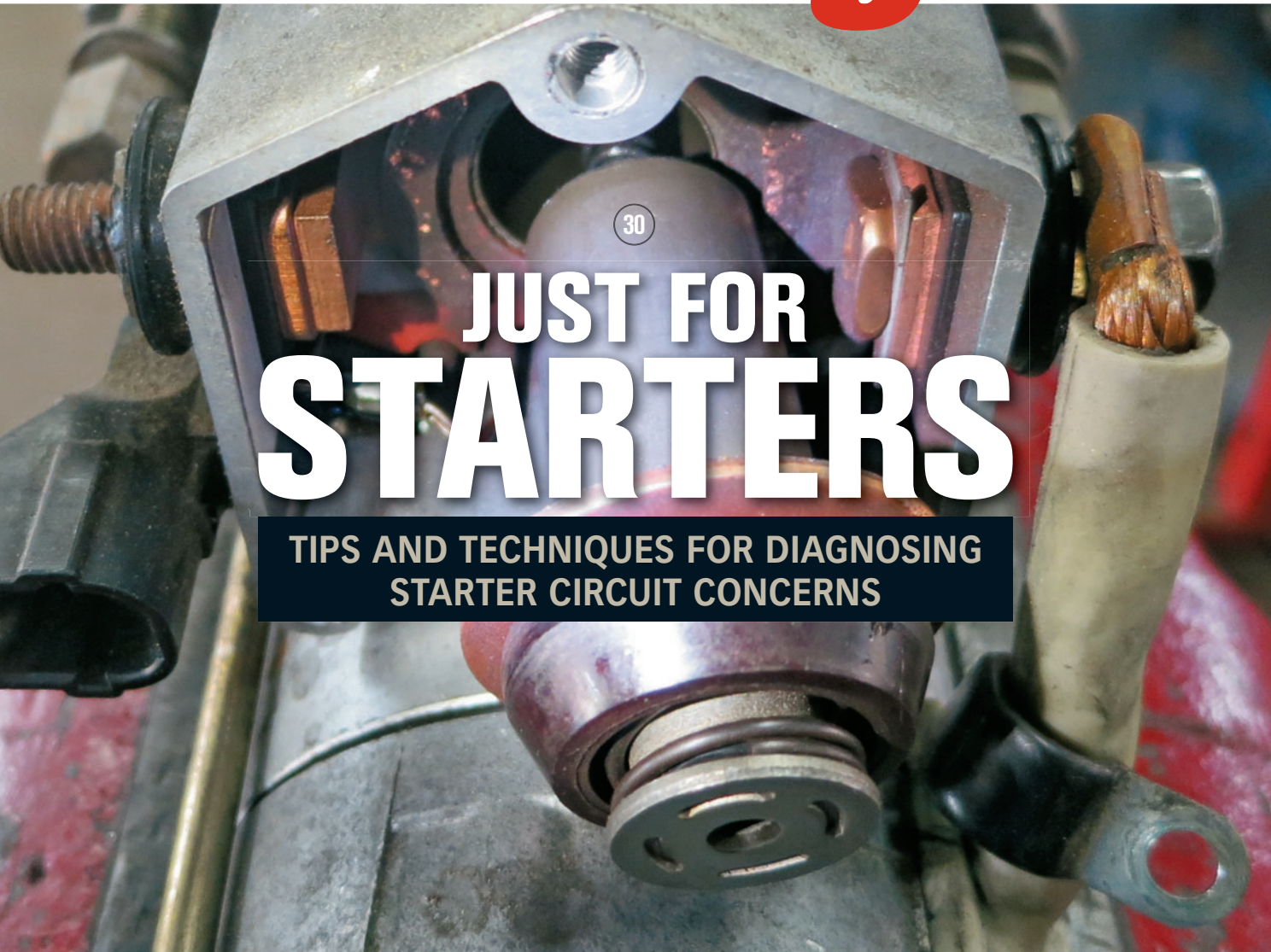


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JUST FOR STARTERS

TIPS AND TECHNIQUES FOR DIAGNOSING
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THE CAT IS OUT OF THE BAG

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Diagnosing OBDI and OBDII catalytic converter concerns

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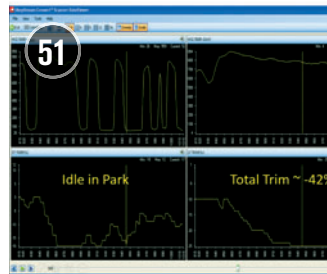
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SOP WHITEPAPER

Creating and implementing Standard Operating Procedures (SOPs) are the best ways to ensure employees know the right way to perform tasks. Read more in this free whitepaper.

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In the webinar, Pete Meier and G. Jerry Truglia cover essential testing techniques to speed up your electrical diagnosis and find disguised problems. Watch it now.

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INNOVATION STARTS WITH THE ORIGINAL




FROM LEFT TO RIGHT: Jim Savas, UBM Automotive VP & GM; Michael Johannes, Brand Manager Automechanika; Dan Risley, President and Executive Director of the Automotive Service Association; and Dennis Smith, President and CEO, Messe Frankfurt North America.

BREAKING NEWS

CONNECTED CARS

VEHICLE-TO-VEHICLE WIRELESS STANDARD UNDER FIRE

 A group of consumer advocacy associations issued a letter to the Federal Communications Commission voicing concerns about the possible commercial use of the dedicated short-range communications (DSRC) spectrum band that will be used for vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) connected car applications. The concerns focused on both driver privacy and safety if OEMs are allowed to provide commercial services using wireless technology.

In 2014, the National Highway Traffic Safety Administration (NHTSA) released an advance notice of proposed rulemaking that would mandate DSRC-based V2V communications in light vehicles. The agency was most interested in left-turn assist and intersection movement assist

>> **DSRC CONTINUES ON PAGE 8**

PARTNERSHIP

AUTOMECHANIKA CHICAGO, NACE TO PARTNER IN 2017

 FRANKFURT, Germany — Automechanika Chicago, the largest U.S. trade show dedicated to high-end technical and management-related training for automotive collision and service repair shops, along with NACE (the International Autobody Congress & Exposition), the premiere event for the U.S. collision repair industry, have signed a letter of intent to combine forces starting in 2017.

The co-production between Automechanika Chicago and NACE will create an unified stage using NACE's

strong relationships within the collision and OE community combined with Automechanika Chicago's global strength throughout the automotive aftermarket. Working in collaboration, the two entities will create an unprecedented partnership focused on training and product discovery for the automotive technicians, shop owners and parts distributors. A combined Automechanika Chicago and NACE show will take place July 26-29, 2017 in Chicago.

>> **PARTNERS CONTINUES ON PAGE 8**

TRENDING

AAPEXEDU TO HIGHLIGHT CONNECTED CAR OPPORTUNITIES

AAPEX is increasing its focus on technology with an all-new Connected Car Opportunities education track during the 2016 AAPEXedu program in Las Vegas.
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HOW TO KEEP AUTO TECHS IN YOUR SHOP

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NHTSA PUBLISHES PROPOSED RULE ON RECALL NOTIFICATION

Rule would require manufacturers to notify consumers electronically, such as through text or email, as well as by first-class mail.

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TST'S BIG EVENT AGAIN COMING IN MARCH

The TST 14th Annual Technician Training Big Event, aimed to help techs stay current with training, will take place Saturday, March 25, 2017, in Tarrytown, NY.

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Faster Ways Ahead

We're all looking for the fastest way. Whether it's a faster internet connection, a speed pass at an amusement park or just the shortest line at the grocery store, we all want to live life in the fast lane.



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1. FASTER WAY TO FALL ASLEEP The National Sleep Foundation recommends a bedroom temperature of 60 to 67 degrees Fahrenheit. A relaxing shower can also be helpful. And instead of counting sheep, try visualizing yourself in a tranquil place. Good night and sleep tight.

1



2. FASTER WAY TO CHILL ROOT BEER To chill your beverages in only 2 minutes, put them in a bucket and add water. Then mix in about 1 cup of salt for every 3 pounds of ice and mix. Your refreshments will be cold lickety-split. Cheers!

2



3. FASTER WAY TO CLEAN A PUMPKIN

Before carving, cut a hole at the bottom of the gourd and scrape from the top of the pumpkin to the base. Also, try using an ice cream scooper to clean out all the guts instead of traditional scrapers. It's scary fast. Boo!

1

4. FASTER WAY TO FIRE UP YOUR GRILL

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>> PARTNERS CONTINUED FROM PAGE 4

"We are extremely pleased with this alliance. The industry has been asking for this and we listened. By combining the expertise of two undisputed market leaders, Automechanika Chicago and NACE, we are confident of our ability to offer a comprehensive platform for companies interested in reaching collision and mechanical repair shops en masse," stated Dennis Smith, President and CEO, Messe Frankfurt North America.

Automechanika Chicago produced

its inaugural show in April of 2015 in partnership with UBM, formerly Advanstar Communications, training more than 2,000 technicians and shop owners. NACE has served the automotive repair and collision market for more than 30 years. The strong commitment to the automotive industry by each of these groups solidifies the combined position to exceed the demands of the market.

"By combining resources, this collaboration will provide the market with

a unique opportunity to connect each segment of the industry, thus serving the entire automotive collision and service repair audience," said Dan Risley, President and Executive Director of the Automotive Service Association (ASA)."

"This partnership is a real opportunity for shop owners, managers and technicians to connect at an event tailored to them by groups that understand their training needs and the real-world repair issues they face," said UBM Automotive VP & GM Jim Savas. **TL**

>> DSRC CONTINUED FROM PAGE 4

systems that would help drivers by alerting them to cars that are running red lights, or preventing drivers from making a left turn into oncoming traffic. According to NHTSA's findings, just those two systems could prevent up to 592,000 crashes and save more than 1,083 lives per year. The proposed mandate would take effect in 2020, and General Motors plans to include the technology in vehicles as early as the 2017 model year.

The consumer and privacy groups support a request by Public Knowledge and the New America Foundation for an emergency stay on the use of DSRC in the 5.9GHz spectrum band because of the possibility of connected cars being hacked or companies misusing vehicle owners' personal information. The Intelligent Transportation Society of America (ITSA), Alliance of Automobile Manufacturers and the Association of Global Automakers filed a counter petition to deny that emergency request.

The letter to the FCC was signed by representatives of Consumer Watchdog, Consumer Action, the Center for Digital Democracy, the Consumer Federation of America, the Electronic Frontier Foundation and other groups.

Dr. William Whyte, author of the

IEEE 1609.2 V2V security standard, met with White House officials in late summer to discuss the issue. "There is no doubt that connected cars are vulnerable to hacking and the examples the petition provides do an excellent job proving that," Whyte said. "However, all of those attacks were done through cellular connections, on-board diagnostic (OBDII) port dongles, remote keyless entry fobs and other wireless connections. Unlike each of these technologies, DSRC was designed from the start with security and privacy in mind."

According to the letter from the consumer advocates, ITSA and automakers hope to deploy commercial services on the DSRC spectrum, which may not be covered by the privacy-by-design protections proposed by NHTSA in its 2014 Technical Report and advanced notice of proposed rulemaking. Instead, application providers would be responsible for providing whatever level of privacy they wanted.

According to the letter: "Without Commission action on the petition, DSRC licensees are free to partner with any commercial data broker, advertiser or any other third party with virtually no notice to consumers and no need to obtain consumer permission — or even provide consumers with a means of

opting out of those arrangements."

Consumer protection concerns have been increased by cybersecurity vulnerabilities highlighted in the 2015 Markey Report, as well as private testing by different companies and hackers. DSRC units could potentially be exploited to spread malware from car to car, putting personal information at risk and creating a safety hazard.

According to automotive industry groups, the request for a stay is flawed because DSRC systems don't collect or store information that can be linked to a specific driver or vehicle. According to the Alliance of Automobile Manufacturers, the stay is also flawed because it doesn't meet the FCC's requirements for such a request.

The IEEE 1609 DSRC Working Group defended the security of the standard to the FCC. "Security and privacy have been fundamental DSRC technical and policy requirements since its inception," the group said.

"It is essential that the intelligent transportation revolution continue," said Regina Hooper, ITSA president and CEO. "From saving lives to reducing emissions to easing traffic congestion, the full promise of intelligent transportation is transformative. Such a move would be reckless and unwarranted, undermining the clear public interest." **TL**

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GETTING RESULTS FROM CUSTOMER RELATIONSHIPS

Treat your customers the same way you treat the people you care about outside the shop

DAVID ROGERS // Contributing Editor

PHOTO: GETTYIMAGES / XXINXING

Early on after I came to work for Terry Keller at Keller Bros., I remember a woman calling in a panic.

I'll never forget that red and white pickup truck pulling into our shop. It was 7 p.m. on a Friday — long after the shop had closed. She was in tattered clothes carrying a crying infant and completely broken.

We got the car diagnosed and told the woman she needed a new brake master cylinder and reservoir, and she broke down again, unable to pay. She wanted to get back in the car and drive off. I asked her to wait a moment and went into the office to call Terry.

I offered to buy the parts and told Terry that the tech was willing to donate his time. We knew she needed our help, but Terry would have to okay using the bay to fix the car.

Terry said no.

He said that when somebody trusts us so completely, it's a relationship the entire shop needed to protect. He purchased the parts for her and paid the tech time-and-a-half that night for sticking around to fix her car.

She cried again when I told her what Terry was doing for her. Being able to help this woman, who was at the absolute end of her rope, is still one of my favorite memories.

I admire Terry, and this story is a good example of why. He treats every customer as family and it was never something that he had to be taught or needed to practice. For him, it's a natural instinct. When a customer speaks to Terry they know how much he genuinely cares.

It isn't always easy for shop owners to build such personal connections with their customers. When shop owners also have to manage technicians, train ser-

vice advisors, watch the bottom line and protect their business, taking the time to foster deep relationships with every customer often slips off the priority list.

In my experience, building those relationships is the most critical part of running a shop. Creating lasting relationships allows you to get more done!

It's a principle I call "Getting Results from Relationships," and the first step in building strong, lasting relationships is to cultivate a team of loyal, caring and committed people.

Building relationships

Customer relationships are a lot like the other relationships in your life — friends, family, even romantic relationships. The same principles that apply when you are forming a new personal relationship apply with the customers in your shop. Acknowledging this simi-

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larity is the first step to getting results from customer relationships.

First impressions

What kind of impression does your shop make when a new customer visits? It's not just what you say and do at the front counter. Your uniforms, your waiting room, your parking lot, your sign, the way you answer the phone — all of the mes-

sages you send are a part of your marketing, and they tell your customer what to expect from a relationship with you.

When you go on a first date, you put a little extra care and effort into your appearance because you want to make a good impression. Every day that you welcome a new customer, your shop is going on a first date. Put your best foot forward.

Sometimes the first date is the only

date. If your shop is rude, pushy or otherwise doesn't leave a good first impression, the customer won't be back.

Courting your customers

Not all customers are great customers. Not everyone who drives by is somebody you want in your shop. It's important to ask yourself, "Is this a good relationship? Am I attracting the right kind of customers with my marketing?"

If the customer will be a good long-term match and you want to pursue a relationship with that customer, you must earn that relationship. The minute you take a relationship for granted, it is over, which is why follow-up is so important. It gives you the opportunity to check in and make sure the customer is doing okay. If the customer is unhappy, follow-up is your opportunity to make it right.

Without follow-up, a customer may simply disappear, and you'll never know they were unhappy.

Whether it's a first date or a life-long friend, you must continually nurture the relationships in your life. If you treat your customers with the same respect, dignity and goodwill that you treat the people you care about outside of the shop, superior service advising will happen naturally.

Treat customers like family

In our shop, we have taught every person on the team one principle that has virtually eliminated mistakes. In fact, when mistakes are made, they are typically so small it barely registers.

We teach our employees to take a moment before taking any action to ask themselves a question: "Is that what I would want somebody to do for my mother or grandmother?"

When a technician is tempted to pencil whip an inspection form, this question forces them to stop and remember their values. If a service advisor is busy and starts to rush through the advising process, they must take a breath and give

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every customer the same advice they would want somebody to give the people they care about most.

Treating a customer like family means they are no longer just an inspection form or a sale to be closed. It forces us to put their needs above our own, earn their trust and deliver on the promises we make.

Getting results

It shouldn't come as a surprise that when you create these relationships, service writers can't act like sales people. Doing hard closes won't build trust. Tricking them into coming to your shop through false hope won't build trust. Taking away their options so they feel pushed into an expensive repair won't build trust either.

So how does a shop get results from relationships? Stop selling. It is very hard to trust a salesman. When the sale is front and center, the relationship is pushed to the back.

When you bring the relationship forward, you empower the customer and educate them to make the right decision. You become their teacher, protector and defender. When you help them understand the services you are recommending — not only the “what” but also the “why” — you remove the

regret and remorse and build value instead.

Ask questions

I have seen too many relationships fall apart because one person forgot to check in with the other. They think they understand what their partner wants, but they never bother to check in and ask if they are right. Do not make that mistake with your customers.

The moment you assume you know what your customer is thinking is the moment you put the relationship on the wire.

Ask your customers if they have any questions about their vehicle. They may be holding onto a question, thinking it's silly.

Ask them if they need a ride while you're working on their vehicle. They may not know you can drive them to work. They may be embarrassed to ask.

Ask them if they'd like to come back in the shop to look under the hood of their car as you explain the results of the inspection. Just because they didn't ask doesn't mean it won't build trust to see the car in the air or touch the problem.

In other words, never assume you understand a customer's thinking. They may not know the questions to ask. They may have a personal situation you don't know about. Only when you step to the other side of the counter, both literally and figuratively, can you begin to understand your customer and build that relationship.

It doesn't end here. Getting results from relationships is an ongoing process your entire team must commit to and work towards every day. Building a relationship starts before a customer even comes into the shop and lasts long beyond the repair.

About three years after that red and white pickup drove off, a woman walked into Keller Bros. She was confident and dressed in an expensive suit. She asked if I recognized her, and I said she seemed familiar, but I couldn't place her exactly.

The second she told me her name, the memories of that night flooded over me. Her broken truck, her ragged appearance, her tears of joy.

She told me how that night had changed her. Knowing there were good people in the world had led her to change direction in her life. She had gone back to school, gotten licensed and was now the manager for an insurance agency. She said they had a fleet of 30 cars, and there was nobody else she would trust to take care of them.

This story is one of my most cherished memories and a continual reminder that when we stop selling and start treating our customers like family, we create genuine relationships with every customer that lead to valuable, lasting results. **TM**



DAVID ROGERS is COO of Keller Bros. Inc., and president of Auto Profit Masters. contact@autoprofitmasters.com



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Can you afford to hire great techs and writers?

Shops must begin raising their labor rate to remain competitive

Overheard veteran coach Brian Hunnicutt explaining to his 20 Group his feeling on the future of hiring and retaining great employees in the years to come. Brian began his talk by saying, “The topic that gets the most reaction from my clients when I bring it up is labor rate. It is always followed by silence.”

What is your labor rate and why is it the rate that it is? What would happen if you increased it by \$25 an hour? \$50 an hour? Here you were just thinking that I was talking about \$2 or \$5 an hour, right?

The reason that labor rate is even a topic right now is because of your employees or the lack of great employees.

Better benefits and pay

Let’s see how this is going to play out as the lack of technicians becomes even greater. Who will have the best techs? Will it be the shop that pays them OK or the shop that pays them better than average? Is the average going to go up? I believe it is. So if you are supposed to make at least 60 percent on the labor margin and you have to factor in whatever your extra load is that

you are paying them, it stands to reason that the labor rate will need to go up.

Effective labor rate vs door rate

Does your door labor rate match what you are really collecting per hour? What is your real or effective labor rate? Take your labor dollars and divide them by the hours you give your techs credit for performing — that is your effective labor rate. Most shops are around \$15 to \$20 under their door labor rate. Say you do \$10K in labor sales and you have a \$100 labor rate. You would need 100 hours to get your labor rate. But your techs got credit for 120 hours. Your labor rate is now \$83.34 an hour.

What do you charge for an oil change in labor? If you charge \$10 labor for the oil change, what credit do you give the tech who did it — .1, .3 or .5 hours? Unless you only gave them .1, your labor rate is not really your labor rate. You just lost .2 or .4 hours with the other responses.

So what is your effective labor rate? That is the number we need to use to see if you are in fact hitting the right 60

percent margin in your labor.

The type of shop you own or manage tells us how many hours per vehicle you should be shooting for. Quick lubes would love to have .75 hours with the huge car count. For tire shops and state inspection shops, the goal is 1.5 hours per vehicle. Regular auto repair shops are going for 2.5 hours and Asian and Euro shops go for 4 to 7 hours per shop, with Asian on the low end and Euro on the high end.

So a normal shop is 2.5 hours, and if you raised the labor rate \$25 per hour, then the normal increase to the customer would be \$62.50 on a 2.5-hour job. Is this a deal breaker? It is if you are selling price rather than warranties and benefits.

On a 10-hour job it would be an additional \$250, but the bill would already be around \$2,000. Is an additional \$250 a deal breaker? We may not be able to raise our rate to \$25 or \$50 an hour all at once right now, but we need to start moving it up if we are going to attract and pay the best techs and service writers.

If you are interested in a worksheet that will help you determine what your effective labor rate is, simply go to www.ationlinetraining.com/2016-10 for a limited time to download your own copy. **TL**

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Chris “Chubby” Frederick, CEO



CHRIS “CHUBBY” FREDERICK is the CEO and founder of the Automotive Training Institute. ATI’s 115 associates train and coach more than 1,400 shop

owners every week across North America to drive profits and dreams home to their families. This month’s article was written with the help of Coach Brian Hunnicutt. cfrederick@autotraining.net



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Industry demand will drive up the price of technicians

Your life will change once you focus on billed labor at the correct rate

The future for the independent sector looks very promising and will prove to be an exceptionally profitable period over the next 10 years, but only for the shop owners who truly understand their client base, their business and their industry.

