



## Introduction

The contents of Sections F6, F7, and F8 apply to 1989 model year turbocharged cars fitted with an exhaust emission control system.

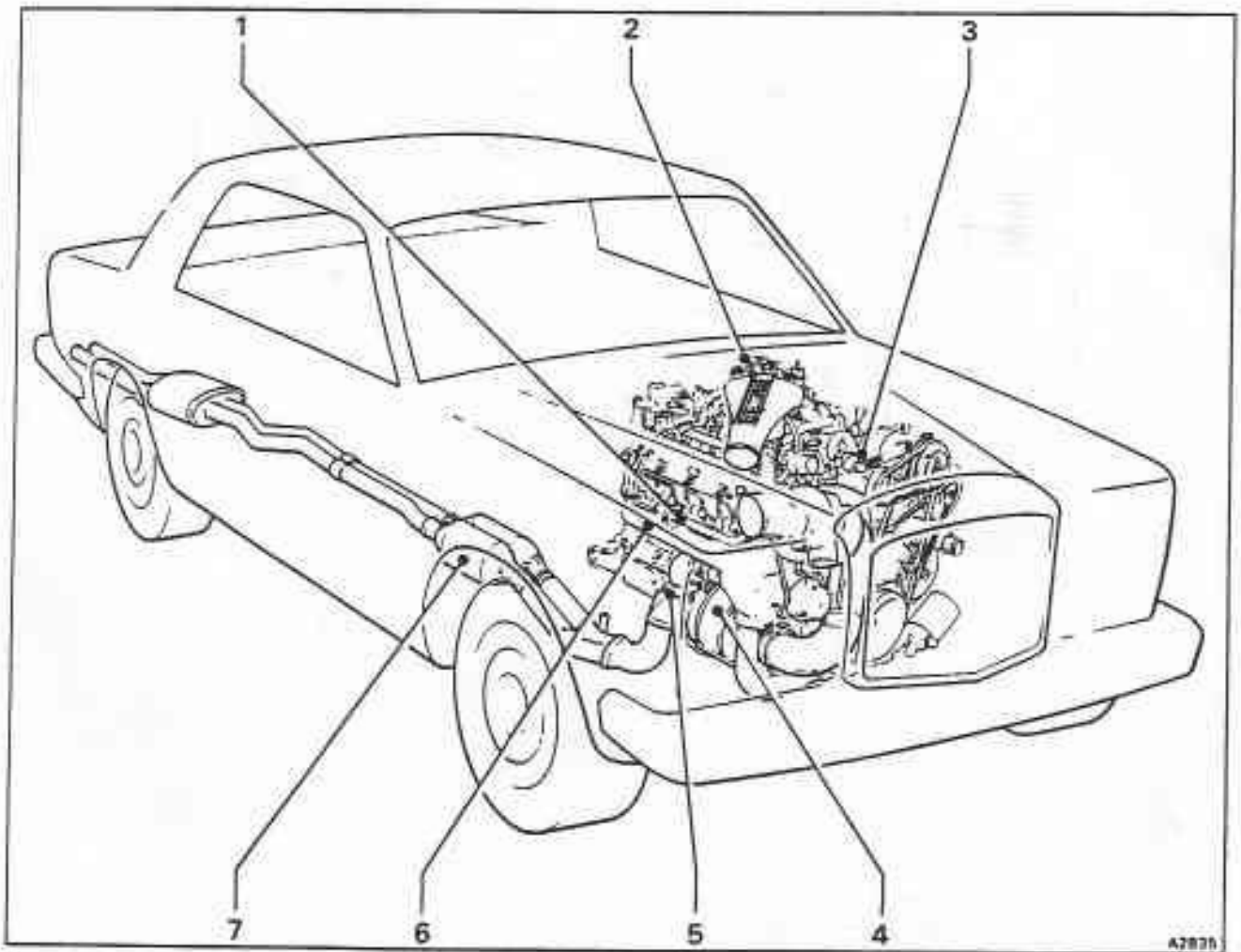
The exhaust emission control system (see fig. F6-1) is designed to reduce the carbon monoxide, hydrocarbon, and oxides of nitrogen content in the exhaust gas.

To comply with exhaust emission control regulations that apply in certain countries, cars destined for these countries are fitted with a warm-up catalytic converter and two main catalytic converters mounted in parallel. The converters are of the three-way catalyst type.

In order to achieve maximum efficiency the catalytic converters require very accurate control of the engine air/fuel ratio. This is accomplished by the use of a continuous fuel injection system with 'closed loop' mixture control (refer to Chapter B).

The following additional system is also fitted to improve the control of exhaust emissions.

The air injection system comprises a belt driven pump, that during the warm-up period passes air via check valves to the exhaust manifolds. The injected air combines with the exhaust from the combustion chambers to promote oxidation of the gases and reduce the catalytic converter warm-up time.



**Fig. F6-1 Exhaust emission control systems**

- |   |                             |
|---|-----------------------------|
| 1 'A' bank air manifold                   | 5 Heated oxygen sensor      |
| 2 Air meter and fuel distributor assembly | 6 'A' bank exhaust manifold |
| 3 Air pump                                | 7 Main catalytic converters |
| 4 Warm-up catalytic converter             |                             |



Whenever the coolant temperature is above 33°C (91.4°F), a switch in the thermostat housing opens, thus deactivating the clutch on the air pump pulley. An overspeed limiting device also deactivates the pump clutch at engine speeds in excess of 3000 rev/min. Whenever the clutch is deactivated, the air pump is disengaged and there is no air injection.

For details of the servicing and maintenance requirements of the exhaust emission control system, refer to the Service Schedules Manual TSD 4702.



## Air injection system

The air injection system comprises a belt driven air pump which delivers air via check valves to the exhaust manifolds during the warm-up phase of engine operation. This air combines with the exhaust from the combustion chambers and promotes oxidation of the gases and faster warm-up of the catalytic converters.

The air injection system only operates immediately after a cold start. It is switched off when the engine coolant temperature rises above 33°C (91.4°F) via a relay connected to the air pump clutch.

