

ENGINE FUEL & EMISSION CONTROL SYSTEM

SECTION **EF & EC**

EF & EC

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PRECAUTIONS

BATTERY

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

E.C.C.S. COMPONENTS

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

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

AIR FLOW SYSTEM

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

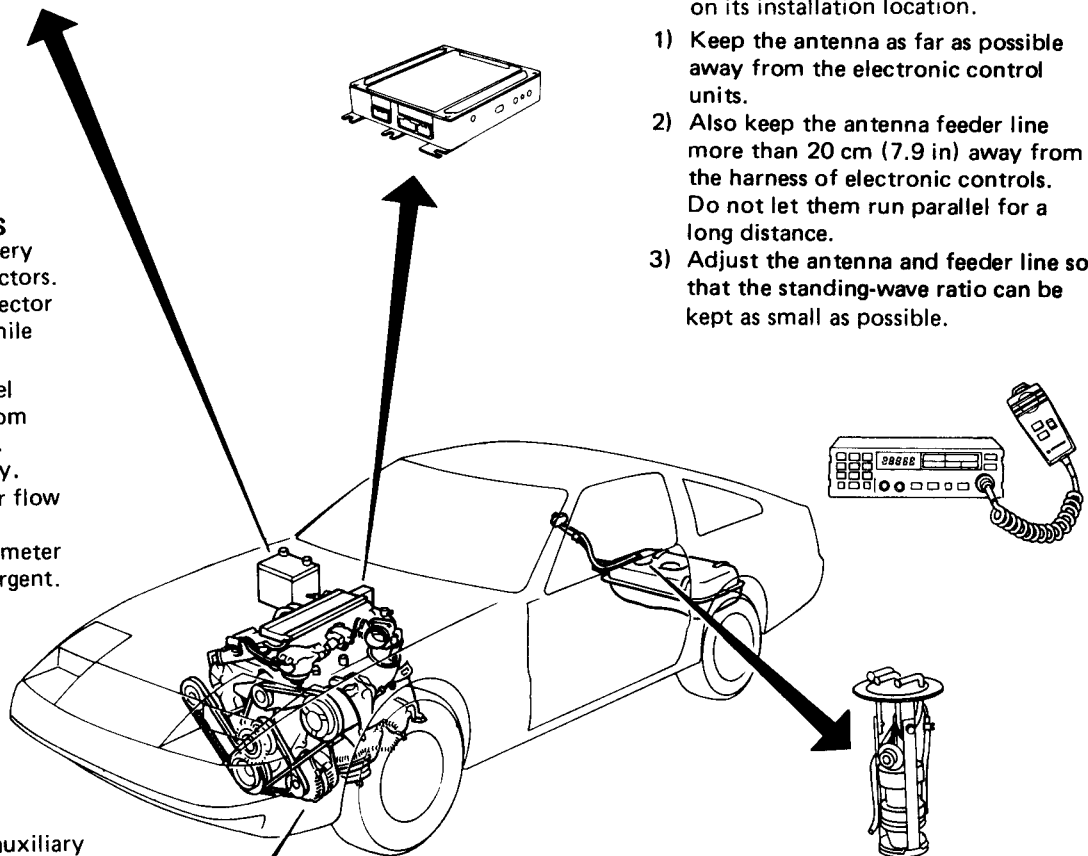
E.C.C.S. CONTROL UNIT

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

HAM RADIO & VEHICLE PHONE

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

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



FUEL SYSTEM

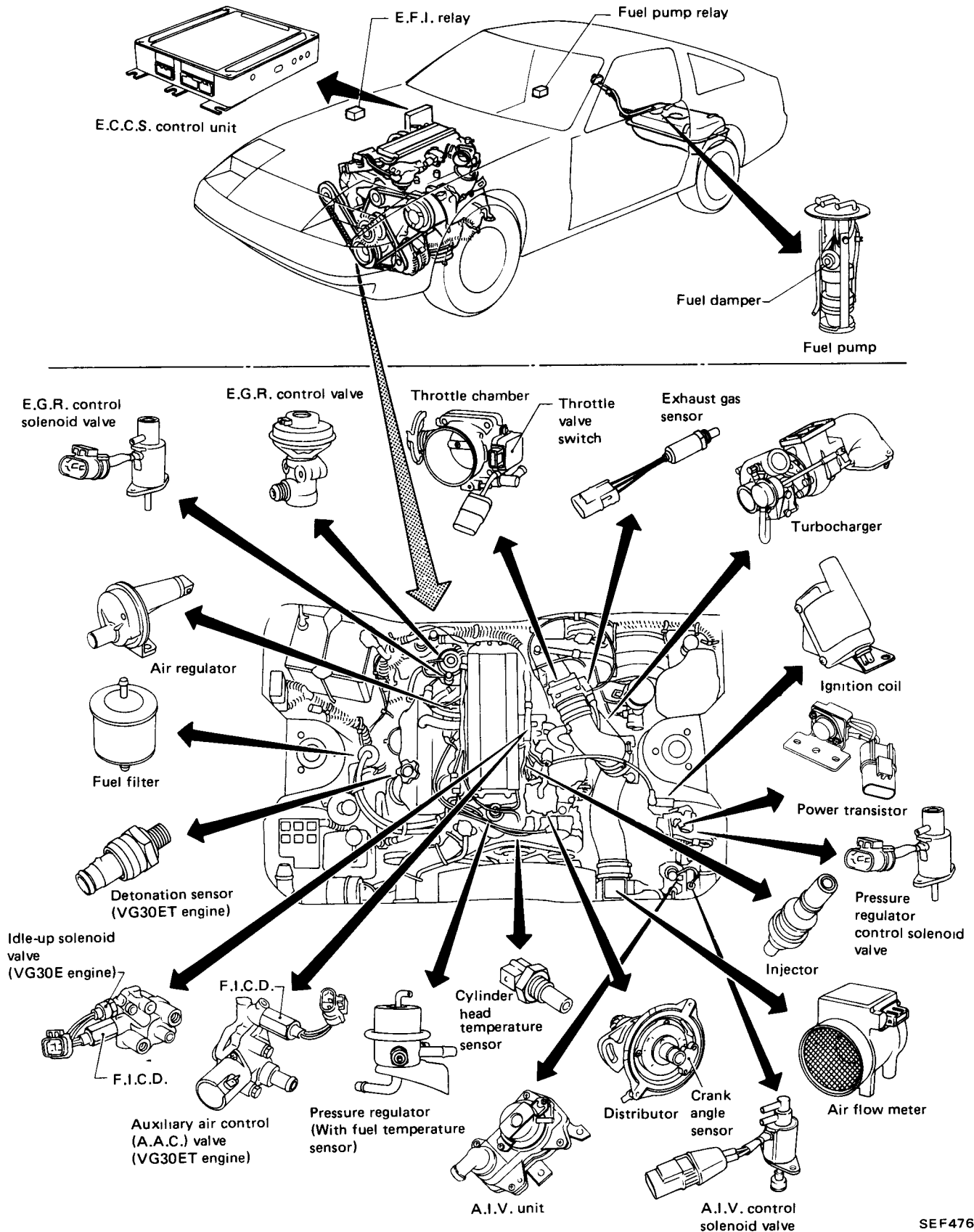
- Do not operate fuel pump when the fuel lines are empty.
- Do not reuse fuel hose clamps.

HARNESS CONNECTORS

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

SEF475D

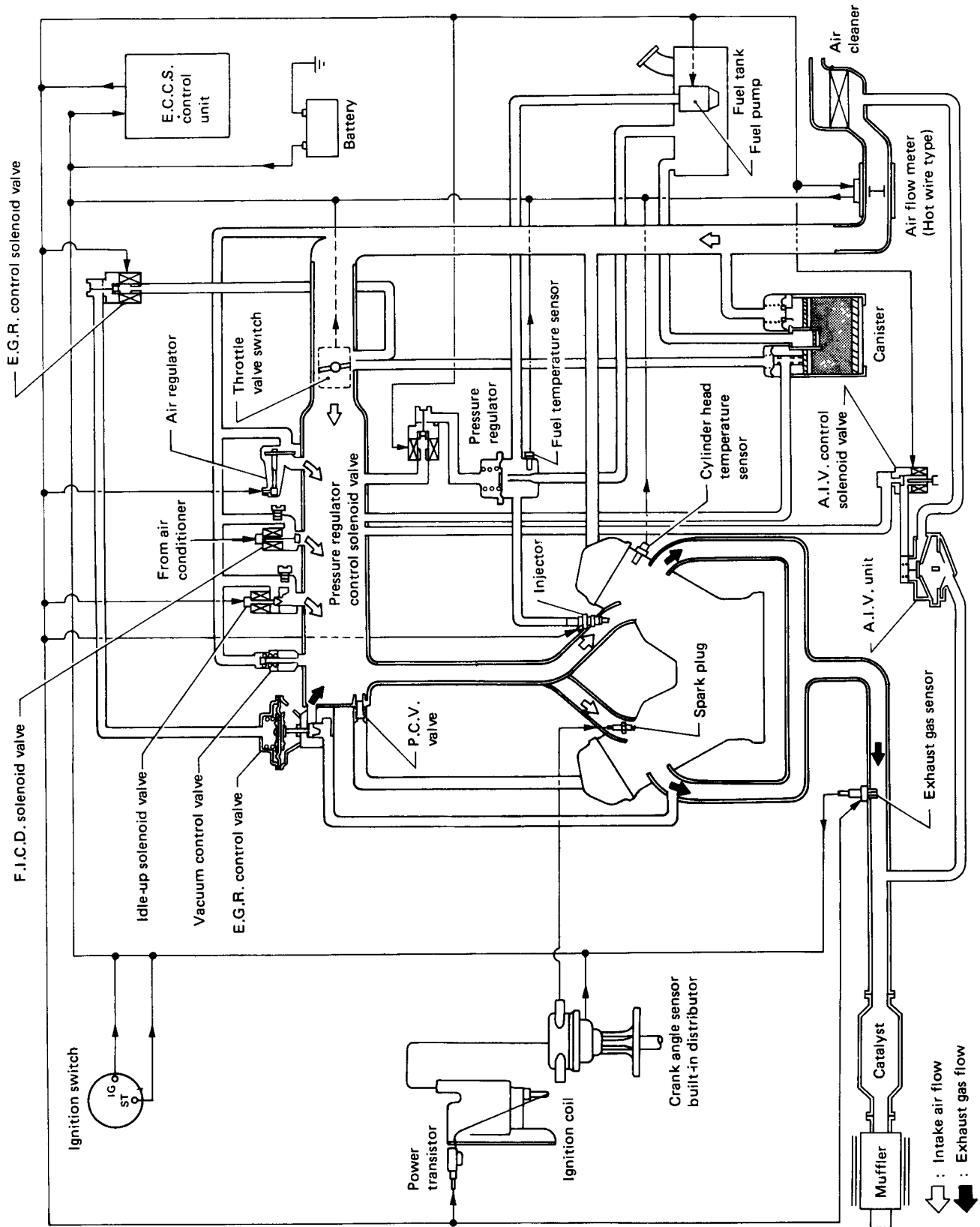
COMPONENT PARTS LOCATION



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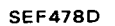
E.C.C.S. DIAGRAM

VG30E Engine (Without turbocharger)



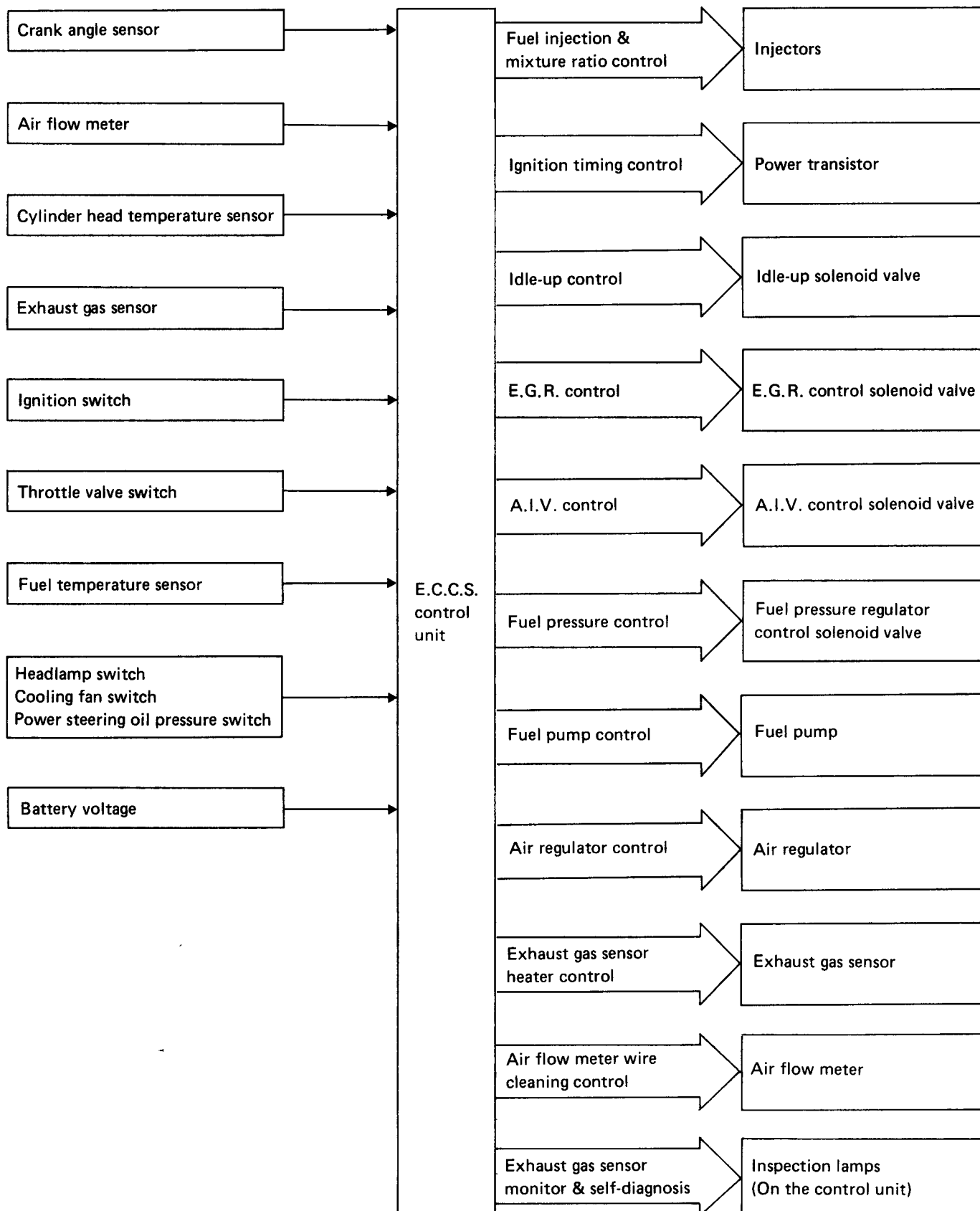
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VG30ET Engine (With turbocharger)



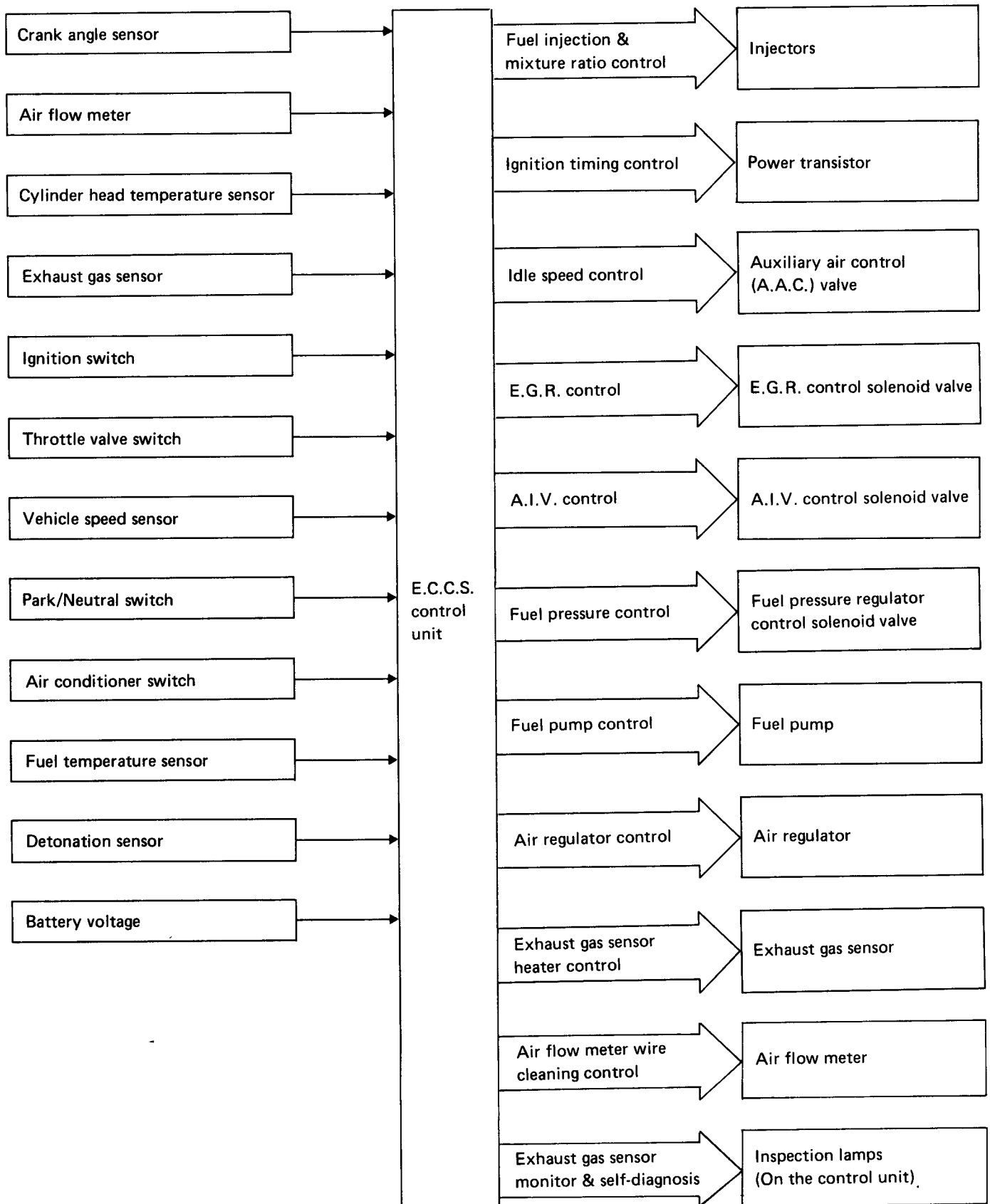
E.C.C.S. CHART

VG30E Engine (Without turbocharger)

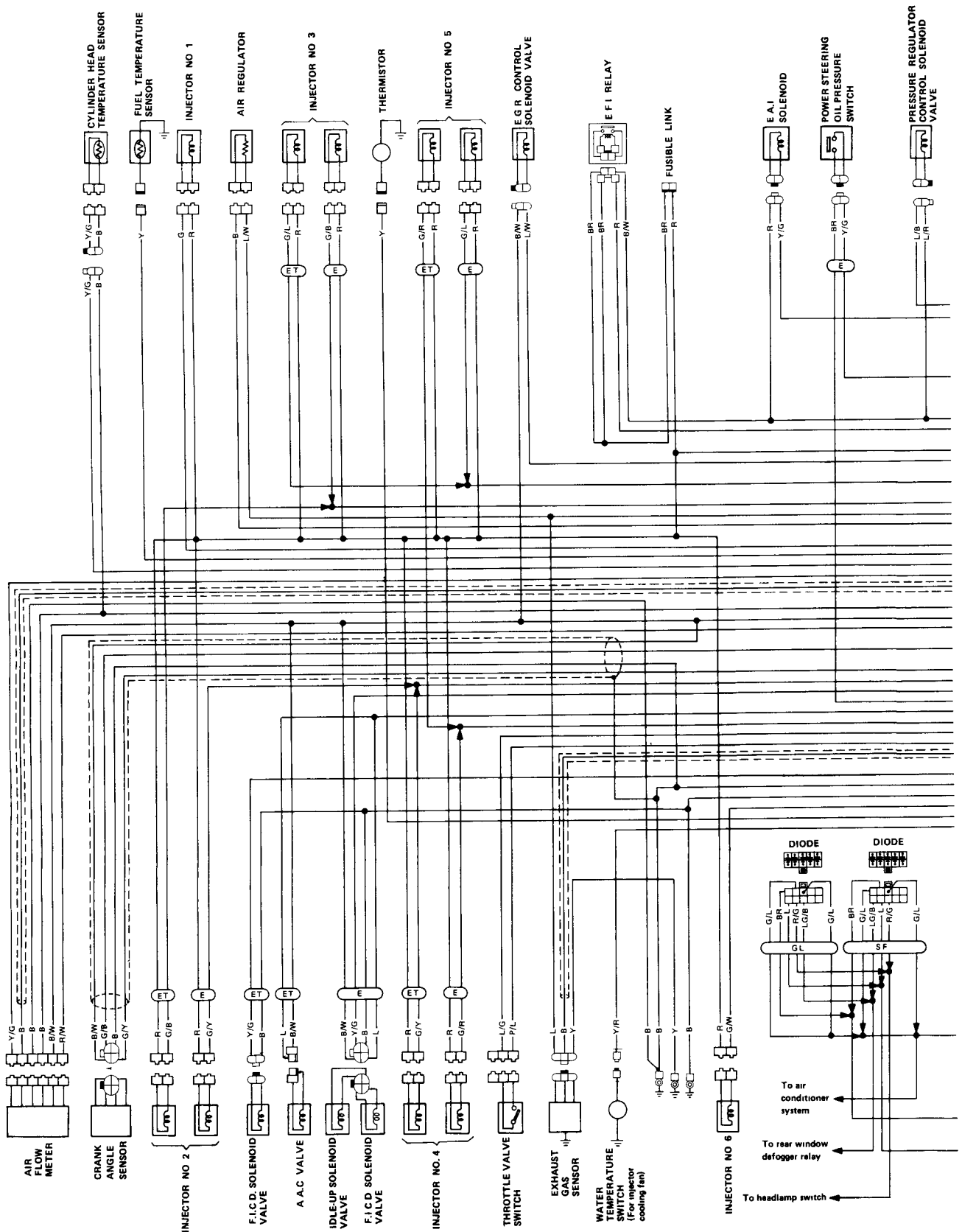


E.C.C.S. CHART

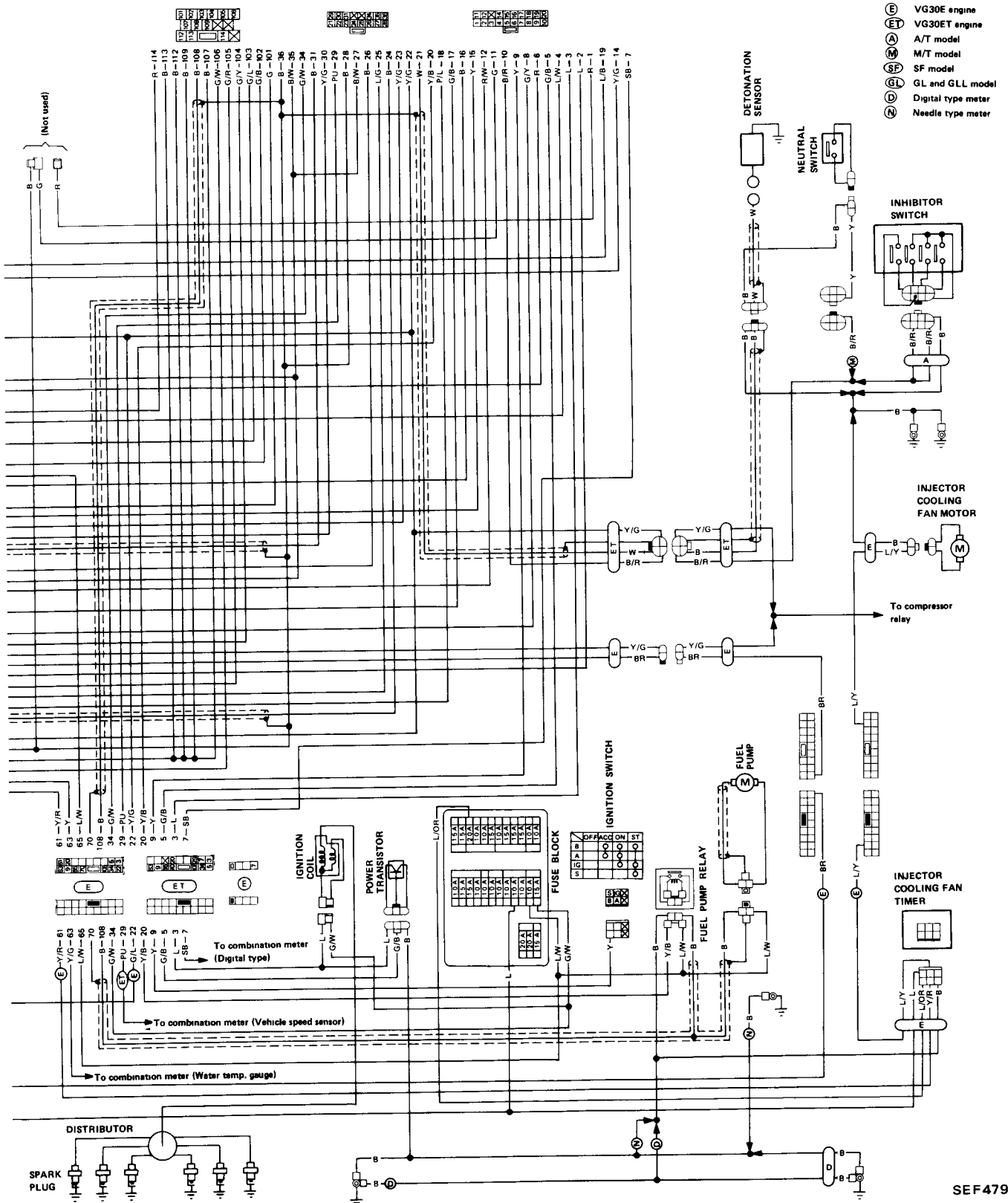
VG30ET Engine (With turbocharger)



E.C.C.S. WIRING DIAGRAM



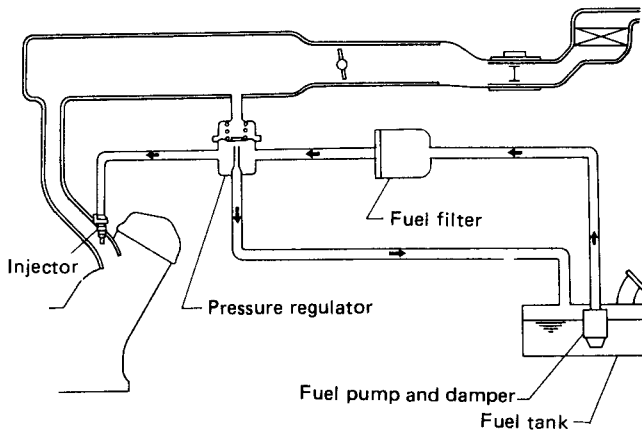
E.C.C.S. WIRING DIAGRAM



SEF479D

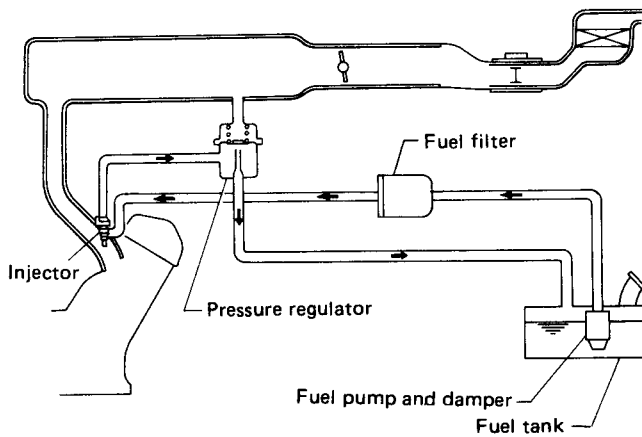
FUEL FLOW SYSTEM DESCRIPTION

VG30E engine (Without turbocharger)



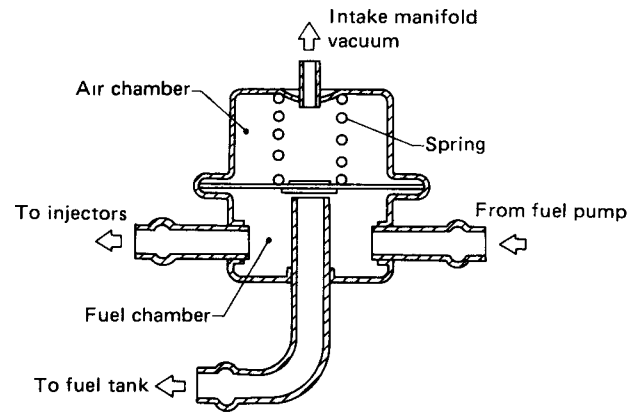
SEF480D

VG30ET engine (With turbocharger)

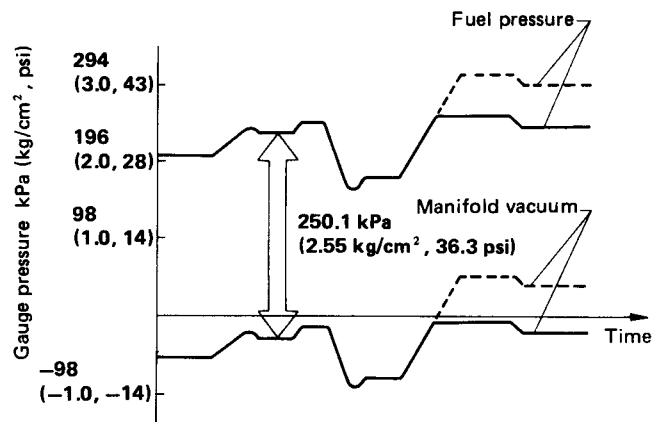


SEF481D

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



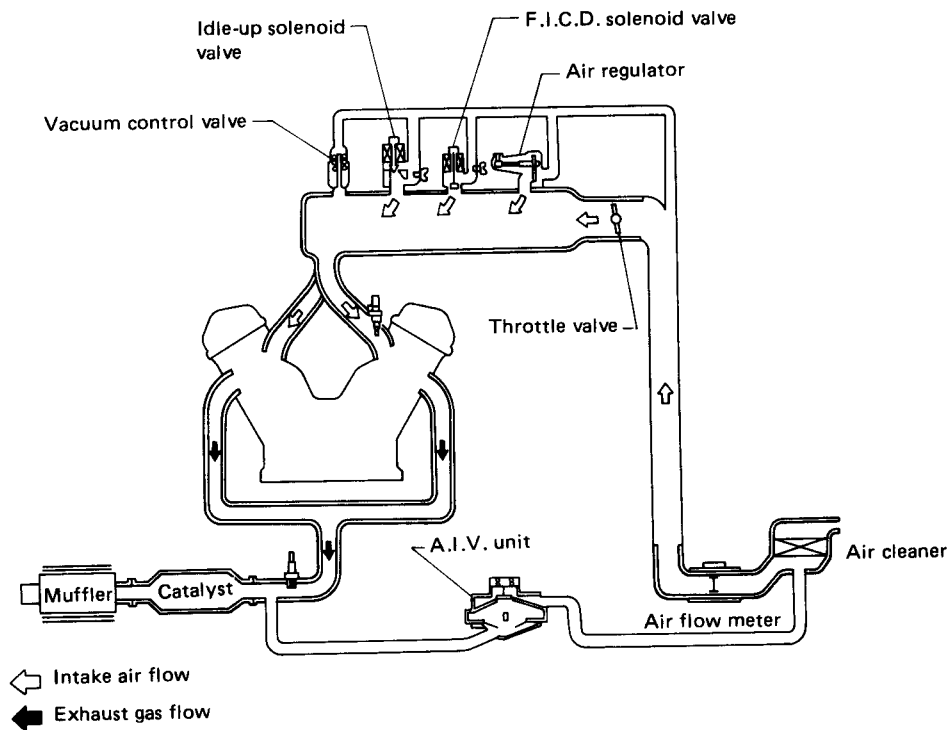
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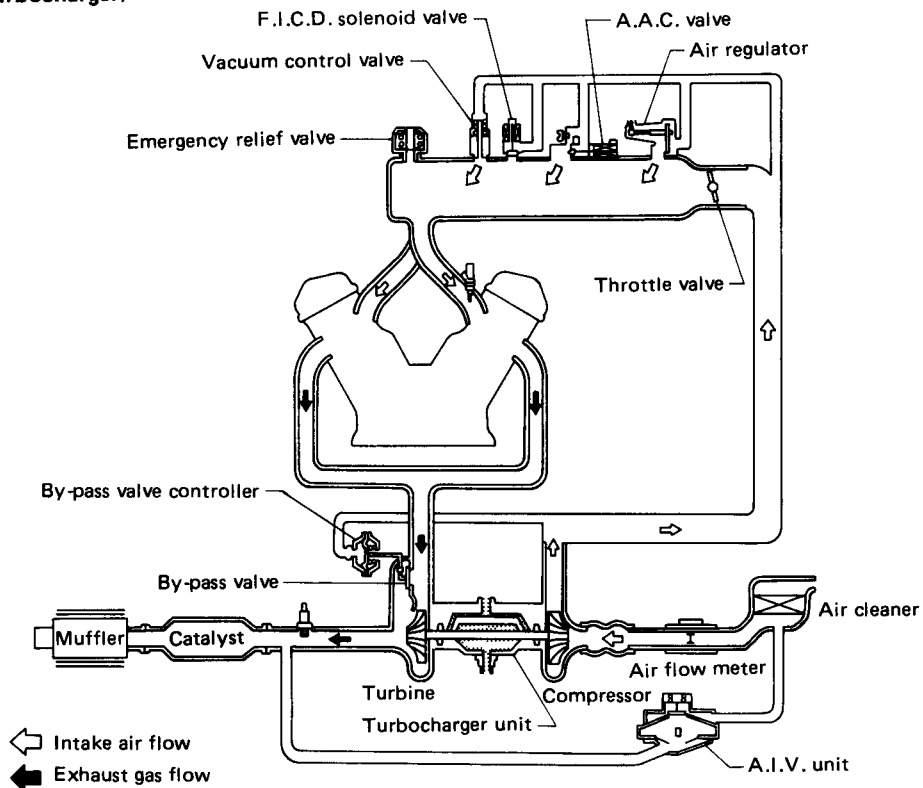
AIR FLOW SYSTEM DESCRIPTION

VG30E engine (Without turbocharger)



SEF482D

VG30ET engine (With turbocharger)



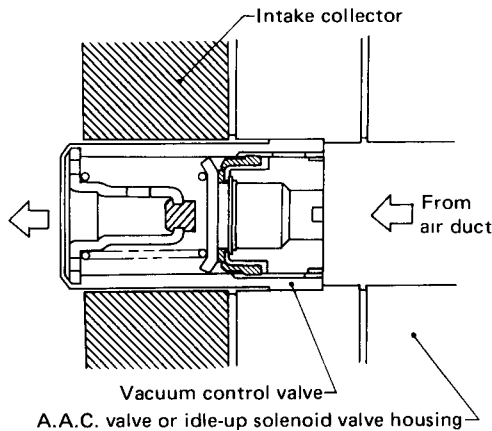
SEF483D

AIR FLOW SYSTEM DESCRIPTION

VACUUM CONTROL VALVE

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

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

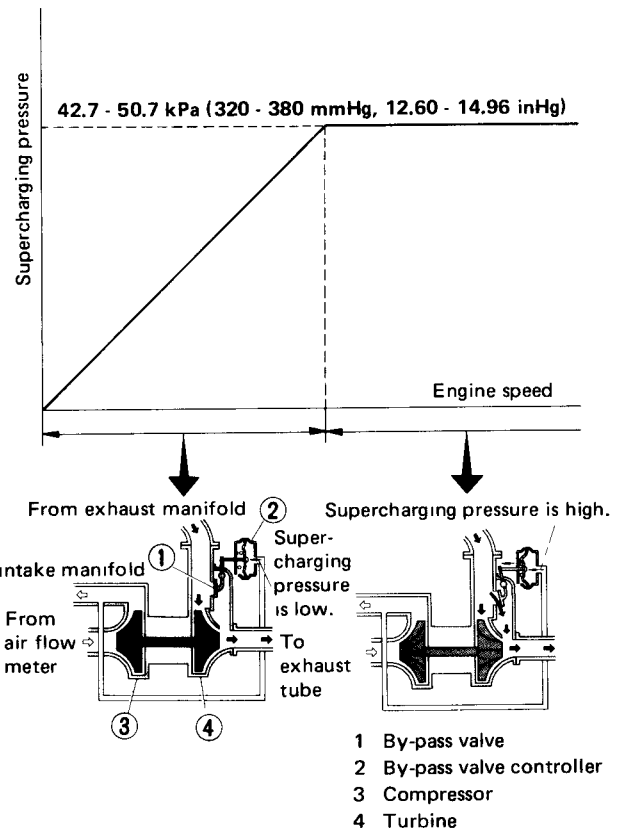


SEC303A

TURBOCHARGER

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

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



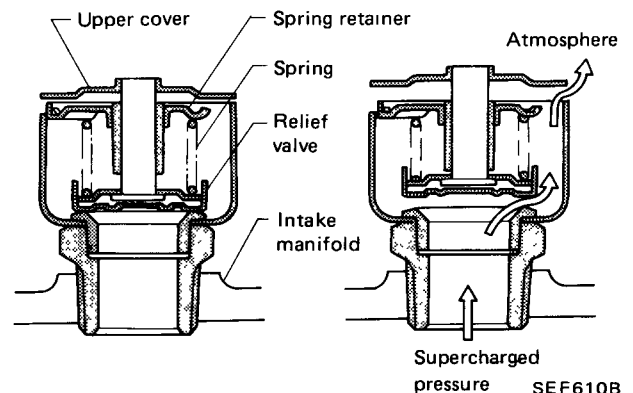
SEF609B

EMERGENCY RELIEF VALVE

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

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

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



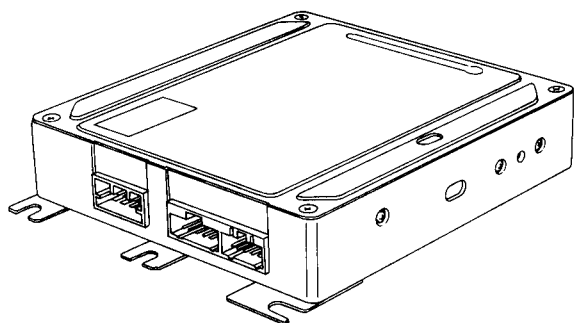
SEF610B

E.C.C.S. COMPONENT DESCRIPTION

E. C. C. S. Components

E.C.C.S. CONTROL UNIT

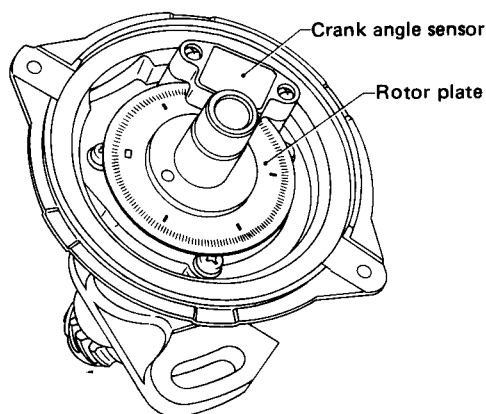
The E.C.C.S. control unit consists of a micro-computer, connectors for signal input and output and power supply, inspection lamps and diagnostic mode selector. The control unit controls the amount of fuel that is injected, ignition timing, idle speed, E.G.R., fuel pump operation, feedback of the mixture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



SEF611B

CRANK ANGLE SENSOR

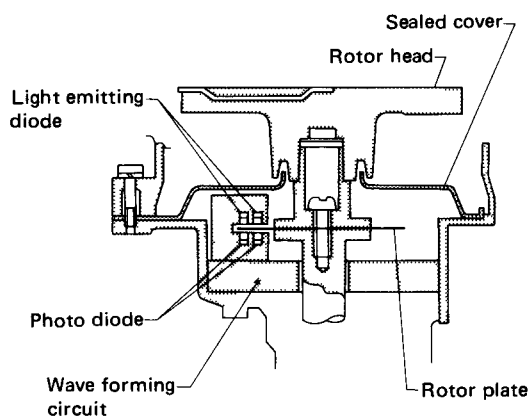
The crank angle sensor is a basic signal sensor for the entire E.C.C.S. It monitors engine speed and piston position, and it sends signals to the E.C.C.S. control unit for control of fuel injection, ignition timing, idle speed, fuel pump operation and E.G.R. operation.



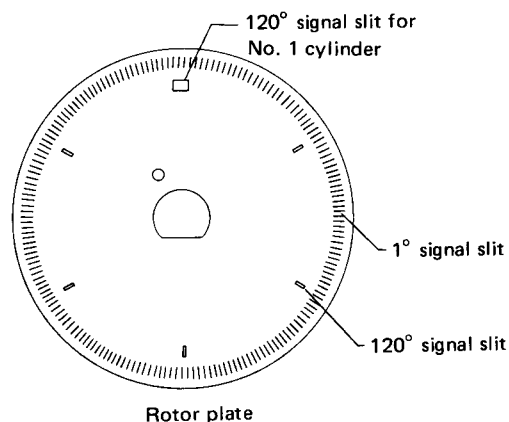
SEF612B

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

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



SEF613B



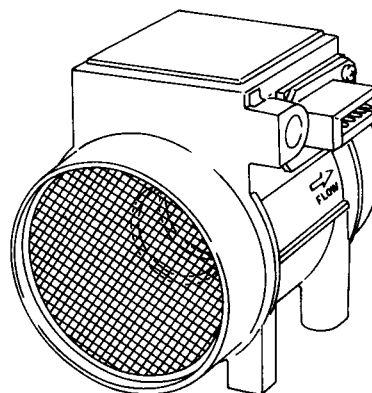
SEF614B

E.C.C.S. COMPONENT DESCRIPTION

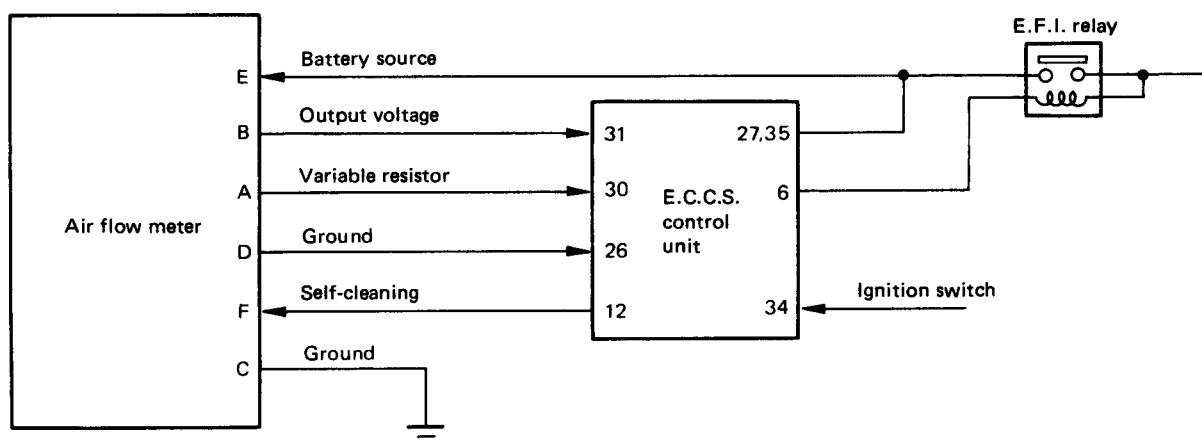
E.C.C.S. Components (Cont'd)

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.

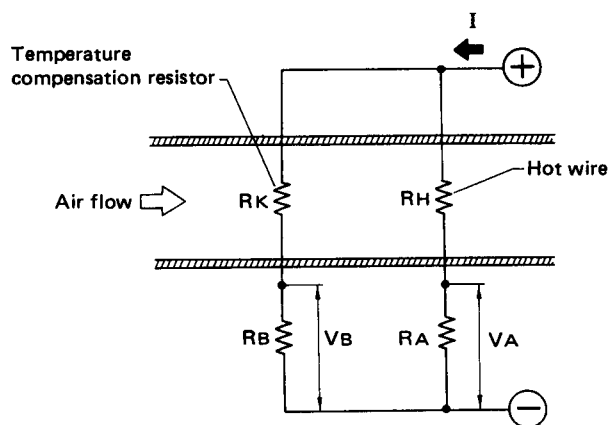


SEF615B



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.



