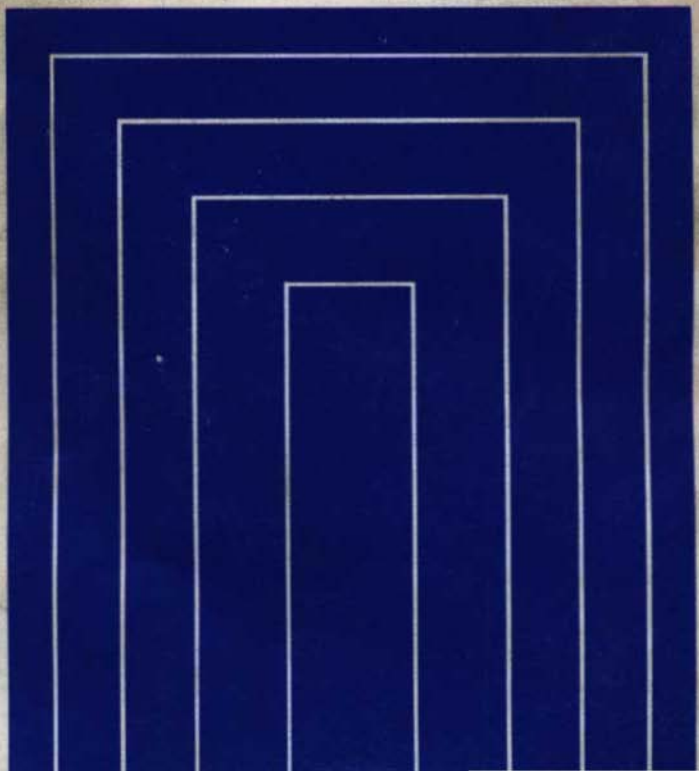
TOYOTA

4A-F, 4A-GE

ENGINE

REPAIR MANUAL

May, 1987



Pub.No.RM063

HOW TO USE THIS MANUAL

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

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

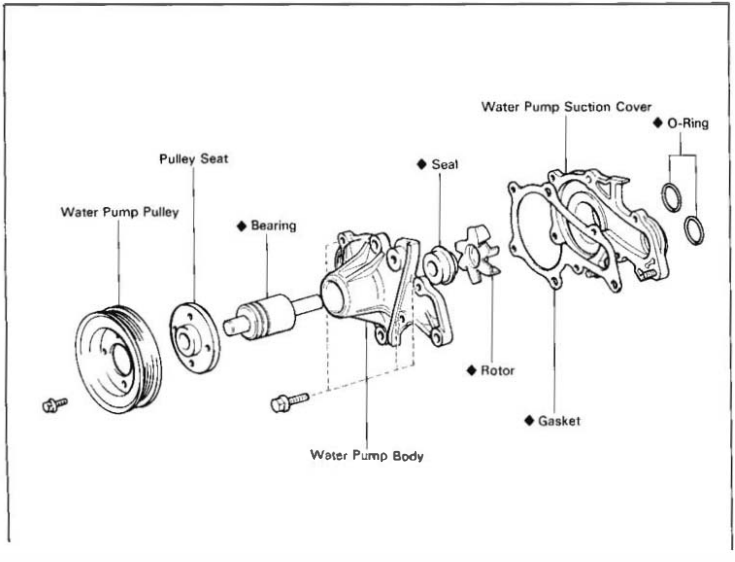
At the beginning of each section, **PRECAUTIONS** are given that pertain to *all* repair operations contained in that section. *Read these precautions before starting any repair task.*

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

REPAIR PROCEDURES

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

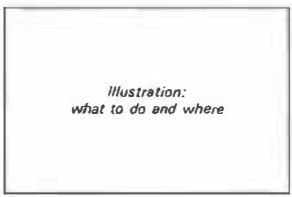
Example:



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

3. DISCONNECT CONNECTING ROD FROM PISTON

Using SST, press out the pin from the piston.

SST 09221-25022
(09221-00050, 09221-00130, 09221-00140)

Set part No. *Component part No.*

Detail text: how to do it

(d) Install and alternately tighten the cap nuts in several passes.

Torque: 500 kg-cm (36 ft-lb, 49 N·m)

Specification

This format provides the experienced technician with a FAST TRACK to the information needed. He can read the task headings and only refer to the detailed text when he needs it. 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 go to.

SPECIFICATIONS

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

WARNINGS, CAUTIONS, NOTES:

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

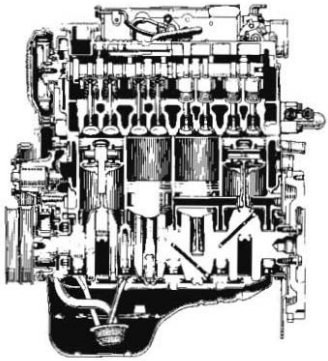
ABBREVIATIONS USED IN THIS MANUAL

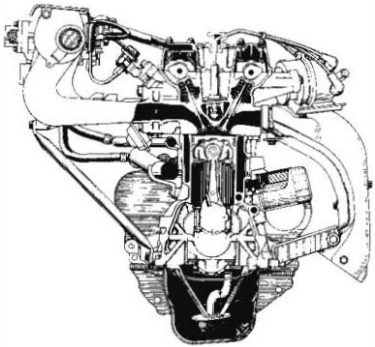
AAP	Auxiliary Acceleration Pump
A/C	Air Conditioner
AS	Air Suction
A/T	Automatic Transmission
BTDC	Before Top Dead Center
CB	Choke Breaker
DP	Dash Pot
ECU	Electronic Controlled Unit
EFI	Electronic Fuel Injection
EGR	Exhaust Gas Recirculation
ESA	Electronic Spark Advance
EX	Exhaust (manifold, valve)
Ex.	Except
FIPG	Formed in Place Gasket
HIC	Hot Idle Compensation
HAI	Hot Air Intake
IG	Ignition
IIA	Integrated Ignition Assembly
IN	Intake (manifold, valve)
ISC	Idle Speed Control
LH	Left-hand
LHD	Left-hand Drive
LLC	Long Life Coolant (Year Around Coolant)
MP	Multipurpose
M/T	Manual Transmission
O/S	Oversized
PCV	Positive Crankcase Ventilation
RH	Right-hand
RHD	Right-hand Drive
RON	Research Octane Number
PS	Power Steering
SSM	Special Service Materials
SST	Special Service Tools
STD	Standard
S/W	Switch
TDC	Top Dead Center
TP	Throttle Positioner
T-VIS	TOYOTA-Variable Induction System
TVSV	Thermostatic Vacuum Switching Valve
TWC	Three-way Catalyst
U/S	Undersized
VSV	Vacuum Switching Valve
w/	With
w/o	Without

DESCRIPTION

4A-GE ENGINE

The 4A-GE engine is an in-line 4-cylinder 1.6 liter DOHC 16 valve engine.





EM4623
EM4624

The 4A-GE engine is an in-line 4-cylinder engine with the cylinders numbered 1-2-3-4 from the front. The crankshaft is supported by 5 bearings specified by the inside of the crankcase. These bearings are made of aluminum alloy.

The crankshaft is integrated with 8 weights which are cast along with it for balancing. Oil holes are built into the center of the crankshaft for supplying oil to the connecting rods, pistons and other components.

This engine's 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 in the center of the combustion chambers.

The intake manifold has 8 independent long ports and utilizes the inertial supercharging effect to improve engine torque at low and medium speeds.

Exhaust and intake valves are equipped with irregular pitch springs made of oil tempered silicon chrome steel wire which are capable of following the valves even at high engine speeds.

Both the exhaust side cam shaft and the intake side cam shaft 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. Lubrication of the cam journal and cam is accomplished by oil being 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, in which valve adjusting shims are located above the valve lifters. This permits replacement of the shims without removal of the camshafts.

The resin timing belt cover is made in 3 pieces. A service hole is provided in the No.2 belt cover for adjusting the timing belt tension.

Pistons are made of highly temperature-resistant aluminum alloy, 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 piston boss nor the connecting rods. Instead, snap rings are fitted on both ends of the pins, preventing the pins from falling out.

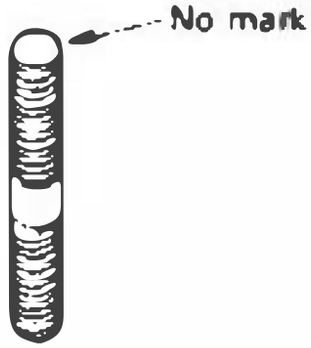
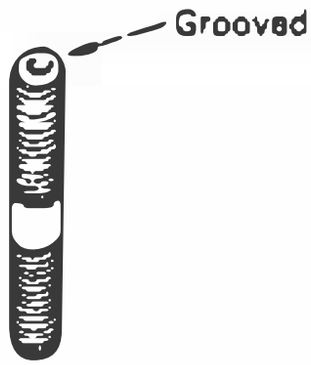
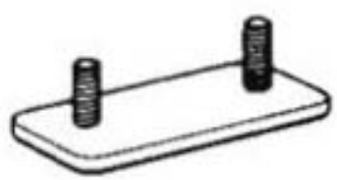
The No.1 compression ring is made of steel and the No.2 compression ring is made of cast iron. The oil ring is made of a combination of steel and stainless steel. The outer diameter of each piston ring is slightly largar than the diameter of the piston and the flexibility of the rings allows them to hug the cylinder walls when they are mounted on the piston. Compression rings No.1 and No.2 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 chamber.

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 the lower end of the cylinders becomes the crankcase, in which the crankshaft is installed. 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. This dividing plate also prevents the oil from making waves when the vehicle is stopped suddenly and thus shifting the oil away from the oil pump suction pipe.

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			

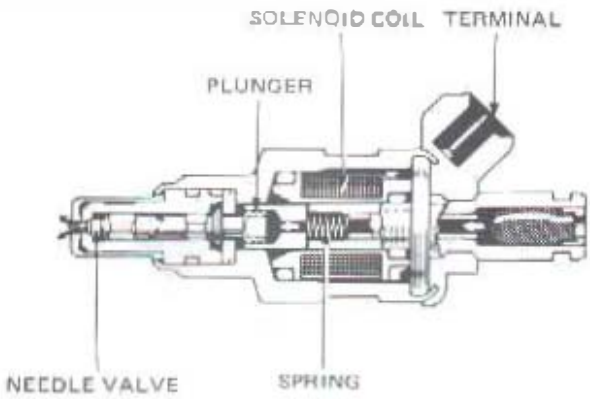
SPECIFIED TORQUE FOR STANDARD BOLTS

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		–	
6T	8	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		–	

FUEL SYSTEM

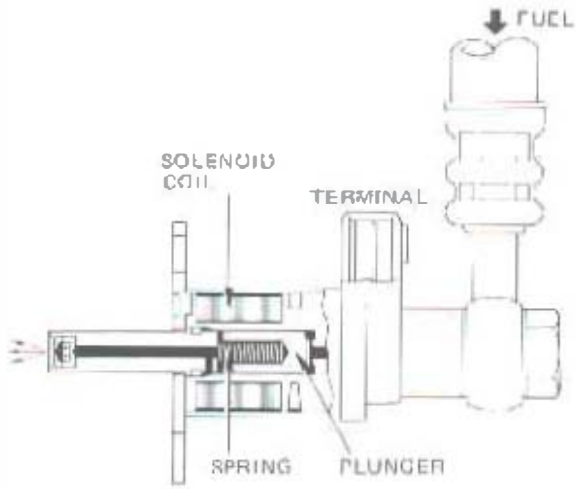
● INJECTOR ● COLD START INJECTOR

INJECTOR



The injector performs the injection of fuel in accordance with a computercalculated injection signal. When a pulse from the computer is received by the solenoid coil, the plunger is pulled against spring tension. Since the needle valve and plunger are a single unit, the valve is also pulled off of the seat and fuel is injected as shown by the arrows. Because the needle valve stroke is fixed, injection continues as long as the needle valve is open and fuel volume is controlled by the duration of the electrical pulse.

COLD START INJECTOR



A cold start injector, installed in the center area of the air distribution chamber, is provided to improve starting when the engine is cold.

This injector functions in accordance with directions from the start injector time switch and only during engine cranking when the coolant temperature is below 35° C.

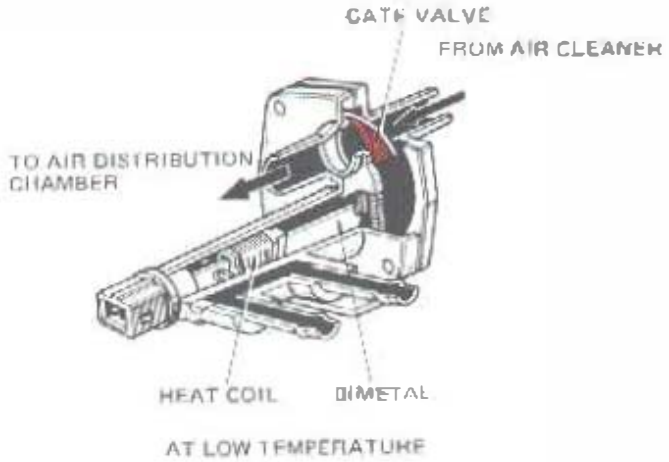
The injector tip employs a special design to improve mist spray.

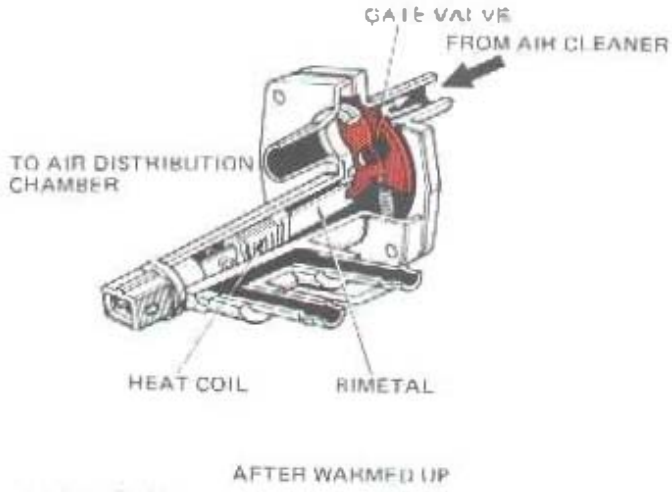
When the start injector time switch signal is applied to the solenoid coil, the plunger is pulled against spring tension. Thus, the valve will open and fuel will flow over the plunger and through the injector tip. Once the engine has been started, current to the start injector is cut off and injection is terminated.

AIR INDUCTION SYSTEM

● AIR VALVE

AIR VALVE





The air valve is a fast idle device operated by a bimetal and heat coil to increase engine rpm when the engine is cold.

OPERATION

When starting a cold engine, the gate valve is open allowing air from the air cleaner to bypass the throttle valve and flow directly through the air valve to the air intake chamber.

Thus, even though the throttle valve is in the closed position, intake air volume is increased and idle speed will be slightly faster than normal (fast idle).

When the engine is started, current begins to flow to the heat coil. As the bimetal is heated, the gate valve will gradually close and engine rpm will decrease.

Once warmed up, the gate valve will be fully closed, preventing air flow, and idle speed will return to normal.

CHARGING SYSTEM

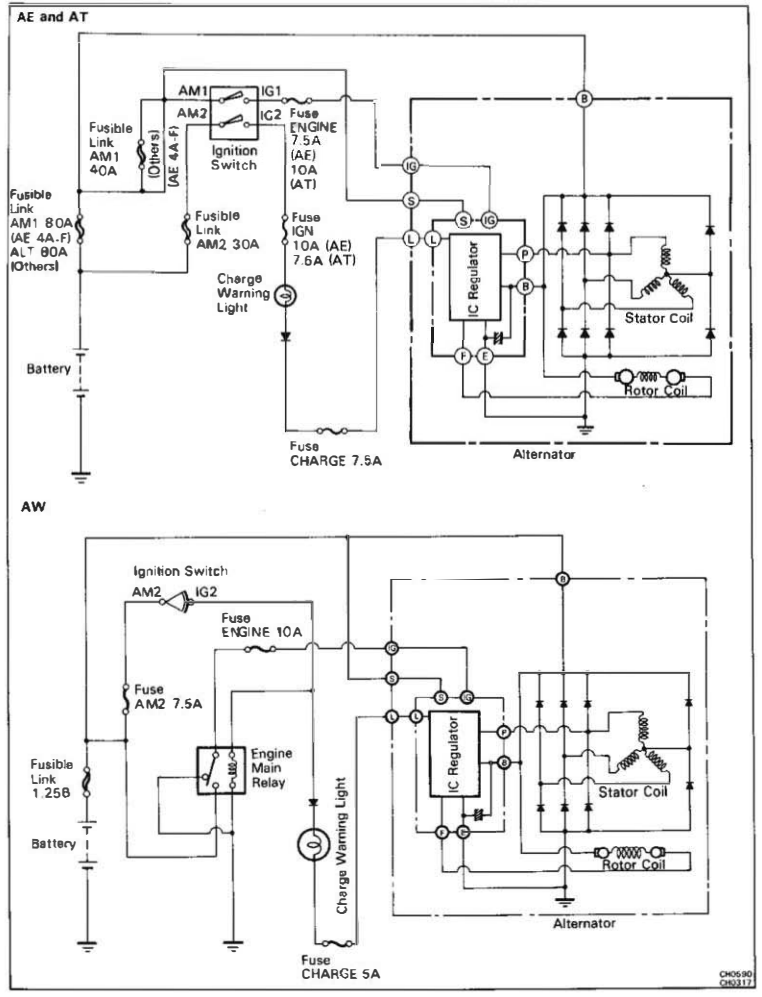
PRECAUTIONS

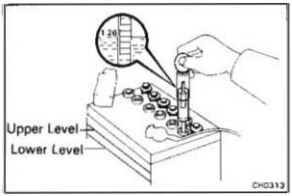
1. **Check that the battery cables are connected to the correct terminals.**
2. **Disconnect the battery cables when the battery is given a quick charge.**
3. **Do not perform tests with a high voltage insulation resistance tester.**
4. **Never disconnect the battery while the engine is running.**

TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Discharge warning light does not light with ignition ON and engine off	Fuse blown	Check "CHARGE" and "IGN" (AE and AT) or "AM2" (AW) fuses	
	Light burned out	Replace light	
	Wiring connection lose	Tighten loose connections	
	IC regulator faulty	Replace IC regulator	CH-7
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-4
	Battery cables loose, corroded or worn	Repair or replace cables	
	Fuse blown	Check "CHARGE" or "ENGINE" fusa	
	Fusible link blown	Replace fusible link	
	IC regulator or alternator faulty	Check charging system	CH-3
	Wiring faulty	Repair wiring	

CHARGING CIRCUIT





ON-VEHICLE INSPECTION

1. INSPECT BATTERY SPECIFIC GRAVITY AND ELECTROLYTE LEVEL

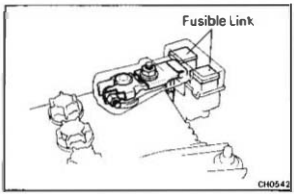
(a) Check the specific gravity of each cell.

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

If not within specifications, charge the battery.

(b) Check the electrolyte quantity of each cell.

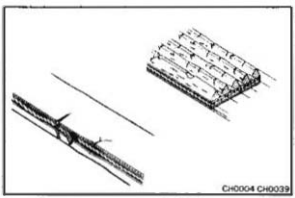
If insufficient, refill with distilled (or purified) water.



2. CHECK BATTERY TERMINALS AND FUSIBLE LINKS

ia) Check that the battery terminals are not loose or corroded.

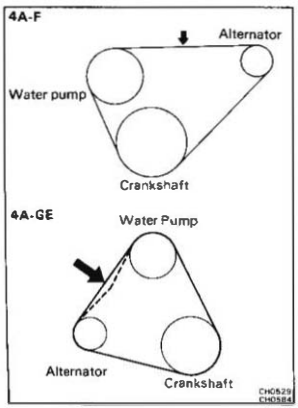
Ib) Check the fusible links for continuity.



3. INSPECT DRIVE BELT

(e) Visually check the belt for separetion 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 of worn ribs or cracks in the inner ridges of the ribs.

If the belt has any of the above defects, replace it.



(b) Check the drive belt deflection of pressing on the belt at the points indicated in the figure with 10 kg (22.0 lb, 98 N) pressure.

Drive belt deflection:

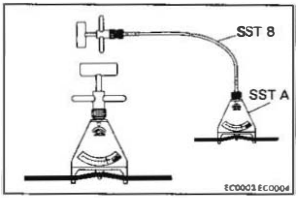
4A-F

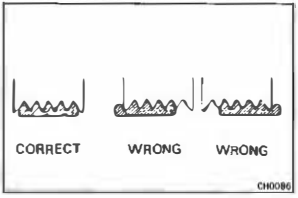
New belt 8.5 — 10.5 mm (0.335 — 0.413 in.)
Used belt 10.0 — 12.0 mm (0.39 — 0.47 in.)

4A-GE

New belt 4 — 5 mm (0.16 — 0.20 in.)
Used belt 6 — 7 mm (0.24 — 0.28 in.)

If necessary, adjust the drive belt deflection.





(Reference)
Using SST, check the drive belt tension.

SST A 09216-00020
SST 8 09216-00030

Drive belt tension:

4A-F

New belt	60 — 70 kg
Used belt	40 — 55 kg

4A-GE

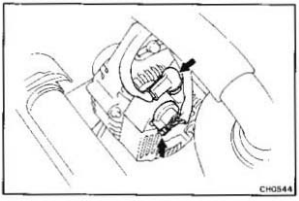
New belt	70 — 80 kg
Used belt	30 — 45 kg

NOTE:

- "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 the balt, run the engine for approx. 5 minutes and recheck the deflection or tension.

4. CHECK FUSES FOR CONTINUITY

- **CHARGE 7.5A (AE and AT), 6A (AW)**
- **IGN 10A (AE), 7.6A (AT)**
- **ENGINE 7.5A (AE), 10A (AT and AW)**
- **AM2 7.6A (AW)**



5. VISUALLY CHECK ALTERNATOR WIRING AND LISTEN FOR ABNORMAL NOISES

(a) Check that the wring 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

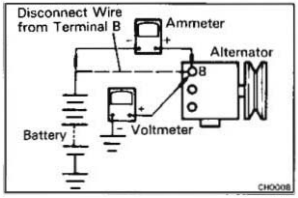
(a) Warm up the engine and turn it off.

(b) Turn off all accessories.

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

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

If the light does not operate as specified, troubleshoot the warning light circuit.

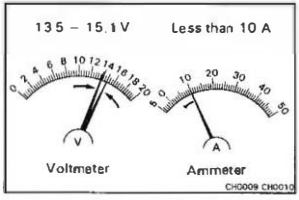


7. CHECK CHARGING CIRCUIT WITHOUT LOAD

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

(a) If a tester is not available, connect a voltmeter and ammeter to the charging circuit as follows:

- Disconnect the wire from terminal B of the alternator and connect the wire to the negative (–) terminal of the ammetar.
- 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.

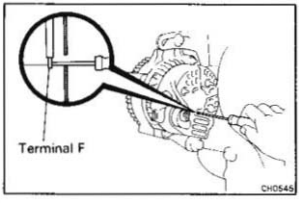


(b) Check the charging circuit as follows:

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

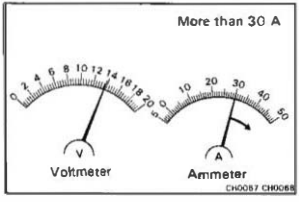
Standard amperage: Less than 10 A
Standard voltage: 13.9 – 15.1 V at 25°C (77°F)
13.5 – 14.3 V at 115°C (239°F)

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.

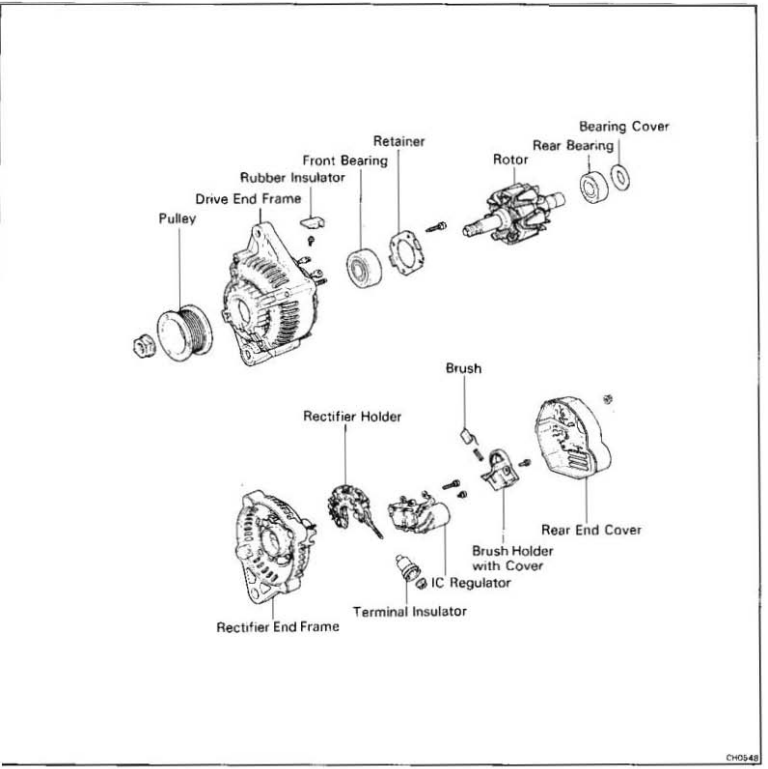
Standard amperage: More than 30 A

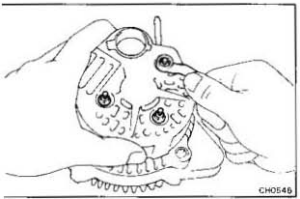
If the ammeter reading is less than 30 A, repair the alternator. (See page CH-7)

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

ALTERNATOR

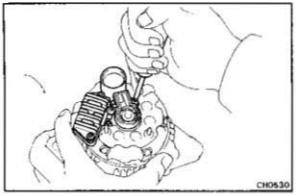
COMPONENTS





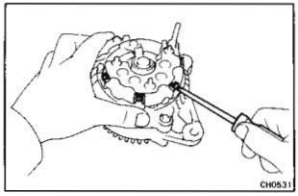
DISASSEMBLY OF ALTERNATOR

1. **REMOVE REAR END COVER**
   (a) Remove the nut and terminal insulator.
   (b) Remove the three nuts and end cover.



2. REMOVE BRUSH HOLDER AND IC REGULATOR

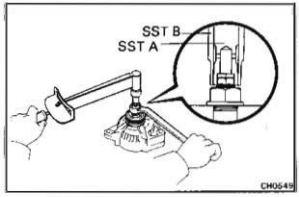
Remove the five screws, brush holder and IC regulator.



3. REMOVE RECTIFIER HOLDER

(a) Remove the four screws and rectifier holder.

(b) Remove the four rubber insulators.



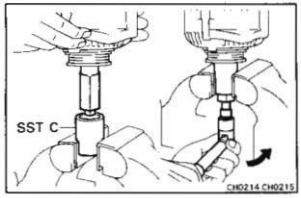
4. REMOVE PULLEY

(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.

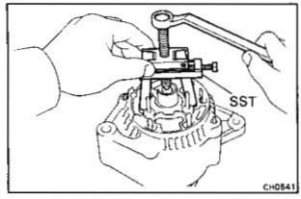
(d) To loosen the pulley nut turn SST A in the direction shown in the figure.

CAUTION: 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.



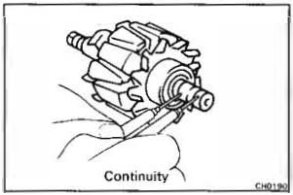
5. REMOVE RECTIFIER END FRAME

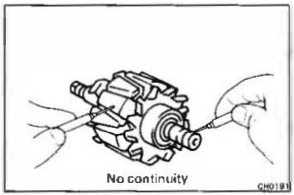
(a) Remove the four nuts.

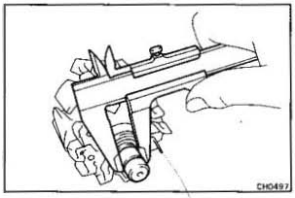
(b) Using SST, remove the rectifier end frame.

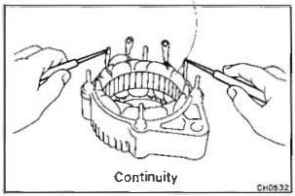
SST 09286-46011

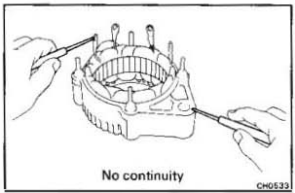
6. REMOVE ROTOR FROM DRIVE END F AME











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.

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.

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 — 0.667 in.)

Minimum diameter: 14.0 mm (0.551 in.)

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

Stator

1. INSPECT STATOR FOR OPEN CIRCUIT

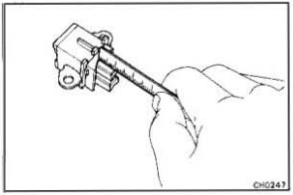
Using an ohmmeter, check that there is continuity between the coil leads.

If there is no continuity, replace the drive end frame assembly.

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.

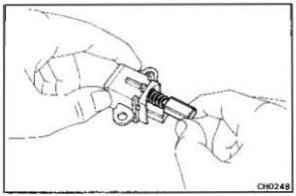


Brushes

1. **MEASURE EXPOSED BRUSH LENGTH**

Minimum exposed length: 4.5 mm (0.177 in.)

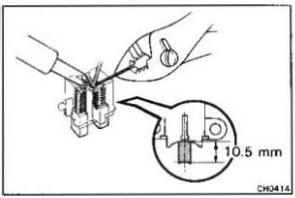
If the brush length is less than minimum, replace the brushes.



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.

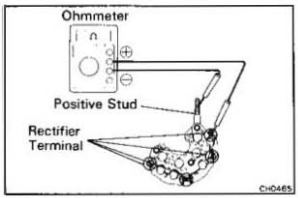
(e) Cut off the excess wire.

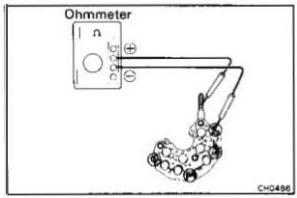
(f) Apply insulation paint to the soldered point.

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.

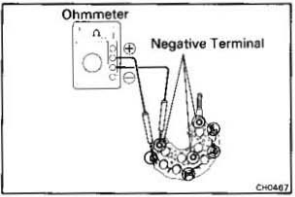




(b) Reverse the polarity of the tester probes.

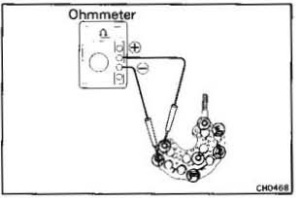
(c) Check that one shows continuity and the other shows no continuity.

If not, replace the rectifier holder.



2. **INSPECT NEGATIVE SIDE RECTIFIER**

(a) Connect one tester probe to each rectifier terminal and the other to eech rectifier negative terminal.

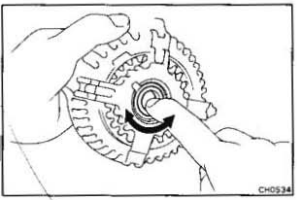


(b) Reverse the polarity of the tester probes.

(c) Check that one shows continuity and the other shows no continuity.

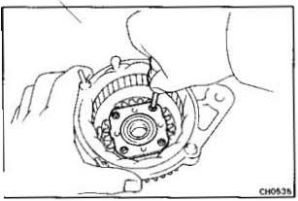
If not, replace the rectifier holder.

Bearings



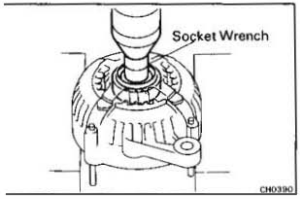
1. **INSPECT FRONT BEARING**

Check that the bearing is not rough or worn.

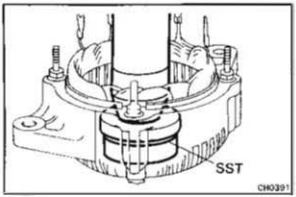


2. **IF NECESSARY, REPLACE FRONT BEARING**

(a) Remove the four screws and bearing retainer.

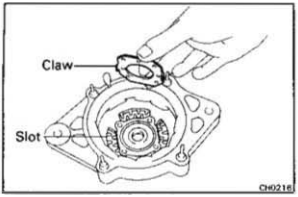


(b) Using a press end socket wrench, press out the front bearing.



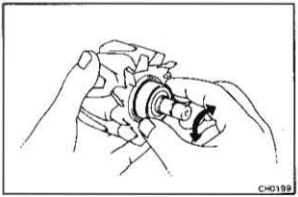
(c) Using SST and a press, press in a new front bearing into the drive end frame.

SST 09608-20012 (09608-00030)



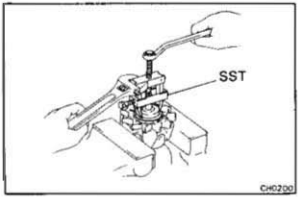
(d) Align the claws of the bearing retainer with the slots of the drive end frame.

(e) Install the bearing retainer with the four screws.



3. INSPECT REAR BEARING

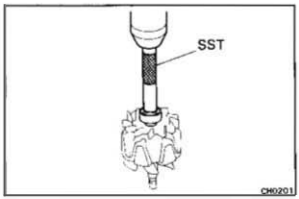
Check that the bearing is not rough or worn.



4. IF NECESSARY, REPLACE REAR BEARING

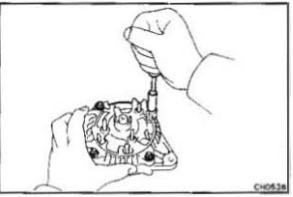
(a) Using SST, remove the bearing cover and bearing.

SST 09820-00021



(b) Using SST and a press, press in a new bearing and the bearing cover.

SST 09285-76010



ASSEMBLY OF ALTERNATOR

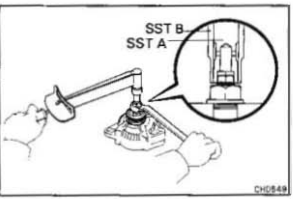
(See page CH-7)

1. **INSTALL ROTOR TO DRIVE END FRAME**

2. **INSTALL RE TIFIER END FRAME**

   (a) Using a plastic-faced hammer, lightly tap in the end frame.

   (b) Install the four nuts.



3. **INSTALL PULLEY**

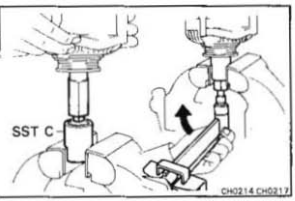
   (a) Install the pulley to the rotor shaft by tightening the pulley nut by hand.

   (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.



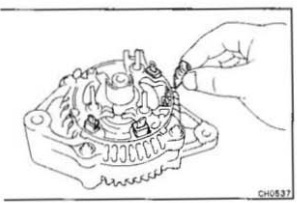
   (d) As shown in the figure, mount SST C in a vise, and install the alternator to SST C.

   (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)

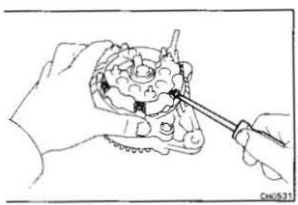
   (f) Remove the alternator from SST C.

   (g) Turn SST B and remove SSTs A and B.

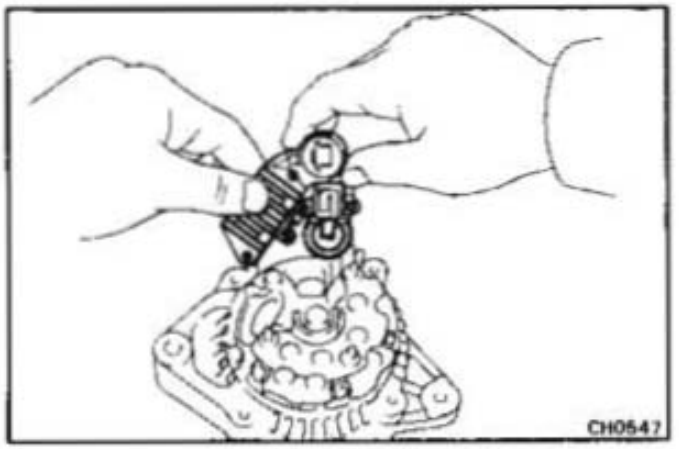


4. **INSTALL RECTIFIER HOLDER**

   (a) Install the four rubber insulators on the lead wires.



   (b) Instal the rectifier holder with the four screws.

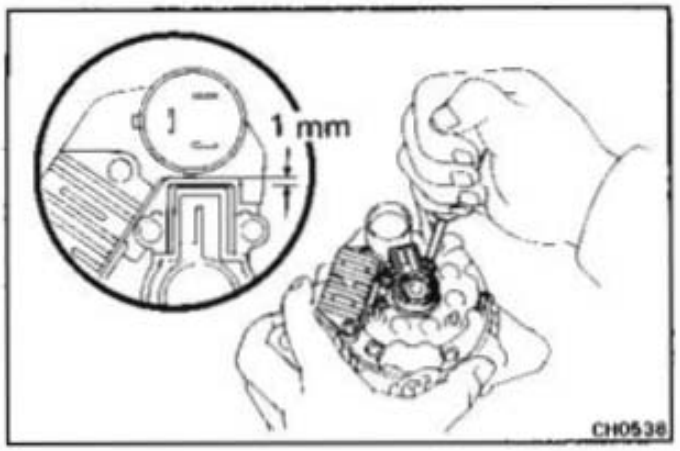


5. INSTALL BRUSH HOLDER AND IC REGULATOR

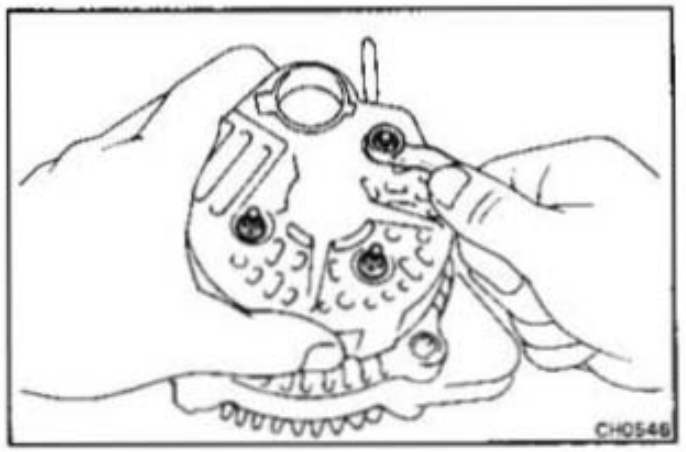
(a) Place the brush holder cover to the brush holder

(b) Install the IC regulator and brush holder to the rear end frame horizontally as shown in the figure.

NOTE: Make sure the brush holder's cover doesn't slip to one side during installation.



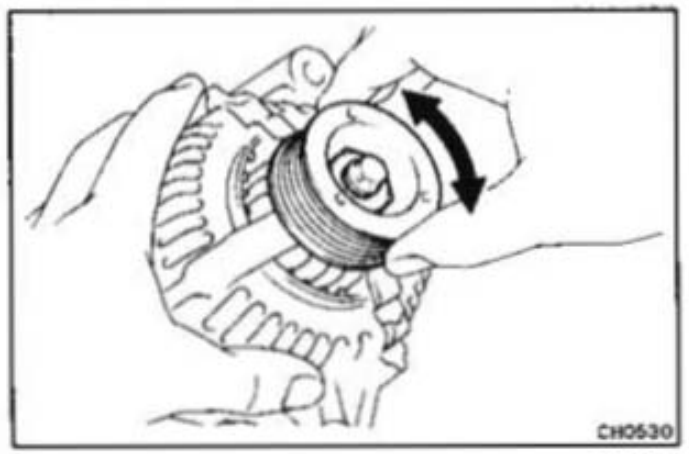
(c) Tighten the five screws until there is a clearance of at least 1 mm (0.04 in.) between the brush holder cover and connector.



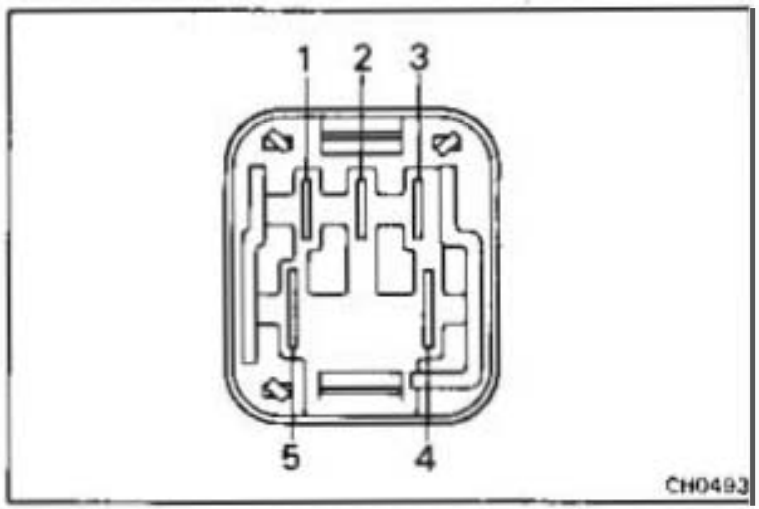
6. INSTALL REAR END COVER

(a) Install the end cover with the three nuts.

(b) Install the terminal insulator with the nut.



7. MAKE SURE ROTOR ROTATES SMOOTHLY

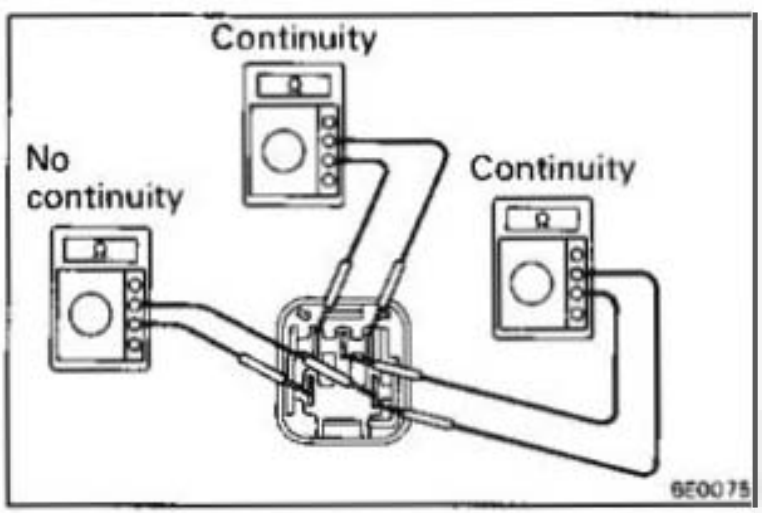


ENGINE MAIN RELAY

INSPECTION OF ENGINE MAIN RELAY

LOCATON:

AE and AT	In the engine compartment relay box.
AW	In the No.5 junction block of the front luggage compartment.



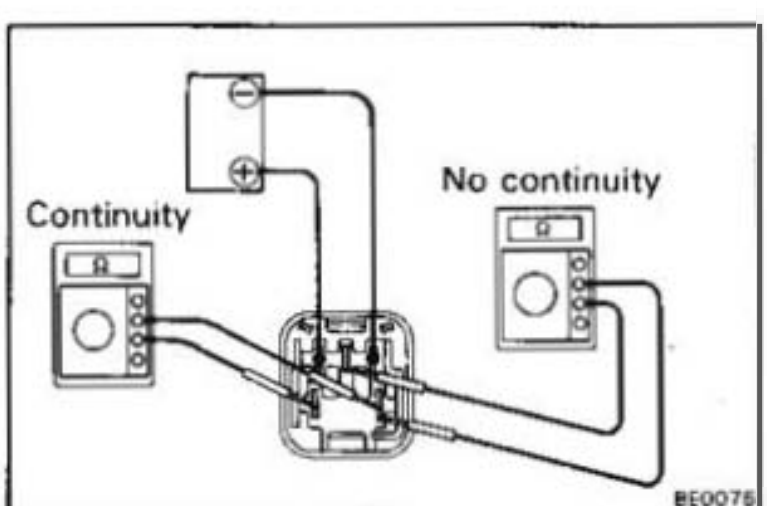
1. INSPECT RELAY CONTINUITY

(a) Using an ohmmeter, check that there is continuity between terminals 1 and 3.

(b) Check that there is continuity between terminals 2 and 4.

(c) Check that there is no continuity between terminals 4 and 5.

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 4 and 5.

(c) Check that there is no continuity between terminals 2 and 4.

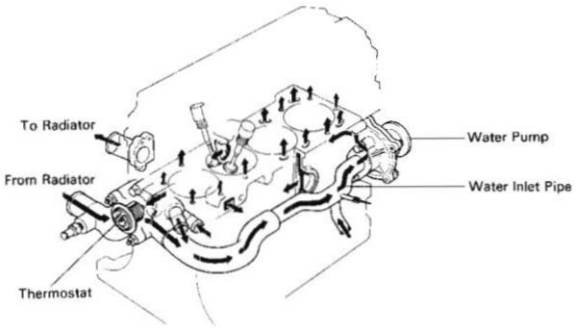
If operation is not as specified, replace the relay.

COOLING SYSTEM

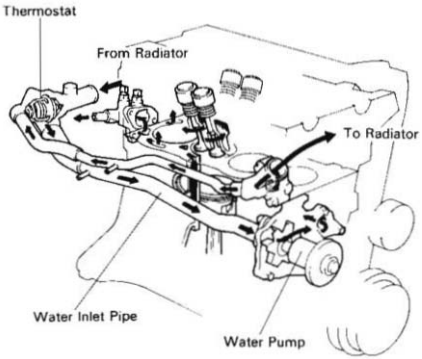
DESCRIPTION

This engine utilizes a pressurized water forced circulation cooling system which includes a thermostat equipped with a bypass valve mounted on the inlet side.

4A-F



4A-GE



The cooling system is composed of the water jacket (inside the cylinder block and cylinder head), radiator, water pump, thermostat, electric fan, hoses and other components.

Coolant which is heated in the water jacket is pumped to the radiator, through which an electric fan blows air to cool the coolant as it passes through. 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 are combustion chambers which become the hottest during engine operation.

RADIATOR

Ex. MR2

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 filter 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 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. The air sucked through the radiator by the electric fan, as well as the wind generated by the vehicle's travel, passes through the radiator, cooling it. Models with automatic transmissions include an automatic transmission fluid cooler built into the lower tank of the radiator. A fan with an electric motor is mounted behind radiator to assist the flow of air through the radiator. The fan operates when the coolant temperature becomes high in order to prevent it from becoming too high.

MR2

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 in the MR2 is different from that in other models, in that it is a cross flow type in which the coolant flows horizontally. It includes side tanks and a core which connects them. The inlet for coolant from the water jacket and the drain cock for draining out coolant are located in the left side tank. The outlet for coolant and an air drain, which facilitates the supply of coolant to the engine, are located in the right side tank. The core contains many tubes through which coolant flows from the left side tank to the right-side tank as well as cooling fins which radiate heat away from the coolant in the tubes. Air sucked in by the electric fan, as well as the wind generated by the vehicle's travel, passes through the radiator, cooling the coolant heated by the water jacket as it passes through the tubes in the core. Models with automatic transmission include an automatic transmission fluid cooler incorporated into the cooling pipes. A fan with an electric motor is mounted behind the radiator to assist the flow of air through the radiator. The fan operates when the coolant temperature becomes high in order to prevent it from becoming too high. The radiator cap is the same as those used with ordinary vehicles, but due to the layout of the MR2, it is located on a coolant pipe in the engine space.

RADIATOR CAP

The radiator cap is a pressure type can which seals the radiator, resulting in pressurization of the radiator as the coolant expends. 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 through the overflow pipe 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/cm², 4.3 – 14.2 psi, 29.4 – 98.1 kPa). The vacuum valve opens to alleviate the vacuum which develops in the coolant system after the engine is stopped and the coolant temperature drops. The valve's opening allows the pressure in the cooling system to return to the coolant in the reservoir tank.

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. The coolant in the reservoir tank returns to the radiator when the coolant temperature drops, thus keeping the radiator full at all times and avoiding needless coolant loss. Check the reservoir tank level to learn if the coolant needs to be replenished.

WATER PUMP

The water pump is used for forced circulation of coolant through the cooling system. It is mounted on the front of the cylinder block and driven by a V-ribbed belt.

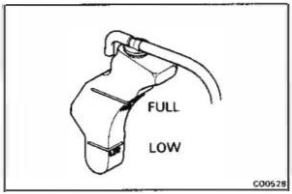
THERMOSTAT

The thermostat has a wax type bypass valve and is mounted in the water inlet housing. The thermostat includes a type of automatic valve operated by fluctuations in the coolant temperature. This valve closes when the coolant temperature drops, preventing the circulation of coolant through the engine and thus permitting the engine to warm up rapidly. The valve opens when the coolant temperature has risen, allowing the circulation of coolant. 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 82°C (180°F).

TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Engine overheats	Water pump drive belt loose or missing	Adjust or replace belt	CH-4
	Dirt, leaves or insects on radiator	Clean radiator	CO-19
	Hoses, water pump, thermostat housing, radiator, heater, core plugs or head gasket leakage	Repair as necessary	
	Thermostat faulty	Check thermostat	CO-18
	Ignition timing retarded	Set timing	
	Electric cooling system faulty	Inspect electric cooling system	CO-26
	Radiator hose plugged or rotted	Replace hose	
	Water pump faulty	Replace water pump	CO-10
	Radiator plugged or cap faulty	Check radiator	CO-19
	Cylinder head or block cracked or plugged	Repair as necessary	

NOTE: The thermostat is equipped with a by-pass valve. therefore, if the engine tends to overheat, removal of the thermostat would have an adverse effect, causing a lowering of cooling efficiency.



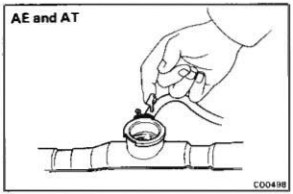
CHECK AND REPLACEMENT OF ENGINE COOLANT

Check of Engine Coolant

1. CHECK ENGINE COOLANT LEVEL AT RESERVE TANK

The coolant level should be between the "LOW" and "FULL" lines.

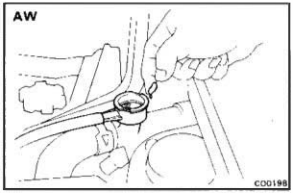
If low, check for leaks and add coolant up to the FULL line.

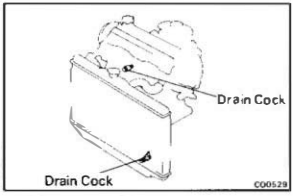


2. CHECK ENGINE COOLANT QUALITY

There should not be any excessive rust deposits or scales around the radiator (water outlet) cap or radiator (water outlet) filler hole, and the coolant should be free from oil.

If excessively dirty, replace the coolant.





Replacement of Engine Coolant (AE and AT)

REPLACE ENGINE COOLANT

(a) Remove the radiator cap.

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

(c) Close the drain cocks.

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

(d) Fill the system with coolant.

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

We recommend more than 50% ethyleneglycol and alcohol (But not more then 70%) be used for your system.

Capacity (w/ Heater):

4A-F		
M/T	**Europe**	**6.2 liters (5.5 US qts, 4.6 Imp. qts)**
	General	**5.6 liters (5.9 US qts, 4.9 Imp. qts)**
A/T		**5.5 liters (5.8 US qts, 4.8 Imp. qts)**
4A-GE		**6.0 liters (6.3 US qts, 5.3 Imp. qts)**

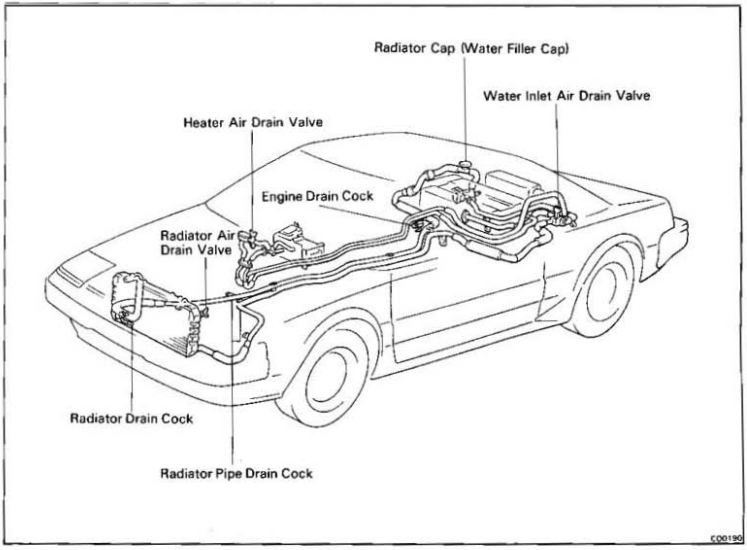
(e) Install the radiator cap.

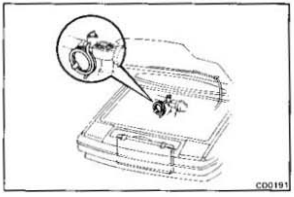
(f) Start the engine and check for leaks.

(g) Recheck the coolant level and refill as necessary.

Replacement of Engine Coolant (AW)

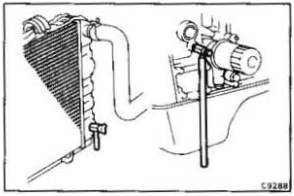
COOLANT CIRCUIT

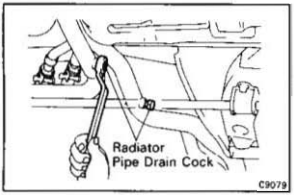




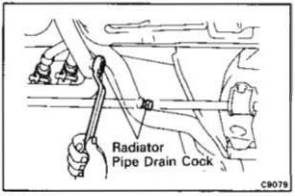
DRAINAGE OF ENGINE COOLANT

1. REMOVE SPARE TIRE AND FRONT LUGGAGE COMPARTMENT TRIM
2. REMOVE SERVICE HOSE
3. REMOVE NO.1 FUEL TANK PROTECTOR
4. SET HEATER CONTROL LEVER TO MAX HOT
5. REMOVE WATER FILLER CAP
6. DRAIN ENGINE COOLANT
   (a) Connect the service hoses to drain cock.
   (b) Drain the coolant from the radiator and engine drain cocks.





(c) Drain the coolant from the two radiator pipe drain cocks.



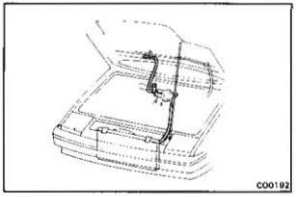
REFILL OF ENGINE COOLANT

1. CLOSE DRAIN COCKS

Tight the radiator pipe, radiator and engine drain cocks.

Torque:

Radiator pipe	**170 kg-cm (12 ft-lb, 17 N·m)**
Engine	**130 kg-cm (9 ft-lb, 13 N·m)**



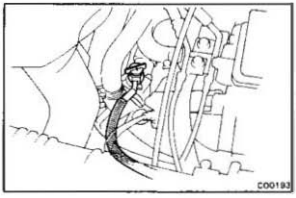
2. CONNECT SERVICE HOSES

(a) Connect the service hoses to the radiator and heater air drain valves.

(b) Suspend the opposite end of the hose connected to the radiator to the hood stay.

(c) Suspend the opposite end of the hose connected to the heater air drain valve to the windshield washer tube.

NOTE: Do not close-off or pinch any of the tubes.



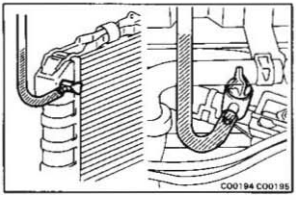
3. REFILL ENGINE COOLANT

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

(a) Open the water inlet, radiator and heater air drain valves about three turns.

(b) Pour the coolant to the water filler.

(c) When the coolant begines to come out of the water inlet air drain valve, stop pouring and close the air drain valve.

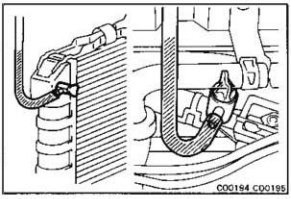


(d) Again, pour coolant into the water filler hote until it is full.

(e) Check that the coolantlevels in the suspended hoses come up to the level of the water filter nozzle.

If the coolant levels in either hose does not come up to filler nozzle lever, check the hose forfolds or obstructions. Repeat steps (d) and (e) above.

Capacity(w/ Heater):
12.4 liters (13.1 US qts, 10.9 Imp. qts)



(f) Close the radiator and heater air drain valves.

(g) Disconnect th service hoses.

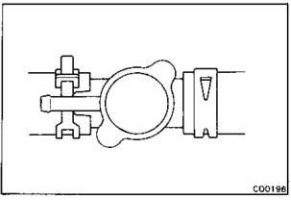
NOTE: When removing the service hoses, place a rag beneath the valve to catch any dripping coolant.

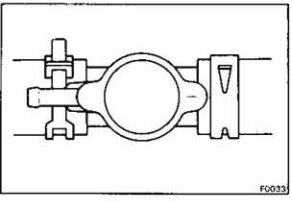
(h) Fasten the radiator cap (water filler cap) to the first stop point.

NOTE: Do not tighten the radiator cap completely (to the second stop point).

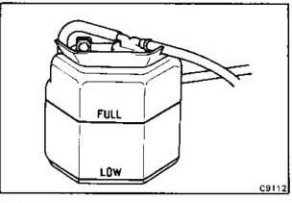
(i) Start the engine and run at fast idle for about 3 minutes, and then turn it off.

If the level in the water filler hole fell, add coolant as before. Then repeat steps (h) and (i) above.





(j) Completely tighten the radiator cap.



(k) Fill coolant into the reservoir tank up to the "FULL" mark.

4. INSTALL NO.1 FUEL TANK PROTECTOR

5. INSTALL SERVICE HOSE

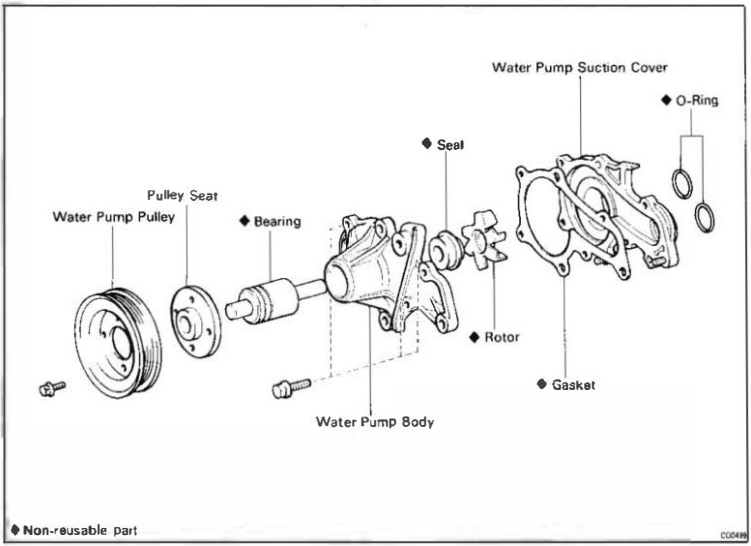
NOTE: Thoroughly flush out remaining coolant in hoses.

6. START ENGINE AND CHECK FOR LEAKS

7. INSTALL FRONT LUGGAGE COMPARTMENT TRIM AND SPARE TIRE

WATER PUMP

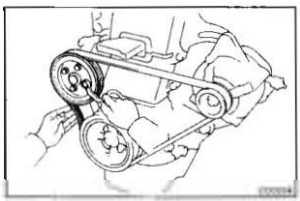
COMPONENTS



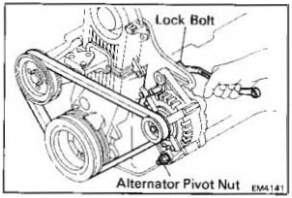
REMOVAL OF WATER PUMP

1. **DRAIN COOLANT**
   (See page CO-6 or 7)

2. **(4A-GE)**
   REMOVE PS AND/OR A/C DRIVE BELT



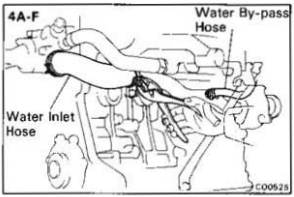
3. **LOOSEN WATER PUMP PULLEY AND REMOVE ALTERNATOR DRIVE BELT**
   (a) Loosen the four water pump pulley bolts.



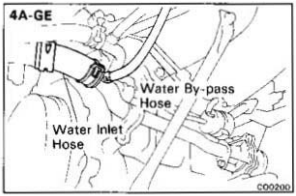
(b) Loosen the lock bolt and pivot nut.
(c) Move the alternator fully right, and remove the drive belt.

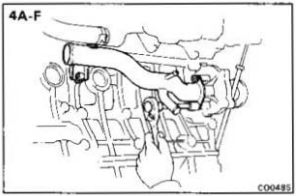
4. (4A-FI
REMOVE PS DRIVE BELT

5. **REMOVE WATER PUMP PULLEY**
Remove the four bolts and pump pulley.

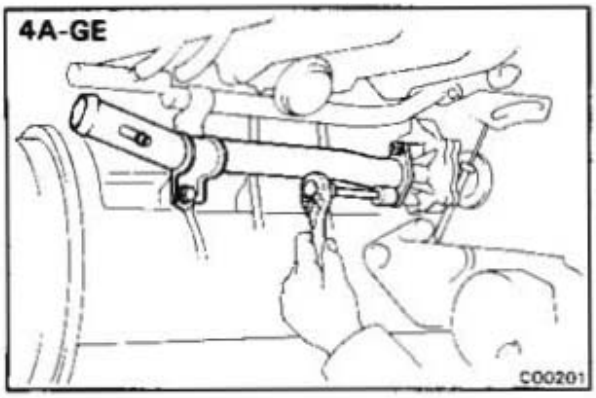


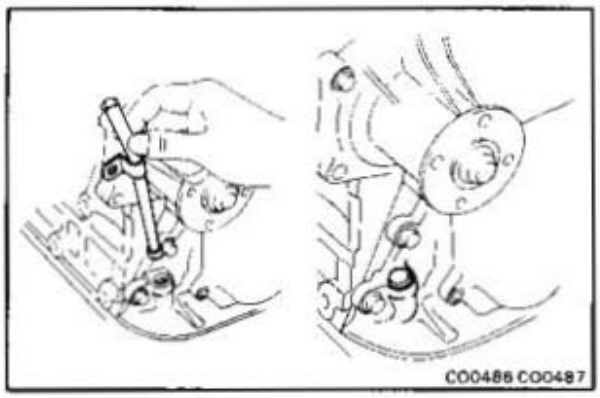
6. **REMOVE WATER INLET PIPE**
(a) Disconnect the water inlet and water by-pass hoses from the inlet pipe.





(b) Remove the two nuts and clamp bolt.
(c) Remove the water inlet pipe and O-ring.





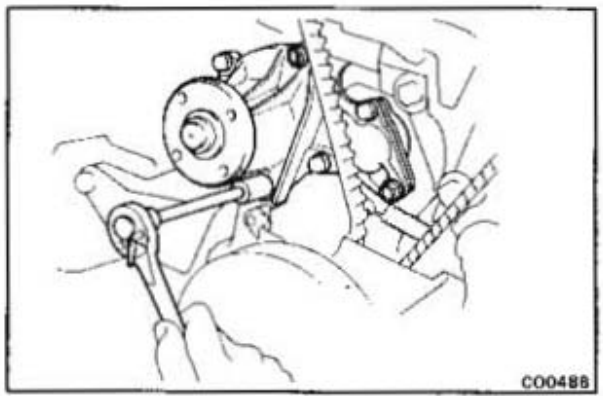
7. REMOVE OIL DIPSTICK GUIDE AND DIPSTICK

Remove the mounting bolt and pull put the dipstick guide and gauge.

NOTE: After pulling out the oil dipstick guide, be sure to plug the oil pump body hole.

8. REMOVE NO.3 AND NO.2 TIMING BELT COVERS

4A-F (See page EM-69)
4A-GE (See page EM-102)



9. REMOVE WATER PUMP

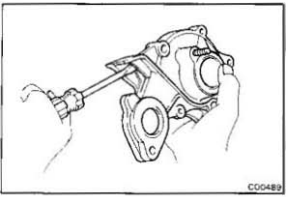
Remove the three bolts and water pump.

CAUTION: Be careful not to get coolant on the timing belt.

INSPECTION OF WATER PUMP

INSPECT WATER PUMP

Turn the pulley and check that the water pump bearing moves smoothly and quietly.



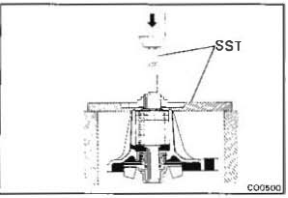
DISASSEMBLY OF WATER PUMP

(See page CO-10)

1. REMOVE WATER PUMP SUCTION COVER

(a) Remove the three bolts.

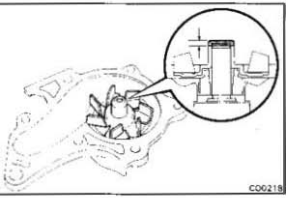
(b) Using a screwdriver, pry off the water pump suction cover.



2. REMOVE PULLEY SEAT

Using SST and a press, remove the pulley seat from the water pump bearing shaft.

SST 09236-00101 (09237-00010, 09237-00040)

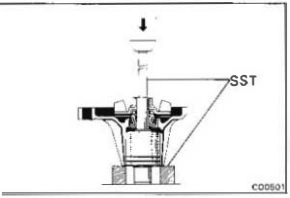


3. REMOVE WATER PUMP BEARING

(a) Using a grinding wheel, grind the water pump rotor as shown.

CAUTION: Do not grind water pump bearing shaft.

(b) Heat the water pump body to approx. 85°C (185°F).

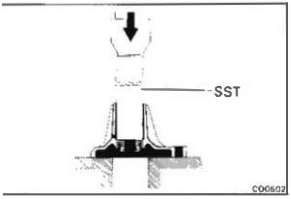


(c) Using SST and a press, remove the water pump rotor and bearing.

SST 09236-00101 (09237-00010, 09237-00040)

(d) Remove the seal set from the water pump body.

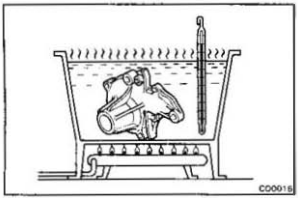
CAUTION: Do not damage the water pump body.



4. REMOVE SEAL

Using SST and a press, remove the seal.

SST 09236-00101 (09236-15010)



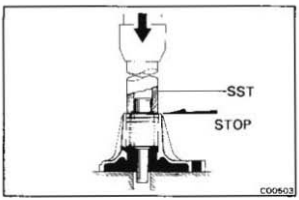
ASSEMBLY OF WATER PUMP

(See pege CO-10)

NOTE: Always assemble the water pump with a new seal set, a new rotor and a new bearing.

1. INSTALL WATER PUMP BEARING

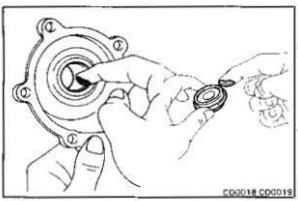
(a) Gradually heat the water pump body to approx. 85°C (185°F).



(b) Using SST and a press, install a new water pump bearing into the water pump body.

SST 09236-00101 (09237-00020)

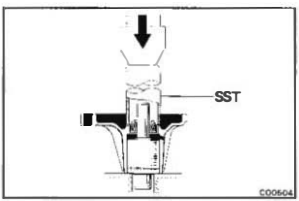
NOTE: The bearing end face should be flush with the body top surface.



2. INSTALL SEAL

(a) Apply a seal packing No 1282-B to a new seal and pump body.

Seal packing: Part No. 08826-00100 or equivalent



(b) Using SST and a press, install the seal on the water pump bearing.

SST 09236-00101 (09237-00020)

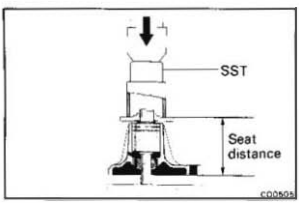
3. INSTALL PULLEY SEAT

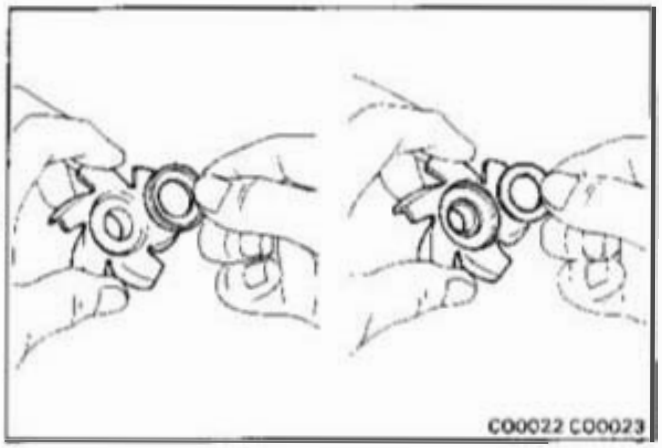
Using SST and a press, install the pulley seat on the water pump bearing shaft.

SST 09236-00101 (09237-00020)

NOTE: As shown in the figure, the distance from the pulley seat to the installation surface of the pump body should be as follows:

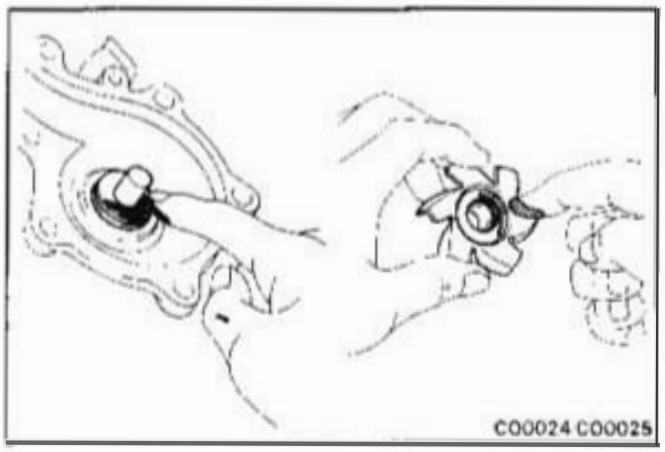
Seat distence: 76.7 mm (3.020 in.)



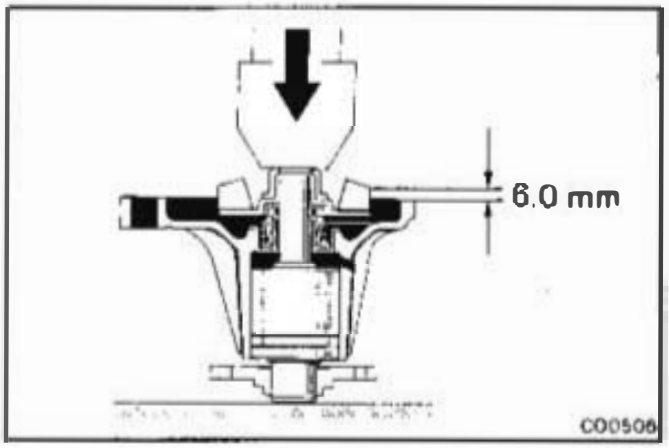


4. INSTALL ROTOR

(a) Install a new packing and seat into the rotor.



(b) Apply a little LLC to the seal and rotor contact surface.

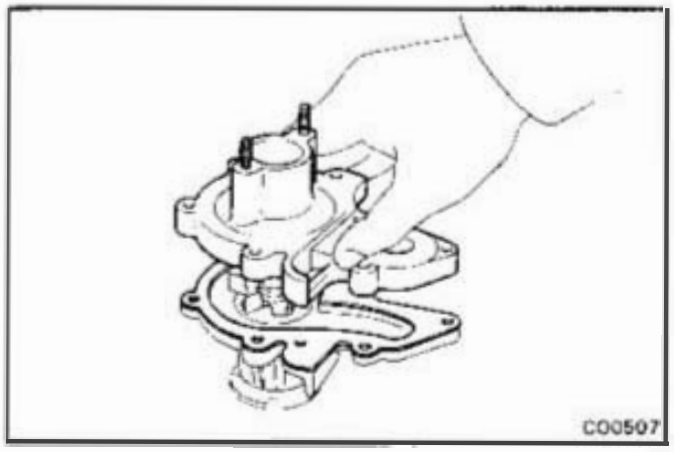


(c) Using a press, install a new rotor on the water pump bearing shaft.

NOTE: As shown in the figure, the distance from the rotor edge to the installation surface of the pump body should be 6.0 mm (0.236 in.)

5. CHECK WATER PUMP

After assembly make sure that the rotor rotates smoothly.

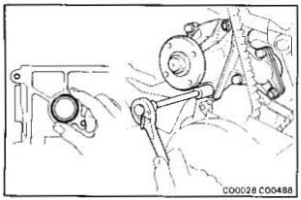


6. INSTALL WATER PUMP SUCTION COVER

Install the water pump suction cover on a new gasket with three bolts.

Torque: 95 kg-cm (82 in.-lb, 9.3 N-m)

NOTE: After installing, make sure that the rotor is not in contact with the water pump suction cover.



INSTALLATION OF WATER PUMP

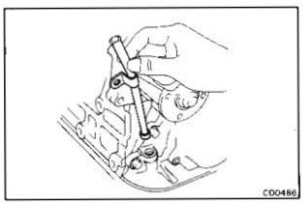
1. INSTALL WATER PUMP

Place a new O-ring on the block and install the pump with three bolts.

Torque: 150 kg-cm (11 ft-lb, 15 N·m)

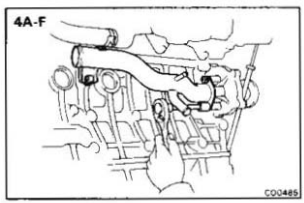
2. INSTALL NO.2 AND NO.3 TIMING BELT COVERS

4A-F **(See page EM-94)**
4A-GE **(See page EM-121)**



3. INSTALL OIL DIPSTICK GUIDE AND DIPSTICK

(a) Install a new O-ring on the oil dipstick guide.
(b) Apply small amount of engine oil to O-ring.
(c) Push in the oil dipstick guide with the O- ring.
(d) Install the mounting bolt.

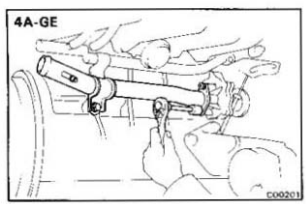


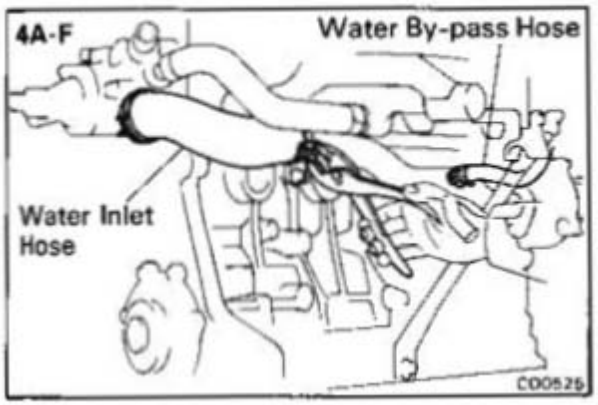
4. INSTALL INLET PIPE

(a) Install the inlet pipe and a new O- ing to the water pump with the two nuts.

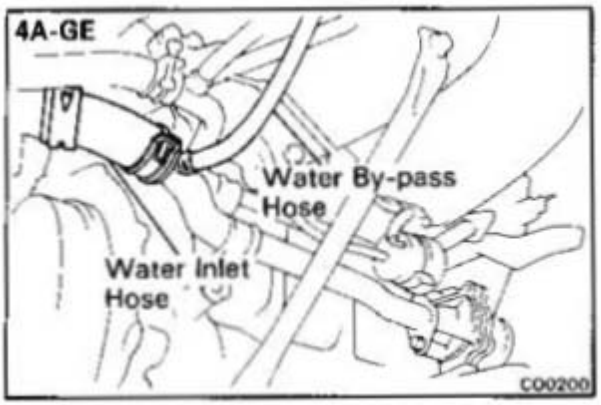
Torque: 200 kg-cm (14 ft-lb, 20 N·m)

(b) Install the inlet pipe clamp bolt.





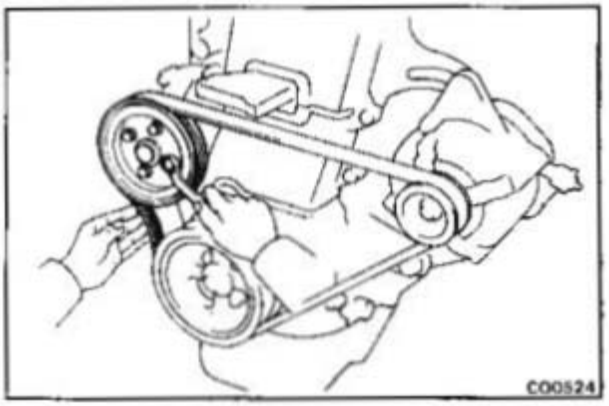
(c) Connect the water inlet and water by-pass hoses to the inlet pipe.



5. TEMPORARILY INSTALL WATER PUMP PULLEY

Install the water pump pulley and temporarily tighten the four bolts.

6. (4A-F)
INSTALL PS DRIVE BELT



7. INSTALL ALTERNATOR DRIVE BELT

(a) Place the drive belt on the each pulley and set up the drive belt.

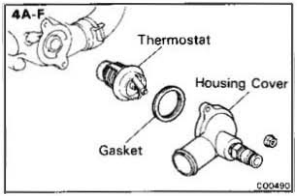
(b) Tighten the four bolts of the water pump pulley.

8. (4A-GE)
INSTALL PS AND/OR A/C DRIVE BELT

9. ADJUST DRIVE BELT (See page CH-4)

10. REFILL WITH COOLANT (See page CO-6 or 8)

11. START ENGINE AND CHECK FOR LEAKS



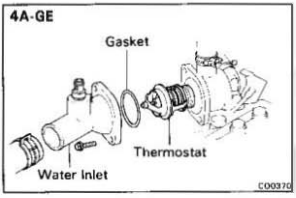
THERMOSTAT

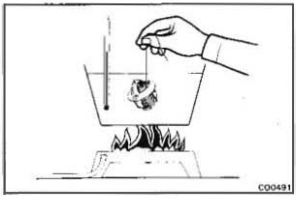
REMOVAL OF THERMOSTAT

1. **DRAIN COOLANT**
(See page CO-6 or 7)

2. **REMOVE WATER INLET HOUSING COVER AND THERMOSTAT**

Remove the two nuts, the housing cover and thermostat from the water inlet housing.





INSPECTION OF THERMOSTAT

NOTE: 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.

Valve opening temperature: 80 — 84°C (176 — 183°F)

If the valve opening temperature is not within specification, replace the thermostat.

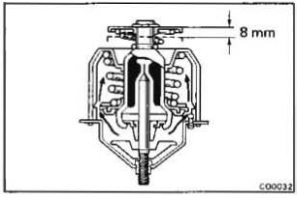
(c) Check the valve lift.

Valve lift: 8 mm (0.31 in.) or more at 95°C (203°F)

If the valve lift is less than specification, replace the thermostat.

(d) Check that the valve spring is tight when the thermostat is fully closed.

If necessary, replace the thermostat.



INSTALLATION OF THERMOSTAT

1. **PLACE THERMOSTAT IN WATER INLET HOUSING**

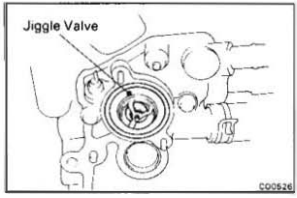
Install a new gasket to the thermostat and align the jiggle valve of the thermostat as shown in the water inlet housing.

2. **INSTALL WATER INLET HOUSING COVER**

Install the water inlet housing cover with the two nuts.

3. **REFILL RADIATOR WITH COOLANT**
(See page CO-6 or 8)

4. **START ENGINE AND CHECK FOR LEAKS**

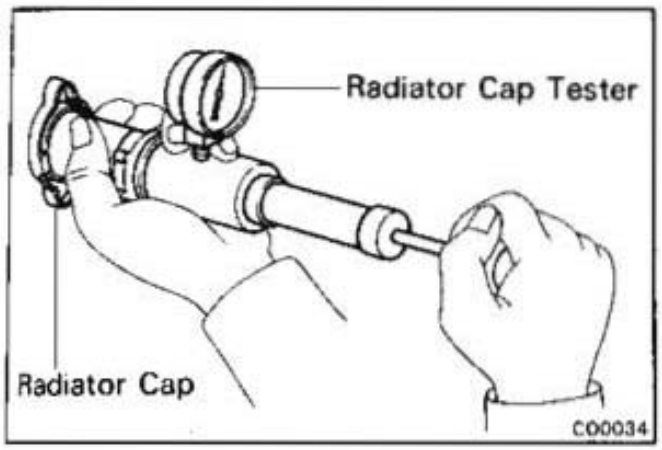


RADIATOR

CLEANING OF RADIATOR

Using water or steam cleaner, remove any mud and dirt from the radiator core.

CAUTION: If using a high pressure type cleaner, be careful not to deform the fins of the radiator core. If the cleaner nozzle pressure is 30 — 35 kg/cm² (427 — 498 psi, 2, 942 — 3,432 kPa), keep a distance of at least 40 — 50 cm (15.75 — 19.69 in.) between the radiator core and cleaner nozzle.



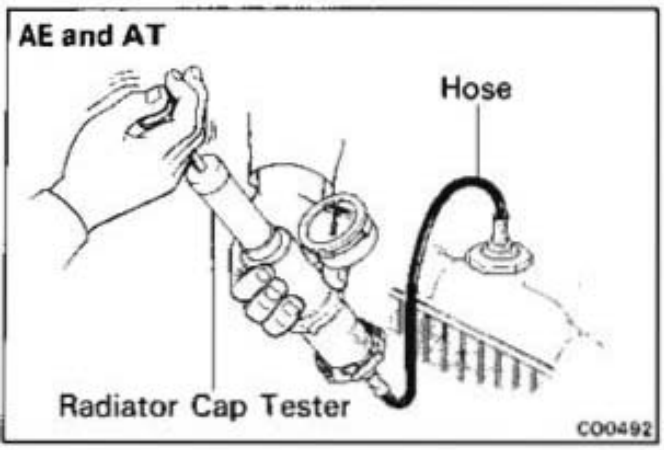
INSPECTION OF RADIATOR

1. CHECK RADIATOR (WATER OUTLET) CAP

Using a radiator cap tester, pump the tester until the relief valve opens. Check that the valve opens between 0.75 kg/cm² (10.7 psi, 74 kPa) and 1.05 kg/cm² (14.9 psi, 103 kPa).

Check that the pressure does not drop rapidly when pressure on the cap is below 0.6 kg/cm² (8.5 psi, 59 kPa).

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



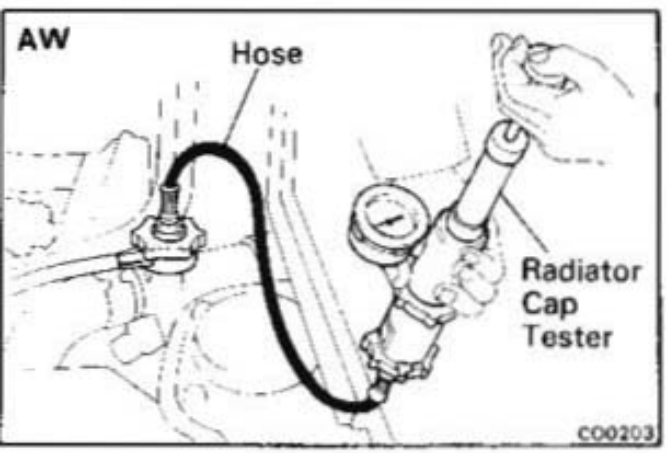
2. CHECK COOLING SYSTEM FOR LEAKS

(a) Fill the radiator with coolant and attach a radiator cap tester.

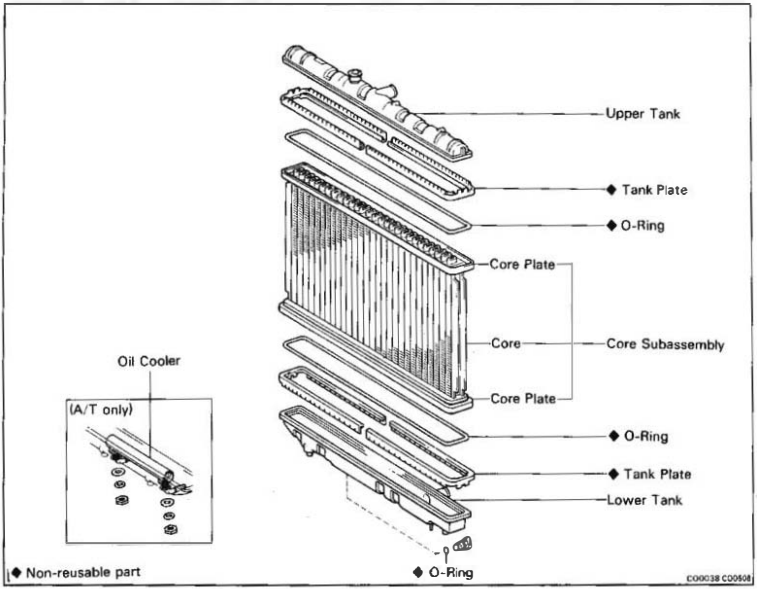
(b) Warm up the engine.

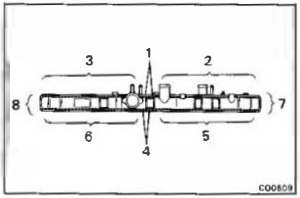
(c) Pump it to 1.2 kg/cm² (17 psi, 118 kPa), check that pressure does not drop.

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



COMPONENTS





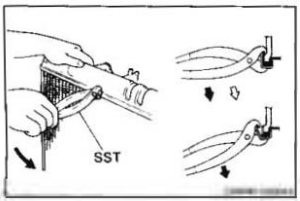
DISASSEMBLY OF RADIATOR (AE and AT)

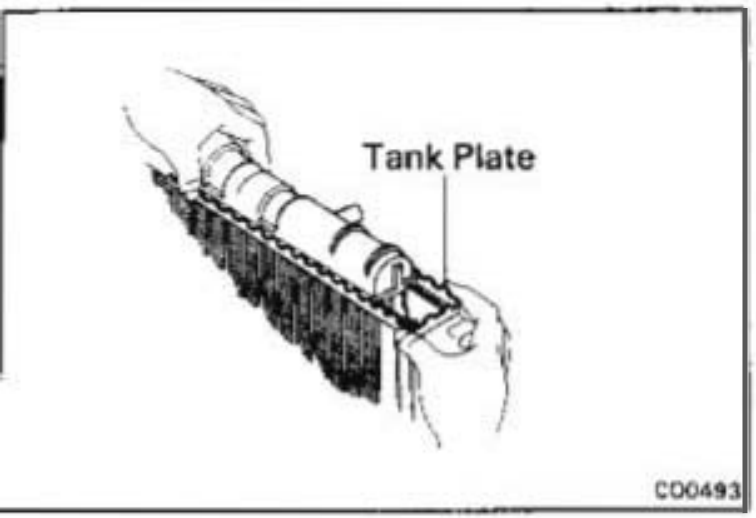
1. **REMOVE TANK PLATE**

   (a) Raise the claws of the tank plates with SST in the numerical order shown in the figure.

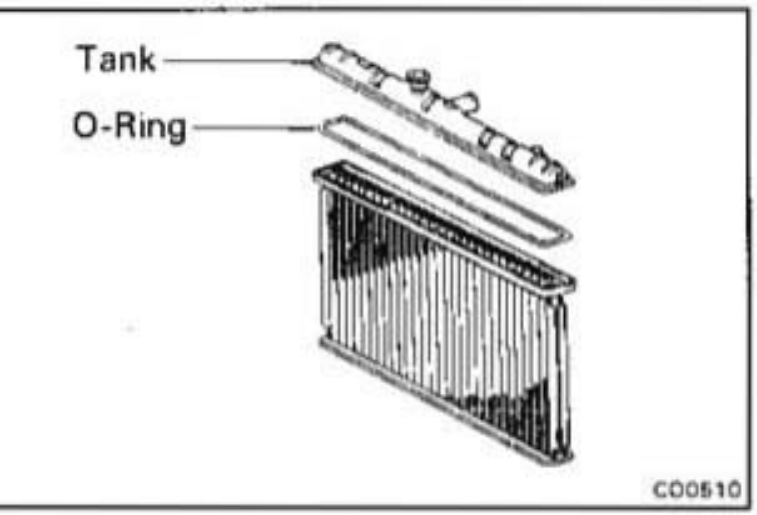
   SST 09230-00010

   NOTE: Be careful not to damage the core plate.





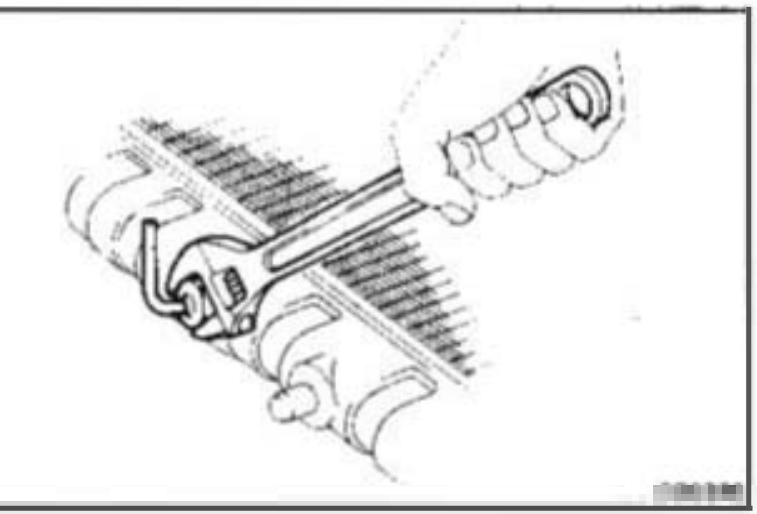
(b) Pull the tank plates outward.



2. REMOVE TANK AND O-RING

(a) Pull the tank upward.

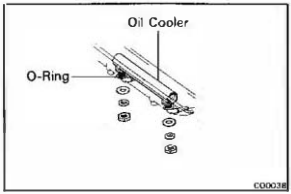
(b) Remove the O-ring.



3. (A/T)
REMOVE OIL COOLER FROM LOWER TANK

(a) Remove the two nuts, spring washers, plate washers and oil cooler.

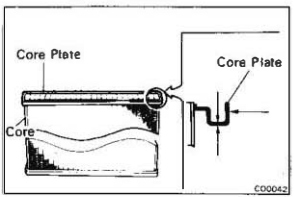
(b) Remove the O-ring from the oil cooler.



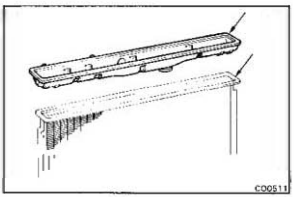
ASSEMBLY OF RADIATOR (AE and AT)

(See page CO-20)

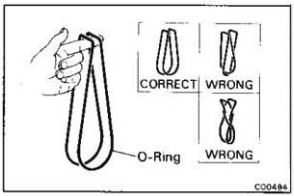
1. (A/T)
INSTALL OIL COOLER TO LOWER TANK
   (a) Clean the O-ring contact surface of the lower tank and oil cooler.
   (b) Install new O-ring to the oil cooler.
   (c) Install the oil cooler with the O-rings to the lower tank.
   (d) Install the plate washers, spring washers and nuts.



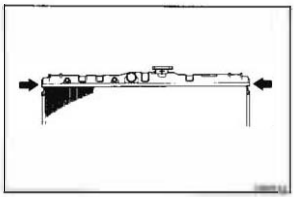
2. **INSPECT CORE PLATE**
Inspect the core plate for damage
NOTE:
- If the sides of the core plate groove are deformed, reassembly of the tank will be impossible
- Therefore, first correct any deformation with pliers or like object. Water leakage will result if the bottom of the core plate groove is damaged or dented. Therefore, repair or replace if necessary.



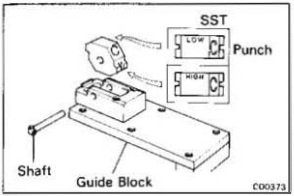
3. **INSTALL NEW O-RING AND TANK**
NOTE:
- Clean the tank and core plate



- Take out any twists.



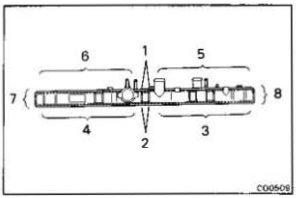
4. **INSTALL TANK PLATE**
Install the tank plates from both ends in the direction of the arrows. Insert to where the portions shown by the arrows contact with the tank.



6. STAKE CLAW OF TANK PLATE

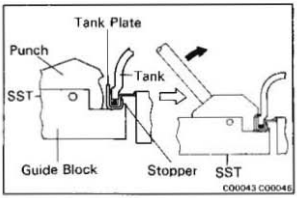
(a) Setthe punch of SST to "LOW".

SST 09230-00010



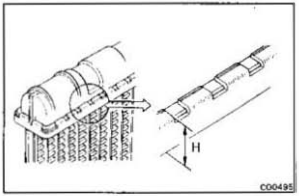
(b) Stake the claws of the tank plates with SST in the numerical order shown in the figure.

SST 09230-00010



CAUTION: If the bottom of the core plate is staked with the SST on the guide block stopper, it may result in water leakage.

