E - THEORY/OPERATION

1991 Mazda Miata

1991 ENGINE PERFORMANCE
Theory & OperationPiston Engine

B2200, B2600i, Miata, MPV, MX-6,
Navajo, Protege, 323, 626, 929

INTRODUCTION

This article covers basic description and operation of engine performance-related systems and components. Read this article before diagnosing vehicles or systems with which you are not completely familiar.

AIR INDUCTION SYSTEM

TRIPLE INDUCTION CONTROL SYSTEM (TICS) (929)

All 3.0L engine cylinder heads have 3 valves per cylinder: 2 intake and one exhaust. To improve intake efficiency at idle and low RPM, the TICS closes a swirl control valve in the intake runners. See Fig. 1. This forces most of the intake air through a small passage called a swirl port, located below main intake runner. This causes a strong swirl in the combustion chamber, improving combustion and fuel economy.

VARIABLE INERTIA CHARGING SYSTEM (VICS) (PROTEGE DOHC)

Shutter valves in intake manifold control length of intake air path, depending upon engine RPM. At less than 5000 RPM, the shutter valves close, improving torque output. At more than 5000 RPM, the shutter valves open, increasing airflow while improving high RPM performance.

VARIABLE RESONANCE INDUCTION SYSTEM (VRIS) (929 & MPV 3.0L)

A shutter valve in the dynamic chamber changes intake runner effective length depending upon engine RPM. See Fig. 2. To improve torque output at low-to-medium engine RPM, intake runners are opened into a resonance chamber, providing improved cylinder filling. At high engine speed, shutter valve closes, shortening intake runner length and improving high RPM performance.

TURBOCHARGER (MX-6 & 626 TURBO)

MX-6 and 626 turbo use liquid-cooled (coolant) turbochargers, mounted directly to the exhaust manifold. Turbocharger consists of a turbine/compressor assembly, oil supply system and wastegate.

The pressure-actuated wastegate is the system's safety valve, preventing excessive intake boost pressure. Wastegate operation is also controlled by the Electronic Control Unit (ECU). Engine knock control unit senses engine knock and sends this signal to ECU. The ECU opens a wastegate solenoid valve and lowers boost pressure up to 2.2 psi.

COMPUTERIZED ENGINE CONTROLS

ELECTRONIC FUEL INJECTION

The Electronic Fuel Injection (EFI) computerized engine control system monitors various engine/vehicle functions to control engine operation and lower emissions, while maintaining fuel economy and driveability.

FEEDBACK CARBURETOR (B2200)

The Feedback Carburetor (FBC) computerized engine control system monitors various engine/vehicle functions to control engine operation and lower emissions while maintaining fuel economy and driveability.

