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April 1991

ATTENTION SERVICE MANAGER

Service Notes Manual 'Section EMK' (engine management system, non-catalyst Elan S.E.) C100T0327J. Update package 1991/01

Sir/Madam,

Please find enclosed update pages (stamped '1991/01') for the above engine management manual:

Discard	Insert
Section EMK.1.	
Pages 13/14, 15/16	Pages 13/14, 15/16 ('1991/01')
Section EMK.3.	
Page 5/6	Page 5/6 ('1991/01')
Pages 9/10, 11/12, 13/14, 15/16	Pages 9/10, 11/12, 13/14, 15/16 ('1991/01')
Section EMK.4.	
Pages 9/10, 11/12	Pages 9/10, 11/12 ('1991/01')
Pages 17/18, 19/20, 21/22, 23/24	Pages 17/18, 19/20, 21/22, 23/24 ('1991/01')
Pages 45/46, 47/48	Pages 45/46, 47/48 ('1991/01')
Page 53/54	Page 53/54 ('1991/01')
Page 57	Page 57 ('1991/01')
Section EMK.6.	
Page 3/4	Page 3/4 ('1991/01')

Please ensure that this update is correctly filed in the appropriate manual, and that extra copies, if required, are ordered immediately using the attached postcard. *Do not forget to check for manuals held in parts stock, and order* updates accordingly. This letter should be filed in the Dealer's working copy for record purposes.

Requests from customers are sometimes received by Lotus, asking to be included on update mailing lists. For logistical reasons this is not possible, but it is most important that dealers ensure that prior to the sale of any manual, all appropriate update packages are included. All Service Notes manuals purchased from Lotus are fully updated at the time of shipment.

Yours faithfully,

Dave Massey

Dave Massey
Senior Technical Author

ENGINE MANAGEMENT & FUEL INJECTION

SECTION EMK - LOTUS ELAN TURBO

SECTION EMK.1 - INTRODUCTION

EMK.1 - A EMK SECTIONS EXPLAINED

Introduction - EMK.1

This section starts with a general description of the fuel injection and engine management system to provide an overview of the system and its components.

The operation of the 'Check Engine' light is explained, and how to read trouble codes without a scanner tool. The 'Tech 1' scanner tool is introduced and its operation and advantages explained. Further tools required for full diagnostic/ repair procedures are also listed.

Basic Function - Systems and Components - EMK.2

This section explains the function of each individual component and where it is fitted in order that a thorough understanding of the operation of the system may be gained.

Individual Component Diagnosis and Replacement - EMK.3

This section contains the circuit diagrams, fault finding charts and test procedures necessary to diagnose faults in each component. Replacement procedures and torque figures are also included.

Trouble Code Diagnosis Using 'Tech 1' Tool - EMK.4

'Trouble Codes' are numbers which relate to certain types of fault as detected by the on-vehicle self diagnostic system. The 'Tech 1' tool is an electronic scanner which plugs into the on-vehicle diagnostics and displays trouble codes stored by the electronic control module.

If a 'Tech 1' tool is available, this section should be used to diagnose any problem by following three basic steps.

i) Are the on-vehicle diagnostics working? This is established by performing the "Diagnostic Circuit Check" contained at the front of the section. ALWAYS START HERE.
   If the on-vehicle diagnostics are not working, this procedure will refer to another chart in section EMK.4 to correct the problem. If the on-vehicle diagnostics are O.K. the next step is:

ii) Is there a trouble code stored? If a trouble code is stored, refer directly to the trouble code chart of that number in section EMK.4. This will determine if the fault is still present. If no trouble code is stored, the third step is:

iii) 'Scan' serial data. This involves using the 'Tech 1' tool to read the information available from the serial data stream. Information on the 'Tech 1' tool and the meaning of the displays is contained in section EMK.1 - G.

This procedure, which takes only a short time will result in problem diagnosis being made in the most cost effective and reliable manner.

'Trouble Code' Diagnosis Without 'Tech 1' Tool - EMK.5

This section enables fault diagnosis to be made without the use of a scanner tool ('Tech 1').