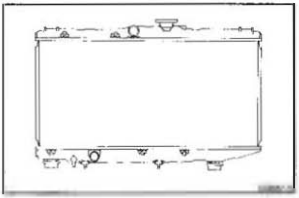
SST 09230-00010



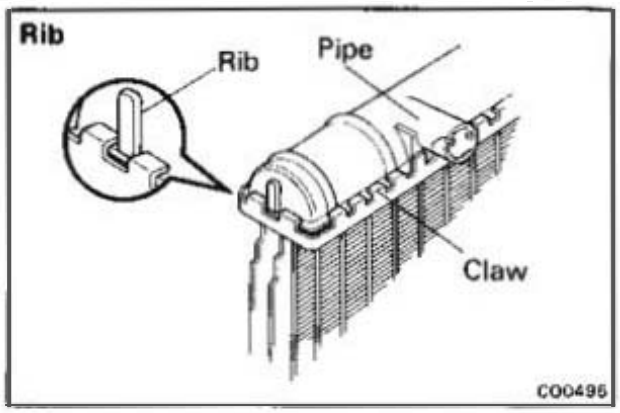
NOTE:

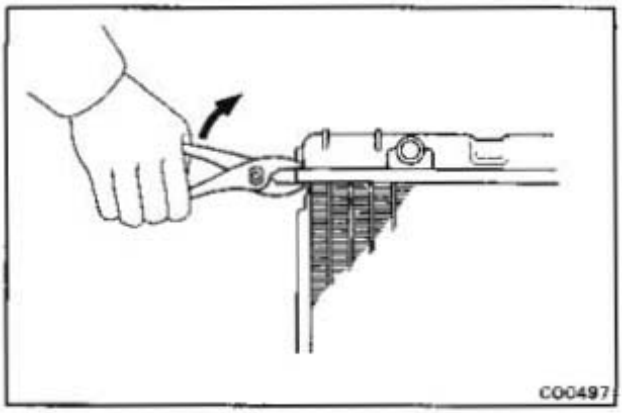
- Stake with just enough pressure to leave a mark on the claw. The staked plate height (H) should be as follows:

Plate height: 9.08 — 9.43 mm (0.3576 — 0.3713 in.)

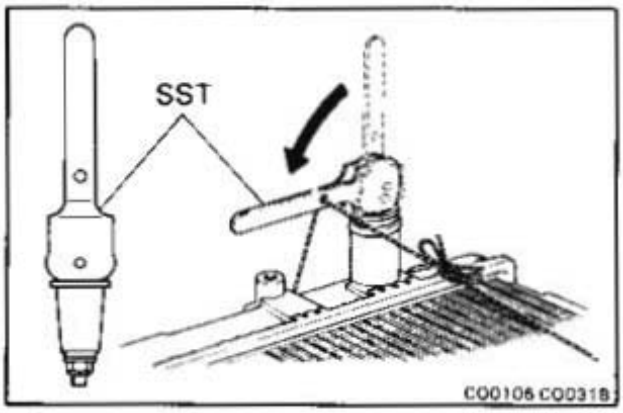


- Do not stake the areas protruding around the pipes, brackets or tank ribs.





- The points shown in tha illustration cannot ba staked with the SST. Use a pliers or like object and be careful not to damage the core plates.



6. INSPECT FOR WATER LEAKS

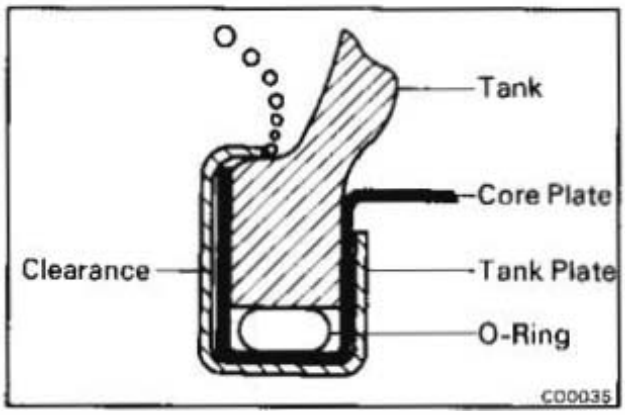
(a) Tighten the drain plug.

(b) Plug the inlet and outlet pipes of the radiator with SST.

SST 09230-00010

(c) Using a radiator cap tester, apply pressure to the radiator.

Test pressure: 1.5 kg/cm² (21 psi, 147 kPa)

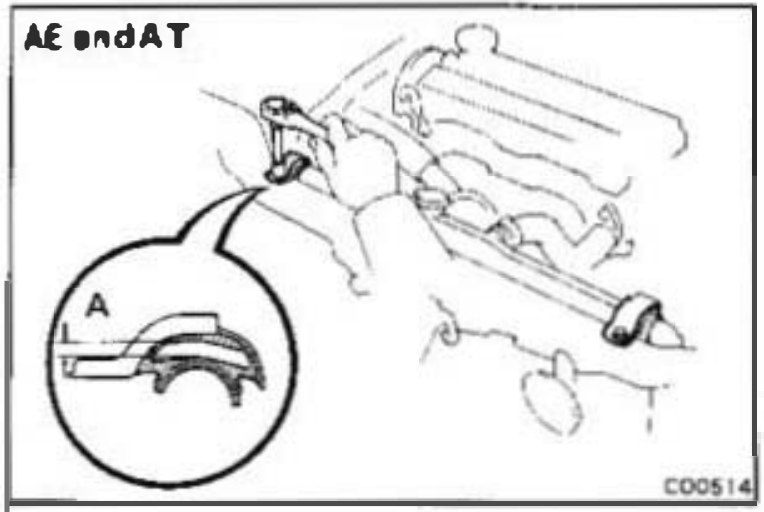


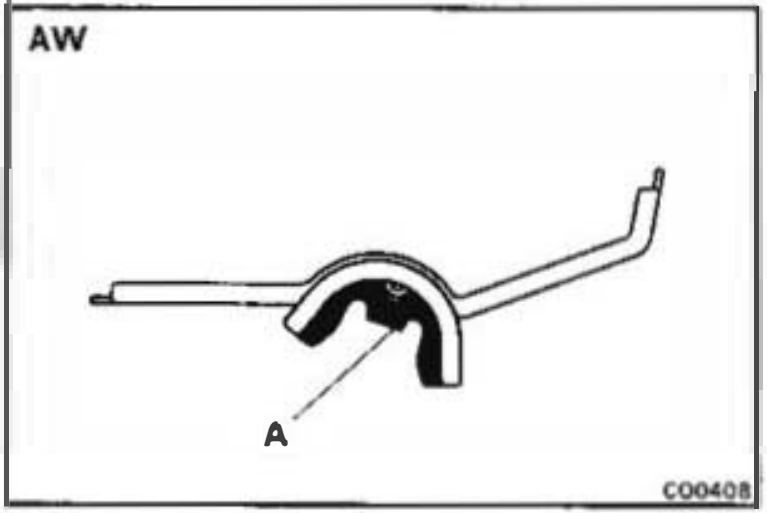
(d) Inspect for water leaks.

NOTE: On radiator with resin tanks, there is a clearance between the core plate and tank plate where a minute amount of air will remain, giving tha appearance of an air leak when the radiator is submerged in water. Therefore, before performing the water leak test, first switch the radiator around in the water untilall air bubbles disappear.

7. PAINT TANK PLATE

NOTE: If the water leak test checks out okay, allow the radiator to completely dry and then paint the tank plates.





INSTALLATION OF RADIATOR

INSTALL RADIATOR

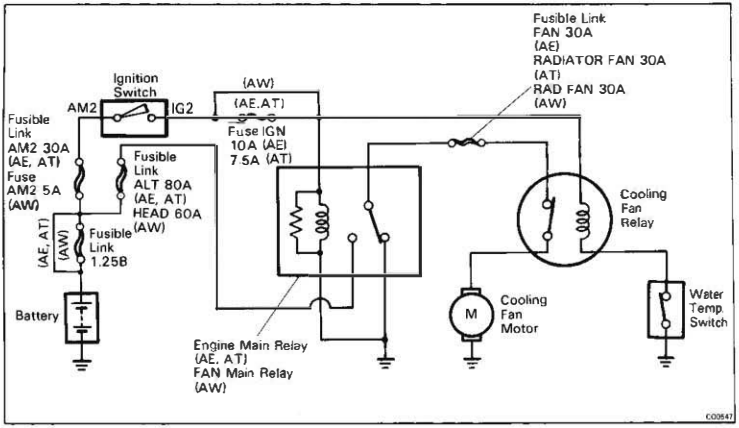
Place the radiator in installed position and install the two supports with the two bolts.

NOTE: After installation, confirm that the rubber cushion (A) of the support is not depressed.

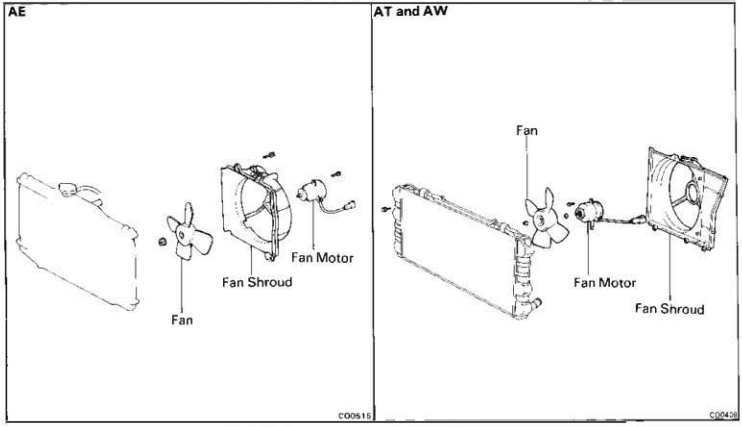
ELECTRIC COOLING FAN

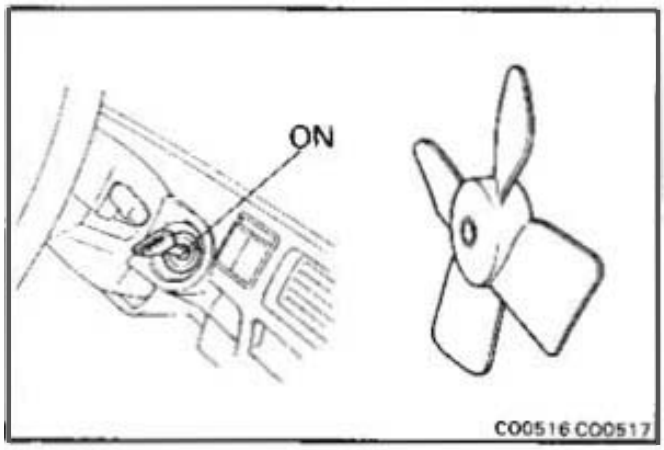
Radiator Cooling Fan (Ex. AW Europe)

SYSTEM CIRCUIT



COMPONENTS





ON-VEHICLE INSPECTION

Low Coolant Temperature (below 83°C (181°F))

1. **TURN IGNITION SWITCH ON**

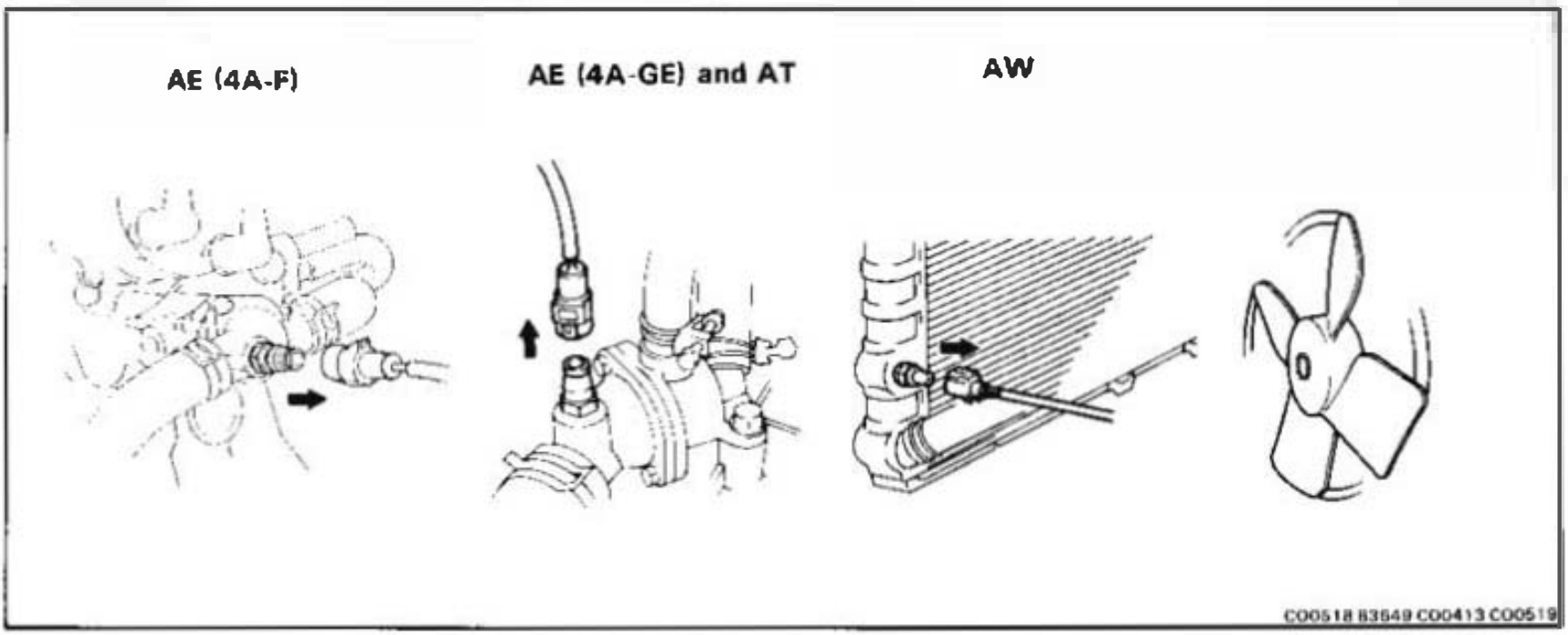
   Check that the fan does not rotate.

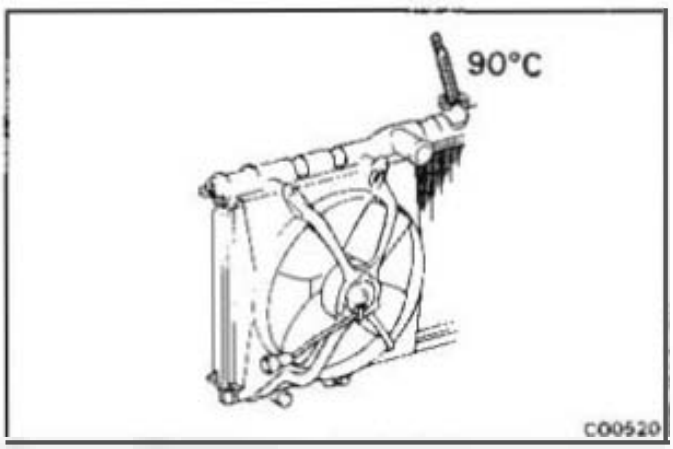
   If it rotates, check the fan relay and temperature switch, and check for a separated connector or severed wire between the relay and temperature switch.

2. **DISCONNECT TEMPERATURE SWITCH CONNECTOR**

   Check that the fan rotates.

   If it does not, check the fan relay, fan motor, ignition relay and fuse, and check for a short circuit between the fan relay and temperature switch.





3. **CONNECT TEMPERATURE SWITCH CONNECTOR**

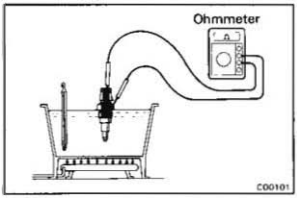
High Coolant Temperature (above 90°C (194°F))

4. **START ENGINE**

   (a) Raise engine coolant to above 90°C (194°F).

   (b) Check that the fan rotates.

   If it does not, replace the temperature switch.



INSPECTION OF ELECTRIC COOLING FAN

1. INSPECT TEMPERATURE SWITCH

LOCATION:

AE and AT	On the water inlet housing.
AW	On the radiator left side.

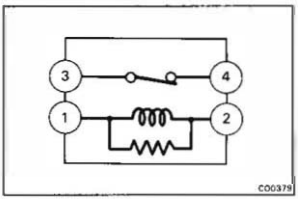
(a) Using an ohmmeter, check that there is no continuity when the coolant temperature is above 93°C (199°F).

(b) Check that there is continuity when the coolant temperature is below 83°C (181°F).

If continuity is not as specified, replace the switch.

2. INSPECT ENGINE MAIN RELAY (AE and AT) OR FAN MAIN RELAY (AW)

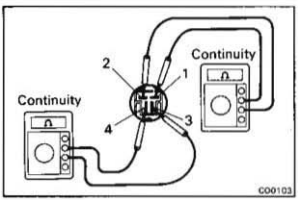
(See procedure Engine Main Relay on page CH-15)



3. INSPECT COOLING FAN RELAY

LOCATION:

AE and AT	In the engine compartment relay box.
AW	In the No.5 junction block of the front luggage compartment.

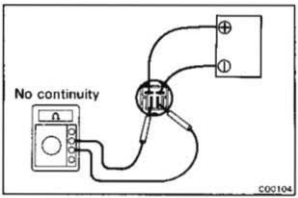


A. Inspect relay continuity

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

(b) Check that there is continuity between terminals 3 and 4.

If continuity is not as specified, replace the relay.

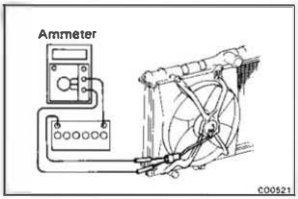


B. Inspect relay operation

(a) Apply battery voltage across terminals 1 and 2.

(b) Check that there is no continuity between terminals 3 and 4.

If operation is not as specified, replace the relay.



4. INSPECT FAN MOTOR

(a) Connect the battery and ammeter to the fan motor connector.

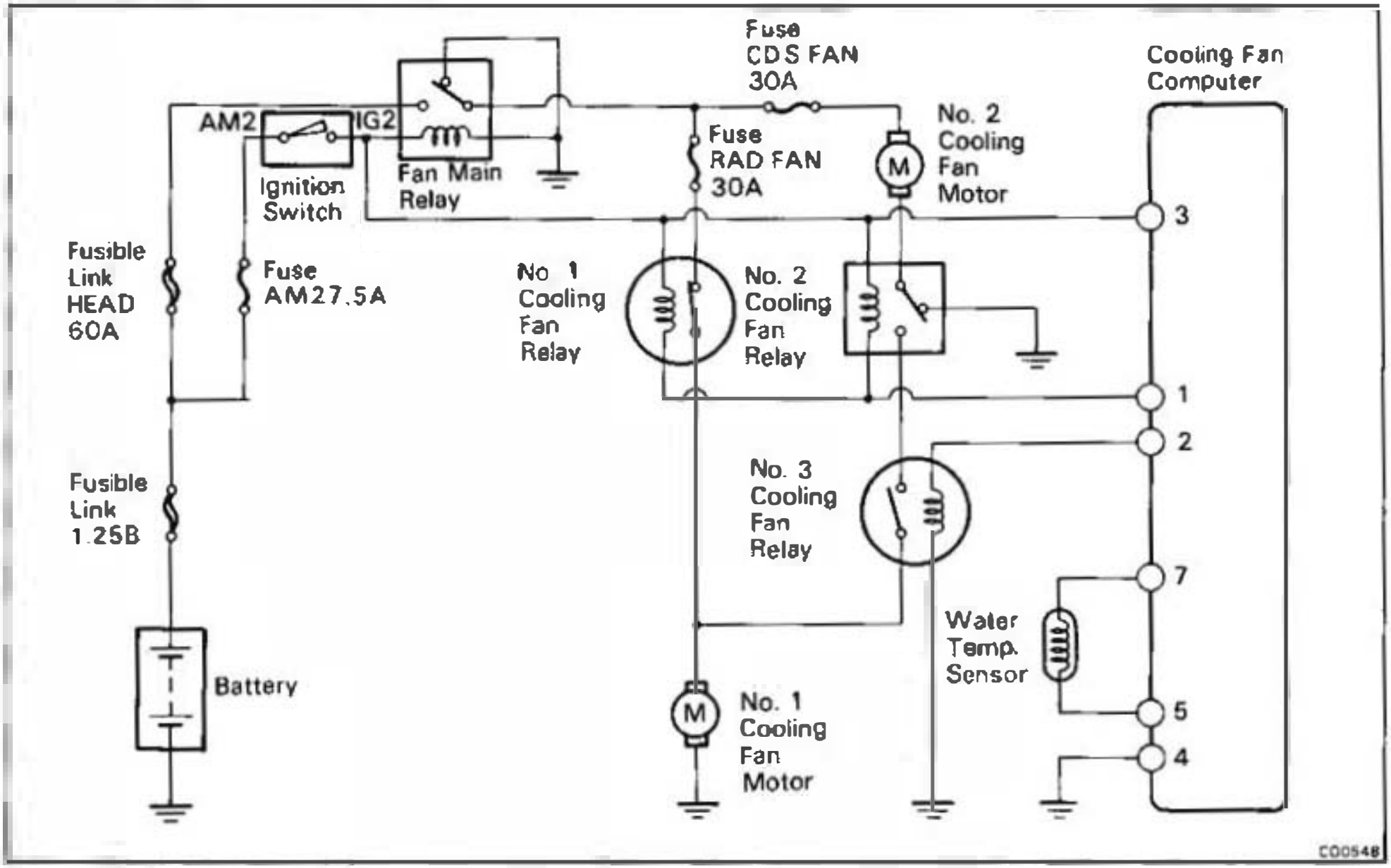
(b) Check to see that the motor rotates smoothly, and current is as follows:

Standard amperage:

AE and AT	**3.2 — 4.4 A**
AW	**5.8 — 7.4 A**

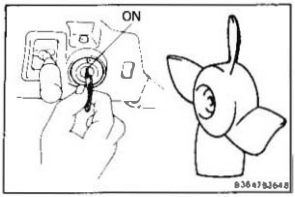
Radiator Cooling Fan (AW Europe)

SYSTEM CIRCUIT



COMPONENTS

(See page CO-26)



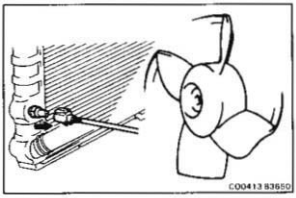
ON-VEHICLE INSPECTION

Low Coolant Temperature (below 85°C (185°F))

1. **TURN IGNITION SWITCH ON**

   Check that the fan does not rotate.

   If it rotate, check the fan relay and temperature switch, and check for a separated connector or severed wire between the relay and temperature switch.

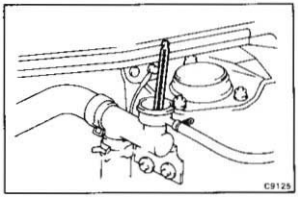


2. **DISCONNECT TEMPERATURE SWITCH CONNECTOR**

   Check that the fan rotates.

   If it does not, check the fan relay, fan motor, ignition relay and fuse, and check for a short circuit between the fan relay and temperature switch.

3. **CONNECT TEMPERATURE SWITCH CONNECTOR**



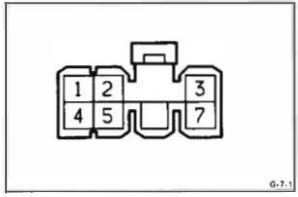
High Coolant Temperature (above 90°C (194°F))

START ENGINE

(a) Raise engine coolant to above 90°C (194°F).

(b) Check that the fan rotates.

If it does not, replace the temperature switch.



INSPECTION OF COOLING FAN COMPUTER CIRCUIT

INSPECT COOLING FAN COMPUTER CIRCUIT

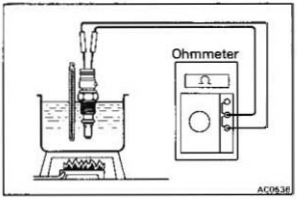
LOCATION:

RHD In the right side of the front compartment.

LHD In the left side of the front compartment.

Disconnect the cooling fan computer, and check the connector on the wiring harness side as shown in the chart below.

Check for	Tester connection	Condition		Specified value
Voltage	1 – Ground	Ignition S/W ON		Battery voltage
Continuity	2 – Ground	–		Continuity
Continuity	4 – Ground	–		Continuity
Resistance	5 – 7	Coolant temp.	85°C (185°F)	Approx. 1.35 kΩ
			90°C (194°F)	Approx. 1.19 kΩ
			95°C (203°F)	Approx. 1.05 kΩ



INSPECTION OF ELECTRIC COOLING FAN COMPONENTS

1. INSPECT WATER TEMPERATURE SENSOR

LOCATION: On the radiator left side.

Using an ohmmeter, measure the resistance between the terminals.

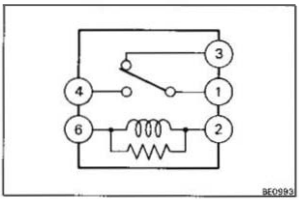
Resistance:

Approx. 1.35 kΩ at 85°C (185°F)
Approx. 1.19 kΩ at 90°C (194°F)
Approx. 1.05 kΩ at 95°C (203°F)

If resistance is not as specified, replace the sensor.

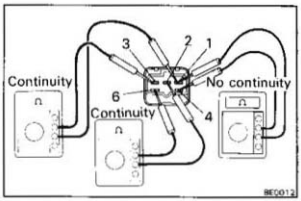
2. INSPECT NO.1 COOLING FAN RELAY
(See procadure Cooling Fan Relay on pege CO-28)

LOCATION: In the No.5 junction block of the front luggage compartment.



3. INSPECT NO.2 COOLING FAN RELAY

LOCATION: In the No.5 junction block of the front luggage compartment.



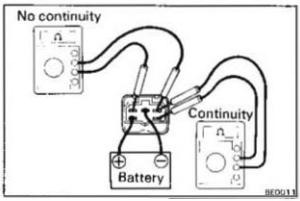
A. Inspect relay continuity

(a) Using an ohmmeter, check that there is continuity between terminals 2 and 6.

(b) Check that there is continuity between terminals 1 and 3.

(c) Check that there is no continuity between terminals 1 and 4.

If continuity is not as specified, replace the relay.



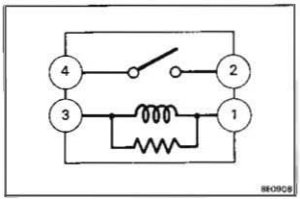
B. Inspect relay operation

(a) Apply battery voltage across terminal 2 and 6.

(b) Using an ohmmeter, check that there is no continuity between terminals 1 and 3.

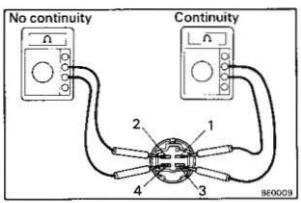
(c) Check that there is continuity between terminals 1 and 4.

If operation is not as specified, replace the relay.



4. INSPECT NO.3 COOLING FAN RELAY

LOCATION: In the No.5 junction block of the front luggage compartment.

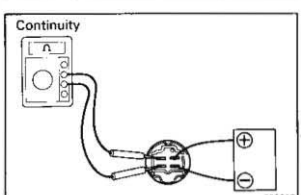


A. Inspect relay continuity

(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.



B. Inspect relay operation

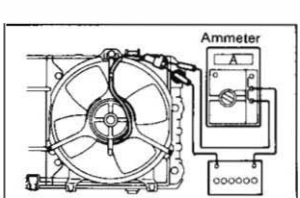
(a) Apply battery voltage across terminal 1 and 3.

(b) Using an ohmmeter, check that there is continuity between terminals 2 and 4.

If operation is not as specified, replace the relay.

5. INSPECT FAN MAIN RELAY
(See procedure Engine Main Relay on page CH-15)

LOCATION: In the No.5 junction block of the front luggage compartment.



6. INSPECT COOLING FAN MOTORS

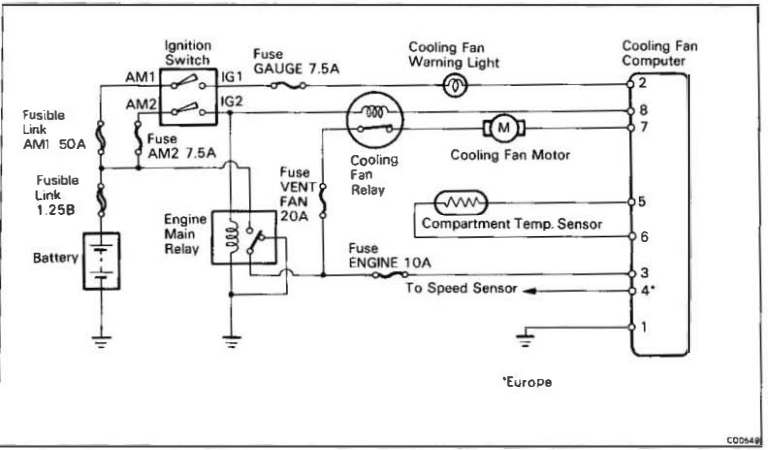
(a) Connect battery and ammeter to the fan motor connector.

(b) Check that the fan motor rotates smoothly, and check the reading on the ammeter.

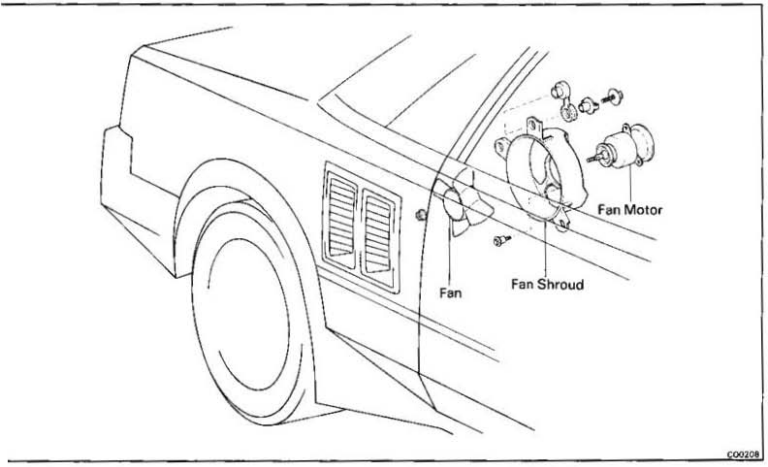
Standard amperage: 8.8 — 10.8 A

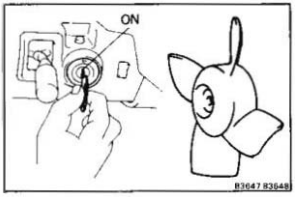
Engine Compartment Cooling Fan (AW)

SYSTEM CIRCUIT



COMPONENTS





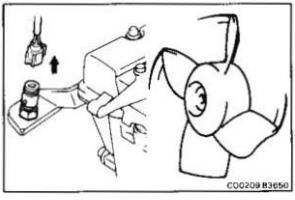
ON-VEHICLE INSPECTION

Low Temperature (Below 64°C (147°F))

1. **TURN IGNITION SWITCH "ON"**

   Check that the fan stops.

   If it does not check the cooling fan relay and compartment temperature sensor, and check for a separated connector or severed wire between the cooling fan relay and compartment temperature sensor.

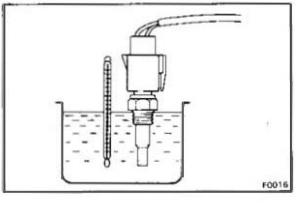


2. **DISCONNECT COMPARTMENT TEMPERATURE SENSOR CONNECTOR**

   Check that fan rotates.

   If not, check the cooling fan relay, fan motor, engine main relay and fuse, and check for a short circuit between the cooling fan relay and compartment temperature sensor.

3. **CONNECT COMPARTMENT TEMPERATURE SENSOR CONNECTOR**



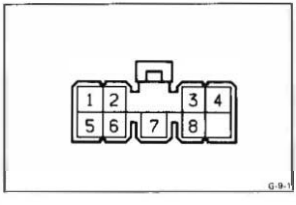
High Temperature (Above 80°C (176°F))

START ENGINE

(a) Raise the compartment temperature to above 80°C (176°F).

(b) Check that the fan rotates.

If not, replace the compartment temperature sensor.



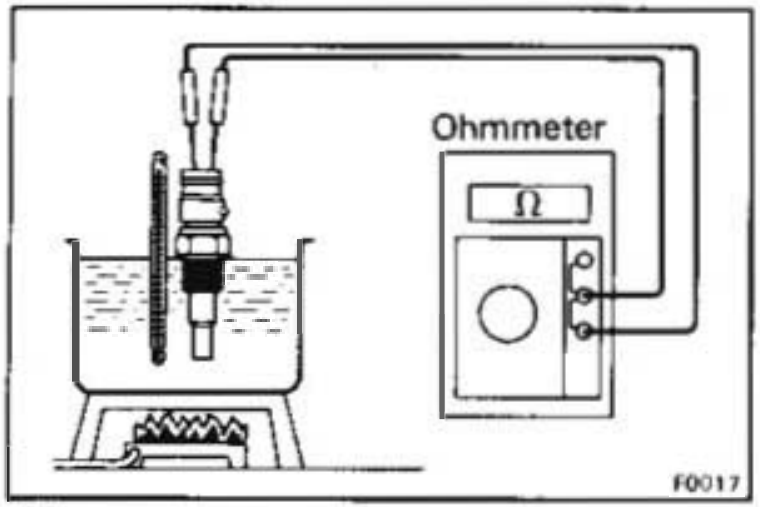
INSPECTION OF COOLING FAN COMPUTER CIRCUIT

INSPECT COOLING FAN COMPUTER CIRCUIT

LOCATION: In the right side of the rear engine compartment.

Disconnect the cooling fan computer, and check the connector on the wiring harness side as shown in the chart below.

Check for	Tester connection	Condition		Specified value
Continuity	1 – Ground	–		Continuity
Voltage	2 – Ground	Ignition S/W ON		Battery voltage
Voltage	3 – Ground	–		Battery voltage
Resistance	5 – 6	Air temp.	54°C (129°F)	Approx. 627.0 Ω
			80°C (176°F)	Approx. 295.5 Ω
Voltage	7 – Ground	–		No voltage
Voltage	8 – Ground	Ignition S/W ON		Battery voltage



INSPECTION OF ELECTRIC COOLING FAN COMPONENTS

1. INSPECT COMPARTMENT TEMPERATURE SENSOR

LOCATION: On the cylinder head rear plate.

Using an ohmmeter, measure the resistence between the terminals.

Resistance:

Approx. 627.0 Ω at 54°C (129°F)
Approx. 295.5 Ω at 80°C (178°F)

If resistance is not as specified, replace the sensor.

2. INSPECT COOLING FAN RELAY

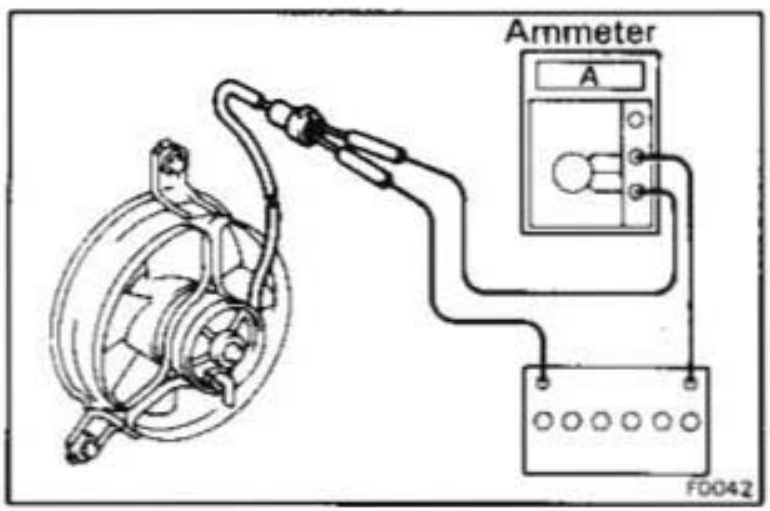
(See procedure Cooling Fan Relay on page CO-28)

LOCATION: In the No.5 junction block of the front luggage compartment.

3. INSPECT ENGINE MAIN RELAY

(See procedure Engine Main Relay on page CH-15)

LOCATION: In the No.2 junction block of the engine compartment.



4. INSPECT COOLING FAN MOTOR

(a) Connect battery and ammeter to the fan motor connector.

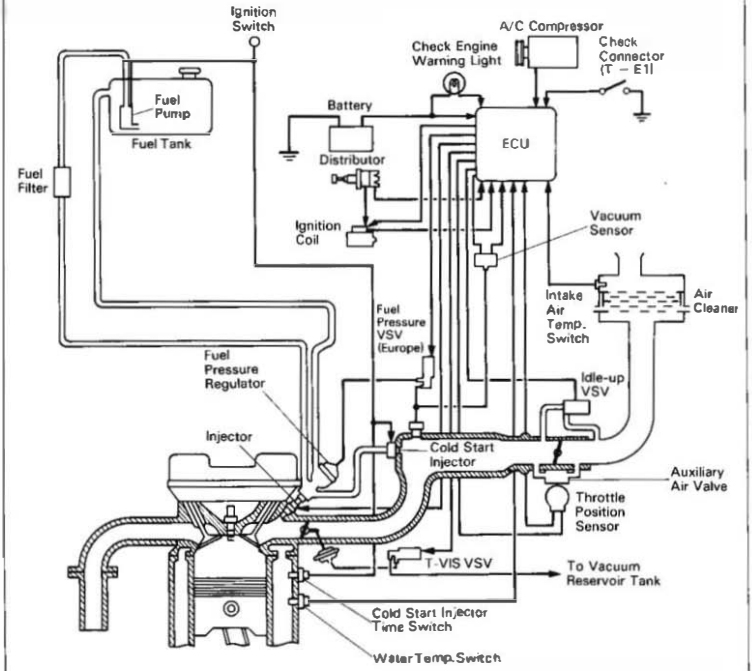
(b) Check that the fan motor rotetes smoothly, and check the reading on the ammeter.

Standard amperage: 3.1 — 4.3 A

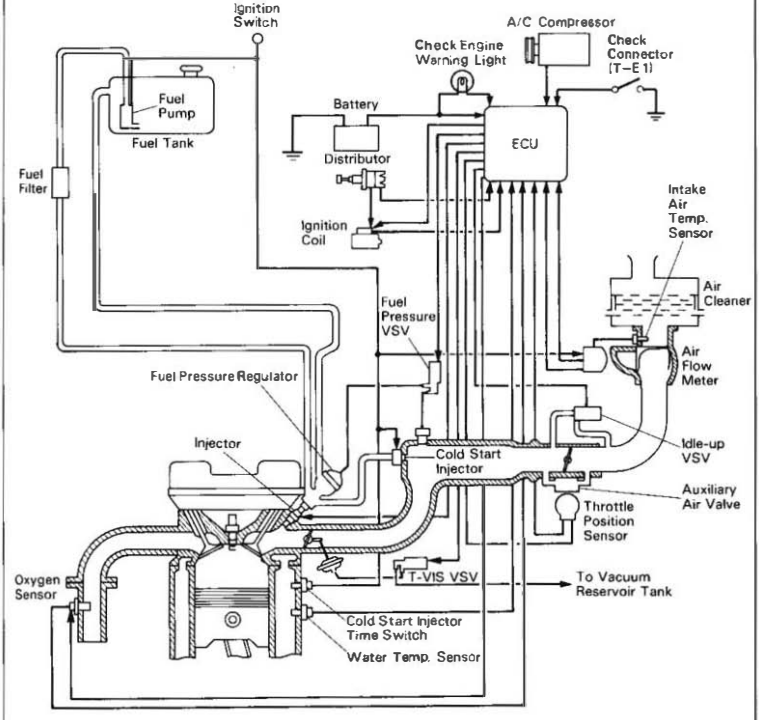
EFI SYSTEM

SYSTEM DESCRIPTION

w/o Air Flow Meter



w/Air Flow Meter



The EFI system is composed of three basic subsystem: Fuel Induction, Air Induction and Electronic Control System.

FUEL SYSTEM

Fuel is supplied under constant pressure to the EFI injectors by an electric fuel pump. The injectors inject a metered quantity of fuel into the inteke manifold in accordance with signals from the ECU (Electronic Control Unit).

AIR INDUCTION SYSTEM

The air induction system provides sufficient air for engine operation.

ELECTRONIC CONTROL SYSTEM

The 4A-GE engine is equipped with a Toyote 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 operating conditions such as:

   Intake manifold absolute pressure
   (w/o Air flow meter)
   Intake air volume
   (w/ Air flow meter)
   Intake air temperature
   Coolant temperature
   Engine rpm
   Acceleration/deceleration
   Exhaust oxygen content (w/ TWC) 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, coolant temperature, etc.), the microcomputer (ECU) triggers the spark at precisely the right instant. (See IG section)

3. Diagnosis

   The ECU detects any malfunctions or abnormalties in the sensor network and lights a 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 and E1 are short-circuited. The diagnostic codes are refer to the later page.
   (See page FI-25 or 26)

4. Fail-Safe Function

   In the event of the sensor malfanctioning, a back-up circuit will take over to provide minimal driveability, and the check engine warning light will light.

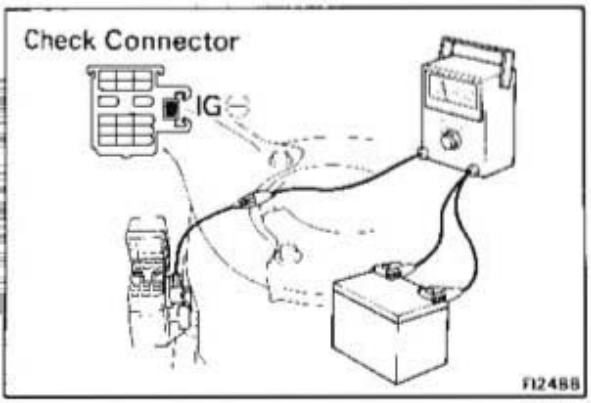
PRECAUTIONS

1. **Before working on the fuel system, disconnect the cable from negative (⊖) terminal of the battery.**

   NOTE: Any diagnostic 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 on open flame when working on the fuel system.**

3. **Keep gasoline off rubber or leather parts.**



INSPECTION PRECAUTIONS

MAINTENANCE PRECAUTIONS

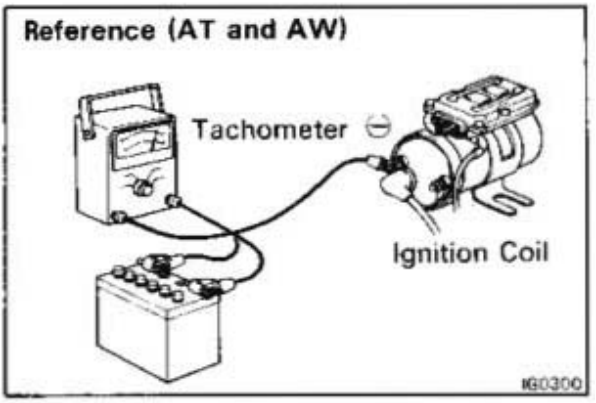
1. **CHECK CORRECT ENGINE TUNE-UP**
   (See page EM-34)

2. **PRECAUTIONS WHEN CONNECTING GAUGE**

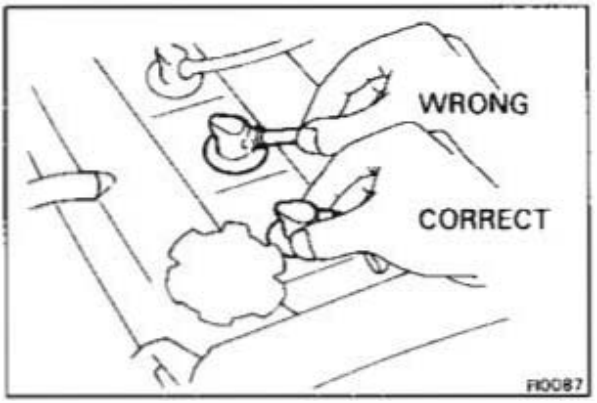
   (a) Use the battery as the power source for the timing light, tachometer, etc.

   (b) Connect the test probe of a tachometer to terminal IG⊖ of the check connector.

   LOCATION: See page FI-89



   (Reference (AT and AW))
   Connect the test probe of a tachometer to the negative (⊖) terminal of the ignition coil.



3. **IN EVENT OF ENGINE MISFIRE 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 lines are reconnected securely.

   (d) When cleaning the engine compartment, be especially careful to protect the electrical system from water.

4. **PRECAUTIONS WHEN HANDLING OXYGEN SENSOR**

   (a) Do not allow oxygen sensor to drop or hit against an object.

   (b) Do not allow the sensor to come into contact with water.

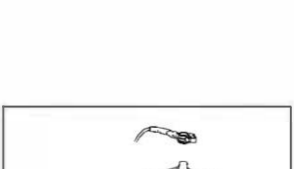
IF VEHICLE IS EQUIPPED WITH MOBILE RADIO SYSTEM (HAM, CB, ETC.)

The ECU has been designed so that it will not be affected by outside interference. However, if your vehicle is equipped with a CB radio transceiver, etc. (even one with about 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:

1. Install the antenna as far as possible from the ECU. The ECU is located under the radio (AE and AT), center the rear luggege compartment (AW), so the antenna should be installed at the rear side of the vehicle.
2. Keep the antenna feeder as far away as possible from the ECU wires – atleast 20 cm (7.87 in.) – and, especially, do not wind them together.
3. Check that the feeder and antenna are properly adjusted
4. Do not equip your vehicle with a powerful mobile radio system.

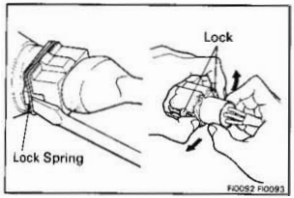
AIR INDUCTION SYSTEM

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 throttle body and cylinder head will allow air suction and cause the engine to run out of tune.

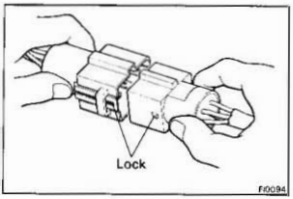

FI1066

ELECTRONIC CONTROL SYSTEM

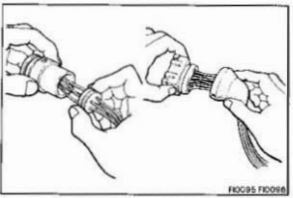
1. Before removing EFI wiring connectors, terminals, etc., first disconnect the power by either turning the ignition switch OFF or disconnecting the battery terminals.
2. When installing the battery, be especially careful not to incorrectly connect the positive (⊕) and negative (⊖) cables.
3. Do not permit parts to receive a severe impact during removal or installation. Handle all EFI parts carefully, especially the ECU.
4. Do not be careless 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 compertment, prevent water from getting on the EFI parts and wiring connectors.
7. Parts should be replaced as an assembly.



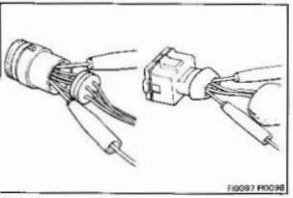
8. Care is raquired when pulling out and inserting wiring connectors.
   (a) Release the lock and pull out the connector, pulling on the connectors.



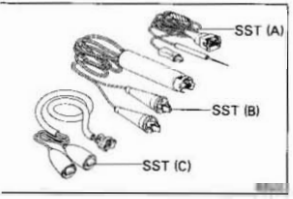
   (b) Fully insert the connector and check that it is locked.



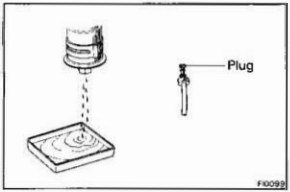
9. When inspecting a connector with a volt/ohmmeter.
   (a) Carefully take out the water-proofing rubber if it is a water-proof type connector.



   (b) Insert the test probe into the connector from wiring side when checking the continuity, amperage or voltage
   (c) Do not apply unnecessary force to the terminal
   (d) After checking, install the water-proofing rubber on the connector securely.

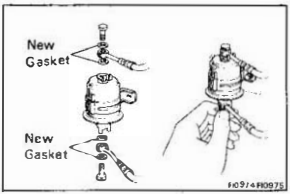


10. Use SST for inspection or test of the injector, cold start injector or its wiring connector.
    SST w/o Air flow meter
    09842-30050 (A) and 09842-30060 (B)
    w/ Air flow meter
    09842-30050 (A) and 09842-30070 (C)



FUEL SYSTEM

1. When disconnecting the high fuel pressure line, a large amount of gasoline will spill out, so observe the following procedure:
   (a) Put a a container under the connection.
   (b) Slowly loosen the connection.
   (c) Disconnect the connection.
   (d) Plug the connection with a rubber plug.

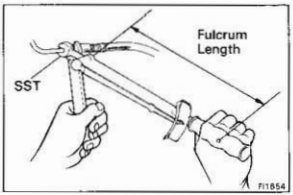


2 When connecting the flare nut or union bolt on the high pressure pipe union, observe the following procedure:

(Union Bolt Type)

(a) Always use a new gasket.
(b) Tighten the union bolt by hand.
(c) Tighten the union bolt to the specified torque.

Torque: 300 kg-cm (22 ft-lb, 29 N·m)



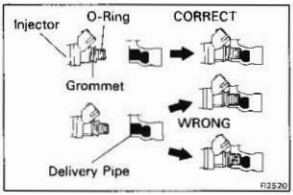
(Flare Nut Type)

(a) Apply a light coat of engine oil the flare and tighten the flare nut by hand.
(b) Using SST, tighten the flare nut to specified torque.

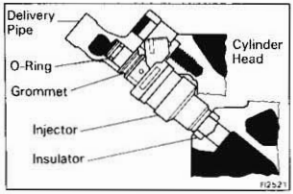
SST 09631-22020

Torque: 310 kg-cm (22 ft-lb, 30 N·m)

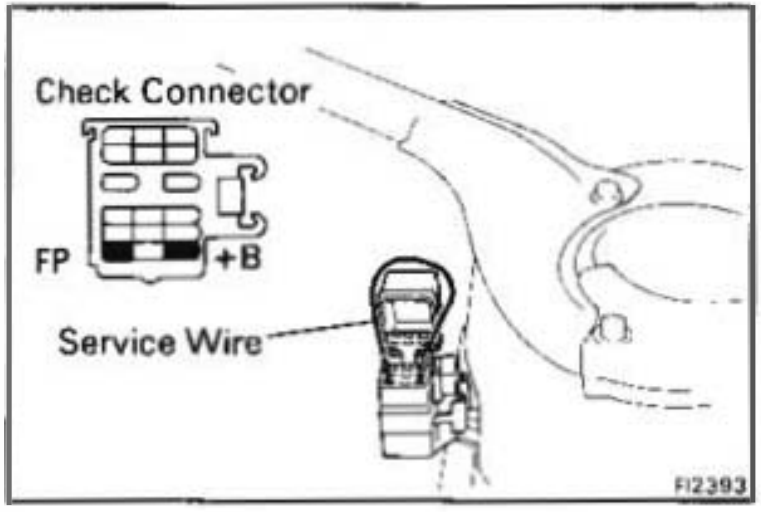
NOTE: Use a torque wrench with a fulcrum length of 30 cm (11.81 in.)



3. Observe the following precautions when removing end installing the injectors.
   (a) Never reuse the O-ring.
   (b) When placing a new O-ring on the injector, take care not to damage it in any way.
   (c) Coat a new O-ring with spindle oil or gasoline before installing – never use engine, gear or brake oil



4. Install the injector to delivery pipe and cylinder head as shown in the figure.

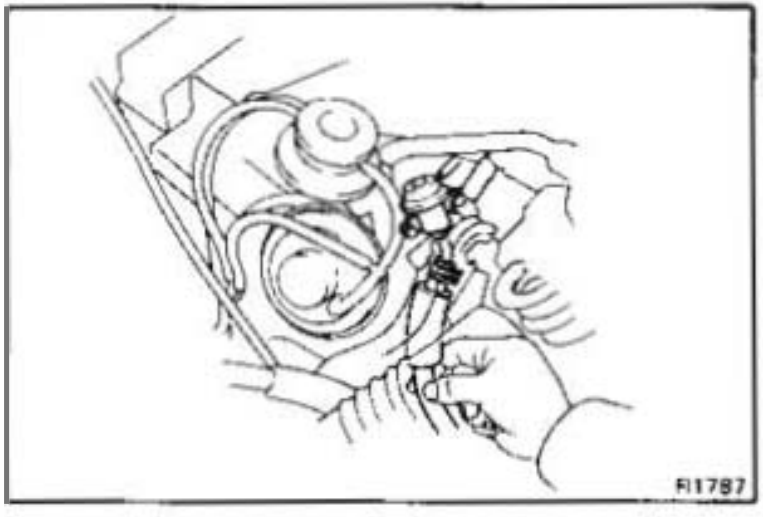


5. Check that there are no fuel leaks after performing any maintenance on the fuel system.

(a) With engine stopped, turn the ignition switch ON.

(b) Using a service wire, short terminals +B and FP of the check connector.

LOCATION: See page FI-89



(c) When the fuel return hose is pinched, the pressure within 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.

CAUTION: Always pinch the hose. Avoid bending as it may cause the hose to crack.

TROUBLESHOOTING

TROUBLESHOOTING HINTS

1. Engine trouble 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

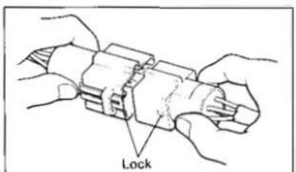
   (c) Fuel supply
      - Fuel leakage
      - Fuel filter
      - Fuel pump

   (d) Ignition system
      - Spark plugs
      - High-tension cords
      - Distributor
      - Ignition coil
      - Igniter

   (e) Air induction system
      - Vacuum leaks

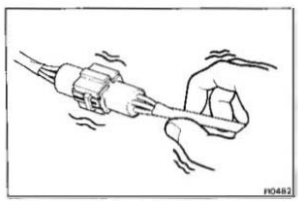
   (f) Emission control system
      - PCV system
      - EGR system (w/ Air flow meter)

   (g) Others
      - Ignition timing
      - Idle speed
      - etc.



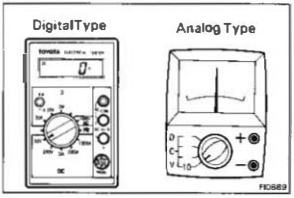
2. The most frequent cause of problems is simply a bad contact in wiring connectors. Always check that connections are secure.

   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 troubleshooting for other causes before replacing the ECU, as the ECU is of high quality and expensive.



4. Use a volt/ohmmeter with high impedance (10 kΩ/V minimum) for troubleshooting of the electrical circuit. (See page FI-29)

TROUBLESHOOTING PROCEDURES
SYMPTOM — DIFFICULT TO START OR NO START (ENGINE WILL NOT CRANK OR CRANKS SLOWLY)

CHECK ELECTRIC 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. St rter 3. Wiring/Connection

SYMPTOM — DIFFICULT TO START OR NO START (CRANKS OK)

CHECK DIAGNOSIS SYSTEM
Check for output of diagnosis code. (See page FI-22)
→ Malfunction code(s) → Diagnosis code(s) (See page FI-25 or 26)

Normal code ↓

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

OK ↓

CHECK IGNITION SPARK (See page IG-19) → BAD → 1. High-tension cords 2. Distributor 3. Ignition coil, igniter

OK ↓

CHECK IGNITION TIMING
1. Short terminals T and E1 of the check connector.
2. Check ignition timing.
Standard: 10° BTDC @ idle
→ NO → Ignition timing – Adjust (See page EM-37)

OK ↓ CONTINUED ON PAGE FI-12

OK CONTINUED FROM PAGE FI-11

CHECK FUEL SUPPLY TO INJECTOR
1. Fuel in tank
2. Fuel pressure in fuel line
   (1) Short terminals +B and FP of the check connector.
   (2) Fuel pressure at fuel hose of fuel filter can be felt. (See page FI-67)

BAD →
1. Fuel line – Leakage – deformation
2. Fuse
3. Circuit opening relay (See page FI-91)
4. Fuel pump (See page FI-65)
5. Fuel filter
6. Fuel pressure regulator (See page FI-75)

OK

(w/ AIR FLOW METER)
CHECK FUEL PUMP SWITCH IN AIR FLOW METER
Check continuity between terminals FC and E1 while measuring plate of air flow meter is open.

BAD → Air flow meter (See page FI-82)

OK

CHECK SPARK PLUGS
Standard: 1.1 mm (0.043 in.)
NOTE: Check compression pressure and valve clearance if necessary

NO →
1. Spark plugs
2. Compression pressure
   Minimum: 10.0 kg/cm² (142 psi, 981 kPa) at 250 rpm
3. Valve clearance (Cold)
   Standard: IN 0.15 – 0.25 mm (0.006 – 0.010 in.)
   EX 0.20 – 0.30 mm (0.008 – 0.0012 in.)

BAD (ALL Plugs WET) →
1. Injectors – shorted or leaking
2. Injector wiring – short circuited
3. Cold start injector – leakage (See page FI-72)
4. Cold start injector time switch (See page FI-95)

OK

CHECK AUXILIARY AIR VALVE
(See page FI-87)

BAD →
1. Auxiliary air valve
2. Water hoses
3. Air hoses

OK

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER
(See page FI-29)

BAD →
1. Wiring connections
2. Power to (ECU)
   (1) Fusible links
   (2) Fuses
   (3) EFI main relay
3. Air flow meter (w/ Air flow meter)
4. Vacuum sensor (w/o Air flow meter)
5. Water temp. sensor
6. Air temp. sensor
7. Injection signal circuit
   (1) Injector wiring
   (2) Solenoid resistor (w/o Air flow meter)
   (3) ECU

SYMPTOM – ENGINE OFTEN STALLS

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-22)

→ Malfunction code(s) → Diagnostic code(s) (See page FI-25 or 26)

↓ Normal code

CHECK FOR VACUUM LEAKS IN AIR INTAKE LINE

→ BAD →
1. Oil filler cap
2. Oil dipstick
3. Hose connections
4. PCV hose(s)
5. EGR system – EGR valve stays open

↓ OK

CHECK FUEL SUPPLY TO INJECTOR
1. Fuel in tank
2. Fuel pressure in fuel line
   (1) Short terminals +B and FP of the check connector.
   (2) Fuel preasure at fuel hose of fuel filter. (See page FI-67)

→ BAD →
1. Fuel line – leakage – deformation
2. Fuses
3. Circuit opening relay (See page FI-91)
4. Fuel pump (See page FI-65)
5. Fuel filter
6. Fuel pressure regulator (See page FI-75)

↓ OK

CHECK AIR FILTER ELEMENT

→ BAD → Element – Clean or replace

↓ OK

CHECK IDLE SPEED (AND IDLE CO CONCENTRATION)
Standard: 800 rpm

→ NO → Idle speed – Adjust (See page EM-39 or 42)

↓ OK

CHECK IGNITION TIMING
1. Short terminals T and E1 of the check connector.
2. Check ignition timing.
   Standard: 10° BTDC @ idle

→ NO → Ignition timing – Adjust (See page EM-37)

↓ OK

CHECK SPARK PLUGS
Standard: 1.1 mm (0.043 in.)
NOTE: Check compression pressure and valve clearance if necessary.

→ NO →
1. Spark plugs
2. Compression pressure
   Minimum: 10.0 kg/cm² (142 psi, 981 kPa) at 250 rpm
3. Valve clearance (Cold)
   Standard: IN 0.15 – 0.25 mm (0.006 – 0.010 in.)
   EX 0.20 – 0.30 mm (0.008 – 0.012 in.)

↓ OK

CHECK COLD START INJECTOR
(See page FI-72)

→ BAD →
1. Cold start injector
2. Cold start injector time switch. (See page FI-95)

↓ OK CONTINUED ON PAGE FI-14

OK CONTINUED FROM PAGE FI-13

CHECK AUXILIARY AIR VALVE
(See page FI-87)

BAD →
1. Auxiliary air valve
2. Water hose
3. Air hoses

OK

CHECK FUEL PRESSURE
(See page FI-67)

BAD →
1. Fuel pump (See page FI-65)
2. Fuel filter
3. Fuel pressure regulator (See page FI-75)

OK

CHECK INJECTORS
(See page FI-77)

BAD →
Injection condition

OK

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER
(See page FI-29)

BAD →
1. Wiring connections
2. Power to ECU
   (1) Fusible links
   (2) Fuses
   (3) EFI main relay
3. Air flow meter (w/ Air flow meter)
4. Vacuum sensor (w/o Air flow meter)
5. Water temp. sensor
6. Air temp. sensor
7. Injection signal circuit
   (1) Injector wiring
   (2) Solenoid resistor (w/o Air flow meter)
   (3) ECU

SYMPTOM — ENGINE SOMETIMES STALLS

CHECK DIAGNOSTIC SYSTEM
Check for output of diagnostic code.
(See page FI-22)

Malfunction code(s) →
Diagnostic(s) (See page FI-25 or 26)

Normal code

(w/ AIR FLOW METER)
CHECK AIR FLOW METER
(See page FI-82)

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. Connectors
2. EFI main relay (See page FI-90)
3. Circuit opening relay (See page FI-91)

SYMPTOM – ROUGH IDLING AND/OR MISSING

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-22)

Malfunction code(s) → Diagnostic code(s) (See page FI-25 or FI-26)

Normal code ↓

CHECK FOR VACUUM LEAKS IN AIR INTAKE LINE

BAD → 1. Oil filler cap
2. Oil dipstick
3. Hose connections
4. PCV hose(s)
5. EGR system – EGR valve stays open

OK ↓

CHECK AIR FILTER ELEMENT

BAD → Element – Clean or replace

OK ↓

CHECK IDLE SPEED (AND IDLE CO CONCENTRATION)
Standard: 800 rpm

NO → Idle speed – Adjust

OK ↓

CHECK IGNITION TIMING
1. Short terminals T and E1 of the check connector
2. Check ignition timing.
Standard: 10° BTOC @ idle

NO → Ignition timing – Adjust (See page EM-37)

OK ↓

CHECK T-VIS INTAKE AIR CONTROL VALVE
Check that the air control valve is closed.

NO → 1. VSV for air control valve
2. Vacuum leaks

OK ↓

CHECK SPARK PLUGS
Standard: 1.1 mm (0.043 in.)
NOTE: Check compression pressure and valve clearance if necessary.

NO → 1. Spark plugs
2. Compression pressure
Minimum: 10.0 kg/cm² (142 psi, 981 kPa) at 250 rpm
3. Valve clearance (Cold)
Standard: IN 0.15 – 0.25 mm (0.006 – 0.010 in.)
EX 0.20 – 0.30 mm (0.008 – 0.012 in.)

OK ↓

CHECK COLD START INJECTOR
(See page FI-72)

BAD → 1. Cold start injection
2. Cold start injector time switch (See page FI-95)

OK CONTINUED ON PAGE FI-16

OK CONTINUED FROM PAGE FI-15

CHECK FUEL PRESSURE
(See page FI-67)
BAD →
1. Fuel pump (See page FI-65)
2. Fuel filter
3. Fuel pressure regulator (See page FI-75)

OK

CHECK INJECTORS
(See page FI-77)
BAD → Injection condition

OK

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER
(See page FI-29)
BAD →
1. Wiring connections
2. Power to ECU
   (1) Fusible links
   (2) Fuses
   (3) EFI main relay
3. Air flow meter (w/ Air flow meter)
4. Vacuum sensor (w/o Air flow meter)
5. Water temp. sensor
6. Air temp. sensor
7. Injection signal circuit
   (1) Injector wiring
   (2) Solenoid resistor (w/o Air flow meter)
   (3) ECU
8. Oxygen sensor (w/ TWC)

OK

(w/o AIR FLOW METER)
CHECK VARIABLE RESISTOR
(See page FI-98)
BAD → Variable resistor

SYMPTOM — HIGH ENGINE IDLE SPEED (NO DROP)

CHECK ACCELERATOR LINKAGE
BAD → Linkage — Stuck

OK

CHECK AUXILIARY AIR VALVE
(See page FI-87)
BAD → Auxiliary air valve — Always open

OK

CHECK AIR CONDITIONER IDLE-UP CIRCUIT
BAD → Air valve for air conditioner — Leakage

OK

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-22)
Malfunction code(s) → Diagnostic code(s) (See page FI-25 or 26)

Normal code

CHECK THROTTLE POSITION SENSOR
(See page FI-84)
BAD → Throttle body

OK CONTINUED ON PAGE FI-17

OK CONTINUED FROM PAGE FI-16

CHECK FUEL PRESSURE
(See page FI-67)
BAD → Fuel pressure regulator – High pressure

OK

CHECK COLD START INJECTOR
(See page FI-72)
BAD → Cold start injector – Linkage

OK

CHECK INJECTORS (See page FI-77)
BAD → Injectors – Leakage, Injection quantity

OK

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER
(See page FI-29)
BAD →
1. Wiring connection
2. Power to ECU
   (1) Fusible links
   (2) Fuses
   (3) EFI main relay
3. Air flow meter (w/ Air flow meter)
4. Vacuum sensor (w/o Air flow meter)
5. Water temp. sensor
6. Air temp. sensor
7. Injection signal circuit
   (1) Injector wiring
   (2) Solenoid resistor (w/o Air flow meter)
   (3) ECU

SYMPTOM – ENGINE BACKFIRES-Lean Fuel Mixture

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-22)
Malfunction code(s) → Diagnostic code(s) (See page FI-25 or 26)

Normal code

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

OK

CHECK IGNITION TIMING
1. Short terminals T and E1 of the check connector
2. Check ignition timing.
   Standard: 10° BTDC @ idle
NO → Ignition timing – Adjust (See page EM-37)

OK

CHECK IDLE SPEED (AND IDLE CO CONCENTRATION)
(See page EM-39 or 42)
NO →
1. Idle speed – Adjust
2. Idle CO concentration – Adjust

OK CONTINUED ON PAGE FI-18

OK CONTINUED FROM PAGE FI-17

CHECK COLD START INJECTOR
(See page FI-72)

BAD →
1. Cold start injection
2. Cold start injector time switch.
(See page FI-95)

OK

CHECK FUEL PRESSURE
(See page FI-67)

BAD →
1. Fuel pump (See page FI-65)
2. Fuel filter
3. Fuel pressure regulator
(See page FI-75)

OK

CHECK INJECTORS
(See page FI-77)

BAD → Injectors — Clogged

OK

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER
(See page FI-29)

BAD →
1. Wiring connections
2. Power to ECU
   (1) Fusible links
   (2) Fuses
   (3) EFI main relay
3. Air flow meter (w/ Air flow meter)
4. Vacuum sensor (w/o Air flow meter)
5. Water temp. sensor
6. Air temp. sensor
7. Throttle position sensor
8. Injection signal circuit
   (1) Injector wiring
   (2) Fuel cut RPM (See page FI-108)
   (3) ECU
9. Oxygen sensor (w/ TWC)

OK

(w/o AIR FLOW METER)
CHECK VARIABLE RESISTOR
(See page FI-98)

BAD → Variable resistor

SYMPTOM — MUFFLER EXPLOSION (AFTER FIRE)-Rich Fuel Mixture-Misfire

CHECK DIAGNOSIS SYSTEM
Check for output of diagnostic code.
(See page FI-22)

Malfunction code(s) → Diagnostic code(s) (See page FI-25 or 26)

Normal

CHECK IGNITION TIMING
1. Short terminals T and E1 of the check connector
2. Check ignition timing.
Standard: 10° BTDC @ idle

NO → Ignition timing — Adjust
(See page EM-37)

OK CONTINUED ON PAGE FI-19

OK CONTINUED FROM PAGE FI-18

CHECK IDLE SPEED (AND IDLE CO CONCENTRATION)
(See page EM-39 or 42)

NO →
1. Idle speed – Adjust
2. Idle CO concentration – Adjust

OK ↓

CHECK COLD START INJECTOR
(See page FI-72)

BAD →
1. Cold start injector
2. Cold start injector time switch. (See page FI-95)

OK ↓

CHECK FUEL PRESSURE
(See page FI-67)

BAD →
Fuel pressure regulator

OK ↓

CHECK INJECTORS (See page FI-77)

BAD →
Injectors – Leakage

OK ↓

CHECK SPARK PLUGS
Standard: 0.11 mm (0.043 in.)
NOTE: Check compression pressure and valve clearance if necessar .

NO →
1. Spark plugs
2. Compression pressure
   Minimum: 10.0 kg/cm² (142 psi, 981 kPa) at 250 rpm
3. Valve clearance (Cold)
   Standard: IN 0.15 – 0.25 mm (0.006 – 0.010 in.)
   EX 0.20 – 0.30 mm (0.008 – 0.012 in.)

OK ↓

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER
(See page FI-29)

BAD →
1. Throttle position sensor
2. Injection signal circuit
   (1) Injector wiring
   (2) Fuel cut RPM (See page FI-108)
   (3) Solenoid resistor (w/o Air flow meter)
   (4) ECU
3. Oxygen sensor (w/ TWC)

SYMPTOM – ENGINE HESITATES AND/OR POOR ACCELERATION

CHECK CLUTCH OR BRAKES

BAD →
1. Clutch – Slips
2. Brakes – Drag

OK ↓

CHECK FOR VACUUM LEAKS IN AIR INTAKE LINE

BAD →
1. Oil filler cap
2. Oil dipstick
3. Hose connections
4. PCV hose(s)
5. EGR system – EGR valve stays open

OK CONTINUED ON PAGE FI-20

OK CONTINUED FROM PAGE FI-19

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(s) → Diagnostic code(s) (See page FI-25 or 26)

Normal code

CHECK IGNITION SPARK
(See page IG-19)

BAD → 1. High-tension cords
2. Distributor
3. Ignition coil, igniter

OK

CHECK IGNITION TIMING
1. Short terminals T and E1 of the check connector
2. Check ignition timing.
Standard: 10° BTDC @ idle

NO → Ignition timing – Adjust
(See page EM-37)

OK

CHECK FUEL PRESSURE
(See page FI-67)

BAD → 1. Fuel pump (See page FI-65)
2. Fuel filter
3. Fuel pressure regulator
(See page FI-75)

OK

CHECK INJECTORS
(See page FI-77)

BAD → Injection condition

OK

CHECK SPARK PLUGS
Standard: 1.1 mm (0.043 in.)
NOTE: Check compression pressure and valve clearance if necessary.

BAD → 1. Spark plugs
2. Compression pressure
Minimum: 10.0 kg/cm² (142 psi, 981 kPa) at 250 rpm
3. Valve clearance (Cold)
Standard: IN 0.15 – 0.25 mm (0.006 – 0.010 in.)
EX 0.20 – 0.30 mm (0.008 – 0.012 in.)

OK

CHECK T-VIS AIR CONTROL VALVE
Check its air control valve open with engine running at Approx. 5,000 rpm (w/o TWC), 4,350 rpm (w/ TWC) or above.

NO → 1. VSV for air control valve
2. Vacuum leaks

OK CONTINUED ON PAGE FI-21

OK CONTINUED FROM PAGE FI-20

CHECK EFI ELECTRONIC CIRCUIT USING VOLT/OHMMETER
(See page FI-29)

BAD

1. Wiring connections
2. Power to ECU
   (1) Fusible links
   (2) Fuses
   (3) EFI main relay
3. Air flow meter (w/ Air flow meter)
4. Vacuum sensor (w/o Air flow meter)
5. Water temp. sensor
6. Air temp. sensor
7. Throttle position sensor
8. Injection signal circuit
   (1) Injector wiring
   (2) Solenoid resistor (w/o Air flow mete
   (3) ECU

DIAGNOSIS SYSTEM

DESCRIPTION

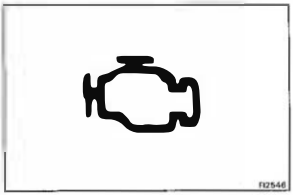
The ECU contains a built-in self-diagnosis system by which troubles with the engine signal network are detected and a check engine warning light on the instrument panel flashes.

By analyzing various signals as shown in the lster table (See page FI-25 or 26) the ECU detects system malfunctions which are related to the various operating parameter sensors or actuator. The ECU stores the failure code associated with the detected failure until the diagnosis system is cleared by removing the fuse stop 15A (AE), EFI 15A (AT) or AM2 7.5A (AW) with the ignition switch OFF.

The check engine warning light on the instrument panel informs the driver that a malfunction has been detected.

The light goes out automatically when the malfunction has been cleared.

CHECK ENGINE WARNING LIGHT CHECK

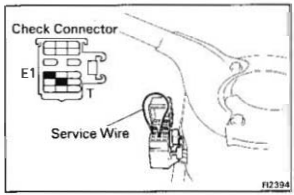

FI2546

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 or abnormality in the system.

OUTPUT OF DIAGNOSTIC CODES

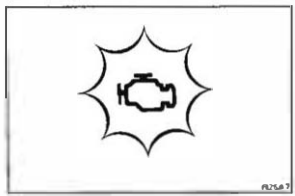
To obtain an output of diagnostic codes, proceed as follow:

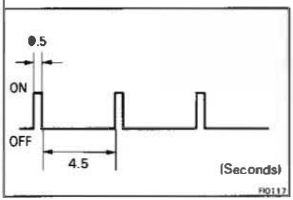


FI2394

1 Initial conditions
   (a) Battery voltage 11 volts or more
   (b) Throttle valve fully closed (throttle position sensor IDL points closed)
   (c) Transmission in neutral position
   (d) Accessories switched OFF
   (e) Engine at reach normal operating temperature
2. Turn the ignition switch to ON. Do not start the engine.
3. Using a service wire, short terminals T and E1 of the check connector.

   LOCATION: See page FI-89
4. Read the diagnostic code as indicated by the number of flashes of the check engine warning light.


FI2547

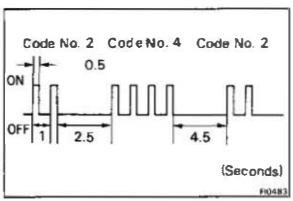


Diagnostic Codes (See page FI-25 or 26)

(TCCS ECU w/o Air Flow Meter)

(a) Normal System Operation (code No.1) (normal function)

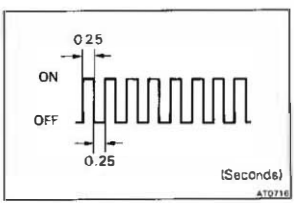
- The light will blink every 4.5 seconds.



(b) Malfunction Code Indication

- The light blink a number of times equal to the malfunction code indication with a 2.5 second interval between each indication
- After all the codes have been output, there will be a 4.5 second pause and they will all be repeated as long as terminals T and E1 of the check connector are shorted.

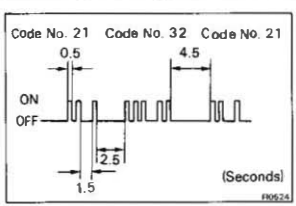
NOTE: In the event of a number of trouble codes, indication will begin from the smaller value and continue in order to the larger.



(TCCS ECU w/ Air Flow Meter)

(a) Normal System Operation (no malfunction)

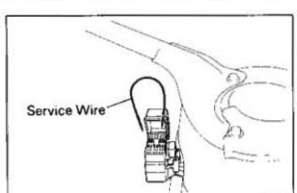
- The light will alternately blink on and OFF for 0.25 second intervals.



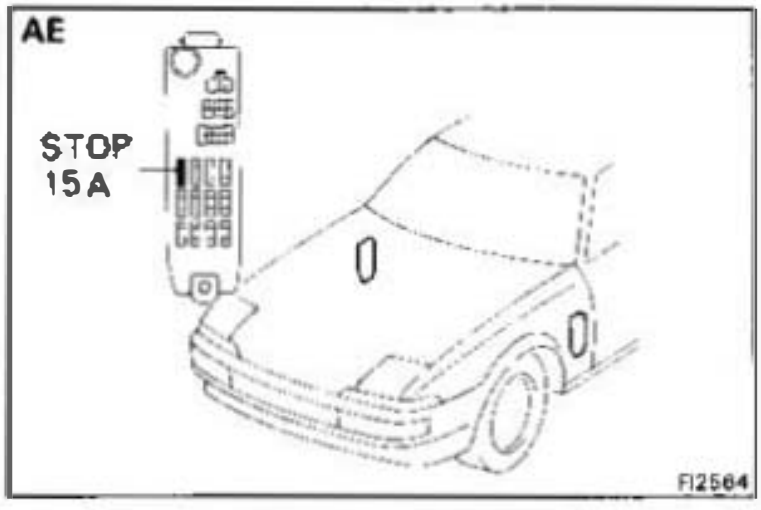
(b) Malfunction Code Indication

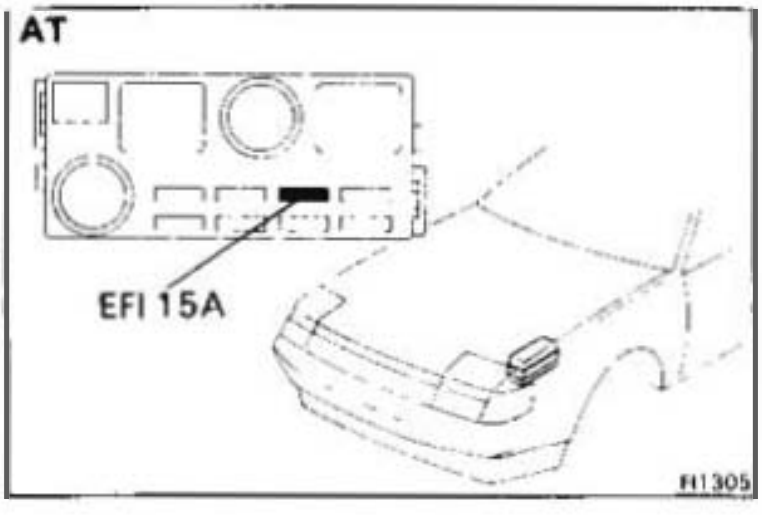
- In the event of a malfunction, the light will blink every 0.5 seconds. The first number of blinks will equal the first digit of a 2-digit diagnostic code and, after a 1.5 second pause, the 2nd number of blinks will equal the 2nd. If there are two or more codes, there will be a 2.5 second pause between each.
- After all the codes have been output, there will be a 4.5 second pause and they will all be repeated as long as the terminals T and E1 of the check connector are shorted.

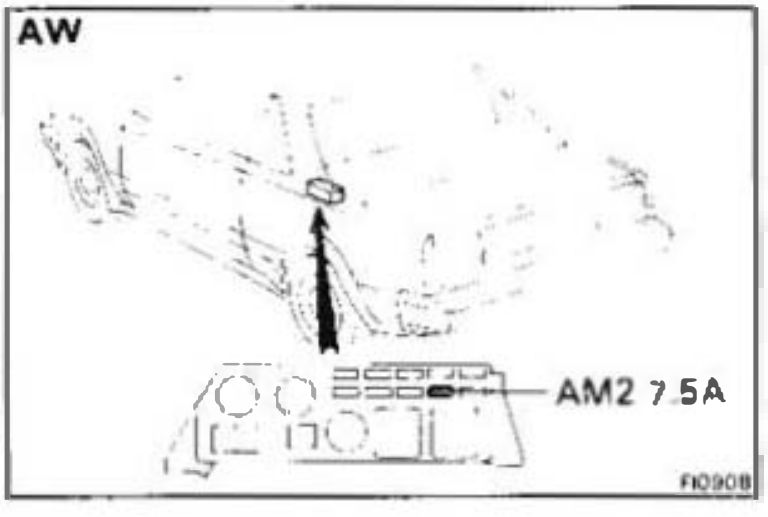
NOTE: In the event of a number of trouble codes, indication will begin from the smaller value and continue in order to the larger.



5. After the diagnosis check, remove the service wire.







CANCELLING DIAGNOSTIC CODE

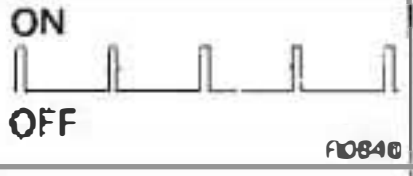
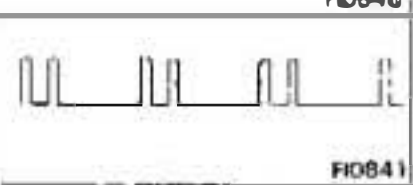
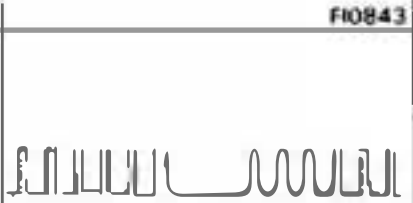
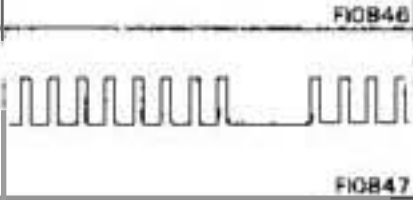
1. After repair of trouble area, the diagnostic code retained in memory by the ECU must be cancelled out by removing the fuse STOP 15A (AE), EFI 16A (AT) or AM2 7.5A (AW), located in the engine compartmentrelay box, for 10 seconds or more, depending on ambient temperature (the lower the temperature, the longer the fuse must be left out) with the ignition switch OFF.

   NOTE:
   - Cancellation can also be done by removing the battery negative (⊖) terminal, but in this case, other memory systems (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 the 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 is has been recorded.

2. After cancellation, road test the vehicle to check that a normal code is now read on the check engine warning light.

   If the same diagnostic code appers, it indicates that the trouble area has not been repaired thoroughly.

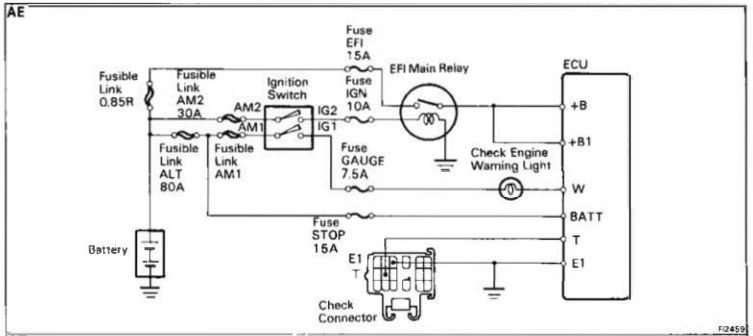
DIAGNOSTIC CODES (TCCS ECU w/o Air Flow Meter)

Code No.	Number of CHECK ENGINE blinks	System	Diagnosis	Trouble area	See page
1		Normal	This appears when none of the other codes (2 thru 11) are identified.	—	—
2		Vacuum sensor signal	Open or short circuit in vacuum sensor signal.	1. Vacuum sensor circuit 2. Vacuum sensor 3. ECU	FI-44
3		Ignition signal	No signal from igniter four times in succession.	1. Ignition circuit (+B, IGF, IGT) 2. Igniter 3. ECU	FI-37
4		Water temp. sensor signal	Open or short circuit in water temp. sensor signal.	1. Water temp. sensor circuit 2. Water temp. sensor 3. ECU	FI-46
6		RPM signal	• No NE, G signal to ECU within several seconds after engine is cranked. • No NE signal to ECU when the engine speed is above 1,000 rpm	1. Distributor circuit 2. Distributor 3. Igniter 4. Starter signal circuit 5. ECU	FI-37
7		Throttle position sensor signal	Open or short circuit in throttle position sensor signal.	1. Throttle position sensor circuit 2. Throttle position sensor 3. ECU	FI-35
8		Intake air temp. sensor signal	Open or short circuit in intake air temp. sensor signal.	1. Intake air temp. sensor circuit 2. ECU	FI-45
9		Vehicle speed sensor signal	• Engine rpm is between 2,000 – 5,500 rpm. • Water temp. is 80°C (176°F) or more. • Manifold pressure is a certain value or more and vehicle speed continues at 0 km/h for seconds or more.	1. Vehicle speed sensor circuit 2. Vehicle speed sensor 3. ECU	—
10		Starter signal	No STA signal to ECU when vehicle stopped and engine over 800 rpm.	1. Starter relay circuit (A/W) 2. IG switch circuit (starter) 3. IG switch 4. ECU	FI-39
11		Switch signal	Air conditioner switch ON, idle switch OFF or shift position in D range during diagnosis check.	1. Air con. switch 2. Throttle position sensor circuit 3. Throttle position sensor 4. Neutral start switch 5. ECU	—

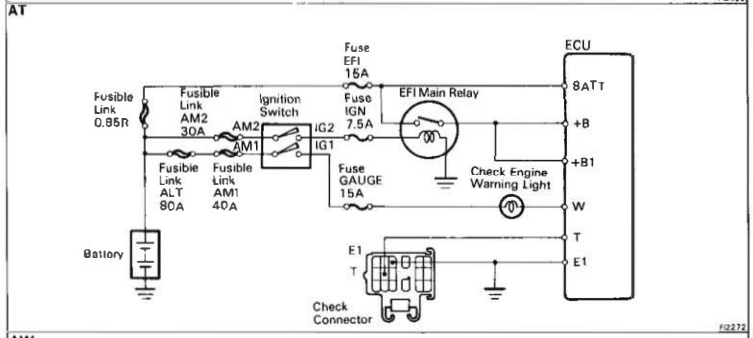
DIAGNOSTIC CODES (TCCS ECU w/ Air Flow Meter)

Code No.	Number of CHECK ENGINE blinks	System	Diagnosis	Trouble area	See page
—	 FI1401	Normal	This appears when none of the other codes (12 thru 51) are identified.	—	—
12	FI1389	RPM signal	No NE, G signal to ECU within several seconds after engine is cranked.	1. Distributor circuit 2. Distributor 3. Starter signal circuit 4. ECU	IG-18
13	 FI1390	RPM signal	No NE signal to ECU within several seconds after engine reaches 1,500 rpm.	Same as 12. above	
14	 FI1391	Ignition signal	No signal from igniter 4 – 5 times in succession.	1. Igniter circuit (+B, IGT, IGF) 2. Igniter 3. ECU	FI-54
21	FI1400	Oxygen sensor signal	Oxygen sensor signal output decreases.	1. Oxygen sensor circuit 2. Oxygen sensor 3. ECU	—
22	 FI1392	Water temp. sensor signal	Open or short circuit in water temp. sensor signal (THW).	1. Water temp. sensor circuit 2. Water temp. sensor 3. ECU	FI-63
24	 FI1611	Intake air temp. sensor signal	Open or short circuit in intake air temp. sensor signal (THA).	1. Intake air temp. sensor circuit 2. Intake air temp. sensor 3. ECU	FI-62
25	FI2562	Lean signal	Oxygen sensor signal continues to indicate a lean condition.	1. Injector 2. Air flow meter 3. Water temp. sensor 4. Intake air temp. sensor 5. Oxygen sensor	—
26	 FI2563	Rich signal	Oxygen sensor signal continues to indicate a rich condition.	Same as 25. above.	—
31	FI1394	Air flow meter signal	• Open circuit in VC, VS, VB or E2. • Short circuit in VC.	1. Air flow meter circuit 2. Air flow meter 3. ECU	
41	 FI1396	Throttle position sensor signal	Open or short circuit in throttle position sensor signal.	1. throttle position sensor circuit 2. throttle position sensor 3. ECU	FI-52
42	FI1397	Vehicle speed sensor signal	• Engine rpm is between 2,000 – 5,500 rpm. • Water temp. is 80°C (176°F) or more. • Basic injection duration is a certain value or more.	1. Vehicle speed sensor circuit 2. Vehicle speed sensor 3. ECU	—
43	 FI1398	Starter signal	No STA signal to ECU when vehicle stopped and engine running over 800 rpm	1. Starter relay circuit (AW) 2. IG switch circuit (starter) 3. IG switch 4. ECU	FI-56
51	 FI1399	Switch signal	Air conditioner switch ON, idle switch OFF of shift position other than P or N range during diagnosis check.	1. Air con. switch 2. Throttle position sensor circuit 3. Throttle position sensor 4. Neutral start switch 5. ECU	—

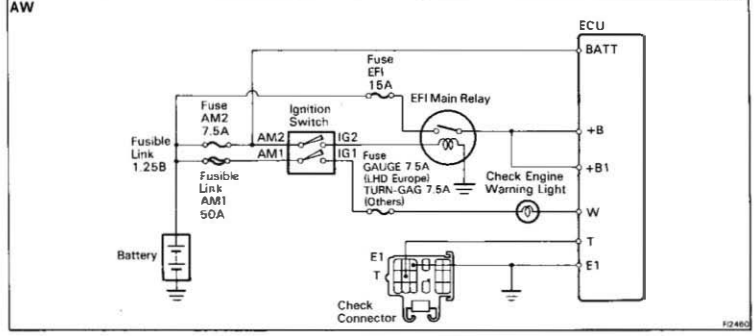
AE


Fusible Link 0.85R
Fusible Link AM2 30A
Fusible Link ALT 80A
Fusible Link AM1
Ignition Switch
AM2
AM1
IG2
IG1
Fuse EFI 15A
Fuse IGN 10A
Fuse GAUGE 7.5A
Fuse STOP 15A
EFI Main Relay
ECU
+B
+B1
W
BATT
T
E1
Check Engine Warning Light
Battery
E1
T
Check Connector
FI2459

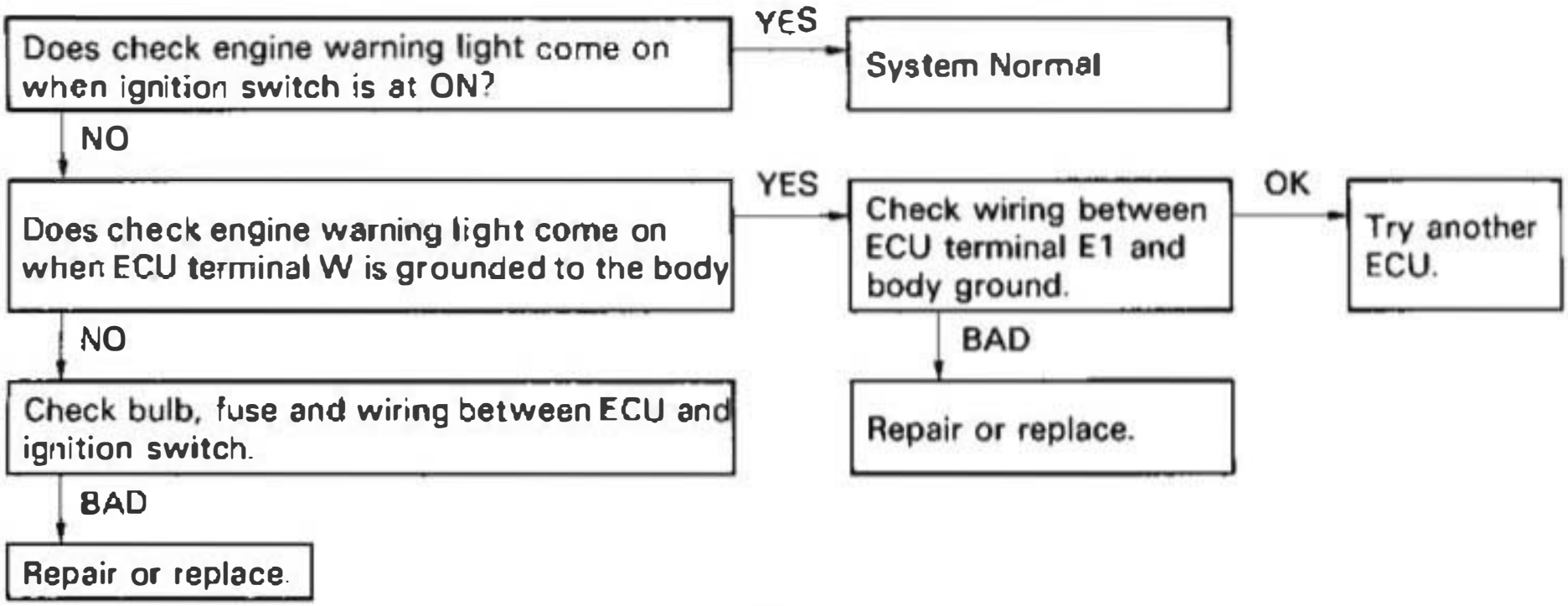
AT


Fusible Link 0.85R
Fusible Link AM2 30A
Fusible Link ALT 80A
Fusible Link AM1 40A
Ignition Switch
AM2
AM1
IG2
IG1
Fuse EFI 15A
Fuse IGN 7.5A
Fuse GAUGE 15A
EFI Main Relay
ECU
BATT
+B
+B1
W
T
E1
Check Engine Warning Light
Battery
E1
T
Check Connector
FI2272

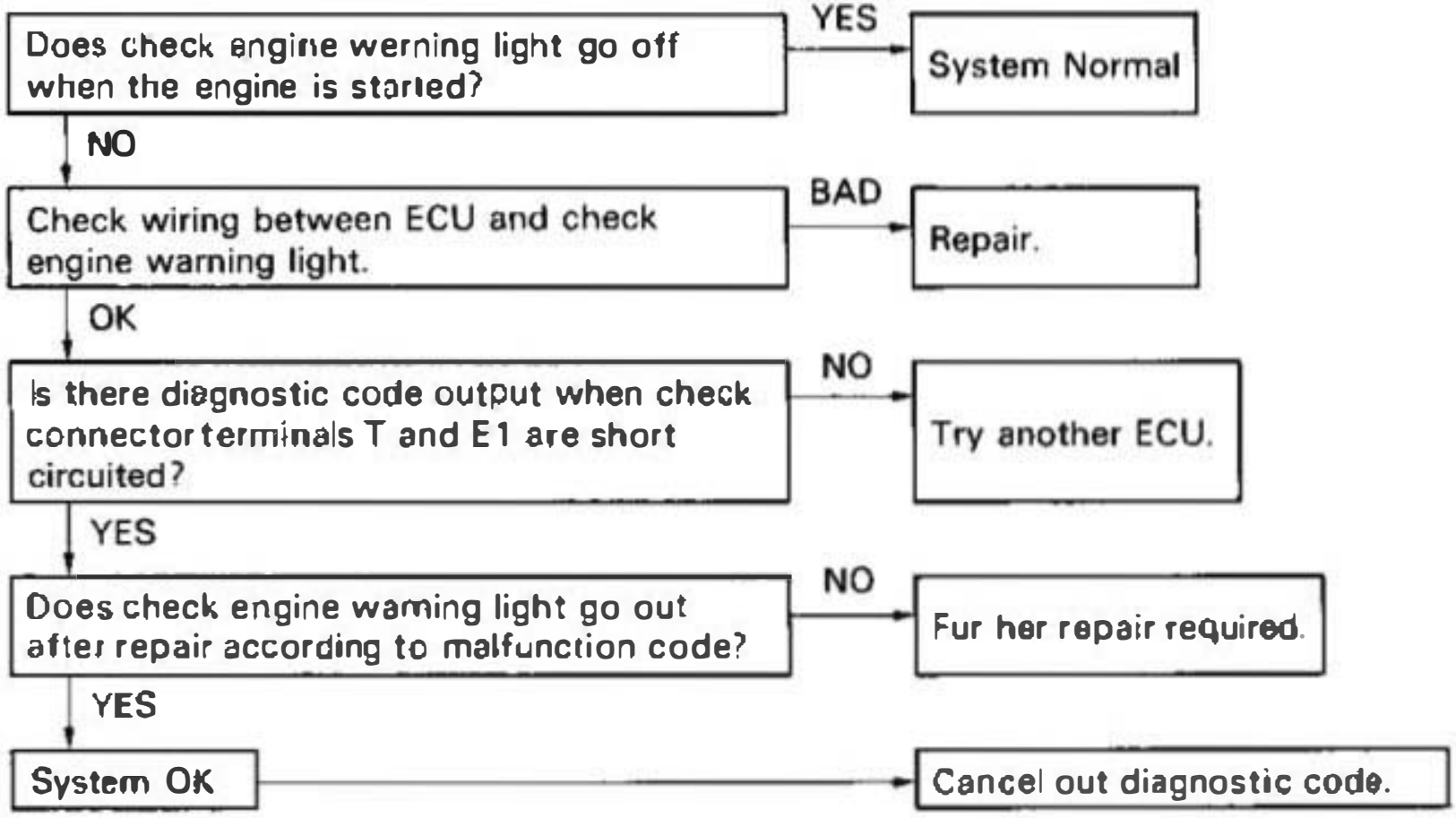
AW


Fusible Link 1.25B
Fusible Link AM1 50A
Fuse AM2 7.5A
Ignition Switch
AM2
AM1
IG2
IG1
Fuse EFI 15A
Fuse GAUGE 7.5A (LHD Europe) TURN-GAG 7.5A (Others)
EFI Main Relay
ECU
BATT
+B
+B1
W
T
E1
Check Engine Warning Light
Battery
E1
T
Check Connector
FI2460

1.


