Sniffing Out Trouble:

Diagnosing Honda Emissions Systems

How many times has a customer brought a car to your shop for a 'tune-up,' when the unspoken reason for the visit was because the car had failed an emissions test? Some customers may 'forget' to mention this important piece of information. But if you screw in some new plugs and replace the fuel and air filters, the car is pretty likely to go out the door blowing the same tailpipe mix it came in with.

What comes out the tailpipe depends on the proper performance of several systems. Like every other car, Hondas have specific components that are responsible for controlling emissions. If you're not aware what they are and how they work, you'll have a heck of a time getting one to run clean. Familiarity with these systems allows you to tell almost at a glance whether they are functioning properly or not.

This time around, we'll get into possible causes why a carbureted Honda has failed an emissions test, and we'll describe what to test if something does go wrong. Although many of these cars are still delivering reliable transportation to their owners, they're also getting pretty long in the tooth. Consequently, there are some components — like air temp switches, power valves, and air control valves to name a few — that need your scrutiny, just because these vehicles are likely to have many miles on them. We'll start at the beginning with non-feedback-controlled models, and work our way through the later feedback-controlled, carbureted Hondas.

Non-Feedback-Controlled Hondas

Carbureted Hondas prior to 1984 do not have an oxygen sensor in the exhaust manifold and consequently have no feedback mixture control. These cars have an EGR system that's controlled by ported vacuum, which means 2-4 in. hg vacuum should be present at the EGR valve vacuum port at about 4000 rpm. A secondary or pulse-air system pumps air into the exhaust at all engine speeds above idle to afterburn residual fuel. If one of these vehicles fails an emissions test, check for leaking carb secondaries, a vacuum leak at the carb insulator, a failed cat or a ruptured power valve diaphragm. These are the most common causes.

Feedback-Controlled Hondas

It is a mistake to say a Honda has a "feedback carburetor." The carburetor's function remains unchanged from open to closed loop. To correct an overrich mixture on a carbureted Honda, frequency solenoid controlled air correction adds air directly to the intake manifold. This correction only occurs at cruising speeds with a warm engine.

Right: *The red test lead attached to this 1989 Accord air temperature thermistor reads 3.367 volts at 74 degrees Fahrenheit. There should be no secondary air at or below this temperature. The temperature quickly increases a few seconds after engine startup. At roughly 2.5 volts, the secondary air should start gurgling.*

The carb is jetted slightly rich to deliver good cold driveability. Consequently, anything that makes the engine stay in open loop and fail an emissions test will also affect fuel economy. In addition to the air control system, which truly corrects the air/fuel mixture before it enters the cylinder, Hondas also use secondary air injection — a reed valve system introduces fresh air in the exhaust to burn off fuel residue (at warm idle).

Temperature Sensor

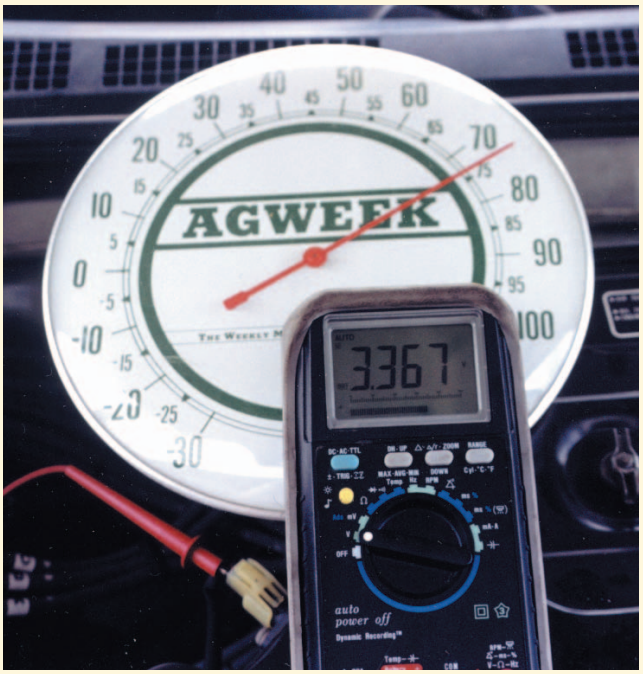
When the engine is started cold, there is no fuel or exhaust emission control of any kind until the air temp switch or sensor (depending on model year) signals the ECU that intake air temperature is high enough to control emissions without affecting driveability. On 1984-85 Accords, the switch is closed above 65 degrees F. 1984-87 Civics and Preludes have a similar switch, but they are open above the 65 degree value. 1986-89 Accords use a thermistor to provide a variable resistance reading, rather than a simple open/closed signal.

