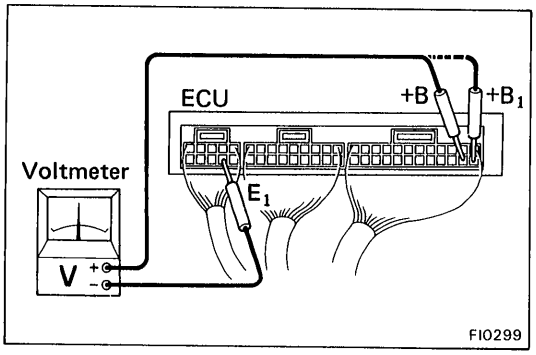
MEASURE RESISTANCE OF EGR GAS TEMP. SENSOR

Using an ohmmeter, measure the resistance between both terminals.

Resistance:

69.40 — 88.50 kΩ at 50°C (122°F)
11.89 — 14.37 kΩ at 100°C (212°F)
2.79 — 3.59 kΩ at 150°C (302°F)

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



ECU

INSPECTION OF ECU

HINT:
- The ECU itself cannot be checked directly.
- The EFI circuit can be checked by measuring the resistance and voltage at the wiring connectors of the ECU.

1. MEASURE VOLTAGE OF ECU

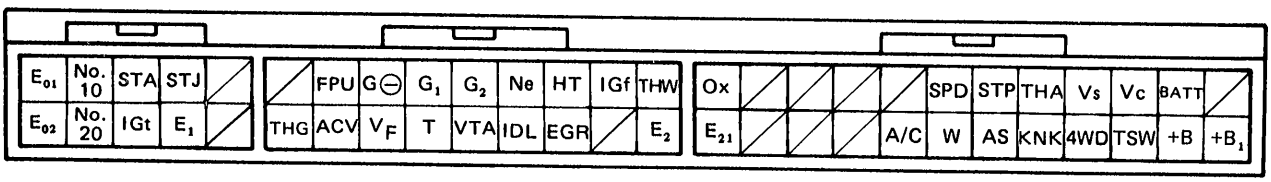
Check the voltage between each terminal of the wiring connectors.

- Remove the right kick panel.
- Turn the ignition switch to ON.
- Measure the voltage at each terminal.

HINT: 1. Perform all voltage measurements with the connectors connected.
2. Verify that the battery voltage is 11 V or above when the ignition switch is ON.

Voltage at ECU Wiring Connectors (M/T)

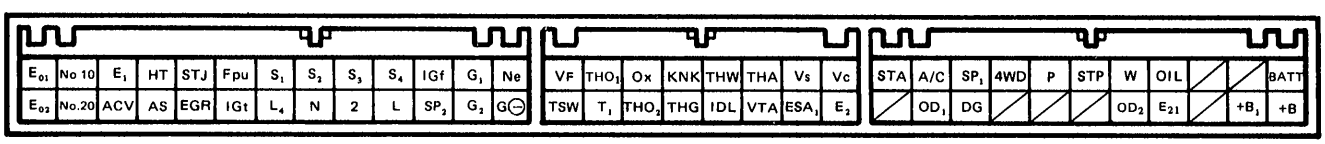
Terminals	Condition		STD voltage
BATT – E_1	–		10 – 14
+B – E_1	Ignition S/W ON		
$+B_1$ – E_1			
IDL – E_2 (E_{21})	Ignition SW ON	Throttle valve open	8 – 14
Vc – E_2 (E_{21})		–	4 – 6
VTA – E_2 (E_{21})		Throttle valve fully closed	0.1 – 1.0
		Throttle valve fully opened	3 – 5
Vc – E_2 (E_{21})	Ignition SW ON	–	4 – 6
Vs – E_2 (E_{21})		Measuring plate fully closed	3.7 – 4.3
		Measuring plate fully open	0.2 – 0.5
	Idling		2.3 – 2.8
	3,000 rpm		0.3 – 1.0
THA – E_2 (E_{21})	IG SW ON	Intake air temperature 20°C (68°F)	1 – 3
THW – E_2 (E_{21})	IG SW ON	Coolant temperature 80°C (176°F)	0.1 – 1.0
STA – E_1	Ignition SW ST position		6 – 12
No. 10 – E_{01} No. 20 – E_{02}	Ignition SW ON		10 – 14
IGt – E_1	Cranking or Idling		0.7 – 1.0
W – E_1	No trouble (CHECK ENGINE light off) and engine running		10 – 14
STJ – E_1	Ignition SW ST position	Coolant temperature 80°C (176°F)	6 – 12
STP – E_1	Stop light switch ON		8 – 14

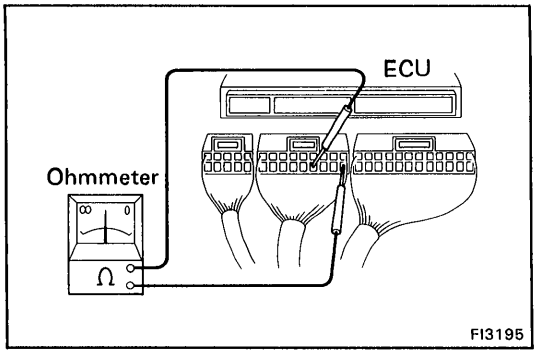


FI0574

Voltage at ECU Wiring Connectors (A/T)

Terminals	Condition		STD voltage
BATT – E_1	–		10 – 14
+B – E_1	Ignition SW ON		
$+B_1$ – E_1			
IDL – E_2 (E_{21})	Ignition SW ON	Throttle valve open	8 – 14
Vc – E_2 (E_{21})		–	4 – 6
VTA – E_2 (E_{21})		Throttle valve fully closed	0.1 – 1.0
		Throttle valve fully opened	3 – 5
Vc – E_2 (E_{21})	Ignition SW ON	–	4 – 6
Vs – E_2 (E_{21})		Measuring plate fully closed	3.7 – 4.3
		Measuring plate fully open	0.2 – 0.5
	Idling		2.3 – 2.8
	3,000 rpm		0.3 – 1.0
THA – E_2 (E_{21})	IG SW ON	Intake air temperature 20°C (68°F)	1 – 3
THW – E_2 (E_{21})	IG SW ON	Coolant temperature 80°C (176°F)	0.1 – 1.0
STA – E_1	Ignition SW ST position		6 – 12
No. 10 – E_{01} No. 20 – E_{02}	Ignition SW ON		10 – 14
IGt – E_1	Cranking or Idling		0.7 – 1.0
W – E_1	No trouble (CHECK ENGINE light off) and engine running		10 – 14
STJ – E_1	Ignition SW ST position	Coolant temperature 80°C (176°F)	6 – 12
STP – E_1	Stop light switch ON		8 – 14





2. MEASURE RESISTANCE OF ECU

NOTICE:

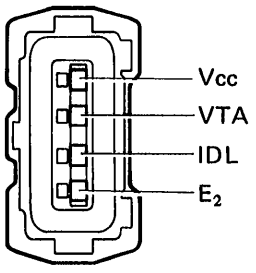
- **Do not touch the ECU terminals.**
- **The tester probe should be inserted into the wiring connector from the wiring side.**

Check the resistance between each terminal of the wiring connector.

- Remove the right kick panel.
- Unplug the wiring connectors from the ECU.
- Measure the resistance between each terminal of the wiring connectors.

Resistance at ECU Wiring Connectors

Terminals	Condition	Resistance (kΩ)
IDL – E_2 (E_{21})	Throttle valve open	Infinity
	Throttle valve fully closed	0 – 0.1
VTA – E_2 (E_{21})	Throttle valve fully open	3.3 – 10
	Throttle valve fully closed	0.2 – 0.8
Vc – E_2 (E_{21})	Air flow meter connector disconnected	4 – 9
THA – E_2 (E_{21})	Intake air temperature 20°C (68°F)	2 – 3
THW – E_2 (E_{21})	Coolant temperature 80°C (176°F)	0.2 – 0.4
+B – E_1	–	0.2 – 0.4
Vc – E_2 (E_{21})	Throttle position sensor connector disconnected	0.1 – 0.3
Vs – E_2 (E_{21})	Measuring plate fully closed	0.02 – 0.1
	Measuring plate fully open	0.02 – 1.00
Ne – E_1	–	0.14 – 0.18
STJ – E_1	–	Infinity
FPU – E_1	–	Infinity
HT – E_1	–	Infinity



Throttle Position Sensor Wiring Connector Side

FI0547

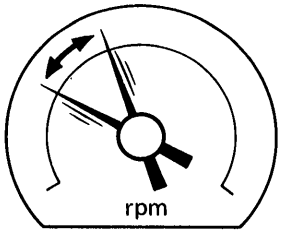
Fuel Cut RPM

INSPECTION OF FUEL CUT RPM

(a) Start and warm up the engine.

(b) Disconnect the connector from the throttle position sensor.

(c) Connect terminals IDL and E_2 on the wiring connector side.



Tachometer

FI1142

(d) Gradually raise the engine rpm and check that there is fluctuation between the fuel cut and fuel return points.

HINT:

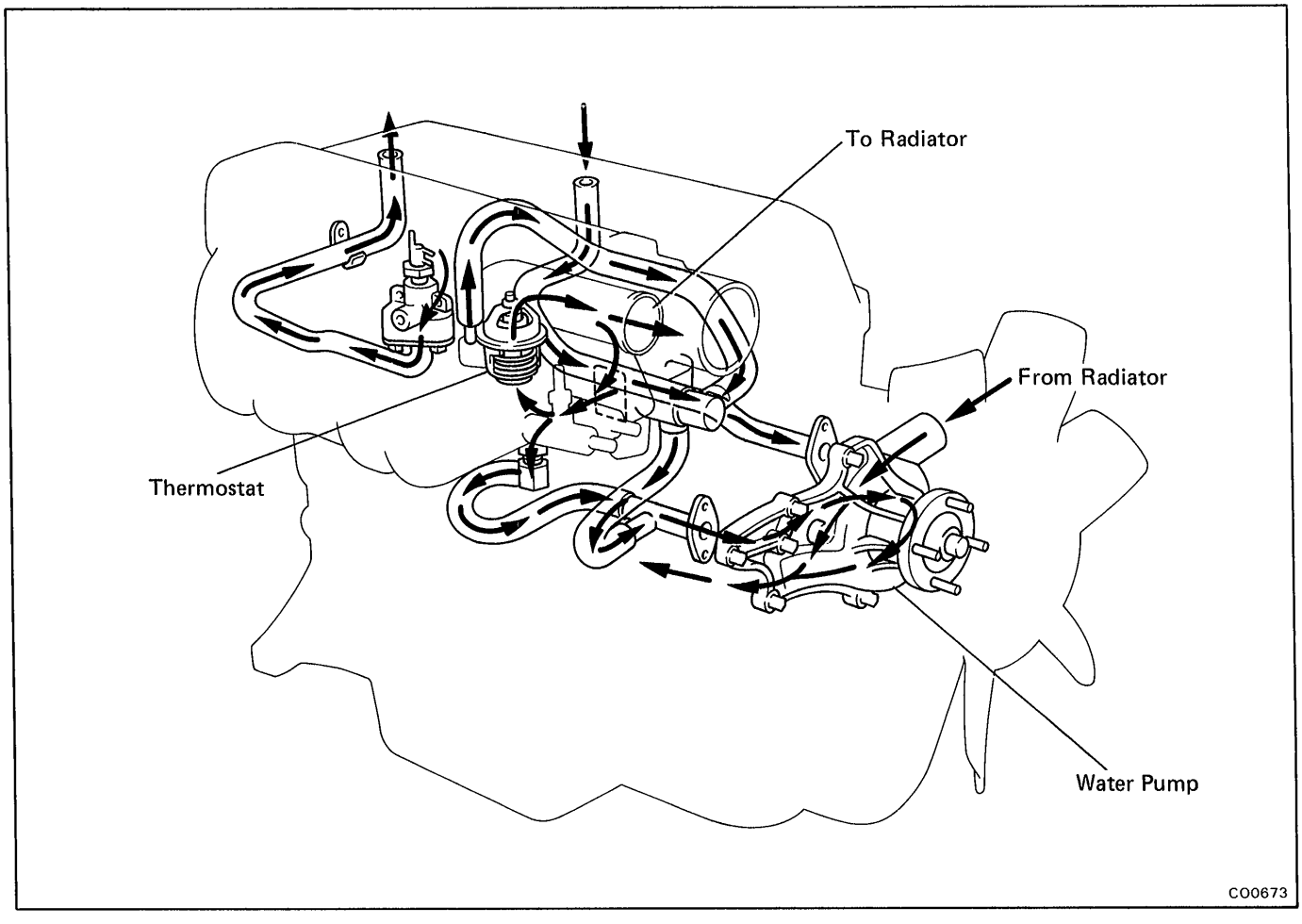
- The vehicle should be stopped.
- Accessories switched off.

Fuel cut rpm:	**M/T 1,300 rpm**
	A/T 1,800 rpm
Fuel return rpm:	**M/T 1,000 rpm**
	A/T 1,500 rpm

COOLING SYSTEM

DESCRIPTION

This engine utilizes a pressurized water forced circulation cooling system which includes a thermostat mounted on the outlet side.



The cooling system is composed of the water jacket (inside the cylinder block and cylinder head), radiator, water pump, thermostat, cooling fan, fluid coupling, hoses and other components.

Coolant which is heated in the water jacket is pumped to the radiator, where it is cooled by the cooling fan and the vehicle windstream. Coolant which has been cooled is then sent back to the engine by the water pump, where it cools the engine.

The water jacket is a network of channels in the shell of the cylinder block and cylinder head through which coolant passes. It is designed to provide adequate cooling of the cylinders and combustion chambers which become the hottest during engine operation.

Radiator

The radiator performs the function of cooling the coolant which has passed through the water jacket and become hot, and is mounted in the front of the vehicle. The radiator consists of an upper tank and lower tank, and a core which connects the two tanks.

The upper tank contains the inlet for coolant from the water jacket and the filler inlet. It also has a hose attached through which excess coolant or steam can flow. The lower tank contains the outlet for coolant and the drain cock. The core contains many tubes through and cooling fins which coolant flows from the upper tank to the lower tank so that coolant which has been heated up as it passes through the water jacket is cooled here by the air sucked through the radiator by the electric fan, as well as the wind generated by the vehicle's travel. Models with automatic transmissions include an automatic transmission fluid cooler built into the lower tank of the radiator.

Radiator Cap

The radiator cap is a pressure type can which seals the radiator, resulting in pressurization of the radiator as the coolant expands. The pressurization prevents the coolant from boiling even when the coolant temperature exceeds 100°C (212°F). A relief valve (pressurization valve) and a vacuum valve (negative pressure valve) are built into the radiator cap. When the pressure generated inside the cooling system exceeds the limit (coolant temperature: 110 — 120°C, 230 — 248°F pressure: 0.3 — 1.0 kg/cm^2, 4.3 — 14.2 psi, 29.4 — 98.1 kPa) the relief valve is opened by the pressure and lets steam escape through pipe. The vacuum valve opens to allow atmospheric air to enter to alleviate the vacuum which develops in the cooling system after the engine is stopped and the coolant temperature drops.

Reservoir Tank

The reservoir tank is used to catch coolant which overflows the cooling system as a result of volumetric expansion when the coolant is heated. When the coolant temperature drops coolant in the reservoir tank returns to the radiator, thus keeping the radiator full at all times and avoiding needless coolant loss. To find out if the coolant needs to be replenished check the reservoir tank level.

Water Pump

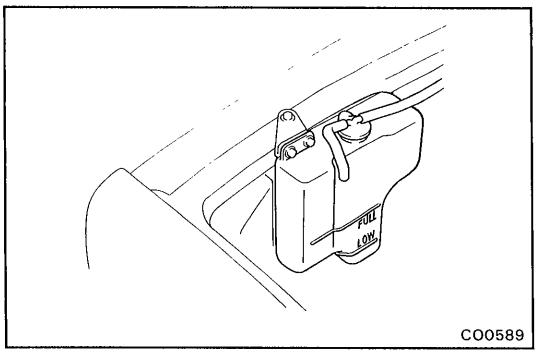
The water pump is used for forced circulation of coolant through the cooling system. It is mounted on the front of the timing chain cover and driven by a V belt.

Thermostat

The thermostat is a wax type, mounted in the water outlet housing. The thermostat is a type of automatic valve operated by fluctuations in the coolant temperature. When the coolant temperature drops the valve closes, preventing the circulation of coolant through the engine and thus permitting the engine to warm up rapidly. When the coolant temperature has risen the valve opens, allowing the coolant in the engine to circulate through the radiator. Wax inside the thermostat expands when heated and contracts when cooled. Heating the wax thus generates pressure which overpowers the force of the spring which keeps the valve closed, thus opening the valve. When the wax cools, its contraction causes the force of the spring to take effect once more, closing the valve. The thermostat in this engine operates at a temperature of 88°C (190°F).

TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Engine overheats	Radiator plugged or cap faulty	Check radiator	CO-9
	Alternator drive belt loose or missing	Adjust or replace belt	
	Dirt, leaves or insects on radiator or condenser	Clean radiator or condenser	CO-9
	Hoses, water pump, water outlet housing, radiator, heater, core plugs or head gasket leakage	Repair as necessary	
	Thermostat faulty	Check thermostat	CO-8
	Ignition timing retarded	Reset timing	IG-10
	Fluid coupling faulty	Replace fluid coupling	CO-6
	Radiator hose plugged or rotted	Replace hose	CO-9
	Water pump faulty	Replace water pump	CO-6
	Cylinder head or block cracked or plugged	Repair as necessary	

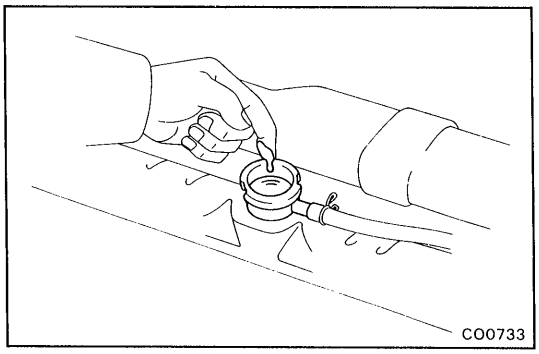


CHECK AND REPLACEMENT OF ENGINE COOLANT

1. CHECK ENGINE COOLANT LEVEL

The coolant level should be between the "LOW" and "FULL" lines.

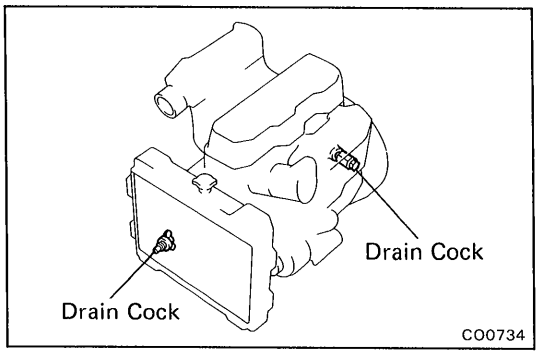
If low, check for leaks and add coolant up to the "FULL" line.



2. CHECK ENGINE COOLANT QUALITY

There should not be any excessive deposits of rust or scales around the radiator cap or radiator filler hole, and the coolant should be free from oil.

If excessively dirty, replace the coolant.



3. REPLACE ENGINE COOLANT

(a) Remove the radiator cap.

(b) Drain the coolant from the radiator and engine drain cocks.

(c) Close the drain cocks.

(d) Fill the system with coolant.

Use a good brand of ethylene-glycol base coolant, mixed according to the manufacturer's directions.

Coolant capacity (w/ heater or air conditioner):

Ex. 4WD A/T

8.4 liters (8.9 US qts, 7.4 Imp. qts)

4WD A/T

9.1 liters (9.6 US qts, 8.0 Imp. qts)

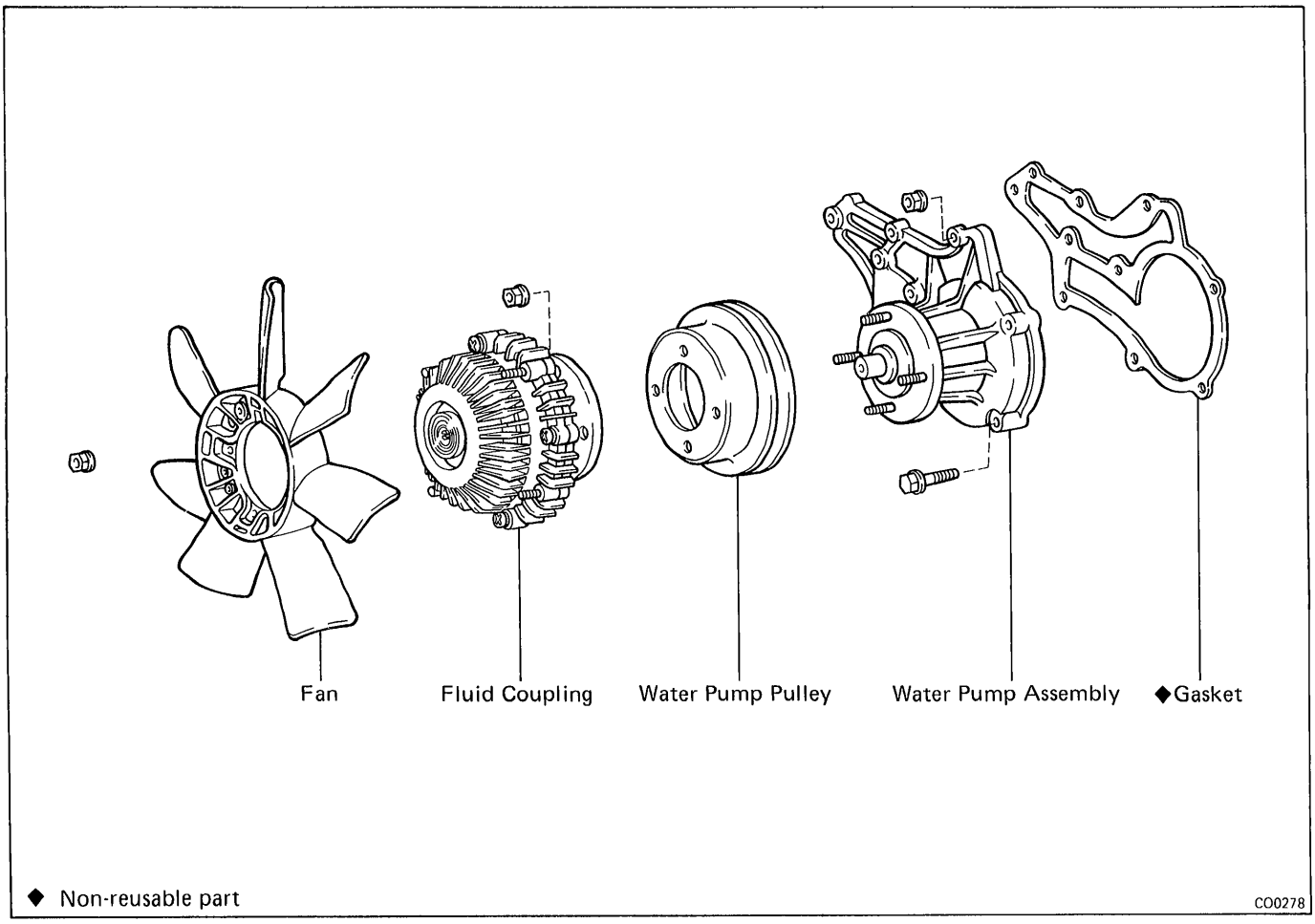
(e) Install the radiator cap.

(f) Start the engine and check for leaks.

(g) Recheck the coolant level and refill as necessary.

WATER PUMP

COMPONENTS



REMOVAL OF WATER PUMP

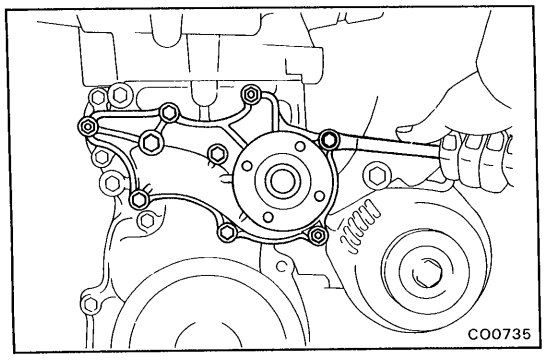
1. DRAIN COOLANT
   (See step 3 on page CO-5)

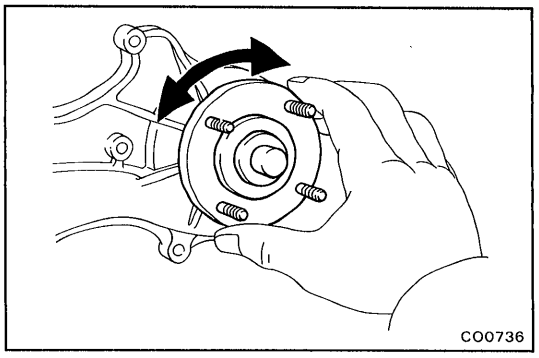
2. (w/ PS)
   REMOVE PS BELT

3. (with A/C)
   REMOVE A/C BELT

4. REMOVE FLUID COUPLING WITH FAN AND WATER PUMP PULLEY
   (See step 3 on page EM-38)

5. REMOVE WATER PUMP
   Remove the six bolts, three nuts, water pump and gasket.

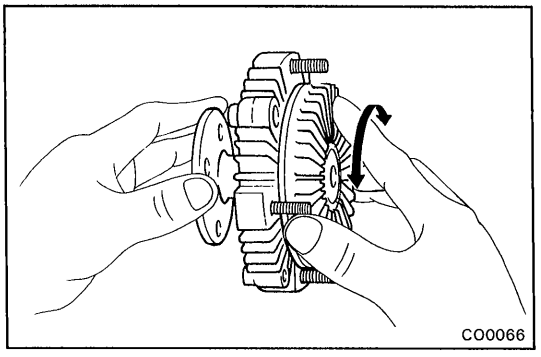




INSPECTION OF WATER PUMP

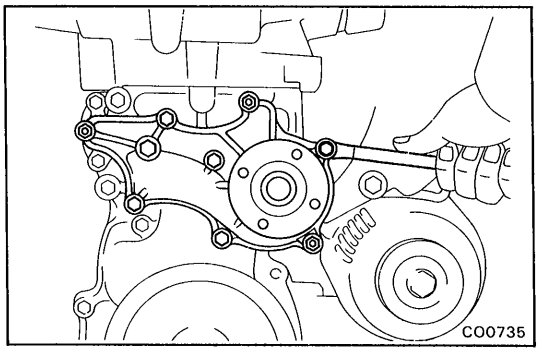
1. **INSPECT WATER PUMP BEARING**

   Check that water pump bearing moves smoothly and quietly.



2. **INSPECT FLUID COUPLING**

   Check the fluid coupling for damage and silicone oil leakage.



INSTALLATION OF WATER PUMP

(See page CO-6)

1. **INSTALL WATER PUMP OVER NEW GASKET**

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

2. **INSTALL WATER PUMP PULLEY AND FLUID COUPLING WITH FAN**
   (See step 9 on page EM-42)
   (See page MA-6)

3. **(with A/C)**
   INSTALL A/C BELT **(See page MA-6)**

4. **(w/ PS)**
   INSTALL PS BELT **(See page MA-6)**

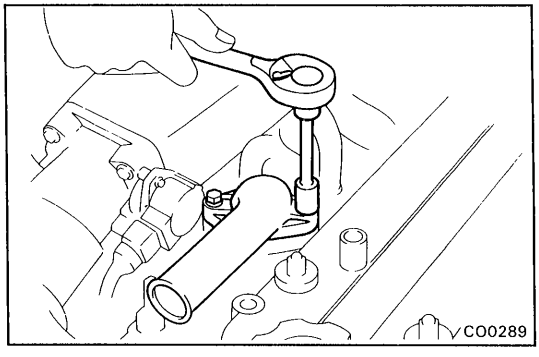
5. **REFILL COOLANT**
   (See page CO-5)

THERMOSTAT

REMOVAL OF THERMOSTAT

1. **DRAIN COOLANT**

2. **DISCONNECT FOLLOWING HOSES:**
   (a) Vacuum hoses
   (b) PCV hose
   (c) (with A/C)
   Idle up hose



3. **DISCONNECT RADIATOR INLET HOSE**

4. **REMOVE THERMOSTAT**
   (a) Remove the two bolts and water outlet from the intake manifold.
   (b) Remove the thermostat with gasket.
   (c) Remove the gasket from thermostat.

INSPECTION OF THERMOSTAT

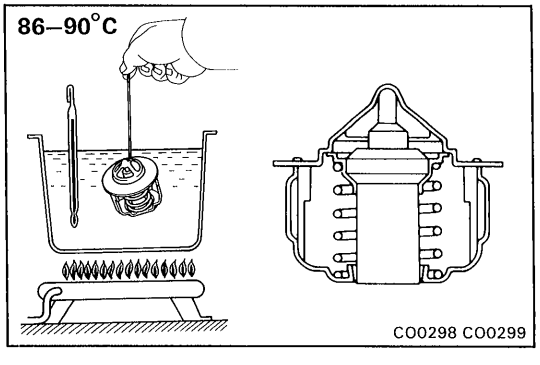
HINT: The thermostat is numbered according to the valve opening temperature.

(a) Immerse the thermostat in water and heat the water gradually.

(b) Check the valve opening temperature and valve lift.

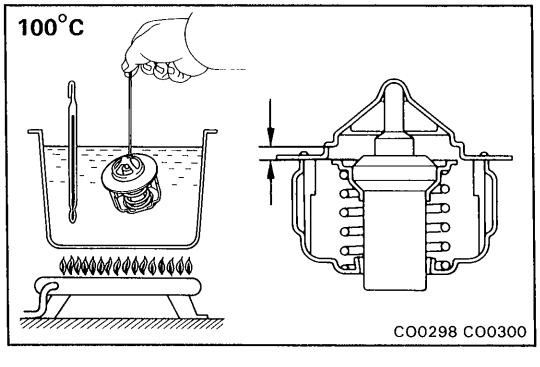
Valve opening temperature:
86 — 90°C (187 — 194°F)

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



If the valve opening temperature and valve lift are not within specifications, replace the thermostat.

(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**
   (a) Place a new gasket to thermostat.
   (b) Install the thermostat to intake manifold.
   (c) Install the water outlet with two bolts.
   Torque: 195 kg-cm (14 ft-lb, 19 N·m)

2. **CONNECT RADIATOR INLET HOSE**

3. **CONNECT FOLLOWING HOSES:**
   (a) (with A/C)
   Idle up hose
   (b) PCV hose
   (c) Vacuum hoses

4. **FILL WITH COOLANT**

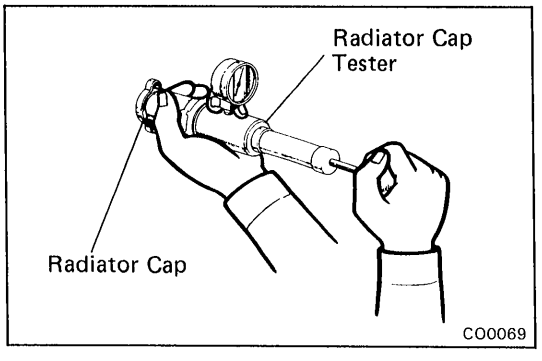
5. **START ENGINE AND CHECK FOR LEAKS**

RADIATOR

CLEANING OF RADIATOR

Using water of steam, remove mud and dirt from the radiator core.

NOTICE: If using high-pressure type cleaner, be careful not to deform the fines of the radiator core. For example, keep a distance of more than 40 — 50 cm (15.75 — 19.69 in.) between the radiator core and cleaner nozzle when the cleaner nozzle pressure is 30 — 35 kg/cm² (427 — 498 psi, 2,942 — 3,432 kPa).



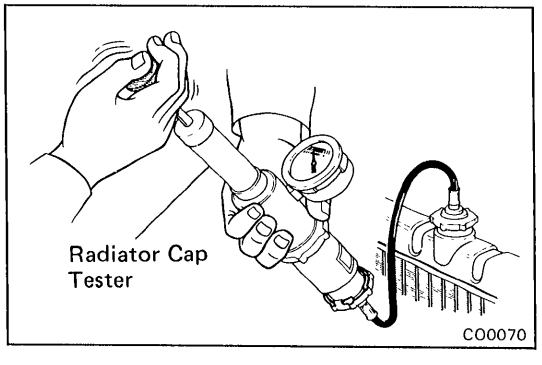
INSPECTION OF RADIATOR

1. CHECK RADIATOR CAP

Using radiator cap tester, cap tester until relief valve opens. Check that valve opens between 0.75 kg/cm² (10.7 psi, 174 kPa) and 1.05 kg/cm² (14.9 psi, 103 kPa).

Check that pressure gauge does not drop rapidly when pressure on cap is below 0.6 kg/cm² (8.5 psi, 159 kPa).

If either check is not within limit, replace cap.



2. CHECK COOLING SYSTEM FOR LEAKS

(a) Fill the radiator with coolant and attach a radiator cap tester.

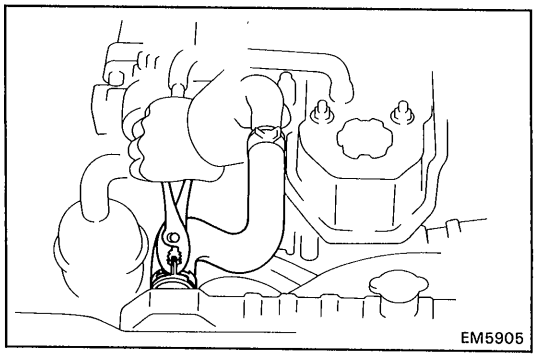
(b) Warm up the engine.

(c) Pump it to 1.2 kg/cm² (17.1 psi, 118 kPa), check that pressure does not drop.

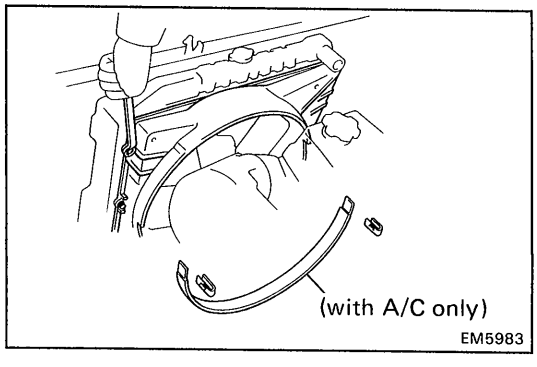
If the pressure drop, check for leaks from the hoses, radiator or water pump. If no external leaks are found, check the heater core, block and intake manifold.

REMOVAL OF RADIATOR

1. **DRAIN COOLANT**
2. **REMOVE ENGINE UNDER COVER**
3. **REMOVE AIR INTAKE CONNECTOR**



4. **REMOVE RADIATOR**
   (a) Disconnect the reservoir hose.
   (b) Remove the radiator hoses.



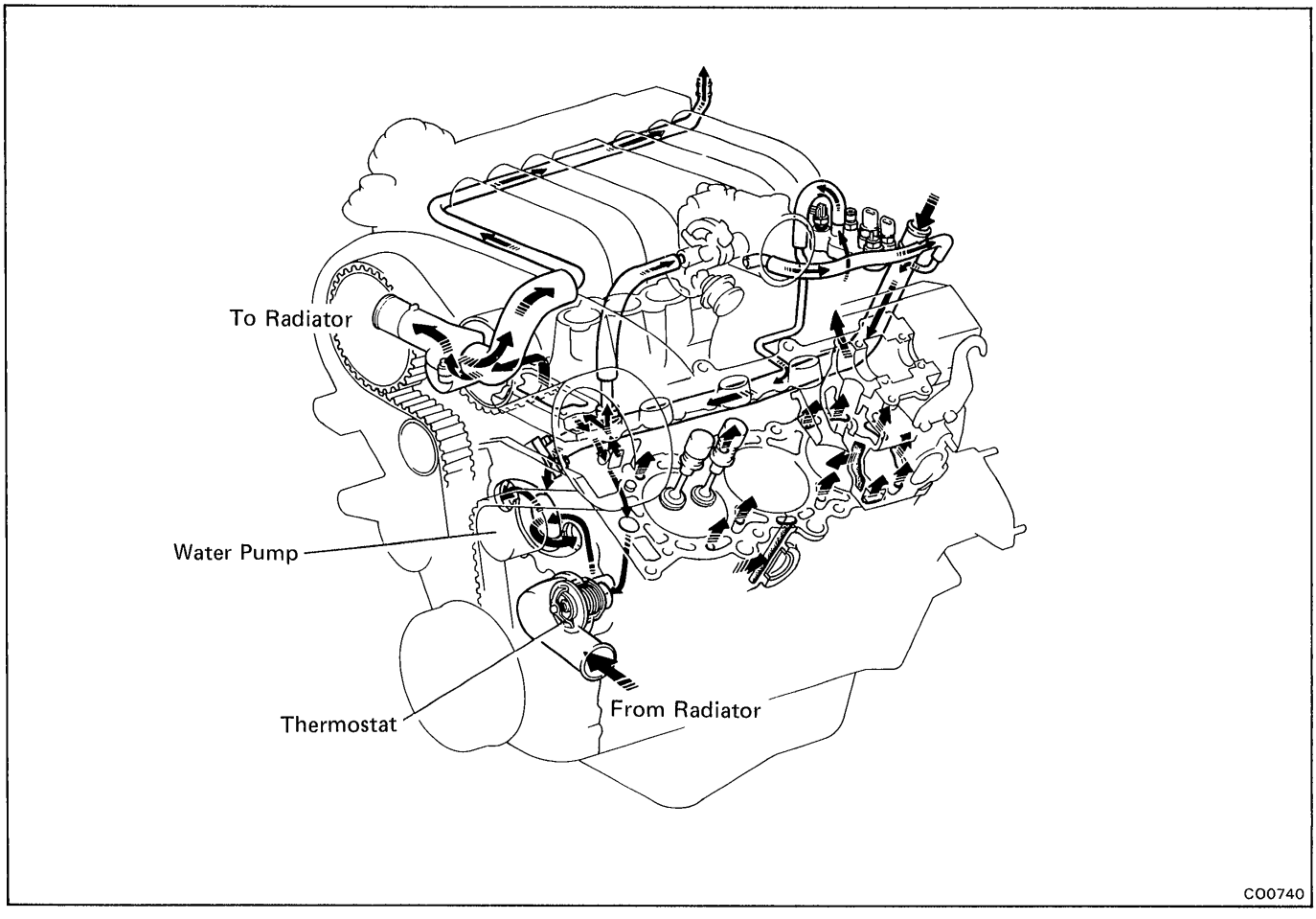
   (c) (with A/C)
   Remove the No.2 fan shroud.
   (d) Remove the No.1 fan shroud.
   (e) (A/T)
   Disconnect the oil cooler hoses.

   HINT:
   - Be careful as some oil will leak out. Catch it in a suitable container.
   - Plug the hose to prevent oil from escaping.

   (f) Remove the four bolts and radiator.

DESCRIPTION

This engine utilizes a pressurized water forced circulation cooling system which includes a thermostat mounted on the inlet side, equipped with a bypass valve.



The cooling system is composed of the water jacket (inside the cylinder block and cylinder head), radiator, water pump, thermostat, cooling fan, fluid coupling, hoses and other components.

Coolant which has been heated in the water jacket is pumped to the radiator where it is cooled by air sucked in by the cooling fan and air flow from the vehicle's movement. This coolant is then sent by the water pump back to the engine, where it cools the engine.

The water jacket is a network of channels in the outer area of the cylinder block and cylinder head. It is designed so that the coolant flowing through it can provide adequate cooling of the cylinders and combustion chambers which become the hottest parts during engine operation.

Radiator

The radiator cools the coolant which has passed through the water jacket and become hot. It is mounted in the front of the vehicle. The radiator consists of an upper and lower tank and a core which connects the two tanks.

The upper tank has an inlet for coolant from the water jacket and it has a filler inlet. It also has a hose attached through which excess coolant or steam can flow. The lower tank has an outlet for the coolant and a drain cock. Automatic transmission models include an automatic transmission fluid cooler. The core contains many tubes through which coolant flows from the upper tank to the lower tank, as well as cooling fins which radiate heat away from the coolant in the tubes.

Radiator Cap

The radiator cap is a pressure type cap which seals the radiator, resulting in pressurization of the radiator as the coolant expands. The pressurization prevents the coolant from boiling even when the coolant temperature exceeds 100°C (212°F).

