Exhaust gas recirculation system – fault diagnosis chart
Start and run the engine at idle speed.
Increase the engine speed, noting the operation of the EGR valve.
The valve should open at between 1280 rpm/min and 1380 rpm/min.

Valve either fails to open or opens late

Faulty electrical control circuit

Detach the hose from the EGR valve
Can you blow down the hose and through the solenoid?

YES

Ensure that the engine is fully warmed-up.

NO

Detach the temperature switch plug (see item 8 and 9)
Bridge the cables in the plug ignition on.
Can you blow down the hose and through the solenoid?

NO

Investigate and rectify blocked hoses to the throttle body or renew the control solenoid (solenoid below connector see item 4).

YES

Check the temperature switch circuit.

Leave the temperature switch bridged.
Measure the voltage on the white/blue cable at the solenoid plug and socket (see item 6 and 7)
Is it 12 volts?

NO

YES

Disconnect the solenoid plug and socket.
Check the black cable to earth for continuity.
Is it continuous?

NO

Rectify the fault on the cable

YES

Check the throttle position circuit.

Disconnect the temperature switch plug (see item 8 and 9)
Measure the voltage on the white cable as the throttle position switch plug and socket 4 way (see item C and 10)
Is it 12 volts?

NO

YES

Refer to TSG 4701.
Check the ignition feed white cable to fuse 83 on fuseboard

NO

Replace the solenoid

System functions satisfactorily

Valve begins to open early

Check for retarded ignition timing refer to Chapter E

Check for advanced ignition timing refer to Chapter E

Check the voltage on the slave/blue cable in the temperature switch plug 12 way plug and socket (see item D and 11) Is it 12 volts?

NO

YES

Disconnect the 12 way plug and socket.
Disconnect the solenoid plug and socket.
Check for continuity from item 2 to item 7

Measure the voltage on the white/green cable at the throttle position switch plug and socket 4 way (see item C and 10) when the throttles are fully opened Is it 12 volts?

NO

YES

Fully open the throttles.

Measure the voltage on the white/blue cable at the solenoid plug and socket (see item A and 7) Is it 12 volts?

NO

YES

Check for continuity of the white/green and the white/blue cable between items C and 10, and A and 7
Important
Before carrying out a test ensure that the following conditions apply
1. The battery is fully charged
2. The engine is fully warmed-up
3. Use a multimeter to carry out the electrical circuit tests
4. The engine is switched off when either disconnecting or connecting electrical connections
5. Always remake any connection immediately a test is complete
6. Ensure that fuse 63 on fuseboard 1 is intact
7. Ensure that the test is carried out in a well-ventilated area (preferably outside) and without any exhaust extraction or restriction
Air injection system

The air injection system (see fig. F4-1) consists of a belt driven air pump that delivers air via an air switching valve to the exhaust ports, during engine warm-up. This air combines with the exhaust from the combustion chambers, to promote oxidation of the gases and faster warm-up of the catalytic converter.

When the coolant temperature is above 33°C (91°F) the air switching valve vents the output of the air pump into the engine air intake.

For details of the servicing and maintenance requirements of the air injection system refer to the Service Schedules Manual TSD 4702.

Air injection pump
The rotary vane pump is mounted at the front of the engine, and belt driven from the refrigeration compressor pulley. Air is drawn into the pump, through a centrifugal filter and exits from a connection on the rear of the pump.

Air switching valve (see fig. F4-2)
The air switching valve comprises a vacuum operated valve with integral control solenoid.

When the coolant temperature is below 33°C (91°F) the solenoid is energized thus applying inlet manifold vacuum to the diaphragm chamber. This causes the injected air to be re-routed to the exhaust manifolds.

When the solenoid is de-energized (at a coolant temperature above 33°C (91°F)) the manifold vacuum signal is inhibited and the diaphragm chamber vented to atmosphere. This causes the internal spring to return the valve to the rest position, routing the injection air to the engine air intake system.

Pressure relief valve
A pressure relief valve is fitted between the air injection pump and the air switching valve. It consists of a spring loaded disc that opens at a set pressure. This prevents excessive pressure build-up, that could damage the pump vanes under extreme conditions.

Check valves
A check valve is fitted into the air injection pipe to each exhaust manifold.

Each valve assembly consists of a spring and one-way disc. The assembly prevents the flow of exhaust gases back to the air switching valve if either the exhaust back pressure exceeds the pump delivery pressure, or the pump belt fails.

Air pump drive belt
Before commencing to adjust the drive belt inspect it for signs of wear or cracking. If the belt is found unsatisfactory it should be renewed.

