

Volkswagen Cabriolet How-to

Adjusting CIS Air/Fuel Mixture & Idle

Before Beginning

Requirements:

- Car should be otherwise well-tuned (*see below for further information*)
- No vacuum leaks
- Distributor advance mechanism(s) should be operating correctly
- Timing should be correctly set with a closed throttle plate
- Air/fuel mixture plug removed (*see page 6 for removal instructions*) and mixture screw free of gunk

Tools needed:

- Digital volt-ohm multimeter (DVOM) that measures dwell or duty cycle
 - If using a duty cycle meter: CIS produces a negative slope duty cycle. Some meters will only measure in a positive slope range, while others can be changed to read in a negative slope range; know what your meter reads before beginning (if it can't be determined ahead of time, print out the testing table so your meter's slope can be revealed while testing). If it reads only in a positive slope range, no worries: Simply subtract your readings from 100 and you've got your car's duty cycle readings.
- 7mm open-end wrench
- Long 3mm Allen wrench

Start with a complete tune up (if not recently conducted):

- Replace ignition components: spark plugs, cap, rotor, wires (use Bosch ignition parts and use only W7DC or W7DTC plugs)
- Replace air and fuel filters
- Replace injector seals and idle screw O-ring
- Tighten the injector holders; replace the injector holders if needed
- Check for vacuum leaks using carburetor cleaner (spray around hoses, gaskets, injector O-rings); if idle goes up, leak found (replace faulty part -- use a *bit* of RTV when replacing gaskets)
- Check your K-Jetronic grounds
- Test your oxygen sensor and replace if need be (*page 5*)
- Check your throttle switches and idle boost valves
- Check your CIS system and control pressures: <http://www.geocities.com/jonnyguru/vw/fpressure.html>
- Check your distributor's centrifugal and vacuum advance mechanisms
- Set your timing, if need be (*page 6*)

"Do not try to correct engine trouble by making simple adjustments to the idle speed or the idle mixture (CO). Changing these settings without the proper measuring equipment will only be a hindrance when trying to locate the real fault."

To adjust the idle without a DVOM, please visit <http://merlyyn.com/tech/> .

Once you've made sure all the basic stuff is working as designed, should you still find improper idle conditions and/or drivability problems, post your findings/troubles on the Cabriolet forums listed on www.cabby-info.com/links so that it can be discussed to a conclusion, or more likely, several conclusions.

Measuring Duty Cycle, Adjusting Air/Fuel Mixture & Idle

Steps

1. Warm up car to operating temp (80°C) – cooling fan should cycle on/off at least once. Be sure all electrical accessories are off (A/C, lights, cooling fan, etc.).
2. Connect the red (+) meter probe to the blue/white wire's female terminal in the two-pin test connector by the cold-start valve. Connect the black (-) meter wire to any convenient ground*. If using the dwell setting, set meter to "4 cyl"; if using the duty cycle setting, set meter to "frequency %" (read your meter's instructions; some meters require an additional step, such as pressing a button or two).

*If you have installed spade terminals in place of the OEM connector, simply attach the red (+) probe's alligator clip to the blue/white wire terminal and the black (-) probe's alligator clip to the brown wires' terminal.

3. Your target reading is $45^\circ \pm 7^\circ$ dwell / $50\% \pm 8\%$ duty cycle (if it is not within this range, complete the next steps).

45° dwell = 50% duty cycle

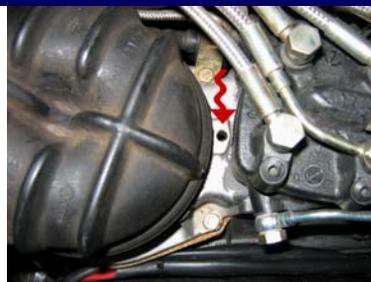
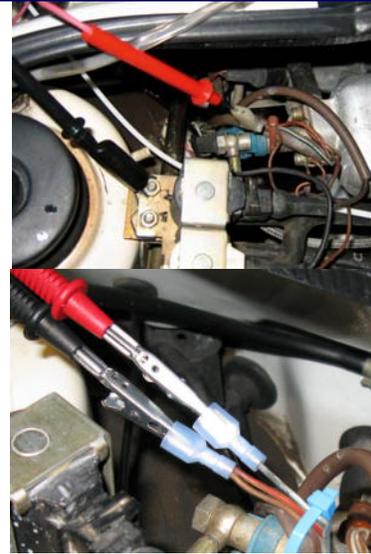
- **Higher than 45° / 50% = running lean**
- **Lower than 45° / 50% = running rich**

The picture at right shows an initial dwell reading bouncing between 17.1° and 20.9° (this Cabriolet is running rather rich). If the dwell bounce is higher than a range of 10 (a bounce between 35 and 50, for example), there are other issues that need resolving before continuing.

4. Get out your long 3mm Allen wrench to adjust the air/fuel mixture (next to the fuel distributor on top of the air filter housing). **The weight of the wrench will affect the mixture!** Turn the wrench a little, just enough to feel it move, then lift the wrench out of the adjustment screw. Repeat this process until $45^\circ \pm 7^\circ$ dwell / $50\% \pm 8\%$ duty cycle is achieved.

