ENGINE FUEL & EMISSION CONTROL SYSTEM

SECTION EF & EC

EF & EC

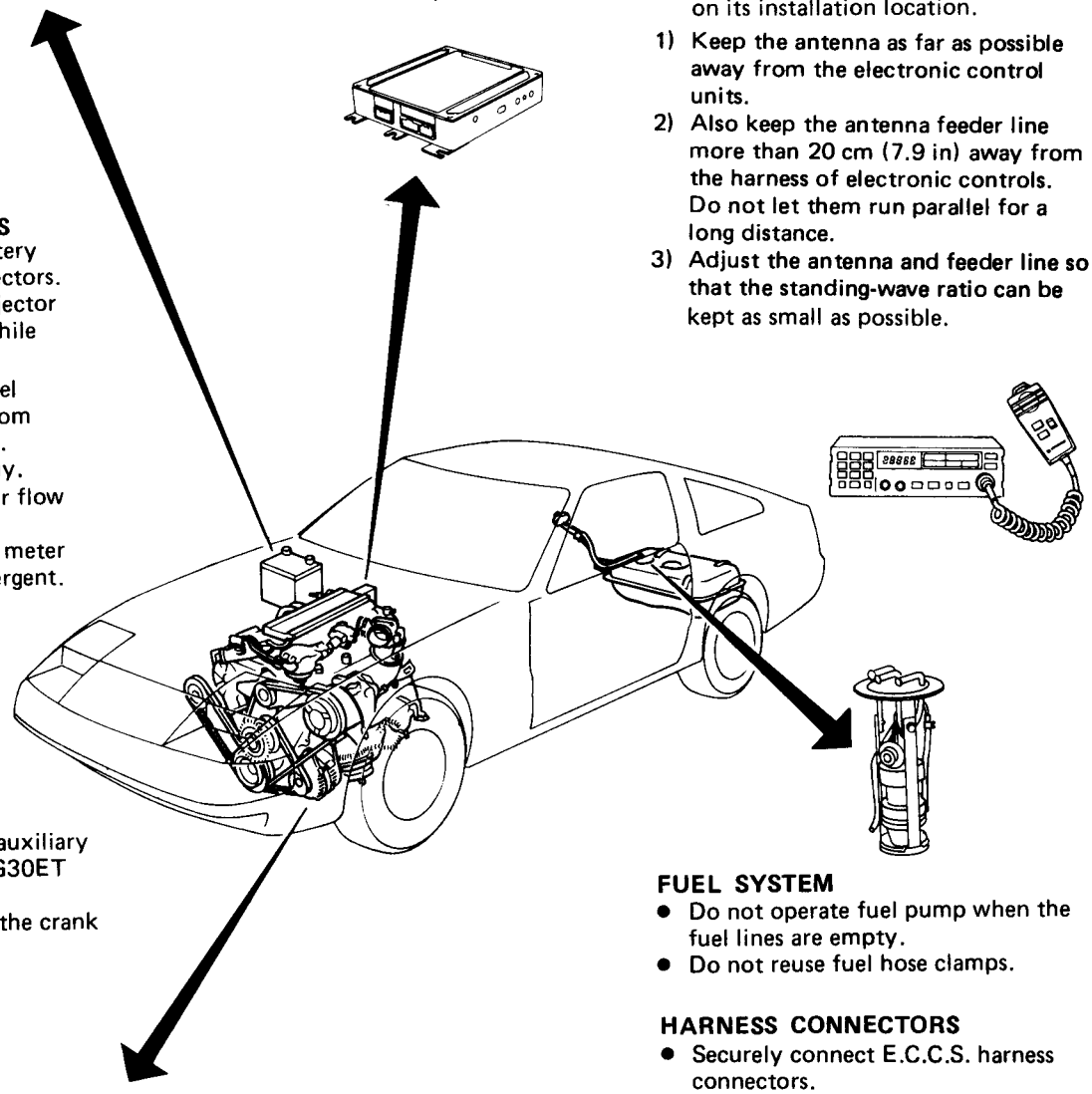
CONTENTS

BATTERY
- Do not attempt to disconnect battery cables while engine is operating.

E.C.C.S. CONTROL UNIT
- Do not disassemble E.C.C.S. control unit.
- Do not turn diagnosis mode selector forcibly.

HAM RADIO & VEHICLE PHONE
- When installing a C.B. ham radio or a vehicle phone, be sure to observe the following as it may adversely affect electronic control systems depending on its installation location.

1) Keep the antenna as far as possible away from the electronic control units.
2) Also keep the antenna feeder line more than 20 cm (7.9 in) away from the harness of electronic controls. Do not let them run parallel for a long distance.
3) Adjust the antenna and feeder line so that the standing-wave ratio can be kept as small as possible.



E.C.C.S. COMPONENTS
- Do not apply the battery power directly to injectors.
- Do not disconnect injector harness connectors while engine is operating.
- Do not remove the fuel temperature sensor from the pressure regulator. Replace as an assembly.
- Do not disassemble air flow meter.
- Do not clean air flow meter with any type of detergent.

- Do not disassemble auxiliary air control valve (VG30ET engine).
- Do not shock or jar the crank angle sensor.

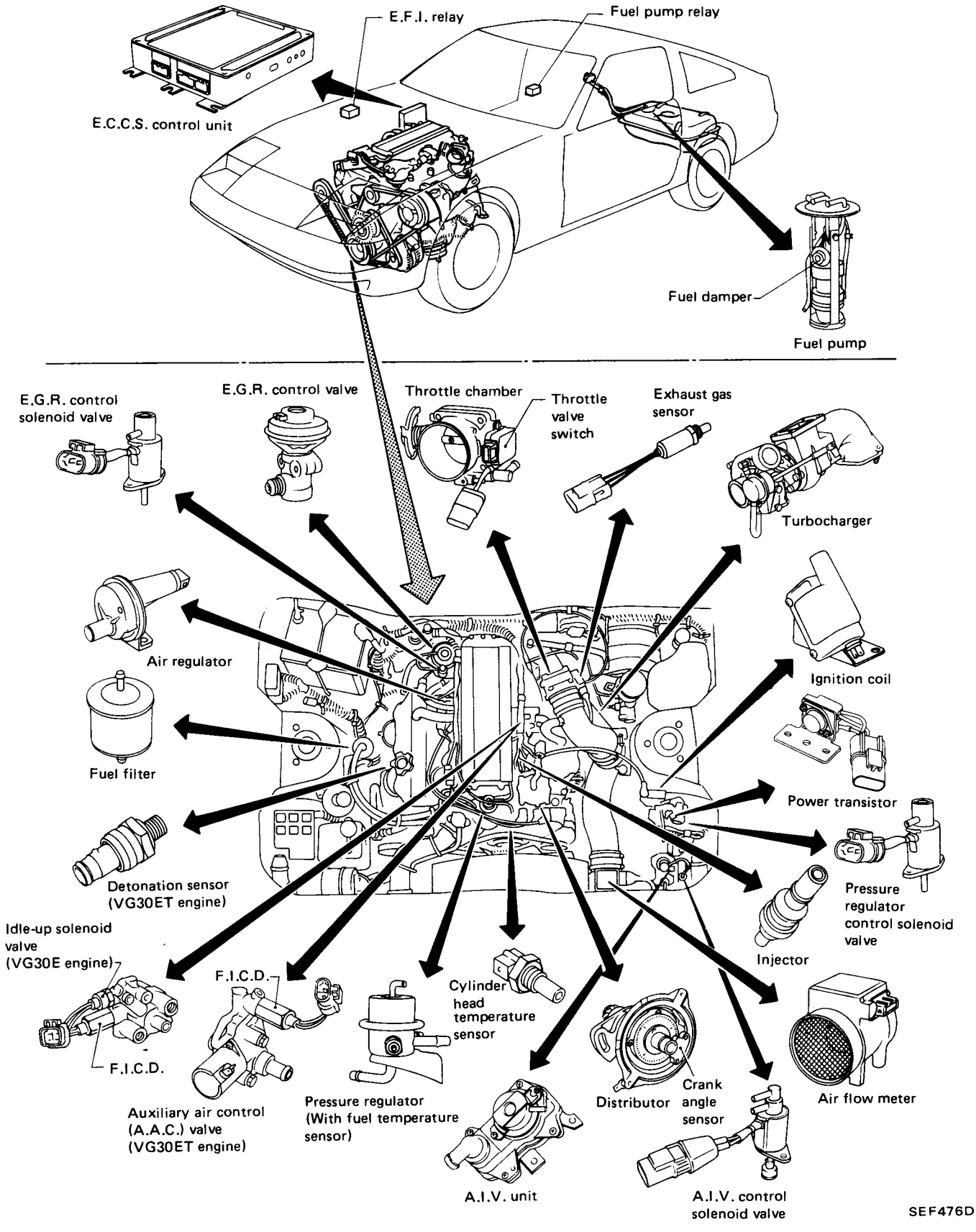
AIR FLOW SYSTEM
- Even a slight leak in the air intake system can cause serious problems.

FUEL SYSTEM
- Do not operate fuel pump when the fuel lines are empty.
- Do not reuse fuel hose clamps.

HARNESS CONNECTORS
- Securely connect E.C.C.S. harness connectors.
  A poor connection can cause an extremely high (surge) voltage to develop in coil and condenser, thus resulting in damage to IC circuit.
- Keep E.C.C.S. harness at least 10 cm (3.9 in) away from adjacent harnesses, to prevent an E.C.C.S. system malfunction due to reception of external noise, degraded operation of IC circuit, etc.
- Keep E.C.C.S. parts and harnesses dry.
- Before removing parts, turn off ignition switch and then disconnect battery ground cable.

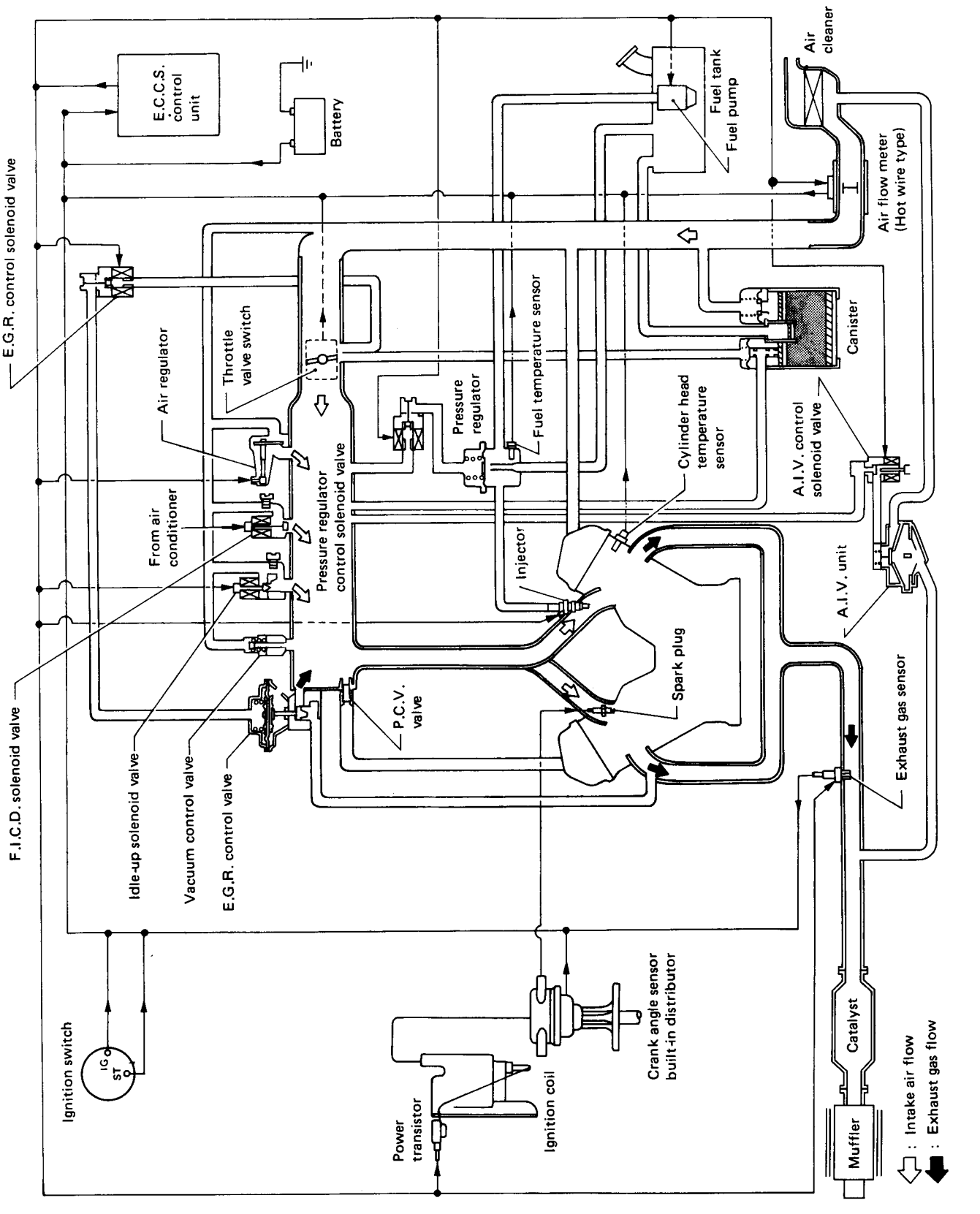
SEF475D

COMPONENT PARTS LOCATION



E.C.C.S. DIAGRAM

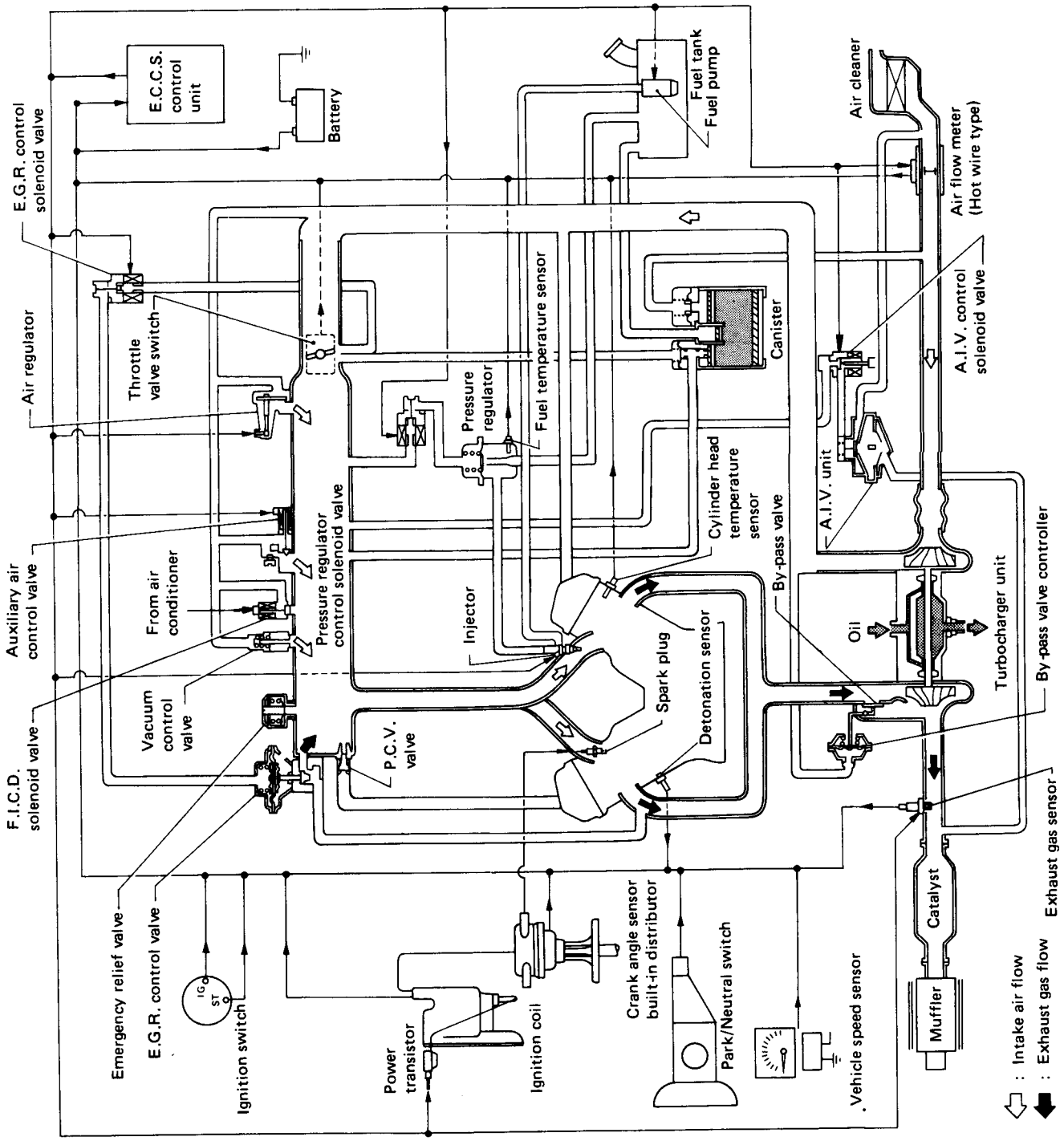
VG30E Engine (Without turbocharger)



SEF477D

E.C.C.S. DIAGRAM

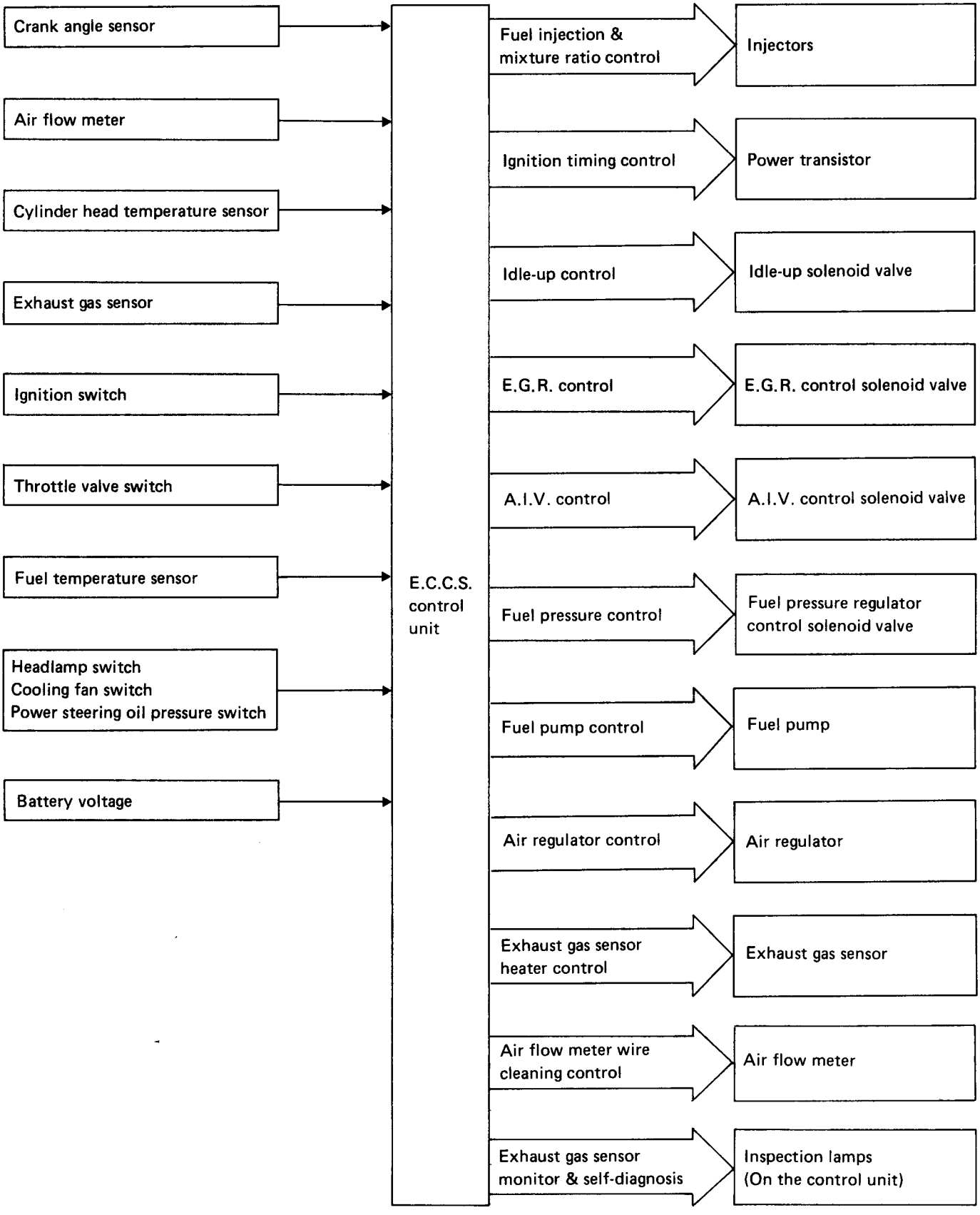
VG30ET Engine (With turbocharger)



SEF478D

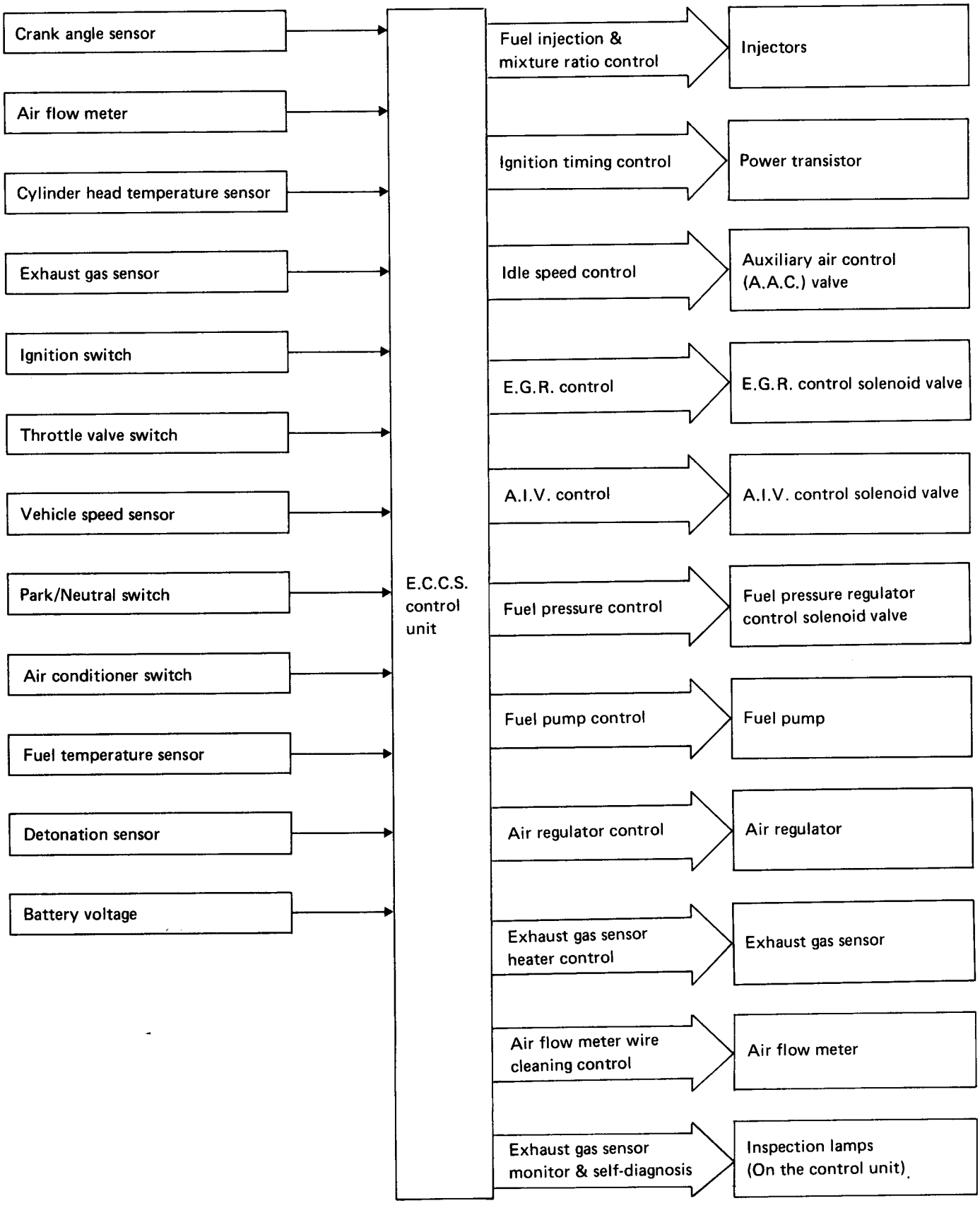
E.C.C.S. CHART

VG30E Engine (Without turbocharger)

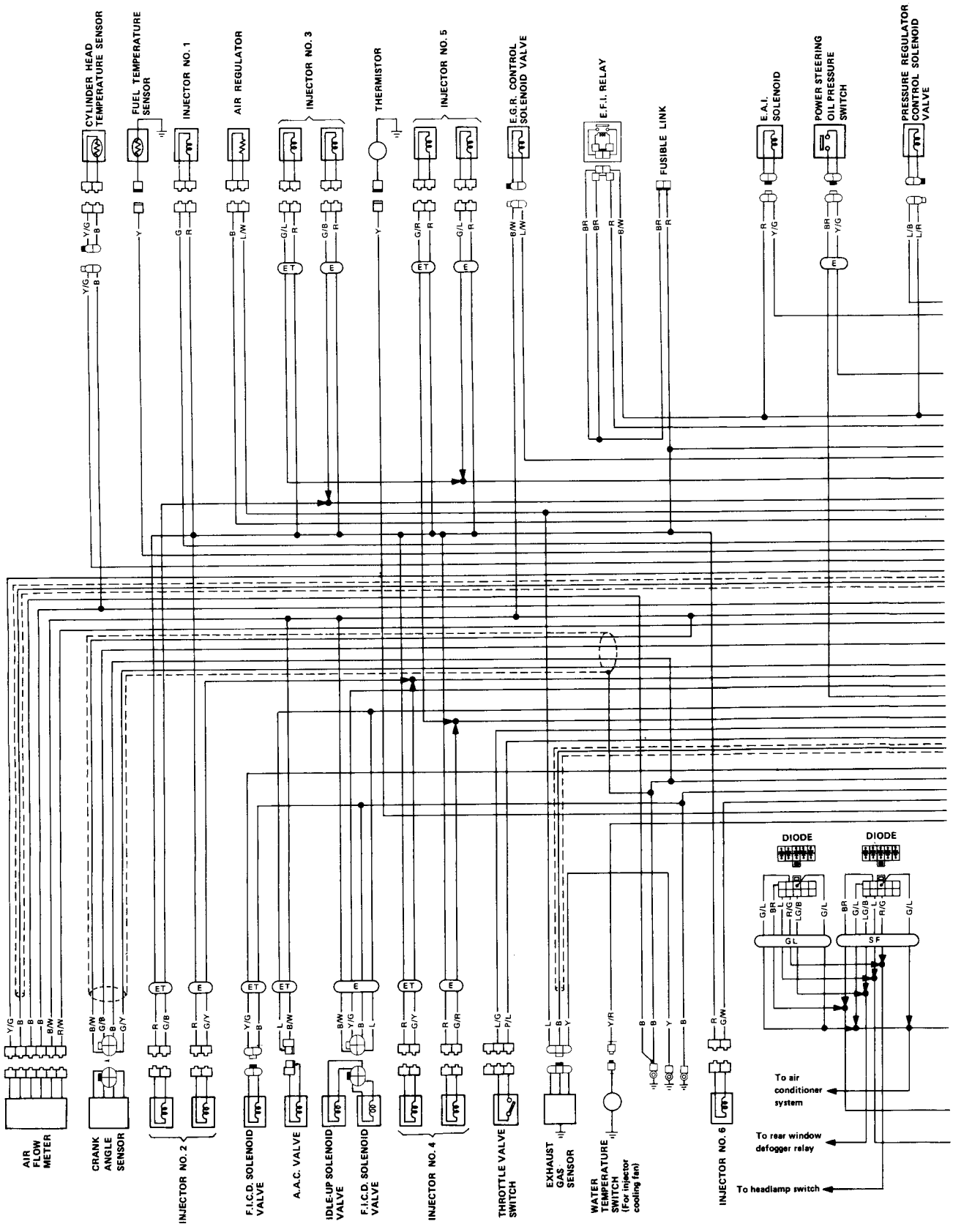


E.C.C.S. CHART

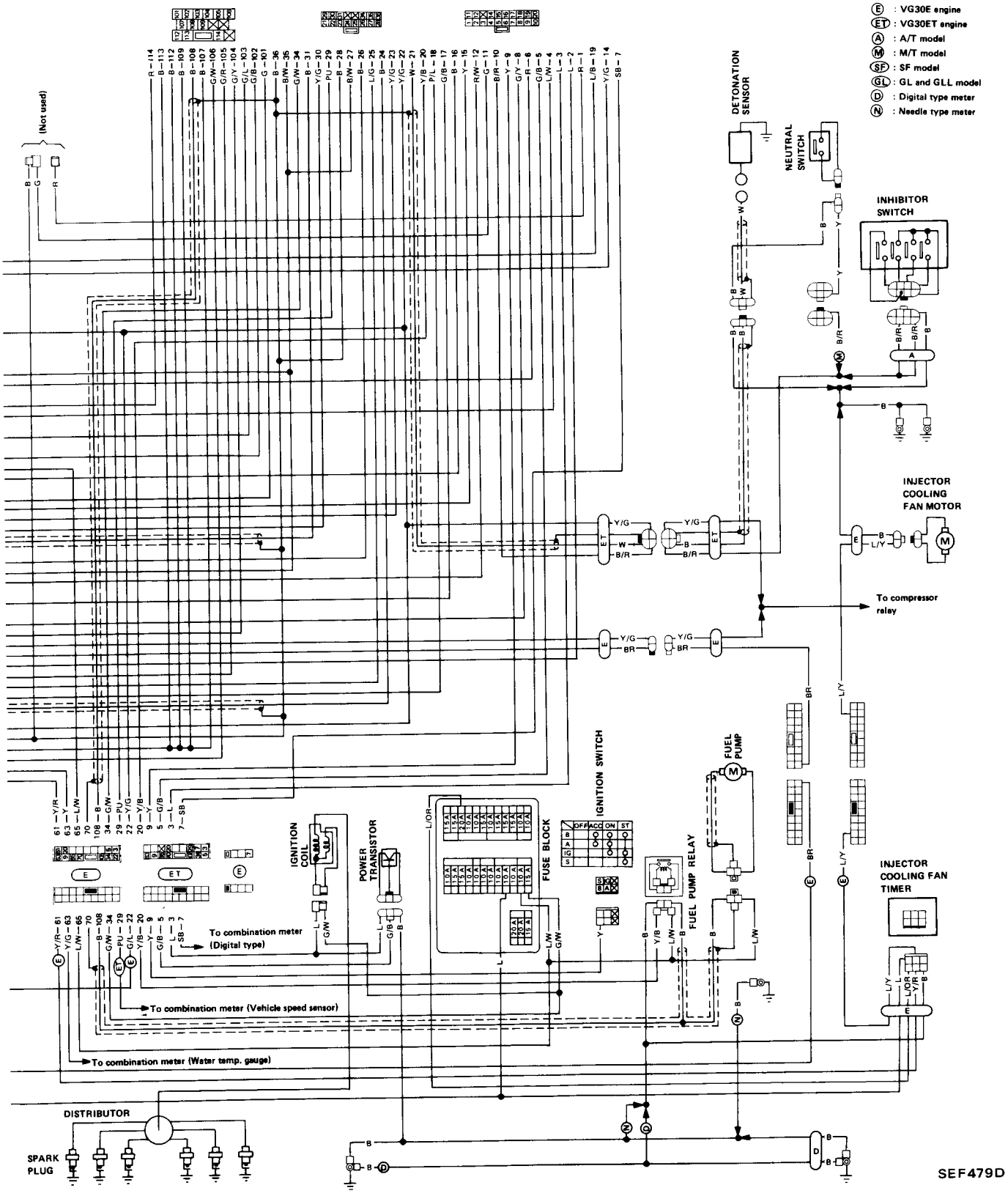
VG30ET Engine (With turbocharger)



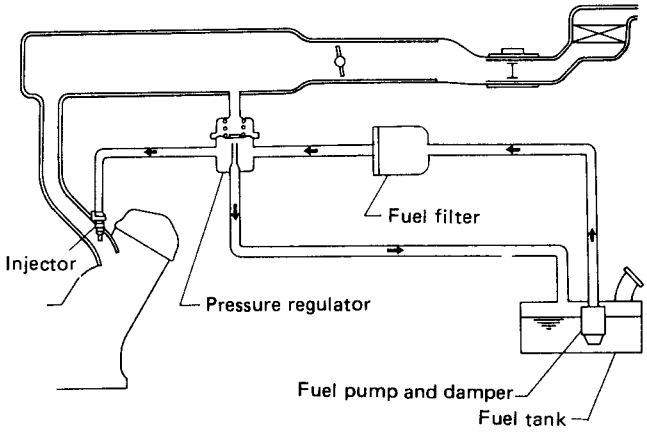
E.C.C.S. WIRING DIAGRAM



E.C.C.S. WIRING DIAGRAM

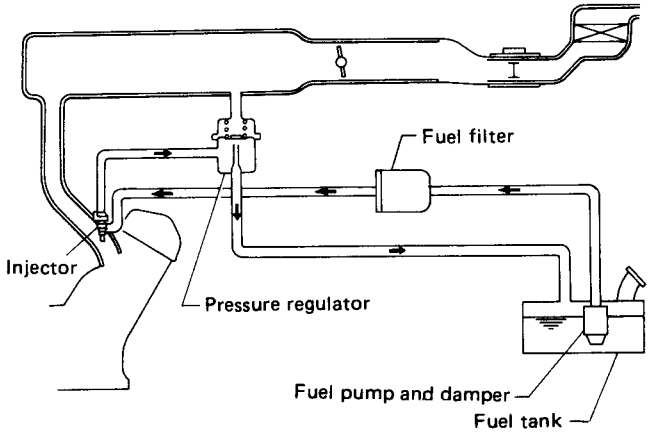


VG30E engine (Without turbocharger)



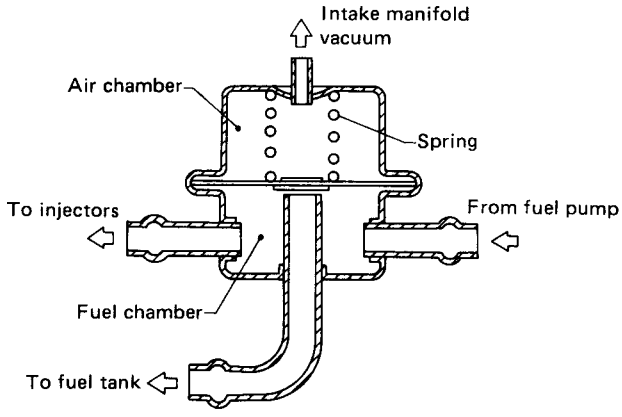
SEF480D

VG30ET engine (With turbocharger)

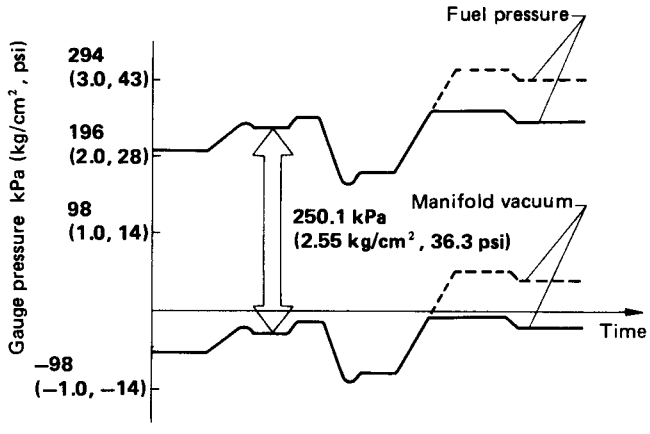


SEF481D

The amount of fuel to be injected is determined by the injection pulse duration as well as by a pressure difference between fuel pressure and intake manifold vacuum pressure. The E.C.C.S. control unit controls only the injection pulse duration. For this reason, the pressure difference between the fuel pressure and intake manifold vacuum pressure should be maintained at a constant level. Since the intake manifold vacuum pressure varies with engine operating conditions, a pressure regulator is placed in the fuel line to regulate the fuel pressure in response to changes in the intake manifold vacuum pressure.

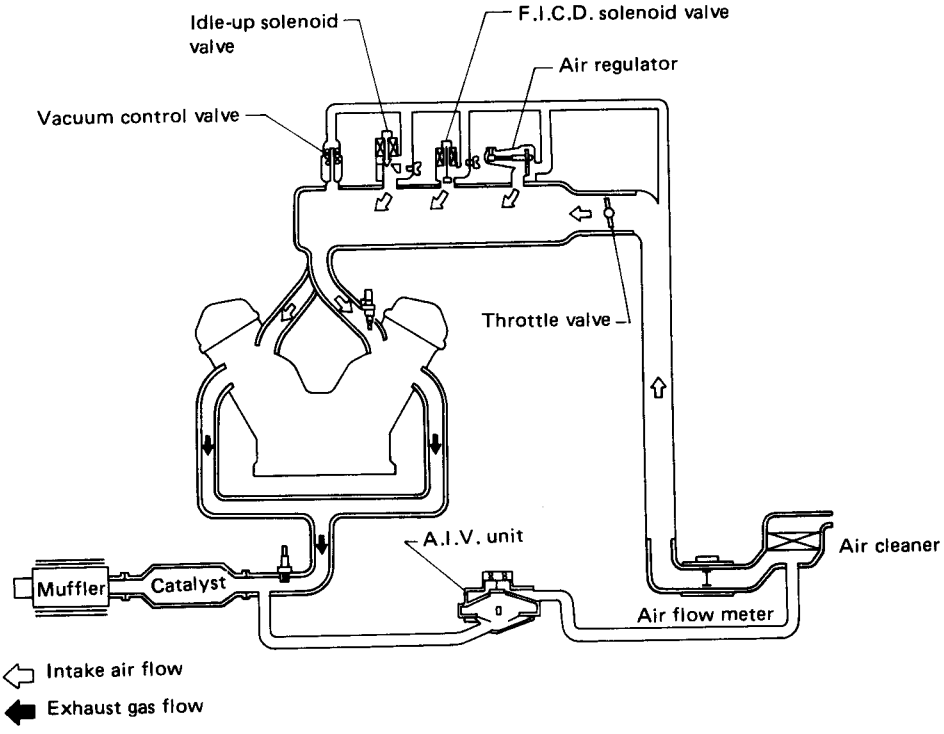


SEF591C



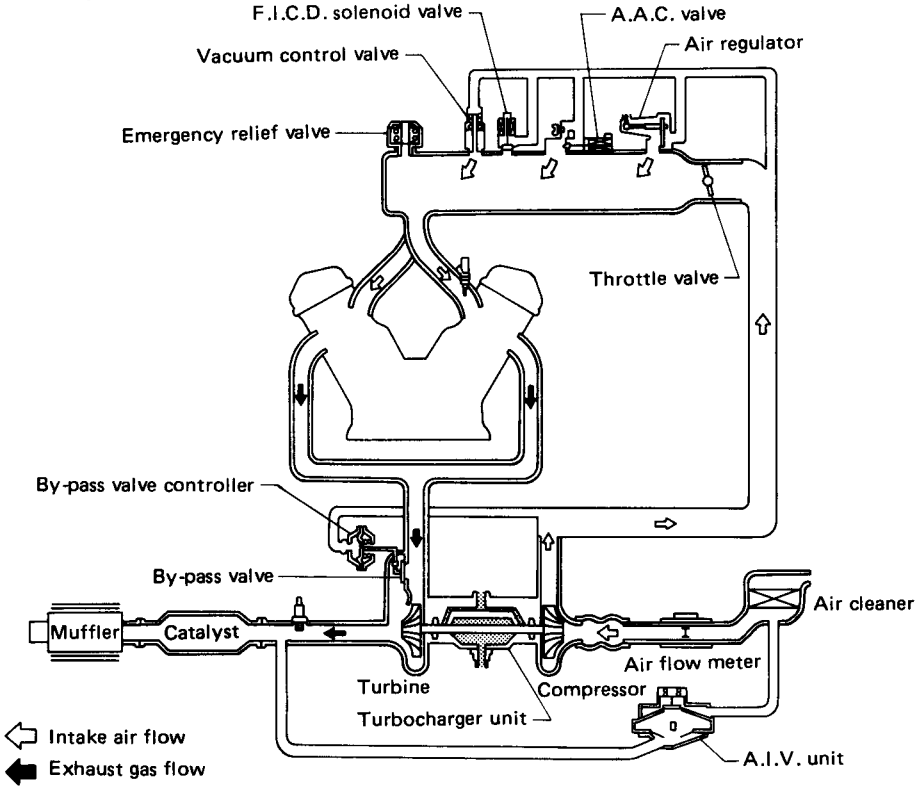
SEF606B

VG30E engine (Without turbocharger)



SEF482D

VG30ET engine (With turbocharger)

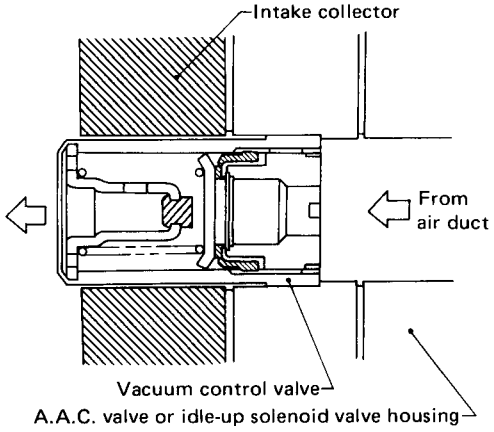


SEF483D

VACUUM CONTROL VALVE

The vacuum control valve is provided to reduce the engine lubricating oil consumption when the intake manifold vacuum increases to a very high level during deceleration.

