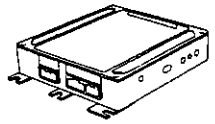
ENGINE FUEL & EMISSION CONTROL SYSTEM

SECTION EF & EC

CONTENTS

- Always use 12 volt batteries as power source
- Do not attempt to disconnect battery cables while engine is operating

- Do not disassemble E C C S control unit
- Do not turn diagnosis mode selector



- When installing large capacity wireless equipment 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 smaller

- Do not apply battery power directly to injectors
- Do not remove the fuel temperature sensor from the pressure regulator
  Replace as an assembly

- Do not operate fuel pump when there is no fuel in lines
- Do not use anti-freeze agents in fuel
- Do not reuse fuel hose clamps
- Tighten fuel hose clamps sufficiently

- Handle air flow meter carefully to avoid damage
- Do not disassemble air flow meter
- Do not clean air flow meter with any type of detergent
- Even a slight leak in the air intake system can cause serious problems

- Do not shock or jar the crank angle sensor

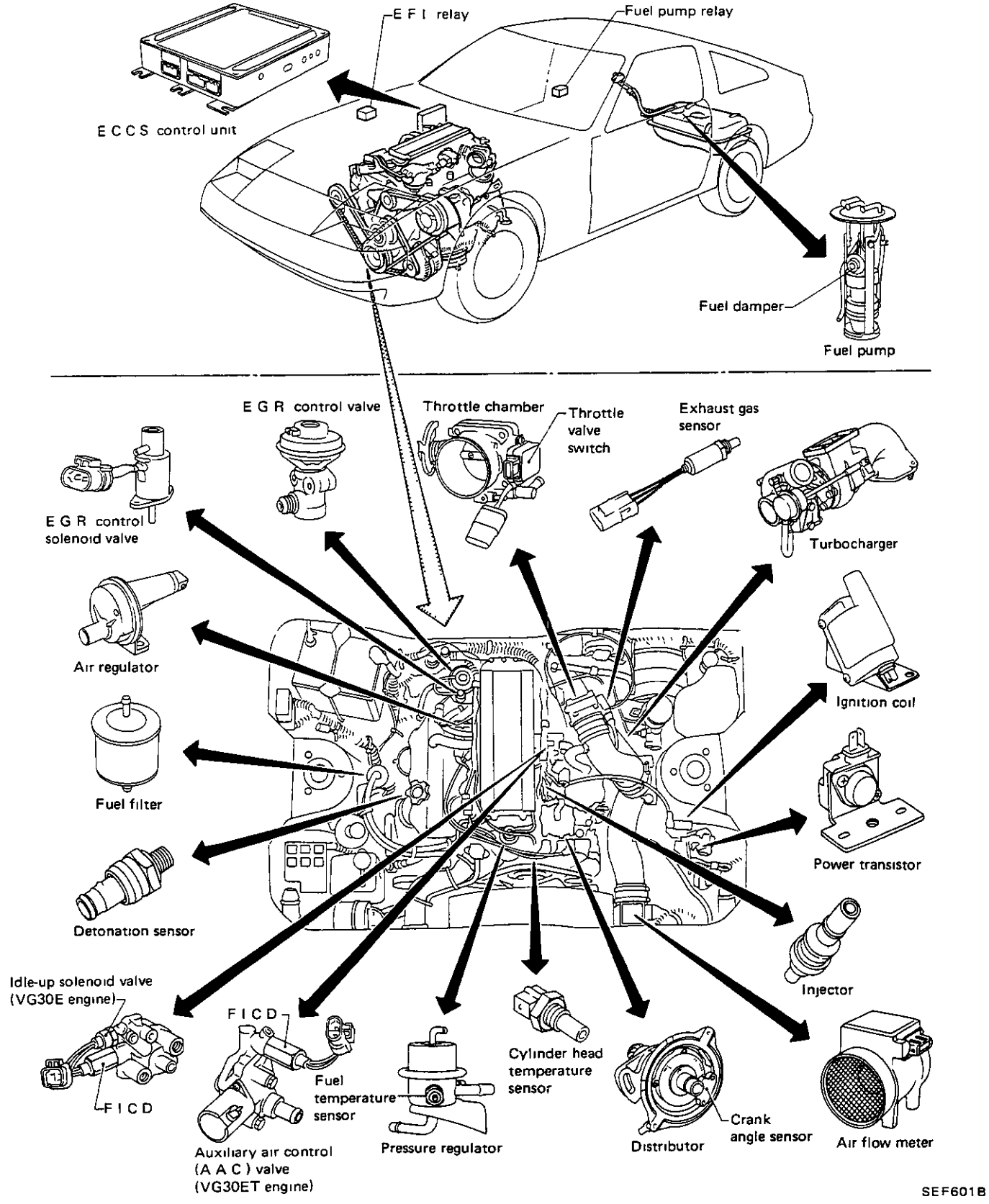
- Do not disassemble auxiliary air control valve (VG30ET engine)

- Do not depress accelerator pedal when starting
- Immediately after starting, do not rev up engine unnecessarily
- Do not rev up engine just prior to shutdown

- 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

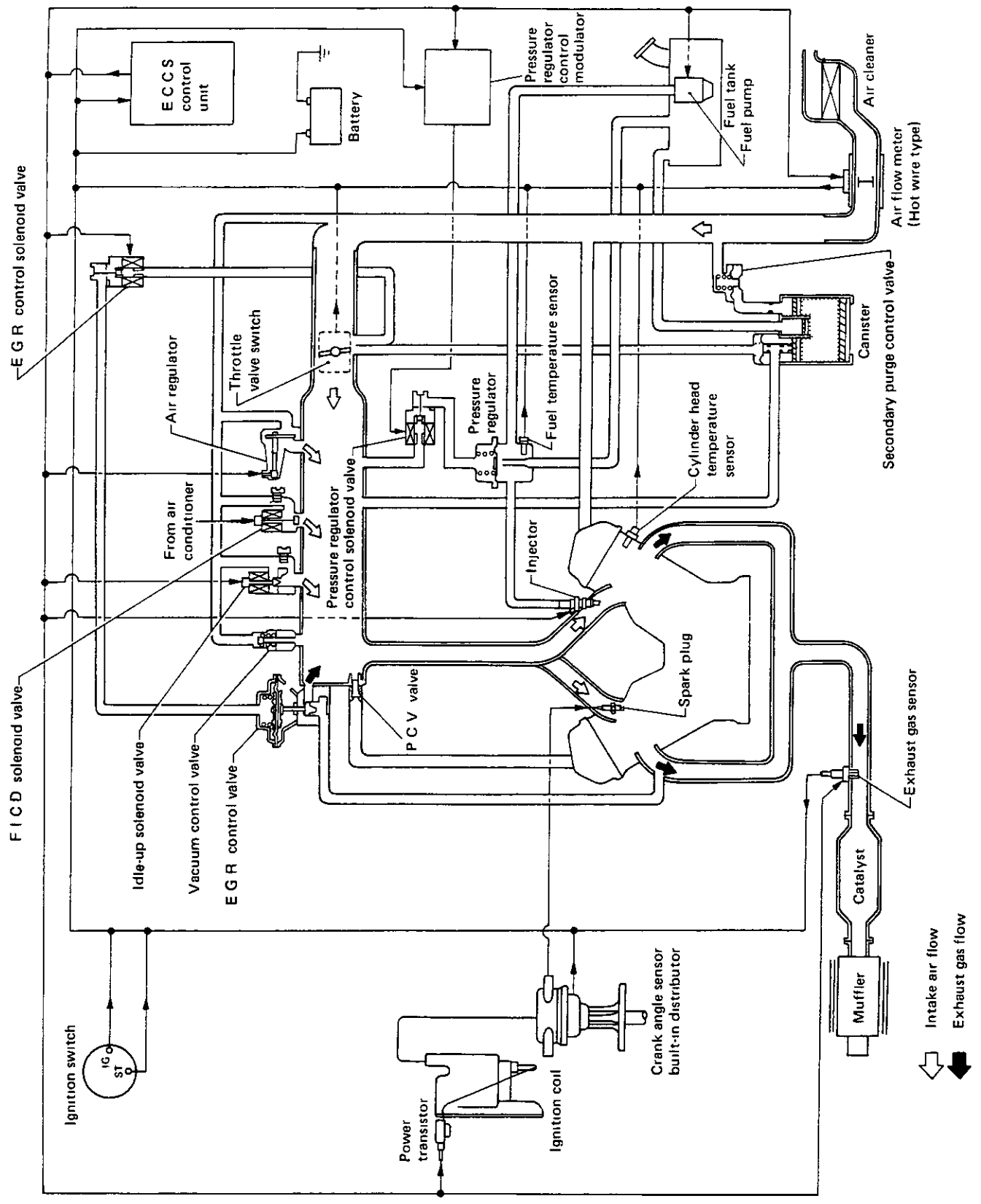
SEF600B

COMPONENT PARTS LOCATION



E.C.C.S. DIAGRAM

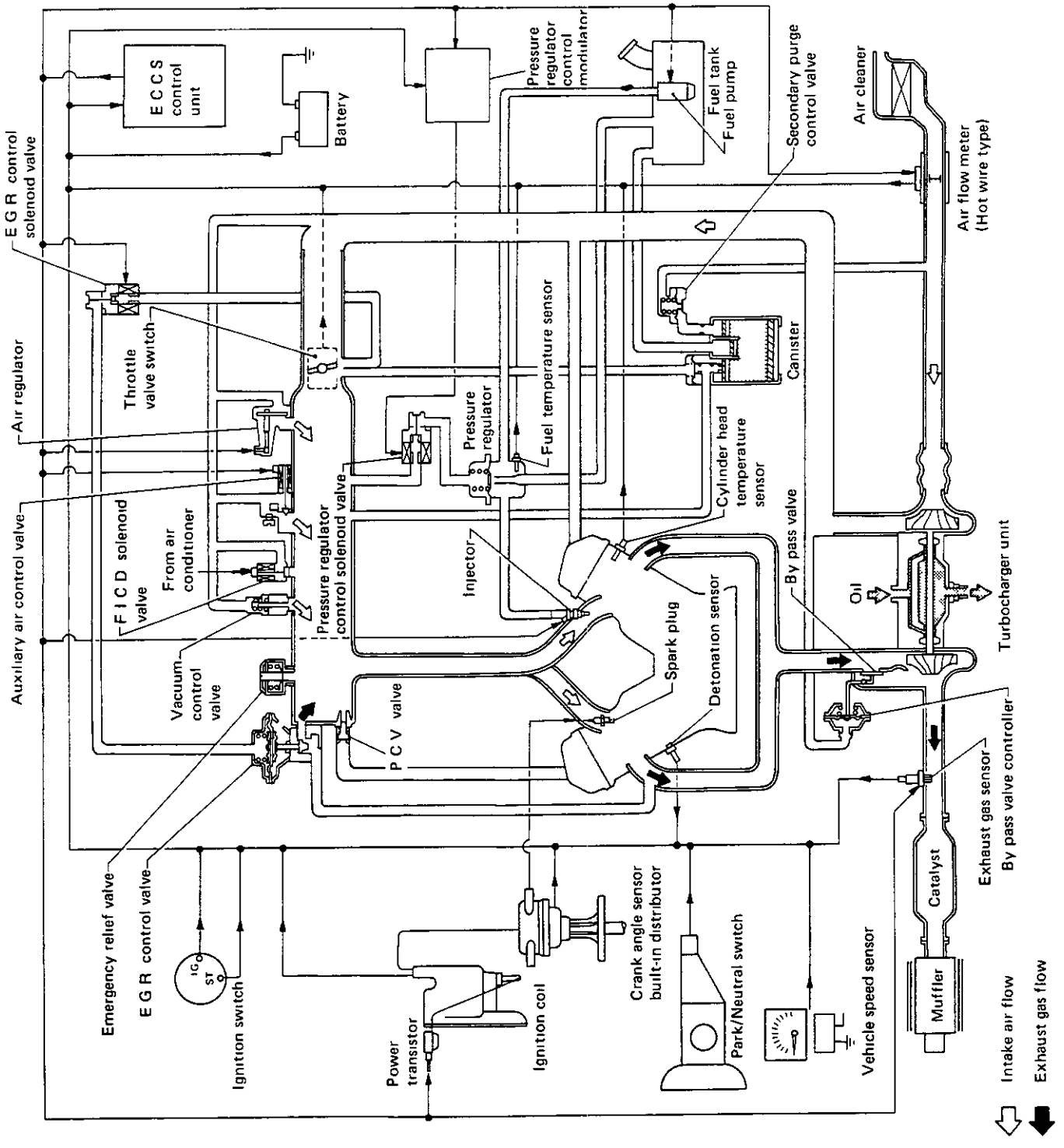
VG30E Engine (Without turbocharger)



SEF602B

E.C.C.S. DIAGRAM

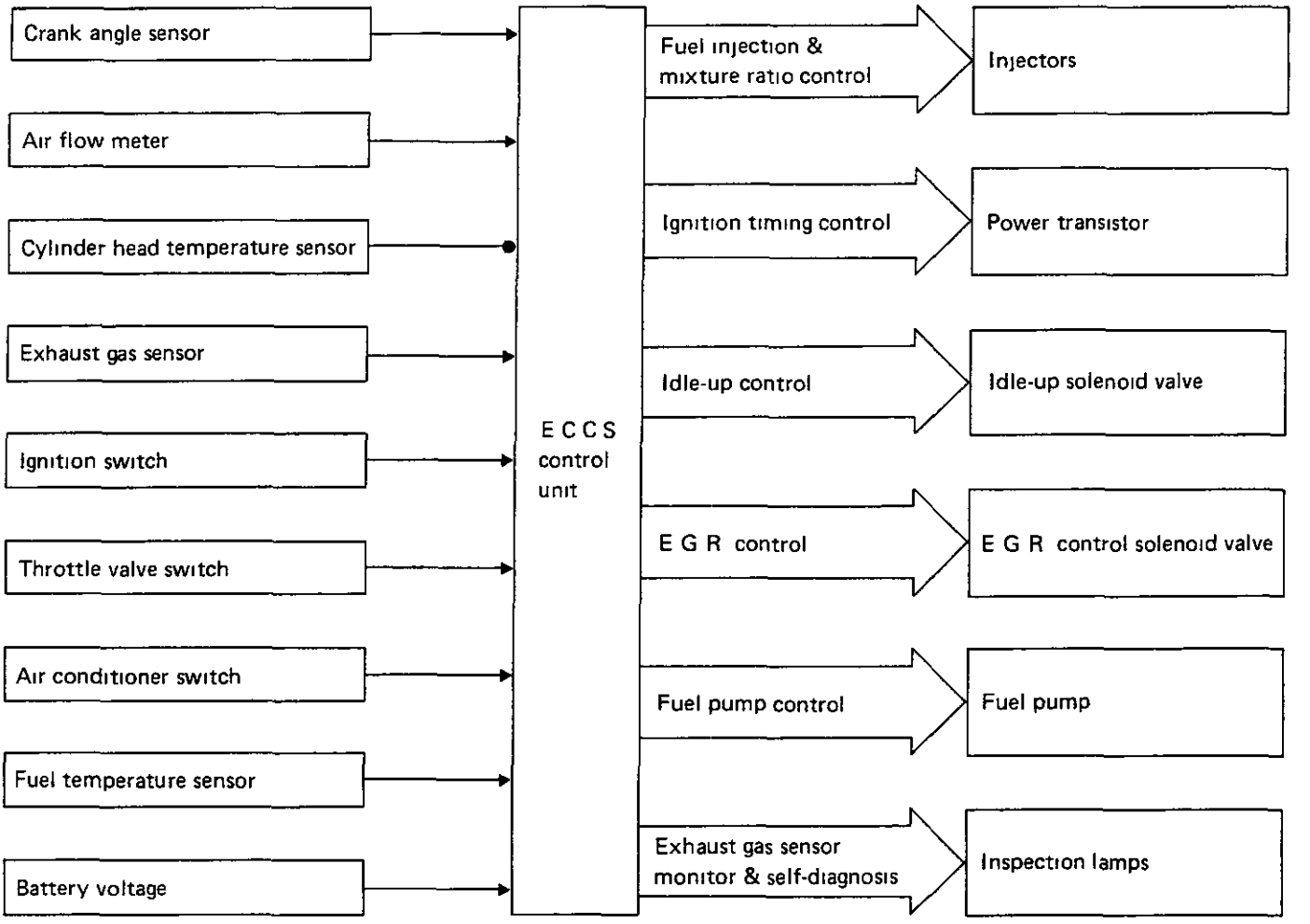
VG30ET Engine (With turbocharger)



SEF603B

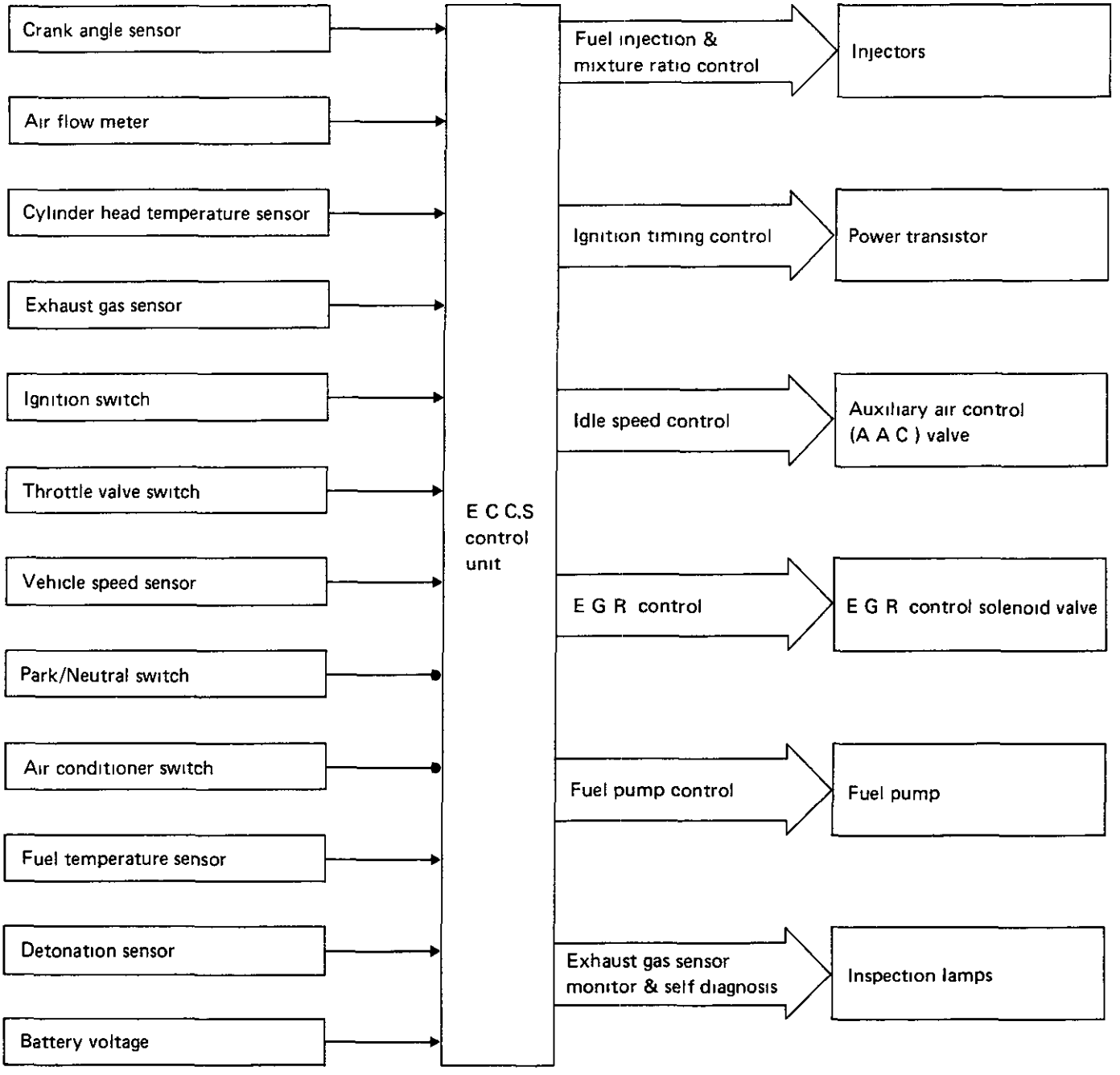
E.C.C.S. CHART

VG30E Engine (Without turbocharger)

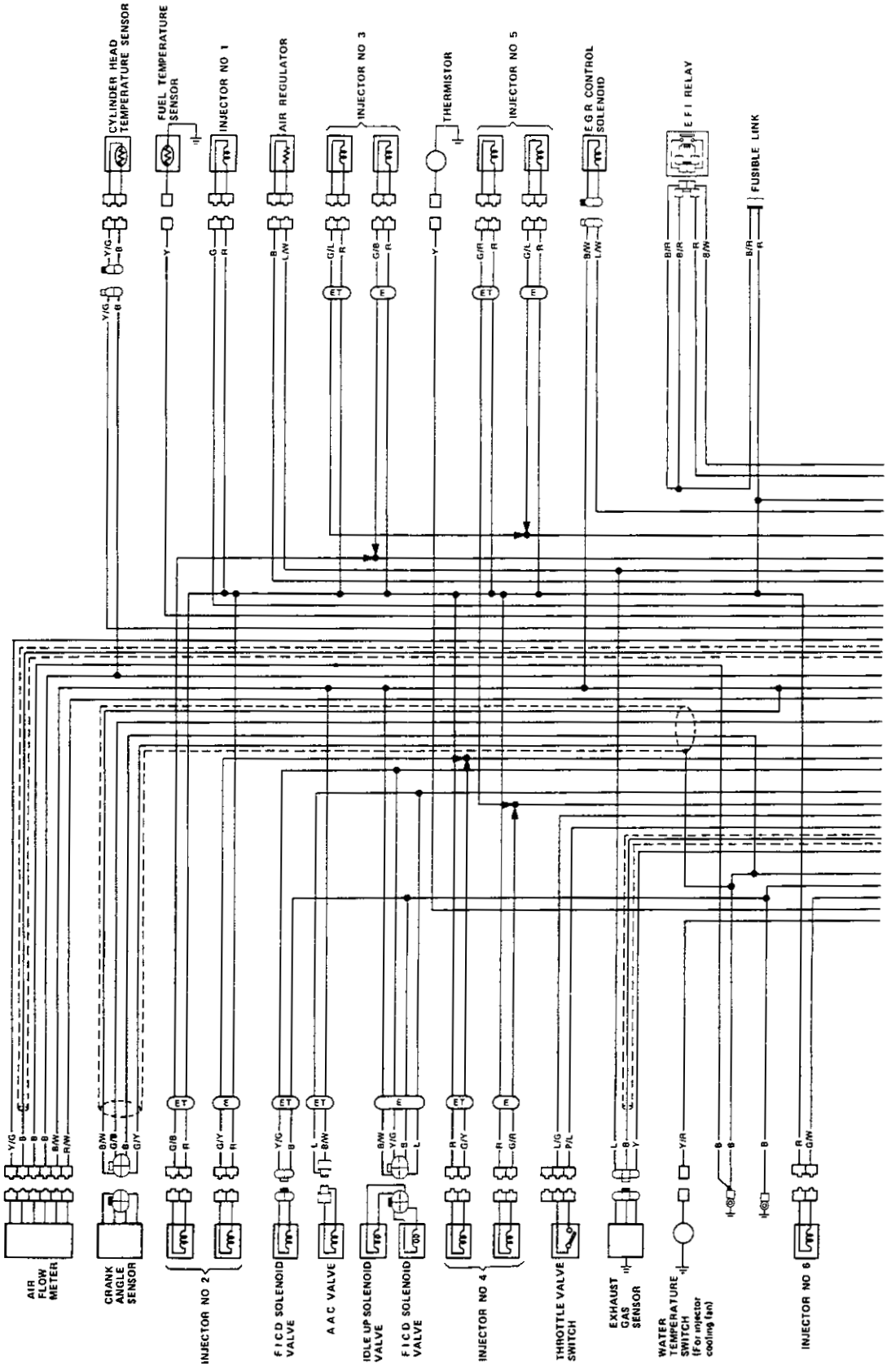


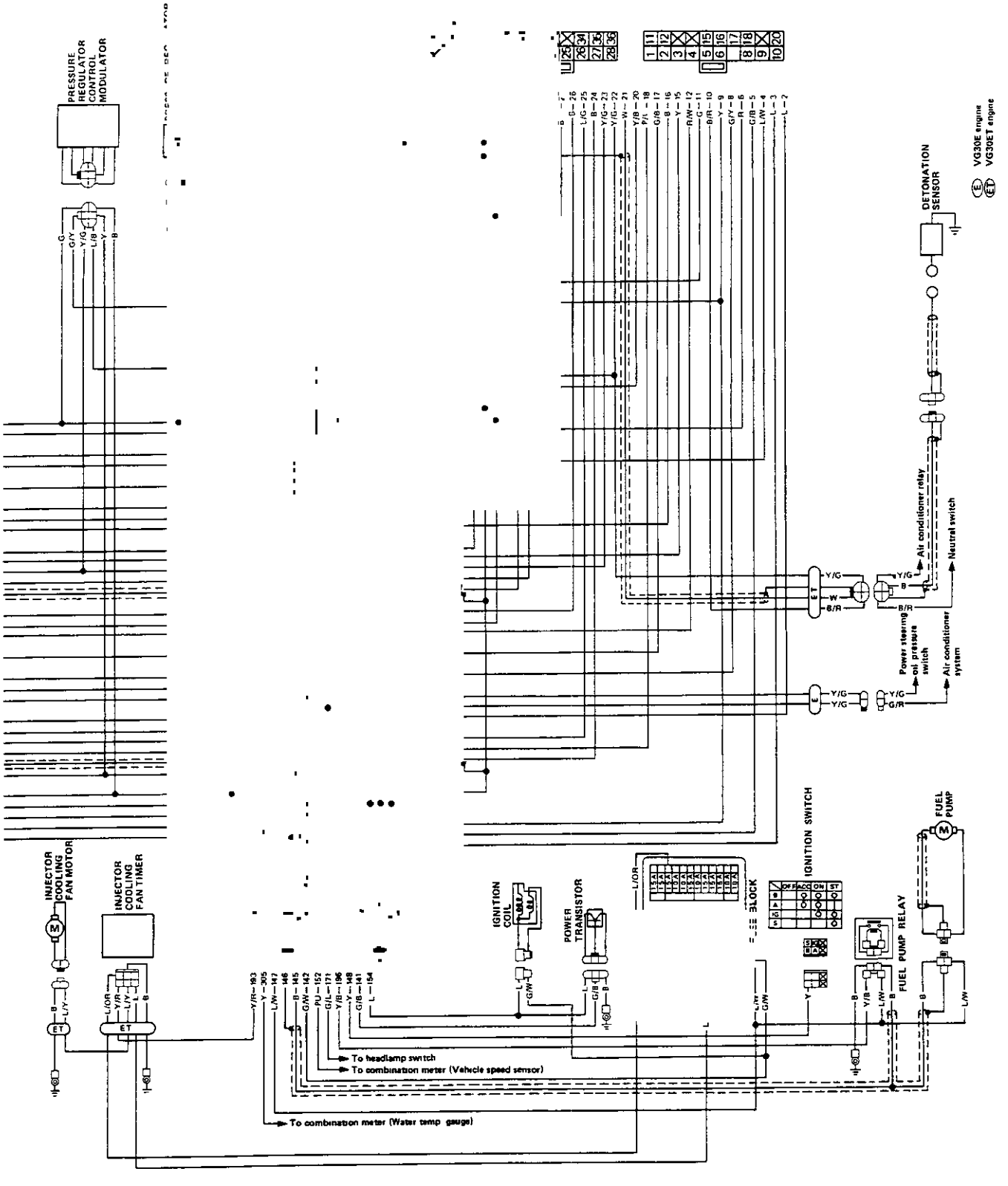
E.C.C.S. CHART

VG30ET Engine (With turbocharger)