Fault Diagnosis With Intermittent or No Trouble Codes - EMK.6

If a problem is diagnosed as being 'intermittent' the trouble code charts in section EMK.4 should be used only as a guide, or good components may be needlessly replaced. Section EMK.6 helps to diagnose intermittent problems and driveability problems which do not cause a trouble code to be set.

EMK.1 - B GENERAL DESCRIPTION

The electronic multi-point fuel injection system used on the Lotus Elan is a General Motors fully electronic, processor controlled system, using a separate fuel injector in the intake tract of each cylinder.

The injectors are supplied with fuel at constant pressure (relative to intake manifold pressure) from a common fuel rail, with the quantity of fuel delivered to the engine being controlled by the length of time for which the solenoid operated injectors are opened. The injectors are 'pulsed' in two pairs (1/3 and 2/4) once every engine revolution, with half of the fuel requirement for each cylinder's combustion being supplied by each pulse. The injectors are controlled by a processor called an Electronic Control Module (E.C.M.) which calculates the amount of fuel required by the engine under the operating conditions at any particular time. This information is fed into the E.C.M. by a series of sensors measuring air and coolant temperature, inlet manifold pressure, throttle position and engine and vehicle speed. On the basis of these signals and others, the E.C.M. also controls the ignition timing, turbocharger boost pressure, engine idle speed, and air conditioning compressor clutch.

The Direct Ignition (D.I.) system does away with the conventional distributor and uses two separate ignition coils, a cam angle sensor, an ignition module and Electronic Spark Timing (E.S.T.) control circuitry incorporated into the E.C.M. This type of distributorless ignition system uses a 'waste spark' method of distribution wherein cylinder pairs 1/4 and 2/3 are provided with a spark every revolution, i.e. on both compression stroke and exhaust stroke. At engine cranking speed the ignition module (part of the ignition coil pack) alone controls the spark advance, but at speeds above 800 rpm, the E.C.M. takes over ignition timing control based on inlet manifold air pressure, air temperature, coolant temperature, engine speed and detection of the onset of detonation.