The relay is operated by a temperature switch situated in the thermostat housing and switches off

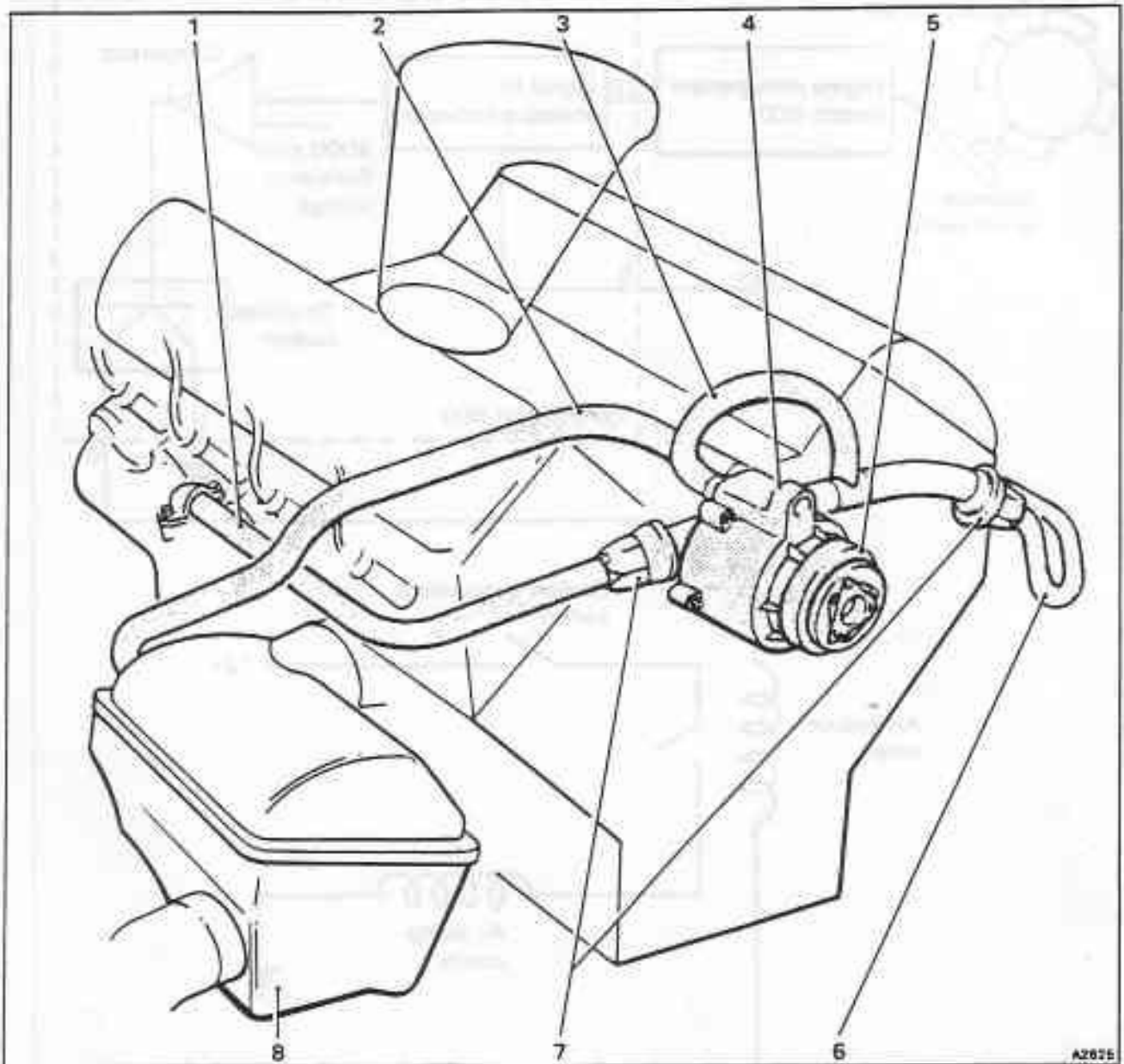


Fig. F7-1 Air injection system

- 1 'A' bank air injection feed pipe
- 2 Air pump inlet hose
- 3 Air pump outlet hose
- 4 Air pump

- 5 Clutch assembly
- 6 'B' bank air injection feed pipe
- 7 Check valves
- 8 Air filter housing



the electrical supply to the air pump clutch.

In order to protect the pump from excessive speeds, particularly after starting in low ambient temperatures, the clutch is disengaged when the engine speed exceeds 3000 rev/min. This is achieved by using a speed signal from the engine management system ECU.

The speed signal is processed in a separate control unit which outputs a signal to the air injection relay when the engine speed exceeds 3000 rev/min. The relay then cuts the electrical supply to the air

pump clutch which disengages the drive to the air pump.

#### Air injection pump

The rotary vane pump incorporating a clutched drive, is mounted at the front of the engine and is belt driven from the air conditioning system compressor pulley. Drive is engaged when an electrical current is applied to the clutch.

Filtered air is supplied to a port on the rear of the pump from the engine air cleaner housing. Air is