Does check engine warning light come on when ignition switch is at ON?
YES
System Normal
NO
Does check engine warning light come on when ECU terminal W is grounded to the body
YES
Check wiring between ECU terminal E1 and body ground.
OK
Try another ECU.
NO
BAD
Check bulb, fuse and wiring between ECU and ignition switch.
Repair or replace.
BAD
Repair or replace.

2.


Does check engine werning light go off when the engine is started?
YES
System Normal
NO
Check wiring between ECU and check engine warning light.
BAD
Repair.
OK
Is there diagnostic code output when check connector terminals T and E1 are short circuited?
NO
Try another ECU.
YES
Does check engine waming light go out after repair according to malfunction code?
NO
Fur her repair required.
YES
System OK
Cancel out diagnostic code.

TROUBLESHOOTING WITH VOLT/OHMMETER

NOTE: The following troubleshooting procedures are designed for inspection of each separate system, and therefore the actual procedure may vary somewhat. However, troubleshooting should be performed refering to the inspection methods described in this manual.

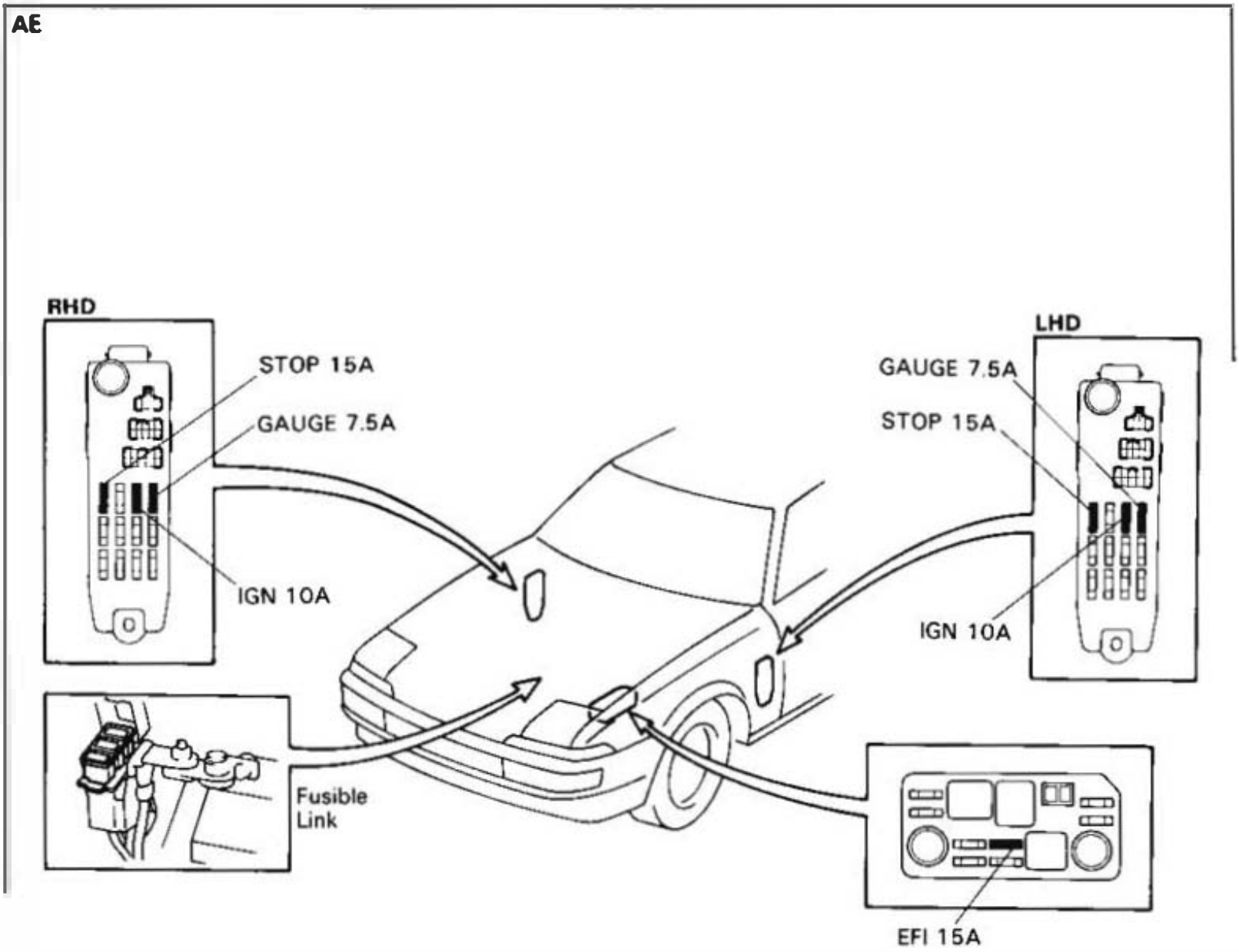
Before eginning inspection, it is best to first make a simple check of the fuses, fusible links and the condition of the connectors.

The following troubleshooting procedures are based on the supposition that the tr uble 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 through proper operating voltage is detected in the computer connector, then it can be assumed that the ECU is faulty and should be replaced.

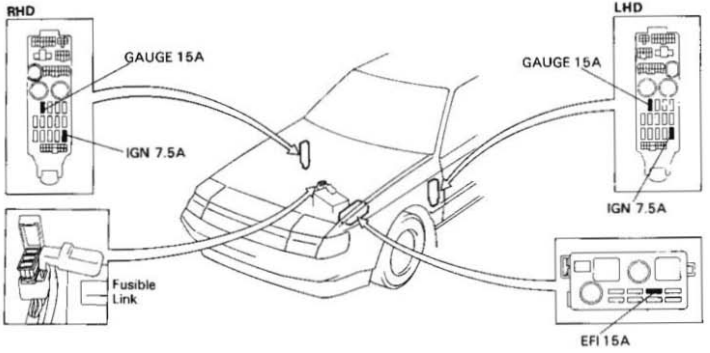
LOCATION OF FUSES AND FUSIBLE LINKS

AE

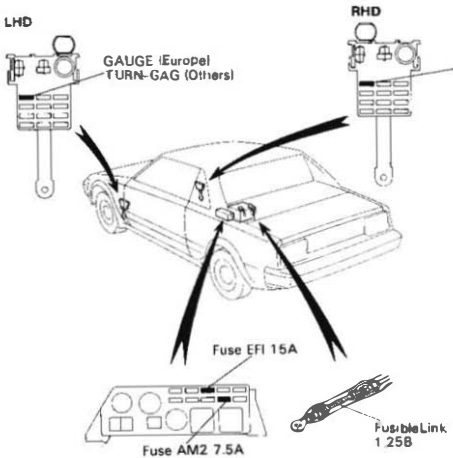


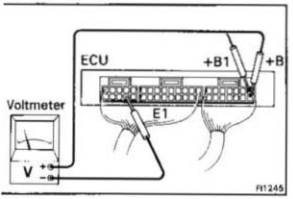
LOCATION OF FUSES AND FUSIBLE LINKS (Cont'd)

AT



AW





EFI SYSTEM CHECK PROCEDURE

NOTE:

- Perform all voltage measurements with the connectors connected.
- Verify that the battery voltage is 11 V or more when the ignition switch is at "ON".

Using a voltmeter with high impedence (10 kΩ/V minimum), measure the voltage at each terminal of the wiring connectors.

Terminals of ECU (TCCS ECU w/o Air Flow Meter)

Symbol	Terminal Name	Symbol	Terminal Name
E01	ENGINE GROUND	T	CHECK CONNECTOR
E02	ENGINE GROUND	IDL	THROTTLE POSITION SENSOR
No.10	INJECTOR	THA	INTAKE AIR TEMP. SENSOR
No.20	INJECTOR	VCC	VACUUM SENSOR
STA	STARTER SWITCH	PIM	VACUUM SENSOR
IGT	IGNITER	VTA	THROTTLE POSITION SENSOR
E1	ENGINE GROUND	THW	WATER TEMP. SENSOR
* FPU	FUEL PRESSURE VSV	E2	SENSOR GROUND
V-ISC	IDLE-UP VSV	SPD	SPEED SENSOR
STH	T-VIS VSV	FC	CIRCUIT OPENING RELAY
VAF	VARIABLE RESISTOR	A/C	A/C MAGNET SWITCH
VF	CHECK CONNECTOR	* SEL	SENSOR GROUND
G⊖	DISTRIBUTOR	BATT	BATTERY
E21	SENSOR GROUND	W	WARNING LIGHT
G	DISTRIBUTOR	+B1	MAIN RELAY
NE	DISTRIBUTOR	+B	MAIN RELAY
IGF	IGNITER		

* Europe

ECU Terminals

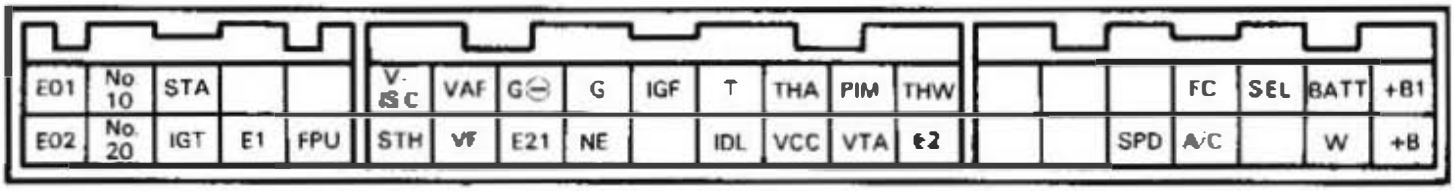
E01	No. 10	STA			V-ISC	VAF	G⊖	G	IGF	T	THA	PIM	THW				FC	SEL	BATT	+B1
E02	No. 20	IGT	E1	FPU	STH	VF	E21	NE		IDL	VCC	VTA	E2			SPD	A/C		W	+B

FI0605

Voltage at ECU Wiring Connectors (TCCS ECU w/o Air Flow Meter)

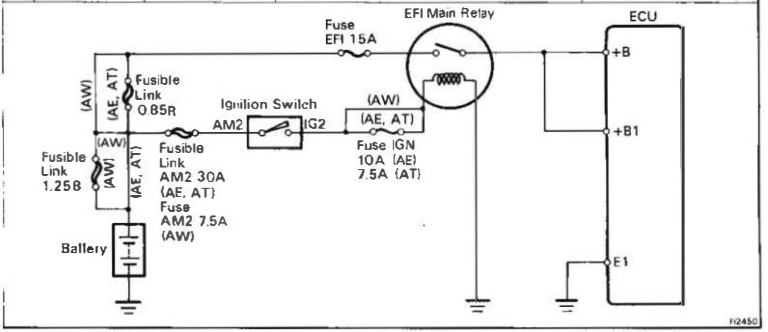
No.	Terminals	STD voltage (V)	Condition		See page
1	+B, +B1 – E1	10 – 14	Ignition S/W ON		FI-33
2	BATT – E1	10 – 14	—		FI-34
3	IDL – E2	4.5 – 5.5	Ignition S/W ON	Throttle valve open	FI-35
	VTA – E2	0.5 or less		Throttle valve fully closed	
		3.5 – 5.5		Throttle valve fully open	
	VCC – E2	4.5 – 5.5		—	
4	IGT – E1	0.7 – 1.0	Cranking or idling		FI-37
5	STA – E1	6 – 14	Cranking		FI-39
6	No. 10 – E01, No. 20 – E02	9 – 14	Ignition S/W ON		FI-41
7	W – E1	9 – 14	No trouble (Check engine warning light off) and engine running		FI-43
8	PIM – E2	3.3 – 3.9	Ignition S/W ON		FI-44
	VCC – E2	4.5 – 5.5			
9	THA – E2	2.0 – 2.8	Ignition S/W ON	Intake air temp. 20°C (68°F)	FI-45
10	THW – E2	0.4 – 0.8		Coolant emp. 80°C (176°F)	FI-46
11	A/C – E1	5 – 14		Air conditioning ON	FI-47

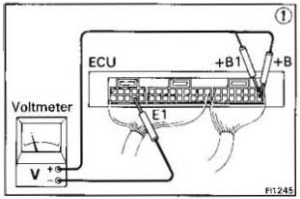
ECU Terminals

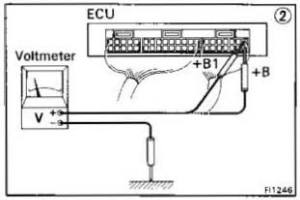


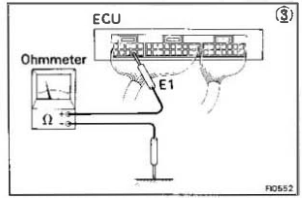
FI0606

No.	Terminals	Trouble	Condition	STD voltage
1	+B, +B1 — E1	No voltage	IG S/W ON	10 – 14 V









① No voltage between ECU terminals +B or +B1 and E1. **(IG S/W ON)**

② Check that there is voltage between ECU terminal +B or +B1 and body ground. **(IG S/W ON)**

NO → Check fuses, fusible links and ignition switch. BAD → Repair or replace.

OK → Check EFI main relay. (See page FI-90) BAD → Replace.

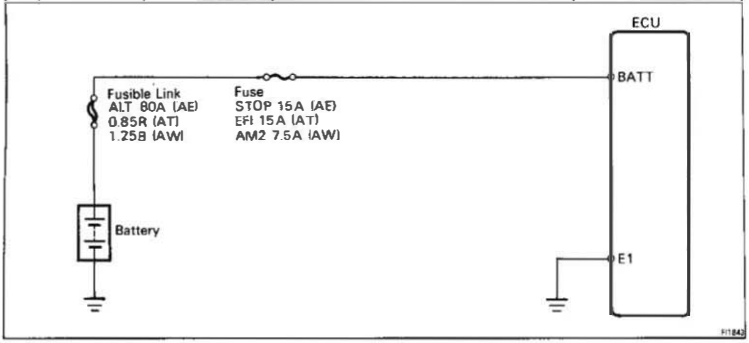
OK → Check wiring between EFI main relay and battery. BAD → Repair or replace.

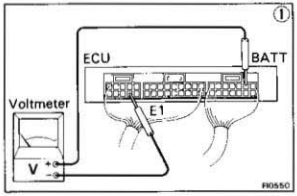
OK → ③ Check wiring between ECU terminal E1 and body ground.

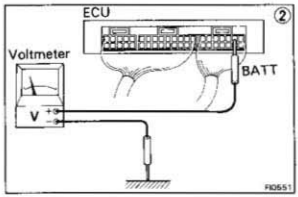
OK → Try another ECU.

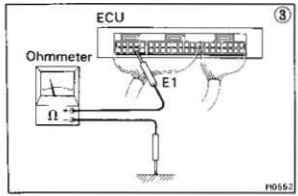
BAD → Repair or replace.

No.	Terminals	Trouble	Condition	STD voltage
2	BATT – E1	No voltage	–	10 – 14 V









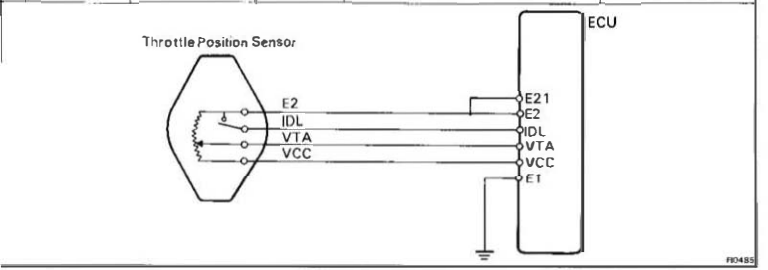
① No voltage between ECU terminals BATT and E1.

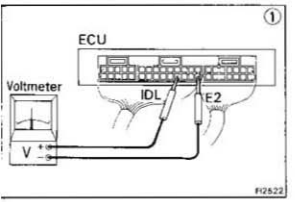
② Check that there is voltage between ECU terminal BATT and body ground.

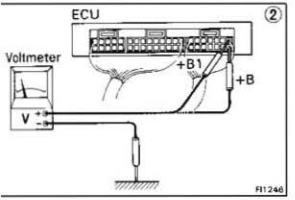
NO → Check fuse and fusible link.
- BAD → Replace.
- OK → Check wiring between ECU terminal and battery.
  - BAD → Repair or replace.

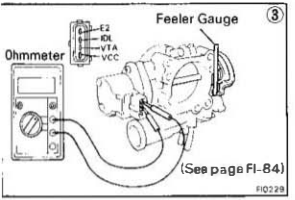
OK → ③ Check wiring between ECU terminal E1 and body ground.
- OK → Try another ECU.
- BAD → Repair or replace.

No.	Terminals	Trouble	Condition		STD voltage
3	IDL – E2	No voltage	IG S/W ON	Throttle valve open	4.5 – 5.5 V
	VTA – E2			Throttle valve fully closed	0.5 V or less
				Throttle valve fully open	3.5 – 6.5 V
	VCC – E2			–	4.5 – 5.5 V









• **IDL – E2**

① There is no voltage between ECU terminals IDL and E2. **(IG S/W ON)** (Throttle valve open)

② Check that there is voltage between ECU terminal +B1 or +B and body ground. **(IG S/W ON)**

NO

OK

Check wiring between ECU terminal E1 and body ground.

BAD

Repair or replace.

Refer to No. 1 (See page FI-33)

BAD

Repair or replace.

OK

③ Check throttle position sensor (See page FI-84)

BAD

OK

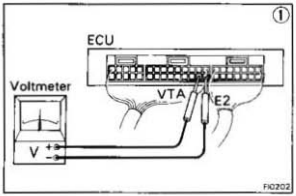
Repair or replace throttle position sensor.

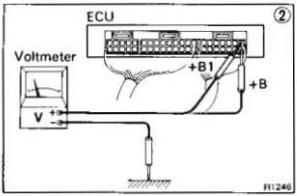
Check wiring between ECU and throttle position sensor.

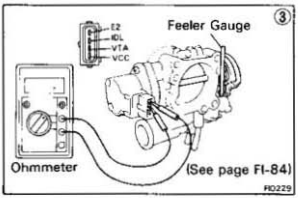
BAD

OK

Try another ECU.







• **VTA – E2**

① There is no specified voltage at ECU terminals VTA and E2. **(IG S/W ON)**

↓

② Check that there is voltage between ECU terminal +B1 or +B and body ground. **(IG S/W ON)**

NO → ↓ OK

Check wiring between ECU terminal E1 and body ground.

↓ BAD

Repair or replace.

Refer to No. 1 (See page FI-33) — BAD → Repair or replace.

↓ OK

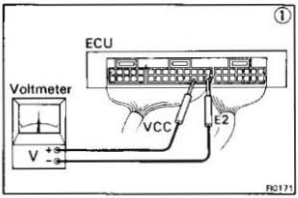
③ Check throttle position sensor. (See page FI-84) — BAD → Repair or replace.

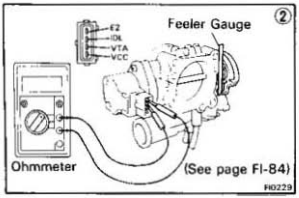
↓ OK

Check wiring between ECU and throttle position sensor. — BAD → Repair or replace.

↓ OK

Try another ECU.





• **VCC – E2**

① There is no voltage between ECU terminals VCC and E2. **(IG S/W ON)**

↓

Check that there is voltage between ECU terminal +B1 or +B and body ground. **(IG S/W ON)**

OK → ② Check throttle position sensor (See page FI-84)

NO → Refer to No. 1 (See page FI-33)

② BAD → Repair or replace.

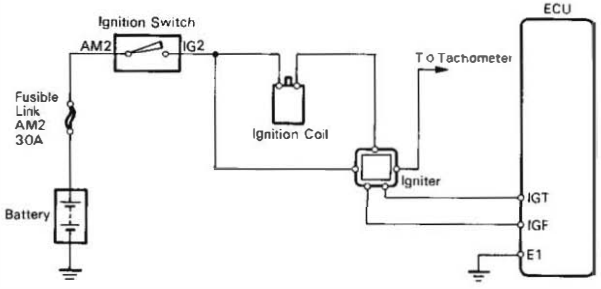
② OK → Check wiring between ECU and throttle position sensor.

Check wiring between ECU and throttle position sensor. — OK → Try another ECU.

Check wiring between ECU and throttle position sensor. — BAD → Repair or replace wiring.

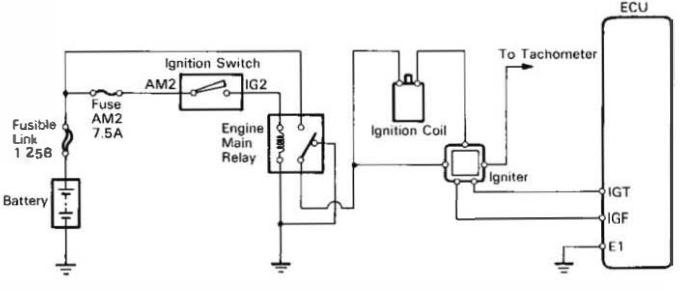
No.	Terminals	Trouble	Condition	STD voltage
4	IGT – E1	No voltage	Idling	0.7 – 1.0 V

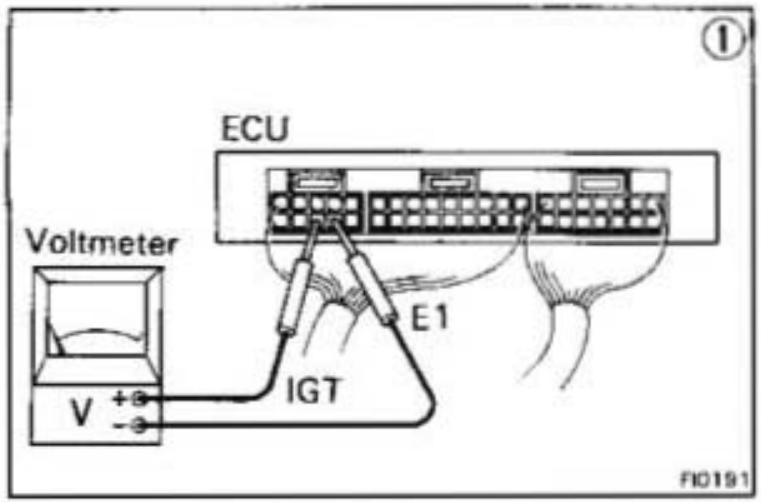
AE and AT

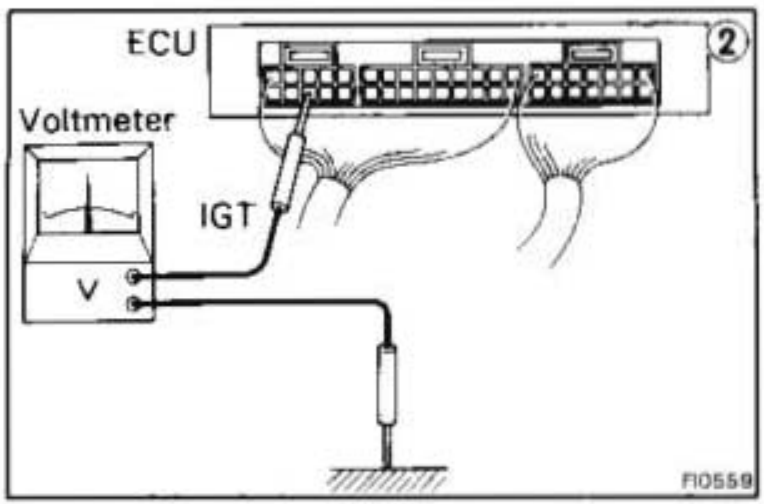


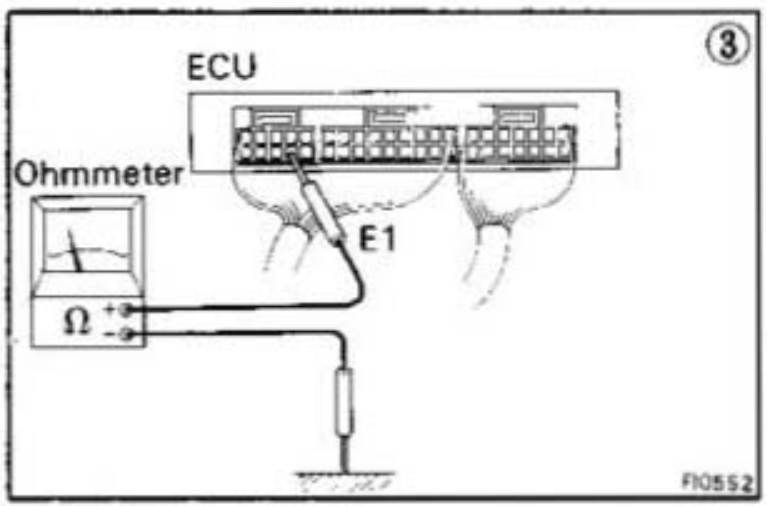
FI2456

AW









① No voltage between ECU terminals IGT and E1. (Idling)

② Check that there is voltage between ECU terminal IGT and body ground. (Idling)

NO → OK

③ Check wiring between ECU terminal E1 and body ground.

BAD → Repair or replace.

OK → Try another ECU.

Check fuse, fusible link, ignition switch and starter relay (AW).

BAD → Repair or replace.

OK

Check distributor. (See page IG-23)

BAD → Repair or replace.

OK

Check wiring between ECU and battery.

BAD → Repair or replace.

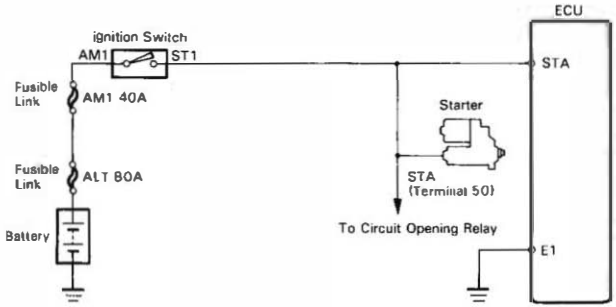
OK

Check igniter. (See page IG-23)

BAD → Repair or replace.

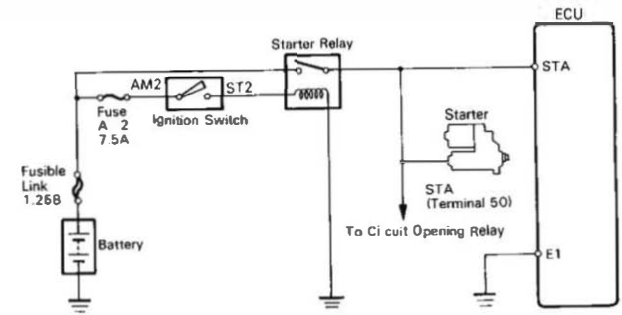
No.	Terminals	Trouble	Condition	STD voltage
5	STA – E1	No voltage	Cranking	6 – 14 V

AE and AT

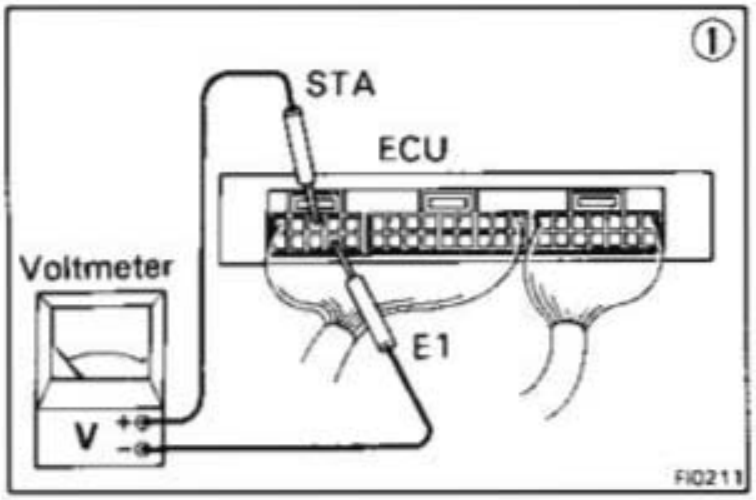


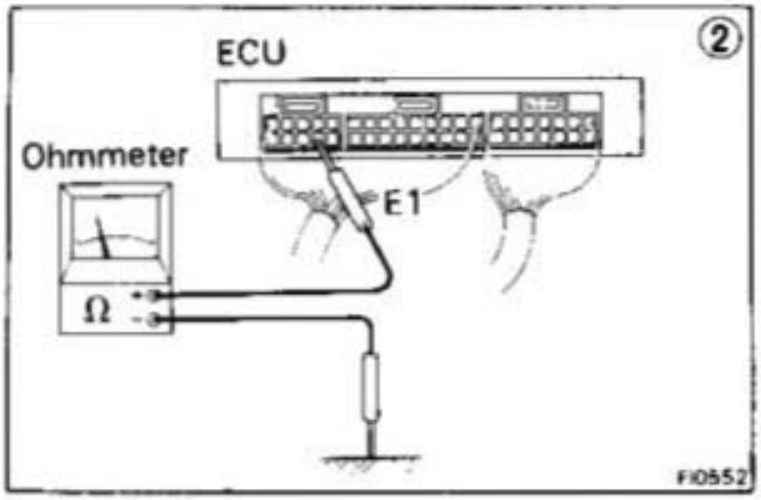
FI2451

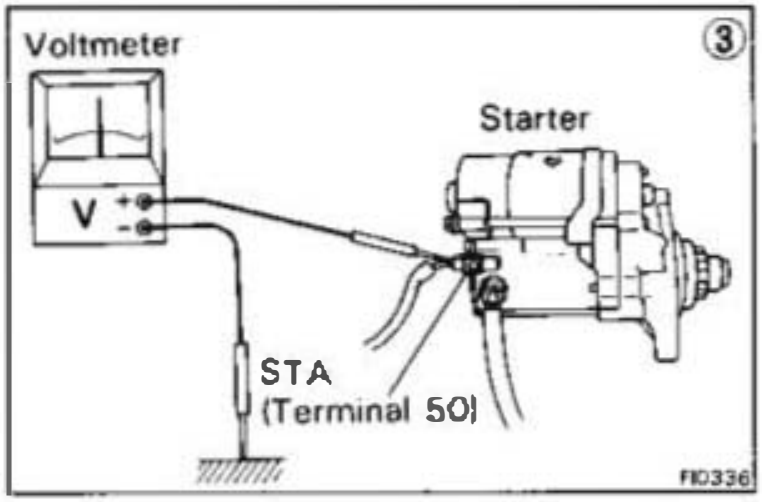
AW



FI2452





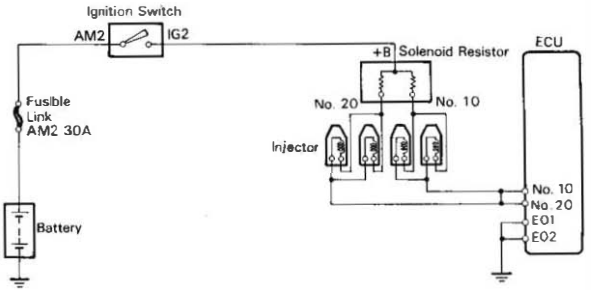


① No voltage between ECU terminals STA and E1. **(IG S/W START)**

Check starter operation.
- OK → Check wiring between ECU terminal STA and ignition switch terminal ST1 (AE and AT) or ST2 (AW).
  - OK → ② Check wiring between ECU terminal E1 and body ground.
    - OK → Try another ECU.
    - BAD → Repair or replace.
  - BAD → Repair or replace.
- BAD → Check fuse, fusible links, battery, wiring, ignition switch and starter relay (AW).
  - BAD → Repair or replace.
  - OK → ③ Check that there is voltage at STA (50) terminal of starter. **(IG S/W START)** **STD voltage: 6 – 12 V**
    - OK → Check starter.
    - NO → Check wiring between ignition switch terminal ST1 (AE and AT) or ST2 (AW) and starter terminal STA (50).

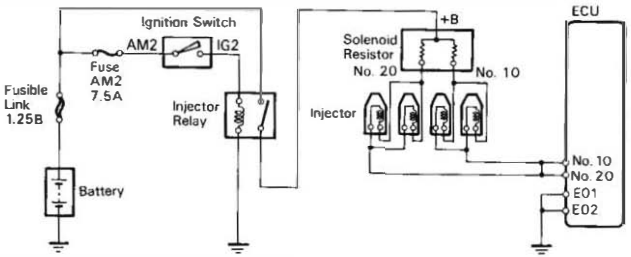
No.	Terminals	Trouble	Condition	STD voltage
6	No. 10 _ E01 No. 20 E02	No voltage	IG S/W ON	9 – 14 V

AE and AT

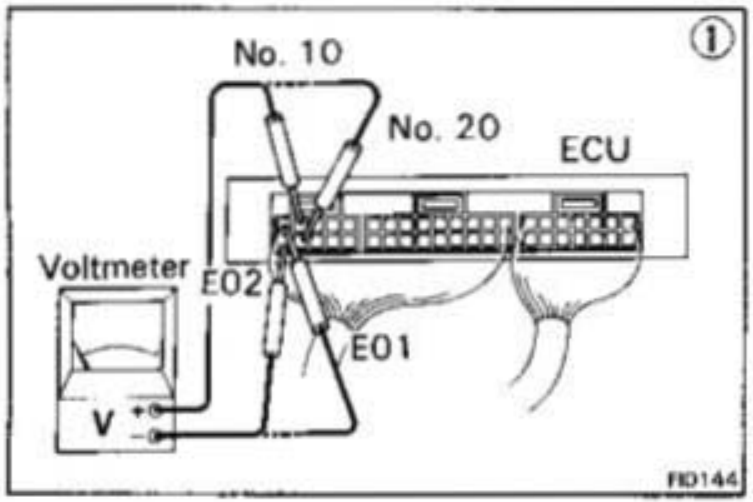


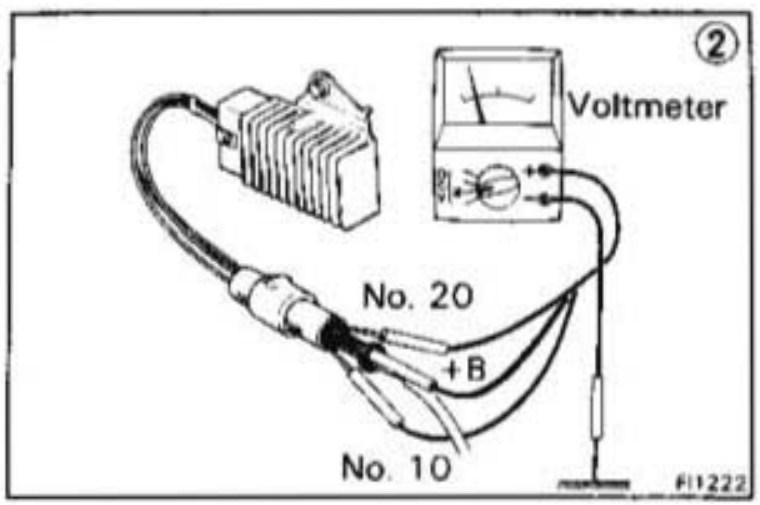
FI2455

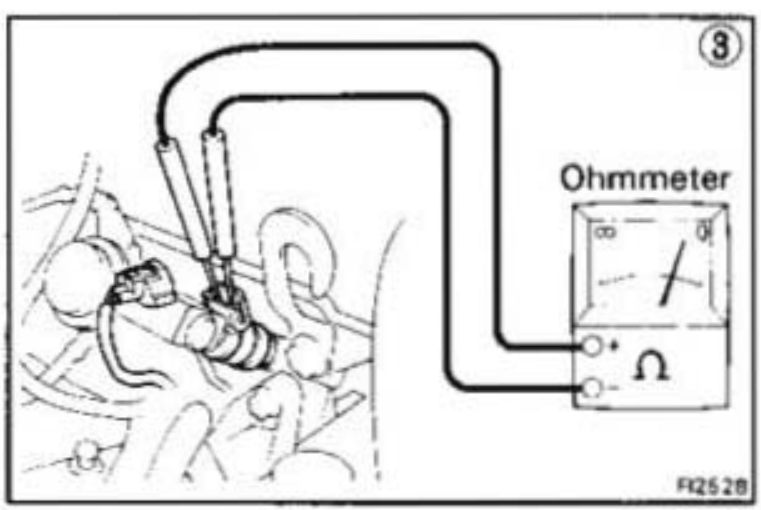
AW



FI2454







① No voltage between ECU terminals No. 10 and/or No. 20 and E01 and/or E02. **(IG S/W ON)**

② Check that there is specified voltage between solenoid resistor terminal +B and body ground. **STD voltage: 9 – 14 V**

OK

NO → Check fuse, fusible link, wiring ignition switch and starter relay (AW). → BAD → Repair or replace.

② Check that there is specified voltage between resistor terminal (NO. 10 or NO. 20) and body ground. **STD voltage: 9 – 14 V**

OK

NO → Replace resistor.

③ Check resistance of magnetic coil in each injector. **STD resistance: Approx. 2.3Ω**

OK

BAD → Replace injector.

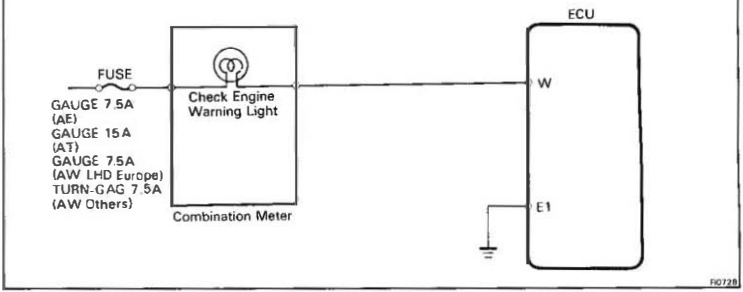
Check wiring between ECU and resistor.

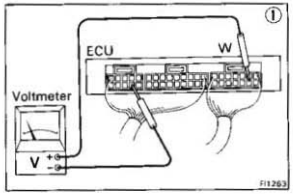
BAD → Replace or replace wiring.

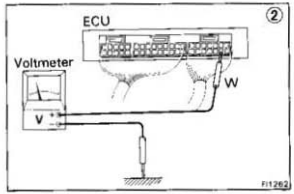
OK

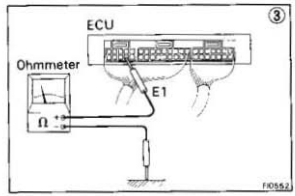
Try another ECU.

No.	Terminals	Trouble	Condition	STD voltage
7	W — E1	No voltage	No trouble (check engine warning light off) and engine running.	9 — 14 V









① No voltage between ECU terminals W and E1. (Idling)

↓

② Check that there is voltage between ECU terminal W and body ground.

NO → Check fuse and check engine warning light.

OK → ③ Check wiring between ECU terminal E1 and body ground.

③ OK → Try another ECU.

③ BAD → Repair or replace.

Check fuse and check engine warning light.

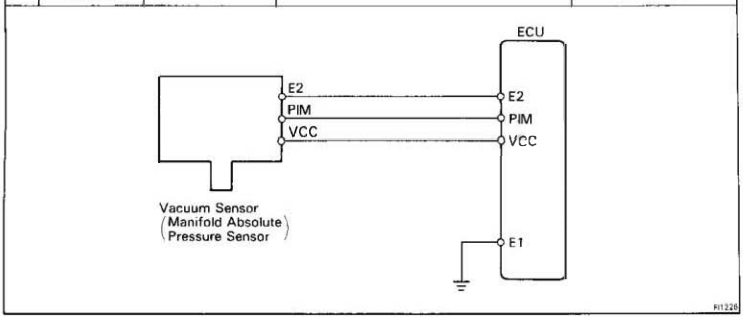
OK → Check wiring between ECU terminal W and fuse.

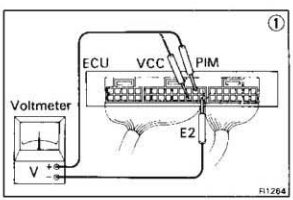
BAD → Try another ECU.

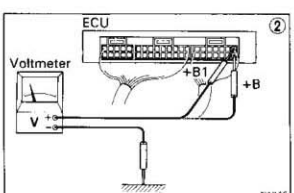
Fuse blows again → Check wiring between ECU terminal W and fuse.

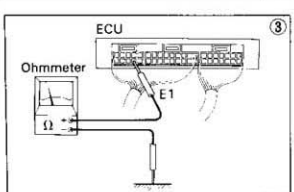
BAD → Repair or replace.

No.	Terminals	Trouble	Condition	STD voltage
8	PIM – E2	No voltage	IG S/W ON	3.3 – 3.9 V
	VCC – E2			4.5 – 5.5 V









① No voltage at ECU terminals PIM or VCC and E2. **(IG S/W ON)**

↓

② Check that there is voltage between ECU terminal +B or +B1 and body ground. **(IG S/W ON)**

NO → ③ Check wiring between ECU terminal E1 and body ground.

③ BAD → Repair or replace.

② NO → Refer to No. 1. (See page FI-33) BAD → Repair or replace.

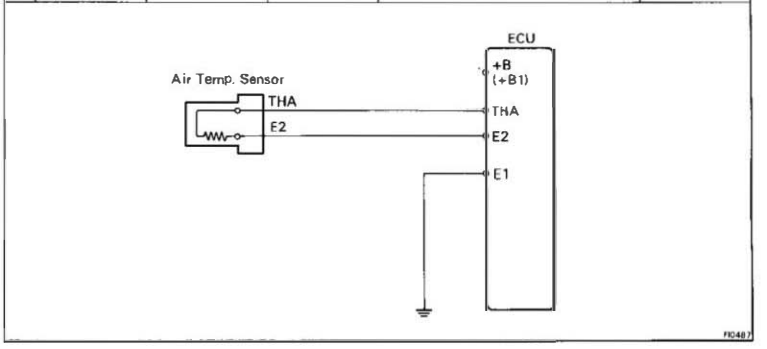
OK →

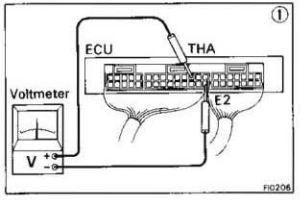
Check wiring between ECU and vacuum sensor. BAD → Repair or replace

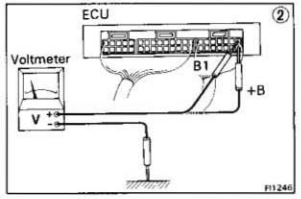
OK →

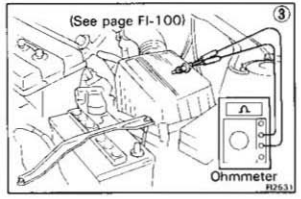
Try another ECU.

No.	Terminals	Trouble	Condition		STD voltage
9	THA – E2	No voltage	IG S/W ON	Intake air temp. 20°C (68°F)	2.0 – 2.8 V







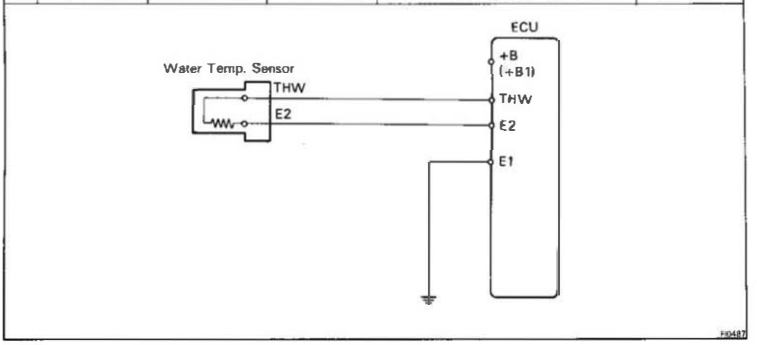


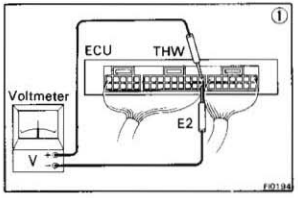
① No voltage between ECU terminals THA and E2. **(IG S/W ON)**

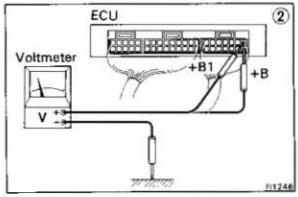
② Check that there is voltage between ECU terminal +B or +B1 and body ground. **(IG S/W ON)**

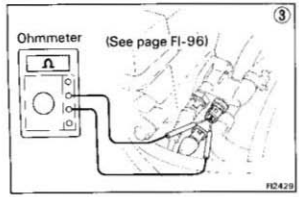
- OK → Check wiring between ECU terminal E1 and body ground.
  - OK → ③ Check air temp. sensor. (See page FI-100)
    - BAD → Replace air temp. sensor.
    - OK → Check wiring between ECU and air temp. sensor.
      - OK → Try another ECU.
      - BAD → Repair or replace wiring.
  - BAD → Repair or replace.
- NO → Refer to No. 1. (See page FI-33)

No.	Terminals	Trouble	Condition		STD voltage
10	THW – E2	No voltage	IG S/W ON	Coolant temp. 80°C (176°F)	0.4 – 0.8 V









① No voltage between ECU terminals THW and E2. **(IG S/W ON)**

② Check that there is voltage between ECU terminal +B or +B1 and body ground. **(IG S/W ON)**

OK → Check wiring between ECU terminal E1 and body ground.

NO → Refer to No. 1. (See page FI-33)

OK → ③ Check water temp. sensor. (See page FI-96)

BAD → Repair or replace.

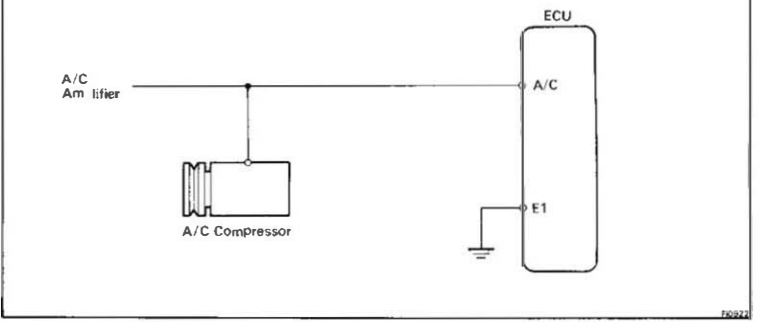
BAD → Replace water temp. sensor.

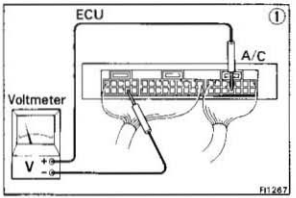
OK → Check wiring between ECU and water temp. sensor.

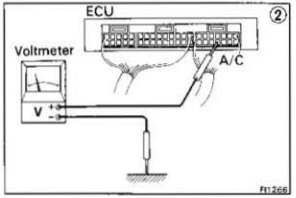
OK → Try another ECU.

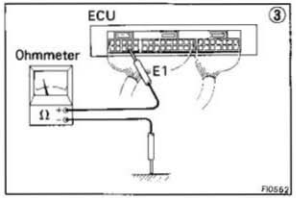
BAD → Repair or replace.

No.	Terminals	Trouble	Condition	STD voltage
11	A/C – E1	No voltage	Air conditioning ON	6 – 14 V









① No voltage between ECU terminals A/C and E1. **(Air conditioning ON)**

② Check that there is voltage between ECU terminal A/C and body ground.

NO — OK

③ Check wiring between ECU terminal E1 and body ground.

OK — BAD

Try another ECU. — Repair or replace.

Check compressor running.

OK — Check wiring between ECU terminal A/C and am lifier.

ND

BAD — Repair or replace.

Check that there is voltage between amplifier terminal and body ground.

BAD — Repair or replace.

OK

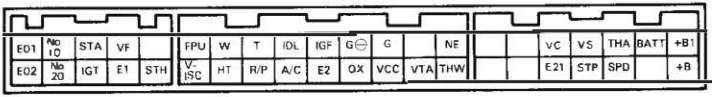
Check wiring between amplifier and ECU or compressor.

BAD — Repair or replace.

Terminals of ECU (TCCS ECU w/ Air Flow Meter)

Symbol	Terminal Name	Symbol	Terminal Name
E01	ENGINE GROUND	E2	SENSOR GROUND
E02	ENGINE GROUND	G⊖	DISTRIBUTOR
No.10	INJECTOR	OX	OXYGEN SENSOR
No.20	INJECTOR	G	DISTRIBUTOR
STA	STARTER SWITCH	VCC	VACUUM SENSOR
IGT	IGNITER	VTA	THROTTLE POSITION SENSOR
VF	CHECK CONNECTOR	NE	DISTRIBUTOR
E1	ENGINE GROUND	THW	WATER TEMP. SENSOR
STH	T-VIS VSV	VC	AIR FLOW METER
FPU	FUEL PRESSURE VSV	E21	SENSOR GROUND
V-ISC	T-VIS VSV	VS	AIR FLOW METER
W	WARNING LIGHT	STP	STOP LIGHT SWITCH
HT	OXYGEN SENSOR	THA	INTAKE AIR TEMP. SENSOR
T	CHECK CONNECTOR	SPD	SPEED SENSOR
R/P	FUEL CONTROL SWITCH	BATT	BATTERY
IDL	THROTTLE POSITION SENSOR	+B1	MAIN RELAY
A C	A/C MAGNET SWITCH	+B	MAIN RELAY
IGF	IGNITER		

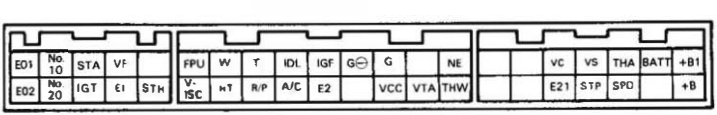
ECU Terminals



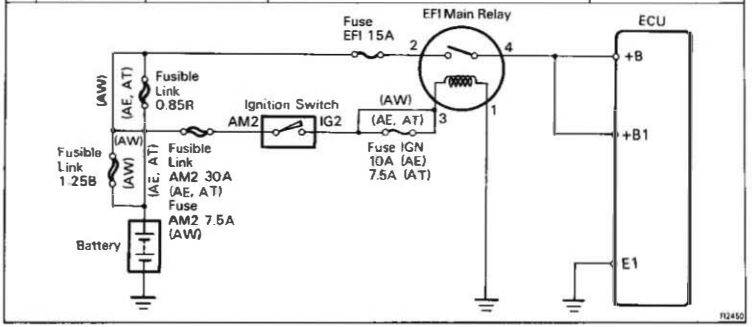
Voltage at ECU Wiring Connectors (TCCS ECU w/ Air Flow Meter)

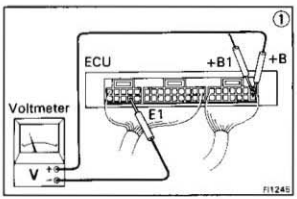
No.	Terminals	STD voltage (V)	Condition		See page
1	+B, +B1 – E1	10 – 14	Ignition S/W ON		FI-50
2	BATT – E1	10 – 14	—		FI-51
3	IDL – E2	10 – 14	Ignition S/W ON	Throttle valve open	FI-52
	VTA – E2	0.5 or less		Throttle valve fully closed	
		3.5 – 5.5		Throttle valve fully open	
	VCC – E2	4.5 – 5.5		—	
4	IGT – E1	0.7 – 1.0	Cranking or idling		FI-54
5	STA – E1	6 – 14	Cranking		FI-56
6	No. 10 – E01 No. 20 – E02	9 – 14	Ignition S/W ON		FI-58
7	W – E1	9 – 14	No trouble (Check engine warning light off) and engine running		FI-60
8	VC – E2	5.1 – 10.8	Ignition S/W ON	—	FI-61
	VS – E2	2.5 – 5.4		Measuring plate fully closed	
		6.2 – 8.8		Measuring plate fully open	
		3.9 – 5.8	Idling		
9	THA – E2	2 – 2.8	Ignition S/W ON	Intake air temp. 20°C (68°F)	FI-62
10	THW – E2	0.4 – 0.7		Coolant temp. 80°C (176°F)	FI-63
11	A/C – E1	5 – 14		Air conditioning ON	FI-64

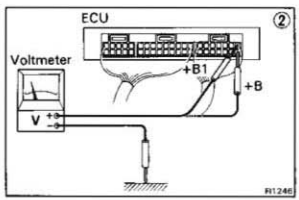
ECU Terminals

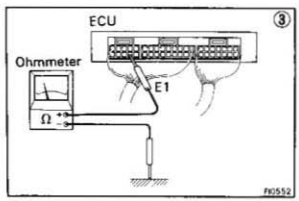


No.	Terminals	Trouble	Condition	STD voltage
1	+B, +B1 — E1	No voltage	IG S/W ON	10 – 14 V









① No voltage between ECU terminals +B or +B1 and E1. **(IG S/W ON)**

↓

② Check that there is voltage between ECU terminal +B or +B1 and body ground. **(IG S/W ON)**

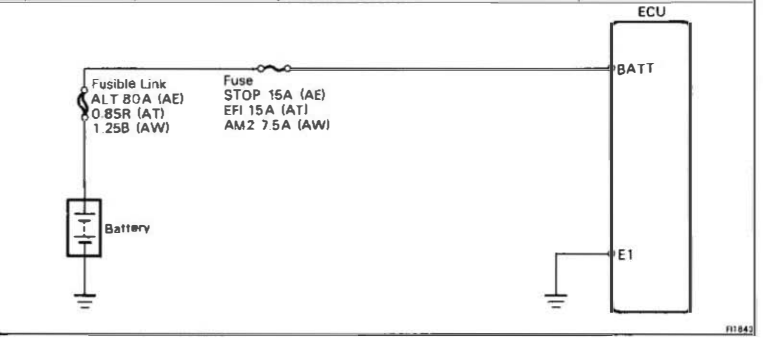
NO → ③ Check wiring between ECU terminal E1 and body ground.
- OK → Try another ECU.
- BAD → Repair or replace.

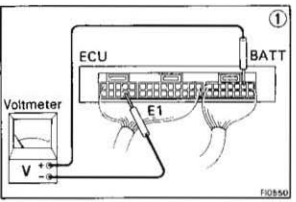
OK → Check fuses, fusible links and ignition switch.
- BAD → Repair or replace.

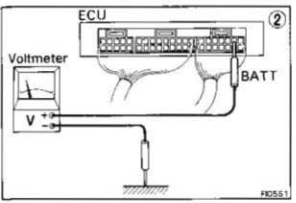
OK → Check EFI main relay. (See page FI-90)
- BAD → Replace.

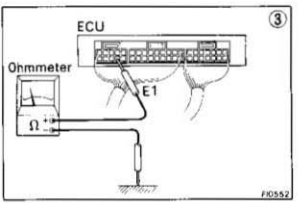
OK → Check wiring between EFI main relay and battery.
- BAD → Repair or replace.

No.	Terminals	Trouble	Condition	STD voltage
2	BATT – E1	No voltage	–	10 – 14 V







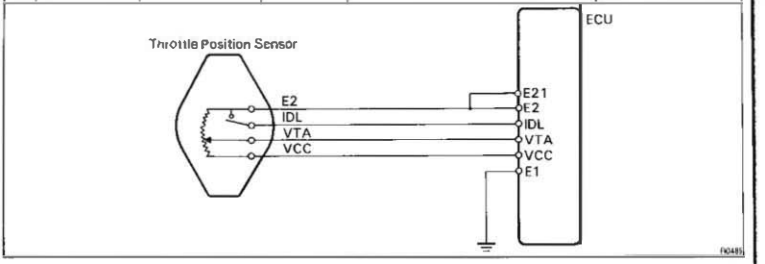


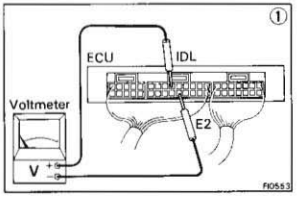
① No voltage between ECU terminals BATT and E1.

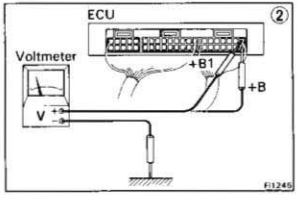
② Check that there is voltage between ECU terminal BATT and body ground.
- NO → Check fuse and fusible link.
- OK → ③ Check wiring between ECU terminal E1 and body ground.
  - OK → Try another ECU.
  - BAD → Repair or replace.

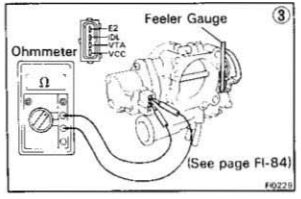
Check fuse and fusible link.
- BAD → Replace.
- OK → Check wiring between ECU terminal and battery.
  - BAD → Repair or replace.

No.	Terminals	T ouble	Condition		STD voltage
3	IDL – E2	No voltage	IG S/W ON	Throttle valve open	10 – 14 V
	VTA – E2			Throttle valve fully closed	0.5 V or less
				Throttle valve fully open	3.5 – 5.5 V
	VCC – E2			–	4.5 – 5.5 V









• **IDL – E2**

① There is no voltage between ECU terminals IDL and E2. **(IG S/W ON)** (Throttle valve open)

② Check that there is voltage between ECU terminal +B1 or +B and body ground. **(IG S/W ON)**

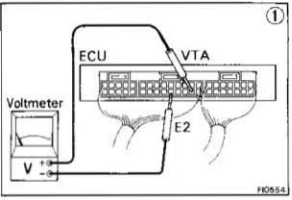
NO → Check wiring between ECU terminal E1 and body ground.
- BAD → Repair or replace.

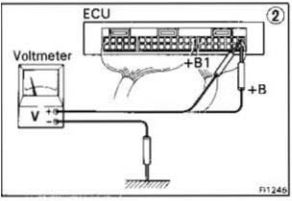
OK →

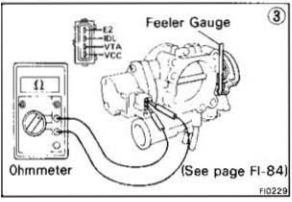
Refer to No. 1. (See page FI-50)
- BAD → Repair or replace.

OK →

③ Check throttle position sensor. (See page FI-84)
- BAD → Repair or replace throttle position sensor.
- OK → Check wiring between ECU and throttle position sensor.
  - OK → Try another ECU.
  - BAD → Repair or replace.







• **VTA — E2**

① There is no specified voltage at ECU terminals VTA and E2. **(IG S/W ON)**

② Check that there is voltage between ECU terminal +B1 or +B and body ground. **(IG S/W ON)**

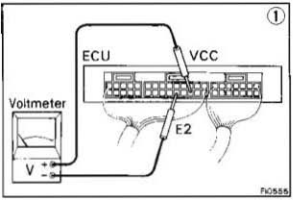
NO → Refer to No. 1. (See page FI-50)
- BAD → Repair or replace.
- OK →

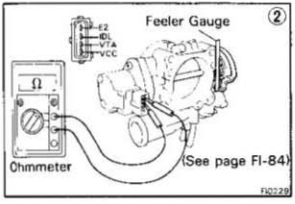
OK → Check wiring between ECU terminal E1 and body ground.
- BAD → Repair or replace.

③ Check throttle position sensor. (See page FI-84)
- BAD → Repair or replace.
- OK →

Check wiring between ECU and throttle position sensor.
- BAD → Repair or replace.
- OK →

Try another ECU.





• **VCC — E2**

① There is no voltage between ECU terminals VCC and E2. **(IG S/W ON)**

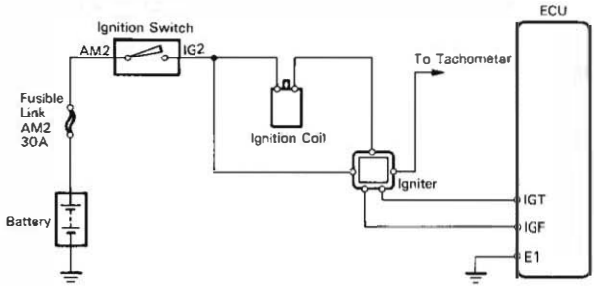
Check that there is voltage between ECU terminal +B1 or +B and body ground. **(IG S/W ON)**

OK → ② Check throttle position sensor. (See page FI-84)
- BAD → Repair or replace.
- OK → Check wiring between ECU and throttle position sensor.
  - OK → Try another ECU.
  - BAD → Repair or replace wiring.

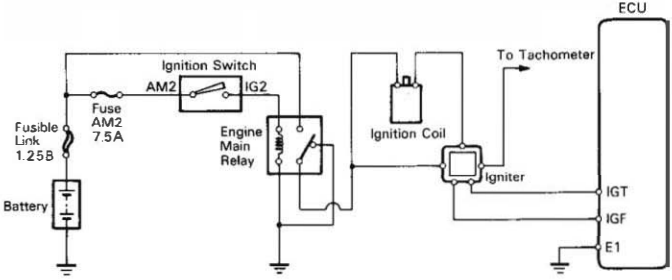
NO → Refer to No. 1. (See page FI-50)

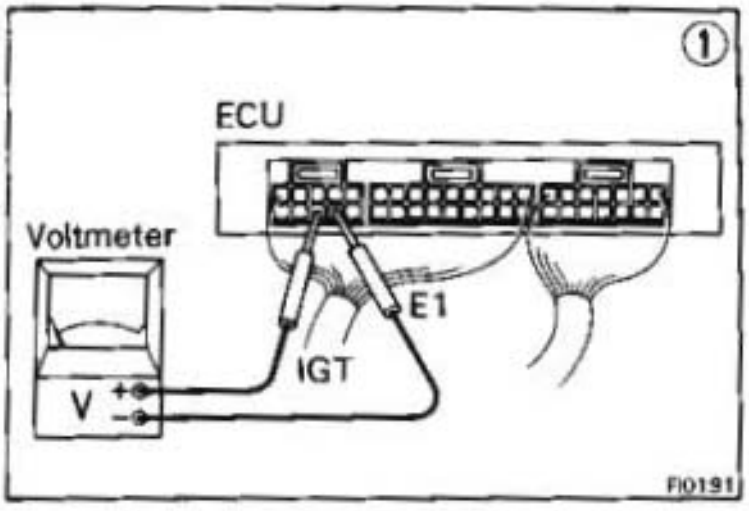
No.	Terminals	Trouble	Condition	STD voltage
4	IGT – E1	No voltage	Idling	0.7 – 1.0 V

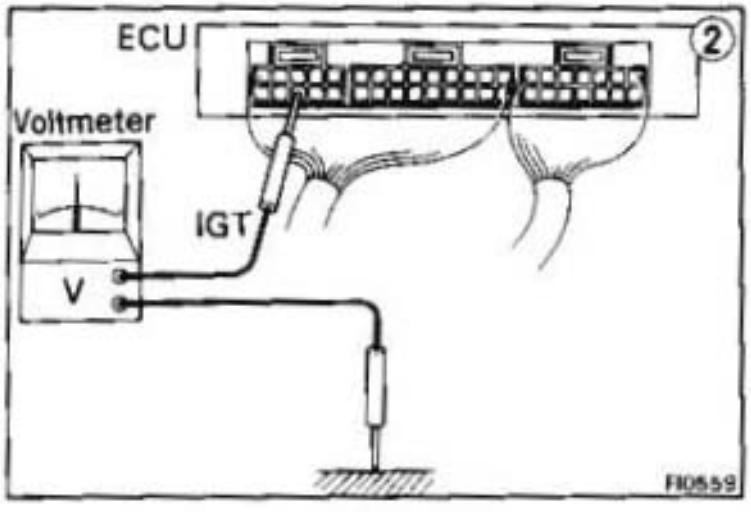
AE and AT

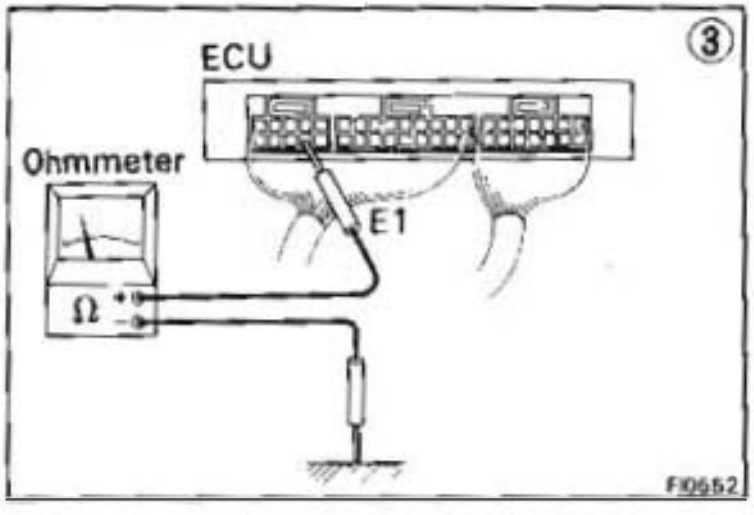


AW









① No voltage between ECU terminals IGT and E1. **(Idling)**

② Check that there is voltage between ECU terminal IGT and body ground. **(Idling)**

NO

OK

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

OK

Try another ECU.

Check fuse, fusible link, ignition switch and starter relay (AW). — BAD → Repair or replace.

OK

Check distributor. (See page IG-23) — BAD → Repair of replace.

OK

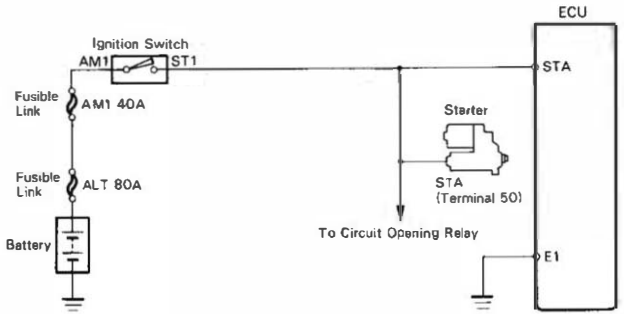
Check wiring between ECU and battery. — BAD → Repair or replace.

OK

Check igniter. (See page IG-23) — BAD → Repair or replace.

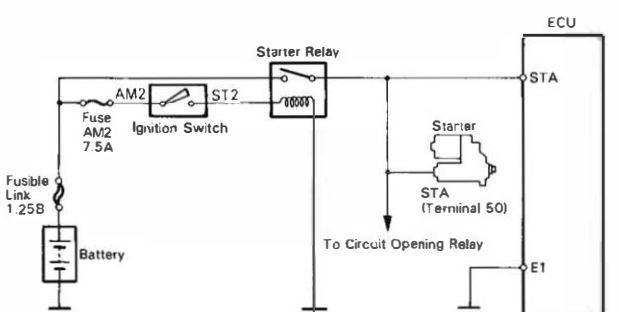
No.	Terminals	Trouble	Condition	STD voltage
5	STA – E1	No voltage	Cranking	6 – 14 V

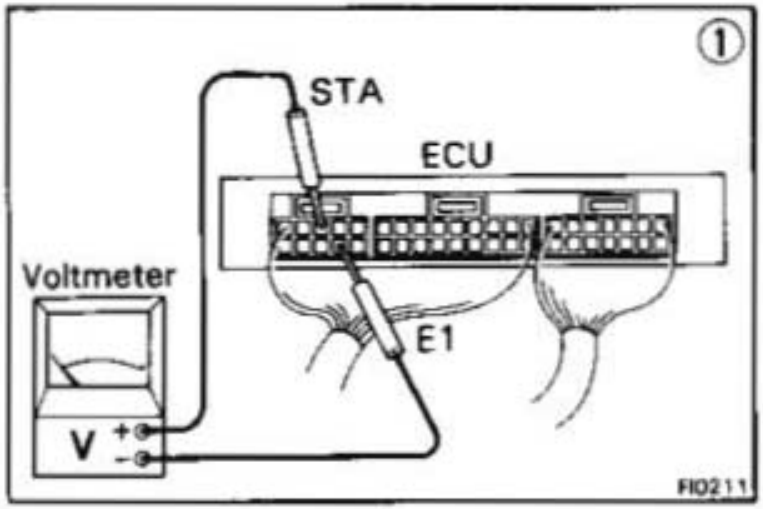
AE and AT

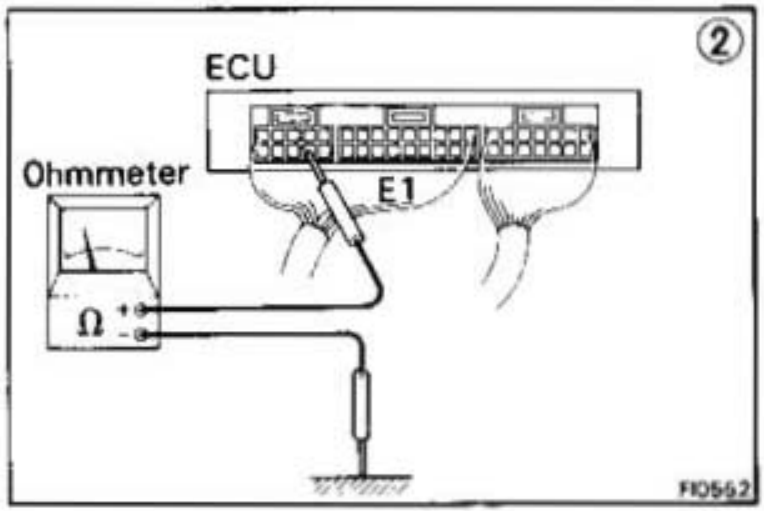


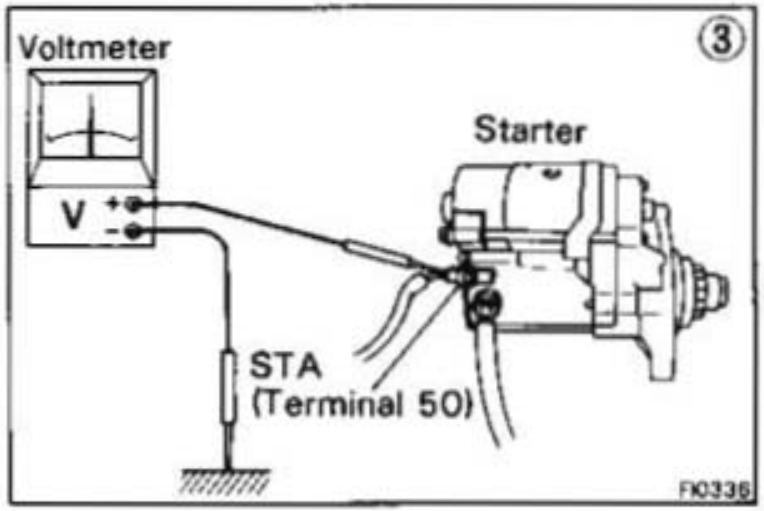
FI2451

AW







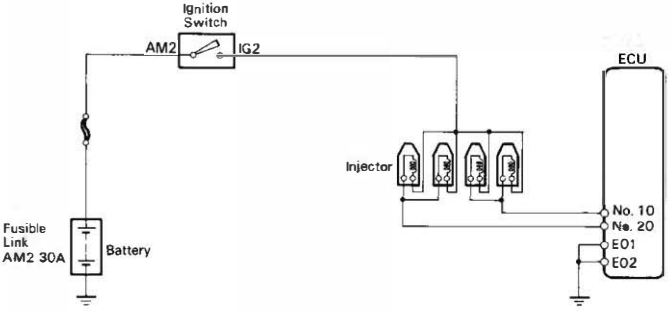


① No voltage between ECU terminals STA and E1.
(IG S/W START)

Check starter operation.
- OK → Check wiring between ECU terminal STA and ignition switch terminal ST1 (AE and AT) or ST2 (AW).
  - OK → ② Check wiring between ECU terminal E1 and body ground.
    - OK → Try another ECU.
    - BAD → Repair or replace.
  - BAD → Repair or replace.
- BAD → Check fuse, fusible links, battery, wiring, ignition switch and starter relay (AW).
  - BAD → Repair or replace.
  - OK → ③ Check that there is voltage at STA (50) terminal of starter.
    (IG S/W START) **STD voltage: 6 – 12 V**
    - OK → Check starter.
    - NO → Check wiring between ignition switch terminal ST1 (AE and AT) or ST2 (AW) and starter terminal STA (50).

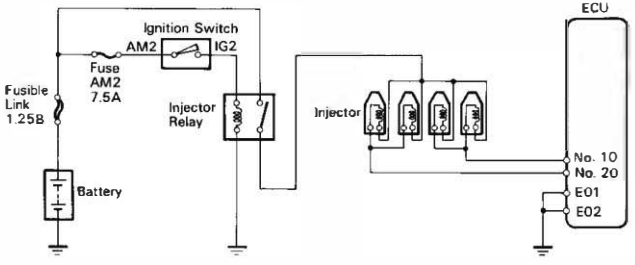
No.	Terminals	Trouble	Condition	STD voltage
6	No. 10 – E01 No. 20 – E01	No voltage	IG S/W ON	9 – 14 V

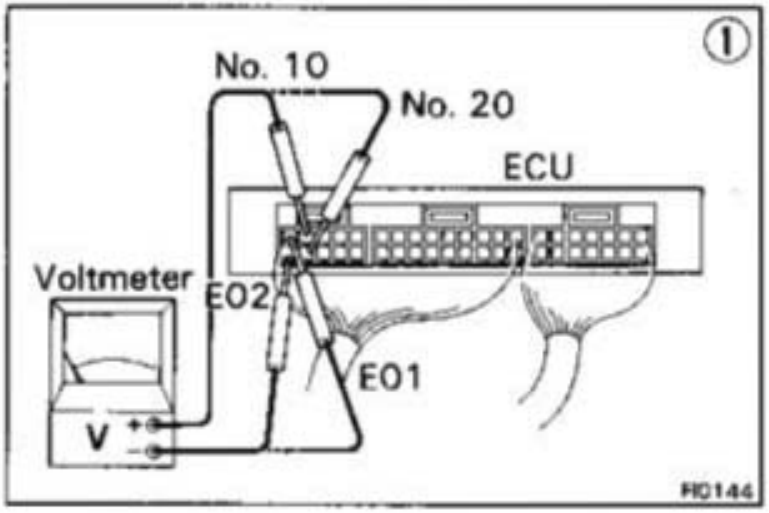
AEandAT

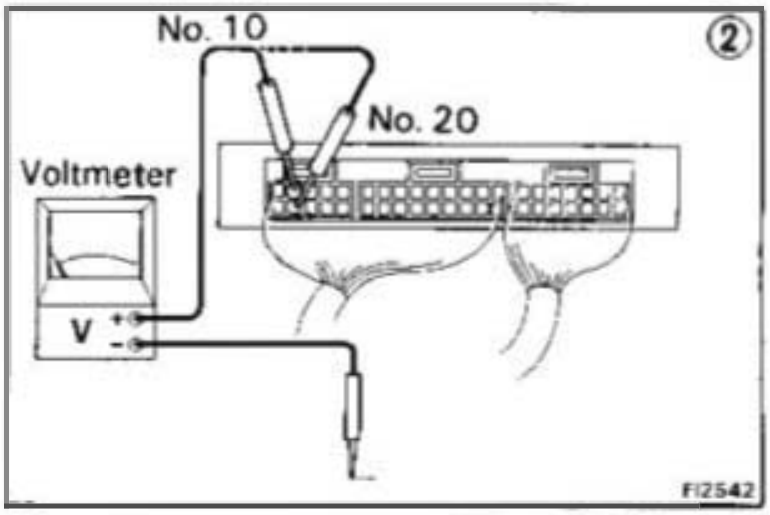


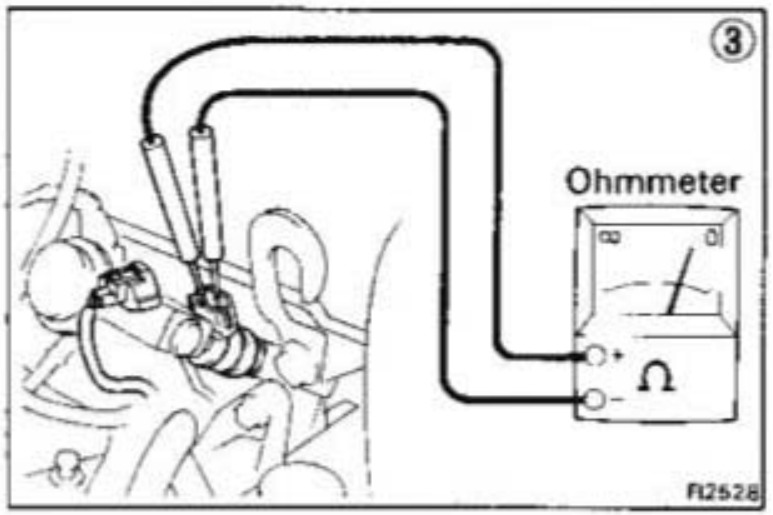
FI2537

AW









① No voltage between ECU terminals No. 10 and/or No. 20 and E01 and/or E02. **(IG S/W ON)**

↓

② Check that there is voltage between ECU terminal No. 10 and/or No. 20 and body ground.

NO → Check fuse, fusible link, ignition switch and starter relay (AW).

OK → Check wiring between ECU terminal E01 and/or E02 and body ground.

OK → Try another ECU.

BAD → Repair or replace.

BAD → Repair or replace.

OK

↓

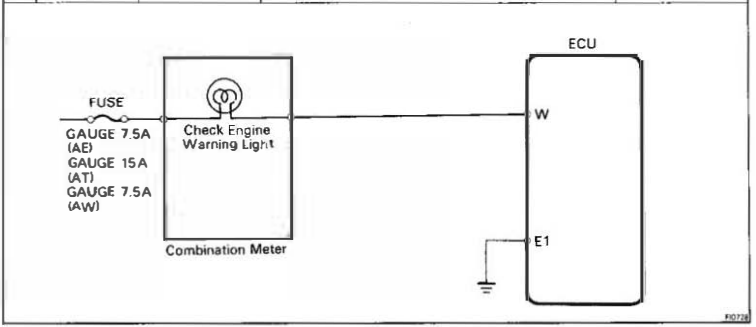
③ Check resistance of magnetic coil in each injector.
STD resistance: Approx. 13.8 Ω

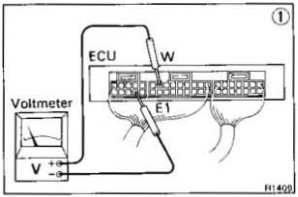
OK → Check wiring between ECU terminal No. 10 and/or No. 20 and battery.

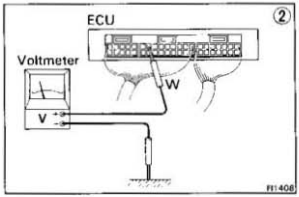
BAD → Repair or replace.

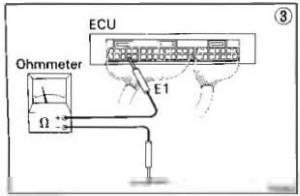
BAD → Replace injector.

No.	Terminals	Trouble	Condition	STD voltage
7	W – E1	No voltage	No trouble (check engine warning light off) and engine running.	9 – 14 V









① No voltage between ECU terminals W and E1. **(Idling)**

② Check that there is voltage between ECU terminal W and body ground.

NO → Check fuse and check engine warning light.

OK → ③ Check wiring between ECU terminal E1 and body ground.

③ OK → Try another ECU.

③ BAD → Repair or replace.

Check fuse and check engine warning light.

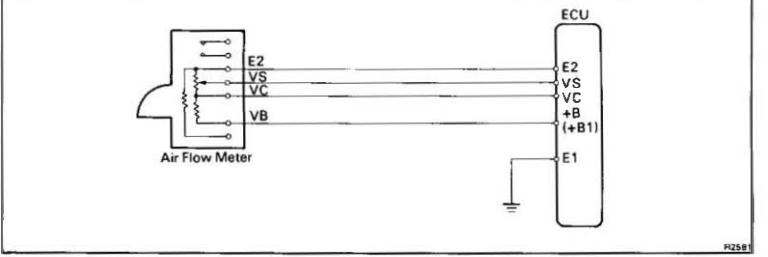
OK → Check wiring between ECU terminal W and fuse.

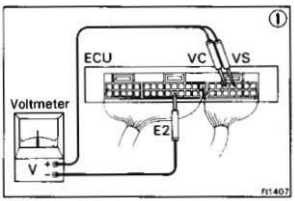
BAD → Try another ECU.

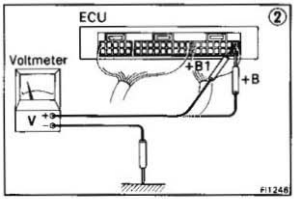
Fuse blows again → Check wiring between ECU terminal W and fuse.

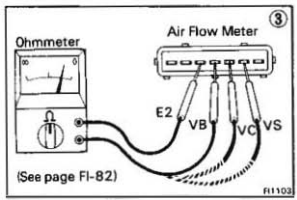
BAD → Repair or replace.

No.	Terminals	Trouble	Condition		STD voltage
8	VC – E2	No voltage	IG S/W ON	–	6.1 – 10.8 V
	VS – E2			Measuring plate fully closed	2.5 – 5.4 V
				Measuring plate fully open	6.2 – 8.8 V
			Idling		3.9 – 5.8 V









① No specified voltage at ECU terminals VC or VS and E2. **(IG S/W ON)**

② Check that there is voltage between ECU terminal +B or +B1 and body ground. **(IG S/W ON)**

OK → Check wiring between ECU terminal E1 and body ground.

NO → Refer to No. 1. (See page FI-50)

Check wiring between ECU terminal E1 and body ground.

OK → ③ Check air flow meter. (See page FI-82)

BAD → Repair or replace.

③ Check air flow meter. (See page FI-82)

BAD → Replace air flow meter.

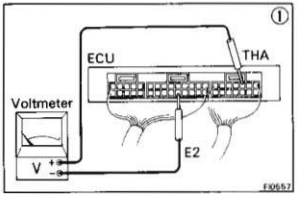
OK → Check wiring between ECU and air flow meter.

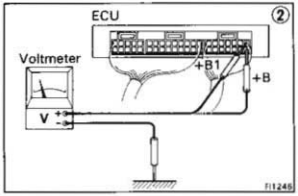
Check wiring between ECU and air flow meter.

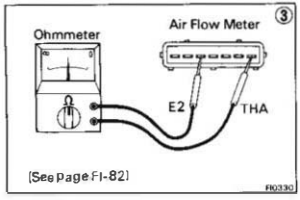
OK → Try another ECU.

BAD → Repair or replace.

No.	Terminals	Trouble	Condition		STD voltage
9	THA – E2	No voltage	IG S/W ON	Intake air temp. 20°C (68°F)	2 – 2.8 V





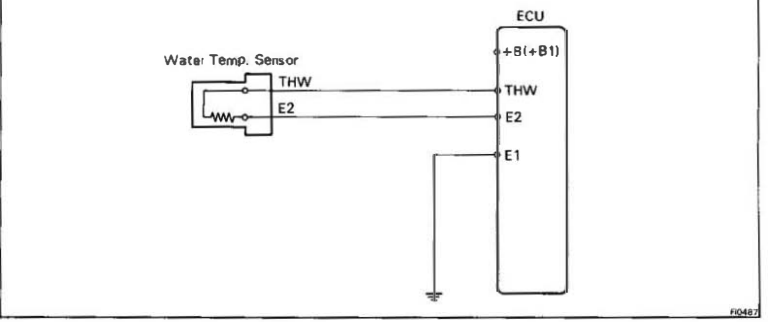


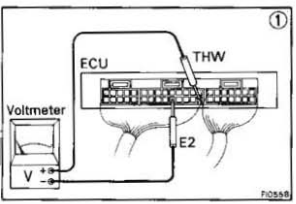
① No voltage between ECU terminals THA and E2. **(IG S/W ON)**

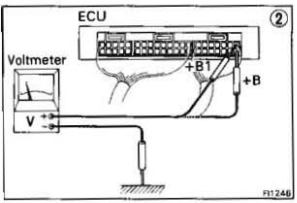
② Check that there is voltage between ECU terminal +B or +B1 and body ground. **(IG S/W ON)**

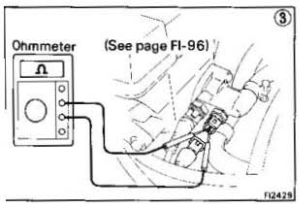
- OK → Check wiring between ECU terminal E1 and body ground.
  - OK → ③ Check air temp. sensor. (See page FI-82)
    - BAD → Replace air flow meter.
    - OK → Check wiring between ECU and air temp. sensor.
      - OK → Try another ECU.
      - BAD → Repair or replace.
  - BAD → Repair or replace.
- NO → Refer to No. 1. (See page FI-50)

No.	Terminals	Trouble	Condition		STD voltage
10	THW — E2	No voltage	IG S/W ON	Coolant temp. 80°C (176°F)	0.4 — 0.7 V









① No voltage between ECU terminals THW and E2. **(IG S/W ON)**

② Check that there is voltage between ECU terminal +B or +B1 and body ground. **(IG S/W ON)**

OK → Check wiring between ECU terminal E1 and body ground.

NO → Refer to No. 1. (See page FI-50)

OK → ③ Check water temp. sensor. (See page FI-96)

BAD → Repair or replace.

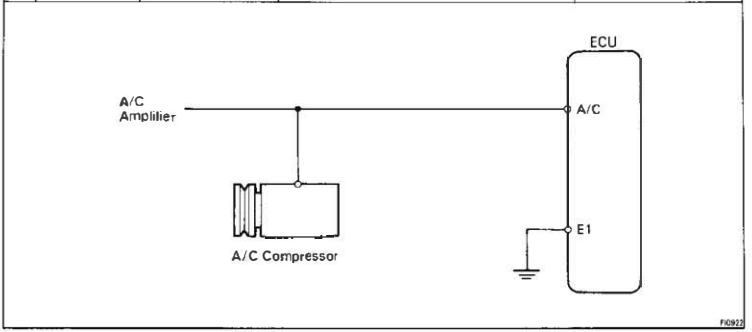
BAD → Replace water temp. sensor.

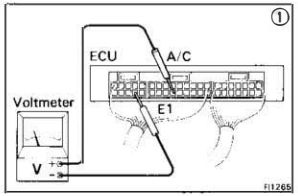
OK → Check wiring between ECU and water temp. sensor.

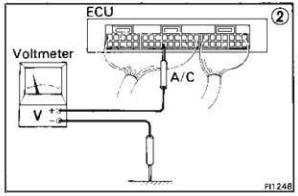
OK → Try another ECU.

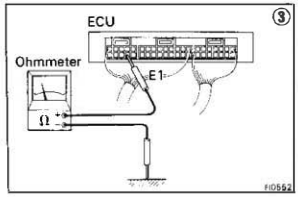
BAD → Repair or replace.

No.	Terminals	Trouble	Condition	STD voltage
11	A/C – E1	No voltage	Air conditioning ON	5 – 14 V









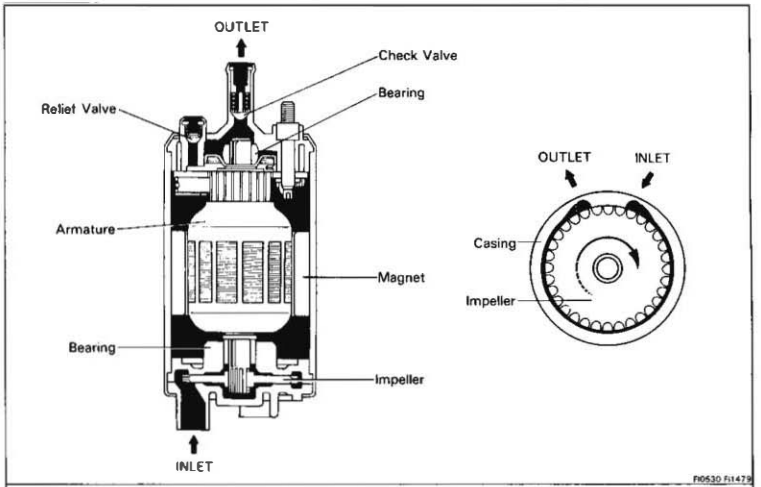
① No voltage between ECU terminals A/C and E1. **(Air conditioning ON)**

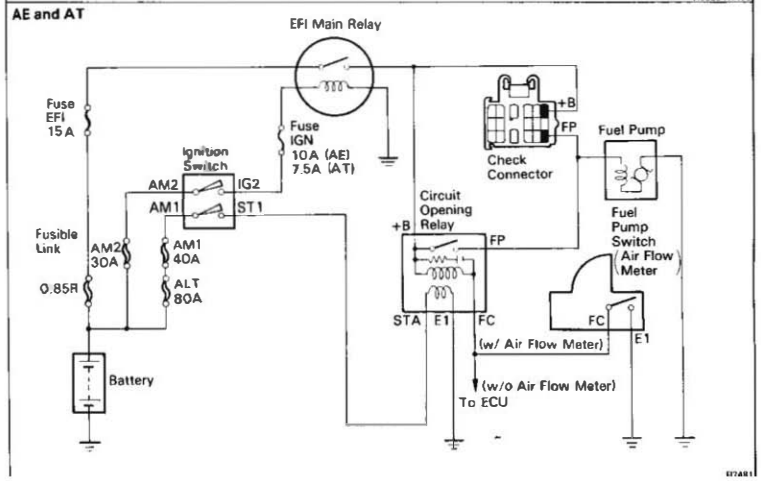
② Check that there is voltage between ECU terminal A/C and body ground.
- NO → Check compressor running.
- OK → ③ Check wiring between ECU terminal E1 and body ground.
  - OK → Try another ECU.
  - BAD → Repair or replace.

Check compressor running.
- OK → Check wiring between ECU terminal A/C and amplifier.
  - BAD → Repair or replace.
- NO → Check that there is voltage between amplifier terminal and body ground.
  - BAD → Repair or replace.
  - OK → Check wiring between amplifier and ECU or compressor.
    - BAD → Repair or replace.

