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A DIAGNOSTIC SUCCESS PLAN

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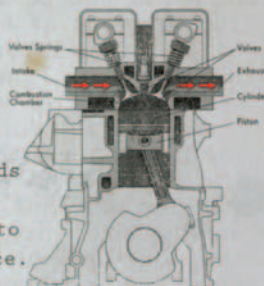


Fig. 2-Engine Fuel System

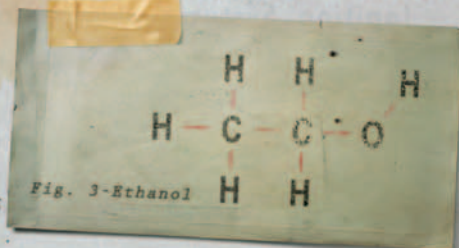


Fig. 3-Ethanol

Ethanol is a solvent that attacks metal surfaces, allowing water in the fuel system to have a faster and more corrosive impact.

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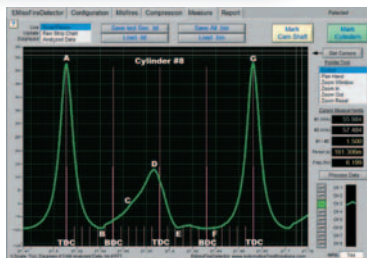
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Indispensable Automotive Innovations

It was not so very long ago that telephones, microwaves and computers were considered mere fads for a privileged few. But as each innovation showed how daily life could be simpler, safer and more efficient, each became indispensable to the masses.

3



The same is true of automotive innovations that once seemed odd or pricey. Each has vastly improved life on the road, and today, we can't imagine driving without them.

1. CHILD SAFETY SEATS

It's hard to imagine a child traveling in a burlap sack or booster chair, but those were considered valid options in the early 20th century. In 1968, General Motors developed the "Love Seat for Toddlers," followed by the "GM Infant Love Seat," which were designed for crash protection. Today, the federally mandated Lower Anchors and Tethers for Children (LATCH) system helps make car seat installation easier and safer.

2. AIR CONDITIONING

First offered in the 1930s, early air conditioning systems filled vehicle trunks and cabins with giant evaporators and visible tubing, and cost the modern equivalent of \$5,000. But by the late 1960s, more than half of domestic automobiles were equipped with affordable under-hood, vented systems similar to those today, putting sweaty summer commutes in history's rearview mirror.

3. CONNECTIVITY

Options for staying connected on the road were long limited to the CB radio, payphones or expensive car phones. But today, a new wave of mobile technology makes in-vehicle communication more reliable and accessible. Systems such as OnStar offer Hands-Free Calling, Advanced Automatic Collision Notification, Turn-by-Turn Navigation and 4G Wi-Fi® to help drivers and passengers keep in touch, stay productive and stream on the go.

4. BRAKING

Automatic Emergency Braking (AEB) systems have been offered on luxury vehicles for years, helping to prevent or lessen the impact of collisions by applying brakes on a driver's behalf. But this once-rare technology is going mainstream, with General Motors being one of 20 automakers committed to making AEB standard equipment on virtually all new U.S. vehicles by 2022.

2



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ONLINE COVERAGE

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U.S. HOUSE COMMITTEE HOLDS HEARING ON STRENGTHENING CARL D. PERKINS CAREER AND TECHNICAL EDUCATION ACT

Those who testified during the hearing explained how quality training benefits not only students, but also their community and the specific industry in which they are being trained.

»» MOTORAGE.COM/EDUCATIONACT

MITCHELL 1'S SCHALK FIRST WOMAN TO RECEIVE 2016 TECHNICAL AWARD

Susan Schalk, senior repair information specialist at Mitchell 1, has been recognized by the Auto Care Association as one of 12 recipients and the only woman to receive the 2016 World Class Technician Award.

»» MOTORAGE.COM/SCHALK

U.S. DEPARTMENT OF LABOR ISSUES OVERTIME RULE

The Department of Labor issued a new rule for the nation's overtime regulation that increases the minimum salary to qualify as exempt from overtime requirements.

»» MOTORAGE.COM/OVERTIME

AFTERMARKET PARTS, SERVICES STILL VIABLE TO KEEP ELECTRIC VEHICLE FLEETS RUNNING

Repairers and parts providers serving fleet accounts are being urged to become current with electric vehicle expertise and continued training as governmental and commercial motor pools are increasingly going green with EV technologies.

»» MOTORAGE.COM/EVFLEETS

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More than 130 suppliers and manufacturers worldwide hosted exhibits at the 2016 WORLDPAAC STX event.

INDUSTRY TRAINING

WORLDPAAC event hosts training, expo

Take a hard look around the industry, and you'll see an increased interest among the aftermarket and OE supply companies in providing training to the men and women who ultimately service, install and repair their products. WORLDPAAC, a leading importer and distributor of OE and quality aftermarket parts, didn't wait for the trend, though. They helped create it.

WORLDPAAC's Supplier and Training EXPO (STX) events were initially created in 2009 as the company's vision to help their customers better succeed in the changing aftermarket environment. It has since grown into an eagerly anticipated biennial event for the 40,000 strong network of WORLDPAAC customers. This opportunity to learn the latest in advanced vehicle technologies, as well as the creative business skills needed to take an independent repair business to the next level, are exclusively offered to WORLDPAAC partners. The 2016 event, held at the Gaylord Texan Resort outside of Dallas, hosted more than 1,600 attendees who took advantage of 160+ course offerings taught by industry experts in their fields.

In addition to the training, the event also hosts a trade expo featuring more than 130 displays from parts and tool suppliers from around the world. Here, attendees had the opportunity to interact directly with the suppliers and manufacturers and take advantage of special show pricing on the tools and equipment they need to compete in an ever increasingly competitive business.

For more information on how your shop can become a participant in this program, visit worldpac.com.

BREAKING NEWS RECALL REALITIES

ENCOURAGE RECALL REPAIRS TO ENHANCE CUSTOMER RELATIONSHIPS

Although you may be feeling queasy about sending a hard-won and loyal customer out to the Auto Mile, non-dealership repairers can gain goodwill by letting patrons know that a recall is in play and assist in answering their preliminary questions.

Official notifications sent to drivers — if they even make it into the hands of the vehicle's correct current owner — frequently end up "under the pile of junk mail, and you can help with that education," reports Ann Wilson, senior vice president of government affairs at the Motor & Equipment Manufacturers Association (MEMA). "It demonstrates to your customers that you have their best interests in mind, and it paves the way to have the work done. You have the ability to look up

[RECALL] CONTINUES / PAGE 6

Photos: Pete Meier

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[RECALL]

CONTINUED. FROM PAGE 4

the VIN when you have the vehicle in your bay. It shows that you're on top of the new technology and that you know what's going on."

Recall repairs tend to be exclusively within the dealership domain because of the federally mandated responsibilities of OEMs to effectively remedy the problem. And as Capitol Hill committees hold hearings on the amount of recall notices that have yet to be heeded by the motoring public, regulators, automakers, suppliers, insurers and other industry organizations are implementing programs aimed at motivating drivers to actually come in and get their repairs accomplished.

Throughout the U.S. in 2015 a record-setting 51.2 million vehicles were issued notices, topping the 50.9 million vehicles recalled in 2014. During the first eight weeks of 2016 there were already 84 new recalls impacting 8.6 million vehicles.

As many as one-third of all American car owners have experienced the unpleasantness of receiving a recall notification about their vehicle, according to a recent national poll conducted by Liberty Mutual Insurance.

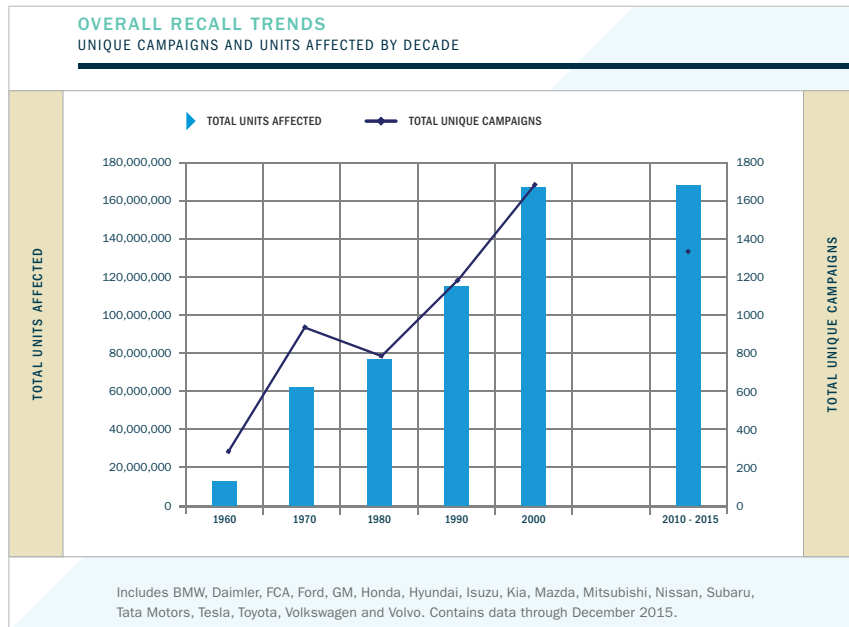
"We found that 62 percent of those surveyed believe it's the manufacturer's responsibility to notify them if their car has been recalled," notes Chad Lovell, the carrier's managing director of emerging partnerships and strategic programs.

"The overwhelming majority of Americans — 91 percent — reported they would find it valuable if someone proactively notified them that their vehicle has been recalled," says Lovell, referring to Liberty's recent launch of its Auto Recall Notification Service that utilizes up-to-date recall data compiled by third-party vendor CarProof.

With access to VINs and policyholders' most current contact information, "we have a direct line to the driver that auto manufacturers may not have to provide a proactive alert to any recalls associated with their cars," he says.

Remaining on the radar

Aimed at shop owners, J.D. Power's new SafetyIQ system incorporates doc-



umentation from the National Highway Traffic Safety Administration (NHTSA) to present daily online updates regarding vehicle recalls, technical service bulletins and driver-filed complaints in a searchable database covering make, model, year and component.

"A key part of keeping customer cars well maintained is making sure the recall repairs are up to date," observes Vern Poyner, general manager at Carfax, which has collaborated with Dealerlogix to produce an integrated version of myCarfax "so dealerships can identify more vehicles with open recalls in their service lanes."

"This integration automatically looks up open recalls and adds them to the appointment or repair order with zero effort on the part of the service advisor," says Dealerlogix President Mark Brandon.

Assessing risk factors

The Alliance of Automobile Manufacturers and the Association of Global Automakers have been conducting research to understand why roughly 25 percent of the owners of recalled vehicles never seek their free repairs.

Results indicate that many motorists are doing their own risk assessments when they receive a notice and deciding if the recall is deemed important enough for a response.

The perceived ramifications of a given recall's safety risk significantly impacts participation rates, creating

a scenario in which shop owners can impart your customer-centric influence to ensure that everyone remains safe behind the wheel.

People who have a relationship with a dealer participate in recalls more often, according to the survey. Those who bought their vehicle new are more likely to report getting their recall fixed — 68 percent compared to 56 percent who bought their vehicle used. Those who routinely service their vehicles at a dealership respond to safety recalls more often than those who take their vehicle in for service elsewhere.

Springing ahead

"Recalls are a serious safety issue that should be promptly addressed. An informed consumer is one of our strongest allies in ensuring recalled vehicles are repaired," says U.S. Transportation Secretary Anthony Foxx, who in January unveiled NHTSA's "Safe Cars Save Lives" public awareness campaign.

Motorists are urged to look up their VINs twice a year on NHTSA's website when they "spring ahead" and "fall back" in altering their clocks for daylight saving time.

And mechanical shops and collision repairers alike are positioned to play a significant role in getting the word out. Says NHTSA Administrator Mark Rosekind: "Boosting repair rates requires effective communication at every level and every step of the way."



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UTI HOSTS INAUGURAL TRAINING EVENT

BY PETE MEIER | DIRECTOR OF TRAINING

The blue gray of the mountains forms a fitting backdrop to the Phoenix, Ariz., campus of the Universal Technical Institute on the last Friday evening of April. Inside, the cohost of *All Girls*

Garage and MAHLE spokeswoman Bogi Lateiner, is welcoming area technicians and shop owners to the inaugural session of Service-Edu, a unique training event featuring trainers from four major aftermarket companies: MAHLE, NGK, Timken and Gates.

Friday night was a short dinner and networking opportunity, and the real work began in earnest the following Saturday morning. While first appearances may lead one to believe the pre-

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All Girls Garage costar and Phoenix shop owner Bogi Lateiner welcomes techs to the inaugural Service-Edu event.



MAHLE's Bill McKnight shows attendees the ins and outs of gaskets and debunked several myths in the process.



Timken's Rick Domin is no stranger to *Motor Age* readers, having been featured in more than one video and webinar on bearing service and inspection.

sentations would be highly product oriented (what we techs call a "sales pitch"), the reality was the sharing of very valuable technical information that will go a long way to helping techs perform repairs more effectively and professionally. Topics covered included how coolant contamination and inhibitor package failures can lead to a variety of problems with other engine systems to how to properly preload a replacement hub bearing to avoid premature failure.

With a dozen UTI locations around the country, the plan is to take this event on the road. Since this writing, the trainers have appeared at the Irving, Texas UTI campus and others are planned for later this year. To take advantage of a session near you, log on to service-edu.com for more information.

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OPERATIONS

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MANAGEMENT



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**THE ROLE OF
CULTURE
IN SUCCESS**

YOUR SHOP CULTURE DETERMINES YOUR OPERATION'S PROFITABILITY, EFFICIENCY AND EMPLOYEE RETENTION

BY **JEFF PEEVY** | CONTRIBUTING EDITOR

IN THE last few years the reference to culture in business within our industry speaks to heightened awareness of it. I have traveled the country speaking on the topic of culture within businesses for several years and have had shop owners come up to me saying they were not sure if their business has a culture. My answer is simple and straightforward: you do. And it is determining your operation's profitability, efficiency and even employee retention. A famous psychologist once said, "The range of what we think and do is limited by what we fail to notice." I believe this is true with the culture within a business. Mark Fields of Ford gave Peter Drucker credit for saying, "Culture eats strategy for breakfast." If you have ever seen

repair businesses that attempted to implement Lean or Five "S" initiatives and a year later you find them back to the way they always did things, it is likely the culture of the shop that caused them to abandon the effort to improve and change.

The learning culture

In the book *Creating a Learning Culture*, Marcia Connor and James Clawson define culture by the following statement: "Culture can be defined as a pattern of learned assumptions that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think and feel in relation to the problems of survival and integration." This definition gets to the heart of how a culture develops within a business and I believe uncovers looming performance-killers that can exist. The idea is that our employees are operating under a pattern of learned assumptions and that these assumptions are considered to be so correct in the way someone should think and act that they are taught to new members as the way to operate and act. Keep in mind these assumptions most likely set in motion are, at a minimum, encouraged by the business' leadership. Whether a business has a formal training program that teaches their

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pattern of assumptions or not, you can bet they are being taught informally. As the definition states, being accepted or integrated into the business as an employee is determined by how well one accepts these assumptions as the correct way to perceive, think and feel. If these patterns of learned assumptions are indeed correct, the business will be profitable, efficient, have better than average employee retention and keep up with the changes required to sustain it. If the assumptions are not correct, the business will continue to struggle and typically look externally for the reasons for it.

Culture, good or bad, starts with leadership. It can't be changed overnight, but starts by realizing it exists and is founded on a pattern of assumptions. Since staff take their cues from the leadership of the business they work in, owners and managers must accept that they own the culture within their business. This means they also have the ability to start the process of testing and changing their culture and at least work to integrate better, more

grounded assumptions.

One of the things I have personally seen in the very best performing repair businesses is that with their pattern of learned assumptions they have engrained an understanding of the role learning plays in maintaining success. We refer to this pattern as a "learning culture." The learning culture sets the stage for a sustainable competitive advantage. Businesses with such a culture maximize every effort to improve. They get the most out of every tool or piece of equipment. They tend to continuously improve shop flow and facility design. Their businesses are never caught "flat-footed" or unprepared when new technology rolls in their door. Learning is without a doubt the only source of a sustainable competitive advantage — accept it and start the process of adopting a learning culture today.

Lead the way to learning

To begin, understand that it is a process and that it begins with you. It should start with leadership, but

anyone within a business can be the catalyst for adopting a culture of learning. First, believe the principle that "knowledge equals competitiveness; learning then is the only source of a sustainable competitive advantage." Knowledge has a shelf life, and it is getting shorter and shorter as things change more rapidly. Learning and the ability to learn quickly overcomes this shelf life and keeps knowledge fresh and relevant. At the Automotive Management Institute, we have adopted this as our core belief; it guides what we do and how we do it. Just reading and saying the phrase that "knowledge equals competitiveness and learning is the only source of a sustainable competitive advantage" is not enough; it must be sincerely accepted and implemented as a personal core belief. Once it becomes a personal core belief, it will be acted on, and as a leader you will begin to set a series of expectations for yourself and your staff. If you are not a leader within a business, you should know that accepting this belief is infectious and



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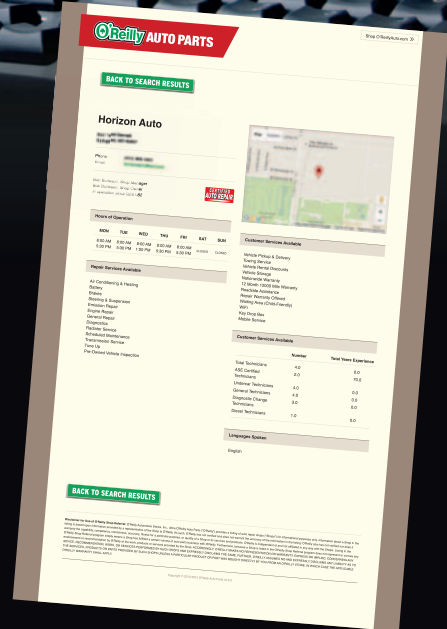
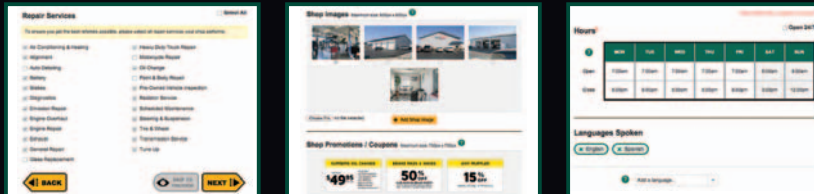
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will influence those around you. If it doesn't, find another place to work because the business' inability to sustain success is just not present in their culture and your career potential is limited there.

As a leader, set an expectation for everyone in the business to learn everything they can and in every way possible. Begin to discuss things you have recently learned and engage your staff to do the same. When you send someone to a training class or require them to take an online class, frame it as an opportunity to learn and explain why learning is important for the employee personally and for the business. Set an expectation for the employee to take what they have learned and share it. Recently acquired knowledge is maximized when it is shared. When learning is expected, employees tend to sit up front, take notes and ask questions. When it is not, the employee tends to sit in the back and does just what they have to in order to get through the class.

Share knowledge

This leads to the next important element of a learning culture: the expectation to share knowledge. Consider even establishing a quick meeting on a regular schedule that is focused solely on what the team members have learned since the last meeting. In a healthy way this drives the point home and places a bit of pressure on learning something between meetings until it becomes a habit. Start the habit also of simply asking, "What have we learned?" as a conversation starter. As you move into this phase of adopting a culture of

learning, be sensitive to individuals who perceive themselves as knowing everything and lack the respect of coworkers — commonly referred to as a "know-it-all." This individual will work against advancing the idea of knowledge sharing, as they see it as a license to spend even more of their time trying to convince everyone how smart they are instead of productively participating in the learning opportunity. If you are serious about growing into a modern, successful learning culture, terminate their employment. Find team members who "get it" and can embrace and accept that they must learn, be open to accepting knowledge from their coworkers and share "real" knowledge that helps everyone.

Make a commitment to expertise

Another important element in your quest to grow a learning culture within your business is to establish the need for all employees to make a personal commitment to expertise. This seems simple enough, but most of us never stop and sincerely make that commitment. We do what we have to do to get through the day and never make the commitment to ourselves and to our boss and coworkers that we will intentionally learn and develop in every way possible within the role we have, within the business we work in. Do it. Do it in a meeting as an example to everyone, and as you do, explain how it benefits the business and everyone in it if everyone works to become all they can be. This makes for a healthy, prosperous place to work and ultimately is personally rewarding.

Recruit the right employees

The final thing I will cover is recruiting. In the research I have been involved in, we found an interesting phenomenon that I am convinced drives future success to its fullest. When recruiting, highlight the need to learn, grow and share knowledge as the very first thing used to describe what the candidate must have in order to be successful within your business. We found this attracts a younger, more educated individual — someone the repair business has likely never seen in its recruitment efforts. The typical repair businesses all state similar things they want in a help-wanted ad: "must have experience," "must have tools," "high production capabilities" and finally, "ASE certification or comparable technical training a plus." It's not that these things aren't important, but they should be secondary or in addition to "willingness to learn and share knowledge." Someone with experience who is attracted to the mention of willingness to learn and share knowledge will typically have extensive training and certifications, because they have an interest in expertise.

As soon as you accept and adopt a culture of learning, you will see how this all comes together and how it will make a difference in your business now and sets the stage for sustainable success and competitive advantage. **TM**



JEFF PEEVY
CONTRIBUTING
EDITOR

Jeff Peavy is the president of the Automotive Management Institute. Jeff has been involved in industry training and education for more than 20 years.

✉ Email Jeff at jpeevy@amionline.org



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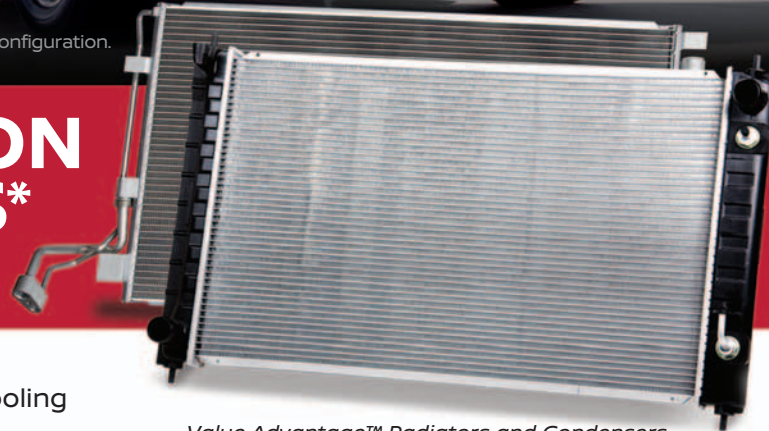
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MAINTENANCE MIX

YOUR COUNTER PERSON IS RESPONSIBLE FOR RECOMMENDING MAINTENANCE. AREN'T THEY?

BY CHRIS "CHUBBY" FREDERICK | CONTRIBUTING EDITOR

SHOULD your techs be responsible for recommending maintenance? Should your front counter be responsible? Should your customer be responsible? It is their car, after all. ATI coach Brian Hunnicutt has a suggestion that will help shop owners increase revenue, keep it simple, keep from losing customers and stay the best shop in their market. Let's hear what Brian has to say about who is responsible for maintenance.

Let's look at this from the ground up. We know that for the most part the customer is not going to understand what they need and is so misinformed it is not even funny. Our techs each have their own opinions and so do your service writers. You should find out what each of their opinions are, but it is the opinion of the owner of the store that ultimately matters — you sign the checks.

A short list of items would be shocks, struts, flushes, filters, belts, hoses, timing belts, spark plugs, balance and alignment. Please don't forget tires as well. When should each one of these be replaced? I have a mileage interval chart that I can share with you, no problem. It is generic and you have to have your brain attached, but it is pretty comprehensive.

Now that we have a grasp on when we are going to recommend what, we can address who is responsible to educate everyone and take care of the maintenance. If a shock is leaking or a filter is dirty or any of the fluids smell bad or are looking bad, then we are talking about repairs, not maintenance, right? Read the previous sentence again. Maintenance means that these items are being replaced before leaking, smelling or clogging. Why do we change the oil before it is looking or smelling bad — same thing, right?



So I think the front counter person is responsible for building the relationship with the customer and educating them about what we are going to do with them and for them, so they don't feel like we are doing anything to them. To do this is simple and hard at the same time. If you use a hybrid of the five steps to a tire sale to get the maintenance sold today, in the way the tire salespeople get tires sold today, then we stand a great chance of winning.

Five steps to selling

What are the five steps to a tire sale? Stop and write them down if you know them — meet and greet; determine needs; qualify customer; features and benefits; and then ask for the sale. These steps were designed to make a shopping customer a buying customer. Back in the day before phones were everywhere, the normal customer would drive to at least three tire stores to price the tires before buying. If we had told the manager back then that

they needed to build a relationship with the client, talk about push back. But by making them do the five-step process, the shop owner had the manager build a relationship with the customer without even knowing they were. By showing interest in the customer and going out to their car, they were building relationships. Determining the need and qualifying the customer is done at the car. How do you like the car? What kind of driving do you do? Oh, I see you have a trailer hitch; what do you tow and how often do you do it? Would you buy another car like this one? How long do you plan on keeping the car? Who else drives the car?

Going out to the car and doing the walk around is critical. The thing that takes the most time in a shop's life is not making the sale. You go through the entire process and get nothing out of it. That takes more time than any other piece of the five-step process. More time than diagnostics, parts, doing the courtesy check, building estimates or

Photo: Thinkstock

“WHAT IS THE FASTEST WAY TO START SELLING MAINTENANCE GOALS? GIVE YOUR ASSOCIATES THE SMELL TEST CHECKLIST AND FIND OUT WHOSE BELIEFS ARE SLOWING DOWN THE SALES PROCESS.”

- CHRIS “CHUBBY” FREDERICK [ATI CEO]

even paperwork; you cannot spend all that time and money to make the phone ring and then leave it to chance about making the sale. So if we don't start with the walk around, then we may not get as many customers to understand what we are doing with them and for them. They might not just say no, but even think we are trying to rip them off. With the proper relationship and education, we put ourselves in their shoes, and they learn to trust us.

Six bridges into maintenance discussions

So we have the six basic items of bridging into maintenance: relationship, education, courtesy check, estimating, asking for the sale and service after the sale. While we do the walk around, we should start the car and make sure the warning lights go out while we are getting the mileage. Making sure the warning lights are out in association with the walk around will get rid of most of your customer complaints. With the mileage, we can start educating them about the specific maintenance items we are going to be looking at as part of the multi-point courtesy check that we are going to perform today. We will be calling them later. That way they will not feel like a baby seal that you are sneaking up on to club over the head when you ask for the sale.

If they are a new customer, then you have the conversation about who has been maintaining their car, and ask if you may make copies of the records so that you can build a plan for saving them money by maintaining their car properly. When was the last maintenance performed and so on?

Hang the work order on the board and open the work order on your com-

puter; we are going to build the estimate before the courtesy check is performed or while it is being performed. Remember, the tech is not responsible for maintenance, your front counter staff is. Now based on time and mileage, we are going to go down the list and put maintenance items on the estimate as needed. This should save time for when we get the courtesy check back and help ensure the customer will not be tapping their foot or looking at their watch.


If the customer is returning and has an appointment, before the day even starts we could make the work order for what they are coming in for and then print it. Open the work order, and based on the history, we should have a good idea what the mileage is and what maintenance items the car will need. We start to build the estimate based on maintenance, and when we do the walk around, we are even better armed to educate the customer. I am not saying to show the preliminary estimate to the customer at that time, but start the education process.

How much time will we save if the estimate is started with maintenance and all we have to add to it is what the techs find as a safety or repair item during the courtesy check? It will also give us a chance to double check the preliminary estimate and make sure we did not forget anything.

Not only is this great for your customers, but you can use lower-line techs

to get the bulk of this done. Except for alignments, some hoses and timing belts, your C-almost-B tech can do almost everything else. By having your lower-line employees knock it out, you can also maximize your gross profit.

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CHRIS “CHUBBY” FREDERICK
CONTRIBUTING
EDITOR

Chris “Chubby” Frederick is the CEO and founder of the Automotive Training Institute. ATI's 115 associates train and coach more than 1,400 shop owners every week across North America to drive profits and dreams home to their families. 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 life-line. This month's article was written with the help of former shop owner and current coach Brian Hunnicutt.

 Email Chubby at cfrederick@autotraining.net



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OPERATIONS

SHOP PROFILE

A snapshot of one of the industry's leading shops

25TH STREET AUTOMOTIVE / PHOENIX, ARIZONA



The smiling guy

Owner and his staff craft a 25-year plan to keep everyone involved in the business smiling as well

BY **ROBERT BRAVENDER** | CONTRIBUTING EDITOR

Bill Coniom is the smiling guy. Of course, it's easy to smile when you run one of the top shops in the Phoenix, Ariz., area, but he has also always looked at the brighter side of things.

Co-owner of 25th Street Automotive, Coniom likes to, as he puts it, work at solutions backwards.

"From my early days," he recounts, "it was never about sales objectives, that employees have to do this or sell that to keep their jobs; I believe everyone ought to be on performance-based pay, but there ought to be ethical ways for them to make a respectable paycheck. It was about understanding needs and presenting them to the customer. We didn't sell things to people, we let them know what their car needed."

To help accomplish this, Coniom and staff formulated a 25-year plan. "We looked at modest goals: how the gross sales would change over the years, even if only to keep up with inflation, and how long various employees intended to work here," he explains. "Then we worked backwards from there. If someone retires in 2019, am I going to have to hire somebody years in advance to train them? Now we're looking 5-10 years ahead for a key em-

ployee to figure out when I have to recruit and train a replacement, and transition when they're ready to go."

Coniom champions the concept of servant leadership. An ancient philosophy putting "the needs of others first and helping people develop and perform as highly as possible," it was codified for modern business by Robert K. Greenleaf in a series of essays back in the 1970s. (Source: Wikipedia)

"One of my goals when I became a manager was 'can I make a difference?'" Coniom explains. "What can I do for my employees, what can I do for the community? — that's the way I run my life. I owe it both to the motoring public and the staff at my shop to remain profitable so that I can be here to honor our 24-month warranty, to hire the next generation of technicians, and to serve their children — for we've now been here long enough to serve multiple generations."

The second of two shops, the first was founded by Coniom's business part-

25TH STREET AUTOMOTIVE

Bill Coniom and Tony Guido

Owners

Phoenix, Ariz.

