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SEPTEMBER 2015

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September 2015
Talk Shop Anytime
AUTOPRO WORKSHOP
Vol. 134, No. 9


# THE OTHER EUROPEANS

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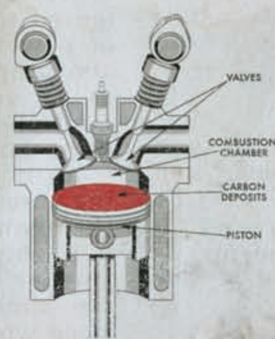


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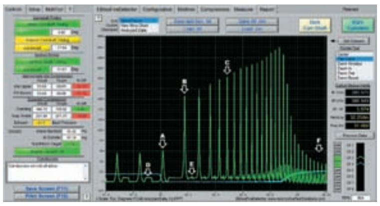
## COMMUNITY



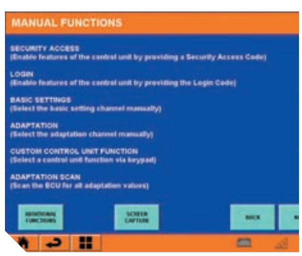
## TECHNOLOGY





## POWERTRAIN PRO





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# OPERATIONS

## MANAGEMENT

### SOCIAL MEDIA MARKETING

BY **BRIAN CANNING** | CONTRIBUTOR

**10** Put your marketing money where your social media mouth is. Step out from behind the counter and go to where your customers are: online.

## PROFIT MATTERS

### RECRUIT AND SUCCEED

BY **CHRIS "CHUBBY" FREDERICK** | CONTRIBUTOR

**14** Are you recruiting only after your technician terminates?

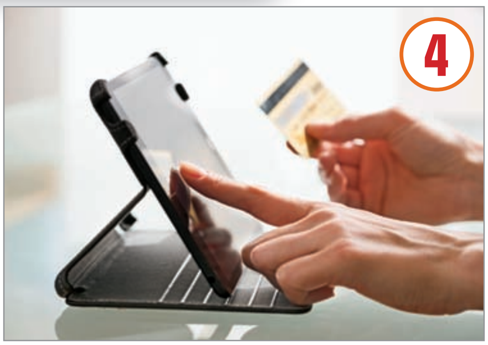
## FINANCIAL FIGURES

### ARE YOU READY FOR A COACH?

BY **BOB GREENWOOD** | CONTRIBUTOR

**18** Prepare to make the most important step for your business.

# TRENDING



### USE ONLINE PAYMENTS TO IMPROVE BUSINESS

BY **KATIE OCHIEANO** | CONTRIBUTING EDITOR

**4** Doing business and accepting online payments can help grow your customer base and sales.

### MOTOR AGE LAUNCHES SERVICE CONTRACT PLAN

**4** Extended service contract plan is available for independent shops to offer their customers.

### NEED FOR PENNSYLVANIA SAFETY INSPECTION PROGRAM

**4** A recent study stresses the need for a Pennsylvania safety inspection program.

### NTEA REPORT EXPLORES ADVANCED VEHICLE TECHNOLOGIES

**4** The report showcases directional trends on commercial vehicle efficiency, system electrification and idle reduction.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ONLINE COVERAGE

## THERE'S MORE ONLINE:

**NTEA REPORT EXPLORES ADVANCED VEHICLE TECHNOLOGIES**

The report showcases directional industry trends on commercial vehicle efficiency, system electrification and idle reduction.

*»» MOTORAGE.COM/NTEA*

**STUDY SHOWS NEED FOR PENNSYLVANIA SAFETY INSPECTION PROGRAM**

The annual vehicle safety inspection program helps to keep vehicles maintained and in safe driving condition.

*»» MOTORAGE.COM/PENNSAFETY*

**MOTOR AGE LAUNCHES A NO-RISK, TURNKEY SERVICE CONTRACT PLAN**

*Motor Age* has launched an exclusive extended service contract plan for independent automotive repair shops to offer their customers.

*»» MOTORAGE.COM/MAVPP*

**AUTO AFTERMARKET SWEET SPOT CONTINUES TO EVOLVE, EXPERIAN SAYS**

The sweet spot volume of vehicles has been declining over the last few years.

*»» MOTORAGE.COM/SWEETSPOT*

**BREMBO, AUTOMOBLOX LAUNCH PARTNERSHIP**

Nearly all 2016 Automoblox cars will be equipped with Brembo brakes, calipers and rotors.

*»» MOTORAGE.COM/BREMBOPARTNERS*

**REPAIR SIMULATIONS STRESS IMPORTANCE OF TRAINING**

The 2015 Bosch Xperience Mobile Tour is bringing virtual repair scenarios to shops.

*»» MOTORAGE.COM/BOSCHXPERIENCE*

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SHOP MANAGEMENT

# Use online payments to improve business

BY **KATIE OCHIEANO** | CONTRIBUTING EDITOR

The online payments space can be tricky to navigate, especially for auto shops dealing with the demands of daily business operations. Doing business and accepting online payments can help grow your customer base and sales, help your shop get paid for services, aid you in staying in touch with valued clients and ensure security for both your business and your customers. By understanding and leveraging online payments, shop owners can unlock the hidden potential in their auto businesses. Getting started can seem challenging at first, but by picking the online payments partner that's right for your business, you'll be in the right gear to get moving.

## Pick a one-stop shop

Credit card processing alone may not be enough to drive conversion of all of your potential customers, as some remain reluctant to directly give card info online. Offering several trustworthy payment options like digital wallets (those that don't require exchange of financial data), in addition to credit cards, helps you attract more customers and ultimately increase sales. Give customers a choice in how they pay, but with as much operational ease as possible.

[Use online payments] CONTINUES / PAGE 6

BREAKING NEWS

LIABILITY

# MANSLAUGHTER CHARGES FOR TECH AFTER LACKING INSPECTION

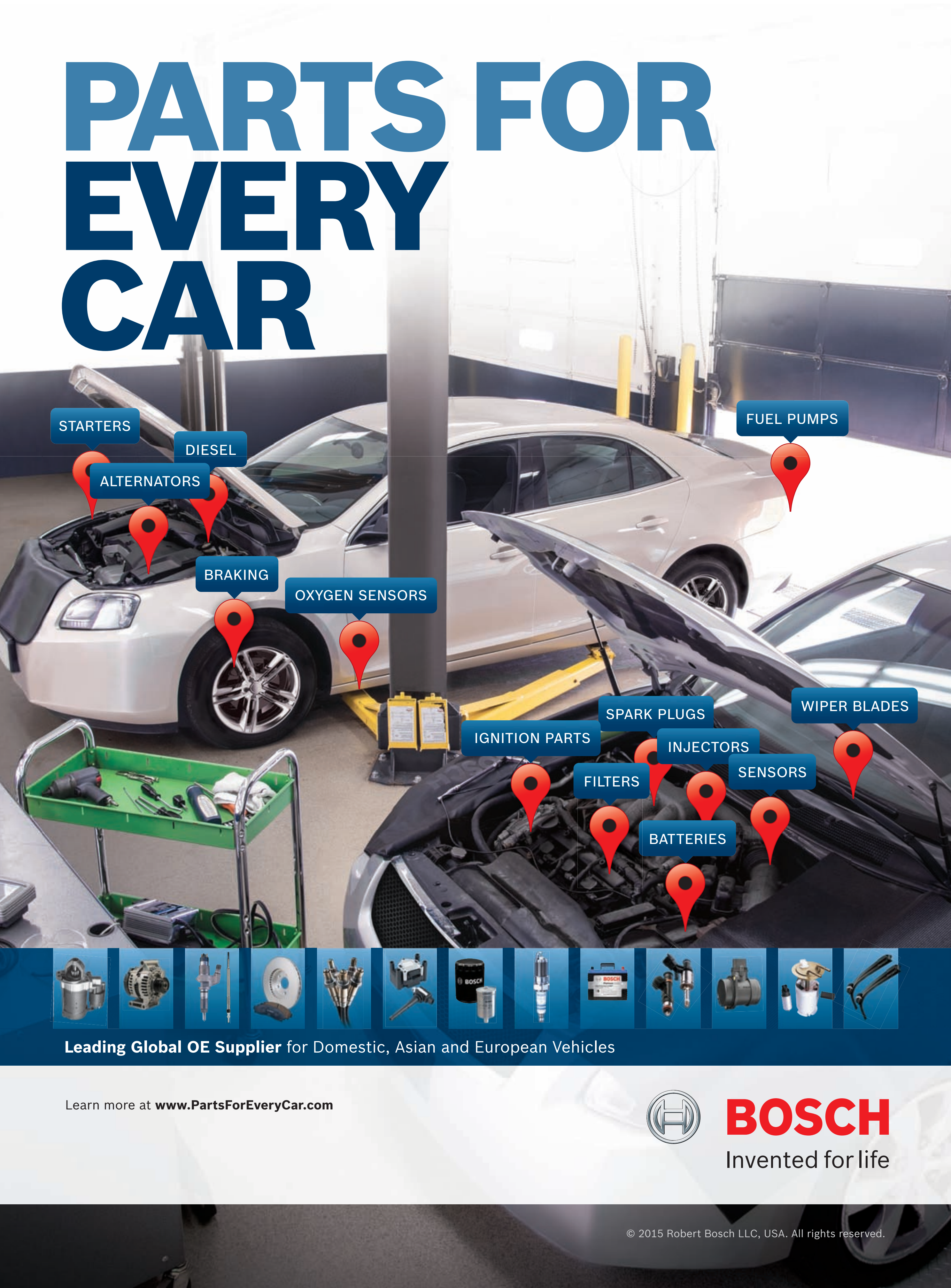
A Vermont technician was arrested on charges of manslaughter and reckless endangerment after his failure to properly inspect a vehicle contributed to a woman's death, according to a report by WPTZ NewsChannel 5.

Steven Jalbert of Barre, Vt., inspected a 1992 Chevrolet Corsica, owned by Donald and Elizabeth Ibey, in May 2014. Elizabeth, 83, died in a car crash two months later. A death, investigators say, could have been avoided.

Jalbert, one of 5,900 technicians in the state licensed by the Vermont Department of Motor Vehicles, failed to test the brakes, remove a wheel, put the vehicle on a lift or test it on the road,

[Charges] CONTINUES / PAGE 6

*Discussion is on-going in MotorAge.com forums*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**[Use online payments]**
CONTINUED FROM PAGE 4

### Get cash fast
In the early days of online payments, "holds" on proceeds from online sales were more common. Today, select payment processors are minimizing holds and reserves. Some even offer next-day settlement for smaller businesses. Be sure to understand your options for fast and complete settlement with any processor, and look for a payment processor that commits to delivering the quickest possible access to your money.

### Make it easy on yourself
Easy setup and ongoing, payments-specific customer support is key. Initiating payment processing can require technical knowledge. Tackling a heavy-lifting payments integration can be costly and take your focus away from driving sales and running your business. Find a payment processor that offers plug-and-play service with your existing business platform providers (e.g., e-commerce platforms or in-house/third-party development partners), with ongoing specialized payments support that will be valuable as you grow and make changes to your business.

### Protect your business and customers from fraud
Despite continuing improvements in anti-hacker technology, fraudsters can still beat the system with stolen financial information. Other customer fraud still exists, too. You may receive a payment, ship an item, and then get a complaint from the customer claiming that the package never arrived and requesting a refund (when, in fact, they did receive the package).

Customer data theft from retailers, such as credit card information and personal identity information, is big business for cybercriminals and other fraudsters. As you evaluate payment-processing vendors, look for those with proven reputations for security, including those that offer digital-wallet payment products that do not share customer financial information at the moment of transaction.

Continue reading at MotorAge.com/onlinepayments.



**[Charges]**
CONTINUED FROM PAGE 4

according to WPTZ. AJ's Sunoco in Barre, where Jalbert is employed, was using an out-of-date manual.

"When you go in and you pay the fees to have your vehicle inspected, you're depending on that inspection mechanic to take the time to go through and examine that vehicle and tell you, 'Yes, that vehicle is safe to drive,'" Glen Button, director of enforcement at the DMV told WPTZ.

It is vital that technicians follow the most current model for annual safety inspections, Button says. "It really is critical. They're examining the suspension of the vehicle, the steering mechanism of the vehicle. They're looking at the exhaust. Any of those systems, if there is a problem, it could really be tragic," he said.


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## ASE GUIDES QUESTION OF THE MONTH

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☑SURVEY: Technician A says that in-cylinder pressure testing can help identify a problem with cam timing and/or issues with variable valve timing systems. Technician B says that in-cylinder pressure testing can help a technician identify a problem in the fuel delivery to the tested cylinder. Who is correct?

A. Technician A
B. Technician B
C. Both A and B
D. Neither A nor B

Answer at motorage.com/sep15survey then register to win a free prize from our partner, Federated Auto Parts!

FROM THE BLOG SPHERE

# Social media strategies for small businesses

## Small businesses can manage social media, even when they lack time and budget

BY **DOUGLAS KARR** | MARKETING TECHNOLOGY BLOG

It's not as simple as people think. Sure, after a decade of working on it, I have one heck of a nice following on social media. But small businesses typically don't have ten years to ramp up and create momentum on their strategy. Even in my small business, my ability to execute a highly strategic social media marketing initiative is a challenge. I know I need to continue growing my reach and authority, but I can't do it at the cost of my business.

"For small businesses, a lack of resources often stands in the way of achieving social media success. Fortunately, there is a way for small businesses to manage social, even when they lack time, personnel, and budget. In this post, we look at strategies to create an effective social media strategy with minimal resources," says Kristi Hines from Salesforce Canada Blog.

Salesforce has broken down a social media strategy for small business to 5 basic stages:

1. Set realistic goals
2. Choose the right networks to achieve your goals
3. Focus on the activity that will help you achieve your goals

MotorAge.com BEST OF THE BLOGS

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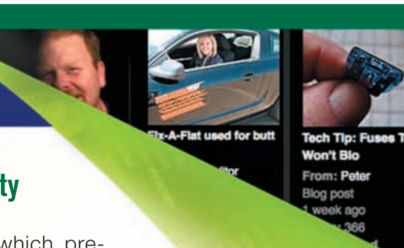



## BEST OF THE BLOGS are articles written by bloggers in the service repair community

### Real Fix: Less is more

The manifold absolute pressure sensor measures the intake manifold pressure. As pressure decreases, (vacuum increases), manifold absolute pressure sensor signal voltage decreases. The damaged grommet in this situation caused the low signal voltage and was responsible for the fault code. Save yourself some time and your customer some money by reading this Real Fix from Mitchell 1's SureTrack and replacing the manifold absolute pressure sensor grommet instead of the whole sensor.

**Vehicle:** 2002 Cadillac Escalade, 6.0L

**Title:** P0106, Replaced Manifold Absolute Pressure Sensor Grommet

**Complaint:** The customer states the check engine light is on.

**Cause:** Connected a scan tool and found code P0106 – Manifold Absolute Pressure/Barometric Pressure Circuit Range/Performance. Used the scan tool to record stored freeze frame data and clear the code. Performed a road test under the same conditions as the freeze frame data, used the scan tool to monitor code status and found the code P0106 set. At idle, used the scan tool to monitor live data and found the manifold absolute pressure (MAP) sensor parameter read 0.3 volts, which was below the specification of 0.5 volts. Snapped the throttle, monitored live data on the scan tool and found the MAP sensor parameter only reached 1.2 volts, when it should have read 4.5 volts at wide open throttle. Performed an inspection of the MAP sensor circuits and found no faults in the wiring or connectors. Upon further inspection, found the MAP sensor grommet was split, which prevented the sensor from correctly reading the engine intake manifold vacuum.

**Correction:** Replaced the manifold absolute pressure sensor grommet, cleared codes, performed a road test and verified the vehicle operated properly. The check engine light did not illuminate and no fault codes returned.

*Real Fixes from Mitchell 1's new SureTrack® expert information resource are documented issues from actual shop repair orders and community discussions. Read on to see how SureTrack can help you correct issues that are not easily diagnosed using OEM information alone. SureTrack is currently available free in our ProDemand product.*

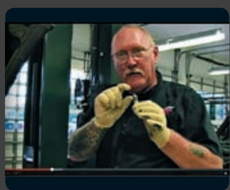
4. Spend advertising budgets on targeted advertising
5. Measure your results

I will add that this is not a complete path — it is a circle. After you measure your results, you must return to No. 1 again and reset your goals and work through the process, refining and optimizing your strategy along the way.

Continue reading at Motorage.com/socialmediastrategy. *MA*

## *Motor Age* TOP VIDEOS

MOST WATCHED VIDEO



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### Driveway diagnostics

*Motor Age*'s own Pete Meier works on his Ford Ranger pickup and shares what professional technicians really do when their personal vehicle breaks. Is it different from how they handle customer vehicles in the shop? Find out.

**MotorAge.com/driveway**

### The reasons for considering a coach

*Motor Age* contributor Brian Canning shares reasons for why shop owners should consider hiring a coach to boost business.

**MotorAge.com/considercoach**

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## Noteworthy

comments from *Motor Age*'s Facebook page

In response to the article, "Manslaughter charges for tech after lacking inspection" (see page 4), Motor Age Magazine wrote:
As professionals, we have a moral and ethical obligation to advise our customers of any unsafe condition we find and perform, at the very least, a quick visual inspection on every car we touch. This tech was responsible for performing a state vehicle inspection on this car, so he had additional obligations to meet. Who is responsible for paying a judgement if a civil case is filed and won? Is there liability insurance out there for us?

Kim Brant:
Printed disclaimers detailing the issues and stating customer declined repair on the work orders/receipts signed by the customer act as our insurance!

Dale Weber:
Both the technician and the business should have noticed faulty brakes as soon as they drove the car.

Kim Brant:
We as technicians are liable for everything we touch on a vehicle, most especially safety-related systems!

Joe Eckenrod:
I don't think we can be held responsible for every car that comes in. If a customer comes into my shop and wants new tires, I comply. If I notice something, I will inform them, but I don't do a thorough inspection of the whole vehicle while it's in the shop. I live in Pennsylvania and we have a pretty thorough inspection process, but even with that I can't guarantee any vehicle will leave my shop and not have problems within the next year. I can only go by the guidelines set forth by the state. And even then there is room for failure.

join the community—join the discussion **MotorAge.com/Community**

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## ABRN.COM

### Measuring for success
Without using KPIs, how do you know if you've improved or gotten worse? KPIs help our industry from a broader perspective.
*ABRN.com/measurekpis*

### BASF predicts car colors for 2019 and beyond
BASF's 2015/2016 Color Collection features 65 global automotive paint colors.
*ABRN.com/basfcolors*

### Developing and maintaining SOPs: part one
Ease your daily business stress by clearly identifying each step, process and requirement.
*ABRN.com/sopspartone*

## AFTERMARKETBUSINESS.COM

### Dayco adds interactive routing guides to online catalog
This latest online feature gives end-users a more efficient way to find replacement parts.
*AftermarketBusiness.com/daycorouting*

### DENSO partners with Dinex to launch after-treatment product line
DENSO introduces a new line of emissions control products for heavy-duty trucks in the Americas.
*AftermarketBusiness.com/densopartners*

### CRP Industries acquires Atlantic Automotive Enterprises
AAE will function as a wholly owned subsidary of CRP Industries Inc.
*AftermarketBusiness.com/crpacquisition*

## 2015 INDUSTRY CALENDAR

**November 2-4**
AVI Conference
Las Vegas, Nev.

**November 2-5**
AAPEX 2015
Las Vegas, Nev.

**November 3-6**
SEMA 2015
Las Vegas, Nev.

**November 4**
NASTF General meeting
Las Vegas, Nev.

**February 11-13, 2016**
MACS 2016 Training Event and Trade Show
Orlando, Fla.

read it on MotorAge.com

**NEW CONTITECH SITE IS INFO SOURCE FOR TECHS**
New website features tips for troubleshooting
*/newsite*

**KATHLEEN SCHMATZ ON INDUSTRY PODCAST**
Auto Care CEO discusses industry
*/schmatz*

**ASA EMPHASIZES VEHICLE SAFETY INSPECTION**
Service Repair Leadership Forum examines topic
*/asasafety*

MANAGEMENT


# PUT YOUR MARKETING MONEY WHERE YOUR SOCIAL MEDIA MOUTH IS

BY **BRIAN CANNING** | CONTRIBUTING EDITOR

**GETTING** customers to come into your shop is one of the most difficult and expensive things you will ever have to do as a shop owner. Typically you will spend four cents out of every revenue (sales) dollar on marketing, as well as hours upon hours in creating campaigns, doing follow up, managing and measuring the results. And at the end of it all you are very likely to tell me you need more cars. Though many of us still hold on to an earlier time of direct interaction with our customers, and marketing that was straightforward and honest (and mostly ended up in the trash), the ways that we engage our customers in today's service world demand that we step out from behind our counter and try new ways of attracting and retaining customers. Not for the sake of new, but for the much more practical reason that this is where our customers are. It is where we have to go to find new customers and retain those we already have. Welcome to the world of social media marketing.

People are not opening that big yellow book when they need tires or their car serviced; the internet, mobile technology and social media have changed all of that. You need to hop on that bus and ride that change to the new and exciting places it will take you. The links below will set you on the shore of the vast ocean that social media represents. All you need to do is steel yourself for the journey ahead, and jump on in. A world of new and different customer interactions is waiting.

