WINNEBAGO

SERVICE

Ctasca

SERVICE MANUAL

BENDIX FUEL INJECTION SYSTEM

1989-90 LeSharo, Phasar & Utility Van

701674-11-000

TABLE OF CONTENTS

ENGINE SPECIFICATIONS

General Specifications

Type	In-Line, 4 Cylinder, OHC
Bore	88 mm (3.46 in.)
Stroke	88 mm (3.50 in.)
Displacement	2.2 Liter (132 cu. in.)
Compression Ratio	9.2:1
Firing Order	1-3-4-2
Fuel Requirement	Unleaded

Cylinder Head

Cylinder Head Height	111.6 mm (4.394 in.)
Combustion Chamber Volume	58.15 cc
Valve Guide Inside Diameter	8 mm (0.315 in.)
Valve Stem-to-Guide Clearance	0.1 mm (0.004 in.)
Intake Valve Seat Angle	60°
Exhaust Valve Seat Angle	45°
Intake Valve Seat Width	1.6 mm (0.07 in.)
Exhaust Valve Seat Width	1.6 mm (0.06 in.)
Cylinder Head Warpage (maximum)	0.05 mm (0.002 in.)

Cylinder Block and Liners

Liner Height	148.5 mm (5.846 in.)
Bore Diameter	88 mm (3.464 in.)
Base Locating Diameter	93.6 mm (3.685 in.)
Liner Protrusion (w/o O-ring)	0.08 to 0.15 mm (0.003 to 0.006 in.)
Liner Height to Flange	93.065 to 93.096 mm (3.663 to 3.665 in.)
Cylinder Block Depth to Flange	92.942 to 92.985 mm (3.659 to 3.660 in.)
Cylinder Block Depth	149.25 to 149.75 mm (5.875 to 5.895 in.)

Rocker Arm Clearance (Cold)

Intake	0.10 to 0.15 mm (0.004 to 0.006 in.)
Exhaust	0.20 to 0.25 mm (0.008 to 0.010 in.)

Crankshaft

Number of Main Bearings	5
Main Bearing Journal Diameter	62.892 mm (2.476 in.)
Regrind Diameter	62.842 mm (2.456 in.)
Grinding Tolerance	-0.0 to -0.01(mm (-0.0 to -0.0007 in.)
Connecting Rod Journal Diameter	58.296 mm (2.216 in.)
Regrind Diameter	58.046 mm (2.206 in.)
Grinding Tolerance	-0.01 to -0.029 mm (-0.0004 to -0.0011 in.)
End Play	0.07 to 0.3 mm (0.002 to 0.009 in.)

Valve Train

Camshaft End Play	0.05 to 0.13 mm (0.002 to 0.005 in.)
Intake Valve Timing	
Opens	12° BTDC
Closes	52° ABDC
Exhaust Valve Timing	
Opens	52° BBDC
Closes	12° ATDC
Valve Overlap	24°

Pistons, Connecting Rods and Piston Pins

Piston-to-Connecting Rod Fit	Press-Fit
Connecting Rod End Play - Large End	0.31 to0.57 mm (0.012 to 0.022 in.)
Piston Pin Length	75 mm (2.952 in.)
Piston Pin External Diameter	20 mm (0.905 in.)
Piston Pin Internal Diameter	14 mm (0.551 in.)

Valves

Valve Stem Diameter	8.0 mm (0.315 in.)
Intake Valve Head Diameter	44 mm (1.732 in.)
Intake Valve Face Angle	60°
Exhaust Valve Head Diameter	38.5 mm (1.516 in.)
Exhaust Valve Face Angle	45°

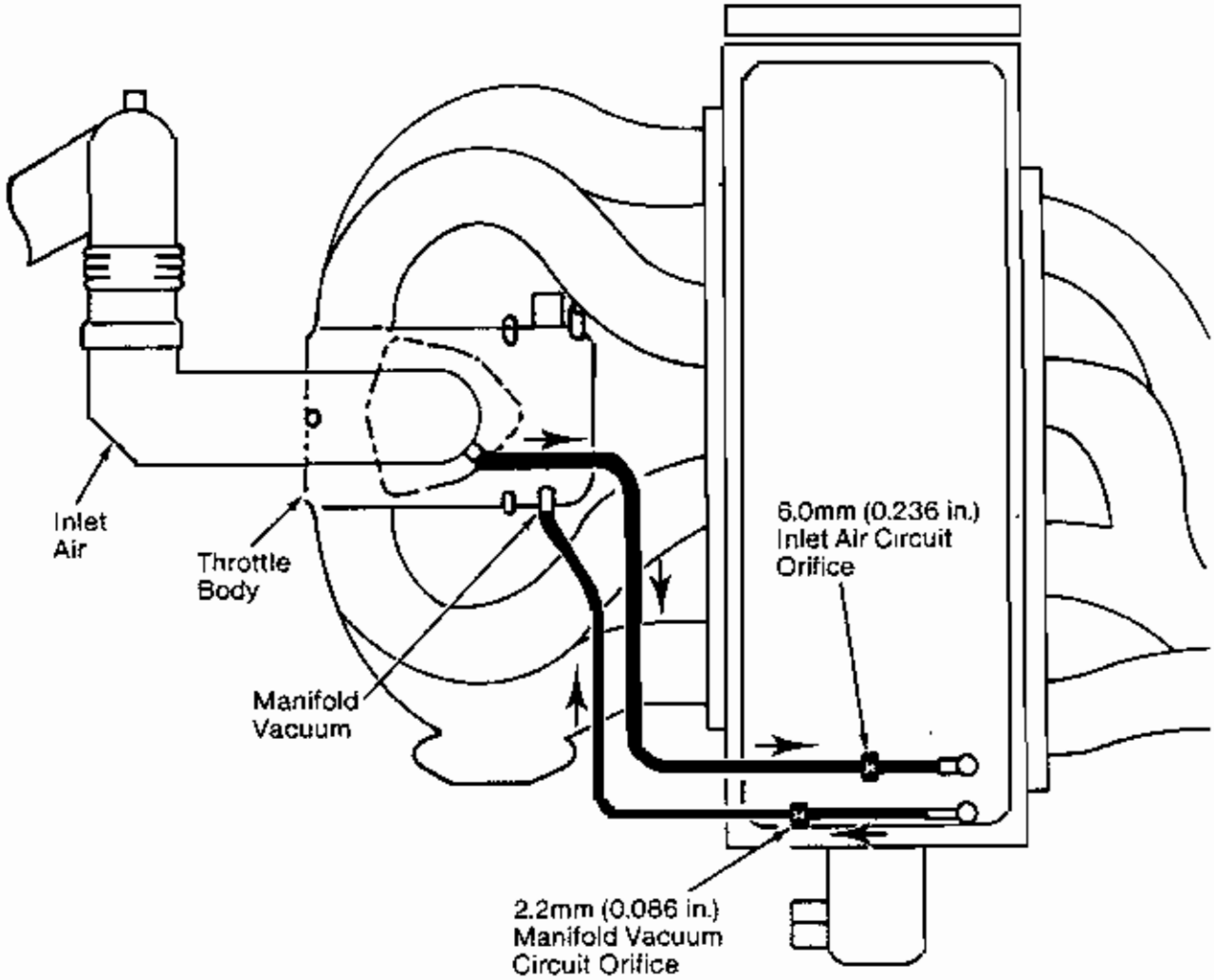
Piston Rings

Piston Ring Thickness	
Top Compression	1.75 mm (0.068 in.)
Upper Compression	2.00 mm (0.078 in.)
Oil Scraper	4.00 mm (0.157 in.)
Piston Ring Gap	Pre-Adjusted

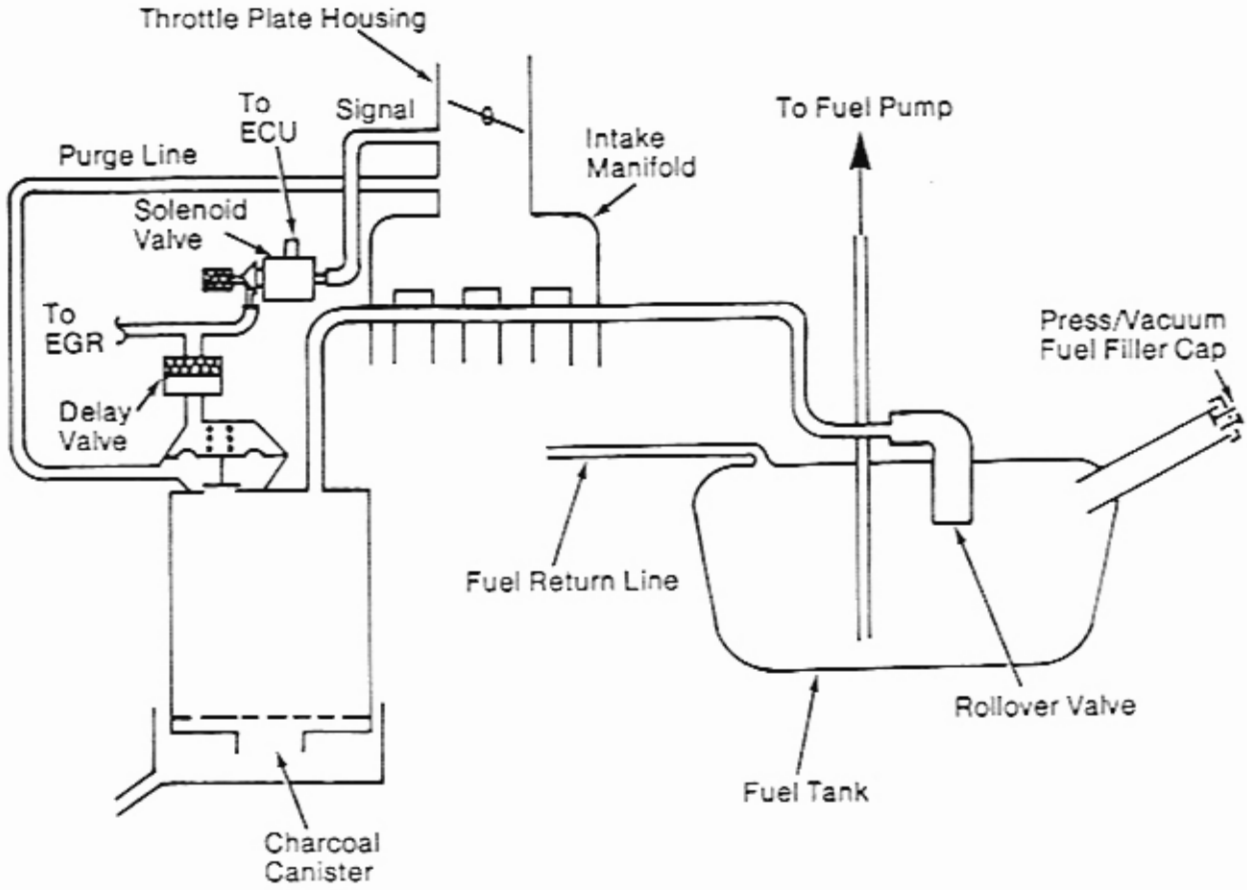
Lubrication System

Oil Capacity	
Without Filter Change	**5.0 Liters (5.3 quarts)**
With Filter Change	**5.5 Liters (5.8 quarts)**
Operating Pressure at Idle	**0.8 bars (12 psi)**
Operating Pressure at 3,000 rpm	**3.0 bars (44 psi)**
Oil Pump-Gear End Clearance	
Minimum	**0.05 mm (0.002 in.)**
Maximum	**0.12 mm (0.005 in.)**
Oil Pump-Gear to Body Clearance	
Minimum	**0.02 mm (0.001 in.)**
Maximum 0.10 mm (0.004 in.)	

PCV SYSTEM


Inlet
Air
Throttle
Body
Manifold
Vacuum
6.0mm (0.236 in.)
Inlet Air Circuit
Orifice
2.2mm (0.086 in.)
Manifold Vacuum
Circuit Orifice

FUEL EVAPORATIVE SYSTEM SCHEMATIC

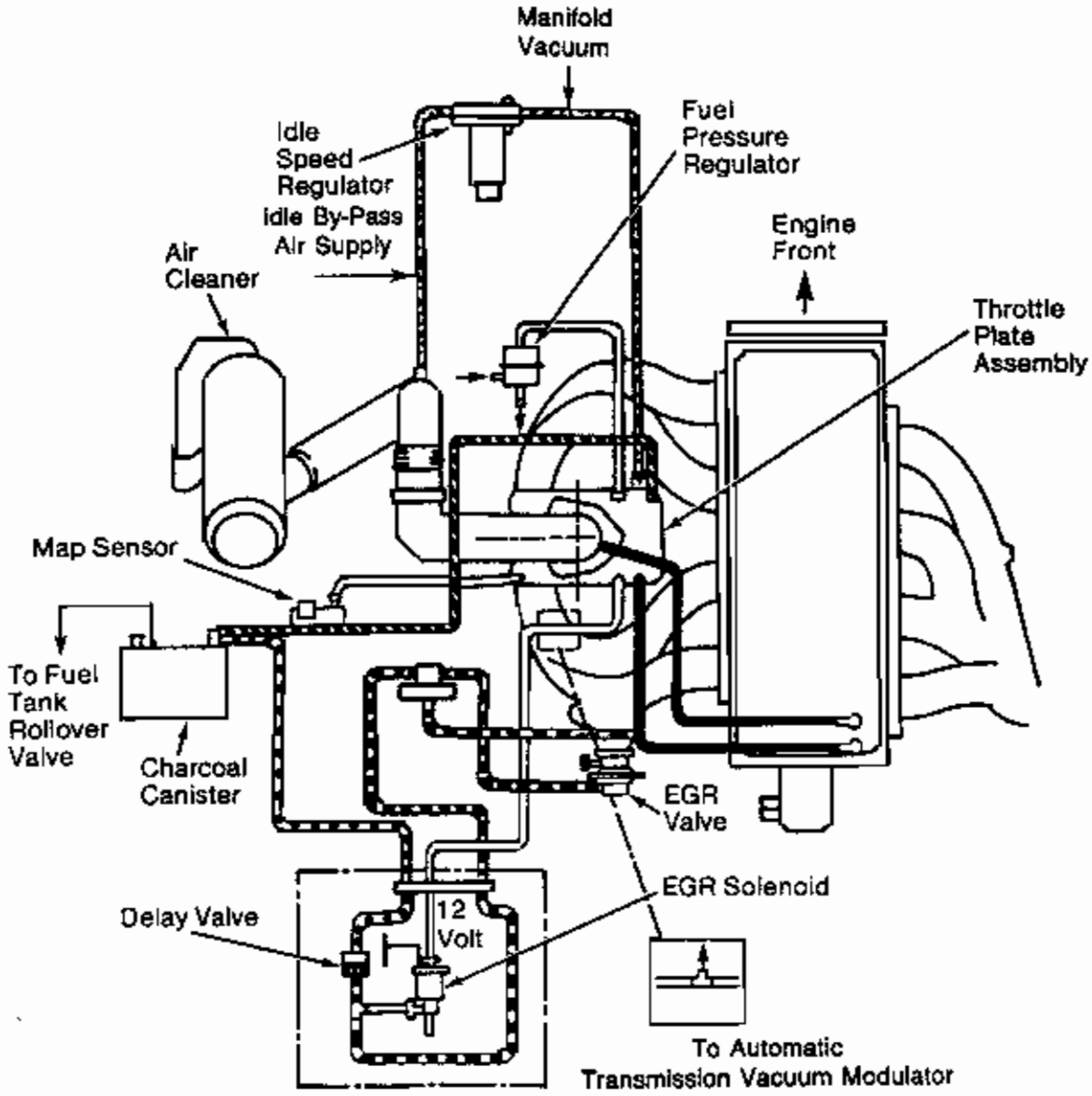


NOTE: Overfilling the fuel tank may cause charcoal canister saturation. This would result in driveability problems, such as flooding and over-rich conditions.

ENGINE

EMISSION SYSTEM SCHEMATICS

EXHAUST EMISSION SYSTEM SCHEMATIC



ELECTRONIC CONTROL UNIT (ECU)

The 2.2L multipoint fuel injection system is controlled by a digital microprocessor referred to as an Electronic Control Unit or ECU. The ECU is actually a microcomputer that receives information from various input sensors. Based on this information, the ECU is programmed to provide a precise amount of fuel and the correct ignition timing to meet existing engine speed and load conditions.

The fuel system's ECU also calculates ignition timing and operates the ignition power module. Ignition timing is modified by the ECU to meet any engine operating condition. Information such as air temperature, engine coolant temperature, engine speed, absolute pressure in the intake manifold, or the presence of a spark knock is used by the ECU when calculating the correct ignition timing.

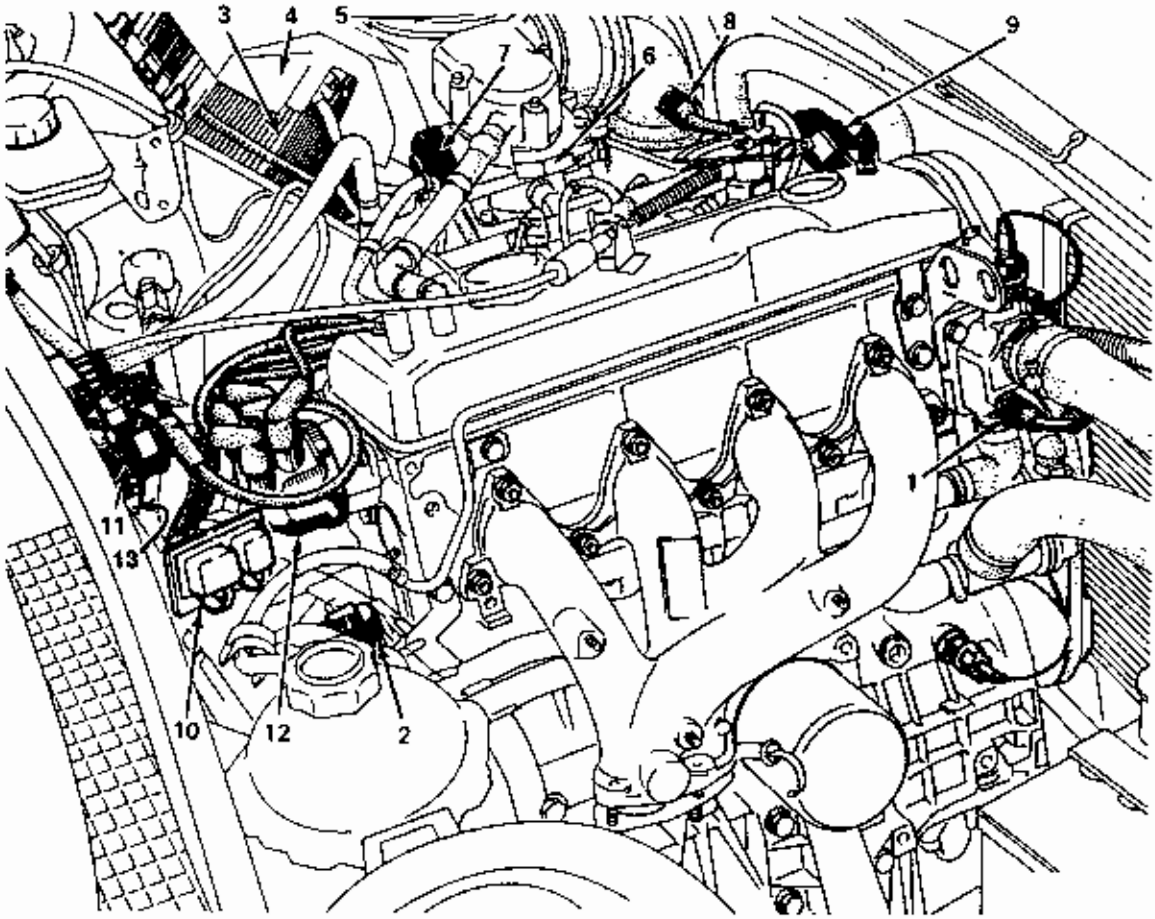
The ECU controls the engine by receiving the following input values:

- Manifold Absolute Pressure (MAP)
- Engine Speed Sensor
- Knock Sensor
- Exhaust Oxygen (O_2) Sensor
- Throttle Position Switch
- Coolant Temperature Sensor
- Air Temperature Sensor
- Battery Voltage

Then sending output signals to the following components:

- Fuel Pump Relay (Fuel Delivery System)
- Fuel Injectors
- Idle Speed Regulator
- Ignition Power Module
- EGR Valve

POSITIONS OF COMPONENTS

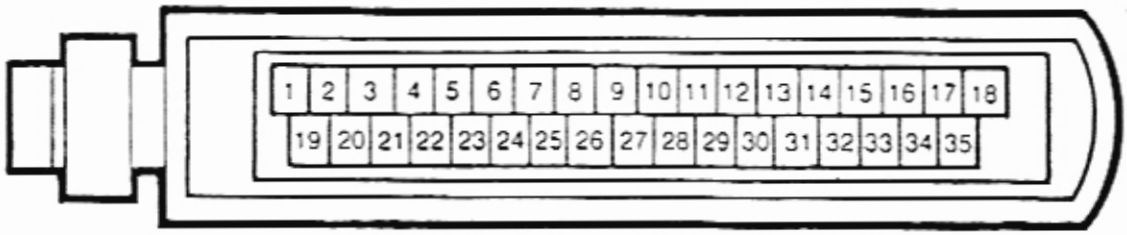


1. Coolant Temperature Sensor
2. Speed Sensor
3. Computer and Protective Housing
4. Protective Housing
5. Air Filter
6. Throttle
7. Throttle Position Switch
8. Air Temperature Sensor
9. Idle Speed Regulator
10. Diagnostic Plug
11. Ignition Module
12. Distributor
13. Map Sensor (Below ign. Module)

ECU CONNECTOR

This is the ECU connector used for the Bendix fuel injection system. Terminal identification and specific application is detailed in the following chart.

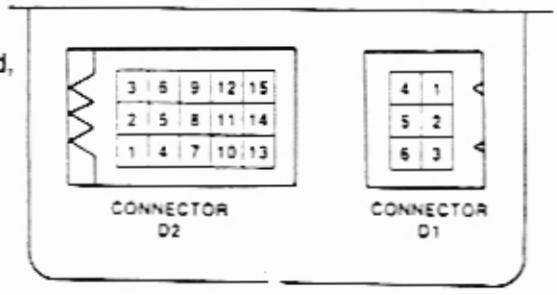
WINNEBAGO BENDIX



1. Ground
2. Ground
3. Not Used
4. Permanent Memory Power Supply
5. EGR Valve/Canister Purge
6. Fuel Pump Relay
7. System Power Relay (latch relay)
8. WOT Switch
9. Not Used
10. Not Used
11. Speed Sensor Input (B)
12. Park Neutral Switch (auto. trans. only)
13. Not Used
14. Manifold Air Temperature Sensor
15. Coolant Temperature Sensor
16. Manifold Absolute Pressure - Supply Voltage
17. Manifold Absolute Pressure and Oxygen Sensor Ground
18. ECU Diagnostic Signal Output (to D2-1)
19. System Power (B+)
20. Injector Output Signal
21. Injector Output Signal
22. AC Relay Ground Output
23. Idle Speed Regulator (Coil 1)
24. Idle Speed Regulator (Coil 2)
25. Closed Throttle (idle) Switch
26. Not used
27. Timing Control Signal (Tach. Output)
28. Speed Sensor Input (A)
29. Crank Signal Input
30. A/C Select
31. Knock Sensor Input
32. Temperature Sensor Ground
33. MAP Sensor Output
34. A/C Thermostat
35. O_2 Sensor Input

DIAGNOSTIC CONNECTORS

The diagnostic connector is located under the hood, on the firewall near the ignition module.



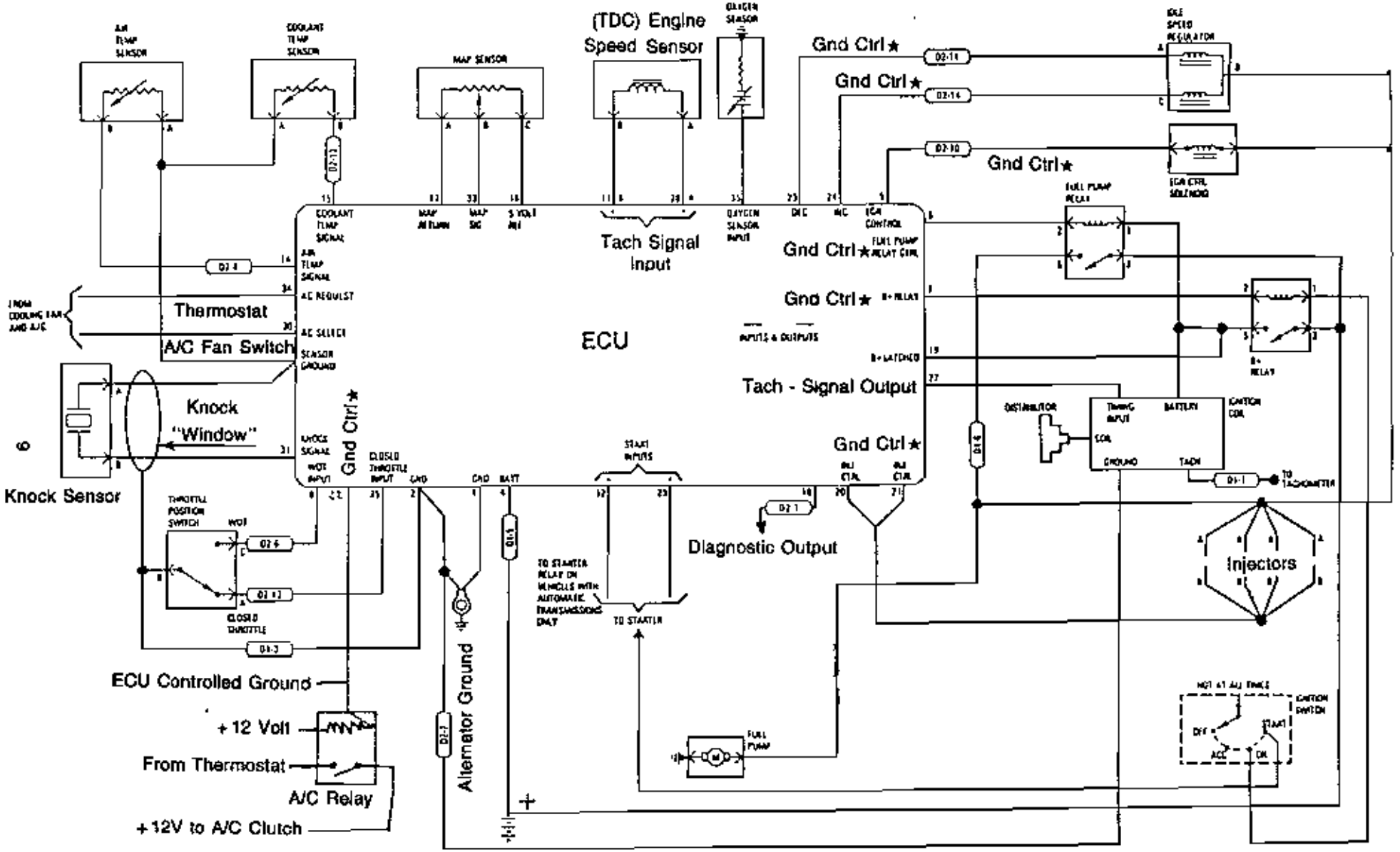
Connector D2

1. ECU Diagnostic Output
2. Not Used
3. Not Used
4. B+ Relay
5. Not Used
6. WOT
7. Ground
8. Air Temperature Sensor
9. Not Used
10. EGR
11. Idle Speed Regulator (Coil 1)
12. Coolant Temperature Sensor
13. Closed Throttle Switch
14. Idle Speed Regulator (Coil 2)
15. Automatic Transmission Diagnosis (BV A module)