Fig. F4-1 Air injection system
1 Air pump
2 Vent hose to air cleaner
3 'A' bank check valve
4 Relief valve
5 'A' bank exhaust manifold connection
6 'B' bank exhaust manifold connection
7 Vacuum hose
8 Air switching valve
9 'B' bank check valve

Fig. F4-2 Air switching valve
1 Inlet
2 Outlet to engine air intake
3 Outlets to exhaust ports
4 Inlet manifold vacuum
5 Solenoid valve
6 Diaphragm chamber
7 Atmospheric air bleed
A Solenoid de-energized
B Solenoid energized
The belt tension must be checked at a point midway between two pulleys (see fig. F4-3) by use of a belt tension meter.

Belt dressing must not be applied to prevent belt slip.

Refrigeration compressor to air pump
Load may be applied on either side of the belt run.

New belt and retensioning load
Belt tension meter 24.9 kgf to 29.4 kgf (55 lbf to 65 lbf)

1. The tension of the belt is adjusted by altering the position of the air pump.
2. Slacken the pivot setscrews located at the front of the air pump. Also slacken the tensioner nut on the threaded adjustment arm.
3. Adjust the tensioner nut until the belt tension is correct.
4. Tighten both pivot setscrews.
5. Check that the belt tension is still correct when the air pump is fully secured.

Air pump - To remove and fit
1. Slacken the worm drive clip securing the hose to the pump outlet.
2. Release the belt tension (see Air pump drive belt).
3. Unscrew and remove the pivot setscrews (see fig. F4-3).
4. Fit the air pump by reversing the removal procedure, ensuring that the belt tension is correctly set.

Checking the air injection system for leaks and correct operation
To check that the system is functioning correctly, refer to the flow chart (see fig. F4-4).
If an air leak is suspected, proceed as follows.
1. Disconnect the vent hose to the air cleaner (see item A on the flow chart).
2. Start and run the engine.
3. Listen carefully for any evidence of an air leak from the system. When the coolant temperature increases to approximately 33°C (91°F) the air will be switched from the exhaust manifolds towards the air cleaner. This change can be detected by the noise the air will make as it leaves the open connection of the air switching valve.
4. If an air leak is suspected coat the suspect component with a soap solution; soap bubbles will confirm an air leak.
5. Fit the disconnected hose to the air cleaner.
Air injection system – fault diagnosis chart
1. Disconnect the air injection vent hose at the air cleaner (see item A)
   Switch on the ignition
2. Disconnect the plug from the front temperature switch in the thermostat housing.
   Bridge the white and slate/blue cables in the plug
   Start the engine, ensure that it is running on all eight cylinders
   Is air flowing through the vent hose (see item A)?

   NO

   Stop the engine, unbridge the temperature switch in the thermostat housing.
   Connect the plug to the switch.
   Start and run the engine until it is fully warmed-up. Allow the engine to run at the idle speed setting
   Is air flowing through the vent hose (see item A)?

   YES

   Check the air switching valve vacuum hose and connections for air leaks (see item B)
   Are there any leaks?

   NO

   Stop the engine otherwise damage to the catalytic converter may result.
   Check the electrical wiring circuit as follows

   Locate the link loom 2 way plug and socket (see item D and E)
   Measure the voltage on the slate/blue cable in the plug
   Is it 12 volts?

   NO

   Disconnect the link loom plug and socket
   Check for continuity of the black cable (see item B)

   YES

   Rectify the fault on the black earth cable

   Replace faulty relief valve

   Rectify the fault

   System functions satisfactorily
Check the voltage on the white cable at the thermostat loom plug and socket (see item E and 2). Bridge the cables in the plug. Again, check the voltage on the cable at the 12 way plug and socket. Is it 12 volts?

- YES
  - Detach the plug from the front temperature switch in the thermostat housing (see item C and 3). Bridge the cables in the plug. Again, check the voltage on the cable at the 12 way plug and socket. Is it 12 volts?
    - NO
      - Leave the plug to the temperature switch bridged. Disconnect the 12 way plug and socket. At the 12 way plug and socket check for continuity of the cable and the white cable through the temperature switch plug.
    - YES
      - Replace the temperature switch

- NO
  - Renew the air switching valve

**Important**

Before carrying out a test ensure that the following condition apply:
1. The battery is fully charged
2. The engine is cold
3. Use a multimeter to carry out the tests
4. The ignition is switched off when either disconnecting or connecting electrical connections
5. Always remake any connection immediately a test is complete
6. Ensure that the fuse B3 on fuseboard 1 is intact
Three-way catalyst system

The exhaust system is basically of dual pipe construction that utilizes a single catalytic converter in place of a conventional front silencer.

The dual exhaust pipes from the engine combine into a single pipe just prior to the catalytic converter. From the converter, the system reverts to a twin pipe system with both pipes entering a common rear silencer. A single tailpipe then conveys the exhaust to atmosphere.

Catalytic converter protection
To protect the catalytic converter from possible damage the following precautions should be taken.