Here are some important names that could assist you in launching your social media marketing efforts and your broader automotive vision for the future:

Getting started with **Facebook**: https://www.facebook.com/business/

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A 013 154 8102 83

Getting started with **Twitter**: https://biz.twitter.com/en-gb/marketing-twitter

Getting started with **Instagram**: https://business.instagram.com/gettingstarted/

Getting Started with **Pinterest**: https://business.pinterest.com/en

Getting started with **Google** and **Google+**: http://www.google.com/+/brands/index.html

Getting started with **LinkedIn**: https://smallbusiness.linkedin.com/small-business-marketing

Another far-reaching impact of mobile technology is search engine optimization, or SEO. Many of us are only just now getting used to the idea and theory of SEO and its driving viability on the search engines consumers often use in locating service providers. With Siri, Cortana (Windows), and Google Now (Android), we have to look at restructuring our SEO efforts to include the impact of mobile technology on our local search engine optimization.

A.J. Kumar of Entrepreneur magazine says, "Siri can call you a cab after a night on the town by automatically processing information about local cab companies in response to the query, 'Call me a cab.' Automating the search process means you never look up 'cab companies in your area' in the search engines, avoiding the traditional search engine results pages and pay-per-click advertisements entirely, therefore limiting their importance and influence." In other words, the website you have worked so hard to set up could be invisible to mobile applications, which is huge. The very strong trend is toward people (your customers and potential customers) signing on to the internet through a mobile device. If you are not being seen, it is difficult to attract new customers and just as difficult to retain the ones you currently have.

The rules of marketing are in the midst of huge change. Our visibility on the internet and on our smartphones seems the only viable path to automotive salvation. Marketing remains critical and as difficult a decision as it has always been. The technology that goes into running a successful shop today changes nearly as fast and with the same regularity as the technology you see in the cars we are working on. Just like with those cars, the job demands that you update those tools every once in a while. Technology lights the way; we need to embrace it and invest in it, both with resources (money) and with our time.

A great and affordable (free!) starting place for your digital journey would be a partnership between Google and the Small Business Administration (The federal General Services Administration), where they "have partnered to educate local businesses about how to succeed online. Each video describes how a small business owner successfully uses the internet to grow his or her business. It's important to be where your customers are...online!"

Social Media Marketing, by its very nature, is living, breathing and hopefully finds a way to be engaging. Considering how our customers and would-be customers search for goods and services, our very worst action in this environment is to do nothing and be invisible to those looking for the services we provide. We have to be where our customers are and seen as a provider of the services they need. Even being a bit off center and seen in a negative light (bad review) is better than being invisible. If nobody sees you, you have no chance to grow, you have no chance to prosper, and you have no chance of attracting new customers. If you are not attracting new customers, you have no chance of survival.

What does a shop owner have to do to get started with social media marketing? What does a shop owner have to do to make him or herself more visible? The answer to these questions is both easy and very complex. The easy part is deciding that you want to be part of the conversation and fundamentally change the way you communicate, engage, acquire and retain customers.

As with any marketing, it is best to start with a plan that has a framework, a budget, and clearly defined goals. Since social media marketing will only represent a portion of your total marketing effort, your plan needs to seamlessly integrate with your broad marketing plan and even complement those efforts.

Here are 8 considerations to get you started.

1. **Set reasonable goals and meet them** – ROI, timelines, and areas of improvement
2. **Create a budget and live by it** — Marketing (all forms) should be 4 percent of total sales
3. **Integrate social media marketing efforts with your existing marketing plan**
4. **Measure it so you can manage it** — Know where you are and where you want to go
5. **Know who you are trying to reach and where to reach them** — Demographics
6. **Be part of the conversation on social media and let it go wherever it goes**
7. **Focus on quality content versus quantity** — That saying about first impressions…
8. **Be willing to learn and be willing to try something new** – Make some mistakes!

Because most shop owners are very busy and because social media marketing requires time, attention to detail and follow up, I strongly recommend hiring a professional to develop, implement and oversee a plan unique to your operation. That doesn't let you off the hook. Somebody needs to communicate the vision and values your shop represents (honesty, quality, price, convenience, etc.), and somebody needs to set the expectations and budget and somebody needs to oversee performance. That somebody is you!

It's 8:00 o'clock. Do you know where your customers are? MA

**BRIAN CANNING**
CONTRIBUTOR

Brian Canning is 30-year veteran of the automotive repair industry. He has been a leadership coach, Goodyear service manager, retail sales manager for a distributor, run a large fleet operation and headed a large multi-state sales territory for an independent manufacturer of automotive parts.

Email Brian at brimarc@hotmail.com

# RECRUIT & SUCCEED

## ARE YOU RECRUITING AFTER YOUR TECHNICIAN TERMINATES?

BY **CHRIS "CHUBBY" FREDERICK** | CONTRIBUTOR

THINK about it: being without a key player in your business is just painful for you, the other employees, and most of all, for the customers. But rarely when I talk to shop owners do I hear them say, "An employee gave me notice, so I have set up four quality interviews for next week." Typically I hear, "An employee gave me his two week notice. Can you help me write a great ad, and where is the best place to post it?"

Let's face it — we never want to receive notice from an employee, but we all know it happens. So why are we always surprised and unprepared for an event that will never stop occurring, like taxes and death? This month our coach, Mike Haley, is going to give you a little secret that will always prepare you for the worst situation we all face.

Obviously we never want to lose a great employee, and as I write this article I have already started thinking about my next article — how to keep your employees. There are two types of turnovers: good and bad. The good turnover would be an underperforming employee who is receiving performance counseling and not responding as we would like, and the employee is not a fit for our team and culture. The bad turnover would be an employee we value, who is an asset to our company but is leaving for reasons that (we hope) are out of our control. Maybe their spouse received a promotion that is relocating them out of the area.

Owners often tell me employees are forced to leave a job to care for elderly or failing parents who do not live in the area. Whatever the reason, when it is bad turnover we are not anticipating, we are typically not prepared or able to fill the position in a timely manner.


### Recruit like college sports coaches

Look to sports coaches, specifically college-level coaches, as examples for our approach to recruiting and succession planning. Think about what the college coaches are doing every year. They canvass the nation's high schools and sports tournaments to find the best of the best, or the best fit for what their needs are. Some even travel globally to find untapped talent. Think about it when you watch your favorite sport. Mine happens to be football. When the quarterback gets hurt, the coach doesn't tell the tailback he is now the quarterback and to go out there and throw for 300 yards with no interceptions. They have a backup quarterback who is practicing with the team and knows the plays just as well as the starters. If the starting quarterback has a long-term injury, the general manager is on the phone as soon as he receives the news and is calling a short list of quarterbacks he knows and probably has had conversations with in the last year about "what if?"

In class, I use the example of my son's college lacrosse team. He played Division 1 lacrosse for Mount St. Mary's University in Maryland. Every year

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## "HOW CAN I BE MORE PREPARED FOR EMPLOYEE TERMINATION? KEEP THE SUCCESSION CHART UP TO DATE AT THE END OF THIS ARTICLE AND YOUR LIFE WILL BE MUCH LESS STRESSFUL."

CHRIS "CHUBBY" FREDERICK [ATI CEO]

they have the same goal: win their conference and make it to the NCAA tournament. It's a spring sport, but let's be real — it's a year-round commitment. In his sophomore year, they felt they had a real chance of winning the conference and going deep into the tournament. They already had a proven all-conference goalie, and the coach had a great recruiting year and signed three other goalies.

Everyone returns or starts school at the end of August. Within the first month, one of the freshmen was able to get in enough trouble with campus police and the administration that he was asked to leave. The second goalie, a sophomore, tore his ACL in a scrimmage. The senior and all-conference goalie was in his room playing Xbox, sitting on the floor with his legs crossed, and when he stood up he tore his MCL. So the team started in August with four goalies and started the season with only one, who was a freshman. If something happened to him, the coach was going to ask if anyone on the team ever played goalie in rec league or at least knew how to put on the equipment.

> **"The goal is to have the best players in position and to have not one, but two moves to fill the position if it becomes available."** – Chris "Chubby" Frederick

How many of you are playing with one goalie? And not if — but when — he or she goes down, do you have a backup?

I have been in that situation and even worse. I once was running a 12-bay shop and lost three technicians in a matter of weeks. Being unprepared, I was forced to take up the slack, working 14-hour days six days a week. Then of course, being desperate, I panicked and made bad hires. It would take up to 90 days to work them out and start the search over again. It took me months to recover from not being prepared. I still blame that one event for my gray hair and waistline. Afterwards, I promised myself I would never go through that pain again. That's when I created the succession chart I want to share with you today.



### Use a succession chart

What this chart will do is help you evaluate your current staff and identify areas of weakness. The goal is to have the best players in position and to have not one, but two moves to fill the position if it becomes available. Currently I would say that without this succession chart, most owners have an idea or plan for one vacancy in their business. But after that one move, they are out of moves and need to start the recruiting process to prepare for the next move. The problem with that is it's too late. This succession chart will help you prepare for all the positions in your business, so you have not one but two moves per position. This is why we always are recruiting and preparing for the next two moves.

I get a lot of owners who ask me in class how I interview a person when I don't have a position to offer them that day. It's simple — being wanted is a basic human emotion. Everyone needs to feel wanted. If you explain to the candidate you are interviewing for the purpose of future needs and possible expansion, you are being up front and sincere, which they will respect. In all the years I have conducted interviews, I never had a candidate say, "If you're not prepared to hire me immediately, I'm not willing to sit down with you." You are creating a depth chart for each position in your business.

The succession chart also recognizes employees already in your business who have potential to fill another position at a future date. The chart will help you create training programs to cross train employees so they are better prepared for the next move, rather than what we do today, which is typically "Congratulations, your new title is (fill in blank) and it starts Monday. Good luck."

I have to admit filling in this chart completely will take hard work and dedication. As Martin DeBey from DeBey's Service in Greeley, Colo., says, "It doesn't happen overnight, but [when] you have it completely filled out, you get a real sense of accomplishment and know you are prepared."

I promise if you pull the chart out every month and work the plan, you will have the best players in position and have up to two moves for every position in your business, which is a great situation to be in when the industry is short so many qualified candidates. Once you've completely filled out your succession chart, drop me a note.

If you would like your own copy of our ATI Succession Chart, simply go to www.ationlinetraining.com/2015-09 and, for a limited time, you can download a copy.

Good luck and happy recruiting! MA

**CHRIS "CHUBBY" FREDERICK**
CONTRIBUTOR

Chris "Chubby" Frederick is the CEO and founder of the Automotive Training Institute. ATI's 108 associates train and coach more than 1,250 shop owners every week across North America to drive profits and dreams home to their families. Our associates love helping shop owners who are having the same struggle as many of them have had, and who are looking for the same answers – and in some cases looking for a lifeline. This month's article was written with the help of ATI Coach Brian Hunnicut.

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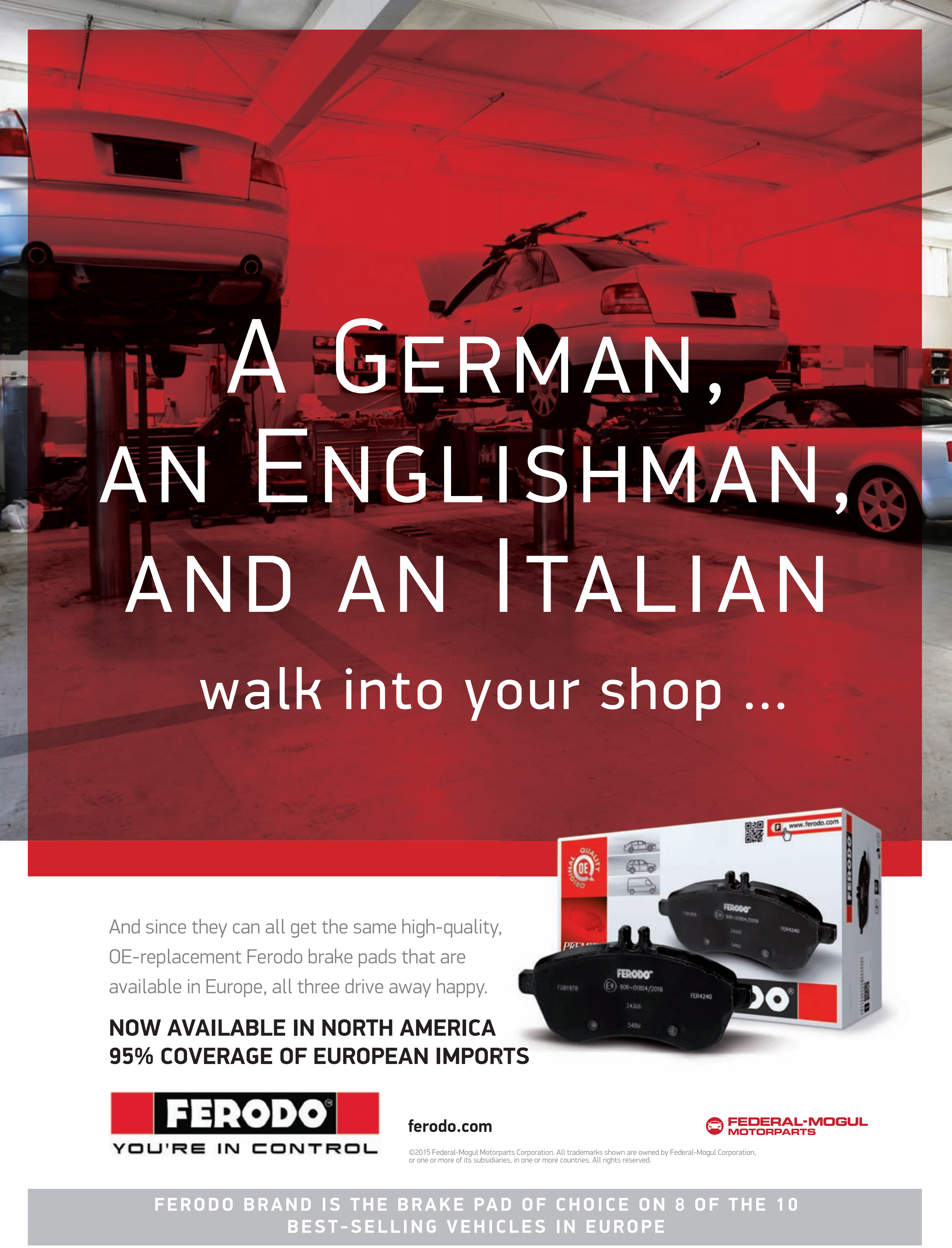
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# ARE YOU READY FOR A COACH?

## PREPARE TO MAKE THE MOST IMPORTANT STEP IN YOUR BUSINESS

BY **BOB GREENWOOD** | CONTRIBUTING EDITOR

THERE are shop owners across the country who have worked diligently ON their business for years compared to IN their business where so many owners have found themselves trapped.

These ON-your-business silent minority owners understand the difference between cost and investment into the business. "Net income" is a concept they embrace; they insist the business provides a professional income for their own family and their staff, and they build a great loyal clientele and customer base. One other important point is that they develop a proven historical record to show that the business has a "progressive system" in place to sustain profitability and grow the business through ongoing evaluation procedures so it can be sold properly down the road.

Everything appears to be on track for those progressive shops. But how can an average shop reach that level when the path for the next five years is far from crystal clear?

Perhaps you are one of those shop owners who is now ready for the next step in your business.

The next step, which today many progressive shops don't talk too much about, is the understanding of having a personal business coach and mentor working behind the scenes with them on their business.

This is a very humbling step and process to go through. It is very private and confidential. It is personal and focused, and it makes people throughout the shop accountable. Everything is measured monthly in the business, and most importantly, if you truly are an entrepreneur capable of taking direction, it brings incredible results.

A professional coaching and mentoring service is not something you sign up for; it is a service that you must apply and qualify for.

The best quality and proven coaching and mentoring services specialize in the automotive service shop business. That is all they do. They evaluate the business and industry continuously, viewing everything from the outside at that 10,000-foot level that is required today to see how the business and aftermarket is evolving and what issues will affect their clientele. The business coach supports the owner completely through being very accessible. They also provide the necessary management and staff business training to move things forward.

The coaching/mentoring service has a procedure and process for their new potential clients to take before they are even accepted as a client because this will be a three- to five-year contractual relationship. In all cases there will be a minimum prerequisite of having attended certain business courses within the past year and a half to ensure the owner has a thorough understanding of today's business realities. It will always involve a complete in-depth analysis of the business's financial statements for the past two to four years. The reason for this is because the service company wants to know if a minimum of an additional $75,000 to $100,000 in gross profit per year is buried in the current business which, when pulled out, provides an excellent return for the business for the fees being paid for the service. Also, interviews with the owner are completed to ensure the owner is committed to the business changes that the coach knows will be required and most importantly, the coach/mentor and owner's personalities can work together.

Too many shop owners think a coaching service will "do it for me," which means "they don't get it," as compared to the understanding of what the owner is really looking for today which is, "what should I do,

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where do I direct my time and efforts, and how do I do it to get the results?"

The service is very in-depth, but when you think about it, the coaching/mentoring service must be in-depth, as running a professional automotive service shop is the most complex retail business in the marketplace today. Most shops would automatically say, "I can't afford such a service," but that means the owner is not thinking like an entrepreneur and has closed the door before the owner even looks into the next room. When the coaching service is a quality service, their fees turn out to be equivalent to an inexpensive part-time employee that provides a solid return.

The coach/mentor is not going to take the shop on as a client if the service does not provide a proper financial return. No reputable business coach will accept a client that is set up for failure, and that is why they are specific as to their processes of evaluating potential clients. An entrepreneurial-thinking shop owner understands that and will be looking for the return for the investment to be made before the service is going to be accepted. The business coach is looking at the owner's capability and attitude of being able to do what he/she said he/she would do as well as the true desire to grow his/her business. You can have all the systems, procedures and quality advice available, but if the owner can't follow through with his/her responsibility and do what he/she said he/she would do to ongoing self-discipline issues, the coach will not allow that owner onto his team.

Once the business coach has at least six and a maximum of eight clients in a region, he will organize a confidential focus group. Then like-minded owners can get together, with the coach as the facilitator, to share valuable marketplace experiences and information, evaluate each other's businesses using the same measurement criteria (comparing apples with apples), and analyze required internal business processes. This provides more accountability for each member to ensure that things are on track to getting done. Talk is cheap; it is the results that are important.

The aftermarket must move into the 21st Century and start embracing modern techniques and new services that move business forward. The shop owner can no longer do it alone. They cannot think they know it all and are aware of all the changes coming down the road that will affect their business. This is an in-depth profession today, and the business capabilities must be put in place to ensure success.

So I ask again, "Are you ready for the next most important step in your business to ensure its survival and prosperity?"

Investigating this topic may be the best exercise with your time that you ever do for yourself and your busines. MA


**BOB GREENWOOD**
CONTRIBUTOR

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.

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# FOCUS ON ACTIVITY, NOT RESULTS

## RESULTS ARE NOT ABOUT QUANTITY, BUT ABOUT ATTRACTING THE RIGHT CUSTOMER

BY **DAVID ROGERS** | CONTRIBUTING EDITOR

EARLY in my career, I went to a marketing meet up hosted by a "guru" in the industry. He had asked each of us to bring in two examples of our best advertising pieces to share with the group. So I searched through the piles and records until I found a couple that I wanted to share.

At the end of the event the host collected the samples we each brought, scanned them, bound them and offered to sell our own advertisements back to us at $300 a pop. No analysis, no advice. Just the opportunity to buy ads we'd already spent the time and money to create!

Now I may have been young, but I wasn't naïve. I wasn't about to go spend my hard-earned dollars for that book, but not for the reason you might think.

This guy just didn't get it. The point of advertising and marketing is to set yourself apart from competitors, not to copy them. You wouldn't end up with better messages using that book, you'd end up with a Frankenstein's monster that managed to look and sound like every other repair shop ad that your customers already receive.

In a nutshell, that's the difference between what the average ad vendor wants and what you want. They want to sell marketing, and it almost never matters whether you look the same or different from your competition. They want to drive as many customers into your shop as possible and as quickly as possible, regardless of quality. In a word, they want activity.

You, on the other hand, want results.

### Focusing on activity

Ad vendors have their own goals to balance with yours, but the goals don't always line up. They want to prove that what they're selling works, so they share the numbers that tell the story they want. But most vendors are focused on the wrong things.

Let's look at response rate, for example. An ad vendor might say your mailer worked great because it had so many people using the coupon on it. But that's not the full story.