Connector D1

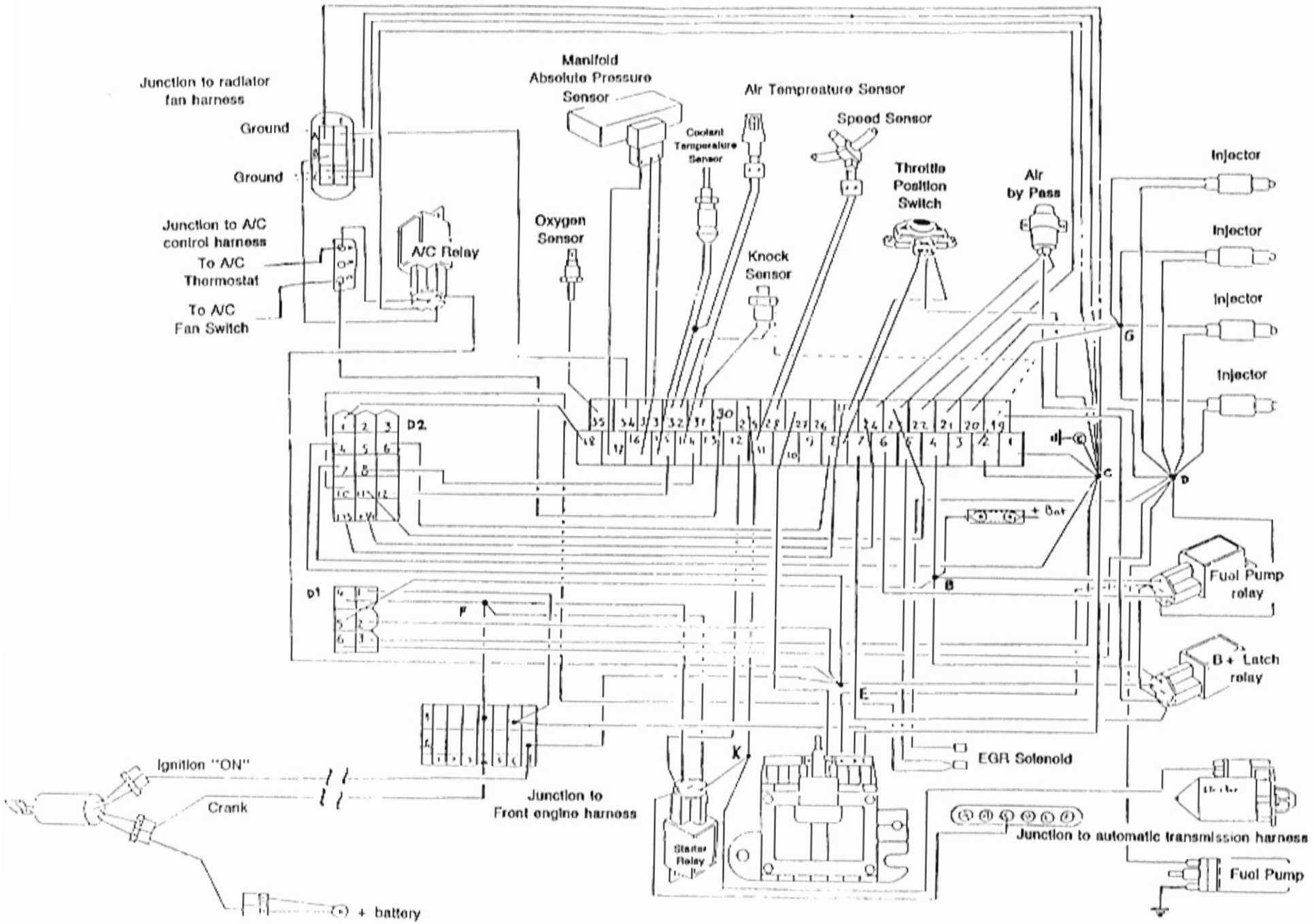
1. Tach Signal
2. Ignition
3. Ground
4. Start Relay
5. Battery
6. Fuel Pump Relay

ECU SCHEMATIC DIAGRAM-INPUTS/OUTPUTS

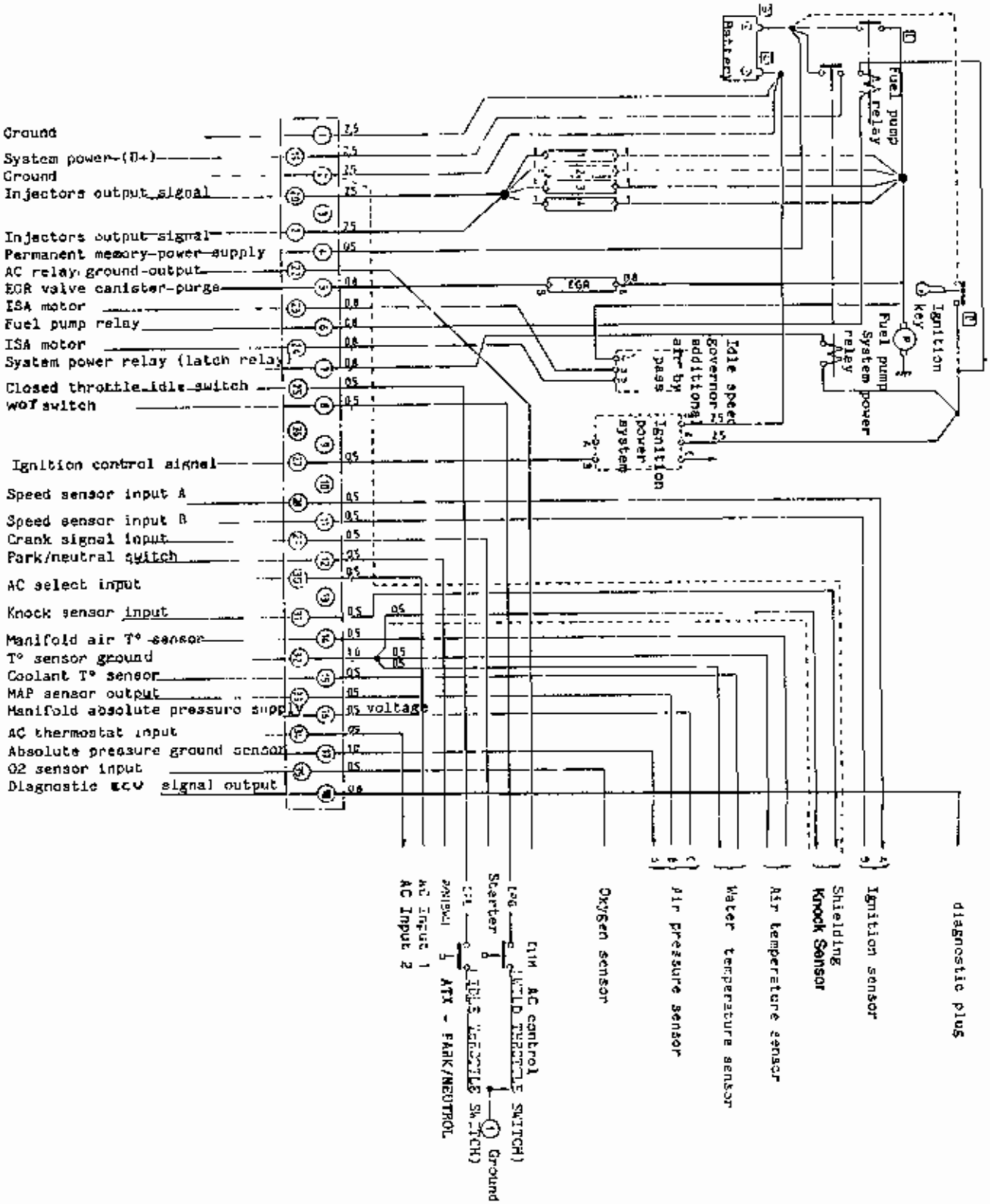


Gnd Ctrl★ - The components in this system are grounded through the ECU. The ECU then controls components by connecting or disconnecting the ground (—) contact. This is referred to as a "ground control" or "controlled ground" system.

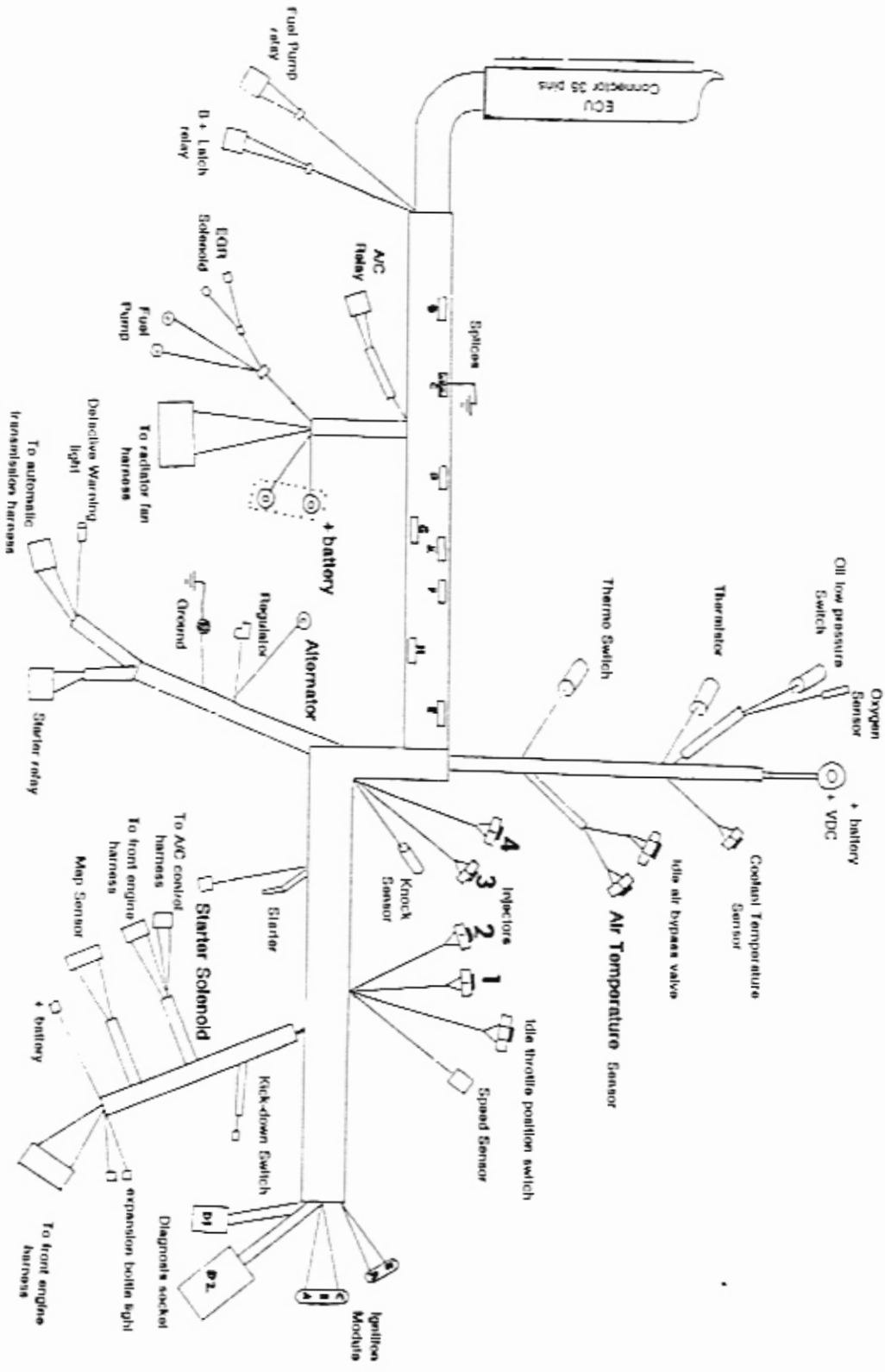
BENDIX INJECTION SYSTEM WIRING DIAGRAM



BENDIX INJECTION SCHEMATIC DIAGRAM - ECU CONNECTOR



BENDIX INJECTION SYSTEM WIRING HARNESS



MODES OF OPERATION

The 2.2L engine used a Pressure-Speed type fuel injection system. This means that the amount of fuel injected into the engine depends almost entirely upon intake manifold pressure and engine speed. Other factors, such as engine coolant temperature, air temperature, throttle position, exhaust oxygen content, and even battery voltage are monitored and used to calculate fuel injection.

As input signals to the ECU change, the ECU must adjust its response to the output devices. For example, the ECU must calculate a different injector pulse width and ignition timing for idle that it calculates for wide open throttle (WOT). There are eight different modes of operation that determine how and why the ECU responds to various input signals. The eight modes are:

- Key ON mode
- Crank mode
- Warm-Up mode
- Idle mode – Operating Temperature
- Cruise mode – Operating Temperature
- Deceleration mode
- Wide-Open Throttle (WOT) mode
- Key OFF mode

Modes of operation exist as two different types. Crank, Warm-Up, Deceleration, and WOT modes are OPEN LOOP modes. The Idle and Cruise modes at operating temperature are CLOSED LOOP modes.

In the OPEN LOOP modes, the ECU receives input signals and responds only according to the preset ECU programming.

In the CLOSED LOOP modes, the ECU also receives a signal from the exhaust oxygen (O_2) sensor which indicates whether or not the calculated injector pulse width results in the ideal air/fuel mixture of 14.7 parts air to 1 part fuel. By monitoring the exhaust oxygen content with the O_2 sensor, the ECU can "fine-tune" the injector pulse width and achieve close to perfect economic and low-emission engine operation.

Key ON Mode

When the ignition switch is placed in the ON position, with the engine not running, the ECU responds to the following inputs:

- Manifold absolute pressure (MAP) sensor
- Air temperature sensor
- Coolant temperature sensor
- Throttle position switch
- Battery voltage signal

The ignition switch supplies voltage to the B+ relay. The ECU provides a ground path and the B+ relay is energized.

The ECU receives and stores a barometric pressure value, from the MAP sensor, in preparation for engine start.

Voltage is supplied to the fuel pump relay from the B + relay. The ECU provides a ground path for 1 to 3 seconds. During this period, the fuel pump relay is energized and the fuel pump pressurizes the fuel supply system.

Voltage is supplied to the injectors via the fuel pump relay. The ECU regulates duration and timing of the injectors by controlling the injector ground circuit.

The idle regulating valve opens fully.

Crank Mode

During engine cranking, the ECU responds to the following inputs:

- Manifold absolute pressure (MAP) sensor
- Engine speed sensor
- Air temperature sensor
- Throttle position switch
- Starter relay (automatic transmission only)
- Battery voltage signal

The ECU provides a ground path for the fuel pump relay and the fuel pump is energized.

The ECU restricts EGR and canister purge operation by energizing the EGR/canister purge solenoid.

Voltage is supplied to the injectors. The ECU controls injector pulse width by controlling the length of time that the injector circuit ground path remains completed.

Based on signals received from the engine speed sensor, the ECU determines correct ignition timing and triggers the ignition coil.

All four injectors are energized, simultaneously, once per engine revolution except during cold engine start conditions, when the injectors are energized twice per engine revolution. This extra fuel delivery continues for a few seconds after the engine starts.

To eliminate the possibility of engine flooding, the ECU limits the number of times that the injectors can be energized twice per engine revolution. This limit is calculated solely on the basis of engine coolant temperature. Under conditions of extremely low coolant temperatures, the ECU increases the number of times that the double injection sequence is possible during engine start. If coolant temperatures are high, the ECU permits fewer double injections.

When the ignition switch is turned to "START," a crank signal is sent to the ECU. If the vehicle is equipped with an automatic transmission, the starter relay prevents the signal from reaching the ECU if the transmission is not in Park or Neutral.

NOTE: This is an OPEN LOOP mode.

Warm-up Mode

During engine warm-up, the ECU responds to the following inputs:

- Manifold absolute pressure (MAP) sensor
- Engine speed sensor
- Air temperature sensor
- Coolant temperature sensor

- Throttle position switch
- Gear indicator signal
- Air conditioning select signal
- Knock sensor

The ECU restricts EGR and canister purge operation by energizing the EGR/canister purge solenoid.

Voltage is supplied to the injectors. The ECU controls injector pulse width by controlling the length of time that the injector circuit ground path remains closed.

All four injectors are energized, simultaneously, once per engine revolution.

The ECU establishes correct idle speed by providing the required ground to the idle regulating valve. If required, idle speed is also adjusted to meet the increased engine load from A/C compressor operation.

The ECU determines the correct ignition timing and triggers the ignition power module.

NOTE: This is an OPEN LOOP mode.

Idle Mode

During engine idle, the ECU responds to the following inputs:

- Manifold absolute pressure (MAP) sensor
- Engine speed sensor
- Air temperature sensor
- Coolant temperature sensor
- Throttle position switch
- Battery voltage signal
- O_2 sensor
- Knock sensor
- Air conditioning select signal

The ECU restricts EGR and canister purge operation by energizing the EGR/canister purge solenoid.

Voltage is supplied to the injectors. The ECU controls injector pulse width by controlling the length of time that the injector circuit ground path remains closed.

All four injectors are energized, simultaneously, once per engine revolution.

By monitoring the O_2 sensor signal, the ECU can "fine-tune" injector pulse width until the ideal air/fuel mixture of 14.7 parts air to 1 part fuel is achieved.

The ECU establishes correct idle speed by providing the required momentary ground to the idle speed regulating valve. If required, the idle speed is also adjusted to meet the increased engine load from A/C compressor operation.

The ECU determines correct ignition timing and triggers the ignition coil.

NOTE: This is a CLOSED LOOP mode.

Cruise Mode

When the vehicle is at cruising speed, the ECU responds to the following inputs:

- Manifold absolute pressure (MAP) sensor
- Engine speed sensor
- Air temperature sensor
- Coolant temperature sensor
- Throttle position switch
- Battery voltage signal
- O_2 sensor
- Knock sensor
- Air conditioning select signal

The ECU opens the ground path for the EGR/ canister purge solenoid. The EGR transducer and the evaporative vapor canister receive manifold vacuum.

Voltage is supplied to the injectors. The ECU controls injection pulse width by controlling the time that the injector circuit ground path remains closed.

All four injectors are energized simultaneously, once per engine revolution.

The ECU determines correct ignition timing and triggers the ignition power module.

NOTE: This is a CLOSED LOOP mode.

Wide Open Throttle (WOT) Mode

During WOT conditions, the ECU responds to the following inputs:

- Manifold absolute pressure (MAP) sensor
- Engine speed sensor
- Air temperature sensor
- Coolant temperature sensor
- Battery voltage signal
- Knock sensor
- Barometric pressure is updated

The ECU restricts EGR and canister purge operation by energizing the EGR/canister purge solenoid.

Voltage is supplied to the injectors. The ECU controls injection pulse width by controlling the time that the injector circuit ground path remains closed.

All four injectors are energized simultaneously, once per engine revolution.

The ECU determines correct ignition timing and triggers the ignition power module.

If a spark knock is detected, the ECU retards ignition timing at the cylinder which is knocking, until the knock is eliminated. Ignition timing progressively returns to its value prior to when the knock was detected.

NOTE: This is an OPEN LOOP mode.

Deceleration Mode

During engine deceleration, the ECU responds to the following inputs:

- Manifold absolute pressure (MAP) sensor
- Engine speed sensor
- Air temperature sensor
- Coolant temperature sensor
- Throttle position switch
- Air conditioning select signal

The ECU restricts EGR and canister purge by energizing the EGR/canister purge solenoid.

Voltage is supplied to the injectors. The ECU controls injection pulse width by controlling the time that the injector circuit ground path remains closed.

All four injectors are energized simultaneously, once per engine revolution.

The ECU determines correct ignition timing and triggers the ignition power module.

If the ECU receives a closed throttle signal and engine speed is over 1,500 RPM, the ECU determines that the engine is in a hard deceleration condition and responds by completely shutting off fuel injection. Fuel injection is resumed when engine speed decreases to 1,500 RPM.

NOTE: This is an OPEN LOOP mode

Key OFF Mode

When the ignition switch is moved to the OFF position, the ECU breaks the injector ground circuit and all fuel injection stops.

The ignition power module is deactivated.

The ECU opens the ground circuit for the B+ relay. The relay opens and voltage supply to all fuel injection circuitry is terminated

SPECIAL OPERATING CONDITIONS

Full Load – Altitude Correction

When the pressure in the intake manifold is near atmospheric pressure (normally at or near WOT position), the ECU will modify the fuel mixture to increase gradually from normal enrichment to full enrichment.

The atmospheric pressure is stored in the ECU. It is measured each time the key is turned to the "ON" position and brought up to date each time the throttle is fully opened or each time the pressure noted is higher than atmospheric pressure.

Air pressure is lower at high altitude, which means that it contains less oxygen per volume unit than low altitude air (normal pressure). Based on low pressure signals from the MAP sensor, the ECU makes the fuel mixture leaner to correspond to the lower oxygen content.

Operation In Defect Mode ("Limp")

The injection system can remain operative when some of its sensors are defective. The ECU diagnoses its sensors by comparing their values to preset limits. If the value sensed does not lie between these limits, the sensor is treated as defective and the system operates in a defect mode.

If the coolant sensor is inoperative, air temperature is used in determining injection pulse and ignition timing values. The air temperature value is then increased as a function of engine RPM to simulate coolant sensor output.

If the O_2 sensor is inoperative, open loop operation is forced.

The engine will run without an input signal to the computer from the following components:

- Coolant Temperature Sensor
- Air Temperature Sensor
- O_2 Sensor
- Throttle Position Switch
- Knock Sensor
- Idle Speed Regulator

Performance will be affected without this input this input, but the engine will still operate.

The engine will not run without input from:

- MAP Sensor
- Engine Speed Sensor (TDC Indicator)

During engine operation, the ECU constantly monitors signals from several different input sensors. Inputs that influence the ECU are:

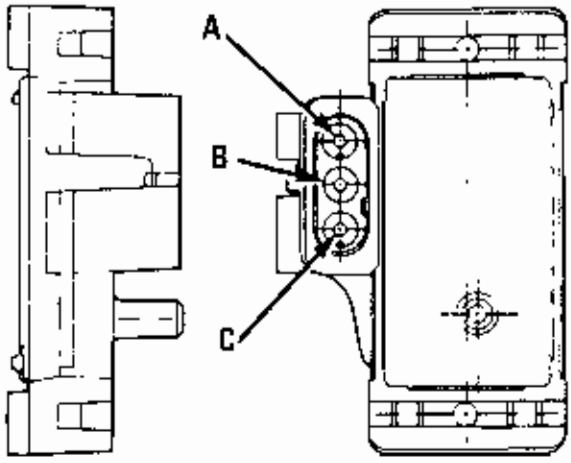
- Manifold Absolute Pressure (MAP) Sensor
- Engine Speed Sensor
- Air Temperature Sensor
- Coolant Temperature Sensor
- Throttle Position Switch
- Engine Crank Signal
- Battery Voltage Signal
- Exhaust Oxygen Sensor
- Knock Sensor
- Air Conditioning Select Signal
- Gear Indicator Signal

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The MAP sensor reacts to absolute pressure in the intake manifold and provides a voltage signal to the ECU. This signal is the main factor used to calculate the amount of fuel that enters the engine.

The ECU provides the sensor with a 5 volt reference voltage. The sensor is connected to the intake manifold by a tube. Changes in intake manifold pressure alter the resistance of areas coated with a silicon crystal inside the sensor. Due to this resistance, the voltage signal sent back to the ECU will be something less than 5 volts. By measuring the difference between reference voltage and the MAP sensor signal, the ECU is able to determine the absolute pressure inside the intake manifold.

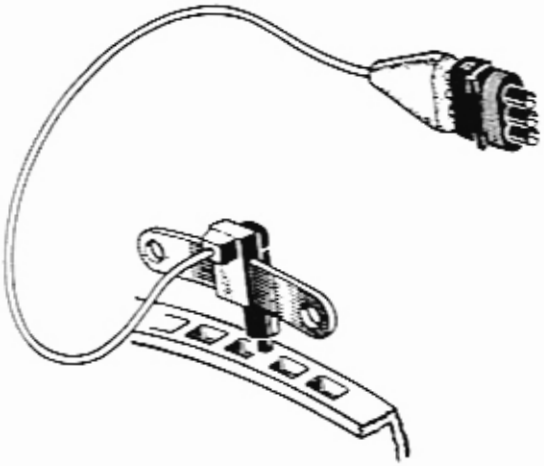
As the pressure in the intake manifold changes, the resistance of the MAP sensor changes. The ECU determines the pressure in the intake manifold by measuring the voltage drop across the MAP sensor as it changes.



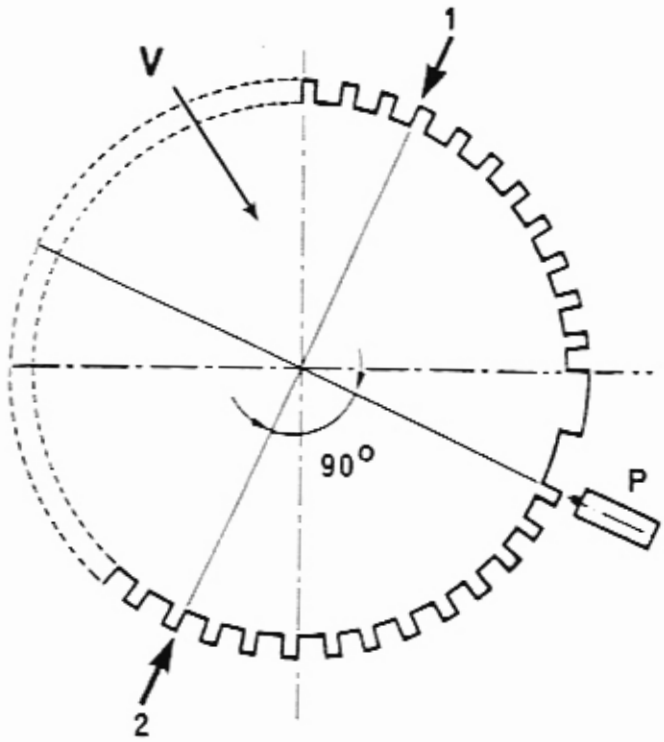
A. Ground
B. Output Voltage
C. 5 Volts

The MAP sensor is located at the firewall, below the ignition module.

ENGINE SPEED (TDC) SENSOR

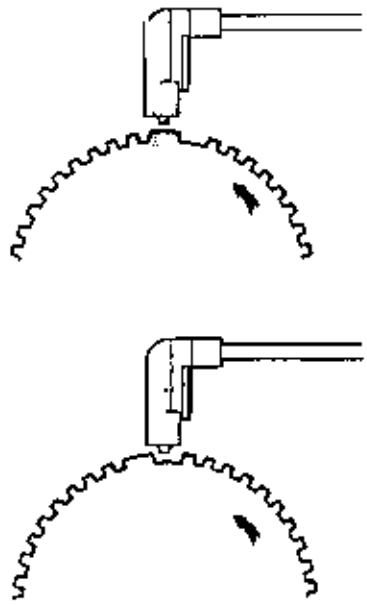


This sensor detects the passing of teeth on the flywheel and is able to send engine speed and crankshaft angle information to the ECU. The ECU in turn, uses this information to determine proper fuel injection and ignition timing.



Two of the flywheel teeth are special "trigger" teeth. These trigger teeth provide the ECU with an absolute indication 90° before and after top dead center.

Because the sensor is a magnetized component, when the trigger tooth nears the speed sensor's magnet, the magnetic lines of force are concentrated and the strength of the magnetic field increases. The magnetic field is at its maximum strength when the tooth is aligned with the sensor's magnet.



When the field strength is increasing at its most rapid rate, a voltage is induced in the speed sensor's inductive pickup coil.

As the trigger tooth passes and moves away from the sensor, the magnetic field collapses, inducing a voltage in the sensor's pickup coil. This voltage is then sent to the ECU.

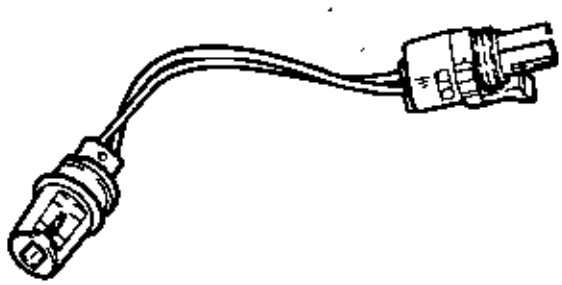
Weaker voltages are generated each time one of the smaller teeth passes the sensor. These voltages allow the ECU to actually "count" the passing teeth. Because the ECU knows that top dead center occurs 12 teeth after the trigger tooth and notch, it can adjust the timing by counting these smaller teeth.

AIR TEMPERATURE SENSOR

This sensor is a thermistor that receives a 5 volt reference voltage from the ECU. The sensor's internal resistance, which varies with temperature, determines the sensor's voltage signal back to the ECU. By comparing the sensor's signal to the reference voltage, the ECU can determine manifold air temperature.

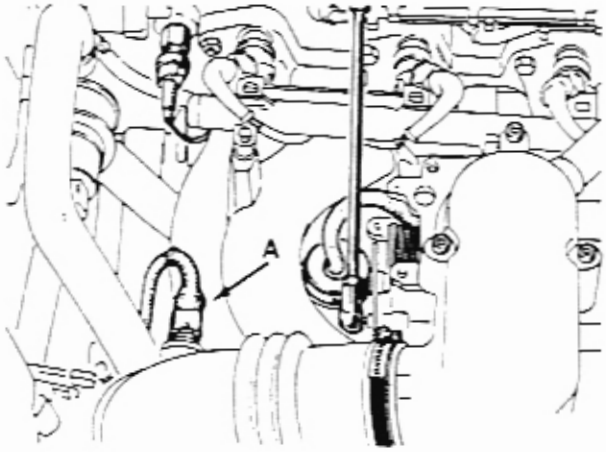
This provides air density information to the ECU. When the air temperature falls, its density increases. The ECU responds by increasing the amount of fuel injected to maintain the required air/fuel mixture ratio.

At cold temperatures, the sensor's resistance is low. As the temperature increases, the sensor's resistance increases.



If the air temperature sensor fails, the ECU is programmed to an air temperature default value of 68°F (20°C). This means that when the computer is not receiving a signal from the air sensor, it will automatically assume that the air temperature is 68°F and it will control all other systems accordingly. Although the vehicle will suffer decreased performance, it will still be driveable. This provision is known as defect mode or "limp mode".

The air temperature sensor (A) is located in the air intake duct between the air filter and the intake manifold.