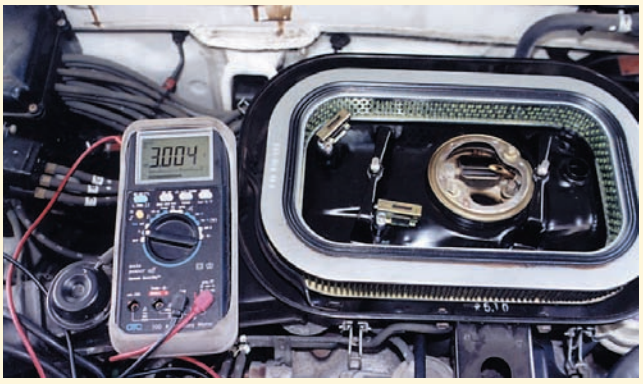
Secondary Air

Secondary air (pulse-air) is an air supply connected to the exhaust through a reed valve system. After each exhaust pulse, there is a vacuum wave in the exhaust. The reed valve allows fresh air into the exhaust during the vacuum wave, but blocks the exhaust pressure wave from backing up into the air cleaner.

On Hondas, secondary air comes through a large (thumb-sized) port in the air cleaner base, through a rubber hose, to a large black plastic silencer. This is on the intake manifold behind the valve cover on Accords. On Civics, it's on the passenger side of the carb, and on Preludes it's by the upper timing cover. From the reed valve, a steel pipe leads under the distributor and into the passenger side of the exhaust manifold (all models).

As the air temp switch closes (or warms to about 2.5 volts on the 1986-89 Accords with the thermistor), watch for the pulse-air system to start operating. Listen for a gurgling sound in the large vacuum hose. If you remove the air cleaner lid to listen for this sound, the carb will not draw air from the snorkel (where the air temp sensor is), and the sensor may cool to an open-loop value. On Civics and Preludes, unplugging the switch will tell it to go back to the control mode. On 1984-85 Accords, jump the air-temp switch wires together. On 1986-89 Accords, the NTC thermistor must be plugged in and warm.

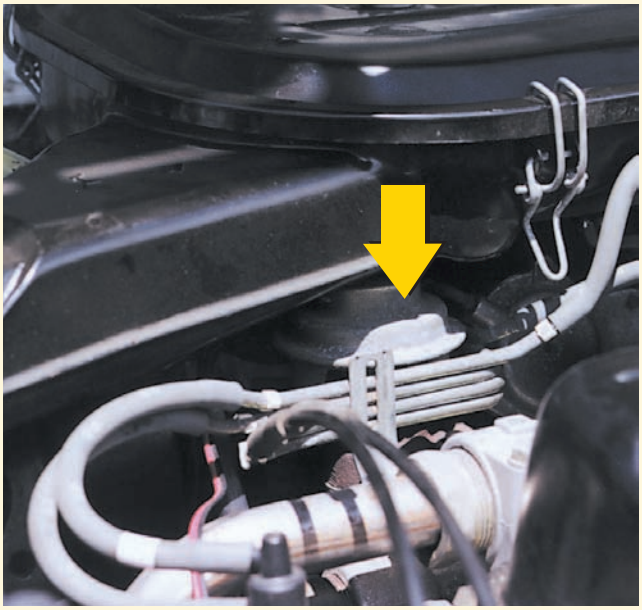




Above: *The two bimetallic vacuum control switches are visible with the air cleaner lid removed. The switch at the upper left controls vacuum to the hot air door in the snorkel, which should have vacuum to it at temps below 100 degrees F. Above that, the bimetallic switch opens and vents vacuum. Remove the brass cap (but don't snag the valve), then press down on the strip between the screw and stopper to raise the opening temperature. Tug lightly upward on the stopper end to lower it.*

The vacuum switch closest to the valve cover is the bleed for the secondary air diaphragm. This should be closed below 130 degrees F, and bend up (open) to shut off secondary air above 130 degrees. Both of these switches can get bent if someone is in a big hurry when replacing the air filter.