The vacuum control valve senses the manifold vacuum. As the manifold vacuum increases beyond the specified value, the valve opens and air is sucked into the intake manifold.

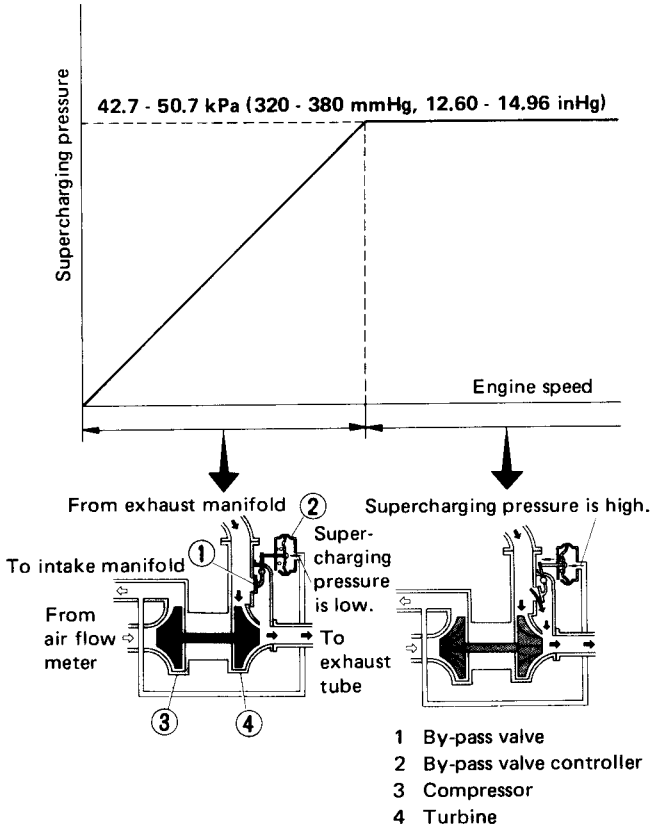


SEC303A

TURBOCHARGER

The turbocharger is installed on the exhaust manifold. This system utilizes exhaust gas energy to spin the turbine wheel which is directly connected to the compressor wheel. The compressor supplies pressurized air through the throttle chamber into the intake manifold. Thus, the turbocharger increases charging efficiency and thereby increases power and torque.

To prevent an excessive rise in the supercharging pressure, the turbine speed is maintained within a safe range by controlling the amount of exhaust gas that passes through the turbine. This system consists of a by-pass valve which allows some of the exhaust gas to by-pass the turbine and to flow directly into the exhaust tube.



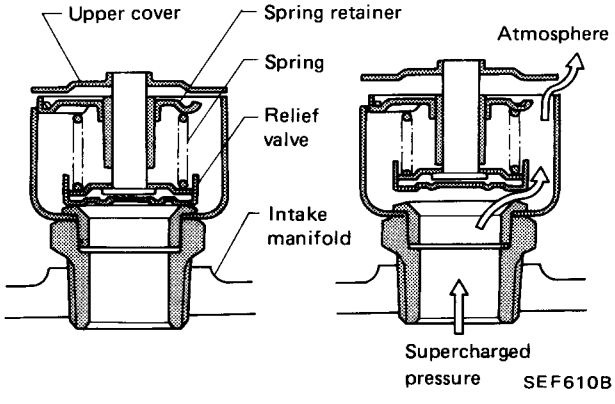
SEF609B

EMERGENCY RELIEF VALVE

To prevent an abnormal rise in supercharging pressure, and possible engine damage, in case the by-pass valve fails to open properly, an emergency relief valve is provided as a safety device on the intake manifold.

When the pressure in the intake manifold is below 55.3 kPa (415 mmHg, 16.34 inHg)

When the pressure in the intake manifold is above 63.3 kPa (475 mmHg, 18.70 inHg)

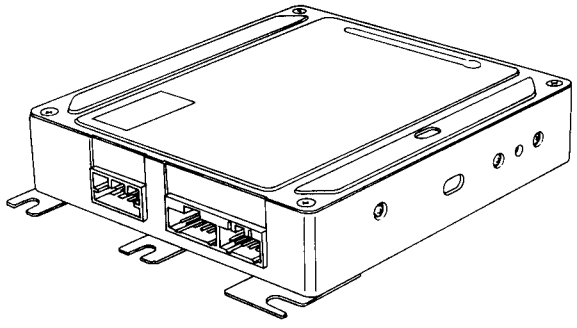


SEF610B

E.C.C.S. Components

E.C.C.S. CONTROL UNIT

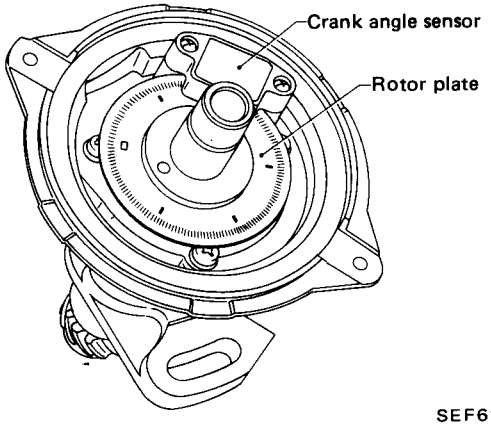
The E.C.C.S. control unit consists of a micro-computer, connectors for signal input and output and power supply, inspection lamps and diagnostic mode selector. The control unit controls the amount of fuel that is injected, ignition timing, idle speed, E.G.R., fuel pump operation, feedback of the mixture ratio, etc.



SEF611B

CRANK ANGLE SENSOR

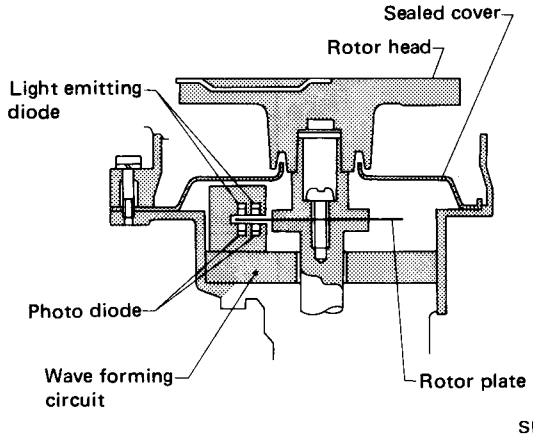
The crank angle sensor is a basic signal sensor for the entire E.C.C.S. It monitors engine speed and piston position, and it sends signals to the E.C.C.S. control unit for control of fuel injection, ignition timing, idle speed, fuel pump operation and E.G.R. operation.



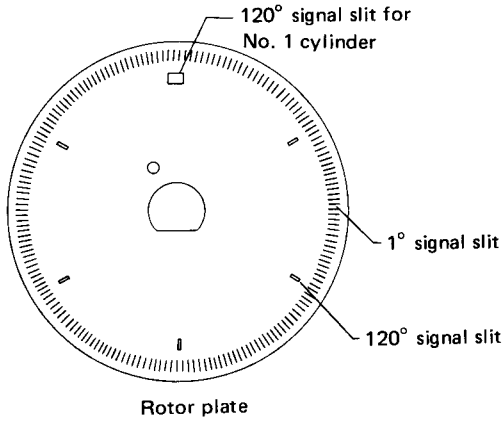
SEF612B

The crank angle sensor has a rotor plate and a wave forming circuit. Rotor plate has 360 slits for 1° signal (engine speed signal) and 6 slits for 120° signal (crank angle signal). Light Emitting Diodes (L.E.D.) and Photo Diodes are built into wave forming circuit.

When the signal rotor plate passes the space between the L.E.D. and Photo Diode, the slit of the signal rotor plate alternately cuts the light which is sent to the photo diode from the L.E.D. This causes an alternating voltage which is then converted into an on-off pulse by the wave forming circuit. The on-off signal is sent to the control unit.



SEF613B

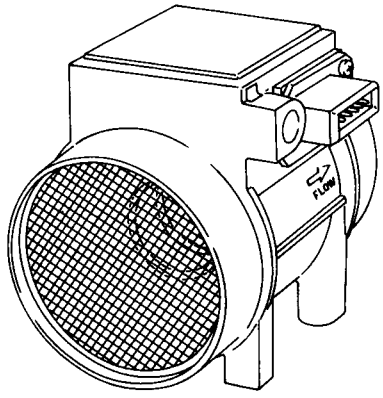


SEF614B

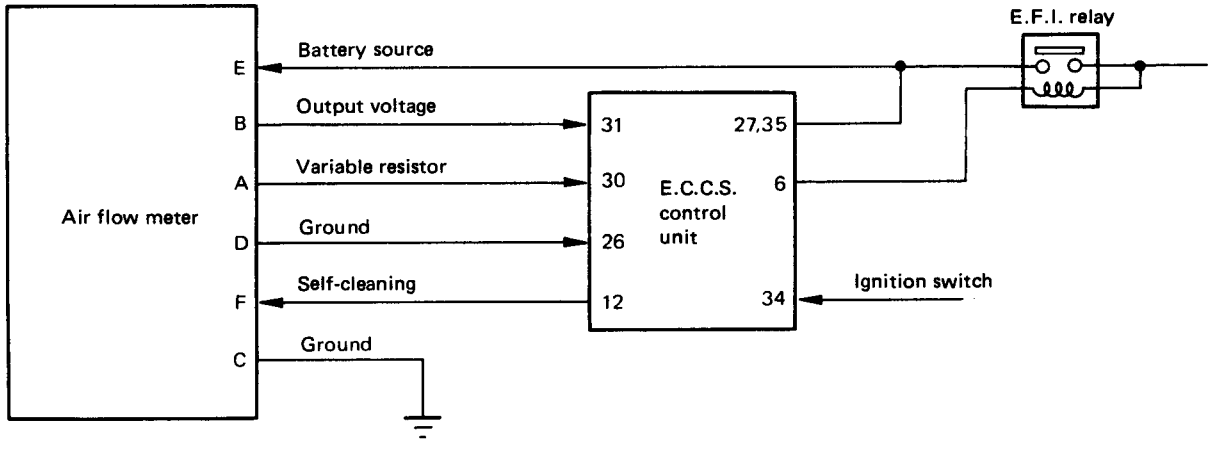
E.C.C.S. Components (Cont'd)

AIR FLOW METER

The air flow meter measures the mass flowrate of intake air. Measurements are made in such a manner that the control circuit emits an electrical output signal in relation to the amount of heat dissipated from the hot wire placed in the stream of intake air.

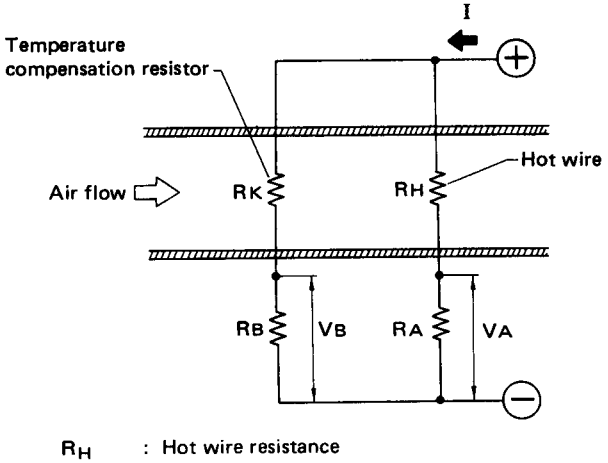


SEF615B



SEF616B

The air flowing around the hot wire removes the heat from the hot wire. The temperature of the hot wire is very sensitive to the mass flowrate of the air. The higher the temperature of the hot wire, the higher its resistance value. This change in the temperature (or: resistance) is determined by the mass flowrate of the air. The control circuit accurately regulates current (I) in relation to the varying resistance value (R_H) so that V_A always equals V_B. The air flow meter transmits an output for voltage V_A to the control unit where the output is converted into an intake air signal.

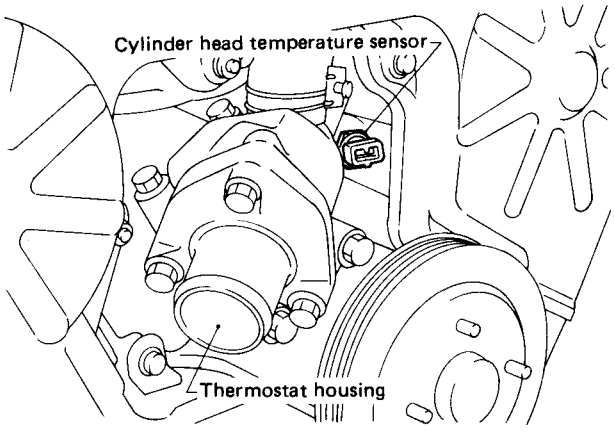


R_H : Hot wire resistance
R_K : Temperature compensation resistance
R_A, R_B : Constant resistance

SEF617B

E.C.C.S. Components (Cont'd)

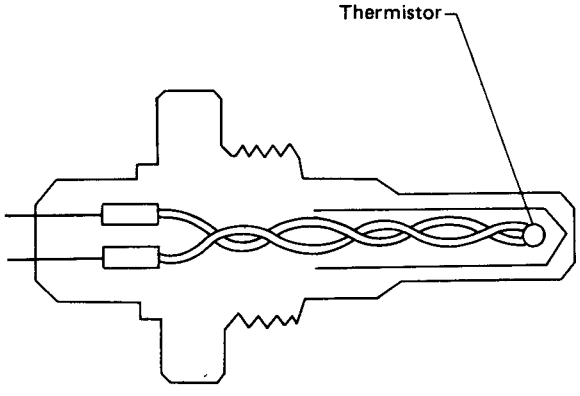
CYLINDER HEAD TEMPERATURE SENSOR



SEF619B

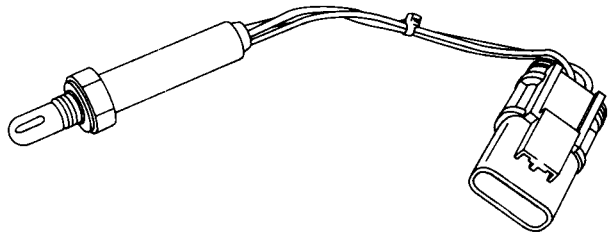
The cylinder head temperature sensor, built into the cylinder head, monitors changes in cylinder head temperature and transmits a signal to the E.C.C.S. control unit.

The temperature sensor employs a thermistor which is sensitive to the change in temperature. Electrical resistance of the thermistor decreases in response to the temperature rise.



SEF620B

EXHAUST GAS SENSOR



SEF397D

The exhaust gas sensor, which is built into the exhaust manifold, monitors the density of oxygen in the exhaust gases.

It consists of ceramic titania (major sensor), ceramic alumina and other components. The ceramic alumina which contains the ceramic titania is exposed to the exhaust gas in the exhaust manifold.

In order to ensure the stable performance of the exhaust gas sensor, a heater is employed in the ceramic alumina.

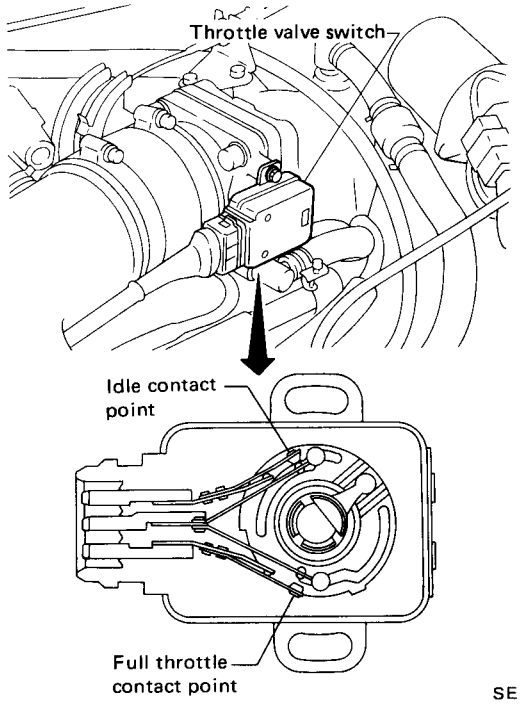
E.C.C.S. Components (Cont'd)

THROTTLE VALVE SWITCH

The throttle valve switch is attached to the throttle chamber and actuates in response to accelerator pedal movement.

This switch has idle contact and full throttle contact. The idle contact closes when the throttle valve is positioned at idle and opens when it is at any other position.

The full throttle contact is used only for the electronic controlled automatic transmission.



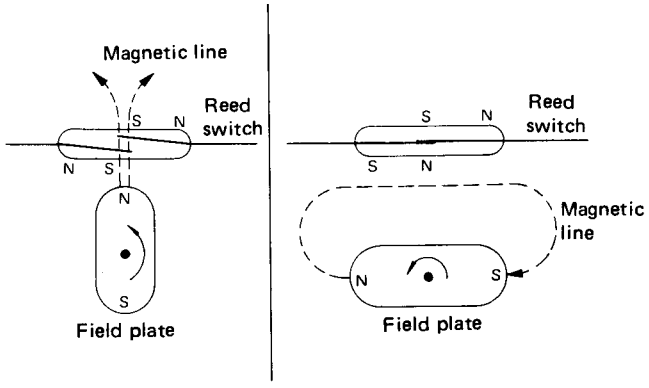
SEF623B

VEHICLE SPEED SENSOR (VG30ET engine only)

The vehicle speed sensor provides a vehicle speed signal to the E.C.C.S. control unit.

- **Needle type speedometer models**

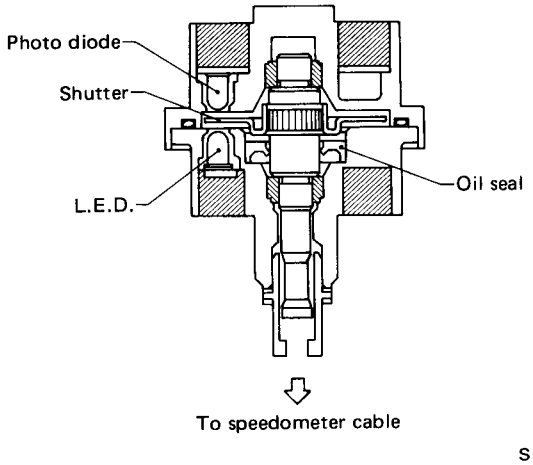
The speed sensor consists of a reed switch, which is installed in the speed meter unit and transforms vehicle speed into a pulse signal.



SEF624B

- **Digital type speedometer models**

The speed sensor consists of an L.E.D., photo diode, shutter and wave forming circuit. Its principle is the same as that of the crank angle sensor.

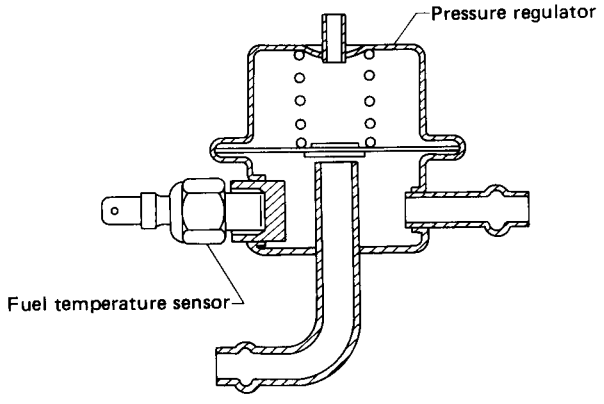


SEF680B

E.C.C.S. Components (Cont'd)

FUEL TEMPERATURE SENSOR

The fuel temperature sensor is built into the pressure regulator, and senses fuel temperature. When the fuel temperature is higher than the specified level, the E.C.C.S. control unit enriches fuel injected.

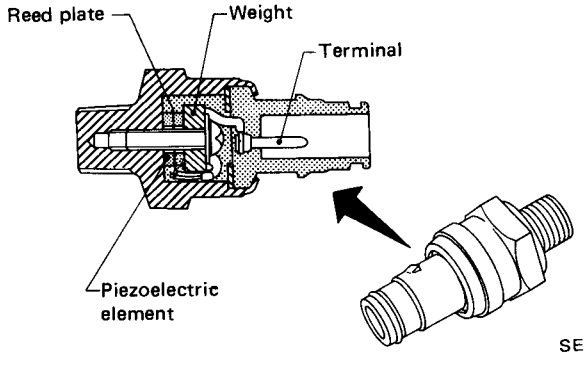


SEF625B

Do not remove fuel temperature sensor from pressure regulator. Always replace as an assembly.

DETONATION SENSOR (VG30ET engine only)

The detonation sensor is attached to the cylinder block and senses engine knocking conditions.
A knocking vibration from the cylinder block is applied as pressure to the piezoelectric element. This vibrational pressure is then converted into a voltage signal which is delivered as output.

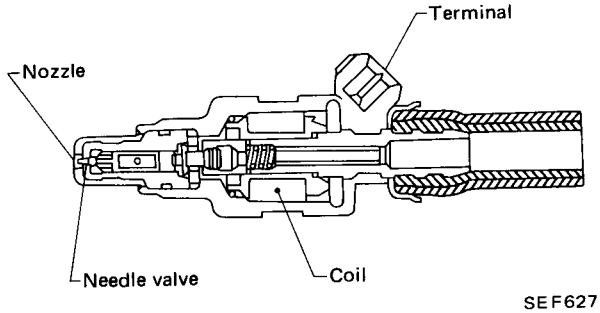


SEF626B

FUEL INJECTOR

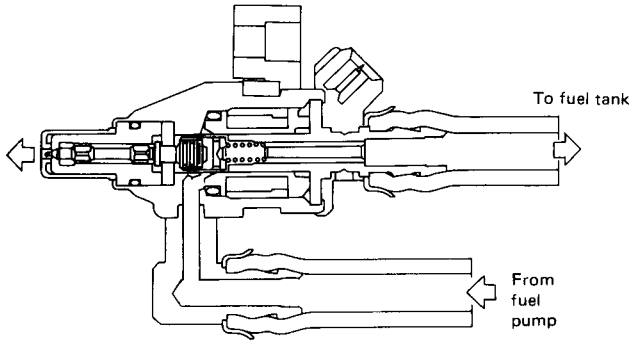
The fuel injector is a small, precision solenoid valve. As the E.C.C.S. control unit outputs an injection signal to each fuel injector, the coil built into the injector pulls the needle valve back, and fuel is injected through the nozzle to intake manifold. The amount of fuel injected is controlled by the E.C.C.S. control unit as an injection pulse duration.

Conventional type



SEF627B

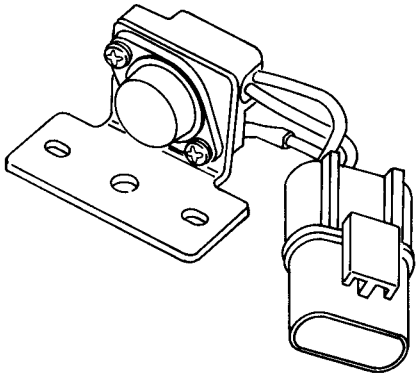
Bottom feed type



SEF484D

POWER TRANSISTOR

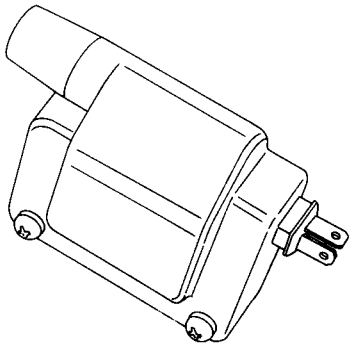
The ignition signal from the E.C.C.S. control unit is amplified by the power transistor, which connects and disconnects the coil primary circuit to induce the proper high voltage in the secondary circuit.



SEF162C

IGNITION COIL

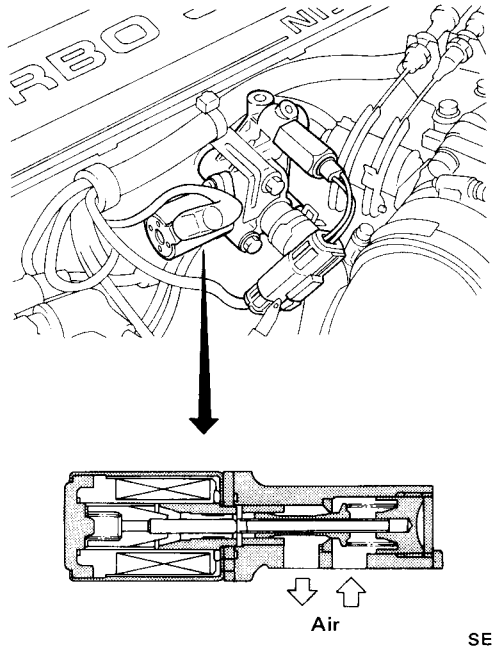
The ignition coil is a molded type.



SEF629B

AUXILIARY AIR CONTROL (A.A.C.) VALVE (VG30ET engine only)

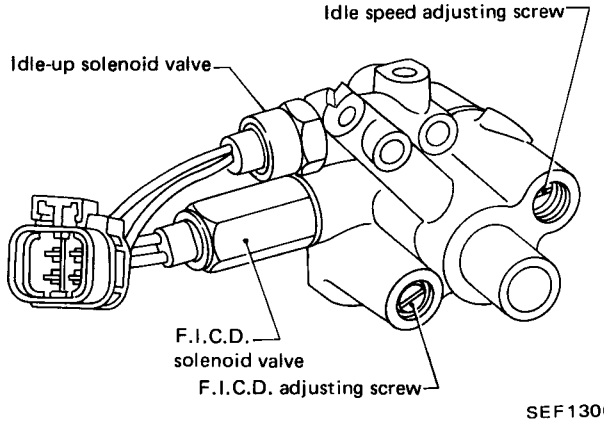
The A.A.C. valve is attached to the intake collector. The E.C.C.S. control unit actuates the A.A.C. valve by an ON/OFF pulse of approximately 160 Hz. The longer that ON duty is left on, the larger the amount of air that will flow through the A.A.C. valve.



SEF630B

IDLE-UP SOLENOID VALVE (VG30E engine only)

The idle-up solenoid valve is attached to the intake collector. The solenoid valve actuates to stabilize idle speed when engine load is heavy because of electric load, power steering oil pump, etc.

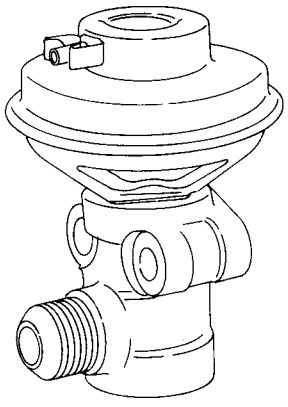


SEF130C

E.C.C.S. Components (Cont'd)

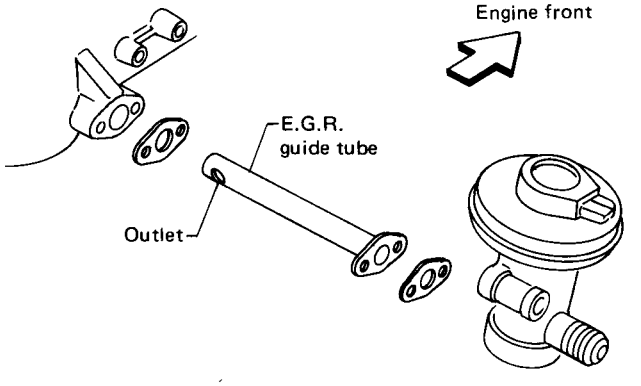
E.G.R. CONTROL VALVE

The E.G.R. control valve controls the quantity of exhaust gas to be led to the intake manifold through vertical movement of the taper valve connected to the diaphragm, to which vacuum is applied in response to the opening of the throttle valve.



SEF632B

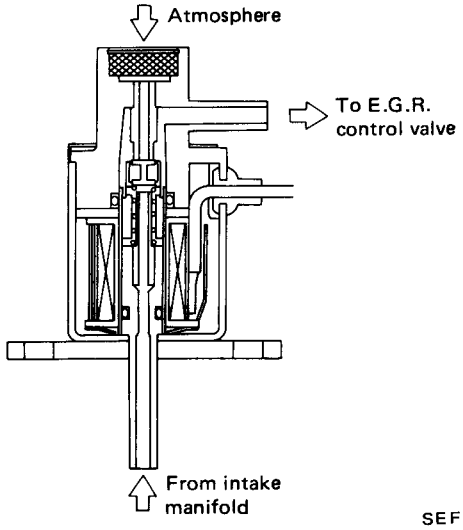
When installing the E.G.R. guide tube, be careful of its direction. The outlet faces the rear of the engine. Otherwise the distribution efficiency of the exhaust gas will be reduced.



SEF689B

E.G.R. CONTROL SOLENOID VALVE

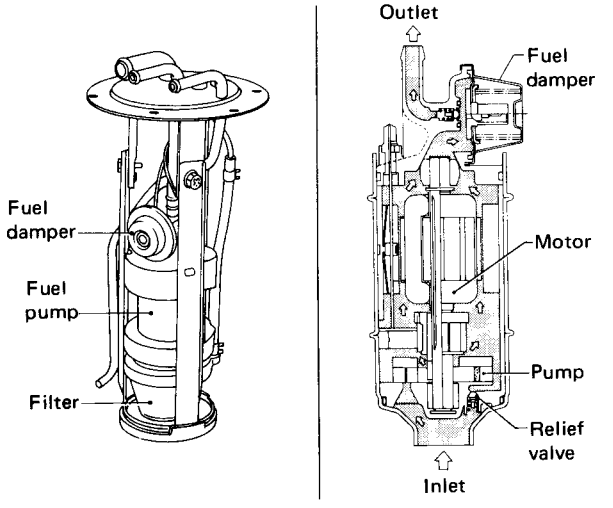
The E.G.R. control solenoid valve cuts the intake manifold vacuum signal for E.G.R. control. The solenoid valve actuates in response to the ON/OFF signal from the E.C.C.S. control unit. When the solenoid is off, a vacuum signal from the intake manifold is fed into the E.G.R. control valve. As the control unit outputs an ON signal, the coil pulls the plunger downward, and cuts the vacuum signal.



SEF633B

FUEL PUMP

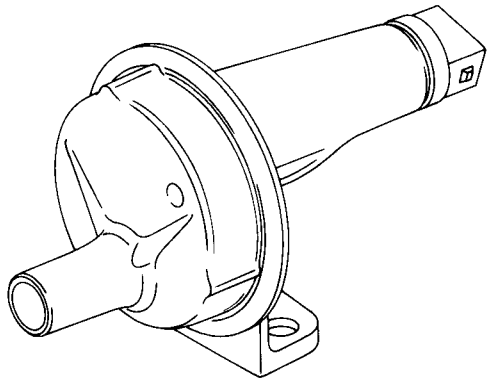
The fuel pump, which is located in the fuel tank, is a wet type pump where the vane rollers are directly coupled to a motor which is filled with fuel.



SEF634B

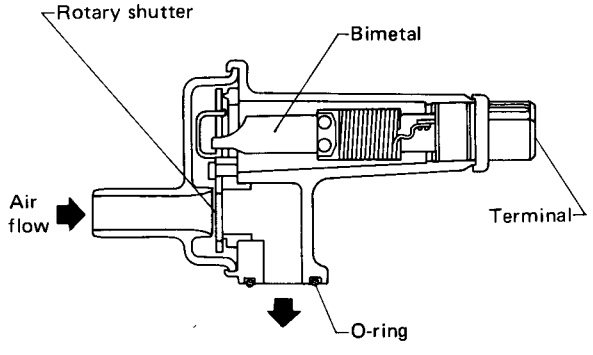
AIR REGULATOR

Air regulator gives an air by-pass when the engine is cold for the purpose of a fast idle during warm-up.



SEF635B

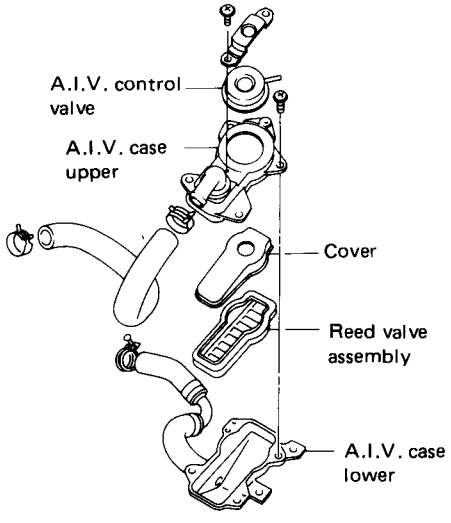
A bimetal, heater and rotary shutter are built into the air regulator. When the bimetal temperature is low, the air by-pass port is open. As the engine starts and electric current flows through a heater, the bimetal begins to rotate the shutter to close off the by-pass port. The air passage remains closed until the engine is stopped and the bimetal temperature drops.



SEF636B

AIR INJECTION VALVE (A.I.V.)

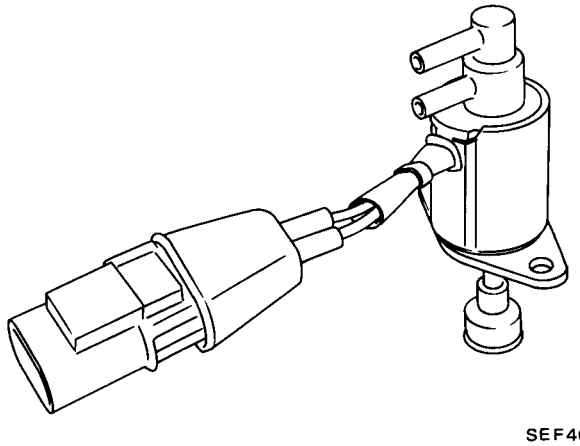
The air injection valve sends secondary air to the exhaust manifold, utilizing a vacuum caused by exhaust pulsation in the exhaust manifold. When the exhaust pressure is below atmospheric pressure (negative pressure), secondary air is sent to the exhaust manifold. When the exhaust pressure is above atmospheric pressure, the reed valves prevent secondary air from being sent back to the air cleaner.



SEF485D

A.I.V. CONTROL SOLENOID VALVE

The A.I.V. control solenoid valve cuts intake manifold vacuum signal for A.I.V. control. The solenoid valve actuates in response to the ON/OFF signal from the E.C.C.S. control unit. When the solenoid is off, the vacuum signal from the intake manifold is cut. As the control unit outputs an ON signal, the coil pulls the plunger downward, and feeds the vacuum signal to the A.I.V. control valve.

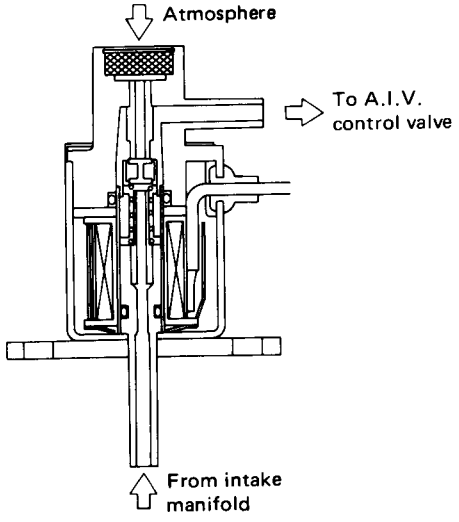


SEF402C

E.C.C.S. Components (Cont'd)

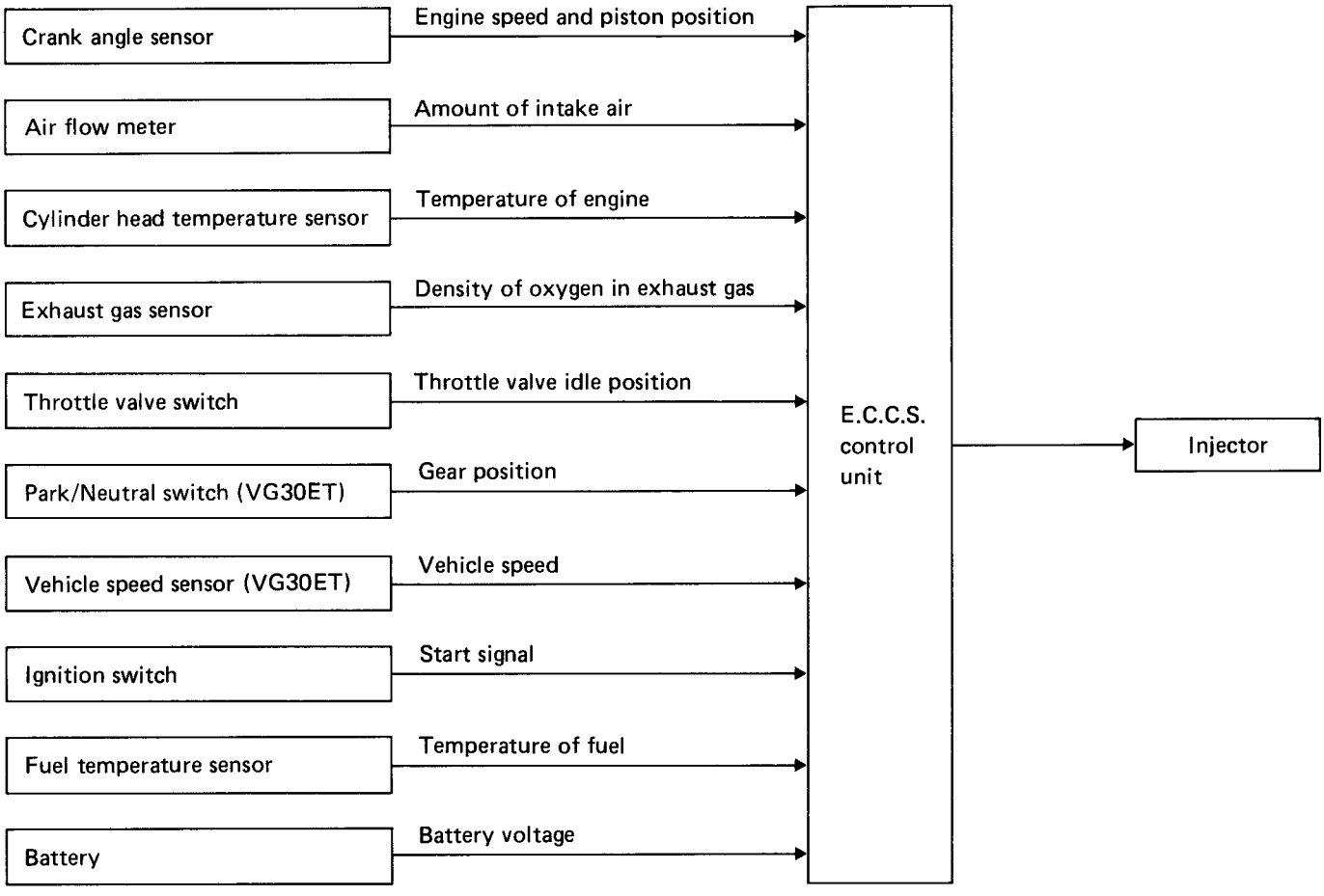
PRESSURE REGULATOR CONTROL SOLENOID VALVE

The pressure regulator control solenoid valve cuts the intake manifold vacuum signal for pressure regulator control. The solenoid valve actuates in response to the ON/OFF signal from the E.C.C.S. control unit. When it is off, a vacuum signal from the intake manifold is fed into the pressure regulator. As the control unit outputs an ON signal, the coil pulls the plunger downward, and cuts the vacuum signal.



SEF633B

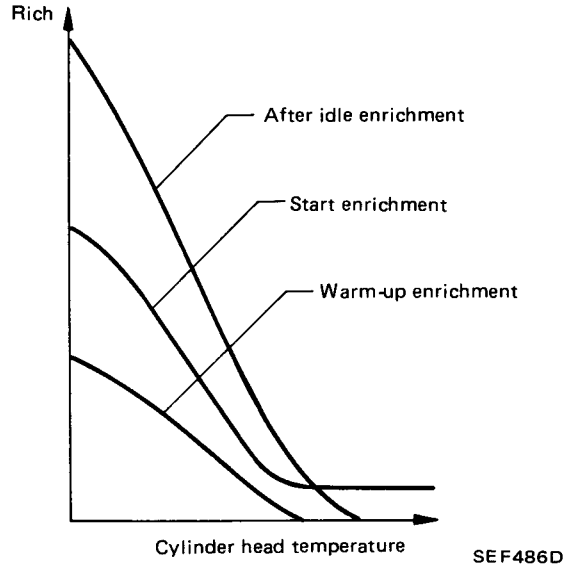
Fuel Injection Control



The E.C.C.S. control unit calculates the basic injection pulse width by processing signals from crank angle sensor and air flow meter. Receiving signals from each sensor which detects various engine conditions, the E.C.C.S. control unit adds various enrichments, which are pre-programmed in the control unit, to the basic injection amount. Thus, the optimum amount of fuel is injected through the injectors.

