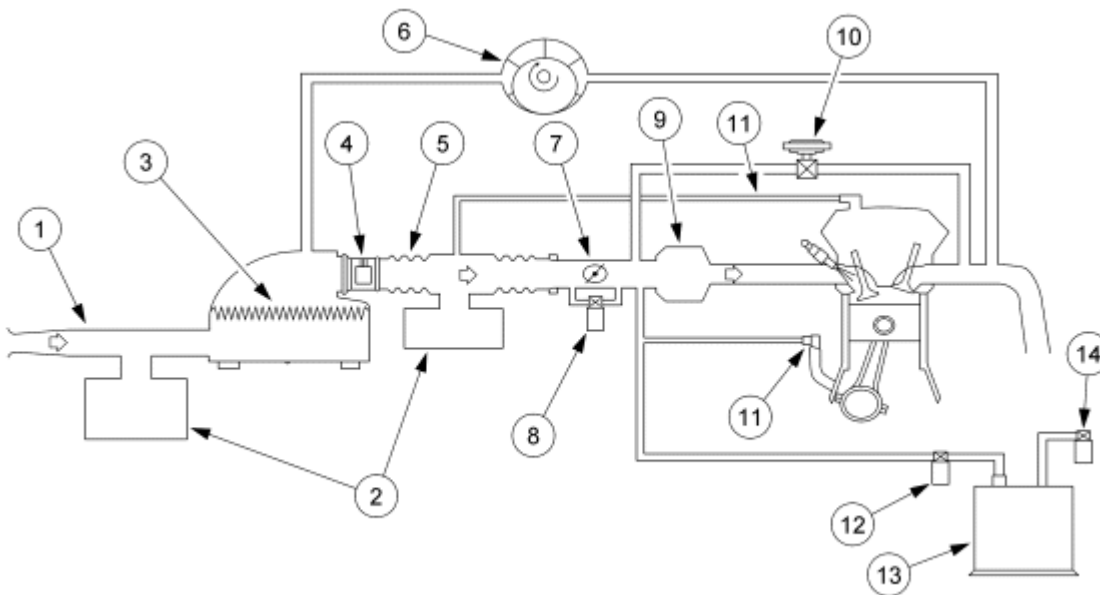


Intake Air Systems

Overview

The intake air system provides clean air to the engine, optimizes air flow, and reduces unwanted induction noise. The intake air system consists of an air cleaner assembly, resonator assemblies, and hoses. Some vehicles use a hydrocarbon filter trap to help reduce emissions by preventing fuel vapor from escaping into the atmosphere from the intake when the engine is off. It is typically located inside the intake air system. The mass air flow (MAF) sensor is attached to the air cleaner assembly and measures the volume of air delivered to the engine. The hydrocarbon trap is part of the EVAP system. For more information on the EVAP system, refer to [Evaporative Emission \(EVAP\) Systems](#) in this section. The MAF sensor can be replaced as an individual component. The intake air system also contains a sensor that measures the intake air temperature (IAT), which is integrated with the MAF sensor. For additional information on the intake air system components, refer to [Engine Control Components](#) in this section. Intake air components can be separate components or part of the intake air housing. The function of a resonator is to reduce induction noise. The intake air components are connected to each other and to the throttle body assembly with hoses.



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Typical Intake Air System

Intake Air System	Component
1	Air Cleaner Intake Pipe
2	Intake Air Resonator
3	Air Cleaner Element
4	Mass Air Flow/Intake Air Temperature
5	Air Cleaner Outlet
6	Secondary AIR Pump (if equipped)
7	Throttle Body
8	Idle Air Control
9	Upper Intake Manifold
10	Exhaust Gas Recirculation (EGR)

11	Positive Crankcase Ventilation (PCV)
12	Evaporative Emission Canister Purge Valve
13	Evaporative Emission Canister
14	Evaporative Emission Canister Vent (CV) Solenoid

Throttle Body System Overview

Note: This overview is for applications without electronic throttle control (ETC). For ETC applications, refer to [Torque Based Electronic Throttle Control \(ETC\)](#) in this section.

Note: The traditional idle air adjust procedure and the throttle return screw are no longer used on OBD applications.

The throttle body system meters air to the engine during idle, part throttle, and wide open throttle (WOT) conditions. The throttle body system consists of an idle air control (IAC) valve assembly, an idle air orifice, single or dual bores with butterfly valve throttle plates, and a throttle position (TP) sensor. One other source of idle air flow is the positive crankcase ventilation (PCV) system. The combined idle air flow (from idle air orifice IAC flow and PCV flow) is measured by the MAF sensor on all applications.