Think about your costs and return on investment — how much did you really spend on the ad to print it and send it? How much did each new customer really spend after all discounts are applied, and how much did it cost you to perform the service? But even

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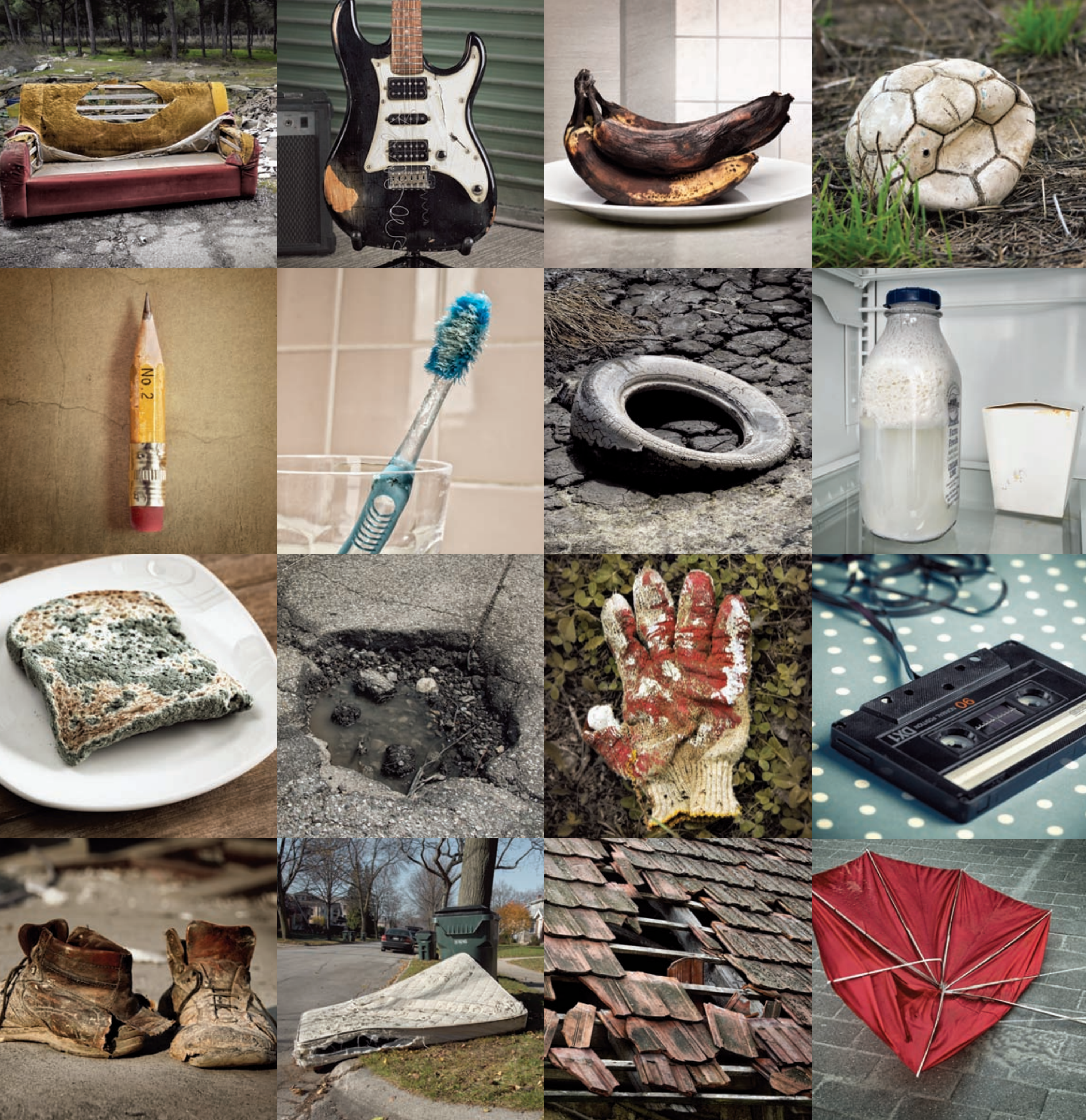


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Take it a step further – think about the type of customer that brought in that coupon. Did they listen to the other advice you offered or did they brush it off and just take the discount? Did they whine and complain and argue to save an extra penny? How much stress did they cause your employees? What are the chances that they'll come back to you the next time they need car repairs instead of hunting around for the best deals and cheapest coupons?

These are just some of the costs that run a lot deeper than your bank account.

Really understanding the effectiveness of your marketing isn't a one-time measurement. Truly valuable marketing produces results that last months, even years beyond the initial drop. So how can one number or a single report give you the whole picture?

Some ad vendors will claim that they are doing their job – they are getting customers through your door, and if they aren't converting to high quality, valuable customers then it's your fault.

Of course, the fate of your shop isn't entirely in the hands of good advertising. Marketing includes superior customer service, quality repairs, friendly advisors, etc. All of these are necessary for success in your shop. But even if you've perfected your in-house service, sending the wrong message can do more harm than good.

## Focusing on results

A well-crafted marketing message resonates with the right customers. It shows that you understand their needs. It sets you apart. It is memorable, sincere, and effective. It lays the foundation for a solid relationship for years to come. It is focused on results.

My business partner, Terry Keller, owner of Keller Bros Auto Repair and co-founder of Auto Profit Masters, said it best: "Our goal in marketing should be to attract people who trust our recommendations, who want a relationship, and who refer friends and family. That's thinking in terms of results instead of just activity."

Results aren't about immediate action, fast-switch response, or getting just any customer through the door. Results are about long-term goals, developing relationships, and attracting the RIGHT customers.

Activity is easier to tally, but you can measure real results too – look at the quality and value of your customer base. What is your customer retention rate telling you? The ROI for real results is more than the first transaction.

> **"The hardest part about shifting from an activity-focused marketing plan to a results-driven marketing plan is a virtue: patience."**
> – David Rogers

Let's look at customer loyalty, for example. If your marketing is sending the wrong message, you could be losing the trust of your customer base. They'll start dropping off slowly, coming into your shop less often. Take the real shop below, whose customer visits per year dropped just a fraction, from 1.76 to 1.58 – yet that 0.18 drop in customer visits means they lost 220 cars and $81,620 in sales in that year.

Coupon redemptions might have been high, but is it worth losing over $80,000 in sales? Are you seeing the whole picture?

The full value of results-based marketing does include the profitability of the first transaction, but also loyalty and long-term value to the shop, how many referrals they send, and the value they add to your business. It's about attracting the RIGHT customer, repeat customers, and referring customers – valuable customers.

That's when you'll start to see true results.

## Driving REAL results

The hardest part about shifting from an activity-focused marketing plan to a results-driven marketing plan is a virtue: patience.

Results don't just happen. In our shop, it took tens of thousands of tries to perfect the message, finding the best things to say and the best ways to say them. But we did.

And every day, I'm grateful that we held onto that patience – that we stuck it out, that we didn't fall for advertising tricks and schemes to bump up car count for one week, only to irreparably destroy the trust of our customer base for months to follow.

Relationships are the heart of results-based marketing. And just like your personal relationships with your spouse, parents, siblings, or friends, relationships with your customers take work.

Trust can't be bought – it must be earned. When new customers bring their vehicle into your shop for the first time, they are trusting you and your team to take care of it. Everything you do must earn and sustain that trust. From the things that you say to the work that you do, every interaction with your customers is an opportunity to build the relationship or break their trust.

Relationships don't happen overnight. But with the right marketing message, you can lay the foundation for a long-term relationship before a new customer ever walks through the doors of your shop.

Before you send your next marketing piece, think about the goals you have in your shop. Do you need cars fast in order to drive activity up in the shop now? Does your message work to build long-term relationships or is it slowly burning the trust of your customer base?

You can't know unless you turn to the numbers. Don't just consider coupon redemptions or ROI. Look at retention, customer loyalty, and the health of your customer base. Don't fall for flashy, short-term activity. Plan your marketing to build the trust, value, and quality of your customer base.

That's how you get results. MA

**DAVID ROGERS**
CONTRIBUTOR

David Rogers is chief operating officer of Keller Bros. Inc., president of Auto Profit Masters, and creator of the RPM ToolKit™, which integrates with shop POS software to help owners identify problems in their shop and get one-click training solutions.

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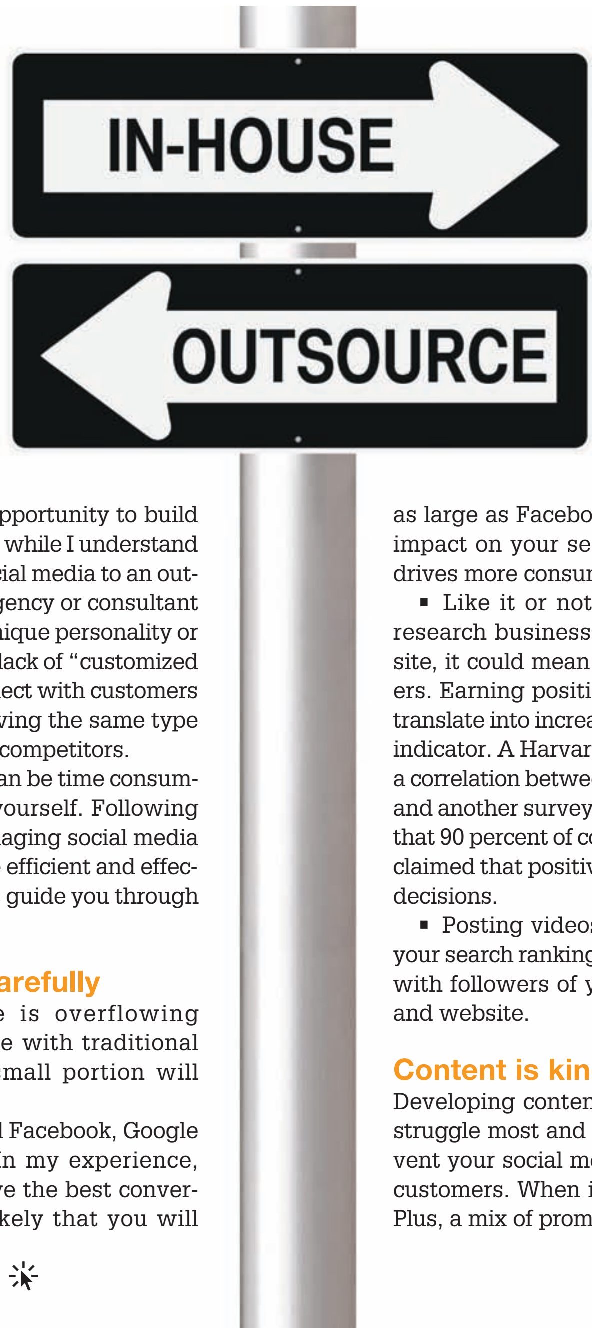
# KEEPING SOCIAL MEDIA IN HOUSE

## OUTSOURCING EFFORTS MAY CREATE A DISCONNECT WITH CUSTOMERS

BY **KILEY FASANO** | CONTRIBUTING EDITOR




TRYING to navigate the ever-expanding world of social media can be a confusing task, especially for shop owners who are often more focused on replacing fuel pumps than posting new photos on Facebook. As a result, many shop owners either turn to a social media agency to manage their social media efforts or forgo social media altogether.

Neither option is ideal, but opting out of social media altogether is worse, since it can potentially cost a shop the opportunity to build relationships and drive sales. And while I understand the convenience of delegating social media to an outside vendor, it's rare to find an agency or consultant who can accurately convey the unique personality or characteristics of your shop. That lack of "customized content" makes it difficult to connect with customers and can actually result in you having the same type of generic posts as many of your competitors.

So, while I know social media can be time consuming, I believe it is worth doing yourself. Following some simple rules can make managing social media not only less frustrating, but more efficient and effective. Here are some basics to help guide you through the social media maze.

### Choose your channels carefully

The social media landscape is overflowing with options, but as is the case with traditional advertising vehicles, only a small portion will benefit your business.

For shop owners, I recommend Facebook, Google Plus, Yelp and and YouTube. In my experience, these four channels seem to have the best conversion rates and make it more likely that you will reach your target audience.

- Facebook is the world's largest social network, and it's becoming the place consumers are increasingly turning to when searching for goods and services. Nearly 1 in 3 Facebook users has purchased a product or service after sharing, liking or commenting on it on the social media platform, making it the channel most likely to drive purchases, according to the software and marketing research firm Vision Critical.
- Google Plus may not be as large as Facebook, but it can have a tremendous impact on your search rankings and anything that drives more consumers to your site is worthwhile.
- Like it or not, millions of people use Yelp to research businesses, so if you're not active on the site, it could mean missing out on potential customers. Earning positive reviews on the site could also translate into increased sales if research serves as any indicator. A Harvard Business School study identified a correlation between high Yelp rankings and revenue and another survey from Dimensional Research found that 90 percent of consumers who read online reviews claimed that positive reviews influenced their buying decisions.
- Posting videos on YouTube can not only boost your search rankings but also drive more engagement with followers of your Facebook, Google Plus page and website.

### Content is king

Developing content is where shop owners seem to struggle most and where falling short can often prevent your social media efforts from connecting with customers. When it comes to Facebook and Google Plus, a mix of promotions, advice and unique content

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seems to work best. The unique content can be anything from reviews to photos of staff and customers to comments on current events to information about a shop's community contributions. For examples check out Houston-based Kacal's Auto Repair's Facebook page, (www.facebook.com/kacalsautoandtruckservice) where the shop's posts include asking followers about the longest they've owned their cars and which Top Gear host they like best.

For Yelp, engagement is key. Thank customers for positive reviews and let them know you value their business. Apologize to customers who post bad reviews and offer solutions to resolve whatever issue was raised. Replying consistently can help you build your brand and protect your online reputation.

YouTube is the channel that seems to intimidate shop owners most. Many think they have to hire an expensive videographer or spend months learning how to shoot and edit video on their own. But shooting something simple with your iPhone about why people should frequent your shop can work just as well.

## Cultivate a following

There's no point putting time into these platforms if you don't have an audience to conduct a dialog with. Encourage your customers to follow you on the social channels where you have a presence every time you interact with them. Make sure there are links to your various social media pages on your website and on everything you distribute – from your mailers to your newsletters and even at the bottom of your email signatures. Posting interesting content frequently is also a good way to attract fans. For Facebook and Google Plus, that means posting at least three times a week. If you run a promotion, make sure you place a specific time limit on the special to create a sense of urgency.

Gathering reviews from Yelp can be trickier. Some shop owners have an iPad at their front desk and ask customers to write reviews during the check out process. Another option is to send an email to customers as soon as the repair order is closed, encouraging them to post a review with links to your Yelp site.

Remember to also use your website to direct traffic back to your social media channels. Posting reviews or videos can help tremendously with your audience-building efforts.

There's no denying that social media does take time and energy, but if you target the right channels, create personalized content, and stay consistent, you'll see the return is worth the effort MA

**KILEY FASANO**
CONTRIBUTING EDITOR

Kiley Fasano is director of marketing and production for Kukui Corp., which makes marketing software for the automotive repair industry. Before joining Kukui, she served as a tradeshow and event planner for startup companies in the San Francisco Bay Area. A graduate of The Art Institute of Colorado, Kiley is passionate about digital media design.

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# EVALUATE YOUR ADVERTISING EFFORTS

## EFFECTIVE MARKETING AND ADVERTISING STRATEGIES ARE ESSENTIAL FOR YOUR BUSINESS

BY **GREG SANDS** | CONTRIBUTING EDITOR

WHEN it comes to the things shop owners want to spend money on, marketing and advertising aren't typically at the top of the list. Most of us can think of a million other items we'd rather invest in, from new equipment to additional technicians. But the reality is, without marketing or advertising, you'll never generate the revenue needed to fund new tool purchases or staff expansions.

Still, I can understand why there's a reluctance to allocate budget for marketing and advertising expenditures. More often than not, shop owners tell me their marketing and advertising programs often fall short of expectations, and they fail to see a solid return on their investment. While it's true some advertising vehicles are bound to underperform because they're too broad-based (i.e. radio advertisements), if a more strategically-targeted approach still isn't delivering results, then the problem might lie in your evaluation methods.

### Think strategically

In my experience, tracking the wrong metric can cause you to abandon a marketing vehicle too soon. These days, the industry trend is to measure your performance based on ticket averages. Under this approach, an uptick in ticket average following an ad campaign would be considered a success. But let's say the month after your campaign hits, your ticket averages decline, but your car counts rise. If you follow industry norms, you'd probably consider the campaign a failure.

But I believe that way of thinking is too simplistic. An effective advertising effort can deliver a number of benefits. For some shops, a successful marketing campaign might increase car count, for others, it might stem a downward sales trend or generate repeat visits. The point is that judging success or failure simply on ticket average is fairly restrictive and encourages shop owners to try to obtain more sales from fewer cars – an increasingly difficult task given how well-built modern cars are.

Instead, I advocate tracking a number of factors and tying those factors to the goals you want to achieve. Before you start any kind of marketing effort, take a look at your sales — not just month to month but the same month year after year — so you can get a clearer sense of the situation and whether you have problems that aren't due simply to seasonal trends. Once you have the numbers, you'll be in a better position to determine what you want your advertising campaigns to accomplish.

I am not going to talk a lot about what type of marketing works best, but I think whatever you decide to use should be tracked. If you can't track it, that should be a sign that it might not be worth your money. Everything I do has a unique tracking number. So, if I post a coupon on my website, the number to call for that offer is going to be different than the number on my direct mail postcards or the number that comes up on my pay-per-click ads.

### The art of call tracking

Tracking the number of calls that are generated from each advertising source is key, but perhaps even more important is listening to the way those calls were handled. Again, if you're working with a vendor that doesn't record those calls, consider it a red flag. You want to track as thoroughly as you can.

When you listen to the calls, evaluate the responsiveness of your staff. Are they asking callers when they can bring their cars in or are they telling the caller that they can't fit them into the shop's schedule? Are they turning away $25 oil changes because their bonuses are tied to pulling in higher cost repairs? Failing to say yes to potential customers can cost your shop valuable leads and may cause you to

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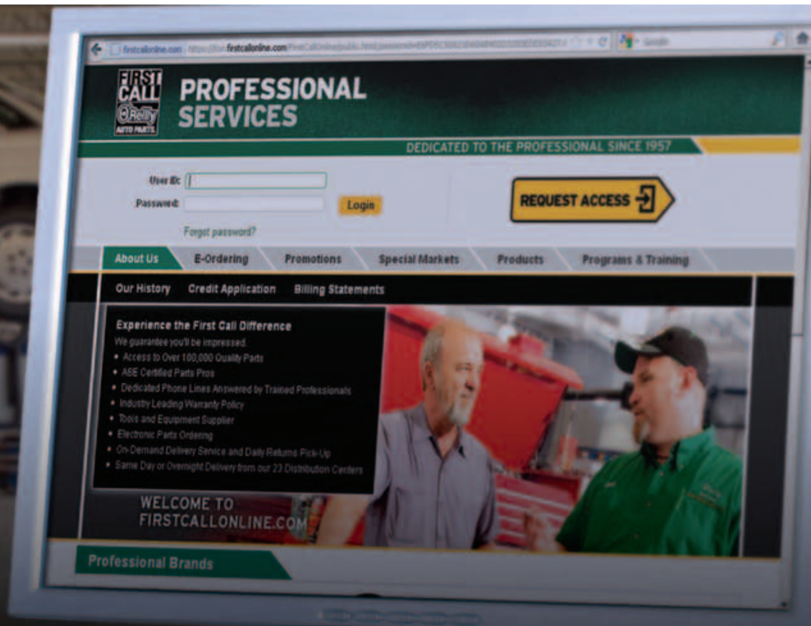


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end a campaign that could've been successful with a better trained staff.

## Think long-term

Another common mistake, especially when it comes to tracking direct mail, is to count the number of coupons that are redeemed and base the effectiveness of the campaign solely on that number. Limiting your evaluation to coupon redemption is a bad approach because it doesn't include the non-coupon shopper. I tend to target high-income areas with my marketing campaigns and those consumers don't typically use coupons, yet they are coming to my shops because they've seen my mailers.

By focusing on coupon redemptions, shop owners also discount the impact that new customers will have over the lifetime of their relationship with you. If your campaign generates 100 new customer visits, and 75 of those customers stay with you, those relationships could have a tremendous impact – generating thousands of dollars for your shop over the long term. But if you only look at what a campaign generates initially, it's a wash. Focus on customer counts and total revenue and you'll have a better idea of the effectiveness of your efforts.

## Innovations abound

Of course, there are now tools that can help you dig even deeper. Mudlick Mail, the company I developed to make direct mail more user friendly and the one I use for all my mailings, offers a penetration report that will help you determine if you're targeting the right customers. The report examines your response rate and analyzes which leads came from which carrier routes. That way, you can see which routes are underperforming. You want to put your money in the routes that are going to give you the best return.

You also want to ensure that your campaigns are attracting the right kind of customer for your shop. If you operate a shop that's been open for a few years, your focus might be on building loyalty. I can't speak about the capabilities of other companies, but Mudlick provides a database matching program that can examine your database to see if the sales produced by a direct mail campaign are coming from existing customers or customers new to your shop.

At the end of the day, the key is to be more strategic in your approach to tracking and measuring your return on investment based on only one metric — whether it's sales or your average repair order isn't going to give you the full picture. Instead, look at the goals you want your campaign to achieve and track your results based on how well your marketing efforts met your objectives. MA

GREG SANDS
CONTRIBUTOR

Greg Sands started in 1993 as a manager for an auto repair chain in Houston, later becoming minority owner and helping grow the company. In 2001, Greg launched SRSANDCO LLC to develop and operate full service automotive repair facilities. He owns and operates 29 auto repair shops in four states, and is founder and CEO of Mudlick Mail, which provides strategically targeted direct mail campaigns for auto repair shops nationally.