Location

1

Number of locations

15

Years in business

2

Total number of technicians

2,500 square feet

Shop size

5

Number of bays

AAA, ASA, BBB

Shop affiliations

ner Tony Guido. A former gas station, this facility grew until it couldn't anymore, at which point Guido decided to expand. "You either get bigger or you go multiple," says Coniom, "and it wasn't our business model to get bigger."

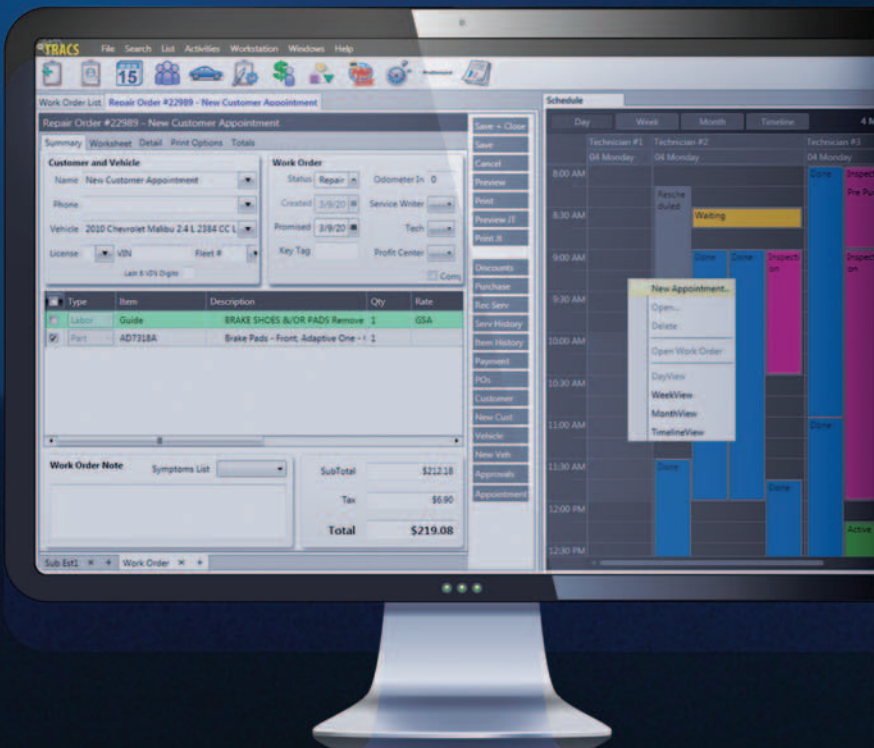
Coniom relates that he was a dealership technician when Guido hired him "in the hopes of opening up another facility that I would run," he says. "He hardly knew me and he's handing me plane tickets to go to California to take training. Kelly Bennett and Bob O'Conner of one of the Bottom Line Impact Groups had put together a series of classes for technician time management, service advisor skills and in-depth management training."

They found a little shop for sale only a few miles away on 25th Street, "close

Photos: 25th Street Automotive

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enough that we could be a support structure for each other, but far enough that we shouldn't be eating away at each other's customer base," comments Coniom. With the original shop already an industry leader, the pair opened the new facility 15 years ago.

"I'm considered the managing partner of this business," he explains. "Tony gave me half ownership of this shop, making the same offer to the manager at the other shop. It's sweat equity; in addition to my manager's



salary, the longer I work here the bigger the stake I have in it."

However, Coniom found the new shop didn't have much of a community reputation. "We came straight in, knowing that we wanted to make changes," he said. "We started off by joining the neighborhood association because we're right near a lot of residences; we attended those meetings and brought cookies and things. We put a stop to 'blasting' up and down the street test driving cars and became a part of the community to where we were more appreciated.

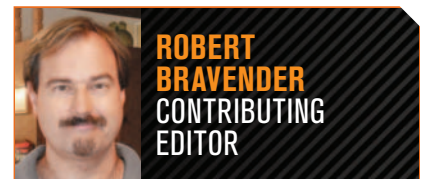
"I assumed that we could take the (original) business model in its entirety, its marketing, everything, and just move it over here," he laughs. "It's still Phoenix, it's only a few miles away — how different can it be? And it wouldn't work. The first problem was that while it's an affordable piece of small real estate, it has no major frontage. Twenty-fifth Street is not a main road; it's more of a residential street, so there is not a lot of traffic. The other thing I found was that the people who live in this neighborhood are less likely to have someone at home who can drop a car off for repairs. They go to work and the neighborhood empties out. So I had to focus more on the neighboring businesses."

For this, Coniom had a secret weapon — Krispy Kremes. "Three mornings of the week — not in the summer because the donuts melt too fast — I would get 8 dozen assorted donuts," he explains. "Then I'd run by local businesses and say, 'excuse me, but if I left some Krispy Kremes, would your staff appreciate them?' I would go in everywhere — fitness centers, didn't matter. It made a good



impression. It brought us a lot of our new customers during that portion of our growth period. Of course people try to be healthier now; Krispy Kreme doesn't get as much mileage as it once did."

Now Coniom has a new business model that is more community oriented. "We're a little family shop," he smiles. "We only have two full-time technicians here, but we really do what we can. The Salvation Army was having trouble with a water drive, so I reached in the cash drawer and had our part-time trade school helper buy some cases of water and take it to them. When things need to be done, we do them, because it's our culture to do what's right, whether it's the people in the building or in the community."ZZ



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

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INTRODUCE A NEW SHOP ROLE: THE LEARNING MANAGER

Make a staff member responsible for helping drive your training initiatives

BY CHRIS CHESNEY |
CONTRIBUTING EDITOR

The decision to make the commitment to grow a skilled team ready to service your customers' needs before they arrive is not entirely painless, but like anything unfamiliar, it's a plan that will help get great results. The first step in this commitment to training is to establish standards of performance around how your team learns new skills. Here we will discuss the first steps in creating that plan, beginning with the introduction of a new role in your organization: the learning manager.

This person could be the shop owner, a service manager or an administrator who manages human resources for the company. Whoever takes this role must be willing to be held to the same standard of performance as any other role in your organization. In a modern repair facility, the learning manager's role is to manage the following:

- Identify and/or create all job roles in the business.
- Identify and/or create the learn-

ing plan for each job role.

- Evaluate each team member and ensure they are placed in the appropriate role.
- Assign each team member to a career path and learning plan and hold them accountable for their learning.
- Ensure the organization has the commitment of the owner for all the above.

Let's go through each of these points in detail. The first step is to make sure you clearly define job roles for everyone in the business. It is important to create job roles that fit your business model, not just who you have on your team at the time. We could spend an infinite amount of time writing a job description and job role, so we will just cover the high-level points. I encourage you to do research on creating a job role. A best practice in creating a job role is to include the following basic elements:

- Position details — general information about the job, including title and summary
- Job duties — this is the "what they do" section and conveys the

scope and level of responsibility

- Key accountabilities — 3 to 5 main areas of responsibility, i.e. "Vehicle Inspection"
- Duty statements — 2 to 3 detail statements for each key accountability
- Percentage of time — estimate of time spent in each key accountability area
- Performance standards — this is the "how they do the job" section and provides the details and expectations for the job. It also provides a basis for measuring performance.
- Job factors — outlines the knowledge and skills needed to be successful in the job
- Minimum education, years of experience, and ongoing education

A well-written job role/description will illustrate the training areas needed to successfully perform the duties of the job and maintain that level of performance, especially as technologies continue to change. Another best practice is to align each job role around ASE topic areas. For example, a C-level technician might

CONTINUES ON [PAGE 26](#)

COMMITMENT TO TRAINING SUPPORTERS



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—PETE MEIER, DIRECTOR OF TRAINING

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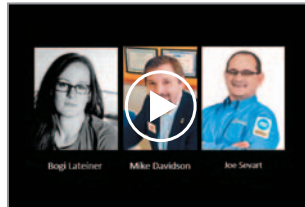
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SOCIAL INSIGHTS



• Quality comes first when selecting repair parts

Auto technicians seek quality first when selecting parts to repair their customers' vehicles, according to the 2016 *Aftermarket Business World Technician Attitude Study*.

When asked who their preferred supplier is, technicians overwhelmingly agreed that they tend to purchase parts from auto parts retailers. View the rest of the study results here.

MotorAge.com/techstudy

• Addressing carbon buildup in GDI-equipped vehicles

Motor Age Technical Editor and Director of Training Pete Meier shares a valuable tech tip from Stephen Albert, a product manager at Bosch, regarding the increasing problem of carbon build-up in Gasoline Direct Injection (GDI) engines.

Learn what technicians should do to service and repair GDI systems.

MotorAge.com/carboncars

• How repair shops are leaving money on the table

Service repair shops could significantly increase their ride control business and therefore shop profits and return customers by actively educating and engaging clients about the realities of the replacement of worn shocks and struts.

According to Bill Johnston, director of sales, North America Aftermarket at Tenneco, the primary reason ride control components are not replaced is because repair shops aren't inspecting and recommending replacement.

Here's what you need to do to double your shop's ride control business.

MotorAge.com/leavemoney

• Why the Volvo XC60 is 27 percent less likely to be involved in a fender bender

The National Transportation Safety Board estimates that approximately 1,700 people are killed in rear-end crashes every year, with another 500,000 injured in those same accidents. It is with these and other statistics in mind that lead entities like the National Highway Traffic Safety Administration (NHTSA) to make some collision avoidance systems mandatory.

Learn more about how car manufacturers are incorporating accident avoidance technology and systems into their function and design plans for practically every new car model on the road or soon to be released to the public.

MotorAge.com/volvexc60

• Multiple conditions can limit an engine's ability to breathe

In this article, *Motor Age* contributor Scott Shotten tackles the process involved in diagnosing low power, engine breathing and other drivability issues. He provides a diagnostic technique that applies to engine breathing issues as well as low power, lean codes and transmission shifting.

Read more to learn this technique.

MotorAge.com/breathenow

• Alcohol's effect on drivability diagnostics

When federal laws forced gasoline manufacturers to include up to 10 percent alcohol in consumer fuel, we were immediately introduced to a whole new world of diagnosing alcohol-related problems. Large numbers of cars with fuel leaks started appearing in the automotive repair shops.

Although there are very few alcohol-related leaks anymore, now vehicles are suffering from "alcohol poisoning." Take a look at the symptoms of too much alcohol in the fuel.

MotorAge.com/alcohol effects

TRAINING EVENTS

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• **2016 NACE/CARS Expo;**
Anaheim Convention Center
Anaheim, California

SEPTEMBER 16-18

• **2016 CAN Conference;**
Westin Chicago Northwest
Itasca, Illinois

OCTOBER 8

• **AERA Conference;**
Speedway Motors Museum of American Speed
Lincoln, Nebraska

OCTOBER 15

• **Automechanika Chicago LIVE — Training Event;**
Fox Valley Technical College
Appleton, Wisconsin

OCTOBER 31-NOVEMBER 3

• **AAPEX 2016; Sands Expo**
Las Vegas, Nevada

NOVEMBER 19

• **Automechanika Chicago LIVE — Training Event;**
Joliet Junior College
Joliet, Illinois

CONTINUES FROM PAGE 24

need to have knowledge and skills in suspension and steering (A4), brakes (A5) and engines (A1); a B-level technician might need to have knowledge and skills in all ASE areas (A1-A8); while an A-level technician is required to have knowledge and skill in all areas, including the advanced topics of A9, L1, L2 and L3. Using ASE topic areas aligns your job roles with those of NATEF-certified vocational programs and will serve you well as you hire new technicians in the future. Once we have the job roles defined, we will create the learning plan.

Getting through the process of creating job roles should result in some traction and clarity when it comes to building out your learning plan. For each job role, you need to identify the key skills that are critical to the role. Use the ASE topic areas for guidance. You can find the task lists for each ASE topic at www.ASE.com. This site serves as a good resource to assist you in identifying the content that is accessible to you. There are many sources of content for this effort.

Carquest Technical Institute (CTI) provides a wide range of online content and instructor-led opportunities that can fill each learning plan. There are also great online courses from the OEMs available on their websites. Keep in mind some content is great, some content is good and a lot of content is really bad. You need to spend time with each provider option you have to find the content that fits your business and team needs. Assign the appropriate content to each job role to ensure the success of that team member. Finally, you need to review your learning plans every year to make sure they meet the current needs of your business, team members and customers. This is an area that the aftermarket industry is beginning to address in a consolidated effort. Next, it's time to assess your team.

Technician assessments are difficult. In fact, it is one area where you

need to invest some time and money in creating reporting that identifies services where team members struggle. This is true for every role in the shop but most importantly the technician. First you need to have processes that ensure the vehicle is fixed right the first time. A good quality assurance (QA) process will help, but tracking data from your service management system that illustrates the success and challenges of each technician will identify areas where a technician needs help. Current technician assessment models consist of 100 or more questions focused on all vehicle systems. That sounds like a good method on the surface, but consider the number of systems on a vehicle and you quickly realize that you're trying to assess a technician's knowledge base on the results of about 10 questions per system. There are new practical application assessments that consist of virtual reality vehicles that can be bugged with realistic faults to challenge a technician to use their problem-solving skills and knowledge to fix the problem. These systems use virtual tools and equipment that mimic the real process. They can test circuits, replace parts and fix circuits, but without the need to bug a real vehicle. This scalable technology is relatively new but promising in gauging the ability of a technician to apply the knowledge they have to solving a problem.

Once the assessment is complete, it's time to assign the learning plans to each team member. There is a good possibility that you will find you need to assign a learning plan for a job role that is beneath the existing job role for a team member. For example, you may discover via the assessment process that your B tech struggles with several C tech skills. It is okay to assign B and C tech-level learning plans in this situation. Establishing a learning plan in your business has a starting point that will require many to go back and brush up on their knowledge in order to advance their skill set. At the end of the day, the goal is to encourage and enable your entire

team. There needs to be incentives to get the results you seek, but the first step in getting buy-in from your team is to include them in the process from the beginning.

Once implemented, hold the entire team accountable to their commitment to the process. Place timelines for completion of their initial learning plan. Don't be unreasonable in this effort by requiring them to complete 30 online courses and 50 hours of instructor-led classes in the next three months. Work with the team on a realistic timeline. Gain that commitment and reward their success. The rewards don't always need to be financial in nature. They can include recognition: certificates, dinner for their family, lunch for the team, a press release in your shop newsletter, etc. Tracking the results of their production and accuracy to show value are all ways to reward your team.

Last but certainly not least, the most important step is commitment by the owner and the team. Implementing a learning plan is hard work unless you bring the team together during the development phase. Identifying the responsible learning manager who takes ownership of building out the process based on input from the team is not an option; it is a requirement in your endeavor to be ready to service your customers before they arrive and to provide them with the best customer experience. **TL**



Chris Chesney has more than 40 years of technical training experience in the automotive aftermarket and currently serves as Senior Director of Customer Training for CARQUEST Technical Institute (CTI) and Advance Professional. Chesney received his ASE certifications in 1972 and has led thousands of technician trainings across North America.

 Email Chris at Chris.Chesney@carquest.com

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Figure 1

THROUGH THE
EYES OF A SCOPE

A SIMPLE TOOL CAN MAKE COMPLEX DIAGNOSTICS EASIER TO SOLVE

BY SCOT MANNA | CONTRIBUTING EDITOR

Vehicle diagnostics can be quite simple or very complex depending on the problem you're faced with. Any tech knows that the first item to check when a customer says their vehicle pulls to the left is tire pressure — simple, right? When a customer states their car's engine stalls once or twice a week, the problem and solution can be much more complicated. The focus of this article will be on complex problem diagnostics using multi-trace lab scopes. I have been asked to solve several tough, intermittent problems and the key to finding the source of the concern is data collection and analysis.


When diagnosing a problem such as a very intermittent engine stall, the

choices for a technician fall into two categories: replace the parts you guess may be responsible or connect equipment and operate the vehicle to capture the event and then analyze the captured data. If you decide to start replacing parts, there are several items to consider. You may perform some research to determine what common problems occur on the vehicle in question and replace these items, but if the problem remains, the customer will probably not be happy and may ask for a refund or to have the old parts put back on. Guess work is not what most consumers want from the professional technicians they hire to repair their car. When confronted with an intermittent diagnostic problem, a solid plan is necessary along with the right test equipment.

A problematic Impala

I will use a 2003 Chevrolet Impala with a 3.4-liter V6 to illustrate the point of this article. This Impala has a very intermittent stall and no-start problem. The dealer has looked at the car and said nothing seems wrong, but they were unable to get the problem to occur so no diagnosis can be made. When you choose to take on a problem like this, you must clearly inform the customer of the challenges and costs involved along with the time needed to resolve their issue. You certainly would not want to connect a scope and scan tool and then have the customer call and say they need the car now to pick up the kids. Make sure up front you have the time you need to find the problem and fix the car.

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The next item you must know is system operation and layout so you can connect test equipment to gather the data you need. Connecting a multi-channel scope takes some thought so you have the best chance to capture the data you need when the problem occurs. This vehicle will be tested with a Pico 4000 series 8-channel scope. While not a common tool in most shops, I need to make an important point here: the more information you have when making a decision allows you to make a better decision. When scan testing an engine for a fuel trim code, would you want to look at two data items or 12 items? Can you make a diagnosis with engine RPM and oxygen sensor voltage alone, or do you need STFT, LTFT, Mass Airflow, load and other important data to make a correct diagnosis? The same holds true with scopes — the more channels you have, the more circuits you can test. The problem is you may only get one crack at capturing data if you can get the problem to occur, so the more data you have, the greater the chance to make a correct diagnosis. An otherwise normal engine can stall or not start due to a lack of spark or fuel, so the circuits responsible for the control of these systems should be tested.

After careful review of the engine wiring diagram, I decide to connect the scope to the following circuits. Channel A is connected to the battery feed to the ignition module. There are three rotation sensors on this engine; channel B is connected to the 7X CKP signal at the ignition module. Channel C is connected to PCM terminal 8, the 3X reference input from the ICM. Channel D is connected to PCM terminal 7, the cam sensor input. Channel E is connected to PCM pin 9, CKP 24X sensor input and channel F is connected to PCM pin 79, which is injector #6 control or ground. Channel G is connected to PCM pin 19, switched ignition feed to the PCM and channel H has a low-amp current probe connected to the DFI fuse in the underhood fuse box. This fuse powers both the ignition coils' primary circuit and the ICM. These signals should allow me to determine what was lost if the engine stalls or does not start. The scope is set up with channel A at the bottom and the remaining channels stacked on top of one another with channel H on top.

Figure 1 shows some of the scope

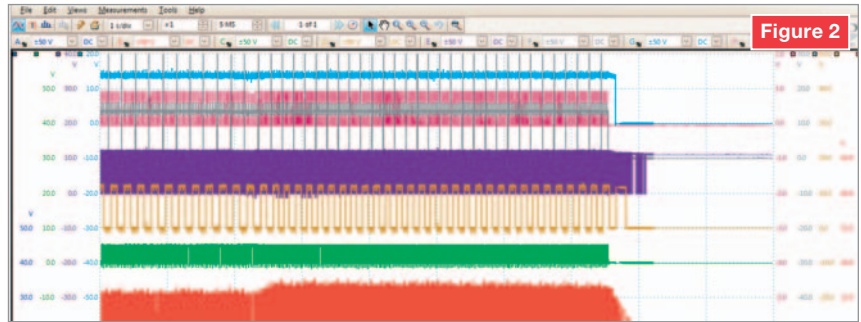


Figure 2

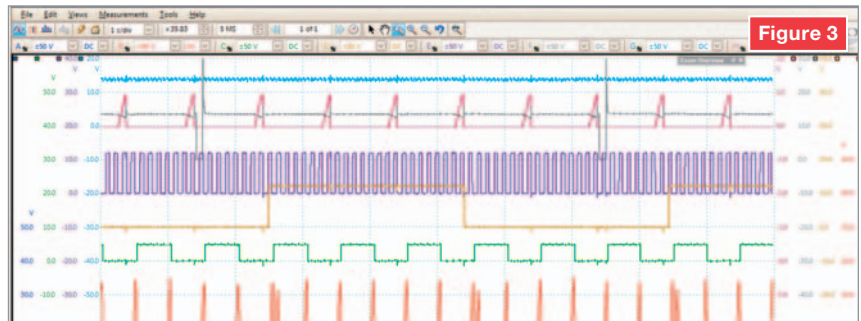


Figure 3

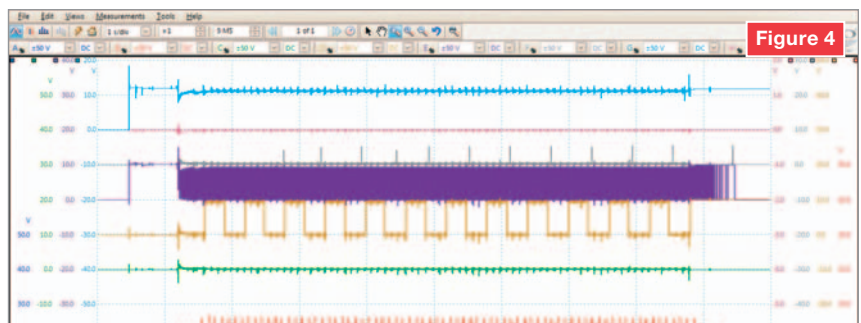


Figure 4

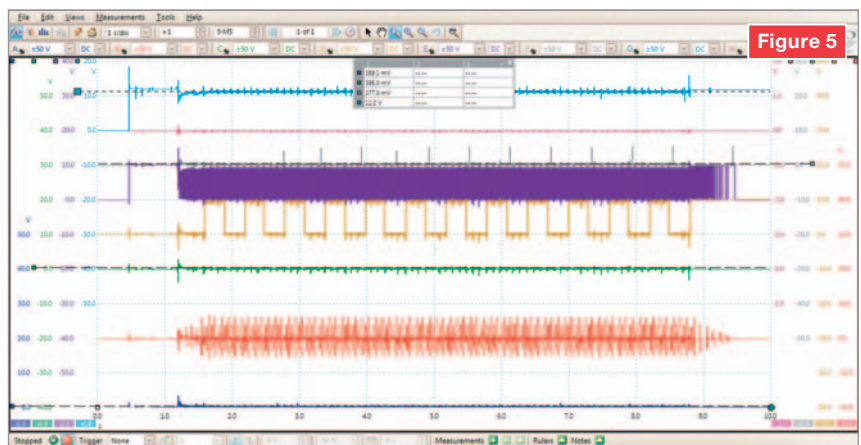


Figure 5

connections at the PCM located inside the air cleaner housing.

Figure 2 shows a capture of the engine running, then turning off the key and the engine stops. I always capture a normal key off event to compare to an engine stall. After four days of extensive test driving, the Impala never misses a beat and I'm somewhat annoyed at the growing time involved

in this job. On the fifth morning, when attempting to pull the car out of the bay, a cranking no-start occurs.

Do I have what I need?

Fortunately, the scope was connected and powered up and the no-start was captured. It is important to note that the leads have to stay connected and the scope has to be ready every time



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the engine is started or the car driven. Murphy's law states that the one time you try and move the car with the scope turned off is the time it will act up, so always be ready! The scope is set at 1 second per horizontal division so there is 10 seconds of time on the screen. The Pico scope has powerful zoom capabilities so there is no need to see much signal detail while test driving the vehicle. **Figure 3** is a zoom in of the previous waveform for a detailed look at the captured signals.

The cranking no-start capture is seen

in **Figure 4**. The scope cursors will be used to measure signal amplitude on channel A, C, F and G. Channel A voltage is only 379 millivolts, the voltage feed to the ignition module. Channel C shows no reference pulse to the PCM because the ignition module is not receiving enough voltage to operate. Channel F is only 380 millivolts, the fuel injector control circuit. Channel G, the

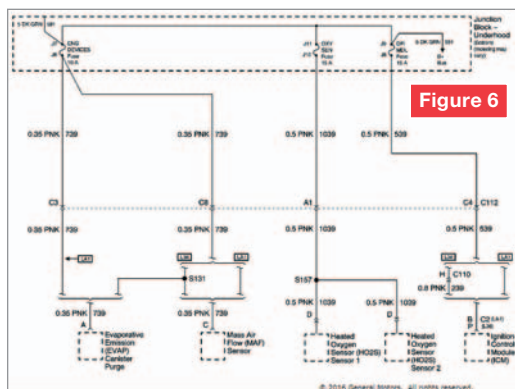


Figure 6

PCM-switched ignition feed, is normal for a cranking engine, reading 11.2 volts. These readings are seen in **Figure 5**.

The three engine rotation sensors, 7X, 24X and CMP are all generating normal waveforms. If replacement of the crank or cams' sensors were done at the beginning due to a guess, you would have been wrong! The cause of the crank no-start is clearly a lack of voltage. Before jumping the gun

and replacing the ignition switch, (high failure rate item on GMs, as the current recalls point out) you must look at the circuit wiring and see what is responsible for supplying voltage to these circuits. Remember, switched ignition feed to the PCM seen on channel G is normal. The voltage supply for PCM pin 19 comes from the ignition switch, through the PCM/BCM/Cluster fuse in the underhood fuse box. The next step is a check of the power distribution schematic to see where voltage is coming from for the DFI fuse circuit that has low voltage applied. **Figure 6** shows the DFI fuse and you must follow the dark green wire circuit 591 at the upper left corner back to its source, which is not shown on this schematic. Checking further power distribution schematics reveals the diagram seen in **Figure 7**. The IGNITION Relay supplies power to the DFI fuse and the Fuel INJ fuse that also showed low voltage supply seen on the injector waveform on channel F of the no-start scope capture.

It appears we are zooming in on the potential problem. Failed relay contacts are a fairly common issue, but you must make sure the relay is being energized. As a quick test, the IGN relay is swapped with another relay of the same part number from the underhood fuse box. Another start attempt is made, but the engine still does not start. The relay is clicking so I know the control circuit is good. A careful examination of the fuse box reveals a concern. One of the four relay terminals in the fuse box appears spread. A drag test using a proper male terminal is performed on all 4 terminals and the terminal in question is clearly loose. The fuse box is taken apart and the relay terminal replaced. The engine now starts right up! **Figure 8** shows a view of the

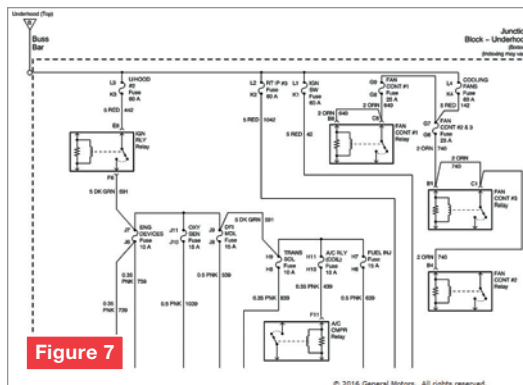


Figure 7

Photos: GM



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relay terminals with the bad terminal at the upper right position.

In review, the scope was able to capture the problem when it occurred. If a two- or four-channel scope was used and only connected to the three rotation sensors and a current probe used on the same fuse, could a diagnosis be made when the no-start happened? How many times would you have to move leads and try again if the engine re-started? The value of having more channels when diagnosing intermittent problems cannot be overstated. Another point to ponder is if you don't test, you could have replaced the ignition module, ignition switch, CKP, CMP, PCM, coils and the relay and STILL not have fixed the car! Carefully documenting my tests and diagnosis and showing the customer made this vehicle owner a customer for life and a walking referral for the shop.

Another GM

My next diagnosis was performed with a four-channel Pico 4000 scope on a 1991 Buick Regal with a 3.8 V6. The customer complaint is the engine stalls unexpectedly, and the car is not safe to drive with this problem. While the vehicle is old, the 3.8 distributor-less ignition system has been in use for over two decades and can be seen on millions of GM vehicles. Upon initial visual inspection, it can be seen that some work has been done to correct this problem. A new crankshaft position sensor and rebuilt Mass Airflow sensor are seen, (what I would call the usual suspects). The replacement crankshaft sensor is seen in **Figure 9**. Since the problem remains, it is time to start testing and stop replacing. The Pico scope's channel A is connected to terminal P at

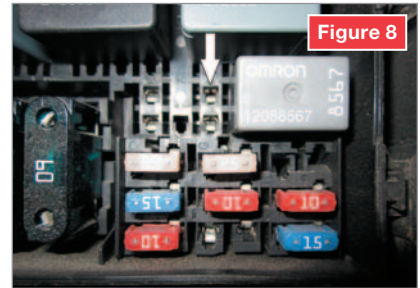


Figure 8



Figure 9

the ignition module, the 12-volt feed for the module. Ignition coil charging can be seen on this voltage signal to determine if the coils are triggering. Channel B is connected to ignition module terminal G, the CKP 18x input to the module. Channel C is connected to terminal H of the ignition module, the CKP 3x input signal. Channel D is connected to the ground side of fuel injector #1. The channels are stacked on the scope display from bottom to top, A on the bottom and D on the top.