The large opening at three o'clock from the carb throat supplies filtered air to the silencer, then on to the secondary air control valves. Barely visible behind the large port is the small vent opening for hose 17. The engine will not idle If this hose is capped.



Lower: *We're looking over the top of the distributor to spot the EGR valve under the air cleaner snorkel (arrow). Above 4000 rpm, look for about 1-4 inches of vacuum to hose 16 at the EGR. The EGR valve should hold vacuum, and it should cause the engine to stall if applied at idle.*

Left: *The secondary air reed valve assembly is the rectangle with a diaphragm on top. Hose 5 should supply engine vacuum to the diaphragm when the engine is warm. If removing vacuum or the air cleaner lid cures a stalling problem, one of the reeds inside the valve has probably broken and exhaust is blowing back into the air cleaner. Exhaust is routed from the passenger side of the exhaust manifold through a large steel tube that passes under the distributor.*

Secondary Air Reed Valves

There should be no signs of soot in the air cleaner or the large hose. If you must remove the air cleaner lid to get the engine to run, and reinstalling the lid makes it stall, one of the reeds in the secondary air reed assembly has broken and is letting exhaust enter the air cleaner housing. Replace the reed assembly.

A control diaphragm on top of the secondary air valve keeps air from entering the exhaust when the engine is cold. So if the secondary air enters the exhaust with the choke on, the superabundant supply of fuel and oxygen will quickly melt down the catalytic converter.

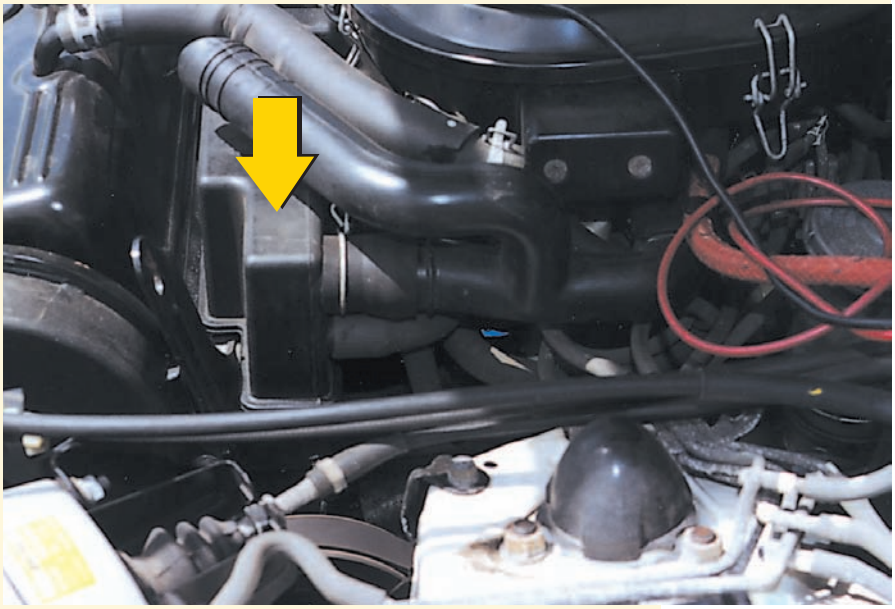
When the engine warms up, the ECU controls vacuum to hose 5 on the control diaphragm. There should be no vacuum when the engine is cold, and vacuum should be present when the engine is warm. A bimetal switch in the air cleaner, much like the bimetal control for the hot air door in the air cleaner snorkel, controls hose 15. Hose 15 is a vent, normally closed by the bimetallic switch. If the air cleaner temperature reaches 130 degrees F (warm enough to boil the fuel in the bowl and create an over-rich condition), the reed switch opens, bleeds off vacuum to the secondary control diaphragm and shuts down secondary air. The same thing would occur if the hot air door remained closed above 100 degrees F.