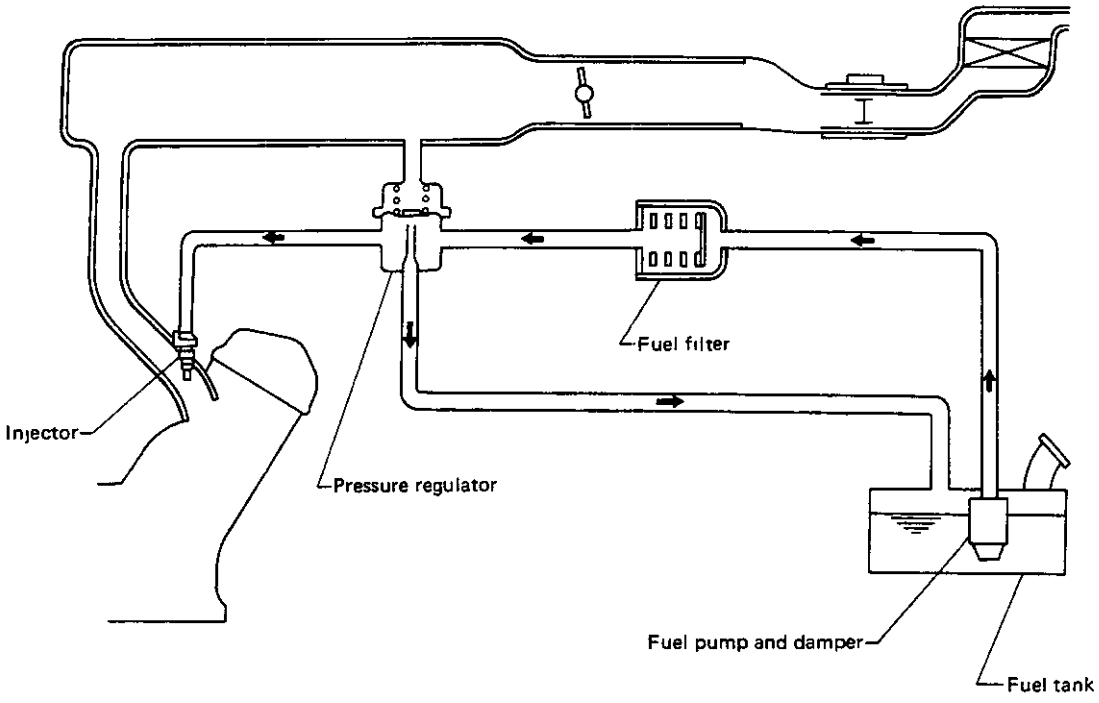
E.C.C.S. WIRING DIAGRAM




PRESSURE REGULATOR CONTROL MODULATOR
DETONATION SENSOR
VG30E engine
VG30ET engine
Air conditioner relay
Neutral switch
Power steering oil pressure switch
Air conditioner system
INJECTOR COOLING FAN MOTOR
INJECTOR COOLING FAN TIMER
IGNITION COIL
POWER TRANSISTOR
IGNITION SWITCH
FUEL PUMP
FUEL PUMP RELAY
To headlamp switch
To combination meter (Vehicle speed sensor)
To combination meter (Water temp. gauge)

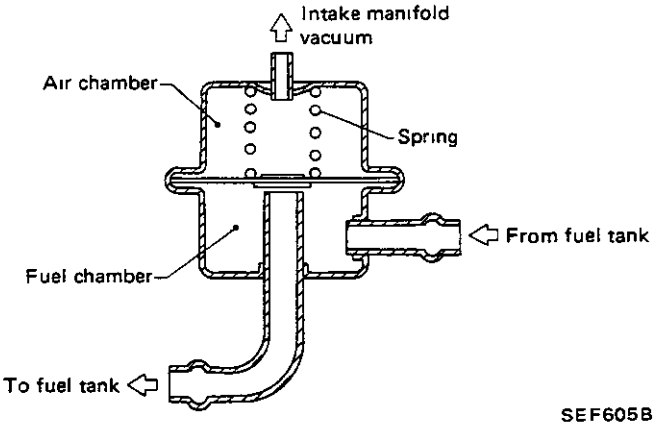
SEF747B

FUEL FLOW SYSTEM DESCRIPTION

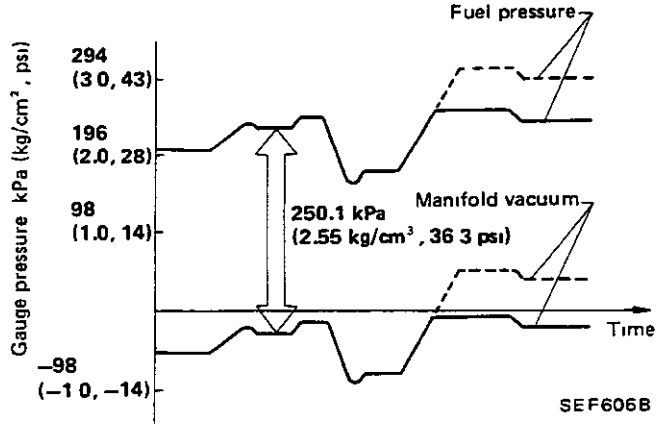


SEF604B

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

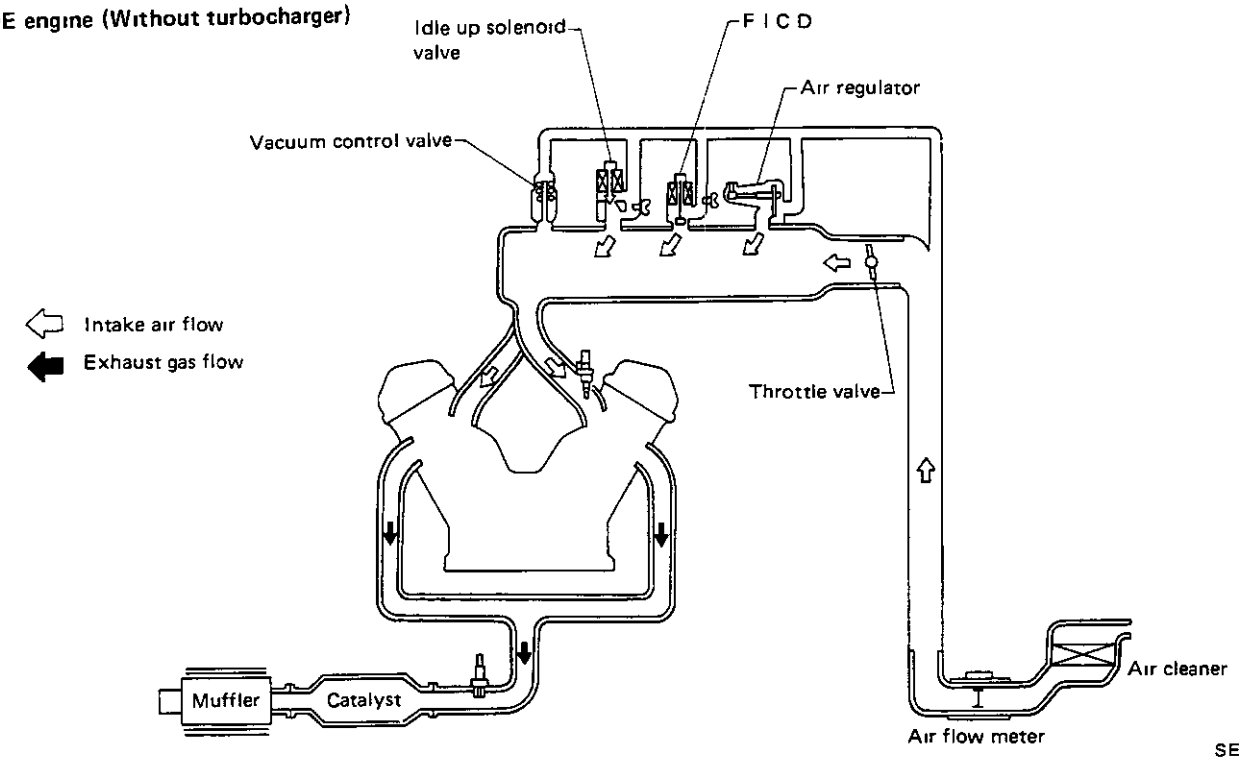


SEF605B



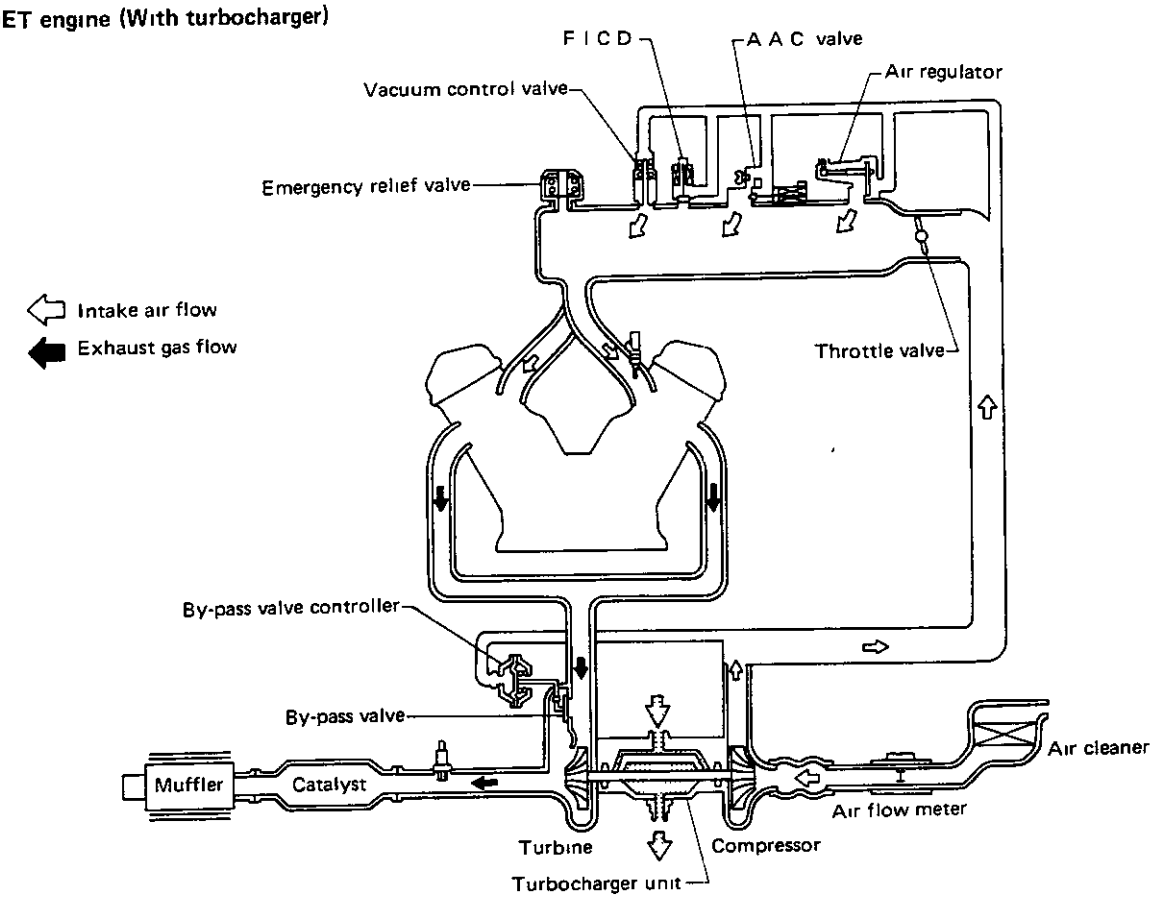
SEF606B

VG30E engine (Without turbocharger)



SEF607B

VG30ET engine (With turbocharger)

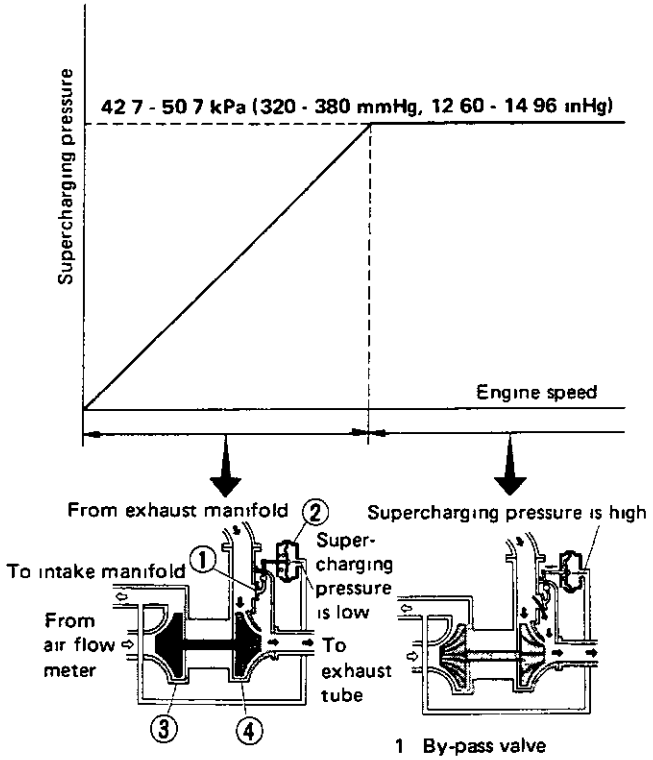


SEF608B

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.

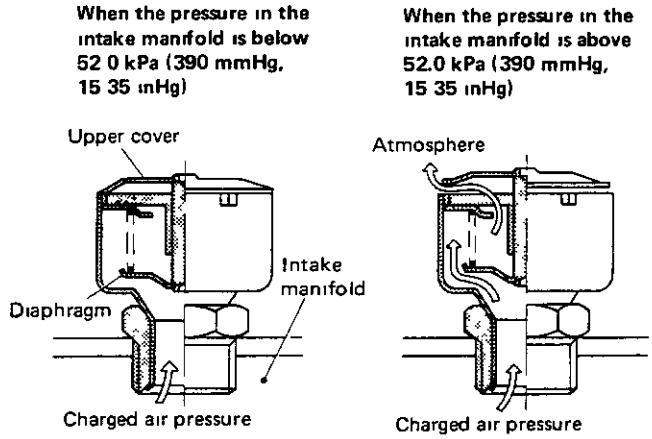
To prevent an excessive rise in the supercharging pressure, the turbine speed is maintained within a safe range by controlling the amount of exhaust gas that passes through the turbine. This system consists of a by-pass valve which allows some of the exhaust gas to by-pass the turbine and to flow directly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

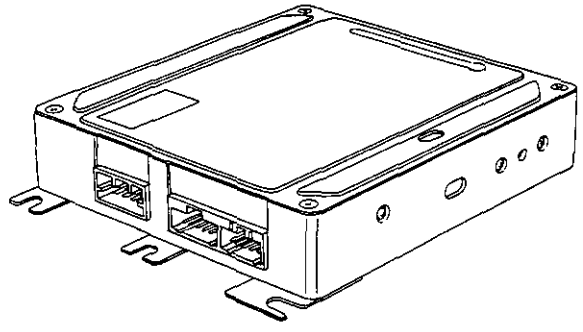


SEF610B

E.C.C.S. Components

E C C.S. CONTROL UNIT

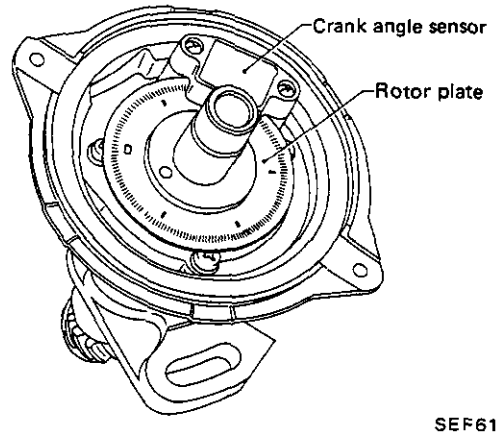
The E C C S control unit consists of a micro-computer, connectors for signal input and output and power supply, inspection lamps and diagnostic mode selector The control unit controls the amount of fuel that is injected, ignition timing, idle speed, E G R , fuel pump operation, and feedback of the mixture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



SEF611B

CRANK ANGLE SENSOR

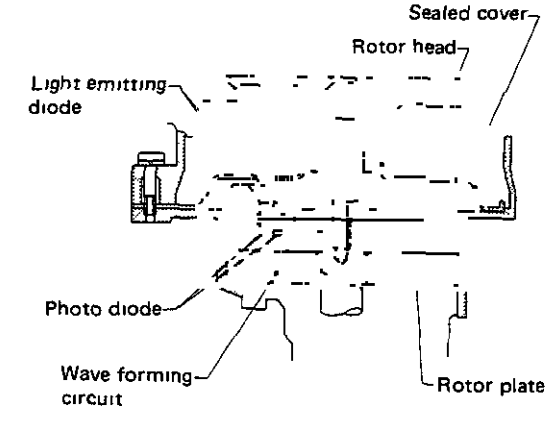
Crank angle sensor is a basic signal sensor for the entire E C C S It monitors engine speed and piston position, and it sends signals to the E C C S control unit for control of fuel injection, ignition timing, idle speed, fuel pump operation and E G R operation.



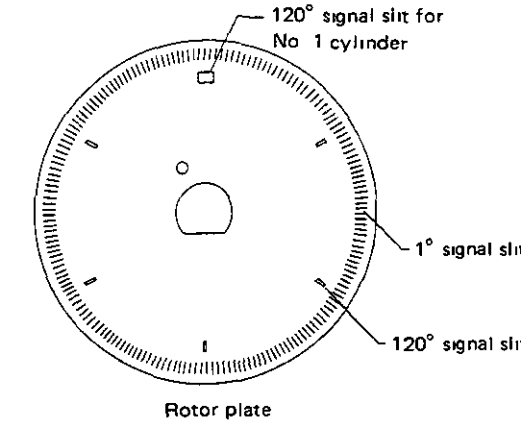
SEF612B

Crank angle sensor has rotor plate and 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 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 alternative voltage and it is then converted into an on-off pulse by the wave forming circuit, which is sent to the control unit



SEF613B

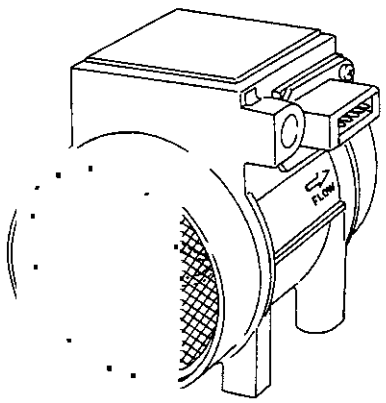


SEF614B

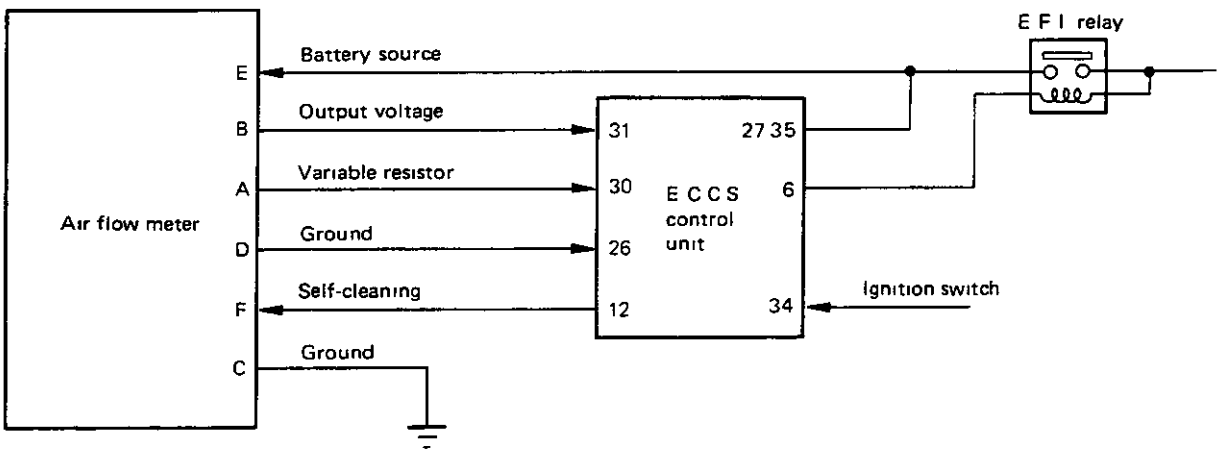
E.C.C.S. Components (Cont'd)

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.

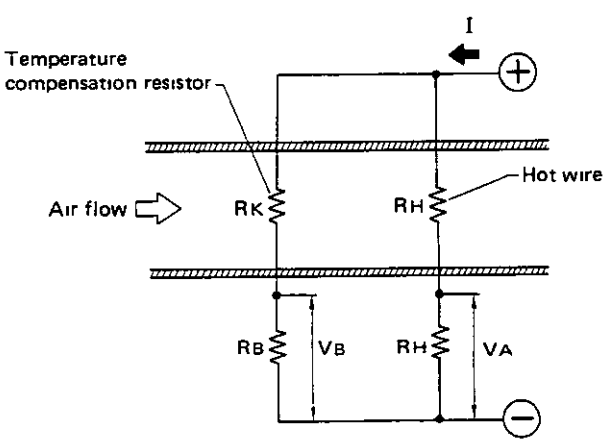


SEF615B



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.



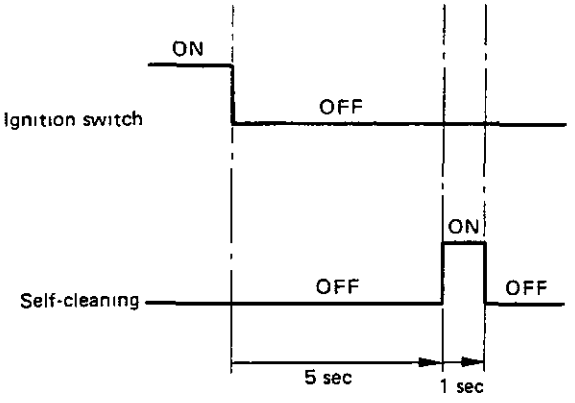
R_H Hot wire resistance
R_K Temperature compensation resistance
R_A, R_B Constant resistance

SEF617B

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

Self-cleaning

After 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

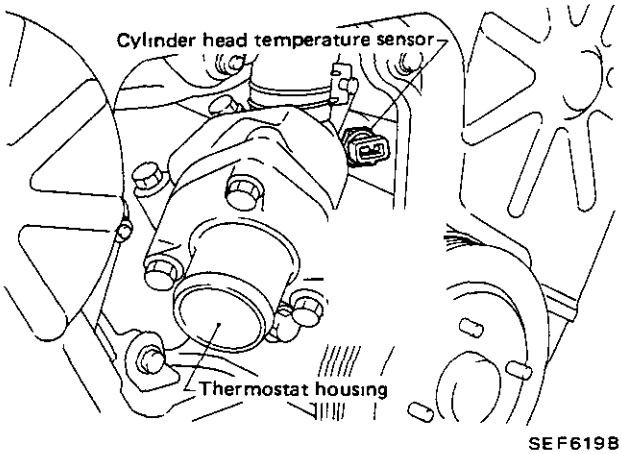


SEF618B

Self-cleaning operation

Condition	Operation
After running engine at above 1,500 rpm After driving vehicle at above 20 km/h (12 MPH) Cylinder head temperature is more than 115°C (239°F)	Operates
Except above	Does not operate

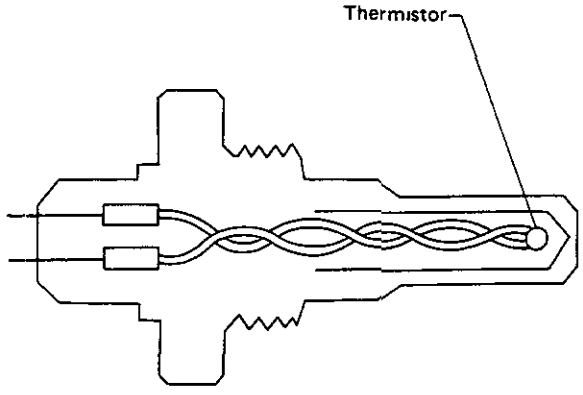
CYLINDER HEAD TEMPERATURE SENSOR



SEF619B

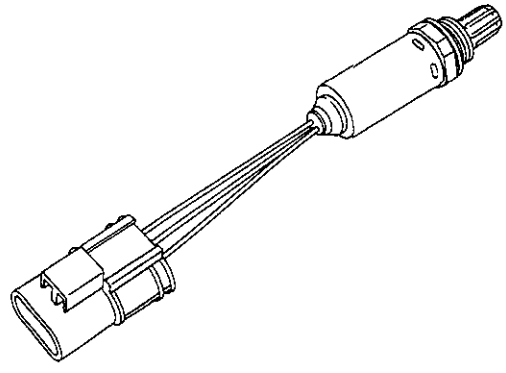
The cylinder head temperature sensor, built into the cylinder head, monitors changes in cylinder head temperature and transmits a signal to the E C C S control unit

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



SEF620B

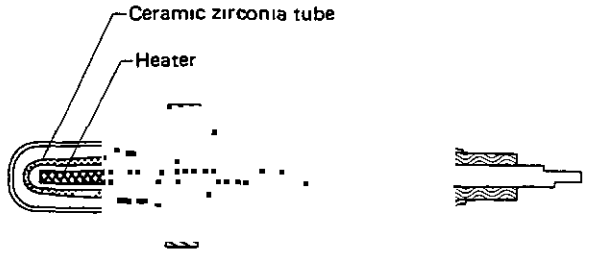
EXHAUST GAS SENSOR



SEF621B

The exhaust gas sensor, which is built into the exhaust manifold, monitors the density of oxygen in the exhaust gas It consists of a closed-end tube made of ceramic zirconia and other components. Porous platinum electrodes cover the tubes inner and outer surfaces The closed-end of the tube is exposed to the exhaust gas in the exhaust manifold The outer surface of the tube contacts the exhaust gas while the inner surface contacts the air

In order to ensure the stable performance of the exhaust gas sensor, a ceramic heater is employed inside the zirconia tube



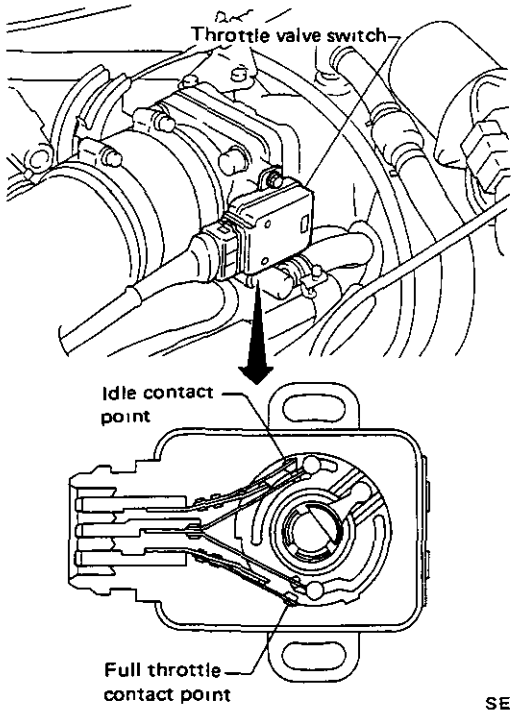
SEF622B

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



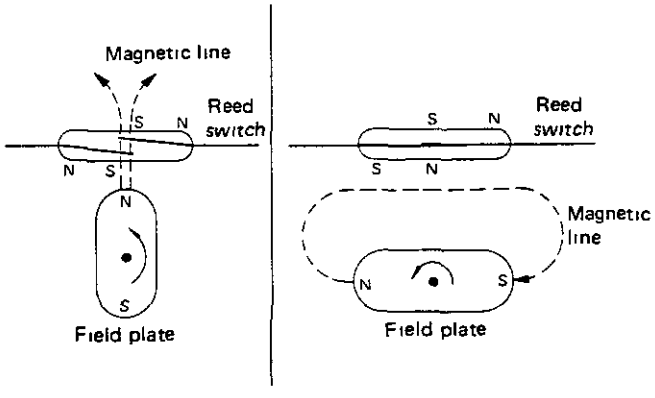
SEF623B

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**

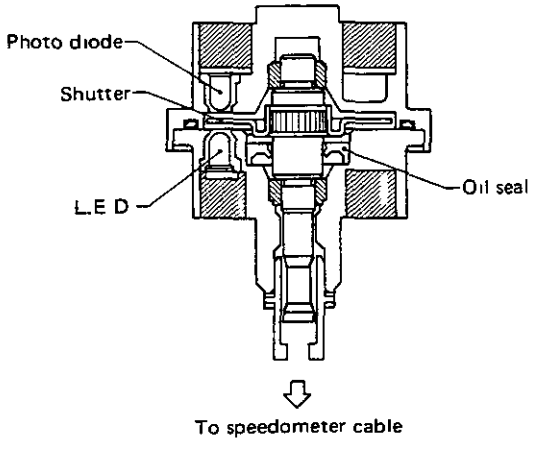
The speed sensor consists of a reed switch, which is installed in the speed meter unit and transforms *vehicle speed into a pulse signal.*