1) Fuel enrichment
   In each of the following conditions, fuel is enriched.

- During warm-up
- When starting
- After idle
- With heavy load
- When cylinder head temperature is high.



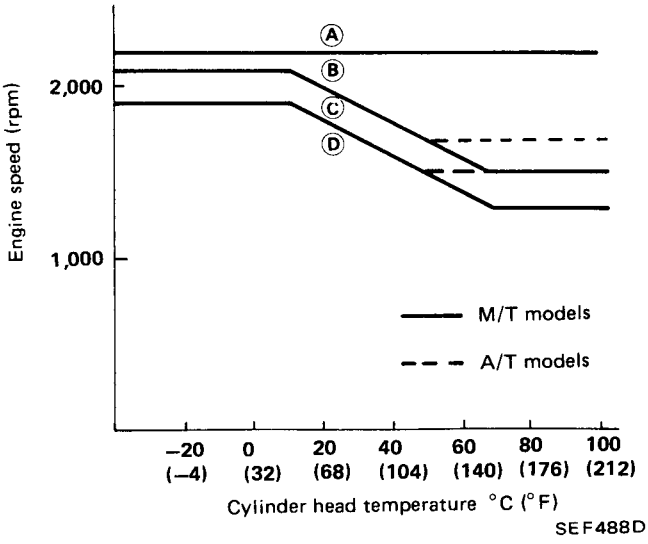
The enrichment rate for "when accelerating" and "with heavy load" are pre-programmed for engine speed and basic injection pulse width.

Fuel Injection Control (Cont'd)

2) Fuel shut-off
Fuel shut-off is accomplished under the following conditions:

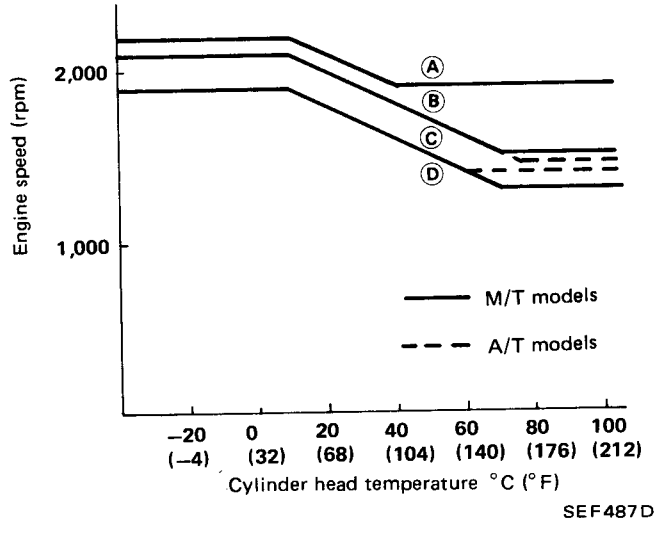
a. During deceleration

VG30E engine



SEF488D

VG30ET engine



SEF487D

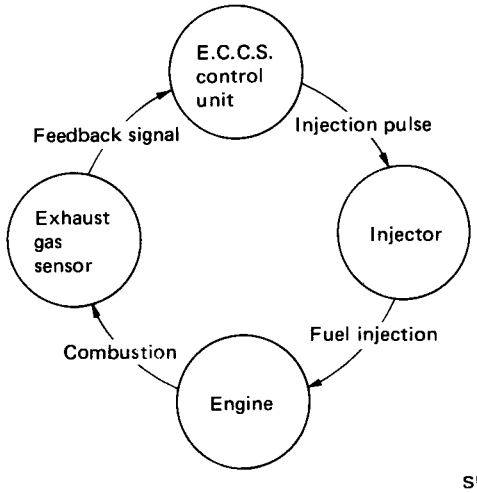
M/T in top gear and A/T	Fuel shut-off zone	Fuel recovery zone
Deceleration from Ⓐ	Ⓑ and Ⓒ	Ⓓ
Deceleration from Ⓑ	Ⓒ	Ⓓ
Deceleration from Ⓒ or Ⓓ	–	–

M/T except in top gear	Fuel shut-off zone	Fuel recovery zone
Deceleration from Ⓐ	Ⓑ and Ⓒ	Ⓓ
Deceleration from Ⓑ	–	–
Deceleration from Ⓒ or Ⓓ	–	–

b. High engine speed
When engine speed is more than 6,500 rpm, fuel is shut-off for safety reasons.

c. High vehicle speed (VG30ET engine only)
When vehicle speed is more than 200 km/h (137 MPH), fuel is shut-off for safety reasons.

3) Mixture ratio feedback control
The mixture ratio feedback system is designed to control the mixture ratio precisely to the stoichiometric point so that the three-way catalyst can minimize CO, HC and NOx emissions simultaneously. This system uses an exhaust gas sensor located in the exhaust manifold to give an indication of whether the air-fuel ratio is richer or leaner than the stoichiometric point. The control unit adjusts the injection pulse width according to the sensor voltage so the mixture ratio will be within the narrow window around the stoichiometric air fuel ratio.



SEF639B

However, this system will open under the following conditions:

- When starting engine.

Fuel Injection Control (Cont'd)

- When engine and exhaust gas sensor is cold.
- When driving at high speeds or under heavy load.
- At idle
- When exhaust gas sensor monitors a too lean condition for more than 10 seconds.
- When fuel shut-off is in operation.
- When exhaust gas sensor is malfunctioning.
- When pressure regulator control system is in operation.

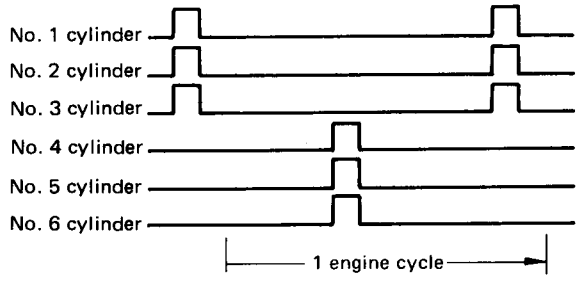
4) Injection timing

Two types of fuel injection systems are used – simultaneous injection and group injection. In the former, fuel is injected into all six cylinders simultaneously twice each engine cycle.

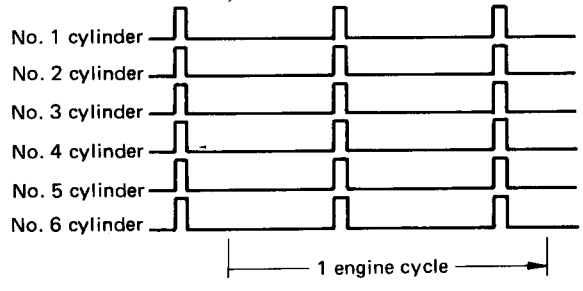
In other words, pulse signals of the same width are simultaneously transmitted from the E.C.C.S. control unit to the six injectors two times for each engine cycle.

In the group injection system, six injectors are divided into two groups – No. 1, No. 2, No. 3 and No. 4, No. 5, No. 6. And fuel is injected into each group separately once each engine cycle.

• Group injection



• Simultaneous injection

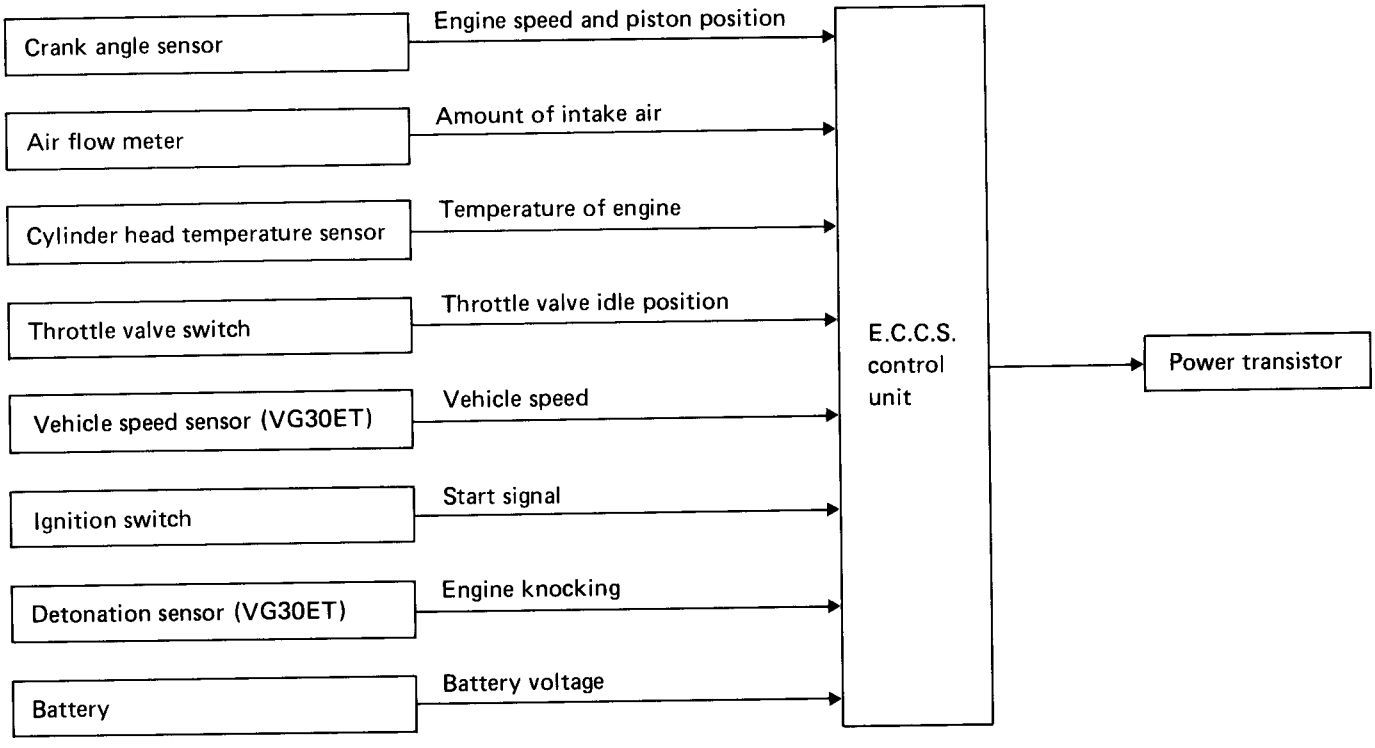


SEF640B

When any of the following conditions are met, fuel injection shifts to simultaneous injection from group injection.

- Engine speed is more than 3,000 rpm.
- Injection pulse duration is more than 6.5ms.
- Cylinder head temperature is below 60°C (140°F).
- When starting.

Ignition Timing Control

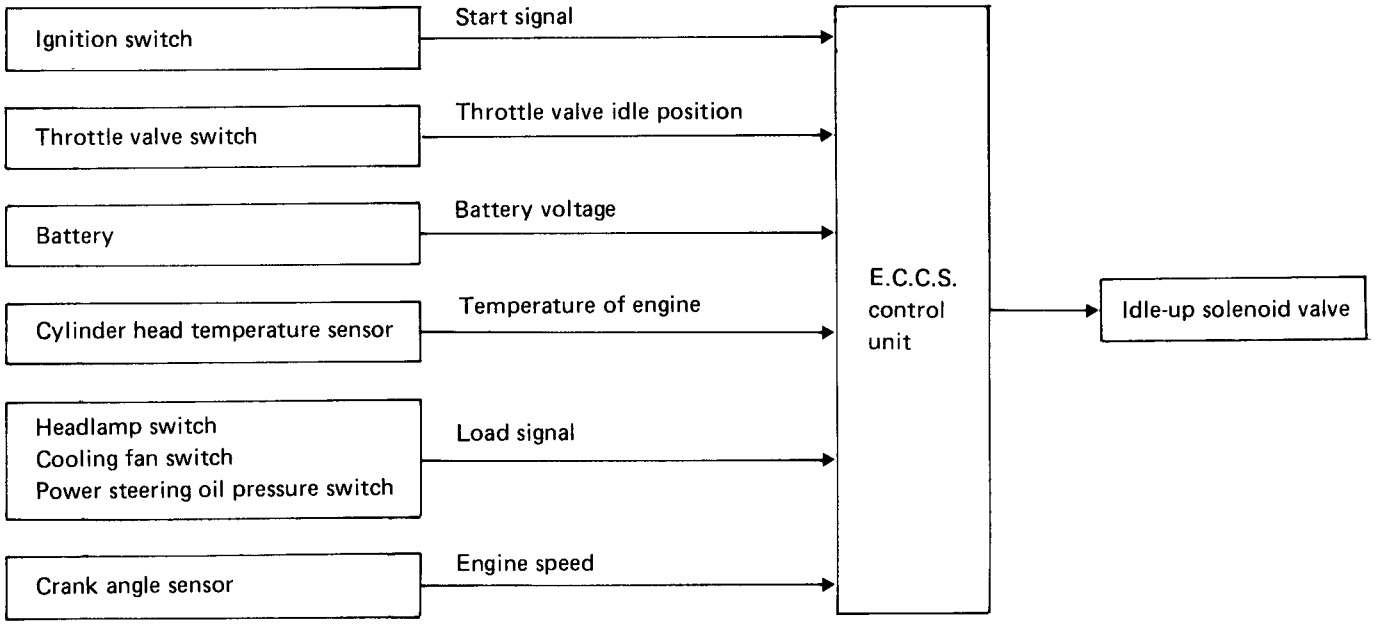


Ignition timing is controlled, corresponding to the engine operating conditions, by the E.C.C.S. control unit: that is, as the optimum ignition timing in each driving condition has been pre-programmed in the control unit, the ignition timing is determined by electrical signals processed in the unit.
The signal from the E.C.C.S. control unit is transmitted to power transistor, and controls ignition timing.

Detonation feedback operation

The retard system by detonation sensor is designed only for emergencies on VG30ET engines. The basic ignition timing is pre-programmed within the anti-knocking zone, even if recommended fuel is used under dry conditions. Consequently, the retard system does not operate under normal driving conditions.
However, if engine knocking occurs, the detonation sensor monitors the knocking condition and the signal is transmitted to the E.C.C.S. control unit. After receiving it, the control unit retards the ignition timing to avoid the knocking condition.

Idle-up Control (VG30E engine)



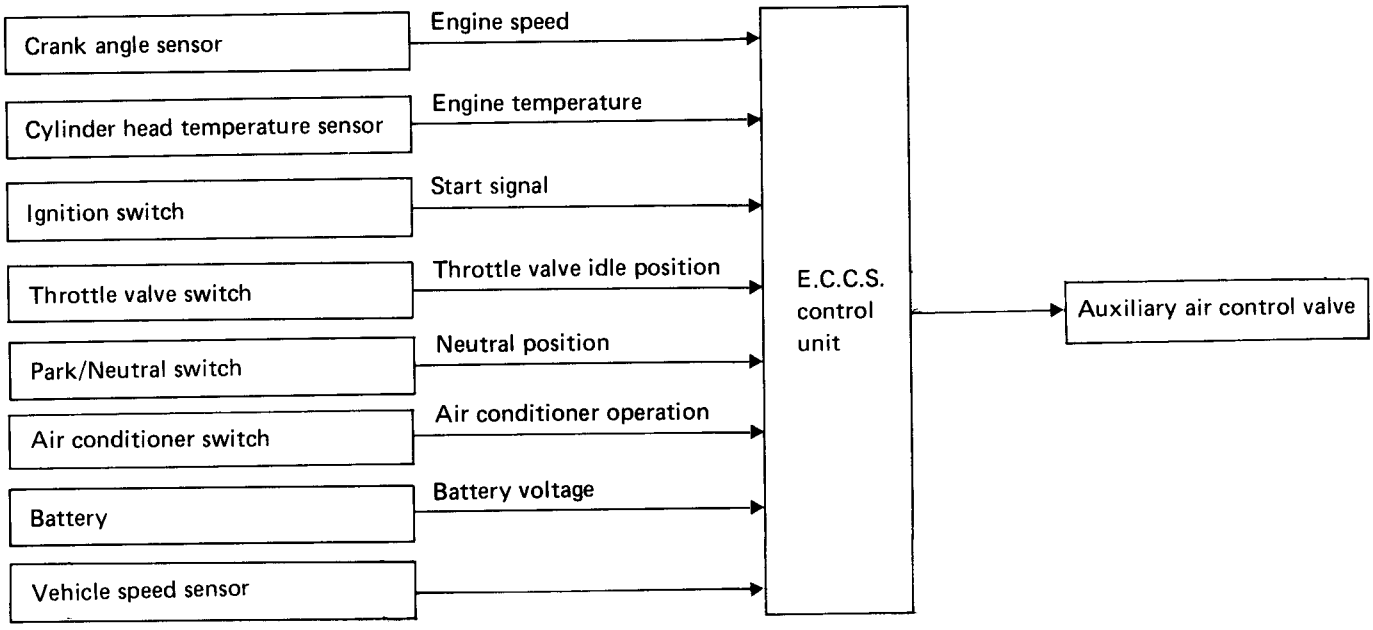
The idle speed is compensated by the E.C.C.S. control unit to prevent rough idle when any of the following conditions are met.
The control unit senses the idle condition, and determines ON/OFF signal. The signal from the control unit is transmitted to the idle-up solenoid valve to stabilize idle speed.

Operation

Condition	Idle-up solenoid operation
During engine start 20 seconds after engine start Battery voltage is below 12V Headlamp switch ON Cooling fan switch ON Power steering oil pressure switch ON Engine speed is higher than 1,200 rpm with idle switch "ON".	ON
Except above	OFF

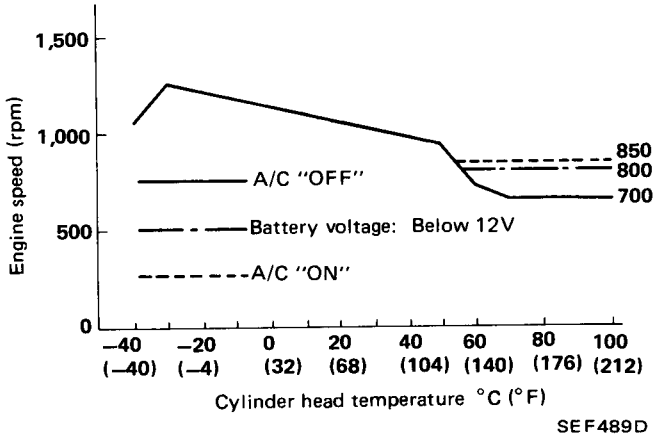
E.C.C.S. SYSTEM DESCRIPTION

Idle Speed Control (VG30ET engine)



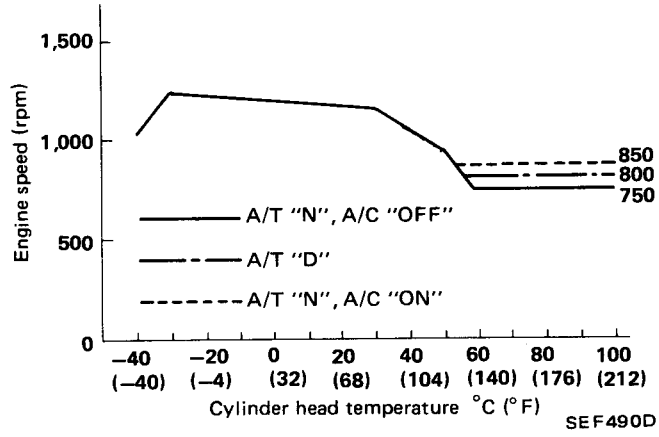
The idle speed is controlled by the E.C.C.S. control unit, corresponding to the engine operating conditions. The E.C.C.S. control unit senses the engine condition and determines the best idle speed at each cylinder head temperature and gear position. The control unit then sends an electronic signal corresponding to the difference between the best idle speed and the actual idle speed to the A.A.C. valve.

M/T models



SEF489D

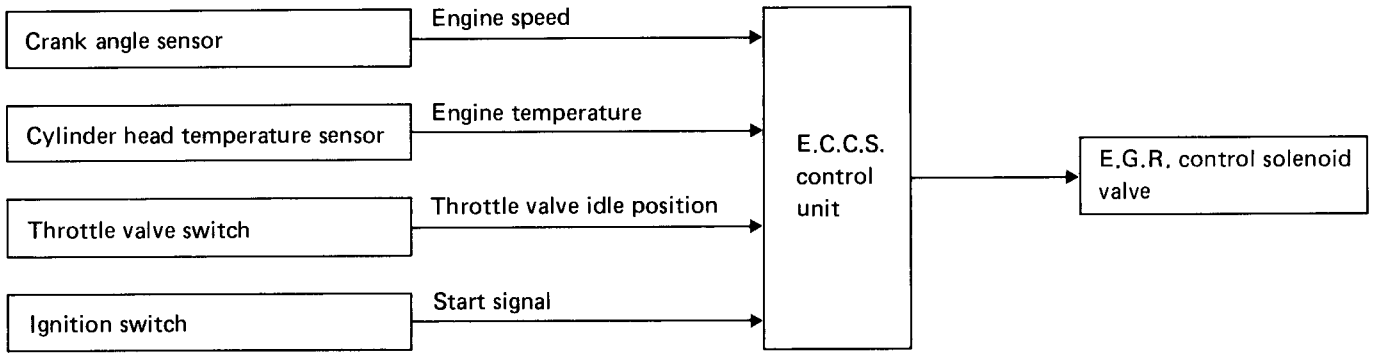
A/T models

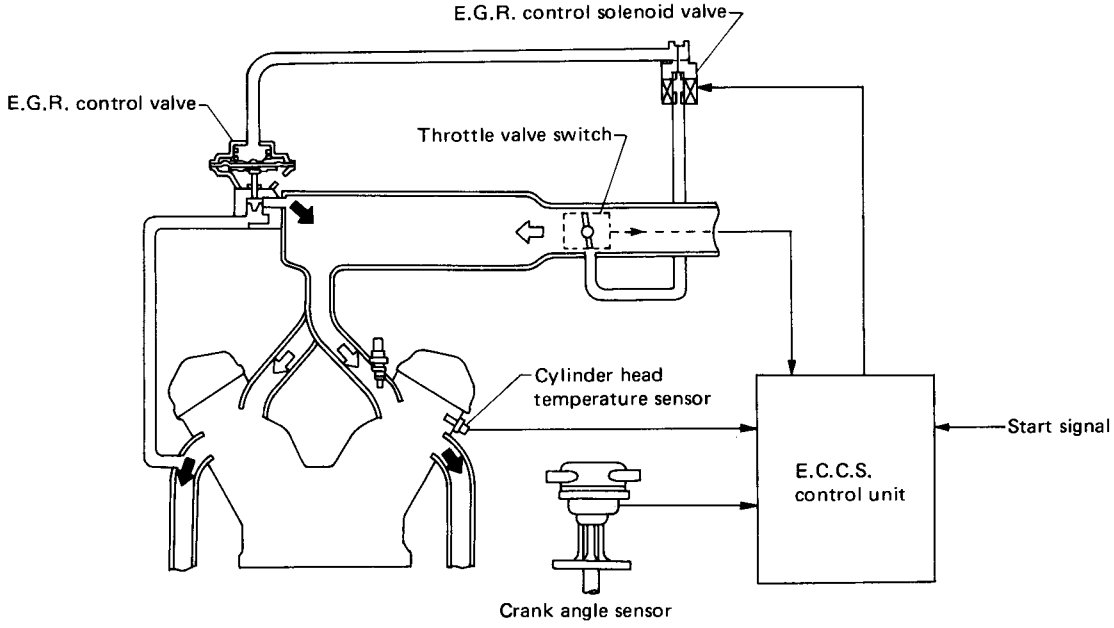


SEF490D

E.C.C.S. SYSTEM DESCRIPTION

Exhaust Gas Recirculation (E.G.R.) Control





SEF642B

OPERATION

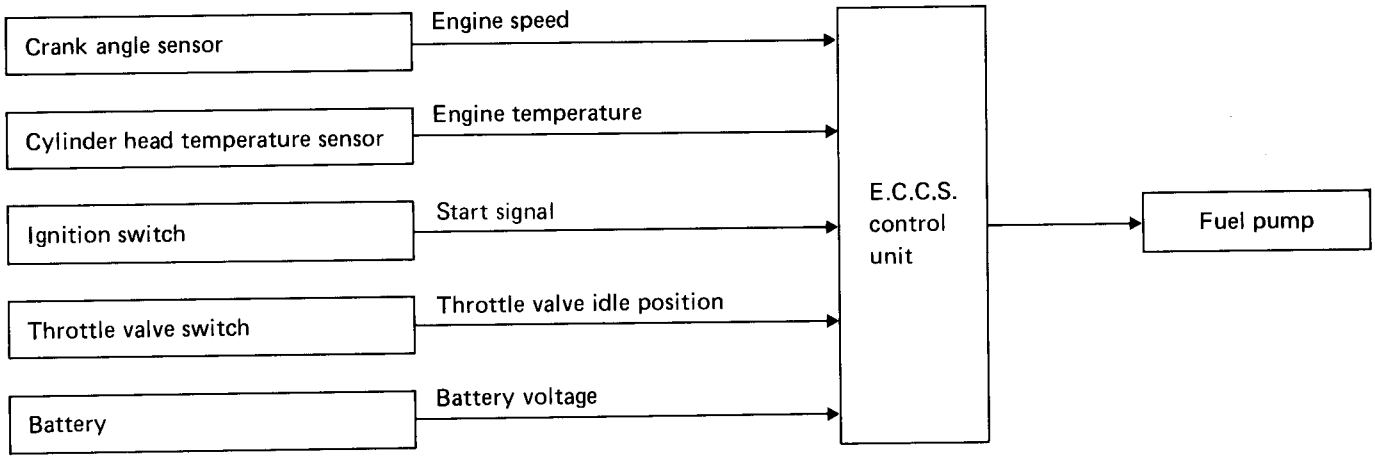
In the exhaust gas recirculation system, some of the exhaust gas is returned to the combustion chamber to lower the flame temperature during combustion. This results in a reduction of the nitrogen oxide density in the exhaust gas.

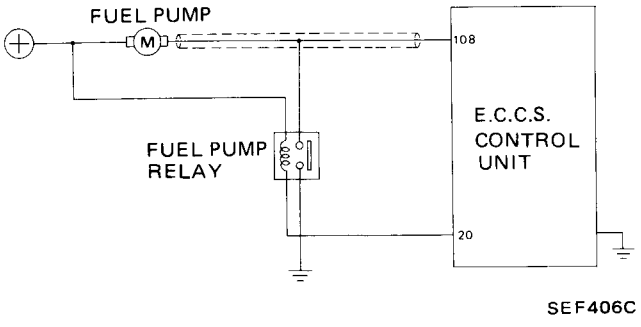
When the E.G.R. control valve is open, some of the exhaust gas is led from the exhaust manifold to the E.G.R. tube. The exhaust gas is then regulated by E.G.R. valve, and is introduced into the intake manifold.

The signal from the E.C.C.S. control unit is sent to the E.G.R. control solenoid valve, which cuts the vacuum line for the E.G.R. control valve when any of the following conditions are met.

Condition	E.G.R. control solenoid	E.G.R. system
Engine starting Throttle valve switch "ON" Under heavy load driving Low engine temperature High engine temperature Engine speed above 2,700 rpm	ON	Does not operate
Except above	OFF	Operates

Fuel Pump Control





Description

The fuel pump is controlled by the E.C.C.S. control unit adjusting the output voltage supplied to the fuel pump.

Fuel pump ON-OFF control

1) Fuel pump ON-OFF control (terminal (108))

Condition	Fuel pump operation
Ignition switch is tunred to ON.	Operates for 5 seconds
Engine running and cranking	Operates
When engine is stopped	Stops in 1 second
Except as shown above	Stops

2) Fuel pump relay ON-OFF control (terminal (20))

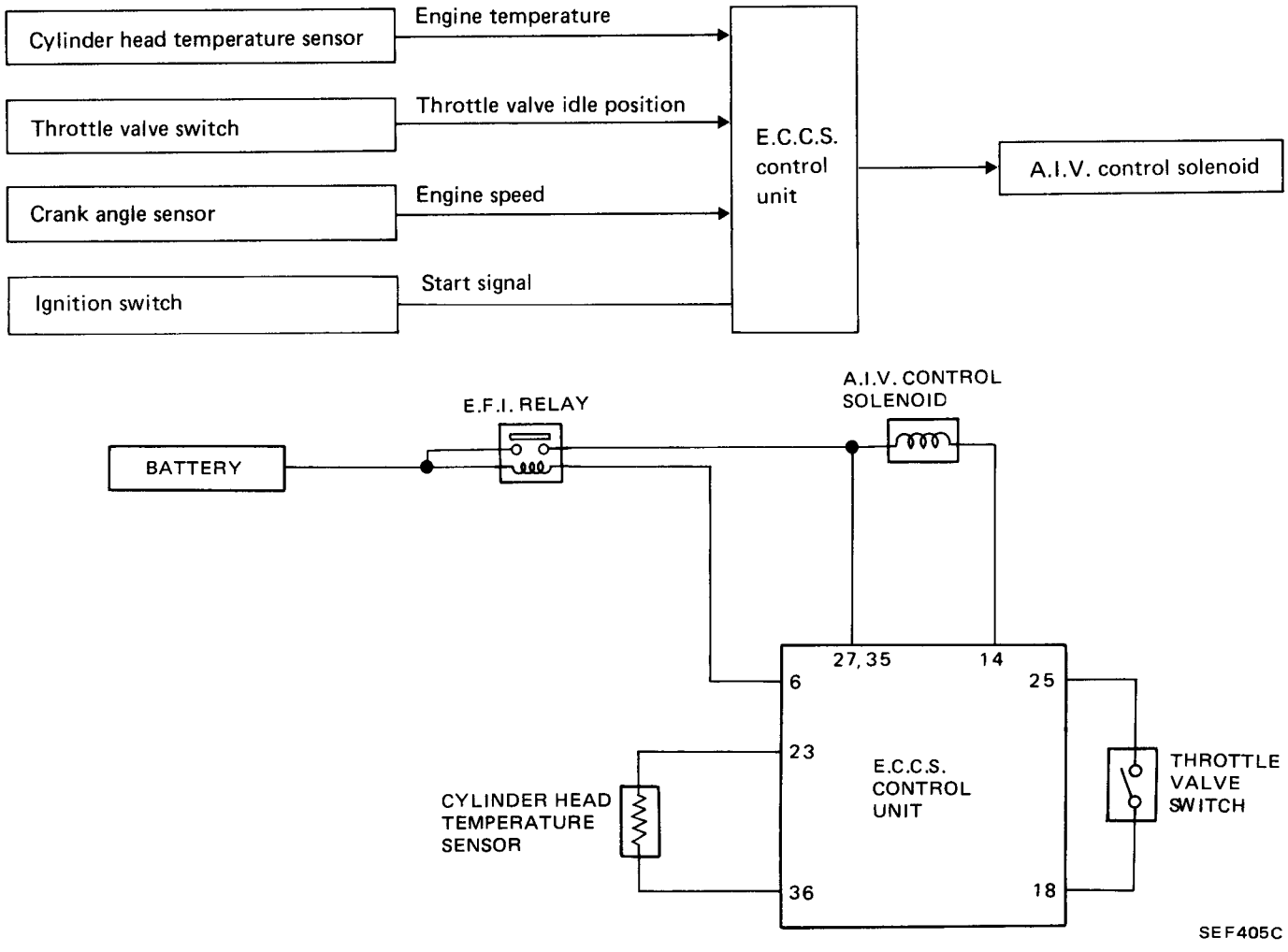
Condition	Fuel pump relay operation	Fuel pump operation
Ignition switch is turned to ON	ON for 5 seconds	Operates for 5 seconds
When engine is starting [Engine temp.: above 100°C (212°F)]	ON	Operates
After started [Engine temp.: above 100°C (212°F)]	ON for 30 seconds	Operates
When engine stalls and except as shown above	OFF	Stops

Fuel pump voltage control

Conditions	Voltage
5 seconds after ignition switch is turned to ON Engine cranking 30 seconds after engine start [above 50°C (122°F)] Engine temp. above 90°C (194°F) [Idle switch "OFF"] Engine temp. below 10°C (50°F)	Approximately 13.4 [V]
Except above	9.4 ~ 13.4 [V]

E.C.C.S. SYSTEM DESCRIPTION

Air Injection Valve (A.I.V.) Control



The exhaust air induction system is designed to send secondary air to the exhaust manifold, utilizing a vacuum caused by exhaust pulsation in the exhaust manifold.

The exhaust pressure in the exhaust manifold usually pulsates in response to the opening and closing of the exhaust valve and it decreases below atmospheric pressure periodically.

If a secondary air intake pipe is opened to the atmosphere under vacuum conditions, secondary air can be drawn into the exhaust manifold in proportion to the vacuum.

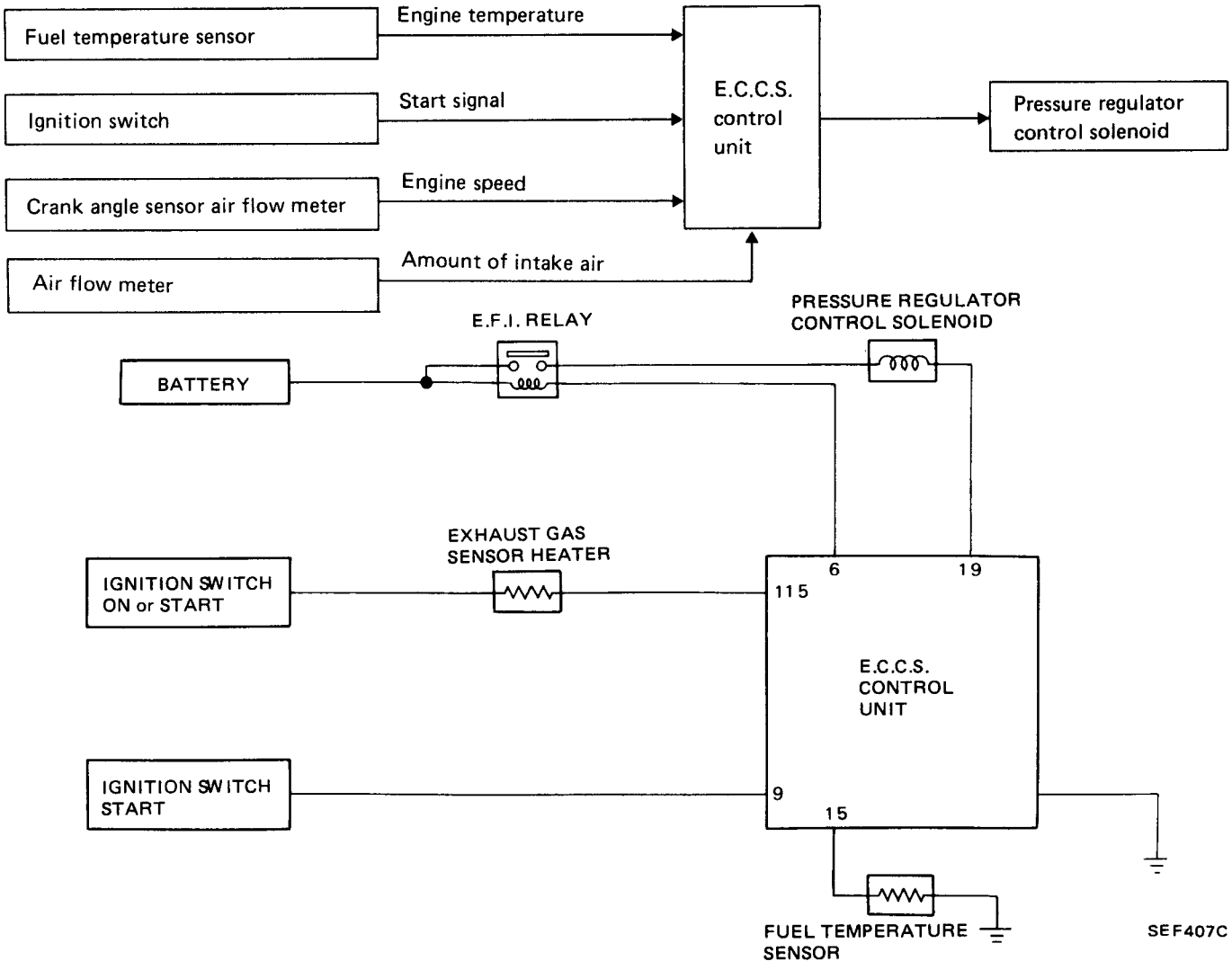
The air injection valve is controlled by the E.C.C.S. control unit, corresponding to the engine temperature. When the engine is cold, the A.I.V. control system operates to activate the 3-way catalytic converter quickly. This system also operates during deceleration for the purpose of blowing off water around the air injection valve.

Condition	A.I.V. control solenoid	A.I.V. control system
Low engine temp.	ON	Operates
During deceleration		
Except above*	OFF	Does not operate

*: Including cylinder head temperature sensor circuit malfunctioning

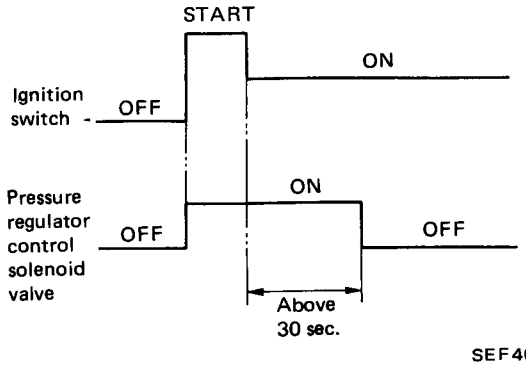
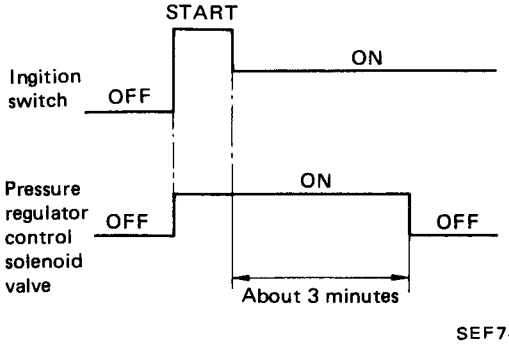
E.C.C.S. SYSTEM DESCRIPTION

Pressure Regulator Control



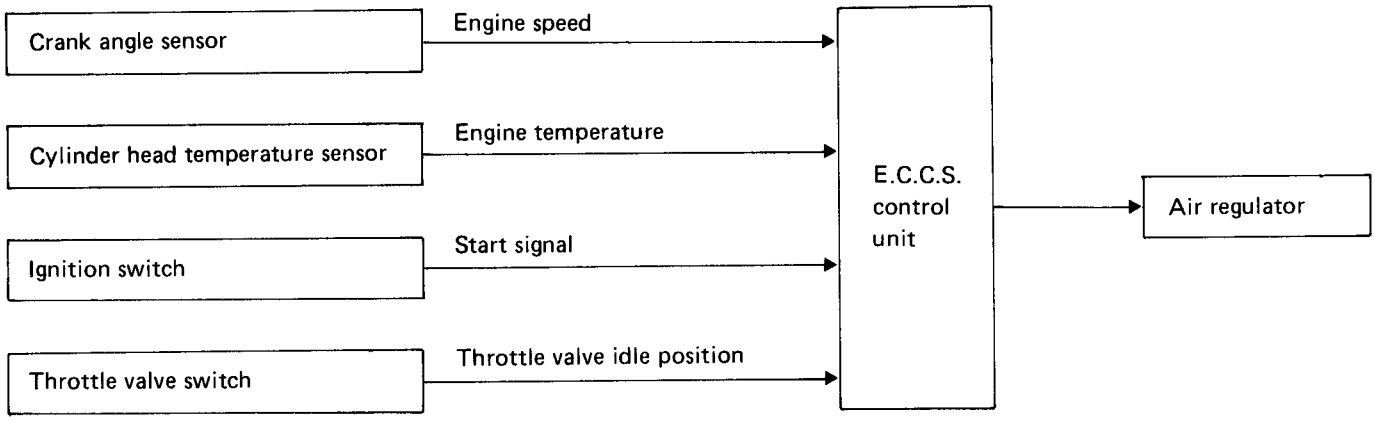
This system improves the startability of a hot engine by cutting off the intake manifold vacuum and increasing the fuel pressure.

Operation

Fuel temp. 40 - 78°C (104 - 172°F)	above 78° (172°F)
	
SEF408C	SEF741B

E.C.C.S. SYSTEM DESCRIPTION

Air Regulator Control



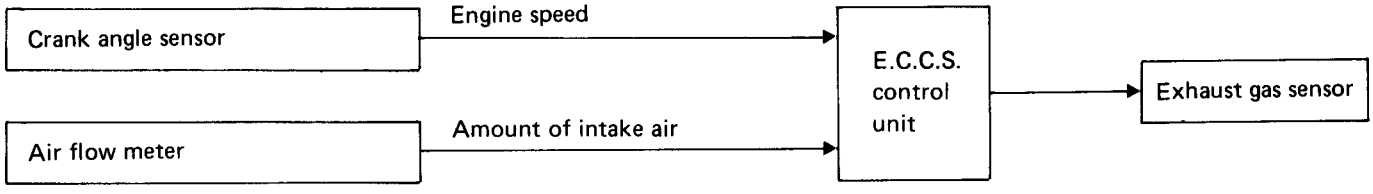
Description

The air regulator is controlled by the E.C.C.S. control unit at the same time as fuel pump ON-OFF control.

