23 Idle Control / Idle Air Control (IAC) Valve

23.1 General Overview

Idle control, along with fuel control are two of the most important sub-systems of the PGMFI fuel injection system. These two systems have a large impact on the driveability of a car. If the idle control system is not operating correctly, many driveability symptoms can occur, some of which are:

- Idle RPM too high
- Idle fluctuating wildly
- Idle RPM too low and/or erratic
- Idle fluctuating when loads occur to the engine
- Fast idle too low for cold starts

The main output device that controls engine idle is the idle air control (IAC) valve. This valve was added to all models in 1988 and is controlled by at least the following inputs:

- Air Conditioning Switch
- Brake Light Switch
- Clutch Switch (Manual Transmissions)
- Electric Load Detector (ELD)
- Engine Coolant Temp (ECT) Sensor
- Engine RPM
- Gear Position Switch (Automatics)
- Power Steering Pressure (PSP) Switch
- Starter Signal Input

The Honda PGMFI system is a speed/density type fuel injection system. It does not measure actual mass airflow, but calculates it from the engine RPM and the manifold absolute pressure (MAP) sensor input. On speed/density fuel injection systems, idle is controlled by simply controlling the air that bypasses the throttle plate.

The idle control system is one of the PGMFI sub systems that has seen a lot of change since the first 1985 models. The early idle control systems were primitive by today's standards. The curb idle was set by an air by-pass screw in the throttle body. This screw controlled how much air bypassed the throttle blade. Except for the fast idle controls the only other feature was a vacuum diaphragm that opened the throttle to offset the air conditioning compressor load.

The idle control systems of these earlier models had the characteristics of a carburetor. The engine control module (ECM) had no control over the idle other than the air conditioning vacuum diaphragm. To help make the idle more stable, the

Module 23
Idle Control / Idle Air Control (IAC) Valve

Author: Grant Swaim

E-mail: sureseal@nr.infi.net

URL: www.tech2tech.net

Phone: (336) 632-9882

Fax: (336) 632-9688

Postal Address: Tech-2-Tech Website
PO Box 18443
Greensboro, NC 27419

Physical Address: 220-4 Swing Rd
Greensboro, NC 27409

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- Misfire Monitor
- Oxygen Sensor Monitor
- Oxygen Sensor Heater Monitor
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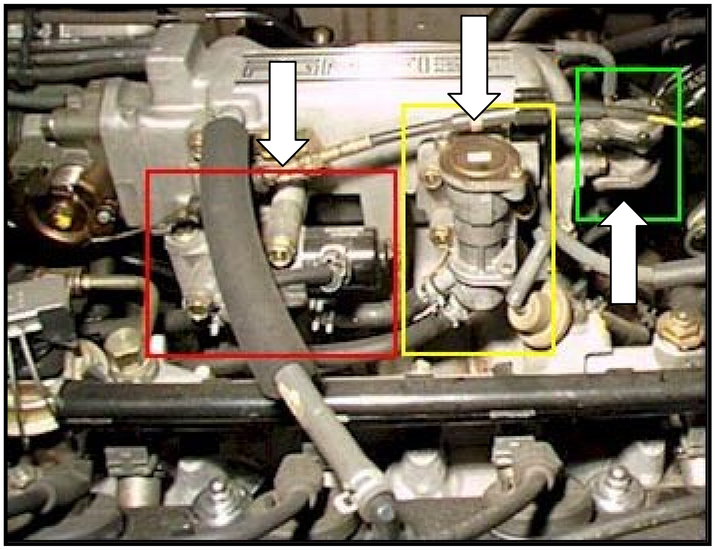
Miscellaneous Training Material

- Glossary of Terms

ECM would typically widen the injector pulse width (PW) slightly, and increase timing, when any type of load was sensed.

23.2 Methods Used To Control Idle RPM

Image 23-1 Idle Controllers



Honda has used at least five different methods to control idle speed. In many cases you will find several different methods used on the same car. The engine shown in Image 23-1 utilizes three of the main idle control methods.