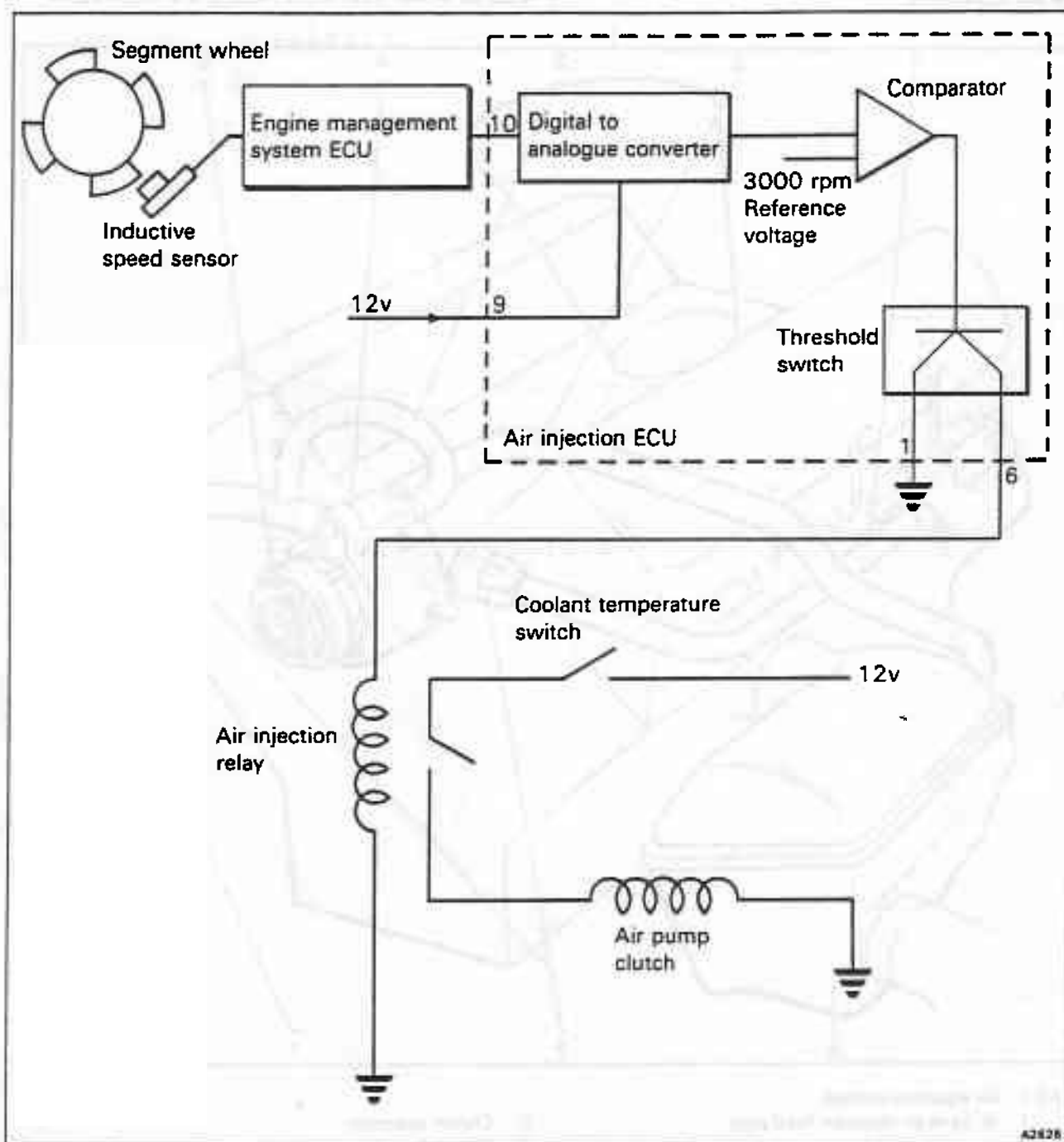


Fig. F7-2 Air pump speed limiting



Figure F7-6

# Air injection system – fault diagnosis chart

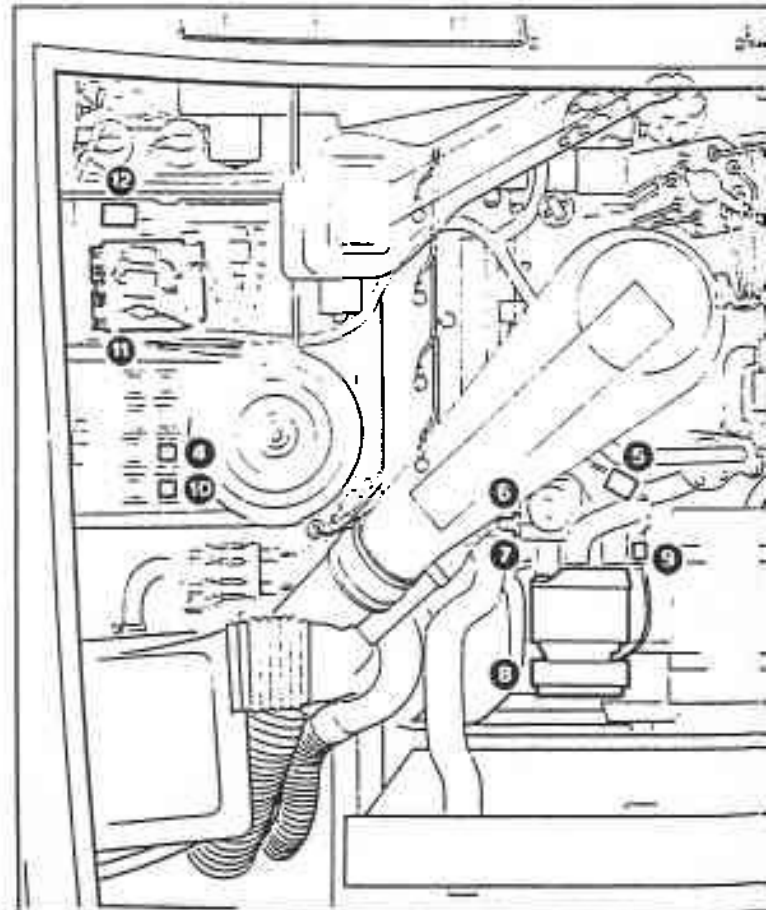
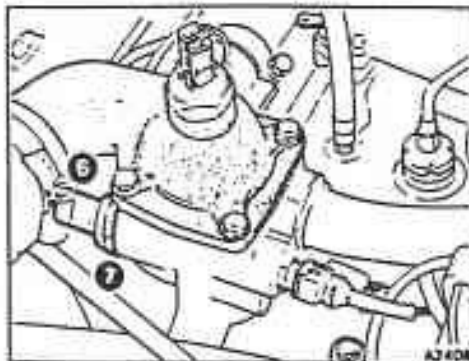
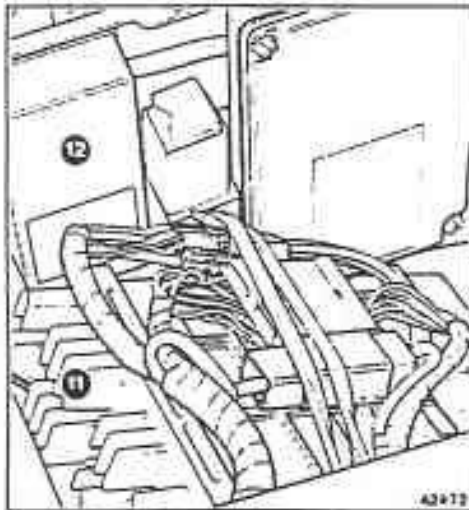
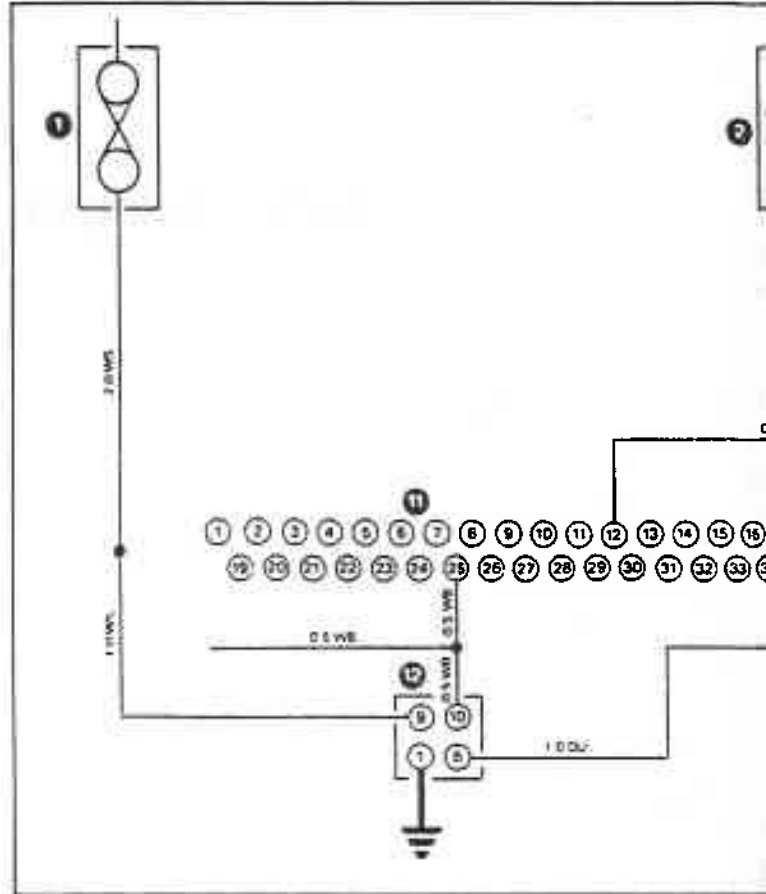
## Sheet 1 of 2