Operation (Air regulator ON-OFF control)

Condition	Air regulator operation
Ignition switch is turned to ON	Operates for 5 seconds
While engine is running and cranking	Operates
When engine is stopped	OFF in 1 second
Except as shown above	OFF

Exhaust Gas Sensor Heater Control

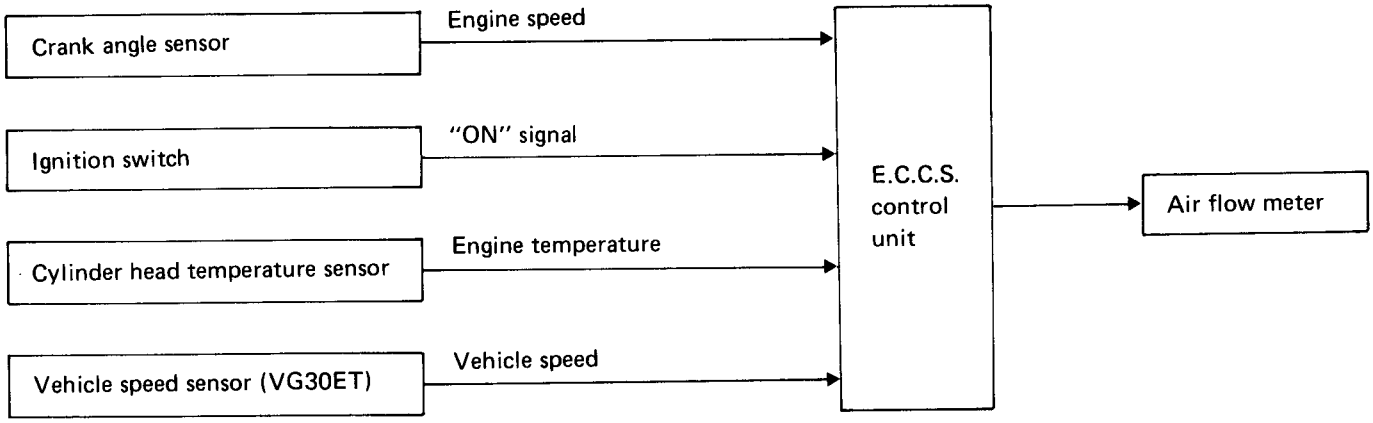


The E.C.C.S. control unit controls the heater operation in the following way.

Operation

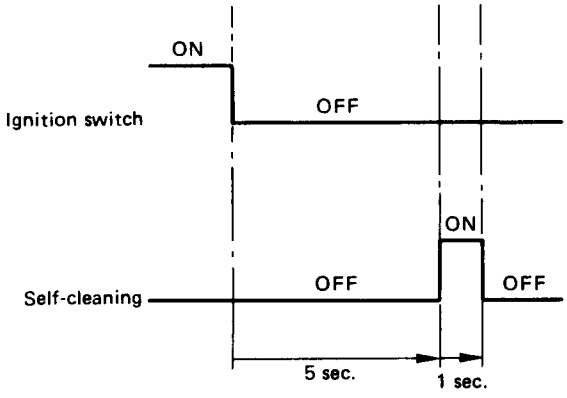
Condition	Exhaust gas sensor heater
• Engine speed is less than 2,800 rpm (VG30ET) 3,200 rpm (VG30E) • Except under heavy load	ON
Except as shown above	OFF

Air Flow Meter Self-cleaning Control



Description

After the engine is stopped, the E.C.C.S. control unit heats up the hot wire to approximately 1,000°C (1,832°F) to burn out dust which adhered to the hot wire.



SEF618B

Operation

Condition	Self-cleaning system
• Engine speed has not exceeded 1,500 rpm before key off. • Car speed has not exceeded 20 km/h (12 MPH) before key off. • Water temperature is higher than 115°C (239°F) when key off. • Engine stall with key in ON position.	Does not operate
Except as shown above	Operates

Fail-safe System

AIR FLOW METER

Description

When the output voltage of air flow meter is lower than the preprogrammed value, the E.C.C.S. control unit judges it as a malfunctioning of air flow meter. The E.C.C.S. control unit fixes the systems in the following condition.

Operation

System	Fixed condition
E.G.R. control system	OFF
Idle speed control system	A duty ratio is fixed at the preprogrammed value.
Fuel injection control system	Fuel is shut off above 2,000 rpm. (Engine speed does not exceed 2,000 rpm.)

CYLINDER HEAD TEMPERATURE SENSOR

Description

When the output signal of cylinder head temperature sensor is abnormal the E.C.C.S. control unit judges it as a malfunctioning of cylinder head temperature sensor.
The E.C.C.S. control unit decides the cylinder head temperature according to the time from ignition switch ON.

Operation

Condition	Cylinder head temperature decided
Just as ignition switch is turned ON or Start	20°C (68°F)
More than 6 minutes after ignition ON or Start	80°C (176°F)
Except as shown above	20 - 80°C (68 - 176°F) (Depends on the time)

DIAGNOSTIC PROCEDURE

Caution

a. Before connecting or disconnecting E.C.C.S. harness connectors to or from any E.C.C.S. unit, be sure to turn the ignition switch to the "OFF" position and disconnect the negative battery terminal.
Otherwise, there may be damage to control unit.

b. Do not attempt to disassemble any E.C.C.S. component parts. To conduct electrical checks on these component parts, closely follow the steps outlined under "ELECTRONIC CONTROL SYSTEM INSPECTION" on pages EF & EC-50 through EF & EC-91.

c. When conducting self-diagnosing, follow the steps outlined under "SELF-DIAGNOSIS" on pages EF & EC-44 through EF & EC-49 in order to obtain accurate diagnosing results. After self-diagnosis has been completed, erase the memory properly.

d. Always turn the diagnosis mode selector carefully using a screwdriver. If it is turned forcibly, it may be damaged, resulting in the inability to perform the self-diagnosis or to monitor the mixture ratio.

e. Never disconnect injector harness connectors with engine running. If disconnected, current will flow to other injectors instead of to the proper one, causing damage to the solenoid in the injector.

Tips on Diagnosis

1. Engine troubles are usually not caused by the E.C.C.S. system.
When trouble-shooting, always check the components listed below first.

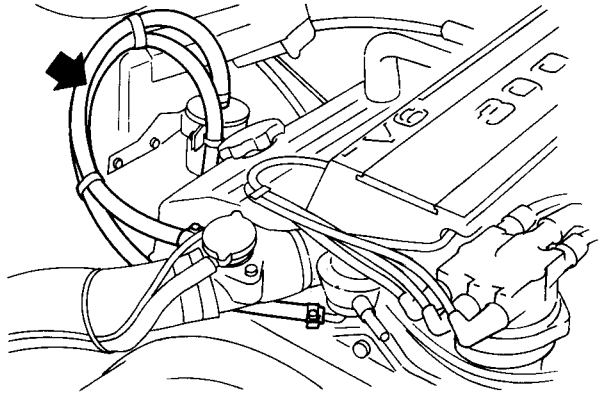
a. Electric source
- Battery charge
- Fusible links
- Fuses

b. Body ground

c. Fuel
- Fuel level and additives
- Fuel gasohol level
- Fuel leakage
- Fuel filter
- Fuel pump
- Fuel pressure

Expedient way to check fuel pressure

Turn ignition switch "ON" and immediately pinch the fuel feed hose with your finger.



SEF492D

d. Ignition system
- Spark plug condition
- High-tension wires
- Distributor rotor and cap
- Power transistor and ignition coil

e. Air flow system
- Vacuum leaks
- Air leaks

f. Emission control system
- EGR system
- PCV system

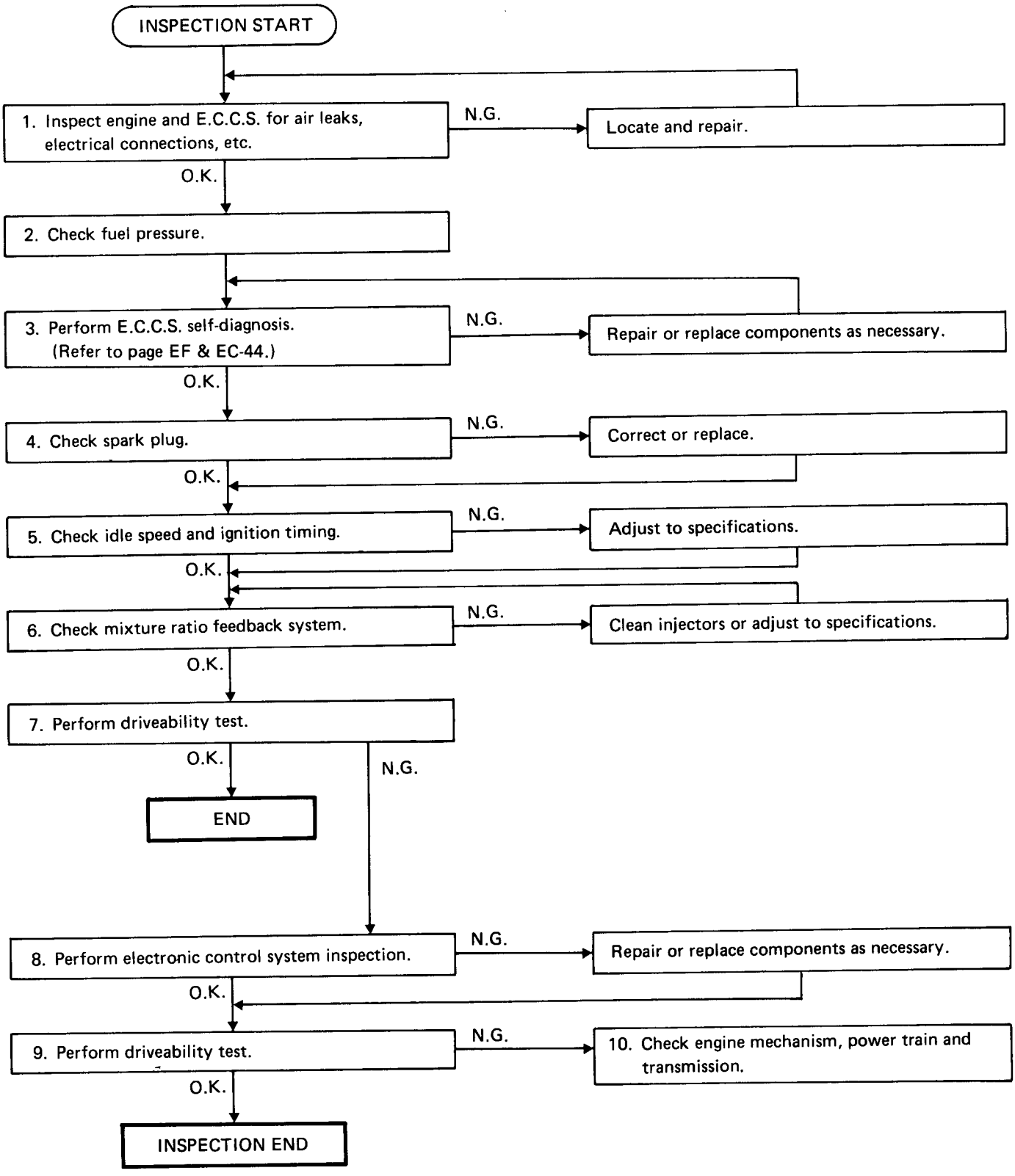
g. Throttle valve switch adjustment

Refer to page EF & EC-63.

2. Most E.C.C.S. troubles are caused by poor or incorrect contacts of E.C.C.S. connectors. Always make sure that connectors are securely connected.
3. Checking by exchanging E.C.C.S. control unit with a known good unit is helpful for trouble-shooting.

DIAGNOSTIC PROCEDURE

Driveability



Driveability (Cont'd)

1. Inspect engine and E.C.C.S. for air leaks, proper electrical connections, etc.
1) Check all hoses, tubes and ducts for air leaks.
2) Check air cleaner filter for clogging.
3) Check harness connectors for proper connections.
4) Check ignition wiring.
5) Check gaskets for leaks at all air intake components.
6) Check E.G.R. valve operation.
7) Check air regulator operation.
8) Check idle-up solenoid valve/A.A.C. valve.
9) Check P.C.V. valve operation.
2. Check fuel pressure.
3. Perform E.C.C.S. self-diagnosis.
   Follow the procedure in E.C.C.S. SELF-DIAGNOSIS (Page EF & EC-44).
4. Check spark plugs.
5. Check idle speed and ignition timing.
   Follow the procedure in IDLE SPEED AND IGNITION TIMING INSPECTION (Page EF & EC-40).
6. Perform mixture ratio feedback system inspection.
   Follow the procedure in MIXTURE RATIO FEEDBACK SYSTEM INSPECTION (Page EF & EC-91).
7. Perform driveability test.
   Evaluate effectiveness of adjustments by driving vehicle. If unsatisfactory, proceed to step 8.
8. Perform electronic control system inspection.
   Check the following using circuit tester.
- Injector circuits
- Air regulator circuit
- E.G.R. control solenoid circuit
- Exhaust gas sensor heater circuit
- Air flow meter self-cleaning circuit

   Follow the procedure in ELECTRONIC CONTROL SYSTEM INSPECTION (Page EF & EC-50).
9. Perform driveability test.
   Re-evaluate vehicle performance.
10. Check engine mechanism, power train, transmission and exhaust system.

a. Engine mechanism
- Compression pressure
- Valve timing

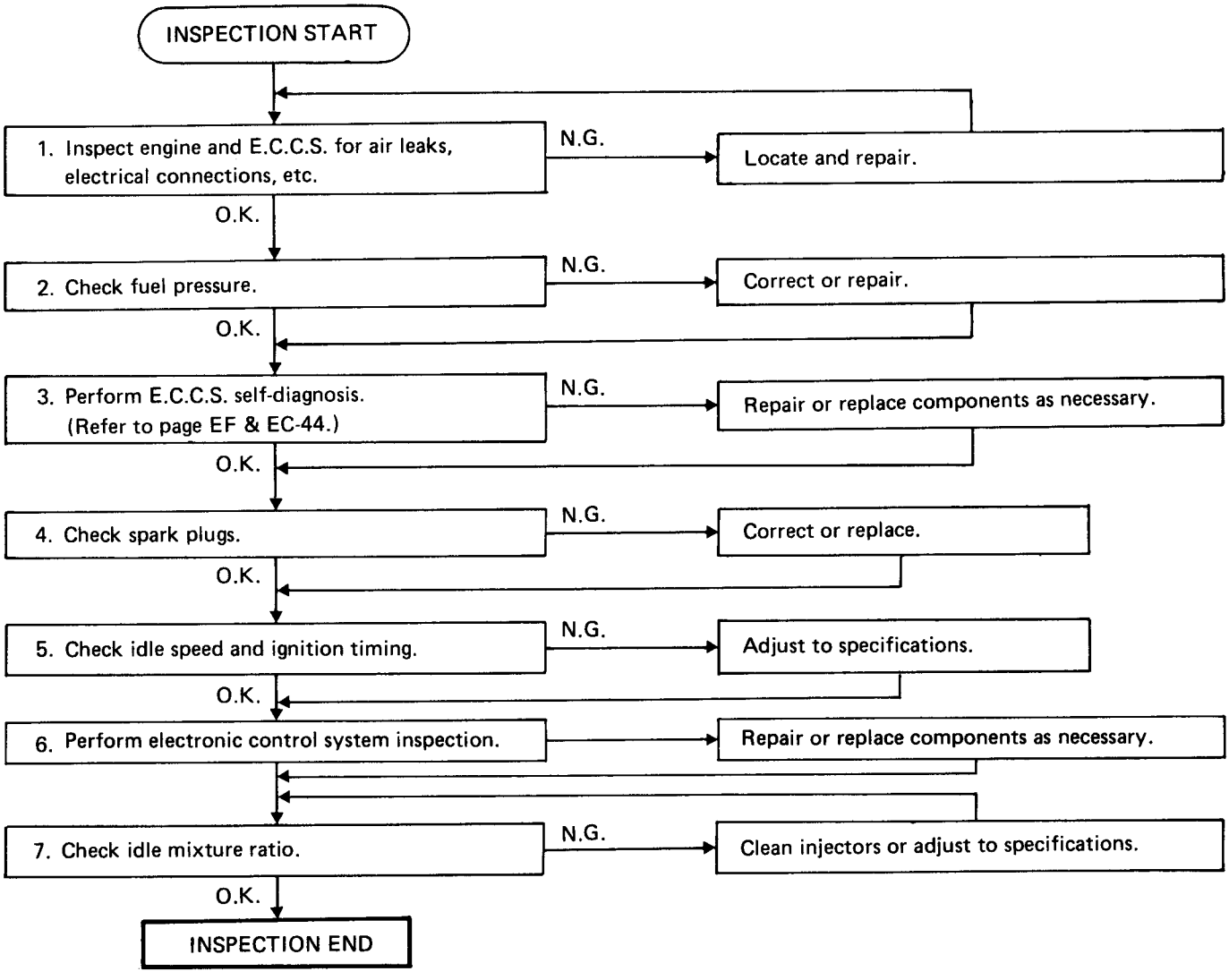
b. Power train
- Tire balance
- Drive shaft balance
- Clutch disc wear

c. Transmission
- Check for abnormal noise and shift schedule (A/T).

d. Exhaust system
- Clogged catalytic converter
- Squeezed exhaust tube

DIAGNOSTIC PROCEDURE

Improper Idling and Stall

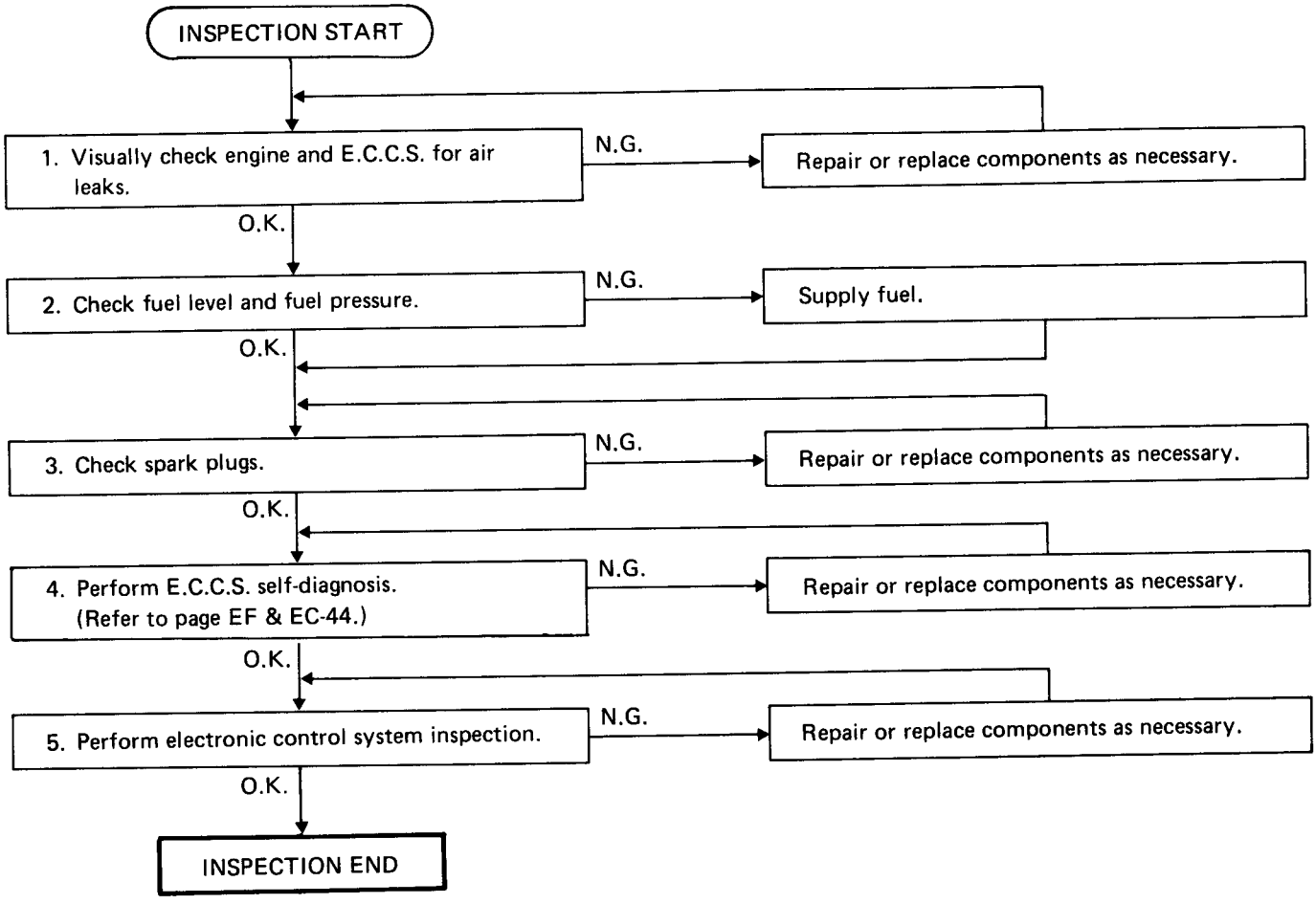


1. Inspect engine and E.C.C.S. for air leaks, electric connections, etc.
   Refer to DRIVEABILITY.
2. Check fuel pressure.
3. Perform E.C.C.S. self-diagnosis.
   Follow the procedure in E.C.C.S. SELF-DIAGNOSIS (Page EF & EC-44).
4. Check spark plugs.
5. Check idle speed and ignition timing.
   Refer to Idle Speed and Ignition Timing Inspection.
6. Perform electronic control system inspection.
   Check the following using circuit tester.
   - Injector circuit
   - Air regulator circuit
   - Idle-up solenoid valve/A.A.C. valve
   - E.G.R. control solenoid circuit
   - Pressure regulator control system

   Follow the procedure in ELECTRONIC CONTROL SYSTEM INSPECTION (Page EF & EC-50).
7. Check idle mixture ratio.
   Refer to Idle Mixture Ratio Inspection (Page EF & EC-43).

DIAGNOSTIC PROCEDURE

Engine Startability



1. Inspect engine and E.C.C.S. for air leaks.
   Refer to DRIVEABILITY.
2. Check fuel level and fuel pressure.
   If fuel level is low or empty, add fuel.
3. Check spark plugs.
   Visually check spark plug appearance for indication that the trouble is caused by mixture ratio or ignition spark.
4. Perform E.C.C.S. self-diagnosis. Follow the procedure in E.C.C.S. SELF-DIAGNOSIS (Page EF & EC-44).
5. Perform electronic control system inspection. Check the following using circuit tester.
   - Injector circuit
   - Air regulator circuit
   - E.G.R. control system

   Follow the procedure in ELECTRONIC CONTROL SYSTEM INSPECTION (Page EF & EC-50).

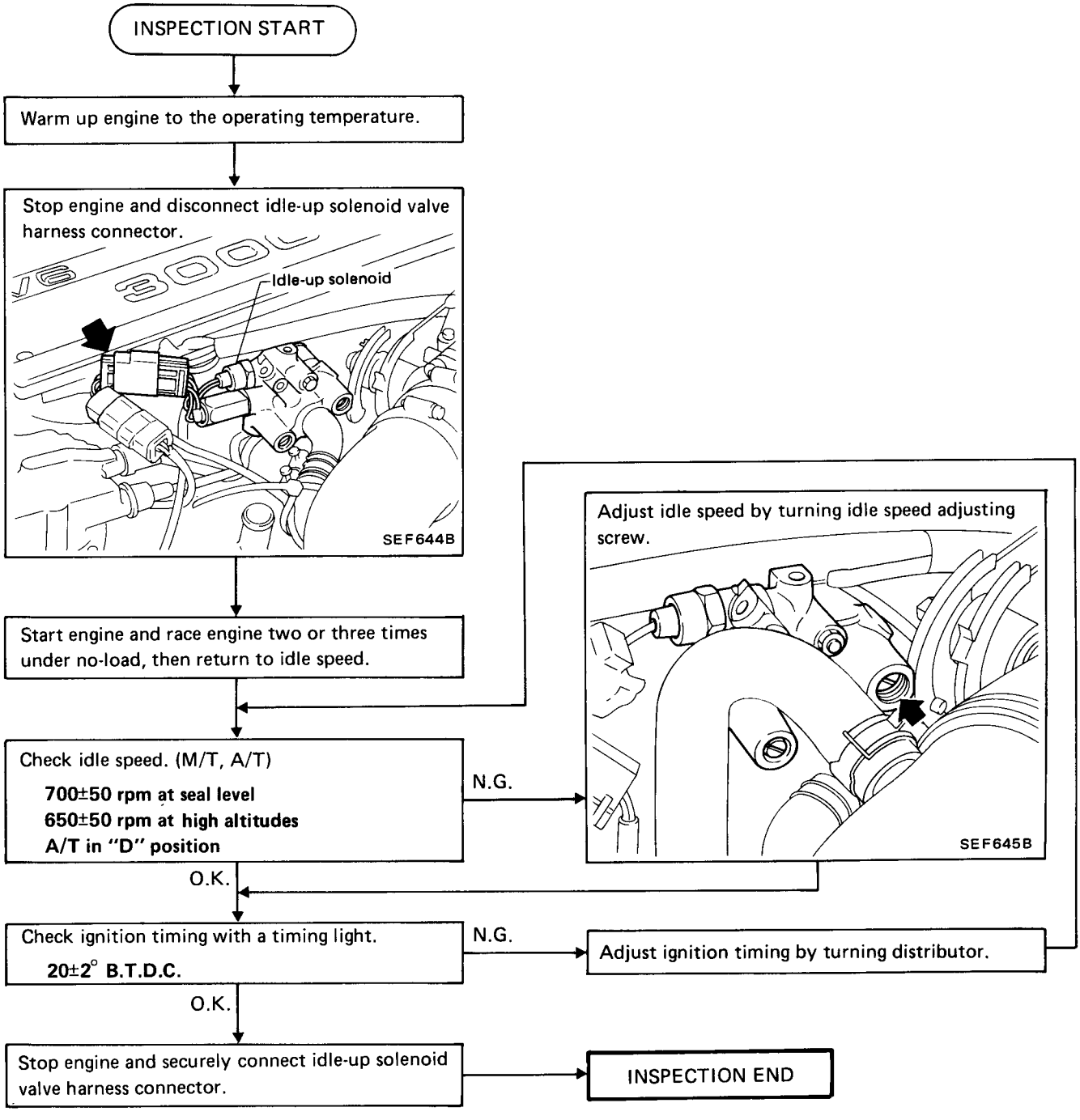
DIAGNOSTIC PROCEDURE

Idle Speed and Ignition Timing Inspection

PREPARATION

- Headlamp switch: OFF
- Heater blower: OFF
- Air conditioner switch: OFF
- Rear window defogger: OFF
- Front wheel (Power steering model): KEEP STRAIGHT AHEAD

INSPECTION PROCEDURE (VG30E engine)



Idle Speed and Ignition Timing Inspection (Cont'd)

INSPECTION PROCEDURE (VG30ET engine)

INSPECTION START

Warm up engine to operating temperature.

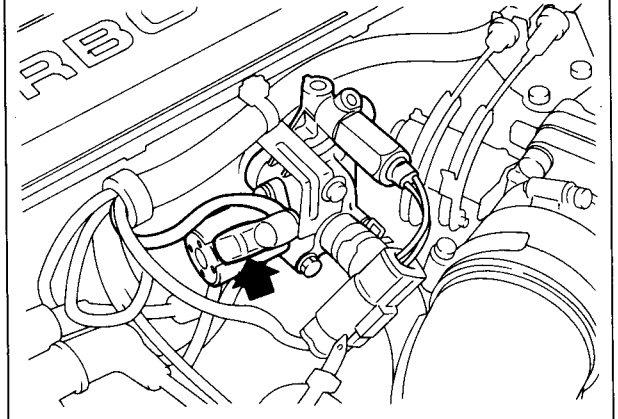
Race engine two or three times under no-load, then run engine at idle speed.

Check idle speed.
M/T: 700±50 rpm
A/T: 650±50 rpm (in "D" position)

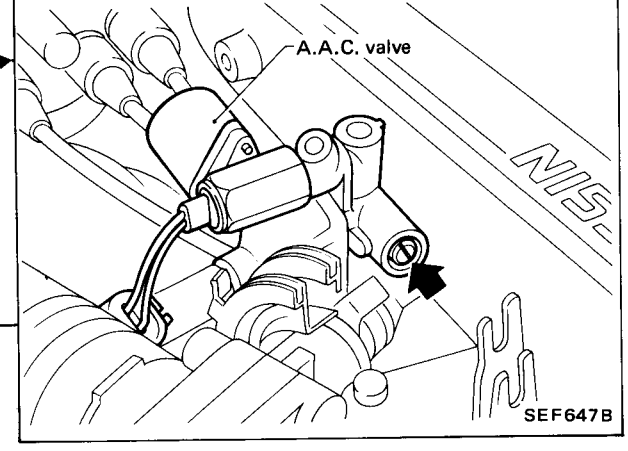
O.K. → (B)

N.G.

Stop engine and disconnect A.A.C. valve harness connector.



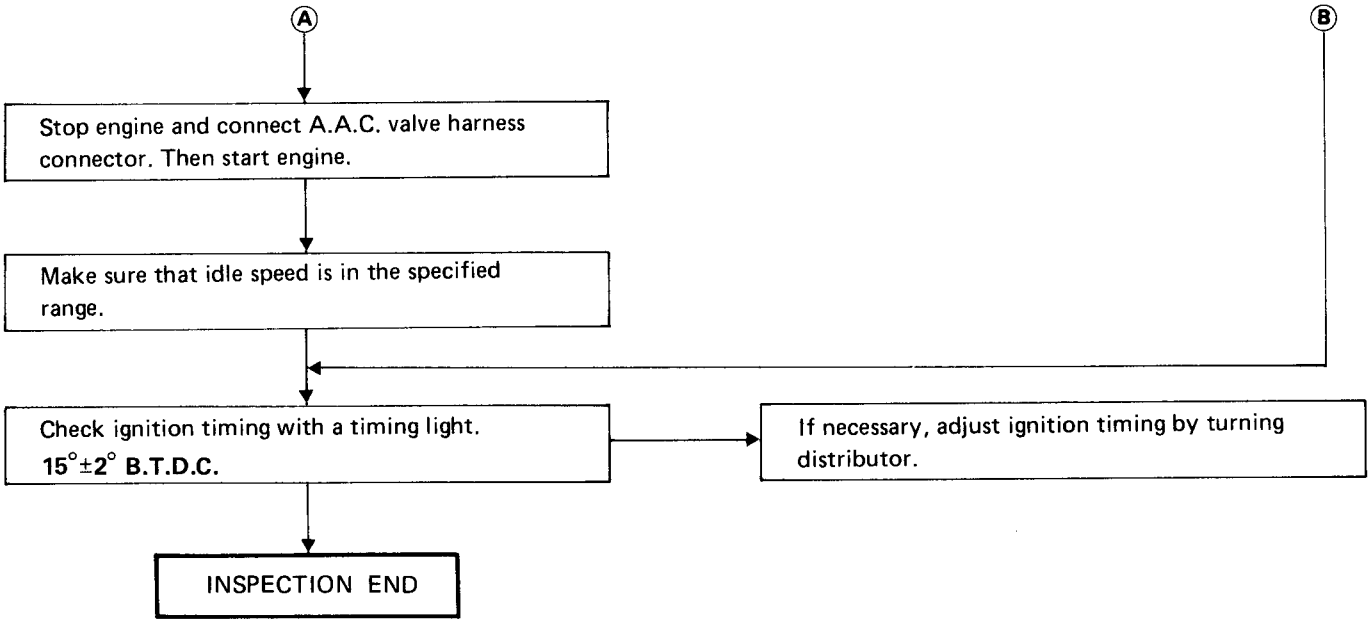
Start engine and adjust engine speed by turning idle speed adjusting screw.
M/T: 650 rpm
A/T: 600 rpm (in "D" position)



(A)

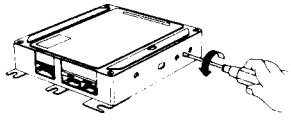
DIAGNOSTIC PROCEDURE

Idle Speed and Ignition Timing Inspection (Cont'd)

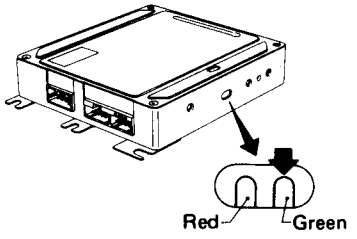


DIAGNOSTIC PROCEDURE

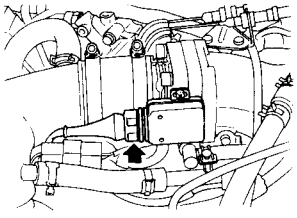
Idle Mixture Ratio Inspection



SEF651B



SEF706B



SEF707B

INSPECTION START

Warm up engine to the normal operating temperature.

Verify that diagnosis mode selector is turned fully counterclockwise.

Run engine at 2,000 rpm for about 2 minutes under no-load.

Make sure that Green L.E.D. on control unit goes on and off more than 5 times during 10 seconds at 2,000 rpm.

N.G.

Go to MIXTURE RATIO FEEDBACK SYSTEM INSPECTION. (Refer to page EF & EC-92.)

O.K.

Disconnect throttle valve switch harness connector.

Race engine two or three times under no-load, then run engine at idle speed.

Make sure inspection lamps flash.
Both L.E.D.s should flash alternately or simultaneously.

Does not flash

Go to MIXTURE RATIO FEEDBACK SYSTEM INSPECTION. (Refer to page EF & EC-92.)

Flash

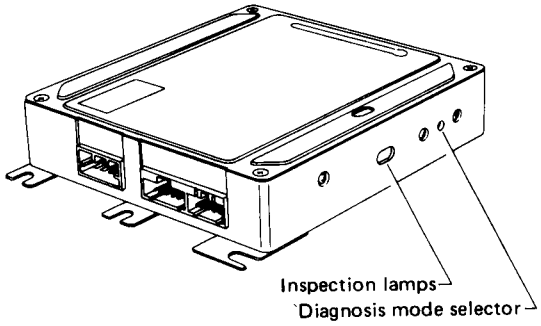
Securely connect throttle valve switch harness connector.

INSPECTION END

Self-diagnostic System

DESCRIPTION

The self-diagnostic system determines malfunctions of signals which provide data to the E.C.U. The malfunctions may not be only E.C.C.S. component malfunctions but may also be poor contact of the connectors, shorted or open circuit of the harnesses and malfunctions of transit relays and diodes. Some of the malfunctions are stored in the E.C.U. and others are not. A malfunction is displayed by the red and green L.E.D.s (Light Emitting Diodes) which are located in the control unit. Self-diagnosis is performed when the self-diagnosis selector is turned on.



SEF650B

DISPLAYS OF MALFUNCTIONING CODES

A malfunctioning area is displayed by the number of both the red and green L.E.D.s. First, the red L.E.D. flashes and the green follows.

The red L.E.D. refers to the tenth digit while the green one refers to the unit digit. For example, when the red L.E,D. flashes three times and the green L.E.D. flashes twice, this imples number "32". In this way, malfunctioning areas are classified by code numbers.

Self-diagnostic System (Cont'd)

DISPLAYED CODE

CODE	L.E.D. display (Red → Green)	Malfunctioning area	Items retained in memory
11	⊛	Crank angle sensor circuit	X
12	⊛ ⊛⊛	Air flow meter circuit	X
13	⊛ ⊛⊛⊛	Cylinder head temperature circuit	X
14	⊛ ⊛⊛⊛⊛	Vehicle speed sensor (VG30ET engine)	–
21	⊛⊛ ⊛	Ignition signal missing in primary coil	X
22	⊛⊛ ⊛⊛	Fuel pump circuit	X
23	⊛⊛ ⊛⊛⊛	Throttle valve switch (Idle switch) circuit	–
24	⊛⊛ ⊛⊛⊛⊛	Neutral/Park switch (VG30ET engine)	–
31	⊛⊛⊛ ⊛	Load signal circuit (Power steering oil pressure switch, Headlamp switch, Radiator fan switch, Rear defogger switch, Heater/air conditioner switch)	–
32	⊛⊛⊛ ⊛⊛	Starter signal circuit	–
34	⊛⊛⊛ ⊛⊛⊛⊛	Detonation sensor (VG30ET engine)	X
41	⊛⊛⊛⊛ ⊛	Fuel temperature sensor circuit	X
44	⊛⊛⊛⊛ ⊛⊛⊛⊛	No malfunctioning in the above circuit (Check other electrical systems.)	–

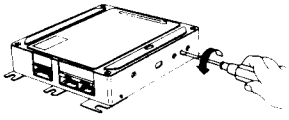
X: Yes –: No

CAUTION:

a. Always turn the diagnosis mode selector carefully using a screwdriver. Do not press hard to turn. Otherwise, the selector may be damaged.
b. When the engine fails to start, crank the engine more than two seconds before starting the self-diagnosing.
c. Before starting the self-diagnosing, do not erase the stored memory. Doing so will reduce the self-diagnosis function considerably.
d. After a malfunctioning area has been corrected, be sure to erase the memory.
e. The self-diagnosed results are retained in the memory by a small current flow from the battery. Disconnecting the battery cable or the E.C.C.S.'s 15-pin connector erases the memory stored.
f. The crank angle sensor signal plays an important role in the E.C.C.S. A malfunctioning of air flow meter is sometimes accompanied by a malfunctioning of the crank angle sensor. So when the crank angle sensor and the air flow meter are both malfunctioning, always start by checking the crank angle sensor first.
g. Start the self-diagnosis 10 seconds after the ignition switch is turned to "OFF" because the air flow meter self-cleaning system is working.
h. Shift the transmission first before checking load signals.

Self-diagnostic Procedure

INSPECTION START



SEF651B

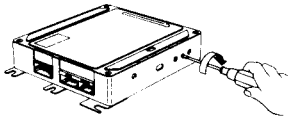
Verify that diagnosis mode selector is turned fully counterclockwise.

Turn ignition switch to "ON" position.

Make sure that inspection lamps on control unit stay "ON". (Bulb check)

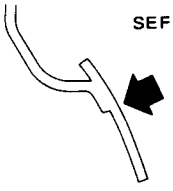
N.G. → Check harness for battery source. (Refer to page EF & EC-75.) If battery is O.K., replace control unit.

O.K.



SEF652B

Turn diagnosis mode selector fully clockwise.



SEF653B

Depress accelerator pedal, then release.

Shift transmission control lever (VG30ET engine only).
Neutral → Others → Neutral

SEF655B

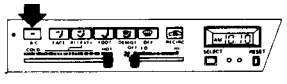
Start engine.
Apply brakes and shift to "D" position (A/T models).

Drive vehicle at more than 10 km/h (6 MPH) (VG30ET engine only).

VG30E engine models
Code No. 31 will be erased after the E.C.C.S. control unit detects one of the load signals below.
- Power steering oil pressure switch
- Air conditioner/Heater switch
- Headlamp switch
- Rear defogger switch
- Radiator fan switch

- Turn one of the load switches (VG30E engine).
  OFF → ON → OFF
- Turn air conditioner switch and heater fan switch (VG30ET engine).
  OFF → ON → OFF

VG30ET engine models



SEF656B

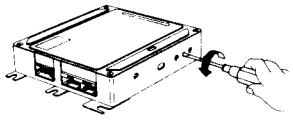
Make sure that inspection lamps on control unit are displaying code No. 44.

N.G. → Write down the malfunctioning code.

O.K.

Ⓐ

Self-diagnostic Procedure (Cont'd)



SEF651B

Ⓐ

Turn diagnosis mode selector fully counter-clockwise.

Turn off engine.

See decoding chart (Next page).

Check malfunctioning area (Pages EF & EC-50 - 72).

Erase the memory of self-diagnosis results.

Procedure for memory erasure

Turn ignition switch to "ON" position.

Turn diagnosis mode selector fully clockwise and keep it there for more than 2 seconds.

Turn diagnosis mode selector fully counter-clockwise and keep it there for more than 2 seconds.

Turn ignition switch to "OFF" position.