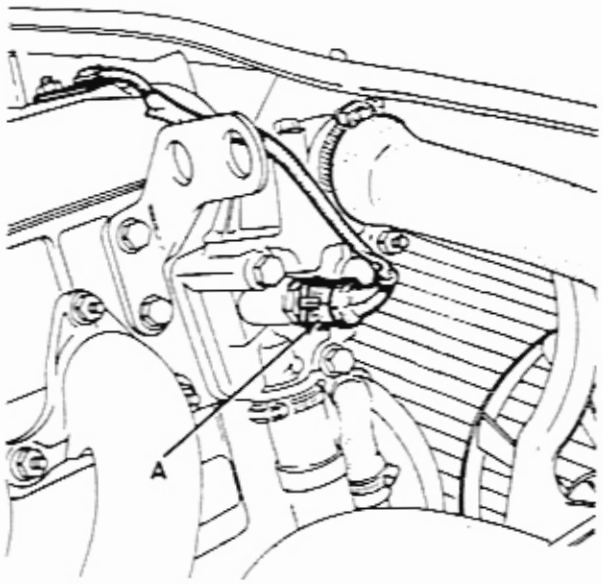
COOLANT TEMPERATURE SENSOR

This sensor is a thermistor that receives a 5 volt reference voltage from the ECU. The sensor's internal resistance, which varies with engine coolant temperature, determines the sensor's voltage signal back to the ECU. By comparing the sensor's signal to the reference voltage, the ECU can determine the engine coolant temperature.

The ECU changes the fuel mixture and timing advance based on the coolant temperature sensor input.

At cold temperatures, the sensor's resistance is low. As the temperature increases, the sensor's resistance increases.

The coolant temperature sensor (A) is mounted near the upper radiator hose.



If the coolant temperature sensor fails, the ECU is programmed to a coolant temperature default value of 198°F (90°C). This means that when the computer is not receiving a signal from the coolant sensor, it will automatically assume that the coolant temperature is 198°F and it will control all other systems accordingly. Although the vehicle will suffer decreased performance, it will still be driveable. This provision is known as defect mode or "limp mode".

2.2L MULTI-POINT FUEL INJECTION

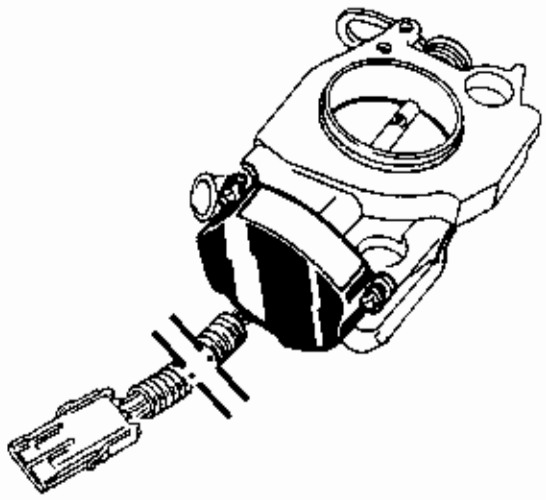
ECU INPUTS

THROTTLE POSITION SWITCH

This switch provides a voltage signal to the ECU when the throttle is either fully open (WOT) or when it is fully closed. The signal is sent to the ECU 10° before WOT and 2° before it is fully closed.

The WOT signal is used to tell the ECU that the injectors must supply more fuel because of the increased air flow.

The closed throttle signal tells the ECU that the engine is in one of two conditions. If the ECU receives a closed throttle signal and engine speed is over 1500 RPM, the ECU determines that the engine is in a hard deceleration condition and responds by completely shutting off fuel injection. If the ECU receives a closed throttle signal and engine speed is under 1500 RPM, the ECU concludes that the engine is at or approaching idle and it must maintain idle speed by using the idle speed regulator. Refer to Deceleration Mode for more information.



ENGINE CRANK SIGNAL

When the starter relay is energized, the relay provides a voltage signal to the ECU. This voltage signal informs the ECU that the engine starter is engaged.

The starter relay is mounted on the left side of the radiator support bracket.

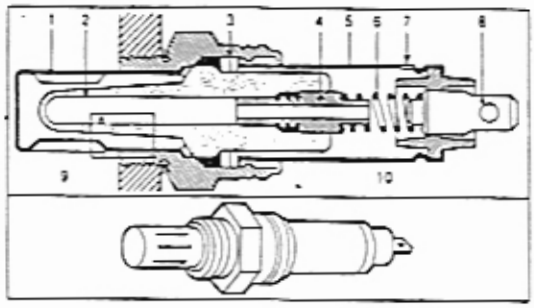
BATTERY VOLTAGE SIGNAL

The vehicle battery provides a nominal supply of 12 volts. Depending on operating conditions, this voltage can vary between 8 and 16 volts. This affects the time the injectors are open. The time increases as the battery voltage falls. To compensate for this change in the opening time, the actual injection time at the injectors is corrected to correspond to the battery voltage.

EXHAUST OXYGEN (O_2) SENSOR

The O_2 sensor is a variable battery which sends exhaust oxygen content information to the ECU. The O_2 sensor determines the exhaust gas oxygen ratio which changes depending on the richness of the mixture. As the air/fuel ratio varies from ideal the O_2 sensor output voltage changes.

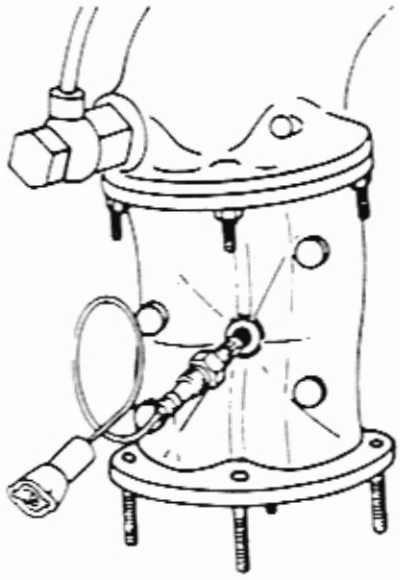
The sensor is built so that one side of a ceramic detector is in contact with the exhaust gases, while the other side is in contact with surrounding air. Each side is connected to a terminal. The gases always contain a small amount of oxygen depending on the mixture ratio, while surrounding air has a very high oxygen content. This difference of concentration causes a motion of oxygen ions through the ceramic detector which generates a voltage. The voltage is picked-up at a terminal and transmitted to the control box which reacts by modifying the width of the injection pulses.



LAMBDA sensor in section

1 - Shield.
2 - Ceramic detector.
3 - Threaded socket.
4 - Contact sleeve.
5 - Protection casing.
6 - Contact spring.
7 - Venting hole.
8 - Terminal.
9 - Exhaust gas.
10 - Surrounding air.

The O_2 sensor (A) is located in the exhaust pipe behind the exhaust manifold.



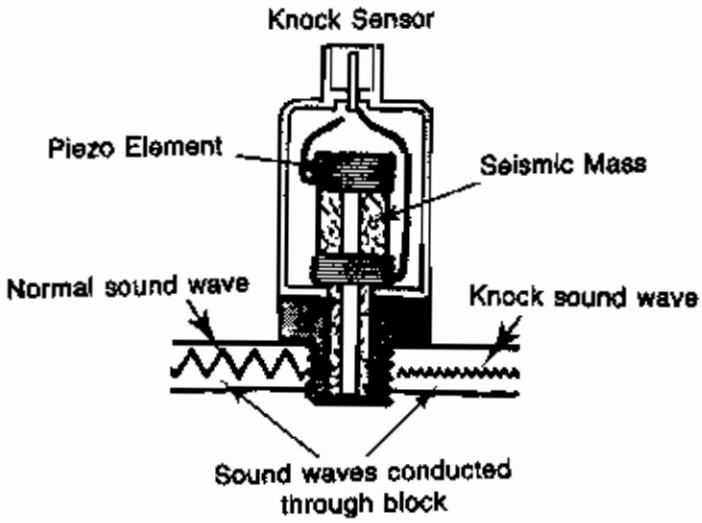
KNOCK SENSOR

This sensor is an electro-mechanical device capable of measuring a vibration and converting it into an electrical signal. The sensor is designed to vibrate at the same frequency as a spark knock.

During knock, a variation in pressure on a body with a crystalline structure produces a current. A cable consisting of two shielded wires transmits this current to the ECU.

If knock occurs, vibrations of a given frequency appear and produce electrical pulses of the same frequency and the ECU retards the advance.

The knock sensor emits signals in a range from 1800-5500 rpm, but the ECU is programmed not to receive the signals until at least 3600 rpm.



Although only one knock sensor is used, the system is adjusted cylinder by cylinder.

If the knock detector or its circuit fails (no further signals transmitted) the system operates in defect mode and retards timing by -3° in relation to its nominal settings.

AIR CONDITIONING SELECT SIGNAL

The ECU receives a voltage signal whenever the A/C control switch is turned ON. Since A/C compressor operation increases engine load, the A/C select signal is used by the ECU as an indication that an increased air/fuel charge may be required to maintain correct engine speed.

GEAR INDICATOR SIGNAL

The neutral safety switch sends a voltage signal to the ECU whenever the gear select lever has been placed in a drive mode.

Similar to the A/C select signal, the gear indicator signal is an indication to the ECU that an increased air/fuel charge may be required to maintain the correct engine speed.

ECU OUTPUTS

Based on the information received from the various input sensors, the ECU controls seven output components. The components that receive output signals from the ECU are:

- B + Relay
- Fuel Pump Relay (Fuel Supply System)
- Fuel Injectors
- Ignition Power Module
- EGR/Canister Purge Solenoid
- Idle Speed Regulating Valve

B+ RELAY

This relay is energized whenever the ignition switch is moved to the ON position. With the relay's contacts closed, battery voltage is supplied to the ECU and to the fuel pump relay. The relay is disengaged whenever the ignition switch is moved to the OFF position.

The B + relay is located in the ECU housing on the left inner fender.

FUEL PUMP RELAY (Fuel Supply System)

System voltage to operate the fuel pump is routed through the fuel pump relay. The relay contacts are normally open and close when the ECU provides a ground path for the relay coil.

When the fuel pump relay's contacts close, power is supplied to the injectors, idle speed regulator, EGR/canister solenoid and the fuel pump. When the ECU opens the coil's circuit, the coil's magnetic field collapses, spring pressure opens the relay contacts, and the pump's operation ceases.

The fuel pump relay is located in the ECU housing on the left inner fender.

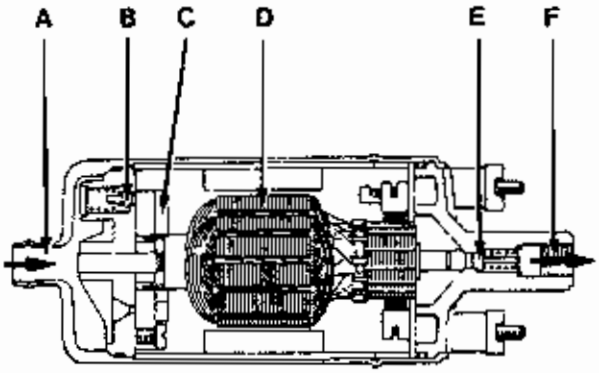
Electric Fuel Pump

The function of the pump is to supply fuel, under pressure, to the injectors. The pump capacity is greater than the maximum engine consumption so that the pressure in the fuel system is always maintained.

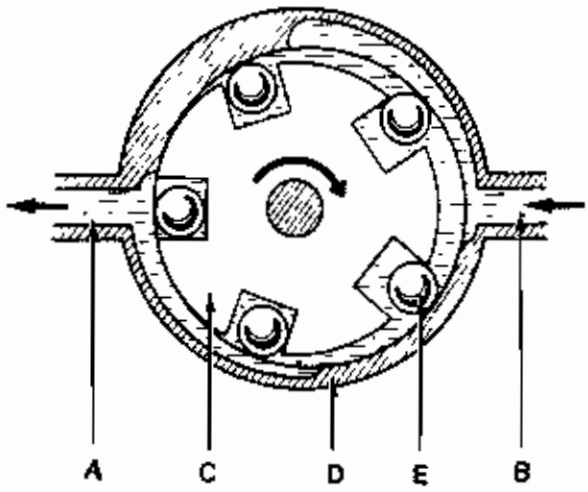
The fuel pump is a multi-cell roller type, driven by a permanent magnet field-type electric motor. Because it is a one-speed, positive displacement design, the pump requires a pressure regulation device. Whenever pressure inside the pump exceeds a predetermined limit, a pressure-relief valve bypasses fuel inside the pump. There is also a check valve that maintains fuel pressure in the system when the engine and or fuel pump are not operating.

2.2L MULTI-POINT FUEL INJECTION

ECU OUTPUTS - FUEL PUMP



A. Suction Side
B. Safety Valve
C. Multi-cell Roller Pump
D. Electric Motor Armature
E. Check Valve
F. Pressure Side



A. Pressure Side
B. Suction Side
C. Pump Rotor
D. Pump Housing
E. Roller

The fuel pump operates when the key is turned to the "ON" position but will stop after 3 seconds if the engine is not started. The pump operates continuously when the key is in the "START" position.

The pump terminals are marked (+) and (−) and the connectors are different in size to ensure that the pump rotates in the correct direction. Since the pump uses a permanent magnet motor, it will turn backwards if the electrical connections are reversed.

Fuel Filter

The fuel filter removes any dirt or contaminants which might plug the fuel injectors. It is specially designed to separate water from the fuel and withstand high pumping pressures.

The fuel filter is located on the left frame rail benea' the driver's seat area.

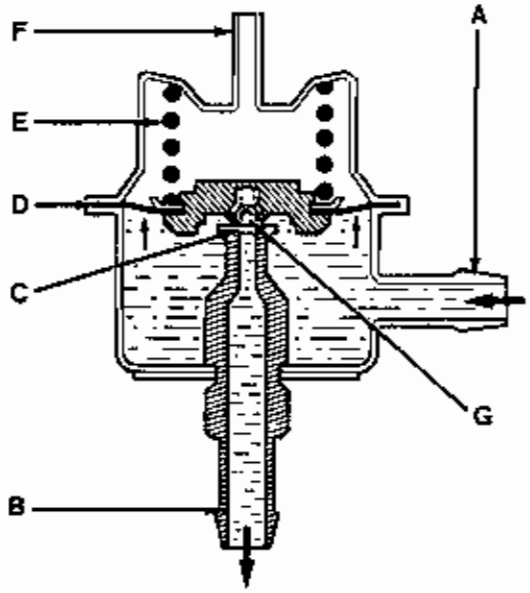
Fuel Pressure Regulator

The fuel system pressure is held constant by the pressure regulator. The regulator is connected through a vacuum line to intake manifold vacuum. As a result, the difference between the intake manifold pressure and the fuel pressure is held constant. The drop in pressure across the injectors is the same for all load conditions. The connection to manifold vacuum is necessary to maintain the correct fuel flow through the fuel injectors. Since less fuel is required at idle, more fuel must be bypassed back to the fuel tank to maintain the correct pressure differential. At higher engine speeds and loads, more fuel must be directed to the injectors. Under these conditions the bypass flow back to the tank must be restricted. In effect, the fuel pressure regulator maintains a constant fuel flow through the injectors by controlling the amount of fuel allowed to return to the fuel tank.

The fuel pressure is preset.

When the pressure exceeds 2.5 bars (36 psi) ± 0.2 bars (3 psi), the regulator valve will open and allow fuel to return to the fuel tank through the fuel return line.

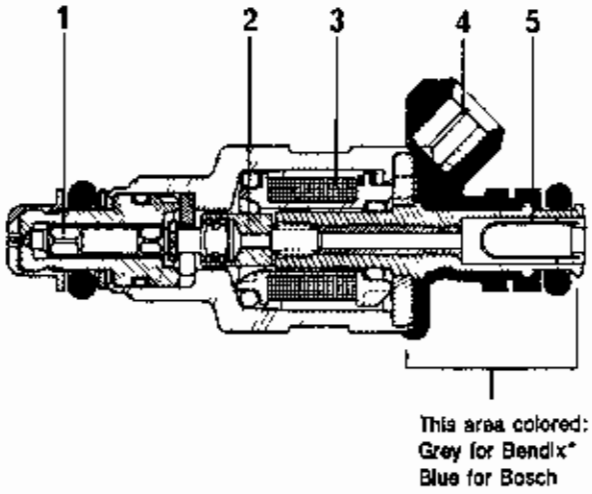
The regulator contains a diaphragm and a calibrated spring. The lower side of the diaphragm is influenced by fuel pressure while the upper side of the diaphragm is influenced by intake manifold vacuum. The spring in the upper side of the regulator is constantly working to keep the outlet to the fuel return line closed. The combination of fuel pressure in the lower half and intake manifold vacuum in the upper half of the regulator act in unison to open the fuel outlet against spring pressure.



A. Fuel Connection
B. Return to Tank
C. Valve Support
D. Diaphragm
E. Compression Spring
F. Intake Manifold Connection
G. Valve

FUEL INJECTORS

A fuel injector is an electro-mechanical device which acts as a valve for controlling fuel flow into the engine. The injector consists of a body which contains an electro-magnetic coil, a fuel metering plunger with a magnetic core and a spring. When the magnetic coil is energized, the plunger is pulled off its seat and pressurized fuel is allowed to pass into the intake manifold. Because each injector is connected to system voltage through the fuel pump relay, the injectors will open whenever they are provided a ground path by the ECU.



1. Injector Needle
2. Magnetic Core
3. Magnetic Coil
4. Electrical Connection
5. Filter

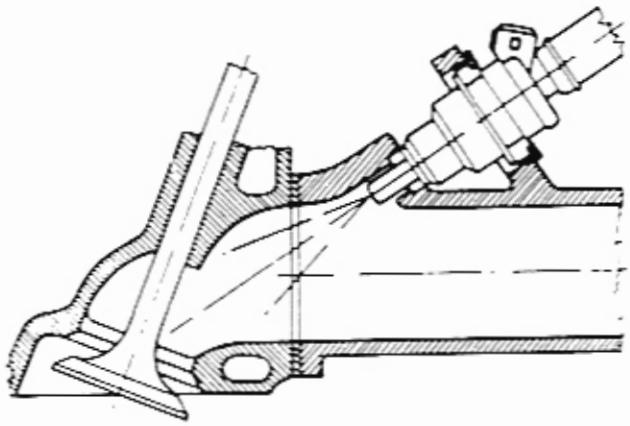
CAUTION

Bendix and Bosch Injectors ARE NOT INTERCHANGEABLE!

Fuel injector operation is controlled exclusively by the ECU. Because the injectors receive system voltage from the fuel pump relay, the injectors are only open when a ground path is provided by the ECU. The ECU completes the ground path of the coil which sets up a magnetic field. The magnetic core is attracted and the needle lifts from its seat to allow the pressurized fuel to pass. When the ground path is turned off, the spring returns the needle to its seat and fuel flow stops.

After receiving inputs from various sensors, the ECU determines the correct injector pulse width to meet the existing engine speed and load conditions. The ECU performs this task by varying the length of time that the injector is provided with a ground path.

Each cylinder has an injector, mounted on its inlet duct, that sprays fuel in front of the intake valve.

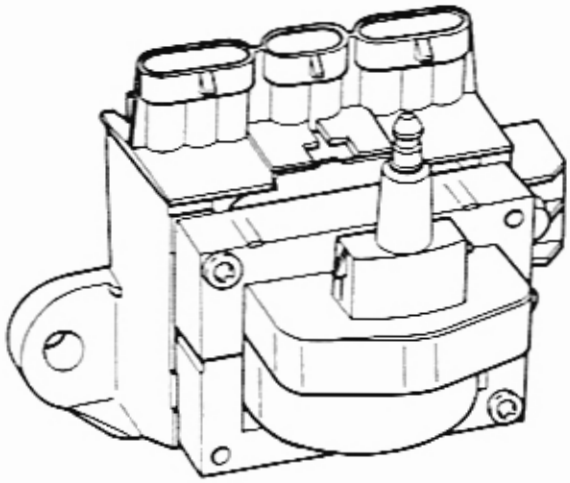


The injectors operate as a group which simplifies the system. They inject twice per cycle (once per engine revolution) except on starting, when a special procedure is used.

IGNITION MODULE

Based on information received from the input sensors, the ECU calculates the precise ignition timing for any given engine condition. As ignition timing is calculated, the ECU provides the power module with the signal to trigger the ignition coil.

The module consists of a coil and a power control operated by the ECU.

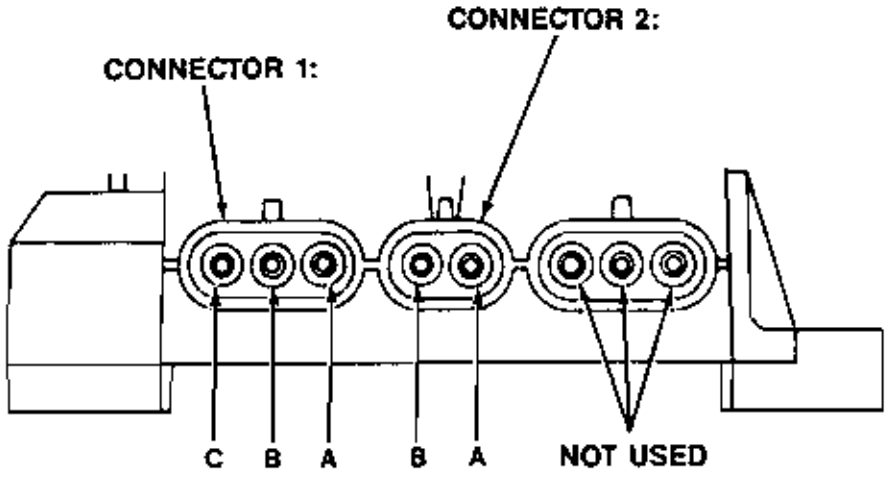


2.2L MULTI-POINT FUEL INJECTION

ECU OUTPUTS

Ignition firing signals from ECU terminal 27 are transmitted through terminal B of connector 2 on the ignition module. The ignition signal from the ECU is received by the module in the form of a 5 volt square wave. As the leading edge of the wave contacts the ignition circuitry in the module, the module charges the coil primary windings.

When coil saturation occurs, the module circuitry opens the primary windings to collapse the magnetic field in the windings. This induces the high voltage in the coil secondary windings which is then transmitted to the spark plugs via the rotor, distributor cap and coil wire.



CONNECTOR 1:
A - Ignition (+)
B - Ground (-)
C - Tach Output (D1-Pin 1)

CONNECTOR 2:
A - Not Used
B - ECU, Ignition Coil Timing Input

CAUTION: Never allow a high voltage spark to ground on the electronic control module.

The Distributor is mounted at the rear of the cylinder head and is driven by the camshaft. The distributor contains no electrical components other than the rotor and distributor cap. The sole function of the distributor is to transmit the high voltage (developed in the ignition coil secondary windings) to the spark plugs in the required firing sequence. The only connection between the ignition coil and distributor is the coil wire.

Proper advance is provided by a load table in the ECU that accurately determines the requirements of the engine.

If the ECU determines that there is a knock, it will automatically retard ignition timing and then slowly return timing to the preset value as determined by engine load.

The ignition power module is mounted in the engine compartment on the center of the firewall.

EGR/CANISTER PURGE SOLENOID

The vacuum source for both the EGR valve and the evaporative vapor control canister is controlled by one solenoid. This solenoid receives system voltage from the fuel pump relay and is energized when provided a ground path by the ECU. When energized, the EGR/ canister purge solenoid restricts vacuum to the EGR valve and the evaporative vapor control canister.

With vacuum restricted, the EGR valve is closed and the evaporative vapor control canister is not being purged.

During certain conditions, the ECU breaks the solenoid path to ground.

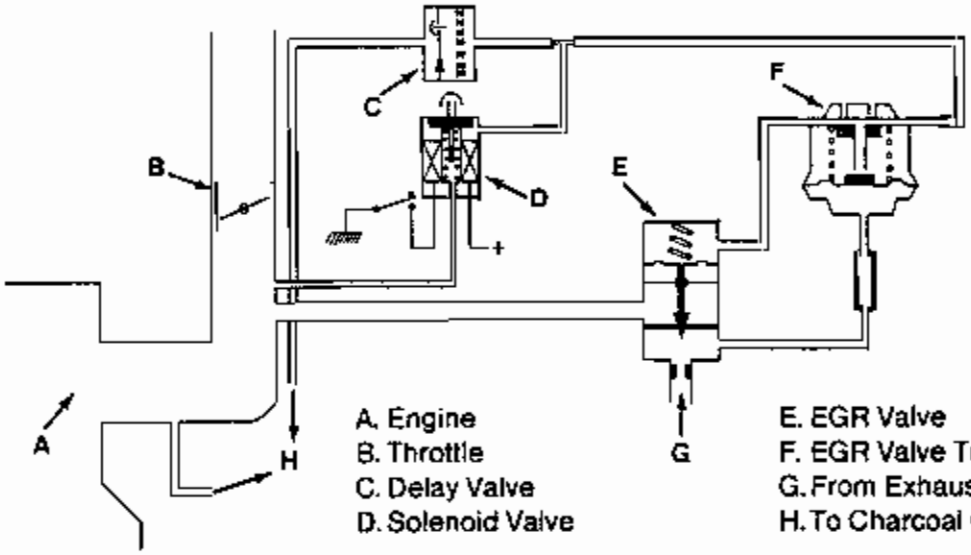
When the solenoid is not energized, both the EGR transducer and the evaporative vapor control canister receive manifold vacuum.

The EGR/canister purge solenoid is located in the ECU housing on the left inner fender.

NOTE: If the solenoid's electrical connector is removed, the EGR valve and canister purge will be ON at all times.

The EGR valve is functional from 1200-4300 rpm under the following conditions:
- water temperature at least 133°F (56°C)
- air intake temperature at least 59°F (15°C)
- Manifold Absolute Pressure (MAP) between 391 - 1024 Millibars

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

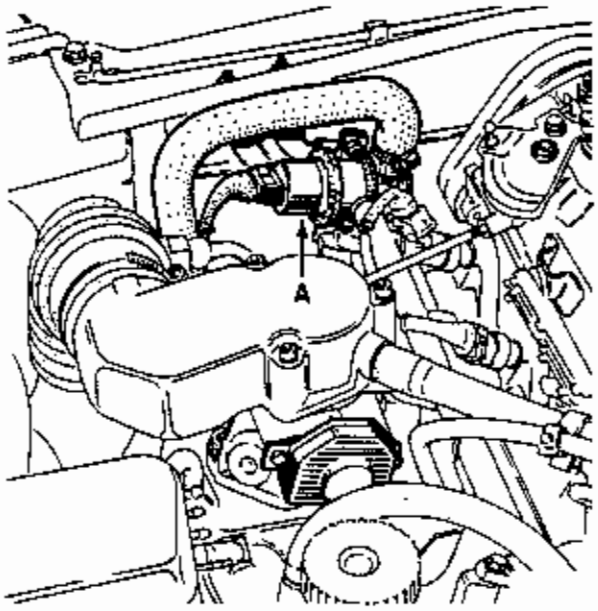


A. Engine
B. Throttle
C. Delay Valve
D. Solenoid Valve
E. EGR Valve
F. EGR Valve Transducer
G. From Exhaust Gases
H. To Charcoal Canister

IDLE SPEED REGULATOR

A permanent magnet motor inside this component positions the regulating valve between the fully open and fully closed positions. The motor receives system voltage from the fuel pump relay. The ECU provides the motor with two "ground" leads. The motor will turn one way or the other depending on which ground lead the ECU selects.

The regulator valve (A) consists of two coils fed by battery voltage and grounded through ECU control. When the ignition is turned to the "ON" position and the engine is not running, the ECU will ground one coil and open the regulating valve to provide maximum air bypass. The valve will remain open during crank.



When engine speed increases above a preset adjustment speed, the ECU grounds the second coil while opening the circuit of the first coil. By alternating the ground control of these coils, the ECU can adjust the air bypass flow rate to maintain proper idle speed.

The idle regulating valve cannot be adjusted.

The idle regulating valve is mounted on the front of the intake manifold.

Idle Speed According to Coolant Temperature

Base Idle - 800 ± 50 rpm.

Coolant Temp.	RPM*
-40°F (-40°C)	1300
-4°F (-20°C)	1200
32°F (0°C)	1050
68°F (20°C)	1000
140°F (60°C)	900
176°F (80°C)	800

*Tolerance ± 50 rpm.

GENERAL INFORMATION

Before performing any tests, ensure that:

- the trouble is not caused by a component that is not part of the injection system (spark plugs, ignition module etc.)
- there are no air leaks into the intake and/or exhaust systems
- the injectors are supplied with fuel (check pressure in the circuit)
- do not disconnect or connect any component without first turning off the ignition
- with the engine stopped, the fuel pump should run for a few seconds when the ignition is turned to the ON position.

After any tests, reset the injection system (memories) by disconnecting the ECU.

Disconnect the battery before charging.