Special Secondary Air Notes

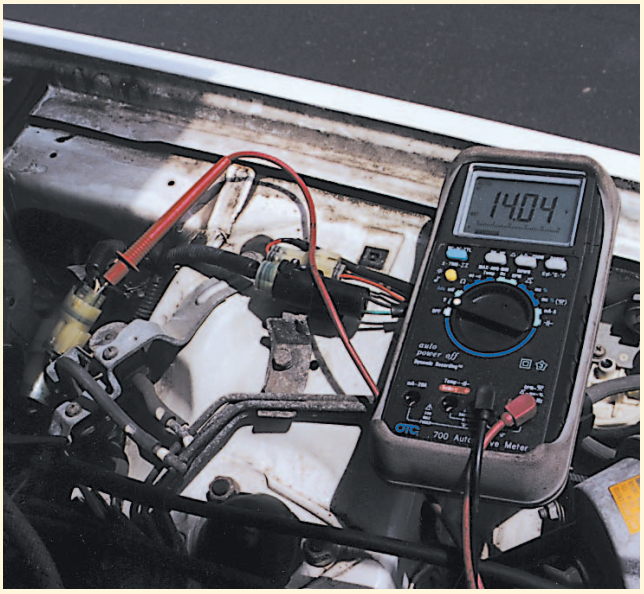
1984-85 Preludes have some unique features that have caused many techs extra grief. Preludes of this vintage will *always* fail a cruise emissions test, unless the front wheels are moving at more than twenty miles per hour during the test.

These Preludes are jetted slightly rich at idle, and too much fuel with too much secondary air can create a super-heated converter. Consequently, the secondary air shuts down after three minutes at idle to prevent catalytic converter meltdown.

Inform your customer that to pass the emissions test he may need to shut the vehicle off after rolling into the testing lane, then restart the engine. Even after restarting, this reset is only good for another three minutes of pulse-air. If the emissions test includes a check of cruise rpm emissions, the front wheels must be rolling above 20 mph. To avoid a false failure, test lane operators should also be made aware of this vehicle strategy.



Above: *The large black plastic box behind the valve cover (arrow) is the silencer for the pulse-air system. Fresh air comes from the air filter through the large black plastic hose. The lower 14mm hoses run to air control valve B and the afterburn valve. If clamping off either lower hose cures a stalling problem, there may be an errant control vacuum to the valve downstream from where you clamped it, or the valve itself may have failed.*



Above: *Above 1800 rpm, voltage at the yellow/white wire to frequency solenoid valve B switches from zero to a pulsed battery voltage signal to control vacuum to air control valve B. Vacuum hose 17 vents to the air cleaner and hose 32. Hose 32 is also Teed into the upper chamber of air control valve B and to the white plastic vacuum regulator located to the right of the meter in this photo (it's behind the A/C idle up solenoid). Vacuum at the regulator is held to 5 in. hg.*

Throttle Input

Carbureted Hondas do not have a TPS to report throttle position to the ECU. Ported vacuum through hose 4 or 7 (depending on model) on the firewall side of the carburetor signals the ECU to determine when to switch from idle mode with secondary air to feedback operation. The easiest way to check this system is to rev the engine slowly to about 2500 rpm. Somewhere above 1800 rpm the secondary air should shut down, and the air control solenoids should start clicking.

A note about 0_2 sensors: Pulse-air is on at idle, so there should be an abundance of 0_2 in the exhaust, and the 0_2 sensor voltage should read very low. If you condemn an 0_2 sensor based on idle readings, you've probably jumped the gun. Raise the engine speed to the point where the secondary air shuts down. You should see normal 0_2 crosscount readings while feedback mode is in operation.

Honda feedback, or air control valve systems, are too complicated for you to remember what the 'X 'or 'M' systems do. Fixing cars is hard enough without having to remember things you could just as easily look up. Essentially, one tunes the fuel mixture, and the other fine-tunes it. One taps it with a hammer, and the other adjusts it with a screwdriver. The X system won't operate without the M, and vice versa.