During idle, the throttle body assembly provides a set amount of air flow to the engine through the idle air passage and the PCV valve. The IAC valve assembly provides additional air when commanded by the powertrain control module (PCM) to maintain the correct engine idle speed under varying conditions. The IAC valve assembly mounts directly to the intake manifold assembly in most applications. Idle speed is controlled by the PCM and cannot be adjusted.

Throttle rotation is controlled by a cam/cable linkage to slow the initial opening rate of the throttle plate. The TP sensor monitors the throttle position and provides a signal to the PCM. Some throttle body applications provide an air supply channel upstream of the throttle plate to provide fresh air to the PCV or IAC systems. Other throttle body applications provide individual vacuum taps downstream of the throttle plate for PCV return, exhaust gas recirculation (EGR), evaporative emission (EVAP), and miscellaneous control signals.

Throttle Body System Hardware

The major components of the throttle body assembly include the TP sensor, the IAC valve assembly, and the throttle body housing assembly. For additional information on the intake air system components, refer to [Engine Control Components](#) in this section.

Throttle Body Housing

The throttle body housing assembly is a single piece aluminum or plastic casting with an air passage and a butterfly throttle plate with linkage mechanisms. When the throttle plate is in the idle (or closed) position, the throttle lever arm should be in contact with the throttle return stop. The throttle return stop prevents the throttle plate from contacting the bore and sticking closed. The setting also establishes the amount of air flow between the throttle plate and bore. To minimize the closed plate air flow, a special coating is applied to the throttle plate and bore to help seal this area. This sealant/coating also makes the throttle body resistant to engine intake sludge accumulation.

Features of the Throttle Body Assembly include:

1. IAC valve assembly mounted directly to the throttle body assembly (some vehicles).
2. A pre-set stop to locate the WOT position.
3. An air supply channel upstream of the throttle plate to provide fresh air to the PCV system (some vehicles only).
4. Individual vacuum taps for PCV, EGR, EVAP and miscellaneous control signals (some vehicles only).
5. PCV air return (if applicable).

6. A throttle body-mounted TP sensor.
7. A sealant/coating on the throttle bore and throttle plate makes the throttle body air flow tolerant to engine intake sludge accumulation. These throttle body assemblies must not be cleaned and have a white/black attention decal advising not to clean.
8. A non-adjustable stop screw for close plate idle air flow.

Overview of the Intake Manifold Runner Control (IMRC) and Intake Manifold Tuning Valve (IMTV) Systems

There are three basic types of intake air sub systems:

- IMRC electric actuated system
- IMRC vacuum actuated system
- IMTV

There are several different styles of hardware used to control airflow within the engine air intake system. In general, the devices are defined based on whether they control in-cylinder motion (charge motion) or manifold dynamics (tuning).

The IMRC is a charge motion device that modifies the air charge motion in the manifold. The IMRC control valve is located close to the intake valve/cylinder head. The IMRC actuator can be either electric or vacuum controlled. The IMRC system must have a monitor feedback system in order to meet OBDII regulations.

The IMTV is a manifold tuning device that effects the air flow volume of the manifold by connecting multiple plenums or inlets within the manifold system. The IMTV control valve is located in the center of the intake manifold away from the intake valve or cylinder head. The IMTV actuator can be either electric or vacuum controlled. The IMTV system does not have to be monitored for OBDII regulations.

Some vehicles may use both systems.

These subsystems are used to provide increased intake airflow to improve torque, emissions and performance. The overall volume of air metered to the engine is controlled by the throttle body. Vehicles equipped with electronic throttle control (ETC) do not use idle air control (IAC).

Intake Manifold Runner Control (IMRC) Electric Actuated System



WARNING: SUBSTANTIAL OPENING AND CLOSING TORQUE IS APPLIED BY THIS SYSTEM. TO PREVENT INJURY, BE CAREFUL TO KEEP FINGERS AWAY FROM LEVER MECHANISMS WHEN ACTUATED. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN PERSONAL INJURY.