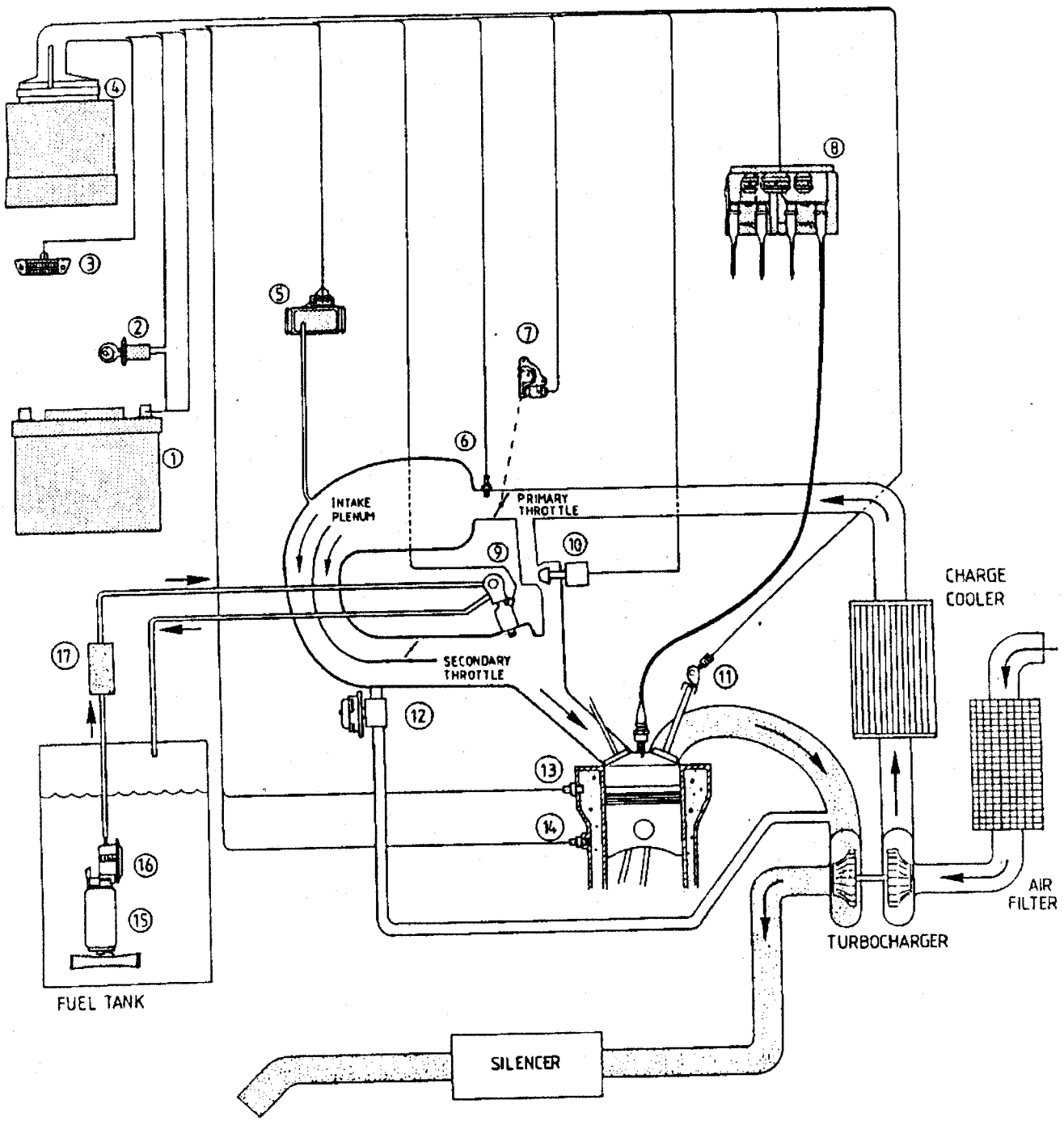
In addition to these functions, the E.C.M. monitors the signals received from the various sensors and compares them with pre-programmed tolerance bands to enable it to recognise 'faults' in the system and light a 'check engine' tell tale lamp on the fascia. This informs the driver that a fault has been detected and furthermore stores in its memory a 'trouble code' for the particular type of fault detected in order that a technician may access the code and be guided to the problem area.

A facility is also provided for the data monitored by the E.C.M. to be tapped via a hand held electronic scanner (known as the 'Tech 1' tool) with an LCD display panel. This tool aids rapid fault diagnosis by displaying all sensor readings and trouble codes.

