



Gateway Air Repair

A Newsletter for the Vehicle Repair Industry

Volume 9 Number 1

January 2007

Case Study - 1997 Oldsmobile Cutlass: P0171

This article was reprinted by permission from VCERT NEWS – a publication of the Vermont Center for Emissions Repair and Technician Training – A Partnership of Vermont Technical College and the Vermont Department of Environmental Conservation. www.VCERTT.org

This fall we had the chance to work on a pesky Cutlass with a persistent DTC, P0171 System Too Lean, Bank 1. The vehicle came to us after a couple of repair attempts at another garage. The front oxygen sensor had been replaced along with the spark plugs, wires and coil pack. We drove the vehicle and noted no unusual drivability concerns other than a slightly high idle. Our visual inspection showed nothing, though we looked and listened carefully for a vacuum leak. We used our new favorite tool, the smoke machine, to check for vacuum leaks. A vacuum leak is a common cause of lean Fuel Trim DTCs and with the high idle we were hopeful that we'd quickly find the problem. We found no leaks. If you don't have a smoke machine you can use propane to try to find a vacuum leak.

When the propane is taken into the engine through the leak, the idle quality will change. We did bring out our propane next, in order to test the oxygen sensor. Even if it was new we wanted to be sure that it was working properly and that the PCM was receiving its signal. On a scan tool with the vehicle idling and at 2500 rpm it was clear that the oxygen sensor signal was staying at a lower voltage, .1 - .4V, indicating a lean condition to the PCM. If the system were working properly we would expect to see the oxygen sensor signal cycling regularly between 0 and 1 volt, (.1-.7-.3-.8-.4-.5-.2-.8, for example). The long term fuel trim (LTFT) was running between +19% and +26%. Long term fuel trim is displayed in percentages between -100% to +100%. A reading of 0% indicates that the PCM is making no correction to the



“Other likely causes of a lean condition include problems with the fuel system such as a plugged fuel filter, dirty injectors, a weak fuel pump or a faulty fuel pressure regulator. Sensors can also cause lean running.”

preprogrammed fuel delivery value for the current operating conditions based on the sensor inputs.

The PCM changes fuel trim in response to the oxygen sensor (O2S) signal. If the O2S indicates a lean condition (low voltage) in the exhaust stream, the PCM responds by adding fuel by increasing the injector pulse width. It does this constantly through short term fuel trim (STFT). These are instantaneous changes made in direct response to the O2S. When the STFT increases enough, the PCM makes a fuel trim correction in long term fuel trim and resets the STFT to 0%. It will continue to adjust STFT then LTFT until it has control of the fuel system. When LTFT rises over or falls below a preprogrammed amount, typically plus or minus 20%, the PCM recognizes that there is a problem, sets a DTC and turns on the MIL. If the system is running too rich, the PCM subtracts fuel and the LTFT drops into the negative zone. For diagnosis the LTFT numbers are the ones to watch, these indicate the fuel trend not just the mixture at a particular instant.

On this vehicle, we needed to be certain that the oxygen sensor was capable of generating a higher voltage signal and that it was correctly reporting an excess of oxygen in the exhaust stream. We introduced propane into a vacuum port to richen the fuel mixture. We kept a close eye on the O2S reading on the scan tool to see how it responded before the PCM could compensate. Sure enough it shot right up to .9 volts and stayed there. The LTFT started dropping as we held the propane on and the idle began to smooth out. This proved

continued on page 2

1997 Oldsmobile Cutlass: P0171

continued from page 1

that the sensor was at least active and that the PCM saw the signal and could respond. Now we knew we were actually dealing with an excess of oxygen in the exhaust stream, likely a lean condition, not a faulty oxygen sensor.

Next we had to eliminate all the possible causes of a lean condition or excess oxygen in the exhaust. A misfire will cause excess oxygen in the exhaust, even though the fuel mixture is not necessarily lean. If the mixture does not burn fully the remaining oxygen in the combustion chamber passes by the O2S causing a low voltage reading. This vehicle did not appear to be misfiring under any conditions. Other likely causes of a lean condition include problems with the fuel system such as a plugged fuel filter, dirty injectors, a weak fuel pump or a faulty fuel pressure regulator. Sensors can also cause lean running. A mass

airflow sensor (MAF) that is not reporting all the air passing by will cause the PCM to deliver less fuel. This is currently a common problem. We did clean the MAF but saw no changes in the readings. The ECT sensor or IAT sensor could also skew the fuel delivery but they were fine. Before digging deep into the fuel system we followed a hunch and looked at the slightly noisy, shiny PCV valve. It looked and rattled fine but it had a slight whistle. When we blocked off the vacuum side, the fuel trim began to drop, reaching very close to 0%.