- **Higher than 45° / 50%: turn wrench clockwise** (this richens up a lean mixture)
- **Lower than 45° / 50%: turn wrench counterclockwise** (this leans out a rich mixture)

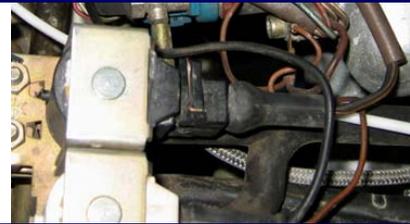
Photos



5. Have your 7mm open-end wrench handy; you may have to tweak the idle bypass screw (backside of the throttle body) if the idle changes too much. You need to stay below about 900 RPM while adjusting the idle. Use the tach on the dash and your ears, you know what sounds right and normal. If you go over 900 RPM, the centrifugal advance starts to kick in, changing the timing and confusing all your readings. Set the idle RPM at $900 \pm$ but above the threshold of the idle boost valve.



6. If the idle boost valve kicks in while you are adjusting, you've dropped too low on idle RPM. You can unplug the idle boost valve electrical connector, or better, pinch off either of the hoses going to it. When the idle boost valve (or hose) is reconnected, idle should not change if you've adjusted the idle correctly.



7. Switch on the A/C to make sure that the A/C idle boost valve works; idle should stay about the same with the A/C compressor running.

Should you find questionable meter operation while setting frequency valve duty cycle (ex., the reading never changes), connect your test lead to the Hall generator green/white wire and test your meter. It should read a very steady 36-37° on the 4 cylinder scale, 40.5-40.6% duty cycle. If the meter proves to be good, conduct tests 1-5 in the table on the next page.

All idle adjustment info above supplied by "tolusina" of VWvortex.com with minor edits by Cabby-Info.com; all pictures supplied by KamzKreationz.

Table for Oxygen Sensor System Testing

If you have out-of-the-ordinary readings during the mixture adjustment: After verifying that your meter is good, print the following chart (warm-up and operating temp are the same measurements you took initially; they're included in the table for convenience), conduct the tests listed, write your readings in the "Your Reading" column and compare them to what the readings should be to help determine what component could be faulty.

Test	Oxygen Sensor	Full-throttle Switch	Oxygen Sensor Thermoswitch	Running Condition/Stage	Dwell Reading Should Be...	Duty Cycle Reading Should Be...	Your Dwell or Duty Cycle Reading
Warm-up	Connected	Connected	Connected	cold-running enrichment	72° ±2° 1987+: 58.5° ±2°	80% ±2% 1987+: 65% ±2%	
Operating Temp	Connected	Connected	Connected	closed-loop	45° ±7°	50% ±8%	
1	Connected or Disconnected	Connected	Disconnected	open-loop	45° ±2°	50% ±2%	
2	Connected	Connected & actuated	Disconnected	full-throttle enrichment	58.5° ±2°	65% ±2%	
3	Connected	Connected	Disconnected, leads bridged w/ jumper wire	cold-running enrichment	72° ±2°	80% ±2%	
3a 1987-1989	Connected	Connected	Disconnected, brown/red wire grounded	cold-running enrichment	58.5° ±2°	65% ±2%	
3b 1987-1989	Disconnected	Connected	Disconnected, leads bridged w/ jumper wire	cold-running enrichment	58.5° ±2° (45°: check vacuum switch)	65% ±2% (50%: check vacuum switch)	
4	Disconnected, ECU lead grounded	Connected	Disconnected	lean condition, rich correction (closed loop)	78.3° and increasing	87% and increasing	
5	Disconnected, +1.5V applied to ECU lead, -1.5V grounded	Connected	Disconnected	rich condition, lean correction (closed loop)	18° and decreasing	20% and decreasing	
Notes	Tests 4 & 5 require a D-cell 1.5V battery; ECU lead wire is green	Front part of throttle body	Underside of coolant flange on head	Tests 1-5 are condition simulation tests; being at operating temp is unnecessary		Negative slope %; if readings are positive, subtract from 100	

If the meter, thermoswitch, frequency valve, and oxygen sensor control unit all prove to be working correctly, but the readings are still whacky (as shown below), the test port should be suspected of being faulty. Solution: Cut off the stupid OEM plug and install spade terminals (one on the blue/white wire, one on the two brown ground wires); use alligator clip adapters on your meter's probes and attach them to the new spade terminals. Your readings should now be within specs outlined in the table above; if they are, resume your air/fuel and/or idle adjustments, if need be.