The supply/demand economic equation must be clearly understood by most shop owners, as the supply of competent technicians has dried up. However, the demand is increasing throughout the industry, which will force wage levels to rise dramatically over the next five years. Already, we know of some areas where competent technicians are earning within the range of \$28 to \$35 per hour with a signing bonus and a comprehensive benefit package, which proves that this shortage is not confined to one area of the country.

Finding competent technicians is certainly one issue, but what will happen to our industry and the independent shop itself under this financial scenario? In the long run, this is excellent for our industry — competent technicians will finally become recognized by the public as working in a “profession” rather than a “trade” and be seen as highly skilled individuals deserving of a professional income. In the short run, it could cause absolute financial ruin, as most shop owners are not aware of the detailed numbers of their business and how they contribute to net income. Additionally, most shop owners are not properly versed on how to pass on the right labor costs to their clients. They are running their business based mainly on “price,” and they have failed to educate their clients about the level of expertise that is required to maintain today’s vehicles.

Shop owners must change how they measure their labor revenue component. Labor should be broken down into a minimum of three categories: a maintenance/mechanical labor, diagnostic labor and re-flash labor. Each labor department has a different skill level of technicians. Each skill set can have different additional payroll costs with specific benefit packages included. As an example, the maintenance mechanical labor



THE SUPPLY/ DEMAND ECONOMIC EQUATION MUST BE UNDERSTOOD BY SHOP OWNERS, AS THE SUPPLY OF COMPETENT TECHS HAS DRIED UP.

door rate would be set at 4.5 times the top mechanical technicians’ hourly wage (i.e. $\$21 \times 4.5 = \94.50 or $\$95$). The diagnostic labor rate would be set at a minimum of 5.35 times the diagnostic technicians’ wage (i.e. $\$26 \times 5.35 = \139.10 per hour), and the re-flash rate would come in at 6 times the top technicians’ hourly wage (i.e. $\$26 \times 6 = \156). These higher multiplier rate factors over the maintenance rate are necessary not only to cover high-tech equipment purchase/lease costs and their replacement costs, but also ongoing software upgrades, diagnostic training, subscriptions and management’s time spent educating the client as to the diagnostic process or re-flash process to take place. Until the client vehicle mix of the shop is measured and understood, an interim guideline of a minimum of an additional 20 percent of the labor hours billed through the bays in maintenance billings should be going out at the combined diagnostic rate and re-flash rate. For example, if the shop billed 200 maintenance hours in the month, then an additional 40 hours should

have been obtained in diagnostic and re-flash billed hours for a total of 240 hours billed for the month. Understanding your vehicle mix allows you to see where diagnostic and re-flash opportunities lie.

When shop management understands who they are selling to and how to implement the new strategies and sell these additional rates with client satisfaction, the contribution to gross profit of the shop can be tremendous. Are you up to date in your management responsibilities to embrace the new profit potential available in our industry? **ZZ**

BOB GREENWOOD, AAM, is president and CEO of Automotive Aftermarket E-Learning Centre Ltd. (AAEC), a company focused on providing business management resources and development for the independent sector of the automotive aftermarket industry utilizing the internet environment. Bob has more than 36 years of business management experience within the independent aftermarket industry, consulting independent retail shops on all facets of their business operations. Bob is one of 150 worldwide AMI-approved instructors. greenwood@aaec.ca



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CHOOSE THE RIGHT MAIL

Automotive mail advertising: Direct mail vs. shared mail vs. money mailers — the pros and cons

TIM ROSS // Contributing Editor

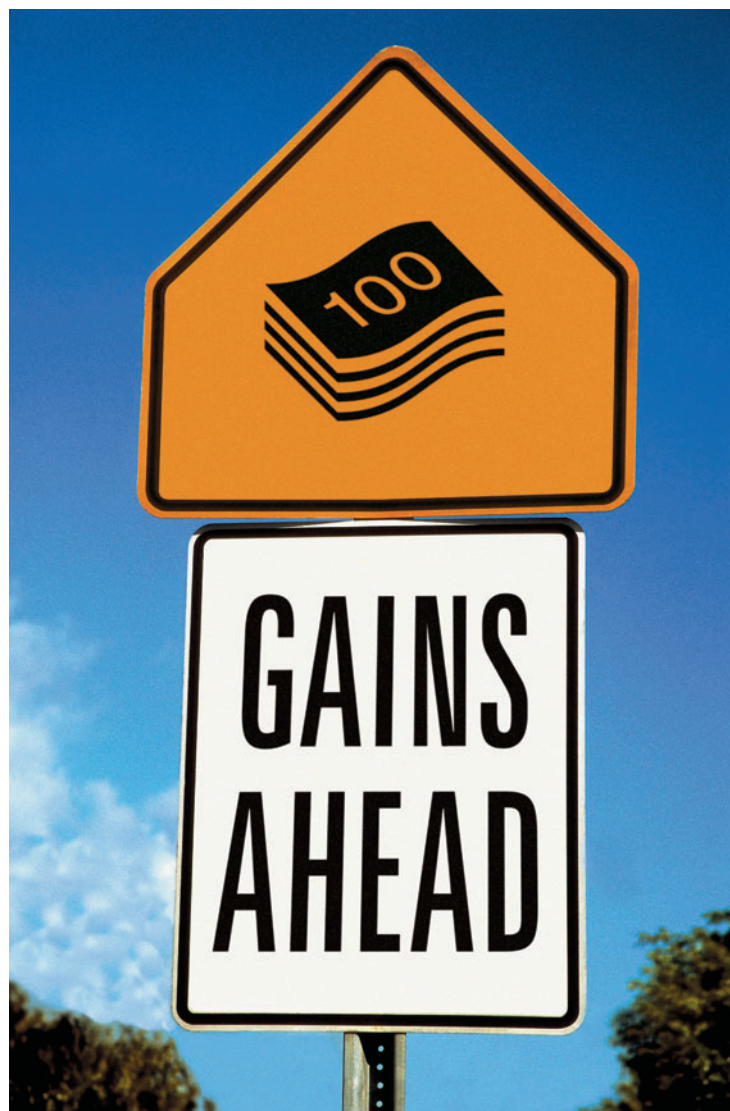
As someone who fervently believes that direct response marketing still has a viable place in a digitally focused world, I am often asked about the pros and cons of the various options that small- to large-size businesses have today when they want to target their customers and prospects with physical mail. While traditional direct mail has been around for more than a century, in recent years a variety of formats have been introduced. So, with all these choices, which format is best for your business and marketing objectives?

As with any product comparison, there are a variety of features that must be explored in order to understand which format will be most appropriate. The four that I will use for this comparison are:

- applicable size restrictions
- delivery and timing
- targeting options
- typical response rates

Traditional direct mail

Traditional direct mail marketing offers many options when it comes to targeting, personalization, size options and tracking capabilities. This format is heavily used and is the most popular among all direct mail formats. You'll have complete control over the design, the size, the mailing list and delivery dates. Traditional direct mail offers the most advanced campaign



tracking; it offers the ability to measure response rates and return on investment. You can track how many of your mail ads were delivered and have the “return to sender” ads route back to you to help optimize your mailing lists.

Applicable size restrictions: Traditional direct mail is the most flexible in terms of size options. Your size options are unlimited, which gives you the ability to stand apart with unique mail ads. However, as you move from a letter to a flat and beyond, not only does the production cost of the mailer increase, but also the postage costs.

Delivery and timing: This type of mail can be sent via first class or standard postage. You have the flexibility to advertise a time specific to an event or promotional offer. Provides the greatest control of the production timing and when the ad arrives in mailboxes.

Targeting options: The major advantage of traditional di-

rect mail is having the ability to target prospects or existing customers based on any combination of demographic and/or lifestyle attributes. Marketers can be extremely precise and targeted with their messaging and use personalization, which garners higher response rates. You have the options of providing a list from your customer database or purchasing a mailing list from a third party provider.

Typical response rates: 3.7 percent (database list); 1.0 percent (prospect list).

Every door direct mail

Every door direct mail (EDDM) is a class of direct mail that the United State Postal Service (USPS) launched a few years ago. The concept was created to send your message to “everyone” in a carrier route (think of a zip code as a pie — a carrier route is a slice of the pie). A critical factor to consider is the level of waste associated with ads delivered to vacant homes and/or bad prospects or targets. Mail ad personalization is not available when using this format.

Applicable size restrictions: There are specific mail size restraints and weight restrictions that must be observed to qualify for this format. You’ll also need to include a mailing label and the correct indicia.

Delivery and timing: The advertiser or business using this format is required to prepare the mail for delivery, which includes creating the design, choosing the list, bundling the mail ads by carrier routes and delivering the bundles to the assigned postal office. Similar to traditional direct mail, businesses can control when a piece is mailed.

Targeting options: Zip codes and sub zip codes will be the primary attribute used to define your mailing list. Your EDDM bulk mailers will be delivered to each residence and business within that specified zip code area. While some filtering options are available (age range, average household income, average

household size), ultimately you cannot choose to mail to one specific address vs. another. You can only mail up to a 5-mile radius of your business.

Typical response rates: 0.5 percent.

Shared mail

Shared mail is a category of direct mail advertising that allows multiple advertisers (i.e. multiple businesses) to share the cost of third-class mailing by combining printed ads into one open package. Shared mail marketing dramatically reduces your individual distribution costs while getting your brand and message in the mailboxes of thousands of homes. Service is not available in all markets.

Applicable size restrictions: There are specific size restraints that must be observed for mailers to qualify for this format. Shared mail size restrictions can vary greatly and are usually dependent upon who you use as a vendor.

Delivery and timing: Shared mail advertisements arrive in the weekly newspaper circular or bundled in a stack of 20 or more cards in a plastic wrap. Typically, there is a 2-5 week window between the order date and the mailbox delivery date. As such, it may not be the right option for some time sensitive events or promotions.

Targeting options: Shared mail inserts are very low cost saturation mailings within pre-selected zip codes. No specifications can be made about which part of a zip code your mail ads will be sent to, but the zip codes can be selected based on certain basic demographic criteria (average age of home, average household income, average age of the residents). Not all zip codes are available, however most major cities are covered throughout the nation (some 90 percent of the USA). All shared mail vendors require a minimum print quantity per mailing, usually 10,000 – 20,000.

Typical response rates: 0.25 percent (greatly impacted by the number of ads in the pack).

Money mailers or Valpak

This format is very similar to the shared mail format. It allows multiple advertisers (i.e. multiple businesses) to share the cost of third-class mailing by combining printed ads that are coupon/discount driven into one envelope package. On average, each Money Mailer envelope contains 38 inserts/advertisers.

Applicable size restrictions: There are specific size restraints that must be observed for coupon mailers to qualify for this format. Size options vary across Money Mailer franchisee vendors.

Delivery and timing: The vendor will provide an annual calendar with scheduled dates for mail delivery. Most Money Mailer franchisees distribute the shared mail envelope to consumers once per month. You’ll be able to select the months you desire based on a pre-set annual calendar.

Targeting options: You can mail anywhere in the United States, but this format is only available for local targeting. You choose zones to target, which are defined by whole cities and zip codes.

Typical Response Rates: 0.02 percent coupon redemption rate.

It is nearly impossible to make a blanket statement that one method is better than another when factoring in business type and structure, products/services offering, location, target market and ultimately marketing goals and objectives. At the same time, I will suggest that the more personal and targeted you can make your direct mail marketing, the better chance you have of the recipient noticing it and actually taking action. When these elements are coupled with quality data, the results can be remarkable. *TM*




TIM ROSS is president of Mudlick Mail, a provider of direct mail services for the automotive service industry. He has been with Mudlick Mail since 2008. info@mudlick.com

Bright bikes, big city

Motorcycle shop thrives in the heart of Manhattan

ROBERT BRAVENDER // Contributing Editor

 In the whole width and breadth of the United States, we rarely entertain the notion that a dealership, let alone a repair shop, can exist in the middle of Manhattan. And yet here's Mototainment, a firm in the island's SoHo district specializing in Italy's Ducati and Britain's Triumph motorcycles.

And you think you've got problems?

"It's very difficult," Service Manager Kerry Sano confirms. "We're very high volume as far as sales and repairs, but we are constrained by space and parking and all of the things that you can imagine being in a major metropolitan city — the service department is in the basement and we can only get bikes down through a union-run elevator."

"It's funny because it's literally only 800 square feet," remarks General Manager and owner Steve Radt. "But 800 square feet in Manhattan is gold, so we took that space and created something very unique, very SoHo, very New York: a dedicated apparel boutique which only has high end products like gloves, suits, and full carbon fiber helmets worth \$4,000 apiece."

Like the Harley-Davidson business model, they're not just selling bikes, they're selling a lifestyle. The only independently owned franchise motorcycle dealership on Manhattan, Mototainment is also the only Ducati and Triumph dealer in New York's five boroughs. "In calendar year 2015 we were the number one Ducati dealer in North America," he observes. "That is what is novel about us; we're an independent dealer and we're able to put out that kind of volume."

Meanwhile Radt brings his own sensibility to bear on the business; coming up through Ducati corporate as a mechanical engineer in product development, an opening at Mototainment caught his eye. "I was ready to do something else," he explains. "I had never worked retail before, and I always wanted to work in Manhattan, so I actually took the opportunity to run the store."

He had his work cut out for him. Upon taking over, the store was facing bankruptcy, but Radt was able to keep it open for another two years before the owner decided to sell, except with a lease set to expire in 2014 accompanied by escalating rents, no one was willing to buy.

"I ended up offering to buy the dealership myself," reports Radt. However he and the owner couldn't come to an agree-



MOTOTAINMENT

New York, NY // ducatitriumphnyc.com



Steve Radt
Owner

5
Years in Business

19
No. of Employees

800
Total Square Footage of Shops

1
No. of Shops

7
No. of Employees

ment either, "so I walked out and the dealership closed." But he had good relationships with the OEMs and the landlord, and kept his offer on the table should things get sorted out. Five months later they did.

"I signed the lease literally the next day with the landlord and restarted conversations with all the OEMs and our particular vendors," Radt says. "But by that point the place had been picked over, an empty shell, so it took me about two and half months to actually rehab [the facility] and get it back open. The dealership had closed in December of 2010 and we didn't open in earnest till August of 2011."

Taking advantage of some unused space also allowed Radt to move the apparel department from the basement to an



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upstairs level. “By doing that we were also able to double our service area,” he reports. “While we were a high-volume dealer in terms of sales, we weren’t always able to capture the service aspect for our customers, which in essence drove them away from our dealership because we didn’t have the capacity. Now we’re able to retain our service work and keep our customer base, which allows us to continue to grow.”

That’s where Kerry Sano comes in. “I started out doing cars in North Carolina,” she recalls. “I went to school to work on race cars and I worked as a regular mechanic. Then I moved to San Francisco and got a job doing bikes, and fell in love doing motorcycles — a lot more than cars.”

Starting out as a technician with Mototainment, she became the Service

Manager a few years ago, overseeing three techs, a service writer, and two porters. “(The latter) do things like drive the bikes for test rides, pick-ups and deliveries as well as moving them up and down from the street to our basement,” she explains.

“Motorcycles are a little different than cars,” submits Sano. “We don’t offer quite as many services because cars have such a high volume that they are able to recoup a lot more of their budget. Also, it’s not like you can have someone pick up a bike and take it to a detailer or just drop it off and have them take care of it and bring them back to you. It’s a little bit more involved because not everybody is capable of riding a motorcycle. We also used to have a detail shop across the street, which is now a condo, so it is increasingly difficult to go above

and beyond with our service.”

Besides doing basic maintenance and warranty work, they’ve also been building a line of custom bikes. “We can do that on a commission basis for the customer,” says Radt, “but very often we build the bike on our own and then present it to the customer base.”

Between Radt’s own background in product development and input from seasoned veterans on the technical staff, Mototainment has really carved out a market niche for itself. “There are a lot of custom houses out there,” Radt observes, “but I think we build very unique, very custom bikes that still come with a two year full factory warranty from the manufacturer.”

As pictured on their website, Mototainment’s custom lines are quite extensive and individualized; it’s simply amazing how a shrewd use of accessories and custom parts can mold a bike’s character — much like the city of New York itself. As Radt notes, “having never worked retail, having never owned a business beforehand, if I failed, I’d fail spectacularly. But there is something about Manhattan; if I was going to go for it, I’d go for it here.” *MZ*



ROBERT BRAVENDER

graduated from the University of Memphis with a bachelor’s degree in film and video production. He has edited magazines and produced shows for numerous channels, including “Motorhead Garage” with longtime how-to guys Sam Memmolo and Dave Bowman.

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In business, it's all about the relationships you build

THE DOS AND DON'T OF BECOMING A MASTER NETWORKER

KIM WALKER // Contributing Editor

When it comes to marketing your business, it's all about the relationships you develop. People want to do business with people they know, like and trust. In other words, your potential customers need to get to know you before you can win them over.

Networking is a key part of your business success. Think about it: people are always looking for personal recommendations for an auto repair shop. They don't care about the fancy ads on TV. They want to know they can trust their car tech. A personal recommendation is like gold. If you are the one out there connecting with people, then you're more likely to be that person who's recommended by others as a trustworthy technician.

So how can you get people to know you? It comes down to becoming a master networker. Of course, you can't just wave a magic wand and become the

king or queen of connections over night. There is some skill and artistry at work. Below are a few dos and don'ts to help you increase your connections and make the most of your networking efforts.

Here's what you should (and shouldn't) do as you network:

Do join associations, including the Chamber of Commerce, Business Networking International, Rotary, Kiwanis and others.

Don't assume joining is enough. Anyone can sign up and say they're a member, but only those who actively participate will see a true and lasting benefit. That means attending meetings, events and any other social gatherings that serve as an opportunity for you to meet and connect with people.

Do make the most of attending events, which requires strategy and forethought. If you go in without a plan, you'll either spend your time unsure of who to talk to or you'll miss out on an opportunity that could have evolved into a lasting relationship.

We suggest you spend time preparing for your event. This includes see-

ing — if possible — who has registered. From that list, pick out a few specific people you intend to meet. Make sure this is a reasonable amount of people so that it gives you enough time to converse and establish a connection.

Do know where to wear your nametag. It's best worn on the right half of your chest, since most people shake with their right hands. As they greet you, their eyes will naturally travel from your hand up to your nametag.

Do listen more than you talk. The best way to sell your offering is to sit back and let others engage with you. It can be a negative experience when you're the one doing all the talking. So let them do the talking so that they walk away feeling good about that connection. Your goal is to keep the focus on the other person. See the continuation of this article here next month!



KIM WALKER is Marketing Director for Vizoop, a social media management tool that helps shop manage their own

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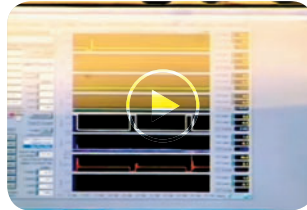
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SOCIAL INSIGHTS



READER WEIGHS IN ON "TECHNICIAN SHORTAGE" ARTICLE

Director of Training Pete Meier received the following email about his article, "In response to your email," (August 2016), which can be seen at MotorAge.com/shortage. Jim Morton with Morton's Automotive Technical Services, wrote:

"I teach at a post-secondary automotive training center in Pennsylvania. The owner is an ASE Master technician who understands what we need and how to get it done. I was only asked to fill in for an instructor who walked out on a group of students and to complete the second half of a 40-day course on electrical, and here I am 20 years later still teaching for the school.

After we found a qualified instructor to teach the course going forward, I told the owner I would be going back to mobile diagnostics full time. He asked me to stay and give his students the edge they needed. This is where my Advanced Engine Performance class came in. What I do in this course is start every day with what I was hit with the day before, and we go through a diagnostic strategy of what to do when confronted with a similar problem.

NATEF states that four weeks of engine performance is the requirement in the trade schools; we have the students go through eight weeks of Engine Performance, then they come into my course for an additional eight weeks. I'm not going to say this is equal to real-world experience, but it is the closest thing because I'm throwing real-world problems at them.

Then they go out to secure a position in the field, and, as you stated, are offered bare-bones money that won't come close to paying off student loans, and they become the low man on the floor. The funny part is that a lot of times the seasoned tech waits until my student gets to the shop to begin the diagnostics on a problem vehicle.

I witness what you stated every day and feel for my students. They, in a short amount of time, become the leader in the shop if they can take the abuse in the beginning.

As you stated, this industry had better wake up and realize there is some great young talent out there and they don't want to or shouldn't have to be doing only oil changes."