The air control valves operate much like an EGR valve. The lower chamber has one large hose connected to a manifold vacuum port and another to filtered air, and to a control port with a small vacuum hose. Vacuum building on the small hose opens the two larger ports to each other, allowing fresh air to flow into the intake manifold. Vacuum on the small hose is controlled by frequency solenoids, which constantly adjust the amount of vacuum vented to the atmosphere.

The feedback solenoids controlling this vacuum (about 5 in. hg) are on the firewall behind the carb on 1984-85 Accords, in the emissions box behind the driver's headlights on 84-87 Civics and behind the driver's strut on 1986-89 Accords. The solenoids receive no voltage at idle, and battery voltage above 1800 to 2500 rpm.

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The yellow/white wire shows about 74 Hz with the meter set to frequency. The reading may normally fluctuate in a range between 40 and 80 Hz.

When checking feedback solenoid frequencies, look for about 30-70 Hz as the 0_2 sensor crosscounts. If the frequency reading is absent or incorrect, check for a failed air temp switch, a broken or clogged ported vacuum hose on the back of the carb or a dead 0_2 sensor. And if it's a 1984-85 Prelude, did you remember to spin the wheels?

On Accords, the number 17 vent hose is attached to a fresh air port inside the air cleaner. When removing the air cleaner, leave this hose or port unplugged. If you plug it into something, the control vacuum will back up to the air control valve on hose 32 and open it all the way. This will make the engine run lean at idle.

EGR

The EGR valve on carbureted Hondas should receive 3-4 in. hg vacuum at about 4000 rpm. Applying vacuum to the EGR valve at idle should stall the engine, and the EGR valve diaphragm should hold vacuum.

The intake manifold EGR passages on carbureted Hondas may become clogged with carbon. Remove the valve to clean the passages with a flexible drill or a coathanger. If vacuum is *never* present at the EGR valve, check the controls in the firewall-mounted emissions box. Diagnosis of the EGR control system could be an article in itself, so we'll save it for another time.

Real World Scenarios

Idle CO Too High (Rich Mixture), or HC And O_2 High (Lean Mixture With Misfire)

Check the idle mixture. Adding propane should increase the idle speed 30-40 rpm on manual trans cars, and 50-75 on auto-shifted models. Spraying carb cleaner down the secondaries should not increase or decrease idle speed. If the idle speed changes, that indicates the secondaries are open slightly. Clean or replace the carb to repair this problem.

Check the carb base for a leaking insulator or other signs of vacuum leaks by spraying carb cleaner around the carb base.

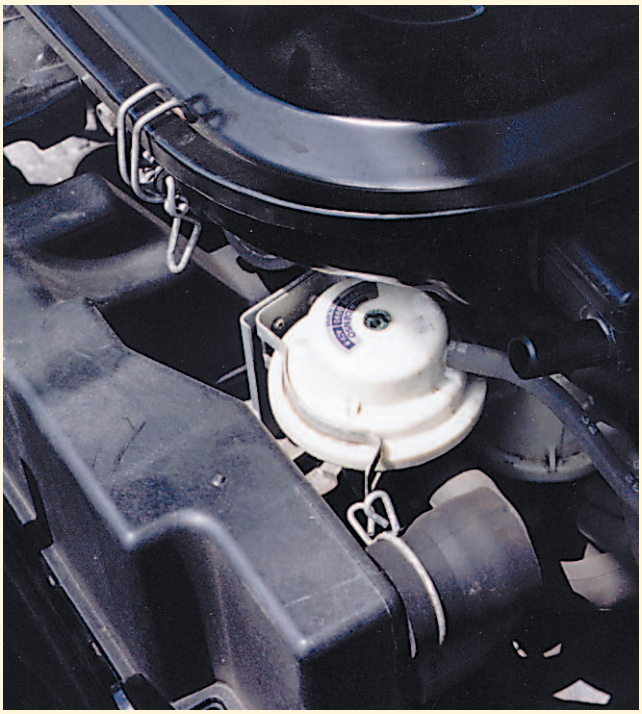
On 1984-85 Accords, check for puddled fuel in hose 14 at the bottom driver's side of the carb. Any wetness indicates a ruptured power valve diaphragm, which you can replace separately.