Unleaded gasolene
Use unleaded gasolene only 87AKI* RON= Min. The use of leaded gasolene will result in a substantial reduction in the performance of the catalyst.

Under no circumstances add fuel system cleaning agents to the fuel tank for induction into the engine, as these materials may have a detrimental effect on the catalytic converter.

*AKI = Anti-knock index
RON= Research octane number

Engine malfunction
If the engine misfires or suffers from a lack of power that could be attributed to a malfunction in either the ignition system or fuel system, operation of the vehicle should be discontinued. Driving the vehicle with a malfunction could cause overheating and consequent damage to the catalytic converter.

Fuel
Do not allow the vehicle to run out of fuel. A warning lamp situated on the facia illuminates to warn the driver of a low fuel level in the fuel tank. If the vehicle runs out of fuel at high speed, possible damage to the catalytic converter could result.

Starting the engine
The vehicle must not be pushed or towed to start the engine. Failure to observe this warning could cause overheating and consequent damage to the catalytic converter.

Exhaust emission control system
It is important that the vehicle is maintained in its correct operating condition. Failure to do so will result not only in loss of fuel economy and emission control but could also cause damage to the catalytic converter due to overheating.

Catalytic converter - To remove and fit (see fig. F5-2)
1. Remove the screws retaining the grass-fire shield(s)

Fig. F5-1 Catalytic converter
1 Stainless steel mesh retaining rings
2 Stainless steel mesh
3 Monolithic catalyst (1 of 3 blocks)

Fig. F5-2 Catalytic converter in position
1 Oxygen sensor
2 Exhaust joint clamps

located below the catalytic converter.

Note Take care when removing the shield(s) as any sharp edges could cause injury to the operator’s hands.

2. Ensure that the weight of the catalytic converter is temporarily supported.
3. Support the weight of the downtake pipes.
4. Unscrew and remove the oxygen sensor.
5. Unscrew the nuts from the exhaust clamps forward and rearward of the catalytic converter. Collect the washers and bolts, then free the clamps.
6. Discard the temporary support and withdraw the catalytic converter.
7. Collect the sealing rings from the joints as the converter is removed.
8. Fit the catalytic converter by reversing the removal procedure, noting the following points.
9. The sealing rings and pipe flares must be
thoroughly clean and free from scale. They may be lightly dressed with fine emery cloth if required.
10. Apply Never-seiz anti-seize compound to the clamp bolt threads before assembly.
11. The sealing rings, pipe flares, and grooves in the spherical joint clamp brackets should be lightly smeared with either graphite lubricant or Never-seiz compound. This will assist alignment of the parts upon assembly.
12. The parts should be loosely assembled and then manoeuvred to give the best alignment, before the joints are tightened.
13. Smear the threads of the oxygen sensor with Never-seiz assembly compound. It is important that the Never-seiz is applied only to the threads of the unit. Care must be taken to ensure that the compound does not contact the slotted shield below the threaded portion.

To check that the warning panel bulb is operating satisfactorily, ensure that the panel illuminates during engine cranking (i.e. starter motor engaged).

Exhaust system
For information relating to the remainder of the exhaust system refer to TSD 4700 Chapter Q, Exhaust system.

Oxygen sensor warning lamp
On cars conforming to Australian and North American specifications an oxygen sensor warning lamp is situated on the facia.

When permanently illuminated, the lamp informs the driver that a malfunction has occurred in the 'closed loop' mixture control system. The cause of the malfunction must then be investigated by referring to the appropriate fault diagnosis chart contained in Chapter B.

The warning lamp may illuminate when the engine is being cranked but should extinguish soon after the engine starts. The lamp will however, remain illuminated until the oxygen sensor reaches its normal operating temperature.

Oxygen sensor
For details relating to the oxygen sensor refer to Chapter B.

Exhaust system overheat warning lamp
On cars conforming to a Japanese specification an exhaust overheat warning system is fitted. The warning panel for this system is situated on the facia. Illumination of the panel indicates that an overheating condition caused through an engine malfunction has been reached in the exhaust system.

If an exhaust overheat condition is indicated, stop the vehicle as soon as possible and switch off the ignition. After three minutes the engine may be started again and providing the overheat warning lamp remains extinguished, the vehicle can be accelerated gently up to a speed of 30 km/h (18 mile/h). This speed must not be exceeded until the cause of the overheat warning has been corrected by referring to the appropriate fault diagnosis flow chart (see fig. F5-3).
Exhaust overheat warning system – fault diagnosis chart
Sheet 1 of 2
Before carrying out a full diagnostic inspection ensure that the vehicle did not run out of fuel.