TRAINING EVENTS

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OCTOBER 15

Automechanika Chicago LIVE — Training Event
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NOVEMBER 1-3

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NOVEMBER 1-4

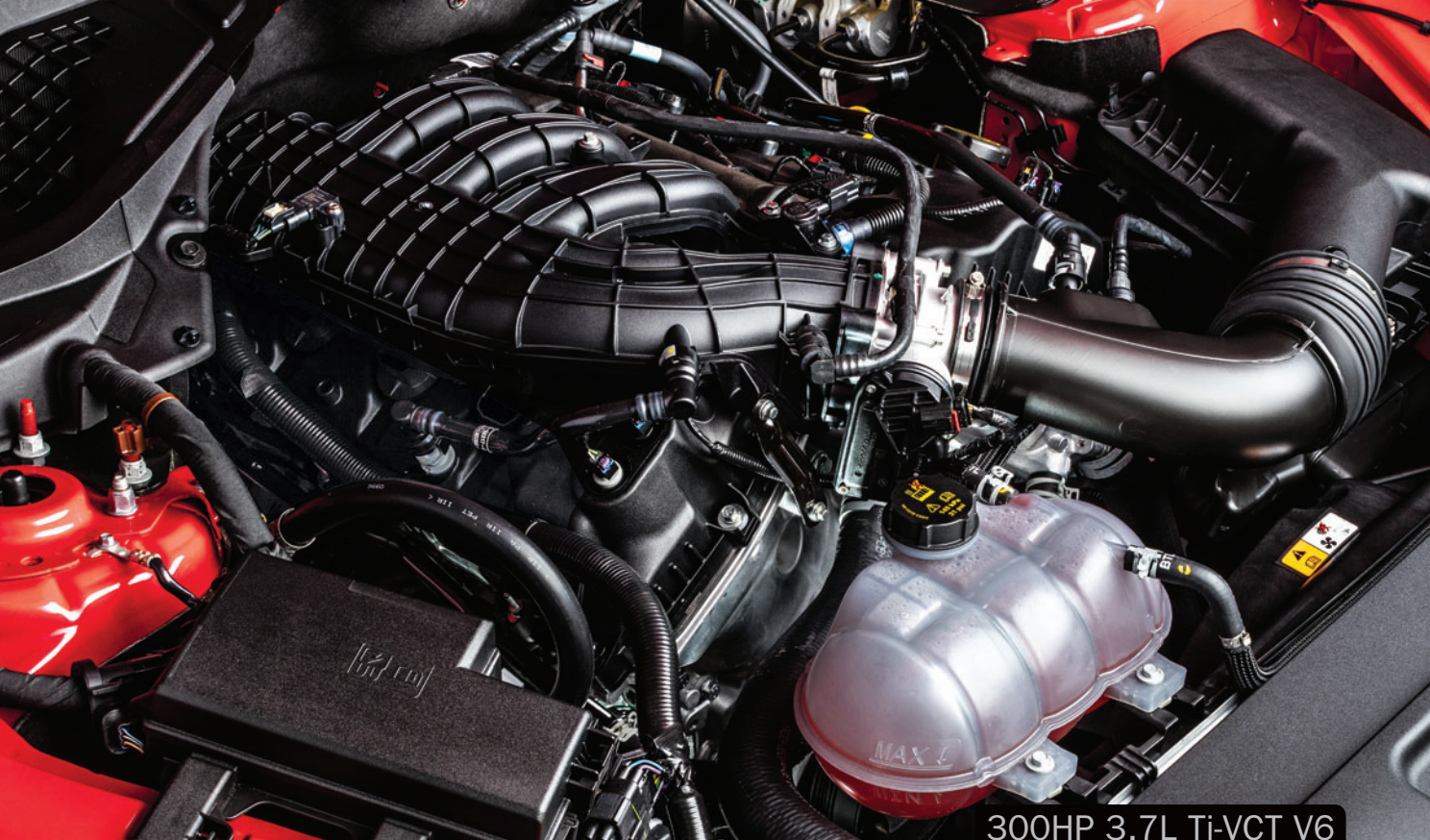
SEMA
Las Vegas Convention Center
Las Vegas, Nevada

NOVEMBER 19

Automechanika Chicago — LIVE Training Event
Joliet Junior College
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JUST FOR STARTERS

THIS IS THE STARTER that was removed from a Lexus LS400 – it's mounted underneath the intake manifold, but the focus of this photo is to show how the big copper washer and the solenoid core work together to slam the copper washer hard in order to close the connection between the battery terminal and the one that sends current into the starter motor.

TIPS AND TECHNIQUES FOR DIAGNOSING STARTER CIRCUIT CONCERNS

RICHARD MCCUISTIAN // Contributing Editor

Most tech-savvy folks know how you can make an electromagnet by wrapping insulated wire around a metal core and feeding current through the wire. And as the polarity of the electricity is reversed, so is the north/south orientation of the magnetic field. Put the magnet end

to end on a spinning core in between two permanent magnets and fit it with a contact commutator with a pair or pairs of discrete contacts feeding DC current to the core. Then, when you apply power to fixed brushes sliding on the commutator, the core spins because the magnetic field in the core is constantly repelling from its like poles

in the outer magnets.

Where DC brushless motors are concerned, you simply put the magnets on the part that spins. Put the electromagnetic windings on the outside, sort of like an alternator with a permanent magnet rotor, only you're feeding the stator instead of harvesting its energy. The brushless AC motors in hybrid vehicle



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transmissions work in a similar fashion, but they're fed by AC current from an inverter instead of DC. A brushless DC motor needs some electronics to make it work, because you have to feed pulses to the external fixed windings in such a way that they're timed with the north-south swapping of the permanent magnets built into the rotor. Thus, you're

taking the DC and turning it into AC inside the motor.

Brushless DC motor electronics have to use a sensor to keep up with where the rotor is at any given time, and a Hall-Effect sensor is typically used for that. Furthermore, because of the electronics, you can't simply reverse the polarity of the current you feed a DC brushless

motor and expect it to spin backwards unless its electronics have been set up to work that way.

Starters, voltage and "stealth" voltage drop

Starters have a tough job to begin with and low voltage — whether from a weak battery or voltage drop due to bad cables and connections — will overheat a starter the same as if you were to stall it out trying to spin a half-locked up engine. That's why having a good, strong battery and good, clean connections are so important. Taken to the extreme, voltage drop can render the starter totally inoperative.

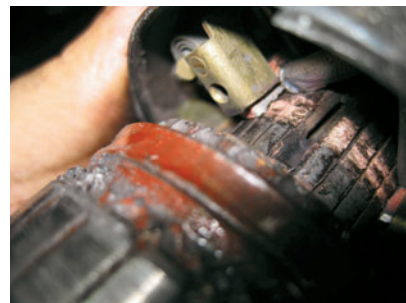
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LOW-VOLTAGE PROBLEMS (due to voltage drop or a weak battery) can make short work of a once-healthy starter. This commutator was destroyed by repeated starts with a battery that had barely enough voltage to start the engine.

Sometimes you can see the place where voltage drop is happening. Sometimes you can't. Back in the mid-70s when I was a teenager, I was already known to be a wrench guy, and a local farmer called on me to have a look at his Massey Ferguson tractor. It had molded battery cable ends, and they were clean and tight. The battery was new, but it wouldn't even begin to spin. It took me about 10 minutes (with no test light or meter) to figure out that there was NO electrical connection between the positive molded cable end and the cable that was molded into it. I took the cable completely off, laid it on a part of the plow frame, and pounded it where the cable

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entered it with a hammer. In doing that I squished the lead back into contact with the copper and got the tractor started. It was my first experience with “stealth” voltage drop on a clean cable that was factory



made and looked as healthy as new.

For a more modern example of “stealth” voltage drop, I remember a brand new 2000 Mustang Cobra came in to the Ford dealer on the hook for a



GROUND CONNECTIONS LIKE THIS one can look just fine until some fairly simple exploratory surgery reveals otherwise. It's pretty interesting that the factory would make this kind of mistake, but it happens! We attacked this boss with a wire brush and shined up the terminal lug and its bolt as well.

no-crank scenario, and when I drew the work order, I passed it along to my young protégé. He was all excited to be working on that slick red Mustang, so I let him do the job by himself.

He checked the battery and found it fully charged, then got under the car to check the solenoid wire that engages the starter. He found a nice, bright 12 volts with the key in the start position, so that ruled out a neutral safety switch issue. He figured the starter was bad, so he got a starter charged out under warranty from the parts department and busted his fanny putting it on there, only to find that he still had the same problem.

What I showed him after all his hard work was that if you connected a test light to the ground side of the battery and touched the probe to the engine block, the entire block would light up with 12 volts. He had that deer-in-the-

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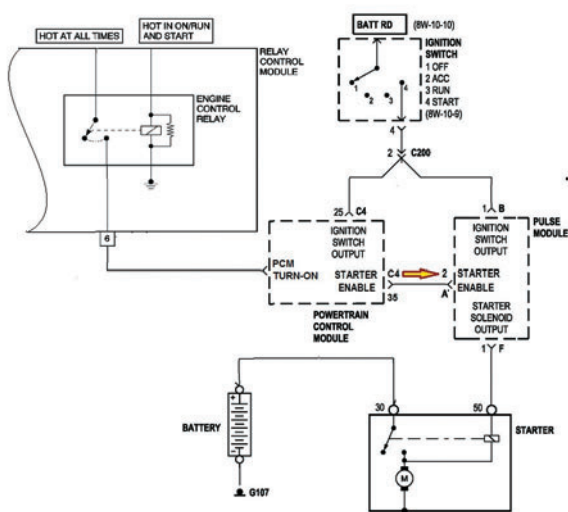


headlights look until I explained that he had 100 percent voltage drop on the negative side of the system. The only ground path was through the test light bulb, you see, thus the electrically “hot” engine block.

That particular vehicle’s battery-to-engine ground was on the driver’s side of the block between the head and the oil pan, and while it looked clean and felt tight, all the voltage was being dropped right there. We screwed that anodized cable-to-block bolt out and saw a lot of engine paint between the cable lug and the block, and just as much in the threads where the bolt went. Wire brushing everything and cinching it back down fixed that one.

Likewise, when somebody comes with a vehicle that has a new starter and a new battery but the starter is still straining to turn the engine, grab your voltme-

ter and make the necessary connections to find out where the voltage is being lost. If the engine is mechanically unbound, it’s the smart thing to do. But first it’s wise to check for mechanical binding. If the



ON THE 2005 CROSSFIRE, the “pulse module” prevents starter motor damage by only allowing the starter to be engaged until the engine is running. Furthermore, it won’t allow starter operation when the PCM knows the engine is running either. This is a distinctly German concern. VWs did this for years mechanically with the ignition switch. If, however, the PCM never wakes up, the starter never engages at all. That was the problem with the Crossfire.

starter only clicks but the battery is hot, look for things like seized A/C clutch bearings or similar water pump issues. If you take the belt off and it starts right up, find out which pulley is locking things up — it’ll probably be one of the big ones. Sometimes the starter itself can be the cause of a locked up engine, so don’t neglect it during diagnosis.

And remember, a little-used vehicle that is only driven two or three miles each way every day may need a starter at very low mileage because, mile for mile, it has been called upon to start the engine a lot more than higher mileage vehicles.

A couple of weird ones

I guess the weirdest ones I’ve seen in a very long time was a 1997 Mazda that kept burning up one starter after another. Even a new starter would struggle to spin the engine and after a few starts, it would be destroyed. There was no voltage drop between the battery and the main starter terminal and none between the battery and the engine block.

The voltage drop on this one was somewhere you wouldn’t expect it to be. It was in the ignition switch itself. The starter solenoid trigger feed from the ignition switch through the neutral safety switch was weak as a result,

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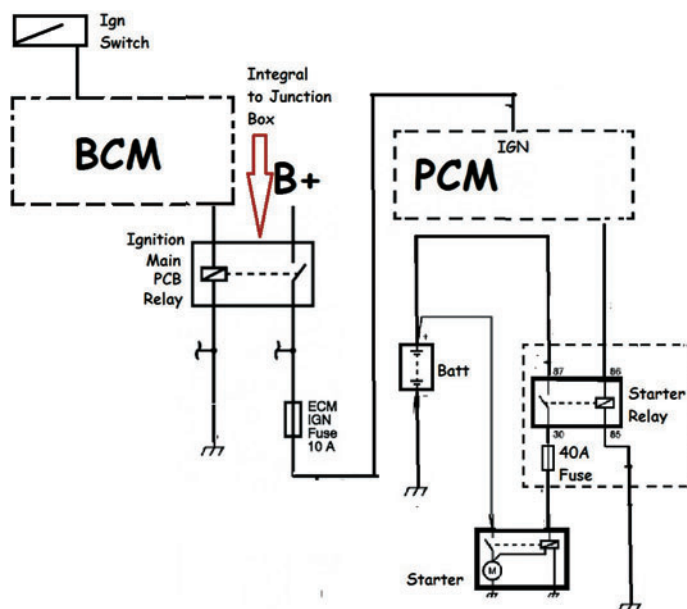
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but the neutral safety switch wasn't dropping the voltage. The Starter Cut Relay was also a possibility, but it had already been eliminated.

Because the starter solenoid wasn't getting enough current to vigorously slap its big internal copper washer against the battery stud and its companion stud that feeds battery power into the starter, the solenoid wasn't acting like the contactor it's supposed to be – it was only getting enough voltage to engage slowly and to strike an arc in there time after time, which blistered and burned the washer and the studs, only you couldn't see that happening. Thus the starter would die of low voltage sickness.

A good way to find this kind of thing is to do an overall voltage drop test between the positive battery terminal and the



ON THE IMPALA, turning the ignition switch sends a start request signal to the BCM. The BCM then sends a CRANK request message to the PCM, which verifies that the transmission is in Park or Neutral, and then the PCM supplies 12 volts to the control circuit of the starter relay. When this occurs, battery positive voltage is supplied through the switch side of the starter relay to the S terminal of the starter solenoid. If the Ignition Main PCB relay doesn't fire up the PCM, there is no starter operation.

solenoid trigger wire, and then do it again between the battery and the post we don't usually think about checking that feeds battery voltage from the solenoid into the starter itself. Every connection in the system is a potential voltage drop point. The moral of the story is that if the starter fails more than once, it's a good idea to find out why. But we all know that, don't we?

Another weird starter problem was my own 2007 Taurus. The starter died suddenly at about 100,000 miles and I was forced to jack it up in the driveway and replace it with a parts house unit from around the corner. It started flawlessly for about two months, and then one day when I slid behind the wheel to drive home, the starter motor would begin to spin as soon as I turned the key to the start position so that it was whirling full speed before it ever engaged. This bounced the starter drive off the flywheel with that startling, ear-piercing scream and no flywheel movement whatsoever.

Think about it: No starter is supposed to begin to spin until the starter drive teeth are fully engaged in the flywheel. It's a theoretical impossibility for that to happen because the contactor we call the solenoid doesn't even feed current to the starter motor until the drive is fully extended and engaged. Yet this one did exactly that. Another starter took care of the problem. Something had gone wrong inside the solenoid that had caused this.

The "whack it!" syndrome

Most people who drive old cars have learned to "whack" the starter if it doesn't work, but that should be done carefully — those ceramic magnets can't take a lot o' whackin' before they get to crackin'. But one day a lady came to me and said somebody had replaced the starter on her Chrysler because you had

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to whack it to start it, and she discovered that even after the starter was replaced, you still had to whack it about every other time to get it to start.

What I found on that one was a loose brush holder screw on the rear starter motor cover, and you could see where it had been arcing. The ground brushes in the starter depend heavily on these screws for their ground connection. I had seen this numerous times on those lightweight aluminum Asian-made starters Ford used on the late 90s Power Stroke diesels. You could see on the rear motor cover where the brush holder retaining screw was arcing just about every time the vehicle was started, and all I had to do was remove the screws one at a time, brush them and their mating surface, and reinstall them with the proper torque. That's what I did on the Chrysler. It was a 10-minute fix without even removing the starter.

When a no-crank isn't starter-related

For the past 10 years or so, many fairly common platforms have been giving the PCM full control of the starter and not just on the push-button start systems, either. You simply turn the key briefly to the start position on the ignition switch and the engine starts. On a system where the PCM doesn't wake up for one reason or another, there will be no starter operation, so don't neglect to break out the scan tool.

I wrote a while back about a Chrysler Crossfire that had been to the dealer for an intermittent no-crank issue, and the owner told us that the dealership service department had replaced the PCM in a shotgun attempt at repairing that concern. The repair bill was staggering from that misdiagnosis, and the problem remained.

At my shop, we analyzed the starter

trigger circuit, which is a Mercedes design. The PCM is in total control of the starter operation on that one. The start signal goes to the PCM and to a "Pulse Module" that relays the starter signal to the solenoid. Identifix posts favored the Pulse Module as a favorite cause, but our diagnosis found that when these no-cranks were being caused by a failure of the Relay Module, a Mercedes-made part, which, among other things, contains the Engine Control and Fuel Pump relays. Our troubleshooting led us to the Engine Control relay in the Relay Module, which sometimes wouldn't provide current to the PCM, and when the PCM is asleep, the Pulse Module does nothing. It took a \$400 Relay Module, but we eliminated that intermittent no-crank problem.

On that same order, just this past week we worked out a 2008 Impala that had an intermittent no-crank issue that wasn't starter-related. This one was easy to duplicate, and while there were a few cases of underhood junction box replacements for this concern, there were just about as many bad BCMs, and it's never a good idea to throw an expensive part without verification of what's missing from where.

Interestingly, like the Chrysler Crossfire, it turned out that this Impala had a faulty relay that was integral to the underhood junction box, and we caught it in the act of not delivering power to wake up the PCM, first with the scan tool and then with a test light. And when we back-fed power into that circuit and verified our diagnosis, our troubleshooting was done and the Impala was out the door. *ZZ*



RICHARD MCCUISTIAN is an ASE-certified Master Auto Technician and was a professional mechanic for more than 25 years. Richard is now an auto mechanics instructor at LBW Community

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SHIFTING REPAIRS

A LOOK AT MULTIPLE SHIFT PROBLEMS AND HOW TO SOLVE THEM

WAYNE COLONNA // Contributing Editor

The front wheel drive six speed transmission called the 09G used in a variety of Volkswagen vehicles is plagued with shift problems. Particularly shifts that have engine revs in between shift transitions we call flared shifts. This transmission is dependent on a wide range of things for proper shift overlap. If any of these items become compromised, it affects the quality of the shifts. For this reason the 09G is plagued with shift quality complaints.

Let's run through a laundry list of common items that need to be checked and repaired or replaced if necessary. Afterwards, a couple of not-so-well-known items to be aware of will be covered, which has proven to be very helpful in resolving shift overlap concerns.

Here is the common laundry list affecting proper shift overlap:

1. Clutch adaptation issues
2. Fluid pressure concerns
3. Solenoid failure
4. Valve body bore wear
5. Counter balance pistons problems
6. Transmission Fluid Temperature invalid
7. Worn bushings
8. Shrunk sealing rings
9. K2 clutch sealing ring sleeve leak
10. Excessive clutch clearances
11. Excessive end play
12. Basic settings or throttle relearn not performed

Each of these points can be discussed in great detail about the ways in which they can negatively affect shift

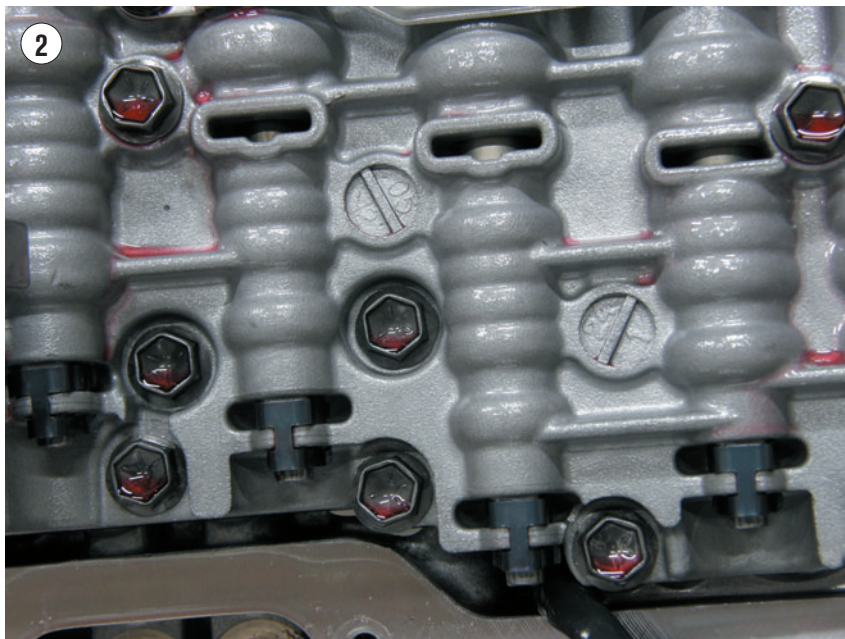
CONTROL MODULE SELECTION

02 Auto Trans

GROUP SELECTION

08 Measured Blocks

<i>Data Block</i>	ATF Temp G93	ATF Temp Voltage	Trans Condition	Voltage Supply
010	94.0°C	.60V	ERROR	13.50V



overlap. Much of this information, however, is already out in bulletins, articles and seminar materials. But there have been times when it seems that everything on this list has been checked, repaired and/or replaced and yet the problems of flared shifts remain.

Lorenzo Ortiz from Phillips transmission in Scottsdale, Ariz., made an

interesting discovery. While conducting a road test to reset clutch adaptations in an attempt to get rid of flared shift problems, he had his VAG-COM hooked up to the vehicle. He was scrolling through the different data blocks looking at data to see why adaptations were not setting. When he reached Data Block 10, one of the pa-



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rameters said “Trans Condition.” Inside the display window for that PID it said ERROR (Fig. 1). He didn’t recall seeing any codes but he ran the vehicle for codes anyway and not one showed up. He decided to clear codes anyway, and when he returned to Data Block 10, the Trans Condition window was empty. As he continued to road test the vehicle, after some flared shifts the ERROR message would come back. He would then erase codes and continue the road test adaptation procedure with an empty window. Within several drive cycles his shifts were fine and the Trans Condition display window remained clear.