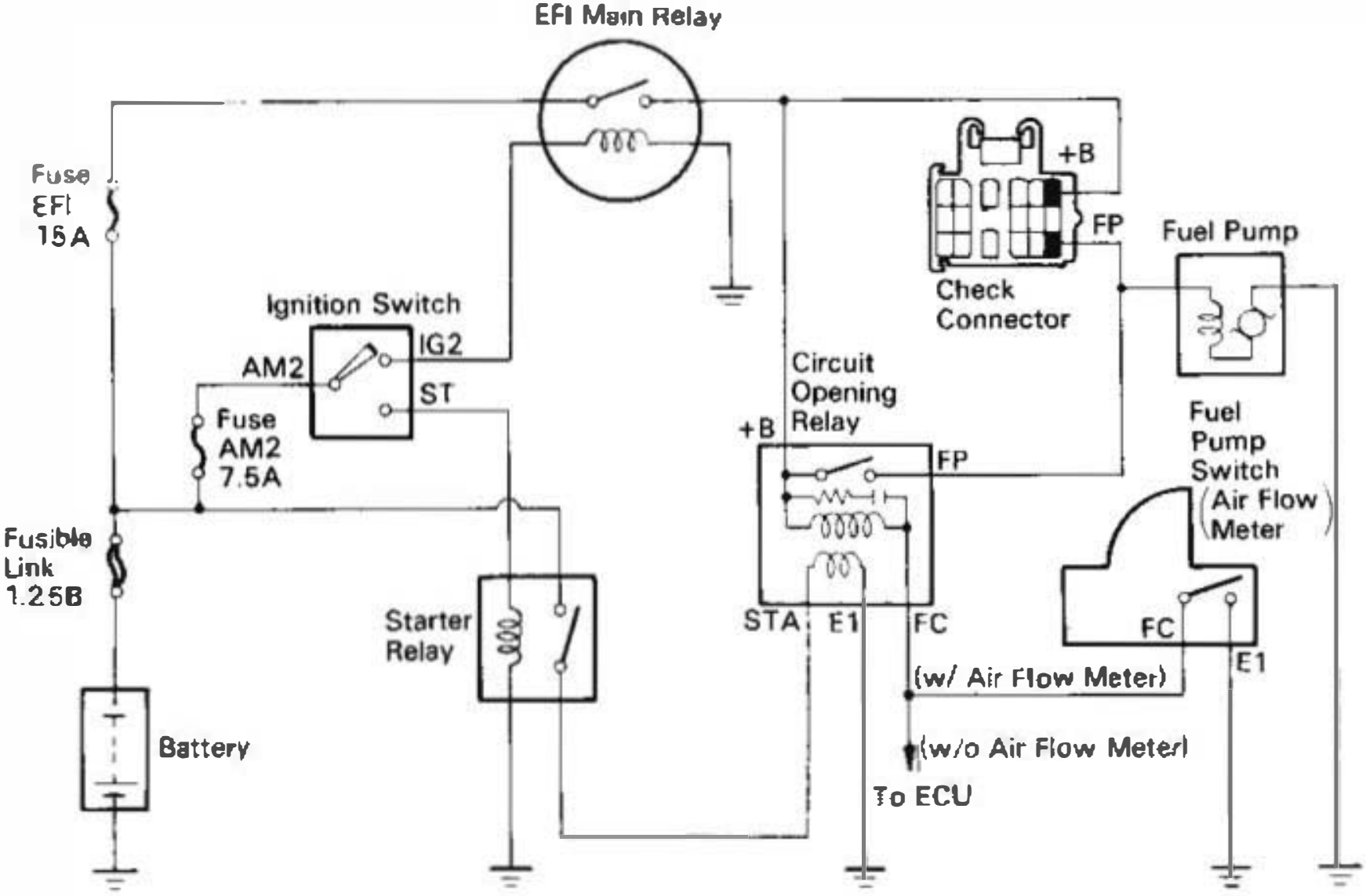
FUEL SYSTEM

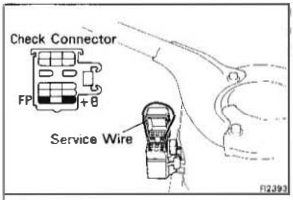
Fuel Pump





AW


EFI Main Relay
Fuse
EFI
15A
Ignition Switch
AM2
IG2
ST
Fuse
AM2
7.5A
Fusible
Link
1.25B
Battery
Starter
Relay
+B
FP
Check
Connector
Fuel Pump
Circuit
Opening
Relay
+B
FP
STA
E1
FC
Fuel
Pump
Switch
(Air Flow
Meter)
FC
E1
(w/ Air Flow Meter)
(w/o Air Flow Meter)
To ECU



ON-VEHICLE INSPECTION

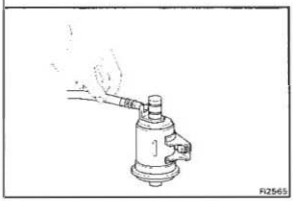
1. INSPECT FUEL PUMP OPERATION

(a) Turn the ignition switch ON.

NOTE: Do not start the engine.

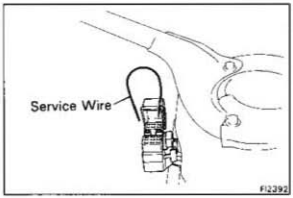
(b) Using a service wire, short terminals +B and FP of the check connector.

LOCATION: See page FI-89



(c) Check that there is pressure in the hose from the fuel filter.

NOTE: At this time, you will hear fuel return noise.



(d) Remove the service wire.

(e) Turn the ignition switch OFF.

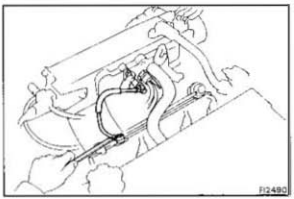
If there is no pressure, check the following parts:

- Fusible links
- Fuses
- EFI main relay
- Circuit opening relay
- Fuel pump
- Wiring connections

2. INSPECT FUEL PRESSURE

(a) Check the battery voltage above 12 volts.

(b) Disconnect the cable from the negative (⊖) terminal of the battery.

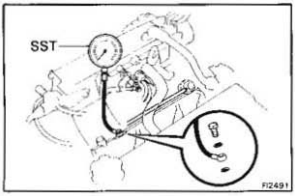


(c) Disconnect the cold start injector connector.

(d) Put a suitable container or shop towel under the cold start injector pipe.

(e) Remove the two union bolts, four gaskets and cold start injector pipe.

NOTE: Slowly loosen the union bolt.



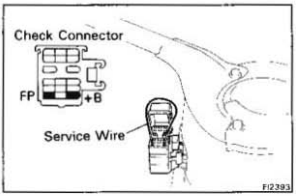
(f) Install SST (pressure gauge) to the delivery pipe with new two gaskets and union bolt.

SST 09268-45011

Torque: 150 kg-cm (11 ft-lb, 15 N·m)

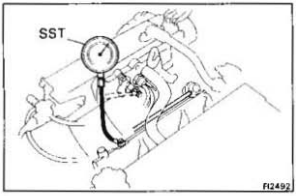
(g) Wipe off any splattered gasoline.

(h) Reconnect the battery negative (⊖) cable.



(i) Using a service wire, short terminals +B and FP of the check connector.

LOCATION: See page FI-89



(j) Turn the ignition switch ON.

(k) Measure the fuel pressure.

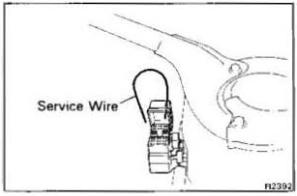
Fuel pressure: 2.7 — 3.1 kg/cm² (38 — 44 psi, 265 — 304 kPa)

If pressure is high, replace the fuel pressure regulator.

If pressure is low, check the following parts:

- Fuel hoses and connection
- Fuel pump
- Fuel filter
- Fuel pressure regulator

(l) Remove the service wire.

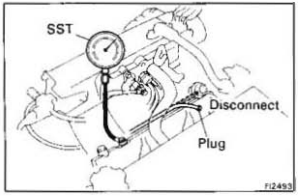


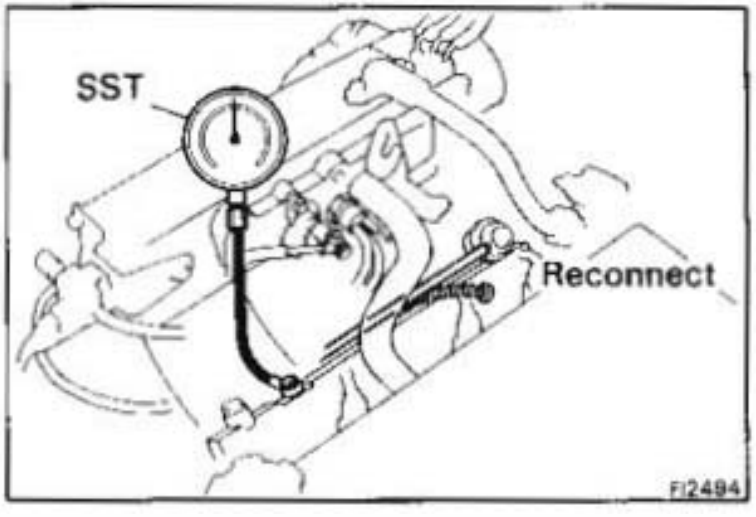
(m) Start the engine.

(n) Disconnect the vacuum sensing hose from the fuel pressure regulator, and plug the hose end.

(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 sensing hose to the fuel pressure regulator.

(q) Measure the fuel pressure at idling.

Fuel pressure: 2.1 — 2.3 kg/cm² (30 — 33 psi, 206 — 226 kPa)

If pressure is not as specified, check the vacuum sensing hose and fuel pressure regulator.

(r) Stop the engine. Check that the fuel pressure remains 1.5 kg/cm² (21 psi, 147 kPa) or more for 5 minutes after the engine is turned off.

If pressure is not as specified, check the fuel pump, pressure regulator and/or injector.

(s) After checking fuel pressure, disconnect the battery negative (⊖) cable and carefully remove the SST to prevent gasoline from splashing.

SST 09268-45011

(t) Install the cold start injector pipe with new four gaskets and two union bolts.

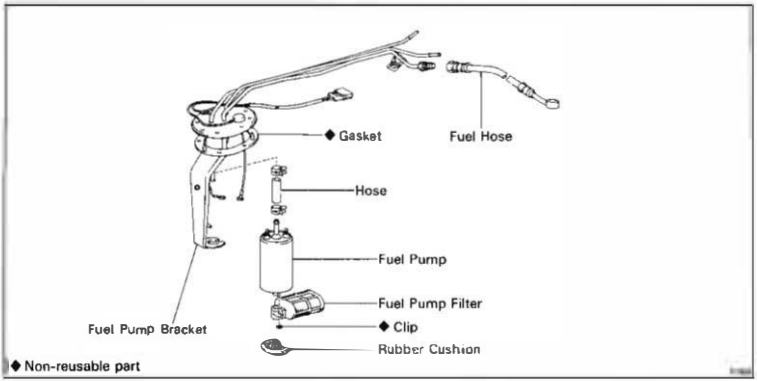
Torque: 150 kg-cm (11 ft-lb, 15 N-m)

(u) Reconnect the cold start injector connector.

(v) Reconnect the cable to the negative (⊖) terminal of the battery.

(w) Check for fuel leakage.

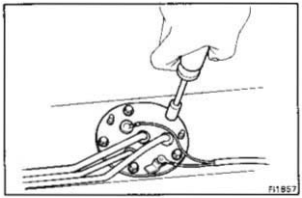
REMOVAL OF FUEL PUMP



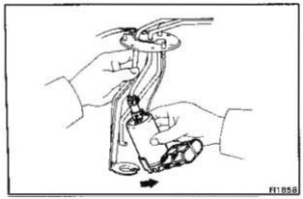
1. **DRAIN FUEL TANK**

   WARNING: Avoid smoking and open flame when working on the fuel pump.

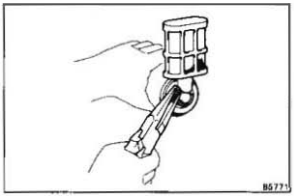
2. **REMOVE FUEL TANK**



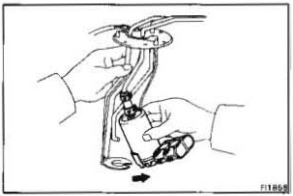
3. **REMOVE FUEL PUMP BRACKET FROM FUEL TANK**
   (a) Remove the five bolts.
   (b) Pull out the pump bracket.



4. **REMOVE FUEL PUMP FROM FUEL PUMP BRACKET**
   (a) Remove the two nuts, disconnect the wires from the fuel pump.
   (b) Pull off the bracket from the lower side of the fuel pump.
   (c) Remove the fuel pump from the fuel hose.



5. **REMOVE FUEL PUMP FILTER FROM FUEL PUMP**
   (a) Remove the rubber cushion.
   (b) Remove the clip, and pullout the pump filter.

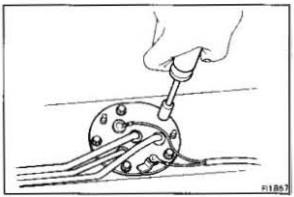


INSTALLATION OF FUEL PUMP

(See page FI-70)

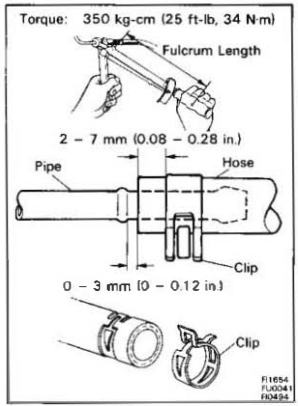
1. **INSTALL FUEL PUMP FILTER TO FUEL PUMP**

2. **INSTALL FUEL PUMP TO FUEL PUMP BRACKET**
   (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 pump bracket.



3. **INSTALL FUEL PUMP BRACKET**
   (a) Place the pump bracket with a new gasket on the fuel tank.
   (b) Install and torque the five bolts.

   Torque: **35 kg-cm (30 in.-lb, 3.4 N-m)**

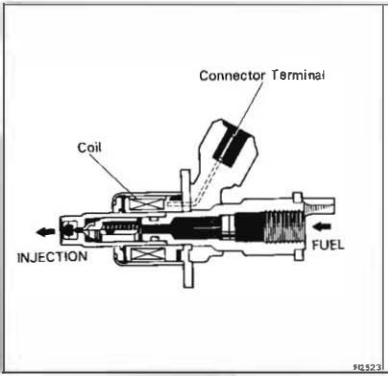


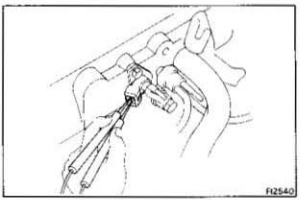
4. **INSTALL FUEL TANK**

   CAUTION:
   - **Tighten the fuel tank mount bolts, etc. to the specified torque.**
   - **Tighten the pipe union and flare nut (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 FUEL**

Cold Start Injector





ON-VEHICLE INSPECTION

INSPECT RESISTANCE OF COLD START INJECTOR

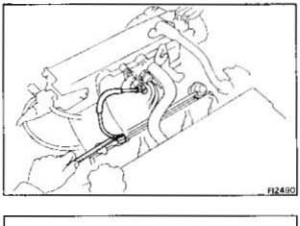
(a) Disconnect the cold start injector connector.

(b) Using an ohmmeter, measure the resistance between the terminals.

Resistance: 2 – 4 Ω

If the resistance is not as specified, replace the injector.

(c) Reconnect 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 PIPE**

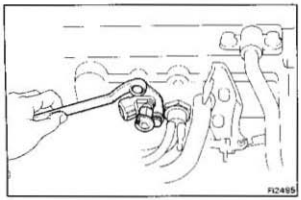
   (a) Put a suitable container or shop towel under the injector pipe.

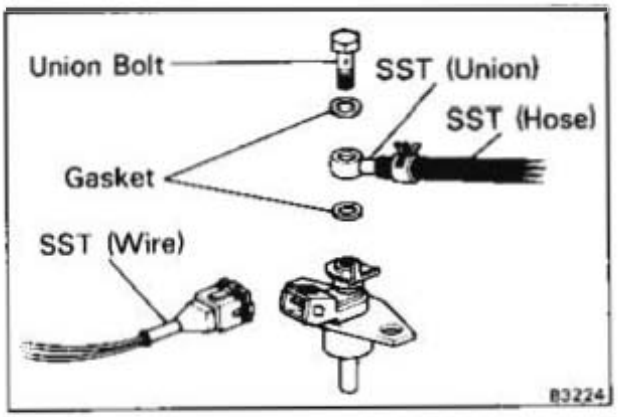
   (b) Remove the two union bolts, four gaskets and injector pipe.

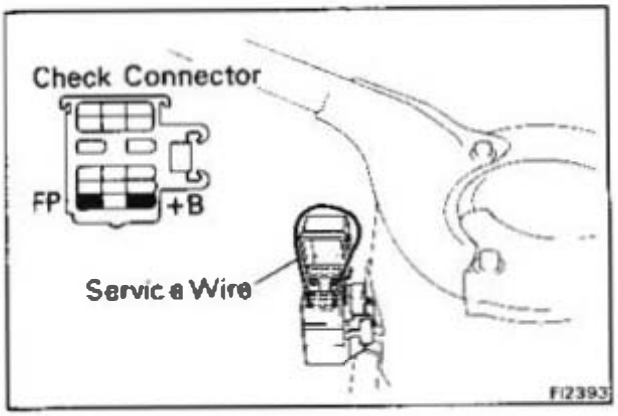
   NOTE: Slowly loosen the union bolts.

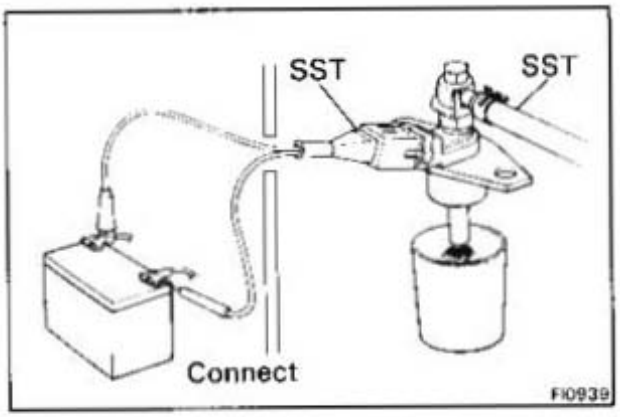
4. **REMOVE COLD START INJECTOR**

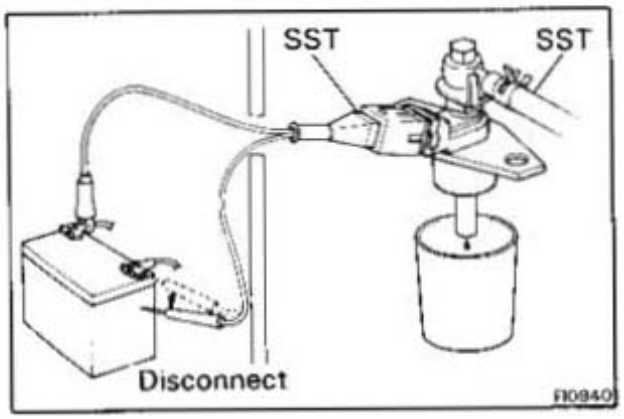
   Remove the two bolts, injector and gasket.











INSPECTION OF COLD START INJECTOR

1. INSPECT INJECTION OF COLD START INJECTOR

WARNING: Keep clear of sparks during the test.

(a) Install SST (two unions) to the injector and delivery pipe with new gaskets and the union bolts.

SST 09268-41045

(b) Connect the unions with SST (hose).

SST 09268-41045

(c) Connect SST (wire) to the injector.

SST 09842-30050

(d) Put a container under the injector.

(e) Reconnect the battery negative (⊖) cable.

(f) Turn the ignition switch ON.

NOTE: Do not start the engine.

(g) Using a service wire, short terminals +B and FP of the check connector.

LOCATION: See page FI-89

(h) Connect the test probes of the SST (wire) to the battery, and check that the fuel spray is as shown.

SST 09842-30050

CAUTION: Perform this within the shortest possible time.

2. INSPECT LEAKAGE

(a) In the condition above, disconnect the test probes of SST (wire) from the battery and check fuel leakage from the injector.

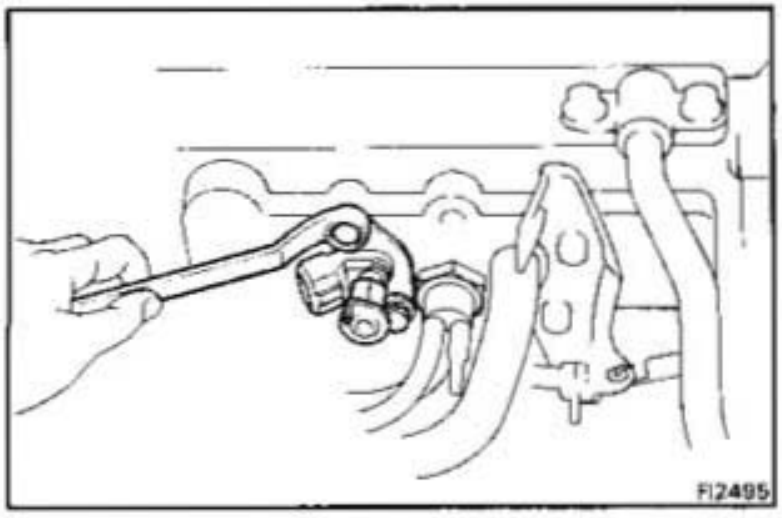
SST 09268-30050

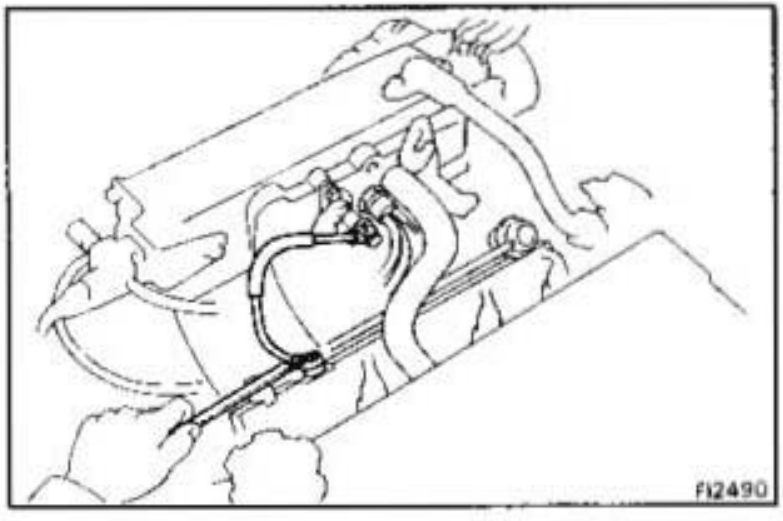
Fuel drop: One drop or less per minute

(b) Disconnect the battery negative (⊖) cable.

(c) Remove SST and the service wire.

SST 09268-41045 and 09842-30020





INSTALLATION OF COLD START INJECTOR

1. **INSTALL COLD START INJECTOR**

   Install a new gasket and the injector with the two bolts.

   Torque: 75 kg-cm (65 in.-lb, 7.4 N·m)

2. **INSTALL COLD START INJECTOR PIPE**

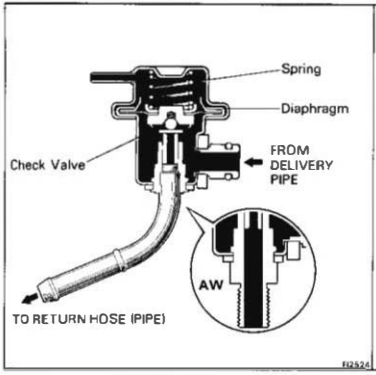
   Install the injector pipe with new four gaskets and the two union bolts.

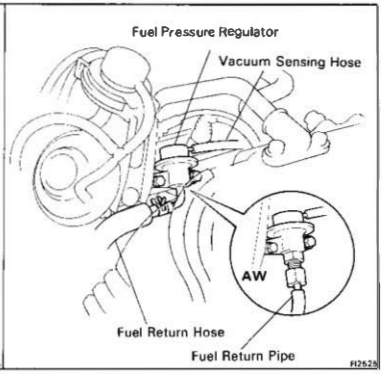
   Torque: 160 kg-cm (11 ft-lb, 15 N·m)

3. **CONNECT COLD START INJECTOR CONNECTOR**

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

Fuel Pressure Regulator





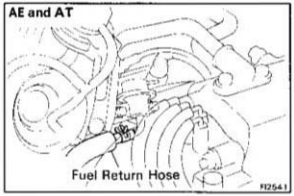
ON-VEHICLE INSPECTION

INSPECT FUEL PRESSURE (See page FI-67)

REMOVAL OF FUEL PRESSURE REGULATOR

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

2. **DISCONNECT VACUUM SENSING HOSE**

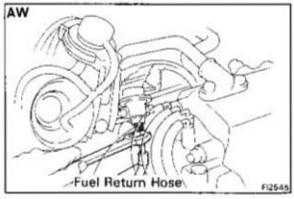


3. **DISCONNECT FUEL RETURN HOSE (AE AND AT) OR PIPE (AW)**

   (a) Put a suitable container or shop towel under the pressure regulator.

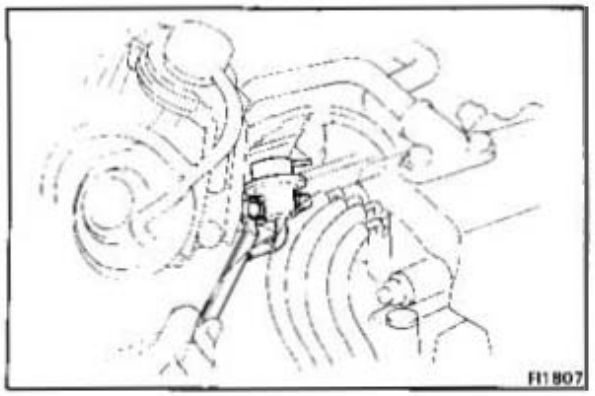
   (b) (AE and AT)
   Loosen the clip, and disconnect the return hose.

   NOTE: Slowly disconnect the return hose.



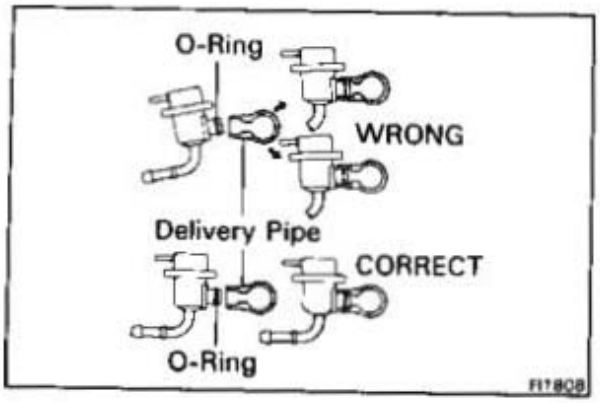
   (c) (AW)
   Loosen the flare nut, and remove the return pipe.

   NOTE: Slowly loosen the flare nut.



4. **REMOVE FUEL PRESSURE REGULATOR**

Remove the two bolts, and pull out the pressure regulator.



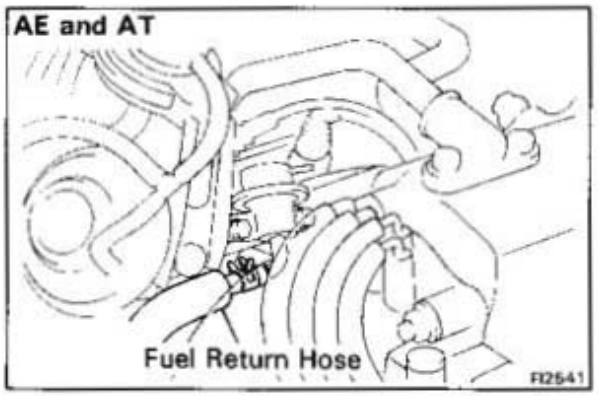
INSTALLATION OF FUEL PRESSURE REGULATOR

1. **INSTALL FUEL PRESSURE REGULATOR**

(a) Apply a light coat of gasoline to a new O-ring, and install it to the pressure regulator.

(b) Install the pressure regulator with the two bolts.

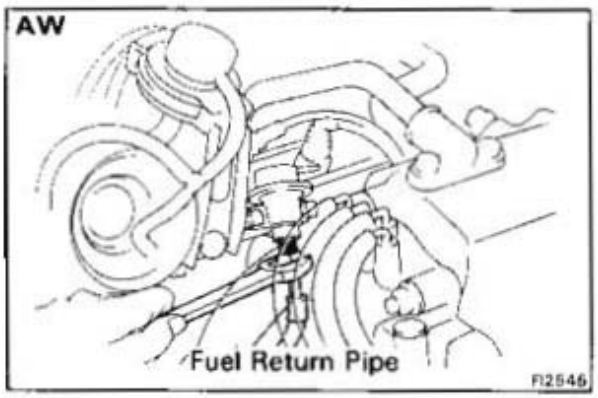
Torque: 75 kg-cm (65 in.-lb, 7.4 N·m)



2. **CONNECT FUEL RETURN HOSE (AE AND AT) OR PIPE (AW)**

(AE and AT)

Install the return hose with with the clip.



(AW)

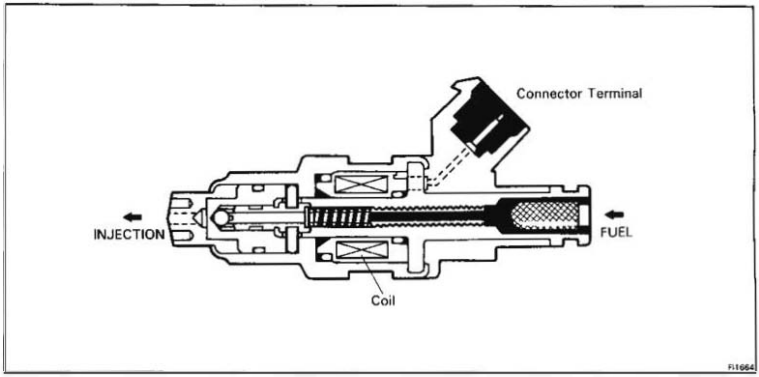
Install the return pipe with the flare nut.

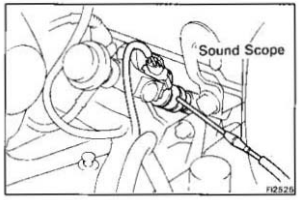
Torque: 300 kg-cm (22 ft-lb, 29 N·m)

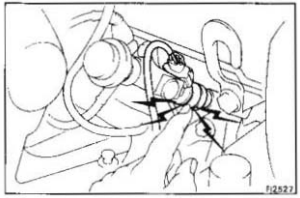
3. **CONNECT VACUUM SENSING HOSE**

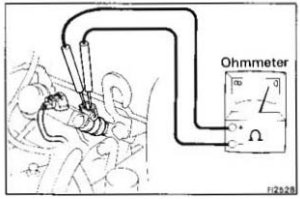
4. **CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY**

Injectors









ON-VEHICLE INSPECTION

1. INSPECT INJECTOR OPERATION

Check operation 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, resistor or injection signal from ECU.

2. INSPECT INJECTOR RESISTANCE

(a) Disconnect the injector connector.

(b) Using an ohmmeter, measure the resistance between the terminals.

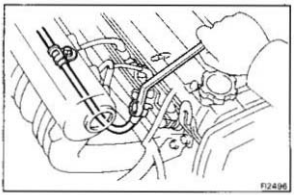
Resistance: w/o Air flow meter Approx. 2.3 Ω
w/ Air flow meter Approx. 13.8 Ω

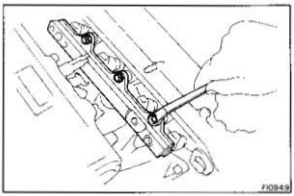
If the resistance is not as specified, replace the injector.

(c) Reconnect the injector connector.

REMOVAL OF INJECTORS

1. **DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY**
2. **REMOVE COLO START INJECTOR PIPE**
   (See steps 2 and 3 page FI-72)
3. **DISCONNECT VACUUM SENSING HOSE FROM FUEL PRESSURE REGULATOR**
4. **DISCONNECT INJECTOR CONNECTORS**
5. **DISCONNECT HOSE FROM FUEL RETURN PIPE**
6. **REMOVE FUEL INLET PIPE**
   (a) Remove the inlet pipe mount bolt.
   (b) Remove the union bolt, two gaskets and inlet pipe.





7. **REMOVE DELIVERY PIPE AND INJECTORS**
   (a) Remove the three bolts and delivery pipe together with the four injectors.

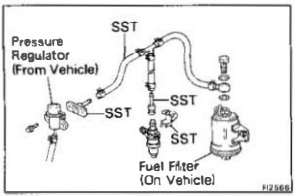
   CAUTION: Be careful not to drop the injectors, when removing the delivery pipe.

   (b) Remove the four insulators and three spacers from the cylinder head.
   (c) Pull out the four injectors from the delivery pipe.

INSPECTION OF INJECTORS

1. **INSPECT INJECTOR INJECTION**

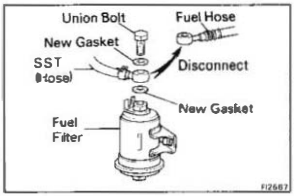
   WARNING: Keep clear of sparks during the test.

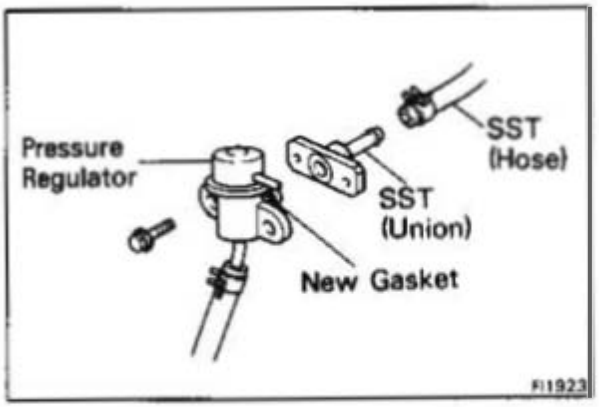


(a) Disconnect the fuel hose from the fuel filter outlet.
(b) Connect SST (union and hose) to the fuel filter outlet with new gaskets and the union bolt.

SST 09268-41045

NOTE: Use the vehicle's fuel filter.





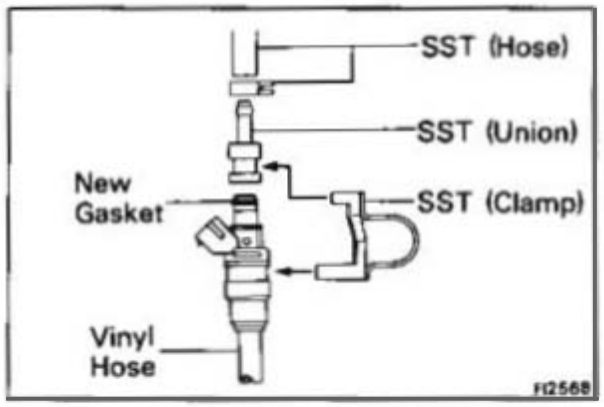
(c) Install a new O-ring to the pressure regulator.

(d) Remove the pressure regulator. (See page FI-75)

(e) Connect SST (union and hose) to the pressure regulator with two bolts.

SST 09268-41045

(f) Connect the fuel return hose (AE and AT) or pipe (AW).



(g) Install a new O-ring to the injector.

(h) Connect SST (hose) to the injector, with SST (union), and hold the injector and SST (union) with SST (clamp).

SST 09268-41045

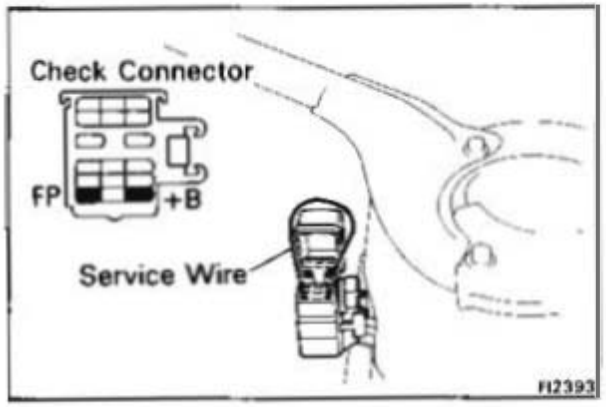
(i) Put the injector into the graduated cylinder.

NOTE: Install the a suitable vinyl hose onto the injector to prevent gasoline from splashing out.

(j) Reconnect the battery negetive (⊖) cable.

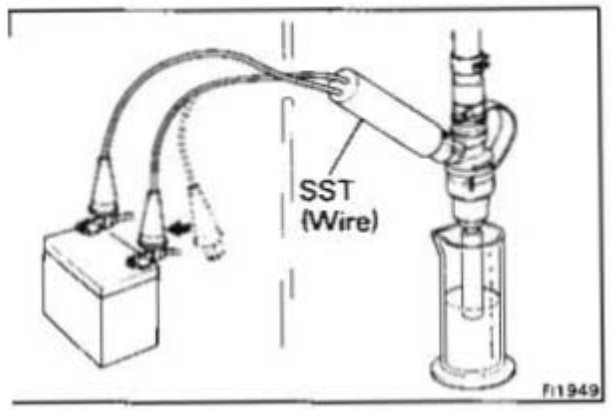
(k) Turn the ignition switch ON.

NOTE: Do not start the engine.



(l) Using a service wire, short terminals +B and FP of the check connector.

LOCATION: See page FI-89



(m) 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 09842-30060 (w/o Air flow meter)
09842-30070 (w/ Air flow meter)

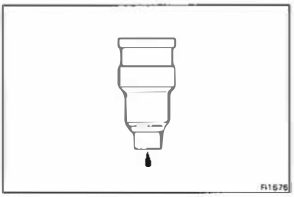
Volume:

w/o Air flow meter
44 — 49 cc (2.7 — 3.0 cu in.) per 15 sec.

w/ Air flow meter
48 — 53 cc (2.9 — 3.2 cu in.) per 15 sec.

Difference between each injector:
5 cc (0.3 cu in.) or less

If the injection volume is not as specified, replace the injector.



2. INSPECT LEAKAGE

(a) In the condition above, disconnect the test probes of SST (wire) from the battery and check the fuel leakage from the injector.

SST 09842-30060 (w/o Air flow meter)
09842-30070 (w/ Air flow meter)

Fuel drop: One drop or less per minute.

(b) Disconnect the battery negative (⊖) cable.

(c) Remove SST and the service wire.

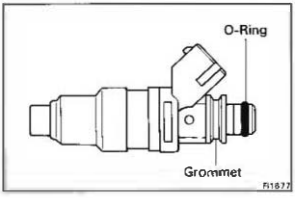
SST 09268-41045

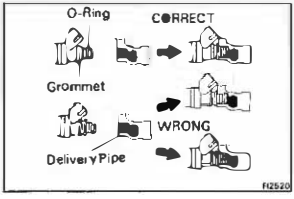
INSTALLATION OF INJECTORS

1. INSTALL INJECTORS AND DELIVERY PIPE

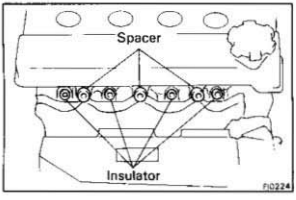
(a) Install a new grommet to the injector.

(b) Apply a light coat of gasoline to a new O-ring and install it to the injector.



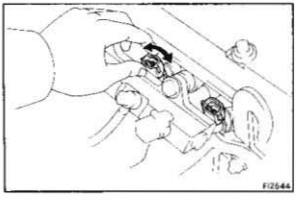


(c) While turning the injector left and right, install it to the delivery pipe. Install the four injectors.



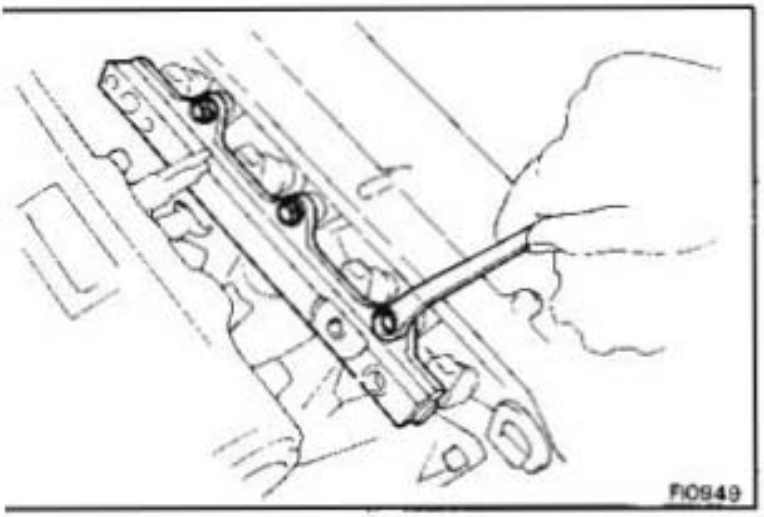
(d) Place the four insulators and three spacers in position on the cylinder head.

(e) Place the injectors together with the delivery pipe in position on the cylinder head.



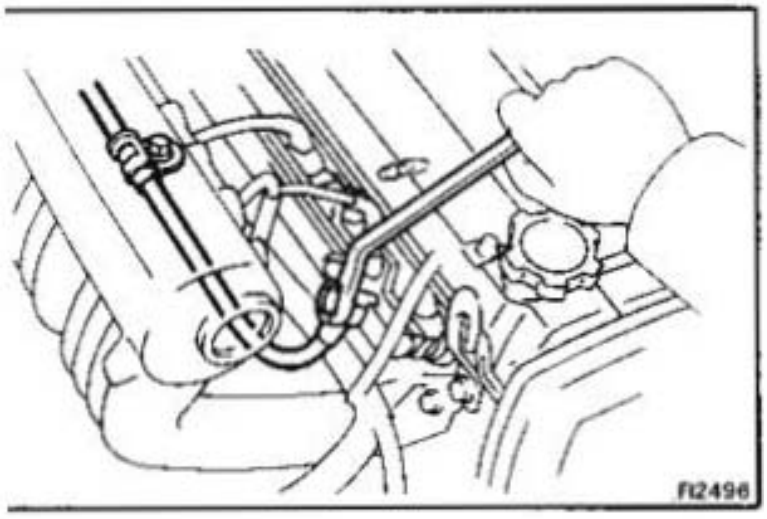
(f) Check that the injectors rotate smoothly.

NOTE: If injectors do not rotate smoothly, the probable cause is incorrect installation of O-rings. Replace the O-rings.



(g) Install and torque the three bolts.

Torque: 175 kg-cm (13 ft-lb, 17 N·m)



2. INSTALL FUEL INLET PIPE

Install a new gasket, the inlet pipe end a new gasket with the union end mount bolts.

Torque: 300 kg-cm (22 ft-lb, 29 N·m)

3. CONNECT FUEL RETURN HOSE

4. CONNECT INJECTOR CONNECTORS

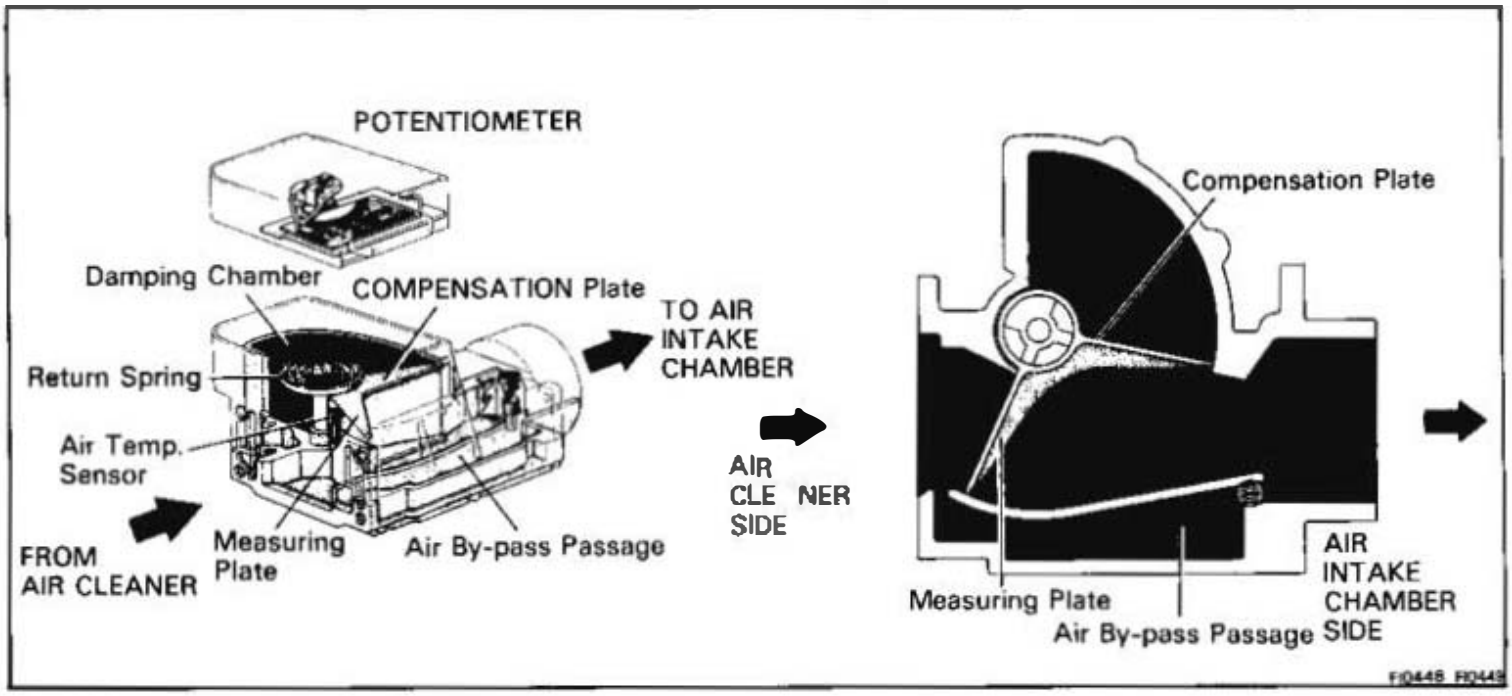
5. CONNECT VACUUM SENSING HOSE

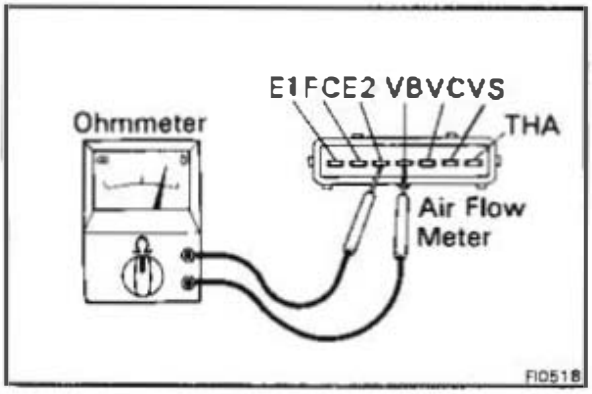
6. INSTALL COLD START INJECTOR PIPE
(See step 2 and 3 on page FI-74)

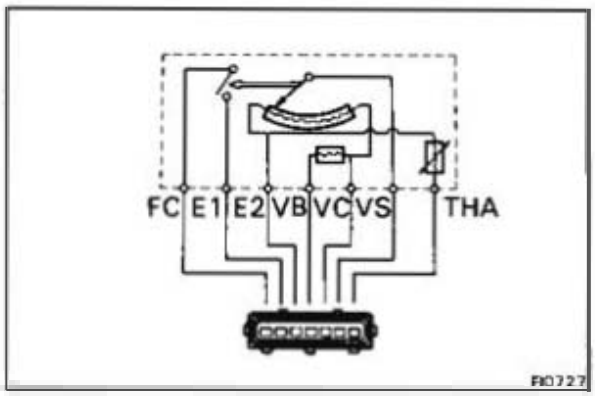
7. CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY

8. CHECK FOR FUEL LEAKAGE (See page FI-9)

AIR INDUCTION SYSTEM
Air Flow Meter (w/ Air Flow Meter)







ON-VEHICLE INSPECTION

INSPECT RESISTANCE OF AIR FLOW METER

(a) Disconnect the air flow meter connector.

(b) Using an ohmmeter, measure the resistance between each terminal.

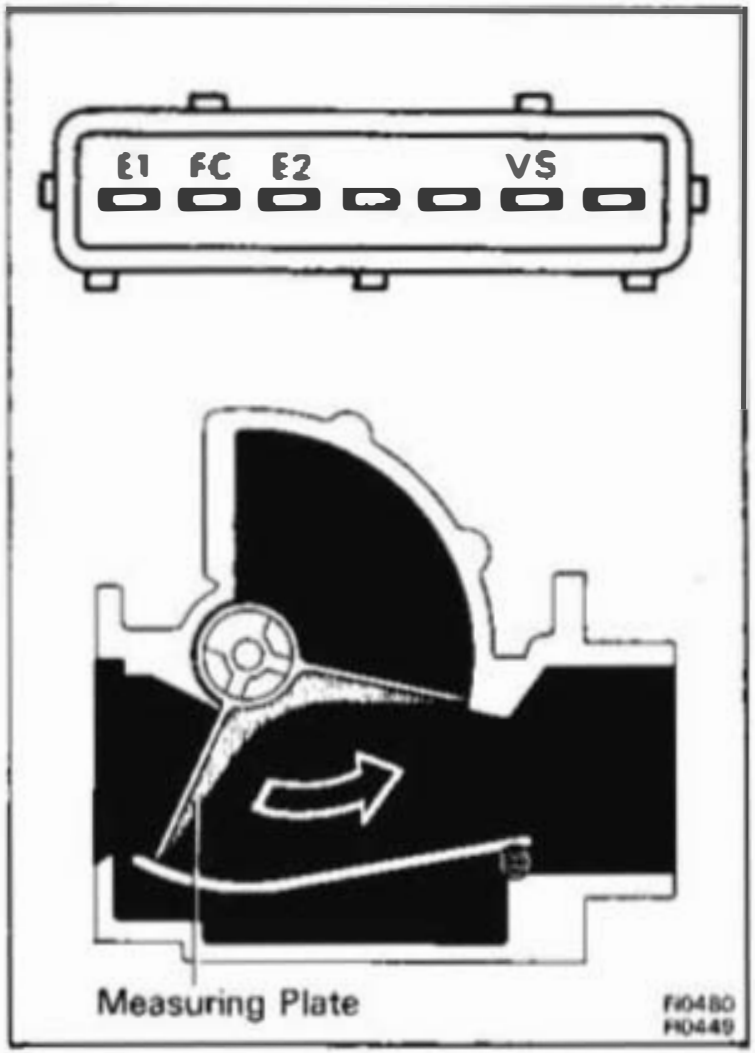
Between terminals	Resistance Ω	Temp. °C (°F)
VS – E2	20 – 3,000	–
VC – E2	100 – 300	–
VB – E2	200 – 400	–
THA – E2	10,000 – 20,000 4,000 – 7,000 2,000 – 3,000 900 – 1,300 400 – 700	–20 (–4) 0 (32) 20 (68) 40 (104) 60 (140)
FC – E1	Infinity	–

If the resistance is not as specified, replace the air flow meter.

(c) Reconnect the air flow meter connector.

REMOVAL OF AIR FLOW METER

1. DISCONNECT AIR FLOW METER CONNECTOR
2. DISCONNECT AIR CLEANER HOSE
3. REMOVE AIR FLOW METER



INSPECTION OF AIR FLOW METER

INSPECT RESISTANCE OF AIR FLOW METER

Using an ohmmeter, measure the resistance between each terminal by moving the measuring plate

Between terminals	Resistance Ω	Measuring plate opening
FC – E1	Infinity	Fully closed
	0	Other than closed position
VS – E2	20 – 400	Fully closed
	20 – 3,000	Fully open

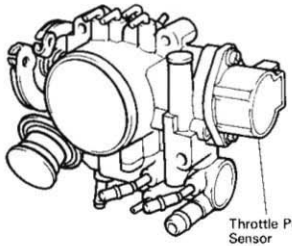
NOTE: Resistance between E2 and Vs will change in a wave pattern as the measuring plate slowly opens.

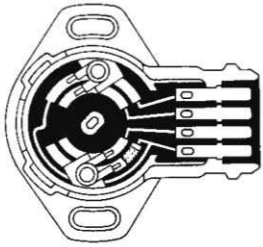
If the resistance is not as specified, replace the meter.

INSTALLATION OF AIR FLOW METER

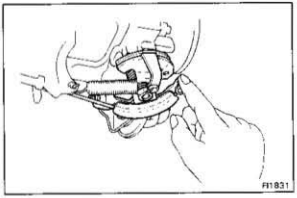
1. INSTALL AIR FLOW METER
2. CONNECT AIR CLEANER HOSE
3. CONNECT AIR FLOW METER CONNECTOR

Throttle Body





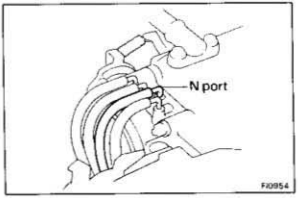
FI2497 FI0504



FI1831

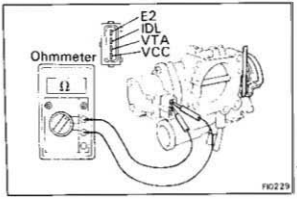
ON-VEHICLE INSPECTION

1. **INSPECT THROTTLE BODY**
   (a) Check that the throttle linkage moves smoothly.



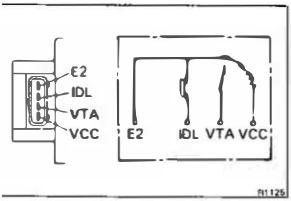
FI0954

(b) Check the vacuum at N port.
- Start the engine.
- Check the vacuum with your finger.



FI0229

2. **INSPECT THROTTLE POSITION SENSOR**
   (a) Disconnect the sensor connector.
   (b) Insert a feeler gauge between the throttle stop screw and stop lever.
   (c) Using an ohmmeter, measure the resistance between each terminal.



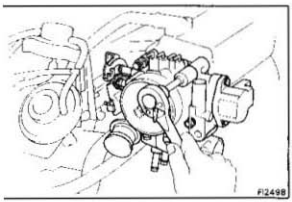
Clearance between lever and stop screw mm (in.)	Between Terminal	Resistance Ω
0 (0)	VTA – E2	200 – 800
0.35 (0.014)	IDL – E2	2,300 or less
0.59 (0.023)	IDL – E2	Infinity
Throttle valve fully opened position	VTA – E2	3,300 – 10,000
–	VCC – E2	3,000 – 7,000

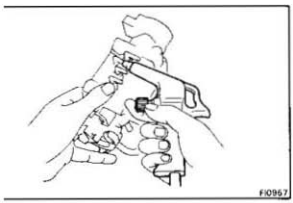
(d) Reconnect the sensor connector.

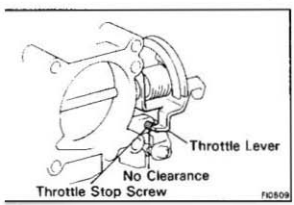
REMOVAL OF THROTTLE BODY

1. **DRAIN ENGINE COOLANT**
2. **(A/T) DISCONNECT THROTTLE CABLE FROM THROTTLE LINKAGE**
3. **DISCONNECT ACCELERATOR CABLE FROM THROTTLE LINKAGE**
4. **DISCONNECT AIR CLEANER HOSE**
5. **DISCONNECT THROTTLE POSITION SENSOR CONNECTOR**
6. **REMOVE THROTTLE BODY**
   (a) Disconnect the following hoses:
   - PCV hose
   - Water hoses
   - Air hose
   - Emission control vacuum hoses

   (b) Remove the two bolts, two nuts, throttle body and gasket.
7. **IF NECESSARY, REMOVE AIR VALVE FROM THROTTLE BODY (See step 2 on page FI-87)**





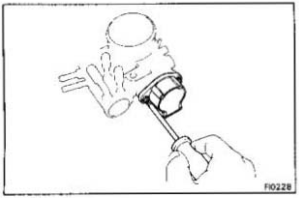


INSPECTION OF THROTTLE BODY

1. **CLEAN THROTTLE BODY**
   (a) Using a soft brush and carburetor cleaner, clean the cast parts.
   (b) Using compressed air, clean all the passages and apertures.

   CAUTION: To prevent deterioration, do not clean the throttle position sensor.
2. **INSPECT THROTTLE VALVE**

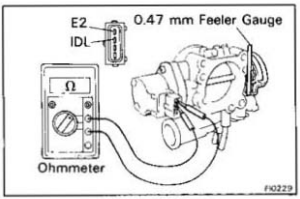
   Check that there is no clearance between the throttle stop screw and throttle lever when the throttle valve is fully closed.



3. **INSPECT THROTTLE POSITION SENSOR**
(See step 2 on page FI-84)

4. **IF NECESSARY, ADJUST THROTTLE POSITION SENSOR**

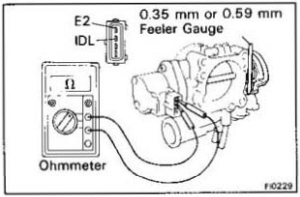
(a) Loosen the two mount screws of the sensor.



(b) Insert a 0.47 mm (0.019 in.) feeler gauge, between the throttle stop screw and stop lever.

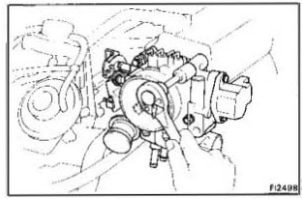
(c) Connect the test probe of an ohmmeter to the terminals IDL and E2 of the sensor.

(d) Gradually turn the sensor clockwise until the ohmmeter deflects, and secure it with the two screws



(e) Recheck the continuity between terminals IDL and E2.

Clearance between lever and stop screw mm (in.)	Continuity (IDL – E2)
0.35 (0.014)	Continuity
0.59 (0.023)	No continuity



INSTALLATION OF THROTTLE BODY

1. **INSTALL AIR VALVE TO THROTTLE BODY**
(See step 1 on page FI-88)

2. **INSTALL THROTTLE BODY**

(a) Install a new gasket and the throttle body with the two bolts and two nuts.

Torque: 220 kg-cm (16 ft-lb, 22 N·m)

(b) Connect the following hoses:

- PCV hose
- Water hoses
- Air hose
- Emission control vacuum hoses

3. **CONNECT THROTTLE POSITION SENSOR CONNECTOR**

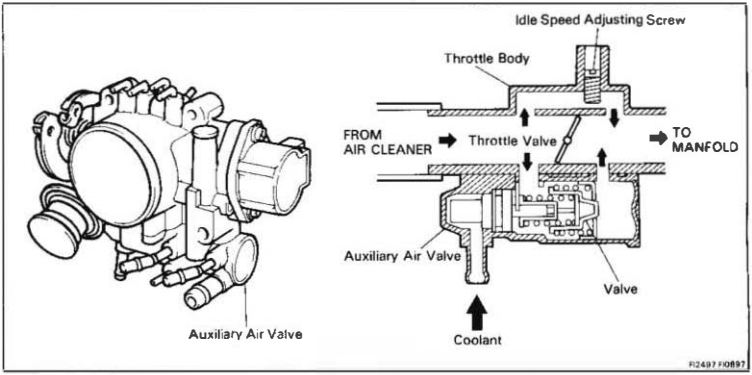
4. **CONNECT AIR CLEANER HOSE**

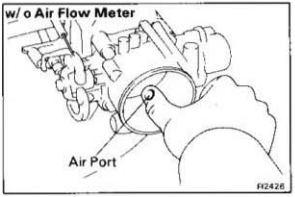
5. **CONNECT ACCELERATOR CABLE TO THROTTLE LINKAGE**

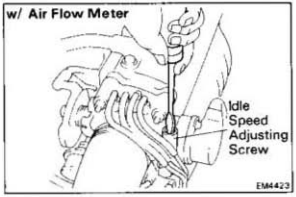
6. **(A/T)**
CONNECT THROTTLE CABLE TO THROTTLE LINKAGE

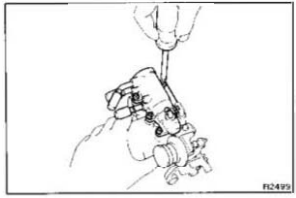
7. **FILL WITH ENGINE COOLANT**
(See page CO-3 or 5)

Auxiliary Air Valve









ON-VEHICLE INSPECTION

INSPECT AIR VALVE OPERATION

(w/o Air Flow Meter)

(a) Remove the air cleaner hose.

(b) Check the engine rpm by closing the air port on the throttle body.

At low temp. (Coolant temp.: below 80°C (176°F))

- The engine RPM should drop.

After warm-up

- Check that engine RPM does not drop more than 100 rpm.

If operation is not as specified, replace the air valve.

(w/ Air Flow Meter)

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 and drop.

After warm-up

- When the idle speed adjusting screw is in, the engine rpm should drop below idle speed duel stop.

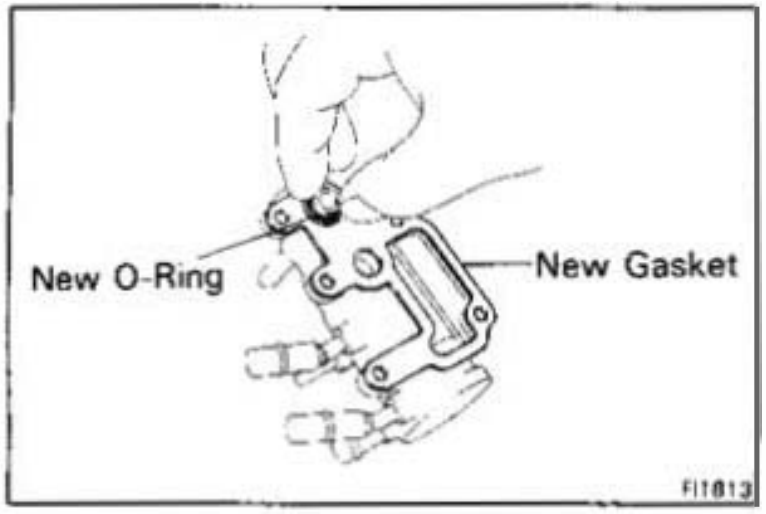
If operation is not as specified, replace the air valve.

REMOVAL OF AIR VALVE

1. **REMOVE THROTTLE BODY**
(See steps 1 to 6 on page FI-85)

2. **REMOVE AIR VALVE FROM THROTTLE BODY**

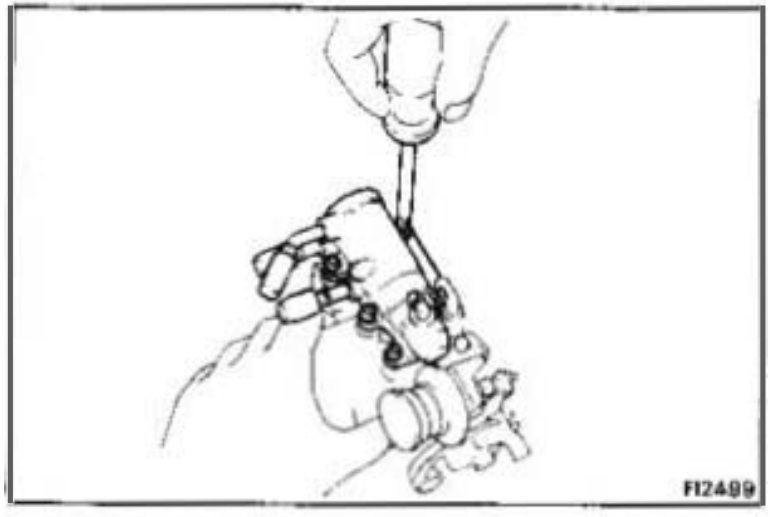
Remove the five screws, air valve, gasket and O-ring.



INSTALLATION OF AIR VALVE

1. INSTALL AIR VALVE TO THROTTLE BOOY

(a) Place new gasket and O-ring on the throttle body.



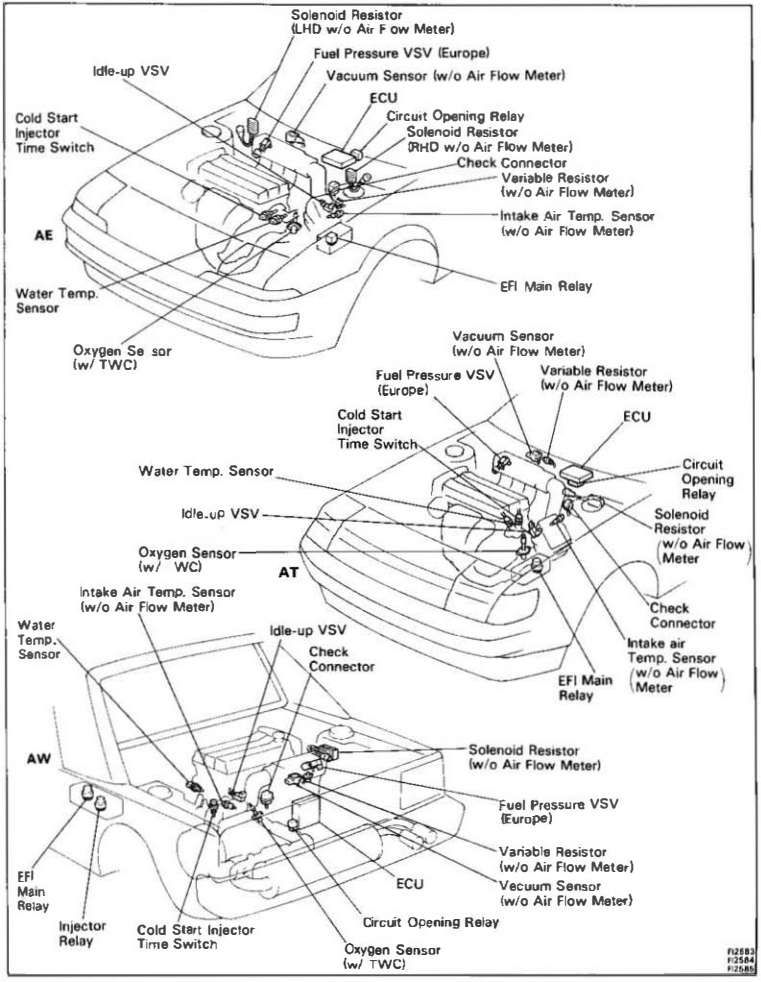
(b) Install the air valve with the five screws.

2. INSTALL THROTTLE BODY

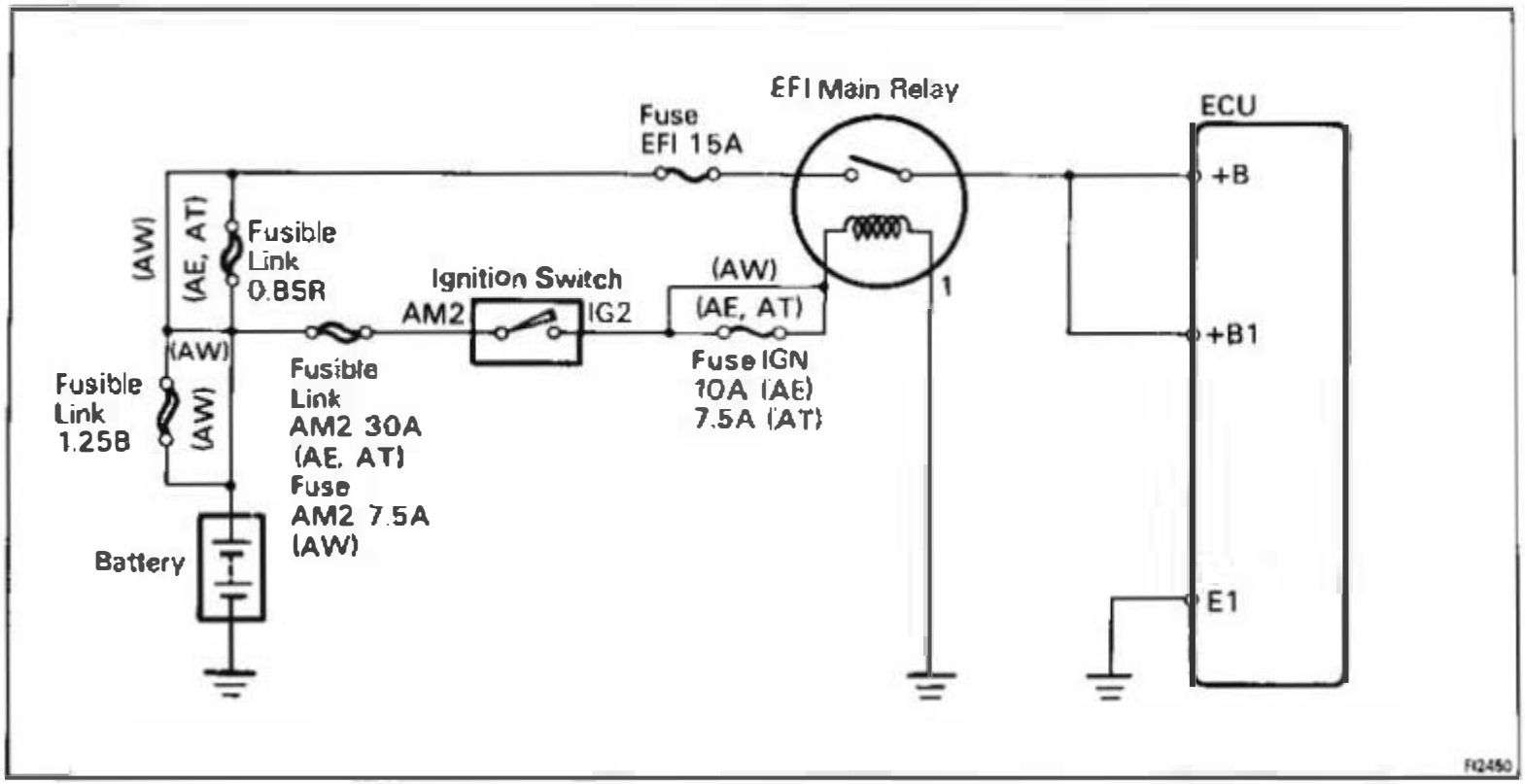
(See steps 2 to 8 on page FI-86)

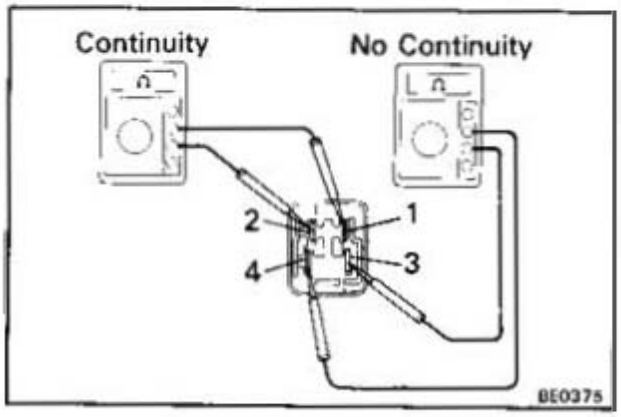
ELECTRONIC CONTROL SYSTEM

Location of Electronic Control Parts



EFI Main Relay





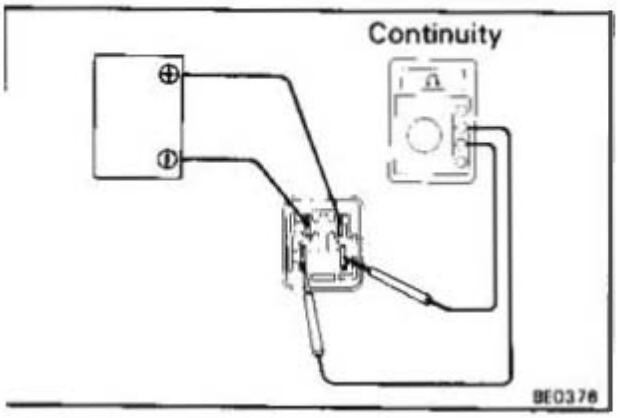
INSPECTION OF EFI MAIN RELAY (AE)

1. INSPECT RELAY CONTINUITY

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

(b) Check that there is no continuity between terminals 3 and 4.

If continuity is not as specified, replace the relay.



2. INSPECT RELAY OPERATION

(a) Apply battery voltage across terminals 1 and 2.

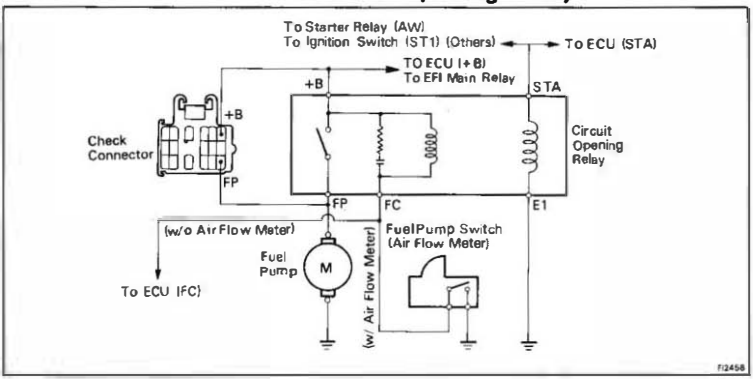
(b) Using an ohmmeter, check that there is continuity between terminals 3 and 4.

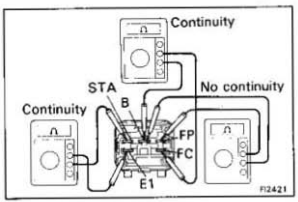
If operation is not as specified, replace the relay.

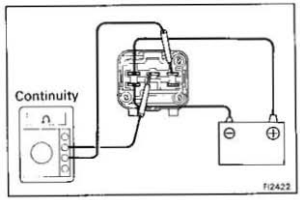
INSPECTION OF EFI MAIN RELAY (AT and AW)

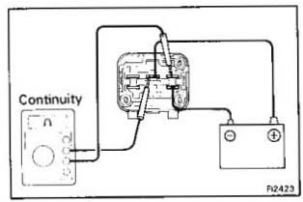
(See procedure No.3 Cooling Fan Relay on page CO-32)

Circuit Opening Relay









INSPECTION OF CIRCUIT OPENING RELAY (AE w/o Air Flow Meter, AT and AW)

1. **INSPECT RELAY CONTINUITY**

   (a) Using an ohmmeter, check that there is continuity between terminals STA and E1.

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

   (c) Check that there is no continuity between terminals B and FP.

   If continuity is not as specified, replace the relay.

2. **INSPECT RELAY OPERATION**

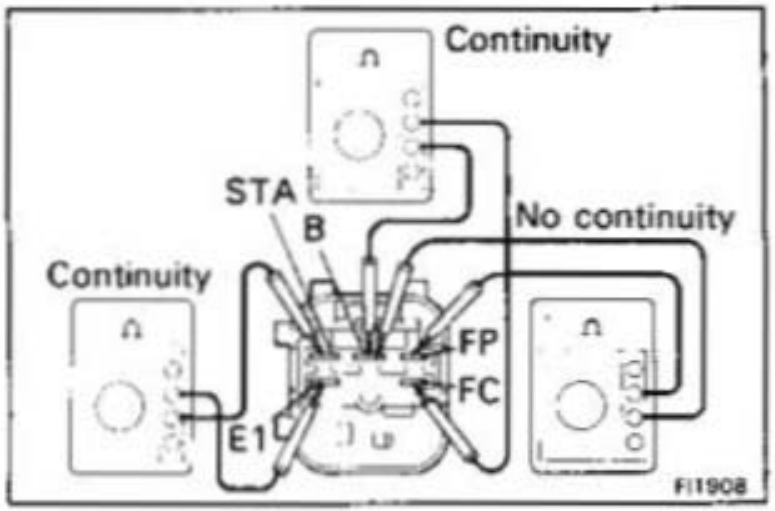
   (a) Apply battery voltage across terminals STA and E1.

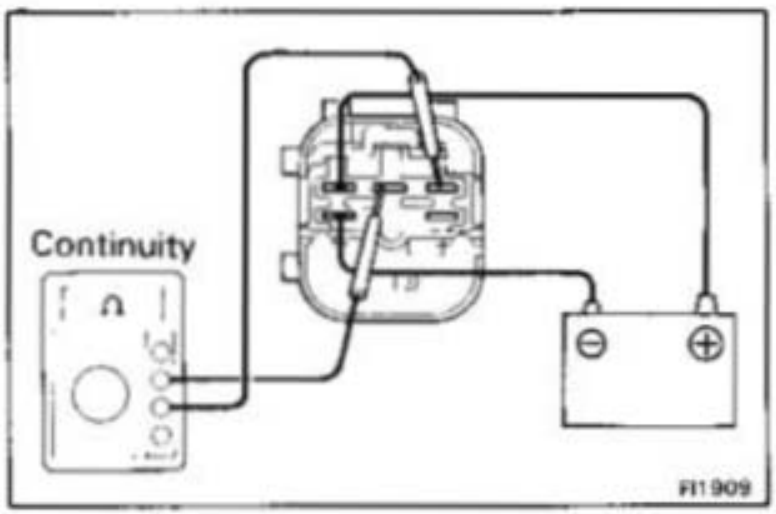
   (b) Using an ohmmeter, check that there is continuity between terminals B and FP.

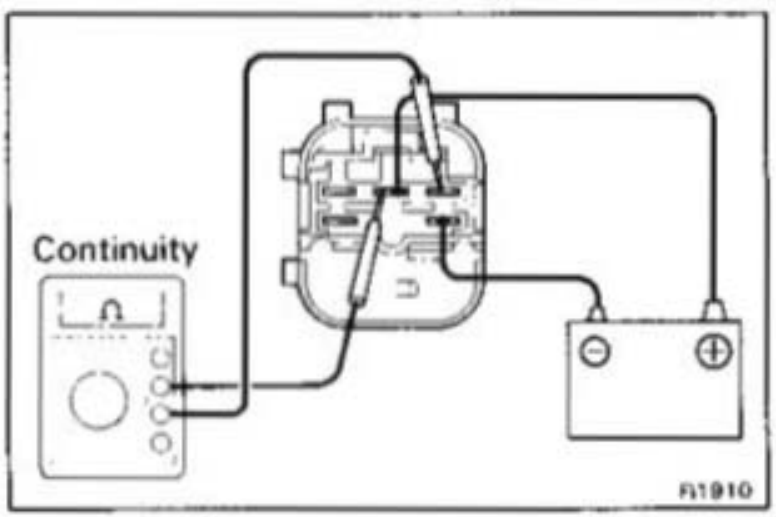
   (c) Apply battery voltage across terminals B and FC.

   (d) Check that there is continuity between terminals B and FP.

   If operation is not as specified, replace the relay.







INSPECTION OF CIRCUIT OPENING RELAY (AE w/ Air Flow Meter)

1. INSPECT RELAY CONTINUITY

(a) Using an ohmmeter, check that there is continuity between terminals STA and E1.

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

(c) Check that there is no continuity between terminals B and FP.

If continuity is not as specified, replace the relay.

2. INSPECT RELAY OPERATION

(a) Apply battery voltage across terminals STA and E1.

(b) Using an ohmmeter, check that there is continuity between terminals B and FP.

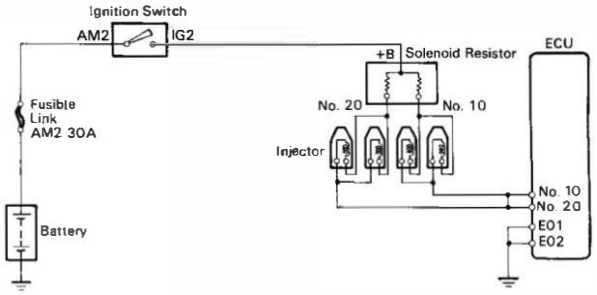
(c) Apply battery voltage across terminals B and FC.

(d) Check that there is continuity between terminals B and FP.

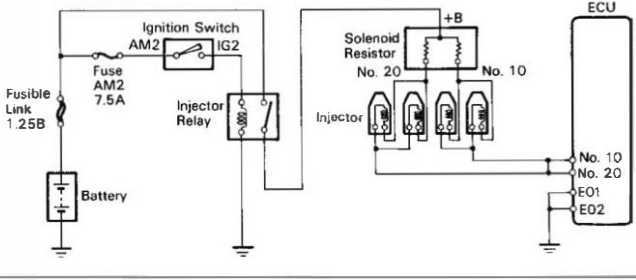
If operation is not as specified, replace the relay.

Solenoid Resistor and Injector Relay

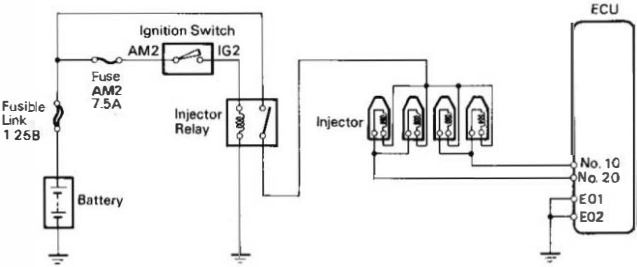
AE (w/o Air Flow Meter) and AT (w/o Air Flow Meter)

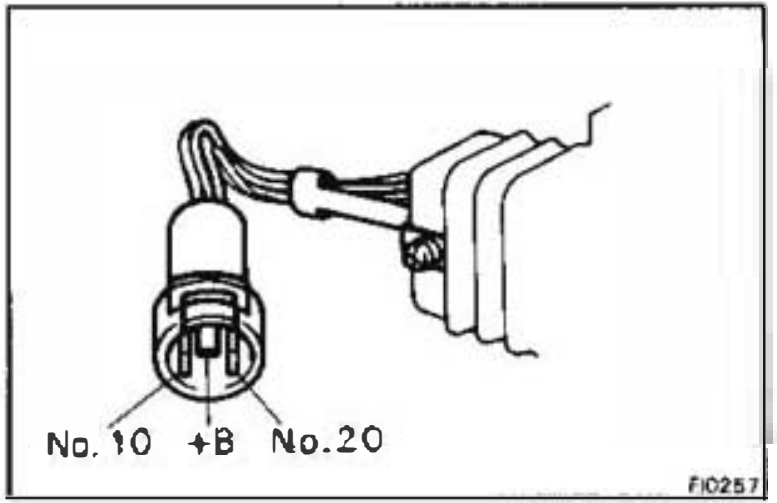


AW (w/o Air Flow Meter)



AW (w/ Air Flow Meter)





INSPECTION OF SOLENOID RESISTOR (w/o Air Flow Meter)

INSPECT SOLENOID RESISTOR RESISTANCE

Using an ohmmeter, measure the resistance between terminal B and other terminals (No.10, No.20).

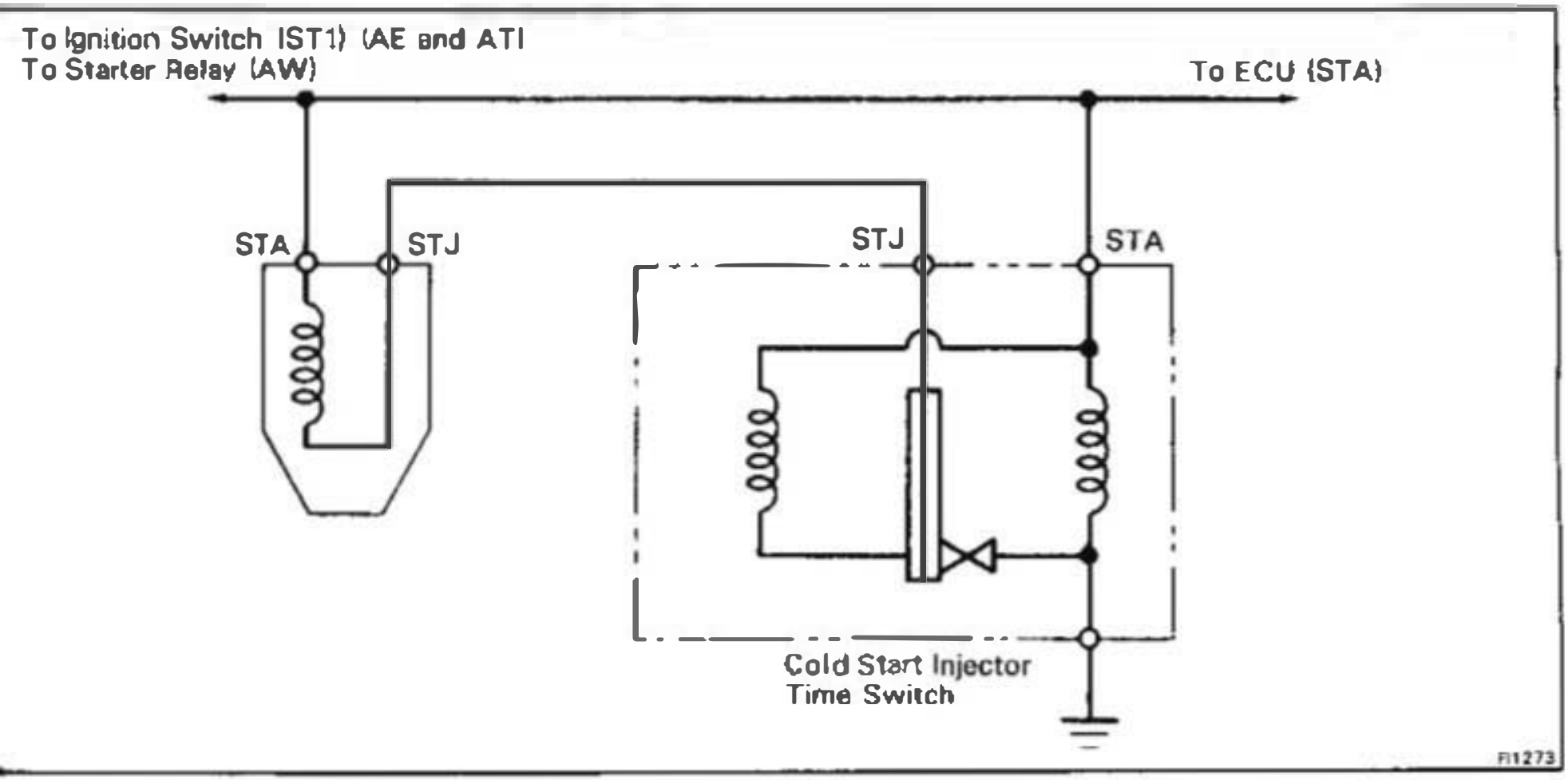
Resistance: 2 — 3 Ω each

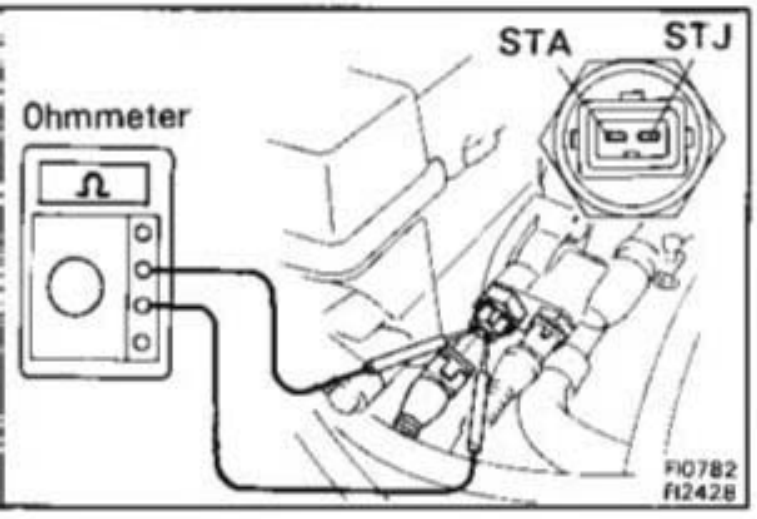
If the resistance is not as specified, replace the resistor

INSPECTION OF INJECTOR RELAY (AW)

(See procedure No.3 Cooling Fan Relay on page CO-32)

Cold Start Injector Time Switch





INSPECTION OF COLD START INJECTOR TIME SWITCH

INSPECT COLD START INJECTOR TIME SWITCH

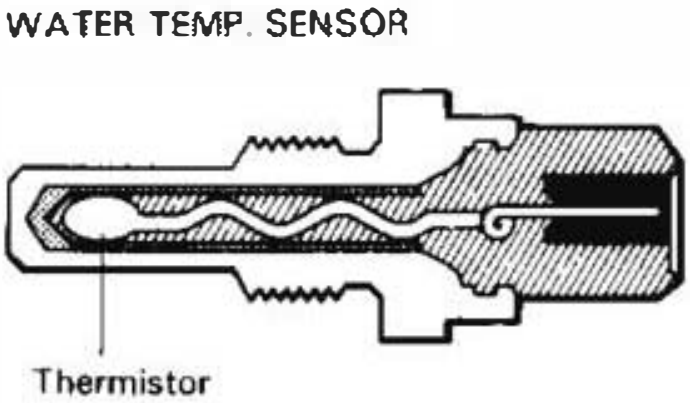
Using an ohmmeter, measure the resistance between each terminal.

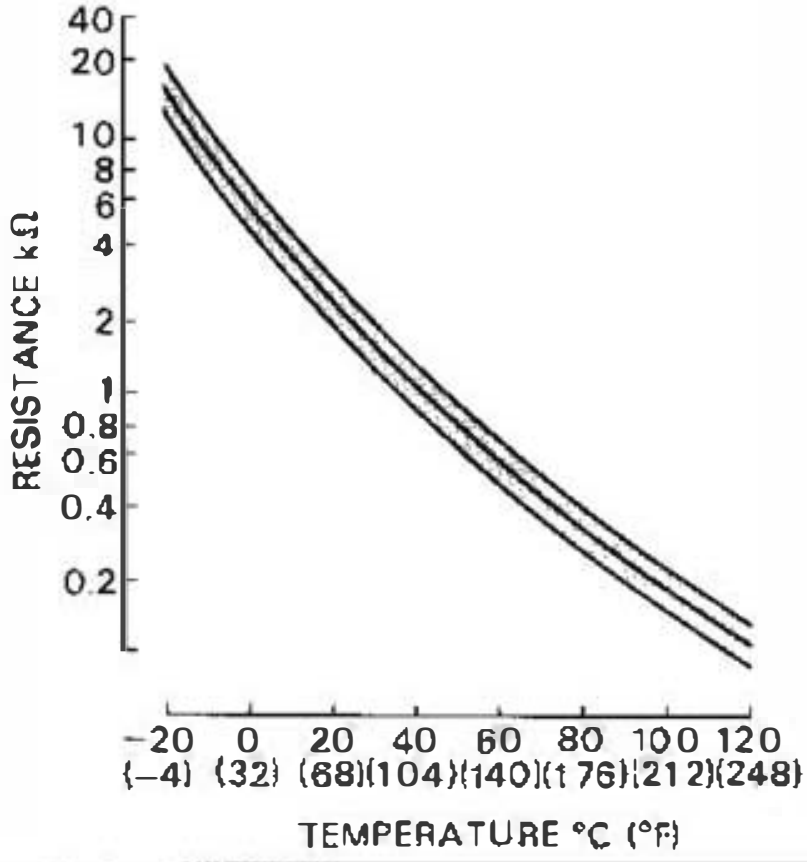
Resistance:

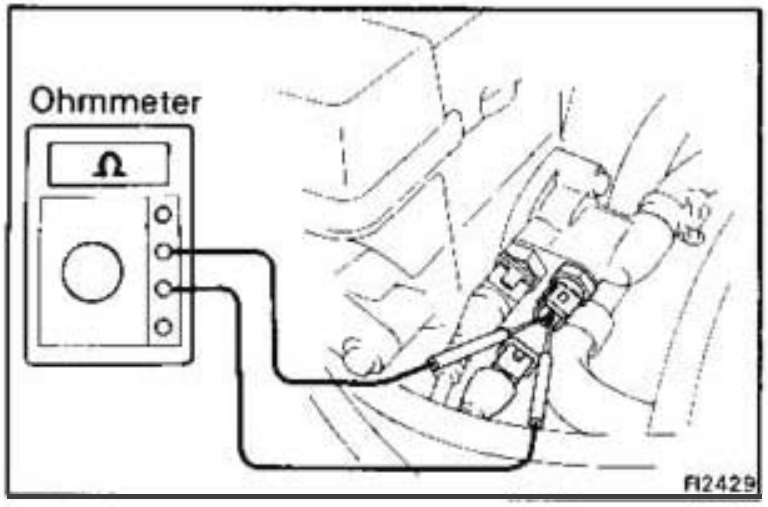
STA – STJ	**20 – 40 Ω below 30°C (86°F)**
	40 – 60 Ω above 40°C (104°F)
STA – Ground	**20 – 80 Ω**

If the resistance is not as specified, replace the switch.

Water Temperature Sensor







INSPECTION OF WATER TEMPERATURE SENSOR

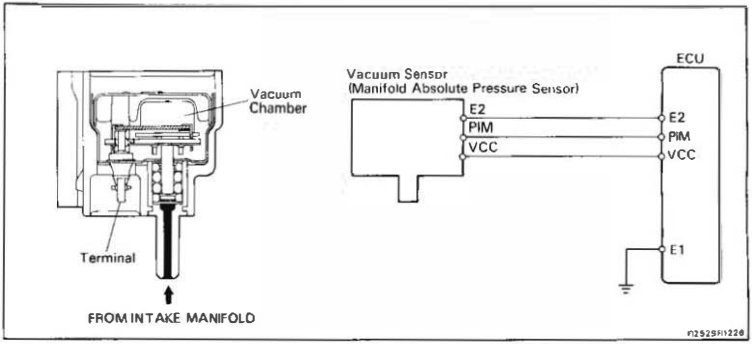
INSPECT WATER TEMPERATURE SENSOR

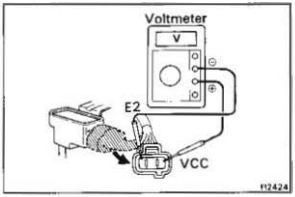
Using an ohmmeter, measure the resistance between the ter inals.

Resistance: Refer to chart

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

Vacuum Sensor (w/o Air Flow Meter) (Manifold Absolute Pressure Sensor)





INSPECTION OF VACUUM SENSOR

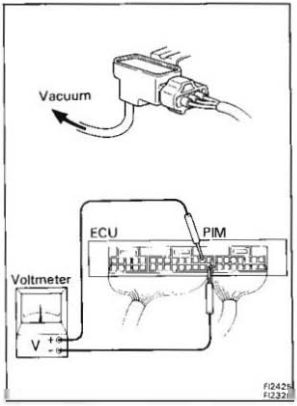
1. INSPECT POWER SOURCE VOLTAGE OF VACUUM SENSOR

(a) Disconnect the vacuum sensor connector.

(b) Turn the ignition switch ON.

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

Voltage: 4 — 6 V



2. INSPECT POWER OUTPUT OF VACUUM SENSOR

(a) Turn the ignition switch ON.

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

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

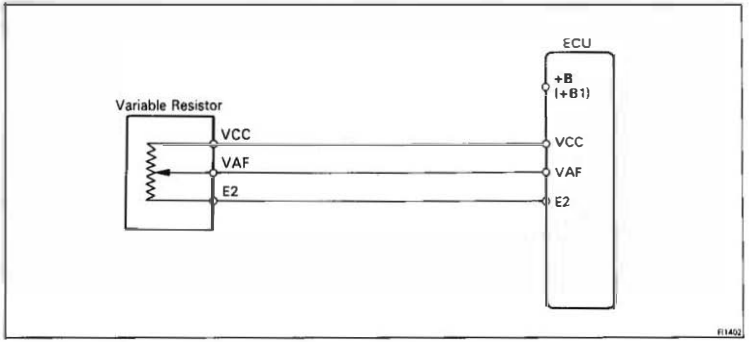
(d) Apply vacuum to the vacuum sensor in 100 mmHg (3.94 in.Hg, 13.3 kPa) segments to 500 mmHg (19.69 in.Hg, 66.7 kPa).

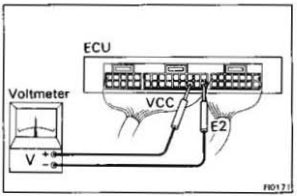
(e) Measure voltage drop from step (c) above for each segment.