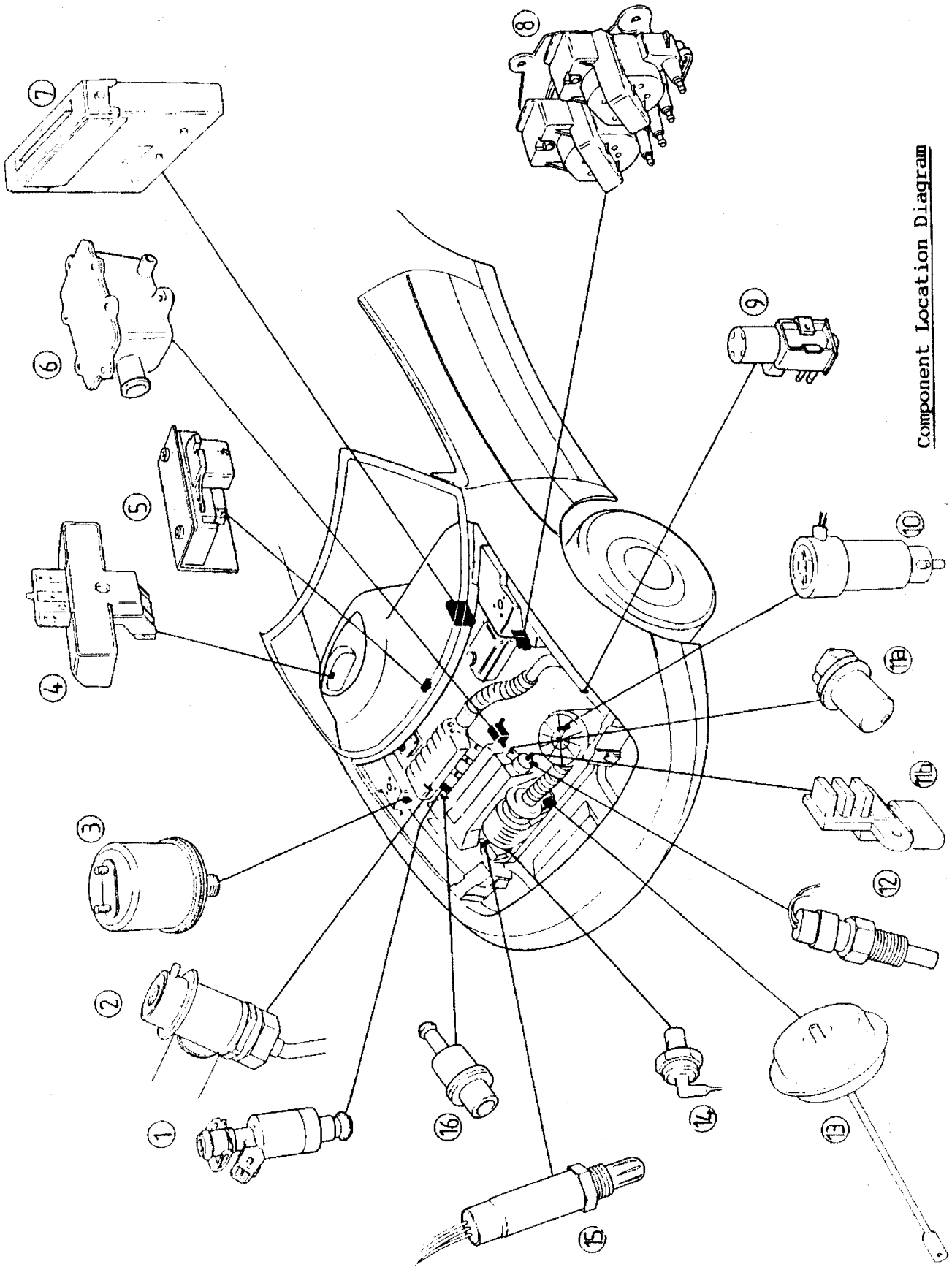
Key to Schematic Diagram

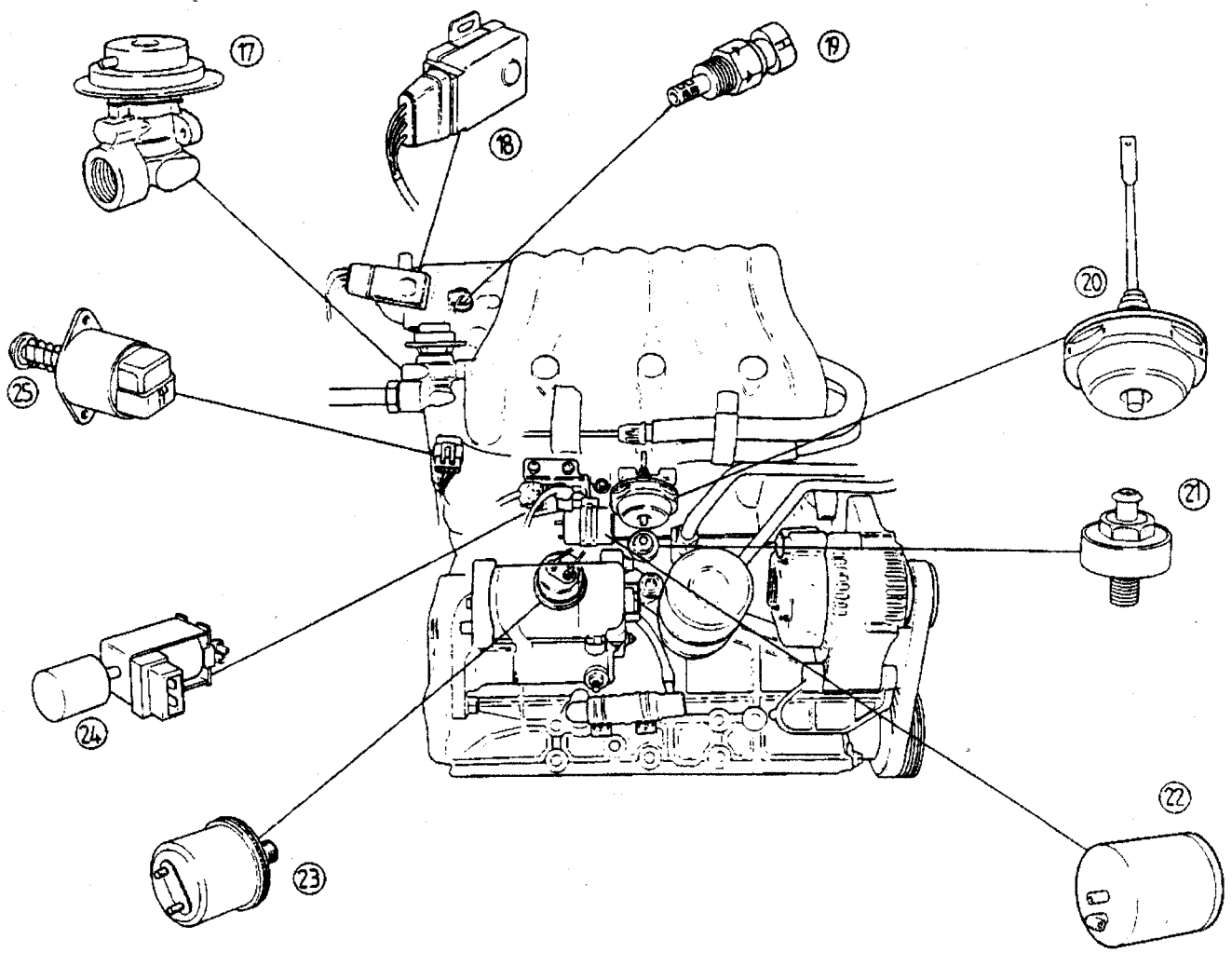
1. Battery
2. Ignition switch
3. Assembly Line Diagnostic Link (ALDL)
4. Electronic Control Module (ECM)
5. Manifold Air Pressure (MAP) sensor
6. Mass Air Temperature (MAT) sensor
7. Throttle Position Sensor (TPS)
8. Direct Ignition (DI) module and coils
9. Fuel injector (4 off)
10. Idle Air Control (IAC) valve
11. Cam angle sensor
12. Exhaust Gas Recirculation (EGR) valve
13. Coolant Temperature Sensor (CTS)
14. Knock sensor
15. Fuel pump
16. Pulsator
17. Fuel filter