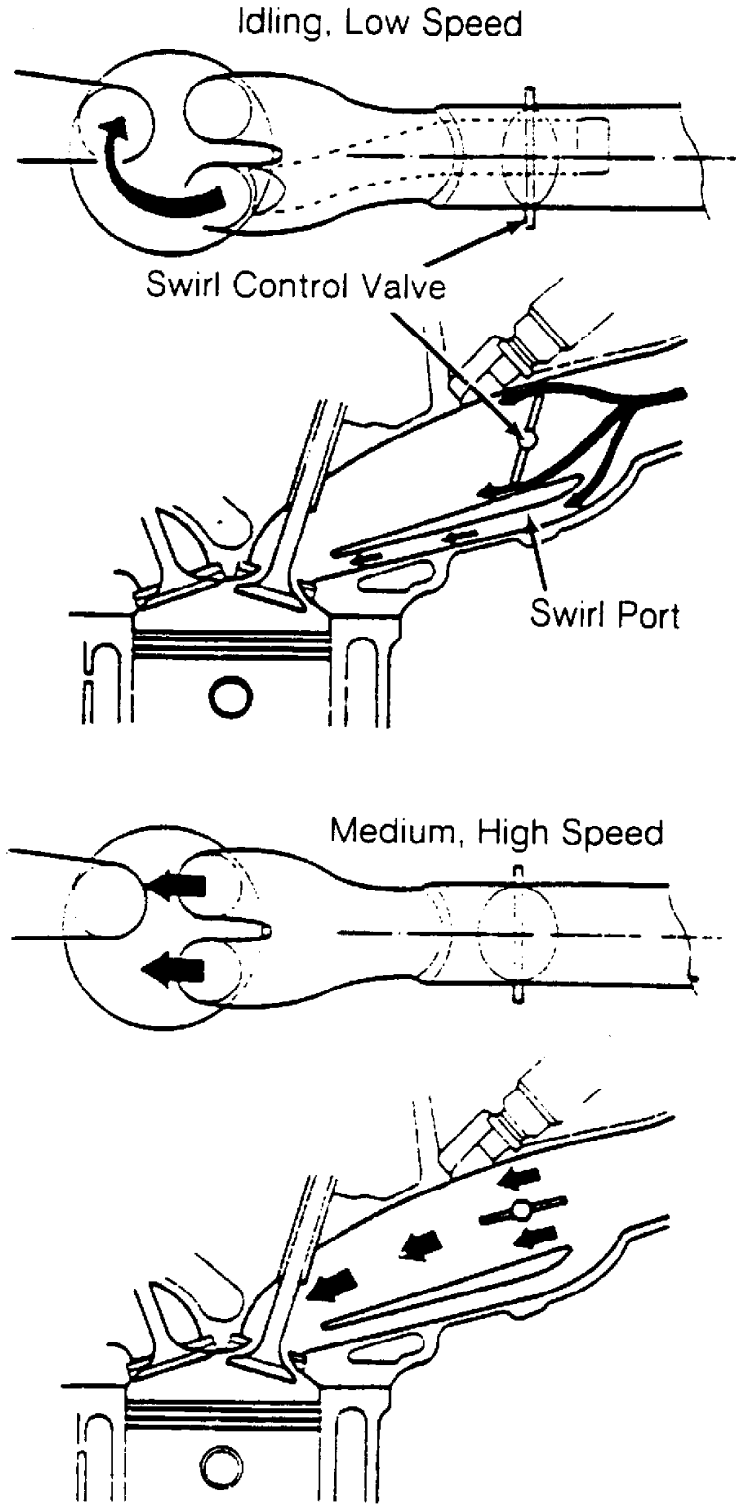

Fig. 1: Cross-Sectional View of Triple Induction Control System (929)
Courtesy of Mazda Motors Corp.

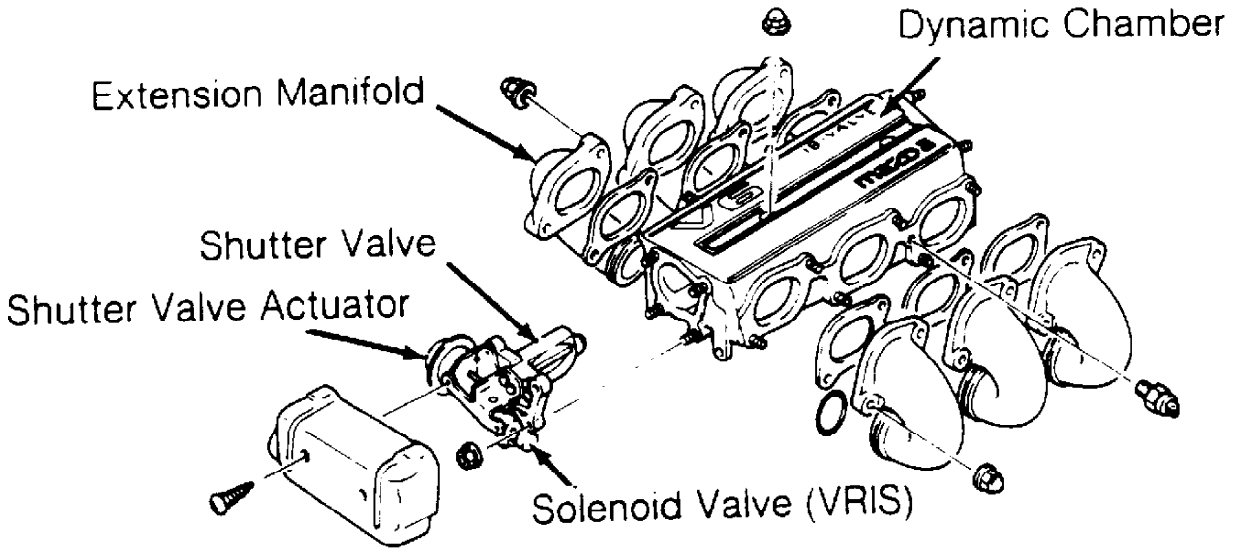

Fig. 2: Identifying Variable Resonance Induction System (3.0L)
Courtesy of Mazda Motors Corp.

NOTE: Components are grouped into 2 categories. The first category covers INPUT DEVICES, which control or produce voltage signals monitored by the ECU/ECA. The second category covers OUTPUT SIGNALS, which are components controlled by the ECU/ECA.