SEF624B

- **Digital type speedometer models**

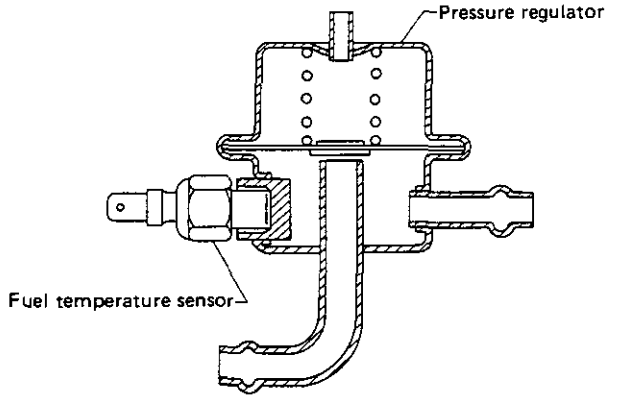
The speed sensor consists of an L E D , photo diode, shutter and wave forming circuit. Its principle is the same as that of the crank angle sensor



SEF680B

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

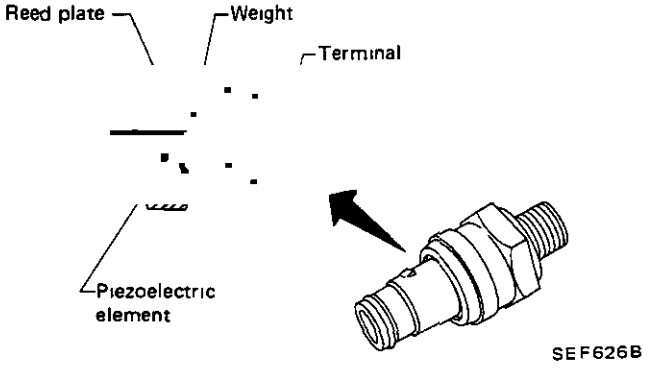


SEF625B

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

DETONATION SENSOR (VG30ET engine only)

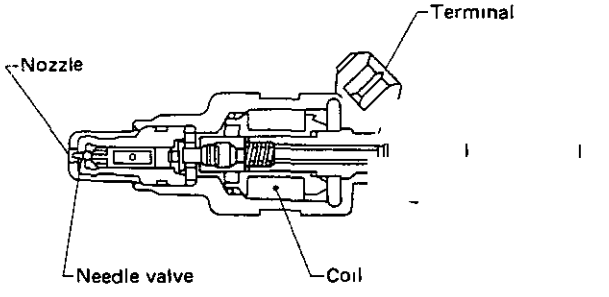
The detonation sensor is attached to the cylinder block and senses engine knocking conditions
A knocking vibration from the cylinder block is applied as pressure to the piezoelectric element This vibrational pressure is then converted into a voltage signal which is delivered as output



SEF626B

FUEL INJECTOR

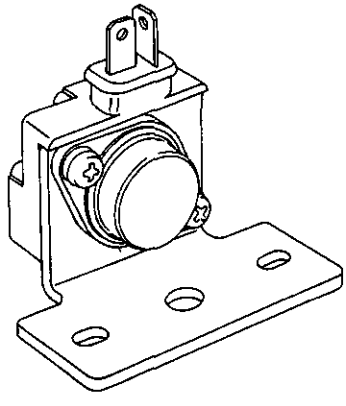
The fuel injector is a small, precision solenoid valve As the E C C S control unit outputs an injection signal to each fuel injector, the coil built into the injector pulls the needle valve back, and fuel is injected through the nozzle to intake manifold The amount of fuel injected is controlled by the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



SEF627B

POWER TRANSISTOR

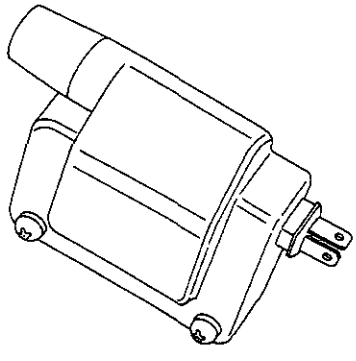
The ignition signal from the E C C S control unit is amplified by the power transistor, which connects and disconnects the coil primary circuit to induce the proper high voltage in the secondary circuit



SEF628B

IGNITION COIL

The ignition coil is a mold type

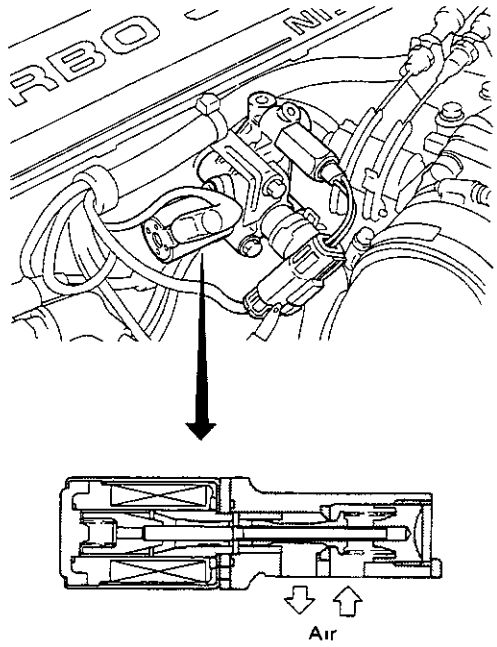


SEF629B

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

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

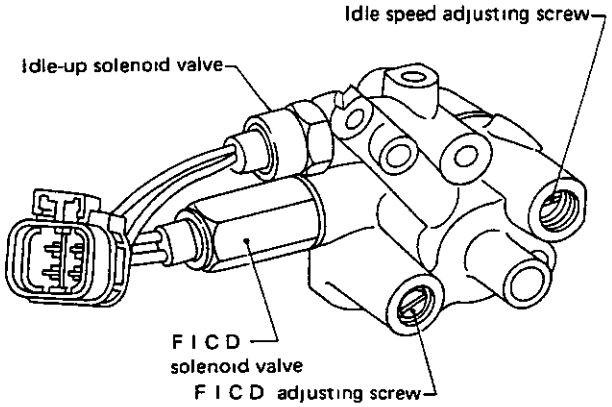
The A A C valve is attached to the intake collector The E C C S control unit actuates A A C valve by ON/OFF pulse of approximately 160 Hz The longer that ON duty is left on, the larger the amount of air that will flow through the A A C valve



SEF630B

IDLE-UP SOLENOID VALVE (VG30E engine)

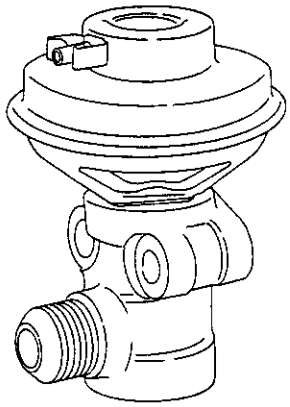
The idle-up solenoid valve is attached to the intake collector The solenoid valve actuates to stabilize idle speed when engine load is heavy because of electric load, power steering oil pump, etc.



SEF631B

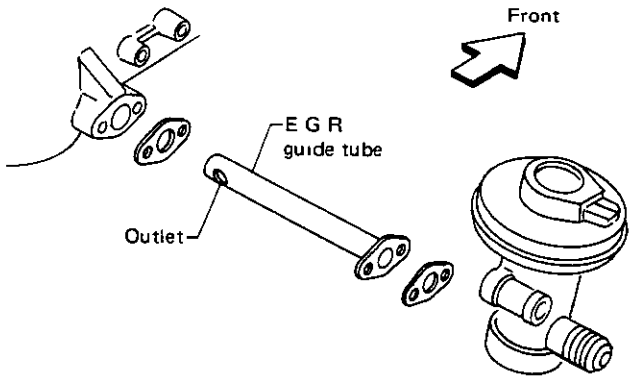
E G R CONTROL VALVE

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. Otherwise the distribution efficiency of the exhaust gas will be reduced.

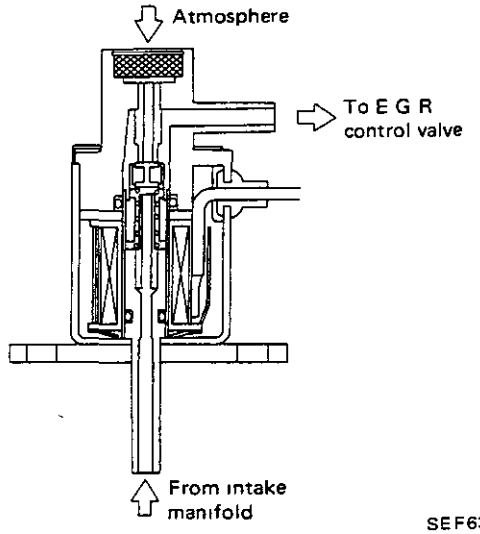


SEF689B

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

E.G.R. CONTROL SOLENOID VALVE

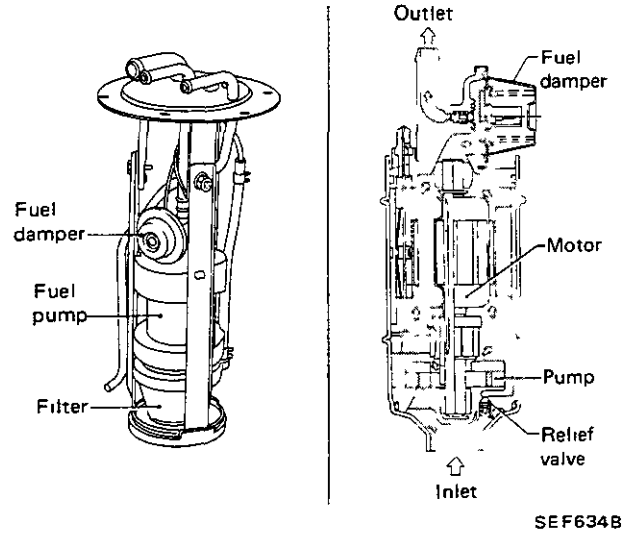
E G R control solenoid valve cuts intake manifold vacuum signal for E G.R control The solenoid valve actuates in response to the ON/OFF signal from the E C.C S control unit. When the solenoid is off, vacuum signal from intake manifold is fed into the E G R control valve As the control unit outputs an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



SEF633B

FUEL PUMP

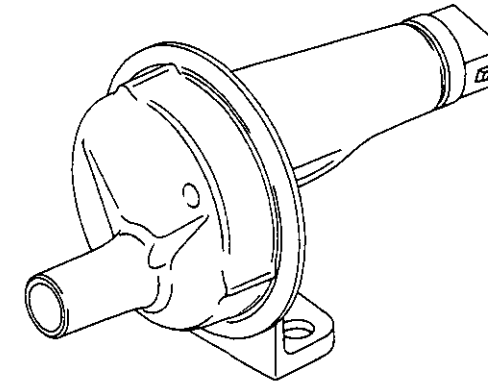
The fuel pump, which is located in the fuel tank, is a wet type pump where the vane rollers are directly coupled to a motor which is filled with fuel



SEF634B

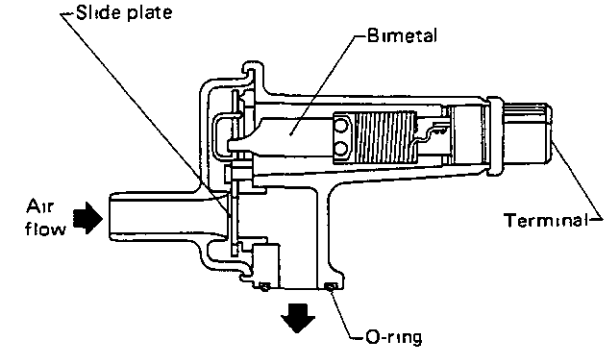
AIR REGULATOR

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



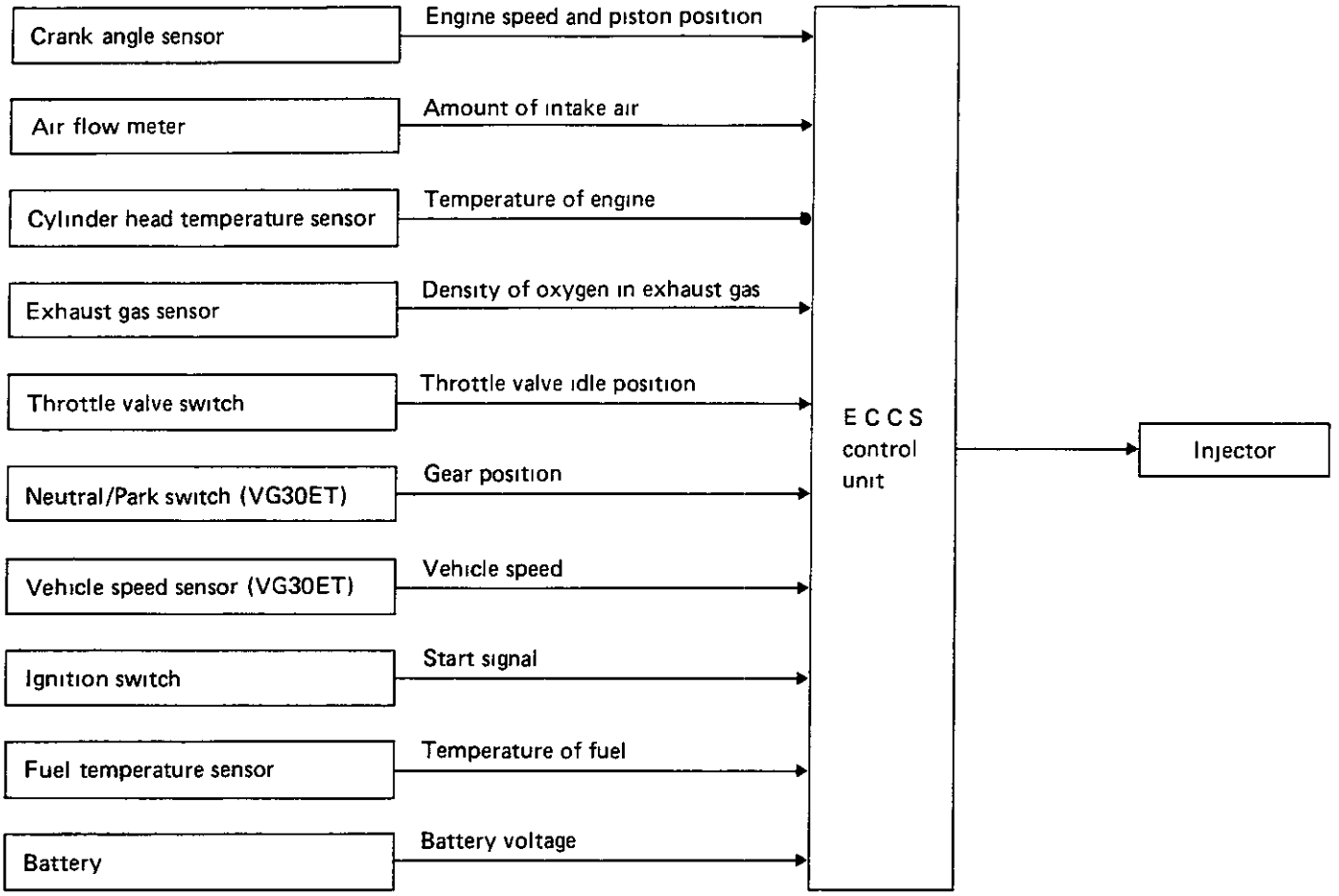
SEF635B

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

Fuel Injection Control

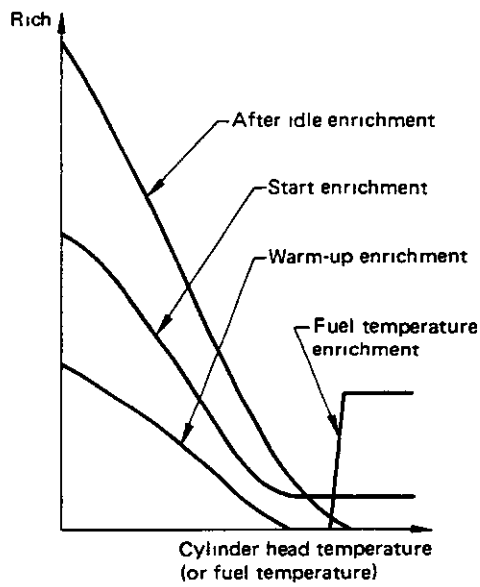


The E.C C S control unit calculates basic injection pulse width by processing signals from crank angle sensor and air flow meter Receiving signals from each sensor which detects various engine conditions, E C.C S control unit adds various enrichments, which are pre-programmed in the control unit, to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

1) Fuel enrichment

   In the following each conditions, fuel is enriched

- During warm-up
- When starting
- After idle
- When accelerating
- With heavy load
- When fuel temperature is high



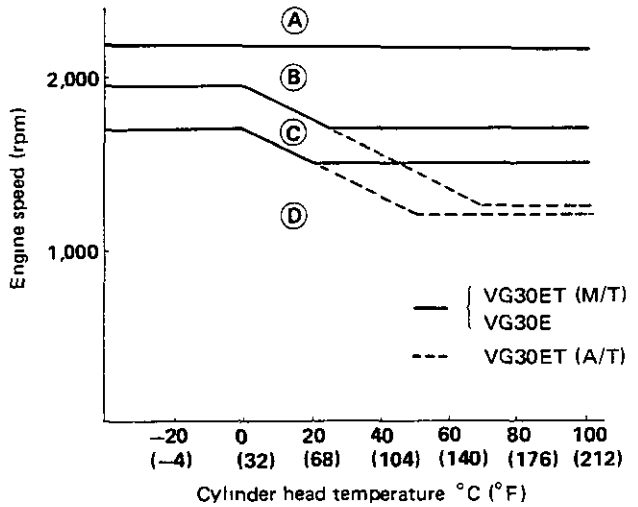
SEF637B

Enrichment rates 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



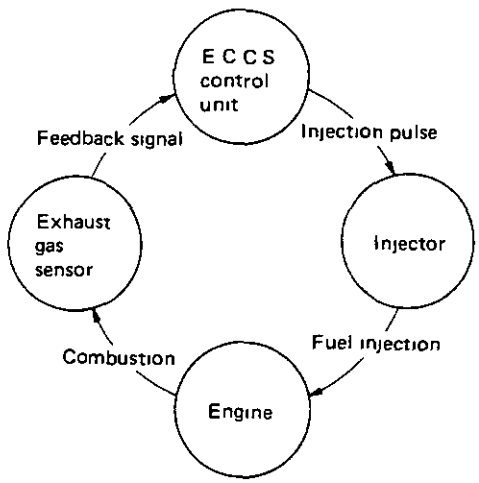
SEF638B

	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 220 km/h (137 MPH), fuel is shut-off for safety reasons

3) Mixture ratio feedback control
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 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

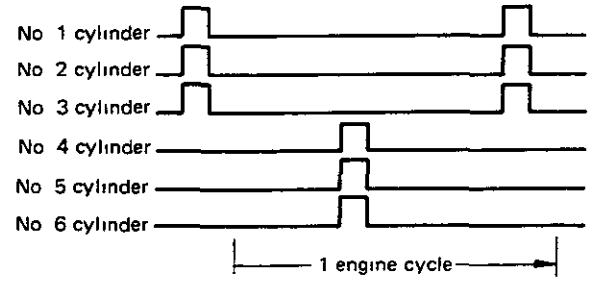
However, this system will open under the following conditions:

- When starting engine.
- 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

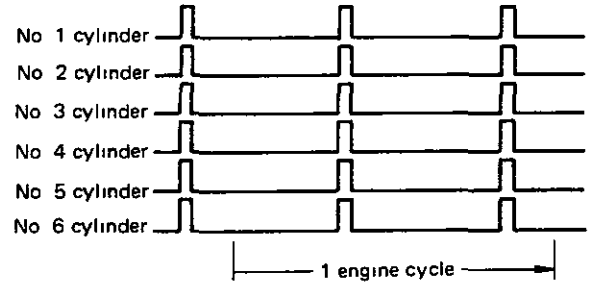
Fuel Injection Control (Cont'd)

4) Simultaneous injection and group injection
On the VG30ET engines, 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

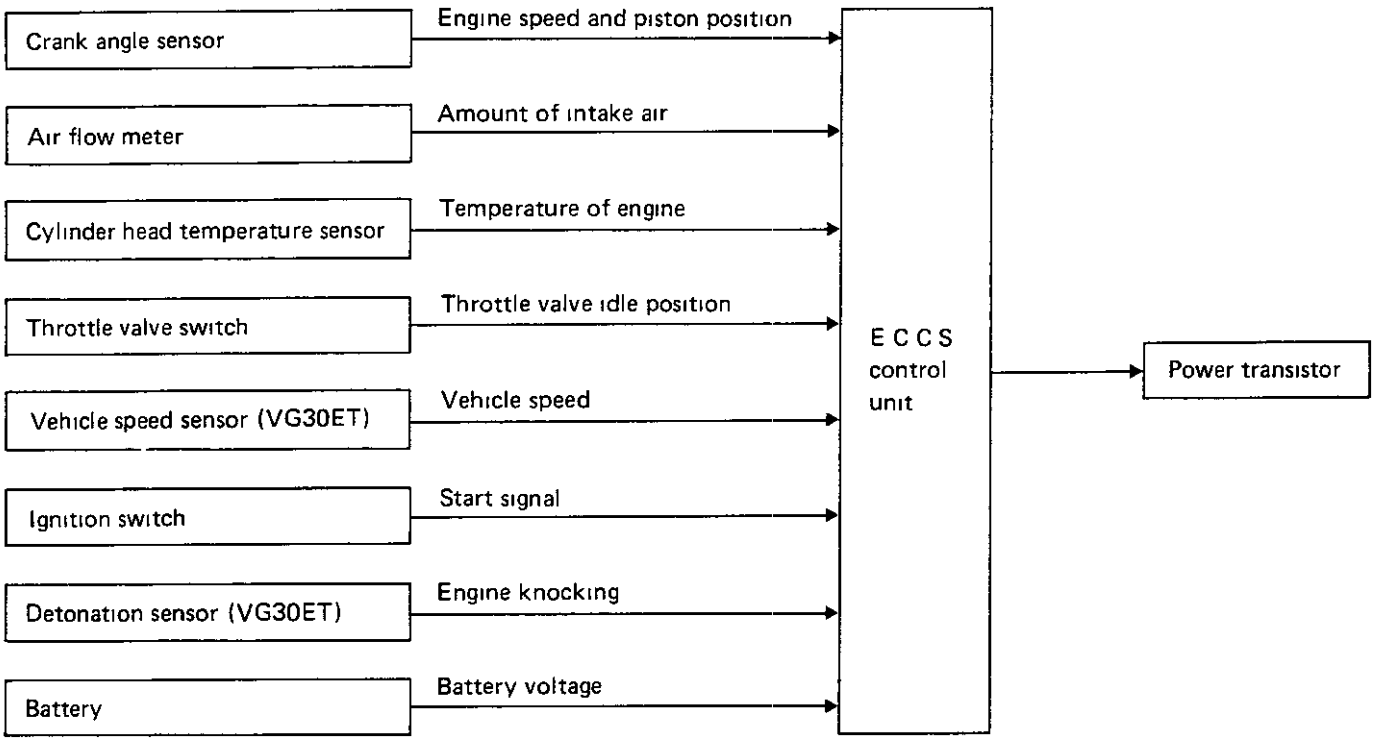


SEF640B

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)

Ignition Timing Control



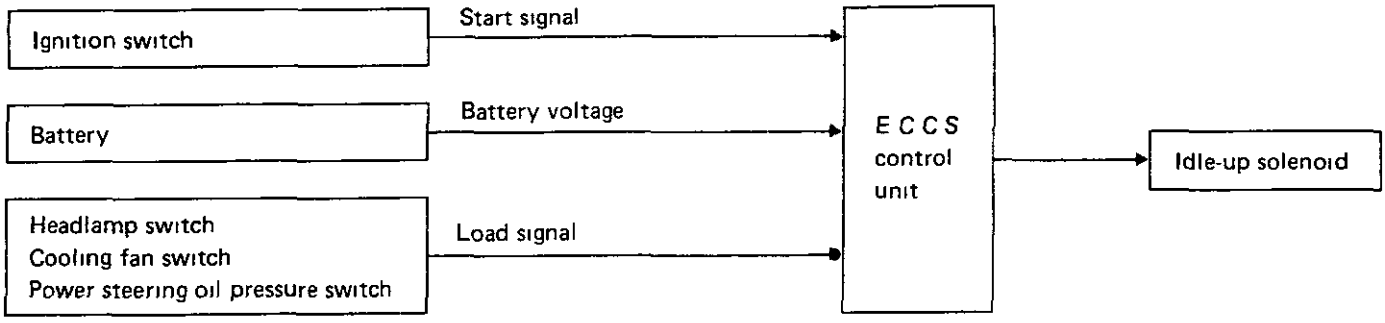
Ignition timing is controlled, corresponding to the engine operating conditions, by the E C C S control unit that is, as the optimum ignition timing in each driving condition has been pre-programmed in the control unit, the ignition timing is determined by electrical signals processed in the unit

The signal from E C C S control unit is transmitted to power transistor, and controls ignition timing

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 there engine knocking occurs, the detonation sensor monitors 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)

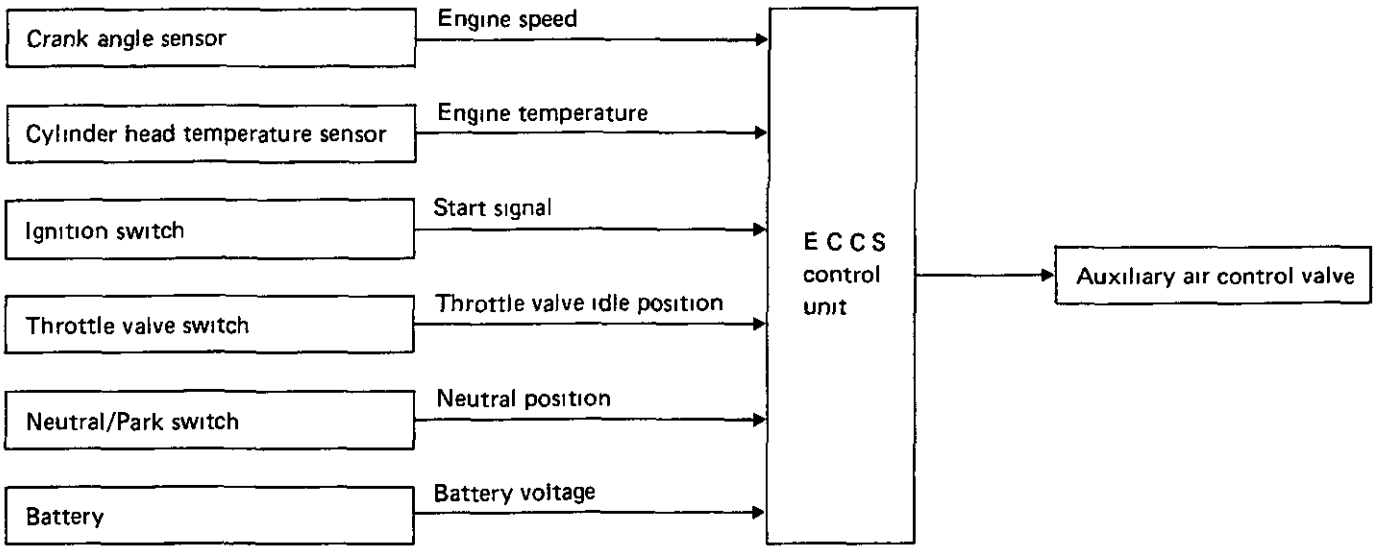


The idle speed is compensated by the E C C S control unit to prevent rough idle when any of the following conditions are met

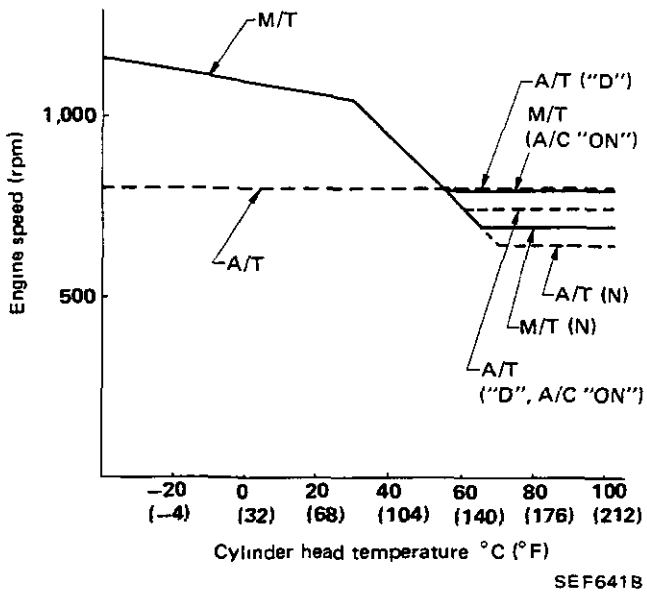
The control unit senses the idle condition, and determines ON/OFF signal The signal from control unit is transmitted to the idle-up solenoid valve to stabilize idle speed.