Honda used all these methods over the years. Sometimes the same task would be handled using one method on one model and another method for the same task on another model within the same year. This training module will not attempt to identify exactly which method is used on what model. The training module will explain all the idle control tasks, but will not identify exactly which method is used to perform the tasks on each model.

With a little practice, a tech should be able to identify all the methods used to perform idle control tasks, on any given Honda model by performing an underhood inspection. This is helpful since most specific idle problems can be associated with specific idle control task and the method used to perform the task.

The six main methods used to control idle speed are summarized below:

23.2.1 IAC Valve

The left most arrow, in Image 23-1, highlights an IAC valve. The IAC valve was added in 1988 to all models and it gave the ECM total control over the idle. The IAC valve is covered in detail in the "Basic Idle Speed" section.

23.2.2 Fast Idle Thermo Valve

The middle arrow, in Image 23-1, highlights the fast idle thermo valve, which is an all mechanical valve. The valve is heat sensitive and it will let air bypass the throttle plate when the engine is cold. The fast idle valve is covered in detail in the "Fast Idle" section.

23.2.3 Starting Air Valve

The right most arrow, in Image 23-1, highlights a vacuum activated mechanical valve that is used to add air at each start-up to temporarily increase idle speed. The valve is covered in more detail in the "Extra Air at Start-Up" section.

23.2.4 Air Dump Solenoid

A fourth technique used to add air to the intake manifold under certain circumstances is the use of an air dump solenoid. The solenoid is usually located in an emission box. The solenoid would be activated by the ECM to add a fixed amount of air to the intake manifold.

Air dump solenoids have been used by different models to compensate for a number of different loads. They have been used to offset for A/Cs, automatic transmission loads, and to add air at initial startup.

23.2.5 Throttle Kick-Up Vacuum Diaphragm

The fifth technique used to control idle was the use of a simple vacuum diaphragm to actually open the throttle valve a set amount. This technique is covered in more detail in the "Air Conditioning Idle Boost" section.

23.2.6 Pulse Width and Ignition Timing

When the ECM senses a load on the engine, it will typically enrichen the air/fuel mixture and add several degrees of ignition timing. This helps to stabilize the idle. This method is covered in more detail in the "Load Event" section.

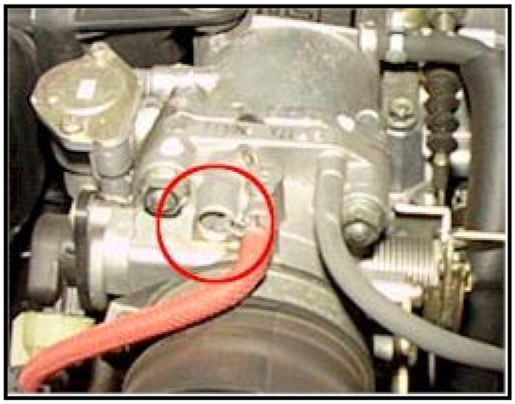
23.3 The Idle Control Tasks

On all models, certain idle control tasks must be performed. Over the years several different methods were used to perform these tasks. Following is a listing of idle control tasks that have to be performed on every Honda by using some method or a combination of methods.

23.3.1 Idle Speed Control

The idle control systems on the earliest PGMFI systems were very basic. Other than a fast idle system and an air conditioning idle boost, the idle was totally controlled by how much air bypassed the throttle plate. This bypass air was controlled by the idle air bypass screw. The idle air bypass screw is a large brass screw with a flat slot and is located on the throttle body. The idle air bypass screw in Image 23-2 is shown inside the circle.

Image 23-2 Air Bypass Screw



To adjust the idle follow the instructions from the underhood label or the service manual. The technique used to set idle for models with an IAC valve is different than the earlier models.