Schematic Diagram



Component Location Diagram





Component Location - Rear Side of Engine

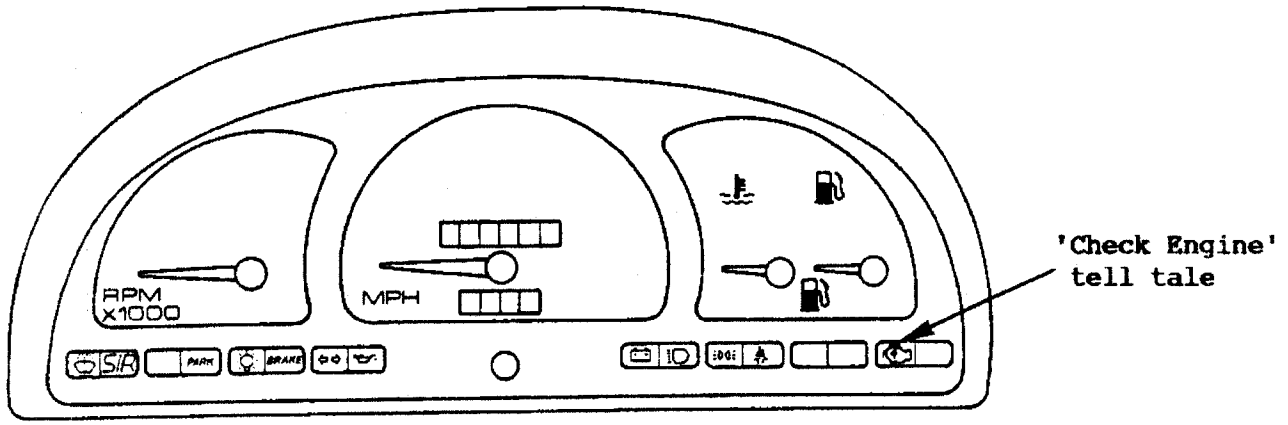
Key to Component Location Diagram

1. Fuel injector
2. Fuel pressure regulator valve
3. Boost gauge transducer
4. Vehicle Speed Sensor (VSS)
5. Manifold Air Pressure (MAP) sensor
6. Crankcase breather oil seperator
7. Electronic Control Module (ECM)
8. Ignition module & H.T. coils
9. Exhaust Gas Recirculation (EGR) vacuum solenoid valve
10. Boost control frequency valve
11. Cam angle sensor:
    11A. Magnetic pick up
    11B. Hall effect sensor
12. Coolant Temperature Sensor (CTS)
13. Wastegate actuator capsule
14. Power Steering Pressure Switch (PSPS)
15. Oxygen (O_2) sensor
16. Positive Crankcase Ventilation (PCV) valve
17. Exhaust Gas Recirculation (EGR) valve
18. Throttle Position Switch (TPS)
19. Manifold Air Temperature (MAT) sensor
20. Secondary throttle vacuum actuator
21. Knock sensor
22. Secondary throttle vacuum reservoir
23. Oil pressure transducer
24. Secondary throttle vacuum solenoid valve
25. Idle Air Control (IAC) valve

EMK.1 - C 'CHECK ENGINE' LIGHT

A 'check engine' tell tale lamp in the instrument binnacle is provided to:

i) To tell the driver that a problem has occurred and that the vehicle should be taken for check/repair as soon as is practicable;
ii) To enable the technician to read out any 'trouble codes' and help diagnose system problems.



As a bulb and system check, the lamp will light with the ignition on, and should go out when the engine is started. If, however, the lamp remains on, or comes on whilst driving, this indicates that the self diagnostic system has detected a problem and a trouble code has been stored in the memory. If the fault cures itself, or is no longer detected, the lamp will go out in most cases after about 10 seconds, but the trouble code will remain stored in the memory for the next 50 starts to indicate to the technician that an intermittent fault has been detected. If no recurrence is recorded during this period, the stored trouble code will be erased from the memory. Certain types of detected fault result in the ECM imposing a 4,000 rpm limit, to prevent engine damage.

Trouble Codes

Trouble codes may be categorised as either 'intermittent' or 'hard' where an 'intermittent' code is one which was set by a detected fault no longer present, and a 'hard' code is one where the fault still exists. The trouble code charts in sections EMK.4 and EMK.5 are designed to use this discrimination to aid diagnosis.

On the facing page of each trouble code chart are the readings the E.C.M. expects to receive from the relevant sensors. If these readings are outside of the specification, the check engine tell tale will be lit and a trouble code stored in the memory. The trouble code indicates in which CIRCUIT a problem was detected. Such a circuit would include the sensor, the wiring and connectors to it, and the E.C.M.

In order to read any trouble codes stored in the memory, it is necessary to use the Assembly Line Diagnostic Link (ALDL) connector.