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	ON
Except above	OFF

Idle Speed Control (VG30ET engine)

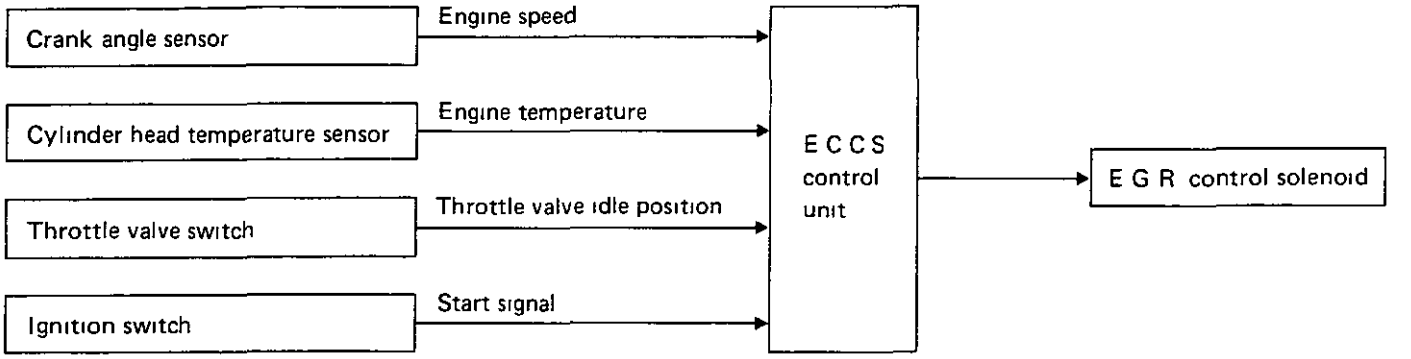


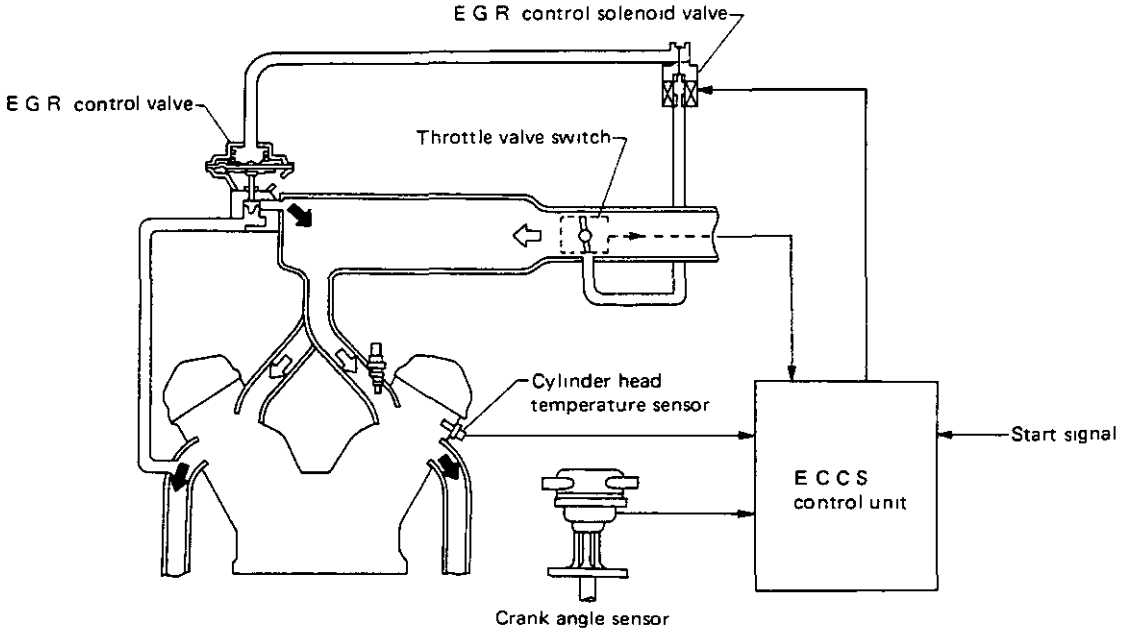
The idle speed is controlled by the E.C C S. control unit, corresponding to the engine operating conditions. The E C C S control unit senses the engine condition and determines the best idle speed at each cylinder head temperature and gear position. The control unit then sends an electronic signal corresponding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



E.C.C.S. 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.

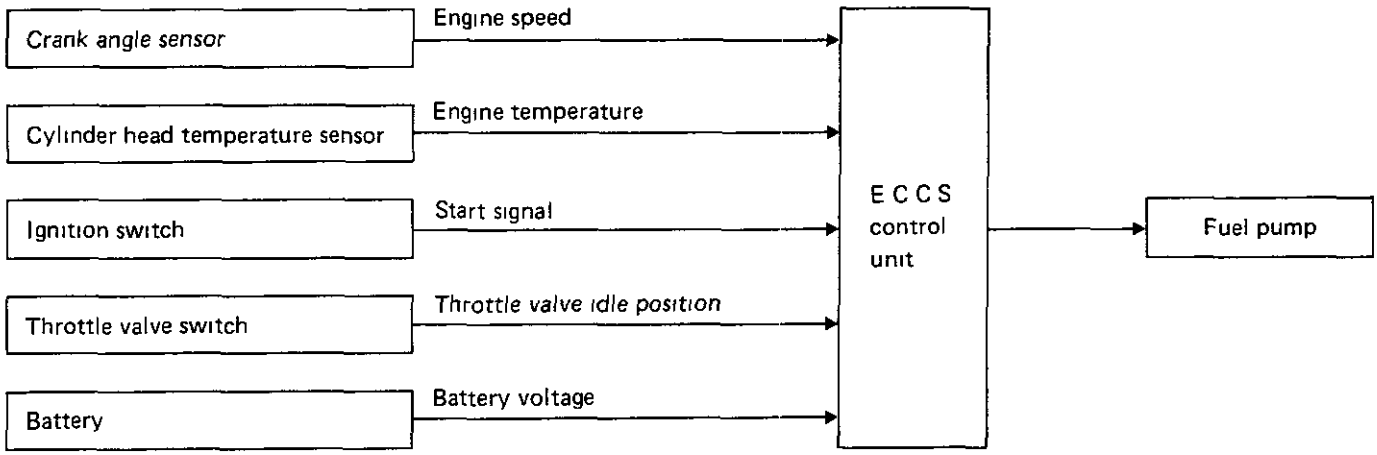
The signal from the E C C.S control unit is sent to the E.G.R control solenoid valve, which cuts the vacuum line for the E G.R control valve when any of the following conditions are met

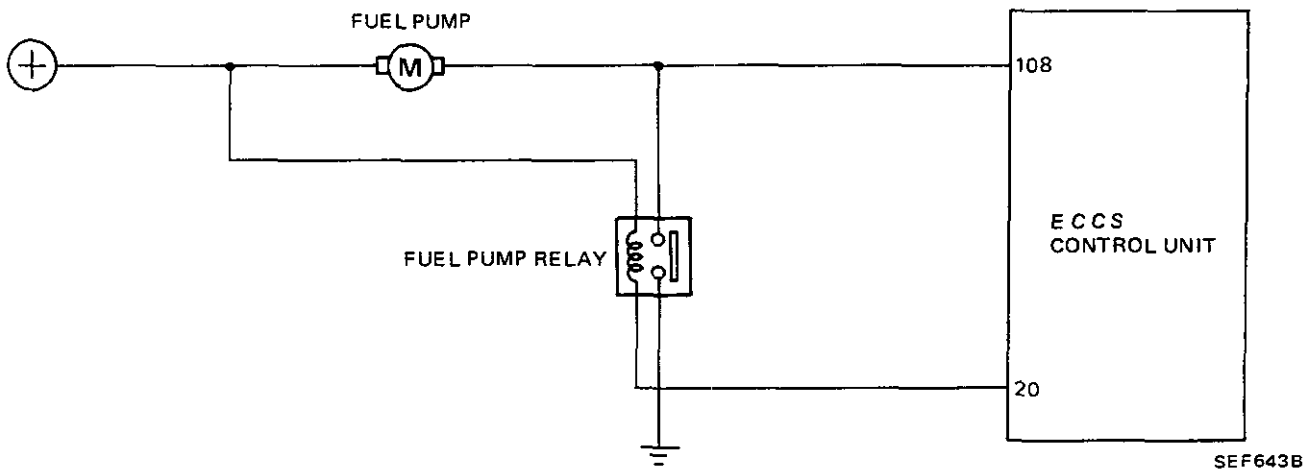
Operation

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

E.C.C.S. DESCRIPTION

Fuel Pump Control





Fuel pump voltage control

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

Conditions	Voltage
5 seconds after ignition switch is turned to ON Engine cranking 25 5 seconds after engine start [above 50°C (122°F)] Engine temp above 90°C (194°F) Engine temp below 10°C (50°F)	Approximately 13 4 [V]
Except above	9 4 ~ 13 4 [V] *1, 10 1 ~ 13 4 [V] *2

*1 VG30E engine
*2 VG30ET engine

Fuel pump ON-OFF control

Ignition switch position	Engine condition	Fuel pump relay	Fuel pump operation
ON	Stopped	OFF	Operates for 5 seconds
	Starting	ON for 30 seconds	Operates
	Running	OFF	Operates
	After stall	OFF	Stops in 1 second

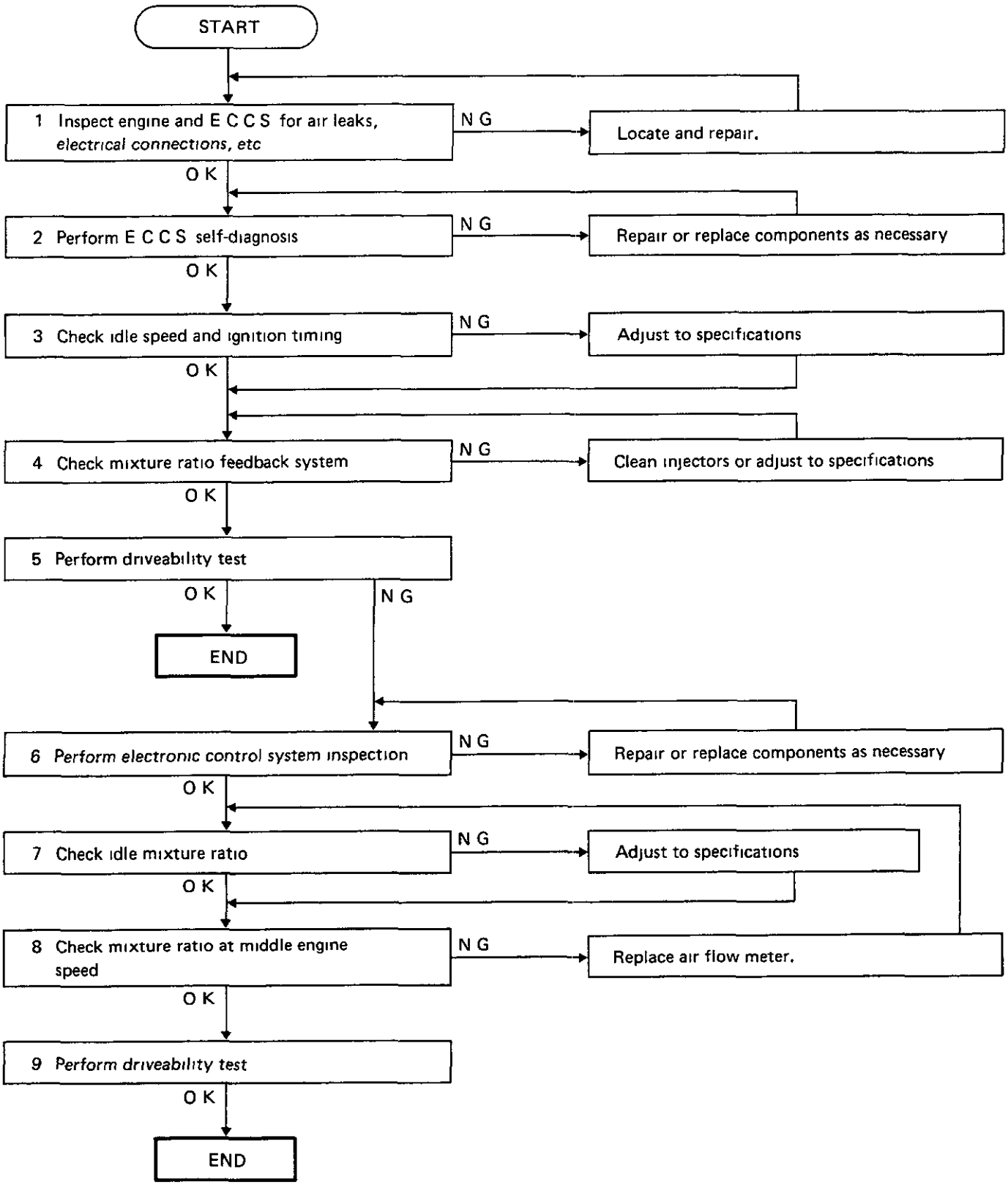
DIAGNOSTIC PROCEDURE

Caution

a. Before connecting or disconnecting E C C S harness connector 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-43 through EF & EC-59.
c When conducting self-diagnosing, follow the steps outlined under "SELF-DIAGNOSIS" on pages EF & EC-35 through EF & EC-42 in order to obtain accurate diagnosing results After self-diagnosing 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-diagnosing or to monitor the mixture ratio
e Before troubleshooting, ensure that all harness connectors are secure.

DIAGNOSTIC PROCEDURE

Driveability



1. Inspect engine and E C C.S. for air leaks, proper electrical connections, etc
1) Check all hoses and ducts for air leaks
2) Check air cleaner 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

2 Perform E C C S self-diagnosis
Follow the procedure in E C C S SELF-DIAGNOSIS (Page EF & EC-35)

3 Check idle speed and ignition timing

a. Prepare the following conditions:

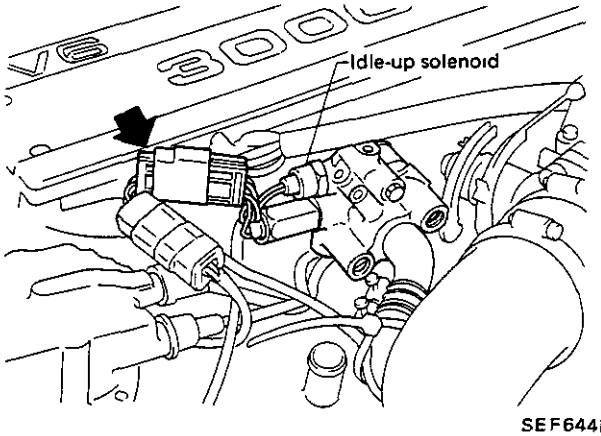
- **Headlamp switch· OFF**
- **Heater blower: OFF**
- **Air conditioner switch: OFF**
- **Front wheel (Power steering model):**
  KEEP STRAIGHT AHEAD

b. *Warm engine to operating temperature.*

Check and adjust as follows

[VG30E engine (Without turbocharger)]

1) Stop engine and disconnect idle-up solenoid valve harness connector



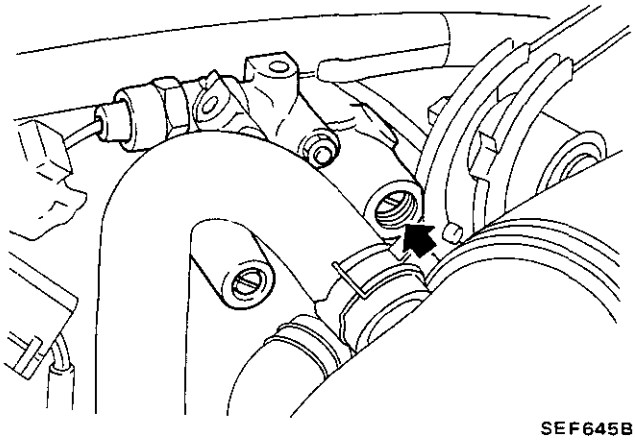
SEF644B

2) Start engine and race engine two or three times under no-load, then run engine at idle speed

3) Check idle speed

M/T & A/T (in "D" position)
700±50 rpm at sea level
650±50 rpm at high altitude condition

If necessary, adjust to the specified speed by turning idle speed adjusting screw



SEF645B

4) Stop engine and connect idle-up solenoid valve harness connector

5) Start engine and check ignition timing with a timing light

20°±2° B.T.D.C.

If necessary, adjust ignition timing by turning distributor

[VG30ET engine (With turbocharger)]

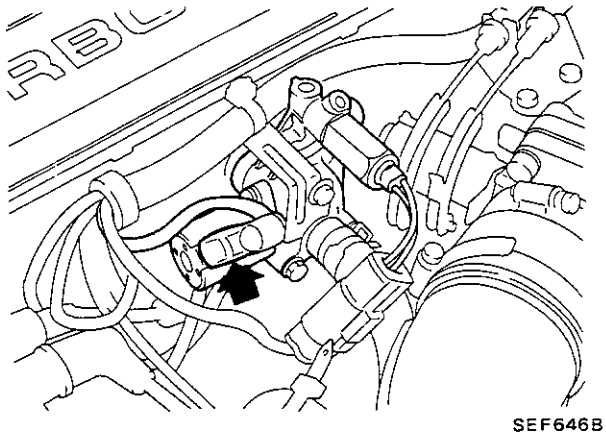
1) Race engine two or three times under no-load, then run engine at idle speed

2) Check idle speed.

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

If out of specification, adjust as follows

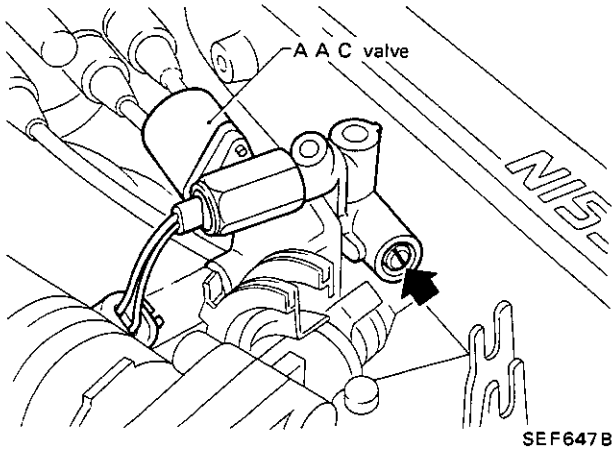
a Stop engine and disconnect A A C valve harness connector



SEF646B

b Start engine and adjust engine speed by turning idle speed adjusting screw

M/T: 650 rpm
A/T: 600 rpm (in "D" position)



SEF647B

c. Stop engine and connect A.A.C. valve harness connector Then start engine

d Make sure that idle speed is in the specified range.

3) Check ignition timing with a timing light

20°±2° B.T.D.C.

If necessary, adjust ignition timing by turning distributor

4 Perform mixture ratio feedback system inspection

Follow the procedure in MIXTURE RATIO FEEDBACK SYSTEM INSPECTION (Page EF & EC-60)

5 Perform driveability test

Evaluate effectiveness of adjustments by driving vehicle If unsatisfactory, proceed to step 6

6 Perform electronic control system inspection

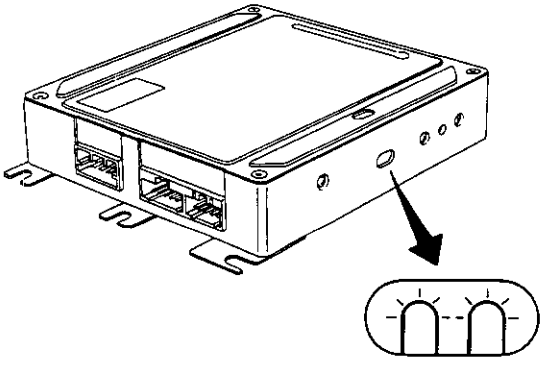
Check the following using circuit tester

- Injector circuits
- Air regulator circuit
- E G R control solenoid circuit
- Exhaust gas sensor heater circuit

Follow the procedure in ELECTRONIC CONTROL SYSTEM INSPECTION (Page EF & EC-43)

7 Check idle mixture ratio

1) Warm up engine to operating temperature
2) Turn off engine and disconnect throttle valve switch harness connector
3) Verify that the diagnosis mode selector is turned fully counterclockwise
4) Start engine and verify that engine is still at operating temperature.
5) Race engine two or three times under no-load, then run engine at idle speed
6) Look at inspection lamps (red and green)

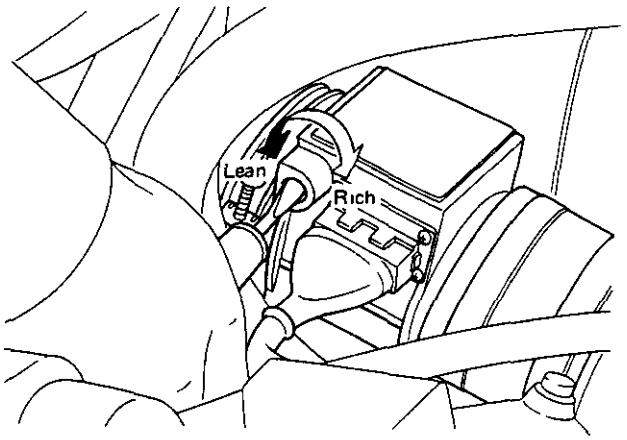


SEF648B

- **When both inspection lamps blink, it indicates that the idle mixture ratio is correct.**

Driveability (Cont'd)

7) If N G., adjust idle mixture ratio by turning variable resistor on air flow meter so that inspection lamps blink simultaneously



SEF649B

8 Check mixture ratio at middle engine speed

1) Verify that inspection lamps on control unit blink simultaneously at idle.
2) Race engine two or three times under no-load, then run engine at idle speed
3) Gradually increase engine speed and check for operating (blinking) of the inspection lamps at different engine rpms (up to approximately 2,000 rpm).

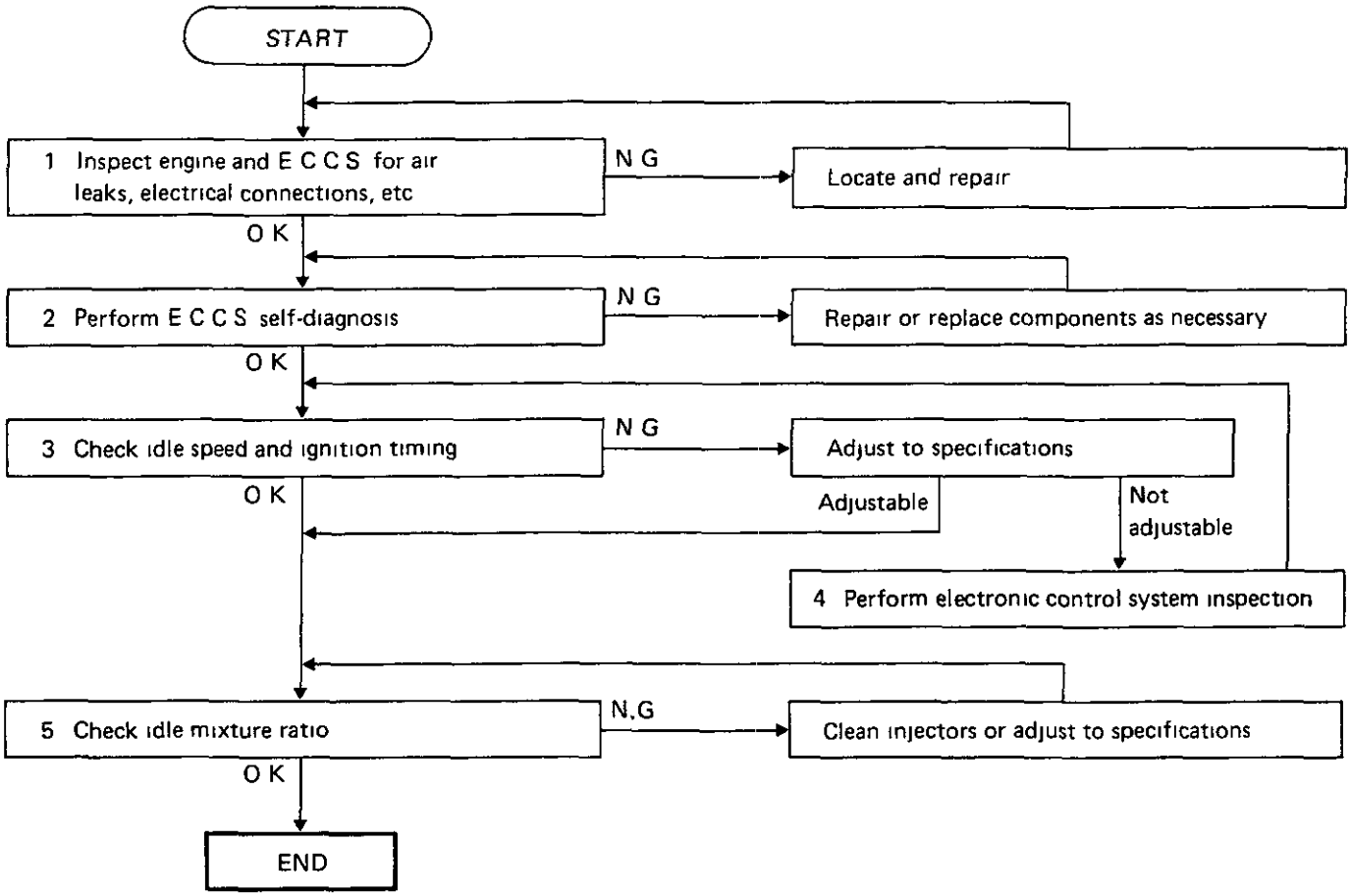
- If both inspection lamps continue to blink during idle to 2,000 rpm range, it indicates that the idle mixture ratio is correct

4) If N.G., replace air flow meter and adjust idle mixture ratio as per step 7
5) Turn off engine and connect throttle valve switch harness connector