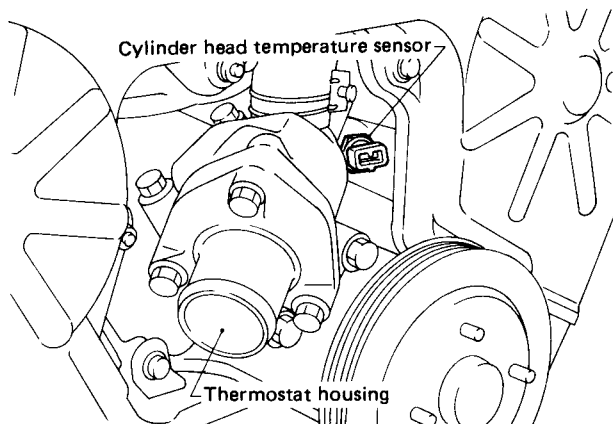
R_H : Hot wire resistance
 R_K : Temperature compensation resistance
 R_A, R_B : Constant resistance

SEF617B

E.C.C.S. COMPONENT DESCRIPTION

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

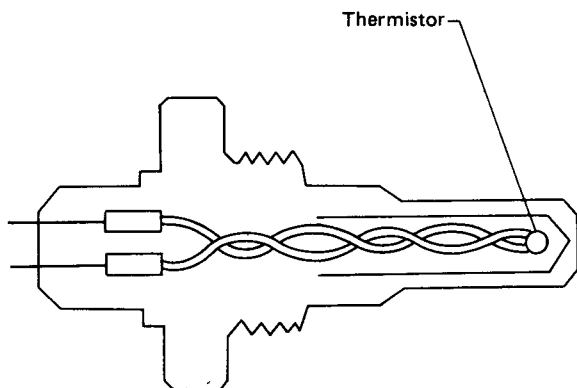
CYLINDER HEAD TEMPERATURE SENSOR



SEF619B

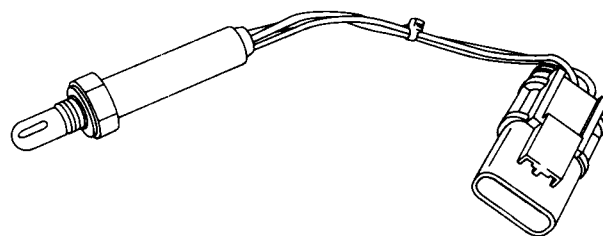
The cylinder head temperature sensor, built into the cylinder head, monitors changes in cylinder head temperature and transmits a signal to the E.C.C.S. control unit.

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



SEF620B

EXHAUST GAS SENSOR



SEF397D

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

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

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

E.C.C.S. COMPONENT DESCRIPTION

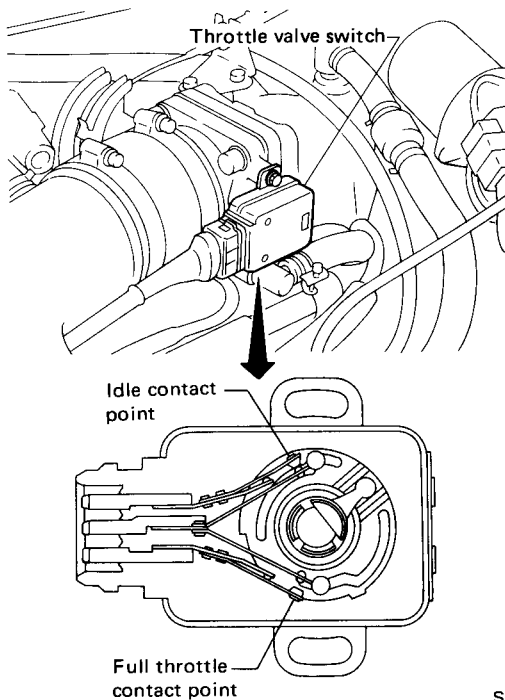
E.C.C.S. Components (Cont'd)

THROTTLE VALVE SWITCH

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

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

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

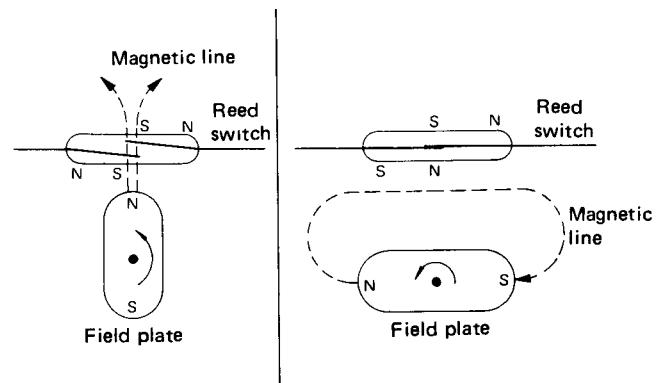


VEHICLE SPEED SENSOR (VG30ET engine only)

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

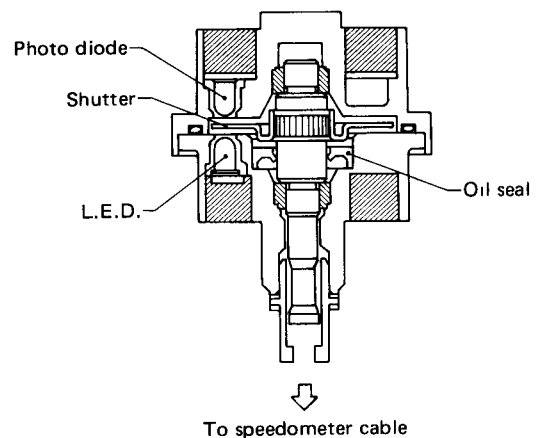
- **Needle type speedometer models**

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



- **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.

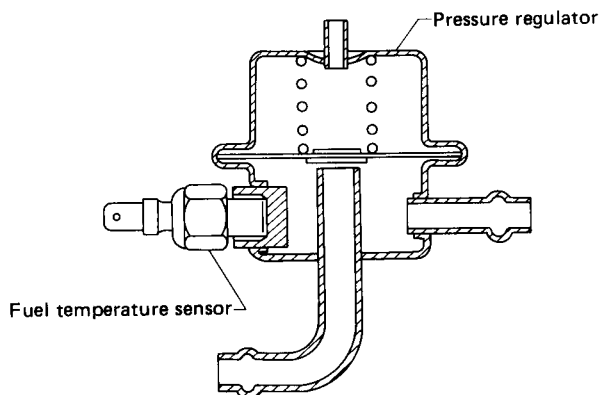


E.C.C.S. COMPONENT DESCRIPTION

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

FUEL TEMPERATURE SENSOR

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

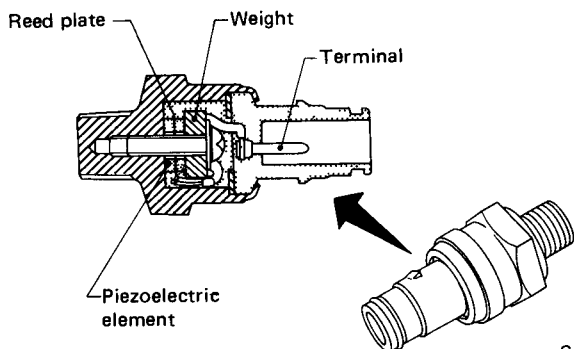


SEF625B

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

DETONATION SENSOR (VG30ET engine only)

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

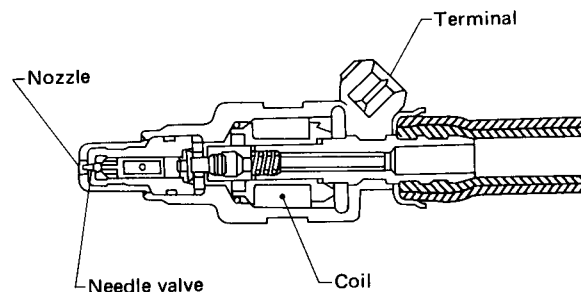


SEF626B

FUEL INJECTOR

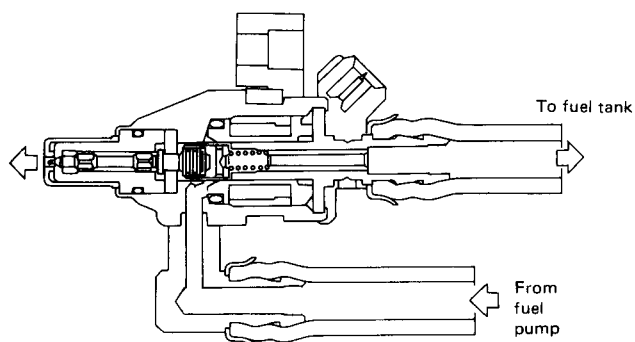
The fuel injector is a small, precision solenoid valve. As the E.C.C.S. control unit outputs an injection signal to each fuel injector, the coil built into the injector pulls the needle valve back, and fuel is injected through the nozzle to intake manifold. The amount of fuel injected is controlled by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

Conventional type



SEF627B

Bottom feed type



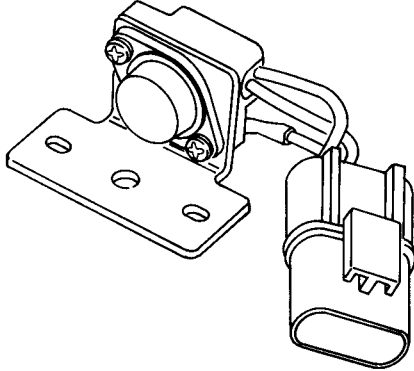
SEF484D

E.C.C.S. COMPONENT DESCRIPTION

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

POWER TRANSISTOR

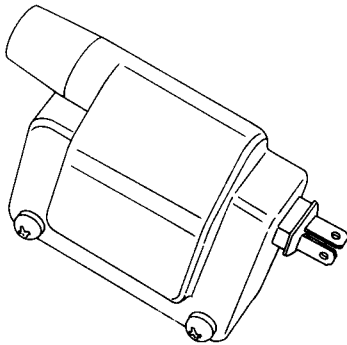
The ignition signal from the E.C.C.S. control unit is amplified by the power transistor, which connects and disconnects the coil primary circuit to induce the proper high voltage in the secondary circuit.



SEF162C

IGNITION COIL

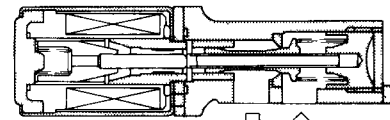
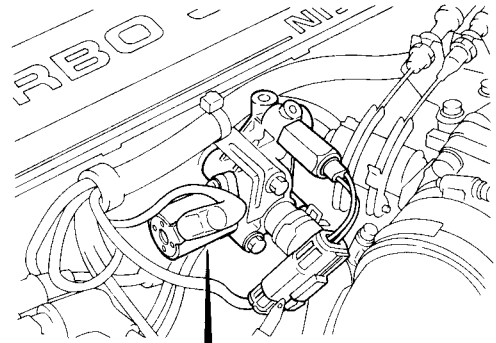
The ignition coil is a molded type.



SEF629B

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

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

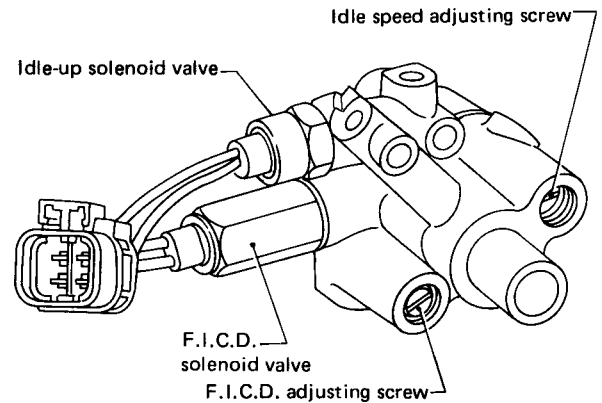


Air

SEF630B

IDLE-UP SOLENOID VALVE (VG30E engine only)

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



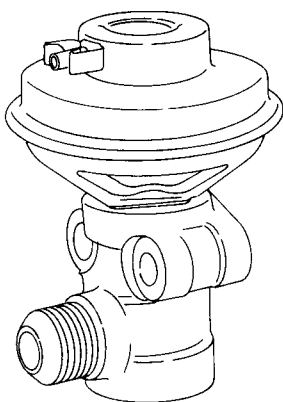
SEF130C

E.C.C.S. COMPONENT DESCRIPTION

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

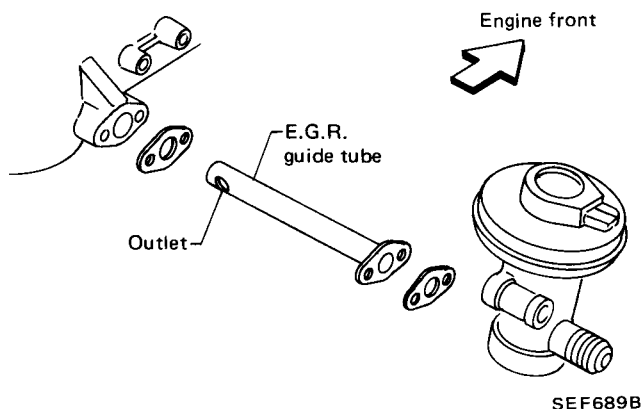
E.G.R. CONTROL VALVE

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



SEF632B

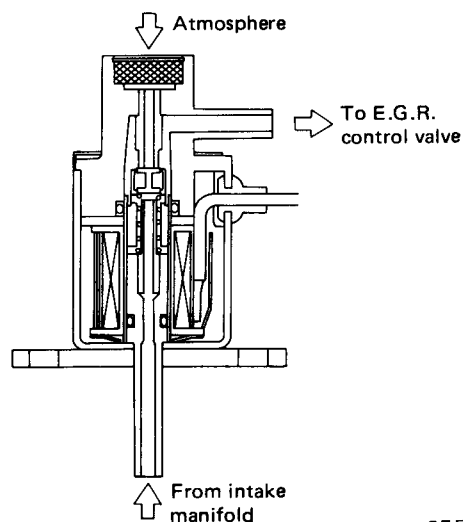
When installing the E.G.R. guide tube, be careful of its direction. The outlet faces the rear of the engine. Otherwise the distribution efficiency of the exhaust gas will be reduced.



SEF689B

E.G.R. CONTROL SOLENOID VALVE

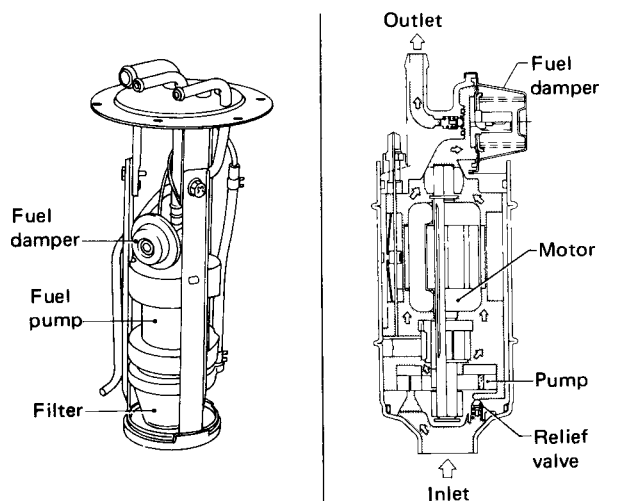
The E.G.R. control solenoid valve cuts the intake manifold vacuum signal for E.G.R. control. The solenoid valve actuates in response to the ON/OFF signal from the E.C.C.S. control unit. When the solenoid is off, a vacuum signal from the intake manifold is fed into the E.G.R. control valve. As the control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



SEF633B

FUEL PUMP

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



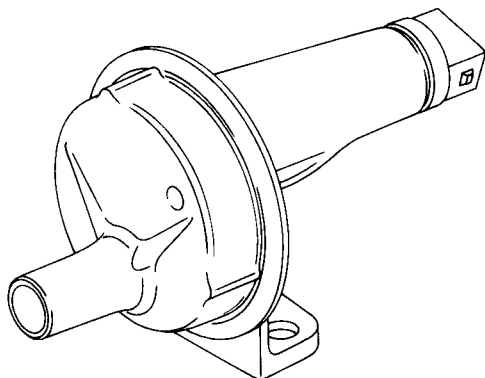
SEF634B

E.C.C.S. COMPONENT DESCRIPTION

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

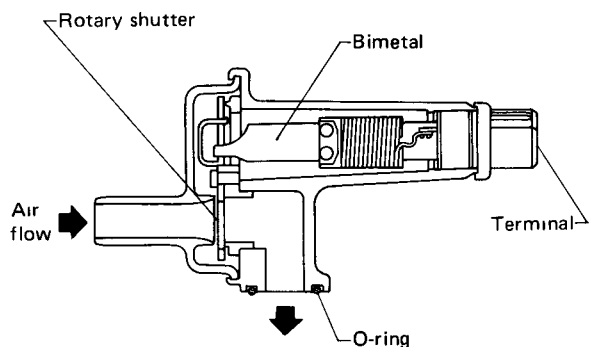
AIR REGULATOR

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



SEF635B

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

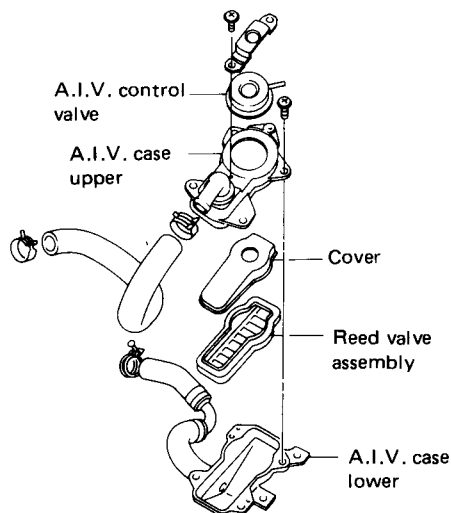


SEF636B

AIR INJECTION VALVE (A.I.V.)

The air injection valve sends secondary air to the exhaust manifold, utilizing a vacuum caused by exhaust pulsation in the exhaust manifold. When

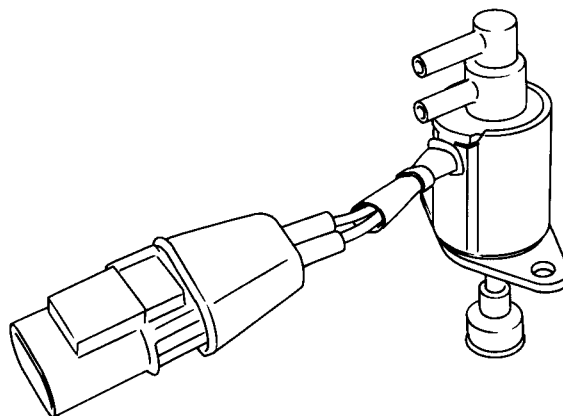
the exhaust pressure is below atmospheric pressure (negative pressure), secondary air is sent to the exhaust manifold. When the exhaust pressure is above atmospheric pressure, the reed valves prevent secondary air from being sent back to the air cleaner.



SEF485D

A.I.V. CONTROL SOLENOID VALVE

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



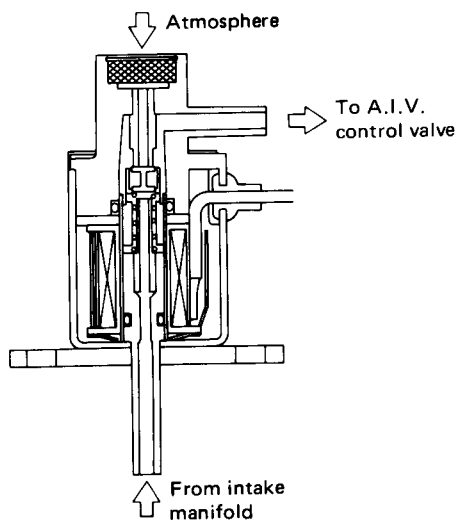
SEF402C

E.C.C.S. COMPONENT DESCRIPTION

— E.C.C.S. Components (Cont'd)

PRESSURE REGULATOR CONTROL SOLENOID VALVE

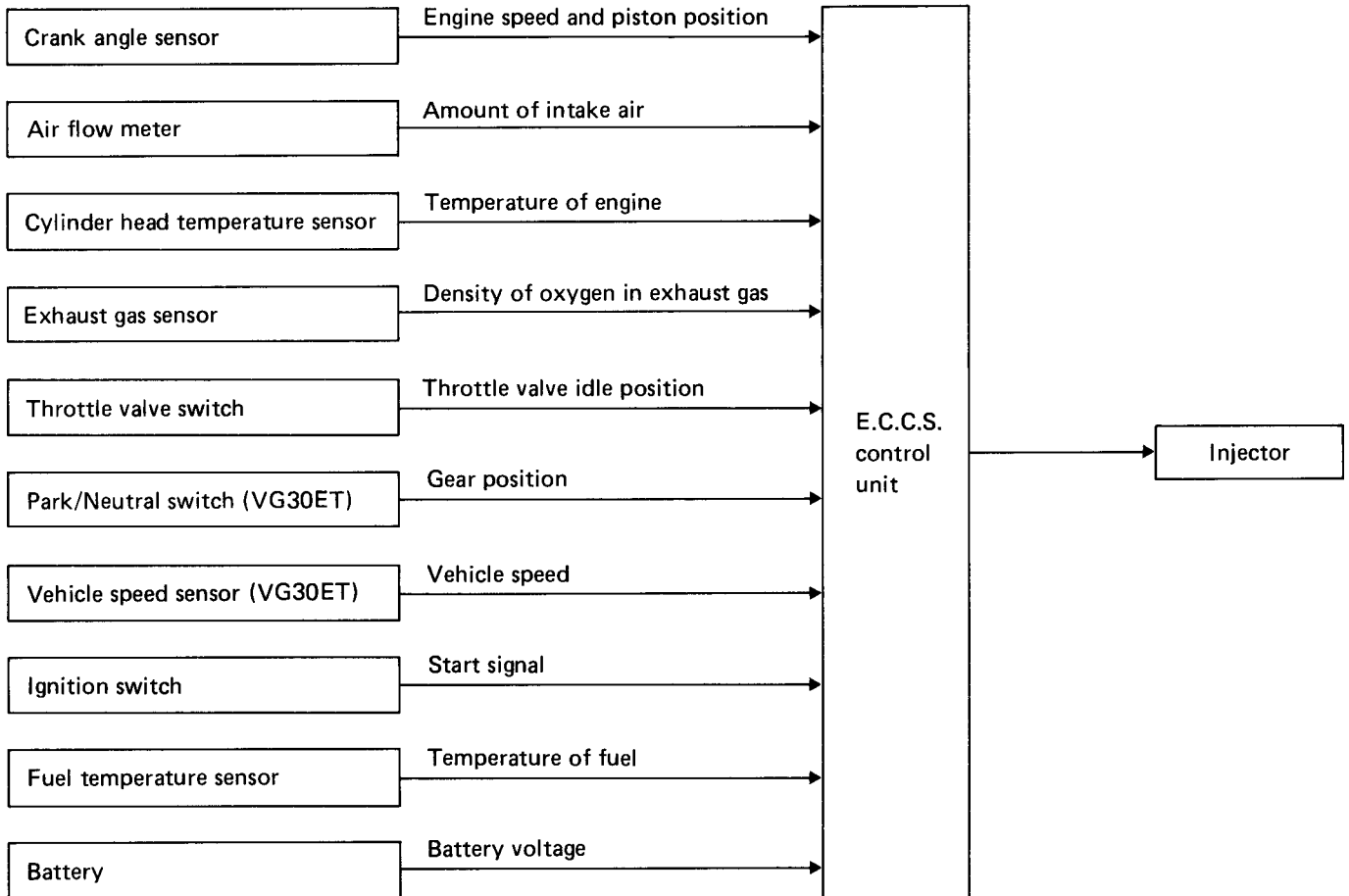
The pressure regulator control solenoid valve cuts the intake manifold vacuum signal for pressure regulator control. The solenoid valve actuates in response to the ON/OFF signal from the E.C.C.S. control unit. When it is off, a vacuum signal from the intake manifold is fed into the pressure regulator.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



SEF633B

E.C.C.S. SYSTEM DESCRIPTION

Fuel Injection Control

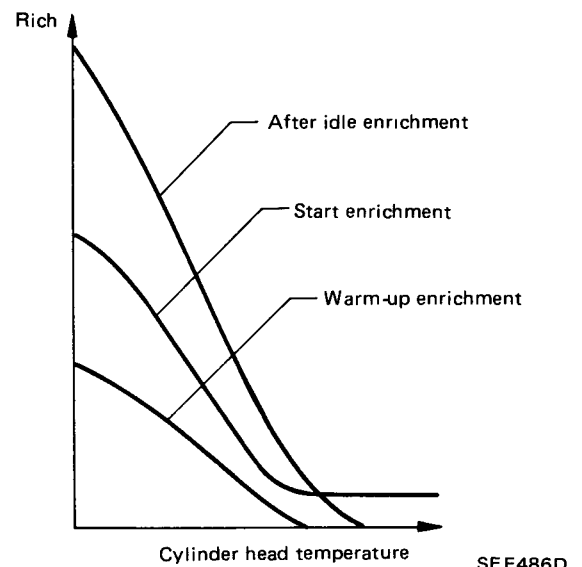


The E.C.C.S. control unit calculates the basic injection pulse width by processing signals from crank angle sensor and air flow meter. Receiving signals from each sensor which detects various engine conditions, the E.C.C.S. control unit adds various enrichments, which are pre-programmed in the control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

1) Fuel enrichment

In each of the following conditions, fuel is enriched.

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



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

E.C.C.S. SYSTEM DESCRIPTION

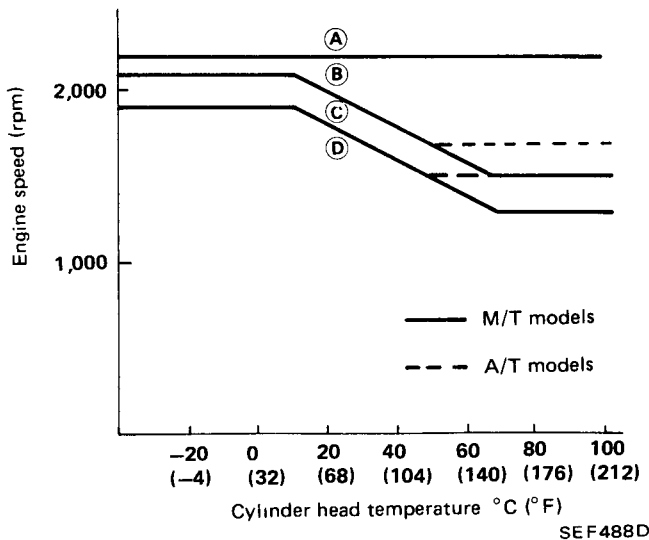
Fuel Injection Control (Cont'd)

2) Fuel shut-off

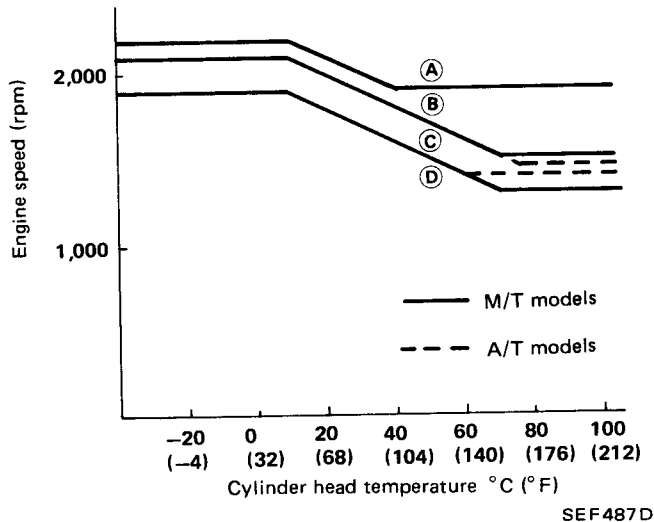
Fuel shut-off is accomplished under the following conditions:

a. During deceleration

VG30E engine



VG30ET engine



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

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

b. High engine speed

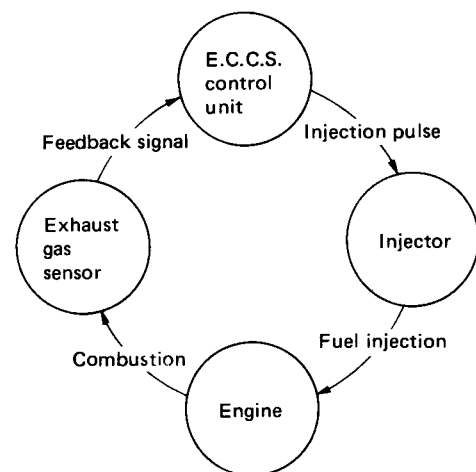
When engine speed is more than 6,500 rpm, fuel is shut-off for safety reasons.

c. High vehicle speed (VG30ET engine only)

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

3) Mixture ratio feedback control

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



SEF639B

However, this system will open under the following conditions:

- When starting engine.

E.C.C.S. SYSTEM DESCRIPTION

Fuel Injection Control (Cont'd)

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

4) Injection timing

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

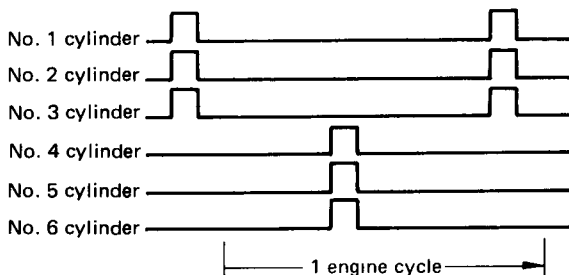
In other words, pulse signals of the same width are simultaneously transmitted from the E.C.C.S. control unit to the six injectors two times for each engine cycle.

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

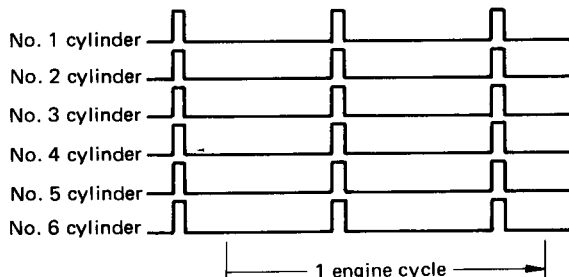
When any of the following conditions are met, fuel injection shifts to simultaneous injection from group injection.

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

• Group injection



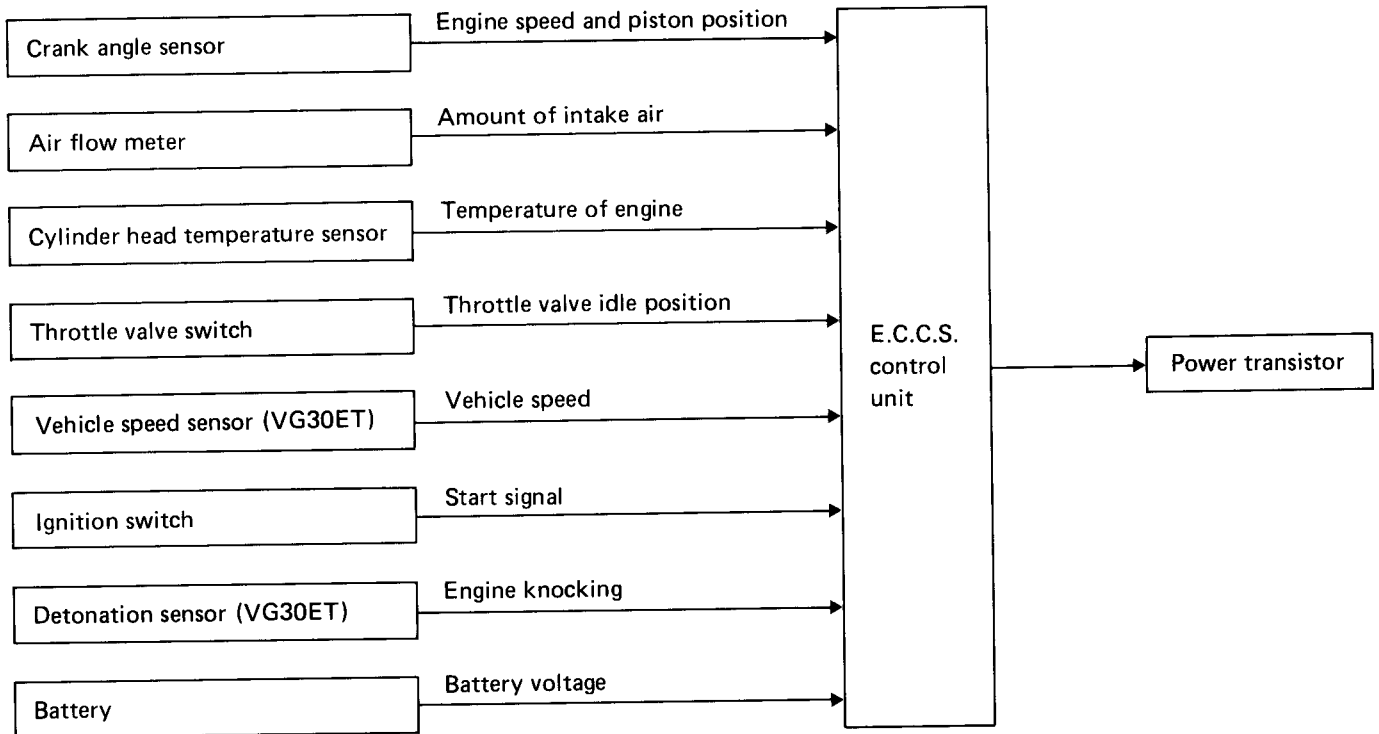
• Simultaneous injection



SEF640B

E.C.C.S. SYSTEM DESCRIPTION

Ignition Timing Control



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

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

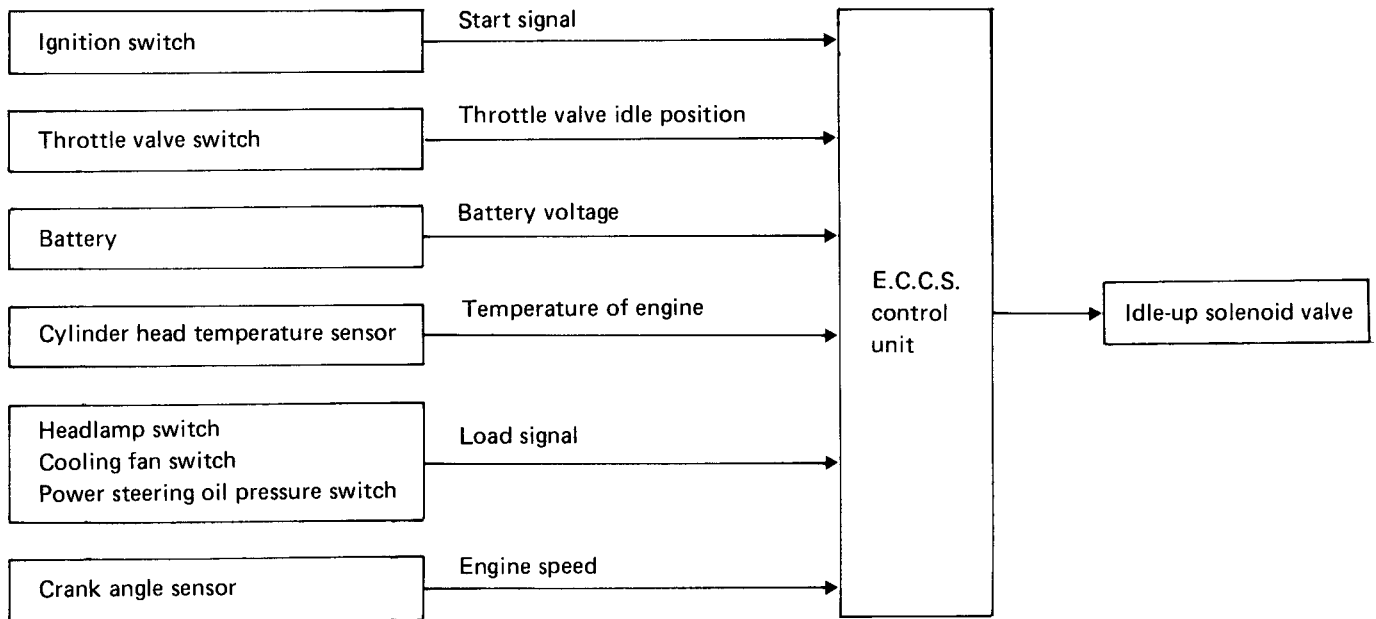
Detonation feedback operation

The retard system by detonation sensor is designed only for emergencies on VG30ET engines. The basic ignition timing is pre-programmed within the anti-knocking zone, even if recommended fuel is used under dry conditions. Consequently, the retard system does not operate under normal driving conditions.

However, if engine knocking occurs, the detonation sensor monitors the knocking condition and the signal is transmitted to the E.C.C.S. control unit. After receiving it, the control unit retards the ignition timing to avoid the knocking condition.

E.C.C.S. SYSTEM DESCRIPTION

Idle-up Control (VG30E engine)



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

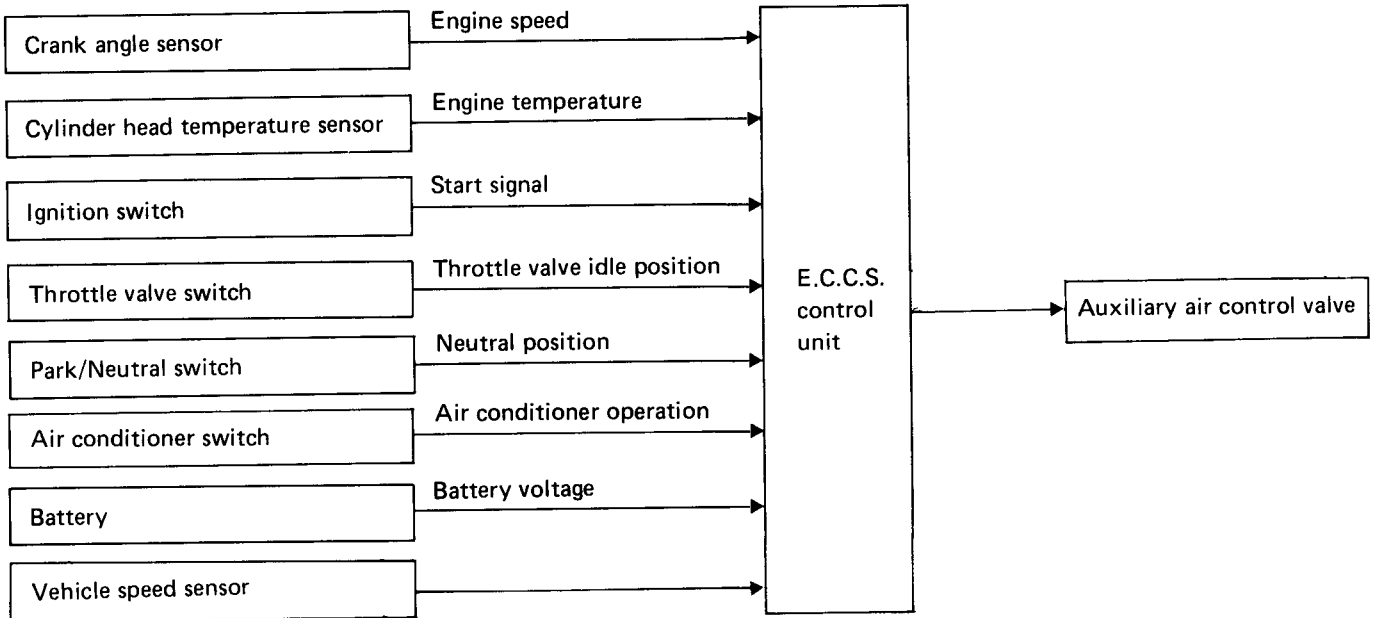
The control unit senses the idle condition, and determines ON/OFF signal. The signal from the control unit is transmitted to the idle-up solenoid valve to stabilize idle speed.

Operation

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

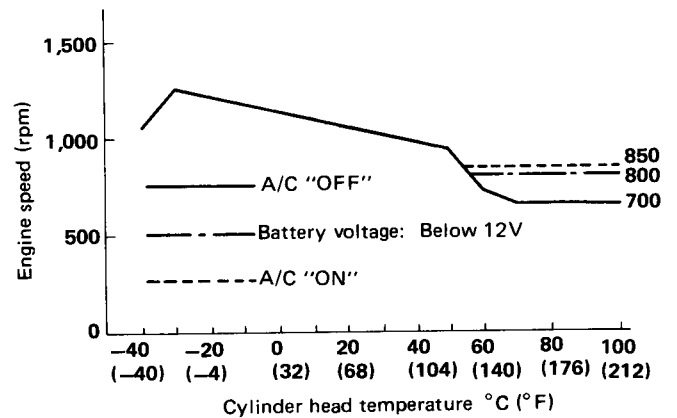
E.C.C.S. SYSTEM DESCRIPTION

Idle Speed Control (VG30ET engine)



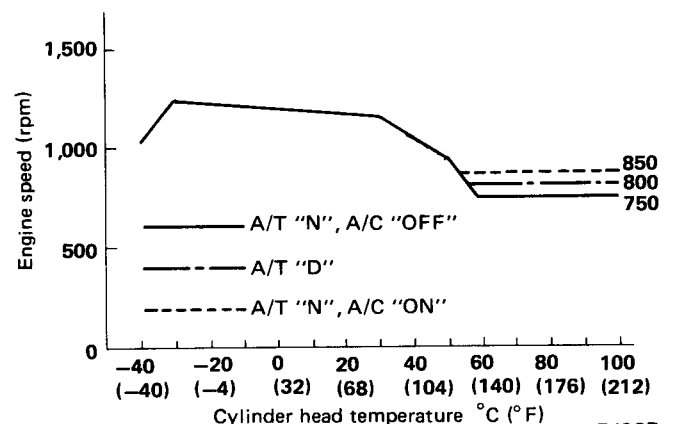
The idle speed is controlled by the E.C.C.S. control unit, corresponding to the engine operating conditions. The E.C.C.S. control unit senses the engine condition and determines the best idle speed at each cylinder head temperature and gear position. The control unit then sends an electronic signal corresponding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

M/T models



SEF489D

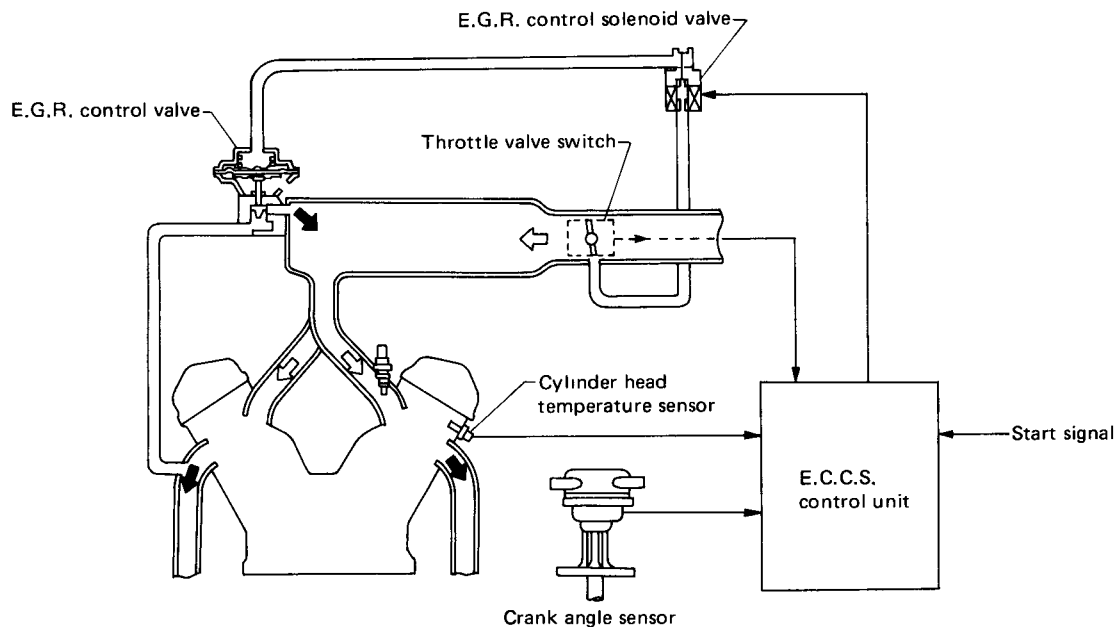
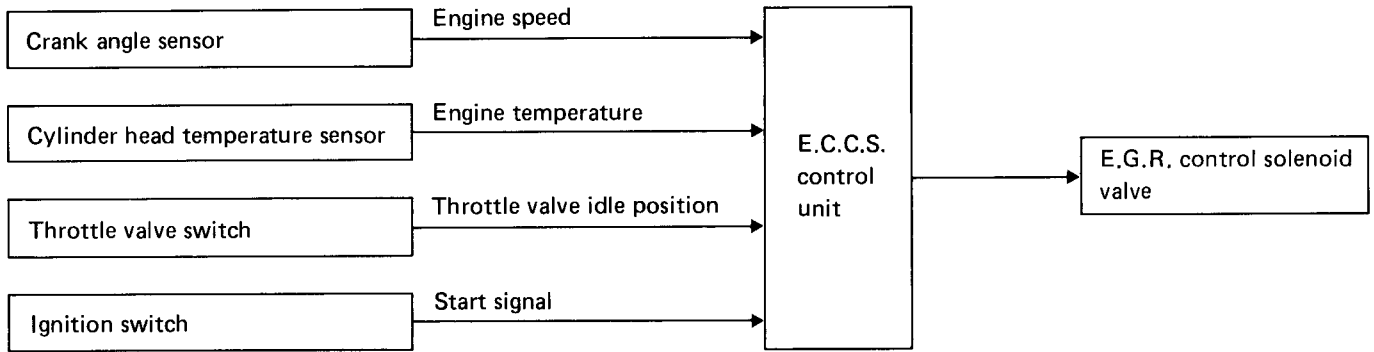
A/T models



SEF490D

E.C.C.S. SYSTEM DESCRIPTION

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



SEF642B

OPERATION

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

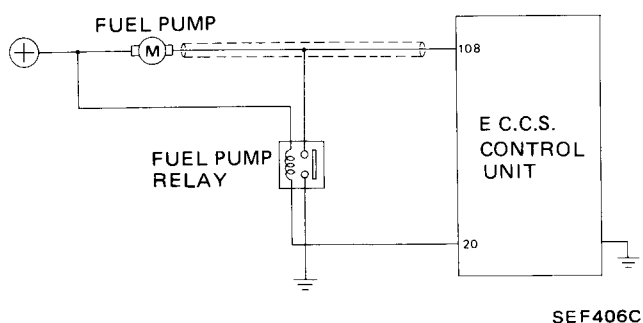
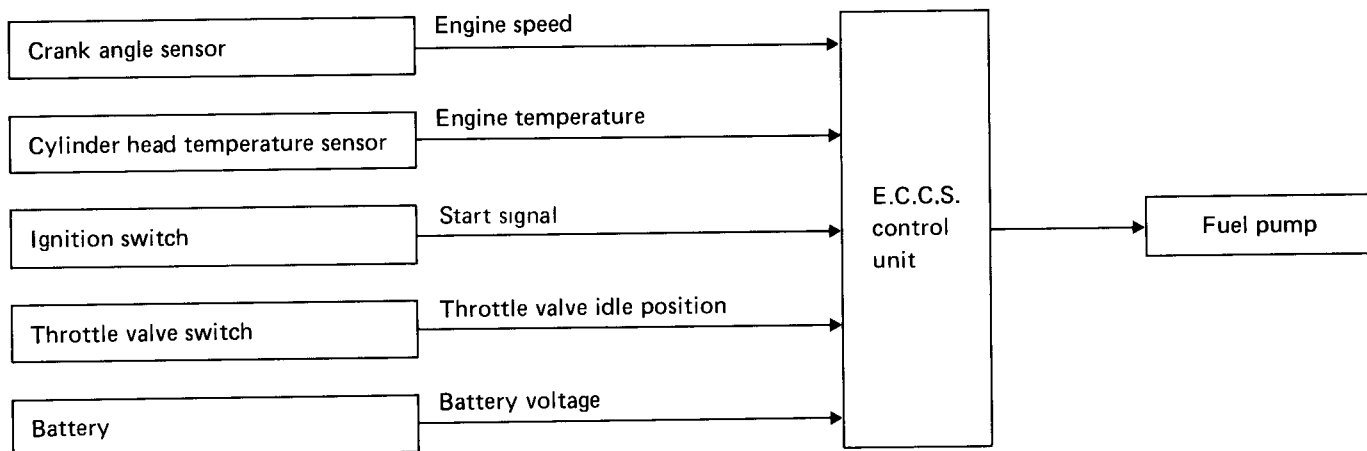
When the E.G.R. control valve is open, some of the exhaust gas is led from the exhaust manifold to the E.G.R. tube. The exhaust gas is then regulated by E.G.R. valve, and is introduced into the intake manifold.