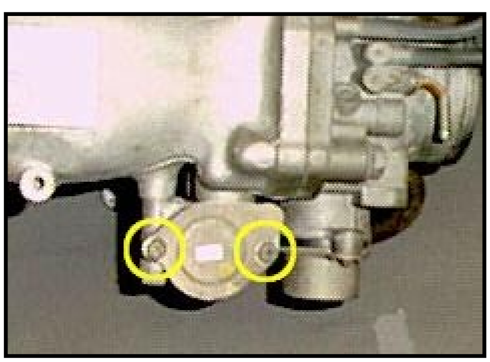
In 1988 Honda added an IAC valve to the PGMFI system. By adding the IAC valve the ECM now had full control over the idle. The IAC valve is an electrically activated valve that controls the amount of air that bypasses the throttle blade. Now the ECM could increase the idle to offset the load from any event that occurred. An IAC valve is shown at the left most arrow, in Image 23-1.

23.3.2 Fast Idle

When a Honda is started cold, the idle must be increased until the engine warms up. This is accomplished by the use of a fast idle thermo valve on most models. The fast idle valve is located at the middle arrow in, Image 23-1.

The valves were used by the first PGMFI systems in 1985 and have been used on most models until the late 90s. When the IAC valve was added to all models in 1988, the fast idle thermo valve was kept. Many newer systems have dropped the fast idle valve and use the IAC valve for all idle control. When this is done the 3-wired systems are usually used.

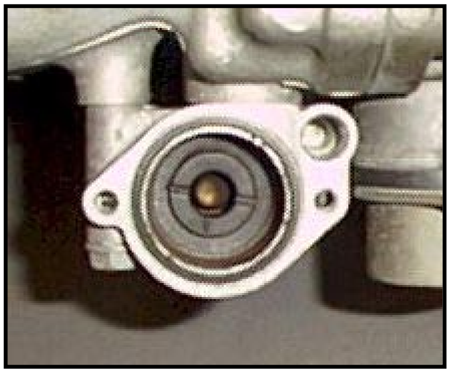
Image 23-3



The valve is open when cold (below 86 Deg F) and will gradually close as the car warms up. When the valve is open it allows air to by-pass the throttle blade. The valve is closed by an expanding wax pellet that is heated up by the engine's coolant. The valve is opened by a spring that opposes the force from the wax pellet. When the engine has reached a certain temperature, the fast idle valve will be completely closed and the idle will be under the control of the IAC valve (on 88 and later models).

The fast idle valve, being an all mechanical device, does tend to give some problems. The most common problem is that the expanding wax pellet gets "lazy" and the valve will not completely close.

Figure 23.4



You can easily check the valve by removing the two screws shown inside the circles in Image 23-3, and removing the lid.

If the valve does not completely close down (after the coolant has reached 86 Deg F), the IAC valve will not be able to control the idle speed with this additional air entering the intake.

You check for the valve closing down completely by sticking your finger in the hole in the middle of the seat (shown in Image 23-4). If the plunger is not sealing off the air on the seat, you will feel suction. You can usually hear air rushing also.

If a fast idle thermovalve is not closing down when the engine is fully warmed the valve should be replaced. While some techs readjust the valve seat when the IAC valve does not close off at full operating temperature, it is not a good practice. When the wax pellet gets "lazy" and the plunger does not fully close, adjusting the valve seat down to meet the plunger cuts RPMs off the fast idle on cold start-ups.

Also note that a Honda with a coolant system that is not heating up properly may not cause the thermovalve to close completely. Before replacing a thermovalve, make sure the cooling system is working properly and a good supply of coolant is being supplied to the valve.

23.3.3 Extra Air at Start-Up

When a Honda is initially started up, it will run better right after start up if additional air is added to the intake manifold. This is accomplished either by a mechanical starting air valve, electronically by the ECM activating an "air dump" solenoid, or handled by the IAC valve. A mechanical starting air valve is shown at the right most arrow, in Image 23-1.

Image 23-5

The mechanical style uses a starting air valve, which is normally open and allows air to enter the intake manifold. While the engine is cranking this valve is open and adding air. Once the engine has started the rising intake manifold vacuum will close the valve down and no more air will be added to the manifold from this valve.

Some models do not use a mechanical valve but do dump additional air into the manifold by activating a solenoid (shown in Image 23-5). The ECM activates a solenoid (usually located in an emission box), which adds air to the intake during starting.