One other tip that can be very helpful has to do with adjusting the solenoid. Each clutch regulating solenoid has a threaded plug that adjusts the tension of the spring acting on the regulator valve (Fig. 2). If after inspections and repairs you

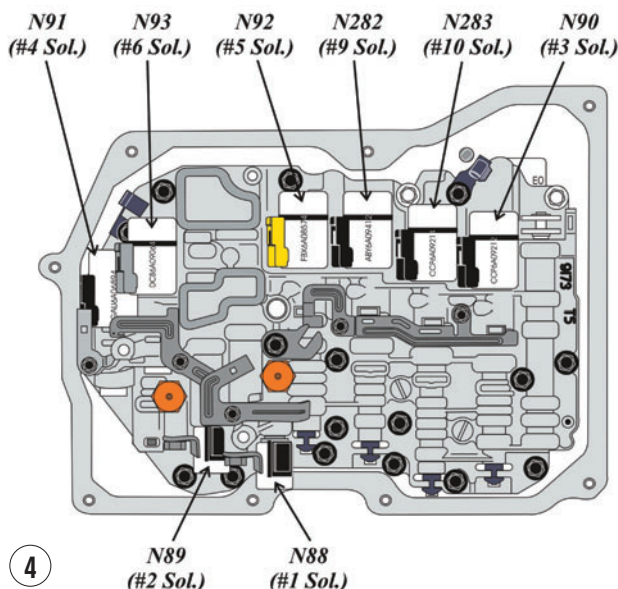
3 CLUTCH APPLICATION CHART						
Gear	Component					
	K1	K2	K3	B1	B2	F1
1st Gear	X				X*	X
2nd Gear	X			X		
3rd Gear	X		X			
4th Gear	X	X				
5th Gear		X	X			
6th Gear		X		X		
Rev Gear			X		X	

are pretty confident the unit is good and you are still fighting flares, adjust the offending regulating clutch solenoid adjustment plug 1.5 turns counter-clockwise.

Use the application clutch chart in Fig. 3 and the solenoid identification and location illustration in Fig. 4 to determine which regulating valve spring needs to be adjusted.

For example, if you are fighting a 3-4 flare you will notice that the K2 clutch is applied for fourth gear. The solenoid that regulates that clutch to apply is the N282 solenoid. If you are confident the K2 clutch drum ring sleeve is not leaking and you have a remanufactured valve body on the transmission, back the N282 adjusting plug out 1.5 turns and give it a road test. This will resolve your flare concern if you do not have any other problems.

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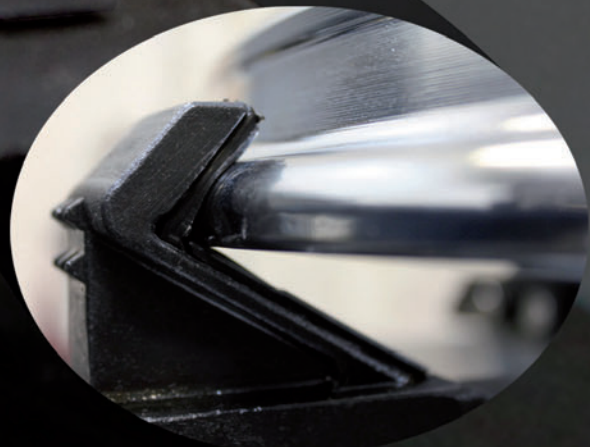
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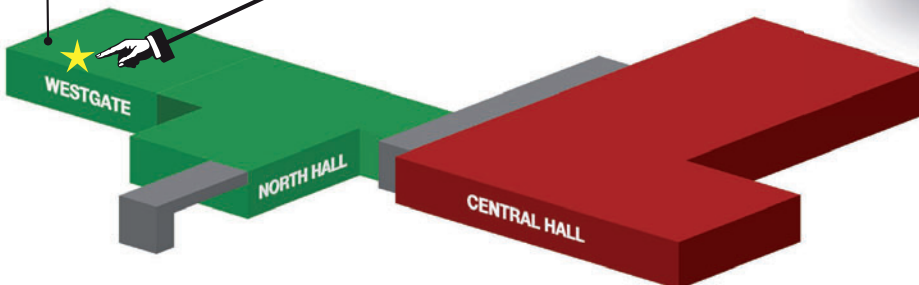


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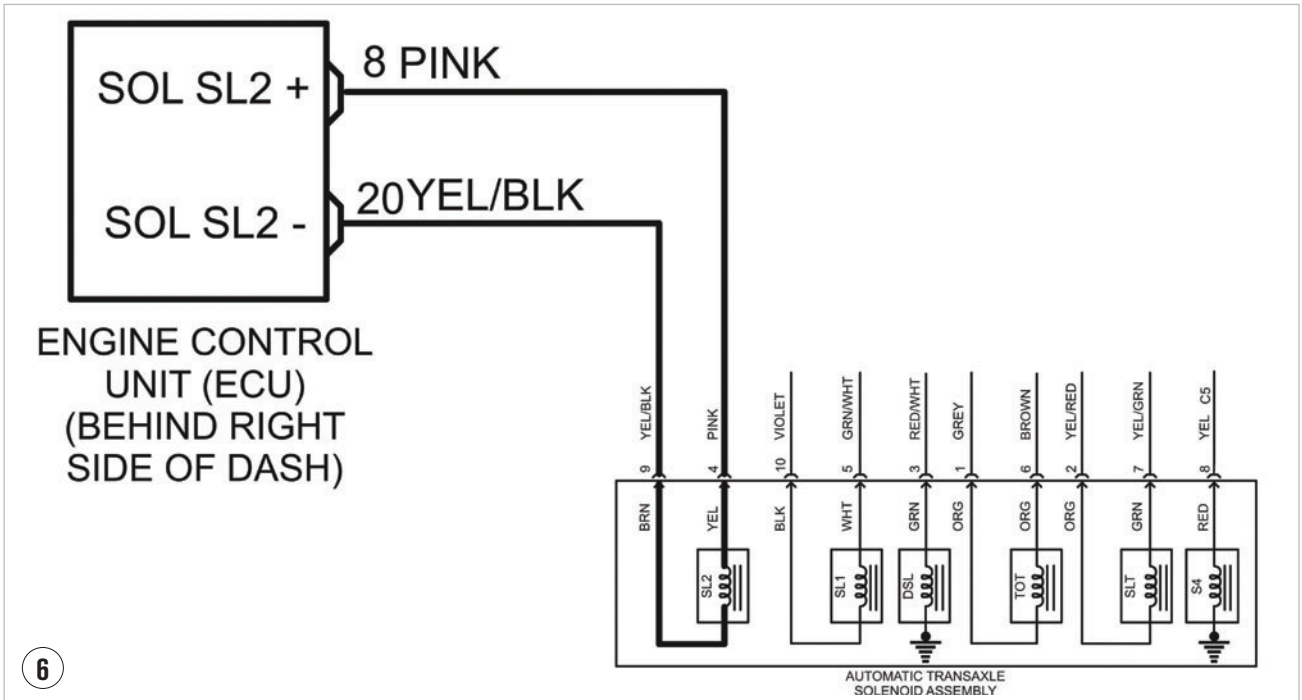
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- Solenoid N90 controls K3 clutch
- Solenoid N282 controls K2 clutch
- Solenoid N283 controls the B1 brake

Toyota U Series 2-3 shift problems

The ECM shift function of Toyota RAV 4s and other models including Lexus with the U series transmission is as follows. In order to exhaust pressure from the direct clutch circuit, the ECM must provide voltage to SL2 solenoid. When voltage is removed, the direct clutch applies.

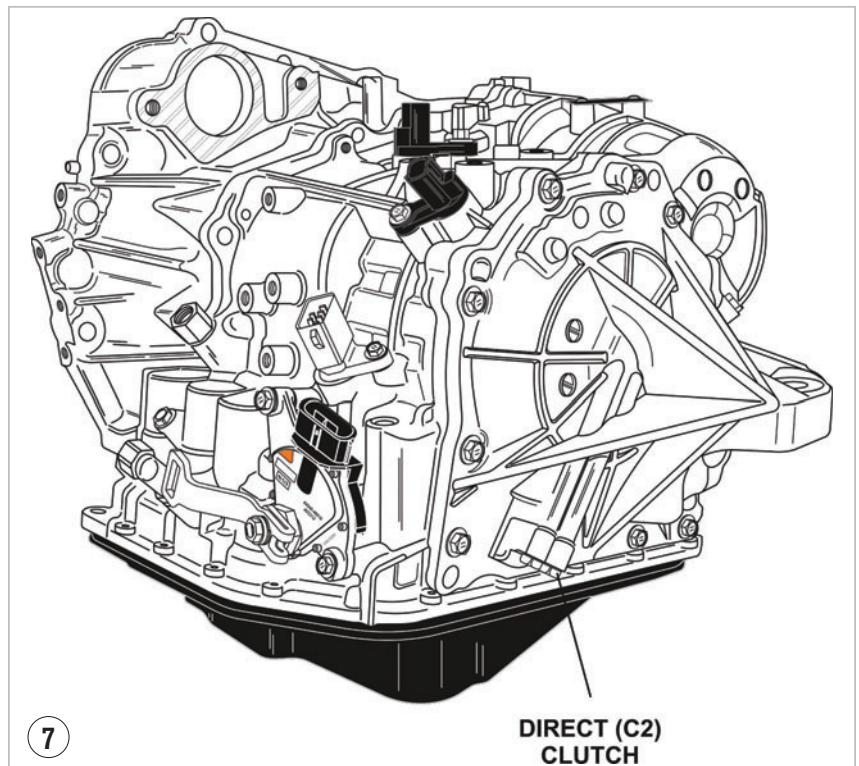
In cases where the ECM begins to fail, voltage supplied to SL2 solenoid from the ECM begins to drop due to faults inside the ECM — most common being circuit board issues.

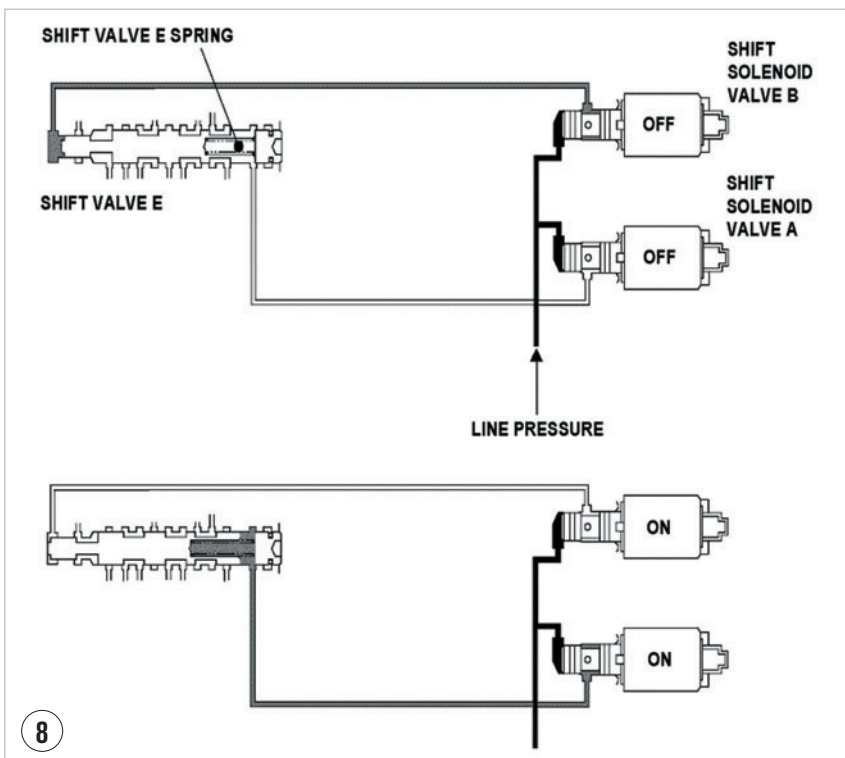
Although the factory specs indicate an 11 to 14 volt reading should be seen on this circuit, in all the testing we have done we never saw this amount of voltage. What we have seen in all cases is a 6.7 to 8.9 voltage range (Fig. 5). Most typical working systems will range in the 7.5 to 8.5 volts and work well.

Once the ECM has failed and can

no longer supply the proper amount of voltage to the solenoid, direct clutch begins to partially apply, which is the reason we experience the bucking, binding sensation and high gear starts and also

set solenoid performance codes (not to be confused with solenoid circuit or electrical codes). Performance codes are no different then ratio codes for that matter.





To properly test this system, connect the positive voltmeter lead to the SL2 solenoid positive wire and the negative lead to SL2 negative wire at the ECM (Fig. 6). Then install a pressure gauge to direct clutch pressure port on the transmission (Fig. 7).

When the ECM has proper voltage, you will have a 0psi reading at pressure gauge. When voltage begins to drop under 5.0 volts to 4.5 volts, pressure will begin to slowly rise; the lower the voltage, the higher the pressure will rise.

The severity of symptoms on these vehicles will depend on how faulty the ECM function is. It has been our experience with these vehicles that there is no uniform failure, and although there may be vehicles with no codes or symptoms of high gear starts, bucking or binding, some ECM failures will be subtle and only cause intermittent complaint of 2-3

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It is highly recommended to properly test the ECM so as to ensure that a rebuilt transmission does not continue to fail without a known cause.

An excellent alternative to purchasing a new ECM from Toyota would be to look into Circuit Board Medics at www.circuitboardmedics.com.

Where is Shift Solenoid Valve E?

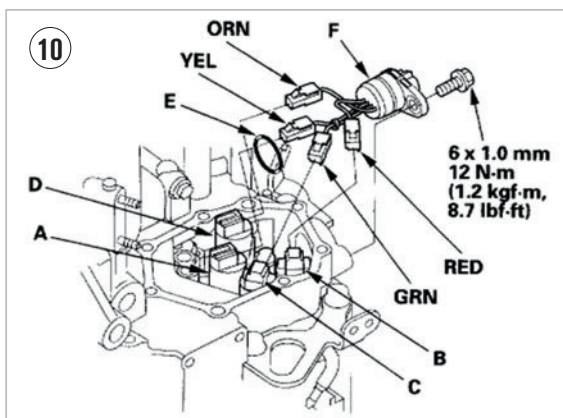
A 2007 Acura MDX 3.7L V6 using a BYFA 5-speed automatic transmission comes into your shop sporting a DTC P1744. The definition of this code is as follows: Problem in Shift Control System; Shift Valve E Stuck ON. Many transmissions today refer to solenoids as valves and most do not have an actual valve in the valve body identified by just one letter. If it does have valve names using a letter, it typically refers to the solenoid that operates the valve. As a result, the reaction to this code is to look for Shift Solenoid Valve E. But when you do, you discover that this transmission contains seven solenoids. Pressure Control Solenoid Valves A, B and C and Shift Solenoid Valves A, B, C and D. So where is E? You'll never find it because there is no such solenoid.

Acura provides the following general description for DTC P1744:

Shift valve E is incorporated in the control circuit of the transmission. It is controlled by pressure from shift solenoid valve B, and it is locked by the line pressure. It switches off when shift solenoid valve B turns off and shift solenoid valve A turns on (Fig. 8).

The PCM monitors the mainshaft speed and the countershaft speed at the gear change determined by the shift schedule. When an improper gear ratio is output compared to the predetermined gear change mode, a shift valve E ON failure is detected and a DTC is stored.

Simply explained, shift valve E keeps the valve in the un-stroked (closed) position. This valve needs to stay in the closed position for first, second and third gear. Shift Solenoid A assists the spring in keeping the valve closed in second and third gear. Shift solenoid B strokes the valve in fourth and fifth gear. If the valve does not stroke, fifth gear will be




un-attainable. If the valve is stuck in the stroked position, the vehicle will take off in fifth gear instead of first. Third gear is affected also should this valve be stuck in the stroked position.

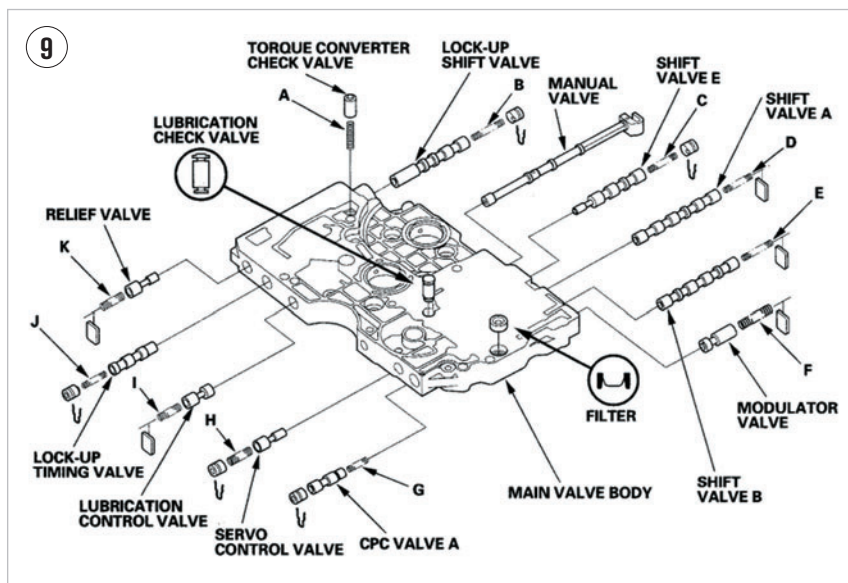
The most common cause producing this code is a stuck shift valve E located in the secondary valve body next to the manual valve (Fig. 9). Sometimes Shift Solenoid Valve B mechanically fails (Fig. 10). When this solenoid is OFF, it applies pressure to its respective valves. Shift Valve E is one of them. When this solenoid turns ON, it blocks pressure from stroking its valves. Shift Solenoid Valve A works in the opposite way. In fact, Shift Solenoid Valves B and C are Normally Applied Solenoids while Shift Solenoid Valves A and D are Normally Vented Solenoids. Care must be taken that they are installed in their correct location and that they are plugged in correctly.

The Yellow wire connector goes to shift solenoid valve A.

The Green wire connector goes to shift solenoid valve C.

The Red wire connector goes to shift solenoid valve B.

The Orange wire connector goes to shift solenoid valve D. 



WAYNE COLONNA

is the president of the Automatic Transmission Service Group in Cutler Bay, Fla. wayne@atsg.us

THE CAT IS OUT OF THE BAG

DIAGNOSING OBDI AND OBDII CATALYTIC CONVERTER CONCERNS

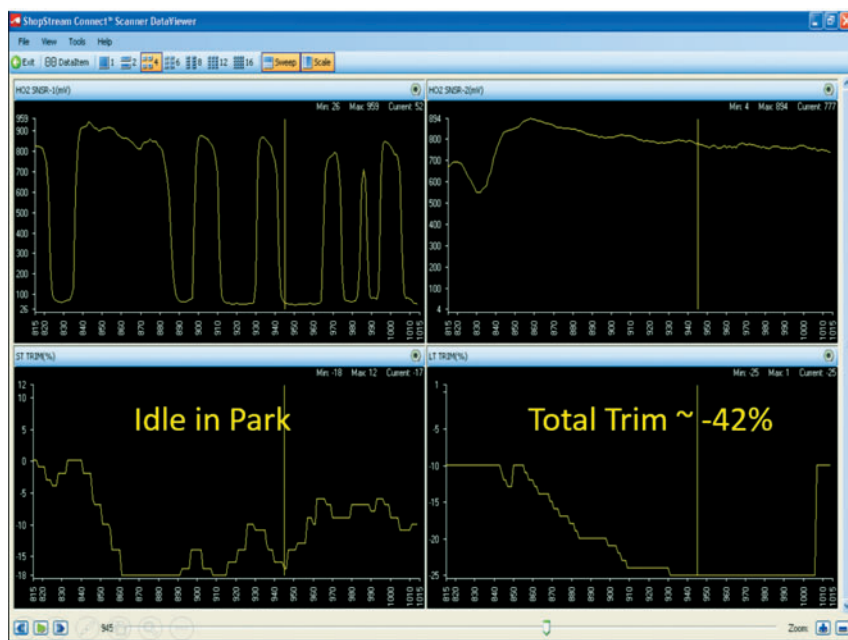
SCOTT SHOTTON // Contributing Editor

The focus of this article was supposed to be on diagnosing P0420 and P0430 issues. However, because I travel continuously to work with shops all around the country, I realize that pre-OBDII vehicles are still emissions tested in some areas. As a result, we will explore catalytic converter issues and testing for a wide range of vehicles.

In order to do this, we will break down diagnosis into two parts: pre-OBDII vehicles and OBDII-compliant vehicles. Please note that if your demographic mainly consists of OBDII vehicles, the first half of this article will still be valuable to you, as it pertains to the understanding of how a catalytic converter works. So now with the disclaimer out of the way, we shall move forward.

Regardless of which type of vehicle you are working on — OBDI or OBDII — the vehicle needs to be running correctly before we can even consider testing the converter. For example, misfires, exhaust leaks or fuel system issues will all need to be fixed prior to proceeding with converter diagnosis. It is also important for you to know that what happens inside of a catalytic converter is a chemical reaction. Conditions have to be precisely correct to facilitate this reaction. If the vehicle is running correctly, then the conditions for appropriate catalytic converter operation should exist.

Aha, the chemical reaction! We could spend a lot of time describing how the oxidation reaction in a catalytic converter changes CO into CO₂, HC into CO₂ and water, and NO_x into



COULD THESE FUEL TRIM numbers false fail a catalytic monitor that runs at idle?

N₂ and O₂, but we will not go there.

As technicians, our understanding of what happens in the catalytic converter is valuable for many reasons, yet it is not completely necessary. I do, however, encourage technicians to learn the details of the reaction that occurs. That being said, oxygen is the key.

OBDI catalytic converter testing

There are a variety of tests that are available to technicians that can be used to diagnose catalytic converter issues. There are pros and cons to each of these tests. It is important to know the value and limitations of each test. Let's attack each testing technique individually.