END

Decoding Chart

Code No.	Diagnosis	Inspection	Reference page
11	• 1° or 120° signal is not entered for one second while engine is running. • 120° signal is not entered for one second during engine cranking. • Either 1° or 120° signal is not entered often enough while the engine speed is higher than 600 rpm.	• Crank angle sensor harness and connectors • Starting system • Crank angle sensor • E.C.U.	EF & EC-50
12	• An abnormally high output voltage is entered while engine is off. • An abnormally low output voltage is entered while the engine speed is higher than 600 rpm.	• Air flow meter harness and connectors • Air flow meter • Air flow meter self-cleaning system • E.C.U.	EF & EC-53
13	• The cylinder head temperature circuit is open or shorted. (An abnormally high or low output is entered)	• Cylinder head temperature sensor harness and connectors • Cylinder head temperature sensor	EF & EC-56
14	• The vehicle speed signal is not entered while the vehicle is running.	• Vehicle speed sensor harness and connectors • Vehicle speed sensor	EF & EC-58
21	• The ignition signal in the primary coil is not entered more than 10 times.	• Harness between E.C.U. and ignition coil. • Power transistor • Ignition coil • High tension cables • Spark plugs • Distributor • E.C.U.	EF & EC-59
22	• The electric current for fuel pump is extremely low or high.	• Fuel pump harness and connectors • Fuel pump • Fuel pump relay • E.C.U.	EF & EC-62
23	• The ON-OFF signal from idle switch is not entered after ignition switch is turned to "ON".	• Throttle valve switch harness and connectors • Throttle valve switch • Idle switch improper adjustment	EF & EC-63
24	• The ON-OFF signal from neutral/park switch is not entered after ignition switch is turned to "ON".	• Neutral/Park switch harness and connectors • Neutral/Park switch	EF & EC-65

Decoding Chart (Cont'd)

Code No.	Diagnosis	Inspection	Reference page
31	VG30E engine models • An ON-OFF signal from the switches is not entered after ignition switch is turned to "ON".	• Power steering oil pressure switch harness and connectors • Power steering oil pressure switch • Lighting system • Air conditioner system • Rear defogger system • Radiator fan control system • Heater system	EF & EC-67
	VG30ET engine models • An ON-OFF signal from the air conditioner system is not entered after the ignition switch is turned to "ON".	• Air conditioner system	EF & EC-68
32	• The start signal from the ignition switch is not entered after the engine has started.	• Ignition switch • Ignition system harness and connectors	EF & EC-69
34	• The detonation sensor circuit is shorted with the engine operating at a speed of above 2,000 rpm.	• Detonation sensor harness and connectors • Detonation sensor	EF & EC-70
41	• The fuel temperature sensor circuit is open or shorted. (An abnormally high or low output is entered.)	• Fuel temperature sensor harness and connectors • Fuel temperature sensor	EF & EC-71
44	• The systems which are diagnosed by E.C.U. are working normally.	• Inspect other electric control systems.	–

Crank Angle Sensor

INSPECTION START

Perform self-diagnosis. (Refer to page EF & EC-44.)

Code No. 11 Displayed?

No → Does the engine run normally?

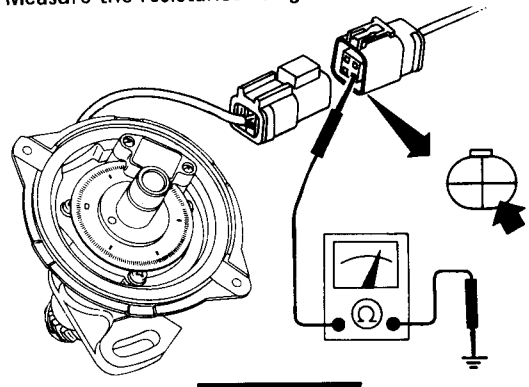
No → Check other systems.
- Ignition timing
- Fuel supply system
- Air flow meter

Yes → INSPECTION END

Yes

Check the battery voltage

1. Disconnect the crank angle sensor harness connector.
2. Measure the resistance for ground.

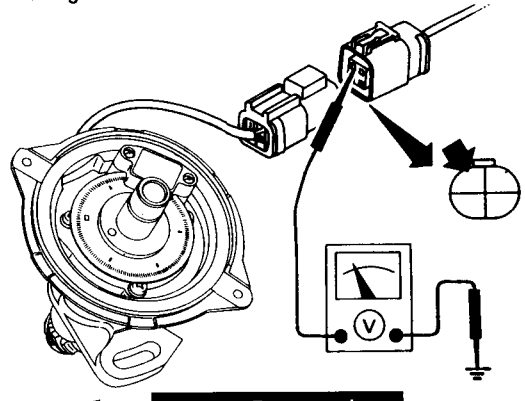


Resistance: 0Ω

SEF493D

N.G. → Repair/Replace the harness.

3. Turn ignition switch "ON" and measure the voltage.



Voltage: Battery voltage

SEF494D

N.G. → Check E.F.I. relay and harness related battery source.

→ Repair/Replace.

O.K.

Ⓐ

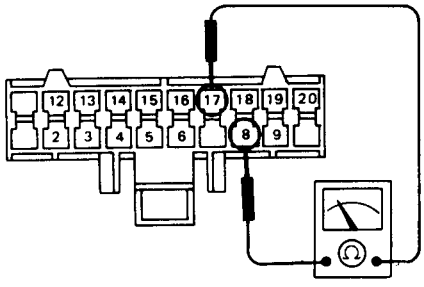
Ⓑ

Crank Angle Sensor (Cont'd)

Ⓐ

Check harness between the crank angle sensor and E.C.U.

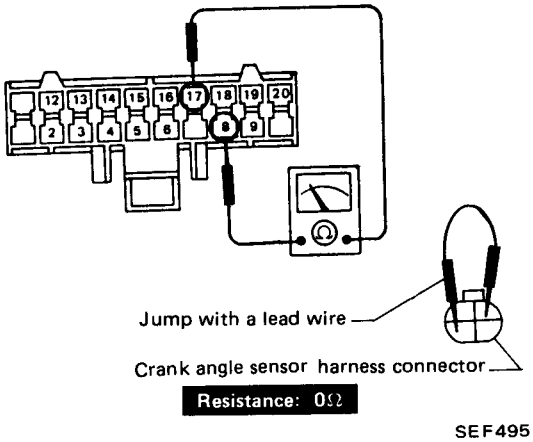
1. Turn ignition switch "OFF".
2. Disconnect E.C.U. 20-pin connector and measure the resistance between ⑰ and ⑧ as an insulation check.



Resistance: ∞Ω

SEF943C

3. Connect crank angle sensor harness terminals with a lead wire and measure the resistance between ⑰ and ⑧ as a continuity check.



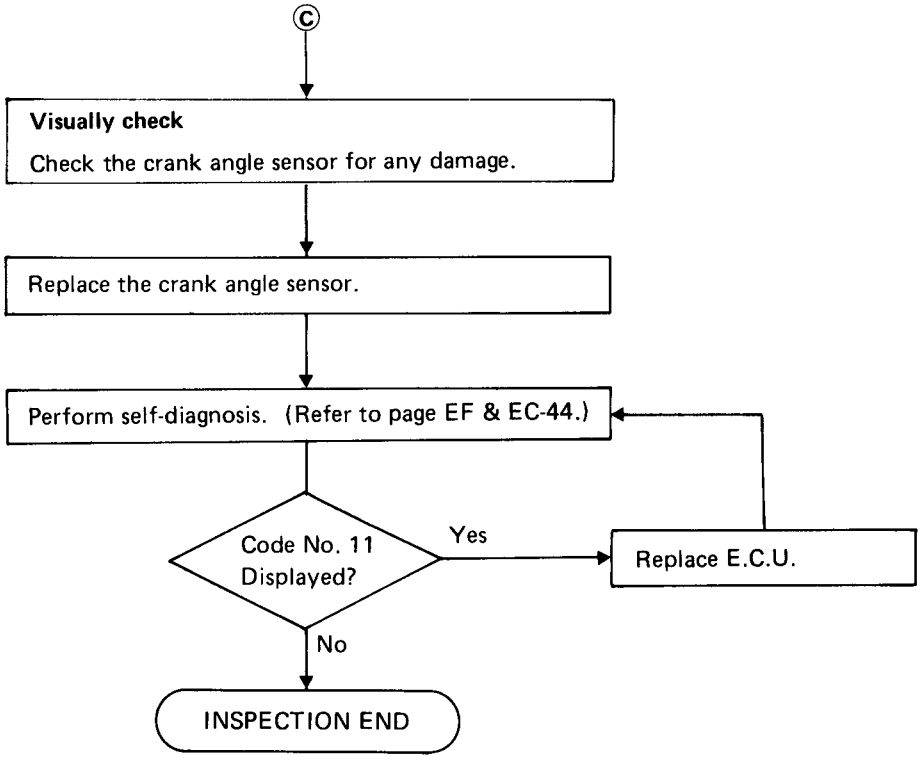
Resistance: 0Ω

SEF495D

N.G. → Repair/Replace the harness. → Ⓑ

O.K. → Ⓒ

Crank Angle Sensor (Cont'd)



Air Flow Meter

Refer to page EF & EC-85 for checking self-cleaning system.

INSPECTION START

Perform self-diagnosis. (Refer to page EF & EC-44.)

CAUTION:
***If Code No. 11 and Code No. 12 are both displayed, first check the crank angle sensor.**

Code No. 12 Displayed?

No → Does the engine run normally?

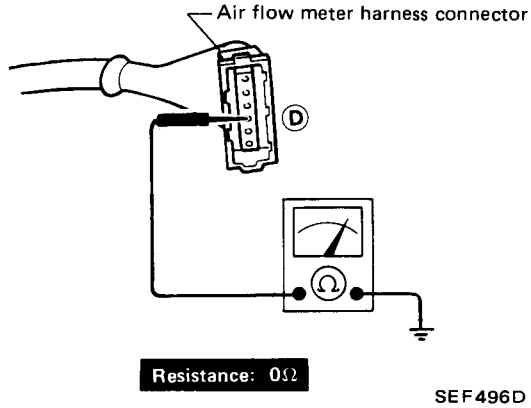
No → Check other systems.
- Fuel system
- Ignition timing
- Crank angle sensor

Yes → END

Yes

Check the battery voltage

1. Disconnect air flow meter harness connector.
2. Measure the resistance for ground.

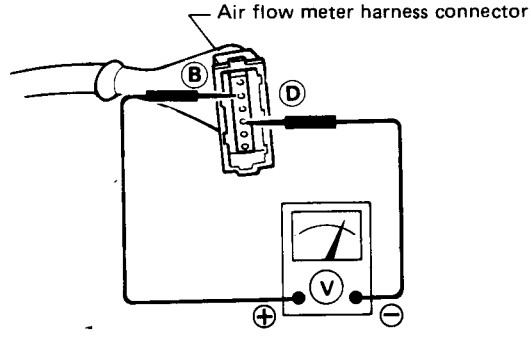


Resistance: 0Ω

SEF496D

N.G. → Repair/Replace the harness.

3. Turn ignition switch "ON" and measure the voltage at (B).



Voltage: Battery voltage

SEF497D

N.G. → Check E.F.I. relay and harness related battery source. → Repair/Replace.

O.K. → (A)

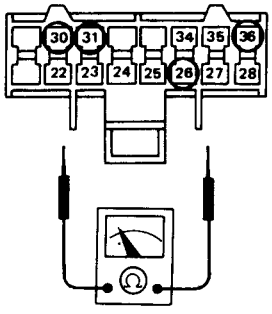
(B)

Air Flow Meter (Cont'd)

Ⓐ

Check harness between the air flow meter and E.C.U.

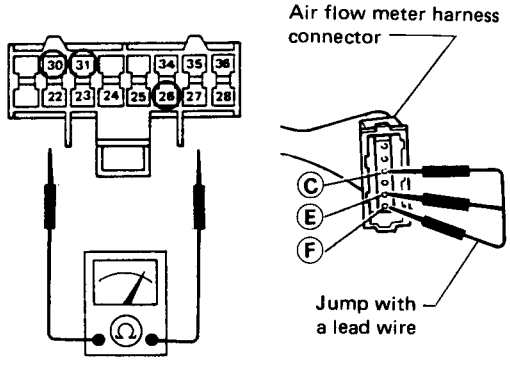
1. Turn ignition switch "OFF".
2. Disconnect E.C.U. 16-pin connector and measure the resistance between terminals as an insulation check.



Terminals	Resistance (Ω)
㉖ - ㉚	∞
㉖ - ㉛	∞
㉚ - ㉛	∞
㊱ - ㉖	∞
㊱ - ㉚	∞
㊱ - ㉛	∞

SEF948C

3. Connect air flow meter harness connector terminals with a lead wire and measure the resistance as a continuity check.



Terminals	Resistance (Ω)
㉖ - ㉚	0
㉖ - ㉛	0
㉚ - ㉛	0

SEF498D

N.G. → Repair/Replace the harness. → Ⓑ

O.K. → Ⓒ

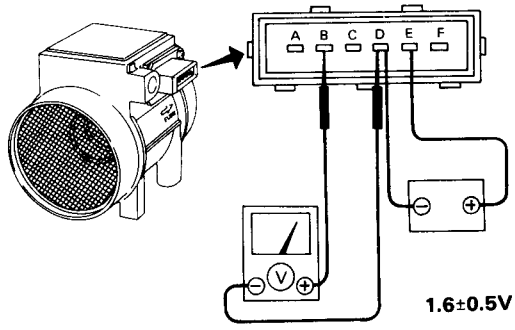
Ⓓ

Air Flow Meter (Cont'd)

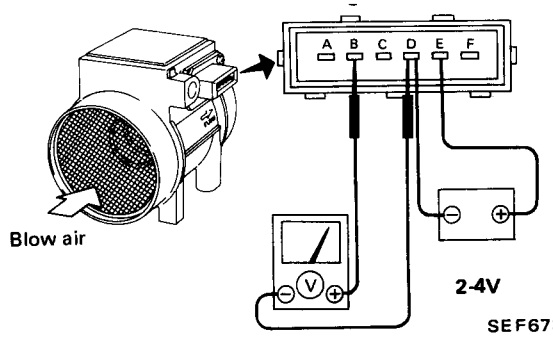
Ⓒ

Check air flow meter

1. Remove air flow meter. Apply battery voltage to terminals D and E.
   Then measure voltage between terminals B and D.



2. Blow air through air flow meter and observe the voltage change between terminals B and D.



N.G. → Replace air flow meter. → Ⓓ

O.K. → Replace E.C.U. → Ⓓ

Cylinder Head Temperature Sensor

INSPECTION START

Perform self-diagnosis. (Refer to page EF & EC-44.)

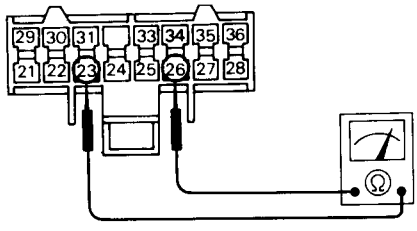
Code No. 13 Displayed?

No → INSPECTION END

Yes

Check entire circuit

Disconnect 16-pin connector and measure the resistance between terminals ㉓ and ㉖.

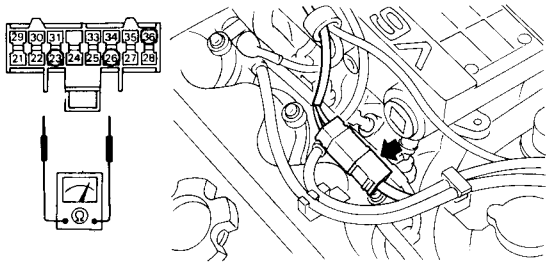


SEF676B

Cylinder head temperature	Resistance
Above 20°C (68°F)	Below 2.9 kΩ
Below 20°C (68°F)	Above 2.1 kΩ

N.G. → **Check harness**

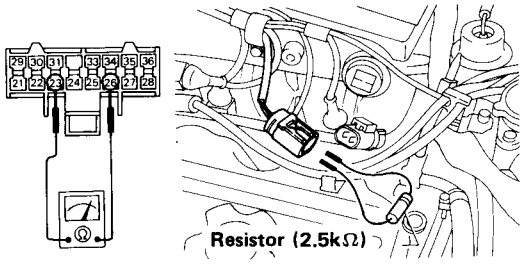
1. Disconnect cylinder head temperature sensor harness connector and measure the resistance between ㉓ and ㉖ as an insulation check.



Terminals	Resistance (Ω)
㉓ - ㉖	∞
㉓ - ㊱	∞
㉖ - ㊱	∞

SEF499D

2. Connect cylinder head temperature sensor harness connector with a lead wire and measure the resistance between ㉓ and ㉖ as a continuity check.



Terminals	Resistance (Ω)
㉓ - ㉖	0

SEF500D

O.K. → Ⓐ

N.G. → Repair/Replace the harness. → Ⓒ

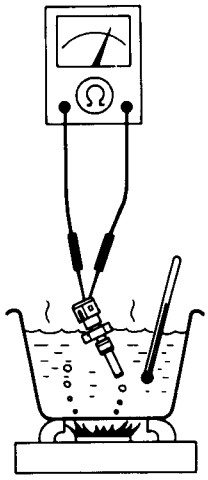
O.K. → Replace control unit. → Ⓑ

Cylinder Head Temperature Sensor (Cont'd)

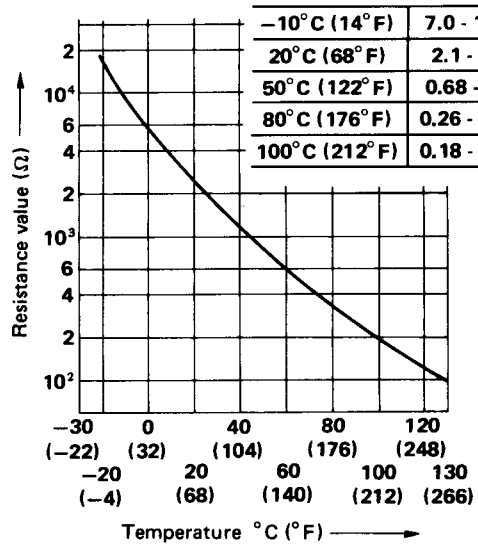
Ⓑ Ⓐ Ⓒ

Check cylinder head temperature sensor

Dip the sensor into water maintained at a temperature of 20°C (68°F), 80°C (176°F), etc., and read its resistance.



−10°C (14°F)	7.0 - 11.4 kΩ
20°C (68°F)	2.1 - 2.9 kΩ
50°C (122°F)	0.68 - 1.0 kΩ
80°C (176°F)	0.26 - 0.39 kΩ
100°C (212°F)	0.18 - 0.20 kΩ



SEF677B

O.K.

N.G.

Replace cylinder head temperature sensor.

Vehicle Speed Sensor

INSPECTION START

Perform self-diagnosis. (Refer to page EF & EC-44.)

Code No. 14 Displayed?

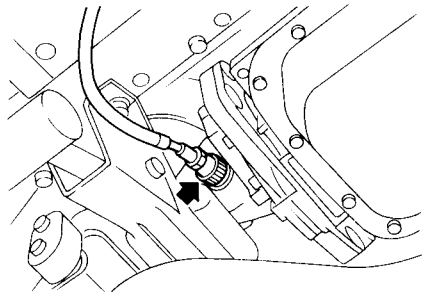
No → Does the engine run normally?

No → Check other systems.
- Fuel supply system
- Air flow meter
- Crank angle sensor

Yes → INSPECTION END

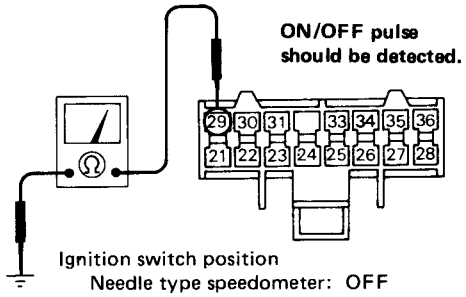
Yes

Disconnect speedometer cable from transmission.



SEF678B

Disconnect 16-pin connector from E.C.C.S. control unit and check continuity between terminal ㉙ and ground while slowly turning speedometer cable.



SEF679B

N.G. → Check harness and vehicle speed sensor. (Refer to "METER AND GAUGES" in EL section.)

O.K. → Replace E.C.C.S. control unit.

Ignition Signal

INSPECTION START

Perform self-diagnosis. (Refer to page EF & EC-44.)

Code No. 21 Displayed?

No → Does the engine run normally?

No → Check other systems.
- Fuel supply system
- Air flow meter
- Crank angle sensor

Yes → INSPECTION END

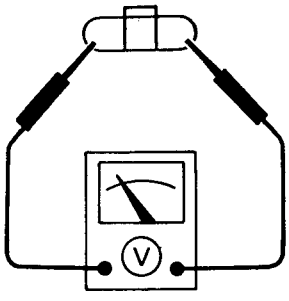
Yes

Check spark plugs, ignition wires, distributor cap and distributor rotor.

If abnormality is found, repair or replace.

Check battery voltage at power transistor

1. Disconnect the harness connector at power transistor.
2. Turn ignition switch "ON" and measure the voltage.



Voltage: Battery voltage

SEF501D

3. Turn ignition switch "OFF".

N.G. → Repair/Replace the harness.

O.K.

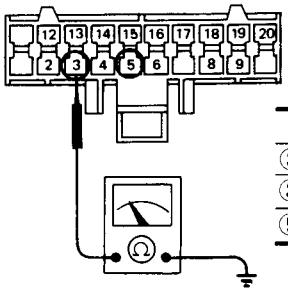
Ⓐ Ⓒ Ⓑ

Ignition Signal (Cont'd)

Ⓐ

Check harness between E.C.U. and power transistor

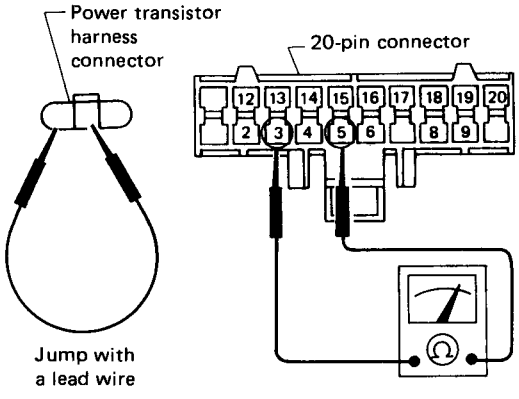
1. Disconnect E.C.U. 20-pin connector and check for insulation at ③ and ⑤.



Terminals	Resistance (Ω)
③- ⑤	∞
③- Ground	∞
⑤- Ground	∞

SEF953C

2. Connect terminals with a lead wire and measure the resistance between ③ and ⑤ as a continuity check.



SEF502D

N.G. → Ⓒ

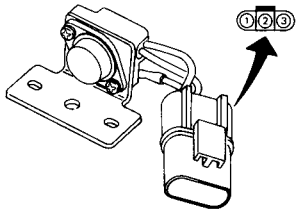
O.K. → Ⓓ

Ⓑ → Ⓔ

Ignition Signal (Cont'd)

Ⓓ

Check power transistor.



Tester	Measuring current of tester		Should read
Ohmmeter	①	③	Continuity exists
	②	③	
	②	①	

SEF587C

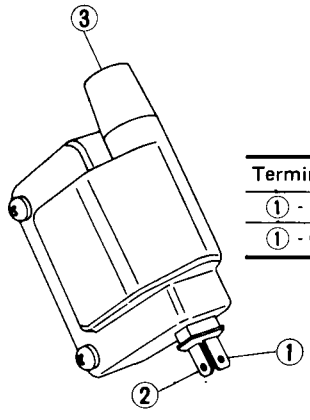
N.G.

Replace power transistor.

O.K.

Check ignition coil with harness

Check for continuity.



Terminals	Resistance
① - ②	1Ω
① - ③	10 kΩ

SEF956C

O.K.

Replace E.C.U.

N.G.

Replace the ignition coil.

Ⓔ

Fuel Pump

INSPECTION START

Check the fuse.

Perform self-diagnosis. (Refer to page EF & EC-44.)

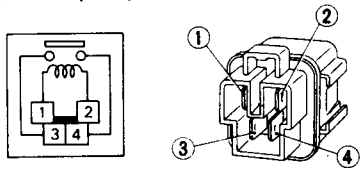
Code No. 22 Displayed?

No → Check fuel pressure. → INSPECTION END

Yes

Turn ignition switch "ON" and listen to the fuel pump operating sound. The sound must be heard for about 5 seconds.

N.G. → Check fuel pump relay and fuse.

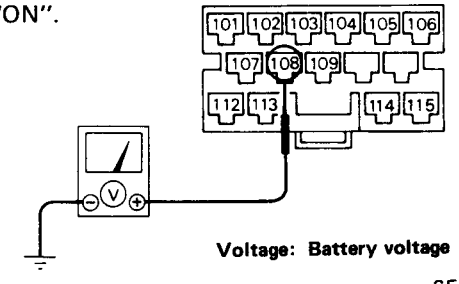


Check terminals	Normal condition	12V direct current is applied between terminals ① and ②
① – ②	Continuity	–
③ – ④	No continuity	Continuity

SEF685B

O.K. → Check battery voltage

1. Disconnect E.C.C.S. 15-pin connector, and check voltage between terminal (108) and ground when ignition switch is turned to "ON".



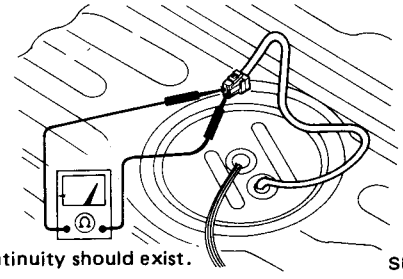
Voltage: Battery voltage

SEF683B

2. Turn ignition switch "OFF".

O.K. → Check fuel pump

1. Check fuel pump for continuity.



Continuity should exist.

SEF503D

2. Check fuel pump for insulation.

O.K. → Replace E.C.U.

O.K. → Check harness

1. Check harness between E.C.U. and fuel pump.
2. Check harness between fuel pump and fuse block.

O.K. → (to Check fuel pump)

N.G. → Repair/Replace.

N.G. → Replace fuel pump.

N.G. → Replace fuel pump relay.

Throttle Valve Switch

INSPECTION START

Adjust accelerator wire.

Perform self-diagnosis. (Refer to page EF & EC-44.)

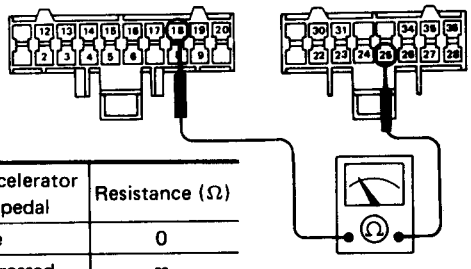
Code No. 23 Displayed?

No

Yes

Check signal for E.C.U.

1. Disconnect E.C.U. 20-pin and 16-pin connectors.
2. Check for continuity between ⑱ and ㉕.



Accelerator pedal	Resistance (Ω)
Free	0
Depressed	∞

SEF959C

N.G.

O.K.

Replace E.C.U.

Adjust throttle valve switch (Idle switch)

1) Confirm that the idle speed is in the specified range.

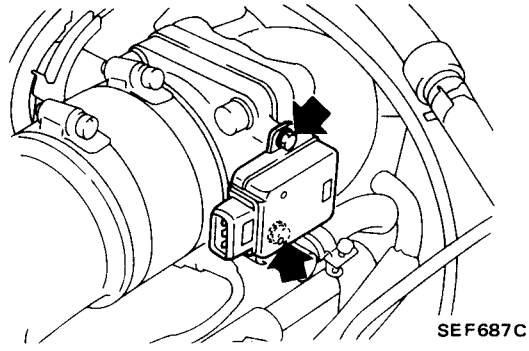
Idle speed:

At sea level 700±50 rpm
At high altitude 650±50 rpm
(A/T should be adjusted shifting in "D" position)

2) Adjust idle switch so that the switch turns on at the engine speed as shown below.

OFF → ON:

Idle speed (rpm) + 250 (rpm)
(In neutral position)
allowance: ±150 rpm

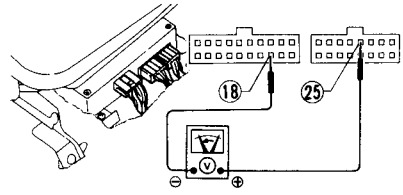


SEF687C

3) Check that the idle switch is "ON" at the idle speed.

Confirm idle switch operation

1. Turn ignition switch "ON".
2. Check voltage between ⑱ and ㉕.



Observe that the voltage changes to 0V from 12V when the engine speed is passing at about 900 rpm by reducing.

SEF958C

3. Stop engine.

INSPECTION END

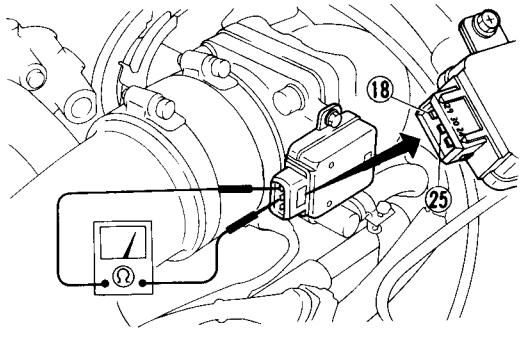
Ⓐ Ⓒ Ⓑ

Throttle Valve Switch (Cont'd)

Ⓐ

Check throttle valve switch

1. Disconnect throttle valve switch harness connector.
2. Check the throttle valve switch for continuity between ㉕ and ⑱.



SEF686C

Throttle valve	Continuity
Idle position	Yes (0Ω)
Slightly opened position	No (∞Ω)

N.G.

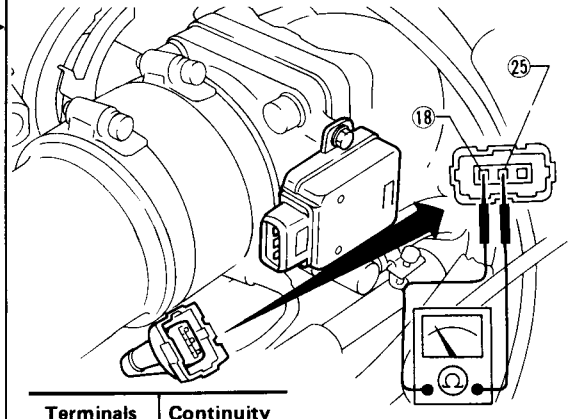
Replace throttle valve switch.

O.K.

Ⓒ

Check harness for continuity

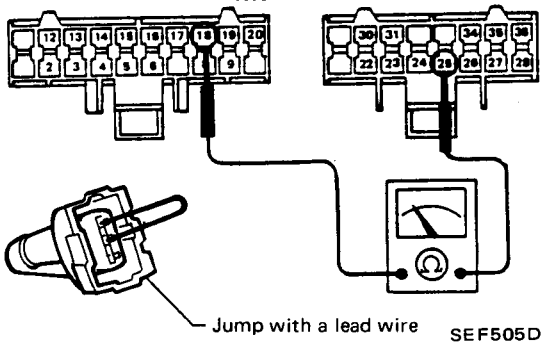
1. Check for insulation.



SEF504D

Terminals	Continuity
⑱ - ㉕	No
⑱ - Ground	No
㉕ - Ground	No

2. Connect terminals with a lead wire and check for continuity. Resistance: 0Ω



SEF505D

N.G.

Repair/Replace harness.

Ⓑ

Neutral Switch

INSPECTION START

Perform self-diagnosis. (Refer to page EF & EC-44.)

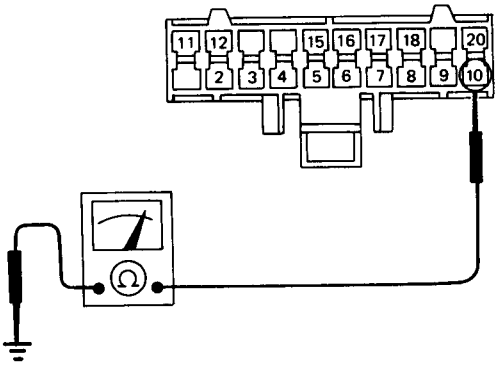
Code No. 24 Displayed?

No → INSPECTION END

Yes

Check neutral/park switch harness.

1. Disconnect 16-pin connector.
2. Turn ignition switch "ON" and measure resistance between terminal ⑩ and ground.



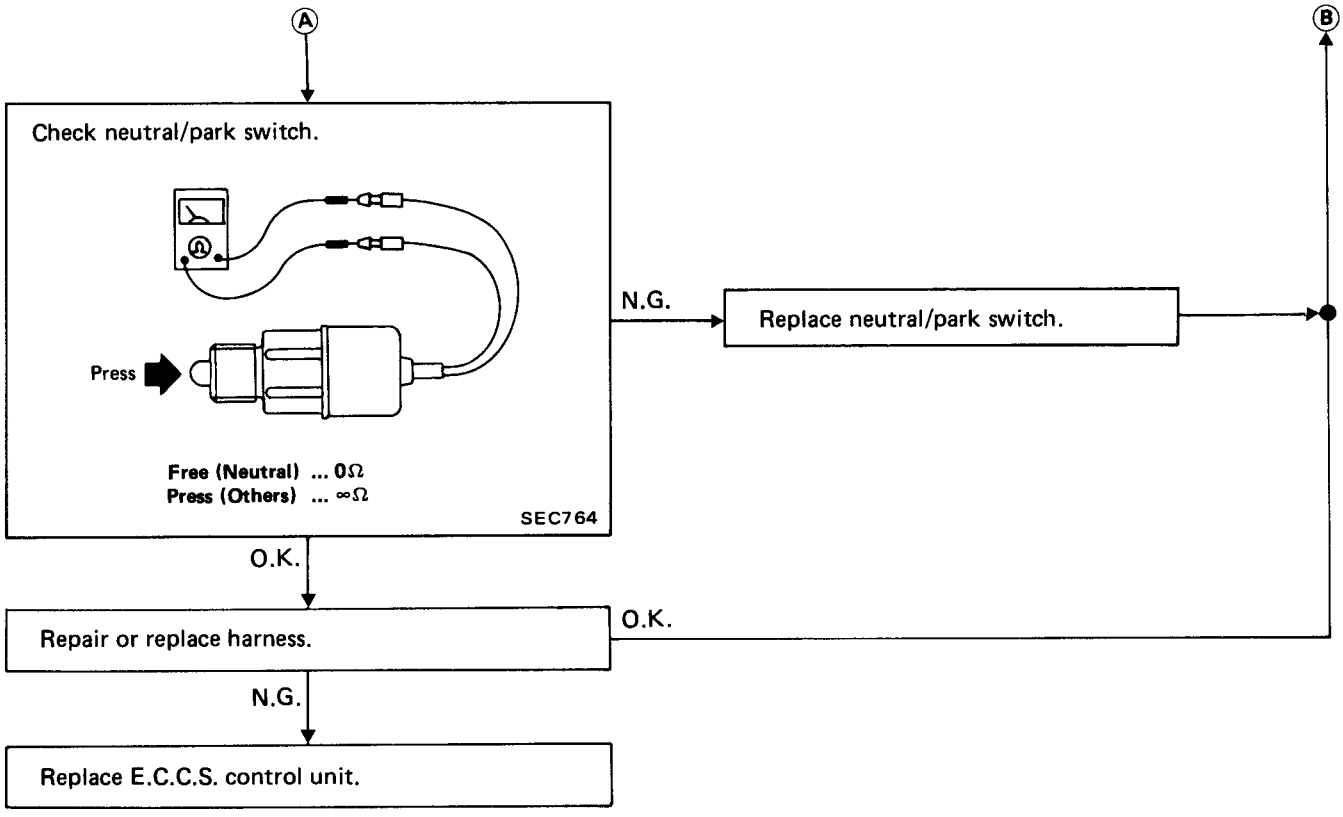
Gear position	Continuity
Except neutral/park	∞Ω
Neutral/park	0Ω

SEF512D

Ⓐ

Ⓑ

Neutral Switch (Cont'd)



Load Signal

INSPECTION START

Perform self-diagnosis. (Refer to page EF & EC-44.)

Code No. 31 Displayed?

No

Check idle-up solenoid valve operation

M/T:
1. Start and warm up the engine.
2. Check that the engine speed is increased when the headlamp switch is turned on.

A/T:
1. Start and warm up the engine.
2. Shift to "D" position and turn on the headlamp switch.
3. Check that the engine speed is reduced when the idle-up solenoid valve harness connector is disconnected.

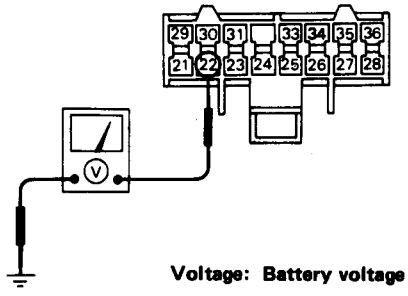
O.K.

INSPECTION END

Yes

Check input signals

1. Disconnect 16-pin connector. Turn ignition switch "ON" and measure voltage between terminal (22) and ground when any of the following switches are turned "ON".
   - Power steering oil pressure switch
   - Heater/Air conditioner switch
   - Headlamp switch
   - Rear defogger switch
   - Radiator fan switch



Voltage: Battery voltage

SEF690B

2. Turn all switches "OFF".

O.K.

Replace E.C.U.

N.G.

Check load-signal system

Check following system operation:
- Power steering oil pressure switch
- Heater/Air conditioner
- Headlamp
- Rear defogger
- Radiator fan

N.G.

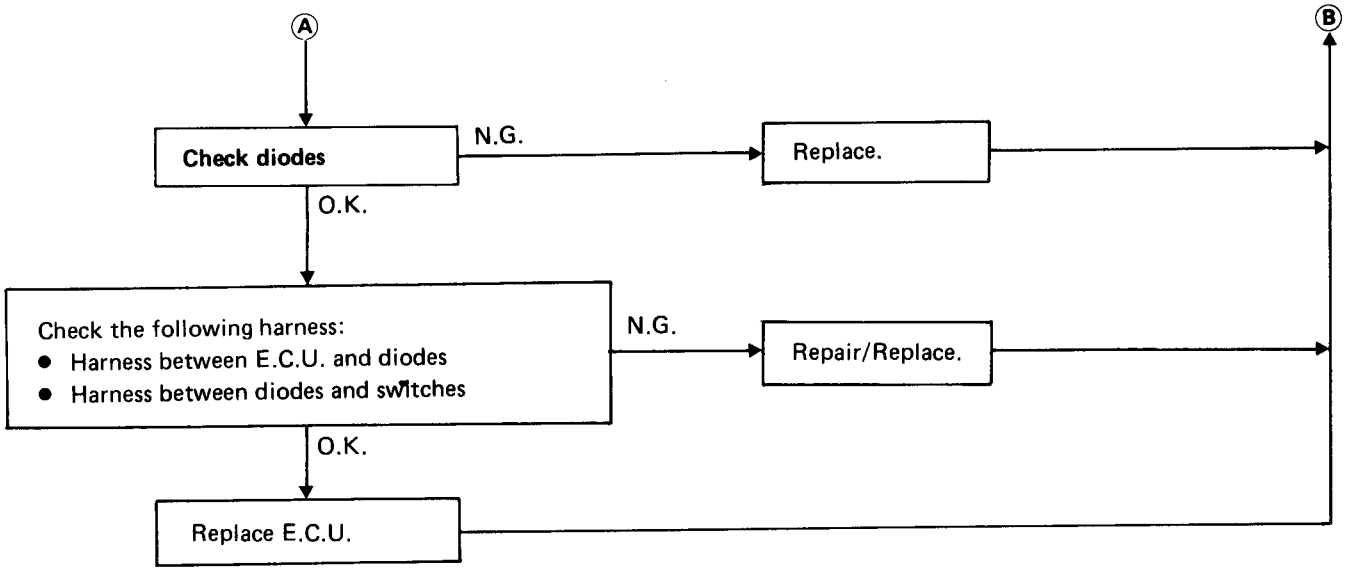
Repair/Replace.

O.K.