9. Perform driveability test
   Re-evaluate vehicle performance.

DIAGNOSTIC PROCEDURE

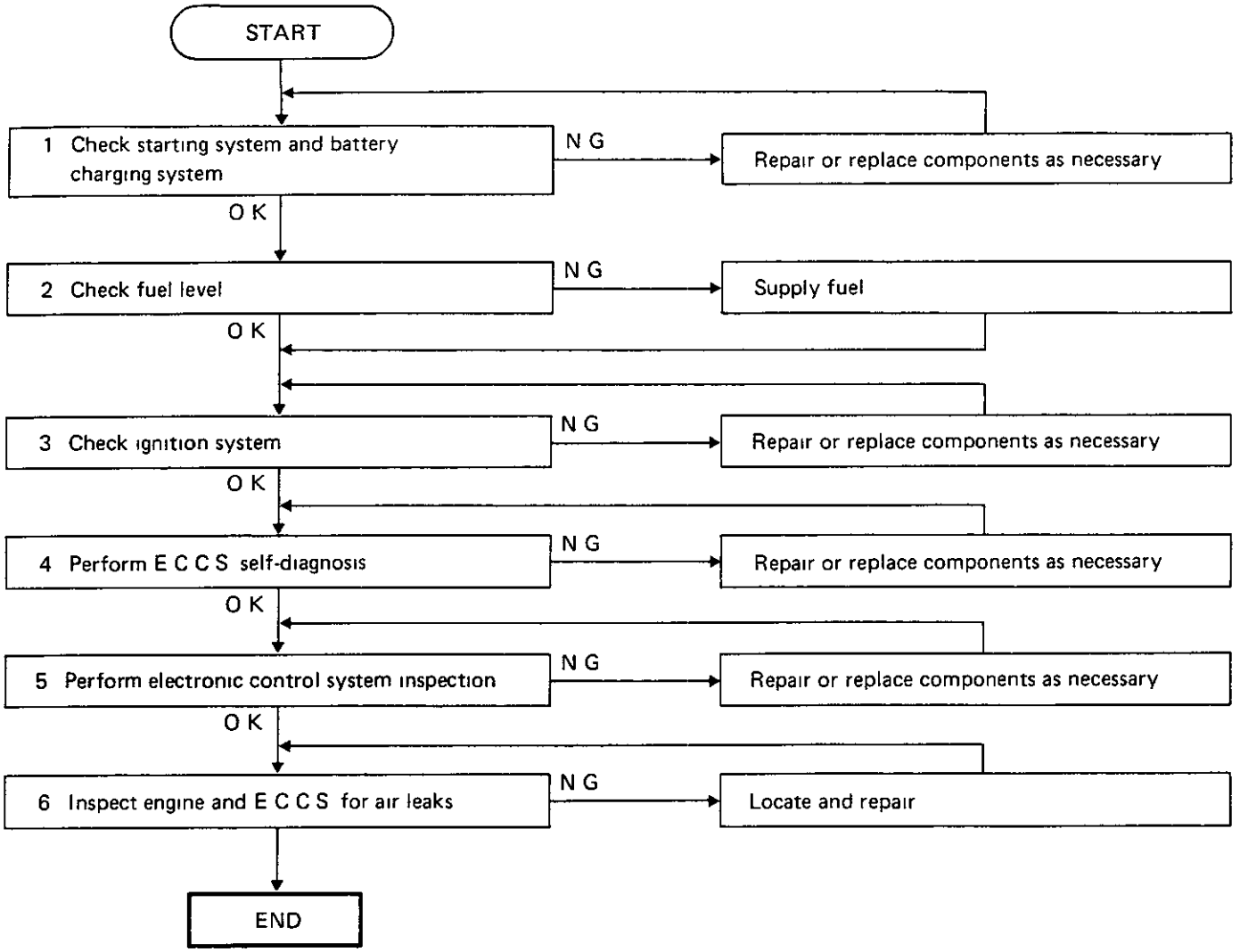
Improper Idling and Stall



1. Inspect engine and E C C S for air leaks, electric connections, etc
   Refer to DRIVEABILITY
2 Perform E C C S self-diagnosis
   Follow the procedure in E.C C S. SELF-DIAGNOSIS (Page EF & EC-35).
3 Check idle speed and ignition timing.
   Refer to DRIVEABILITY
4. Perform electronic control system inspection.
   Check the following using circuit tester
- Injector circuit
- Air regulator circuit
- Idle-up solenoid valve (Without turbocharger)
- A.A.C. valve (With turbocharger)
- E G R. control solenoid circuit
   Follow the procedure in ELECTRONIC CONTROL SYSTEM INSPECTION (Page EF & EC-43)
5. Check idle mixture ratio.
   Refer to DRIVEABILITY

DIAGNOSTIC PROCEDURE

Engine Startability



1. Check starting system and battery charging system
1) Check starter operation
2) Check battery voltage.
Repair or replace as necessary.
2 Check fuel level
If fuel level is low or empty, add fuel
3 Check ignition system.
1) Check ignition wiring
2) Check distributor rotor head
3) Check spark plug
4 Perform E C C.S. self-diagnosis. Follow the procedure in E.C.C.S. SELF-DIAGNOSIS (page EF & EC-35)
5 Perform electronic control system inspection. Check the following using circuit tester.

- Injector circuit
- Air regulator circuit
- E G.R control solenoid valve

Follow the procedure in ELECTRONIC CONTROL SYSTEM INSPECTION (page EF & EC-43)

6 Inspect engine and E C C S for air leaks
Refer to DRIVEABILITY

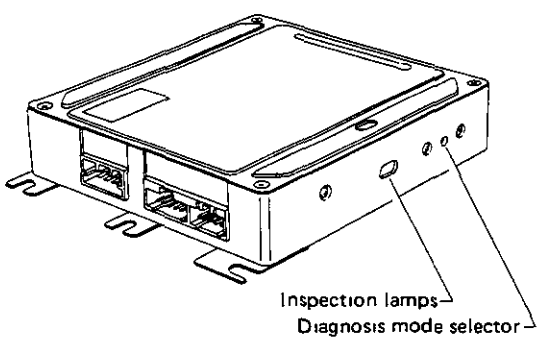
Self-diagnostic System

The self-diagnostic system determines malfunctions of signal systems such as sensors, actuators, and wire harnesses based on the status of the input signals received by the E C C S control unit A malfunction is displayed by both the red and green L E D s (Light Emitting Diodes).

Basically, self-diagnosis is always performed when the power is furnished to the E C C S control unit The self-diagnosis results are retained in the memory chip of the E C C S control unit and are displayed only when the diagnosis mode selector (located on the side of the E C C S. control unit) is turned fully clockwise

The self-diagnostic system is provided with functions which display malfunctions being checked as well as those which are stored in the memory In this sense, it is very effective in determing an "intermittent" malfunction The results which is or was stored in the memory can be erased by following the steps specified

A malfunctioning area is determined by the number of blinks of both the red and green L E D s First, the red L E D blinks 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. blinks three times and the green L E.D blinks twice, this implies number "32" In this way, all problems are classified by code numbers.



SEF650B

Judging the self-diagnosis results

1 When the ignition switch is turned "ON", the diagnostic system judges a malfunction until the specified input signal is entered and detected as O K
(These input signals are not stored in the memory)

1) Vehicle speed sensor circuit (VG30ET engine)
When the vehicle speed exceeds 10 km/h (6 MPH) and its corresponding signal is entered
2) Throttle valve switch (idle switch) circuit, neutral switch circuit (VG30ET engine) and air conditioner switch circuit
After the ignition switch is turned "ON" and "ON-OFF" signals from each switch are entered
3) Start signal
After the engine has started and when start signals "ON" and then "OFF" are entered

2 After the self-diagnostic system has detected a malfunction, it continues to provide a malfunction display until the memory is erased properly by the sepcified steps

1) Crank angle sensor circuit
- When 1° or 120° signal is not entered after the engine has started
- When either 1° or 120° signal is not entered often enough

2) Air flow meter circuit
- When the air flow meter produces an abnormally high output voltage with the engine off
- When the air flow meter produces an abnormally low output voltage with the engine running.

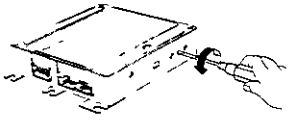
3) Cylinder head temperature sensor circuit
When the cricuit is shorted or open
4) Ignition signal
When an ignition signal is not produced on the primary winding of the ignition coil after the engine has started
5) Fuel pump circuit
When current flowing through the E C C.S control unit to drive the fuel pump is too small or too large while the engine is operating.
6) Detonation sensor circuit (VG30ET engine)
When the circuit is shorted with the engine operating at a speed of above 2,000 rpms
7) Fuel temperature sensor circuit
When the circuit is shorted or open

Self-diagnostic System (Cont'd)

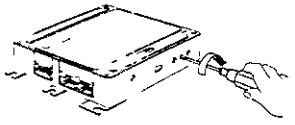
CAUTION.

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. Always perform the self-diagnosing regarding "intermittent" checks before disconnecting.
f The crank angle sensor signal plays an important role in the E.C.C.S. A malfunctioning sensor is sometimes accompanied by a display which shows malfunctions in other signal systems. In such a case, always start with checking the crank angle sensor.

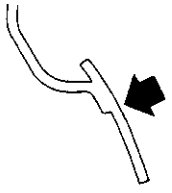
Self-diagnostic Procedure



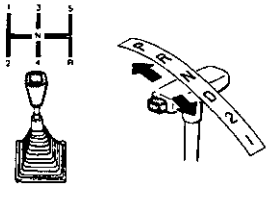
SEF651B



SEF652B



SEF653B



SEF654B

START

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-59, Ⓡ) If battery is O K, replace control unit

O K

Turn diagnosis mode selector fully clockwise

Make sure that inspection lamps on control unit are displaying code No. 23, No 24 (VG30ET) and No 31.

N G → Write down the malfunctioning code

O K

Depress accelerator pedal, then release

Make sure that inspection lamps on control unit are displaying code No 24 (VG30ET) and No 31

N G → Write down the malfunctioning code

O K

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

Make sure that inspection lamps on control unit are displaying code No 31

N G → Write down the malfunctioning code

O K

Start engine

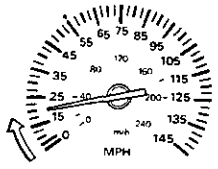
Make sure that inspection lamps on control unit are displaying code No 14 (VG30ET) and No. 31

N G → Write down the malfunctioning code

O K

Ⓐ

Self-diagnostic Procedure (Cont'd)



SEF655B

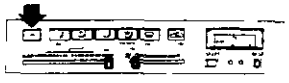
Ⓐ

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

Make sure that inspection lamps on control unit are displaying code No. 31

N G → Write down the malfunctioning code

O K



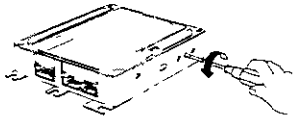
SEF656B

Turn air conditioner switch OFF → ON → OFF

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

N G → Write down the malfunctioning code

O K



SEF651B

Turn diagnosis mode selector fully counterclockwise

Turn off engine

See decoding chart (Pages EF & EC 39 - 42)

Check malfunctioning area (Pages EF & EC 43 - 53)

Erase the memory of self-diagnosis results

Procedure for memory erasure

Turn ignition switch to "ON" position

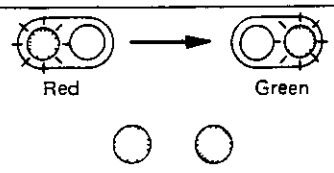
Turn diagnosis mode selector fully clockwise and keep it there for more than 2 seconds

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

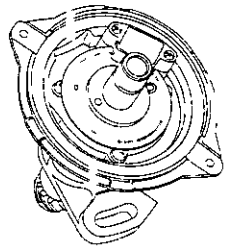
Turn ignition switch to "OFF" position → END

Decoding Chart

Code No 11



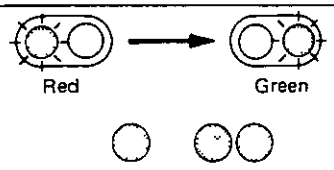
Crank angle sensor circuit is malfunctioning



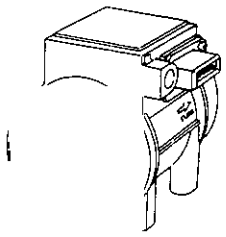
See page EF & EC-43 (A)

SEF657B

Code No 12



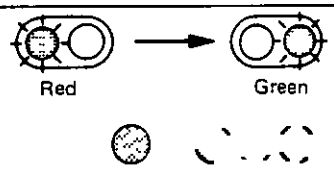
Air flow meter circuit is malfunctioning



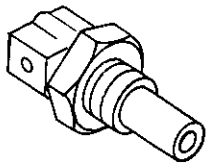
See pages EF & EC-44 & 45 (B)

SEF658B

Code No 13



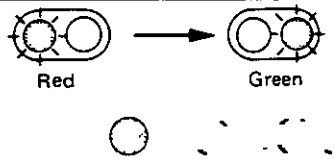
Cylinder head temperature sensor circuit is malfunctioning



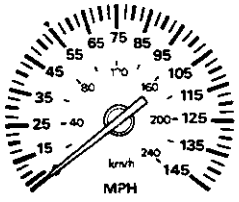
See page EF & EC-46 (C)

SEF659B

Code No 14



Vehicle speed sensor circuit is malfunctioning (VG30ET engine)

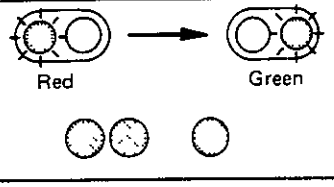


See page EF & EC-47 (D)

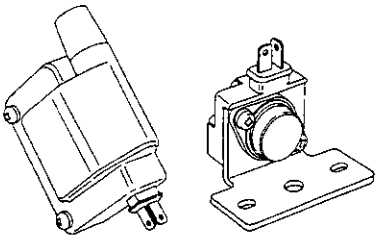
SEF660B

Decoding Chart (Cont'd)

Code No 21



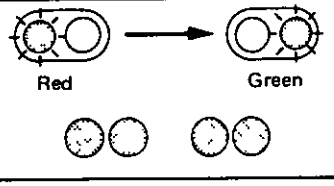
Ignition signal is malfunctioning



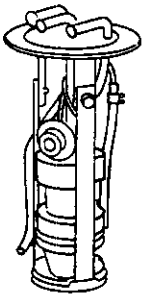
See page EF & EC-48 (E)

SEF661B

Code No 22



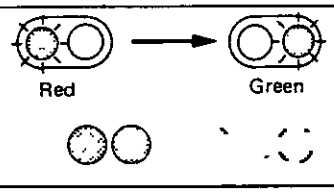
Fuel pump circuit is malfunctioning



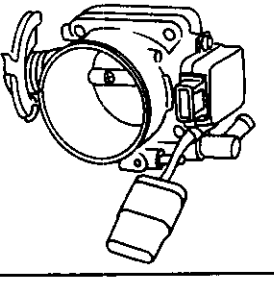
See page EF & EC-49 (F)

SEF662B

Code No. 23



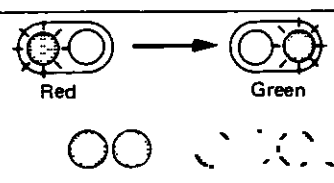
Throttle valve switch (Idle switch) circuit is malfunctioning



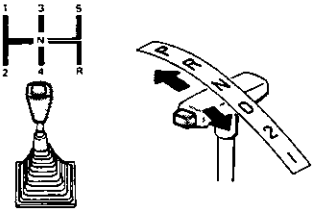
See page EF & EC-50 (G)

SEF663B

Code No. 24



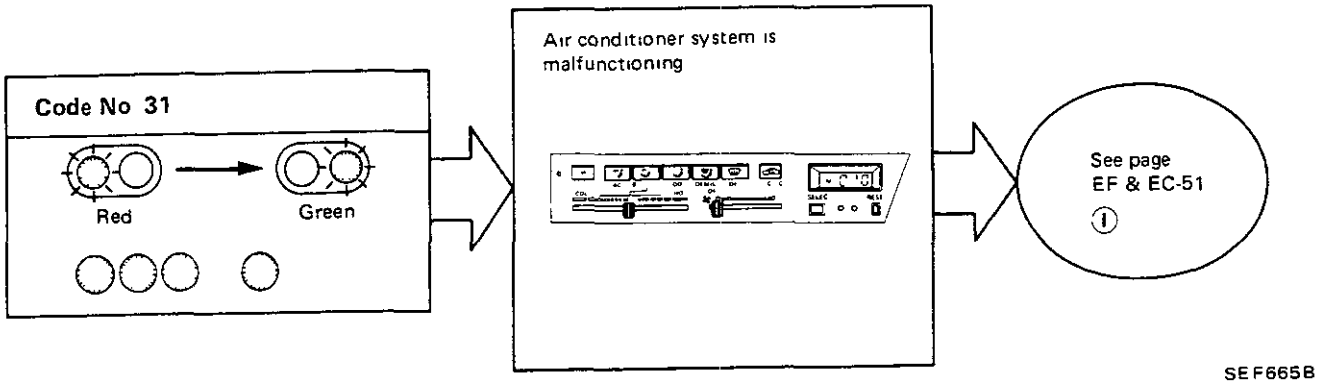
Neutral/Park switch circuit is malfunctioning (VG30ET engine)



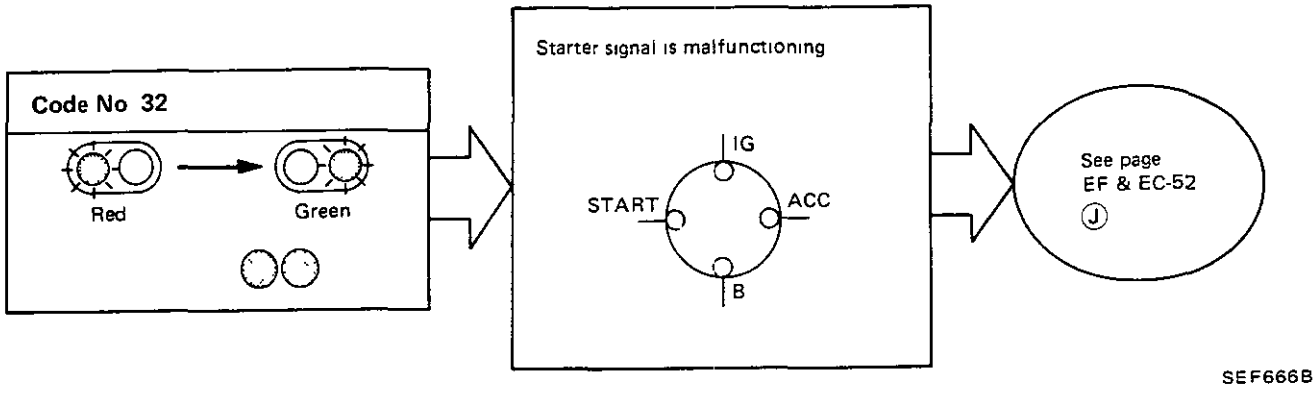
See page EF & EC-51 (H)

SEF664B

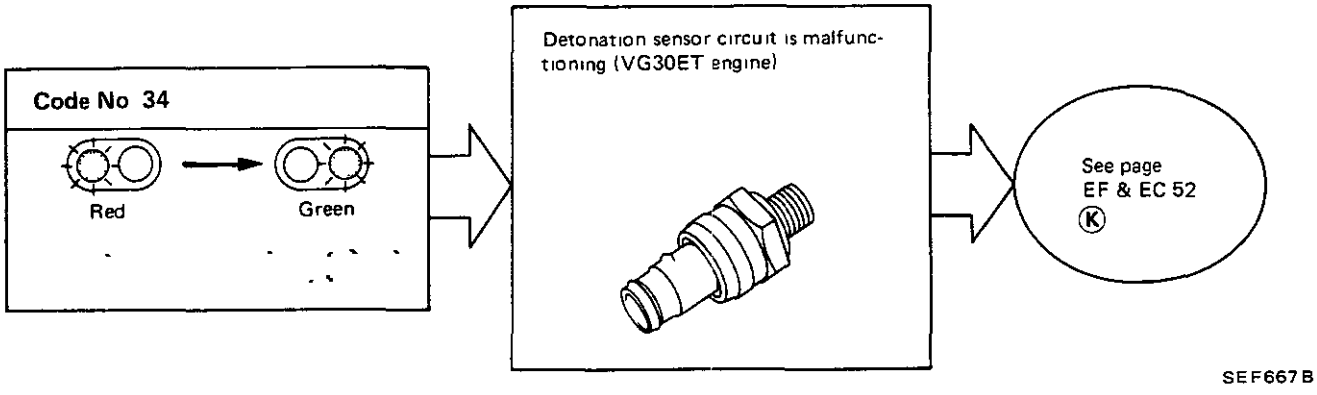
Decoding Chart (Cont'd)



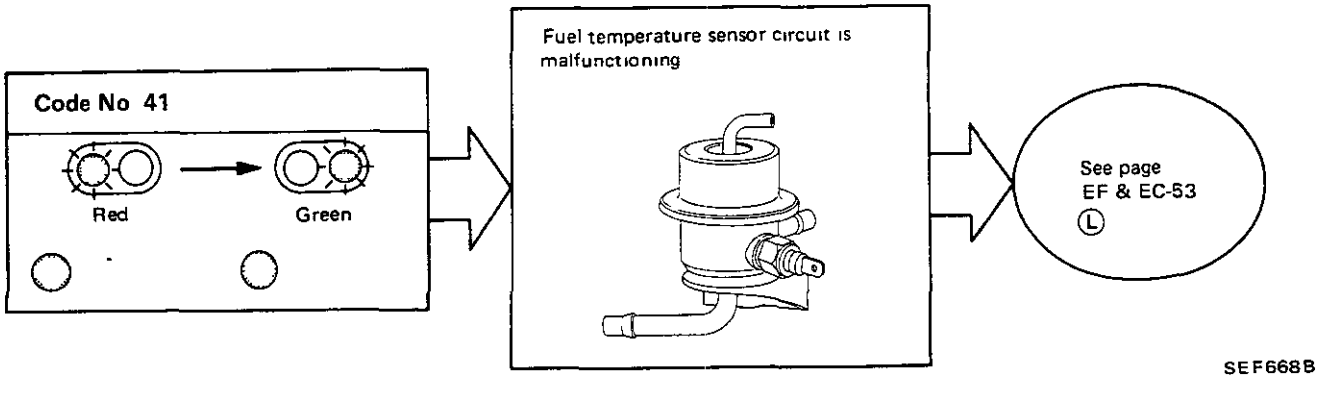
SEF665B



SEF666B

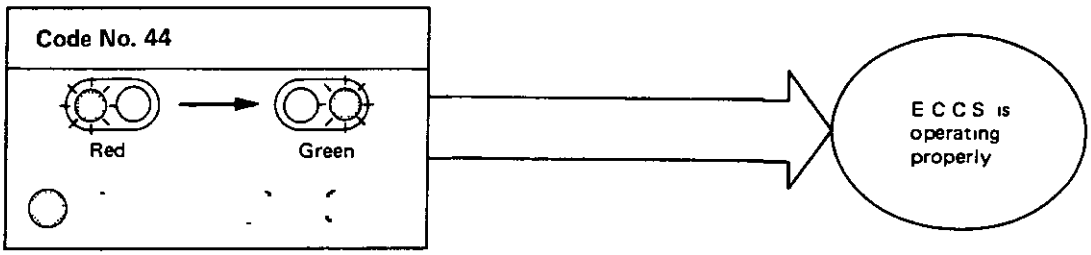


SEF667B



SEF668B

Decoding Chart (Cont'd)

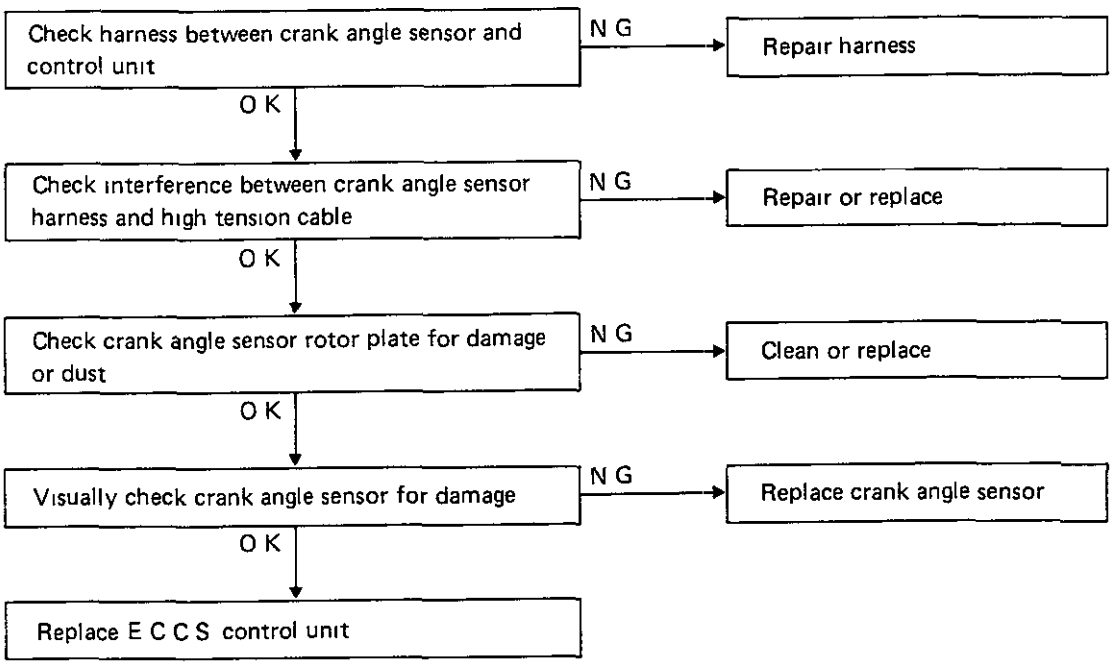


SEF669B

PREPARATION

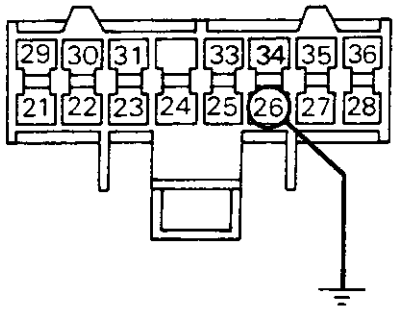
Before checking the following items, ensure that each connector is securely connected

Ⓐ Crank angle sensor (Code No. 11)



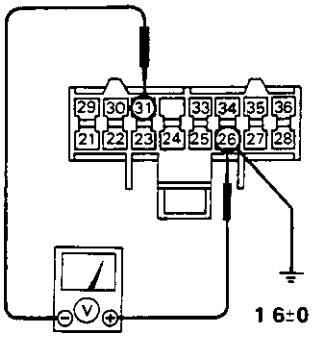
Ⓑ Air flow meter (Code No 12)