ELECTRONIC FUEL INJECTION CONTROL UNIT

The Electronic Control Unit/Assembly (ECU/ECA), through various input sensors, monitors battery voltage, engine RPM, intake air volume, cranking signal, crankshaft angle, intake air temperature, radiator and engine coolant temperatures, exhaust oxygen content, throttle position, atmospheric pressure, gearshift lever position, clutch engagement, braking, power steering operation, and A/C compressor operation.

The ECU/ECA uses this input information in controlling fuel injection and the actuating of other output devices. On Miata, MX-6 turbo, 626 turbo and all 929 models, spark timing is controlled by the ECU.

The ECU/ECA has a built-in, fail-safe mechanism. If a fault occurs while driving, the ECU/ECA will substitute pre-programmed values. Driving performance will be affected, but vehicle may still be driven.

The ECU/ECA has a self-diagnostic function which allows the unit to store a number of trouble codes in its memory. A Malfunction Indicator Lamp (MIL) informs the driver of system problems. The MIL is in the center of the instrument cluster, under the engine symbol marked CHECK.

FEEDBACK CARBURETOR (B2200) CONTROL UNIT

The Electronic Control Unit (ECU), through various input sensors, monitors battery voltage, engine RPM, amount of intake air, cranking signal, intake temperature, radiator and engine coolant temperatures, oxygen concentration in exhaust gases, EGR operation, throttle opening, atmospheric pressure, gearshift lever position,

clutch engagement, and A/C compressor operation.

The ECU uses all input information to control air/fuel solenoid valve, idle-up solenoid valves, slow fuel-cut solenoid valve, coasting richer solenoid valve, vacuum solenoid valve, Air Control Valve (ACV) solenoid valve, purge solenoid valve, and duty solenoid valve. ECU has a built-in, fail-safe mechanism. If a fault occurs while driving, ECU will substitute pre-programmed values. Driving performance will be affected, but vehicle may still be driven.

INPUT DEVICES - ELECTRONIC FUEL INJECTION

Vehicles are equipped with different combinations of input devices. Not all devices are used on all models. To determine the input usage on a specific model, see appropriate wiring diagram in L-WIRING DIAGRAMS article in the ENGINE PERFORMANCE section. The available input signals include the following:

Air Conditioning Switch
Closes when A/C or blower is in the ON position.

Air Charge Temperature (ACT) Sensor (Navajo)
ACT sensor provides electronic fuel injection system with mixture temperature information. The ACT sensor is used both as a density corrector for airflow calculation and to proportion cold enrichment fuel flow.

Airflow Meter Inlet Air Temperature Sensor
Varies voltage signal to ECU in relation to inlet air temperature.

Airflow Meter (Vc)
Corrected airflow meter voltage.

Airflow Meter (Vs)
Airflow meter flap position signal.

Airflow Sensor (B2200, B2600i & MPV 2.6L)
The airflow sensor uses an electrically heated hot wire to determine the air mass entering the engine.

Atmospheric Pressure Sensor
Varies voltage signal according to altitude.

Barometric Pressure (BP) Sensor (Navajo)
BP sensor measures barometric pressure of atmosphere. Variations in atmospheric pressure (changes in altitude) modify an electrical signal monitored by ECA.

Brake Light Switch
Signals ECU of vehicle braking condition.

Coolant Thermosensor
Varies input voltage signal according to engine coolant temperature.

Coolant Temperature Switch
Switch opens and closes according to radiator temperature.

Crank Angle Sensor (Miata)
Signals No. 1 and 4 cylinder TDC for fuel injection and ignition timing. Detects crankshaft angle at 90 degree intervals to trigger ignition coils and provide ECU with data to control injection amount and injection timing.

Distributor Signal
Signals cylinder TDC (No. 1 on 4-cylinder engines and No. 1 and 4 on V6 engines) for fuel injection timing. Detects crankshaft angle at 30 degree intervals.

EGR Position Sensor (929)
Signals EGR control valve opening.

Electrical Load Control/CPU
Signals ECU of additional electrical load.

Engine Coolant Temperature (ECT) Sensor (Navajo)
ECT sensor inputs coolant temperature to ECA.

Heated Exhaust Gas Oxygen (HEGO) Sensor (Navajo)
When at operating temperature, the O(2) sensor monitors oxygen content of exhaust gases. A heating circuit is used to warm O2 sensor to operating temperature, enabling faster conversion of feedback system to closed loop operation.
The O2 sensor produces low voltage (less than .4 volt) to indicate a lean mixture (high amount of oxygen) and a high voltage (more than .6 volt) to indicate a rich mixture (low amount of oxygen). This voltage signal is transmitted to ECA.

Idle Switch
Indicates throttle open or closed position.

Ignition Coil
Signals engine speed.