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

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

E.C.C.S. SYSTEM DESCRIPTION

Fuel Pump Control



Description

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

Fuel pump ON-OFF control

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

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

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

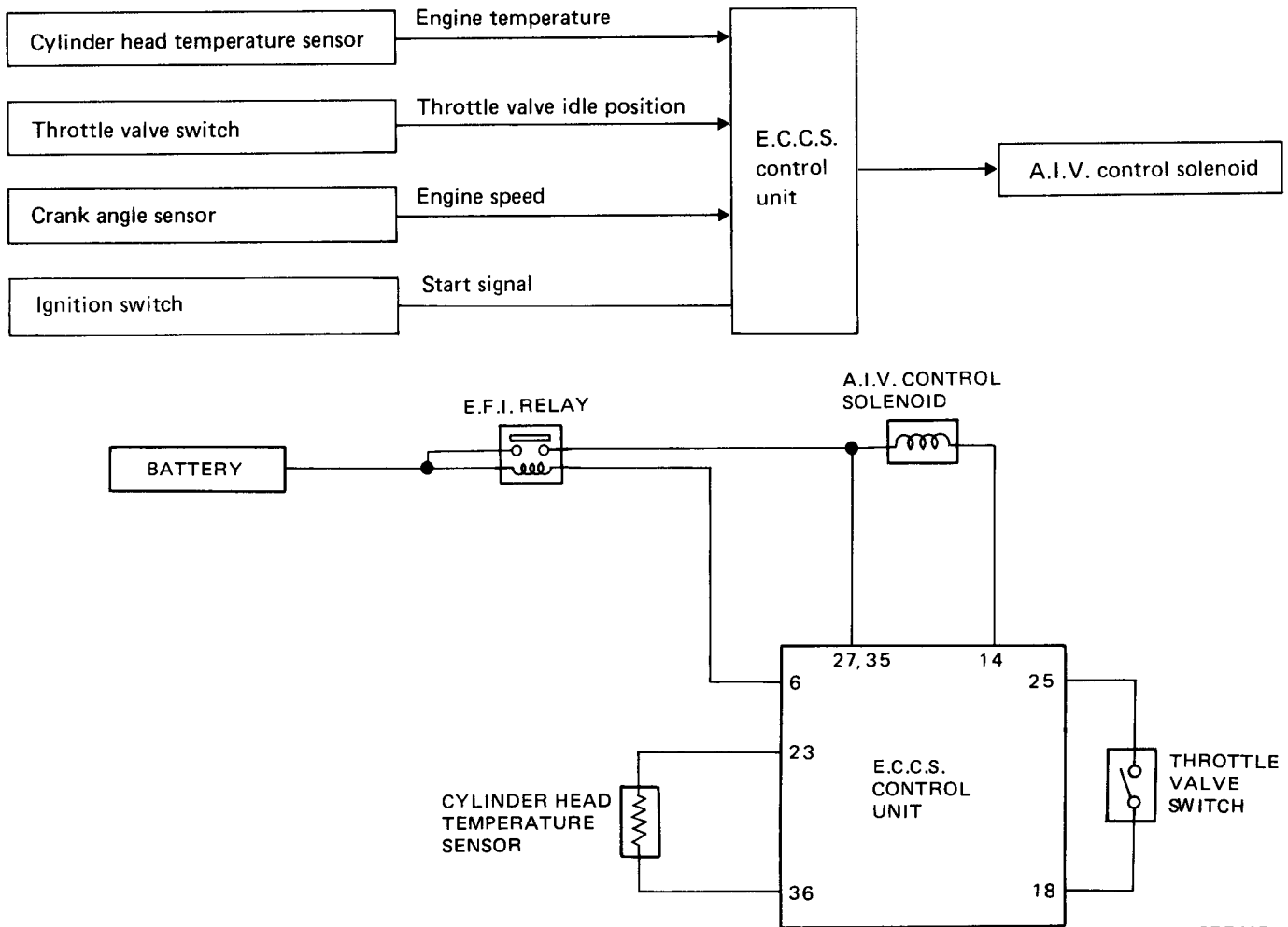
Condition	Fuel pump relay operation	Fuel pump operation
Ignition switch is turned to ON	ON for 5 seconds	Operates for 5 seconds
When engine is starting [Engine temp.: above 100°C (212°F)]	ON	Operates
After started [Engine temp.: above 100°C (212°F)]	ON for 30 seconds	Operates
When engine stalls and except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

Fuel pump voltage control

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

E.C.C.S. SYSTEM DESCRIPTION

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



SEF405C

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

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

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

The air injection valve is controlled by the E.C.C.S.

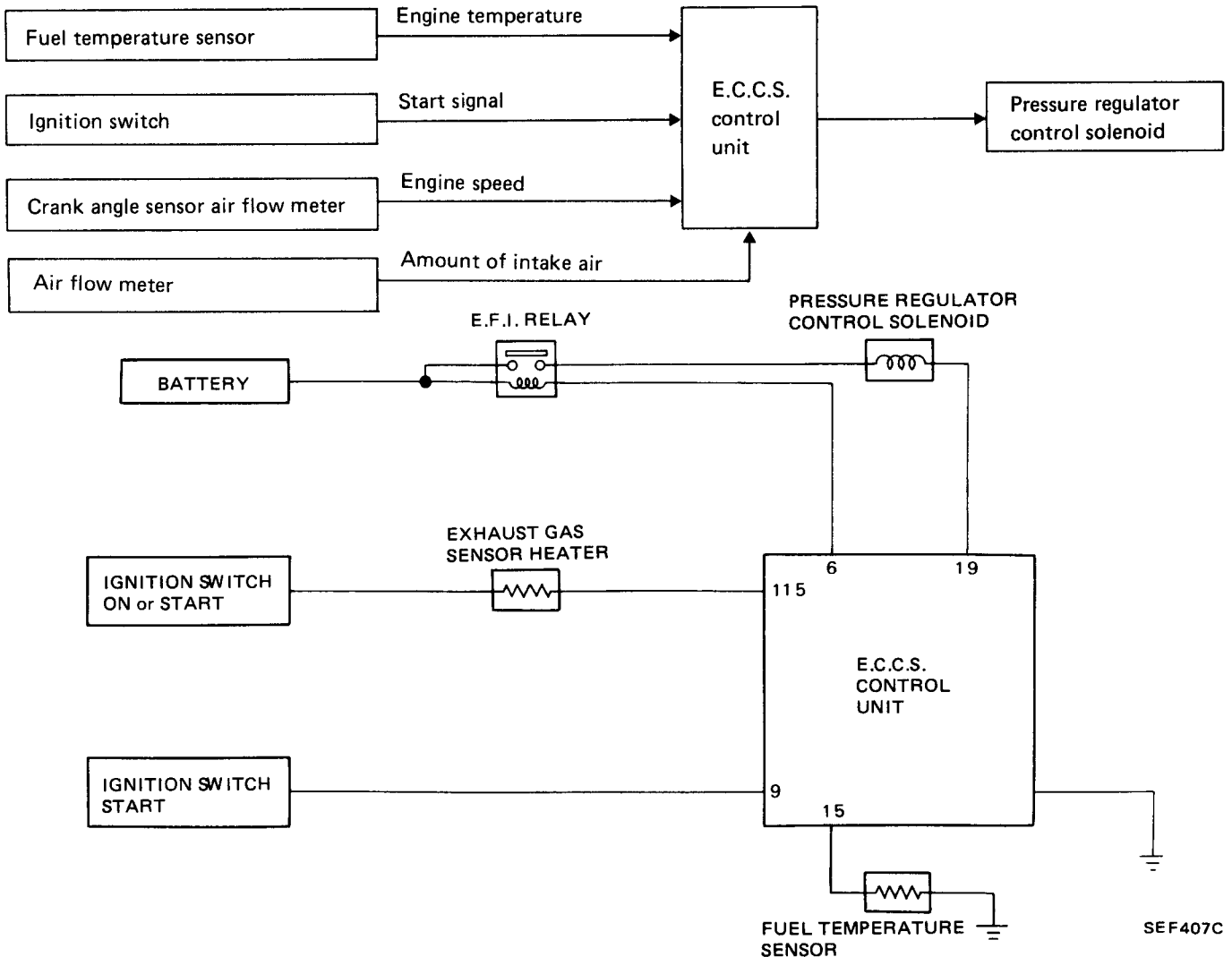
control unit, corresponding to the engine temperature. When the engine is cold, the A.I.V. control system operates to activate the 3-way catalytic converter quickly. This system also operates during deceleration for the purpose of blowing off water around the air injection valve.

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

*: Including cylinder head temperature sensor circuit malfunctioning

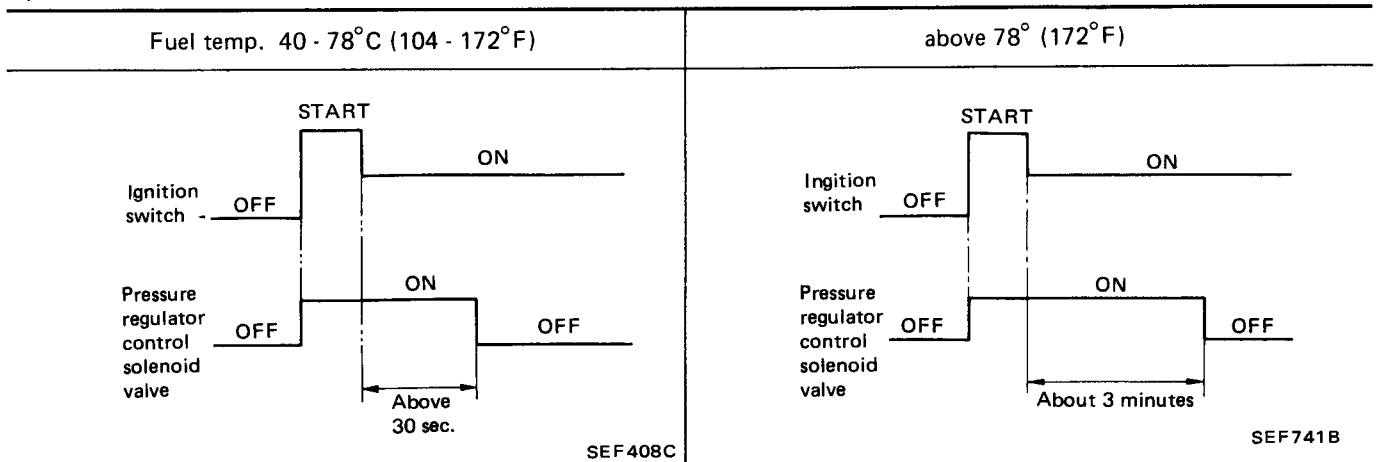
E.C.C.S. SYSTEM DESCRIPTION

Pressure Regulator Control



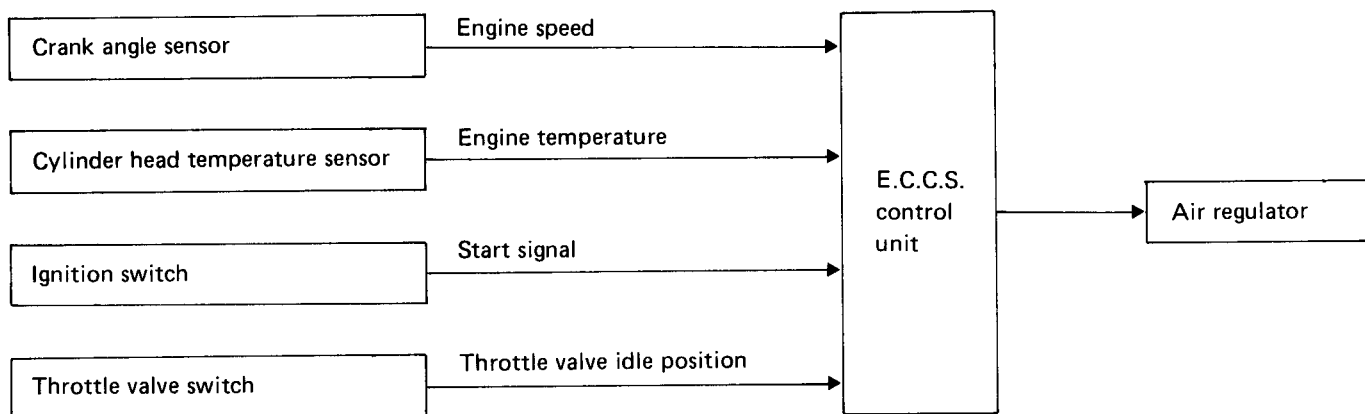
This system improves the startability of a hot engine by cutting off the intake manifold vacuum and increasing the fuel pressure.

Operation



E.C.C.S. SYSTEM DESCRIPTION

Air Regulator Control



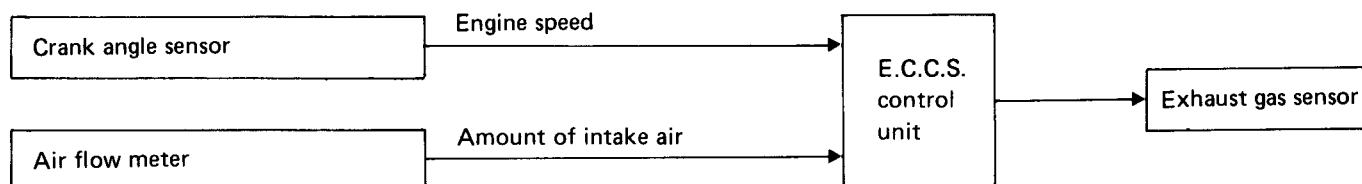
Description

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

Operation (Air regulator ON-OFF control)

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

Exhaust Gas Sensor Heater Control



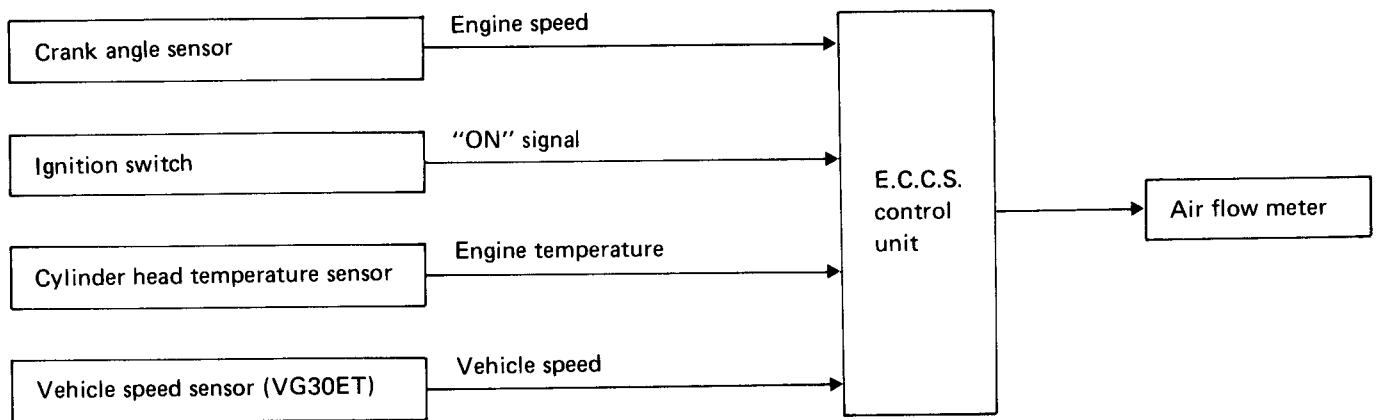
The E.C.C.S. control unit controls the heater operation in the following way.

Operation

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

E.C.C.S. SYSTEM DESCRIPTION

Air Flow Meter Self-cleaning Control

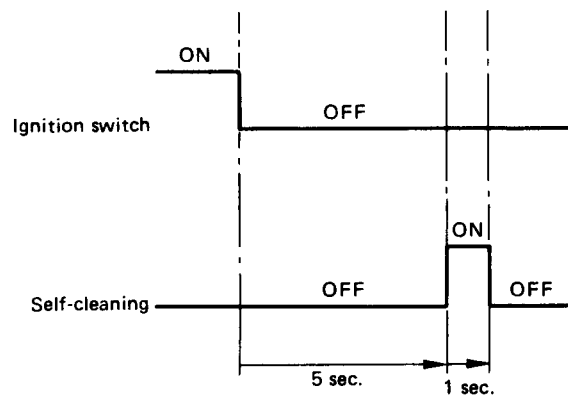


Description

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

Operation

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



SEF618B

E.C.C.S. SYSTEM DESCRIPTION

Fail-safe System

AIR FLOW METER

Description

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

Operation

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

CYLINDER HEAD TEMPERATURE SENSOR

Description

When the output signal of cylinder head temperature sensor is abnormal the E.C.C.S. control unit judges it as a malfunctioning of cylinder head temperature sensor.

The E.C.C.S. control unit decides the cylinder head temperature according to the time from ignition switch ON.

Operation

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

DIAGNOSTIC PROCEDURE

Caution

- a. Before connecting or disconnecting E.C.C.S. harness connectors to or from any E.C.C.S. unit, be sure to turn the ignition switch to the "OFF" position and disconnect the negative battery terminal.
Otherwise, there may be damage to control unit.
- b. Do not attempt to disassemble any E.C.C.S. component parts. To conduct electrical checks on these component parts, closely follow the steps outlined under "ELECTRONIC CONTROL SYSTEM INSPECTION" on pages EF & EC-50 through EF & EC-91.
- c. When conducting self-diagnosing, follow the steps outlined under "SELF-DIAGNOSIS" on pages EF & EC-44 through EF & EC-49 in order to obtain accurate diagnosing results. After self-diagnosis has been completed, erase the memory properly.
- d. Always turn the diagnosis mode selector carefully using a screwdriver. If it is turned forcibly, it may be damaged, resulting in the inability to perform the self-diagnosis or to monitor the mixture ratio.
- e. Never disconnect injector harness connectors with engine running. If disconnected, current will flow to other injectors instead of to the proper one, causing damage to the solenoid in the injector.

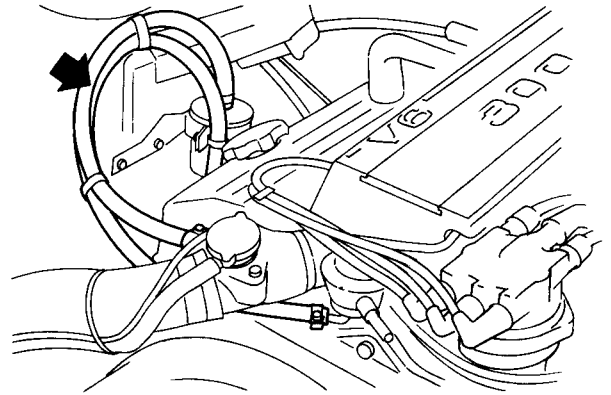
Tips on Diagnosis

1. Engine troubles are usually not caused by the E.C.C.S. system.
When trouble-shooting, always check the components listed below first.
 - a. Electric source
 - Battery charge
 - Fusible links
 - Fuses
 - b. Body ground

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

Expedient way to check fuel pressure

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



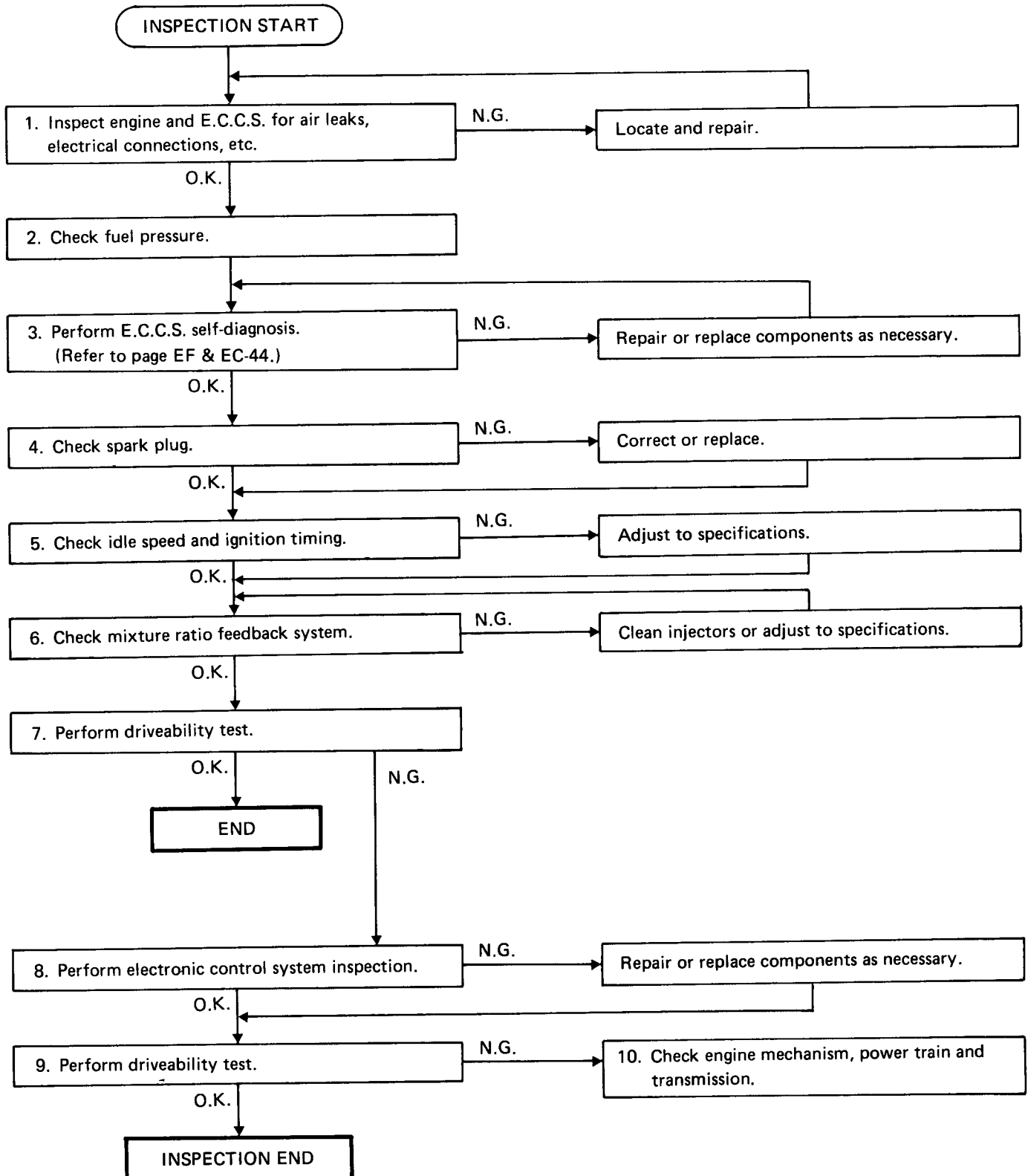
- d. Ignition system
 - Spark plug condition
 - High-tension wires
 - Distributor rotor and cap
 - Power transistor and ignition coil
- e. Air flow system
 - Vacuum leaks
 - Air leaks
- f. Emission control system
 - EGR system
 - PCV system
- g. Throttle valve switch adjustment

Refer to page EF & EC-63.

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

DIAGNOSTIC PROCEDURE

Driveability



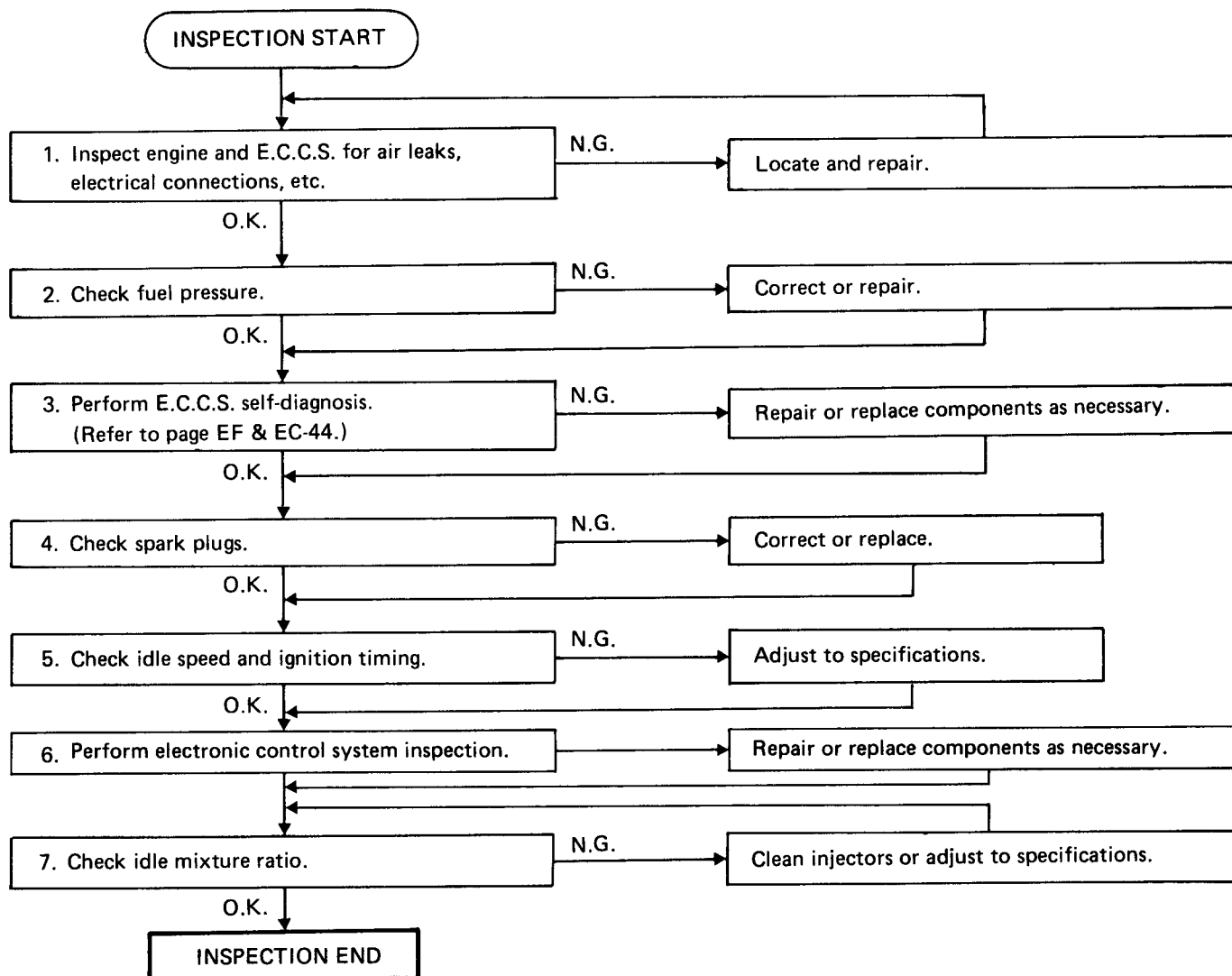
DIAGNOSTIC PROCEDURE

Driveability (Cont'd)

1. Inspect engine and E.C.C.S. for air leaks, proper electrical connections, etc.
- 1) Check all hoses, tubes and ducts for air leaks.
- 2) Check air cleaner filter for clogging.
- 3) Check harness connectors for proper connections.
- 4) Check ignition wiring.
- 5) Check gaskets for leaks at all air intake components.
- 6) Check E.G.R. valve operation.
- 7) Check air regulator operation.
- 8) Check idle-up solenoid valve/A.A.C. valve.
- 9) Check P.C.V. valve operation.
2. Check fuel pressure.
3. Perform E.C.C.S. self-diagnosis.
Follow the procedure in E.C.C.S. SELF-DIAGNOSIS (Page EF & EC-44).
4. Check spark plugs.
5. Check idle speed and ignition timing.
Follow the procedure in IDLE SPEED AND IGNITION TIMING INSPECTION (Page EF & EC-40).
6. Perform mixture ratio feedback system inspection.
Follow the procedure in MIXTURE RATIO FEEDBACK SYSTEM INSPECTION (Page EF & EC-91).
7. Perform driveability test.
Evaluate effectiveness of adjustments by driving vehicle. If unsatisfactory, proceed to step 8.
8. Perform electronic control system inspection.
Check the following using circuit tester.
 - Injector circuits
 - Air regulator circuit
 - E.G.R. control solenoid circuit
 - Exhaust gas sensor heater circuit
 - Air flow meter self-cleaning circuitFollow the procedure in ELECTRONIC CONTROL SYSTEM INSPECTION (Page EF & EC-50). -
9. Perform driveability test.
Re-evaluate vehicle performance.
10. Check engine mechanism, power train, transmission and exhaust system.
 - a. Engine mechanism
 - Compression pressure
 - Valve timing
 - b. Power train
 - Tire balance
 - Drive shaft balance
 - Clutch disc wear
 - c. Transmission
 - Check for abnormal noise and shift schedule (A/T).
 - d. Exhaust system
 - Clogged catalytic converter
 - Squeezed exhaust tube

DIAGNOSTIC PROCEDURE

Improper Idling and Stall

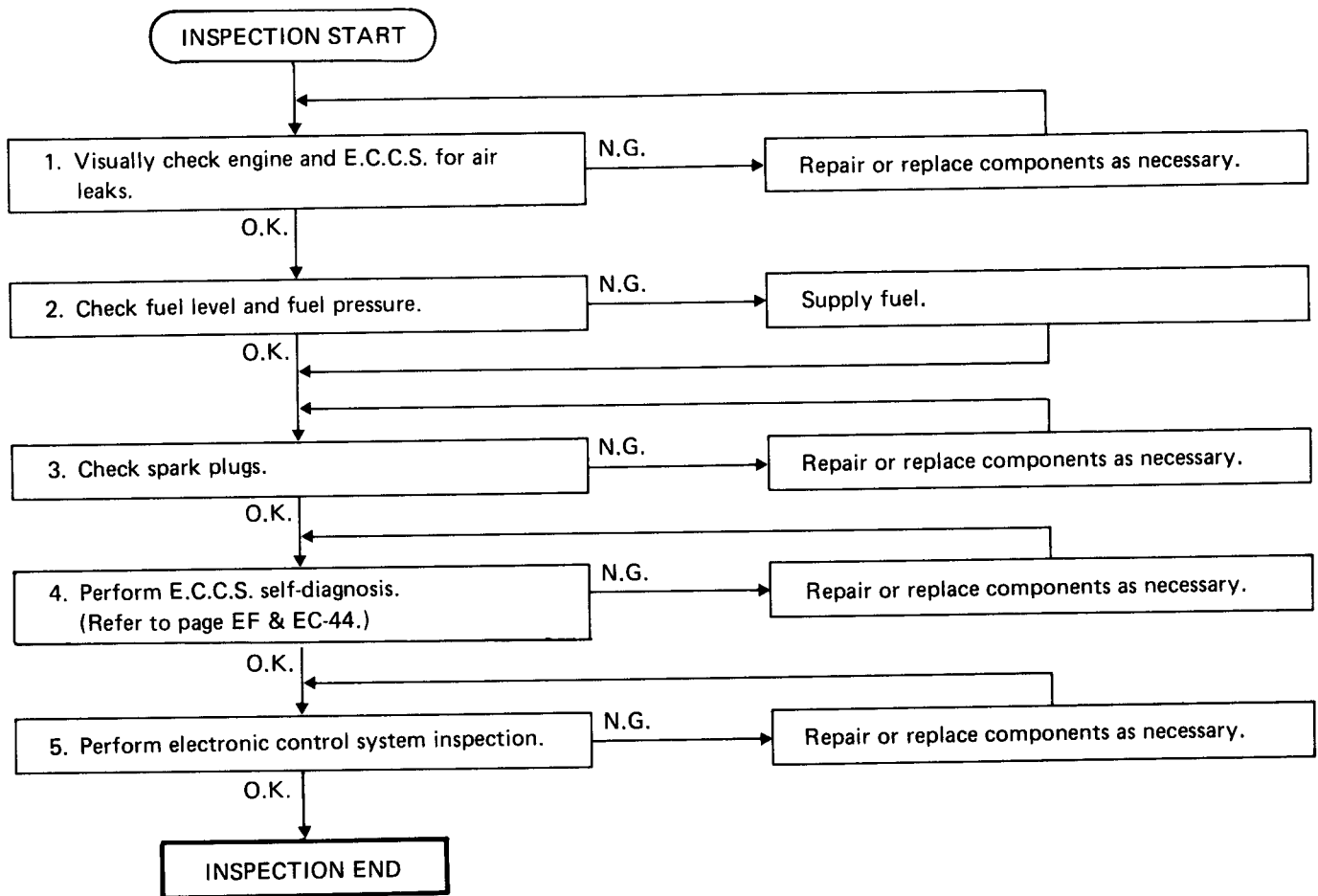


1. Inspect engine and E.C.C.S. for air leaks, electric connections, etc.
Refer to DRIVEABILITY.
2. Check fuel pressure.
3. Perform E.C.C.S. self-diagnosis.
Follow the procedure in E.C.C.S. SELF-DIAGNOSIS (Page EF & EC-44).
4. Check spark plugs.
5. Check idle speed and ignition timing.
Refer to Idle Speed and Ignition Timing Inspection.

6. Perform electronic control system inspection.
Check the following using circuit tester.
 - Injector circuit
 - Air regulator circuit
 - Idle-up solenoid valve/A.A.C. valve
 - E.G.R. control solenoid circuit
 - Pressure regulator control systemFollow the procedure in ELECTRONIC CONTROL SYSTEM INSPECTION (Page EF & EC-50).
7. Check idle mixture ratio.
Refer to Idle Mixture Ratio Inspection (Page EF & EC-43).

DIAGNOSTIC PROCEDURE

Engine Startability



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

- Injector circuit
 - Air regulator circuit
 - E.G.R. control system
- Follow the procedure in ELECTRONIC CONTROL SYSTEM INSPECTION (Page EF & EC-50).

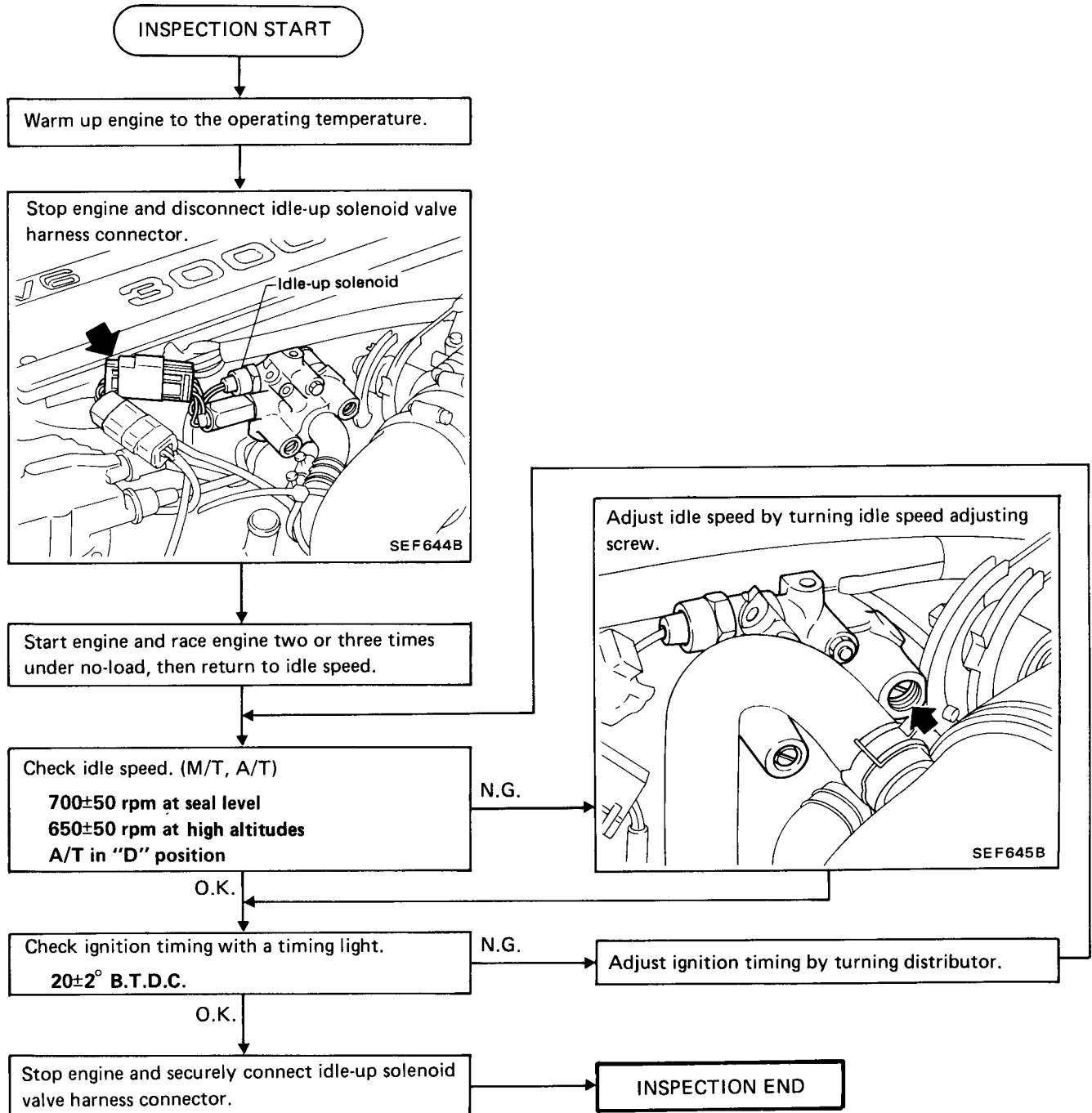
DIAGNOSTIC PROCEDURE

Idle Speed and Ignition Timing Inspection

PREPARATION

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

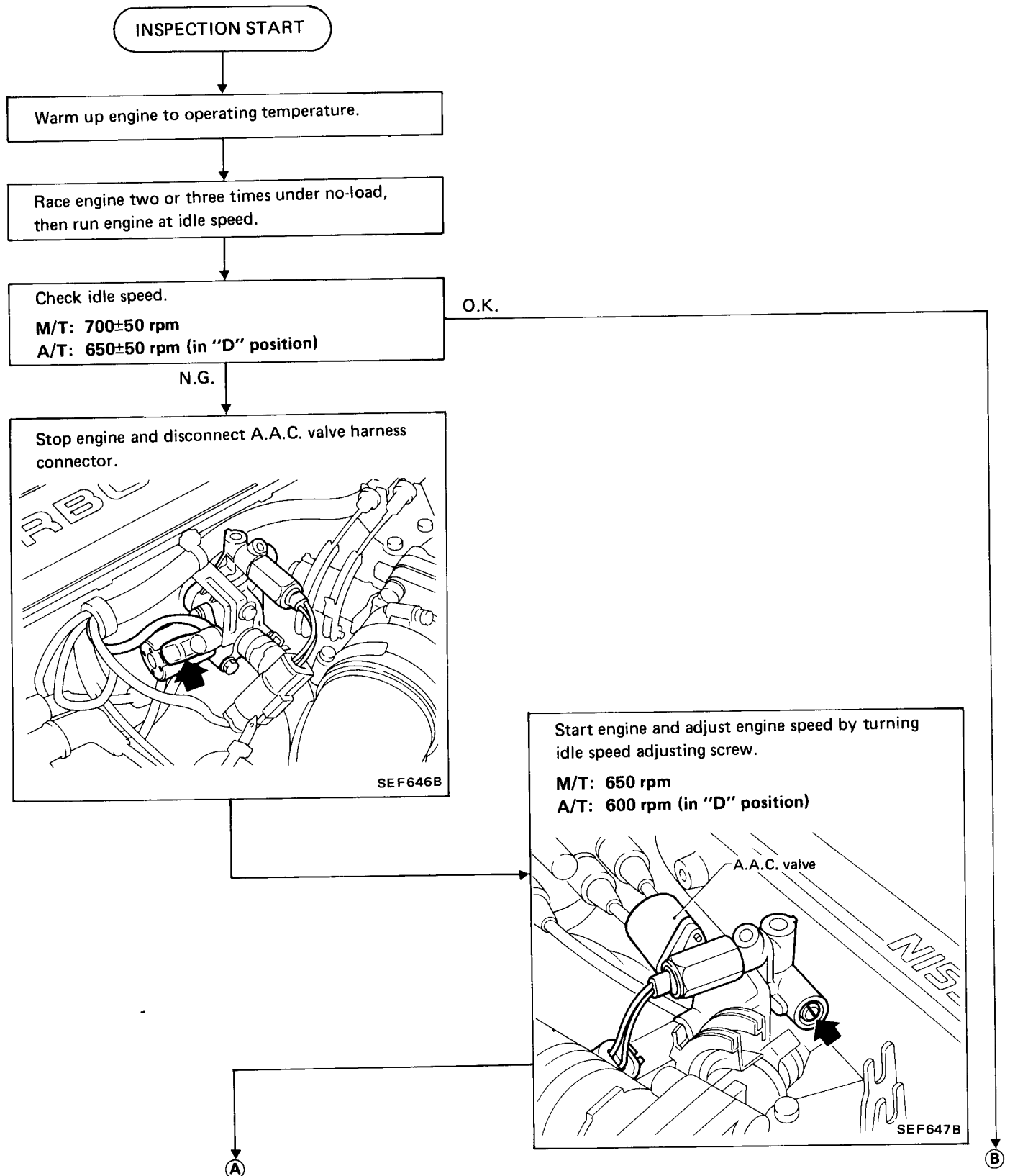
INSPECTION PROCEDURE (VG30E engine)