Disconnect 16-pin connector and connect terminal ㉖ to ground with a jumper wire



SEF670B

Turn ignition switch "ON" and measure voltage between terminals ㉛ and ㉖



SEF671B

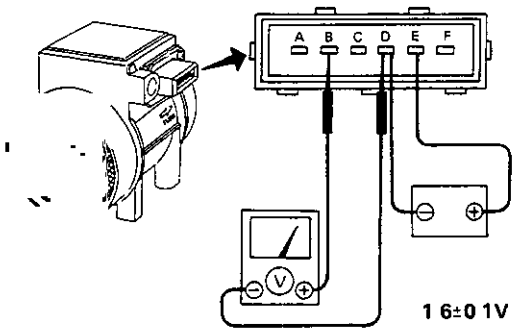
N G → Check harness for continuity

O K

N G → Repair harness

O K

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

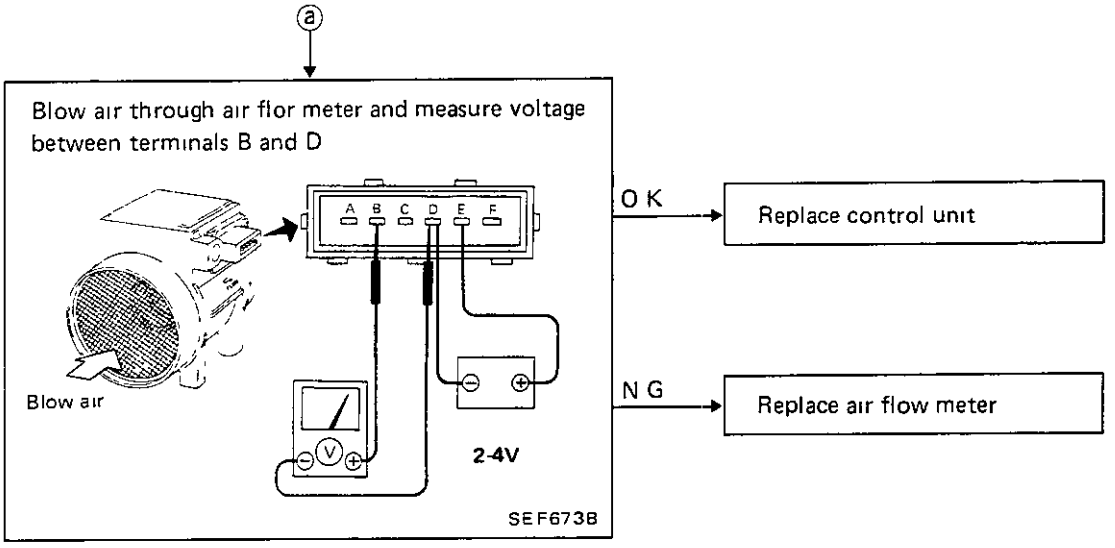


SEF672B

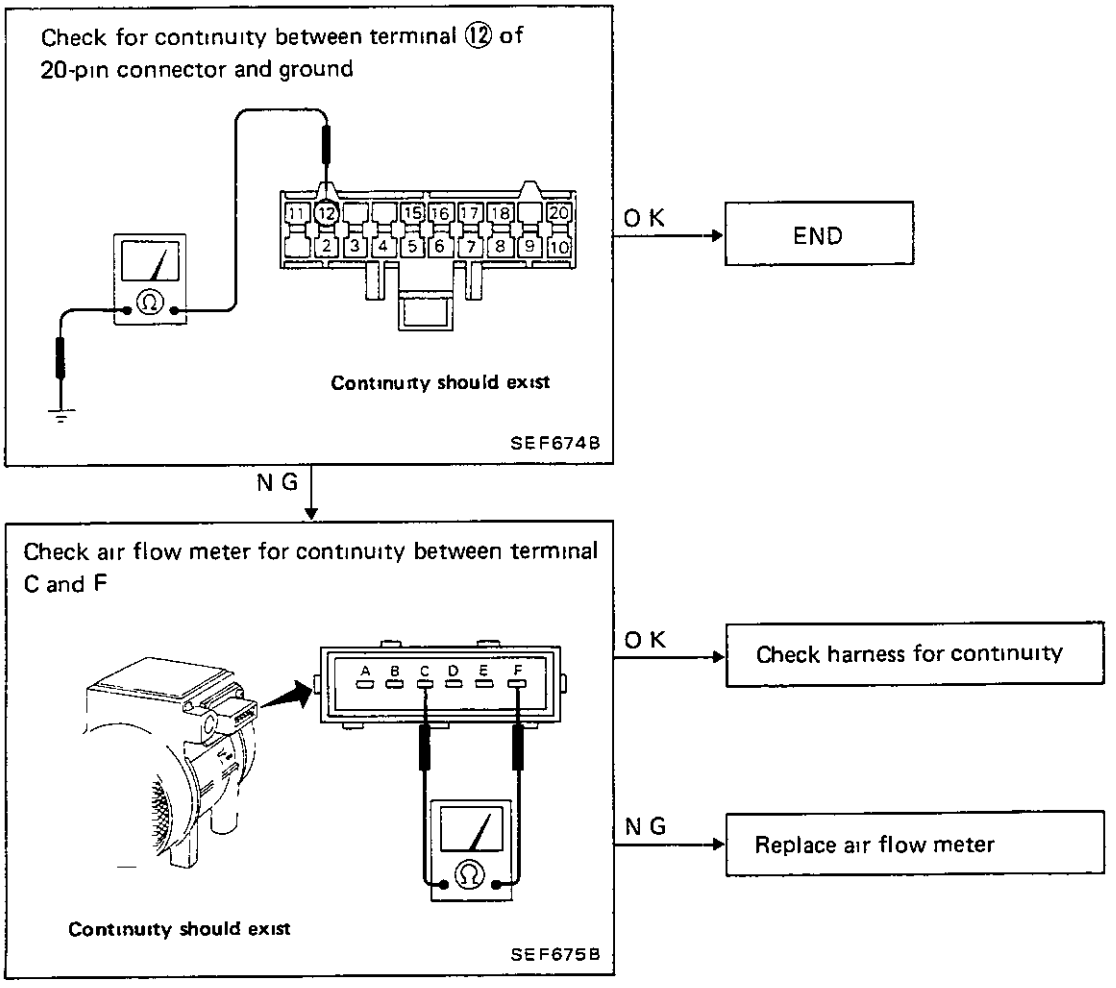
N G → Replace air flow meter

O K

ⓐ

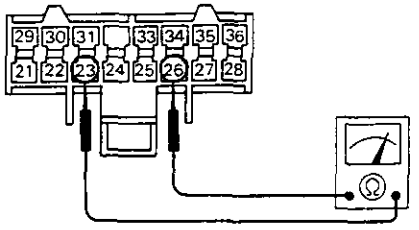


- Air flow meter self cleaning circuit



© Cylinder head temperature sensor (Code No 13)

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

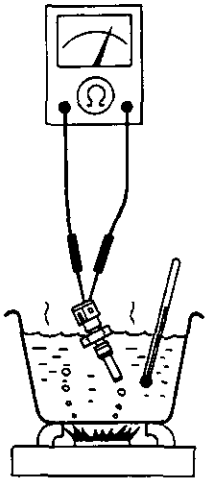
O K → Replace control unit

N G → Check harness

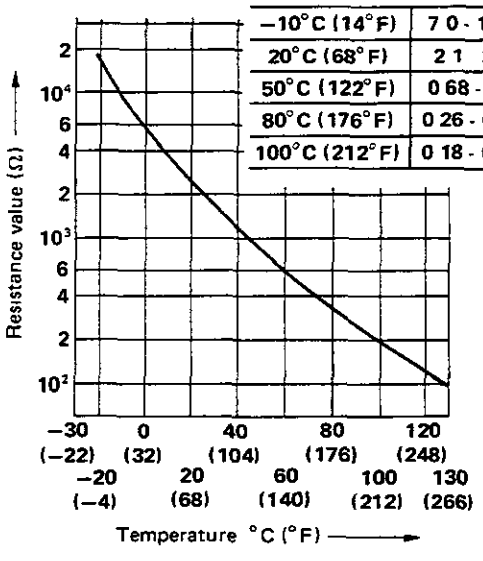
Check harness: N G → Repair harness

Check harness: O K →

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



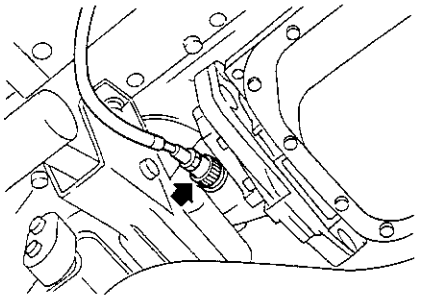
SEF677B

O K → (back to Replace control unit)

N G. → Replace cylinder head temperature sensor

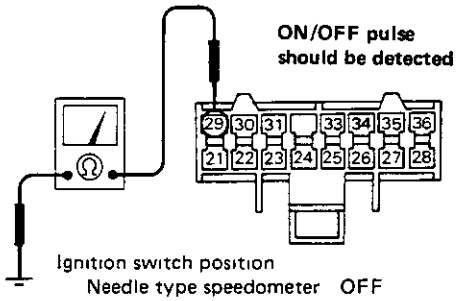
Ⓓ Vehicle speed sensor (Code No. 14)

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



Ignition switch position
Needle type speedometer OFF
Digital type speedometer ON

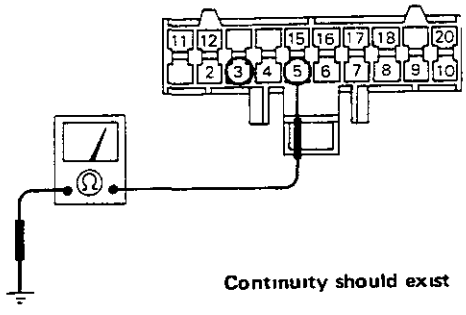
SEF679B

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 (Code No 21)

Disconnect 20-pin connector and check continuity between terminals ③, ⑤ and ground



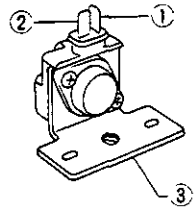
SEF681B

N G → Check harness, and repair as necessary

O K ↓

Check power transistor

Without harness connector



With harness connector

Tester	Leads to pins (+)	Leads to pins (−)	Should read
Ohmmeter	①	③	Continuity exists
	②	③	
	①	②	

SEF682B

N G → Replace power transistor

O K ↓

Replace E C C S control unit

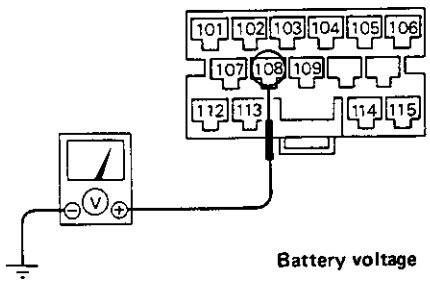
Ⓕ Fuel pump (Code No. 22)

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

O K → Replace E C C S control unit

N G ↓

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



SEF683B

N G → Check harness for continuity

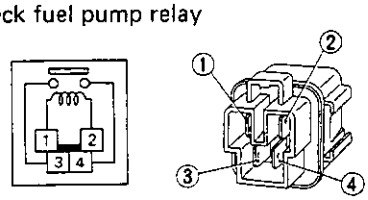
O K ↓

Check harness for continuity

N G → Repair harness

O K ↓

Check fuel pump relay



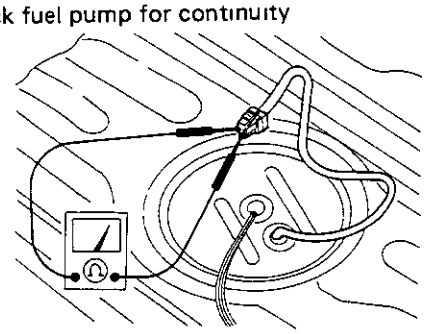
Check terminals	Normal condition	12V direct current is applied between terminals ① and ②
① – ②	Continuity	–
③ – ④	No continuity	Continuity

SEF685B

N G ↓

Replace fuel pump relay

O K ← Check fuel pump for continuity



SEF684B

O K ↓

Replace E C C S control unit

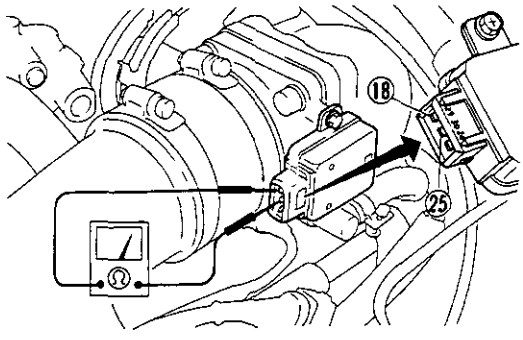
N G ↓

Replace fuel pump

Ⓖ Throttle valve switch (Code No. 23)

Check harness for continuity
- NG → Repair harness
- OK ↓

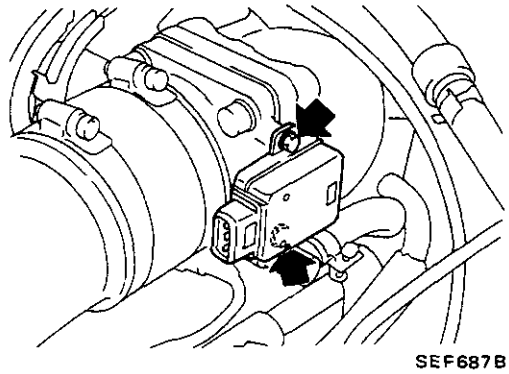
Check the throttle valve switch for continuity between ⑱ and ㉕



Continuity should exist

SEF686B

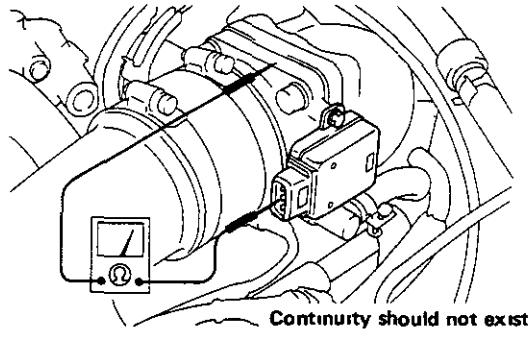
- NG → Adjust idle switch
  1) On VG30ET engine only, disconnect A A C valve harness connector
  2) Hold engine speed as follows by manually opening the throttle valve
     VG30E engine (Without turbocharger)
     900±50 rpm
     VG30ET engine (With turbocharger)
     850±50 rpm
  3) *Adjust idle switch so that the switch turns on at that engine speed*



SEF687B

  4) If idle switch cannot be adjusted, replace throttle valve switch
  5) Connect A A C valve harness connector
- O.K ↓

Check continuity between ⑱, ㉕ and ground (Insulation check)



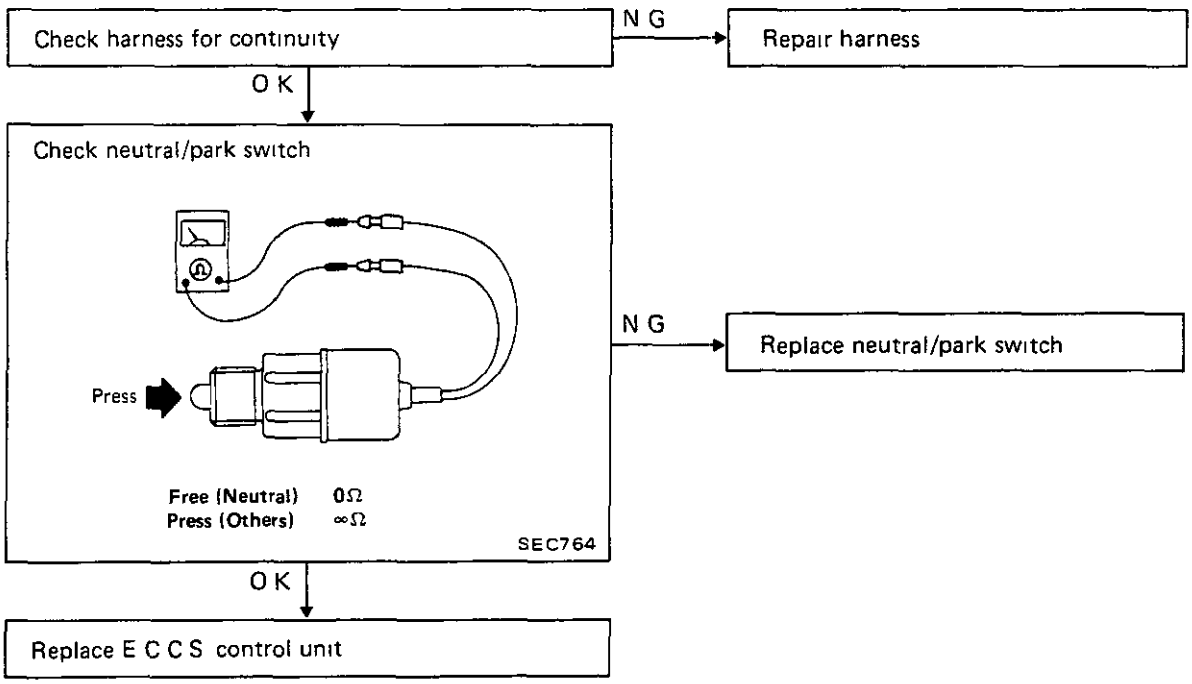
Continuity should not exist

SEF688B

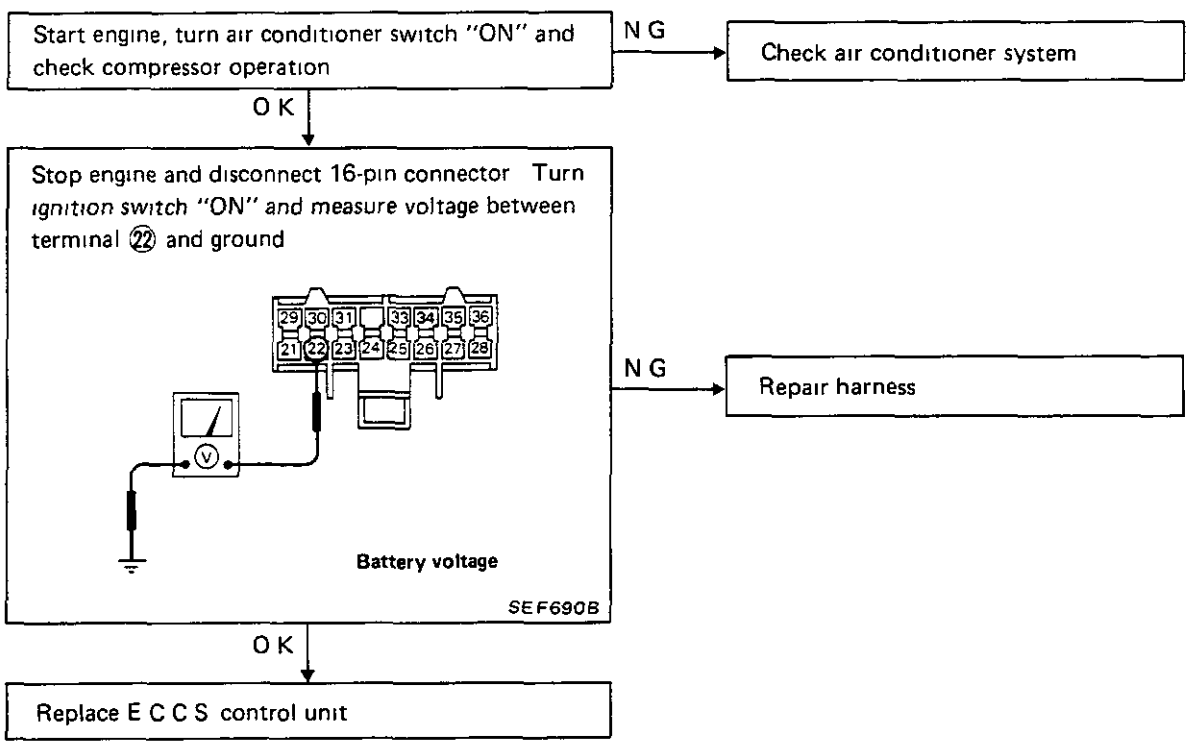
- NG → Replace throttle valve switch
- OK ↓

Replace E C C.S control unit

Ⓗ Neutral/Park switch (Code No. 24)



Ⓘ Air conditioner (Code No. 31)

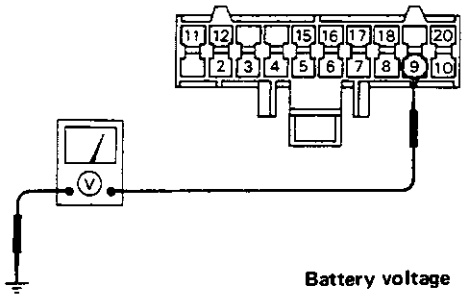


Ⓙ Start signal (Code No. 32)

Check starting system → NG → Repair or replace

OK ↓

Disconnect starter motor "S" terminal Disconnect 20-pin connector and measure voltage between terminal ⑨ and ground



SEF691B

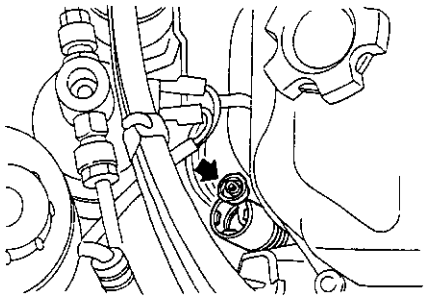
NG → Repair harness (Refer to EL section)

OK ↓

Replace E C C S control unit

Ⓚ Detonation sensor (Code No. 34)

1) Disconnect detonation sensor harness connector
2) Start engine and increase engine speed while checking ignition timing
3) Check if ignition timing retards by 5 degrees when engine speed increases when engine speed increases more than 2,000 rpm



SEF692B

NG → Replace E C.C.S control unit

OK ↓

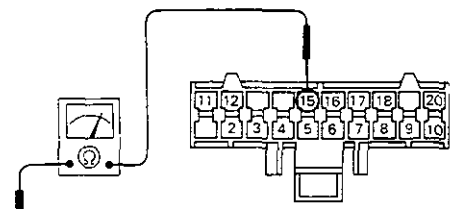
Check harness for continuity → N.G → Repair harness

OK ↓

Replace detonation sensor.

Ⓛ Fuel temperature sensor (Code No. 41)

Disconnect 20-pin connector and measure the *resistance between terminal ⑮ and ground*



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

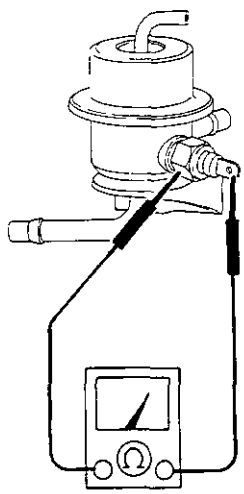
SEF693B

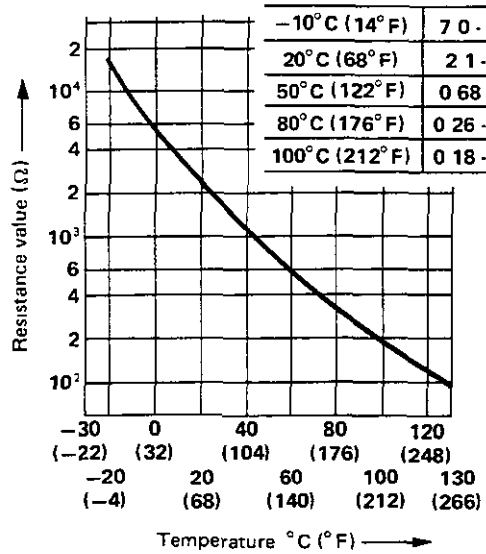
O K → Replace E.C.C.S. control unit

N G → Check harness for continuity

N G → Repair harness

O K → Measure the resistance of the fuel temperature sensor





−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

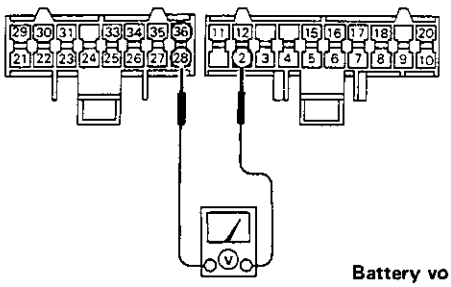
SEF694B

O K → Replace E.C.C.S. control unit

N G → Replace fuel temperature sensor and pressure regulator as an assembly

Ⓜ Auxiliary air control (A A.C.) valve or idle-up solenoid valve

Disconnect E C C S 20-pin connector, and check voltage between terminal ② and ground when ignition switch is turned to ON



Battery voltage

SEF695B

O K → END

N G ↓

Check harness

N G → Repair harness

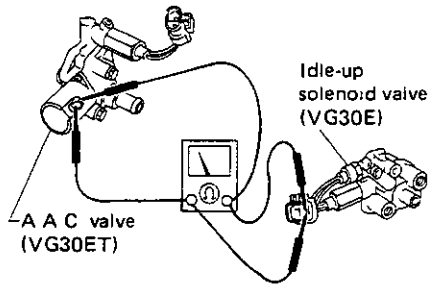
O.K ↓

Using the same procedure as that for the fuel pump relay, check E F I relay

N G → Replace E F I relay

O K ↓

Check A A C valve or idle-up solenoid valve



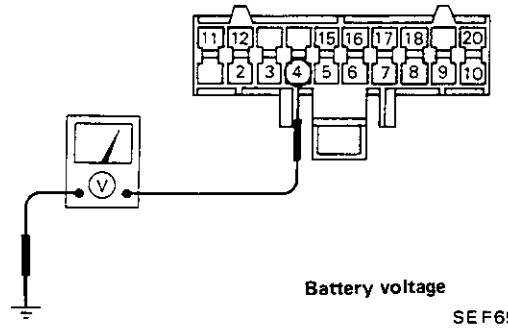
Continuity should exist

SEF696B

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

Ⓝ E.G.R. control valve

Disconnect E C C S 20-pin connector, and check voltage between terminal ④ and ground when ignition switch is turned to ON



O K → END

N G

Check harness for continuity

N G → Repair harness

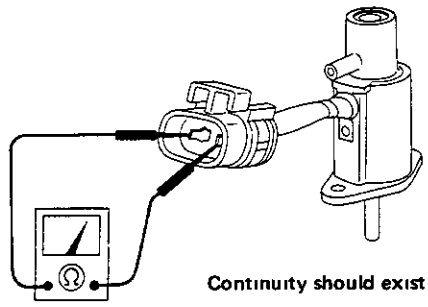
O K

Using the same procedure as that for the fuel pump relay, check E F I relay

N G → Replace E F I relay

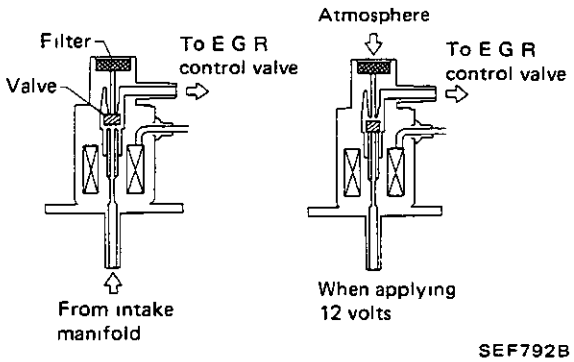
O K

Check E G R control valve for continuity



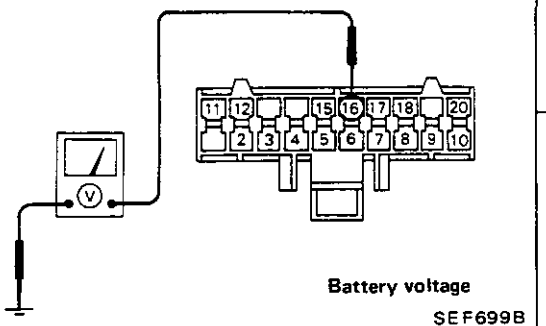
N G → Replace E G R control valve

Check E G R control valve for operation



⓪ Air regulator

Disconnect E C C S 20-pin connector, and check voltage between terminal ⑯ and ground when ignition switch is turned to ON



Battery voltage

SEF699B

O K → END

N G

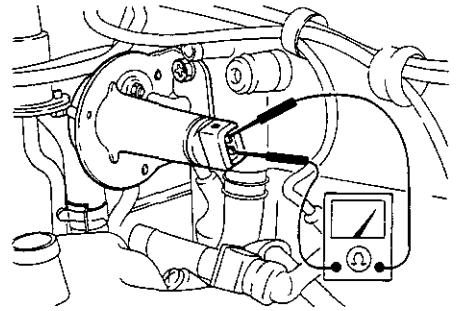
Check harness

N G → Repair harness

O K

Check air regulator

a Check continuity



Continuity should exist

SEF700B

N G → Replace air regulator

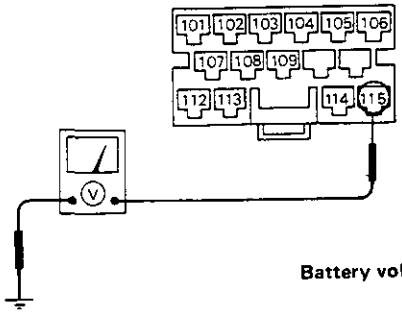
b Remove air regulator and visually check shutter opening.