We would expect it to drop some but thought that a full drop to 0% pointed to a problem. The part number was not applicable to this vehicle. With the correct PCV valve (lower flow) the fuel trim dropped and the O2S started cycling regularly between .1 and .9 volts. We had the luxury of driving the vehicle for a while to see if the PCM would extinguish the MIL on its own. It took several drives and an overnight cool down but the OBD system did recognize the correction and the PCM turned the MIL off.

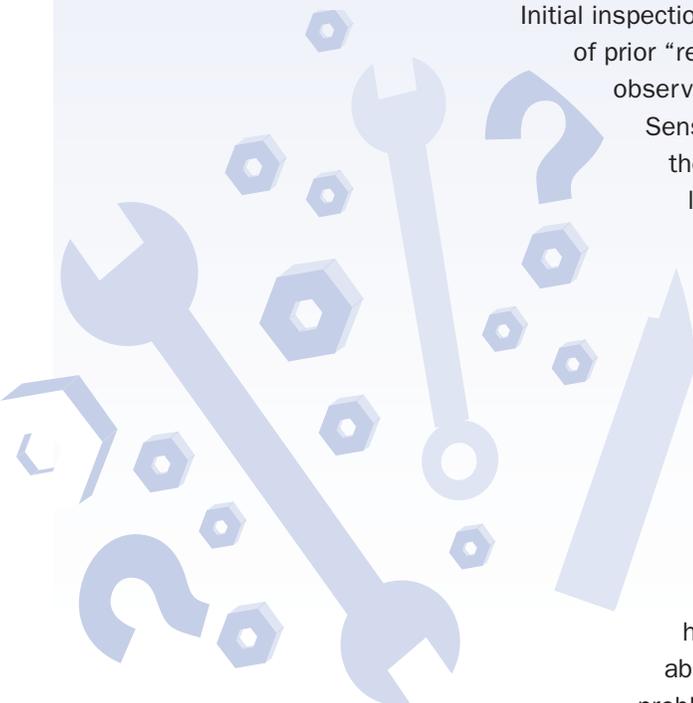
Mystery Solved – Vacuum vs. Pressure

By Art Castillo, Imperial Automotive, Reprinted by permission from the Illinois Air Repair Newsletter

We recently had a 2002 Kia Sportage come in to our shop with the following codes: P0440 “Evap system malfunction” and P0442 “Evaporative Emission Control System Leak Detected (small leak).” It had been to the dealer several times with a recurring MIL. After many parts and no fix, the customer had resigned himself to just driving the car with the light on. With his license suspension looming, he showed up at our door.

Initial inspection revealed some missing evap hose clamps and other signs of prior “repairs.” During testing with our smoke machine, no leaks were observed and the system was able to hold pressure for twenty minutes. Sensor voltages were normal as was solenoid operation. I replaced the missing clamps and retested the system and everything looked good. The next step was to run the fairly arduous drive cycle. Disappointingly, the P0442 reset. Changing strategy, I put the system into a vacuum and discovered it would not hold a vacuum.

By isolating parts of the system we were able to narrow it down to the fuel tank. As it turns out, the cap was able to hold pressure but would not hold vacuum. Typical cap testers use pressure, so no fault was found with a conventional test. Looking at the list of changed parts from the dealer showed no new gas cap. With a new gas cap installed, we ran the monitor and there were no codes. The vehicle passed the test and we had one happy customer. We now have a new way of thinking about evap leaks. Pressure testing alone does not always find the problem. It is necessary to think about how the vehicle tests the system. Is it done with pressure or vacuum?



TROUBLE SHOOTER

By Karl Seyfert, Reproduced by permission of MOTOR Magazine © 2006

Catalytic converters usually are big-ticket items. The process of deciding when replacement is necessary and determining the reasons for the original failure, shouldn't be rushed.

P0420 REDUX

A customer forwarded your June Trouble Shooter column to me because my company has been selling catalytic converters in California for 20 years and I spend a tremendous amount of time trying to get technicians to actually work on the problems that cause converter failure. If I hear one more time that "the computer says it's a bad cat," I think I will scream! Could you discuss the relationship between DTC P0420 and the PCM's assessment of catalyst efficiency? I would appreciate your assistance in my educational efforts.