The engine is run and a stall is captured, see as shown in **Figure 10**. The scope capture will be analyzed once the event is zoomed in. When analyzing a stall pattern, you look for which signal dropped first. The arrow in the capture shows the voltage drop on the power feed wire to the ignition module that indicates coil firing, or spark output. You can clearly see ignition was lost before the fuel injector stopped firing. It

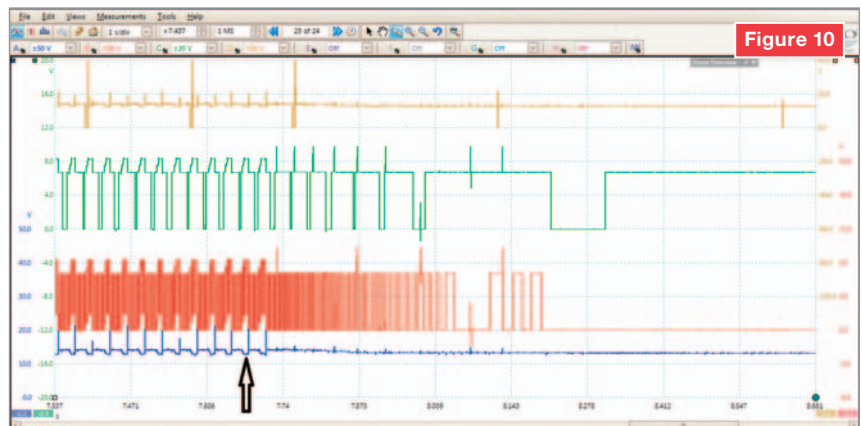


Figure 10

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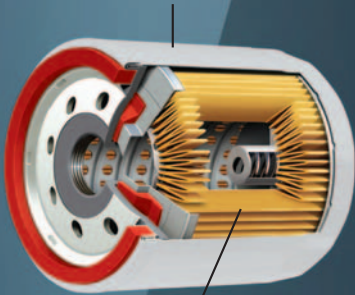
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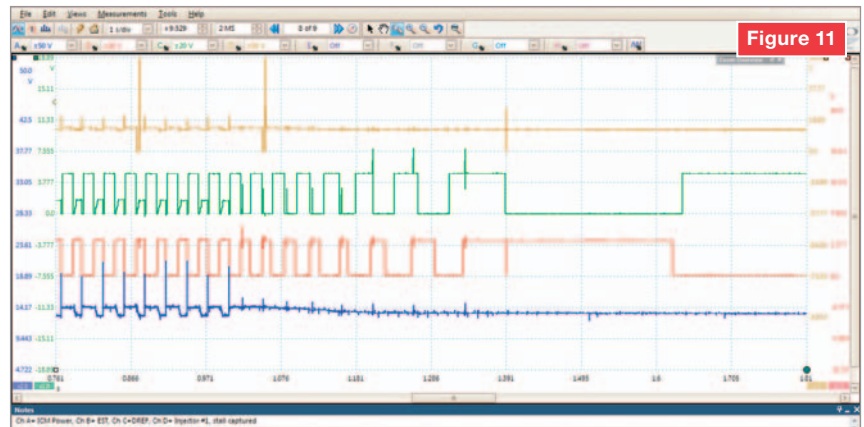


Figure 11

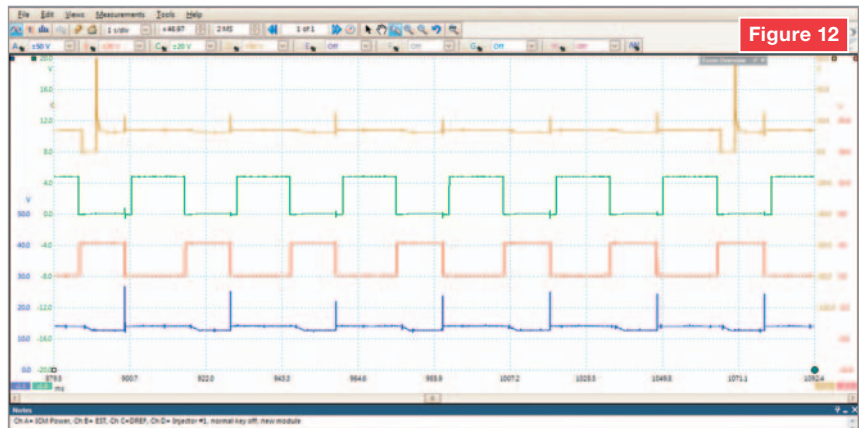


Figure 12

is also clear the crankshaft sensor signals were still present. The CKP signals show a rise each time a coil is turned on. This seems unusual, but without a similar vehicle around to test, you would need a known good waveform to determine if this is really an issue. What I do know is that neither CKP signal directly fires the ignition coils. Coil triggering is the responsibility of the PCM when the engine is running in electronic spark timing mode. If the EST signal is lost, the coil firing may cease, so the scope leads need to be moved. It is obvious the CKP is not the problem, so the leads are removed from it and moved to ignition module terminal A, the EST signal from the PCM, and terminal C, the spark reference signal to the PCM.

Once again, the engine is started and another stall is captured by the scope and is seen in **Figure 11**.

As seen in the previous test, the first signal to drop is the ignition coil voltage drop seen on channel A. The falling edge of the EST signal turns off the coil and fires the spark plugs. The EST signal remains well after the coil firing stops. This means the PCM is good

and the wiring between the PCM and module did not fail. The only remaining possibility is a failing ignition control module. Once the customer approved the repair, a new module was installed and the stalling was gone. A follow-up waveform also confirms the signal rise seen from coil firing in the spark reference waveform on channel C is gone (**Figure 12**). Only through the eyes of a scope can these problems be seen and corrected. I hope this article helps the drivability technician in any shop hone his understanding and ability in performing advanced vehicle diagnostics with a scope. Best of luck finding those vehicle gremlins. *TM*



SCOT MANNA
CONTRIBUTING
EDITOR

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Solenoids installed in wrong location
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New problems arise during an overhaul
/nreverse

TOYOTA, LEXUS FIELD SHIFT COMPLAINTS AFTER REBUILD
Shift feel, drivability complaints roll in
/rebuild

The heartbeat of the transmission

HOW SOLENOID, HYDRAULIC INTERACTION ACHIEVES A SPECIFIC GEAR AND DIAGNOSTIC TIPS

BY **WAYNE COLONNA** | POWERTRAIN PRO PUBLISHER

A previous article in Powertrain Pro — “The heart of the matter,” (April 2016) — delved into the operation of the pump in GM’s 8L90 (M5U) transmission. It covered some of the benefits of an off-axis pump, which this transmission uses in its operation. A comment was made by a reader named Larry Bloodworth, who pointed out yet another benefit an off-axis pump has — that it can be positioned closer to the sump, lessening the distance of the drawing length through the filter into the pump.

This is certainly a beneficial addition to using an off-set pump.

With the pump being the heartbeat of the transmission and pumping fluid into its veins, it brings to life eight forward speeds, converter clutch apply and reverse. This article will provide a glimpse into how the solenoids interact with the hydraulics to achieve a specific gear. It will also provide an example of diagnostics should a problem develop.

Beginning with the solenoids, there

are a total of nine on the valve body, as seen in **Figure 8**. There is an assigned letter in the casting for each of the solenoids, as seen in **Figures 2 and 3**. Here is where some confusion may occur, as the solenoids are primarily referred to by their function and by a number, not their letter. To clear up any possible confusion, the identification of the solenoids is listed as follows: VB casting letter is listed first, followed by its function. In parenthesis is the solenoid number associated with diagnostic trouble codes.

- A is the TCC Control Solenoid (Solenoid 7)
- B is the 2-3-4-6-8 Control Solenoid (Solenoid 4)
- C is the 1-3-5-6-7 Control Solenoid (Solenoid 3)
- D is the 4-5-6-7-8 Reverse Control Solenoid (Solenoid 5)
- E is the 1-2-7-8 Reverse Control Solenoid (Solenoid 1)
- F is the 1-2-3-4-5 Reverse Control Solenoid (Solenoid 2)
- G is the Default Control Solenoid (Solenoid 8)
- H is the 1-2-3-4-5 Reverse Boost Solenoid (Solenoid 9)
- J is the Line Pressure Control Solenoid (Solenoid 6)

Five of these solenoids are supplied with a fixed reduced pressure feed called the Actuator Feed oil. They are solenoids D, E, G, H and J. The

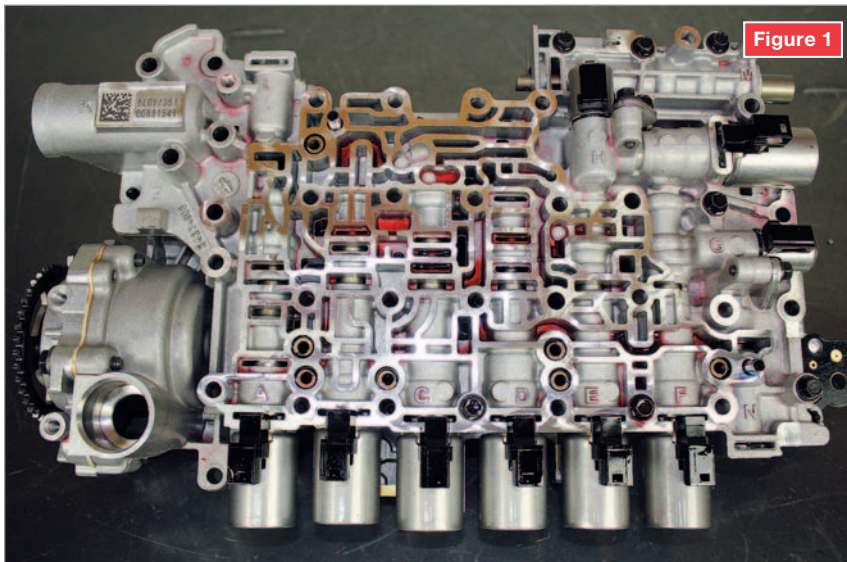


Figure 1



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.

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remaining four solenoids — A, B, C and F — are supplied with Line Pressure.

The Actuator Feed valve in previous GM transmissions is known to wear its bore, causing a loss of solenoid supply pressure. Should this happen with the 8L90, it will have quite an undesirable effect in both forward and reverse ranges.

The solenoids that receive line pressure (A, B, C and F) will regulate that pressure to a lower pressure with which to regulate their respective control valves. These control valves sit forward of the solenoid inside the valve body and are also supplied with line pressure.

When the solenoid influences its control valve, it regulates the valve to control line pressure to the clutch. For example, the 1-2-3-4-5 Reverse Control Solenoid (F) regulates its 1-2-3-4-5 Reverse Control valve in the valve body located directly in front of the solenoid. If a problem with this circuit fails, P0776 or P0777 may set. The system description for codes P0776 and P0777 provided by GM is as follows:

The transmission control solenoid 2 is a high-pressure, normally low, variable-force solenoid. The transmission control solenoid valve 2 regulates and directs pressurized oil to the 1-2-3-4-5-Reverse Clutch assembly to apply the clutch. The transmission control module (TCM) uses information from the speed sensors along with serial data information from other control modules to calculate the correct gear ratio and apply the correct clutch assemblies. The TCM compares the calculated ratio to the commanded gear ratio. The calculated and commanded gear ratios must match.

When they do not, depending on the failure, either P0776 or P0777 will set. These codes are defined as:

DTC P0776 – Transmission Control Solenoid Valve 2 Stuck Off – The 1-2-3-4-5-Reverse Clutch did not apply due to a hydraulic/mechanical condition. This results in a neutral condition.

DTC P0777 – Transmission Control Solenoid Valve 2 Stuck On – The 1-2-3-4-5-Reverse Clutch did not release due to a hydraulic/mechanical condition. This results in a tie-up condition.

These are type A codes, which will cause the TCM to disable transmission adaptation and will freeze current adapt values. It will disable Tap Up/Tap Down control and converter clutch apply. It will also request the ECM to disable powertrain braking, neutral idle control, auto grade braking and auto stop function. The TCM will command a default shift pattern and ignore all other requests. In this case, the command for P0776 is 6th gear and reverse only while P0777 will be 2nd gear and reverse only.

The order of diagnostics would be to first check the o-rings on the S2 (F) solenoid and then inspect the solenoid to see if it has failed mechanically being stuck in the low or high position (**Figure 4**). The next step would be to inspect the condition of the 1-2-3-4-5-Reverse Control Valve in front of the solenoid in the valve body to see if it is stuck or if the bore is worn (**Figure 5**). Next, refer to a hydraulic to see if there are any other valves or check balls in the circuit that would require inspection. In this example, the pressure being sent to the 1-2-3-4-5-Reverse clutch from the regulating valve is also going to the 1-2-3-4-5-Reverse Clutch Boost valve. This, too, will also need to be inspected (**Figure 6**). If all these items pass inspection, it's time to go into the transmission

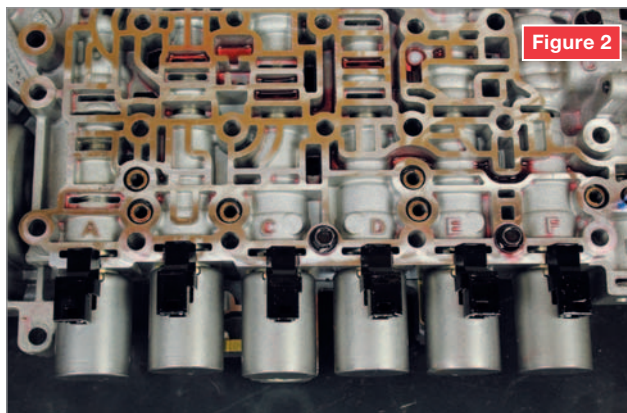


Figure 2

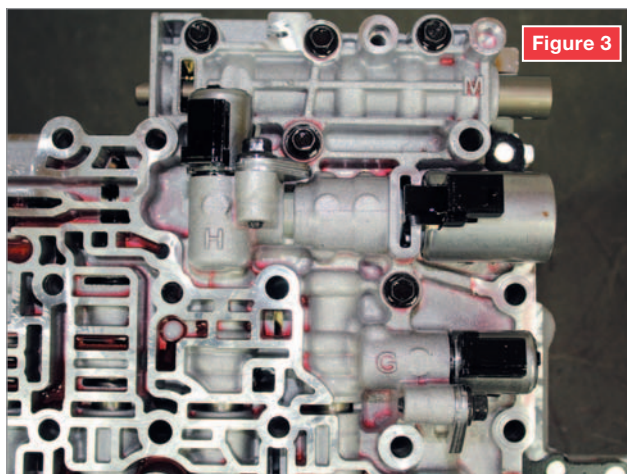


Figure 3

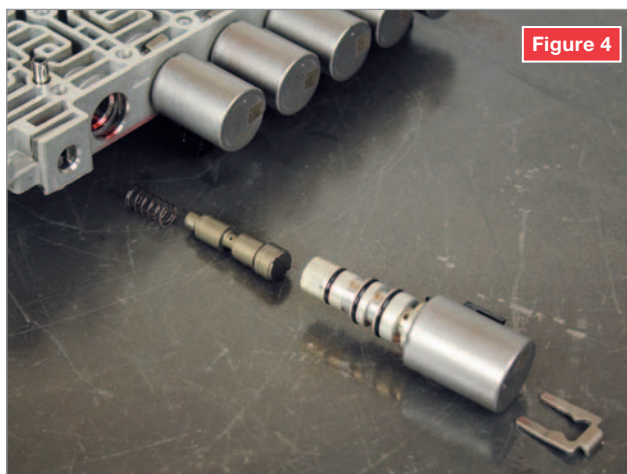


Figure 4

and check the clutch assembly and piston seals.

The 1-2-3-4-5-Reverse clutch pack (**Figure 7**) happens to be the last set of clutches inside the transmission. The application and release of this clutch pack is controlled by an apply piston and a clutch piston dam. These two pistons are mounted in a case extension as seen in **Figure 8**. **Figure 9** shows the clutch piston dam assembly out of the case extension. This piston has three rubber D-rings to inspect. **Figure 10** shows the clutch apply piston off of the case extension. This clutch apply piston has two rubber D-rings to inspect; one on the piston and one on the case extension.

The clutch piston dam is always supplied with minimum pre-fill pressure, which GM calls the 1-2-3-4-5 Clutch Knockdown pressure. When the 1-2-3-4-5 Reverse clutch is not being applied with line pressure, it too is supplied with the same minimum pre-fill pressure. The rubber D-rings for both of these pistons is constantly sealing pressure as is with all the other pistons in this transmission for the same reasons. For obvious reasons, these seals cannot be compromised in any way otherwise shift quality will be affected.

Using S2 (F) as an example, similar diagnostics steps would be taken for the other three solenoids that are fed with line pressure.

- S7 (A): Torque Converter Clutch with codes P2808 for stuck off and P2809 for stuck on.
- S4 (B): 2-3-4-6-8 Clutch with codes P2714 for stuck off and P2715 for stuck on.
- S3 (C): 1-3-5-6-7 Clutch with codes P0796 for stuck off and P0797 for stuck on.

Each of these solenoids has their own performance characteristic data stored in the TCM. Any time the transmission, the valve body, solenoids or the TCM has been replaced, a Solenoid Valve Characterization Reprogramming must be performed. Currently, solenoids are not available separately for servicing requiring the purchase of the entire valve body assembly.

The following information about this programming procedure has been provided by GM.

The solenoids in this transmission require unique performance characteristic data in order to function at maximum efficiency. This data is programmed and stored in the vehicle's TCM. When a transmission assembly, TCM, or solenoids are replaced during service, the performance characteristic data for the solenoids must be retrieved from a web server "cloud" repository and reprogrammed into the TCM.

Reprogramming also ensures that the characteristic data relationship is properly matched between the solenoids, valve body and transmission. Solenoid characterization reprogramming is performed using the TIS2Web Service Programming System (SPS).

Solenoid characterization may also be performed to "refresh" characterization data. To perform solenoid characterization after a transmission component replacement:

1. Document the new Transmission Unique Number (TUN)

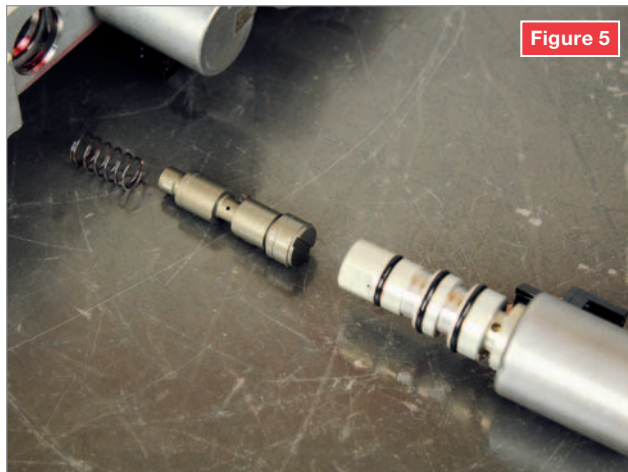


Figure 5

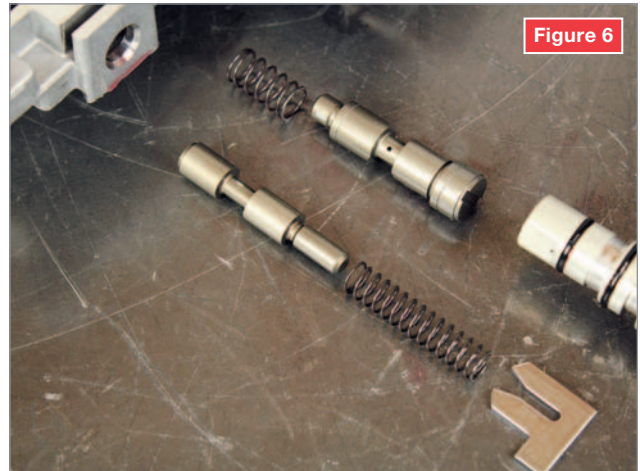


Figure 6



Figure 7

or Part Unique Number (PUN) as required. The TUN location may be found here: Transmission Identification Information. Since the TUN can be difficult to access when the transmission is installed in the vehicle, ensure you document the TUN prior to installing the transmission in the vehicle.

2. Log into TIS2Web/SPS.
3. Type the vehicle identification number (VIN).
4. Perform the SPS Transmission Control Module programming event.
 - Select "Transmission Control Module — Programming" to update TCM calibrations and Solenoid Characterization data.
 - OR
 - Select "Transmission Control Module — MCVM Operations" to update Solenoid Characterization data only.
5. From the "MCVM (Mechanical Characterization and Virtual Matching) Operation Selection" screen, select the applicable service procedure to be performed. You will be prompted to provide the necessary TUN or PUN when replacing a transmission part. At this point, the system will read the VIN from the ECM using the multiple diagnostic interface (MDI) and then retrieve the applicable genealogy



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data tree from the cloud. This data tree accesses the original characterization data so that it may be updated with the new component information. The system acquires characterization data for the given TUN/PUN via the cloud and updates the genealogy tree. The TCM is updated with the correct solenoid characterization data, and the cloud is updated with the new genealogy relationship.

A basic diagnostic code list for the 8L90 transmission:

- DTC P0601- P0604, P0606, P062F, P16F3, P16F4, or P16FB: Control Module Memory
- DTC P0658 or P0659: Actuator High Control Circuit Group 1
- DTC P0711- P0713: Transmission Fluid Temperature Sensor
- DTC P0716, P0717, P07BF, or P07CO: Input Speed Sensor
- DTC P071A: Transmission Tow Mode Switch
- DTC P0722, P0723, P077C, or P077D: Output Speed Sensor
- DTC P0746 or P0747: Transmission Control Solenoid Valve 1 Stuck
- DTC P0776 or P0777: Transmission Control Solenoid Valve 2
- DTC P0796 or P0797: Transmission Control Solenoid Valve 3 Stuck
- DTC P0815, P0816, or P0826: Upshift/Downshift Switch
- DTC P0851: Park/Neutral Position Switch
- DTC P0960, P0962, or P0963: Transmission Control Solenoid Valve 1
- DTC P0964, P0966, or P0967: Transmission Control Solenoid Valve 2
- DTC P0968, P0970, or P0971: Transmission Control Solenoid Valve 3
- DTC P175F: Acceleration Sensor Signal Message Counter
- DTC P1761: Up and Down Shift Switch Signal Message Counter
- DTC P176B-P176D: Intermediate Speed Sensor
- DTC P1824, P182D, P18B8, P18BD, or P18C2: Internal Mode Switch P Circuit
- DTC P182A, P1838, P18B5, P18BA, or P18BF: Internal Mode Switch A
- DTC P182B, P182C, P18B6, P18BB, or P18CO: Internal Mode Switch B
- DTC P182E or P1915: Internal Mode Switch

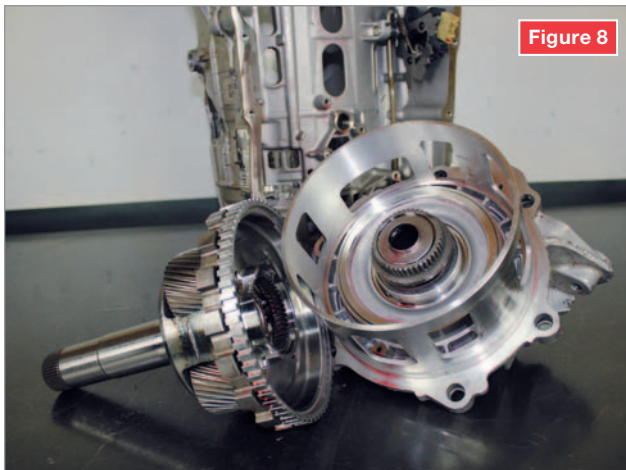


Figure 8

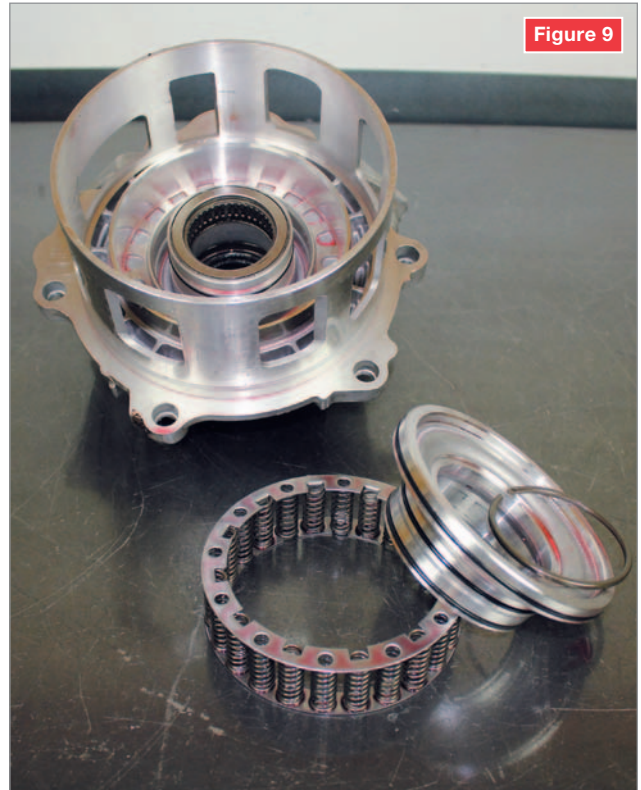



Figure 9

- DTC P182F, P1839, P18B7, P18BC, or P18C1: Internal Mode Switch C
- DTC P1840, P1841, P18B9, P18BE, or P18C3: Internal Mode Switch S
- DTC P2670 or P2671: Actuator High Control Circuit Group 2
- DTC P2714 or P2715: Transmission Control Solenoid Valve 4 Stuck
- DTC P2718, P2720, or P2721: Transmission Control Solenoid Valve 4
- DTC P2723 or P2724: Transmission Control Solenoid Valve 5
- DTC P2727, P2729, or P2730: Transmission Control Solenoid Valve 5
- DTC P2736, P2738, or P2739: Transmission Control Solenoid Valve 6
- DTC P27A7-P27AD: Transmission Control Solenoid Valve 1-7
- DTC P2808 or P2809: Torque Converter Clutch (TCC) System Stuck
- DTC P2812, P2814, or P2815: Transmission Control Solenoid Valve 7
- DTC P2817 or P2818: Transmission Control Solenoid Valve 8 Stuck
- DTC P281 D or P281 E: Transmission Control Solenoid Valve 8
- DTC P2824, P2826, or P2827: Transmission Control Solenoid Valve 9

Special thanks to Transtec for the use of the 8L90 transmission needed for this article and “The heart of the matter” article that appeared in the *Motor Age* April 2016 issue. 

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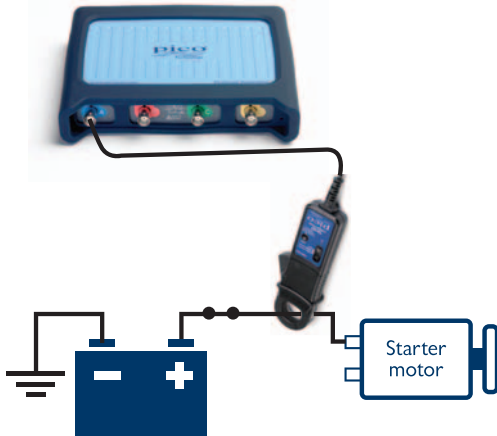
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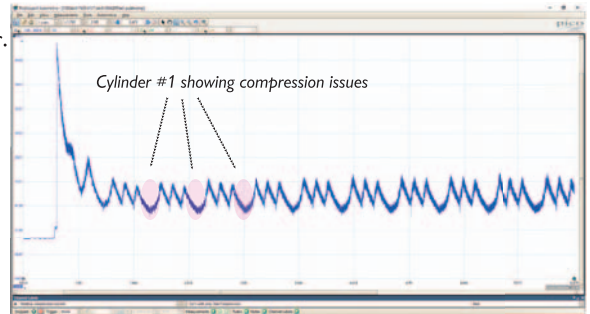
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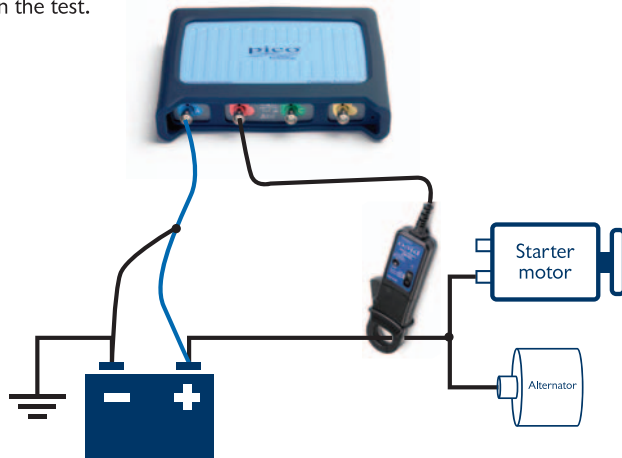
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Figure 6



A GAME PLAN FOR DIAGNOSTIC SUCCESS

TACKLING ANY DIAGNOSTIC DILEMMA WITHOUT A PLAN IS A SURE WAY TO FAIL

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

In order to find a vehicle problem, a technician must be prepared to interrogate the vehicle owner and address their concerns. The following should all be a part of your diagnostic game plan: a vehicle test drive with the vehicle owner (if possible), a visual inspection and a check of all the basics — battery, fluid levels, complete vehicle system scan and service information, including TSBs. Asking the right questions such as those to better determine when the vehicle exhibits the problem — when cold, hot, after sitting awhile, on a rough road, at a certain speed or while backing up — will help you narrow down your search for what may be the problem.

Putting a stop to the problem

Years ago I had a vehicle that was dropped off from another shop with a complaint of a rough-running engine

only when the vehicle was at a stop or on bumpy roads. This vehicle had a bunch of new components in it including new plugs, plug wires, air and fuel filters, fuel pump, injectors and even a PCM. While I performed a visual inspection, I noticed that the brake pedal was worn on the side facing the throttle pedal, along with a hole in the carpet. This visual indicated to me that the owner (who I never met or spoke to) most likely wore work boots or a shoe with a hard sole. The next thing I observed was that the engine started right up and ran at a normal high idle before dropping down to a smooth normal idle. After applying the brake pedal while I was selecting the D range on the shifter, the engine began to run rough until I started to drive the vehicle. With my foot off the brake, the engine ran smooth; but once I pressed on the brakes, the engine ran rough again. I thought that this may

be a problem with fuel delivery even though the vehicle already had a new fuel pump and filter installed. Since this vehicle had an accessible fuel pump relay, I thought that I would current ramp the fuel pump to see if the amperage was at the normal level of 6 amps. Once I installed my amp clamp on my labscope, I found that the pump current ramping waveform was normal at idle. When I pressed on the brake pedal, the engine ran rough and the amperage dropped to about 3 amps. I tried applying and releasing the brake pedal multiple times only to come up with the same exact results. My next step was to look up the wiring diagram for the vehicle circuit to see what the common denominator was. What did the brake pedal and the fuel delivery have in common? It was G402 (**Figure 1**) ground, which had 16 loads (light bulbs), including the fuel pump, on the same ground circuit.