A relief valve (pressurization valve) and a vacuum valve (negative pressure valve) are built into the radiator cap. The relief valve opens and lets steam escape out the overflow pipe when the pressure generated in the cooling system exceeds the limit (coolant temperature: 110—120°C 230—248°F, pressure: 0.3—1.0 kg/cm^2, 4.3—14.2 psi, 29.4—98.1 kPa). The vacuum valve opens to allow coolant to enter in order to alleviate the vacuum which develops in the coolant system after the engine has stopped and the coolant temperature drops.

Reservoir Tank

The reservoir tank is used to catch coolant which overflows the cooling system as a result of volumetric expansion when the coolant is heated. When the coolant temperature drops coolant in the reservoir tank returns to the radiator, thus keeping the radiator full at all times and avoiding needless coolant loss. To find out if the coolant needs to be replenished check the reservoir tank level.

Water Pump

The water pump is used for forced circulation of coolant through the cooling system. It is mounted on the from of the engine block and driven by the timing belt.

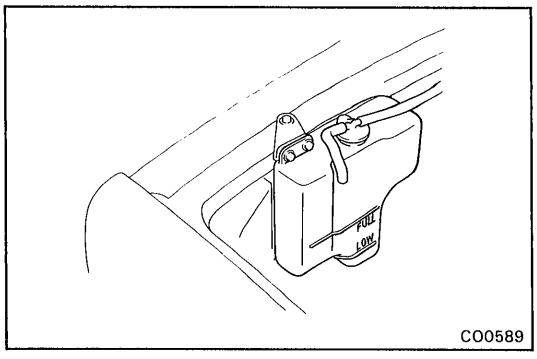
Thermostat

The thermostat has a wax type bypass valve and is mounted in the water inlet houising. The thermostat is a type of automatic valve operated by fluctuations in the coolant temperature. When the coolant temperature is low, the valve closes to prevent the coolant flowing to the radiator, thus permitting the engine to warm up rapidly. When the bypass valve opens the bypass circuit, the engine coolant coatinues to circulate inside the engine, quickly and uniformly warming up to the oppropriate temperature.

When the coolant temperature is high, the valve opens and the coolant flows to the radiator where it is cooled. When the wax inside the thermostat is heated, it expands and thus creates pressure which over powers the force of the spring which keeps the valve closed. When the wax cools, its contraction causes the force of the spring to take effect once more, closing the valve. The thermostat in this engine operates at a temperature of 82°C (180°F).

TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Engine overheats	Radiator plugged or cap faulty	Check radiator	CO-18
	Timing belt loose or missing	Adjust or replace belt	
	Dirt, leaves or insects on radiator or condenser	Clean radiator or condenser	CO-18
	Hoses, water pump, water outlet housing, radiator, heater, core plugs or head gasket leakage.	Repair as necessary	
	Thermostat faulty	Check thermostat	CO-17
	Ignition timing retarded	Reset timing	IG-20
	Fluid coupling faulty	Replace fluid coupling	EM-101
	Radiator hose plugged or rotted	Replace hose	
	Water pump faulty	Replace water pump	CO-15
	Cylinder head or block cracked or plugged	Repair as necessary	

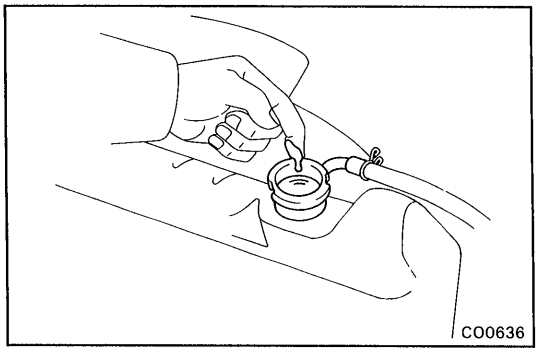


CHECK AND REPLACEMENT OF ENGINE COOLANT

1. CHECK ENGINE COOLANT LEVEL

The coolant level should be between the "LOW" and "FULL" lines.

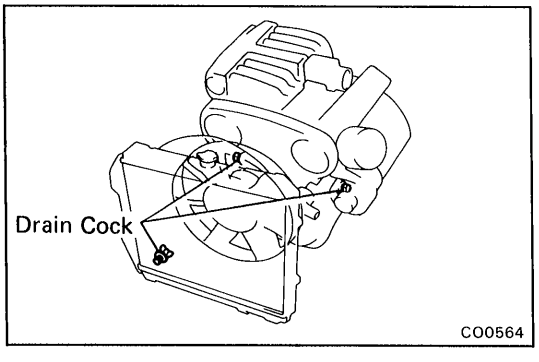
If low, check for leakage and add coolant up to the "FULL" line.



2. CHECK COOLANT QUALITY

There should not be any excessive deposits of rust or scales around the radiator cap or radiator filler hole, and the coolant should be free from oil.

If excessively dirty, replace the coolant.



3. REPLACE ENGINE COOLANT

(a) Remove the radiator cap.

(b) Drain the coolant from the radiator and engine drain cocks.

(c) Close the drain cocks.

(d) Fill the system with coolant.

Use a good brand of ethylene-glycol base coolant, mixed according to manufacturer's directions.

Coolant capacity (w/ heater or air conditioner):

2WD	**M/T**	**10.4 liters (11.0 US qts, 9.2 Imp. qts)**
	A/T	**10.2 liters (10.8 US qts, 9.5 Imp. qts)**
4WD	**M/T**	**10.5 liters (11.1 US qts, 9.2 Imp. qts)**
	A/T	**10.3 liters (10.9 US qts, 9.1 Imp. qts)**

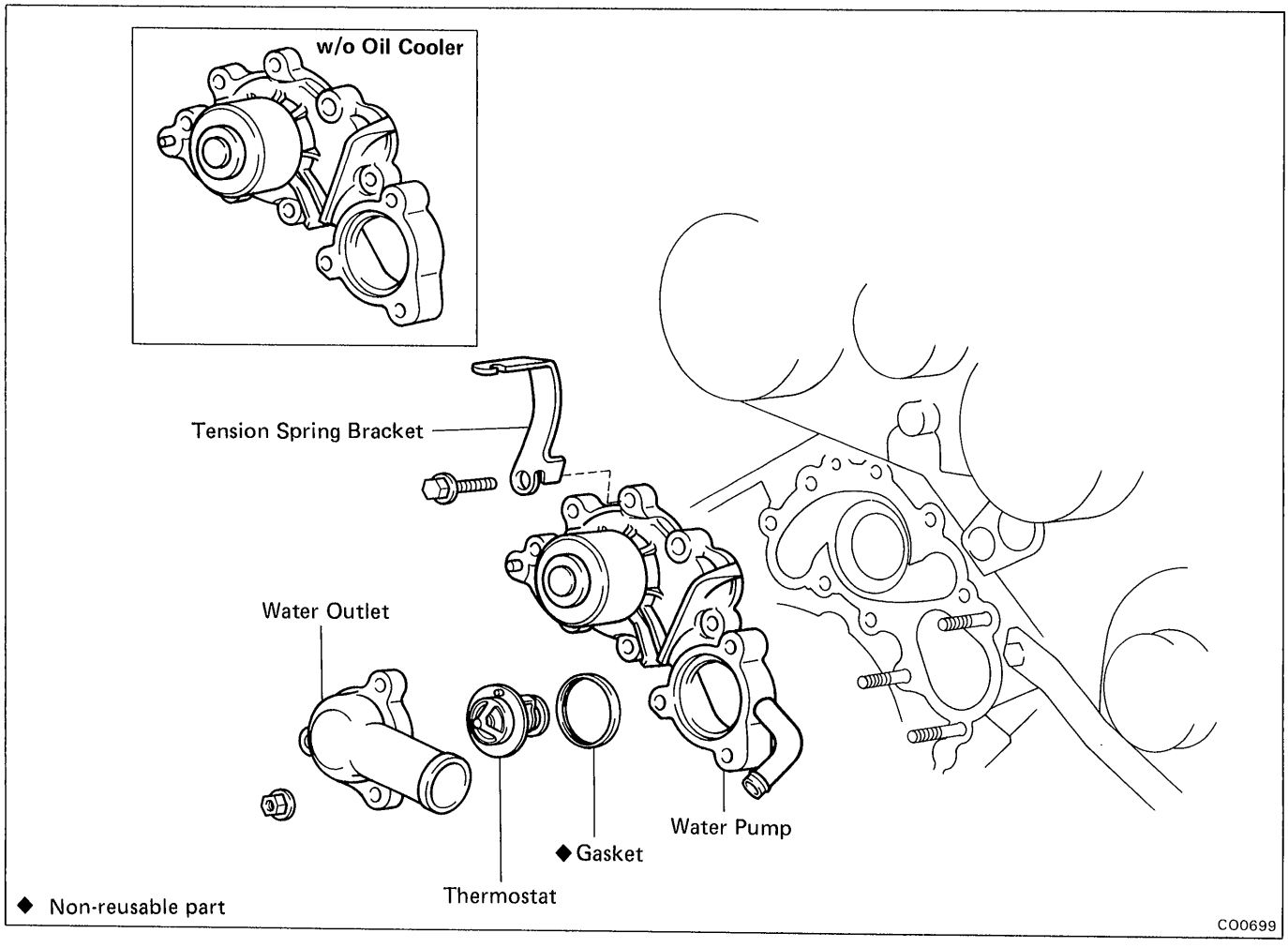
(e) Install the radiator cap.

(f) Start the engine and check for leaks.

(g) Recheck the coolant level and refill as necessary.

WATER PUMP

COMPONENTS

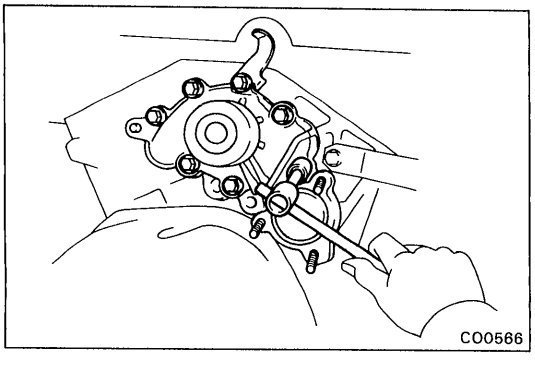


REMOVAL OF WATER PUMP

1. **REMOVE TIMING BELT**
   (See steps 1 to 9 and 11 to 13 on pages EM-100 to 103)

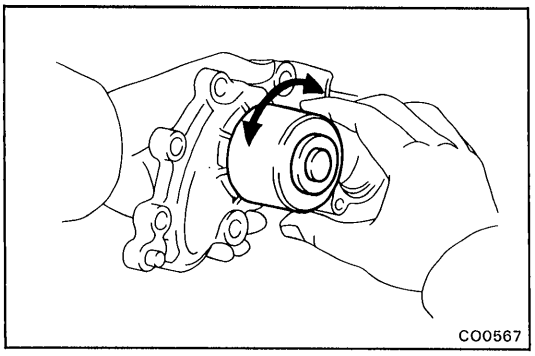
2. **REMOVE NO.1 IDLER PULLEY**

3. **REMOVE THERMOSTAT**
   (See step 3 on page CO-17)



4. **REMOVE WATER PUMP**

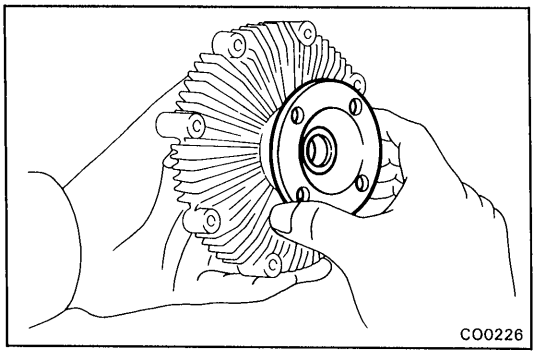
   Remove the seven bolts, tension spring bracket and water pump.



INSPECTION OF WATER PUMP

1. **INSPECT WATER PUMP BEARING**

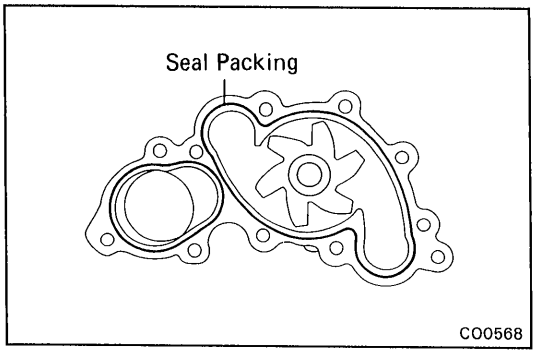
   Check that water pump bearing moves smoothly and quietly.



2. **INSPECT FLUID COUPLING**

   Check the fluid coupling for damage and silicone oil leakage.

3. **INSPECT FAN PULLEY BRACKET**
   (See step 3 on page EM-105)



INSTALLATION OF WATER PUMP

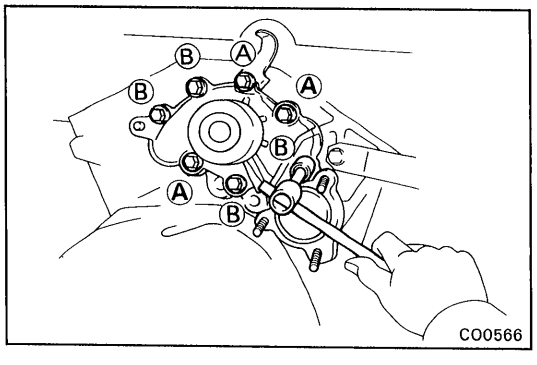
(See page CO-15)

1. **INSTALL WATER PUMP**

   (a) Apply seal packing to the water pump.

   Seal packing: Part No. 08826-00100 or equivalent

   HINT: Clean installation surface and apply seal packing. However, use a nozzle cut to 2 mm (0.08 in.). (See page LU-23)



   (b) Install the water pump and tension spring bracket with the seven bolts.

   Torque: (A) 185 kg-cm (13 ft-lb, 18 N·m)
   (B) 200 kg-cm (14 ft-lb, 20 N·m)

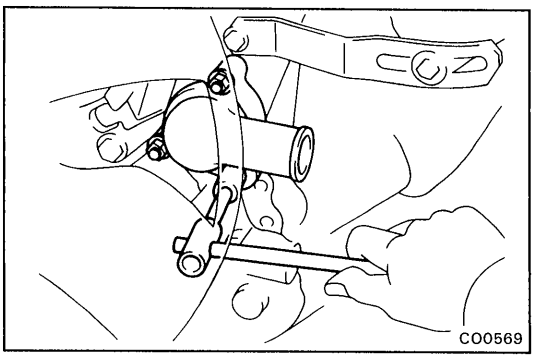
2. **(w/ Oil cooler)**
   CONNECT NO.2 OIL COOLER HOSE

3. **INSTALL THERMOSTAT**
   (See step 1 on page CO-17)

4. **INSTALL NO.1 IDLER PULLEY**

   Torque: 380 kg-cm (27 ft-lb, 37 N·m)

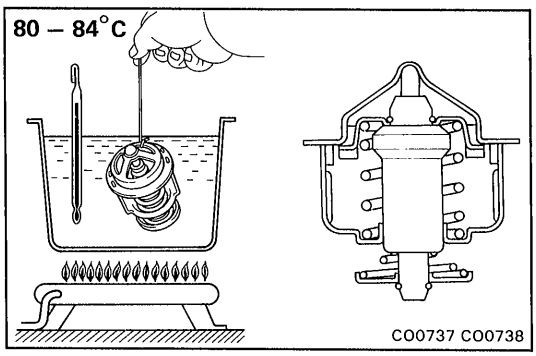
5. **INSTALL TIMING BELT**
   (See steps 2 to 6, 9, 10 and 12 to 20 on pages EM-106 to 110)



THERMOSTAT

REMOVAL OF THERMOSTAT

1. **DRAIN COOLANT**
2. **DISCONNECT RADIATOR OUTLET HOSE**
3. **REMOVE THERMOSTAT**
   (a) Remove the three nuts, water inlet and thermostat with gasket from the water pump.
   (b) Remove the gasket from the thermostat.



INSPECTION OF THERMOSTAT

HINT: Thermostat is numbered according to the valve opening temperature.

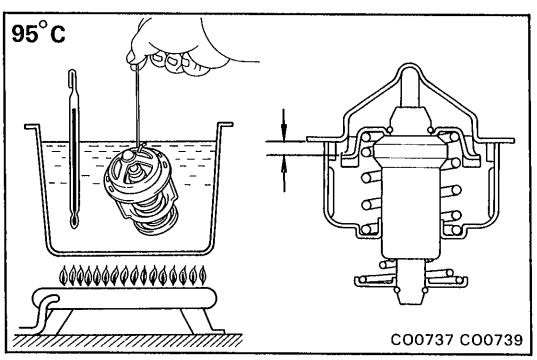
(a) Immerse the thermostat in water and heat the water gradually.
(b) Check the valve opening temperature and valve lift.

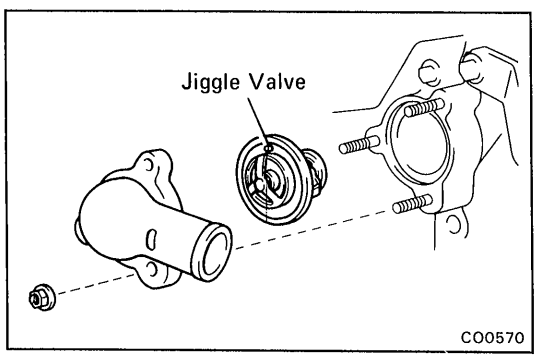
Valve opening temperature:
80 – 84°C (176 – 183°F)

Valve lift:
More than 8 mm (0.31 in.) at 95°C (203°F)

If the valve opening temperature and valve lift are not within specifications, replace the thermostat.

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





INSTALLATION OF THERMOSTAT

1. **INSTALL THERMOSTAT**
   (a) Place a new gasket to thermostat.
   (b) Install the thermostat and water inlet with the jiggle valve upward.
   (c) Install and torque the three nuts.
   Torque: 200 kg-cm (14 ft-lb, 20 N·m)
2. **CONNECT RADIATOR OUTLET HOSE**
3. **FILL WITH COOLANT**
4. **START ENGINE AND CHECK FOR LEAKS**

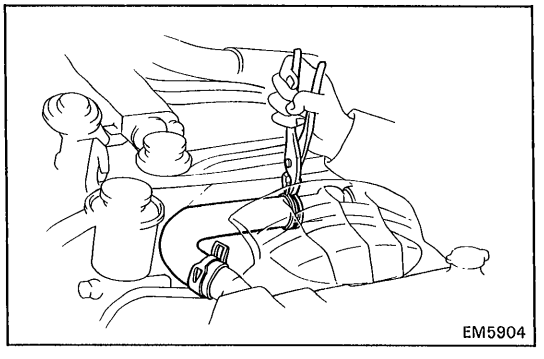
RADIATOR

CLEANING OF RADIATOR

(See page CO-9)

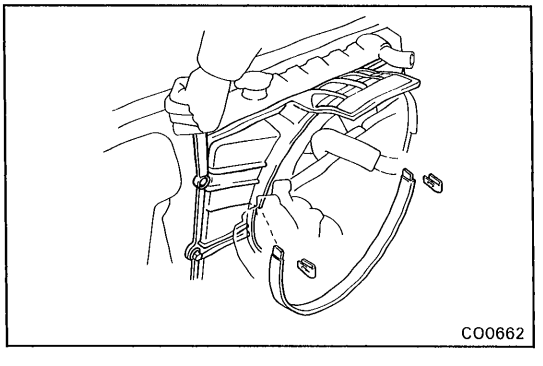
INSPECTION OF RADIATOR

(See page CO-9)


EM5904

REMOVAL OF RADIATOR

1. **DRAIN COOLANT**
2. **REMOVE ENGINE UNDER COVER**
3. **REMOVE RADIATOR**
   (a) Disconnect the reservoir hose.
   (b) Remove the radiator hoses.


CO0662

(c) Remove the No.2 fan shroud.
(d) Remove the No.1 fan shroud.
(e) Disconnect the oil cooler hoses.

HINT:

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

(f) Remove the four bolts and radiator.

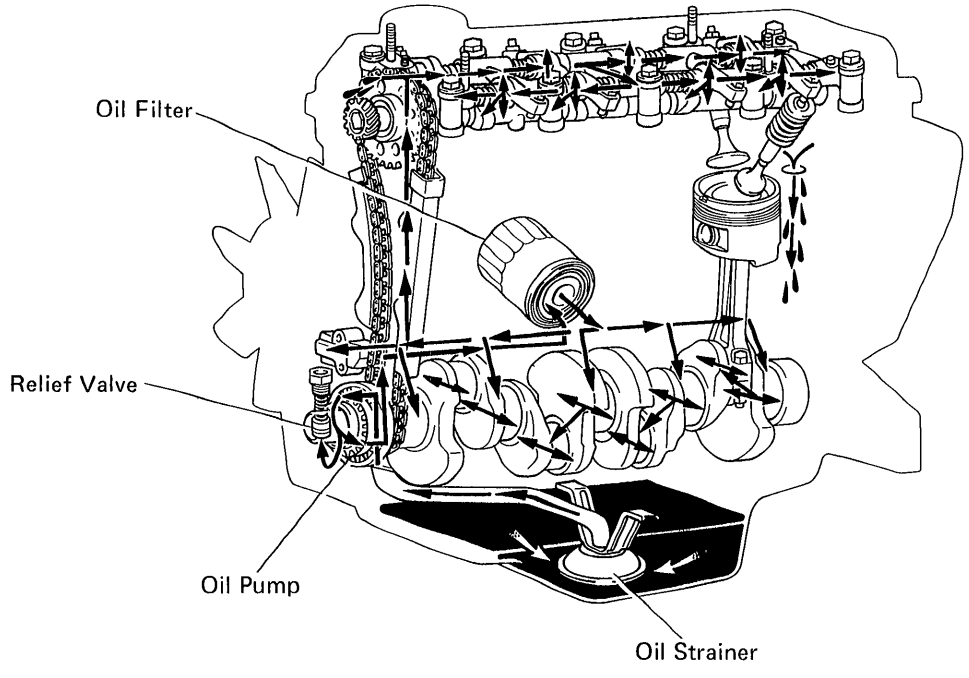
LUBRICATION SYSTEM

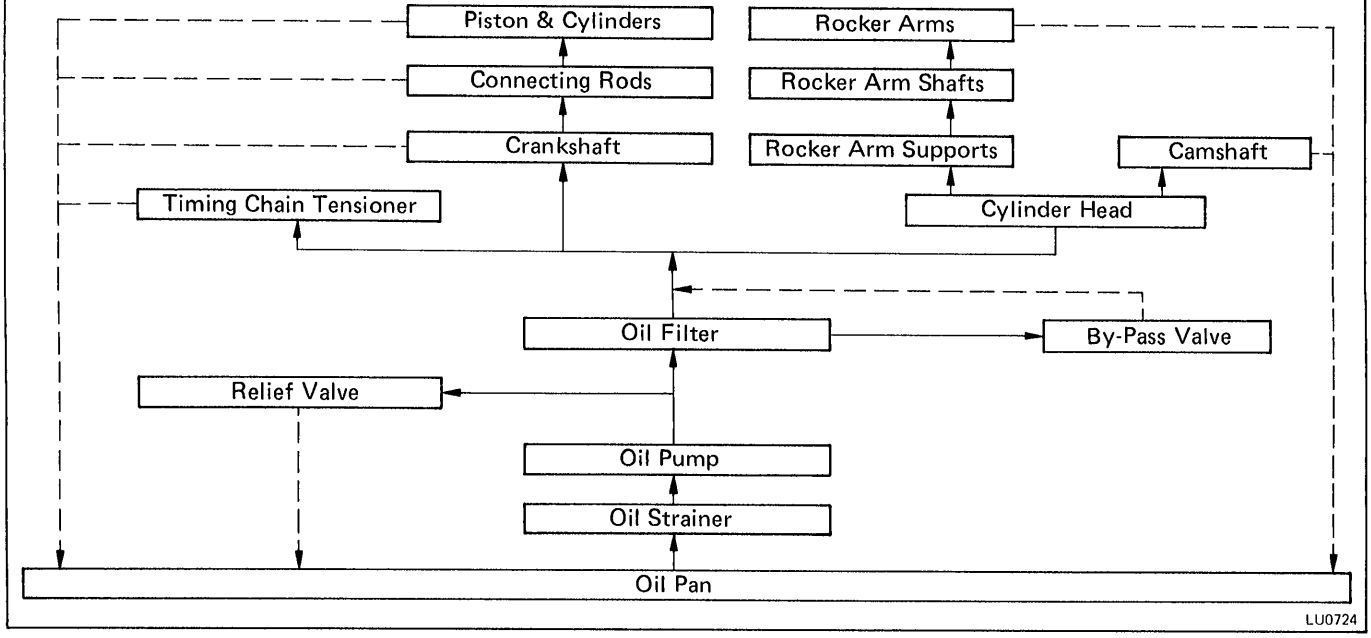
(22R-E ENGINE)

(3VZ-E ENGINE)

DESCRIPTION

A fully pressurized, fully filtered lubrication system is used in these engine.





A pressure feeding lubrication system has been adopted to supply oil to the moving parts of this engine. The lubrication system consists of an oil pan, oil pump and oil filter, etc. The oil circuit is shown in the illustration at the top of the previous page. Oil from the oil pan is pumped up by the oil pump. After it passes through the oil filter, it is fed through the various oil holes in the crankshaft and cylinder block. After passing through the cylinder block and performing its lubricating function, the oil is returned by gravity to the oil pan. A dip stick on the side of the oil pump body is provided to check the oil level.

Oil Pump

The oil pump pumps up oil from the oil pan and sends it under pressure to the various parts of the engine. An oil strainer is mounted in front of the inlet to the oil pump to remove impurities. The oil pump itself is an internal gear pump, which uses a drive gear and driven gear inside the pump body. When the drive gear rotates, the driven gear rotates in the same direction. When both gears rotate, the space between the two gears changes. Oil is drawn in when this space widens, and is discharged when the space becomes narrow.

Oil Pressure Regulator

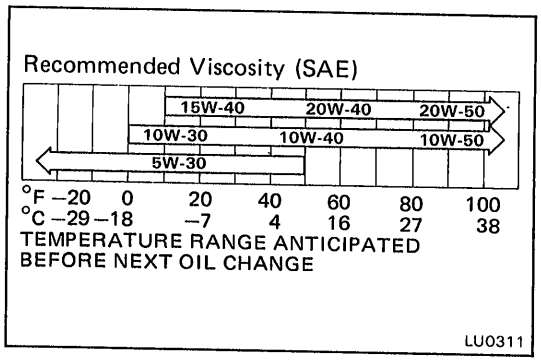
At high engine speeds, the oil pump supplies more oil to each part that is necessary. For this reason, an oil pressure regulator which works to prevent an oversupply of oil is installed on the oil pump. During normal oil supply, a coil spring and valve keep the bypass closed, but when too much oil is being supplied, the pressures become extremely high, overpowering the force of the spring and opening the valves. This allows the excess oil to flow through the relief valve and return to the oil pan.

Oil Filter

The oil filter is a full flow type with a paper filler element and built in relief valve. Particles of metal from wear, airborn dirt, carbon and other impurities can get in the oil during use and could cause accelerated wear or siezing if allowed to circulate through the engine. The oil filter, integrated into the oil line, removes these impurities as the oil passes through it. The filter is mounted outside the engine to simplify replacement of the filter element. A bypass valve is also included ahead of the filter element to relieve the high oil pressure in case the filter element becomes clogged with impurities. The relief valve opens when the oil pressure overpowers the force of the spring. Oil passing through the relief valve bypasses the oil filter and flows directly into the main oil hole in the engine.

TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Oil leakage	Cylinder head, cylinder block or oil pump body damaged or cracked	Repair as necessary	
	Oil seal faulty	Replace oil seal	EM-65
	Gasket faulty	Replace gasket	
Low oil pressure	Oil leakage	Repair as necessary	
	Relief valve faulty	Repair relief valve	LU-8
	Oil pump faulty	Repair oil pump	LU-8
	Engine oil poor quality	Replace engine oil	LU-6
	Crankshaft bearing faulty	Replace bearing	EM-44
	Connecting rod bearing faulty	Replace bearing	EM-44
	Oil filter clogged	Replace oil filter	LU-6
High oil pressure	Relief valve faulty	Repair relief valve	LU-8



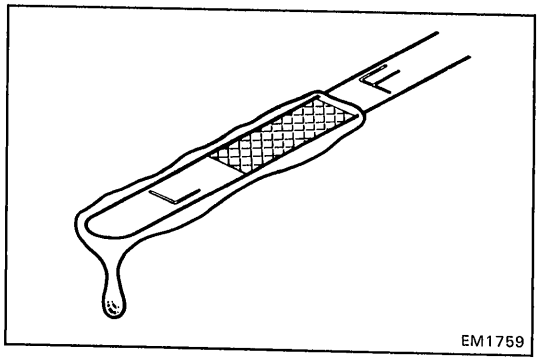
OIL PRESSURE CHECK

1. CHECK OIL QUALITY

Check the oil for deterioration, entry of water, discoloring or thinning.

If oil quality is poor, replace.

Use API grade SG multigrade, fuel-efficient and recommended viscosity oil.



2. CHECK OIL LEVEL

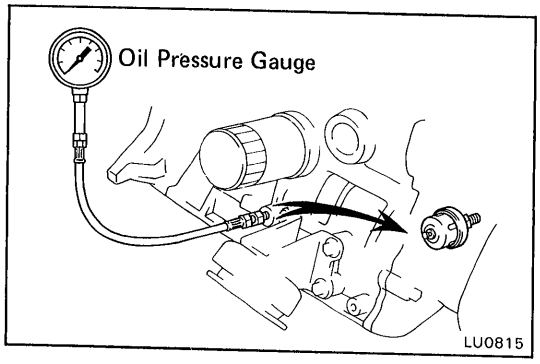
The oil level should be between the "L" and "F" marks on the level gauge. If low, check for leakage and add oil up to the "F" mark.

3. REMOVE OIL PRESSURE SENDER GAUGE

4. INSTALL OIL PRESSURE GAUGE

5. START ENGINE

Start engine and warm it up to normal operating temperature.



6. MEASURE OIL PRESSURE

Oil pressure:

At idle speed	**More than 0.3 kg/cm² (4.3 psi, 29 kPa)**
At 3,000 rpm	**2.5 — 5.0 kg/cm² (36 — 71 psi, 245 — 490 kPa)**

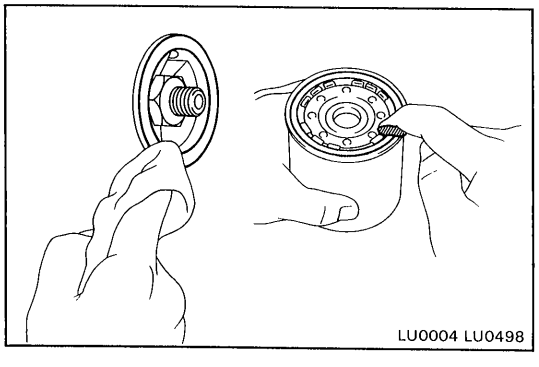
HINT: Check for oil leakage after reinstalling the oil pressure sender gauge.

REPLACEMENT OF ENGINE OIL AND OIL FILTER

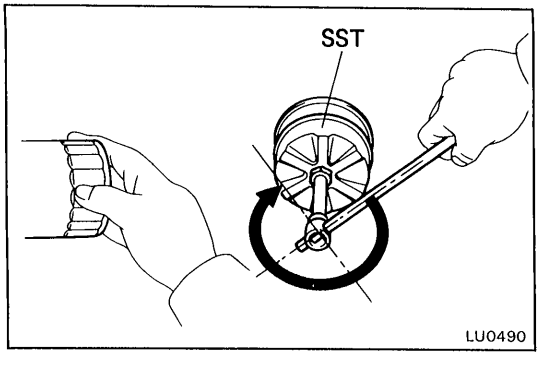
NOTICE:

- **Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.**
  Adequate means of skin protection and washing facilities should be provided.
- **Care should be taken, therefore, when changing engine oil, to minimize the frequency and length of time your skin is exposed to used engine oil.**
  Protective clothing and gloves, that cannot be penetrated by oil, should be worn. The skin should be thoroughly washed with soap and water, or use waterless hand cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.
- **In order to preserve the enviroment, used oil must be disposed of only at designated disposal sites.**

1. **DRAIN ENGINE OIL**
   (a) Remove the oil filler cap.
   (b) Remove the oil dipstick.
   (c) Remove the oil drain plug and drain the oil into a container.

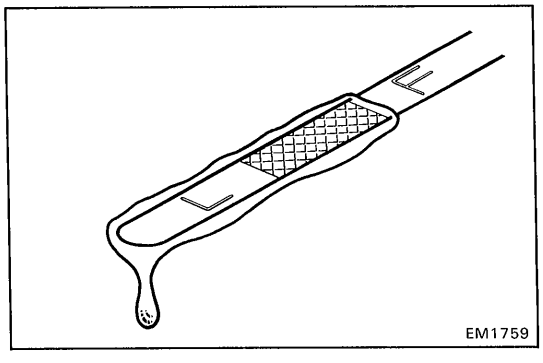

LU0004 LU0498

2. **REPLACE OIL FILTER**
   (a) Using SST, remove the oil filter (located on right side of the cylinder block).
   SST 09228-07500
   (b) Inspect and clean the oil filter installation surface.
   (c) Apply clean engine oil to the gasket of new oil filter.



LU0490

   (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 09228-07500


EM1759

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 SG 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	**3.8 liters (4.0 US qts, 3.3 Imp. qts)**
w/ Oil filter change	**4.3 liters (4.5 US qts, 3.8 Imp. qts)**

4. **START ENGINE AND CHECK FOR LEAKS**

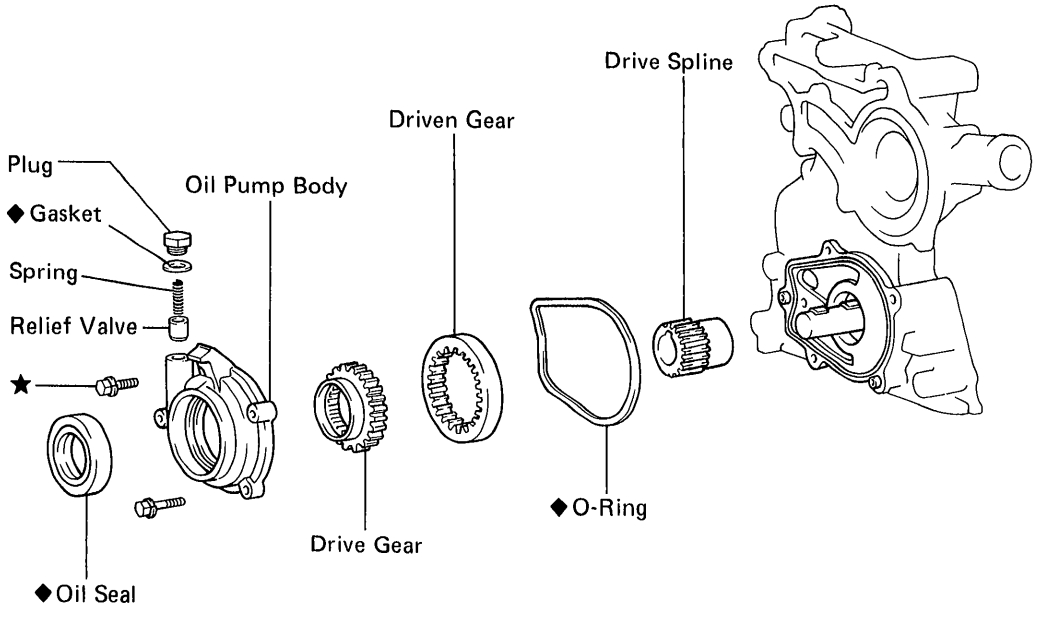
5. **RECHECK ENGINE OIL LEVEL**

Recheck the engine oil level and refill as necessary.

HINT: Insert the oil dipstick with the curved tip pointed toward the engine.

OIL PUMP

COMPONENTS



◆ Non-reusable part
★ Precoated part

LU0687

REMOVAL OF OIL PUMP

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

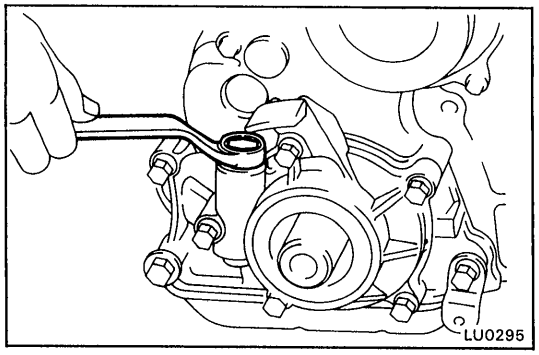
1. **REMOVE OIL PAN**
   (See steps 3, 4 on page EM-37)

2. **REMOVE OIL STRAINER**
   Remove the four bolts holding the oil strainer.

3. **REMOVE DRIVE BELTS**

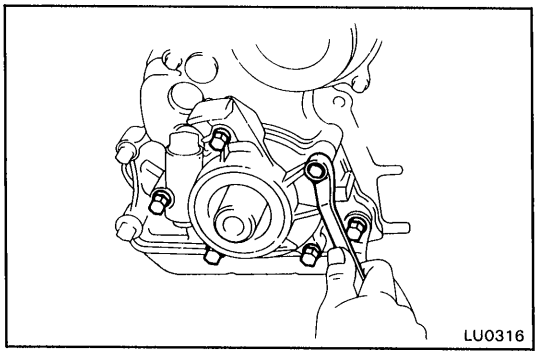
4. **REMOVE CRANKSHAFT PULLEY**
   (See step 4 on page EM-38)

5. **(with A/C)**
   REMOVE A/C COMPRESSOR AND BRACKET

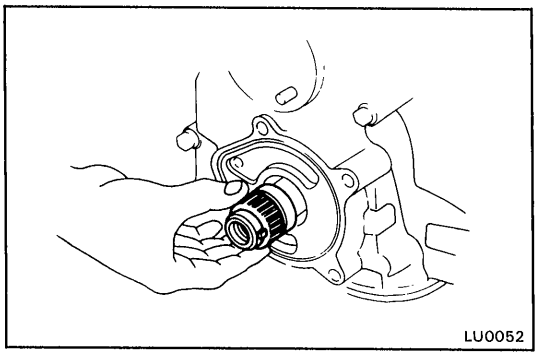


6. REMOVE OIL PUMP ASSEMBLY

(a) Loosen the oil pump relief valve plug.



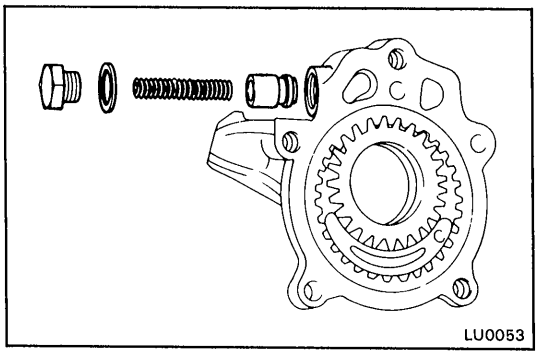
(b) Remove the five bolts, the oil pump assembly and O-ring.



7. REMOVE OIL PUMP DRIVE SPLINE

HINT: If the oil pump drive spline cannot be removed by hand, use SST. Use SST to remove them together. (See page EM-39)

SST 09213-36020



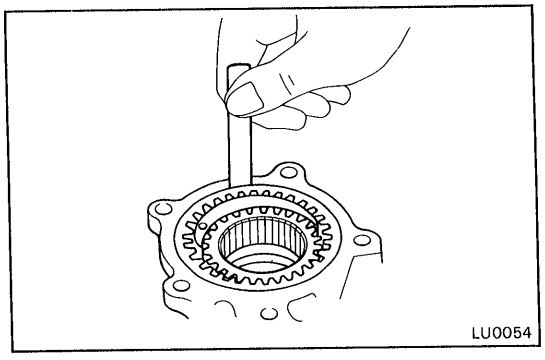
DISASSEMBLY OF OIL PUMP

1. REMOVE RELIEF VALVE

Unscrew the relief valve plug and gasket, and remove the spring and the relief valve.

2. REMOVE DRIVEN AND DRIVE GEARS

Remove the drive and the driven gears.