DIAGNOSTIC PROCEDURE

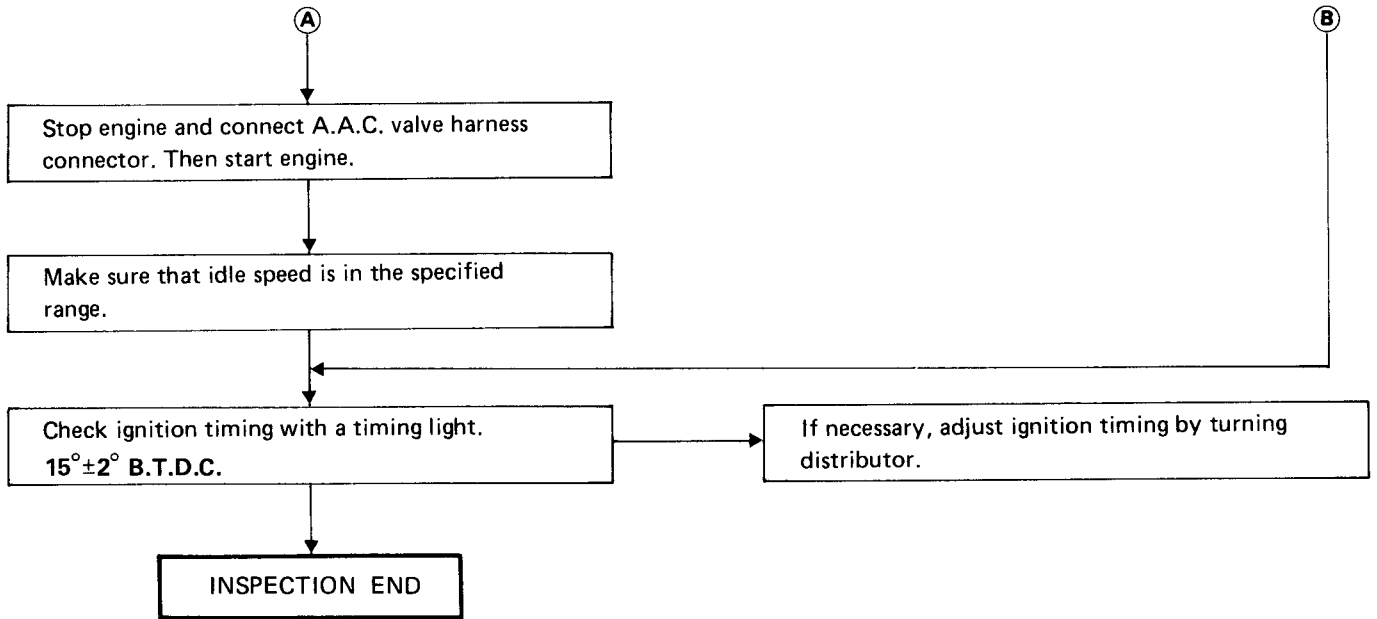
Idle Speed and Ignition Timing Inspection (Cont'd)

INSPECTION PROCEDURE (VG30ET engine)



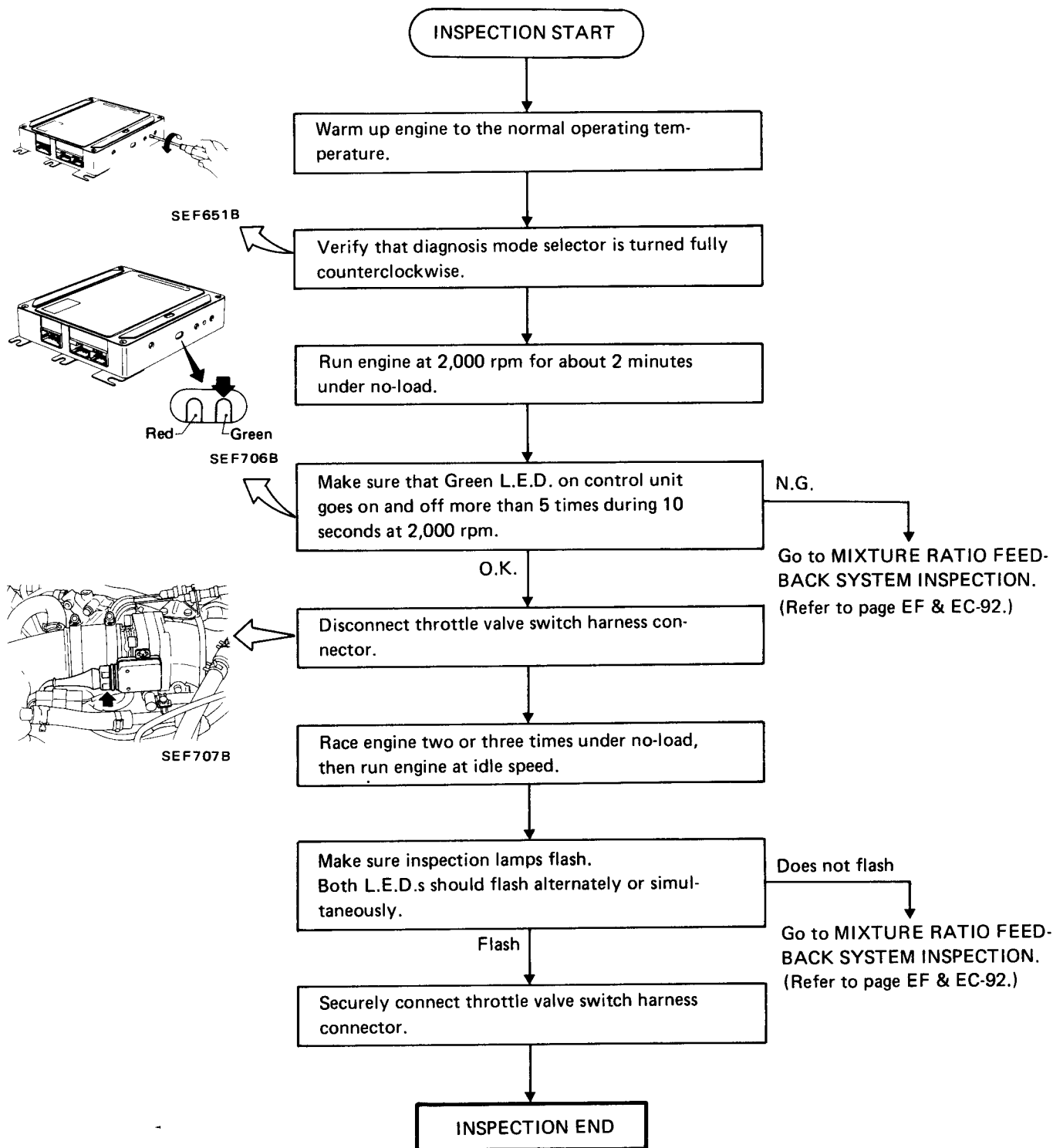
DIAGNOSTIC PROCEDURE

Idle Speed and Ignition Timing Inspection.(Cont'd)



DIAGNOSTIC PROCEDURE

Idle Mixture Ratio Inspection

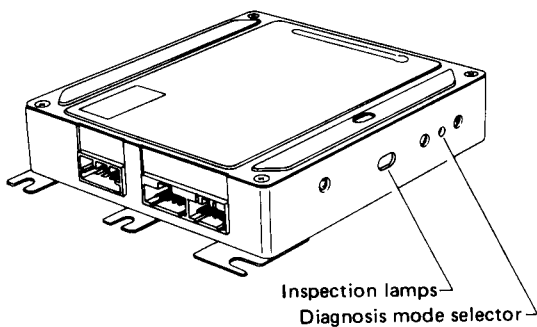


SELF-DIAGNOSIS

Self-diagnostic System

DESCRIPTION

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



SEF650B

DISPLAYS OF MALFUNCTIONING CODES

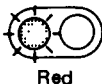
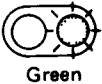
A malfunctioning area is displayed by the number of both the red and green L.E.D.s. First, the red L.E.D. flashes and the green follows.

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

SELF-DIAGNOSIS

Self-diagnostic System (Cont'd)

DISPLAYED CODE

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

X: Yes —: No

CAUTION:

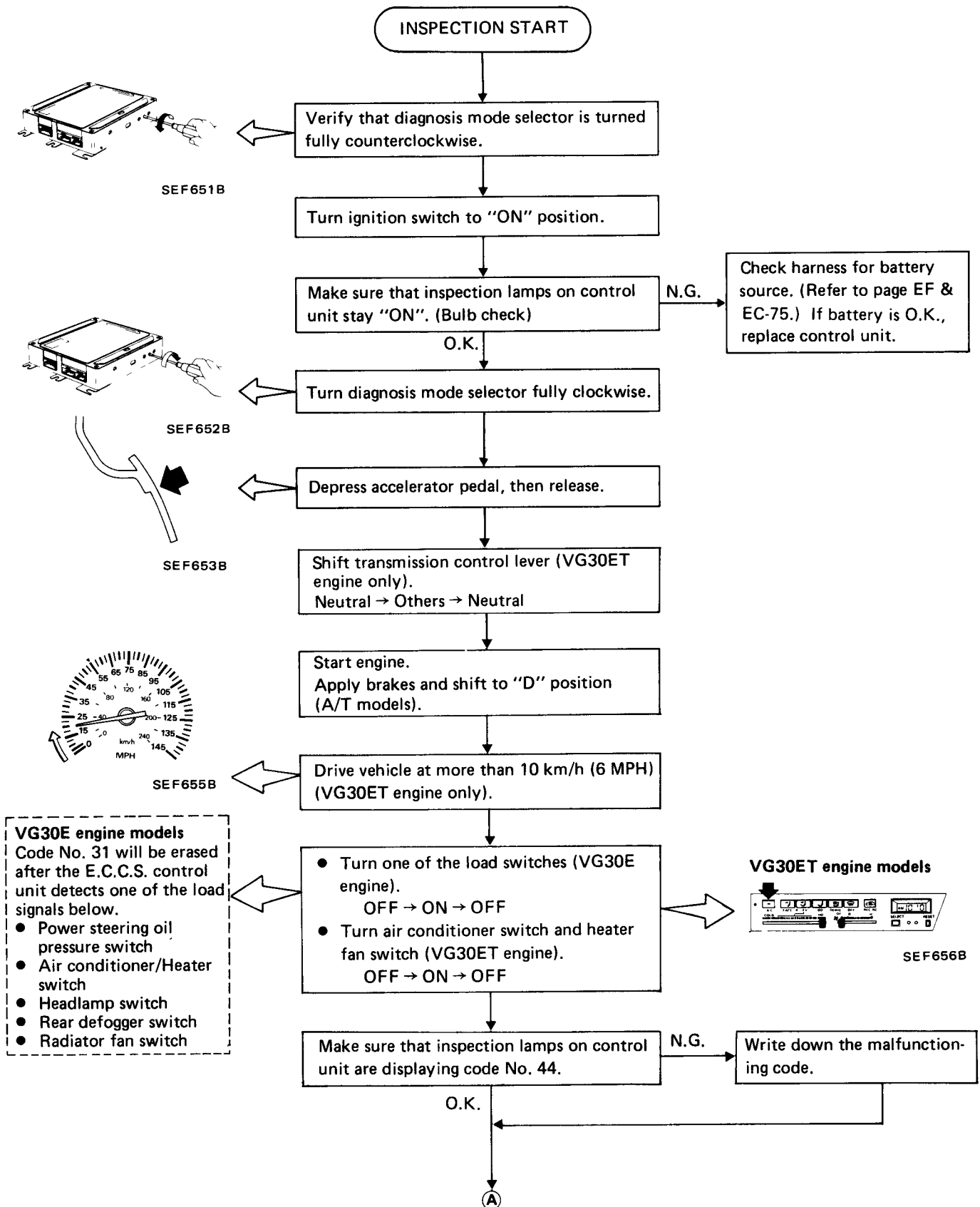
- Always turn the diagnosis mode selector carefully using a screwdriver. Do not press hard to turn. Otherwise, the selector may be damaged.
- When the engine fails to start, crank the engine more than two seconds before starting the self-diagnosing.
- Before starting the self-diagnosing, do not erase the stored memory. Doing so will reduce the self-diagnosis function considerably.
- After a malfunctioning area has been corrected, be sure to erase the memory.
- 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.

- The crank angle sensor signal plays an important role in the E.C.C.S. A malfunctioning of air flow meter is sometimes accompanied by a malfunctioning of the crank angle sensor. So when the crank angle sensor and the air flow meter are both malfunctioning, always start by checking the crank angle sensor first.
- Start the self-diagnosis 10 seconds after the ignition switch is turned to "OFF" because the air flow meter self-cleaning system is working.
- Shift the transmission first before checking load signals.

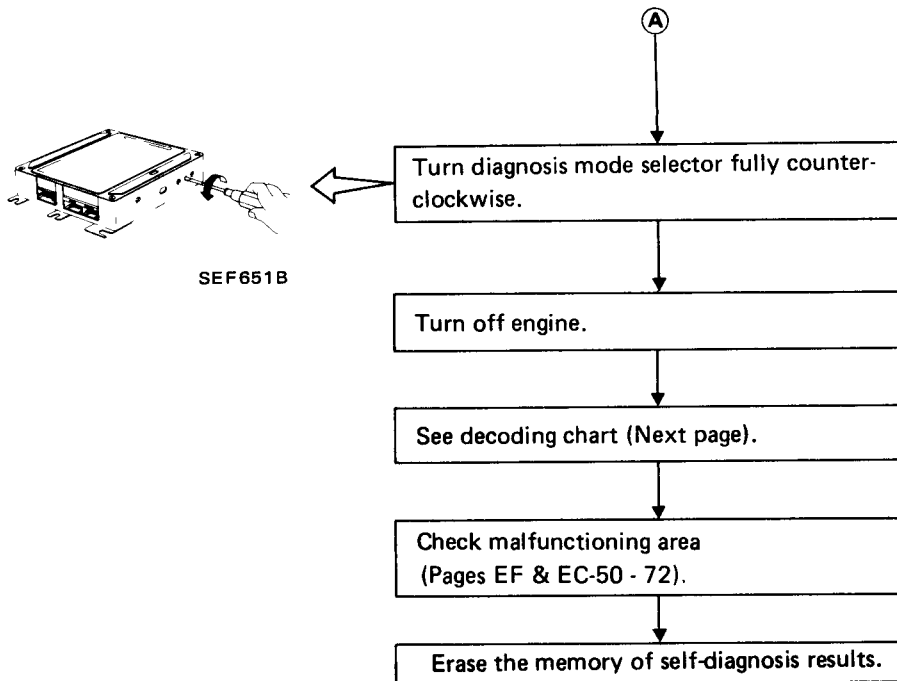
SELF-DIAGNOSIS

Self-diagnostic Procedure

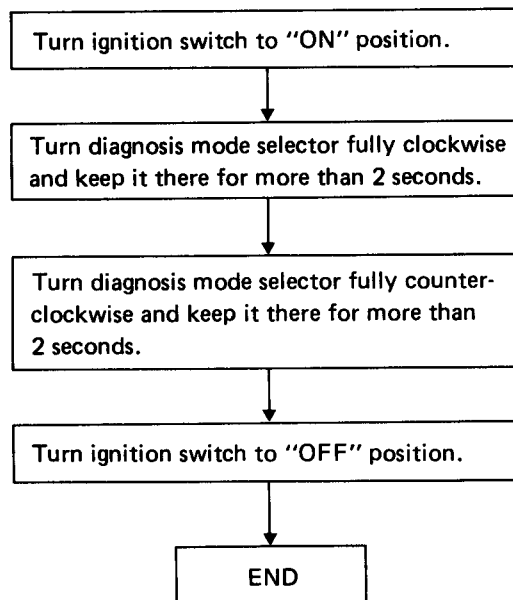


SELF-DIAGNOSIS

Self-diagnostic Procedure (Cont'd)



Procedure for memory erasure



SELF-DIAGNOSIS

Decoding Chart

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

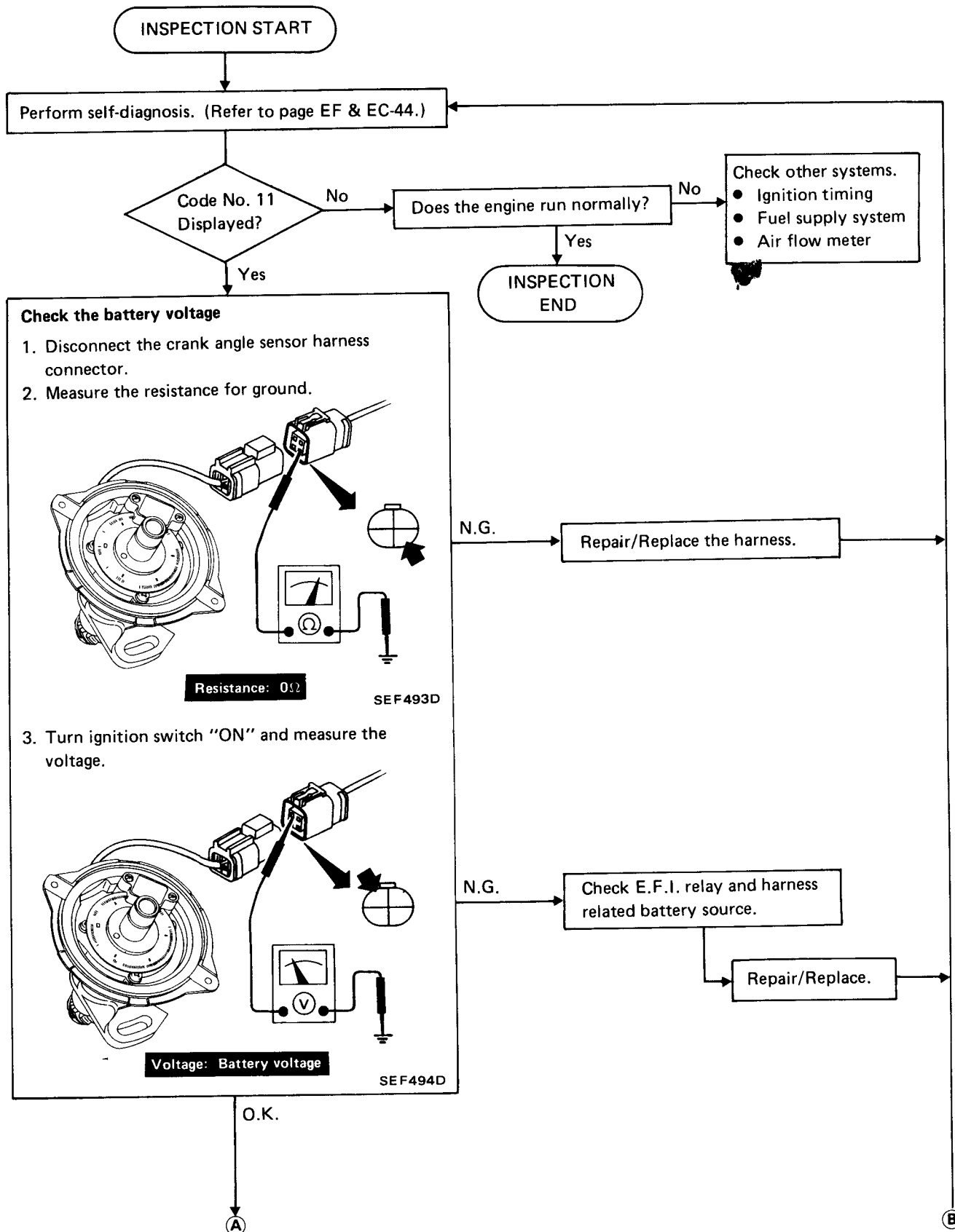
SELF-DIAGNOSIS

Decoding Chart (Cont'd)

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

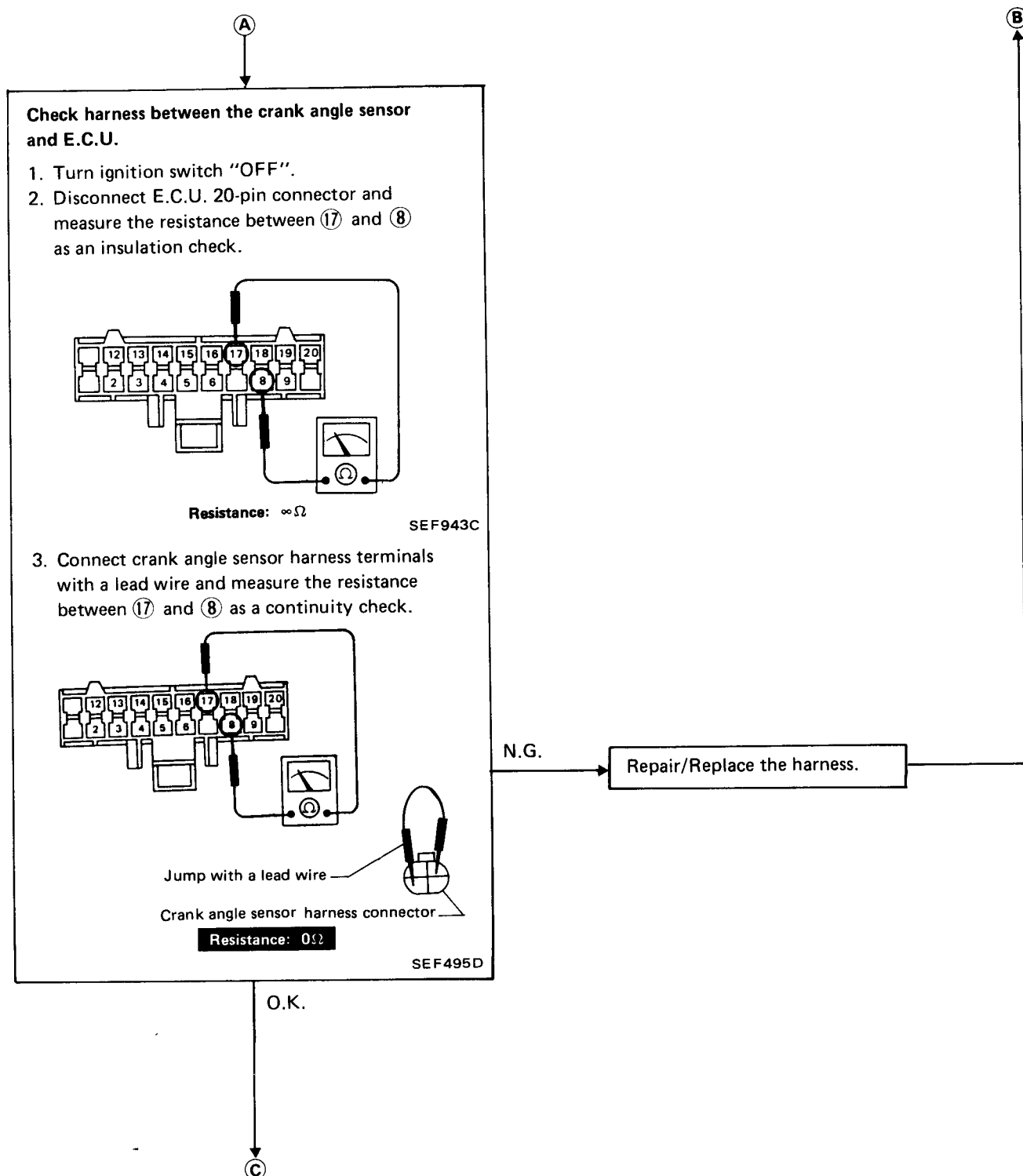
ELECTRONIC CONTROL SYSTEM INSPECTION

Crank Angle Sensor



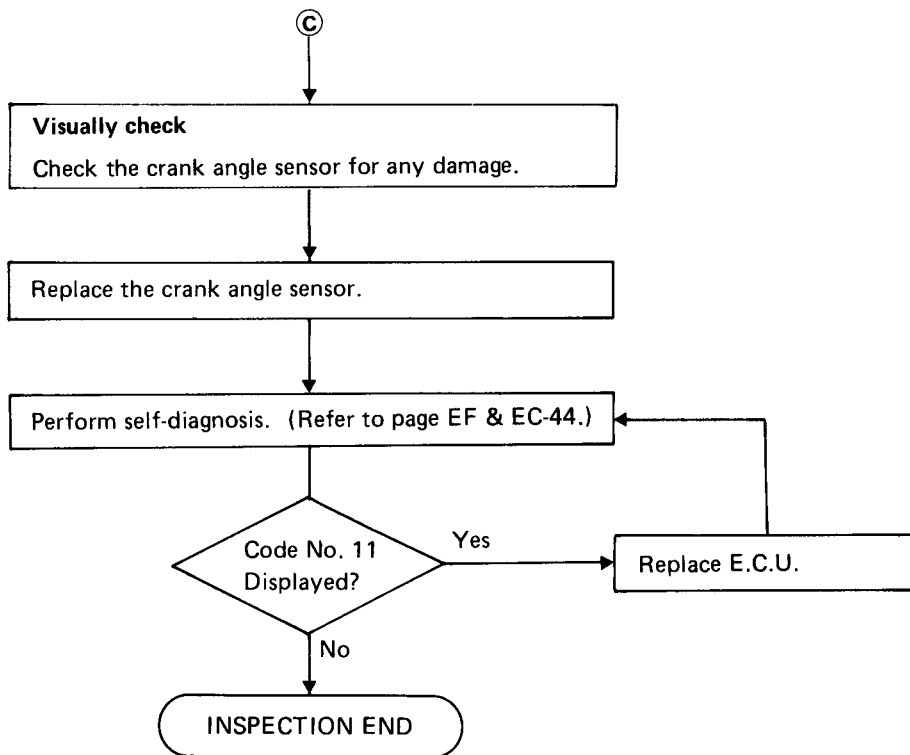
ELECTRONIC CONTROL SYSTEM INSPECTION

Crank Angle Sensor (Cont'd)



ELECTRONIC CONTROL SYSTEM INSPECTION

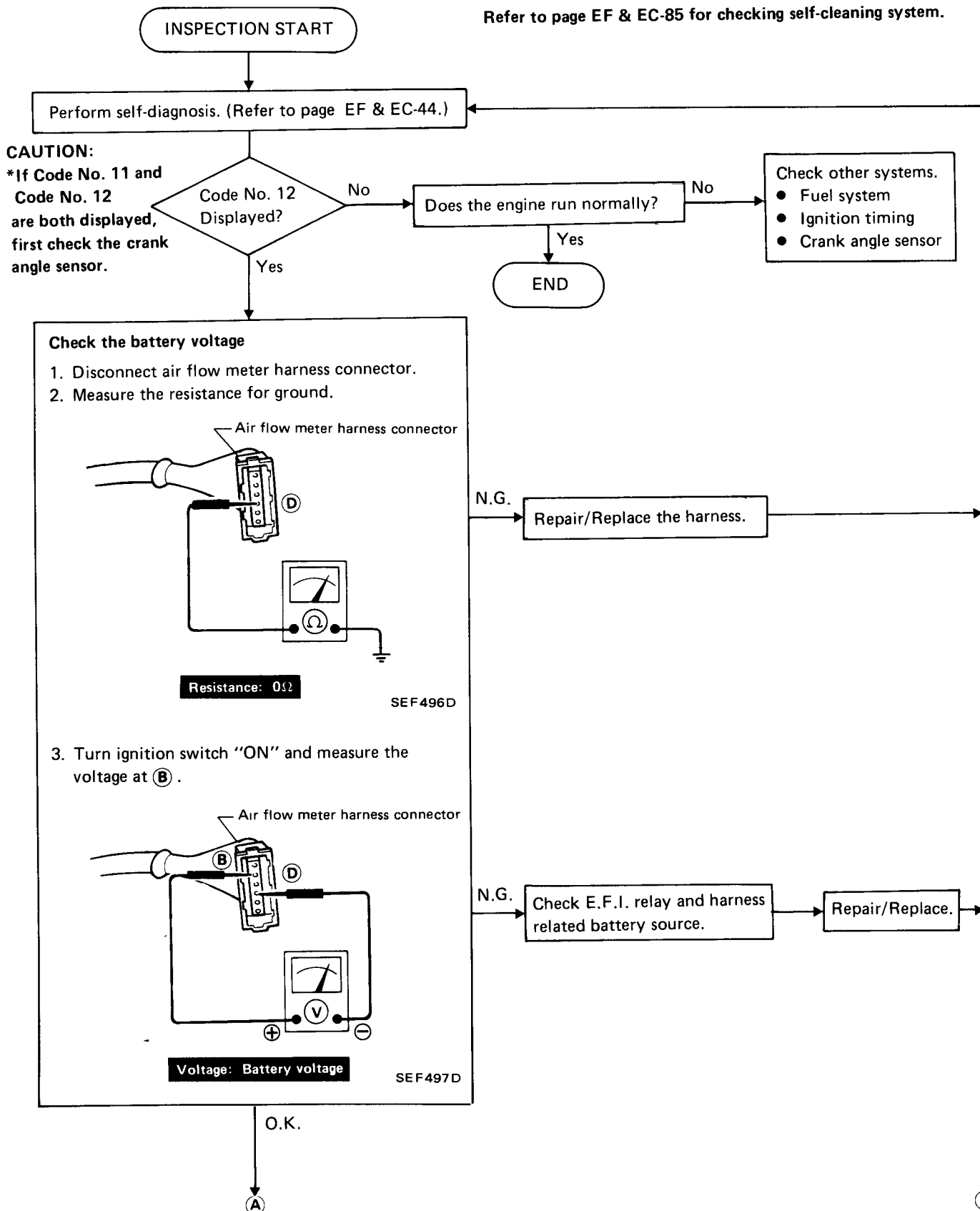
Crank Angle Sensor (Cont'd)



ELECTRONIC CONTROL SYSTEM INSPECTION

Air Flow Meter

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



ELECTRONIC CONTROL SYSTEM INSPECTION

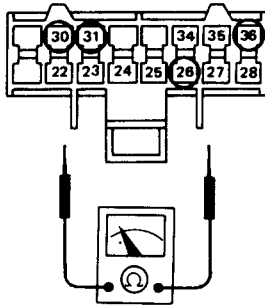
Air Flow Meter (Cont'd)

(A)

(B)

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

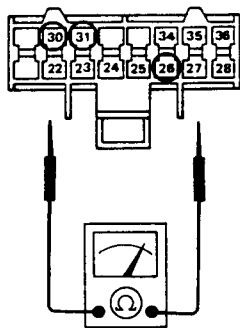
1. Turn ignition switch "OFF".
2. Disconnect E.C.U. 16-pin connector and measure the resistance between terminals as an insulation check.



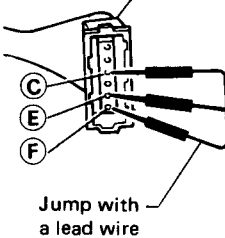
Terminals	Resistance (Ω)
26 - 30	∞
26 - 31	∞
30 - 31	∞
36 - 26	∞
36 - 30	∞
36 - 31	∞

SEF948C

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



Air flow meter harness connector



N.G.

Repair/Replace the harness.

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

SEF498D

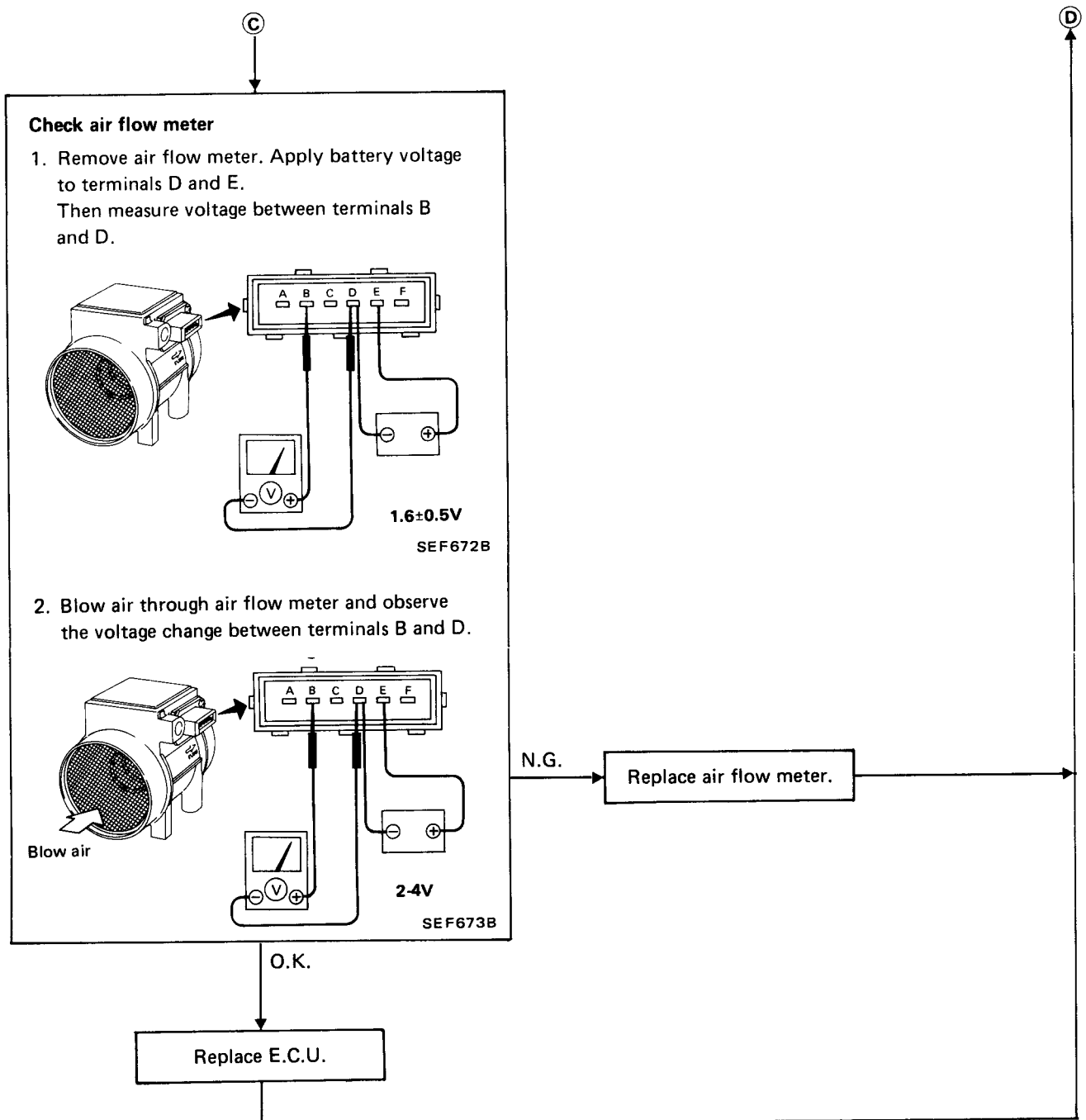
O.K.

(C)

(D)

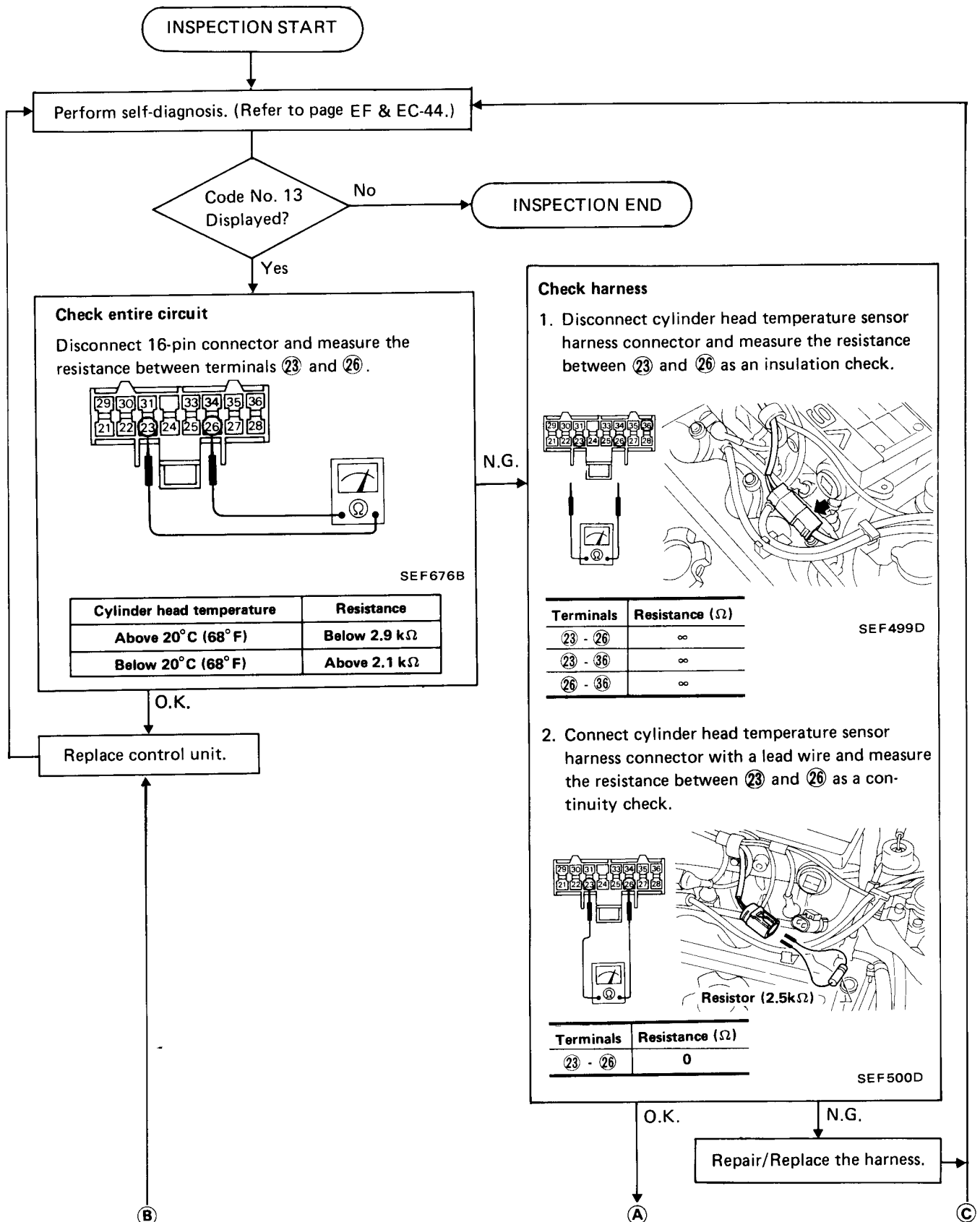
ELECTRONIC CONTROL SYSTEM INSPECTION

Air Flow Meter (Cont'd)



ELECTRONIC CONTROL SYSTEM INSPECTION

Cylinder Head Temperature Sensor

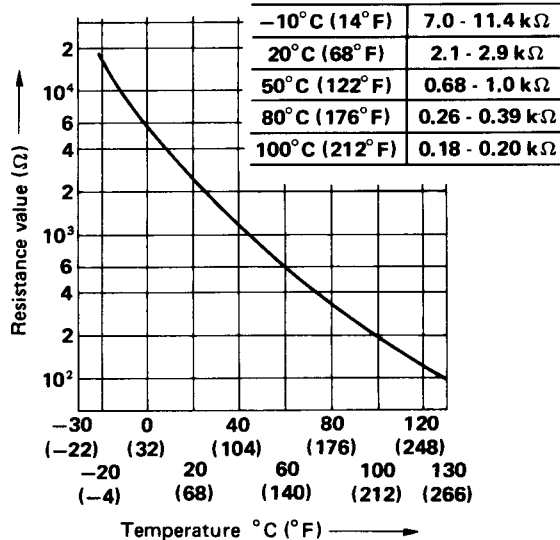
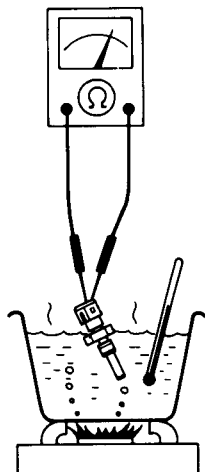


ELECTRONIC CONTROL SYSTEM INSPECTION

Cylinder Head Temperature Sensor (Cont'd)

Check cylinder head temperature sensor

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



SEF677B

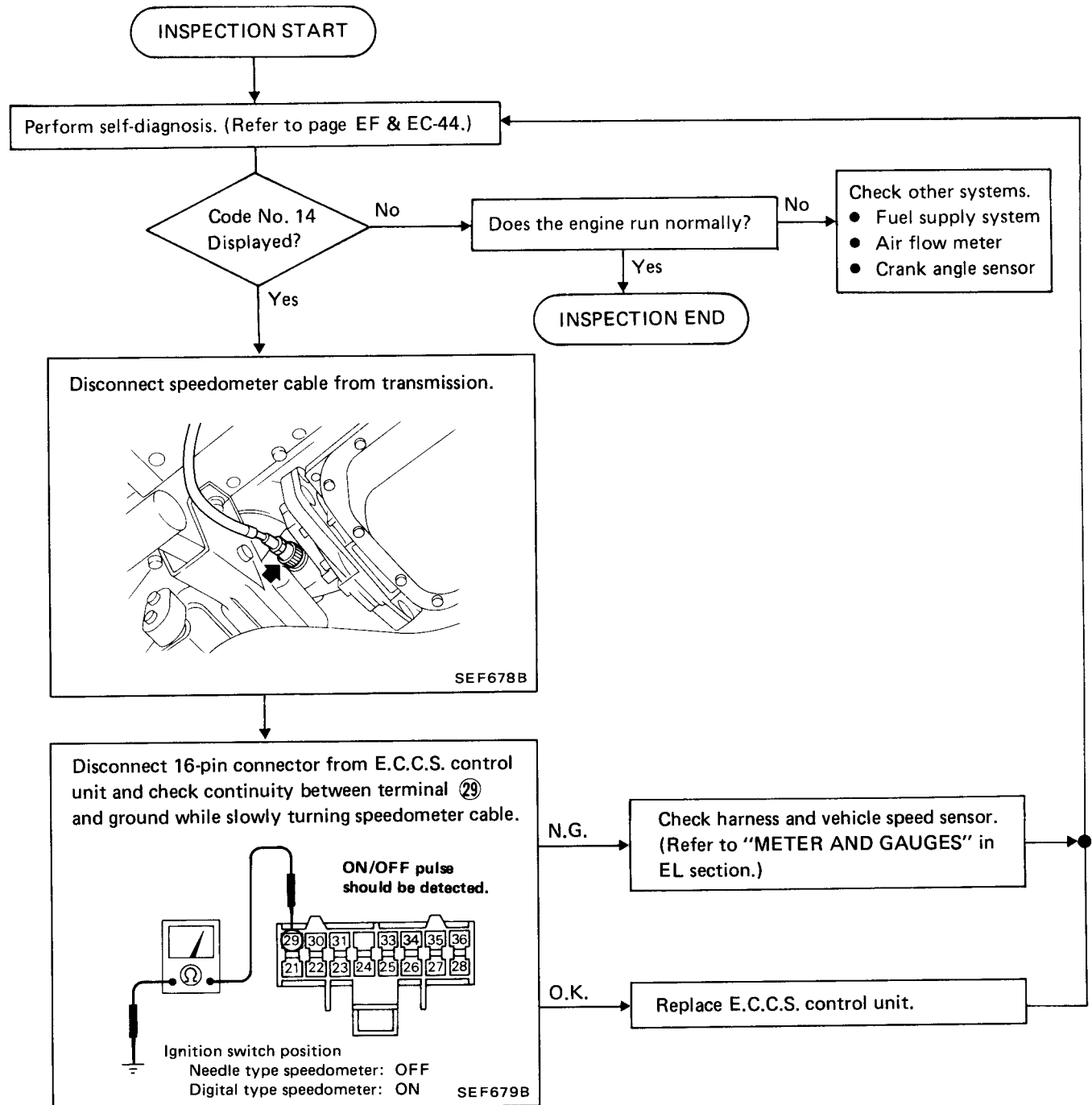
O.K.