I used the wiring diagram like you would use a map to find what road to take. I found that G402 (**Figure 2**) was located in the trunk on the left rear wheel housing. When I located the ground, I noticed that the area it was attached to was badly rusted. To

Photos: G. Jerry Truglia

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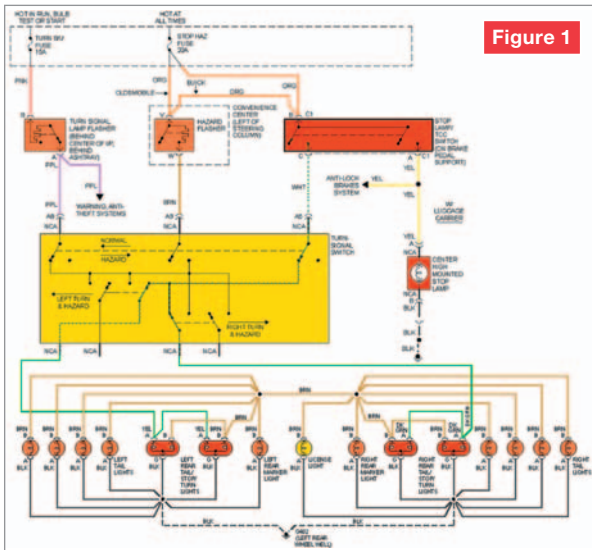


Figure 1

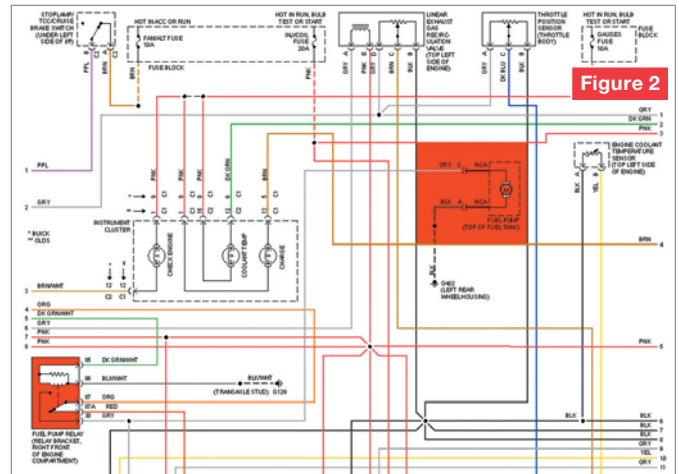


Figure 2

confirm that the ground was the problem, I connected the ground pigtail that is attached to the Power Probe handle to the existing ground and depressed the brake pedal. The result was that the engine no longer ran rough with the brake pedal depressed. Since connecting a good ground confirmed that the engine ran smooth while the amperage stayed at 6 amps, I knew that all I had to do was clean up the ground terminal ends, along with the star washer and bolt and relocate the ground to a rust-free area. After I located a good rust-free area, I cleaned it down and installed the bolt, star washer and ground wires followed by applying the brakes again. Now there were no signs of a rough-running engine.

A game plan with coolant temperature

Let's take a look at a cooling system issue on a 2003 BMW 535xi that has an illuminated MIL along with a P0128 (Coolant Temperature Below Threshold) DTC. When this 535xi came in, the vehicle still had good heat and the engine was not overheating. Most of the time when we think of a cooling system issue, there is either a problem with the vehicle not getting enough heat or worse yet, it's overheating. Since this vehicle did not exhibit either of these problems, we had to look elsewhere for answers. One good place to start since this vehicle had an illuminated MIL is checking out Freeze Frame to see important information that may lead us to the heart of the problem. Unfortunately, the Freeze Frame data did not reveal any important clues. However, we did notice that the temperature was only at 177°F/88°C when the DTC was set. Our next step was to check the time to temperature to see if the cooling system could reach the desired temperature within a specific amount of time. We connected the EScan, the only scan tool that provides important information on Time to Temperature by testing the cooling system. While performing this test using the EScan, the user is able to see if the thermostat or cooling system has a problem.

The graph shows that the temperature starts high but drops rapidly over a short period and then only rises a small amount. The test does not even display a time in seconds in the upper right corner for the rise time as it should.

Now let's take a look at the Time To Temperature screen

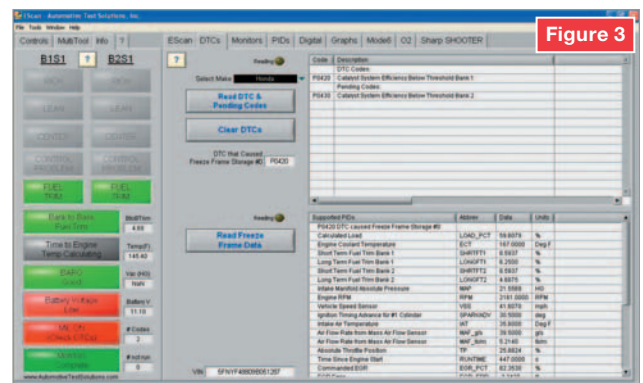


Figure 3

after we replaced the thermostat, added coolant and bled the system. The temperature rise is now a smooth line that reaches 199°F/93°C in 0.12 seconds. Also notice that the DTC from the first screen (second box from the bottom left of the scan tool) that was in red is now yellow, which means that the DTC has gone from a hard DTC that turns the MIL light on, to one that is now pending. Remember an illuminated MIL can turn off if the conditions that caused the DTC are met and it passes certain OBD II criteria or trips.

Now let's take a look at a vehicle that has a cooling system issue that did not set a DTC. One such vehicle that came in was a 2009 Honda Pilot that had an illuminated MIL with a P0420 (Catalyst System Efficiency Below Threshold Bank 1) DTC and a Pending P0430 (Catalyst System Efficiency Below Threshold Bank 2).

Let's see what clues can lead us to the problem. Take a look at the Freeze Frame data (Figure 3) and note the engine temperature when the DTC was set. Because the engine was on the cool side, it caused the engine to run richer for a longer period and thus set the current DTC. There are other causes for a rich condition, but when we take a very close look at long-term fuel trim (LTFT), we see that they are at 4 and 6 in the Freeze Frame data.

Take a look at the RPM and low load of fuel trim (Figure 4). Note that it continues to be high all the way through the cell blocks. There are a few causes for these high numbers, such as the Mass Air Flow (MAF) sensor (another shop already replaced the sensor with a new OE sensor), fuel delivery and temperature.

Looking at the Time To Temperature test (**Figure 5**), we see that even though the passenger compartment was getting heat and the engine was not overheating, we had a problem. The rise to operating temperature was too slow, which caused the engine to stay in a colder range that requires more fuel. Over time, rich mixtures ruin catalytic converters. In 135,739 miles/218,450 km, the thermostat and coolant were never changed, which helped “kill the cat.” The fix for this vehicle was to replace both converters, flush the cooling system, replace the thermostat and tune up the vehicle.

No crank, no start Audi

A 2007 Audi Q7 was towed in from an Audi dealer with the symptoms of no crank, start and transmission shift selector that would not go into park, preventing the ignition key from being removed. When this vehicle was towed in, it had a noticeable yellowish plastic (**Figure 6**) cover on the front windshield and hood. This indicated to me that the vehicle was taking on water, but then again it's not much different than most other European vehicles. The dealer diagnosed the vehicle with a wiring problem and gave the owner an estimate of more than \$18,000 to fix the vehicle with no guarantees. The vehicle owner had already installed a new battery and had tried to get it repaired somewhere else prior to towing it to the dealer. What amazed me was that the dealer charged the owner thousands and yet was not able to get the engine cranking, running or even get the shifter to move to park.

The other overlooked area that the dealer did not address was that they did not code the new battery to the vehicle computer system. This was a simple process where we use our Autologic to code the battery and check the system. After checking all the vehicle systems to find out why there was a no crank, no start, it was time to dig in and start checking powers and grounds. My lead tech Bill found extensive water damage to the main underhood fuse box (**Figure 7**) that houses a bunch of fuses and relays. As you can see from the picture, the water damage was a result of a leak over time. Since the damage was con-

tained to this area, Bill started checking and cleaning the nonexistent powers and grounds, along with replacing all of the fuses and some of the relays (**Figures 8 and 9**) that had internal corrosion. There were other relays that did not need to be changed since they could be cleaned. To ensure problem-free connections, Bill applied Stabilant 22 to all the wiring connections and terminals in both the fuse and relay boxes. After Bill completed the cleaning and replacement procedure, the engine was able to

crank, but still did not start. However, even though the engine would not start, the transmission shift selector could now be shifted into park and the ignition key could be removed. With the problems being narrowed down, Bill once again checked the complete system using the Ross-Tech scan tool. What he found on this vehicle that only had 67,300 miles on it was amazing. The Ross-Tech system scan came up with more than 15 modules reporting serious malfunctions.

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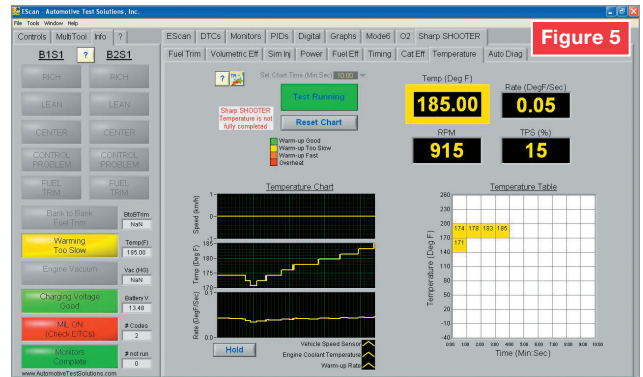
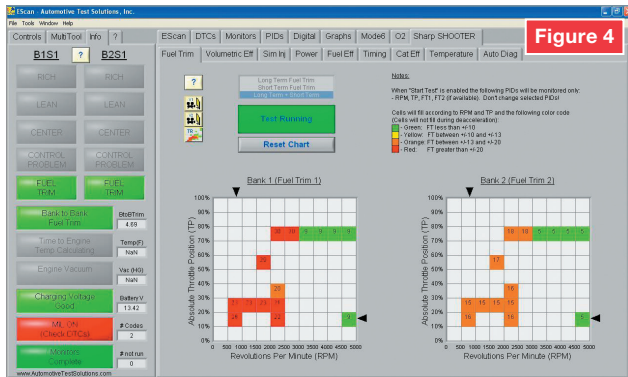
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ance and get another set of eyes on the problem, Bill contacted Ross-Tech tech support and reviewed the complete system log. On a vehicle that had so many problems, an extra set of eyes is always a good move. Unfortunately, tech support was unable to provide Bill with an exact fix and said they had not seen anything like this. Since I was on the road teaching, I was not able to be there from the beginning, so I asked Bill to get me up to speed. After trying multiple tests and looking over the vehicle, I came to the conclusion that the ECU/PCM was not always providing information. This is why it is a good idea to always have at least two scan tools in your shop to make sure it's not the scan tool. With two scan tools showing me the same results along with all power and grounds now in good condition, I decided to call

for a new ECU/PCM. The price and availability for a new ECU/PCM was about \$2,000 and was going to take 10 days to get. Instead we called AutoPCMs.com and we were able to get one overnighted for less than \$500.

Once the ECU/PCM arrived, we had another problem, since the ECU/PCM needed to be programmed along with aligning the immobilizer security code to other vehicle computers. Since I already had an LSID (Locksmith Identification Number) that I signed up for on the National Automotive Service Task Force, I was now able to apply for the Audi license for the ODIS factory scan tool that is needed to perform this task. The process took a few days after I signed up on the Audi/VW website, so we were lucky that the vehicle owner was able to wait or we would have lost this job.



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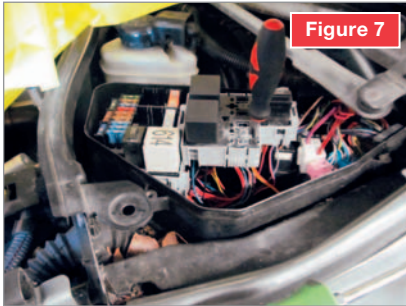
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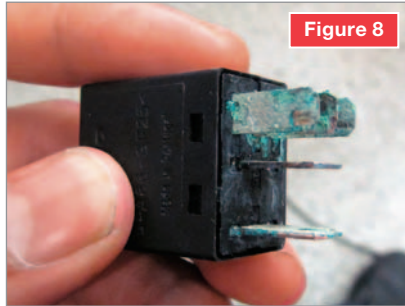
All parts in a system are engineered to work in concert and wear at about the same rate. Combine belts and tensioners, water pumps and hoses, and use timing component kits for a complete system repair. The best way to prevent costly system failure is to remember the Car Care Council's recommendation. Start **inspecting** the serpentine, cooling and timing systems at **60K** miles, and **replacing** worn components by **90K** miles, or as advised by the manufacturer.

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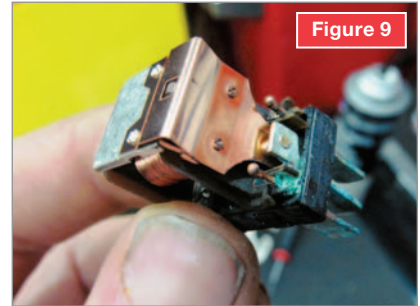




After receiving the Audi/VW approval, I was able to download the latest software and go in and see (Figure 10) all the modules that were preventing the vehicle from starting. Now it was time to program the unit and align the security on all the modules, but it was not going to be all that easy. Having used only the older version of ODIS in the past, I was not familiar with the new version and how to program the vehicle from the ODIS diagnostic portal. Since I have Autologic tech support, I contacted Justin who was able to connect me to an Audi/VW specialist.



When the specialist called me back, he logged onto my laptop and walked me through the new process of programming the vehicle. What he showed me was that I could not be in diagnostics and select programming without first existing diagnostics. After a lesson learned, all of the modules (Figure 11) except one (the TPMS module that needs to be replaced for a different reason) were now confirmed good and working. It's a good idea to network with others and have a backup since it's impossible to know everything. Many times when I am teach-



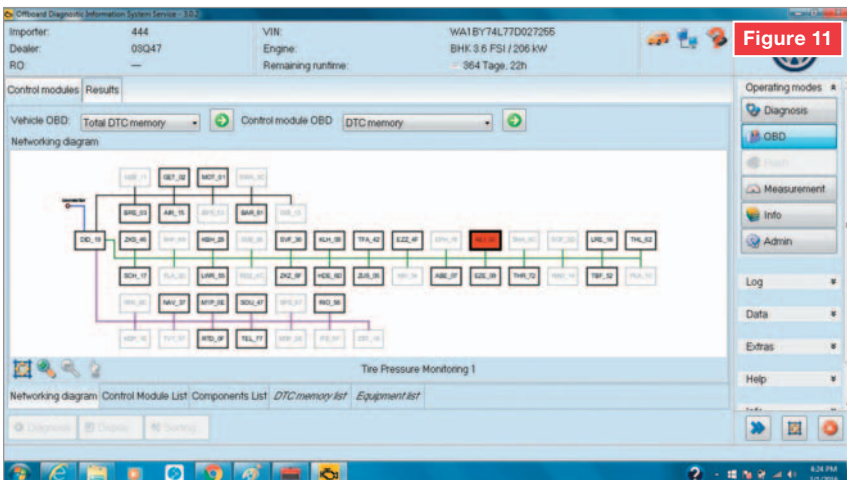
ing a class a tech will say to me, "You know everything."

"I only wish I did," I respond. I only have a "G" and a half of an "o," and I will never get the other half of the "o" or "d" since only God knows everything.

If we use quality tools, get training and use resources such as ALLDATA, Mitchell 1, Motologic, Identifix, iATN, Google, YouTube, hotlines, each other and most importantly our brains, we will find the best route in diagnosing and repairing the vehicle.

A closing note

I think it's important for each shop to have a technician who is trained and has an LSID license, and if you work on Audi/VWs, you need their license as well. In 2017, some things in our business are going to change for the technician who works on drivability problems. In order to program all vehicles, the standard is going to utilize a J2534 device, such as a Drew Tech CARDAQ M that will be the hardware interface for the OE's full-factory scan tool. If you think that you are just going to replace a computer in a vehicle and use your current scan tool to get the vehicle running, you are mistaken. Don't wait until the horse is out of the barn; get involved, trained and go to www.NASTF.org and start the LSID process so you can diagnosis, program and fix vehicles. *TZ*



G. JERRY TRUGLIA
CONTRIBUTING
EDITOR

G. Jerry Truglia, ASE World Class Triple Master Technician Auto, Truck & School Bus, L1, L3, F1, A9, X1 C1, is president of Technicians Service Training and a nationally recognized trainer/author. He founded TST to bring affordable training to fellow techs and owners.

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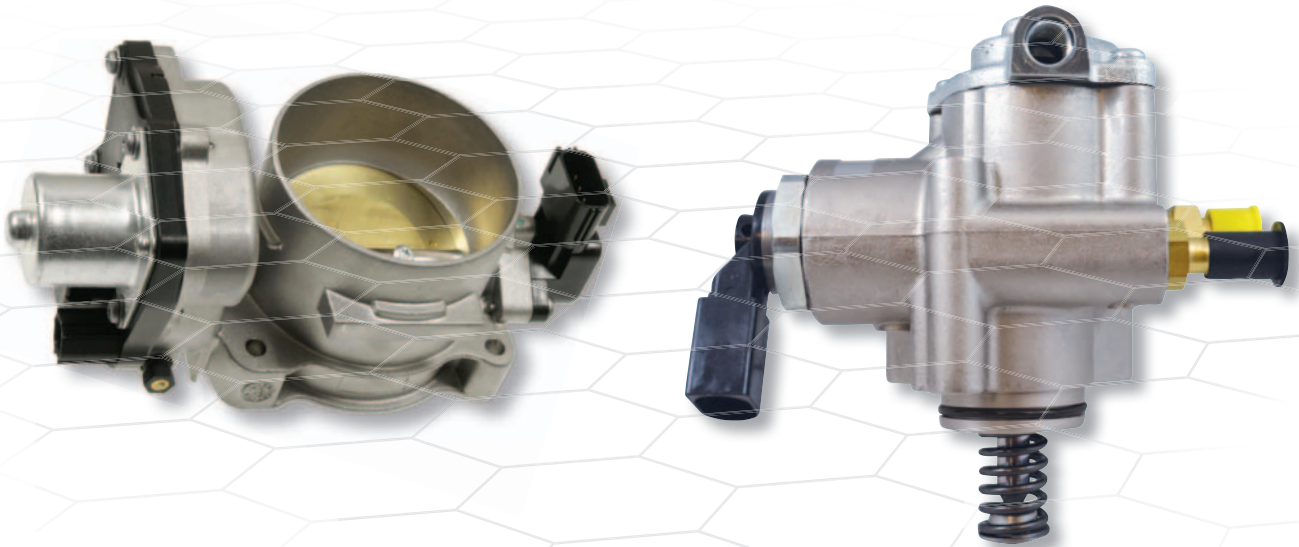
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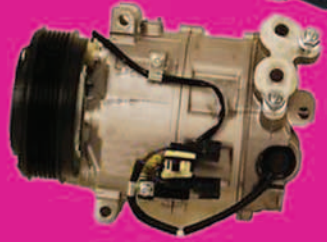


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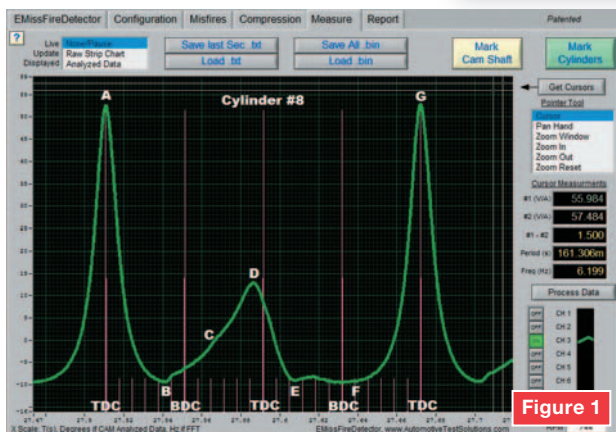


Figure 1

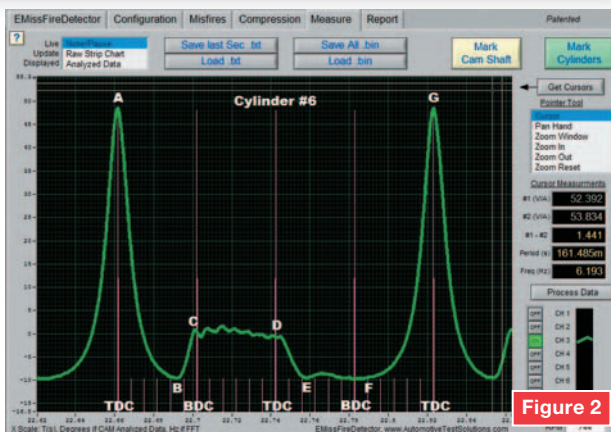


Figure 2

MASTERING IN-CYLINDER PRESSURE TESTING IV

REMOVING THE SPARK PLUG FROM THE CYLINDER AND INSTALLING A PRESSURE TRANSDUCER IN ITS PLACE HAS A GAME-CHANGING EFFECT

BY **BERNIE THOMPSON** | CONTRIBUTING EDITOR

This simple technique has changed the way the internal combustion engine is diagnosed around the world. If you are not aware of the power of this simple truth please read the *Motor Age* articles "Mastering In-Cylinder Pressure Testing," installments I, II and III. These articles cover the basics of in-cylinder compression waveforms at crank, idle and snap throttle.

This technique is not only good when used to find failures, but is great in eliminating possible problems as well. I can recall a time when checking a drivability problem would include checking the ignition timing, not necessarily to find an ignition timing problem, but to rule one out. The in-cylinder compression waveform can be used in the same way. Many times in my career

I have found myself diagnosing a problem with an engine I thought was of a mechanical nature, but with no way to confirm my suspicions. Now, with this game-changing technique, you can test the mechanical condition of the engine quickly and accurately.

Applying the technique

Now let's use this game-changing technology to look at an engine that produces a misfire under load. The vehicle is a 2003 BMW 745Li with a V8 4.4 Liter DOHC engine. The misfiring cylinder is identified with a tailpipe exhaust pressure transducer, which shows cylinder No. 8 as the culprit. This agrees with the DTC set by the Digital Management Engine (DME) control module as a P0308. Using the tailpipe pressure sensor allows a way to confirm the DTC

set by the DME. This is a very important step to complete due to the fact that many engine control modules will report the wrong cylinder(s), and if the wrong cylinder is reported, you could waste precious time on a cylinder that has no problem at all.

The spark plug is removed from cylinder No. 8 and a 300 PSI transducer installed. The engine is then started and allowed to idle. The in-cylinder running pressure waveform taken from cylinder No. 8 is shown in **Figure 1**. This waveform clearly shows a problem, which can be seen by comparing it to an in-cylinder compression waveform taken from good cylinder No. 6, as seen in **Figure 2**. Let's look at problem cylinder No. 8 in **Figure 1**. Point A is where the piston came as close to the cylinder head as mechanically possible; this is a true Top Dead Center (TDC) position. Point B is where the exhaust valve opened far enough to establish flow. This can be seen by the pressure changing direction at the 40-degree marker located before Bottom Dead Center (BDC). The pressure then starts to rise and crosses the BDC marker with -6 PSI, indicating a problem is

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present with cylinder No. 8. This pressure at the BDC marker should have risen to 0 PSI.

Let's look at **Figure 2**. It can clearly be seen at point B that the exhaust valve opening occurred and the pressure is changing direction at the 40-degree marker located before BDC. Once the exhaust valve has opened, the pressure changes direction, quickly rising to 0 PSI at point C, located just before the BDC marker. The pressure rise to 0 PSI happens in less than 40 degrees of crankshaft rotation. Now, let's look at **Figure 2**. At point C where the pressure achieves 0 PSI, there is some 110 degrees of crankshaft rotation after the exhaust valve opened. As the piston continues to rise toward the cylinder head, the pressure continues to rise to its peak pressure of 13 PSI, located at point D just before the TDC marker. When compared to good cylinder No. 6 in **Figure 2**, the pressure located at D is very close to 0 PSI.

Now let's look at **Figure 3**. This is a snap throttle waveform of cylinder No. 8. Point A is the peak pressure within the cylinder located at TDC. Point B is where the exhaust scavenge cycle is started. As the piston moves toward the cylinder head, the volume becomes less, forcing the exhaust out of the cylinder and into the exhaust system. At point C, the pressure has increased to 64 PSI and then drops just before TDC. This drop occurs due to the intake valve opening, allowing the high pressure within the cylinder to move to the low pressure within the intake system. In **Figure 4**, good cylinder No. 6 is shown on a snap throttle event, and it can be clearly seen that no pressure increase occurs as the piston comes up to the

TDC marker located at point C.

Interpreting the results

The question is what is happening in bad cylinder No. 8? Let's look at **Figure 1**. When the exhaust valve opens at point D, the pressure should rise rapidly to atmospheric pressure, which is 0 PSI. At point D, the cylinder pressure is in a negative state of pressure shown at -10 PSI or -20.36 inHg. Since a high pressure (more energy) always moves to a low pressure (less energy), when the exhaust valve opens, the exhaust pressure — being close to that of the atmospheric pressure — it moves to the low-pressure area contained within the cylinder. This inflow of atmospheric pressure causes the in-cylinder pressure to rise rapidly until it matches the atmospheric pressure. However, this is not what is happening in bad cylinder No. 8. Since the cylinder is in a vacuum state when the valve opens and the pressure does not change quickly, the path for the flow volume must be impaired. Additionally, as the piston moves toward the cylinder head, the volume contained within the cylinder does not move out of the cylinder. If it did, then the pressure within the cylinder would not increase.

This increase in pressure as the piston moves upward at the 360 marker clearly shows an exhaust gas scavenging problem. An exhaust gas scavenge problem at idle could be caused by (1) an exhaust camshaft timing issue; (2) an exhaust valve that is limited in its opening; or (3) an exhaust runner that is restricted. (1) If the exhaust camshaft has an advanced valve closing then the pressure at TDC will increase. Any

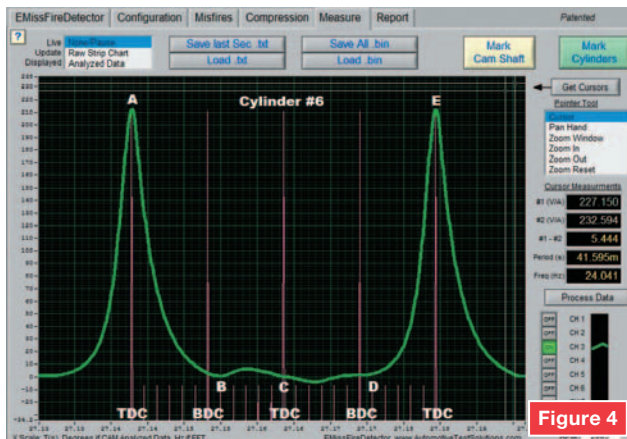


Figure 4



Figure 5

exhaust gas volume still in the cylinder will be trapped with the early valve closing, and the piston moving toward the cylinder head will create additional pressure within the cylinder. However, if this was the cause of the pressure rise at the 360 marker on cylinder No. 8, the exhaust valve opening would be much earlier than the 40-degree opening that cylinder No. 8 has. Additionally, the pressure would change quickly from a vacuum to atmospheric pressure with the exhaust valve opening, which is not the case with cylinder No. 8.

If the exhaust valve opening is the cause of this pressure increase, depending on how far the exhaust valve is moving off of the valve seat, the pressure rise within the cylinder will move more quickly. This is due to the volume being trapped within the cylinder. When limited exhaust gas can escape from the cylinder, the pressure within the cylinder will build quickly.

If the exhaust runner is plugged, at

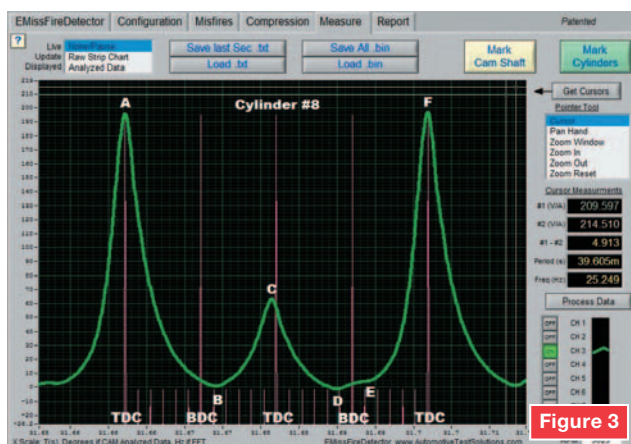


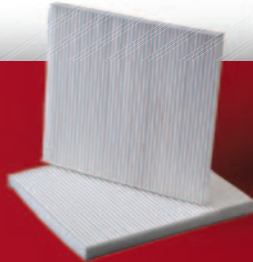
Figure 3

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least some of the cylinder volume will be able to move out of the cylinder, allowing a slower pressure build rate within the cylinder. This is what is happening in cylinder No. 8, as can be seen in **Figure 5**. **Figure 5** shows an exhaust runner that is restricted by carbon. Even with a problem as unusual as this, it is quite easy to diagnose when using in-cylinder pressure testing.

On to the Hyundai

Now let's look at another vehicle — a Hyundai XG 350 with a V6 3.5 Liter DOHC engine. This engine cranks and tries to start, but fails to run. In **Figure 6**, cylinder No. 1 from bank 1 is shown. Points A and E are the TDC positions. By marking these two positions, which represents one fire cycle or 720 degrees of crankshaft rotation, you can now divide this waveform into segments. These segments can represent the four strokes of the internal combustion engine or be divided into the number of cylinders the engine you are working on has. If your scope does not automatically mark these segments, then this can be accomplished on your scope by simply marking the compression waveform with the scope cursors. Now look at the time given by the scope for the time between the cursors, then take the time and multiply it by .25 = 180; .50 = 360; .75 = 540.

So in **Figure 6**, take the time shown on the right in the period (S) display, which is 474ms, and multiply this to set your TDC and BDC locations. So in this example: 474ms x .25 = 118.5ms BDC; 474ms x .50 = 237ms TDC; 474ms x

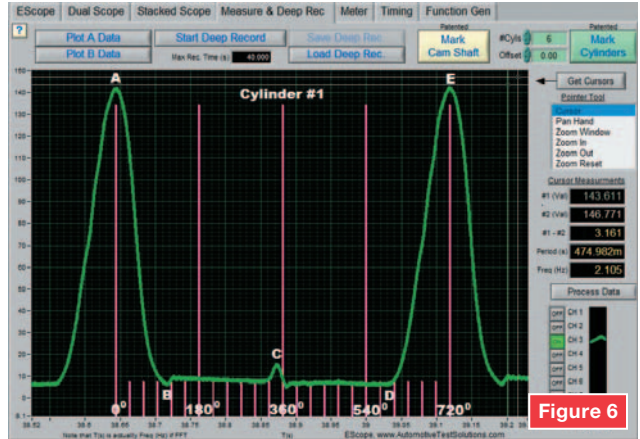


Figure 6

.75 = 355.5ms BDC. This will provide the time to move your right-side cursor so you can mark the stroke of the engine. In moving the right-side cursor, the TDC and BDC mark can be identified. Whether you mark the four strokes of the engine or mark the number of cylinders, this is a very important technique, as you clearly see on this Hyundai.