LU0054

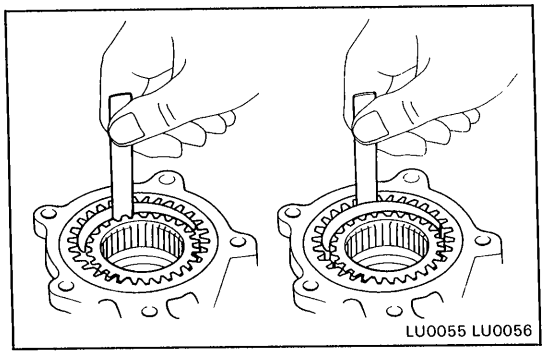
INSPECTION OF OIL PUMP

1. INSPECT BODY CLEARANCE

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

Standard clearance: **0.09 — 0.15 mm (0.0035 — 0.0059 in.)**
Maximum clearance: **0.2 mm (0.008 in.)**

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

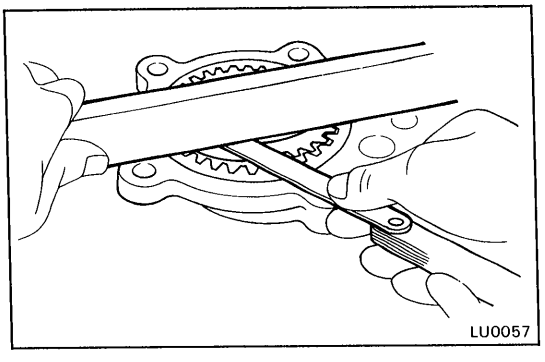

LU0055 LU0056

2. INSPECT TIP CLEARANCE

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

Standard clearance:
Driven 0.15 — 0.21 mm (0.0059 — 0.0083 in.)
Drive 0.22 — 0.25 mm (0.0087 — 0.0098 in.)
Maximum clearance: **0.3 mm (0.012 in.)**

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

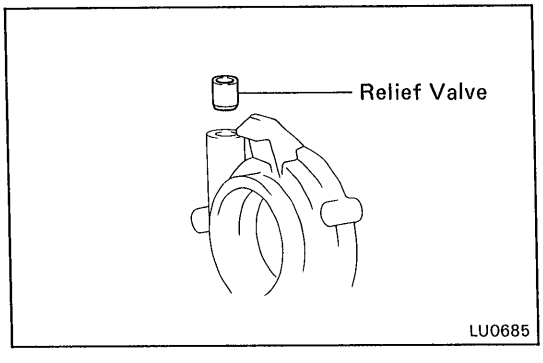

LU0057

3. INSPECT SIDE CLEARANCE

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

Standard clearnce: **0.03 — 0.09 mm (0.0012 — 0.0035 in.)**
Maximum clearance: **0.15 mm (0.0059 in.)**

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



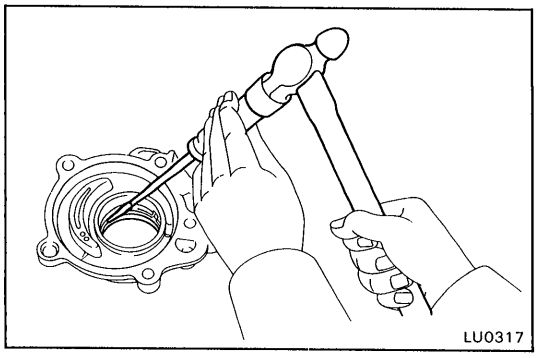
LU0685

INSPECTION OF PRESSURE REGULATOR

INSPECT PRESSURE REGULATOR VALVE

Coat the relief valve with engine oil and check that it falls smoothly into the valve hole by its own weight.

If necessary, replace the relief valve and/or oil pump assembly.

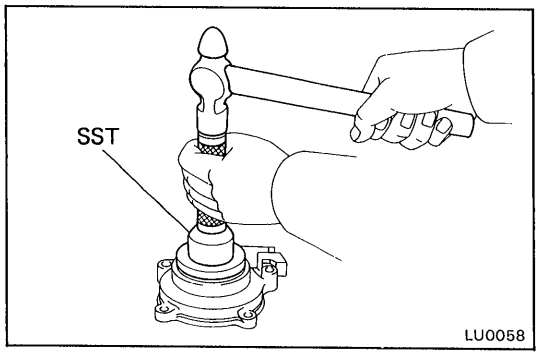


REPLACEMENT OF FRONT OIL SEAL

1. REMOVE OIL SEAL

(a) Remove the drive and driven gears.

(b) Using a screwdriver, remove the oil seal.

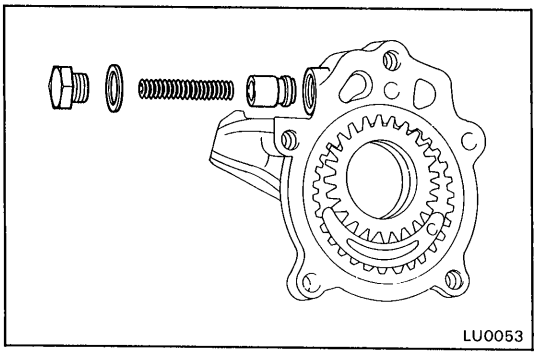


2. INSTALL OIL SEAL

(a) Apply MP grease to a new oil seal lip.

(b) Using SST, drive in the new oil seal.

SST 09223-50010



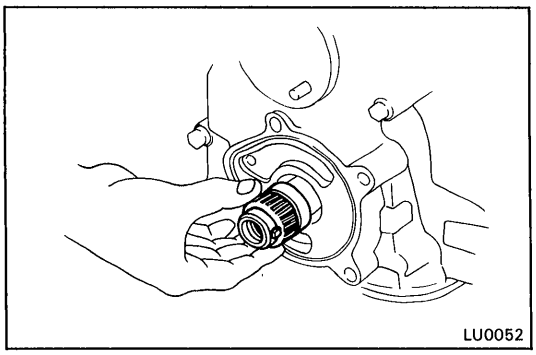
ASSEMBLY OF OIL PUMP

(See page LU-8)

1. ASSEMBLE OIL PUMP ASSEMBLY

(a) Install relief valve and the spring in the body, and screw on the relief valve plug with a new gasket.

(b) Insert the drive and driven gears into the pump body.



INSTALLATION OF OIL PUMP

(See page LU-8)

1. INSTALL OIL PUMP DRIVE SPLINE AND O-RING

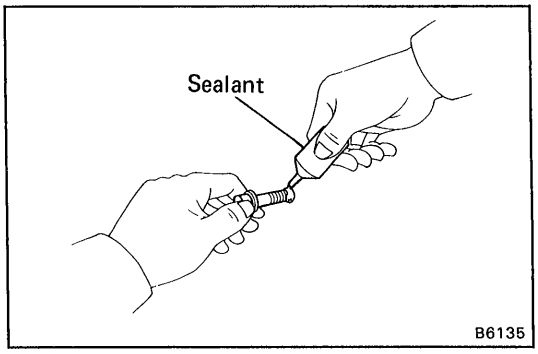
(a) Slide the pump drive spline onto the crankshaft.

HINT: If the oil pump drive spline cannot be installed by hand, use SST. (See page EM-41)

(b) Place the O-ring into the groove.

2. INSTALL OIL PUMP

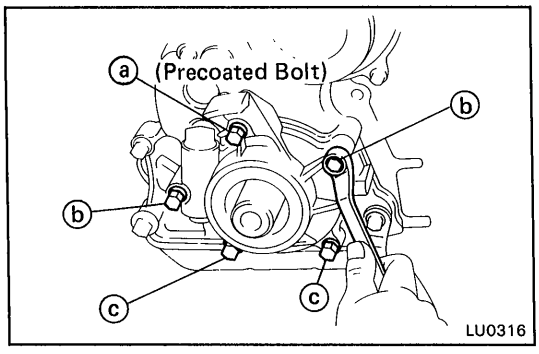
(a) Clean the upper set bolt to most threads and timing chain cover bolt holes of any sealer, oil or foreign particles.
Remove any oil with kerosene or gasoline.



(b) Apply sealant to 2 or 3 threads of the bolt end.

Sealant: Part No. 08833-00070, THREE BOND 1324 or equivalent

HINT: This adhesive will not harden while exposed to air. It will act as a sealant or binding agent only when applied to threads, etc. and air is cut off.



(c) Torque the five bolts.

Torque: ⓐ250 kg-cm (18 ft-lb, 25 N·m)
ⓑ195 kg-cm (14 ft-lb, 19 N·m)
ⓒ130 kg-cm (9 ft-lb, 13 N·m)

(d) Torque the relief valve plug.

Torque: 375 kg-cm (27 ft-lb, 37 N·m)

3. INSTALL CRANKSHAFT PULLEY
(See step 8 on page EM-42)

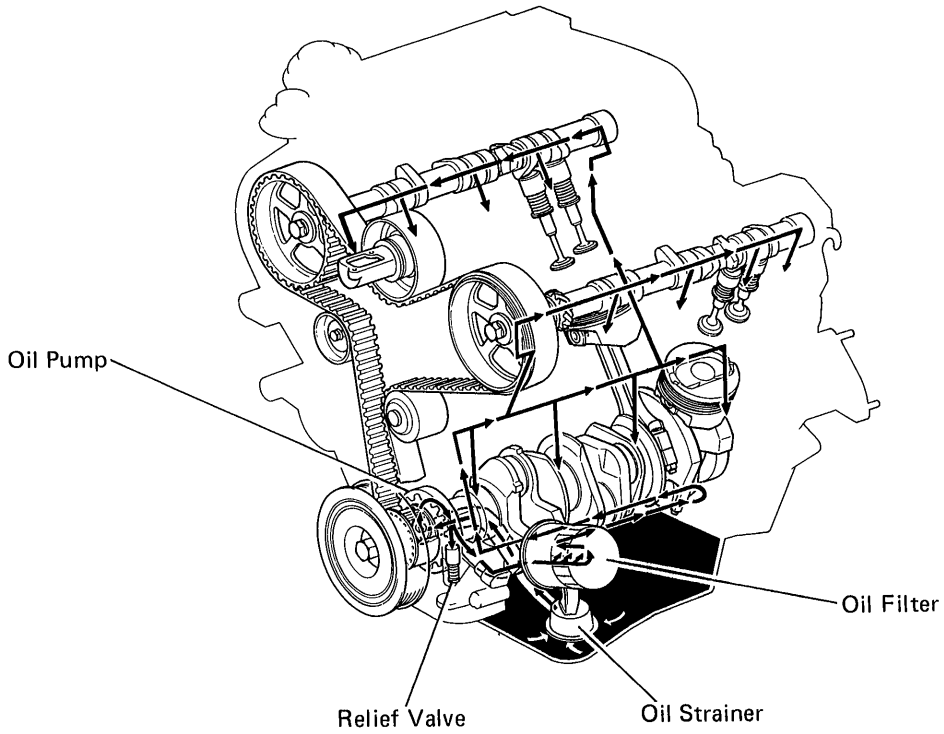
4. INSTALL AND ADJUST DRIVE BELT
(See page MA-6)

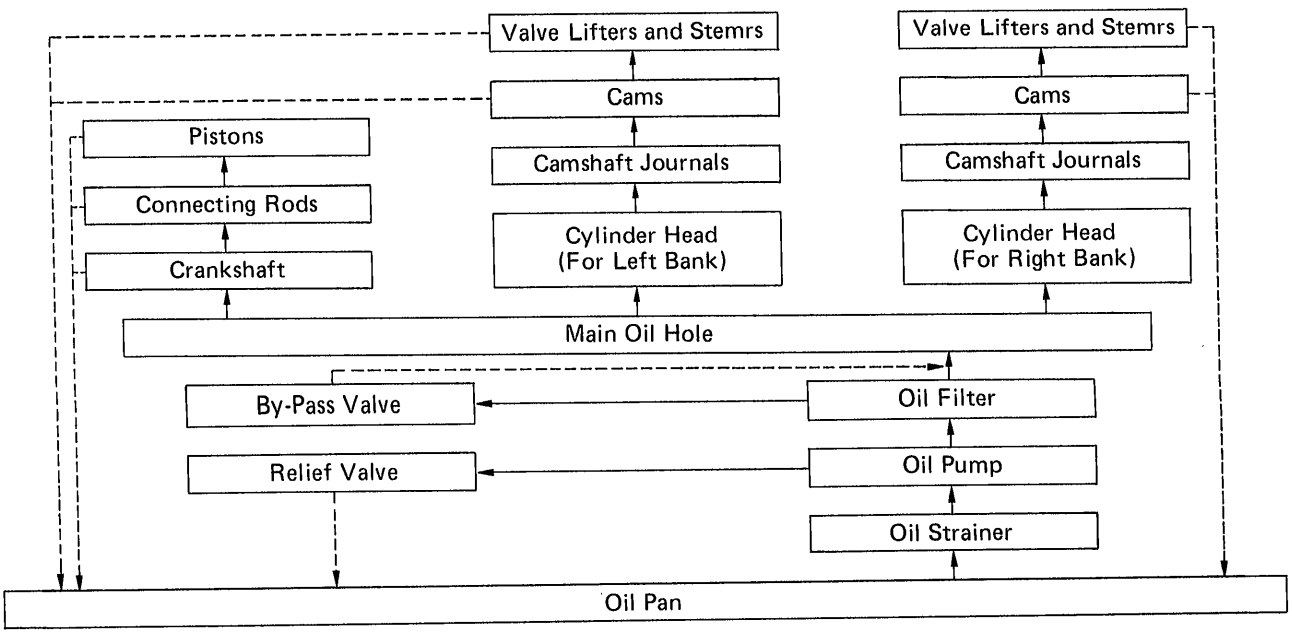
5. INSTALL OIL STRAINER
(See step 2 on page EM-72)

6. INSTALL OIL PAN
(See step 13 on page EM-43)

DESCRIPTION

A fully pressurized, fully filtered lubrication system is used in these engine.





LU0610

A pressure feeding lubrication system has been adopted to supply oil to the moving parts of this engine. The lubrication system consists of an oil pan, oil pump, oil filter and other external parts which supply oil to the moving parts in the engine block. The oil circuit is shown in the illustration at the top of the previous page. Oil from the oil pan is pumped up by the oil pump. After it passes through the oil filter, it is fed through the various oil holes in the crankshaft, cylinder block and cylinder head. After passing through the cylinder block and performing its lubricating function, the oil is returned by gravity to the oil pan. A dip stick on the side of the oil pump body is provided to check the oil level.

Oil pump

The oil pump pumps up oil from the oil pan and sends it under prossure to the various parts of the engine. An oil strainer is mounted in front of the inlet to the oil pump. The oil pump itself is a trochoid type pump, inside of which is a drive rotor and a driven rotor. When the crankshaft causes the drive rotor to rotate, the driven rotor rotates in the same direction, and since the axis of the driven rotor shaft is different from the center of the driven rotor, the space between the two rotors is changed as they rotate. Oil is drawn in when the space is wide and is discharged when the space is narrow.

Oil Pressure Regulator

At high engine speeds, the oil pump supplies more oil to each part that is necessary. For this reason, an oil pressure regulator which works to prevent an oversupply of oil is installed on the oil pump. During normal oil supply, a coil spring and valve keep the bypass closed, but when too much oil is being supplied, the pressures become extremely high, overpowering the force of the spring and opening the valves. This allows the excess oil to flow through the relief valve and return to the oil pan.

Oil Filter

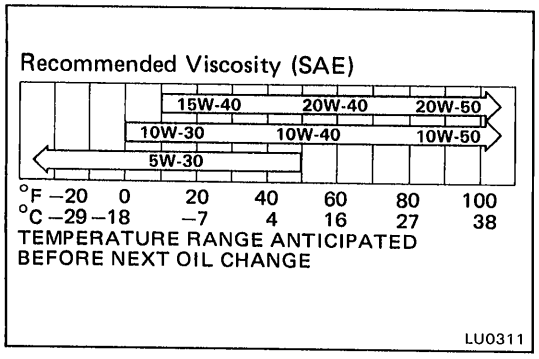
The oil filter is a full flow type filter with a paper filter element built-in relief valve. Particles of metal from wear, airborn dirt, carbon and other impurities can get in the oil during use and could cause accelerated wear or siezing if allowed to circulate through the engine. The oil filter, intograted into the oil line, removes these impurities as the oil passes through it.

The filter is mounted outside the engine to simplify replacement of the filter element.

A relief valve is included in from of the filtor element to relieve the high oil pressure in case the filter element becomes clogged with impurities. The bypass valve opens when the difference in the oil pressure of the inlet and outlet ports exceeds a specified value. Oil passing through the relief valve by-passes the oil filter and flows directly into the main oil hole in the engine.

TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Oil leakage	Cylinder head, cylinder block or oil pump body damaged or cracked	Replace as necessary	
	Oil seal faulty	Replace oil seal	EM-167
	Gasket faulty	Replace gasket	
Low oil pressure	Oil leakage	Replace as necessary	
	Relief valve faulty	Replace relief valve	LU-19
	Oil pump faulty	Repair oil pump	LU-19
	Engine oil poor quality	Replace engine oil	LU-17
	Crankshaft bearing faulty	Replace bearing	EM-142
	Connecting rod bearing faulty	Replace bearing	EM-142
	Oil filter clogged	Replace oil filter	LU-17
High oil pressure	Relief valve faulty	Repair relief valve	LU-19



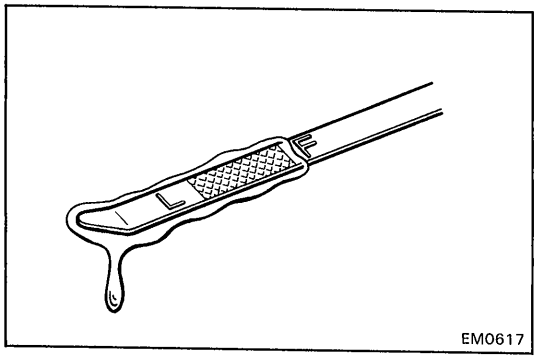
OIL PRESSURE CHECK

1. CHECK OIL QUALITY

Check the oil for deterioration, entry of water, discoloring or thinning.

If oil quality is poor, replace.

Use API grade SG multigrade, fuel-efficient and recommended viscosity oil.



2. CHECK OIL LEVEL

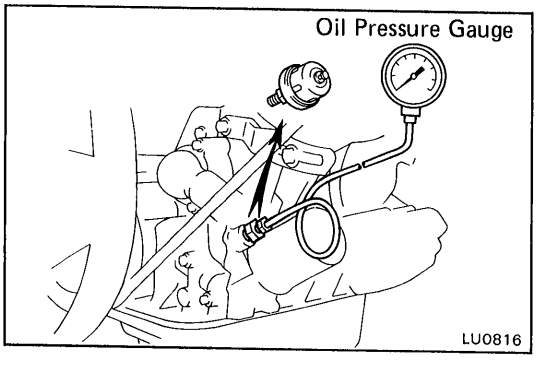
The oil level should be between the "L" and "F" marks on the level gauge. If low, check for leakage and add oil up to the "F" mark.

3. REMOVE OIL PRESSURE SENDER GAUGE

4. INSTALL OIL PRESSURE GAUGE

5. START ENGINE

Start engine and warm it up to normal operating temperature.



6. MEASURE OIL PRESSURE

Oil pressure:

At idle speed	**More than 0.3 kg/cm² (4.3 psi, 29 kPa)**
At 3,000 rpm	**2.5 — 5.3 kg/cm² (36 — 75 psi, 245 — 520 kPa)**

HINT: Check for oil leakage after reinstalling the oil pressure sender gauge.

REPLACEMENT OF ENGINE OIL AND OIL FILTER

NOTICE:

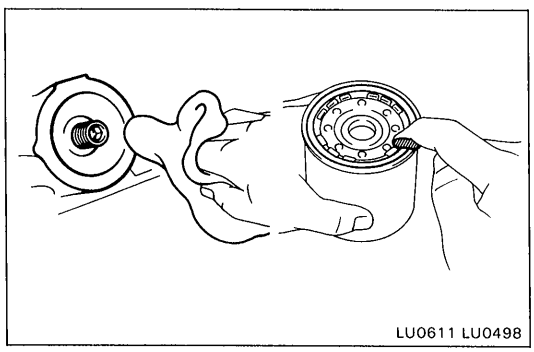
- **Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.**
  Adequate means of skin protection and washing facilities should be provided.
- **Care should be taken, therefore, when changing engine oil, to minimize the frequency and length of time your skin is exposed to used engine oil.**
  Protective clothing and gloves, that cannot be penetrated by oil, should be worn. The skin should be thoroughly washed with soap and water, or use waterless hand cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.
- **In order to preserve the environment, used oil must be disposed of only at designated disposal sites.**

1. DRAIN ENGINE OIL

(a) Remove the oil filler cap.

(b) Remove the oil dipstick.

(c) Remove the oil drain plug and drain the oil into a container.



LU0611 LU0498

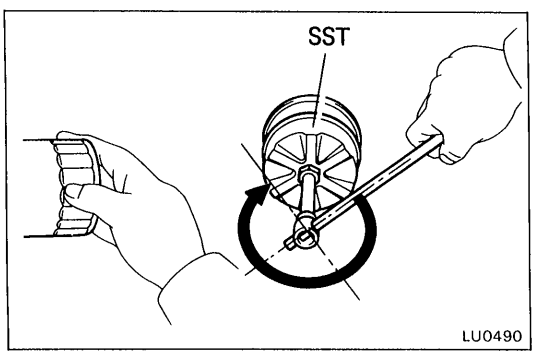
2. REPLACE OIL FILTER

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

SST 09228-07500

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

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

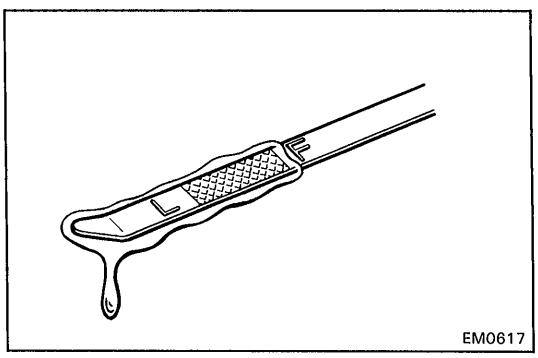


LU0490

(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 09228-07500



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 SG multigrade, fuel-efficient and recommended viscosity oil.

Oil capacity:

Dry fill
5.3 liters (5.6 US qts, 4.7 Imp. qts)

w/o Oil filter change
4.2 liters (4.4 US qts, 3.7 Imp. qts)

w/ Oil filter change
4.5 liters (4.8 US qts, 4.0 Imp. qts)

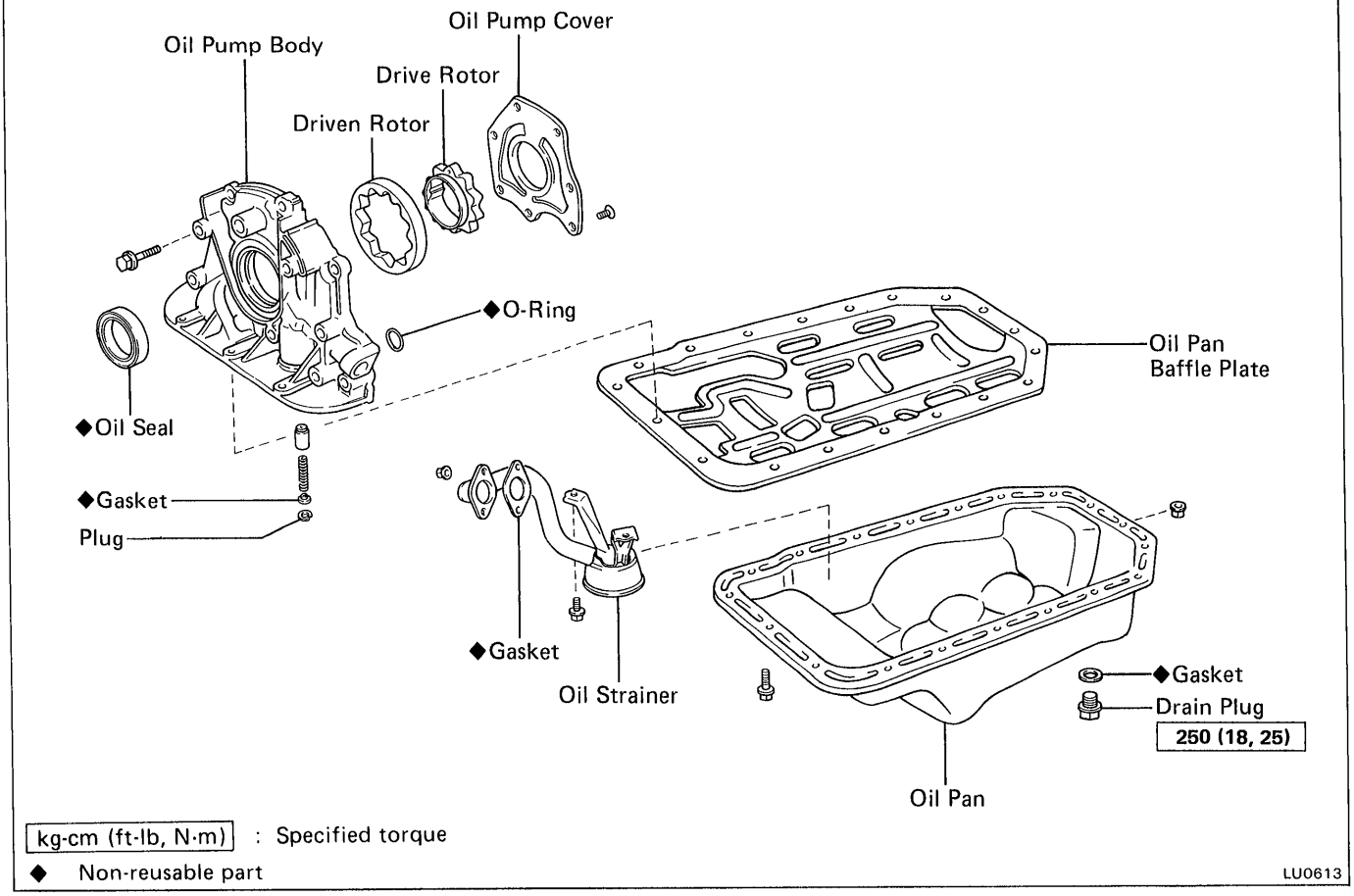
4. START ENGINE AND CHECK FOR LEAKS

5. RECHECK ENGINE OIL LEVEL

Recheck the engine oil level and refill as necessary.

OIL PUMP

COMPONENTS



REMOVAL OF OIL PUMP

1. **REMOVE ENGINE UNDER COVER**

2. **(4WD)**
   REMOVE FRONT DIFFERENTIAL
   (See Page SA-40)

3. **DRAIN ENGINE OIL**

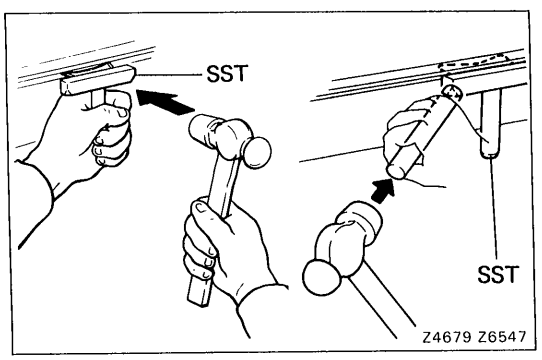
4. **REMOVE TIMING BELT**
   (See steps 1 to 15 on pages EM-100 to 103)

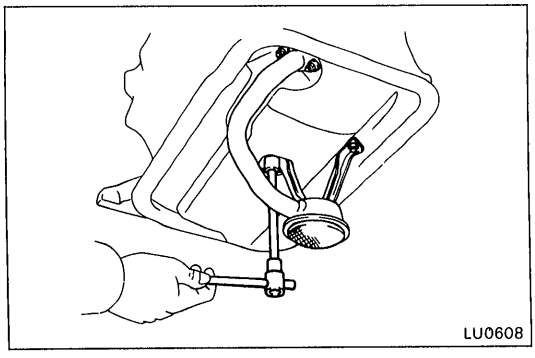
5. **REMOVE CRANKSHAFT TIMING PULLEY**
   (See step 16 on page EM-103)

6. **REMOVE OIL PAN**
   (a) Remove the seventeen bolts and two nuts.
   (b) Using SST and a brass bar, separate the oil pan from the baffle plate.

   SST 09032-00100

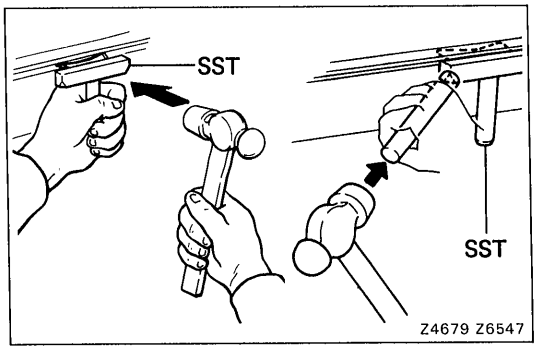
   HINT: When removing the oil pan, be careful not to damage the oil pan flange.





7. REMOVE OIL STRAINER

Remove the two bolts, nuts and oil strainer and gasket.

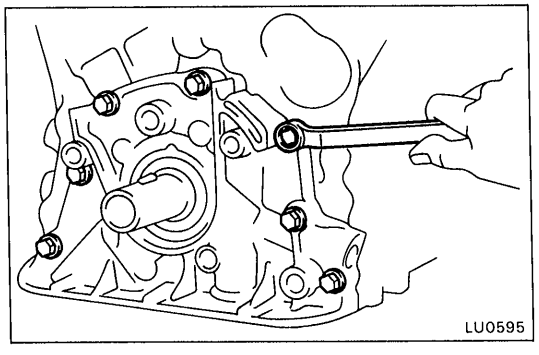


8. REMOVE OIL PAN BAFFLE PLATE

Insert the blade of SST between the cylinder block and baffle plate, cut off applied sealer and remove the baffle plate.

SST 09032-00100

HINT: When removing the baffle plate, be careful not to damage the baffle plate flange.



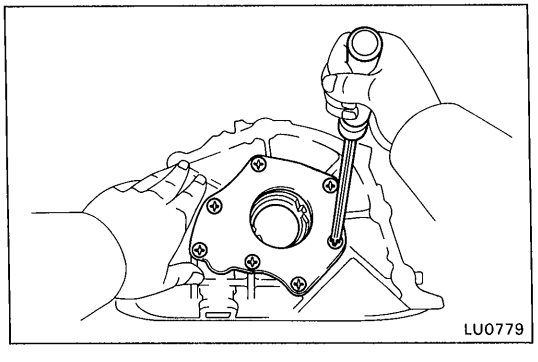
9. REMOVE OIL PUMP

(a) Remove the seven bolts and oil pump.

(b) Using a plastic-faced hammer, carefully tap the oil pump body.

(c) Remove the O-ring from the cylinder block.

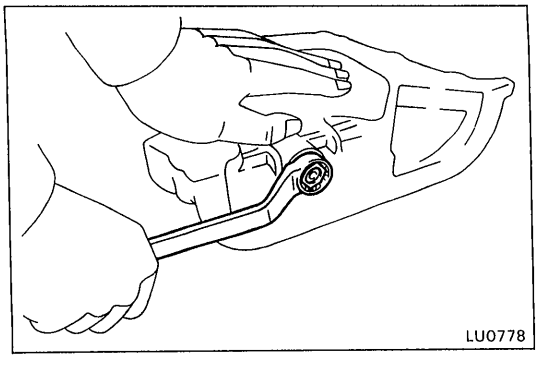
DISASSEMBLY OF OIL PUMP



1. REMOVE DRIVEN AND DRIVE ROTOR

(a) Remove the seven screws and pump body cover.

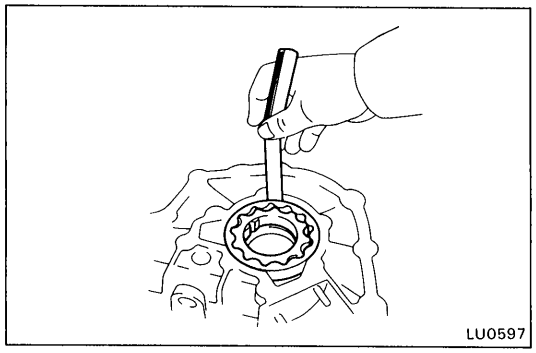
(b) Remove the drive and driven rotor.



2. REMOVE RELIEF VALVE

(a) Unscrew the relief valve plug and gasket.

(b) Remove the spring and relief valve.


LU0597

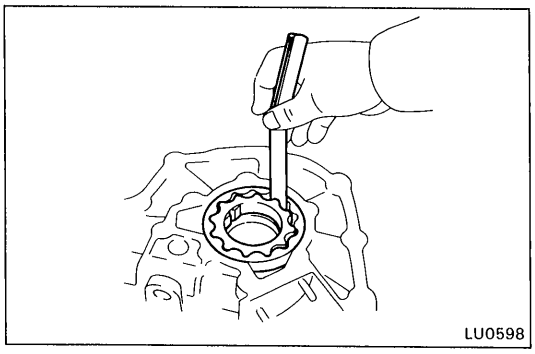
INSPECTION OF OIL PUMP

1. INSPECT BODY CLEARANCE

Using a thickness gauge, measure the clearance between the driven rotor and pump body.

Standard clearance: **0.10 — 0.13 mm (0.0039 — 0.0051 in.)**
Maximum clearance: **0.30 mm (0.0118 in.)**

If the clearance is greater than maximum, replace the oil pump rotor set and/or pump body.

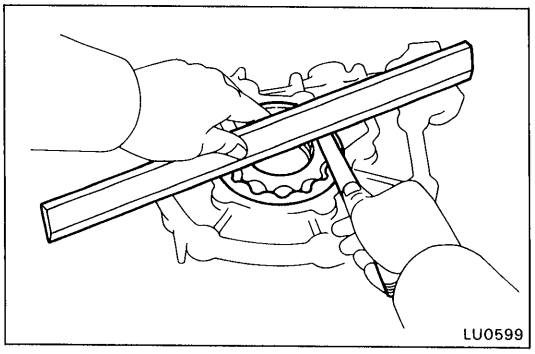

LU0598

2. INSPECT TIP CLEARANCE

Using a thickness gauge, measure the clearance between both rotor trips.

Standard clearance: **0.11 — 0.24 mm (0.0043 — 0.0094 in.)**
Maximum clearance: **0.35 mm (0.0138 in.)**

If the clearance is greater than maximum, replace the oil pump rotor set.

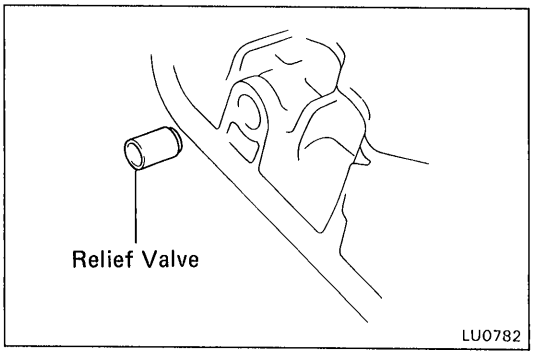

LU0599

3. INSPECT SIDE CLEARANCE

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

Standard clearance: **0.03 — 0.09 mm (0.0012 — 0.0035 in.)**
Maximum clearance: **0.15 mm (0.0059 in.)**

If the clearance is greater than maximum, replace the oil pump rotor set and/or pump body.



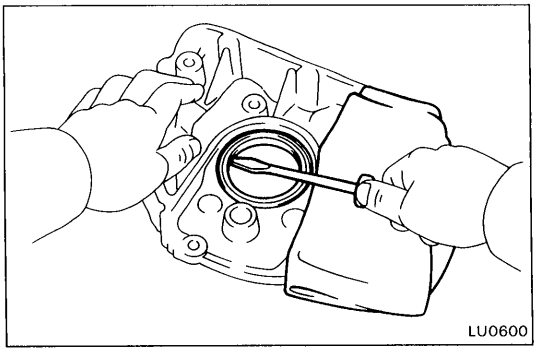
LU0782

INSPECTION OF PRESSURE REGULATOR

INSPECT PRESSURE REGULATOR VALVE

Coat the relief valve with engine oil and check that it falls smoothly into the valve hole by its own weight.

If necessary, replace the relief valve and/or oil pump assembly.

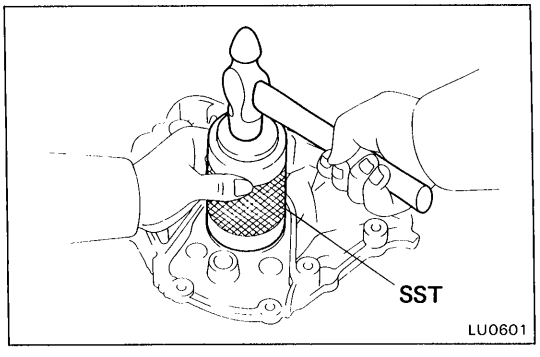


REPLACEMENT OF OIL PUMP OIL SEAL

1. REMOVE OIL SEAL

(a) Remove the drive and driven rotor.

(b) Using a screwdriver, pry out the oil seal.

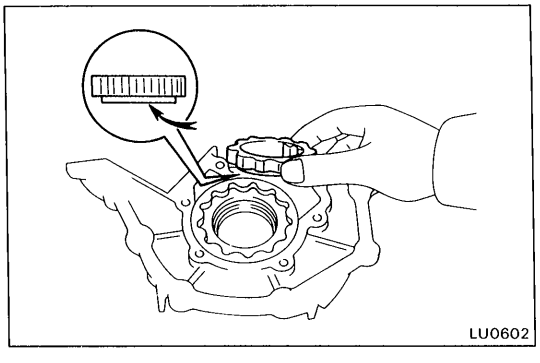


2. INSTALL OIL SEAL

(a) Apply MP grease to a new oil seal lip.

(b) Using SST, drive in the new oil seal.

SST 09309-37010

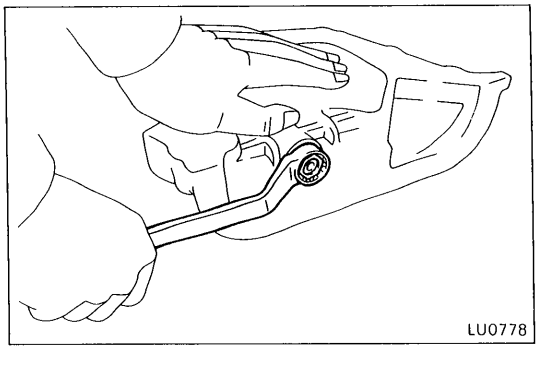


(c) Put the drive and driven rotors in the pump body.

ASSEMBLY OF OIL PUMP

1. INSTALL RELIEF VALVE

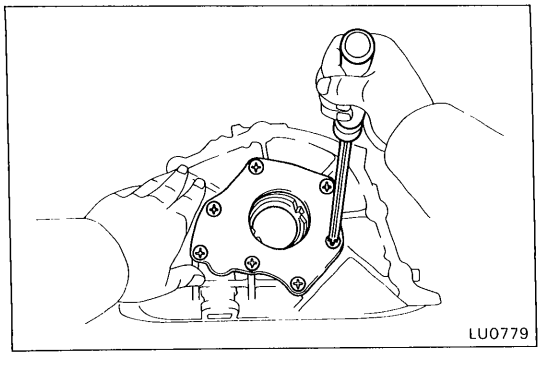
Install relief valve and the spring in the body, and screw on the relief valve plug with a new gasket.

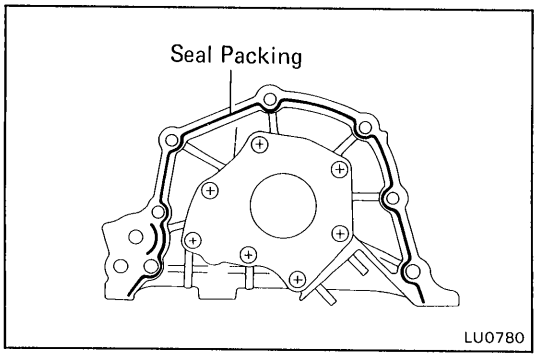


2. INSTALL PUMP BODY COVER

Install the pump body cover with seven screws.