- 1 Fuse A4 (10 amp), fuseboard 1
- 2 Fuse B5 (20 amp), fuseboard 2
- 3 Fuse B3 (15 amp), fuseboard 1
- 4 Fuel pump relay
- 5 Thermostat plug and socket 12 way
- 6 Coolant temperature switch plug
- 7 Coolant temperature switch
- 8 Air injection pump clutch
- 9 Air injection pump plug and socket 2 way
- 10 Air injection relay
- 11 K-Motronic ECU
- 12 Air injection ECU
- Splice

**Important**

Before carrying out a test ensure that the following conditions apply

- 1 The battery is fully charged
- 2 The engine is cold
- 3 Use a multi-meter 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 fuses listed are intact





pumped to the exhaust manifolds from the second port on the rear of the pump assembly.

#### Check valves

Check valves are located in the air injection pipes between the pump and the exhaust manifolds. Each check valve operates as a one-way disc valve to prevent the flow of exhaust gases back to the air pump.

#### 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.

The belt tension must be checked at a point midway between the two pulleys (see fig. F7-4) 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.
3. Slacken the adjusting arm pivot nut situated on the air conditioning system compressor.
4. Slacken the tensioner nut on the threaded adjustment arm.
5. Adjust the tensioner nut until the belt tension is correct.
6. Tighten both pivot setscrews and the adjusting arm pivot nut.
7. 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 clips securing the pump inlet and outlet hoses.
2. Release the belt tension (see Air pump drive belt).
3. Unscrew and remove the pivot setscrews and the adjusting arm pivot nut.
4. Withdraw the pump.
5. Fit the air pump by reversing the removal procedure, ensuring that the belt tension is correctly set.

#### Checking the air injection system for leaks

1. Ensure that the engine is cold.
2. Start and run the engine.
3. Inspect the various hoses and components within the system for air leaks. If an air leak is suspected, coat the suspect component with a soapy solution; soap bubbles will confirm an air leak.
4. As the engine coolant temperature reaches 33°C (91°F) the air pump clutch will be disengaged and the air injection system deactivated.