Voltage drop

Applied Vacuum mmHg (in.Hg, kPa)	100 (3.94, 13.3)	200 (7.87, 26.7)	300 (11.81, 40.0)	400 (15.75, 53.3)	500 (19.69, 66.7)
Voltage drop V	0.3–0.5	0.7–0.9	1.1–1.3	1.5–1.7	1.9–2.1

Variable Resistor (w/o Air Flow Meter)



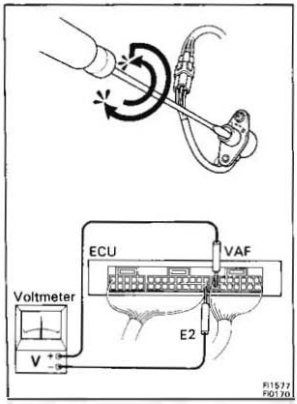


INSPECTION OF VARIABLE RESISTOR

1. INSPECT VOLTAGE OF VARIABLE RESISTOR

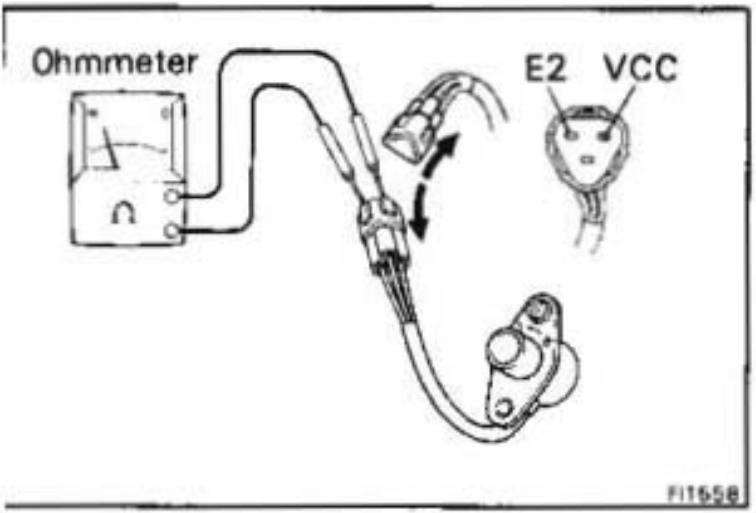
(a) Using a voltmeter, measure the voltage between ECU terminals VCC and E2.

Voltage: 4 — 6 V



(b) Measure the voltage between ECU terminals VAF and E2 while slowly turning idle mixture adjusting screw first fully counterclockwise, and then fully clockwise.

(c) Check that the voltage changes smoothly from 0 V to approx. 5 V.

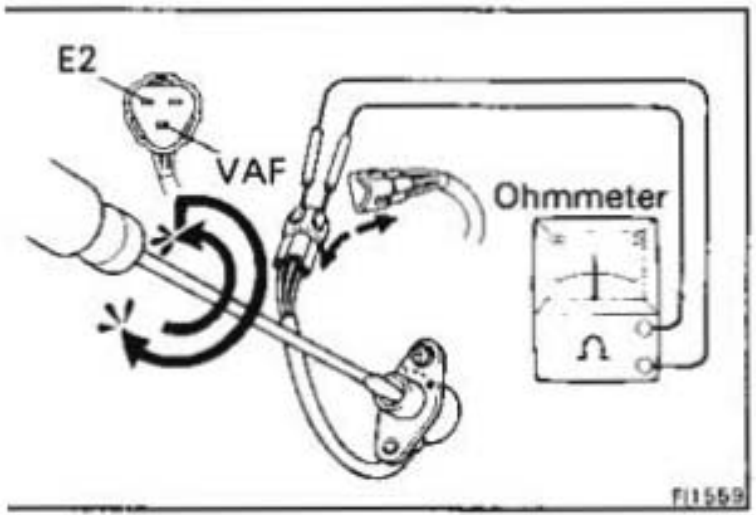


2. INSPECT RESISTANCE OF VARIABLE RESISTOR

(a) Disconnect the variable resistor connector.

(b) Using an ohmmeter, measure the resistance between the terminals VCC and E2.

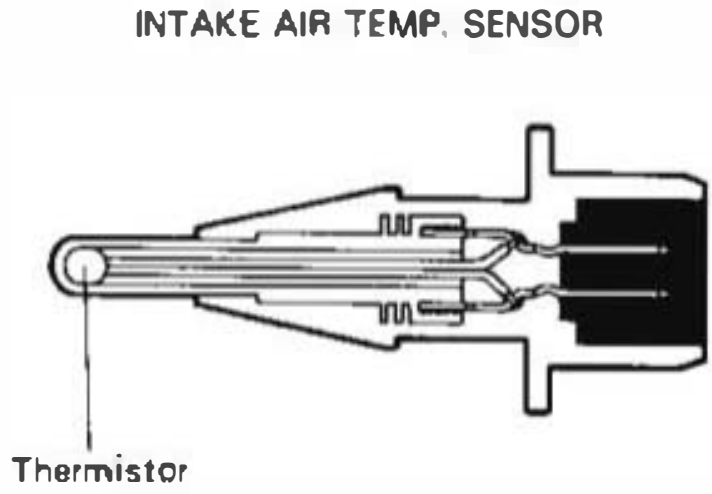
Resistance: 4 — 6 kΩ

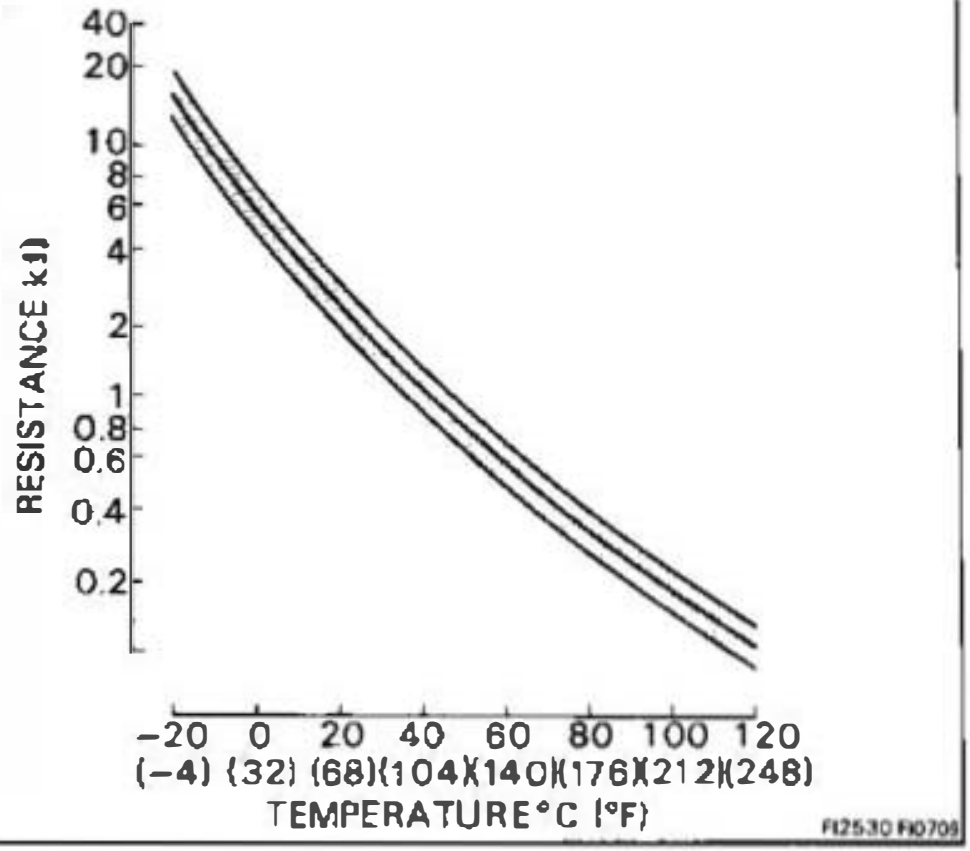


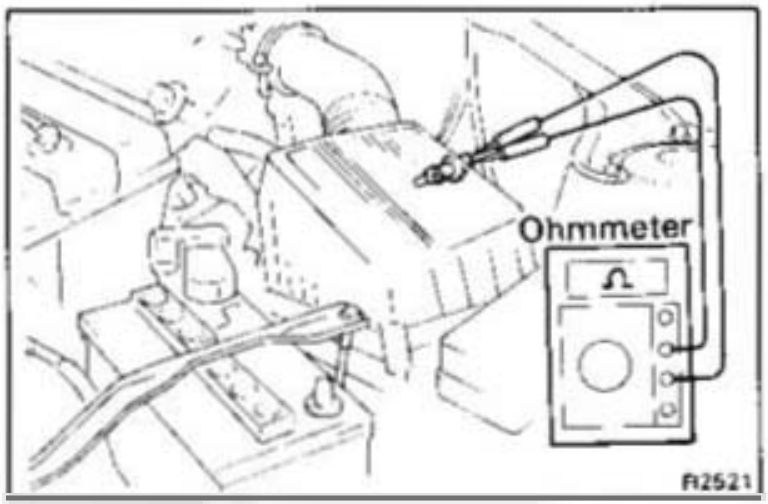
(c) Turn the idle mixture adjusting screw fully counterclockwise.

(d) Connect an ohmmeter to terminals VAF and E2. Turn the adjusting screw fully clockwise and check that the resistance value changes from approx. 5 kΩ to 0 Ω accordingly.

Intake Air Temperature Sensor (w/o Air Flow Meter)







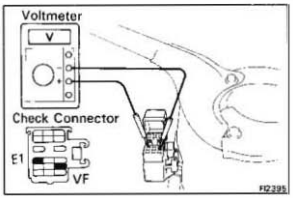
INSPECTION OF INTAKE AIR TEMPERATURE SENSOR

INSPECT RESISTANCE OF INTAKE AIR TEMPERATURE SENSOR

Using an ohmmeter, measure the resistance between the terminals.

Resistance: Refer to chart

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



Oxygen Sensor (w/ TWC)

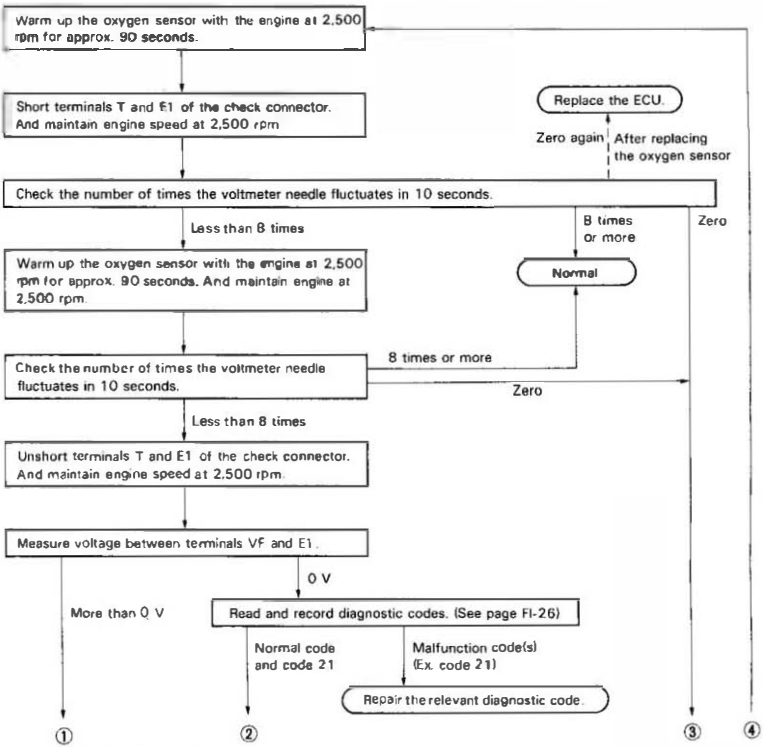
INSPECTION OF OXYGEN SENSOR

1. WARM UP ENGINE

Allow the engine to reach normal operating temperature.

2. INSPECT FEEDBACK VOLTAGE (VF)

Connect the positive (⊕) probe of a voltmeter to terminal VF of the check connector, and negative (⊖) probe to terminal E1. Perform the test as follows:



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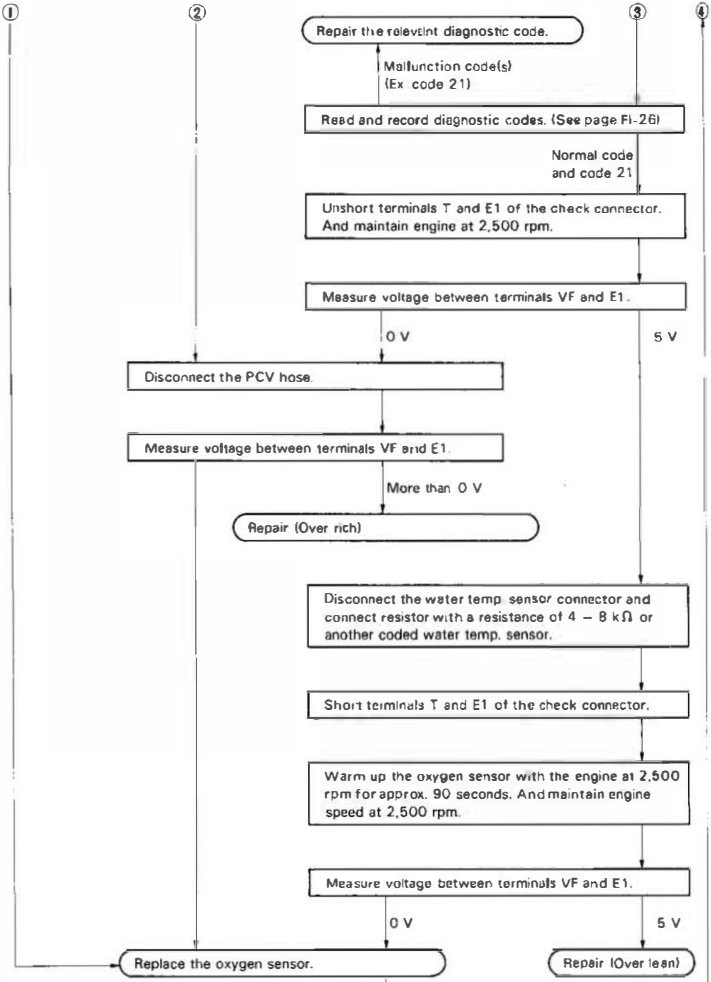
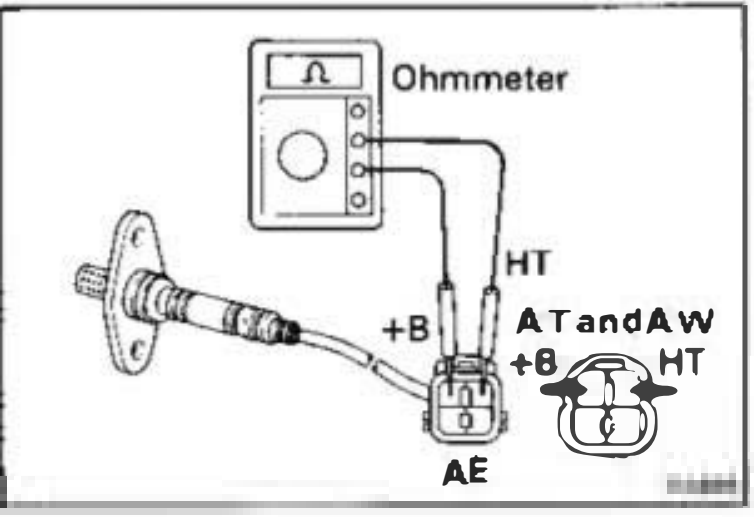


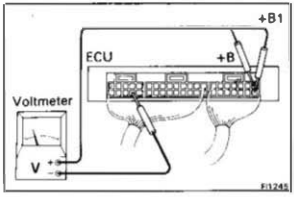


3. INSPECT HEATER COIL RESISTANCE OF OXYGEN SENSOR

Using an ohmmeter, measure the resistance between the terminals +B and HT.

Resistance: 5.1 — 6.3 Ω

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



Electronic Controlled Unit (ECU)

INSPECTION OF ECU

NOTE: The EFI circuit can be checked by measuring the resistance and voltage at the wiring connectors of the ECU.

1. INSPECT VOLTAGE OF ECU

Check the voltage between each terminal of the wiring connectors.

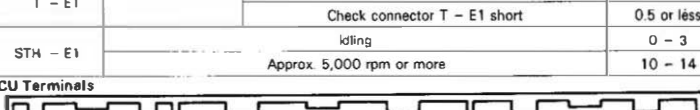
- Turn the ignition switch ON.
- Measure the voltage at each terminal

NOTE:
- Perform all voltage measurements with the connectors connected.
- Verify that the battery voltage is 11 V or more when the ignition switch is ON.

Voltage at ECU Wiring Connectors (TCCS ECU w/o Air Flow Meter)

Terminals	Condition		ST*) voltage (V)
+B, +B1 – E1	Ignition S/W ON		10 – 14
BATT – E1	—		10 – 14
IDL – E2	Ignition S/W ON	Throttle valve open	4.5 – 5.5
VTA – E2		Throttle valve fully closed	0.5 or less
		Throttle valve fully open	3.5 – 5.5
VCC – E2		—	4.5 – 5.5
IGT – E1	Cranking or idling		0.7 – 1.0
STA – E1	Cranking		6 – 14
No. 10 – E01, No. 20 – E02	Ignition S/W ON		9 – 14
W – E1	No trouble (Check engine warning light off) and engine running		9 – 14
PIM – E2	Ignition S/W ON		3.3 – 3.9
VCC – E2			4.5 – 5.5
THA – E2	Ignition S/W ON	Intake air temp. 20°C (68°F)	2.0 – 2.8
THW – E2		Coolant temp. 80°C (176°F)	0.4 – 0.8
A/C – E1		Air conditioning ON	5 – 14
T – E1		Check connector T – E1 not short	4.5 – 5.5
		Check connector T – E1 short	0.5 or less
STH – E1	Idling		0 – 3
	Approx. 5,000 rpm or more		10 – 14

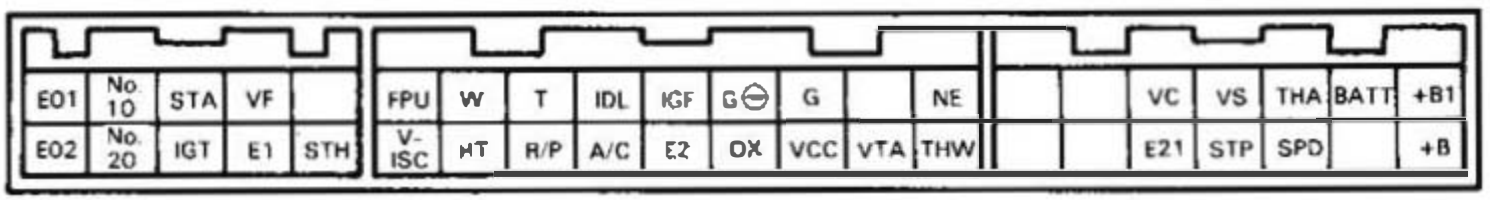
ECU Terminals

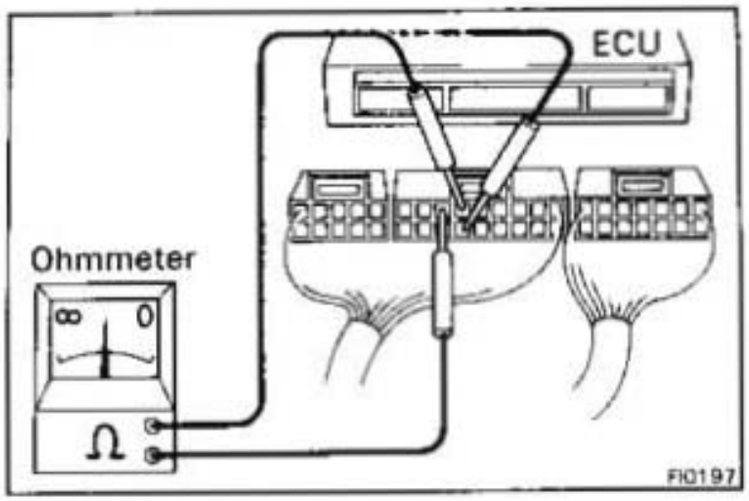


Voltage at ECU Wiring Connectors (TCCS ECU w/ Air Flow Meter)

Terminals	Condition		STD voltage (V)
+B, +B1 – E1	Ignition S/W ON		10 – 14
BATT – E1	—		10 – 14
IDL – E2	Ignition S/W ON	Throttle valve open	10 – 14
VTA – E2		Throttle valve fully closed	0.5 or less
		Throttle valve fully open	3.5 – 5.5
VCC – E2		—	4.5 – 5.5
IGT – E1	Cranking or idling		0.7 – 1.0
STA – E1	Cranking		6 – 14
No. 10, No. 20 – E01, E02	Ignition S/W ON		9 – 14
W – E1	No trouble (Check engine warning light off) and engine running		9 – 14
VC – E2	Ignition S/W ON	—	5.1 – 10.8
VS – E2		Measuring plate fully closed	2.5 – 5.4
		Measuring plate fully open	6.2 – 8.8
	Idling		3.9 – 5.8
THA – E2	Ignition S/W ON	Intake air temp. 20°C (68°F)	2 – 2.8
THW – E2		Coolant temp. 80°C (176°F)	0.4 – 0.7
A/C – E1		Air conditioning ON	5 – 14
T – E1		Check connector T – E1 not short	10 – 14
		Check connector T – E1 short	0.5 or less
R/P – E1		Fuel control S/W NORMAL	10 – 14
		Fuel control S/W SUPER	0.5 or less
STH – E1	Idling		0 – 3
	Approx. 4,350 rpm or more		10 – 14

ECU Terminals





2. INSPECT RESISTANCE OF ECU

CAUTION:

- **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 connectors.

- Disconnect the connectors from the ECU.
- Measure the resistance at each terminal.

Resistance of ECU Wiring Connectors (TCCS ECU w/o Air Flow Meter)

Terminals	Condition	Resistance (Ω)
IDL – E2	Throttle valve open	Infinity
	Throttle valve fully closed	2,300 or less
VTA – E2	Throttle valve fully open	3,300 – 10,000
	Throttle valve fully closed	200 – 800
VCC – E2	–	3,000 – 7,000
THA – E2	Intake air temp. 20°C (68°F)	2,000 – 3,000
THW – E2	Coolant temp. 80°C (176°F)	200 – 400
G – G⊖	–	140 – 180
NE – G⊖	–	140 – 180

ECU Terminals

E01	No. 10	STA			V-ISC	VAF	G⊖	G	IGF	T	THA	PIM	THW				FC	SEL	BATT	+B1
E02	No. 20	IGT	E1	FPU	STH	VF	E21	NE		IDL	VCC	VTA	E2			SPD	A/C		W	+B

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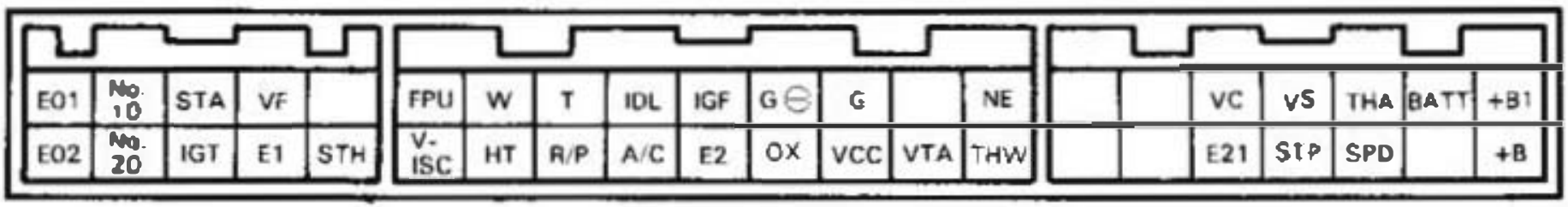
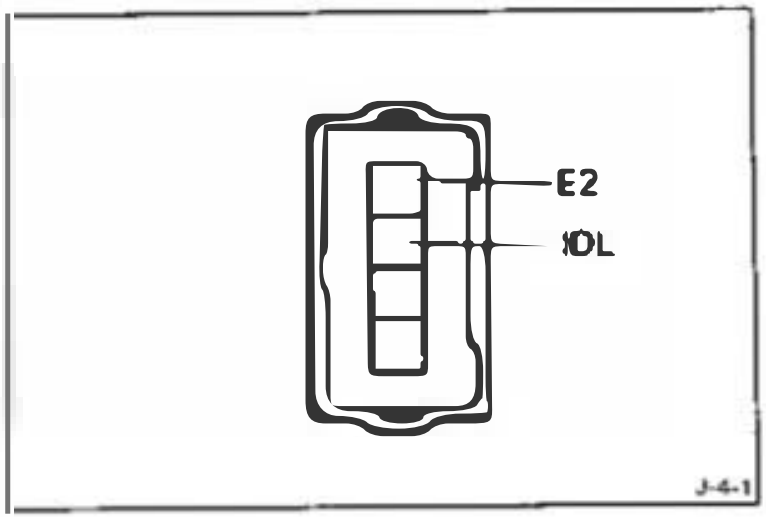
Resistance of ECU Wiring Connectors (TCCS ECU w/ Air Flow Meter)

Terminals	Condition	Resistance (Ω)
IDL – E2	Throttle valve open	Infinity
	Throttle valve fully closed	2,300 or less
VTA – E2	Throttle valve fully open	3,300 – 10,000
	Throttle valve fully closed	200 – 800
VCC – E2	—	3,000 – 7,000
VS – E2	Measuring plate fully closed	20–400
	Measuring plate fully open	20 – 3,000
VC – E2	—	100 – 300
THA – E2	Intake air temp. 20°C (68°F)	2,000 – 3,000
THW – E2	Coolant temp. 80°C (176°F)	200 – 400
G – G⊖	—	140 – 180
NE – G⊖	—	140 – 180

ECU Terminals



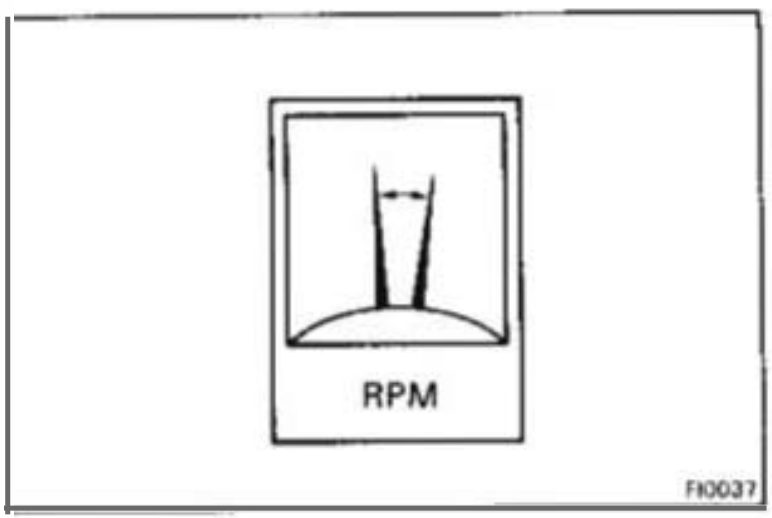


Fuel Cut RPM

INSPECTION OF FUEL CUT RPM

1. WARM UP ENGINE

Allow the engine to reach normal operating temperature.



2. INSPECT FUEL CUT RPM

(a) Disconnect the connector from the throttle position sensor.

(b) Short terminals IDL and E2 of the wiring connector.

(c) Gradually raise the engine rpm and check that there is fluctuation between the fuel cut and fuel return points.

NOTE: The vehicle should be stopped.

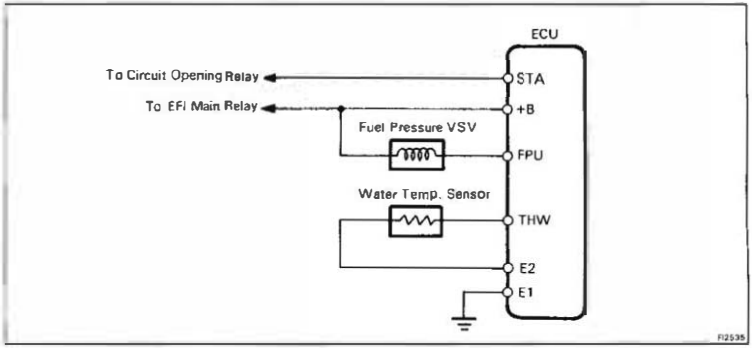
Fuel cut rpm:

w/o Air flow meter	**1,800 rpm**
w/ Air flow meter	**1,400 rpm M/T (Idle-up VSV OFF)**
	1,600 rpm M/T (Idle-up VSV ON)
	1,600 rpm A/T

Fuel return rpm:

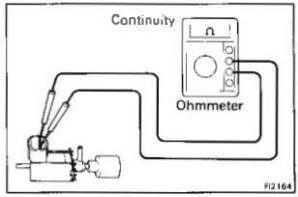
w/o Air Flow Meter	**1,400 rpm**
w/ Air Flow Meter	**1,200 rpm**

High-temperature Line Pressure up System (Europe)



INSPECTION OF HIGH-TEMPERATURE LINE PRESSURE UP SYSTEM

1. **INSPECT WATER TEMPERATURE SENSOR (See page FI-96)**



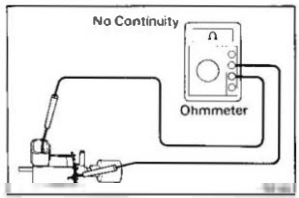
2. **INSPECT FUEL PRESSURE VSV**

A. Inspect VSV for open circuit

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

Resistance (Cold): 33 – 39 Ω

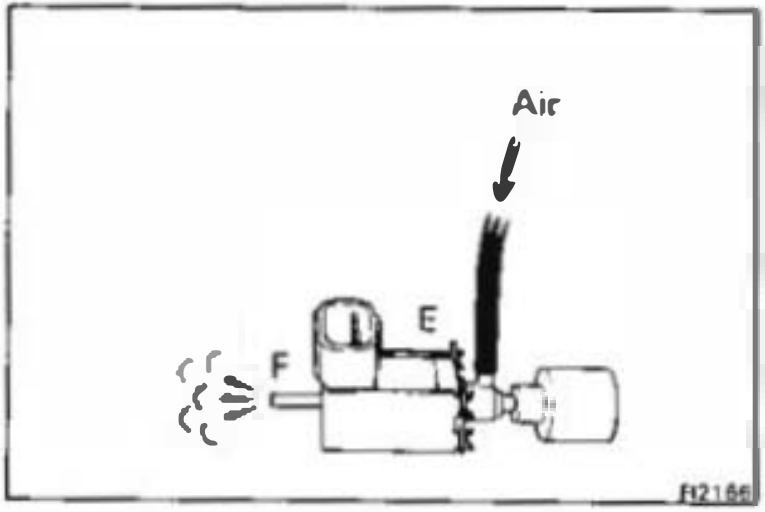
If there is no continuit , replace the VSV.



B. Inspect VSV for ground

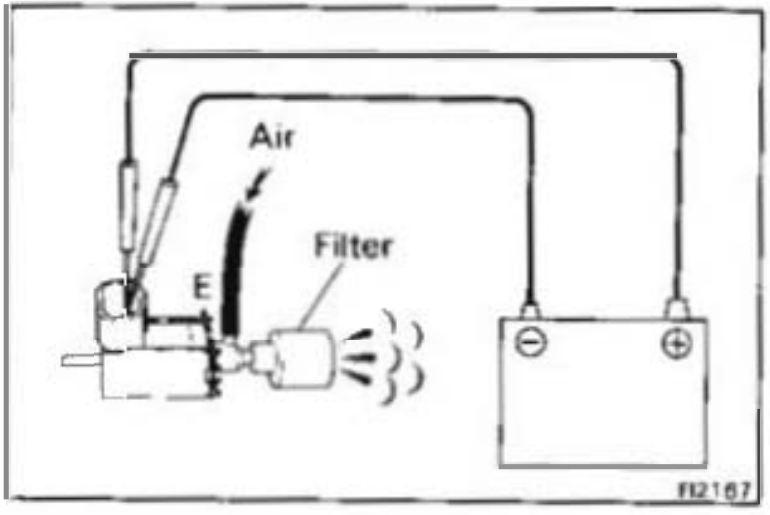
Using an ohmmeter, check that there is no continuity between each terminal and the body.

If there is continuity, replace the VSV.



C. Inspect VSV operation

(a) Check that air does not flow from pipe E to pipe F.

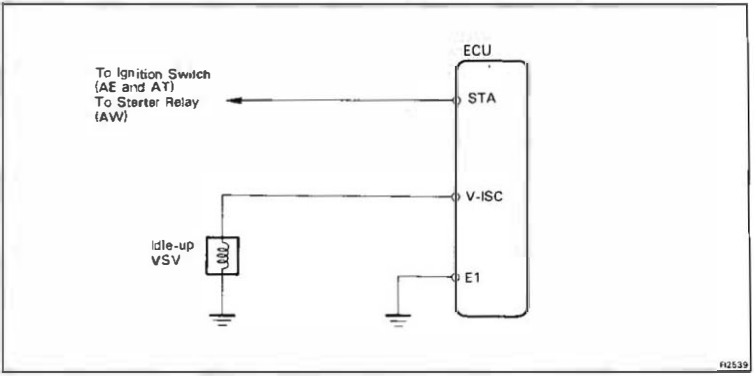


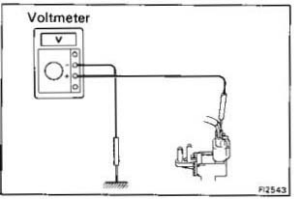
(b) Apply battery voltage across the terminals.

(c) Check that air flows from pipe E to the filter.

If operation is not as specified, replace the VSV.

Idle-up System



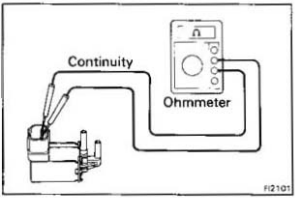


INSPECTION OF IDLE-UP SYSTEM

1. INSPECT BATTERY VOLTAGE OF IDLE-UP VSV

(a) All accessories switched off.

(b) Using a voltmeter, check that it indicates battery voltage during cranking and for ten seconds after starting.



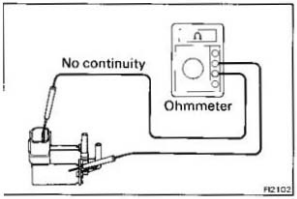
2. INSPECT IDLE-UP VSV

A. Inspect VSV for open circuit

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

Resistance (Cold): 37 — 44 Ω

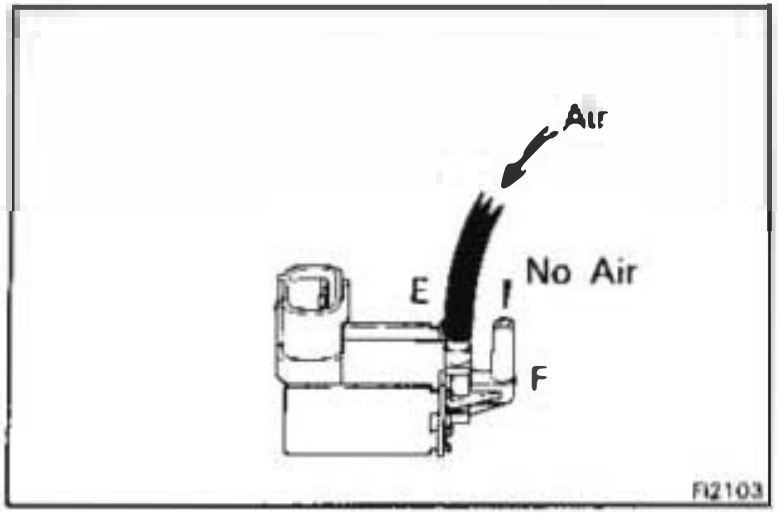
If there is no continuity, replace the VSV.



B. Inspect VSV for ground

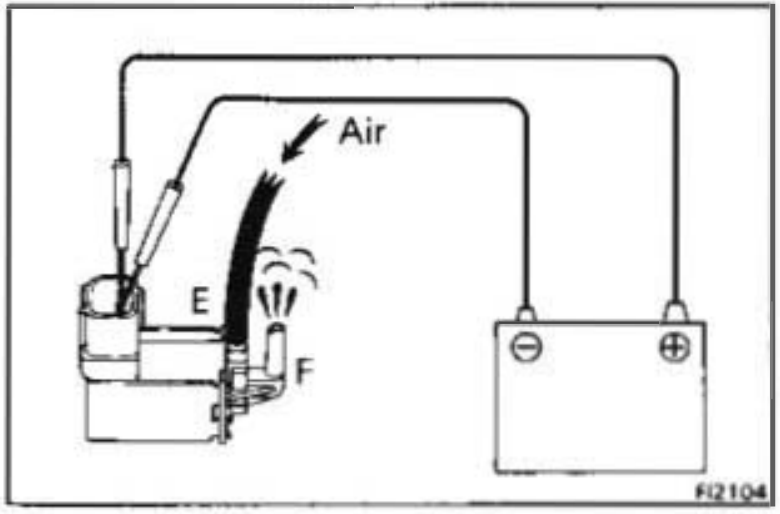
Using an ohmmeter, check that there is no continuity between each terminal and the body.

If there is continuity, replace the VSV.



C. **Inspect VSV operation**

(a) Check that air flows from pipe E to pipe F.



(b) Apply battery voltage across the terminals.

(c) Check that air flows from pipe E to pipe F.

If operation is not as specified, replace the VSV.

TROUBLESHOOTING (4A-GE)

ENGINE OVERHEATING

Problem	Possible cause	Remedy	Page
Engine overheats	Cooling system faulty	Troubleshoot cooling system	CO-5
	Incorrect ignition timing	Reset timing	EM-37

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 (crank OK)	No fuel supply to injector • No fuel in tank • Fuel pump not working • Fuel line clogged or leaking	Troubleshoot EFI system	FI-10
	EFI system problems	Repair as necessary	
	Ignition problems • Ignition coil • Igniter • Distributor	Perform spark test	IG-19
	Spark plug faulty	Inspect plugs	IG-20, 21
	High-tension cord disconnected or broken	Inspect cords	IG-20
	Vacuum leaks • PCV line • EGR line (w/ EGR system) • Intake manifold (Air intake chamber) • Intake air control valve • Throttle body • Brake boosterline	Repair as necessary	
	Pulling in air between air flow meter and throttle body	Repair as necessary	
	Low compression	Check compression	EM-47

ROUGH IDLING

Problem	Possible cause	Remedy	Page
Rough idle, stalls or misses	Spark plug faulty	Inspect plugs	IG-20, 21
	High-tension cord faulty	Inspect cords	IG-20
	Ignition wiring faulty	Inspect wiring	
	Ignition problems • Ignition coil • Igniter • Distributor	Inspect coil Inspect igniter Inspect distributor	
	Incorrect ignition timing	Reset timing	EM-37
	Incorrect valve clearance	Adjust valve clearance	EM-35

ROUGH IDLING (Cont'd)

Problem	Possible cause	Remedy	Page
Rough idle, stalls or misses (Cont'd)	Vacuum leaks ● PCV line ● EGR line (w/ EGR system) ● Intake manifold ● Air intake chamber (Intake air control valve) ● Throttle body ● Brake booster line	Repair necessary	
	Pulling in air between air flow meter and throttle body	Repair as necessary	
	Incorrect idle speed	Adjust idle speed	EM-39,42
	EFI system problems	Repair as necessary	
	EGR valve faulty	Check EGR valve	
	Engine overheats	Check cooling system	CO-5
	Low compression	Check compression	EM-47

ENGINE HESITATES/POOR ACCELERATION

Problem	Possible cause	Remedy	Page
Engine hesitates/ poor acceleration	Spark plug faulty	Inspect plugs	IG-20, 21
	High-tension cord faulty	Inspect cords	IG-20
	Vacuum leaks ● PCV line ● EGR line ● Intake manifold (Air intake chamber) ● Intake air control valve ● Throttle body ● Brake booster line	Repair as necessary	
	Pulling in air between air flow meter and throttle body	Repair as necessary	
	Incorrect ignition timing	Reset timing	EM-37
	Incorrect valve clearance	Adjust valve clearance	EM-35
	Fuel system clogged	Check fuel system	
	Air cleaner clogged	Check air cleaner	EM-34
	EFI system problems	Repair as necessary	
	Engine overheats	Check cooling system	CO-5
	Low compression	Check compression	EM-47

ENGINE DIESELING

Problem	Possible cause	Remedy	Page
Engine dieseling (turns when ignition switch is turned off)	EFI system problems	Repair as necessary	
	Incorrect ignition timing	Reset timing	EM-37
	EGR system faully (w/ EGR system)	Check EGR system	

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	
	DP system always off	Check DP system	
Muffler explosion (after fire) all the time	Air cleaner clogged	Check air cleaner	EM-34
	EFI system problem	Repair as necessary	
	Incorrect ignition timing	Reset timing	EM-37
	Incorrect valve clearance	Adjust valve clearance	EM-35
Engine backfires	EFI system problem	Repair as necessary	
	Vacuum leak • PCV hoses • Intake manifold (Air intake chamber) • Intake air control valve • Throttle body • Brake booster line	Check hoses and repair as	
	Pulling in air between air flow meter and throttle body	Repair as necessary	
	Insufficient fuel flow	Troubleshoot fuel system	
	Incorrect ignition timing	Reset timing	EM-37
	Incorrect valve clearance	Adjust valve clearance	EM-35
	Carbon deposits in combustion chambers	Inspect cylinder head	EM-106

EXCESSIVE OIL CONSUMPTION

Problem	Possible cause	Remedy	Page
Excessive oil consumption	Oil leak	Repair as necessary	
	PCV line clogged	Check PCV system	
	Piston ring worn or damaged	Check rings	EM-137
	Valve stem and guide busing worn	Check valves and guide bushings	EM-107
	Valvestem oil seal worn or damaged	Check Oil seals	

EXCESSIVE FUEL CONSUMPTION

Problem	Possible cause	Remedy	Page
Poor gasoline mileage	Fuel leak	Repair as necessary	
	Air cleaner clogged	Check air cleaner	EM-34
	Incorrect ignition timing	Reset timing	EM-37
	EFI system problems ● Injector faulty ● Deceleration fuel cut system faulty	Repair as necessary	
	Idle speed to high	Adjust idle speed	EM-39, 42
	Spark plug faulty	Inspect plugs	IG-20, 21
	EGR system always on	Check EGR system	
	Low compression	Check compression	EM-47
	Tires improperly inflated	Inflate tires to proper pressure	
	Clutch slips	Troubleshoot clutch	
	Brakes drag	Troubleshoot brakes	

UNPLEASANT ODOR

Problem	Possible cause	Remedy	Page
Unpleasant odor	Incorrect idle speed	Adjust idle speed	EM-39, 42
	Incorrect ignition timing	Resettiming	EM-37
	Vacuum leaks ● PCV line ● EGR line (w/ EGR system) ● Intake manifold (Air intake chamber) ● Intake control valve ● Throttle body ● Brake booster line	Repair as necessary	
	EFI system problems	Repair as necessary	

ENGINE TUNE-UP (4A-GE)

INSPECTION OF ENGINE COOLANT

(See steps 1 and 2 page CO-6)

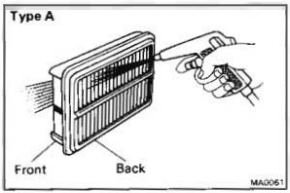
INSPECTION OF ENGINE OIL

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

INSPECTION OF BATTERY

(See steps 1 and 2 page CH-4)

Standard specific gravity:
1.26 — 1.27 when fully charged at 20°C (68°F)



INSPECTION OF AIR FILTER

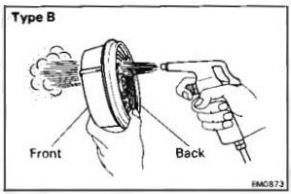
1. **INSPECT AIR FILTER**

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

2. **CLEAN AIR FILTER**

   Clean the element with compressed air.

   First blow from the back thoroughly. Then blow off the front of the element.



INSPECTION OF HIGH-TENSION CORDS

(See page IG-20)

Maximum resistance: 25 kΩ per cord

INSPECTION OF SPARK PLUGS

Conventional Tipped Type
(See page IG-20)

Correct electrode gap: 1.1 mm (0.043 in.)
Recommended spark plugs:
ND Q20R-U11
NGK BCPR6EY11

Platinum Tipped Type
(See page IG-21)

Maximum electrode gap: 1.3 mm (0.051 in.)
Correct electrode gap of new plug:
1.1 mm (0.043 in.)
Recommended spark plugs:
ND PQ16R
NGK BCPR6EP11

INSPECTION OF ALTERNATOR DRIVE BELT

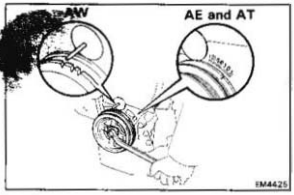
(See step 3 page CH-4)

Drive belt deflection:
New belt 4 — 5 mm (0.16 — 0.20 in.)
Used belt 6 — 7 mm (0.24 — 0.28 in.)
Drive belt tension (Reference):
New belt 70 — 80 kg
Used belt 30 — 45 kg

ADJUSTMENT OF VALVE CLEARANCE

NOTE: Adjust the valve clearance while the engine is cold.

1. **REMOVE CYLINDER HEAD COVER (See page EM-102)**

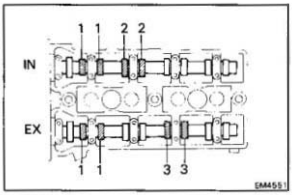


2. **SET NO.1 CYLINDER TO TDC/COMPRESSION**

(a) Turn the crankshaft pulley and align its groove with the timing mark "0" of the No.1 timing belt cover (AE or AT) or timing pointer (AW).

(b) Check that the valve lifters on the No.1 cylinder are loose and valve lifters on the No.4 are tight.

If not, turn the crankshaft one revolution (360°) and align the mark as above.



3. **ADJUST VALVE CLEARANCE**

(a) Check only those valves indicated as shown.

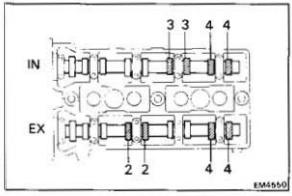
- Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
- Record the valve clearance maasurements which ara out of spacification. They will be used later to determine the required replacement adjusting shim.

Valve clearance (Cold):

Intake	**0.15 — 0.25 mm (0.006 — 0.010 in.)**
Exhaust	**0.20 — 0.30 mm (0.008 — 0.012 in.)**

(b) Turn the crankshaft one revolution (360°) and align the mark as above. (See procedure step 2)

(c) Check only the valves indicated as shown. Measure the valve clearance. (See procedure step (a)).



(d) Remove the adjusting shim.

- Turn the crankshaft to position the cam love of the camshaft on the adjusting valve upward.
- Using SST (A), press down the valve lifter and place SST (B) between the camshaft and valve lifter. Remove SST (A).

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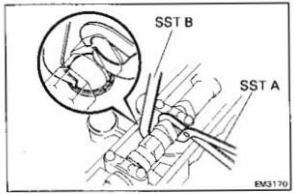
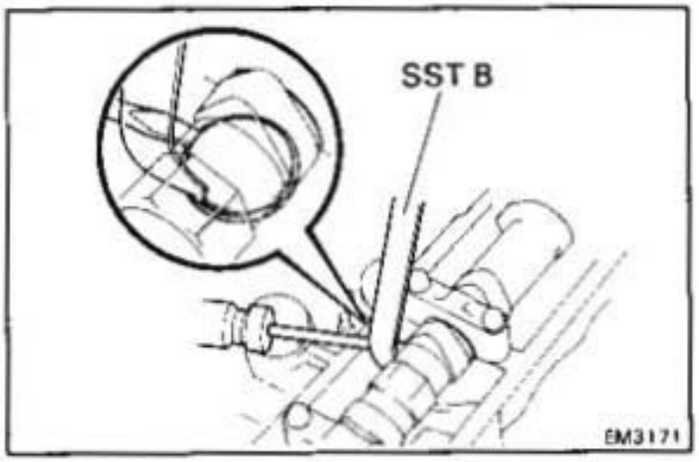
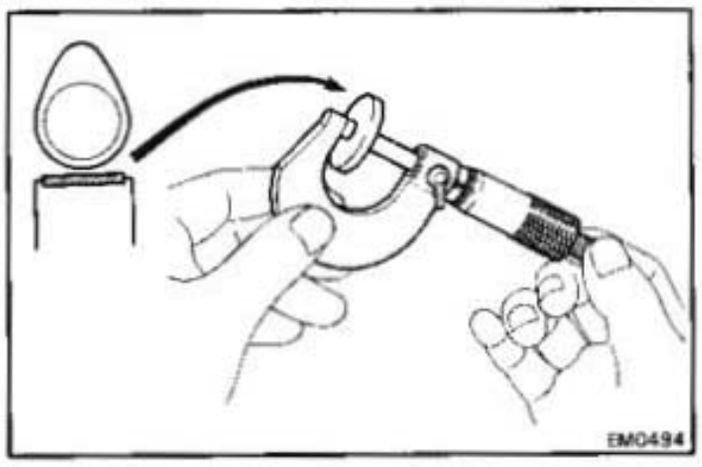
NOTE: Before pressing down the valve lifter, position the notch toward the spark plug.





- Remove the adjusting shim with a small screwdriver and magnetic finger.



(e) Determine the replacement adjusting shim size following Formula or Charts:

- Using a micrometer, measure the thickness of the shim which was removed.
- Calculate the thickness of a new shim so the valve clearance comes within specified value.

T ..... Thickness of used shim
A ..... Measured valve clearance
N ..... Thickness of new shim

Intake $N = T + (A - 0.20 \text{ mm } (0.008 \text{ in.}))$
Exhaust $N = T + (A - 0.25 \text{ mm } (0.010 \text{ in.}))$

- Select a new shim with a thickness as close as possible to the calculated values.

NOTE: Shims are available in seventeen sizes of 0.05 mm (0.0020 in.), from 2.50 mm (0.0984 in.) to 3.30 mm (0.1299 in.).

(f) Install a new adjusting shim.

- Place a new adjusting shim on the valve lifter.
- Using SST (A), press down the valve lifter and remove SST (B).

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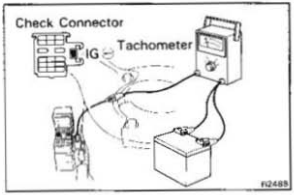
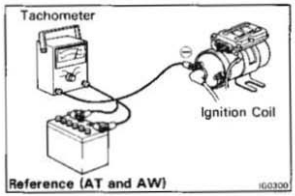
(g) Recheck the valve clearance.

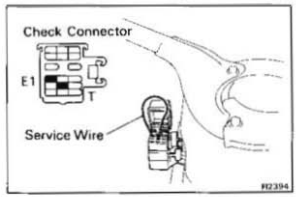
4. REINSTALL CYLINDER HEAD COVER
(See page EM-121)

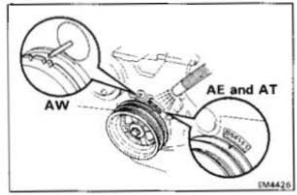
Adjusting Shim Selection Using Chart

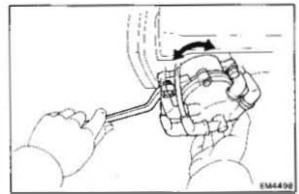
(See pages EM-19 and 20)











ADJUSTMENT OF IGNITION TIMING

1. WARM UP ENGINE

Allow the engine to reach normal operating temperature.

2. CONNECT TACHOMETER

(AE, AT and AW)

Connect the test probe of a tachometer to terminal IG⊖ of the check connector.

LOCATION: See page FI-89

(Reference (AT and AW))

Connect the test probe of a tachometer to the negative (⊖) terminal of the ignition coil.

CAUTION:

- **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 until before using.**

3. SHORT TERMINALS T AND E1

Using a service wire, short terminals T and E1 of the check connector.

LOCATION: See page FI-89

4. ADJUST IGNITION TIMING

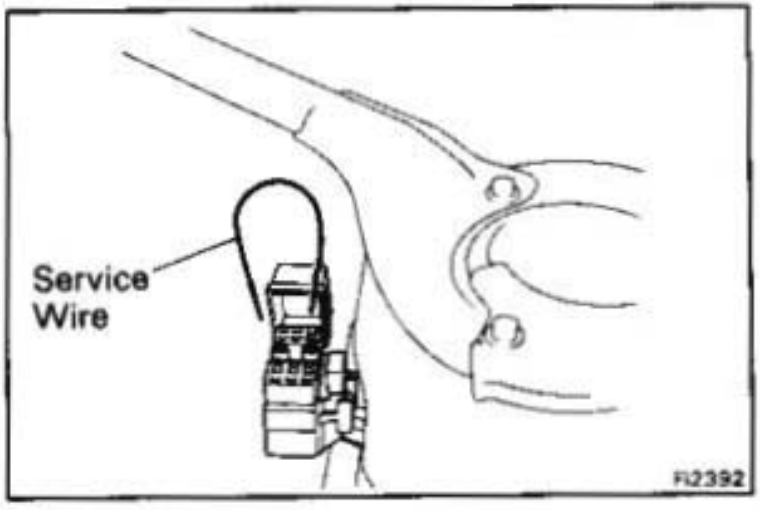
(a) Using a timing light, check the ignition timing.

Ignition timing: 10° BTDC @ idle

(b) Loosen the two hold-down bolts, and adjust by turning the DISTRIBUTOR.

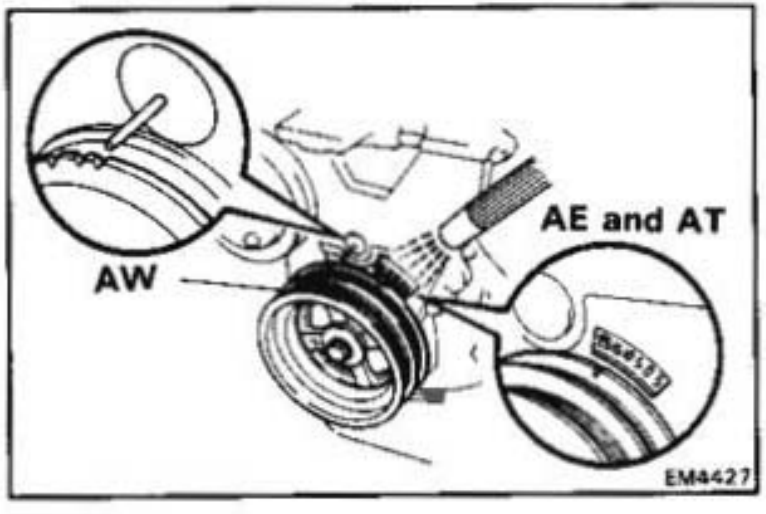
(c) Tighten the hold-down bolts, and recheck the ignition timing.

Torque: 200 kg-cm (14 ft-lb, 20 N·m)



5. UNSHORT TERMINALS T AND E1

Remove the service wire from the check connector.



6. FURTHER CHECK IGNITION TIMING

Ignition timing: 16° BTDC or more @ idle

ADJUSTMENT OF IDLE SPEED (w/ TWC)

1. INITIAL CONDITIONS

(a) Engine at reach normal operating temperature

(b) Air cleaner installed

(c) All pipes and hoses of air induction system connected

(d) All vacuum lines connected

NOTE: All vacuum hoses for EGR systems, etc. should be properly connected.

(e) EFI system wiring connectors fully plu ged

(f) Ignition timing set correctly

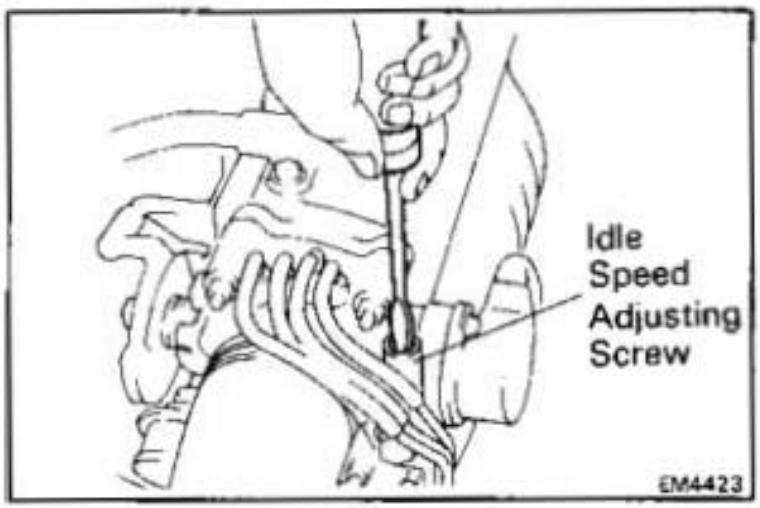
(g) All accessories switched OFF

(h) Transmission in "N" range

2. START ENGINE

3. CONNECT TACHOMETER (See page EM-37)

4. CHECK AIR VALVE OPERATION (See page FI-87)



5. ADJUST IDLE SPEED

(a) Race the engine at 2,500 rpm for a few seconds.

(b) Check the idle speed.

Idle speed: 800 rpm (w/ Cooling fan OFF)

(c) Adjust the idle speed by turning the IDLE SPEED ADJUSTING SCREW.

IDLE HC/CO CONCENTRATION CHECK METHOD (w/ TWC)

NOTE: This check is used only to determine whether or not the idle HC/CO complies with regulations.

1. INITIAL CONDITIONS

(a) Engine at reach normal operating temperature

(b) Air cleaner installed

(c) All pipes and hoses of air induction system connected

(d) All accessories switched OFF

(e) All vacuum lines properly connected

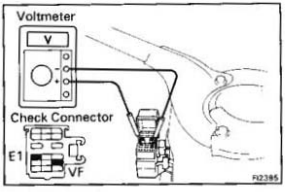
NOTE: All vacuum hoses for EGR systems, etc. should be properly connected.

(f) EFI system wiring connectors fully plugged

(g) Ignition timing set correctly

(h) Transmission in N range

(i) Tachometer and HC/CO meter calibrated and at hand.



2. CHECK OXYGEN SENSOR (See page FI-101)

3. CHECK VF VOLTAGE

(a) Connect the positive (+) probe of a voltmeter to terminal VF of the check connector, and negative (−) probe to terminal E1.

(b) Hold the engine speed at 2,500 rpm for approx. 90 seconds to warm up the oxygen sensor.

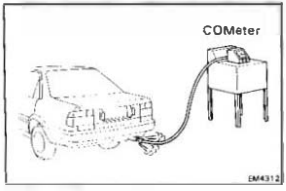
(c) With engine idling, measure the VF voltage.

VF voltage: 2.5 ± 0.6 V

If the VF voltage is not as specified, check the air induction system. If necessary, see EFI SYSTEM.

4. RACE ENGINE AT 2,500 RPM FOR APPROX. 90 SECONDS

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



6. CHECK CO CONCENTRATION AT IDLE

Wait at least one minute before measuring to allow the concentration to stabilize. Complete the measuring within three minutes.

Idle CO concentration: 0 – 0.5 %
(w/ Cooling fan OFF)

If the CO concentration does not conform to regulations, see the table below for possible causes.

Troubleshooting

HC	CO	SYMPTOMS	CAUSES
High	Normal	Rough idle	1. Faulty ignition: ● Incorrect timing ● Fouled, shorted or improperly gepped plugs ● Open or crossed ignition wires ● Cracked distributor cap ● Intake air control valve 2. Incorrect valve clearance 3. Leaky EGR valve (w/ EGR system) 4. Leaky intake and exhaust velves 5. Leaky cylinder
High	Low	Rough idle (Fluctuating HC reading)	1. Vacuum leak: ● Vacuum hose ● EGR valve (w/ EGR system) ● Intake manifold (Air intake chamber) ● Intake control valve ● Throttle body ● Cylinder head gasket ● Brake booster line 2. Lean mixture causing misfire
High	High	Roughidle (Bleck smoke from exhaust)	1. Restricted air filter 2. Faulty EFI system: ● Faulty pressure regulator ● Clogged fuel return line ● Faulty airflow meter ● Defective water temp. sensor ● Detective air temp. sensor ● Faulty ECU ● Faulty injector ● Faulty cold start injector ● Faulty throttle position sensor

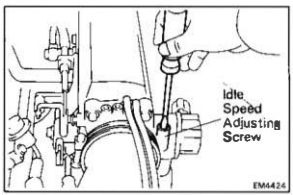
ADJUSTMENT OF IDLE SPEED AND IDLE MIXTURE (w/o TWC)

1. **INITIAL CONDITIONS**
   - (a) Engine at reach normal operating temperature
   - (b) Air cleaner installed
   - (c) All pipes and hoses of air induction system connected
   - (d) All vacuum lines properly connected
   - (e) EFI system wiring connectors fully plugged
   - (f) Ignition timing set correctly
   - (g) All accessories switched OFF
   - (h) Transmission in "N" range

2. **START ENGINE**

3. **CONNECT TACHOMETER (Ses page EM-37)**

4. **CHECK AIR VALVE OPERATION (See page FI-87)**

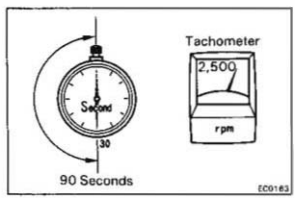


5. **ADJUST IDLE SPEED**
   - (a) Race the engine at 2,500 rpm for a few seconds.
   - (b) Check the idle speed.

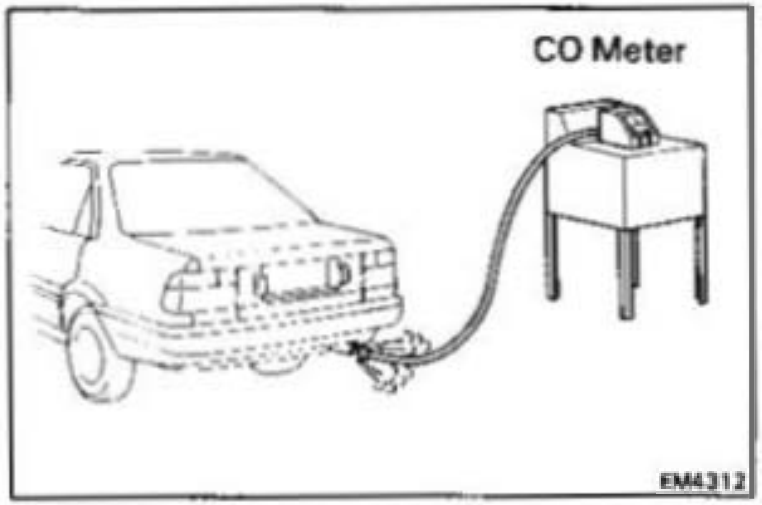
   Idle speed: 800 rpm (w/ Cooling fan OFF)
   - (c) Adjust the idle speed by turning the IDLE SPEED ADJUSTING SCREW.

6. **ADJUST IDLE MIXTURE**

   CAUTION: Always use a CO meter when adjusting the idle mixture. It is not necessary to adjust with the idle mixture adjusting screw in most vehicle if they are in good condition. If a CO meter is not available, DO NOT ATTEMPT TO ADJUST IDLE MIXTURE.



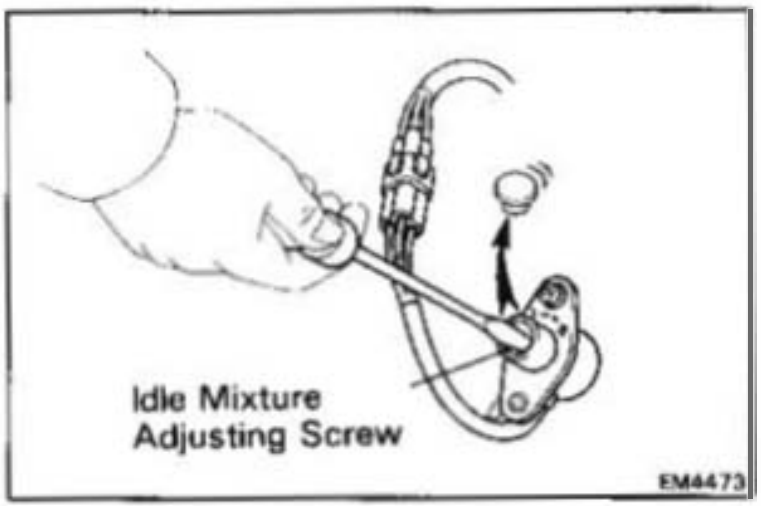
- (a) Race the engine at 2,500 rpm for approx. 90 seconds.



(b) Insert a testing probe at least 40 cm (1.3 ft) into the tailpipe.

(c) Measure the concentration with 1 – 3 minutes after racing the engine to allow the concentration to stabilize.

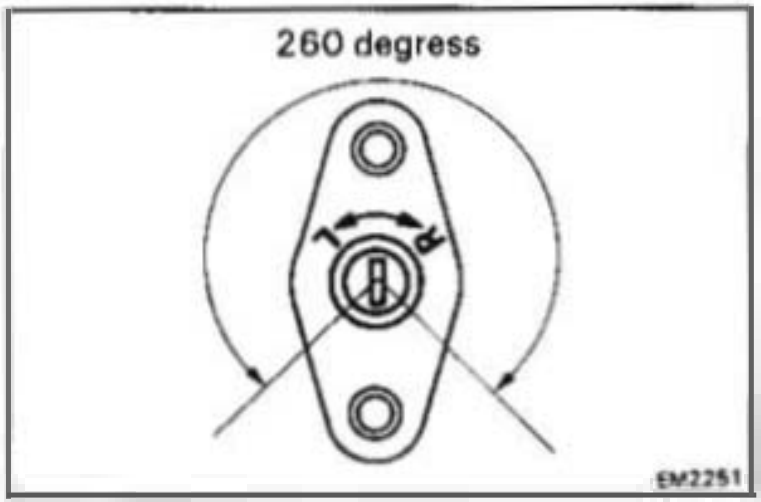
Idle CO concentration: 1.5 ± 0.5 %
(w/ Cooling fan OFF)

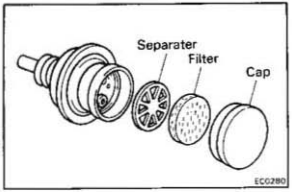


If the CO concentration is not as specified, adjust the idle mixture by turning the IDLE MIXTURE ADJUSTING SCREW in the variable resister.

- If the concentration is within specification, this adjustment is complete.
- If the CO concentration cannot be corrected by idle mixture adjustment, see the table on page EM-41 for other possible causes.

NOTE: Always check the idle speed after turning the idle mixture adjusting screw. If it is incorrect, repeat steps 5 and 6.





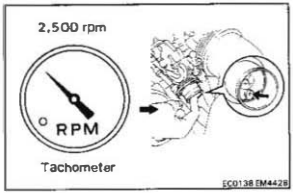
ADJUSTMENT OF DASH POT (DP) SETTING SPEED (w/ Air Flow Meter)

1. **WARM UP AND STOP ENGINE**

   Allow the engine to reach normal operating temperature.

2. **CHECK IDLE SPEED (See page EM-39)**

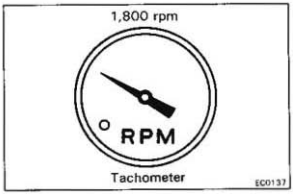
3. **REMOVE CAP, FILTER AND SEPARATER FROM DP**



4. **ADJUST DP SETTING SPEED**

   (a) Race the engine at 2,500 rpm for a few seconds.

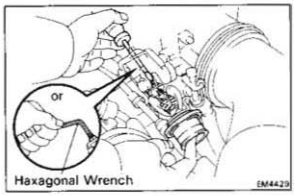
   (b) Plug the VTV hole.



   (c) Release the throttle valve.

   (d) Check the DP setting speed.

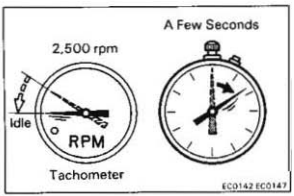
   DP setting speed: 1,800 rpm (w/ Cooling fan OFF)



   (e) Adjust the DP setting speed by turning the DP ADJUSTING SCREW.

   (f) Repeat steps from (a) to (c), and recheck the DP setting speed.

5. **REINSTALL DP SEPARATER, FILTER AND CAP**



6. **CHECK VTV OPERATION**

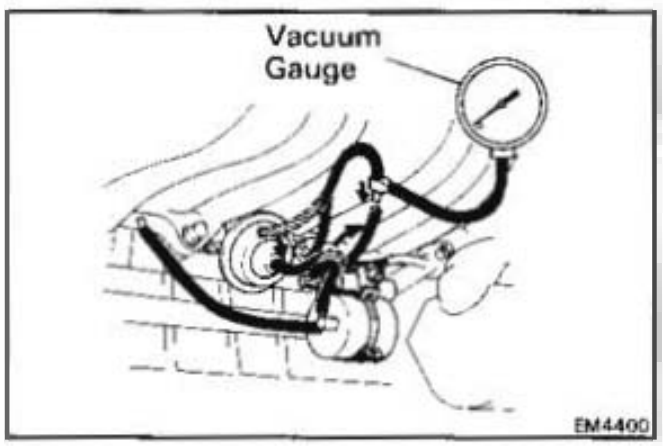
   Race the engine at 2,500 rpm for a few seconds, release the throttle valve and check that the engine returns to idle in a few seconds.

INSPECTION OF TOYOTA-VARIABLE INDUCTION SYSTEM (T-VIS)

1. WARM UP AND STOP ENGINE

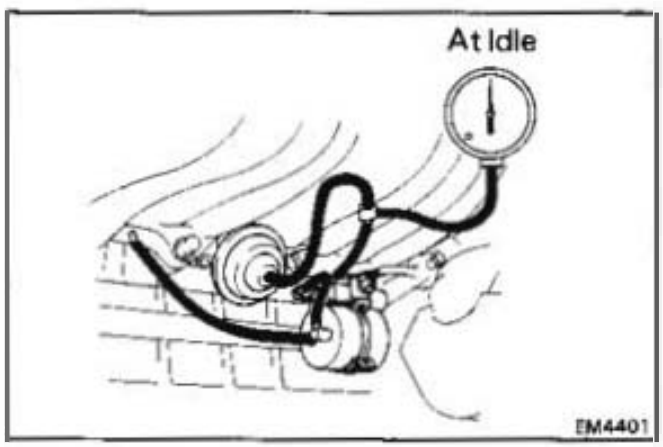
Allow the engine to reach normal operating temperature.

2. CONNECT TACHOMETER (See page EM-37)



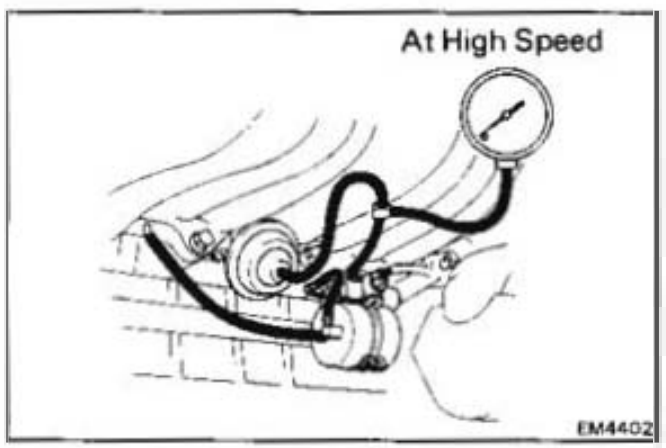
3. CONNECT VACUUM GAUGE

Using a 3-way connector, connect a vacuum gauge to the hose between the VSV and actuator.



4. INSPECT T-VIS

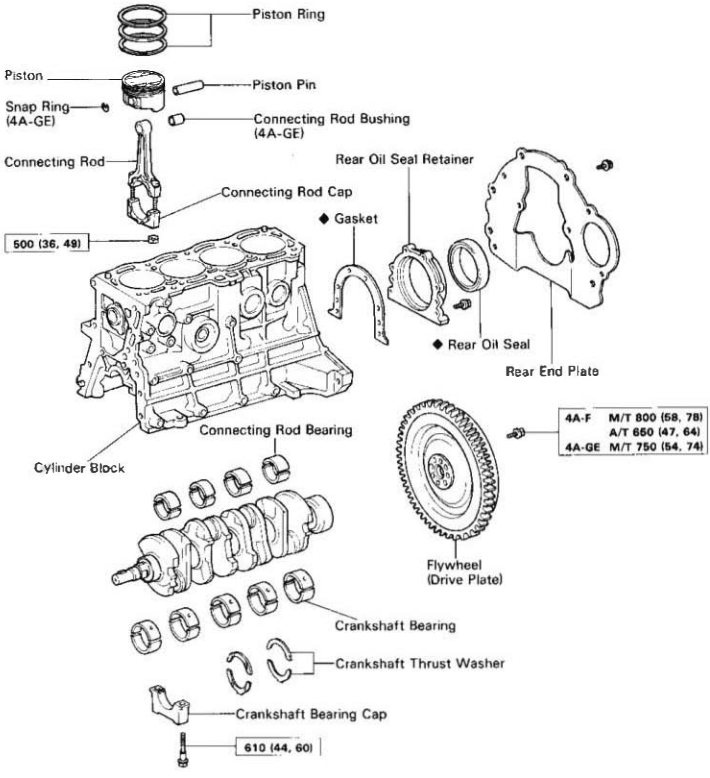
(a) Check that the vacuum gauge indicates vacuum at low speed.



(b) Check that the vacuum gauge indicates zero at high speed (w/ TWC approx. 4,350 rpm or w/o TWC approx. 5,000 rpm)

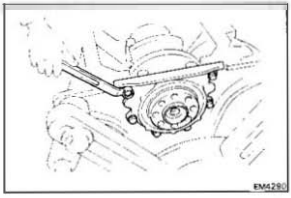
CYLINDER BLOCK

COMPONENTS



PREPARATION FOR DISASSEMBLY

1. REMOVE CLUTCH COVER AND DISC (M/T only)
2. REMOVE FLYWHEEL (M/T) OR DRIVE PLATE (A/T)
3. REMOVE REAR END PLATE
4. INSTALL ENGINE ASSEMBLY TO ENGINE STAND FOR DISASSEMBLY
5. REMOVE A/C COMPRESSOR MOUNT (A/C only)
6. REMOVE ALTERNATOR AND BRACKET
7. REMOVE RH MOUNTING BRACKET
8. REMOVE TIMING BELT AND TIMING PULLEYS
   4A-F (See peges EM-48 to 50)
   4A-GE (See peges EM-67 to 69)
9. REMOVE EXHAUST AND INTAKE MANIFOLD STAYS
10. DISCONNECT WATER INLET HOUSING HOSES
11. REMOVE CYLINDER HEAD ASSEMBLY
    4A-F (See pages EM-71 to 74)
    4A-GE (See pages EM-100 to 104)
12. REMOVE WATER PUMP ASSEMBLY
    (See pages CO-11 and 12)
13. REMOVE OIL PAN, OIL STRAINER AND OIL PUMP ASSEMBLY (See pages LU-8 and 9)
14. REMOVE OIL FILTER BRACKET
    (See page LU-20 or 21)

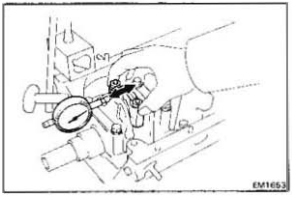


DISASSEMBLY OF CYLINDER BLOCK

(See page EM-125)

1. **REMOVE REAR OIL SEAL RETAINER**

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



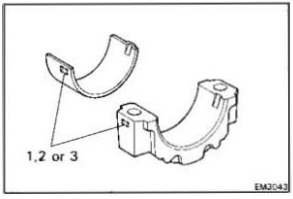
2. **MEASURE CONNECTING ROD THRUST CLEARANCE**

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

Standard thrust clearance: 0.15 — 0.25 mm (0.0059 — 0.0098 in.)

Maximum thrust clearance: 0.30 mm (0.0118 in.)

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



3. **REMOVE CONNECTING ROD CAPS AND MEASURE OIL CLEARANCE**

If replacing the bearing, replace with one having the same number as marked on the bearing cap.

There are three sizes of standard bearings supplied, marked 1, 2 or 3 respectively.

Bearing thickness (Center wall):

STD

No.1 1.486 — 1.490 mm (0.0585 — 0.0587 in.)

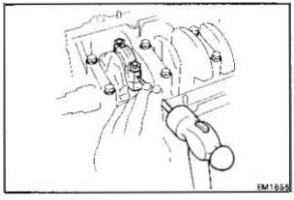
No.2 1.490 — 1.494 mm (0.0587 — 0.0588 in.)

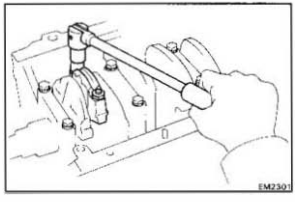
No.3 1.494 — 1.498 mm (0.0588 — 0.0590 in.)

U/S

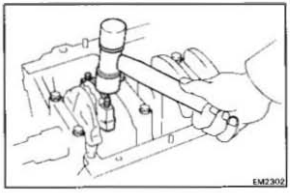
0.25 1.607 — 1.613 mm (0.0633 — 0.0635 in.)

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



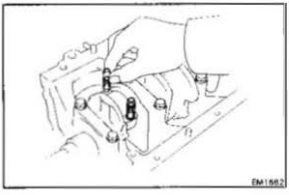


(b) Remove the connecting rod cap nuts.

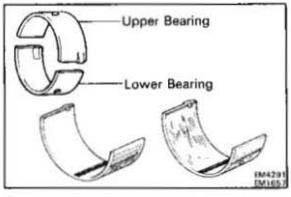


(c) Using a plastic-faced hammer, lightly tap the connecting rod bolts and lift off the connecting rod cap.

NOTE: Keep the lower bearing inserted with the connecting rod cap.



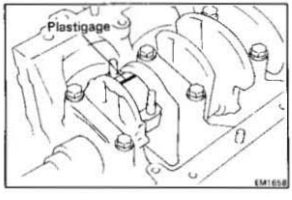
(d) Cover the connecting rod bolts with a short piece of hose to protect the crankshaft from damage.



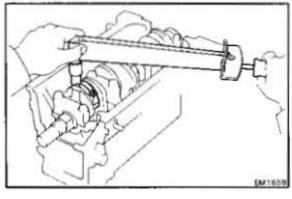
(e) Clean the crank pin and bearing.

(f) Check the crank pin and bearing for pitting and scratches.

If the crank pin or bearing are damaged, replace the bearings. If necessary, replace the crankshaft.



(g) Lay a strip of Plastigage across the crank pin.

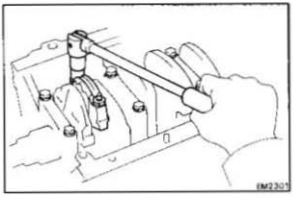


(h) Align the punched marks on the rod and cap. Install and torque the cap nuts alternately, in two or three passes. (See page EM-146)

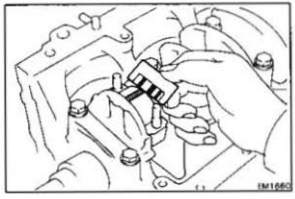
Torque: 600 kg-cm (36 ft-lb, 49 N-m)

NOTE:

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



(i) Remove the connecting rod cap.
(See procedure (b) and (c) above)



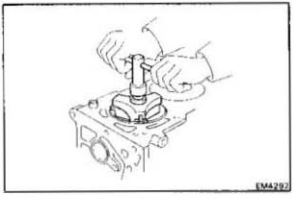
(j) Measure the Plastigage at its widest point.

Standard oil clearance:

STD	**0.020 — 0.051 mm (0.0008 — 0.0020 in.)**
U/S 0.25	**0.019 — 0.073 mm (0.0007 — 0.0029 in.)**
Maximum oil clearance:	**0.08 mm (0.0031 in.)**

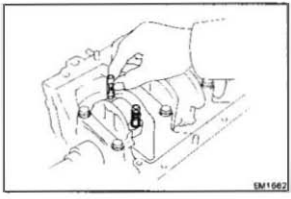
If the oil clearance is greater than maximum, replace the bearings. If necessary, replace the crankshaft.

(k) Completely remove the Plastigage.



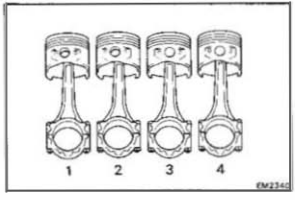
4. REMOVE PISTON AND CONNECTING ROD ASSEMBLIES

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

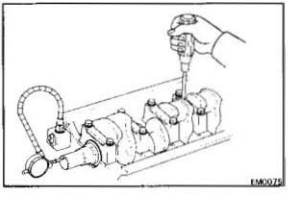


(b) Cover the rod bolts with a short piece of hose to protect the crankshaft from damage.

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



NOTE:
- Keep the bearing insert with the connecting rod and cap.
- Arrange the piston and connecting rod assemblies in order.



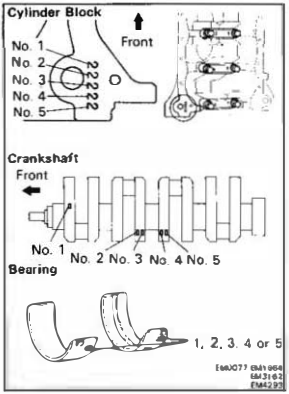
5. CHECK CRANKSHAFT THRUST CLEARANCE

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

Standard thrust clearance: 0.02 — 0.22 mm (0.0008 — 0.0087 in.)

Maximum thrust clearance: 0.30 mm (0.0118 in.)

If the clearance is greater than maximum, replace the thrust washers as a set.



6. REMOVE MAIN BEARING CAPS AND CHECK OIL CLEARANCE

NOTE: If replacing a bearing, 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	3	1	2	3	1	2	3
Crankshaft No.	0	0	0	1	1	1	2	2	2
Bearing No.	1	2	3	2	3	4	3	4	5

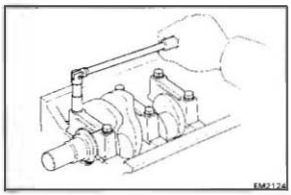
Example: Cylinder Block No.2, Crankshaft No.1 =Bearing No.3

(Reference) mm (in.)

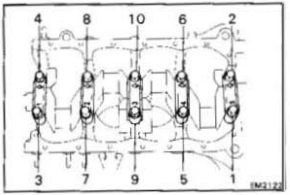
No.	Cylinder block main journal bore	No.	Crankshaft diameter	No.	★ Bearing thickness
1	52.025-52.031 (2.0482-2.0485)	0	47.994-48.000 (1.8895-1.8898)	1	2.002-2.005 (0.0788-0.0789)
				2	2.005-2.008 (0.0789-0.0791)
2	52.031-52.037 (2.0485-2.0487)	1	47.988-47.994 (1.8893-1.8895)	3	2.008-2.011 (0.0791-0.0792)
				4	2.011-2.014 (0.0792-0.0793)
3	52.037-52.043 (2.0487-2.0489)	2	47.982-47.988 (1.8891-1.8893)	5	2.014-2.017 (0.0793-0.0794)

★ Bearing thickness = Center wall thickness

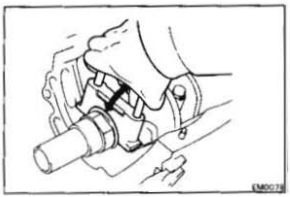
Bearing thickness (center wall):
U/S 0.25
2.121 — 2.127 mm (0.0835 — 0.0837 in.)



(a) Remove the bearing caps with the lower bearing and lower thrust washers.

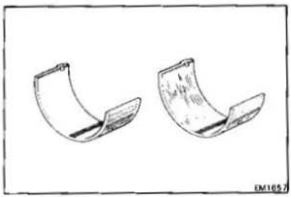


NOTE: Gradually loosen and remove the bearing cap bolts in three passes and in the numerical order shown.



(b) Using the removed bearing cap bolts, wiggle the bearing cap back and forth, and remove it with the lower bearings and thrust washers (No.3 cap only).

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



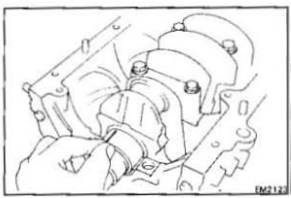
(c) Lift out the crankshaft.

NOTE: Keep the upper bearings and upper thrust washers (No.3 cap only) inserted in the cylinder block.

(d) Clean each journal and bearing.

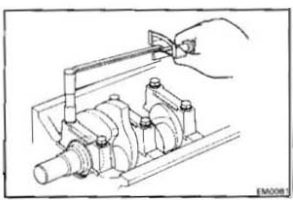
(e) Check each journal and bearing for pitting and scratches.

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



(f) Place the crankshaft on the cylinder block.

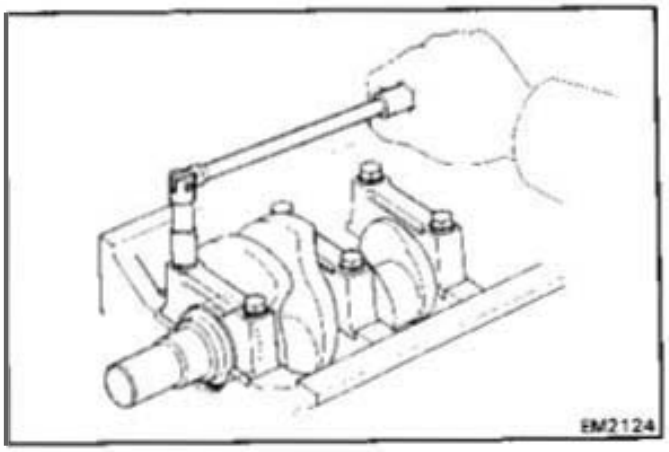
(g) Lay a strip of Plastigage across each journal.



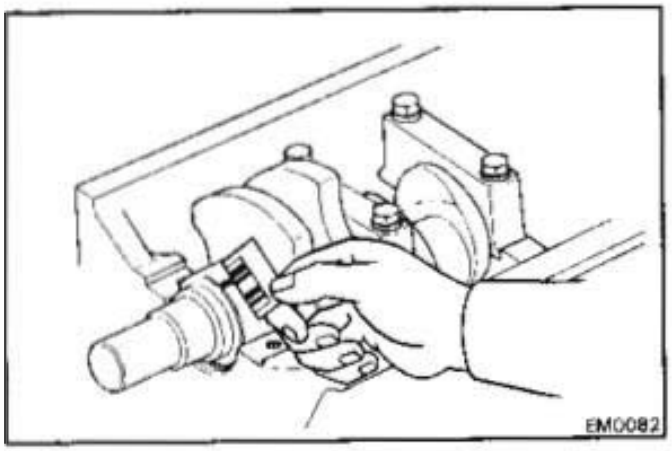
(h) Install the bearing caps with the lower bearing and thrust washers (No. 3 cap only).
(See step 4 on page EM-145)

Torque: 610 kg-cm (44 ft-lb, 60 N·m)

NOTE: Do not turn the crankshaft.



(i) Remove the bearing caps with the lower bearing and thrust washers (No.3 cap only).
(See procedura (e) and (b) above)



(j) Measure the Plastigage at its widest point.

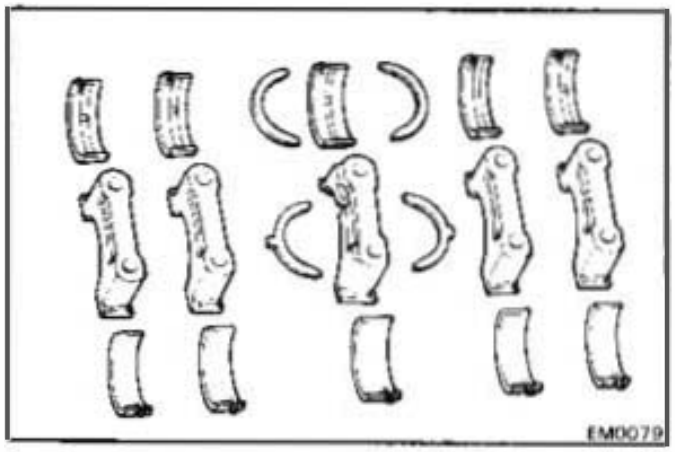
Standard oil clearance:

STD	**0.015 – 0.033 mm (0.0006 – 0.0013 in.)**
U/S 0.25	**0.013 – 0.053 mm (0.0005 – 0.0021 in.)**
Maximum oil clearance:	**0.10 mm (0.0039 in.)**
Undersized:	**U/S 0.25**

NOTE: If replacing the cylinder block subassembly, the bearing standard clearance will be:
0.015 – 0.045 mm (0.0006 – 0.0018 in.).

If the oil clearence is greater than maximum, replace the bearings. If necessary, grind or replace the crankshaft.

(k) Completely remove the Plastigage.



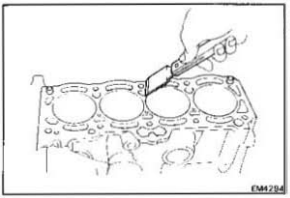
7. REMOVE CRANKSHAFT

(a) Lift out the crankshaft.

(b) Remove the upper bearings and upper thrust washers.

NOTE:

- Arrange the caps, bearings and thrust washers in correct order.
- The pilot bearing in the crankshaft rear end is permanently lubricated and requires no cleaning or lubrication.



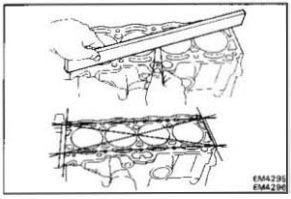
INSPECTION OF CYLINDER BLOCK

1. REMOVE GASKET MATERIAL

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

2. CLEAN CYLINDER BLOCK

Using a soft brush and solvent, clean the block.

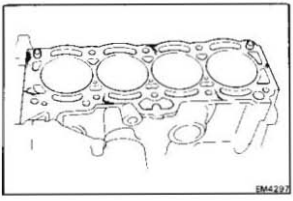


3. INSPECT TOP OF CYLINDER BLOCK FOR FLATNESS

Using a precision straight edge and feeler gauge, measure the surfaces contacting the cylinder head gasket for warpage.

Maximum warpage: 0.05 mm (0.0020 in.)

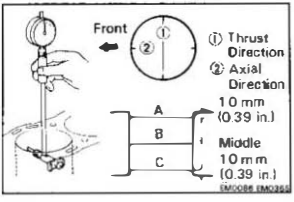
If warpage is greater than maximum, replace the cylinder block.



4. INSPECT CYLINDERS FOR VERTICAL SCRATCHES

Visually check the cylinder for vertical scretches.

If deep scratches are present, rebore all four cylinders or 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.

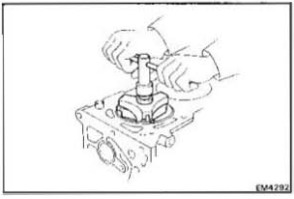
Standard diameter:

STD	**81.00 — 81.03 mm (3.1890 — 3.1902 in.)**
O/S 0.50	**81.50 — 81.53 mm (3.2087 — 3.2098 in.)**

Maximum diameter:

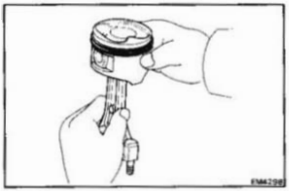
STD	**81.23 mm (3.1980 in.)**
O/S 0.50	**81.73 mm (3.2177 in.)**

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



6. REMOVE CYLINDER RIDGES

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

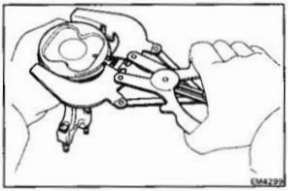


DISASSEMBLY OF PISTON AND CONNECTING ROD ASSEMBLIES

(See page EM-125)

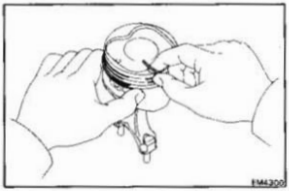
1. CHECK FIT BETWEEN PISTON AND PIN

Try to move the piston back and forth on the piston pin. If any movement is felt, replace the piston and pin as a set.



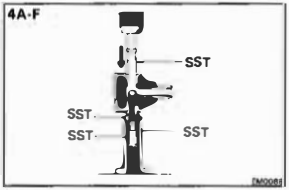
2. REMOVE PISTON RINGS

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



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

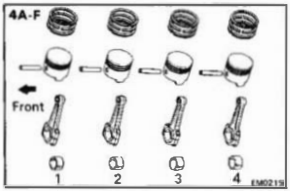
NOTE: Arrange the rings in correct order.



3. DISCONNECT CONNECTING ROD FROM PISTON (4A-F)

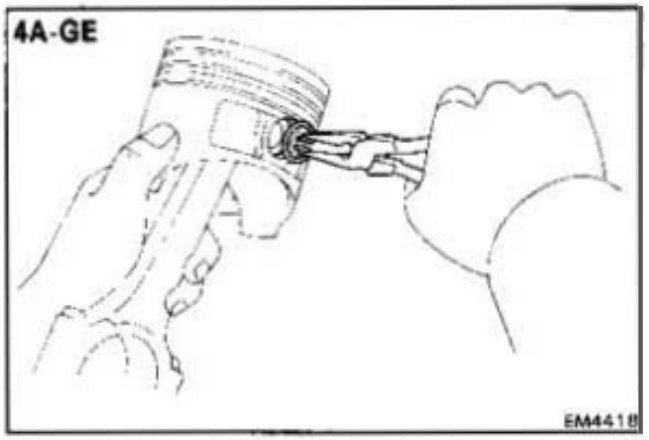
Using SST, press out the pin from the piston.