Torque: 105 kg-cm (8 ft-lb, 10 N·m)





INSTALLATION OF OIL PUMP

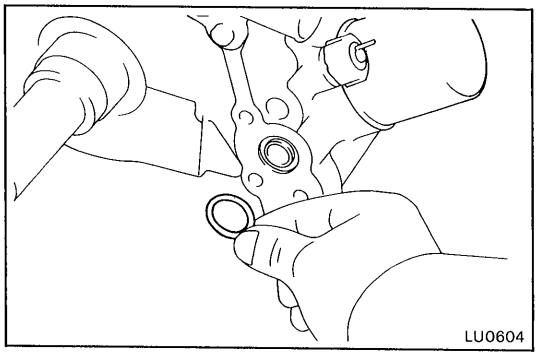
(See page LU-19)

1. INSTALL OIL PUMP ASSEMBLY

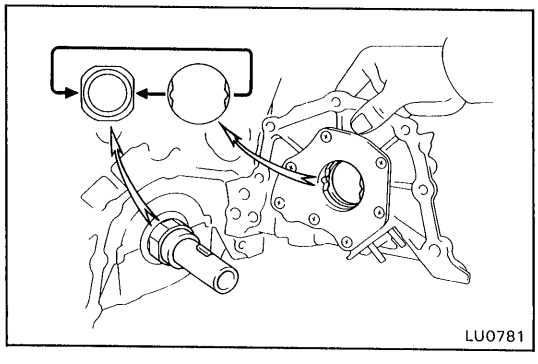
(a) Apply seal packing to the oil pump body as shown in the figure.

Seal packing: Part No. 08826-00080 or equivalent

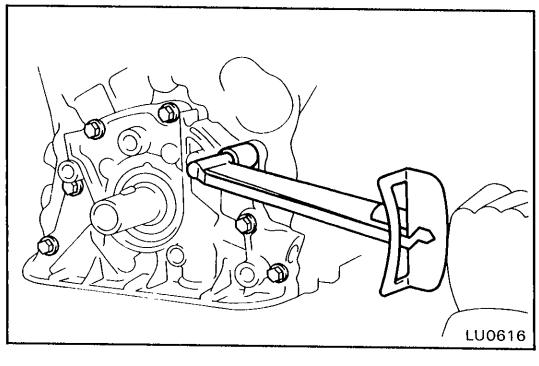
HINT: Cleaning and application of seal packing to the installation surface is the same as for the oil pan baffle plate. However, use a nozzle cut to 2 mm (0.08 in.)



(b) Place a new O-ring into the groove of cylinder block.



(c) Install the oil pump to the crankshaft with the spline teeth of the drive rotor engaged with the large teeth of the crankshaft.



(d) Install the oil pump with the seven bolts.

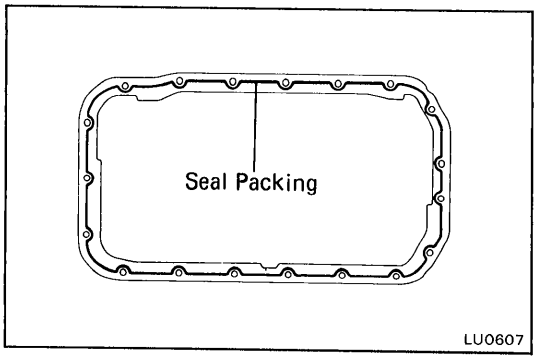
Torque: 200 kg-cm (14 ft-lb, 20 N·m)

2. CLEAN OIL PAN BAFFLE PLATE AND OIL PAN

Remove any old packing material and be careful not to drop any oil on the contacting surfaces of the oil pan baffle plate and cylinder block.

- Using a razor blade and gasket scraper, remove all the remaining seal packing (FIPG) material from the gasket surfaces.
- Thoroughly clean all components to remove all the loose material.
- Clean both sealing surfaces with a non-residue solvent.

NOTICE: Do not use a solvent which will affect the painted surfaces.



3. INSTALL OIL PAN BAFFLE PLATE

(a) Apply seal packing to the baffle plate as shown in the figure.

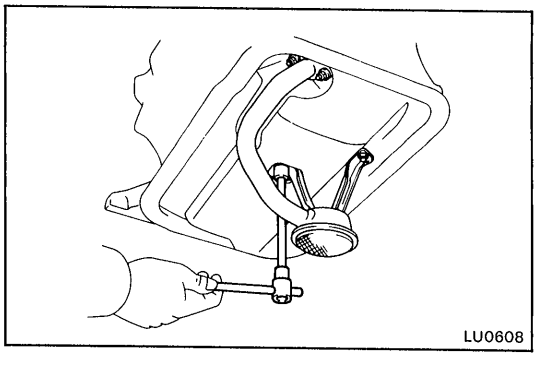
Seal packing: Part No. 08826-00080 or equivalent

However, use a nozzle cut to 3 mm (0.12 in.).

HINT: Avoid applying an excess amount to the surface. Be particularly careful near oil passages.

- Parts must be assembled within 15 minutes of application. Otherwise, the seal packing must be removed and re-applied.
- Immediately remove nozzle from tube and reinstall cap.

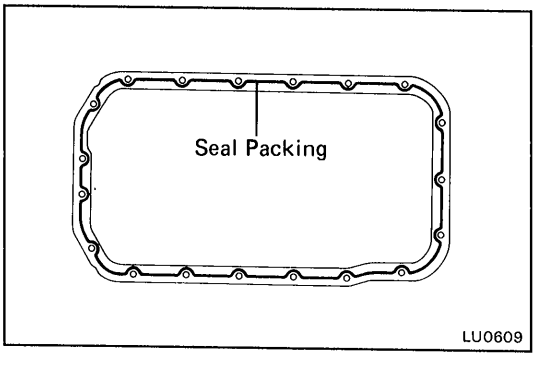
(b) Install the baffle plate.



4. INSTALL OIL STRAINER

Place a new gasket and install the oil strainer with two nuts and two bolts.

Torque: 70 kg-cm (61 in.-lb, 6.9 N·m)



5. INSTALL OIL PAN

(a) Apply seal packing to the oil pan as shown in the figure.

Seal packing: Part No. 08826-00080 or equivalent

However, use a nozzle cut to 3 mm (0.12 in.).

HINT: Avoid applying an excess amount to the surface. Be especially careful near oil passages.

- Parts must be assembled within 15 minutes of application. Otherwise, the seal packing must be removed and re-applied.
- Immediately remove nozzle from tube and reinstall cap.

(b) Install the oil pan with the two nuts and seventeen bolts.

Torque: 60 kg-cm (52 in.-lb, 5.9 N·m)

6. INSTALL CRANKSHAFT TIMING PULLEY
(See step 1 on page EM-106)

7. INSTALL TIMING BELT
(See steps 2 to 18 on pages EM-106 to 110)

8. (4WD)
INSTALL FRONT DIFFERNTIAL
(See page SA-89)

9. ENGINE UNDER COVER

10. FILL ENGINE OIL
(See step 3 on page LU-18)

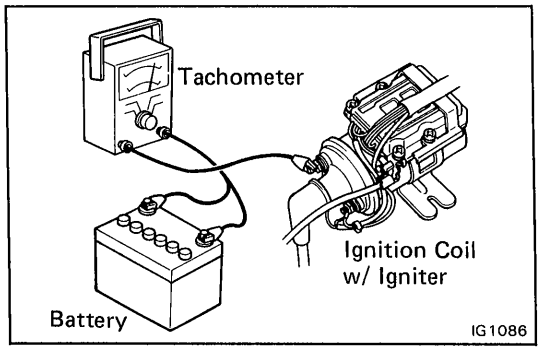
11. START ENGINE AND CHECK FOR LEAKS

12. RECHECK ENGINE OIL LEVEL
(See step 2 on page LU-16)

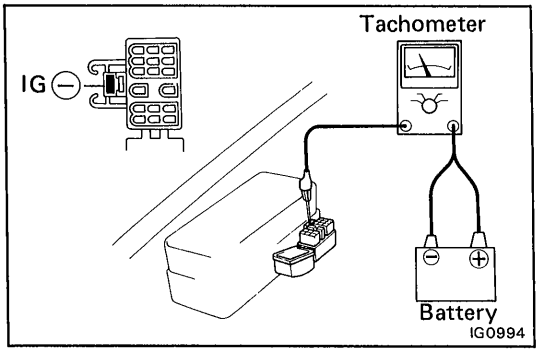
IGNITION SYSTEM

PRECAUTIONS

1. **Do not allow the ignition switch to be ON for more than 10 minutes if the engine will not start.**



2. **When a tachometer is connected to the system, connect the tachometer test probe to the ignition coil negative terminal.**



HINT: The rpm signal can also be taken from the IG ⊖ terminal of the check connector.

3. **As some tachometers are not compatible with this ignition system, we recommended that you cofirm the compatibility of your unit before using.**

4. **NEVER allow the ignition coil terminals to touch ground as it could result in damage to the igniter and/or ignition coil.**

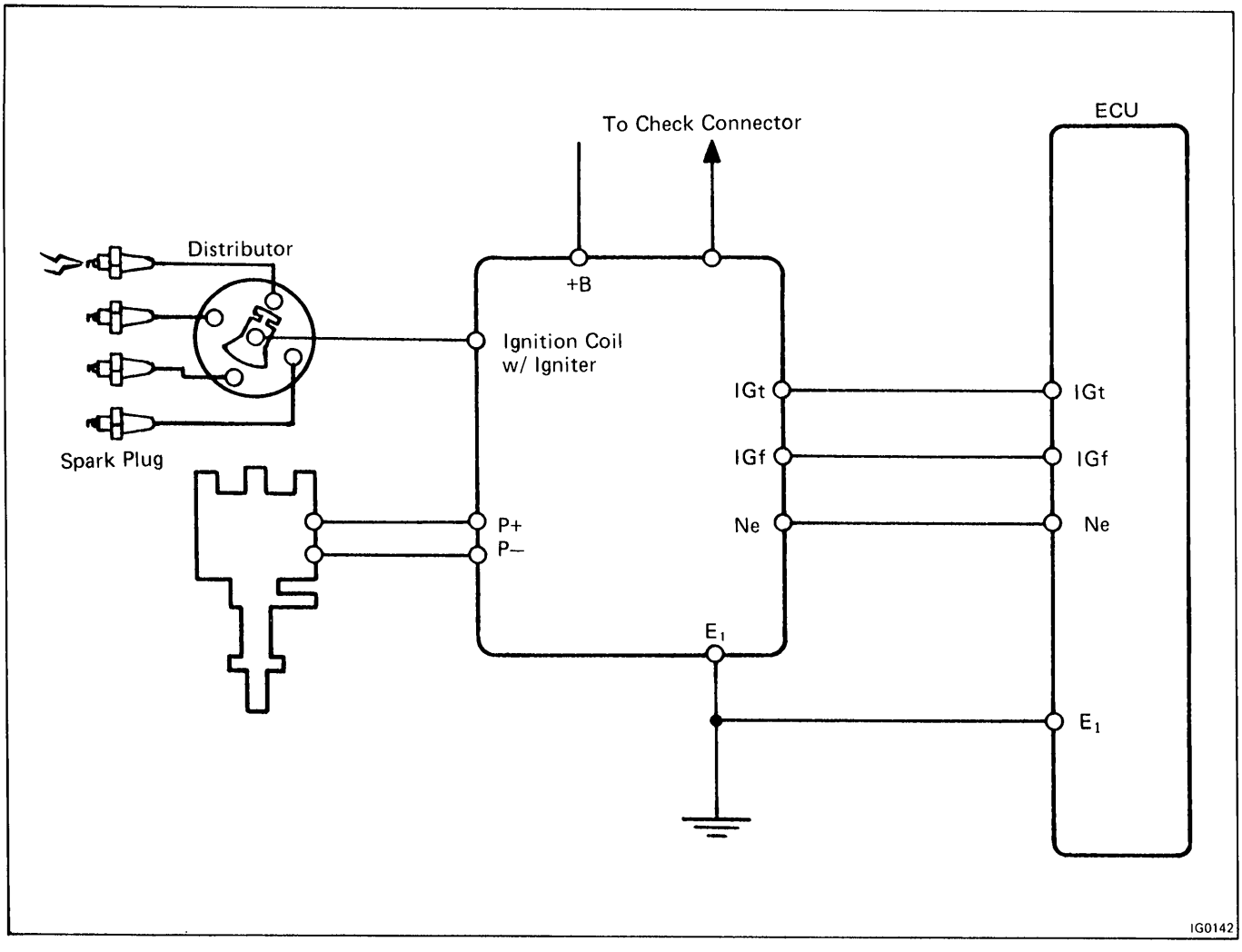
5. **Do not disconnect the battery when the engine is running.**

6. **Make sure that the igniter is properly grounded to the body.**

TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Engine will not start/ Hard to start (cranks ok)	Ignition problems • Ignition coil • Igniter • Distributor Spark plugs faulty High-tension cords disconnected or broken	Perform spark test Inspect coil Inspect distributor Inspect plugs Inspect cords	IG-5 IG-7 IG-7 IG-6 IG-6
Rough idle or stalls	Spark plugs faulty High-tension cords faulty Incorrect ignition timing Ignition problems • Ignition coil • Igniter • Distributor	Inspect plugs Inspect cords Reset timing Perform spark test Inspect coil Inspect distributor	IG-6 IG-6 IG-10 IG-5 IG-7 IG-7
Engine hesitates/ Poor acceleration	Spark plugs faulty High-tension cords faulty Incorrect ignition timing	Inspect plugs Inspect cords Reset timing	IG-6 IG-6 IG-10
Muffler explosion (after fire) all the time	Incorrect ignition timing	Reset timing	IG-10
Engine backfires	Incorrect ignition timing	Reset timing	IG-10
Poor fuel economy	Spark plugs faulty Incorrect ignition timing	Inspect plugs Reset timing	IG-6 IG-10
Engine overheats	Incorrect ignition timing	Reset timing	IG-10

IGNITION SYSTEM CIRCUIT



ELECTRONIC SPARK ADVANCE (ESA)

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.

ON-VEHICLE INSPECTION

SPARK TEST

CHECK THAT SPARK OCCURS

(a) Disconnect high-tension cord from the distributor.

(b) Hold the end approx. 12.7 mm (0.50 in.) from body of car.

(c) Check if spark occurs while engine is being cranked.

HINT: To prevent gasoline from being injected from injectors during this test, crank the engine for no more than 1 — 2 seconds at a time.

If the spark does not occur, perform the test as follows.

SPARK TEST

BAD

CHECK RESISTANCE OF HIGH-TENSION CORDS
(See page IG-6)

BAD → Replace the cord.

OK

CHECK POWER SUPPLY TO IGNITION COIL
1. Ignition switch turn to ON.
2. Check that there is battery voltage at ignition coil positive (+) terminal.

BAD → Check wiring between ignition switch to ignition coil.

OK

CHECK RESISTANCE OF IGNITION COIL
Resistance(cold)
Primary: 0.5 — 0.7 Ω
Secondary: 11.4 — 15.6 kΩ

BAD → Replace the ignition coil.

OK

CHECK RESISTANCE OF DISTRIBUTOR SIGNAL GENERATOR (PICKUP COIL)
Resistance: 140 — 180 Ω

BAD → Replace the distributor.

OK

CHECK AIR GAP OF DISTRIBUTOR
(See page IG-7)
Air gap: 0.2 — 0.4 mm (0.008 — 0.016 in.)

BAD → Replace the distributor.

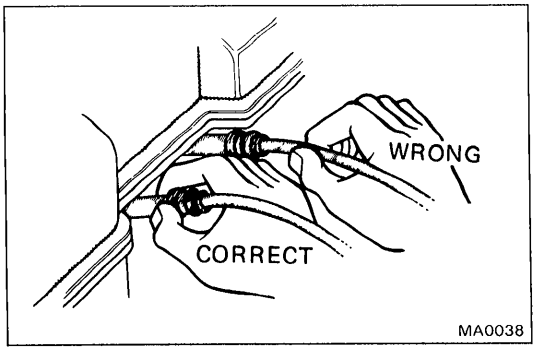
OK

CHECK IGt SIGNAL FROM ECU
(See page FI-42)

BAD → Check wiring between ECU and distributor, only then try another ECU.

OK

TRY ANOTHER IGNITER



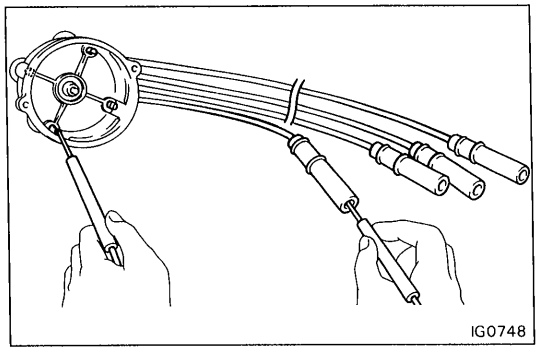
INSPECTION OF HIGH-TENSION CORD

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

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

2. **INSPECT HIGH-TENSION CORD TERMINALS**

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



3. **INSPECT HIGH-TENSION RESISTANCE**

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

   Maximum resistance: 25 kΩ per cord

INSPECTION OF SPARK PLUGS

1. **REMOVE SPARK PLUGS**

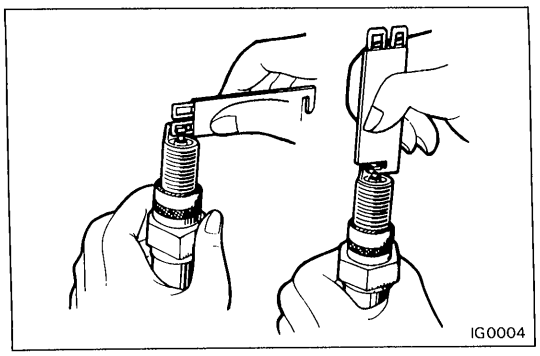
2. **CLEAN AND INSPECT SPARK PLUGS**

   (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.)

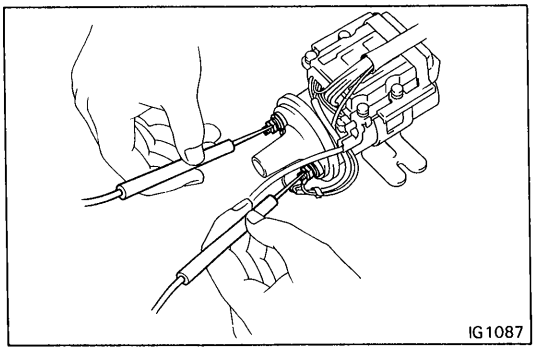
4. **INSTALL SPARK PLUGS**

   Torque: 180 kg-cm (13 ft-lb, 18 N·m)

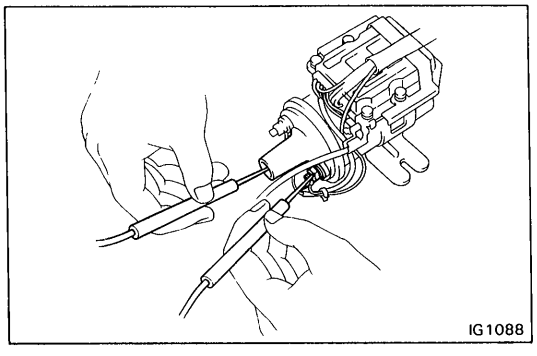
INSPECTION OF IGNITION COIL

1. **DISCONNECT HIGH-TENSION CORD**

2. **CLEAN COIL AND CHECK FOLLOWING:**
   (a) Check for cracks or damage.
   (b) Check the terminals for carbon tracks.
   (c) Check the high-tension cord hole for carbon deposits and corrosion.

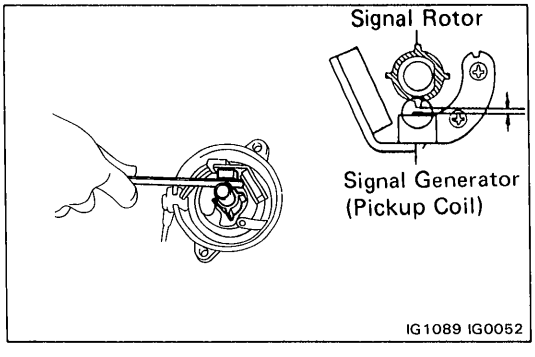

IG1087

3. **MEASURE PRIMARY COIL RESISTANCE**
   Using an ohmmeter, measure the resistance between the positive (+) and negative (−) terminals.
   Primary coil resistance (cold): 0.5 — 0.7 Ω


IG1088

4. **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 kΩ

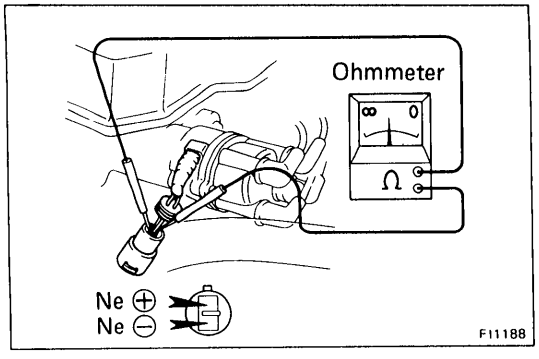
5. **CONNECT HIGH-TENSION CORD**



IG1089 IG0052

INSPECTION OF DISTRIBUTOR

1. **INSPECT AIR GAP**
   Using a thickness gauge, measure the gap between the signal rotor and the signal generator (pickup coil) projection.
   Air gap: 0.2 — 0.4 mm (0.008 — 0.016 in.)
   If the air gap is not within specification, replace the distributor assembly.

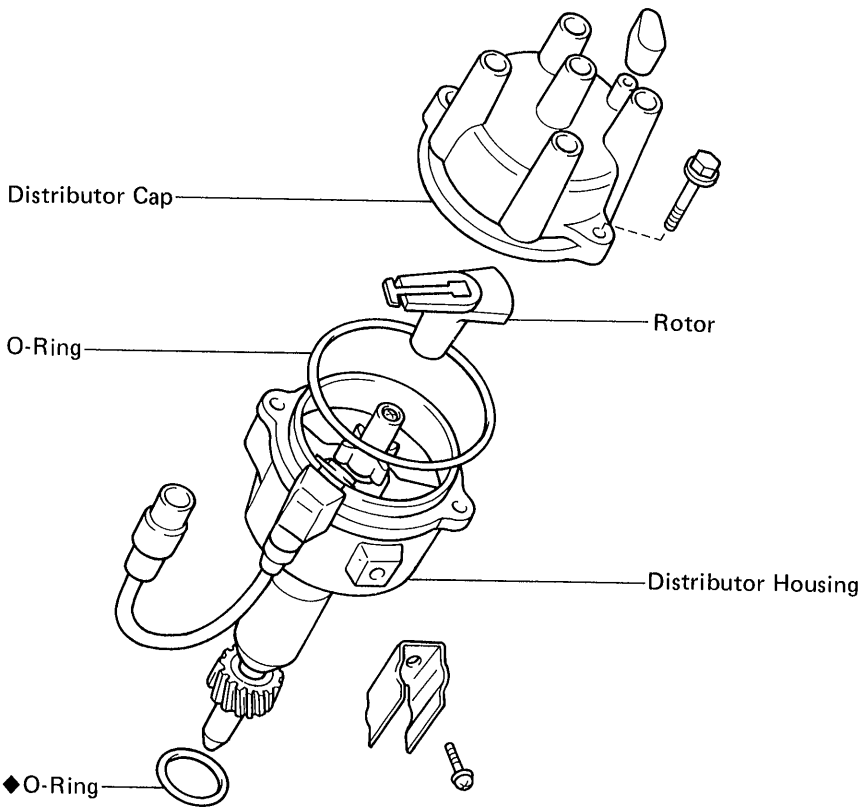


F11188

2. **CHECK SIGNAL GENERATOR (PICKUP COIL)**
   Using an ohmmeter, check the resistance of the signal generator (pickup coil).
   Generator resistance: 140 — 180 Ω
   If the resistance is not within specification, replace the distributor assembly.

DISTRIBUTOR

COMPONENTS



◆ Non-reusable part

IG1017

REMOVAL OF DISTRIBUTOR

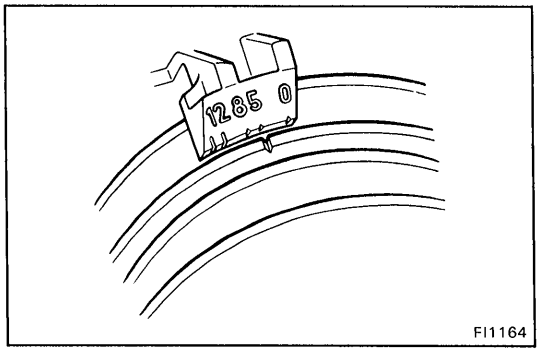
1. DISCONNECT HIGH-TENSION CORDS AND WIRING CONNECTOR
2. REMOVE TWO SCREWS AND PULL OFF DISTRIBUTOR CAP
3. REMOVE HOLD-DOWN BOLT AND PULL OUT DISTRIBUTOR

INSTALLATION OF DISTRIBUTOR

1. INSTALL DISTRIBUTOR AND SET TIMING

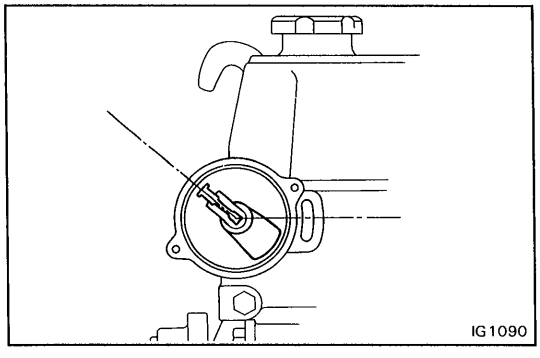
(a) Install a new O-ring to the distributor.

HINT: Always use a new O-ring when installing the distributor.



(b) Turn the crankshaft pulley until the timing mark is aligned with 5° BTDC mark.

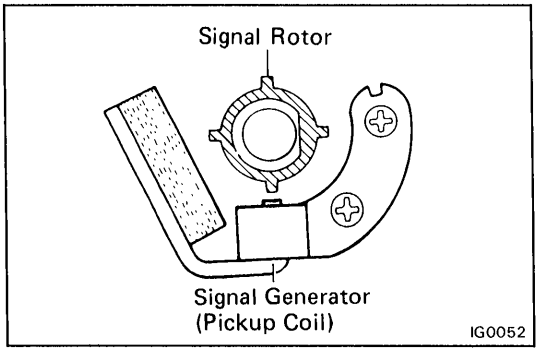
HINT: Check that the rocker arms on the No.1 cylinder are loose. If not, turn the crankshaft one full turn.



(c) Temporarily install the rotor.

(d) Begin insertion of the distributor with the rotor pointing upward and the distributor mounting hole approximately at center position of the bolt hole.

When fully installed, the rotor will rotate to the position shown.



(e) Align the rotor tooth with the signal generator (pick-up coil) projection.

Install and torque the bolt.

Torque: 195 kg-cm (14 ft-lb, 19 N·m)

(f) Install the rotor and distributor cap with wires.

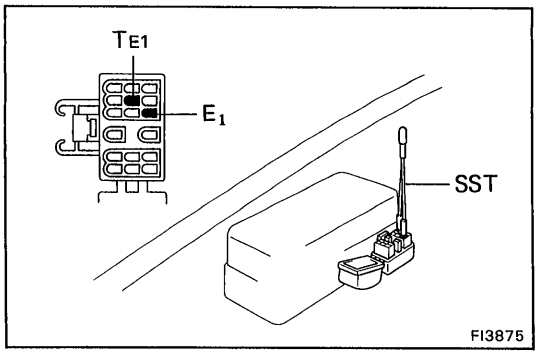
2. CONNECT HIGH-TENSION CORDS AND WIRING CONNECTOR

3. WARM UP ENGINE

Allow the engine to reach normal operating temperature.

4. CONNECT TACHOMETER AND TIMING LIGHT TO ENGINE

(See page IG-2)



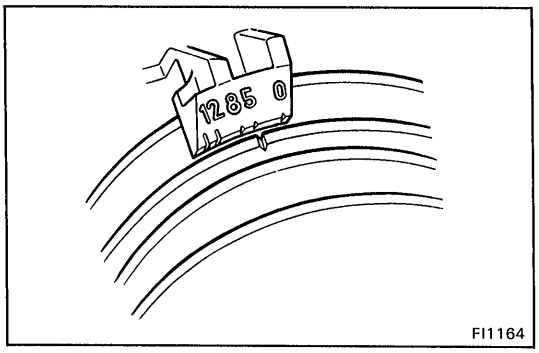
5. ADJUST IGNITION TIMING

(a) Using SST, connect terminals TE1 and E1 of the check connector.

SST 09843-18020

(b) Check that the idle speed.

Idle speed: 750 rpm



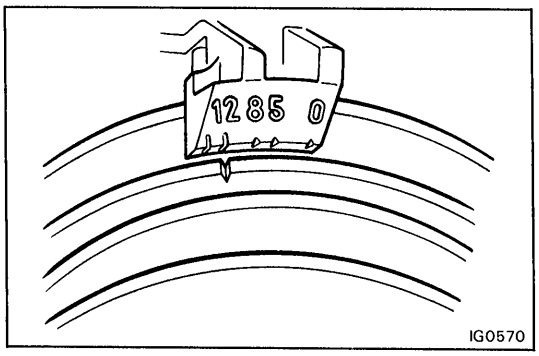
(c) Check the ignition timing.

Ignition timing: 5° BTDC @ idle

Torque: 195 kg-cm (14 ft-lb, 19 N·m)

If necessary, loosen the distributor bolt and turn the distributor to align the marks. Recheck the timing after tightening the distributor bolt.

(c) Disconnect the check connector.



6. FURTHER CHECK IGNITION TIMING

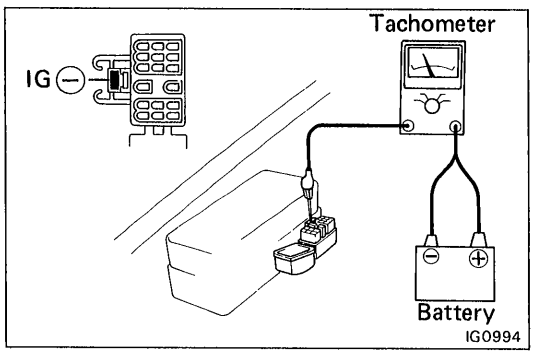
Check that the ignition timing advances.

Ignition timing: 10 — 14° BTDC @ idle

7. DISCONNECT TACHOMETER AND TIMING LIGHT FROM ENGINE

PRECAUTIONS

1. Do not leave the ignition switch on for more than 10 minutes if the engine does not start.



2. When a tachometer is connected to the system, connect the tachometer positive terminal to the IG ⊖ terminal of the check connector.

3. As some tachometers are not compatible with this ignition system, we recommend that you confirm the compatibility of your unit before using.

4. NEVER allow the tachometer terminals to touch ground as it could result in damage to the igniter and/or ignition coil.

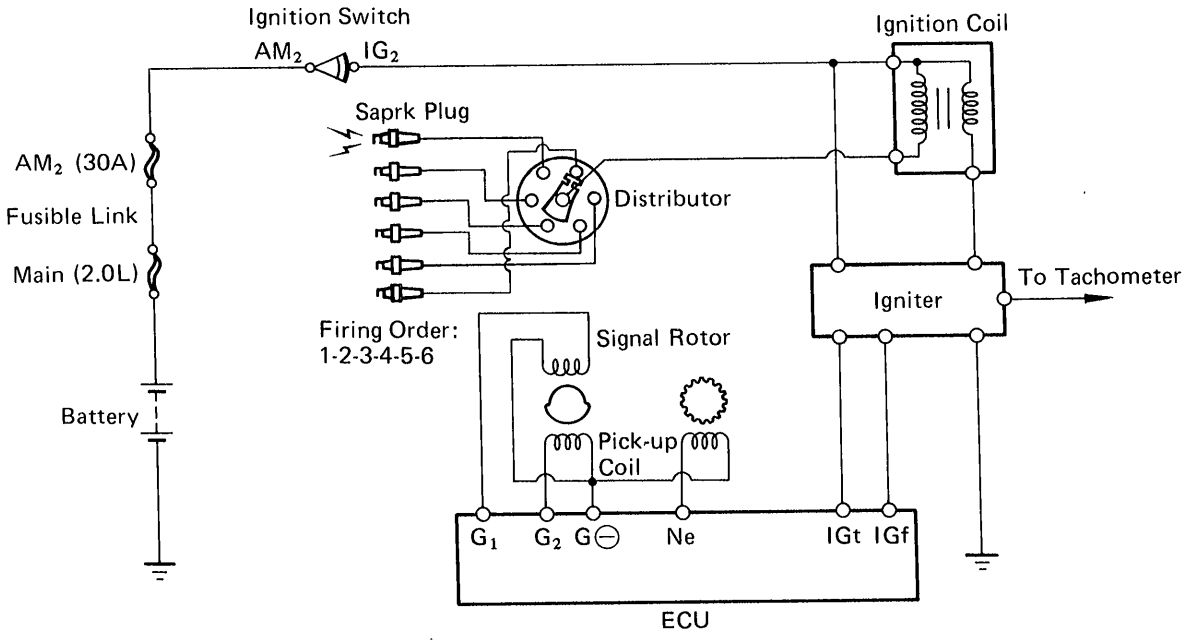
5. Do not disconnect the battery while the engine is running.

6. Make sure that the igniter is properly grounded to the body.

TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Engine will not start/Hard to start (cranks OK)	Ignition problems • Ignition coil • Igniter • Distributor Spark plugs faulty High-tension cords disconnected or broken	Perform spark test Inspect coil Inspect distributor Inspect plugs Inspect cords	IG-14 IG-16 IG-16 IG-15 IG-15
Rough idle or stalls	Spark plugs faulty High-tension cords faulty Incorrect ignition timing Ignition problems • Ignition coil • Igniter • Distributor	Inspect plugs Inspect cords Reset timing Perform spark test Inspect coil Inspect distributor	IG-15 IG-15 IG-19 IG-14 IG-16 IG-16
Engine hesitates/ Poor acceleration	Spark plugs faulty High-tension cords faulty Incorrect ignition timing	Inspect plugs Inspect cords Reset timing	IG-15 IG-15 IG-19
Muffler explosion (after fire) all the time	Incorrect ignition timing	Reset timing	IG-19
Engine backfires	Incorrect ignition timing	Reset timing	IG-19
Poor fuel economy	Spark plugs faulty Incorrect ignition timing	Inspect plugs Reset timing	IG-15 IG-19
Engine overheats	Incorrect ignition timing	Reset timing	IG-19

IGNITION SYSTEM CIRCUIT



ELECTRONIC SPARK ADVANCE (ESA)

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.

ON-VEHICLE INSPECTION

SPARK TEST

CHECK THAT SPARK OCCURS

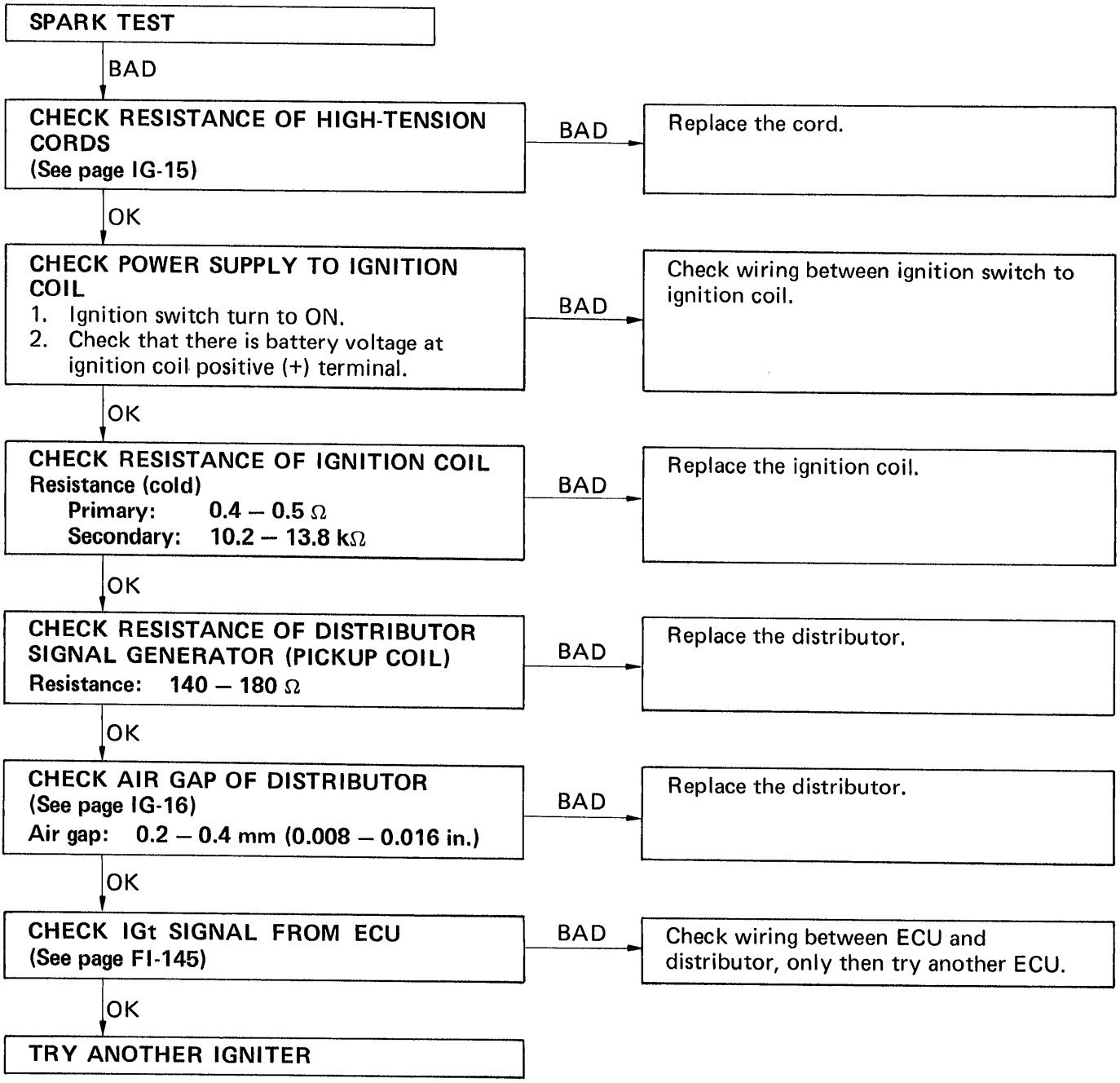
(a) Disconnect high-tension cord from the distributor.

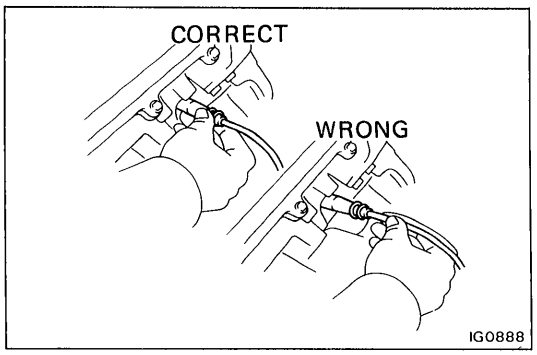
(b) Hold the end approx. 12.7 mm (0.50 in.) from body of car.

(c) See if spark occurs while engine is being cranked.

HINT: To prevent gasoline from being injected from injectors during this test, crank the engine for no more than 1 — 2 seconds at a time.

If the spark does not occur, perform the test as follows.





INSPECTION OF HIGH-TENSION CORDS

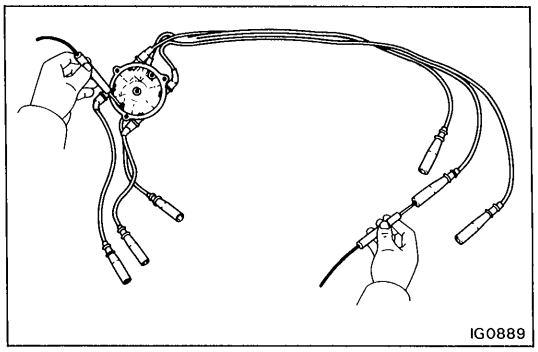
1. **CAREFULLY REMOVE HIGH-TENSION CORD BY RUBBER BOOT**

   NOTICE: Pulling on or bending the cords may damage the conductor inside.

2. **INSPECT HIGH-TENSION CORD TERMINALS**

   Check the terminals for corrosion, breaks or distortion.

   Replace cord as required.



3. **INSPECT HIGH-TENSION CORD RESISTANCE**

   Using an ohmmeter, measure the resistance without disconnecting the cap.

   Maximum resistance: 25 kΩ per cord

   If resistance exceeds maximum, check the terminals.

   If necessary, replace the high-tension cord and/or distributor cap.

INSPECTION OF SPARK PLUG

1. **REMOVE SPARK PLUGS**

   Using a plug wrench (16 mm), remove the spark plugs.