Ignition Switch
Supplies battery voltage to ECU during engine cranking.

Ignitor (3.0L)
Signals engine speed.

Inhibitor Switch (A/T)
Signals ECU of gear selection.

Intake Air Thermosensor (Dynamic Chamber - 2.6L & 3.0L)
Varies voltage signal to ECU in relation to engine air temperature. All 929 models except 929S use 2 intake air temperature sensors. One sensor is located inside the airflow meter, the other is located near the intake runner on cylinder head.

Knock Sensor (MX-6, 626 & 929S)
Sends signal to knock control unit which retards ignition timing when knocking occurs. On MX-6 turbo and 626 turbo, knock control unit reduces turbocharger boost pressure under knock condition.

Mass Airflow (MAF) Sensor (Navajo)
MAF sensor measures flow of air entering the engine. This measurement of airflow is a reflection of engine load (throttle opening). The sensing element (hot wire) is a thin platinum wire wound on a ceramic bobbin and coated with glass.
The hot wire is maintained at 392°F (200°C) above cold wire (ambient) temperature. Cold wire is located downstream of hot wire. As air passes through the airflow sensor, the air temperature is measured as air passes over the cold wire sensor. The ECA uses this information to control fuel delivery.

Main Relay
Provides battery voltage to ECU and injectors.

Neutral/Clutch Switch (M/T)
Signals ECU of clutch operation and transaxle gear selection.

Oxygen (O2) Sensor
Generates voltage signal depending on oxygen content of exhaust.

Throttle Position Sensor
Provides signal in response to wide open throttle position.

Vehicle Speed Sensor (VSS) (Navajo)
Sends a pulsing signal to ECA when vehicle is moving.

INPUT DEVICES - CARBURETOR (B2200)

Air Conditioning Switch
Closes when A/C or blower switch is in the ON position.

Atmospheric Pressure Sensor
Varies voltage signal according to altitude.

Coolant Thermosensor
Varies input voltage signal according to engine coolant temperature.

Coolant Temperature Switch
Switch opens and closes according to radiator temperature.

Clutch Switch
Signals ECU of clutch engagement.

EGR Position Sensor
Detects EGR operation, sends signal to ECU.

Idle Switch
Indicates throttle closed position.

Ignition Coil
Signals engine speed.

Ignition Switch
Supplies battery voltage to ECU during engine cranking.

Inhibitor Switch (A/T)
Signals ECU of gear selection.

Intake Air Thermosensor
Detects intake air temperature, sends signal to ECU.

Neutral/Clutch Switch (M/T)
Signals ECU of clutch operation and transaxle gear selection.

Oxygen (O2) Sensor
Generates voltage signal proportional to oxygen content of exhaust gases.

Vacuum Sensor
Detects intake manifold vacuum, sends signal to ECU.

OUTPUT SIGNALS - ELECTRONIC FUEL INJECTION

NOTE: Vehicles are equipped with different combinations of computer-controlled components. Not all components listed below are used on every vehicle. For theory and operation of each output component, refer to the system indicated after component.

The ECU processes information from the input sensors and sends appropriate voltage control signals to the following engine controls:

A/C Cut-Out System
See IDLE SPEED under FUEL SYSTEM.

By-Pass Air Control (BAC) Valve
See IDLE SPEED under FUEL SYSTEM.

CHECK ENGINE Light
See SELF-DIAGNOSTICS SYSTEM.

Heated Oxygen (O2) Sensor Element
See INPUT DEVICES.

Idle Speed Control (ISC) Valve
See IDLE SPEED under FUEL SYSTEM.

Ignition Timing Advance Control
See IGNITION TIMING CONTROL SYSTEMS under IGNITION SYSTEMS.

Fuel Pump Relay
See FUEL DELIVERY under FUEL SYSTEM.

Triple Induction Control System Solenoid
See AIR INDUCTION SYSTEM.

Variable Inertia Charging System Solenoid
See AIR INDUCTION SYSTEM.

Variable Resonance Induction System Solenoid
See AIR INDUCTION SYSTEM.

Wastegate Solenoid
See TURBOCHARGER under AIR INDUCTION SYSTEM.

OUTPUT SIGNALS CARBURETOR (B2200)

NOTE: For theory and operation on each output component, refer to system indicated after component.

The ECU processes information from input sensors and sends appropriate voltage control signals to the following engine controls:

CHECK ENGINE Light
See SELF-DIAGNOSTICS SYSTEM.

Deceleration Control System
See EMISSION SYSTEMS.

Fuel Pump Control Unit (B2200 With A/T)
See FUEL DELIVERY under FUEL SYSTEM.