SST 09221-25022
(09221-00050, 09221-00130, 09221-00140)



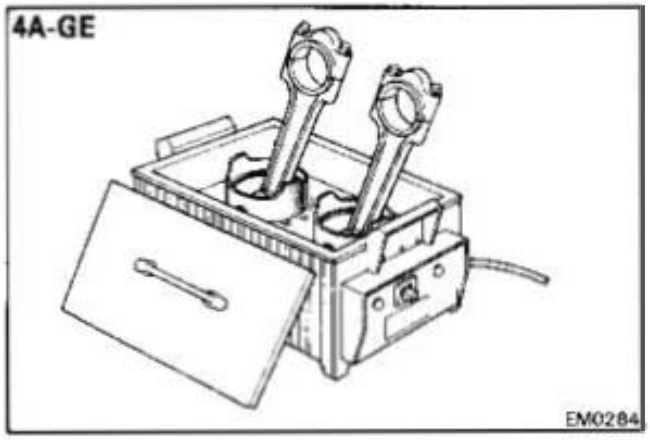
NOTE:

- The piston and pin are a matched set.
- Arrange the pistons, pins, rings, connecting rods and bearings in correct order.

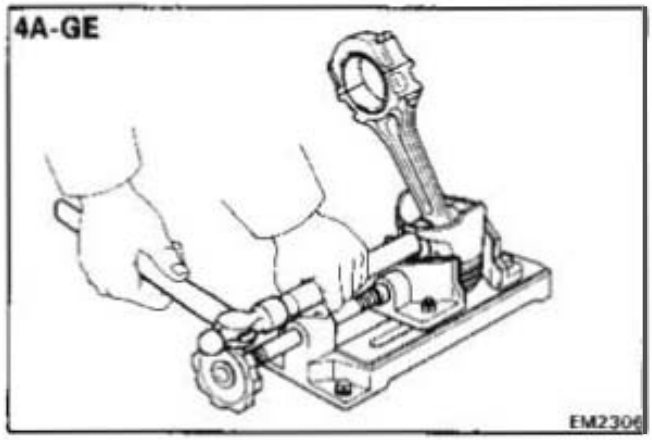


(4A-GE)

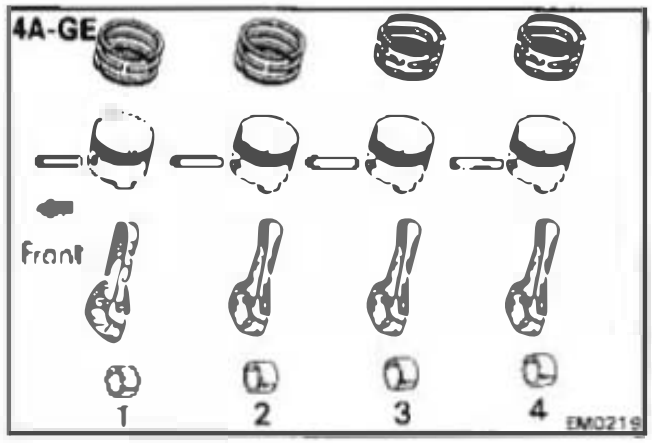
(a) Using needle-nose pliers, remove the snap rings.



(b) Gradually heat the piston to 70 – 80°C (158 – 176°F).

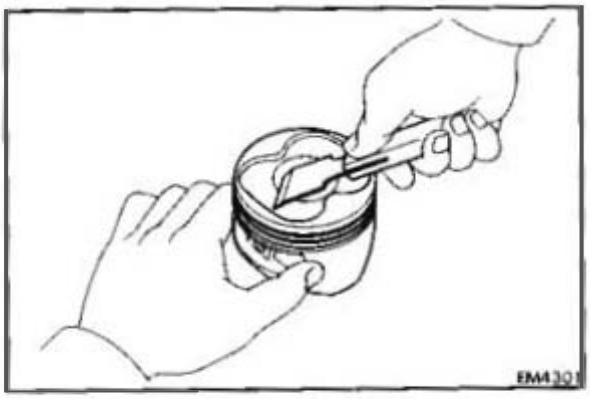


(c) Using a plastic-faced hammer and brass bar, lightly tap out the piston pin and remove the connecting rod.



NOTE:

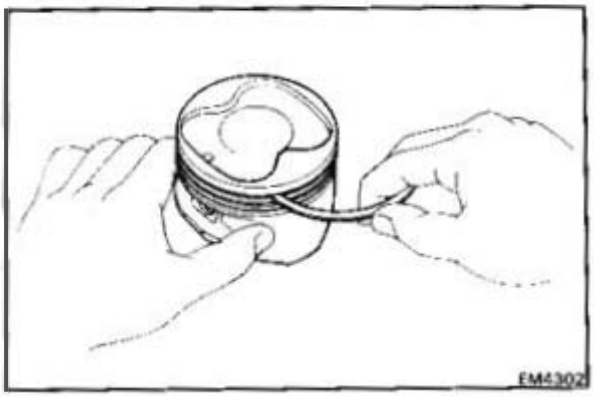
- The piston and pin are a matched set.
- Arrange the pistons, pins, rings, connecting rods and bearings in correct order.



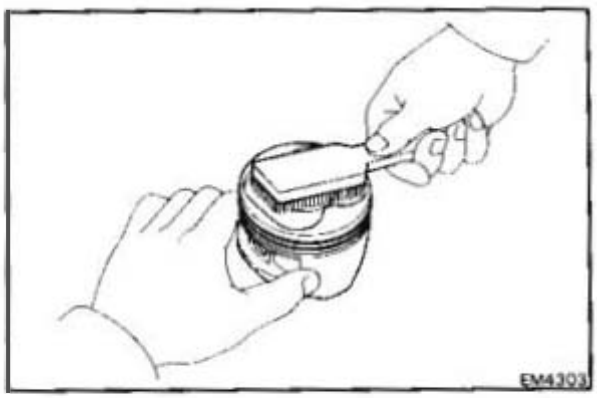
INSPECTION OF PISTON AND CONNECTING ROD ASSEMBLIES

1. CLEAN PISTONS

(a) Using e gesket screper, remove the carbon from the piston top.

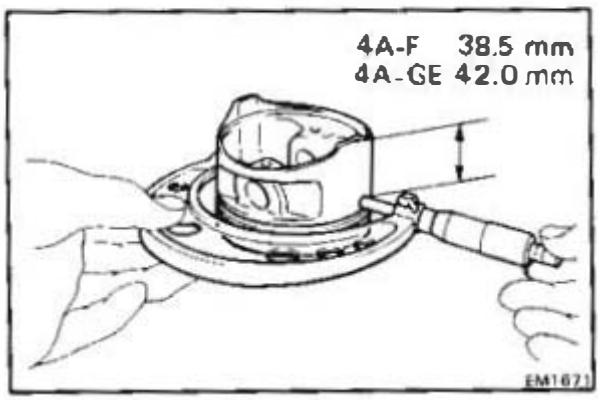


(b) Using a groove cleaning tool or broken ring, clean the ring grooves.



(c) Using a soft brush end solvent. thoroughly clean the piston.

CAUTION: Do not damage the piston.



2. INSPECT PISTON DIAMETER AND OIL CLEARANCE

(a) Using e 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 skirt bottom edge.

4A-F 38.5 mm (1.576 in.)
4A-GE 42.0 mm (1.654 in.)

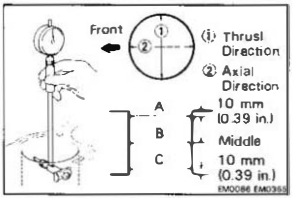
Piston diameter:

4A-F

STD	80.93 – 80.96 mm (3.1862 – 3.1874 in.)
O/S0.50	81.43 – 81.46 mm (3.2059 – 3.2071 in.)

4A-GE

STD	80.89 – 80.92 mm (3.1848 – 3.1858 in.)
O/S 0.50	81.39 – 81.42 mm (3.2043 – 3.2055 in.)

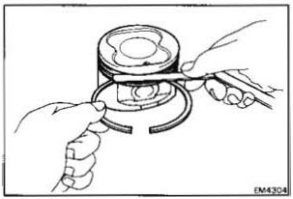


(b) Measure the cylinder bore diameter in thrust directions (See page EM-133) and subtract the piston diameter measurement from the cylinder bore diameter measurement.

Piston oil clearance:

4A-F	**0.06 — 0.08 mm (0.0024 — 0.0031 in.)**
4A-GE	**0.10 — 0.12 mm (0.0039 — 0.0047 in.)**

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



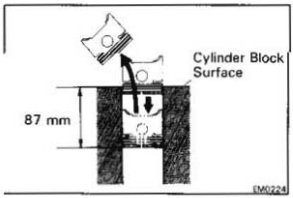
3. INSPECT PISTON RING GROOVE CLEARANCE

Using a feeler gauge, measure the clearance between a new piston ring and the wall of the piston ring groove.

Piston ring groove clearance:

No.1	**0.04 — 0.08 mm (0.0016 — 0.0031 in.)**
No.2	**0.03 — 0.07 mm (0.0012 — 0.0028 in.)**

If the clearance is not within specification, replace the piston.



4. INSPECT PISTON RING END GAP

(a) Insert the piston ring into the cylinder bore.

(b) Using a piston, push the piston ring a little beyond the bottom of the ring travel to 87 mm (0.43 in.) from the top surface of the cylinder block.

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

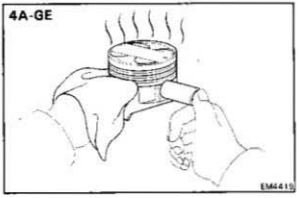
Standard piston ring end gap:

4A-F	**No. 1**	**0.25 — 0.35 mm (0.0098 — 0.0138 in.)**
	No. 2	**0.15 — 0.30 mm (0.0059 — 0.0118 in.)**
	Oil	**0.10 — 0.60 mm (0.0039 — 0.0236 in.)**
4A-GE	**No. 1**	**0.25 — 0.47 mm (0.0098 — 0.0185 in.)**
	No. 2	**0.20 — 0.42 mm (0.0079 — 0.0165 in.)**
	Oil	**0.15 — 0.52 mm (0.0059 — 0.0205 in.)**

Maximum piston ring end gap:

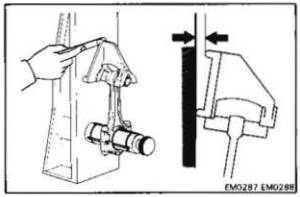
4A-F	**No. 1**	**1.07 mm (0.0421 in.)**
	No. 2	**1.02 mm (0.0402 in.)**
	Oil	**1.62 mm (0.0638 in.)**
4A-GE	**No. 1**	**1.07 mm (0.0421 in.)**
	No. 2	**1.02 mm (0.0402 in.)**
	Oil	**1.12 mm (0.0441 in.)**

If the gap is greater than maximum, replace the piston ring.
If the gap is greater than maximum, even with a new piston ring, rebore the cylinder and use an O/S piston ring.



5. (4A-GE)
INSPECT PISTON PIN FIT

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



6. **INSPECT CONNECTING RODS**

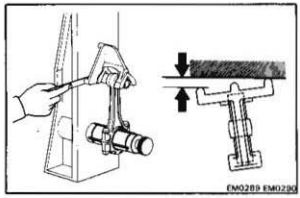
Using a rod aligner, check the connecting rod alignment.

(a) Check for bend.

Maximum bend:

4A-F 0.05 mm (0.0020 in.) per 100 mm (3.94 in.)
4A-GE 0.03 mm (0.0012 in.) per 100 mm (3.94in.)

If bend is greater than maximum, replace the connecting rod assembly.



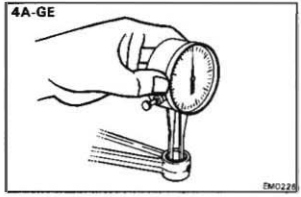
(b) Check for twist.

Maximum twist:

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

If twist is greater than maximum, replace the connecting rod assembly.

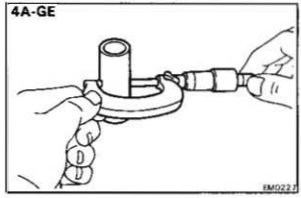
NOTE: If replacing the connecting rod, replace the same number of connecting rod bearings as that of new connecting rod caps. (See page EM-127)



7. (4A-GE)
INSPECT PISTON PIN OIL CLEARANCE

(a) Using a caliper gauge, measure the inside diameter of the connecting rod bushing.

Bushing inside diameter: 20.012 — 20.022 mm (0.7879 — 0.7883 in.)



(b) Using a micrometer, measure the piston pin diameter.

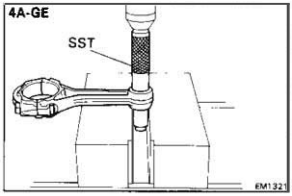
Piston pin diameter: 20.006 — 20.016 mm (0.7876 — 0.7880 in.)

(c) Subtract the piston pin diameter measurement from the bushing inside diameter measurement.

Standard oil clearance: **0.004 — 0.008 mm (0.0002 — 0.0003 in.)**

Maximum oil clearance: **0.05 mm (0.0020 in.)**

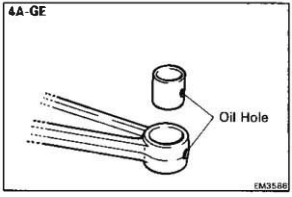
If clearance is greater than maximum, replace the bushing. If necessary, replace the piston and piston pin assembly.



8. **(4A-GE)**
IF NECESSARY, REPLACE CONNECTING ROD BUSHINGS

(a) Using SST and a press, push out the bushing.

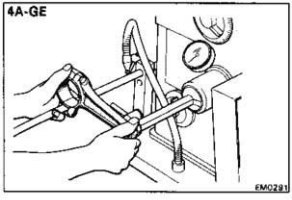
SST 09222-30010



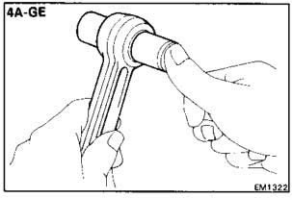
(b) Align the oil holes of the bushing and connecting rod.

(c) Using SST and a press, press in the bushing.

SST 09222-30010



(d) Using a pin hole grinder, hone the bushing to obtain the standard specified clearance (See step 7) between the bushing and piston pin.



(e) Check the piston pin fit at normal room temperature.

Coat the piston pin with engine oil and push it into the connecting rod with your thumb.

BORING OF CYLINDERS

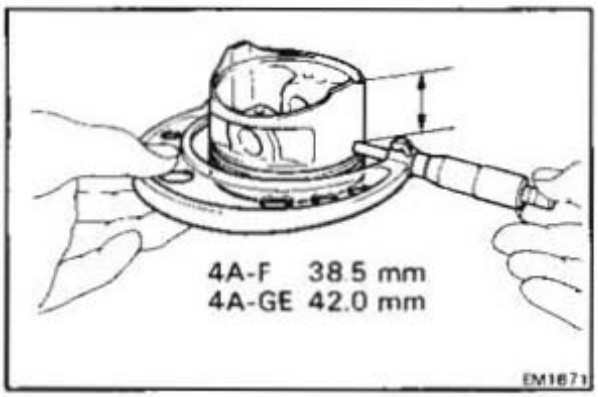
NOTE:

- Bore all four cylinders for the oversized piston outside diameter.
- Replace the piston rings with ones to match the oversized pistons.

1. KEEP OVERSIZED PISTON

Oversized piston diameter:

4A-F	**O/S 0.50**	**81.43 – 81.46 mm (3.2059 – 3.2071 in.)**
4A-GE	**O/S 0.50**	**81.39 – 81.42 mm (3.2043 – 3.2055 in.)**



2. CALCULATE AMOUNT TO BORE CYLINDER

(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 skirt bottom edge.

4A-F 38.5 mm (1.576 in.)
4A-GE 42.0 mm (1.654 in.)

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

Size to be rebored = P + C – H

P = Piston diameter

C = Piston clearance

4A-F 0.06 – 0.08 mm (0.0024 – 0.0031 in.)
4A-GE 0.10 – 0.12 mm (0.0039 – 0.0047 in.)

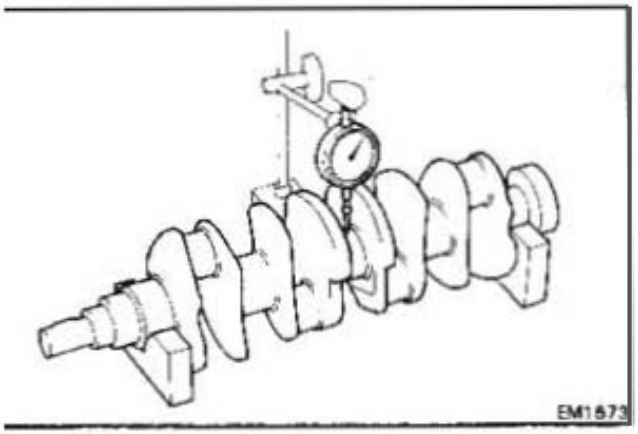
H = allowance for honing

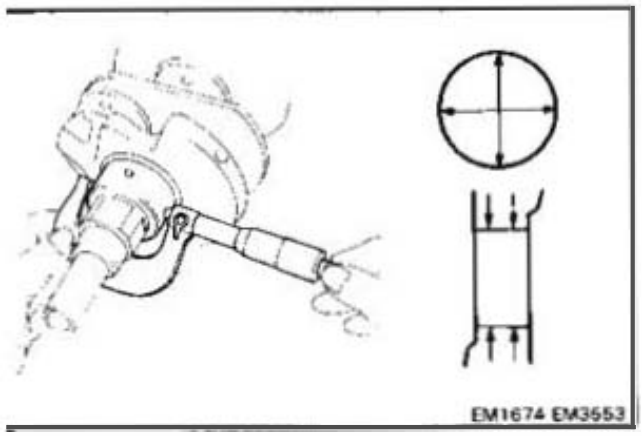
Less than 0.02 mm (0.0008 in.)

3. BORE AND HONE CYLINDERS TO CALCULATED DIMENSIONS

Amount of honing: 0.02 mm (0.0008 in.) maximum

CAUTION: Excess honing will destroy the finished roundness.


EM1673


EM1674 EM3553

INSPECTION OF CRANKSHAFT

1. INSPECT CRANKSHAFT FOR RUNOUT

(a) Place the crankshaft on V-blocks.

(b) 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 crankshaft.

2. INSPECT MAIN JOURNALS AND CRANK PINS

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

Main journal diameter:		**47.882 — 48.000 mm (1.8891 — 1.8898 in.)**
Crank pin diameter:	**4A-F**	**39.985 — 40.000 mm (1.5742 — 1.5748 in.)**
	4A-GE	**41.989 — 42.000 mm (1.6529 — 1.8535 in.)**

If the diameter is not within specification, check the oil clearance.

(b) Check each main journal and crank pin for taper and out-of-round as shown.

Maximum taper and out-of-round: 0.02 mm (0.0008 in.)

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

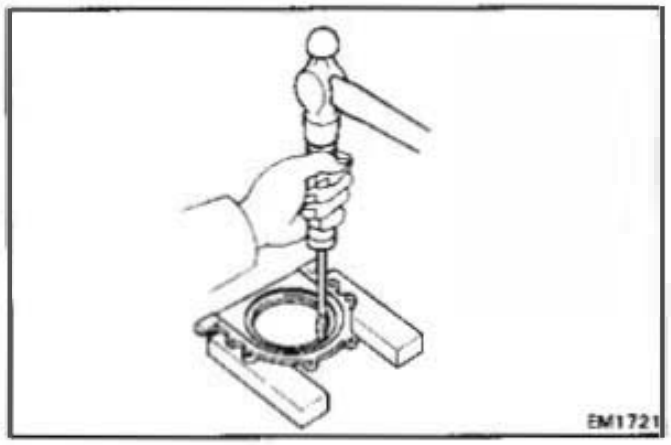
3. GRIND CRANK PIN AND/OR MAIN JOURNAL IF NECESSARY

Grind the crank pins and/or main journals to the undersized finished diameter.
Install a new pin and/or main undersized bearings.

Bearing size (U/S 0.25)

Main journal finished diameter:
U/S 0.25
47.745 — 47.755 mm (1.8797 — 1.8801 in.)
Crank pin finished diameter;
U/S 0.25
4A-F
39.745 — 39.755 mm (1.5648 — 1.5652 in.)
4A-GE
41.745 — 41.755 mm (1.6435 — 1.6439 in.)

Taper and out-of-round limit: 0.02 mm (0.0008 in.)

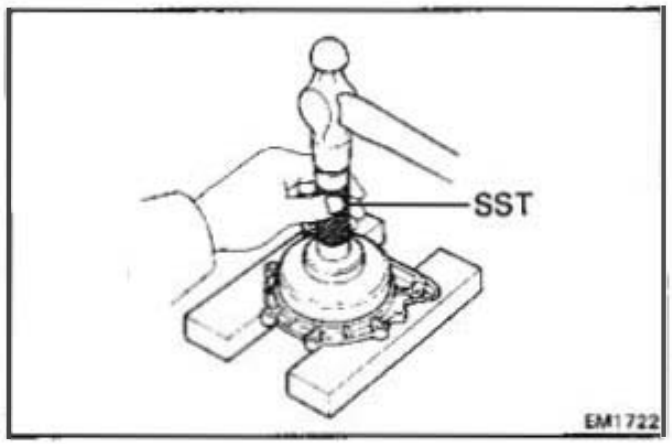


REPLACEMENT OF CRANKSHAFT OIL SEAL

NOTE: There are two methods replace the oil seal depending on whether the rear oil seal retainer is assembled to the engine or not.

1. REPLACE CRANKSHAFT REAR OIL SEAL

(a) Using a screwdriver and hammer, tap out the oil seal.

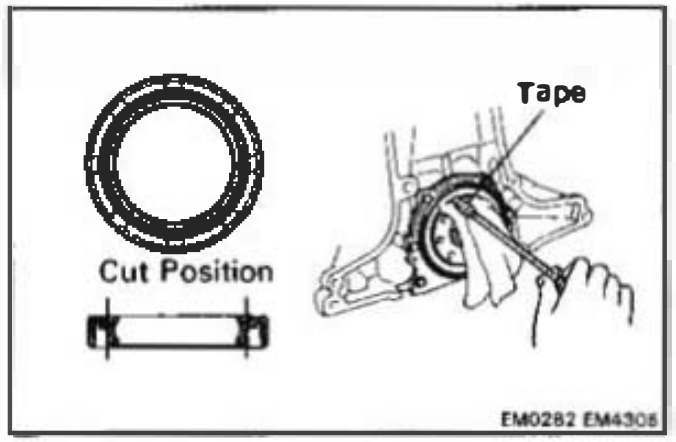


(b) Using SST and a hammer, tap in a new oil seal until its surface is flush with the rear oil seal retainer edge.

SST 09223-41020

NOTE: Be careful not to install the oil seal slantwise.

(c) Apply MP grease to the oil seal lip.



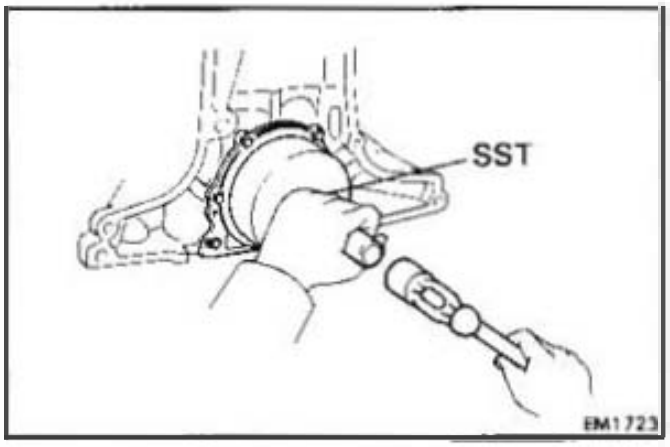
2. IF REAR OIL SEAL RETAINER IS INSTALLED ON CYLINDER BLOCK

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

(b) Using a screwdriver of taping tip, pry out the oil seal

CAUTION: Be careful not to damage the crankshaft.

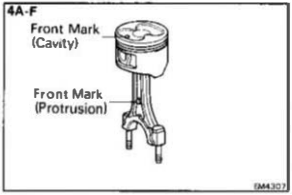
(c) Check the oil seal lip contact surface of the crankshaft for cracks or damage.



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

(e) 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

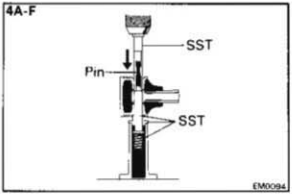


ASSEMBLY OF PISTON AND CONNECTING ROD ASSEMBLIES

1. **ASSEMBLE PISTON AND CONNECTING ROD**

(4A-F)

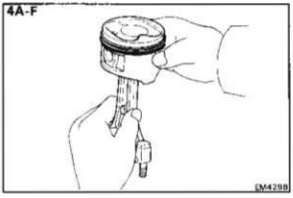
(a) Align the front marks of the piston and connecting rod.



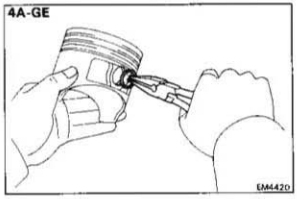
(b) Coat the piston pin with engine oil.

(c) Using SST, press in the piston pin.

SST 09221-25022
(09221-00050, 09221-00130, 09221-00140)

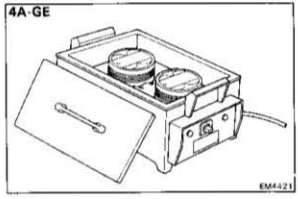


(d) Check that the piston moves smoothly back and forth on the piston pin.

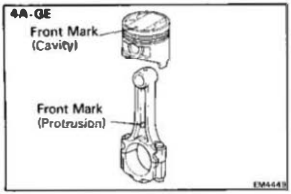


(4A-GE)

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



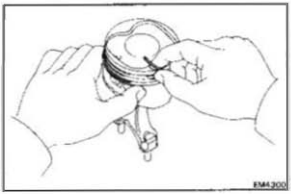
(b) Gradually heat the piston to 70 — 80°C (158 — 176°F)



(c) Coat the piston pin with engine oil.

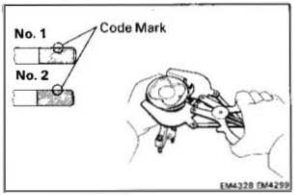
(d) Align the front marks of the piston and connecting rod, and push in the piston pin with your thumb.

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

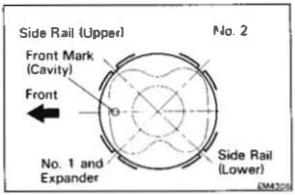


2. INSTALL PISTON RINGS

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

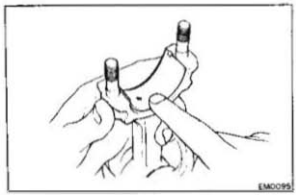


(b) Using a piston ring expander, install the two compression rings with the code mark facing upward.



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

CAUTION: Do not align the end gaps.



3. INSTALL BEARINGS

(a) Align the bearing claw with the claw groove of the connecting rod or connecting rod cap.

(b) Install the bearing in the connecting rod and rod cap.

(c) Lubricate the face of the bearings with clean engine oil.

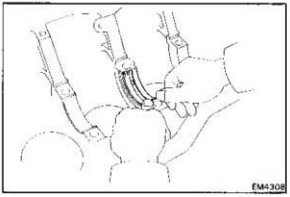
NOTE: If replacing the bearings, replace with one having the same number as marked on the bearing cap.

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

ASSEMBLY OF CYLINDER BLOCK

(See page EM-125)

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


EM4308

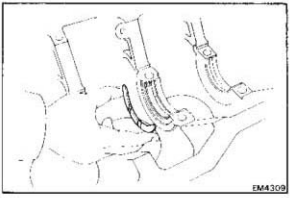
1. INSTALL MAIN BEARINGS

(a) Align the bearing claw with the claw groove of the main bearing cap or cylinder block.

(b) Install the bearing in the cylinder block and bearing caps.

(c) Lubricate the faces of the bearings with clean engine oil.

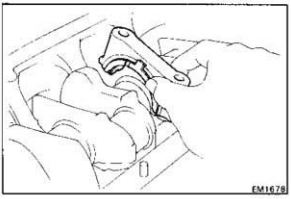
CAUTION: Install the bearing with the oil hole in the block.


EM4309

2. INSTALL UPPER THRUST WASHERS

Install the thrust washers on the center main bearing with the oil grooves facing outward.

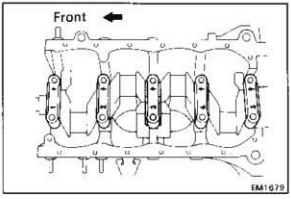
3. PLACE CRANKSHAFT ON CYLINDER BLOCK


EM1678

4. INSTALL MAIN BEARING CAPS AND LOWER THRUST WASHERS

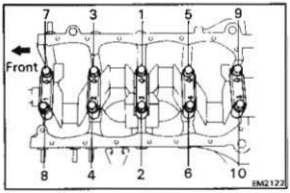
NOTE: Each bearing cap has a number and front mark.

(a) Install the thrust washers on the center bearing cap with the oil grooves facing outward.



EM1679

(b) Install the bearing caps in numerical order with the arrows facing forward.



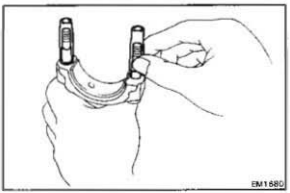
(c) Apply a light coat of engine oil on the threads and under the heads of the cap bolts.

(d) Install and uniformly tighten the ten cap bolts in several passes, in the sequence shown.

Torque: 610 kg-cm (44 ft-lb, 60 N·m)

(e) Check that the crankshaft turns smoothly.

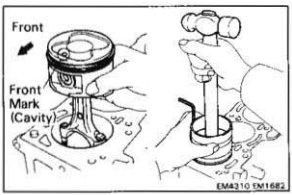
(f) Check the crankshaft thrust clearance.
(See page EM-130)



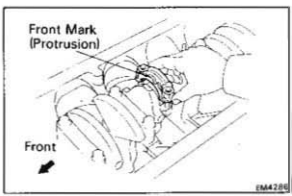
5. INSTALL PISTON AND CONNECTING ROD ASSEMBLIES

(a) Lubricate the cylinder bores and crank pins with clean engine oil.

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



(c) Using a piston ring compressor, push the correctly numbered piston and connecting rod assembly into each cylinder with the front mark of the piston facing forward.

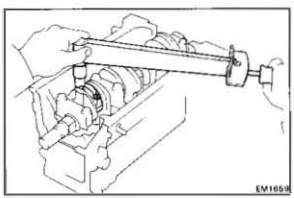


6. INSTALL CONNECTING ROD CAPS

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

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

NOTE: Align the marks punched on the rod and cap.



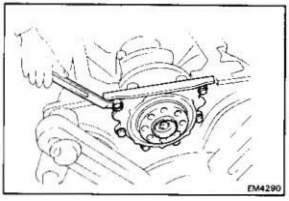
(c) Apply a light coat of the engine oil on the threads and under the nuts of the connecting rod cap.

(d) Install and alternately tighten the cap nuts in several passes.

Torque: 600 kg-cm (36 ft-lb, 49 N·m)

(e) Check that the crankshaft turns smoothly.

(f) Check the connecting rod thrust clearance.
(See page EM-127)

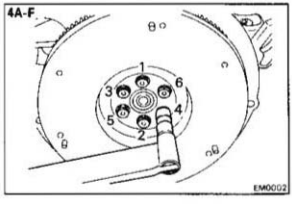


7. **INSTALL REAR OIL SEAL RETAINER**
   Install a new gasket and the rear oil seal retainer with tha six bolts.
   Torque: 95 kg-cm (82 in-lb, 9.3 N·m)

ASSEMBLY OF ENGINE

1. **INSTALL OIL FILTER BRACKET**
   (See page LU-22 or 23)
2. **INSTALL OIL PUMP ASSEMBLY, OIL STRAINER AND OIL PAN**
   (See pages LU-14 to 16)
3. **INSTALL WATER PUMP ASSEMBLY**
   (See pages CO-16 and 17)
4. **INSTALL CYLINDER HEAD ASSEMBLY**
   4A-F (See pages EM-88 to 92)
   4A-GE (See pages EM-117 to 124)
5. **CONNECT INLET WATER HOUSING HOSES**
6. **INSTALL INTAKE AND EXHAUST MANIFOLD STAYS**
7. **INSTALL TIMING PULLEYS AND TIMING BELT**
   4A-F (See pages EM-53 to 66)
   4A-GE (See pages EM-62 to 65)

4A-F



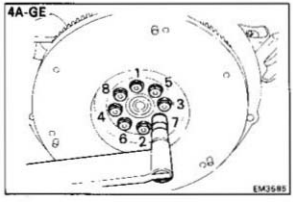
8. **INSTALL RH MOUNTING BRACKET**
   Torque: 500 kg-cm (36 ft-lb, 49 N·m)
9. **INSTALL BRACKET AND ALTERNATOR**
   Torque(Bracket): 500 kg-cm (36 ft-lb, 49 N·m)
10. **INSTALL A/C COMPRESSOR MOUNT (A/C only)**
11. **REMOVE ENGINE ASSEMBLY FROM ENGINE STAND**
12. **INSTALL REAR END PLATE**
13. **INSTALL FLYWHEEL (M/T) OR DRIVE PLATE (A/T)**
    Install the flywheel or drive plate on the crankshaft. Tighten the bolts to the specified torque in two or thre passes in the sequence shown.

    Torque:

Flywheel	**4A-F**	**800 kg-cm (58 ft-lb, 78 N·m)**
	4A-GE	**750 kg-cm (54 ft-lb, 74 N·m)**
Drive plate (4A-F)		**650 kg-cm (47 ft-lb, 64 N·m)**

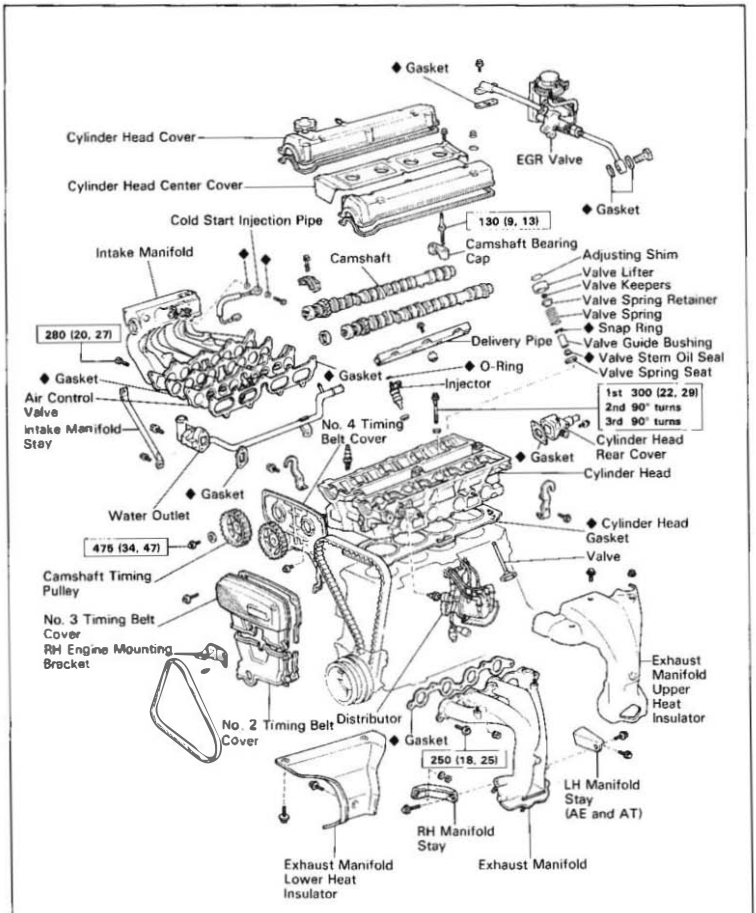
14. **INSTALL CLUTCH DISC AND COVER (M/T only)**
    NOTE: If necessar , inspect the clutch unit before installation.

4A-GE



CYLINDER HEAD

COMPONENTS

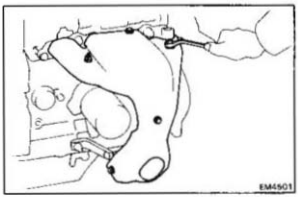


kg-cm (ft-lb, N·m) : Specified torque
◆ Non-reusable part

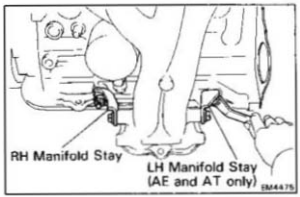
REMOVAL OF CYLINDER HEAD

(See page EM-99)

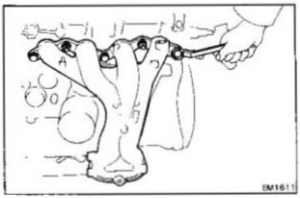
1. DRAIN ENGINE COOLANT (See page CO-6 or 7)
2. REMOVE DISTRIBUTOR



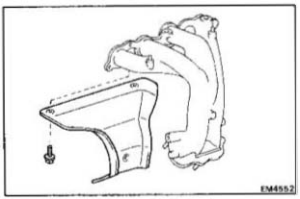
3. REMOVE EXHAUST MANIFOLD
   (a) Remove the four bolts, two nuts and upper heat insulator



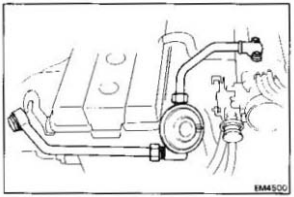
   (b) (AE and AT)
   Remove the three bolts, nut, RH and LH manifold stays.
   (c) (AW)
   Remove the bolt, nut and RH manifold stay.



   (d) Remove the three bolts, two nuts, manifold and gasket.



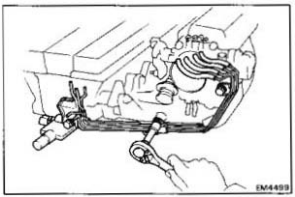
   (e) Remove the three bolts and lower heat insulator.



4. **(w/ EGR SYSTEM)**
REMOVE EGR VALVE AND MODULATOR
   (a) Disconnect the vacuum hoses from the vacuum pipe.
   (b) Remove the bolt and EGR vacuum modulator.
   (c) Remove the union bolt, four bolts, the EGR valve, pipes assembly and gaskets.

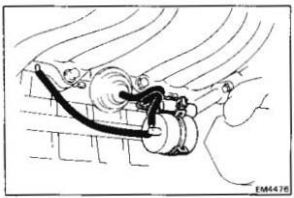
5. **REMOVE COLD START INJECTOR PIPE**
(See steps 2 and 3 on page FI-72)

6. **REMOVE DELIVERY PIPE AND INJECTORS**
(See steps 3 to 7 on page FI-76)

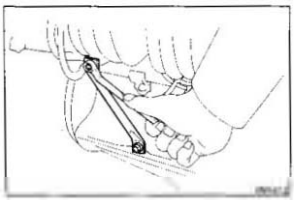


7. **REMOVE VACUUM PIPE (w/ EGR SYSTEM) AND CYLINDER HEAD REAR COVER**
   (a) (w/ EGR System)
   Disconnect the vacuum hoses from the throttle body
   (b) (w/o EGR System)
   Remove the two bolts, rear cover and gasket.
   (c) (w/ EGR System)
   Remove the four bolts, vacuum pipe, rear cover and gasket.

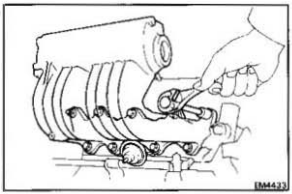
8. **REMOVE THROTTLE BODY**
(See steps 5 and 6 on page FI-85)



9. **REMOVE T-VIS VSV AND VACUUM TANK**
   (a) Disconnect the vacuum hoses from the air control valve and actuator.
   (b) Remove the two bolts, the VSV and vacuum tank assembly.

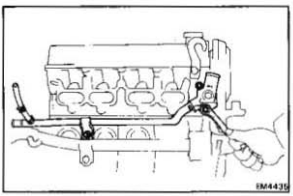


10. **REMOVE INTAKE MANIFOLD**
   (a) Remove the two bolts and manifold stay.



(b) Remove the PCV hose.

(c) Remove the seven bolts, two nuts, intake manifold, air control valve and gaskets.

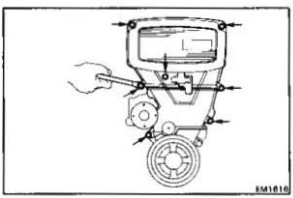


11. REMOVE WATER OUTLET AND BY-PASS PIPE

(a) Remove the three bolts and alternator drive belt adjusting bar.

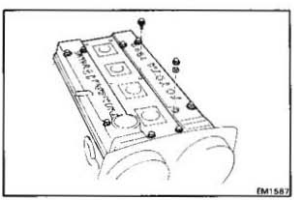
(b) Remove the three bolts, the water outlet, by-pass pipe assembly and gasket.

12. REMOVE WATER PUMP PULLEY AND DRIVE BELT



13. REMOVE NO.3 AND NO.2 TIMING BELT COVERS

Remove the seven bolts, No.3, No.2 belt covers and gaskets.

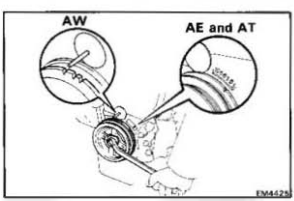


14. REMOVE CYLINDER HEAD COVER

(a) Remove the four bolts, center cover and gasket.

(b) Remove the eight cap nuts, seal washers, two head covers and gaskets.

15. REMOVE SPARK PLUGS (See page IG-20)

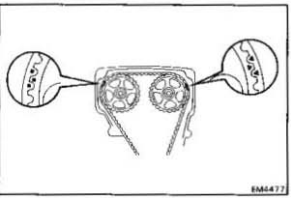


16. SET NO.1 CYLINDER TO TDC/COMPRESSION

(a) Turn the crankshaft pulley and align its groove with the timing mark "0" of the No.1 timing belt cover (AE and AT) or timing pointer (AW).

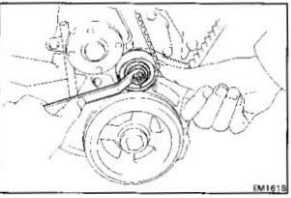
(b) Check that the valve lifters on the No.1 cylinder are loose and valve lifters on the No.4 cylinder are tight.

If not, turn the crankshaft one revolution (360°).

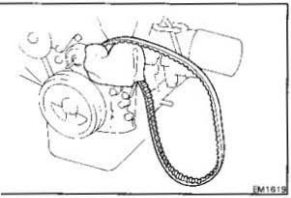


17. DISCONNECT TIMING BELT FROM CAMSHAFT TIMING PULLEYS

(a) Place matchmarks on the camshaft timing pulleys and timing belt.



(b) Loosen the idler pulley bolt and shift the pulley toward the left as far as it will go, temporarily tighten it.

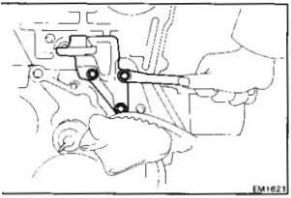


(c) Remove the timing belt from the camshaft timing pulleys.

NOTE:

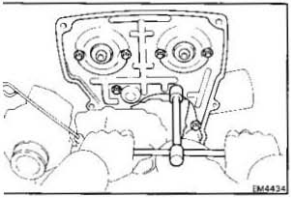
- Support the belt so the meshing of the crankshaft timing pulley and timing belt does not shift.
- Be careful not to drop anything inside the timing belt cover.
- Do not allow the belt to come into contact with oil, water or dust.

18. REMOVE CAMSHAFT TIMING PULLEYS
(See step 11 on page EM-59)



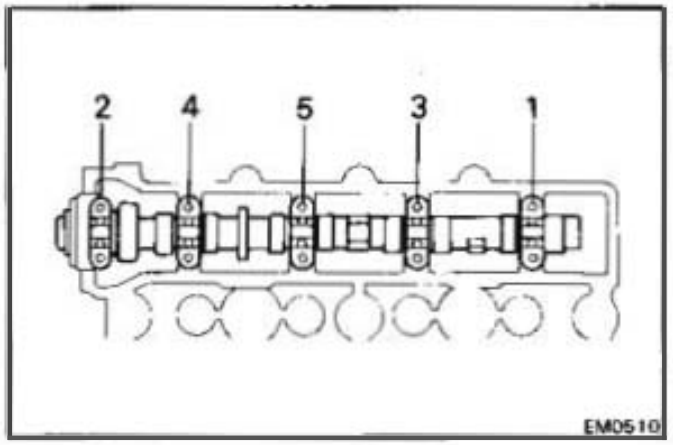
19. REMOVE RH MOUNTING BRACKET

Remove the three bolts and bracket.



20. REMOVE NO.4 TIMING BELT COVER

Remove the seven bolts and belt cover.

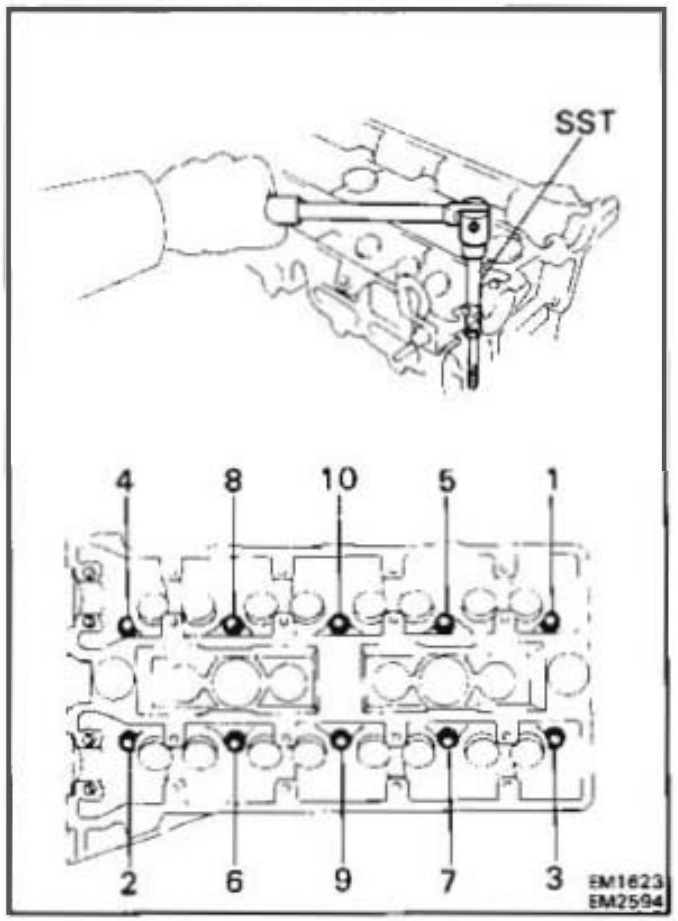


21. REMOVE CAMSHAFTS

(a) Uniformly loosen and remove the bearing cap bolts in several passes, in the sequence shown.

(b) Remove the bearing caps, oil seal and camshaft.

NOTE: Arrange the intake and exhaust camshafts.

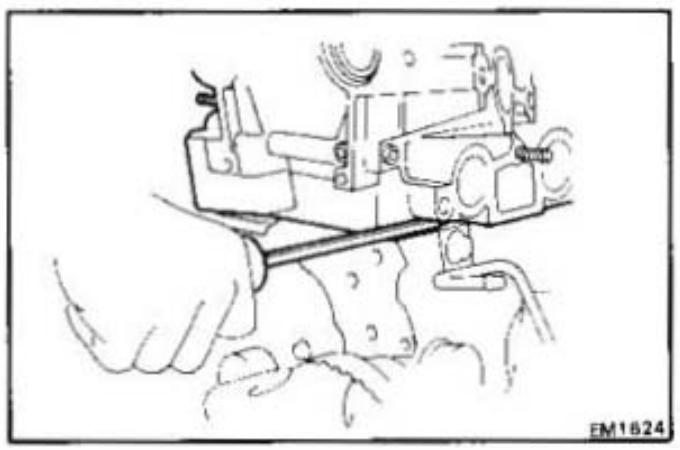


22. REMOVE CYLINDER HEAD

(e) Using SST, uniformly loosen and remove the ten cylinder head bolts in several passes, in the sequence shown.

SST 09205-16010

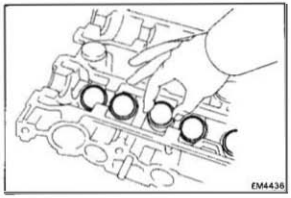
CAUTION: Head warpage or cracking could result from removing bolts in incorrect order.



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

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

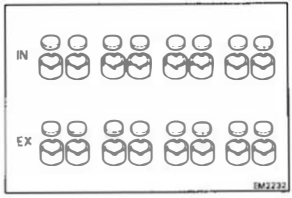
CAUTION: Be careful not to damage the cylinder head and cylinder block surfaces of cylinder head gasket side.



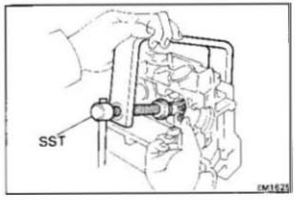
DISASSEMBLY OF CYLINDER HEAD

(See page EM-99)

1. **REMOVE VALVE LIFTERS AND SHIMS**



NOTE: Arrange the valve lifters and shims in correct order.

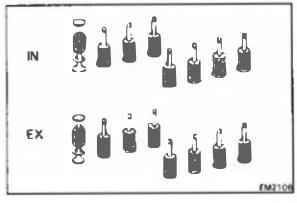


2. **REMOVE VALVES**

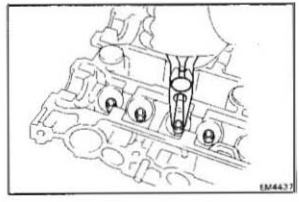
(a) Using SST, compress the valve spring and remove the two keepers.

SST 09202-70010

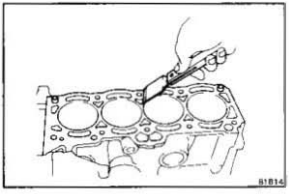
(b) Remove the spring retainer, valve spring, valve and spring seat.

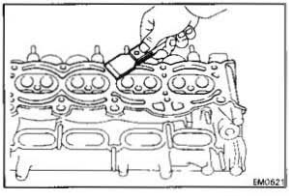


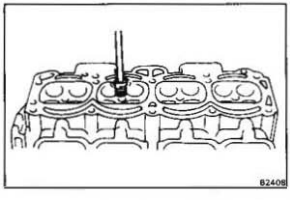
NOTE: Arrange the valves, valve springs, spring seats and spring retainers in correct order.

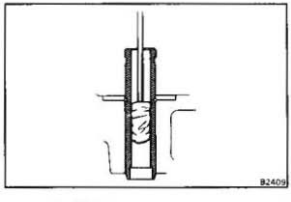


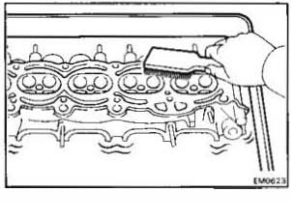
(c) Using needle-nose pliers, remove the oil seal.











INSPECTION, CLEANING AND REPAIR OF CYLINDER HEAD COMPONENTS

1. CLEAN TOP OF PISTONS AND TOP OF BLOCK

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

(b) Remove all the gasket material from the top of the cylinder block.

(c) Using compressed air, blow carbon and oil from the bolt holes.

WARNING: Protect your eyes when using high pressure air.

2. REMOVE GASKET MATERIAL

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

CAUTION: Be careful not scratch the surfaces.

3. CLEAN COMBUSTION CHAMBERS

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

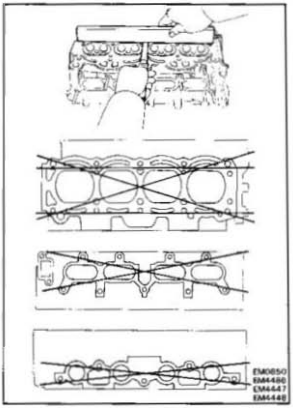
CAUTION: Be careful not to scratch the head gasket contact surface.

4. CLEAN VALVE GUIDE BUSHINGS

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

5. CLEAN CYLINDER HEAD

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



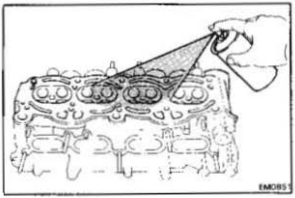
6. INSPECT CYLINDER HEAD FOR FLATNESS

Using a precision straightedge and feeler gauge, measure the surfaces contacting the cylinder block manifolds for warpage.

Maximum warpage:

Cylinder block side	**0.05 mm (0.0020 in.)**
Intake manifold side	**0.05 mm (0.0020 in.)**
Exhaust manifold side	**0.10 mm (0.0039 in.)**

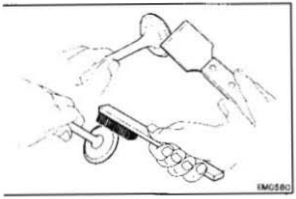
If warpage is greater than maximum, replace the cylinder head.



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.

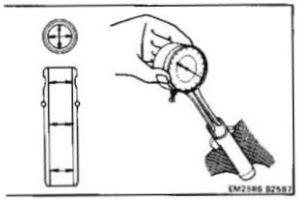
If cracked, replace the cylinder head.



8. CLEAN VALVES

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

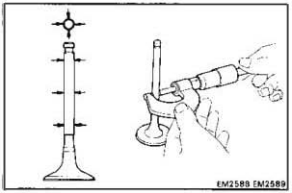
(b) Using a wire brush, thoroughly clean the valve.



9. INSPECT VALVE STEMS AND GUIDE BUSHINGS

(a) Using a caliper gauge, measure the inside diameter of the guide bushing.

Bushing inside diameter:
6.010 – 8.030 mm (0.2388 – 0.2374 in.)



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

Valve stem diameter:

Intake	**5.970 – 5.985 mm (0.2350 – 0.2356 in.)**
Exhaust	**5.955 – 5.980 mm (0.2348 – 0.2354 in.)**

(c) Subtract the valve stem diameter measurement from the guide bushing inside diameter measurement.

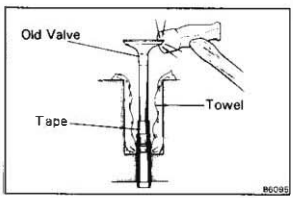
Standard oil clearance:

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

Maximum oil clearance:

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

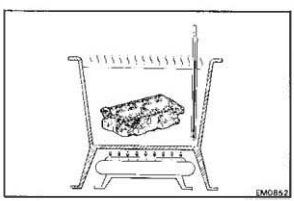
If the clearance is greater than maximum, replace the valve and guide bushing.



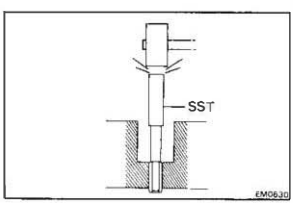
10. IF NECESSARY, REPLACE VALVE GUIDE BUSHINGS

(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.

CAUTION: Be careful not to damage the lifter hole.

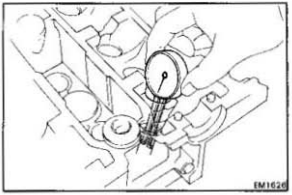


(b) Gradually heat the cylinder head to 80 – 100°C (176 – 212°F).



(c) Using SST and a hammer, tap out the guide bushing

SST 09201-70010



(d) Using a caliper gauge, measure the bushing bore diameter of the cylinder head.

Both intake and exhaust

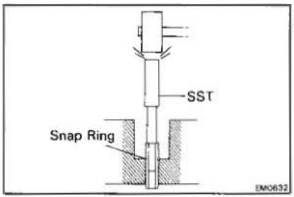
Bushing bore mm (in.)	Bushing size
11.000 ~ 11.027 (0.4331 – 0.4341)	Use STD
Over 11.027 (0.4341)	Use O/S 0.05

(e) Select a new guide bushing (STD size or O/S 0.05).

If the bushing bore diameter of the cylinder head is greater then 11.027 mm (0.4341 in.), machine the bushing bore to the following dimension:

Rebored cylinder head bushing bore dimension:
11.050 – 11.077 mm (0.4350 – 0.4361 in.)

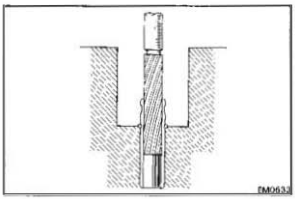
If the bushing bore diameter of the cylinder head is greater than 11.077 mm (0.4361 in.), replace the cylinder head.



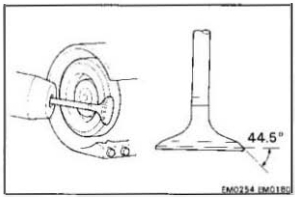
(f) Gradually heat the cylinder head to 80 – 100°C (176 – 212°F).

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

SST 09201-70010



(h) Using a sharp 6 mm reamer, ream the guide bushing to obtain the standard specified clearance (See page EM-108) between the guide bushing and valve stem.

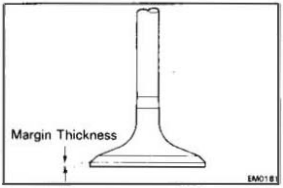


11. INSPECT AND GRIND VALVES

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

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

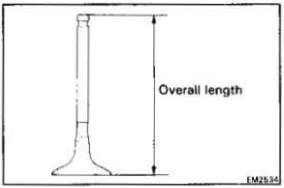
Valve face angle: 44.5°



(c) Check the valve head margin thickness.

Standard margin thickness: 0.8 — 1.2 mm (0.031 — 0.047 in.)
Minimum margin thickness: 0.5 mm (0.020 in.)

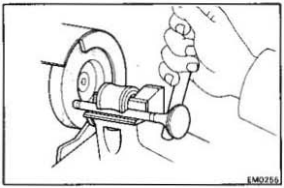
If the margin thickness is less than minimum, replace the valve.



(d) Check the valve overall length.

Standard overall length:
Intake 99.60 mm (3.9213 in.)
Exhaust 99.75 mm (3.9272 in.)
Minimum overall length:
Intake 99.10 mm (3.9016 in.)
Exhaust 99.25 mm (3.9075 in.)

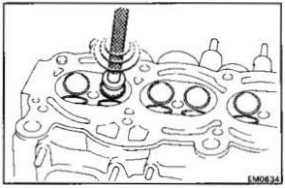
If the overall length is less than minimum, replace the valve.



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

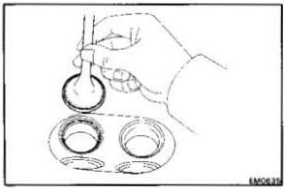
If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.

CAUTION: Do not grind off more than the minimum overall length.



12. INSPECT AND CLEAN VALVE SEATS

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



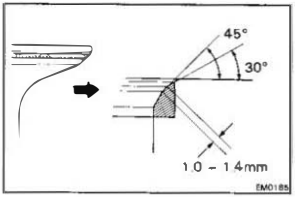
(b) Check the valve seating position.

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

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

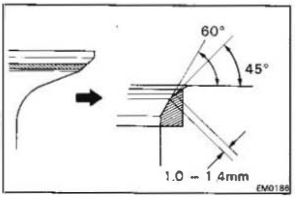
- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
- If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
- Check that the seat contact is on the middle of the valve face with the following width:

1.0 — 1.4 mm (0.039 — 0.055 in.)

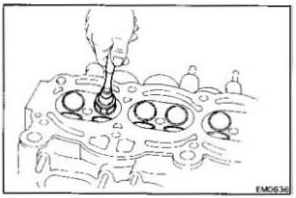


If not, correct the valve seats as follows:

(1) If the seating is too high on the valve face, use 30° and 45° cutters to correct the seat.



(2) If the 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 an abrasive compound.

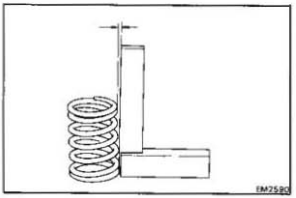
(e) After hand-lapping, clean the valve and valve seat.

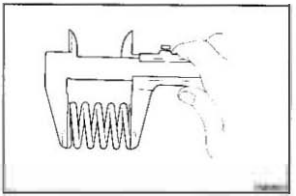
13. INSPECT VALVE SPRINGS

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

Maximum squareness: 1.8 mm (0.071 in.)

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

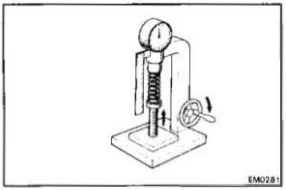




(b) Using calipers, measure the free length of the valve spring.

Free length: 41.09 mm (1.6177 in.)

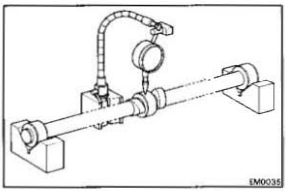
If the free length is not as specified, replace the valve spring.



(c) Using a spring tester, measure the tension of the valve spring at the specifie installed length.

Installed tension:
14.6 — 17.0 kg (32.2 — 37.5 lb, 143 — 167 N) at 34.7 mm (1.366 in.)

If the installed tension is not as specified, replace the valve spring.



14. INSPECT CAMSHAFTS AND BEARINGS

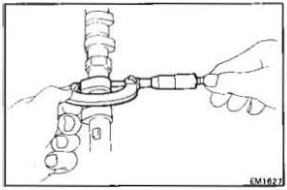
A. Inspect camshaft for runout

(a) Place the camshaft on V-blocks.

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

Maximum circle runout: 0.04 mm (0.0016 in.)

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



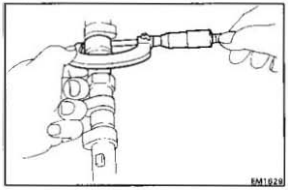
B. Inspect cam lobes

Using a micrometer, measure the cam lobe height.

Standard cam lobe height: 36.410 — 35.510 mm (1.3941 — 1.3980 in.)

Minimum cam lobe height: 36.11 mm (1.3823 in.)

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

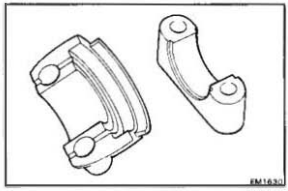


C. Inspect camshaft journals

Using a micrometer, measure the journal diameter.

Journal diameter: 26.949 — 26.965 mm (1.0610 — 1.0616 in.)

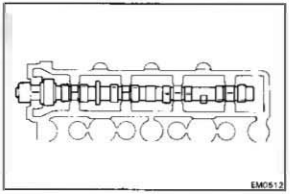
If the journal diameter is not as specified, check the oil clearance.

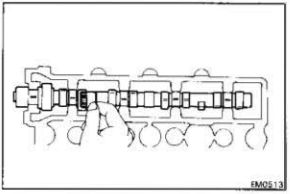


D. Inspect camshaft bearings

Check the bearings for flaking and scoring.

If the bearings are damaged, replace the bearing caps and cylinder head as a set.


EM0512


EM0513

E. Inspect camshaft journal oil clearance

(a) Clean the bearing caps and camshaft journals.

(b) Place the camshafts on the cylinder head.

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

(d) Install the bearing caps.
(See step 2 on pages EM-118 and 119)

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

NOTE: Do not turn the camshaft.

(e) Remove the bearing caps.

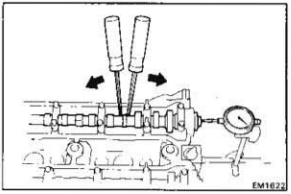
(f) Measure the Plastigage at its widest point.

Standard oil clearance: 0.035 — 0.072 mm (0.0014 — 0.0028 in.)

Maximum oil clearance: 0.10 mm (0.0039 in.)

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

(g) Completely remove the Plastigage.


EM1622

F. Inspect camshaft thrust clearance

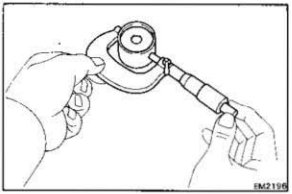
(a) Install the camshafts.
(See step 2 on pages EM-118 and 119)

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

Standard thrust clearance: 0.080 — 0.190 mm (0.0031 — 0.0075 in.)

Maximum thrust clearance: 0.30 mm (0.0118 in.)

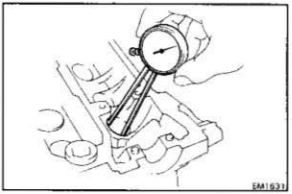
If the thrust clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.


EM2196

15. INSPECT VALVE LIFTERS AND LIFTER BORES

(a) Using a micrometer, measure the lifter diameter.

Lifter diameter: 27.975 — 27.986 mm (1.1014 — 1.1018 in.)


EM1631

(b) Using a caliper gauge, measure the lifter bore diameter of the cylinder head.

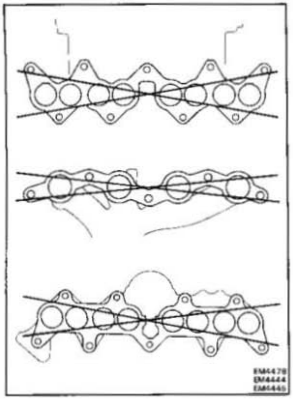
Lifter bore diameter: 28.000 — 28.021 mm (1.1024 — 1.1032 in.)

(c) Subtract the lifter diameter measurement from the lifter bore diameter measurement.

Standard oil clearance: 0.015 — 0.046 mm (0.0008 — 0.0018 in.)

Maximum oil clearance: 0.07 mm (0.0028 in.)

If the oil clearance is greater than maximum, replace the lifter. If necessary, replace the cylinder head.



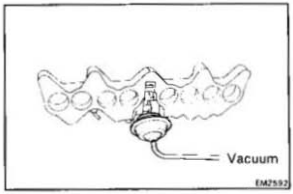
16. **INSPECT INTAKE, EXHAUST MANIFOLDS AND AIR CONTROL VALVE**

Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head or air control valve for warpage.

Maximum warpage:

Intake manifold	**0.05 mm (0.0020 in.)**
Exhaust manifold	**0.30 mm (0.0118 in.)**
Air control valve	**0.05 mm (0.0020 in.)**

If warpage is greater than maximum, replace the manifold.



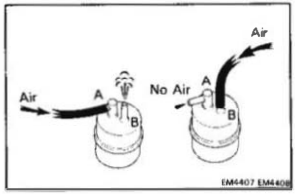
INSPECTION OF TOYOTA – VARIABLE INDUCTION SYSTEM (T-VIS)

1. **INSPECT AIR CONTROL VALVE**

(a) With 300 mmHg (11.81 in.Hg, 40.0 kpa) of vacuum applied to the actuator, check that the control valve moves smoothly to the fully closed position.

(b) With the vacuum released, check that the valve quickly fully opens.

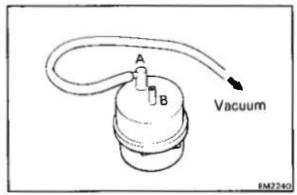
If abnormal, replace the valve.



2. **INSPECT VACUUM TANK**

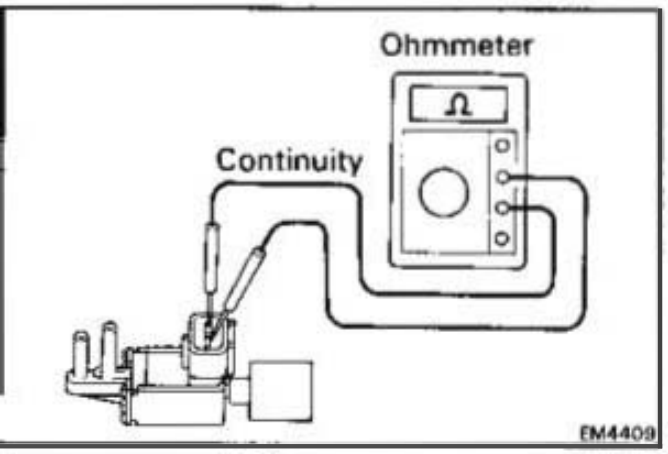
(a) Check that air flows from pipes A to B.

(b) Check that air does not flow from pipes B to A.



(c) Apply 500mmHg (19.69 in.Hg, 66.7 kPa) of vacuum to pipe A and check that there is no change in vacuum after one minute.

If there is change, replace the vacuum tank.



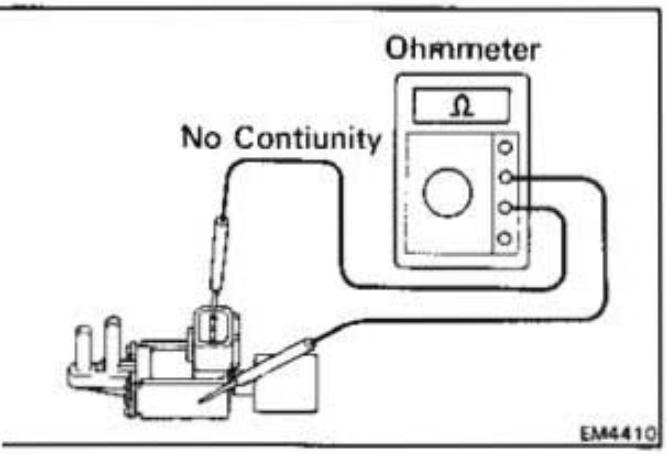
3. INSPECT VACUUM SWITCHING VALVE (VSV)

A. Inspect VSV for open circuit

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

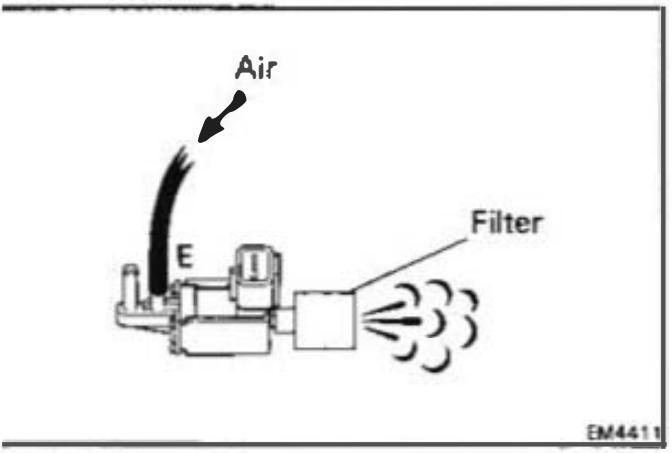
Resistance (Cold): 33 — 39 Ω

If there is no continuity, replace the VSV.



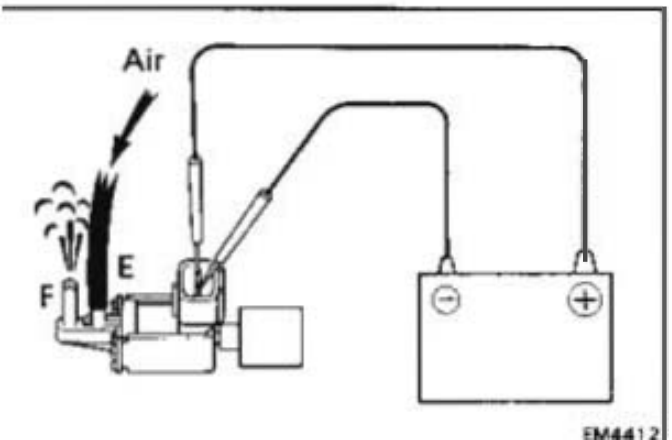
B. Inspect VSV for ground

Using an ohmmeter, check that there is no continuity between each terminal and the VSV body
If there is continuity, replace the VSV.



C. Inspect VSV operation

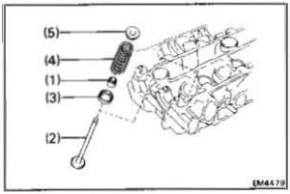
(a) Check that air flows from pipe E to the filter.



(b) Apply battery voltage across the terminals.

(c) Check that air flows from pipes E to F.

If operation is not as specified, replace the VSV.



ASSEMBLY OF CYLINDER HEAD

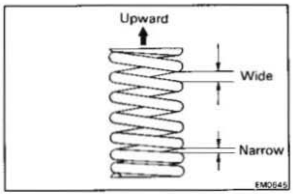
(See page EM-99)

NOTE:
- Tho oughly clean all parts to be assembled.
- Before installing the parts, apply new engine oil to all sliding an rotating surfaces.
- Replace all gaskets and oil seals with new ones.

1. INSTALL VALVES

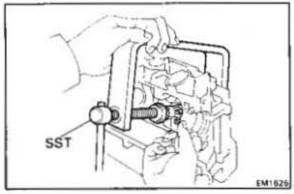
(a) Install the following parts:
(1) New oil seal
(2) Valve
(3) Spring seat
(4) Valve spring
(5) Spring retainer

CAUTION: Confirm the correct direction of the valve spring.

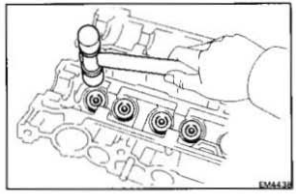


(b) Using SST, comp ess the valve spring and place the two keepers around the valve stem.

SST 09202-70010



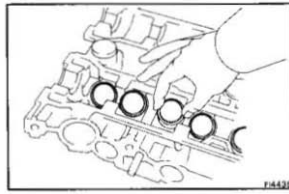
(c) Using a plastic-face hammer, lightly tap the valve stem tip to assure proper fit.

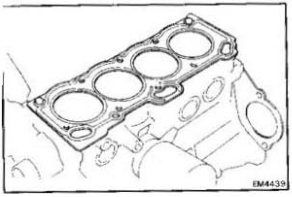


2. INSTALL VALVE LIFTERS AND SHIMS

(a) Install the valve lifter and shim.

(b) Check the valve lifter rotates smoothly by hand.





INSTALLATION OF CYLINDER HEAD

(See page EM-99)

1. INSTALL CYLINDER HEAD

A. Place cylinder head on cylinder block

(a) Place a new cylinder head gasket in position on the cylinder block.

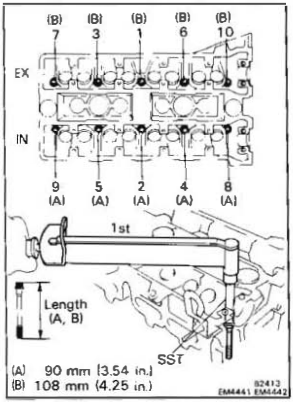
CAUTION: Be careful of the installation direction.

(b) Place the cylinder head in position on the cylinder head gasket.

B. Tighten cylinder head bolts

NOTE:

- The cylinder head bolts are tighten in three progressive steps.
- If any of bolts break or defrom, replace them.



(a) Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.

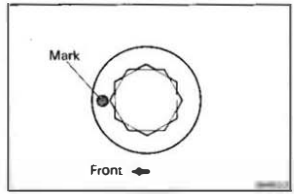
(b) First, using SST, install and uniformly tighten the ten cylinder head bolts in several passes, in the sequence shown.

SST 09205-16010

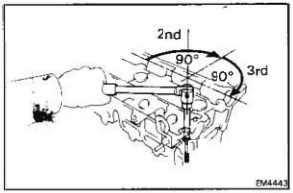
Torque: 300 kg-cm (22 ft-lb, 29 N·m)

NOTE: Each bolt length is indicated in the figure.

If any one of the bolts not meet the torque specification, replace the bolt.



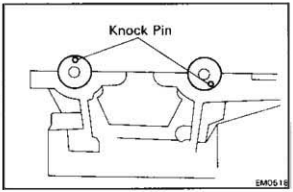
(c) Mark the front of the cylinder head bolt head with peint.



(d) Second, retighten the ten cylinder head bolts 90° in the numerical order shown.

(e) Third, retighten the ten cylinder head bolts by an additional 90°.

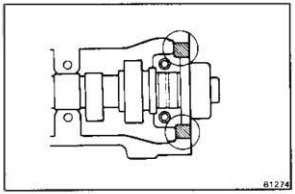
(f) Check that the paint mark is now facing rearward.



2. INSTALL CAMSHAFTS

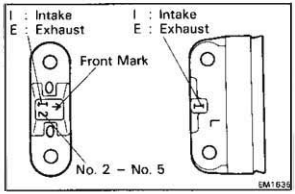
(a) Place the camshafts in position on the cylinder head as shown in the figure.

NOTE: The exhaust camshaft has a distributor drive gear.

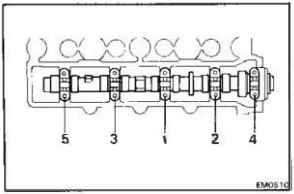


(b) Apply seal packing to the cylinder head as shown in the figure.

Seal packing: Part No.08826-00080 or equivalent



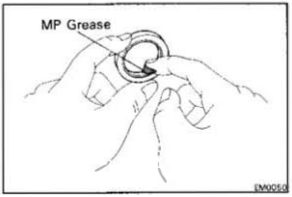
(c) Install the bearing caps in their proper locations.



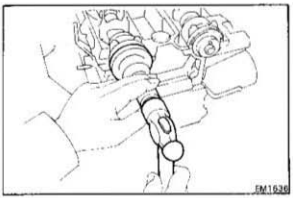
(d) Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.

(e) Install and uniformly tighten the bearing cap bolts in several passes, in the sequence shown.

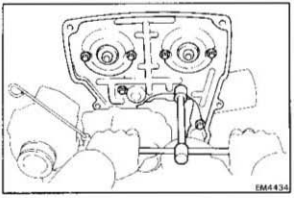
Torque: 130 kg-cm (9 ft-lb, 13 N·m)



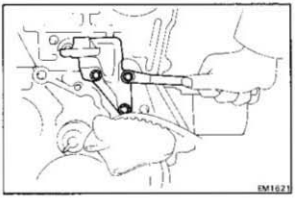
(f) Apply MP grease to a new oil seal lip.



(g) Using SST, tap in the oil seal.
SST 09223-50010

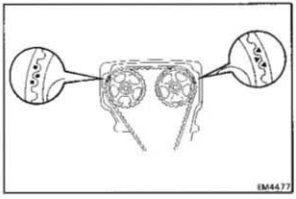


3. **INSTALL NO.4 TIMING BELT COVER**
Install the belt cover with the seven bolts.
Torque: 95 kg-cm (82 in.-lb, 9.3 N·m)

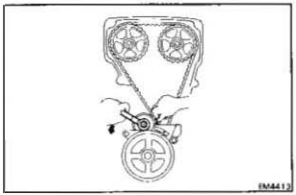


4. **INSTALL RH MOUNTING BRACKET**
Install the mounting bracket with the three bolts.
Torque: 250 kg-cm (18 ft-lb, 25 N·m)

5. **INSTALL CAMSHAFT TIMING PULLEYS**
(See step 1 on page EM-62)
Torque: 475 kg-cm (34 ft-lb, 47 N·m)

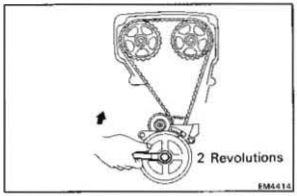


6. **INSTALL TIMING BELT**
CAUTION: The engine should be cold.
Align the matchmarks of the camshaft timing pulleys and timing belt, and install the timing belt.
NOTE: Be careful not to shift the meshing of the crankshaft timing pulley and timing belt.



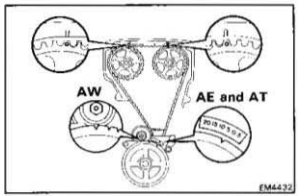
7. CHECK VALVE TIMING AND TIMING BELT DEFLECTION

(a) Slowly loosen the idler pulley bolt.



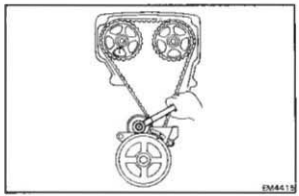
(b) Turn the crankshaft pulley two revolutions from TDC to TDC.

NOTE: Always turn the crankshaft clockwise.



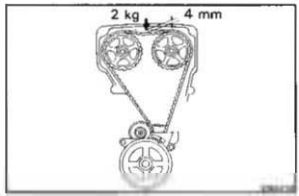
(c) Check that each pulley aligns with the timing marks as shown in the figure.

If the marks do not align, shift meshing of the timing belt and timing pulley and readjust according to steps 6 to 8.



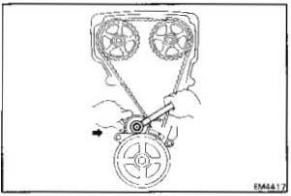
(d) Torque the idler pulley bolt.

Torque: 375 kg-cm (27 ft-lb, 37 N·m)



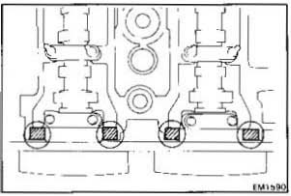
(e) Check that there is belt deflection at the position indicated in the figure.

Deflection: 4 mm (0.16 in.) at 2 kg (4.4 lb, 20 N)

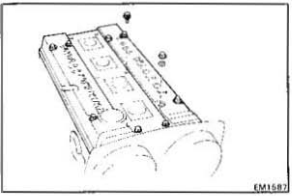


If the deflection is not as specified, adjust with the idler pulley.

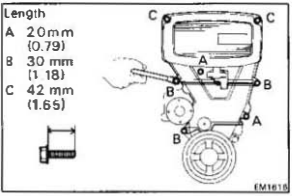
8. **INSTALL SPARK PLUGS (See page IG-21)**
   Torque: 180 kg-cm (13 ft-lb, 18 N·m)



9. **INSTALL CYLINDER HEAD COVER**
   (a) Apply seal packing to the cylinder head as shown in the figure.
   Seal packing: Part No.08826-00080 or equivalent



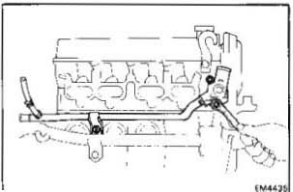
   (b) Install the gaskets to the head covers.
   (c) Install the two head covers with the four seal washers and cap nuts.
   Torque: 130 kg-cm (9 ft-lb, 13 N·m)
   (d) Install the gasket to the center cover.
   (e) Install the center cover with the four bolts.



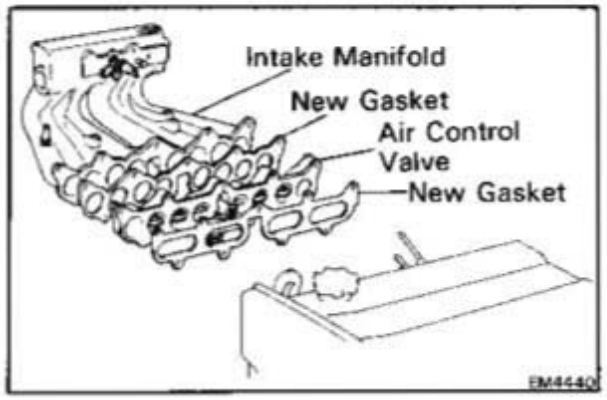
10. **INSTALL NO.2 AND NO.3 TIMING BELT COVERS**
    (a) Install the gaskets to the belt covers.
    (b) Install the No.2 and No.3 belt covers with the seven bolts.
    NOTE: Each bolt length is indicated in the figure.

11. **INSTALL WATER PUMP PULLEY AND DRIVE BELT**

12. **INSTALL WATER OUTLET AND BY-PASS PIPE**
    (a) Install a new gasket, the water outlet and by-pass pipe assembly with the three bolts.
    Torque:
    Cylinder head side
    280 kg-cm (20 ft-lb, 27 N·m)
    Cylinder block side
    130 kg-cm (9 ft-lb, 13 N·m)



    (b) Install the alternator drive belt adjusting bar with the three bolts.
    Torque: 185 kg-cm (13 ft-lb, 18 N·m)

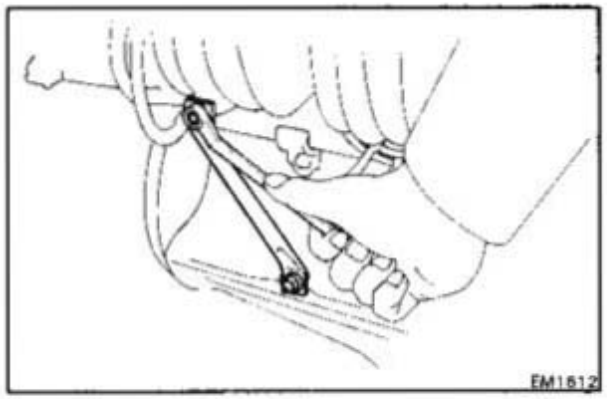


13. INSTALL INTAKE MANIFOLD

(a) Install a new gasket, the air control valve, a new gasket and the intake manifold with the seven bolts and two nuts.

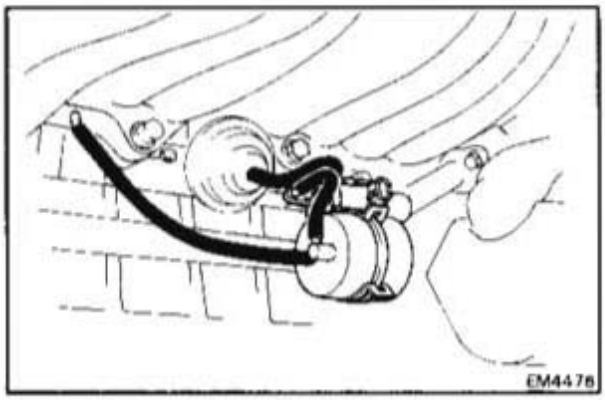
Torque: 280 kg-cm (20 ft-lb, 27 N·m)

(b) Install the PCV hose.



(c) Install the manifold stay with the two bolts.

Torque: 220 kg-cm (16 ft-lb, 22 N·m)

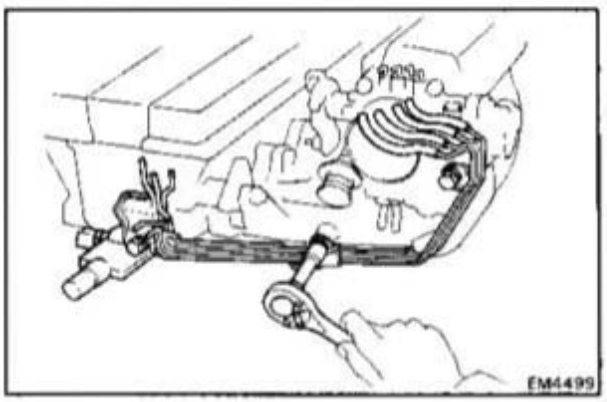


14. INSTALL T-VIS VSV AND VACUUM TANK

(a) Install the VSV and vacuum tank assembly with the two bolts.

(b) Connact the vacuum hoses.

15. INSTALL THROTTLE BODY
(See steps 2 and 3 page FI-86)



16. INSTALL CYLINDER HEAD REAR COVER AND VACUUM PIPE (w/ EGR SYSTEM)

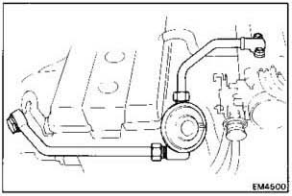
(a) (w/o EGR Systam)
Install a new gasket and rear cover with the two bolts.

(b) (w/ EGR System)
Install a new gasket, rear cover and vacuum pipe with the four bolts.

(c) (w/ EGR System)
Connect the vacuum hoses.

17. INSTALL INJECTOR AND DELIVERY PIPE
(See steps 1 to 6 on pages FI-80 and 81)

18. INSTALL COLD START INJECTOR PIPE
(See steps 2 and 3 on page FI-73)



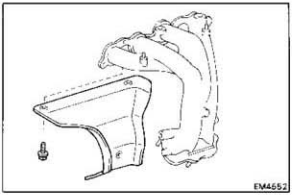
19. (w/ EGR SYSTEM)
INSTALL EGR VALVE AND MODULATOR

(a) Install a new gasket, the EGR valve and pipes assembly with the four bolts.

Torque:
Union bold 700 kg-cm (51 ft-lb, 69 N·m)
Bolt 190 kg-cm (14 ft-lb, 19 N· m)

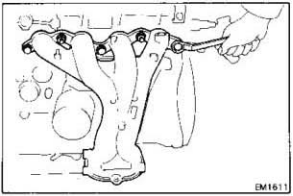
(b) Install the EGR vacuum modulator with the bolt.

(c) Install the vacuum hoses.



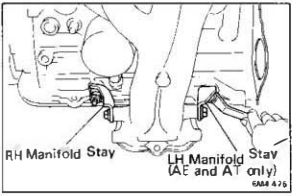
20. INSTALL EXHAUST MANIFOLD

(a) Install the lower heat insulator to the manifold with the three bolts.



(b) Install a new gasket and the manifold with the three bolts and two nuts.

Torque: 250 kg-cm (18 ft-lb, 25 N·m)

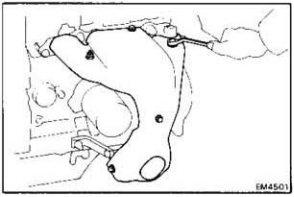


(c) (AE and AT)
Install the RH and LH manifold stay with the two bolt and two nut.

Torque: 400 kg-cm (29 ft-lb, 39 N·m)

(d) (AW)
Install the RH manifold stay with the bolt and nut.

Torque: 400 kg-cm (29 ft-lb, 39 N·m)



(e) Install the upper heat insulator with the six bolts.

21. INSTALL DISTRIBUTOR (See page IG-26)

22. FILL WITH ENGINE COOLANT (See page CO-7 or 8)

Capacity (w/ Heater):

AE and AT

6.0 liters (6.3 US qts, 5.3 Imp. qts)

AW 12.4 liters (13.1 US qts, 10.9 Imp. qts)

23. START ENGINE AND CHECK FOR LEAKS

24. PERFORM ENGINE ADJUSTMENT

(a) Adjust the valve clearance. (See page EM-37)

Valve clearance (Cold):

Intake 0.15 – 0.25 mm (0.006 – 0.010 in.)

Exhaust 0.20 – 0.30 mm (0.008 – 0.012 in.)

(b) Adjust the ignition timing. (See page EM-39)

Ignition timing:

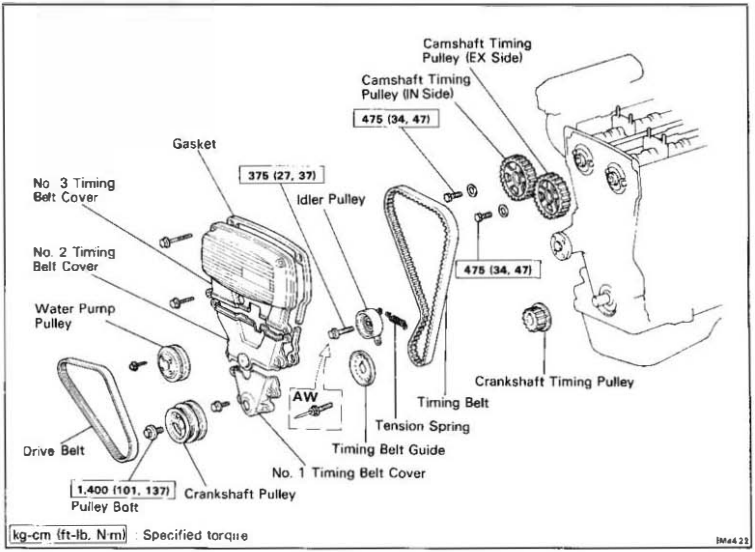
10° BTDC @ idle

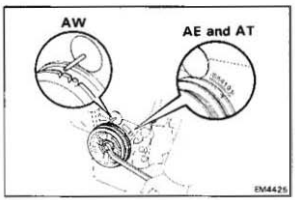
(w/ Terminals T and E1 short-circuited)

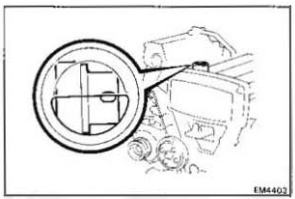
25. RECHECK ENGINE COOLANT LEVEL AND OIL LEVEL

TIMING BELT (4A-GE)

COMPONENTS





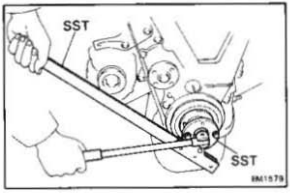


REMOVAL OF TIMING BELT

1. **REMOVE WATER PUMP PULLEY AND DRIVE BELT**
2. **REMOVE SPARK PLUGS (See page IG-20)**
3. **SET NO.1 CYLINDER TO TDC/COMPRESSION**
   (a) Turn the crankshaft pulley and align its groove with the timing mark "0" of the No.1 timing belt cover (AE and AT) or timing pointer (AW).

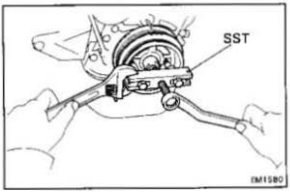
   (b) Remove the oil filler cap, and check that you can see the cavity of the camshaft.

   If not, turn the crankshaft one revolution (360°).

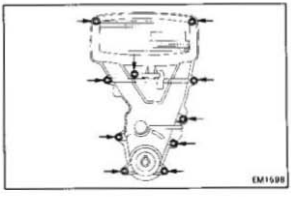


4. REMOVE CRANKSHAFT PULLEY

(a) Using SST, remove the pulley mount bolt.
SST 09213-70010 and 09330-00021



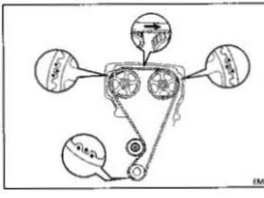
(b) Using SST, remove the pulley.
SST 09213-31021



5. REMOVE TIMING BELT COVERS

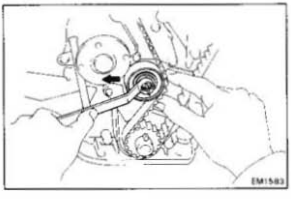
Remove the ten bolt, the No.3, No.2, No.1 belt covers and gaskets.

6. REMOVE TIMING BELT GUIDE



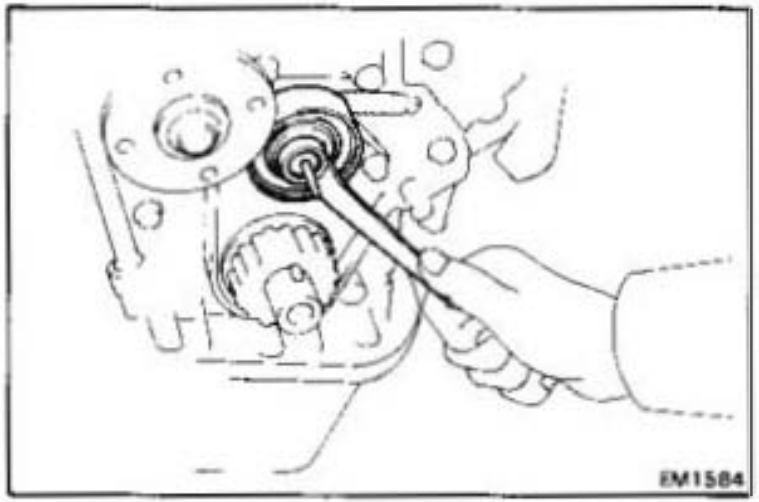
7. REMOVE TIMING BELT

NOTE: If reusing the timing belt, draw a direction arrow on the timing belt (in direction of engine revolution), and place the matchmarks on the timing pulleys and timing belt.