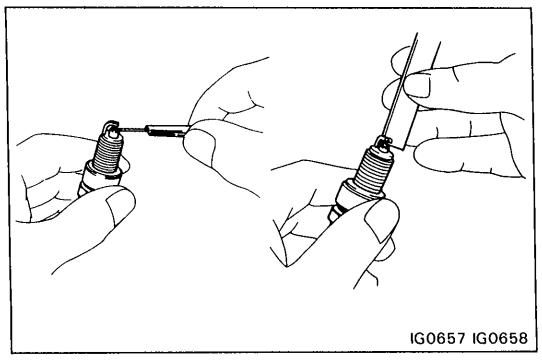
2. **CLEAN AND INSPECT SPARK PLUGS**

   (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.

   Recommended spark plug: ND K16R-U
   NGK BKR5EYA



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**

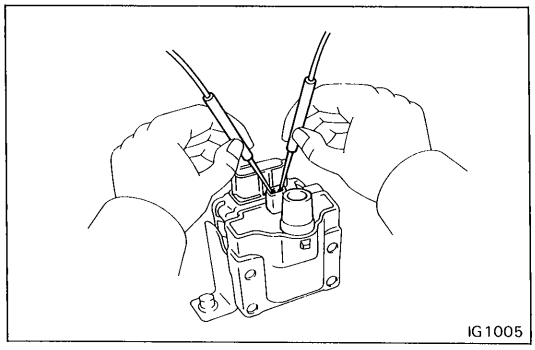
   Using a plug wrench (16 mm), install and torque the spark plug.

   Torque: 180 kg-cm (13 ft-lb, 18 N·m)

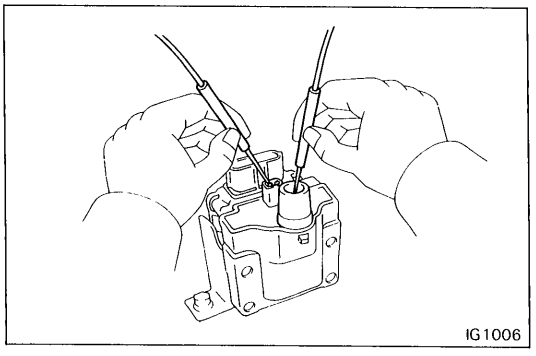
INSPECTION OF IGNITION COIL

1. **DISCONNECT HIGH-TENSION CORD**

2. **CLEAN COIL AND CHECK FOLLOWING:**
   (a) Check for cracks or damage.
   (b) Check the terminals for carbon tracks.
   (c) Check the high-tension cord hole for carbon deposits and corrosion.

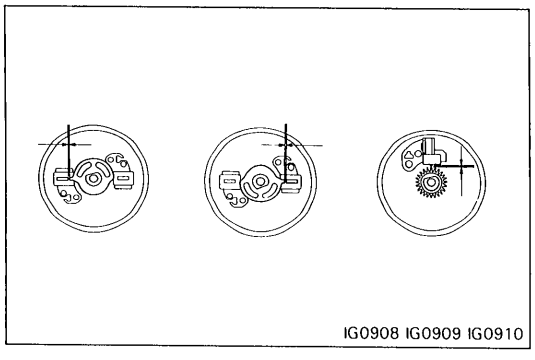

IG1005

3. **INSPECT PRIMARY COIL RESISTANCE**
   Using an ohmmeter, measure the resistance between the positive (+) and negative (—) terminals.
   Primary coil resistance (cold): 0.4 — 0.5 Ω


IG1006

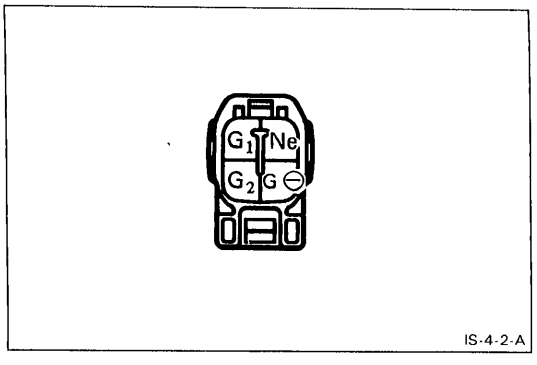
4. **INSPECT SECONDARY COIL RESISTANCE**
   Using an ohmmeter, measure the resistance between the positive (+) terminal and high-tension terminal.
   Secondary coil resistance (cold): 10.2 — 13.8 kΩ

5. **CONNECT HIGH-TENSION CORD**


IG0908 IG0909 IG0910

INSPECTION OF DISTRIBUTOR

1. **INSPECT AIR GAPS**
   Using a thickness gauge, measure the gap between the signal rotor and pickup coil projection.
   Air gap: 0.2 — 0.4 mm (0.008 — 0.016 in.)
   If the gap is not within specification, replace the distributor assembly.

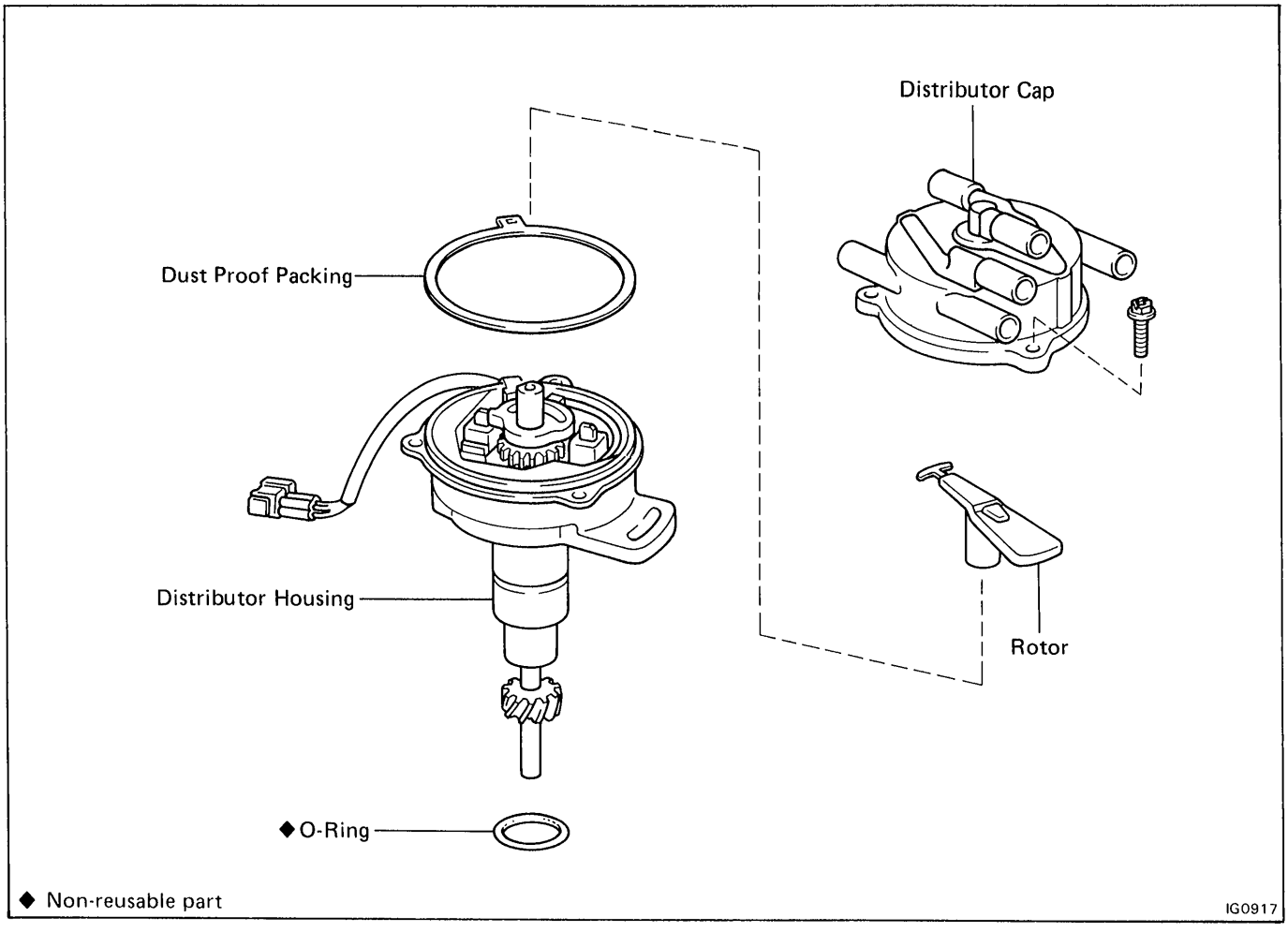


IS-4-2-A

2. **INSPECT PICKUP COILS**
   Using an ohmmeter, check resistance of the pickup coil.
   G1 pickup coil resistance:
   G_1 — G⊖ 140 — 180 Ω
   G2 pickup coil resistance:
   G_2 — G⊖ 140 — 180 Ω
   Ne pickup coil resistance:
   Ne — G⊖ 140 — 180 Ω
   If the resistance is not within specification, replace the distributor assembly.

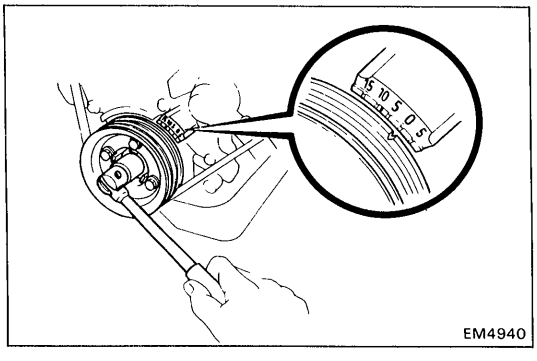
DISTRIBUTOR

COMPONENTS

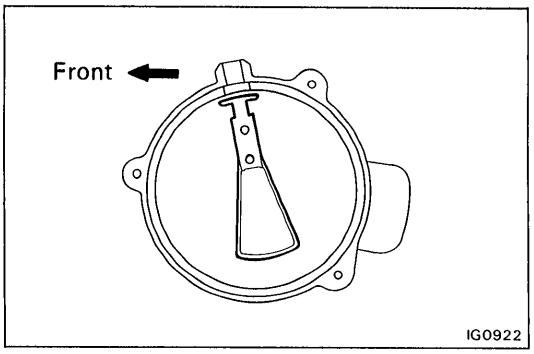


REMOVAL OF DISTRIBUTOR

1. **DISCONNECT HIGH-TENSION CORDS FROM DISTRIBUTOR CAP**
2. **DISCONNECT DISTRIBUTOR CONNECTOR**
3. **REMOVE DISTRIBUTOR CAP AND DUST PROOF PACKING**



4. **SET NO.1 CYLINDER TO TDC/COMPRESSION**
   (a) Turn the crankshaft pulley until the timing mark is aligned with the "0" mark on the No.1 timing belt cover.



(b) Check that the distributor rotor direction is as shown.
If not, turn the crankshaft pulley one complete revolution.

5. REMOVE DISTRIBUTOR

(a) Remove the hold-down bolt.

(b) Pull out the distributor from the cylinder head.

6. REMOVE O-RING

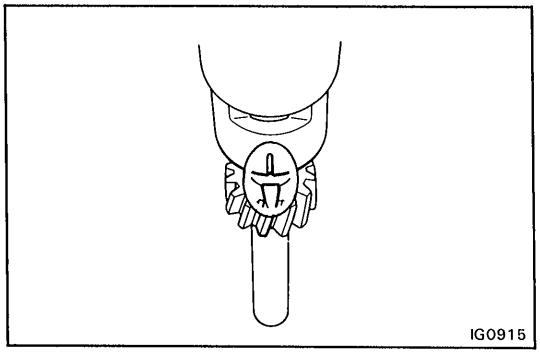
INSTALLATION OF DISTRIBUTOR

1. **CHECK NO.1 CYLINDER TO TDC/COMPRESSION**

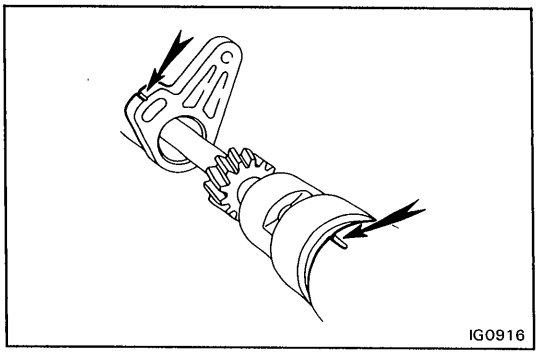
2. **INSTALL DISTRIBUTOR**

(a) Install a new O-ring to the distributor.

HINT: Always use a new O-ring when installing the distributor.



(b) Align the protrusion on the driven gear with the groove of the housing.



(c) Insert the distributor, aligning the groove of the distributor housing with that of the groove on the No. 4 camshaft bearing cap.

(d) Lightly tighten the hold-down bolts.

3. **INSTALL DUST PROOF PACKING AND DISTRIBUTOR CAP**

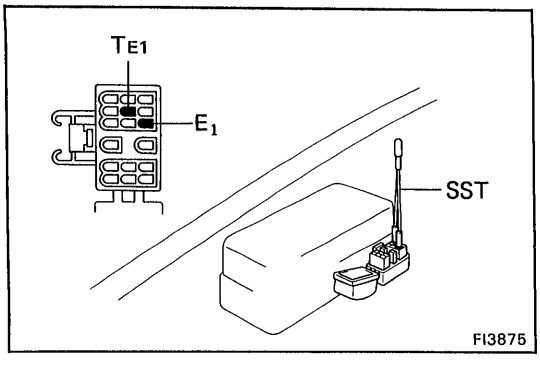
4. **CONNECT DISTRIBUTOR CONNECTOR**

5. **CONNECT HIGH-TENSION CORDS TO DISTRIBUTOR CAP**

6. **WARM UP ENGINE**

Allow the engine to reach normal operating temperature.

7. **CONNECT TACHOMETER AND TIMING LIGHT TO ENGINE (See page IG-11)**



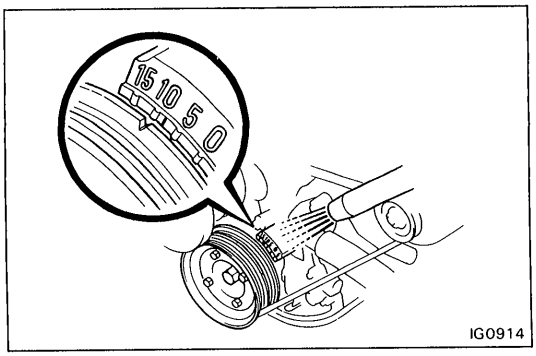
8. **ADJUST IGNITION TIMING**

(a) Using SST, connect terminals T_{E1} and E_1 of the check connector.

SST 09843-18020

(b) Check that the idle speed.

Idle speed: 800 rpm

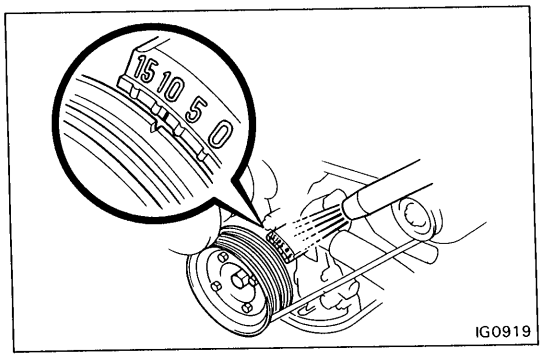


(c) Using a timing light, slowly turn the distributor until the timing mark on the crankshaft pulley is aligned with the 10° mark. Tighten the distributor bolt and recheck the ignition timing.

Ignition timing: 10° BTDC @ idle (Transmission in "N" range)

Torque: 185 kg-cm (13 ft-lb, 18 N·m)

(d) Disconnect the check connector.



9. FURTHER CHECK IGNITION TIMING

Check that the ignition timing advances.

Ignition timing: 8° BTDC @ idle

10. DISCONNECT TACHOMETER AND TIMING LIGHT FROM ENGINE

STARTING SYSTEM

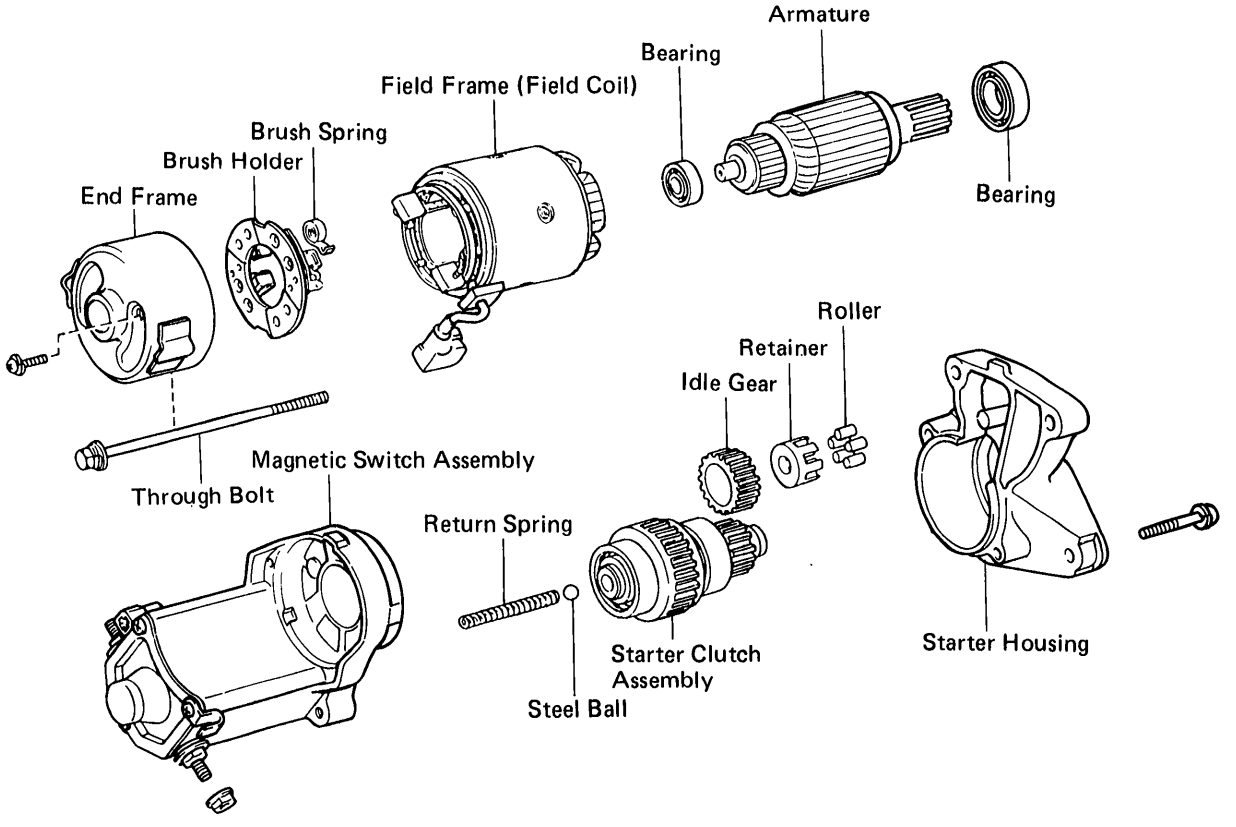
TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Engine will not crank	Battery charge low	Check battery specific gravity Charge or replace battery	CH-3
	Battery cables loose, corroded or worn	Repair or replace cables	
	Starter relay faulty (M/T)	Replace relay	ST-14
	Clutch start switch faulty (M/T)	Adjust switch position or replace switch	
	Neutral start switch faulty (A/T)	Replace switch	
	Fusible link blown	Replace fusible link	
	Starter faulty	Repair starter	ST-3
	Ignition switch faulty	Replace ignition switch	
Engine cranks slowly	Battery charge low	Check battery specific gravity Charge or replace battery	CH-3
	Battery cables loose, corroded or worn	Repair or replace cables	
	Starter faulty	Repair starter	ST-3
Starter keeps running	Starter faulty	Repair starter	ST-3
	Ignition switch faulty	Replace ignition switch	
	Short in wiring	Repair wiring	
Starter spins — engine will not crank	Pinion gear teeth broken or faulty starter	Repair starter	ST-3
	Flywheel teeth broken	Replace flywheel	
	Drive plate teeth broken	Replace drive plate	

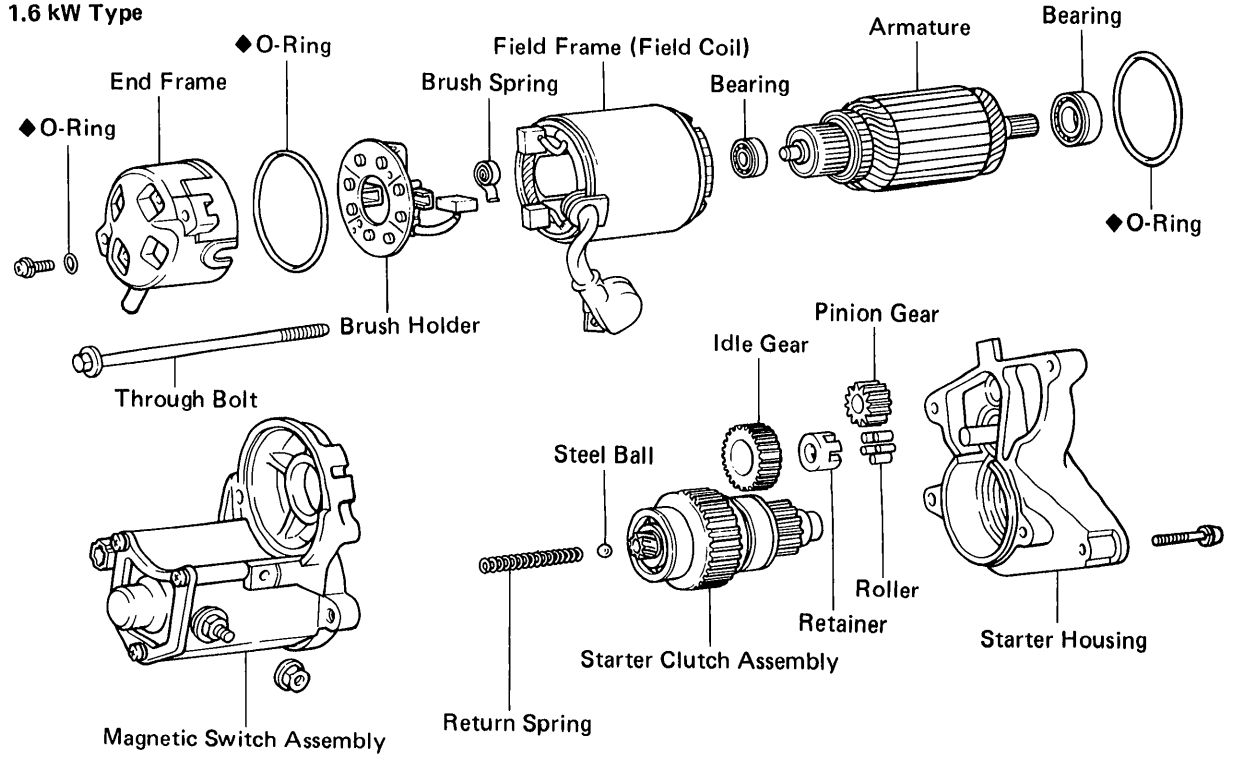
STARTER

COMPONENTS

1.0 kW Type



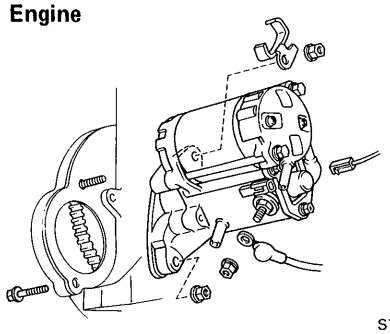
1.4, 1.6 kW Type



◆ Non-reusable part

ST0310
ST0311

22R-E Engine



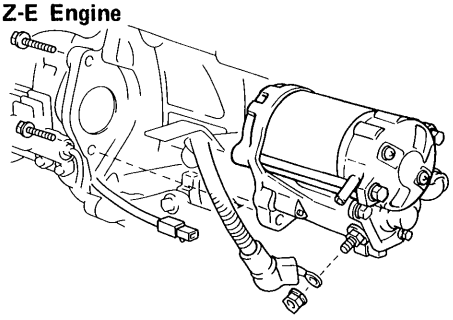
ST0319

REMOVAL OF STARTER

1. **DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY**

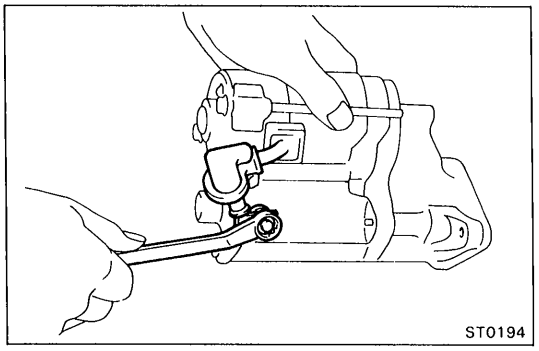
2. **DISCONNECT TWO WIRES FROM STARTER**
   (a) Remove the nut and disconnect the battery cable from the magnetic switch on the starter motor.
   (b) Disconnect the other wire from terminal 50.

3VZ-E Engine



ST0494

3. **REMOVE STARTER MOTOR**
   (22R-E Engine)
   Remove the nut and bolt, and remove the starter motor from the flywheel bellhousing.
   (3VZ-E Engine)
   Remove the two mounting bolts, and remove the starter motor from flywheel bellhousing.

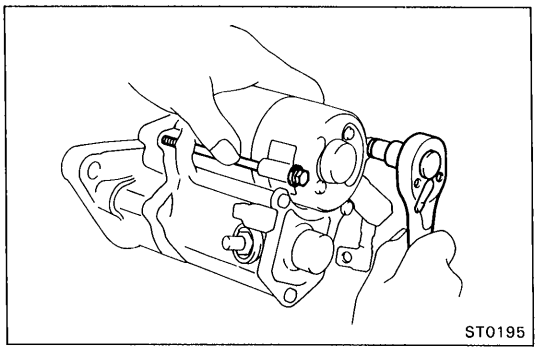


ST0194

DISASSEMBLY OF STARTER

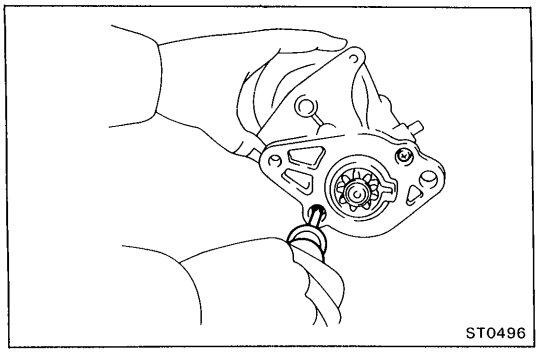
(See page ST-3)

1. **REMOVE FIELD FRAME WITH ARMATURE FROM MAGNETIC SWITCH ASSEMBLY**
   (a) Remove the nut and disconnect the lead wire from the magnetic switch terminal.



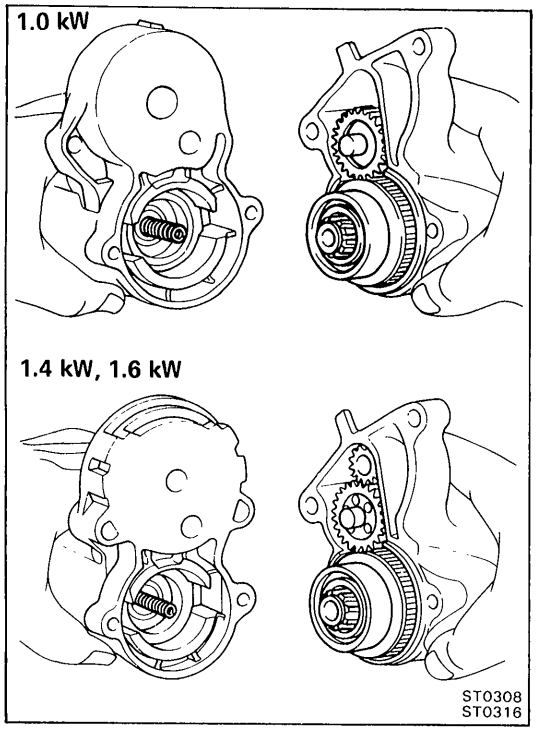
ST0195

   (b) Remove the two through bolts. Pull out the field frame with the armature from the magnetic switch assembly.
   (c) (1.4, 1.6 kW)
   Remove the O-ring.

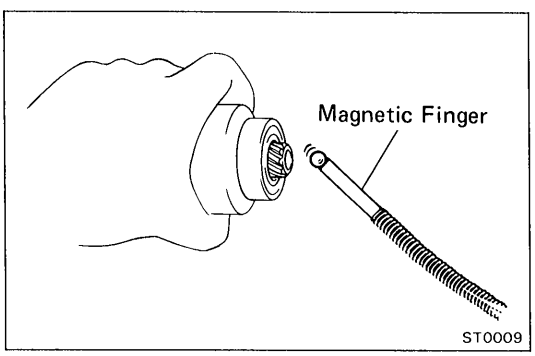


ST0496

2. **REMOVE STARTER HOUSING FROM MAGNETIC SWITCH ASSEMBLY**
   (a) Remove the two screws.



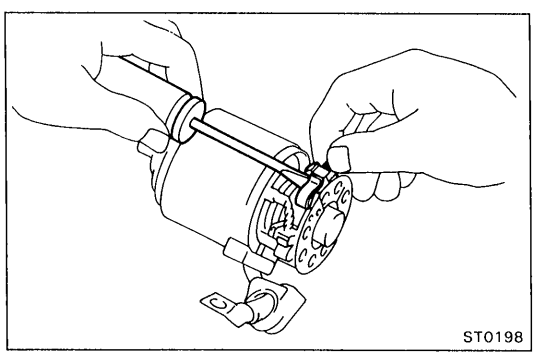
(b) Remove the starter housing with the pinion gear (1.4, 1.6 kW), idler gear, bearing and clutch assembly.



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.

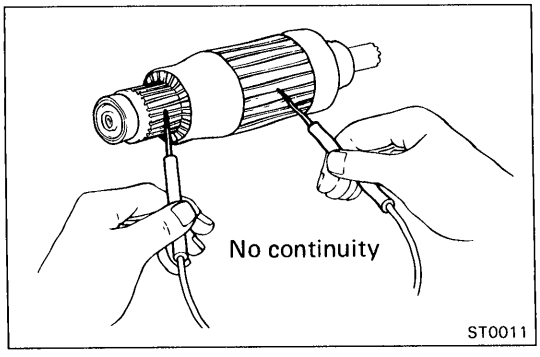


5. REMOVE BRUSHES AND BRUSH HOLDER

(a) Remove the two screws and pull the end cover with O-ring (1.4, 1.6 kW) off 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.

6. REMOVE ARMATURE FROM FIELD FRAME



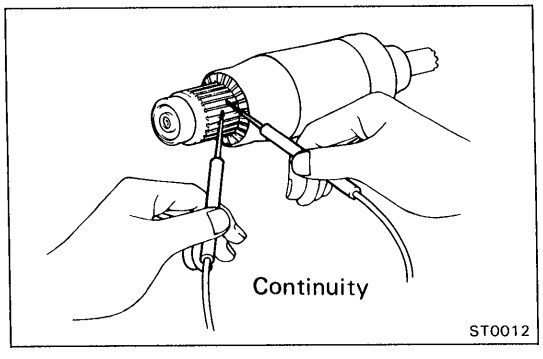
INSPECTION OF STARTER

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**

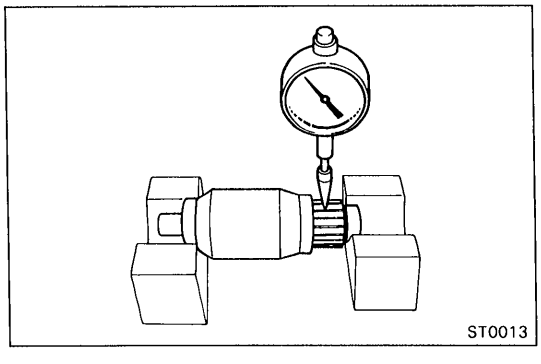
Using an ohmmeter, check that there is continuity between the segments of the commutator.

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

Commutator

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

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



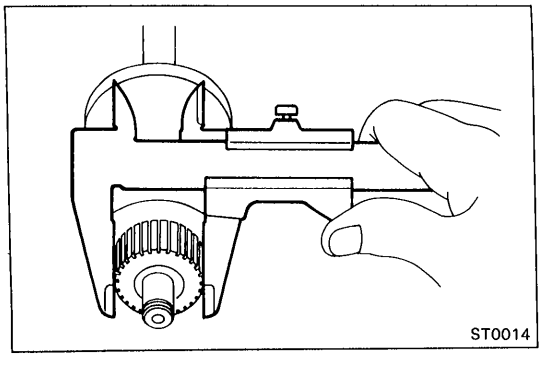
2. **INSPECT COMMUTATOR CIRCLE RUNOUT**

(a) Place the commutator on V-blocks.

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

Maximum circle runout: 0.05 mm (0.0020 in.)

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

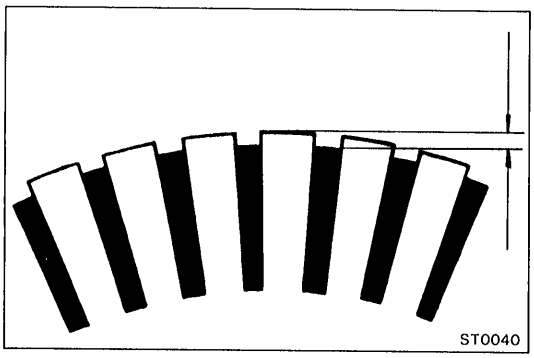


3. **INSPECT COMMUTATOR DIAMETER**

Using calipers, measure the commutator diameter.

Standard diameter: 30 mm (1.18 in.)
Minimum diameter: 29 mm (1.14 in.)

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

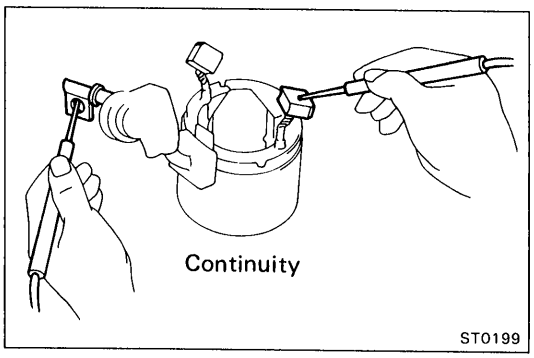

ST0040

4. **INSPECT UNDERCUT DEPTH OF SEGMENT**

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

Standard undercut depth: 0.6 mm (0.024 in.)
Minimum undercut depth: 0.2 mm (0.008 in.)

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



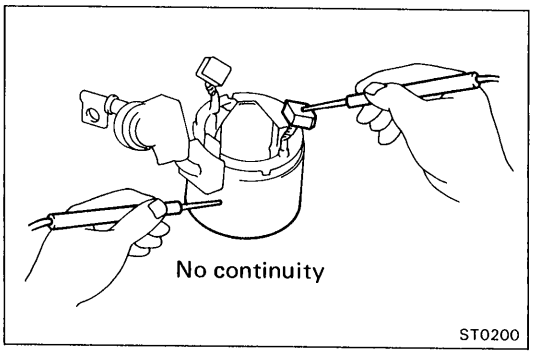
ST0199

Field Frame (Field Coil)

1. **INSPECT FIELD COIL FOR OPEN CIRCUIT**

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

If there is no continuity, replace the field frame.

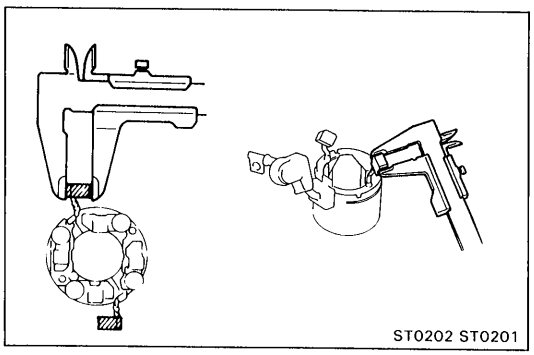


ST0200

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

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

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


ST0202 ST0201

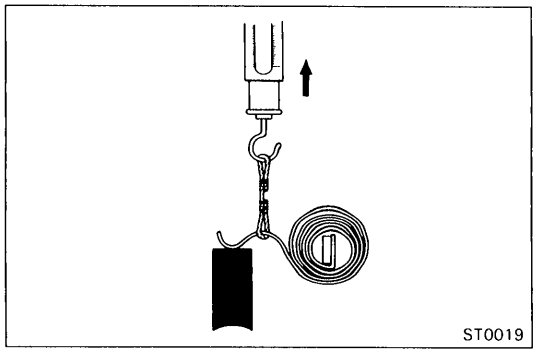
Brushes

INSPECT BRUSH LENGTH

Using calipers, measure the brush length.

Standard length: 1.0 kW 13.5 mm (0.531 in.)
1.4 kW 15.5 mm (0.610 in.)
1.6 kW 15.5 mm (0.610 in.)
Minimum length: 1.0 kW 8.5 mm (0.335 in.)
1.4 kW 10.0 mm (0.394 in.)
1.6 kW 10.0 mm (0.394 in.)

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



Brush Springs

INSPECT BRUSH SPRING LOAD

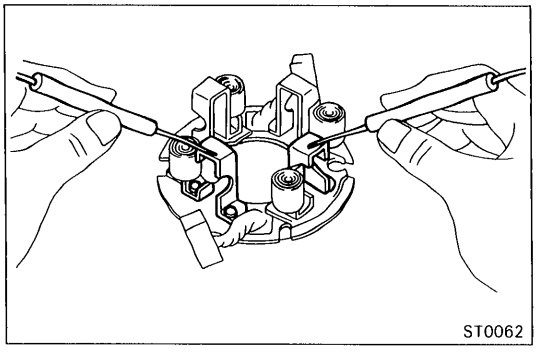
Take the pull scale reading the instant the brush spring separates from the brush.

Standard installed load:
1.785 — 2.415 kg (3.9 — 5.3 lb, 18 — 24 N)

Minimum installed load:
1.2 kg (2.6 lb, 12 N)

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

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



Brush Holder

INSPECT INSULATION OF BRUSH HOLDER

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

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

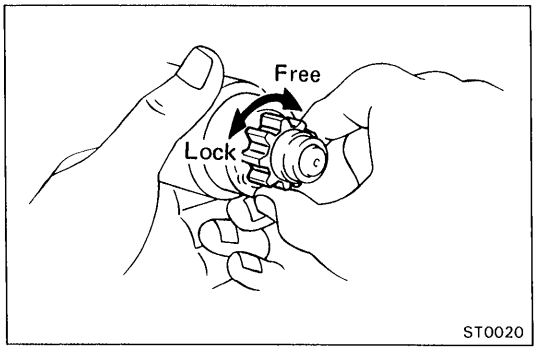
Clutch and Gears

1. INSPECT GEAR TEETH

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

If damaged,replace the gear or clutch assembly.

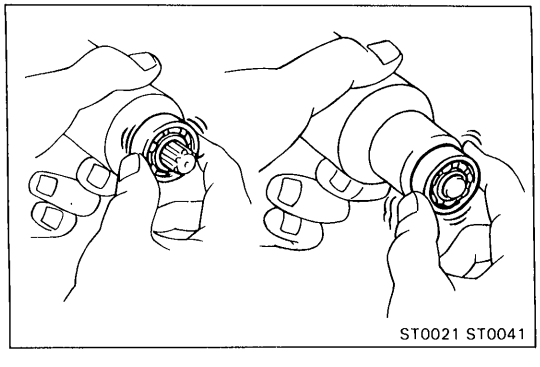
If damaged, also check the flywheel ring gear for wear or damage.



2. INSPECT CLUTCH

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

If necessary, replace the clutch assembly.

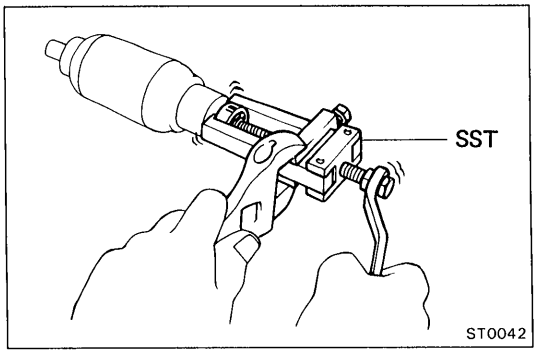


Bearings

1. INSPECT BEARINGS

Turn each bearing by hand while applying inward force.