- Elaine Lester
Riverside, CA

A DTC P0420 indicates that the PCM believes catalytic converter efficiency has fallen below a prescribed level. This level is tied to the vehicle's ability to comply with applicable emissions requirements, OBD II's prime directive. So the converter could conceivably be working, just not well enough to meet with the PCM's approval. What could lead the PCM to believe something is wrong with the converter? There are several possibilities.

First, the converter must have the correct feed gases to function properly, so a P0420 diagnosis should begin with a check of the basics. Are all of the oxygen sensors working properly? Watch the long-term and short-term fuel trims during a road test, as well as the rear sensor activity if the vehicle uses its input to determine fuel trims. If the vehicle is not in fuel control or if the PCM is forced to make large fuel trim corrections, the cat will not be able to do its job correctly.

Fix all exhaust leaks, both before and after the cat. Any stray oxygen that sneaks into the exhaust that didn't pass through the intake manifold will confuse the oxygen sensor readings and affect the PCM's fuel control decisions. An exhaust leak in front of the converter or in front of the rear oxygen sensor could cause a P0420.

Make sure the engine is in a proper state of tune. Even small changes in the feed gas mixture entering the converter can have a significant effect on how well the

converter performs. Spend some time with an ignition scope to verify that combustion is occurring correctly in each cylinder. An intermittent misfire can destroy a new converter that was originally installed to correct a P0420.

If everything else is in order, it's time to let the PCM do the final test and see if it likes the converter it's supposed to be protecting. As I explained last time, the PCM doesn't directly monitor the operation of the converter. Rather, the PCM must infer the converter's state of health by monitoring the oxygen sensors (or air/fuel ratio sensors) that are located at the converter inlet and outlet. If the converter is working properly, the oxygen sensor signal after the converter should look decidedly different from the sensor signal before the converter.

The rear sensor reads the post-cat exhaust gases to monitor cat efficiency and to help the PCM determine if it's going bad on the oxidation side. On some vehicles, it also helps the PCM make decisions on injector ON-times to account for long-term fuel control errors (LTFT). The rear sensor will look slower and more gradual in its response because over 90% of the gases to which the sensor responds are taken away by the cat.

You can observe this with a two-channel lab scope. In closed-loop, the front sensor should cycle between rich and lean with a high number of crosscounts. The rear oxygen sensor should fluctuate much less and the crosscount rate should be much slower. The amplitude of the readings for the rear sensor will also be lower. This indicates the catalyst's ability to store free oxygen, which it then uses to reduce emissions. If the catalyst is degraded, the rear sensor waveform will look very similar to the front sensor waveform.

So if the front and rear sensors are switching at the same rate, we normally suspect that the converter has failed. This indicates low catalyst oxygen storage capability and the converter will fail the efficiency test when the PCM runs the monitor. Conversely, a really good converter should clean the exhaust so well that it almost puts the rear sensor to sleep, or flatline at .20 volt. But the PCM has to

continued on page 7

Help is Just a Phone Call (or Click) Away

The following resources are presented for informational purposes only and are not necessarily official productions of the Missouri Department of Natural Resources or the Gateway Clean Air Program. No one affiliated with the Gateway Clean Air Program is responsible for the content or accuracy of any unofficial site listed below:

EMISSIONS TESTING INFORMATION

- www.gatewaycleanair.com
- Gateway Clean Air Program repair industry hotline: 1-888-748-0377
- Gateway Clean Air Program general information hotline: 1-888-748-1247
- Missouri Department of Natural Resources: (314) 416-2115 – Information about Missouri Recognized/Qualified Repair Technicians (MRRT/MQRT) status and technical assistance

EMISSIONS REPAIR INFORMATION

Assistance Finding Emissions Parts:

- HELP Smog Parts: 1-800-544-4357
- Brown Recycling: 1-800-367-9271 – For information on certified used catalytic converters
- www.tomco-inc.com or (314) 815-6944

EMISSIONS-RELATED HEALTH AND SAFETY INFORMATION

- www.lungusa.org
- www.envirosafeshop.com

INDUSTRY SUPPORT

- www.iatn.com
- www.asecert.com
- www.acc-online.org
- www.sae.org
- www.theautomotivetechshop.com
- www.carcarecouncil.org

OBDII INFORMATION

- www.obdclearinghouse.com
- www.obdiicsu.com
- www.obdii.com
- www.autotap.com
- bob@servicemycar.com (for free OBDII software)