(a) Loosen the idler pulley bolt and shift the pulley toward the left as far as it will go, temporarily tighten it.

(b) Remove the timing belt.

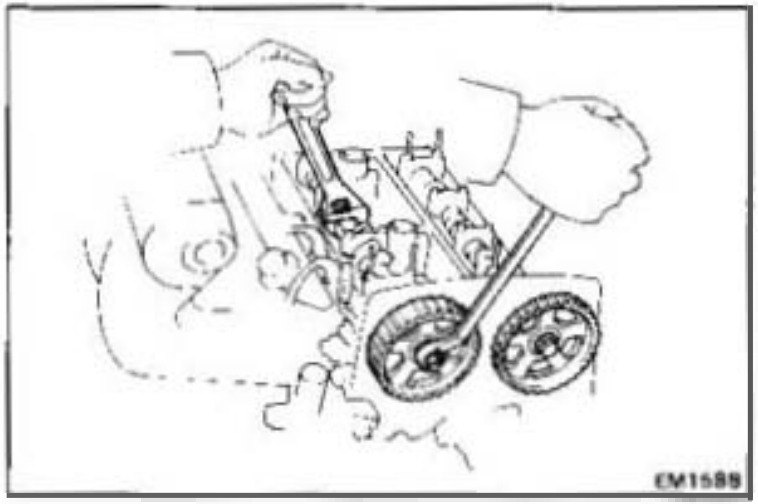


8. REMOVE IDLER PULLEY AND TENSION SPRING

Remove the bolt, pulley and tension spring.

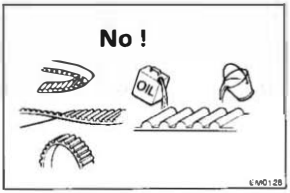
9. REMOVE CRANKSHAFT TIMING PULLEY

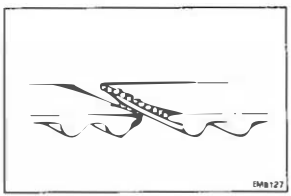
10. REMOVE CYLINDER HEAD COVERS
(See step 14 on page EM-102)

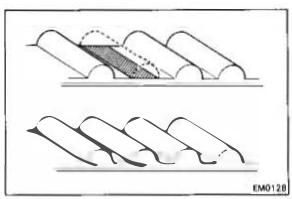


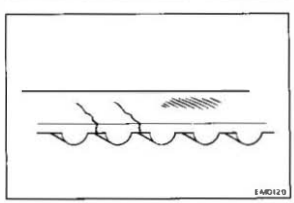
11. REMOVE CAMSHAFT TIMING PULLEYS

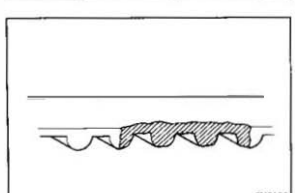
Secure the hexagonal wrench head portion of the camshaft, remove the bolt, plate washer and pulley. Remove the two camshaft pulleys.











INSPECTION OF TIMING BELT COMPONENTS

1. **INSPECT TIMING BELT**

CAUTION:

- **Do not bent, twist or turn the timing belt inside out.**
- **Do not allow the timing belt to come into contact with oil, water or steam.**
- **Do not utilize timing belt tension when installing or removing the mount bolt of the camshaft timing pulley.**

If there are defect as shown in the figures, check the following points:

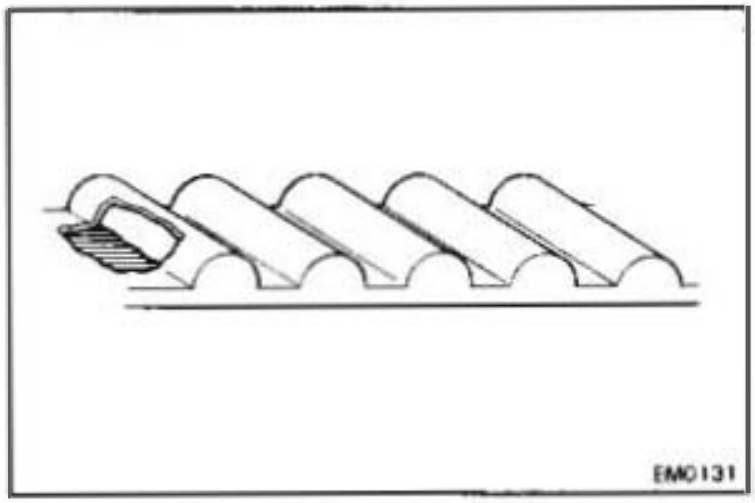
(a) Premature parting

- Check for proper installation.
- Check the timing cover gasket for damage and proper installation.

(b) If the belt teeth are cracked or damaged, check to see if either the camshaft or water pump is locked.

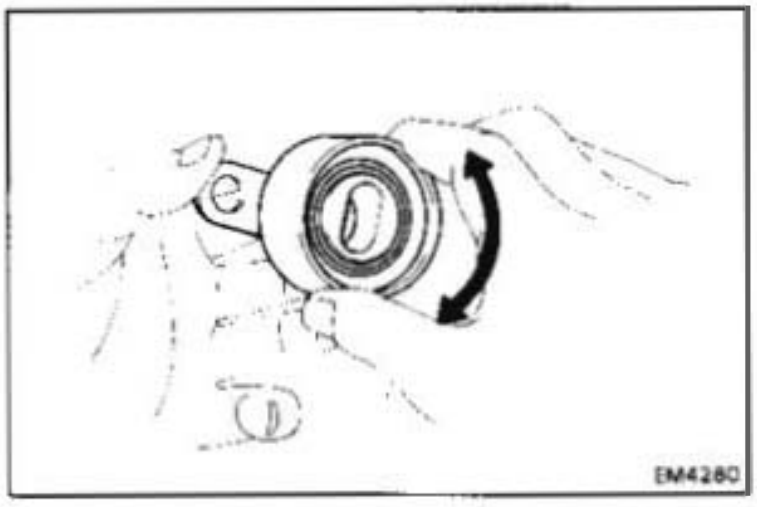
(c) If there is noticeable weer or cracks, on the belt face, check to see if there nicks on side of the idler pulley lock.

(d) If there is wear or damage on only one side of the belt, check the belt guide and the alignment of the each pulley.



(e) If there is noticeable wear on the belt teeth, check timing cover for damage and check for correct gasket installation. Check for foreign material on the pulley teeth.

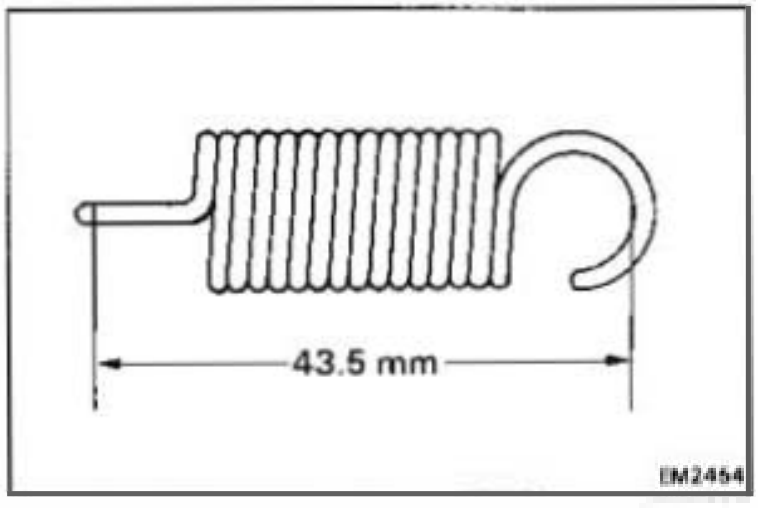
If necessary, replace the timing belt.



2. INSPECT IDLER PULLEY

Check the turning smoothness of the idler pulley.

If necessary, replace the idler pulley.



3. INSPECT TENSION SPRING

(Reference)

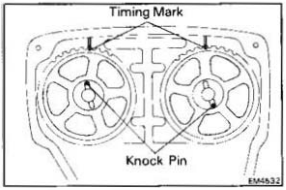
(a) Measure the free length of the tension spring.

Free length: 43.5 mm (1.713 in.)

If the free length is not as specified, replace the tension spring.

(b) Measure the tension of the tension spring at the specified installed length.

Installed tension: 9.97 kg (22.0 lb, 98 N) at 50.2 mm (1.976 in.)



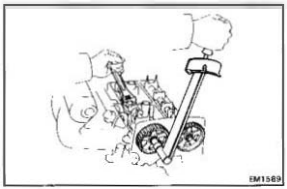
INSTALLATION OF TIMING BELT

(See page EM-57)

1. INSTALL CAMSHAFT TIMING PULLEYS

(a) Position the knock pin of the camshafts as shown in the figure.

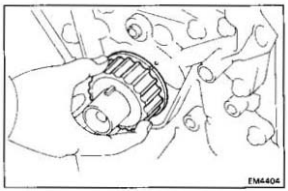
(b) Align the camshaft knock pin with the knock pin groove of the pulley, and slide the pulley, facing the timing mark upward.



(c) Secure the hexagonal wrench head portion of the camshaft, and install the plate washer and bolt. Torque the bolt.

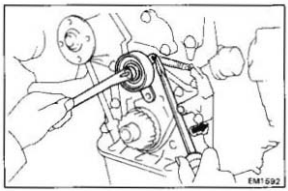
Torque: 475 kg-cm (34 ft-lb, 47 N·m)

2. INSTALL CYLINDER HEAD COVERS
(See step 9 on page EM-121)



3. INSTALL CRANKSHAFT TIMING PULLEY

Align the pulley set key with the key groove of the pulley, and slide the pulley.

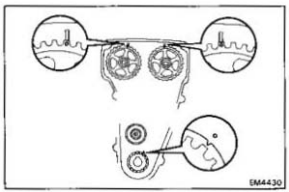


4. TEMPORARILY INSTALL IDLER PULLEY AND TENSION SPRING

(a) Install the pulley with the bolt. Do not tighten the bolt yet.

(b) Install the tension spring.

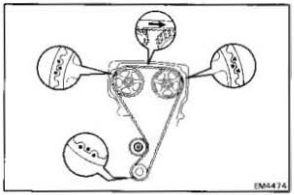
(c) Pry the pulley toward the left as far as it will go and tighten the bolt.



5. SET NO.1 CYLINDER TO TDC/COMPRESSION

(a) Align the timing marks of the camshaft timing pulleys and No.4 timing belt cover by turning the camshafts.

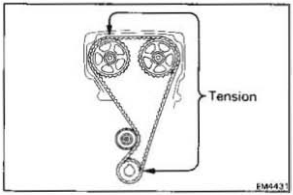
(b) Align the timing marks of the crankshaft timing pulley and oil pump body by turning the crankshaft.



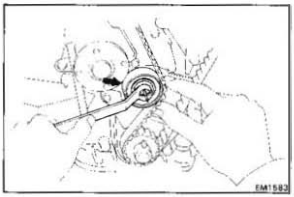
8. INSTALL TIMING BELT

CAUTION: The engine should be cold.

NOTE: If reusing the timing belt, align the points marked during removal, and install the belt with the arrow pointing in the direction of engine revolution.

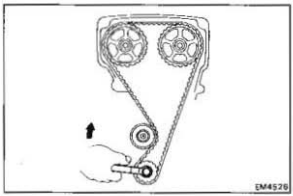


Install the timing belt, insuring the tension between the intake camshaft and crankshaft timing pulleys.



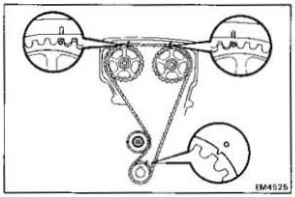
7. CHECK VALVE TIMING AND TIMING BELT DEFLECTION

(a) Slowly loosen the idler pulley bolt.



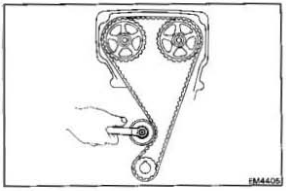
(b) Temporarily install the crankshaft pulley bolt, and turn the crankshaft pulley two revolutions from TDC to TDC.

NOTE: Always turn the crankshaft clockwise.



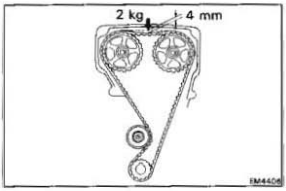
(c) Check that each pulley aligns with the timing marks as shown in the figure.

If the marks do not align, remove the timing belt and reinstall it.



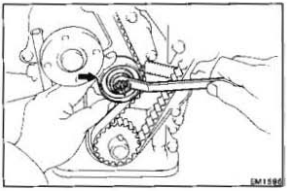
(d) Torque the idler pulley bolt.

Torque: 375 kg-cm (27 ft-lb, 37 N-m)



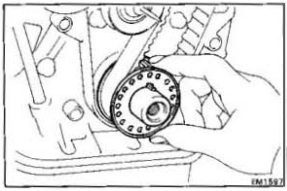
(e) Check that there is belt deflection at the position indicated in the figure.

Deflection: 4 mm (0.16 in.) at 2 kg (4.4 lb, 20 N)



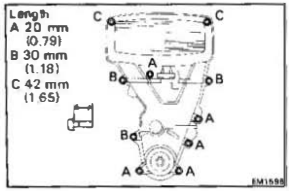
If the deflection is not as specified, adjust with the idler pulley.

(f) Remove the temporarily installed crankshaft pulley bolt.



8. INSTALL TIMING BELT GUIDE

Install he guide, facing the cup side outward.

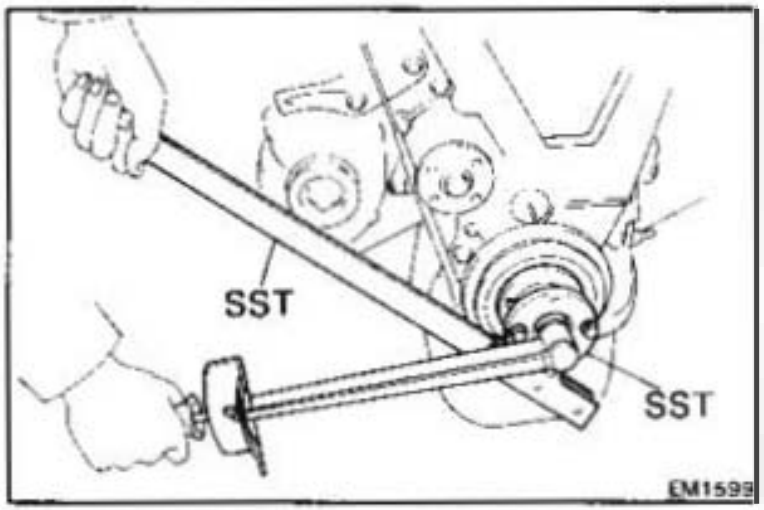


9. INSTALL TIMING BELT COVERS

(a) Install the geskets to the belt covers.

(b) Install the No.1, No.2 and No.3 belt cover with the ten bolts.

NOTE: Each bolt length is indicated in the figure.



10. INSTALL CRANKSHAFT PULLEY

(a) Align the pulley set key with the key groove of the pulley, slide the pulley.

(b) Using SST, install and torque the the bolt.

SST 09213-70010 and 09330-00021

Torque: 1,400 kg-cm (101 ft-lb, 137 N·m)

11. INSTALL SPARK PLUGS (See page IG-21)

Torque: 180 kg-cm (13 ft-lb, 18 N·m)

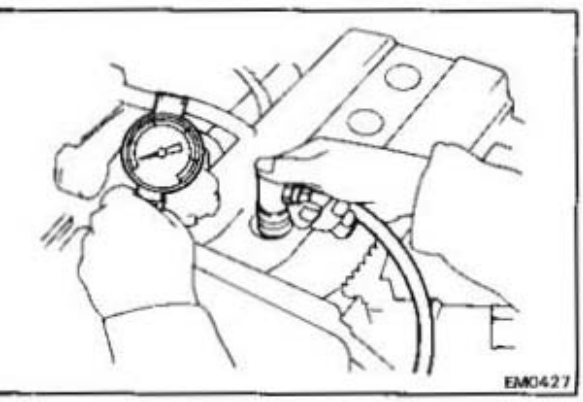
12. INSTALL WATER PUMP PULLEY AND DRIVE BELT

Adjust the drive belt. (See page CH-4)

COMPRESSION CHECK (4A-GE)

NOTE: If there is lack of power, excessive oil consumption or poor fuel economy, measure the compression pressure.

1. **WARM UP AND STOP ENGINE**
2. **DISCONNECT SOLENOID RESISTOR CONNECTOR**
3. **DISCONNECT COLD START INJECTOR CONNECTOR**
4. **DISCONNECT DISTRIBUTOR CONNECTOR**
5. **REMOVE SPARK PLUGS (See page IG-20)**
6. **CHECK CYLINDER COMPRESSION PRESSURE**


EM0427

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

(b) Fully open the throttle.

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

NOTE: Always use a fully charged battery to obtain engine revolution of 250 rpm or more.

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

CAUTION: This measurement must be done in as short a time as possible.

Compression pressure:
12.6 kg/cm² (179 psi, 1,236 kPa)

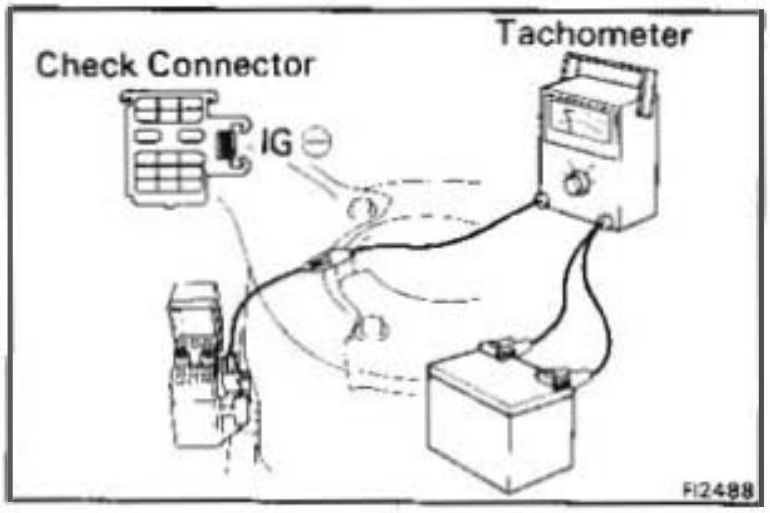
Minimum pressure:
10.0 kg/cm² (142 psi, 981 kPa)

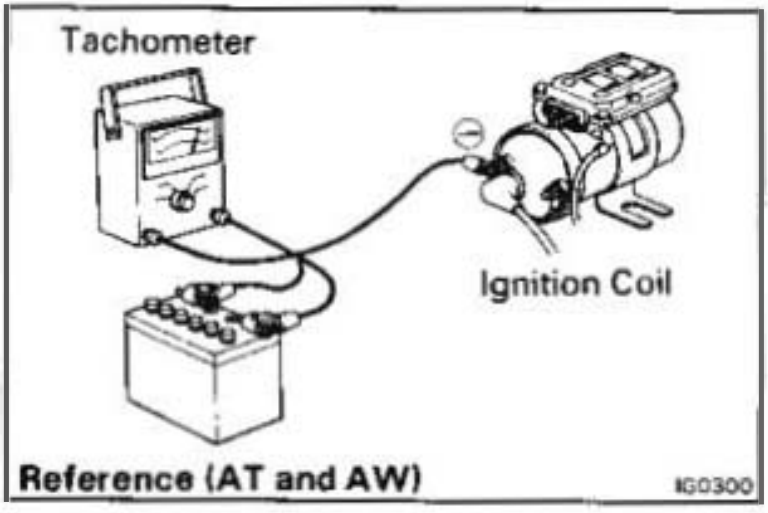
Difference between each cylinder:
1.0 kg/cm² (14 psi, 98 kPa) or less

(e) If the 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 cylinder with low compression.

- 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.

7. **REINSTALL SPARK PLUGS (See page IG-21)**
   Torque: 180 kg-cm (13 ft-lb, 18 N·m)
8. **RECONNECT DISTRIBUTOR CONNECTOR**
9. **RECONNECT COLD START INJECTOR CONNECTOR**
10. **RECONNECT SOLENOID RESISTOR CONNECTOR**





PRECAUTIONS

1. Do not leave the ignition switch on for more than 10 minutes if the engine will not start.

2. With e tachometer is connected to the system. connect the test probe of the tachometer to terminelIG ⊖ of the check connector.

   LOCATION: See page FI-89

   (Reference) (AT and AW)
   With a tachometer is connected to the system, connect the test probe of the tachometer to negative (⊖) terminal of the ignition coil.

3. As some tachometer are not compatible with this ignition system, we recommend that you confirm the compatibility of your unit before using.

4. NEVER eltow the tachometer terminal to touch ground as this could damage the igniter and/or ignition coil.

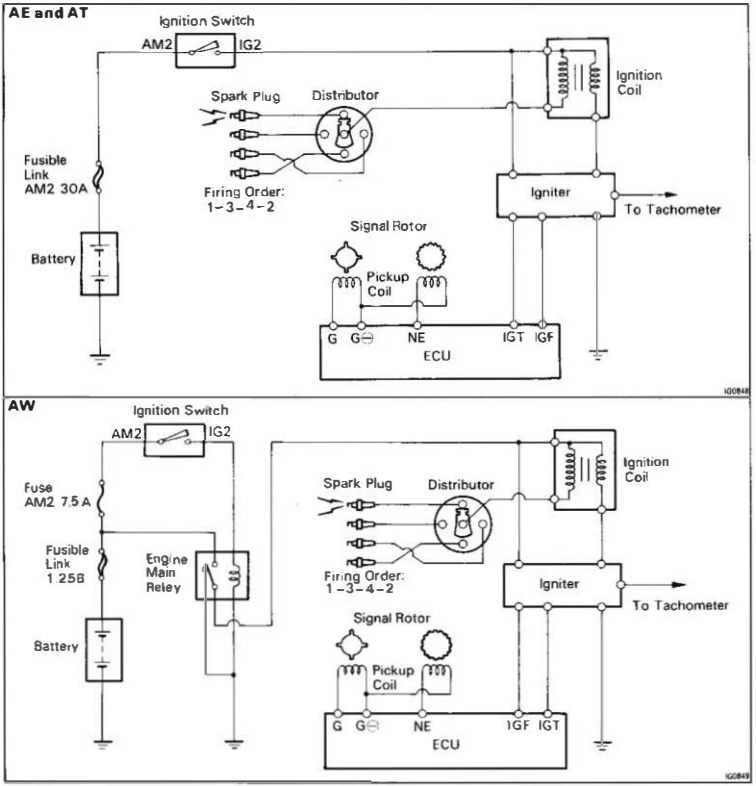
5. Do not disconnect the battery when the engine is running.

6. Check that the igniter Is properly grounded to the body.

TROUBLESHOOTING

Problem	Possible cause	Remedy	Page
Engine will not start/ hard to start (cranks OK)	Incorrect ignition timing	Reset timing	
	Ignition problems		
	• Ignition coil	Inspect coil	IG-22
	• Igniter	Inspect igniter	IG-23
	• Distributor	Inspect distributor	IG-23
	• High-tension cords	Inspect high-tension cords	IG-20
	Ignition wiring disconnect or broken	Inspect wiring	
Rough idle or stalls	Spark plug faulty	Inspect plugs	IG-20, 22
	Ignition wiring faulty	Inspect wiring	
	Incorrect ignition timing	Reset timing	EM-37
	Ignition problems		
	• Ignition coil	Inspect coil	IG-22
	• Igniter	Inspect igniter	IG-23
	• Distributor	Inspect distributor	IG-23
	• High-tension cords	Inspect high-tension cords	IG-20
Engine hesitates/ poor acceleration	Spark plug faulty	Inspect plugs	IG-20, 21
	Ignition wiring faulty	Inspect wiring	
	Incorrect ignition timing	Reset timing	EM-37
Engine dieseling (runs after ignition switch is turned off)	Incorrect ignition timing	Reset timing	EM-37
Muffler explosion (after fire) all the time	Incorrect ignition timing	Reset timing	EM-37
Engine backfires	Incorrect ignition timing	Reset timing	EM-37
Poor gasoline mileage	Spark plug faulty	Inspect plugs	IG-20, 21
	Incorrect ignition timing	Reset timing	EM-37
Engine overheats	Incorrect ignition timing	Reset timing	EM-37

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

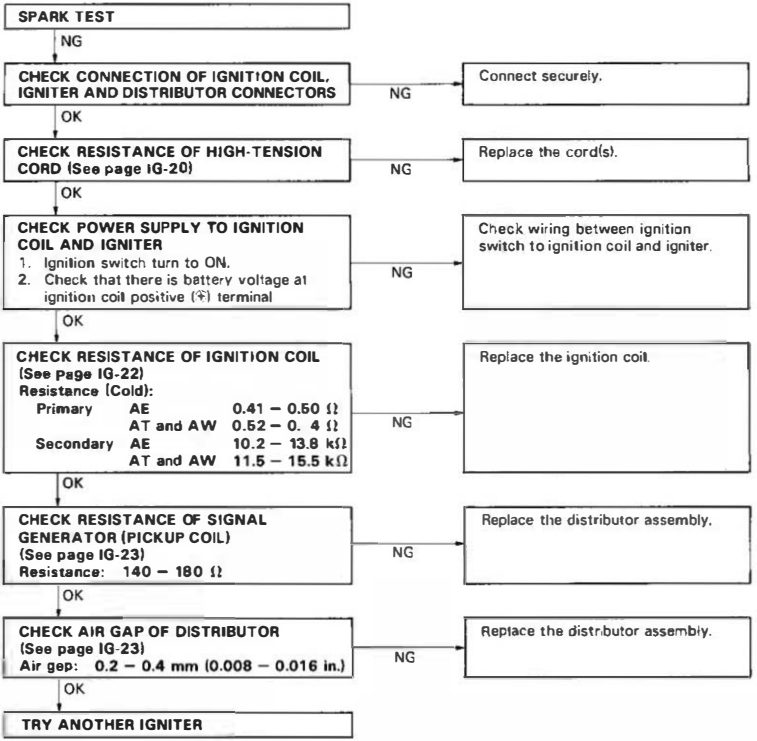
(a) Disconnect the high-tension cord from the distributor.

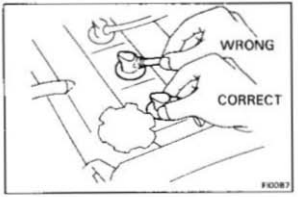
(b) Hold the end about 12.5 mm (1/2") from body of car.

(c) See if spark occurs white engine is being cranked.

NOTE: To prevent gasoline from being injected from injectors during this test, crank the engine for no more than 1 – 2 seconds at time.

If the spark does not occurs, perform the test as follows:

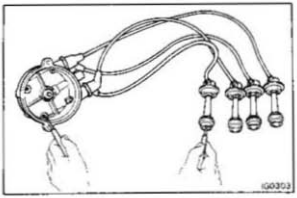




INSPECTION OF HIGH-TENSION CORDS

1. **CAREFULLY REMOVE HIGH-TENSION CORDS BY THEIR RUBBER BOOTS FROM SPARK PLUGS**

   CAUTION: Pulling on or bending the cords may damage the conductor inside.

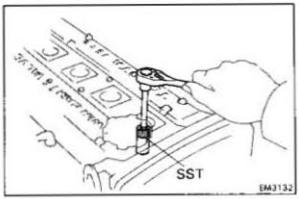


2. **INSPECT HIGH-TENSION CORD RESISTANCE**

   Using an ohmmeter, measure the resistance without disconnecting the distributor cap.

   Maximum resistance: 26 kΩ per cord

   If the resistance is greater than maximum, check the terminals. If necessary, replace the high-tension cord and/or distributor cap.

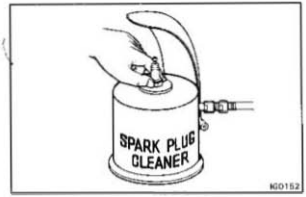


INSPECTION OF SPARK PLUGS (Conventional Tipped Type)

1. **REMOVE SPARK PLUGS**

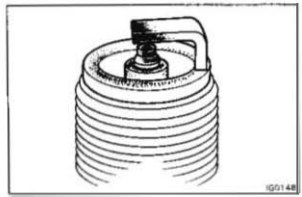
   Using SST, remove the spark plug.

   SST 09155-16100



2. **CLEAN SPARK PLUGS**

   Using a spark plug cleaner or wire brush, clean the spark plug.

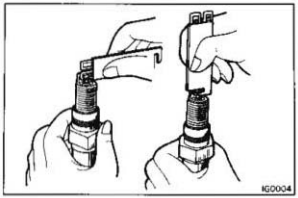


3. **VISUALLY INSPECT SPARK PLUGS**

   Check the spark plug for electrode wear, thread damage and insulator damage.

   If abnormal, replace the spark plug.

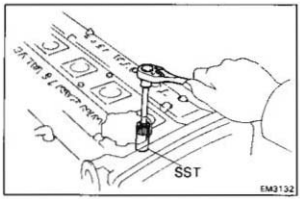
   Recommanded spark plug: ND Q20R-U11
   NGK BCPR6EY11



4. ADJUST ELECTRODE CAP

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

Correct electrode gap: 1.1 mm (0.43 in.)



5. INSTALL SPARK PLUGS

Using SST, install the spark plug.

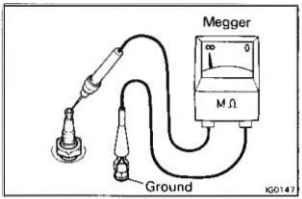
SST 09155-16100

Torque: 180 kg-cm (13 ft-lb, 18 N·m)

INSPECTION OF SPARK PLUGS (Platinum Tipped Type)

CAUTION:

- **Never use a wire brush for cleaning.**
- **Never attempt to adjust the electrode gap on used spark plug.**
- **Spark plug should be replaced every 100,000 km (60,000 miles).**



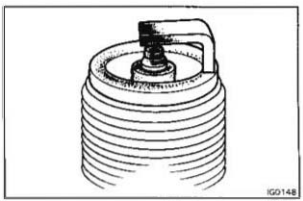
1. INSPECT ELECTRODE

A. If using e megger (insulation resistence meter):

Measure the insulation resistance.

Correct insulation resistance: 10 MΩ or more

If the resistance is less than specified, clean the spark plug.

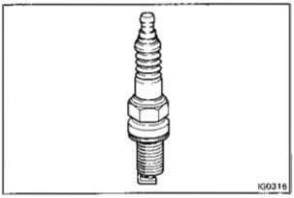


B. If not using a megger:

(a) Quickly race the engine to 4,000 rpm five times.

(b) Remove the spark plug.
(See step 1 on page IG-20)

(c) Visually check the spark plug.
If the electrode is dry ..... Okey
If the electrode is wet ..... Proceed to step 3



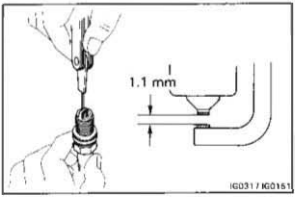
2. REMOVE SPARK PLUGS
(See step 1 on page IG-6)

3. VISUALLY INSPECT SPARK PLUGS

Check the spark plug for thread or insulation damage.

If abnormal, replace the spark plug.

Recommended spark plug: ND PQ16R
NGK BCPR6EP11

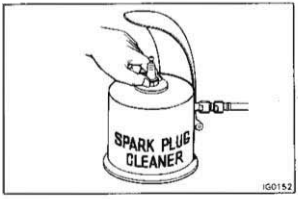


4. INSPECT ELECTRODE GAP

Maximum electrode gap: 1.3 mm (0.051 in.)

If the gap is greater than maximum, replace the spark plug.
Correct electrode gap of new spark plug:
1.1 mm (0.043 in.)

If adjusting the gap of a new spark plug, bend only the base of the ground electrode. Do not touch the tip.



6. CLEAN SPARK PLUGS

If the electrode has traces of wet carbon, allow it to dry and then clean with a spark plug cleaner.

Air pressure: Below 6 kg/cm² (85 psi, 588 kPa)
Duration: 20 seconds or less

NOTE: If there are traces of oil, remove it with gasoline before using the spark plug cleaner.

6. INSTALL SPARK PLUGS (See step 5 on page IG-21)

Torque: 180 kg-cm (13 ft-lb, 18 N·m)

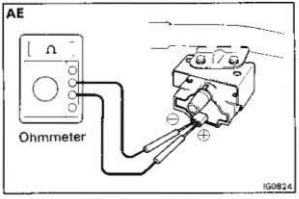
INSPECTION OF IGNITION COIL

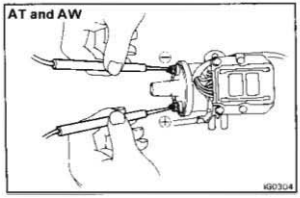
1. INSPECT PRIMARY COIL RESISTANCE

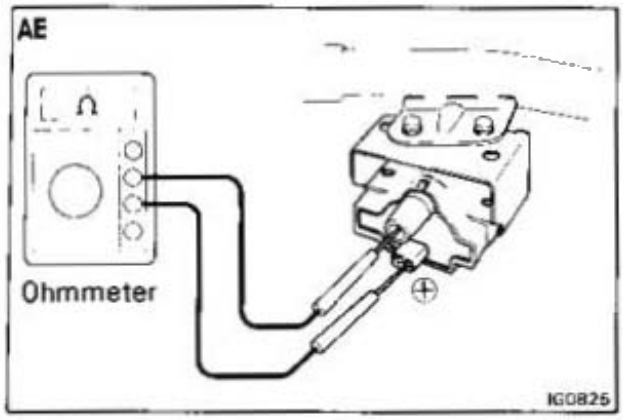
Using an ohmmeter, measure the resistance between positive (⊕) and negative (⊖) terminals.

Primary coil resistance (Cold):
AE 0.41 – 0.60 Ω
AT and AW 0.52 – 0.64 Ω

If the resistance is not as specified, replace the ignition coil.







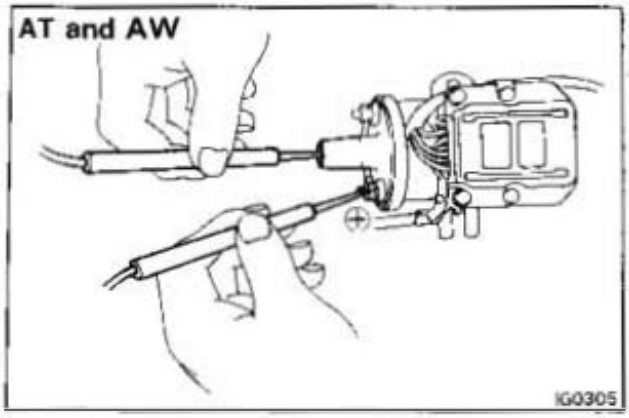
2. INSPECT SECONDARY COIL RESISTANCE

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

Secondary coil resistance (Cold):

AE	**10.2 — 13.8 kΩ**
AT and AW	**11.5 — 15.5 kΩ**

If the resistance is not as specified, replace the ignition coil.



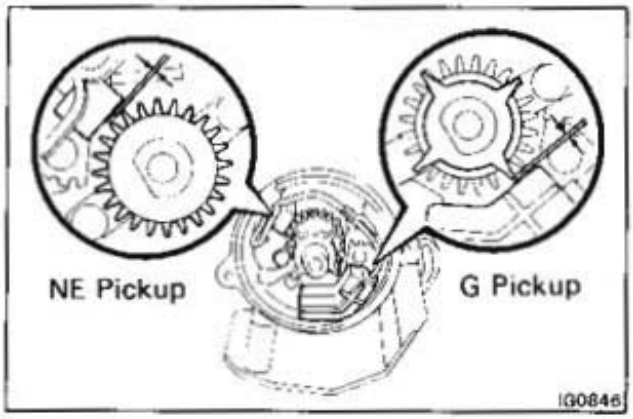
INSPECTION OF DISTRIBUTOR

1. INSPECT AIR GAP

Using a feeler 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 air gap is not as specified, replace the distributor assembly.

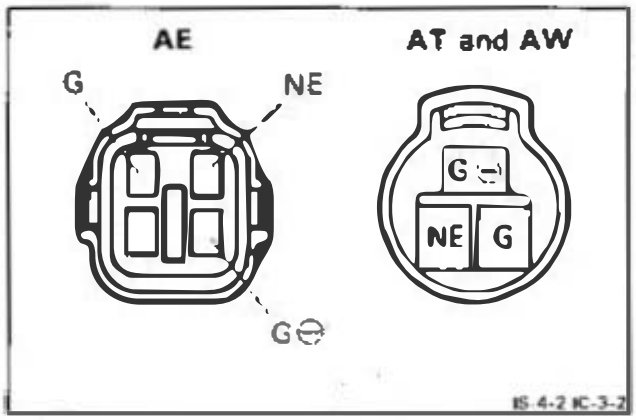


2. INSPECT SIGNAL GENERATOR (PICKUP COIL) RESISTANCE

Using an ohmmeter, measure the resistance between the terminals.

G pickup coil resistance (G — G⊖):	**140 — 180 Ω**
NE pickup coil resistance (NE — G⊖):	**140 — 180 Ω**

If the resistance is not as specified, replace the distributor assembly.

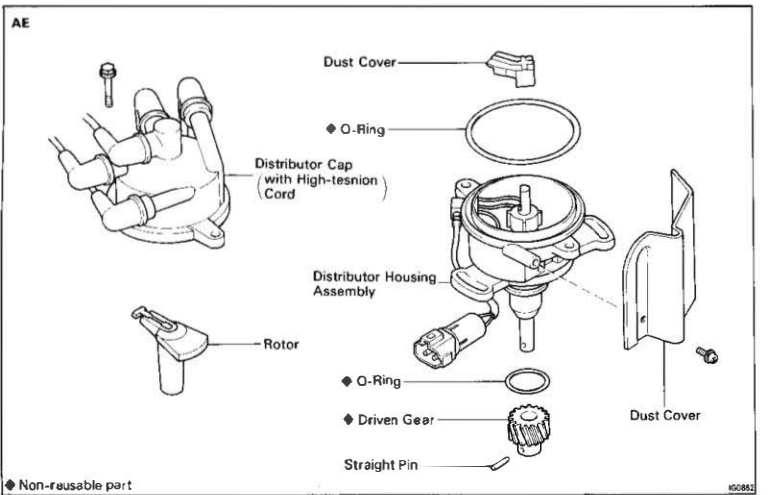


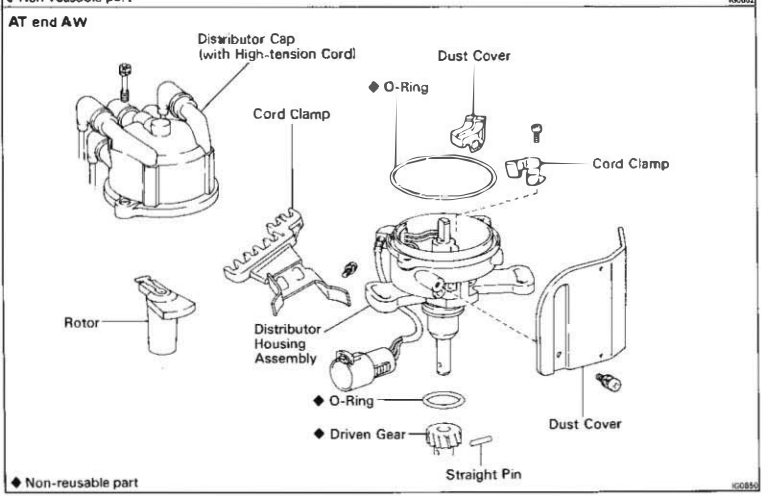
INSPECTION OF IGNITER

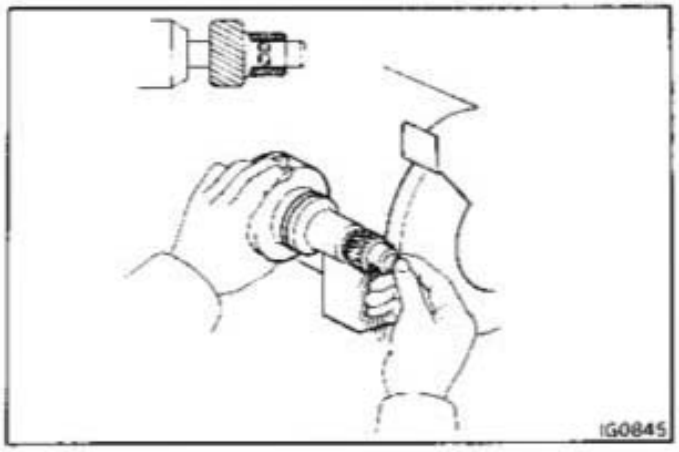
(See procedure Spark Test on page IG-19)

DISTRIBUTOR

COMPONENTS





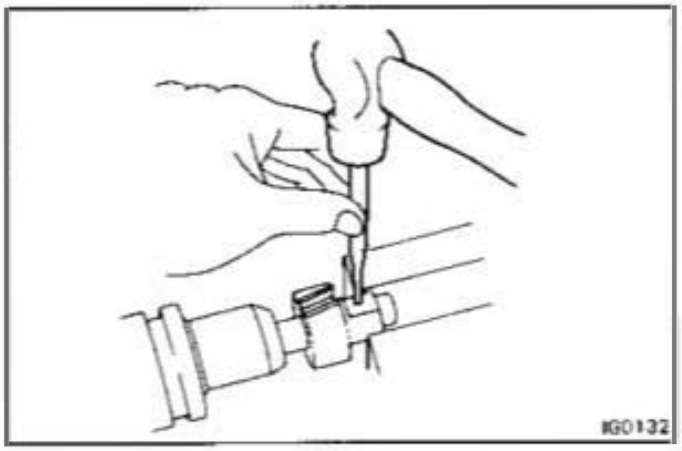


REPLACEMENT OF DISTRIBUTOR DRIVEN GEAR

1. REMOVE DRIVEN GEAR

(a) Using a grinder, grind the driven gear and straight pin.

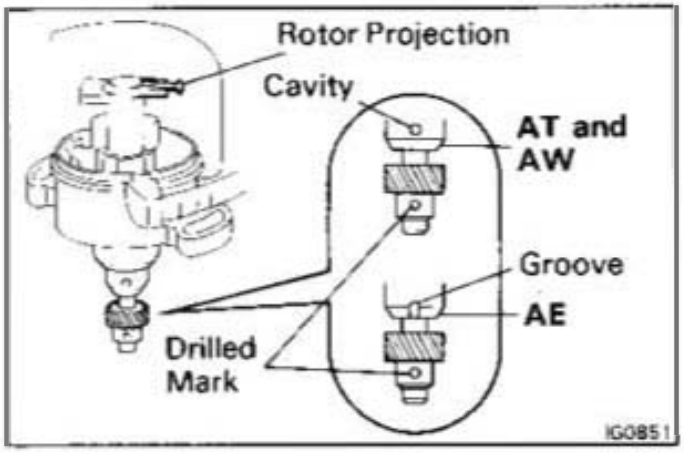
CAUTION: Be careful not to damage the governor shaft.



(b) Mount the driven gear in a vice.

(c) Using a pin punch and hammer, tap out the straight pin.

(d) Remove the driven gear.



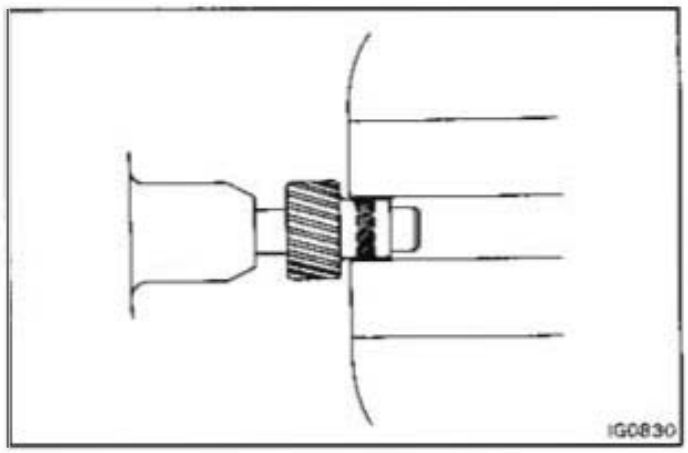
2. INSTALL NEW DRIVEN GEAR

(a) Remove the two bolts, distributor cap and O-ring

(b) Slide the driven gear onto the governor shaft.

(c) Align the drilled mark of the driven gear (not driven gear straight pin hole) with the groove (AE) or cavity (AT and AW) of the housing.

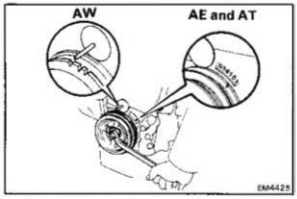
CAUTION: Be sure to check the rotor projection is positioned as shown.



(d) Install a new straight pin.

(e) Secure the ends of the straight pin in a vice.

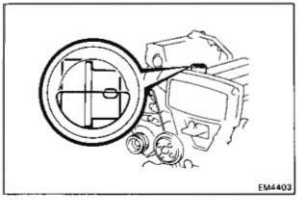
(f) Reinstall the O-ring and distributor cap with the two bolts.



INSTALLATION OF DISTRIBUTOR

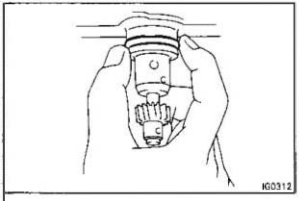
1. SET NO.1 CYLINDER TO TDC/COMPRESSION

(a) Turn the crankshaft pulley, and align its groove with the "0" mark of the No.1 timing belt cover (AE and AT) or timing pointer (AW).



(b) Remove the oil filter cap, and check that you can see the cavity of the camshaft.

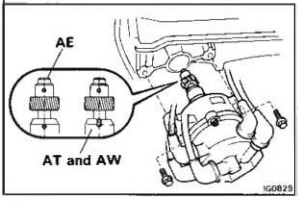
If not, turn the crankshaft one revolution (360°).



2. INSTALL DISTRIBUTOR

(a) Install a new O-ring to the housing.

(b) Apply a light coat of engine oil on the O-ring.



(c) Align the drilled mark of the driven gear with the groove (AE) or cavity (AT and AW) of the housing.

(d) Insert the distributor, aligning the center of the flange with that of the bolt hole on the cylinder head.

(e) Lightly tighten the two hold-down bolts.

(f) Install the high-tension cord clamp with the bolt.

3. CONNECT HIGH-TENSION CORDS TO SPARK PLUGS

Firing order: 1 — 3 — 4 — 2

4. CONNECT DISTRIBUTOR CONNECTOR

5. CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY

6. ADJUST IGNITION TIMING (See page EM-37)

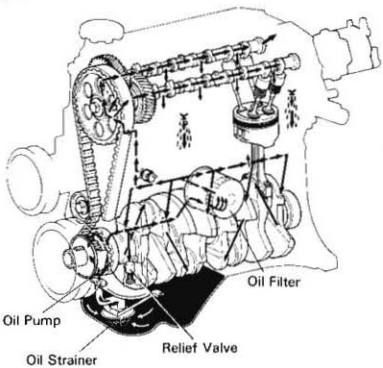
Ignition timing:
10° BTDC @ idle
(w/ Terminals T and E1 short-circuited)

LUBRICATION SYSTEM

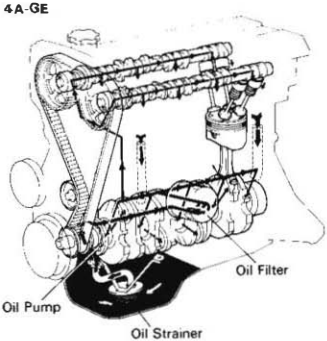
DESCRIPTION

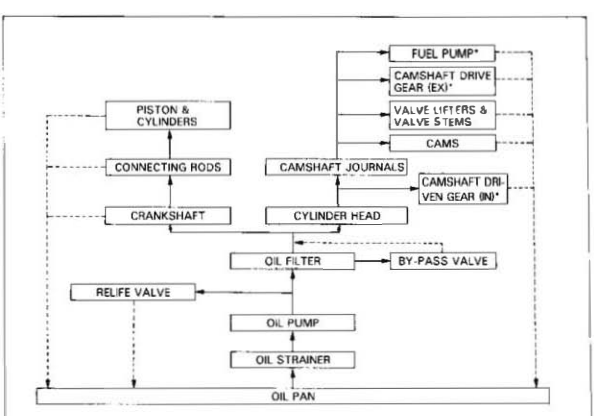
A fully pressurized, fully filtered lubrication system has been adopted for this engine.

4A-F



4A-GE





* 4A-F only

LU0572
LU0573

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 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

4A-F

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. The oil pump itself is a trochoid type pump, inside of which is a drive rotor and a driven rotor. When the drive rotor rotates, 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 in narrow.

4A-GE

The oil pump pumps up oil from the oil pan and sends it under pressure to the various parts of the engine. An oil streiner is mounted in front of the inlet to the oil pump. 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 geers changes. Oil is drawn in when this space is wide, and is discharged when the space is narrow.

OIL PRESSURE REGULATOR

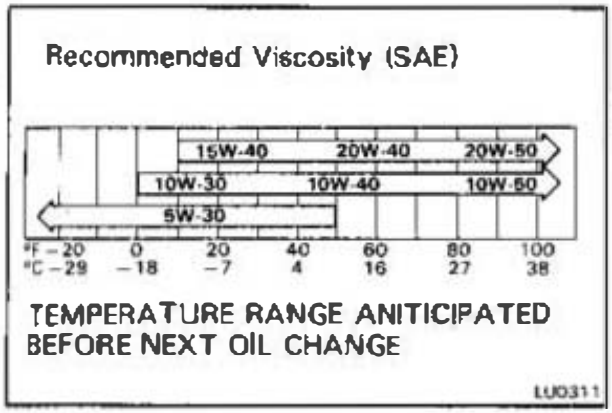
At high engine speeds, the engine oil supplied by the oil pump exceeds the capacity of the engine to utilize it. For that reason, the oil pressure regulator works to prevent an oversupply of oil. During normal oil supply, a coil spring and valve keep the bypass closed, but when too much oil is being fed, the pressure become extremely high, overpowering the force of the spring and opening the valves. This allows the excess oil to flow through the valve and return to the oil pan.

OIL FILTER

The oil filter is a full flow type filter with a built-in paper filter element. Particles of metal from wear, airborn dirt, carbon and other impurities can get in the oil during use and could cause accelereted 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 relief 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

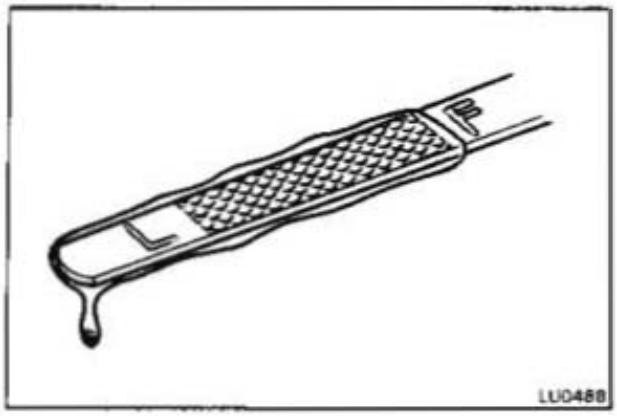
Problem	Possible cause	Remedy	Page
Oil leakage	Cylinder head, cylinder block or oil pump body damaged or cracked	Repair as necessary	
	Oil seal faulty	Replace oil seal	LU-12, EM-142
	Gasket fauly	Replace gasket	
Low oil pressure	Oil leakage	Repair as necessary	
	Relief valve faulty	Repair relief valve	LU-10,13
	Oil pump faulty	Repair oil pump	LU-7
	Poor quality engine oil	Replace engine oil	LU-6
	Crankshaft bearing faulty	Replace bearing	EM-130
	Connecting rod bearing faulty	Replace bearing	EM-127
	Oil filter clogged	Replace oil filter	LU-6
High oil pressure	Relief valve faulty	Repair relief valve	LU-10,13



OIL PRESSURE CHECK

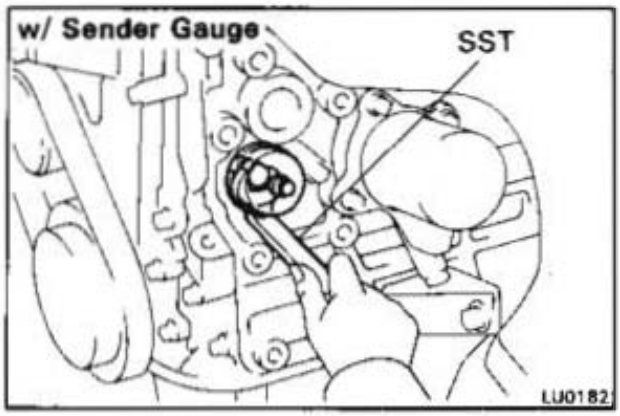
1. CHECK ENGINE OIL QUALITY

Check the oil for deterioration, entry of water, discoloring of thinning.
If the quality is poor, replace the oil.
Use API grade SC, SD, SE, SF or better and recommended viscosity oil.



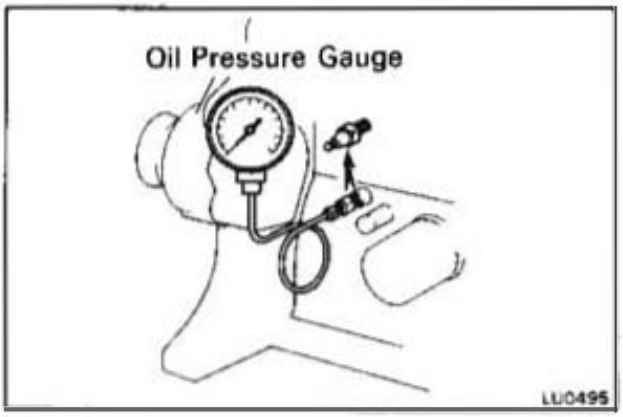
2. CHECK ENGINE OIL LEVEL

The oil level should be between the "L" and "F" marks on the dipstick.
If low, check for leakage and add oil up to the "F" mark.



3. REMOVE OIL PRESSURE SWITCH OR SENDER GAUGE

NOTE (w/ Sender gauge): Use SST.
SST 09027-12140



4. INSTALL OIL PRESSURE GAUGE

5. START ENGINE

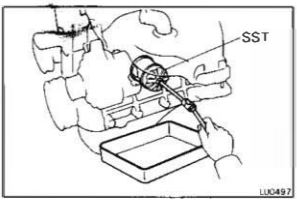
Start engine and warm it up to normal operating temperature.

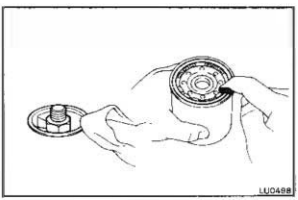
6. MEASURE OIL PRESSURE

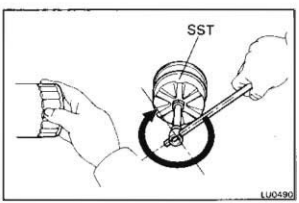
Oil pressure:

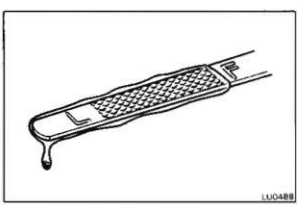
At idle	**0.3 kg/cm² (4.3 psi, 29 kPa) or more**
At 3,000 rpm	**2.5 — 6.0 kg/cm² (36 — 71 psi, 245 — 490 kPa)**

NOTE: Check for oil leakage after reinstalling the oil pressure switch or sender gauge.









REPLACEMENT OF ENGINE OIL AND OIL FILTER

1. DRAIN ENGINE OIL

(a) Remove the oil filler cap.

(b) Remove the oil drain plug and drain the oil into a container.

2. REPLACE OIL FILTER

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

SST 09228-06500

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

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

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

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

SST 09228-06500

3. REFILL WITH ENGINE OIL

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

Torque: 350 kg-cm (25 ft-lb, 34 N·m)

(b) Fill the engine with new oil. API grade SC, SD, SE, SF or better.

Capacity (Without Oil cooler):

Drain and refill

Without oil filter change

3.0 liters (3.1 US qts, 2.6 Imp.qts)

With oil filter change

3.3 liters (3.5 US qts, 2.9 Imp.qts)

Dry fill

3.7 liters (3.9 US qts, 3.3 Imp.qts)

Capacity (With Oil cooler):

Drain and refill

Without oil filter change

3.4 liters (3.6 US qts, 3.0 Imp.qts)

With oil filter change

3.7 liters (3.9 US qts, 3.3 Imp.qts)

Dry fill

4.1 liters (4.3 US qts, 3.6 Imp.qts)

(c) Install the oil filler cap with the gasket.

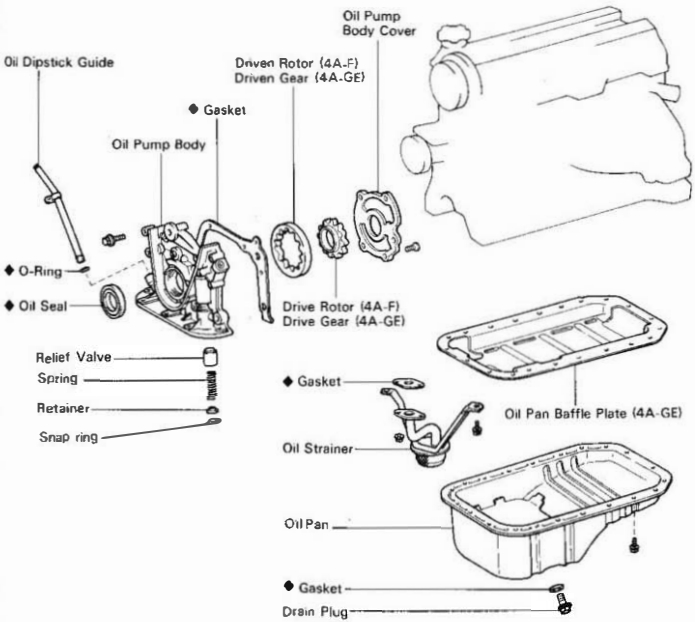
4. START ENGINE AND CHECK FOR LEAKS

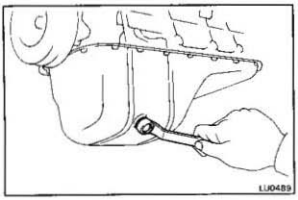
5. RECHECK ENGINE OIL LEVEL

Recheck the engine oil level and refill if necessary.

OIL PUMP

COMPONENTS





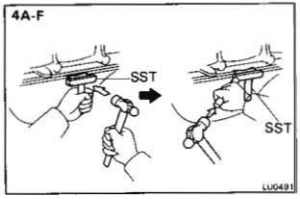
REMOVAL OF OIL PUMP

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

1. DRAIN ENGINE OIL

(a) Remove the oil filler cap.

(b) Remove the oil drain plug and drain the oil into a container.

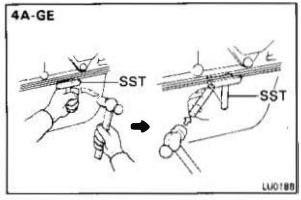


2. REMOVE OIL PAN

(a) Remove the two nuts and nineteen bolts.

(b) (4A-F)
Insert the blade of SST between the oil pan and cylinder block, cut off applied sealer and then remove the oil pan.

SST 09032-00100

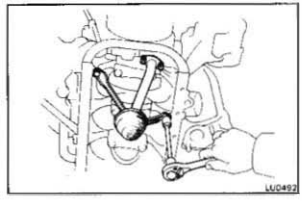


(c) (4A-GE)
Insert the blade of SST between the oil pan and baffle plate, cut off applied sealer and then remove the oil pan.

SST 09032-00100

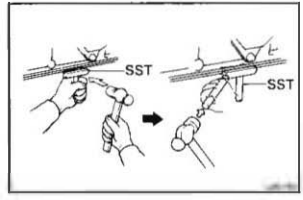
CAUTION:

- **Do not use SST for the oil pump body side. If necessary, use a screwdriver.**
- **When removing the oil pan, be careful not to damage the oil pan flange.**



3. REMOVE OIL STRAINER

Remove the two bolts, nuts, oil strainer and gasket.



4. (4A-GE)
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.

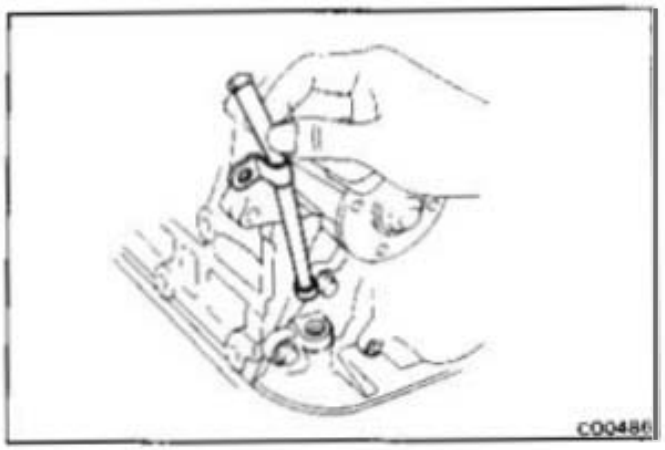
SST 09032-00100

CAUTION:

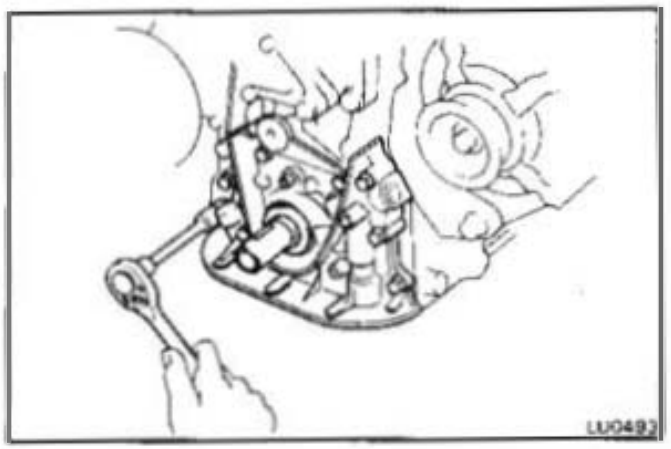
- **Do not use SST for the oil pump body side. If necessary, use a screwdriver.**
- **When removing the baffle plate, be careful not to damage the baffle plate flange.**

5. REMOVE TIMING BELT, IDLER PULLEY AND CRANKSHAFT TIMING PULLEY

4A-F (See pages EM-48 to 50)
4A-GE (See pages EM-57 to 59)

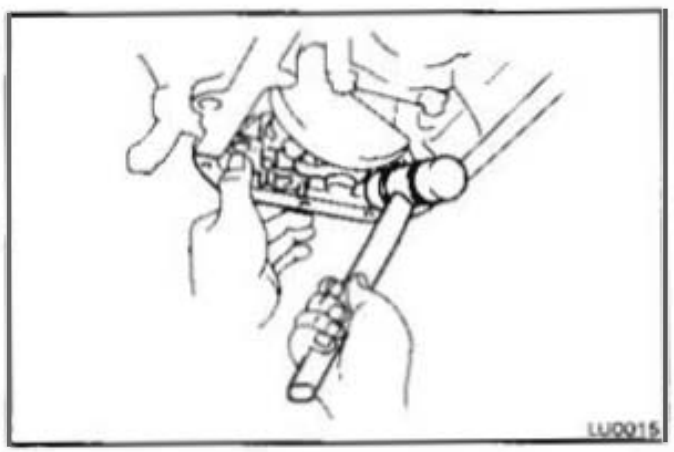


6. REMOVE OIL DIPSTICK GUIDE AND DIPSTICK

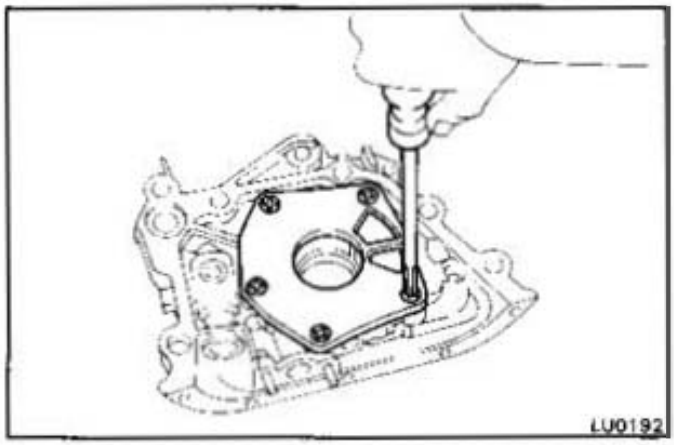


7. REMOVE OIL PUMP

(a) Remove the seven bolts.



(b) Using a plastic-faced hammer, carefully tap the oil pump body.

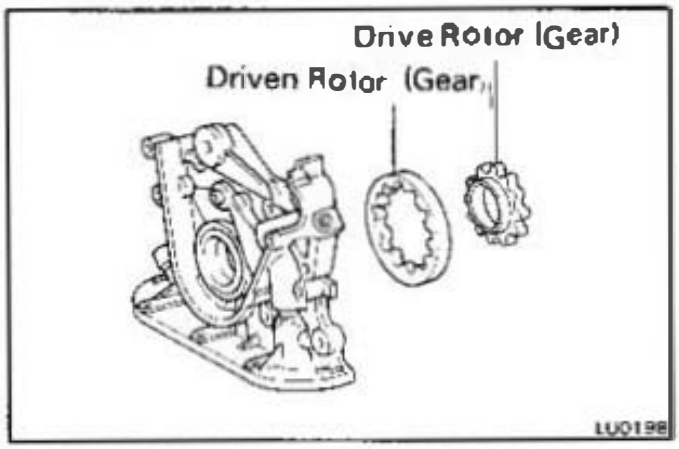


DISASSEMBLY OF OIL PUMP

(See page LU-7)

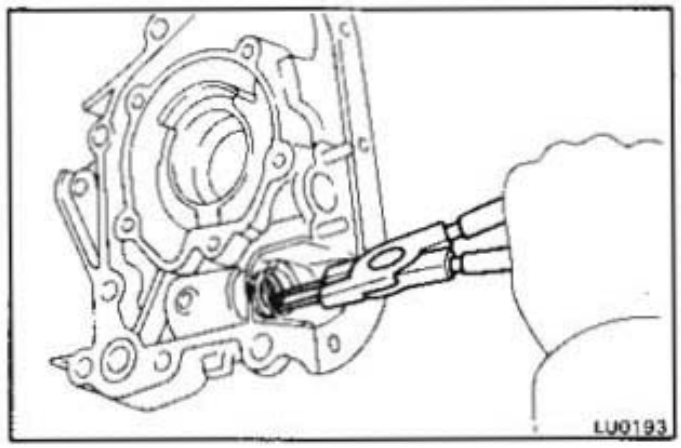
1. REMOVE DRIVE AND DRIVEN ROTORS (GEARS)

(a) Remove the five bolts and oil pump body cover.

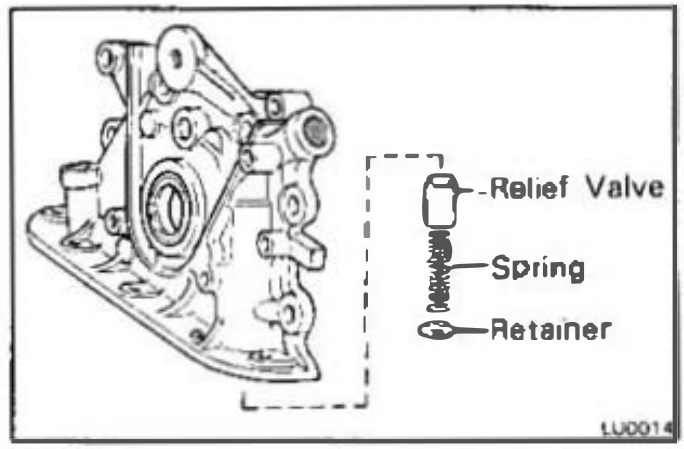


(b) Remove the drive and driven rotors (gears).

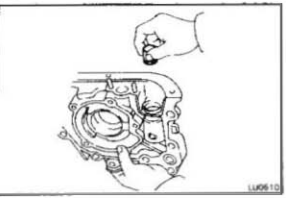
2. REMOVE RELIEF VALVE



(a) Using snap ring pliers, remove the snap ring.



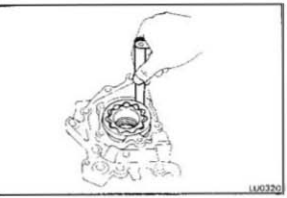
(b) Remove the retainer, spring and relief velve.



INSPECTION OF RELIEF VALVE

INSPECT RELIEF VALVE

Coat the relief valve with engine oil and check that it falls smoothly into the valve hole by its own weight.
If it does not, replace the relief valve. If necessary, replace the oil pump assembly.



INSPECTION OF OIL PUMP

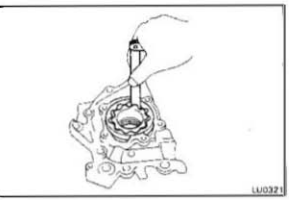
(4A-F)

1. MEASURE BODY CLEARANCE

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

Standard clearance: 0.080 — 0.135 mm (0.0031 — 0.0053 in.)
Maximum clearance: 0.20 mm (0.0079 in.)

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

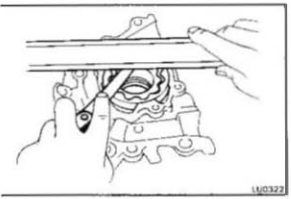


2. MEASURE TIP CLEARANCE

Using a feeler gauge, measure the clearance between both rotor tips.

Standard clearance: 0.116 — 0.156 mm (0.0046 — 0.0061 in.)
Maximum clearance: 0.35 mm (0.0138 in.)

If the clearance is greater than maximum, replace the rotor set.

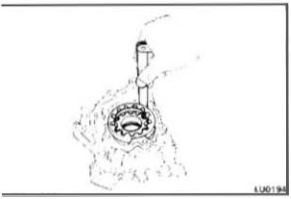


3. MEASURE SIDE CLEARANCE

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

Standard clearance: 0.25 — 0.065 mm (0.0010 — 0.0026 in.)
Maximum clearance: 0.10 mm (0.0039 in.)

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



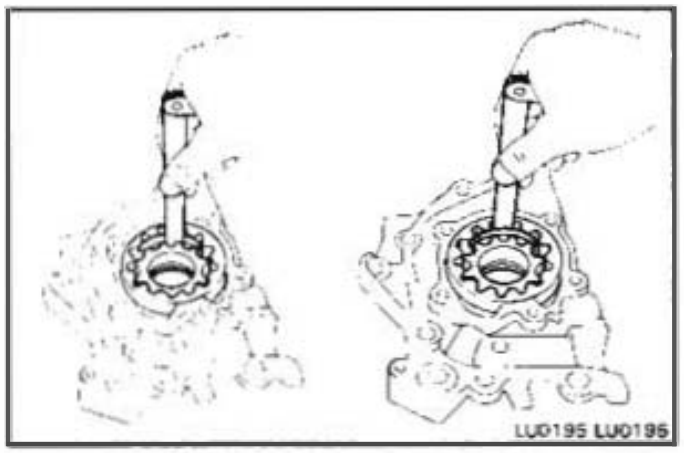
(4A-GE)

1. MEASURE BODY CLEARANCE

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

Standard clearance: 0.100 — 0.191 mm (0.0039 — 0.0075 in.)
Maximum clearance: 0.20 mm (0.0079 in.)

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

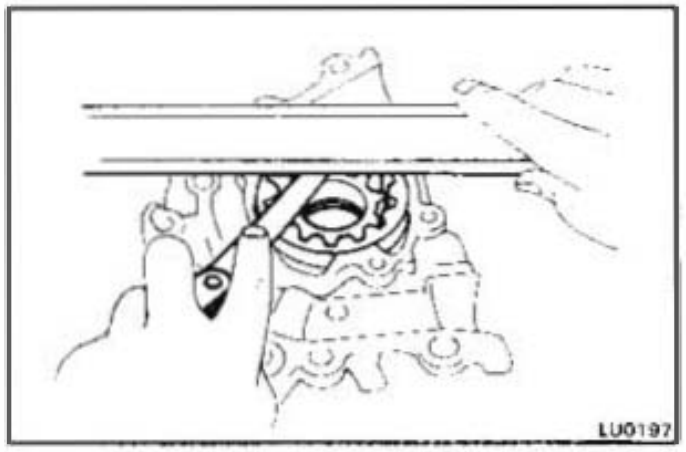


2. MEASURE TIP CLEARANCE

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

Standard clearance:
Drive gear to crescent
0.107 — 0.248 mm (0.0042 — 0.0098 in.)
Driven gear to crescent
0.058 — 0.310 mm (0.0023 — 0.0122 in.)
Maximum clearance: 0.35 mm (0.0138 in.)

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



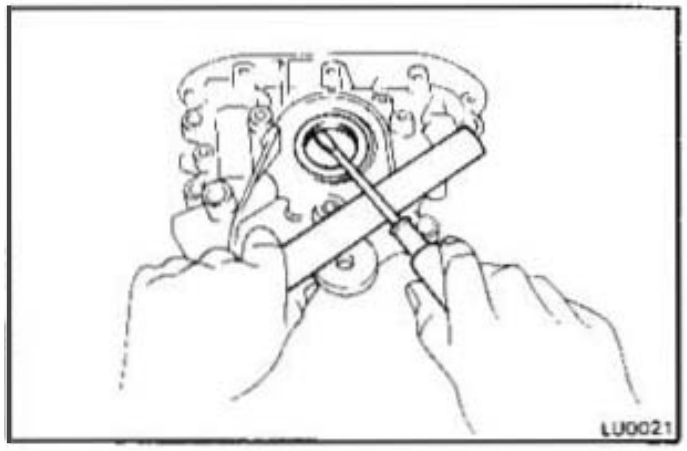
3. MEASURE SIDE CLEARANCE

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

Standard clearance: 0.025 — 0.075 mm (0.0010 — 0.0030 in.)
Maximum clearance: 0.10 mm (0.0039 in.)

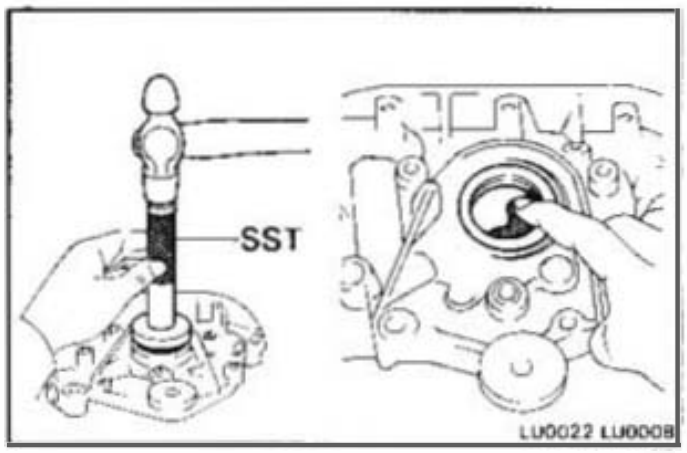
If the clearance is greater than maximum, replace the gear set and/or body.

REPLACEMENT OF OIL SEAL



1. REMOVE OIL SEAL

Using a screwdriver, pry out the oil seal.



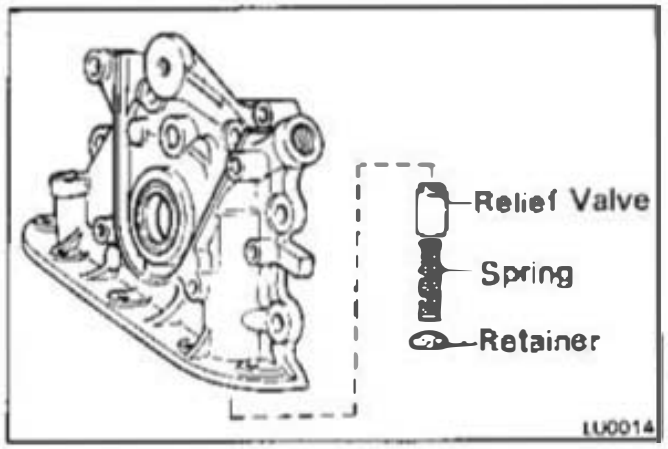
2. INSTALL OIL SEAL

(a) Using SST and a hammer, drive in a new oil seal

SST 09517-30010

NOTE: Be careful not to install a new oil seal slantwise.

(b) Apply MP grease to the oil seal lip.

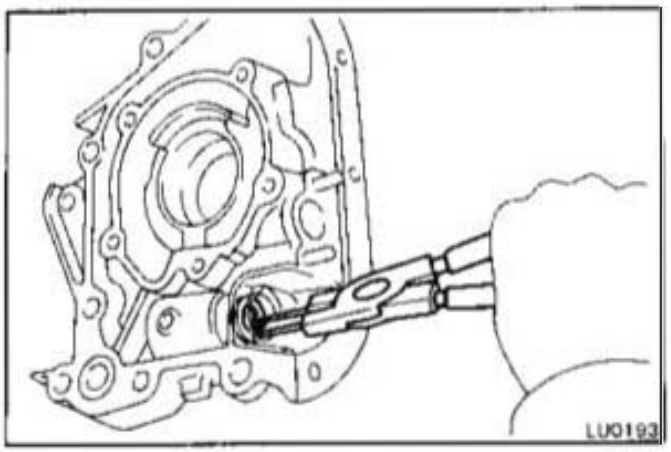


ASSEMBLY OF OIL PUMP

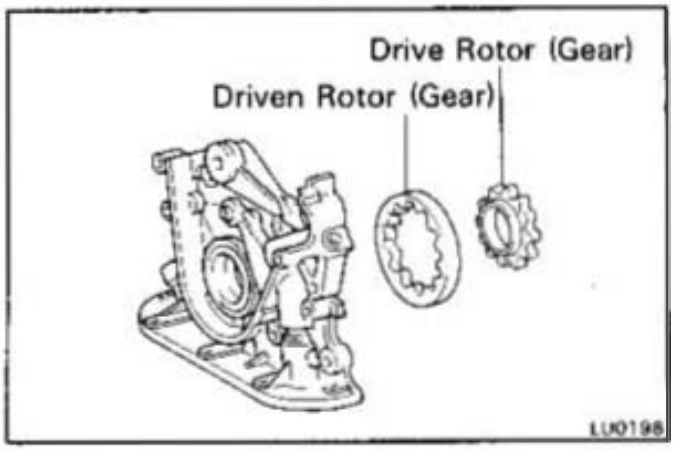
(See page LU-7)

1. INSTALL RELIEF VALVE

(a) Insert the relief valve, spring and retainer into the pump body.

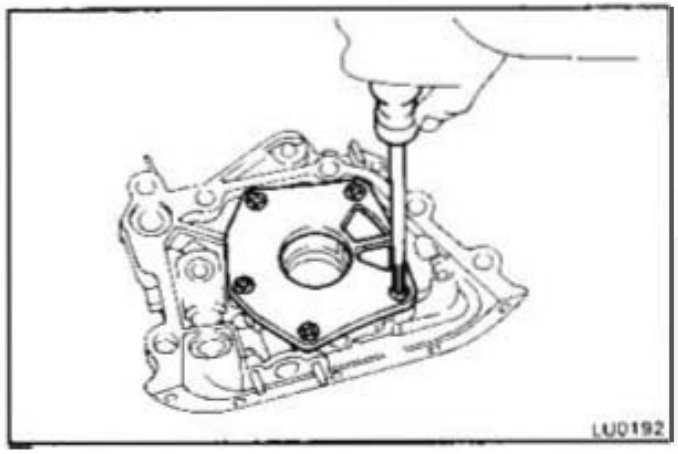


(b) Using snap ring pliers, install the snap ring.



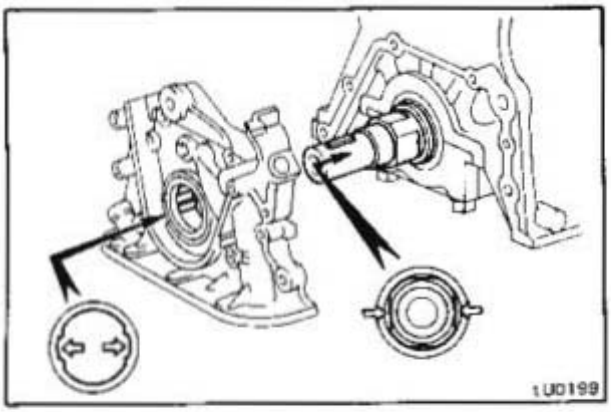
2. INSTALL DRIVE AND DRIVEN ROTORS (GEARS)

(a) Insert the drive and driven rotors (gears) into the pump body.



(b) Install the oil pump body cover with the five screws. Torque the screws.

Torque: 105 kg-cm (8 in.-lb, 10 N·m)



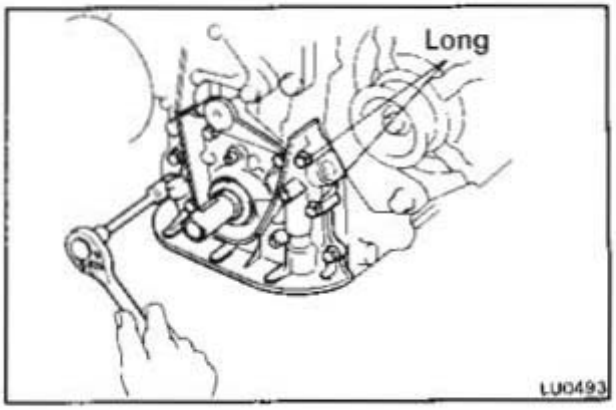
INSTALLATION OF OIL PUMP

(See page LU-7)

1. INSTALL OIL PUMP ASSEMBLY

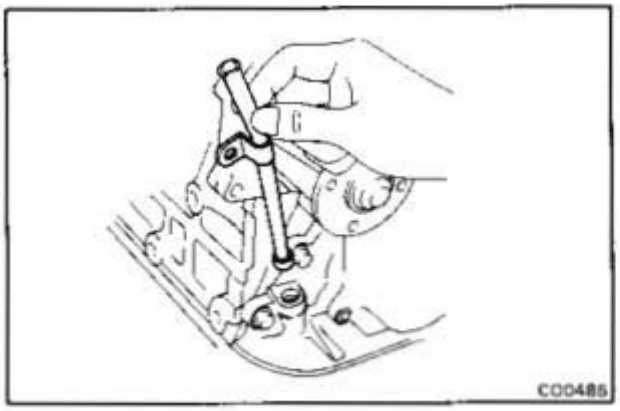
(a) Place a new gasket on the block.

(b) Install the oil pump to the crankshaft with the spline teeth of the drive gear engaged with the large teeth of the crankshaft.



(c) Install and torque the seven bolts.

Torque: 218 kg-cm (16 ft-lb, 21 N·m)



2. INSTALL OIL DIPSTICK GUIDE AND DIPSTICK

(a) Push in the oil dipstick guide with the O-ring coated with a small amount of engine oil.

(b) Install a new O-ring to the oil dipstick guide.

(c) Install the mounting bolt.

(d) Insert the oil dipstick.

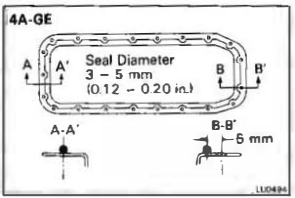
3. INSTALL CRANKSHAFT TIMING PULLEY, IDLER PULLEY AND TIMING BELT

4A-F (See pages EM-53 to 56)
4A-GE (See pages EM-62 to 65)

4. (4A-GE) INSTALL OIL PAN BAFFLE PLATE

(a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contacting surfaces of the baffle plate 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.

CAUTION: Do not use a solvent which will affect the painted surfeces.

(b) Apply seal packing to the baffle plate as shown in the figure.

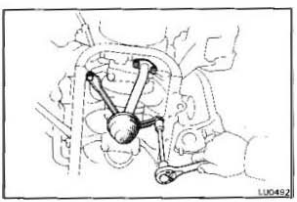
Seal packing: Part No. 08826-00080 or equivalent

- Install a nozzle that has been cut to a 3 – 5 mm (0.12 ~ 0.20 in.) opening.

NOTE: Avoid applying an excess amount to the surface. Be particularly careful near oil passages.

- Parts must be assembled within 3 minutes of application. Otherwise, the material must be removed and reapplied.
- Immediately remove nozzle from tube and reinstall cap.

(c) Install the baffle plate.



5. INSTALL OIL STRAINER

Place a new oil strainer gasket and install the oil strainer with two bolts and two nuts. Torque the bolts and nuts.

Torque: 95 kg-cm (82 in.-lb, 9.3 N·m)

6. INSTALL OIL PAN

(a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contacting surfaces of the oil pan and cylinder block (4A-F) or baffle plate (4A-GE).

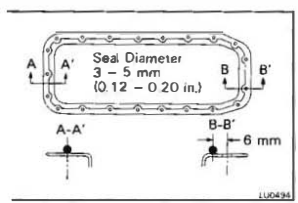
- Using a razor blade and gasket scraper, remove all the packing (FIPG) material from the gasket surfaces.
- Thoroughly clean all components to remove all the loose material.
- Clean both sealing surfaces with a non-residue solvent.

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

(b) 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 3 – 5 mm (0.12 – 0.20 in.) opening.



NOTE: Avoid applying an excess amount to the surface. Be particularly careful near oil passages.

- Parts must be assembled within 3 minutes of application. Otherwise, the material must be removed and reapplied.
- Immediately remove nozzle from tube and reinstall cap.

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

Torque: 50 kg-cm (43 in.-lb, 4.9 N·m)

7. REFILL WITH ENGINE OIL (See step 3 on page LU-6)

8. START ENGINE AND CHECK FOR LEAKS

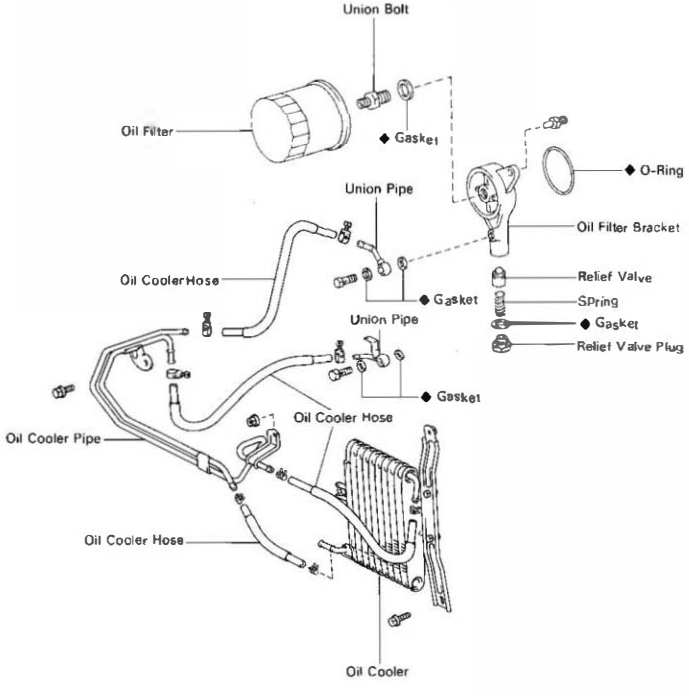
9. RECHECK OIL LEVEL

Recheck the engine oil level and refill if necessary.

OIL COOLER AND PRESSURE REGULATOR

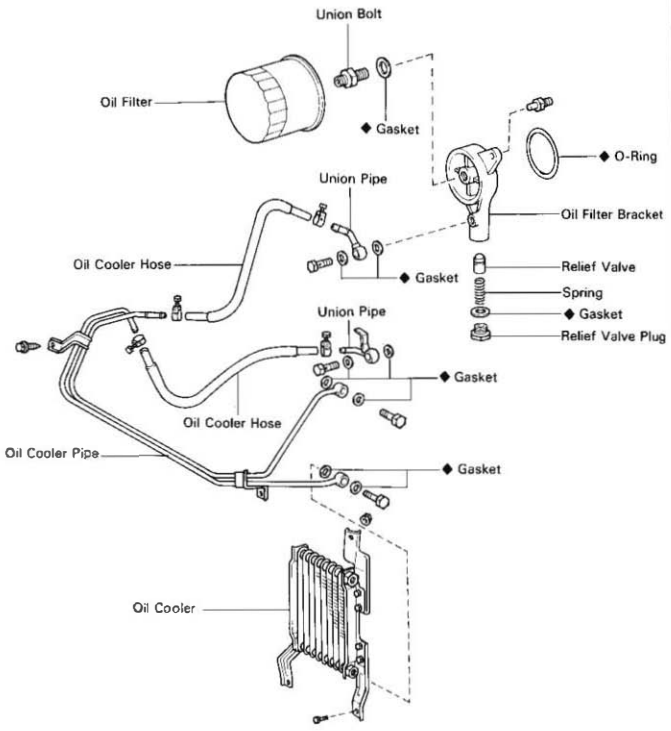
COMPONENTS

AE



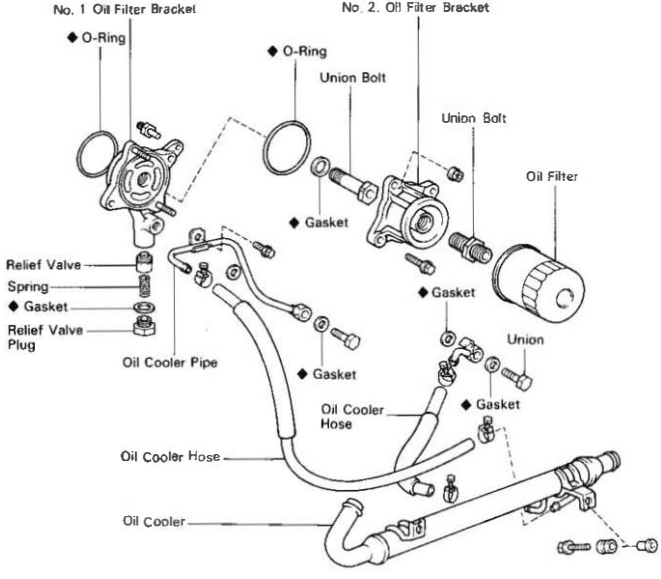
COMPONENTS (Cont'd)

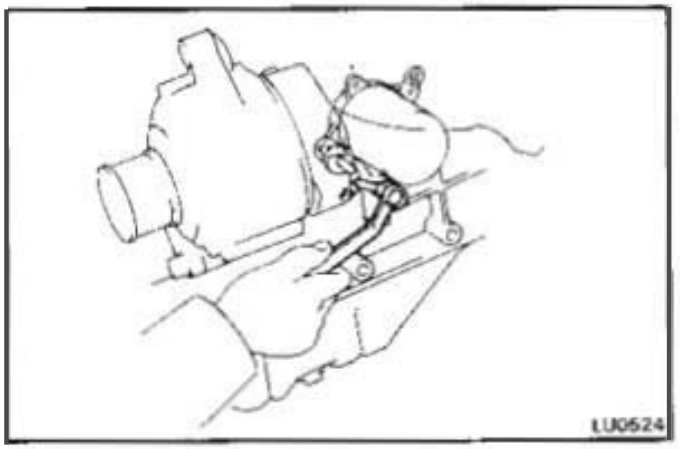
AT



COMPONENTS (Cont'd)

AW



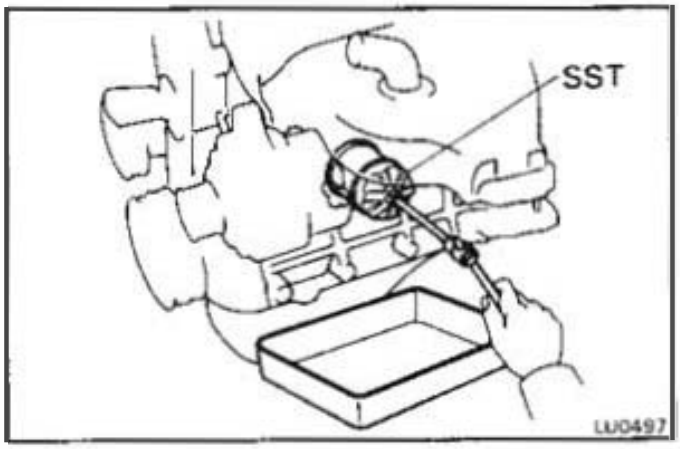


REMOVAL AND DISASSEMBLY OF OIL COOLER AND PRESSURE REGULATOR (AE and AT)

(See page LU-17 or 18)

1. REMOVE UNION PIPE

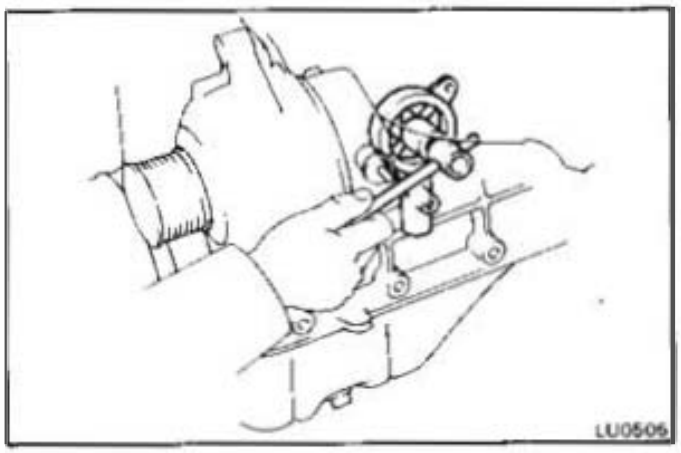
Remove the union bolt, two gaskets and union pipe.