Delta temperature test

The delta temperature test is relatively

simple. It involves measuring exhaust temperature just before the converter and just after the converter with an infrared thermometer or pyrometer.

The engine should be at operating temperature, in closed loop, running correctly and at approximately 2,000 revolutions per minute. The converter inlet temperature is then compared to its outlet temperature.

The general industry standard for a good converter is a 50-degree Fahrenheit increase at the outlet compared to the inlet. What this indicates to us is that a chemical reaction is occurring in the converter. The chemical reaction is exothermic, which means that when it occurs, it releases heat.

The pros of this test are if temperature increases, we know that a chemical reaction is occurring in the converter. The

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cons of this test are that we do not know what reaction is occurring and how well it is happening. Are we reducing hydrocarbons, or carbon monoxide or both? We don't know. In addition, we do not know how well it is performing its conversion. Obviously, if there is a temperature decrease, we know the converter is doing nothing. But, if the temperature increases, we can only say it is doing "something." We have no way of knowing how well the converter is doing its job.

Oxygen storage test

The oxygen storage test requires the use of an exhaust gas analyzer. Again, the vehicle is brought to operating temperature and is running correctly. The exhaust gas analyzer is in the tailpipe, and the engine is brought to around 2000 RPM. The oxygen level in the exhaust should eventually be near zero percent. If the vehicle is equipped with an air injection system, it will need to be disabled at this point.

The next step is to do a hard wide-open throttle snap. The throttle snap should force the engine rich and flood the converter with carbon monoxide, causing a CO increase at the tailpipe as well. Immediately after the throttle is released, the PCM will run the engine lean and oxygen levels should increase. The timing of these events is key to determining converter function.

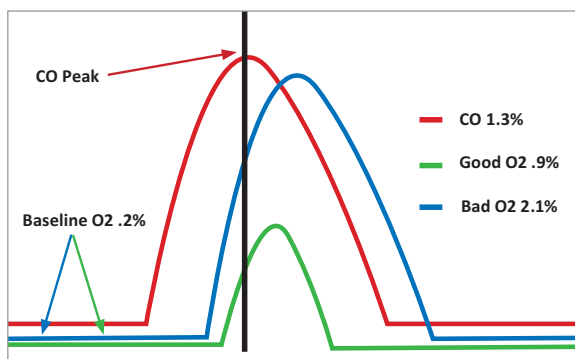
The gauge of this test is oxygen content at carbon monoxide's peak. This

means that when CO peaks, O₂ should not exceed a magic number. The magic number is 1.2 percent above the initial O₂ reading.

To illustrate my point, refer to the figure at the top of page 54, which shows a baseline oxygen reading of .2 percent. The throttle is snapped and CO rises. At CO's peak, marked by the black cursor, O₂ rises. The blue trace would indicate a bad catalytic converter. Its oxygen level rose from .2 percent to 2.1 percent. That equates to a 1.9 percent increase, which is above our 1.2 percent standard and indicates a bad converter. The green trace comes in at .9 percent O₂. This .7 percent increase indicates a passing converter that is capable of storing and using oxygen.

Remember, oxygen will hit a much higher peak on deceleration. It is important to make our measurements at the moment that CO hits its highest point.

What is being illustrated in the previous example is the converter's ability to store oxygen, which is very similar to how some OBDII vehicles test converters. The pro here is that we can see the converter's ability to store oxygen and convert CO into CO₂. The con to this test is that we have no clue how well hydro-



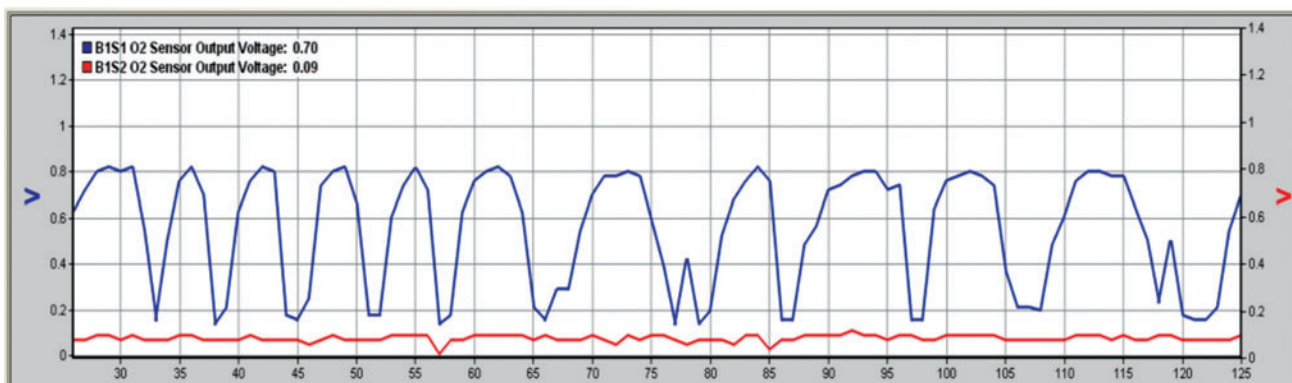
A COMPARISON OF oxygen to carbon monoxide levels for good vs. bad catalysts while performing the O₂ storage test with a gas analyzer

carbons, or HC, are being converted. It is a decent test, but if a vehicle fails for HC only, we may be lacking in our testing.

Propane conversion test

The propane conversion test is another test option that we have available to us. It is time consuming and often it is not worth the time required to perform the test. It involves running the vehicle until it obtains operating temperature and a converter that has achieved a high enough temperature to function. Ignition and fuel are then disabled before the converter cools, which is the toughest part on some vehicles, and then the engine is cranked over while metering a specific amount of propane into the intake manifold.

The idea behind this type of test is to feed HC and O₂ into the converter while cranking, which feeds oxygen and hydrocarbons into the converter,



COMPARING UPSTREAM to downstream oxygen sensor switching — is this catalyst good?



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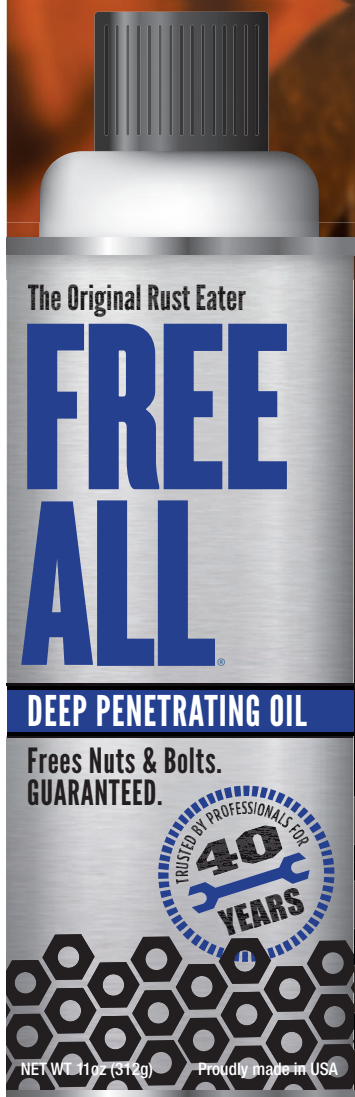
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and see what gases come out of the tail pipe. A functioning converter will change HC (propane) into CO₂. The results can be compared to a pass/fail chart.

The pros of the propane conversion test are that we can see how well the converter is capable of converting HC into CO₂. The cons of this test are the time investment a technician must make in order to complete the test properly and the lack of results regarding the CO to CO₂ reaction.

Pre- and post-exhaust gas comparison

This type of test involves intrusively measuring exhaust gas before the catalytic converter — sometimes called feed gas — and comparing it to the tailpipe readings. Tapping into the exhaust before the converter requires special adapters.

This technique also requires above-average knowledge of exhaust gasses, and, as with the propane conversion test, this is also time consuming. Even with extensive knowledge of exhaust gas theory, this technique can be tough without a dynamometer. Different driving conditions — specifically loaded conditions — change the exhaust volume and can affect our results.

Technically, the exhaust volume issue affects all of the previous tests. For example, a pre- and post-exhaust gas comparison test might pass in the shop when the vehicle is operated at 1500 RPM in park, but may fail an IM240 (or similar test) while being operated on a dynamometer under load at 50 miles per hour.

Secondary air injection

An additional thing to keep in mind when working toward diagnosis is that a malfunctioning secondary air injection system can also affect catalytic converter efficiency. Air injection provides additional oxygen to the catalyst under certain situations in order to enhance its effectiveness. Again, oxygen is required for the desired reaction to happen and a malfunctioning secondary air system could work to reduce a catalyst's efficiency. It is important to note that while performing the previously mentioned tests, an air injection system should be disabled in order to obtain accurate results.

OBDI summary

All of the tests we have previously discussed here in detail are valid methods to help the technician effectively judge how well the converter may or may not be working. Provided everything else is working correctly and as it should be on the vehicle, and the converter fails one or more of these tests, it is a pretty safe bet that the converter is not up to par.

OBDII converter testing

A failed converter — or more specifically a catalyst code



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— on an OBDII-compliant vehicle will lead us to utilize a completely different diagnostic approach. Any one of the previous tests we have discussed — delta temperature test, oxygen storage test, propane conversion test and pre- and post-exhaust comparison — can be performed on an OBDII vehicle, and we can use the tests' findings to make a judgment call on how well the converter works.

However, it doesn't matter how good or bad we as technicians think the converter is. So who ultimately has the final decision as to whether or not the converter is bad? The PCM and the catalyst monitor. For example, a vehicle may have acceptable test results using any of the tests we have previously described. But if the PCM still sets a P0420, then the vehicle is still broken. This means that on an OBDII vehicle, all of the previous tests discussed are worthless.

Think about it this way: The PCM is the component that makes the judgment call on the condition of the converter. As technicians, our job is to make sure that the PCM has everything it needs in order to make that judgment call correctly — and then we have to trust in its determined assessment.

A perfect example of this would be comparing the upstream and downstream oxygen sensors on a scan tool. If we observe these inputs, just as the PCM does, can we decide if a converter passes or fails? This next example is from a 2000 Honda Odyssey with a P0420 code. Just as we have been taught, the upstream oxygen sensor is switching back and forth while the downstream oxygen sensor is relatively flat.

Our judgment call might be that the converter is good, yet the PCM still sets a P0420. In this case, the catalyst

was bad and needed replacement.

Given this dilemma, OBDII catalyst codes require a different approach. Diagnosing a catalyst code can be done successfully on almost every OBDII-compliant vehicle if the following six steps are performed effectively. Let's address each one individually.

Step 1: Read and understand the operation

It is very important to take a few moments to read the operation of the catalyst monitor for the vehicle in question. Enabling criteria and testing conditions, as well as what actually sets the code, are important to know.

In addition, Technical Service Bulletins (TSBs) can provide insight into and explanations for potential pattern failures or updated module calibrations. Many vehicles have calibration updates that may or may not require converter replacement. These TSBs may help technicians to resolve issues.

It is always better to know this information, if it is available, as early in the diagnostic process as possible. This helps shops and their technicians avoid potentially unnecessary testing and wasted time. Your customers will thank you for your diligence.

Step 2: Are there any codes that interfere?

This step involves taking the information you have gathered in Step 1 and determining if any other diagnostic trouble codes could be interfering with the catalyst monitor or causing false fails.

For example, a P0171 Lean Bank 1 code needs to be resolved before we can even think about addressing a catalyst code.

Conversely, a code stored for an oil pressure switch circuit should have no effect on the catalyst monitor.

Step 3: Verify exhaust integrity

Exhaust leaks can cause some very

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OBD II Converter Code Diagnostic Steps

1. Check TSB's and read about the vehicles catalyst monitor operation
2. Check for any codes that could interfere with catalyst monitor's successful completion
3. Verify exhaust integrity
4. Verify O2 sensor operation
5. Verify engine is running correctly (fuel trim numbers) and not misfiring
6. Mode \$06 analysis (also for repair verification)

weird things to happen. A crack in an exhaust manifold can actually draw ambient oxygen into the exhaust. This additional oxygen can skew oxygen sensors and affect catalyst and catalyst monitor operation. A quick check of the exhaust system needs to be performed before we can proceed.

The three most common methods of checking the exhaust are:

- Visual inspection
- Plugging the exhaust and listening/feeling for leaks, or
- Introducing smoke into the exhaust with a smoke machine

My personal preference is to use a smoke machine because I feel then even the smallest leaks will be easier to find.

Step 4: Verify oxygen sensor operation

In order for the catalyst monitor to run, the vehicle has to have functioning oxygen sensors. These sensors are vital, as they are the inputs the PCM uses to evaluate the catalyst.

In addition, the exhaust integrity addressed in Step 3 is also required for accurate oxygen sensor input. A scope or a scan tool can be used to evaluate oxygen sensor performance. Use whichever technique you are comfortable with or deem appropriate in order to test performance, but do not skip this step.

Step 5: Verify the engine is running correctly

A proper running engine is required for the catalyst monitor to run correctly. A misfiring engine will definitely need to be diagnosed and repaired first before a

catalyst code can then be addressed. In addition, fuel trim numbers should be consulted in order to confirm that the engine is running without any significant fuel corrections.

To illustrate my point, take a look at a 2002 Pontiac Bonneville with a P0420 (as seen on page 51). A shop has already replaced the catalyst and the vehicle returned a week later with a P0420 set again. At 2500 RPMs, the total fuel trim correction is -4 percent, which is definitely acceptable. However, when the vehicle is returned to idle, the total fuel trim correction is more than -40 percent.

On this particular vehicle, if we back up to Step 1: Read and understand the operation, we would find that this catalyst monitor runs at idle. Is it feasible that a -42 percent fuel trim number at idle might be interfering with proper catalyst monitor operation?

I cannot tell you why this vehicle did not set a P0172 for the rich running condition. However, it did false fail the catalyst monitor. A ruptured fuel pressure regulator diaphragm was the cause and a new regulator resolved the P0420 issue.

Step 6: Mode \$06 analysis

The final step of analyzing Mode \$06 data is, in fact, optional. However, the data obtained could provide an additional piece of information that points to a faulty converter. It can also be valuable on a dual bank vehicle where a catalyst code has been set for only one bank. Mode \$06 data for the opposite bank may indicate that its converter may not be far behind the failing bank. This could result in a justified additional converter sale and avoid potential come backs for your customers.

The following example is from a Crown Victoria that set a P0430. The Mode \$06 results indicate that the bank 2 converter did fail, but we also get a glance at the condition of the bank 1 catalyst.

Rear to Front Switch Ratio Bank 1	Rear to Front Switch Ratio Bank 2
10	10
11	21
<=0.8:1	<=0.8:1
0.67:1	0.87:1

DO BOTH CATALYSTS require replacement?

Could this information be valuable while deciding if a single catalyst needs to be replaced or a pair of converters is justified? Mode \$06 data can also be used as repair verification after a converter has been replaced.

The OBDII diagnostic conclusion

If the first five steps pass our inspection (Step 6 was for the sake of information), then the PCM has everything it needs to analyze converter efficiency. We now must trust the PCM's judgment and replace the converter. If any of the previous steps did not pass our inspection, then the corresponding issue must be resolved and the catalyst monitor should be run again before we condemn the converter.

Catalytic converter diagnosis obviously differs based on the age of the vehicle. The approach we chose will depend on the faults the vehicle has and model year of said vehicle. The important things to remember are: have a repeatable diagnostic procedure that covers the bases and make sure all other systems are working correctly before pulling the trigger on a new catalyst. **TL**



SCOTT SHOTTON As owner of The Driveability Guys, Scott performs mobile diagnostics, reprogramming, as well as industry training and has been a college instructor for the past 14 years. With a degree in Automotive Service Technology, Scott holds more than 21 ASE certifications. scott@driveabilityguys.com

MAKING SENSE OF STABILITY CONTROL SYSTEMS

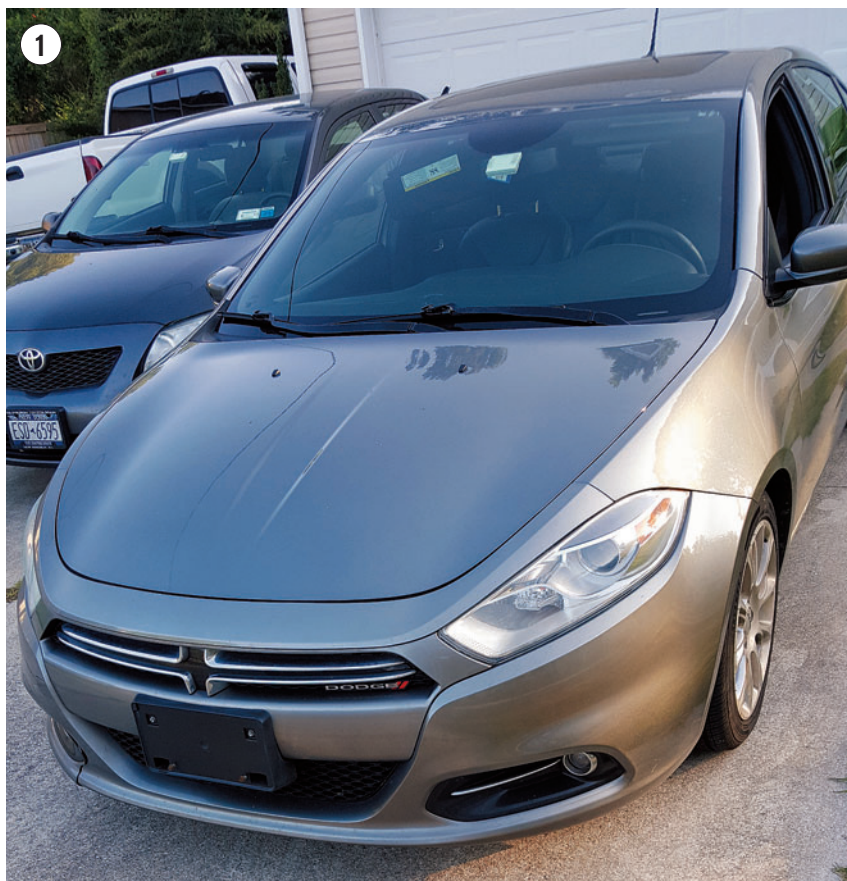
YOUR CUSTOMERS ARE UNAWARE OF HOW HARD THEIR STABILITY CONTROL SYSTEMS WORK — UNTIL THEY STOP WORKING!

EDWIN HAZZARD // Contributing Editor

As technicians working in the automotive field, you have no doubt experienced many different types of systems on vehicles of today. Many of those systems work separately or they work in conjunction with another system. Isn't it great that you can turn the ignition on and see 15 or more warning indicators light up on the instrument cluster during a bulb check and then have to know what each one stands for or what system they represent? As an older technician like myself, maybe no. My internal hard drive is pretty full with not much more room for data unless I purge some and make room for new technology. In this month's article, I'm going to touch on Vehicle Stability Control (VSC), Electronic Stability Control (ESC), Electronic Stability Program (ESP), Dynamic Stability Control (DSC) and even Dynamic Stability and Traction Control (DSTC) systems. Each manufacturer uses a different name for their system, but the fundamentals of how the systems work are relatively the same.

What is stability control?

It's hard to believe that vehicle stabil-



2013 Dodge Dart

ity control was found on vehicles as far back as 1987 by Toyota and Mercedes-Benz in the form of traction control. So what is vehicle stability control? It is a combination of antilock brakes, traction control and an electronic stability

program combining the two. So in simple terms, if your vehicle has ESP or a VSC on board, it also provides you with two further active safety systems: the Antilock Braking System (ABS) and the Traction Control System (TCS). ABS

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prevents the wheels from locking during braking; TCS prevents the wheels from spinning when starting off and accelerating. While ABS and TCS intervene on a vehicle's longitudinal dynamics, ESP or VSC additionally improve the lateral

dynamics, thus ensuring stable driving in all directions. See what I mean when I said one system works in conjunction with another system?

Let's look at how one of these systems work. General Motors calls their system ESC, also referred to as ESP or DSC, and is a computerized technology that improves a vehicle's stability by detecting and reducing loss of traction (skidding). When ESC detects loss of steering control, it automatically applies the brakes to help "steer" the vehicle where the driver intends to go. Braking is automatically applied to wheels individually, such as the outer front wheel to counter over steer or the inner rear wheel to counter under steer. Some ESC systems also reduce engine power until control is regained. ESC does not improve a vehicle's cornering performance; it helps to minimize the loss of control. For ex-

ample, on a 2009 GMC Acadia, the systems involved with stability control are the ABS, TCS, the bi-state engine mount (BSM), the dynamic rear proportioning (DRP), variable effort steering (VES) and the vehicle stability enhancement system (VSES). Just to summarize how complex some of these systems can be, the components of this system are electronic brake control module (EBCM), the brake pressure modulator valve (BPMV), the ABS pump motor, the bi-state engine mount solenoid, the brake booster vacuum sensor, the variable effort steering solenoid, a lateral accelerometer, a master cylinder pressure sensor, a steering wheel position sensor, a yaw rate sensor, four-wheel speed sensors and last but not least a traction control switch.

So what's amazing is this vehicle has six systems and 11 components that make up the stability control system, and the vehicle is seven years old already! Oh, did I forget to mention the body control module (BCM) along with the instrument cluster (IC) that control the warning indicators for the dash? I would suggest that with any stability control problem you face that you read up on how the system



THE DART HAD multiple warning lights illuminated on the dash.