TRAINING AND RESOURCES

www.theautochannel.com
www.aspireinc.com or 1-800-247-1099
www.caat.org
www.ccar-greenlink.org
www.automotivetestsolutions.com
www.secondchancegarage.com
www.autoed.com
www.beyondparts.com
www.fuelline.com
www.fedworld.gov/pub/auto/auto.htm
www.aera.org
www.apra.org
www.autoshop101.com
www.toolsforeducation.com
www.bergwall.com
www.diagnostichotline.com
www.learntofixcars.com
www.asetestprep.com
www.asecert.org
www.allexperts.com
www.asld.com
www.smogfree.com
www.car-sound.com
www.mad-mechanic.com
www.carleysoftware.com
www.aecc.be



SPECIAL DELIVERY

If you would like to receive the Gateway Air Repair at your home instead of your workplace, please complete the information sheet on the back of this issue. Check the new address box and mail to:

Gateway Air Repair Editor

PO Box 1034

St. Charles, MO 63302.

Or, e-mail information directly to:

gretchen.harman@esph.com

Training and Special Events



The following is a list of known training available in the St. Louis area. This information is for reference only and is neither endorsed nor sponsored by the Gateway Clean Air Program. To find out what training is currently being offered, please contact any of the training providers listed below. Please contact trainers to confirm dates, course costs and to arrange payment.

CARQUEST

The trainer is Vince Manship. For more information, contact Mike Mulcahy at (314) 345-4856 or visit www.carquest.com. Courses are held at South St. Louis county, O'Fallon and Belleville locations. The MRRT Training Voucher is accepted. Verify course desired is MRRT Approved.

OBD-205 Controller Area Network Diagnosis

- January 24 - 25

Controller Area Network (CAN) is the new standard communication protocol between the scan tool and the vehicle that will be fully implemented by 2008. Starting in 2005 this new robust system will be phased in to approximately 25% of the fleet each year. CAN has been around for many years on Euro and some other domestic vehicles and will provide many new enhancements to your diagnostic capabilities. This course will cover the basics of CAN, how to recognize a CAN system and will focus on the changes that will affect your diagnostic strategies.

OBD-206 Advanced Mode 06

- March 28 - 29

Mode 06 is the scan tools request for the latest test results from the PCM for all non-continuous monitors. This concept was first introduced in OBD-203. Now we will cover practical uses of Mode 06, deal with the difficult Mode 06 information from GM and Chrysler as well as review the changes in Mode 06 on CAN vehicles.

Area Trainers

Are you currently offering automotive repair training in the St. Louis area? If so, please contact the Gateway Clean Air Program to be included in future issues of the Gateway Air Repair. Please include a detailed description of your course, including topics covered, dates, costs and location. Notices may be sent to the Gateway Air Repair editor by e-mail or fax at: GCAP@esph.com or (314) 739-2901.

If the training is emissions-related and you would like it evaluated as a continuing education course offered to all Missouri Recognized Repair Technicians, please contact the Missouri Department of Natural Resources at (314) 416-2115.

DESIGN TECHNOLOGY, INC.

The trainer is Lou Craven. For information on training offered by DTI, call (636) 939-5670 or fax (636) 477-9093. The MRRT Training Voucher is accepted. Verify course desired is MRRT Approved.

MUST Level 1 Classes

Mondays (8:30 a.m. – 3:30 p.m.)
Tuition per Tech \$166 per class or \$1,494 for Series

- Fuel Systems-Hydraulic/Electronic January 29
- Automotive Computer Technology February 26
- O2 Waveform Analysis March 26

MUST Advanced Level 2 Classes

Wednesday and Thursday (4:00 p.m. – 7:30 p.m.)
Tuition per Tech \$166 per class or \$1,494 for Series
All classes are approved for MRRT

- No Start/Rough Idle January 24 - 25
- IC Spark Control February 21 - 22
- Current Ramping II March 21 - 22

MUST Advanced Level 3 Classes

Tuition per Tech \$166 per class or \$1,494 for Series

- OBDII "Introduction" January 11
- GM OBD II – Fuel Control Strategies February 8
- GM OBD II – Ignition Control Systems March 8

Articles Wanted The Gateway Clean Air Program wants to continue to bring readers pertinent repair information. If you have an idea for an article, or have a topic you would like discussed in a future issue, please contact the Gateway Air Repair editor by fax at (314) 739-2901.