N.G.

Replace cylinder head temperature sensor.

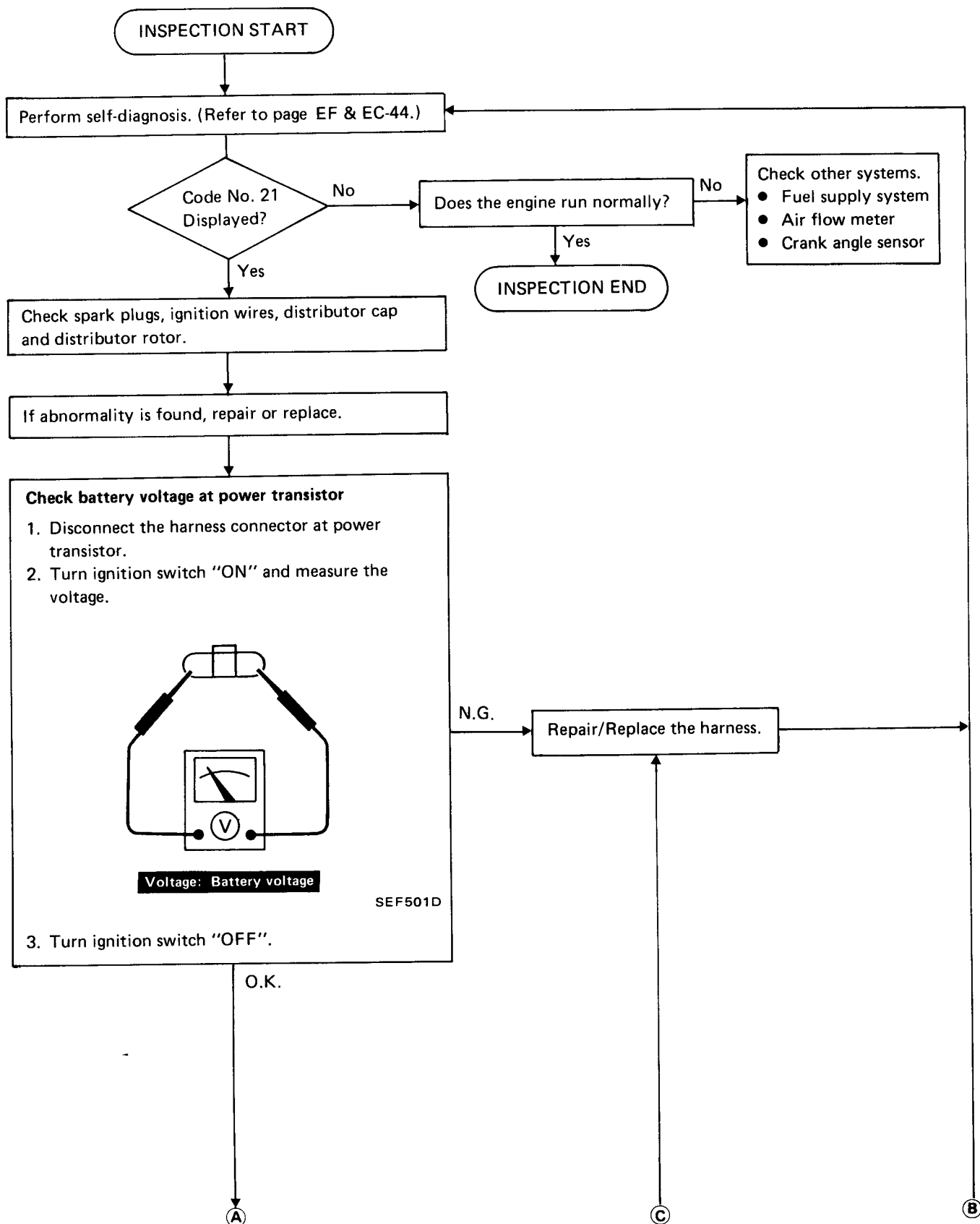
ELECTRONIC CONTROL SYSTEM INSPECTION

Vehicle Speed Sensor



ELECTRONIC CONTROL SYSTEM INSPECTION

Ignition Signal

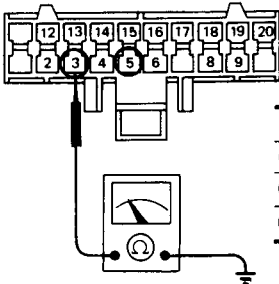


ELECTRONIC CONTROL SYSTEM INSPECTION

Ignition Signal (Cont'd)

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

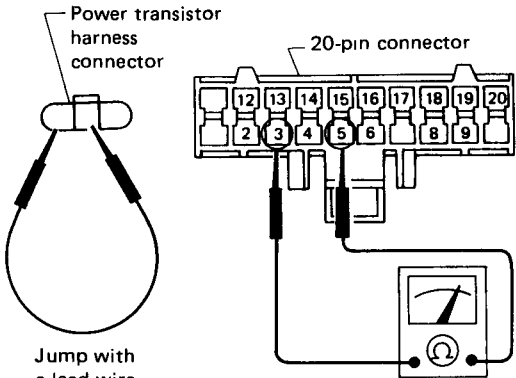
1. Disconnect E.C.U. 20-pin connector and check for insulation at ③ and ⑤.



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

SEF953C

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



Power transistor harness connector

20-pin connector

Jump with a lead wire

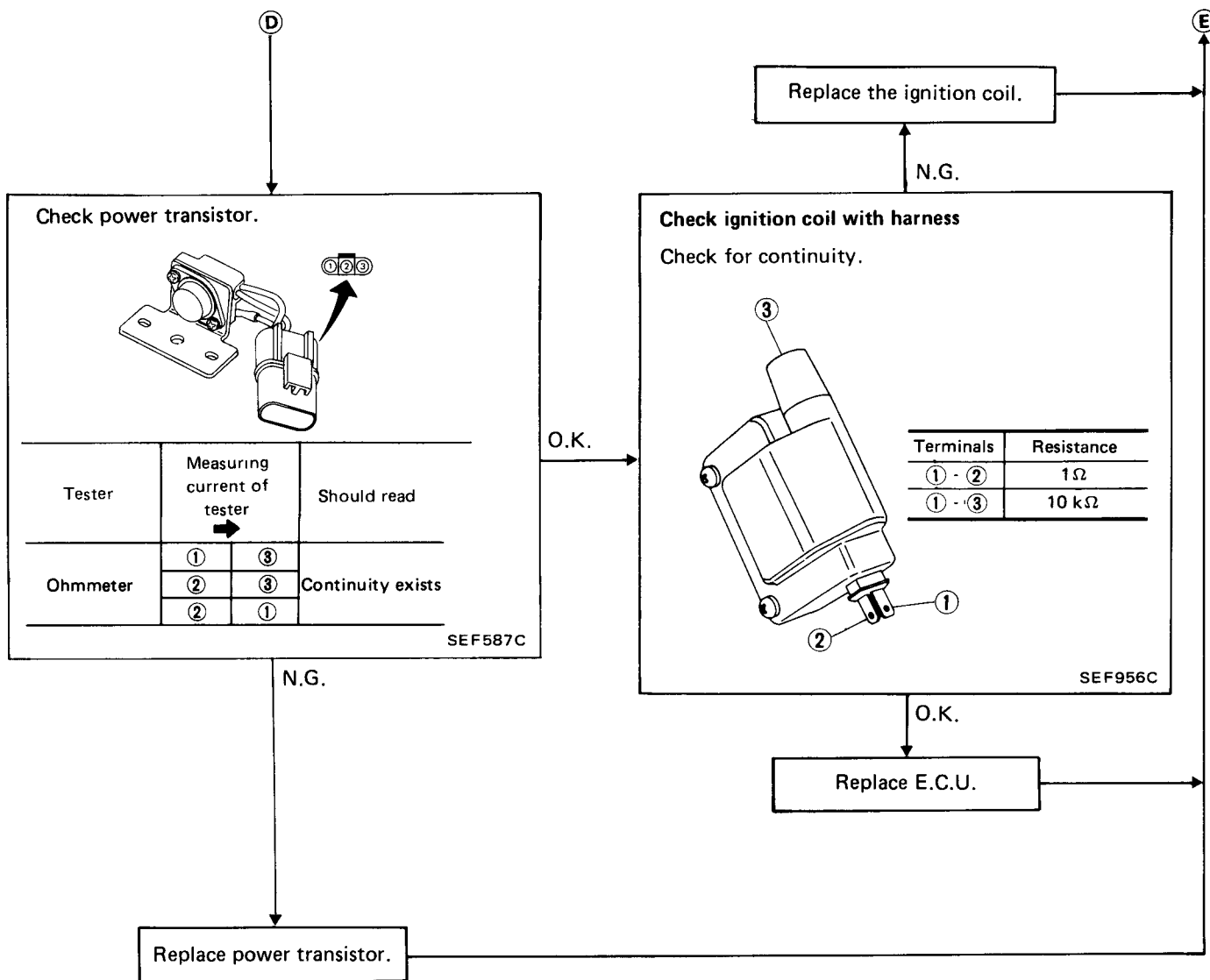
SEF502D

O.K.

N.G.

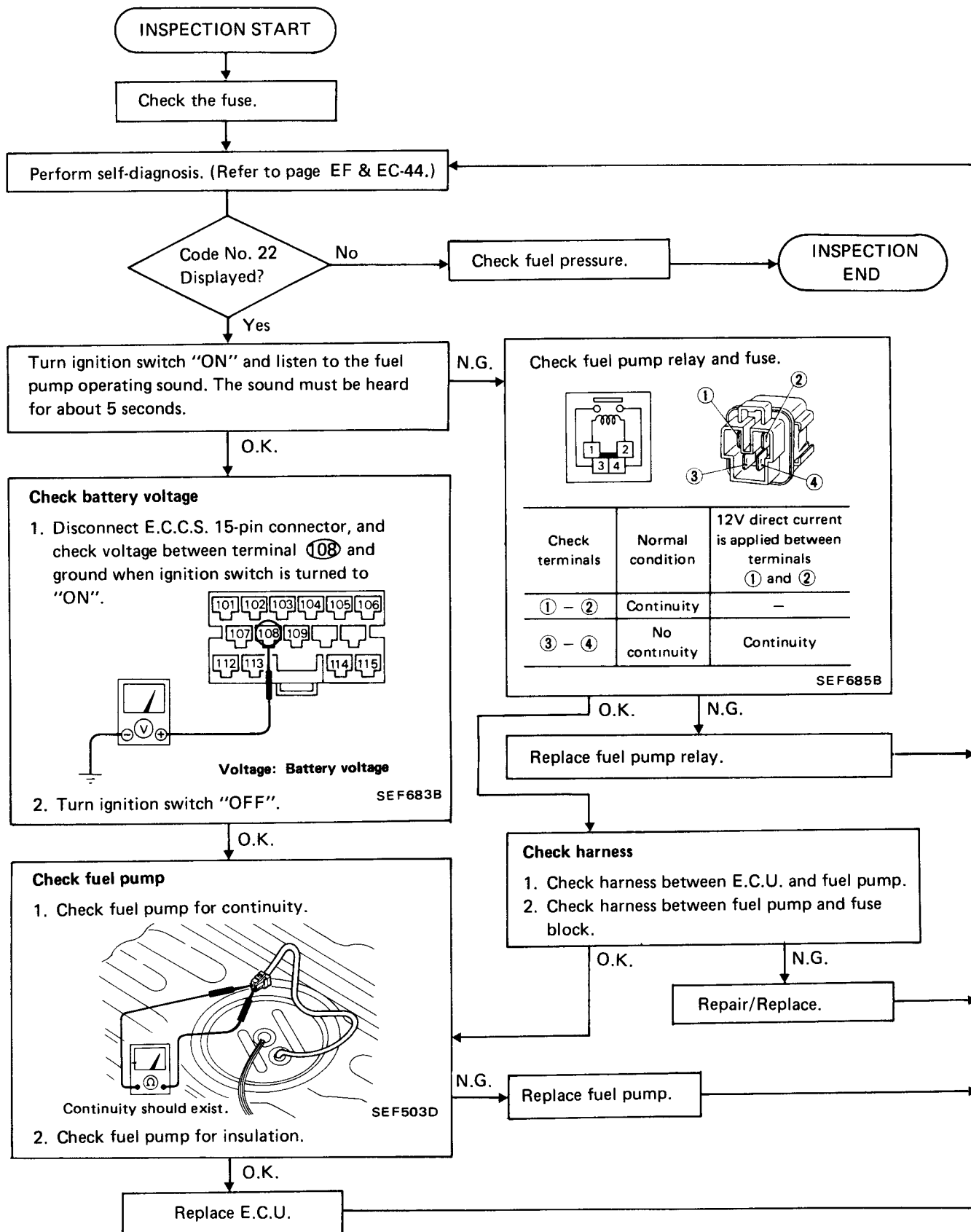
ELECTRONIC CONTROL SYSTEM INSPECTION

Ignition Signal (Cont'd)



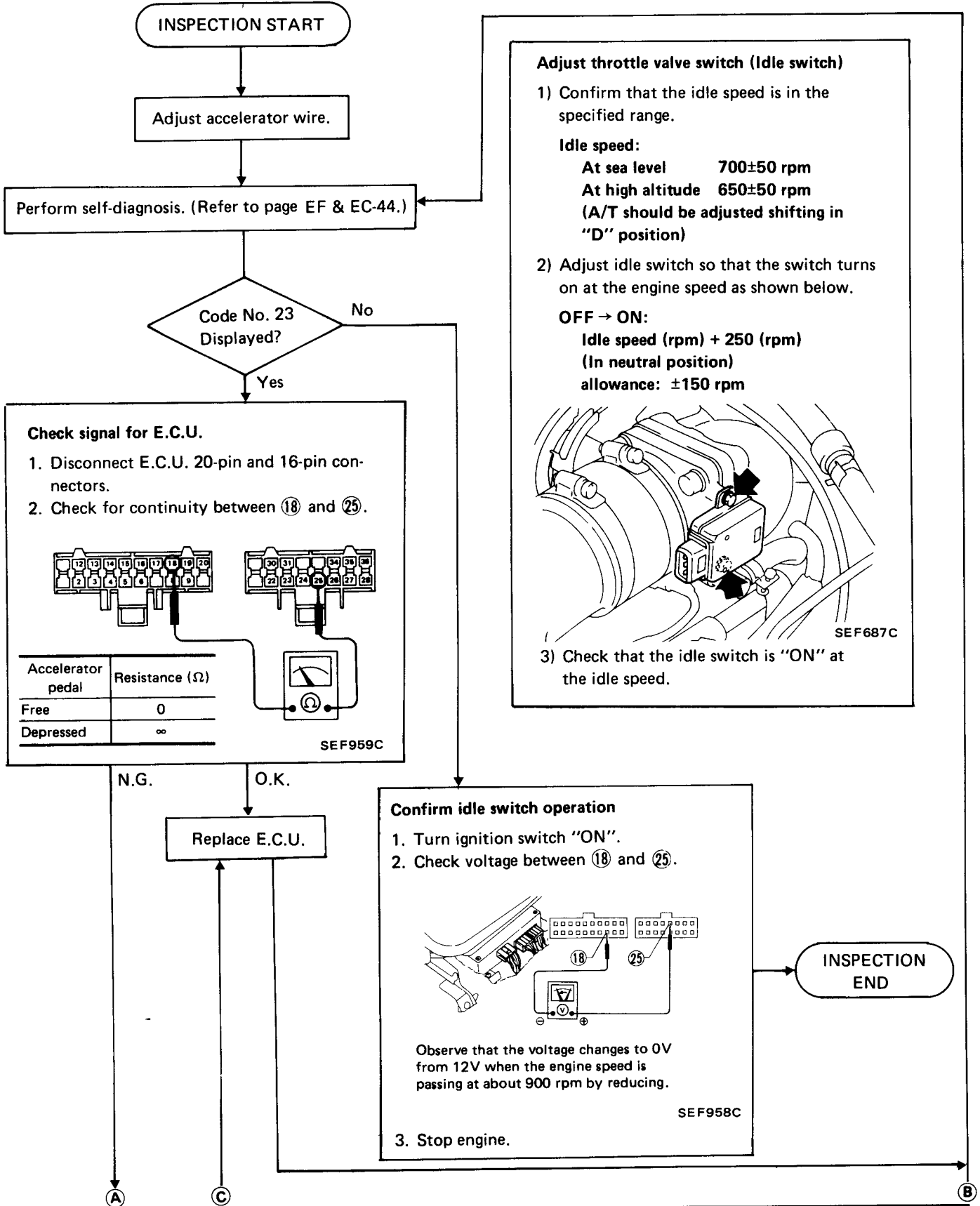
ELECTRONIC CONTROL SYSTEM INSPECTION

Fuel Pump



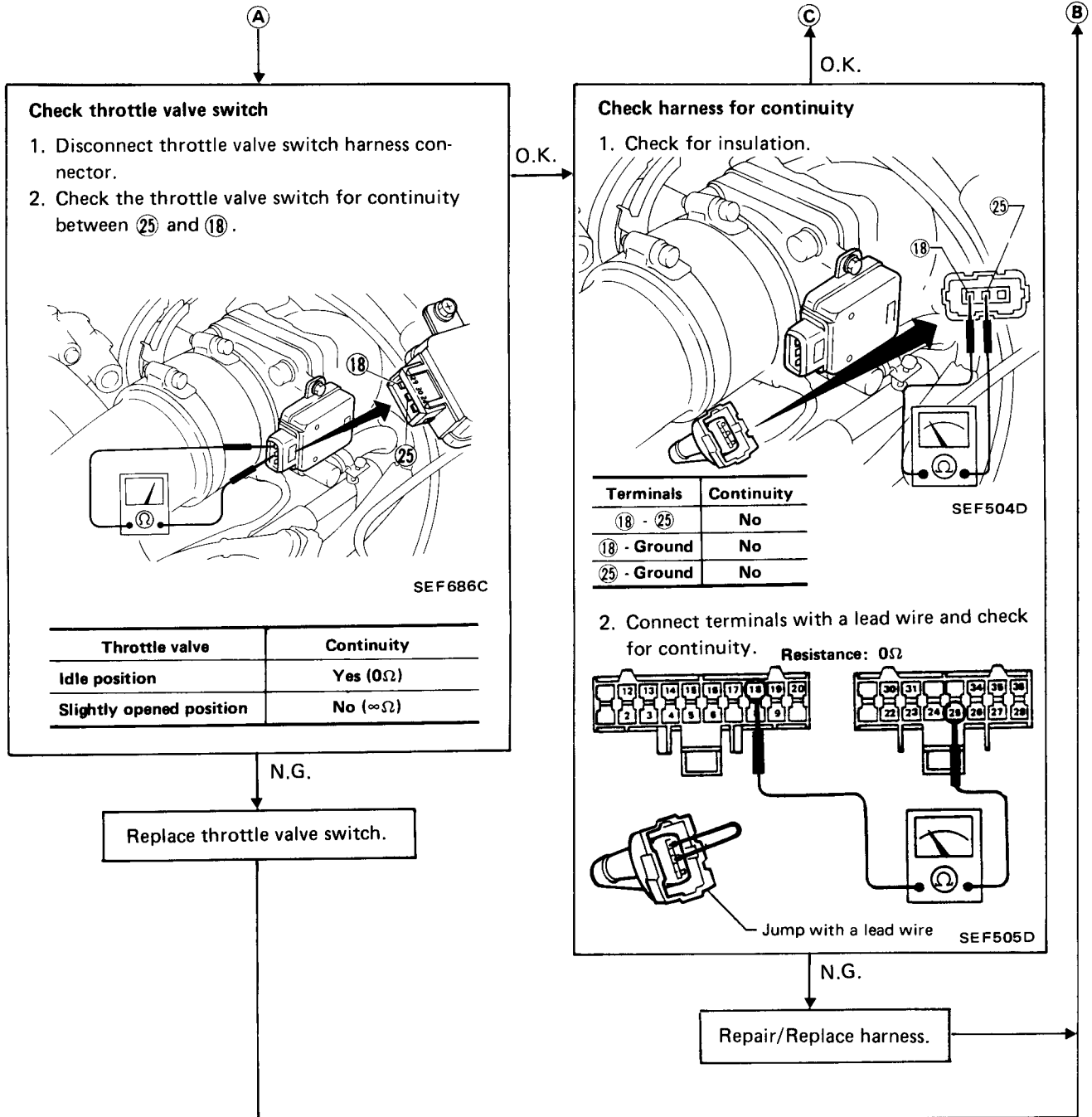
ELECTRONIC CONTROL SYSTEM INSPECTION

Throttle Valve Switch



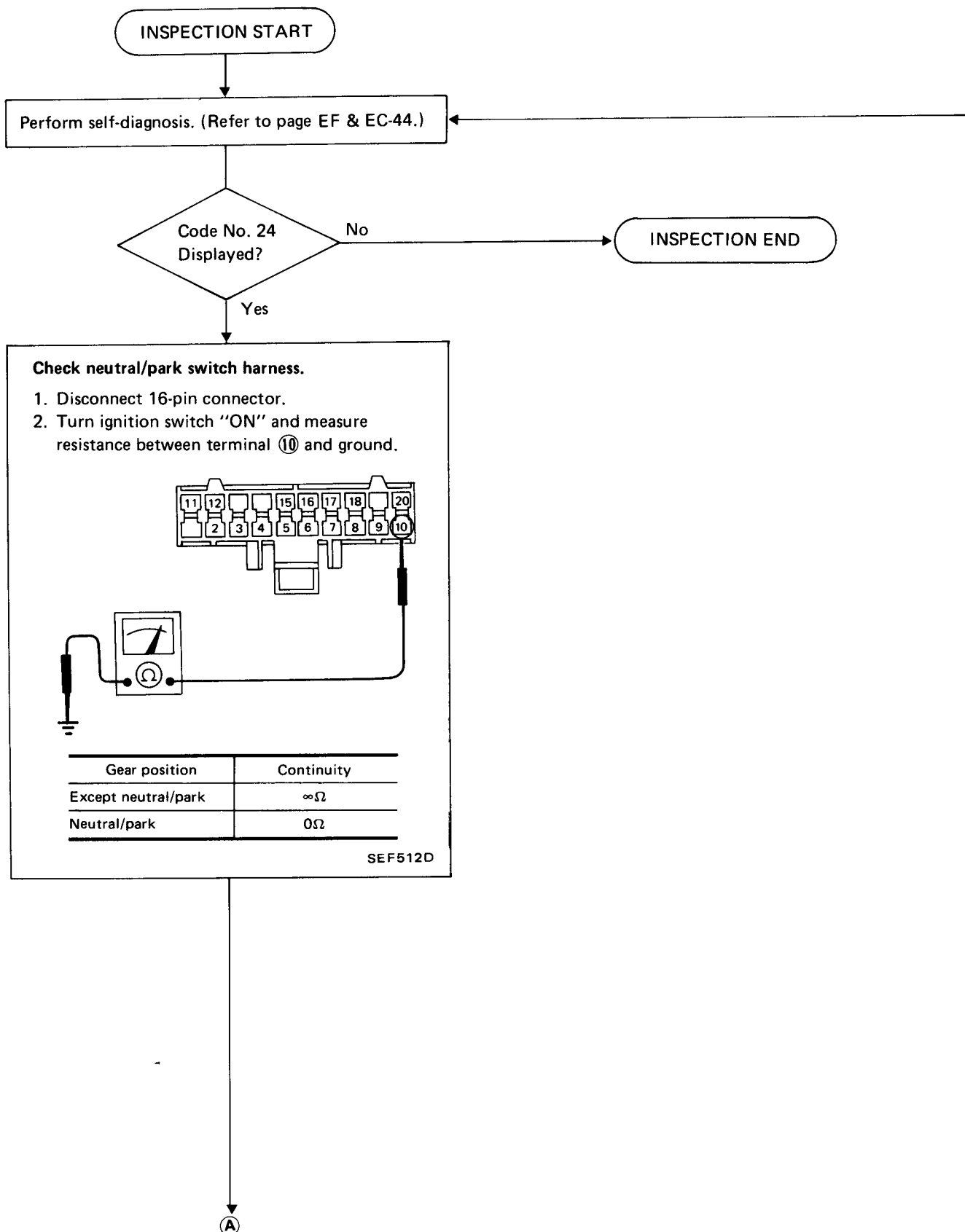
ELECTRONIC CONTROL SYSTEM INSPECTION

Throttle Valve Switch (Cont'd)



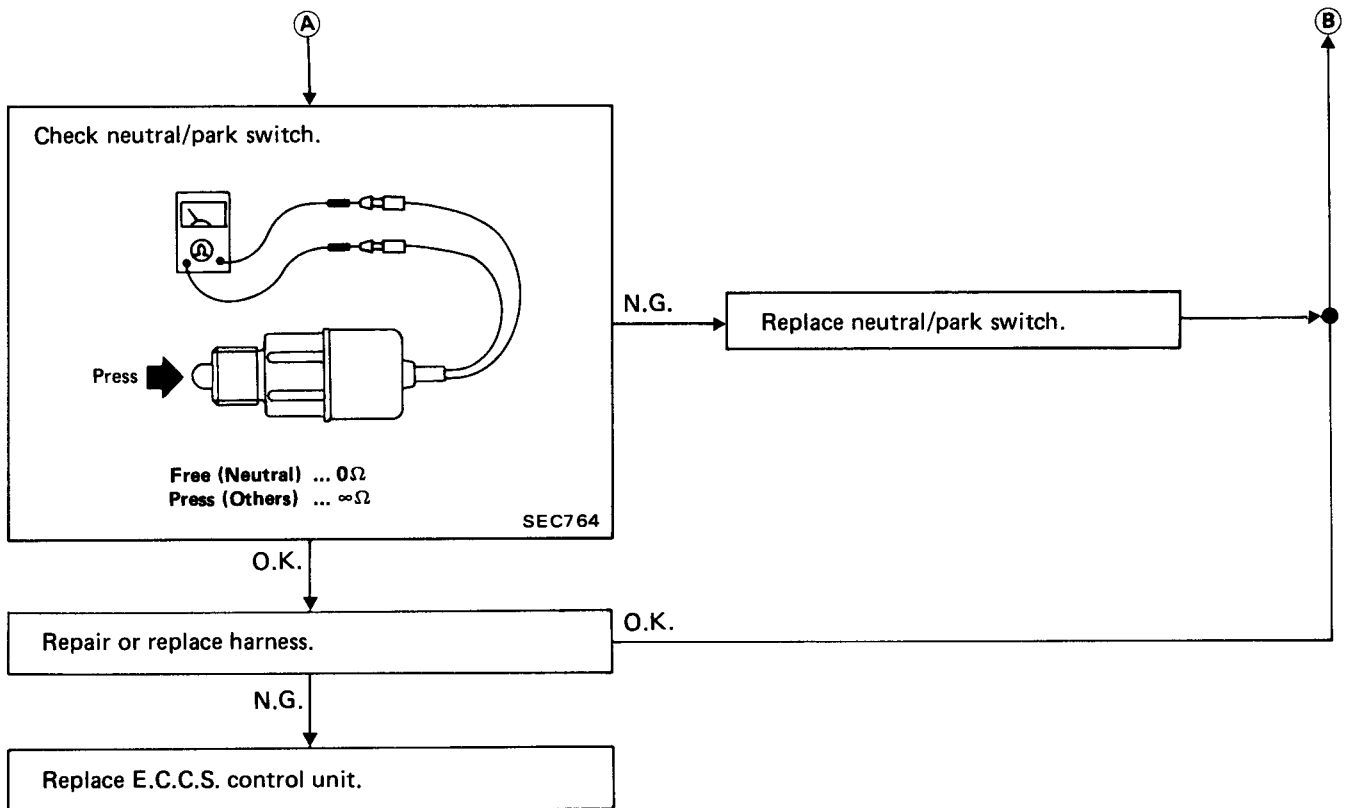
ELECTRONIC CONTROL SYSTEM INSPECTION

Neutral Switch



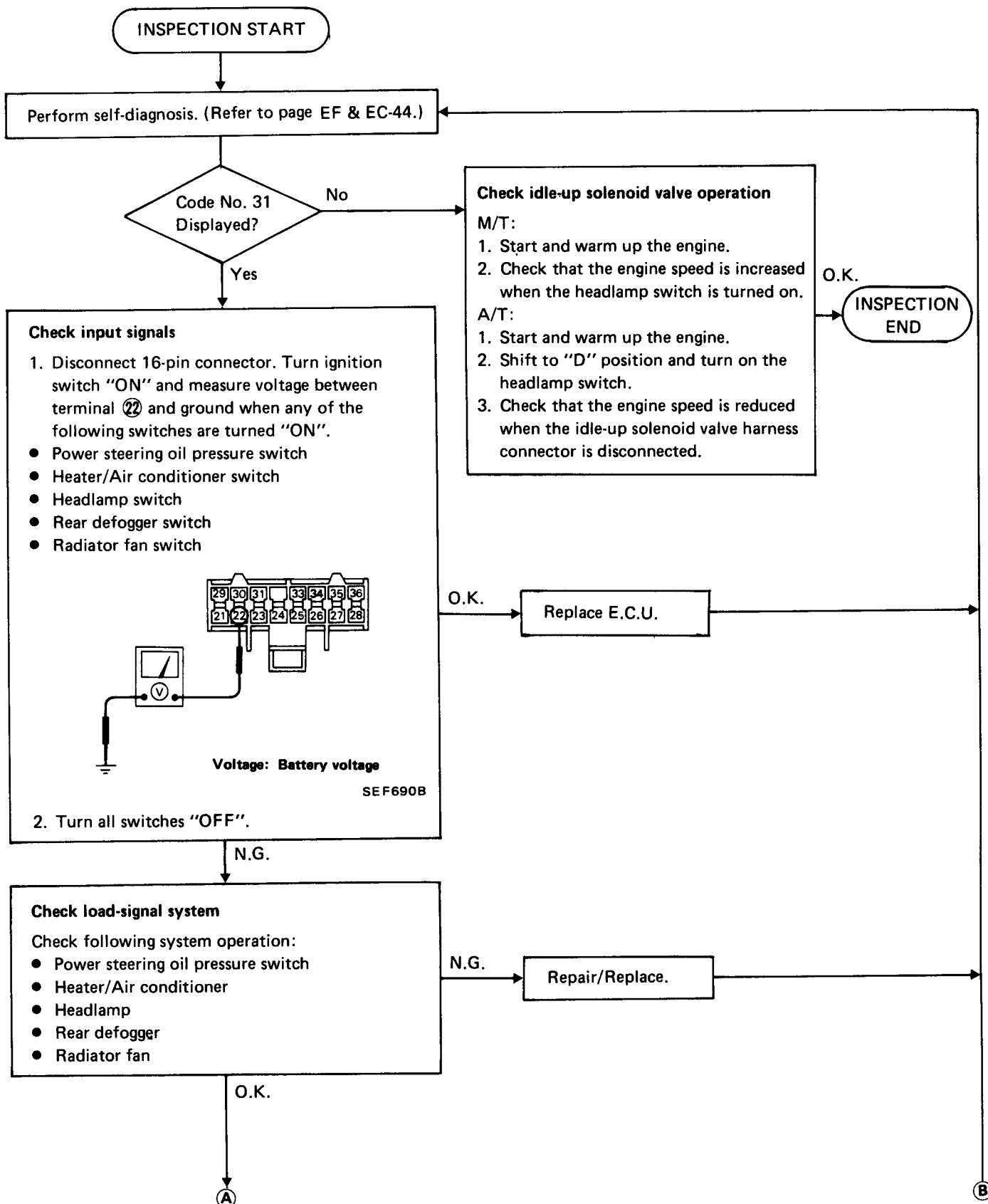
ELECTRONIC CONTROL SYSTEM INSPECTION

Neutral Switch (Cont'd)



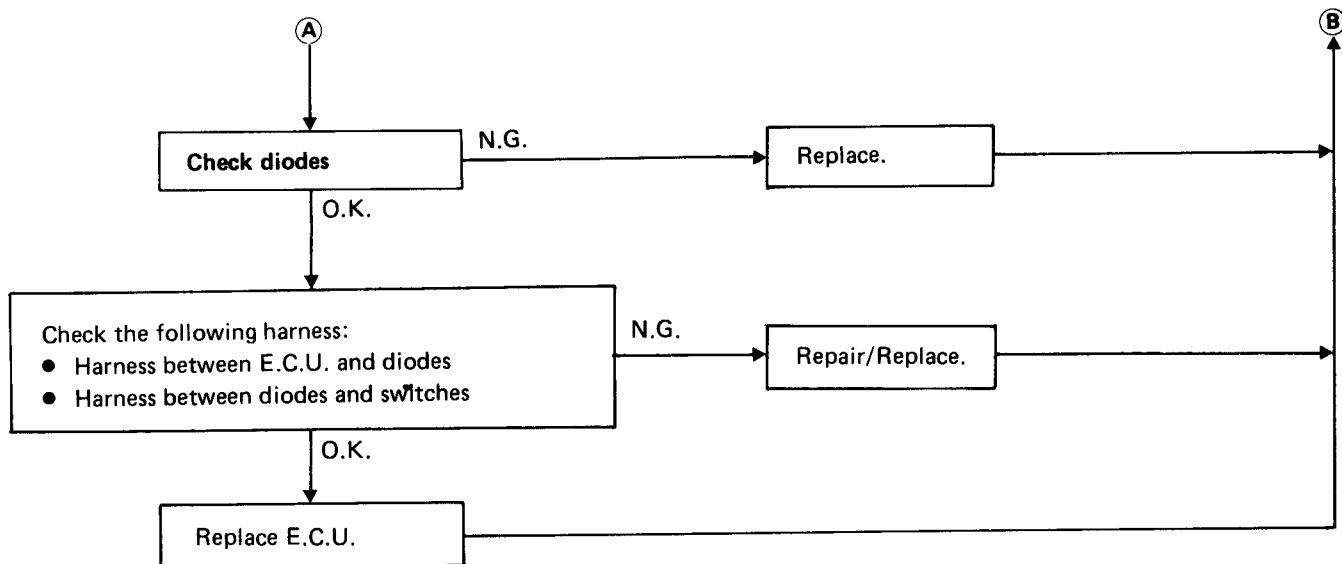
ELECTRONIC CONTROL SYSTEM INSPECTION

Load Signal

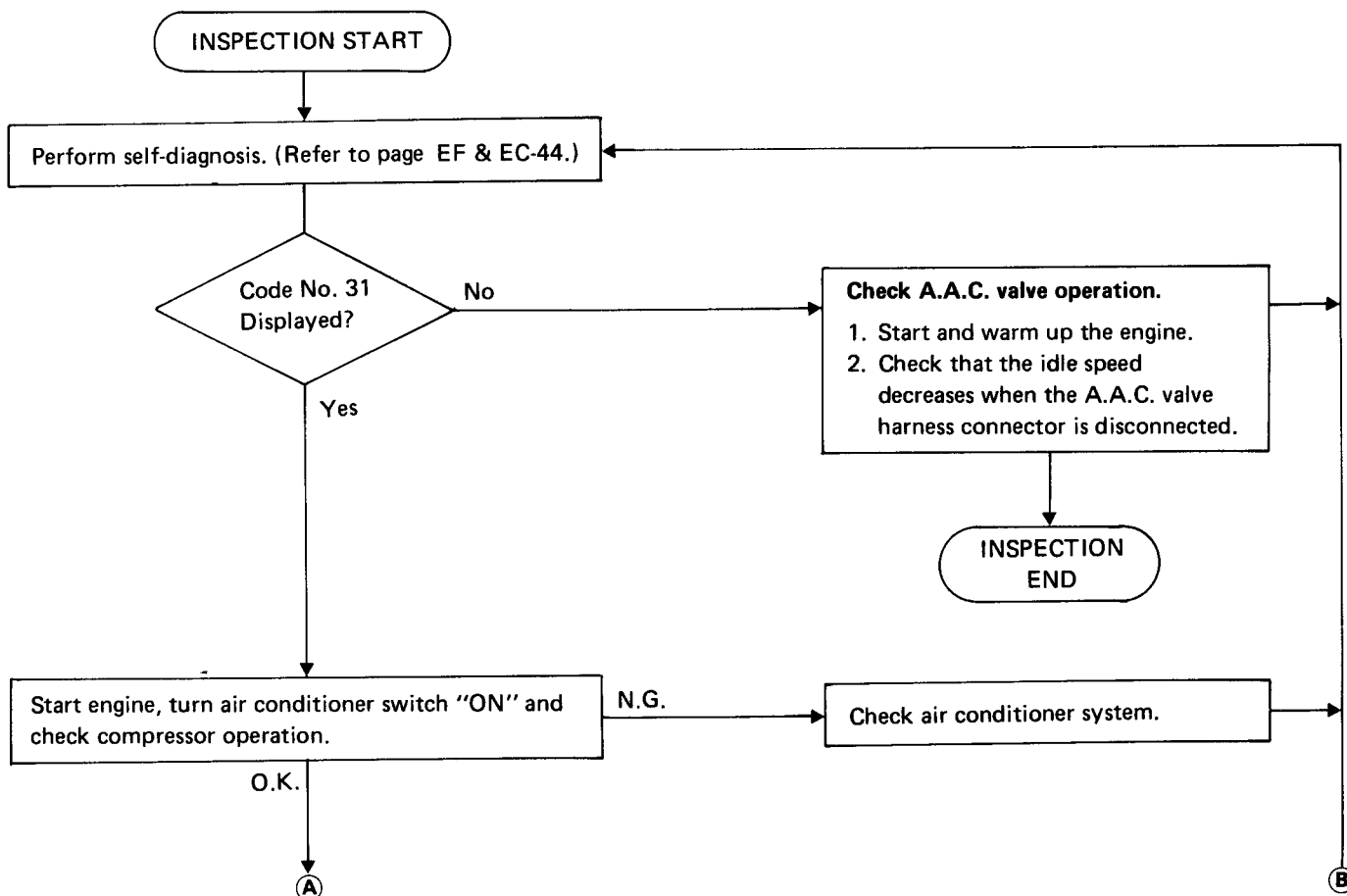


ELECTRONIC CONTROL SYSTEM INSPECTION

Load Signal (Cont'd)

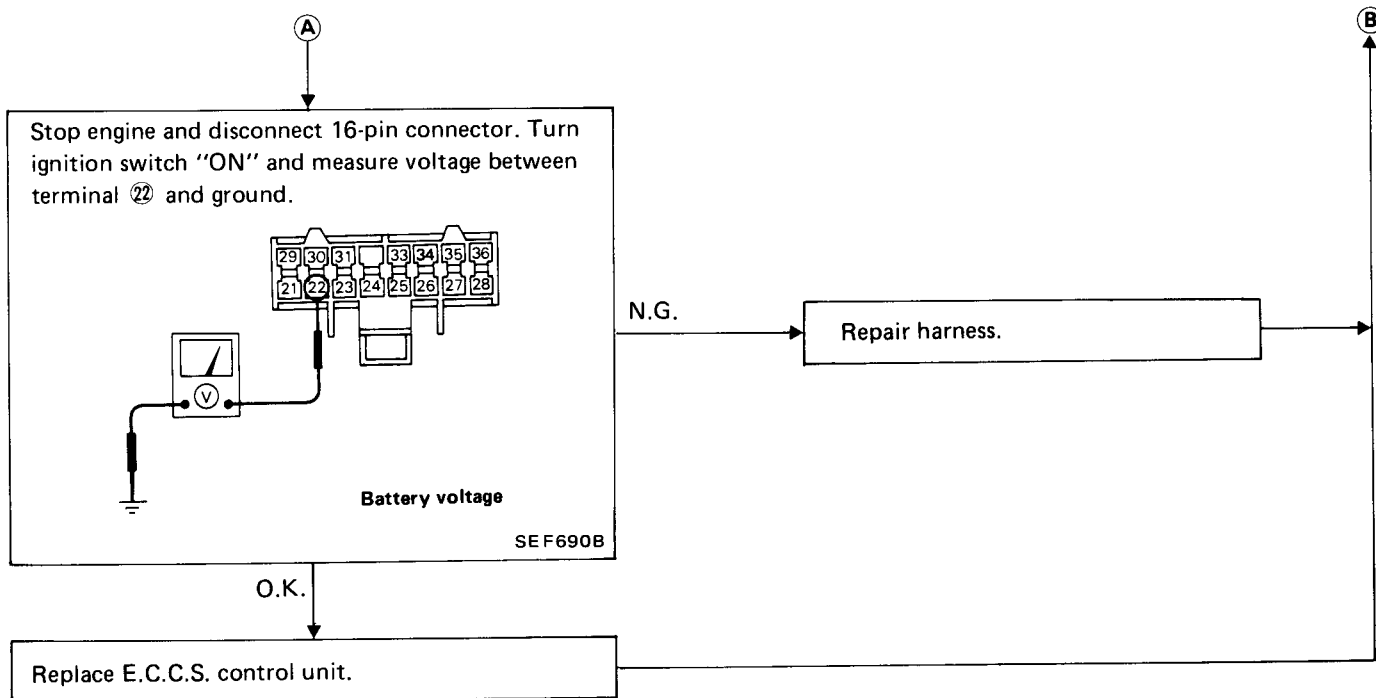


Air Conditioner Signal

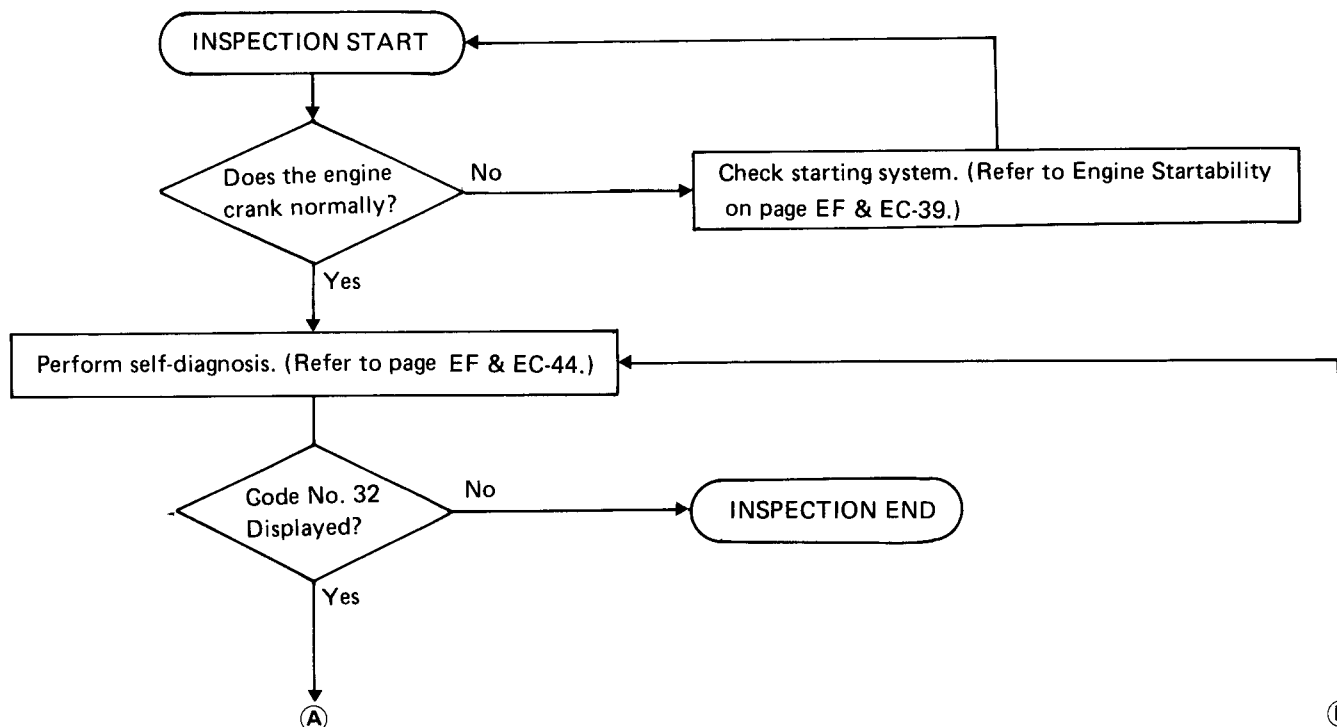


ELECTRONIC CONTROL SYSTEM INSPECTION

Air Conditioner Signal (Cont'd)