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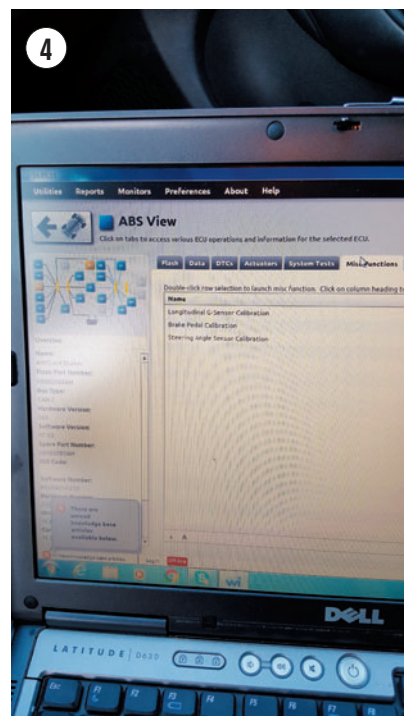
works and who the players involved are. It's only going to get more complicated as technology progresses.

Solving system issues: A case study

Let's take a look at a 2013 Dodge Dart (Fig. 1) that I actually made a house call on, which just so happens to be my daughter's vehicle. It had an ESC light, ABS light (Fig. 2) and a SRS light illuminated on the dash. The SRS light is for the airbag restraint system. On this vehicle, the ESC uses the ABS and traction control along with the Dynamic sensor and the steering angle sensor. The Dynamic sensor is incorporated into the Occupant Restraint Controller (ORC), and the steering angle sensor is located in the Electronic Power Steering (EPS) gear. Now so far we know that there are four separate systems involved with the

indicator lights on the dash.

The first order of business is to hook up a scan tool to this vehicle that is capable of accessing all these system (Fig. 3). If your tool is able to do an all-system scan, then I would recommend doing that so you can see if there are any other modules that have any codes stored that pertain to the dash indicator warning lights. After doing the code scan, I noticed that there were codes in the ABS and ORC systems. The code retrieved in the ORC system was a C10CC-49, which is an internal electronic failure of the Dynamic sensor. The code stored in the ABS module is a U0125-00, which is a loss of communication with the multi-axis sensor. Here is a hint — notice that the code set in the ORC has a first digit that starts with a "C?" That typically is a chassis fault code, isn't it? So why is the a "C" code



USING THE Chrysler Wi-Tech to perform the calibration of the dynamic sensor under miscellaneous tests.

in the airbag system? Aren't they typically "B" codes? If you read up on the system, you would know that the stability control system is incorporated into the ORC by way of the Dynamic sensor/multi-axis sensor. This code will set in the ABS module if it does not receive a message from the Dynamic sensor within 150ms. So what we know is that the ABS module isn't receiving a data message from the ORC Dynamic sensor. Now it's time to focus on the ORC system. But wait! Isn't this a stability control case study, not a restraint control issue? This is why when working on today's modern vehicles you can't just focus on one thing right away — you need to look at the complete picture.

So getting back to our stability control issue, the Dynamic sensor measures side-to-side lateral motion and vehicle rotational sensing, which is how fast the vehicle is turning. To properly test this sensor, the service information states that the calibration proce-

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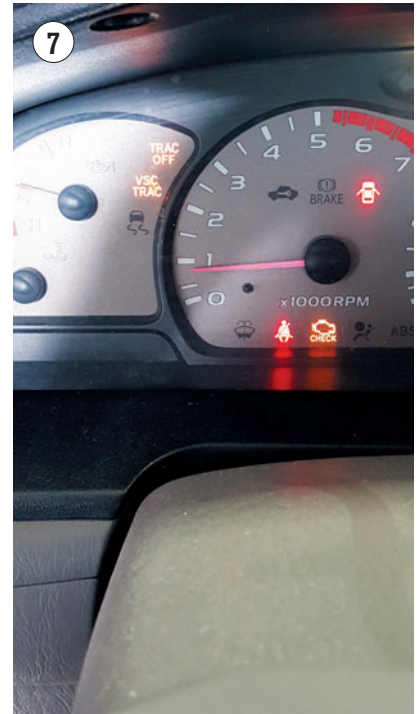
THE DARTS ABS module located by the engine firewall.

dures needs to be performed under the C006A-54 code in the anti-lock brake section. This test requires you to drive the vehicle between 5 and 15 mph turning left and right. Be careful when you do this as not to run into anything or perform this by a police officer for fear of a drunk driving appearance. This test is located in the scan tool under miscellaneous functions (Fig. 4). If the calibration of the multi-axis sensor



2003 TOYOTA Sequoia in the shop.

does not set after the second time, then the ABS module needs to be inspected for a wiring issues or plug connection problems. I inspected the ABS module and its connection and did not visually find any fault, so I knew that the real culprit was the ABS module (Fig. 5). The ABS module wasn't receiving the necessary data from the ORC even though the data was being sent to the ABS. See, a complicated ESC issue isn't



THIS SEQUOIA has a VSC light on, which appears in the IP cluster.

so complicated after all as long as you understand how the system works.

Another example

Working on a vehicle that has a stability control issue is more often than not caused by a fault from another system or an obvious alteration to the stability control system on the vehicle. Such was the case of a 2003 Toyota Sequoia (Fig. 6). The vehicle has a VSC light on the dash (Fig. 7). The vehicle displayed a DTC 1337 stored in the ABS module. This code is for a mismatched tire size. On vehicles with stability control, the module that controls this system has a calibration file programmed for that specific vehicle. In that program, the module reads the tire size along with a vehicle speed and some other inputs and processes that information so it can make an informed decision on what it needs to do to correctly apply the brakes and steering effort for safe operation of the vehicle. Upon inspection of the tires, I found that this vehicle should have P245/70R16 tires, which it did for



HERE'S THE CAUSE of our Stabilitrak light on the 2012 Malibu (seen in Fig. 8).

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three out of the four tires. The right front tire was a P265/70R16. Both of these tire sizes are correct for this vehicle; however, they all need to be the same. The P265/70R16 tire is 1.18 of an inch taller than the other size tire. The revolutions per mile at 60 mph on a P245/70R16 is 661 as opposed to the P265/70R16, which is 637. The right front wheel is actually turning 24 times less than the rest of the wheels. When the ABS module — on this vehicle it's referred to as a skid steer ECU — receives the information from the wheel speed sensors, it will notice the difference in the wheel rotation on the right front wheel. Even though this DTC is an ABS system DTC, it will also illuminate the VSC indicator as well due to the fact that these two systems work together to control braking and steering control. The ABS system did not set a code for an erratic or malfunctioning

right front wheel speed sensor because the reading was consistent — it just wasn't correct. How the incorrect tire size was put on this vehicle is a mystery, but never the less it's always a good practice to look over replacement parts carefully prior to installation. If you're wondering why the ABS light is not illuminated on the dash in our photo along with the VSC indicator, it is because the indicator bulb for the ABS light was burned out. That was an additional repair added to our VSC malfunction issue.

Remember, vehicles with stability control systems work with many different players. The VSC system of our Dodge Dart is very different than that of our Toyota Sequoia, but the way the systems operate are very similar. As these systems become more complex, the method of diagnosis is still the same — that is, for now.



2012 CHEVROLET MALIBU with a StabiliTrak warning message on the dash. This vehicle didn't actually have a stability control problem.

Vehicle stability control systems have been around for a long time. They are not going to go away anytime soon. In fact, they will become more complex as technology increases. I know I have stated this before, but the best rule of thumb that I have in diagnosing any vehicle drivability or electrical problem is to know the system you're working on. Grab a cold beverage and sit down and spend a few minutes reading up on how these systems work. You will be amazed by how much easier it will be if you have a grasp on how each component and/or system works. Remember, if you put the time in and become more proficient in tackling these types of jobs, you just might see an increase in your wallet, not to mention further driving your passion for repairing today's vehicles. And isn't that the ultimate goal? **TM**



EDWIN HAZZARD
Edwin Hazzard has more than 30 years experience in the automotive industry as a tech, service consultant and mobile diagnostic tech. He is the owner of a successful

mobile auto and truck repair service in Newburgh, NY.
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DIAGNOSING EVAP SYSTEMS

IS FINDING THOSE VERY SMALL LEAKS A CHALLENGE IN YOUR SHOP? NOT ANYMORE!

BERNIE THOMPSON // Contributing Editor

Perhaps one of the toughest jobs in the automotive field is diagnosing small leaks, especially A/C and Fuel Vapor (EVAP) leaks. Finding these leaks can be time consuming and frustrating to say the least. Small EVAP system leaks may be the most difficult to locate because of several issues. First, the system test pressure is low at less than 1 PSI. Second, the leak sites that you must find are small at .005 to .030 of an inch. You may think you will not need to find these small .005 leaks; however, you do. These small leaks can become large leaks with thermal expansion and contraction. The third issue is that the EVAP system is located from one end of

the vehicle to the other end of the vehicle. All of these are serious concerns and will require you to have a great understanding of EVAP systems and the test equipment used in order to find these elusive leak sites.

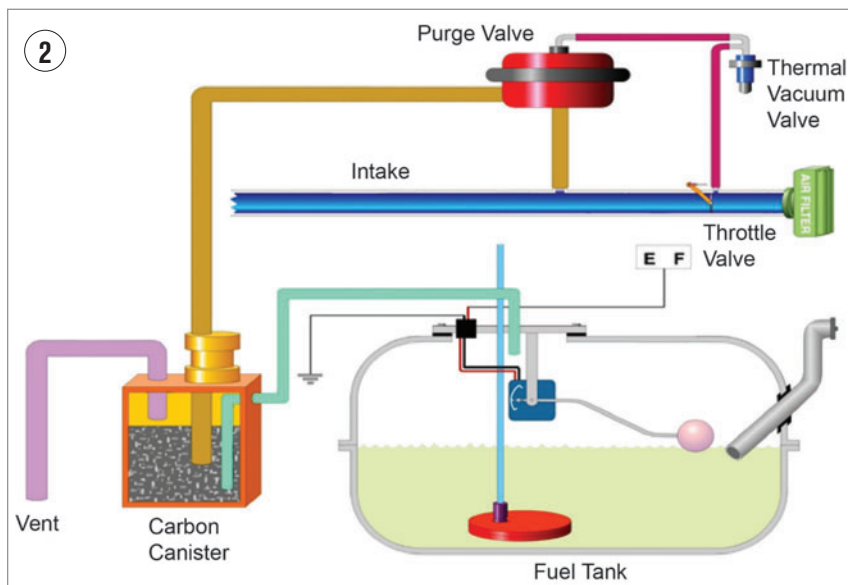
Why do we have EVAP systems on vehicles? In southern California, air quality became an issue in the mid 1960s. In order to control the air quality for human health, emission regulations were enforced on the automotive industries. California established a new organization called the California Air Resource Board (CARB) in 1967. CARB is the “Clean Air Agency” of California. This organization became the first to impose requirements on the automo-



tive industry and still leads the nation on regulating vehicle pollutants. After CARB was established, the Environmental Protection Agency (EPA) was established in 1970 to regulate pollutants in the United States that harm human health.

At first these regulations covered the internal combustion engine’s tailpipe and crankcase emissions and in 1970 moved to regulate the fuel handling and containment system (EVAP), which includes the engine’s tailpipe, crankcase emissions and fuel vapor, and produces smog — an acronym for smoke and fog.

Photochemical smog is a type of air pollution caused by chemical reactions that occur between the sun’s ultraviolet light and pollutants such as hydrocarbons and oxides of nitrogen. Since smog is created in part by hydrocarbons in the atmosphere reacting with sunlight, it has become necessary to prevent these hydrocarbons from entering the atmosphere.



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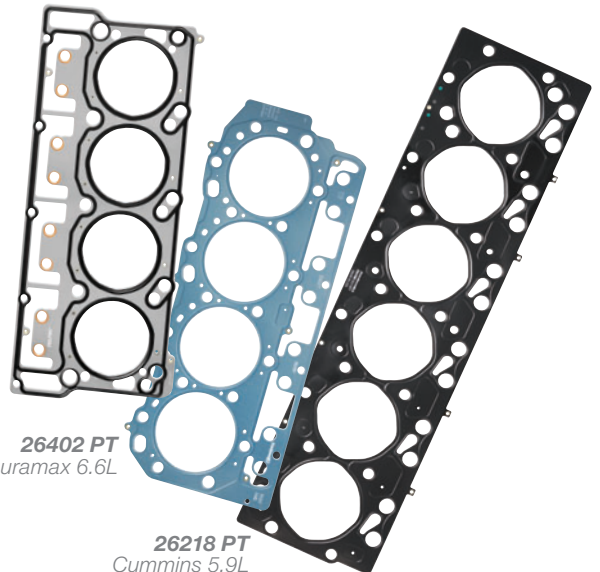
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Controlling fuel vapor

In order to accomplish reduced hydrocarbons, the fuel handling and containment system was required to trap the fuel vapor and then pull this trapped fuel vapor into the engine to be burned. To trap the fuel vapor (gasoline), activated carbon is used (Fig. 1). The carbon canister provides a bed of activated carbon that allows absorption and desorption of the many different species of hydrocarbons, which are contained in gasoline. These hydrocarbons are caught in the cracks in the activated carbon when the fuel handling system is venting hydrocarbons under atmospheric pressure. The activated carbon will absorb these fuel vapors until it becomes saturated. In this saturated condition, the activated carbon cannot take on any more hydrocarbons, thus the hydrocarbons go into the atmosphere. In order for this not to occur, the activated carbon must have a desorption cycle. This is accomplished by the purge cycle and is controlled by the purge valve. The hydrocarbons are then purged (pulled out) from the activated carbon using negative pressure applied by the running engine. And early EVAP systems (Fig. 2) were controlled by mechanical valving.

This purge control valve is normally closed and is opened to allow atmospheric air to enter the running engine through the carbon canister vent. As the air moves through the vent and the carbon canister, it removes the hydrocarbons from the activated carbon. This air and hydrocarbon mixture is then moved into the running engine and burned. Since this mixture of air and hydrocarbons varies, it can affect the drivability of the engine. This air/fuel mixture can affect the fuel control system and can be seen in the fuel trim. If the activated carbon has no hydrocarbons absorbed within it, the mixture will be lean. If the activated carbon has hydrocarbons contained within it, the mixture will be rich. If you have a fuel trim issue at idle and light load, vacuum, disconnect and plug the purge valve. This will indicate if the fuel trim issue is caused by the purge control or not.

As the air quality continued to degrade from the mid 1960s, the need to prevent these hydrocarbons from escaping into the atmosphere has brought stringent emission regulations from CARB and the EPA. These regulations are referred to as “Enhanced EVAP.” In 1996 with the OBDII emission regulations, EVAP containment regulations required vehicle manufacturers to monitor and detect leakage for the gasoline containment system that exceeded an area equal to a hole diameter of .040 of an inch (1mm) in size (P0442). They are also required to test the function of the purge and vent valves, along with monitoring the electric circuits of the EVAP components. In order to

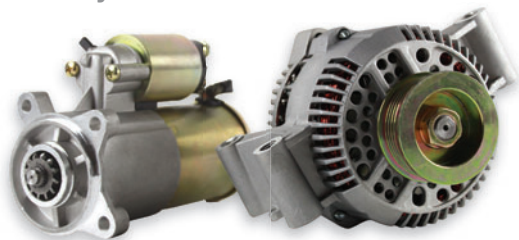


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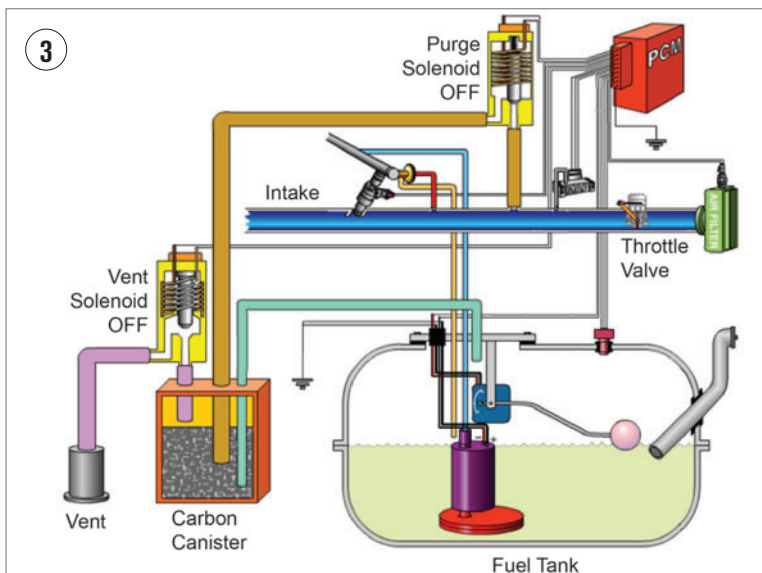
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be compliant with these stringent emission regulations, a microprocessor is used to control the EVAP system (Fig. 3).

In 2000 with the OBDII emissions regulations, EVAP containment regulations required that the vehicle manufacturer had to monitor and detect leakage for the gasoline containment system that exceeded an area equal to a hole diameter of .020 of an inch (.5mm) in size (P0456). This .020 area is not half that of a .040 area, but is one fourth of the size, as this is a product of the hole size area. A dime weighs 2.268 grams; under the right conditions, the area equal to a .020 hole size can emit about “a dime’s” worth of HCs per every two miles. This would be more than 30 times the current allowable exhaust emission standard. As you can see, the need to control leakage in these systems is important. In order for the OBDII diagnostic test results to fall under the EVAP regulations, the area of the leak size to be tested will need to be reduced. This can be seen by looking at the bell curve in Fig. 4. The testing bell curve determines the need to run the EVAP leak test at a smaller hole diameter than the standard. In this case, the standard .040 leak area will be



tested at a .030 leak area and the standard .020 leak area will be tested at a .015 leak area.

There are two automotive fuel containment leak detection methods used: Negative Pressure and Positive Pressure (Fig. 5). Pressure is the ratio of force to the area over which that force is distributed. Pressure is measured in any unit of force divided by any unit of area. The lb./square inch (PSI) is the traditional unit of pressure used in the US and the UK. These units can be read in absolute pressure, which is read from 0 pressure, or can be read in gauge pressure. Gauge pressure is where the pressure reading of the atmospheric pressure is not accounted for. Because the area the pressure is pushing against multiplies the force, it will be important to never adjust the testing pressure higher than the system’s operating pressure, as this could cause severe damage to the system. The maximum EVAP testing pressure is 1 PSI or 27.68 inches of water column (inH₂O). An example of the force being multiplied is if an area of 36 in. x 36 in. had 1 PSI applied on it, the force would be 1,296 lbs. If this pressure was increased to 10 PSI, the force would be increased to 12,960 lbs. The OBDII EVAP diagnostic system will use the difference in pressure between what is contained within the EVAP system and that of the atmospheric pressure to determine if the system leak area is above or below the standard. Pressure differential is the difference in energy between a higher pressure and a lower pressure. High pressure, having more force, always moves to a low pressure, having less force. When the fuel containment system has a higher (positive) or lower (negative) pressure contained within it and a leak is present, the pressure difference will change over time.

In order for the EVAP system to be pressurized, the system must first be sealed. One of the more common OBDII

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leak detection methods, referred to as vacuum decay, is set up using a valve that is installed in the canister vent. This valve is called the vent valve and is normally open (Fig. 3), which allows the internal EVAP pressure to be vented to the atmosphere just as in the early EVAP systems. However, this vent valve will be closed during an OBDII diagnostic fuel containment leak test. Once the vent valve is closed, the negative pressure from the engine is used to pull the fuel containment system into a vacuum. A pressure sensor is used in order to monitor the pressure within the containment system. If there is no leak present, the pressure will remain constant. If a leak is present, the pressure will change or decay. The rate at which this pressure changes is proportional to the size of the leak. However, the vapor space volume will change this decay rate. This means the vapor space contained within the fuel containment system becomes important to know. The OBDII program checks the fuel gauge in order to calculate this vapor space. If the fuel gauge misreads the liquid fuel level, the system could set a false leak code.

Controlling fuel vapor

This can be seen with an example of an 18-gallon volume with a .015 inch leak area. At 25 inH₂O the system will lose 1 inH₂O in 30 seconds, which will set a leak DTC. This same 18-gallon volume with a .010 inch leak area at 25 inH₂O will lose 1 inH₂O in 40 seconds, which will not set a leak DTC. This makes sense that a larger leak size would leak at a faster rate. However, when a smaller volume is tested, such as 9 gallons of volume with a .010 inch leak area at 25 inH₂O, the system will lose 1 inH₂O in 22 seconds, which would not set a leak DTC. This is a faster leak rate than the .015 leak area with 18-gallon volume by

8 seconds that would set a leak DTC. The OBDII diagnostic program looks up a leak rate table that is based on the vapor space, so if the vapor space volume is not correct, the test outcome cannot be correct.

In order to test the fuel gauge, a simple test can be run. Look at the fuel gauge in the instrument panel. Now let's say the fuel gauge is reading one fourth of a tank and the tank has a 20-gallon volume. This is approximately 5 gallons of gas and 15 gallons of vapor space. Now add 2 gallons of volume for the hoses and carbon canister; 15 gallons + 2 gallons = 17 gallons of vapor space volume. In order to test this vapor space, take the testing equipment that you use for EVAP systems and fill an empty 5-gallon gasoline can. Time how long it takes to bring the pressure up to the maximum amount your equipment can produce or a known value; do this multiple times. Now you know how long it takes to fill 5 gallons without a leak. Use this known time-to-volume fill rate from your equipment when filling the fuel containment system on the vehicle. For example, if you are filling the system and it has 10 gallons of vapor space, double the known fill time. After you do this just one time, you will see how simple it is, and you will do this each time you are filling the system when looking for a leak. If you are filling the system and the fill time is very short, suspect a restriction between the carbon canister and the fuel tank connection hose.