Gateway Air Repair

is published by ESP Missouri Inc.

- E-mail: GCAP@esph.com
- Phone: (314) 739-8500
- Fax: (314) 739-2901

Send all address changes, mailing requests and letters to the Gateway Air Repair editor at:

Gateway Air Repair, PO Box 1034, St. Charles, MO 63302-1034

“Used” Vehicle Emission Test Requirements

ISSUE #1: VEHICLES BOUGHT FROM A DEALER

(Statutes containing the following requirements supersede “as is” or “junk, salvage or rebuild” declarations on a sale contract or bill of sale to individuals.)

Automobile dealers have an obligation to sell vehicles that meet the emission test requirements for an approved vehicle. (643.315.5, Missouri Revised Statutes). Dealers have two ways to do this.

A. SALES WITH “VEHICLE TEST REPORT AND COMPLIANCE CERTIFICATE”

Dealers may use an approved emission test certificate, one resulting in a “Pass” or “Waiver”, for sales purposes if within 120 days of the emission test. The dealer must inform the purchaser of the test result and provide the certificate to them to comply with this rule.

The purchaser must use the certificate to register the vehicle within 120 days of the test date or be obligated to have a new emission test performed at their expense. Vehicles that received a “Waiver” prior to the sale may require the new owner to perform additional repairs to acquire an emission test certificate valid for registration purposes.

B. SALES WITHOUT “VEHICLE TEST REPORT AND COMPLIANCE CERTIFICATE”

Dealers may also sell a vehicle without a valid emission test certificate. Dealers are required to inform the purchaser in writing on both the bill of sale and the purchase contract they must return the vehicle to the dealer within 10 days and with less than 1000 additional miles to receive free repairs should the vehicle fail the emission test. Vehicles receiving a “Fail” or, for 1996 and newer vehicles, a “Reject” test result should be returned to the dealer for repairs if within the time frame and mileage noted.

The dealer is required to either repair a vehicle returned to them for this reason so the vehicle, and new owner, receive a “Pass” emission certificate within five (5) days of the date returned; or come to some other mutually agreeable decision regarding the purchase. If purchasers are not satisfied with a dealer’s response, they can call the Consumer Protection Hotline at 1-800-392-8222 or the Department of Revenue’s Investigation Bureau at (314) 977-0393.

Purchasers providing the dealer with a signed and notarized “Junk, Salvage or Rebuild Affidavit” or initially

testing the vehicles emissions after 10 days or 1000 miles are responsible for acquiring the emission test certificate needed to register the vehicle.

ISSUE #2: VEHICLES BOUGHT FROM A PRIVATE INDIVIDUAL

Dealer requirements apply for residents of the emission test area (St. Louis City and Franklin, Jefferson, St. Charles and St. Louis Counties) regardless of the dealer’s location in Missouri.

Vehicles registered in the emission test area of St. Louis City and Franklin, Jefferson, St. Charles and St. Louis Counties are required to be emission inspected and approved prior to a sale or title transfer occurring (643.315.1, Missouri Revised Statutes).

A private citizen selling a vehicle must provide the purchaser with a “Vehicle Test Report and Compliance Certificate” valid for registration purposes at the time of sale. A valid certificate is one for which a “Pass” or “Waiver” is the final test outcome.

The vehicle purchaser should register the vehicle within 60 days of the emission test date, not the sale date, to use the certificate. New owners failing to register the vehicle in the allotted time will need to test the vehicle themselves. In some instances, repairs may be necessary to acquire the certificate valid for registering the vehicle.

A purchaser providing the seller with a signed and notarized “Junk, Salvage or Rebuild Affidavit” is responsible for acquiring the emission test certificate needed to register the vehicle.

TIPS FOR PURCHASING A “USED” VEHICLE

- Ask the seller to see the vehicle service history.
- No service records may indicate the vehicle is not such a good buy.
- Even leased vehicles should have a service history.
- Take the vehicle to your own mechanic for a once over.
- Paying \$12 for a complete “Safety Inspection” is the least you should do for yourself.
- Require the owner provide you with a valid emission test usable for registration.
- You may incur substantial emission related repair costs if you accept responsibility for acquiring the certificate yourself.

continued on page 7

2006 IN REVIEW

by Haskins Hobson, P.E., I/M Team Coordinator

January 2007 will mark the completion of the seventh year of the Gateway Clean Air Program. The current, centralized program is scheduled to end on Saturday, Sept. 1, 2007. The department is in the process of implementing a decentralized (test-and-repair) vehicle emissions inspection program that is scheduled to begin on Tuesday, Sept. 4, 2007. The department hopes that you are making plans to participate in the next program. For more information about these changes, please visit the department's I/M Redesign Web site at: <http://www.dnr.mo.gov/env/apcp/gcap/IMredesign.htm>.