Now let's look at **Figure 6** taken from cylinder No. 1. Point B is where the exhaust valve opening is located at 70 degrees before BDC. While cranking the engine, this exhaust valve opening position should fall between 30 degrees to 60 degrees before BDC. So at 70 degrees, this exhaust valve opening is clearly in an advanced position. Now look at point C. The pressure increases as the piston nears the TDC position. At 15 degrees before TDC, the pressure tops out and then quickly drops, due to the intake valve opening. If the exhaust valve opens too early, it will also close too early. When the exhaust valve closes early, the volume that is still contained in the cylinder will be trapped. As the piston continues to move upward, the trapped volume is compressed, thus increasing the in-cylinder pressure. At point D, the intake valve is closing. This can be seen at the point the pressure starts to increase at some 50 degrees of crankshaft rotation. From point D to point E, the volume within the cylinder is compressed, thus increasing the in-cylinder pressure. It is interesting to note that the rising pressure is not smooth, but has slight changes in it. Additionally, the compression tower has a slight lean to it. This can be seen by looking at the pink TDC marker and comparing the rising and falling

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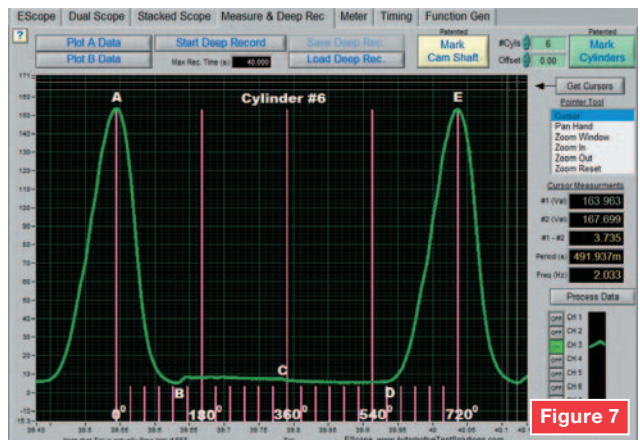


Figure 7

pressure. The falling pressure is closer to the marker than the rising pressure. These two pressures should be within 20 degrees from one another, or should look even from the TDC marker on a cranking compression waveform.

Now let's look at **Figure 7**. Point B is where the exhaust valve opened on cylinder No. 6. It can be determined that the valve opening position is located at 50 degrees before BDC, which is some 20 degrees different from cylinder No. 1. Additionally, at point C there is no pressure increase occurring. Point D, where the intake valve is closing, occurs at the 30-degree mark after BDC, which shows some 20 degrees difference from cylinder No. 1 as well.

It will always be very important to look at the intake pressure changes and exhaust pressure changes at the same time you are looking at the in-cylinder pressure changes; this is shown in **Figure 8**. The green trace shown is from the in-cylinder pressure, the blue trace is from the intake pressure and the yellow trace is from the exhaust pressure. The pink markers are dividing the pressure waveforms by the number of cylinders contained within the engine. This 3.5 Liter Hyundai engine has 6 cylinders, so there are six cylinder boxes. Each cylinder box is marked for the cylinder number of each intake box in blue or exhaust box in yellow. These boxes are marked by the firing order from the engine. To find the intake box and exhaust box from the cylinder under inspection, simply find the 360 marker; the intake box is located to the right of the 360 marker and the exhaust box is located to the left of the 360 marker.

Data collected

These waveforms are extremely interesting. The first observation you can make is that there are not enough pressure pulses from the intake or from the exhaust. This is a 6-cylinder engine, so there should be six intake pulls and six exhaust pushes; however, there are only three intake pulls and three exhaust pushes. When analyzing the intake pulls, there should be one pull for each cylinder box. These intake pulls are formed smoothly to produce one pull for two cylinder boxes, which is incorrect. If this waveform was produced correctly, there

should be six evenly-formed smooth humps, one associated with each cylinder box. As the intake hump moves upward, more vacuum is indicated and as it drops, less vacuum is indicated. As each piston is moving downward, more vacuum is created, thus more vacuum is indicated in the pressure waveform. As the piston reaches BDC, the intake valve for that cylinder starts to close, causing the vacuum to drop. Then another intake valve opens and the piston starts its downward move-

ment, thus increasing the vacuum again. Therefore, each individual cylinder will produce a vacuum hump.

When looking at the exhaust pushes, there should be one exhaust push for each cylinder. During the exhaust cycle, the exhaust valve opens before BDC and the piston starts its upward movement. This creates a higher pressure in the cylinder than in the surrounding atmospheric pressure, allowing the cylinder contents to be forced out of the cylinder. During a cranking compression test, the

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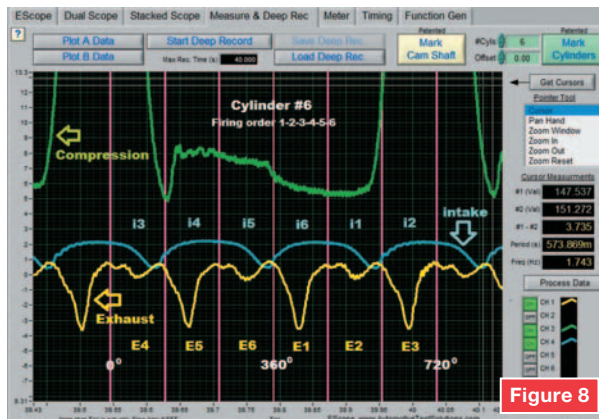


Figure 8

engine is downed so it cannot start. This allows the cylinder to be in a vacuum state when the valve is opened so the atmospheric pressure rushes back in to the tailpipe. This inflow of air is shown in the exhaust pressure waveform by a drop in the waveform. These vacuum drops can be seen in cylinders E5, E1 and E3. Each individual cylinder should have this drop, but perhaps the drop would not be as great, as these drops are in this 3.5 Liter Hyundai. A typical exhaust pressure drop during a no-start cranking event would be 1 to 2 inches of water, where this Hyundai has 5 inches of water in exhaust drop.

Now let's look over the data: Bank 1's camshaft timing is off by some 20 crankshaft degrees, whereas Bank 2's camshaft timing is correct. Bank 1 contains cylinders 1, 3 and 5. Bank 2 contains cylinders 2, 4 and 6. If the camshaft timing is off by 20 crankshaft degrees, there should still be an intake pull and an exhaust push for each cylinder. Additionally, the exhaust valve opening on Bank 1 is opening when the cylinder is in a greater vacuum than would be expected. These data points indicate that either the camshafts in Bank 1 are the wrong camshafts for this engine or the camshafts have been crossed. In other words, the exhaust camshaft is in the intake side and the intake camshaft is in the exhaust side. When the valve cover was removed and the camshafts were inspected, the intake camshaft was marked RI and the exhaust camshaft was marked RE. The shop that had towed the vehicle in was called and asked if the camshafts could have been replaced with the wrong camshaft for this 3.5 Liter Hyundai. They assured us this could not have happened. Therefore, there is only one possibility: the camshafts have to be crossed. The camshafts were then removed and positioned correctly and this 3.5 Liter Hyundai engine roared to life. What is important is to always follow the data; make your diagnostic decisions based only on the data. If you do this, you will always fix the vehicle.



BERNIE THOMPSON
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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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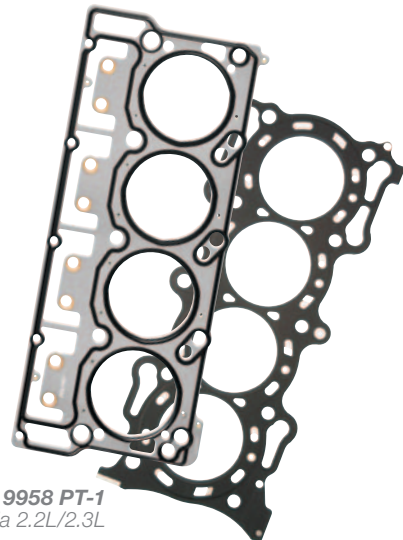
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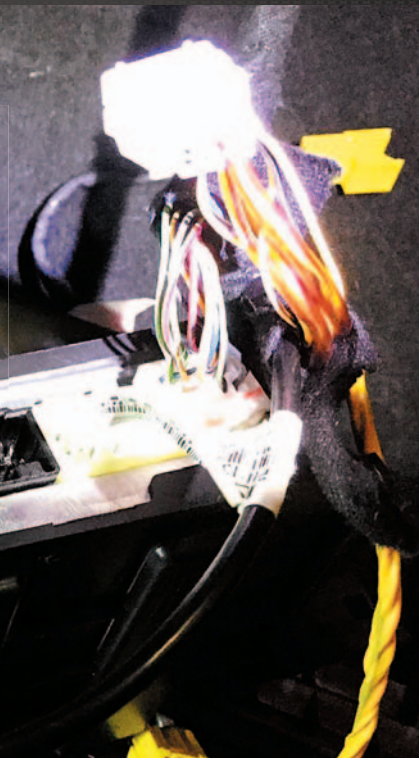
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TELEMATICS AND TECHNICIANS



Connectors on this GM OnStar module from L-R are Bluetooth, GPS and the two vehicle interface connections with low-level audio out, low-level audio in (both AC signals) and the various powers, grounds and serial bus connections for both GM high-speed and low-speed CAN.

THE INTEGRATION OF THE AUTOMOBILE INTO THE “INTERNET OF THINGS” BRINGS NEW CHALLENGES TO YOUR BAYS.

BY **DAVE HOBBS** | CONTRIBUTING EDITOR

Telematics has become very personal to me lately. If you've been wondering what all the hype about telematics is and how it will affect your role as a vehicle service professional, read on. If you're not sure what in the heck telematics even is, read on! Telematics merges many of the onboard vehicle communications systems we work with every day with the world of cellular communications. If you recall the birth of GM's OnStar in 1996, however, you know telematics is not a new thing. Recent advances in vehicle communications and the desire of private vehicle and fleet owners to keep their vehicles and occupants safe and connected has caused a surge in the growth of vehicle telematics. Telematics is yet another electronic system that requires diagnosis and repair. Sometimes this technology creates unwanted side effects on the vehicle's electrical systems,

thereby creating diagnostic problems in the service bay.

Consumer appeal and emotions

Telematics volume is growing rapidly on a very large number of vehicles and is being utilized by a diverse group of drivers. Truck drivers know where their next load is waiting for pick up and their fleet service managers know when that rig will need serviced next. Parents of young drivers can sleep with a little peace of mind knowing their teenagers are actually driving sensibly and within their allowed boundaries of travel. For the personal side of this popular technology, my 87-year-old mother recently became a telematics user. Mom has never been a fan of technology. On the other hand, my father has been the key person for the past five decades inspiring me in the auto repair industry. Dad has always been excited about technol-


ogy. He built a repair business in the 1960s that lasted close to 50 years, and it was there I learned the fundamentals of automotive electronics.

Now, Dad has some problems with dementia that are advanced enough for Mom to have taken over the driving duties. If you have an elderly loved one with Alzheimer's or dementia, my prayers are with you. If you've been fortunate to miss this experience, you have no idea what families go through. In just a few short years, Dad spiraled from being one of the nation's best auto electric and vehicle diagnostic guys to needing his son (yours truly) to replace a tail light for him. Tasks like this are an honor to complete for him, yet very sad at the same time. As far as mishaps go, so far we've been lucky. Dad has, on a couple occasions, taken off in his 2002 Chevy Trailblazer only to be brought home a few hours later by some very understanding police officers. Mom keeps thinking she has retrieved every spare key dad has made for the Chevy. Even though he can't find his way home at the end of his joy rides, he seems to find where Mom has hidden the keys. Moving into a specialized care facility isn't an option

Photos: Dave Hobbs



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at the moment. Mom and the rest of the family constantly worrying about Dad finding another Trailblazer key and disappearing is no longer an option either. Telematics was an option. Now, thanks to the GPS tracking and cellular technologies incorporated into a telematics dongle, Mom and a few other family members know exactly where the family Trailblazer is just in case Dad manages another joy ride.

Human nature — safe and connected

Telematics in today's privately-owned vehicles combine vehicle position, vehicle on-board diagnostics and external telecommunications. Many drivers today want to feel safe and connected, which is an important driving force in increased acceptance of this technology, especially for women. For example, human nature reveals that some male customers may grumble a bit due to the inconvenience of a no start while at the same time enjoy a bit of the challenge in finding out what the problem might be. After all, the average American male driver (especially baby boomers) has been socially conditioned to view auto repair as something they should be able to understand (like their fathers or grandfathers) but don't due to the increased complexities of today's vehicles. When they find out telematics can help with vehicle diagnostics they often embrace that option. A sense of self sufficiency is boosted. All technicians reading this can relate! Most women drivers, on the other hand, see both the inconvenience and potential hazard to their personal safety when a no-start condition occurs.

Telematics nuts and bolts

Most all telematics contain three main subsystems:

1. Global Positioning System (GPS)
2. GMS or CDMA Cellular Phone (may or may not allow voice communications)
3. Vehicle Interface Module (connected to serial buses)

Telematics for private-passenger cars and light-duty trucks come in two distinct types:

1. OEM — Wired into the vehicle

OEM systems include the very first GM OnStar, dating back to 1996, along with BMW Assist, Toyota Mayday, Lexus Link, Mercedes Mbrace,

Ford Sync, Honda OnStar, Infinity Connection and Hyundai Blue Link, to name a few. The 1990s were the years of analog cellular phone technology, which gave way to digital 2D, 3D and then the current 4D digital technology requiring GM owners of older vehicles to either give up the OnStar operation or retrofit an up-to-date module into their vehicles. The latest model cars allow smart phones and other gadgets to integrate into the overall "infotainment system" of the vehicle. Features such as Bluetooth control of the phone via the OE radio for 3G or 4G internet services such as Pandora (internet radio) are becoming commonplace. The latest Ford Sync system allows for OE radio interface control of the popular Apple iPhone's Siri feature. The woman's voice who will answer your questions from who was the third U.S. president to what the temperature is in Peoria now can be activated through the radio, keeping your hands off your phone and your eyes closer to watching the road, instead of looking at your smart phone. Vehicle connectivity is very in-depth with OE telematics.

There are, of course, the time-honored features of vehicle GPS tracking for verbal turn-by-turn directions (displayed on your NAV radio screen on some vehicles) and stolen vehicle tracking. OE telematics modules are often on several of the vehicle's serial data buses to activate power door locks, (for lock outs) horn and headlamps (when you can't find your car in a parking lot), along with airbag deployment emergency response features. When any warning lights illuminate (not just powertrain-related problems) a typical OE telematics module (such as in the case of OnStar) can relay the DTC numbers and definitions to a call center at the customer's request via a cellular link, or the customer can simply log in to their telematics website to read out DTCs, fuel level, tire pressure, battery voltage, etc. right on their home PC or smart phone app.

OnStar's family link allows vehicle owners to observe current vehicle location, location history and even get a text alert on the vehicle's location. OnStar's remote link allows you to unlock, start the engine, retrieve DTCs and even check tire pressures from anywhere in the world with the app on your smart phone.



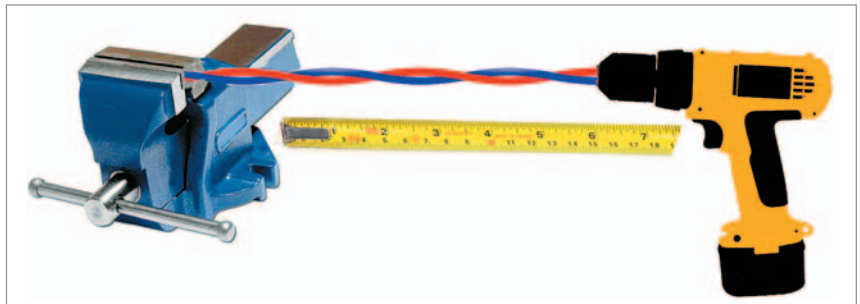
The aftermarket telematics dongles are small and simply plug into the OBD II DLC. Cellular communications of data from the vehicle's serial bus and GPS location info are pulled together to allow consumers, parents and insurance companies to leverage valuable information about the vehicle in order to be safe and connected. The Delphi model pictured above allows repair shops to intelligently manage preventive maintenance and repairs for their valued customers.

2. Aftermarket — DLC Plug In

Aftermarket telematics for private-passenger vehicles are growing in popularity for a variety of reasons. Insurance companies can offer lower rates if their insured agree to keep a telematics dongle plugged into the DLC. The unit uses GPS and cellular technology to update the insurance company on the miles the vehicle is driven along with the hours of the day (or night) in order to develop a premium on a usage-based system. A driver who only drives a few miles each day is much less likely to be involved in an accident compared to the driver who drives 40 miles a day to and from work on a midnight shift, when driving is considered more dangerous due to the increased rate of intoxicated drivers on the road late at night. Other features such as door unlocking and stolen vehicle tracking also help to keep the company's rates lower.

Consumer-based telematics are also popping up courtesy of various cellular providers. These units focus more on giving the vehicle owner peace of mind with geo fencing for the parents

of younger drivers, as well as children of certain elderly drivers. Some of the consumer-based telematics also allow the customer to perform select features often associated with OEM systems such as remote vehicle diagnostics and remote engine starts. Many repair shops are providing telematics units for their customers as a way to establish a connection between their customers' vehicles and the shop for increased peace of mind for the customer and greater preventive maintenance opportunities for the shop. Custom reports ranging from odometer status to brake usage to battery voltage levels afford the shop with a means to market necessary maintenance to customers in real time. A customer's anxiety around the various instrument cluster telltale illuminations can build good will between them and their service provider, who can inform them on vehicle issues, letting them know when the vehicle must be seen right away, or whenever a service appointment is convenient. For example, you really want your customers with a P0301 accompanied by a blinking MIL to get in right away before



You can easily make twisted pair wiring yourself. First, select a couple of wires with different colors of the right gauge and cut them to about a foot of extra length than you will need. You can cut off the excess later. Next, lay out a tape measure on the bench, chuck up a couple of wires in the vice on one end of the wires you want to twist in a drill and clamp the other ends in the vice. Finally, with the wires laying closely to the tape measure slowly pull the trigger on the drill until you've twisted the two wires to the same number of twists per inch the OEM wiring had. Cut off the excess and install into the section of harness you are replacing using the proper solder splice and insulation methods to end up with great connections and a neat job.

they damage their catalytic converter. The customer with an occasional P0440 evap DTC may be able to wait a while before scheduling that repair.

Diagnostics

The first thing any technician needs to do on any electronic system with a

potential problem is to get a full grip on four things:

1. Is it really broken?

a. Do you AND the customer know the consumer side of how the system is supposed to work?

b. Can you duplicate the problem?

2. What makes it tick?

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Exactly how does the system operate (service manual theory of operation) and what are its connections into the vehicle (service manual's wiring schematics and connector pin outs)? For many OEM telematics, you may be wise to spend the \$20-\$30 for a short-term subscription to the factory service manual to download these documents, along with any associated diagnostic charts. These systems are often complex enough to justify the extra edge you can get from factory information. A note on obtaining factory info: I recently went looking for GM's OEM info access. A technical trainer friend of mine advised me that www.NASTF.org is more closely monitored and updated by that organization than other online sites, so it may be more reliable.

3. What are the preliminary clues?

In addition to the obvious of extracting all DTCs from all modules on the vehicle, you should also check all fuses, observe the presence of additional aftermarket equipment, signs of body damage/repairs, battery state of health and anything else that triggers your visual and audible mental diagnostic alarm bells.

OEM telematics modules are often serial bus gateways connecting to multiple buses so if you have DTCs or other complaints with systems on more than one serial data bus, a gateway is always a potential suspect. In addition to looking for U-Codes, also observe your scan tool's screen when retrieving all DTCs in all modules. Many modern PC-based scan tools will have a section of their display that is in larger font, giving you an incremental indication of DTCs it finds in each module as it polls the busses for DTCs. Some of those same tools also have a real-time status of which module is being hit with the scan tool's serial data bus "roll call," one module at a time. For example, the statement on your tool's display says "Communicating with OnStar" followed by "Failure to communicate with OnStar." If the vehicle doesn't have the familiar OnStar buttons on the rearview mirror, then that vehicle did not come equipped with that option. On the other hand, sometimes U-codes for modules not communicating on the bus simply were never part of that module/system's original diagnostics. You look at the mirror and sure enough there are OnStar buttons. Communications DTCs

or not, it should be answering back on your scan tool with a message such as "Communications successfully established with OnStar."

Telematics and phantom problems

Several carmakers (GM, Ford and VW come to mind) have TSBs regarding phantom problems that are caused by certain aftermarket telematics devices. Because all telematics (OEM or aftermarket) are connected to at least the CAN bus, you don't have to have a subscription for that system to have it show as a potential "troublemaker" in the world of electronic gremlins. Disconnecting the unit from the OEM harness, or DLC in the case of the aftermarket versions, to determine if a symptom goes away is of course a logical step in the diagnostic process. For the aftermarket units, often technicians don't even think about that DLC-mounted telematics system as the source of an intermittent problem on the vehicle. They grab their scan tool, disconnect the device from the DLC and lay it on the seat while they connect and pull codes/read data PIDs. They often overlook that the culprit might well be laying on the seat! Have a DLC "Y" adapter so you can keep the customer's aftermarket DLC connected while performing diagnostics. That way, if you are able to replicate a customer's concern, you can simply disconnect the telematics to see if the concern goes away/changes.

Numerous complaints have been logged by the GM OnStar call centers indicating the remote door unlock function to free a customer that has locked their keys in their car was inoperative, thanks to an interfering insurance telematics dongle on the vehicle. Imagine that — telematics fighting other telematics! Other aftermarket telematics-induced troubles have ranged from intermittent transmission shift complaints, odd lights on the IPC, poor engine power on diesels when in 4WD, battery rundown, radio won't turn off, etc.

How are your audio skills?

OEM telematics typically interact with the factory audio system. Many techs still think audio is for the OE dealer only or the stereo shop. That's not the case. Audio has become yet another system fully integrated into the big

picture of systems we need to master. OEM telematics will typically use low-level audio outputs to connect to the factory radio head or remote amplifier. A microphone input is also connected into the telematics unit. Both circuits are very prone to picking up interference and should have good grounds on the shield that runs with these circuits that is terminated and grounded at only one end. EMI noise shields are not supposed to work as ground circuits to carry current, hence their termination at only one end of their span. Twisted pair wiring is essential in low-current circuits that are susceptible to interference and should be recreated with the same number of twists per inch as the OE wiring had when replacing any faulty harness sections (see page 71).

A final thought

That 2002 Trailblazer my parents own that is now sporting the aftermarket DLC type of telematics came with OnStar. For a very small additional monthly fee on top of a regular OnStar account, an extra service called Family Link provides the same geo fencing and vehicle location alerts to concerned family members of young and elderly drivers. Why did Mom choose an aftermarket version of telematics from the cell phone store over the OE option? She needed a new phone and a savvy cell phone rep saw their need for telematics and made the sale. Either way, the entire family feels much better. If Dad only could comprehend, he'd be proud of her. I suspect that one day in heaven, where foggy minds and ailing memories are no more, Dad will give Mom a great big high five for connecting with the kind of technology he was excited to work on for so many years. We hope this article has helped you with some increased knowledge and excitement regarding the growing world of telematics! 📶



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AVOID GETTING YOUR BUTT KICKED

EVERY TECHNICIAN HAS HAD THAT CAR THAT JUST SEEMED TO REFUSE TO BE FIXED.

BY PETE MEIER |
DIRECTOR OF TRAINING

My last butt whooping came from my son's 2007 Toyota Corolla CE. He brought it to me complaining that the belt was making noise when he accelerated, and a little prodding on the accelerator pedal easily duplicated that complaint. "No problem," I told him, "we should get this figured out pretty quick." After all, it's not like I haven't repaired dozens of similar complaints over the years when I got greasy for a living. Now that I get to do it for fun, it should be even easier.

Or so I thought.

There are only but so many reasons a serpentine belt will squeal. It's either a tension-related issue or a pulley alignment one. The belt manufacturers have devised a high-tech test to point us in the right direction. They tell us to spray the running belt with water, aiming the spray at the rib side of the belt. If the noise goes away, it's an alignment issue and if it gets worse, it's a tension issue.

The noise went away, so I took a quick look at the pulleys. It wasn't hard to see that the harmonic balancer was wiggling in and out, obviously damaged. I also noticed that the main oil seal was leaking so I replaced that while the pulley was off. I put it all back together and took a close look at the belt itself before reinstalling it. And yes, I know that serpentine belts today are made of a different material than they used to be a decade ago. A simple visual check really doesn't tell you anything so I used one of the



To check a serpentine belt for wear today requires a special tool like this one made by Dayco.

belt inspection tools I had to physically check the condition of the ribs. It all passed.

The squeal continues

I guess now it was time to take a closer look at the pulleys, using a laser alignment tool I got some time ago from Dayco. The laser rests on the harmonic balancer and the target is moved from pulley to pulley. The laser aligns with the target and provides a visual indication of any accessory pulley that is not running true to the crankshaft. In order to check all the pulleys on the Toyota, I had to remove the upper mount in order to get a clear shot at everything. This was turning into more work than I had originally anticipated, but at least, once I was done, I knew for sure that that pulley alignment was not the cause of this problem. Remembering the oil seal leak, I had my son pick up a

replacement belt to eliminate belt contamination as a cause. He came back with a "house" brand belt from his favorite parts store, and we installed it on the car.

Still squealing. I hit the new belt with some water from my spray bottle and the noise got worse. A tension issue now?

What was I missing? Once again, the belt came off (after marking the installation direction) and I rechecked all the pulleys, looking for any sign of bearing wear or damage. I had done this the first time, and was surprised when I felt play in the tensioner pulley bearing. A closer look, and I found the tensioner rocking at its pivot.

Are you familiar with the tensioner on a Toyota Corolla four-banger? It looks like a mini shock absorber. The car had over 100,000 miles on the odometer and online data reinforced

the idea that it could be worn to the point that it wasn't maintaining sufficient tension on the belt. I installed a new tensioner to eliminate that possibility.

And it's still making noise. At this point, I'm getting a little ticked off – both at the situation and my apparent inability to resolve the problem in a more professional manner. I felt like a parts changer, not a technician.

So I dropped back and remembered my days in the shop. I would never have used a house-brand belt, always preferring a name brand I knew I could trust. So I sent the boy back to exchange the belt he had bought for one made by Gates (I would have just as quick-

ly used one made by any other major player, but that's what his parts store stocked). The new belt was installed, and the noise was finally gone.

Where did I go wrong?

Even though I get to work on cars for fun now, I still feel a passion for doing a job right the first time. It's still my name on the work, regardless of whom I'm doing the work for. Looking back, I should have been more thorough in checking all the pulleys even though I saw the harmonic balancer right away. Power steering pulleys are the No. 1 source of pulley misalignment, by the way, either from improper installation of an old pulley to a new pump or by the pulley's attempt to walk off the pump shaft. Had I done that and then rechecked the source of squeal with the old belt reinstalled, I would have moved to tension issues sooner.

The other mistake I made was using less-than-quality parts. I have to admit that I'm one of those technicians who has no love for "white box" parts, preferring to use parts made by reputable manufacturers. Sometimes they work, sometimes they don't and what cued me to replacing the belt was remembering an older Chrysler



Did the Toyota need a new tensioner? Probably not...

TSB that had factory techs replacing brand new belts on some of the minivans with a different brand because the first one didn't play well with the design and was noisy from the start. Had we replaced the belt on the Toyota off the bat with the Gates belt, I would have been done a lot sooner and been a lot happier.

Other lessons learned

The story above reminded me that I've gotten my butt kicked more than once on stubborn problems that refused to be solved — quickly, anyway. And while I won't lie to you and tell you I never met a car I couldn't fix, I will tell you I never walked away from a fight, and I won a lot more than I lost. Always looking back to learn from those trials, I often could see where I could or should have had the answers I was seeking much sooner had I just asked the right questions to begin with. Isn't that part of the process of becoming a more skilled technician?

Yes, learning from your mistakes is certainly one way to improve. Better, though, is to learn from the mistakes other people make. And even better is to learn from those who have done the legwork and learned how to avoid the

mistakes in the first place.

You do that by furthering your knowledge using every resource you can find: trade magazines like this one, online webinars offered by sources you know and trust, and best of all — live training events where you can interact with the instructor and the other techs in the room. And we have the ticket to all three: available through the Commitment To Training initiative we launched this year (see pages 4 and 24!). Sign up for my newsletter at motorage.com/fortechs or look for our Commitment To Training group on Facebook or LinkedIn to learn more, then take advantage of all *Motor Age* has to offer! 🛠️



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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WHICH WAY TO GO?

THE STEPS, TOOLS AND REDUNDANT TESTS TO PERFORM TO PROVE WITHOUT A DOUBT WHAT IS CAUSING A CUSTOMER'S COMPLAINT.

BY **JAIME LAZARUS** | CONTRIBUTING EDITOR

There is a skill we all share, one that most who do not repair vehicles for a living either lack or have not refined. This skill is honed regularly by the individuals who must diagnose and not quite as much by those of us who instead regularly perform maintenance or do the actual repairs. I'm not sure if there's a name for this skill of which I speak because it encompasses so many that already have names like "instinct," "ESP (Extra Sensory Perception)" and "second nature."

Diagnostic technicians are a breed unto themselves who can sense in what direction to proceed when it seems there are none. They even know in which direction to go when misdirected, like during those times when they have only partial information.

We as a group are truly creative when it comes to inventing testing methods. By this I mean we think of

ways to apply theories we've learned to applications not originally intended. For instance, I may apply the training I received about a Ford Drive-By-Wire Throttle Body to some other manufacturer, as the testing procedures may be the same. Or I could tell you about some of the tools I made just to test a component another way that wasn't in the manual (haven't you?). The truth is, we should take pride in our abilities to do such things because it is this creativity, this artistry coupled with the skill I spoke of, that results in a great diagnostician! You also use a strategy — that's what a diagnostician does!

There is no arguing how easily one can jump to a conclusion when having a piece of indisputable evidence pointing to a cause for a customer complaint. It is the well-seasoned tech though, who insists more than one conclusive test result is needed before making a decision! I've said it for years — do not base a diagnostic decision on one positive test result while omitting other tests. I know of no automotive component that cannot be tested in multiple ways. Can you think of any?