When the IAC valve was added in 1988, many models added extra air at start-up with it. Some models still retained a starting air valve or an air dump solenoid even after an IAC valve was added.

23.3.4 Air Conditioning Idle Boost

All Honda PGMFI systems have a way to compensate for the load of the air conditioning. At least four different methods have been used over the years to do this. Following is a closer look at the methods used by the PGMFI system.

The earliest systems used a vacuum diaphragm to actually open the throttle much like the earlier carbureted systems did. This system was only used for a couple of years.

Image 23-6 A/C Boost

When the A/C was turned on the ECM would activate a solenoid that applied vacuum to the idle boost diaphragm (inside the large circle in Image 23-6). The idle speed, for when the A/C was activated, was set by a screw in the linkage (inside the small circle).

All the A/C idle boost methods used since the diaphragm method do not open the throttle, they add air to the intake manifold.

Image 23-7 A/C Boost

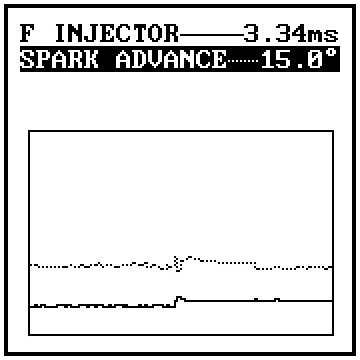
One of the earlier methods used to boost the idle was a valve like pictured in Image 23-7. When the A/C was turned on, the ECM would activate a solenoid that would apply vacuum to the top hose. This would open a valve that would let air enter the intake manifold. The amount of air that was added was controlled by the white plastic knob (shown inside the circle).

Air dump solenoids were used on a few models to add a specific amount of air to offset the load of the A/C.

The latest method used is to simply use the IAC valve to offset the load of the A/C. When the IAC valve was first added, in 1988, many models still used some of the other methods to control A/C load. Later models use the IAC valve only to control operational idle.

23.3.5 Load Events

Screen Capture 23-1



The Honda engines run so lean at idle that virtually any event will cause the idle to "bobble". When a load event occurs, more than just the IAC valve makes a correction. Small changes are also made to the PW and the ignition timing.

Screen Capture 23-1 shows the effect of an electrical load on the PW and ignition timing. This technique was used prior to the IAC valve in an attempt to help stabilize the idle when loads occurred.

Even with the addition of the IAC valve, this strategy continued. When a load occurs on a late model car, the IAC valve opens, the PW widens, and the timing is increased.

The ECM monitors the idle and will compensate for any load that attempts to pull the idle down. The disadvantage with this approach is that the idle must start dropping before the ECM can make a correction. This would result in the idle "bobbling" on every load event.

To help prevent this, the ECM monitors most components that could have a significant effect on the base idle. It can then begin making a correction before the idle has a chance to drop. The PCM is programmed to apply a specific package of adjustments to the IAC valve, PW, and ignition timing for each load event signal.

Some of the inputs that are used by the ECM to anticipate a load are:

- A/T Gear Position Switch
- Air Conditioning Switch
- Brake Light Switch
- Clutch Switch
- Electrical Load Detector (ELD) Sensor
- Power Steering Pressure (PSP) Switch

23.4 Idle Air Control (IAC) Valve Overview

Honda used two different types of IAC valves. The most popular is the 2-wire unit. The two wire IAC valve uses current through a winding to open a plunger against a spring. On some of the later model Hondas, a 3-wire IAC valve is used.

The 3-wire is a rotary type valve. The following information applies to the 2-wire IAC valve. The 3-wire IAC valve is covered at the end to this section.