2. REMOVE OIL FILTER

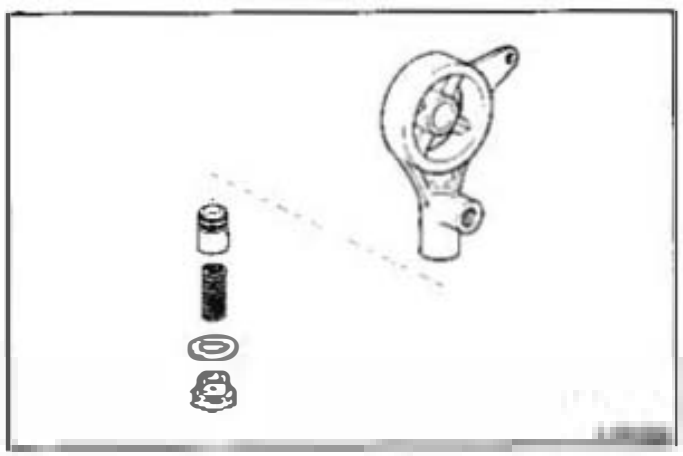
Using SST, remove the oil filter.

SST 09228-06500



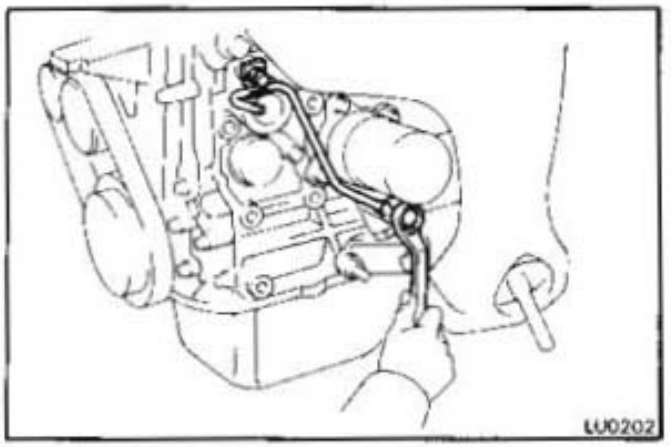
3. REMOVE OIL FILTER BRACKET (OIL PRESSURE REGULATOR)

Remove the union bolt, oil filter bracket and O-ring.



4. DISASSEMBLE OIL FILTER BRACKET (OIL PRESSURE REGULATOR)

Remove the plug, gasket, spring and relief valve.



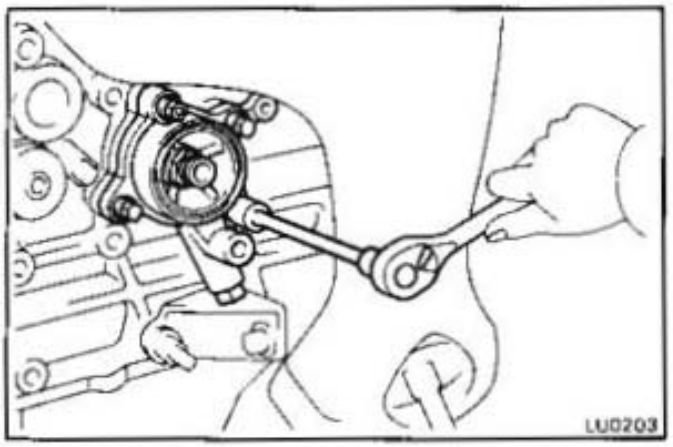
REMOVAL AND DISASSEMBLY OF OIL COOLER AND PRESSURE REGULATOR (AW)

(See page LU-18)

1. **DISCONNECT OIL COOLER PIPE**

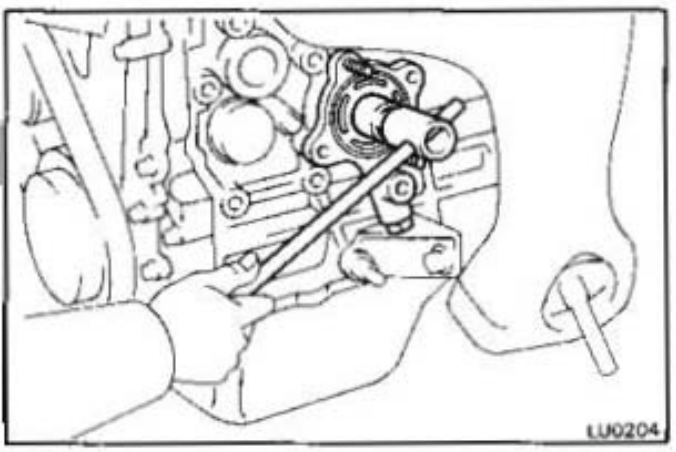
   Remove the bolt, union bolt, cooler pipe and two gasket.

2. **REMOVE OIL FILTER (See page LU-20)**



3. **REMOVE NO.2 OIL FILTER BRACKET**

   Remove the two bolts, two nuts, filter bracket and O-ring.

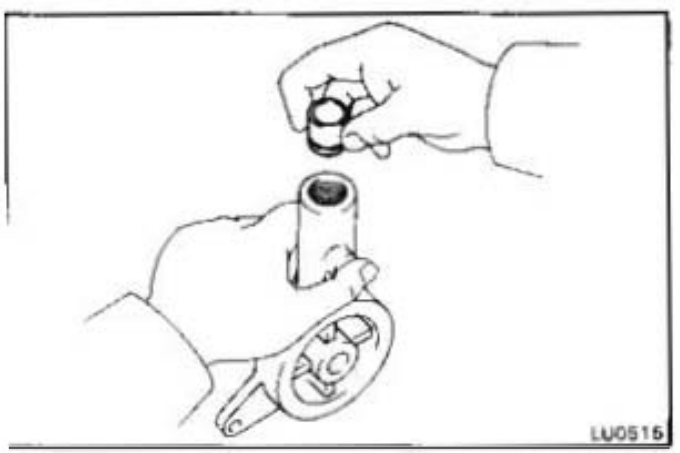


4. **REMOVE NO.1 OIL FILTER BRACKET (OIL PRESSURE REGULATOR)**

   Remove the union bolt, gasket, filter bracket and O-ring.

5. **DISASSEMBLE NO.1 OIL FILTER BRACKET (OIL PRESSURE REGULATOR)**

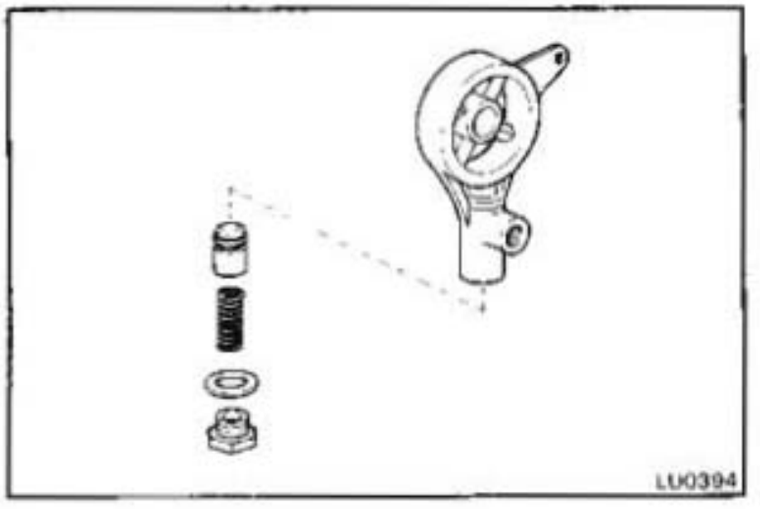
   (See step 4 on page LU-20)



INSPECTION OIL PRESSURE REGULATOR

INSPECT RELIEF VALVE

Coat the relief valve with engine oil, and check that it falls smoothly into the valve hole by its own weight.
If it does not, replace the relief valve. If necessary, replace the oil filter bracket (No. 1) and relief valve as a set.



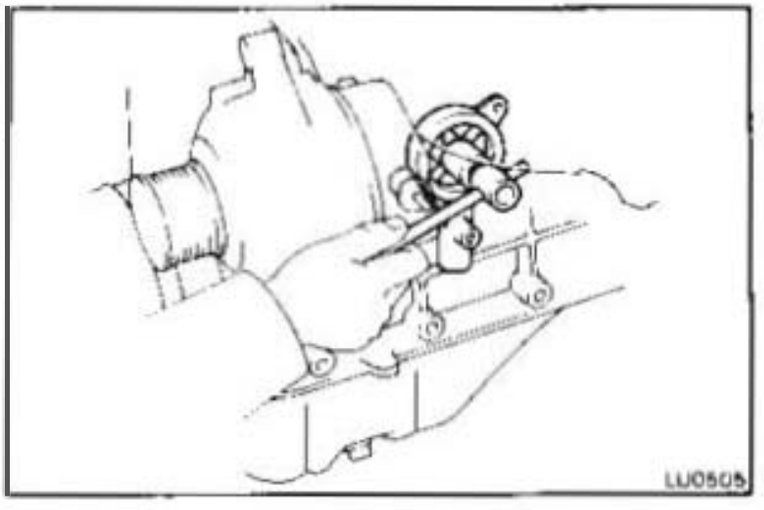
ASSEMBLY AND INSTALLATION OF OIL COOLER AND PRESSURE REGULATOR (AE and AT)

(See page LU-17 or 18)

1. **ASSEMBLE OIL FILTER BRACKET (OIL PRESSURE REGULATOR)**

   Insert the relief valve, spring, a new gasket and screw on the relief valve plug. Torque the plug.

   Torque: 375 kg-cm (27 ft-lb, 37 N·m)

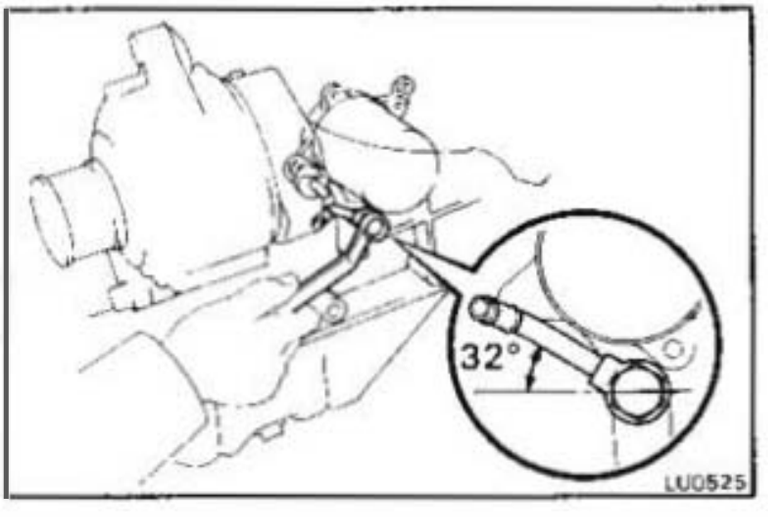


2. **INSTALL OIL FILTER BRACKET**

   Insert a new O-ring and the filter bracket with the union bolt. Torque the union bolt.

   Torque: 450 kg-cm (33 ft-lb, 44 N·m)

3. **INSTALL OIL FILTER (See page LU-6)**



4. **INSTALL UNION PIPE**

   Install the union pipe with two new gaskets and union bolt as shown. Torque the union bolt.

   Torque: 300 kg-cm (22 ft-lb, 29 N·m)

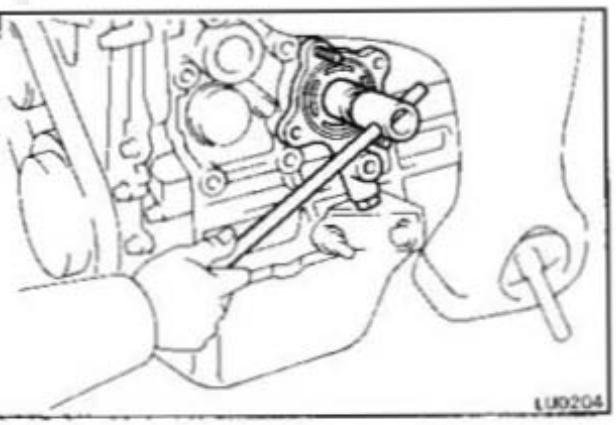
5. **REFILL WITH ENGINE OIL (See page LU-6)**

6. **START ENGINE AND CHECK FOR LEAKS**

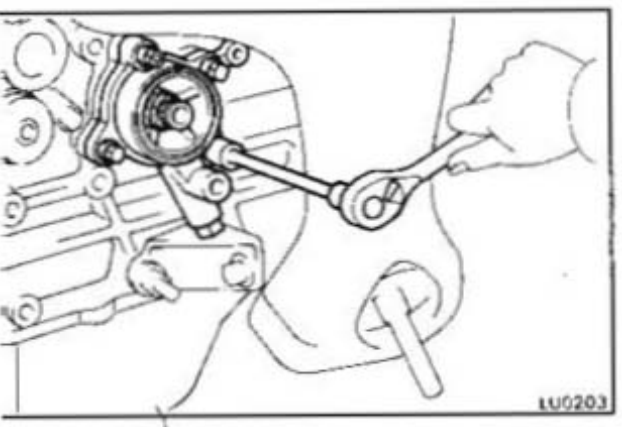
ASSEMBLY AND INSTALLATION OF OIL COOLER AND PRESSURE REGULATOR (AW)

(See page LU-19)

1. **ASSEMBLE NO.1 OIL FILTER BRACKET (OIL PRESSURE REGULATOR)**
   (See page LU-22)
   Torque: 375 kg-cm (27 ft-lb, 37 N·m)

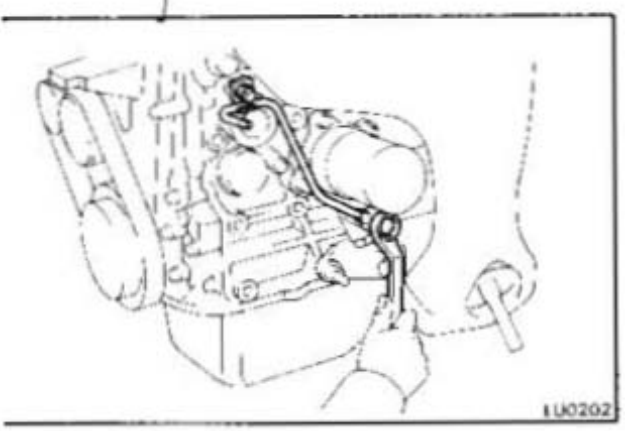


2. **INSTALL NO.1 OIL FILTER BRACKET (OIL PRESSURE REGULATOR)**
   Install a new O-ring and the filter bracket with a new gasket and the union bolt. Torque the union bolt.
   Torque: 450 kg-cm (33 ft-lb, 44 N·m)



3. **INSTALL NO.2 OIL FILTER BRACKET**
   Install a new O-ring and the filter bracket with the two bolts and two nuts.
   Torque: 200 kg-cm (14 ft-lb, 20 N·m)

4. **INSTALL OIL FILTER (See page LU-6)**



5. **CONNECT OIL COOLER PIPE**
   Install the cooler pipe with the bolt, new two gaskets and the union bolt. Torque the union bolt.
   Torque (Union bolt): 300 kg-cm (22 ft-lb, 29 N·m)

6. **REFILL WITH ENGINE OIL (See page LU-6)**

7. **START ENGINE AND CHECK FOR LEAKS**

ENGINE MECHANICAL (4A-GE)

Specifications (Cont'd)

Engine tune-up	Drive belt (Alternator)				
	Deflection	New belt	4 – 5 mm	0.16 – 0.20 in.	
		Used belt	6 – 7 mm	0.24 – 0.28 in.	
	Tension (Reference)	New belt	70 – 80 kg		
		Used belt	30 – 45 kg		
	Engine coolant capacity (w/ Heater)				
	A/E and A/T		6.0 liters	6.3 US qts	5.3 Imp. qts
	A/W		12.4 liters	13.1 US qts	10.9 Imp. qts
	Engine oil capacity				
	w/o Oil cooler	Drain and refill			
		w/o Oil filter change	3.0 liters	3.2 US qts	2.6 Imp. qts
		w/ Oil filter change	3.3 liters	3.5 US qts	2.9 Imp. qts
		Dry fill	3.7 liters	3.9 US qts	3.3 Imp. qts
	w/ Oil cooler	Drain and refill			
		w/o Oil filter change	3.4 liters	3.6 US qts	3.0 Imp. qts
		w/ Oil filter change	3.7 liters	3.9 US qts	3.3 Imp. qts
		Dry fill	4.1 liters	4.3 US qts	3.6 Imp. qts
	Battery specific gravity		1.25 – 1.27 when fully charged at 20°C (68°F)		
	High-tension cord resistance	Limit	25 kΩ per cord		
	Spark plug				
	Conventional tipped type				
	Type	ND	Q20R-U11		
		NGK	BCPR6EY11		
	Air gap		1.1 mm	0.043 in.	
	Platinum tipped type				
	Type	ND	PQ16R		
		NGK	BCPR5EP11		
	Air gap	STD	1.1 mm	0.043 in.	
		Limit	1.3 mm	0.051 in.	
	Ignition timing		10° BTDC @ idle (w/ Terminals T and E1 short-circuited)		
	Firing order		1 – 3 – 4 – 2		
	Valve clearance	Intake	0.15 – 0.25 mm	0.006 – 0.010 in.	
		Exhaust	0.20 – 0.30 mm	0.008 – 0.012 in.	
	Idle speed		800 rpm (w/ Cooling fan OFF)		
	VF voltage		2.5 ± 0.6 V		
	Idle CO concentration	w/ TWC	0 – 0.5 %		
		w/o TWC	1.5 ± 0.5 %		
	Dash pot setting speed (w/ Air flow meter)		1,800 rpm (w/ Cooling fan OFF)		
Intake manifold vacuum	at idle speed		400 mmHg (15.75 in.Hg, 53.3 kPa)		
Compression pressure	at 250 rpm	STD	12.6 kg/cm² (179 psi, 1,236 kPa)		
		Limit	10.0 kg/cm² (142 psi, 981 kPa) or more		
	Difference of pressure between each cylinder		1.0 kg/cm² (14 psi, 98 kPa) or less		

Specifications (Cont'd)

Idler pulley tension spring	Free length			43.5 mm	1.713 in.
	Installed load	at 50.2 mm (1.976 in.)		9.97 kg (22.0 lb, 98 N)	
Cylinder head	Warpage	Cylinder block side	Limit	0.05 mm	0.0020 in.
		Intake manifold side	Limit	0.05 mm	0.0020 in.
		Exhaust manifold side	Limit	0.10 mm	0.0039 in.
	Valve seat	Relacing angle		30°, 45°, 60°	
		Contacting angle		45°	
		Contacting width		1.0 – 1.4 mm	0.039 – 0.055 in.
Valve guide busing	Insidediameter			6.010 – 6.030 mm	0.2366 – 0.2374 in.
	Outside diameter		STD	11.033 – 11.044 mm	0.4344 – 0.4348 in.
			O/S 0.05	11.083 – 11.094 mm	0.4363 – 0.4368 in.
Valve	Valve overall length	STD	Intake	99.60 mm	3.9213 in.
			Exhaust	99.75 mm	3.9272 in
		Limit	Intake	99.10mm	3.9016 in.
			Exhaust	9925 mm	3.9075 in.
	Valve face angle			445°	
	Stem diameter		Intake	5970 – 5.985 mm	0 2350 – 0 2356 in.
			Exhaust	5.965 – 5.980 mm	0.2348 – 0.2354 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.
	Margin thickness	STD		0.8 – 1.2 mm	0.031 – 0.047 in.
		Limit		0.5 mm	0.020 in.
Valve spring	Free length			41.09 mm	1.6177 in.
	Installed tension	at 34.7 mm (1.366 in.)		14.6 – 17.0 kg (32.2 – 37.5 lb, 143 – 167 N)	
	Squareness		Limit	1.8mm	0.071 in
Valve lifter	Lifter diameter			27.975 – 27.985 mm	1.1014 – 1.1018 in.
	Cylinder head lifter bore diameter			28.000 – 28.021 mm	1.1024 – 1.1032 in.
	Oil clearance		STD	0.015 – 0.046 mm	0.0005 – 0.0018 in.
			Limit	0.07 mm	0.0028 in.
Manifold	Warpage	Intake manifold	Limit	0.05 mm	00020 in.
		Exhaust manifold	Limit	0.30mm	0.0118 in.
Air control valve	Warpage		Limit	0.05 mm	00020 in.
T-VIS VSV	Resistance			33 – 39 Ω	
Camshaft	Thrust clearance		STD	0.08 – 0.190 mm	0.0031 – 0.0075 in.
			Limit	0.30 mm	0.0118 in.
	Journal oil clearance		STD	0.035 – 0.072 mm	0.0014 – 00028 in
			Limit	0.10mm	0.0039 in.

Specifications (Cont'd)

Camshaft (Cont'd)	Journal diameter		26.949 – 26.965 mm	1.0610 – 1.0616 in.
	Circle runout	Limit	0.04 mm	0.0016 in.
	Cam lobe height	STD	35.410 – 35.510 mm	1.3823 – 1.3980 in.
		Limit	35.11 mm	1.3823 in.
Cylinder block	Cylinder head surface warpage	Limit	0.05 mm	0.0020 in.
	Cylinder bore diameter STD		81.00 – 81.03 mm	3.1890 – 3.1902 in.
		O/S 0.50	81.50 – 81.53 mm	3.2087 – 3.2098
	Limit	STD	81.23 mm	3.1980 in.
		O/S 0.50	81.73 mm	3.2177 in.
Piston and piston ring	Piston diameter	STD	80.89 – 80.92 mm	3.1848 – 3.1858 in.
		O/S 0.50	81.39 – 81.42 mm	3.2043 – 3.2055 in.
	Piston oil clearance		0.10 – 0.12 mm	0.0039 – 0.0047 in.
	Piston ring groove clearance	No. 1	0.04 – 0.08 mm	0.0016 – 0.0031 in.
		No. 2	0.03 – 0.07 mm	0.0012 – 0.0028 in.
	Piston ring end gap STD	No. 1	0.25 – 0.47 mm	0.0098 – 0.0185 in.
		No. 2	0.20 – 0.42 mm	0.0079 – 0.0165 in.
		Oil	0.15 – 0.52 mm	0.0059 – 0.0205 in.
	Limit	No. 1	1.07 mm	0.0421 in.
		No. 2	1.02 mm	0.0402 in.
		Oil	1.12 mm	0.0441 in.
Connecting rod	Thrust clearance	STD	0.15 – 0.25 mm	0.0059 – 0.0098 in.
		Limit	0.30 mm	0.0118 in.
	Connecting rod oil clearance			
	STD	STD	0.020 – 0.051 mm	0.0008 – 0.0020 in.
		U/S 0.25	0.019 – 0.073 mm	0.0007 – 0.0029 in.
	Limit		0.08 mm	0.0031 in.
	Connecting rod bearing center wall thickness			
	STD	No. 1	1.486 – 1.490 mm	0.0585 – 0.0587 in.
		No. 2	1.490 – 1.494 mm	0.0587 – 0.0588 in.
		No. 3	1.494 – 1.498 mm	0.0588 – 0.0590 in.
	Bent Limit per 100 mm (3.94 in.)		0.03 mm	0.0012 in.
	Twist Limit per 100 mm (3.94 in.)		0.05 mm	0.0020 in.
	Bushing inside diameter		20.012 – 20.022 mm	0.7879 – 0.7883 in.
	Piston pin diameter		20.008 – 20.016 mm	0.7878 – 0.7880 in.
	Piston pin oil clearance	STD	0.004 – 0.006 mm	0.0002 – 0.0003 in.
		Limit	0.05 mm	0.0020 in.
Crankshaft	Thrust clearance	STD	0.02 – 0.22 mm	0.0008 – 0.0087 in.
		Limit	0.30 mm	0.0118 in.
	Thrust washer thickness	STD	2.440 – 2.490 mm	0.0961 – 0.0980 in.
	Main journal oil clearance			
	STD	STD	0.015 – 0.033 mm	0.0006 – 0.0013 in.
		U/S 0.25	0.013 – 0.053 mm	0.0005 – 0.0021 in.
	Limit		0.10 mm	0.0039 in.
	Main journal diameter	STD	47.982 – 48.000 mm	1.8891 – 1.8898 in.
		U/S 0.25	47.745 – 47.755 mm	1.8797 – 1.8801 in.

Specifications (Cont'd)

Crankshaft (Cont'd)	Main bearing center wall thickness			
	STD	No. 1	2.002 – 2.005 mm	0.0788 – 0.0789 in.
		No. 2	2.005 – 2.008 mm	0.0789 – 0.0791 in.
		No. 3	2.008 – 2.011 mm	0.0791 – 0.0792 in.
		No. 4	2.011 – 2.014 mm	0.0792 – 0.0793 in.
		No. 5	2.014 – 2.017 mm	0.0793 – 0.0794 in.
	Crank pin diameter	STD	41.985 – 42.000 mm	1.6529 – 1.6535 in.
		U/S 0.25	41.745 – 41.755 mm	1.6435 – 1.6439 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 taper and out-of-round	Limit	0.02 mm	0.0008 in.

Torque Specifications

Part tightened		kg-cm	ft-lb	N·m
Camshaft timing pulley x Camshaft		475	34	47
Idler pulley x Cylinder block		375	27	37
Crankshaft pulley x Crankshaft		1,400	101	137
Cylinder head x Cylinder block	1st	300	22	29
	2nd	90° turns		
	3rd	90° turns		
Camshaft bearing cap x Cylinder head		130	9	13
Intake manifold x Cylinder head		280	20	27
Intake manifold stay x Cylinder head		220	16	22
Intake manifold stay x Cylinder block		220	16	22
EGR pipe x Exhaust manifold		700	51	69
Exhaust manifold x Cylinder head		250	18	25
Exhaust manifold stay x Exhaust manifold		400	29	39
Exhaust manifold stay x Cylinder block		400	29	39
Main bearing cap x Cylinder block		610	44	60
Connecting rod cap x Connecting rod		500	36	49
Flywheel x Crankshaft		750	54	74

EFI SYSTEM (4A-GE)

Specifications

Fuel pressure regulator	Fuel pressure	at No vacuum	2.7 – 3.1 kg/cm² (38 – 44 psi, 265 – 304 kPa)
Cold start injector	Resistance		2 – 4 Ω
	Fuel leakage		One drop or less per minute
Injector	Resistance	w/o Air flow meter	Approx. 2.3 Ω
		w/ Air flow meter	Approx. 13.8 Ω
	Injection volume	w/o Air flow meter	46 – 49 cc (2.8 – 3.0 cu in.) per 15 sec.
		w/ Air flow meter	50 – 53 cc (3.1 – 3.2 cu in.) per 15 sec.
	Difference between each injector		5 cc (0.31 cu in.) or less
	Fuel leakage		One drop or less per minute
Throttle body	Throttle body fully closed angle		6°

Throttle position sensor	Clearance between stop screw and lever	etween terminals	Resistance
	0 mm 0 in.	VTA – E2	200 – 800
	0.35 mm 0.014 in.	IDL – E2	2,300 Ω or less
	0.59 mm 0.023 in.	IDL – E2	Infinity
	Throttle valve fully opened position	VTA – E2	3,300 – 10,000 Ω
	—	VCC – E2	3,000 – 7,000 Ω

Solenoid resistor (w/o Air flow meter)	Resistance	+B – No. 10	2 – 3 Ω
		+B – No. 20	2 – 3 Ω
Cold start injector time switch	Resistance	STA – STJ below 30°C (68°F)	20 – 40 Ω
		above 40°C (104°F)	40 – 60 Ω
		STA – Ground	20 – 80 Ω
Air flow meter (w/ Air flow meter)	Resistance	VS – E2	20 – 400 Ω (Measuring plate fully closed)
			20 – 3,000 Ω (Measuring plate fully closed-open)
		VC – E2	100 – 300 Ω
		VB – E2	200 – 400 Ω
		THA – E2 at –20°C (–4°F)	10,000 – 20,000 Ω
		at 0°C (32°F)	4,000 – 7,000 Ω
		at 20°C (68°F)	2,000 – 3,000 Ω
		at 40°C (104°F)	900 – 1,300 Ω
		at 80°C (140°F)	400 – 700 Ω
		FC – E1	Infinity (Measuring plate fully closed)
			0 (Others)
Air temp. sensor (w/o Air flow meter) and water temp. sensor	Resistance	at –20°C (–4°F)	10 – 20 kΩ
		at 0°C (32°F)	4 – 7 kΩ
		at 20°C (68°F)	2 – 3 kΩ
		at 40°C (104°F)	0.9 – 1.3 kΩ
		at 60°C (140°F)	0.4 – 0.7 kΩ
		at 80°C (176°F)	0.2 – 0.4 kΩ
Oxygen sensor	Heater coil resistance		5.1 – 6.3 Ω
Fuel pressure VSV	Resistance		33 – 39 Ω
Idle-up VSV	Resistance		37 – 44 Ω

Specifications (Cont'd)

ECU

NOTE:
- Perform all voltage and resistance measurements with the computer connected.
- Verify that the battery voltage is 11 V or above with the ignition switch is ON.

Voltage (TCCS ECU w/o Air flow meter)

Terminals	Condition		STD voltage (V)
+B, +B1 – E1	IG S / W ON		10 – 14
BATT – E1	—		10 – 14
IDL – E2	IG S/W ON	Throttle valve open	4.5 – 5.5
VTA – E2	IG S/W ON	Throttle valve fully closed	0.5 or less
	IG S/W ON	Throttle valve fully open	3.5 – 5.5
VCC – E2	IG S/W ON	—	4.5 – 5.5
IGT – E1	Cranking or idling		0.7 – 1.0
STA – E1	Cranking		6 – 14
No. 10, No. 20 – E1	IG S/W ON		9 – 14
W – E1	No trouble (check engine warning light off) and engine running		9 – 14
PIM – E2	IG S/W ON		3.3 – 3.9
VCC – E2	IG S/W ON		4.5 – 5.5
THA – E2	IG S/W ON	Intake air temperature 20°C (68°F)	2.0 – 2.8
THW – E2	IG S/W ON	Coolant temperature 80°C (176°F)	0.4 – 0.8
A/C – E1	IG S/W ON	Air conditioning ON	5 – 14
T – E1	IG S/W ON	Check engine connector T – E1 not short	4.5 – 5.5
	IG S/W ON	Check engine connector T – E1 short	0.5 or less
STH – E1	Idling		0 – 3
	Approx. 5,000 rpm or more		10 – 14

Resistance (TCCS ECU w/o Air flow meter)

Terminals	Condition	Resistance (Ω)
IDL – E2	Throttle valve fully open	Infinity
	Throttle valve fully closed	2,300 or less
VTA – E2	Throttle valve fully open	3,300 – 10,000
	Throttle valve fully closed	200 – 800
VCC – E2	—	3,000 – 7,000
THA – E2	Intake air temperature 20°C (68°F)	2,000 – 3,000
THW – E2	Coolant temperature 80°C (176°F)	200 – 400
G – G⊖	—	140 – 180
NE – G⊖	—	140 – 180

Specifications (Cont'd)

ECU (Cont'd)

Voltage (TCCS ECU w/ Air flow meter)

Terminals	Condition		STO voltage (V)
+B, +B1 – E1	IG S/W ON		10 – 14
BATT – E1	—		10 – 14
IDL – E2	IG S/W ON	Throttle valve open	10 – 14
VTA – E2	IG S/W ON	Throttle valve fully closed	0.5 or less
	IG S/W ON	Throttle valve fully open	3.5 – 5.5
VCC – E2	IG S/W ON	—	4.5 – 5.5
IGT – E1	Cranking or idling		0.7 – 1.0
STA – E1	Cranking		6 – 14
No. 10, No. 20 – E1	IG S/W ON		9 – 14
W – E1	No trouble (check engine warning light off) and engine running		9 – 14
VC – E2	IG S/W ON	—	5.1 – 10.8
VS – E2	IG S/W ON	Measuring plate fully closed	2.5 – 5.4
	IG S/W ON	Measuring plate fully open	6.2 – 8.8
	Idling		3.9 – 5.8
THA – E2	IG S/W ON	Intake air temperature 20°C (68°F)	2 – 2.8
THW – E2	IG S/W ON	Coolant temperature 80°C (176°F)	0.4 – 0.7
A/C – E1	IG S/W ON	Air conditioning ON	5 – 14
T – E1	IG S/W ON	Check engine connector T – E1 not short	10 – 14
	IG S/W ON	Check engine connector T – E1 short	0.5 or less
R/P – E1	IG S/W ON	Fuel control S/W NORMAL	10 – 14
	IG S/W ON	Fuel control S/W SUPER	0.5 or less
STH – E1	Idling		0 – 3
	Approx. 4,350 rpm or more		10 – 14

Resistance (TCCS ECU w/ Air flow meter)

Terminals	Condition	Resistance (Ω)
IDL – E2	Throttle valve fully open	Infinity
	Throttle valve fully closed	2,300 or less
VTA – E2	Throttle valve fully open	3,300 – 10,000
	Throttle valve fully closed	200 – 800
VCC – E2	—	3,000 – 7,000
VS – E2	Measuring plate fully closed	20 – 400
	Measuring plate fully open	20 – 3,000
VC – E2	—	100 – 300
THA – E2	Intake air temperature 20°C (68°F)	2,000 – 3,000
THW – E2	Coolant temperature 80°C (176°F)	200 – 400
G – G⊖	—	140 – 180
NE – G⊖	—	140 – 180

Specifications

ECU (Cont'd)	Fuel cut rpm (w/ Vehicle speed 0 km/h and coolant temperature 80°C (176°F))	Fuel cut rpm	w/o Air flow meter	1,800 rpm
			w/ Air flow meter	1,400 rpm M/T (V-ISC OFF)
				1,800 rpm M/T (V-ISC ON)
				1,600 rpm A/T
		Fuel return rpm	w/o Air flow meter	1,400 rpm
			w/ Air flow meter	1,200 rpm

Torque Specifications

Part tightened		kg-cm	ft-lb	N·m
Fuel line	Union bolt type	300	22	29
	Flare nut type	310	22	30
Fuel pump x Fuel tank		35	30 in.-lb	3.4
Cold start injector x Intake manifold		75	65 in.-lb	7.4
Cold start injector pipe x Cold start injector		150	11	15
Cold start injector pipe x Delivery pipe		150	11	15
Fuel pressure regulator x Delivery pipe		75	65 in.-lb	7.4
Fuel pressure regulator x fuel return pipe (AW)		300	22	29
Delivery pipe x Cylinder head		175	13	17
Fuel inlet pipe x Delivery pipe		300	22	29
Throttle body x Air intake chamber (intake manifold)		220	16	22

COOLING SYSTEM

Coolant capacity w/ heater or air conditioner					
	4A-F	M/T	Europe	5.2 liters	5.5 US qts 4.6 Imp. qts
			General	5.8 liters	6.9 US qts 4.9 Imp. qts
		A/T		5.5 liters	5.8 US qts 4.8 Imp. qts
	4A-GE	AE and AT		6.0 liters	6.3 US qts 5.3 Imp. qts
		AW		12.4 liters	13.1 US qts 10.9 Imp. qts
Radietor	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
Water pump	Bearing installing temperature			85°C	185°F
Thermostat	Valve opening temperature				
	Starts to open at			80 – 84°C	178 – 183°F
	Fully opens at			95°C	203°F
	Valve opening travel			8 mm or more	0.31 in. or more

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 (35.8 – 71.1 psi, 245 – 490 kPa)	
Oil pump	4A-F				
	Body clearance		STD	0.080 – 0.135 mm	0.0031 – 0.0053 in.
			Limit	0.20 mm	0.0079 in.
	Tip clearance		STD	0.116 – 0.156 mm	0.0048 – 0.0061 in.
			Limit	0.35 mm	0.0138 in.
	Side clearance		STD	0.025 – 0.065 mm	0.0010 – 0.0026 in.
			Limit	0.10mm	0.0039 in.
	4A-GE				
	Body clearance		STD	0.100 – 0.191 mm	0.0039 – 0.0075 in.
			Limit	0.20 mm	0.0079 in.
	Tip clearance				
	Drive gear to crescent		STD	0.107 – 0.248 mm	0.0042 – 0.0098 in.
			Limit	0.35 mm	0.0138 in.
	Driven gear to crescent		STD	0.058 – 0.310 mm	0.0023 – 0.0122 in.
			Limit	0.35 mm	0.0138 in.
	Side clearance		STD	0.025 – 0.075 mm	0.0010 – 0.0030 in.
			Limit	0.10mm	0.0039 in.

STARTING SYSTEM

Starter	Type		Conventional		Reduction	
	Rated voltage and output power		12 V 0.8 kw		12 V 1.0 kw	
		rpm	More than 5,000 rpm		More than 3,000 rpm	
	Armature thrust clearance	STD	0.05 – 0.60 mm (0.0020 – 0.0236 in.)		–	
	Pinion end to stop collar clearance	STD	0.1 – 0.4 mm (0.004 – 0.016 in.)		–	
	Brush Length	STD	16 mm	0.63 in.	13.5 mm	0.531 in.
		Limit	10 mm	0.39 in.	8.5 mm	0.335 in.
	Spring installed load	STD	1.4 – 1.6 kg (3.1 – 3.5 lb, 14 – 16 N)		1.765 kg – 2.415 kg (3.9 – 5.3 lb, 18 – 24N)	
		Limit	1.0 kg (2.2 lb, 10 N)		1.2 kg (2.6 lb, 12 N)	
	Commutator					
	Outer diameter	STD	28 mm	1.10 in.	30 mm	1.18 in.
		Limit	27 mm	1.06 in.	29 mm	1.14 in.
	Undercut depth	STD	0.6 mm	0.024 in.	—	
		Limit	0.2 mm	0.008 in.	—	
	Circle runout	Limit	0.4 mm	0.016 in.	0.05 mm	0.0020 in.

CHARGING SYSTEM

Battery specific gravity When fully charged at 20°C (68°F)			1.25 – 1.27	
Alternator	Rated output		12 V 60 A, 12 V 70 A	
	Rotor coil resistance		2.8 – 3.0 Ω	
	Slip ring diameter	STD	14.2 – 14.4 mm	0.559 – 0.567 in.
		Limit	14.0 mm	0.551 in.
	Brush exposed length	STD	10.5 mm	0.413 in.
		Limit	4.5 mm	0.177 in.
Alternator regulator (IC)	Regulating voltage at 25°C (77°F)		13.9 – 15.1 V	
	at 115°C (239°F)		13.5 – 14.3 V	

IGNITION SYSTEM (4A-GE)

Ignition timing			See page A-6	
Spark plug			See page A-6	
Firing order			1 – 3 – 4 – 2	
High-tension cord	Resistance		25 kΩ per cord	
Ignition coil	Primary coil resistance	AE	0.41 – 0.50 Ω	
		AT and AW	0.52 – 0.64 Ω	
	Secondary coil resistance	AE	10.2 – 13.8 kΩ	
		AT and AW	11.5 – 15.5 kΩ	
Distributor	Air gap		0.2 – 0.4 mm	0.008 – 0.016 in.
	Signal generator (pickup coil) resistance		140 – 180 Ω	

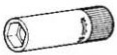
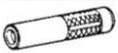
SST (SPECIAL SERVICE TOOLS)

NOTE: Classification

A = SST required for vehicle inspections and minor repairs and multipurpose SST.

B = SST required for major repairs involving disassembly of components.

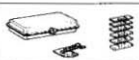
C = SST required for rather special, less frequent work not classifiable as either A or B.

Section / Classification / Part Name / Part No. / Illustration				EM	FI (4A-GE)	FU (4A-F)	CO	LU	IG	ST	CH	Note
	09027-12140	Angled Open End Wrench 12 x 14	C					●				4A-GE
	09032-00100	Oil Pan Seal Cutter	A					●				
	09156-16100	(Spark Plug Wrench)	A	●					●			
	09201-41020	Valve Stem Oil Seal Replacer	B	●								4A-F
	09201-70010	Valve Guide Bushing Remover & Replacer	B	●								
	09202-70010	Valve Spring Compressor	A	●								
	09205-16010	Cylinder Head Bolt Wrench	A	●								
	09213-14010	Crankshaft Pulley Holding Tool	A	●								4A-F
	09213-31021	Crankshaft Pulley Puller	A	●								
	09213-70010	Crankshaft Pulley Holding Tool	A	●								4A-GE

SST (SPECIAL SERVICE TOOLS) (Cont'd)

Section / Classification / Part Name / Part No. / Illustration				EM	FI (4A-GE)	FU (4A-F)	CO	LU	IG	ST	CH	Note
	09216-00020	(Belt Tension Gauge)	A	●							●	
	09216-00030	(Belt Tension Cable)	A	●							●	
	09221-25022	(Piston Pin Remover & Replacer)	B									
	(09221-00050)	(Bushing "B")		●								4A-F
	(09221-00130)	(Guide "G")		●								
	(09221-00140)	(Guide "H")		●								
	09222-30010	(Connecting Rod Bushing Remover & Replacer)	B	●								4A-GE
	09223-41020	(Crankshaft Rear Oil Seal Replacer)	B		●							
	09223-46011	(Crankshaft Front Oil Seal Replacer)	B	●								4A-F for camshaft oil seal
	09223-50010	(Crankshaft Front Oil Seal Replacer)	B	●								4A-GE for camshaft oil seal
	09228-06500	(Oil Filter Wrench)	A					●				
	09230-09010	(Radiator Service Tool Set)	B				●					

SST (SPECIAL SERVICE TOOLS) (Cont'd)

Illustration	Part No.	Part Name	Classification	EM	FI (4A-GE)	FU (4A-F)	CD	LU	IG	ST	CH	Note
	09236-00101	Water Pump Overhaul Tool Set	B									
	(09236-15010)	(Bearing Stay)					●					
	(09237-00010)	Water Pump Bearing Remover & Replacer					●					
	(09237-00020)	(Bearing Stay)					●					
	(09237-00040)	(Shaft "A")					●					
	09240-00014	Carburetor Adjusting Gauge Set	A			●						
	09240-00020	(Wire Gauge Set)	A			●						
	09243-00020	Idle Adjusting Screw Wrench	A	●								4A-F
	09248-55010	Valve Clearance Adjust Tool	A	●								
	09268-41045	Injection Measuring Tool Set	B		●							
	09268-45011	EFI Fuel Pressure Gauge	A		●							
	09285-76010	Injection Pump Camshaft Bearing Cone Replacer	C							●*1	●*2	*1 Starter front bearing for 1.0kw type *2 Rear bearing
	09286-46011	Injection Pump Spline Shaft Puller	C							●*1	●*2	*1 Starter front bearing for 1.0 kw type *2 Rectifier end frame

SST (SPECIAL SERVICE TOOLS) (Cont'd)

Section / Classification / Part Name / Part No. / Illustration				EM	FI (4A-GE)	FU (4A-F)	CO	LU	IG	ST	CH	Note
	09330-00021	(Companion Flange Holding Tool)	A	●								Crankshaft pulley
	09517-30010	(Rear Axle Shaft Oil Seal Replacer)	B					●				Crankshaft front oil seal
	09560-10012	"B" Replacer Set	B									
	09552-10010	(No. 2 Replacer Handle)		●								4A-F for spark plug tube gasket
	09560-10010	(Knuckle Outer Bearing Replacer)		●								
	09608-20012	(Front Hub & Drive Pinion Bearing Tool Set)	B									
	09608-00030	(Replacer)									●	Rotor front bearing
	09631-22020	(Power Steering Hose Nut 14 x 17 Wrench)	A		●							Fuel line flare nut
	09820-00021	(Alternator Rear Bearing Puller)	B								●	
	09820-63010	(Alternator Pulley Set Nut Wrench Set)	B								●	
	09842-30050	(Wiring "A" EFI Inspection)	B		●							
	09842-30060	(Wiring "E" EFI Inspection)	B		●							w/o Air flow meter
	09842-30070	(Wiring "F" EFI Inspection)	B		●							w/ Air flow meter
	09860-11011	(Carburetor Drive Set)	A			●						

SSM (SPECIAL SERVICE MATERIALS)

Part Name	Part No.	Sec.	Use etc.
Seal packing or equivalent	08826-00080	EM	Cylinder head cover Camshaft bearing cap No. 1 Half circle plug (For 4A-F)
		LU	Oil pan Oil pan baffle plate (For 4A-GE)
		IG	Ignition coil
Seal packing No. 1282-8 or equivalent	08826-00100	EM	Water inlet housing Water outlet pipe
		CO	Water pump seal
Adhesive 1324, Three bond 1324 or equivalent	08833-00070	EM	Spark plug tube (For 4A-F)
		IG	Pickup set screw (For 4A-F)

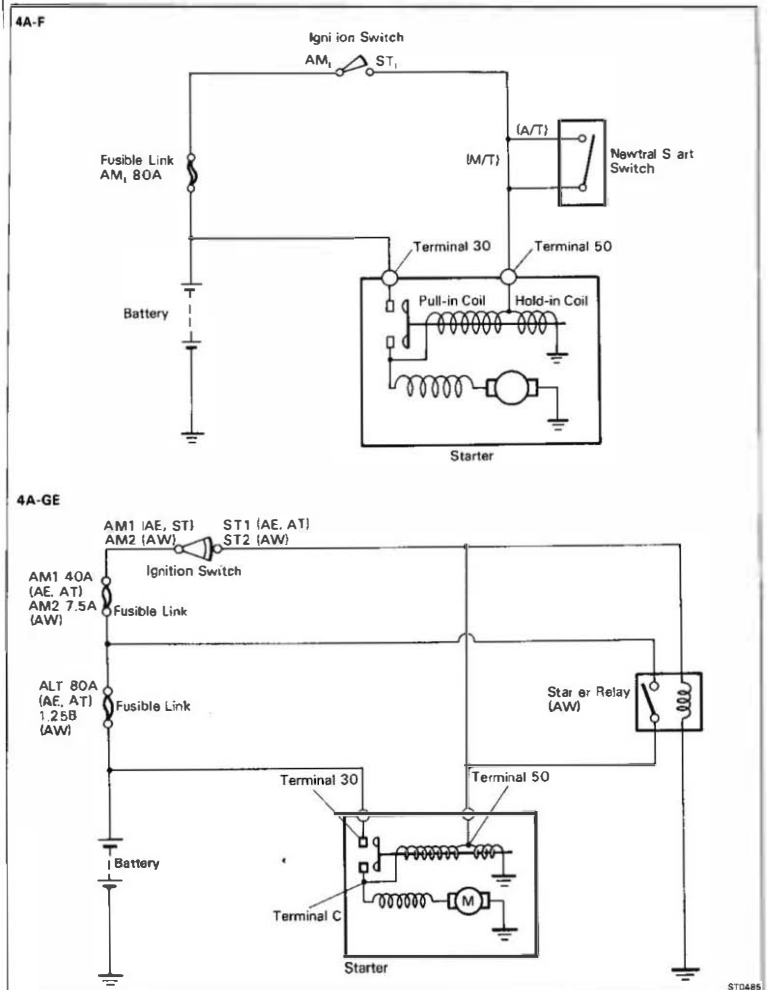
STARTING SYSTEM

S

TROUBLESHOOTING

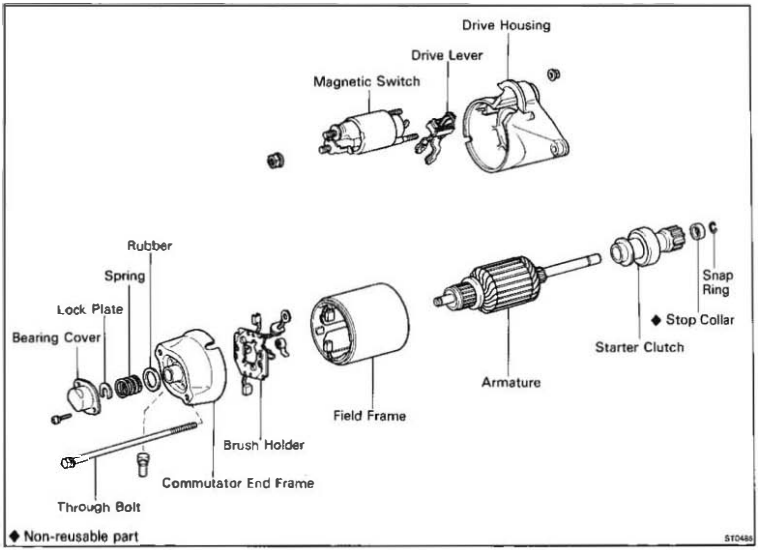
Problem	Possible cause	Remedy	Page
Engine will not crank	Battery charge low	Check battery specific gravity Charge or replace battery	CH-4
	Battery cables loose, corroded or worn	Repair or replace cables	
	Neutral start switch faulty (A/T only)	Adjust or replace switch	
	Fusible link blown	Replace fusible link	
	Starter faulty	Repair starter	ST-4 or 14
	Ignition switch faulty	Replace ignition switch	
Engine cranks slowly	Battery charge low	Check battery specific gravity Charge or replace battery	CH-4
	Battery cables loose, corroded or worn	Repair or replace cables	
	Starter faulty	Repair starter	ST-4 or 14
Starter keeps running	Starter faulty	Repair starter	ST-4 or 14
	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-4 or 14
	Flywheel teeth broken	Replace flywheel	

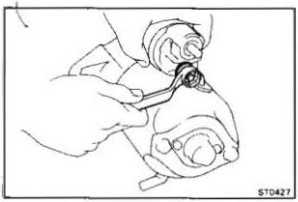
STARTING SYSTEM CIRCUIT



CONVENTIONAL TYPE STARTER

COMPONENTS



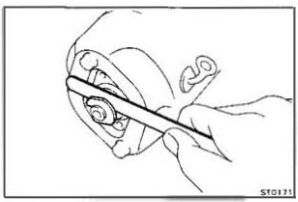


DISASSEMBLY OF CONVENTIONAL TYPE STARTER

1. REMOVE MAGNETIC SWITCH

(a) Remove the nut, and disconnect the lead wire from the magnetic switch terminal.

(b) Loosen the two nuts holding the magnetic switch to the drive housing. Lift the magnetic switch up and out to unhook the plunger from the drive lever.

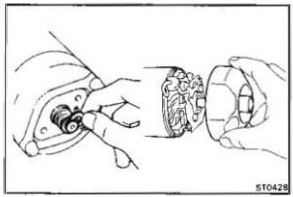


2. REMOVE END FRAME

(a) Remove the screws and bearing cover.

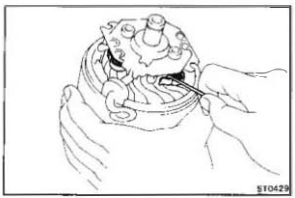
(b) Using a thickness gauge, check the armature shaft thrust clearance between the lock plate and end frame.

Thrust clearance: 0.05 – 0.60 mm (0.0020 – 0.0236 in.)



(c) Remove the lock plate, spring and rubber.

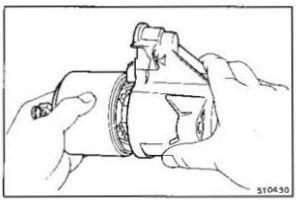
(d) Remove the two through bolts and pull out the commutator end frame.



3. REMOVE BRUSHES AND BRUSH HOLDER

(a) Using a piece of steel wire, separate the brush springs, and remove the brushes from the brush holder.

(b) Pull the brush holder off the armature.



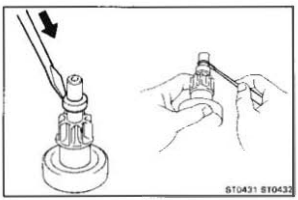
4. REMOVE FIELD FRAME FROM DRIVE HOUSING

Pull apart by hand.

5. REMOVE ARMATURE

(a) Remove the drive lever from the drive housing.

(b) Pull the armature from the drive housing.

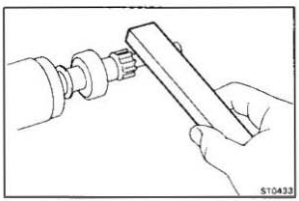


6. REMOVE STARTER CLUTCH

(a) Using a screwdriver, tap in the stop collar.

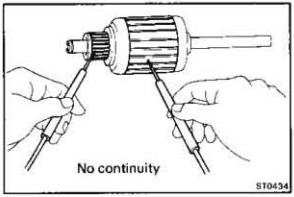
(b) Using a screwdriver, pry off the snap ring.

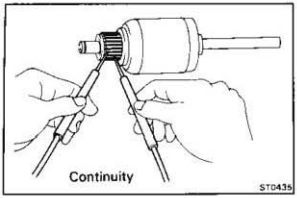
(c) Remove the stop collar from the shaft.



(d) If the pinion was difficult to pull out, smooth the shaft with an oil stone.

(e) Remove the starter clutch.





INSPECTION OF CONVENTIONAL TYPE STARTER

Armature Coil

1. CHECK 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. CHECK COMMUTATOR FOR OPEN CIRCUIT

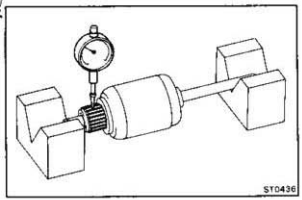
Using an ohmmeter, check for continuity between the segments of the commutator.

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

Commutator

1. INSPECT COMMUTATOR FOR DIRT AND BURNT SURFACES

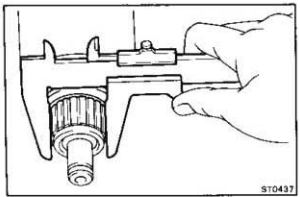
If surface is dirty or burnt, correct with sandpaper (No.400) or a lathe.



2. CHECK COMMUTATOR RUNOUT

Maximum circle runout: 0.4 mm (0.016 in.)

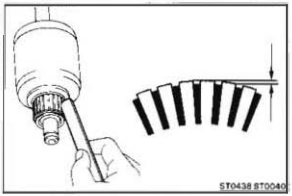
If runout is greater than maximum, correct with a lathe.



3. MEASURE DIAMETER OF COMMUTATOR

Standerd diameter: 28 mm (1.10 in.)
Minimum diameter: 27 mm (1.06 in.)

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



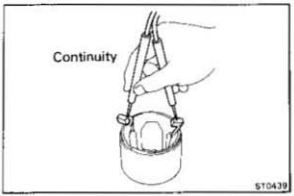
4. CHECK SEGMENT

Check that the segment is clean and free of foreign particles.

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 with a hacksaw blade and smooth out the edge.

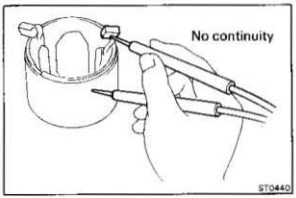
Field Coil



1. CHECK FIELD COIL FOR OPEN CIRCUIT

Using an ohmmeter, check for continuity between the field coil brush leads.

If there is no continuity, replace the field frame.

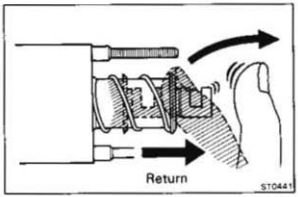


2. CHECK THAT FIELD COIL IS NOT GROUNDED

Using an ohmmeter, check for no continuity between the field coil end and field frame.

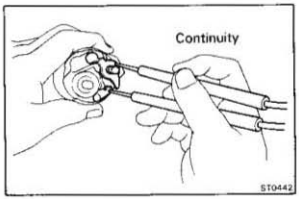
If there is continuity, replace the field frame.

Magnetic Switch



1. CHECK PLUNGER

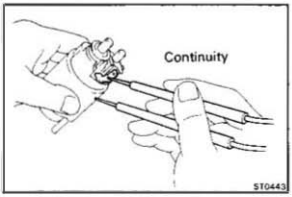
Push in the plunger and release it. Check that it returns quickly to its original position.



2. PERFORM PULL-IN COIL OPEN CIRCUIT TEST

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

If there is no continuity, replace the magnetic switch.



3. PERFORM HOLD-IN COIL OPEN CIRCUIT TEST

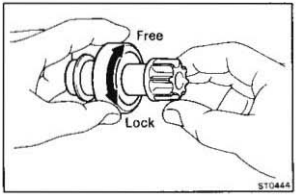
Using an ohmmeter, check for continuity between terminal 50 and the switch body.

If there is no continuity, replace the magnetic switch.

Starter Clutch

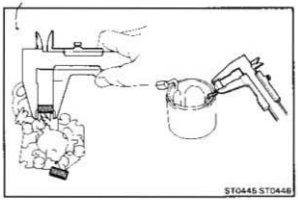
1. INSPECT PINION GEAR AND SPRINE TEETH

Inspect the pinion gear and spline teeth for wear or damage. If damaged, replace and also inspect the flywheel ring gear for wear or damage.



2. CHECK CLUTCH

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

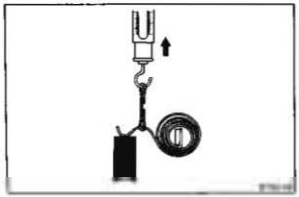


Brushes

MEASURE BRUSH LENGTH

Standard length: 16 mm (0.63 in.)
Minimum length: 10 mm (0.39 in.)

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



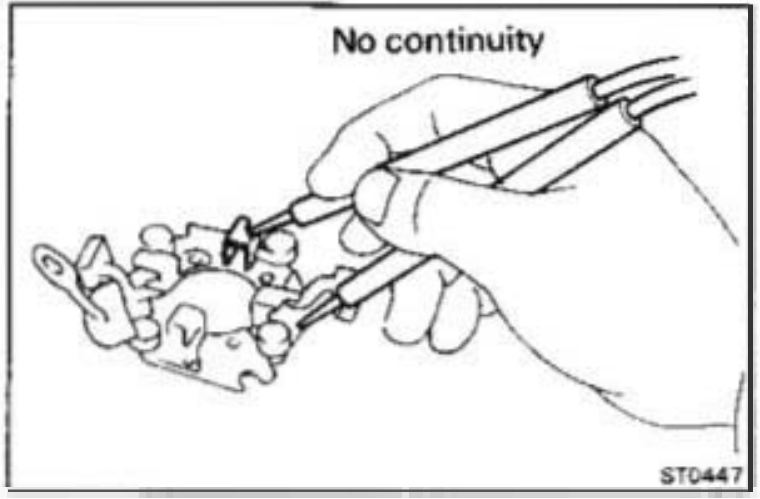
Brush Springs

MEASURE BRUSH SPRING LOAD WITH A PULL SCALE

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

Standard installed load: 1.4 — 1.6 kg (3.1 — 3.5 lb, 14 — 16 N)
Minimum installed load: 1.0 kg (2.2 lb, 10 N)

If the installed load is less than minimum, replace the brush springs.



Brush Holder

CHECK INSULATION OF BRUSH HOLDER

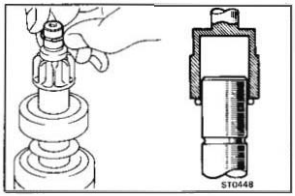
Using an ohmmeter, check for no continuit between the positive and negative brush holders.

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

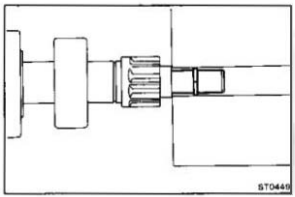
ASSEMBLY OF CONVENTIONAL TYPE STARTER

(See page ST-4)

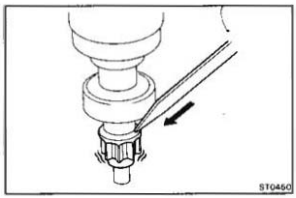
NOTE: Use high-temperature grease to lubricate the bearings and sliding parts when assemblying the starter.



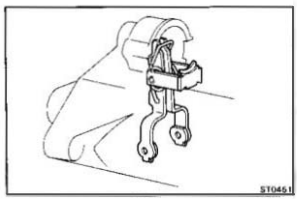
1. **ASSEMBLE STARTER CLUTCH TO ARMATURE**
   (a) Place a new stop collar on the armature.
   (b) Drive in the snap ring with a 14 mm (0.55 in.) socket wrench, then fit it into the shaft groove.



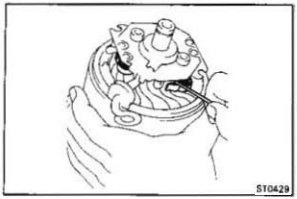
   (c) Using a vise, compress the snap ring. Make sure that the snap ring fits correctly.



   (d) Using a screwdriver, tap the pinion to slide the stop collar onto the snap ring.



2. **ASSEMBLE DRIVE LEVER TO DRIVE HOUSING AND FIELD FRAME TO ARMATURE**
   (a) Apply grease to the drive lever and drive housing bushing.
   (b) Install the drive lever to the drive housing.
   (c) Install the field frame on the armature.



3. INSTALL BRUSH HOLDER AND BRUSHES

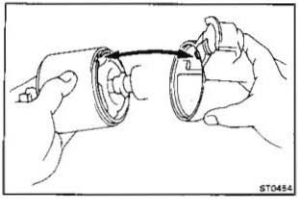
(a) Place the brush holder, over the armature shaft.

(b) Using a piece of steel wire, hold the brush spring back and install the brush in the brush holder. Install the four the brushes.

4. INSTALL END FRAME

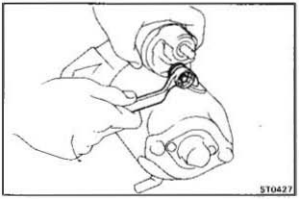
(a) Apply grease to the end frame bushing.

(b) Install the end frame on the armature shaft.

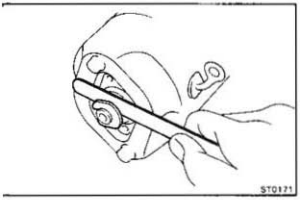


5. INSTALL FIELD FRAME WITH ARMATURE AND END FRAME IN DRIVE HOUSING

(a) Match the protrusion of the drive lever with field frame



(b) Install and tighten the two through bolts.



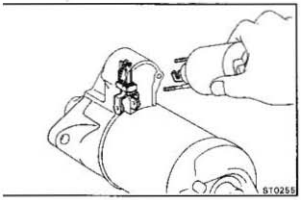
6. INSTALL BEARING COVER

(a) Install the rubber, spring and lock plate.

(b) Using a thickness gauge, measure the armature thrust clearance between the lock plate and end frame.

Thrust clearance: 0.05 — 0.60 mm (0.0020 — 0.0236 in.)

(c) Install the bearing cover with the two screws.

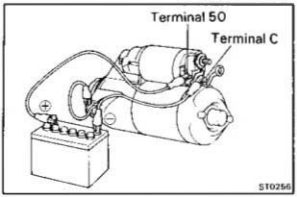


7. INSTALL MAGNETIC SWITCH

Hook the magnetic switch stud underneath the drive lever spring. Install the two nuts.

PERFORMANCE TEST OF CONVENTIONAL TYPE STARTER

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

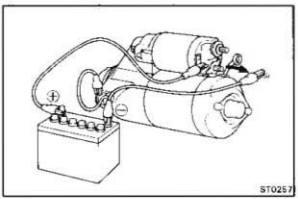


1. PERFORM PULL-IN TEST

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

(b) Connect the battery to the magnetic switch as shown. Check that the pinion moves outward.

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

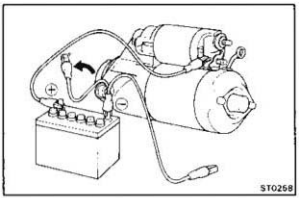


2. PERFORM HOLD-IN TEST

With the battery connected as above and with the pinion out, disconnect the negative lead from terminal C.

Check that the pinion remains out.

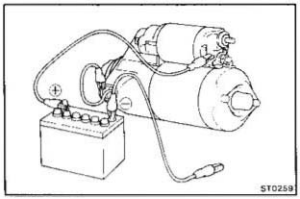
If the pinion returns inward, replace the magnetic switch.



3. CHECK PINION RETURN

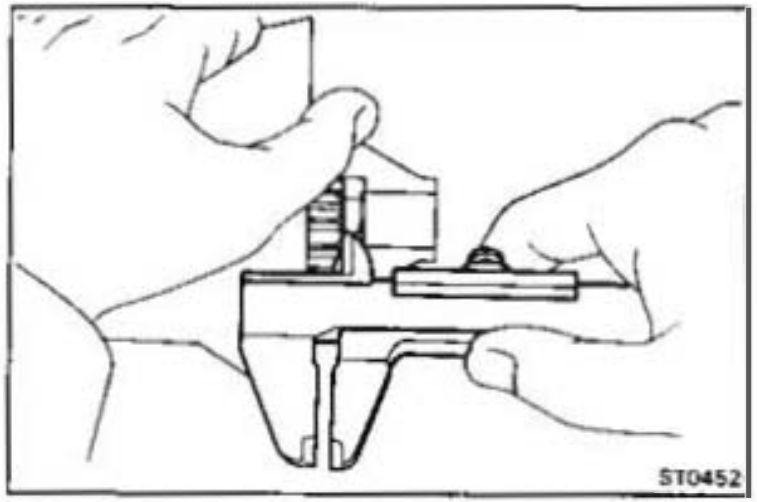
Disconnect the negative lead from the switch body. Check that the pinion returns inward.

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



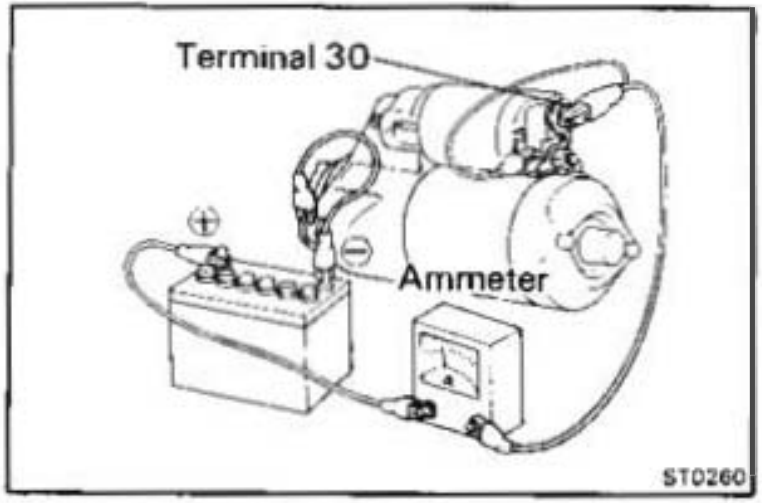
4. CHECK PINION CLEARANCE

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



(b) Move the pinion gear toward the armature to remove slack and measure the clearance between the pinion end and stop collar.

Standard clearance: 0.1 – 0.4 mm (0.004 – 0.016 in.)



5. PERFORM NO-LOAD PERFORMANCE TEST

(a) Connect the field coil lead to terminal C. Make sure the lead is not grounded.

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

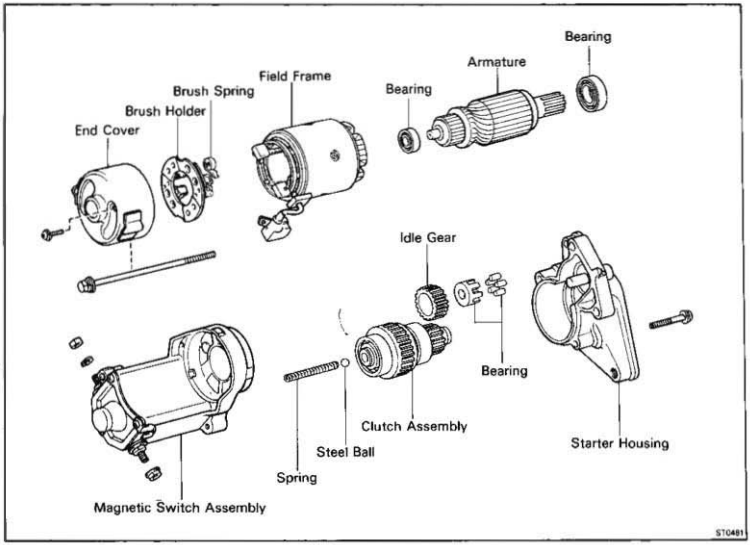
(c) Check that the starter rotates smoothly and steadily with the pinion moving out.

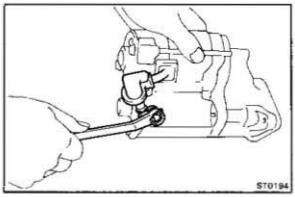
(d) Check that the ammeter reads the specified current.

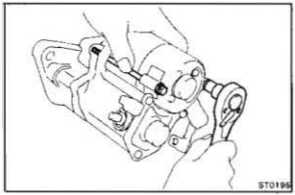
Specified current: Less than 60 A at 11 V

REDUCTION TYPE STARTER

COMPONENTS





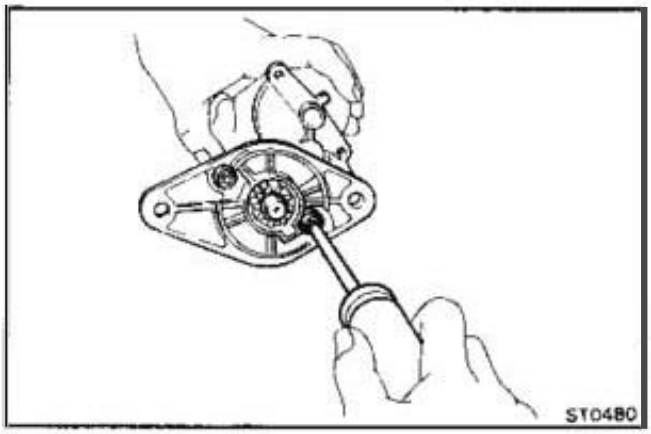


DISASSEMBLY OF REDUCTION TYPE STARTER

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

   (a) Remove the nut. Disconnect the lead wire from the magnetic switch terminal.

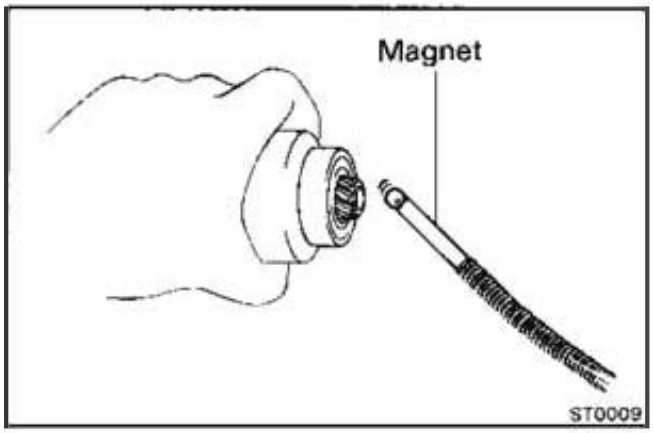
   (b) Remove the two through bolts. Pull out the field frame with the armature from the magnetic switch.



2. REMOVE STARTER HOUSING FROM MAGNETIC SWITCH ASSEMBLY

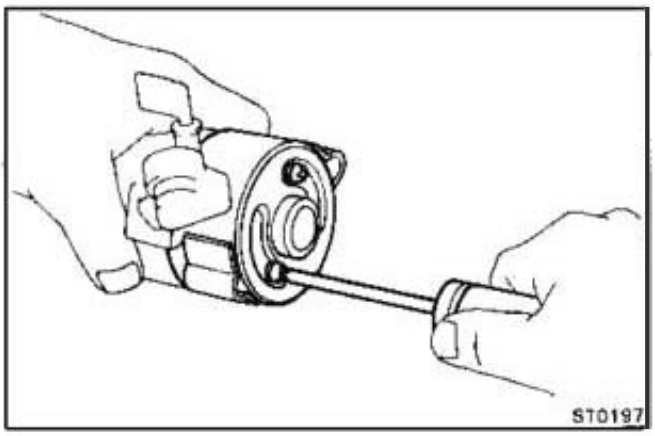
Remove the two screws and remove the starter housing with the idler gear and clutch assembly.

3. REMOVE CLUTCH ASSEMBLY AND IDLER GEAR FROM STARTER HOUSING



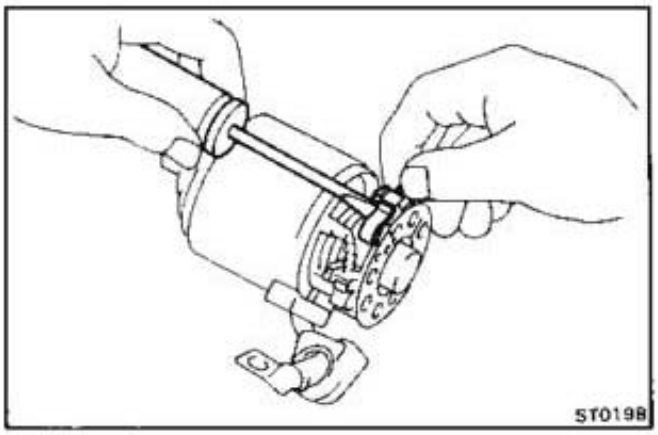
4. REMOVE STEEL BALL AND SPRING

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



5. REMOVE BRUSHES AND BRUSH HOLDER

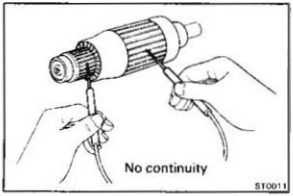
(a) Remove the two screws and end cover from the field frame.



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

(c) Pull the brush holder off the armature.

6. REMOVE ARMATURE FROM FIELD FRAME



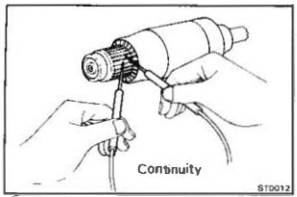
INSPECTION OF STARTER

Armature Coil

1. **INSPECT THAT COMMUTATOR IS NOT GROUNDED**

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

If there is continuity, replace the armature.



2. **INSPECT COMMUTATOR FOR OPEN CIRCUIT**

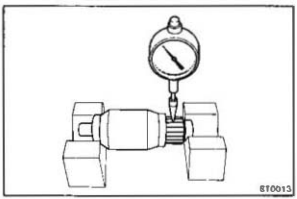
Using an ohmmeter, check for continuity between the segments of the commutator.

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

Commutator

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

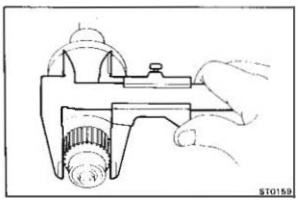
If the surfece is dirty or burnt, correct with sandpaper (No.400) or a lathe.



2. **INSPECT COMMUTATOR RUNOUT**

Maximum circle runout: 0.05 mm (0.0020 in.)

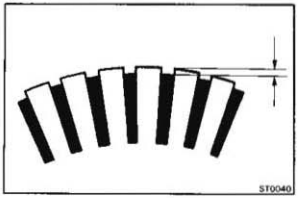
If the circle runout is greater than maximum, correct it with a lathe.



3. **MEASURE DIAMETER OF COMMUTATOR**

Standard diameter: 30 mm (1.18 in.)
Minimum diameter: 29 mm (1.14 in.)

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


ST0040

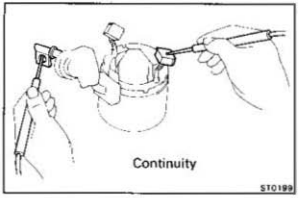
4. CHECK SEGMENT

Check that the segment is clean and free of foreign particles.

Standard undercut depth: 0.6 mm (0.24 in.)
Minimum undercut depth: 0.2 mm (0.008 in.)

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

Field Coil

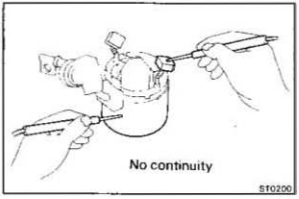


ST0199

1. INSPECT FIELD COIL FOR OPEN CIRCUIT

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

If there is no continuity, replace the field frame.



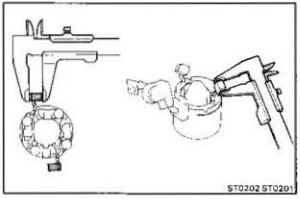
ST0200

2. INSPECT THAT FIELD COIL IS NOT GROUNDED

Using an ohmmeter, check for no continuity between the field coil end and field frame.

If there is continuity, repair or replace the field frame.

Brushes

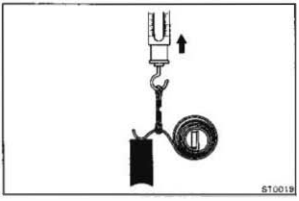

ST0202 ST0201

MEASURE BRUSH LENGTH

Standard length: 13.5 mm (0.531 in.)
Minimum length: 8.5 mm (0.335 in.)

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

Brush Spring

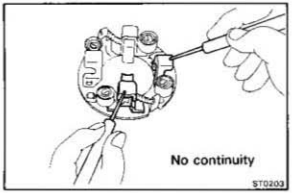

ST0019

MEASURE BRUSH SPRING LOAD WITH PULL SCALE

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

Standard installed load: 1.786 — 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.



Brush Holder

INSPECT INSULATION OF BRUSH HOLDER

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

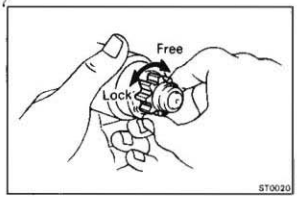
If there is continuity, repair or replace the brush holder.

Clutch and Gears

1. INSPECT GEAR TEETH

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

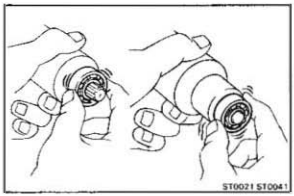
If damaged, replace, and also check the flywheel ring gear for wear or damage.



2. INSPECT CLUTCH

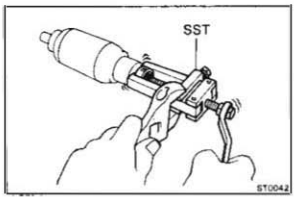
Rotate the pinion clockwise and check that it turns freely. Try to rotate the pinion counterclockwise and check that it locks.

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.

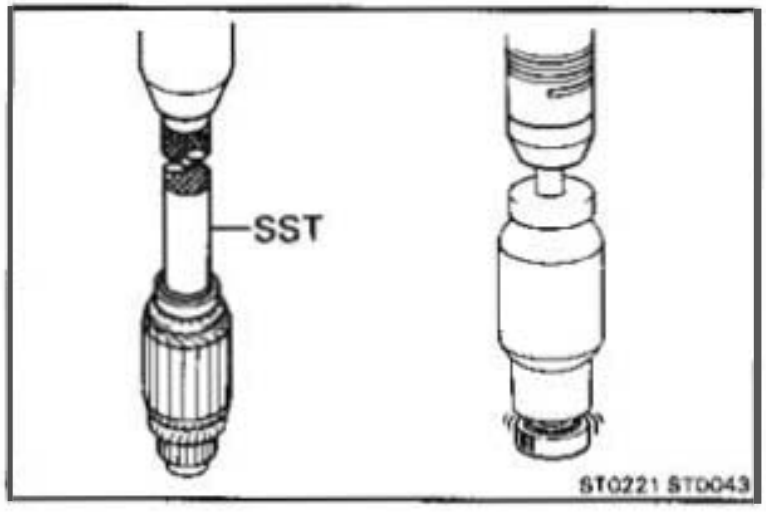


2. IF NECESSARY, REPLACE BEARINGS

(a) Using SST, remove the bearing from the armature shaft.

(b) Using SST, remove the other bearing from the opposite side.

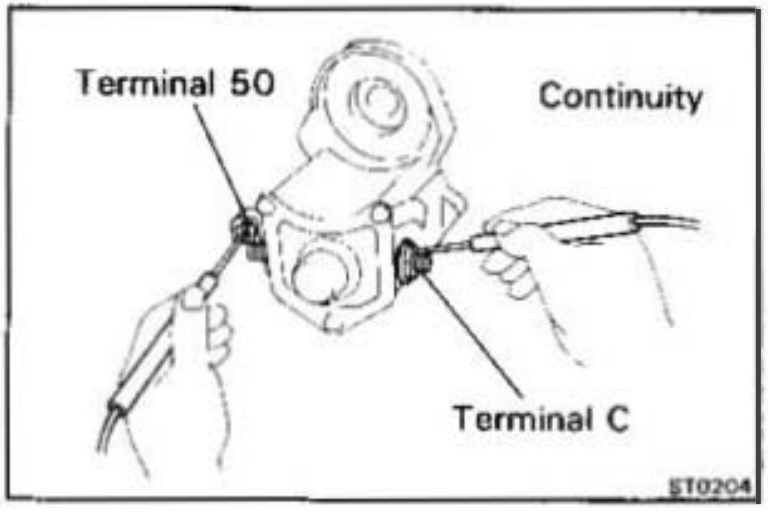
SST 09286-46011



(c) Using SST and a press, install a new front bearing onto the shaft.

SST 09285-76010

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

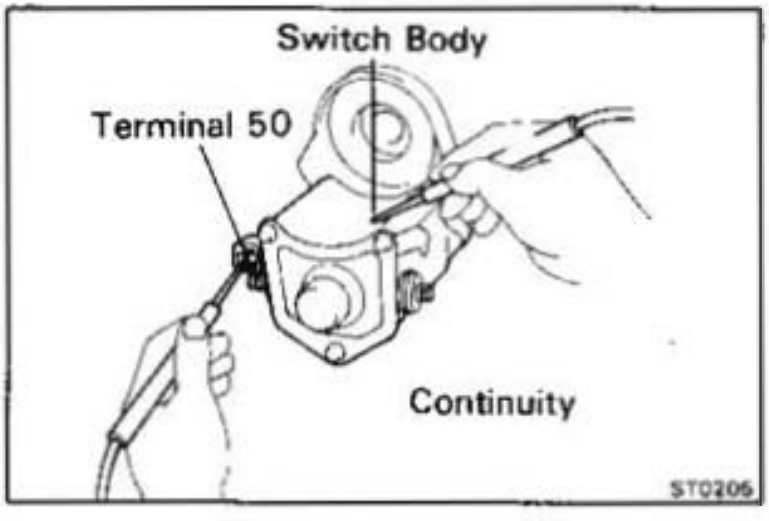


Magnetic Switch

1. PERFORM PULL-IN COIL OPEN CIRCUIT TEST

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

If there is no continuity, replace the magnetic switch.



2. PERFORM HOLD-IN COIL OPEN CIRCUIT TEST

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

If there is no continuity, replace the magnetic switch.

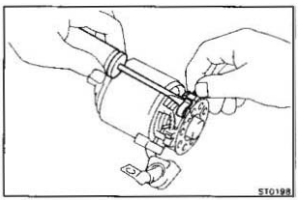
ASSEMBLY OF REDUCTION TYPE STARTER

(See page ST-14)

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

1. PLACE ARMATURE INTO FIELD FRAME

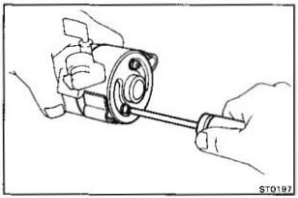
Apply grease to the armature bearings and insert the armature into the field frame.



2. INSTALL BRUSH HOLDER AND BRUSHES

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

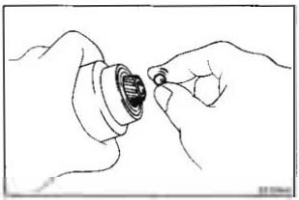
NOTE: Make sure that the positive lead wires are not grounded.

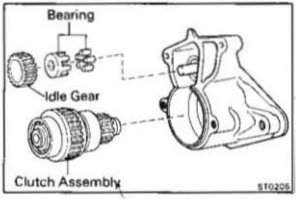


(b) Install the end cover to the field frame.

3. INSERT STEEL BALL INTO CLUTCH SHAFT HOLE

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

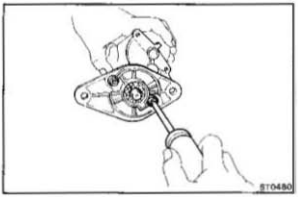




4. INSTALL GEAR AND CLUTCH ASSEMBLY

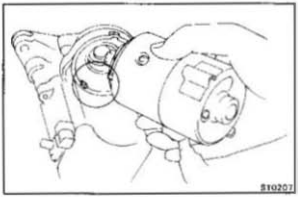
(a) Apply grease to the gear and clutch assembly.

(b) Place the clutch assembly, idler gear and bearing in the starter housing.



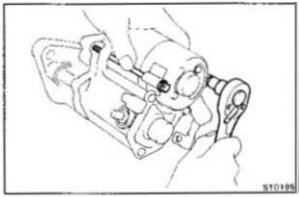
5. INSTALL STARTER HOUSING

Place the starter housing on the magnetic switch and install the two screws.

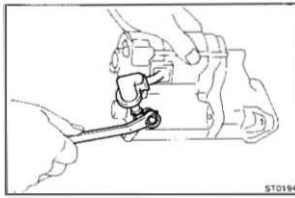


6. INSTALL FIELD FRAME WITH ARMATURE IN MAGNETIC SWITCH

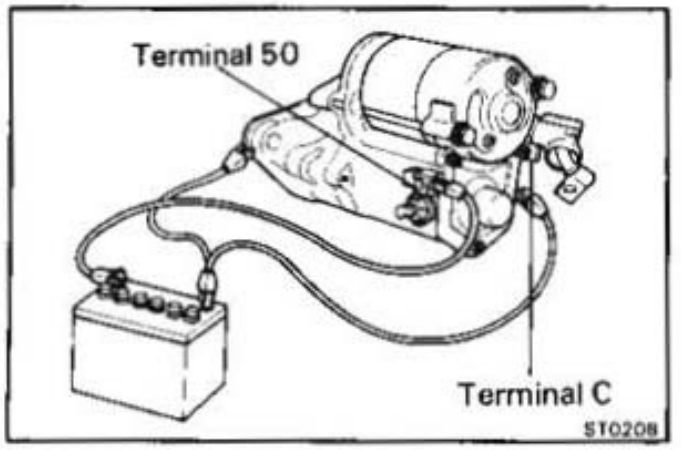
(a) Match the protrusion of the field frame with the magnetic switch.



(b) Install the two through bolts.



(c) Connect the coil lead to the terminal on the magnetic switch.



PERFORMANCE TEST OF STARTER

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

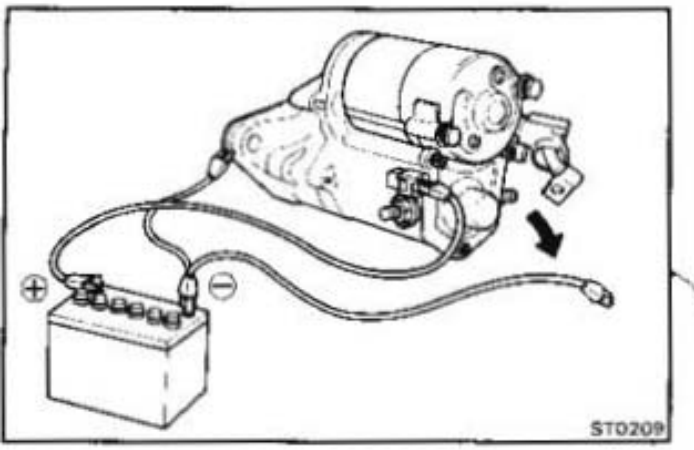
1. PERFORM PULL-IN TEST

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

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

(c) Check that the plunger moves outward.

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

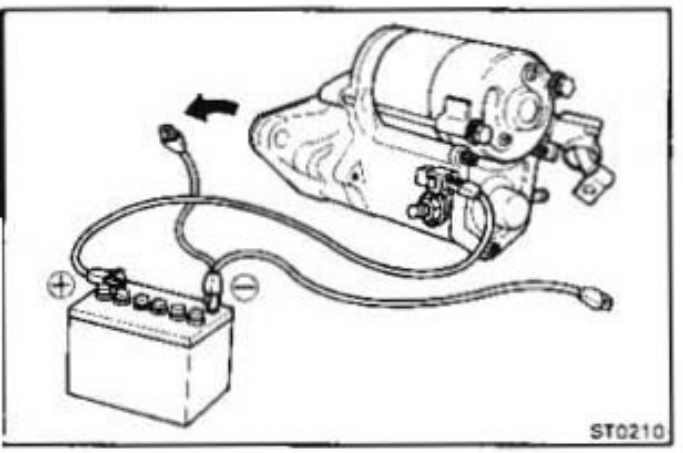


2. PERFORM HOLD-IN TEST

(a) While connected as above with the plunger out, disconnect the negative lead from terminal C.

(b) Check that the plunger remains out.

If the plunger returns inward, replace the magnetic switch.

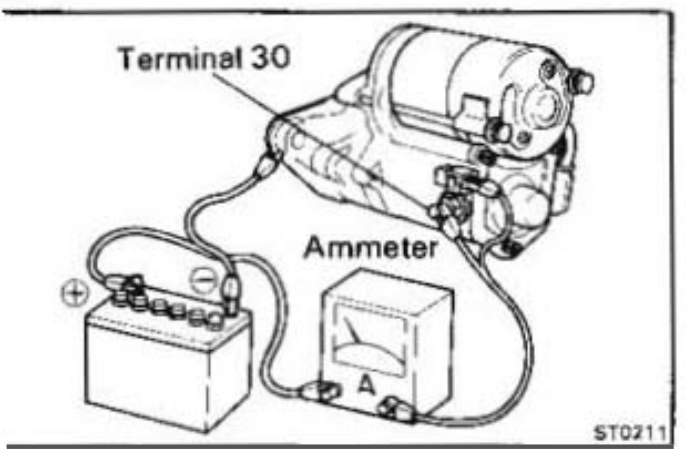


3. INSPECT PLUNGER RETURN

(a) Disconnect the negative lead from the switch body.

(b) Check that the plunger returns inward.

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



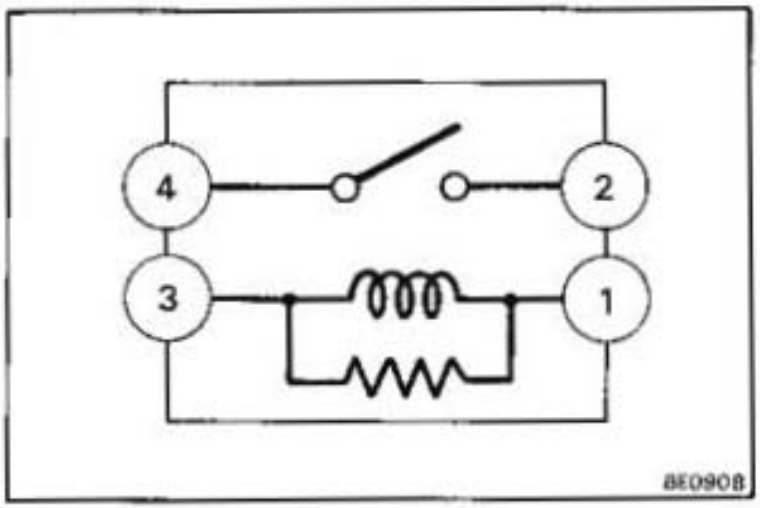
4. PERFORM NO-LOAD PERFORMANCE TEST

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

(b) Check that the starter rotates smoothly and steadily with the pinion moving out.

(c) Check that the ammeter reads the specified current.

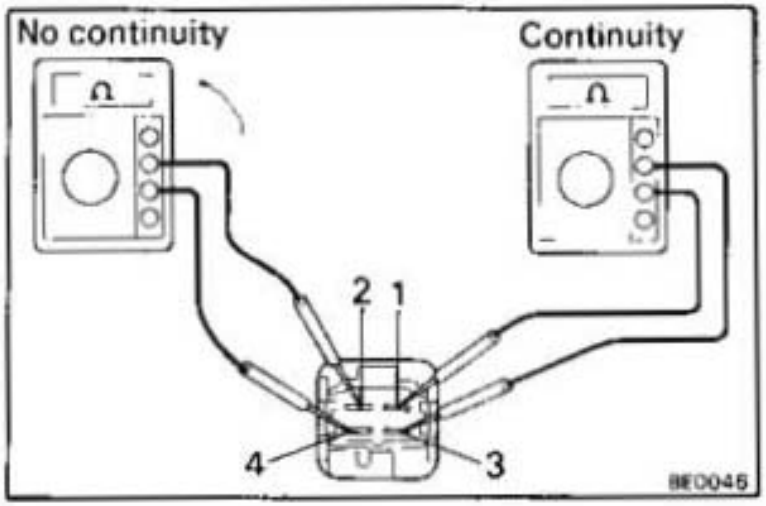
Specified current: Less than 90 A at 11.5 V



STARTER RELAY (AW)

INSPECTION OF STARTER RELAY

LOCATION: In the No. 2 junction block of the engine compartment.

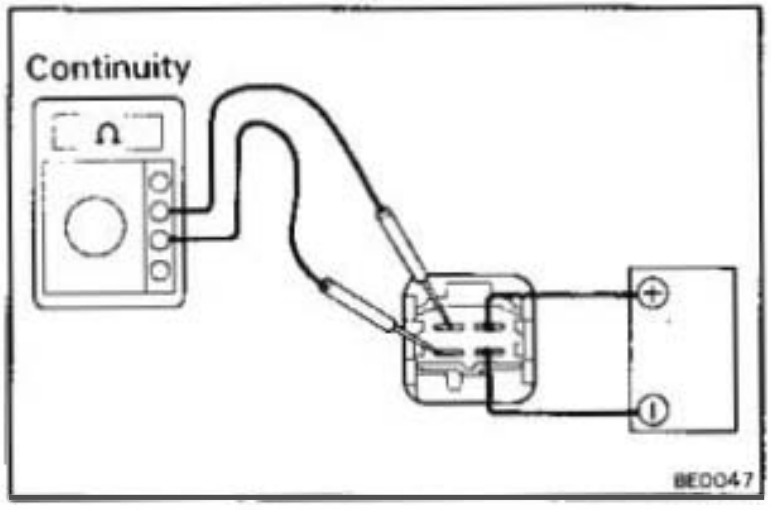


1. INSPECT RELAY CONTINUITY

(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.

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.