EMK.1 - D ASSEMBLY LINE DIAGNOSTIC LINK (ALDL) CONNECTOR

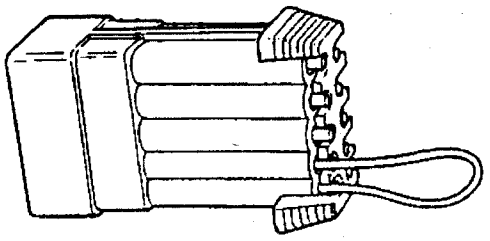
The ALDL electrical connector is plugged into a stowage socket fixed at the front of the passenger footwell:

The ALDL connector is used:

i) at the end of the factory production line to check out the engine management system;
ii) to connect the hand held diagnostic scanner tool ('Tech 1'). Data is read via terminal G;
iii) to read stored trouble codes without a scanner tool.

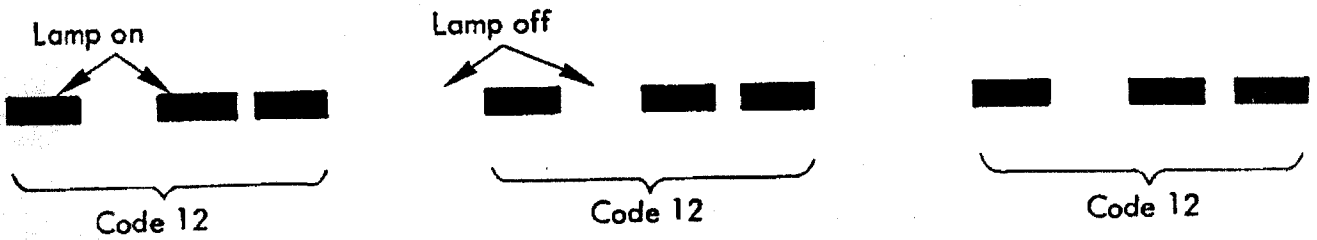
EMK.1 - E DIAGNOSTIC MODE (no scanner tool)

If the diagnostic terminal (B) of the ALDL connector is grounded (terminal A) using bridging connector T000T0909 with the ignition on and the engine stopped, the system will enter the diagnostic mode, and:



Bridging plug
T000T0909

i) Display a code 12 by flashing the 'Check Engine' tell tale, to indicate that the diagnostic mode is operating. Codes are displayed by the lamp quickly flashing the first digit of the (two digit) number with a short pause before the second digit is similarly flashed.
For example, code 12 would consist of one flash, followed by a short pause then two flashes in quick succession.
If no trouble codes are stored, code 12 will continue to be flashed repeatedly until the diagnostic terminal is ungrounded.



ii) If one or more trouble codes are stored, code 12 will flash 3 times, followed by a short pause before the first trouble code is flashed 3 times in succession, then the next trouble code (if any), until code 12 is again flashed to complete the cycle.
The trouble codes charts in section EMK.5 are used to diagnose the problem and determine if the fault is 'hard' or 'intermittent'.

iii) Energise all ECM controlled relays and solenoids except the fuel pump relay.

iv) Fully extend the idle air control (IAC) valve.

Note that trouble codes can only be displayed with the engine stopped. Grounding the diagnostic terminal with the engine running provides the 'CO adjustment mode' described below.

EMK.1 - F CO ADJUSTMENT MODE

If the diagnostic terminal (B) of the ALDL connector is grounded (use tool T000T0909) with the engine running, the system will enter the CO adjustment mode, and the 'Check Engine' tell tale will light. See section EMK.3 - E for the CO adjustment procedure.

EMK.1 - G 'TECH 1' SCANNER TOOL

The 'Tech 1' is a hand held electronic scanner tool with an LCD display panel which, by plugging into the ALDL connector, is able to display (numerically) any stored trouble codes and allow a quick check of sensors and switches which are inputs to the ECM. Any pair of sensor inputs may be displayed simultaneously either in the workshop, or if necessary whilst driving on the road.