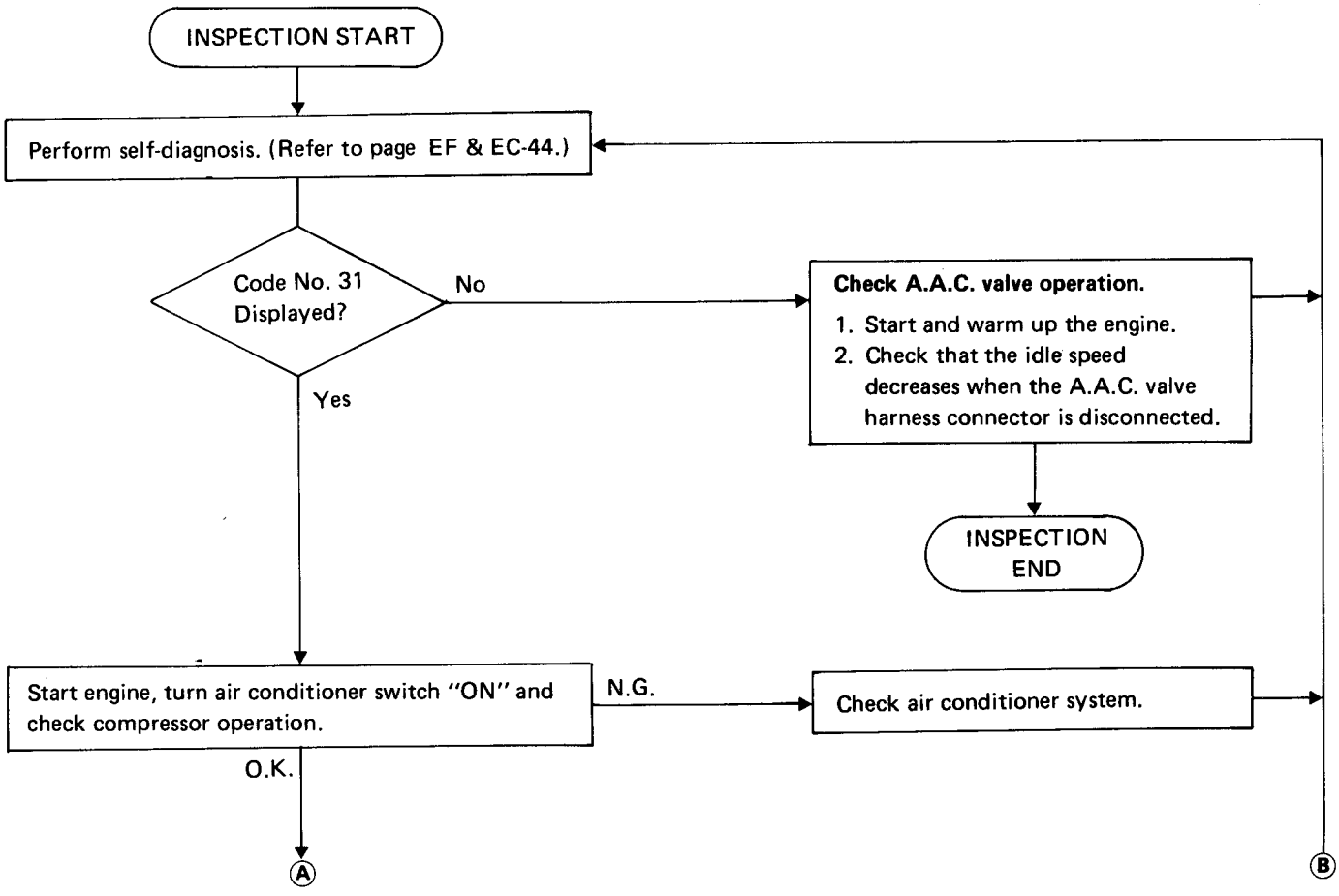
(A)

(B)

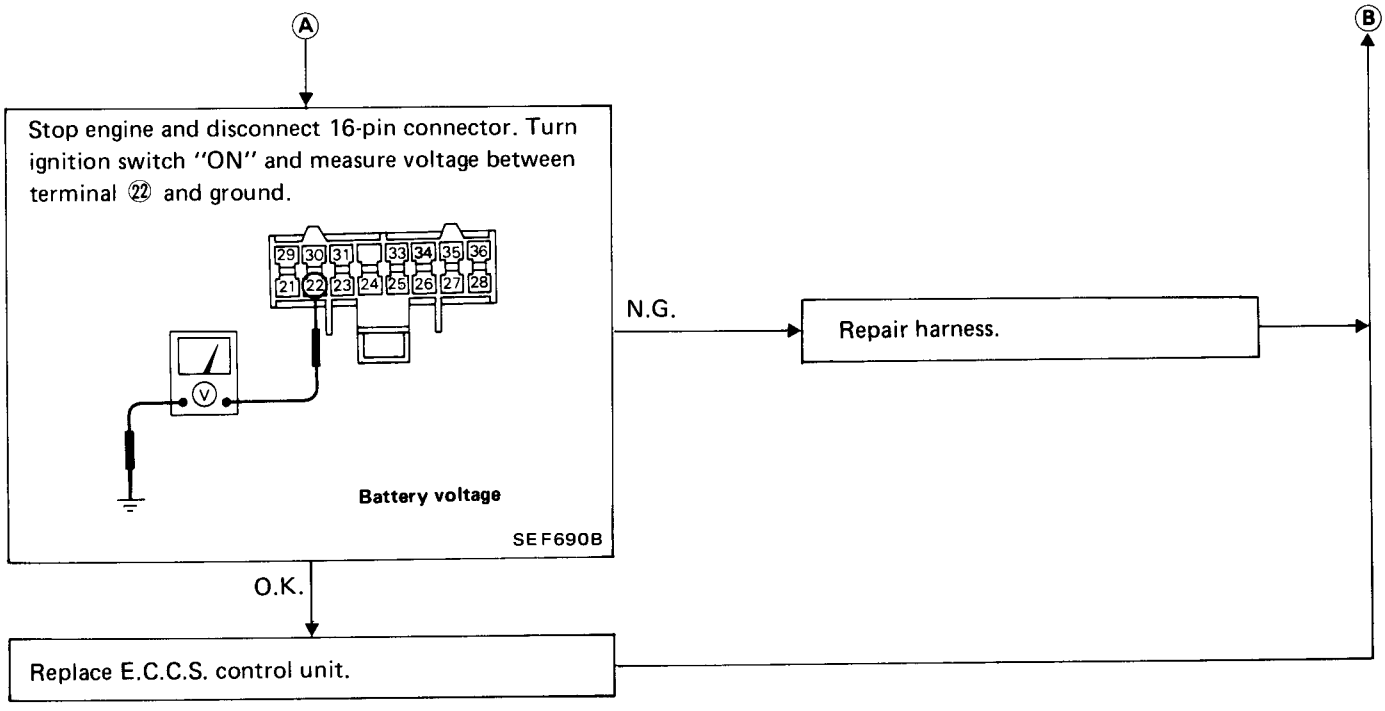
Load Signal (Cont'd)



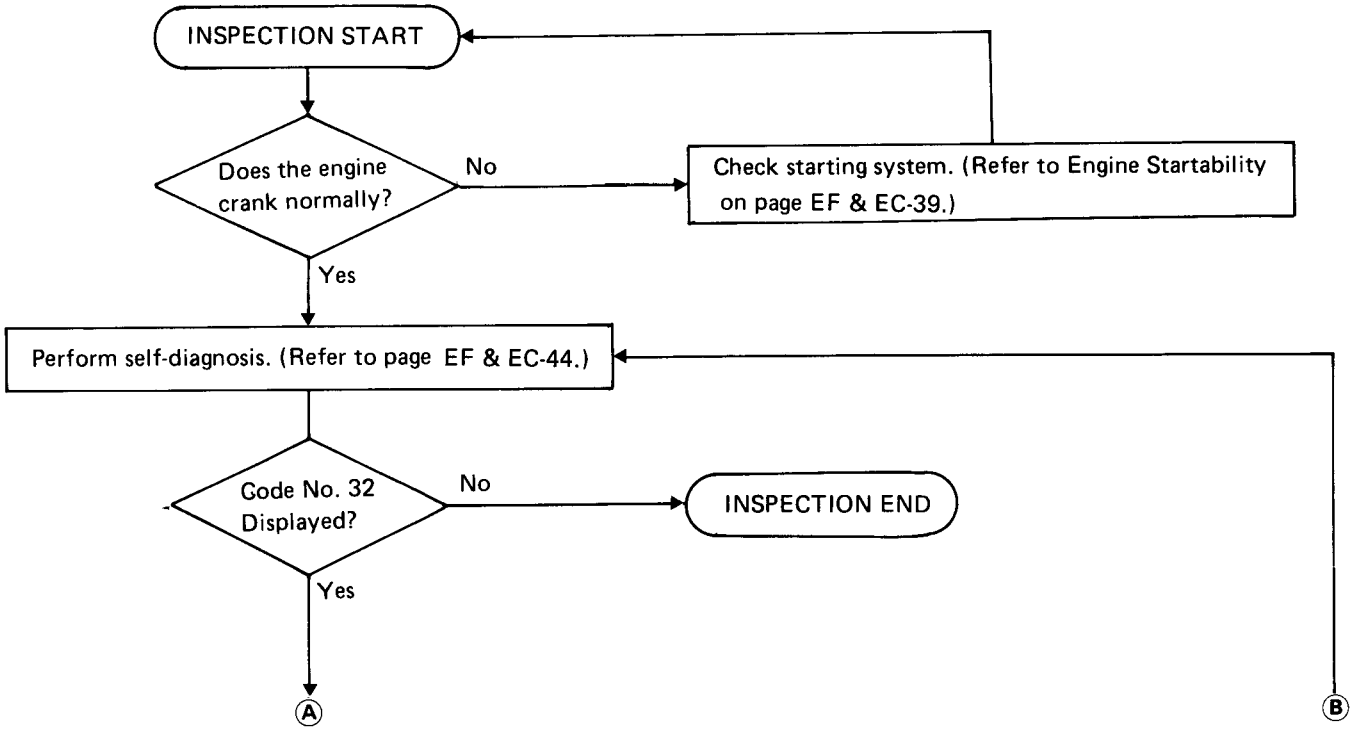
Air Conditioner Signal



Air Conditioner Signal (Cont'd)



Start Signal

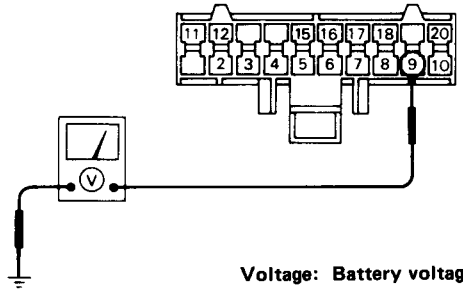


Start Signal (Cont'd)

Ⓐ

Check the start signal

1. Disconnect starter motor "S" terminal. Disconnect 20-pin connector.
2. Hold the ignition key at START position and measure voltage between terminal ⑨ and ground.



Voltage: Battery voltage

SEF691B

3. Turn ignition switch "OFF".

O.K. → Replace E.C.U. → Ⓑ

N.G.

Check the following parts:
- Ignition switch
- Inhibitor switch (A/T models)
- Inhibitor relay (A/T models)

N.G. → Repair/Replace. → Ⓑ

O.K.

Check the following harnesses:
- Harness between E.C.U. and ignition switch
- Harness between E.C.U. and inhibitor relay
- Harness between ignition switch and inhibitor switch
- Harness between inhibitor relay and inhibitor switch

N.G. → Repair/Replace. → Ⓑ

O.K.

Replace E.C.U. → Ⓑ

Detonation Sensor

Check harness for continuity.

N.G. → Repair harness.

O.K.

Replace detonation sensor.

Fuel Temperature Sensor

INSPECTION START

Is the fuel temperature sensor securely installed?

No → Tighten sensor.

Yes

Perform self-diagnosis. (Refer to page EF & EC-44.)

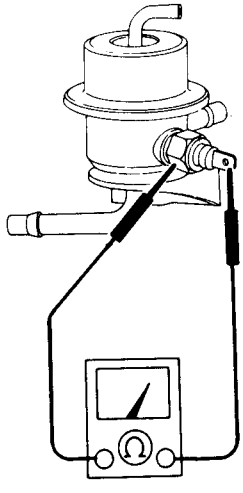
Code No. 41 Displayed?

No → Check pressure regulator control system operation. (Refer to page EF & EC-86.) → INSPECTION END

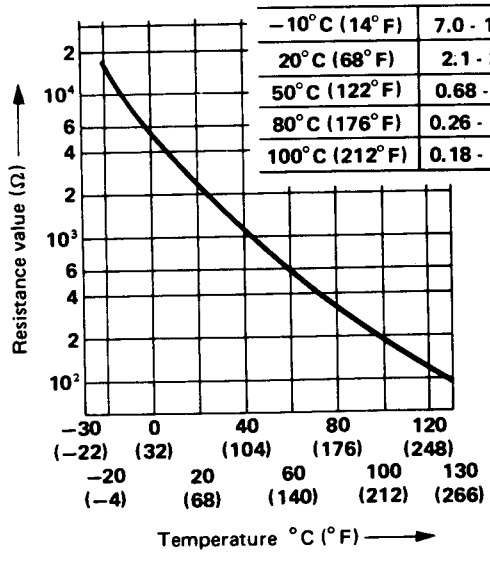
Yes

Check fuel temperature sensor

Measure the resistance of the fuel temperature sensor and compare to temperature chart.



−10°C (14°F)	7.0 - 11.4 kΩ
20°C (68°F)	2.1 - 2.9 kΩ
50°C (122°F)	0.68 - 1.0 kΩ
80°C (176°F)	0.26 - 0.39 kΩ
100°C (212°F)	0.18 - 0.20 kΩ



SEF694B

O.K.

Ⓐ

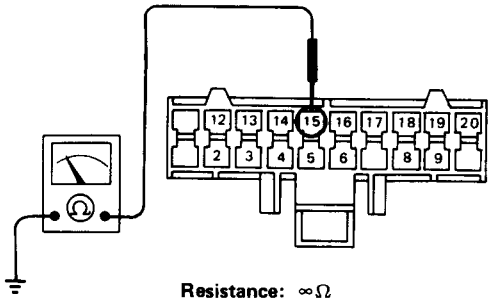
Ⓑ

Fuel Temperature Sensor (Cont'd)

Ⓐ

Check harness for continuity

1. Insulation check
a. Disconnect fuel temperature sensor harness connector.
b. Disconnect 20-pin connector and check continuity between ⑮ and ground.

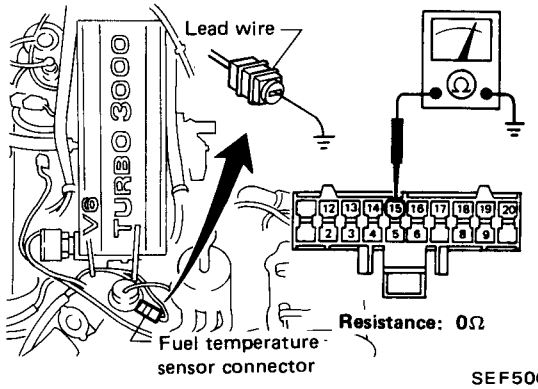


Resistance: ∞Ω

SEF962C

N.G. → Repair/Replace. → Ⓑ

2. Continuity check
a. Connect the connector and ground with a lead wire.
b. Measure the resistance between ⑮ and ground.



SEF506D

O.K. → Replace E.C.U. → Ⓑ

Injector

INSPECTION START

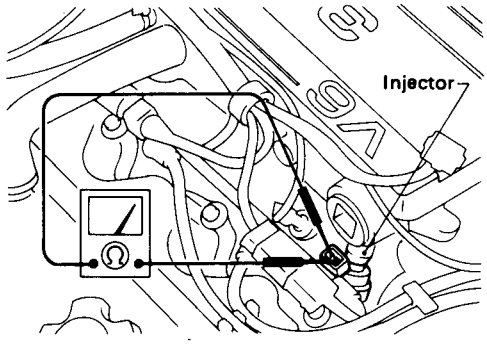
Do the injectors operate normally?

Yes → INSPECTION END

No

Check injectors

Check each injector for continuity.



Resistance: Approximately 3 Ω. SEF704B

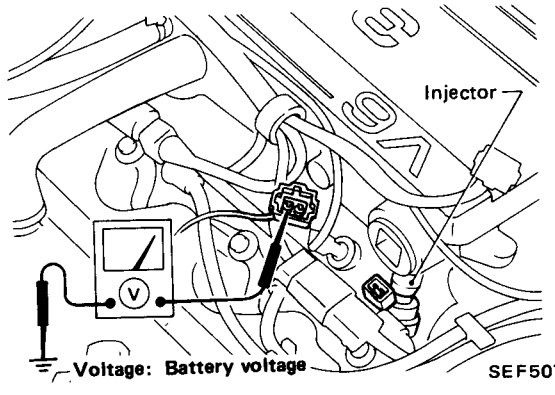
N.G. → Replace the injector. → (B)

O.K.

Check battery voltage at each injector

Disconnect E.C.U. 15-pin connector.

Ignition switch: OFF



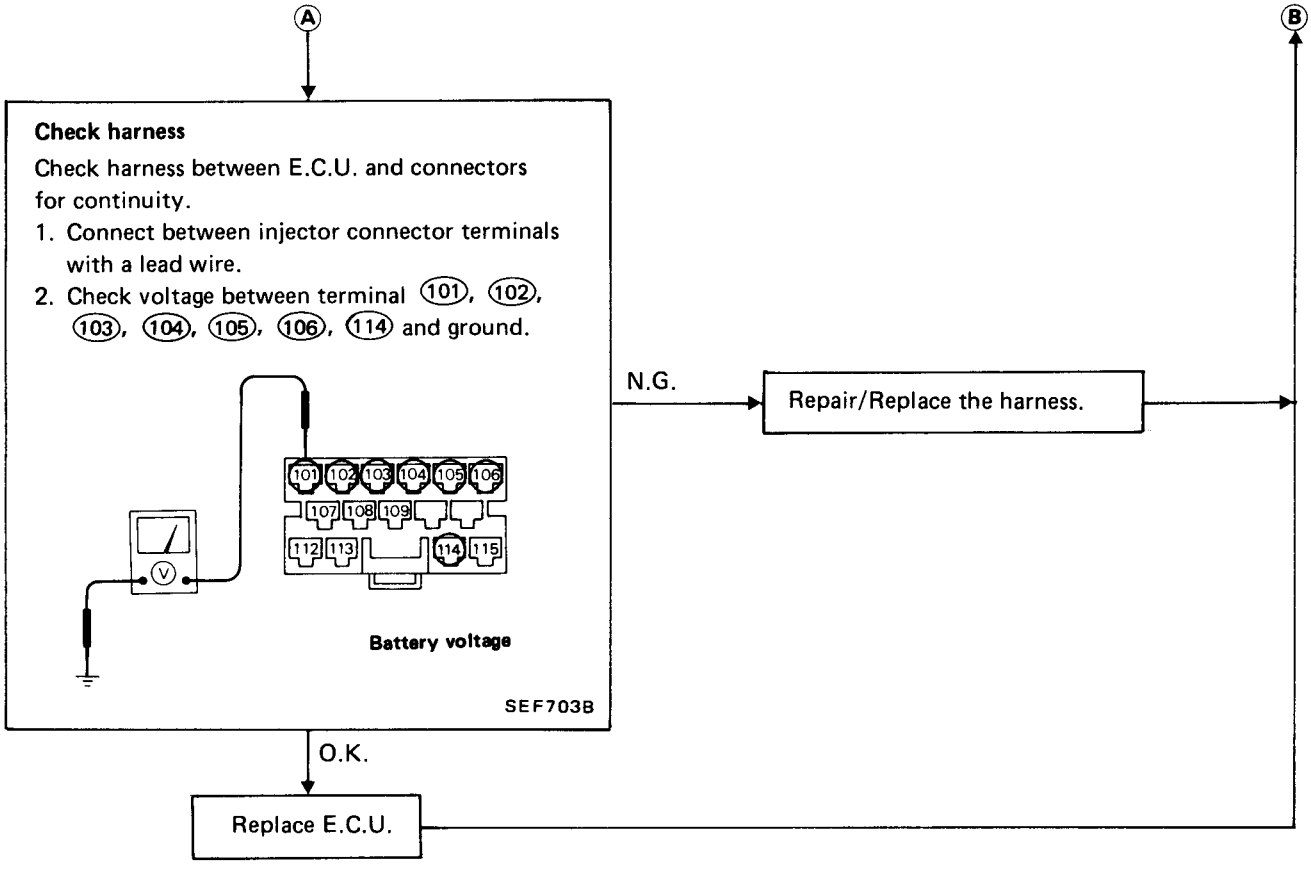
SEF507D

N.G. → Check harness and fusible link. → (B)

O.K.

(A)

Injector (Cont'd)



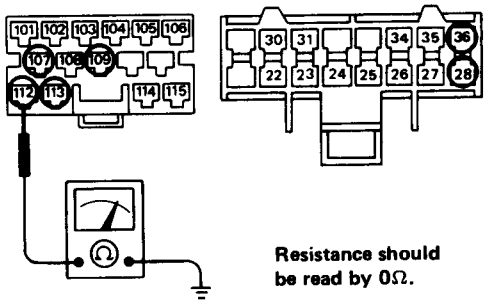
ELECTRONIC CONTROL SYSTEM INSPECTION

Battery Voltage and Ground Test

INSPECTION START

Check ground terminals

1. Disconnect E.C.U. 15-pin and 16-pin connectors.
2. Check for continuity at (28), (36), (107), (109), (112) and (113).



SEF965C

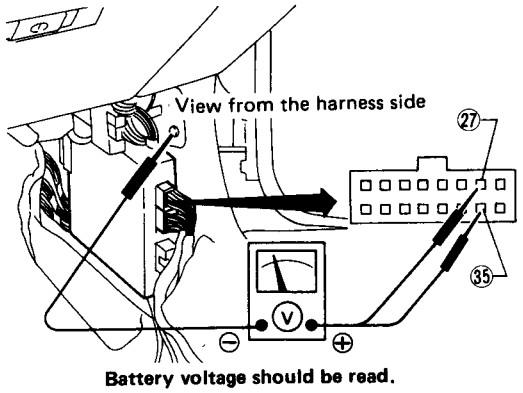
N.G. → Check that the ground terminal is securely mounted.

- O.K. → Repair/Replace ground harnesses.
- N.G. → Securely mount.

O.K.

Check battery voltage

1. Securely connect E.C.U. 15-pin and 16-pin connectors.
2. Turn ignition switch "ON" and measure the voltage at (27) and (35).

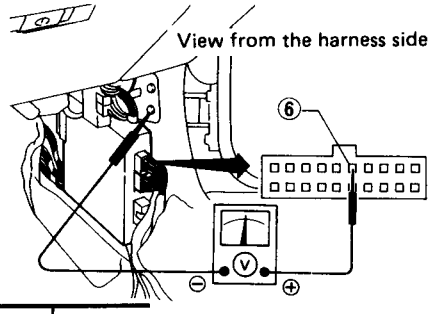


SEF508D

N.G. →

Check E.F.I. relay control

Measure the voltage at (6) for 6 seconds when ignition switch is turned to "OFF" from "ON" position.



Ignition	Voltage
OFF	12 V
ON	0 V

SEF509D

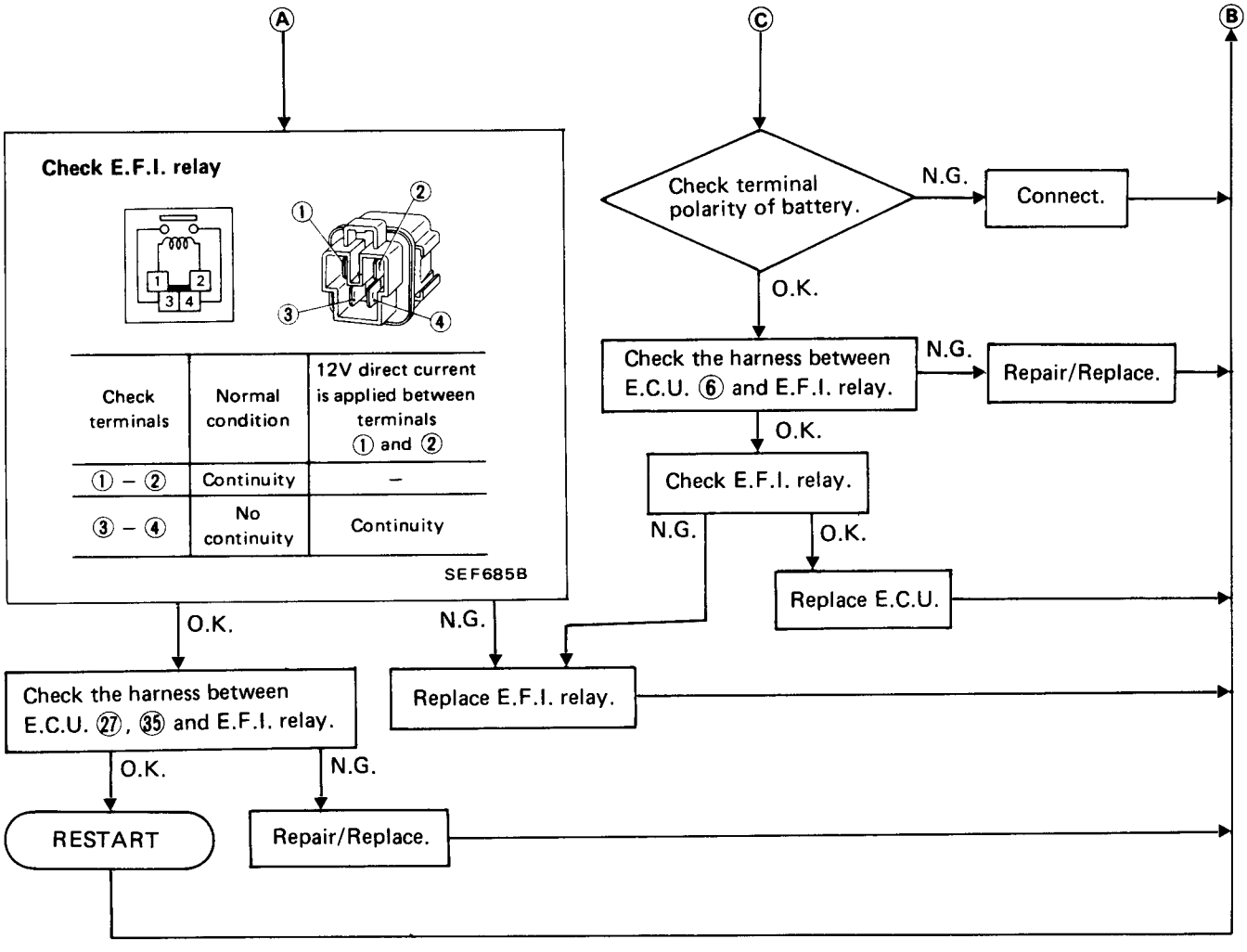
O.K. → (A)

N.G. → (C)

O.K. → INSPECTION END

(B)

Battery Voltage and Ground Test (Cont'd)



Air Regulator

INSPECTION START

Visually check air regulator shutter for operation

Condition	Shutter position
In cold condition [Before starting at 20°C (68°F)]	1/2 open
After warm-up	Fully open

O.K. → Check air regulator shutter opening time.

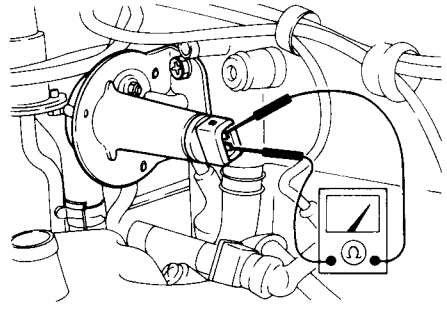
Reasonable? Yes → INSPECTION END

No → Check air regulator shutter for smooth operation.

N.G.

Check air regulator for continuity

Disconnect air regulator harness connector.



Resistance: Approximately 70 Ω.

SEF700B

N.G. → Replace air regulator.

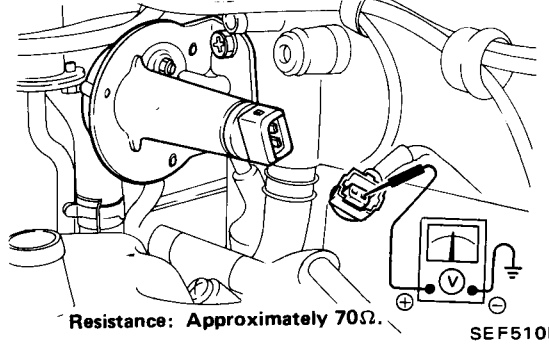
O.K.

Check battery voltage

1. Turn ignition switch "ON" and measure the voltage at connector.

Check air regulator for continuity

Disconnect air regulator harness connector.



Resistance: Approximately 70Ω.

SEF510D

2. Turn ignition switch "OFF".

N.G. → Check the following:
- Ignition switch
- Harness between ignition switch and air regulator
- Battery

O.K.

Ⓐ

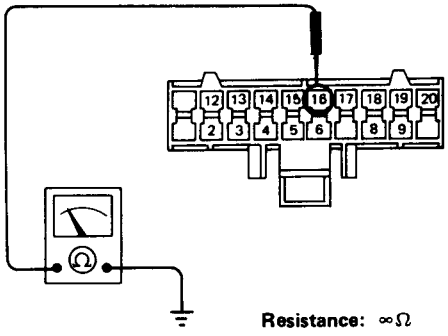
Ⓑ

Air Regulator (Cont'd)

Ⓐ

Check harness between E.C.U. ⑯ and air regulator

a. Insulation check
Disconnect E.C.U. 20-pin connector and check continuity between ⑯ and ground.

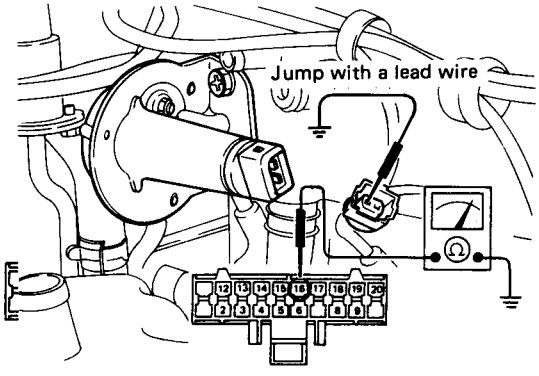


Resistance: ∞Ω

SEF969C

N.G. → Repair/Replace harness. → Ⓑ

b. Continuity check harness
Connect air regulator harness connector and ground with a lead wire, then check for the resistance.



Resistance: 0Ω should be read.

SEF511D

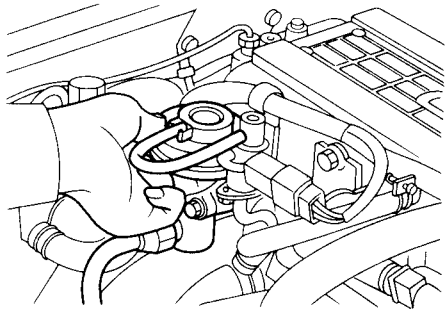
O.K. → Replace E.C.U. → Ⓑ

E.G.R. Control System

INSPECTION START

Warm up engine.

Check the movement of E.G.R. valve diaphragm by keeping engine speed at 900 rpm to 3,200 rpm.



SMA954A

- While engine is cold, diaphragm should not move.
- While engine is hot, diaphragm should move upwards.

O.K. →

N.G.

Check E.G.R. vacuum

1. Disconnect the vacuum hose at E.G.R. valve.
2. Check if a vacuum appears when keeping engine speed at 900 rpm to 3,200 rpm.
3. Stop the engine.

O.K. →

N.G.

Ⓐ

***: Checking should be performed by self-diagnosis.**

****: Check by shorted or open cylinder head temperature sensor.**

Check E.G.R. valve for operation.

Condition	E.G.R. control solenoid	E.G.R. system
Engine starting Throttle valve switch "ON" Low engine temperature** High engine temperature** Engine speed below 900 rpm above 3,200 rpm	ON	Does not operate
Except above	OFF	Operates

O.K. →

END

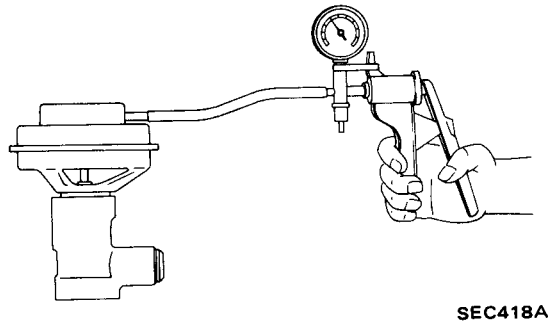
N.G.

* Check the following systems.

- Throttle valve switch
- Cylinder head temp. sensor
- Ignition signal
- Starting system

Check E.G.R. control valve.
Apply a vacuum of −13.3 to −14.7 kPa (−100 to −110 mmHg, −3.94 to −4.33 inHg) to E.G.R. control valve. The valve is approximately fully open.

−13.3 to −14.7 kPa
(−100 to −110 mmHg, −3.94 to −4.33 inHg)



SEC418A

O.K. →

RESTART INSPECTION

N.G. →

Replace E.G.R. valve.

Ⓑ

E.G.R. Control System (Cont'd)

Ⓐ

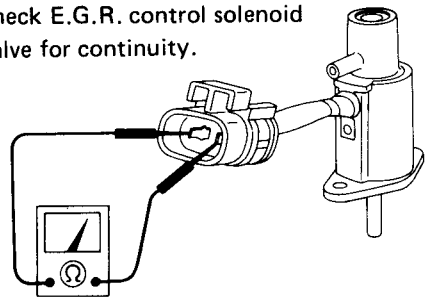
Check vacuum hose for proper connection, distortion plugging and breaks.

N.G. → Replace/Correct. → Ⓑ

O.K.

Check solenoid valve

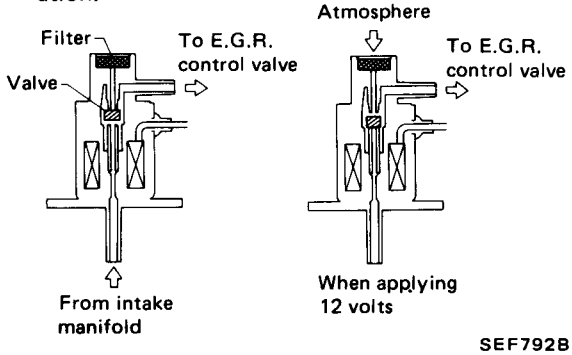
1. Check E.G.R. control solenoid valve for continuity.



Resistance: Approximately 30 Ω. SEF698B

N.G. → Replace E.G.R. control solenoid valve. → Ⓑ

2. Check E.G.R. control solenoid valve for operation.



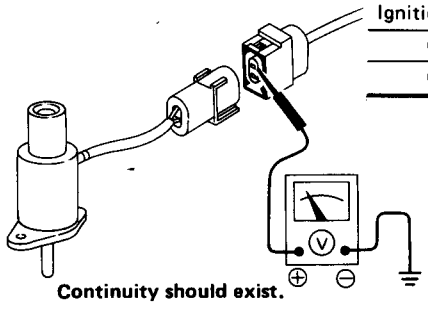
SEF792B

O.K.

Check battery voltage

1. Disconnect E.G.R. control solenoid valve harness connector and check voltage with ignition switch "ON".

Ignition switch	Voltage
OFF	0V
ON	12V



Continuity should exist. SEF513D

N.G. → Check the following systems:
- Harness between the solenoid and E.C.U. ㉗, ㉟
- Battery source for E.C.U.

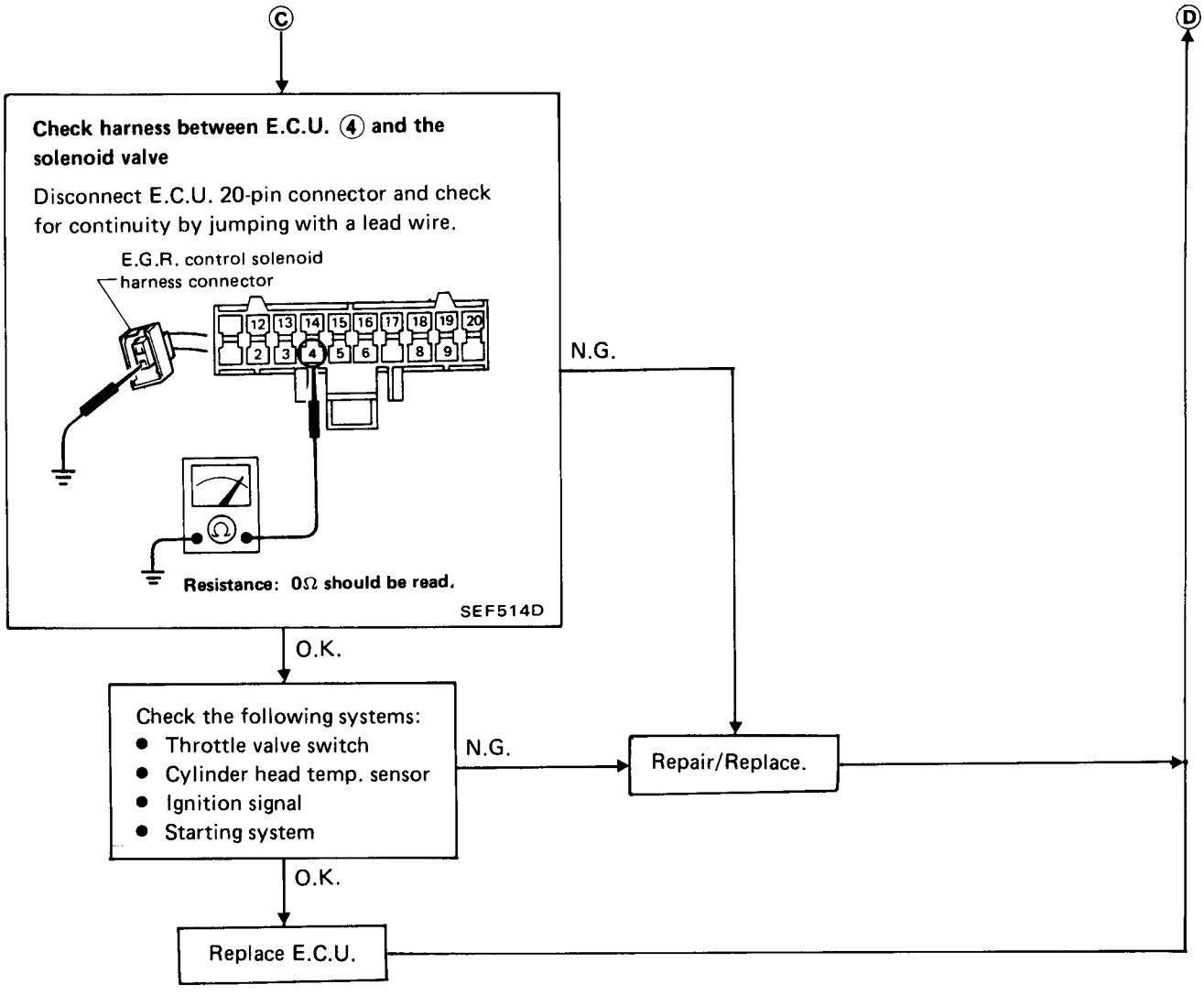
Refer to Battery Source and Ground.

O.K. → RESTART → Ⓑ

N.G. → Repair/Replace. → Ⓑ

2. Turn ignition switch "OFF".

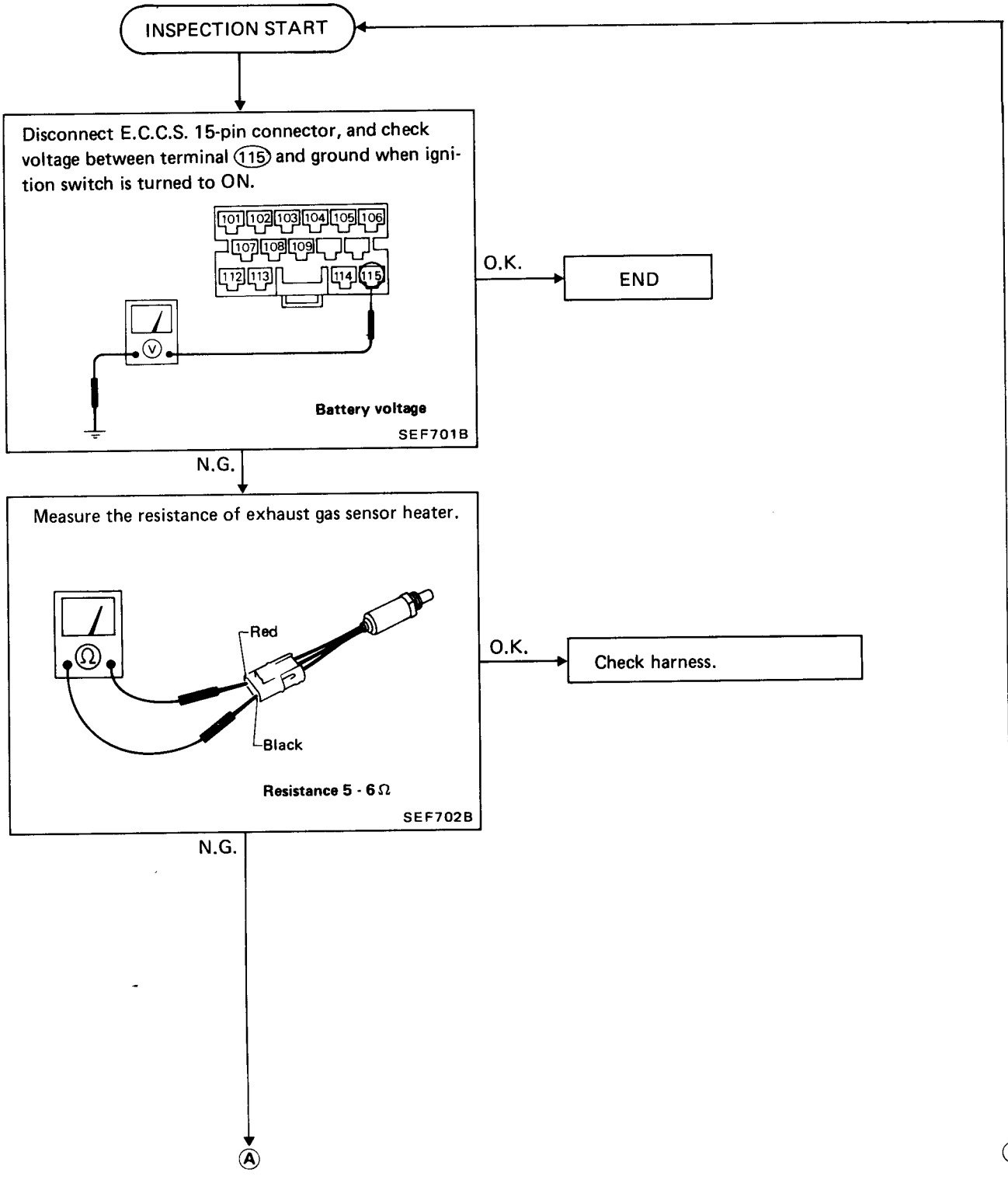
O.K. → Ⓒ


Ⓒ
Check harness between E.C.U. ④ and the solenoid valve
Disconnect E.C.U. 20-pin connector and check for continuity by jumping with a lead wire.
E.G.R. control solenoid harness connector
12 13 14 15 16 17 18 19 20
2 3 4 5 6 8 9
Resistance: 0Ω should be read.
SEF514D
N.G.
O.K.
Check the following systems:
• Throttle valve switch
• Cylinder head temp. sensor
• Ignition signal
• Starting system
N.G.
Repair/Replace.
O.K.
Replace E.C.U.
Ⓓ

MAIN CIRCUIT

Refer to MIXTURE RATIO FEEDBACK SYSTEM INSPECTION.