Idle-Up Valve
See IDLE SPEED under FUEL SYSTEM.

FUEL SYSTEM

FUEL DELIVERY

Fuel Pump

Fuel under pressure from electric fuel pump flows through a fuel damper, fuel filter, injector fuel rail and fuel pressure regulator. Fuel pump is located in fuel tank. Electrical power for fuel pump operation during cranking mode is provided from starter relay, via fuel pump relay and ECU (fuel pump control unit on carbureted B2200 with A/T).

Fuel Pump Relay

The ECU turns on fuel pump relay based on inputs from the ignition switch and the ignition coil. During cranking, the ignition switch cranking circuit energizes fuel pump relay. After engine starts and key is released to RUN position (engine speed more than 50 RPM), ECU provides fuel pump relay ground.

Fuel Pressure Regulator

The pressure regulator is a sealed unit, divided by a diaphragm into 2 chambers (fuel and spring chambers). The fuel chamber receives fuel through the inlet side of injector fuel rail. The spring chamber is connected to intake manifold vacuum.At idle, intake manifold vacuum is high. The diaphragm is pulled back by intake manifold vacuum and excess fuel is returned to the fuel tank. As the throttle opens, intake manifold vacuum decreases. The regulator spring overcomes manifold vacuum, increasing fuel pressure.

Fuel Pump Shutoff (Inertia) Switch (Navajo)

Navajo uses an electrical interrupt switch in fuel system. During a collision or vehicle roll-over, electrical contacts within inertia switch open, shutting off current to electric fuel pump. Fuel supply is interrupted even when engine is running.

A reset button is located on switch assembly. If electrical circuit trips, vehicle will not restart until switch is reset. Fuel system should be inspected before resetting switch.

NOTE: DO NOT reset fuel pump shutoff (inertia) switch after an accident until entire fuel system has been inspected for leaks.

High Pressure Fuel Pump (Navajo)

The high pressure fuel pump is positioned inside fuel tank. A reservoir is built onto pump and sender assembly, instead of as part of tank. The high pressure fuel pump is capable of pumping over 16 gallons (60 liters) of fuel per hour at a working pressure of 39.2 psi (2.75 kg/cm^2). This pump also has internal pressure relief and discharge check valves.

FUEL CONTROL

Electronic Fuel Injection

Electronic Fuel Injection (EFI) system is an electronically controlled system operated by incoming airflow. The EFI system also contains a feedback system which measures oxygen content of exhaust gases and maintains the air/fuel ratio near 14.7:1. The EFI system consists of 3 sub-systems: air intake system, fuel system and computerized system (ECA).

Each cylinder has a solenoid-operated injector which sprays fuel toward back of each intake valve. Injector bodies consist of

solenoid-actuated pintle and needle valve assembly. Injector flow orifice is fixed, and fuel pressure at injector tip is constant. Atomizing spray is obtained by shape of pintle.

The ECA controls fuel injectors to meter pulse width or time each injector is energized. Each injector receives battery voltage through ignition switch circuit. The ECA completes ground circuit to energize injector. The ECA receives inputs from engine sensors to compute fuel flow necessary to maintain proper air/fuel mixture throughout entire engine operational range.

Feedback Carburetor (B2200)

Feedback Carburetor (FBC) computerized engine control system monitors various engine/vehicle functions to control engine operation and lower emissions, while maintaining fuel economy and driveability.

The Electronic Control Unit (ECU), through various input sensors, monitors battery voltage, engine RPM, amount of intake air, cranking signal, intake temperature, radiator and engine coolant temperatures, oxygen concentration in exhaust gases, EGR operation, throttle opening, atmospheric pressure, gearshift lever position, clutch engagement and A/C compressor operation.

The ECU uses input information to control output signals to air/fuel solenoid valve, idle-up solenoid valves, slow fuel-cut solenoid valve, coasting richer solenoid valve, vacuum solenoid valve, ACV solenoid valve, purge solenoid valve and duty solenoid valve.

ECU has a built-in fail-safe mechanism. If a fault occurs while driving, ECU substitutes pre-programmed values. Engine performance will be reduced, but vehicle can still be driven.

IDLE SPEED

A/C Cut-Out System

During acceleration (60 percent throttle or more with transmission in gear and clutch pedal is released) and about 5 seconds after starting the engine, the ECU opens A/C relay, cutting off power to A/C compressor clutch. This improves idle after start-up and during heavy acceleration. A/C is cut off for about 10 seconds.