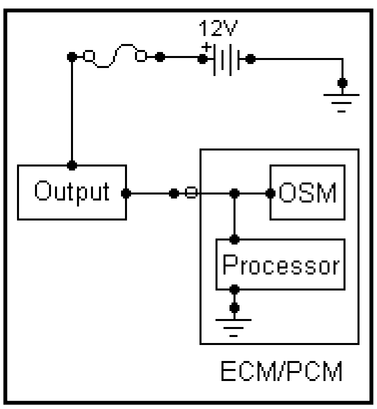
The models with IAC valves still have an idle air bypass screw that allows the base idle to be set. The base idle speed is set by unplugging the IAC valve and adjusting the idle air bypass screw. Unplugging the IAC valve will set a diagnostic trouble code (DTC). It is best to clear the DTC with scan tool so that adaptive learning will not be lost.

The base idle speed is important. If the base idle is set too high, the IAC valve will not be able to bring down the idle speed by reducing the bypass air. If the base idle is set too low, the IAC valve will not be able to add enough air to compensate for large loads.

When the base idle speed is set correctly, the IAC valve will need to open some to supply additional air for the engine to reach correct idle speed.

23.5 Two Wire IAC Valve

Illustration 23-1



The 2-wire IAC valve is supplied battery voltage on one side of its winding and the ECM supplies an electronically simulated ground on the other side, as shown in Illustration 23-1.

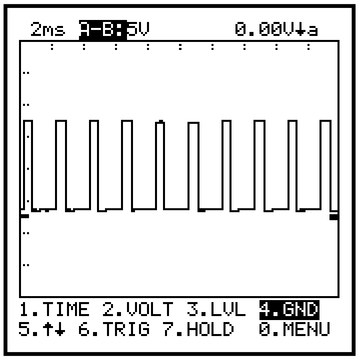
The ECM controls the current in the IAC valve winding by controlling the amount of time the ground is supplied to the IAC valve. The amount of current that flows through the IAC valve windings control how strong the magnetic force is that opens the plunger against spring tension.

On OBD-II equipped Hondas, the functionality of the IAC valve is checked by an output state monitor (OSM) inside the ECM. The current needed to operate the IAC valve is compared to a standard. If the current requirements deviate significantly from the normal level a DTC could be set.

The ground signal supplied by the ECM is a duty cycle type signal. The current is controlled in the IAC valve winding by controlling the amount of time the ground is supplied.

The valve does not fully open and close, but is held open a certain amount by the current in the valve windings. The ground is turned on and off so fast that the plunger does not have enough time to fully closed.

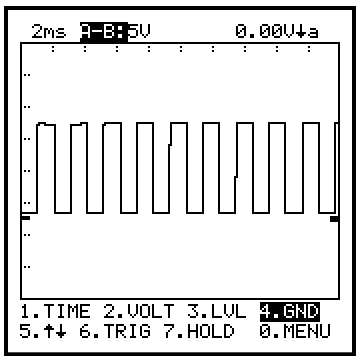
Screen Capture 23-2



In Screen Capture 23-2 you can see the voltage reading of an IAC valve ground wire taken with a digital storage oscilloscope (DSO). When the voltage is at 0v (at the bottom of the signal) a ground is being supplied to the IAC valve and current is flowing through the IAC valve winding.

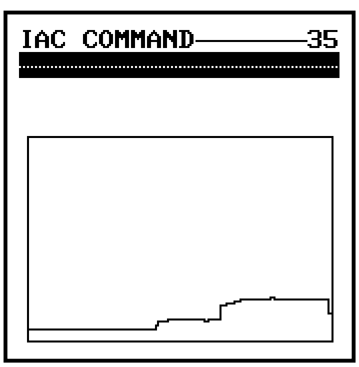
The DSO Screen Capture 23-2 was taken on a cold engine. You can see that the ground time (0 volts) is more than the no ground time (battery voltage). This causes the IAC valve to be more open and increases the idle.

Screen Capture 23-3



Screen Capture 23-3 is the same car but just warmed up to normal operating temperature. You will notice now that the on/off time is virtually the same.

Screen Capture 23-4



Screen Capture 23-4 shows the IAC valve current as loads are created. Turning on the defrosters made the first "hump" and turning on the air conditioning created the second one.

This is the information that is available by using a Mastertech with the Honda/Acura software on some models as early as 1992. Many scan tools cannot provide this information prior to OBD-II. Since "IAC Command" is an OBD-II defined parameter, it is available on all OBD-II equipped models with a generic scan tool (GST).