Check the secondary-air reed system fresh air hose in the air cleaner. If there is soot in the hose, or if the engine idles better with the air cleaner lid removed, one of the reeds has probably broken, backflowing exhaust into the air cleaner. Extreme cases may plug the carburetor air bleeds with soot. When this happens, the engine won't idle unless the power brake booster hose is left open.

Check for vacuum to hose 5 at the secondary air control valve on the reed assembly. If the control valve does not receive vacuum, pulse-air will be inoperative, and the cat will struggle to clean things up. Check for an inoperative air temp switch, or a deformed bimetal valve in the air cleaner.

Forget about the O_2 sensor for idle diagnosis. The ECU ignores the O_2 sensor at idle, unless someone has misrouted a ported vacuum hose 4 or 7 to a manifold source. This will make the engine stall, as it wasn't designed to handle air mixture correction at idle.

Don't plug vacuum hose 17 when the air cleaner is removed. Doing so will keep the engine from idling because air control valve B will get control vacuum on hose 32 all the time. This allows the air correction passage in air control valve B to open wide. There is one 10mm hose running to fresh air at the black air cleaner silencer box above the water pump, and another to the intake manifold. You'll make yourself nuts trying to figure out why there is vacuum to hose 32 at air control valve B.



With the larger hoses out of the way, the white air control valve B is visible behind the silencer. Hose 32 at the top connects the frequency solenoid to the vacuum control valve. Any vacuum to the vacuum control valve will open the valve, allowing fresh air to pass directly into the intake manifold. There are two large hoses on the bottom of the valve. One connects to the silencer (in shadows) and the other to the intake manifold. Behind it, (to the right in the photo) is the anti-afterburn valve.

The single-wire oxygen sensor is in the exhaust manifold, right below the hot air stove. No oxygen sensor — no feedback system. To check the oxygen sensor with your DVOM, follow the harness to the connector below the distributor. It's much easier to slide your meter probe into the connector, rather than backprobing the wire. There's no risk of piercing an RFI shield if you slide your meter probe along the wire into the rubber seal at the connector.

Check the ground at the thermostat housing. Without a good ground, the choke won't warm up, the secondary air won't turn on, and the power valve won't receive vacuum and will stay open.

CO Or HC Too High At Cruise But Okay At Idle

Now's the time to check for that failed O_2 sensor. If the car passes an emissions test at idle but fails at cruise, check the O_2 sensor by carefully backprobing the connector (rather than the wire) to avoid piercing the shielded cable. If the secondary air operates at idle, the ground at the thermostat is probably okay.

If the cruise emissions problem persists, it may be due to a main metering problem — such as a clogged air bleed or high fuel level. Also check for vacuum to the power valve on the oval-tops. On the round-top carbs, try applying or removing vacuum to see whether this changes cruise CO. If vacuum is present at the power valve, the piston in the carb top may be worn and leaking air.

Even with a dead cat, carbureted Hondas will idle at about 0.4-0.6 percent CO with an HC reading of 150 PPM or so. If you're getting these kinds of numbers, and everything else appears to work, the cat may be dead. If your tailpipe emissions are the same on a cold engine as they are when it's fully warmed up, that's a good clue the cat has failed. The last nine times I had my '89 Accord sniffed, it read zero percent CO and 4-9 PPM HC. As I revved it up, I could hear the secondary air shut off at 1800 rpm, and the frequency solenoids started to click.

Avoid Headaches — Use Your Head

I've talked to many Honda techs who have replaced carbs, plugs, filters, changed the oil and so on, when the root problem was a bad air temp switch. My favorites were 1984-85 Accords that failed emissions tests when the cooling fans came on, all because the corroded ground circuit connection couldn't handle the additional load.

I believe the expression 'common sense' is an oxymoron. Like 'jumbo shrimp' or 'military intelligence,' combining the words doesn't provide the intended meaning. More accurately, I believe 'uncommon sense' is required to follow directions and take a logical path (if you know it) to actually fix cars. The emission control components I've described in this article are high-odds failure possibilities. If you use your head when diagnosing Honda emission control problems, this information can be combined with you own uncommon sense to produce a very effective headache remedy. ■

—By Marlowe Peterson