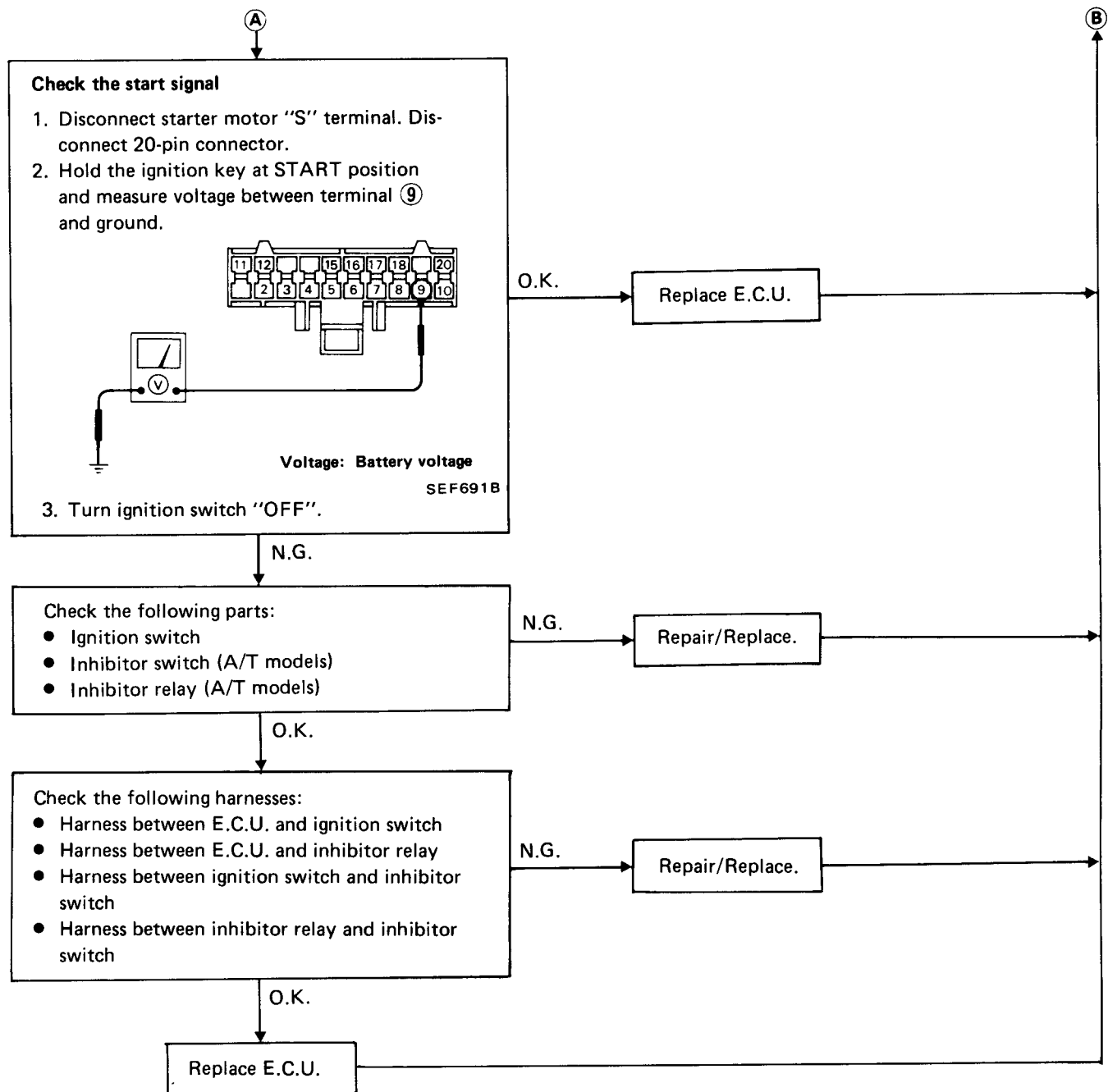


Start Signal

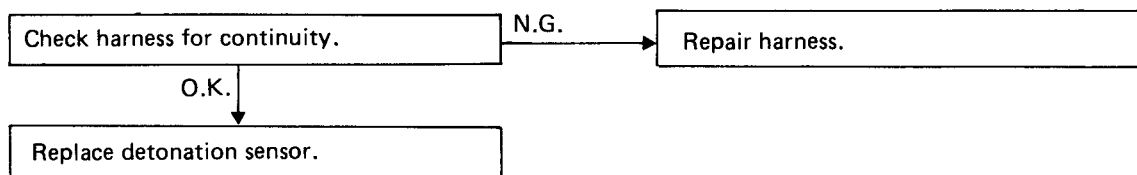


ELECTRONIC CONTROL SYSTEM INSPECTION

Start Signal (Cont'd)

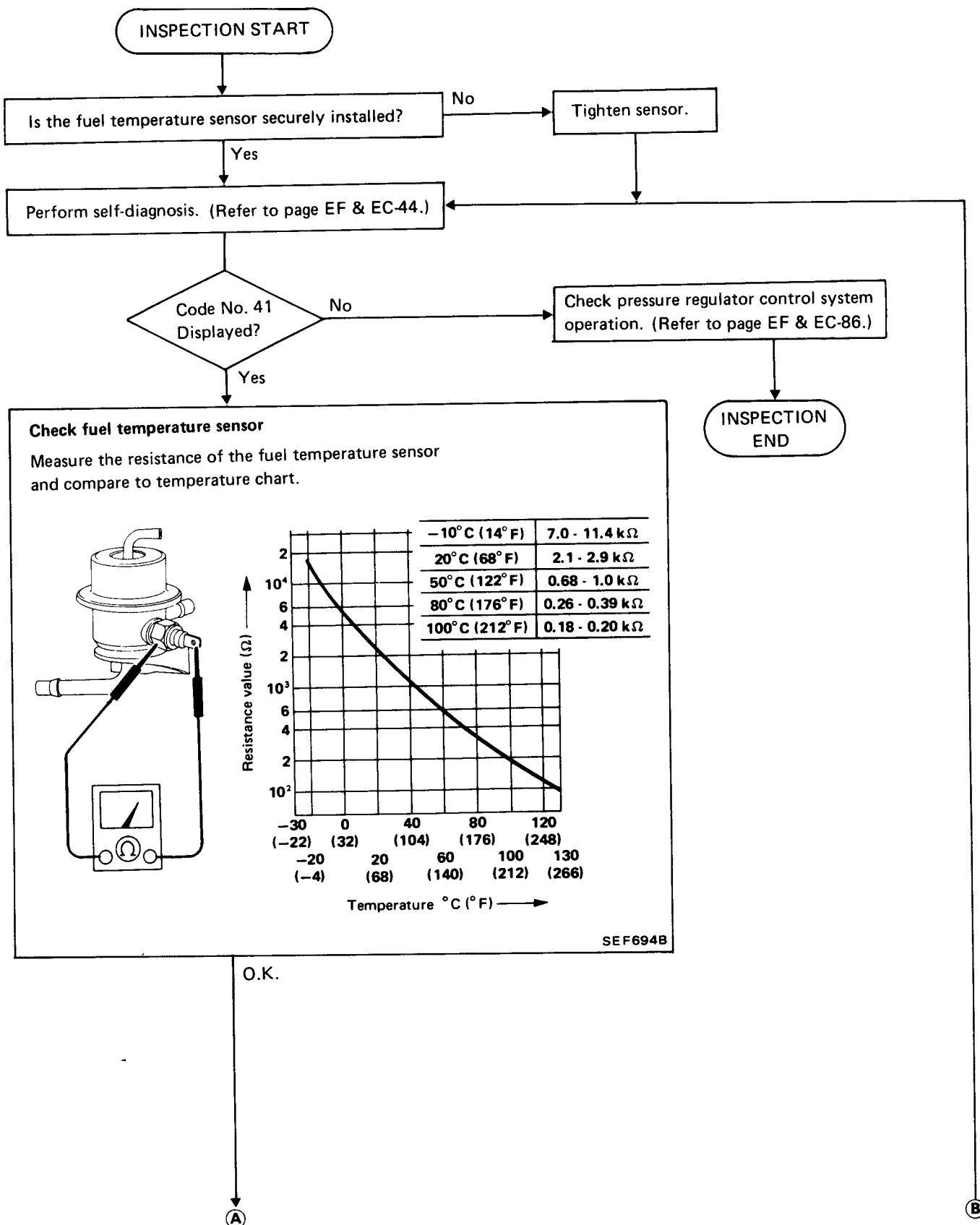


Detonation Sensor



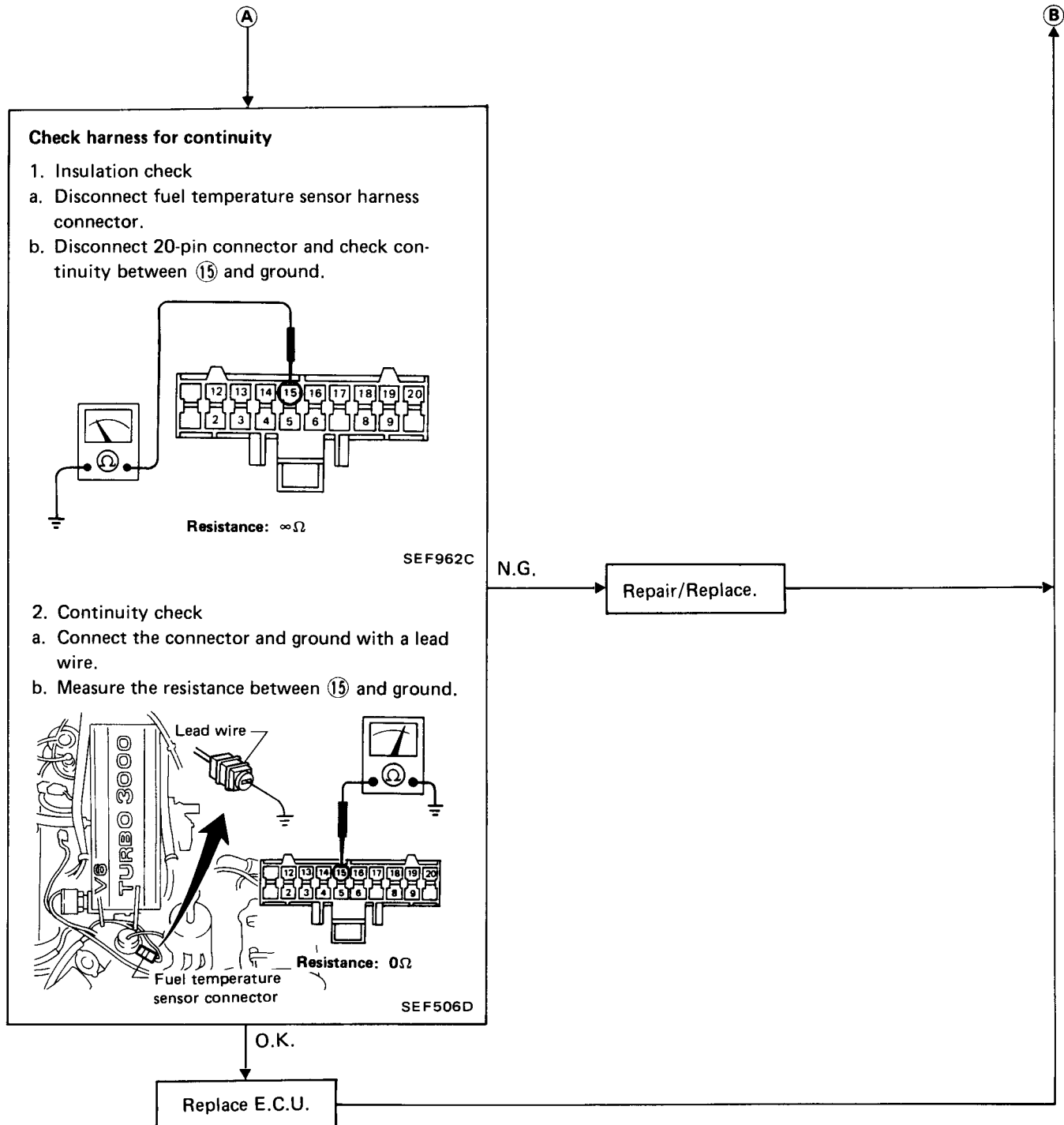
ELECTRONIC CONTROL SYSTEM INSPECTION

Fuel Temperature Sensor



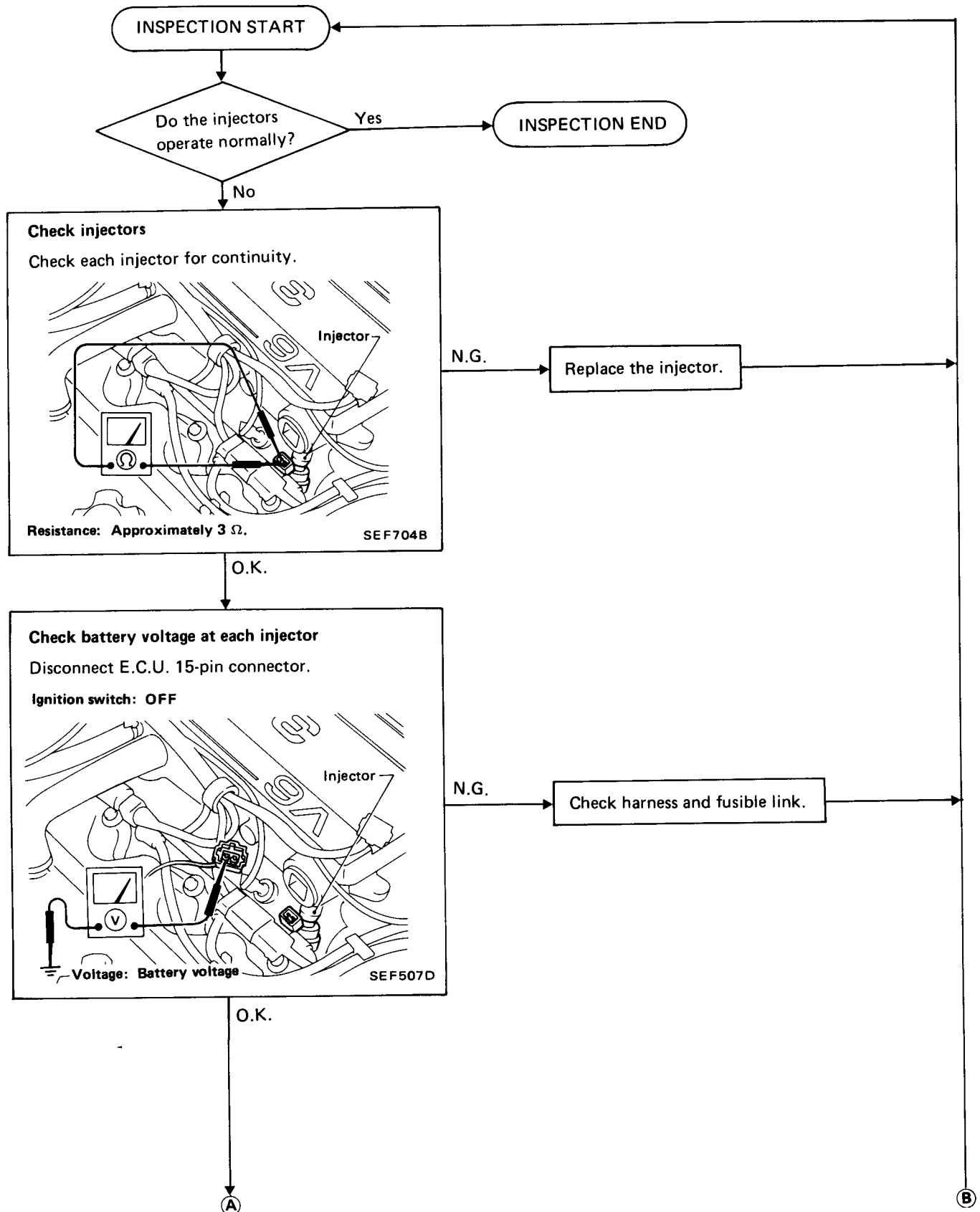
ELECTRONIC CONTROL SYSTEM INSPECTION

Fuel Temperature Sensor (Cont'd)



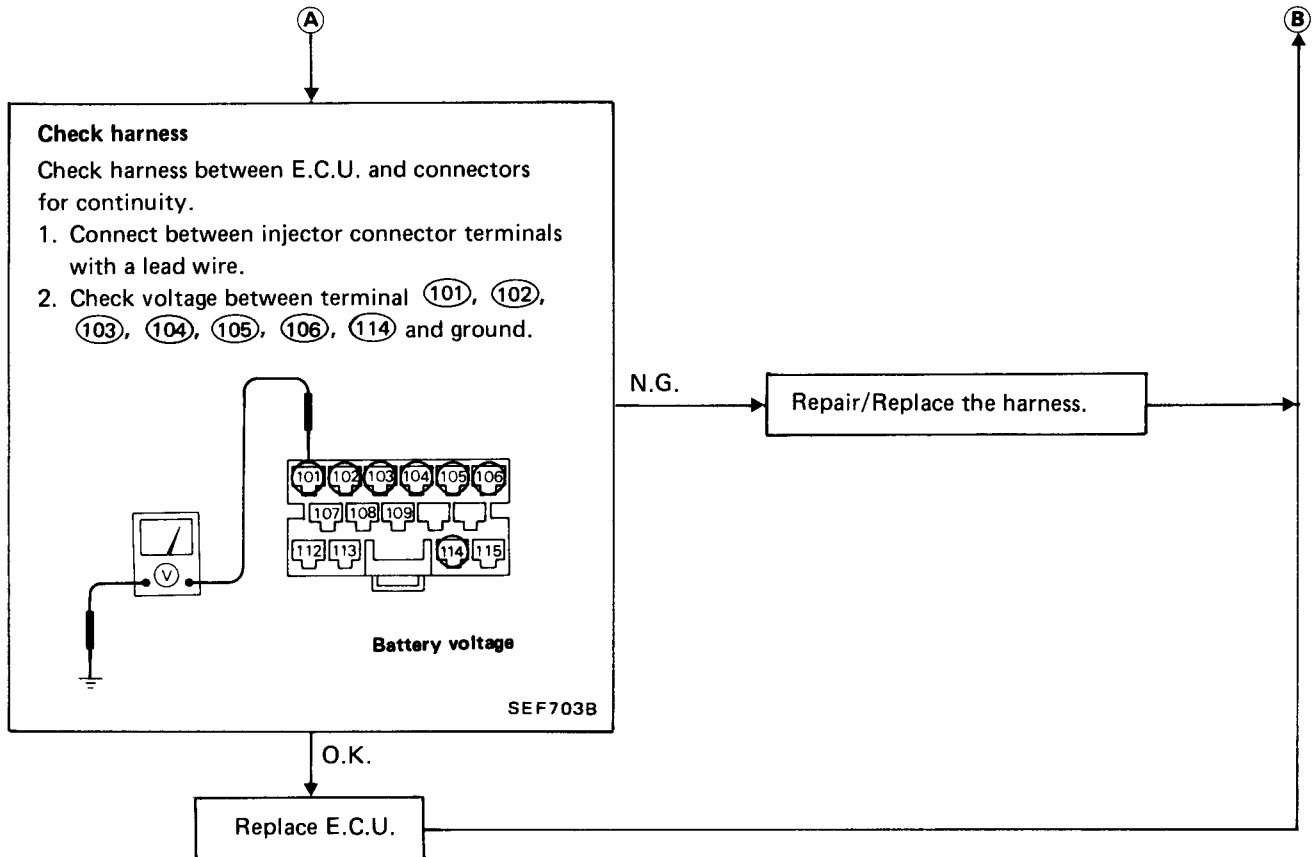
ELECTRONIC CONTROL SYSTEM INSPECTION

Injector



ELECTRONIC CONTROL SYSTEM INSPECTION

Injector (Cont'd)



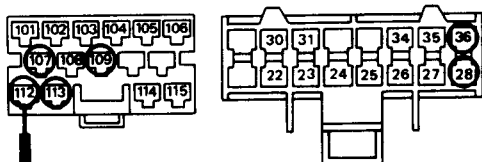
ELECTRONIC CONTROL SYSTEM INSPECTION

Battery Voltage and Ground Test

INSPECTION START

Check ground terminals

1. Disconnect E.C.U. 15-pin and 16-pin connectors.
2. Check for continuity at ②⑧, ③⑥, ①①⑦, ①①⑨, ①①② and ①①③.



Resistance should be read by 0Ω.

SEF965C

N.G.

Check that the ground terminal is securely mounted.

O.K.

Repair/Replace ground harnesses.

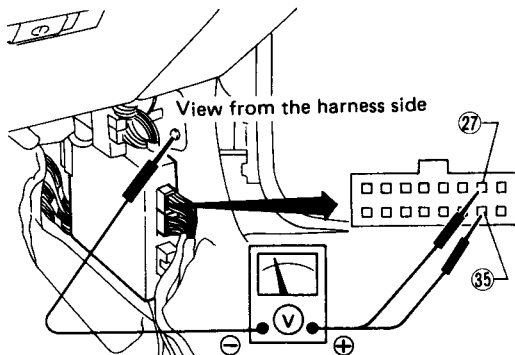
N.G.

Securely mount.

O.K.

Check battery voltage

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



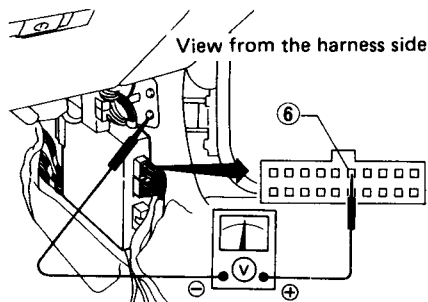
Battery voltage should be read.

SEF508D

N.G.

Check E.F.I. relay control

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



Ignition	Voltage
OFF	12 V
ON	0 V

SEF509D

O.K.

N.G.

INSPECTION END

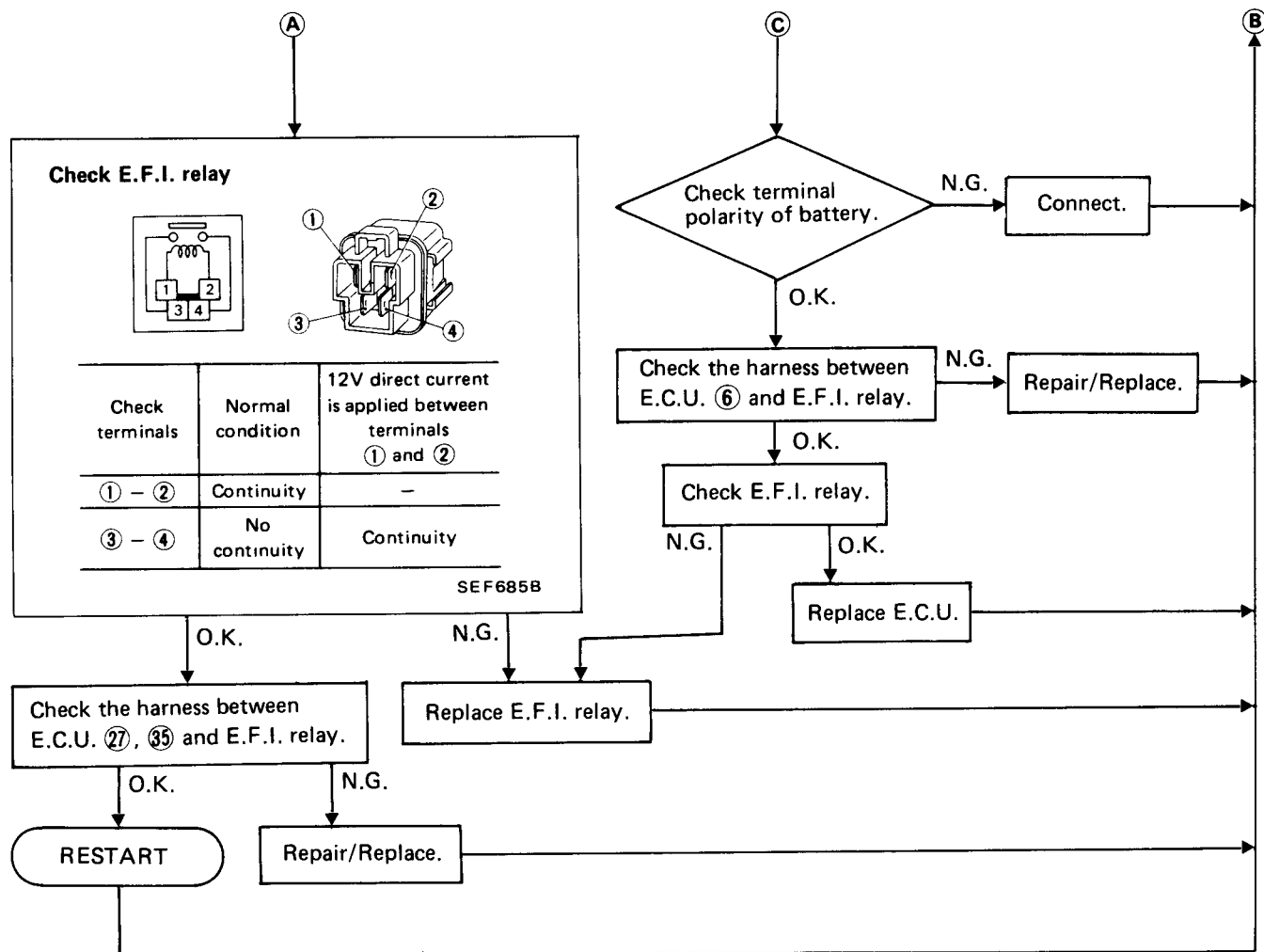
A

C

B

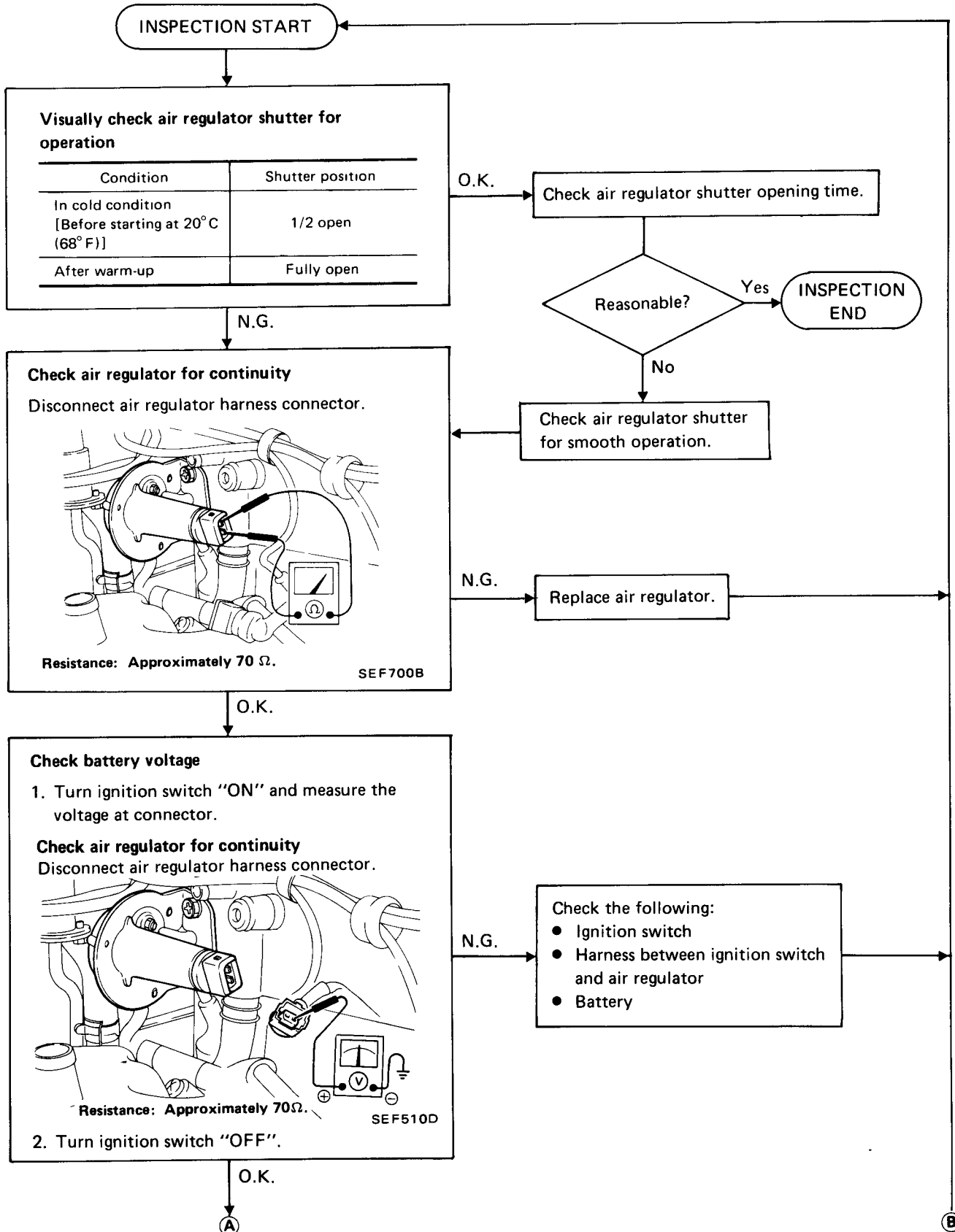
ELECTRONIC CONTROL SYSTEM INSPECTION

Battery Voltage and Ground Test (Cont'd)



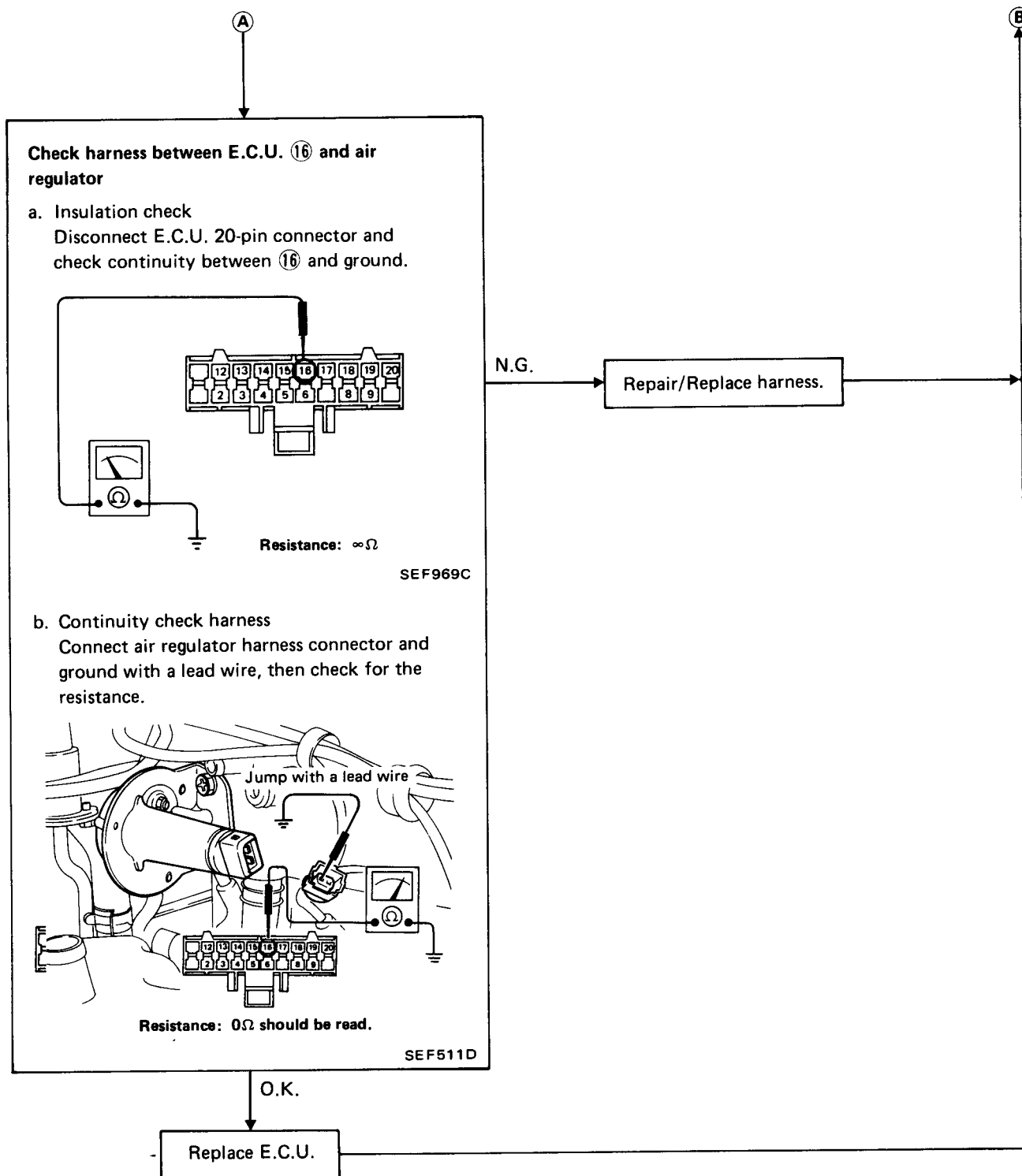
ELECTRONIC CONTROL SYSTEM INSPECTION

Air Regulator



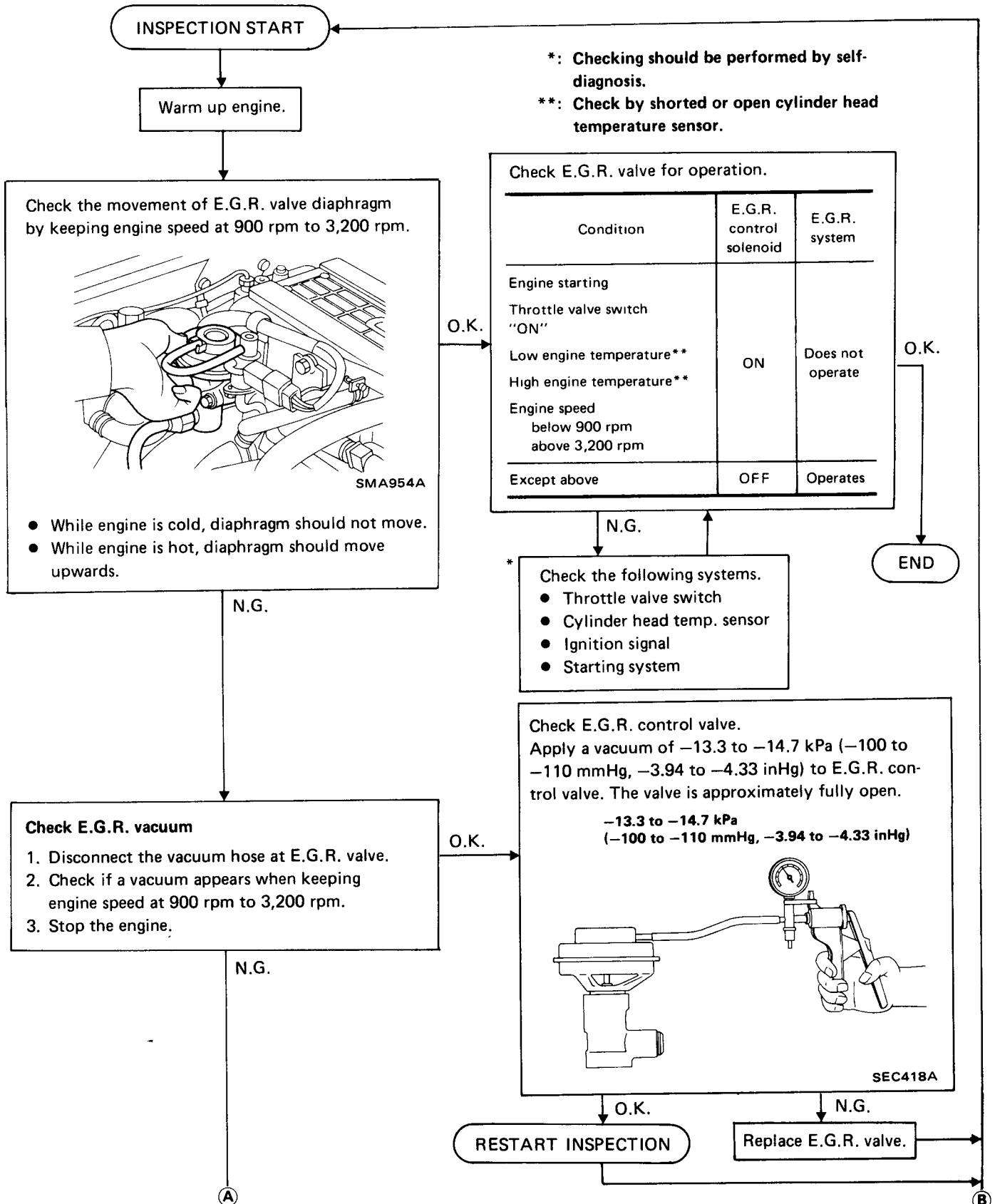
ELECTRONIC CONTROL SYSTEM INSPECTION

Air Regulator (Cont'd)