When you use the Mastertech unit with the Honda/Acura software on pre OBD-II Hondas, the unit of measure is in amperes. The unit of measure for IAC valves since OBD-II is in "counts". It is a relative number that increases when the IAC valve current increases and decreases when the IAC valve current decreases.

The IAC valve is supplied heated water, via two small coolant hoses, to keep the valve from developing ice during cold operation. The IAC valve is not sensitive to the temperature increase from the heated water. The position of the IAC valve's plunger is totally dependent upon the amount of time the ground is on, which is controlled by the ECM.

IAC valves traditionally give very little trouble. You can test them for full open and full close operation as follows:

23.5.1 To Cause the IAC Valve to Fully Close

If you want to test the IAC valve to make sure it will fully close down, you can temporarily unplug it. When you unplug the IAC valve the idle should drop to the base idle. When the car is fully warmed up, and is on base idle, all the air is being controlled on the idle bypass screw. If the idle air bypass screw does not seem to have total control over the idle, the IAC valve may not be shutting down completely, or there is another source of unmetered air.

23.5.2 To Cause the IAC Valve to Fully Open

If you want to test the IAC valve to make sure it will fully open, you can temporarily ground the wire that goes from the IAC valve to the ECM. One wire will read steady battery voltage, and one will have varying volts. The varying volts wire is the one you should ground. When you ground this wire, the idle should increase significantly.

You can also test the 2-wire IAC valve winding with an ohmmeter. Make sure there is no continuity between the winding and the case. Check for approximately 11.5 ohms on the winding itself.

23.6 Rotary Type IAC Valves (3-Wire Units)

The 3-wire IAC valve is a rotary type valve and can handle larger volumes of bypass air. Usually a model using a 3-wire IAC valve will not utilize a fast idle thermo valve. You will find a 3-wire IAC valve on 96-98 Civics (with A/T), 98 Accords, and 98 Odyssey.

Very little theory of operation or testing information is revealed in the Honda service manuals about the 3-wire IAC valves. I will be doing further field research and will have more theory of operation information and testing information available soon !

You can check the 3-wire IAC valve with an ohm meter. The center terminal is the power feed to two windings. The two outside terminals are grounds for each of the two windings and they are connected to the ECM. You should read 16-28 ohms between the center terminal and each outside terminal. As usual, you should have no continuity between any windings and the body of the IAC valve.

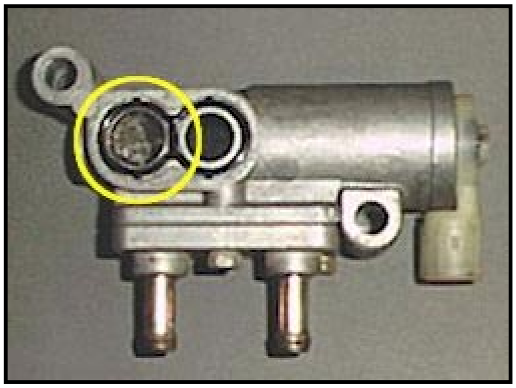
23.7 Service Issues

The idle control systems on Hondas are more prone to malfunction since they are a blend of mechanical and electrical devices. Also, older Hondas may use many of the different idle control methods on one car. Later model Hondas are less prone to idle control problems since virtually all the idle control is done with one component, the IAC valve.

Following is some of the more common service problems that you may experience in the field.

23.7.1 IAC Valve Not Responding to a Load

Image 23-8



If you have a Honda that is equipped with an IAC valve and it does not appear to be responding to a load, check for a blocked inlet screen (shown inside the circle in Image 23-8). The inlet screen can become clogged, and stop bypass air even if the IAC valve is open.

The inlet screen had been used on some models, but there seems to be no pattern. Most IAC valves do not have this screen, but you should be aware if it.