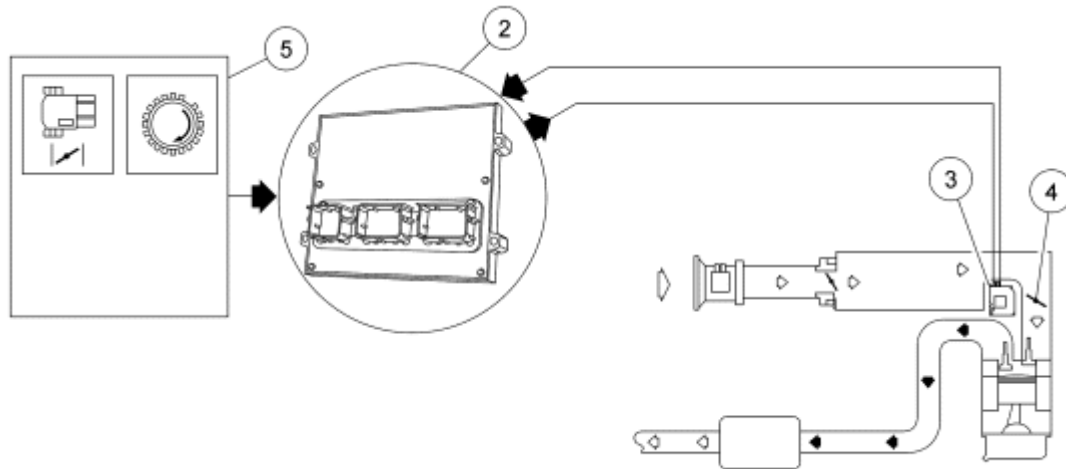
The IMRC electric actuated system consists of a remote mounted motorized actuator with an attaching linkage for each housing on each bank. For additional information on IMRC components, refer to [Engine Control Components](#) in this section. The linkage attaches to the housing butterfly plate levers. Some variations can have either two intake air passages for each cylinder with one passageway that is always open and the other is opened and closed with a butterfly valve plate. The other type has a butterfly valve with a small passageway that opens up into a larger size orifice when the butterfly plates are opened. The butterfly valve plates are opened and closed by an electric motor and the motorized actuator houses an internal switch or switches, depending on the application, to provide feedback to PCM indicating the butterfly valve plate position. If the IMRC system is not working correctly then a diagnostic trouble code (DTC) is set.

The motorized actuator does not energize below 3,000 RPM, allowing the linkage to fully extend and the butterfly plates to remain closed. The motorized actuator energizes above 3,000 RPM allowing the attaching linkage to pull the butterfly valve plates open. Some vehicles activate the IMRC near 1,500 RPM.

1. The PCM uses the TP sensor and CKP signals to determine activation of the IMRC system. There must be a positive change in voltage from the TP sensor along with the increase in RPM to open the valve plates.
2. The PCM uses the information from the input signals to control the IMRC motorized actuator based upon

RPM and changes in the throttle position.

3. The PCM energizes the actuator to open the butterfly plates.
4. The IMRC housing contains butterfly plates to allow increased air flow.



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Intake Manifold Runner Control (IMRC) Electric Actuated System.

Intake Manifold Runner Control (IMRC) Vacuum Actuated System

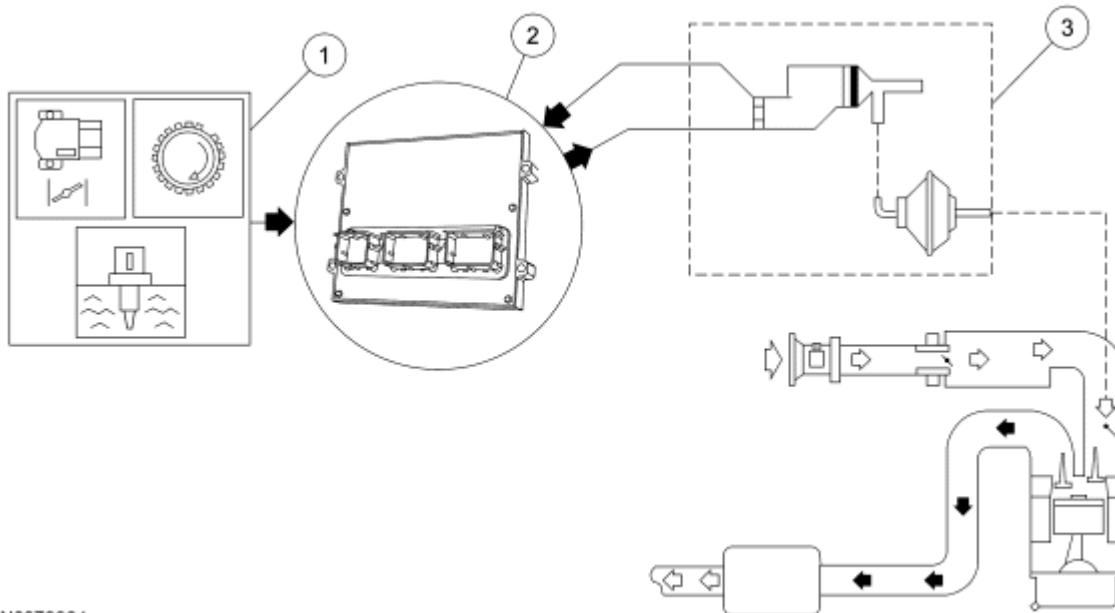


WARNING: SUBSTANTIAL OPENING AND CLOSING TORQUE IS APPLIED BY THIS SYSTEM. TO PREVENT INJURY, BE CAREFUL TO KEEP FINGERS AWAY FROM LEVER MECHANISMS WHEN ACTUATED. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN PERSONAL INJURY.