Examples of whacked-out readings caused by a faulty test connector

Test	Dwell Reading Should Be...	Your Reading	Duty Cycle Reading Should Be...	Your Reading
Warm-up	72° ±2°	84°	80% ±2%	76-98%, fluctuating
Op. Temp	45° ±7°	84°	50% ±8%	76-98%, fluctuating
1	45° ±2°	84°	50% ±2%	70-98%, fluctuating; 58% avg. high after fan cycled
2	58.5° ±2°	84°	65% ±2%	90-98%, fluctuating
3	72° ±2°	84° w/ slight idle drop	80% ±2%	89-98%, fluctuating w/ slight idle drop
4	78.3° and increasing	65° & decreasing	87% and increasing	rose to 53.7% and stopped
5	18° and decreasing	42° & decreasing w/ slight idle drop	20% and decreasing	dropped to 91.2% w/ slight idle drop

Testing the Oxygen (O₂) Sensor

Tools needed:

- high impedance volt/ohm meter (DVOM) like the one shown above
- D-cell 1.5 volt DC battery

Steps	Photos
1. Depending on the DVOM you are using, set the dial to 2 DCV or 4 DCV (you can use two DVOMs in this test procedure: the second DVOM is connected as described above to obtain the dwell/duty cycle readings in addition to the voltage readings).	
2. Disconnect the oxygen sensor wire from the Lambda control unit lead wire; connect the DVOM to the oxygen sensor wire. Ground the Lambda control unit lead wire to bare metal to simulate a lean condition (an extension adapter is being used in the picture at right due to the control unit wire not being long enough to reach a ground). The O ₂ sensor's voltage should go high, 0.8 to 1.0 DCV (the duty cycle/dwell should also go high, 85%/75° or higher, a rich compensation).	
3. Now connect the 1.5 volt battery's positive end to the Lambda control unit lead wire and ground the negative end of the battery against bare metal; this simulates a very rich condition. The O ₂ sensor's voltage should go low, 0.15 DCV or lower (the duty cycle/dwell should also go very low, around 11%/25°, a lean correction). Note: The system may go so lean that the engine stalls; this is normal.	
<p>If all that is good, the duty cycle adjustment procedure should all go well.</p> <p>A sluggish O₂ sensor may cause a failed smog inspection while exhibiting absolutely no other drivability issues.</p> <p>CIS-equipped Cabriolets built from July 1987 through 1989 have heated O₂ sensors. Should you see 12 DCV (or charging voltage) at the O₂ sensor wire, replace the O₂ sensor immediately (the heater has shorted to the sensor).</p> <p>Should you see an operating range at the O₂ sensor ranging from -0.5 DCV to + 0.5 DCV (instead of the normal +0.1 DCV to +0.9 DCV), your sensor has been permanently damaged by chemical contamination and needs replacing.</p> <p>Should the Lambda control unit happen to be faulty, it will fail to compensate for the simulated lean/rich conditions described above. The Lambda control unit rarely goes bad; therefore, before condemning the control unit as being faulty, verify that the control unit is receiving power and that all ground wires/connections are good. Additionally, if the duty cycle stays at 65% or 80%, disconnect the cold running enrichment switch (if installed) and the full-throttle switch, one at a time, then both together if need be.</p> <p><small>Above testing info supplied by "Thomas_covenant" of Yahoo! Groups and "tolusina" of VWvortex.com (edited by CabbyInfo.com).</small></p>	

DIY Timing

The proper method for setting your car's timing requires the use of a timing light. If you're without a timing light, use the [Bad Habit Rabbit](#)'s method until you can set the timing properly:

"All of your VWs have marks on the rotating parts to denote 0° TDC. The cam has a dot that lines up with the valve cover. The flywheel has a notch that lines up with the center of the hole on top of the bell housing. The distributor has a slash that lines up with the rotor. Line all of these up and your car is at 0. No advance. No retard.

In a pinch, I've put the car in 5th gear (with the car off!) loosened the distributor and pulled the car forward until the advance mark on the flywheel appeared in the little timing hole. I then turned the distributor until the hash mark lined up with the rotor and tightened her down. If your flywheel notch is at 3° or 5° or whatever, now your distributor is at 3° or 5°. It's probably good for keeps or at least until you can get your hands on a timing light, but it DOES work accurately!"

Removing the Anti-tamper Plug

It's very possible that your air/fuel mixture adjustment hole still has its anti-tamper plug installed. If so, it will need to be removed, or tampered with, in order to adjust the air/fuel mixture as described in the idle adjustment section.

The following tampering instructions are courtesy of "tolusina" of VWvortex.com:

"The easiest way to [remove the anti-tamper plug] is to flip the complete sensor plate assembly over and punch the plug out with a long thin punch.

The other tamper method requires drilling a centered hole in the plug, screwing in a sheet metal screw and pulling the screw up. You've got to be sure in advance that the drill bit used is small enough that the sheet metal screw you choose will have plenty to grip. Also, grind the point off the tip of the sheet metal screw so it doesn't bottom out. Oh, yeah; you can't drill all the way through the aluminum plug [because] there's a floating steel disc in the bottom of the plug that will just spin when the drill bit hits it. The steel disc is to prevent drill chips from dropping inside. The steel disc is also what a pointed sheet metal screw will bottom out on before the rest of the screw gets a good grip.

If you booger things up with a drill and sheet metal screw, no worries; flip the assembly and punch it out, bottom-up."

* * Remember, **you** are responsible for working on **your** car; Cabby-Info.com, VWvortex.com, VAG, VWoA, or anyone else are not responsible if **anything** goes wrong while **you** are working on, in and under **your** car!
Use this information at your own risk!* *