For example

I was recently called to a shop for a job that required strict adherence to a diagnostic strategy or else a lot of time could have been wasted on my part. I'll review the steps I used to diagnose a 2005 Hyundai GX350. The shop was

trying to extinguish the Malfunction Indicator Light (MIL), which was on as the result of a recurring Diagnostic Trouble Code (DTC) P0305 — Misfire cylinder #5. The complicating factor is that the DTC wasn't present when the vehicle's owner dropped the car off for an oil leak repair!

I was told: "The vehicle came in for a routine service, and it was noted the valve cover gaskets were leaking. The job was sold, and the work was performed. It was after the repair that the technician noticed a rough-running condition, poor performance while driving and an illuminated MIL." His scan showed the misfire code so he went to work replacing parts; a new spark plug didn't fix it, so he "swapped" coils. When that had no effect, he replaced the fuel injector on that cylinder (but broke the injector connector in the process). A new injector sub-harness was ordered because of the broken connector and some wiring insulation that was crumbling. It was installed, but it, too, had no effect. That P0305 came back immediately every time the engine (FIG 2) was started. He had already performed countless hours of work and was preparing to tear the engine apart when the shop owner called me in for a second opinion.

Let's pause here and think about this. An oil leak turns into a P0305 nightmare. Is this supposed to happen? Whether you are familiar with



MYSTERY MIL

2005 HYUNDAI GX350

Vehicle Year/Make/Model

52,895

Mileage

3.5 LITER V-6 MPFI

Engine

AUTOMATIC

Transmission

RECURRING MIL ILLUMINATION

Complaint

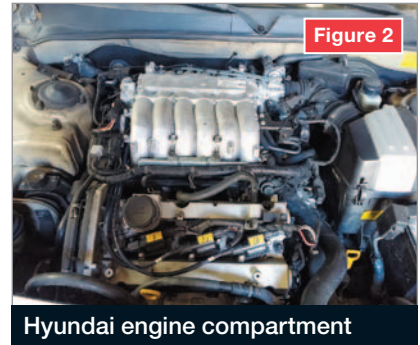
this vehicle/engine or not, is it typical for any vehicle to develop these symptoms after a “minor” repair? So, what important step was missing so far? Did the technician base a diagnostic decision on one piece of information (and therefore began working)?

My usual first step in a diagnostic strategy is to duplicate the customer’s complaint. In this case, I wanted to run the engine while observing data on my scanner. The technician was very thorough when he scanned the vehicle and reviewed with me his findings. The STFT and LTFT readings did, in fact, support the presence of a misfire, as did some other data PIDs. But I felt more than one cylinder misfire immediately upon starting the car. I heard the engine trying desperately to keep idling. I smelled the overly rich exhaust. After reviewing the DTC, I shifted gears over to the Global OBDII Mode 6 data to see what that information had to offer (yes, multiple misfires). In other words, I was using my senses to help me analyze the situation.

I probably jinxed myself when I

thought, “Mechanical, electrical or fuel — misfires can only be caused by one of these. Simple!” It was because the PCM had no other DTCs (pending or active) that I first performed a Relative Cranking Compression test. Using a high-current probe attached to an oscilloscope, you’re measuring the amperage flowing through the battery cable while cranking the engine — after its ability to start has been impaired. Each compression stroke will cause the starter to work its hardest and when displayed over a period of time, one compares each “hump,” “valley” and shape for uniformity. In this case, there was little difference in any of the cylinders’ images, which can be interpreted to mean each cylinder was compressing air fairly equally. This test is a fast and easy way to help us identify many mechanical causes of misfires, or eliminates most mechanical faults as a cause, as in this case (FIG 3).

Knowing we are probably not dealing with a mechanical reason for the poor running condition, in which direction would you go next?



Hyundai engine compartment

More than one to chase

The engine was running as if multiple cylinders were misfiring, despite what the PCM was reporting. I redirected my diagnostic path toward the ignition system for many reasons. Instinctively I suspected there was more likelihood that an electrical fault was easier to create than a fuel-related one, especially a fault affecting all cylinders, while doing valve cover gaskets. Also, it is highly unlikely a single fuel-related fault wouldn’t be obvious — since the top of the engine was worked on — that could cause it to run so poorly. Yes, contamination and other reasons can do this, but the car ran well before the work was performed.

Being inherently lazy and since I already had my scope set up, I grabbed my new coil-on-plug ignition wand and started looking at the patterns of each of the three coils. This ignition system has three coils mounted atop of three spark plugs, and each coil has a spark plug wire that wraps around the front, upper part of the engine and attaches to the companion cylinder. It is a waste-spark ignition system, one of which I have never been formally taught to diagnose, but as I stated earlier, I applied the theories of other waste-spark systems for which I have been trained, and went to work.

I looked first at the coil that fires cylinders #2 and #5, then at the other two. Unfortunately, none of the patterns provided me with usable information. They all jumped around; sometimes many firing events occurred in a short period of time (no, this is not a multi-strike system), there was no uniformity nor were any patterns displayed as I expected. I knew I was headed in the right direction and that here is where a lot of time can be wasted. I

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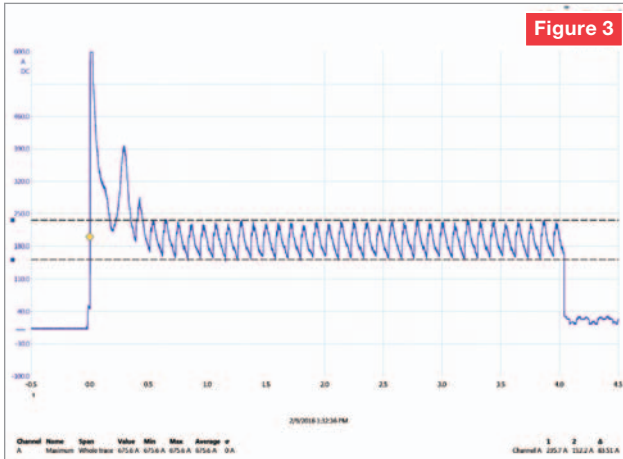


Figure 3

Relative cranking compression



Figure 4

#1 injector volts, #1+4 coil control and all coils' amps

was at the point in my diagnostic routine where I had to research how this system was designed to work and then analyze why it wasn't working as designed. My intention was to gain more direction here to try and isolate whether the problem was a component or a control (command). What would your next step be?

I don't read well (but I garner a lot of information from pictures) so I got the ignition system wiring diagram and studied it.

The diagram shows all three coils are powered through an Ignition Coil fuse in the Engine Compartment Junction Block. I used this easy-to-get-to location, installed a Fuse Buddy in

place of that fuse, then attached my low-current probe so I could look at the scope waveforms of all of the coils at the same time. I hooked a second scope channel to the also easy-to-get-to #1 fuel injector so I could determine which coil firing event(s) might be happening incorrectly. What I saw only caused more confusion (FIG 4)!



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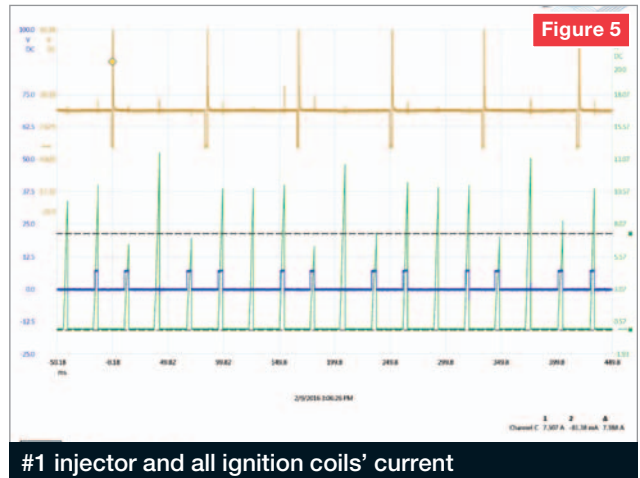
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That explains the fuel smell

Yes, you are seeing an injector firing event once for every crankshaft revolution! It is injecting fuel on the intake and on the exhaust stroke! Immediately I started thinking of how this one thing would wreak havoc on the PCM. Of course this explains the fuel trim readings being so skewed, and a host of other PIDs not reading within specifications! Then I noticed one of the coil's amperage peaks was not reaching the same amperage as the following three firing events, and then it happened again (but to a different coil this time)! Now equipped with this information, what would be your next step, dear readers?

My gut was saying to look at the PCM's ignition coil control circuits. Again, it is easy to access these because the three coils are mounted on the cylinder head closest to the radiator (not buried under an intake plenum). I was wondering whether these coils were being commanded improperly and if so, I was hoping to see something familiar in the scope pattern that would help me identify why the PCM was doing all of these things incorrectly. I chose the coil that fires #2 and #5 spark plugs first.

Wow! Would you look at that? There is amperage flowing through the coil when it isn't being turned on by the PCM (FIG 5)! How can that be? In addition, the PCM is commanding more coil firing events than it should! The tech at this point showed me a video he captured on his cell phone of this car still running after the Ignition Failure Sensor connector was disconnected from the sensor (all 12-volt power for the



ignition coils passes through this sensor)! How can that be? Are you ready to bail on this one yet? Neither was I!

I looked at the other two coils and captured similar waveforms before I informed the shop owner that I felt it was time to do some research and asked them to not do any more work to this car until I find out in which direction we should go. He asked if I had any hunches, to which I replied I was concerned he might have (at least) one bad ignition coil that was back-feeding high voltage to the PCM, which might be confusing it, then added "or the car might have a faulty Ignition Failure Sensor." I stressed these are only hunches and that I'd prefer no more money be spent right now, but he felt it worth the investment and ordered them.

There's a very important tool we all have access to, but it doesn't fit in any of our toolboxes. It's called information. Without it, a business will surely fail. I believe I fix more vehicles by using that tool than I do with any other. It is knowing when to stop wrenching and start to enlist its use that is important. I gathered just enough information in that one-hour visit to bring home with me so I could concentrate on what the real problem was.

Time to study

I started my research by confirming what I thought while with the car. I used service information sites to verify the systems installed on this vehicle were of the design I'd thought, and that the diagnostic procedures are the same. I also searched for any related Technical Service Bulletins (TSBs), but found none. I used Identifix and iATN (the International Automotive Technician's Network) to see if someone else had been there and done this before me. I found several hits for similar problems on the Korean brands



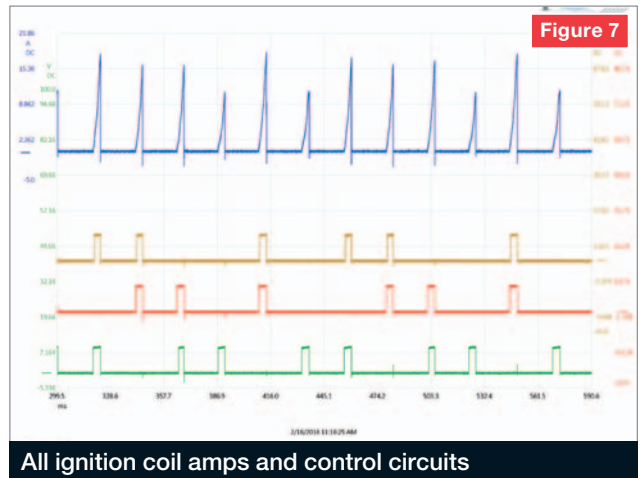
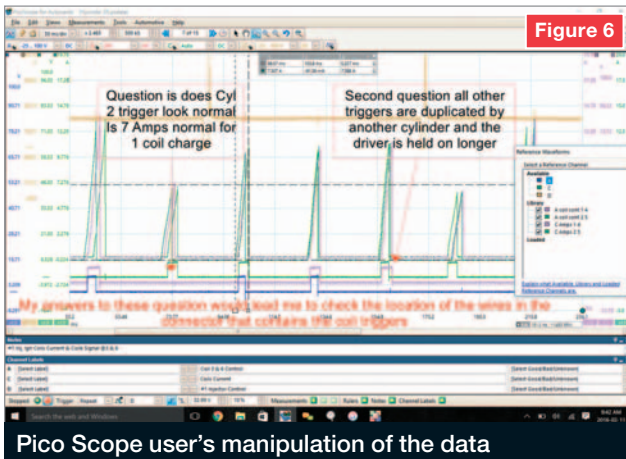
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equipped with a 3.5 liter engine, but none of them led me to determine which diagnostic path I should follow.

So what avenues can you turn to when it seems you've exhausted your resources? I decided to reach out to a friend. Over the years I have become a member of numerous automotive-related website forums and decided to post the problem I was having on the Autonerdz Communities Forums. On this forum, as on others, you'll find helpful folks willing to assist those in need.

Almost as soon as I'd posted my request for assistance some of the other subscribers were responding, had looked at the waveforms I'd captured thus far and were pointing out parts of each they noticed that weren't as they should be. Although interesting and obviously playing a part in the overall performance problems, I wanted to overlay all three of the waveforms I captured that showed the individual ignition coil control circuits, but had no idea how to do this. I didn't think to capture this waveform during my initial visit. A very talented Pico Scope user named Mick took the time to create exactly what I was looking for (FIG 6).

Here I saw the higher amperage coil firing events were on coils that were actually being commanded to fire twice and the lower amperage coil firings only had a single command. Now the only questions that remained were why was the PCM firing the coils this way and why are the fuel injectors firing twice as often as they should? I was ready to head back to the shop and get a few more waveforms. Do you know which ones I wanted to get this time?

The first one I captured was of the current flowing through all coils along with each of the three coils' commands from the PCM, like what Mick had compiled for me (FIG 7).

I confirmed what I suspected about the higher amperage being caused by the multi-firing of the ignition coils (and

conversely, the lower amperage caused by the single-firing events). Next, let's find out why.

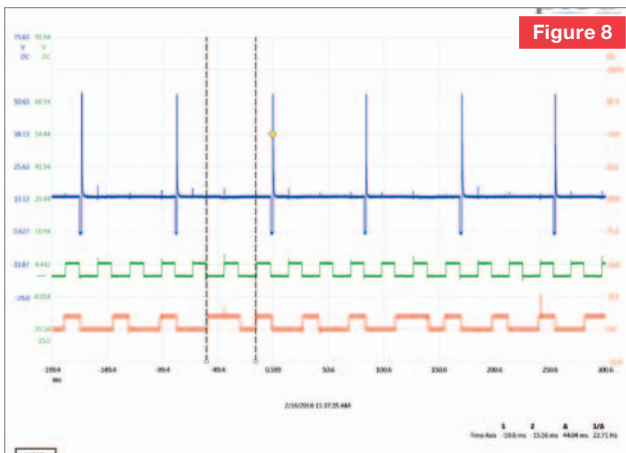
My theory, after much discussion on the Autonerdz forum, was the PCM was unable to accurately determine where cylinder #1 TDC was occurring; it may have had conflicting information (inputs) and therefore was bank firing the injectors in order to just keep the engine running. I suspected that if the mechanical components aren't in time, the PCM can't properly control fuel injection or ignition coil firing events. I wanted to capture a waveform that included the Crankshaft Position Sensor (CKP) and the Camshaft Position

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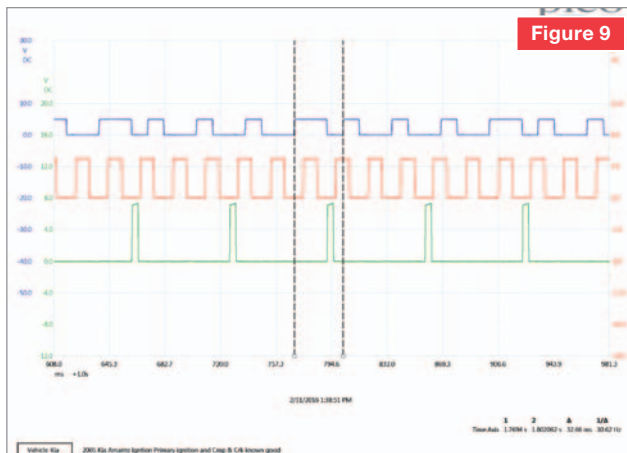
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#1 injector volts, CKP and CMP



CKP/CMP waveform from 2005 Kia with same engine

Sensor (CMP) on the same screen, then compare what I have with a known good example waveform. There was only one problem — I wasn't able to find such a waveform anywhere!

The technician had visually verified that the components were in time. He told me he did so already, but would do it again to verify. In his own words, he “peeled back the timing cover enough” to take a picture of the camshaft gears. He said he was sure the piston was up at top because if he rotated it any further it “got easier to rotate the crank.”

I was unconvinced. Do you know why? Of course you do. Remember what I said about making a decision based

on one piece of information? Just because the cams are in time does not mean the crank is. I easily back-probed the signal wires for each sensor, as their connectors are readily accessible on the top front of the engine, and captured a waveform (FIG 8).

As they say, a picture says a thousand words. Compare our Hyundai CKP/CMP waveform with one graciously captured by Autonerdz Forum user Abndanger on a 2005 Kia with the same engine (FIG 9).

One can easily see the difference! This engine is not in time! But wait a minute. Would that fact alone cause this engine to run so poorly? What caused this to happen? What was causing those extra coil firing events? Why weren't all three coils experiencing the same commands? I felt a lot of questions will remain unanswered until the engine is put back in time, which is what I instructed the technician to do next, and then I left. Before I made it home, the technician was texting me saying the engine ran perfectly once the new sensors were installed and the timing components were realigned.

In closing, there are some questions that still remain. I want to know what kind of cleaner was used to remove the oil that leaked from the valve cover gaskets. Could it have caused the sensors to be damaged? Were the damaged sensors causing more problems than the misaligned timing components? Also, what caused the timing belt to jump two crankshaft gear teeth? On the cars on which I've replaced the valve cover gaskets the timing belts had never jumped any teeth.

I did my best to outline the process in hopes you could apply this method to applications you'll see in your bays. I had a few hours spent in the shop, a few more in front of a computer and my associates at Autonerdz had a few hours assisting me as well. The shop had much more invested. **TL**



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CONTRIBUTING EDITOR

Jaime Lazarus is an ASE Master Technician with L-1 certification. He has regularly presented technical seminars since 1985. He recently taught instructors at the North American Council of Automotive Teachers conference and the NASCAR Technical Institute.

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That's why ACDelco's industry-leading training combines a variety of proven delivery methods to ensure maximum learning benefits for service professionals. More than 400 courses range from traditional instructor-led technical training courses and seminars to a wide selection of online courses that offer the latest available business and technical updates.

ACDelco's 24/7 online courses allow participants to train at their own pace and schedule. They also align with hands-on courses that are considered the gold standard of industry training. And, with Virtual Classroom Training, ACDelco offers the benefits of live instructor expertise with the convenience of the internet.

Technicians complete nearly 100,000 hours of ACDelco training each year. Professional Service Center Premium level participants can send an unlimited number of participants to Instructor-Led Training (ILT) courses as well as web-based. PSC Professional level participants can purchase discounted subscriptions for access to web-based and instructor-led courses.

Here's a look at what ACDelco offers:

- **Web-Based Training** (WBT) courses are typically less than an hour and are available 24/7. They are accessed through the ACDelco Learning Management System (LMS).
- **Instructor-Led Training** (ILT) courses are typically 1- to 2-hour

courses presented by an ACDelco instructor. Training is presented utilizing vehicles and hands-on exercises. Registration for these courses can be accessed through the LMS. Each instructor-led course is available to ACDelco PSC Premium level participants for no additional charge — or for a nominal fee for Professional level shops.

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The ACDelco Technician Training Program rewards technicians and shops for making the commitment to enhance their skills and expertise through ACDelco training. The program gives technicians the opportunity to increase their knowledge and skills in each of the core automotive ASE areas. These are represented on a training path, each of which includes about 40 hours of a combination of web-based and face-to-face training.

Upon 100-percent completion of training paths, both technicians and shop owners receive:

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The training path courses represent the latest automotive technologies. Ten available training paths offer technicians the ability to achieve "Specialist" status.

The ACDelco Learning Management System, or LMS, is the hub for accessing and tracking training. To access the LMS, go to acdelcotraining.com, create a new user account with your organization's six-digit number, and you're ready to go.

Use the ACDelco 2016 Course Catalog to browse the training portfolio. Launch online training directly from the LMS site 24/7, or search for and enroll in training coming to your area if you're looking for face-to-face training.

Once you register, the LMS will generate emails to remind you of your upcoming training. We'll even text you if that's more convenient. Manage your preferences in your profile so we can better accommodate your needs. You even have the ability to view your training progress at-a-glance and print-off certificates of completion. Your ASE certifications can also be added to your training completion paths to show your accomplishments.

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ARE YOU UP TO SPEED ON TECHNOLOGY?

In all likelihood, you fall into one of four categories when it comes to new technology. You're either enthusiastic, cautious, reactive or suspicious. Regardless of how you approach it, technology is changing so fast that simply staying up to speed is a daunting task. That's where attending AAPEX 2016 can make the difference, as this year's event is revving up its focus on technology to keep you ahead of the curve.

AAPEX 2016 will feature an all-new Automotive Technology section on the show floor to showcase many of the technology products and services that are having an impact on automotive repair shops and throughout the supply chain.

Technology products will include vehicle telematics solutions, mobile payments, diagnostic tools and equipment, and solutions to improve the customer experience for today's digitally connected drivers.

To complement the new section, AAPEX is launching "Let's Tech," short 20-minute presentations to take place in the AAPEX TV studio. Topics will include the various technologies related to vehicles, aftermarket solutions, business and channels of distribution.

AAPEXedu also will offer free sessions on the impact of OE technology, disruptive technology and the technology used to operate a business. Sessions will cover both the opportunities and uncertainties of telematics, big data, "connected cars," and online ordering and e-commerce to name a few. The future of shipping and delivery, plus changes in the supply chain also will be part of the AAPEXedu 2016 program.

"According to a recent study by Deloitte and MHI, traditional supply chains will radically change over the next 5 to 10 years as a result of new technologies, competition and customer demands. The convergence of big data, fast and cheaper computer power, and increasing demands of



customers will accelerate the adoption of innovative products and services," said Scott Sopher, principal at Deloitte Consulting LLP and AAPEXedu 2015 speaker. "The speed at which supply chain innovation is being adopted -- coupled with rising customer expectations for anytime, anywhere service — is stressing traditional supply chains almost to the breaking point. This is especially

relevant in the automotive aftermarket parts industry where high volumes, increasing SKU complexity, erratic demand, short lifecycles, and complex webs of value-chain networks are the norm. Every link in the automotive value chain must learn to adopt, innovate and integrate to keep up with the increasing pace of change."

AAPEX 2016 will be held Tuesday, Nov. 1 through Thursday, Nov. 3, at the Sands Expo in Las Vegas, with AAPEXedu sessions starting on Monday, Oct. 31.

The event is expected to feature more than 2,200 exhibitors and 45,000 targeted buyers. Approximately 160,000 automotive aftermarket professionals from more than 140 countries are projected to be in Las Vegas during AAPEX.

To register, visit: www.aapexshow.com/advert. From now through Friday, Oct. 14, online attendee registration is only \$40 (US). The fee for AAPEX registration via fax or mail is \$65 (US) through Oct. 14. Registration includes the AAPEX trade show, access to all sessions in the AAPEXedu 2016 program, networking with 45,000 targeted buyers and entry into the SEMA Show, a separate event taking place in Las Vegas the same week as AAPEX.

AAPEX represents the \$328.2 billion global aftermarket auto parts industry. It is co-owned by the Auto Care Association and the Automotive Aftermarket Suppliers Association (AASA), the light vehicle aftermarket division of the Motor & Equipment Manufacturers Association (MEMA).

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*First Research, February 2015.

**Study conducted by ORC International, funded by Aramark, 2016. Based on qualified respondents who had automotive repair service in prior 12 months.



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WHAT ARE THE SYMPTOMS OF A BLOWN HEAD GASKET?

First, what is a head gasket? The head gasket forms a seal between the engine block and the cylinder head. This seals both the combustion chamber and the coolant passages in your engine. This means your head gasket has to seal both extremely hot high pressure combustion gases as well as engine coolant which can be anywhere from cold ambient temperatures to the normal operating temperature of your engine. Do to the wide range of temperatures and relatively large surface area, it is not unusual for head gaskets to develop leaks over time.

Since the head gasket seals the coolant passage both from the atmosphere and the combustion chamber you can't see or get too much of the head gasket on a vehicle. Because much of the gasket can't be seen without disassembling the engine, it can be very difficult to diagnose a head gasket leak. Since a visual inspection usually will not prove a head gasket leak, it is important to know the other symptoms so you can accurately diagnose a head gasket problem.

Blown Head Gasket Symptoms:

- Coolant leaking externally from below the exhaust manifold
- White smoke from the exhaust pipe
- Overheating engine
- Bubbles in the radiator or coolant overflow tank
- White milky oil
- Significant loss of coolant with no visible leaks

The only externally visible sign of a blown head gasket would be coolant externally leaking from the head gasket. The head gasket will be below or inboard of the exhaust manifold. Most head gasket leaks will be between the combustion chamber and the coolant passage in your engine. On the intake stroke of the cylinder closest to the leak, coolant will be drawn in under the vacuum created along with the intake air charge. Upon combustion, the high pressure will force exhaust gases past the head gasket into the coolant passage. This process will repeat itself for every revolution the engine makes.

As coolant is pulled into the combustion chamber it will cause your engine coolant level to drop. This can cause a low coolant light and overheating if the cooling system on your vehicle is not continually topped off. Also, once your engine is turned off the coolant still left in the engine cylinder will seep past your piston rings into your engine oil. Coolant mixed with oil will make a white milky substance. You may see this on your engine oil dip stick or on a ring around your oil cap.

If your engine is running the small amount of coolant that is in the com-

bustion chamber will turn into steam and white smoke upon combustion. If you are checking your exhaust pipe for signs of white smoke, make sure your vehicle is fully warmed up and idling during a warm part of the day. A cold engine on a cool day will produce a small amount of water vapor which will look like white smoke from your exhaust pipe. If the exhaust has a sweet smell to it then it mostly likely is a head gasket problem.

Lastly, during the combustion process the high pressures in the cylinder can push exhaust gases past the head gasket into the engine cooling system. The exhaust gases will be trapped in the cooling system and will be circulated through your engine and into the radiator. During normal operation your engine's cooling system remains under pressure, so never remove the radiator cap while the engine is operating or still warm. If your vehicle has a coolant overflow tank you can check that for the presence of bubbles. To be certain you can purchase a test kit from your local auto parts store that will chemically check your engine coolant for the presence of exhaust gases.

Usually one of these symptoms by itself is not enough to prove you have a head gasket leak, but if you have multiple symptoms at the same time it is likely that you have a head gasket leak. It is important to drive your vehicle as little as possible if you have a head gasket leak. The hot gases and cold coolant moving through the hole in the gasket can quickly erode or warp the metal head or engine block leaving you with costly machining bills or even having to purchase new heads or a new engine.

To quickly a permanently seal your blown head gasket, go to your local auto parts store and pick up one of BlueDevil Product's head gasket sealing products. If you have a small leak or 4 or 6 cylinder engine pick up BlueDevil Pour-N-Go 16oz head gasket sealer. Simply add it to your radiator and your head gasket leak will be sealed as your drive! For larger leaks or 8 cylinder engine use BlueDevil Head Gasket Sealer. BlueDevil Head Gasket Sealer requires the removal of your vehicles thermostat and a complete cooling system flush but is guaranteed to fix your blown head gasket!

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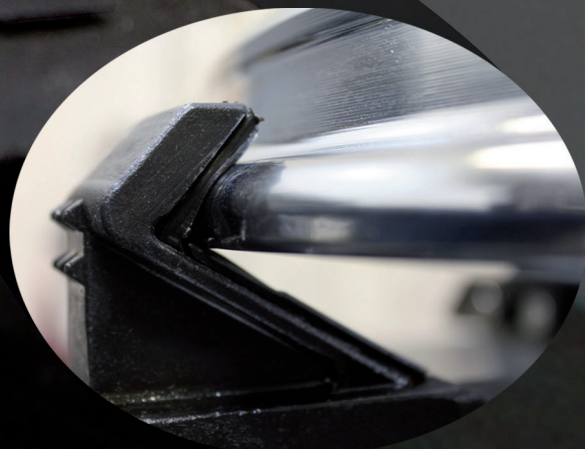
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FAST AND ACCURATE ALIGNMENTS**

The model 3DP4100 Target 3DPro™ is the fastest, most accurate wheel alignment system in the industry thanks to advanced imaging technology that delivers fast and accurate alignments. It streamlines the entire alignment process delivering critical readings in less than two minutes. With minimal investment and reduced training, the Ranger Target 3DPro aligner expands your service potential and sends more profit to your bottom line.

Call **1-800-253-2363** or Visit **bend.pk/Target-3D-Pro**

*Free shipping on all Ranger Products to most areas in the 48 contiguous states.
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CAR-LIFT SAFETY: MAINTAINING AND USING PROPER LIFTING ADAPTERS

Two-post lifts are the most common lift type found in almost every professional or home auto/body shop in the world. The two-post design offers relatively simple installation combined with telescoping lift arms and adapters that allow for many different vehicle types to be lifted and worked on. Two-post lifts allow suspension and driveline components to hang free, making them a popular choice for undercar service, as well as wheel, brake and suspension work.



Improper use of two-post lifts is unfortunately more common than it needs to be. If used improperly, vehicles can fall from the lift and the consequences are too heavy to take lightly. Lack of training, operator error and neglected maintenance are among the things that can result in lift-related accidents. A vehicle falling from a lift can result in serious bodily injury, property damage or even death.

WARNING

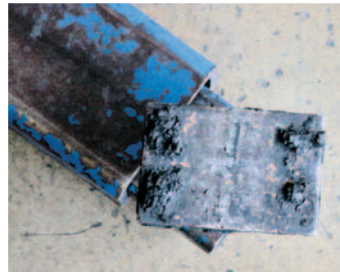
Because two-post lifts make direct contact with vehicle frames, the lift's arms are fitted with contact pads and adapters of varying styles. Some lifts feature adjustable screw pads that allow you to raise or lower the pad depending on

your needs, while others use drop-in style frame-contact pads with different height stacking adapters.

Whichever type you are using, regular maintenance is required. Lifting pads must be in good condition, appropriate for the vehicle being lifted and kept clean from oil



BendPak's Telescoping Adjustable Screw Pad.



Replace Worn or Missing Pads

and grease. A damaged or contaminated frame-contact pad may allow the arm to move under pressure or cause the vehicle to slide, allowing the vehicle being lifted to fall off the lift. Never use a lift with missing or damaged rubber pads.