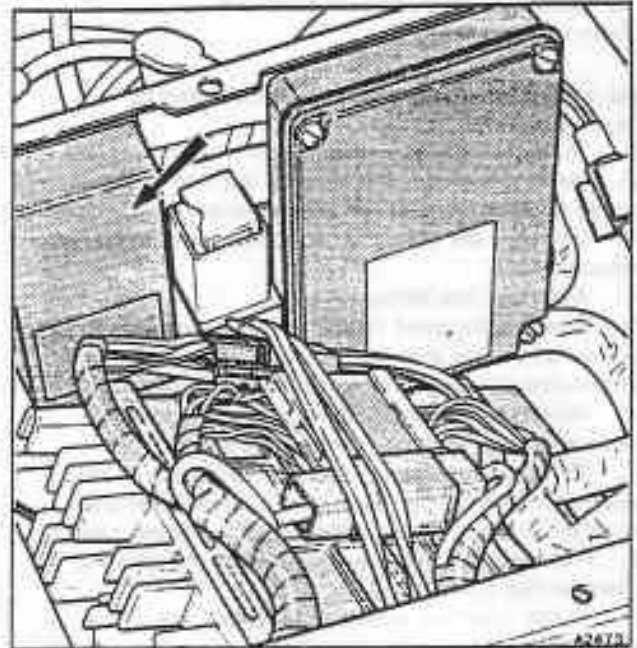


Fig. F7-3 Location of air injection system ECU

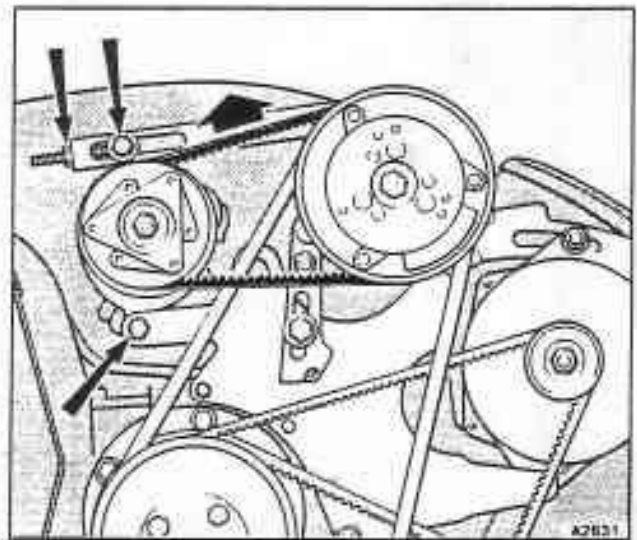


Fig. F7-4 Air pump drive belt adjustment and tension check point

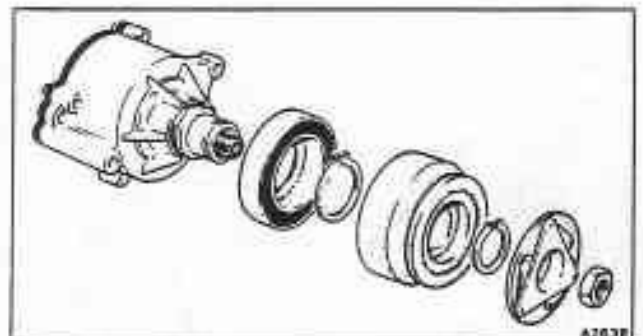


Fig. F7-5 Air pump clutched pulley



**Air injection system - Functional check**  
Refer to figure F7-6.

**Air injection clutched pulley - To remove and fit**  
(see fig. F7-5)

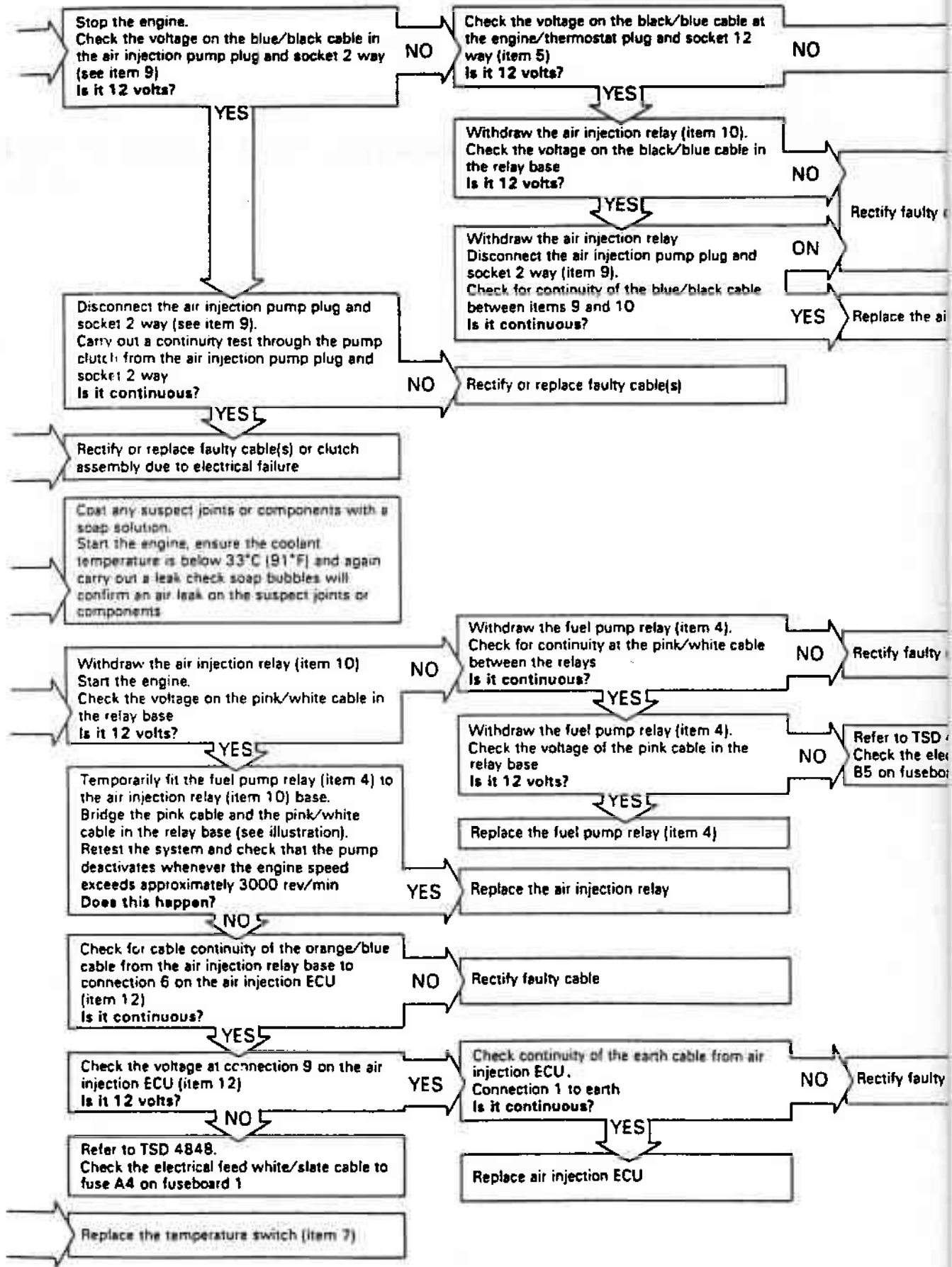
1. Slacken the drive belt tension.
2. Insert a 6 mm Allen key into the end of the pump shaft, to hold the shaft stationary.
3. Unscrew the pulley securing nut from the pump driving shaft.
4. Withdraw the friction clutch.
5. Remove the small circlip from its groove in the drive-shaft. Note that the circlip is fitted with the chamfered side pointing away from the pump body.
6. Withdraw the pulley/bearing housing from the bearing surface of the air pump drive-shaft.
7. Remove the large circlip from its groove in the drive-shaft. Note that the circlip is fitted with the chamfered side pointing away from the pump body.
8. Withdraw the electro-magnet from its locating dowel in the pump body.
9. Fit the clutched pulley by reversing the dismantling procedure.