Contact Greg in our Workshop at Mudlick Mail

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# A look at CVT-7

## THIS COMPACT, EASY-TO-WORK-ON SYSTEM MAY CHANGE YOUR MIND ON TRANSMISSION WORK

BY **WAYNE COLONNA** | POWERTRAIN PRO PUBLISHER

AS promised in last month's Powertrain Pro article (*The JF011E to the JF015E*), we will now take a brief look at the CVT-7 transmission (Figure 1). If you recall, this little CVT can be referred to as the JF015E in Dodge, the RE0F11A in Nissan and the FICJB in Mitsubishi applications. As you can see in Figure 1, torque input is delivered to the transmission through a conventional torque converter.

There are three very interesting aspects to this CVT transmission. The first being a full complete apply of the converter clutch taking place at approximately 11 mph (10 km/h).

The second being the use of a low brake, high clutch, and reverse brake located between the pulley assembly and the differential (Figure 2), similar to the way Honda places their Start Clutch as discussed in July's Powertrain Pro article.

The third is the elimination of a stepper motor and ratio control valve to ratio the pulleys. This stepper motor and ratio control valve have been replaced with the use of Line Pressure Solenoid (A) and Primary Pressure Solenoid (B) as identified in Figure 3.

It is a nicely compact little CVT and very pleasant to work on. If CVT transmissions have not been a transmission you would ever consider working on, this one might change your mind. It all comes apart and goes back together again very easily, including the Primary and Secondary Pulleys.

Having a low brake, high clutch, and reverse brake located between the pulley assembly and the differential, similar to the way Honda places its Start Clutch, allows for a variety of strategies and features. Smaller pulleys, while achieving a 7.3 total ratio spread, would be one advantage to this type of design. The placements of the pulleys are closer to being horizontally mounted rather than being closer to a vertical mount with the secondary pulley higher than the primary pulley. This provides a compact little CVT.

The location of the clutch and brake assemblies is referred to as the "Auxiliary Gearbox" section of the transmission, which a ravigneaux planetary gear is a part of. The carrier is driven by the secondary pulley assembly through the carrier's short shaft that spline into the pulley assembly. The High Clutch Drum contains

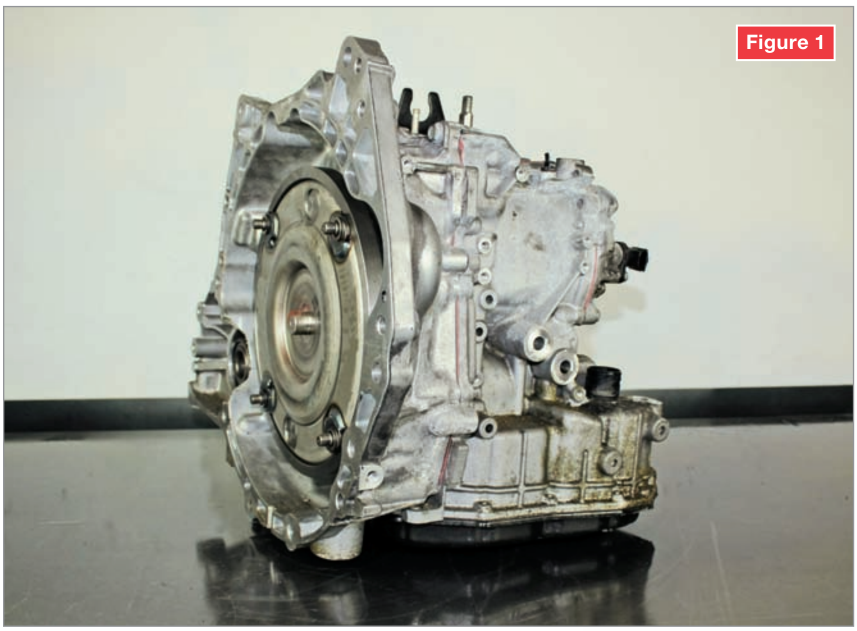

Figure 1

**WAYNE COLONNA**
is President of the Automatic Transmission Service Group (ATSG) in Cutler Bay, Fla., and a frequent speaker/instructor for transmission training around the globe.



Photos: Wayne Colonna

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the ring gear, which locks to the carrier when the High Clutch is applied. The Reverse Brake splines to the High Clutch Drum and is used to hold the ring gear stationary. There is a sun gear and shell, which the Low Brake is spline to holding the sun gear stationary when applied.

In addition to providing both forward and reverse direction of the vehicle, it also provides Idle Neutral Control, coordinated and non-coordinated shifting.

Nissan describes the Idle Neutral Control as follows:

If a driver has no intention of starting (moving) the vehicle in D position, TCM operates the low brake solenoid valve and controls the oil pressure of the low brake to be low pressure. Therefore, the low brake is in the release (slip) status and the power transmission route of transaxle is the same status as the N position. In this way, the transaxle is in idling status and load to the engine can be reduced to improve fuel economy.

Idle neutral control is started when all of the following conditions are fulfilled. However, during idle neutral control, idle neutral control is stopped when any of the following conditions are not met.

Driving environment: Flat road or road with mild grade
Selector lever position: *D* position
Vehicle speed: 0 km/h (0 MPH)
Accelerator pedal position: 0.0/8
Brake pedal: Depressed
Engine speed: Idle
Turn signal lamp/hazard signal lamp: Not activated

Idle neutral control stops or is prohibited when the TCM and ECM detect that the vehicle is in one of the following conditions.

- Engine coolant temperature and CVT fluid temperature are the specified temperature or more, or the specified temperature or less.
- When a transaxle malfunction occurs.
- When the vehicle detects DTC and is in the fail-safe mode.
- When idle speed increases due to heavy electric load*.

*When any one of rear window defogger switch, A/C switch, headlamp, fog lamp is turned ON or when the steering wheel is operated.

## Idle neutral control resume condition

When the idle neutral control finishes, if the vehicle is driven at more than the specified speed and the idle neutral control start conditions are satisfied, the idle neutral control starts again. If the vehicle has a malfunction, the idle neutral control does not start.

## System shift control

The ravigneaux planetary assembly provides a 1.714 reverse gear ratio but it also provides a low gear 1.821 ratio and a high gear 1.000 ratio. In other words, the pulley ratio from a low ratio wrap to a higher ratio wrap can be driven through the ravigneaux planetary gear set while in reduction when the low brake is applied. An actual shift can be made from the low brake to the high clutch, taking the ravigneaux gear set out of reduction into a direct drive rotation.

The lowest overall ratio when the low brake is applied and the pulleys are in the lowest ratio wrap is 4.0 to 1. Likewise, the highest overall ratio when the high clutch is applied and

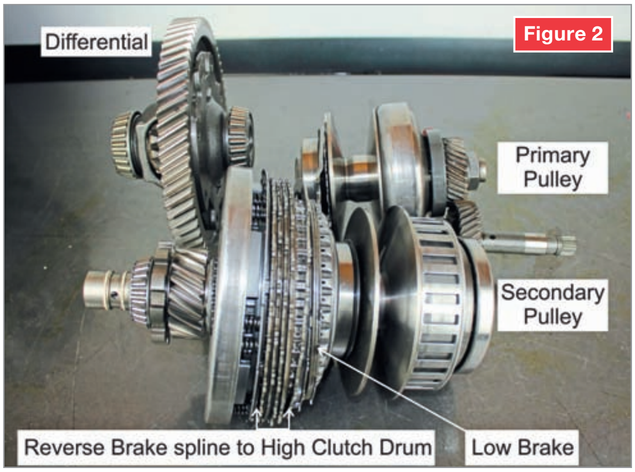


Figure 2

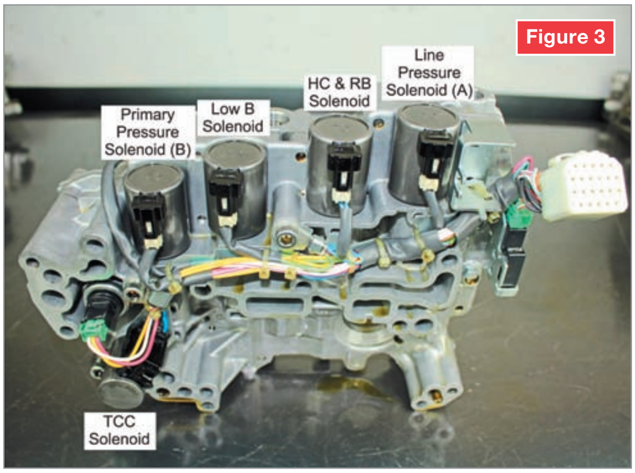


Figure 3

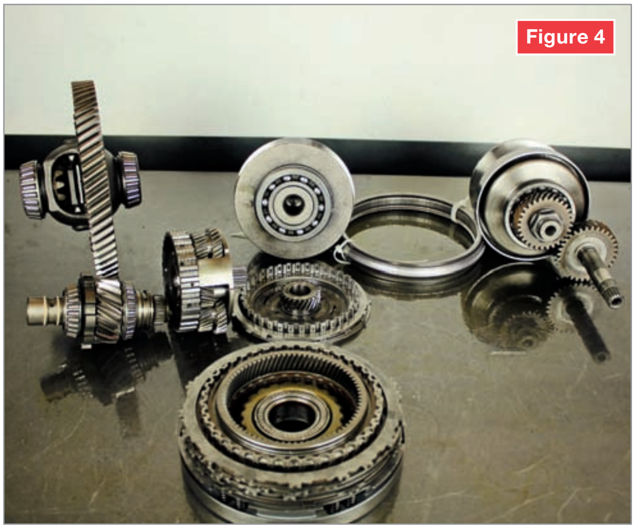

Figure 4

the pulleys are in the highest ratio wrap is 0.55 to 1. When 0.55 is divided into 4.0, you discover that this CVT has a 7.3 (7.273) ratio spread for improved efficiency.

System shift control is to provide smooth acceleration free from shift shock. Engine speed and torque is suppressed while the auxiliary transmission shifts (when the low brake is released and the high clutch is applied).

The auxiliary transmission shifts from first to second (the

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low brake to the high clutch) near the highest shift ratio of the pulley-belt system so as to minimize torque fluctuation when the transmission shifts.

System shift control will also allow the auxiliary transmission to shift to second while the pulley-belt system is on the low ratio side. This makes possible more frequent use of second gear to provide good torque transfer during light throttle conditions.

The system shift control strategy requires various system inputs to properly control the auxiliary transmission. One important input is a G sensor. Nissan has used this sensor in other vehicles for years in conjunction with their AWD systems. The G-Sensor is a lateral accelerator sensor converting front and rear accelerations (g-force) and inclination applied to the vehicle to voltage signal. The TCM evaluates front and rear G and inclination angle of the vehicle from the voltage signal. The TCM then stores calibration data (inherent characteristic values) of the G sensor to provide accurate transmission shifting control. Therefore, it is required to perform calibration of the G sensor after removal, installation or replacement of the G sensor or the replacement of the TCM.

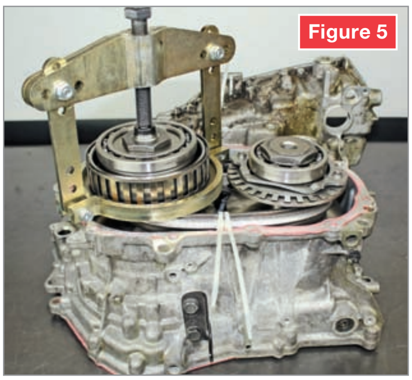


Figure 5


Figure 6

With the simplicity of using only seven valves and five solenoids to control the pulleys, brake and clutch apply as well as converter clutch apply. It is without question clever engineering.

One strategy that Honda uses with its start clutch is to release it during rapid braking from high speed to low speed. This allows for the pulleys to remain in rotation so they can quickly adjust for a lower ratio take off. Although nothing I have read indicates the CVT-7 will do the same, it has the capability to employ such a strategy.

With most other CVT transmissions having the planetary system between the input shaft and primary pulley, the stationary half of the secondary pulley sits inside the pulley cover. This allows a tool to be mounted on the secondary moveable pulley half to open it and release the tension of the belt between the two pulleys for service.

Due to the design of this CVT-7 transmission, the stationary half of the secondary pulley faces the ravigneaux planetary gear so it can drive the carrier. This means the moveable half of the secondary pulley sits inside the pulley cover. Both the primary and secondary pulley assemblies are bolted into the cover. There is quite a bit of tension on the belt with no area to mount a tool to release this pressure. Using a vacuum pump does not open these pulleys either.

To remove the pulleys, place tie straps on the belt to prevent separation of the bands and elements that make up the belt. This can be a real mess if it all separates, resulting in the need to buy a new push belt. Once the tie straps are on, simply unbolt the primary and secondary pulley retaining bolts from the cover and remove the assembly as carefully as possible. Yoram Levy from Edmond Garage in Israel re-assembles the pulleys using a tool to open the secondary pulley, allowing him to assemble the belt and pulleys into the main case, then release the tool and install the cover onto the pulleys (Figure 5).

When removing the pulleys from the cover (Figure 6), a self-inflicted injury can easily occur if you are not careful. There is a flimsy exciter ring next to the cover side support bearing on the primary pulley assembly (Figure 7). It does not take very much to bend the exciter ring tabs when handling the pulley. If this goes unnoticed during assembly, the compromised air gap for the input speed sensor will certainly cause an erratic input speed signal. This is trouble you do not need. Once the pulleys are mounted into the case, before you put the cover on, carefully realign any of the exciter ring tabs that have been bent (Figure 8).

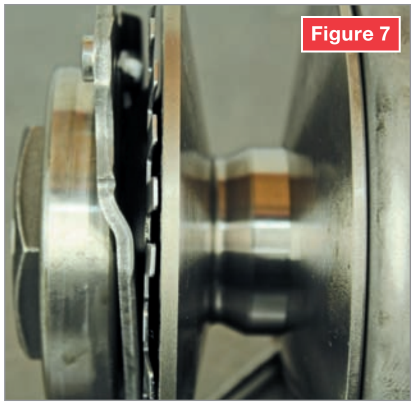


Figure 7

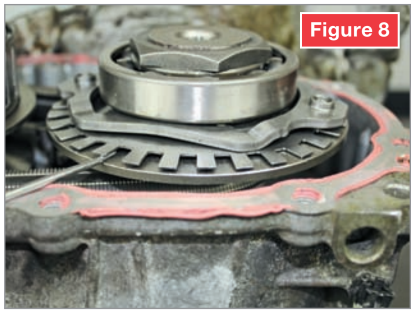


Figure 8

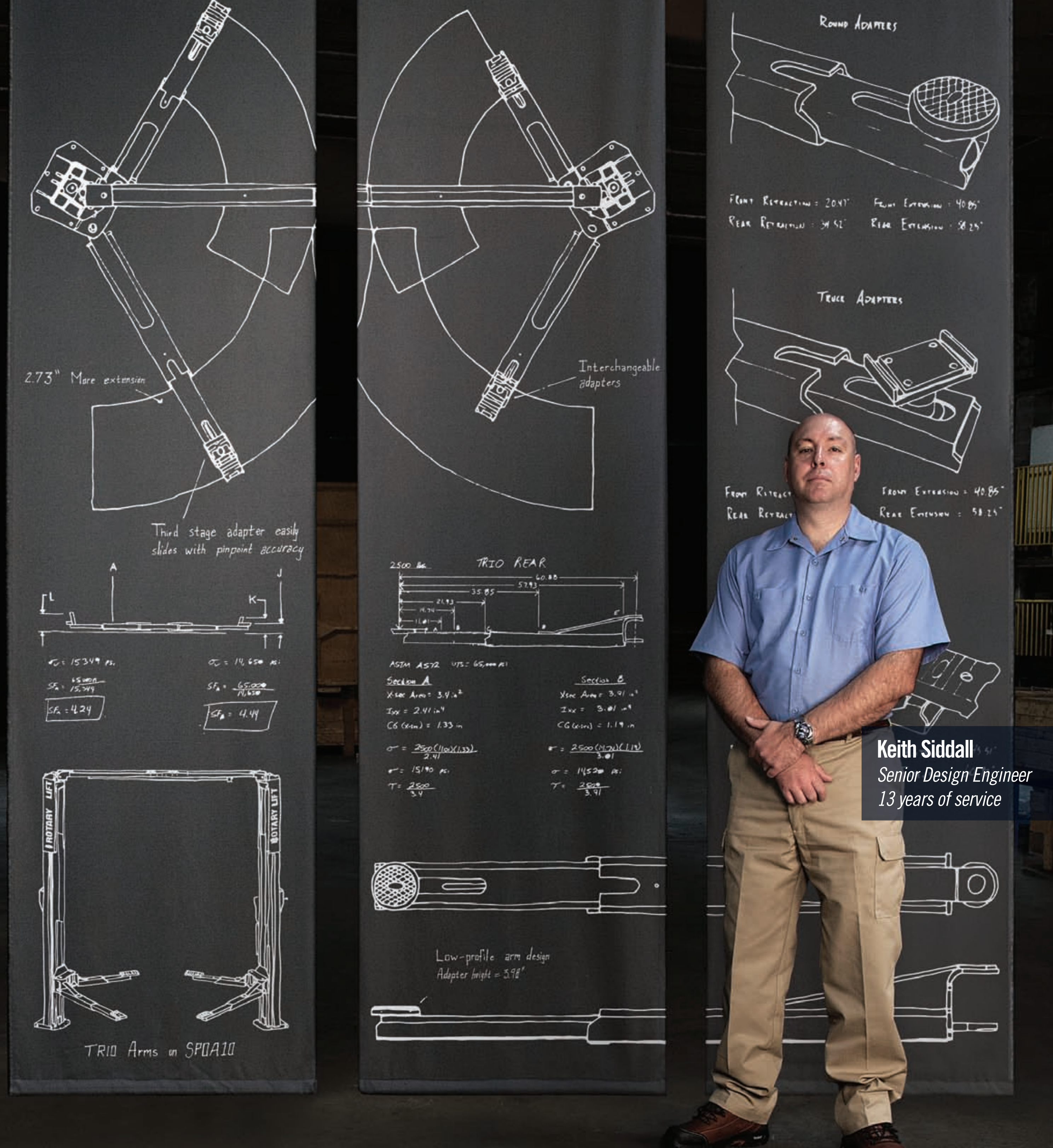
Speaking about having some trouble, there are several protection control strategies to be aware of.

Should wheel spin be detected, the engine output and gear ratio become limited and line pressure is increased. Low brake pressure is also increased.

When the CVT fluid temperature is high, the gear shift permission maximum revolution and the maximum torque are reduced more than usual to prevent increase of the oil temperature. This means power performance may be lowered compared to normal control.

Engine output is controlled according to vehicle speed while reversing the vehicle lowering power performance. Torque returns to normal by placing the selector lever in a range other than reverse.

If the selector lever is placed into reverse while moving forward, reverse will be prohibited. MA

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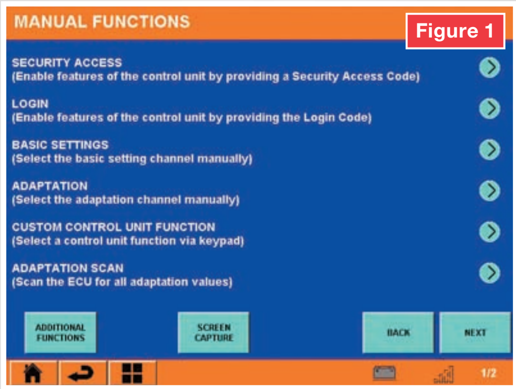

Figure 1

# REAL WORLD EUROPEAN PROGRAMMING

## UNLOCKING THE MYSTERY AND OFFERING SOME PRACTICAL GUIDANCE ON EURO MODELS

BY **G. JERRY TRUGLIA** | CONTRIBUTING EDITOR

If you are working on European vehicles you know that one of the most common procedures you will need to perform after replacing a component is coding. Coding can be used to adapt a part or control unit to the vehicle right through many scan tools without going on the Internet. The coding information usually resides on the scan tool so there is no need to do anything other than carry out the function from the scan tool. As you can see from our example from an Autologic scan tool (Figure 1), there is a manual function that has been selected to code the control unit to the vehicle. Another common example that comes to mind is coding of the transmission transfer case motor on a BMW X drive vehicle. Many vehicle owners forget the golden rule of making sure they have all the same tread depth as well as tire style on all wheels of the vehicle. When a vehicle owner cheaps out by not installing four matching tires, they will damage their transfer case servomotor and possibly damage the transfer case.

Look at Figure 2 and see what happened on this 2007 BMW 328xi when this vehicle owner only replaced one tire while leaving three others that had different tread depths. After the vehicle was driven 5,000 miles or so he lost his "X" drive and had to go for an expensive repair along with four new tires. As you can see, the transfer case servomotor gear is completely stripped out. Our repair included draining and flushing the transfer case to remove debris before installing a new servomotor. The next step is very important and involves using a suitable scan tool that is capable of coding the servomotor to complete the job.

Now that we got the coding out of the way, it's time to look at programming and reprogramming and what's needed to be successful. These procedures can be as a simple as ignition key reprogramming or updating software of a computer module. There are a few different ways to program modules from OE to aftermarket scan tool interfaces. You're going to need the vehicle's battery voltage to remain stable by installing a clean low AC voltage output battery maintainer. When working on European vehicles you will need to invest in a battery maintainer that is suitable for the vehicle. Some vehicles, such as some newer BMWs, need a steady 14.6 volts with up to 90 amps depending on the model. Another precaution to follow is making sure you route the scan tool OBD II cable through the door without crushing the cable. This is usually done by leaving the door open after locking the latch lever on the door. If you route the cable through the open window, it may be crushed as the vehicle is being programmed due to the windows being activated during the programming procedure.