If the overheat warning lamp illuminates for reasons other than the above, a fault has occurred in:

1. The various systems that lead into the exhaust (fuel system, air intake, etc.) or in the exhaust itself particularly the catalytic converter.
2. Any faults in these areas can be determined as system faults.
3. The overheat warning circuit (faulty converter thermocouple, electronic control unit, wiring connections, etc.) causing the lamp to illuminate although the system is operating satisfactorily.
4. These faults can be determined as circuit faults.

Does an overheat condition exist and/or is the warning lamp illuminated at the commencement of the test?

**NO**

Verify the exact conditions prevailing at the time of the exhaust overheat warning.

Start the engine.
Does the warning lamp illuminate during engine cranking and extinguish immediately the engine starts?

**NO**

Road test the car.
Does the exhaust overheat condition occur and the warning lamp illuminate?

**NO**

Fully warm-up car.
Does the vehicle appear exceptionally hot particularly in the area of the catalytic converter?

**YES**

Does the system fault or a circuit fault has occurred.

If the overheat warning lamp illuminates (except during cranking and/or warning lamps test) for any reason other than running out of fuel, either a system fault or a circuit fault has occurred.

**YES**

Suspect a system fault

The following is a list of components and systems that may contribute to a malfunction in the exhaust resulting in overheating of the catalytic converter.

Any condition resulting in an engine misfire or uneven running should always be investigated first.

1. Ignition system – Chapter E
2. Faulty purge flow system – Chapter G
3. Faulty fuel injection system – Chapter B
4. Faulty EGR system – Chapter F
5. Blocked fuel system – Chapter C
6. Air injection system operating continuously – Chapter F

Replace the faulty component.

Disconnect the diagnostic test socket in the blue and the black wires or replace the thermocouple.

Replace the faulty component.

Check the engine.
Verify if it is serviceable.

Replace the faulty component.

Replace the faulty component.

Replace the faulty component.

Replace the faulty component.
Overheat warning

If an overheat condition is indicated, stop the vehicle as quickly as possible in a safe and orderly manner.

Switch off the ignition.

After three minutes the engine may be started again and providing the overheat warning lamp remains extinguished, the vehicle may be accelerated gently up to a speed of 30 km/h (18 miles/h). This speed must not be exceeded until the cause of the overheat warning has been corrected.

Check the warning lamp bulb between items C and 12, and F and 2. Is it shorted to earth?

Rectify the cable

YES

Discard the original ECU

NO

Substitute the ECU. Does the warning lamp bulb illuminate during engine cranking?

YES

Check the warning lamp test circuit. Refer to TSD 4701

Rectify the thermocouple.

NO

弯 the ECU in position (see item D).

Disconnect the 2 way plug and socket situated approximately 278.4 mm (11 in) from the ECU.

Check the continuity of the brown cable and of the blue cable between items 9 and 10. Are they continuous?

Rectify the cable(s)

NO

Connect the multimeter between either thermocouple cable and earth. Have the cables been shorted to earth?

YES

Rectify cables

NO

Check the continuity of the brown cable and the thermocouple 2 way plug and engine compartment (see item F) for continuity between the brown cables to the thermocouple.

YES

NO

Check the brown cable continuity.
Exhaust overheat warning system – fault diagnosis chart
Sheet 2 of 2
I. Way plug

Sensor connection

Post earth probe

Test plug

At warning light socket

At warning light socket

Test circuit:

1. Amp test circuit.

   NO Rectify as necessary

   YES Check the white cable at the socket (see items C, D, and 12)

   NO Correct the cable mis-match

   YES Check the ignition feed white cable from the fuse for 12 volts supply (see wiring diagram)

   NO Check the white/purple cable for continuity and/or short circuiting to another cable

   YES Rectify the fault on the black cable

   NO ECU and thermocouple in test

   YES
Keep the 2 way plug and socket disconnected. Connect the multimeter between the end of the brown cable (see item 10) and earth. Connect the multimeter from the engine compartment between the end of the blue cable (see item 10) and earth.

Is either cable shorted to earth?

YES

Rectify the cable(s)

NO

Remake the electrical connections ensuring that the cable colours match (i.e. brown to brown). Do the cable colours correspond?

YES

Check the warning.

Refer to TSD 47.

Is it satisfactory?

YES

Check the voltage on the ECU 4 way plug (see items 10 and 12).

Is it 12 volts?

NO

Check the white/purple cable.

to the warning lamp.

Is it 12 volts?

YES

Rectify the fault on the black/purple cable.

NO

Remake the connections.

Check the electrical connections ensuring that the cable colours match (i.e. brown to brown).

Do the cable colours correspond?

Check the warning.

Refer to TSD 47.

Is it satisfactory?

Check the voltage on the ECU 4 way plug (see items 10 and 12).

Is it 12 volts?

Check the white/purple cable.

to the warning lamp.

Is it 12 volts?

Disconnect the ECU (see items C, D, and 7).

Check the black (see item G and 7).

Is it continuous?