CAUTION

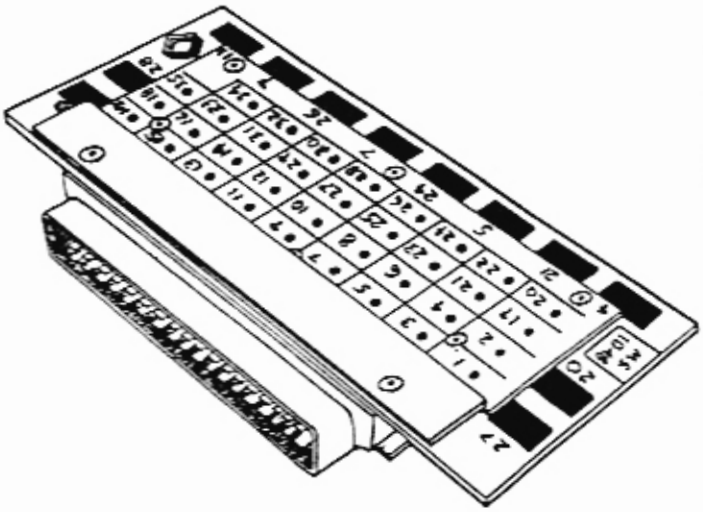
Before doing any electric welding on the vehicle, **disconnect the ECU.**

DIAGNOSTIC REFERENCE CHART

1. Engine not starting or starts poorly	2. Engine starts then stalls	3. Rough idle	4. Poor acceleration	5. Misfiring at all speeds	6. Excessive fuel consumption	7. Loss of power	8. Engine spark knocks	9. Idle speed too high	10. Idle speed too low	POSSIBLE CAUSE	CHECK
•										Electric fuel pump not running	Check for voltage at fuel pump relay and at fuel pump. Check fuel pressure.
		•	•			•		•		Throttle Position Switch	Check the closed throttle adjustment. Check for fully closed throttle.
•		•	•					•		Intake manifold air leak	Check the intake manifold for leaks. Check all hoses and fittings.
•		•			•	•				Defective injectors	Check the injectors individually by removing the electrical connectors one at a time and measuring RPM drop.
•		•				•				Fuel pressure too low or zero p.s.i.	Check fuel pressure, fuel filter, the fuel lines, the pressure regulator, and the fuel pump.
					•					Fuel pressure too high	Check pressure regulator, check for vacuum to pressure regulator, check for pinched fuel return line.
•								•	•	Inoperative idle speed regulator	Check operation of valve. If it is defective, replace the regulator valve.
•	•									MAP sensor defective	Check vacuum at sensor, check MAP sensor input and output voltages.
•										Speed sensor defective	Check speed sensor resistance.
•										Ignition power module defective	Check module voltage supply and coil resistance.
	•					•				Air sensor defective	Check sensor resistance.
		•								Throttle not closing	Free throttle linkage, adjust throttle linkage.
						•				Throttle not opening fully	Adjust accelerator cable.
•	•	•	•	•	•	•	•	•	•	Open in wiring harness or poor connection	Check wiring harness and connections.
•	•	•	•	•				•	•	ECU Defective	Test vehicle with XR25 diagnostic tester before replacing ECU.
•	•									B+ Relay Defective	Check voltage at relay. Replace relay if defective. Check wiring.

2.2L MULTI-POINT FUEL INJECTION

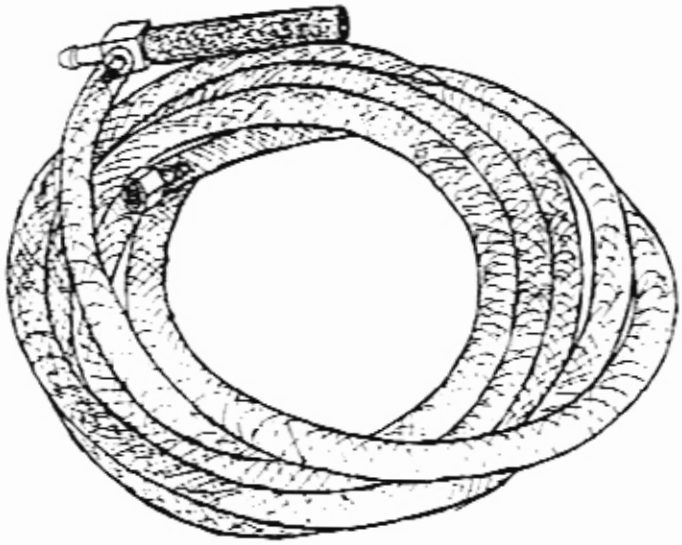
DIAGNOSTIC/SPECIAL TOOLS



Part No.
700001-04-800

ECU Test Circuit Board
(Used for ECU Wiring & Component Test)

Tool No.
MS 1048



Part No. 700000-90-400

Fuel Pressure Extension Hose
(Must be used with a fuel pressure gauge of 0 to 6 bars)

Tool No.
Mot. 904

DIAGNOSIS/SPECIAL TOOLS

Checking the Injectors

With the engine stopped.

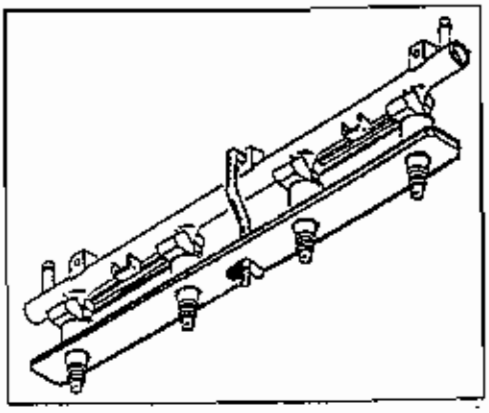
Disconnect the connectors. Remove the injector fuel rail. Pull out the assembly so that each injector can be placed in a 100 cc flask (Mot. 845)

When the fuel rail/injector assembly is removed from the engine, the injector retaining clips are not strong enough to hold the injectors to the fuel rail when fuel pump pressure is applied.

Therefore, it is necessary to make a retaining clamp. (See sketch below) Attach this tool as soon as the intake manifold injection gallery is removed, **before starting the electric fuel pump.**

This clamp can be made at a local machinist shop using the plans shown below. Dimensions are shown in Metric mm, with approximate English dimensions shown in parenthesis (").

Since the engine is designed in Metric, the center-to-center distance between injector holes is crucial and must be measured only in mm as shown.



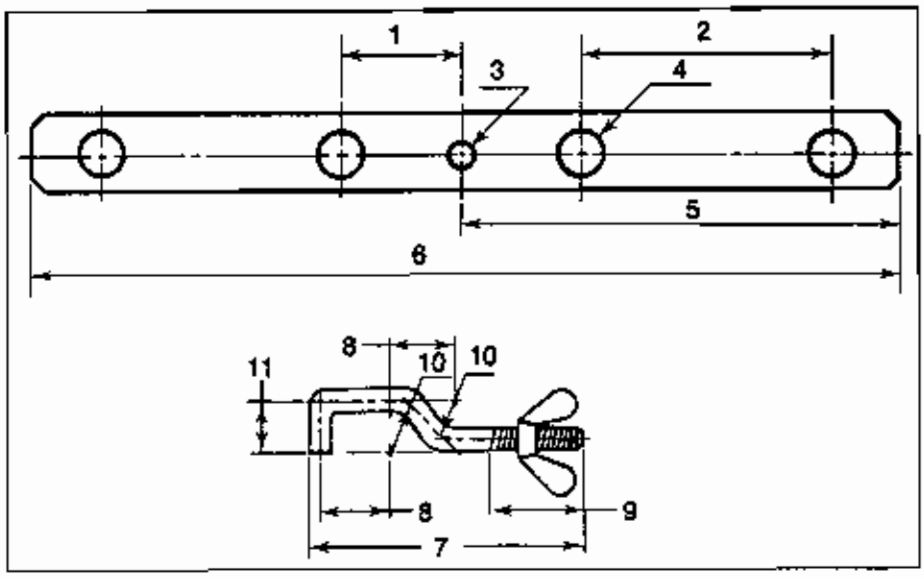
MATERIALS:

"Bar" - Flat Stock 30m x 5mm x 350 mm long
(1-1/4" x 1/4" x 13-3/4")
Drilled as shown

"Hook" - Round Stock 8mm x 125 mm
(1/4" x 5" long)
Bend and thread as shown or use threaded stock if desired.

"Nut" - Wing Nut 8mm (1/4")
Corresponding to "hook" threads

INJECTOR RETAINING CLAMP



1. 49mm
2. 98mm (3 places)
3. Ø 9mm/ .35 in. dia.
4. Ø 18mm/ .70 in. dia. (4 holes)
5. 175mm/ 6.84 in. (2 places)
6. 350mm/ 13.67 in.
7. 105mm/ 4.10 in.
8. 30mm/ 1.17 in.
9. 25mm/ .98 in.
10. 15mm/ .59 in. r
11. 15mm/ .59 in.

CHECKING FUEL PRESSURE

Disconnect the hose from the fuel pressure regulator to the fuel rail.

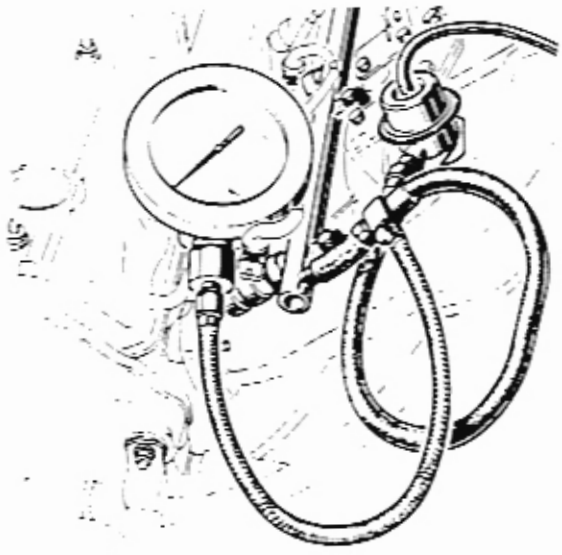
Connect a fuel pressure gauge to the fuel rail.

Disconnect the vacuum hose from the pressure regulator and connect it to a vacuum pump.

Start the engine.

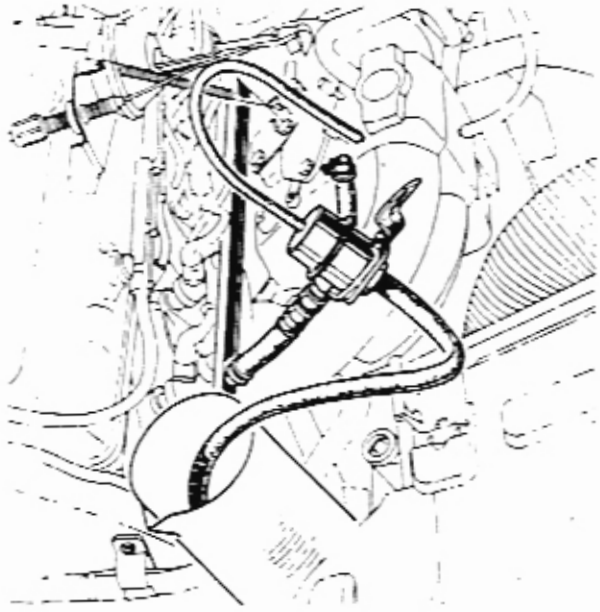
Check and record the pressure reading. The reading should be 2.5 ± 0.2 bars (36 ± 3 psi).

Apply a vacuum of approximately 15 inches Hg to the pressure regulator. The fuel pressure should drop to 2.0 ± 0.2 bars (29 ± 3 psi).



CHECKING THE FUEL PUMP DELIVERY

Disconnect the fuel return hose at the pressure regulator and place it in a 2000 ml graduated beaker.



Disconnect the ECU.

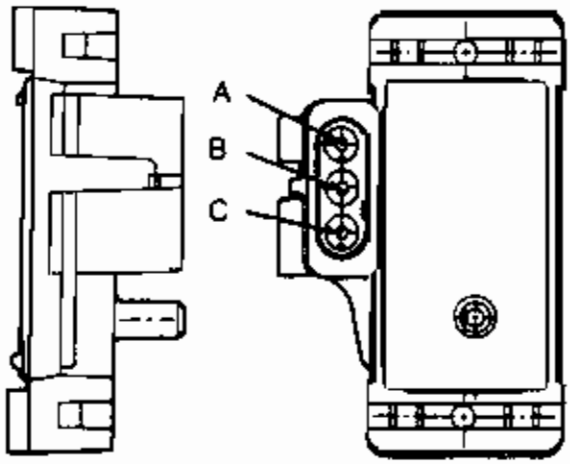
Start the fuel pump by placing a jumper wire between terminals D1-5 and D1-6 (diagnostic plug).

Minimum delivery should be 130 liters/hour (137 quarts/hour) or more than 1.8 liters (2 quarts) in one minute.

MAP SENSOR TEST

Inspect the MAP sensor vacuum hose connections at the intake manifold and sensor for kinks or sharp bends in the hose. Repair as necessary.

Test the MAP sensor output voltage at the MAP sensor connector terminal B (as marked on the sensor body) with the ignition switch ON and the engine OFF.



A. Ground
B. Output Voltage
C. 5 Volts

The output voltage should be 4 to 5 volts.

NOTE: The voltage should drop to 0.5 to 1.5 volts with a hot engine at idle and in neutral.

Test ECU terminal 33 for the same voltage described previously to verify the wire harness condition.

Repair as necessary.

Test MAP sensor supply voltage at the sensor connector terminal C with the ignition ON.

The voltage should be 5 ± 0.5 volts.

The same voltage should also be at terminal 16 of the ECU wire harness connector.

Repair or replace the wire harness as necessary.

Using an ohmmeter, test the MAP sensor ground circuit at sensor connector terminal A and ECU connector terminal 17.

Repair the wire harness if necessary.

Test the MAP sensor ground circuit at the ECU connector between terminal 17 and terminal 2 with an ohmmeter.

If the ohmmeter indicates an open circuit, inspect for a defective sensor ground connection located on the right side of the cylinder block.

Test the MAP circuit using the XR25 tester.

ENGINE SPEED (TDC) SENSOR TEST

Disconnect the TDC sensor connector from the ignition control module.

Place an ohmmeter between terminals A and B (marked on the connector).

Reading should be 200 ± 75 ohms (hot engine).

Replace sensor if readings are not to specifications.

AIR TEMPERATURE SENSOR TEST

Measure the resistance of the sensor as a function of the ambient air temperature. An accurate thermometer can be placed in the air filter intake. Replace the sensor if the temperature and resistance don't match the chart.

Temperature	°C	0°±1°	20°±1°	40°±1°
	°F	31° to 33°	67° to 69°	103° to 105°
Resistance Ω		254 to 266	283 to 297	315 to 329

COOLANT TEMPERATURE SENSOR TEST

Measure the sensor resistance, as a function of the temperature, after leaving it to stabilize for a minimum of 10 minutes, with the sensor removed from the engine. Replace the sensor if the temperature and resistance don't match the chart.

Temperature	C	20°±1°	80°±1°	90°±1°
	F	67° to 69°	175° to 179°	193° to 195°
Resistance Ω		283 to 297	383 to 397	403 to 417

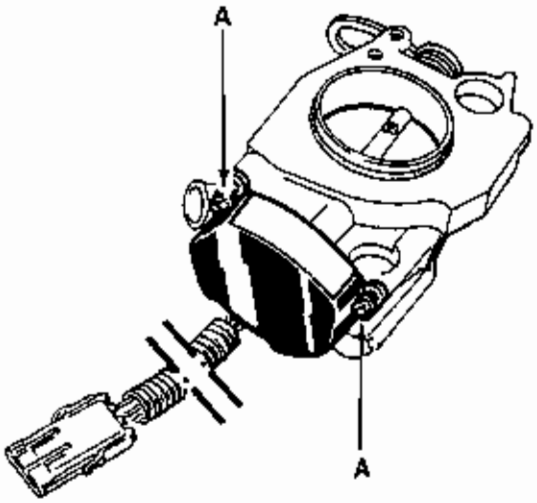
THROTTLE POSITION SWITCH TEST AND ADJUSTMENT

Testing and Adjustment

THROTTLE POSITION	Resistance between connector terminals in ohms (Ω)	
	C and B	B and A
Closed	0 Ω	Infinite
Partial	Infinite	Infinite
Full (WOT)	Infinite	0 Ω

NOTE: The switch is adjusted by moving it on the throttle housing when screws (A) have been loosened.

When the switch is properly adjusted, it should "click" as soon as the throttle is moved toward the open position.

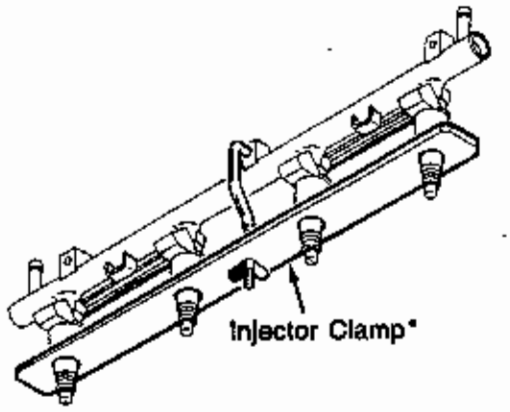


INJECTOR TEST WITH ENGINE STOPPED

Disconnect the injector connectors.

Pull out the fuel rail and injectors as an assembly so that each injector can be placed in a 100 cc beaker.

NOTE:
The injector retaining clips are not strong enough to hold the injectors in place when the fuel pressure is applied. It is therefore necessary to install a retaining clamp to the fuel rail assembly before starting the electric fuel pump. See "Special Tools" Section, page 37, for information on fabricating this retaining clamp.



Energize the fuel pump and inspect the injector tips for leaks. Replace any leaking injectors.

NOTE: A slight dampness at the tip of an injector is acceptable.

Replace injectors if required.

Reinstall the injectors and fuel rail as described in Component Replacement.

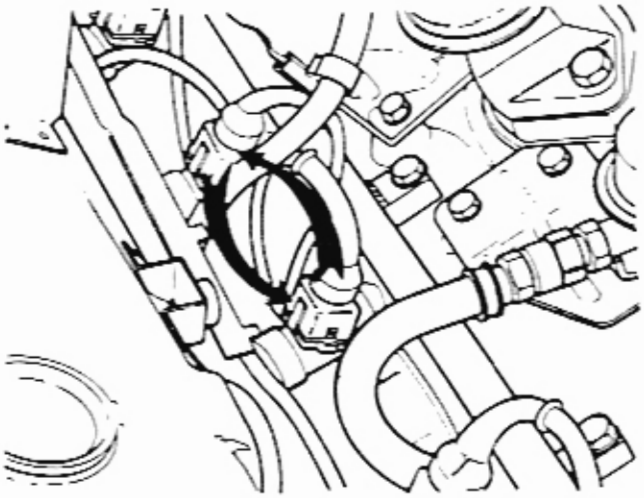
INJECTOR TEST WITH ENGINE RUNNING

WARNING: Use extreme caution when the engine is running. Do NOT put your hands near the pulleys, belts or fans. Do NOT wear loose clothing.

Disconnect each injector wire harness connector in turn.

A loss of engine speed should be noticed while each injector is inoperative.

If any one cylinder is not operational because of an inoperative injector, switch the wire harness connectors between the inoperative injector and an operational injector.



If the previously operational injector does not function, the wire harness is faulty.

IDLE SPEED REGULATOR TEST

With the regulator valve removed, rotate it rapidly by hand in both directions and the valve should open and close.

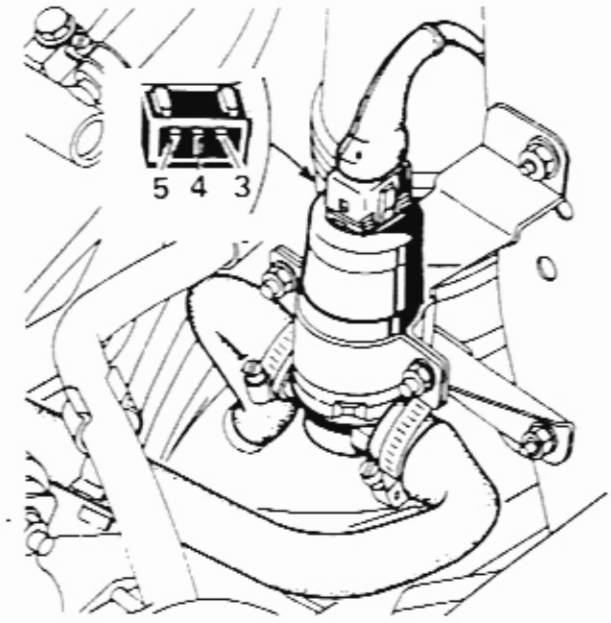
Disconnect the electrical connector.

CAUTION: Never supply the connector at the ECU end with 12 volts. The ECU will be damaged.

Supply 12 volts to terminal 4 on valve side of connector. Connect to ground briefly:

- Terminal 5.
  The valve should close (if the engine is running, the speed should drop rapidly to below normal idling speed).

- Terminal 3.
  The valve should open (if the engine is running, the speed should increase to above 2000 RPM).



To further test the regulator, connect the XR25 tester to the vehicle.

XR25 DIAGNOSTIC ANALYZER

The XR25 Analyzer is an electronic tester that can be connected to the diagnostic output plug on the vehicle. The XR25 analyzes the diagnostic codes transmitted by the ECU. This provides quick and easy "Go/No-Go" functional tests of vital electronic components in the Bendix fuel injection system.

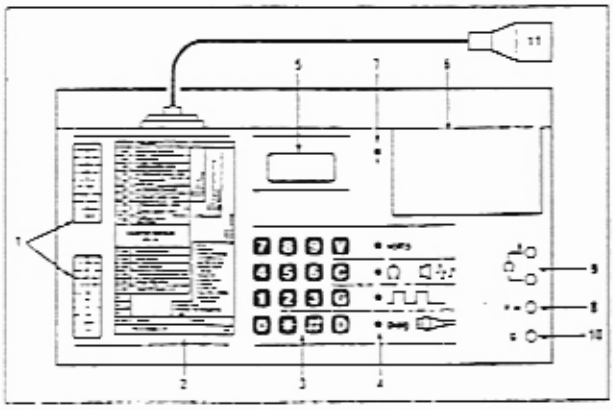
It also provides a digital readout of several engine operating conditions, such as coolant temperature, air temperature, air pressure, battery voltage, engine RPM, etc.

The XR25's memory function is an extremely useful feature. This allows you to perform a road test to recreate a malfunction, then store the actual engine operating conditions under which the malfunction occured. Later, you can recall them one at a time for diagnostic evaluation.

In addition to analyzing malfunctions, the XR25 can be used as a voltmeter, continuity tester, pulse sensor and pulse generator.

The XR25 can also be used to diagnose transmission malfunctions on all type ME and ML automatic transmissions. ATX Functional tests can be found in the "Centauri, LeSharo, Phasar & Utility Van Service Manual."

XR25 DIAGNOSTIC ANALYZER



DESCRIPTION

1. Go/No-Go Display - LCD bar graphs
2. Test Card - code guide
3. Data Input Keypad
4. Function Keys/Indicator Lights
5. Digital Display - LCD readout
6. Memory Cartridge Location
7. Cartridge "Ready" Light
8. Voltmeter/Pulse Sensor Input Jack
9. Continuity/Isolation Test Inputs
10. Pulse Generator Output Jack
11. Diagnostic Plug & Test Cord

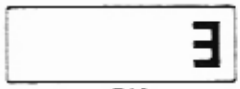
Function Keys

Press the corresponding key to change functional mode of the XR25 analyzer.

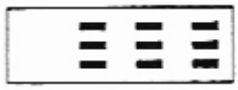
V - Voltmeter Mode
C - Continuity Tester
G - Pulse Generator/Sensor
D - Diagnostic Mode

Digital Displays

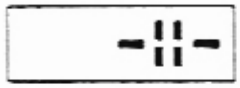
(From 0000 to 9999)



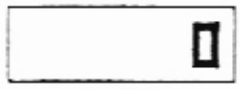
OK



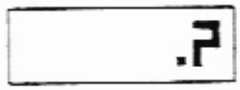
No Diagnostic Grid



No Data



No Data



Error or Waiting for command

Bar Graphs

Generally indicates an open circuit or a strong signal

Generally indicates a short circuit or a weak signal

OPERATING INSTRUCTIONS

STATIONARY - SHOP TESTS

Raise the hood and place the XR25 on a stand or cart near the front of the vehicle for easy visibility.

Plug the XR25 test cord into the D2 diagnostic connector (large plug).

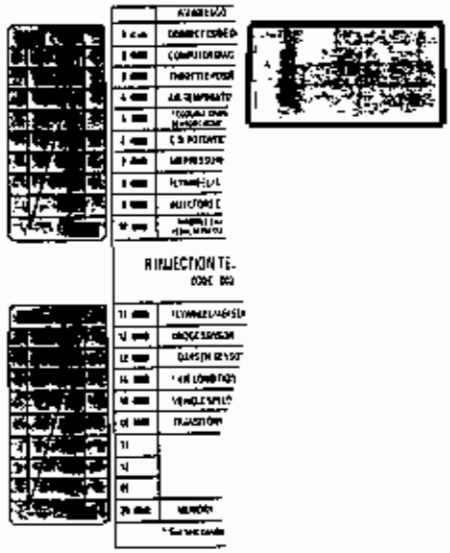
The diagnostic plugs are located on the bulkhead (firewall) at the center of the engine compartment, just above the valve cover.

Turn ignition key to ON position

Be sure all accessories (lights, fans, etc.) are OFF for initial testing. Some items may be switched on later in test procedure.

Plug other end of test cord into XR25 Analyzer

The instant the cord is plugged in you will hear a rapid series of electronic tones. The XR25 will then start a self-diagnosis sequence.



Self-test sequence:

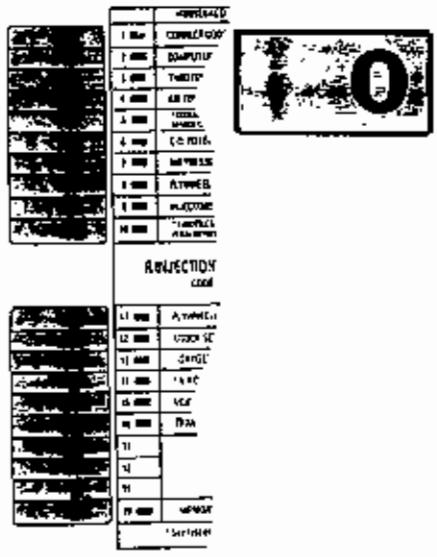
This is the sequence that **should** occur during the self-test. The XR25 is checking itself only - not the engine components.

1 - All segments of the bar graph display will come on briefly, then go out.

2 - Each segment will come on and go off in turn, beginning with the top left segment and ending with the bottom right segment.

No segment should remain on.

3 - The digital readout display will cycle numbers 0000, 1111, 2222, etc. thru 9999, then hold with a single 0.



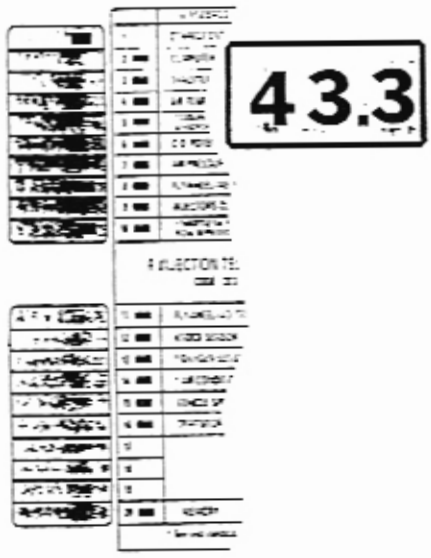
When the self-test is complete, the displays should look like this:

NOTE: If an abnormality occurs, it means that a problem exists with the XR25. First, check to see that the diagnostic cartridge is properly inserted. If this is not the case, an internal problem may exist. Return the XR25 to Winnebago Part Sales for repair.

Key in D-0-3. The displays should look like this:

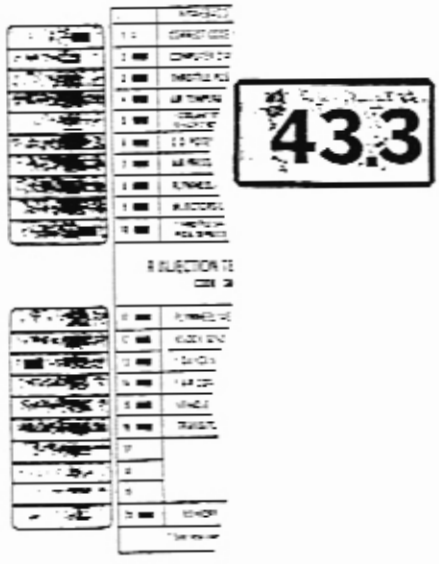
A - Key ON/Engine not running:

Fig. A



B - Engine Running:

Fig. B



NOTE: If the digital display does not read 43.3, it indicates one of two things:
1.) an incorrect diagnostic cartridge is installed in the XR25, or
2.) an incorrect ECU is installed in the vehicle.

The proper cartridge for Bendix system diagnostics is imprinted with the name WINNEBAGO and the number 921-063. This cartridge will also perform diagnostics on all model ME and ML automatic transmissions.

Follow the "Functional Test" as described on pages 49 thru 51.

Key in the required diagnostic code for each test.

NOTE: The # key must be pressed before each number code. Do not press keys too quickly or the code may not register.

WARNING

Fully engage the handbrake before working in front of the vehicle with the engine running.