HEATER CIRCUIT

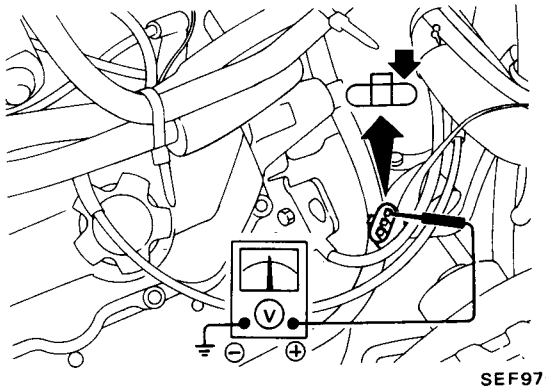


Exhaust Gas Sensor (Cont'd)

Ⓐ

Check battery voltage

1. Turn ignition switch "ON" and measure the voltage at connector.



SEF975C

2. Turn ignition switch "OFF".

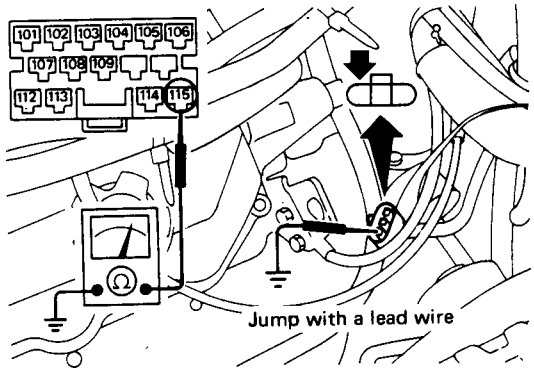
N.G. → Check the following systems:
- E.F.I. relay
- Harness between E.F.I. relay and exhaust gas sensor
- Harness between E.F.I. relay and battery

→ Ⓑ

O.K.

Check harness

Check harness between E.C.U. (115) and exhaust gas sensor.



SEF976C

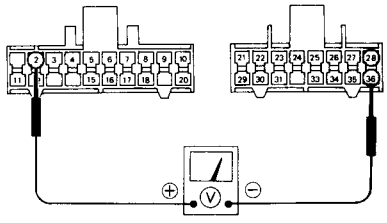
N.G. → Repair/Replace. → Ⓑ

O.K.

Replace E.C.U. → Ⓑ

Check voltage between terminals ② and ㉘, ㊱ with 16-pin and 20-pin connectors connected to the control unit.

Ignition switch: ON



Battery voltage

SEF695B

O.K. → END

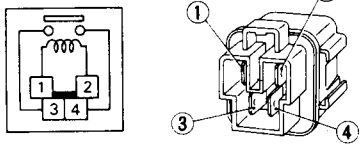
N.G. →

Check harness for continuity.

N.G. → Repair harness.

O.K. →

Check E.F.I. relay.



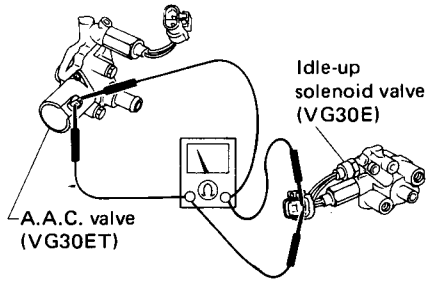
Check terminals	Normal condition	12V direct current is applied between terminals ① and ②
① – ②	Continuity	–
③ – ④	No continuity	Continuity

SEF685B

N.G. → Replace E.F.I. relay.

O.K. →

Check A.A.C. valve or idle-up solenoid valve.



Continuity should exist.

SEF696B

N.G. → Replace A.A.C. valve or idle-up solenoid valve.

Self-cleaning Hot Wire

INSPECTION START

Start engine and race engine to above 2,500 rpm.

Drive vehicle at above 30 km/h (19 MPH) (VG30ET only) then run engine at idle.

Remove air duct from air flow meter (air cleaner side) while engine is idling.

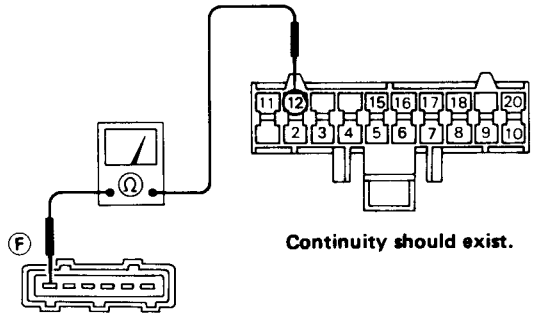
Using a mirror, ensure that hot wire heats up to a red glow for one second after the ignition switch has been turned off for five seconds.

O.K. → INSPECTION END

N.G.

Check harness for continuity.

Check for continuity between terminal ⑫ of 20-pin connector and terminal Ⓕ of air flow meter harness connector.



Continuity should exist.

SEF674B

N.G. → Repair/replace harness.

O.K.

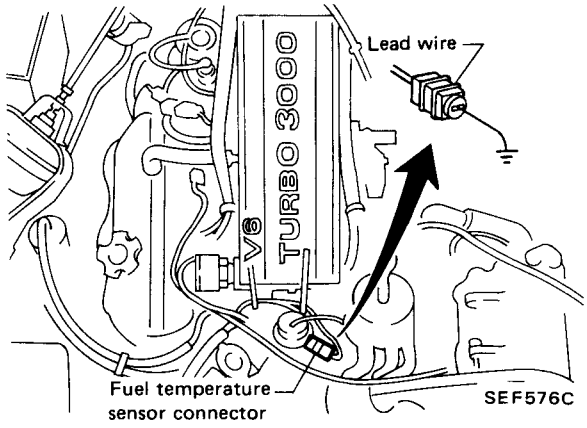
Replace air flow meter.

Pressure Regulator Control Solenoid Valve

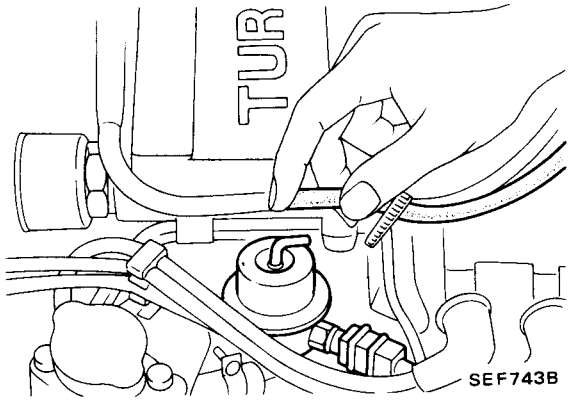
INSPECTION START

Check the system operation

1. Disconnect fuel temperature sensor harness connector and connect to ground with a lead wire.



2. Disconnect a vacuum hose between pressure regulator and solenoid valve.
3. Start engine.
4. These should be no vacuum in the hose for 3 minutes.



5. Stop the engine.

O.K. → Check fuel temperature sensor. → INSPECTION END

N.G. → (A)

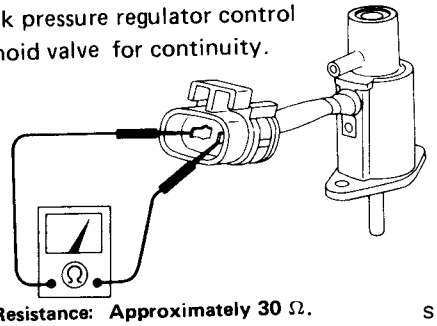
(B)

Pressure Regulator Control Solenoid Valve (Cont'd)

Ⓐ

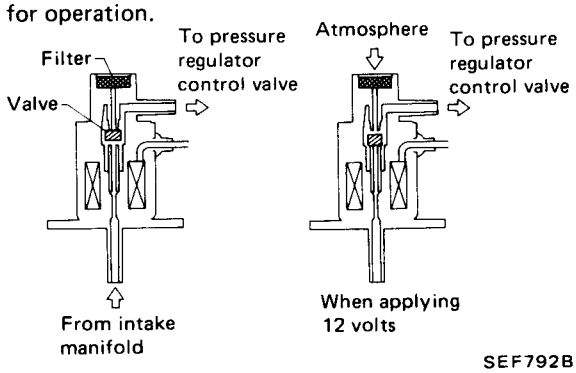
Check the solenoid valve

Check pressure regulator control solenoid valve for continuity.



Resistance: Approximately 30 Ω. SEF698B

Check pressure regulator control solenoid valve for operation.



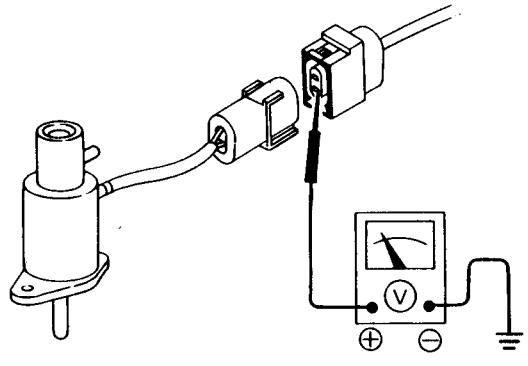
SEF792B

N.G. → Replace pressure regulator control valve. → Ⓑ

O.K.

Check battery source

1. Check battery voltage at the solenoid valve by turning on ignition switch.



Ignition switch: ON
Voltage: Battery voltage

SEF515D

N.G. → Check the following systems:
- Harness between E.F.I. relay and solenoid valve
- Battery source and ground

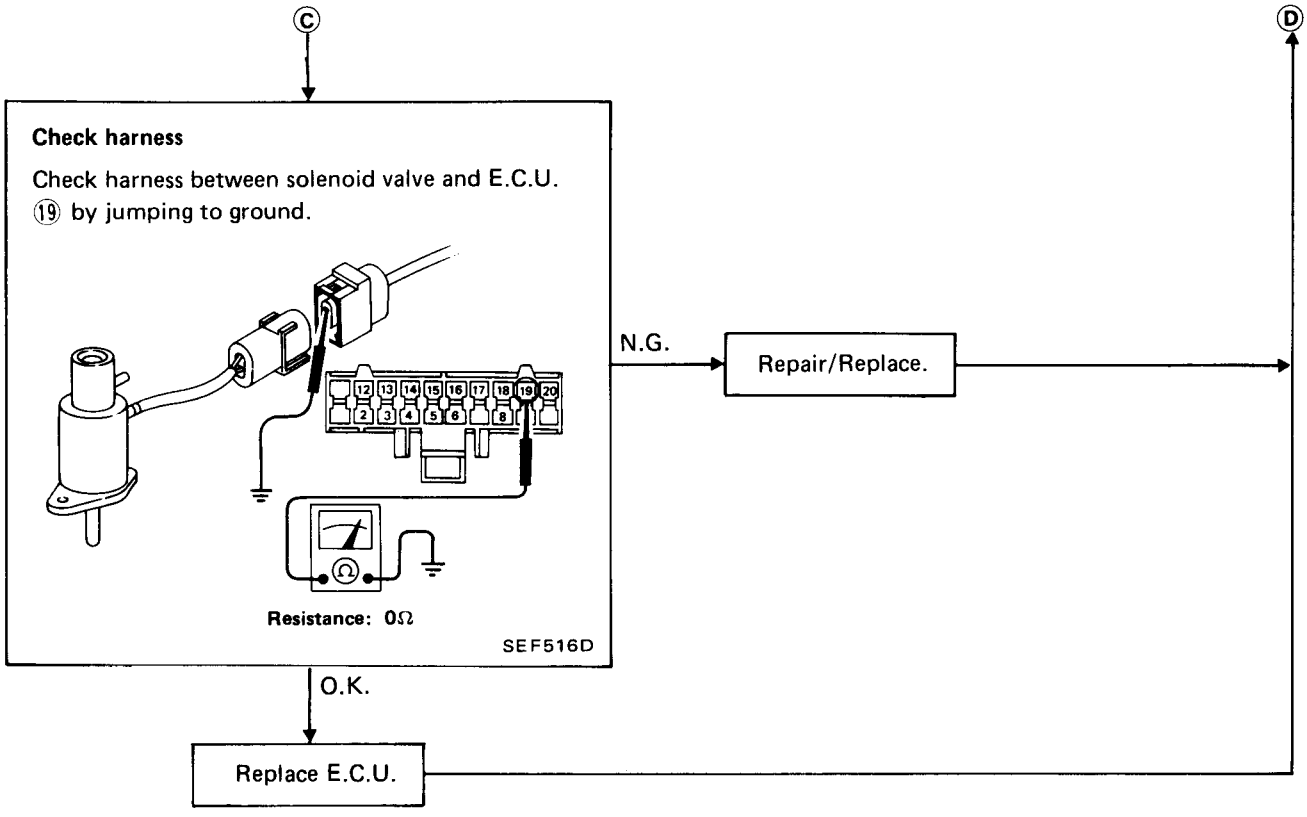
→ Ⓓ

2. Turn ignition switch "OFF".

O.K.

Ⓒ

Pressure Regulator Control Solenoid Valve (Cont'd)

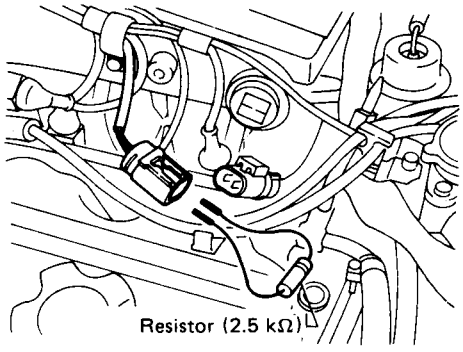


Air Injection Valve (A.I.V.) Control System

INSPECTION START

Check the system operation

Disconnect cylinder head temperature sensor harness connector. Connect a resistor (2.5 kΩ) between terminals of cylinder head temperature sensor harness connector.

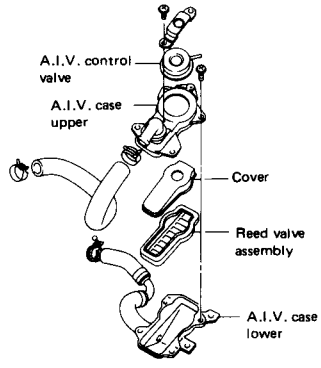


SEF711B

Start engine. Check if the A.I.V. valve operates by listening to the operating sound.

O.K.

Disassemble A.I.V. case and check A.I.V. control valve and reed valves for binding or damage.



SEF485D

O.K.

Check cylinder head temp. sensor.

O.K.

END

N.G.

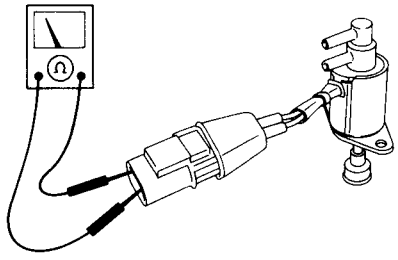
Ⓐ

Ⓑ

Ⓐ

Check the solenoid valve

1. Check A.I.V. control solenoid valve for continuity.

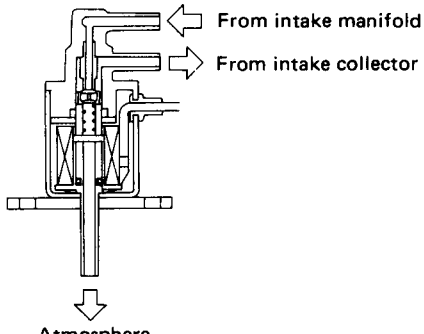


Resistance: Approximately 30 Ω.

SEF435C

N.G. → Replace the solenoid valve. → Ⓑ

2. Check A.I.V. control solenoid valve for operation.

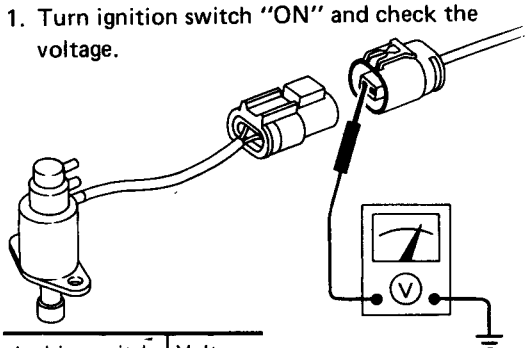


SEF436C

O.K.

Check battery voltage

1. Turn ignition switch "ON" and check the voltage.



Ignition switch	Voltage
OFF	0V
ON	12V

SEF518D

N.G. → Check the following:
- Battery voltage and ground for E.C.U.
- Harness between E.F.I. relay and the solenoid valve.

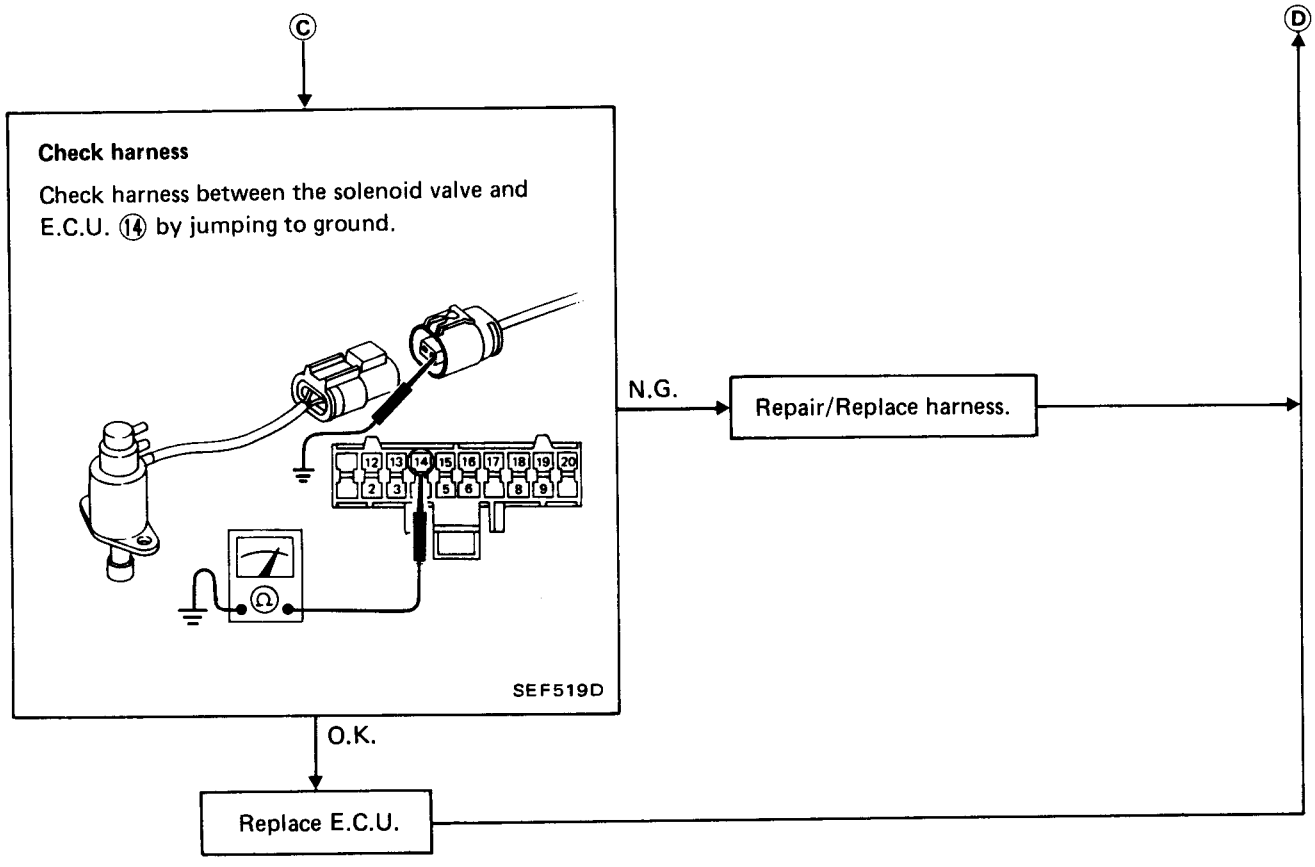
→ Ⓓ

2. Turn ignition switch "OFF".

O.K.

Ⓒ

Air Injection Valve (A.I.V.) Control System (Cont'd)



MIXTURE RATIO FEEDBACK SYSTEM INSPECTION

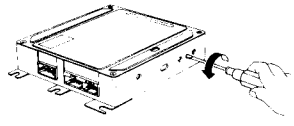
PREPARATION

1. Make sure that the following parts are in good order.
- Battery
- Ignition system
- Engine oil and coolant levels
- Fuses
- E.C.C.S. harness connectors
- Vacuum hoses
- Air intake system
  (oil filler cap, oil level gauge, etc.)
- Engine compression
- E.G.R. valve operation
- Throttle valve and throttle valve switch operation

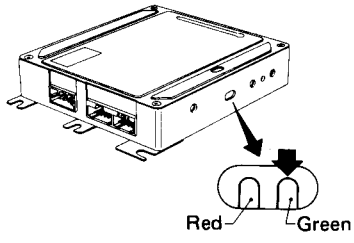
2. On air conditioner equipped models, checks should be carried out while the air conditioner is "OFF".
3. On automatic transmission equipped models, when checking idle rpm, ignition timing and mixture ratio, checks should be carried out while shift lever is in "D" position.
4. Make sure that diagnosis mode selector on E.C.C.S. control unit is turned fully counterclockwise.

WARNING:

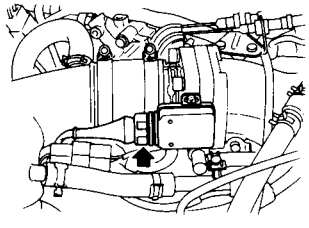
a. When selector lever is shifted to "D" position, apply parking brake and block both front and rear wheels with chocks.
b. Depress brake pedal while racing the engine to prevent forward surge of vehicle.
c. After the adjustment has been made, shift the lever to the "N" or "P" position and remove wheel chocks.



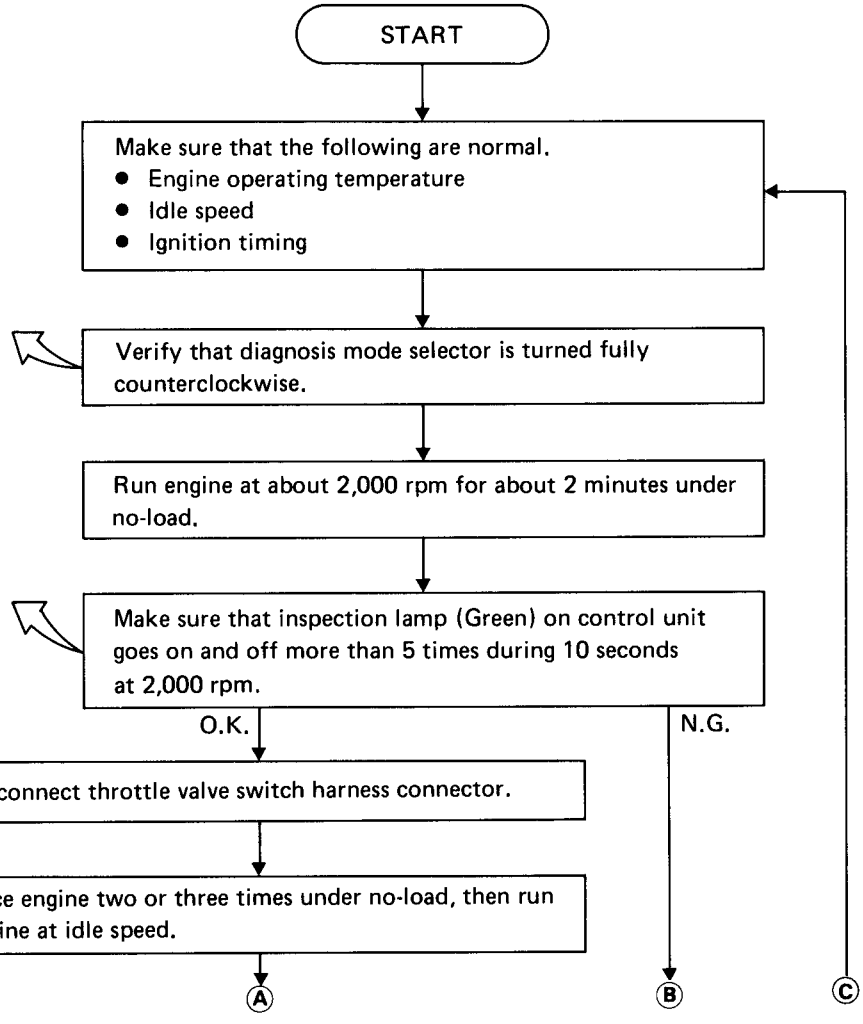
SEF651B



SEF706B



SEF707B



MIXTURE RATIO FEEDBACK SYSTEM INSPECTION

Ⓐ Ⓑ Ⓒ

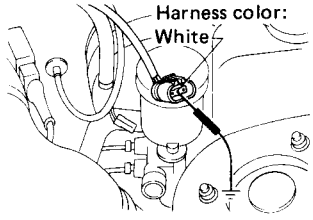
Do not blink

Check inspection lamp blinks.
Inspection lamps should blink.

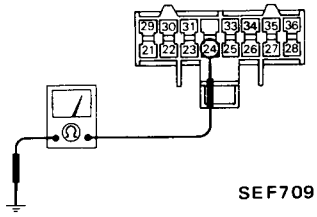
Blink

END

Connect throttle valve switch harness connector.



SEF708B



SEF709B

Check exhaust gas sensor harness:

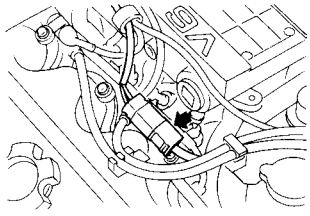
1) Turn off engine and disconnect battery ground cable.
2) Disconnect 16-pin connector from control unit.
3) Disconnect exhaust gas sensor harness connector and connect terminal for exhaust gas sensor to ground with a jumper wire.
4) Check for continuity between terminal ㉔ of 16-pin connector and ground metal on vehicle body.

Continuity exists ..... O.K.
Continuity does not exist ..... N.G.

O.K.

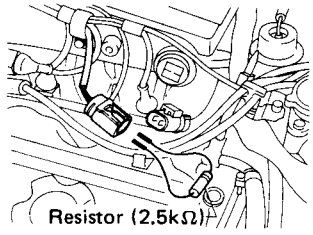
N.G.

Repair or replace E.C.C.S. harness.



SEF710B

Disconnect cylinder head temperature sensor harness connector.



SEF711B

Connect a resistor (2.5 kΩ) between terminals of cylinder head temperature sensor harness connector.

Start engine and warm up engine until water temperature indicator points to the middle of gauge.

Race engine two or three times under no-load, then run engine at idle speed.

Check CO%.

Idle CO: 0.2 - 4.0%

After checking CO%,
1) Disconnect the resistor from terminals of cylinder head temperature sensor.
2) Connect cylinder head temperature sensor harness connector to cylinder head temperature sensor.

N.G.

O.K.

Ⓔ Ⓕ Ⓓ Ⓒ

MIXTURE RATIO FEEDBACK SYSTEM INSPECTION

Ⓔ

Ⓕ

Connect exhaust gas sensor harness, and disconnect throttle valve switch harness connector.

Turn off engine and remove air flow meter from vehicle.

Drill a hole in seal plug which seals variable resistor of air flow meter and remove seal plug.

Install air flow meter on vehicle. Start engine and warm up engine until water temperature indicator points to the middle of gauge.

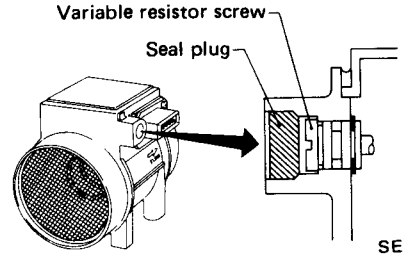
Ⓓ

Replace exhaust gas sensor and make sure that inspection lamp on control unit goes on and off more than 5 times during 10 seconds. (2,000 rpm)

O.K. → Ⓒ

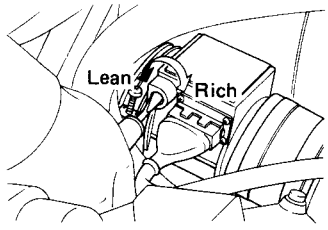
N.G.

Replace E.C.C.S. control unit. → Ⓒ



SEF712B

Do not exceed a depth of 5.5 mm (0.217 in) when drilling through the seal plug. Damage to the plastic variable resistor screw could result.



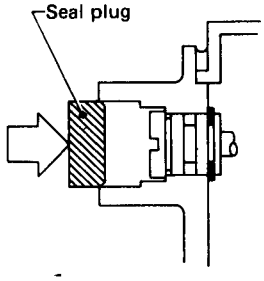
SEF649B

Adjust idle mixture ratio by turning variable resistor of air flow meter so that inspection lamps blink simultaneously.

Adjustable

Not adjustable → Replace air flow meter → Ⓒ

Turn off engine and remove air flow meter from vehicle.



SEF713B

Insert new seal plug into variable resistor hole. Tap seal plug with a suitable bar, thereby installing seal plug on air flow meter.

Install air flow meter on vehicle.

Connect throttle valve switch harness connector. → Ⓒ

FUEL SYSTEM INSPECTION

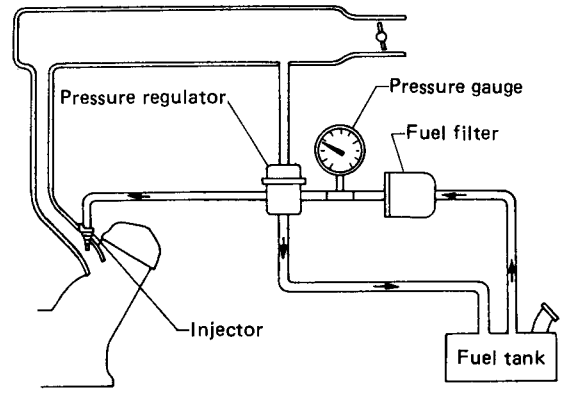
Releasing Fuel Pressure

Before disconnecting fuel line, release fuel pressure from fuel line to eliminate danger.

1. Remove the fuse for fuel pump.
2. Start engine.
3. After engine stalls, crank engine two or three times to make sure that pressure is released.
4. Turn ignition switch off and install the fuel pump fuse.

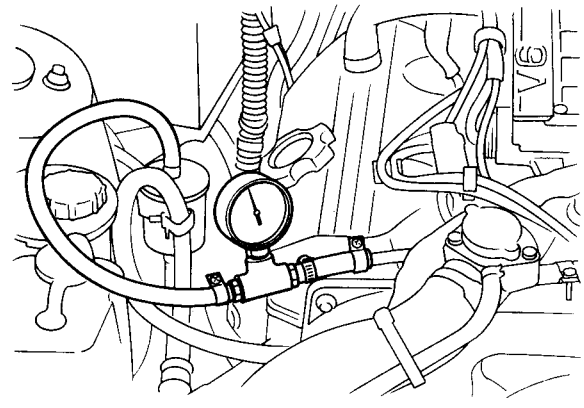
Fuel Pressure Check

a. **When reconnecting fuel line, always use new clamps and be sure to position them correctly.**
b. **Use a torque driver to tighten clamps.**
c. **Use Pressure Gauge (J-2540034) to check fuel pressure.**



SEF584C

1. Release fuel pressure to zero.
2. Disconnect fuel hose between fuel filter and fuel tube (engine side).
3. Install pressure gauge between fuel filter and fuel tube.



SEF716B

Fuel Pressure Check (Cont'd)

4. Start engine and check for fuel leakage.
5. Read the indication of fuel pressure gauge.

   At idling:

   Approximately 206 kPa
   (2.1 kg/cm^2, 30 psi)

   The moment accelerator pedal is fully depressed:

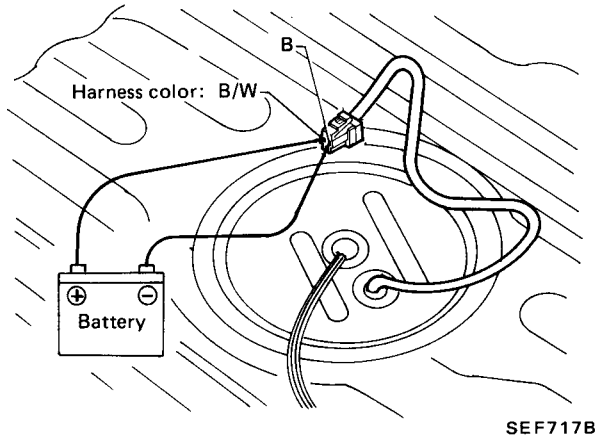
   [VG30E]

   Approximately 255 kPa
   (2.6 kg/cm^2, 37 psi)

   [VG30ET]

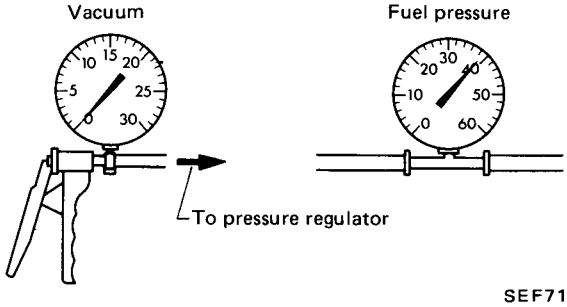
   Approximately 304 kPa
   (3.1 kg/cm^2, 44 psi)

6. Stop engine and disconnect fuel pressure regulator vacuum hose from intake collector.
7. Plug intake collector with a rubber cap.
8. Connect variable vacuum source (J-23738 or equivalent) to fuel pressure regulator.
9. Disconnect fuel pump connector and apply battery voltage as follows:



SEF717B

10. Start engine and read the indication of fuel pressure gauge as vacuum is changed.



SEF718B

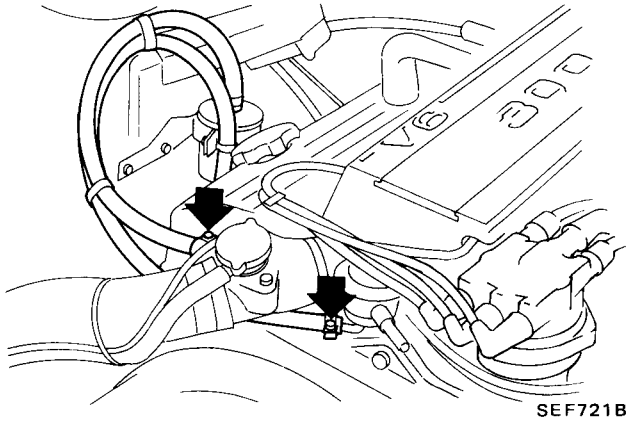
Vacuum kPa (mmHg, inHg)	Fuel pressure kPa (kg/cm^2, psi)
0 (0, 0)	248.1 - 255.0 (2.53 - 2.60, 36.0 - 37.0)
16.9 (127, 5.00)	227.5 - 241.3 (2.32 - 2.46, 33.0 - 35.0)
33.9 (254, 10.00)	213.8 - 220.7 (2.18 - 2.25, 31.0 - 32.0)
50.8 (381, 15.00)	200.1 - 206.9 (2.04 - 2.11, 29.0 - 30.0)
67.7 (508, 20.00)	179.5 - 193.2 (1.83 - 1.97, 26.0 - 28.0)

Fuel pressure should decrease as vacuum increases. If results are unsatisfactory, replace fuel pressure regulator.

Injector Removal and Installation

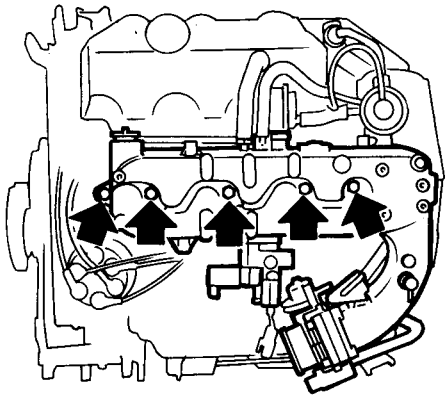
1. Release fuel pressure to zero.
2. Disconnect the following from intake collector.
- Air duct
- Accelerator wire
- Blow-by hoses
- Air regulator hose
- E.G.R. tube
- Harness clamps
- Harness connectors
- Intake collector cover

3. Disconnect fuel hoses.



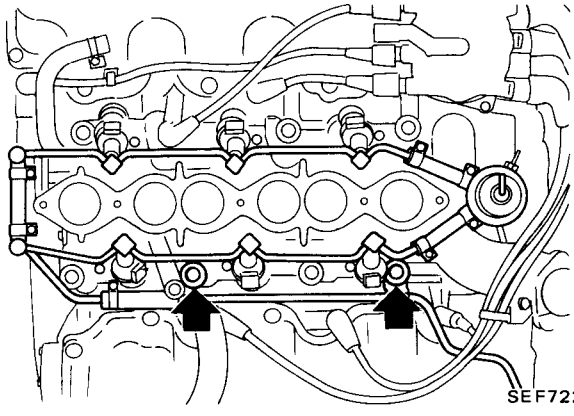
SEF721B

4. Remove intake collector.



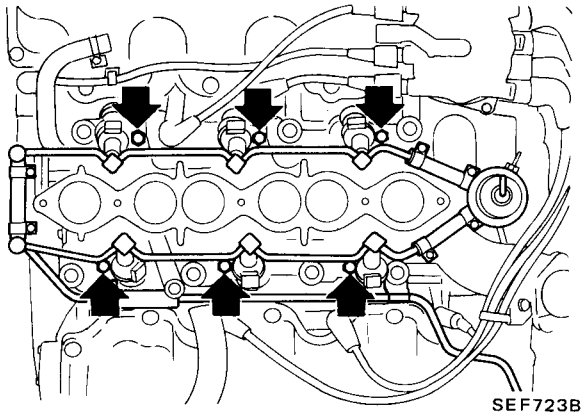
SEF720B

5. Remove bolts securing fuel tube.



SEF722B

6. Remove bolts securing injectors and remove injectors, fuel tubes and pressure regulator as an assembly.

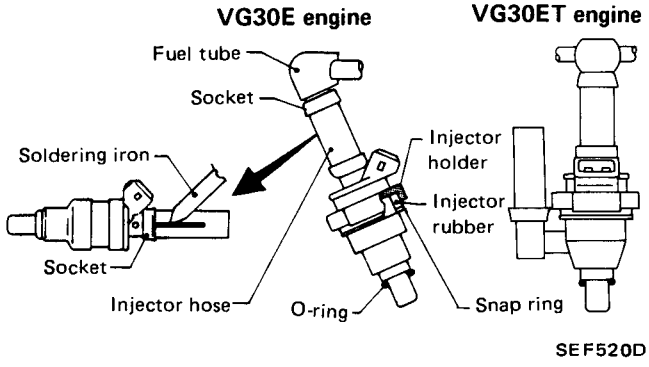


SEF723B

7. Remove fuel hose.

1) Heat soldering iron (150 watt) for 15 minutes. Cut into hose braided reinforcement from mark to socket end and fuel tube end.

Do not allow soldering iron to cut all the way through the hose and touch the injector tail piece.



SEF520D

2) Then pull rubber hose out with hand.

a. **Be careful not to damage socket plastic connector, etc. with soldering iron.**

b. **Never place injector in a vise when disconnecting rubber hose.**

8. Install fuel hose as follows:

1) Clean exterior of injector tail piece and fuel tube end.
2) Wet inside of new rubber hose with fuel.
3) Push end of rubber hose with hose sockets onto injector tail piece and fuel tube end by hand as far as they will go.