By-Pass Air Control (BAC) Valve

The BAC valve contains an air valve and Idle Speed Control (ISC) valve. Engine coolant is directed around the air valve, warming the thermowax element. When engine coolant temperature is less than 122°F (50°C), the wax is contracted and the engine idles fast. When coolant temperature is more than 122°F (50°C), the wax is fully expanded, closing valve.

The Idle Speed Control (ISC) valve, controlled by ECU, regulates air by-pass during cold and warm engine operation. During cold engine operation, the ISC valve opens, raising fast idle speed to a predetermined RPM. The ISC valve also compensates for all engine loads during warm engine operation to maintain a preset idle RPM.

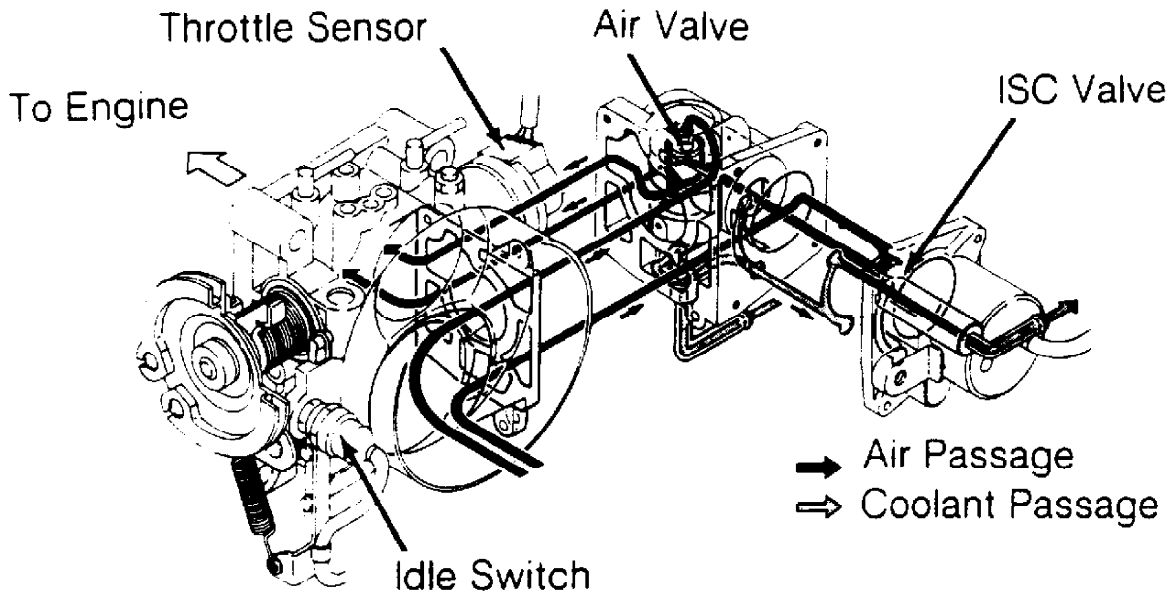

Fig. 3: Identifying By-Pass Air Control (BAC) Valve
Courtesy of Mazda Motors Corp.

Idle Speed Control (ISC) Valve

The ISC valve, mounted on the throttle body, controls idle smoothness by regulating throttle plate by-pass air. ISC valve consists of an air by-pass valve, which functions during cold engine conditions below 122°F (50°C), and the idle speed control solenoid valve, which works throughout the entire temperature range. The air by-pass valve is affected by the engine coolant temperature. The idle speed control solenoid is controlled by ECA.

Idle is controlled by idle speed control air by-pass valve. The throttle air by-pass valve is a solenoid-operated valve controlled by ECA. The valve allows air to by-pass throttle plates to control cold engine fast idle, no-touch start, dashpot, overtemperature idle boost and engine load idle correction.

Air by-pass channel carries idle airflow regulated by air by-pass valve. Air by-pass valve is controlled by ECA to adjust both cold and warm idle speeds. Air by-pass valve uses solenoid valve to vary idle airflow volume allowed to enter engine.

Idle-Up System (B2200 - Carbureted)

The idle-up system is used on models with engine-powered accessories that decrease engine RPM. To maintain proper engine performance, the idle-up system increases idle RPM to required specifications.

The idle-up system consists of an idle-up solenoid valve, servo diaphragm, connecting hoses and electrical components. Models with A/C and A/T use a dual-servo diaphragm.

IGNITION SYSTEMS

DISTRIBUTORLESS IGNITION SYSTEM (MIATA)

The distributorless ignition system contains a crankshaft angle sensor to control ignition timing. Two individual ignition coils are used to send spark to cylinders No. 1 and No. 4, and No. 2 and No. 3. Paired cylinders will spark every complete crankshaft rotation (360

degrees).