Figure F7-6

# Air injection system – fault diagnosis chart

## Sheet 2 of 2



ble

injection relay

ble

B4B  
trical feed pink cable to fuse  
rd 2

able

Check the voltage on the pink/white cable at the engine/thermostat plug and socket 12 way (see item 5)  
**Is it 12 volts?**

NO

Refer to TSD 4848  
Check the ignition feed pink/white cable to fuse B3 on fusboard 1

YES

Ensure that the engine is still cold (i.e. coolant temperature below 33°C (91°F)). Disconnect the engine/thermostat plug and socket 12 way (item 5). Check for continuity between the orange and the pink cables in the plug  
**Is it continuous?**

YES

Check the cable connections within the engine/thermostat plug and socket 12 way (item 5)

NO

Withdraw the temperature switch plug (item 6) and bridge the contacts in the plug. Disconnect the engine/thermostat plug and socket 12 way (item 5). Repeat the continuity check between the orange and the pink cables in the plug  
**Is it continuous?**

YES

Replace the temperature switch in the thermostat housing

NO

With the plug and socket 12 way (item 5) and the plug (item 6) still disconnected but the bridge removed, check the orange and the pink cables individually for continuity  
**Is each cable continuous?**

YES

Check and rectify the cable connections

NO

Rectify faulty cable(s)

able

injection relay

able

848  
trical feed pink cable to fuse  
rd 2

able

Check the voltage on the pink/white cable at the engine/thermostat plug and socket 12 way (see item 5)  
**Is it 12 volts?**

**NO**  
Refer to TSD 4848  
Check the ignition feed pink/white cable to fuse B3 on fusboard 1

**YES**  
Ensure that the engine is still cold (i.e. coolant temperature below 33°C (91°F)). Disconnect the engine/thermostat plug and socket 12 way (item 5). Check for continuity between the orange and the pink cables in the plug  
**Is it continuous?**

**YES**  
Check the cable connections within the engine/thermostat plug and socket 12 way (item 5)

**NO**  
Withdraw the temperature switch plug (item 6) and bridge the contacts in the plug. Disconnect the engine/thermostat plug and socket 12 way (item 5). Repeat the continuity check between the orange and the pink cables in the plug  
**Is it continuous?**

**YES**  
Replace the temperature switch in the thermostat housing

**NO**  
With the plug and socket 12 way (item 5) and the plug (item 6) still disconnected but the bridge removed, check the orange and the pink cables individually for continuity  
**Is each cable continuous?**

**YES**  
Check and rectify the cable connections

**NO**  
Rectify faulty cable(s)



## Catalytic converter system

The catalytic converter system uses two main converters mounted in parallel and a warm-up converter which houses a heated oxygen sensor in its outlet cone. A three-way catalyst is used in each converter.

The warm-up converter is positioned downstream of the turbocharger and close to the engine. This is to minimise the time taken to reach its operating temperature.

To further reduce warm-up time, the warm-up converter and the pipe leading from the turbocharger are lagged with a thermal insulating material.

When the engine is running under boost conditions a proportion of the exhaust gas is diverted around the warm-up converter. The diverted gases by-pass both the turbocharger (to limit boost pressure) and the warm-up converter (to limit converter temperature).

The twin main catalytic converters are situated in the central under floor area. The connecting pipes between the warm-up converter and the main converters are partly lagged with thermal insulating material to retain exhaust heat for optimum catalytic conversion.

Each three-way catalytic converter promotes reactions between the hydrocarbons, carbon monoxide, oxides of nitrogen and residual oxygen in the exhaust gas. Optimum catalytic conversion efficiency is achieved when an essentially stoichiometric air/fuel mixture is present. This condition is achieved by means of the 'closed loop' mixture control system (see Chapter B).

### Warm-up catalytic converter assembly – To remove and fit

1. Unscrew and remove the oxygen sensor.
2. On cars produced to the Japanese specification, unscrew and remove the exhaust thermocouple probe.
3. Unscrew the clamp nut from the three joints situated adjacent to the warm-up converter assembly.
4. Free the joint clamps and manipulate the assembly to release the joints. Collect the olive from the rear joint and the restrictor from the by-pass pipe.
5. Support the weight of the downtake pipes.
6. Unscrew and remove the nuts and clamps from the rear of the downtake pipes. Free the joints and withdraw the downtake pipes.
7. Unscrew the setscrew securing the warm-up converter bracket to the crankcase.
8. Withdraw the warm-up converter assembly.
9. Fit the assembly by reversing the procedure, noting the general fitting instructions.

### Twin main catalytic converter assembly – To remove and fit

1. Remove the screws retaining the grass-fire shield(s) that are situated below the two catalytic converters.
- 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 converter assembly is temporarily supported.
  3. Support the weight of the exhaust system before