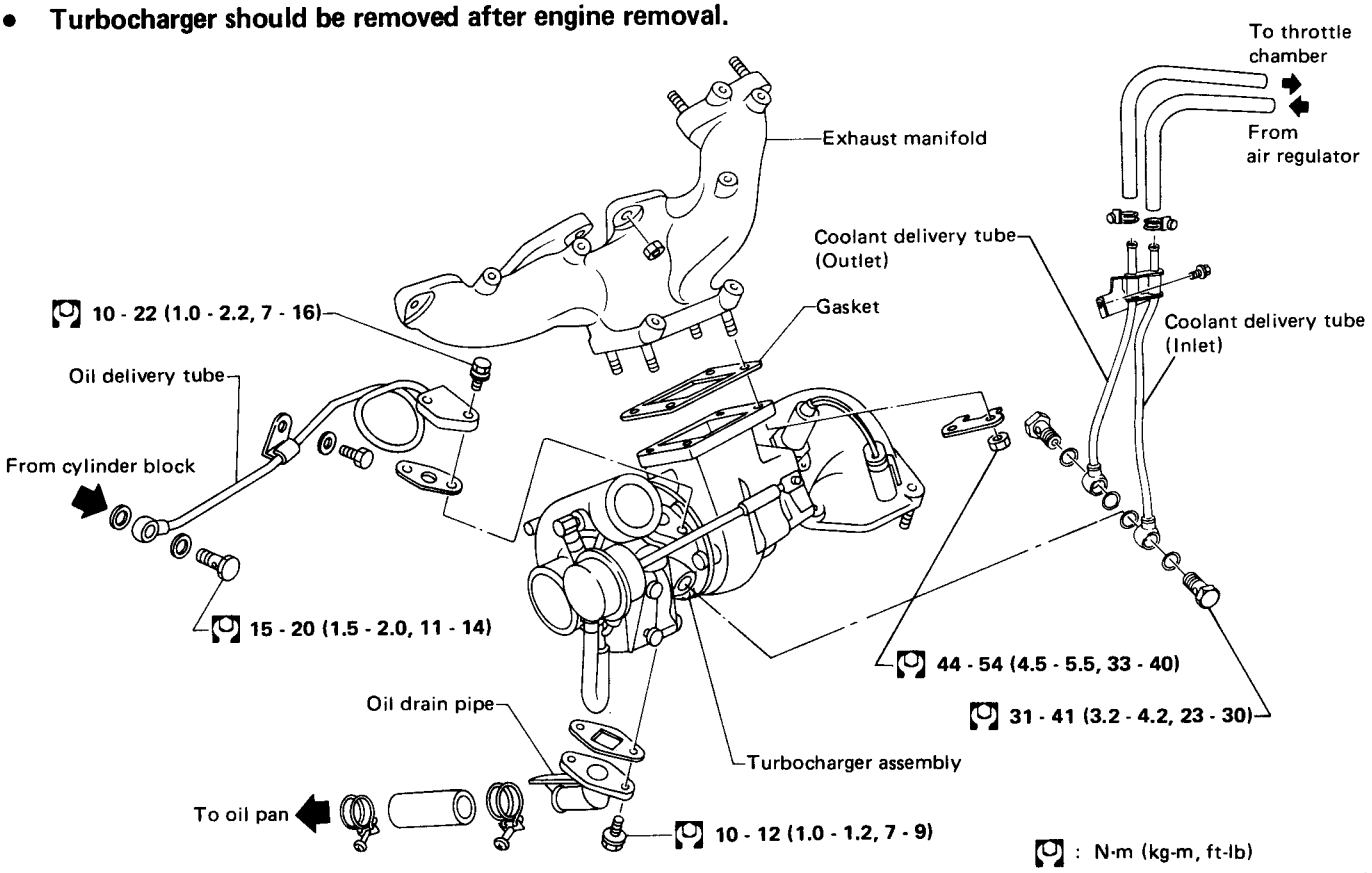
Clamp is not necessary at the connections.

CAUTION:

After properly connecting fuel hose to injector and fuel tube, check connection for fuel leakage.

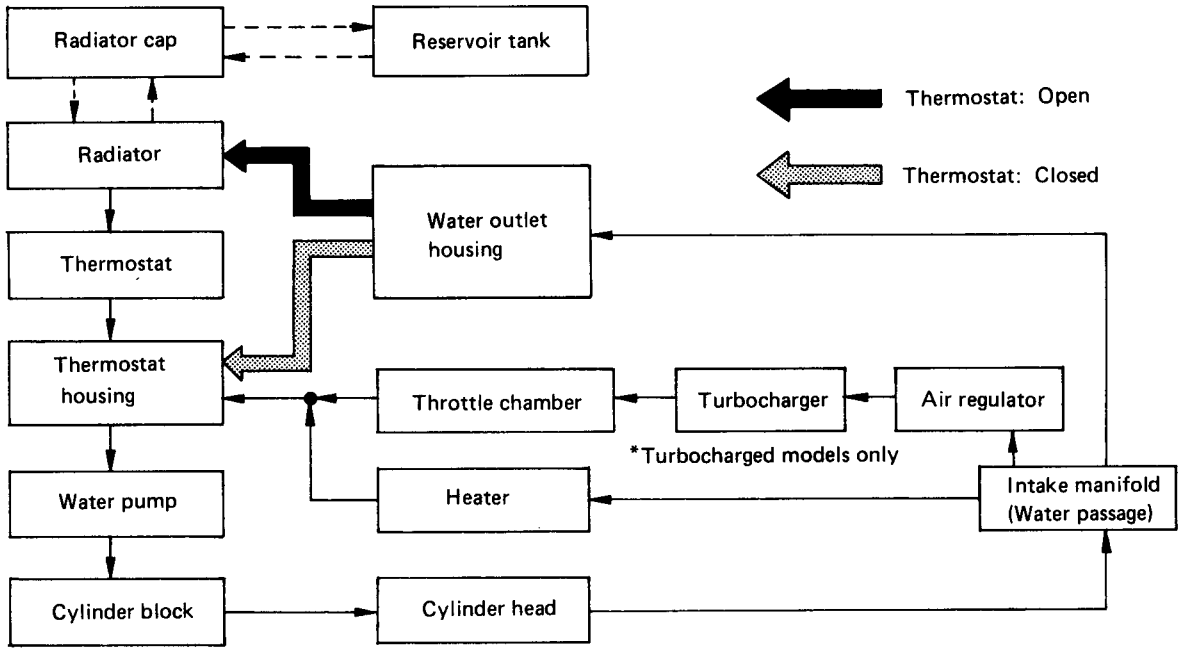
DISASSEMBLY AND ASSEMBLY

- **Turbocharger should not be disassembled.**
- **Turbocharger should be removed after engine removal.**



SEF583C

COOLING CIRCUIT



SLC728

Inspection

Condition 1: Low engine power

Probable cause	Corrective action
Air leak at the connection of compressor housing and suction hose/inlet tube, or inlet tube and intake manifold.	Correct the connection.
Exhaust gas leak at the connection of turbine housing and exhaust manifold, connecting tube or exhaust outlet	Correct the connection or replace gasket.
By-pass valve is stuck open.	Replace turbocharger assembly.
Stuck or worn journal or bearing	
Broken shaft	
Sludge on back of tubine wheel	
Broken turbine wheel	

Condition 2: Excessively high engine power

Probable cause	Corrective action
Disconnected or cracked rubber hose on by-pass valve.	Correct or replace rubber hose.
By-pass valve is stuck closed.	Replace turbocharger assembly.
Controller diaphragm is broken.	

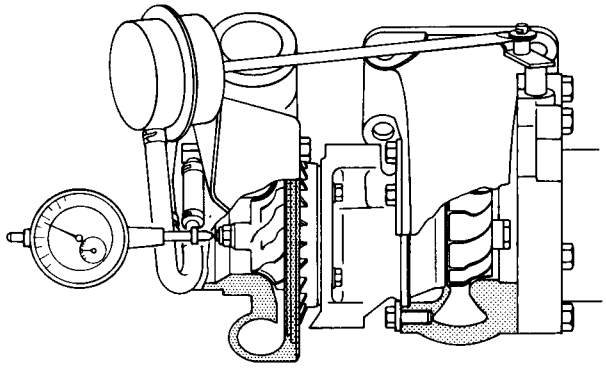
Inspection (Cont'd)

Condition 3: Excessively high oil consumption or exhaust shows pale blue smoke

Probable cause	Corrective action
Oil leak at the connection of lubricating oil passage	Correct the connection.
Oil leak at oil seal of turbine	Replace turbocharger assembly.
Oil leak at oil seal of compressor	
Worn journal or bearing	

1. Inspect turbine and compressor wheel as follows:
- Visually check for cracks, clogging, deformity or other damage.
- Revolve wheels to make sure that they turn freely without any abnormal noise or friction.
- Measure play in axial direction.

Play (axial direction):
0.013 - 0.091 mm (0.0005 - 0.0036 in)

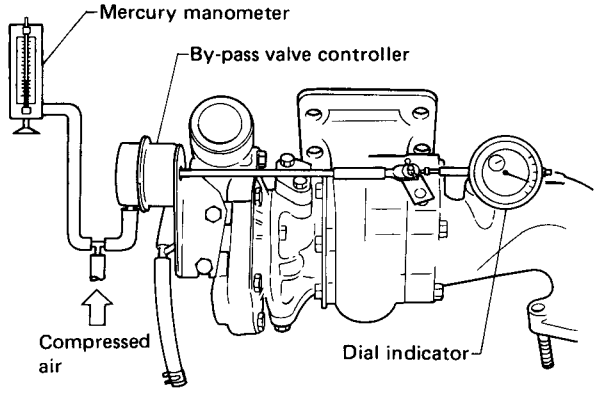


SEF726B

2. Check operation of by-pass valve controller.
- Move by-pass valve to make sure that it is not sticking or scratched.
- Measure rod end play of the by-pass valve controller.

Do not apply more than 66.7 kPa (500 mmHg, 19.69 inHg) pressure to controller diaphragm.

By-pass valve controller stroke/pressure:
0.38 mm (0.0150 in)/51.3 - 56.7 kPa
(385 - 425 mmHg, 15.16 - 16.73 inHg)

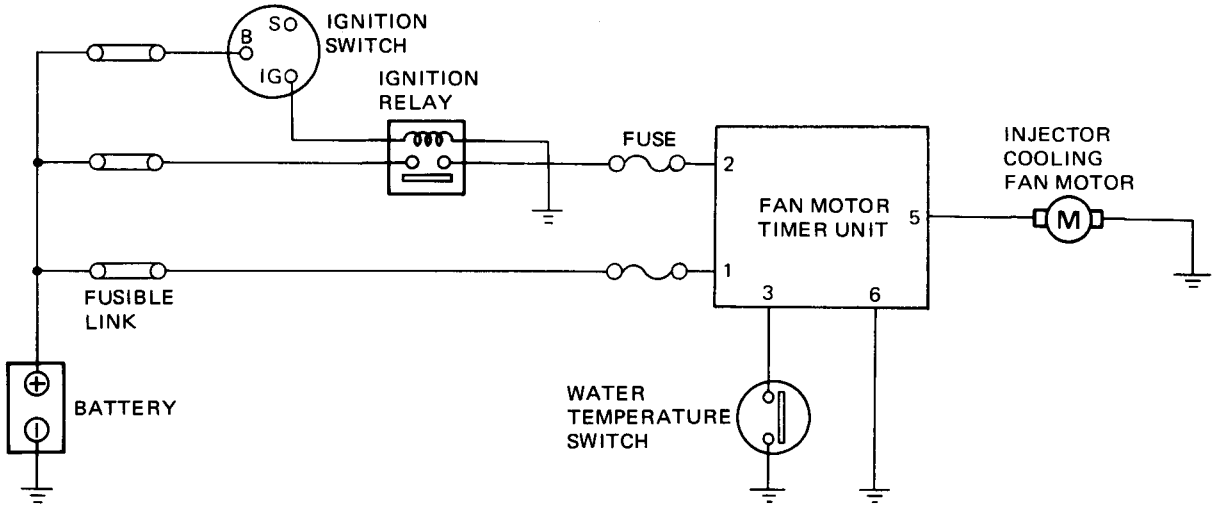


SEC727B

Always replace the turbocharger as an assembly if damaged.

INJECTOR COOLING FAN (VG30E)

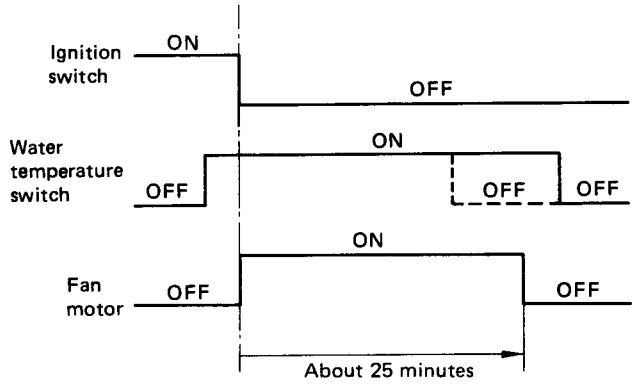
Operation



SEF728B

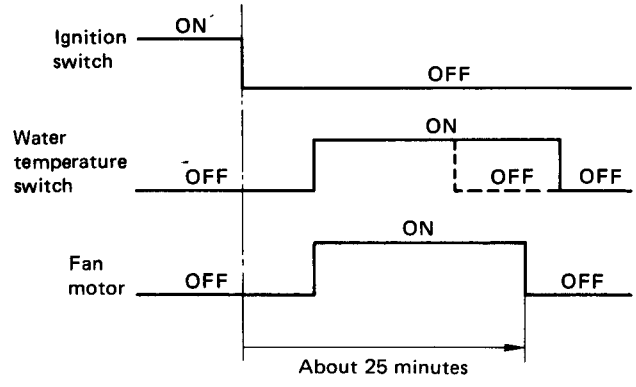
The injector cooling fan operates to cool down the temperature of fuel inside the injector and the fuel gallery when engine is stopped under high engine temperature condition. The injector cooling fan is mounted on the R.H. side of the cylinder block.

Operation 1:



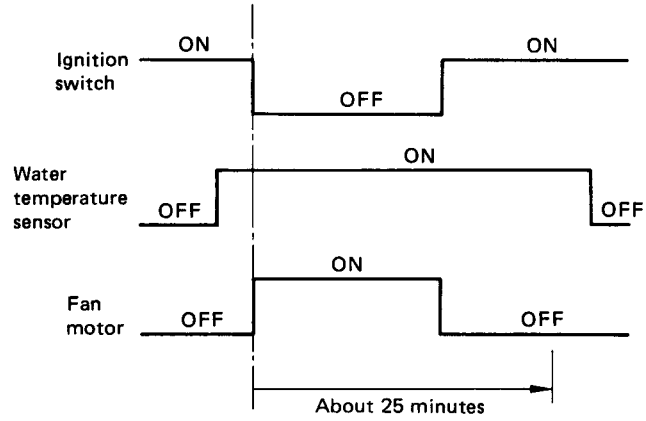
SEF729B

Operation 2:



SEF730B

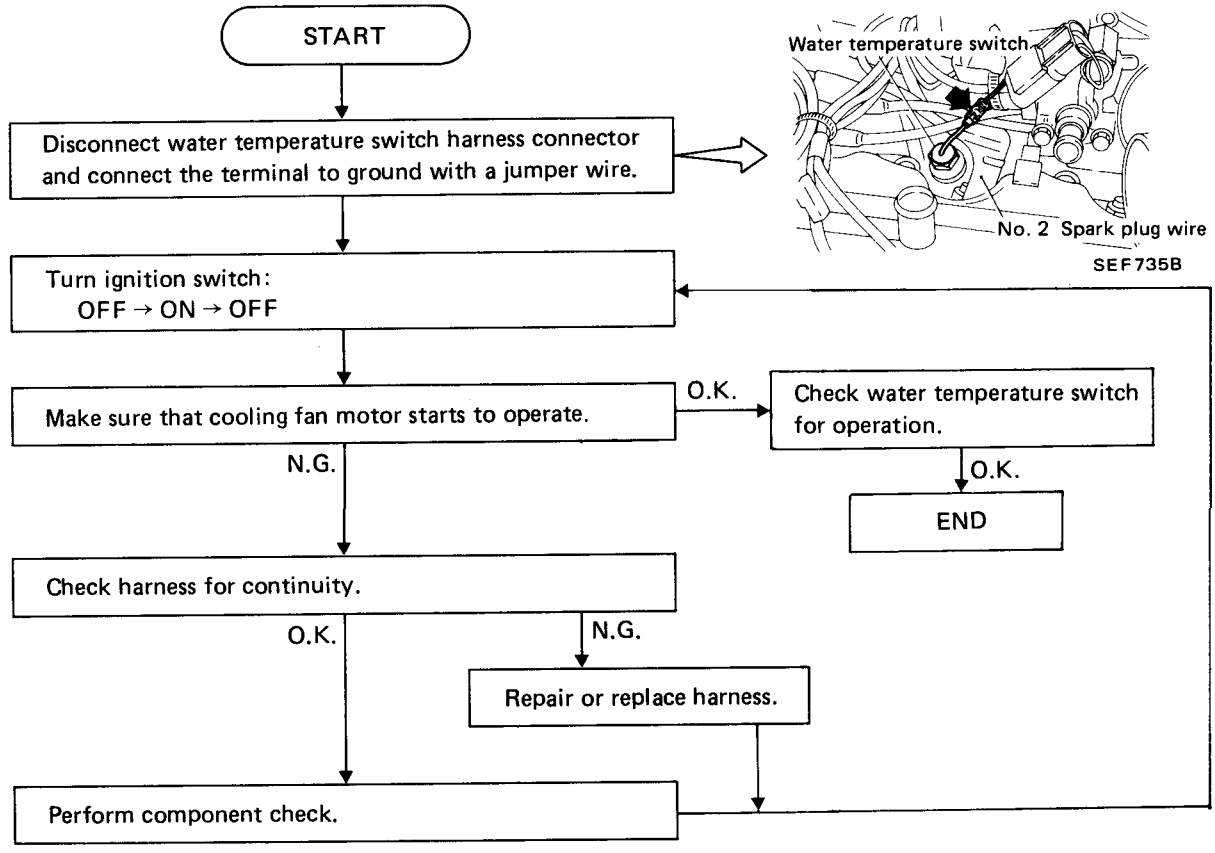
Operation 3:

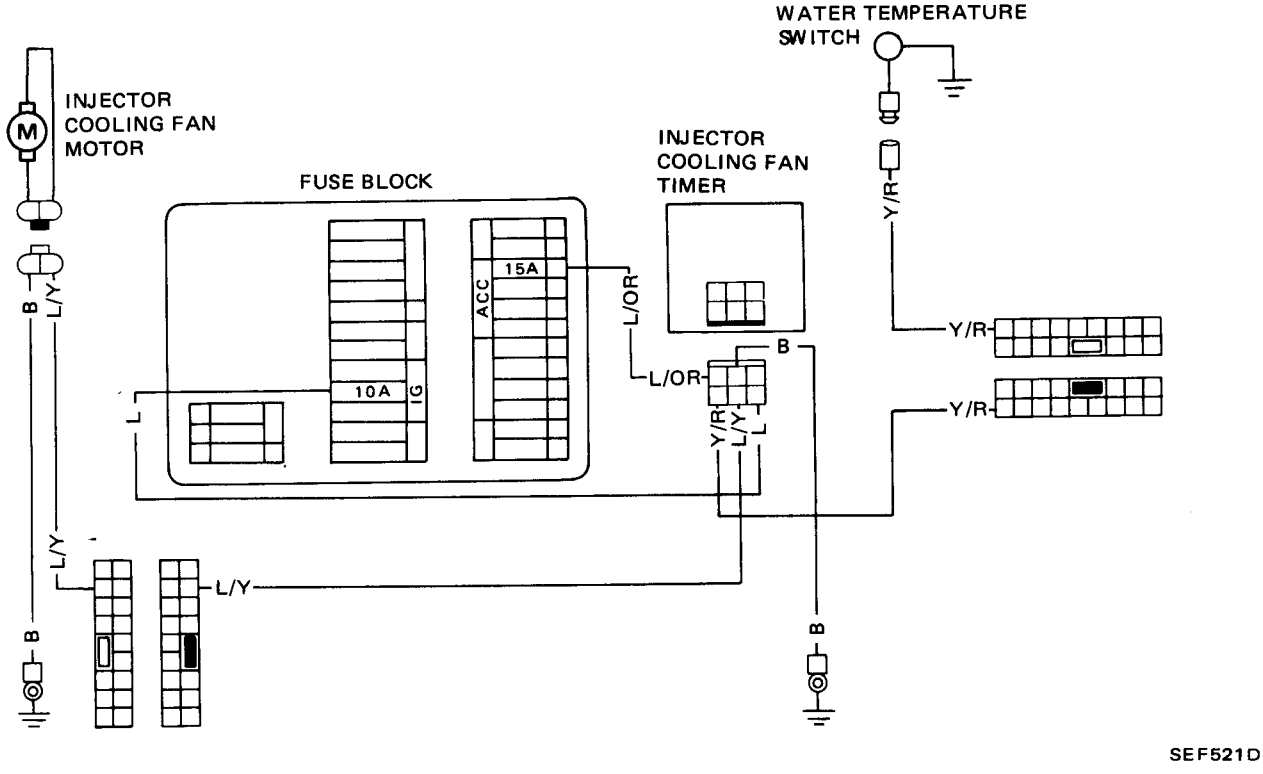


SEF731B

INJECTOR COOLING FAN (VG30E)

Inspection



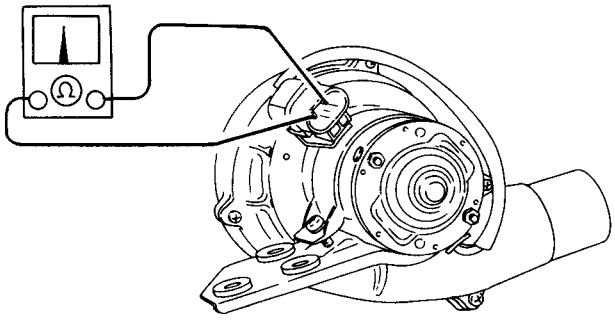


Inspection (Cont'd)

COMPONENT CHECK

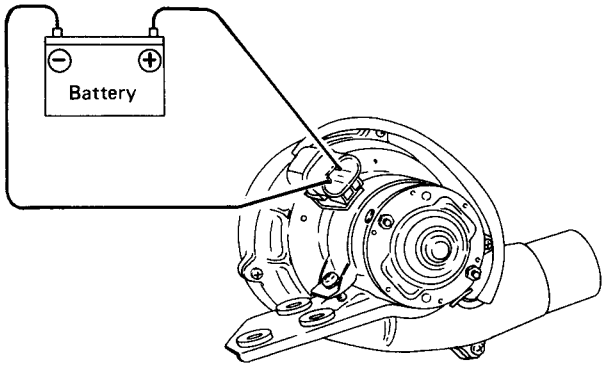
A. Fan motor

1. Make sure that continuity exists between terminals of fan motor.



Continuity should exist. SEF519C

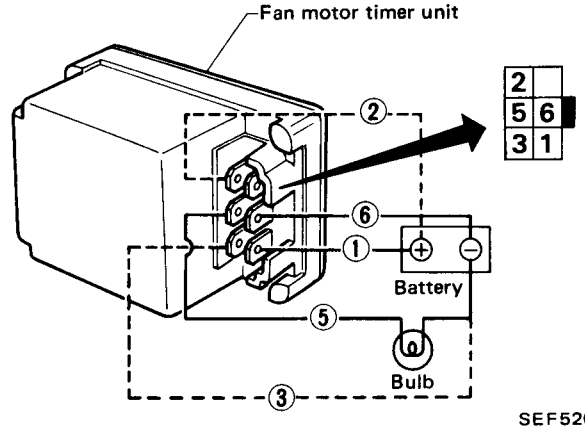
2. Apply battery voltage to the terminals of fan motor. If fan motor does not operate, replace.



SEF734B

B. Fan motor timer unit

Check the timer unit with a battery source and a test lamp (12V-3W), following the procedure below.



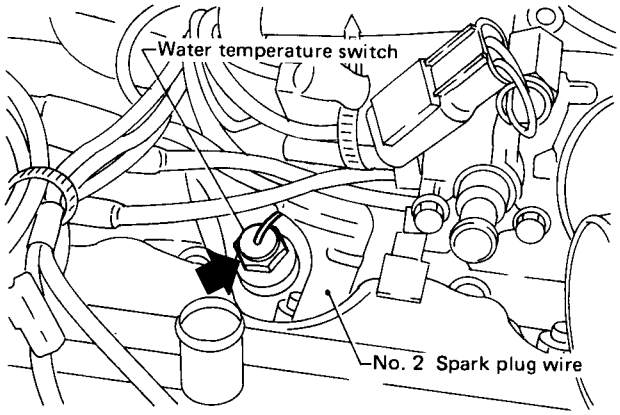
SEF520C

1. Connect terminal ⑥ to negative terminal of power source, terminal ⑤ to test lamp terminal and the other test lamp terminal to negative terminal of the power source.
2. Connect terminal ① to positive terminal of power source.
   - Test lamp does not glow ..... O.K.
   - Test lamp glows ..... N.G.
3. Connect terminal ② to positive terminal of power source and disconnect it. (Operate timer)
4. Connect terminal ③ to negative terminal of power source.
   - Test lamp glows ..... O.K.
   - Test lamp does not glow ..... N.G.
5. Make sure that test lamp should remain on for about 17 minutes after step 3 is performed, and then go out.
6. While test lamp is on, connect terminal ② to positive terminal of power source.
   - Test lamp goes out ..... O.K.
   - Test lamp does not go out ..... N.G.

Inspection (Cont'd)

C. Water temperature switch

1. Remove water temperature switch.

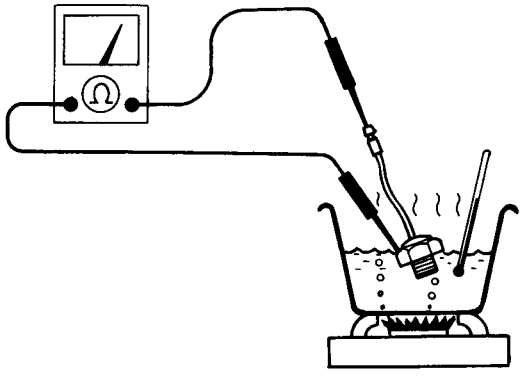


SEF737B

2. Check water temperature switch for proper operation.

Operating temperature:

OFF → ON 90±3°C (194±5.4°F)

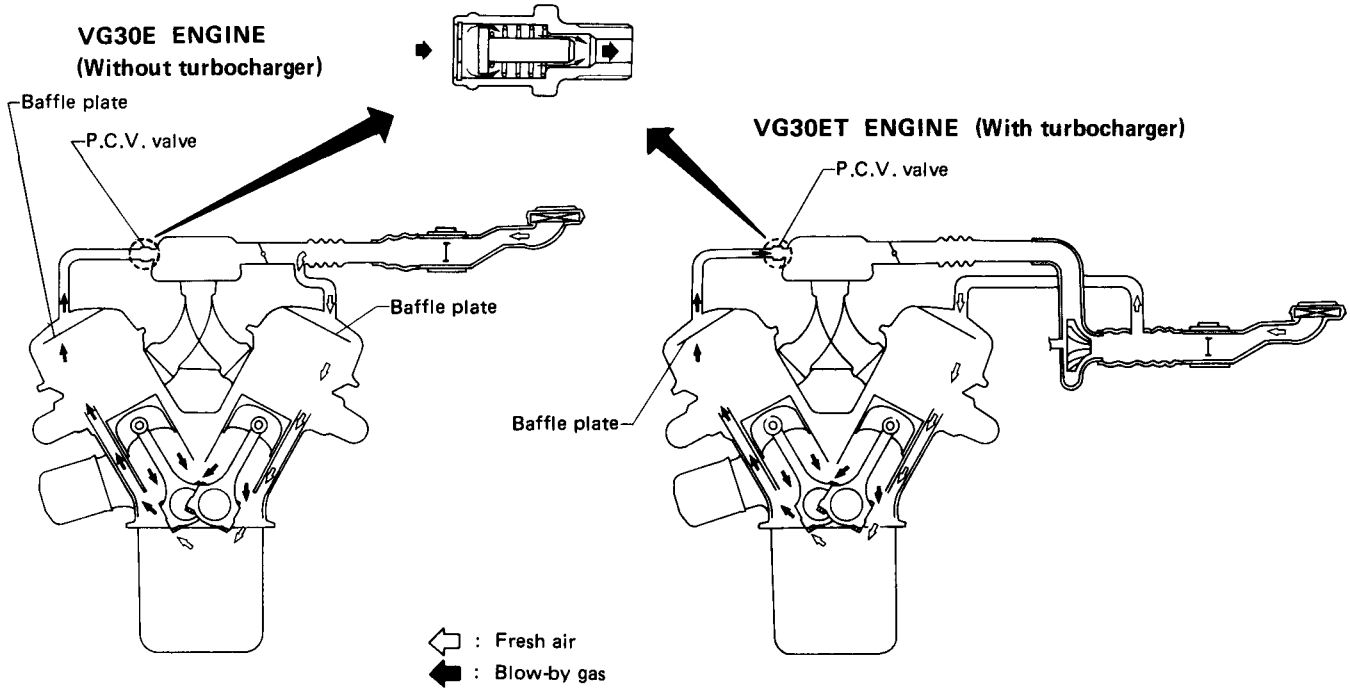


SEF738B

CRANKCASE EMISSION CONTROL SYSTEM

Description

This system is designed to return the blow-by gas to the intake manifold and to charge fresh air into the crankcase. The positive crankcase ventilation (P.C.V.) valve is provided on the intake manifold collector.

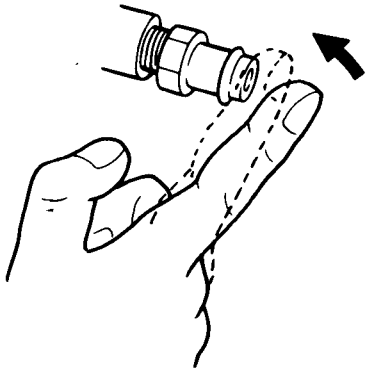


SEC501A

Inspection

P.C.V. VALVE

With engine running at idle, remove ventilation hose from P.C.V. valve; if valve is working properly, a hissing noise will be heard as air passes through it and a strong vacuum should be felt immediately when a finger is placed over valve inlet.



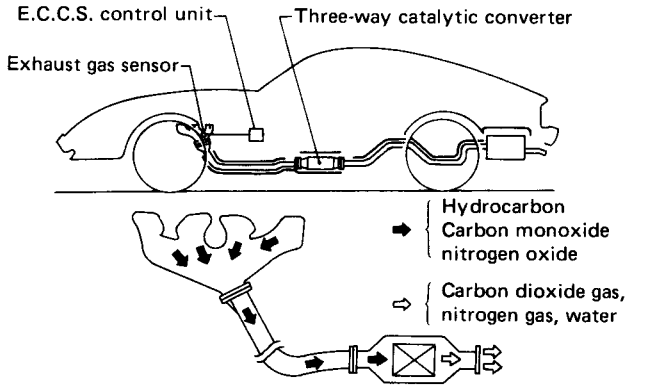
SEC137A

VENTILATION HOSE

1. Check hoses and hose connections for leaks.
2. Disconnect all hoses and clean with compressed air. If any hose cannot be freed of obstructions, replace.

Catalytic Converter

The exhaust gas contains unburned, harmful gases. While the mixture ratio is maintained to the stoichiometric point by the mixture ratio feedback system, the three-way catalytic converter activates to oxidize and reduce harmful gases (HC, CO and NOx) into harmless gases (CO_2, H_2O and N_2). In this way, the catalytic converter cleans the exhaust gas and emits CO_2, H_2O and N_2 into the atmosphere.



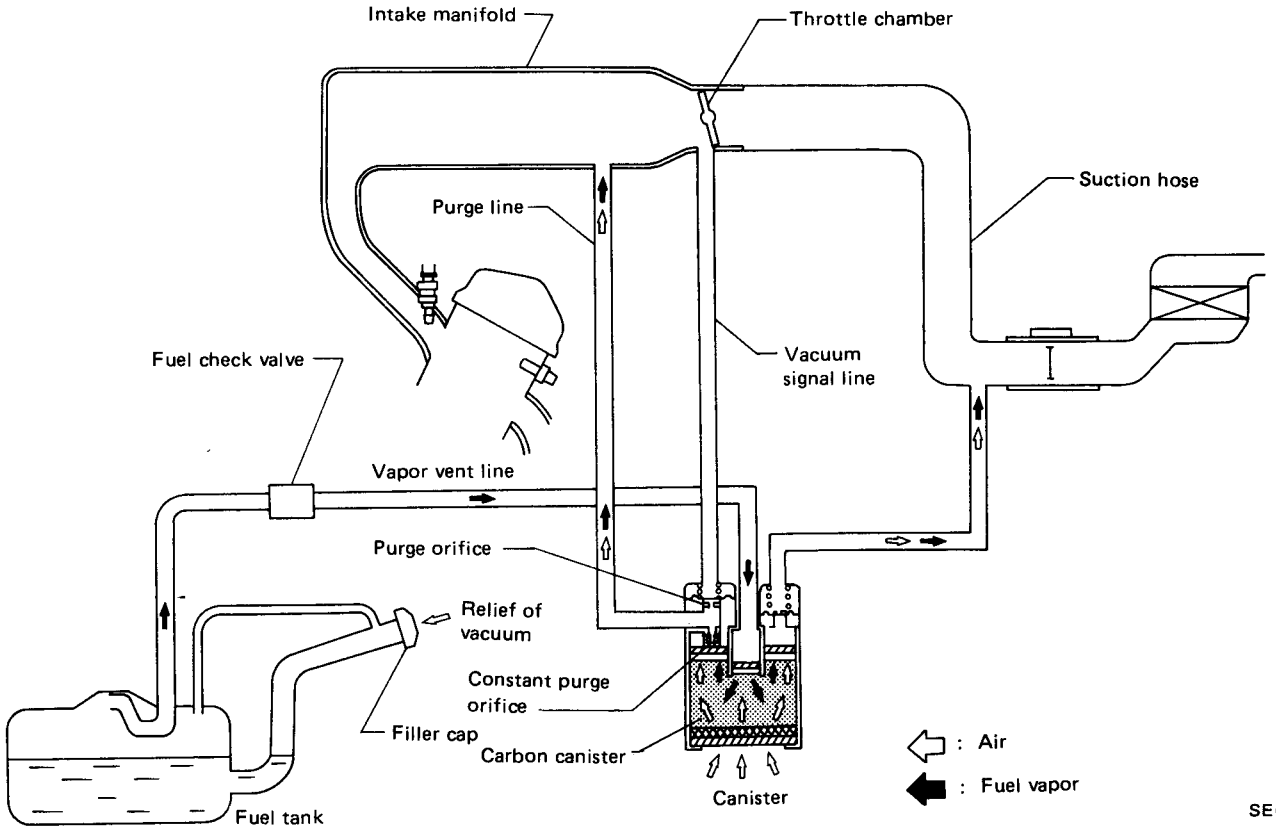
SEC304A

Operation

The fuel vapor from the sealed fuel tank is led into the canister which contains activated carbon and the vapor is stored there when the engine is not running.

The canister retains the fuel vapor until the canister is purged by the air drawn through the purge line to the intake manifold when the engine is running. When the engine runs at idle, the purge control valve is closed.

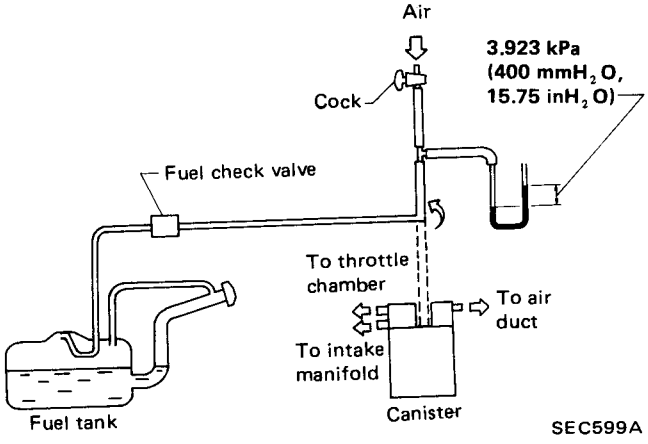
Only a small amount of purge air flows into the intake manifold through the constant purge orifice. As the engine speed increases, and the throttle vacuum rises higher, the purge control valve opens and the vapor is sucked into the intake manifold through both the fixed orifice and the constant purge orifice.



SEC598A

Inspection

VAPOR VENT LINE

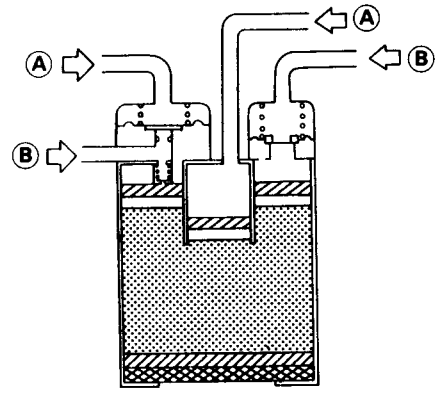


1. Check hoses and fuel tank filler cap.
2. Disconnect the vapor vent line connecting carbon canister to fuel tank.
3. Connect a 3-way connector, a manometer and a cock (or an equivalent 3-way charge cock) to the end of the vent line.
4. Supply fresh air into the vapor vent line through the cock little by little until pressure becomes 3.923 kPa (400 mmH_2O, 15.75 inH_2O).
5. Shut the cock completely and leave it unattended.
6. After 2.5 minutes, measure the height of the liquid in the manometer.
7. Variation in height should remain at 0.245 kPa (25 mmH_2O, 0.98 inH_2O).
8. When filler cap does not close completely, the height should drop to zero in a short time.
9. If the height does not drop to zero in a short time when filler cap is removed, the cause is a clogged hose.

In case the vent line is clogged the fuel tank is not able to breathe thus causing insufficient delivery of fuel to engine or vapor lock. The line must, therefore, be repaired or replaced.

CARBON CANISTER

Check carbon canister as follows:



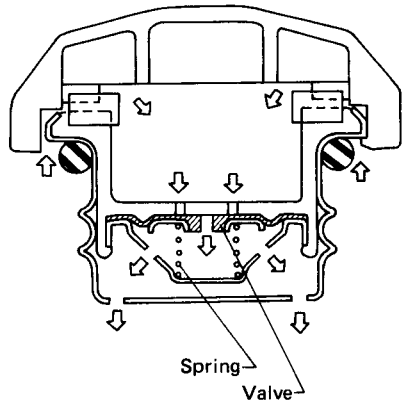
Ⓐ : Blow air and ensure that there is no leakage.
Ⓑ : Blow air and ensure that there is leakage.

SEC600A

If malfunctioning, replace faulty part.

FUEL TANK VACUUM RELIEF VALVE

1. Wipe clean valve housing and have it in your mouth.
2. Inhale air. A slight resistance accompanied by valve indicates that valve is in good mechanical condition. Note also that, by further inhaling air, the resistance should disappear with valve clicks.
3. If valve is clogged, or if no resistance is felt, replace cap as an assembled unit.

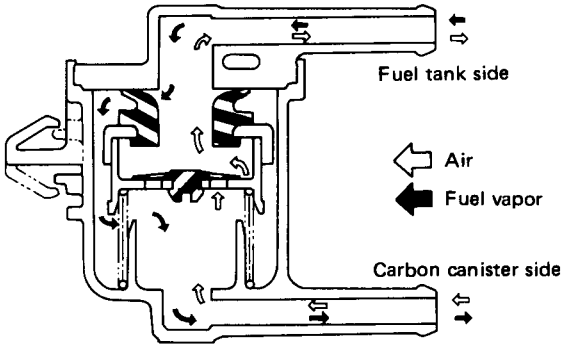


SEC308A

Inspection (Cont'd)

FUEL CHECK VALVE

1. Blow air through connector on fuel tank side.
   A considerable resistance should be felt at the mouth and a portion of air flow be directed toward the engine.
2. Blow air through connector on engine side.
   Air flow should be smoothly directed toward fuel tank.
3. If fuel check valve is suspected of not functioning properly in steps 1 and 2 above, replace.



SEC309A

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

General Specifications

Fuel pump	
Cut-off discharge pressure kPa (kg/cm², psi)	422 - 490 (4.3 - 5.0, 61 - 71)
Pressure regulator	
Regulated pressure kPa (kg/cm², psi)	250 (2.55, 36.3)
Air regulator	
Air flow amount [at 20°C (68°F)] m^3 (cu ft)/hr	27.5 (971)
Turbocharger	
Max. supercharging pressure kPa (mmHg, inHg)	42.7 - 50.7 (320 - 380, 12.60 - 14.96)
Emergency relief valve	
Valve opening pressure kPa (mmHg, inHg)	55.3 - 63.3 (415 - 475, 16.34 - 18.70)

Inspection and Adjustment

Fuel pressure	
At idle kPa (kg/cm², psi)	Approximately 206 (2.1, 30)
The moment accelerator pedal is fully depressed kPa (kg/cm², psi)	VG30E Approximately 255 (2.6, 37) VG30ET Approximately 304 (3.1, 44)
Air flow meter	
Voltage between terminals B and D	1.6±0.5 V
Cylinder head temperature sensor and fuel temperature sensor	
Thermistor resistance at −10°C (14°F)	7.0 - 11.4 kΩ
at 20°C (68°F)	2.1 - 2.9 kΩ
at 50°C (122°F)	0.68 - 1.0 kΩ
Throttle valve switch Engine speed when idle switch is turned from "OFF" to "ON" (In Neutral position)	Idle speed + 250 rpm allowance: ±150 rpm
Exhaust gas sensor	
Heater resistance	5 - 6Ω

*With A.A.C. valve harness connector disconnected.

Tightening Torque

Unit	N·m	kg-m	ft-lb
Throttle chamber securing bolt	18 - 22	1.8 - 2.2	13 - 16
Intake collector bolt	18 - 22	1.8 - 2.2	13 - 16
Cylinder head temperature sensor	12 - 16	1.2 - 1.6	9 - 12
Exhaust gas sensor	40 - 50	4.1 - 5.1	30 - 37
E.G.R. control valve	18 - 23	1.8 - 2.3	13 - 17
E.G.R. tube	34 - 44	3.5 - 4.5	25 - 33
Detonation sensor	25 - 34	2.5 - 3.5	18 - 25
Fuel hose clamp	1.0 - 1.5	0.10 - 0.15	0.7 - 1.1