23.7.2 Engine RPM "Dips" When a Load Event Occurs

If the RPM dips or bobbles when a certain load is introduced, it is probably not getting an "advanced warning" about the load. For instance, if every time you turn the steering wheel the idle fluctuates, the ECM is probably not getting a signal from the PSP switch.

23.7.3 Idle Speed Too High

This seems to be one of the more common problems with the idle control system. Since the PGMFI is a speed/density fuel injection system, any additional air will cause the idle to increase. Some of the sources of additional air could be:

- Intake manifold to cylinder head vacuum leaks
- IAC valve not closing down
- Base idle speed set too high
- Throttle blade not closing completely
- Vacuum leaks from vacuum lines
- Vacuum leak from a vacuum operated component
- Fast idle thermovalve not closing

The most common reason for a high idle is a defective fast idle thermovalve. The testing of this valve was covered earlier in this module.

The second most common problem is that the throttle plate is not shut. The PGMFI system is designed to run with the throttle shut and all the air that enters the engine at idle bypassing the throttle plate.

Image 23-9 Throttle Stop Srew

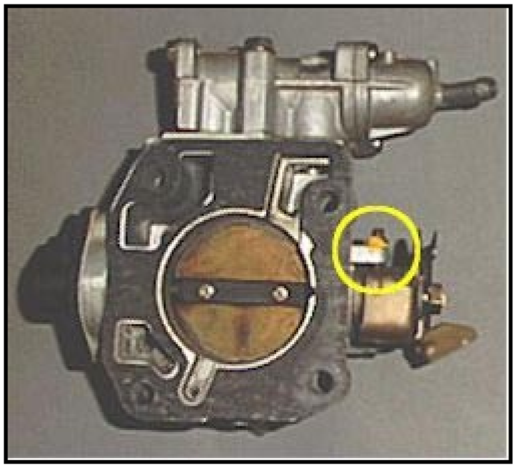


Image 23-10 Throttle Stop Screw

The first thing to check for is a tight throttle cable. This is fairly common, especially on Civics. Make sure the cable has slack when the car is at idle.

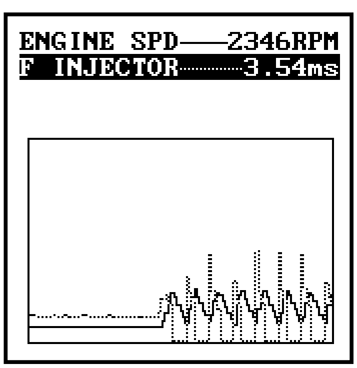
If the cable is not too tight, but you suspect the throttle is being held open, check the throttle stop screw. The throttle has an external stop that keeps the throttle blade from actually hitting the bore of the throttle body. It is set at the factory and should never need setting.

Images 23-9 and 23-10 show a typical throttle stop screw on a multi port injection system and a dual point injection system. The screws are usually hard to find since you should not be adjusting on them. Look and see if the yellow paint has been broken. It is not uncommon to find that somebody has used this screw to set the idle.

Honda does not offer an adjustment procedure for this screw since it is a factory setting. If the throttle stop needs setting simply unscrew it until the throttle is resting against the bore. Then turn the stop screw in until it starts moving the throttle. Go an additional 1/2 turn or so

23.7.4 Idle Fluctuates Wildly

Screen Capture 23-5



This situation is also common. This is not really a malfunction, but more of a symptom. It is symptom of an idle that is too high after the car is fully warmed

What is actually going on is the ECM's fuel cut on deceleration strategy is cutting the injectors off at 1100 RPM. You can see this from the scan tool Screen Capture 23-5. When the solid line (RPM) goes up to 1100, the dotted line (PW) goes to zero. When the RPM drops to below 1100 the injector turns back on. This cycle will repeat until the idle is brought below 1100 RPM.

The ECM determines that the car is decelerating if it sees the throttle closed and the RPM above 1100 RPM. During deceleration (at normal operating temperature) the ECM cuts the injectors off for fuel economy and emissions control. This same situation occurs if the idle RPM is too high (throttle closed and over 1100 RPM).

To correct this problem look for the source of air that is causing the engine to idle so high.