- When engine is cold — Open
- After warm-up — Closed

c Pry air regulator shutter to open with a screwdriver, and check if shutter opens and closes smoothly

Ⓟ **Exhaust gas sensor heater**

Disconnect E C C S 15-pin connector, and check voltage between terminal (115) and ground when ignition switch is turned to ON



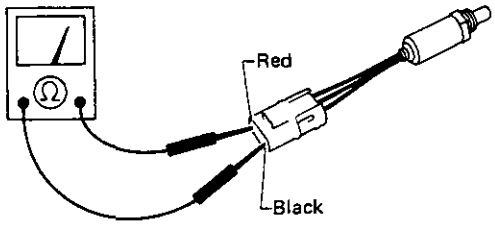
Battery voltage

SEF701B

O K → END

N G ↓

Measure the resistance of exhaust gas sensor heater



Resistance 2 87±0 25Ω

SEF702B

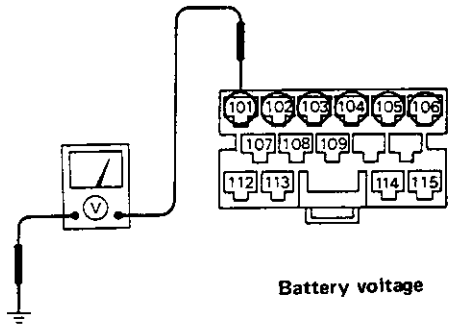
O K → Check harness

N G ↓

Replace exhaust gas sensor

ⓐ Injector

Disconnect E C C S 15-pin connector, and check voltage between terminal (101), (102), (103), (104), (105), (106) and ground



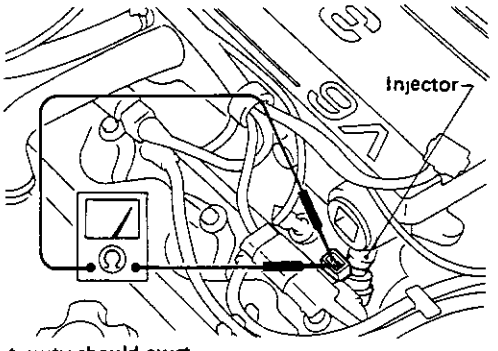
Battery voltage

SEF703B

O K → END

N G

Check each injector for continuity



Continuity should exist

SEF704B

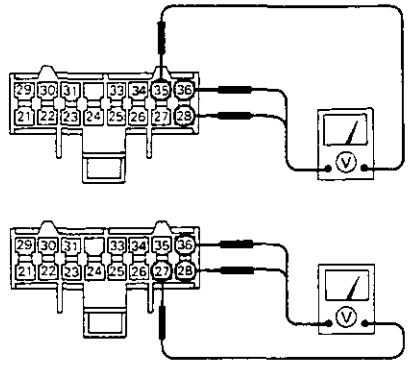
O.K → Check harness

N G

Replace injector

Ⓡ **Battery source and ground**

Disconnect E C C S 16-pin connector, and check voltage between ㉗, ㉟ and ㉘, ㊱ when ignition switch is turned to ON



Battery voltage

SEF705B

O K → END

N G → Repair harness

MIXTURE RATIO FEEDBACK SYSTEM INSPECTION

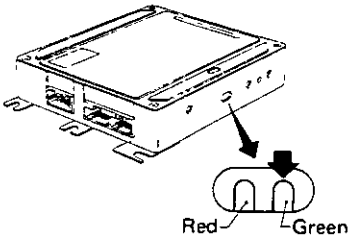
START

Make sure that the following are normal
- Engine operating temperature
- Idle speed
- Ignition timing

SEF651B

Verify that diagnosis mode selector is turned fully counterclockwise

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

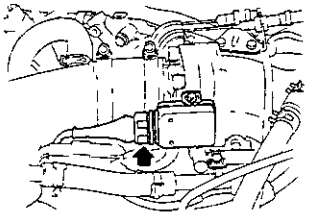


SEF706B

Make sure that inspection lamp (Green) on control unit goes on and off more than 5 times during 10 seconds (2,000 rpm)

O K

N G



SEF707B

Disconnect throttle valve switch harness connector

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

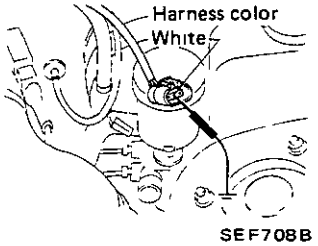
Do not blink

Check inspection lamp blinks
Inspection lamps should blink

Blink

END

Connect throttle valve switch harness connector

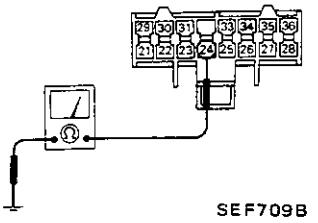


SEF708B

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



SEF709B

O K

N G

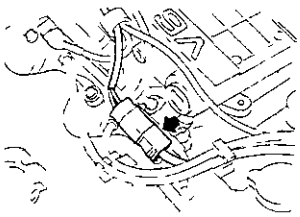
Ⓒ

Ⓐ

Ⓑ

Ⓓ

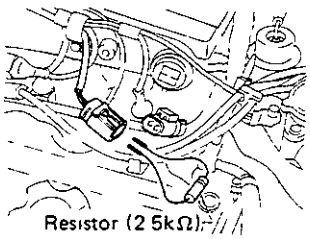
MIXTURE RATIO FEEDBACK SYSTEM INSPECTION



SEF710B

Repair or replace E C C S harness

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

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

(E)

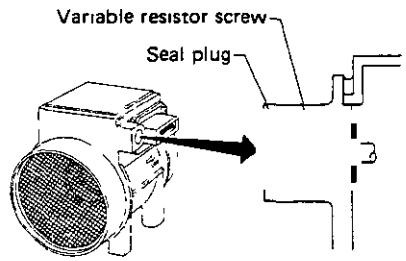
O K

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

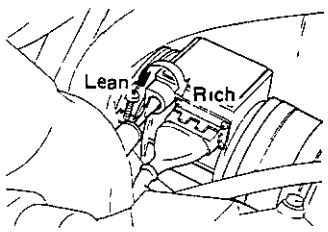
N G

Replace E C C S control unit

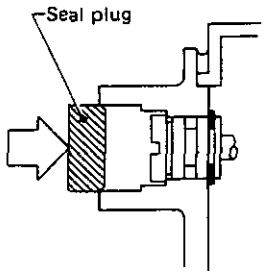


SEF712B

(C) (A) (B) (D) (D)



SEF649B



SEF713B

Ⓔ

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

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

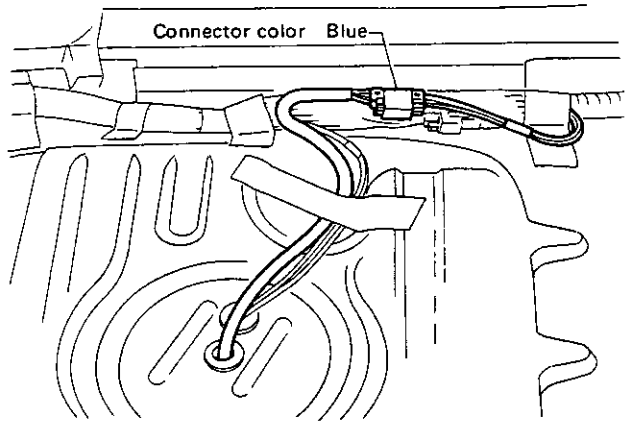
Ⓓ

FUEL SYSTEM INSPECTION

Releasing Fuel Pressure

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

1 Start engine
2. Remove luggage floor mat
3 Disconnect fuel pump connector with engine running

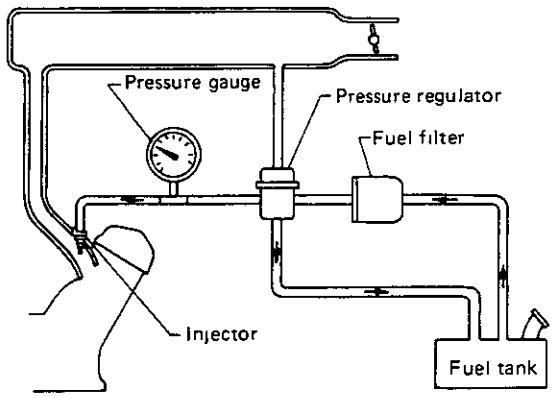


SEF714B

4 After engine stalls, crank engine two or three times to make sure that pressure is released
5. Turn ignition switch off and connect fuel pump connector.

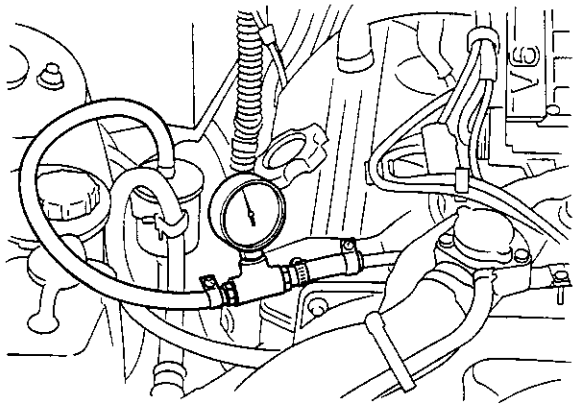
Fuel Pressure Check

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.



SEF715B

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



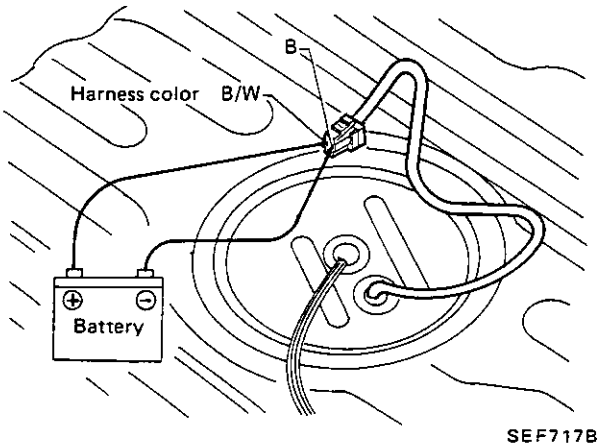
SEF716B

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

At idling:
Approximately 206 kPa
(2.1 kg/cm², 30 psi)
The moment accelerator pedal is fully depressed:
Approximately 255 kPa
(2.6 kg/cm², 37 psi)

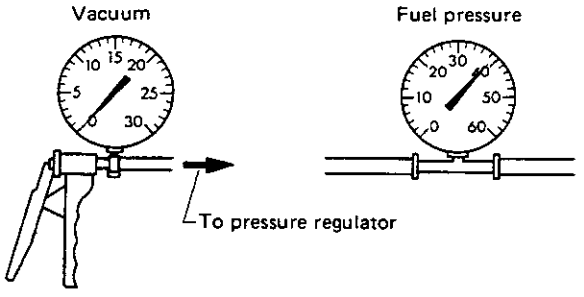
Fuel Pressure Check (Cont'd)

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

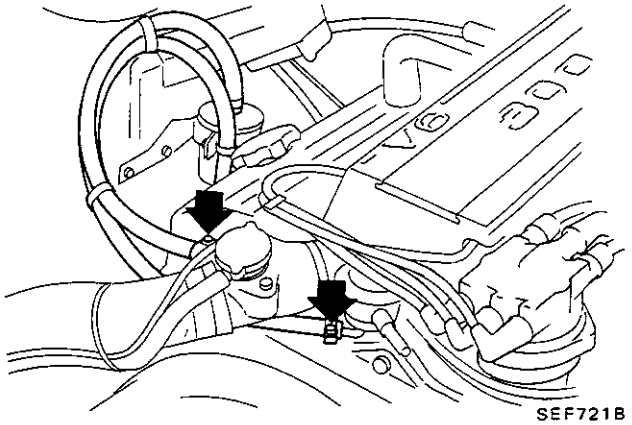
Vacuum kPa (mmHg, inHg)	Fuel pressure kPa (kg/cm^2, psi)
0 (0, 0)	248 1 - 255 0 (2 53 - 2 60, 36 0 - 37 0)
16 9 (127, 5 00)	227 5 - 241 3 (2 32 - 2 46, 33 0 - 35 0)
33 9 (254, 10 00)	213 8 - 220 7 (2 18 - 2 25, 31 0 - 32 0)
50 8 (381, 15 00)	200 1 - 206 9 (2 04 - 2 11, 29 0 - 30 0)
67 7 (508, 20 00)	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.

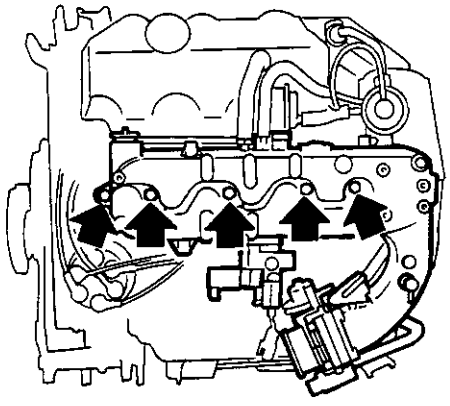
Injector Removal and Installation

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

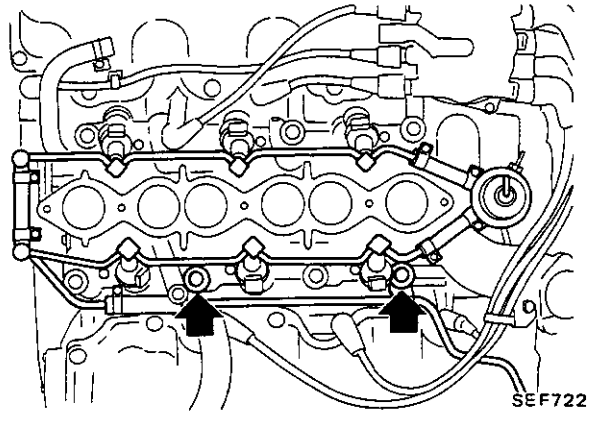
3 Disconnect fuel hoses


SEF721B

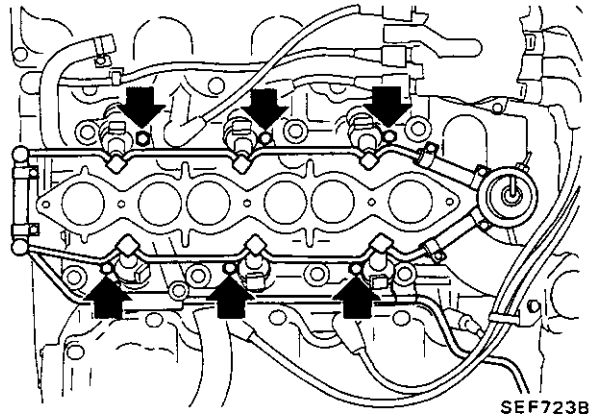
4 Remove intake collector


SEF720B

5 Remove bolts securing fuel tube


SEF722B

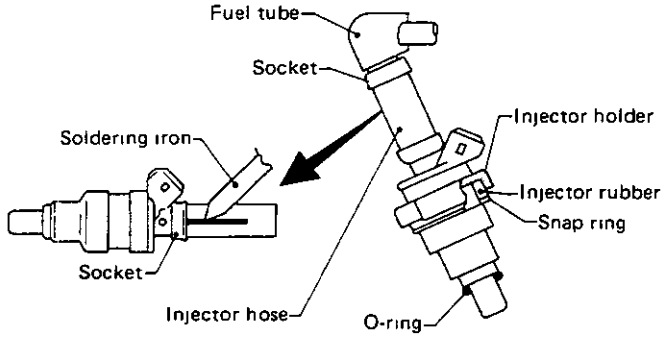
6. Remove bolts securing injectors and remove injectors, fuel tubes and pressure regulator as an assembly


SEF723B

7 Remove fuel hose

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

Do not feed soldering iron until it touches injector tail piece.



SEF719B

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.

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	Correct or replace rubber hose
By-pass valve is stuck closed	Replace turbocharger assembly
Controller diaphragm is broken	

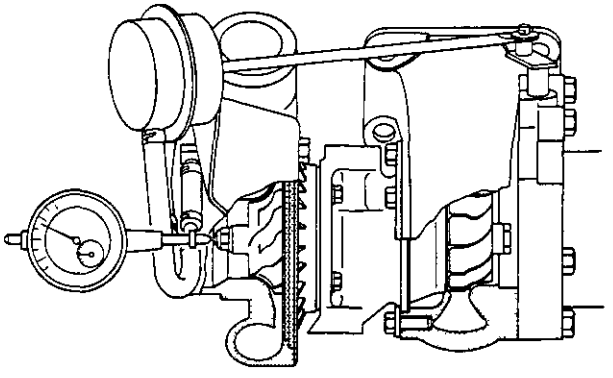
Inspection (Cont'd)

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)

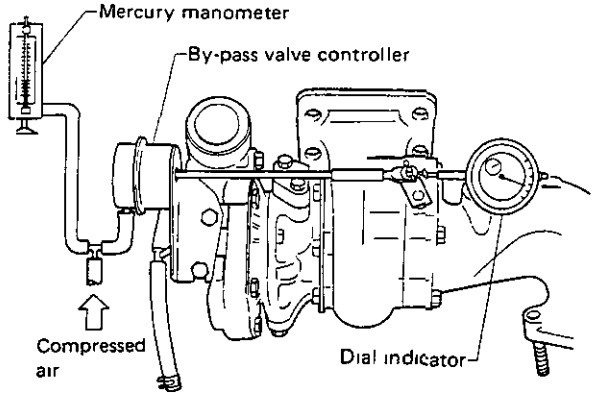


SEF726B

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)



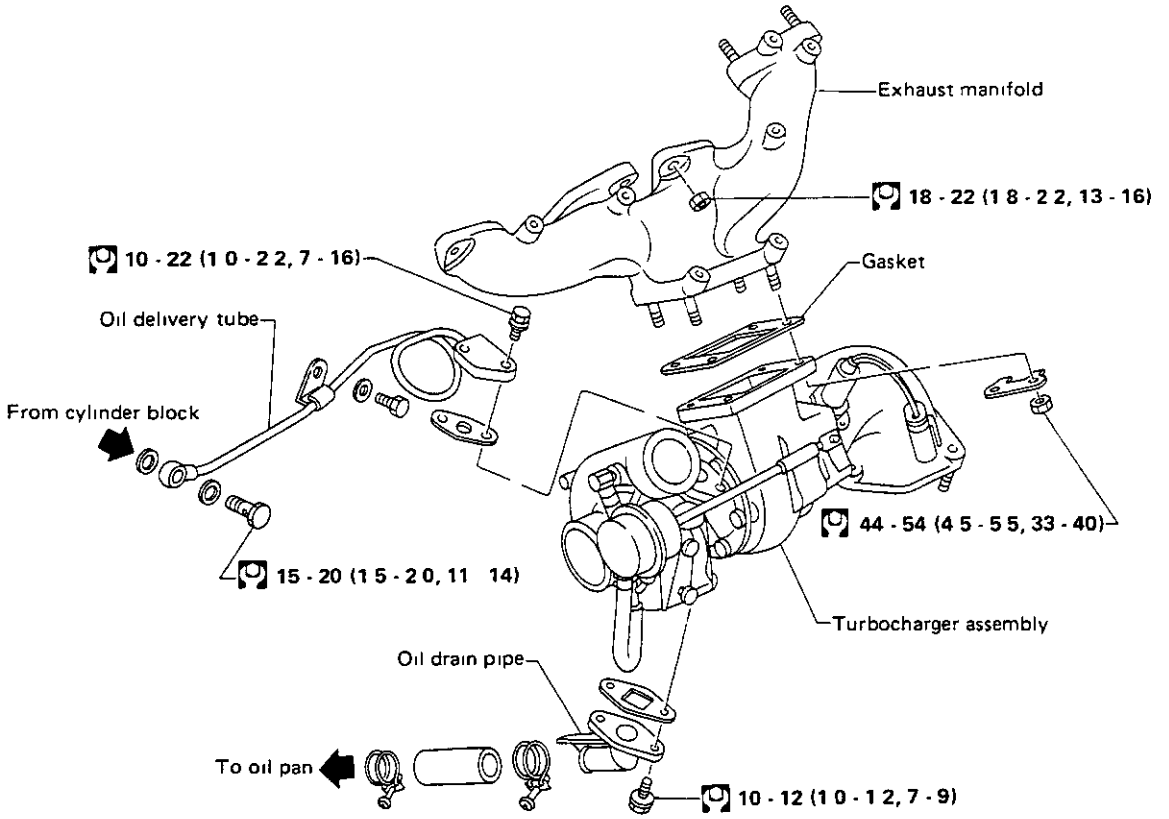
SEC727B

Always replace the turbocharger as an assembly if faulty

TURBOCHARGER

Removal and Installation

Turbocharger should not be disassembled

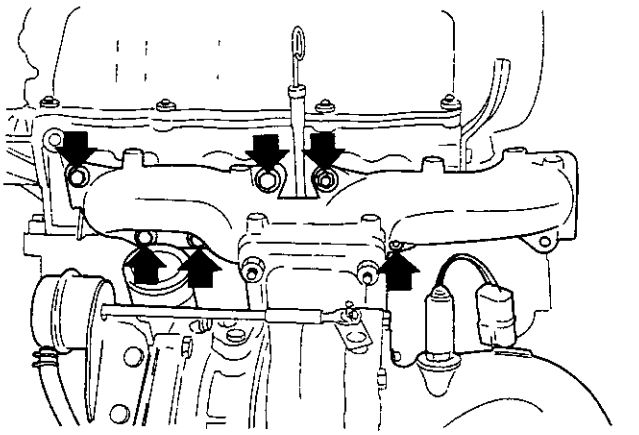


N m (kg-m, ft-lb)

SEF724B

1 Remove the following
- Compressor and compressor bracket
- Exhaust front tube
- Center cable
- Heat insulator for brake master cylinder
- Air duct and hoses
- Exhaust manifold connecting tube and heat shield plate
- Oil delivery tube and return hose

2 Remove exhaust manifold and turbocharger as an assembly



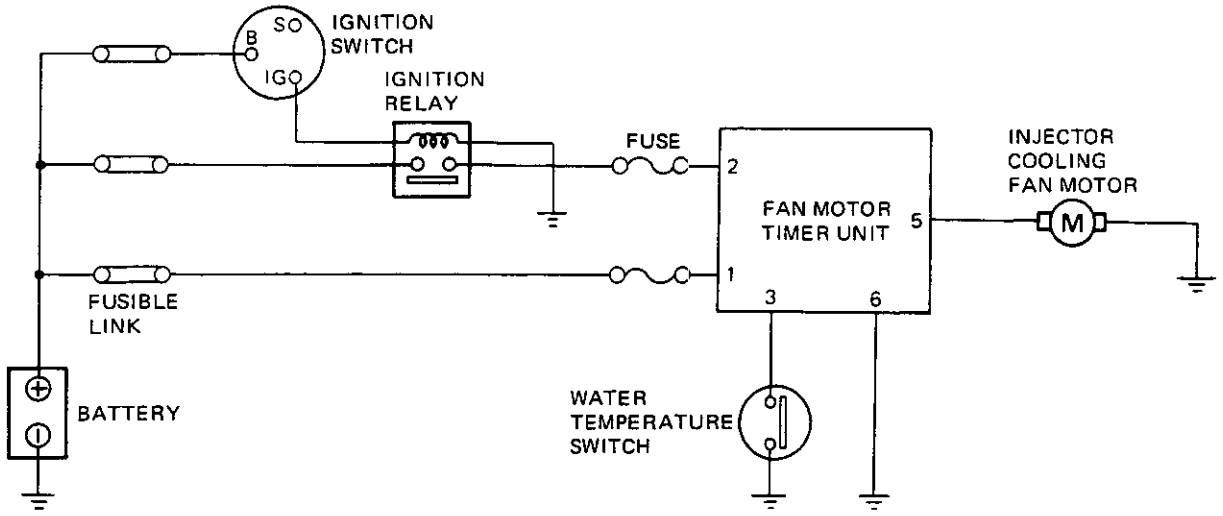
SEF725B

3 Disconnect the turbocharger from the exhaust manifold

4 When installing turbocharger to exhaust manifold, securely tighten nuts and bend up new lock washers

INJECTOR COOLING FAN (VG30ET)

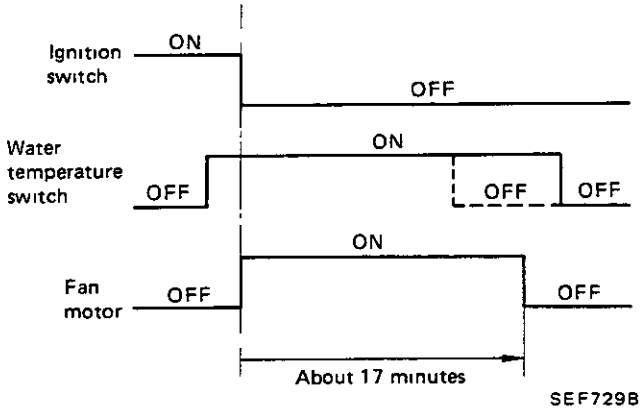
Operation



SEF728B

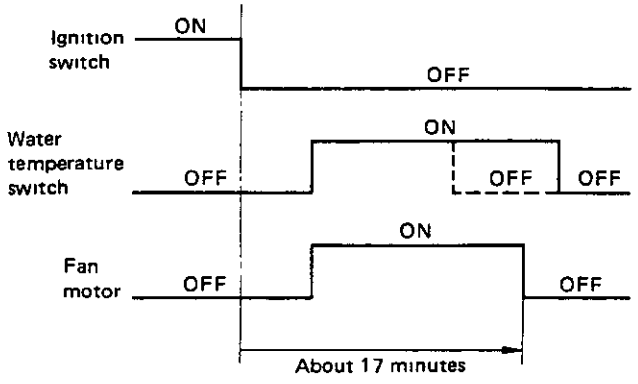
The injector cooling fan operates to cool down the temperature of fuel inside the injector and the fuel gallery when engine is stopped under high engine temperature condition