When looking for a leak in the EVAP system there are two things you must know. First, you need to know if the system is leaking right now or not. The second thing you need to know is how big the leak size is. To find the answer to these questions, seal and pressurize the system with a gauge attached. Now shut off the flow going

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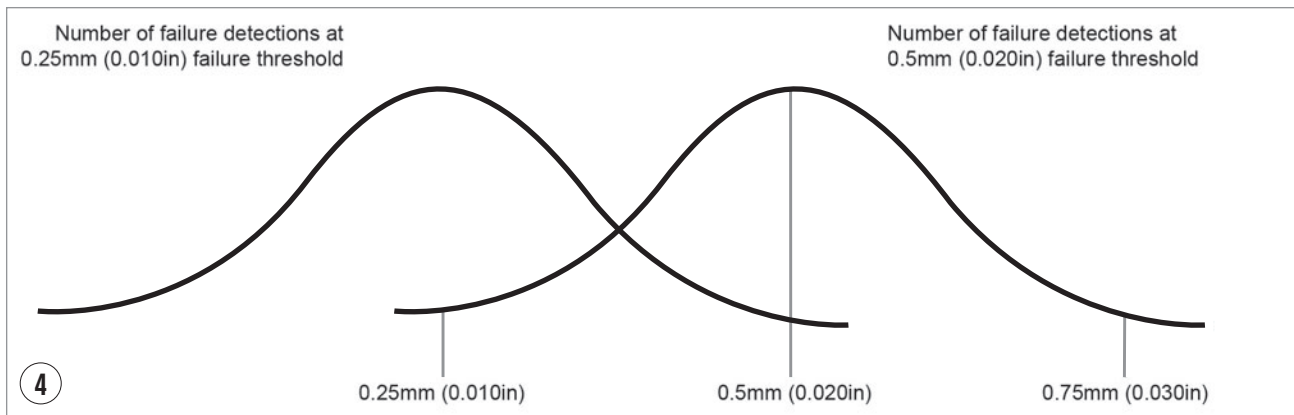


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into the system. Watch the gauge for a pressure loss. If no pressure is lost, there is currently no leak present; if there is a pressure loss, a leak is currently present in the system. How fast the pressure drops in relation to how much vapor space is present will indicate the leak size.

Now before you go looking for the EVAP DTCs such as a P0456 or

P0442, you will know there is a leak present right now and how large the system leak is. This information is imperative in order to find the leak site(s) location(s). The leak volume is based on the operating system pressure and the size of the leak site area. The larger the leak site the more volume will escape, or the higher the pressure the more volume will escape. If both the

leak site and the pressure are low, a small amount of volume will escape from the leak site. This makes these EVAP leaks difficult to locate.

Finding the leak site

There are several ways in which you can find the locations of EVAP leak sites. There are three basic methods: Soap, Smoke and Gas. “Soap” is based on surfactants. These are chemicals that lower the surface tension of a fluid. In a state where there is less surface tension, a bubble can be produced. When the fluid is water, the surface tension of the soapy water is much lower — about a third of pure water — so the molecules of the bubble are less stressed and therefore stable. This allows the bubble to be produced and last longer. If the volume of gas escaping from the leak site is too small, there will not be enough energy, or a pressure jump, to produce a bubble. Therefore, the leak site will not be detected. If the pressure or volume is too great, the bubble will not form. This is due to the escaping gas having enough energy to instantly break through the soap surface tension. Once the soap surface tension is broken, the escaping gas goes into the atmosphere instead of filling the area within the bubble; therefore, the leak site will not be detected. Additionally, the soap’s very slick nature creates a problem when applying the soap to the surface of the sealed system. When applying the soap



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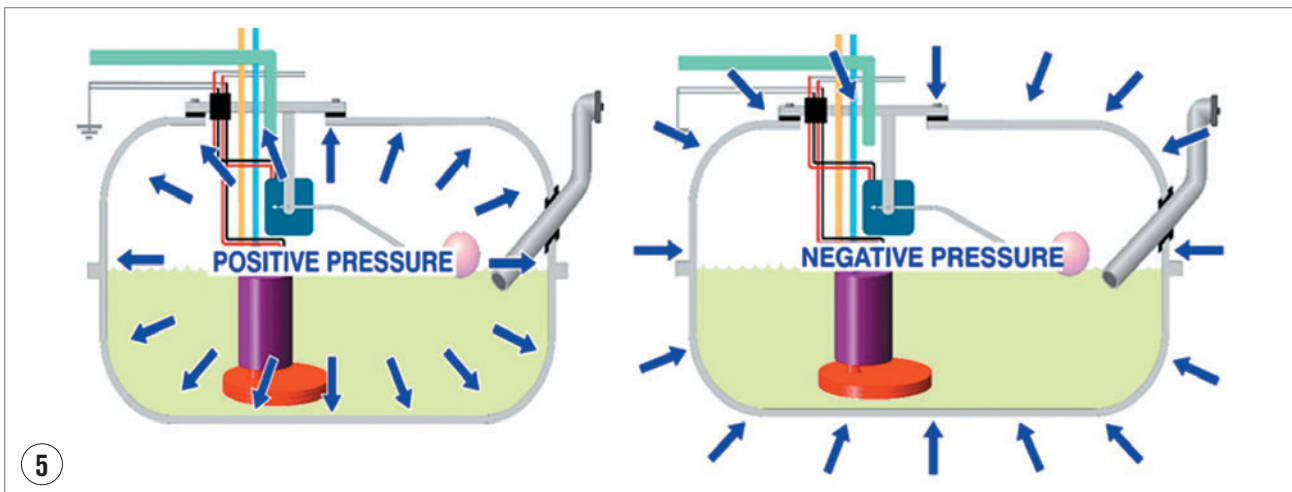
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5

to a vertical surface, the soap will tend to slide off of the surface. If the surface is that of plastic, the soap will just run off. If the soap cannot stay in place over the leak site, a bubble will not be produced; therefore, no leak can be found. If the conditions are just right, the soap will produce a bubble or bubbles at the leak site, thus allowing you to locate the leak site within the sealed system.

Yet another leak detection method is using vapor or smoke. The problem here is that smoke vapor is a poor visual indicator. This can best be understood by looking at water vapor in the air. A cloud is water vapor that has condensed to a point where it can distort light and thus be seen. On a day with high humidity (water vapor in the air) there may not be a cloud in the sky but the vapor in the sky is high; however, this vapor cannot be seen. This is the same as the vapor from a smoke machine. There will need to be a large amount of smoke vapor condensed together to distort light so it will be visible. When the leak site is small, there is not enough smoke vapor present to distort the light so the leak cannot be seen. Additionally, the smoke vapor is produced from oil. When using this type of leak detection equipment in a fuel containment and handling system, the gasoline will break down the oil

vapor. In chemistry, likes breakdown likes, meaning the smoke being produced from heavier oil hydrocarbons will be broken down by the lighter gasoline hydrocarbons. Thus, smoke may not be detectable. Additionally, the carbon canisters in these systems are designed to catch hydrocarbons. The smoke being produced from hydrocarbons will be caught in the activated charcoal. So a leak at the carbon canister may not be found. The main problem with smoke is that many large leaks (> .030) can be found with smoke, so technicians think it works for all leaks including small leaks; but this is just not the case.

In the last few years, significant advances have been made in leak detection equipment. These new equipment developments are based on gas and can be used in all sealed systems. It can find all leak sizes small and large fast and accurately. These new leak detection systems use a new technology based on carbon dioxide (CO₂) gas. CO₂ is a very small molecule that moves through small leak sites with ease. The sealed system to be tested is pressurized with CO₂. The sealed system now, being at a higher pressure than the surrounding atmospheric pressure, will allow the CO₂ gas to escape if a leak is present. An advanced electronic CO₂ leak de-

tor is used to locate the approximate area of the leak site. Finding the exact location of the leak site can be difficult when using any gas-based electronic leak detector, especially if several connections or components are all located within a small area. Because CO₂ gas can cause a specifically-formulated foam to change color, pinpointing the source of the leak is simplified. The specifically-formulated foam is applied to the general area identified by the advanced CO₂ leak detector, and the leaking CO₂ gas changes the color of the foam from a pinkish-red color to yellow at the exact location of the leak site. The use of CO₂ gas makes false detection a thing of the past, allowing you to be absolutely positive as to the location and size of the leak. With a good understanding of these EVAP systems and knowledge of your equipment, these EVAP leaks will be easy to locate. **ZZ**

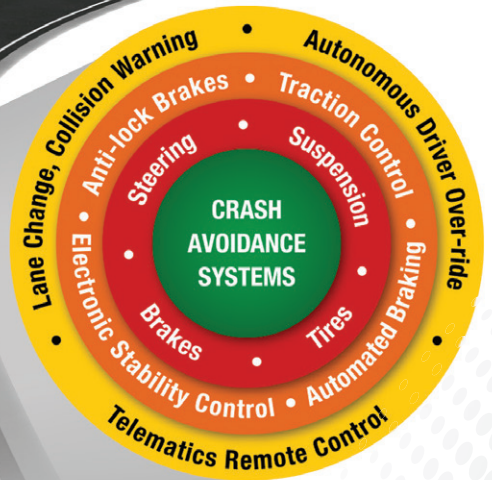
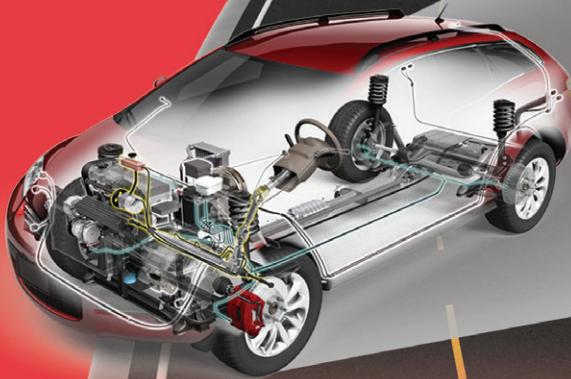


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ARE YOU A 'CAR GUY'?

WHAT TURNS YOU ON ABOUT BEING A TECHNICIAN?

PETE MEIER // Director of Training

I first started getting an interest in cars when I was 15 years old. The idea of the freedom my own transport would allow was exciting, and I had the good fortune of growing up in the Muscle Car era of the late '60s, early '70s. Copies of popular car enthusiast magazines of the day could be found anywhere in my house, often to the chagrin of my mom and dad. No, not the high-end ones like *Road and Track* — I mean the ones that got a young man's blood going, featuring asphalt-tearing big blocks and filled with articles on how to make those monsters even meaner.

It was easy in those days to know what kind of car was coming down the road, too. Exhaust notes were unique among the brands, front grill and headlight designs easily identified a Mus-

tang from a Camaro, and the passing taillights also lent easy clues as to the kind of car that just passed you by. That doesn't apply today, as the necessary streamlining and aerodynamic needs have made many cars almost carbon copies of one another.

At the time, the idea of being a mechanic (technicians didn't exist back then) wasn't even close to being on my radar. I actually enrolled in college shortly after graduating high school, and initially majored in criminal justice with a goal of one day becoming an FBI agent. I'll continue my story after you stop giggling...

While going to college, I decided to invest in a Honda CB350 motorcycle to make my commute. My school was located in the city, and parking was at a

premium. Riding a motorcycle to school made it easier to park close to campus and turned out to be a lot of fun. It was a bigger extension of the small off-road bikes I grew up on. The bug bit so hard I decided to leave college and pursue a technical education in motorcycle mechanics — a decision that led me to fabulous Daytona Beach, Florida. The education in the classroom adequately prepared me for a future in the motorcycle repair field, and the education out of the classroom prepared me for a youth of debauchery and rowdiness. A lifestyle, I admit, I would have remained in had it not been for the birth of my first son.

I moved from the motorcycle side of the business and went into the car side by reason of sheer economics. Motorcycles in my home town were seasonal, and so was the work. That's OK if you're a single guy, or even a young couple starting out, but it doesn't cut it for a family man.

The making of a car enthusiast

I often get asked questions related to the enthusiast side of this business that I must tell you go clear over my head. I know little about the classics and their histories, and I often sit in amazement as I listen to conversations true car nuts have about loves of the past or arguments about which is better: the big block Chevy or the Chrysler Hemi (from back in the day, youngsters, not the current versions of either!). And then there are the techno-fans, the technicians of today that drool over conversations that involve scan tools and scopes. While I



PHOTOS: PETE MEIER

THAT'S MY DAD on the far right, a master carpenter by any world standard and the reason I have the professional ethics I try to live up to today.



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consider myself competent as a technician, these men and women are at the top of the game, and I learn from each and every one of them. In fact, I share with everyone who attends any of my seminars that I claim no responsibility for any of the lessons I'm passing along. My role with the magazine is to go out and collect knowledge from the best in the business and then share it with all of you — a goal I strive to meet daily, by the way.

Does that make me any less of a car enthusiast? I was pondering that question on the flight home from the latest industry event I had attended, and I think the answer is “no.” More precisely, I would consider myself a “car repair enthusiast.”

To understand where that is coming from, I need to tell you a bit about my dad. My dad is a carpenter, trained in Europe in the old way, who started as an apprentice and worked his way up.

In those days, you weren't considered a master anything until the existing masters (in your specialty) viewed your “masterpiece” and pronounced you as such. My father immigrated to the United States before he created his masterpiece and to this day will argue that he is still a journeyman, but seeing him work and having witnessed his creations, make no mistake — he's any carpenter's Yoda! I tried to follow in his footsteps but just didn't have the same love for building that he had. But one lesson (of many) that has served me well was this truism: “Any man that can work with his hands will always be able to take care of his family.”

And that has held true for me. Over the last 40-plus years, the economy has



MY KIDS and their friends keep me busy in the shop, but the true diagnostic challenges aren't as common as they used to be.

gone up and down. There have been good times and bad times, inflation and recession, and through it all I've always been able to support my family by being a part of this business. But that is only one reason I made my living with a wrench in my hand. Another lesson I learned from my father was the importance of taking pride in what

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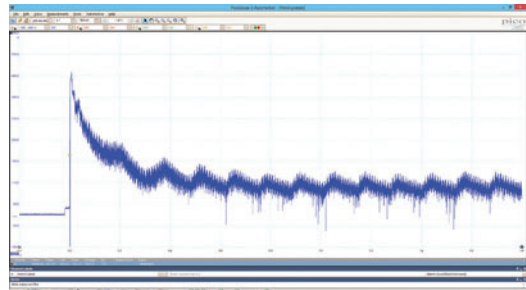
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TODAY, I STRIVE to be the informational funnel – collecting lessons from the best I can find and bringing them to you.

you do. In the summers I worked with him, I would see the pride he had each day, stepping back to see the building that was taking shape by his hand, a work that would be there for years to come, and he was adamant that every 2"x 4", every piece of trim, every nail was installed and in place correctly. His trim work, for example, looked as if the accents in the room were made from one piece of wood with no seam visible. Many times he would make me rip out the work I had tried to perform and redo it because it didn't meet his standard. That would be easy to comprehend if we were building multi-million dollar homes, but we weren't. The cost of the final project made no difference to my dad — they all had his name associated with it and that was reason enough to do our best. It's a commitment to quality shared by few today, it seems.

My enthusiasm for my chosen profession came from a similar source. I enjoyed taking a broken motorcycle or

car and making it whole again. The satisfaction only grew when the challenge had been taken on by others who were unable to overcome the task. My personal mantra was always "If a man designed it and a man broke it, a man can fix it." I always refused to admit defeat, though on some occasions I did have my butt handed to me by a stubborn vehicle. Sometimes I spent more time on a problem car than I should have, actually losing money in the process, but as I learned and matured, the time I had to spend finding a solution became less and less. Training played a big role in that, and with the advent of the internet, learning resources became more readily available. Today, there is no reason any technician should settle at being less than the best he or she can be as more and more trustworthy sources of information and training become available to all.

I've been beaten, bruised and bled by this business over the last four decades, yet I still get that electric tingle when the lights come on and I've fig-

ured out another tough problem. The challenges don't come to me as often as they used to, stuck behind a desk as I am most of the time today. But I'm not complaining, for now I get to pay back to an industry that has treated me, overall, pretty damn well by passing along not only what I've learned, but by bringing some of the brightest trainers and technicians to you via the pages of this magazine, our online efforts and of course, Automechanika Chicago — a combination world quality trade show and equally high ranked training event that we look forward to presenting again in July 2017. I really look forward to seeing you all there very soon. *TM*



PETE MEIER is an ASE certified Master Technician and sponsoring member of iATN. He has over 35 years practical experience as a technician and

educator, covering a wide variety of makes and models. His primary goal is to bring working techs the information they need.

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EXORCISING THOSE DIAGNOSTIC DEMONS

TACKLE SEEMINGLY OTHER-WORLDFLY VEHICLE PROBLEMS BY RELYING ON THE DATA

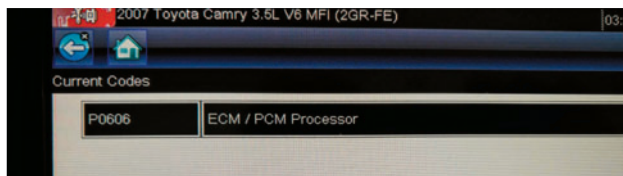
MCHAEL MILLER // Contributing Editor

With Halloween coming up, I have lately been reminded of the short-story horror series, *Tales from the Crypt*. That's because every so often some of the vehicle problems we encounter can seem sort of paranormal. Even though we keep telling ourselves that there must be some logical explanation for what is causing the fault, the data we are observing is incomprehensible and our usual tried-and-true testing reveals little or no guidance. With that theme in mind, here's our first story.

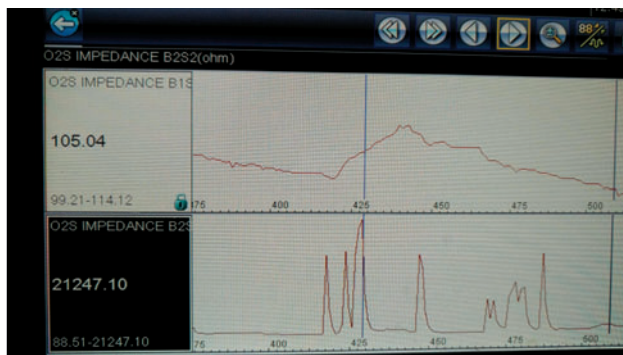
2007 Toyota Camry with Code P0606 ECM Processor Error

On this vehicle, I needed to program a new ECM that had been diagnosed and installed by another tech. Maybe programming isn't the proper term, however, since pretty much all that was needed was a VIN Write, but I was happy to oblige. When the tech got back from the test drive, code P0606 was already set, and I was asked to go over the diagnosis that led to the ECM needing to be replaced. Now, even though there needs to be some verification of the controller's power(s) and ground(s), when you get an internal processor code it is highly likely that you will be replacing the ECM, so what went wrong on this diagnosis?

When looking at the trouble code flowchart, I noticed that there were two options for diagnosis: one for a P0606 stored with other codes and one for a P0606 stored by itself. Well, only the P0606 is stored with nothing else even in pending status, so according to the flow chart: REPLACE ECM. No testing, no checking, nothing, just replace. Ok, I can see where the tech called for the replacement ECM, and he was justified in making the call. But there had to be a reason the same code would reset with a new OEM ECM. My first thought was a poor ground connection, so I used an ECM connector pin from ALLDATA and my LOADPro dynamic test leads to check the integrity of the grounds for the ECM. If you're not familiar with the LOADPro, it is a device that replaces your



AFTER A SHORT TEST DRIVE with a new ECM installed, the same Code P0606 returned. This is the only code that is set, which is why the technician ignored the code flowchart that had the O₂ sensor codes combined with the P0606. They instead followed the code flowchart for P0606 only, which simply states to Replace ECM.



SOMETHING I HAVE NOT MONITORED before but definitely looks out of place is the impedance for the B2S2 Oxygen Sensor. Note that it has several spikes reaching over 21,000 ohms. Ultimately, this is what was setting the ECM processing error.

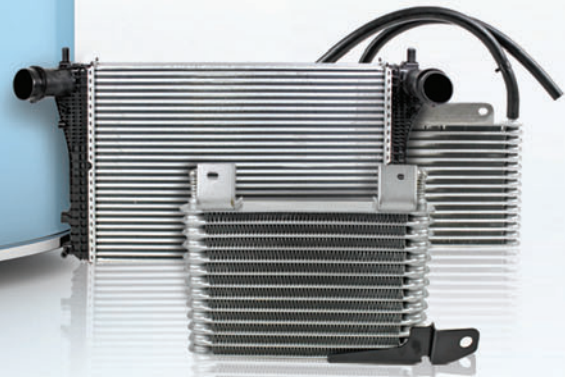
regular voltmeter leads and allows you to perform a dynamic voltage drop test with a push of a button on the circuit you are testing. Well guess what? The grounds tested fine with virtually no voltage drop. Since I was there, I checked the voltage supply, too. Same thing. The terminals of the harness connector also passed a pin drag test.