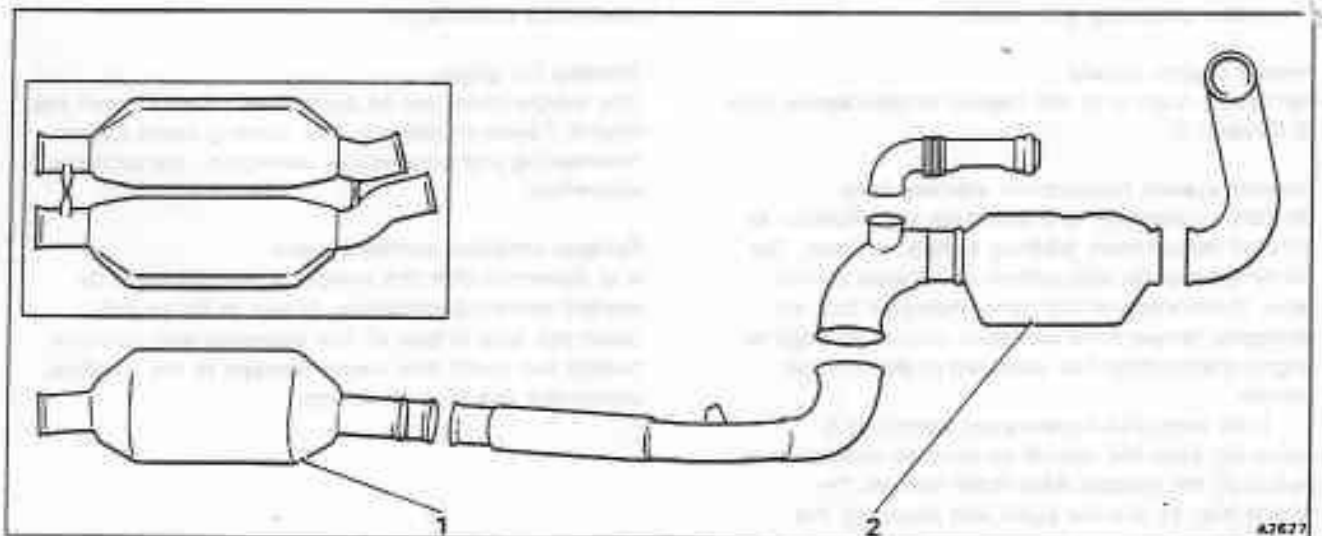


Fig. F8-1 Catalytic converter system

- 1 Twin main catalytic converters
- 2 Warm-up catalytic converter



and after the converters assembly.

4. Locate the exhaust joints before and after the converter assembly.
5. Unscrew the nuts from the exhaust clamps. Collect the washers, withdraw the bolts and free the clamps.
6. Discard the temporary support and withdraw the twin catalytic converters assembly.
7. Collect the four sealing rings from the joints as the assembly is removed.
8. Fit the catalytic converter assembly by reversing the removal procedure, noting the general fitting instructions.

#### General fitting instructions

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.

1. Apply Never-seez anti-seize compound to the clamp bolt threads before assembly.
2. The sealing rings, pipe flares and grooves in the spherical joint clamp brackets should be lightly smeared with either graphite lubricant or Never-seez compound. This will assist alignment of the parts upon assembly.
3. The parts should be loosely assembled and then manoeuvred to give the best alignment, before the joints are tightened.
4. Smear the threads of the oxygen sensor with Never-seez assembly compound. It is important that the Never-seez 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.
5. Torque tighten the exhaust clamp nuts and oxygen sensor to the figures given in Chapter L.

Do not allow the assembly compound to enter the exhaust system, particularly up stream (in front) of the catalytic converters otherwise damage to the converters assembly will result.

#### Heated oxygen sensor

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

#### Exhaust system temperature warning lamp

On cars conforming to a Japanese specification an exhaust temperature warning system is fitted. The warning panel for this system is situated on the fascia. Illumination of the panel indicates that an excessive temperature condition caused through an engine malfunction has occurred in the exhaust system.

If an excessive temperature 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 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 warning has been corrected by

referring to the appropriate fault diagnosis flow chart (see fig. F8-4).

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.

#### Catalytic converter protection

To protect the catalytic converters from possible damage the following precautions should be taken.

#### Unleaded gasoline

Use unleaded gasoline only 90 AKI (95 RON)\* Min. The use of leaded gasoline 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 converters.

\* 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 converters.

#### Fuel

Do not allow the vehicle to run out of fuel. A warning lamp situated on the fascia illuminates to warn the driver of a low fuel level. If the vehicle runs out of fuel at high speed, possible damage to the catalytic converters 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 converters.