The crank angle sensor, mounted on rear of intake camshaft, monitors No. 1 and No. 4 cylinder TDC, ignition and fuel injection reference points. Signals created by crank angle sensor are sent to the Electronic Control Unit (ECU).

The ECU delivers ignition signals to the ignitor to control ignition. Ignitor triggers appropriate ignition coil. Power for ignition coils is supplied from ignition switch.

ELECTRONIC DISTRIBUTORLESS IGNITION SYSTEM (EDIS) (NAVAJO)

The EDIS system consists of a Variable Reluctance Sensor (VRS), an EDIS ignition module, an ECA and one 6-tower coil pack.

During system operation, EDIS ignition module receives crankshaft position information from VRS. In turn, EDIS ignition module generates a Profile Ignition Pick-Up (PIP) signal and sends it to ECA. The ECA responds with a Spark Angle Word (SAW) signal containing advance or retard timing information, which it sends to EDIS module. The EDIS ignition module then processes VRS and SAW signals to decide which coils to fire. In addition, EDIS ignition module generates an Ignition Diagnostic Monitor (IDM) signal and sends it to ECA, which uses it during failure mode to provide a tach output signal.

The EDIS ignition module is a microprocessor and makes decisions about spark timing and coil firing. The EDIS ignition module turns coils on and off at correct times and in proper sequence, based on VRS and SAW signals. The EDIS ignition module, upon receiving VRS and SAW signals, produces PIP and IDM output signals and sends these signals to ECA.

ELECTRONIC IGNITION SYSTEM (EXCEPT MIATA & NAVAJO)

Mitsubishi breakerless electronic ignition consists of an ignitor, ignition coil, pick-up coil and distributor. The control module is mounted inside the distributor with the pick-up coil assembly.

When ignition is on, ignition coil primary circuit is energized. As distributor shaft rotates, the reluctor rotates inside the stator assembly.

As armature teeth pass pegs of pick-up coil, a signal is sent to the ignitor. The ignitor then breaks the primary circuit in coil, causing a high voltage surge in coil secondary circuit required to fire spark plugs.

IGNITION TIMING CONTROL SYSTEMS

Ignition Timing Advance Control

Miata, MX-6 turbo, 626 turbo and 929 use an ECU-controlled Electronic Spark Advance (ESA) system. The ECU determines ignition timing based on signals from input devices. All other models use centrifugal and vacuum advance units, located in distributor.

Detonation (Knock) Retard Operation

The 929S and turbocharged models use an ignition retard system consisting of knock sensor(s) and knock control unit. The knock sensor detects engine detonation (knocking) in the engine and sends a signal to knock control unit. This signal is modified by the knock control unit and sent to the ECU.

Timing can be retarded up to 6 degrees, depending upon amount of knocking. On MX-6 turbo and 626 turbo models, knock control unit also controls turbocharger wastegate solenoid valve, lowering turbo boost pressure up to 2.2 psi during knock conditions.

EMISSION SYSTEMS

DECELERATION CONTROL SYSTEM (B2200 CARBURETED)

To reduce emissions and increase fuel economy during deceleration, a deceleration control system is used, consisting of a slow fuel-cut solenoid valve, a coasting richer solenoid valve, vacuum solenoid valve, dash pot and mixture control valve.

Slow fuel-cut solenoid valve closes primary slow fuel passage on command from ECU. Coasting richer solenoid valve supplies extra air/fuel mixture to add to primary slow fuel on command from ECU. Vacuum solenoid valve supplies intake manifold vacuum to distributor vacuum advance on command from ECU. Dashpot closes throttle valve gradually. Mixture control valve release air into intake during first stage of deceleration.

EXHAUST GAS RECIRCULATION (EGR) CONTROL

The Exhaust Gas Recirculation (EGR) system allows measured amounts of exhaust gas into the intake manifold to reduce oxides of nitrogen (NOx).

The EGR system on B2200 models consists of EGR control valve, EGR valve position sensor, duty solenoid valve, connecting hoses and pipes.

The EGR system on MX-6 and 626 models consists of EGR control valve, EGR modulator valve (non-turbo), EGR solenoid valve, EGR position sensor (Calif. and turbo), connecting hoses and pipes.

The EGR system on 929 models consists of EGR control valve, EGR solenoid valves (vacuum side and vent side), EGR position sensor, connecting hoses and pipes.

FUEL EVAPORATION SYSTEM

Fuel evaporation system prevents escape of raw fuel vapor to atmosphere. System components include fuel tank with integral vapor separator, check-and-cut valve, air vent solenoid valve (B2200 carbureted), purge control solenoid valve, charcoal canister, fuel filler cap, coolant thermovalve (except MX-6, 323, 626 and 929) and connecting lines.