Operation 1



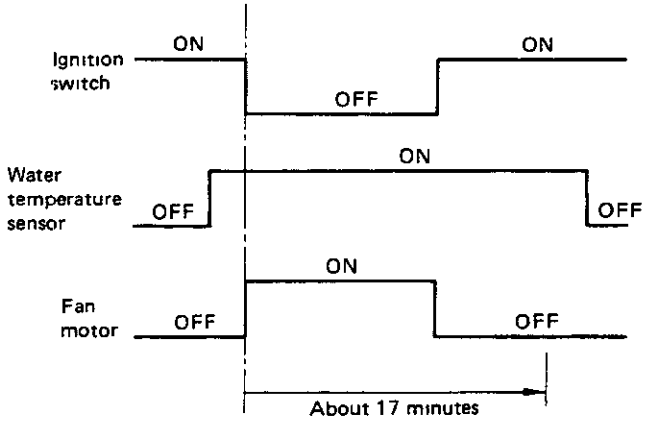
SEF729B

Operation 2

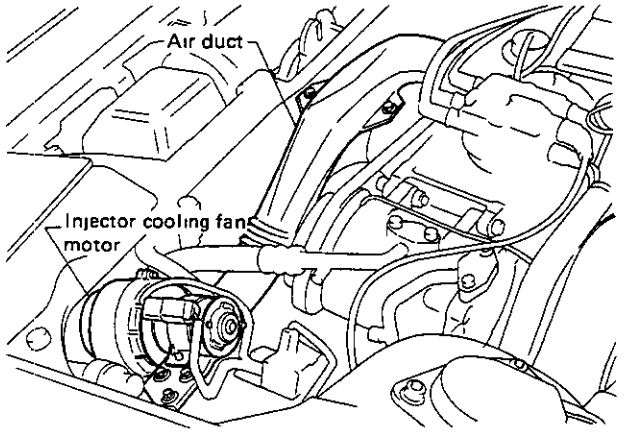


SEF730B

Operation 3

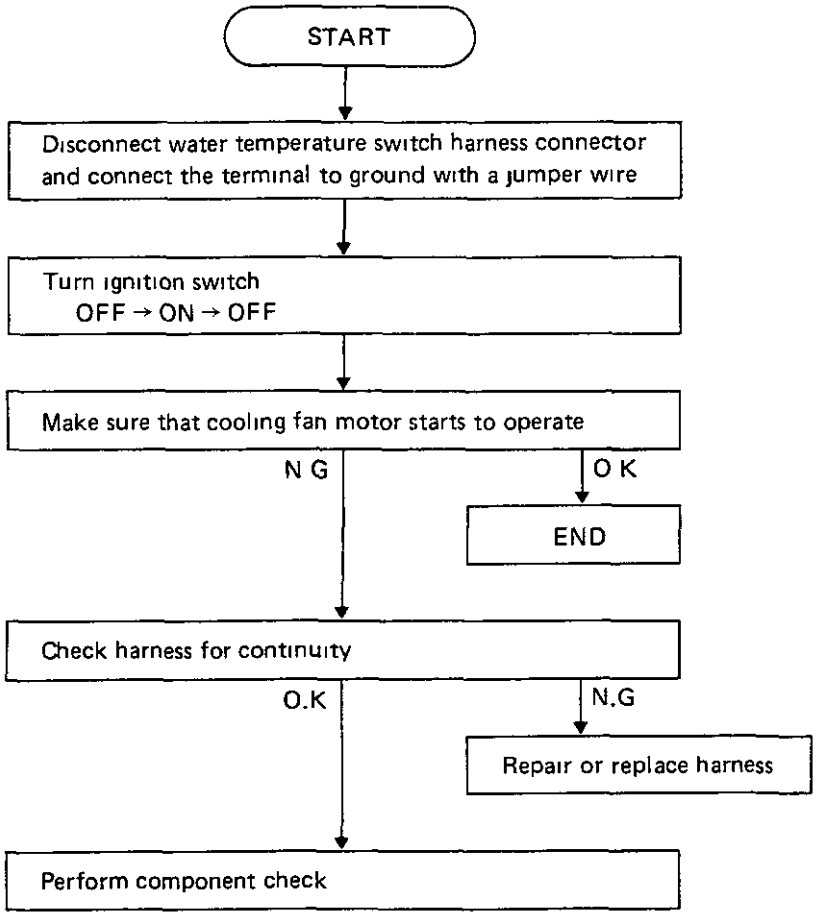


SEF731B



SEF732B

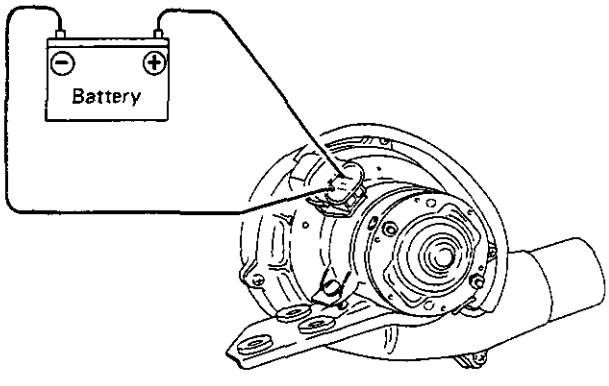
Inspection



COMPONENT CHECK

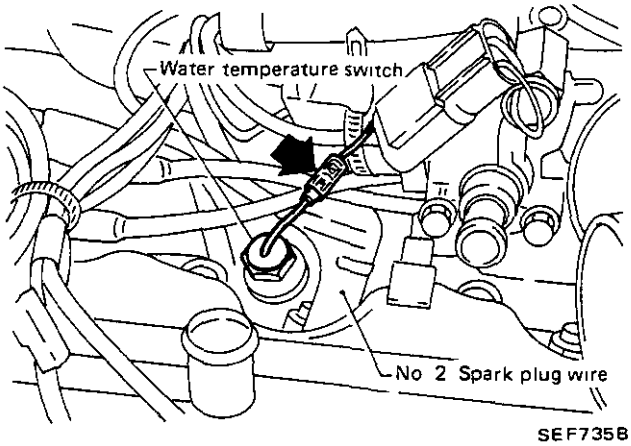
A Fan motor

1 Make sure that continuity exists between terminals of fan motor



SEF734B

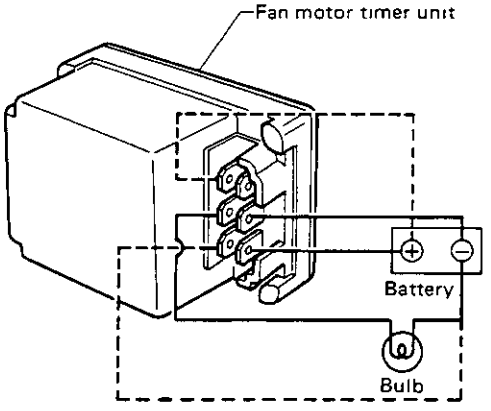
2. Apply battery voltage to the terminals of fan motor. If fan motor does not operate, replace



SEF735B

Inspection (Cont'd)

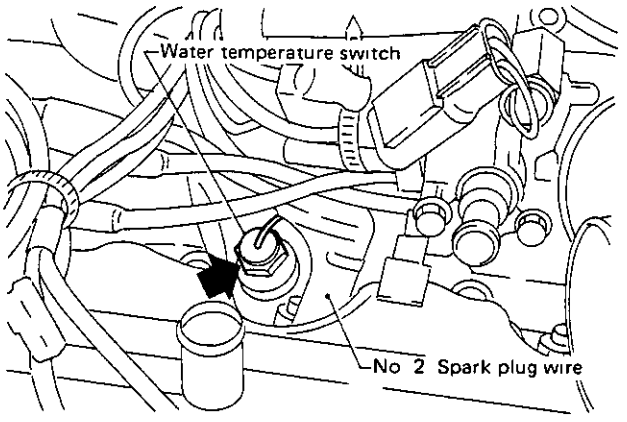
B. Fan motor timer unit
Check the timer unit with a battery source and a bulb (12V-3W), following the procedure below



SEF736B

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

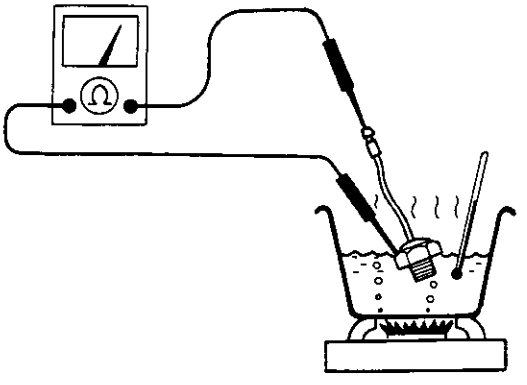
C Water temperature switch
1 Remove water temperature switch



SEF737B

2 Check water temperature switch for proper operation

Operating temperature:
OFF → ON 80°C (176°F)

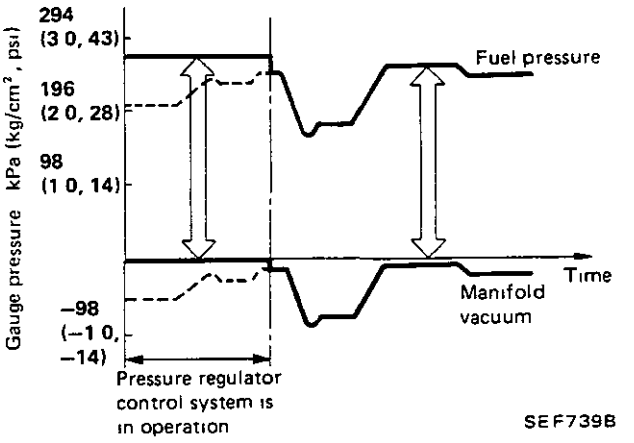


SEF738B

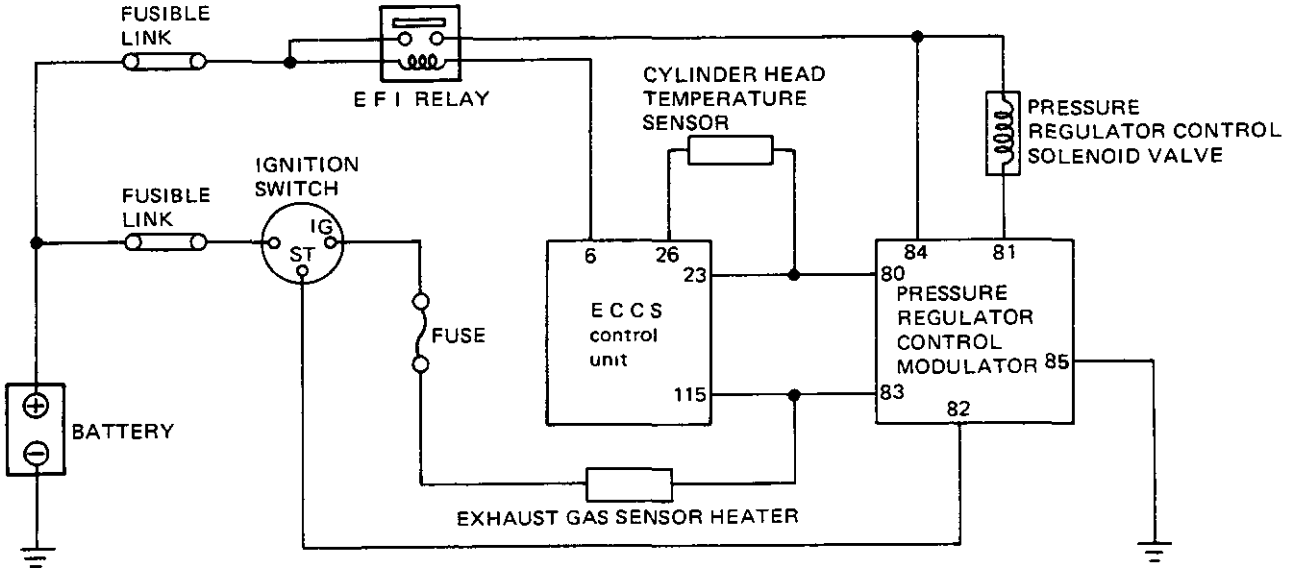
PRESSURE REGULATOR CONTROL

Operation

The pressure regulator control improves the starting of a hot engine by cutting off the intake manifold vacuum pressure and increasing the fuel pressure



SEF739B

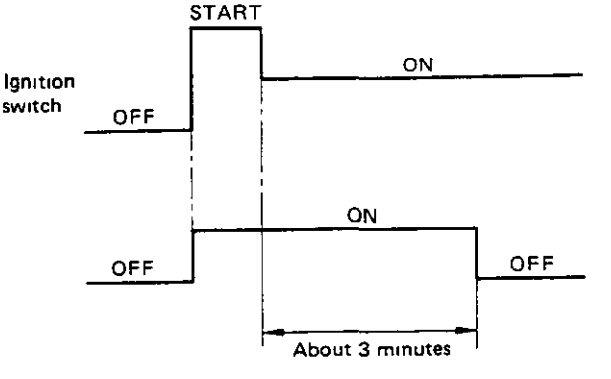


SEF740B

Operation

This system operates when all of the following conditions are met.

- Cylinder head temperature is above 100°C (212°F).
- During starting and after 3 minutes after starting

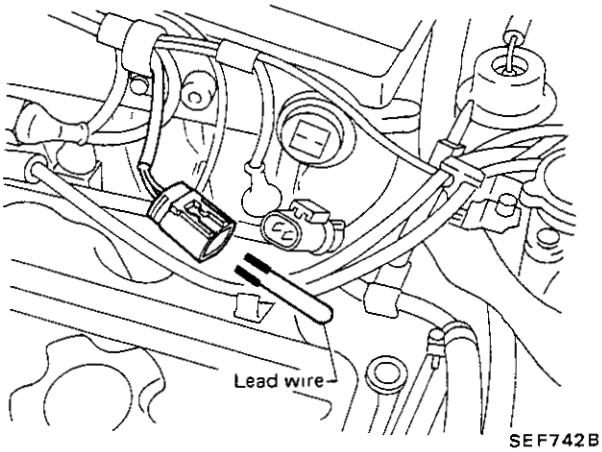


SEF741B

- Exhaust gas sensor heater is ON

Inspection

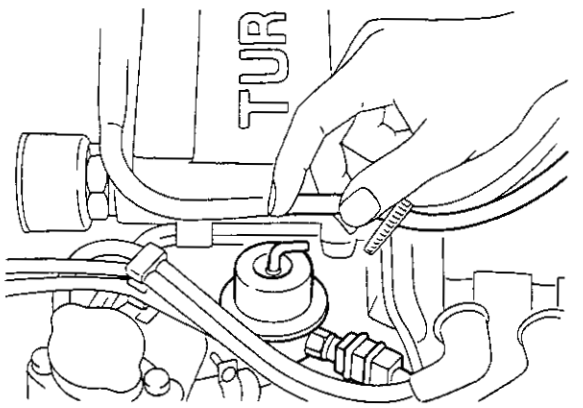
1 Disconnect cylinder head temperature sensor harness connector and connect terminals of harness connector with a lead wire



SEF742B

2 Disconnect a vacuum hose between pressure regulator and solenoid valve

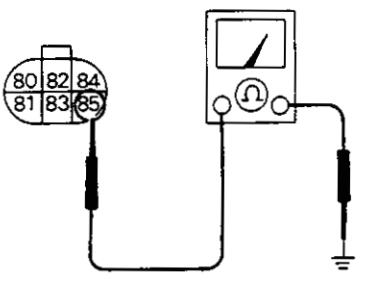
3 Start engine and make sure that the vacuum does not exist for three minutes



SEF743B

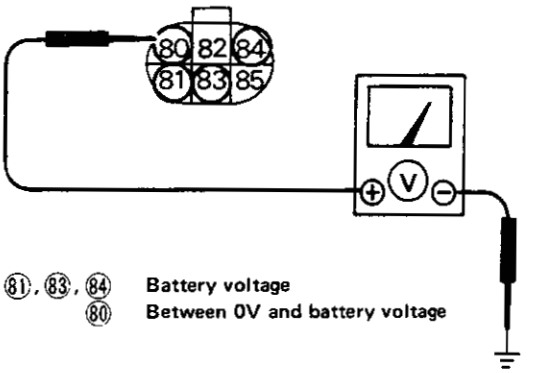
4 If vacuum exists, disconnect pressure regulator control modulator harness connector for the modulator located under the battery and check solenoid valve and circuit

a Ignition switch OFF



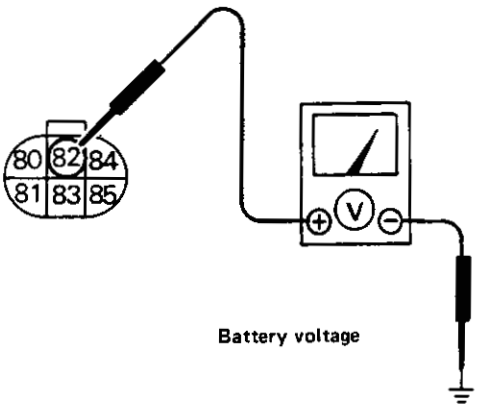
SEF744B

b Ignition switch ON



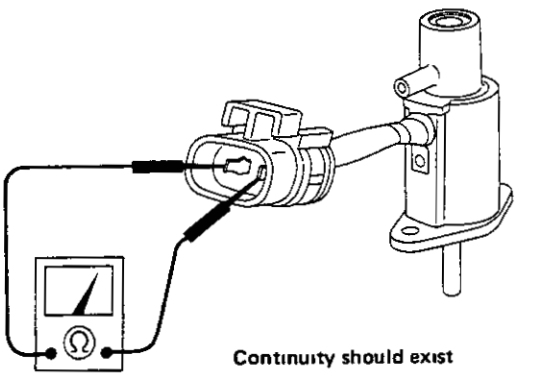
SEF745B

c. Ignition switch START
Disconnect starter motor "S" terminal



SEF746B

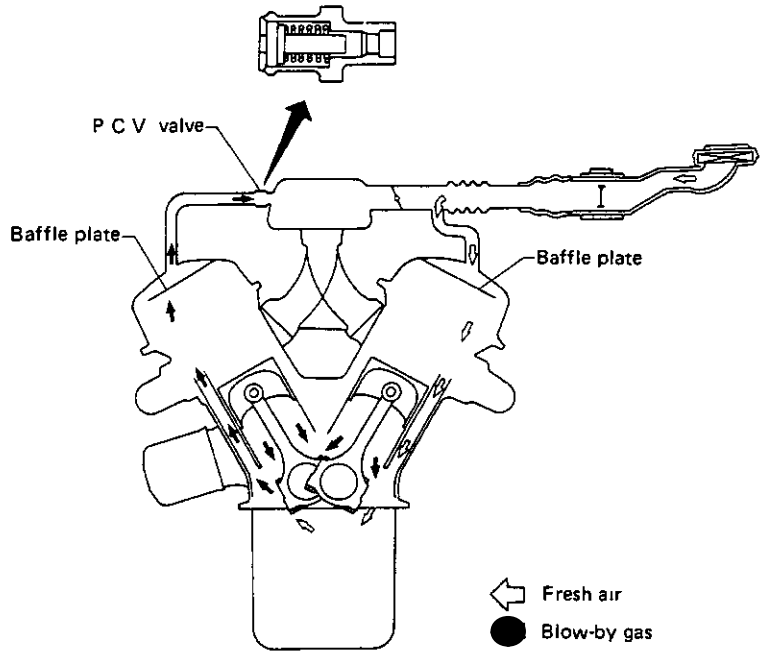
d Check continuity between terminals of solenoid valve



SEF698B

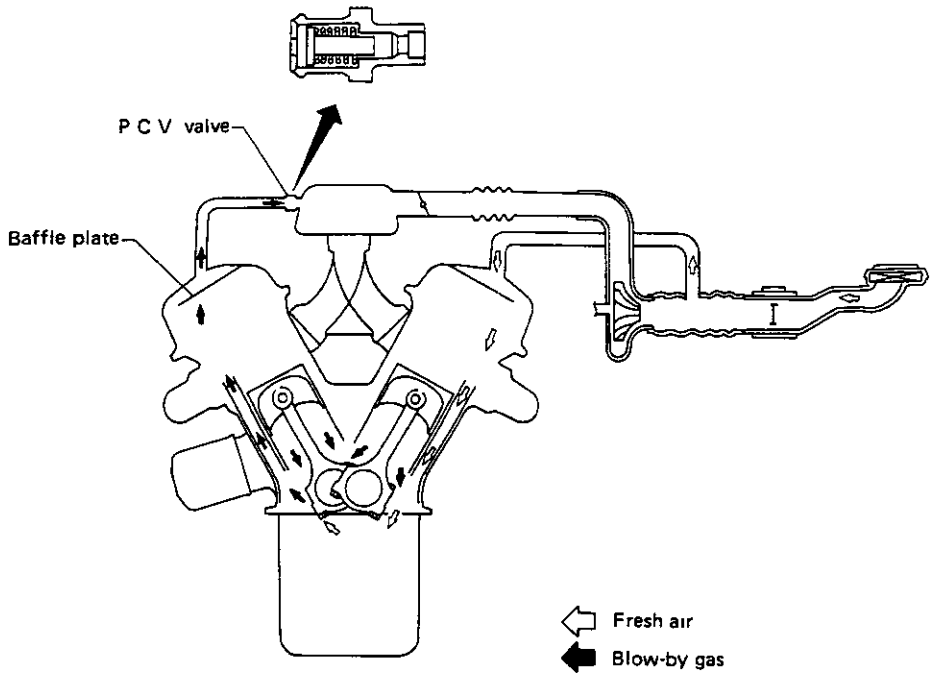
5 If solenoid valve and circuit are O.K , replace pressure regulator control modulator.

VG30E ENGINE (Without turbocharger)



SEC301A

VG30ET ENGINE (With turbocharger)



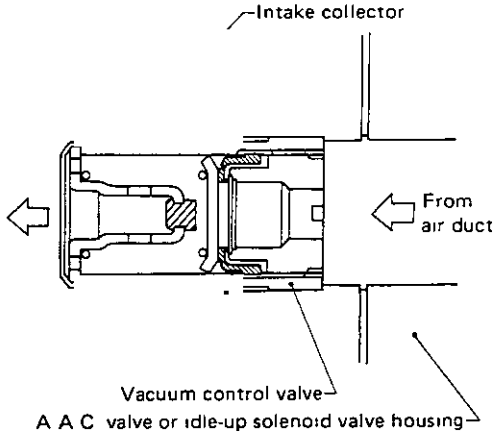
SEC302A

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

Intake Manifold Vacuum Control

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

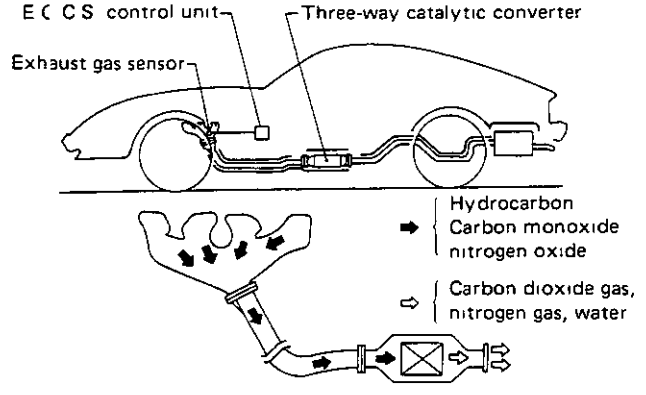
The vacuum control valve senses the manifold vacuum. As the manifold vacuum increases beyond the specified valve, the valve opens and air is sucked into the intake manifold



SEC303A

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



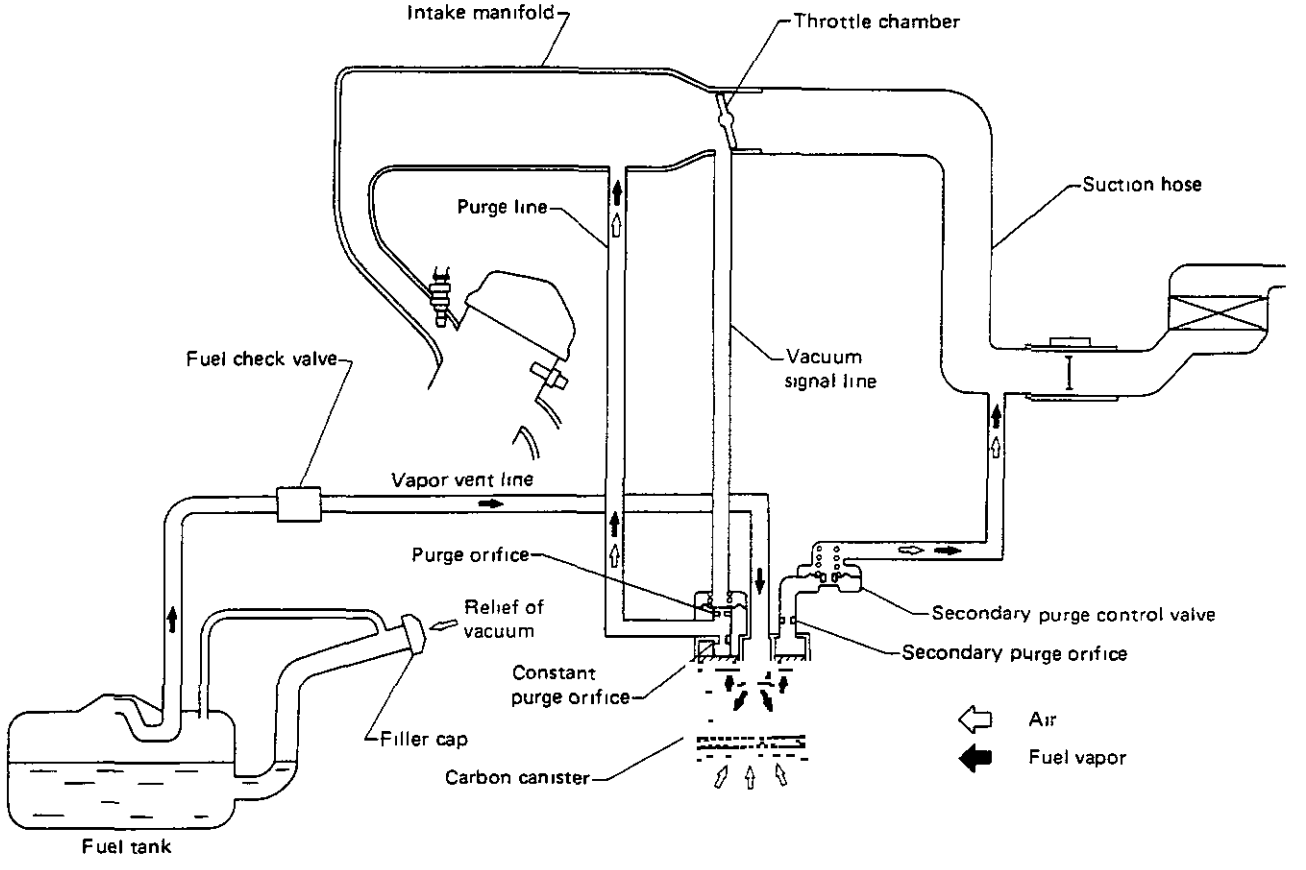
SEC304A

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.

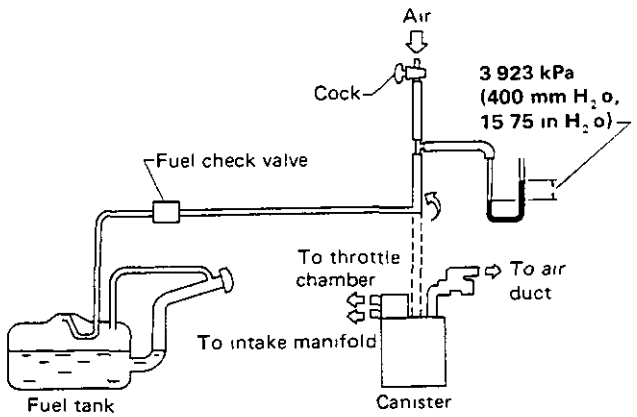
Only a small amount of purge air flows into the intake manifold through the constant purge orifice As the engine speed increases, and the throttle vacuum rises higher, the purge control valve opens and the vapor is sucked into the intake manifold through both the fixed orifice and the constant purge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



SEC305A

Inspection

VAPOR VENT LINE



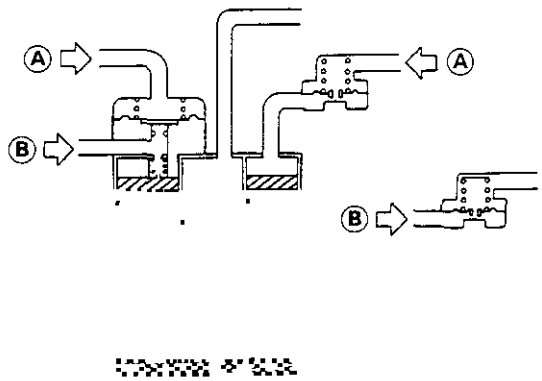
SEC306A

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 stuffy hose.

In case the vent line is stuffy the breathing in fuel tank is not thoroughly made thus causing insufficient deliver of fuel to engine or vapor lock. It must, therefore, be repaired or replaced.

CARBON CANISTER

Check carbon canister as follows



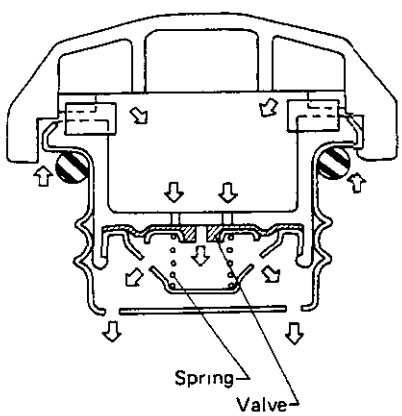
Ⓐ Inhale air and ensure that there is no leakage
Ⓑ Inhale air and ensure that there is leakage

SEC307A

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 be disappeared with valve clicks
3. If valve is clogged, or if no resistance is felt, replace cap as an assembled unit

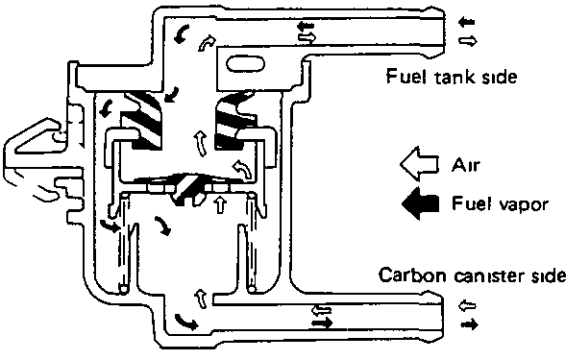


SEC308A

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 being properly functioning 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 1 (2 55, 36 3)
Air regulator Air flow amount [at 20°C (68°F)] m³ (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)	50 7 - 53 3 (380 - 400, 14 96 - 15 75)

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)	Approximately 255 (2 6, 37)
Air flow meter Voltage between terminals B and D	1 6±0 1 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 "ON" to "OFF"	Approximately 900 rpm
Exhaust gas sensor Heater resistance	2 6 - 3 1 Ω

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