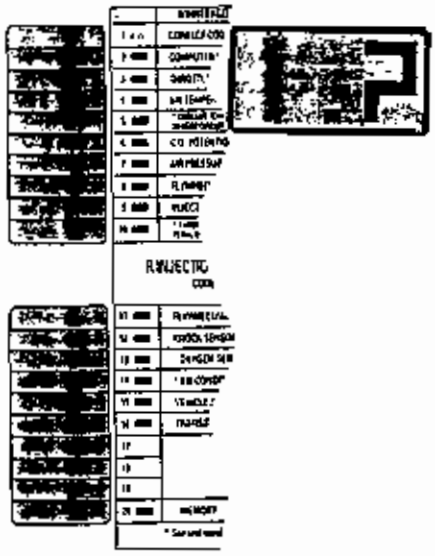
Diagnostic Codes
Using # key:

#01 - Atmospheric Pressure (mBar)
#02 - Coolant Temperature (C°)
#03 - Air Temperature (C°)
#04 - Battery Voltage
#05 - 0_2 Sensor Voltage
#06 - Engine RPM
#08 - Ignition Timing (°BTDC)
#12 - Idle Speed Governor Volts
#13 - Knock Sensor Volts
(at 3600+ RPM)

XR25 DIAGNOSTIC ANALYZER

TRANSITORY - ROAD TESTS
Using Memory Function

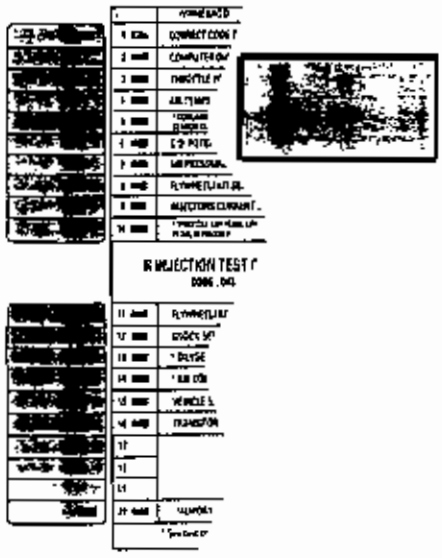
Place the XR25 inside the driver compartment.
The best location is on the floor between the front seats.



Connect the test cord to the diagnosic harness and to the XR25 Analyzer.
Route the cord through the engine access panel in the bulkhead (firewall). DO NOT route the cord out the side of the hood and through a window. This could damage the cord.

Start the vehicle and let the XR25 complete its self-test sequence.

Key in D-0-3. Then key in D-0 and begin the road test.
The XR25 will be in "wait" mode until you key in the "store" command. The displays should look like this:



When the engine malfunction occurs, key in 0 (zero).
This is the memory "store" command. You will hear a rapid series of electronic tones while the XR25 stores the memory. The displays should look like this:

You can now discontinue the road test.

IMPORTANT DO NOT SWITCH IGNITION OFF or you will lose the stored data.

To Recall the diagnostic readouts, just key in the desired diagnostic code(s). Press # followed by any of the two-number codes.

To Reset or Clear the memory, key in D-0-3.
This is useful when you want to stop along the road-side to record test results, then repeat the road test to get a "second opinion".

The memory will be cleared automatically when the ignition is switched OFF for at least 5 seconds.

OTHER FUNCTIONS

Pulse Sensor

* Measures the duration of a pulse.
* Tests the ignition module signal emitted by the ECU (if high tension is not present).
* Allows detection of an incorrect contact on a ground feed or return line.

- Connect a test lead between the test point and terminal V of the XR25.
- Then press function G.
- Recreate the conditions under which the malfunction occurs (such as moving the wiring), then read the digital display. Range: Ω to 1999 milliseconds.

Frequency Generator

Simulates a "running" condition to test ignition module high tension.

- Connect a test lead between terminal G of the XR25 and terminal B of Connector 2 on the ignition module. (See pg. 31)
- Press function key G, then key in Ω. This generates a frequency of 2 pulses/second.
- See whether there is spark at the high tension secondary winding.

Voltmeter

Measures DC voltage.

- Press function key V.
- Connect test lead to terminal V.

Continuity Detector

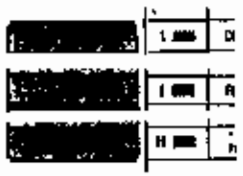
Allows you to check continuity of a wiring harness or coil.

- Press function key C.
- Connect test leads from Ω terminals on the XR25 to component to be tested.
- If the resistance is less than 1000 Ω, a buzzer will sound on the XR25.

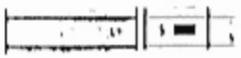
FUNCTIONAL TEST USING XR25 TESTER
(BENDIX EFI)

Date: _____ Unit: _____ S.N. _____ Insp. _____ Engine S.N. _____

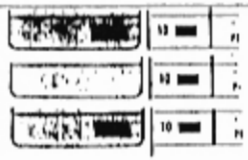
SECTION 1 Before Starting Engine

FUNCTION	CONDITION	TESTER CODE	TESTER LINE NUMBER	TESTER DISPLAY LIGHT "ON" OR OFF"	READOUT/COMMENTS
PLUG IN INJECTION TESTER	ENGINE "OFF" IGNITION KEY "ON": -SYSTEM OPERATIONAL -TOP DEAD CENTER -THROTTLE CLOSED	0.03	 L1 L8 L10		ECU IDENTIFICATION [ ] 42.3 FOR MANUAL 43.3 FOR ATX
THROTTLE POSITION SWITCH	ENGINE "OFF" IGNITION KEY "ON": -THROTTLE CLOSED -LIGHT THROTTLE -WOT		 L10 L10 L10		
ABSOLUTE PRESSURE SENSOR	ENGINE "OFF" IGNITION KEY "ON":	#01			[ ] 950<XXXX<1025 MBAR

SECTION II Engine Warm and at Idle (After one cooling fan cycle)

FUNCTION	CONDITION	TESTER CODE	TESTER LINE NUMBER	TESTER DISPLAY LIGHT "ON" OR OFF"	READOUT/COMMENTS
COOLANT T ^{0} SENSOR	ENGINE WARM IDLE	#02	L5		80 ^{0} C $\leq$XXX$\leq$ 110 ^{0} C
AIR T ^{0} SENSOR	ENGINE AT IDLE	#03	L4		XXX>OUTSIDE T ^{0} IN CELSIUS $\pm$ 7 ^{0} C

SECTION III Engine Hot and Running

FUNCTION	CONDITION	TESTER CODE	TESTER LINE NUMBER	TESTER DISPLAY LIGHT "ON" OR OFF"	READOUT/COMMENTS
IDLE SPEED	-ENGINE HOT AT IDLE -ALL ACCESSORIES OFF (FANS, A/C, LIGHTS, POWER STEERING PUMP.....)	#06 #12			RPM IN NEUTRAL 750<XXX<850 RCO 2.8<X, XX<3, 5
THROTTLE POSITION SWITCH	CLOSED THROTTLE LIGHT THROTTLE RETURN GENTLY TO CLOSED THROTTLE		L10 L10 L10		
ANTI KNOCK SYSTEM	ENGINE RUNNING AT: 3500 +200 RPM -000 RPM	#13	L12	 HAS TO BE OFF	-HAS TO BE VARIABLE MUST BE ZERO AT IDLE -SENSOR OPERATIONAL

SECTION III Engine Hot and Running Continued

FUNCTION	CONDITION	TESTER CODE	TESTER LINE NUMBER	TESTER DISPLAY LIGHT "ON" OR OFF"	READOUT/COMMENTS
OXYGEN SENSOR	AT IDLE SPEED ENGINE MUST BE WARM	#05	L13	 HAS TO BE OFF	OXYGEN SENSOR OPERATIONAL 0-1 VOLT
EGR VALVE	TEE. CONNECT A 0-1000 MILLIBAR VACUUM GAUGE TO EGR. -ACCELERATE				-AT IDLE: NO VACUUM -DURING ACCELERATION: VACUUM BETWEEN 50 AND 100 MILLIBAR
A.C. INFORMATION TO ECU	TURN A C ON TURN THERMOSTAT MAX COLD	#06	L14	 A.C CLUTCH A.C. ON	RPM IN NEUTRAL 850 <XXX<950

BENDIX MULTI-POINT FUEL INJECTION SYSTEM
ECU WIRING & COMPONENT TEST

Test No.	Volt/Ohmmeter Probe Locations (* = ECU Connector Pin No.)	Special Conditions or (Remarks)	Approximate Test Display Values
V1	*4 - *1	(B+ voltage test)	12 volts
V2	*6 - *1	Ignition switch on	12 volts
V3	*7 - *1	Ignition switch ON	12 volts
V4	*22 - *1	Ignition switch ON (A/C relay test)	12 volts
V5	*29 - *1	Ignition in START	12 volts
V6	*30 - *1	Ignition switch ON A/C fan switch ON	12 volts
V7	*34 - *1	Ignition switch ON A/C fan and thermostat ON	12 volts
O1	*1 - Ground	(verify ground)	0Ω
O2	*2 - Ground	(verify ground)	0 Ω
O3	*5 - Org/Wht wire connector at EGR Solenoid	(EGR Solenoid)	0Ω
O4	*8 - *1	Throttle closed	
O5	*8 - *1	Throttle fully open	0 Ω
O6	*11 - *28	(TDC/RPM Sensor resistance	200 Ω ± 75
O7	*12 - 1	Transmission in P or N (Starter relay-ATX MP switch continuity)	8 MegaOhms†
O8	*14 - 32	Engine cold - not running (Air Temp. Sensor)	See page 40

† Many multimeters are not capable of measuring resitance in the MegaOhm range. On these meters, the resistance will register as infinite ohms (∞).

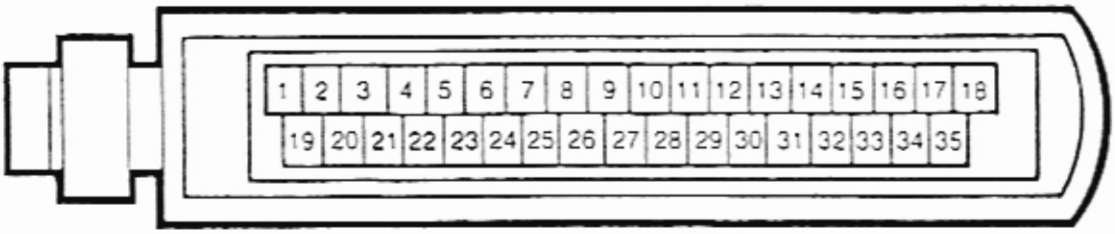
BENDIX MULTI-POINT FUEL INJECTION SYSTEM
ECU WIRING & COMPONENT TEST

Test No.	Volt/Ohmmeter Probe Locations (* = ECU Connector Pin No.)	Special Conditions or (Remarks)	Approximate Test Display Values
O9	*15 - *32	Engine cold - not running (Coolant Temp. Sensor)	See page 40
O10	*16 - *17	(MAP Sensor)	1400 Ω ± 50
O11	*16 - *33	(MAP Sensor)	285K Ω ± 50
O12	*17 - *33	(MAP Sensor)	285K Ω ± 50
O13	*18 - *D2-1 (Diagnostic plug)	(verify wire continuity)	0 Ω
O14	*19 - Brn 16 ga. wire at B+ relay		0 Ω
O15	*20 - *21	Injector signal circuit continuity)	
O16	*20 or *21 - Brn 10 ga. wire at fuel pump relay	(Injector resistance - good/bad)	1.6
O17	*23 - *1	(Idle speed regulator ground circuit continuity)	23
O18	*24 - *1	(Idle speed regulator - fuel pump relay ground circuit)	23
O19	*25 - *1	Throttle closed	0 Ω
O20	*25 - *1	Throttle open	
O21	*27 - Pin B connector 2 of ignition module harness	(See page 31)	0 Ω
O22	*30 - Pin C of 3-pin Female connector A/C plug by Ignition module		0 Ω
O23	*31 - Any one pin of 2-pin Knock sensor connector		0 Ω
O24	*32 - Other pin of 2-pin Knock sensor connector		0 Ω
O25	*34 - Pin A-1 of 6-pin male A/C fan connector		0 Ω
O26	*35 - 0_2 Sensor connector		0 Ω

ECU CONNECTOR

This is the ECU connector used for the Bendix fuel injection system. Terminal identification and specific application is detailed in the following chart.

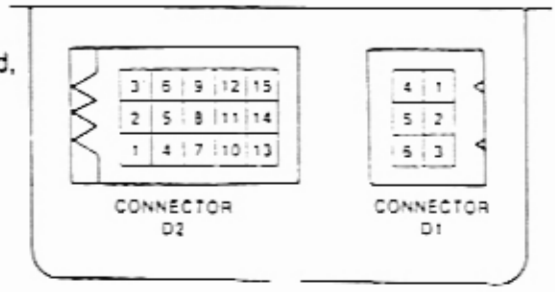
WINNEBAGO BENDIX



1. Ground
2. Ground
3. Not Used
4. Permanent Memory Power Supply
5. EGR Valve/Canister Purge
6. Fuel Pump Relay
7. System Power Relay (latch relay)
8. WOT Switch
9. Not Used
10. Not Used
11. Speed Sensor Input (B)
12. Park Neutral Switch (auto. trans. only)
13. Not Used
14. Manifold Air Temperature Sensor
15. Coolant Temperature Sensor
16. Manifold Absolute Pressure - Supply Voltage
17. Manifold Absolute Pressure and Oxygen Sensor - Ground
18. ECU Diagnostic Signal Output (to D2-1)
19. System Power (B +)
20. Injector Output Signal
21. Injector Output Signal
22. AC Relay Ground Output
23. Idle Speed Regulator (Coil 1)
24. Idle Speed Regulator (Coil 2)
25. Closed Throttle (idle) Switch
26. Not used
27. Timing Control Signal (Tach. Output)
28. Speed Sensor Input (A)
29. Crank Signal Input
30. A/C Select
31. Knock Sensor Input
32. Temperature Sensor Ground
33. MAP Sensor Output
34. A/C Thermostat
35. O_2 Sensor Input

DIAGNOSTIC CONNECTORS

The diagnostic connector is located under the hood, on the firewall near the ignition module.



Connector D2

1. ECU Diagnostic Output
2. Not Used
3. Not Used
4. B + Relay
5. Not Used
6. WOT
7. Ground
8. Air Temperature Sensor
9. Not Used
10. EGR
11. Idle Speed Regulator (Coil 1)
12. Coolant Temperature Sensor
13. Closed Throttle Switch
14. Idle Speed Regulator (Coil 2)
15. Automatic Transmission Diagnosis (BV A module)

Connector D1

1. Tach Signal
2. Ignition
3. Ground
4. Start Relay
5. Battery
6. Fuel Pump Relay

2.2 MULTI-POINT FUEL INJECTION COMPONENT REPLACEMENT

ECU

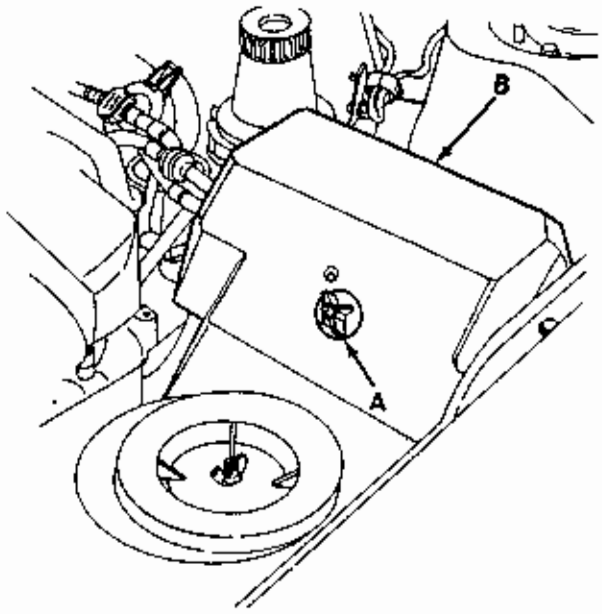
Removal

The ECU is contained in a splash-proof housing located in the engine compartment behind the air filter.

Remove retaining strap.

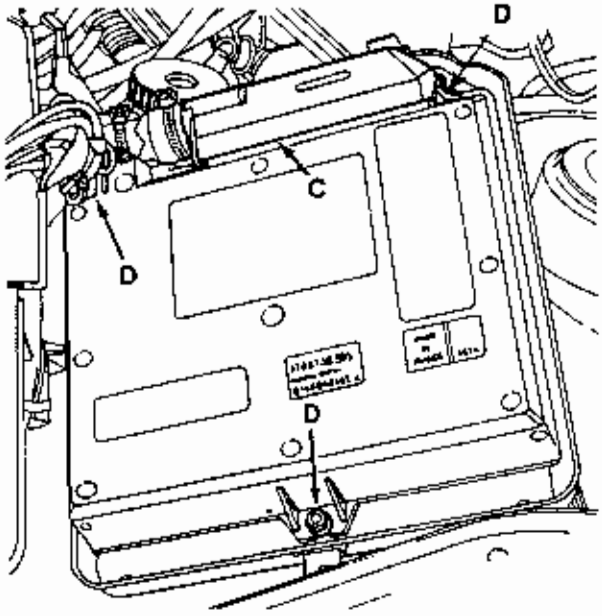
Remove the wing nut (A) and the splash-proof housing (B).

Remove the plastic housing and open it.



Disconnect the ECU connector (C).

Remove the ECU retaining nuts (D).



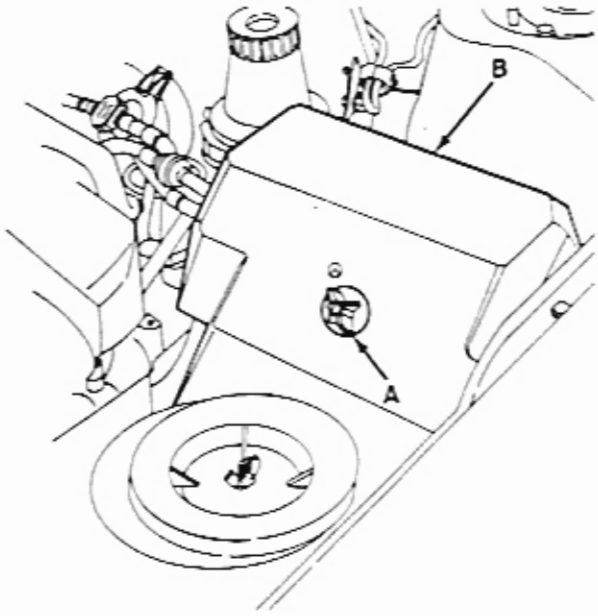
Installation

Install the ECU into the housing and install the retaining nuts.

Connect the ECU connector to the ECU.

Install the ECU housing halves together and position the ECU housing into place.

Install splash-proof housing using wing nut. Attach retaining strap.



B+ RELAY

Removal

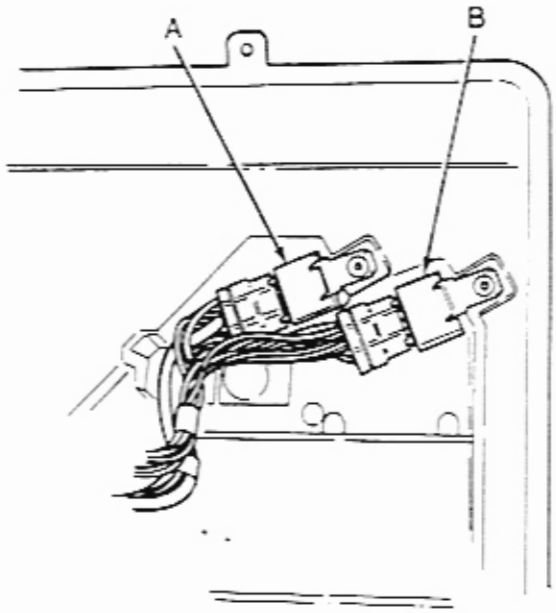
The ECU is contained ina splash-proof housing located in the engine compartment behind the air filter.

Remove retaining strap.

Remove the wing nut (A) and the splash-proof housing (B).

Remove the plastic housing and open it.

Disconnect the wire connectors from the B+ relay (A) or the fuel pump relay (B).



Remove the retaining screw and remove the relay.

Installation

Position relay into place and install retaining screw.

Connect the wire harness to the B+ relay or the fuel pump relay.

Install the ECU housing halves together and position the ECU housing into place.

Install splash-proof housing using wing nut.

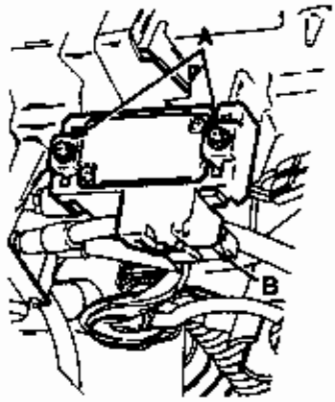
Attach retaining strap.

2.2L MULTI-POINT FUEL INJECTION COMPONENT REPLACEMENT

MAP SENSOR

Removal

The MAP sensor is located in the engine compartment below the ignition module.



Remove the MAP sensor retaining screws (A).

Disconnect the MAP sensor electrical connector (B).

Disconnect the vacuum hose from the map sensor and remove the sensor.

Installation

Install the vacuum hose to the MAP sensor.

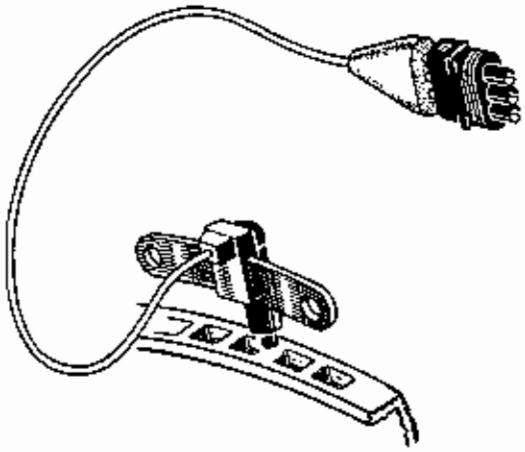
Connect the electrical connector to the MAP sensor.

Remount the MAP sensor and install retaining screws.

ENGINE SPEED SENSOR (TDC Indicator)

Removal

Disconnect the speed sensor electrical connector at the injection loom.



Remove the sensor retaining bolts.

Remove the sensor.

Installation

Position the sensor on the transmission clutch housing.

Install the mounting bolts. Ensure that the spacers are correctly installed onto the bolts so that the sensor does not contact the flex plate.

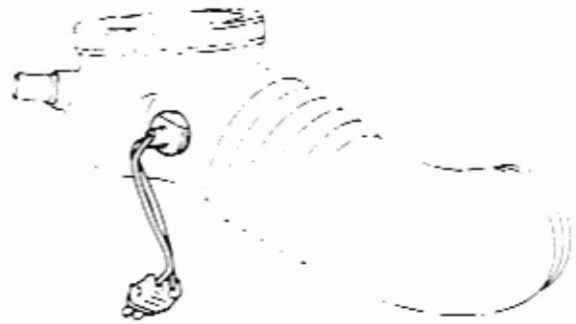
Connect the sensor electrical connector to the injection loom.

NOTE: The sensor is not adjustable.

AIR TEMPERATURE SENSOR REPLACEMENT

Disconnect the electrical connector from the sensor.

Remove the sensor by pulling it out of the air inlet duct.



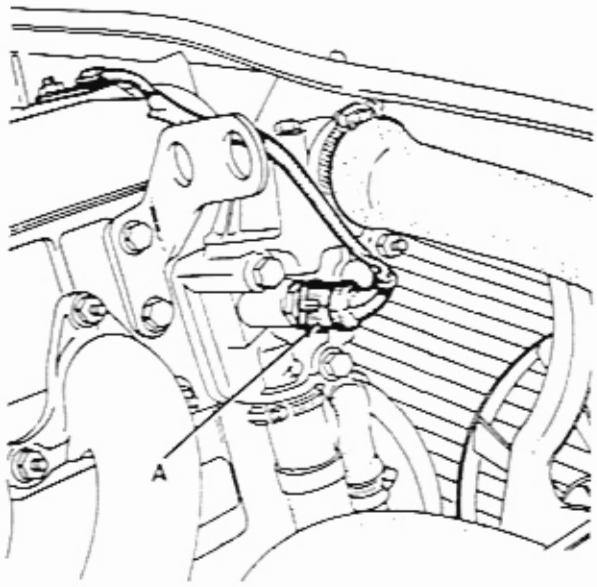
Install replacement sensor in position by pushing sensor into the air inlet duct grommet.

Connect the electrical connector.

COOLANT TEMPERATURE SENSOR REPLACEMENT

CAUTION: DO NOT remove the coolant temperature sensor from the engine when the coolant is hot as serious burns may result.

With the engine cold, disconnect the electrical connector from the coolant sensor (A).



Unscrew the sensor and quickly plug the hole to prevent coolant loss.

Install replacement sensor into position and tighten securely.

Connect the electrical connector to the coolant sensor.

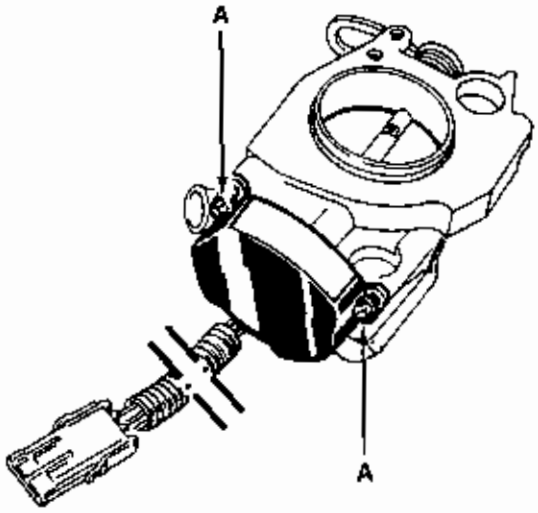
THROTTLE POSITION SWITCH (TPS)

Removal

Remove the TPS retaining screws (A).

Disconnect the electrical connector (B).

Slide the TPS away from the throttle plate assembly and remove the TPS.



Installation

Align the flat of the TPS with the flat of the throttle shaft.

Install retaining screws but do not tighten.

Slowly rotate the TPS in the direction of the arrow until the closed throttle switch "clicks". Tighten the retaining screws.

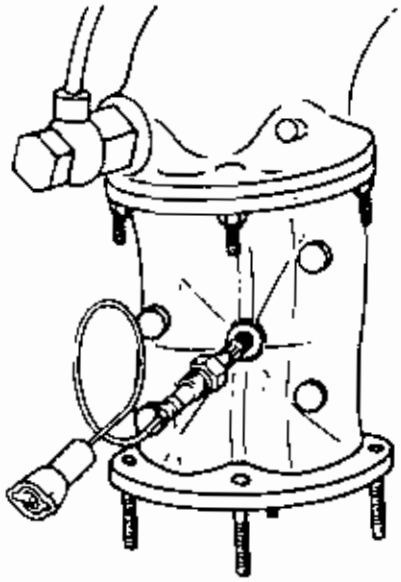
Connect the wire harness to connector.

EXHAUST OXYGEN (O_2) SENSOR

Removal

Disconnect the O_2 sensor wire connector.

Remove the O_2 sensor from the exhaust manifold to exhaust pipe adapter.



Installation

The replacement O_2 sensor comes with anti-seize compound applied to the threads.

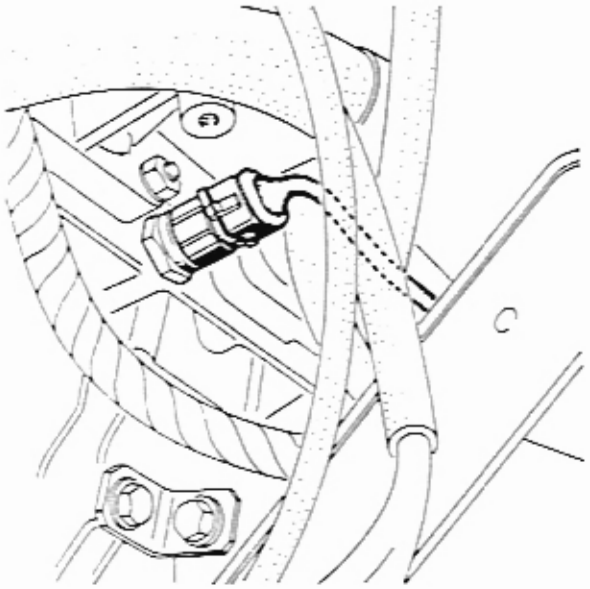
Install the O_2 sensor into the exhaust manifold adapter.

KNOCK SENSOR

Removal

Disconnect the knock sensor connector.

Remove the knock sensor by loosening it with an open end wrench from underneath the intake manifold. Access from beneath vehicle.



Installation

Install the knock sensor into position in the cylinder head.

Connect the knock sensor wire connector.

FUEL PUMP RELAY REPLACEMENT

For fuel pump relay Removal/Installation, refer to B+ relay Removal/Installation.

FUEL PUMP

Removal

The fuel pump is mounted to the left frame rail beneath the driver's seat area.

Install clamps MOT. 453.01 to the fuel pump inlet and outlet hoses.

Disconnect and remove the fuel hoses from the fuel pump.

Disconnect the electrical connectors from the fuel pump.

Remove the retaining strap and remove the fuel pump.

Installation

Position the fuel pump into place and secure with strap.

Connect the electrical connectors. The pump terminals are different sizes to ensure that the fuel pump rotates in the correct direction. The wire connectors have different size inside diameters that correspond to the correct terminal.

Connect the hoses to the fuel pump and tighten the clamps.

Remove clamps MOT. 453.01

FUEL FILTER

Removal

Install clamps MOT. 453.01 to the inlet and outlet hoses of the fuel filter.