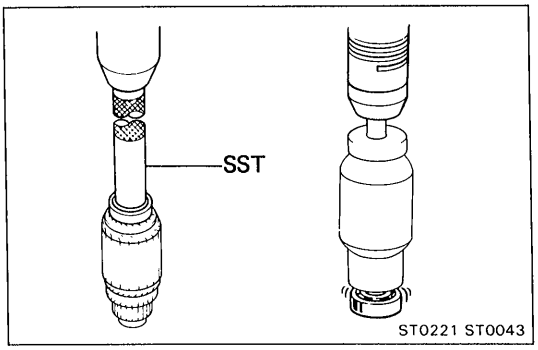
If resistance is felt or if the bearing sticks, replace the bearing.



2. **IF NECESSARY, REPLACE BEARINGS**

(a) Using SST, remove the bearing.

SST 09286-46011



(b) Using SST and a press, press in a new bearing.

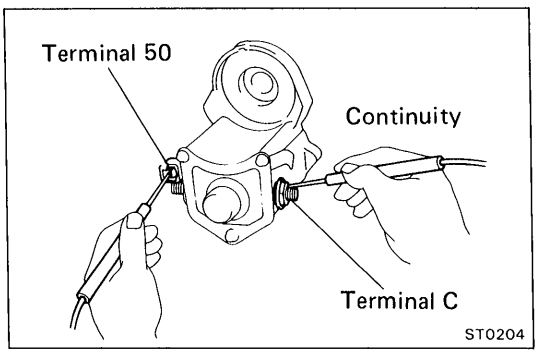
SST 1.0 kW 09285-76010
1.4 kW, 1.6 kW 09201-41020

Magnetic Switch

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

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

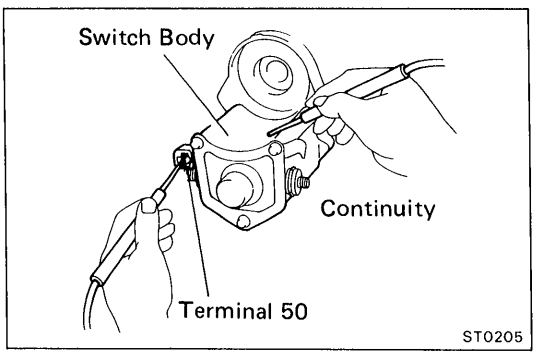
If there is no continuity, replace the magnetic switch assembly.



2. **PERFORM HOLD-IN COIL CIRCUIT TEST**

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

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



ASSEMBLY OF STARTER

(See page ST-3)

HINT: 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

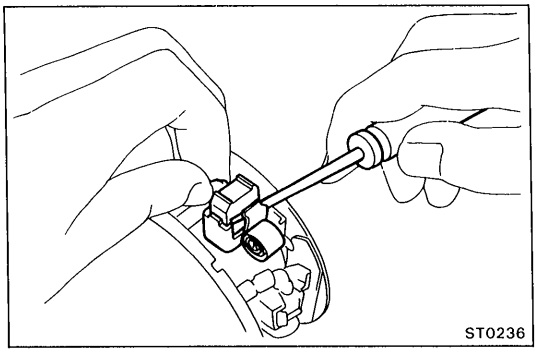
(a) Place the brush holder over the frame.

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

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

(c) (1.4 kW, 1.6 kW)
Place the O-ring on the field frame.

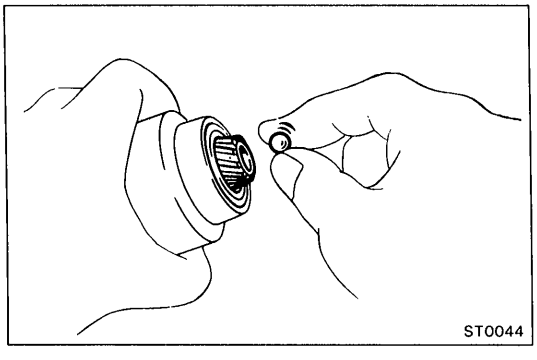
(d) Install the end cover to the field frame with the two screws.



3. INSERT STEEL BALL INTO CLUTCH SHAFT HOLE

(a) Apply grease to the steel ball.

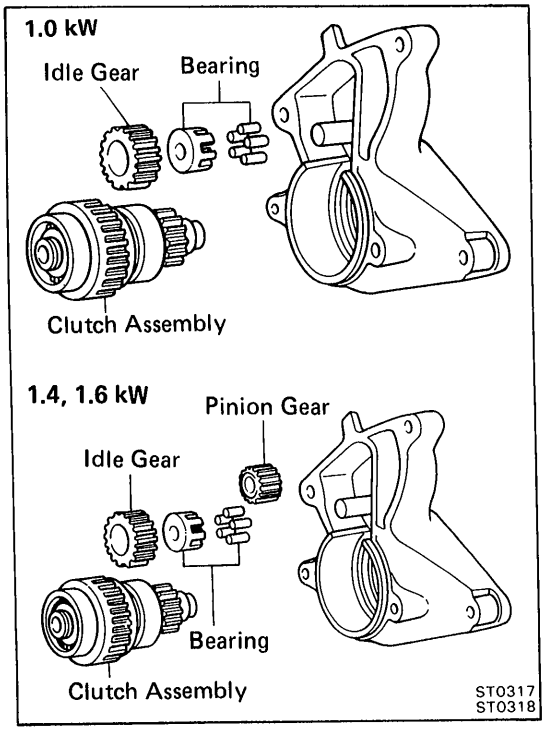
(b) Insert the steel ball into the clutch shaft hole.

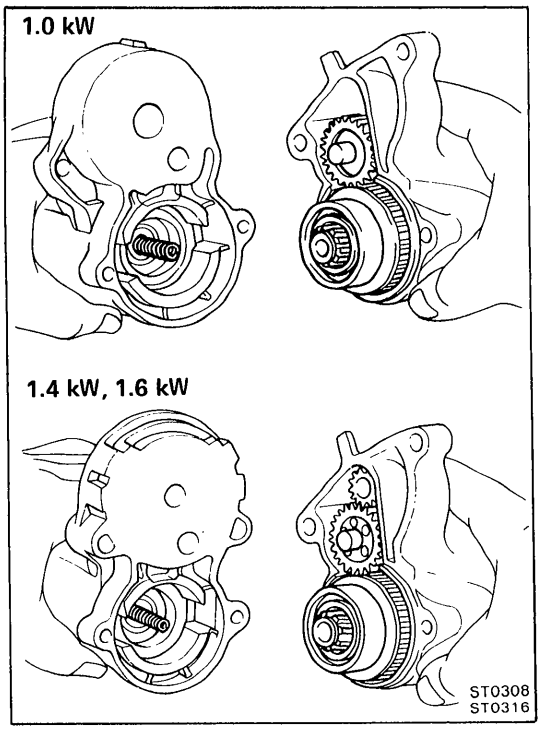


4. INSTALL GEARS AND CLUTCH ASSEMBLY

(a) Apply grease to the gears and clutch assembly.

(b) Place the clutch assembly, idler gear, bearing and pinion gear (1.4, 1.6 kW) in the starter housing.



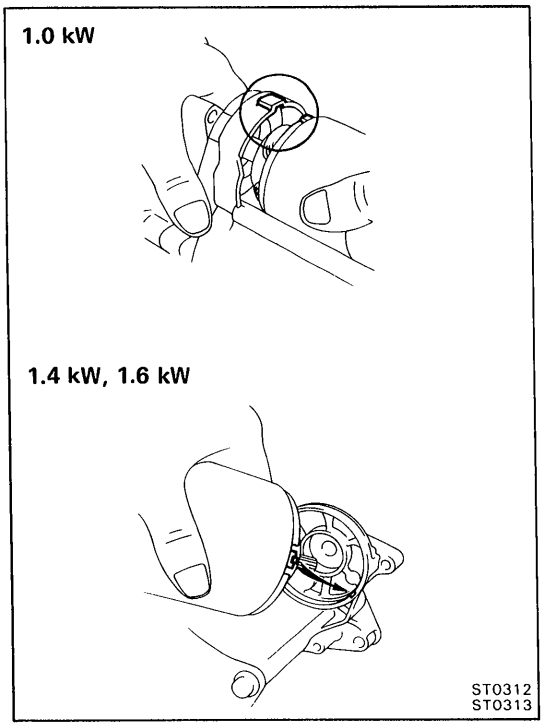


5. INSTALL STARTER HOUSING

(a) Apply grease to the return spring.

(b) Insert the return spring into the magnetic hole.

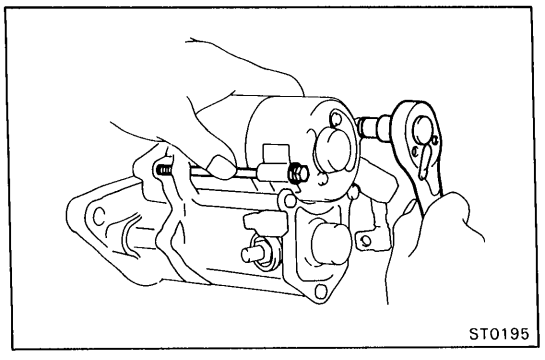
(c) Place the starter housing on the magnetic switch and install the two screws.



6. INSTALL FIELD FRAME WITH ARMATURE TO MAGNETIC SWITCH ASSEMBLY

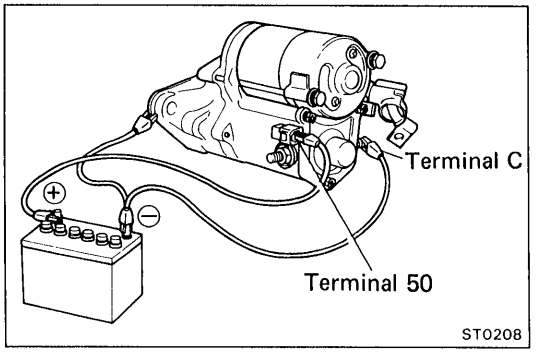
(a) (1.4, 1.6 kW)
Place the O-ring on the field frame.

(b) Align the protrusion of the field frame with the cutout of the magnetic switch.



(c) Install the two through bolts.

(d) Connect the lead wire to the magnetic switch terminal C, and install the nut.



PERFORMANCE TEST OF STARTER

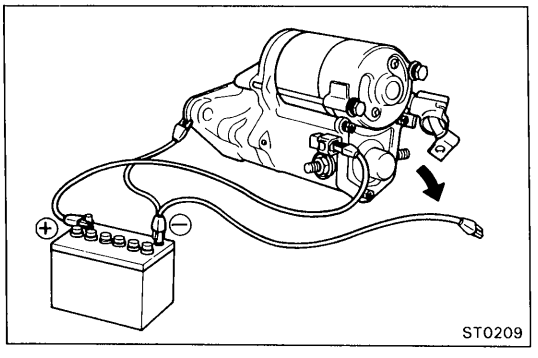
NOTICE: These tests must be performed within 3 to 5 seconds to avoid burning out the coil.

1. PERFORM PULL-IN TEST

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

(b) Connect the battery to the magnetic switch as shown. Check that the clutch pinion gear moves outward.

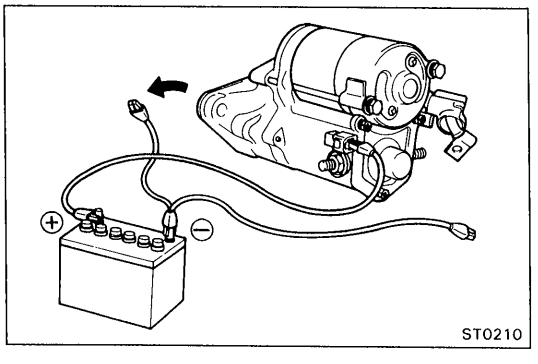
If the clutch pinion gear does not move, replace the magnetic switch assembly.



2. PERFORM HOLD-IN TEST

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

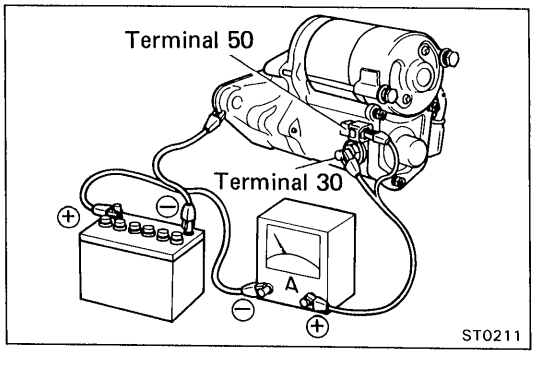
If the clutch pinion gear returns inward, replace the magnetic switch assembly.



3. INSPECT CLUTCH PINION GEAR RETURN

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

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



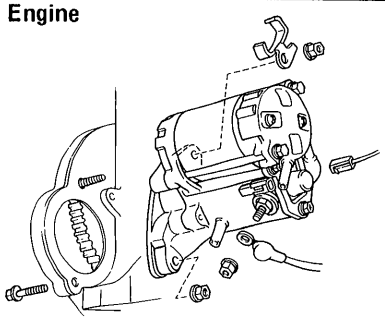
4. PERFORM NO-LOAD PERFORMANCE TEST

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

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

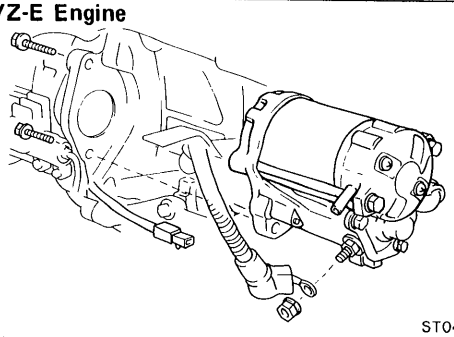
Specified current:
90 A or less at 11.5 V

22R-E Engine



ST0319

3VZ-E Engine



ST0494

INSTALLATION OF STARTER

1. INSTALL STARTER MOTOR ON TRANSAXLE

(22R-E Engine)
Place the starter motor in the flywheel bellhousing. Install and torque the bolt and nut.

(3VZ-E Engine)
Place the starter motor in the flywheel bellhousing install and torque the starter mounting bolts.

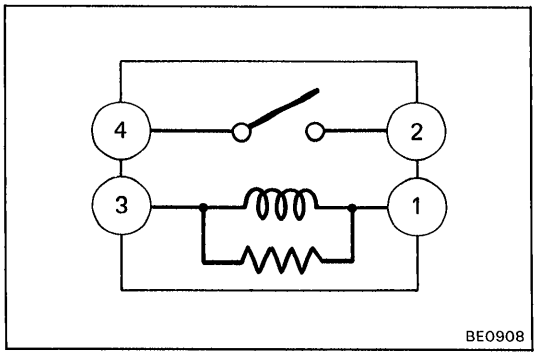
Torque: 400 kg-cm (29 ft-lb, 39 N·m)

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. CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY

Check that the engine starts.

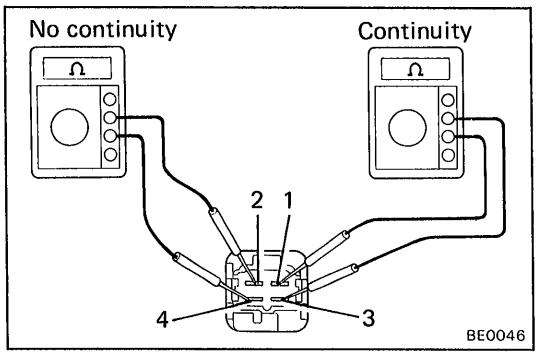


STARTER RELAY (M/T only)

INSPECTION OF STARTER RELAY

INSPECT CLUTCH STARTER RELAY

LOCATION: The relay is located in the No.1 junction block on the driver's side.

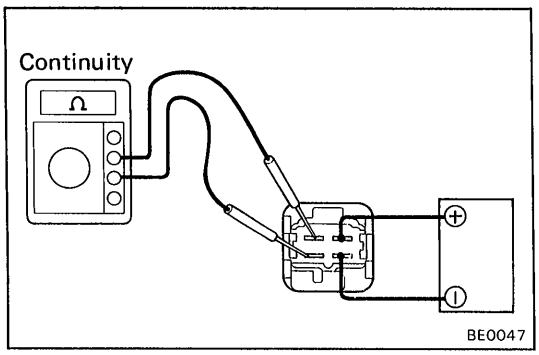


Inspect Relay Continuity

(a) Using an ohmmeter, check that there is continuity between terminals 1 and 3.

(b) Check that there is no continuity between terminals 2 and 4.

If continuity is not as specified, replace the relay.



Inspect Relay Operation

(a) Apply battery voltage across terminals 1 and 3.

(b) Check that there is continuity between terminals 2 and 4.

If operation is not as described, replace the relay.

CLUTCH START SWITCH (M/T only)

(See page CL-4)

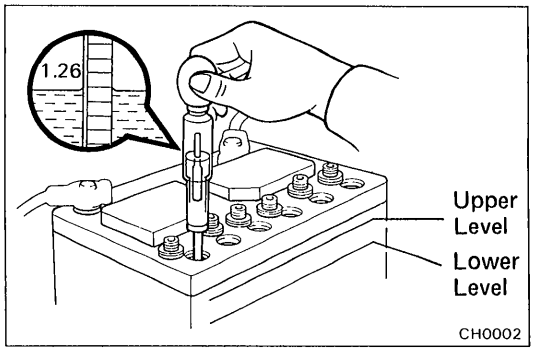
CHARGING SYSTEM

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 while 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	
	Light burned out	Replace light	
	Wiring connection loose	Tighten loose connections	
	IC regulator faulty	Replace IC regulator	CH-6
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	
	Fuse blown	Check "ENGINE" fuse	
	Fusible link blown	Replace fusible link	
	IC regulator or alternator faulty	Check charging system	CH-4
	Wiring faulty	Repair wiring	



ON-VEHICLE INSPECTION

1. INSPECT BATTERY SPECIFIC GRAVITY AND ELECTROLYTE LEVEL

(a) Check the specific gravity of each cell.

Standard specific gravity

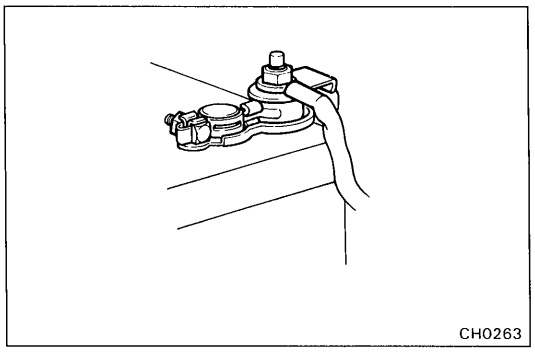
When fully charged at 20°C (68°F):

22R-E		**1.25 — 1.27**
3VZ-E	**55D23R**	**1.25 — 1.27**
	80D26R	**1.27 — 1.29**

If not within specifications, charge the battery.

(b) Check the electrolyte quantity of each cell.

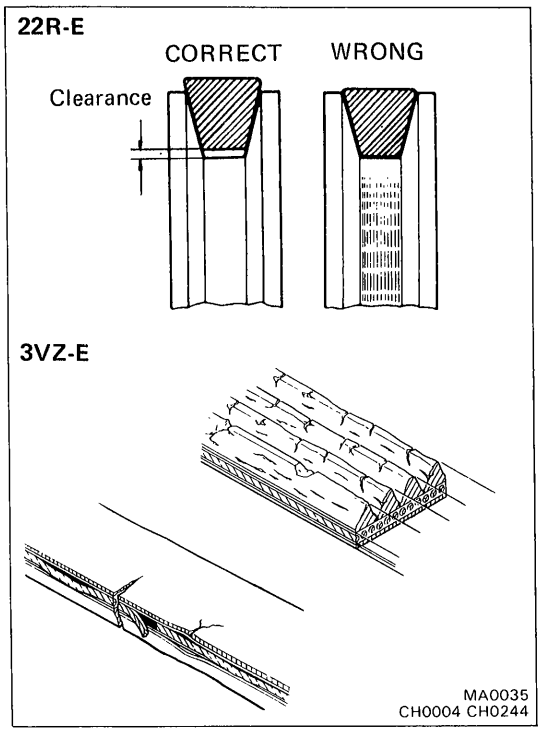
If insufficient, refill with distilled (or purified) water.



2. CHECK BATTERY TERMINALS AND FUSIBLE LINKS

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

(b) Check the fusible links for continuity.

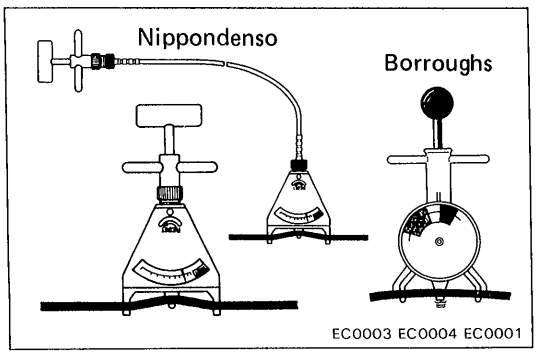


3. INSPECT DRIVE BELTS

(a) Visually check the belt for separation of the adhesive rubber above and below the core, core separation from the belt side, severed core, separation of the rib from the adhesive rubber, cracking or separation of the ribs, torn or worn ribs or cracks in the inner ridges of the ribs.

22R-E Engine only: 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.

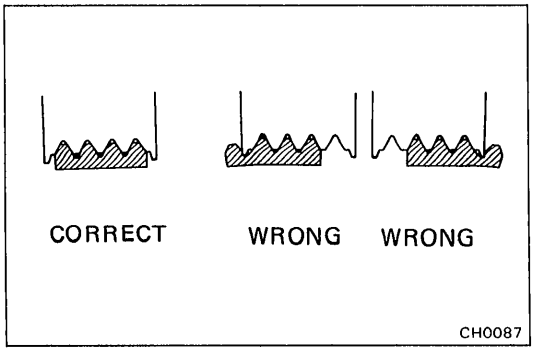
Belt tension gauge:

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

Drive belt tension:

22R-E	**New belt**	**125 ± 25 lb**
	Used belt	**80 ± 20 lb**
3VZ-E	**New belt**	**160 ± 25 lb**
	Used belt	**100 ± 20 lb**

If necessary, adjust the drive belt tension.

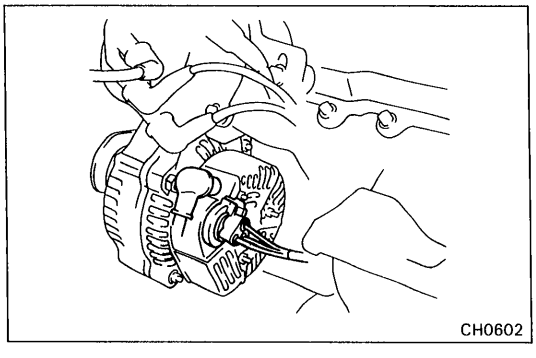


HINT:

- "New belt" refers to a belt which has been used less than 5 minutes on a running engine.
- "Used belt" refers to a belt which has been used on a running engine for 5 minutes or more.
- After installing the drive belt, check that it fits properly in the ribbed grooves. Check with your hand to comfirm that the belt has not slipped out of the groove on the bottom of the crank pulley.
- After installing a new belt, run the engine for approx. 5 minutes and then recheck the tension.

4. INSPECT FUSES FOR CONTINUITY

- ENGINE 15A
- CHARGE 7.5A



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. INSPECT DISCHARGE WARNING LIGHT CIRCUIT

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

(b) Turn off all accessories.

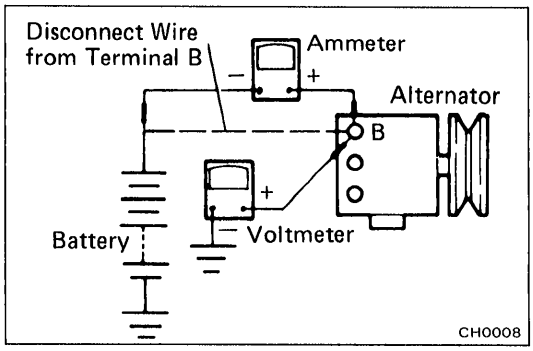
(c) Turn the ignition switch to ON. Check that the discharge warning light is light.

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

If the light does not operate as specified, troubleshoot the warning light circuit.

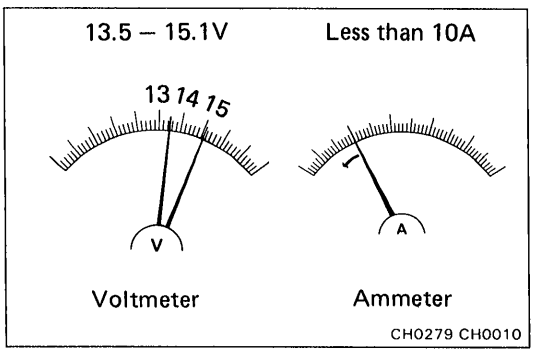
7. CHECK CHARGING CIRCUIT WITHOUT LOAD

HINT: 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 the wire 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.
- Ground the negative (−) lead of the voltmeter.

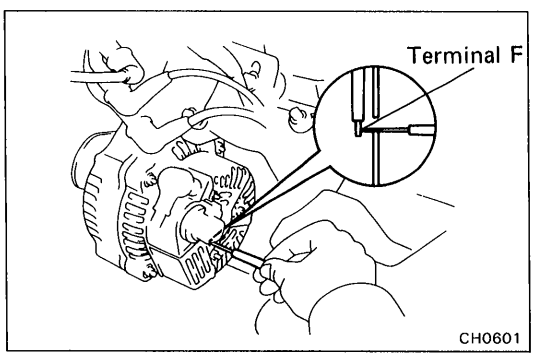


(b) Check the charging circuit as follows:

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

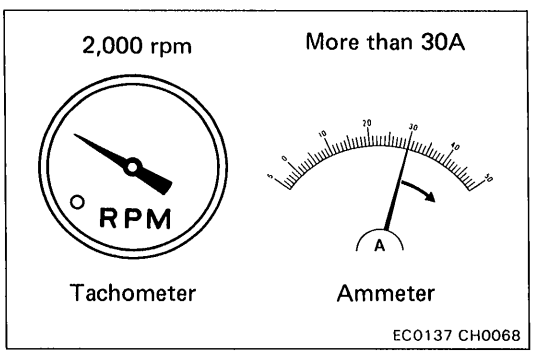
Standard amperage: Less than 10 A
Standard voltage: 13.9 – 15.1 V at 25°C (77°F)
13.5 – 14.3 V at 115°C (239°F)

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 higher than standard voltage, replace the IC regulator.
- If the voltage reading is less than standard voltage, repair the alternator.



8. INSPECT 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

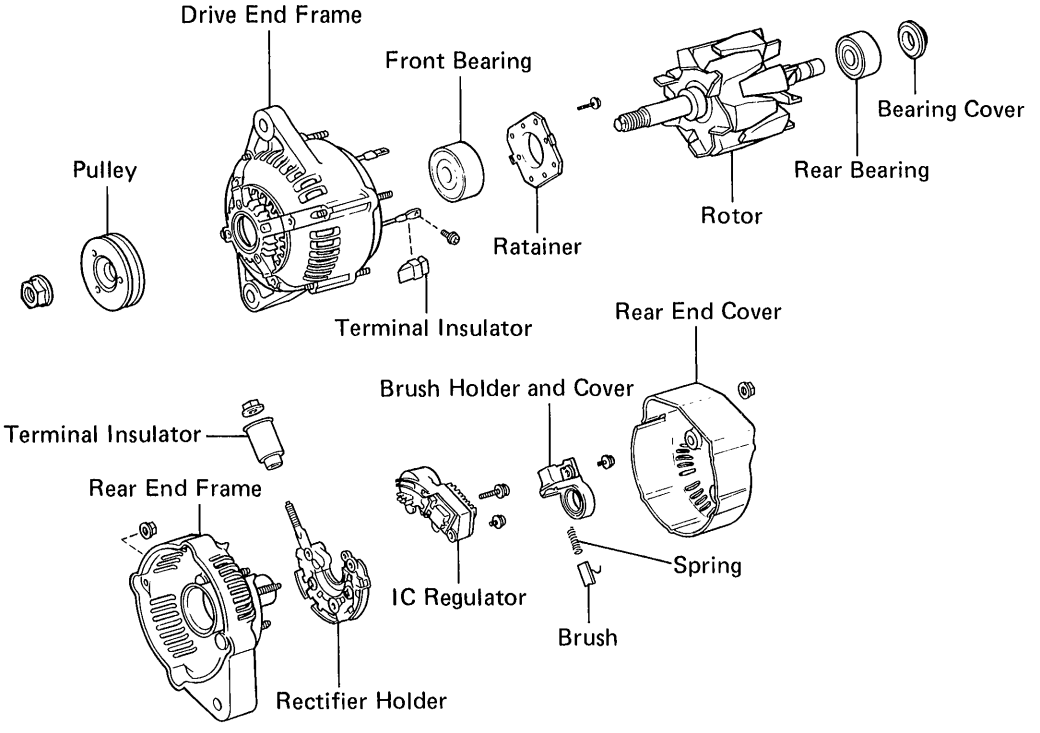
If the ammeter reading is less than 30 A, repair the alternator. (See page CH-7)

HINT: If the battery is fully charged, the indication will sometimes be less than 30 A.

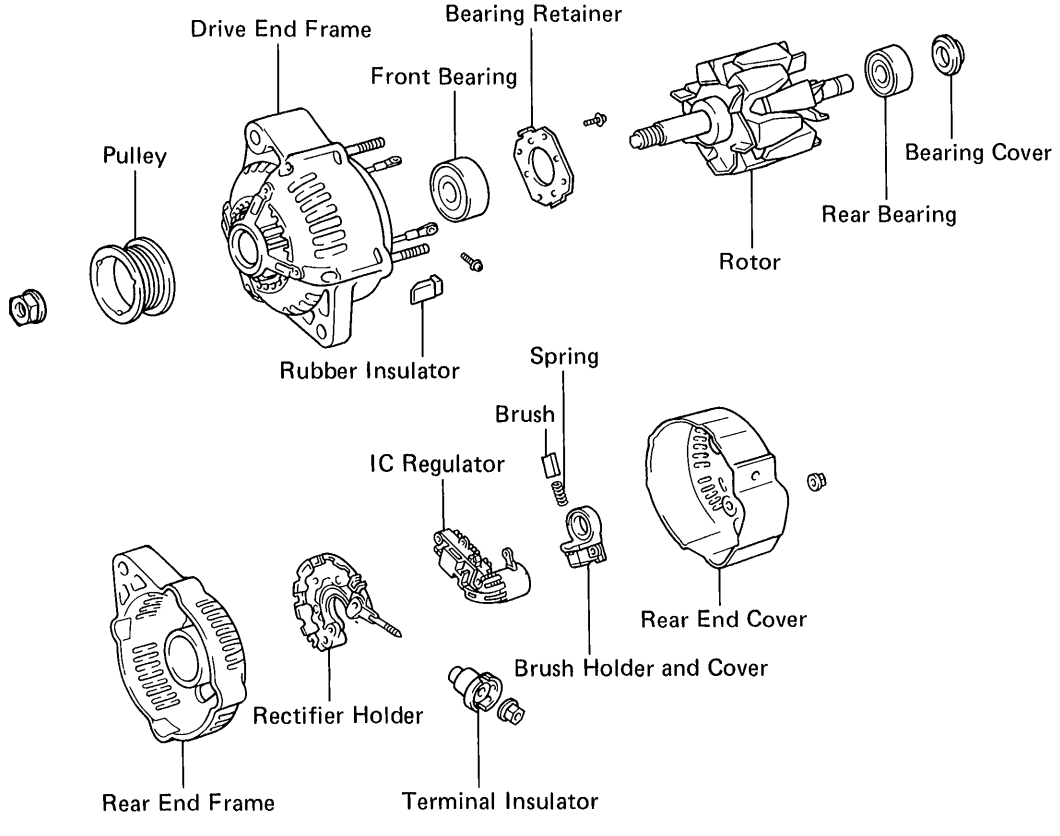
ALTERNATOR

COMPONENTS

22R-E Engine



3VZ-E Engine

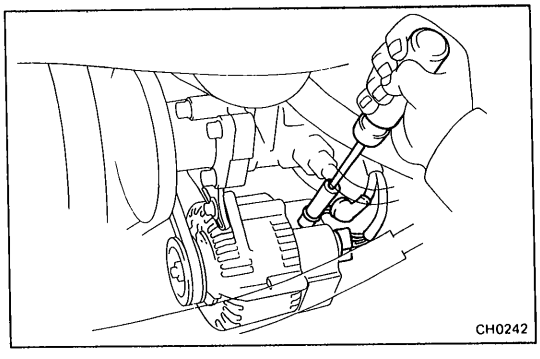


CH0238
CH0603

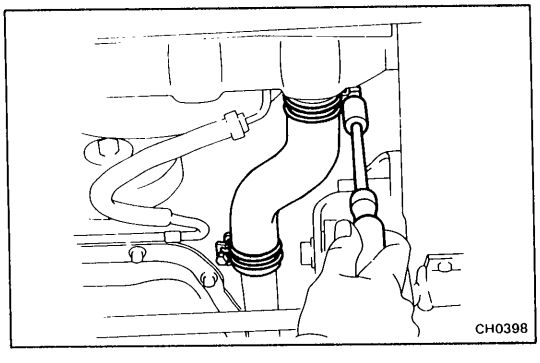
REMOVAL OF ALTERNATOR (22R-E)

1. **DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY**

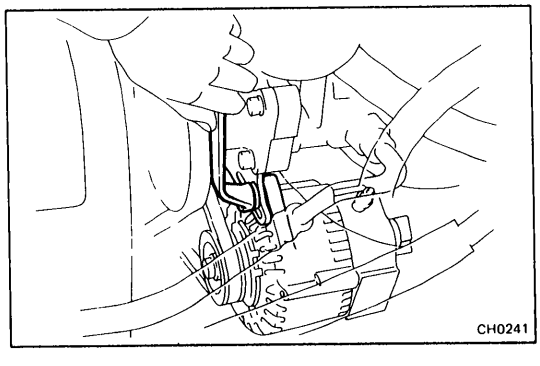
2. **(w/ PS)**
   DRAIN COOLANT



3. **DISCONNECT WIRING FROM ALTERNATOR**
   (a) Disconnect the connector from the alternator.
   (b) Remove the nut and wire from the alternator.



4. **(w/ PS)**
   REMOVE WATER INLET HOSE
   (a) Remove the engine under cover.
   (b) Remove the water inlet hose.
   (c) (with A/C)
   Remove the No. 2 fan shroud.



5. **REMOVE ALTERNATOR DRIVE BELT**
   (a) Loosen the alternator pivot and remove the adjust bolt.
   (b) Remove the drive belt.

6. **REMOVE ALTERNATOR**
   (a) Hold the alternator and remove the pivot.
   (b) Remove the alternator.

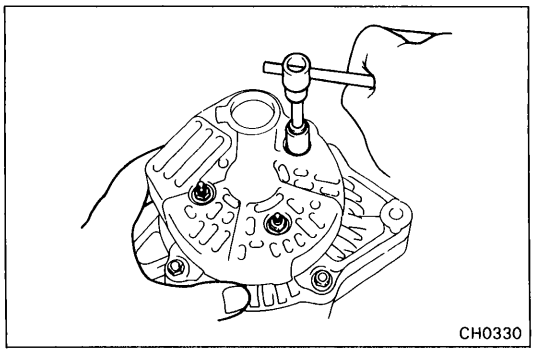
REMOVAL OF ALTERNATOR (3VZ-E)

1. **DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY**

2. **DISCONNECT WIRING FROM ALTERNATOR**
   (a) Disconnect the connector from the alternator.
   (b) Remove the nut and disconnect the wire from the alternator.

3. **REMOVE ALTERNATOR DRIVE BELT**
   Loosen the alternator pivot bolts, adjusting nut and lock bolt and remove the alternator drive belt.

4. **REMOVE ALTERNATOR**
   (a) Remove the pivot bolt and adjusting lock bolts.
   (b) Remove the alternator.



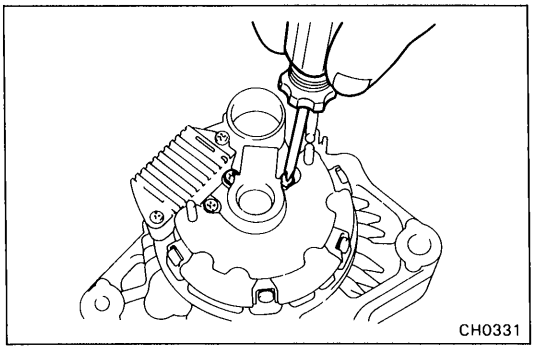
DISASSEMBLY OF ALTERNATOR

(See page CH-6)

1. REMOVE REAR END COVER

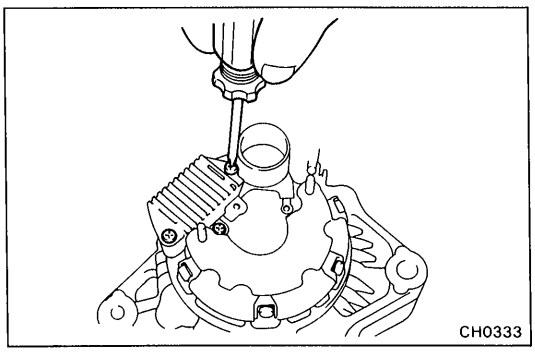
(a) Remove the nut and terminal insulator.

(b) Remove the three nuts and end cover.



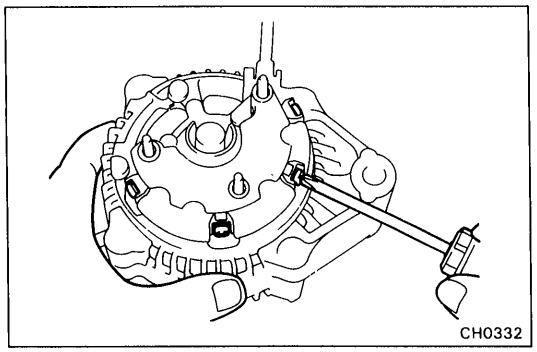
2. REMOVE BRUSH HOLDER

Remove the two screws, brush holder and cover.



3. REMOVE IC REGULATOR

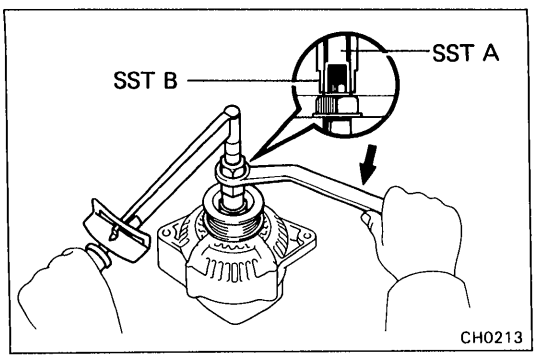
Remove the three screws and IC regulator.



4. REMOVE RECTIFIER HOLDER

(a) Remove the four screws and rectifier holder.

(b) Remove the four rubber insulators.



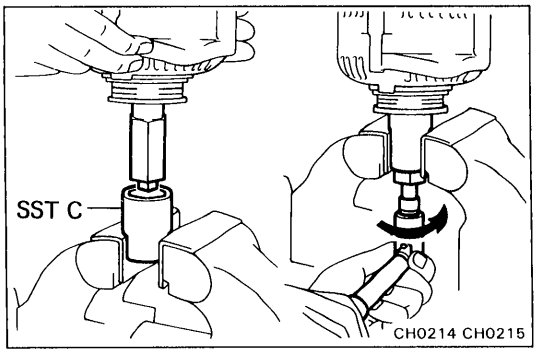
5. REMOVE PULLEY

(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) Check that SST A is secured to the rotor shaft.



(c) As shown in the figure, mount SST C in a vise, and install the alternator to SST C.

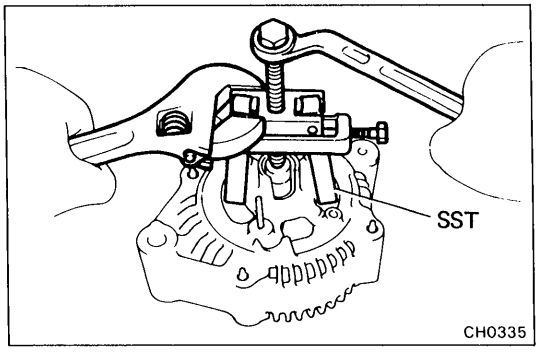
(d) To loosen the pulley nut turn SST A in the direction shown in the figure.