The average wait time in 2006 was 5.3 minutes with 95.2% of motorists waiting fewer than 15 minutes. As of Dec. 27, 2006, OBD tests made up 71.2% of the emissions tests performed at the inspection stations in 2006. The 2006 OBD connection rate at the enhanced stations was 99.0%. The OBD pass rate in 2006 was 88.5%, with 6.2% of the vehicles failing the OBD test and 5.3% being rejected for unset readiness monitors. The three most common DTC groups were Auxiliary Emissions Control (PX4XX), 42.2%, Fuel and Air Metering (PX1XX), 32.0% and Ignition System/Misfire (PX3XX), 18.1%. These top three groups made up 92.3% of the 28,989 DTCs collected. For more 2006 emissions test information, see the table below.

Test Type	Initial Tests	% of Total	Initial Fails	% of Test Type	Waivers	% of Initial Fails
OBD II	395,596	71.2%	27,593	7.0%	488	1.8%
IM240	124,801	22.5%	18,943	15.2%	756	4.0%
SSI	34,867	6.3%	1,573	4.5%	46	2.9%
Total	555,264	100.0%	48,109	8.7%	1,290	2.7%

In 2006, there were 497 Missouri Recognized Repair Technicians working at 300 MRRT shops. The department would like to thank all of the MRRTs who have been involved with the success of the Gateway Clean Air Program. It is through your hard work, expertise and professionalism that motorists are continuing to receive effective repairs. And, because the majority of failed vehicles are being repaired to pass the emissions inspection, St. Louis is benefiting from reduced concentrations of ground-level ozone. Thank you for your efforts and have a good year in 2007!

Trouble Shooter

continued from page 3

know the rear sensor is working, so it attempts to drive it to the middle of its range.

After everything else has been eliminated, it really comes down to the accuracy of the vehicle's catalyst efficiency monitor. If the PCM says the catalyst efficiency has degraded and a P0420 has set, does that mean the converter really is bad?

Since the June column was published, I've heard from a few Motor readers who absolutely believe in the accuracy of the catalyst monitor on Subaru vehicles. If the PCM sets a P0420, they believe that it's time to pony up for a new converter. Some also are firmly convinced that only an original equipment replacement converter will satisfy the PCM during a catalyst efficiency monitor and prevent a recurrence of the P0420 on a Subaru.

Unless stated otherwise, all converters, whether from OE or aftermarket sources, are supposed to meet the same standards of performance. Before you install any converter, make sure you install it in an environment where it can do the job it was designed to do.

"Used Vehicle Requirements

continued from page 6

- Don't let yourself be pressured into a purchase.
- If the seller is unwilling to allow you to verify the vehicle is in good operating condition, walk away.
- Don't sign a "Junk, Salvage, or Rebuild Affidavit" unless you are able and willing to pay for likely safety and emission related repairs necessary to get the vehicle registered.

ADDITIONAL INFORMATION

For more information about the emission test process, you may call the Gateway Clean Air Program at 1-800-748-4227 or visit the Web site at www.gatewaycleanair.com.

You may also call or write:
Missouri Department of Natural Resources
Inspection/Maintenance Program
7545 South Lindbergh, Suite 210
St. Louis, MO 63125
Office (314) 416-2115, Fax (314) 416-2970

Gateway Air Repair
PO Box 1034
St. Charles, MO 63302-1034

PLEASE POST. Please pass on to any Missouri Recognized/Qualified Repair Technicians working at this address.

 THIS NEWSLETTER PRINTED ON RECYCLED PAPER

Count Me In!

I'd like more information about the Gateway Clean Air Program!

Please Print

Name _____ Technician ID Number _____
Company Name _____ Facility ID Number _____
Address _____
City, State, Zip _____
Phone _____ E-mail Address _____

I'd like to receive the Gateway Air Repair electronically.

I'd like to receive future issues at home.

Please change or correct my address.

I am interested in:

- Send me OBDII brochures
- Training opportunities
- More information on becoming a Missouri Recognized Repair Technician or a Missouri Qualified Repair Technician