Disconnect and remove the fuel hoses from the filter assembly.

Remove the filter retaining strap.

Remove the fuel filter.

Installation

Position the filter in place and secure with retaining strap.

Connect the hoses to the fuel filter assembly and tighten clamps.

Remove clamps MOT. 453.01.

FUEL PRESSURE REGULATOR

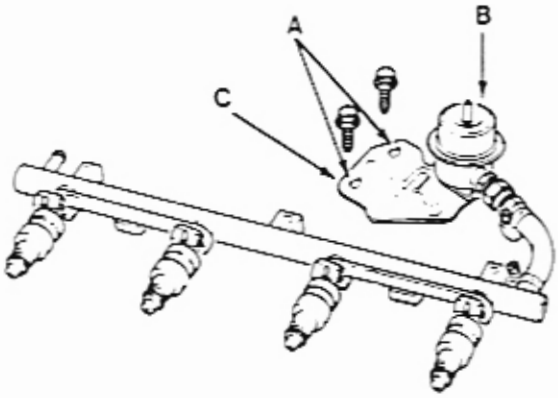
Removal

Remove the fuel hose from the front of the fuel rail.

Disconnect the vacuum hose from the pressure regulator.

Locate and remove the 3 bolts (A) that retain the pressure regulator to the bottom of the intake manifold.

Remove the fuel return line from the bottom of the pressure regulator.



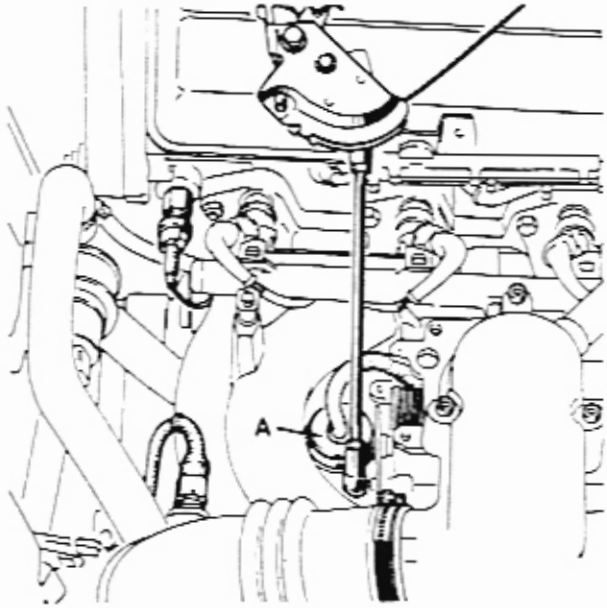
Remove the pressure regulator (B) from its bracket (C).

Installation

Install the pressure regulator to its bracket.

Connect the fuel return line to the bottom of the pressure regulator.

Install the pressure regulator and bracket into position and install retaining bolts.



Connect the fuel hose to the front of the fuel rail assembly.

Connect the vacuum hose to the pressure regulator.

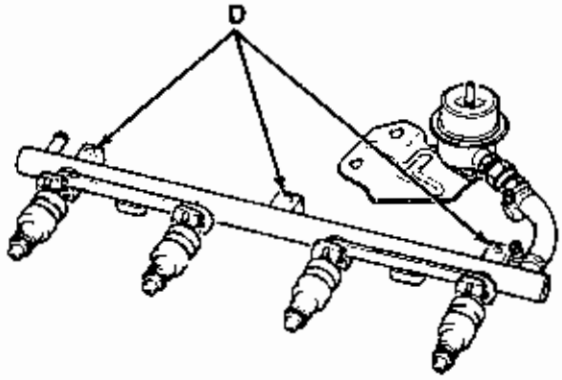
FUEL RAIL

Removal

Disconnect the injector electrical connectors.

Remove the fuel hoses from each end of the fuel rail.

Remove the fuel rail retaining bolts (D).



Remove the fuel rail and injectors as an assembly.

Installation

Position the fuel rail and injector assembly with injectors in position.

Install retaining bolts to the fuel rail at (D).

Connect the fuel hoses to the fuel rail assembly.

Connect the injector electrical connectors.

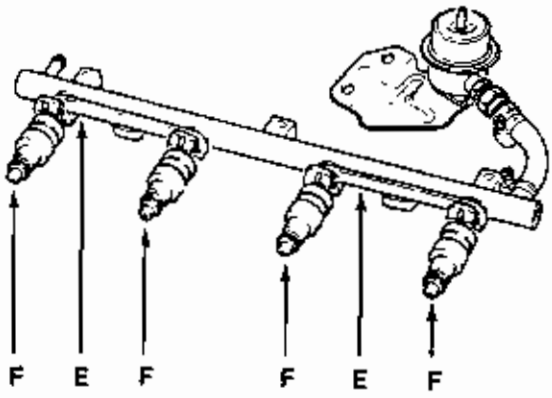
INJECTOR

Removal

Remove the fuel rail as previously described.

Remove the injector retaining clips (E) (1 clip for 2 injectors)

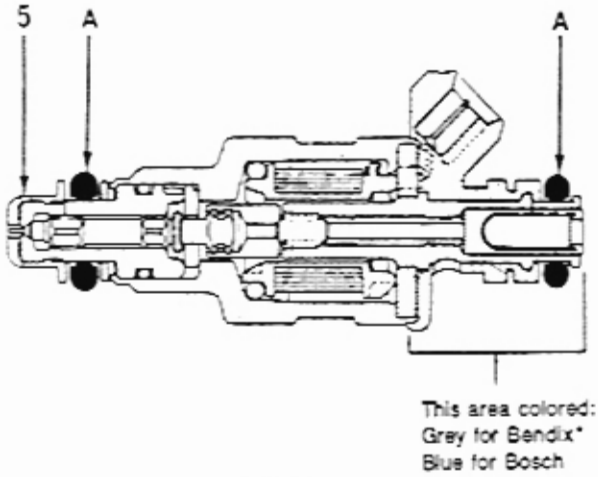
Remove the injector (F) from the fuel rail by pulling it out.



Installation

NOTE: Before installation inspect that the O-ring seals (A) are in good condition. Replace the seals if they are cut or damaged in any way.

Install seals Part No. R14636-35-261 after applying a light coat of silicone grease.



CAUTION

Bendix and Bosch injectors ARE NOT INTERCHANGEABLE!

Install the injectors to the fuel rail and install retaininer clips.

Install the fuel rail assembly as previously described.

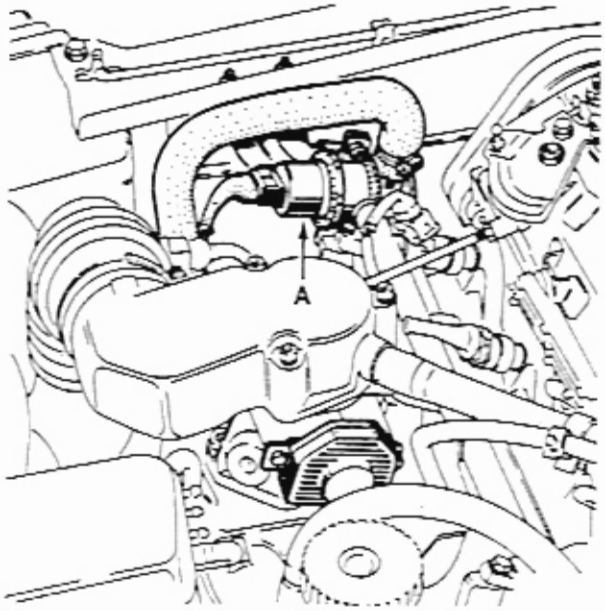
IDLE SPEED REGULATOR

Removal

Disconnect the idle speed regulator (A) electrical connector.

Remove the air hoses from the regulator.

Remove the regulator retaining clamp screws and rèmove the regulator.



Installation

Install the regulator into position with the arrow on the base of the valve pointing in the direction of the air flow.

Install retaining clamp and screws.

Install the air hoses to the regulator.

Connect the wire harness to the regulator.

GENERAL SERVICE INFORMATION

Recommended Coolant

Recommended coolant for the 2.2L engine cooling system is Prestone II® .

Do not use any type of antifreeze containing Borax or similar alkaline products.

Coolant Mixture Concentration

A 50/50 mixture of clean water and the recommended antifreeze will provide protection to - 40°C (-40°F).

The 50/50 mixture is recommended for very cold climates.

Do not use a pure antifreeze solution at any time. Pure antifreeze provides considerably less protection than a mixture of antifreeze and water.

The maximum concentration of antifreeze in the system should not exceed 60 percent.

Coolant Level

Check engine coolant level when the engine is cold and the coolant at ambient temperature.

The correct coolant level is between the ADD and FULL marks on the coolant expansion tank when the coolant is at an ambient temperature.

Thermostat

A pellet-type thermostat is used in 2.2L engines. The thermostat is located in the 2.2L engines. The thermostat is located in the end of the radiator upper hose connected to the cylinder head.

Thermostat operation is as follows:

- Starts to open at 89°C (192°F).
- Fully open at 101°C (213°F).
- Thermostat opening travel is 7.5 mm (0.295 in.)

Cooling Fan Operation

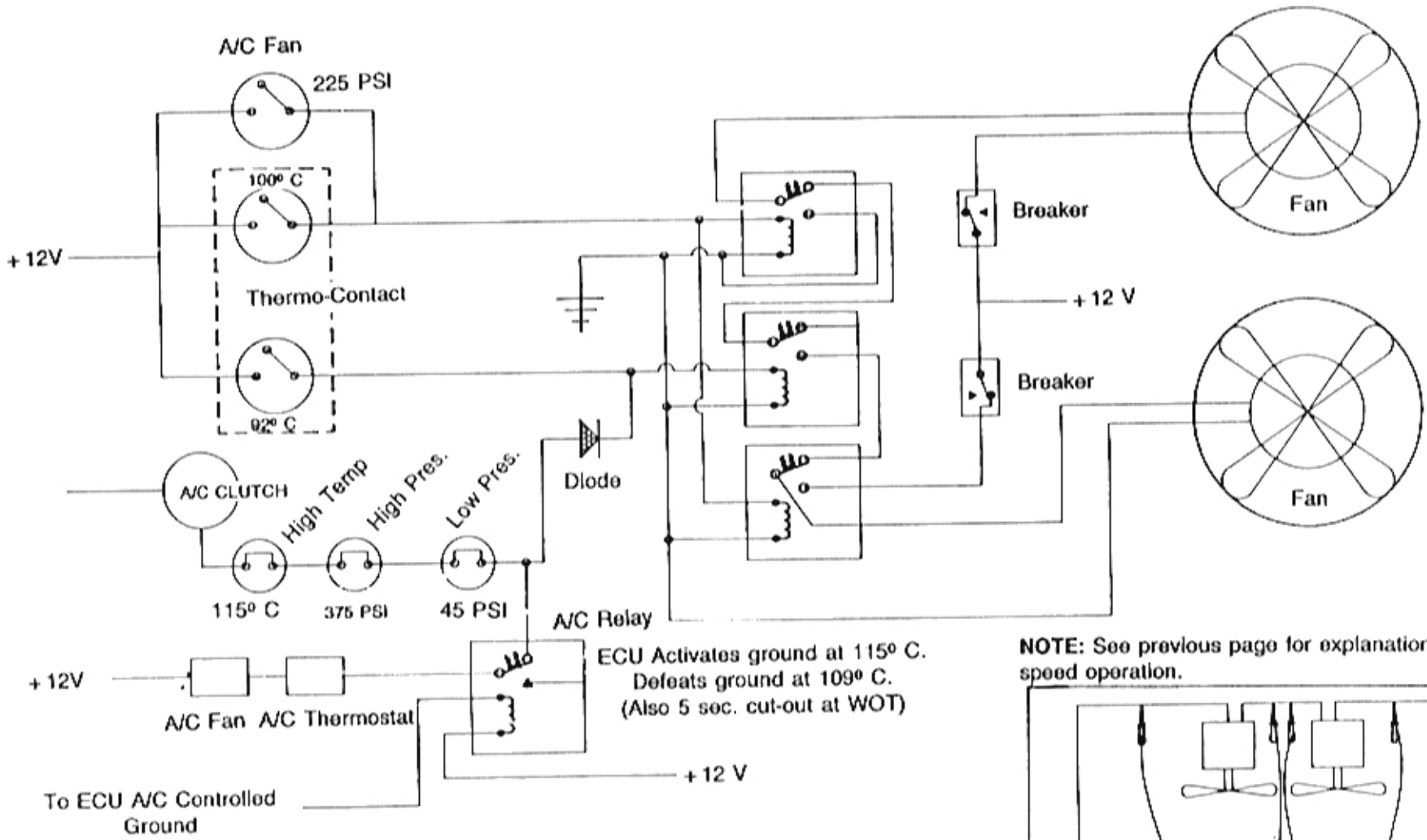
Models with air conditioning and/or automatic transaxle, are equipped with a dual-coolant thermo-switch. The switch is located in the radiator. The switch allows the cooling fans to operate at high or low speed depending upon coolant temperature.

When coolant temperature is above 92°C (198°F), but below 100°C (212°F), the switch low speed contacts close. This energizes a low speed relay which supplies battery voltage (in series) to each fan for low speed operation. In a series circuit, each fan receives 1/2 battery voltage. (Approximately 6 volts)

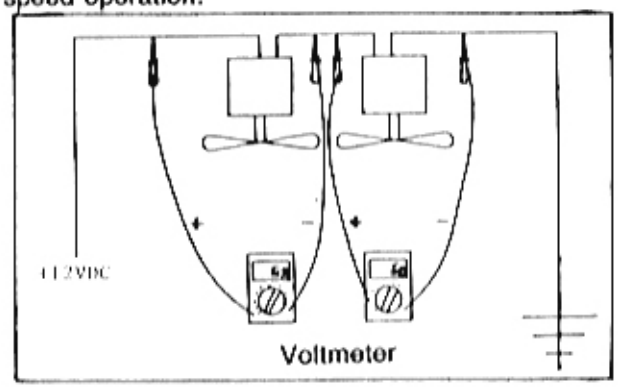
When coolant temperature rises above 100° C (212° F), the high speed switch contacts close. This energizes two high speed relays which supply battery voltage (in parallel) to each fan for high speed operation. In a parallel circuit, each receives full battery voltage.

On A/C models, the cooling fans operate continuously at low speed while the A/C system is being used. Fan speed is varied according to coolant temperature during operation. However, a pressure switch in the A/C system will immediately switch the fans to high speed if system pressure exceeds 225 psi.

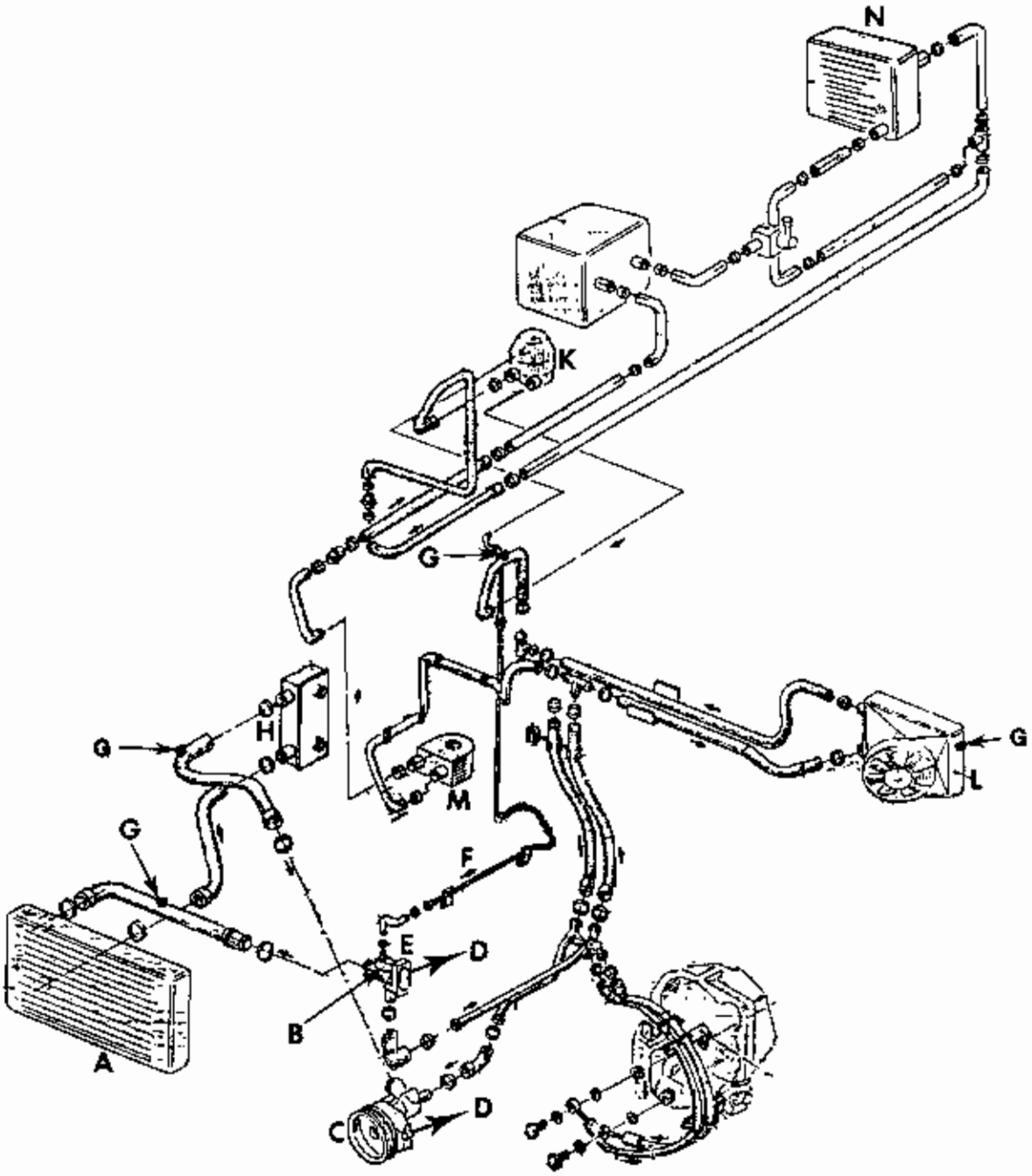
COOLING FANS & AIR CONDITIONING WIRING DIAGRAM



NOTE: See previous page for explanation of fan low speed operation.



COOLING SYSTEM COMPONENTS



The 2.2L engine cooling system components.

A - Radiator
B - Cooling Fan Switch
C - Water Pump
D - Engine BLock
E - Thermostat
F - Restrictor
(3 mm diameter)
G - Bleed Screw (4 places)
H - ATX Cooler
J - Final Drive Oil Cooler
K - Coolant Expansion Tank
L - Heater Core
M - Engine Oil Cooler
N - Rear Auto Heater

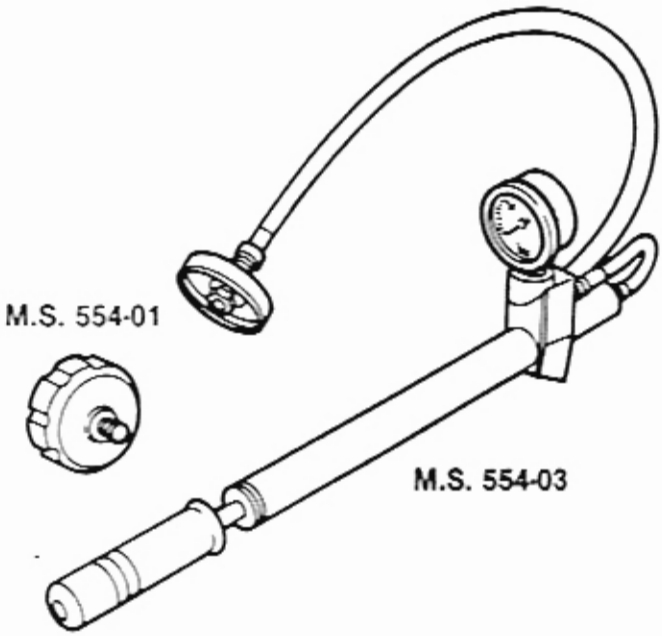
COOLANT LEAK TESTING

Leak testing is performed with pressure tester M.S. 554.03, adapter M.S. 554.01 and 554.04

Leak Test Procedure

Remove the cap from the expansion tank and install adapter M.S. 554.01 in place of the cap.

Connect tool M.S. 554.03 to the adapter just installed on the expansion tank.



Run the engine until it reaches normal operating temperature. Then stop the engine.

Pump tool M.S. 554.03 until pressure on the tool gauge is 1.3 bar (18.8 psi).

Pressure should remain steady. If a pressure drop occurs, check the system for leaks visually

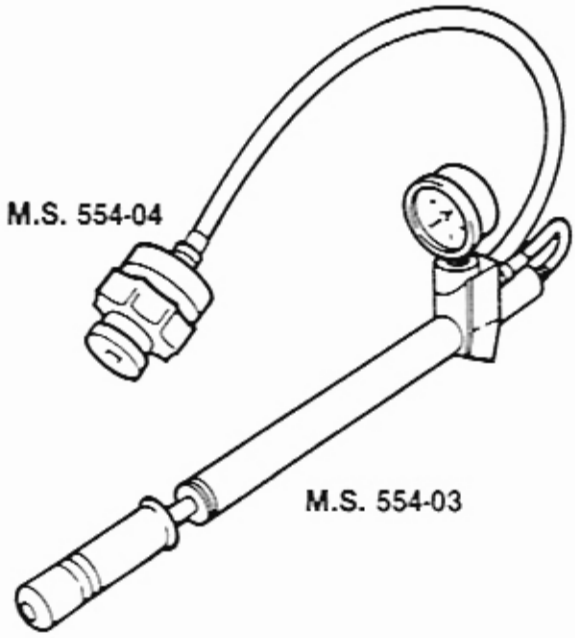
Correct any leaks and test the system again.

Disconnect the tester tools from the expansion tank and test pressure of the expansion tank cap.

Install adapter M.S. 554.04 on pressure tester M.S. 554.03.

Install the expansion tank cap (A) on adapter M.S. 554.04 and pressurize the cap 1.2 bars (17.5 psi).

Cap pressure should stabilize within ±0.1 bar (1-1/2 psi) of the setting imprinted on the cap. Replace the cap if pressure does not stabilize within specified limits.



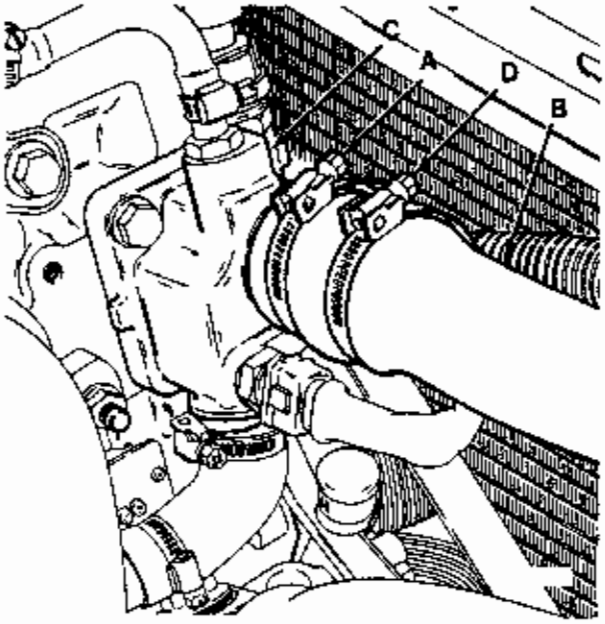
THERMOSTAT REMOVAL

WARNING: Do not loosen the cooling system pressure caps, hoses or bleed screws while the coolant is still hot and the system pressurized. Hot engine coolant can cause severe burns. Allow the system to cool down before beginning service operations.

Disconnect the radiator lower hose and drain the coolant into a container.

Loosen the upper radiator hose clamp (A) and disconnect the hose (B) from the housing (C).

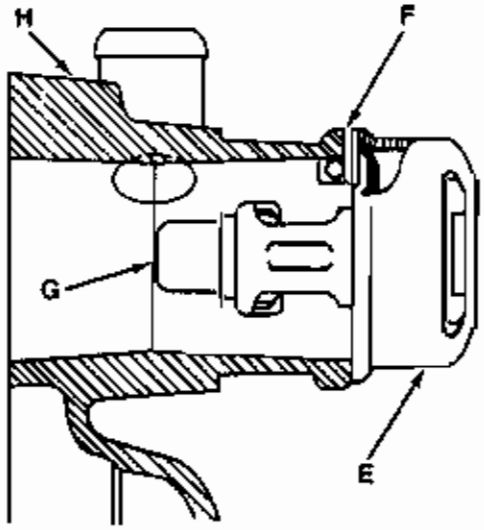
Loosen the thermostat retaining clamp (D) and remove the thermostat from the upper hose (B).



THERMOSTAT INSTALLATION

Insert the thermostat (E) into the upper radiator hose.

NOTE: Be sure the thermostat check ball (F) is positioned at the top and the valve (G) is towards the housing (H).



Install and tighten the thermostat retaining clamp.

Connect the radiator upper hose to the housing and tighten the hose clamp.

Connect the radiator lower hose.

Fill and purge the cooling system. Refer to the procedure in this section.

WATER PUMP REMOVAL

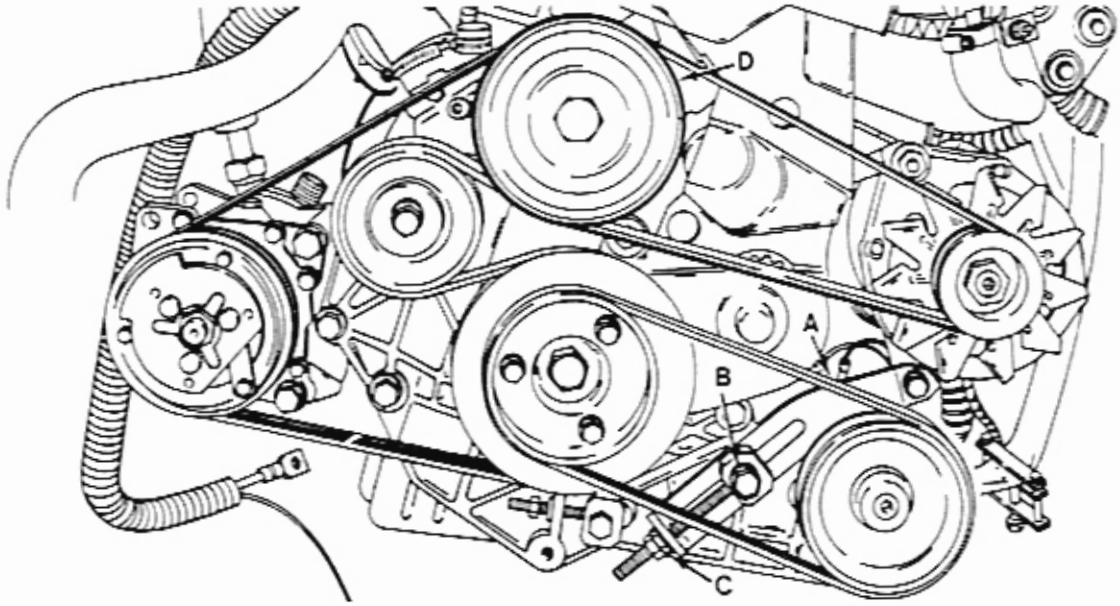
WARNING: Do not loosen the cooling system pressure caps, hoses or bleed screws while the coolant is still hot and the system pressurized. Hot engine coolant can cause severe burns. Allow the system to cool down before beginning service operations.

Disconnect the battery negative cable.

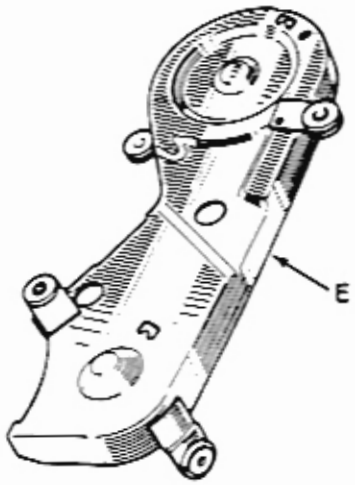
Disconnect the radiator lower hose and drain the coolant into a container.

Loosen the power steering pump belt (A).

Loosen the serpentine drive belt adjustment bolt (B) and nut (C). Loosen the belt and remove it from the water pump (D).

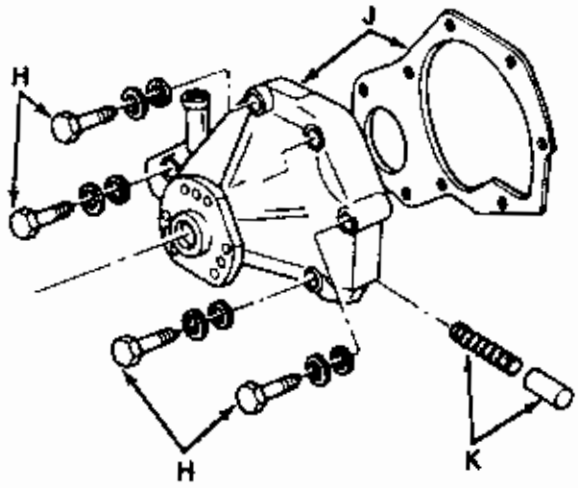


Remove the timing belt cover (E).