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

(e) Remove the alternator from SST C.

(f) Turn SST B and remove SSTs A and B.

(g) Remove the pulley nut and pulley.



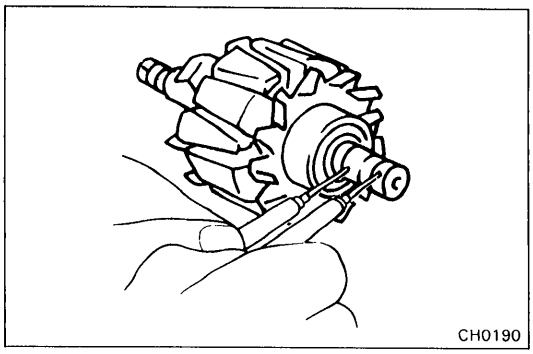
6. REMOVE REAR END FRAME

(a) Remove the four nuts.

(b) Using SST, remove the rear end frame.

SST 09286-46011

7. REMOVE ROTOR FROM DRIVE END FRAME


CH0190

INSPECTION AND REPAIR OF ALTERNATOR

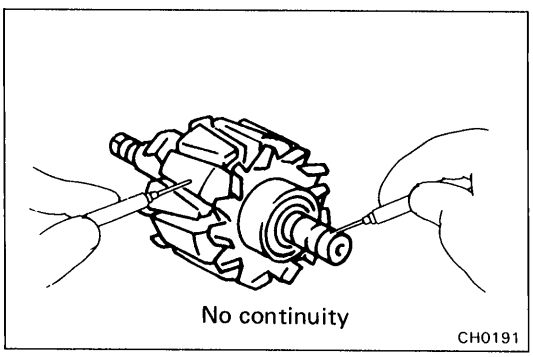
Rotor

1. INSPECT ROTOR FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the slip rings.

Standard resistance (cold): 2.8 — 3.0 Ω

If there is no continuity, replace the rotor.

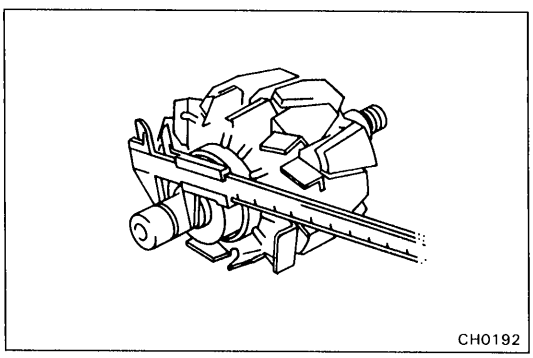


CH0191

2. INSPECT 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.


CH0192

3. INSPECT SLIP RINGS

(a) Check that the slip rings are not rough or scored.

If rough or scored, replace the rotor.

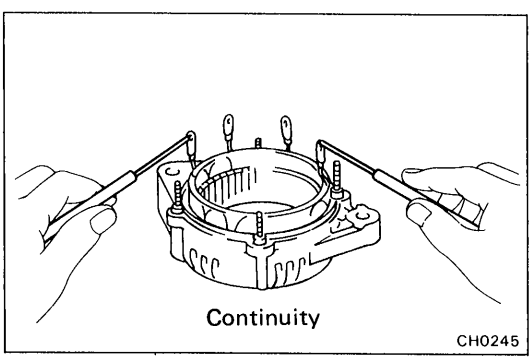
(b) Using calipers, measure the slip ring diameters.

Standard diameter: 14.2 — 14.4 mm (0.559 — 0.567 in.)

Minimum diameter: 12.8 mm (0.504 in.)

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

Stator

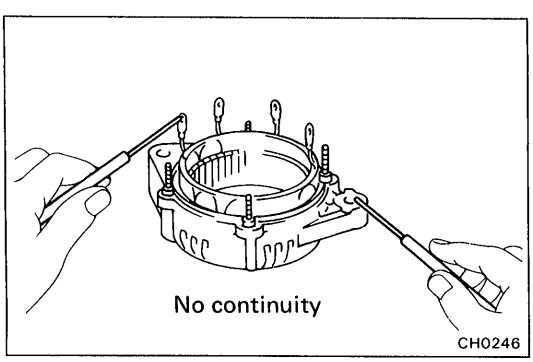


CH0245

1. INSPECT STATOR FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the coil leads.

If there is no continuity, replace the drive end frame assembly.

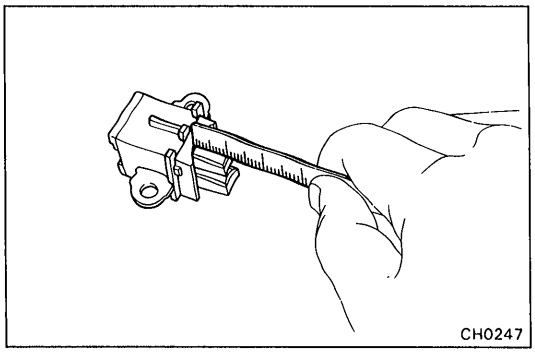


CH0246

2. INSPECT STATOR FOR GROUND

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.



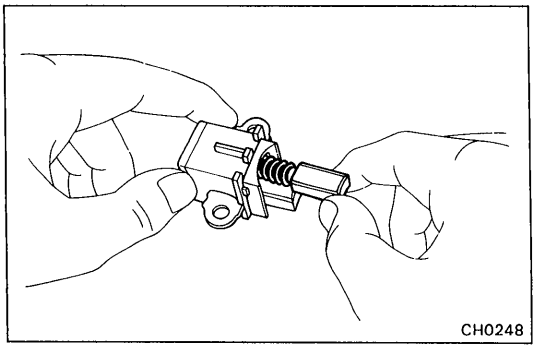
Brushes

1. **INSPECT EXPOSED BRUSH LENGTH**

Using a scale, measure the exposed brush length.

Standard exposed length: 10.5 mm (0.413 in.)
Minimum exposed length: 1.5 mm (0.059 in.)

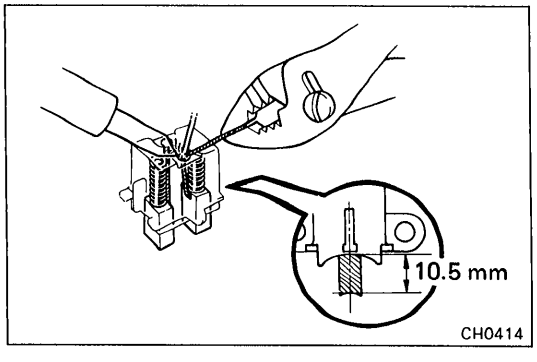
If the exposed length is less than minimum, replace the brushes.



2. **IF NECESSARY, REPLACE BRUSHES**

(a) Unsolder and remove the brush and spring.

(b) Run the wire of the brush through the hole in the brush holder, and insert the spring and brush into the brush holder.



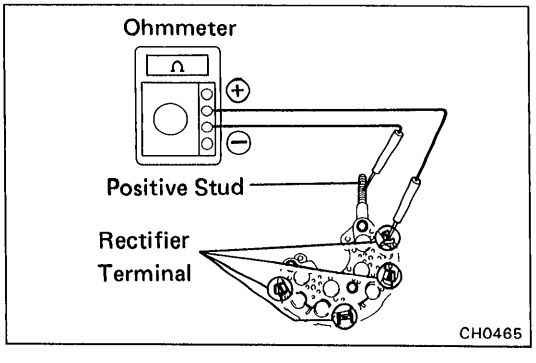
(c) Solder the brush wire to the brush holder at the exposed length.

Exposed length: 10.5 mm (0.413 in.)

(d) Check that the brush moves smoothly in the brush holder.

(e) Cut off the excess wire.

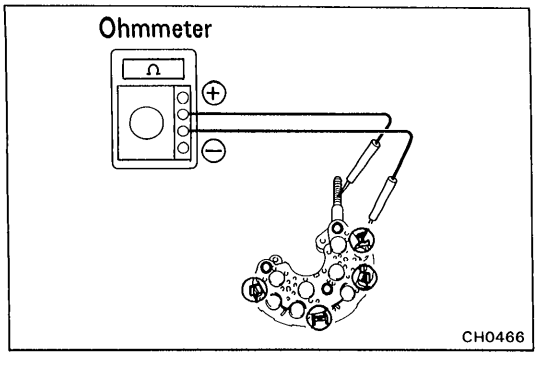
(f) Apply insulation paint to the soldered point.



Rectifier

1. **INSPECT POSITIVE SIDE RECTIFIER**

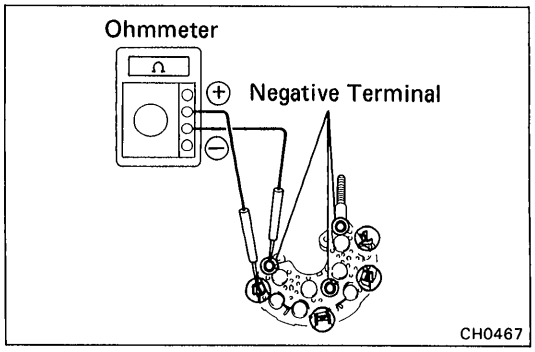
(a) Using an ohmmeter, connect one tester prove to the positive stud and the other to each rectifier terminal.



(b) Reverse the polarity of the tester probes.

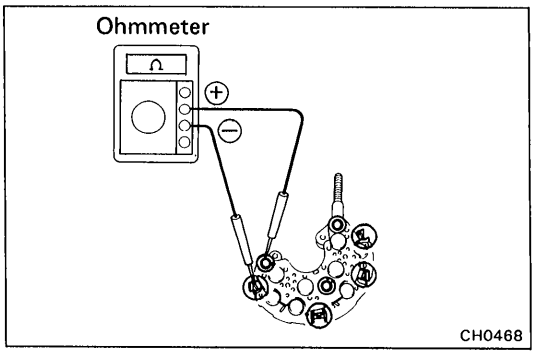
(c) Check that one shows continuity and the other shows no continuity.

If not, replace the rectifier holder.



2. INSPECT NEGATIVE SIDE RECTIFIER

(a) Connect one tester probe to each rectifier terminal and the other to each rectifier negative terminal.



(b) Reverse the polarity of the tester probes.

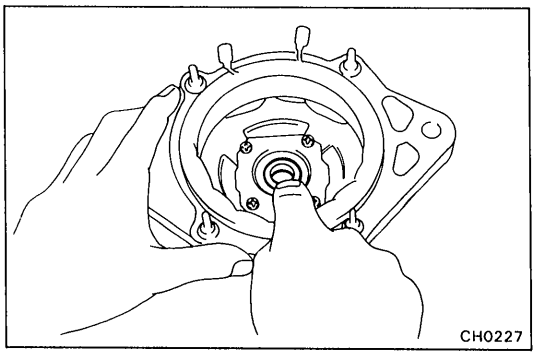
(c) Check that one shows continuity and the other shows no continuity.

If not, replace the rectifier holder.

Bearings

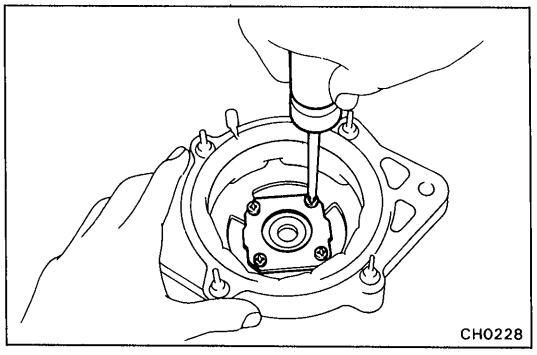
1. INSPECT FRONT BEARING

Check that the bearing is not rough or worn.

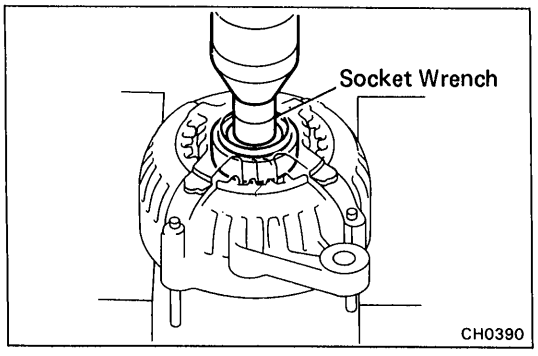


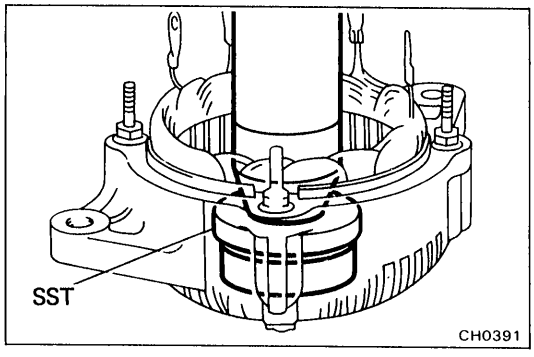
2. IF NECESSARY, REPLACE FRONT BEARING

(a) Remove the four screws and bearing retainer.



(b) Using a press and socket wrench, press out the front bearing.

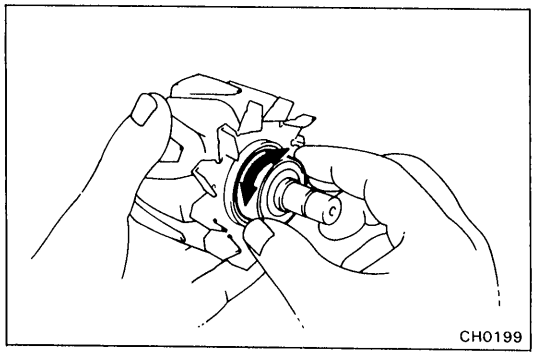




(c) Using SST and a press, press the front bearing into the drive end frame.

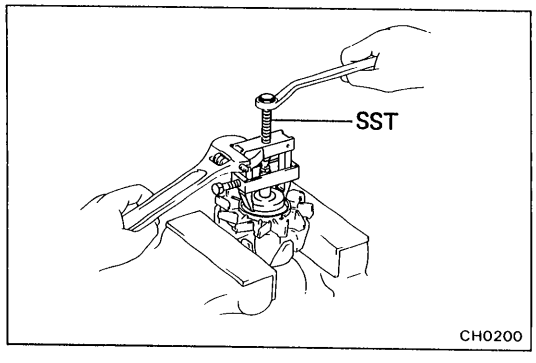
SST 09608-20012 (09608-00030)

(d) Install the bearing retainer with the four screws.



3. INSPECT REAR BEARING

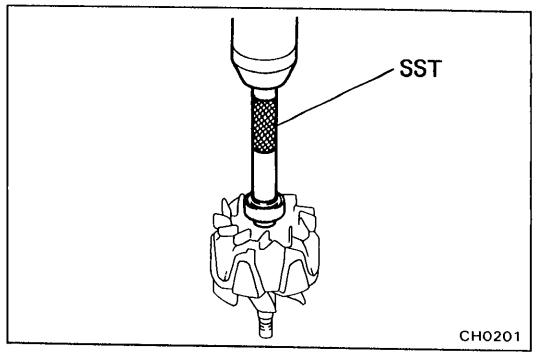
Check that the bearing is not rough or worn.



4. IF NECESSARY, REPLACE REAR BEARING

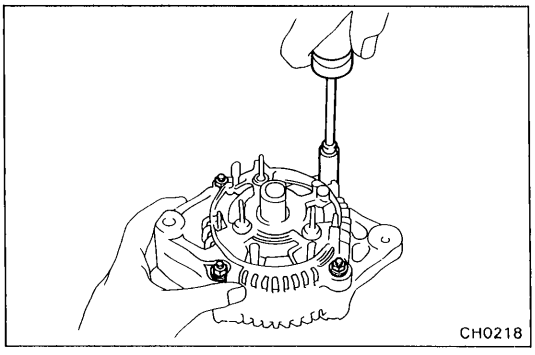
(a) Using SST, remove the bearing cover and bearing.

SST 09820-00021



(b) Using SST and a press, press in a new bearing and the bearing cover.

SST 09285-76010



ASSEMBLY OF ALTERNATOR

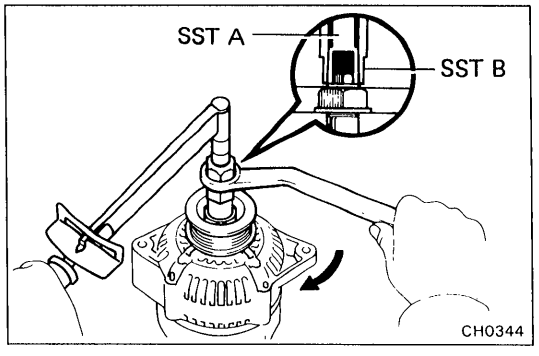
(See page CH-6)

1. INSTALL ROTOR TO DRIVE END FRAME

2. INSTALL REAR END FRAME

(a) Using a plastic-faced hammer, lightly tap in the rear end frame.

(b) Install the four nuts.



3. INSTALL PULLEY

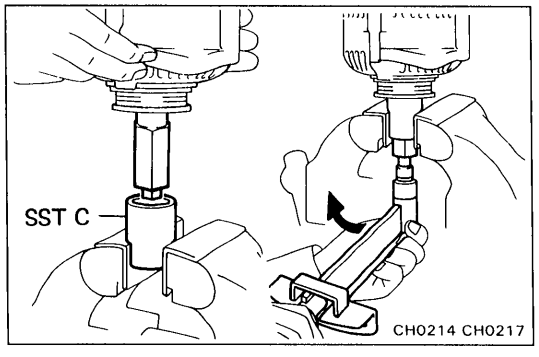
(a) Install the pulley to the rotor shaft by tightening the pulley nut by hand.

(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) Check that SST A is secured to the pulley shaft.



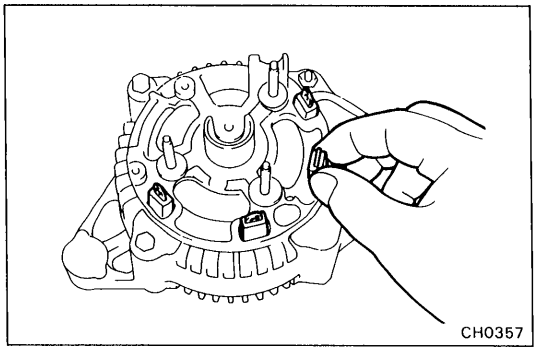
(d) As shown in the figure, mount SST C in a vise, and install the alternator to SST C.

(e) To torque the pulley nut turn SST A in the direction shown in the figure.

Torque: 1,125 kg-cm (81 ft-lb, 110 N·m)

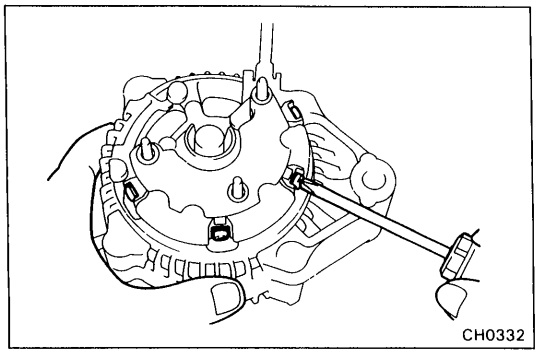
(f) Remove the alternator from SST C.

(g) Turn SST B and remove SSTs A and B.

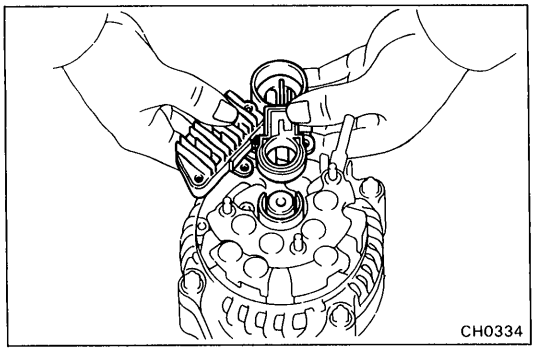


4. INSTALL RECTIFIER HOLDER

(a) Install the four rubber insulators on the lead wires.



(b) Install the rectifier with the four screws.

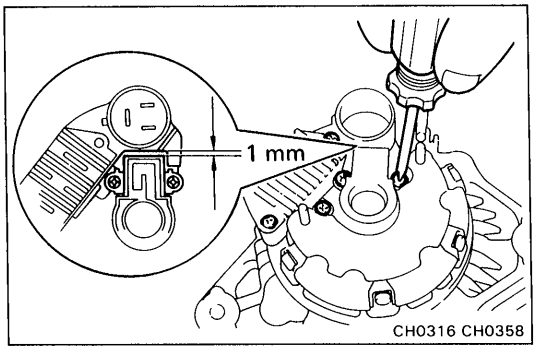


5. INSTALL BRUSH HOLDER AND IC REGULATOR

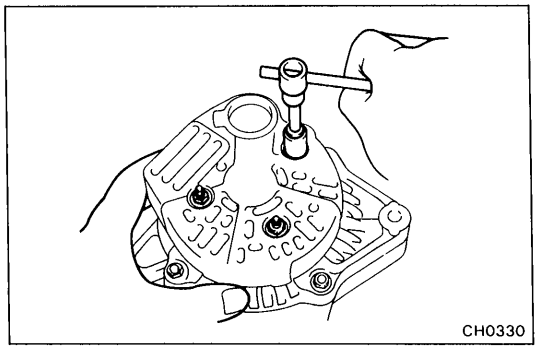
(a) Place the brush holder cover to the brush holder.

(b) Install the IC regulator and brush holder to the rear end frame horizontally as shown in the figure.

HINT: Make sure the brush holder's cover doesn't slip to one side during installation.



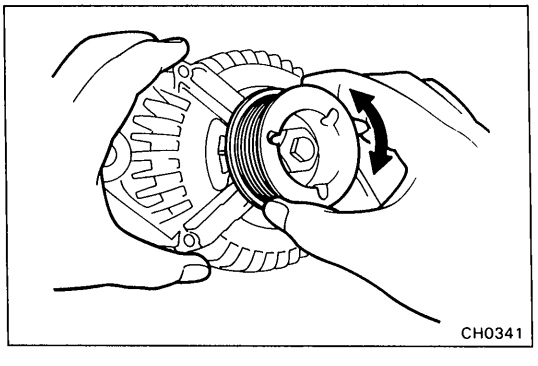
(c) Tighten the five screws until there is a clearance of at least 1 mm (0.04 in.) between the brush holder cover and connector.



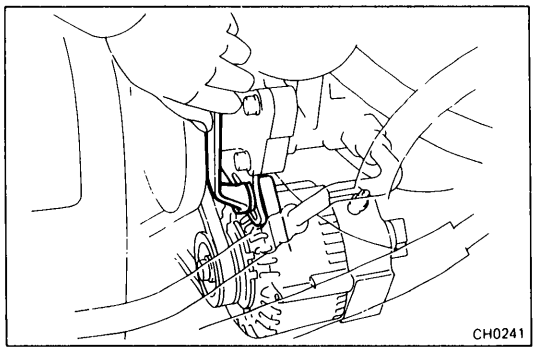
6. INSTALL REAR END COVER

(a) Install the end cover with the three nuts.

(b) Install the terminal insulator with the nut.



7. MAKE SURE ROTOR ROTATES SMOOTHLY

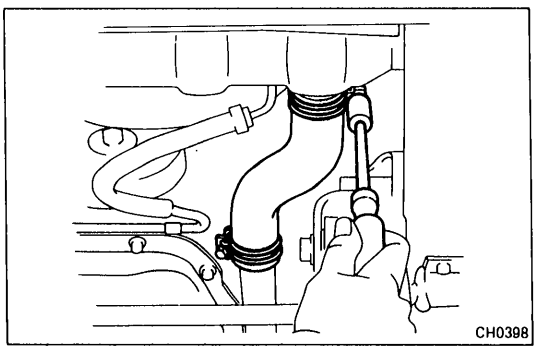


INSTALLATION OF ALTERNATOR (22R-E)

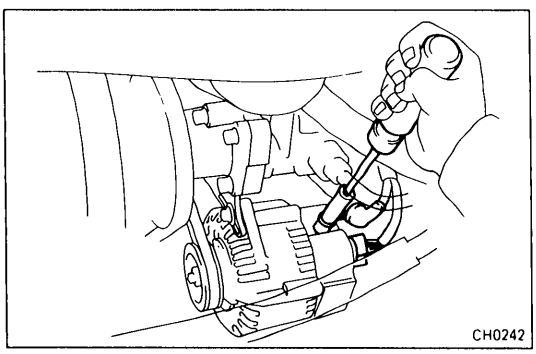
1. **INSTALL ALTERNATOR**

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

2. **INSTALL DRIVE BELT**
   (See page MA-6)



3. **INSTALL WATER INLET HOSE**
   (a) Install the water inlet hose.
   (b) Install the engine under cover.
   (c) (with A/C)
   Install the NO.2 fan shroud.



4. **CONNECT WIRING TO ALTERNATOR**
   (a) Connect the wire to the alternator and install the nut.
   (b) 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)

INSTALLATION OF ALTERNATOR (3VZ-E)

1. **INSTALL ALTERNATOR**

   Mount the alternator on the alternator bracket with pivot bolt and adjusting lock bolts.

   Do not tighten the bolts.

2. **INSTALL DRIVE BELT**
   (See step 3 on page CH-3)

3. **CONNECT WIRING TO ALTERNATOR**

   (a) Connect the wire to the alternator with the nut.

   (b) Connect the connector to the alternator.

4. **CONNECT NEGATIVE CABLE TO BATTERY**

5. **PERFORM ON-VEHICLE INSPECTION**
   (See pages CH-3 to 5)

SERVICE SPECIFICATIONS

22R-E ENGINE

MAINTENANCE

Engine

Drive belt tension		Used belt	80 ± 20 lb		
		New belt	125 ± 25 lb		
Spark plug	Type	ND	W16EXR-U		
		NGK	BPR5EY		
	Gap		0.8 mm	0.031 in.	
Engine oil capacity	Drain and refill				
		w/o Oil filter change	3.8 liters	4.0 US qts	3.3 Imp. qts
		w/ Oil filter change	4.3 liters	4.5 US qts	3.8 Imp. qts
Coolant capacity w/ heater or air conditioner		Ex. 4WD A/T	8.4 liters	8.9 US qts	7.4 Imp. qts
		4WD A/T	9.1 liters	9.6 US qts	8.0 Imp. qts
Valve clearance (hot)		Intake	0.20 mm	0.008 in.	
		Exhaust	0.30 mm	0.012 in.	
Idle speed			750 rpm		
Firing order			1—3—4—2		

Chassis

Front brake				
Pad thickness	Limit	1.0 mm	0.039 in.	
Disc thickness	Limit	18.0 mm	0.709 in.	
Disc runout	Limit	0.09 mm	0.0035 in.	
Rear brake				
Lining thickness	Limit	1.0 mm	0.039 in.	
Drum inner diameter	Limit	297.0 mm	11.693 in.	
Steering wheel freeplay	Limit	30 mm	1.18 in.	
Front axle and suspension				
Ball joint vertical play	Limit	2.3 mm	0.091 in.	
Wheel bearing friction preload (at starting)		2.9 — 5.7 kg	6.4 — 12.6 lb	28 — 56 N
Torque specifications				
Seat mounting bolts		375 kg-cm	27 ft-lb	37 N·m

ENGINE MECHANICAL

Specifications

Compression pressure		STD	12.0 kg/cm²	171 psi	1,177 kPa
		Limit	10.0 kg/cm²	142 psi	981 kPa
	Difference between each cylinder		Less than 1.0 kg/cm² (14 psi, 98 kPa)		
Cylinder head	Head surface warpage	Limit	0.15 mm		0.0059 in.
	Manifold surface warpage	Limit	0.20 mm		0.0079 in.
	Valve seat Refacing angle	Intake	30°, 45°, 60°		
		Exhaust	30°, 45°, 65°		
		Contacing angle	45°		
		Contacting width	1.2 — 1.6 mm		0.047 — 0.063 in.
Valve guide busing	Inner diameter	Intake	8.01 — 8.03 mm		0.3154 — 0.3161 in.
		Exhaust	8.01 — 8.03 mm		0.3154 — 0.3161 in.
	Outer diameter	STD	13.040 — 13.051 mm		0.5134 — 0.5138 in.
		O/S 0.05	13.090 — 13.101 mm		0.5154 — 0.5158 in.
	Replacing temperature (cylinder head side)		Approx. 90°C (194°F)		
Valve	Valve overall length	STD Intake	113.5 mm		4.468 in.
		Exhaust	112.4 mm		4.425 in.
	Valve face angle		44.5°		
	Stem diameter	STD Intake	7.970 — 7.985 mm		0.3138 — 0.3144 in.
		Exhaust	7.965 — 7.980 mm		0.3136 — 0.3142 in.
	Stem end refacing	Limit	0.5 mm		0.020 in.
	Stem oil clearance	STD Intake	0.025 — 0.06 mm		0.0010 — 0.0024 in.
		Exhaust	0.03 — 0.065 mm		0.0012 — 0.0026 in.
		Limit Intake	0.08 mm		0.0031 in.
		Exhaust	0.10 mm		0.0039 in.
	Valve head edge thickness	STD	1.0 mm		0.039 in.
		Limit	0.6 mm		0.024 in.
Valve spring	Free length		48.5 mm		1.909 in.
	Installed load at 40.5 mm (1.594 in.)				
		STD	30.0 kg	66.1 lb	294 N
		Limit	28.5 kg	62.8 lb	279 N
	Squareness	Limit	1.6 mm		0.063 in.
Rocker arm and shaft	Rocker arm inside diameter		16.000 — 16.018 mm		0.6299 — 0.6306 in.
	Rocker shaft diameter		15.97 — 15.99 mm		0.6287 — 0.6295 in.
	Shaft to arm oil clearance	STD	0.01 — 0.05 mm		0.0004 — 0.0020 in.
		Limit	0.08 mm		0.0031 in.
Intake, exhaust manifold and air intake chamber	Manifold surface warpage				
	Limit	Intake	0.2 mm		0.008 in.
		Exhaust	0.7 mm		0.028 in.
		Air intake chamber	0.2 mm		0.008 in.
Chain and sprocket	Crankshaft sprocket wear	Limit	59.4 mm		2.339 in.
	Camshaft sprocket wear	Limit	113.8 mm		4.480 in.

Specifications (Cont'd)

Tension and damper	Tensioner head thickness	Limit		11.0 mm	0.433 in.
	No. 1 damper wear	Limit		0.5 mm	0.020 in.
	No. 2 damper wear	Limit		0.5 mm	0.020 in.
Camshaft	Thrust clearance	STD		0.08 — 0.18 mm	0.0031 — 0.0071 in.
		Limit		0.25 mm	0.0098 in.
	Journal oil clearance	STD		0.01 — 0.05 mm	0.0004 — 0.0020 in.
		Limit		0.1 mm	0.004 in.
	Journal diameter	STD		32.98 — 33.00 mm	1.2984 — 1.2992 in.
	Circle runout	Limit		0.2 mm	0.008 in.
	Cam height	STD	Intake	42.63 — 42.72 mm	1.6783 — 1.6891 in.
			Exhaust	42.69 — 42.78 mm	1.6807 — 1.6842 in.
		Limit	Intake	42.25 mm	1.6634 in.
			Exhaust	42.30 mm	1.6654 in.
Cylinder block	Cylinder head surface warpage		Limit	0.05 mm	0.0020 in.
	Cylinder bore	STD	No. 1	92.00 — 92.01 mm	3.6220 — 3.6224 in.
			No. 2	92.01 — 92.02 mm	3.6224 — 3.6228 in.
			No. 3	92.02 — 92.03 mm	3.6228 — 3.6232 in.
	Cylinder bore wear	Limit		0.2 mm	0.008 in.
	Taper	Limit		0.02 mm	0.0008 in.
	Out-of-round	Limit		0.02 mm	0.0008 in.
	Cylinder block main journal bore				
		STD	No. 3	64.004 — 64.010 mm	2.5198 — 2.5201 in.
			No. 4	64.010 — 64.016 mm	2.5201 — 2.5203 in.
			No. 5	64.016 — 64.022 mm	2.5203 — 2.5205 in.
		U/S 0.25		64.004 — 64.022 mm	2.5198 — 2.5205 in.
Piston and piston ring	Piston diameter	STD	No. 1	91.975 — 91.985 mm	3.6211 — 3.6214 in.
			No. 2	91.985 — 91.995 mm	3.6214 — 3.6218 in.
			No. 3	91.995 — 92.005 mm	3.6218 — 3.6222 in.
		O/S 0.50		92.475 — 92.505 mm	3.6407 — 3.6419 in.
		O/S 1.00		92.975 — 93.005 mm	3.6604 — 3.6616 in.
	Piston to cylinder clearance			0.015 — 0.035 mm	0.0006 — 0.0014 in.
	Ring to ring goove clearance				
		STD		0.03 — 0.07 mm	0.0012 — 0.0028 in.
		Limit		0.2 mm	0.008 in.
	Piston ring end gap	STD	No. 1	0.25 — 0.47 mm	0.0098 — 0.0185 in.
			No. 2	0.60 — 0.82 mm	0.0236 — 0.0323 in.
			Oil	0.20 — 0.57 mm	0.0079 — 0.0224 in.
		Limit	No. 1	1.07 mm	0.0421 in.
			No. 2	1.42 mm	0.0559 in.
			Oil	1.17 mm	0.0461 in.
	Piston pin installing temperature			80°C	176°F
Connecting rod and bearing	Thrust clearance	STD		0.16 — 0.26 mm	0.0063 — 0.0102 in.
		Limit		0.3 mm	0.012 in.
	Bearing oil clearance	STD		0.025 — 0.055 mm	0.0010 — 0.0022 in.
		Limit		0.10 mm	0.0039 in.

Specifications (Cont'd)

Connecting rod and bearing (cont'd)	Big end inner diameter	STD A	56.000 — 56.006 mm	2.2047 — 2.2050 in.
		B	56.006 — 56.012 mm	2.2050 — 2.2052 in.
		C	56.012 — 56.018 mm	2.2052 — 2.2054 in.
		U/S 0.25	56.000 — 56.018 mm	2.2047 — 2.2054 in.
	Connecting rod bearing center wall thickness			
		STD A	1.484 — 1.488 mm	0.0584 — 0.0586 in.
		B	1.488 — 1.492 mm	0.0586 — 0.0587 in.
		C	1.492 — 1.496 mm	0.0587 — 0.0589 in.
		U/S 0.25	1.626 — 1.636 mm	0.0640 — 0.0644 in.
	Pin to bushing oil clearance			
		STD	0.005 — 0.011 mm	0.0002 — 0.0004 in.
		Limit	0.015 mm	0.0006 in.
	Rod bend per 100 mm (3.94 in.)			
		Limit	0.05 mm	0.0020 in.
	Rod twist per 100 mm (3.94 in.)			
		Limit	0.15 mm	0.0059 in.
Crankshaft	Thrust clearance	STD	0.02 — 0.22 mm	0.0008 — 0.0087 in.
		Limit	0.3 mm	0.012 in.
	Thrust washer thickness	STD	2.690 — 2.740 mm	0.1059 — 0.1079 in.
		O/S 1.25	2.753 — 2.803 mm	0.1084 — 0.1104 in.
		O/S 2.50	2.815 — 2.865 mm	0.1108 — 0.1128 in.
	Main journal oil clearance	STD	0.025 — 0.055 mm	0.0010 — 0.0022 in.
		Limit	0.08 mm	0.0031 in.
	Main journal diameter	STD	59.984 — 60.000 mm	2.3616 — 2.3622 in.
	Main journal finished diameter			
		U/S 0.25	59.701 — 59.711 mm	2.3504 — 2.3508 in.
	Main bearing center wall thickness			
		STD No. 3	1.988 — 1.992 mm	0.0783 — 0.0784 in.
		No. 4	1.992 — 1.996 mm	0.0784 — 0.0786 in.
		No. 5	1.996 — 2.000 mm	0.0786 — 0.0787 in.
		U/S 0.25	2.216 — 2.136 mm	0.0837 — 0.0841 in.
	Crank pin diameter	STD	52.988 — 53.000 mm	2.0861 — 2.0866 in.
	Crank pin finished diameter			
		U/S 0.25	52.701 — 52.711 mm	2.0748 — 2.0752 in.
	Circle runout	Limit	0.1 mm	0.004 in.
	Main journal taper and out-of-round			
		Limit	0.01 mm	0.0004 in.
	Crank pin journal taper and out-of-round			
		Limit	0.01 mm	0.0004 in.

Torque Specifications

Part tightened	kg-cm	ft-lb	N·m
Cylinder head x Cylinder head cover	60	52 in.-lb	5.9
Cylinder head x Camshaft bearing cap	200	14	20
Cylinder head x Spark plug	180	13	18
Cylinder head x Intake manifold	195	14	19
Cylinder head x No. 1 air injection manifold	130	9	13
Cylinder head x EGR valve	130	9	13
Cylinder head x Exhaust manifold	450	33	44
Cylinder head x Cylinder head rear cover	130	9	13
Cylinder block x Cylinder head	800	58	78
Cylinder block x Chain damper	220	16	22
Cylinder block x Chain tensioner	195	14	19
Cylinder block x Engine mounting	400	29	39
Cylinder block x Rear oil seal retainer	180	13	18
Cylinder block x Fuel filter bracket	195	14	19
Oil cooler relief valve x Cylinder block	700	51	69
Cylinder block x Crankshaft bearing cap	1,050	76	103
Cylinder block x Oil strainer	130	9	13
Cylinder block x Oil pan	130	9	13
Cylinder block x Engine mounting bracket	400	33	44
Valve clearance adjusting screw	250	18	25
Camshaft x Distributor drive gear	800	58	78
Crankshaft pulley x No. 2 crankshaft pulley	195	14	19
Air intake chamber x EGR pipe	130	9	13
Air intake chamber x Intake manifold	195	14	19
Air intake chamber x Accelerator control cable bracket	130	9	13
Intake manifold x Water outlet	195	14	19
Intake manifold x AS reed valve	130	9	13
No. 1 air injection manifold x AS reed valve	130	9	13
No. 1 air injection manifold x No. 2 air injection manifold	130	9	13
Exhaust manifold x No. 2 exhaust manifold heat insulator	195	14	19
Exhaust manifold x No. 2 air injection manifold			
10 mm bolt	450	33	44
8 mm bolt	220	16	22
Connecting rod x Connecting rod cap	700	51	69
Crankshaft x Crankshaft pulley	1,600	116	157
Crankshaft x Flywheel	1,100	80	108
Crankshaft x Drive plate	850	61	83
Oil pan x Drain plug	250	18	25

EFI SYSTEM

Specifications

Pressure regulator	Fuel presssure	at No vacuum	2.7 — 3.1 kg/cm² 38 — 44 psi 265 — 304 kPa	
Cold start injector	Resistance Fuel leakage		2 — 4 Ω Less than one drop of fuel per minute	
Injector	Resistance Injection volume Difference between each injector Fuel leakage		13.4 — 14.2 Ω 45 — 55 cc/15 sec. (2.4 — 3.1 cu in.) Less than 6 cc (0.37 cu in.) Less than one drop of fuel per minute	
Air flow meter	Resistance	E_2 — Vs	20 — 400 Ω (Measuring plate fully closed) 20 — 1,200 Ω (Measuring plate fully open)	
		E_2 — Vc	100 — 300 Ω	
		E_2 — V_B	200 — 400 Ω	
		E_1 — Fc	∞ (Measuring plate fully closed) 0 Ω (Measuring plate open)	
		E_2 — THA	10 — 20 kΩ (—20°C, —4°F) 4 — 7 kΩ (0°C, 32°F) 2 — 3 kΩ (20°C, 68°F) 0.9 — 1.3 kΩ (40°C, 104°F) 0.4 — 0.7 kΩ (60°C, 140°F)	
Throttle body	Throttle valve fully closed angle		6°	
Throttle position sensor	Clearance between lever and stop screw		Between terminals	Resistance
	0 mm	0 in.	VTA — E_2	0.2 — 0.8 kΩ
	0.57 mm	0.0224 in.	IDL — E_2	Less than 2.3 kΩ
	0.85 mm	0.0335 in.	IDL — E_2	Infinity
	Throttle valve fully opened position		VTA — E_2	3.3 — 10 kΩ
	—		Vcc — E_2	4 — 9 kΩ
Start injector time switch	Resistance	STA — STJ	30 — 50 Ω (below 10°C, 50°F) 70 — 90 Ω (above 25°C, 77°F)	
		STA — Ground	30 — 90 Ω	
Water temp. sensor	Resistance		10 — 20 kΩ (—20°C, —4°F) 4 — 7 kΩ (0°C, 32°F) 2 — 3 kΩ (20°C, 68°F) 0.9 — 1.3 kΩ (40°C, 104°F) 0.4 — 0.7 kΩ (60°C, 140°F) 0.2 — 0.4 kΩ (80°C, 176°F)	
VSV (FPU)	Resistance	at 20°C (68°F)	30 — 50 Ω	

Specifications (Cont'd)

Oxygen sensor heater	Resistance at 20°C (68°F)	5.1 — 6.3 Ω
EGR gas temp. sensor	Resistance	69.40 — 88.50 kΩ (50°C, 122°F) 11.89 — 14.37 kΩ (100°C, 212°F) 2.79 — 3.59 kΩ (150°C, 302°F)
Fuel cut rpm	Fuel cut rpm 2WD A/T (stop light switch ON) Others Fuel return rpm 2WD A/T (stop light switch ON) Others	 1,300 rpm 1,900 rpm 1,000 rpm 1,600 rpm

ECU (Voltage)

NOTE:
- Perform all voltage and resistance measurements with the ECU connected.
- Verify that the battery voltage is 11 V or above when the ignition switch is ON.
- The testing probes must not make contact with the ECU oxygen V_F terminals.