Also on the list is making sure all accessories are off and insuring nothing is disturbed during the process. Remember, in many cases the procedure can take hours. If anything is interrupted during the programming process there is a good chance the unit being programmed will be damaged and will not be recoverable. A damaged controller on a European vehicle will be a very expensive mistake.

Now let's take a look at an easy task — key reprogramming — that you are most likely to encounter since keys and fobs are either broken or lost. Our example vehicle is an Audi/VW key reprogramming procedure, which can either be very easy or not. The procedure can range from using an existing key that has already been linked to the vehicle's security system, to programming a new replacement key. If the key and fob have been previously linked to the vehicle, the following procedure will work on many Audi/VW vehicles. The procedure for previously programmed keys and fobs are as follows:

Photos: G Jerry Truglia

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1. Make sure the batteries in the key fob are good.

2. Press and hold the unlock button on the remote.

3. While continuing to hold down the unlock button, insert the key into the ignition.

4. Turn the ignition to the "On" position, making sure the unlock button is still depressed for two seconds.

5. After two seconds have elapsed, turn the ignition off and release the button.

Check the key fob for all functions of lock, unlock and starting the vehicle. Make sure when you go to start the vehicle that the engine runs for more than a minute to confirm the key is linked.

Now if you are adding a new key, the procedure requires a scan tool capable of programming the key and requires a bit more time. You will need to insert a working key in the ignition that starts, runs and locks and unlocks doors before you proceed. Turn the working key until the dash lights are illuminated followed by rolling down the driver's side window to prevent any lock out problems. The next steps are:

1. Exit the car and shut the door with the window down.

2. Use the new key and lock the door by turning the key in a clockwise direction.

3. Take the new remote and press the unlock button. The lights should flash once.

4. Wait 10 seconds then press the unlock button making sure the doors unlock.

If this procedure does not work and you tried it a few times you will have to use a scan tool such as the dealer ODIS or an aftermarket tool that is capable of programming the keys to the vehicle.

In many cases, programming is not a plug and play process; care must be taken before reprogramming or programming a vehicle's computer. Before you begin, be sure you review all of your service information resources for any known issues, including TSBs and OE calibration lists.

If you're using a laptop to program or reflash a vehicle, look up the OE requirements for the vehicle that you are working on before attempting to


Figure 2

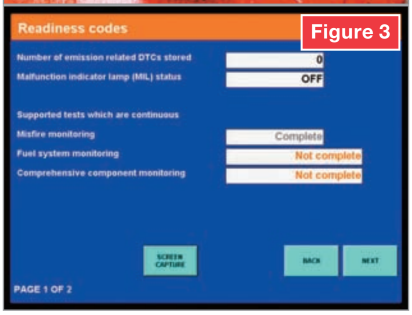
Figure 3


perform the function. These are some common requirements: a laptop with Windows 7 Professional with Service Pack 3 (SP3), minimum 2 USB ports, 9 male pin RS232 for older GM and some other vehicles, 4 GB of memory, 32 or 64 bit as per OE, and software Java (check the version the OE requires and do not install the latest version for most OEs). Disable automatic downloading and deleting of old versions for Java, Acrobat Reader, Internet Explorer (IE) (could be 9, 10, 11 or other) rather than check the version required and make sure there is no virus protection software on the laptop. You may think this is a bunch of mumbo jumbo, but it is important information with specifications that must be followed to be successful in programming or reprogramming vehicle computers.

You also need a good, stable high speed wired or wireless Internet connection along with the application software from the OE website. Turn off all accessories, make sure there are no DTCs in the vehicle's computers, use a battery maintainer that has less than 1 volt AC ripple and make sure the maintainer can output the required voltage and amperage required by the manufacturer.

***NOTE:** you cannot use your shop's battery charger for this and if you try, you'll be buying a lot of new control modules!*

Take a look at the Volvo website (Figure 3) that has information on using their factory scan tool called VIDA. Take a look at what they have printed in bold about using the correct Internet browser. It states that VIDA and their download software will not work using Internet Explorer (IE) 11. Also look at some of their announcements that refer to using Windows XP, programming instructions and laptop issues with the Panasonic semi rugged Toughbook 53. This screen shot is an example from one OE. Others will have different information and requirements that you need to follow. Purchasing subscriptions for programming/reflashing of a Euro vehicle can range from approximately $50 to $1,400. Check NASTF.org for more information.

Now let's move on to programming a vehicle to see that it's not that difficult. If it's your first time programming or reflashing a control unit, take the time to make sure you have everything you need before you proceed. Make sure the laptop is plugged in and has a good battery in case of a power interruption. It's important to make sure you concentrate on the task at hand without being interrupted during the process. These steps are very important because computers can become "bricked" (not reusable) if you don't follow the proper procedure that the OE has outlined. So, once again, make sure to be prepared and read all the information they recommend prior.

A real-world problem vehicle that my friend John was working on is a great example of a vehicle that needs to be programmed. The vehicle was a 2003 BMW Z4 with 124,000 on the odometer that failed state inspection for monitor problems. The vehicle had two Continuous Monitors (Figure 3) that were not Ready. There are three Continuous Monitors — Comprehensive Component, Fuel and Misfire — that are always displayed as Ready/Complete on all OBD II vehicles. This Z4 only displayed the Misfire Monitor as Complete and the other two as Not Complete, while all the Non Continuous Monitors were Complete. A check of TSBs found that there was a software update available. John understood that there was no drive cycle or enabling criteria that he could perform to change the vehicle's Non Complete/Ready status. The option he had available was to tell the shop that the unit could be reprogrammed with no guarantee it would work or purchase another ECU/PCM that would need programming as well. The shop owner opted to go with the programming of the PCM because it was the cheaper of the two choices available.

Looking for an explanation on what the software update would fix was another story. In researching TSBs for this vehicle I found one that is related to an emission problem that deals with sensors not reporting the correct information to the PCM. This TSB is important but most likely will not resolve the problem at hand. Looking at it another way, it's good information to use when speaking to the vehicle owner and suggesting reprogramming the vehicle. Since there is an update to show the vehicle owner, it makes it easier to suggest that the vehicle be reprogrammed with the latest software first. The procedure started by connecting a battery maintainer to the vehicle, turning off all accessories, and starting the program to update the software.

Once the program was complete, the vehicle's Continuous Monitor was now set to Complete. The vehicle now needed to be driven to complete the Non Continuous Monitors that were cleared due to the programming of the PCM. Any time a vehicle battery is disconnected, DTCs are cleared or the PCM is programmed, all the Non Continuous Monitors will be Not Complete while the Continuous Monitors are always Complete and ready to run looking for emission problems. The vehicle was repaired with reprogramming of the PCM to the latest software version.

Our next programming example is a 2006 Land Rover LR3SE with a 4.4L motor that was plagued with a bunch of problems that were reported on a system scan. Many of the problems reported just did not make sense, especially after checking all the basics along with powers and grounds to the PCM. The faults in the report were everything from low battery voltage to misfires along with suspension, transfer case, control unit calibration issues, CAN Bus problems and so on. There was an overwhelming amount of problems that did not make sense. The vehicle owner was told after spending over $3,500 at the dealer that there was at least another $4,500 or more that this vehicle needed before it was going to be repaired. I questioned the vehicle owner on what problems he was experiencing with the vehicle. He told me the vehicle was not performing like it used to and that the check engine light was on. He showed me the repair order from the Land Rover dealer that had a list of parts from a crank sensor to spark plugs beside a three-hour minimum of diagnostics fees. After reviewing the invoice and speaking to the vehicle owner, I still had no clue what the problem was. I checked everything I could get my hands on from TSBs, to Identifix, Alldata, ProDemand, Google and YouTube. Since this is a European vehicle, I decided to check the computer areas for signs of water leaks, which are a common problem. The areas where the computers were located and the computers themselves were all dry, so I ruled out that possibility. Since I had no other direction to go, I decided to perform a battery disconnect by removing both battery cables and connecting a 1 ohm – 10 watt resistor that will bring the capacitors down and reset the computers. I drove the vehicle around for a few days before performing a full system scan test again, only to come up with the same results. Now I decided to connect my Autologic to the Internet server and downloaded all the program files needed to update the controllers. I followed the normal procedure of clearing all DTCs in every computer, installing a battery maintainer, and making sure all accessories on the vehicle were off. I started with programming the PCM first since it seemed the most logical place to start. After programming the vehicle, I rescanned the system to check for any DTCs and found none. I called the vehicle owner to inform him where I was with the repair and suggested he leave it with me for a few more days. After driving the vehicle approximately the same amount, if not more miles than I did on the previous test drive, I rescanned the vehicle and found no problems in any of the controllers. The new program files (update) were just what this vehicle needed to be fixed. If I did not have the ability and tooling to reprogram this vehicle it would have not have been repaired.

Speaking of water problems, the

2003 BMW Z4 had the airbag module go for a swim. This vehicle had a problem with the convertible top that was no longer sealing water out. The seal to the convertible top on the driver's side of the vehicle had been displaced and disfigured due to leaf and twig debris that had made its way between the seal of the convertible top and the vehicle's body. After time, this became the path for water to find its way into the vehicle. The airbag module had water inside of it as well as the vehicle being totally wet on the floor pan. We had to remove the seats and rug to get this vehicle down to the metal so we could dry everything up and install the new module.

Once the new airbag module was installed, we followed the BMW recommended procedure. BMW states that when a control module in the safety system is replaced, the coding programming process must be performed so the system time can be started. If system time has not automatically started after the coding programming process was completed, a fault will be displayed as "System Time Error" in the control module. If the message appears, the system will need to be started manually by using the service function. Lucky for us, the coding programming process on the Z4 airbag module went without a hitch. After the process was completed we checked the module for codes and then ran a complete system scan that provided a DTC and BUS problem-free vehicle.

Remember that programming, reprogramming and coding are functions on European vehicles that are a common task. Getting yourself started in European programming entails research on what tools you need to purchase whether OE or aftermarket. There are two very capable scan tools I use for programming Euro vehicles. The first one I use most often is the Autologic, which also has a great tech support line that is willing to help you through any problem. The other is Autoland Scientech i Scan II wt, which is good for module coding along with some programming capabilities for some vehicles. If you want the OE tools, there is a great option to download the OE software for Audi/VW, BMW, Ranger Rover, Jaguar and Volvo for full factory capability using the Drew Tech CarDAQ- Plus or CarDAQ-M as the J2534 link between the laptop and the vehicle. One last and important tool I mentioned before is a good battery maintainer, such as Associated, Midtronics or the Fronius, that is adjustable and capable of handling all European vehicle lines.

Hopefully I've provided you with some insight on what you need and can do to program European vehicles. MA

G. JERRY TRUGLIA
CONTRIBUTING EDITOR

G. Jerry Truglia, president of Technicians Service Training, has been in the auto repair business for a long time as a tech, shop owner and nationally recognized trainer/author. He founded TST to bring affordable training to his fellow techs and shop owners.

Email G. at gtruglia@tstseminars.org

# Why one is greater than two.

IN THIS SECTION





DRIVABILITY

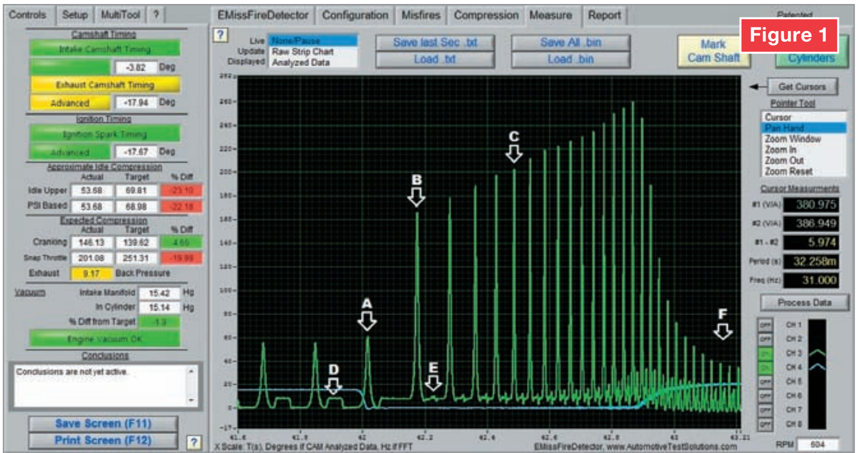


Figure 1

# INTRODUCTION TO IN-CYLINDER TESTING: PART III

## LEARN THE NUANCES OF THE IN-CYLINDER PRESSURE PATTERN

BY **BERNIE THOMPSON** | CONTRIBUTING EDITOR

**Editor's Note:** *We encourage you to review Thompson's June 2013 article "Introduction to in-cylinder pressure testing," which covers the running idle compression waveform; and his May 2014 "Introduction to in-cylinder pressure testing part II," covering the cranking compression waveform. You can find a complete listing of all of Thompson's articles online at www.motorage/author/bernie-thompson.*

Cylinder pressure testing is becoming one of the most important new diagnostic tools for a shop to use. This technique provides valuable information to the technician that cannot be obtained in any other way. This waveform can convey such things to the technician as true Top Dead Center (TDC), camshaft timing, ignition timing, restricted exhaust, intake valve problems, exhaust valve problems and piston sealing problems in just seconds. By understanding the pressure changes in the combustion chamber, hours of diagnostic time can be saved.

It is important to understand that the specific pressure changes that occur within the cylinder are what the in-cylinder pressure waveforms are comprised of. This means that each time the throttle valve is changed the pressure within the cylinder also changes. The three basic throttle pressure states that will be analyzed are cranking with a closed throttle, running with a closed throttle (idle) and running snap throttle (WOT). Each of these pressure states will provide different information to the technician that will aide in the diagnosis.

The amount of incoming air will change depending on where the throttle valve is located. The throttle valve offers resistance to the air flowing into the engine. The air entering the engine will be regulated as the throttle valve is moved in comparison to the throttle bore. This difference of air volume flowing into the cylinder causes the in-cylinder pressures to change.

## Seeing is believing

In Figure 1, the in-cylinder pressure changes are shown as the engine goes from a closed throttle (idle) to a wide open throttle (WOT) revving. During the idle state the throttle is in a closed position. At idle the throttle is allowing only enough air to enter the engine so that, when mixed with the fuel stock, the power released from the air/fuel charge can overcome the parasitic losses of the engine. These parasitic losses include engine pumping losses, friction losses, viscometric flow losses (pumping oil) and any external load losses (power steering, alternator, A/C, etc.). The amount of air entering the engine at hot unloaded idle can be measured in grams per second and will equal approximately the liter size of the engine. So a five-liter engine will have approximately five grams per second of airflow in order to overcome the parasitic losses of the engine.

As the throttle is snapped open, the restriction is removed from the air induction system. Since the air can now flow freely into the engine, the air volume into the engine increases. This

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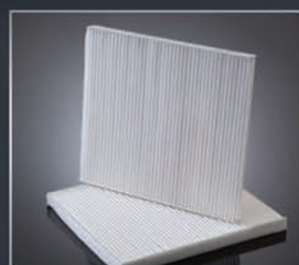

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increased volume changes the pressure within the cylinder. The first pressure changes that we will analyze within the cylinder can be seen at point A, which is with a closed throttle at idle and at point B, which is at WOT. At point A the peak pressure is 60 psi and at point B the peak pressure is 165 psi. This pressure difference is greater than double that of the idle pressure with an increase of 105 psi and occurs within one fire cycle or 720 degrees of crankshaft rotation. Additionally the pressure at point B should be equal to or greater than the cranking compression pressure of a good cylinder. When looking for a cylinder that is leaking, point B is a good indicator due to the piston velocity still being low. As the speed of the engine increases the pressure will also increase as can be seen at point C. At point C the peak pressure is 205 psi, which is a difference of 40 psi from point B and 145 psi from point A. During the snap throttle event, the peak pressure should increase approximately by double within the first fire cycle, and approximately three times by the fifth fire cycle. It is important to note that if the engine is running poorly, the throttle valve or idle speed control will allow more air into the engine in order to keep the engine at a target idle speed. This in turn will allow a higher peak idle pressure within the cylinder. Keep in mind that some drive by wire throttle control systems may not allow the throttle to open rapidly.

When looking at the pressure changes within the cylinder, it is best to think about the pressure changes as volume changes. In order to have pressure you must have volume and something that the volume can push against. This idea of volume and pressure can best be seen in Boyle's ideal gas law:

$$PV = k$$

(where P is the pressure of the gas, V is the volume of the gas, and k is a constant)

The amount of matter in a closed system is always constant but if the area (volume) that encloses the matter changes, the force (pressure) changes in proportion. The equation shows that as volume increases, the pressure of the gas decreases in proportion. Similarly, as volume decreases the pressure of the gas increases. If the temperature of the contained gas changes, the volume of the gas will also change. Air expands when heated, or more correctly, heat energy causes the air molecules to move faster. Faster moving particles take up more space, thus larger volume. Cool air contracts/condenses for the exact opposite reason. The particles do not have as much energy to rapidly move around taking up space, so they can be closer together, meaning less volume.

## Make sense?

The question is, why would the peak pressure be greater under snap throttle compared to the cranking peak pressure? During cranking the swept volume of the cylinder has more time to fill so the volumetric efficiency of the cylinder is at its highest point. With more volume contained within the cylinder the peak pressure should be at its highest point as well, however this is not the case. During

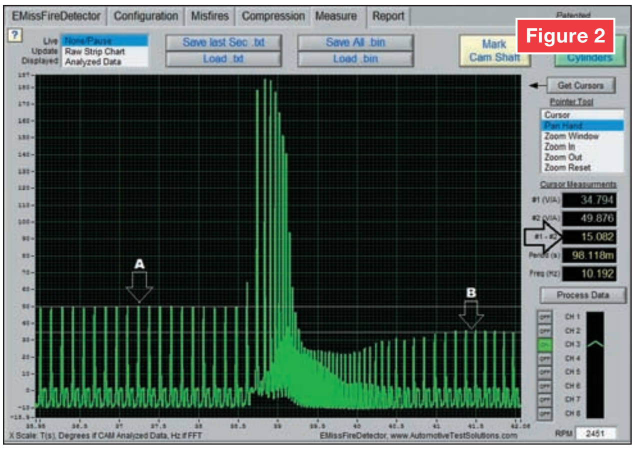


Figure 2

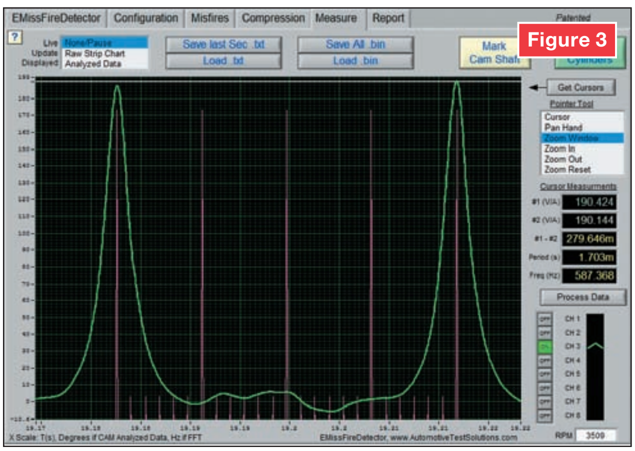


Figure 3

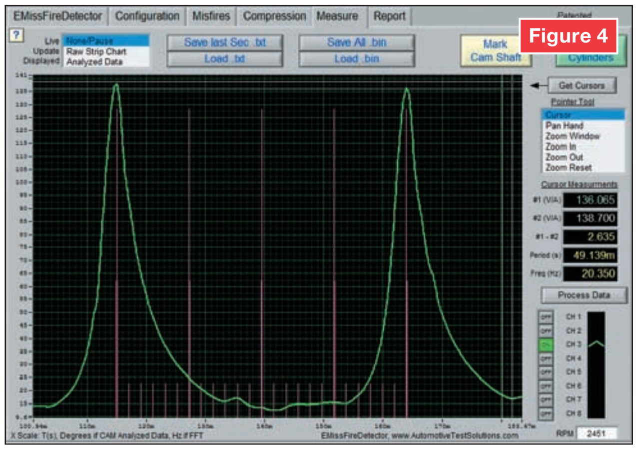


Figure 4

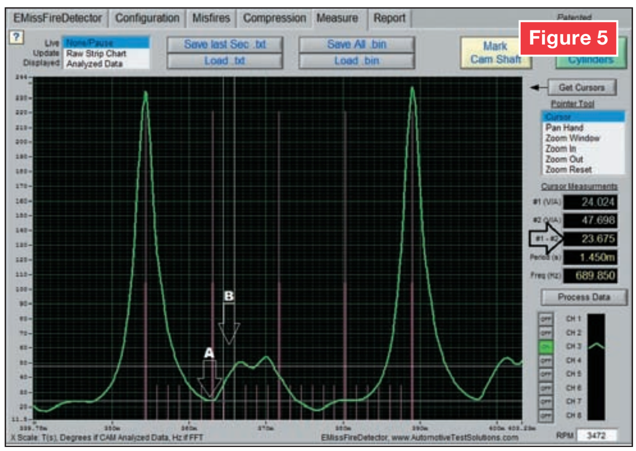


Figure 5

engine crank, the engine Revolutions Per Second (RPM) are approximately 150 to 250. During a snap throttle event the RPM can be 2000 to 3000. This increase in the engine's RPM is what allows the peak pressure to increase. As the engine spins faster the piston's velocity is increased; this kinetic energy from the piston is put into the air volume contained within the cylinder. As the piston moves up in the cylinder, the air molecules hit the piston crown, thus being accelerated. These accelerated air molecules now hit one another, creating heat. This increase in temperature allows the air volume within the cylinder to increase as well. Thus, the peak cylinder pressure increases; more volume = more pressure, less volume = less pressure.