Remove the water pump pulley bolt (F). Then remove the pulley (G) from the pump shaft.

Remove the pump attaching bolts (H). Remove the pump and gasket (J) and the timing belt and belt tensioner (K).



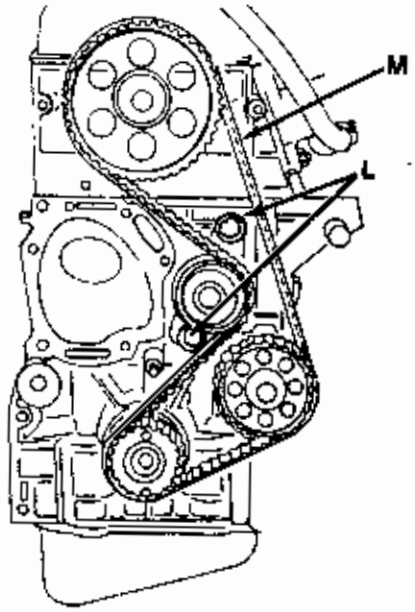
Clean the gasket surfaces of the pump and engine block.

WATER PUMP INSTALLATION

Position a replacement gasket on the water pump.

Install the pump, belt tensioner and timing belt.

Loosen the timing belt tensioner bolts (L) and allow the tensioner spring to tighten the belt (M).



Install the timing belt cover.

Install the water pump pulley and the pulley retaining bolt.

Adjust the serpentine and power steering belts to specified tension and only in the sequence outlined in the belt adjustment procedures.

Connect the radiator hoses and fill and purge the cooling system.

DRIVE BELT ADJUSTMENT

The drive belts must be adjusted in sequence to avoid over-or-under tightening the belts.

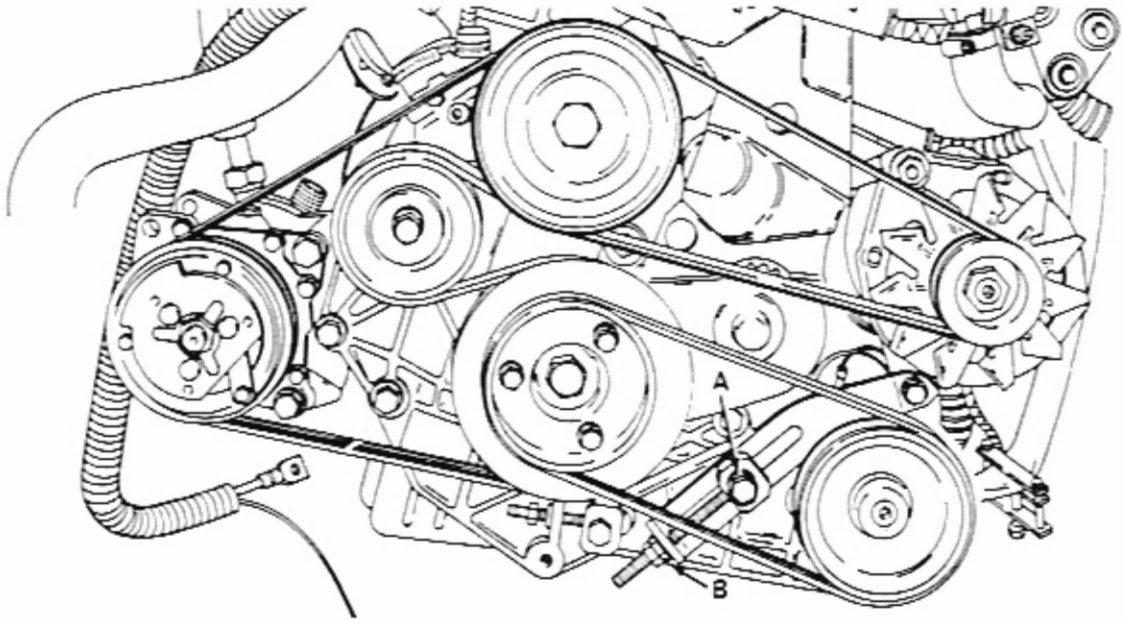
The correct tightening sequence is: power steering pump belt first — serpentine belt last.

Use a tension gauge or deflection gauge Ele. 346.02 to check/verify drive belt tension.

The correct method of using deflection gauge Ele. 346.02 is outlined in this section.

Belt Adjustment Procedure

Loosen the power steering pump belt. Then loosen the serpentine belt adjusting bolt (A) and nut (B).



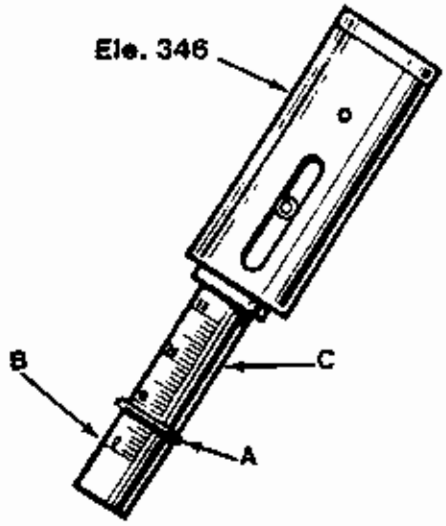
Adjust the power steering pump belt to specified tension and tighten the pump bolts.

Adjust the serpentine belt to specified tension and tighten the adjusting bolt and nut.

Refer to the Belt Tension Specifications Chart in the Specifications section for measuring points and adjustment specifications.

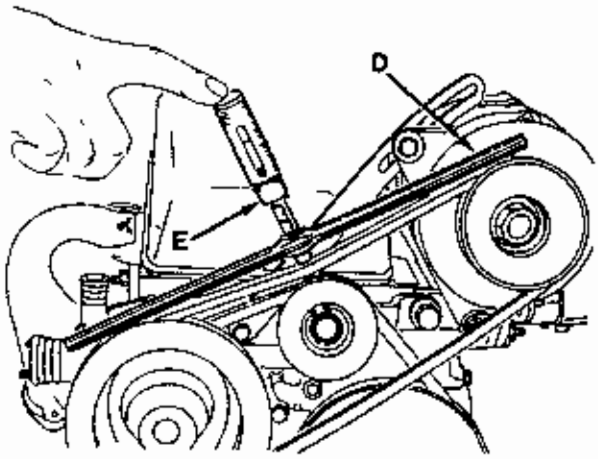
Using Belt Deflection Gauge Ele. 346.02

Position the rubber indicator ring (A) opposite the zero line (B) on the gauge plunger (C).

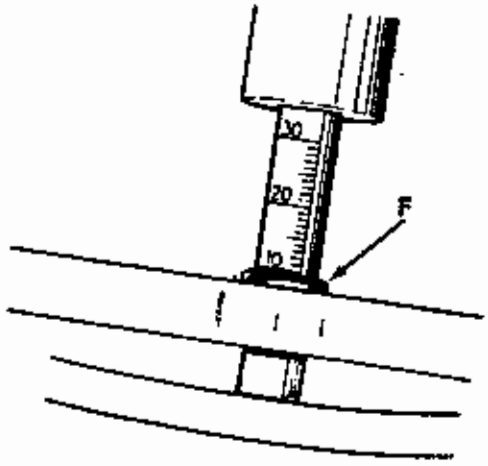


Place the Ele. 346.02 gauge bar (D) on the necessary belt span.

Insert the gauge plunger through the bar. Then press the gauge barrel downward until the shoulder of the barrel (E) contacts the gauge bar (D).



Remove the gauge and note amount of deflection indicated at the underside of the rubber ring (F).



Serpentine Drive Belt:

- Measure the tension at (F)

  new - 1.5 mm/800-890 N/180-200 lbs./ft.

  used - 2.5 mm/623-712 N/140/160 lbs./ft.

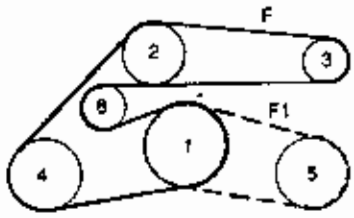
Power Steering Belt:

- Measure the tension at (F1)

  new - 3.5 mm/556-689 N/125-155 lbs./ft.

  used - 5.3 mm/400-512/90-115 lbs./ft.

1. Crankshaft
2. Water Pump
3. Alternator
4. A/C Compressor
5. Power Steering Pump
6. Idler Pulley



CHECKING COOLANT PROTECTION LEVEL

Protection level of engine coolant can be checked with a hydrometer. Be sure to follow the manufacturers instructions carefully when using the hydrometer. Incorrect use will produce inaccurate readings.

If coolant freeze protection is insufficient for anticipated temperatures, add only enough antifreeze to increase protection to the necessary level.

A 50/50 mixture of antifreeze and water will provide protection to - 40 °C (- 40 °F). The maximum concentration of antifreeze in the mixture must not exceed 60 percent.

Use the following chart as a general guide when pure antifreeze must be added to increase coolant protection level.

Coolant Protection Level Guide

Protection Level Indicated by Hydrometer (a)	System Capacity	Amount of Pure Antifreeze Needed for −23° C (−9° F) Protection	New Protection Level After Adding Pure Antifreeze
−5° C (23° F)	6.8 L (7.1 qt)	1.8 L (1.9 qt)	−23° C (−9° F)
−10° C (14° F)		1.3 L (1.4 qt)	
−15° C (6° F)		1.0 L (1.1 qt)	
−20° C (4° F)		0.3 L (0.3 qt)	
−5° C (23° F)	6.8 L (7.1 qt)	2.8 L (2.9 qt)	−40° C (−40° F)
−10° C (14° F)		2.5 L (2.6 qt)	
−15° C (6° F)		2.2 L (2.3 qt)	
−20° C (−4° F)		1.7 L (1.8 qt)	
−25° C (−13° F)		1.4 L (1.5 qt)	
−30° C (−22° F)		1.2 L (1.3 qt)	
−35° C (−31° F)		0.6 L (0.7 qt)	

(2) Protection level checked with coolant at temperature of 40° C (104° F).

FILLING AND PURGING THE COOLING SYSTEM

Verify that all hose connections are secure.

Open the 4 cooling system bleed screws. Refer to Item "G" on page 67.

ATX GEAR SPECIFICATIONS & RATIOS

Sun Wheel - Forward 16
Reverse 16

Planet Wheel - Forward 30
Reverse 31

First Step - Down Gears - Primary 28
Secondary 25

Second Step - Down Gears - Primary 23
Secondary 32

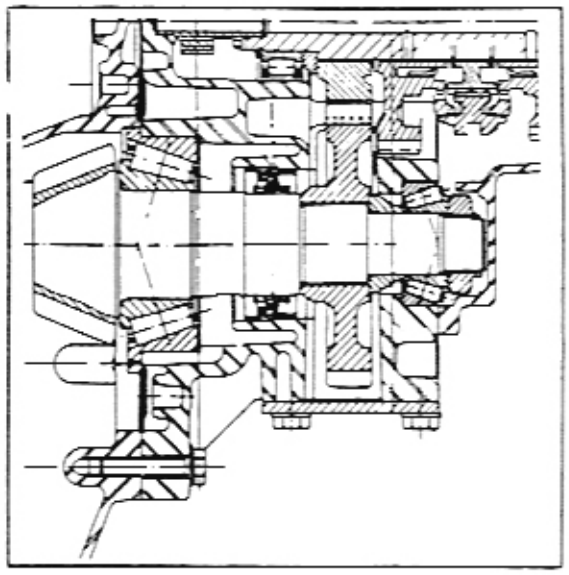
Final Drive Radio 11/42

Tachometer Ratio 5/21

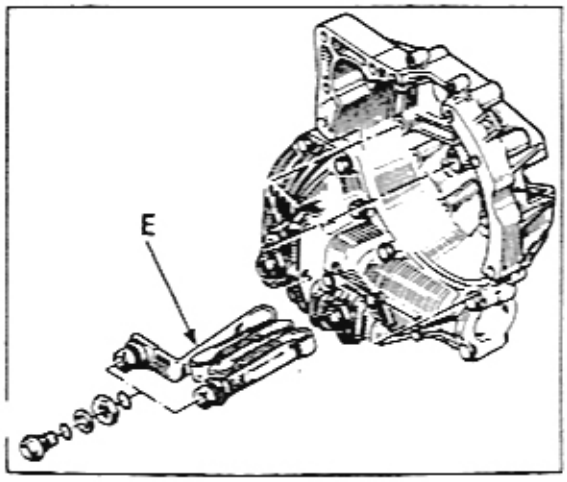
Special features

TYPE NE FINAL DRIVE UNIT - Special features

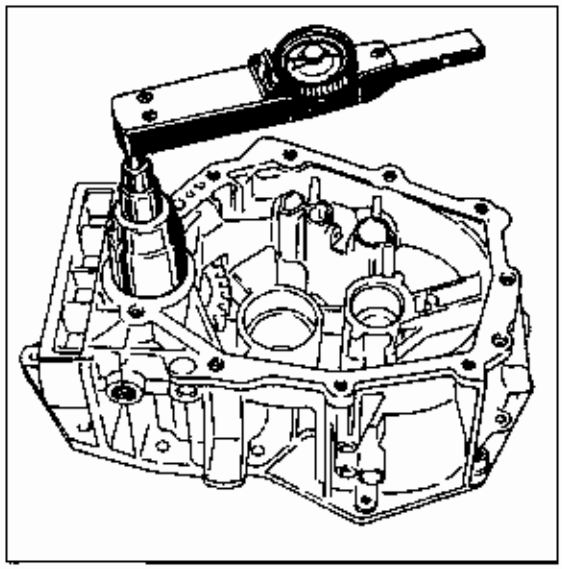
- The oil capacity of the final drive section has been increased.
- The diameter of the crown wheel has been increased.
- The final drive pinion is mounted on taper roller bearings.
- The seal between the final drive section and the gearbox section consists of a double lip type seal.



These vehicles are fitted with a water/oil type cooler (E) mounted inside the differential casing.



ADJUSTING THE FINAL DRIVE PINION BEARING PRELOAD



Re-used bearings	New bearings
Free, without play 0 to 0.7 N.m 0 to 6 lb./in.	0.7 to 2.5 N.m 6 to 22 lb./in.

The pinion depth is not adjustable.

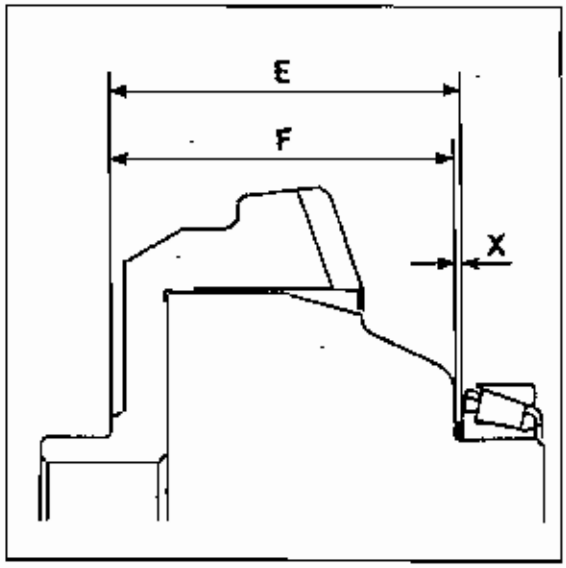
ADJUSTING THE BACKLASH

The backlash cannot be measured once the gearbox is assembled and is therefore to be adjusted when the differential bearings are fitted by measuring the following dimensions :

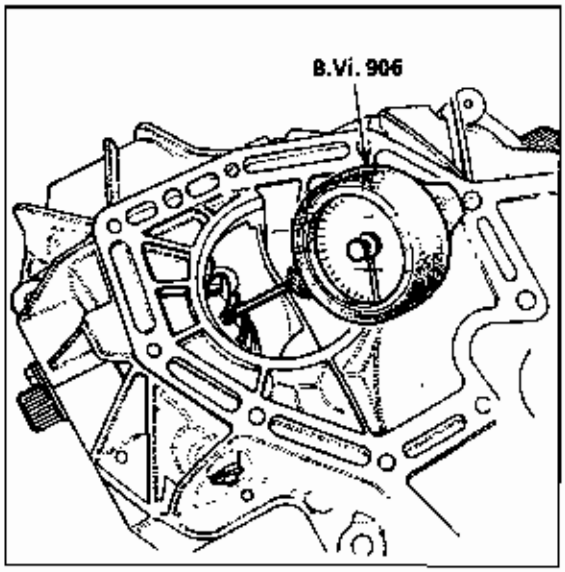
Dimension E : nominal dimension
93.93 + 0.07
+ 0

Dimension F : dimension between the differential bearing locating faces.

Dimension X : thickness of the shim to be placed between the bearing and the differential casing.



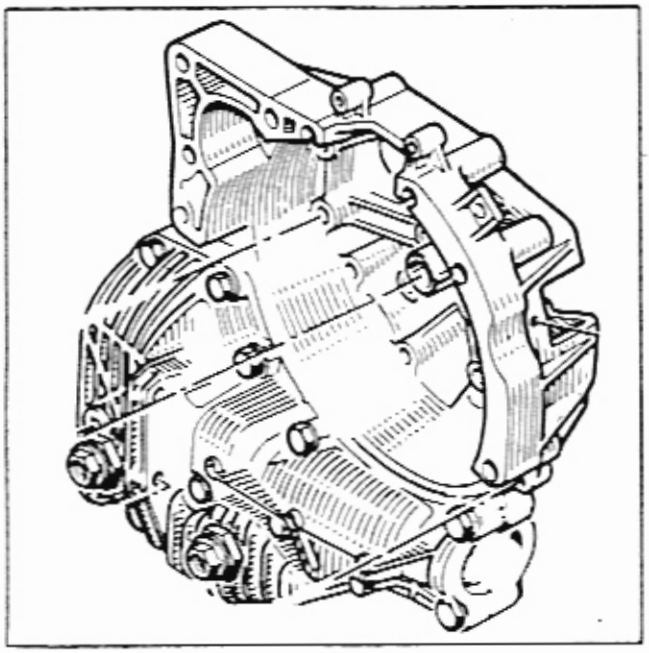
ADJUSTING THE DIFFERENTIAL BEARING PRELOAD



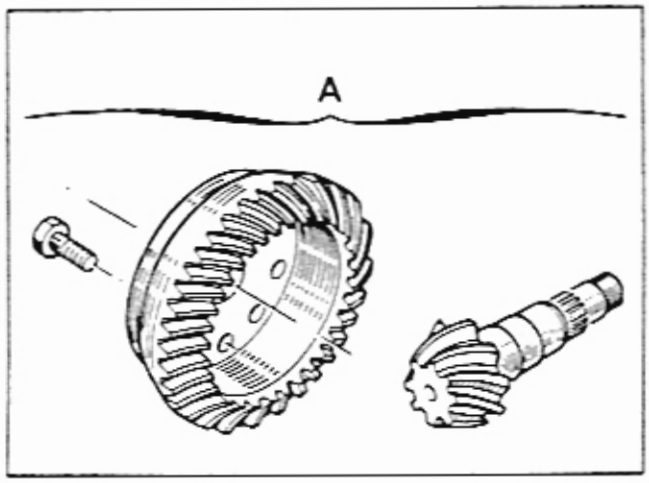
Re-used bearings	New bearings
Free, without play	2 to 2.5 daN. (15 to 18 lb./ft.

MATCHED PARTS

Clutch housing and final drive unit housing.



Final drive pinion and crown wheel (A).



Synchroniser hubs and sliding gears

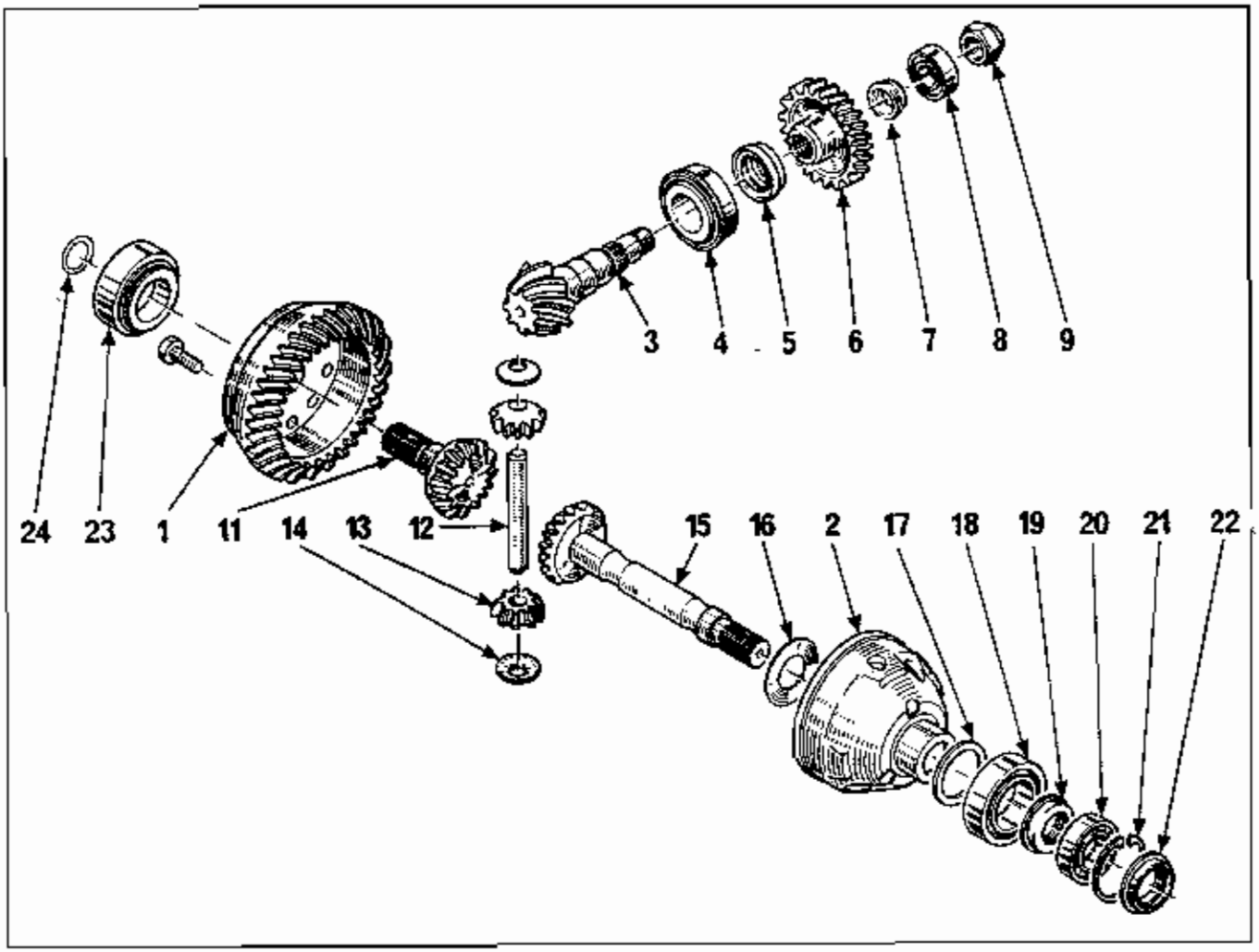
In all cases we recommend the marking of the positions of the sliding gears on their hubs.

Bearing track rings and cages

PARTS THAT MUST BE REPLACED BY NEW ONES

Paper gaskets.
Lip seals.
Differential housing securing bolts.
Speedometer drive pinion.
Circlips.
O ring seals.
Snap rings.
Final drive pinion nut.
Pentagonal clip on clutch shaft.

Dismantling



1 Crown wheel
2 Differential housing
3 Final drive pinion
4 Taper roller bearing
5 Double lip seal
6 Step-down gear
7 Pre-load adjusting spacer
8 Taper roller bearing
9 Nut
11 Short sun wheel
12 Planet wheel shaft
13 Planet wheel
14 Cup
15 Sun wheel
16 Washer
17 Backlash adjusting shim
18 Taper roller bearing
19 Lip seal
20 Ball race
21 Circlip
22 Plastic ring
23 Taper roller bearing
24 O ring

Dismantling

ESSENTIAL SPECIAL TOOLS	
B.Vi. 654	Castellated spanner for adjusting the differential clearance
B.Vi. 805	Spanner for differential nut
B.Vi. 905-02	Tools for replacing the speedometer drive shaft seal
B.Vi. 906	Torque measuring tool
B.Vi. 1059	Rings for fitting the differential bearings
B.Vi. 1087	Support for step-down gear housing
B.Vi. 1088	Tool for tightening the final drive pinion
B.Vi. 1089	Tool for fitting the double lip seal
B.Vi. 1090	Tool for centralising the final drive pinion

TIGHTENING TORQUES - daNm (lb./ft.)		
Final drive pinion nut		4 (29) then 18 (132)
Crown wheel bolts		12.5 (92)
Bolts on final drive half housing	Ø 8	3 (22)
	Ø 10	5 (37)
Bolts securing final drive clutch housing to step-down housing cover		3 (22)
Bolts on step-down housing cover		3 (22)

CONSUMABLES	
LOCTITE 518	Housing assembly faces
GREASE No. 20	Sun wheel splines
GEARBOX OIL	Oil all the parts and lip seals before refitting them

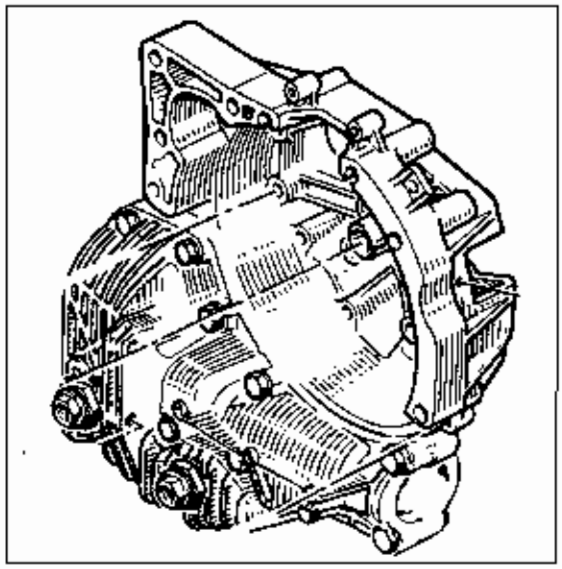
Dismantling

Disconnect the clutch housing from the step-down housing.

Mark the position of the differential nut.

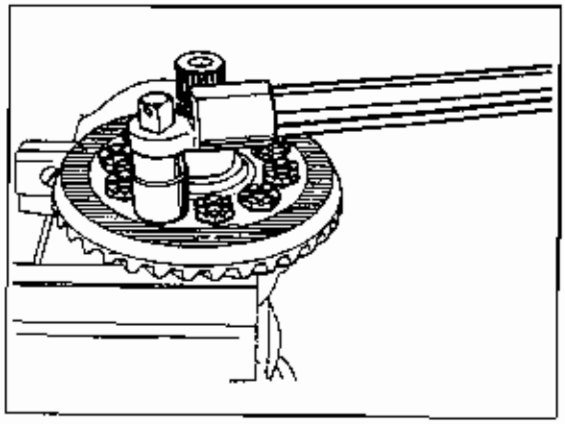
DIFFERENTIAL

Remove the differential casing cover.

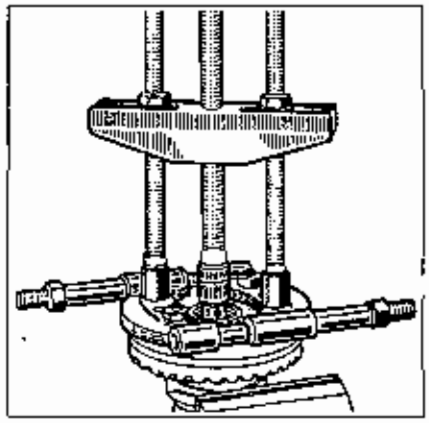


Take out the differential.

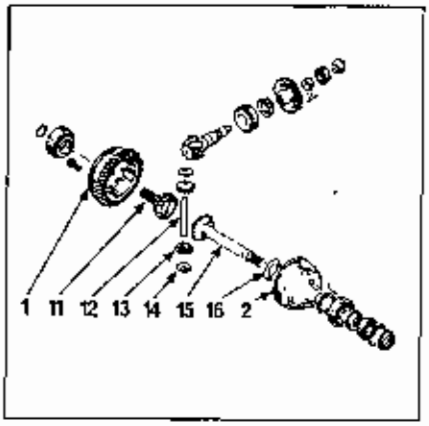
Remove the bolts that secure the crown wheel (they cannot be re-used). Leave two, diametrically opposite one another, in position.



Extract the three bearings using tool type FACOM U53G + U53E or a similar tool.



Remove parts (11) to (16).



Check the parts
Check the
condition : - of the gear teeth,
- of the bearing areas,
- of the washers (planet wheel),
- of the splines in the housing,
- of the area on which the lip seal locates on sun wheel.

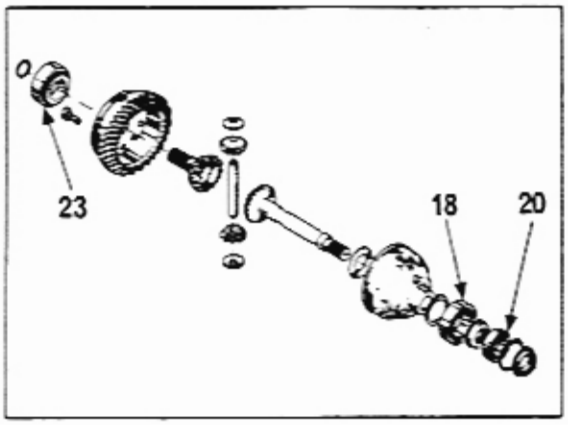
The pinion shaft and related parts cannot be rebuilt in the field, so the intermediate section must be replaced as an assembly.