Terminals	STD voltage	Condition	
BATT — E_1	10 — 14	—	
+B — E_1		Ignition SW ON	
$+B_1$ — E_1			
IDL — E_2 (E_{21})	8 — 14	Ignition SW ON	Throttle valve open
Vcc — E_2 (E_{21})	4 — 6		—
VTA — E_2 (E_{21})	0.1 — 1.0		Throttle valve fully closed
	3 — 5		Throttle valve fully opened
Vc — E_2 (E_{21})	6 — 10	Ignition SW ON	—
Vs — E_2 (E_{21})	0.5 — 2.5		Measuring plate fully closed
	5 — 10		Measuring plate fully open
	2 — 8	Idling	
	0.3 — 1.0	3,000 rpm	
THA — E_2 (E_{21})	1 — 3	Ignition SW ON	Intake air temperature 20°C (68°F)
THW — E_2 (E_{21})	0.1 — 1.0		Coolant temperature 80°C (176°F)
STA — E_1	6 — 12	Ignition SW ST position	
No. 10 — E_{01} No. 20 — E_{02}	10 — 14	Ignition SW ON	
IGt — E_1	0.7 — 1.0	Cranking or idling	
W — E_1	10 — 14	No trouble (CHECK ENGINE light off) and engine running	
STJ — E_1	6 — 12	Ignition SW ST position	Coolant temperature 80°C (176°F)
STP — E_1	8 — 14	Stop light switch ON	

Specifications (Cont'd)

ECU (Resistance)	Terminals	Resistance (kΩ)	Condition
	IDL — E_2 (E_{21})	Infinity	Throttle valve open
		0 — 0.1	Throttle valve fully closed
	VTA — E_2 (E_{21})	3.3 — 10	Throttle valve fully open
		0.2 — 0.8	Throttle valve fully closed
	Vcc — E_2 (E_{21})	4 — 9	—
	THA — E_2 (E_{21})	2 — 3	Intake air temperature 20°C (68°F)
	THW — E_2 (E_{21})	0.2 — 0.4	Coolant temperature 80°C (176°F)
	+B — E_2 (E_{21})	0.2 — 0.4	—
	Vc — E_2 (E_{21})	0.1 — 0.3	—
	Vs — E_2 (E_{21})	0.02 — 0.4	Measuring plate fully closed
		0.02 — 1.00	Measuring plate fully open
	Ne — E_1	0.14 — 0.18	—
	STJ — E_1	Infinity	—
	FPU — E_1	Infinity	—
	HT — E_1	Infinity	—

Torque Specifications

Part tightened	kg-cm	ft-lb	N·m
Fuel hose x Fuel filter	310	22	30
Fuel hose x Fuel main tube	310	22	30
Fuel filter x Fuel filter bracket	195	14	19
Delivery pipe x Pressure regulator	300	22	30
Delivery pipe x Intake manifold	195	14	19
Delivery pipe x Fuel tube	450	33	44
Delivery pipe x Fuel pipe	195	14	19
Fuel pipe x Cold start injector	195	14	19
Air intake chamber x Cold start injector	80	69 in.-lb	7.8
Air intake chamber x Throttle body	195	14	19
Fuel pump	40	35 in.-lb	3.9
Fuel drain plug	65	56 in.-lb	6.4
Fuel tank x Body	300	22	29

COOLING SYSTEM

Radiator	Relief valve opening pressure	STD	0.75—1.05 kg/cm² 10.7—14.9 psi 74—103 kPa
		Limit	0.6 kg/cm² 8.5 psi 59 kPa
Thermostat	Valve opening temperature		
	Starts to open at		88°C 190°F
	Fully opens at		100°C 212°F
	Valve opening travel		More than 8 mm (0.31 in.)

LUBRICATION SYSTEM

Oil pressure (normal operating temperature)			
	at Idle speed		More than 0.3 kg/cm² (4.3 psi, 29 kPa)
	at 3,000 rpm		2.5—5.0 kg/cm² 36—71 psi 245—490 kPa
Oil Pump	Body clearance	STD	0.09 — 0.15 mm 0.0035 — 0.0059 in.
		Limit	0.2 mm 0.008 in.
	Tip clearance		
	Driven gear to crescent	STD	0.15 — 0.21 mm 0.0059 — 0.0083 in.
		Limit	0.3 mm 0.012 in.
	Drive gear to crescent	STD	0.22 — 0.25 mm 0.0087 — 0.0098 in.
		Limit	0.3 mm 0.012 in.
	Side clearance	STD	0.03 — 0.09 mm 0.0012 — 0.0035 in.
		Limit	0.15 mm 0.0059 in.
	Relief valve operating pressure		3.5—4.5 kg/cm² 50—64 psi 343—441 kPa

IGNITION SYSTEM

Spark plug	Type	ND	W16EXR-U
		NGK	BPR5EY
	Gap		0.8 mm 0.031 in.
High-tension cord	Resistance	Limit	Less than 25 kΩ per cord
Ignition coil	Primary coil resistance		0.5 — 0.7 Ω
	Secondary coil resistance		11.4 — 15.6 kΩ

STARTING SYSTEM

Starter	Rated voltage and output power			12 V, 1.0 kW		12 V, 1.4 kW
	No-load characteristic		Current	Less than 90 A		Less than 90 A
			rpm	More than 3,000 rpm at 11.5 V		More than 3,500 rpm at 11.5 V
	Brush length		STD	13.5 mm	0.531 in.	15.5 mm 0.610 in.
			Limit	8.5 mm	0.335 in.	10.0 mm 0.394 in.
	Commutator	Outer diameter	STD	30 mm	1.18 in.	←
			Limit	29 mm	1.14 in.	←
		Undercut depth	STD	0.6 mm	0.024 in.	←
			Limit	0.2 mm	0.008 in.	←
		Circle runout	Limit	0.05 mm	0.0020 in.	←
	Spring installed load		STD	1,785 — 2,415 g (3.9—5.3 lb, 18—24 N)		←
			Limit	1.2 kg (2.6 lb, 12 N)		←

CHARGING SYSTEM

Battery specific gravity When fully charged at 20°C (68°F)			1.25 — 1.27	
Alternator	Rated output ampere		70 A	
	Rotor coil resistance		2.8 — 3.0 Ω	
	Brush exposed length	STD	10.5 mm	0.413 in.
		Limit	1.5 mm	0.059 in.
	Slip ring diameter	STD	14.2 — 14.4 mm	0.559 — 0.567 in.
		Limit	12.8 mm	0.504 in.
Alternator regulator	Regulator voltage	at 25°C (77°F)	13.9 — 15.1 V	
		at 115°C (239°F)	13.5 — 14.3 V	

LUBRICANT

Item	Capacity			Classification
	Liters	US qts	Imp. qts	
Engine oil				API grade SG multigrade, fuel efficient and recommended viscosity oil
Drain and refill				
w/o Oil filter change	3.8	4.0	3.3	
w/ Oil filter change	4.3	4.5	3.8	
Dry fill	4.8	5.1	4.2	

3VZ-E ENGINE

MAINTENANCE

Engine

Drive belt tension	Alternator	Used belt	100 ± 20 lb		
		New belt	160 ± 20 lb		
	PS	Used belt	80 ± 20 lb		
		New belt	125 ± 25 lb		
	A/C	Used belt	80 ± 20 lb		
		New belt	125 ± 25 lb		
Spark plug	Type	ND	K16R-U		
		NGK	BKR5EYA		
	Gap		0.8 mm	0.031 in.	
Engine oil capacity	w/o Oil filter change		4.2 liters	4.4 US qts	3.7 Imp. qts
	w/ Oil filter change		4.5 liters	4.8 US qts	4.0 Imp. qts
Coolant capacity		2WD M/T	10.4 liters	11.0 US qts	9.2 Imp. qts
		A/T	10.2 liters	10.8 US qts	9.5 Imp. qts
		4WD M/T	10.5 liters	11.1 US qts	9.2 Imp. qts
		A/T	10.3 liters	10.9 US qts	9.1 Imp. qts
Valve clearance (cold)		Intake	0.18 — 0.28 mm	0.007 — 0.011 in.	
		Exhaust	0.22 — 0.32 mm	0.009 — 0.013 in.	
Idle speed			800 rpm		
Firing order			1—2—3—4—5—6		

Chassis

Front brake				
Pad thickness	Limit	1.0 mm	0.039 in.	
Disc thickness	Limit	18.0 mm	0.709 in.	
Disc runout	Limit	0.09 mm	0.0035 in.	
Rear brake				
Lining thickness	Limit	1.0 mm	0.039 in.	
Drum inner diameter	Limit	297.0 mm	11.693 in.	
Steering wheel freeplay	Limit	30 mm	1.18 in.	
Front axle and suspension				
Ball joint vertical play	Limit	2.3 mm	0.091 in.	
Wheel bearing friction preload (at starting)		0.6 — 1.8 kg	1.3 — 4.0 lb	5.9 — 18 N
Torque specifications				
Seat mounting bolts		375 kg-cm	27 ft-lb	37 N·m

ENGINE MECHANICAL

Specifications

Compression pressure		STD	12.0 kg/cm²	171 psi	1,177 kPa
		Limit	10.0 kg/cm²	142 psi	981 kPa
	Difference between each cylinder		Less than 1.0 kg/cm² (14 psi, 98 kPa)		
Idler pulley tension spring	Free length		56.275 mm		2.2155 in.
Cylinder head	Head surface warpage	Limit	0.10 mm		0.0039 in.
	Manifold surface warpage	Limit	0.10 mm		0.0039 in.
	Valve seat	Refacing angle	30°, 45°, 60°		
		Contacting angle	45°		
		Contacting width	1.2 — 1.6 mm		0.047 — 0.063 in.
Valve guide bushing	Inner diameter		8.010 — 8.030 mm		0.3154 — 0.3161 in.
	Outer diameter	STD	13.040 — 13.051 mm		0.5134 — 0.5138 in.
		O/S 0.05	13.090 — 13.101 mm		0.5154 — 0.5158 in.
	Replacing temperature (cylinder head side)		Approx. 90°C (194°F)		
Valve	Valve overall length	STD	104.3 mm		4.106 in.
		Limit	104.0 mm		4.094 in.
	Valve face angle		44.5°		
	Stem diameter	STD Intake	7.970 — 7.985 mm		0.3138 — 0.3144 in.
		Exhaust	7.965 — 7.980 mm		0.3136 — 0.3412 in.
	Stem end refacing	Limit	0.5 mm		0.020 in.
	Stem oil clearance	STD Intake	0.025 — 0.060 mm		0.0010 — 0.0024 in.
		Exhaust	0.030 — 0.065 mm		0.0012 — 0.0026 in.
		Limit Intake	0.08 mm		0.0031 in.
		Exhaust	0.10 mm		0.0039 in.
	Valve head edge thickness	STD	1.5 mm		0.059 in.
		Limit	1.3 mm		0.051 in.
Valve spring	Free length		47.01 mm		1.8508 in.
	Installed load at 40.0 mm (1.575 in.)				
		STD	26.0 kg	57 lb	255 N
		Limit	24.7 kg	54 lb	242 N
	Squareness	Limit	1.23 mm		0.0484 in.
Valve lifter	Outer diameter	STD	37.922 — 37.932 mm		1.4930 — 1.4934 in.
	Oil clearance	STD	0.028 — 0.053 mm		0.0011 — 0.0021 in.
		Limit	0.1 mm		0.004 in.
Intake and exhaust manifold, intake chamber	Manifold surface warpage				
	Limit	Intake	0.10 mm		0.0039 in.
		Exhaust	0.70 mm		0.0276 in.
		Air intake chamber	0.10 mm		0.0039 in.

Specifications (Cont'd)

Camshaft	Thrust clearance	STD		0.08 — 0.19 mm	0.0031 — 0.0075 in.
		Limit		0.25 mm	0.0098 in.
	Journal oil clearance	STD		0.025 — 0.066 mm	0.0010 — 0.0026 in.
		Limit		0.10 mm	0.0039 in.
	Journal diameter	STD		33.959 — 33.975 mm	1.3370 — 1.3376 in.
	Circle runout	Limit		0.06 mm	0.0024 in.
	Cam height	STD		47.83 — 47.93 mm	1.8830 — 1.8870 in.
		Limit		47.50 mm	1.8701 in.
Cylinder block	Cylinder head surface warpage				
		Limit		0.05 mm	0.0020 in.
	Cylinder bore	STD	No. 1	87.500 — 87.510 mm	3.4449 — 3.4453 in.
			No. 2	87.511 — 87.520 mm	3.4453 — 3.4457 in.
			No. 3	87.521 — 87.530 mm	3.4457 — 3.4461 in.
	Cylinder bore wear	Limit		0.2 mm	0.008 in.
	Taper	Limit		0.02 mm	0.0008 in.
	Out-of-round	Limit		0.02 mm	0.0008 in.
	Cylinder block main journal bore				
		STD	No. 1	68.010 — 68.016 mm	2.6776 — 2.6778 in.
			No. 2	68.017 — 68.022 mm	2.6778 — 2.6780 in.
			No. 3	68.023 — 68.028 mm	2.6781 — 2.6783 in.
		U/S 0.25		68.010 — 68.028 mm	2.6776 — 2.6783 in.
		U/S 0.50		68.010 — 68.028 mm	2.6776 — 2.6783 in.
Piston and piston ring	Piston diameter	STD	No. 1	87.410 — 87.420 mm	3.4413 — 3.4417 in.
			No. 2	87.421 — 87.430 mm	3.4418 — 3.4421 in.
			No. 3	87.431 — 87.440 mm	3.4422 — 3.4425 in.
		O/S 0.50		87.910 — 87.940 mm	3.4610 — 3.4622 in.
	Piston to cylinder clearance			0.08 — 0.10 mm	0.0031 — 0.0039 in.
	Ring to ring groove clearance				
		STD		0.03 — 0.07 mm	0.0012 — 0.0028 in.
		Limit		0.20 mm	0.0079 in.
	Piston ring end gap	STD	No. 1	0.23 — 0.33 mm	0.0091 — 0.0130 in.
			No. 2	0.38 — 0.48 mm	0.0150 — 0.0189 in.
			Oil	0.15 — 0.40 mm	0.0059 — 0.0157 in.
		Limit	No. 1	0.83 mm	0.0327 in.
			No. 2	0.93 mm	0.0366 in.
			Oil	0.90 mm	0.0354 in.
Connecting rod and bearing	Thrust clearance	STD		0.15 — 0.33 mm	0.0059 — 0.0130 in.
		Limit		0.38 mm	0.0150 in.
	Bearing oil clearance	STD		0.024 — 0.053 mm	0.0009 — 0.0021 in.
		Limit		0.08 mm	0.0031 in.
	Big end inner diameter	STD	No. 1	58.000 — 58.008 mm	2.2835 — 2.2838 in.
			No. 2	58.009 — 58.016 mm	2.2838 — 2.2841 in.
			No. 3	58.017 — 58.024 mm	2.2843 — 2.2844 in.
		U/S 0.25		58.000 — 58.024 mm	2.2835 — 2.2844 in.
		U/S 0.50		58.000 — 58.024 mm	2.2835 — 2.2844 in.

Specifications (Cont'd)

Connecting rod and bearing (cont'd)	Connecting rod bearing center wall thickness			
		STD No. 1	1.484 — 1.488 mm	0.0584 — 0.0586 in.
		No. 2	1.489 — 1.492 mm	0.0586 — 0.0587 in.
		No. 3	1.493 — 1.496 mm	0.0588 — 0.0589 in.
		U/S 0.25	1.605 — 1.611 mm	0.0632 — 0.0634 in.
		U/S 0.50	1.730 — 1.736 mm	0.0681 — 0.0683 in.
	Connecting rod bolt diameter			
		STD	7.860 — 8.000 mm	0.3094 — 0.3150 in.
		Limit	7.60 mm	0.2992 in.
	Rod bend per 100 mm (3.94 in.)			
		Limit	0.05 mm	0.0020 in.
	Rod twist per 100 mm (3.94 in.)			
		Limit	0.15 mm	0.0059 in.
Crankshaft	Thrust clearance	STD	0.02 — 0.22 mm	0.0008 — 0.0098 in.
		Limit	0.30 mm	0.0118 in.
	Thrust washer thickness	STD	2.44 — 2.49 mm	0.0961 — 0.0980 in.
	Main journal oil clearance	STD	0.0024 — 0.0042 mm	0.0009 — 0.0017 in.
		Limit	0.80 mm	0.0031 in.
	Main journal diameter	STD No. 0	63.996 — 64.000 mm	2.5195 — 2.5197 in.
		No. 1	63.990 — 63.995 mm	2.5193 — 2.5195 in.
		No. 2	63.985 — 63.989 mm	2.5191 — 2.5192 in.
	Main journal finished diameter			
		U/S 0.25	63.745 — 63.755 mm	2.5096 — 2.5100 in.
		U/S 0.50	63.495 — 63.505 mm	2.4998 — 2.5002 in.
	Main bearing center wall thickness			
		STD No. 1	1.989 — 1.992 mm	0.0783 — 0.0784 in.
		No. 2	1.993 — 1.995 mm	0.0785 — 0.0785 in.
		No. 3	1.996 — 1.998 mm	0.0786 — 0.0787 in.
		No. 4	1.999 — 2.001 mm	0.0787 — 0.0788 in.
		No. 5	2.002 — 2.004 mm	0.0788 — 0.0789 in.
		U/S 0.25	2.110 — 2.116 mm	0.0831 — 0.0833 in.
		U/S 0.50	2.235 — 2.241 mm	0.0880 — 0.0882 in.
	Crank pin diameter	STD	54.987 — 55.000 mm	2.1648 — 2.1654 in.
	Crank pin finished diameter			
		U/S 0.25	54.745 — 54.755 mm	2.1553 — 2.1557 in.
		U/S 0.50	54.495 — 54.505 mm	2.1455 — 2.1459 in.
	Circle runout	Limit	0.06 mm	0.0024 in.
	Main journal taper and out-of-round			
		Limit	0.02 mm	0.0008 in.
	Crank pin journal taper and out-of-round			
		Limit	0.02 mm	0.0008 in.

Torque Specifications

Part tightened		kg-cm	ft-lb	N·m
No. 2 idler pulley x Water outlet		85	74 in.-lb	8.3
Fan pulley bracket x Fluid coupling		55	48 in.-lb	5.4
Camshaft x Camshaft timing pulley		1,100	80	108
Crankshaft x Crankshaft pulley		2,500	181	245
No. 3 timing belt cover x No. 4 timing belt cover		85	74 in.-lb	8.3
Intake manifold x No. 2 idler pulley		185	13	18
Intake manifold x Water by-pass outlet		185	13	18
Intake manifold x Air intake chamber		185	13	18
Exhaust manifold x Exhaust crossover pipe		400	29	39
Air intake chamber x Air pipe		130	9	13
Cylinder head x No. 1 idler pulley		380	27	37
Cylinder head x Alternator bracket		380	27	37
Cylinder head x Engine hanger		410	30	40
Cylinder head x Camshaft bearing cap		160	12	16
Cylinder head x No. 3 timing belt cover		85	74 in.-lb	8.3
Cylinder head x Intake manifold		185	13	18
Cylinder head x Exhaust manifold		400	29	39
Cylinder head x Spark plug		180	13	18
Cylinder block x Crankshaft bearing cap	First	625	45	61
	Second	90° turns		
Cylinder head x Cylinder block 10 mm bolt		380	27	37
Others	First	450	33	44
	Second	90° turns		
	Third	90° turns		
Cylinder block x Fan pulley bracket		420	30	41
Cylinder block x Rear oil seal retainer		80	69 in.-lb	7.8
Cylinder block x Engine mounting bracket		410	30	40
Cylinder block x Oil hole cover plate		500	36	49
Cylinder block x Water pump	Short bolt	200	14	20
	Long bolt	185	13	18
Cylinder block x Water inlet		200	14	20
Cylinder block x Tension spring bracket		185	13	18
Cylinder block x No. 1 water by-pass pipe	Bolt	50	43 in.-lb	4.9
	Nut	70	61 in.-lb	6.9
Cylinder block x Oil filter union		250	18	25
Cylinder block x Oil pressure switch		150	11	15
Cylinder block x Oil pump		200	14	20
Crankshaft x Flywheel		900	65	88
Crankshaft x Drive plate		850	61	83
Connecting rod x Connecting rod cap	First	250	18	25
	Second	90° turns		
Oil strainer x Crakshaft bearing cap		70	61 in.-lb	6.9
Oil strainer x Oil pump		70	61 in.-lb	6.9

Torque Specifications (Cont'd)

Part tightened	kg-cm	ft-lb	N·m
EGR valve x No. 1 and No. 2 EGR pipes	800	58	78
No. 1 EGR pipe x Exhaust manifold	300	22	29
No. 2 EGR pipe x Air intake chamber	300	22	29
EGR valve x Air intake chamber	185	13	18
EGR vacuum modulator bracket x Air intake chamber	120	9	12
AS reed valve x AI manifold	400	29	39
AS reed valve x Cylinder head	380	27	37
Exhaust manifold x AI manifold	300	22	29
Distributor x No. 4 camshaft bearing cap	185	13	18

EFI SYSTEM

Specifications

Pressure regulator	Fuel pressure	at No vacuum	2.7—3.1 kg/cm² 38—44 psi 265—304 kPa	
Cold start injector	Resistance Fuel leakage		2 — 4 Ω Less than one drop of fuel per minute	
Injector	Resistance Injection volume Difference between each injector Leakage		13.4 — 14.2 Ω 45 — 55 cc/15 sec. (2.7 — 3.4 cu in.) Less than 6 cc (0.4 cu in.) Less than one drop of fuel per minute	
Air flow meter	Resistance	E_2 — Vs	200 — 600 Ω (Measuring plate fully closed) 20 — 1,200 Ω (Measuring plate fully open)	
		E_2 — Vc	200 — 400 Ω	
		E_1 — Fc	Infinity	
		E_2 — THA	10 — 20 kΩ (—20°C, —4°F) 4 — 7 kΩ (0°C, 32°F) 2 — 3 kΩ (20°C, 68°F) 0.9 — 1.3 kΩ (40°C, 104°F) 0.4 — 0.7 kΩ (60°C, 140°F)	
Throttle body	Throttle valve fully closed angle		6°	
Throttle position sensor	Clearance between lever and stop screw		Between terminals	Resistance
	0 mm	0 in.	VTA — E_2	0.2 — 0.8 kΩ
	0.50 mm	0.0197 in.	IDL — E_2	Less than 2.3 kΩ
	0.77 mm	0.0303 in.	IDL — E_2	Infinity
	Throttle valve fully opened position		VTA — E_2	3.3 — 10 kΩ
	—		Vcc — E_2	4 — 9 kΩ
Start injector time switch	Resistance	STA — STJ	30 — 50 Ω (below 10°C, 50°F) 70 — 90 Ω (above 25°C, 77°F)	
		STA — Ground	30 — 90 Ω	
Water temp. sensor	Resistance		10 — 20 kΩ (—20°C, —4°C) 4 — 7 kΩ (0°C, 32°F) 2 — 3 kΩ (20°C, 68°F) 0.9 — 1.3 kΩ (40°C, 104°F) 0.4 — 0.7 kΩ (60°C, 140°F) 0.2 — 0.4 kΩ (80°C, 176°F)	
VSV (FPU)	Resistance	at 20°C (68°F)	30 — 50 Ω	

Specifications (Cont'd)

Oxygen sensor heater	Resistance at 20°C (68°F)		5.1 — 6.3 Ω
EGR gas temp. sensor	Resistance		69.40 — 88.50 kΩ (50°C, 122°F) 11.89 — 14.37 kΩ (100°C, 212°F) 2.79 — 3.59 kΩ (150°C, 302°F)
Fuel cut rpm	Fuel cut rpm	M/T	1,300 rpm
		A/T	1,800 rpm
	Fuel return rpm	M/T	1,000 rpm
		A/T	1,500 rpm

ECU (Voltage)

NOTE:
- Perform all voltage and resistance measurements with the ECU connected.
- Verify that the battery voltage is 11 V or above when the ignition switch is ON.
- The testing probes must not make contact with the ECU oxygen V_F terminals.

Terminals	STD voltage	Condition	
BATT — E_1	10 — 14	—	
+B — E_1		Ignition SW ON	
$+B_1$ — E_1			
IDL — E_2 (E_{21})	8 — 14	Ignition SW ON	Throttle valve open
Vc — E_2 (E_{21})	4 — 6		—
VTA — E_2 (E_{21})	0.1 — 1.0		Throttle valve fully closed
	3 — 5		Throttle valve fully opened
Vc — E_2 (E_{21})	4 — 6	Ignition SW ON	—
Vs — E_2 (E_{21})	3.7 — 4.3		Measuring plate fully closed
	0.2 — 0.5		Measuring plate fully open
	2.3 — 2.8	Idling	
	0.3 — 1.0	3,000 rpm	
THA — E_2 (E_{21})	1 — 3	Ignition SW ON	Intake air temperature 20°C (68°F)
THW — E_2 (E_{21})	0.1 — 1.0		Coolant temperature 80°C (176°F)
STA — E_1	6 — 12	Ignition SW ST position	
No. 10 — E_{01} No. 20 — E_{02}	10 — 14	Ignition SW ON	
IGt — E_1	0.7 — 1.0	Cranking or idling	
W — E_1	10 — 14	No trouble (CHECK ENGINE light off) and engine running	
STJ — E_1	6 — 12	Ignition SW ST position	Coolant temperature 80°C (176°F)
STP — E_1	8 — 14	Stop light switch ON	

Specifications (Cont'd)

ECU (Resistance)	Terminals	Resistance (kΩ)	Condition
	IDL — E_2 (E_{21})	Infinity	Throttle valve open
		0 — 0.1	Throttle valve fully closed
	VTA — E_2 (E_{21})	3.3 — 10	Throttle valve fully open
		0.2 — 0.8	Throttle valve fully closed
	Vc — E_2 (E_{21})	4 — 9	Air flow meter connector disconnected
	THA — E_2 (E_{21})	2 — 3	Intake air temperature 20°C (68°F)
	THW — E_2 (E_{21})	0.2 — 0.4	Coolant temperature 80°C (176°F)
	+B — E_2 (E_{21})	0.2 — 0.4	—
	Vc — E_2 (E_{21})	0.1 — 0.3	Throttle position sensor connector disconnected
	Vs — E_2 (E_{21})	0.02 — 0.1	Measuring plate fully closed
		0.02 — 1.00	Measuring plate fully open
	Ne — E_1	0.14 — 0.18	—
	STJ — E_1	Infinity	—
	FPU — E_1	Infinity	—
	HT — E_1	Infinity	—

Torque Specifications

Part tightened	kg-cm	ft-lb	N·m
Cold start injector x Air intake chamber	80	69 in.-lb	7.8
Delivery pipe x Pulsation damper	400	29	39
Delivery pipe x Pressure regulator	300	22	29
Delivery pipe x Cold start injector tube	180	13	18
Delivery pipe x No. 3 fuel pipe	300	22	29
Delivery pipe x No. 2 fuel pipe	300	22	29
Delivery pipe x Intake manifold	130	9	13
Fuel line	310	22	30
Fuel pump	40	35 in.-lb	3.9
Fuel drain plug	65	56 in.-lb	6.4
Fuel tank x Body	300	22	29

COOLING SYSTEM

Radiator	Relief valve opening pressure	STD	0.75—1.05 kg/cm² 10.7—14.9 psi 74—103 kPa
		Limit	0.6 kg/cm² 8.5 psi 59 kPa
Thermostat	Valve opening temperature		
	Start to open at		82°C 180°F
	Fully open at		95°C 203°F
	Valve opening travel		More than 8 mm (0.31 in.)

LUBRICATION SYSTEM

Oil pressure (normal operating temperature)			
	at Idle speed		More than 0.3 kg/cm² (4.3 psi, 29 kPa)
	at 3,000 rpm		2.5—5.3 kg/cm² 36—75 psi 245—520 kPa
Oil pump	Body clearance	STD	0.10 — 0.13 mm 0.0039 — 0.0051 in.
		Limit	0.30 mm 0.0118 in.
	Tip clearance	STD	0.11 — 0.24 mm 0.0043 — 0.0094 in.
		Limit	0.35 mm 0.0138 in.
	Side clearance	STD	0.03 — 0.09 mm 0.0012 — 0.0035 in.
		Limit	0.15 mm 0.0059 in.
	Relief valve operating pressure		4.6—5.4 kg/cm² 65—77 psi 451—530 kPa

IGNITION SYSTEM

Spark plug	Type	ND	K16R-U
		NGK	BKR5EYA
	Gap		0.8 mm 0.031 in.
High-tension cord	Resistance	Limit	Less than 25 kΩ per cord
Ignition coil	Primary coil resistance		0.4 — 0.5 Ω
	Secondary coil resistance		10.2 — 13.8 kΩ
Distributor	Air gap		0.2 — 0.4 mm 0.008 — 0.016 in.
	Pick-up coil resistance	G_1 — G ⊖	140 — 180 Ω
		G_2 — G ⊖	140 — 180 Ω
		Ne — G ⊖	140 — 180 Ω

STARTING SYSTEM

Starter	Rated voltage and output power			12 V, 1.0 kW		12 V, 1.4 kW, 1.6 kW
	No-load characteristic		Current	Less than 90 A		Less than 90 A
			rpm	More than 3,000 rpm at 11.5 V		More than 3,500 rpm at 11.5 V
	Brush length		STD	13.5 mm	0.531 in.	15.5 mm 0.610 in.
			Limit	8.5 mm	0.335 in.	10.0 mm 0.394 in.
	Commutator	Outer diameter	STD	30 mm	1.18 in.	←
			Limit	29 mm	1.14 in.	←
		Undercut depth	STD	0.6 mm	0.024 in.	←
			Limit	0.2 mm	0.008 in.	←
		Circle runout	Limit	0.05 mm	0.0020 in.	←
	Spring installed load		STD	1,785 — 2,415 g (3.9—5.3 lb, 18—24 N)		←
			Limit	1.2 kg (2.6 lb, 12 N)		←

CHARGING SYSTEM

Battery specific gravity				
When fully charged at 20°C (68°F)			55D23R	1.25 — 1.27
			80D26R	1.27 — 1.29
Alternator	Rated output ampere			60 A
	Brush exposed length		STD	10.5 mm 0.413 in.
			Limit	1.5 mm 0.059 in.
	Rotor coil resistance			2.8 — 3.0 Ω
	Slip ring diameter		STD	14.2 — 14.4 mm 0.559 — 0.567 in.
			Limit	12.8 mm 0.504 in.
Alternator regulator	Regulator voltage	at 25°C (77°F)		13.9 — 15.1 V
		at 115°C (239°F)		13.5 — 14.3 V

LUBRICANT

Item	Capacity			Classification
	Liters	US qts	Imp. qts	
Engine oil				API grade SG multigrade, fuel efficient and recommended viscosity oil
Drain and refill				
w/o Oil filter change	4.2	4.4	3.7	
w/ Oil filter change	4.5	4.8	4.0	
Dry fill	5.3	5.6	4.7	

Torque Specifications

Part tightened	kg-cm	ft-lb	N·m
Adaptor × Reduction gear case	400	29	39
Reduction gear case × Front case × Rear case	400	29	39
Rear case × Extension housing	400	29	39
Front case × Rear case	400	29	39
Reduction case × Front case	400	29	39
Reduction case × Transfer case cover	90	78 in-lb.	8.8
Output shaft × Companion flange	1,250	90	123
Front drive gear bearing retainer × Front case	185	13	18
Front case × Bearing retainer	185	13	18
Straight screw plug	120	9	12
Transfer indicator switch	350	25	34
Speedometer driven gear lock plate	115	8	11

TRANSFER (Planetary Gear Type Tansfer/G58, R150F)

Specifications

Oil pump body	Body clearance	STD	0.10 — 0.16 mm	0.0039 — 0.0063 in.
		Limit	0.16 mm	0.0063 in.
	Tip clearance	STD	0.08 — 0.16 mm	0.0031 — 0.0063 in.
		Limit	0.16 mm	0.0063 in.
	Side clearance	STD	0.03 — 0.08 mm	0.0012 — 0.0031 in.
		Limit	0.08 mm	0.0031 in.
Rear output shaft assembly	Drive sprocket thrust clearance	STD	0.10 — 0.25 mm	0.0039 — 0.0098 in.
		Limit	0.25 mm	0.0098 in.
	Driven sprocket oil clearance	STD	0.010 — 0.055 mm	0.0004 — 0.0022 in.
		Limit	0.055 mm	0.0022 in.
	Rear output shaft journal diameter			
	Part A	Limit	27.98 mm	1.1016 in.
	Part B	Limit	36.98 mm	1.4559 in.
	Front drive shift fork to hub sleeve clearance	Limit	1.0 mm	0.039 in.
	High and low shift fork to hub sleeve clearance	Limit	1.0 mm	0.039 in.
	Rear output shaft snap ring thickness			
		Mark		
		A	2.10 — 2.15 mm	0.0827 — 0.0846 in.
		B	2.15 — 2.20 mm	0.0846 — 0.0866 in.
		C	2.20 — 2.25 mm	0.0866 — 0.0886 in.
		D	2.25 — 2.30 mm	0.0886 — 0.0906 in.
		E	2.30 — 2.35 mm	0.0906 — 0.0925 in.
		F	2.35 — 2.40 mm	0.0925 — 0.0945 in.
		G	2.40 — 2.45 mm	0.0945 — 0.0965 in.
		H	2.45 — 2.50 mm	0.0965 — 0.0984 in.
		J	2.50 — 2.55 mm	0.0984 — 0.1004 in.
		K	2.00 — 2.05 mm	0.0787 — 0.0807 in.
		L	2.05 — 2.10 mm	0.0807 — 0.0827 in.

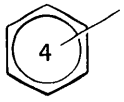
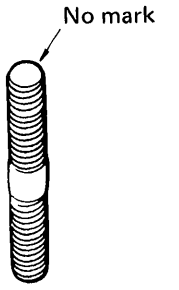
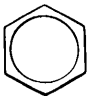
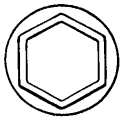
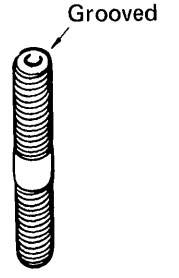
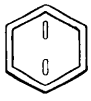
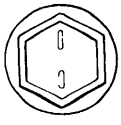
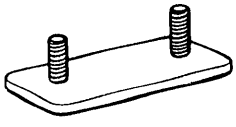
Specifications (Cont'd)

Input shaft	Input shaft journal outer diameter	Limit	47.59 mm	1.8736 in.
	Input shaft bushing diameter	Limit	39.14 mm	1.5409 in.
	Synchronizer ring to sprocket clearance			
		STD	1.15 — 1.85 mm	0.0453 — 0.0728 in.
		Limit	0.8 mm	0.0031 in.
	Input shaft snap ring thickness	Mark		
		A	2.10 — 2.15 mm	0.0827 — 0.0846 in.
		B	2.15 — 2.20 mm	0.0846 — 0.0866 in.
		C	2.20 — 2.25 mm	0.0866 — 0.0886 in.
		D	2.25 — 2.30 mm	0.0886 — 0.0906 in.
		E	2.30 — 2.35 mm	0.0906 — 0.0925 in.
		F	2.35 — 2.40 mm	0.0925 — 0.0945 in.
		G	2.40 — 2.45 mm	0.0945 — 0.0965 in.
		H	2.45 — 2.50 mm	0.0965 — 0.0984 in.
		J	2.50 — 2.55 mm	0.0984 — 0.1004 in.
		K	2.55 — 2.60 mm	0.1004 — 0.1024 in.
		L	2.60 — 2.65 mm	0.1024 — 0.1043 in.
		M	2.65 — 2.70 mm	0.1043 — 0.1063 in.
		N	2.70 — 2.75 mm	0.1063 — 0.1083 in.
		P	2.75 — 2.80 mm	0.1083 — 0.1102 in.
		Q	2.80 — 2.85 mm	0.1102 — 0.1122 in.
		R	2.85 — 2.90 mm	0.1122 — 0.1142 in.
		S	2.90 — 2.95 mm	0.1142 — 0.1161 in.
		T	2.95 — 3.00 mm	0.1161 — 0.1181 in.
		U	3.00 — 3.05 mm	0.1181 — 0.1201 in.
Planetary gear	Pinion gear thrust clearance	STD	0.11 — 0.86 mm	0.0043 — 0.0339 in.
		Limit	0.86 mm	0.0339 in.
	Pinion gear oil clearance	STD	0.009 — 0.038 mm	0.0004 — 0.0015 in.
		Limit	0.038 mm	0.0015 in.
	Outer bearing snap ring thickness			
		Mark		
		1	1.45 — 1.50 mm	0.0571 — 0.0591 in.
		2	1.50 — 1.55 mm	0.0591 — 0.0610 in.
		3	1.55 — 1.60 mm	0.0610 — 0.0630 in.
		4	1.60 — 1.65 mm	0.0630 — 0.0650 in.
		5	1.65 — 1.70 mm	0.0650 — 0.0669 in.
	Inner bearing depth		5.0 — 5.6 mm	0.197 — 0.220 in.
Oil seal	Speedometer driven gear oil seal depth		25 mm	0.98 in.
	Shift fork shaft oil seal depth		−0.5 — 0.5 mm	−0.020 — 0.020 in.

STANDARD BOLT TORQUE SPECIFICATIONS

STANDARD BOLT TORQUE SPECIFICATIONS

HOW TO DETERMINE BOLT STRENGTH

	Mark	Class		Mark	Class
Hexagon head bolt	 Bolt head No. 4– 5– 6– 7–	4T 5T 6T 7T	Stud bolt	 No mark	4T
	 No mark	4T			
Hexagon flange bolt w/ washer hexagon bolt	 No mark	4T		 Grooved	6T
Hexagon head bolt	 Two protruding lines	5T			
Hexagon flange bolt w/ washer hexagon bolt	 Two protruding lines	6T	Welded bolt		4T
Hexagon head bolt	 Three protruding lines	7T			

SPECIFIED TORQUE FOR STANDARD BOLTS

Class	Diameter mm	Pitch mm	Specified torque					
			Hexagon head bolt			Hexagon flange bolt		
			kg-cm	ft-lb	N·m	kg-cm	ft-lb	N·m
4T	6	1	55	48 in.-lb	5.4	60	52 in.-lb	5.9
	8	1.25	130	9	13	145	10	14
	10	1.25	260	19	25	290	21	28
	12	1.25	480	35	47	540	39	53
	14	1.5	760	55	75	850	61	83
	16	1.5	1,150	83	113		–	
5T	6	1	65	56 in.-lb	6.4		–	
	8	1.25	160	12	16		–	
	10	1.25	330	24	32		–	
	12	1.25	600	43	59		–	
	14	1.5	930	67	91		–	
	16	1.5	1,400	101	137		–	
6T	6	1	80	69 in.-lb	7.8	90	78 in.-lb	8.8
	8	1.25	195	14	19	215	16	21
	10	1.25	400	29	39	440	32	43
	12	1.25	730	53	72	810	59	79
	14	1.5		–		1,250	90	123
7T	6	1	110	8	11	120	9	12
	8	1.25	260	19	25	290	21	28
	10	1.25	530	38	52	590	43	58
	12	1.25	970	70	95	1,050	76	103
	14	1.5	1,500	108	147	1,700	123	167
	16	1.5	2,300	166	226		–	