At this point, I am getting the eerie feeling that we received a defective ECM, but what are the odds that a new ECM would have the exact same problem as the one we replaced? Maybe this vehicle is possessed. Remember when I looked up the code and there were two options listed for P0606? A lot of



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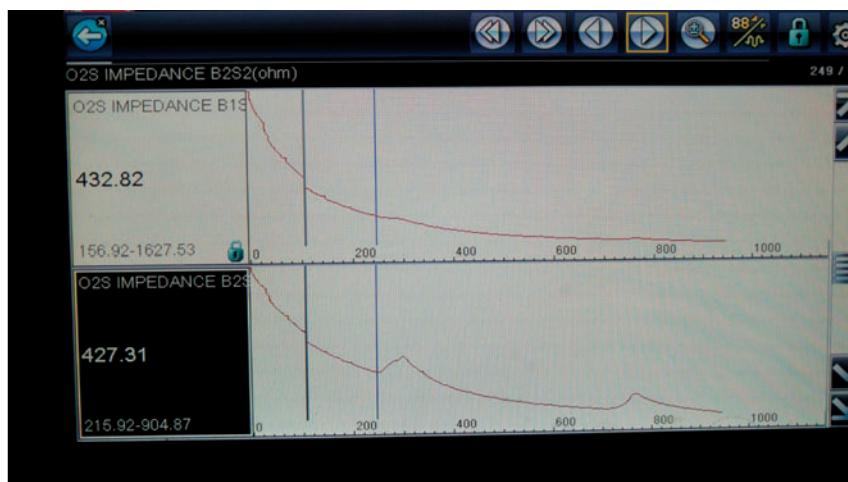
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times, if there are multiple codes, it would make sense to ignore a certain code if other codes are set that have a higher priority, or it could be that they could cause that code to set. Well the other codes are oxygen sensor codes. Could an O₂ sensor cause an ECM processor malfunction? Yes, according to the code set criteria. A malfunction of the Air/Fuel Ratio Sensor transistor or the Heated Oxygen Sensor transistor could cause the ECM to believe there is an internal processing error. After hooking up the scan tool and graphing the data from the oxygen sensors, I couldn't believe what I was seeing. Looking at the impedance on the Rear Oxygen Sensors, it was easy to see that while Bank 1 Sensor 2 was reading in the range of 90 ohms, Bank 2 Sensor 2 was exhibiting spikes up to 21,247 ohms! I guess that is something that can trick an ECM.

After replacement of the Bank 2 Sensor 2 Heated Oxygen Sensor, we found that both rear bank oxygen sensors' impedance came down as the engine warmed up and stayed relatively flat. Keep in mind when monitoring the impedance on a cold engine that the resistance will be higher, but will drop as the sensors warm up. A long test drive confirmed that the poltergeist that was possessing the Camry had been exorcised.

2007 Hyundai Sante Fe with Code P0133 B1S1 slow response

Our next story turns out to prove that sometimes we are our own worst enemy. A 2007 Hyundai Sante Fe with a 3.3L engine showed up at our shop with an illuminated MIL due to a P0171 Bank 1 Lean and P0174 Bank 2 Lean codes currently present. The technician who diagnosed the problem — a very competent one at that — smoke tested the vehicle and found that the intake gaskets were not sealing, causing the lean con-



AFTER INSTALLING a new rear O₂ sensor on Bank 2 the readings were back to normal and the code did not reset. Note how the impedance of the rear O₂ sensors drop as they warm up to operating temperature.



THE DATA obviously matches the code description for a slow responding Bank 1 O₂ sensor, but the graph of the sensor looks eerily familiar to a post cat O₂ sensor.

dition the customer was experiencing. After removing the intake and installing new gaskets, the technician test drove the vehicle to verify everything was good. However, horror struck when they found a pending code P0133 Bank 1 Oxygen Sensor slow response. The technician took a quick look at the scan data to confirm a problem with the Bank 1 Front Oxygen Sensor and added it to the ticket to get replaced.

A second test drive was performed with the new oxygen sensor installed and déjà vu — a pending code for the Bank 1 O₂ Sensor returned from the grave. The tech asked for some advice

on what could be causing it, so I suggested checking for exhaust leaks. It was just in for some lean codes and maybe the condition wasn't all caused from the intake leaking. Both a visual inspection and a smoke test of the exhaust system were performed and no problems were found. This time, I was asked to take a look at the vehicle myself. The first step was to check for any TSBs, as anyone who has gotten burned by not doing this before can attest.

I like to graph data so that I can see the change of the PID over time, especially if it's something like an oxygen sensor. Using the Hyundai GDS scan

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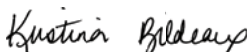
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Date: 09/30/16

I certify that the statements made by me above are correct and complete.



THE BANK 1 FRONT and Bank 1 Rear O₂ sensors are located right next to each other in the darkness of the back of the intake plenum and the firewall.



NOTICE THAT WITH THE FRONT and rear oxygen sensor connectors unplugged, the locating tabs are identical so the technician did not notice any problem with reconnecting them in reverse locations.

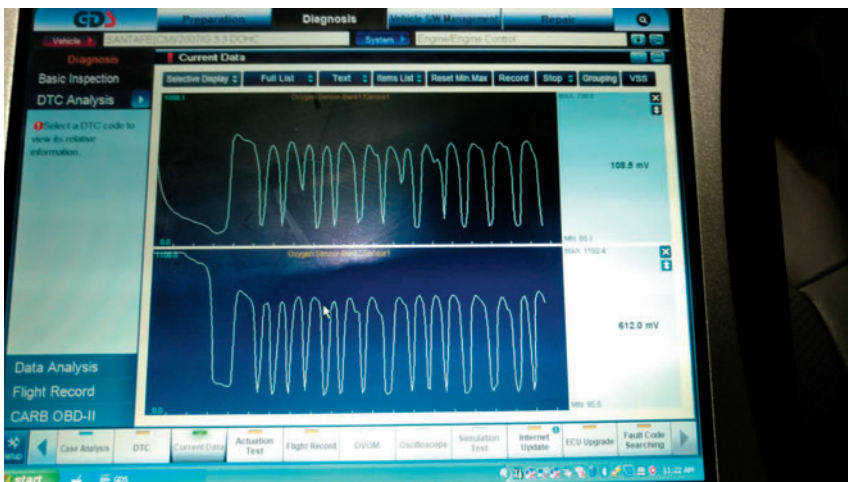
tool, I graphed both front oxygen sensors so I could compare them to each other, and what I found was creepy. The oxygen sensor for Bank 2 was switching normally and within a good operating range. Bank 1, however, was definitely slower, about seven times slower than Bank 2. So I was seeing why the PCM would flag the code and also why the other tech made the call on a defective sensor. I politely asked if he was sure he put the new sensor on the correct bank (notice I said politely, since asking a frustrated technician a question like that can have painful side effects). He assured me he did. Creating a vacuum leak did show a response from both sensors, but again, Bank 1's response time was lagging way behind

Bank 2. Could it be a bad sensor? It's possible, but how could it fail in such a way that voltage fluctuation peaks are OK but they just occur at such a slower rate than the other side? Almost like a pre- and post-catalytic convertor oxygen sensor, like a lightning bolt it came to me. The Bank 1 pre-cat sensor is on the side closest to the firewall and a little difficult to get to. It just so happens that the connector for the Bank 1 post-cat oxygen sensor is right next to it. Well when the tech replaced the intake manifold gaskets, he disconnected the Bank 1 front and rear O₂ sensor connectors and, wouldn't you know it, both connectors have the exact same locating notch. Since the connectors are right next to each other, there was no

stretch on the wiring and although the sensors' connector ends do have different colors, without good lighting in the tight, dark area between the back of the intake and firewall, he probably just put them together thinking there was no problem since they both snapped together easily without any resistance. Reconnecting the front and rear Bank 1 oxygen sensors into their correct corresponding harness connectors corrected the slow responding O₂ graph and fixed the vehicle.

2010 Ford Mustang running lean and mean

Our last story is another vehicle I received from a tech who had been struggling with a rough running and hesitation condition on a 2010 V-8 Ford Mustang. While using freeze frame to see when a code sets is an important piece of information, an entire diagnosis should not be based off the readings. This is what I believe happened when the tech made the decision to replace the intake manifold gaskets on this vehicle. The freeze frame showed that the engine was just warming up when a lean condition was occurring, so instead of suspecting leaking manifold gaskets and confirming the problem, the trigger was pulled to replace and he shot himself in the foot. As many have said; test first, replace later. The tech continued to struggle with the



AFTER SWAPPING THE BANK 1 Front and Rear Oxygen Sensor Connectors to their correct locations, the Bank 1 Front Oxygen Sensor was reading at a similar frequency to the Bank 2 and the vehicle was ready to be returned to the customer.

WIPERS: YOUR NO-RISK SERVICE RECOMMENDATION

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In spite of the obvious benefits of wiper replacement, it is one of the most commonly overlooked service needs. Drivers might not notice the gradual loss of wipe quality until they face a serious weather-related visibility challenge. Plus, they simply might not have the time or patience to purchase and install new blades. Some technicians and service writers are reluctant to suggest add-on services, but these recommendations can actually add value to the customer relationship, according to Strobe.

“Most consumers understand the importance of replacing blades but just haven't gotten around to doing it. That's why suggesting this service as an add-on to another job is actually doing them a favor in many cases. You're saving them time, eliminating hassle and also helping keep them safe,” he said.

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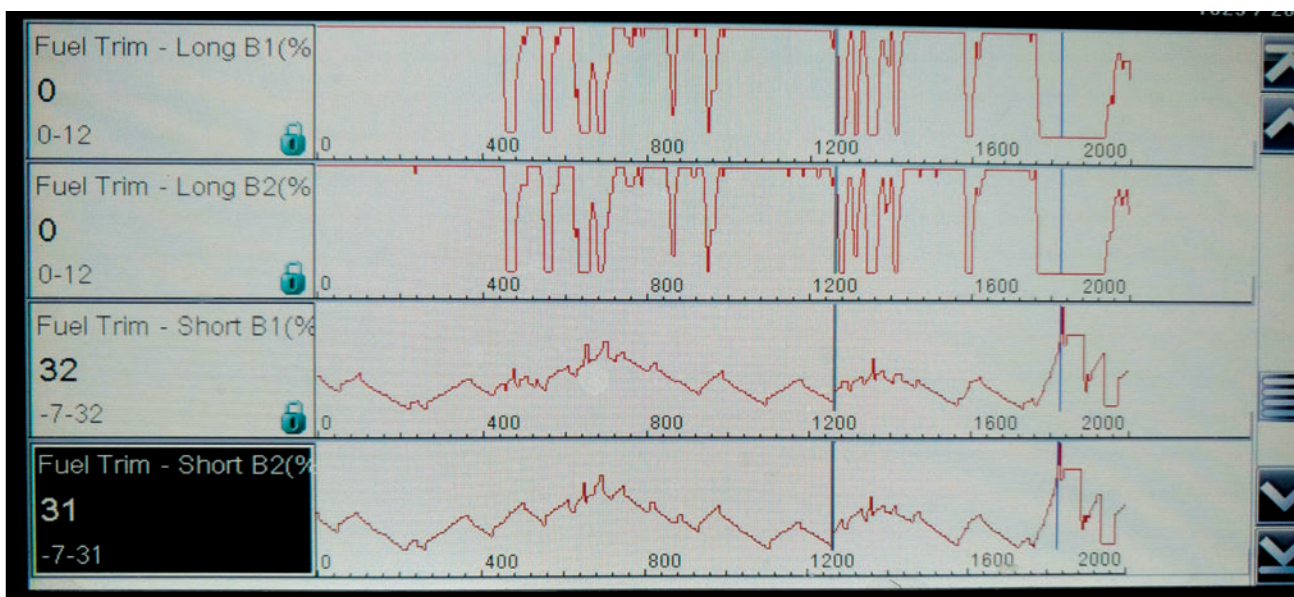
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vehicle over the next couple of days testing fuel pressure and volume. He smoke tested the intake and exhaust system for leaks but found none. He also replaced the Mass Airflow Sensor with an OE one from the dealer, but the problem remained unaffected by the repair attempts.

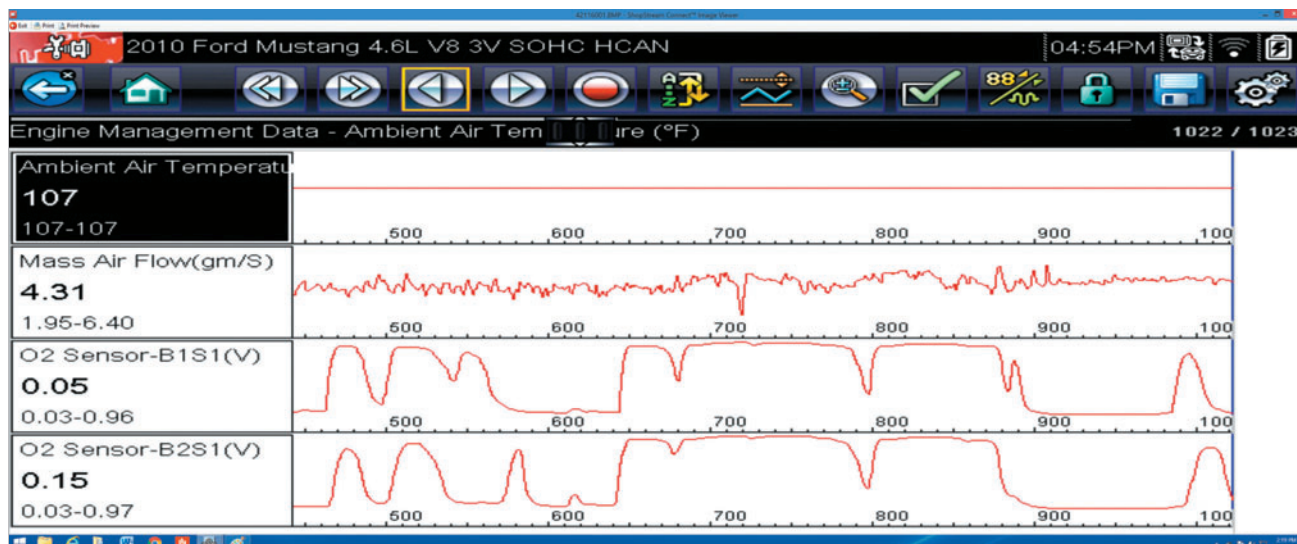
When I was asked to look at the vehicle, I first thought I knew what the problem was before even looking at

it, since I had seen other vehicles with lean conditions caused by the quality of fuel. Not that I have a crystal ball, but here in Las Vegas we have a large amount of gas stations that carry E-85 and it is fairly common for someone to just put the cheapest gas offered by a station because they assume it is 87 octane. Most of the time the vehicle still runs OK, but the check engine light is on due to a lean condition. A quick tech

tip to determine if the fuel contains 85 percent ethanol is to monitor the fuel trims at idle and 2500 RPM. Vacuum leaks will usually show positive trims at idle, but improve at high RPM, while fuel delivery issues are just the opposite, usually reading OK at idle but trending positive at higher loads. E85, however, is positive at both idle and 2500 RPM. In other words, you may have +22 percent fuel trim at idle and



WHILE THE VOLUMETRIC EFFICIENCY TEST showed great results, there was definitely a problem with fuel control on this Mustang. Note that the short-term fuel trims were fluctuating wildly from -7 to over +30.



THE CLUE THAT LED ME to the cause of the problem was looking closely at the scan data from the Mass Airflow Sensor. Notice the erratic movements of the sensor while the vehicle was idling.

+25 percent at 2500 RPM. If I see fuel trims move like that, the first thing to check is the fuel quality. After a quick peak at the fuel trims I realized that this was not going to be that easy of a diagnosis. The short fuel trims were all over the place, ranging from -7 to +32, and long term was ranging from 0 to +12. I kept thinking that I must have bad scan data since this is not making any sense. I still took a fuel quality sample, but it showed the normal 10 percent ethanol content.

I needed to determine if I was having an airflow measurement problem, so I decided to perform a volumetric efficiency test. With the VE calculator app on my phone, I entered the numbers from my test drive. The results showed 87 percent efficient and on a naturally aspirated vehicle, that is better than most. So that rules out an engine breathing problem and the MAF was already replaced. On the test drive I had noticed that the vehicle was struggling under acceleration, like it wasn't getting enough fuel, so that's where I shifted my focus. I confirmed the fuel pressure by attaching a gauge and watching it as I made some hard accelerations; pressure remained rock solid. Scan data showed that long-term fuel trims were actually perfect at higher RPMs, but short term ranged from slightly rich (-7 and -7) to extremely lean (+32 and +31). At this point, I was ready to phone in a medium because something unworldly was occurring — great volumetric efficiency, steady fuel pressure, good quality fuel and fuel trims that are making no sense whatsoever. With the file of the test drive saved on my Snap-on Solus Edge, I loaded it into Snap-on's Shopstream Connect software program. I decided to think about it overnight while trying to pick out something I was overlooking on the data. Since the mass airflow sensor was a new OE part and I had good volumetric efficiency, I never paid much attention to it until I zoomed in. Looking closely at an idle portion of the data revealed a lot of oscillations of the sensor, which in turn created havoc with both front O₂ sensors. Something is causing a disturbance in the airflow and



THE ADHESIVE THAT SECURED the heat liner to the underside of the air box had given up the ghost and allowed part of the material to flap in front of the MAF sensor, creating all kinds of turbulence in the air stream.

it's being picked up by the MAF sensor. Since the MAF sensor does not require the air filter box to be removed to change, the previous tech never removed it. When I did separate the air box from the air filter, I found a piece of heat insulating material that was glued to the top half of the box had partially fallen down and was flapping in front of the opening that led to the MAF sensor. This was causing all kinds of turbulence in the air stream.

Gluing the piece of insulating material back to the top of the air box reincarnated the Mustang, as its engine wailed when test driven on the road.

Sometimes we encounter vehicles with problems that make little or no sense, and it can drive us to a point of exhaustion trying to decide what to test next to get a grasp on what may be causing the concern. What I have found is that it is best to step back from the vehicle and look deeper in the scan data for answers before we lose our heads. **ZZ**



MICHAEL MILLER lives and works in Las Vegas, NV. He is an ASE certified World Class Technician. He holds degrees in both Mechanical Engineering and Automotive Technology.
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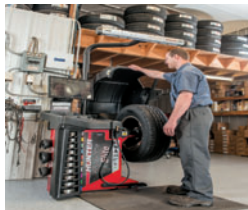
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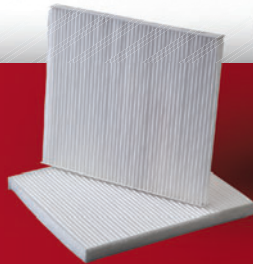
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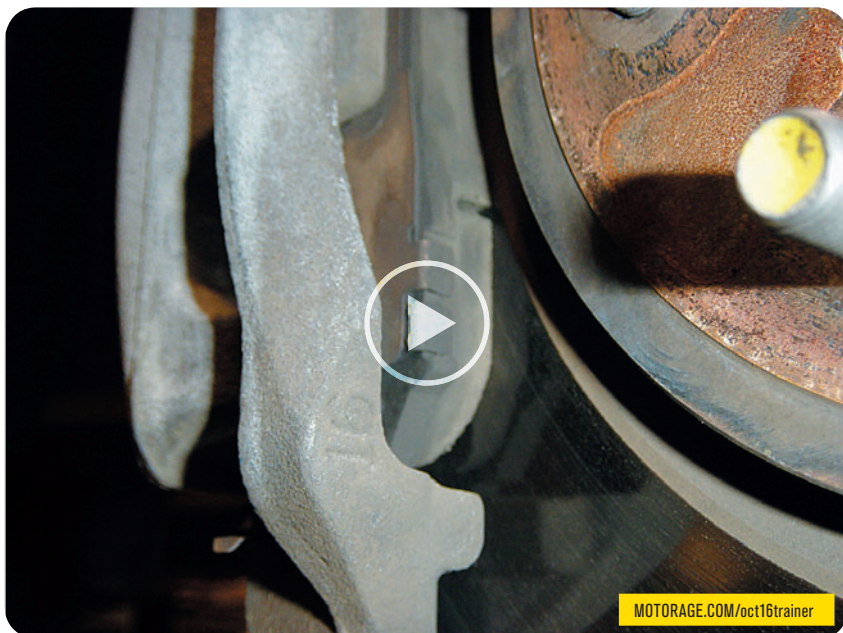
PAD SLAP OR PROFESSIONAL BRAKE JOB? TIPS AND TECHNIQUES FOR BRAKE INSPECTION AND SERVICE

PETE MEIER // Director of Training

Odds are your customers have no clue what we mean when we talk about doing a “pad slap.” Heck, odds are pretty good some of our younger techs don’t know what we mean by that either, and that could be a good thing!

A “pad slap” is a reference to the removal and replacement of a vehicle’s disc brake pads, without performing any additional procedures. The rotor, hardware and bearing assemblies are left untouched. In most cases, you only have to remove one caliper bolt (once the wheel is off) to do the job. This is by no means a professional way to perform a brake service, and hopefully no one reading this is guilty of performing this antiquated task!

At the very least, such a short cut will result in brake noise and reduced brake pad life. At the worst, pedal pulsation and decreased braking ability will be the final outcome. To do a thorough job, every component of the system needs to be inspected and restored to OEM specifications.



CONSIDERED BY MANY to be one of the simplest repairs to make, performing a brake inspection/service can be even better by following a few tips.

In this edition of The Trainer, I’ll share tips and techniques that will help you eliminate noise and pulsation complaints. I’ll also show you how to inspect and service system components so you and your customers can be assured of a brake job

that will perform as it’s supposed to. In the end, you’ll spend a little more time doing the work than a “pad slap” would require, but the end result will be a professional service you can be proud to sign your name to. (You did read my column this month, right?) **TM**

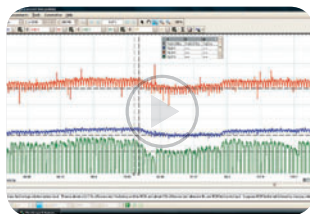


VIDEOS



Demystifying VW/Audi diagnostics

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Reprogramming: Come on in — the water is fine!

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