Intermediate section remanufacturing is an extremely precise operation requiring specialized tools and highly accurate measuring instruments. This is only possible at the original assembly factory.

REASSEMBLING THE DIFFERENTIAL - Special features

Oil all the parts before reassembly.

The taper roller bearing on the crown wheel side of the differential is larger in diameter than that on the housing side.



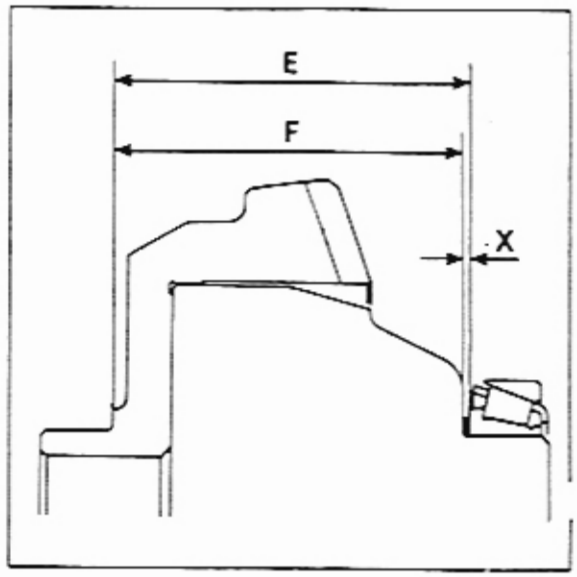
ADJUSTING THE BACKLASH

The backlash cannot be measured after the gearbox has been assembled and must therefore be adjusted when the differential bearings are refitted, by measuring the following dimensions :

Dimension E : nominal dimension
93.93 + 0.07
+ 0

Dimension F : dimension between the differential bearing locating faces.

Dimension X : thickness of the shim to be inserted between the bearing and the differential housing.



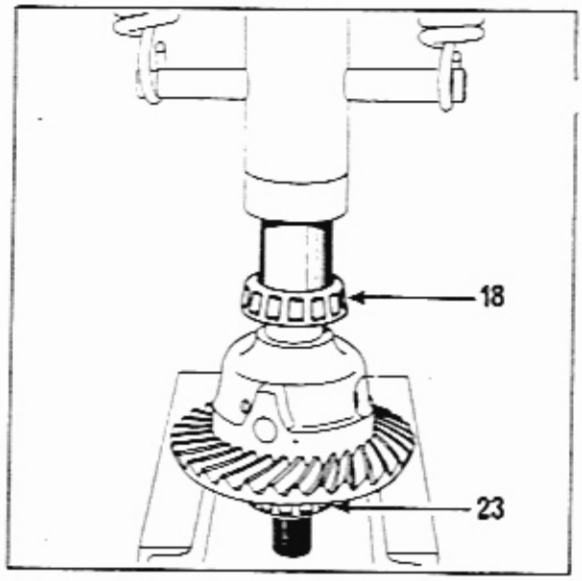
Assemble the differential housing and the crown wheel by fitting the three bolts.

Measure dimension F (using a vernier calliper with jaws 90 mm long).

$$X = E - F$$

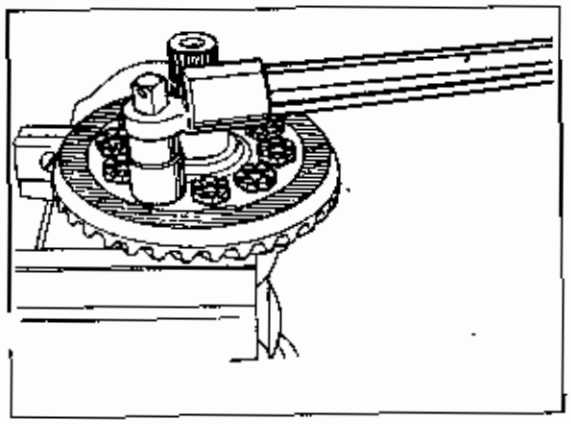
Shims are available in thickness from 0.8 to 1.4 mm in increments of 0.05 mm.

Fit the bearings on the press.



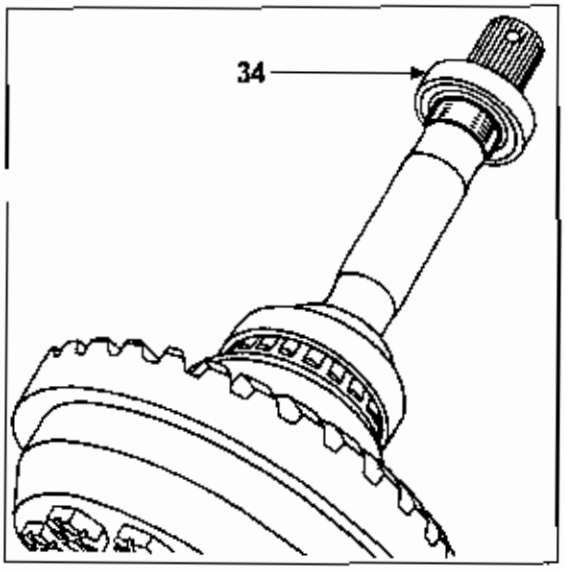
Assemble the crown wheel to the housing using new bolts.

Tighten the bolts to a torque of 12.5 daN.m. (92 lb./ft.)



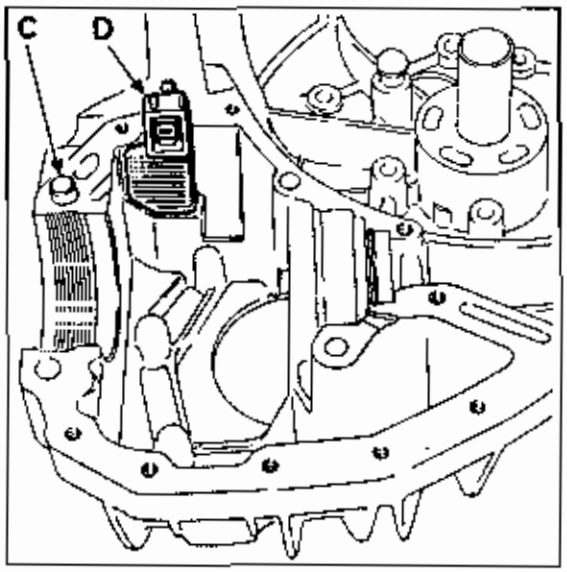
Fit the lip seal to the sun wheel.

Push the straight roller bearing (34) on to the large sun wheel, by a few millimetres, in order to centralise it.

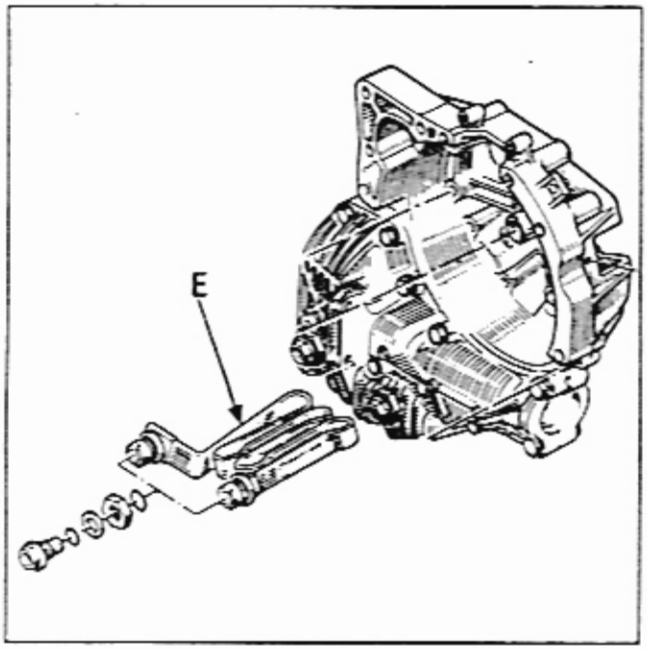


Fit the assembly into the differential casing (bearing (34) is not in its final position).

Check that the following are in place :
- the locating dowel (C) on the casing,
- the breather (D) in its location.



SPECIAL FEATURES INVOLVING THE WATER/OIL COOLER (fitted to certain versions)



Fit the cooler (E) using new O rings that have previously been oiled, to the differential casing cover.

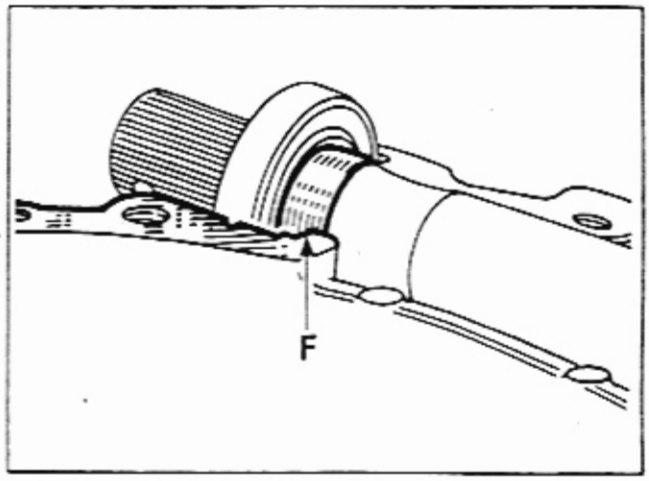
Assemble the housings to ensure that the cooler assembly does not make contact with the differential casing/housing-sunwheel assembly.

Coat the assembly faces on the casings and housings with LOCTITE 518 and assemble them by fitting a few of their bolts, without fully tightening the bolts.

Fit the differential nut using tool B.Vi. 645 + B.Vi.805, using a new, oiled O ring.

Tighten the nut until it makes contact with the differential bearing outer track ring.

Finish fitting the straight roller bearing (34) by pushing it in until it makes contact with the shoulder (F) on the casing.



Loosen the differential nut by half a turn.

Tighten the bolts on the casing to the specified torque.

Fit, to the large sun wheel side :
- the snap ring,
- the plastic ring.

ADJUSTING THE DIFFERENTIAL BEARING PRELOAD

One of two sets of circumstances may arise :

- If the original bearings are refitted

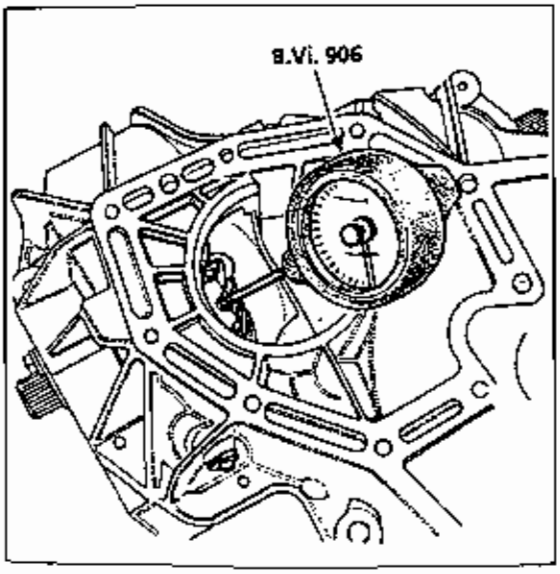
  The differential should rotate without play.

  If all the original mechanical components have been refitted, fit a new, oiled, O ring seal to the nut and refit the nut by screwing it in the same number of turns noted during dismantling and aligning it with the marks.

- If new bearings are fitted

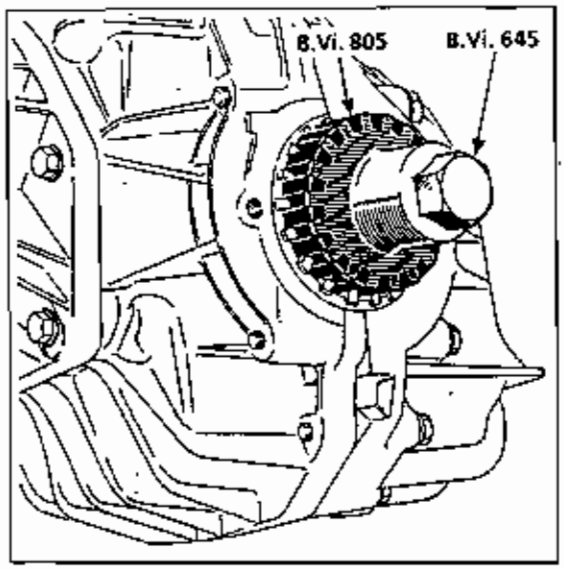
  Ensure that the differential bearings are correctly positioned by turning the assembly.

Place the plunger of the torque measuring instrument B.Vi.906 against one of the crown wheel teeth, at its largest diameter, square with the differential centreline.
Apply a progressively increasing pressure in the same direction as was used when fitting the bearings, until the differential starts to move.
Release the torque measuring instrument and take the reading from the recording pointer (Red).



THE READING SHOULD BE BETWEEN 2 and 2.5 daN. (15 and 18 lb./ft.)

Tighten or loosen the differential nut using tools B.Vi. 645 and B.Vi. 805 and recommence the operation until the torque is between 2 and 2.5 daN. (15 and 18 lb./ft.)



When the correct reading has been obtained, lock the nut with its locking plate.

Assemble the clutch shaft to the primary shaft and assemble the housings after coating their assembly faces with LOCTITE 518.

CHASSIS MAINTENANCE SCHEDULE

Vehicles Equipped with Bendix Fuel Injection Only

MONTHS or MILES x 1000	1 1	6 5	12 10	18 15	24 20	30 25	36 30	42 35	48 40	54 45	60 50	66 55	72 60	96 80
Ref Operation														
1 Engine Oil*†	R	R	R	R	R	R	R	R	R	R	R	R	R	
2 Oil Filter*†	R		R		R		R		R		R		R	
3 Auto Transmission Fluid	R	I	I	R	I	I	R	I	I	R	I	I	R	
4 Manual Transmission Oil	R	I	I	R	I	I	R	I	I	R	I	I	R	
5 Differential Oil	R	I	I	R	I	I	R	I	I	R	I	I	R	
6 Clutch Adjustment	I			I			I			I			I	
7 Idle Speed - (Not Adjustable)														
8 Air Filter†					*		*R						*R	
9 Spark Plugs							*R						*R	
10 Drive Belts	I			I			*A			I			*A	
11 Hoses/Connections	I			I			I			*I			I	
12 Oxygen Sensor														*I
13 Valve Lash							*I						*I	
14 PCV System											*I			
15 Fuel Filter†					R				*R				R	
16 Exhaust System	I			I			I			I			I	
17 Ignition System							I						I	
18 Fluid Checks	I	I	I	I	I	I	I	I	I	I	I	I	I	
19 Engine Coolant							R						R	
20 Evaporative System				I			I			I			I	
21 Timing Belt				I			*A			I			*R	
22 Batteries	I	I	I	I	I	I	I	I	I	I	I	I	I	
23 Brakes	I			I			I			I			I	
24 Tires	I			I			I			I			I	
25 Axles/Suspension/Steering	I			I			I			I			I	
26 Wheels	I	I	I	I	I	I	I	I	I	I	I	I	I	
27 Engine Mountings				I			I			I			I	
28 Lights/Electrical System	I	I	I	I	I	I	I	I	I	I	I	I	I	
29 Rocker Shaft Oil Filter							R						R	
30 Road Test	I	I	I	I	I	I	I	I	I	I	I	I	I	
Kilometers x 1000 (Approx.)	1.6	8.0	16.0	24.0	32.0	40.0	48.0	56.0	64.0	72.5	80.5	88.5	96.5	128.5

R - Replacement necessary
A - Adjustment necessary
I - Inspect and adjust, add or replace if necessary
* - Required to maintain emissions standards and warranty

After 60,000 miles, maintenance should be continued at equivalent intervals by repeating the chassis maintenance schedule (except for the 1,000 mile maintenance check). For reference: 5,000 miles would equal 65,000 miles, 10,000 would equal 70,000 etc.

† NOTE: If the vehicle is used under unusual driving conditions such as driving in dusty areas, extensive engine idling, trailer towing or repeated short trips of 5 miles or less, more frequent service is recommended.

SERVICE OPERATION DESCRIPTIONS

NOTE: Your need for service is determined by a mileage or time interval. In most cases, the odometer mileage will indicate when service is required. However, if you drive very little, your vehicle should be serviced at least every twelve months. Under severe driving conditions, such as driving in dusty areas, extensive engine idling, towing a trailer or repeated short trips of 5 miles or less in freezing temperature, more frequent maintenance is recommended.

1. **Engine Oil** - Change engine oil during the 1000 mile maintenance check, and at each required service interval thereafter. Check oil at each fuel fill.*

NOTE. If you use your vehicle under unusual driving conditions, such as driving in dusty areas, extensive engine idling, towing a trailer, or repeated short trips of 5 miles or less in freezing temperatures, then change your oil every 3 months or 3000 miles.

2. **Engine Oil Filter** - Change engine oil filter during the 1000 mile maintenance check and, thereafter, at listed intervals. Use only Winnebago approved filter.*
3. **Automatic Transmission Fluid** - Change the automotive transaxle fluid and clean filters at the 1000 mile maintenance check and at specified intervals thereafter.*
4. **Manual Transmission Oil Change** - Transmission oil must be changed during the 1,000 mile maintenance service and at each prescribed interval thereafter. Thoroughly inspect for leaks around gaskets and drain plugs after an oil change
5. **Differential Oil** - Change final drive oil during the 1,000 mile maintenance check and, thereafter, at intervals listed. Check level at each engine oil change.*
6. **Clutch Check and Adjustment** - Check operation clearance and adjust, if necessary, during the 1,000 mile maintenance service and at prescribed intervals thereafter.
7. **Idle Speed** - Not adjustable.
8. **Air Filter** - Replace air cleaner element at 30,000 miles. Use only Winnebago approved air filter.*
9. **Spark Plugs** - Replace the spark plugs at 30,000 miles. See Engine Specifications for recommended spark plugs and gap settings.
10. **Drive Belts (Qualified Technician Required)** - Inspect condition and tension of belts driving the water pump, alternator and air conditioner compressor at the 1,000 mile maintenance check and at specified intervals thereafter
11. **Hoses and Connections** - At each 15,000 mile interval, check the condition of hoses, connections and fittings of the following systems. Tighten connections, if necessary
    - Cooling system
    - Brake system
    - Fuel system
    - Power steering
    - Vacuum system (emissions related)
12. **Oxygen Sensor** - At 80,000 miles, check sensor operation and replace if necessary.
13. **Valve Lash** - Adjust valve lash as required at each 30,000 mile interval.
14. **PCV System** - Check and replace defective components if necessary, at 50,000 miles
15. **Fuel Filter - (Qualified Technician Required)** -Replace fuel filter at each 20,000 mile maintenance interval. Inspect fuel lines and tank for leakage and connections for tightness. Inspect fuel system electrical connections. Check filler cap for proper venting.
16. **Exhaust System** - At each 15,000 mile maintenance interval, inspect condition of all exhaust system components for leakage, damage, clearance and mounting. Replace components as necessary
17. **Ignition System (Qualified Technician Required)** - Inspect distributor cap, rotor and ignition wiring and check timing.
18. **Fluid Checks** - During the 1,000 mile maintenance check, and at subsequent maintenance interval, check the level of fluids listed and add or replace as necessary.*
    - transmission fluid
    - differential oil
    - brake fluid
    - power steering fluid
    - coolant
    - windshield washer solvent
19. **Cooling System** - Drain and replace coolant at 30,000 miles and at the beginning of each winter season thereafter. Check hoses and connections for leakage or flaws. Use only Prestone II® brand anti-freeze/coolant when replacing or adding. Pressure test the coolant reservoir cap. This is very important to ensure proper engine cooling
20. **Evaporative System** - Inspect evaporative system hoses and connections for leakage or cracks at the maintenance intervals indicated

* See FLUIDS AND FILTERS for recommendations

21. **Timing Belt (Qualified Technician Required)** -Replace the toothed timing belt at 60,000 miles.
22. **Battery** - At 1,000 miles and at each 5000 mile maintenance interval, check: battery terminals (clean and tighten if necessary), voltage, battery case and hold-downs, and electrolyte level if applicable.
23. **Brakes** - Perform the following services at 1,000 miles and at each 15,000 mile maintenance interval:
    - Check operation and performance of service brakes. Add fluid if necessary.
    - Inspect condition and thickness of front pads and rear linings. Replace if necessary.
    - Adjust handbrake
    - Inspect brake servo filter and clean or replace as necessary.
24. **Tires** - Inspect tires (and spare) for abnormal wear or damage and adjust air inflation pressure, if necessary, at 1,000 miles and at each specified interval therafter or whenever any visible or handling problem is apparent.
25. **Axles/Suspension** - During the 1,000 mile maintenance check and at each 15,000 mile maintenance interval, perform the following and replace as necessary:
    - Steering and suspension components - check for play and wear.
    - Drive axle boots - inspect for cracks.
    - Rear wheel bearings - inspect condition and repack.
    - Torque axle nuts to correct specifications
26. **Wheels** - Check tightness of lug nuts and inspect condition of wheels at 1,000 miles and at each 5,000 mile service interval.
27. **Mountings** - All engine and transmission mounting bolts must be torqued to proper specifications every 15,000 miles.
28. **Lights and Electrical System** - During the 1,000 mile maintenance check and at each 5,000 mile interval, check operation of all lights, turn signals, warning lights, hazard flashes, instruments, horn, wipers, heater fan, etc. Adjust headlight alignment, if necessary, at each 15,000 mile interval.
29. **Rocker Shaft Oil Filter** - Replace rocker shaft oil filter and check valve clearances at each 30,000 mile interval.
30. **Road Test** - During the 1,000 mile maintenance check and at each 5,000 mile interval thereafter, road test the vehicle and check the following:
    - Acceleration and braking
    - Steering, suspension and handling
    - Fluid and body leakage
    - Doors and hood (lubricate if necessary)
    - Body components
    - Accessory operation

ENGINE OIL CHANGE

The first oil change must be performed during the 1,000 mile maintenance service, and thereafter at each interval specified in the maintenance schedule. It is recommended that engine oil be changed more frequently if the vehicle is subjected to very hard use.

To change engine oil:

1. Remove drain plug. Allow time for old oil to escape.
2. Reinsert drain plug into drain hole.
3. Refill crackcase through filler hole on top of engine.

CAUTION

The engine must not be flushed out under any circumstances.

ENGINE OIL FILTER CHANGE

The engine oil filter must be changed during the 1,000 mile maintenance service, and thereafter at each specified interval. **The oil filter is unique to this type of engine and is available from Winnebago Part Sales Department. No substitutions are recommended.**

NOTE: Be sure to allow for the additional capacity of the oil filter when refilling crankcase*.

ENGINE OIL GRADE

Refer to recommendations listed in the FLUIDS AND FILTERS section of this manual concerning service classifications and viscosity requirements.

CAUTION

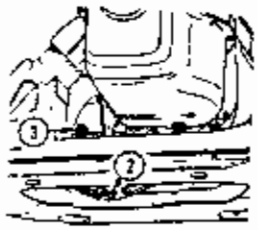
The engine must not be flushed out under any circumstances

* See FLUIDS AND FILTERS for recommendations.

TRANSMISSION AND DIFFERENTIAL OIL AND FLUID CHANGE

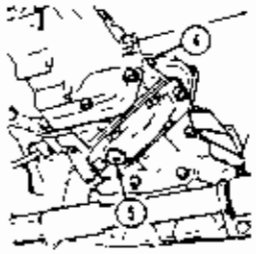
Differential Oil Change:

1. Remove drain plug **2**. Allow adequate time for old oil to escape.
2. Reinsert plug into hole **2**.
3. Refill reservoir through fill plug hole **3** until oil just starts to run out.
4. Reinsert plug into hole **3**.



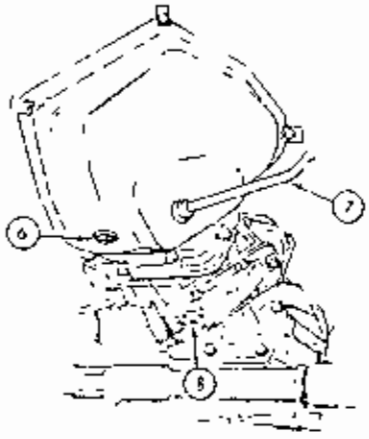
Manual Transmission Oil Change:

1. Remove drain plug **5**. Allow adequate time for old oil to escape.
2. Reinsert drain plug into drain.
3. Refill reservoir through fill plug hole **4** until oil just starts to run out.
4. Reinsert plug into hole **4**.



Automatic Tranmission Fluid Change:

1. Remove drain plugs **6** and **8**. Allow adequate time for fluid to escape.
2. Reinsert drain plug into drain hole.
3. Refill reservoir with recommended transmission fluid through transmission dipstick tube **7**.



AUTOMATIC TRANSMISSION FLUID CHECK

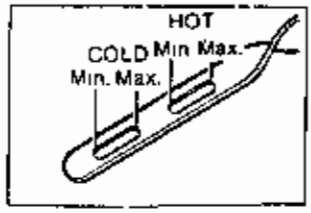
The transmission fluid may be checked while either cold or hot.

When fluid is cold, drive the vehicle forward and backward a short distance to ensure that fluid is distributed throughout the transmission.

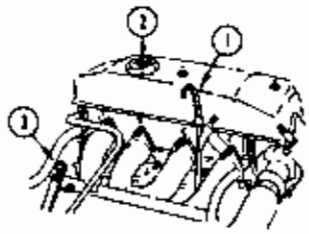
Fluid is "hot" when the transmission is at normal operating temperature, such as after driving for at least 5-10 miles.

1. Park the vehicle on a level surface, with the engine idling and the gear selector in Park (P). **Fully engage the handbrake.**
2. Pull out the transmission dipstick and wipe clean.
3. Reinsert the dipstick fully, then pull out again to read level.
   Cold Level: read lower slot
   Hot Level: read upper slot

Do not allow level to go below "Min" or above "Max" mark or transmission damage may occur. If necessary, add the appropriate amount of transmission fluid through the dipstick tube using a funnel. See "FLUIDS AND FILTERS" for recommended fluid.



Automatic Transmission Dipstick



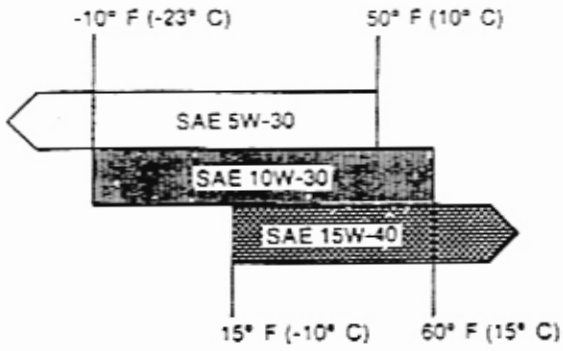
1. Engine Oil Dipstick
2. Oil Fill Cap
3. Transmission Dipstick

* See FLUIDS AND FILTERS for recommendations

FLUIDS AND FILTERS

OIL

Engine: Oil used must correspond to the standard MIL-L-46152B or API-SF. The suffix SF must appear on the container singly or in conjunction with other designations. Refer to the viscosity chart below for recommendations according to ambient temperatures. DO NOT USE 10W-30 above 60° F (15° C). NEVER USE 10W-40 oils in this engine.



5-Speed Manual Transmission: Oil used must correspond to the standard MIL-L-2105B or API-GL5.
Above 32° F (-10° C): SAE 80W-90.
Below 32° F (-10° C): SAE 75W.

Differential: Oil used must correspond to the standard MIL-L-2105B or API-GL5.
All temperatures: SAE 80W-90.

FLUIDS

Automatic Transmission: Mobil 220ATF Dexron® Type II, or equivalent.
Power Steering: Mobil 220 ATF Dexron® Type II, or equivalent.
Brakes/Clutch: SAE J 1703F DOT 3 or SAE J1703F DOT4.
Coolant: Prestone II® anti-freeze/coolant only.

FILTERS

Oil Filter: Part #R77007-30-077
Air Filter: Part #R77013-48-175
Fuel Filter: Part #R14636-35-181

CAUTION

We recommend using high-octane unleaded gasoline if your vehicle is operated during hot weather under severe conditions, such as mountain driving, heavy vehicle loading, or sustained high-speed driving.

FLUID CAPACITIES

VEHICLES EQUIPPED WITH J7T-239 FUEL INJECTED GASOLINE ENGINE

Fuel Tank	15.5 gallons	58.7 litres
Engine Oil (Crankcase)	5.3 quarts	5.0 litres
Engine Oil Filter	.52 quart	.50 litre
Cooling System*	11.0 quarts	10.4 litres
Automatic Transmission	2.1-2.6 quarts	2.0-2.5 litres
Manual Transmission	1.9 quarts	1.8 litres
Differential	1.48 quart	1.4 litre
Brake Circuit (single)	.42 quart	0.4 litre
Brake Circuit (dual)	.74 quart	0.7 litre
Power Steering	1.22 quart	1.15 litre

*Approximate capacity excluding Motoraid Water Heater or Rear Heater.