Do not attempt to lift trucks or other frame type vehicles with standard flat contact pads. Frame cradle contact pads are recommended for use when lifting trucks, vans, or other frame vehicles.

Do not attempt to lift trucks or other frame-type vehicles with standard flat contact pads. Frame-cradle contact pads are recommended for use when lifting trucks, vans or other frame vehicles.

Never compromise when it comes to the quality of your lift or your knowledge of how to properly load and unload vehicles from your lift. Two-post lifts are safe when used properly, but as always, there is no substitute for your own safety awareness.



Frame cradle pads are recommended when lifting trucks or vans



BendPak Inc. / Ranger Products

For more information about brake drum and motor resurfacing, contact Ranger Products at **800-253-2363**; fax **(805) 933-9160** or visit www.bendpak.com



CUT SERVICE TIME WITH THE RIGHT PULLER

You're working on a vehicle and after all the nuts and bolts are off, the part's still stuck. It could be a ball joint, wheel bearing or brake drum or rotor.

What are your options? You can grab a pry bar or a hammer, or you can grab a puller, break the parts loose and get the job done faster.

To find the right puller:

- What are you trying to pull? Are you trying to pull a shaft out of something, pull something out of a hole or pull something off a shaft? This will determine if you need a push-puller, jaw-type puller, slide hammer or one with internal or external-internal adapters.

- Determine the reach and spread you need. This will ensure your puller is long enough and the jaws, if applicable, open wide enough to exert enough force to pull the object.

- Estimate the force needed. If you account for reach and spread, OTC pullers will have enough force. When in doubt, always use the next larger size to account for frozen or rusted parts.

Now find a corresponding puller to finish the job:

- If you're pulling something off a shaft, use a jaw-type, push-puller, slide hammer or bearing puller with attachment. This includes removing a gear, bearing, wheel or pulley.

- If your job includes pulling something out of a hole, look for internal pulling attachments coupled with a slide hammer or a push-puller. These are ideal for removing internal bearing cups, retainers or oil seals that are press-fitted.

- When you need to pull a shaft out of something, look for threaded adapters, internal or external, for use with slide hammers or a push-puller. These are typically needed when removing a transmission shaft or pinion shaft from a bore or housing.



With tons of force, we can't stress safety enough when using pullers. Before using one of our pullers, we recommend reading safety puller information, found at otctools.com/puller-safety.

A puller can speed up most jobs and save you time during vehicle service. Because of the extreme force exerted, manually up to 20 tons, it's important to use the puller safely to avoid damage or injury.

Use the below tips to pull safely:

- Mount the puller tightly to the vehicle. If it's a jaw-type puller, tighten the adjusting strap bolts and square the puller legs and jaws. Where possible, use a 3-jaw puller.

- Make sure you have the right size puller. If you're applying maximum force and nothing is moving, use a larger capacity puller.

- Expect a gradual, controlled pull. Do not use an impact wrench on the forcing screw unless the puller is specifically designed for it.

- Only use legs designed for the puller's maximum force. Swapping legs from one puller to another reduces the effectiveness and can potentially damage tools. Also use the shortest legs pos-

sible when selecting a puller. This will help deliver the force where it's needed.

- Install threaded puller legs evenly to avoid putting too much stress on one side of a component. If you're pulling cockeyed, parts can be broken.

- If using sliding plates, they must be on the opposite side of the cross block from the forcing screw nut or hydraulic cylinder.

- Pulling attachments may not withstand the full force of your puller. Because of this, we recommend using the largest attachments that fit the component. This will help prevent vehicle damage and breakage of your puller.

As with any tool, proper maintenance and care can help them last a lifetime. Keep your pullers clean, lubricate the forcing screw and inspect your tool for dents, cracks or excessive wear. Always replace any puller or part that appears damaged.

OTC



MORE COVERAGE, TESTS AND PROCEDURES

DIAGNOSTIC TOOLS DESIGNED TO
FIX ALL MAKES, ALL MODELS

SCAN, TEST AND REPAIR MOST VEHICLES



OTC 3893 Encore

- 30 years of OEM level USA Domestic, Asian and European coverage
- Industry-leading Cummins, Duramax and Powerstroke coverage
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RESET CHARGING SYSTEMS TO EXTEND BATTERY LIFE



3112 battery reset tool

- Perform reset procedures for BMW, Mini and Ford F-series
- AutoID pulls YMME for more vehicles.

QUICKLY SCAN AND RESET TROUBLE CODES



3210 diagnostics tool

- Expanded European ABS DTC coverage
- 26 Million+ CodeConnect Top Reported Fixes

EASIER, FASTER TPMS SERVICES



OTC 3838 TPMS tool

- Reset, relearn and reprogram most TPMS sensors
- Test key fobs, clear generic codes and TPMS lights

COOLING FAN ASSEMBLIES SAVE TIME, SIMPLIFY REPAIRS

As the summer nears and customers begin to experience electric fan related engine overheating issues, your cooling service business will heat up very quickly. But before you tackle these problems by trying to repair or replace the individual fan motor itself, consider the advantages and benefits of replacing the entire cooling fan assembly as a unit. You'll eliminate a lot of unnecessary steps, hassles and probably unbillable labor.

A fan motor replacement can take almost twice as much time as a complete assembly replacement. You have to pull the assembly, remove and replace the fan motor, and then, refit the fan assembly. If the fan motor was attached to the shroud by rivets instead of nuts and bolts, the rivets need to be drilled out without damaging the plastic shroud. Additionally, some OE manufacturers attach the fan blade to the motor with special fasteners, which are not reusable.

And if all goes smoothly, you are still not out of the woods. After years of use and exposure to temperature extremes, the plastic shrouds tend to get brittle and can be easily damaged during motor replacement or reinstallation. If that happens, the entire fan assembly has to be replaced.



VDO Cooling Fan Assemblies are made to meet OE fit, form and function.

Not all fan assemblies deliver OE fit, form and function

In the past, your options were limited to an OE replacement at dealer price or a call to the salvage yard. Today, you can get a new aftermarket unit at a pretty good price. But you

have to be careful, because not all fan assemblies are created equal. Make sure your fan assembly is designed to meet OE specs. The motor must be vehicle specific to deliver proper cooling airflow, otherwise, you may face an overheating comeback and risk serious damage to your customer's vehicle such as a warped cylinder head, valve bending, plus timing belt and water pump failure. The connector and the shroud should be an exact OE fit to avoid guesswork and installation hassles. You also have to consider reliability and service life. An OE style motor can last up to three times as long as a 'universal' motor.

Cooling Fan Troubleshooting

Although you may be familiar with the steps needed to sort out an overheating engine, here's a quick refresher on the diagnostic steps you should take after eliminating obvious problems, such as low coolant level, leakage, faulty thermostat, fan blade or assembly damage and radiator air-flow blockage.

1. Test fan motor. Connect it to a 12-volt power supply to determine if it functions properly.
2. Check fan motor fuse and replace if necessary.
3. Inspect electrical connection between fan motor and wiring harness. Reconnect if necessary.
4. Check the fan motor relay. Test for proper current at connector.

VDO Cooling Fans offer OE quality and performance

Continental offers a full line of new radiator and condenser fan assemblies. They provide faster, easier installation, and they're very economical. Priced significantly lower than the OE dealer, VDO Cooling Fan Assemblies give you everything you need to do the job right. Just bolt in a new assembly, plug in and you're done. The units are made to the same OE quality standards as the OE components supplied by Continental to automakers worldwide.

For more information, visit: vdo.com/usa or contact: salesupport-us@vdo.com.

VDO

VDO — A Trademark of the Continental Corporation



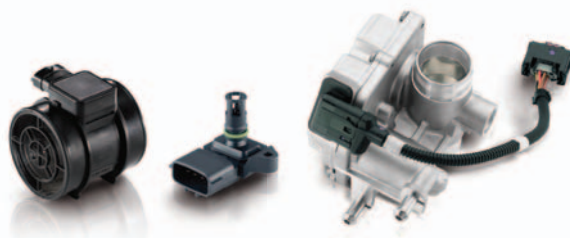
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HOW TO CONDUCT A VOLTAGE DROP TEST ON A FUEL PUMP

Insufficient pressure and flow are indications that a fuel pump is under-performing, but that doesn't necessarily mean that it is failing. Low voltage or a bad connection or ground will cause a pump to underperform, producing the same test results as if the pump were bad.

Before replacing any fuel pump based on pressure and flow test results, always follow the vehicle manufacturer's recommended procedure for testing all electrical connections and the electrical system charge. A minor issue such as a loose ground can cause many problems that resemble more serious malfunctions.



Let's explore how to do a voltage drop test from the power side, and then from the ground side, too. We always put safety first, so be sure you are wearing safety glasses. Do NOT probe the vehicle electrical harness connector with DMM leads. Doing this can damage the terminals in the harness, creating the potential for an overheated fuel pump connector due to excessive electrical resistance. Always use the proper test probe to perform electrical tests.

To do the test from the power side, you'll need a DMM—that's a digital multimeter. You'll need access to the fuel pump connector and battery.

Take the multimeter and set it to twenty volts D-C scale, or D-C if your multimeter has auto-ranging capabilities.

Now connect the multimeter positive probe to the battery positive terminal. With the fuel pump wire harness connected to the fuel pump, connect the multimeter negative probe to the power feed wire at the fuel pump connector.

Turn the ignition to the "on" position. Keep in mind that the pump will only run for about two seconds while the relay is in prime position, or until it gets an RPM signal. The reading should be less than 0.2 volts. If the reading is greater, check for resistance in the power supply circuit for the fuel pump.

Now, to do the test from the ground side, the process is very similar. You will again set the multimeter to 20 volts D-C scale, or D-C if your multimeter has auto ranging capabilities.

This time you will connect the multimeter positive probe to the ground terminal of the fuel pump connector. Make sure the fuel pump wire harness is connected to the fuel pump. Then connect the DMM's negative probe to the battery negative terminal.

Turn the ignition to the "on" position. Again, keep in mind that the pump will only run for about two seconds while the relay is in prime position, or until it gets an RPM signal. Your reading should be less than 0.2 volts D-C. If it's greater than that, check for resistance in the ground supply circuit for the fuel pump.

And that's how you do a voltage drop test. It is important to remember that loose connections produce resistance, which produces heat. If you replace an in-tank fuel pump assembly, make sure you check the terminal fit (for retention) on the wires that connect the vehicle harness to the actual fuel pump. Loose terminals / pig-tails should be replaced to prevent comebacks.

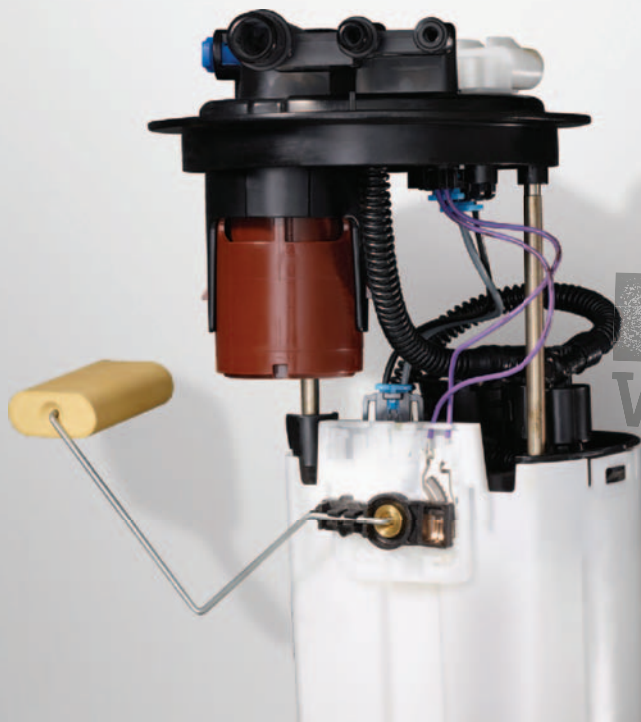
For a video demonstration, go to <http://delphiauto.com/1Wn5G6G>

And for more helpful information on our full product line, go to www.DelphiAutoParts.com.





More Coverage is a Good Thing.




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WAGNER® SETS NEW BENCHMARK IN BRAKING TECHNOLOGY

New Wagner® OE^X Brake Pads Can Stop Pickups, SUVs and CUVs Up to 50 Feet Sooner¹

Wagner®, the global leader in braking innovation, has established yet another impressive industry benchmark with Wagner OE^X brake pads, a revolutionary new line of replacement pads that help consumers stop up to 50 feet sooner when driving light trucks, sport utility vehicles and crossovers¹ — the three fastest growing vehicle categories. These exclusive pads are now available through leading parts distributors nationwide.

Recently introduced after internal and third-party testing as well as pre-launch use by more than 450 U.S. technicians and service locations, new Wagner OE^X brake pads offer an array of additional benefits, including reduced rotor wear and dusting and up to two times longer pad life².

Behind the game-changing performance of Wagner OE^X brake pads is the unsurpassed technical expertise of the global Wagner brake engineering team. The technical story behind their latest innovation can be seen in a new video, “The Science Behind the Stop,” which can be viewed at WagnerBrake.com.

“The Wagner brand’s market leadership has been established in part through our ability to anticipate and address changes in vehicle technology and consumer driving preferences,” explains Christopher Battershell, director of brake product management, North America, Federal-Mogul Motorparts. “With the sustained shift toward utility-type vehicles, our engineers identified the need for a clearly differentiated brake pad technology engineered to help enhance driving safety and overall braking performance on these harder working vehicles.”

New Shapes, Whole New Ballgame

Wagner OE^X brake pads — engineered and manufactured in the U.S. of U.S. and imported components — meet the unique demands of utility-focused vehicles through 114 custom-shaped, application-specific pad designs. These patent-pending shapes, combined with precisely engineered and machined curved slot designs, improve pad performance by increasing turbulent airflow, allowing for cooler operation and improved stopping power — vital characteristics for vehicles that commonly encounter a wider range of loads and other challenging operating conditions.

“These vehicles place unique demands on the brake system, yet consumers need and expect their brake pads to perform equally well or better than those they have used on smaller, lighter vehicles,” Battershell says. “Wagner OE^X brake pads are the first replacement pads engineered not only to meet this expectation, but also to help consumers stop up to 50 feet sooner¹.”



Tech Tested and Talked About

Beyond extensive performance testing conducted by an independent lab, Wagner conducted hands-on, in-market previews of Wagner OE^X pads involving more than 450 technicians and service locations.

Among automotive professionals who participated in these previews, 99 percent found that Wagner provided a higher level of quality. The same percentage of respondents reported an “excellent,” “very good” or “good” experience with the pads, and 95 percent indicated they were likely to recommend Wagner OE^X pads to other professionals and customers. In addition, 99 percent saw a noticeable difference in the new pads, demonstrating the brand’s success in delivering a clearly differentiated pad technology. Written responses from participants included, “This will likely be our pad of choice,” “My customers love them” and “Wow, wow, wow...so different when stopping.”

To learn more about revolutionary Wagner OE^X brake pads, contact your Wagner supplier and visit www.WagnerBrake.com.

WAGNER® OE^X

¹ Results based on 60 mph post fade performance testing conducted by Link Engineering Company comparing Wagner brake pads to competitors’ brake pads on the 2014 Ford F-150, 2011 Toyota RAV4 and 2013 Chevrolet Tahoe.

² Results based on internal testing comparing new Wagner OE^X to other Wagner offerings.



THE STRONG, SILENT TYPE



We may have given Wagner ThermoQuiet® brake pads a shorter name but they haven't lost a thing when it comes to performance. With an innovative "one-piece" design which integrates the friction, shim and backing plate for greater strength, Wagner TQ is still your go-to choice for quieter, more reliable braking. Find out more at wagnerbrake.com.

#partsmatter

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WAGNER | TQ®

MOTORCRAFT® BRAKES: VERIFYING SLIDES AND PIN INTEGRITY



When brake calipers repeatedly seize, take a closer look. Inspect the brakes as if changing the pads. Check calipers and pins for leaks and poor lubrication. Look for damage to seals and piston corrosion or binding. A torn weather seal is likely if rust seizure is present. Leaking or damaged brake calipers should be replaced. If guide pins are stuck or rusted in place, remove with a punch tool. If they're too damaged or corroded, Motorcraft

offers replacement pins and boots. It's a cost-effective way to repair a frozen or binding condition — and avoid the expense of complete caliper replacement.

If the guide pin bore is dirty, clean out the bracket bore using a wire brush or rolled sandpaper to remove corrosion and foreign material. Clean any remainders with brake parts cleaner and compressed air.

Replace the caliper slide pins and seals. Assemble the caliper seals, boots and guide pins. Make certain

the pins are clean, and use the recommended high temperature grease to lubricate the bores and guide pins.

For more, visit Motorcraft.com.

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Go Further

TAKING THE GUESSWORK OUT OF BRAKE CONTROLLERS WITH IPA®'S BRAKE FORCE METER

Although today's vehicle trailer brake-controllers are more technologically advanced than ever, they tend to be finicky and hard to trouble shoot for both professional technicians and truck owners. As a result, there is often confusion surrounding the functionality of these systems and misunderstandings between service providers and their customers. Fortunately, there is a new diagnostic tool from IPA®, which will simulate trailer brakes, quickly troubleshoot faults, display exactly how the controllers are operating and also test the tow lighting functions.

A few years ago, there was a shift in the industry when new trucks started coming with factory-installed, dash-mounted Integrated Brake Controllers (ITBC), which work in unison with the vehicle's speed and brake pressure sensors. Tied into the vehicles computer system, these controllers sense whether the trailer is connected or not. Along with the newer type, aftermarket controllers both systems must sense load from the trailer electric brakes upon hookup, or they simply will not put out power with brake pedal actuation to the brake magnets. This can be a significant safety issue while driving down the road with a fully loaded trailer for obvious reasons. This also creates a common misconception for those familiar with the older aftermarket controllers, who may just assume their new system will actuate the brakes as their previous one did.

The problem is that most technicians do not have a trailer present to verify the vehicle is connecting and even if they have a trailer, they do not have the tools necessary to verify the brake controller output and timing are indeed functioning properly. The #9107 Brake Force Meter with towing Light Tester makes this diagnostic process incredibly simple, does not require a trailer



and is the only tool on the market to address this issue. The patent pending technology automatically interprets the reference ping from the controller and provides the correct load for the ECU to determine a trailer is connected. Often a customer will bring in a truck with the complaint of consistent "Trailer Not Connected" warnings, and no brake power. The #9107 will easily allow techs to determine whether the problem is within the truck or with the trailer by hooking up the tool and utilizing the 25 ft. cord to sit in the cabin. Upon startup, a "Trailer Connected" or similar message/indicator should appear within the vehicle. If not, the controller is faulty or wiring/grounds are suspect and should be cleaned or replaced. Once a connection has been established with the computer, the tech can read brake force output while parked and while driving to ensure the gain settings reflect the actual output at the connector. During this process the tool displays real-time output from the vehicle. This is important because various truck makes and model years approach trailer braking differently. Therefore, one cannot assume that one truck should operate as another did.

The #9107 is a must have tool for techs, fleets, and rental companies dealing with brake controller equipped vehicles. As a diagnostic tool, the #9107

greatly reduces troubleshooting time. As a complimentary inspection, or for companies that rent trailers and equipment, the tool promotes safety and is invaluable for limiting potential liabilities. Ultimately, the #9107 will lead to more satisfied customers and ensure safer towing down the road.

IPA® also manufactures tools for cleaning truck and trailer connections and remote-controlled diagnostic equipment for testing trailers without the need for the truck. For more information on the Brake Force Meter #9107 and other IPA® products contact your professional tool distributor or visit www.ipatools.com.

Contact Information

Innovative Products of America
234 Tinker Street
Woodstock, New York 12498
888-786-7899
info@ipatools.com
www.ipatools.com

IPA®
FUTURE NOW®

#9107 ELECTRIC BRAKE FORCE METER WITH DYNAMIC LOAD SIMULATION AND CIRCUIT TESTING

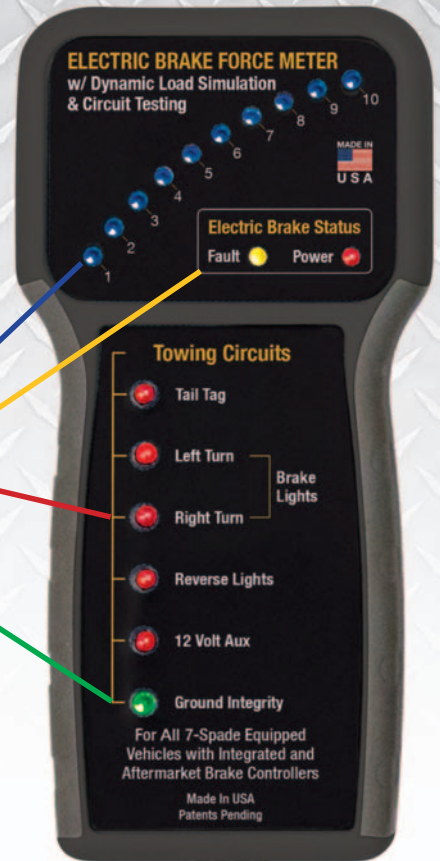


Use with All 7-Spade Equipped Vehicles with Integrated and Aftermarket Brake Controllers

- Test all brake controller and tow lighting functions without the need of a trailer
- Brake Force Meter displays real-time, brake-controller output gain
- Syncs to all make and model brake controllers
- For use with aftermarket and integrated brake controllers
- Indicates fault and connection status
- 25 ft. cable allows for one-man testing



25 ft. Cable



PATENTS PENDING

Brake Force Meter
Electric Brake Status
Towing Circuits
Ground Integrity

Towing Circuits

- Tail Tag
- Left Turn
- Right Turn
- Reverse Lights
- 12 Volt Aux
- Ground Integrity

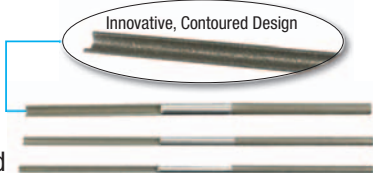
For All 7-Spade Equipped Vehicles with Integrated and Aftermarket Brake Controllers

Made In USA
Patents Pending

#8043 MICRO MALE ELECTRICAL PIN CLEANERS

Clean Deutsch, Cannon, Bullet and Other Round Electrical Pins

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- For use on DC circuitry only
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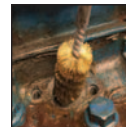


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- Brushes are specially engineered to fit injector seats
- Removes rust, carbon and other debris from seats and cups without damage



Also Available: #8090S STAINLESS STEEL

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Dirty Fuel?

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- Special wands for accessing the bottom of the fuel tank



#8050-8053 AIR COMB®

90° Multi-Port Air Gun

- Cleans air filters, condensers, and radiators
- Focused, high pressure output
- Four sizes: 12", 24", 36", 48"



PATENTS PENDING

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Allows Circuit Bypass and Current Testing for 12V DC Relays

- Control relay circuit independent of "key-on/key-off" systems
- Run all automotive, 12V DC motors with a push of a switch



#9101 LIGHT RANGER MUTT®

Test Your Trailer Without the Truck

- Tests 7 spade, 6 round and 4/5 pin trailers
- Short circuit protection



Also Available: #9102 HEAVY RANGER MUTT® (7 Round Pin Model)



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GUMOUT® MULTI-SYSTEM TUNE-UP: THE OIL CHANGE ACCESSORY

An oil change only does so much. Sure it replaces old oil with new oil, but as old oil is drained out, stubborn carbon deposits (i.e. sludge and varnish) often remain stuck in place, virtually guaran-

teed to continue building up as the new oil around them ages.

This is especially challenging for drivers who frequently use their vehicles for trips of fewer than 10 miles. Short trips like these mean that motor oil is not given enough time to warm to its optimal temperature. When vehicles operate under these conditions, the oil is unable to burn off condensation and other contaminants. The results can be severe.

- o Excess water can lead to rust and corrosion.
- o Metal particles, dirt and deposits remaining from old oil can cause changes in viscosity and lead to sludge build-up, sapping engine performance.
- o Oil passages in the engine can become clogged leading to oil starvation, which can cause increase in friction and wear.

In response, Gumout® created an easy-to-use additive, Multi-System Tune-Up, which uses scientifically proven ingredients like P.E.A. (polyetheramine), the most potent cleaning agent on the market, and other conditioning additives, which result in maximized performance and enhanced engine life.

Tested in the lab, in the fleet, on the track and on the street, the active chemical P.E.A. is ideal for getting the deepest clean under extreme engine conditions. As stubborn deposits are freed from parts and liquefied, they

run their normal course through the engine, being collected in the oil filter as intended. Multi-System Tune-Up also conditions the new oil by adding corrosion inhibitors, anti-oxidants, and friction modifiers. These quality conditioning ingredients help stabilize oil, reduce wear of key engine parts and stop corrosion.

Gumout® has been designed so it can be easily used by DIYers or oil change technicians. Before an oil change, start the vehicle and allow it to get to normal operating temperature. Simply add one ounce of Gumout® Multi-System Tune-Up to every quart of oil. Then, let the engine run for 5-10 minutes to allow the product to begin removing carbon build up. Turn of the engine, change the oil and filter, then add another ounce per quart of oil to condition the engine.

Given the benefits and recommended timing for using Gumout, oil change technicians have been some of the biggest supporters of Gumout Multi-System Tune-Up. Gumout is an affordable add-on to oil changes or regular maintenance visits when customers balk at more expensive alternatives.

Gumout Multi-System Tune-Up is also a great product for cleaning the fuel system and helping vehicles pass emissions testing too. Want to learn more about the science behind Multi-System Tune-Up? Please visit us at Gumout.com.



Science in. Performance out.

CABIN AIR FILTERS: FASTEST GROWING SEGMENT IN THE FILTRATION INDUSTRY

More than 80 percent of new cars sold in the United States and Canada are now equipped with a cabin air filter and that percentage continues to increase at a rapid pace — making cabin air the fastest growing segment in the filtration industry. However, cabin air filter replacement is one of the most overlooked vehicle maintenance items. This provides a significant opportunity for customer education, as well as profitable growth in this category.

Cabin air filters ensure that drivers and passengers breathe in as few pollutants as possible from the outside air. And depending upon where motorists drive, the levels of these contaminants can be very high. In fact, the air that flows into the vehicle through the ventilation ducts during driving contains approximately five times more exhaust gases, pollutants and allergens than fresh air. The most important barrier between this cloud of pollutants and the occupants of the vehicle is the cabin air filter in the ventilation system.

Conventional cabin air filters only prevent particles such as dust, pollen, diesel soot and odors from making their way into the car via the ventilation system. This is why customer education is of utmost importance in this category, as there are advanced options available that are able to absorb almost all allergens, as well as block the growth of mold and bacteria.

Respiratory disorders and the environmental factors that trigger these conditions are growing health concerns for consumers. According to the American College of Allergy, Asthma and Immunology, allergic diseases — including asthma — are the leading

chronic diseases in the U.S. among all ages. Nasal allergies affect an estimated 50 million people in the United States, including as much as 30 percent of adults and 40 percent of children.

FreciousPlus™: Innovation in Cabin Air Filters

The new FreciousPlus™ line of cabin air filters from MANN-FILTER features innovative, three-layer technology to block allergens, bacteria, mold and particulate matter that enter a vehicle's ventilation system while driving. These attributes make FreciousPlus the ideal cabin air filter option for people who suffer from allergies or asthma and families with children.

FreciousPlus cabin air filters use a bio-functional layer with polyphenol — an active substance found in many plants — to trap over 98 percent of free-floating allergens and up to 97 percent of hazardous particulate matter. The innovative bio-functional layer also acts as an antimicrobial agent that blocks the proliferation of allergy-triggering bacteria and molds. Additionally, FreciousPlus is engineered with a high-quality acti-

vated carbon granulate that eliminates unpleasant odors, such as ozone, sulfur dioxide and nitrogen oxide.

To learn more about the FreciousPlus line of cabin air filters from MANN-FILTER, visit [frecious-plus.com](https://www.frecious-plus.com).

Contact Information

MANN+HUMMEL Purolator Filters, LLC.

801 Corporate Center Drive
Raleigh, NC 27607
Phone: 919-926-4200

Web: <https://www.mann-hummel.com/en/mann-filter/home/>



MANN FILTER

FLUID FITTINGS REMINDER

WHEN REPLACING JIFFY-TITE QUICK-CONNECT FITTINGS ON A PLASTIC RADIATOR REMEMBER TO REMOVE AND RE-INSTALL ONE FITTING AT A TIME.

Chances are, whether you are repairing an automatic transmission, or building a replacement heat exchanger, the OE used Jiffy-tite fluid fittings. More than 24 OEMs across the world trust Jiffy-tite fluid fittings for transmission and heat exchange applications, so in order to maintain premium quality - replace the original Jiffy-tite with a Jiffy-tite!

Repairs can be costly, timely and frustrating, here is some technical advice regarding radiators and Jiffy-tite quick-connect fittings.

Jiffy-tite manufactures two basic groups of quick-connects for heat exchangers/radiators. Jiffy-tite provides BOC (Basic Quick-Connect) fittings and IQC (Integral Quick-Connect) fittings. The main difference between these fittings is that a BOC fitting is used for standard metal radiators and an IQC fitting is used in plastic radiators. IQC fittings will always have an external washer on the threaded end of the quick-connect.

When installing a Jiffy-tite quick-connect it's important to understand the function of the fitting you are using. For a

standard metal radiator the cooler is retained in the radiator tank independently of the quick-connect fitting. The BOC threads into the bung of the cooler and allows the transmission line to "snap" into the radiator.

For plastic radiator tanks, Jiffy-tite designed the IQC fittings to replace the retention mechanism which attach the cooler to the tank. The IQC fitting threads directly through the plastic tank to the cooler. When torqued properly the Belleville-Style spring washer creates tension pulling the cooler against the plastic tank. This seals and retains the cooler in the plastic radiator while also providing a quick-connect port for the tube insertion and retention.

Take note — If both Jiffy-tite IQC fittings are removed at the same time there is nothing holding the cooler in place, and the cooler can drop into the tank. This can lead to a contamination of fluids, damage to the cooler or tank, or worst case having to buy a replacement radiator. Therefore, when replacing a Jiffy-tite IQC fitting be sure to remove and replace one at a time.

IQC Fitting



BOC Fitting



Replace a Jiffy-tite WITH a Jiffy-tite

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COOLER CONNECTORS



500 million



That's how many Jiffy-tite parts are in service worldwide today. In fact, chances are whether repairing an automatic transmission, radiator, or auxiliary cooler, the OEM used Jiffy-tite fluid fittings.