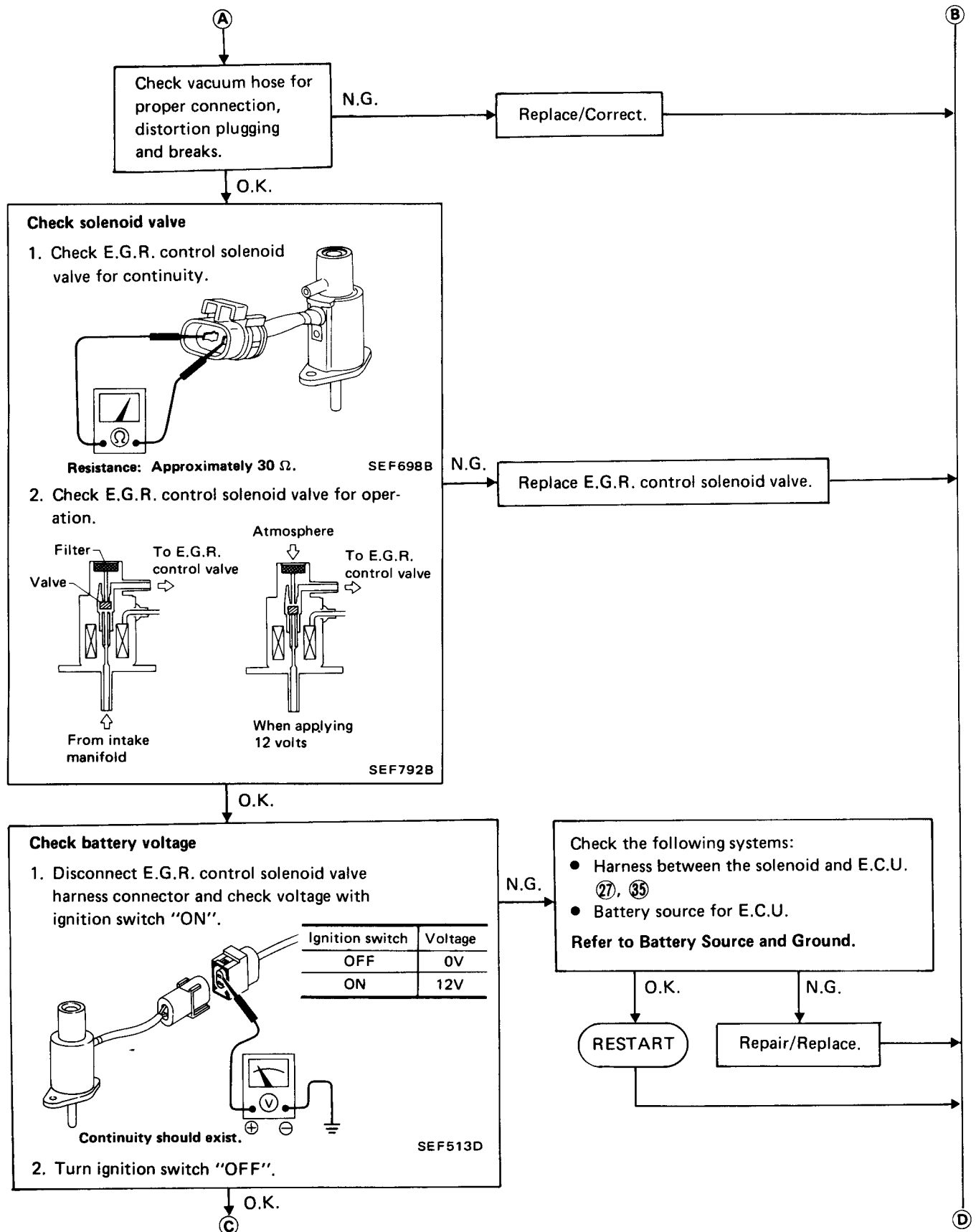
ELECTRONIC CONTROL SYSTEM INSPECTION

E.G.R. Control System



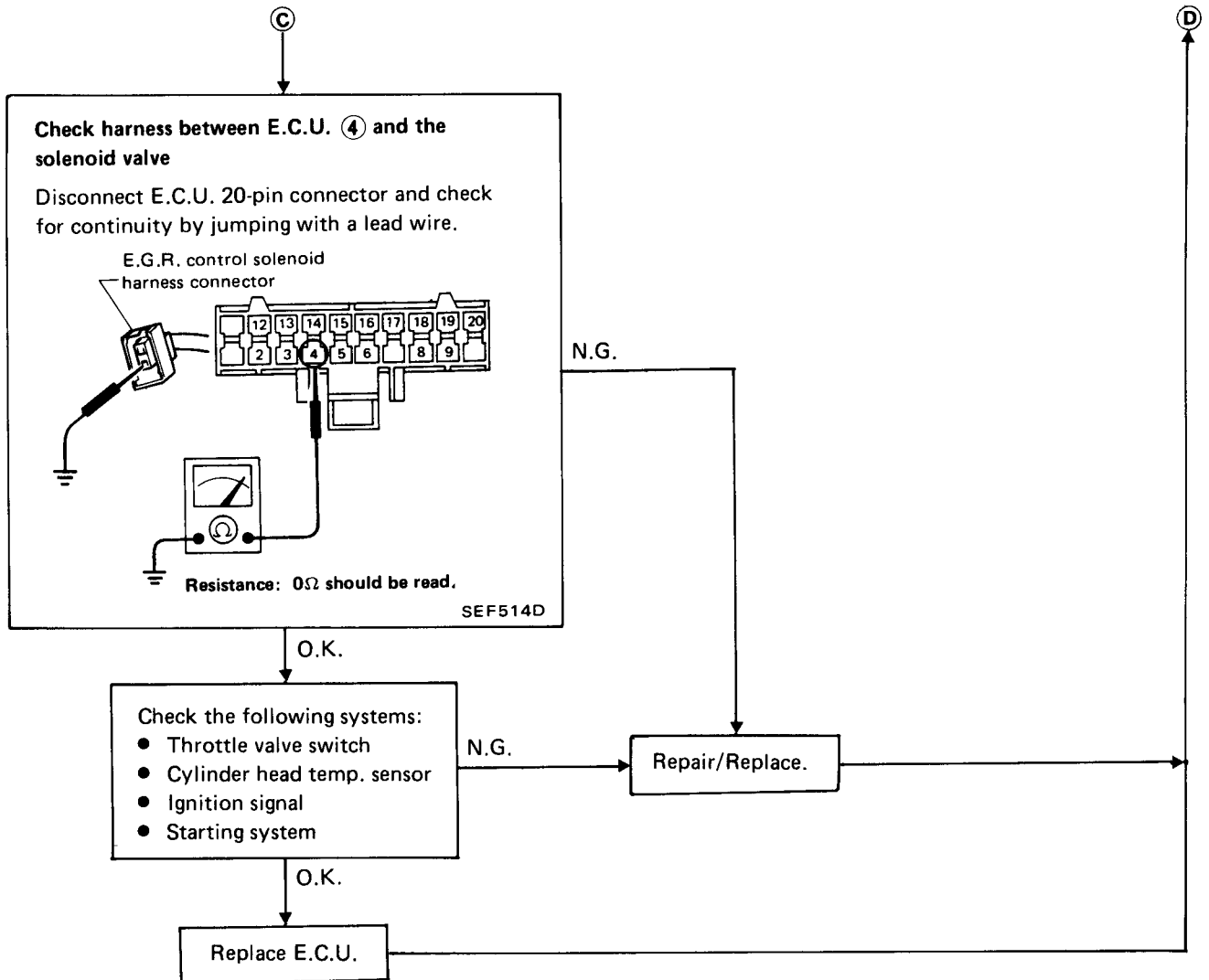
ELECTRONIC CONTROL SYSTEM INSPECTION

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



ELECTRONIC CONTROL SYSTEM INSPECTION

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



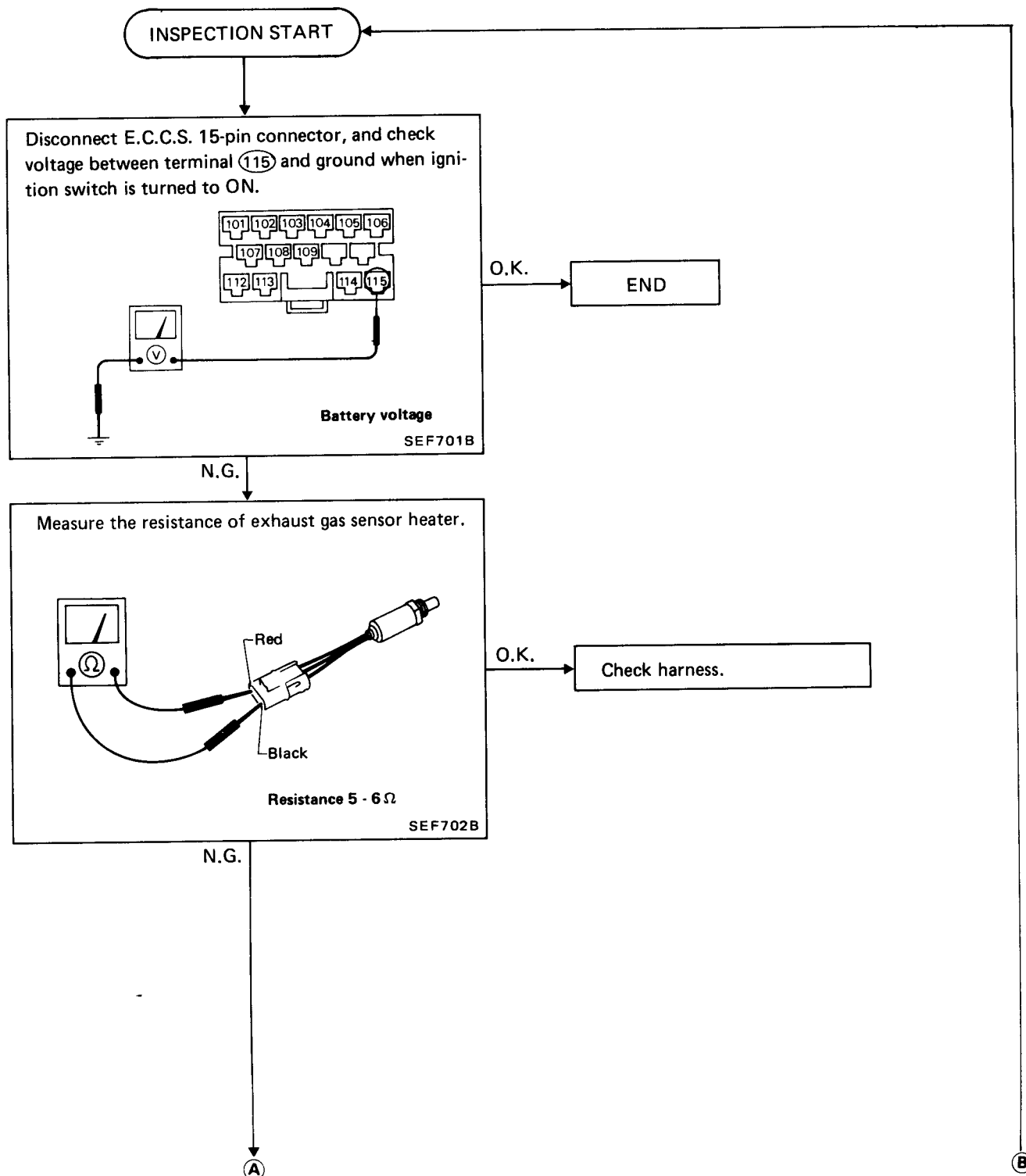
ELECTRONIC CONTROL SYSTEM INSPECTION

Exhaust Gas Sensor

MAIN CIRCUIT

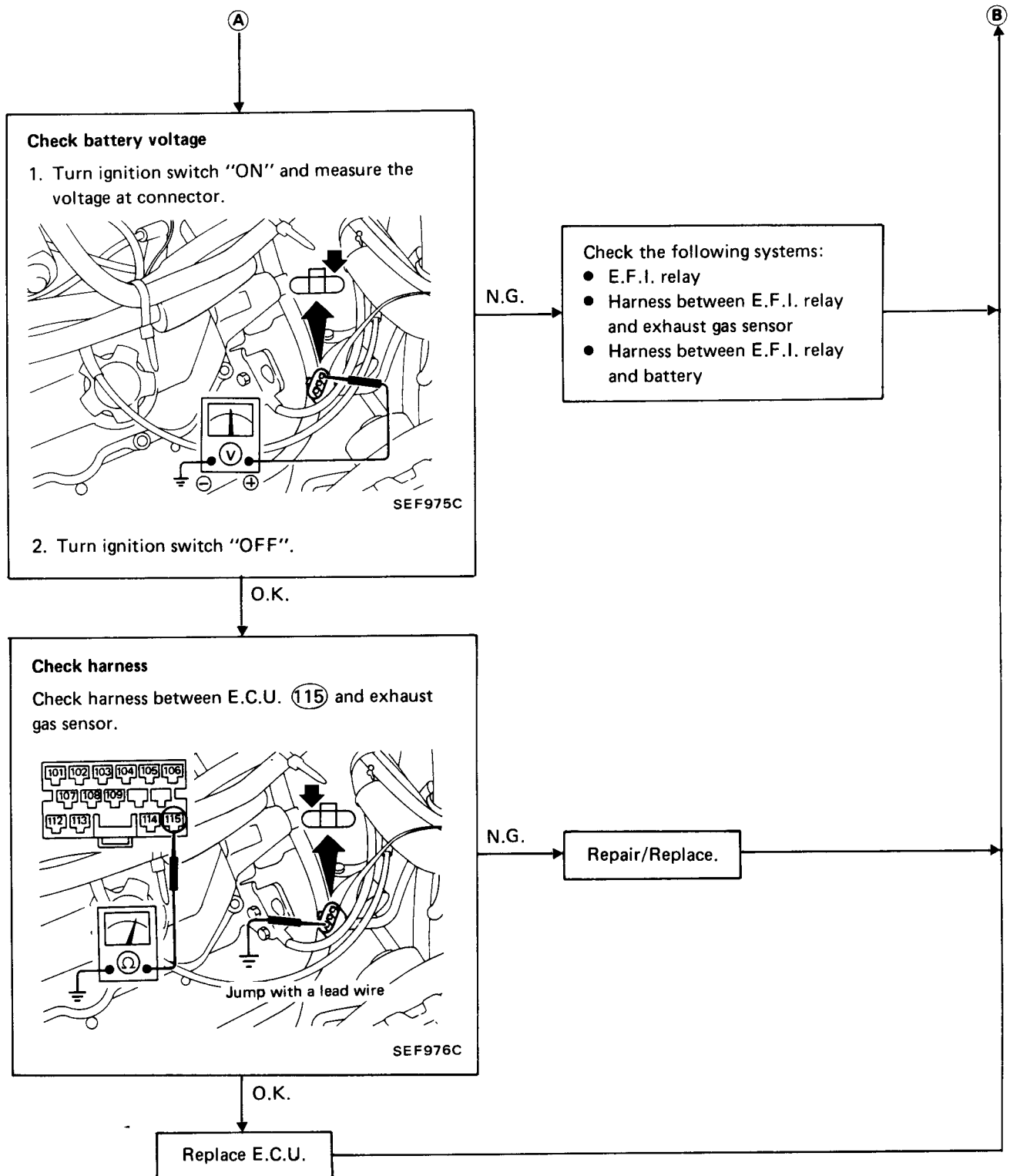
Refer to MIXTURE RATIO FEEDBACK SYSTEM INSPECTION.

HEATER CIRCUIT



ELECTRONIC CONTROL SYSTEM INSPECTION

Exhaust Gas Sensor (Cont'd)

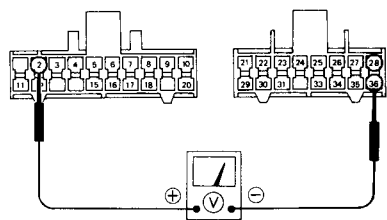


ELECTRONIC CONTROL SYSTEM INSPECTION

Auxiliary air Control (A.A.C.) Valve or Idle-up Solenoid Valve

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

Ignition switch: ON



Battery voltage

SEF695B

O.K.

END

N.G.

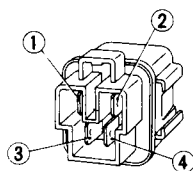
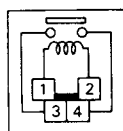
Check harness for continuity.

N.G.

Repair harness.

O.K.

Check E.F.I. relay.



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

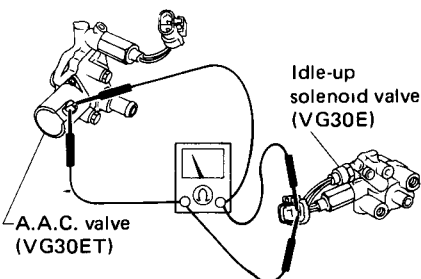
SEF685B

N.G.

Replace E.F.I. relay.

O.K.

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



Continuity should exist.

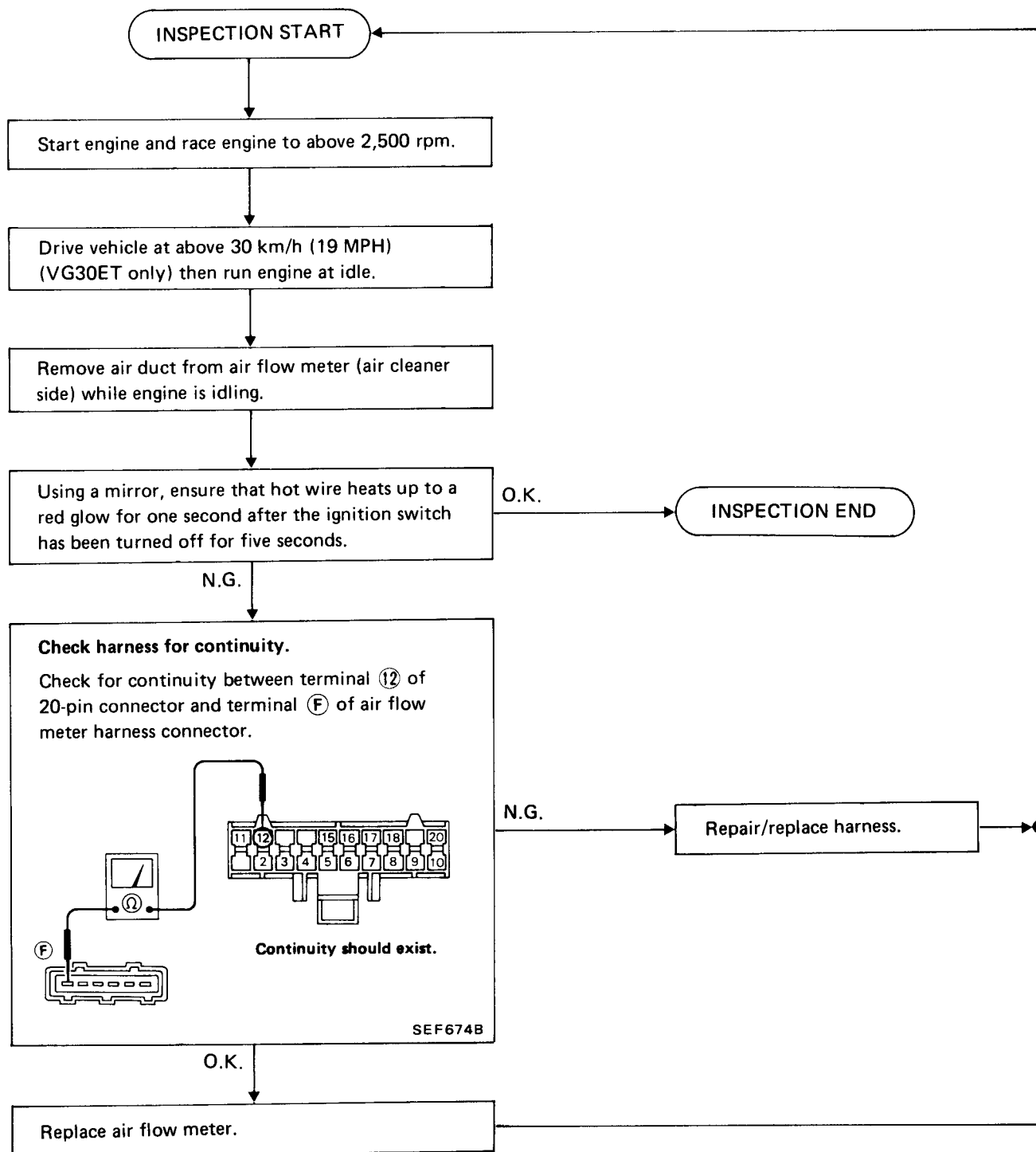
SEF696B

N.G.

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

ELECTRONIC CONTROL SYSTEM INSPECTION

Self-cleaning Hot Wire



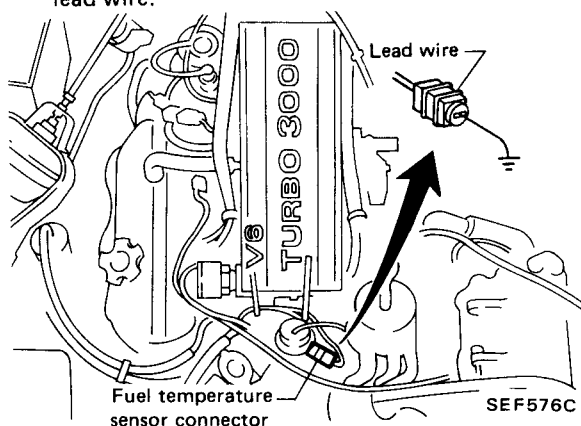
ELECTRONIC CONTROL SYSTEM INSPECTION

Pressure Regulator Control Solenoid Valve

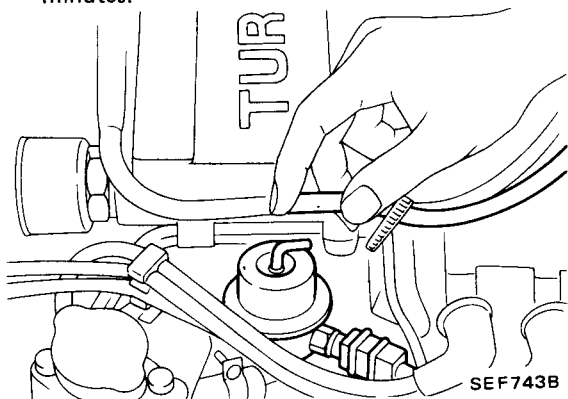
INSPECTION START

Check the system operation

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



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



5. Stop the engine.

O.K.

Check fuel temperature sensor.

INSPECTION END

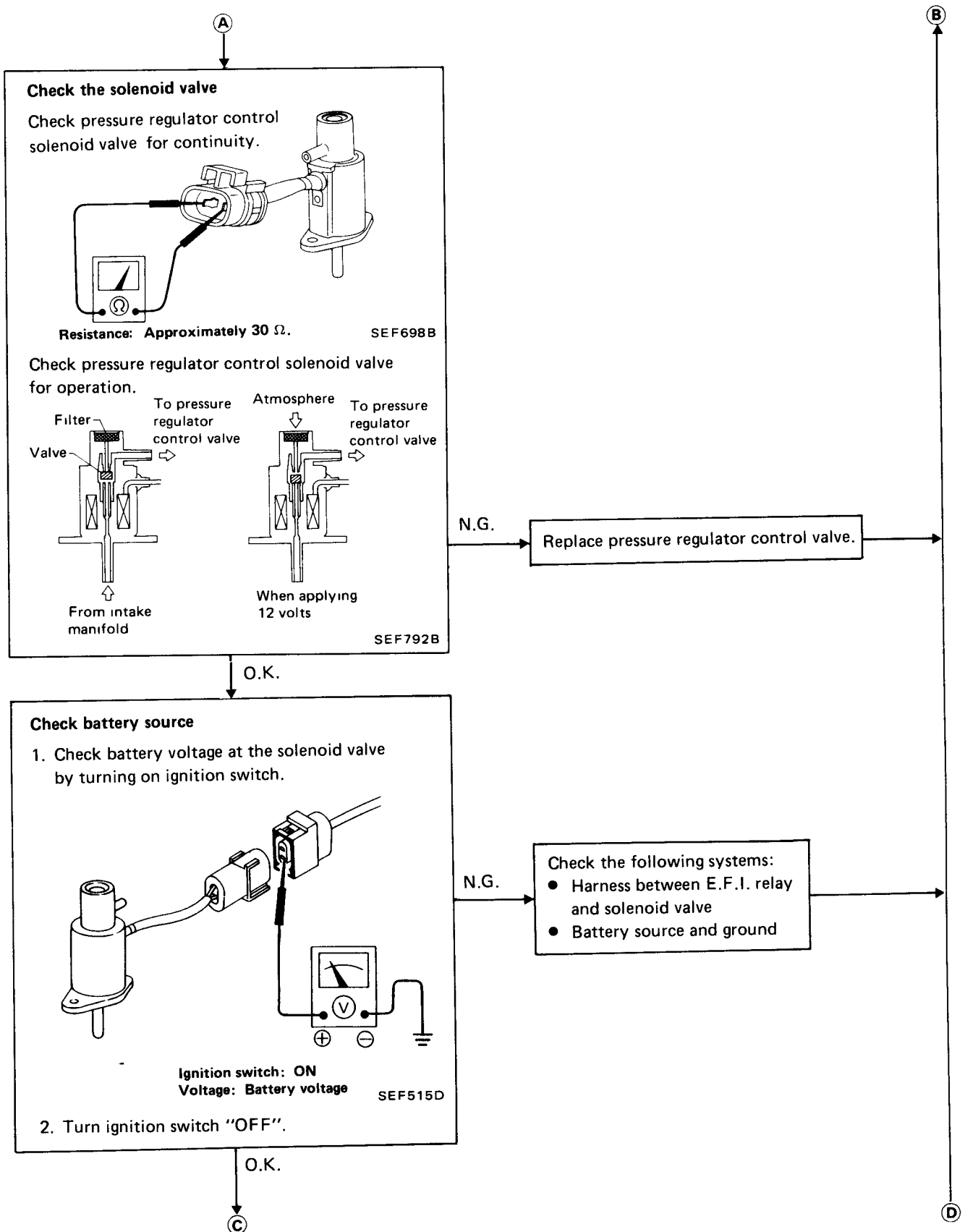
N.G.

A

B

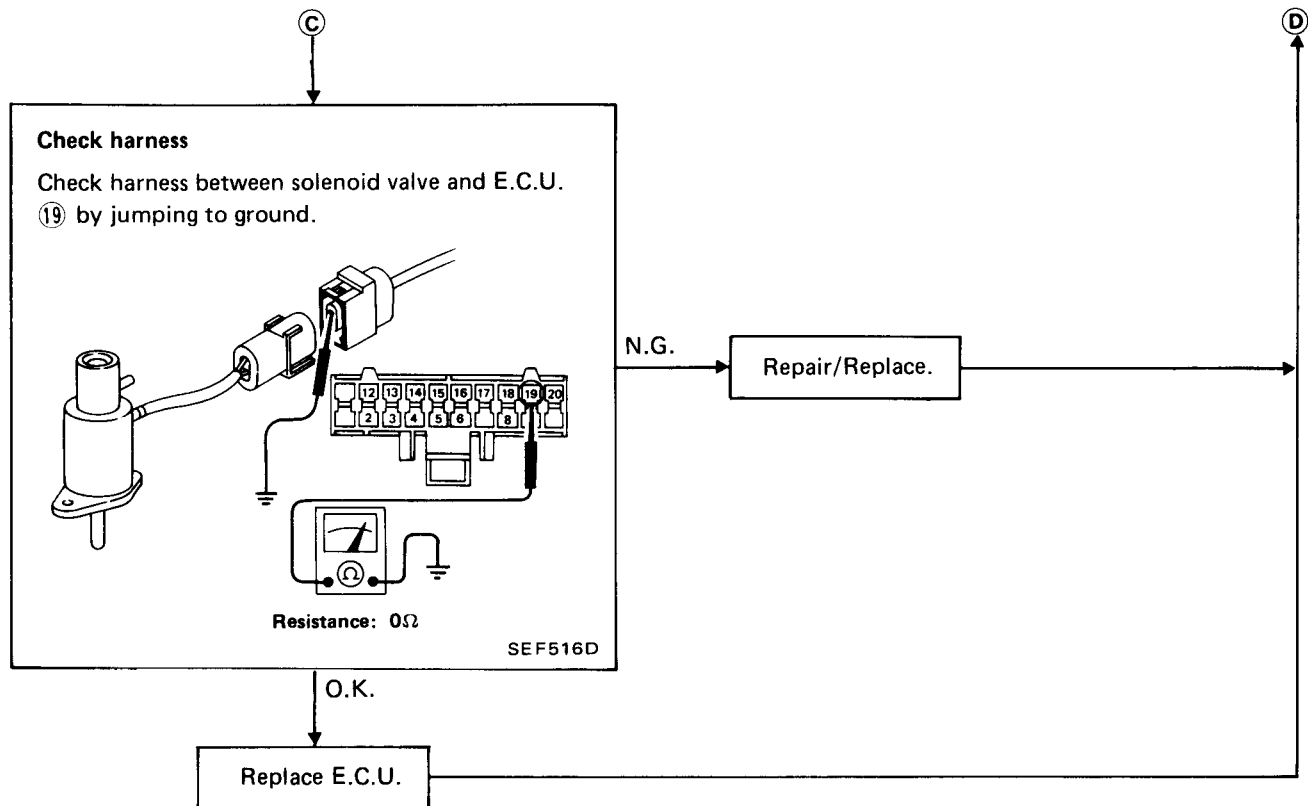
ELECTRONIC CONTROL SYSTEM INSPECTION

Pressure Regulator Control Solenoid Valve (Cont'd)



ELECTRONIC CONTROL SYSTEM INSPECTION

Pressure Regulator Control Solenoid Valve (Cont'd)



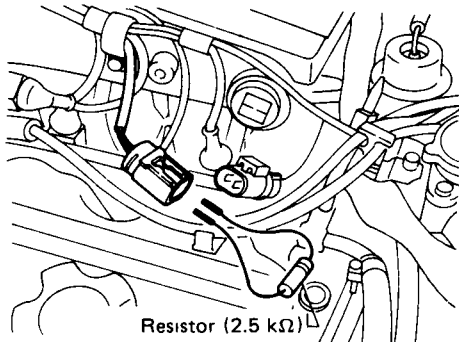
ELECTRONIC CONTROL SYSTEM INSPECTION

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

INSPECTION START

Check the system operation

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



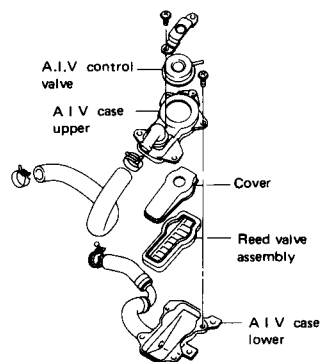
SEF711B

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

O.K.

N.G.

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



SEF485D

O.K.

Check cylinder head temp. sensor.

O.K.

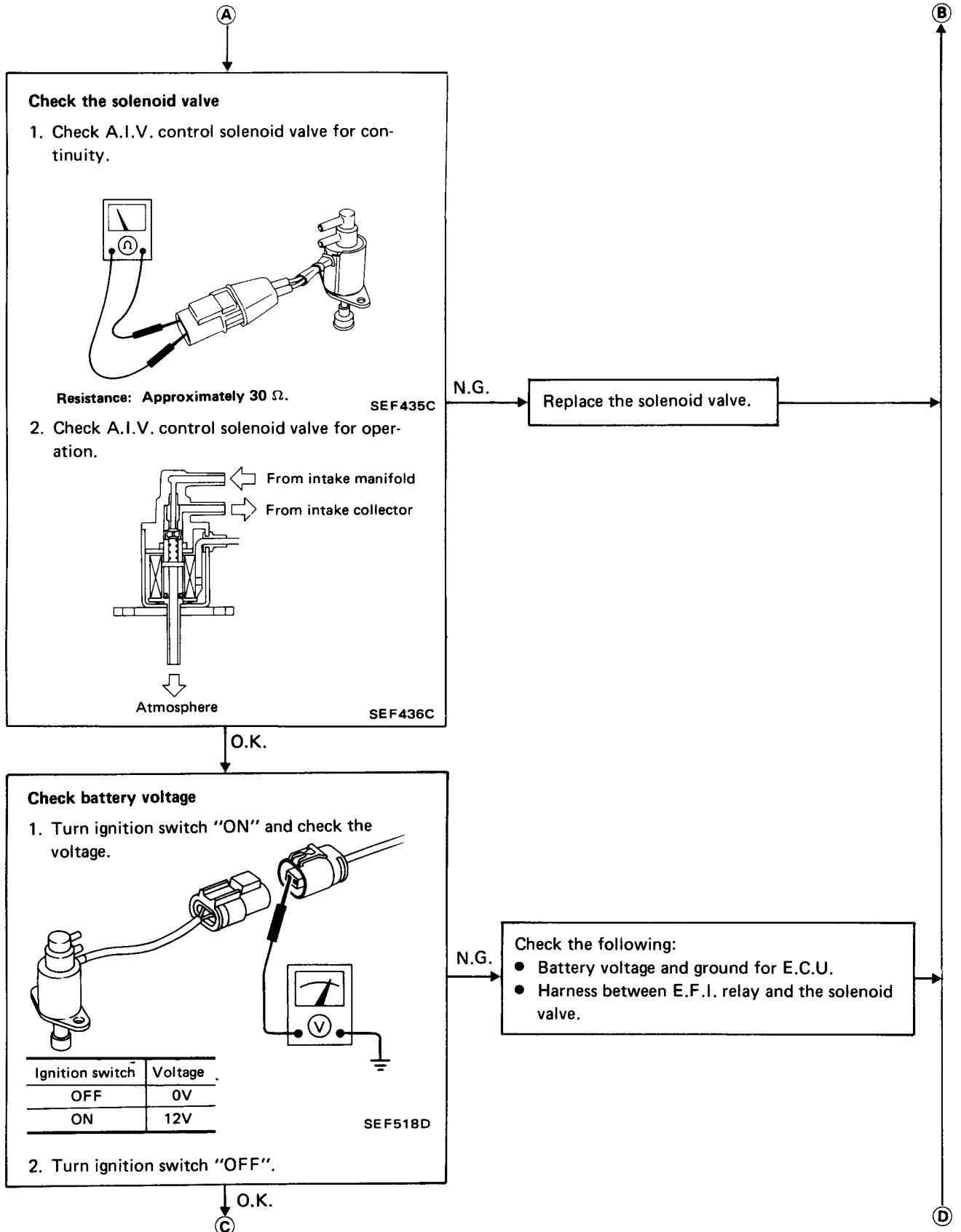
END

(A)

(B)

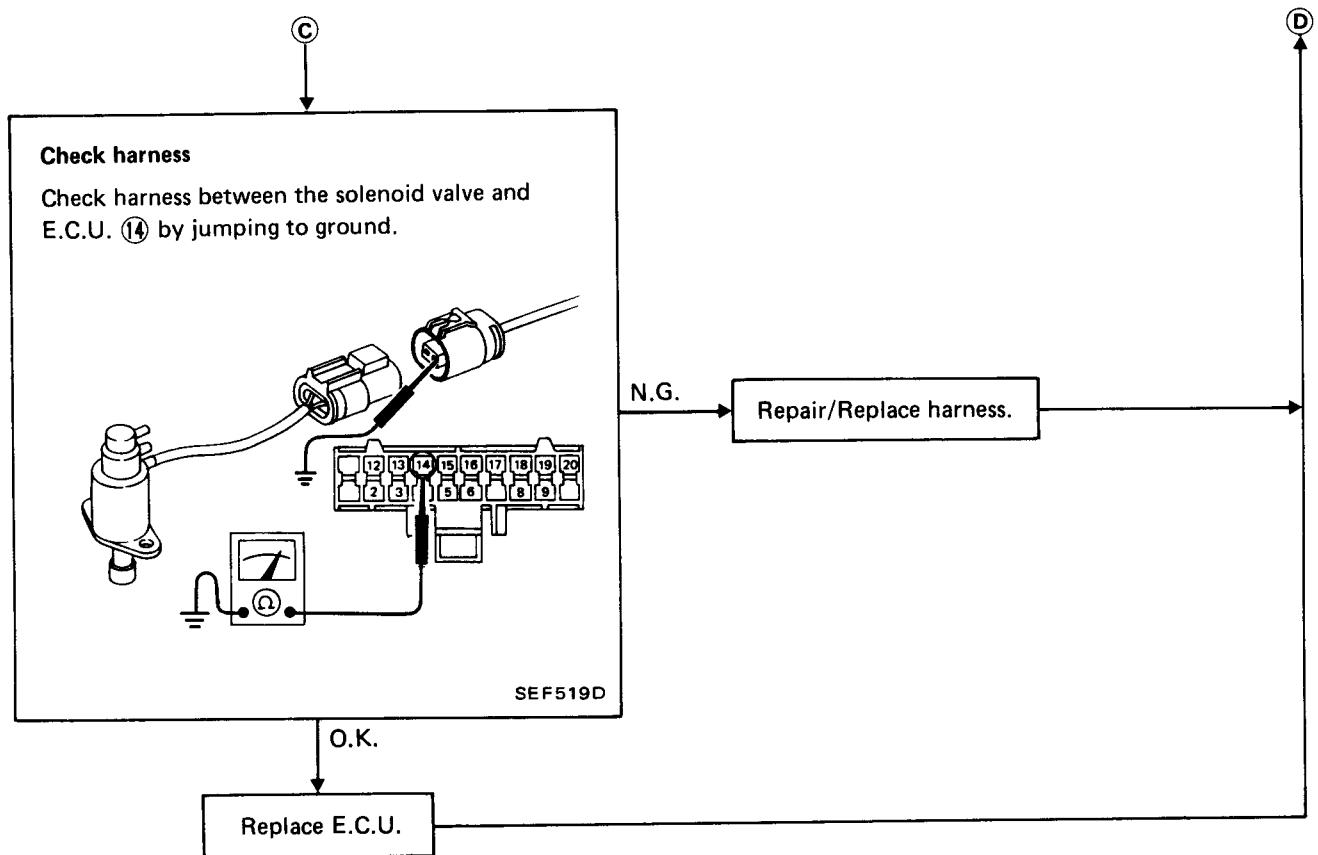
ELECTRONIC CONTROL SYSTEM INSPECTION

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



ELECTRONIC CONTROL SYSTEM INSPECTION

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



MIXTURE RATIO FEEDBACK SYSTEM INSPECTION

PREPARATION

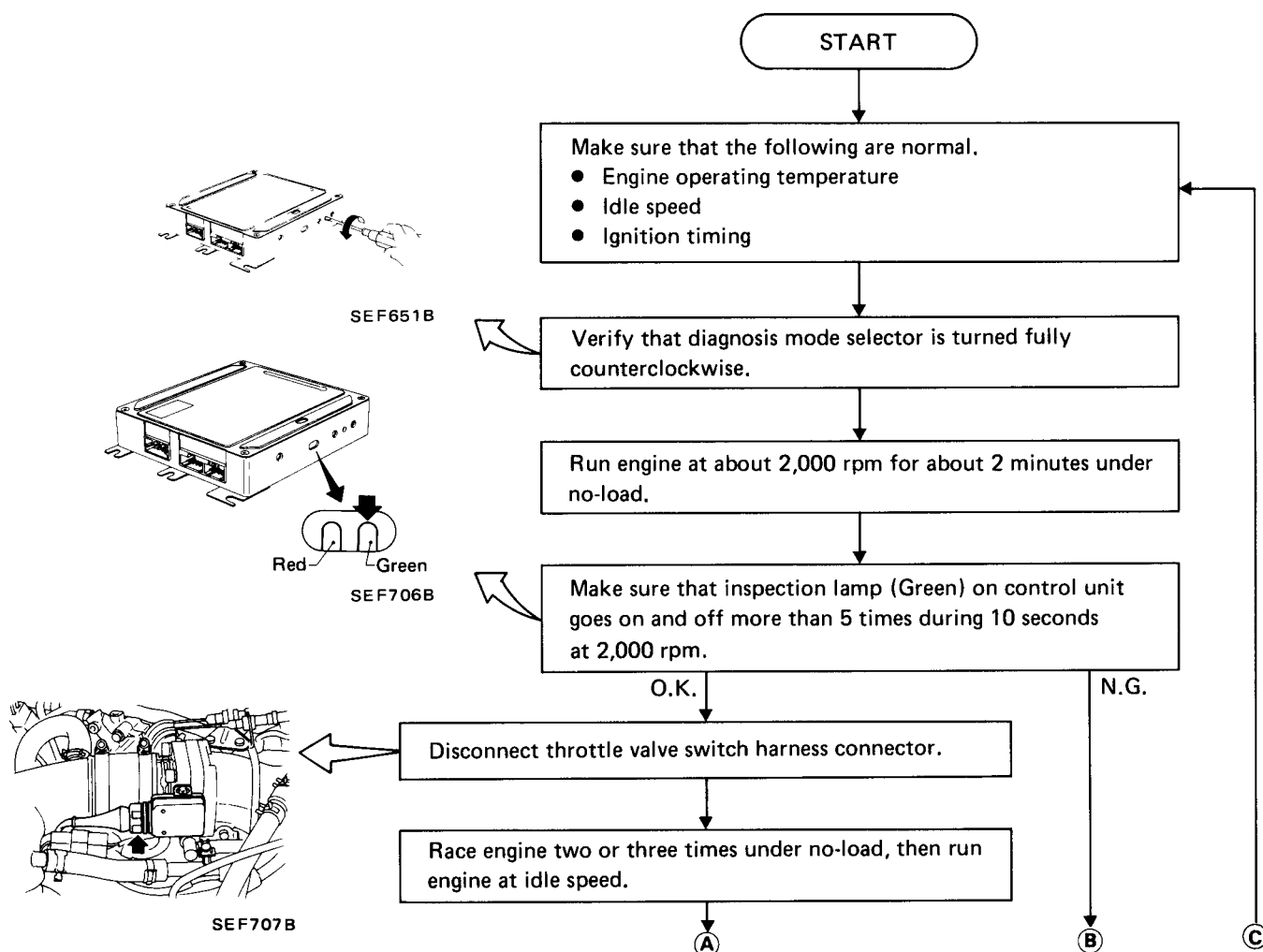
1. Make sure that the following parts are in good order.
 - Battery
 - Ignition system
 - Engine oil and coolant levels
 - Fuses
 - E.C.C.S. harness connectors
 - Vacuum hoses
 - Air intake system
(oil filler cap, oil level gauge, etc.)
 - Engine compression
 - E.G.R. valve operation
 - Throttle valve and throttle valve switch operation
2. On air conditioner equipped models, checks should be carried out while the air conditioner

is "OFF".

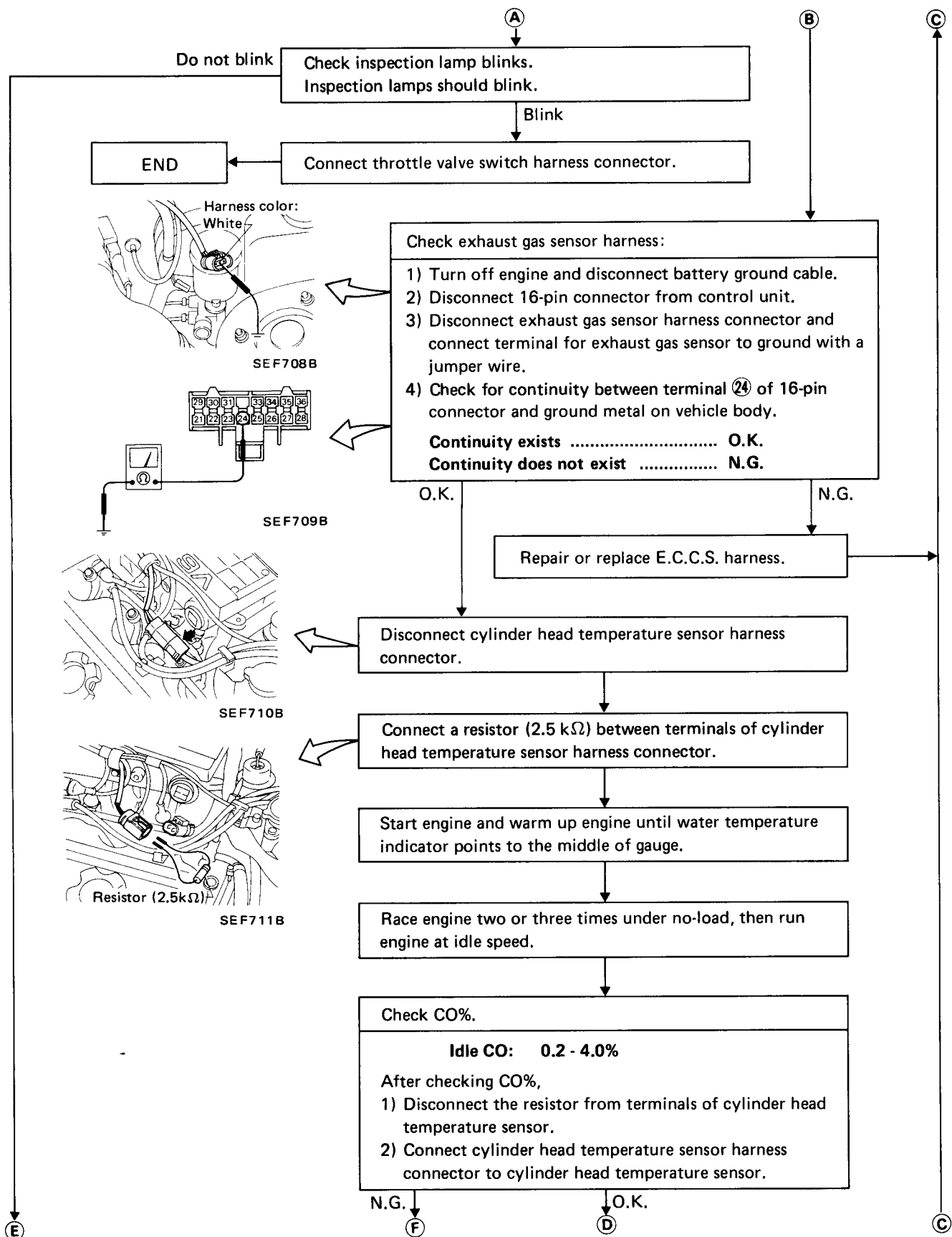
3. On automatic transmission equipped models, when checking idle rpm, ignition timing and mixture ratio, checks should be carried out while shift lever is in "D" position.
4. Make sure that diagnosis mode selector on E.C.C.S. control unit is turned fully counter-clockwise.

WARNING:

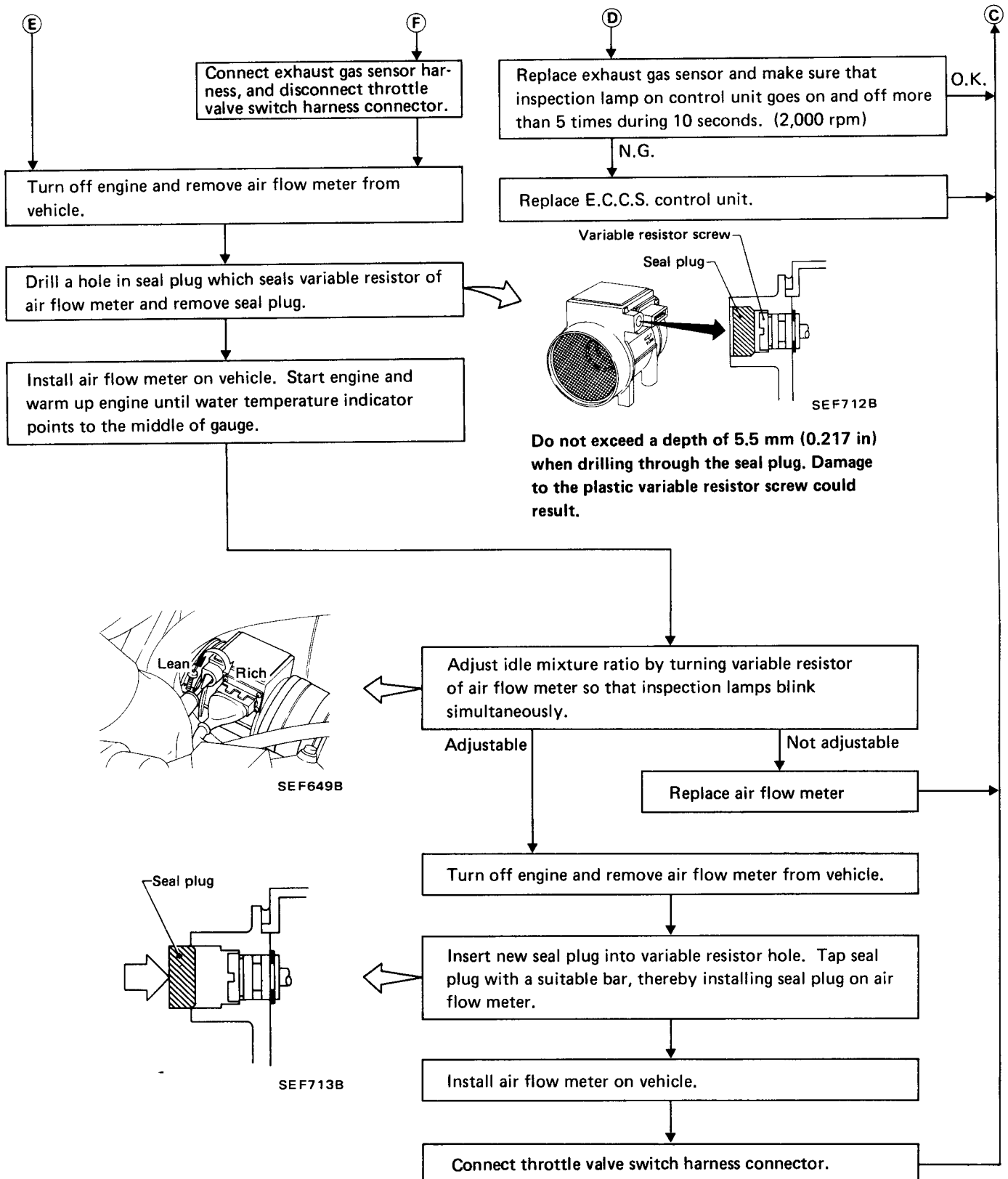
- a. When selector lever is shifted to "D" position, apply parking brake and block both front and rear wheels with chocks.
- b. Depress brake pedal while racing the engine to prevent forward surge of vehicle.
- c. After the adjustment has been made, shift the lever to the "N" or "P" position and remove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



MIXTURE RATIO FEEDBACK SYSTEM INSPECTION



MIXTURE RATIO FEEDBACK SYSTEM INSPECTION



FUEL SYSTEM INSPECTION

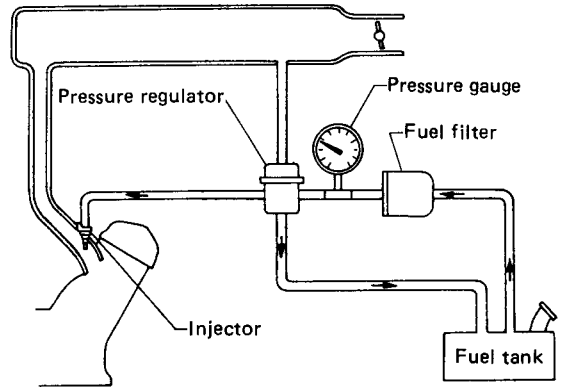
Releasing Fuel Pressure

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

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

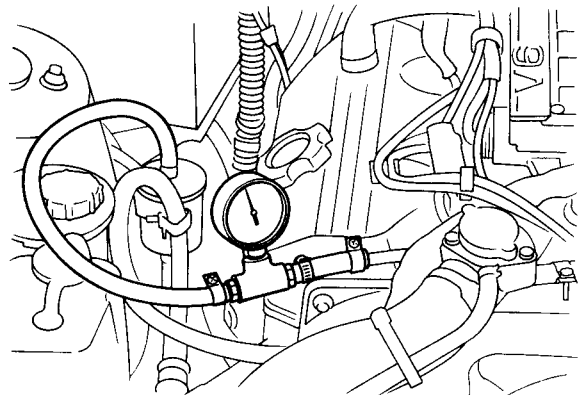
Fuel Pressure Check

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



SEF584C

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



SEF716B

FUEL SYSTEM INSPECTION

Fuel Pressure Check (Cont'd)

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

At idling:

Approximately 206 kPa
(2.1 kg/cm², 30 psi)

The moment accelerator pedal is fully depressed:

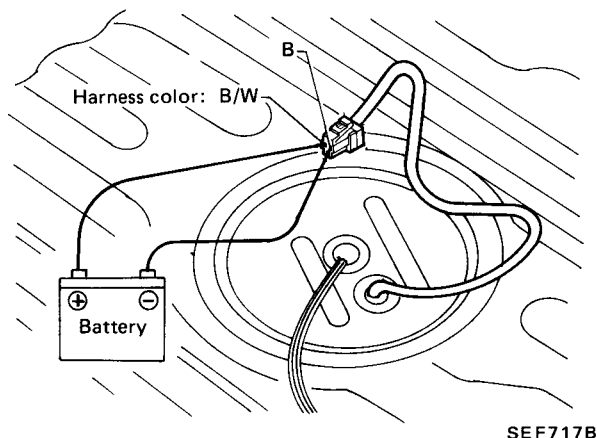
[VG30E]

Approximately 255 kPa
(2.6 kg/cm², 37 psi)

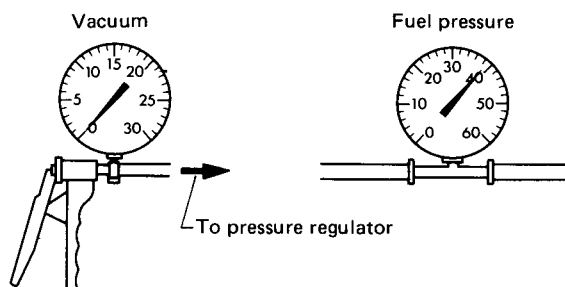
[VG30ET]

Approximately 304 kPa
(3.1 kg/cm², 44 psi)

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



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



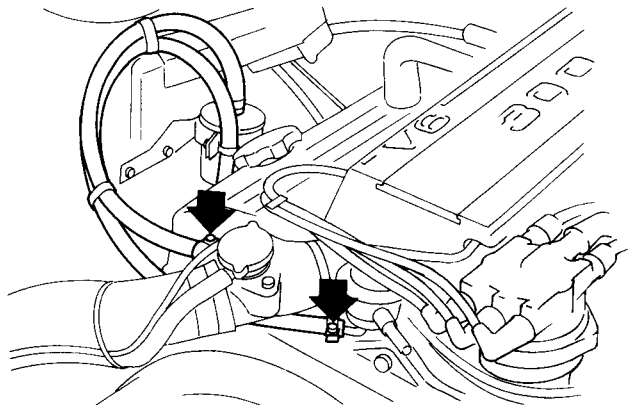
Vacuum kPa (mmHg, inHg)	Fuel pressure kPa (kg/cm ² , psi)
0 (0, 0)	248.1 - 255.0 (2.53 - 2.60, 36.0 - 37.0)
16.9 (127, 5.00)	227.5 - 241.3 (2.32 - 2.46, 33.0 - 35.0)
33.9 (254, 10.00)	213.8 - 220.7 (2.18 - 2.25, 31.0 - 32.0)
50.8 (381, 15.00)	200.1 - 206.9 (2.04 - 2.11, 29.0 - 30.0)
67.7 (508, 20.00)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

FUEL SYSTEM INSPECTION

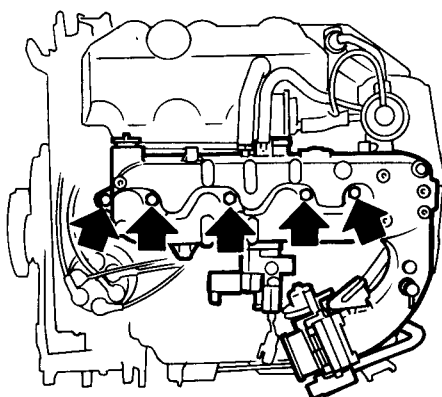
Injector Removal and Installation

1. Release fuel pressure to zero.
2. Disconnect the following from intake collector.
 - Air duct
 - Accelerator wire
 - Blow-by hoses
 - Air regulator hose
3. Disconnect fuel hoses.