The next pressure change that we will examine is at point D and point E of Figure 1. Point D is referred to as the exhaust plateau. This plateau is created by the intake vacuum. When the throttle is snapped open, as can be seen by the blue manifold vacuum trace dropping, the exhaust plateau at point E drops as well. This is due to the loss of manifold vacuum caused by the atmospheric pressure filling the intake manifold in the absence of the throttle restriction. Since the plateau is created by the engine vacuum, as the vacuum goes up or down the exhaust plateau follows the vacuum and will also move up or down. At point F the throttle valve is rapidly closed after the snap throttle event. The engine rotating 2000 to 3000 RPM and the throttle quickly closing creates a very high vacuum condition. This high vacuum causes an engine pumping loss that will slow the engine down quickly. Additionally, note that the peak pressure drops lower than the idle peak pressure. This is due to the engine having a higher RPM with the throttle valve closed. In this condition there is less time to fill the cylinder so less air is sealed within the cylinder, thus a lower peak pressure.

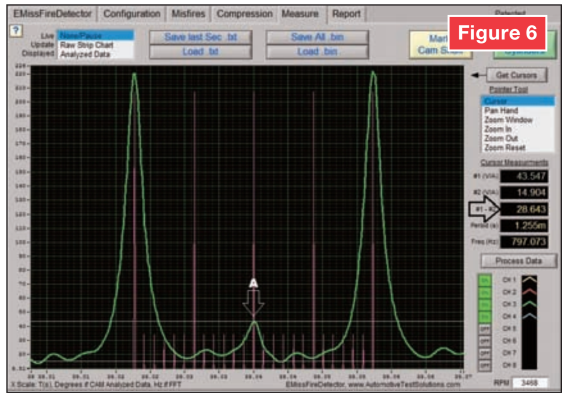
In Figure 2, a snap throttle waveform is shown. At point A, the peak idle pressure is 50 psi. After the snap throttle event the peak pressure is only 35 psi, this is a difference of 15 psi. It is important to analyze the pressure recovery after the snap throttle event. Since the engine RPM has been increased, this energy effects the engine components. Such things as valve springs and lifters may fail with increased energy applied to them. In this example the oil pressure is increased during the snap throttle event. This allowed the lifters to pump up creating a pressure loss within the cylinder thus creating a misfire. This engine had an oil cleaner detergent run through it. This treatment cleaned the lifters fixing this misfire condition.

## The impact of exhaust

There are two basic snap throttle pressure waveforms as can be seen in Figures 3 and 4. Figure 3 is produced from a normal flow snap throttle pressure waveform. Figure 4 is produced from a high flow snap throttle waveform. In a normal flow pressure waveform, the air moving through the engine has a slight restriction due to the engine geometry. In the high flow engine design there are less restrictions to the air flow moving through the engine.

Engine air flow resistance or pressure drop is created by volume against area. The greater the volume, the greater the pressure. In an engine exhaust system there is a channel or area that the wasted exhaust gases must pass through. This base exhaust gas has thermal energy that is trying to expand the gas as it is forced out of the combustion chamber into the exhaust port. This means that the volume of the base exhaust gas is increased by the temperature. At low throttle setting, the volume of this base exhaust gas is low; as the throttle is increased, the volume of this base exhaust gas is also increased. This volume must pass through the exhaust area of the engine.

There are two forces at work as the combustion chamber is being scavenged. The first is the force from the upward piston movement under exhaust—this is forcing the volume out of the combustion chamber. The second is from the energy of the exhaust moving through the area of the exhaust. If the exhaust has mass, which it does, and there is acceleration of the exhaust gas, which there is, there is energy. This energy creates a siphon effect that pulls the exhaust gas out of the combustion chamber. In order to create this siphon effect the velocity of the exhaust gas must be as high as possible. This means that when the engine is being designed the port area will be calculated for the range that the power will be produced . Most passenger vehicles will be operated below 40 percent throttle for approximately 90 percent of the vehicle's life. So the velocity of the exhaust gas will be set by decreasing the exhaust area. This will increase the speed of the exhaust gas at a lower throttle setting and at a lower RPM. This is the normal flow geometry design for an engine and will increase the power of the engine where the engine's operating range will be. However, this will now provide resistance (back pressure) to the exhaust gases at high volumes or loads. In a high flow geometry design this flow rate is set to produce greater power at a higher RPM range. The design of the engine geometry is always a compromise.




In Figure 5, the snap throttle waveform is showing a high backpressure from a restricted exhaust system. At point A the exhaust valve opens and the in-cylinder pressure immediately rises. This is due to the exhaust backpressure being higher than the in-cylinder pressure. Since a high pressure has more force, it will always move to a low pressure that has less force. It is important to measure the pressure waveform correctly. This is done by measuring the pressure at the point the exhaust valve opened at point A, and then measuring to the highest pressure obtained between 30 – 60 degrees after BTC shown at point B. This pressure difference should not exceed 8 psi; most engines will have a pressure difference of 3-6 psi. With a 10 psi difference in pressure from point A to point B, there will be a power loss associated with the engine. Figure 6 shows that there is a 23 psi difference, clearly showing a restriction to the exhaust flow. On this vehicle, the exhaust flow restriction was caused by a plugged catalytic converter. This technique will show a very slight restriction within the exhaust where the power of the engine drops off above 5000 to 6000 RPM.

In Figure 6 the snap throttle waveform is showing a rise in pressure at point A; this is occurring at the 360 degree mark of crankshaft rotation. The pressure rise at the 360 mark is where the piston is coming very close to the cylinder head as the exhaust stoke is ending. This pressure increase will be associated with things such as advanced exhaust camshaft timing, turbocharged engines or restricted exhaust ports. It is important to note that the pressure rise occurred late in the exhaust stoke. In this example the pressure at point A has a 28 psi pressure difference. This is caused by the exhaust gas pushing against a turbine in the turbocharger. If the engine has a turbocharger this is normal, however if the engine is not turbocharged there should not be a high pressure buildup at this point.

As you increase your knowledge about in-cylinder pressure testing, you will wonder how you ever survived without this technique. This is one diagnostic technique your shop needs to master. MA

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Bernie Thompson is an automotive diagnostician and trainer, and co-founder of Automotive Test Solutions in Albuquerque, N.M. He is an expert at diagnostics and repair strategy and designs award winning diagnostic tools and software for the automotive industry.

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# Mystery Mercedes

The 2008 Mercedes-Benz SUV in question.

## CASE STUDY ON A MERCEDES-BENZ THAT HAD MORE THAN ONE ELECTRICAL GREMLIN, WHAT CAUSED THEM AND HOW THE PROBLEMS WERE SOLVED

BY **JAIME LAZARUS** | CONTRIBUTING EDITOR

Limitations—we all have them. Every now and then we should see if the limitations we had in the past still exist today. After all, if we automotive repair professionals live by the constant improvement model, then it's likely we are now better tooled, equipped and trained to perform a task that was previously impossible. Unfortunately, not everyone lives by that model.

In trying to help someone recently, I tested one of my limitations. A shop owner asked me to look at a Mercedes-Benz SUV; however, I told him I didn't possess the factory tool for the Mercedes and have inexperience with the brand (I have focused my career on Asian and Domestic vehicles).

He said others had spoken so highly of my skills and he'd prefer to have a mobile technician come to his shop than to tow it somewhere where he "didn't know what might happen to it." Right now, it's a mystery what's wrong. I promised the shop owner I would put forth my best effort, charge by the hour and utilize all the tools at my disposal. But I still may not be able to finish the job. I warned him payment would still be expected even under those circumstances. He asked how soon I could look at it.

The story begins in a different shop, one that's owned by a regular customer of mine, where I was programming a vehicle after a module installation. Chuck (may not be his real name) called to ask advice from my regular customer about how a 2008 MB GL550 Active Suspension fault could be causing A/C problems. My customer, an air conditioning specialist, agreed that if Chuck would bring the vehicle over, he'd look at it briefly at no charge. Within a few minutes a pickup truck appeared in the parking lot towing a trailer upon which was the almost completely assembled vehicle in question. When my customer heard what had transpired to the vehicle in tow he immediately (and intelligently) tossed it in another direction. Follow along – this gets fun.

The vehicle was originally brought to Chuck's shop with the complaint that the A/C blows warm. Chuck decided it needed a compressor because "when I applied 12 volts with my Power Probe to the A/C compressor connector, the clutch would not engage." After replacing the compressor he had the same problem, but now, before he could get the SUV's engine to even crank, he spent hours determining he must first remove the Air Suspension compressor relay. Note: this phenomenon was not present prior to the A/C compressor replacement (and to this day I've not understood how he came to either conclusion). Now that the engine starts, there are numerous lights illuminated on the instrument cluster and many

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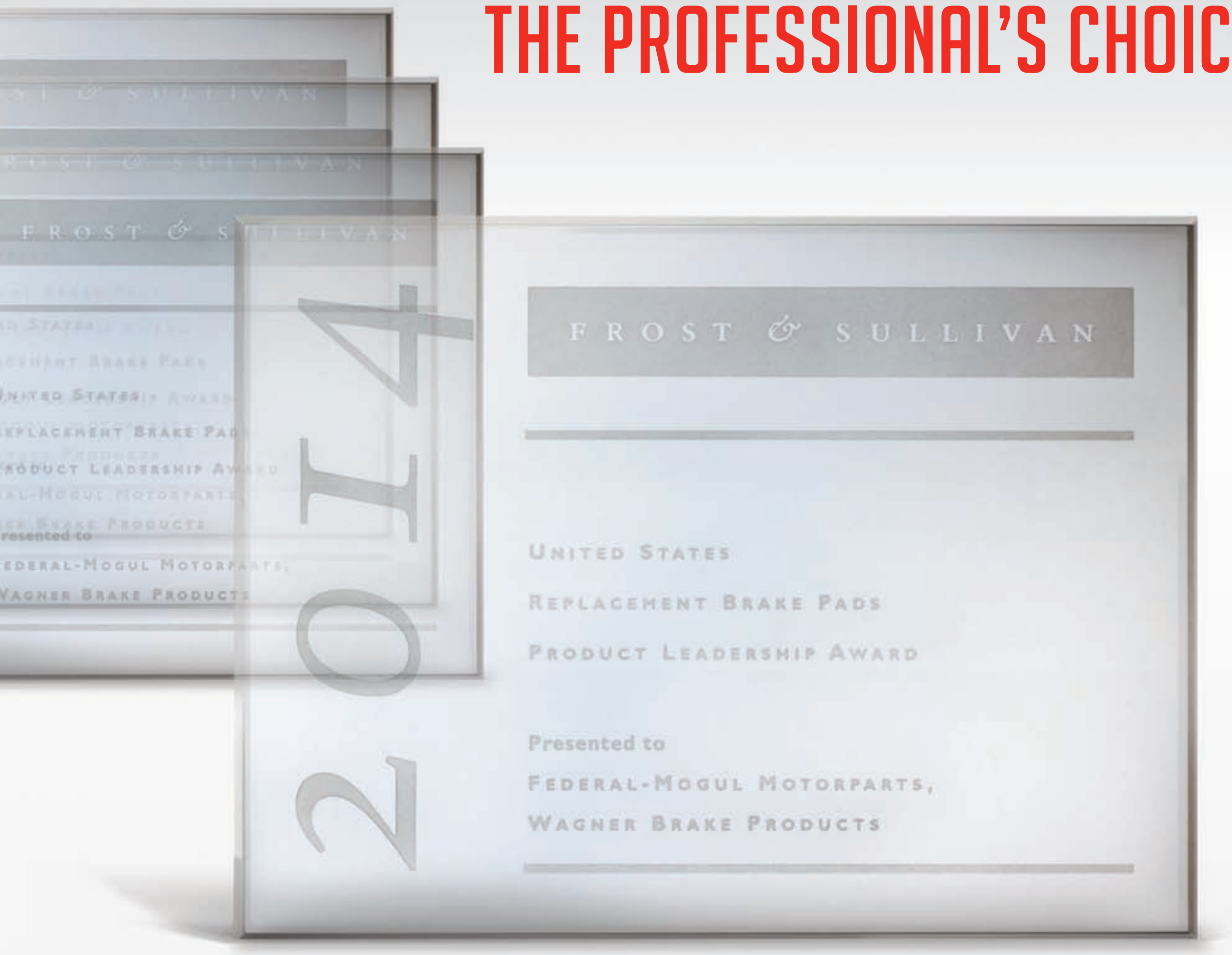


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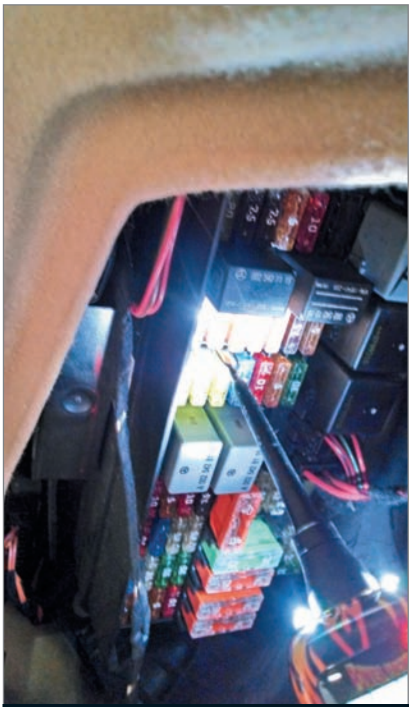
comfort and entertainment systems don't work. In addition, if the air suspension relay is reinserted, the engine stops running. Are you wondering about Chuck's limitations yet? What would be your first steps here (besides turning and running as fast as you could)?

When I arrived at Chuck's shop the next day, I immediately began regretting my decision to help. The shop looked well equipped, just not for repairing modern autos. It appeared better qualified for industrial equipment, farm equipment or lawn care equipment repair. My instincts said to leave after apologizing for my mistake, but I felt I owed Chuck at least an attempt at resolving his dilemma.

After attaching a charger to the completely dead battery, I started with a complete system scan. Well, as complete as three aftermarket scanners would permit anyway. Each one would access some of the systems on board, but each had differing capabilities. In other words, I could get some DTCs, some data, some bi-directional testing available, some module information, etc. from various systems and in most cases each scanner provided similar data, but more often than not, their information differed between each other. I recorded all the information using my phone's camera when the tools' abilities could not store it. It was late in the day so I took some voltage readings, visually inspected the A/C and active suspension compressors (and surrounding areas) and then told Chuck that I would do some research to better understand the systems, analyze the data I stored and look at the wiring diagrams of the systems affected before performing any more testing. He called the next morning to see what I had figured out.

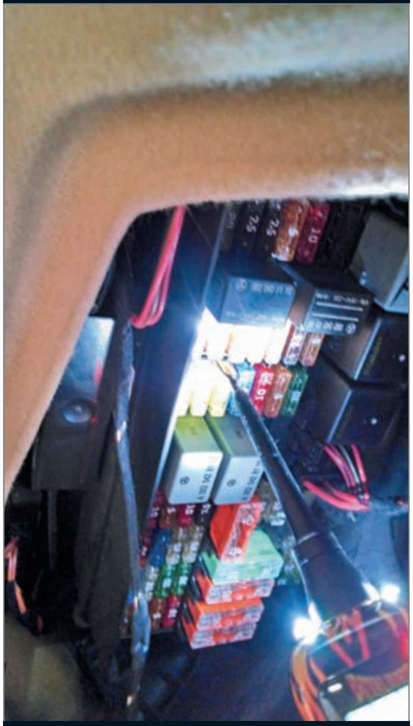

Jumped fuses

DTC P2289 (CAN signal from ckt 15 does not match) was displayed and described similarly by all three scanners. That caught my eye and took a lot of reading to completely understand. I know from experience how CAN BUS codes can wreak havoc on numerous systems in any vehicle, so I prioritize these whenever I encounter them. This was one of 103 active and stored DTCs in the 45 modules identified onboard this vehicle. I'm certain there were more, but my scanners most likely weren't able to identify all the modules or the DTCs. I also identified other history DTCs I felt should be classified as important (like 5557 – No CAN Message Received from Control Unit N51), but knew those could have been induced by improper testing methods or set because of other DTCs and their causes. I put in a few hours analyzing the data, looking for anything the two systems may have had in common before deciding I'd better go back to test some circuits before condemning any component. I suspected the air suspension and the air conditioning systems had a circuit in common but had no idea at this point where the link could be.

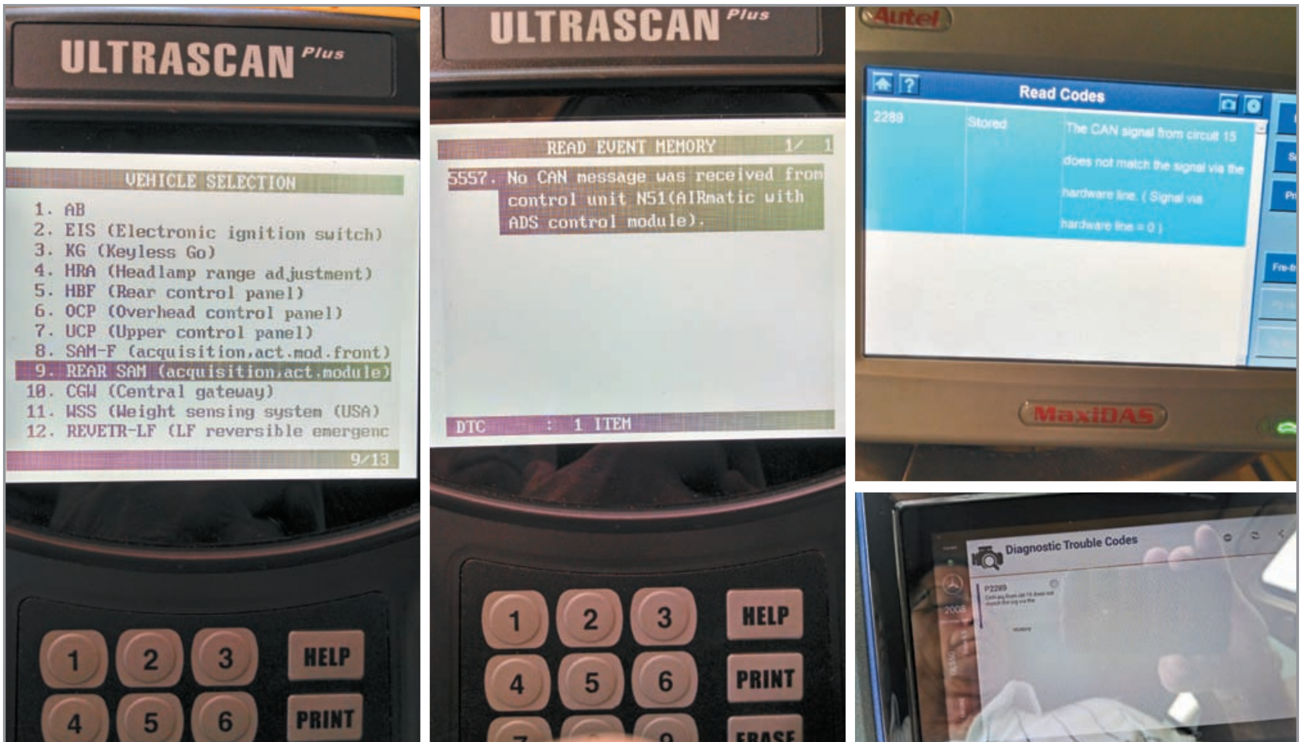
I was curious how so many seemingly unrelated codes could be set in so many modules. I started asking more questions when I returned to the shop. Knowing the air conditioning system diagnostic procedure had not been followed according to the manufacturer's recommendation, nor were the tool manufacturer's instructions for use properly followed, I wondered what procedure was followed to replace the A/C compressor. I had him reflect on everything he'd done and learned plenty as he went through each step. These details are important, so pay attention.

He'd used a floor jack to raise the left front of the vehicle so he could gain


Power Probe shows ground on Circuit 15


Power Probe shows Power on another Circuit 15

access to the area he needed to work in. He realized he also needed to move or loosen other items to get the compressor out and did so. He installed the compressor and reinstalled the other items the following day, as soon as they



The diagnostic trouble codes and data pulled from the vehicle by the scan tool.

were delivered. His description seemed simple enough. However, there were things he'd said that set off red flags or were keys to what got damaged and how. Did you get the same feelings?

I focused on what I felt were the most important and most relevant DTCs that were most likely to affect the most systems at the same time. That code for circuit 15 had me perplexed until I read up on it. This vehicle's ignition-fed circuits are not the same as most vehicles I've worked on. Instead, the ignition switch inputs voltage to certain modules, which in turn control other circuits that will then receive voltage as determined and monitored by those modules controlling it. Sounds overly complicated? It is.