Additional components include a 2-way check valve (MX-6, 323, 626 and 929) and emission control unit.

HOT IDLE COMPENSATION SYSTEM (B2200 CARBURETED)

Hot idle compensation system supplies additional air to the intake manifold to maintain smooth idle and reduce emissions. When intake air temperature is more than 153°F (67°C), the idle compensator valve opens and allows air directly into the intake manifold.

REED VALVE AIR INJECTION (B2200 CARBURETED)

Air injection system draws air into the exhaust system to reduce CO and HC emissions. Reed valve "A" supplies secondary air into exhaust manifold when air control valve No. 1 or 2 air passage opens and when both valves open. Reed valves "B" and "C" supply secondary air into exhaust pipe behind front catalytic converter through exhaust gas pulsations. Basic system components consist of a reed valve assembly, air control valve(s), catalytic converter(s) and connecting hoses and pipes.

THERMOSTATIC AIR CLEANER (B2200 CARBURETED)

The thermostatic air cleaner system controls temperature of air entering the carburetor, depending on outside air temperature. Thermostatic air cleaner system consists of air cleaner housing, bimetallic control valve, flexible air hose and heat stove.

A control valve, controlled by air temperature, opens allowing warm air from heat stove to mix with fuel. This assists in engine warm up, better combustion and emission control.

EVAPORATIVE EMISSION CONTROL

NOTE: Not all listed components are used on every vehicle system. Component usage depends on calibration of vehicle. See appropriate M - VACUUM DIAGRAMS article in the ENGINE PERFORMANCE section.

Canister Purge Solenoid Valve

This normally closed solenoid valve controls fuel vapor flow from canister to intake manifold. It is opened or closed by a signal from ECA during various engine operating modes.

Vapor Vent System

All vapor valves are mounted on fuel tank and use a small orifice which allows vapor (but not liquid) fuel to pass into line running to canister. Fuel vapors in fuel tank are vented though vapor valve assembly on top of fuel tank. Vapors are routed through a vapor line to carbon canister in engine compartment.

POSITIVE CRANKCASE VENTILATION (PCV)

The PCV system uses intake manifold vacuum to eliminate blow-by gases from crankcase. Manifold vacuum draws gases from crankcase, through PCV hose, into combustion chamber. The PCV valve is positioned in hose through which blow-by gases flow on their way to combustion chamber.

By opening and closing in direct relation to engine vacuum, the PCV valve meters blow-by gas flow to combustion chamber. During periods of high manifold vacuum, such as at idle and deceleration, valve is almost completely closed, limiting flow of gases. During cruise speeds, valve permits greatest flow of gases.

Under conditions in which excessively high amounts of blow-by gases are produced (such as worn cylinders or rings), system allows excess gases to flow back through crankcase vent hose and into intake manifold.

SELF DIAGNOSTIC SYSTEM

The ECU is equipped with a self-diagnostic system which detects system failures or abnormalities. When malfunction occurs, the Malfunction Indicator Light (MIL) on the instrument panel is turned on.

By analyzing various input signals, the ECU detects system malfunctions related to various operating parameter sensors. The ECU stores trouble codes associated with the detected failure until the diagnostic system is cleared. For further information see appropriate G - TEST W/ CODES article in the ENGINE PERFORMANCE section.

CHECK ENGINE LIGHT

Also called Malfunction Indicator Light (MIL) by manufacturer, comes on when ignition is turned on. Light remains on for several seconds after engine has started. If an abnormal input

signal occurs, light comes on and code is stored in memory. If the abnormal input signal returns to normal, ECU turns light off but code remains stored in memory until cleared. If ignition is turned on again, light will not come on until ECU detects another malfunction during system operation.

NOTE: ECU diagnostic memory is retained by direct power supply from battery. Memory is not erased by turning off ignition but is erased if battery or ECU is disconnected.

MISCELLANEOUS CONTROLS

NOTE: Although not considered true engine performance-related systems, some controlled devices may affect driveability if they malfunction.

A/C CLUTCH CYCLING PRESSURE SWITCH (CCPS) (NAVAJO)

On models with manual A/C system, the CCPS is mounted on top of the receiver-drier. Based on refrigerant system pressure, a signal is sent to the ECA. The ECA uses this signal to maintain system pressure within the programmed range.

WIDE OPEN THROTTLE A/C (WAC) CUT-OFF (NAVAJO)

During wide open throttle, WAC circuit interrupts power to A/C compressor clutch. The A/C remains off for about 3 seconds after returning from WOT.