The IMRC vacuum actuated system consists of a manifold mounted vacuum actuator and a PCM controlled electric solenoid. For additional information on IMRC vacuum actuated components, refer to [Engine Control Components](#) in this section. The linkage from the actuator attaches to the manifold butterfly plate lever. The IMRC actuator and manifold are composite/plastic with a single intake air passage for each cylinder. The passage has a butterfly valve plate that blocks a large percentage of the opening when actuated, leaving the top of the passage open to generate turbulence. The housing uses a return spring to hold the butterfly valve plates open. The vacuum actuator houses an internal monitor circuit to provide feedback to the PCM indicating the butterfly valve plate position.

The vacuum solenoid does not energize below 3,000 RPM, allowing the manifold vacuum to be applied and the butterfly valve plates to remain closed. The vacuum solenoid de-energizes above 3,000 RPM allowing the vacuum to vent from the actuator and the butterfly valve plates to open.

1. The PCM monitors the TP sensor, CHT, and CKP signals to determine activation of the IMRC system. There must be a positive change in voltage from the TP sensor along with the increase in RPM at the correct engine temperature to open the butterfly valve plates.
2. The PCM uses the information from the input signals to control the IMRC electric solenoid based upon changes in the throttle position, the engine temperature, and the RPM.
3. The PCM energizes the solenoid with the ignition on and the engine running. Vacuum is then applied to the actuator to pull the butterfly valve plates closed.



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Intake Manifold Runner Control (IMRC) Vacuum Actuated System

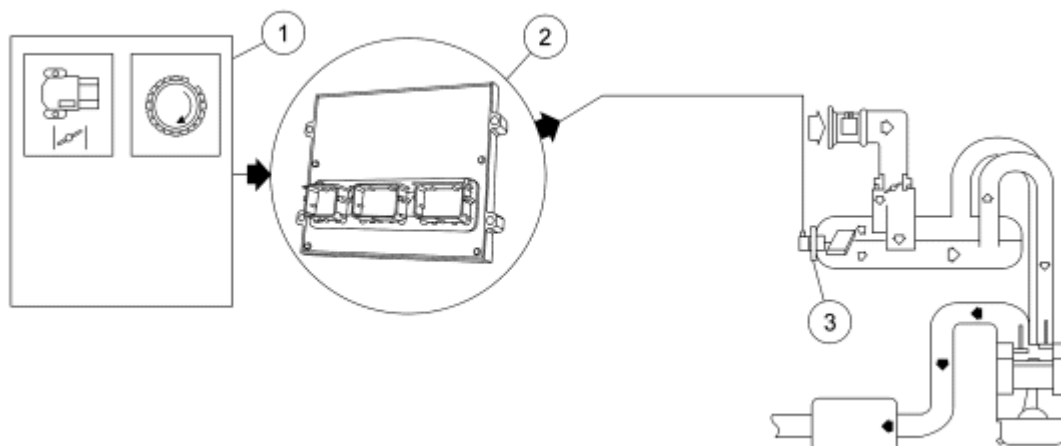
Intake Manifold Tuning Valve (IMTV) System

⚠ WARNING: SUBSTANTIAL OPENING AND CLOSING TORQUE IS APPLIED BY THIS SYSTEM. TO PREVENT INJURY, BE CAREFUL TO KEEP FINGERS AWAY FROM LEVER MECHANISMS WHEN ACTUATED. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN PERSONAL INJURY.

The IMTV is a motorized actuated unit mounted directly to the intake manifold. For additional information on IMTV components, refer to [Engine Control Components](#) in this section.

The motorized IMTV unit is not energized below a calibrated RPM. The shutter is in the closed position not allowing airflow blend to occur in the intake manifold. Above a calibrated RPM the motorized unit is energized. The motorized unit is commanded on by the PCM initially at a 100 percent duty cycle to move the shutter to the open position, and then falling to approximately 50 percent to continue to hold the shutter open.

1. The PCM uses the TP sensor and CKP signals to determine activation of the IMTV system. There must be a positive change in voltage from the TP sensor along with the increase in RPM to open the shutter.
2. The PCM uses the information from the input signals to control the IMTV.
3. When commanded on by the PCM, the motorized actuator shutter opens up the end of the vertical separating wall at high engine speeds to allow both sides of the manifold to blend together.



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Intake Manifold Tuning Valve (IMTV)