Here is where I remember how thankful I am that I learned how to interpret and understand wiring diagrams. Looking at the air conditioning and air suspension modules' diagrams, they both had a terminal identified as 15 (blk/wht). I finally figured out that 15 was a circuit identifier, as was described in the code I received. When tracing that circuit, I found it originates at both the front and rear fuse blocks. The same circuit is shared by almost all the modules that were setting DTCs. On the air suspension diagram, circuit 15 is fed from fuse 53 in the load compartment fuse and relay box (rear fuse block, as you may call it) and the relay that provides power to circuit 15 is controlled by another circuit 15 in the same fuse block. Yes, you read that correctly. The rear fuse block feeds power to the rear fuse block, which then provides power to the rear fuse block (and ultimately to lots of other stuff in the car). Look at the diagram and see for yourself. Oh, and there's another circuit 15 relay in the underhood fuse block.

When testing at the rear fuse block, one can see in the diagram there is a circuit 15 Relay that feeds numerous circuit 15s when energized: Fuse 51 (Activated Charcoal Filter Shut-Off Valve); Fuse 56; Fuse 54 (Front SAM Control Unit); Fuse 52 (Rear Axle Differential Lock Control Module & R&L Front Reversible Emergency Tensioning Retractor); Fuse 53 (Transfer Case Control Module) & Airmatic Control Unit; and lastly, Fuse 55 (Instrument Cluster & Instrument Lamp Switch). When there's something not right with this circuit, almost everything in the car is affected. Since numerous modules monitor the health of circuit 15, many modules were setting codes for circuit 15 CAN System faults. Can you see why I felt I must

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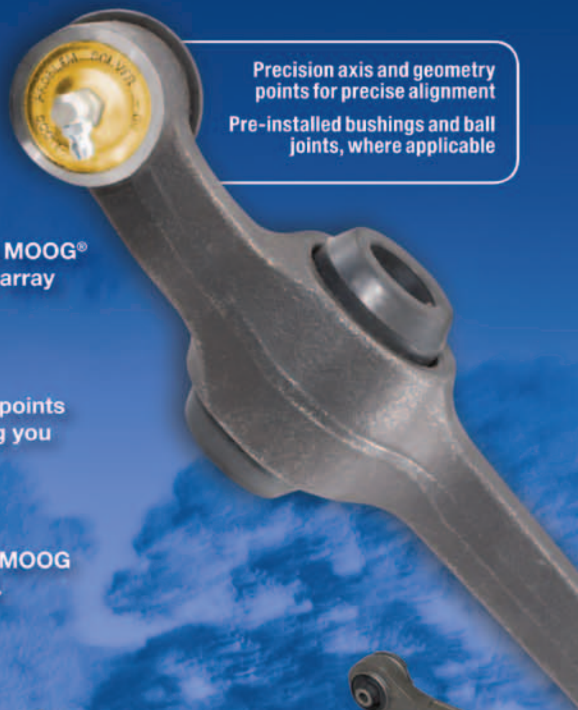


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concentrate on determining why this circuit's faults should be the first to be resolved? Can you imagine how many circuits were affected by the lack of circuit 15 to the front SAM?

The pictures indicate that only some of the fuses that were supposed to be supplied voltage by the circuit 15 relay actually had any voltage. The wiring diagram showed all the circuitry from the relay to the fuses was internally conducted in the rear fuse block. Since only two of the fuses on circuit 15 had power, I knew we needed a new rear fuse block. I attempted to back feed 12 volts to those fuses that were supposed to have 12 volts but was unsuccessful in resolving all the problems by doing so. Some systems came back online but others refused to wake up. Further research indicated the rear fuse block would have to be programmed to the vehicle once it was installed so at this point, I knew I'd reached the end of my capabilities. I realized my limitations on Mercedes vehicles still existed. Chuck would still need to get this vehicle to someone capable of programming a new rear fuse block and configure it if necessary, and I knew this may not resolve all the problems the vehicle had. I recommended he take it to an MB specialist friend of mine who said he would look at it. Steve was able to accurately diagnose it, repair it enough to start properly, and may have even made some recommendations to Chuck about limitations.

There may have been some boring technical stuff in this case study, but was there a resolution? Was there a conclusion? Yes, eventually. Have you forgotten what procedure the customer followed to replace the A/C compressor?


Another shot of the problem vehicle.

The active suspension on this vehicle remains alert whether the key is on or not. Remember, Chuck had to wait a day after beginning the repair for the replacement part to come in. What do you suppose happened when the vehicle was left jacked up on a floor jack overnight? You guessed it! The vehicle tried to level itself and in the process damaged the vehicle's wiring, mostly under the front SAM, including the grounds to the air suspension compressor. So when the components that weren't completely removed (just loosened to allow access to other components) interfered with the suspension trying to correct itself, the plot thickened. When a component is activated but has no ground, the current will flow through other components to complete the circuit. When the air suspension compressor attempted to do its job, a lot of other circuits were affected and subsequent damage occurred, like that found in the rear fuse block.

What about the first problem created? The one where a Power Probe was used on a computer-controlled circuit? For you readers unaware, this A/C compressor has no clutch! It is a variable-displacement compressor that is ECU-controlled through pulse-width modulation. It's possible that by powering a computer-controlled circuit he damaged some other components as well. We all should be careful to not power circuits if we do not have a thorough understanding of that circuit. Chuck never even disconnected the engine harness from the compressor before providing 12 volts to the circuit.

Remember, the testing methods we used in the past may not be appropriate for use on vehicles today. It is our responsibility to know how we are supposed to diagnose the systems we are taking into the shop. Are you accepting that responsibility? Do you live by the constant improvement model? One last question: Do you know where the most expensive training facility is located? Answer: The service bay in your shop. MA


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# THE OTHER EUROPEANS

Another early Saab innovation was DIS ignition systems, but this system is actually a GM design you're probably familiar with – Compression Sense Ignition.

## I'M BETTING WHEN YOU THINK OF EUROPEAN MAKES, THESE COMPANIES DON'T IMMEDIATELY COME TO MIND!

BY **PETE MEIER** | DIRECTOR OF TRAINING

When I think of an issue of *Motor Age* with a European theme, I tend to think we'll focus on brands like BMW, Volkswagen, Audi or Mercedes-Benz. And I think you'll agree that's unfair, as I share the stories of another European marquee you may or may not have turned a wrench on yet: Saab. Yeah, I know what you're thinking. They don't build Saabs anymore. Well, you'd be mistaken on that point and while new models are no longer arriving on American shores, there is a large fleet of existing customers who are still in need of service.

### Born from jets

If you're old enough, you may remember the Saab commercials of the early 2000s, bragging that the same engineers that designed fighter aircraft designed their cars. In fact, Saab was born as an aircraft company to meet Sweden's need for a modern air force to defend against the German Luftwaffe.

In the mid 1930s, Adolph Hitler was preparing his nation for war and neighboring countries, even though many kept smiles on their faces and an open hand outstretched to the German chancellor, were preparing to defend their borders. The Swedish air force consisted of craft that met the needs of World War I but were now woefully outdated and no match for the modern aircraft the Germans were building. Sweden's Prime Minister knew it would be faster and easier to buy aircraft from other countries but insisted instead on developing his own nation's aircraft industry to avoid dependence on others for his nation's defense.

Hence, the birth of SAAB in 1937. The company name in English, roughly translated, means "Swedish Aircraft Corporation." To speed up the learning curve, the first SAAB aircrafts were licensed from existing planes that were considered outdated. But it didn't take the engineers long to learn what they liked and didn't like about the planes they were copying, and soon they gave birth to the first Swedish design, the SAAB 17, with help from American aircraft technicians. The all-metal aircraft made its maiden flight in May 1940. Shortly after, in 1942, the SAAB 18 was introduced. This twin-engine bomber was one of the fastest in the world—a major achievement for a relatively young company. Following the bomber in 1945, the SAAB 21 was their first fighter aircraft, featuring a twin tail "pusher" prop design that would eventually lead to their first fighter jet, the SAAB 21R, taking to the skies in 1947.

As the war drew to an end, SAAB knew that the market for military hardware would shrink and shifted efforts into commercial aircraft design. Even that, though, was not enough to keep them going or to keep their employees working. So a new market was entered – automobiles — and Saab Automobile AB was born in 1945. The first prototype built was the Saab Ursaab ("Ursaab" roughly translated means "original Saab"), also known as the 92001 and was one of four prototypes produced. The engineers charged with the design and build of the prototypes

Photos: Pete Meier

had no real car experience, and according to some sources, only two even had driver's licenses! The first mockup was actually made of alder wood and painted black using shoe polish!

The first production car was the Saab 92, rolling off the assembly lines in 1949. Since that initial birth, Saab has been responsible for many industry firsts. One I'm sure most of you are familiar with is the ignition relocation to the center console. It was a safety design change, helping to prevent knee injuries to occupants who would hit the column-mounted ignition switch assembly in an accident. Here's a few more that stand out:

1963 – first to offer diagonally split dual hydraulic brake circuits

1970 – first to offer headlamp wipers and washers

1976 - first to produce a turbo engine with wastegate to control boost

1978 – first to offer a cabin air filter

1985 – first to pioneer direct ignition, eliminating distributor and plug wires

And that's just a few. Here's another. Did you know that Saab was also a pioneer in developing Variable Compression Ratio engine designs? Their system works by actually tilting the cylinder head in relation to the pistons!

## Not without struggles

Saab entered the U.S. market in 1957 with sales of less than 1500 units. Their customers, however, were typically affluent buyers and the manufacturer earned high praises for their product. In 1969, parent company Saab AB merged with Swedish commercial vehicle maker, Scania-Vabis AB to form Saab-Scania AB. Saab entered into an agreement with Fiat in 1978 to sell a rebadged Lancia Delta as the Saab 600 and jointly develop a new platform. The agreement yielded 1985's Saab 9000, sister to the Alfa Romeo 164, Fiat Croma and Lancia Thema. The 9000 was Saab's first luxury car offering but failed to achieve the planned sales volume. 1978 also was the first year for the 99's replacement: the Saab 900. Nearly one million 900s would be produced, making it Saab's best-selling and most iconic model. Even today, the "classic 900" retains a cult following.

In 1989, the automotive division was established as an independent company with U.S. automaker General Motors owning a 50 percent stake with an option to buy the remainder within 10 years. A new model 900 was introduced in 1994 and allowed Saab to post its first profits in more than seven years. The model, however, never met the mark set by the 900 for owner loyalty or overall quality.

1997 marked Saab's 50th anniversary and with it came a new model, the 9-5. The older 900 received an upgrade and was rebadged the 9-3. In 2000, GM exercised its option and made Saab a wholly-owned subsidiary. It introduced new models, the 9-2x (based on the Subaru Impreza) and the 9-7x (based on the Chevrolet Trailblazer), both of which turned out to be utter commercial failures. Later in 2008, with GM's businesses struggling and facing bankruptcy, it was announced that the Saab division was "under review" by GM executives and was later put on the chopping block and offered up for sale.

Several offers and deals came and crumbled before GM sold the once iconic brand to Spyker. GM would continue to supply Saab with engines and transmissions, and also completed vehicles in the shape of the new Saab 9-4x from GM's Mexican factory. The deal included a loan from the European Investment Bank, guaranteed by the Swedish government. But it didn't take long for Spyker to figure


Saab is an automobile company that truly was "born of fighters," beginning first as an aircraft company prior to WWII.

Photo: Ernst Vikne via Wikimedia Commons

out that running a major automaker was an expensive proposition, and it filed for bankruptcy in 2011 after GM blocked an attempt to sell the company to a Chinese concern, saying that it would not continue its licenses to GM patents and technology to Saab and stating that the new owner's use of the technology was not in the best interest of GM investors.

In 2012, the main assets of Saab Automobile AB and its subsidiaries (Saab Automobile Powertrain AB and Saab Automobile Tools AB) as well as the Saab factory had been acquired by a Chinese consortium called National Electric Vehicle Sweden (NEVS). The intent of the new company was to build electric vehicles for sale in China and continue to refine and build gas-powered 9-3s for sale in both the Chinese and Swedish markets.

## The death of a brand?

For all intents and purposes, though, Saab in the United States is dead and may never return again. At the time of the bankruptcy, it was estimated that over half a million Saab owners (with the exception of those sold under GM ownership) were going to be left high and dry. How will you take care of those customers? Check out a company called Orio. Saab Automobile Parts was not a Saab subsidiary included in the NEVS deal and was renamed Orio AB in 2013. It holds the licenses to produce original equipment parts for Saab models and is expanding into offerings for other makes as well. They are also a tech support source for independent shops still taking care of Saab customers, and you can register to be a part of their authorized Saab service network by emailing the company at contactsaab@saabpna.com or visiting their website at www.orio.com/us.

## A few personal Saab stories

Living in the deep South as I do, I don't see designer cars very often. And that's the niche that Saab truly filled. In their later years and before the homogenization that GM laid on the brand, the cars were of high quality and were unique in many ways. I recall doing a lot of convertible top hydraulic actuator replacements (they used hydraulic solenoids rather than electric motors to operate the mechanisms); most of the work was relatively routine. Here is a tale or two that I did think were interesting enough to share.

The first story is about a Saab 9-5 our shop had for sale. Prior to putting it on the lot, my boss wanted me to repair the missing back-up lamp he said it had. So I turned on the key and put it in reverse. Sure enough, there was no light lit on the left rear. No sweat, likely a bulb...so I pop the trunk, access the bulb, and remove the old one for a visual. Looks OK, but I've been fooled before so what the heck... let's throw one in.

Light still doesn't work.

OK, so it won't be easy. I grabbed my PowerProbe 3 out of the toolbox and hook up to the battery. With the right rear still on, I look for power and ground at the left rear socket. No power at either wire. I'd seen this before on a BMW I had had the week before. The problem there had been a break in the wiring right where the lid harness passes out of the lid, through a rubber shield, and into the body.


The first Saab prototype, the "Ursaab" – meaning "original Saab."

I tested to see if there was power on that wire on the body side of the harness. Hmmm, no power there either? Oh well, guess I have to pull the schematic now.

Interesting! The schematic only shows one back-up lamp on this model! Wonder what the bulb I had in my hand was for? Come to think of it, the lens on this side IS pretty red for a back up lens.

And it does work with the right switch turned on.

It turns out that the left rear bulb is a "rear fog lamp," and has its own switch just below the main lighting switch on the dash. I guess it allows one bright light to stay on in the back in heavy weather/fog to improve the vehicle's visibility. That makes sense considering the weather conditions that Swedish drivers often face. But it

The baffle in place on the replacement tank. Below is an indentation that must line up with the pump on install to prevent the sending unit from hanging high.

One lesson I learned the hard way on a Saab repair — this broken tank baffle was the cause of an erratic fuel gauge.

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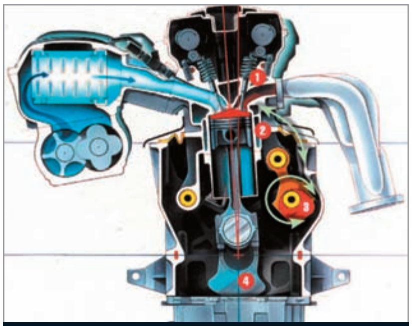
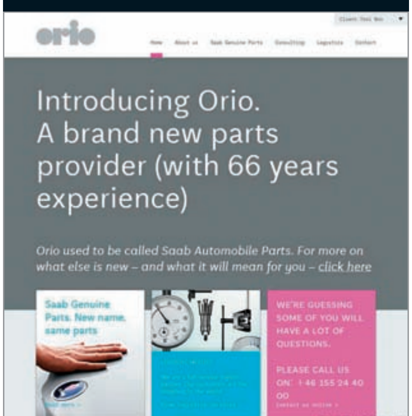
Being the thorough tech that I am, I made sure to check the operation of ALL the lights while I had the car. Lo and behold, the left front high beam was not working either. Should be a simple repair, right? The right side was working on both beams, the left only on low. Likely a bulb, but there are enough cars on the road using separate fuses for the headlights that I started there…with a quick check of the fuses. The PowerProbe was still connected, and it is an excellent tool for this purpose.

All the fuses tested either fine or at 0.0 volts — not unusual since some fuses aren't "hot" unless the system they power is turned on. So, I put a bulb in. Did you guess yet?

Right, not working.



While never finding a home in production, Saab was among the first to develop a variable compression engine. It pivoted the head up or down to increase the volume in the combustion chamber, effectively reducing compression ratio from 14:1 to a little under 9:1.




With half a million cars still on U.S. roads, Orio AB (formerly Saab Automotive Parts AB) steps in to take up the slack, providing replacement parts and training resources.

Photo: Orio AB

OK, let's pull the schematic and do this right. Checking for voltage at the headlight with the key and high beams on ended up with nothing. According to the schematic, the two headlights did indeed have separate fuses, so that was the next stop. One of the fuses that had no power on the first pass was also the one that was supposed to power the headlight that was inoperative.

The next stop was a component labeled the "Front Filament Module." This device looks a lot like a relay, but actually monitors current flow to the headlights. If no flow is detected, it sends a signal to the Driver's Information display to let him know that a bulb is out. Removing the module, I looked for power on the battery side and was rewarded with a "high" beep from the PowerProbe. Last step to verify the problem? Use the PP3 to power the left headlight side of the path. The light came on, and I knew the path to the bulb was OK. The module was the only thing left that could be at fault.

## Another Saab, a different dilemma

This Saab 9-5 customer was complaining of an erratic fuel gauge reading. No sweat — 9 times out of 10 it's the sending unit and this vehicle was old enough to make that a likely suspect. But just to be sure, I decided to pull it out and take a look.

This pump is accessed under the rear passenger seat, and is pretty easy to remove. With the pump out, I hooked up my ohmmeter and moved the sending unit arm through its full range while watching the resistance change. Seeing some drop outs in the reading after doing this three or four times convinced me that the sending unit was faulty, so a replacement was ordered and installed. The car was returned to the customer.

And returned a week later.

But you guessed that already, didn't you? After all, if there wasn't something else going on this would be a boring story!

Had I done something wrong? I had read the service information, and there was a specific note on how to install the pump to make sure the sending unit operated properly. I didn't bother

Not quite dead yet, the Saab 9-3 may live on as an electric vehicle aimed at the growing Chinese market.

Photo: NEVS

to question the information at the time, but now my curiosity was aroused. I removed the pump, and peered into the tank and could see that there was a depression designed for the base of the pump module and off to the side was an additional recess for the sending unit arm. If the pump were positioned improperly, the arm would stop "high" on the lip of the depression instead of being able to move to its lowest point of travel. But, I thought, that would make the gauge read partially full even when the tank was empty, and that didn't jive with the complaint…erratic readings that changed while driving.

Then I noticed something white and plastic floating in the fuel. I removed the tank for a better look.

Apparently, the plastic I was looking at was a baffle that should be fixed to the base of the tank. A call confirmed that this baffle sits in front of the fuel pump module to prevent normal "slosh" from getting to the pump. Now I'm thinking that the floating debris was hitting the float arm and causing the erratic readings the customer was complaining about. Since the one I had was in pieces, a new tank had to be ordered.

Another lesson learned the hard way…hopefully now you won't have to! MA

PETE MEIER
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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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# IT AIN'T ALWAYS EASY

## IT'S THE CHALLENGES THAT HELP US GROW AS TECHS

BY **G. JERRY TRUGLIA** |
CONTRIBUTING EDITOR

A 2008 Porsche Boxster with 18,900 miles came in with a Tire Pressure Monitoring System (TPMS) problem. It was not displaying all the tire pressure readings from its four wheels. Since the vehicle is seven years old, it's possible the TPMS sensor batteries were dead. Most of the time, replacement of TPMS sensors is a routine service that can be easily done. That was not the case on this Porsche — even when we installed an OE and then a programmable sensor.

The problem was that the TPMS sensor data would sometimes read on the dash and at other times it would not be visible at all. Michael and I tried one new Porsche sensor in the left front wheel to see if it would make a difference, but it did not. Our next step was to connect the scan tool to view what was being reported to the TPMS controller. Unfortunately, the TPMS controller was not seeing the sensors even after we programmed the sensor IDs. One problem we were confronted with was that the sensor ID numbers would sometimes be displayed and would change from wheel to wheel. As we continued our diagnosis, we decided to change the TPMS controller since the symptoms were random and not making sense.

### Still not done

We located the TPMS controller under the hood and installed the new dealer unit. As with many Euro controllers, it needed to be programmed before it would work properly. We connected our Autologic scan tool and programmed the controller without any problems. After the programming was completed we were able to obtain the sensor IDs on the scan tool, but there was still a problem. The four TPMS sensors we programmed with our aftermarket TPMS tool were not displaying the same IDs as what was being displayed on the scan tool. Two of the sensors had the same ID number, while the other two had different numbers other than what we programmed.

The frustrating part was that we tried all three TPMS tools that we own only to find out that one of the two could not even pick up the frequency of the sensors, while the other tool was only able to provide the frequency and one of the sensors IDs. One tool read them all, but the IDs that were displayed were not correct. This simple job was turning into a real headache with conflicting information between the tools.

We called two of the TPMS tech lines only to be told that the tool should work (even though it didn't). The vehicle had to be driven to make sure the TPMS sensors reported the proper information as the final part of the repair. Since nothing was working 100 percent after we installed the new TPMS controller, we thought the best way to proceed was to break down all the tires and program the IDs again.