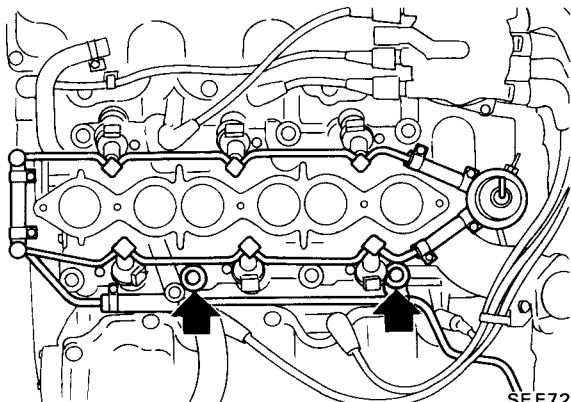
SEF721B

4. Remove intake collector.



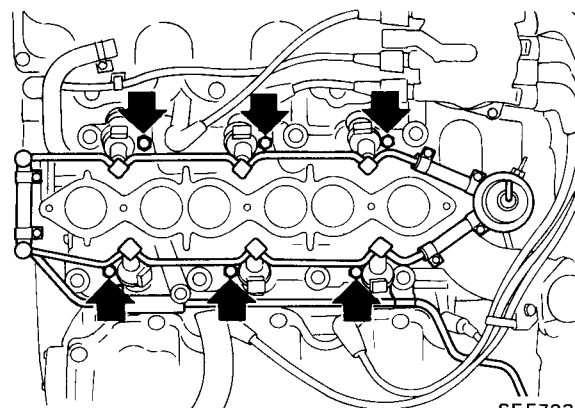
SEF720B

5. Remove bolts securing fuel tube.



SEF722B

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

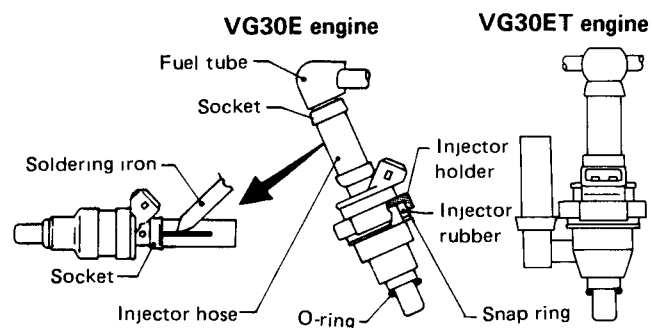


SEF723B

7. Remove fuel hose.

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

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



SEF520D

- 2) Then pull rubber hose out with hand.
 - a. Be careful not to damage socket plastic connector, etc. with soldering iron.
 - b. Never place injector in a vise when disconnecting rubber hose.
8. Install fuel hose as follows:
 - 1) Clean exterior of injector tail piece and fuel tube end.
 - 2) Wet inside of new rubber hose with fuel.
 - 3) Push end of rubber hose with hose sockets onto injector tail piece and fuel tube end by hand as far as they will go.

Clamp is not necessary at the connections.

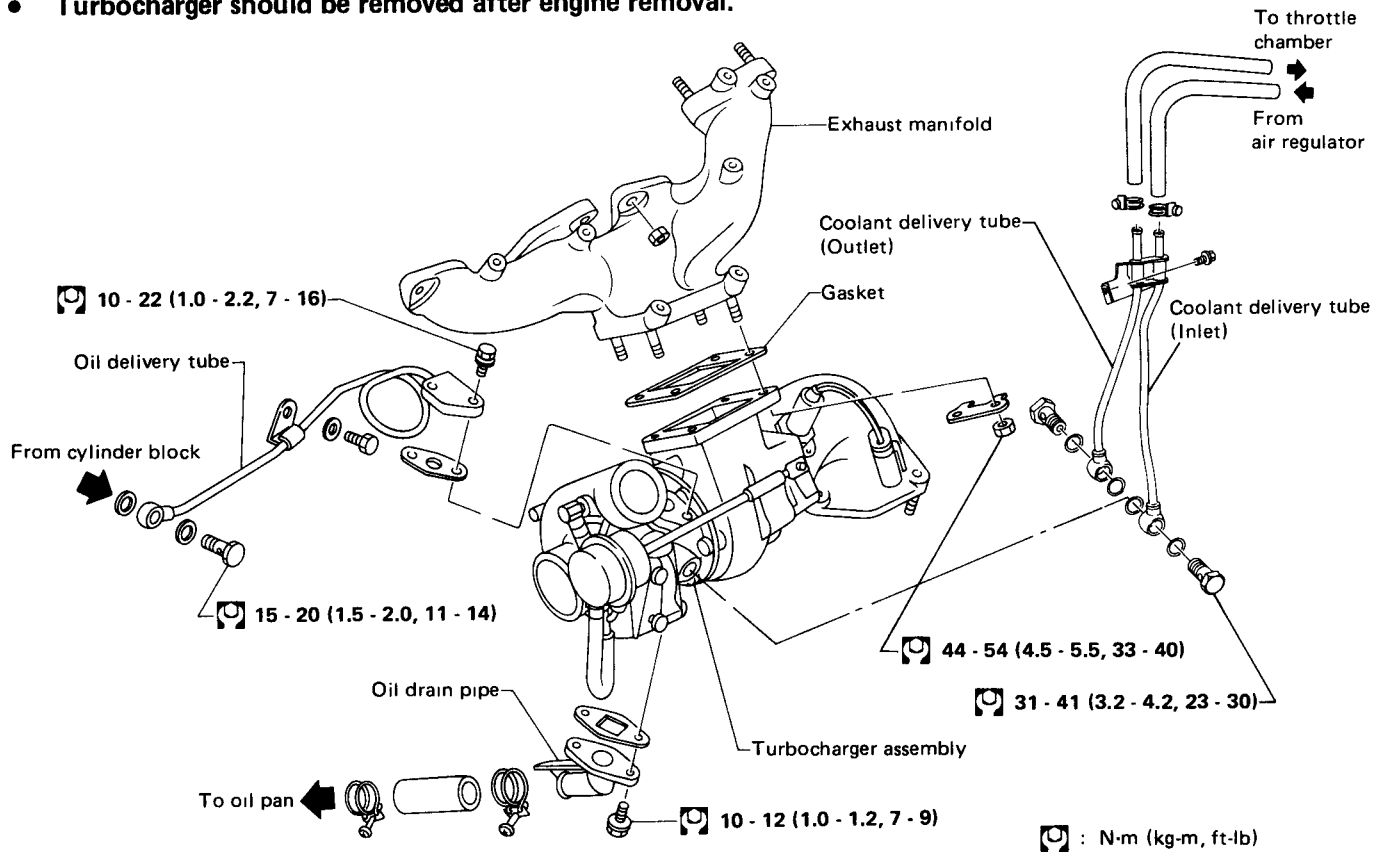
CAUTION:

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

TURBOCHARGER

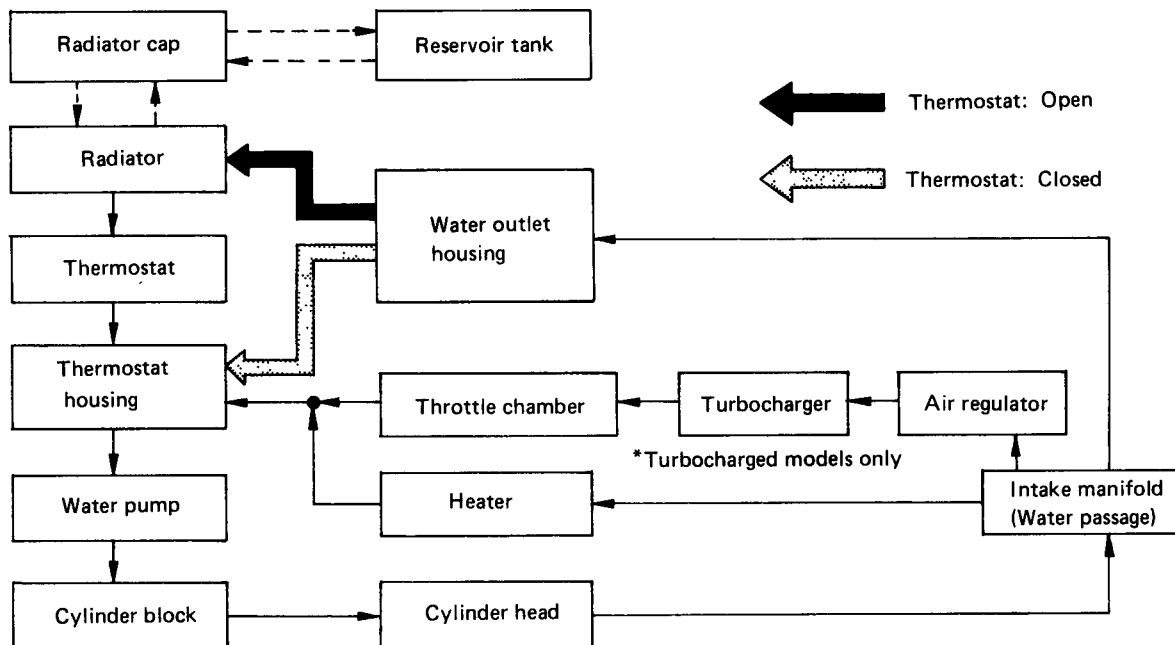
DISASSEMBLY AND ASSEMBLY

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



SEF583C

COOLING CIRCUIT



SLC728

TURBOCHARGER

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.

Stuck or worn journal or bearing

Broken shaft

Sludge on back of turbine wheel

Broken turbine wheel

Replace turbocharger assembly.

Condition 2: Excessively high engine power

Probable cause

Corrective action

Disconnected or cracked rubber hose on by-pass valve.

Correct or replace rubber hose.

By-pass valve is stuck closed.

Replace turbocharger assembly.

Controller diaphragm is broken.

TURBOCHARGER

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

Oil leak at oil seal of compressor

Worn journal or bearing

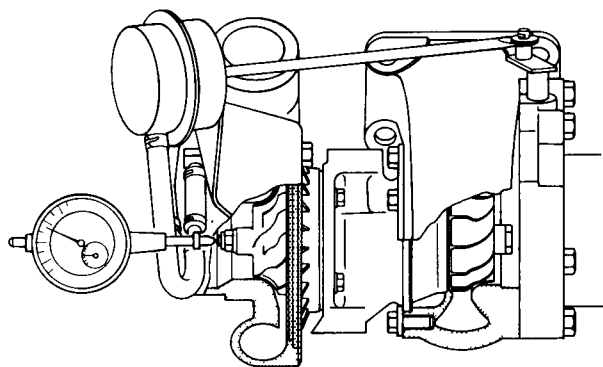
Replace turbocharger assembly.

1. Inspect turbine and compressor wheel as follows:

- Visually check for cracks, clogging, deformity or other damage.
- Revolve wheels to make sure that they turn freely without any abnormal noise or friction.
- Measure play in axial direction.

Play (axial direction):

0.013 - 0.091 mm (0.0005 - 0.0036 in)



SEF726B

2. Check operation of by-pass valve controller.

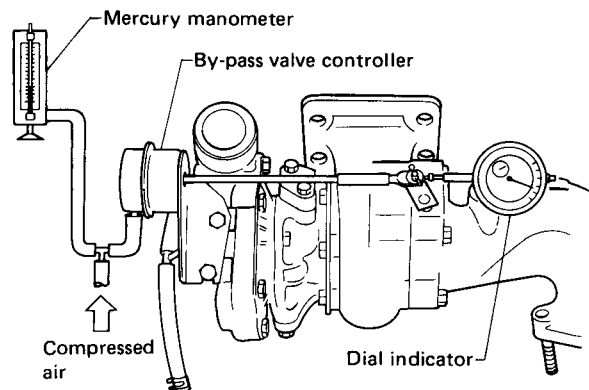
- Move by-pass valve to make sure that it is not sticking or scratched.
- Measure rod end play of the by-pass valve controller.

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

By-pass valve controller stroke/pressure:

0.38 mm (0.0150 in)/51.3 - 56.7 kPa

(385 - 425 mmHg, 15.16 - 16.73 inHg)

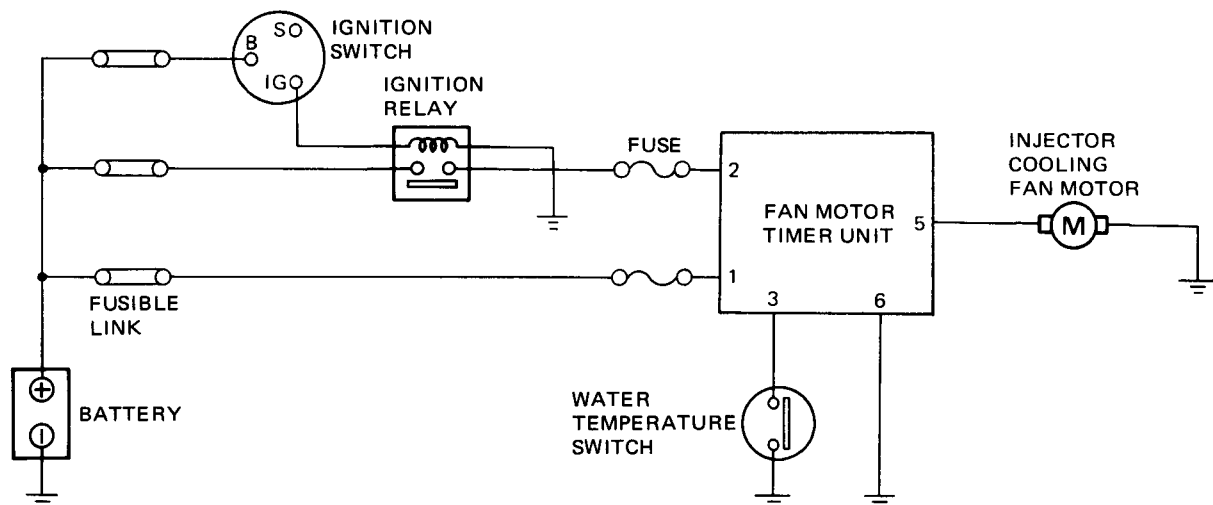


SEC727B

Always replace the turbocharger as an assembly if damaged.

INJECTOR COOLING FAN (VG30E)

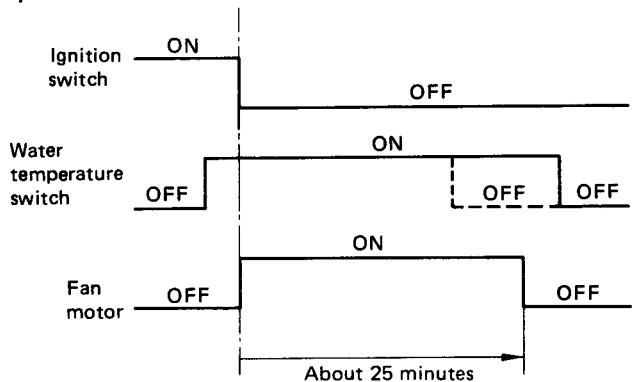
Operation



SEF728B

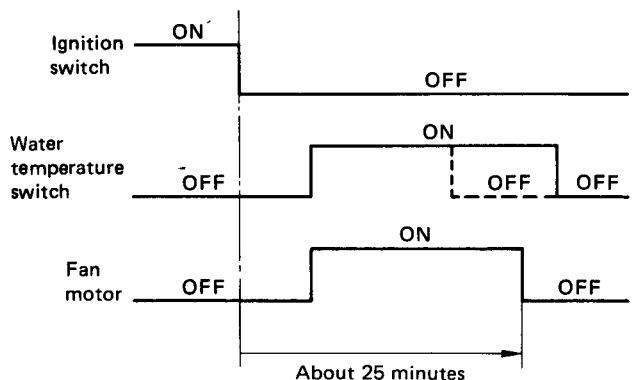
The injector cooling fan operates to cool down the temperature of fuel inside the injector and the fuel gallery when engine is stopped under high engine temperature condition. The injector cooling fan is mounted on the R.H. side of the cylinder block.

Operation 1:



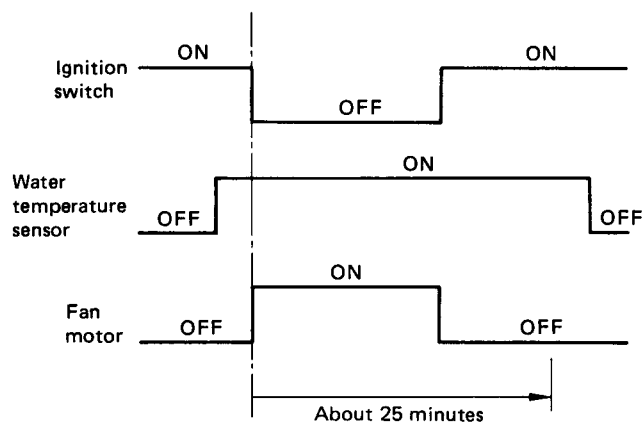
SEF729B

Operation 2:



SEF730B

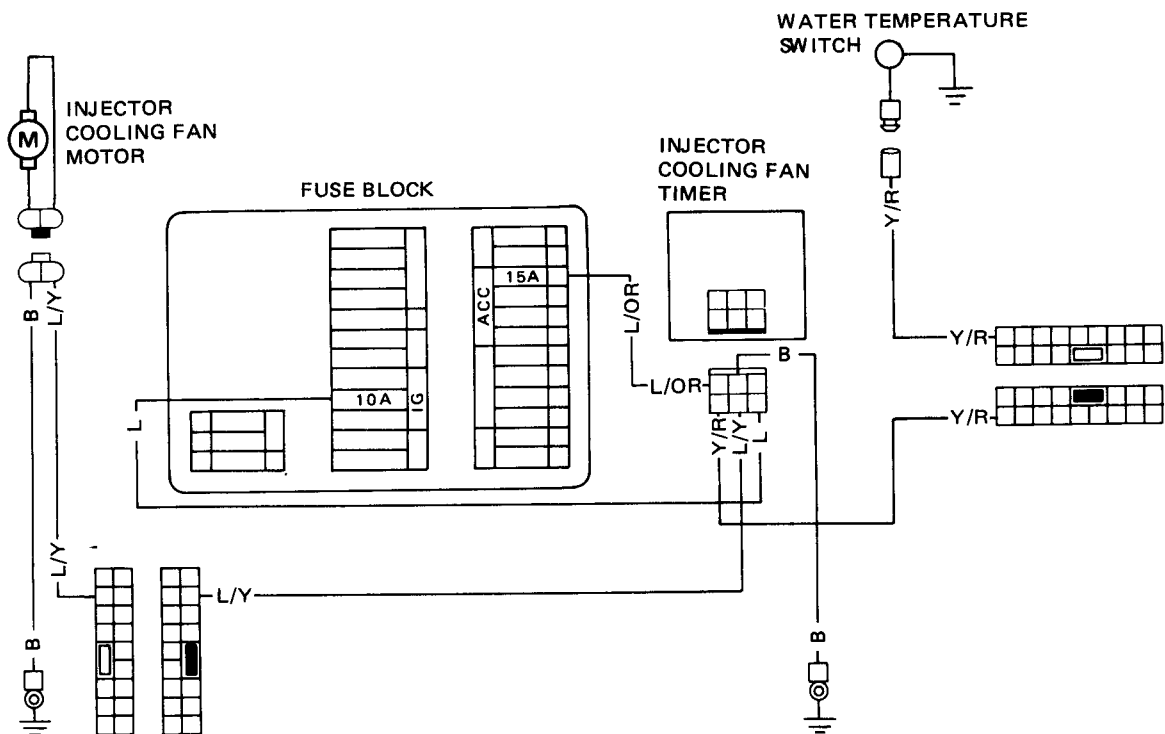
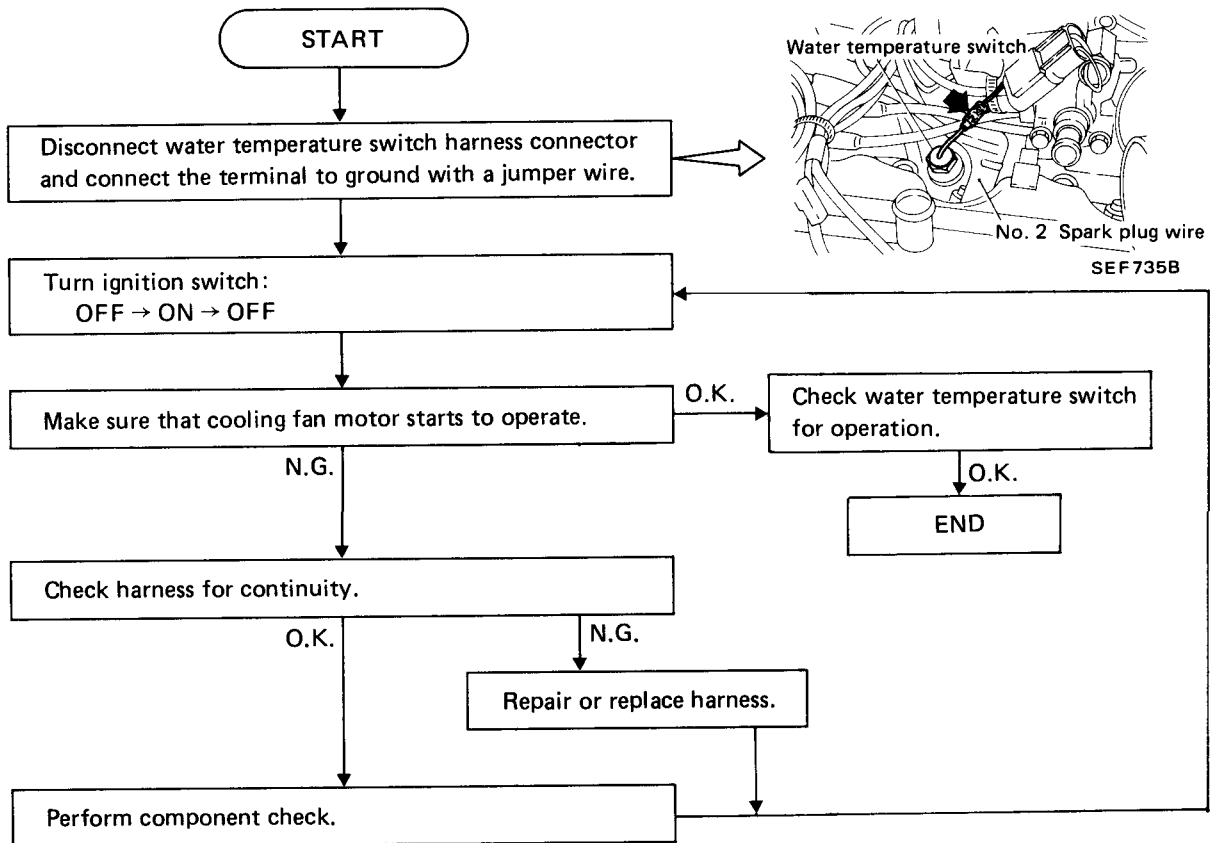
Operation 3:



SEF731B

INJECTOR COOLING FAN (VG30E)

Inspection



SEF521D

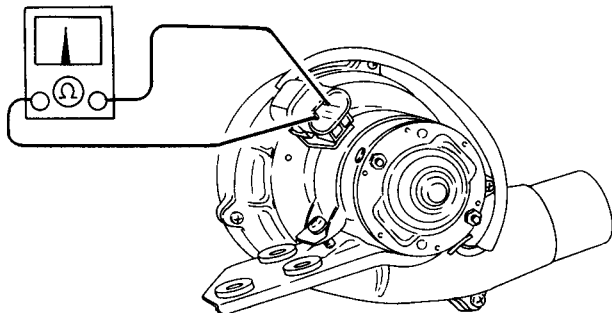
INJECTOR COOLING FAN (VG30E)

Inspection (Cont'd)

COMPONENT CHECK

A. Fan motor

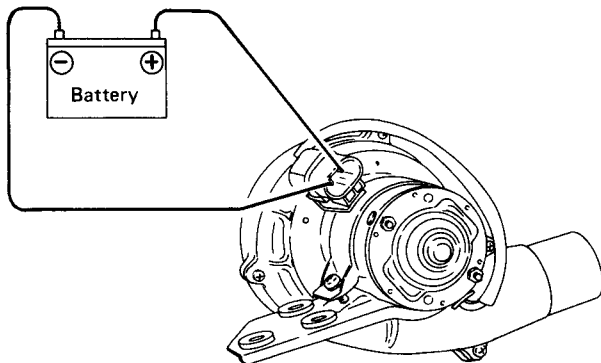
1. Make sure that continuity exists between terminals of fan motor.



Continuity should exist.

SEF519C

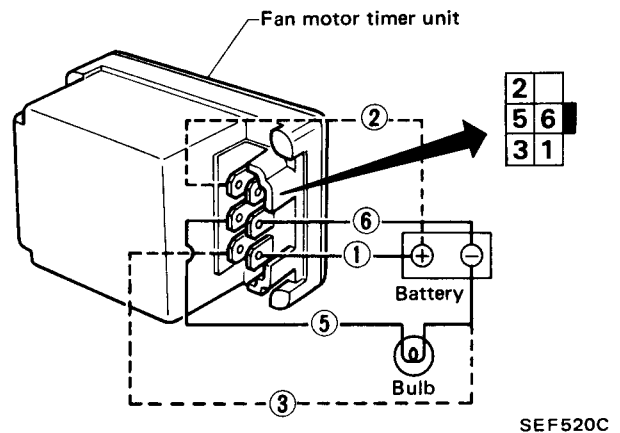
2. Apply battery voltage to the terminals of fan motor. If fan motor does not operate, replace.



SEF734B

B. Fan motor timer unit

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



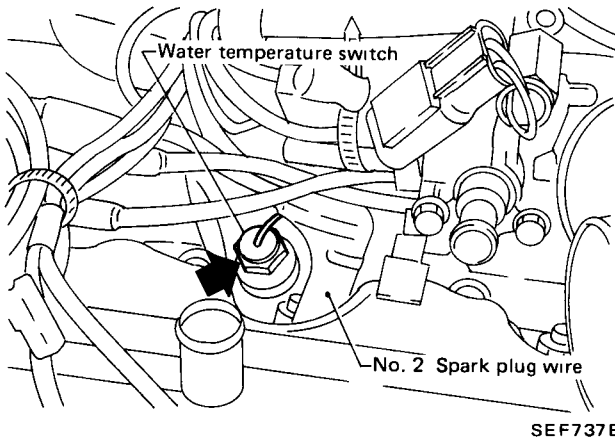
1. Connect terminal ⑥ to negative terminal of power source, terminal ⑤ to test lamp terminal and the other test lamp terminal to negative terminal of the power source.
2. Connect terminal ① to positive terminal of power source.
 - Test lamp does not glow O.K.
 - Test lamp glows N.G.
3. Connect terminal 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.

INJECTOR COOLING FAN (VG30E)

Inspection (Cont'd)

C. Water temperature switch

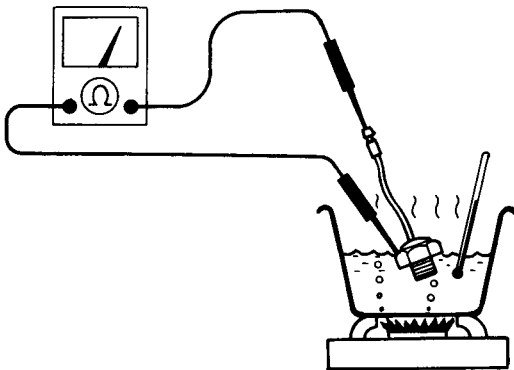
1. Remove water temperature switch.



2. Check water temperature switch for proper operation.

Operating temperature:

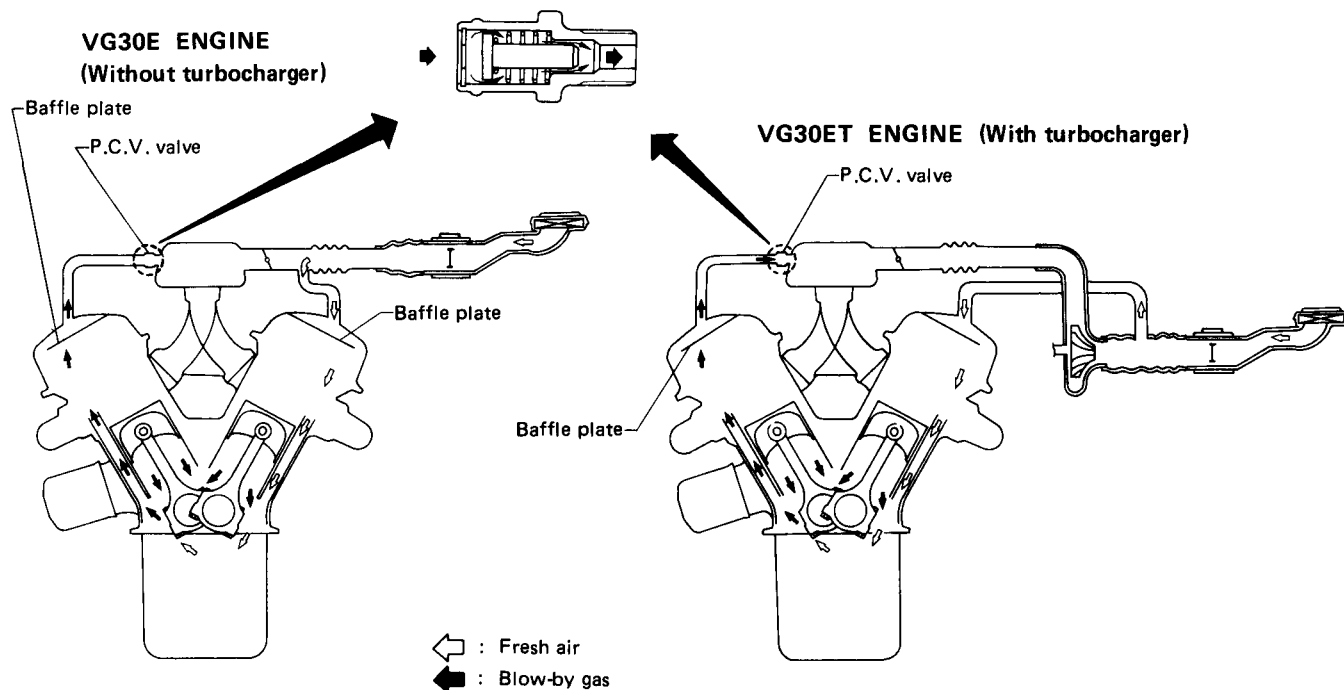
OFF → ON $90 \pm 3^{\circ}\text{C}$ ($194 \pm 5.4^{\circ}\text{F}$)



CRANKCASE EMISSION CONTROL SYSTEM

Description

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

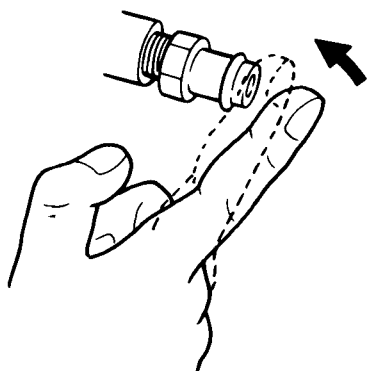


SEC501A

Inspection

P.C.V. VALVE

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



SEC137A

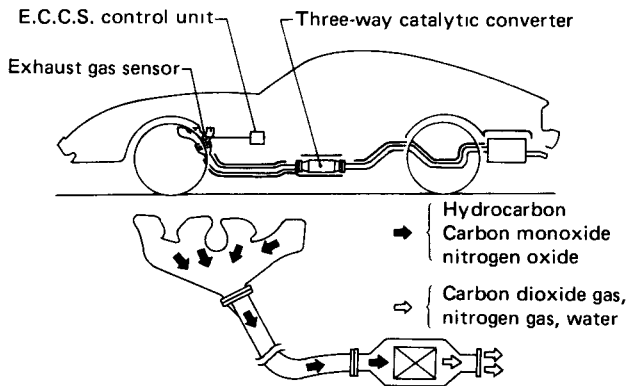
VENTILATION HOSE

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

EXHAUST EMISSION CONTROL SYSTEM

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 NO_x) into harmless gases (CO₂, H₂O and N₂). In this way, the catalytic converter cleans the exhaust gas and emits CO₂, H₂O and N₂ into the atmosphere.



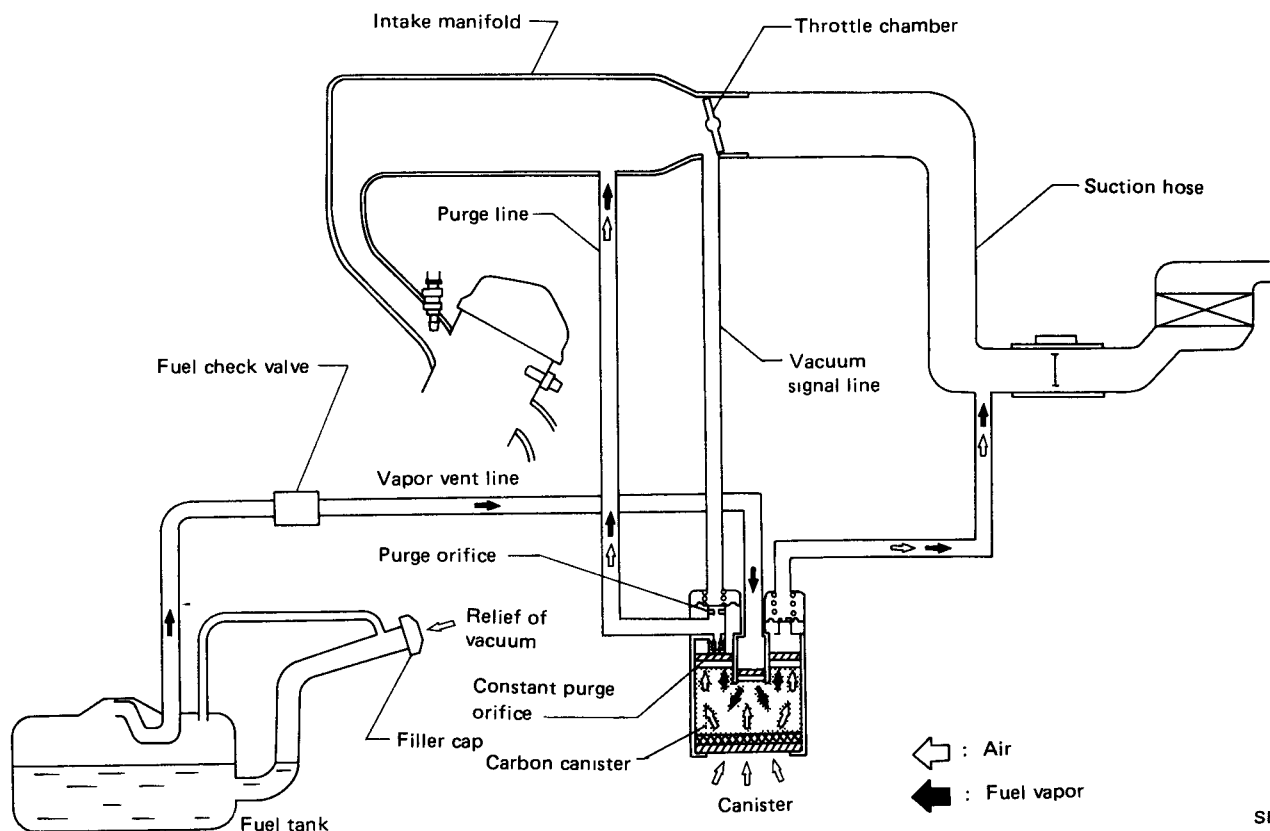
SEC304A

Operation

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

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

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

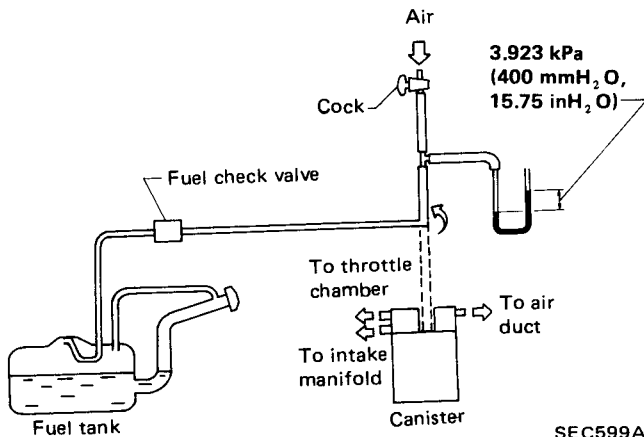


SEC598A

EVAPORATIVE EMISSION CONTROL SYSTEM

Inspection

VAPOR VENT LINE

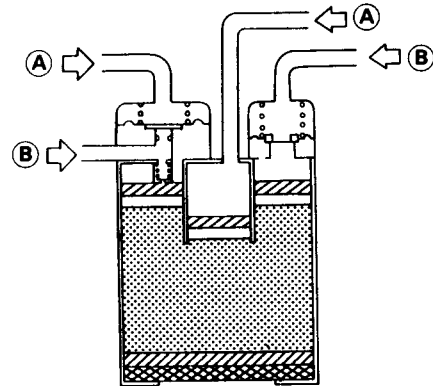


1. Check hoses and fuel tank filler cap.
2. Disconnect the vapor vent line connecting carbon canister to fuel tank.
3. Connect a 3-way connector, a manometer and a cock (or an equivalent 3-way charge cock) to the end of the vent line.
4. Supply fresh air into the vapor vent line through the cock little by little until pressure becomes 3.923 kPa (400 mmH₂O, 15.75 inH₂O).
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 mmH₂O, 0.98 inH₂O).
8. When filler cap does not close completely, the height should drop to zero in a short time.
9. If the height does not drop to zero in a short time when filler cap is removed, the cause is a clogged hose.

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

CARBON CANISTER

Check carbon canister as follows:



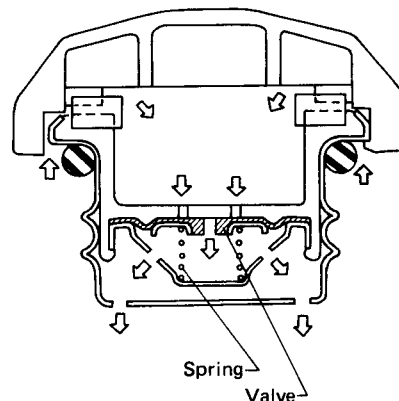
- (A) : Blow air and ensure that there is no leakage.
- (B) : Blow air and ensure that there is leakage.

SEC600A

If malfunctioning, replace faulty part.

FUEL TANK VACUUM RELIEF VALVE

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



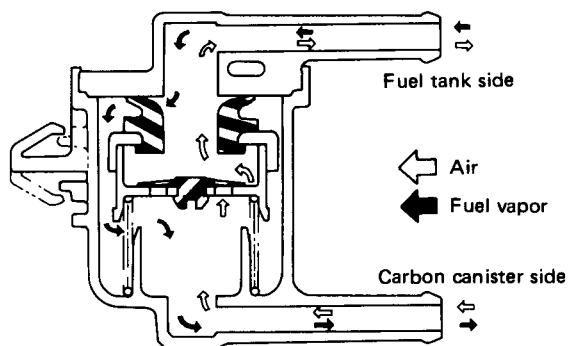
SEC308A

EVAPORATIVE EMISSION CONTROL SYSTEM

Inspection (Cont'd)

FUEL CHECK VALVE

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



SEC309A

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

General Specifications

Fuel pump	
Cut-off discharge pressure kPa (kg/cm ² , psi)	422 - 490 (4.3 - 5.0, 61 - 71)
Pressure regulator	
Regulated pressure kPa (kg/cm ² , psi)	250 (2.55, 36.3)
Air regulator	
Air flow amount [at 20°C (68°F)] m ³ (cu ft)/hr	27.5 (971)
Turbocharger	
Max. supercharging pressure kPa (mmHg, inHg)	42.7 - 50.7 (320 - 380, 12.60 - 14.96)
Emergency relief valve	
Valve opening pressure kPa (mmHg, inHg)	55.3 - 63.3 (415 - 475, 16.34 - 18.70)

Inspection and Adjustment

Fuel pressure	
At idle kPa (kg/cm ² , psi)	Approximately 206 (2.1, 30)
The moment accelerator pedal is fully depressed kPa (kg/cm ² , psi)	
	VG30E Approximately 255 (2.6, 37)
	VG30ET Approximately 304 (3.1, 44)
Air flow meter	
Voltage between terminals B and D	1.6±0.5 V
Cylinder head temperature sensor and fuel temperature sensor	
Thermistor resistance at -10°C (14°F)	7.0 - 11.4 kΩ
at 20°C (68°F)	2.1 - 2.9 kΩ
at 50°C (122°F)	0.68 - 1.0 kΩ
Throttle valve switch Engine speed when idle switch is turned from "OFF" to "ON"	(In Neutral position) Idle speed + 250 rpm allowance: ±150 rpm
Exhaust gas sensor	
Heater resistance	5 - 6Ω

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

Tightening Torque

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