Replace a Jiffy-tite with a Jiffy-tite to maintain premium quality.



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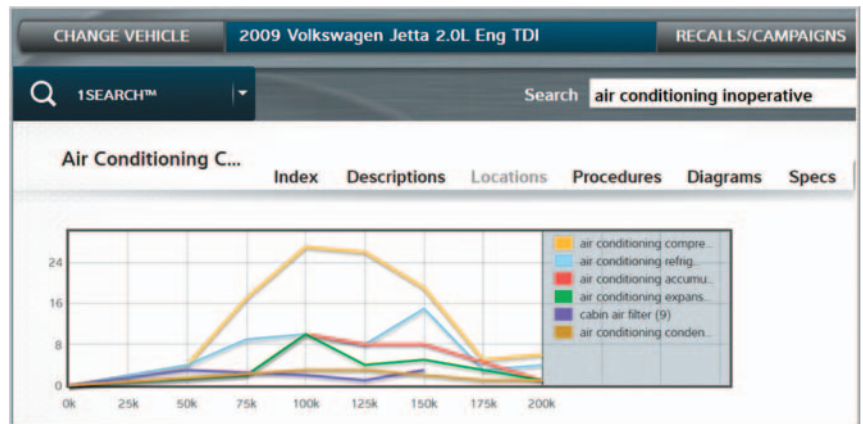
Have you ever jumped “into the weeds” to solve what seems like a complex vehicle issue, only to discover some time later that it was something basic, like an alternator with a bad diode or a loose battery cable? It’s OK, it happens. But it’s happening less often for technicians who use their repair information system to do some quick and simple research right at the beginning of the repair.

Here’s how it might play out. The vehicle arrives at your bay with a “no start” and you check off all the basics: battery, starter, ignition switch, etc. All of those are fine and no DTCs are present, so now you move on to less common problems and components to find the cause. At this point, you turn to your repair information resource to dig in deeper and reveal the culprit. You select the vehicle and then type in the symptom or diagnostic trouble code (DTC). And...

This is where the time-saving magic happens: You are presented with all the components that have historically been associated with that symptom or DTC on your vehicle, ranked from the most common component to the least common. You now have direction to start your diagnosis and repair based on the experience of other professional techs who have faced the same issue with that vehicle.

That is how ProDemand® from Mitchell 1 delivers real-world insight: Mapping symptoms and DTCs to probable components, based on millions of actual repairs from professional auto repair shops. If you are more interested in “rare fixes” — the ones that are not obvious, but solved the problem in some cases — you can also invert the list of probable components to show the least common fixes first.

Would this kind of quick insight guide you to the most likely area to



start your diagnosis and save you time?

As an example, let’s take a 2009 Volkswagen Jetta with an air conditioning problem. The vehicle owner has told you that when she starts the car and begins driving, the AC blows warm air for the first 10-15 minutes and then finally kicks in with cold air. The technician suspected that the compressor clutch was not engaging and set out to find out why. Using ProDemand, he learned that this particular vehicle actually does not have an electrical compressor clutch, but instead uses a variable displacement compressor with a computer-controlled valving system to regulate the output.

After typing in “air conditioning inoperative” into the search field in ProDemand, the air conditioning compressor displayed as the most commonly replaced component for this symptom. However, with only 90,000 miles on the car, he was second-guessing the diagnosis. After all, the car is not that old and compressors are expensive. So,

again he turned to ProDemand and discovered that historically, compressors are replaced on this vehicle starting at 50,000 miles and peaking around 100,000 miles. So the vehicle in the bay is in this “sweet spot” and he felt confident proceeding with the job. He also found all the procedures to remove and replace the compressor, which ultimately did fix the problem.

This is the type of scenario that can give you the big picture and save you from going down the wrong diagnostic path. Just a little bit of research up front can save a whole lot of time and help you keep moving cars through your bays right on schedule.

Contact Information

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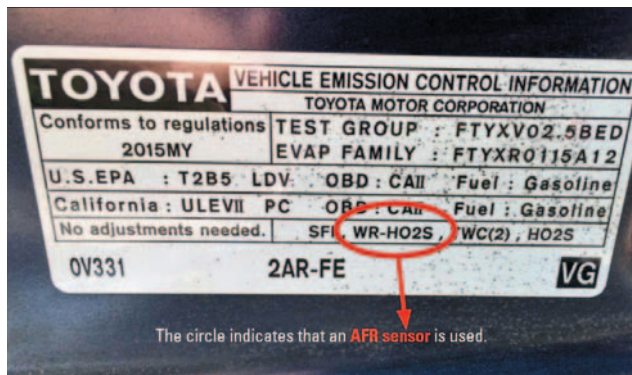
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ALWAYS EVOLVING SENSOR TECHNOLOGY AND DIAGNOSTICS

With many components and subsystems relying on critical inputs for accurate data and drive ability, the inputs to these computers need to be analyzed very carefully. As EPA standards become more efficient the need to accurately measure that input evolves as well. Stronger emission requirements are in turn, increasing the price and complexity of emission components. Components such as; O₂ sensors, AFR sensors and the Wideband sensors, need to be looked at carefully as their inputs to the engine control unit (ECU) are critical to correct fuel control. Maintaining a clear diagnostic path starts with identifying the type of sensor and knowing how it operates to understand how it fails.

First identifying the sensor is critical to an efficient diagnostic process. The switching sensors, also known as O₂ sensors or narrow band sensors, measure the amount of air in the exhaust using a 0-1 volt DC scale. A lab scope should also be used to identify signal imperfections or lazy sensors. Switching sensors use 0.45 volts as Stoichiometric or complete effective combustion without EPA concerns (not rich or lean). Above the 0.45 volts is rich and this would reflect the combustion process has too much fuel needed for combustion. Below the 0.45 volts is known as lean or too much air in the exhaust system. These sensors can be 1-4 wire sensors. A four wire O₂ sensor is different than an AFR four wire. The image below shows how to distinguish which sensor the vehicle has.



The next sensor is also a four wire sensor and is known as an AFR sensor. This sensor cannot be graphed by means of a waveform on a lab scope, and further diagnostics are needed to determine if the vehicle is experiencing abnormal combustion. A diagnostic scanner will be needed to monitor the proportional integrated derivative or PID in which the voltage is converted to AFR or Lambda. The voltage on the AFR sensor is different of the switching sensor. The volt-

age range for the AFR sensor is typically 3.3V-2.5V where 3.0 volts is Stoichiometric, however below 3.0 volts with a AFR sensor is now rich and above is lean, or opposite of the switching sensor. Below are a couple ways to figure out if the vehicle you are servicing is equipped with an AFR sensor. Some AFR sensors require testing amperage per the vehicle specs on the heater element, which can be done with an amp clamp as seen below. These sensors are typically found on Subaru, Toyota, Lexus and Scion vehicle and are located upstream of the converter.

The most accurate and current sensor is a five wire wideband sensor. This is usually the most challenging of all the sensors to diagnose and also carries a high cost of replacement. A diagnostic scanner



must be used to diagnose a wideband sensor, as it does not produce a switching or readable voltage. However, it establishes a reading in millivolt or mV that, inside the ECU is converted to an AFR, such as; 14.7:1 which is Stoichiometric reading 14.7 parts to 1 part fuel. AFRs lower than 14.7:1 or Lambda 1 are known as rich (too much fuel) and above are known as lean (too much air). Wideband sensors can be fooled just as the AFR and switching sensors, so while looking at the sensors output, propane or air can be added to force the sensor to report more air or fuel. Then, if the sensor does not report the change in added air or fuel within 100 milliseconds on the lab scope or diagnostic scanner, the sensor should be replaced.

For more information about oxygen sensors or to attend an Advanced Diagnostics Sensor Training, please call the NTK Oxygen Sensor Tech line at 877-4-SENSOR.



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THE BENEFITS OF USING DRAG REDUCTION CLIPS

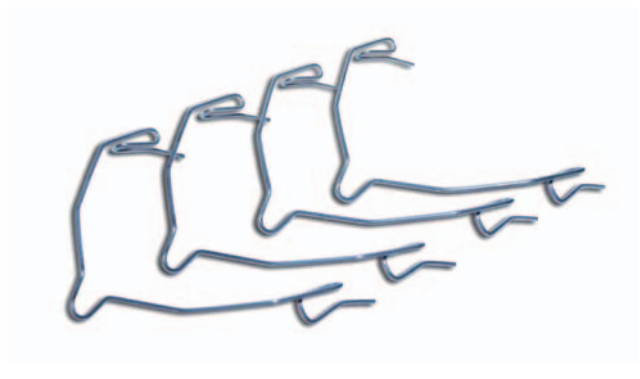
Does your shop ever have a brake job come back with a noise complaint? How about pedal pulsation? Premature wear? There could be several different repairs to correct these concerns but let's talk about one that might cover them all — drag reduction clips.

Raybestos carries this product in the brake hardware line. These pre-bent wires, when installed, keep constant light pressure spreading the pads so they don't contact the rotor. Drag reduction clips have been used by many OE manufacturers over the years so it's not a new idea. Some brake pads have small holes drilled in the backing plates where the clips are installed. Raybestos saw the advantages to this idea and carry an extensive line of these clips for models not installed from the factory.

By reducing drag, you will extend pad life, increase MPG and reduce noise. Their purpose is actually more than just reducing drag, which translates to the features mentioned above. They also prevent brake pedal pulsation by keeping the pad from contacting the rotor when you are not braking. Now this was not a big deal 15-20 years ago as rotor run-out was typically over .008" so there was normally pad to rotor contact every revolution. But when the rotor run-out specifications got real tight in 1999-2001, some manufacturers saw the benefit of reduction clips. Tighter rotor tolerances (most are .002") were due to brake pad compositions. Those older models were using asbestos and NAO (non-asbestos organic) so if the pad hit the rotor every revolution, it didn't affect the rotor dimension.

Now, we use aggressive metals and ceramics in our pads so pad to rotor contact every revolution is not a good thing. In fact, with too much rotor run-out, over the course of two to three months, the rotor will contact the pad millions of times in one area. This constant rubbing will actually change the thickness of the rotor depending on the type of brake pad being used.

When the rotor thickness varies more than .001" to .002", you will get brake pedal pulsation when stopping. Some people inaccurately call it "warped" rotors. Semi-met brake pads will wear the rotor thinner at that contact point. Ceramic



pads actually make the rotor thicker. This is called "material transfer" and is a characteristic of ceramic brake pads. Ideally, the ceramic material would be transferred evenly across the face of the rotor. This transfer is needed for the ceramic pad to stop according to design. Ceramics stop using an adhesive action. The friction material on the rotor comes in contact with the like friction on the brake pads and they stick as the pedal is applied.

On the other hand, semi-met pads stop exactly as you think, with abrasion. The harder you press on the brake pedal, the more friction you create as the metal in the brake pads rub against the rotor. Metals in the pad rubbing against an iron rotor will definitely cause wear. This is also a factor in keeping your wheels clean. Since ceramics don't really wear your rotor, you don't have rotor dust all over your wheels. Installing the clips is easy. Our clips are model specific and do not interfere with normal brake operation. So we can prevent noise, extend pad life, lessen chance of pedal pulsation and increase MPG all because we installed some little wires that spread the pads? Not a bad deal.

Raybestos® has been known as the best in brakes for over 100 years. With a demonstrated commitment to research, development and testing, Raybestos is widely recognized for quality brake components, including friction, rotors, drums, calipers and hydraulic products. For more information on Raybestos, visit www.raybestos.com.

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RED KAP'S NEWEST WORK SHIRTS HAVE YOUR CREW – AND YOUR BOTTOM LINE – COVERED

Where do uniforms fall on your list of daily priorities? Chances are, they are pretty low — if they even make the cut at all. However, the benefits of purpose-built workwear may surprise you. Uniforms can help advertise your business, improve customer perception, lift employee moral, establish expertise and enhance employee performance. Truth be told, just about any uniform can provide these benefits, but only Red Kap continues to raise the bar with products and features designed specifically for the unique needs of the auto industry. The workwear giant's three newest work shirts help improve your crew's overall performance while protecting your customers' vehicles from damage. It's a win-win.

Garage tested for durability and comfort, these new shirts are loaded with auto-specific features designed to get the job done — easily and safely. For an added bonus, your employee's will actually WANT to wear them. You'll be amazed by how small improvements to your shop's uniforms can result in big lifts to employee engagement and moral. All of which mean increased productivity that leads to larger profits.

The latest shirt offerings include the Crew Shirt in two new colors, the Striped Color Block Work Shirt and the Diamond Plate Shop Shirt. Each shirt comes standard with innovative features that prove Red Kap designs apparel with mechanics in mind. Our no-scratch feature keeps buttons under wraps so your customers' vehicles stay polished and protected. Now your crew can worry less about damaging cars and focus more on the task at hand. Plus, they'll look stylish while doing so thanks to Touchtex™



Technology that provides breathable comfort, long-lasting color and superior stain resistance.

The Crew Shirt and Diamond Plate Shop Shirt are both constructed from exclusive ripstop fabric that is 75% stronger than traditional poplin workwear fabrics. That means your staff's work shirts get better mileage than the competition so you can focus less on uniform service complaints and more on your important day-to-day tasks. Both also feature a handy sleeve pocket that is perfect for keeping frequently used tools, gauges and pens close at hand.

The Crew Shirt is available in nine different colors including the new black and charcoal options, plus two-tone styles in charcoal/grey, charcoal/royal blue, black/red, black/charcoal, navy/grey, black/lime and charcoal/orange. The New Diamond Plate Shirt comes in two colors: black with charcoal diamond plate accent and navy with charcoal diamond plate accent.

The Striped Color Block Work Shirt is an unexpected twist to Red Kap's classic Motorsports Shirt. This two-

tone design draws inspiration from race culture while incorporating popular vintage striped fabric for a modern yet traditional look. Pair this upgraded style with a versatile straight hem that looks professional whether tucked in or worn out, and you've got a winning combination. This new work shirt is available in navy blue/light blue stripe with navy contrast and red/charcoal stripe with charcoal contrast.

Red Kap is dedicated to continuously providing purpose-built workwear that not only works hard in the garage but also provides all-day comfort and peace of mind to those who wear it. To learn more about these new product's innovative features, visit www.redkapauto.com



PROPERLY IDENTIFYING, REMOVING, INSPECTING AND REPLACING A U-JOINT

When it's time to replace a U-joint, it is important that you select the proper part for the vehicle. You can identify the proper U-joint for your vehicle with only the yoke and the u-joint. SKF recommends using a specialized ruler that you can download from its website (www.skfusa.com/ujoints) to help you measure full round, half round and wing style yokes, as well as U-joints.



When using the SKF ruler, simply measure the yoke or U-joint and the ruler will identify the corresponding drive-shaft U-joint series needed:

- If measuring a full-round drive shaft yoke, measure from the outside of the yoke ears.
- If measuring a half-round pinion yoke, measure inside the yoke across the flanges.
- If measuring a wing-style yoke, measure across the inside of the pilot diameter making sure the ruler is over the center of each opposing bolt hole.
- If measuring a U-joint, measure across the cap-to-cap

Removal and inspection of the U-joint

Before removing the driveshaft from the vehicle, mark the driveshaft flange to the differential flange. When you reassemble the driveshaft to the vehicle, make sure the marks line up so you know you are not spinning the drive shaft in a different position.

Next, inspect the U-joint. Grab the drive shaft and the yoke and spin it lock to lock in both directions. If you feel any type

of binding or looseness, replace the U-joint. Be sure to check both the front and rear yokes.

There are different methods for removing a U-joint, but SKF recommends using a ball joint/u-joint press set. Remove all the clips with a screw driver or pliers and then remove one cap using the ball joint/U-joint press. Flip the drive shaft around so you are pressing the cross outward to remove the other cap and remove the U-joint off the drive shaft and the flange.

Once you remove the U-joint, you'll want to clean the flange surfaces. It is important to clean the groove that holds the clip in place so the clip seats well. Also you'll want to clean the area where the cap rides within the yoke.

Next set the U-joint into the flange yoke. On the end that will be driven all the way up, put the snap ring in so you know where the U-joint is going to stop. Using the press tool with a ratchet and socket (not an impact wrench), press it into the yoke flange. Flip the driveshaft around and install the other outside snap ring. Then install the caps – be sure not to lose any of the needle bearings out of the caps. With the U-joint completely pressed in, install the last of the clips.

Re-assembly onto the vehicle

Before re-installing the driveshaft back onto the vehicle, make sure the U-joint is not binding in any manner by flexing it in all directions. Some newly installed U-joints may be a bit tight. You can loosen them by lightly tapping the ears of the flange with a mallet.

Put the driveshaft back into the transmission and re-mount the driveshaft to the differential pinion flange. Remember to match the driveshaft flange with the differential pinion flange. Before installing the driveshaft bolts, apply some thread lock to each. Then torque them to manufacturers specifications. Final step is to add a little grease (if working with a greaseable U-joint).

For a complete video on how to measure a U-joint or how to install a U-joint, visit www.skfusa.com/ujoints.



FORWARD-THINKING VALUE OF LIFT INSPECTIONS

Professional lift inspections are a shop's investment in the safety and productivity of its technicians. Lift inspections identify any issues early, before they can grow into major problems. Lift inspections ensure equipment reliability to safeguard technicians, reduce profit-sapping downtime, maintain productivity and lower lift repair costs and shop overhead. In short, lift inspections provide a forward-thinking value for the technician and the shop owner.

Annual lift inspections are required.

The national standard covering lift operation, maintenance and inspection, ANSI/ALI ALOM:2008 (R2013), and a growing number of state codes and regulations mandate that all vehicle lifts be inspected at least annually. Speaking of requirements, documented annual lift inspections can help your operation prevent costly OSHA citations and fines.

Not all inspections are equal.

Forward Lift is a strong supporter of the Automotive Lift Institute (ALI) Lift Inspector Certification program. ALI, the industry authority for lift safety, created the program in 2012 to give shop owners a trustworthy resource for finding qualified lift inspectors. The ALI Lift Inspector Certification Program independently tests and certifies lift inspectors who demonstrate that they meet all of the requirements outlined in the ANSI standard. ALI Certified Lift Inspectors are qualified to inspect any vehicle lift, regardless of manufacturer.

Trained lift support is available locally.

Forward Lift has a nationwide network of factory-trained distributors, installers and ALI Certified Lift Inspectors. These local businesses can provide fast lift sales, service and inspection. In fact,



**REMEMBER
TO INSPECT**
Have your lifts inspected annually.

Forward Lift is part of Vehicle Service Group (VSG) – the lift manufacturer with more ALI Certified Lift Inspectors in its distribution network than any other. To find your local lift inspector, contact your Forward Lift distributor, call Forward Lift at (800) 423-1722 or visit www.autolift.org/find-a-certified-auto-lift-inspector/.

You should inspect to protect every day, too.

Technicians must also take an active role in inspecting the lifts they use every day. Follow the procedures for each lift outlined in the owner's manual. Your Forward Lift distributor is an excellent source for more information and a hands-on demonstration of what to look for during these inspections.

Lift operator safety training made easy.

Forward Lift also recommends that every lift operator take ALI's Lifting It Right online lift safety course hosted by NASCAR legends Richard and Kyle Petty. This interactive course teaches technicians how to properly use vehicle lifts. It also provides shop managers with easily accessible training records and the opportunity to schedule training at optimal times. Over the last two years, this course has helped train nearly 12,000 people on proper lift use and maintenance procedures for safer workplaces. The course costs just \$24 per person and can be purchased at www.autolift.org/ali-store/



Contact Information

Forward Lift
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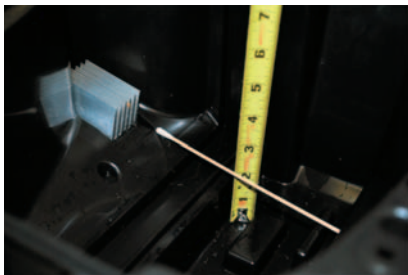
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PREVENTING WATER INTRUSION ON GM BLOWER MOTOR RESISTORS

On most full-size GM trucks and SUVs from 2001–2007, the blower motor resistor has two common failure modes: water damage and excess heat.



Identify Water Damage

The GM vehicles stated above are unable to manage condensation. Plugged condensation collects in the duct creating a pool of water that can seep into, and flood the blower motor resistor module. When draining water

out of the case, make sure there's no debris in the evaporator/heater core case drain. Also check the HVAC air inlet area, where stuck leaves may inadvertently direct water into the case and damage the resistor.

Beware of Excess Heat

Worn OE blower motors can create a demand for current that also damages the resistor module. The excess current melts the wiring and plastic shroud, damaging the interface pins on the resistor module's circuit board.

Don't Forget to Inspect

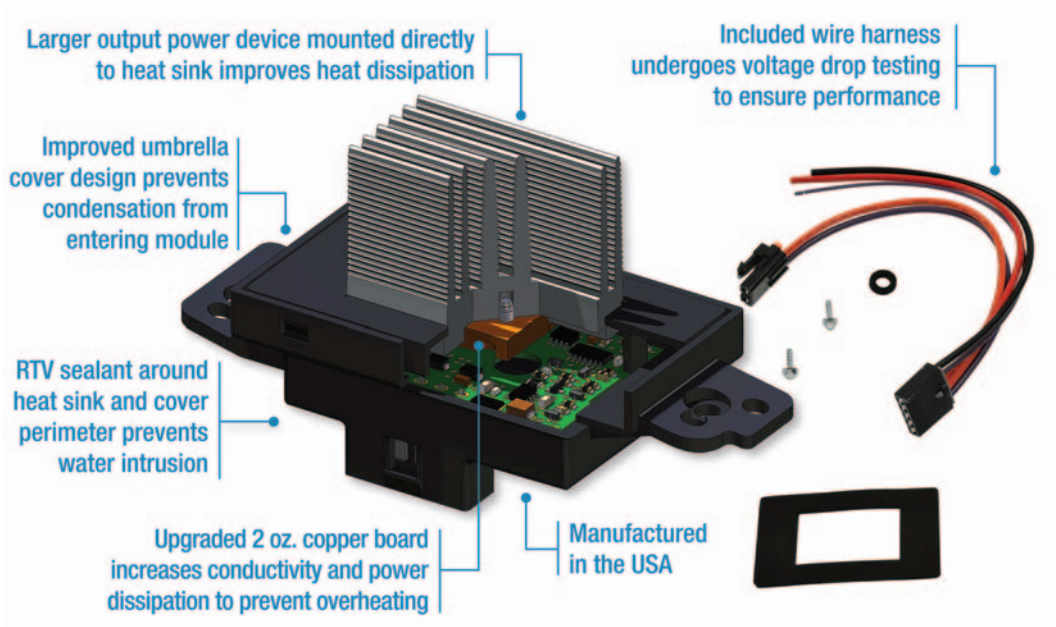
Before completing the repair, use an inductive amp clamp to check that the blower motor current draw is less than 80% of the fuse rating on high. If the current is too high, replace the blower motor. Otherwise, the new resistor will fail, too. If you don't have an

amp clamp, replace the blower motor to ensure the repair's longevity. You should also inspect the mating connector for signs of damage caused by excess heat.

Upgrade Your Replacement

Standard's RU631 Blower Motor Resistor features several improvements over the OE, including an umbrella cover design that prevents water intrusion and a larger-output power device and an upgraded two-ounce copper board that protects against overheating. Like all Standard-made parts, the premium RU631 pictured below is the product of meticulous design, precision manufacturing, extensive testing, and a quality control process that technicians have come to expect from Standard.

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DON'T FORGET ABOUT THE REAR WIPER BLADES!

More than 42 million vehicles on the road today have rear wiper blades. Did you know that rear integral or beam blades should be changed just as often as the front wiper blades? However, most drivers only change their rear blade every five years or so. Rear wiper blades provide critical back windshield visibility and maximize sight lines when driving becomes difficult. When they are worn-out or are no longer working properly, this can pose a serious driving safety hazard—especially during the summer months when thunderstorms coupled with heavy rain are quite frequent.

This presents a perfect opportunity to educate your customers about the importance of rear wiper blades and appropriate replacement intervals.

TRICO Exact Fit® Rear Window Wipers: Original Look, Superior Performance

Many consumers simply want to restore their vehicles back to original factory performance, fit and look. That's why Trico Products has developed the TRICO Factory Replacement Center®, a program that makes it easy to find and install the TRICO Exact Fit® Rear Wipers specifically designed for each driver's vehicle.

TRICO Exact Fit Rear Wiper line features ten distinct blade styles available in 28 different SKUs to cover approximately 96 percent of vehicles on the road today and provide the right options for your customers. Wiper blade sizes are available in lengths from eight to 16 inches. TRICO Exact Fit blades are designed to fit unique rear integral and beam wiper arms, and offer the fit, form and function of original equipment right out of the package.

The company will be adding five new integral rear blade part numbers to the TRICO Exact Fit Rear Wiper line, in lengths of eight, 10 and 12 inches. The new part numbers fit a range of 2006-16 model year vehicles from popular makes Ford, Hyundai, Kia, Lexus, Saab, Saturn and Toyota. The new part number additions have expanded coverage to an additional 3.3 million vehicles equipped with rear integral blades.

More on the TRICO Factory Replacement Center

The TRICO Factory Replacement Center features a newly expanded line of TRICO Exact Fit blades including beam, hybrid, conventional and rear blades that provide unmatched coverage for nearly 98 percent of consumer vehicles on the road today. Leveraging TRICO's close relationships with OEMs, TRICO Exact Fit blades offer the fit, form and function of original equipment right out of the package.

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As consumer demands and automobile technology constantly evolve, Trico Products offers a full selection of advanced products and high-impact merchandising programs to support service technicians and counter professionals. TRICO. Seeing you through®.

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WORLD PAC TRAINING INSTITUTE (WTI) PROVIDES ADVANCED TECHNICAL AND BUSINESS EDUCATION

WORLD PAC Inc. and the WORLD PAC Training Institute (WTI) is focused solely on providing the Aftermarket with the highest quality advanced technical and business training available in the industry, are committed to supporting independent professionals through education.

“Our mission at the WORLD PAC Training Institute (WTI) is to assist customers in growing and increasing the profitability of their business through education,” says Mario Recchia, WORLD PAC Senior VP of Marketing. “WTI OE-style course materials are created explicitly for the independent service center, and are designed and taught by our experienced, professional automotive instructors. Our goal is to establish and maintain relationships with our customers that generate long-term sustainable value.”

The WTI technical training program provides advanced level diagnostic training for independent repair professionals. The complexities of properly diagnosing and repairing late model vehicles requires training that, until recently, has not been readily available to independent service center professionals.

The WTI business development program provides training in the management of the repair shop business. The tools provided in these classes help managers increase productivity, increase profits, and assist with improving troubled areas of the business.

Established in 1997, the WORLD PAC Training Institute (WTI) has trained over 40,000 independent repair professionals. In 2009 the WTI also launched a biennial Supplier & Training Expo (STX) that currently hosts over 1600

WORLD PAC customers and offers 500 total hours of training presented by more than 50 of the industry’s most respected instructors.

“WORLD PAC is dedicated to providing our customers the very best training in our industry,” said Bob Cushing, WORLD PAC President and CEO. “We take great pride in continuing to offer training curriculum designed to meet the demands of growing the independent repair professional’s business.”

“WORLD PAC’s total value proposition focuses on an ease of doing business,” says Mario Recchia. “We have a vested interest in the success of our customer. The WORLD PAC Training Institute (WTI) is a great opportunity to help us better serve today’s and tomorrow’s business owner and technician.”

The WORLD PAC Training Institute (WTI) is just one part of WORLD PAC’s total value proposition. The company specializes in an advanced wholesale distribution model with complete inventory of original equipment automotive parts for import and domestic vehicles, as well as a comprehensive WORLD PAC Tools & Equipment Services (TES) division. WORLD PAC also offers a suite of amenities such as speedDIAL, the company’s industry leading online catalog and fulfillment ordering software, the WORLD PAC app and VIN scanner, OE Detailed Schematic Parts Diagrams, proprietary Digital Delivery systems, customer marketing solutions (CMS), and a vast company-owned fleet of vehicles and drivers providing multiple same-day deliveries from over 120 regional distribution centers across the USA, Canada and Puerto Rico.

Headquartered in Newark, CA, USA, WORLD PAC is an importer and distributor for original equipment and quality aftermarket replacement automotive



parts. With over 120,000 sku's and 11 million applications covering 40 plus car lines, the company provides brand recognized automotive parts directly to independent import and domestic service centers in the US, Canada and Puerto Rico, and also offers customer services such as their highly praised technical and business training, as well as targeted marketing solutions.

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“CONNECTED” CAR DEFINED

WHAT THIS INDUSTRY BUZZWORD MEANS FOR YOU AND YOUR SHOP

BY **PETE MEIER**
Director of Training

Over the past few years, there has been a lot of buzz about the “connected” car. But do you really understand what the industry fortune tellers are talking about when the topic comes up?

Panel discussions, articles and blogs discussing the connected car are generally broken into two subcategories. The first refers to the integration of the vehicle into an owner’s personal information network, tying the car’s systems into the internet and turning it, basically, into one big smartphone. Telematics is another commonly used term when talking about the “internet of everything” and how this technology creates a seamless transition for the vehicle owner in going from home to office to commute.

In addition to bringing all the internet has to offer to the cabin, telematics also refers to the ability of the OEMs to communicate with the vehicle’s onboard systems, gathering information on how the car is being driven and allowing the OEMs to use that information to market to the owner by sending them updates on their car’s condition or need for maintenance by email or text. Some OEMs are even performing flash updates via wireless cell technology to the vehicle while it sits idle in the driveway.



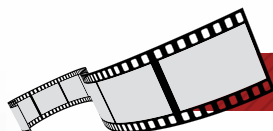
Cars that can communicate with other cars is a futuristic idea that is not too far from everyday reality.

With this technology comes some very real concerns. Among them are the owners’ right to privacy and the vulnerability of these systems to cyber attack.

And while these are certainly worth discussing, this month’s edition of The Trainer is focused on the second definition of a connected car — the one related to the idea of an autonomous

car and the impact on safety such technology represents. Imagine the elimination of accidents caused by momentary driver distractions!

Some of the groundwork for this integration is already laid. Will your shop be ready for the challenge of keeping these systems working the way they should? **TL**



[VIDEOS]



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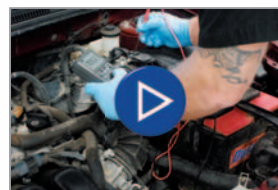
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