We believe that because the TPMS computer was bad, it must have affected the TPMS IDs. Once we reprogrammed the 10 digits into the sensors, we installed the wheels back on the vehicle. We rechecked the TPMS IDs on the scan tool (now all reporting the same IDs we programmed) for each TPMS sensors. Next, I test drove the vehicle to make sure the dash display would be able to display the tire pressure for all four wheels. Take a look at the dash (Figure 1). That, thankfully, was finally displaying the correct information for this orange Porsche Boxster.


Figure 1


Figure 2

### An 'easy' Toyota

Our next vehicle is a 1999 Toyota Rav 4, 2.0L that came in with an illuminated check engine light with Diagnostic Trouble Codes (DTCs) P0171 (System Too Lean – Bank 1) and P1130 (Air Fuel Sensor Circuit Range and Performance) along with a driveability problem. This vehicle had already been to another repair shop that replaced many parts without resolving the problems, making the vehicle owner unhappy. The vehicle owner had lost confidence with the other shop's ability to repair the problem and was looking to get the vehicle fixed.

It's always tough to hear that another shop was not able to repair the

Photos: G. Jerry Truglia

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480-827-TOOL (8665) www.autoenginuity.com vehicle, especially since some vehicle owners tend to not tell you the complete story. We need to stick together and make sure we don't bad mouth each other and always suggest that the customer bring the vehicle back to the other shop. Since the customer was fed up, this Toyota was now our problem and had to be diagnosed and repaired. I gave this job to Bill, who performed a thorough diagnostic routine and came up with the DTCs along with a very high Long Term Fuel Trim (LTFT) reading.

Bill used the right approach and started diagnosing the lean DTC, looking for vacuum leaks that are common on Toyota models. Many of the high LTFT readings that I have found on Toyotas have been due to manifold gasket problems when an engine is cold. A check of the Freeze Frame data, though, showed that the engine temperature at the time the code matured was 192°F, so that ruled out the intake gasket problem. To make sure there were no vacuum leaks, Bill smoked the engine with our evaporative emissions system tester. What else would cause a lean condition? Maybe low fuel delivery, EGR leak, a faulty air fuel ratio sensor, MAP sensor and maybe something else. So rather than guessing, Bill decided to do some research and spend some time online with our service information resources. What he uncovered was that the Bank 1 downstream oxygen sensor (B1S2 $O_2$) could control fuel trims. Before he went too deep, he needed to check the basics, including fuel pressure (in spec) and fuel volume (also in spec). With fuel and vacuum leaks out of the way, the next things to check were the sensors.

Bill verified the sensor inputs all the way to the rear oxygen sensor, which was reading zero volts. We reviewed the Freeze Frame data again to see if we missed anything while checking the current scan data. We found the LTFT reading was the same 44 percent as the Freeze Frame data had reported, along with the rear $O_2$ sensor's zero voltage reading.

Take a look at the EScan Fuel Trim screen shot where Short and Long Term are high at idle and at 60 percent throttle (Figure 2). When we checked the voltage reading of the AF sensor on the scan tool, the voltage was under the normal 3.3 volts at idle, only reading 3.15 volts. The low voltage reading on the AF indicates that the engine was running rich. The odd thing that we noticed was that the rear $O_2$ sensor was still staying at zero volts and not changing as the rpms were changed.

> **"It's always tough to hear that another shop was not able to repair the vehicle, especially since some vehicle owners tend to not tell you the complete story."**

Many vehicles use the rear $O_2$ sensor as an important input signal that will play a part in adjusting fuel trim readings. So we decided to replace the rear $O_2$ sensor followed by removing both the battery cables and installing a one ohm – 10 watt resistor to clear the capacitors to reset the adaptive fuel trims. We test drove the vehicle to see if there was any change in the 44 percent LTFT readings.

We were rewarded with a +9 percent on the LTFT and the Rav4 was no longer exhibiting any driveablity problems. We test drove the vehicle one more time making sure no DTCs reset before returning it to the happy customer.



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# DRIVEWAY DIAGNOSTICS

## DO YOU WORK ON YOUR OWN CAR THE SAME WAY YOU WORK ON YOUR CUSTOMER'S?

BY **PETE MEIER** | DIRECTOR OF TRAINING

I must admit, when I was repairing other people's cars fulltime, the last thing I wanted to do on the weekend was work on my own. But for the last five years or so, I find myself spending more time behind a computer keyboard and less time under a hood. It is vitally important to me that I keep a connection with all of you, our faithful readers, and that I do all I can to keep some grease and callouses on my hands so I never forget how tough it can be to make a living in this business of ours.

So I welcome the occasional challenges offered to me by family and friends, and the occasional help request I get from local shops. Of course, I take care of my own small fleet of vehicles including the subject of today's story – my 1999 Ford Ranger. The MIL (Malfunction Indicator Lamp) has been on for some time now and what symptoms there are have not been serious enough (I think techs and customers have different levels of "serious") to cause me any real issues. The 3.0 liter V6 bucks and runs horribly for the first few minutes of operation, then settles down and runs fine until the next overnight soak.

### TRUCK TROUBLES

**1999 FORD RANGER**
Vehicle Year/Make/Model

**175,432**
Mileage

**3.0 LITER V6**
Engine

**AUTOMATIC, 4WD**
Transmission

**RUNS ROUGH; MIL LIGHT ON**
Complaint

I've had the truck for a while now, having acquired it from my youngest son in exchange for the 2007 Toyota Corolla I once owned. No, it wasn't an equal deal; it was more of a "dad" thing. Now it's time to sell it off in favor of a later model truck I've had an eye on, and before that happens I need to find and correct whatever ails the Ford before passing the keys on to the next owner. The quest for a cure also allows me to share my diagnostic process with all of you and perhaps, together, we might learn a little something along the way.

### What comes first

There's a pretty good bet I already know the kind of code(s) I'm going to find when I connect my scan tool to the truck. The rough running scenario I described earlier must have certainly caused a misfire code of some kind. And while my first diagnostic step is to interview the customer (or service writer that wrote the repair order), I think it's safe to bypass this step and move to my next – connecting a scan tool and taking a look at what the ECM (Engine Control Module) has to share.

Sure enough, a P0302 (Cylinder 2 Misfire Detected) is stored in the ECM, as is a P0455 (EVAP System – Gross Leak Detected). With the codes retrieved, my next step is to check the associated Freeze Frame data to get an idea of when and under what engine conditions the misfire code was recorded. Had I not been already familiar with the cold start symptoms I mentioned earlier, this information will help me simulate those conditions rather than rely on how the truck runs at idle in my bay. The Freeze Frame data confirmed what I suspected – the misfire occurs when the engine is cold.

Now let me ask you. Should I seek out Freeze Frame data on the EVAP (Evaporative Emissions) code?

In my opinion, while it may be stored, there is no real need to review it. The reason? The EVAP monitor is a non-continuous monitor that runs through its tests only once and follows an outlined test procedure. The Freeze Frame data would only indicate the conditions I already know the monitor has to be in to run. The misfire code

Photos: Pete Meier

(as well as fuel trim codes) is a different story. These codes are continuous monitors running over and over again that test the system(s) under a variety of rpm and load conditions. And that is information I have to have to accurately and quickly diagnose the causes for these codes.

### Next — fact finding

Now that I have an idea of what ails the Ford, it's time to move on to a quick visual inspection. At this point, I'm not going to get too deep. I just want to take a look and see if there is anything that immediately catches my eye that doesn't appear right. And I also want to get an idea of how the owner takes care of his vehicle. Does it look like it is getting the maintenance it needs, or is he just driving the wheels off of it?

The 3.0-liter V6 uses a DIS (Distributorless Ignition System), and I had replaced the plugs and wires for my son shortly after he got the truck. I like to baseline maintenance items on used cars I buy, so I can start the "clock" from that point forward. I took a look at wire routing to see if any of the ignition wires were in contact with the hot exhaust or rubbing on engine brackets and saw no issues there. There were no major leaks visible (oil or coolant) but the coolant reservoir was very low – nearly empty as a matter of fact. A peek at the oil dipstick showed no sign of coolant intermix, but the level was low as well. A look at the oil fill cap also revealed no sign of coolant in the oil (that chocolate milk looking mix we see all too often). Still, that coolant had to have gone somewhere, so I kept that information filed for later use.

With the visual inspection done, it was time to do some homework. Before I grab the first tool or make the first test, I want to gather all the background information I can, especially if I'm diagnosing a system that I have little or no experience with. And though I felt relatively fluent on the Ford systems I would be working with, it never hurts to refresh your memory. I want to understand what the code definition really is (NEVER rely on the abbreviated definition for ANY code), what the enabling criteria are, how the ECM tests for the codes I'm chasing, and how the engine management systems work. With that in mind, I can decide what test(s) I want to make, saving me time over just jumping in with a "hit or miss" plan of attack.

My first stop was MotoLOGIC, a relatively new service information system that features all OEM content. Its search function is similar to what you're used to with Google. Simply start typing in a code, system component, or whatever, and it begins to populate a list of suggestions to help speed up the process. It also has a "Quick Spec" tab that brings up the most common service specifications on one page as well as keeping a record of the last 10 vehicles you searched, listing the last 10 items you searched on each one. That makes it nice when more than one tech is using the same access point.

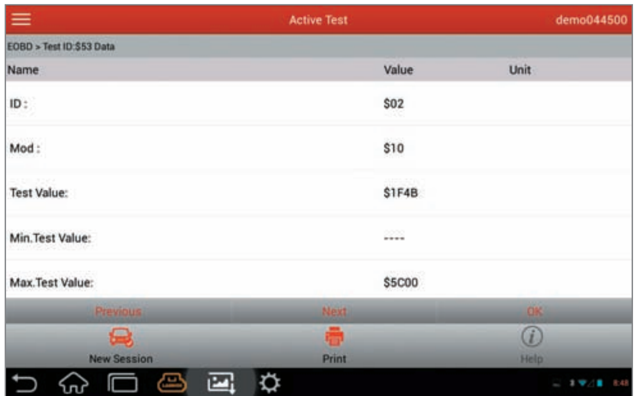
I decided to dig into the misfire code first, pulling up the first article that appeared in my MotoLOGIC search, which just happened to be a detailed description of how the Ford's misfire monitor works. The Ranger, as do most OBDII engines, monitors misfire rate by monitoring the crankshaft sensor signal. Fluctuations in speed that exceed programmed thresholds are logged as a miss. On Fords, any time the battery is disconnected or power is lost to the ECM's Keep Alive Memory, the ECM has to first relearn what a normal crankshaft position sensor signal is before it can once again resume monitoring the engine for misfires. In some older trucks, like this 1999 model, harsh roads or bouncing around off-road could cause a misfire to be recorded. And we all know that the Ford threshold is kind of high, with many models exhibiting the signs of a misfire without codes being set. However, that doesn't mean that the ECM doesn't see the misfire. While there is no misfire-related PID (Parameter Identifier) on your scan tool, there is help in Mode $06 on Ford products (and all makes that use a Controller Area Network (CAN) protocol). You can find out more about the use of Mode $06 on the *Motor Age* website.

While I'm in there, I checked for TSBs (Technical Service Bulletins) out of habit. The MotoLOGIC search revealed none related to the miss (but a few that may shed light on the EVAP code), I next hopped over to some other tech resources I like to tap into to see if anyone else has dealt with a similar problem to mine. With that all completed, it was time to absorb that newfound knowledge and come up with a process that would help me quickly nail down the problem.

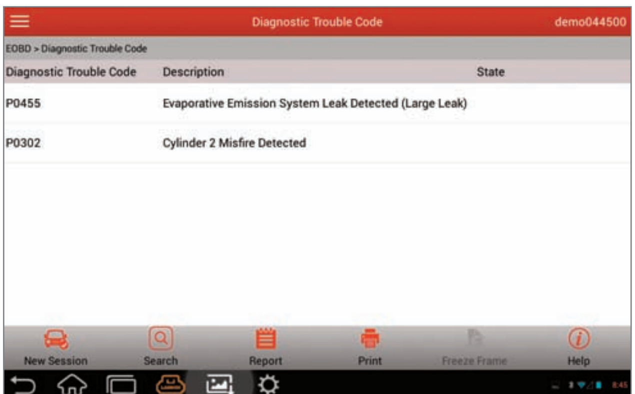
## Time to test

When chasing down a misfire, it is critical to remember that ANY factor that can result in a cylinder contributing less than its share can be a cause. That's why I recommend taking the time to become familiar with the specific systems and code requirements you're dealing with on a particular car. Take the time to think about all you know about those systems, and add in the information you have from your customer, the recorded Freeze Frame data, and your visual inspection. Consider what you see, hear, feel – even taste.

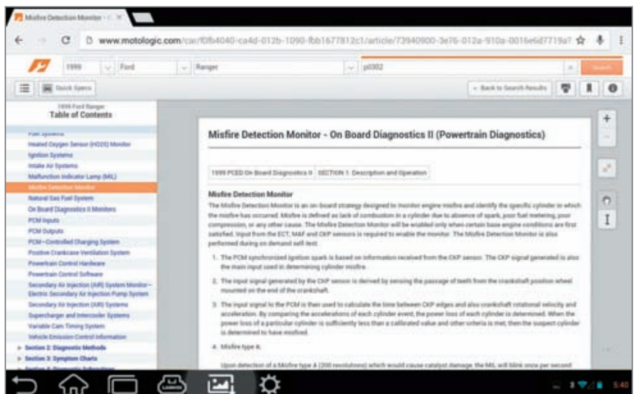
For many, the next step is to begin testing to eliminate all the possible causes you can, and do so in as few tests as you can. Many techs refer to the process as "general" testing, helping them to quickly hone in on a particular area where they can begin more "pinpoint" testing to hone in on the culprit. For others, the process entails the formulation of a hypothesis – taking all the information they have to date and then considering what the most likely causes of that problem might be. Testing is then done to confirm or eliminate the possibilities until the problem is confirmed and repaired. I tend to combine the two; depending on what kind of problem I'm facing and what I know going in. Let's summarize what I know so far regarding the misfire on cylinder #2.




Pre-CAN Fords have a misfire counter of sorts in Mode $06.

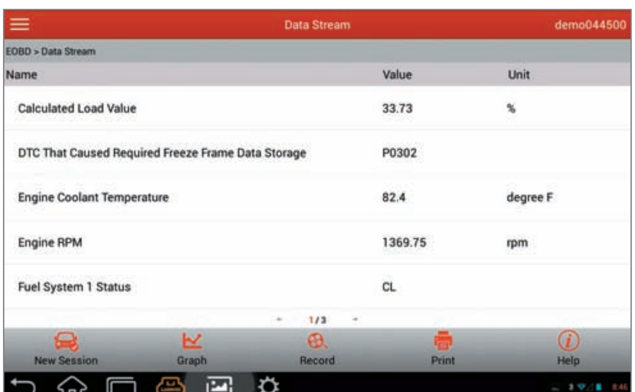



I suspected I'd have a misfire code stored, but wasn't expecting the EVAP code.

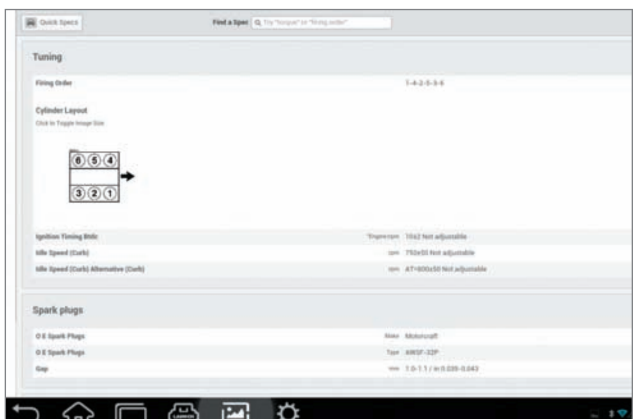



MotoLOGIC uses OEM service information, so I started my research on the P0302 code by first learning how the misfire monitor works.

Photo: MotoLOGIC




The Freeze Frame confirmed what I already knew – the misfire occurs when the engine is first started.




The Quick Spec feature is just one of the time saving tools on MotoLOGIC. Now I know which cylinder is the #2 cylinder on this 3.0.

Photo: MotoLOGIC

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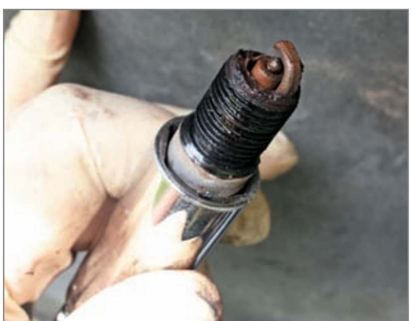
According to the "customer," the engine runs rough, at times very rough, when first started. After a few minutes of operation, the engine smooths out and appears to run fine. The Freeze Frame data confirms what the customer has to say, showing the misfire code recorded while the engine is still cold at an rpm consistent with a fast idle warm-up. Fuel trims are no help here, so they are ignored for the time being. The visual inspection uncovered an unexplained loss of coolant but there was no sign of coolant intermix in the oil. No smoke of any kind is visible on start up coming from the exhaust either.

The coolant level was nearly non-existent with no visual leaks found on my initial inspection.

As part of the initial visual, I checked the ignition wire routing for any obvious signs of problems.

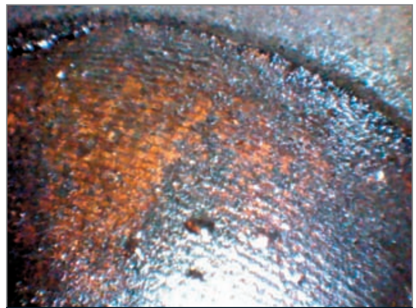


The #2 plug was fouled with heavy deposits around the electrode and inside the shell. Obviously something extra was getting into the cylinder's combustion chamber, but what?

I took the latter with a grain of salt, because I have seen catalytic converters do a good job of eating whatever smoke was passed through them. I remember more than one make, which I'll not name, that was notorious for burning oil at rates that would keep any Middle Eastern country in business all by itself, yet no telltale smoke exited the pipe. I've also seen cases where coolant was getting into places it shouldn't be with no sign of contamination in the oil. In fact, many coolant manufacturers will tell you that coolant leaking into a combustion chamber is more common than you think but that's the topic for another conversation.

My first test was a continuation of the visual inspection process. Since the truck had now been sitting all night and had not been started yet, I removed the #2 spark plug to see what stories it had to tell. I found the plug tip heavily coated with deposits and wet. The presence of the deposits was enough to let me know that something extra was invading the cylinder. I saw no real color in whatever it was that was causing the wet appearance, but the fact that it was wet for so long took fuel out of the equation. Fuel, I thought, would evaporate quickly, especially in a hot engine.

I suspected I had found the coolant leak I was looking for. If it was indeed leaking into the combustion chamber, I should see even more by looking down into the cylinder. The angle of the plughole and its placement, however, made simply shining a light down in for a look impossible. The folks at Automotive Test Solutions, though, had recently sent me a borescope to try and that was my next step. This tool has an excellent resolution and the ability to manipulate the tip, similar to medical grade borescopes, and it provided me the last piece of the puzzle I needed to confirm coolant contamination was the issue. The top of the piston was glistening



Sending the borescope probe down into the cylinder while looking at the image on my little PC provided the final clue – droplets of water on the top of the piston.

in the light of the borescope's camera with individual droplets clearly visible. Just for comparison, I looked at the adjacent cylinders and found them both dry.

As I mentioned earlier, I had seen similar losses before. What happens is relatively simple. The leak is relatively minor, so much so that any loss while the engine is warm and running is burned as quickly as it enters. However, once the engine is shut down and the system is still under pressure, coolant is allowed to pool on top of the piston in sufficient quantity to contaminate the air/fuel mixture on initial start up, resulting in the cold misfire.

Last step? Time to pull the cylinder head and see whether or not it's a gasket problem or a crack in the head. Time to look up the labor time and procedures in MotoLOGIC, get some tools together and enjoy a cold beverage before I dive in. Repairing your own cars at home does have a few advantages! MA

**PETE MEIER**
DIRECTOR OF TRAINING

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.

Email Pete at pmeier@advanstar.com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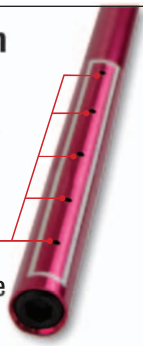

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# GET A GRIP!

## THERE TRULY IS A LOT DEPENDING ON YOUR TIRES!

BY **PETE MEIER**
**Director of Training**


MotorAge.com/sep15trainer

The Isle of Man TT is among the world's great races, and you don't have to be a motorcycle fan to appreciate the skills and talent riders bring to this almost 38-mile-long "track," which is actually a road course that traces a path through the countryside and small towns of this tiny island located in the Irish Sea between Scotland, England, Ireland and Wales. Riders reach speeds of nearly 200 miles per hour while negotiating a seemingly never-ending barrage of bumps, bends, manhole covers and stone walls. As they lean these high horsepower machines over at angles that appear to be nearly horizontal, one has to wonder, "What keeps them on two wheels?"

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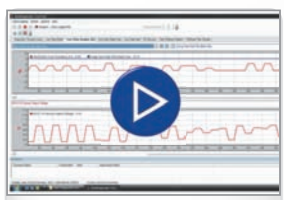

The long and short of fuel trims

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