#### 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 converters due to overheating.



Figure F8-2

# Exhaust temperature warning system – fault diagnosis chart

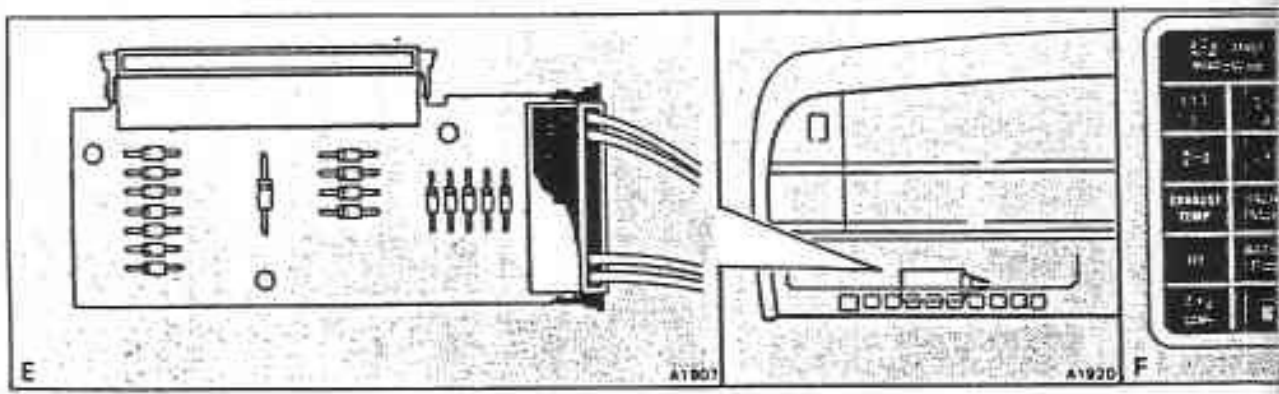
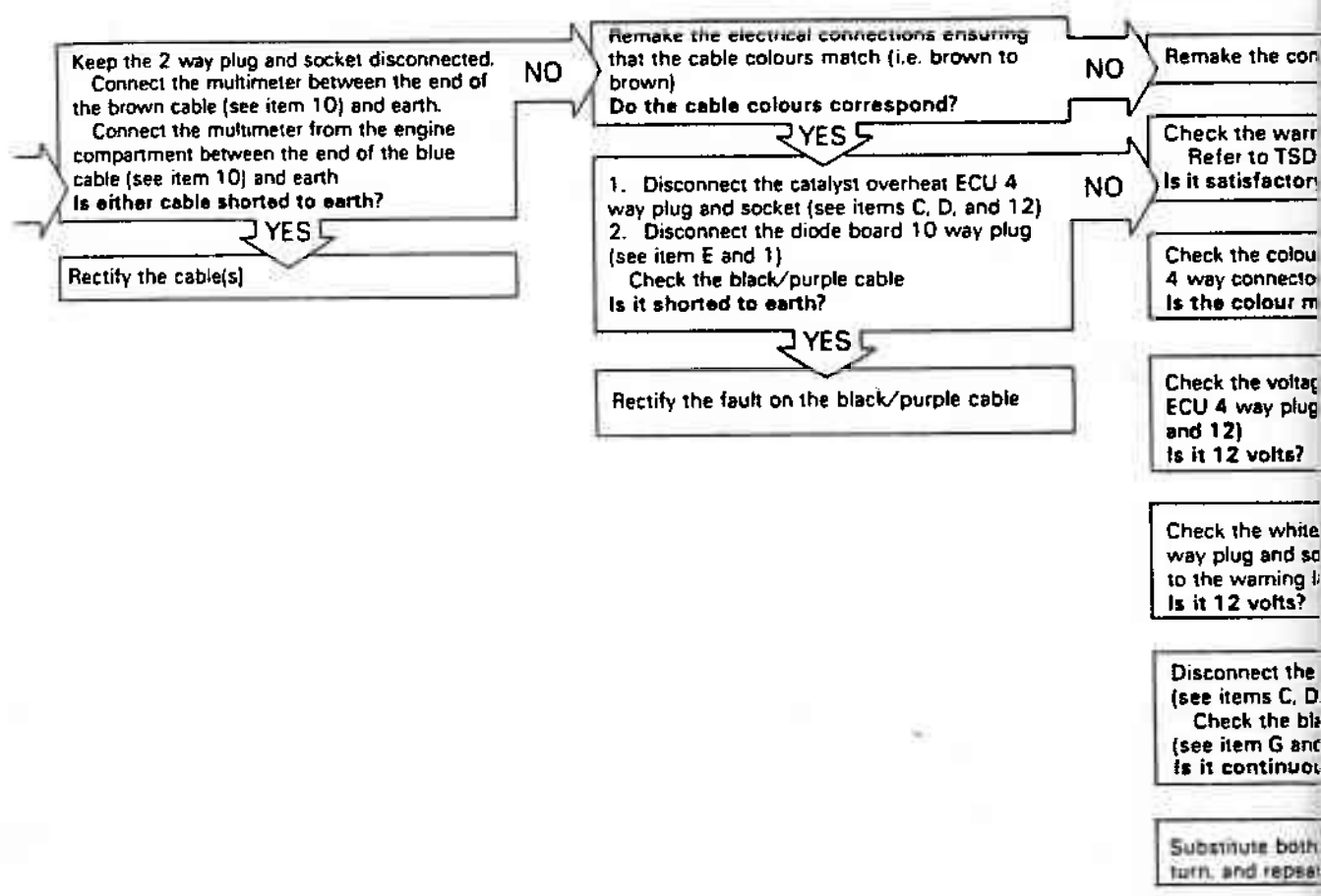
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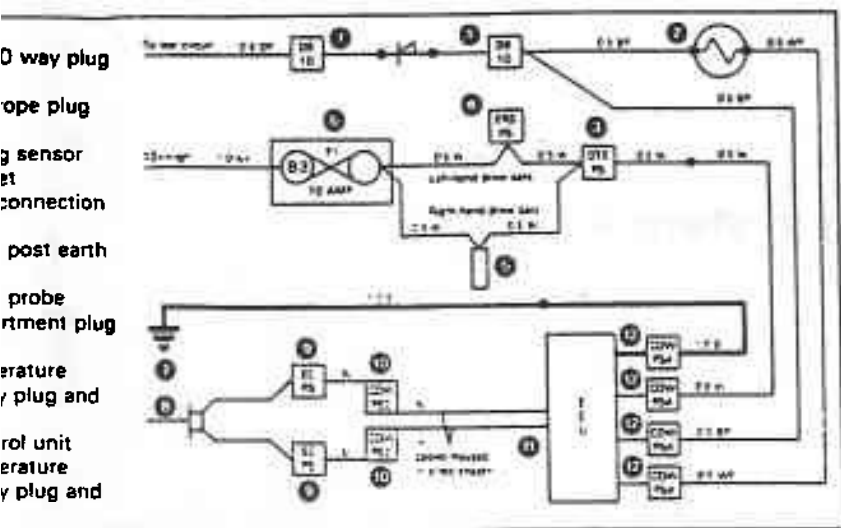


Figure F8-2

# Exhaust temperature warning system – fault diagnosis chart Sheet 2 of 2

Key	
1	Diode board
2	Warning lamp
3	Other than ECU and socket
4	Engine running plug and socket
5	Speedometer
6	Fuse
7	Right-hand 'A' point
8	Thermocouple
9	Engine comp and socket
10	Exhaust temp warning 2 wa socket
11	Electrical con
12	Exhaust temp warning 4 wa socket





Connections correctly

Ignition lamp test circuit.  
4848  
?

NO

Rectify as necessary

YES

Matching of the cables in the  
(see items C, D, and 12)  
itching correct?

NO

Correct the cable mis-match

YES

Check on the white cable at the  
and socket (see items C, D,

NO

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

YES

Check purple cable from the ECU 4  
socket (see items C, D, and 12)  
lamp bulb (see item F and 2)

NO

Check the white/purple cable for continuity and/or short circuiting to another cable

YES

Check ECU 4 way plug and socket  
(see items C, D, and 12)  
black cable to the earth point  
(see item 7)

NO

Rectify the fault on the black cable

YES

Check the ECU and thermocouple in  
the test

